CANADA
DEPARTMENT OF MINES

HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF CARON No. 162 SASKATCHEWAN

BY

B. R. MacKay, H. H. Beach & E. L. Ruggles

Water Supply Paper No. 138

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INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

If one intends to sink a well and wishes to fine the approximate depth to a water-bearing horizon, be must learn: (1) the elevation of the sit , 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 glac l 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 ago.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Ravenscrag Formatioh. 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 côteau. The thickness of the formation seldom exceeds 40 feet.

Bearpaw Formation. The Bearpaw consists mostly of incoherent dark grey to dark brownish grey, partly bentonitic shales, weathering light grey, or, in places where much iron is present, buff. Beds of sand occur in places in the lower part of the formation. It forms the uppermost bedrock formation over much of western and southwestern Saskatchewan and has a maximum thickness of 700 feet or somewhat more.

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

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

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Caron covers an area of 225 square miles in the south-central part of Saskatchewan. It consists of tps. 16, 17, and 18, ranges 28, 29, and 30, W. 2nd mer. Townships 16, 17, and 18, range 30, are each only ½ mile wide, being cut off on the west by the Third meridian. The town of Caron is situated near the centre of the municipality and is 15 miles west and 4 miles north of the city of Moose Jaw.

The main line of the Canadian Pacific railway follows the valleys of Thunder creek and Sandy creek through township 17. The town of Caron is the only centre of population located on this railway line within the municipality. The Darmody division of the Canadian National railways crosses the plain in the northeastern part of the municipality, and on it are situated the hamlets of Archydal and Grayburn. No. 1 highway also extends across the central part of the municipality in an eastwest direction, passing through Caron.

Thunder creek, an intermittent stream, rises in a low marshland in townships 18, ranges 29 and 30, and flows in a southeasterly direction across the northeast corner of township 17, range 29, to leave the municipality in sec. 13, tp. 17, range 28, Sandy creek joins this stream in sec. 35, tp. 17, range 29. The part of the municipality lying to the north of Thunder creek is a gently rolling plain with an average surface elevation of 1,950 feet above sea-level. South of the creek the land surface rises to elevations of 2,000 feet in the southern sections of township 17, range 29, and along the northwest-southeast diagonal of township 17, range 28. From here the slope increases rapidly to form the Missouri coteau, a high range of hills extending from the International Boundary in a northwesterly direction across the south-central part of Saskatchewan. The highest elevation on the coteau in this municipality is approximately 2,400 feet, along the southern border of the municipality.

Throughout the greater part of the municipality little difficulty has been experienced in obtaining supplies of ground water adequate for local requirements. The water is derived from wells, springs, dugouts, sloughs, or creeks. The large quantities of ground water required for the city of Moose Jaw are being obtained in the valleys of Forsythe and Sandy creeks. Some residents in the southern and northern townships have experienced considerable difficulty in obtaining sufficient water for farm needs. The greater part of the ground water supply of the municipality is derived from wells sunk into Recent and glacial deposits. A few springs occur on the slopes of the coteau, and are numerous along the sides of the creek valleys. A few deep wells have penetrated the underlying bedrock formations, and obtain water from them. Sloughs are found in many of the undrained depressions in the southern half of the area. These are used for watering stock and supply water to shallow wells dug adjacent to them. Dugouts have been excavated on some farms to collect surface water for the same purpose. Small dams could be constructed in some of the coulées on the uplands to further conserve surface water for stock.

Water-bearing Horizons in the Unconsolidated Deposits

The unconsolidated deposits of this municipality consist of Recent stream sediments, wind-blown sands forming sand hills, and glacial deposits of various types, which mantle the greater part of the area. A great continental ice-sheet advanced and retreated over the province of Saskatchewan many thousands of years ago. As it moved it deposited over the surface of the then exposed bedrock a heterogeneous mixture of clay and boulders, known as till or boulder clay. In places well-sorted beds of sand and gravel are included in the till. Such material was deposited over this entire municipality, and although now covered in many places by later deposits it is exposed at the surface along the lower slopes of the coteau and in the north-central part of the area as a gently rolling till plain. The retreating ice-sheet is believed to have remained stationary for a considerable period of time on the top of the Missouri coteau, with the result that a much greater thickness of boulder clay of a generally sandy, and hence more porous, nature was laid down. The surface of these deposits is irregularly rolling and characterized by many low knolls and intervening, undrained depressions. Such areas are referred to as moraines in differentiating them from the more gently rolling till plains.

The boulder clay that makes up the greater part of both the till and the moraine is usually yellowish buff in the weathered zone at or near the surface, but becomes greyish blue at depth. The pockets of sand and gravel that occur scattered through the clay, with no apparent uniformity as to depth from the surface or indivi-, dual areal extent, thickness, or porosity, form the water-bearing beds in these types of deposits. Waters issuing from the melting ice-sheet accumulated in the lower land to form great lakes. The northeastern part of this municipality lies within the basin of one of these extinct lakes. Streams flowing from the ice-sheet carried sediments into the lake, so that the areal extent of the lake within this municipality is marked by deposits of lake clay and sand. A deposit of glacial lake clay mantles the northeastern part of the municipality. The clay becomes more sandy toward the margins of the lake, and in several areas along the base of the coteau, at the southwestern margin of the lake, fairly extensive deposits of sands were laid down. Wind action in more recent times has rearranged these sands into dunes, so that sand hills now occupy considerable areas immediately north of Thunder creek and in the west-central lowland part of the municipality.

Recent stream deposits occur in the valleys of Thunder creek and its tributaries. Much of the alluvium in Thunder Creek valley is fine silt or heavy clay, but in places it is interbedded with thin beds of more porous sand. In Sandy Creek valley the alluvium is almost entirely of sand that serves as reservoirs for the water absorbed in the spring of the year. Dug wells ranging in depth from 8 to 26 feet are drawing water supplies from these sands. The water is hard but of good quality, and the yield from individual wells is ample for local needs. In nearly all parts of the valleys water supplies should be obtainable. In some localities where clay occurs at the surface a few test holes may be necessary to locate the water-bearing sands. The wells supplying water for the city of Moose Jaw are located near the creeks, but the large quantities of water obtained in these wells are not derived from the Recent deposits but from the underlying glacial deposits.

More remote from the creeks lie the areas covered by the sand dunes. They cover a considerable area in townships 17, ranges 28, 29, and 30, and a narrow belt along the north side of Thunder Creek valley. These porous sands readily absorb the rainfall or water from melting snow. As the dune sands are quite thin in many places they do not form large reservoirs for ground water accumulation. In other places they probably reach thicknesses of 15 to 20 feet. Compact boulder clay underlying the sands stops the downward seepage of water, so that it may accumulate at this horizon. Where the boulder clay is more porous the water seeps deeper. Several springs in coulées and in the creek valleys are flowing from the zone of contact between these sands and the underlying boulder clay. Little water is being derived from the dune sands by wells in this municipality, but the lower lying deposits are found to be quite productive. A 14-foot well on sec. 20, tp. 17, range 29, appears to be the only well drawing water directly from the dune sands. This well produces enough water for 25 head of stock. Even the boulder clay is found to be more productive in this area than in most places, owing to the decreased run-off and the greater absorption of water at the surface. Four or five wells are reported to be drawing water from the boulder clay beneath the dune sands, and from each the yield is sufficient for 10 to 20, and in one place 53, head of stock. Other wells have encountered pockets of sand and gravel that are scattered through the boulder clay. The yield from each of these wells is ample for 30 or more head of stock. The water from all the wells in the dune sand-covered area is of good quality. From a few wells it is reported to be soft, but in most is moderately hard. On three or four farms located within the area of sand dunes on the north side of Thunder creek and Sandy creek, sufficient water for local requirements has not been obtained from wells. Further prospecting on these farms would probably find water either at the base of the sands or in porous pockets in the underlying boulder clay. The sinking of test holes with a small augor prior to sinking wells has proved effective in some parts. Similarly, throughout the remainder of the area, additional supplies should be readily located by sinking more wells.

Sand beaches were formed on the edges of the glacial lake in some places. An extensive area of sands that were deposited in this manner occurs in the municipality immediately to the east and extends in a narrow belt into this municipality, in township 16, range 28. The deposits are quite porous and wells sunk into them yield good supplies of water. The water is obtained from the sands at depths of less than 30 feet, and is of good quality. Additional supplies should be readily obtained anywhere in the small area in which the glacial lake sands occur.

The entire area lying to the north of Thunder creek, with the exception of the higher land in the north-central part of the municipality, is covered by glacial lake clay. On the south side of the valley the lake clay extends over the northeastern part of township 16, range 28, and the southern part of township 17, range 28. The fine-grained, compact lake clay probably does not exceed 10 to 15 feet in thickness anywhere in this municipality. Owing to its compact nature it absorbs little water from the surface. Hence, little or no water can be derived from the clay in wells. Moreover, very little water percolates through the lake clay into the underlying boulder clay. Wells sunk through the lake clay in the area south of Thunder creek and in the southern part of township 18, range 29, have found water in sand or gravel pockets included in the boulder clay, or in more sandy phases of the clay itself. The greater part of the water found in these areas probably seeps in from the adjacent, higher land where the surface deposits are more porous. The wells range in depth from 11 to 60 feet. Sufficient water for local requirements is obtained from nearly every well. The dissolved mineral salt content of the water at most points is high, and in four of the wells in the northern part of township 16, range 28, it is sufficient to make the water unfit for drinking. Throughout the greater extent of the lake clay-covered area lying to the north of Thunder creek no water is obtained in wells except as seepage from nearby sloughs or dugouts. There appears to be no possibility of obtaining water except as seepage from surface accumulations or by deep drilling into the bedrock. Additional dugouts might be excavated to increase the available supply of surface water. Little water is lost by seepage from dugouts excavated in the lake clay.

