CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

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WATER SUPPLY PAPER No. 215

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF HARRIS NO. 316 SASKATCHEWAN

By

B. R. MacKay, H. N. Hainstock and G. Graham

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CONTENTS

Illustrations

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY

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SASKATCHEWAN

INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

Continental Ice-sheet. The great ice-sheet that covered most of the surface of Canada many thousands of years 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 gravol plains or deltas formed by streams that issued from the continental ice-sheet.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

<u>Belly River Formation</u>. 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.

<u>Marine Shale Series</u>. 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 Harris, No. 316, consists of nine townships west of the Third meridian and comprises an area of 324 square miles, but only the southern six townships, namely townships 31 and 32, ranges 10, 11, and 12, an area of 216 square miles, were investigated in 1935 and are covered by this report. The centre of the area under discussion lies approximately 28 miles south and 35 miles west of the city of Saskatoon. The Saskatoon-Calgary branch of the Canadian National railways enters the area in sec. 34, tp. 32, range 11, and runs in a southwesterly direction, leaving the municipality in sec. 7, tp. 31, range 12. On this line is located, in sec. 12, tp. 32, range 12, the town of Harris, the main trading centre of the area. Provincial Highway No. 7 also serves the municipality, running through Harris in an east-west direction.

The northwestern corner of the area is drained by Eaglehill creek. In part of the area the creek has eroded a valley more than 75 feet deep and at least ½ mile wide. Stonyridge creek drains township 31, range 11, and Macdonald creek drains township 31, range 10. The two creeks join in township 32, range 10, and flow into the depression referred to as Goose lake. At one time Goose lake occupied a large basin, but it was almost dry in 1935, and part of the area was under cultivation. The approximate elevation of this large depression is 1,725 feet above sea-level. Crystal Beach lake occupies an area of approximately 300 acres in the northern part of township 31, range 12, and the southern part of township 32, range 12. The water in this lake is at an elevation of 1,852 feet above sea-level. The land surface in the immediate vicinity of the creeks is rolling, but the remainder of the municipality is fairly level, undulating slightly where dune sands occur. In general the elevation decreases from the west towards the east, although the decrease amounts to only a few feet a mile. The area under discussion is free of tree growth, except for a small area in the vicinity of Crystal Beach lake.

With the exception of three small areas where the glacial till or boulder clay is exposed at the surface, glacial lake deposits cover the municipality. Glacial lake sands cover a large area in the northwestern corner; parts of secs. 2, 3, and 10, tp. 31, range 12; and a small area in the southeastern corner of the area under discussion. In a large area surrounding Crystal Beach lake, and smaller areas in the southeastern part and along the eastern boundary of the area, the lake sands have been windblown and are classified as Recent dune sands.

Water-bearing Horizons in the Unconsolidated Deposits

No continuous or general water-bearing horizons could be outlined in the municipality. In the areas mantled by Recent dune sands water should be obtained within 25 feet of the surface. The wells that obtain water from these deposits are from 6 to 25 feet deep. The water is not under hydrostatic pressure, but the supply obtained is usually quite sufficient for local requirements. The water varies from moderately soft to hard, and it is not as a rule highly mineralized. Most of the residents find it satisfactory for domestic purposes as well as for stock.

The glacial lake sands have been extensively tested in this municipality and appear to be fairly productive. A number of shallow wells obtain water at depths less than 25 feet, but the supply, although usually sufficient for local needs, is not abundant. Two or more wells can be used to obtain adequate supplies. The water is not highly mineralized and is satisfactory for all general farm purposes. No continuous water-bearing horizons exist in the lake sands, but little trouble should be experienced in obtaining satisfactory supplies of usable water.

The glacial lake clays are not thought to be water-bearing. In the lake clay-covered areas, however, a number of wells obtain water at shallow depth, but they are thought to tap pockets of sand and gravel at the contact of the lake clays and the underlying boulder clay, or within the upper part of the boulder clay. The wells that tap the deposits at the contact are not more than 30 feet deep. Similar conditions exist in the areas mantled by lake sands and dune sands. Little trouble should be experienced in obtaining water at shallow depth along the drainage courses, and near sloughs and undrained depressions. Before digging shallow wells it is advisable to test with a small auger to ascertain if water will be encountered at that site. The supply from the shallow wells is usually sufficient for local needs and the water is rarely under hydrostatic pressure.

A few wells have tapped scattered pockets of sand and gravel in the glacial till at depths of 60 to 220 feet. The water from these wells is hard and quite highly mineralized, and that from some wells cannot be used for drinking. The water is usually under hydrostatic pressure. The supply from most of the wells is ample for farm needs. The deposits are of scattered distribution, and some holes may prove to be dry.

In the area mantled by lake clays, dugouts could be advantageously employed for the collection and retention of surface water for stock.

Water-bearing Horizons in the Bedrock

The Belly River formation is thought to underlie the glacial drift throughout the area under discussion. No outcrops were reported. The pre-glacial land surface of the Belly River formation was irregular and the bedrock may be encountered at varying depths within narrow limits. The formation may dip towards the east, and it is thought to occur at an elevation of more than 1,650 feet above sea-level.

