CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 190

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF ROYAL CANADIAN NO. 261 SASKATCHEWAN

By

B. R. MacKay, H. N. Hainstock and P. D. Bugg

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INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Royal Canadian, No. 261, comprises an area of approximately 313 square miles in south-eastern Saskatchewan. It consists of eight full townships, described as townships 24, 25, 26, and 27, ranges 25 and 26; and two partial townships, described as townships 23, ranges 25 and 26; all west of the Third meridian. A branch line of the Canadian National railways runs through townships 26, ranges 25 and 26, and on it are located the village of Eatonia and the hamlet of Laporte. Eatonia, in sec. 15, tp. 26, range 25, is situated 21 miles east of the Saskatchewan-Alberta boundary and 152 miles north of the International Boundary.

South Saskatchewan river, which forms the southern boundary of the municipality, flows to the east. The river has an elevation of 1,880 feet above sea-level. It occupies a wide valley, and in some sections the northern slope rises steeply to an elevation of approximately 2,180 feet above sea-level. Deep tributary valleys extend for a short distance north of the river. From a highland a few miles to the north of, and parallel to, the river the elevation gradually decreases in a northerly direction to a comparatively level plain, which marks the site of glacial lake basins in the central parts of townships 24, ranges 25 and 26. The elevation rises gradually from the lake basins to the northern part of the municipality, where an elevation of 2,500 feet above sea-level is attained. Recent deposits of sands and silts form the flood-plain of South Saskatchewan river. Parts of township 25, range 25, township 26, range 26, and township 27, range 25, are mantled by moraine, and are characterized by rock-strewn knolls and ridges. The remainder of the municipality, approximately 240 square miles, is mantled by glacial till or boulder clay, and the ground surface is

undulating. In the lake basins a thin veneer of glacial lake clay overlies the boulder clay.

Water-bearing Horizons in the Unconsolidated Deposits

No wells are reported in the Recent stream deposits along South Saskatchewan river, but water should be obtained from them at shallow depth. Farmers living along the flood-plain of the river use river water for all purposes.

No water is obtained from the glacial lake clay. The glacial till in the vicinity of the lake deposits and underlying them does not appear to contain deposits of water-bearing sand and gravel. Residents state that it is useless to dig or bore for water in the parts of townships 23, ranges 25 and 26, that lie north of the river, and in townships 24, ranges 25 and 26. The residents of this area, with few exceptions, haul water from South Saskatchewan river for all purposes. During the drought period farmers hauled water from the river for distances of 6 to 8 miles. It is quite possible that deep drilled wells would encounter water-bearing deposits, but most farmers are unable to finance a deep drilled well. The use of dugouts to collect surface water, and cement cisterns to collect rain water is highly recommended. The dugouts should be at least 12 feet deep and located in a depression where the maximum amount of surface water collects. The rain water collected in cisterns should be filtered or boiled before it is used for domestic purposes.

The deposits of glacial till and moraine in townships 25, 26, and 27, ranges 25 and 26, consist in general of 10 to 25 feet of yellow or oxidized boulder clay, which in some sections contains scattered pockets or lenses of sand and gravel; a discontinuous layer of sand or gravel that is present only in a few localities; and unoxidized blue boulder clay that contains layers of sand or gravel at various depths. The uppermost water-bearing

horizon, formed by the pockets of sand and gravel in the yellow clay, or the layer of sand and gravel lying between the yellow and blue boulder clays, is encountered principally in townships 25 and 27, range 25. The amount of water obtained from an individual well depends upon the size of the deposit encountered, and upon the amount of annual precipitation. Most of the wells yield a small supply of water, only sufficient for 10 or 15 head of stock. The water from different wells varies in quality; some yield hard, "alkaline" water, and others yield water that is locally termed soft. The water from most of these wells is usable for domestic purposes, but that from the shallow wells may easily become polluted by surface sewage water, and it is, therefore, advisable to have the water frequently tested by the Provincial Analyst for bacteria. Prior to digging shallow wells it is advisable to locate the water-bearing deposits by means of a small, hand, test auger.

A second water-bearing horizon is encountered at depths of 40 to 75 feet in the northern six townships. This horizon is formed by thin, discontinuous layers of sand and gravel in the blue boulder clay. A few wells in each township yield very large amounts of water, but usually an individual well yields only sufficient water for 10 to 25 head of stock. The water is very highly mineralized, and that from some wells is not suitable for drinking or cooking, but it is being used for all farm purposes except irrigation. To one not accustomed to the use of such water it may have a laxative effect. This horizon is not continuous and dry holes have been dug in the vicinity of producing wells.

In the northern six townships water is also encountered at depths of 90 to 160 feet in the glacial drift. The aquifer of most of the wells is formed by a dark sand, but in some it is formed by a very fine gravel. It is thought that the aquifer of

some of the wells is at the contact of the drift and underlying bedrock. Most of the wells yield large quantities of water and supply 25 to 100 head of stock; several cannot be pumped dry. The water is under considerable hydrostatic pressure, and that from a few wells is hard and alkaline, but with few exceptions it is usable for all domestic purposes. Only two dry holes, 160 and 200 feet deep, were reported in the northern six townships, and it is possible that water can be located at depths of 90 to 200 feet in most localities in the northern part of the municipality.

Water-bearing Horizons in the Bedrock

The Belly River formation is thought to underlie the glacial drift throughout the municipality. The "A" boundary line encloses an area in which bedrock is encountered at depths of 35 to 102 feet, or at an average elevation of 2,415 feet above sea-level. The elevation at which the Belly River formation is encountered in township 25, range 26, is approximately 2,150 feet above sea-level, and in townships 24, ranges 25 and 26, approximately 1,900 to 1,950 feet above sea-level. The general dip of the formation is to the south.

Abundant quantities of water are obtained from wells tapping aquifers in the bedrock in the area outlined by the "A" boundary line. The water is highly mineralized, but that from most wells can be used for domestic purposes. Another water-bearing horizon of small areal extent is encountered at depths of 100 to 189 feet, in townships 25, ranges 25 and 26. The water is obtained from an aquifer that underlies a seam of coal. In some wells two seams of coal, 2 to 8 feet thick, are reported to have been passed through. The water is fairly highly mineralized, but usable for drinking, cooking, and other domestic purposes.

A third water-bearing horizon in the bedrock is located in townships 24, ranges 25 and 26, and township 25, range 26, at depths of 300 to 400 feet. The water is derived from a fine sand, and in some wells this sand plugs the casings. The water from some of the wells is soft and tastes of baking soda, but it is usable for domestic purposes. The water is under hydrostatic pressure and rises to points 100 to 360 feet below the surface. It is possible that this water-bearing horizon in the bedrock would be encountered in other localities, but the poor quality of water and the difficulty of preventing the wells from becoming plugged with sand, do not warrant the expense of drilling.

The northern six townships in this municipality are fairly well supplied with water, and little difficulty should be experienced in obtaining an adequate supply in this area. The southern part of the municipality experiences an extreme shortage of water, and in this area there are only a few shallow wells and five or six 300- to 400-foot drilled wells. In the southern part of the municipality it is recommended that surface water for stock be collected in dugouts. Shallow wells sunk beside the dugouts should yield sufficient water for domestic needs.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 23, Range 25

Approximately 13 square miles of this township lies within the municipality of Royal Canadian. South Saskatchewan river flows in a northeasterly direction, entering the township in section 18 and leaving in section 25. The river lies at an elevation between 1,882 and 1,875 feet above sea-level. The valley is from 1 to 2 miles wide, and the northern slopes rise abruptly from 250 to 300 feet. Recent deposits of sand and silt form the flood-plain of the river. Glacial till or boulder clay underlies the remainder of the township, but in section 31 it is concealed by glacial lake clay. The glacial till on the slopes of the valley has been deeply eroded in places by water action.

Only one 14-foot well, in the NW.$\frac{1}{4}$, section 30, is reported in this partial township. This well was dug through hard, blue clay into a fine sand from which a small supply of water is obtained. The water is very highly mineralized and not usable for domestic purposes. The aquifer of this well is of small areal extent, as shallow, dry holes are reported to have been dug in this vicinity. Practically all water for both domestic and stock purposes is hauled from South Saskatchewan river. The water from the river should be boiled before it is used for drinking purposes.

