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DEPARTMENT OF MINES

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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF NORTH Qu'APPELLE No. 187 SASKATCHEWAN

BY

B. R. MacKay, H. N. Hainstock & G. L. Scott

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF NORTH QU'APPELLE, NO. 187 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 give on the figure. Where contour lines are not shown on the figure, the elevations of adjacent wells as indicated in the Table of Well Records accompanying each report can be used. The approximate elevation of the water-bearing horizon at the well-site can be obtained from the Table of Well Records by noting the elevation of the water-bearing horizon in surrounding wells and by estimating from these known elevations its elevation at the well-site.[1] If the water-bearing horizon is in bedrock the depth to water can be estimated fairly accurately in this way. If the water-bearing horizon is in unconsolidated deposits such as gravel, sand, clay, or glacial debris, however, the estimated elevation is less reliable, because the water-bearing horizon may be inclined, or may be in lenses or in sand beds which may lie at various horizons and may be of small lateral extent. In calculating the depth to water, care should be taken that the water-bearing horizons selected from the Table of Well Records be all in the same geological horizon either in the glacial drift or in the bedrock. From the data in the Table

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Ravenscrag 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 North Qu'Appelle is an area of approximately 213 square miles in southeastern Saskatchewan. It consists of townships 20 and 21, range 13; parts of townships 20, ranges 12, 14, 15, and 16; and parts of townships 21, ranges 14, 15, and 16; all west of the Second meridian. A branch line of the Canadian National railways that runs between Regina and Yorkton passes through the municipality and on it are located the hamlet of Muscow and the villages of Fort Qu'Appelle and Lebret. B Say Tah, a summer resort, is located on the south shore of Echo lake, 3 miles northwest of Fort Qu'Appelle, and the Provincial Sanatarium is located on the north side of the same lake, in the NE.$\frac{1}{4}$, sec. 24, tp. 21, range 14. Pasqua Indian Reserve, No. 79, and parts of Muscowpetung Indian Reserve No. 80 and Standing Buffalo Indian Reserve No. 78 occupy approximately 54 square miles of land within the limits of the municipality.

The main topographical feature of the municipality is Qu'Appelle valley which trends across the northern part of the area in a west-east direction. Qu'Appelle river meanders through the western 6 miles of the valley and its flood-plain, which is about 1 mile wide, is composed of an alluvial deposit of sand, gravel, silt, and clay at least 40 feet thick. The greater part of the valley in the eastern 20 miles of the municipality is occupied by the Fishing lakes. The banks of the valley rise very steeply from the valley floor, at an approximate elevation of 1,590 feet to the plain level which at the top of the valley is at an approximate elevation of 1,875 feet. Numerous short,

deep ravines that contain small streams break the slightly undulating plain surface within a distance of 5 miles from the valley. The three largest ravines contain Jumping Deer, Echo, and Lebret creeks. Each of these streams has built at its mouth an extensive delta, and these deltas, coalescing with smaller deltas deposited at the mouths of the gulches on the opposite sides of the valley, form alluvial flats that divide the Fishing lakes into four component lakes, Qu'Appelle, Echo, Lebret, and Katepwe. The delta that separates Qu'Appelle lake from Echo lake is known as the Sioux Crossing. The villages of Fort Qu'Appelle and Lebret are built on deltas formed by Echo and Lebret creeks, respectively; the first of these separates Echo lake from Lebret lake and the other, Lebret lake from Katepwe lake. Qu'Appelle lake is at an elevation of 1,572 feet above sea-level, and Echo, Lebret, and Katepwe lakes are at elevations of 1,571, 1,570, and 1,569 feet above sea-level. Qu'Appelle lake is 66 feet deep and Echo lake, the shallowest of the four lakes, is 48 feet deep. A fish hatchery is located on the south side of Echo lake near the summer resort village of B Say Tah.

The gulch-like ravines 175 to 200 feet deep have worked headward from Qu'Appelle valley to points approximately 5 miles back into the plains, where they suddenly become shallow coulées less than 50 feet deep. The banks of Qu'Appelle valley and the deep ravines are covered by glacial till and are thickly wooded.

The southeastern part of the municipality is a flat to slightly undulating plain that marks the site of a former glacial lake. Glacial lake clays overlie this area, whereas the remainder of the municipality is covered with deposits of moraine

and glacial till. The ground surface of the moraine-covered areas is usually more rough and rolling and more thickly wooded than is that of the glacial till-covered districts.

The Marine Shale series underlies the glacial drift throughout the entire municipality, but the depth to the shale has not been determined by any well. In this municipality three wells have been drilled to depths of 300, 330, and 335 feet, without any indication of having entered the bedrock. A wide, deep, drift-filled, pre-glacial valley apparently underlies the municipality.

Water-bearing Horizons in the Unconsolidated Deposits

The glacial drift is composed mostly of clay. Yellow, oxidized boulder clay underlies the top soil to depths varying from 5 to 30 feet. Blue clay forms the bulk of the underlying glacial drift. It contains occasional small layers of green, black, grey, and white clays, and layers of hardpan. The sand and gravel that form the aquifers in all the producing wells in the municipality have been deposited at various elevations in the form of pockets or discontinuous layers of extremely variable thickness. This results in the ground water conditions being good in some areas in the municipality, and poor in others. As a rule, well water is more readily found on the south side of Qu'Appelle valley than on the north side.

Moderate supplies of water can always be obtained at depths of less than 20 feet in the deposits of Recent alluvium that forms the flood-plains of the larger ravines and Qu'Appelle river. This water is hard and slightly "alkaline", but is suitable for farm requirements.

Variable supplies of water can also be obtained from the upper part of the glacial drift. It is most readily obtained in the area that is mantled by glacial lake clays. The deposit

of lake clay is quite thin and non-water-bearing, but thick deposits of sand and gravel occur in the boulder clay immediately underlying the lake clay. These deposits occur between a thin layer of yellow boulder clay and the impervious blue clay, and wells tapping them are less than 30 feet deep. The ground water contained in these beds of sand and gravel originates from rainfall, but so much water is stored within this extensive aquifer that the supply was not appreciably decreased during the drought years of 1930 to 1934. This was particularly so in township 20, range 13.

To the west and north of this area the thick deposits of sand and gravel in the upper part of the drift become more discontinuous and occur as scattered pockets. In the western part of township 20, range 16, practically all the wells that yield a large supply of water have been either bored or drilled to depths in excess of 60 feet. In townships 21, ranges 15 and 16, it is almost impossible to find a permanent supply of water at depths of less than 60 feet. Residents of these townships were very short of water during the drought years, and not more than ten farmers obtained sufficient water from their own wells to supply their local needs. The remainder of the farmers were dependant upon a number of seepage wells, which, in years of average rainfall provide sufficient water for 25 to 30 head of stock. In townships 21, ranges 13 and 14, considerable difficulty is experienced in obtaining adequate supplies of water at shallow depths.

The water from the shallow wells that have tapped aquifers lying above the blue clay is hard and slightly "alkaline", but is quite suitable for drinking. The water is not under pressure.

Boring and drilling operations to depths greater than 60 feet throughout the township have not always been successful, as the water-bearing horizons do not occur as continuous layers but are in the form of large lenses or pockets. A considerable number of wells throughout the municipality, however, have tapped pockets of water-bearing sand or gravel at depths ranging from 60 to 330 feet. The supply of water from these wells is abundant and is under hydrostatic pressure. The water from wells 60 to 100 feet deep is usually more highly mineralized than that from the deeper wells, but it is often used for drinking. The areal extent of the various aquifers, however, is unknown.

Farmers who are unable to obtain adequate supplies of water from shallow dug wells are advisedto drill deep wells. The glacial drift is at least 335 feet thick, and the possibilities of striking a water-bearing deposit of sand or gravel within this depth are good.

The undulating ground surface and clayey character of the glacial till and moraine-covered areas are favourable for the excavation of large, deep dugouts. These dugouts should be made at least 12 feet deep and they should be located so as to collect the maximum amount of spring run-off water. Slough basins that are free from "alkali" are usually favourable locations for dugouts. Many small ravines in the municipality offer suitable locations for the construction of small, rock-filled dams. Before digging a shallow well farmers are advised to test with a hand auger, as by this means a water-bearing pocket may be encountered with a minimum amount of effort and expense.