At least eight wells derive water from the bedrock in this municipality, but no continuous water-bearing horizons can be outlined. The wells appear to tap lenticular deposits of sand in the bedrock, but no wells have been drilled into the Belly River formation in this area without encountering water. The aquifers are encountered at depths of 200 to 332 feet, or at elevations of 1,495 to 1,610 feet above sea-level. In most parts of the area it is unlikely that aquifers will be encountered in the bedrock before an elevation of 1,600 feet above sea-level is reached. The supply of water from the producing wells, with the exception of one, is abundant. Some difficulty is experienced in keeping the fine sand from plugging the casings and partly shutting off the supply. The water from two of the wells is recorded soft, but that from the others is hard. It is suitable for domestic purposes as well as for stock.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 31, Range 10

The surface of this township is somewhat rolling and hillocky in the southern half, but becomes fairly level in the northern half. The top soil is considerably lighter in texture in the eastern part than it is in the western. Macdonald creek, an intermittent stream, enters the township in section 2, meanders in a northerly direction, and leaves in section 34. It supplies some water for stock during part of the year. The highest elevation of 1,900 feet above sea-level is attained in the southwestern corner, whereas the lowest, less than 1,750 feet above sea-level, occurs in a depression in the northeastern corner of the township. Most of the surface is covered with glacial lake clays, but the southeastern quarter of the area is covered by glacial lake sands, Recent dune sands, and boulder clay or glacial till. The approximate boundaries of these deposits may be ascertained by consulting Figure 1 of the map accompanying the report.

Water of good quality should be readily obtained throughout the greater part of this township. Water should be found along Macdonald creek at shallow depths, although no wells are recorded as having been dug in this area. The Recent dune sands and the glacial lake sands have not been thoroughly prospected for water-bearing deposits, but water should be derived from these deposits within 35 feet of the surface. The glacial lake clays are not thought to contain water. Wells dug in the lake clay-covered area probably tap pockets of sand and gravel that occur at the contact of the lake clays and underlying boulder clays, or within the upper part of the boulder clay. Three wells only, located in sections 16, 20, and 30, obtain water at depths greater than 35 feet. The water obtained from the wells in this township is of good quality being moderately soft to hard and not containing an excessive amount of mineral salts in solution. The water from some of the wells in the western part of the area is more highly mineralized than that from wells in the east. The water is suitable for stock and is also being used for domestic purposes. Prior to digging shallow wells it is advisable to locate the water-bearing deposits by means of a small test auger. In some localities where the surface deposits are thin water for stock is obtained in some cases by excavating dugouts down to the sand aquifers.

Deposits of water-bearing sand and gravel no doubt occur at depth in the glacial drift. The water, however, will probably be highly mineralized. No wells have been drilled into the bedrock in this township, so its water-bearing possibilities are unknown.

Township 31, Range 11

Except where cut by Stonyridge creek in the eastern part, and by a small ravine in sections 26, 27, and 28, the ground surface in this township is fairly level. The elevation varies from more than 1,950 feet above sea-level in the southwestern corner to approximately 1,775 feet above sea-level in the northeastern corner. The greater part of the area is covered by glacial lake clays. Recent dune sands mantle a large area in the northwestern corner, and parts of sections 32 and 33 are covered by glacial lake sands. In parts of sections 2 and 3, boulder clay or glacial till is exposed at the surface, but elsewhere it is concealed by the lake clays and sands.

Little difficulty should be experienced in obtaining ground water from wells sunk in the area covered by dune sand. Water will probably be encountered within 25 feet of the surface. The water will probably be of good quality and the supply should be sufficient for domestic needs and for a few head of stock. Two or more wells can be used to obtain sufficient water for local needs. Water should also be derived from the glacial lake sands within 30 feet of the surface.

The glacial lake clays may contain a few scattered deposits of water-bearing sand, but it appears more probable that the water obtained from wells sunk in the area covered by the lake clays is derived from sand and gravel deposits in the underlying boulder clay. Some of the deposits are no doubt located near the contact of the two clays, but most of them are located within the boulder clay. The water-bearing deposits do not appear to be continuous and to avoid the possibility of digging dry holes it is advisable to locate the deposits by means of a test auger before going to the expense of sinking a well. Wells that tap the deposits within the boulder clay are from 40 to 132 feet deep. The three wells located in section 4 may be obtaining water from a common aquifer, but the other wells tap individual pockets of sand or gravel. With few exceptions the wells yield a supply of water sufficient for present needs, but should the number of stock be increased the supply would be inadequate. The water obtained in the southern part of the area is of poorer quality than that obtained from wells in the remainder of the area, and some of the water is not suitable for domestic needs. In the glacial lake clay-covered area, surface water can be collected and retained in dugouts.

Four wells located in sections 16, 22, 24, and 28 derive water from aquifers thought to be in the underlying bedrock. The aquifers are encountered at depths of 332, 260, 240, and 300 feet, or at elevations of 1,583, 1,550, 1,600, and 1,525 feet above sea-level, respectively. The elevations of the aquifers appear to indicate that the wells might be drawing their water from a common aquifer, but the quality of the water and the hydrostatic pressure in the different wells would appear to indicate that they have tapped different aquifers. The wells in sections 16 and 28 yield soft water, but that from the other wells is hard. The areal extent of the aquifers cannot be defined, but it seems reasonable to assume that wells sunk in the immediate vicinity of the producing wells should encounter water-bearing deposits. An abundant supply of water is obtained from all but the well in section 16. Possibly fine sand has plugged the casing of this well and shut off some of the available supply.

Township 31, Range 12

The ground surface of this township is fairly level, but in the northwestern corner, in the vicinity of Eaglehill creek, the surface is decidedly hilly. In the northeastern corner Crystal Beach lake covers an area of approximately 300 acres. A large area in the northeastern half of the township is covered by Recent dune sands. A small area in the southern part and another in the northwestern corner are covered by glacial lake sands. A small, narrow area of boulder clay occurs along Eaglehill creek. The remainder of the area is mantled by glacial lake clays. The lake deposits and Recent dune sands are underlain by the boulder clay or glacial till.