The glacial drift of this township is underlain by the Belly River formation. The formation is encountered at an approximate elevation of 1,900 feet in that part of the township to the south of the river, and at an approximate elevation of 1,975 feet above sea-level in township 24, range 25. Wells sunk to depths of 200 to 300 feet in this township will probably encounter this formation, and it should contain water-bearing horizons.

In this township, however, it would be more economical to construct small dams in the ravines and impound surface water. Shallow wells dug beside the reservoirs should yield sufficient water for domestic needs. The water of shallow wells should be frequently tested for bacteria content, as it may be easily contaminated by polluted surface water.

Township 23, Range 26

Only that part of this township lying north of South Saskatchewan river, an area of approximately 14 square miles, lies within this municipality and is covered by this report. The wide flood-plain of the river is mantled by several feet of Recent sands and silts. The northern slope of the valley rises abruptly 250 to 300 feet above the river, or to an approximate elevation of 2,190 feet above sea-level. The north-central part of the area is dissected by deep tributary valleys, and the ground surface is very rough and unsuitable for cultivation. The northwestern part of the area is quite flat and is part of a glacial lake basin. In this area the glacial till or boulder clay that mantles the township is covered by a thin deposit of glacial lake clay. The glacial till on the slopes of the valley has been eroded by water action.

Two wells and one spring were reported in this partial township. The spring is located in the east half of section 29, but it does not yield a large supply and is rarely used. The well in the SE.$\frac{1}{4}$, section 25, is only 5 feet deep and yields sufficient water for household use. Water for stock is hauled from South Saskatchewan river. Several dry holes have been sunk to depths of 30 feet in hard, blue clay in this quarter section. In the NW.$\frac{1}{4}$, section 24, a 40-foot well taps an adequate supply of water in a gravel and sand aquifer, and it is used for all purposes, including the irrigation of a small garden. The water

is not under hydrostatic pressure, but it maintains a fairly constant level 34 feet below the surface. Similar deposits may occur elsewhere in the area.

It may be possible to locate water at depths of approximately 400 feet in the Belly River formation, as wells in the township immediately north have encountered water-bearing sands at similar depths in this bedrock formation. The collecting and retaining of surface water by dugouts or dams is a more economical method of increasing the supply of water in this township.

Township 24, Range 25

The ground surface of the southern and northern parts of this township is slightly rolling, but the central sections are very flat except for a few sloping knolls or rises. The surface elevation rises gradually to the north to approximately 2,300 feet above sea-level. The central part of the area is mantled by a thin veneer of glacial lake clay. Glacial till or boulder clay mantles the remainder of the area, and is exposed at the surface as gently sloping knolls in the glacial lake clay-covered area. This township is sparsely settled and most of the area is used as grazing land. Stock are watered at South Saskatchewan river or at dugouts excavated at intervals throughout the township.

Two wells were drilled in the NW.$\frac{1}{4}$, section 20. A 170-foot well encounters a bed of sand, and yields approximately 40 gallons of water a day. The water is used for domestic purposes. The second well is drilled to a depth of 315 feet, or to an elevation of 1,885 feet above sea-level, and the water is obtained from a bed of sand underlying a seam of coal in the Belly River formation. A 360-foot well in the NE.$\frac{1}{4}$, section 20, also encounters this aquifer at an elevation

of 1,845 feet above sea-level. The water is hard and highly mineralized, and that from the 315-foot well is not used for domestic purposes, but it is suitable for stock use. The water in both wells is under hydrostatic pressure, and rises to points 265 and 280 feet below the surface, or to an average elevation of 1,940 feet above sea-level. It is probable that wells drilled to depths of 250 to 300 feet in other sections of this township would encounter this or similar water-bearing horizons in the Belly River formation. These are the only wells in the township. It is possible that dugouts would be a better source of water, as the surface water is not so highly mineralized and is more suitable for stock use. Shallow wells sunk near the reservoirs will usually yield sufficient water for household purposes.

Township 24, Range 26

A height of land extends from the northwestern corner to the south-central part of the township and attains an elevation of 2,300 feet above sea-level. The township is mantled by glacial till or boulder clay that is exposed only on the height of land and in the northeastern corner, being concealed by a thin deposit of glacial lake clay throughout the remainder of the area.

Only six wells were recorded in this township. It is reported that when the area was first settled many attempts were made to locate water at shallow depth, but all the holes were dry. These numerous dry holes have not been located, and, consequently, are not shown on the map. The residents of this township consider it useless to try to locate water at shallow depth, but three wells in the SE.$\frac{1}{4}$, section 30, NE.$\frac{1}{4}$, section 30, and NW.$\frac{1}{4}$, section 32, have encountered water-bearing beds of sand at depths of 30, 70, and 18 feet, respectively. The 30- and 70-foot wells yield adequate supplies of water for local needs, but each well only waters approximately ten head of stock. The 18-foot well

is situated near a dugout and derives its water by direct seepage from the impounded surface water. The water from the wells is moderately hard and usable for all farm purposes. Possibly with further prospecting other water-bearing deposits could be located at shallow depth, but it is not thought that the sand aquifers of the above wells are continuous over a large area.

Three deep wells have been sunk in the township. A 400-foot well in the NW.$\frac{1}{4}$, section 9, encounters a fine sand aquifer in the Belly River formation at an elevation of 1,880 feet above sea-level. The water is very hard and "alkaline", and is not used for domestic purposes. Considerable trouble is experienced with the fine sand plugging the well casings and shutting off the water supply. When the well is not plugged the water rises to a point 360 feet below the surface, where it maintains a constant level. This well was not in use during the summer of 1935. The other two wells, located in the SW.$\frac{1}{4}$, section 18, and NE.$\frac{1}{4}$, section 16, derive water from sand aquifers, at depths of 365 and 387 feet, respectively, that are also thought to be part of the Belly River formation. The water from these wells is hard, but usable for all domestic purposes, including the washing of clothes. Each well yields an abundant supply of water that rises to points 317 and 325 feet below the surface. It is probable that wells 300 to 400 feet deep in other sections of the township would encounter similar water-bearing deposits, as no deep dry holes have been reported in this area.

More than half the residents of this township are unable to obtain an adequate supply of water from wells, and haul practically all water for domestic and stock needs from South Saskatchewan river, in some instances a distance of at least 6 miles. A few shallow dugouts that retain surface water during part of the year, for stock, are used in some localities. Ice is also packed during the winter and used for domestic purposes.

Unless finances permit the drilling of deep wells into the Belly River formation, the only practical method of securing water for stock use in this township is by collecting surface water in dugouts. Rain water that drains from the roofs of buildings can also be collected in cement or galvanized iron cisterns.

Township 25, Range 25

An area extending from the northwestern to the southeastern corner of this township is mantled by moraine and is characterized by many rock-strewn knolls and ridges. The remainder of the township is mantled by glacial till or boulder clay, the ground surface is slightly rolling, and boulders are scarce. A narrow, flat lowland in the southwestern corner of the township is overlain by a few feet of glacial lake clay. The average elevation throughout the township is 2,300 feet above sea-level.

The uppermost water-bearing horizon in this township is not continuous and is formed by a few scattered pockets of sand and gravel that occur in the unoxidized or yellow boulder clay that forms the upper 25 feet of both the glacial till and moraine. Wells tapping these pockets are located principally in sections 19, 22, 24, and 25. The well in the NE.$\frac{1}{4}$, section 19, yields an abundant supply of water, but the others yield smaller supplies, sufficient for 10 to 30 head of stock. The water varies from soft to very hard and "alkaline", and that from one well was condemned for any farm purpose by the Department of Health at Regina. The striking of water unfit for use at one locality, however, does not necessarily indicate widespread conditions. A few of these wells yield water that is under slight hydrostatic pressure. Prior to digging a shallow well the water-bearing deposits should be located by using a small, hand, test auger.

The principal source of water is thin layers and pockets of sand and gravel in the blue boulder clay. These deposits are encountered at depths of 30 to 60 feet. Three wells in the NE.$\frac{1}{4}$, section 8, SE.$\frac{1}{4}$, section 16, and SE.$\frac{1}{4}$, section 33, yield an abundant supply of water, and have never been pumped dry by an ordinary farm pump. The water from these three wells is hard, but usable for all domestic purposes. The other wells yield smaller supplies of water, and an individual well will water from 5 to 20 head of stock. The water from several of the wells is under slight hydrostatic pressure and rises to points 19 to 45 feet below the surface. Although the deposits that form the aquifers for these wells are not continuous, other wells should encounter similar deposits throughout the township.