Water-bearing Horizons in the Bedrock

No wells in the municipality are deriving their water supply from an aquifer in the Marine Shale series that immediately underlies the glacial drift. Water that has been found in adjoining municipalities in this Marine Shale is too highly mineralized to be of any use to the farmer. Well drillers are, therefore, advised to confine their drilling operations to the glacial drift and not to drill into the Marine Shale series, or "soapstone", as it is locally termed.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 20, Range 12

Only sections 6 and 7, and parts of sections 5, 8, 18, and 19, in this township occur in the municipality of North Qu'Appelle and are discussed in this report. The greater part of this area is dissected by two deep, wide ravines and the steep-sided valley of Qu'Appelle river, all of which valleys are mantled with glacial till or boulder clay. The plain above the valleys is covered by a thin veneer of glacial lake clays, and a small strip of territory bordering Katepwe lake is covered by Recent alluvium. Katepwe lake lies at an elevation of 1,569 feet and the plain, at the top of the valley, is at an approximate elevation of 1,825 feet above sea-level.

The only well in this area examined by the field party is located in the NE.$\frac{1}{4}$, section 18. This well was dug in the deposits of Recent alluvium forming the floor of the valley near Katepwe lake. Gravel was struck at a depth of 6 feet from the surface and the total depth of the well is 9 feet. A good supply of water was obtained. The water is hard, slightly "alkaline", and is suitable for drinking. Similar supplies can doubtless be obtained elsewhere from the alluvium, and some water should occur in sand and gravel deposits in the glacial till.

Township 20, Range 13

The elevation of the ground surface of this township decreases gradually from 1,975 feet at the southwestern corner to 1,800 feet at the top of Qu'Appelle valley, which extends through sections 35, 36, and the NE.$\frac{1}{4}$, section 25. The banks of the valley slope very steeply to the valley floor. A small part of Lebret lake lies within section 35, and it is separated

from Katepwe lake, in section 36, by deposits of Recent alluvium. Katepwe lake lies at an elevation of 1,569 feet above sea-level and Lebret lake at 1,570 feet. Wide, deep, short gullies, which lead into Qu'Appelle valley, occur in sections 1, 13, 24, and 33. The southwestern part of the township and the slopes of the deep gullies and Qu'Appelle valley are covered with a deposit of glacial till. The floor of Qu'Appelle valley is mantled with Recent alluvium. Glacial lake clays cover the remainder of the township. The ground surface is very slightly undulating, and the western half of the township is thickly wooded with poplar.

All the wells in this township are less than 85 feet deep, and the great majority of them are only 10 to 25 feet deep. Yellow clay underlies the top soil to depths of 5 to 15 feet, and a thick bed of sand or gravel usually separates the yellow clay from the underlying blue clay. This extensive deposit of sand and gravel is readily struck by hand dug wells. The water contained in it owes its source to rainfall, but the aquifer is so thick and extensive that prolonged drought periods do not appreciably decrease its supply of water. Only six farmers in the township were unable to obtain a sufficient supply of well water to meet their requirements during the drought of 1930 to 1934. Wells in section 15, 16, 17, 18, 21, 23, 24, 26, 30, 32, and 34, none of which is deeper than 30 feet, yield very abundant supplies of water. The water is hard and slightly mineralized, but it is suitable for drinking. Two bored wells in section 14 encountered a layer of water-bearing gravel beneath yellow and blue clay at depths of 40 and 42 feet, and the water rises under a slight pressure. This water was termed "alkaline" and was unsuitable for drinking. Each of these wells can water 40 head of stock, although the drought of 1930 to 1934 lowered the water-level.

Bored wells to a maximum depth of 85 feet, in sections 10 and 32, failed to encounter water. No attempts have been made to secure a permanent supply of water by drilling to depth, although it is quite possible that water-bearing horizons do exist in the lower part of the glacial drift. The thickness of the glacial drift is estimated to be 350 to 400 feet in this township.

Springs are numerous along the south bank of Qu'Appelle valley. The water from the lakes is slightly "alkaline", but suitable for stock use. The ground water situation of this township is considered good.

Township 20, Range 14

This township is 34 square miles in area, the Pasqua Indian Reservation covering 2 square miles in the northwestern corner. The township is drained by Echo creek, which flows north through its central part, and by a smaller creek that traverses its western part and joins Echo creek in section 27. Both streams flow intermittently through small coulées about 40 feet deep until the point of confluence is reached, beyond which place the valley becomes much deeper and wider, being approximately 150 feet deep and $\frac{1}{4}$ mile wide in sections 27 and 34. The flow of water in the creek in these sections is fairly continuous. An area 1 to 2 miles wide, extending along the western side of the township, is covered by moraine. Part of the southeastern corner, a narrow area paralleling the moraine-covered area, and the slopes of Echo Creek valley are mantled by boulder clay, or glacial till. With the exception of the floor of the ravine, which is covered by Recent stream deposits of sands, gravels, and silts, the remainder of the township is overlaid by glacial lake clays. The ground surface of the moraine and till-covered areas is quite undulating and contains many sloughs, whereas the surface of the glacial lake clay-covered areas is flat. Clumps of poplar trees occur throughout the township.

The majority of the wells in this township have been dug to depths less than 30 feet below the surface. Thick beds of sand and gravel, which are extensive in township 20, range 13, also occur in this township, but they do not appear to be as continuous. Several farmers experience considerable difficulty in securing a good supply of water at shallow depths, whereas others can obtain abundant quantities of water. Wherever possible, farmers have dug their wells in the floors of small coulées or near slight depressions, since in the former there is usually a thick bed of sand or gravel at a shallow depth and in the latter a maximum amount of surface seepage is obtained. In general, however, farmers can derive sufficient, but not always abundant quantities of water at depths of less than 30 feet below the surface.

Boring or drilling operations to depths in excess of 30 feet below the surface have usually been successful, although many dry holes have been bored to depths of 40 to 90 feet in the NE.$\frac{1}{4}$, section 13, and the NW.$\frac{1}{4}$, section 32. The water struck in wells 30 to 120 feet deep rises under a slight hydrostatic pressure. The supply is fairly constant, but the quality of the water is such that it cannot usually be used for drinking. Many wells have been dug, bored, and drilled on the SW.$\frac{1}{4}$, section 25, and, although there was no difficulty in striking an aquifer, the water was very highly mineralized and could not be used even for stock.

One of the best wells in the township is located in the NE.$\frac{1}{4}$, section 5. This well encountered a gravel and sand aquifer at a depth of 185 feet below the surface. The water rose to a point 92 feet below the surface, and the abundant supply was not affected by the drought of 1930 to 1934. The water is

hard, slightly "alkaline", and contains iron, but it is being used for drinking without any ill effects. Farmers who contemplate sinking a well are advised to drill for an abundant and permanent supply of water. The glacial drift is very thick, probably 350 to 400 feet, and the possibility of striking water that is not too highly mineralized is much better between depths of 150 feet and the surface of the underlying bedrock, the Marine Shale series, than it is between depths of 40 and 150 feet. Drilling rather than boring is recommended. It is inadvisable to drill into the Marine Shale or "soapstone" as it is sometimes termed, as both the quality and quantity of water obtained is poor.

Springs are fairly numerous along Echo Creek valley. Several shallow coulées could be dammed and the water used for stock purposes. A few farmers in the township use dugouts.

Township 20, Range 15

This township comprises sections 7 to 24, inclusive. The southwestern half of this area is mantled with glacial till and the northeastern half by moraine. The ground surface is slightly undulating and wooded with poplar, except in sections 7, 8, and 9, where the ground surface is flat and treeless. A small, intermittent tributary of Echo creek has cut its valley in the southeastern part of the township.