At least seven wells derive water from the Recent dune sands within 20 feet of the surface. It is advisable to test with a small auger, however, before digging a well. The water from the dune sands is not highly mineralized and is suitable for all farm needs. In the wells in the vicinity of Crystal Beach lake the water rises to approximately the same elevation as the lake. The supply is usually sufficient for 10 to 50 head of stock. Little difficulty should be experienced in obtaining some water from the Recent dune sands.

The glacial lake sands have not been prospected in this township, but in other parts of the municipality they have proved water-bearing at shallow depth. The wells sunk in the area covered by glacial lake clays obtain water at depths varying from 16 to 98 feet. The shallow wells ranging in depth from 16 to 34 feet may be obtaining their supply from scattered deposits of water-bearing sand and gravel occurring in the lake clays, but more probably the deposits occur at the contact of the lake clays and the underlying boulder clay. With the exception of the southwestern corner of the township the shallow water-bearing deposits appear to be quite extensively distributed and they may form a fairly continuous water horizon. Nevertheless the deposits should be located by means of a small test auger before a well is dug. The supply from the shallow wells is always adequate for domestic needs and a few head of stock, but that from a few of the wells is insufficient for local needs and must be supplemented from other sources. With one exception the water from wells less than 40 feet deep is satisfactory for domestic use as well as for stock needs.

Four wells in the southwestern corner of the township and two in the northwestern corner obtain water at depths of 40 to 98 feet from scattered deposits of sand that occur in the boulder clay. No relationship can be established in the occurrence of the pockets and they do not appear to form a general or continuous water-bearing horizon, but no dry holes were reported in the area. Two of the wells record a supply insufficient for local needs and three of the wells yield water that is highly mineralized and is used only for stock. Similar deposits no doubt exist in other parts of the township.

The bedrock has not been prospected in this township, but it is probable that it will be necessary to drill to depths of at least 300 feet before bedrock aquifers are encountered. They will no doubt yield an abundant supply of water.

Township 32, Range 10

The surface of this township is fairly level and the difference in topographic relief is less than 75 feet. A large depression, Goose lake, occupies approximately one-half the township, but it was nearly dry in 1935 and contained only a small body of water in the southwestern part of the township. Stonyridge creek joins Macdonald creek in section 5 and flows into the lake. An area along the eastern boundary is covered by dune sand. The remainder of the township is mantled by glacial lake clays. Boulder clay or glacial till underlies the lake clays. No difficulty is experienced in obtaining ground water in the eastern half of the township within 25 feet or less of the surface. Glacial lake clays do not generally yield much water, and the deposits of water-bearing sand in the eastern half of the area probably occur at the contact of the glacial till and lake clays. The water-bearing deposits do not appear to form continuous aquifers over a large area, but no dry holes have been sunk, and it appears that the sand deposits are of common occurrence. The water-bearing deposits, however, should be located by means of a small test auger before digging a well. Water should be readily obtained at shallow depth along the creeks and ravines. It is reported that it is possible to obtain water within 6 feet of the surface almost anywhere in the SW.$\frac{1}{4}$, section 35. The supply from the shallow wells is generally sufficient for domestic needs, and for a few head of stock, but in some areas two or more wells must be used to obtain sufficient water for a large number of stock. In the NW.$\frac{1}{4}$, section 2, three wells are required to water 165 head of stock, and in section 24 a large number of wells are used. In section 34 a dugout is used to augment the supply from shallow wells. With the exception of the water from a well in the SW.$\frac{1}{4}$, section 2, the water from the shallow wells is used for drinking and for stock.

A few wells along the western boundary obtain water from aquifers at depths of 35 to 40 feet. These aquifers are probably formed by pockets of sand that occur within the boulder clay or glacial till. Over the small area in which these wells occur the sand deposits may be continuous, but sufficient information is lacking to assume that the deposits form a large water-bearing horizon. Possibly other wells sunk within short distances of the producing wells will also obtain water. One of the wells in the SW.$\frac{1}{4}$, section 19, yields an insufficient supply for local needs, but the others yield adequate supplies for farm requirements. The water is used for domestic purposes as well as for stock, although it is more highly mineralized than that from the shallow wells in the eastern part of the township.

A well located in the NE.$\frac{1}{4}$, section 36, taps an aquifer in the Belly River formation at a depth of 303 feet or at an elevation of 1,452 feet above sea-level. The areal extent of the aquifer is unknown, but other wells sunk in the vicinity to the same, or slightly lower, elevations should encounter water. The supply from the well is abundant and the water rises to within 30 feet of the surface. It is soft, contains a considerable amount of mineral salts in solution, but can be used for domestic needs.

Township 32, Range 11

The ground surface of this township is fairly level, and the elevation decreases from 1,900 feet above sea-level in the southwestern corner to less than 1,750 feet along the eastern border. A small area in the southwestern corner is mantled by Recent dune sands, and a strip from 1 to 2 miles wide along the western border is covered by glacial lake sands. The remainder of the surface is covered by glacial lake clays. These surface deposits are underlain by glacial till or boulder clay.

Throughout most of the southwestern half of the township little difficulty is experienced in obtaining water at depths less than 32 feet. Water-bearing deposits appear to be of common occurrence in this part of the township. Most of the shallow wells yield a sufficient supply of water for domestic needs and a few head of stock. The supply from a few wells must be supplemented by the use of a second well or by the use of a dugout. The water from most of the wells is moderately soft, not highly mineralized, and with few exceptions can be used for domestic purposes.