Four wells, from 87 to 120 feet deep, have encountered deposits of water-bearing sand or gravel, and yield moderate quantities of water. The wells do not tap a common aquifer, but encounter small, local pockets of sand and gravel in the blue boulder clay. Coal was reported near the base of the well in the SW.$\frac{1}{4}$, section 16, or at an approximate elevation of 2,176 feet above sea-level. This well may have encountered the Belly River formation, or the reported coal may be a carbonaceous bed of interglacial origin. Two 120-foot wells, located in the SE.$\frac{1}{4}$, section 18, and the NE.$\frac{1}{4}$, section 20, yield water that is hard, "alkaline", and not usable for domestic purposes, whereas the well that encounters coal yields clear, hard water, which is usable for drinking, cooking, and other domestic purposes. The wells may be deriving water from the contact of the glacial drift and the underlying bedrock Belly River formation. The aquifers are not thought to be continuous or of large areal extent, and a dry hole in the NE.$\frac{1}{4}$, section 8, was drilled to a depth of 200 feet, or to an elevation of 2,100 feet above sea-level.

With few exceptions, the farms in this township are supplied with sufficient water for present needs. With an increase in the number of stock, however, large quantities of water would be required. If dug or bored wells to depths of 20 to 60 feet do not locate water, it is probable that deep drilled wells would encounter water-bearing deposits. The excavation of dugouts to collect and retain surface water for stock use is highly recommended. Small dams can also be constructed on ravines.

Township 25, Range 26

The elevation in this township rises from 2,250 feet in the southern sections to 2,350 feet in the northern sections. The ground surface is very rolling and is particularly rough in the southwestern corner where a small deposit of moraine occurs. The remainder of the township is overlain by glacial till or boulder clay, which extends to a depth of 150 to 200 feet in several sections. In a small depression in sections 12 and 13 the glacial till is overlain by several feet of glacial lake clay. No water is obtained from the lake clay.

Only two shallow wells are reported in this township. They are located in the NW.$\frac{1}{4}$, section 12, and the SE.$\frac{1}{4}$, section 30, and tap small pockets of sand in the yellow boulder clay at depths of 33 and 20 feet, respectively. Both these wells yield very small quantities of water, sufficient for four or five head of stock, but the supply is sufficient for the residents' needs at the present time. The water is hard, but usable for all farm purposes.

The most important and widely distributed water-bearing horizon in this township is encountered at depths of 42 to 110 feet, or between elevations of 2,210 feet and 2,250 feet above sea-level. Wells tapping this horizon increase in depth towards the north, corresponding to the rise in surface

elevation. The aquifer in most of the wells is gravel, but in a few it is reported to be sand. The wells in the SE.$\frac{1}{4}$, section 8, and the SE.$\frac{1}{4}$, section 14, yield an abundant supply of water that flows into the wells very quickly, and they cannot be pumped dry by the regular farm pumps. The other wells yield smaller quantities of water, but an individual well will usually water 10 to 35 head of stock. The water is hard and somewhat "alkaline", but that from all wells, except one, is used for domestic purposes. It may act as a slight laxative, however, on persons not accustomed to its use. With two exceptions, the water from this horizon is under hydrostatic pressure and rises to points 40 to 70 feet below the surface. The water-bearing horizon is not continuous, as deeper wells failed to encounter it in some localities.

Three wells, located in the SE.$\frac{1}{4}$, section 12, SE.$\frac{1}{4}$, section 22, and SE.$\frac{1}{4}$, section 28, tap sand aquifers at depths of 116, 132, and 160 feet, respectively, or at an average elevation of 2,150 feet above sea-level. The sand deposits that these wells tap may occur at the contact of the glacial drift and bedrock, as the Belly River formation is thought to occur at or near the above elevation. Each well yields an abundant supply of water that is under sufficient hydrostatic pressure to rise to points 70 to 75 feet below the surface, where it maintains a constant level. The water is very hard and "alkaline", but it is usuable for all household purposes, although it has a laxative effect on persons not accustomed to its use. These wells are excellent sources of water, and possibly in other sections in the southern part of the township wells drilled to an approximate elevation of 2,150 feet would encounter similar water-bearing deposits.

Seven wells are reported to encounter the Belly River formation. Three wells, in the NE.$\frac{1}{4}$, section 27, NE.$\frac{1}{4}$, section 32,

and NE.$\frac{1}{4}$, section 33, strike coal seams, and obtain water at depths of 190, 150, and 189 feet, respectively, or at an average elevation of 2,140 feet above sea-level. In the 150-foot well two seams of coal were reported, the upper being approximately 2 feet thick and the lower 8 feet thick; the water is obtained from below the thicker coal seam. The water in the other two wells is also obtained from beneath a seam of coal. The water is under hydrostatic pressure and rises to points 150, 85, and 50 feet below the surface. These wells have never been pumped dry and the water maintains a constant level. The water is very hard and highly mineralized, but is used for domestic needs with no apparent ill effects. It is thought that the coal seams and the water-bearing horizons are of small areal extent, as deeper wells did not encounter either coal or water at the above depths.

The other four bedrock wells are situated in the NW.$\frac{1}{4}$, section 20, NE.$\frac{1}{4}$, section 20, NE.$\frac{1}{4}$, section 23, and NW.$\frac{1}{4}$, section 30, and derive water from aquifers at depths of 297, 300, 390, and 334 feet, respectively. Little information is obtainable as to the logs of these wells, but the aquifers of the 334- and 297-foot wells are composed of fine blue sand. The water from these two wells is hard, highly mineralized, and "alkaline", but is being used for domestic needs although it is not desirable for that purpose. The supply is abundant and the hydrostatic pressure is sufficient to raise the water to points 100 and 147 feet below the surface. These wells probably tap a common water-bearing horizon. The character of the aquifers in the 300- and 390-foot wells is not known, but the water in each well is soft, and tastes of baking soda. It is very highly mineralized, and that from the 390-foot well is not usable for domestic purposes. The water from the other well is being used although it is very unsatisfactory. These two wells yield a large supply of water

that maintains a constant level 100 feet below the surface. Wells sunk to depths of 300 to 400 feet in other parts of the township should obtain a large supply of water, but it will doubtless be highly mineralized and unsuitable for domestic needs. As water may be located in the upper part of the drift, it is advisable before drilling a deep well to undertake extensive prospecting with a small auger for a water-bearing deposit at shallow depth. In some sections surface water could be impounded by dams, and in others it could be collected in dugouts.

Township 26, Range 25

With the exception of several, small, rock-strewn hills that form a moraine, this township is mantled by glacial till or boulder clay. The ground surface is fairly rolling, with a few prominent hills, but the township is well settled and the greater part is under cultivation.

The supply of water in this area is obtained from a spring, and from sloughs and wells. The sloughs become dry during the early summer months, but until then they are used as a source of water for stock. A spring situated in the NE.$\frac{1}{4}$, section 28, yields an abundant supply of moderately hard water. The village of Eatonia, in section 14, derives its supply of water from this spring; a reservoir 8 feet deep and 10 feet in diameter is excavated at the site of the spring and a pipe-line runs from it to Eatonia. The water is used for all purposes, including irrigation, and the Canadian National Railways use the water in steam locomotives.

A number of wells from 14 to 33 feet in depth tap pockets of sand and gravel in the yellow boulder clay. Each well yields a small supply of water, sufficient for only 5 to 15 head of stock, but usually two or more such wells are used to supply sufficient water. The quality of the water varies with the

individual well, the water from some being very hard and "alkaline", whereas that from others is quite soft. These wells are poor sources of supply, but generally yield sufficient for domestic needs.

The principal water-bearing horizon in the glacial drift in this township is encountered by a number of wells at depths of 35 to 60 feet below the surface. The aquifer is formed by discontinuous layers of sand and gravel in the blue boulder clay. Three of these wells, situated in the SE.$\frac{1}{4}$, section 16, and SE.$\frac{1}{4}$ and NE.$\frac{1}{4}$, section 4, yield sufficient water for 50 to 60 head of stock throughout the year. Most of the other wells yield sufficient water for 15 to 25 head of stock. The water is highly mineralized and usually "alkaline", but is usable for drinking and other domestic purposes. It may act as a laxative on those not accustomed to the use of such water. The water from the wells that yield larger supplies is under slight hydrostatic pressure, and maintains a constant level 45, 15, and 30 feet below the surface. The deposits do not form a continuous water-bearing horizon, but no dry holes have been dug, and water may be located at similar depths in other sections of the township.