Fifteen farmers in this fractional township depend on shallow wells, less than 20 feet deep, for their supplies of water, and four or five of these farmers also use small dams that have been built along the course of the small creek. Only five of these shallow wells yield a fairly abundant and sufficient supply of water and they have been dug in the floors of ravines. The thick and extensive beds of gravel and sand that occur within 30 feet of the surface in township 20, range 13, and which occur

less frequently in township 20, range 14, do not extend into this township. Small pockets of gravel, however, do occur in the drift, but wells tapping them yield only small supplies of water. The water is hard and suitable for drinking, but the supply is easily affected by drought conditions.

Seven attempts have been made to secure a permanent supply of water by boring or drilling methods, and six of these have been successful. These six wells have tapped three different water-bearing horizons in the glacial drift. The first water-bearing horizon consists of gravel occurring at an approximate elevation of 1,975 feet above sea-level. The two wells that have struck this aquifer are in the SW.$\frac{1}{4}$, section 7, and the NW.$\frac{1}{4}$, section 17, and are 67 and 85 feet deep, respectively. The water rises under a very high pressure to a point 5 feet below the surface, and the supply is very abundant and totally unaffected by variations in rainfall. The water is hard and contains iron, but is suitable for drinking.

The second water-bearing horizon consists of coarse sand lying at an elevation of 1,900 feet, and it is tapped by two wells, one in the SW.$\frac{1}{4}$, section 18, 170 feet deep, and the other in the SW.$\frac{1}{4}$, section 22, 100 feet deep. The water rises to points 10 and 25 feet below the surface and the supply is abundant. The water is hard and of good quality and is suitable for drinking.

The third water-bearing horizon lies at an approximate elevation of 1,715 feet, and it is believed that this layer of sand and gravel lies very near the surface of the Marine Shale series, as a well in the SW.$\frac{1}{4}$, section 2, in this same township but in the municipality of South Qu'Appelle, struck the "soapstone" at an elevation of 1,750 feet above sea-level. The two wells

tapping this horizon are 300 and 330 feet deep, and the water rises to a point approximately 12 feet below the surface. The supply is abundant, and is suitable for drinking .

These three water-bearing horizons are not continuous, as the 330-and 300-foot wells did not encounter the first and second water-bearing horizons. A 200-foot hole in the NW.$\frac{1}{4}$, section 23, also did not encounter the first or second water-bearing horizons, although the elevation of the base of this hole, 1,760 feet, is below that of the two horizons. It must be assumed, therefore, that the horizons consist of large lenses of sand or gravel occurring at a fairly uniform elevation. These lenses must be of large extent in order to yield such an abundant supply of water under such high hydrostatic pressure.

The possibilities of obtaining an abundant supply of usable water by drilling to depths in excess of 60 feet, however, are very good but it is inadvisable to drill deeper than an elevation of 1,700 feet since the bedrock Marine Shale series is thought to occur at this approximate elevation, and it seldom contains usable water.

Township 20, Range 16

Sections 12, 13, 24, and 26 to 35, and the north halves of sections 19 to 23 inclusive, in this township, lie within the borders of the municipality of North Qu'Appelle. The greater part of this partial township is covered with a deposit of glacial till, whereas moraine mantles sections 34, and 35, and parts of sections 19, 20, 26, 27, and 33. The surface of the moraine-covered areas is more undulating and hilly than that of the glacial till-mantled area, and contains numerous small, undrained depressions or sloughs. Clumps of poplar trees are found throughout the township.

The glacial drift is probably more than 400 feet thick. The upper 20 to 30 feet of the glacial drift is composed of yellowish brown boulder clay, whereas the remainder is largely composed of blue clay. Layers of green and white clay were reported in an 85-foot bored well in the SE.$\frac{1}{4}$, section 28. Discontinuous beds of sand and gravel occur within the thick blue clay deposit.

All the wells in the township, with the exception of two, have been bored or drilled to depths greater than 38 feet below the surface, The two shallow wells are located in the SW.$\frac{1}{4}$, section 13, and the SE.$\frac{1}{4}$, section 31. The 38-foot well on section 13 struck a small sand layer that underlies yellow and blue clay. A very small supply of "alkaline" water was obtained, and the well will only yield sufficient water for 15 head of stock. Extensive layers or beds of sand and gravel within the upper 40 feet of the drift appear to be of infrequent occurrence in this township. A flowing artesian well that is only 6 feet deep was dug in a small ravine in the SE.$\frac{1}{4}$, section 31. This well penetrated a 6-inch layer of hardpan before striking the sand aquifer. The water rises under hydrostatic pressure to a point 8 feet above the surface, and the well yields 90 gallons of water an hour. The water is hard, contains a small amount of iron, and is very clear. It is being used for drinking.

The majority of the deeper wells have been bored to depths ranging from 40 to 85 feet below the surface. These wells usually strike a coarse sand aquifer that yields a hard, mineralized water under hydrostatic pressure. The highest pressure was recorded in a 65-foot well in the NE.$\frac{1}{4}$, section 24, and in a 68-foot well in the SE.$\frac{1}{4}$, section 29, where the water rises to points 8 feet below the surface. The supply is abundant and the

water, although "alkaline", is being used for drinking. The only locality where it was impossible to encounter a supply of water was in the SE.$\frac{1}{4}$, section 35. In this area four dry holes have been bored to a maximum depth of 100 feet.

Two drilled wells in the NE.$\frac{1}{4}$, section 20, and the NE.$\frac{1}{4}$, section 34, have tapped a water-bearing horizon composed of very fine sand, at an elevation of 1,710 feet above sea-level. These wells are 290 and 310 feet deep, respectively. Abundant supplies of highly mineralized water that is suitable for stock but not for drinking were obtained, but the casings of both wells have become plugged with fine sand, the well in the NE.$\frac{1}{4}$, section 34, being plugged to a point 150 feet above its base. The present supply from these wells is insufficient for local requirements.

The probabilities of striking a permanent water supply by boring or drilling to depths greater than 40 feet below the surface in this township are good. The deeper wells, however, may become plugged by sand, as fine sand aquifers appear to be more prevalent in the lower part of the drift. The drought of 1930 to 1934 did not affect the well water supply in this township to any great extent.

Township 21, Range 13

Qu'Appelle valley traverses the southern part of this township. The valley floor is approximately 275 feet lower than the plain, and it is about 1 mile wide. The greater part of the valley in this township is occupied by Lebret lake, which is $3\frac{1}{2}$ miles long and about 60 feet deep at its deepest point. The elevation of the surface of the lake is 1,570 feet above sea-level. A small part of Echo lake is in sections 7 and 18, and this lake, which lies at an elevation of 1,571 feet, is separated from Lebret lake by a delta of Recent alluvium, composed of sand and silt, on

which the village of Fort Qu'Appelle is built. Qu'Appelle river connects the two lakes. Echo creek flows through section 7 and empties into Echo lake. Several, small intermittent creeks flow through short deep ravines on the north side of the valley. Moraine covers the northwestern part of the township and glacial till or boulder clay covers the remainder of the area. A thin veneer of glacial lake clays overlies the boulder clay in several small areas. The ground surface is undulating and is thickly wooded with small poplar.

Fairly abundant supplies of hard, mineralized water, which is being used for drinking, can always be obtained by digging to depths of less than 20 feet in the Recent deposits in Qu'Appelle valley. Sand, and less often, gravel is usually struck at a point 10 feet below the surface. The water in these wells is not under pressure and does not rise above the aquifer. The villages of Fort Qu'Appelle and Lebret derive their water supply from several wells of this type. On the plains area of the township large permanent supplies of water are very difficult to locate within 30 feet of the surface. Many farmers depend on shallow seepage wells for a supply and these wells are always dug near or in depressions where the maximum amount of surface water is collected. These farmers usually have more than one well and use them all in order to obtain sufficient water to meet their requirements. In periods of prolonged drought the supply of water for stock use is often inadequate. The majority of the producing wells that yield a fairly abundant supply of water have been dug or bored between depths of 30 and 90 feet. The aquifer is nearly always a fine sand, and in some wells the sand caves in and blocks off the supply. The aquifer is not continuous, but is composed of a series of pockets that lie at various elevations. Eight wells were bored or dug to a maximum depth of 90 feet in the SW.$\frac{1}{4}$, section 27, without striking a water-bearing

horizon. When water is struck it rises under a slight hydrostatic pressure to a point approximately 10 to 20 feet above the top of the aquifer. The water is hard and is generally highly mineralized, but many farmers use it for drinking. Wells that yield a particularly good supply of water are located in the SE.$\frac{1}{4}$, section 16, SW.$\frac{1}{4}$, section 26, NE.$\frac{1}{4}$, section 27, SE. and NW.$\frac{1}{4}$'s, section 28, NE.$\frac{1}{4}$, section 31, NE.$\frac{1}{4}$, section 32, SE.$\frac{1}{4}$, section 34, and SW.$\frac{1}{4}$, section 35.

