CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 155

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF DUFFERIN NO. 190 SASKATCHEWAN

By

B. R. MacKay, H. N. Hainstock and J. A. Chalmers

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF DUFFERIN, NO. 190, SASKATCHEWAN

INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

(3) Glacial Outwash. Sand and 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 Dufferin, No. 190, covers an area of approximately 380 square miles in the central part of southern Saskatchewan. It is bounded on the southwest by Buffalo Pound lake and on the northeast corner by Last Mountain lake and the lower part of Arm river. The centre of the municipality lies approximately 8 miles east and 22 miles north of the city of Moose Jaw. The area consists of nine full townships described as tps. 19, 20, and 21, ranges 23 and 24; tps. 20 and 21, range 25, and tp. 21, range 26; and parts of four townships described as tp. 19, ranges 25 and 26; tp. 20, range 26; and tp. 21, range 22; all W. 2nd mer. The area is drained by Qu'Appelle and Arm rivers and their tributaries. Qu'Appelle valley is from 200 to 250 feet deep, is steep-sided, and has a broad flood-plain. In the southwestern part of the area the valley is wide and contains Buffalo Pound lake. This lake is approximately $\frac{3}{4}$ mile wide, 15 miles long, and from 6 to 10 feet deep. The water contains a considerable amount of mineral salts in solution, but is not excessively hard. Arm River valley is steep and from 100 to 150 feet deep, but has a narrow flood-plain. This river has been known to go practically dry in drought periods. The Saskatoon and Duck Lake branch of the Canadian National railway crosses the central part of this municipality and runs in a northwest-southeast direction. On this line are located the villages of Bethune and Findlater. The Saskatoon and Duck Lake branch of the Canadian Pacific railway follows the shore of Last Mountain lake in the northeastern corner, and on it is located the hamlet of Keddleston.

Recent stream deposits floor Qu'Appelle valley, but as no wells have been sunk into them little information is available concerning the nature or thickness of these deposits. The greater

part of the municipality is overlain by moraine, but glacial till or boulder clay occurs along the lakes and rivers. South of Qu'Appelle river the boulder clay is overlain by glacial lake clay. In parts of secs. 2 and 3, tp. 19, range 23, and parts of secs. 7, 8, 17, and 18, tp. 21, range 22, glacial outwash sand and gravel overlies the glacial till. The land throughout much of this municipality is not very suitable for cultivation as it is very gravelly or stony. The ground surface is quite hilly and undrained depressions are common, particularly in the northwestern part. In this part the highest of the hills rises to an elevation of 2,000 feet above sea-level. From here the general surface elevation decreases towards the eastern border.

Water-bearing Horizons in the Unconsolidated Deposits

No wells have been sunk into the Recent stream deposits in Qu'Appelle valley, but usable water should be derived from them at shallow depth. The supply, however, may not be abundant, but it should be sufficient for domestic needs and a few head of stock.

The glacial lake clays are of a sandy nature, but are not of sufficient thickness to serve as a source of supply. Water supplies in this area are obtained from the underlying glacial till. The glacial outwash deposits previously described should prove to be a good source of water. Few holes have been sunk into these outwash deposits, but they contain water as springs occur at the edge of some of the deposits, and the Canadian National Railway Company derived a moderate supply of water from a well in the SE. $\frac{1}{4}$, sec. 1, tp. 21, range 25. The water should be usable for all farm needs. Wells sunk into the moraine and glacial till or boulder clay encounter pockets of water-bearing sand and gravel. As a rule the upper 30 to 40 feet

of the drift is composed of yellow boulder clay, and shallow wells usually find water-bearing deposits in this part of the drift. In some areas, however, the porous deposits are scarce and blue boulder clay occurs near the surface.

The aquifers encountered are not of large extent, but in some places two or three wells may tap a common aquifer, and in a coulée extending west from Last Mountain lake across the northern part of township 21, range 23, south of the hamlet of Keddleston, into twonship 21, range 24, a sand aquifer may be fairly extensive and continuous. Springs are found along the edge of this coulée and the water is not highly mineralized. In other parts of the area the water from shallow wells is hard and much of it is "alkaline", but as a rule it is usable for domestic purposes and for stock.

Wells sunk into the blue boulder clay that underlies the weathered or yellow clay also tap pockets of sand and gravel, but the wells do not exceed 90 feet in depth in the municipality. Holes have been sunk to greater depths, but they did not encounter water-bearing deposits. In the northwestern part of the municipality water-bearing deposits are very scarce below a depth of 30 feet, and with the exception of a few seepage wells in the central part of township 20, range 25, water cannot be obtained. The water from the lower part of the drift is more highly mineralized than that from the shallower wells, but an 83-foot well in the NE. $\frac{1}{4}$, sec. 33, tp. 21, range 24, yields soft water. The yield from the deeper wells in this municipality is fairly abundant and the water is in many places under hydrostatic pressure.

Water-bearing Horizons in the Bedrock

The Marine Shale series underlies the glacial drift throughout the municipality. The surface of this bedrock is uneven,

especially in the northeastern part of the municipality where it is believed to come within 50 or 60 feet of the land surface. From this area, however, it appears to slope in all directions. No water-bearing deposits occur in the upper part of the bedrock in the northeastern corner of the area, and several dry holes have been sunk into it. Some wells that encounter the bedrock yield water, but it is assumed to be derived from the glacial drift. Such is the case in the 400-foot well in the NE. $\frac{1}{4}$, sec. 19, tp. 21, range 23. The aquifer in this well is composed of fine sand and it has clogged the casing, and very little water is available. Two wells in township 21, range 24, are shown on the map as obtaining water from the bedrock. They encounter good supplies of water at depths of 186 and 200 feet, and may tap a common aquifer. It is not definitely known if the aquifer is in the bedrock, however, and the water may be from the glacial drift. One of these wells is caved in, and the other yields hard water that is usable but not desirable for domestic purposes. Sufficient information on the water-bearing properties of the bedrock in this municipality is not available, but drilling to great depth in the shale is not advised. The possibilities of encountering a moderate supply of water at the contact of the drift and bedrock are, however, good.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 19, Range 23

Qu'Appelle river flows in a west to east direction across the centre of this township, and it has eroded a wide valley that is approximately 200 feet deep. Numerous coulées extend back from the main valley and give the township a very rugged appearance. Recent deposits of sands and silts form the flood-plain of the river. The banks of the valley and larger tributaries, and the area to the south of the river, are mantled by glacial till or boulder clay. In the southern 2 miles of the township the glacial till is concealed by a deposit of glacial lake clay. Glacial outwash sands and gravels occur in a small area in sections 2 and 3. The northern part of the area is covered by moraine, but the difference in surface elevation on the uplands does not exceed 50 feet. The supply of water in this township is derived from springs, wells, dugouts, and from Qu'Appelle river. Most of the wells are shallow and are readily affected by drought conditions, although many of them yield sufficient supplies in years of normal rainfall.

No wells obtain water from the glacial lake clay or from the Recent stream deposits in Qu'Appelle valley. The lake clays do not appear to exceed 10 feet in thickness, but they are rather sandy and may contain water. Little difficulty should be experienced in obtaining a fair supply of usable water at shallow depth from the Recent stream deposits.

Water is obtained from both the deposits of moraine and glacial till, and the ground water conditions in these deposits appear to be quite similar. Approximately one-half the wells obtain water from pockets of sand and gravel at depths of 14 to 40 feet. In the southern part of the township the wells

have passed through the lake clay into the underlying glacial till. One of these wells was dug through 3 feet of soil and brown clay, and 12 feet of white clay, and obtains water in sand in the underlying grey clay. Most of the shallow wells in the municipality, however, are not sunk into the unweathered, blue or grey boulder clay, but tap aquifers in the yellow boulder clay. With the exception of a 22-foot well located in the SE. ¼, section 2, these wells yield hard water. The water from some of the wells is "alkaline", contains a small amount of iron, and acts as a laxative on persons unaccustomed to its use, but in most cases it is usable for domestic purposes or for stock. The water from a well located in the NW. ¼, section 26, is said to be salty and it is not used, but an abundant supply of usable water is obtained from shallow wells in a nearby coulée, and from a dugout. Few of the shallow wells yield large supplies and in some places two or more wells are used to obtain a sufficient supply for local requirements, or the supply is supplemented by the use of a dugout. It is rarely necessary, however, to haul water. Springs break forth on the sides of Qu'Appelle valley, and its tributary coulées. A dugout in section 2 is also supplied by a spring, and it holds water throughout the year. A number of wells sunk to depths of 45 to 70 feet tap pockets of sand and gravel in the drift, commonly in the blue clay. These wells, with the exception of one in section 36, yield hard water and only one in section 33 is not usable. The supply from this part of the drift is not abundant and although some of the wells yield sufficient water for local needs, that from others has to be supplemented from some other sources.

No water is derived from the Marine Shale series in this township. Two wells have been drilled to depths of 300 and 600 feet in the NE. ¼, section 26, and although they are undoubtedly

drilled into the bedrock, the depth to the contact is not known. Water-bearing deposits were encountered, but their location is not known. The water from the 600-foot well was analysed by the Provincial Analyst, and was condemned for any use. No information is available concerning the water from the 300-foot well. It is inadvisable to sink wells into the bedrock, and the possibilities of obtaining water in the upper 40 feet of the drift are just as good as they are at depth. Little difficulty should be experienced in deriving water from the Recent stream deposits on the flood-plain of Qu'Appelle river.

Township 19, Range 24

The surface of this township is very undulating and in the southeastern corner Qu'Appelle river has eroded a valley approximately 200 feet deep. Several deep coulées extend back from the river. Recent stream sands and silts cover the flood-plain of the river. The northern three-quarters of the township is mantled by moraine, and only the southeastern corner and a small area paralleling the river on the north are covered by glacial till or boulder clay. In sections 1, 2, 11, and 12, the boulder clay is overlain by a thin deposit of glacial lake clay. The lake clay is quite sandy and represents a shore phase.

The Recent stream deposits have not been investigated, but they should yield fairly abundant supplies of usable water at shallow depth. The glacial lake deposits are thin and they are not thought to contain water, but water-bearing deposits should be encountered in the underlying boulder clay. With the exception of two shallow wells in section 4, which obtain water from the glacial till at shallow depth, most of the wells in this township derive water from the yellow boulder clay or upper

part of the moraine deposits at depths of 8 to 40 feet. The aquifers for these wells are formed by pockets of sand and gravel and do not constitute a continuous water-bearing horizon, and many dry holes are dug before a water-bearing deposit is encountered. Twenty-five wells were dug in the NW. $\frac{1}{4}$, section 22, without encountering a sufficient supply of water. Small layers of dry sand or gravel were encountered in some of these wells. Similar conditions were encountered throughout the central part of the township. Wells that do tap water-bearing deposits do not yield a large supply of water. Shallow wells located in sections 5 and 19, and in some sections in the northeastern part of the township, yield a fairly large supply of water. The water from the shallow wells varies from moderately hard to hard and slightly "alkaline", but it is suitable for stock and is nearly always usable for domestic purposes.

Only six recorded wells in this area obtain water at depths of 45 to 95 feet below the surface. These wells tap pockets of sand or gravel that occur in the blue boulder clay that underlies the yellow boulder clay. The water from two 45-foot wells is hard and slightly "alkaline", but is usable for domestic purposes as well as for stock. Two wells sunk to depths of 90 and 95 feet yield very poor water. One of these wells is usable for stock, but the other one cannot be used for any purpose. The two 45-foot wells yield sufficient water for local requirements, but the other wells do not yield an adequate supply for livestock requirements.