Eight wells, from 85 to 150 feet deep, derive water from aquifers that occur in the glacial drift at an average elevation of 2,280 feet above sea-level. Most of these wells are situated in the northeastern corner of the township. Two of the wells yield sufficient water for 40 to 50 head of stock, but the others yield much smaller quantities. The water is very hard, usually "alkaline", and unsatisfactory for domestic use, although it is being used as water of better quality is not obtainable in this area. The water is under sufficient hydrostatic pressure to rise to points 40 to 80 feet below the surface. It is possible that wells sunk to similar depths in other parts of the township might encounter water, but the areal extent of the water-bearing deposits is not known.

No wells have been drilled into the Belly River formation in this township, but water should be obtained from it at depths of 200 to 400 feet. The water obtained will probably be very highly mineralized, and may not be suitable for domestic needs. The use of dugouts to collect and retain surface water for stock is recommended as a means of increasing the supply of water in this township.

Township 26, Range 26

The elevation in this township rises from approximately 2,300 feet in the southwestern corner to 2,420 feet above sea-level in the northeastern corner. The northeastern corner is mantled by moraine and is characterized by rock-strewn knolls and depressions. The remainder of the township is covered by glacial till or boulder clay and is undulating.

The moraine and glacial till deposits are similar in composition, and in general consist of 10 to 25 feet of oxidized, yellow boulder clay that contains a few, small, scattered pockets of sand and gravel, and a zone of unoxidized, blue boulder clay that extends to a depth of at least 125 feet, and which also contains deposits of sand and gravel at various elevations.

Two wells tap deposits of water-bearing sand in the yellow clay at depths of 15 feet. The well in the NE.$\frac{1}{4}$, section 36, yields a sufficient supply of water for 25 head of stock, but the well in the NE.$\frac{1}{4}$, section 28, does not yield sufficient water for local requirements. The water is usable for all farm needs. By prospecting with a small hand auger other water-bearing deposits should be located, but a large supply of water is not to be expected from the upper part of the drift.

Several wells have tapped small deposits of sand in the blue boulder clay at depths of 40 to 60 feet, but they yield small supplies of highly mineralized water and, as a rule, are a very poor source of water.

The main supply of water in this township is encountered at depths of 66 to 135 feet, in deposits of sand or gravel. These deposits occur at a fairly constant elevation and may be quite numerous and continuous, as no dry holes were reported. The well in the SW.$\frac{1}{4}$, section 25, yields an abundant supply of water, which is sufficient for at least 100 head of stock. The other wells yield smaller supplies of water, but as a rule supply at least 10 to 25 head of stock. The water is highly mineralized and that from several wells is unfit for domestic use, although it is being used for stock. The water from this part of the drift is under hydrostatic pressure and rises to points 60 to 95 feet below the surface. Other holes drilled to similar depths in this township should also encounter deposits of water-bearing sand.

No wells have been drilled into the bedrock, but water-bearing horizons should be encountered in the Belly River formation at depths of 200 to 400 feet. With few exceptions the farms in this township have sufficient water for present local needs. If larger herds of stock were kept, however, it would be necessary to increase the supply of water. The supply could be increased by drilling deep wells into the bedrock, or by conserving surface water by the use of dugouts or dams.

Township 27, Range 25

A height of land at an elevation of 2,500 feet above sea-level extends in a north-south direction through the central part of the township. This height of land is mantled by moraine and the remainder of the area is covered by glacial till. The ground surface of the moraine-covered area is very rough, but that of the glacial till-covered area is rolling and more suitable for cultivation. The elevation decreases to 2,450 feet in the west and to 2,390 feet above sea-level in the east.

The main supply of water in this township is derived from wells 14 to 25 feet deep that tap pockets or lenses of sand and gravel within the yellow boulder clay, or discontinuous layers of sand and gravel that lie between the yellow and blue boulder clays. These deposits are fairly extensive in some sections, and the farmers use two or more wells either for convenience or to obtain a sufficient supply for local needs. The water is moderately hard, and that from a few wells is termed soft when compared with water from deeper wells. The water from a few wells is slightly "alkaline", but all the wells are being used for domestic and stock needs. It is very probable that water can be located at shallow depth in most sections in the township, but it is advisable to locate the water-bearing deposits of sand and gravel with a small, hand, test auger prior to digging a well.

Eight wells, 40 to 60 feet deep, tap thin layers of sand in the blue boulder clay from which small supplies of water are obtained. The water is highly mineralized, but it can be used for drinking and other domestic purposes. Although other wells will probably encounter water-bearing deposits in this part of the drift, an abundant supply of water is not to be expected.

Three wells, in the SE.$\frac{1}{4}$, section 6, NW.$\frac{1}{4}$, section 25, and SE.$\frac{1}{4}$, section 33, tap aquifers at depths of 83, 95, and 92 feet, respectively. The aquifers are localized and are of small areal extent. The well in the NW.$\frac{1}{4}$, section 25, yields sufficient water for 50 head of stock, but the other two wells yield much smaller quantities. The water is very hard and slightly "alkaline", but it is usable for drinking and cooking. Water-bearing deposits probably exist at similar depths in other parts of the township, but the small quantity of highly mineralized water to be obtained does not warrant the expense of sinking wells. Large supplies of highly mineralized water should be obtained from the Belly River formation at depths of 200 feet and more. It is less expensive to increase the

supply of water by collecting surface water in dugouts and dams, and the water so collected is more suitable for stock than that from deep wells.

Township 27, Range 26

With the exception of a small area in parts of sections 33 and 34 that is mantled by moraine, this township is covered by glacial till or boulder clay. The maximum elevation of 2,500 feet above sea-level is attained in the east-central part of the township. From this area the elevation decreases gradually to 2,300 feet in the western part of the township. The ground surface throughout the area is quite rough and several fairly large, gently sloping valleys extend in an east-west direction. Undrained depressions occur in the south-central and northwestern parts.

Four or five wells have tapped pockets of sand and gravel in the yellow or oxidized boulder clay at depths of 15 to 27 feet. The 27-foot well, in the NE.$\frac{1}{4}$, section 26, taps an aquifer of large areal extent; the water is under hydrostatic pressure and the well has never been pumped dry. The water is moderately hard and usable for all farm purposes. The other shallow wells yield much smaller supplies of water, sufficient for not more than 3 to 10 head of stock. In general, the shallow wells in this township are very poor sources of water.

Seven wells, 45 to 70 feet deep, struck discontinuous beds of water-bearing fine sand or coarse gravel in the blue boulder clay. The well in the NE.$\frac{1}{4}$, section 27, taps an abundant supply of water that is under hydrostatic pressure, and the flow of water into the well is very fast as it cannot be pumped out in order to clean the well. The water is very hard and "alkaline", and is not usable for domestic purposes, but is a very good water for stock. The other wells tap aquifers that yield smaller quantities of water, but an individual well will usually supply 10 to 25 head of stock. The water is very highly mineralized and is not used for household

purposes when other water is obtainable. Probably wells to similar depths would tap water-bearing deposits in other parts of the township.

Thirteen wells from 81 to 138 feet deep tap water-bearing deposits in the unoxidized, blue boulder clay, or that lie at the contact of the glacial drift and the underlying bedrock. Wells in sections 2 and 3 derive water from a blue sand aquifer that is thought to be at or near the drift-bedrock contact. Several of the wells yield an abundant supply of water that is under hydrostatic pressure, and which is usable for drinking, cooking, and other general farm purposes. Only two wells do not yield sufficient water for local needs. The deposits tapped by these wells appear to be fairly continuous and numerous, and wells sunk to similar depths in other sections would probably encounter water-bearing beds. A dry hole, however, was drilled to a depth of 160 feet in the NE.$\frac{1}{4}$, section 22.

Six wells within the area bounded by the "A" line encounter a bedrock formation at depths of 35 to 102 feet, or at an average elevation of 2,415 feet above sea-level. The bedrock is reported to be grey shale and sandstone, underlain by dark sands that form the aquifers for the wells. This is probably the Belly River formation, but deeper wells in the township did not encounter it, and in township 25, range 26, bedrock was not encountered until an elevation of 2,160 feet above sea-level was reached. The highland area may be capped by a thin layer of the Bearpaw formation that overlies the Belly River. The water is hard and fairly highly mineralized, but it is usable for all domestic purposes. An individual well yields an abundant supply of water, and in the deeper wells it is under hydrostatic pressure. It is probable that other wells sunk to similar depths within the area bounded by the "A" line will obtain water from the bedrock.