The boulder clay composing the greater part of the till and moraine that cover the remainder of the township is too compact to produce much water. Dry holes have been sunk into it at points scattered over the area. Where more sandy phases of the clay are encountered they generally yield water, but not in sufficient quantities for both domestic and stock requirements. The greater number of the producing wells derive their water from the sand and gravel deposits that are scattered through the boulder clay. Wells tapping these aquifers range in depth from 8 to 45 feet. A few of the pockets tapped are small and yield only small quantities of water, but in most places ample water for local requirements is obtained. Springs occur at scattered points on the higher slopes in the southern uplands where sand or gravel aquifers lie at or near the surface.

The quality of the water from both the till and the moraine varies considerably from place to place. Soft water is reported from a number of wells, chiefly on the higher land in the southwest, but from the greater number of the wells the water is hard. Only from a few wells is the water reported to be too highly mineralized for domestic use. A spring and wells on sec. 3, tp. 16, range 28, produce water that is not usable for stock. Since the sand and gravel do not form continuous horizons it is advisable to use a test auger and sink test holes in the drift at several points before digging wells. On farms where suitable supplies of ground water cannot be located, residents are well advised to conserve surface supplies by constructing dams or dugouts in suitable places.

Water-bearing Horizons in the Bedrock

Except for one outcrop in the NW. $\frac{1}{4}$, sec. 35, tp. 16, range 29, the bedrock formations underlying this municipality are everywhere covered by a thick mantle of unconsolidated deposits. Since little is known regarding the character and areal distribution of the formations believed to be present beneath the drift, the boundaries of the formations as indicated on Figure 1, of the map accompanying this report, must be regarded as only approximate. On the evidence of a small amount of information obtained in the municipality to the south and west, and from an examination of an outcrop of the bedrock on sec. 35, tp. 16, range 29, it is considered that the Ravenscrag and Eastend bedrock formations may underlie the greater part of townships 16, ranges 29 and 30, and the southwest corner of township 16, range 28. The Ravenscrag formation is believed to be confined to the upland area in the southwest above an approximate elevation of 2,200 feet above sea-level. Where exposed in other nearby areas this formation is made up of yellow to brown clays and shales, beds of coarse, bluish grey sands, and thin seams of lignite coal. The sand beds and coal seams form aquifers favourable for ground water accumulation. A 94-foot well on sec. 4, tp. 16, range 29, is the only known attempt to obtain water from this formation. The extent of water-bearing horizons in the formation is not known and can be determined only by sinking wells. However, owing to the uncertainty of finding water in the bedrock it is not advisable to sink wells this deep unless exhaustive tests in the overlying glacial drift prove fruitless. It is probable, however, that wells sunk to depths not exceeding 100 feet in the uplands of the southwestern townships of the municipality will reach the Ravenscrag formation, and can be expected to yield at least small supplies of water.

The Eastend bedrock formation immediately underlies the Ravenscrag formation where it is present. Owing to its lower elevation it extends farther down the bedrock slopes immediately beneath the glacial drift, and hence it has a slightly greater areal extent than the Ravenscrag. The base of the Eastend formation probably does not lie at elevations lower than 2,100 feet above sea-level. The formation consists of fine grey sands grading downward into fine silts, clays, and shales. No wells in this municipality have penetrated the formation. Water-bearing horizons may occur in the sand beds near the top of the formation. The Ravenscrag formation is probably more productive of water than the Eastend, so that in the area in which the upper formation occurs water would be encountered in wells before the Eastend formation was reached. In the narrow belt of land lying between elevations 2,100 and 2,200 feet above sea-level the water-bearing beds in the Eastend may be found directly beneath the glacial drift. The depth to the bedrock is probably from 80 to 100 feet or more. As in the area that is underlain by the Ravenscrag formation, it is advisable to test carefully for water in the glacial drift before attempting to obtain supplies from the bedrock.

The Bearpaw formation occurs beneath the Eastend formation, and directly underlies the glacial drift throughout all but the upland parts of the municipality. This formation probably extends to depths of 600 to 800 feet beneath this municipality. It consists of dark grey shales, near the top of which are interspersed occasional thin beds of sand at irregular intervals. The top of the formation is very irregular, so that the thickness of the glacial drift covering may range from about 80 feet in the vicinity of Sandy creek to almost 300 feet in the northeast corner. The drift is probably less than 150 feet in thickness over most parts of this municipality. Some difficulty is experienced in distinguishing the dark shales of the Bearpaw formation from the lower, dark, compact clay of the overlying glacial drift. The distinguishing features of the shales are their darker colour, their soapy feel when wet, the almost entire absence in them of stones or even pebbles, and the small, roughly cubical, light grey to buff-coloured fragments into which they crumble upon weathering. Little or no water is to be expected from the shales themselves, and dry holes have been sunk in the northern part of the municipality, penetrating the shales to depths of 300 to 620 feet. Six wells, also in the northern townships, have obtained water supplies from the bedrock. These wells range in depth from 140 to 700 feet, four of them being approximately 300 feet deep. The logs of these wells have not been obtained, but they probably would show that sand beds are the aquifers. In five of the wells the aquifer lies near the top of the Bearpaw formation, whereas in the 700-foot well the aquifer is close to the bottom of this formation. Each of the wells produces enough water for 20 to 40 head or more of stock. There is little uniformity in the quality of the water from the various wells. From two the water is reported to be soft, but from the others it is quite hard. The dissolved mineral salt content is high and makes the water from one well unfit for drinking, and from the 700-foot well unusable even for stock. In the valleys of Thunder creek and its tributaries, and in the area lying to the south of the valleys, attempts at drilling into the bedrock are not advisable, as supplies can be obtained from shallow wells at least after careful prospecting. In the lake clay area north of Thunder creek, however, water is not obtained from shallow wells except where they are located close to sloughs or dugouts, and the only aquifers encountered are in the bedrock. The sands in the Bearpaw formation do not form continuous horizons through the whole area, however, so that there can be no certainty of obtaining water by deep drilling. Wells not striking water in the upper part of this formation would probably have to be extended to the base of the formation before productive aquifers would be encountered.

The 800-foot well on sec. 1, tp. 18, range 29, appears to have penetrated the massive sand beds of the Belly River formation underlying the Bearpaw formation. The aquifer lies at an elevation of 1,170 feet above sea-level. A large supply of water is available in this well. The water is soft, but has an appreciable content of sodium chloride (common salt) in solution.

This formation may offer a reliable source of water throughout the area, but owing to the great depth required to reach it, and the expense incurred in deep drilling, it is questionable if this formation will ever contribute greatly to the ground water supply of this municipality.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 16, Range 28

An almost level plain occupies the northeastern part of the township. To the southwest, along the northeastern slopes of the Missouri coteau, the surface rises to heights of more than 500 feet above the plain. Both on the plain and near the foot of the slope little difficulty has been experienced in obtaining adequate water supplies from wells. Water-bearing deposits at the higher elevations are relatively few, and the supplies derived from them are in many cases small. A few springs occur on the slopes in the southern sections, but yield only small quantities of water. At many points in the moraine-covered upland, and over the till plain, sloughs occur in the undrained depressions between hills and form the source of water for seepage wells dug beside them. The wells provide domestic supplies and the sloughs are used to water stock.

Four more or less distinct types of glacial deposits are known to be present in different parts of this township, the areal distribution of each being indicated on the accompanying map, Figure 1. These are glacial lake clay, glacial lake sands, glacial till, and moraine. The lake clay is confined to the plain in the northeastern sections and probably does not exceed 10 feet in thickness at any point. Water supplies are not obtained from the clay owing to its compact nature, and little water percolated through the lake clay into the underlying boulder clay. Water is present, however, in the more porous beds of the underlying clay. Surface water is believed to enter the porous sand beds at the margins of the lake basin, and to collect in beds of sand or gravel that are scattered through the boulder clay. Wells have been sunk through the lake clay and have tapped these sands and gravels in the boulder clay at depths ranging from 10 to 45 feet. Large supplies are not obtained in this area, but sufficient water for local requirements has been found in all except one of the existing wells. Evidently the waters move slowly through the clay as they contain large quantities of dissolved mineral salts, sufficiently concentrated to make the water in four of the wells in this area unfit for drinking, but in all places it can be used for watering stock. Highly mineralized, but drinkable, water is reported from two other wells. A well on the SW. $\frac{1}{4}$, section 26, of which no log is available contained water that was not usable even for stock. The existing wells do not indicate the individual aquifers to be continuous over large areas, but they are evidently sufficiently numerous to ensure water being found within 50 feet of the surface at nearly all points in the lake clay-covered area.

The glacial lake sands cover only a small part of sections 23 and 24. As these deposits are very porous they readily absorb surface water. The more impervious beds of the underlying boulder clay prevent further downward percolation of the water and it gathers in depressions in the surface of the clay. Water supplies have been found in wells at depths of 9 to 27 feet below the ground surface. Each of the wells is reported to yield sufficient water of good qualtiy for local domestic and stock requirements. Additional supplies of water should be readily obtained by digging wells within the area covered by glacial lake sand.