In the northeastern half of the township only three wells, located in sections 13, 23, and 25, obtain water from sand deposits at depths less than 33 feet. The deposits probably occur near the contact of the lake clays and boulder clay. Water-bearing deposits at shallow depths in this part of the township appear to be lacking, or very sparsely distributed. Test augers should be employed to locate the water-bearing deposits before a shallow well is dug. The three producing wells yield sufficient water for local needs and it is suitable for all farm needs.

A number of wells in this part of the township obtain water from water-bearing deposits of sand located at depths of 60 to 90 feet in the glacial till. The aquifers are probably formed by isolated pockets of sand and gravel and a continuous water-bearing horizon is not thought to exist in this area. The supply from the wells is recorded as being adequate for local requirements. The water is hard, and that from a few wells is quite highly mineralized, but it is used for domestic purposes as well as for stock.

A well located in section 31 is obtaining water from an aquifer located at a depth of 180 feet or at an elevation of 1,680 feet above sea-level. It is not definitely known if the aquifer supplying this well occurs in the glacial drift or in the underlying Belly River formation. The extent of the aquifer, however, is not thought to be large, but other wells in the immediate vicinity may locate water at the same depth. The supply from the well in section 31 is abundant, and the water rises to a point 80 feet above the aquifer. It is hard, and is used for domestic purposes as well as for stock.

Three wells located in sections 14, 21, and 34 are thought to be drawing their supply from aquifers in the Belly River formation. They were drilled to depths of 200, 201, and 250 feet, and tap sand aquifers at elevations of 1,610, 1,624, and 1,585 feet above sea-level, respectively. It is not known if the aquifers they tap are continuous or of considerable areal extent, but wells to similar depths and elevations in the vicinity of the producing wells should encounter water in the bedrock. The supply from the wells is sufficient for local requirements. The water in the well in section 34 is under sufficient hydrostatic pressure to rise to a point 25 feet below the surface. The water is recorded hard, and contains a considerable amount of mineral salts in solution, but it is used for domestic purposes as well as for stock.

Township 32, Range 12

The surface of this township is somewhat irregular and rolling. Eaglehill creek flows in a northerly direction in the western part of the area. Its valley is fairly deep. It is joined in section 17 by a small tributary that flows from the west. Crystal Beach lake covers the southern part of section 2 and appears to have a considerable effect on the ground water supply in this particular part of the area. The top soil is fairly sandy over all the township, most of the area being covered by glacial lake sands. In the southeastern part of the area the sand is windblown and is classified as Recent dune sands. In a small area along the valley of Eaglehill creek the boulder clay or glacial till that underlies the lake and dune sands is exposed at the surface.

A number of wells in this township obtain water at shallow depths, usually within 35 feet of the surface. This type of well is common in the southeastern part of the township, especially in the area covered by dune sands. The water in the wells appears to rise to the same level as that in Crystal Beach lake. The water-bearing deposits are not thought to be continuous over large areas, but in some parts the aquifers of the wells show some relationship. The water from the wells sunk in the dune sands, and from other shallow wells, is of good quality and can be used for domestic purposes. The supply from most of the wells is adequate for local needs. Two or more wells can be used to obtain sufficient water in some localities.

A few wells, especially in the eastern half of the area, obtain water at depths of 35 to 40 feet. This water may be coming from deposits that occur at the contact of the lake sands and boulder clay. The supply from these wells is in general sufficient for local needs and the water can be used for drinking as well as for stock. In the western half of the township a few wells obtain water from scattered deposits of sand which occur in the boulder clay that underlies the glacial lake sands. The deposits are located at depths ranging from 55 to 96 feet, most of them being from 84 to 96 feet, or at elevations of 1,770 to 1,780 feet above sea-level. The same aquifer may be common to most of these wells, but the total areal extent of the water-bearing horizon is not known. Other wells sunk in this part of the township, however, may tap the same or a similar aquifer. The supply from the wells, with one exception, is adequate for farm needs. The water is hard and highly mineralized, and that from some wells acts as a laxative. The water from two wells is used only for stock.

The type of soil in this area is not suitable for the use of dugouts for the collection and retention of surface water for stock.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF HARRIS, NO. 316, SASKATCHEWAN

West of 3rd meridian — Township / Range	31 / 10	31 / 11	31 / 12	32 / 10	32 / 11	32 / 12	Total No. in municipality
Total No. of Wells in township	20	21	22	20	28	29	140
No. of wells in bedrock	0	4	0	0	3	0	7
No. of wells in glacial drift	20	15	15	18	24	28	120
No. of wells in alluvium	0	2	7	2	1	1	13
Permanency of Water Supply							
No. with permanent supply	20	21	22	18	27	29	137
No. with intermittent supply	0	0	0	2	1	0	3
No. dry holes	0	0	0	0	0	0	0
Types of Wells							
No. of flowing artesian wells	0	0	0	0	0	0	0
No. of non-flowing artesian wells	0	10	3	3	11	6	33
No. of non-artesian wells	20	11	19	17	17	23	107
Quality of Water							
No. with hard water	16	17	20	15	27	27	122
No. with soft water	4	4	2	5	1	2	18
No. with salty water	0	0	0	0	0	0	0
No. with "alkaline" water	5	6	6	6	9	7	39
Depths of Wells							
No. from 0 to 50 feet deep	19	10	18	19	14	23	103
No. from 51 to 100 feet deep	1	6	4	0	10	6	27
No. from 101 to 150 feet deep	0	1	0	0	0	0	1
No. from 151 to 200 feet deep	0	0	0	0	2	0	2
No. from 201 to 500 feet deep	0	4	0	1	2	0	7
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0
How the Water is Used							
No. usable for domestic purposes	18	18	20	19	27	26	128
No. not usable for domestic purposes	2	3	2	1	1	3	12
No. usable for stock	20	21	22	20	28	29	140
No. not usable for stock	0	0	0	0	0	0	0
Sufficiency of Water Supply							
No. sufficient for domestic needs	20	20	20	18	25	27	130
No. insufficient for domestic needs	0	1	2	2	3	2	10
No. sufficient for stock needs	19	15	14	14	24	25	111
No. insufficient for stock needs	1	6	8	6	4	4	29