The residents of this township are well supplied with water, and in some sections the supply obtained from wells is sufficient for large herds of live stock. Surface water can be conserved by the use of dams and dugouts.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF ROYAL CANADIAN, NO.261, SASKATCHEWAN

Township	23	23	24	24	25	25	26	26	27	27	Total No. in municipality
West of 3rd mer. Range	25	26	25	26	25	26	25	26	25	26	
Total No. of Wells in Township	1	4	3	6	40	22	33	22	36	32	199
No. of wells in bedrock	0	0	2	3	1	7	0	0	0	6	19
No. of wells in glacial drift	1	4	1	3	39	15	33	22	36	26	180
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply											
No. with permanent supply	1	3	3	6	39	22	33	22	34	31	194
No. with intermittent supply	0	0	0	0	0	0	0	0	2	0	2
No. dry holes	0	1	0	0	1	0	0	0	0	1	3
Types of Wells											
No. of flowing artesian wells	0	0	0	0	0	0	1	0	0	0	1
No. of non-flowing artesian wells	0	0	2	3	13	15	15	12	12	18	90
No. of non-artesian wells	1	3	1	3	26	7	17	10	24	13	105
Quality of Water											
No. with hard water	1	3	3	4	37	20	27	19	32	28	174
No. with soft water	0	0	0	2	2	2	6	3	4	3	22
No. with salty water	0	0	0	0	0	0	0	0	0	1	1
No. with "alkaline" water	0	0	0	1	9	6	11	3	13	10	53
Depths of Wells											
No. from 0 to 50 feet deep	1	4	0	2	32	6	14	6	31	8	104
No. from 51 to 100 feet deep	0	0	0	1	4	5	18	11	5	15	59
No. from 101 to 150 feet deep	0	0	0	0	3	4	1	5	0	8	21
No. from 151 to 200 feet deep	0	0	1	0	1	3	0	0	0	1	6
No. from 201 to 500 feet deep	0	0	2	3	0	4	0	0	0	0	9
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
How the Water is Used											
No. usable for domestic purposes	0	3	1	5	31	20	27	18	30	27	162
No. not usable for domestic purposes	1	0	2	1	8	2	6	4	6	4	34
No. usable for stock	1	3	3	5	39	22	32	20	36	31	192
No. not usable for stock	0	0	0	1	0	0	1	2	0	0	4
Sufficiency of Water Supply											
No. sufficient for domestic needs	1	3	3	6	39	22	33	22	34	31	194
No. insufficient for domestic needs	0	0	0	0	0	0	0	0	2	0	2
No. sufficient for stock needs	1	2	2	5	25	20	23	19	23	22	142
No. insufficient for stock needs	0	1	1	1	14	2	10	3	13	9	54

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

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

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

Analyses of Water Samples from the Municipality of Royal Canadian, No. 261, 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.	Alka-linity	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	NW.	20	24	25	3	315	2,960	700	600	100	109	315	30	173	1,786	1,143	3,059	54		219	202		2,405	179		⁎2
2	NE.	16	24	26	3	365	2,660	400	200	200	142	470	100	94	1,316	1,007	2,617	179		196		60	1,948	234		⁎2
3		9	25	25	3	47	437											(3)	(1)		(2)				(4)	⁎1
4		25	26	25	3	95	503											(3)	(1)		(2)		(4)		(5)	⁎1

Water samples indicated thus, ⁎1, are from glacial drift.
Water samples indicated thus, ⁎2, are from bedrock, Belly River 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. 3 and 4 by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Two samples of water from the glacial drift of the municipality of Royal Canadian were analysed and the results are listed in the accompanying table. The samples are taken from 47- and 95-foot wells, and the total dissolved solid contents are 437 and 503 parts per million, respectively. The dissolved mineral salt contents of these waters are very low, and the waters are usable for all farm purposes. These samples, however, are not thought to be representative of the type of water derived from the drift in this municipality. The water from most of the wells is reported as being very hard, highly mineralized, and "alkaline". As a rule it is usable for domestic needs and is suitable for stock.

Water from the Bedrock

Two samples of water from the bedrock were collected by the field party, and the results are listed in the accompanying report. The samples were taken from wells 315 and 365 feet deep. The samples of water contain 2,960 and 2,660 parts per million of total dissolved solids, and the water is very hard. Sodium sulphate is the predominant mineral salt present, and sodium chloride (common salt), magnesium carbonate, and calcium carbonate are present in lesser amounts. Sample 2 contains 60 parts per million of sodium carbonate (black alkali). The water from these wells is not used for domestic purposes when other water is obtainable, but it is suitable for stock.

WELL RECORDS—Rural Municipality of ROYAL CANADIAN, NO. 261, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NW.	30	23	25	3	Dug	14	2,165	- 13	2,152	13	2,152	Glacial sand	Hard, clear		S	Constant water-level; haul water for domestic needs.
1	NW.	24	23	26	3	Dug	40	1,930	- 34	1,896			Glacial sand and gravel	Hard, clear		D, S	Sufficient for local needs.
2	SE.	25	"	"	"	Dug	5	2,100	0	2,100	4	2,096	Glacial gravel	Hard, clear		D, S	Insufficient for local needs; also a 30-foot dry hole.
3	E.½	29	"	"	"	Spring							Glacial drift				
1	NW.	20	24	25	3	Drilled	315	2,200	-265	1,935	315	1,885	Belly River sand	Hard, clear		S	Sufficient for stock needs; also another well 170 feet deep with poor quality water; #.
2	NE.	20	"	"	"	Drilled	360	2,205	-280	1,925	360	1,845	Belly River sand	Hard, clear		D, S	Sufficient for local needs.
1	NW.	9	24	26	3	Drilled	400	2,280	-360	2,920	400	1,880	Belly River sand	Hard, clear, "alkaline"		N	Not used due to plugging with sand.
2	NE.	16	"	"	"	Drilled	365	2,300	-325	1,975	365	1,935	Belly River sand	Hard, clear		D, S	Abundant supply; #.
3	SW.	16	"	"	"	Drilled	367	2,235	-317	1,918	367	1,848	Belly River sand	Hard, clear		D, S	Sufficient for local needs.
4	SE.	30	"	"	"	Dug	30	2,280	- 25	2,255	25	2,255	Glacial sand	Hard, clear		D, S, I	Sufficient for local needs.
5	NE.	30	"	"	"	Bored	70	2,285	- 60	2,225	60	2,225	Glacial sand	Soft, clear		D	Sufficient for 10 head stock.
6	NW.	32	"	"	"	Dug	16	2,180	- 8	2,172	8	2,172	Glacial sand	Soft, clear		D, S	Insufficient for local needs.
1	NE.	2	25	25	3	Dug	44	2,300	- 42	2,258			Glacial drift	Hard, clear		D, S	Sufficient only for domestic needs and 12 head stock.
2	NW.	6	"	"	"	Bored	45	2,270	- 39	2,231	45	2,225	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
3	NE.	8	"	"	"	Bored	45	2,300	- 31	2,269	45	2,255	Glacial sand	Hard, clear		D, S	Sufficient for 35 head stock; also a 200-foot dry hole.
4		9	"	"	"		47	2,290	- 39	2,251			Glacial sand	Hard			#.
5	SE.	10	"	"	"	Dug	38	2,300	- 34	2,266	38	2,262	Glacial sand	Hard, clear		D, S	Sufficient for 20 head stock.
6	SE.	12	"	"	"	Bored	56	2,300	- 45	2,255	54	2,246	Glacial sand	Hard, clear		D, S	Insufficient for 10 head stock.
7	NW.	12	"	"	"	Dug	40	2,290	- 36	2,254			Glacial sand	Hard, clear, "alkaline"		D	Sufficient only for domestic needs; haul water for stock needs.
8	NE.	14	"	"	"	Bored	39	2,300	- 28	2,272			Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
9	NW.	14	"	"	"	Dug	21	2,300	- 19	2,281	19	2,281	Glacial sand	Hard, clear		D, S	Sufficient domestic needs only; also another well 40 feet deep.
10	SE.	16	"	"	"	Dug	35	2,285	- 32	2,253	45	2,240	Glacial sand	Hard, clear		D, S	Oversufficient for 60 head stock.
11	SW.	16	"	"	"	Bored	104	2,280	- 93	2,187	104	2,176	Belly River gravel	Hard, clear		D, S	Sufficient for 35 head stock.
12	NW.	16	"	"	"	Dug	25	2,300	- 23	2,277	23	2,277	Glacial gravel	Hard, clear		D, S	Insufficient for more than 2 head stock.
13	SE.	18	"	"	"	Bored	120	2,290	-106	2,184			Glacial drift	Hard, cloudy, "alkaline"		S	Sufficient for 15 head stock; also another well 60 feet deep.
14	NE.	19	"	"	"	Dug	21	2,345	- 12	2,333	21	2,324	Glacial sand	Soft, clear		S	Abundant supply.