During drought periods the shortage of water in the township is very acute, but in years of normal rainfall most of the wells yield sufficient water for local needs. It does not appear advisable to sink wells to depth, as the water is of poor quality and the supply is small. The upper 40 feet of the drift is the best source of water. Prior to digging shallow wells,

however, the water-bearing deposits should be located by means of a small test-auger. The best method of increasing the supply of water in this township is by the conservation of surface water. Dugouts, excavated at least 12 feet deep and located in natural depressions where the maximum amount of water collects, are highly recommended.

Township 19, Range 25

Only that part of this township lying north of Buffalo Pound lake is included in the municipality of Dufferin. The surface of this part of the township is very uneven and is characterized by knolls and numerous, undrained depressions. The soil is light and stony and in many places is suitable only for pasture and the growing of hay. The greater part of the area is mantled by moraine, but the slope of the valley is covered by glacial till or boulder clay. The north slope of the valley is steep and drops approximately 200 feet to the lake.

Most of the wells in this township tap pockets of sand and gravel in the yellow boulder clay. These deposits occur at or near the contact of the yellow and blue boulder clay at depths of 14 to 40 feet. The deposits do not form a continuous water-bearing horizon and one well located in the SW. $\frac{1}{4}$, section 14, was dug mostly through gravel, whereas a well in the NW. $\frac{1}{2}$, section 20, was dug through sandy clay until it encountered sand at the bottom. The water from the shallow wells in this township is unsuitable for domestic purposes and for stock, although the water from some of the wells is slightly "alkaline", and would have a laxative effect on persons unaccustomed to its use. Only one well located in the SW. $\frac{1}{4}$, section 24, yields soft water, but that from most wells is not excessively hard. The supply obtained varies according to the size and nature of the water-bearing pocket encountered, and although most of the wells yield a

sufficient supply in years of normal rainfall they are readily affected by drought conditions. Difficulty is experienced in obtaining a suitable supply in sections 29, 32, 35, and 36. Dry holes were sunk in sections 29 and 35, and although some water was obtained in the NW. ¼, section 32, and the NW. ¼, section 36, the supply was not sufficient for local needs, and it is supplemented by the use of dugouts.

Five wells are sunk to depths of 45, 50, and 62 feet, and yield sufficient water for 40 head of stock. The aquifers at depth in the drift are not continuous, but they appear to be more productive, and the water-level in some of the wells cannot be lowered by continuous pumping. The water from all these wells is hard, and that from three of them is also "alkaline" and has a laxative effect on humans. It is suitable for stock, but is rarely used for drinking.

No attempts to derive water at depths greater than 60 feet are recorded, but any water derived at depth will be highly mineralized. Shallow wells sunk beside undrained depressions yield suitable water for domestic needs, and water for stock can be obtained in many places by sinking wells to depths of 50 or 60 feet. The use of dugouts to conserve surface water for stock use is recommended.

Township 19, Range 26

Parts of sections 25 and 35, and section 36, of this township lie within the municipality of Dufferin. The slope of the valley north of Buffalo Pound lake is mantled by glacial till or boulder clay, and the remainder of the area is covered by moraine. The moraine-covered area is hilly and the valley drops steeply to lake level.

No wells are recorded in this area, but it appears probable that small supplies of water could be obtained from

pockets of sand and gravel at depths of 60 feet or less.

Township 20, Range 23

Arm River flows in an easterly direction across the northern part of the township. Its valley is 150 feet deep, and approximately 1 mile wide. The banks of this valley are mantled by glacial till or boulder clay, but the remainder of the area is covered by moraine. The moraine-covered area is rough and stony, but the difference in topographic relief is not great.

Few wells in this township obtain adequate supplies of water at depths less than 30 feet. One well in the SW. $\frac{1}{4}$, section 5, and several wells in the SE. $\frac{1}{4}$, section 4, however, derive sufficient supplies of water from sand and gravel aquifers at depths of 10 to 15 feet. These wells are located in a coulée leading to Qu'Appelle valley, and the water-bearing deposits may be concentrated in this depression.

The other shallow wells yield only small supplies of water and cannot be depended upon to yield sufficient water for local needs, especially in winters and drought periods. The water obtained from the shallow wells is of good quality, however, and can be used for domestic purposes or for stock.

The best supplies of water are obtained at depths of 32 to 70 feet from sand and gravel aquifers that usually occur in the blue boulder clay. The deposits do not form a continuous horizon and may not be very extensive as dry holes have been sunk in sections 2, 11, 20, 25, 30, and 32, to a maximum depth of 85 feet. None of the wells that strike water yields more than is sufficient for 50 or 60 head of stock, and many of them do not yield sufficient water for local needs. Some farmers use several shallow wells to obtain an adequate supply, whereas others use dugouts and haul water. The water in most of the wells is under

hydrostatic pressure and rises above the tops of the aquifers. The water is hard and that from many of the wells is slightly "alkaline" and commonly contains iron, but it is often used for domestic purposes or for stock.

Large supplies of water are not to be expected from wells in this township, and it is very improbable that sufficient supplies of water will be obtained at depths less than 30 feet. The best supply should be obtained at depths of 40 to 60 feet. It is possible that drilled wells may encounter large supplies of water at the base of the drift, but the water will be highly mineralized. The conservation of surface water is recommended as a means of increasing the water supply. This can be done by constructing dams across the coulées, and by excavating dugouts in natural depressions. Shallow wells dug beside the impounded water should yield water that is usable for domestic needs.

Township 20, Range 24

Arm river has eroded a deep valley in the northeastern part of the township. Its valley is 150 feet deep and approximately 1 mile wide. The elevation decreases from more than 1,850 feet above sea-level in the southwestern corner to less than 1,700 feet at river-level. The river valley and an area from 1 to 2 miles wide paralleling the valley on the south is mantled by glacial till or boulder clay. In part of section 31 the glacial till is overlain by glacial outwash sands and gravels. The remainder of the township is covered by moraine and the ground surface is hilly and stony.

Water supplies in this township are obtained from wells, springs, dugouts, sloughs, and Arm river. Wells sunk to depths of 11 to 31 feet obtain water from pockets of sand and gravel that usually occur in the yellow boulder clay. Some of these wells yield fairly abundant supplies of water, but in many places two or

more wells are used to obtain a sufficient supply for local needs. The water varies from moderately soft to hard and slightly "alkaline", but is usable for farm needs.

A number of wells obtain water from pockets of sand and gravel that occur in what is assumed to be blue boulder clay at depths of 35 to 60 feet. The deposits are not continuous, as numerous dry holes have been sunk to a maximum depth of 72 feet, and in section 17 at least fourteen dry holes were dug. Some of the producing wells yield fairly abundant supplies of water, but the supply from most of them is not sufficient for local needs and must be supplemented by using dugouts or two or more similar wells. The water supplies of this township, however, are somewhat better than those of the townships to the east and west. The water from these deeper wells is hard, highly mineralized, and has a slightly laxative effect on those not accustomed to its use. Four wells cannot be used for drinking or domestic purposes.

It appears advisable to prospect the upper 30 feet of the drift in this township with a small test auger. By so doing a deposit of water-bearing sand and gravel may be encountered prior to digging a well. Some water should be obtained at shallow depth in the deposits of glacial outwash sand and gravel. Should a sufficient supply of water not be obtained from the drift, surface water can be collected in dugouts or impounded by dams.

Township 20, Range 25

The maximum elevation of approximately 1,925 feet above sea-level is attained in the southwestern corner, from where it decreases gradually in a northeasterly direction to 1,850 feet above sea-level in the northeastern corner. Moraine mantles all this township with the exception of approximately one square mile in the northeastern corner, which is covered by

glacial till or boulder clay, and part of the NE. ¼, section 36, which is mantled by glacial outwash sands and gravels. The moraine-covered area of the township is characterized by numerous, undrained depressions. The soil is clay and very stony, and is unsuitable for cultivation. As a result much of this township is used for pasture and hay land.

In years of normal rainfall little difficulty is experienced in obtaining sufficient water from shallow wells sunk beside sloughs or depressions. During the drought period of 1930 to 1934, however, a large number of the wells went dry. No definite information was collected on wells in the central part of the township, but it is reported that they are shallow and derive intermittent supplies from undrained depressions. In other parts of the township, however, several wells yield a permanent supply from pockets of sand or gravel encountered at depths of 12 to 27 feet. Most of these wells are not yielding large supplies, but all the recorded wells of this depth, with the exception of a 12-foot well in the SE. ¼, section 6, yield sufficient water for local requirements. A 12-foot well located in the SE. ¼, section 26, appears to have encountered a large pocket of sand as it yields an abundant supply of water. The water from most of these shallow wells is quite hard and it is usable for all general farm purposes.

A number of wells sunk to depths of 33 to 60 feet obtain water from pockets of sand and gravel that occur in the blue boulder clay. The water in several of these wells is under slight hydrostatic pressure, and in some of them it rises to a point 15 to 20 feet below the surface. The water is usually quite hard and that from two of the wells is too "alkaline" for domestic use. The supply obtained varies greatly, some of the wells yielding sufficient water for several farms, whereas others yield very small supplies that are quite insufficient for local needs.

It appears advisable to conserve surface water by the use of dugouts to ensure an adequate supply of water in this township at all times. As the soil is rather light in some areas, care should be taken in selecting a location for the dugout. Small dams could be constructed in coulées in some sections. Prior to digging shallow wells the water-bearing deposits should be located by means of a small test auger. This eliminates the possibility of digging a dry hole.

Township 20, Range 26

Buffalo Pound lake forms the southwestern boundary of this township. The elevation drops from 1,900 feet above sea-level $\frac{1}{2}$ mile northeast of the lake to 1,659 feet at the lake. In sections 20 and 21 the elevation rises to 1,950 feet above sea-level, but elsewhere it is not much greater than 1,900 feet. The north bank of the valley is mantled by boulder clay or glacial till. The remainder of the area, except the flood-plain of the river in section 30, which is mantled by Recent stream deposits, is covered by moraine. The moraine-covered area is characterized by knolls and undrained depressions. The supply of water in this area is obtained from wells, dugouts, sloughs, and Buffalo Pound lake.

A number of wells sunk to depths of 12 to 30 feet obtain water from pockets of sand and gravel that are assumed to occur in the yellow boulder clay or at the contact of the yellow clay and the underlying blue boulder clay. The water in these wells is under little or no pressure and as a rule it is usable for domestic purposes and for stock. It is hard and much of it is slightly "alkaline", but not sufficiently so to have a harmful effect. The supply from these shallow wells is usually sufficient for local needs, only three farmers being forced to haul water or use several wells to obtain an adequate supply. In the northeastern

part of the area wells have had to be sunk somewhat deeper in order to encounter water-bearing deposits. These wells obtain water at depths of 32 to 60 feet, and tap sand and gravel pockets that are thought to be located in the blue boulder clay. The water in many of these wells is under pressure; it is hard, and that from one well is "alkaline", but it is usable for domestic purposes and for stock.

Although some of these wells yield fairly abundant supplies of water, approximately half of them do not yield enough for local requirements and some farmers are forced to use several wells or sloughs to obtain sufficient water. The use of dams and dugouts to conserve surface water for stock use is highly recommended.

Township 21, Range 22

Only that part of this township that lies between Arm river and Last Mountain lake is in the municipality of Dufferin. The surface of this part of the township is mantled by glacial till or boulder clay, but in the eastern part of the area it is overlain by glacial outwash sand and gravel. Approximately one-half the area is set aside as the Long Lake Indian Reserve.