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 Harris, No. 310, 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	
1	NW.	30	32	10	3rd	275	2,200	150	80	70	122	295	70	18	1,132	906	2,150	125		38		133	1,675	185	*2
2			32	12	3rd	Crystal Beach Lake	504											22		323		123	7	29	*1

Water samples indicated thus, *1, are from glacial drift or other unconsolidated deposits.
Water samples indicated thus, *2, are from bedrock, Belly River formation.
Analyses are reported in parts per million.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analysis No. 2 by Canadian National Railways Company.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

No water samples from the unconsolidated deposits in the municipality of Harris were taken by the field party, but the analysis of a sample of water in Crystal Beach lake, analysed by the Chemical Division of the Canadian National railways, is listed on the accompanying table.

A few wells have been dug near undrained depressions or sloughs and in general the water obtained from them is moderately soft. It is satisfactory for stock, and if it is not contaminated by water containing animal refuse, should be suitable for domestic use. In some cases it has an unpalatable taste. It is advisable to have the water from this type of well tested frequently for bacteria content. The water from wells sunk in the Recent dune sands should be found quite satisfactory for domestic use as well as for stock. The mineral salts in solution should not be concentrated and the water should be only moderately hard. Water from wells sunk in the vicinity of Crystal Beach lake will probably be somewhat similar in quality to the water in the lake.

The water obtained from wells sunk in the glacial lake sands should be quite similar to that obtained from the Recent sands. It may be somewhat harder, but should be satisfactory for domestic use.

The water from the sand deposits that occur at the contact of the lake clays and boulder clay, or within the upper part of the boulder clay, is usually suitable for domestic use. It contains more mineral salts in solution than the water from the Recent sands and glacial lake sands, but is nearly always suitable for all farm needs. The water from sand and gravel deposits in the lower part of the drift is considerably harder than that from the shallow wells. It contains a relatively large amount of mineral salts in solution, and that from some wells is not suitable for drinking, as it has a laxative effect due to the large amount of magnesium sulphate and sodium sulphate contained in solution. The water from these deeper wells is suitable for stock, but it is advisable to have it analysed before using it for domestic purposes.

Water from the Bedrock

One sample of water from the Belly River formation was analysed and the results are tabulated in the accompanying table. This analysis should be fairly representative of those waters obtained from the bedrock that are recorded soft in the well records. The sample analysed is usable for drinking as well as for stock. Its continued use for irrigation may prove injurious to vegetation. The water from some of the bedrock wells in this municipality is reported hard. It probably contains a greater amount of calcium and magnesium salts than the sample analysed, but may be suitable for all farm needs.