As may be seen from Figure 1 of the map, a narrow belt of rolling moraine adjoins the areas covered by glacial lake sand and clay. Moraine mantles the higher land in the southwest. On the intervening slopes glacial till occurs at the surface. The till and moraine are composed essentially of the same materials and have similar water-bearing characteristics. The greatest difference in the two types of deposits lies in their topographic expression. The till-covered area is a gently rolling plain, whereas the moraine is marked by numerous, steep-sided hillocks and undrained depressions. Boulder clay is the main component of both types of deposit. In places the boulder clay is too compact to permit percolation of ground water and a number of holes sunk into it yield no water. The clay varies laterally in composition and in other places is more sandy and, hence, forms better reservoirs for ground water accumulation. A few wells sunk in the township have encountered the porous clay and yield supplies of water that are usually too small for both domestic and stock requirements. More productive aquifers have been encountered in the clay in the form of sands and gravels occurring as isolated pockets. In the hollows and coulées some of these pockets lie within a few feet of the ground surface, but in other places they are covered by 10 to 30 feet of boulder clay. The sand or gravel pockets when tapped by wells are usually sufficiently extensive to provide enough water for local requirements. The dissolved mineral salt content of the water is high, but only in a few places is it sufficient to make the water undrinkable. Greater concentrations of mineral salts have been noted in the waters, not only from springs but in wells, in section 3 than in other parts of the township. Water found on this section is reported to be unsuited to farm use. Aquifers are found at shallower depths on the high land in the southern sections than on the slopes to the north. Throughout the area, however, water-bearing sands or gravels are not to be found at all points, and considerable prospecting may be necessary to locate them on some sections. Sloughs are of common occurrence on the rolling uplands, and the water is not so highly mineralized but that shallow wells sunk beside them will yield water that is satisfactory for domestic use.

No holes are known to have penetrated the bedrock formations that occur beneath the glacial deposits in this township.

The Ravenscrag formation is believed to underlie the extreme southwestern corner of the township, and the Eastend formation to occur beneath it and to extend a mile or more down the slopes beyond the boundary of the Ravenscrag formation, as indicated on the accompanying map (Figure 1). Water-bearing beds probably exist in both these formations, but no definite information has been obtained regarding the character of the water the formations contain or the supplies to be expected by sinking wells into them. Two wells in the township immediately to the south have obtained water from a sand bed that appears to be a part of the Ravenscrag formation. These wells are 105 and 115 feet deep. The sand beds or coal seams of this formation should be encountered in the highest part of the township at depths probably not greater than 100 feet.

Water-bearing sands have frequently been found in the Eastend formation in other localities and may be present in this township. Over most of the area the depths necessary to reach this formation will be comparable with those required to penetrate the Ravenscrag formation. Until more definite information is available it appears to be more advisable to prospect for water in the glacial drift than to extend wells into the Eastend bedrock.

The Bearpaw formation, consisting of dark grey shales, directly underlies the glacial deposits throughout slightly more than the northeastern half of the township. The shales are compact and more or less impervious and any small seepages of water they may contain are expected to be too highly charged with dissolved mineral salts to be used for farm requirements. The overlying glacial deposits are 100 feet or more thick and wells should not be sunk beyond this depth.

Township 16, Range 29

A mantle of glacial drift ranging in thickness from about 60 to 100 feet covers the greater part of the township. The drift is evidently much thinner on the steep slopes along the northern border, and in at least one valley in section 35 the bedrock is exposed at the surface. The greater part of the water supply in the township is derived from the glacial deposits, although one well is believed to have tapped an aquifer in the underlying bedrock, and in a few places water for stock is obtained from sloughs. On the greater number of the farms in the township ample water for both domestic and stock use has been obtained.

Moraine covers all but the west-central and the extreme northeastern parts of the township, where the moraine grades into a less rolling till plain. The boulder clay comprising the greater part of both the moraine and till plain is in most places found by itself to be unproductive of water. Many holes have been dug into it in various parts of the township, but only where the wells are situated close to sloughs has water been obtained from the boulder clay. Supplies in these wells are small and fluctuate seasonally. However, in the clay occur non-continuous beds of sand and gravel that have been encountered in wells at many points, at depths ranging from less than 10 to 25 feet below the surface. Generally these isolated pockets of sand and gravel have sufficient storage capacity that enough water for local requirements is derived from wells tapping them. If the aquifer is of limited areal extent, however, only small amounts of water are obtainable from it. Nearly every well in this township that has penetrated the sands and gravels produces enough water for local requirements. A few springs occur on the slopes and yield moderately large supplies of water. The quality of the water varies from place to place. A few of the very shallow wells yield soft water, but from most of them the water is noticeably hard. Only one well is reported to be producing water that is not of good quality for drinking. In prospecting for water in the glacial drift it is almost impossible to determine the location of the aquifers without sinking wells or test holes, owing to the erratic distribution of the water-bearing beds. The bottoms of coulées or the bases of hill-slopes have been found to be favourable well sites on many farms.

The Ravenscrag formation is believed to underlie the township except in the northeastern and northwestern corners where surface elevations are lower. The beds of sand and thin seams of lignite coal that occur interbedded with shale in this formation are expected to be water bearing. A well 94 feet deep on section 4 is believed to have penetrated the sands at a depth of about 60 or 65 feet. Information on this well is incomplete and no definite conclusions can be drawn from it. Water of good quality is to be expected from the formation in wells less than 100 feet deep. In the absence of definite information regarding the water-bearing properties of this formation it seems advisable to prospect carefully in the drift at shallow depths before incurring the expense of sinking deeper wells.

The Eastend formation is expected to underlie the Ravenscrag formation below an approximate elevation of 2,200 feet above sea-level. Water-bearing horizons may occur in the formation, but the overlying Ravenscrag beds are probably more productive and also are more readily accessible. The formation extends farther down the slopes in the northeast and northwest corners of the township, beyond the limits of occurrence of the Ravenscrag formation. The 2,200-feet contour line on the map, Figure 2, marks the approximate northern limit of the Ravenscrag formation, and the 2,100-line the approximate border of the Eastend formation. In this area, in which the Eastend formation occurs directly beneath the drift, some water may be found in sandy phases of the formation.

The Bearpaw formation immediately underlies the glacial drift in the extreme northeast corner of the township. No water is to be expected from the dark grey shales, so that drilling wells into this formation is not recommended. The shales will be encountered about 80 or 100 feet below the surface.

Township 16, Range 30

This fractional township is only one-half mile wide, being cut off on the west by the Third meridian. The glacial deposits covering the area and the bedrock formations underlying the drift are similar to those in township 16, range 29, and are considered to have similar water-bearing possibilities. Two wells have been reported in the area. A 22-foot well on section 1 derives a supply of water ample for local requirements from a sandy phase of the boulder clay. The 24-foot well on section 25 tapped only a small pocket of sand in the boulder clay, and the supply of water obtained is small. Adequate supplies of ground water should be obtainable in this area by sinking wells to depths not exceeding 100 feet.

Township 17, Range 28

Ground water supplies in the township are obtained from the Recent deposits in the valleys of Thunder creek and its tributaries, and from the glacial deposits adjacent to the valleys and in the area to the south. Thunder creek follows a wide valley through the township from section 30 to section 1. Forsythe creek, a small tributary, crosses sections 7 and 18 and joins Thunder creek in section 17. Another, small, unnamed tributary flows in a southerly direction and joins Thunder creek in section 15.

The Recent alluvial deposits in the valleys consist of fine silts and beds of sand. In parts of Thunder Creek valley the silts form the greater part of the alluvium. Since these silts are very fine-grained they do not form reservoirs for any large accumulations of ground water, and adequate supplies cannot be obtained at some places in the valley. In other localities, however, the surface material is more porous and permits of the percolation of water into buried sand beds. In some places the sandy beds will be observed at the surface, but generally they will be located only by sinking test holes or shallow wells. Extensive sand beds occur near the source of Forsythe creek, in section 13 of the township immediately to the west, and are yielding considerable quantities of water. These sand beds become thinner towards the east, however, and may be altogether absent at some points along the creek. Water-bearing sands were encountered in wells in the valley on sections 17 and 18, and it is probable that sand beds do occur along the entire extent of this valley. Considerably more water for farm use should be obtainable from shallow wells dug along the valleys of Forsythe and Thunder creeks. No reports have been received of wells having been sunk along the valley of the tributary on the north side of Thunder creek, but water-bearing sands are also to be expected in the deposits along this valley.

The remaining parts of the township are overlain with various types of glacial deposits, as indicated on Figure 1 of the accompanying geological map. Dune sands cover a considerable part of the western part of the township on both the north and south sides of Thunder Creek valley. The sands appear to form only a thin surface layer over the boulder clay and are too thin to act as reservoirs for water accumulation. They do, however, absorb the surface water and allow it to percolate downward into the boulder clay or to the sands and gravels that occur at some localities in the clay. A dry hole 27 feet deep was dug on section 31, but each of the other wells in this area is producing enough water for local requirements. One well encountered only boulder clay, but in other wells sands and gravels were tapped which served as aquifers. The extent of sands and gravels in the boulder clay underlying the dune sands is not known. They do not occur at all points, but should be located on most sections if a series of test holes is sunk. Sufficient water for local domestic and stock requirements should be obtainable at depths within 50 feet of the surface at almost any point in the area in which the dune sands occur.

Glacial lake clay covers a large part of the township, including the plain to the north of the valley of Thunder creek and about 6 square miles in the south-central part of the township. As the lake clay is quite compact it will not yield supplies of water. Moreover, it does not permit of the percolation of water from the surface into any porous beds that may occur in the underlying boulder clay. Some water seeps into the boulder clay around the margins of the old lake basin and collects in pockets of sand and gravel in the boulder clay. Few holes have been sunk in the area north of the valley, and owing to the impervious surface covering and to the fact that water cannot migrate northward from the porous stream deposits in the valley little water is to be expected. Sands and gravels no doubt occur at some points, but extensive prospecting may be necessary before they are located. South of the valley the clay appears to be slightly more sandy and porous, and water has been located in sand and gravel beds in several wells ranging from 9 to 23 feet in depth. Each well yields ample water for household needs and 20 or more head of stock. The water is of satisfactory quality for use in the households. As these wells are well distributed over the southern sections water supplies are to be expected from similar aquifers on other sections in the district.