Information is not available concerning the water conditions existing in the Indian Reserve. A hole sunk to a depth of 60 feet in the NW. $\frac{1}{4}$, section 7, however, failed to obtain water. Springs are reported to exist in the SE. $\frac{1}{4}$, section 7, and these yield a good supply of hard water. Water is probably obtainable in the outwash deposits in the NE. $\frac{1}{4}$, section 7, and in the NW. $\frac{1}{4}$, section 8, at shallow depth, but apparently no wells have been dug in this area. Little difficulty should be experienced in obtaining a supply of water in this area.

Township 21, Range 23

Last Mountain lake occurs in the northeastern corner of the township and covers approximately one square mile of the area. An area approximately 2 miles wide to the west of the lake is mantled by glacial till or boulder clay. The remainder of the area is covered by moraine. The moraine-covered area is rough, and during wet seasons numerous, undrained depressions occur in the southern part of the township. During drought years, however, most of these sloughs became dry. The southern row of sections are not extensively used for cultivation. A large number of wells have been sunk in this township and on the whole very good supplies of water have been obtained. The water-bearing deposits do not form continuous water-bearing horizons, and although water-bearing beds are encountered in one section numerous dry holes may be sunk in adjoining sections. Springs are commonly found on the sides of ravines or valleys, and they are used for farm needs during dry seasons. A number of wells obtain water from pockets of sand and gravel that usually occur in the yellow boulder clay at depths of 5 to 30 feet. In some areas, however, the blue boulder clay comes close to the surface, such as in the NW. $\frac{1}{4}$, section 7, and the water-bearing deposits occur in it. A ravine is reported to extend in a westerly direction from the lake in section 36, through section 30, and into the township to the west. Water is obtained at several localities in this ravine at shallow depth and springs occur along its banks in some areas. Many of the wells along the ravine yield water that is quite soft and usable for domestic purposes or for stock. The water from the other shallow wells in the township varies greatly, but it is usually hard, highly mineralized, and not under hydrostatic pressure. That from five wells is reported to be "alkaline", but in two places only is it

not usable for domestic purposes. One shallow well located in Keddleston is not usable for stock, and it is difficult to obtain a supply of usable water for the hamlet's needs. Numerous dry holes have been sunk throughout the area, and it is improbable that water-bearing beds of more than local areal extent will be found except along the ravine previously mentioned. The supply obtained varies according to the size of pocket encountered, and some of the wells yield insufficient water for 10 head of stock, whereas others are described as yielding abundant supplies. Where a shortage is obtained farmers are forced to use several wells, use sloughs for the stock, or haul water.

Wells ranging in depth from 30 to 65 feet also obtain water from pockets of sand and gravel that are thought to occur in the blue boulder clay. Some of the wells in the central part of the township may be sunk into the Marine Shale series, but the water is thought to be derived from the glacial drift. If these wells encounter the Marine Shale series it must be considerably higher at this point than elsewhere in the municipality. Bedrock occurs at an elevation of 1,760 feet above sea-level in the NE. $\frac{1}{4}$, section 9, but elsewhere it is at a lower elevation. The Marine Shale series does not contain water and it is inadvisable to drill into the shale when it is encountered. Some water, however, should be obtained at the contact of the drift and bedrock. The water derived from the lower part of the drift is hard and quite highly mineralized. In two wells, 40 and 31 feet deep, in sections 32 and 34, the water is moderately soft, but they are located along the ravine in the northern part of the township and the aquifers may occur some distance above the base of the wells. The water from several of the wells contains iron, but as a rule the water is being used for all farm needs. The supply obtained from these wells is not

large, most of them yielding sufficient water for only 10 to 25 head of stock, but a few wells in the northern part of the township yield sufficient water for 50 to 100 head of stock.

One well located in the NE. $\frac{1}{4}$, section 19, drilled to a depth of 400 feet, appears to have encountered a bed of sand in the Marine Shale series. The water is hard and too highly mineralized for domestic use, but is suitable for stock. The supply of water is abundant, but the fine sand of the aquifer partly clogs the casings and reduces the available supply of water.

Township 21, Range 24

The most pronounced topographic feature of this township is the deep valley cut by Arm river in the southwestern part of the township. This valley is approixmately 150 feet deep, $\frac{3}{4}$ mile wide, and has a broad flood-plain through which the river meanders. The slopes of the valley and an area on each side of the valley are covered by glacial till or boulder clay. Glacial outwash sand and gravel overlies the till in part of section 6, and the remainder of the area is overlain by moraine. The moraine-covered area is very hilly, and the elevation rises from 1,800 feet above sea-level in the northeastern part to 1,850 feet in sections 14 and 15, from where it decreases to 1,800 feet at the edge of the river valley.

Three wells were sunk to a depth of approximately 8 feet in the SE. $\frac{1}{4}$, section 6, and they obtain good supplies of water from sand and gravel aquifers. They probably tap the outwash sands and gravels that occur in that area. The water is soft and usable for all farm needs. There should be no difficulty experienced in deriving a good supply of usable water from the outwash deposits in this part of the township.

A number of wells obtain water from pockets of sand and gravel that occur in the yellow boulder clay at depths of 12 to 36 feet. With few exceptions the water is hard, but that from two wells in sections 26 and 36, which may be obtaining water from aquifers in the ravine mentioned in the township to the east, is moderately soft water. The water from some of the shallow wells, however, is too highly mineralized to be used for domestic purposes, but it is usable for stock. The supply from most of these wells is sufficient for only 15 or 20 head of stock, and some of the wells yield even smaller supplies.

Wells sunk to depths of 45 to 83 feet obtain water from pockets of sand or gravel located in the lower part of the glacial drift. One of these wells, located in the NE. $\frac{1}{4}$, section 33, is sunk to a depth of 83 feet and yields soft water, but the depth to the aquifer is not known. The water from the other wells is hard, commonly under hydrostatic pressure, highly mineralized, and that from approximately half the wells cannot be used for drinking, but is suitable for stock. The supply from these deeper wells is fairly abundant and only two are reported to yield insufficient supplies. Several of them yield enough water for 50 to 100 head of stock. The aquifers do not appear to be continuous, however, as dry holes have been sunk to a maximum depth of 100 feet.

Two wells located in sections 9 and 30, drilled to depths of 200 and 186 feet, respectively, are believed to be obtaining water from the Marine Shale series. The aquifers occur at elevations of approximately 1,630 feet above sea-level, but it is not known if they tap a common water-bearing horizon. The water is hard and suitable for domestic purposes or stock. One of these wells yields a good supply of water, but the other one has caved in and is no longer in use. Drilling into the bedrock,

however, is not advised.

It should not be difficult to locate a moderate supply of water in this township. Test augers should be used to locate a water-bearing deposit in the upper part of the drift prior to digging a shallow well. The deposits of sand and gravel appear to be fairly numerous at depths of 45 to 60 feet. Deep drilling, however, is not advised.

Township 21, Range 25

Arm river flows in a southeasterly direction across the northeastern half of this township, and it has cut a valley slightly more than 100 feet deep. Moraine covers the greater part of the township, but glacial till or boulder clay mantles the river banks in the northern part of the township and an area up to 2½ miles in width in the southeastern corner. Glacial outwash sands and gravels overlie the glacial till in parts of sections 1, 2, 10, and 11. The moraine-covered area is extremely rough, especially south of the river where numerous coulées 10 to 40 feet deep run in a southeasterly direction. The soil is very stony and gravelly, and is not very suitable for cultivation. The ground surface to the north of the river is not so rough as that to the south, but the soil is quite light. Only about half of the land is under cultivation, the remainder being used as pasture land and for the production of hay.

A few springs occur in sections 1, 2, 14, 18, 20, and 22, and yield good supplies of water. The wells in this area are usually not more than 30 feet deep and tap pockets of sand and gravel in the weathered zone of the drift. Most of the wells are from 5 to 15 feet deep and do not appear to tap continuous deposits, especially north of the river where several dry holes and wells yielding small supplies are located. The shallower wells yield fairly abundant supplies of water and in sections 22 and 30 the

water is under sufficient pressure to rise above the surface. The deeper wells do not yield as large a supply. The Canadian Pacific Railway Company tested the spring in the SE. ¼, section 1, but it did not yield a sufficient supply for their requirements. The company obtains an adequate supply from a 14-foot flowing artesian well in the SE. ¼, section 22. Good supplies of water are also being obtained at Findlater at depths of 7 to 10 feet, although one-half mile south of this village only very poor supplies are obtained, at a depth of 32 feet. The water from the springs and shallow wells varies from soft, to hard and "alkaline", and that from some wells cannot be used for domestic purposes, but is usable for stock.

Three wells derive water at depths of 40 and 50 feet, but only the 50-foot well in section 24 yields an adequate supply of water. The other wells, located in sections 5 and 31, yield sufficient water for not more than 5 head of stock. The water is hard and suitable for domestic purposes and stock, although that from the 50-foot well is slightly "alkaline". Dry holes have been sunk to a maximum depth of 107 feet and water-bearing deposits are very scarce in the lower part of the drift.

The best method of increasing the supply in this township is to conserve surface water by constructing dams across some of the coulées or ravines. The top soil may be too porous to use dugouts, but in those areas where the soil is composed of clay their excavation is recommended. Prior to digging shallow wells the water-bearing deposits should be located with a small test auger.

Township 21, Range 26

The surface of this township is rough and hilly, and with the exception of a small, glacial, till-covered area in parts of sections 34 and 35, is mantled by moraine. The northern

part of the moraine-covered area is cut by a number of ravines that extend in a northwest to southeast direction. The surface is characterized by numerous prominent knolls and undrained depressions. One of the hills, located in section 5, attains an elevation of 2,000 feet above sea-level, the maximum elevation in the township. The soil is very light and is not suitable for cultivation, and during the recent drought period many farmers were forced to abandon their farms.

The supply of water in this township is obtained from wells, sloughs, and dugouts. Wells sunk to depths of 6 to 30 feet derive water from sand and gravel beds encountered chiefly in the yellow boulder clay. The sand deposits are apparently small as none of these wells yields more than sufficient water for 50 head of stock, and some of them yield only 1 to 2 barrels of water a day. Where a shortage is obtained, sloughs are commonly used to water the stock and the wells are used merely as a source of domestic supply. Dugouts have also been excavated on some of the farms, and if these reservoirs are made at least 12 feet deep they will retain sufficient water to supply the stock throughout the greater part of the year. The water from the wells, with the exception of one located in the NW. $\frac{1}{4}$, section 3, is hard, but it is usable for domestic purposes as well as for stock.

Three wells have been sunk to depths of 35, 40, and 46 feet, and obtain hard water, which in two of them is "alkaline", and under hydrostatic pressure. The water from the well located in the SE. $\frac{1}{4}$, section 2, is too strongly "alkaline" for domestic use. Two of these wells are reported to yield approximately 20 barrels of water a day.