WELL RECORDS—Rural Municipality of HARRIS NO. 316, 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	SE.	1	31	10	3	Sand-point	10	1,805					Glacial lake sand	Soft	45	D, S	Sufficient supply; spring also supplies water for stock.
2	SW.	4	"	"	"	Dug	35	1,904	- 31	1,873	31	1,873	Glacial sandy gravel	Hard, slightly "alkaline"	41	D, S	Sufficient; waters 25 head stock.
3	SE.	6	"	"	"	Dug	35	1,898	- 31	1,867	31	1,867	Glacial gravel	Hard, slightly iron, "alkaline"	40	D, S	Sufficient supply.
4	NW.	9	"	"	"	Dug	26	1,815	- 23	1,792	26	1,789	Glacial sand	Hard, slightly "alkaline"	42	D, S	Sufficient; waters 15 head stock; 12-foot well in ravine; unused.
5	NE.	16	"	"	"	Dug	35	1,810	- 23	1,787	35	1,775	Glacial gravel	Hard	43	D, S	Sufficient; waters 60 head stock.
6	NW.	16	"	"	"	Dug	32	1,818						Fairly soft	42	D, S	Sufficient; waters 15 head stock.
7	SW.	16	"	"	"	Sand-point	40	1,830					Glacial sand	Hard	40	D, S	Abundant supply; also 40-and 22-foot wells good supplies; but not needed.
8	SW.	20	"	"	"	Dug	56	1,840	- 54	1,786	54	1,786	Glacial sand	Soft	43	D, S	Sufficient; waters 14 head stock; slough provides supply during spring.
9	SE.	20	"	"	"	Dug	20	1,805	- 10	1,795			Glacial sand	Hard, "alkaline"	42	D, S	Sufficient; waters 5 head stock.
10	NE.	24	"	"	"	Dug	23	1,830	- 19	1,811	19	1,811	Glacial gravel	Hard	43	D, S	Ample supply.
11	NE.	25	"	"	"	Sand-point	24	1,770					Glacial gravel	Soft	46	D, S	Ample supply; 22-foot well with soft water; good supply.
12	SW.	25	"	"	"	Sand-point	23	1,765					Glacial sand	Soft, slightly iron	46	D, S	Ample supply; also similar well.
13	SE.	30	"	"	"	Dug	14	1,800	- 8	1,792			Glacial drift	Hard, slightly "alkaline"	42	S	Sufficient; waters 50 head stock; 48-foot well for house purposes.
1	SW.	2	31	11	3	Dug	25	1,905	- 20	1,885	20	1,885	Glacial gravel	Hard	48	D, S	Sufficient; waters 7 head stock.
2	SW.	4	"	"	"	Drilled	132	1,920	-117	1,803			Glacial sand	Hard, iron	45	D, S	Sufficient; supplies 50 barrels a day.
3	SE.	4	"	"	"	Drilled	100	1,900	- 85	1,815			Glacial sand	Hard, iron	46	D, S	Sufficient supply.
4	NW.	4	"	"	"	Bored	91	1,925	- 51	1,874	91	1,834	Glacial sand	Hard, iron, "alkaline"	45	S	Sufficient; waters 16 head stock; laxative 12-foot well for house use.
5	NE.	5	"	"	"	Dug	60	1,935	- 57	1,878	57	1,878	Glacial sand	Hard, iron, "alkaline"	46	S	Insufficient; waters 8 head stock; laxative.
6	SW.	5	"	"	"	Dug	35	1,950	- 10	1,940	35	1,915	Glacial drift	Hard, "alkaline"		S	Insufficient; waters 10 head stock.
7	NE.	6	"	"	"	Dug	18	1,945	- 10	1,935			Glacial sand	Soft	46	D, S	Sufficient; waters 6 head stock.
8	NE.	8	"	"	"	Dug	35	1,945	- 10	1,935	35	1,910	Glacial sand	Hard, slightly "alkaline"	47	D, S	Oversufficient; watered 35 head stock.
9	SE.	14	"	"	"	Dug	40	1,875	- 25	1,850	40	1,835	Glacial sand	Medium hard		D, S	Sufficient; waters 8 head stock.
10	SE.	16	"	"	"	Drilled	332	1,915	- 30	1,885	332	1,583	Belly River	Soft	46	D, S	Insufficient as it fills up with quicksand.
11	SE.	19	"	"	"	Dug	16	1,900	- 11	1,889	11	1,889	Recent dune sand	Hard, slightly "alkaline"	47	D, S	Insufficient; waters 11 head stock; also dug-out with intermittent supply.
12	E½.	21	"	"	"	Dug	60	1,875	- 15	1,860	60	1,815	Glacial sand	Hard	48	D, S	Sufficient; waters 27 head stock.
13	NE.	22	"	"	"	Drilled	260	1,810	- 40	1,770	260	1,550	Belly River ?	Hard, iron	46	D, S	Oversufficient; could water 80 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 HARRIS NO. 316, 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	SW.	24	31	11	3	Drilled	240	1,840	- 70	1,770	240	1,600	Belly River ?	Hard, iron	42	D, S	Abundant supply; watered 700head stock.
15		24	"	"	"	Dug	87	1,840	- 79	1,761	87	1,753	Glacial fine sand	Hard		D, S	Abundant supply.
16	NE.	26	"	"	"	Dug	25	1,790	- 20	1,770	20	1,770	Glacial fine sand	Hard, iron	46	D, S	Sufficient; waters 25 head stock.
17	$E\frac{1}{2}$,	28	"	"	"	Drilled	300	1,825	-180	1,645	300	1,525	Belly River	Soft	42	D, S	Abundant supply; waters 70 head stock.
18	SE.	32	"	"	"	Dug	17	1,850	- 13	1,837	13	1,837	Recent dune sand	Soft	46	D, S	Oversufficient; waters 20 head stock.
19	NW.	36	"	"	"	Bored	78	1,810	- 70	1,740	70	1,732	Glacial fine sand	Hard, iron	47	D, S	Insufficient; waters 12 head stock.
20	SW.	36	"	"	"	Dug	46	1,805	- 40	1,765	40	1,765	Glacial sand	Hard, slightly "alkaline"	47	D, S	Sufficient; waters 28 head stock.