Glacial till or boulder clay occurs at the surface in the southwestern corner of the township, and in two small areas in sections 1 and 12. Wells 23 and 14 feet deep, on sections 6 and 12, are drawing water from the till. Beds of sand and gravel serve as aquifers, and yield supplies of water ample for 42 and 30 head of stock, respectively. Productive aquifers such as these in the till are of local occurrence. Nevertheless, these pockets are probably sufficiently numerous to ensure their being found at comparatively shallow depths throughout the till-covered area, although careful prospecting may be necessary in some of the more level plains.

The Bearpaw formation underlies the glacial deposits throughout this township. Two dry holes, 300 and 620 feet deep, in the northern part of the township have penetrated the dark shales. The thickness of the glacial covering over the bedrock has not been determined, but it is at least 100 feet. Since water supplies are not usually to be found in the Bearpaw formation in this region it is considered inadvisable to sink wells to depths greater than about 100 feet in any part of this township.

Township 17, Range 29

Large quantities of water are being derived from the Recent and glacial deposits in this township. Water from wells in this township is pumped to the city of Moose Jaw and forms the major part of the city's supply. Residents in the area are adequately supplied with water. Sandy creek and Thunder creek in the northern part of the township provide water for stock in the vicinity.

Dune sands occur over the greater part of the township, as indicated on the accompanying map, Figure 1. Stream deposits are found along the valley of Sandy creek. Glacial lake clay is exposed in a small area in sections 32 and 33, and glacial till and moraine cover the southern sections.

The Recent alluvial deposits in the valleys consist of sand beds interbedded with thin layers of silt and clay. Little prospecting for water in the valley has been reported to date. The layers of clay and silt will prevent the collection of large quantities of water below the surface, but small supplies sufficient for farm needs should be obtainable at most points.

Part of the water that percolates downward through the dune sands will collect above the more impervious, underlying boulder clay that occurs at shallow depths. Some of the water will seep to greater depths and become stored in sand or gravel beds in the underlying boulder clay. A part of the water moves along the top of the clay towards lower levels, and on reaching the valleys of Sandy and Thunder creeks forms springs on the valley sides. A few wells in the area have tapped water-bearing sand beds at depths of 10 to 30 feet. Individual wells supply ample water for 25 to 50 or more head of stock, and the water is of good quality. Sufficient good water for local requirements should be obtainable at shallow depths at most points in the area covered by sand dunes. The wells on sections 13 and 28 which supply water to the city of Moose Jaw have been sunk below the dune sands into the underlying boulder clay. Some of the water in these wells is derived from near the surface, but the greater part of the flow is found at depths below 50 feet. These deep beds are limited in extent, however, and are not known to have been found in other parts of the area. The 62-foot well on section 13 is obtaining a large supply of ground water in Forsythe Creek basin. More water could be obtained in the Sandy Creek area from additional wells. The springs feeding this creek on section 19 indicate that water is to be found by sinking wells not only in the valley but in the adjoining, higher land.

Only one well is reported from the area covered by glacial lake clay. This well, located on section 32, is 45 feet deep and provides only enough water for household use. The lake clay itself is non-water bearing and does not readily allow water to percolate from the surface into the underlying deposits. However, water migrating from the lake margin along the surface of the underlying boulder clay collects in the pockets of sand and gravel that occur at its top or are scattered through the boulder clay. The well on section 32 has evidently tapped one of these pockets. It is of small lateral extent and, therefore, produces only a small quantity of water. Other water-bearing pockets may occur in this area, but their location can be determined only by sinking test holes.

Boulder clay containing scattered pockets of sand and gravel composes the till plain and moraine in the southern sections. A supply of water sufficient for local requirements is obtained from a sandy phase of the boulder clay in a 22-foot well on section 4, but in each of the other wells reported in this area either sand or gravel beds form the aquifers. The wells range from 12 to 65 feet in depth. The water follows the porous beds from points of higher elevation to the south, and is under sufficient hydrostatic pressure to cause it to rise above the aquifer in the wells. Ample water for local domestic and stock requirements is obtained on each farm. One well on section 10 yields enough water for 100 head of stock. The water is of good quality. Springs occur on the slopes at a few points where the water-bearing beds approach the surface. Further supplies should be obtainable from additional wells sunk in the southern sections. Water-bearing beds may be absent at some localities, but a few test holes should locate an aquifer, particularly if the tests are made in depressions or at the bases of slopes.

The Bearpaw formation occurs beneath the glacial deposits throughout the township. In the vicinity of Sandy creek it is believed to lie about 80 feet below the surface, but at other points the depth is probably greater. A 308-foot dry hole on section 28 is the only reported attempt to obtain water from the bedrock in the township. As the shales are too impervious to yield water no further deep drilling should be attempted, particularly since good supplies of water are obtainable throughout the area after a limited amount of prospecting at shallower depths.

Township 17, Range 30

This fractional township is approximately one-half mile in width, being cut off on the west by the Third meridian. The Recent and glacial deposits covering this small area and their water possibilities are probably similar in all respects to those occurring in the western part of township 17, range 29. Readers are referred to the immediately preceding section of this report, in which the water-bearing characteristics of these deposits have been discussed in some detail. Good supplies of water are reported from wells on sections 1 and 24. Springs on section 24 feed Sandy creek.

Township 18, Range 28

The surface of the township is an almost level plain, the greater part of which is covered by compact glacial lake clay. Because of this impervious covering and the sparing occurrence of sands or gravels in the underlying deposits very little water has been obtained from the glacial drift.

The glacial lake clay that mantles all of the township except the northwest corner is probably in few places more than 10 feet thick. Small supplies of water, sufficient only for household requirements, are being derived from a few wells in the area. These wells range in depth from 16 to 40 feet. Each well is situated in a hollow, and in most cases is close to sloughs or dugouts. No continuous water-bearing horizon has been encountered in any of these wells, and the water obtained is largely direct seepage from the surface reservoirs. Dugouts excavated in this area should lose little water by seepage, and hence form important sources of supply in this township. Shallow wells dug beside the dugouts provide water for domestic purposes. Little water is to be expected from the boulder clay underlying the lake clay. At isolated points sand and gravel pockets may be present in the boulder clay, but they can be located only by careful testing.

Slightly better conditions are to be expected in the northwest sections where the till is not covered by lake clay. The boulder clay is considerably more porous than the lake clay and should permit some percolation of water from the surface. The 50-foot dry hole on section 30 is the only reported attempt to obtain water in this area. Further prospecting for water in the boulder clay seems worth while, however, as water-bearing sands and gravels should be encountered at isolated points.

The thickness of the glacial deposits, and thus the depth to the bedrock, in the township is not known. Two wells, however, appear to have penetrated the Bearpaw formation that underlies the whole of the area. On section 16 a good supply of water is derived from the bedrock in a well 300 feet deep. The water, although highly mineralized, is usable both for the household and for stock. The nature of the aquifer in this well has not been determined, but it is probably a thin bed of sand. A 140-foot well on section 23 has also penetrated the bedrock and encountered a bed of water-bearing sand. The water in this well is also highly mineralized, but is usable for drinking. Unfortunately the sand fills in the lower part of the well, shutting off the flow of water and the well is not at present in use. The lateral extent of water-bearing sand beds in the Bearpaw formation cannot be stated, owing to a lack of deep drilling in the area. Evidently the productive horizon on section 23, which lies at an elevation of 1,815 feet above sea-level, does not extend to section 16, as the well on the latter section was drilled to an elevation 165 feet lower in order to obtain water. Deep, dry holes in the townships to the east, south, and west also suggest that the aquifers tapped in this township are only local in occurrence. Deep wells drilled in other parts of this township might encounter aquifers in the bedrock, but no assurance can be given.

Township 18, Range 29

Much of the water supply of the township is obtained from wells tapping the glacial deposits and the underlying bedrock. Several springs occur in the southwest part of the area. Sloughs and excavated dugouts store surface water. Some residents in the township have experienced considerable difficulty in obtaining water supplies.

Recent dune sands cover several sections in the south-central part of the township. The sand deposits are too thin to serve as reservoirs for water, but they readily permit of the seepage of water from the surface into the underlying boulder clay, where it accumulates in sand and gravel pockets. Three of the wells dug in the sand dune-covered area encountered only boulder clay in the underlying deposits. These wells produce only small quantities of water. Other wells have tapped sand and gravel pockets in the boulder clay and yield ample water for 20 to 40 head of stock. The water in each well is of good quality. Springs occurring in the small coulées probably have their source in the sands or gravels of the boulder clay. Good water supplies are not to be expected at every point in the area covered by dune sands, but should be found in many localities by sinking test holes.

Glacial lake clay covers the greater part of the township, as indicated on the accompanying map of the municipality, Figure 1. The compact lake clay permits of little or no percolation of water from the surface to the underlying boulder clay, and does not yield water itself. Water migrates into the boulder clay, however, from around the margins of the lake clay-covered area where more porous deposits occur. Close to the northern and southern borders of the lake area shallow wells derive satisfactory supplies of water from sandy phases of the boulder clay encountered after passing through the lake clay. Other wells have tapped sand and gravel pockets in the boulder clay and produce ample water for 20 or more head of stock. The wells range in depth from 9 to 60 feet, but the greater number are from 20 to 30 feet deep. As in areas where the boulder clay occurs at the surface aquifers can be located only by testing. Additional supplies of water will undoubtedly be found in the lake clay-covered sections if a sufficient number of test holes are sunk.