No wells have been sunk to depths greater than 46 feet in this township, and the possibilities of obtaining water in

the lower part of the drift and in the underlying bedrock are not known. Small supplies are apparently obtainable in the upper 30 feet of the drift, but as the aquifers are formed by scattered pockets of sand or gravel they should be located by a small test auger prior to the sinking of wells. Scattered water-bearing deposits are also present at depths of 30 to 46 feet, but as only three wells have been sunk to this depth sufficient information is not at hand to permit the outlining of any aquifers.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF DUFFERIN, NO. 190, SASKATCHEWAN

West of 2nd meridian	Township / Range	19 / 23	19 / 24	19 / 25	19 / 26	20 / 23	20 / 24	20 / 25	20 / 26	21 / 22	21 / 23	21 / 24	21 / 25	21 / 26	Total No. in municipality
Total No. of Wells in Township		58	102	34	0	81	66	44	30	2	166	45	89	13	730
No. of wells in bedrock		2	0	0	0	0	0	0	0	0	5	2	0	0	9
No. of wells in glacial drift		56	102	34	0	81	66	44	30	2	161	43	89	13	721
No. of wells in alluvium		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply															
No. with permanent supply		55	51	29	0	73	53	26	29	1	74	37	33	13	474
No. with intermittent supply		0	5	0	0	1	0	6	0	0	8	2	3	0	25
No. dry holes		3	46	5	0	7	13	12	1	1	84	6	53	0	231
Types of Wells															
No. of flowing artesian wells		0	0	0	0	0	0	0	0	0	0	0	2	0	2
No. of non-flowing artesian wells		17	3	5	0	19	28	6	3	0	6	14	3	3	107
No. of non-artesian wells		38	53	24	0	55	25	26	26	1	76	25	31	10	390
Quality of Water															
No. with hard water		53	49	28	0	74	50	31	29	1	75	31	34	12	467
No. with soft water		2	7	1	0	0	3	1	0	0	7	8	2	1	32
No. with salty water		1	0	0	0	0	0	0	0	0	0	0	0	0	1
No. with "alkaline" water		8	8	8	0	9	19	7	8	0	8	8	3	5	91
Depths of Wells															
No. from 0 to 50 feet deep		47	81	33	0	67	53	38	29	1	159	34	65	13	620
No. from 51 to 100 feet deep		9	21	1	0	14	13	6	1	1	6	9	23	0	104
No. from 101 to 150 feet deep		0	0	0	0	0	0	0	0	0	0	0	1	0	1
No. from 151 to 200 feet deep		0	0	0	0	0	0	0	0	0	0	2	0	0	2
No. from 201 to 500 feet deep		1	0	0	0	0	0	0	0	0	1	0	0	0	2
No. from 501 to 1,000 feet deep		1	0	0	0	0	0	0	0	0	0	0	0	0	1
No. over 1,000 feet deep		0	0	0	0	0	0	0	0	0	0	0	0	0	0
How the Water is Used															
No. usable for domestic purposes		45	55	27	0	72	49	31	27	1	76	35	36	11	465
No. not usable for domestic purposes		10	1	2	0	2	4	1	2	0	6	4	0	2	34
No. usable for stock		55	56	29	0	72	53	32	29	1	81	39	36	13	496
No. not usable for stock		0	0	0	0	2	0	0	0	0	1	0	0	0	3
Sufficiency of Water Supply															
No. sufficient for domestic needs		55	50	29	0	73	53	26	29	1	73	37	33	13	472
No. insufficient for domestic needs		0	6	0	0	1	0	6	0	0	9	2	3	0	27
No. sufficient for stock needs		27	16	17	0	19	32	11	19	1	48	21	25	7	243
No. insufficient for stock needs		28	40	12	0	55	21	21	10	0	34	18	11	6	256

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 Dufferin, No. 190, Saskatchewan

LOCATION						Depth of well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1		24	20	24	2	35	746											3	1		2		4		5	* 1
2	NW.	36	20	26	2	47	3,260												2		3	4	1	5		* 1
3	NE.	16	21	23	2	27	260											1	4	3					2	* 1
4	SE.	34	21	23	2	31	1,446												2		3	4	1	5		* 1
5		34	21	23	2	24	1,746												2		3	4	1	5		* 1

Water samples indicated thus, * 1, are from glacial drift.
Analyses are reported in parts per million; where number (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.
Analyses Nos. 1, 2, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Five samples of water from the glacial drift were analysed by the Provincial Analyst, Regina, and the results are listed on the accompanying table. These samples were taken from wells that tap water-bearing deposits at depths of 24 to 47 feet. The water from these depths varies greatly and the total dissolved solid content of the samples analysed ranges from 260 to 3,260 parts per million. With the exception of sample 2, the waters analysed are suitable for all general farm needs. The water represented by sample 2 is usable for stock, but will probably act as a slight laxative if used for drinking. Sodium sulphate (Glauber's salt), calcium sulphate, magnesium sulphate, sodium carbonate, and sodium chloride are the most predominant mineral salts present in most of the waters, and their abundance decreases in the order given. Wells that tap large pockets of sand or gravel, or extensive deposits of outwash sand and gravel, yield slightly mineralized water. Wells that tap small deposits of sand and gravel yield water that is highly mineralized. The clay contains a greater amount of soluble salts than do sand or gravel, and water that comes into contact with the clay usually contains a relatively large amount of mineral salts in solution. The time in which the water remains in contact with the clay, and the rate of movement of the water affects the amount of mineral salts taken into solution. The water from most of the wells tapping aquifers in the glacial drift of this municipality is as a rule usable for drinking as well as for stock. Of the 499 wells reported in this area 465 are usable for domestic purposes, and 496 yield water that is suitable for stock. A few wells yield moderately soft water, particularly those located in a coulée in the northern part of township 21, range 23. As a rule the water from the deeper wells is more

highly mineralized than that from the shallower wells. The waters from the drift may contain small amounts of iron, but it can be almost totally removed by aerating and filtering the water.

Water from the Bedrock

No samples of water from the bedrock were analysed. Most of the water assumed to be derived from the Marine Shale series in this area is hard. One well located in the NE. $\frac{1}{4}$, sec. 33, tp. 21, range 24, however, yields moderately soft water. The water from a well in the NE. $\frac{1}{4}$, sec. 19, tp. 21, range 23, is not usable for drinking, and that from a 600-foot well in the NE. $\frac{1}{4}$, sec. 25, tp. 19, range 23, was reported to have been analysed by the Provincial Analyst and pronounced unfit for use. The predominant mineral salts in solution are probably sodium sulphate, magnesium sulphate, sodium chloride, and sodium carbonate. Any water derived from the bedrock in this area will probably be too highly mineralized for domestic needs, but it may be suitable for stock.

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WELL RECORDS—Rural Municipality of DUFFERIN, NO. 190, 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	SE.	2	19	23	2	Dug	22	1,850	- 20	1,830	20	1,830	Glacial sand	Soft, clear	40	D, S	Sufficient for local needs; also a dugout and a 6-foot seepage well.
2	NE.	2	"	"	"	Bored	40	1,830	- 10	1,820			Glacial gravel	Hard, clear, iron	42	S	Sufficient for local needs; also a 20-foot well for drinking.
3	NW.	3	"	"	"	Dug	65	1,900	- 59	1,841	59	1,841	Glacial sand	Hard, clear	40	D, S	Insufficient supply; also a similar well and a spring; several shallow wells.
4	NE.	4	"	"	"	Dug	70	1,900	- 55	1,845	55	1,845	Glacial sand	Hard, clear, "alkaline", iron		D, S	Insufficient supply; also a 60-foot well with laxative water.
5	SW.	4	"	"	"	Dug	18	1,900	- 8	1,892			Glacial sand	Hard, clear		D, S	Insufficient for local needs; numerous shallow wells.
6	SW.	6	"	"	"	Bored	45	1,910	- 25	1,885	45	1,805	Glacial sand	Hard, clear		D, S	Sufficient for local needs; also a similar well.
7	NE.	10	"	"	"	Bored	50	1,850	- 13	1,837	50	1,800	Glacial gravel	Hard, clear		D, S	Sufficient for local needs; also a shallow well in coulée.
8	SE.	11	"	"	"	Bored	26	1,850	- 14	1,836	26	1,824	Glacial sand	Hard, clear		D, S	Insufficient for local needs; waters 30 head stock.
9	NW.	11	"	"	"	Dug	33	1,860	- 19	1,841	19	1,841	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also a 25-foot well.
10	SE.	12	"	"	"	Dug	25	1,800					Glacial drift	Hard, clear, iron		D, S	Sufficient for local needs; also a spring in ravine.
11	NW.	13	"	"	"	Dug	20	1,700	- 18	1,682	18	1,682	Glacial sand	Hard, clear		D	Sufficient for domestic use only; also 3 or 4 springs and an 85-foot well, poor supply.
12	NE.	18	"	"	"	Dug	40	1,870	- 28	1,842	40	1,830	Glacial gravel	Hard, iron, "alkaline", cloudy	45	D, S	Sufficient for 40 head stock.
13	NE.	20	"	"	"	Bored	50	1,850	- 47	1,803	47	1,803	Glacial drift	Hard, clear, iron		D, S	Insufficient for 60 head stock; use neighbour's well.
14	NW.	20	"	"	"	Bored	35	1,860	- 20	1,840	35	1,825	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs.
15	SW.	22	"	"	"	Dug	14	1,775	- 5	1,770	5	1,770	Glacial sand	Hard, clear, iron	41	D, S	Sufficient for 20 head stock.
16	NE.	25	"	"	"	Dug	56	1,810	- 33	1,777	56	1,754	Glacial drift	Hard, clear, iron		D, S	Sufficient for local needs; several wells; also a 300-foot well; poor supply.
17	NE.	25	"	"	"	Drilled	600	1,810					Marine shale series	Poisonous		N	
18	NW.	26	"	"	"	Dug	30	1,800	- 24	1,776	24	1,776	Glacial sand	Hard, clear, salty		N	Caving in, several dry holes; several wells in ravine; good yield.
19	SW.	28	"	"	"	Bored	50	1,800	- 38	1,762	38	1,762	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Insufficient for local needs.
20	NE.	30	"	"	"	Dug	32	1,825	- 17	1,808	32	1,793	Glacial gravel	Hard, clear		D, S	Sufficient for 25 head stock.
21	NW.	30	"	"	"	Bored	34	1,820	- 14	1,806	34	1,786	Glacial drift	Hard, clear, "alkaline"		D, S	Also a similar well.
22	NW.	32	"	"	"	Bored	40	1,800	- 20	1,780	40	1,760	Glacial drift	Hard, iron, "alkaline", cloudy		S	Sufficient for 35 head stock; also a similar well.
23	SE.	33	"	"	"	Bored	60	1,800	- 37	1,763	60	1,740	Glacial gravel	Hard, iron, brown		N	Also two 16-foot wells for stock; hauls drinking water.
24	SW.	34	"	"	"	Dug	18	1,810	- 12	1,798	12	1,798	Glacial sand	Hard, clear		D, S	Insufficient for local needs; three similar wells; similar well on the NE.¼, section ?.
25	SW.	36	"	"	"	Bored	60	1,810	- 40	1,770	60	1,750	Glacial gravel	Soft, clear		D, S	Insufficient for local needs; also a similar well and a 40-foot well.