The only well that is deeper than 90 feet is located in the SE.$\frac{1}{4}$, section 13. This well was drilled to a quicksand aquifer 250 feet below the surface, or at an elevation of 1,615 feet above sea-level. The water rises to a point 160 feet below the surface, and the supply is abundant. Unfortunately the water is hard and too highly mineralized for drinking, although it is not injurious to stock.

Water conditions in this township are fair, The glacial drift is very thick, probably in excess of 350 feet, and it is probable that water-bearing horizons of sand and gravel exist within this thick deposit of drift. Where deep drilling operations cannot be financed, dugouts could be used to advantage in collecting and storing run-off water for stock use.

Township 21, Range 14

This township comprises an area of approximately 28 square miles. Qu'Appelle valley traverses the central sections of the township, and it is almost entirely occupied by parts of Qu'Appelle and Echo lakes that lie at elevations of 1,572 and 1,571 feet above sea-level. A delta of Recent alluvium built at the mouth of Jumping Deer creek separates the

two lakes at a point that is known as Sioux Crossing. Jumping Deer creek flows into Qu'Appelle lake ½ mile west of Sioux Crossing. Echo creek on the south side of the valley flows through sections 3, 2, and 1, towards Echo lake. The steep, sloping banks of the valley are broken by several, short, deep, gorge-like ravines. Moraine covers the northeastern and northwestern corners of the township, and boulder clay or glacial till mantles the remainder of the area. A thin veneer of glacial lake clay overlies the boulder clay in the south-central part of the township. The ground surface is flat to slightly undulating, and is thickly wooded with poplar.

It is very difficult to locate a permanent supply of water at depths of less than 60 feet in this township. There are not more than six shallow wells in the township that yield sufficient water for 25 head of stock. Most of the shallow wells have been dug beside depressions and depend upon rainfall for the replenishment of their supply. During the drought years of 1930 to 1934 they yielded an inadequate supply of water. A flowing spring that delivers a very good supply of water is located in the NW.¼, section 17. The water is hard and contains iron, but is suitable for drinking.

Eight wells in the township yield abundant supplies of water from aquifers that lie at depths ranging from 60 to 250 feet below the surface. These water-bearing horizons are not continuous. A 60-foot well in the SE.¼, section 9, struck a bed of quicksand which yields an abundant supply of water that rises under pressure to a point 43 feet below the surface, whereas two dry holes were bored to depths of 75 feet and 100 feet in the SE.¼, section 10. A 75-foot well in the SE.¼, section 16, yields an abundant supply of water from a gravel aquifer, but a 90-foot well in the NW.¼, section 10, yields only sufficient water for

about 30 head of stock, and its supply was decreased by the drought of 1930 to 1934. Three wells have been bored near the Sanatarium to depths of approximately 90 feet. Water was struck at a depth of 47 feet from the surface in gravel and sand deposits which extend to the base of the wells. The holes are 10 inches in diameter and water can be pumped at an average rate of 90 gallons a minute. These wells are near Echo lake and it is probable that much of the water is being derived by seepage from the lake. The water is hard and slightly mineralized, and it is being used as drinking water for the Sanatarium. The deepest well, 250 feet, drilled in the SW.$\frac{1}{4}$, section 29, taps a gravel aquifer that lies at an elevation of 1,600 feet. The water rises only about 35 feet above the aquifer, but the supply is abundant. The water is hard and is being used for drinking.

It appears that drilling operations are the best methods of obtaining a permanent supply of water in this township. It is known that the glacial drift is very thick, and it is probably in excess of 350 feet. Deep drilling should be confined to the glacial drift, since the underlying bedrock Marine Shale series does not contain water-bearing horizons that will yield usable water.

Township 21, Range 15

Qu'Appelle valley traverses the township in an west-east direction through section 18, 17, 16, 15, 14, 13, and 24, and forms the southern boundary of the township. The greater part of the valley is occupied by Qu'Appelle lake. Deposits of Recent alluvium form the flood-plain between the shore-line of the lake and the base of the steep, sloping banks. The banks of the valley are covered by glacial till, whereas the upland part of the township north of the valley is mantled by moraine.

The ground surface of the plains area is very slightly undulating , and the western 4 miles are devoid of any extensive tree growth.

In this township only four farmers are obtaining sufficient water to meet their requirements. These farmers are located in sections 15, 16, 22, and 23. In sections 15 and 23 two flowing springs are used, and they yield a fairly abundant supply of hard slightly "alkaline", but usable water. In section 16 the supply is derived from a 12-foot well that is dug into the Recent alluvium in Qu'Appelle valley. In the NE.$\frac{1}{4}$, section 22, a 126-foot drilled well is obtaining an abundant supply of hard, usable water from a sand aquifer that lies at an elevation of 1,785 feet above sea-level. The water rises to a point 25 feet below the surface, and the supply is not appreciably affected by drought conditions.

Most of the remaining wells have been dug in slough basins and depend entirely on surface seepage for their water supply. In years of average rainfall these wells yield sufficient water for farm needs, but in drought years they become dry or their yield is barely sufficient for household purposes.

Three bored wells, in the NE.$\frac{1}{4}$, section 24, SE.$\frac{1}{4}$, section 25, and SE.$\frac{1}{4}$, section 36 . struck water at depths of 87, 54, and 84 feet, respectively. The sand that forms the aquifer in the first well has caved in and shut off the supply. The second well yields an insufficient supply in winter, and the water in the third well, although abundant in quantity, is much too highly mineralized to be of any use to the farmer.

The deepest hole in the municipality was drilled in the SW.$\frac{1}{4}$, section 35. It is 335 feet deep and no water-bearing horizons were encountered. This hole reached an elevation of 1,585 feet above sea-level, and it is believed that the base is in glacial drift and not bedrock, although the log of the well is very indefinite.

The water-bearing horizons in the glacial drift are apparently not continuous, but occur as large pockets or lenses. Should these pockets be tapped a fairly abundant supply of water will be obtained. Farmers are, therefore, advised to drill in search of such permanent supplies of water.

Township 21, Range 16

This township consists of sections 19 to 36, inclusive, and a small part of section 13. Qu'Appelle river flows in an easterly direction and forms the southern boundary of the township. The valley floor is formed of a thick deposit of Recent alluvium that has accumulated by the frequent flooding of the valley by the river. The northwestern corner of the township and the slopes of Qu'Appelle valley are covered with glacial till, whereas the remainder of the area is overlain by moraine. The ground surface is slightly undulating and scattered clumps of poplar grow throughout the township.

Only a poor supply of ground water is obtained in this township. There is not one well less than 70 feet deep that delivers a satisfactory supply of water. The upper 70 feet of glacial drift is composed of yellow and blue clays that contain small layers of sand or gravel, seldom more than 2 feet thick. Wells that tap these small sand layers derive an insufficient supply of water. The majority of the wells have been dug in sloughs and depend directly on rainfall for their supply. The drought of 1930 to 1934 caused many of these wells to become dry and farmers were forced to haul water for both household and stock use. Each farmer usually owns three or four shallow seepage wells and uses them all in an effort to obtain sufficient water for his stock.