Glacial till or boulder clay occurs at the surface in the northeastern corner of the township and in the low land in the southwestern part. A dry hole 50 feet deep was dug on section 18, and no producing wells have been reported from either of the areas. Water supplies are to be expected under conditions similar to those described for the other areas. The boulder clay composing the greater part of the deposits will yield little or no water, but the sands and gravels that may be scattered through the clay should be water bearing, and are to be expected at depths of less than 50 feet. They are to be found only by testing. From the foregoing discussions of the various types of deposits it will be concluded that ground water conditions vary but little in the areas covered by different types of deposits. Aquifers appear to extend laterally only over small areas, and in some places are evidently entirely absent. More extensive prospecting is advisable throughout the township. Test holes should be spaced to cover thoroughly as great an area as possible.

Four deep wells, ranging from 280 to 800 feet deep, on section 1, 22, 28, and 30, appear to be drawing water from the underlying bedrock formations. The wells 280, 305, and 310 feet deep are sunk into the Bearpaw formation. Fine sand is reported as the aquifer in one of the wells and is probably present also in the others. The water from the shallowest well is soft and of satisfactory quality for household use, but the water in the other wells is hard, highly mineralized, and undrinkable. Sufficient water is available in each well to water 20 to 40 head of stock. Dry holes on sections 14 and 33 indicate the lack of continuity of the water-bearing sands. These wells were drilled deep enough to reach the sands encountered in the wells on sections 22, 28, and 30, but they were not found. The areal extent of the aquifer has not been determined, and it is impossible to predict in what parts of the township water will be found in the bedrock.

The 800-foot well on section 1 appears to have penetrated the upper part of the Belly River formation underlying the Bearpaw shales. Large quantities of water are available in this well, but it is of poor quality owing to the high content of sodium chloride (common salt). Although a continuous water-bearing horizon in this formation may extend through the whole township the expense of drilling to it excludes this horizon as a source of stock water for many residents. Supplies sufficient for local requirements should be obtainable from shallower wells and should they prove inadequately productive, conserving of surface water by means of dugouts should be considered.

Township 18, Range 30

The unconsolidated deposits and the bedrock formation found in this belt one-half mile in width are similar to those occupying the western part of township 18, range 29, and their water-bearing properties are presumably similar. Wells on sections 1, 12, and 13 are reported to be drawing water from the glacial deposits, and a 700-foot well on section 12 encountered a water-bearing horizon in the Bearpaw formation at an approximate elevation of 1,320 feet above sea-level. The water from this well is too salty to be used for any farm requirements. As in the township to the east, it seems better to confine prospecting for water to the glacial deposits. Dugouts may be required for the storage of surface water should wells sunk in the drift yield unsatisfactory supplies.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF CARON, NO. 162, SASKATCHEWAN

Township	16	16	16	17	17	17	18	18	18	Total No. in Municipality
West of 2nd mer. Range	28	29	30	28	29	30	28	29	30	
Total No. of Wells in Township	105	54	3	22	39	6	9	40	4	282
No. of wells in bedrock	0	1	0	2	1	0	2	7	1	14
No. of wells in glacial drift	105	53	3	16	35	6	7	29	3	257
No. of wells in alluvium	0	0	0	4	3	0	0	4	0	11
Permanency of Water Supply										
No. with permanent supply	47	31	3	19	35	6	7	34	4	186
No. with intermittent supply	0	2	0	0	0	0	0	0	0	2
No. dry holes	58	21	0	3	4	0	2	6	0	94
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	1	0	1
No. of non-flowing artesian wells	1	11	0	3	7	0	1	7	2	32
No. of non-artesian wells	46	22	3	16	28	6	6	26	2	155
Quality of Water										
No. with hard water	46	26	3	19	30	5	7	26	4	166
No. with soft water	1	7	0	0	5	1	0	8	0	22
No. with salty water	0	1	0	0	0	0	0	1	0	2
No. with "alkaline" water	19	5	0	6	3	1	2	10	1	47
Depths of Wells										
No. from 0 to 50 feet deep	104	51	3	19	31	6	7	31	2	254
No. from 51 to 100 feet deep	1	3	0	1	6	0	0	1	1	13
No. from 101 to 150 feet deep	0	0	0	0	1	0	1	0	0	2
No. from 151 to 200 feet deep	0	0	0	0	0	0	0	0	0	0
No. from 201 to 500 feet deep	0	0	0	2	1	0	1	7	0	11
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	1	1	2
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	38	32	3	17	35	6	7	33	3	174
No. not usable for domestic purposes	9	1	0	2	0	0	0	1	1	14
No. usable for stock	46	33	3	19	35	6	7	34	3	186
No. not usable for stock	1	0	0	0	0	0	0	0	1	2
Sufficiency of Water Supply										
No. sufficient for domestic needs	44	31	3	19	34	6	7	34	4	182
No. insufficient for domestic needs	3	2	0	0	1	0	0	0	0	6
No. sufficient for stock needs	31	25	2	19	34	6	2	29	4	152
No. insufficient for stock needs	16	8	1	0	1	0	5	5	0	36

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

The term "total dissolved mineral solids" as here used refers to the residue remaining when a sample of water is evaporated to dryness. It is generally considered that waters that have less than 1,000 parts per million of dissolved solids are suitable for ordinary uses, but in the Prairie Provinces this figure is often exceeded. Nearly all waters that contain more than 1,000 parts per million of total solids have a taste due to the dissolved mineral matter. Residents accustomed to the waters may use those that have much more than 1,000 parts per million of dissolved solids without any marked inconvenience,,although most persons not used to highly mineralized water would find such waters highly objectionable.

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

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

Analyses of Water Samples from the Municipality of Caron, No. 162, Saskatchewan

LOCATION						Depth of well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									Source of Water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1	SE.	3	16	28	2	Spring	2,950												(2)		(3)	(4)	(1)	(5)		* 1
2	NE.	17	16	28	2	?	8,145												(2)		(3)	(4)	(1)	(5)		* 1
3	NE.	28	16	28	2	4	1,455	950	900	50	32	225	180	144	787	258	1,365	255	131		429		527	53		* 1
4	NW.	35	16	29	2	12	880	700	600	100	15	360	70	115	201	199	835	125		199	60		426	25		* 1
5	SE.	13	17	29	2	62	745											(3)	(1)		(2)		(4)		(5)	* 1
6	NE.	28	17	29	2	82	1,203												(2)		(4)	(3)	(1)	(5)		* 1
7	SW.	16	18	28	2	300	2,400	1,400	1,100	300	50	480	280	202	1,214	502	2,245	480	27		602		1,053	83		* 2
8	SE.	12	18	30	2	700	2,500	15	-	-	1,260	275	-	7	25	1,127	2,403			15		272	37	2,079		* 2

Water samples indicated thus, * 1, are from glacial drift or other unconsolidated deposits.
Water samples indicated thus, * 2, are from bedrock Bearpaw formation.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analyses Nos. 1, 2, 5 and 6, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

The quality of water derived from the Recent stream deposits at any one place depends largely on the nature and porosity of the sediments forming the source beds. Sands and gravels allow water to circulate freely, and since they do not contain inherently large amounts of readily dissolvable mineral salts, the water is soft or only moderately hard, and suitable for domestic use. The silts, on the other hand, tend to prevent rapid circulation, and thus allow percolating waters ample opportunity to dissolve such mineral salts as are present in the silts. These waters are appreciably "alkaline" and may be unsuited to domestic use. Wells sunk into the Recent stream deposits in this municipality yield hard waters with a fairly high content of dissolved solids. A large proportion of the salts contained in the waters is probably carried into the valley sediments by waters seeping through the boulder clay or lake clay on either side of the valleys. The water from all wells drawing from the Recent deposits is reported to be satisfactory for household use. The dune sands contain only small amounts of readily soluble salts, and hence do not appreciably affect the quality of the water seeping through them. Waters obtained directly from the sand are usually very soft and clear, but in places where wells pass through the sands into the underlying boulder clay the hardness of the water increases, as does the total dissolved salt content.

Considerable variations in the character of the glacial deposits are frequently noted within small areas, and these variations result in corresponding differences in the quality of the water contained in them. The boulder clay that comprises the greater part of the drift is the main source of the mineral salts found in the waters. Water percolating down from the surface through the boulder clay dissolves quantities of mineral salts, in amounts depending on the porosity of the clay and the depth of percolation.

The less porous the clay, and the longer the waters are in contact with it, the greater is the amount of mineral salts dissolved. Water collecting in sand or gravel beds at shallow depths usually has a low mineral content. In undrained, low-lying areas the salt content of surface waters may be greatly concentrated by evaporation, and hence even shallow wells may yield water of very poor quality. As the water percolates to greater depths the content of dissolved salts increases and water from deep wells in the boulder clay is frequently unfit for use. The mineral salts most commonly found in solution in waters from the drift are, in the decreasing order of their relative abundance: sodium sulphate (Na_2SO_4), calcium sulphate ($CaSO_4$), magnesium sulphate ($MgSO_4$), calcium carbonate ($CaCO_3$), and varying amounts of sodium carbonate (Na_2CO_3), magnesium carbonate ($MgCO_3$), and sodium chloride (NaCl).

The analyses of waters from the glacial drift, shown in the accompanying table, illustrate the variations in quality. The total solid content of these six samples ranges from 745 to 8,145 parts per million. In five of the waters analysed sodium sulphate is the predominant salt. The concentration of the combined sulphates in the first two samples is sufficient to make the water unusable either for man or stock. In the other samples the sulphates are present in smaller proportions, and are not sufficiently concentrated to cause any laxative effects. Analyses Nos. 3, 4, 5, and 6 show waters of good quality for domestic use.