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 DUFFERIN, NO. 190, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NE.	4	19	24	2	Dug	24	1,750	- 17	1,733	17	1,733	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs; also a seepage well on the SW.¼.
2	NW.	5	"	"	"	Dug	12	1,890	- 9	1,881	9	1,881	Glacial sand	Soft, clear		D, S	Sufficient for local needs; also a 30-foot well.
3	NE.	6	"	"	"	Bored	32	1,900	- 26	1,874	26	1,874	Glacial gravel	Hard, clear		D, S	Insufficient for local needs; also a 14-foot well.
4	SE.	7	"	"	"	Bored	34	1,900	- 32	1,868	32	1,868	Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
5	NW.	16	"	"	"	Dug	12	1,850	- 8	1,842	8	1,842	Glacial gravel	Hard, clear		D, S	Insufficient for local needs; 20-wells, deepest 55 feet, some are dry.
6	NE.	16	"	"	"	Dug	15	1,850	- 10	1,840	10	1,840	Glacial sand	Soft, clear, "alkaline", iron		D, S	Sufficient for local needs.
7	NE.	18	"	"	"	Dug	8	1,900	- 6	1,894	6	1,894	Glacial gravel	Soft, clear		D, S	Insufficient for local needs; also two similar wells.
8	SE.	19	"	"	"	Dug	24	1,870	- 20	1,850	20	1,850	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also an 8-foot well, good supply.
9	NE.	20	"	"	"	Bored	40	1,850	- 35	1,815	35	1,815	Glacial sand and gravel	Hard, clear		D, S	Insufficient for local needs; also a 21-foot well and a dam.
10	NW.	21	"	"	"		20	1,835					Glacial drift				Small supply.
11	NW.	22	"	"	"	Bored	50	1,860	- 48	1,812	48	1,812	Glacial sand	Hard, clear		D, S	Insufficient for local needs; 25 wells, deepest 90 feet, very poor supply.
12	NE.	24	"	"	"	Bored	35	1,830	- 33	1,797	33	1,797	Glacial drift	Hard, clear, iron		D, S	
13	SW.	25	"	"	"	Dug	47	1,850	- 22	1,828	22	1,828	Glacial gravel	Hard, cloudy, "alkaline"		D, S	Insufficient for local needs; hauls water and uses sloughs.
14	NE.	26	"	"	"	Dug	25	1,850	- 20	1,830	20	1,830	Glacial gravel	Soft, clear		D, S	Sufficient for 25 head stock; also use a dugout.
15		27	"	"	"	Bored	95	1,855	- 87	1,768	87	1,768	Glacial sand	Hard		S	Insufficient for local needs; has 11 dry holes 40 to 60 feet deep.
16	SW.	28	"	"	"	Dug	30	1,855									Several dry holes in glacial drift.
17	SW.	29	"	"	"		14	1,860					Glacial drift			D, S	Sufficient for 14 head stock.
18	SW.	30	"	"	"	Bored	45	1,875	- 41	1,834	41	1,834	Glacial gravel	Hard, clear, "alkaline"		D, S	Oversufficient for 12 head stock; also several dry holes.
19	SE.	33	"	"	"		90	1,860	- 15	1,845			Glacial drift			N	14 dry holes 80 to 90 feet deep.
20	NE.	33	"	"	"	Bored	38	1,860	- 22	1,838	38	1,822	Glacial sand	Hard, clear		D, S	Insufficient for local needs; 14 dry holes 80 to 90 feet deep.
21	NW.	33	"	"	"	Dug	34	1,850	- 32	1,818	32	1,818	Glacial gravel	Hard, clear		D, S	Insufficient supply; also 5 seepage wells and 8 dry holes; use a dugout.
22	NE.	34	"	"	"	Dug	35	1,850	- 34	1,816	34	1,816	Glacial sand	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs.
23	SW.	34	"	"	"	Dug	19	1,850	+ 12	1,838	12	1,838	Glacial drift	Hard, clear		D, S	Sufficient for local needs.
24	SW.	36	"	"	"	Bored	40	1,840	- 38	1,802	38	1,802	Glacial gravel	Hard, clear, "alkaline", iron		S	Insufficient for local needs.
25	SW.	36	"	"	"	Bored	32	1,840	- 17	1,823	17	1,823	Glacial drift	Hard, clear, iron		D, S	Insufficient for local needs; also a 22-foot well beside slough.
26	NW.	36	"	"	"	Bored	45	1,840	- 23	1,817	45	1,795	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also another well, good 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.

B 4-4
R. 7526

WELL RECORDS—Rural Municipality of DUFFERIN, NO. 190, 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.	12	19	25		Dug	14	1,900	- 7	1,893	7	1,893	Glacial sand	Hard, clear		D, S	Sufficient for 23 head stock.
2	SE.	12	"	"	"	Bored	45	1,900	- 29	1,871	29	1,871	Glacial drift	Hard, clear		D, S	Abundant supply.
3	SW.	13	"	"	"	Bored	16	1,900	- 6	1,894	6	1,894	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
4	SE.	13	"	"	"	Bored	50	1,890	- 30	1,860	50	1,840	Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for 40 head stock.
5	SW.	14	"	"	"	Bored	30	1,900	- 29	1,871	29	1,871	Glacial gravel	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
6	NW.	20	"	"	"	Bored	22	1,910	- 20	1,890	20	1,890	Glacial sand	Hard, clear		D, S	Sufficient for local needs; also a spring in valley.
7	NE.	22	"	"	"	Bored	22	1,890	- 15	1,875	15	1,875	Glacial gravel	Hard, clear, iron		D, S	Sufficient for 18 head stock.
8	SE.	22	"	"	"	Dug	30	1,905	- 24	1,881	24	1,881	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 25 head stock; also a well on the SW.¼.
9	SW.	24	"	"	"	Dug	28	1,890	- 18	1,872	18	1,872	Glacial drift	Soft, clear		D, S	Sufficient for 38 head stock.
10	NW.	24	"	"	"	Dug	30	1,885	- 27	1,858	27	1,858	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
11	SE.	24	"	"	"	Dug	20	1,885	- 15	1,870	15	1,870	Glacial sand	Hard, clear		D, S	Sufficient for 35 head stock.
12	SW.	27	"	"	"	Dug	30	1,900	- 16	1,884	16	1,884	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
13	SE.	27	"	"	"	Dug	15	1,895					Glacial drift				
14	NE.	28	"	"	"	Bored	50	1,900	- 33	1,867	50	1,850	Glacial sand and gravel	Hard, clear, iron		D, S	Sufficient for 40 head stock; also a 27-foot well.
15	NW.	28	"	"	"	Bored	62	1,910	- 20	1,890	62	1,848	Glacial sand	Hard, iron, "alkaline", cloudy		S	Sufficient for local needs; haul drinking water.
16	SE.	29	"	"	"	Dug	29	1,900	- 26	1,874	26	1,874	Glacial sand	Hard, clear, iron		D, S	Insufficient for local needs; also two dry holes.
17	NE.	30	"	"	"	Bored	35	1,900	- 27	1,873	27	1,873	Glacial sand	Hard, clear		D, S	Supply insufficient for local needs; also a similar well.
18	NE.	32	"	"	"	Bored	45	1,910	- 20	1,890	45	1,865	Glacial sand	Hard, clear		D, S	Abundant supply.
19	NW.	32	"	"	"	Bored	22	1,910	- 12	1,898	12	1,896	Glacial sand	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs; also another well and a dugout.
20	NE.	34	"	"	"	Bored	38	1,890	- 16	1,874	38	1,852	Glacial drift	Hard, clear		D, S	Sufficient for 25 head stock.
21	SW.	35	"	"	"	Bored	32	1,890	- 16	1,874	16	1,874	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs; several dry holes averaging 40 feet deep.
22	NW.	36	"	"	"	Bored	40	1,875	- 30	1,845	30	1,845	Glacial sand	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs; also two similar wells.
1	SW.	1	20	23	2	Bored	50	1,810	- 20	1,790	50	1,760	Glacial gravel	Hard, iron		D, S	Sufficient for local needs.
2	SW.	2	"	"	"	Bored	65	1,800									Several dry holes and some seepage wells.
3	NE.	3	"	"	"	Dug	17	1,800	- 12	1,788	12	1,788	Glacial gravel	Hard, clear		D, S	Sufficient for 30 head stock; other shallow wells.

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 DUFFERIN, NO. 190, SASKATCHEWAN

B 4-4
R. 7526

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
4	NW.	3	20	23	2	Bored	32	1,800	- 24	1,776	32	1,768	Glacial gravel	Hard, clear		D, S	Sufficient for 30 head stock; also two wells 7 and 37 feet deep.
5	SE.	4	"	"	"	Dug	10	1,800					Glacial sand			D, S	Sufficient for local needs; several wells in ravine, good yields.
6	SW.	5	"	"	"	Dug	15	1,800	- 10	1,790	10	1,790	Glacial gravel	Hard, clear		D, S	Sufficient for 17 head stock; also holes 30 to 40 feet deep.
7	SE.	6	"	"	"	Bored	44	1,810	- 24	1,786	44	1,766	Glacial sand	Hard, "alkaline", iron		D, S	Sufficient for 20 head stock.
8	SW.	6	"	"	"	Bored	40	1,820					Glacial drift	Hard, clear		D, S	Sufficient for local needs; also a 40-foot well not used.
9	NE.	7	"	"	"	Bored	65	1,810	- 42	1,768	65	1,745	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs; also an intermittent well on the SW.¼.
10	SE.	10	"	"	"	Bored	46	1,810	- 16	1,794	46	1,764	Glacial sand	Hard, clear		D, S	Insufficient for local needs; also a 60-foot dry hole.
11	NW.	10	"	"	"	Bored	45	1,810	- 35	1,775	35	1,775	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also two shallow wells and a dugout.
12	SW.	11	"	"	"	Dug	15	1,810					Glacial drift			D, S	Intermittent supply; also a 35-foot well; poor supply.
13	NW.	12	"	"	"	Bored	60	1,810	- 25	1,785	60	1,750	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 50 head stock; also a shallow well on the NE.¼.
14	SE.	13	"	"	"	Bored	60	1,800	- 25	1,775	60	1,740	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 50 head stock.
15	NW.	15	"	"	"	Bored	47	1,810					Glacial drift				Good supply.
16	SE.	16	"	"	"	Bored	47	1,810	- 17	1,793	47	1,763	Glacial drift	Hard, clear, "alkaline", iron		D, S	Good supply; also a number of shallow wells, and two 50-and 60-foot deep.
17	SW.	17	"	"	"	Bored	45	1,820	- 32	1,788	45	1,775	Glacial gravel	Hard, clear		D, S	Insufficient for local needs; also two wells 40 and 75 feet deep, poor water.
18	SE.	18	"	"	"	Bored	70	1,820					Glacial drift				Good supply.
19	NE.	19	"	"	"	Bored	45	1,830	- 25	1,805	45	1,785	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
20	SW.	19	"	"	"	Bored	45	1,830	- 5	1,825			Glacial clay	Hard, clear, iron		D, S	Insufficient supply; hauls water.
21	NW.	19	"	"	"	Bored	70	1,830	- 50	1,780	70	1,760	Glacial sand	Hard, clear, iron		D, S	Insufficient for local needs; 15 wells, maximum depth 25 feet, poor supply.
22	SE.	20	"	"	"	Bored	60	1,820	- 45	1,775	45	1,775	Glacial drift	Hard, claar, iron		D, S	Insufficient for local needs; also 75-foot dry hole, similar well in the NW.¼.
23	SW.	21	"	"	"	Bored	53	1,820	- 23	1,797	53	1,767	Glacial gravel	Hard, clear, iron		D, S	
24	SE.	22	"	"	"	Dug	50	1,810	- 34	1,776	50	1,760	Glacial drift	Hard, clear, "alkaline"		S	Insufficient supply; several 20-foot wells; hauls water and uses Arm River.
25	NW.	22	"	"	"	Bored	50	1,810	- 15	1,795	50	1,760	Glacial drift	Hard, clear		D, S	Abundant supply; several shallow wells.
26	NE.	23	"	"	"			1,800									Several seepage wells.
27	SE.	25	"	"	"		40	1,800									Dry hole, base in glacial drift; also 10-foot seepage well.
28	SW.	30	"	"	"	Bored	56	1,830	- 46	1,784	46	1,784	Glacial sand	Hard, iron		D, S	Insufficient for local needs.
29	NW.	30	"	"	"		50	1,810									Dry hole base in glacial drift.
30	NE.	30	"	"	"		35	1,750					Glacial drift				Fair 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 DUFFERIN, NO. 190, 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
31	NW.	31	20	23	2	Bored	45	1,850	- 35	1,815	35	1,815	Glacial drift	Hard, clear, iron		D, S	Sufficient for 20 head stock.
32	NE.	32	"	"	"	Bored	85	1,810									Dry hole, base in glacial drift; numerous wells, deepest 45 feet, poor supply.
33	NW.	32	"	"	"	Bored	40	1,800									
1	SW.	1	20	24	2	Bored	28	1,840	- 10	1,830	28	1,812	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
2	NW.	1	"	"	"	Bored	40	1,840	- 32	1,808	32	1,808	Glacial gravel	Hard, clear, "alkaline"		D, S	
3	SW.	2	"	"	"	Dug	31	1,850	- 16	1,834	31	1,819	Glacial drift	Hard, clear		D, S	Sufficient for local needs.
4	NE.	2	"	"	"	Bored	44	1,850					Glacial drift	Hard, clear		D, S	Sufficient for local needs.
5	SE.	3	"	"	"	Dug	48	1,850	- 47	1,803	47	1,803	Glacial drift	Hard, clear, iron		D, S	Insufficient for local needs; also a 38-foot well and a dugout.
6	SW.	3	"	"	"	Dug	11	1,850	- 7	1,843	7	1,843	Glacial drift	Hard, clear			
7	NE.	4	"	"	"	Bored	60	1,850	- 12	1,838	60	1,790	Glacial drift	Hard, clear, iron		D, S	Sufficient for 37 head stock; also two wells 72 and 45 feet deep.
8	SE.	5	"	"	"	Dug	18	1,850	- 15	1,835	15	1,835	Glacial sand	Soft, clear		S, D	Sufficient for local needs.
9	SE.	6	"	"	"	Bored	54	1,860	- 15	1,845	54	1,806	Glacial gravel	Hard, clear, iron		D, S	Abundant supply.
10	NE.	7	"	"	"	Bored	40	1,850	- 30	1,820	30	1,820	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs; also a 25-foot well,
11	NW.	7	"	"	"	Bored	28	1,860	- 12	1,848	28	1,832	Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs; also two similar wells.
12	SE.	12	"	"	"	Bored	35	1,830	- 23	1,807	35	1,795	Glacial drift	Hard, clear, iron		D, S	Sufficient for 20 head stock
13	NE.	12	"	"	"		50	1,825									Several dry holes.
14	SW.	12	"	"	"	Bored	50	1,825	- 20	1,805	50	1,775	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
15	SW.	13	"	"	"	Bored	45	1,825	- 25	1,800	45	1,780	Glacial sand	Hard, clear, iron		D, S	Sufficient for 25 head stock.
16	SW.	14	"	"	"	Bored	53	1,830	- 40	1,790	53	1,777	Glacial drift	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs.
17	SE.	15	"	"	"		50	1,830	- 14	1,816	34	1,796	Glacial drift				
18	SE.	16	"	"	"	Bored	40	1,840	- 24	1,816	40	1,800	Glacial gravel	Hard, "alkaline"		D, S	Sufficient for 23 head stock; also two dry holes 42 and 40 feet deep.
19	SE.	17	"	"	"	Bored	28	1,850	- 27	1,823	27	1,823	Glacial gravel	Soft, clear		D, S	Insufficient supply; 44-foot well also used; two wells 28 and 33 feet; 14-foot dry hole.
20	SE.	18	"	"	"	Bored	40	1,855	- 33	1,822	33	1,822	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Insufficient supply; has a dugout.
21	NE.	18	"	"	"	Bored	31	1,850	- 21	1,829	21	1,829	Glacial drift	Hard, clear		D,S	Insufficient supply; has a dugout.
22	SE.	20	"	"	"	Bored	40	1,840	-35	1,805	35	1,805	Glacial drift	Hard, clear, "alkaline", iron		D, S	Insufficient 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 DUFFERIN, NO. 190, SASKATCHEWAN,