Five wells in the township yield an abundant and permanent supply of water that is not readily affected by drought conditions. These wells are located in the NW.$\frac{1}{4}$, section 25, NW.$\frac{1}{4}$, section 30, NW.$\frac{1}{4}$, section 34, NE.$\frac{1}{4}$, section 35, and NW.$\frac{1}{4}$, section 36, and they have been bored to depths of 70, 72, 76, 70, and 78 feet, respectively. Apparently the aquifer is in the form of pockets rather than a continuous layer, since in adjacent sections holes have been dug to depths of 90, 115, and 140 feet and were either dry or yielded a very small supply of water. The water in all five wells is under hydrostatic pressure and rises to points about half-way up the wells. The water is hard, highly mineralized, and not suitable for drinking. Many farmers hauled water from the 70-foot well in the NW.$\frac{1}{4}$, section 25, during the drought.

No holes have been drilled to depths in excess of 140 feet, but it is believed that a fairly abundant supply of water can be obtained at depth in the glacial drift, although the aquifers are not believed to be continuous,,but rather in the form of pockets. Drilling operations should be confined to the glacial drift, which is thought to be at least 360 feet thick, as the underlying Marine Shale series is usually non-water-bearing.

Pasqua Indian Reserve No. 79

Pasqua Indian Reserve No. 79 covers an area of approximately 34 square miles. The centre of the reserve lies about 4 miles west of the hamlet of Muscow. Qu'Appelle river and the south shore of Qu'Appelle lake form the northern boundary of the reserve.

The greater part of the reserve is covered by moraine. From the northern limits of the moraine-covered area to the base of Qu'Appelle valley the ground surface is mantled with glacial till. The valley floor is covered with Recent alluvium. Numerous

deep, short ravines, which contain small, intermittent streams, extend southwards from Qu'Appelle valley. The ground surface is undulating and thickly wooded in the area lying one mile south of the valley.

Most of the water that is used by the residents of this reserve is surface water. Qu'Appelle lake, small streams, and sloughs are used extensively for stock and the water from shallow seepage wells is used for drinking. There are at least 5 deep drilled wells in the reserve, two of which are in use at the present time. Their depths are believed to be approximately 200 feet. A well was being drilled at the time the field party covered this area. It had reached a depth of 315 feet without striking a water-bearing horizon. It is reported that only a small supply of water is derived from the wells in this area, and that the quality of the water is only fair.

Muscowpetung Indian Reserve No. 80

Only 15 square miles of the Muscowpetung Indian Reserve No. 80 is discussed in this report. The centre of the area under discussion lies approximately 16 miles west of the town of Fort Qu'Appelle. Qu'Appelle river flows east along the northern boundary of the reserve. The floor of the valley is overlain by a thick deposit of alluvial sands and silts that were deposited during frequent floodings of the valley. The banks of the valley and the southwestern corner of the reserve are mantled with glacial till, whereas the remainder of the reserve is covered with moraine. The ground surface is undulating and broken by several ravines that drain the surface water towards Qu'Appelle river. A thick growth of poplar covers the entire reserve with the exception of the valley floor.

Many shallow wells have been dug on the reserve, but most of them have caved in. The greater part of the Indian settlement is along Qu'Appelle valley and river water is used extensively. Sloughs, springs, and small streams are also used for both stock and drinking water.

Standing Buffalo Indian Reserve No 78

Only the southern 5 square miles of Standing Buffalo Indian Reserve No. 78 are discussed in this report.. The centre of this area lies approximately 6 miles northwest of the village of Fort Qu'Appelle. The north shores of Qu'Appelle and Echo lakes form the southern boundary of the reserve and Jumping Deer creek forms the western boundary.

The greater part of the reserve is mantled by glacial till. The northeastern corner is covered by moraine and the flood-plain of the valley consists of Recent alluvium. The ground surface of the reserve is undulating and thickly wooded. Jumping Deer creek, a permanent stream of water, flows into Qu'Appelle lake approximately one-half mile west of Sioux Crossing.

The lakes, Jumping Deer creek, and small sloughs are the sources for most of the water used by the Indians for both stock and drinking purposes.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF NORTH QU'APPELLE, NO. 187, SASKATCHEWAN

Township	20	20	20	20	20	21	21	21	21	Total No. in municipality	Total No. in Indian Reserve No. 79
West of 2nd mer. Range	12	13	14	15	16	13	14	15	16		
Total No. of Wells in Township	1	71	91	26	19	65	37	21	53	384	6
No. of wells in bedrock	0	0	0	0	0	0	0	0	0	0	0
No. of wells in glacial drift	0	71	90	26	19	55	36	20	53	370	6
No. of wells in alluvium	1	0	1	0	0	10	1	1	0	14	0
Permanency of Water Supply											
No. with permanent supply	1	57	59	16	14	52	27	13	20	259	6
No. with intermittent supply	0	1	2	4	0	4	7	6	16	40	0
No. dry holes	0	13	30	6	5	9	3	2	17	85	1
Types of Wells											
No. of flowing artesian wells	0	0	0	0	1	0	0	0	0	1	0
No. of non-flowing artesian wells	0	37	12	7	12	11	7	4	7	97	5
No. of non-artesian wells	1	21	49	13	1	45	27	15	29	201	0
Quality of Water											
No. with hard water	1	53	61	20	14	53	32	19	34	287	5
No. with soft water	0	5	0	0	0	3	2	0	2	12	0
No. with salty water	0	0	0	0	0	0	0	0	0	0	0
No. with "alkaline" water	0	13	21	0	3	17	8	10	7	79	0
Depths of Wells											
No. from 0 to 50 feet deep	1	66	68	19	7	49	25	16	34	285	0
No. from 51 to 100 feet deep	0	5	17	3	10	15	10	3	15	78	0
No. from 101 to 150 feet deep	0	0	3	0	0	0	0	1	4	8	0
No. from 151 to 200 feet deep	0	0	3	2	0	0	1	0	0	6	5
No. from 201 to 500 feet deep	0	0	0	2	2	1	1	1	0	7	1
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
How the Water is Used											
No. usable for domestic purposes	1	50	50	19	12	45	30	16	30	253	5
No. not usable for domestic purposes	0	8	11	1	2	11	4	3	6	46	0
No. usable for stock	1	56	55	19	14	55	33	18	35	286	5
No. not usable for stock	0	2	6	1	0	1	1	1	1	13	0
Sufficiency of Water Supply											
No. sufficient for domestic needs	1	57	58	14	14	51	27	13	20	255	5
No. insufficient for domestic needs	0	1	3	6	0	5	7	6	16	44	0
No. sufficient for stock needs	0	48	51	11	12	39	19	10	13	203	5
No. insufficient for stock needs	1	10	10	9	2	17	15	9	23	96	0

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and ~~it represents the~~ amount of mineral salts that cannot be removed by boiling. Temporary hardness is the difference between the total hardness and the permanent hardness and represents the amount of mineral salts that can be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent harness 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 North Qu'Appelle, No. 187, 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	
1	SW.	13	20	13	2	16	600	600	475	125	11	155	80	108	291	39	545	143		10	307		67	18	* 1
2	SE.	31	20	16	2	6	1,600	1,250	1,100	150	15	425	140	191	754	313	1,471	251		146	361		688	25	* 1

Water samples indicated thus, * 1, are from glacial drift.
Analyses are reported in parts per million.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Samples of water were taken from two wells in the municipality of North Qu'Appelle, and the results of their analyses are listed in the accompanying table. Sample 1 is from a well 16 feet deep and sample 2 is from a 6-foot, flowing artesian well.

The total dissolved solid content of the water from the 16-foot well is 600 parts per million. It is very hard, but is suitable for drinking and all farm purposes. Sample 2 has a total dissolved content of 1,600 parts per million. This water may have a slight laxative effect upon persons not accustomed to its use, as it contains 688 parts per million of sodium sulphate and 361 parts per million of magnesium sulphate, but it is usable for drinking. The constituent mineral salts in solution in each sample are identical, magnesium sulphate, sodium sulphate, calcium carbonate, magnesium carbonate, and sodium chloride being present, their relative abundance decreasing in the order given. These waters are sulphate waters.

The water that is derived from the lower part of the drift was not analysed. It probably contains the same type of mineral salts in solution, but the total dissolved solid content will probably be higher. The water is satisfactory for stock and most of it is being used for drinking.