Water from the Bedrock

Only one well in the municipality appears to be drawing water from the Ravenscrag formation. No sample of this water was taken for analysis. The greater part of the mineral salts found in water in this formation is derived from the overlying glacial drift, hence, the waters show characteristics similar to those from the drift. The sulphates of sodium, calcium, and magnesium will probably be the predominant salts. In some localities where water is derived from greater depths in the formation it is found to be softer, with sodium carbonate the predominant salt.

No water is being obtained from the Eastend formation in this municipality. Water from this source will probably be more highly mineralized than water from the overlying Ravenscrag formation, and may be less desirable for farm use.

Water from the upper part of the Bearpaw formation is usually highly mineralized and resembles in character the water obtained from the compact boulder clay of the glacial drift. As the water seeps down through the boulder clay it dissolves out the mineral salts, and these become concentrated in the upper layers of the shale. Of the five wells obtaining water from the upper part of the Bearpaw formation in this municipality only one yields water that is unsuitable for drinking. The water from three of the wells is hard and has a fairly high concentration of sulphate salts. From the other two wells the water is soft and probably contains carbonates in addition to the sulphates. Analysis No. 7 is of water from the upper part of the Bearpaw formation. Sodium sulphate and magnesium sulphate together are present in 1,655 parts per million, and may cause the water to have a laxative effect on persons not accustomed to the use of highly mineralized water.

Analysis No. 8 is of water from the lower part of the Bearpaw formation. The mineral salts found in large concentration at higher levels are here present in only very small amounts. Sodium chloride, inherent in the shales, is highly concentrated in the water, and makes it unfit for household or stock use, or for irrigation.

The water in the 800-foot well on sec. 1, tp. 18, range 29, is believed to be derived from the Belly River formation. The water is soft and contains a noticeable content of common salt in solution, but is being used for all farm requirements. The quality of water to be found in this formation at other points cannot be predicted.

WELL RECORDS—Rural Municipality of CARON, NO. 162, 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
1	NE.	1	16	26	2	Dug	25	2,000	− 10	1,990	10	1,990	Glacial drift	Hard, clear, "alkaline"	42	D, S	In ravine; small supply.
2	SE.	2	"	"	"	Dug	30	2,080	− 26	2,054	26	2,054	Glacial sand	Hard, clear, "alkaline"	40	D, S	Sufficient for local needs.
3	NE.	2	"	"	"	Bored	20	2,040	− 18	2,022	18	2,022	Glacial drift	Hard, "alkaline"	42	S	Water usable only for stock.
4	SE.	3	"	"	"	Spring		2,100		2,100			Glacial drift			N	Small flow; poor quality; #.
5	SW.	3	"	"	"	Dug	10	2,180	− 8	2,172	8	2,172	Glacial sand	Hard, clear, "alkaline"	42	D, S	In ravine; poor quality; sufficient supply.
6	SW.	4	"	"	"	Dug	10	2,180	− 6	2,174	6	2,174	Glacial gravel	Hard, clear, iron	40	D, S	Sufficient supply; also a small spring.
7	NE.	5	"	"	"	Dug	8	2,120	− 4	2,116	4	2,116	Glacial sand	Hard, clear, "alkaline"	40	D, S	Sufficient for local needs.
8	NW.	6	"	"	"	Dug	10	2,260	− 6	2,254	6	2,254	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
9	NW.	8	"	"	"	Dug	20	2,150	− 10	2,140	10	2,140	Glacial drift	Hard, clear	42	N	Only a small supply of seepage water from slough.
10	NE.	10	"	"	"	Dug	20	2,020	− 17	2,003	17	2,003	Glacial gravel	Hard, clear, "alkaline"	40	D, S	Sufficient for local needs.
11	SW.	11	"	"	"	Dug	20	2,025									Dry hole in glacial drift.
12	NE.	11	"	"	"	Dug	12	1,991	− 8	1,983	8	1,983	Glacial drift	Soft, clear	42	D, S	Small supply; seepage well.
13	NE.	11	"	"	"	Dug	18	2,000	− 18	1,982	18	1,982	Glacial drift			D, S	
14	NW.	14	"	"	"	Dug	20	1,950	− 18	1,932	18	1,932	Glacial drift	Hard, clear	40	D, S	Insufficient for local needs.
15	SE.	15	"	"	"	Dug	14	1,995	− 9	1,886	9	1,986	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
16	NE.	15	"	"	"	Dug	26	1,980	− 20	1,960	20	1,960	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
17	SE.	16	"	"	"	Dug	25	2,000	− 19	1,981	19	1,981	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Sufficient supply in wet seasons; two dry holes 20 feet deep.
18	NE.	16	"	"	"	Dug	10	1,980	− 7	1,973	7	1,973	Glacial gravel	Hard, clear	42	D, S	Small quantity water; mostly seepage; dry hole 14 feet deep.
19	NE.	17	"	"	"	Dug	16	2,025	− 8	2,017	8	2,017	Glacial sand	Hard, clear	54	D	Insufficient for local needs; a well containing unusable water filled in; #.
20	SE.	18	"	"	"	Dug	20	2,175									Thirteen dry holes in glacial drift.
21	NW.	19	"	"	"	Dug	30	2,120	− 10	2,110			Glacial sand	Hard, clear	42	D	Poor supply; principally seepage; sixteen dry holes 16 to 30 feet deep.
22	SE.	20	"	"	"			2,030									Several dry holes; also dry hole on SW.¼.
23	NE.	20	"	"	"	Dug	16	2,000	− 11	1,989	11	1,989	Glacial drift	Hard, clear, iron	42	D, S	Seepage well; poor supply; a similar well has gone dry.
24	NW.	21	"	"	"	Dug	18	1,980	− 17	1,963	17	1,963	Glacial drift	Soft, clear	42	D	Sufficient only for domestic needs; dry holes 40 to 50 feet deep.
25	NW.	22	"	"	"	Dug	18	1,985	− 16	1,969	16	1,969	Glacial sand	Hard, clear,	40	D, S	Sufficient for local needs.
26	SE.	22	"	"	"	Dug	10	1,975					Glacial drift				No information.
27	NW.	23	"	"	"	Dug	32	1,950	− 27	1,923	27	1,923	Glacial sand	Hard, clear, "alkaline"	42	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 CARON, NO. 162, 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
28	SW.	24	16	28	2	Dug	30	1,970	- 24	1,946	24	1,946	Glacial sand	Hard, iron, "alkaline"	42	D, S	Sufficient for local needs; two dry holes.
29	NW.	24	"	"	"	Dug	13	1,940	- 9	1,931	9	1,931	Glacial gravel and sand	Hard, clear	40	D, S	Sufficient for local needs.
30	SE.	24	"	"	"	Dug	24	1,950	- 21	1,929	21	1,929	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs; two or three similar wells.
31	SW.	26	"	"	"	Dug		1,940					Glacial drift	Hard, "alkaline"		S	Water usable only for stock.
32	SW.	27	"	"	"	Dug	8	1,950	- 3	1,947	3	1,947	Glacial sand	Hard, "alkaline"	42	S	Sufficient supply, but poor quality.
33	NE.	28	"	"	"	Dug	4	1,920	- 0	1,920	0	1,920	Glacial gravel	Hard, clear	40	I, S	Sufficient supply for local needs; #.
34	SW.	28	"	"	"	Bored	40	1,980	- 31	1,949	31	1,949	Glacial sand	Hard, clear, "alkaline", iron	42	D, S	Fair supply of water; two dry holes.
35	SW.	29	"	"	"	Dug	30	1,940									Two dry holes in glacial drift; dry gravel in each hole.
36	NW.	30	"	"	"	Dug	97	2,025									Thirteen dry holes in glacial drift.
37	SW.	30	"	"	"	Dug	16	2,100	- 14	2,086	14	2,086	Glacial drift			S	Insufficient for local needs.
38	SW.	32	"	"	"	Dug	13	1,970	- 9	1,961	9	1,961	Glacial gravel	Hard, clear	42	D, S	Supplied several farms; municipal well.
39	NW.	32	"	"	"	Dug	11	1,950	- 5	1,945	5	1,945	Glacial gravel and sand	Hard, clear, "alkaline", iron	42	D, S	Sufficient in 1935, not 1934.
40	NW.	33	"	"	"	Bored	45	1,930	- 30	1,900	45	1,885	Glacial gravels	Hard, clear, "alkaline", iron	42	S	Sufficient for local needs; poor quality; two dry holes 25 feet deep.
41	SE.	33	"	"	"	Dug	16	1,920	- 11	1,909	11	1,909	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs; two similar wells in same coulée.
42	NE.	33	"	"	"	Dug	50	1,900	- 30	1,870	30	1,870	Glacial gravel	Hard, clear, "alkaline"	42	S	Sufficient for local needs; poor quality.
43	NW.	34	"	"	"	Dug	16	1,885	- 7	1,877	7	1,877	Glacial sand	Hard, clear, "alkaline"		S	Insufficient for local needs; poor quality.
44	NE.	34	"	"	"	Bored	50	1,870	- 44	1,826	44	1,826	Glacial drift	Hard, clear, "alkaline"	42	S	Unfit for domestic use.
45	NE.	35	"	"	"	Dug	42	1,875	- 26	1,849	26	1,849	Glacial drift	Hard, clear, "alkaline"	42	S	Unfit for domestic use.
1	SE.	1	16	29	2	Dug	16	2,405	- 4	2,401	16	2,389	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
2	SW.	1	"	"	"	Dug	32	2,420									Thirteen dry holes 12 to 32 feet deep in glacial drift.
3	NE.	3	"	"	"	Dug	10	2,420	- 6	2,414	10	2,410	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs; also a 60-foot well with very small supply.
4	SW.	4	"	"	"	Drilled	94	2,350	- 65	2,285	65	2,285	Ravenscrag(?) sand				
5	NW.	4	"	"	"	Dug	13	2,325	- 7	2,318	13	2,312	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
6	NW.	5	"	"	"	Dug	13	2,280	- 5	2,275	13	2,267	Glacial gravel	Soft, clear	42	D, S	Sufficient for local needs.
7	NE.	6	"	"	"	Dug	7	2,298	- 1	2,297	1	2,297	Glacial gravel	Soft, clear	42	D, S	Water easily obtained in locality.