1	NE.	4	31	12	3	Bored	50	1,960	- 40	1,920	50	1,910	Glacial drift	Hard, iron	44	S	Oversufficient; waters 40 head stock.
2	SE.	6	"	"	"	Bored	98	1,955	- 90	1,865	90	1,865	Glacial drift	Hard, "alkaline"	47	S	Sufficient; waters 14 head stock; laxative.
3	NE.	6	"	"	"	Bored	40	1,955	- 30	1,925	30	1,925	Glacial sand	Hard, "alkaline"	46	D, S	Insufficient; waters 10 head stock.
4	NW.	9	"	"	"	Dug	12	1,955	- 8	1,947	8	1,947	Glacial sand	Soft	45	D, S	Insufficient; watered 10 head stock.
5	SE.	10	"	"	"	Dug	16	1,955	- 14	1,941	14	1,941	Glacial sand	Hard, "alkaline"	46	D, S	Insufficient; waters 15 to 18 head stock.
6	NE.	12	"	"	"	Dug	20	1,955	- 16	1,939	16	1,939	Glacial blue sand	Hard, iron	46	D, S	Sufficient; waters 60 head stock.
7	SW.	16	"	"	"	Dug	22	1,955	- 16	1,939	16	1,939	Glacial sand	Hard	45	D, S	Sufficient for 6 head stock.
8	SE.	17	"	"	"	Dug	18	1,950	0	1,950			Glacial fine sand	Hard, iron, cloudy, red sediment	45	S	Insufficient; waters 11 head stock.
9	SW.	18	"	"	"	Bored	80	1,950	- 30	1,920	80	1,870	Glacial drift	Hard	46	D, S	Oversufficient; waters 25 head stock.
10	NE.	19	"	"	"	Dug	18	1,920	- 15	1,905	15	1,905	Glacial drift	Hard	48	D, S	Insufficient for 30 head stock.
11	NE.	20	"	"	"	Dug	34	1,940	- 30	1,910	30	1,910	Glacial fine sand	Hard, iron	48	D, S	Sufficient supply.
12	SW.	20	"	"	"	Bored	32	1,940	- 29	1,911	29	1,911	Glacial fine sand	Slightly hard	46	D, S	Sufficient supply.
13	SE.	20	"	"	"	Dug	25	1,945	- 15	1,930	25	1,920	Glacial sand	Hard	43	D, S	Sufficient; waters 10 head stock.
14	SW.	21	"	"	"	Dug	16	1,945	- 10	1,935	10	1,935	Recent dune sand	Hard	45	D, S	Sufficient; waters 25 head stock.
15	$W\frac{1}{2}$.	21	"	"	"	Dug	16	1,940	- 10	1,930	10	1,930	Recent dune sand	Slightly hard	45	D, S	Sufficient; waters 50 head stock.
16	NE.	21	"	"	"	Dug	20	1,925	- 15	1,910	15	1,910	Recent dune drift	Hard, iron	43	D, S	Insufficient; waters 10 head stock.
17	NW.	22	"	"	"	Dug	20	1,925	- 15	1,910	15	1,910	Recent dune drift	Hard, iron	47	D, S	Just sufficient; waters 6 to 8 head stock.
18	NE.	30	"	"	"	Dug	15	1,890	- 11	1,879	11	1,879	Recent dune sand	Hard	46	D, S	Insufficient supply.
19	SE.	30	"	"	"	Dug	18	1,910	- 14	1,896	14	1,896	Recent dune sand	Hard, slightly "alkaline"	48	S	Sufficient for 30 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 HARRIS NO. 316, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
8	SW.	10	32	11	3	Dug	15	1,825	- 10	1,815	10	1,815	Recent dune sand	Hard, slightly "alkaline"	47	D, S	Sufficient; waters 30 head stock; also 40-foot well used for house; insufficient supply
9	NW.	12	"	"	"	Bored	72	1,760	- 42	1,718			Glacial sand	Hard		D, S	Intermittent; usually waters 18 head stock.
10	W½.	13	"	"	"	Dug	24	1,760	- 8	1,752	24	1,736	Glacial sand	Hard, iron, "alkaline"	46	D, S	Sufficient; waters 20 head stock.
11	SW.	14	"	"	"	Drilled	200	1,810			200	1,610	Belly River ?	Hard, iron	48	D, S	Sufficient; waters 2 head stock.
12	SW.	16	"	"	"	Dug	23	1,850	- 15	1,835	15	1,835	Glacial sand	Hard, iron, red sediment "alkaline"		D, S	Insufficient supply.
13	NW.	17	"	"	"	Dug	30	1,860	- 22	1,838			Glacial sand	Hard, iron, red sediment, "alkaline"	45	S	Oversufficient; waters 5 head stock; has bad taste.
14	SW.	18	"	"	"	Dug	28	1,865	- 22	1,843	22	1,843	Glacial fine sand	Hard		D, S	Oversufficient; could supply 100 head stock.
15	SW.	19	"	"	"	Dug	32	1,865	- 30	1,835	30	1,835	Glacial fine sand	Hard	48	D, S	Sufficient; waters 15 head stock.
16	NE.	21	"	"	"	Drilled	201	1,825	-150	1,675	201	1,624	Belly River ?	Hard, iron, red sediment	47	D, S	Oversufficient; waters 21 head stock; used also for steam-engines.
17	E½.	23	"	"	"	Dug	33	1,805	- 30	1,775	30	1,775	Glacial sand	Hard	46	D, S	Sufficient; could water 50 head stock.
18	W½.	25	"	"	"	Dug	20	1,810	- 15	1,795	15	1,795	Glacial drift	Hard, "alkaline"	47	D, S	Ample supply.
19	NE.	26	"	"	"	Dug	60	1,810	- 50	1,760	60	1,750	Glacial sand	Hard, iron	46	D, S	Sufficient; waters 25 head stock.
20	NE.	29	"	"	"	Bored	75	1,840	- 60	1,780	75	1,765	Glacial sand	Hard, iron, red sediment	48	D, S	Sufficient; waters 7 head stock.
21	SE.	30	"	"	"	Dug	30	1,855	- 15	1,840	30	1,825	Glacial sand	Hard, "alkaline"	46	D, S	Sufficient; waters 50 head stock.
22	NE.	31	"	"	"	Drilled	180	1,860	-100	1,760	180	1,680	Glacial sand	Hard	47	D, S	Sufficient; waters 36 head stock.