Water from the Bedrock

No water is being derived from the Marine Shale series in this municipality. It is probable that any water obtained from it will be too highly mineralized to be used for any farm purpose.

WELL RECORDS—Rural Municipality of NORTH QU'APPELLE NO.187, 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.	18	20	12	2	Dug	9	1,585	- 6	1,579	6	1,579	Recent Stream gravel	Hard	43	D	Good supply; seepage water from a lake.
1	SW.	1	20	13	2	Dug	22	1,800	- 4	1,796			Glacial drift	Hard		D, S	Sufficient supply. Spring water dammed in ravine used for stock.
2	SE.	2	"	"	"	Dug	18	1,800	- 6	1,794	14	1,786	Glacial gravel	Hard	41	D, S	Sufficient supply.
3	NE.	5	"	"	"	Dug	15	1,950	- 11	1,939			Glacial gravel	Hard, "alkaline"	42	D, S	Sufficient supply; one other shallow well also used.
4	SE.	5	"	"	"	Dug	14	1,950	- 10	1,940			Glacial sand and gravel	Hard, iron	42	D	Another 14-foot well is used for stock.
5	SW.	6	"	"	"	Dug	25	1,970	- 5	1,965	10	1,960	Glacial gravel	Hard, iron	38	D, S	Good supply for 10 head stock.
6	NW.	9	"	"	"	Dug	10	1,910	- 7	1,903	7	1,903	Glacial sand and gravel	Hard, "alkaline"	45	D, S	Sufficient supply.
7	NE.	9	"	"	"	Dug	15	1,890	- 12	1,878			Glacial sandy clay	Hard, "alkaline"	43	D	Poor supply. Sufficient for house use only.
8	NW.	10	"	"	"	Bored	60	1,875	- 50	1,825			Glacial gravel	Hard	44	D	Poor supply. Bad tasting water; 2 dry holes 15 and 60 feet deep.
9	SW.	10	"	"	"	Dug	12	1,880	- 9	1,871			Glacial gravelly clay	Hard, "alkaline"	44	D, S	Slough seepage well. Poor supply and insufficient.
10	SW.	12	"	"	"	Dug	14	1,840	- 10	1,830			Glacial gravel and sand	Hard		D, S	Sufficient supply.
11	NW.	12	"	"	"	Dug	8	1,830	- 1	1,829	0	1,830	Glacial gravel	Hard	43	D,	Good supply for 15 head stock.
12	SE.	13	"	"	"	Dug	16	1,795	- 11	1,784			Glacial sand and gravel	Hard, iron	43	D, S	Sufficient supply.
13	SW.	13	"	"	"	Dug	16	1,785	- 8	1,777			Glacial gravel	Hard, "alkaline"	43	D, S	Sufficient supply. #
14	SW.	14	"	"	"	Bored	40	1,840	- 30	1,810			Glacial gravel	Hard, "alkaline"	43	S	Fair supply of highly mineralized water.
15	SE.	14	"	"	"	Bored	42	1,820	- 32	1,788			Glacial gravel	Hard, "alkaline"	42	S	Sufficient for 40 head stock.
16	SW.	15	"	"	"	Dug	10	1,860	- 6	1,854			Glacial gravel	Hard	43	D, S	Abundant supply.
17	SE.	16	"	"	"	Dug	22	1,880	- 18	1,862	18	1,862	Glacial sand and gravel	Hard	42	D, S	Abundant supply.
18	SW.	16	"	"	"	Dug	8	1,910	- 5	1,905			Glacial gravel	Hard	43	D, S	Abundant supply.
19	SE.	17	"	"	"	Bored	12	1,925	- 6	1,919			Glacial fine sand	Hard	44	D, S	Plentiful supply.
20	NE.	17	"	"	"	Dug	14	1,910	- 9	1,901			Glacial gravel	Hard	43	D, S	Well delivers about 1,000 gallons of water a day.
21	SW.	18	"	"	"	Dug	14	1,950	- 6	1,944			Glacial sand	Hard	44	D, S	Intermittent supply.
22	NW.	18	"	"	"	Dug	30	1,940	- 25	1,915	25	1,915	Glacial gravel	Hard	42	D, S	Abundant supply.
23	SW.	19	"	"	"	Dug	18	1,925	- 14	1,911			Glacial gravel	Hard		D, S	Fair supply. Several shallow dry holes have been dug.
24	NE.	20	"	"	"	Dug	20	1,900	- 15	1,885			Glacial fine sand	Hard	41	D, S	Sufficient supply with the aid of another 25-foot well.
25	NE.	21	"	"	"	Bored	18	1,855	- 10	1,845			Glacial sand and gravel	Hard	43	D, S	Abundant supply.
26	NE.	22	"	"	"	Dug	30	1,830	- 26	1,804			Glacial drift	Hard	43	D, S	Slough seepage well; 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 NORTH QU'APPELLE NO.187, 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
27	NE.	23	20	13	2	Dug	12	1,825	- 4	1,821			Glacial fine sand	Hard	43	D, S	Sufficient for 20 head stock.
28	NW.	23	"	"	"	Dug	13	1,830	- 7	1,823			Glacial sand	Hard	43	D, S	Abundant supply.
29	SW.	24	"	"	"	Dug	15	1,810	- 9	1,801			Glacial sand and gravel	Hard	43	D, S	Plentiful supply of water.
30	NE.	26	"	"	"	Dug	12	1,830	- 5	1,825	5	1,825	Glacial sand	Soft	42	D, S	Abundant supply.
31	SW.	26	"	"	"	Dug	20	1,835	- 14	1,821			Glacial sand	Hard, "alkaline"	44	N	Good supply.
32	SW.	28	"	"	"	Dug	15	1,875	- 12	1,863			Glacial gravel and sand	Hard	43	D, S	Sufficient for 10 head stock. Sand often washes in and shuts off the supply.
33	SW.	30	"	"	"	Dug	13	1,910	- 6	1,904			Glacial gravel	Hard	43	D, S	Abundant supply for 70 head stock; 2 other similar wells.
34	NW.	31	"	"	"	Dug	14	1,890	- 11	1,879			Glacial sandy clay	Hard, "alkaline"	43	S, I	Poor and insufficient supply.
35	SW.	31	"	"	"	Dug	14	1,900	- 14	1,886			Glacial sand and gravel	Soft	43	D, S	Sufficient for 10 head stock.
36	NW.	32	"	"	"	Bored	50	1,875					Glacial drift				Dry hole. 2 seepage wells.
37	SW.	32	"	"	"	Dug	20	1,880	- 10	1,870	10	1,870	Glacial sand and gravel	Hard	44	D, S	Plenty of water.
38	NE.	32	"	"	"	Bored	85	1,850					Glacial drift				Dry hole. Many dry holes on this farm; water is hauled.
39	NE.	34	"	"	"	Dug	8	1,825	0	1,825	0	1,825	Glacial white sand	Hard		D, S	Abundant supply.
40	SE.	35	"	"	"	Dug		1,725	0	1,725			Glacial sand	Soft		D, S	Abundant supply.
41	SW.	36	"	"	"	Spring		1,700	0	1,700			Glacial drift	Soft		D, S	Several springs on this quarter section.
1	SE.	1	20	14	2	Dug	22	1,960	- 15	1,945			Glacial gravel	Hard, iron	41	D, S	Sufficient for 40 head stock.
2	SE.	3	"	"	"	Spring		1,910	0	1,910	0	1,910	Glacial gravel	Hard, "alkaline"	38	D, S	Spring flows continuously the year round.
3	SE.	3	"	"	"	Dug	10	1,900	- 7	1,893			Glacial gravel	Hard, "alkaline"	40	D, S	Abundant supply.
4	SW.	4	"	"	"	Dug	26	1,950	- 19	1,931			Glacial gravel	Hard	44	D, S	Good and constant supply.
5	NW.	4	"	"	"	Dug	25	1,940	- 19	1,921			Glacial gravel	Hard		D, S	Good supply.
6	NE.	5	"	"	"	Drilled	185	1,950	- 92	1,858	185	1,765	Glacial sand and gravel	Hard, iron, "alkaline"	42	D, S	Abundant supply.
7	SW.	6	"	"	"	Dug	12	1,990	- 8	1,982			Glacial gravel	Hard	42	D	Sufficient for house use only.
8	SE.	6	"	"	"	Bored	36	1,980	- 16	1,964			Glacial gravelly clay	Hard, "alkaline"	42	S	Sufficient supply; also uses an 18-foot well for stock.
9	NW.	7	"	"	"	Dug	12	1,940	- 10	1,930			Glacial gravel	Hard, iron	42	S	Sufficient for 5 head stock only.
10	NE.	8	"	"	"	Dug	36	1,930	- 29	1,901			Glacial sand and gravel	Hard		D, S	Sufficient supply.
11	NE.	9	"	"	"	Bored	28	1,920	- 23	1,897			Glacial gravel	Hard	43	D, S	Good and constant supply.
12	NE.	10	"	"	"	Sand-point	23	1,900					Glacial sand	Hard, iron, "alkaline"		D	Good supply; well in ravine 12 feet deep with lots of water.