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

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

WELL RECORDS—Rural Municipality of ROYAL CANADIAN, NO. 261, 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
15	SE.	20	25	25	3	Dug	41	2,310	- 39	2,271	39	2,271	Glacial sand	Hard, clear		D, S	Sufficient for 14 head stock.
16	SW.	20	"	"	"	Dug	20	2,330	- 16	2,314	20	2,310	Glacial sand	Hard, clear		D, S	Sufficient for 22 head stock.
17	NE.	20	"	"	"	Bored	120	2,360	- 90	2,270	120	2,240	Glacial sand	Hard, clear, "alkaline"		S	Oversufficient for 20 head stock.
18	SE.	22	"	"	"	Dug	20	2,290	- 19	2,271	19	2,271	Glacial sand	Hard, clear		D	Sufficient for domestic needs; a 25-foot well is used for stock needs.
19	NE.	22	"	"	"	Bored	32	2,315	- 21	2,294			Glacial drift	Hard, clear		S	Insufficient for 20 head stock; another well 20 feet deep is used for domestic needs.
20	NE.	24	"	"	"	Dug	26	2,295	- 16	2,279	18	2,277	Glacial sand	Hard, clear, "alkaline"		S	Sufficient for 30 head stock; another well 24 feet deep is used for domestic needs.
21	SE.	25	"	"	"	Dug	20	2,295	- 17	2,278	17	2,278	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 10 head stock; another similar well.
22	SW.	25	"	"	"	Dug	14	2,300	- 10	2,290	10	2,290	Glacial sand	Hard, clear, "alkaline"		S	Sufficient for 14 head stock; haul water for domestic needs.
23	NE.	27	"	"	"	Dug	20	2,350	- 19	2,331			Glacial drift	Hard, clear		D	Sufficient only for domestic needs; also another well 16 feet deep.
24	SE.	30	"	"	"	Dug	41	2,350	- 37	2,313			Glacial drift	Hard, clear, "alkaline"		D, S	Insufficient for 6 head stock.
25	SE.	32	"	"	"	Bored	87	2,360	- 79	2,281	79	2,281	Glacial sand	Hard, clear		D, S	Sufficient for 20 head stock.
26	NW.	32	"	"	"	Dug	58	2,320	- 43	2,277	58	2,262	Glacial sand	Soft, clear		D, S	Sufficient for 20 head stock.
27	SE.	33	"	"	"	Dug	50	2,325	- 34	2,291	50	2,275	Glacial sand and gravel	Hard, clear		D, S	Sufficient for local needs.
28	SE.	34	"	"	"	Bored	48	2,335	- 46	2,289	46	2,289	Glacial sand	Hard, clear		D, S	Insufficient for more than 9 head stock.
29	NE.	34	"	"	"	Bored	45	2,325	- 40	2,285			Glacial drift	Hard, clear		S	Insufficient for more than 12 head stock; another well 45 feet deep.
30	NE.	35	"	"	"	Bored	41	2,300	- 19	2,281	41	2,259	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock.
31	NE.	36	"	"	"	Bored	43	2,310	- 32	2,278	43	2,267	Glacial coarse sand	Hard, clear		D, S	Sufficient for 20 head stock.
1	SE.	8	25	26	3	Bored	72	2,275	- 65	2,210	65	2,210	Glacial gravel	Hard, clear, "alkaline"		D, S, I	Sufficient for local needs.
2	SE.	10	"	"	"	Dug	42	2,250	- 36	2,214	42	2,208	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock.
3	SE.	12	"	"	"	Bored	116	2,260	- 75	2,185	116	2,144	Glacial sand	Hard, clear		D, S	Abundant supply.
4	NW.	12	"	"	"	Dug	33	2,280	- 30	2,250	30	2,250	Glacial sand	Hard, clear		D, S	Sufficient for 5 head stock.
5	SE.	14	"	"	"	Dug	68	2,285	- 53	2,232	68	2,217	Glacial sand	Hard, clear		D, S	Abundant supply.
6	SW.	15	"	"	"	Bored	65	2,260	- 40	2,220	65	2,195	Glacial sand	Hard, clear		D, S	Sufficient for 25 head stock.
7	SE.	18	"	"	"	Bored	47	2,260	- 43	2,217	47	2,213	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 17 head stock.
8	NE.	20	"	"	"	Drilled	300	2,290					Belly River	Soft, clear		D, S	Abundant supply.
9	NW.	20	"	"	"	Drilled	297	2,270	-147	2,123	297	1,973	Belly River blue sand	Hard, clear		D, S	Sufficient for local needs.

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

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

WELL RECORDS—Rural Municipality of ROYAL CANADIAN, NO. 251, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED: Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
10	SE.	22	25	26	3	Bored	132	2,280	- 71	2,209	132	2,148	Glacial sand	Hard, clear, "alkaline"		D, S	Abundant supply.
11	NE.	23	"	"	"	Drilled	390	2,355	-100	2,255	390	1,965	Belly River	Soft, clear, soda		S	Sufficient for local needs.
12	NE.	24	"	"	"	Bored	110	2,320	- 70	2,250	110	2,210	Glacial gravel	Hard, clear, "alkaline"		S	Sufficientffor local needs.
13	NE.	27	"	"	"	Drilled	190	2,325	-150	2,175	190	2,135	Belly River	Hard, clear		D, S	Abundant supply.
14	SE.	28	"	"	"	Drilled	150	2,315					Glacial drift	Hard, clear		D, S	Sufficient for local needs.
15	SE.	30	"	"	"	Dug	20	2,280	- 18	2,262	18	2,262	Glacial sand	Hard, clear		D, S	Sufficient for 7 head stock.
16	SW.	30	"	"	"	Bored	39	2,280	- 32	2,248	32	2,248	Glacial sand	Hard, clear		D, S	Insufficient for more than 6 head stock.
17	NW.	30	"	"	"	Drilled	334	2,310	-100	2,210	334	1,976	Belly River black sand	Hard, clear, "alkaline"		D, S	Abundant supply.
18	NE.	32	"	"	"	Drilled	150	2,310	- 85	2,225	150	2,160	Belly River	Hard, clear, iron		D, S	Sufficient for 60 head stock.
19	NE.	33	"	"	"	Drilled	189	2,340	- 50	2,290	189	2,151	Belly River	Hard, clear		D, S	Abundant supply.
20	NE.	34	"	"	"	Bored	100	2,350	- 96	2,254	96	2,254	Glacial gravel	Hard, clear		D, S	Insufficient for 18 head stock.
21	NW.	36	"	"	"	Bored	62	2,300	- 53	2,247	53	2,247	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
22	NE.	36	"	"	"	Bored	40	2,300	- 20	2,280	25	2,275	Glacial gravel	Hard, clear, lime		D, S	Sufficient for 7 head stock.
1	SE.	4	26	25	3	Bored	50	2,325	- 30	2,295	50	2,275	Glacial sand and gravel	Soft, clear		D	Oversufficient for school needs.
2	NE.	4	"	"	"	Bored	35	2,342	- 15	2,327	35	2,307	Glacial sandy clay	Hard, clear		D, S	Sufficient for 50 head stock.
3	NE.	10	"	"	"	Bored	74	2,325	- 64	2,261			Glacial drift	Hard, clear, iron		D, S	Sufficient for 20 head stock.
4	NW.	10	"	"	"	Bored	75	2,350	- 68	2,282			Glacial drift	Hard, clear		D, S	Insufficient for more than 12 head stock.
5	SE.	11	"	"	"	Dug	22	2,310	- 10	2,300	117	2,293	Glacial sand	Hard, clear, "alkaline"		S	Sufficient only for 7 head stock; a 21-foot well is used for domestic needs.
6	NW.	11	"	"	"	Bored	78	2,330	- 43	2,287			Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock.
7	NW.	12	"	"	"	Bored	14	2,320	- 13	2,307			Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for domestic needs; also another well 14 feet deep.
8	NW.	13	"	"	"	Bored	83	2,369	- 68	2,301			Glacial drift	Hard, clear, "alkaline"		D, S	Insufficient for 15 head stock.
9	SE.	16	"	"	"	Bored	66	2,360	- 45	2,315			Glacial drift	Hard, clear		D, S	Sufficient for 60 head stock.
10	NW.	16	"	"	"	Dug	35	2,365	- 32	2,333	32	2,333	Glacial sand and gravel	Hard, clear		D, S	Sufficient for 20 head stock.
11	NW.	20	"	"	"	Bored	33	2,380	- 3	2,377	33	2,347	Glacial sand	Soft, clear, iron		D, S	Abundant supply.
12	SE.	21	"	"	"	Bored	80	2,380	- 35	2,345	80	2,300	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 40 head stock.
13	SW.	21	"	"	"	Dug	37	2,350	- 30	2,320			Glacial drift	Hard, clear		D, S	Sufficient for 35 head stock; also a 60-foot well that is not used.