23	NE.	32	"	"	"	Bored	85	1,855	- 81	1,774	81	1,774	Glacial sand	Hard, iron	47	D, S	Sufficient; waters 3 head stock.
24	SE.	34	"	"	"	Drilled	250	1,835	- 25	1,810	250	1,585	Belly River	Hard, iron, red sediment	43	D, S	Sufficient for 100 head stock.
25	NW.	34	"	"	"	Dug	62	1,840	- 60	1,780	60	1,780	Glacial sand	Hard, iron, red sediment	46	D, S	Sufficient; waters 25 head stock.
26	NW.	35	"	"	"	Dug	60	1,825	- 55	1,770	55	1,770	Glacial fine sand	Hard, iron	47	D, S	Sufficient; waters 8 head stock.
27	NW.	36	"	"	"	Bored	70	1,810	- 66	1,744	66	1,744	Glacial sand	Hard, iron, red sediment	46	D, S	Insufficient; waters 150 head stock; laxative.
1	SW.	2	32	12	3	Dug	25	1,850	- 23	1,827	23	1,827	Recent dune sand	Soft	46	D, S	Abundant supply; used for locomotives.
2	NE.	11	"	"	"	Driven	40	1,895	- 39	1,856	39	1,856	Glacial fine sand	Moderately hard	46	D, S	Sufficient; waters 50 head stock.
3	SW.	12	"	"	"	Dug	40	1,890	- 38	1,852	38	1,852	Glacial sand	Hard	46	D, S	Abundant supply.
4	NW.	12	"	"	"	Dug	36	1,895	- 34	1,861	34	1,861	Glacial sand	Hard	46	D	Used only for drinking. #
5	NE.	12	"	"	"	Dug	36	1,890	- 33	1,857	33	1,857	Glacial sand	Soft	48	D, S	Sufficient; waters 70 head stock.
6	NW.	13	"	"	"	Dug	37	1,885	- 32	1,853	32	1,853	Glacial sand	Hard	46	D, S	Sufficient; waters 75 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 HARRIS NO. 316, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED: Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
7	NE.	13	32	12	3	Dug	37	1,885	- 30	1,855	30	1,855	Glacial sand	Hard, "alkaline"	48	D, S	Sufficient; similar well with water too hard for drinking.
8	SE.	15	"	"	"	Dug	14	1,880	- 10	1,870	10	1,870	Glacial sand	Medium hard	46	D, S	Insufficient; waters 25 head stock.
9	SE.	16	"	"	"	Dug	26	1,860	- 25	1,835	25	1,835	Glacial sand	Hard	45	D, S	Oversufficient; waters 10 head stock.
10	NE.	17	"	"	"	Bored	84	1,855	- 76	1,779	84	1,771	Glacial fine sand	Hard	45	D, S	Oversufficient; waters 25 head stock.
11	NW.	17	"	"	"	Dug	26	1,860	- 20	1,840	20	1,840	Glacial drift	Hard, iron, "alkaline"	46	D, S	Sufficient; waters 50 head stock; laxatove.
12	SE.	18	"	"	"	Bored	55	1,855	- 45	1,810	55	1,800	Glacial sand	Hard, iron, "alkaline"	46	D, S	Sufficient; waters 30 head stock.
13	SW.	21	"	"	"	Dug	30	1,825	- 26	1,799	26	1,799	Glacial sand	Hard	46	D, S	Oversufficient; waters 8 head stock.
14	NW.	24	"	"	"	Dug	35	1,870	- 32	1,838	32	1,838	Glacial sand	Hard	46	D, S	Insufficient; yields ½ barrel a day.
15	SE.	25	"	"	"	Dug	28	1,865	- 24	1,841	24	1,841	Glacial sand	Hard	47	D, S	Sufficient for 7 head stock.
16	SE.	26	"	"	"	Bored	40	1,860	- 30	1,830	40	1,820	Glacial sand	Hard	46	D, S	Sufficient; waters 30 head stock.
17	NE.	26	"	"	"	Dug	30	1,860	- 26	1,834	26	1,834	Glacial sand	Hard, iron, red sediment	47	D, S	Sufficient; waters 15 head stock.
18	SW.	27	"	"	"			1,825					Glacial drift	Hard	46	D, S	Oversufficient; waters 25 head stock.
19	NW.	28	"	"	"	Dug	38	1,860	- 36	1,824	36	1,824	Glacial sand	Hard, iron	47	D, S	Sufficient; waters 12 head stock.
20	SW.	29	"	"	"	Bored	90	1,870	- 80	1,790	90	1,780	Glacial sand	Hard, iron, "alkaline"	46	D, S	Sufficient; waters 15 head stock; laxative.
21	S½.	30	"	"	"	Bored	55	1,880	- 45	1,835	55	1,825	Glacial sand	Hard, iron, "alkaline"	46	D, S	Oversufficient; waters 20 head stock; laxative.
22	NW.	32	"	"	"	Bored	96	1,875	- 90	1,785	90	1,785	Glacial sand	Hard, iron, red sediment "alkaline"	46	S	Sufficient; waters 20 head stock; hauls drinking water.
23	SW.	33	"	"	"	Bored	90	1,860	- 80	1,780	90	1,770	Glacial sand	Hard, iron, red sediment "alkaline"	46	S	Sufficient; waters 14 head stock; laxative.
24	NW.	34	"	"	"	Dug	15	1,825	- 10	1,815	10	1,815	Glacial sand	Hard, iron	48	D, S	Insufficient; supplies 3 barrels a day.
25	SE.	34	"	"	"	Bored	84	1,860	- 80	1,780	80	1,780	Glacial gravel	Hard	45	S	Insufficient; waters 10 head stock.
26	SE.	36	"	"	"	Dug	30	1,860	- 18	1,842			Glacial sand	Hard	48	D, S	Sufficient; waters 11 head stock.
27	SW.	36	"	"	"	Dug	40	1,860	- 39	1,821	39	1,821	Glacial sand	Hard		D, S	Sufficient; waters 7 head stock.
28	NE.	36	"	"	"	Dug	40	1,865	- 38	1,827	38	1,827	Glacial sand	Hard,	48	D, S	Sufficient supply.

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

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