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

WELL RECORDS—Rural Municipality of NORTH QU'APPELLE NO.187, 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
13	SE.	10	20	14	2	Dug	28	1,915	- 24	1,891	24	1,891	Glacial gravel	Hard, "alkaline"	43	D, S	Abundant supply.
14	NE.	11	"	"	"	Bored	45	1,940	- 35	1,905			Glacial drift	Hard	43	D	Intermittent supply; better supply from a 12-foot well.
15	SE.	12	"	"	"	Dug	23	1,960	- 21	1,939			Glacial sand	Hard, "alkaline"	43	D, S	Fair supply.
16	NW.	12	"	"	"	Bored	60	1,950	- 48	1,902	60	1,890	Glacial coarse gravel	Hard	38	D, S	Good supply for 40 head stock.
17	NE.	13	"	"	"	Bored	90	1,940					Glacial drift				Dry hole; several dry holes between 60 and 90 feet deep.
18	NW.	15	"	"	"	Dug	10	1,890	- 5	1,885			Glacial gravel	Hard	38	D, S	Abundant supply; another 60-foot bored well used.
19	SW.	16	"	"	"	Dug	28	1,920	- 16	1,904	28	1,892	Glacial gravel	Hard, "alkaline"		D, S	Good supply.
20	NE.	16	"	"	"	Dug	24	1,910	- 21	1,889			Glacial sand	Hard	43	D, S	Insufficient supply.
21	SE.	17	"	"	"	Dug	28	1,915	- 11	1,904	28	1,887	Glacial gravel	Hard, "alkaline"	43	D, S	Abundant supply.
22	NE.	17	"	"	"	Dug	15	1,900	- 3	1,897			Glacial gravel	Hard	42	D	Seepage water from a dugout; a 65-foot well yielded bad water.
23	SE.	18	"	"	"	Test	25	1,930					Glacial drift				Dry hole.
24	SW.	19	"	"	"	Dug	13	1,900	- 8	1,892			Glacial sand	Hard, iron		D, S	Good supply of water.
25	NE.	19	"	"	"	Dug	12	1,890	- 9	1,881			Glacial sand and gravel	Hard, iron		D, S	Abundant supply; well is used by two other farmers.
26	NW.	20	"	"	"	Dug	20	1,885	- 16	1,869			Glacial gravel	Hard		D, S	Abundant supply.
27	SE.	20	"	"	"	Dug	19	1,925	- 11	1,914			Glacial gravel	Hard	42	D, S	Sufficient water with the aid of another 35-foot well.
28	SW.	21	"	"	"	Dug	25	1,875	- 19	1,856			Glacial gravel	Hard	38	D, S	Sufficient for 25 head stock.
29	NE.	21	"	"	"	Dug	25	1,850					Glacial drift				Dry hole.
30	SW.	22	"	"	"	Spring		1,835	0	1,835			Glacial gravel	Hard	40	D, S	Plenty of water.
31	SE.	24	"	"	"	Dug	12	1,935	- 9	1,926			Glacial sand	Hard	44	D, S	Three other similar wells deliver a good supply of water.
32	SW.	25	"	"	"	Bored	106	1,920	- 66	1,854	106	1,814	Glacial gravel	Hard, "alkaline"	42	N	Many wells made to a maximum depth of 200 feet. The water is too highly mineralized to use.
33	NW.	26	"	"	"	Bored	68	1,890			68	1,822	Glacial sand and gravel	Hard	42	S	Abundant supply for 80 head stock; 18-foot well used for the house.
34	SW.	27	"	"	"	Dug	12	1,820	- 7	1,813			Glacial gravel	Hard	44	D, S	Good supply for 12 head stock.
35	NE.	28	"	"	"	Spring		1,820	0	1,820			Glacial gravel	Hard	44	D, S	Sufficient supply.
36	SW.	28	"	"	"	Dug	16	1,850	- 12	1,838			Glacial gravel	Hard	44	D, S	Good and constant supply.
37	SE.	29	"	"	"	Dug	16	1,860	- 12	1,848			Glacial gravel	Hard	43	D, S	Plenty of water.
38	NW.	32	"	"	"	Dug	20	1,915	- 15	1,900			Glacial drift	Hard	44	D	Intermittent supply.
39	NW.	32	"	"	"	Dug	90	1,910					Glacial drift				Dry hole; 14 dry holes 30 to 90 feet deep.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NORTH QU'APPELLE NO.187, 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
40	NW.	34	20	14	2	Spring		1,800	0	1,800			Glacial gravel	Hard		D, S	Many springs in the coulée; creek used for stock.
41	NE.	35	"	"	"	Dug	6	1,750	- 1	1,749	0	1,750	Recent stream sand	Hard, "alkaline"		S	Plenty of water.
42	NW.	36	"	"	"	Bored	39	1,855	- 19	1,836	39	1,816	Glacial sand	Hard	43	D, S	Good supply; also uses a dam to water 25 head stock.
1	SW.	7	20	15	2	Drilled	67	2,055	- 4	2,051	67	1,988	Glacial gravel	Hard	43	D, S	Abundant supply for 40 head stock.
2	NW.	7	"	"	"	Dug	20	2,060	- 18	2,042			Glacial drift	Hard		S	Poor supply; hauls water from section 18.
3	SE.	8	"	"	"	Dug	20	2,040	- 6	2,034			Glacial sand	Hard	43	D, S	Supply depends on rainfall; uses a dam in summer for stock.
4	NE.	8	"	"	"	Dug	21	2,050	- 3	2,047			Glacial drift	Hard	45	D,, S	Intermittent supply; uses a dam for stock in summer.
5	NW.	9	"	"	"	Dug	20	2,025	- 6	2,019			Glacial gravel	Hard	44	D	Intermittent supply; uses a dam in summer and melts snow in winter.
6	SW.	10	"	"	"	Dug	20	2,035	- 10	2,025	10	2,025	Glacial gravel	Hard	42	D	Sufficient for house use only.
7	NE.	11	"	"	"	Dug	20	1,960	- 10	1,950	10	1,950	Glacial gravel	Hard	42	D, S	Intermittent supply.
8	NW.	11	"	"	"	Dug	8	1,930	0	1,930			Glacial gravel	Hard		D, S	Abundant supply.
9	SE.	11	"	"	"	Dug	20	1,970	- 6	1,964			Glacial gravel	Hard	43	D, S	Plentiful supply.
10	NE.	13	"	"	"	Dug	14	1,940	- 10	1,930	10	1,930	Glacial fine sand	Hard, iron	45	D, S	Sufficient for 35 head stock.
11	NW.	14	"	"	"	Dug	20	1,980	- 15	1,965	15	1,965	Glacial gravel	Hard	42	D	Sufficient only for house use.
12	SE.	14	"	"	"	Dug	20	1,955	- 10	1,945	10	1,945	Glacial gravel	Hard	42	D	Sufficient only for house use.
13	SE.	15	"	"	"	Dug	23	1,940	- 3	1,937			Glacial sand	Hard	44	D, S	Abundant supply.
14	NW.	16	"	"	"	Drilled	300	2,025	- 10	2,015	300	1,725	Glacial gravel	Hard	41	D, S	Abundant supply of good water.
15	SE.	16	"	"	"	Dug	10	1,985	- 5	1,980	0	1,985	Glacial gravel	Hard	42	D	Abundant supply; uses a dam for stock.
16	NW.	17	"	"	"	Bored	85	2,050	- 5	2,045	85	1,965	Glacial gravel	Hard, iron		D, S	Abundant supply for 40 head stock.
17	SW.	18	"	"	"	Drilled	170	2,065	- 10	2,055	170	1,895	Glacial sand	Hard	42	D, S	Abundant supply.
18	SW.	21	"	"	"	Drilled	330	2,025	- 15	2,010	320	1,705	Glacial sand	Hard	42	D, S	Abundant supply.
19	SW.	22	"	"	"	Bored	100	2,000	- 25	1,975	100	1,900	Glacial gravel	Hard	44	D, S	Abundant supply.
20	NW.	23	"	"	"	Drilled	200	1,960					Glacial drift				Dry hole; uses a shallow seepage well and hauls water.
21	NE.	24	"	"	"	Dug	30	1,945					Glacial drift				Dry hole; cannot locate water; hauls water for stock and house.
1	NE.	12	20	16	2	Bored	60	2,050	- 24	2,026	60	1,990	Glacial fine white sand	Hard, iron, "alkaline"		D, S	Good supply for 100 head stock; cannot bail the well dry.
2	NE.	13	"	"	"	Bored	71	2,060	- 51	2,009	70	1,990	Glacial drift	Hard		S	Good supply for 10 head stock.
3	SW.	13	"	"	"	Dug	38	2,045	- 23	2,022	34	2,011	Glacial sand	Hard, "alkaline"		D, S	Barely sufficient for 15 head stock.