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 ROYAL CANADIAN, NO. 261, 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
14	NE.	22	26	25	3	Dug	60	2,370	- 56	2,314			Glacial drift	Hard, clear, "alkaline", iron		S	Insufficient for more than 8 head stock.
15	SE.	23	"	"	"	Dug	60	2,395	- 55	2,340	55	2,340	Glacial gravel	Soft, clear		D, S	Sufficient for 20 head stock.
16	SW.	23	"	"	"	Dug	60	2,396	- 56	2,340			Glacial drift	Soft, clear		S	Insufficient for local needs.
17	NW.	23	"	"	"	Bored	48	2,400	- 32	2,368			Glacial drift	Soft, clear		D, S	Sufficient for 30 head stock.
18	SE.	24	"	"	"	Bored	87	2,365	- 47	2,318			Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 50 head stock.
19	SW.	24	"	"	"	Bored	60	2,390	- 54	2,336	60	2,330	Glacial sand	Hard, clear, "alkaline", soda		D, S	Sufficient for 10 head stock.
20		25	"	"	"		95	2,400	- 50	2,350	95	2,305	Glacial gravel	Hard			#.
21	NW.	26	"	"	"	Bored	100	2,430	- 98	2,332	98	2,332	Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for 10 head stock.
22	NE.	28	"	"	"	Dug	8	2,420	0	2,420	8	2,412	Glacial gravel	Hard, clear, iron		D, S	Abundant supply; village of Eatonia obtains its water from this well.
23	NW.	28	"	"	"	Dug	16	2,450	- 11	2,439	11	2,439	Glacial gravel	Soft, clear		D, S	Sufficient for 8 head stock.
24	SE.	30	"	"	"	Bored	58	2,400	- 31	2,369	58	2,342	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 35 head stock.
25	NE.	30	"	"	"	Bored	50	2,418	- 45	2,373			Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for more than 14 head stock.
26	NE.	31	"	"	"	Bored	80	2,445	- 41	2,404			Glacial drift	Hard, iron		D	Sufficient for local needs.
27	SW.	36	"	"	"	Bored	82	2,415	- 37	2,378			Glacial drift	Hard, clear		D, S	Oversufficient for local needs.
28	NW.	36	"	"	"	Bored	98	2,420	- 56	2,364			Glacial sand	Hard, clear, iron		D, S	Sufficient for 35 head stock.
29	NE.	36	"	"	"	Drilled	150	2,425	- 80	2,345	150	2,275	Glacial sand	Hard, clear		S	Abundant supply; also a 50-foot well that is used for domestic needs.
1	NE.	2	26	26	3	Bored	125	2,367	- 75	2,292	125	2,242	Glacial gravel	Hard, clear		D, S	Sufficient for 20 head stock.
2	SW.	2	"	"	"	Bored	95	2,330	- 60	2,270	95	2,235	Glacial sand	Hard, clear		D, S	Sufficient for 15 head stock.
3	NE.	9	"	"	"	Bored	135	2,353					Glacial drift	Hard, clear		D, S	Sufficient only for domestic needs.
4	SW.	10	"	"	"	Dug	66	2,301	- 52	2,249	64	2,237	Glacial sand and gravel	Hard, clear		D, S	Sufficient for 30 head stock.
5	NW.	12	"	"	"	Dug	48	2,395	- 43	2,352	48	2,347	Glacial sand	Hard, clear		D, S	Sufficient for 40 head stock; another well 105 feet deep.
6	NW.	14	"	"	"	Bored	70	2,400	- 50	2,350	70	2,330	Glacial sand	Hard, clear		D, S	Abundant supply.
7	NE.	22	"	"	"	Bored	90	2,400	- 70	2,330	90	2,310	Glacial drift	Hard, clear		D, S	Sufficient for 25 head stock.
8	NW.	22	"	"	"	Bored	110	2,400	- 95	2,305	110	2,290	Glacial drift	Hard, clear		D, S	Sufficient for 20 head stock.
9	SW.	24	"	"	"	Bored	90	2,415					Glacial drift	Hard, clear		D, S	Sufficient for 10 head stock.
10	SW.	25	"	"	"	Bored	80	2,395	- 70	2,325			Glacial sand	Hard, brown, "alkaline"		N	Unfit for use; another similar well 85 feet deep. This well is in the Hamlet of Laporte.

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 ROYAL CANADIAN, No. 261, 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
11	SW.	25	26	26	3	Bored	106	2,420	-76	2,344	106	2,314	Glacial drift	Hard, clear		D, S, I	Sufficient for 100 head stock.
12	NW.	27	"	"	"	Bored	75	2,390					Glacial sand	Hard, clear, iron		D, S	Abundant supply.
13	E.½	27	"	"	"	Bored		2,420					Glacial drift	Hard, clear		D, S	Sufficient for 10 head stock.
14	NE.	28	"	"	"	Dug	32	2,415	- 21	2,394			Glacial sand	Hard		S	Insufficient for stock needs; also another well 15 feet deep.
15	SE.	34	"	"	"	Bored	41	2,420	- 37	2,383			Glacial gravel	Soft, clear		D, S, I	Sufficient for 10 head stock; another similar well 40 feet deep.
16	NE.	35	"	"	"		60	2,460					Glacial drift	Hard, clear		D, S	Sufficient for local needs.
17	NE.	36	"	"	"	Dug	15	2,405	- 10	2,395			Glacial drift	Hard, clear		D, S	Barely sufficient for 25 head stock.
18	NW.	36	"	"	"	Bored	53	2,420					Glacial sand	Hard, clear		D, S	Sufficient for 25 head stock.
1	NW.	1	27	25	3	Dug	16	2,440	- 14	2,426	14	2,426	Glacial gravel	Soft, clear		D, S	Sufficient for 30 head stock; also another well 18 feet deep.
2	NW.	2	"	"	"	Dug	30	2,505	- 10	2,495	30	2,475	Glacial gravel	Hard, clear, iron		D, S	Sufficient for 50 head stock.
3	SE.	3	"	"	"	Bored	60	2,490	- 27	2,463	60	2,430	Glacial sand	Hard, clear, "alkaline"		D	Abundant supply.
4	NW.	3	"	"	"	Dug	45	2,515	- 15	2,500			Glacial drift	Hard, clear		S	Sufficient for 40 head stock.
5	SW.	3	"	"	"	Dug	12						Glacial sand	Soft		D, S	Sufficient supply.
6	SE.	4	"	"	"	Dug	30	2,520	- 23	2,497			Glacial sand	Hard, clear		D, S	Supply insufficient for more than 6 head stock; another similar well 30 feet deep.
7	SE.	6	"	"	"	Bored	83	2,450	- 43	2,407	83	2,367	Glacial sand	Hard, clear, iron		D, S	Oversufficient for 30 head stock.
8	NE.	6	"	"	"	Bored	24	2,450	- 18	2,432			Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for more than 10 head stock; also another well 10 feet deep.
9	NW.	7	"	"	"	Dug	20	2,480	- 10	2,470			Glacial drift	Soft, clear, iron		D, S	Insufficient for more than 6 head stock; another similar well 18 feet deep.
10	NE.	9	"	"	"	Dug	13	2,493	- 9	2,484	9	2,484	Glacial sand	Hard, clear, "alkaline"		D, S	Oversufficient for 13 head stock; another well 14 feet deep with intermittent supply.
11	NW.	9	"	"	"	Dug	22	2,490	- 14	2,476			Glacial drift	Hard, clear, "alkaline"		D	Sufficient supply; another well 10 feet deep is used for stock.
12	SE.	10	"	"	"	Bored	45	2,500	- 42	2,458	42	2,458	Glacial sandy clay	Hard, clear		D	Sufficient only for domestic needs; a 38-foot well is used for stock.
13	NE.	10	"	"	"	Bored	35	2,496	- 32	2,464	32	2,464	Glacial sand	Hard, clear		D	Sufficient for school needs.
14	NW.	10	"	"	"	Dug	14	2,494	- 10	2,484			Glacial drift	Hard, clear		D, S	Insufficient for more than 10 head stock.
15	SE.	11	"	"	"	Bored	24	2,440	- 20	2,420	24	2,416	Glacial sand and gravel	Hard, clear, "alkaline"		S	Sufficient for 25 head stock.
16	NW.	11	"	"	"	Bored	30	2,495	- 21	2,474	25	2,470	Glacial gravel	Hard, clear		D, S	Abundant supply.
17	SW.	12	"	"	"	Bored	45	2,445	- 20	2,425	45	2,400	Glacial sand	Hard, clear, "alkaline", iron		D, S	Abundant supply.
18	NW.	14	"	"	"	Bored	30	2,475	- 26	2,449	26	2,449	Glacial sand	Hard, clear		D, S	Sufficient for 8 head stock.