B 4-4
R. 7526

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED: Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
23	SE.	21	20	24	2	Bored	45	1,840	- 25	1,815	45	1,795	Glacial gravel	Hard, iron, "alkaline"		D,S	Sufficient for 25 headstock; also a dugout.
24	NE.	21	"	"	"	Dug	38	1,825	- 28	1,797	38	1,787	Glacial gravel	Hard, iron, "alkaline"		D, S	
25	NW.	21	"	"	"	Bored	38	1,825					Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for 18 head stock.
26	SE.	22	"	"	"	Bored	60	1,825	- 30	1,795	60	1,765	Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for 25 head stock.
27	NE.	23	"	"	"	Bored	62	1,820	- 40	1,780	62	1,758	Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for 14 head stock; also 65-foot well; 5 dry holes, deepest 72 feet.
28	NE.	23	"	"	"	Bored	18	1,820					Glacial sand	Hard, clear		D, S	Sufficient for local needs.
29		24	"	"	"		35	1,830	- 25	1,805			Glacial drift	Hard, cloudy		D, S	#.
30	SE.	25	"	"	"	Bored	40	1,810	- 20	1,790	40	1,770	Glacial drift	Hard, clear, iron		D, S	Sufficient for 50 head stock.
31	NW.	25	"	"	"	Bored	40	1,820	- 25	1,795	40	1,780	Glacial gravel	Hard, clear, iron		D	Several similar wells.
32	NW.	25	"	"	"	Bored	35	1,800	- 15	1,785	35	1,765	Glacial drift	Hard, clear, "alkaline"		S	Abundant supply.
33	SE.	26	"	"	"	Dug	20	1,810	- 10	1,800	20	1,790	Glacial sand	Hard, clear, "alkaline", iron		D, S	Sufficient for 15 head stock.
34	NE.	27	"	"	"	Dug	45	1,810	- 30	1,780	45	1,765	Glacial sand	Hard, clear, "alkaline"		D, S	
35	NW.	28	"	"	"	Bored	60	1,820	- 40	1,780	60	1,760	Glacial drift	Hard, clear, "alkaline"		D,S	Sufficient for 50 head stock.
36	SE.	30	"	"	"	Bored	60	1,840	- 20	1,820	60	1,780	Glacial sand	Hard, clear		S	Insufficient for local needs; also a 39-foot well for domestic use.
37	SW.	30	"	"	"		6	1,845					Glacial drift				
38	SE.	31	"	"	"	Bored	60	1,840					Glacial drift				
39	NE.	32	"	"	"	Bored	60	1,810	- 30	1,780	60	1,750	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also a 5-foot well; abundant supply.
40	SW.	32	"	"	"	Bored	45	1,825	- 28	1,797	45	1,780	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Oversufficient for 25 head stock; also a 10-foot well.
41	SW.	34	"	"	"	Bored	62	1,810	- 45	1,765	62	1,748	Glacial sand	Hard, clear, iron		D, S	Insufficient for local needs; 12-foot well for house, also use river. Water stock at river. Four dry holes.
42	SE.	36	"	"	"			1,675									
1	NW.	1	20	25	2	Bored	53	5 1,875	- 28	1,847	53	1,822	Glacial sand	Hard, iron, cloudy		D, S	Sufficient for local needs.
2	SW.	4	"	"	"	Dug	20	1,900	- 16	1,884	16	1,884	Glacial drift	Hard, clear		D, S	Sufficient for local needs.
3	SE.	6	"	"	"	Bored	38	1,920	- 18	1,902	38	1,882	Glacial sand	Hard, clear		D, S	Sufficient for local needs; also a 28-foot well, small supply.
4	SW.	6	"	"	"	Dug	18	1,930	- 12	1,918	12	1,918	Glacial gravel	Hard, clear		D, S	Insufficient for 18 head stock.
5	NW.	6	"	"	"	Dug	45	1,910	- 32	1,878	45	1,865	Glacial gravel	Hard, clear, iron		D, S	Sufficient for local needs; also a number of 30-foot intermittent wells.

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 DUFFERIN, NO. 190, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
6	SE.	18	20	25	2	Dug	43	1,910	- 31	1,879	43	1,867	Glacial gravel	Hard, iron		D, S	Sufficient for local needs; also a number of intermittent wells.
7	NW.	18	"	"	"	Bored	53	1,910	- 42	1,868	53	1,857	Glacial sand	Hard, clear, iron		S	Sufficient for local needs.
8	SW.	19	"	"	"	Bored	27	1,910	- 15	1,895	27	1,883	Glacial sand	Soft, clear		D, S	Sufficient for 20 head stock.
9	SW.	20	"	"	"	Bored	60	1,900									Several dry holes 20 to 60 feet deep; use a dugout and haul water.
10	SW.	24	"	"	"	Bored	33	1,860	- 15	1,845	15	1,845	Glacial gravel	Hard, "alkaline"		D, S	Insufficient for local needs; 6 dry holes deepest 68 feet; several wells 28 to 68 feet deep; poor supply.
11	SE.	25	"	"	"	Dug	40	1,845	- 22	1,823	40	1,805	Glacial drift	Hard, clear, "alkaline"		D, S	Insufficient for local needs; several shallow holes, some dry.
12	NE.	25	"	"	"	Bored	36	1,850	- 18	1,832	18	1,832	Glacial drift	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
13	SE.	26	"	"	"	Dug	12	1,860	- 6	1,854	6	1,854	Glacial sand	Soft, clear		D, S	Sufficient for local needs.
14	SE.	30	"	"	"	Dug	60	1,900	- 50	1,850	50	1,850	Glacial drift	Hard, clear, "alkaline"		D	Supply insufficient for local needs; also a dugout and a 60-foot dry hole.
15	SW.	32	"	"	"	Dug	12	1,890					Glacial drift				Good supply.
16	NE.	34	"	"	"	Bored	32	1,880	- 24	1,856	24	1,856	Glacial sand	Hard, clear, iron		D, S	Insufficient for local needs; also three similar wells; also use a slough.
17	NW.	36	"	"	"	Bored	60	1,850	- 58	1,792	58	1,792	Glacial drift	Hard, "alkaline"		S	Insufficient for local needs; also a 14-foot well on the NE.¼, good supply.
1	NE.	2	20	26	2	Dug	22	1,920	- 17	1,903	17	1,903	Glacial drift	Hard, clear		D, S	Oversufficient for local needs.
2	SE.	10	"	"	"	Dug	16	1,900	- 10	1,890	10	1,890	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
3	NE.	10	"	"	"	Dug	12	1,925	- 9	1,916	9	1,916	Glacial drift	Hard, clear		D, S	Oversufficient for local needs.
4	SE.	12	"	"	"	Bored	35	1,930	- 20	1,910	35	1,895	Glacial drift	Hard, clear,		D, S	Oversufficient for local needs.
5	SW.	14	"	"	"	Bored	52	1,920	- 30	1,890	30	1,890	Glacial gravel	Hard, cloudy, "alkaline"		S, D	Yields 2 tanks a day.
6	NE.	14	"	"	"	Dug	24	1,900	- 16	1,884	16	1,884	Glacial gravel	Hard, clear		D, S	Oversufficient for local needs; had a 25-foot well, now filled in.
7	SE.	16	"	"	"	Bored	30	1,875					Glacial drift	Hard, clear		D, S	Sufficient for local needs.
8	NW.	16	"	"	"	Dug	27	1,950	- 24	1,926	24	1,926	Glacial drift	Hard, clear, "alkaline"		D, S	Yields 2 barrels a day; additional supply from lake.
9	NE.	23	"	"	"	Dug	28	1,930	- 20	1,910	28	1,902	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 12 head stock; also a similar well and seepage well.
10	SE.	24	"	"	"	Bored	60	1,915	- 40	1,875	60	1,855	Glacial drift	Hard, clear, iron		D, S	Yields 20 barrels a day.
11	NW.	24	"	"	"	Bored	32	1,910	- 24	1,886	24	1,886	Glacial clay	Hard, clear, "alkaline"		D	Sufficient for domestic needs only; also a 41-foot well not used.
12	NE.	24	"	"	"	Bored	20	1,915	- 15	1,900	15	1,900	Glacial drift	Hard, clear		D, S	Small supply, not used now.
13	NE.	25	"	"	"	Bored	42	1,920	- 27	1,893	27	1,893	Glacial drift	Hard, clear, iron		D, S	Very poor supply.
14	NW.	26	"	"	"	Dug	20	1,925	- 15	1,910	15	1,910	Glacial sand	Soft, clear		D, S	Yields 4 barrels a day; also a 30-foot dry hole.
15	SE.	27	"	"	"	Dug	18	1,940	- 15	1,925	15	1,925	Glacial sand	Hard, clear, "alkaline"		D, S	Yields 1 tank a day; also a similar 24-foot well.