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 CARON, NO. 162, 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	NW.	7	16	29	2	Dug	12	2,240	− 0	2,240	12	2,228	Glacial drift	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
9	NW.	12	"	"	"	Dug	20	2,350	− 14	2,336	14	2,336	Glacial drift	Soft, clear	42	D	Only sufficient for domestic needs; also a shallow seepage well and several dry holes.
10	SW.	13	"	"	"	Dug	18	2,300	− 2	2,298			Glacial drift	Soft, clear	42	D, S	Seepage well by slough; a number of dry test-holes have been sunk.
11	SE.	22	"	"	"	Bored	20	2,240	− 15	2,225	15	2,225	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Another well in quicksand and clay.
12	NE.	23	"	"	"	Dug	12	2,150	− 9	2,141	9	2,141	Glacial gravel	Hard, clear, "alkaline"	42	S	Sufficient for local needs; poor quality.
13	NW.	25	"	"	"	Dug	13	2,070	− 9	2,061	13	2,057	Glacial gravel	Soft, clear	42	D, S	Sufficient for local needs.
14	SW.	25	"	"	"	Dug	12	2,115	− 6	2,109	6	2,109	Glacial drift	Soft, clear, iron	44	D, S	Insufficient for local needs.
15	SE.	25	"	"	"	Dug	12	2,065	− 7	2,058	7	2,058	Glacial drift	Hard, clear	42	D, S	Sufficient for local needs.
16	NW.	25	"	"	"	Dug	16	2,070					Glacial drift	Hard, cloudy	43	D, S	Intermittent supply.
17	NE.	25	"	"	"	Dug	20	2,065					Glacial drift	Hard, clear	42	D, S	Seepage well by slough; intermittent supply.
18	NE.	26	"	"	"	Dug	12	2,100	− 6	2,094	12	2,088	Glacial gravel	Hard, clear, "alkaline"	42	S	Sufficient for 70 head stock.
19	NW.	30	"	"	"	Dug	17	2,180	− 11	2,169	17	2,163	Glacial sandy gravel	Hard, clear	41	D, S	Sufficient for local needs.
20	SW.	30	"	"	"	Dug	24	2,170	− 20	2,150	20	2,150	Glacial gravel	Hard, clear	42	D, S	
21	SW.	31	"	"	"	Dug	35	2,125	− 23	2,102	23	2,102	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs; dry hole 35 feet deep.
22	NW.	32	"	"	"	Dug	25	2,160	− 15	2,145	15	2,145	Glacial drift	Hard, clear	42	D	Only sufficient for household use; another well supplies water for stock.
23	SW.	32	"	"	"	Dug	10	2,230	− 7	2,223	10	2,220	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
24	NE.	32	"	"	"	Dug	12	2,300	− 1	2,299	12	2,288	Glacial gravel	Hard, clear	42	D, S	Another well yields salty water.
25	NE.	33	"	"	"	Dug	15	2,330	0	2,330	15	2,315	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
26	SW.	33	"	"	"	Bored	25	2,360	− 19	2,341	19	2,341	Glacial drift	Hard, clear	42	D, S	Insufficient for local needs; several dry holes; deepest 60 feet.
27	NE.	35	"	"	"	Dug	16	2,055	− 14	2,041	14	2,041	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
28	NW.	35	"	"	"	Dug	12	2,070					Glacial drift	Hard, clear	42	D, S	Insufficient for local needs; #.
29	NW.	36	"	"	"	Dug	25	2,000									Dry hole in glacial clay.
30	NE.	36	"	"	"	Dug	19	2,010	− 3	2,007			Glacial drift	Hard, clear	42	D, S	Sufficient for local needs; seepage from slough.
1	N.½	1	16	30	2	Dug	22	2,300	− 19	2,281	19	2,281	Glacial drift	Hard, clear		D, S	Sufficient for local needs; also has a spring.
2	SE.	25	"	"	"	Drilled	24	2,120	− 4	2,116			Glacial sand	Hard, clear		D, S	Insufficient for local needs.
1	SW.	2	17	28	2	Dug	9	1,850	− 5	1,845	7	1,843	Glacial sand	Hard, clear	44	D, S	Sufficient for 20 head cattle.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of CARON, NO. 162, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
2	SW.	4	17	28	2	Dug	11	1,900	- 7	1,893	7	1,893	Glacial drift	Hard, "alkaline"	40	D, S	Sufficient for local needs.
3	SE.	5	"	"	"	Dug	21	1,910	- 18	1,892	18	1,892	Glacial gravel	Hard, clear	45	D, S	Sufficient for more than 22 head stock.
4	NW.	5	"	"	"	Dug	23	1,940	- 16	1,924			Glacial sand	Hard, clear	41	D, S	Sufficient for local needs.
5	NE.	6	"	"	"	Dug	23	1,910	- 18	1,892	18	1,892	Glacial sand	Hard, clear	48	D, S	Sufficient for 42 head cattle.
6	SE.	11	"	"	"	Dug	9	1,800	- 4	1,796	4	1,796	Recent alluvial sand	Hard, cloudy, "alkaline"	48	S	Sufficient for 30 head stock; poor quality.
7	NE.	12	"	"	"	Dug	14	1,840	- 4	1,836	14	1,826	Glacial gravel	Hard, clear	43	D, S	Sufficient for 30 head stock.
8	NW.	14	"	"	"	Dug	14	1,825	- 11	1,814	11	1,814	Glacial sand	Hard, clear, "alkaline"		S	Sufficient for local needs.
9	SW.	16	"	"	"	Bored	60	1,970					Glacial drift	Hard, "alkaline"		S	Small supply for stock; 12- and 20-foot wells give better supplies of good water.
10	SE.	17	"	"	"	Dug	40	1,910	- 20	1,890	40	1,870	Glacial drift	Hard, clear	45	D, S	Sufficient for more than 15 head stock; also a small spring in the valley.
11	SW.	17	"	"	"	Bored	26	1,850	- 17	1,833	17	1,833	Recent alluvial sand	Hard, clear		D, S	
12	SE.	18	"	"	"	Dug	8	1,875	- 4	1,871	4	1,871	Recent alluvial sand	Hard, clear, "alkaline"	44	D, S	Sufficient for local needs.
13	NW.	13	"	"	"	Dug	40	1,915	- 30	1,885	40	1,875	Glacial sand	Hard, clear		D, S	
14	NW.	20	"	"	"	Dug	13	1,830	- 12	1,818	13	1,812	Recent alluvial sand	Hard, clear		D, S	Sufficient for local needs.
15		26	"	"	"		300	1,910									Dry hole in Bearpaw formation.
16	SW.	27 29	"	"	"	Dug	20	1,840	- 8	1,832	8	1,832	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
17	SW.	31	"	"	"	Dug	12	1,875	- 7	1,868	7	1,868	Glacial sandy gravel	Hard, clear		D, S	Sufficient for local needs; also a dry hole 27 feet deep.
18	SW.	33	"	"	"	Drilled	620	1,925									Dry hole in Bearpaw formation; water supply from a pond.
1	NW.	1	17	29	2	Dug	15	1,970	- 12	1,958	12	1,958	Glacial gravel	Hard, clear		D	Springs on this section.
2	NE.	1	"	"	"	Dug	26	1,960	- 15	1,945	15	1,945	Glacial sand	Hard, clear, "alkaline"	45	D, S	Sufficient for 20 head stock.
3	SE.	2	"	"	"	Dug	18	2,040	- 12	2,028	72	2,028	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
4	NW.	4	"	"	"	Dug	22	2,060	- 14	2,046			Glacial drift	Hard, clear	42	D, S	Sufficient for local needs.
5	SE.	5	"	"	"	Spring		2,100					Glacial drift				
6	NE.	5	"	"	"	Bored	25	2,060	- 13	2,047	23	2,037	Glacial gravel	Hard, clear, "alkaline"	43	D, S	Sufficient for 8 head stock.
7	SW.	8	"	"	"	Dug	112	2,030	- 6	2,024	10	2,020	Glacial drift	Hard, clear	44	D, S	Sufficient for local needs; another well the same.
8	NW.	10	"	"	"	Dug	45	1,985	- 33	1,952	36	1,949	Glacial gravel	Soft, clear	46	D, S	Sufficient for 100 head stock; 65-foot well with practically no water.
9	SE.	12	"	"	"	Dug	46	1,950	- 23	1,927	46	1,904	Glacial sand	Soft, clear	48	D, S	Sufficient for local needs.
10	SW.	12	"	"	"	Springs		1,960					Glacial sand				Several springs in creek bed.