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

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

WELL RECORDS—Rural Municipality of ROYAL CANADIAN, NO. 261, 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
19	NW.	16	27	25	3	Dug	21	2,495	- 11	2,484			Glacial drift	Hard, clear		D, S	Sufficient for 30 head stock.
20	NW.	18	"	"	"	Dug	74	2,450	- 70	2,380	70	2,380	Glacial sand	Hard, clear		D, S	Sufficient for 25 head stock.
21	NE.	22	"	"	"	Dug	12	2,490	- 8	2,482			Glacial drift	Hard, clear, iron		D, S	Sufficient for 70 head stock.
22	SW.	24	"	"	"	Bored	40	2,450	- 20	2,430			Glacial drift	Hard, clear		D, S	Sufficient for 40 head stock.
23	NW.	25	"	"	"	Bored	95	2,390	- 20	2,370			Glacial drift	Hard, clear, "alkaline", iron		D, S	Oversufficient for 50 head stock.
24	NW.	30	"	"	"	Bored	45	2,490	- 20	2,470			Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for 8 head stock.
25	SE.	33	"	"	"	Bored	92	2,510	- 52	2,458			Glacial drift	Hard, clear, "alkaline"		D, S	Insufficient for more than 6 head stock; also another well 20 feet deep for stock needs.
26	SW.	33	"	"	"	Dug	36	2,505	- 20	2,485	36	2,469	Glacial gravelly clay	Hard, clear, iron		D, S	Insufficient for more than 50 head stock.
27	SW.	34	"	"	"	Bored	40	2,500	- 27	2,473	40	2,460	Glacial sand	Hard, clear, iron		D, S	Oversufficient for 25 head stock.
28	NE.	35	"	"	"	Dug	16	2,305	- 14	2,291			Glacial drift	Hard, clear, "alkaline"		D	Intermittent supply.
1	NE.	2	27	26	3	Bored	138	2,475	- 38	2,437	100	2,375	Glacial sand	Hard, clear, iron		D, S	Sufficient for 50 head stock.
2	SW.	2	"	"	"	Bored	100	2,495	- 70	2,425	70	2,425	Glacial sand	Hard, clear, salty		D, S	Sufficient for 30 head stock.
3	SW.	3	"	"	"	Bored	105	2,400	- 64	2,336			Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 50 head stock.
4	SW.	4	"	"	"	Bored	90	2,400	- 75	2,325			Glacial drift	Hard, clear, iron		D, S	Sufficient for 12 head stock.
5	NE.	6	"	"	"	Dug	70	2,330	- 65	2,265	65	2,265	Glacial gravel	Hard, clear, "alkaline"		D, S	Insufficient for 10 head stock.
6	NW.	6	"	"	"	Bored	100	2,300	- 70	2,230	100	2,200	Glacial gravel	Hard, clear, "alkaline"		D, S	Insufficient for 12 head stock.
7	SE.	9	"	"	"	Bored	55	2,400	- 30	2,370	55	2,345	Glacial sand	Hard, clear, iron		D, S	Sufficient for 60 head stock.
8	SW.	9	"	"	"	Dug	45	2,400	- 25	2,375	45	2,355	Glacial sand	Hard, clear, iron		D, S	Sufficient for 50 head stock.
9	NW.	12	"	"	"	Dug	40	2,450	- 33	2,417	33	2,417	Belly River (?) blue sand	Hard, clear		D, S	Sufficient for 20 head stock.
10	NE.	12	"	"	"	Bored	62	2,450	- 30	2,420	30	2,420	Belly River (?) blue sand	Hard, clear		D, S	Sufficient for 100 head stock.
11	SE.	13	"	"	"	Dug	78	2,450	- 70	2,380			Belly River (?) black sand	Hard, clear		D	Sufficient supply.
12	NE.	14	"	"	"	Dug	60	2,505	- 44	2,461			Belly River (?)	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs.
13	NW.	14	"	"	"	Bored	90	2,500	- 60	2,440	90	2,410	Glacial sand	Hard, clear, iron		D, S	Oversufficient for 40 head stock.
14	SW.	17	"	"	"	Bored	65	2,345	- 40	2,305	65	2,280	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock.
15	SW.	18	"	"	"	Dug	15	2,300	- 12	2,288			Glacial drift	Hard, clear		D, S	Sufficient only for domestic 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 ROYAL CANADIAN, NO. 261, 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
16	SE.	20	27	26	3	Bored	118	2,339	- 78	2,261	118	2,221	Glacial gravel	Soft, clear, "alkaline", soda		D, S	Abundant supply.
17	NW.	21	"	"	"	Bored	95	2,370	- 91	2,279			Glacial drift	Hard, clear, iron		D, S	Insufficient for more than 8 head stock.
18	SE.	22	"	"	"	Bored	46	2,460	- 36	2,424			Glacial drift	Soft, clear		S	Insufficient for more than 5 head stock.
19	NE.	22	"	"	"	Dug	22	2,460	- 20	2,440	20	2,440	Glacial sand	Soft, clear		D, S	Insufficient for 10 head stock; also a 160-foot dry hole.
20	SE.	23	"	"	"	Bored	102	2,500	- 67	2,433	102	2,398	Belly River (?)	Hard, clear		D, S	Abundant supply.
21	NW.	24	"	"	"	Bored	105	2,500	- 65	2,435	105	2,395	Belly River (?)	Hard, clear, iron		S	Abundant supply; also a 35-foot well that is used for domestic needs.
22	NE.	26	"	"	"	Dug	27	2,480	- 20	2,460	27	2,453	Glacial sand	Hard, clear		D, S	Abundant supply.
23	SW.	27	"	"	"	Bored	118	2,380	- 93	2,287	118	2,262	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock.
24	NE.	27	"	"	"	Bored	75	2,385	- 50	2,335	75	2,310	Glacial gravel	Hard, clear, "alkaline"		S	Abundant supply.
25	NW.	28	"	"	"	Bored	112	2,400	- 87	2,313	112	2,288	Glacial sand	Hard, clear		D, S	Abundant supply.
26	NE.	30	"	"	"	Bored	96	2,352	- 84	2,268	96	2,256	Glacial sand	Hard, clear		D, S	Sufficient for 50 head stock.
27	NE.	32	"	"	"	Dug	81	2,325	- 72	2,253	81	2,244	Glacial sand and gravel	Hard, clear.		D, S	Sufficient for 12 head stock; also another well 27 feet deep.
28	SE.	34	"	"	"	Bored	55	2,360	- 46	2,314			Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for more than 4 head stock.
29	NW.	34	"	"	"	Bored	130	2,370	- 80	2,290			Glacial gravel	Hard, clear, "alkaline"		S	Insufficient for more than 2 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.