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 DUFFERIN, NOL 190, 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
1o	NW.	27	20	26	2	Bored	20	1,950	- 18	1,932	18	1,932	Glacial gravel	Hard, clear		D, S	Sufficient for 20 head stock.
17	SE.	28	"	"	"	Dug	24	1,950	- 22	1,928	22	1,928	Glacial gravel	Hard, clear		D, S	Yields 5 barrels a day.
18	NW.	28	"	"	"	Dug	25	1,950	- 23	1,927	23	1,927	Glacial gravel	Hard, clear		D, S	Yields 5 barrels a day.
19	SE.	32	"	"	"	Dug	22	1,940	- 15	1,925	15	1,925	Glacial sand	Hard, clear		D, S	Yields 5 barrels a day.
20	SW.	32	"	"	"	Dug	18	1,925	- 16	1,909	16	1,909	Glacial sand	Hard, clear		D, S	Yields 2 tanks a day.
21	NE.	32	"	"	"	Dug	22	1,940	- 8	1,932	8	1,932	Glacial gravel	Hard, clear		D, S	Yields 10 barrels a day.
22	SE.	34	"	"	"	Dug	26	1,950					Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for 8 head stock.
23	NW.	34	"	"	"	Dug	25	1,925	- 17	1,908	17	1,905	Glacial clay	Hard, clear, "alkaline"		S	Insufficient for local needs; also a seepage well.
24	SW.	35	"	"	"	Dug	24	1,950	- 18	1,932	18	1,932	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 30 head stock.
25	NW.	36	"	"	"	Bored	35	1,900	- 27	1,873	27	1,873	Glacial sand	Hard, clear		D	Yields 1 barrel a day; also a 47-foot well, poor quality water; #.
1	SE.	7	21	22	2	Spring		1,640					Glacial drift	Hard, clear		D, S	Good flow.
2	NW.	7	"	"	"	Bored	60	1,735									Dry hole base in glacial drift.
1	SW.	1	21	23	2	Dug	13	1,760	- 11	1,749	11	1,749	Glacial gravel	Hard, clear		D, S	Intermittent supply; also a 6-foot well and a slough.
2	NW.	1	"	"	"	Dug	21	1,765	- 19	1,746	19	1,746	Glacial clay	Hard, clear		D	Intermittent supply; also a spring.
3	SE.	1	"	"	"	Spring		1,640					Glacial gravel	Hard, clear		D, S	Several springs here good flow.
4	SE.	2	"	"	"		13	1,755					Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
5	NW.	2	"	"	"	Dug	7	1,760	- 4	1,756	4	1,756	Glacial sand	Hard, clear		D, S	Sufficient for 20 head stock; several 20-foot dry holes.
6	NE.	4	"	"	"	Bored	39	1,765	- 34	1,731	34	1,731	Glacial sand	Hard, clear		D, S	Insufficient for 10 head stock.
7	SW.	4	"	"	"	Dug	12	1,800	- 10	1,790	10	1,790	Glacial sand	Hard, clear		D, S	Sufficient for 50 head stock.
8	NW.	6	"	"	"	Dug	12	1,800	- 6	1,794	6	1,794	Glacial gravel	Soft, clear		D, S	Abundant supply; also several 30-foot dry holes.
9	SE.	7	"	"	"	Dug	21	1,800					Glacial drift	Hard, clear		D, S	Intermittent supply; also a 31-foot well and use lake.
10	NE.	7	"	"	"	Dug	37	1,790	- 24	1,766	37	1,753	Glacial sand	Hard, clear		D, S	Sufficient for local needs; also a spring; good flow.
11	NW.	7	"	"	"	Dug	30	1,800	- 25	1,775	25	1,775	Glacial sand	Hard, clear		D, S	Sufficient for 30 head stock; also a 10-foot well, fair supply.
12	NE.	9	"	"	"	Bored	60	1,790									Dry hole, base probably bedrock.
13	NE.	9	"	"	"	Dug	14	1,790	- 10	1,780	10	1,780	Glacial sand	Soft		D, S	Sufficient for 40 head stock; also a similar well.
14	NW.	9	"	"	"	Dug	26	1,770	- 18	1,752	18	1,752	Glacial sand	Hard, clear, iron		S	Sufficient for 30 head stock; also a similar well.
15	SE.	10	"	"	"	Dug	10	1,760	- 4	1,756	4	1,756	Glacial sand	Soft, clear		D, S	Sufficient for 50 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 DUFFERIN, NO. 190, 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	NE.	10	21	23	2	Bored	28	1,700	- 14	1,746	14	1,746	Glacial sand	Hard, clear		D, S	Sufficient for 18 head stock; also another well quite "alkaline" water.
17	SW.	10	"	"	"	Bored	30	1,790	- 18	1,772	18	1,772	Glacial sand	Hard, clear, iron		D, S	Insufficient for 10 head stock; also a 40-foot dry hole.
18	NW.	10	"	"	"	Dug	39	1,780									Dry hole, base in glacial drift, several othe shallow dry holes; also an 18-foot intermittent well.
19	NE.	12	"	"	"	Dug	14	1,735	- 9	1,726	9	1,726	Glacial gravel	Hard, clear		D, S	Sufficient for 20 head stock.
20	SW.	12	"	"	"	Dug	8	1,755	- 4	1,751	4	1,751	Glacial sand	Hard, clear		D, S	Sufficient for local needs; also several dry holes, deepest 50 feet.
21	NE.	13	"	"	"	Dug	29	1,760									Dry hole, base in glacial drift; uses a sprin and lake water.
22	SE.	14	"	"	"	Bored	90	1,765									Dry hole, probably in bedrock.
23	SE.	14	"	"	"	Dug	26	1,765	- 24	1,741	24	1,761	Glacial sand	Soft, clear		D	Intermittent supply.
24	SW.	14	"	"	"	Dug	26	1,765					Glacial gravel and sand	Clear		D, S	Sufficient for 60 head stock.
25	NE.	14	"	"	"	Bored	38	1,760	- 22	1,738	22	1,738	Glacial sand	Hard, clear		D, S	Several shallow wells, water stock at lake.
26	SE.	16	"	"	"	Bored	60	1,785									Dry hole, base probably bedrock; 60 dry holes 30 to 40 feet deep.
27	NE.	16	"	"	"	Dug	27	1,790	- 25	1,765	25	1,765	Glacial gravel and sand	Hard, clear		D, S	Sufficient for local needs; #. Several wells good supply.
28	NW.	16	"	"	"	Dug	25	1,780	- 22	1,758	22	1,758	Glacial gravel	Soft, clear		D, S	Sufficient for 40 head stock; also another good well.
29	SE.	18	"	"	"	Dug	40	1,790	- 35	1,755	35	1,755	Glacial gravel	Hard, Clear, iron		D, S	Sufficient for 25 head stock; also a similar 38-foot well.
30	NE.	18	"	"	"	Bored	30	1,790	- 28	1,762	28	1,762	Glacial sand	Hard, clear, "alkaline", iron		D, S	Insufficient for 50 head stock; also two othe 30-foot wells.
31	NW.	18	"	"	"	Bored	31	1,810	- 28	1,782	28	1,782	Glacial sand	Hard, clear, iron		D, S	Sufficient for 10 head stock; also a dry hole
32	NE.	19	"	"	"	Drilled	400	1,790	-100	1,690	400	1,390	Marine Shale, sand	Hard, clear, iron		S	Good supply, but sand cannot be kept out.
33	NE.	20	"	"	"	Dug	20	1,775	- 17	1,758	17	1,758	Glacial sand	Hard, clear		D, S	Insufficient for 14 head stock.
34	NE.	22	"	"	"	Bored	16	1,765	- 12	1,753	12	1,753	Glacial sand	Hard, clear, "alkaline", iron		S	Insufficient supply; several dry holes 35 feet deep.
35	NW.	22	"	"	"	Bored	39	1,770	- 25	1,745	25	1,745	Glacial sand	Hard, clear, iron		D, S	Sufficient for 40 head stock; other holes not used.
36	SW.	24	"	"	"	Dug	18	1,750	- 12	1,738	12	1,738	Glacial sand	Hard, "alkaline"		S	Intermittent supply; also a 60-foot well poor quality, haul water.
37	NW.	25	"	"	"	Dug	25	1,830	- 18	1,812	18	1,812	Glacial gravel	Hard, clear		D	Sufficient for local needs.
38	NW.	25	"	"	"	Dug	24	1,700	- 20	1,680	20	1,680	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for 15 head stock.
39	SE.	26	"	"	"	Dug	28	1,762									Dry hole, base in glacial drift; also two other dry holes, use slough,
40	NW.	26	"	"	"	Dug	16	1,750	- 10	1,740	10	1,740	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 23 head stock; also a 16-foot well for stock.
41	SE.	28	"	"	"	Bored	60	1,700	- 20	1,740	60	1,700	Glacial drift	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs; numerous 25-foot wells,