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 CARON, NO. 162, 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
11	SE.	13	17	29	2	Drilled	62	1,900	− 4	1,890	32	1,868	Glacial sand	Hard, cloudy	44	D, S, M	Part of Moose Jaw city supply; #.
12	NW.	13	"	"	"	Bored	36	1,950	− 25	1,925	32	1,918	Glacial sand	Soft, clear	44	D, S	Sufficient for 30 head stock.
13	NW.	19	"	"	"	Springs		1,950					Glacial sand and gravel				Springs feeding Sandy creek.
14	SW.	20	"	"	"	Dug	14	1,970	− 11	1,959	11	1,959	Recent dune sand	Soft, clear	44	D, S	Sufficient for 25 head stock; also a spring in a hollow.
15	SE.	23	"	"	"	Bored	30	1,950	− 26	1,924			Glacial drift	Hard, clear	50	D, S	Sufficient for 53 head stock.
16	SW.	24	"	"	"	Dug	20	1,925	− 15	1,910			Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 8 head cattle; a similar well is 20 feet deep.
17	NW.	24	"	"	"	Dug	18	1,900	− 11	1,889	11	1,889	Glacial drift	Hard, clear	43	D, S	Sufficient for local needs.
18	NE.	24	"	"	"	Springs		1,900					Glacial drift				Also springs on NE.¼, section 23.
19	SW.	27	"	"	"	Bored	40	1,920	− 22	1,898			Glacial sand	Hard, clear	48	D, S	Sufficient for local needs.
20	NE.	28	"	"	"	Drilled	82	1,900	− 24	1,876	58	1,842	Glacial sand	Hard, clear		D, S	Part of Moose Jaw city supply; produces 26 gallons a minute; #.
21	NE.	28	"	"	"		85	1,945									Dry hole in glacial drift.
22	NE.	28	"	"	"		135										Dry hole in glacial drift.
23	NE.	28	"	"	"		81										Dry hole in glacial drift.
24	NE.	28	"	"	"		85						Glacial sand and gravel				Good supply.
25	NE.	28	"	"	"		308										Dry hole in Bearpaw shale.
26	SW.	30	"	"	"	Dug	5	1,950	− 3	1,947			Recent dune sand	Soft, clear	50	D	Sufficient for local needs; cattle watered at creek.
27	NW.	32	"	"	"	Bored	45	1,925	− 44	1,881	44	1,881	Glacial sand	Hard, clear, iron	42	D, S	Sufficient only for domestic needs.
28	NE.	35	"	"	"	Dug	15	1,850					Recent sand				Sufficient for 35 head stock.
29	NE.	36	"	"	"	Dug	23	1,865	− 17	1,848			Glacial drift	Hard, clear	43	D, S	Sufficient for 15 head stock; similar well also used.
1	SE.	1	17	30	2	Dug	21	2,025	− 18	2,007			Glacial sand	Hard, clear, "alkaline"	44	D, S	Sufficient for local needs; several other wells produced only small supplies.
2	NE.	24	"	"	"	Dug	11	1,945	− 7	1,938	7	1,938	Glacial gravel	Hard, clear	45	D, S	Sufficient for 45 head stock; several springs occur in the valley.
3	NE.	24	"	"	"	Dug	24	1,955	− 22	1,933	22	1,933	Glacial gravel	Soft, clear	44	D,S	Sufficient for local needs.
1	NW.	10	18	28	2	Bored	40	1,940	− 32	1,908	32	1,908	Glacial drift	Hard, clear	42	D, S	Sufficient only for domestic needs; use dugout for stock.
2	SW.	16	"	"	"	Drilled	300	1,950	− 90	1,860	300	1,650	Bearpaw shale	Hard, iron, "alkaline"	44	D, S	Oversufficient for 20 head stock; #.
3	NE.	16	"	"	"	Bored	30	1,945	− 2	1,943			Glacial drift	Hard, clear	48	D	Sufficient only for domestic needs; use a dugout for stock.
4	SW.	21	"	"	"	Dug	18	1,957	− 16	1,941	16	1,941	Glacial drift	Hard, clear	42	D	Sufficient for household only; dugout for stock.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of CARON, NO. 162, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
5	NW.	22	18	28	2	Dug	19	1,950	- 10	1,940	10	1,940	Glacial sand	Hard, clear	46	D	Sufficient for household.
6	NE.	23	"	"	"	Bored	140	1,955			140	1,855	Bearpaw sand	Hard, iron, "alkaline"		D, S	Well is plugged with sand.
7	SW.	26	"	"	"	Dug	16	1,950	- 12	1,938	12	1,938	Glacial drift	Hard, clear	38	D, S	Sufficient only for domestic supply.
8	NE.	30	"	"	"	Dug	50	1,960									Several dry holes in glacial drift.
1	SE.	1	18	29	2		800	1,905	- 8	1,897	735	1,170	Belly River(?) sand	Soft, salty			Large supply.
2	SE.	2	"	"	"	Dug	30	1,880					Glacial drift	Hard, clear, "alkaline"	43	D, S	Insufficient for local needs.
3	SW.	2	"	"	"	Dug	6	1,870					Recent alluvium	Hard, "alkaline"		D, S	Good supply of water.
4	NE.	3	"	"	"	Bored	32	1,875	- 25	1,850	25	1,850	Glacial drift	Hard, clear		D, S	Insufficient for local needs.
5	SE.	5	"	"	"	Dug	20	1,890	- 15	1,875	20	1,870	Glacial drift	Hard, clear, "alkaline"		D, S	Only sufficient for 8 head stock.
6	SW.	6	"	"	"	Dug	40	1,950	- 18	1,932			Glacial drift	Hard, clear	46	D, S	Sufficient for local needs.
7	NE.	6	"	"	"	Dug	3	1,880	+ 5	1,885	0	1,880	Alluvial silt	Soft, clear, "alkaline"	50	D, S	Sufficient for over 25 head stock; several springs in vicinity.
8	SE.	7	"	"	"	Bored	40	1,890	- 34	1,856	34	1,856	Glacial sand	Soft, clear		D, S	Sufficient for local needs; springs in creek bottom.
9	SW.	7	"	"	"	Dug	60	1,920	- 25	1,895	55	1,865	Glacial drift	Soft, clear, iron, "alkaline"	43	D, S	Sufficient for 50 head stock.
10	SE.	9	"	"	"	Dug	12	1,855	- 10	1,845	10	1,845	Recent alluvial sand	Soft, clear, "alkaline"	46	D, S	Sufficient for 34 head stock; two other wells are similar.
11	NW.	9	"	"	"	Dug	14	1,860	- 5	1,855	12	1,848	Glacial gravel	Hard, clear	45	D, S	Sufficient for more than 15 head stock.
12	NE.	9	"	"	"	Spring		1,860					Recent dune sand	Soft			
13	NW.	10	"	"	"	Dug	15	1,870	- 11	1,859			Glacial drift	Hard, clear	41	D, S	Sufficient for local needs; two wells the same.
14	SE.	14	"	"	"		340	1,920									Dry hole in Bearpaw shale.
15	SE.	16	"	"	"	Dug	22	1,880	- 10	1,870			Glacial drift	Hard, clear, "alkaline"		S	Sufficient for 25 head stock.
16	SW.	16	"	"	"	Dug	13	1,865					Glacial gravel	Hard, clear, "alkaline"	43	D, S	
17	NE.	17	"	"	"	Dug	9	1,865	- 4	1,861	4	1,861	Glacial gravel	Hard, clear	42	D, S	Supplies 13 barrels in 20 minutes.
18	SW.	18	"	"	"	Dug	50	1,850									Dry hole in glacial drift.
19	NE.	19	"	"	"	Dug	14	1,860					Glacial drift	Hard, clear, "alkaline"	42	D, S	Only sufficient for 8 head stock.
20	SE.	22	"	"	"	Dug	26	1,940	- 13	1,927	16	1,924	Glacial drift	Hard, clear	42	D, S	Sufficient for more than 20 head stock.
21	NE.	22	"	"	"		310	1,960	-167	1,793			Bearpaw shale	Soft	44		
22	SE.	24	"	"	"	Dug	14	1,940	- 8	1,932			Glacial drift	Hard, clear		D, S	Insufficient for local needs; dry hole 22 feet deep.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of CARON, NO. 162, 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
23	SE.	28	18	29	2	Drilled	305	1,950	-185	1,765	300	1,650	Bearpaw black sand	Soft, clear		N	Sufficient for 40 head stock; well not in use; dry hole 500 feet deep in Bearpaw.
24	SE.	29	"	"	"	Drilled	300	1,925					Glacial gravel				Trace of water at base; not sufficient to be used.
25	SE.	30	"	"	"	Dug	25	1,880	- 5	1,875	20	1,860	Glacial sand	Hard, clear, "alkaline"		S	Sufficient for local needs; 50-foot dry hole in sand.
26	NE.	30	"	"	"	Drilled	280	1,910	-230	1,680			Bearpaw shale(?)	Hard, clear		S	Sufficient for local needs.
27	NE.	32	"	"	"	Dug		1,965						Hard, clear		D, S	
28	SE.	33	"	"	"	Dug	22	1,960	- 14	1,946	14	1,946	Glacial drift	Hard, clear		D	Sufficient for local needs; a dry hole 465 feet deep in Bearpaw sand.
29	NE.	33	"	"	"	Dug	20	1,960	- 10	1,950	8	1,952	Glacial sand and gravel	Hard, clear	40	D	Only sufficient for household use; dugout supplies cattle.
30	SW.	34	"	"	"	Dug	16	1,960	- 6	1,954			Glacial sand	Hard, clear	43	D, S	Sufficient for 25 head stock.
1	SE.	1	18	30	2	Dug	35	1,955	- 28	1,927			Glacial clay	Hard, clear	43	D, S	Only sufficient for 8 horses.
2	SE.	12	"	"	"	Drilled	700	1,920	- 35	1,885	600	1,320	Bearpaw shale	Hard, cloudy	43	N	Large supply of water too highly mineralized for use; an 85-foot well produces usable water; #.
3	NE.	13	"	"	"	Dug	22	1,840	- 14	1,826			Glacial clay	Hard, clear, "alkaline"	42	D, S	Sufficient for 42 head stock.

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

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