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

WELL RECORDS—Rural Municipality of DUFFERIN, NO. 190, 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
42	NE.	28	21	23	2	Bored	55	1,700	- 15	1,745	50	1,700	Glacial sand	Hard, clear, iron		D, S	Sufficient for 50 to 100 head stock.
43	SW.	28	"	"	"	Spring	5	1,700					Glacial drift	Hard		D, S	Abundant supply.
44	SE.	29	"	"	"	Dug	35	1,770									Dry hole base in glacial drift; several dry holes and seepage wells.
45	SE.	30	"	"	"	Dug	37	1,750	- 34	1,716	34	1,716	Glacial drift	Hard, clear		D, S	Sufficient for 23 headstock; also a 48-foot well with "alkaline" water.
46	SW.	32	"	"	"	Dug	40	1,740	- 38	1,702	38	1,702	Glacial sand	Soft, clear		D, S	Sufficient for 20 head stock; several 20-foot seepage wells.
47	SE.	33	"	"	"	Bored	38	1,750	- 24	1,726	24	1,726	Glacial sand	Hard, clear		D, S	Sufficient for 12 head stock; other wells yield intermittent supply.
48	NW.	33	"	"	"	Bored	65	1,750	- 50	1,700	65	1,685	Glacial drift	Hard, clear		D, S	Sufficient for 50 head stock; also a 12-foot well.
49		34	"	"	"	Dug	14	1,730					Glacial sand				Small supply.
50	SE.	34	"	"	"	Bored	31	1,740	- 9	1,731	31	1,709	Glacial gravel and sand	Soft, clear		D, S	Sufficient for 12 head stock; #.
51	NW.	34	"	"	"	Spring	6	1,730					Glacial drift				Yields 5 tanks a day.
52	SE.	34	"	"	"	Spring	6	1,730					Glacial drift				Yields 5 tanks a day.
53	NE.	34	"	"	"	Bored	30	1,730	- 25	1,705	25	1,705	Glacial gravel and sand			N	Good supply not usable; good well in ravine.
54	NE.	35	"	"	"	Dug	18	1,650	- 15	1,635	15	1,635	Glacial sand			N, S	Insufficient for local needs; also uses lake.
1	SE.	2	21	24	2	Bored	45	1,815	- 30	1,785	45	1,870	Glacial drift	Hard, clear, iron		D, S	Sufficient for 25 head stock.
2	NE.	3	"	"	"	Bored	60	1,800	- 34	1,766	60	1,740	Glacial drift	Hard, clear, iron		D, S	Sufficient for 50 head stock.
3	SE.	6	"	"	"	Dug	8	1,810	- 5	1,805	5	1,805	Glacial gravel and sand	Soft, clear		D, S	Sufficient for 50 head stock; also two similar well.
4	NE.	9	"	"	"	Drilled	200	1,830	-150	1,680	200	1,630	Marine shale ?	Hard, clear		D, S	Well caved in; also use two wells 30 and 40 feet deep and haul water.
5	NE.	10	"	"	"	Dug	30	1,800					Glacial gravel	"Alkaline", clear		S	Insufficient for local needs.
6	NE.	13	"	"	"	Bored	52	1,810	- 15	1,795	52	1,758	Glacial sand	Hard, clear, "alkaline", iron		S	Sufficient for local needs.
7	SE.	13	"	"	"	Bored	32	1,805	- 28	1,877	28	1,877	Glacial sand	Hard, clear, iron		D, S	Sufficient for 10 head stock.
8	SE.	14	"	"	"	Bored	60	1,840	- 30	1,810	60	1,780	Glacial clay	Hard, clear, "alkaline"		S	Insufficient for local needs.
9	SE.	15	"	"	"	Bored	52	1,850	- 48	1,802	48	1,802	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs; also another well.
10	NE.	16	"	"	"	Bored	45	1,830	- 30	1,800	45	1,785	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 30 head stock.
11	SE.	18	"	"	"	Bored	60	1,800	- 60	1,740	60	1,740	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs.
12	SW.	18	"	"	"	Dug	25	1,800	- 23	1,777	23	1,777	Glacial sand	Hard, clear		D, S	Also two similar wells.
13	NE.	19	"	"	"	Dug	10	1,815	- 6	1,809	6	1,809	Glacial gravel	Soft			Yields 21 gallons a minute.

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 DUFFERIN, NO. 190, 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	SE.	19	21	24	2	Bored	58	1,820	- 28	1,792	58	1,762	Glacial gravel	Hard, clear, "alkaline"		S	Sufficient for 100 head stock.
15	NW.	20	"	"	"	Bored	50	1,820	- 38	1,782	50	1,770	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Sufficient for 30 head stock.
16	NE.	20	"	"	"	Dug	30	1,810	- 22	1,788	22	1,788	Glacial gravel	Hard, clear		D, S	Insufficient for local needs; also a 30-foot dry hole, hauls water.
17	NE.	21	"	"	"	Bored	100	1,820									Dry hole, base in glacial drift; 50-foot intermittent well, several 50-foot dry holes.
18	NW.	22	"	"	"	Dug	30	1,820	- 20	1,800	20	1,800	Glacial gravel	Soft, clear		D, S	Intermittent supply.
19	SW.	22	"	"	"	Bored	42	1,825	- 16	1,809	42	1,783	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Insufficient for local needs; also an 8-foot well, fair supply.
20	SE.	22	"	"	"	Bored	70	1,825	- 25	1,800	70	1,755	Glacial sand	Hard		D, S	Sufficient for local needs.
21	NW.	24	"	"	"	Bored	80	1,810	- 40	1,770	60	1,730	Glacial gravel	Hard, clear, "alkaline", iron		S	Insufficient for local needs; also two 15-foo dry holes, hauls water.
22	NE.	26	"	"	"	Dug	12	1,790	- 8	1,782	8	1,782	Glacial sand	Soft, clear		D, S	Sufficient for 30 head stock.
23	NE.	28	"	"	"	Bored	64	1,810	- 63	1,847	63	1,847	Glacial sand	Hard, clear,		D, S	Sufficient for 15 head stock.
24	NE.	30	"	"	"	Drilled	186	1,810	-100	1,710	186	1,624	Marine shale?	Hard, clear, iron		D, S	Sufficient for local needs; also a 20-foot well.
25	SE.	30	"	"	"	Dug	22	1,810	- 16	1,794	16	1,794	Glacial drift	Hard, clear		D, S	Insufficient for local needs; haul water.
26	SW.	31	"	"	"	Bored	36	1,800	- 30	1,770	30	1,770	Glacial gravel	Hard, clear, iron		D, S	Sufficient for local needs.
27	NE.	33	"	"	"	Bored	83	1,790	- 80	1,710	80	1,710	Glacial sand	Soft, clear		D, S	Sufficient for 40 head stock.
28	NW.	34	"	"	"	Dug	30	1,790	- 26	1,764	26	1,764	Glacial sand	Hard, clear, iron		D, S	Sufficient for 30 head stock.
29	NE.	34	"	"	"	Bored	26	1,780	- 17	1,763	26	1,754	Glacial sand	Hard, clear		D, S	Sufficient for 15 head stock.
30	SE.	36	"	"	"	Dug	36	1,760	- 33	1,747	33	1,747	Glacial sand	Soft, clear		D, S	Insufficient for local needs; melts snow in winter.
1	SE.	1	21	25	2	Spring		1,825					Glacial sand	Hard, clear		D, S	Yields 8 tanks a day; also a C.N.R. well; no information.
2	NE.	2	"	"	"	Spring		1,825					Glacial sand	Hard, clear		D, S	Sufficient for local needs; numerous springs here.
3	NW.	5	"	"	"	Dug	40	1,860	- 39	1,821	39	1,821	Glacial sand	Hard, clear, iron		S	Insufficient for local needs; hauls water,
4	SE.	9	"	"	"	Bored	107	1,850									Dry hole, base in glacial drift; 20 dry holes 7 to 107 feet deep.
5	NE.	9	"	"	"	Dug	32	1,840					Glacial gravel	Soft, clear		D, S	
6	NE.	10	"	"	"	Dug	7	1,825	- 4	1,821	4	1,821	Glacial sand	Hard, clear		D, S	Sufficient for 40 head stock; other 10-foot wells and a dugout.
7	SE.	10	"	"	"	Dug	12	1,825	- 5	1,820	5	1,820	Glacial gravel	Hard, clear		D, S	Sufficient for 50 head stock; also three 12-foot wells, small supply.
8	SW.	10	"	"	"	Dug	14	1,825									Intermittent supply.
9	NW.	14	"	"	"	Dug	5	1,715					Glacial sand	Hard, clear		D, S	Abundant supply; several springs here also.
10	NW.	15	"	"	"	Dug	10	1,800	- 4	1,796	4	1,796	Glacial gravel	Hard, clear		D, S	Abundant supply.

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

WELL RECORDS—Rural Municipality of DUFFERIN, NO. 190, 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.	15	21	25	2	Bored	32	1,825	- 16	1,809	16	1,809	Glacial drift	Hard, clear		D, S	Intermittent supply; also two wells 14 and 32 feet deep, small supply.
12	NE.	16	"	"	"	Dug	10	1,825	- 8	1,817	8	1,817	Glacial gravel	Hard, clear		D, S	Sufficient for local needs; several similar wells, all in village of Findlater.
13	NE.	18	"	"	"	Bored	80	1,850									Dry hole, base in glacial drift; 30 dry holes 6 to 80 feet; hauls water.
14	SW.	18	"	"	"	Spring		1,860					Glacial drift			D, S	Good supply; several springs.
15	NW.	20	"	"	"	Dug	6	1,840					Glacial sand	Soft, clear		D, S	Sufficient for 100 head stock.
16	NE.	20	"	"	"	Dug	20	1,830					Glacial sand				Chiefly seepage.
17	SE.	22	"	"	"		14	1,875					Glacial gravel	Hard, clear		D,S	C.N.R. well, yields 8,000 gallons an hour..
18	NE.	24	"	"	"	Bored	50	1,820	- 39	1,781	50	1,770	Glacial sand	"Alkaline", clear		D, S	Sufficient for local needs.
19	NW.	28	"	"	"	Dug	22	1,820	- 6	1,814	22	1,798	Glacial gravel	Soft, clear		D, S	Sufficient for 20 head stock; also a 9-foot well in ravine; abundant supply.
20	SW.	30	"	"	"	Dug	15	1,850	0	1,850	15	1,835	Glacial drift	Hard, "alkaline"		D, S	Sufficient for local needs; other 20-foot wells dry.
21	SE.	31	"	"	"		40	1,845					Glacial drift	Hard			
22	NE.	31	"	"	"		60	1,845									Dry hole, base in glacial drift.
23	SW.	32	"	"	"	Dug	30	1,825	- 6	1,819	30	1,795	Glacial gravel	Soft, clear		D, S	Sufficient for 20 head stock.
24	SE.	32	"	"	"	Dug	6	1,825	- 2	1,823	2	1,823	Glacial gravel	Hard, clear, "alkaline"		S	Sufficient for 50 head stock; also a dugout.
25	SW.	35	"	"	"	Bored	95	1,810									Dry hole, base in glacial drift; also two 22-foot wells. Hauls water and uses a dugout.
26	NW.	36	"	"	"	Dug	21	1,850									Dry hole, base in glacial drift.
27	SW.	36	"	"	"	Bored	30	1,820	- 20	1,800	20	1,800	Glacial drift	Soft, clear		D, S	Insufficient for local needs.
1	SE.	2	21	26	2	Bored	46	1,910	- 34	1,876	46	1,864	Glacial drift	Hard, cloudy, "alkaline"		S	Yields 20 barrels a day; also use a slough.
2	NW.	3	"	"	"	Dug	30	1,920	- 24	1,896	30	1,890	Glacial gravel	Soft, clear		D, S	Sufficient for 50 head stock.
3	NW.	4	"	"	"	Dug	14	1,940	- 5	1,935			Glacial sand	Clear		D, S	Insufficient supply; cannot keep out sand.
4	NW.	6	"	"	"	Dug	35	1,940	- 27	1,913	27	1,913	Glacial drift	Hard, clear		D, S	Yields 20 barrels a day.
5	SW.	10	"	"	"	Dug	26	1,935	- 21	1,914	21	1,914	Glacial gravel	Hard, clear		D	Sufficient for domestic needs only; uses a dugout for stock.
6	NW.	10	"	"	"	Dug	18	1,925	- 14	1,911	14	1,911	Glacial sand	Hard, clear		D	Insufficient for local needs; uses a slough for stock.
7	NW.	14	"	"	"	Dug	6	1,850	- 4	1,846	4	1,846	Glacial gravel	Clear	D, S	D, S	Sufficient for local needs.
8	NW.	18	"	"	"	Dug	15	1,940					Glacial gravel and sand	Hard, clear, "alkaline"		D, S	Yields 4 barrels a day; also a similar 18-foot well.
9	SE.	20	"	"	"	Dug	14	1,900	- 12	1,888	12	1,888	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for 20 head stock.
10	SW.	20	"	"	"	Dug	24	1,900	- 21	1,879	21	1,879	Glacial drift	Hard		D	Sufficient for domestic needs; uses a dugout for stock.
11	SW.	28	"	"	"	Bored	40	1,900	- 20	1,880	40	1,860	Glacial drift	Hard, clear, "alkaline"		N	
12	NW.	30	"	"	"	Dug	20	1,940	- 14	1,926	14	1,926	Glacial gravel	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
13	NE.	34	"	"	"	Dug	11	1,850	- 2	1,848	2	1,848	Glacial sand	Hard, iron, cloudy		D, S	Yields 12 barrels a day.

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