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WELL RECORDS—Rural Municipality of NORTH QU'APPELLE NO.187, 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
4	NE.	20	20	16	2	Drilled	290	2,010	- 30	1,980			Glacial sand	Hard, iron, "alkaline"		S	Sufficient for 20 head stock; hauls drinking water.
5	NW.	22	"	"	"	Bored	64	2,025			64	1,961	Glacial drift	Hard, iron		D, S	Good supply for 20 head stock; 1 dry hole 25 feet deep.
6	NW.	23	"	"	"	Bored	47	2,050	- 17	2,033	47	2,003	Glacial drift	Hard		D, S	Well has never been pumped dry.
7	NE.	24	"	"	"	Bored	65	2,045	- 8	2,037	65	1,980	Glacial gravel	Hard, iron		D, S	Well has never been pumped dry.
8	NE.	26	"	"	"	Bored	40	2,045	- 18	2,027	30	2,015	Glacial sand	Hard		D, S	Good supply for 35 head stock.
9	SE.	26	"	"	"	Bored	85	2,020	- 20	2,000	85	1,935	Glacial white sand	Hard, iron		D, S	Well has never been pumped dry.
10	NE.	28	"	"	"	Bored	60	2,020	- 25	1,995	60	1,960	Glacial sand	Hard, iron		D, S	Good supply for 20 head stock.
11	SE.	29	"	"	"	Bored	68	2,000	- 8	1,992	54	1,946	Glacial sand	Hard		D, S	Well has never been pumped dry.
12	SE.	31	"	"	"	Dug	6	1,975	+ 8	1,983	6	1,969	Glacial sand	Hard, iron		D, S	Well delivers 90 gallons of water an hour. #
13	NW.	32	"	"	"	Bored	40	1,980	- 20	1,960	40	1,940	Glacial sand	Hard, iron		D, S	Good supply for 40 head stock.
14	NE.	34	"	"	"	Drilled	310	2,015	- 60	1,955	310	1,705	Glacial fine sand	Hard, iron		D, S	Poor supply; sand has plugged well. Base of well now at 160 feet.
15	SE.	35	"	"	"	Bored	100	2,010					Glacial drift				The deepest of four dry holes; waters stock from NE. ¼. section 26.
1	SE.	1	21	13	2	Dug	7	1,850	- 5	1,845			Glacial gravel	Hard		D	Very small and insufficient supply.
2	SE.	3	"	"	"	Dug	15	1,595	- 10	1,585	10	1,585	Recent stream sand	Hard, "alkaline"	43	D	Seepage water from Lebret Lake.
3	SE.	3	"	"	"	Dug	12	1,800	- 8	1,792			Glacial gravel	Hard	43	D, S	Good supply for 10 head stock.
4	NW.	5	"	"	"	Dug	11	1,600	- 8	1,592	0	1,600	Recent stream sand	Hard, "alkaline"		S	Sufficient supply.
5	NE.	6	"	"	"	Dug	11	1,600	- 8	1,592			Recent stream sand	Hard		D	Good supply for house use.
6	NW.	6	"	"	"	Dug	25	1,595	- 17	1,578			Recent gravel	Soft	43	D, S	Sufficient for 1,000 foxes.
7	NE.	7	"	"	"	Dug	20	1,595	- 12	1,583	12	1,583	Recent gravel	Hard	44	D	Seepage from Qu'Appelle River.
8	NW.	7	"	"	"	Dug	16	1,600	- 13	1,587	13	1,587	Recent sand and gravel	Hard	44	D	Seepage from Echo Lake.
9	NE.	8	"	"	"	Dug	16	1,590	- 10	1,580	10	1,580	Recent stream sand	Hard, "alkaline"		D, S	Seepage from Lebret Lake; uses lake for stock.
10	NW.	9	"	"	"	Dug	18	1,590	- 13	1,577	13	1,577	Recent stream sand	Hard, "alkaline"		D	Seepage from Lebret Lake.
11	NW.	11	"	"	"	Dug	14	1,600	- 4	1,596			Recent stream sand	Hard	43	D, S	Sufficient for 10 head stock.
12	SW.	12	"	"	"	Dug	24	1,620	- 11	1,609			Glacial drift	Hard, "alkaline"	42	D, S	Supply depends on rainfall.
13	NW.	12	"	"	"	Dug	16	1,875	- 10	1,865			Glacial sand and gravel	Soft	44	D, S	Sufficient supply; uses another 20-foot well for the house also.
14	SE.	13	"	"	"	Drilled	250	1,865	-160	1,705	250	1,615	Glacial fine sand	Hard, iron, "alkaline"	42	S	Abundant supply; uses a 24-foot well for household purposes.
15	NW.	14	"	"	"	Bored	40	1,900	- 30	1,870	30	1,870	Glacial sand	Hard, "alkaline"	43	S	Good supply; uses a 32-foot well for the house

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NORTH QU'APPELLE NO.187, 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	NW.	15	21	13	2	Dug	14	1,890	- 8	1,882			Glacial drift	Hard, "alkaline"	43	D, S	Sufficient for 15 head stock.
17	SE.	16	"	"	"	Bored	30	1,860	- 26	1,834	26	1,834	Glacial fine sand	Hard		D, S	Abundant supply; also uses another 30-foot well.
18	SW.	18	"	"	"	Bored	65	1,625	- 63	1,562			Glacial drift	Hard		D	Water level varies with level of the lake.
19	SW.	18	"	"	"	Dug	10	1,580	- 7	1,573			Recent stream sand	Hard		D, S	Plenty of water.
20	SE.	19	"	"	"	Dug	20	1,850	- 16	1,834			Glacial sand	Hard	43	D, S	Fair supply; uses sloughs for stock when possible.
21	SW.	20	"	"	"	Dug	16	1,850	- 10	1,840			Glacial drift	Hard	44	S	Intermittent supply.
22	NW.	21	"	"	"	Bored	60	1,890	- 45	1,845	60	1,830	Glacial fine sand	Hard, "alkaline"		S	Good supply but troubled with sand plugging.
23	SE.	22	"	"	"	Dug	27	1,910	- 24	1,886	24	1,886	Glacial sand	Hard		D, S	Sufficient supply.
24	NW.	23	"	"	"	Dug	14	1,900	- 7	1,893			Glacial fine sand	Hard		D, S	Sufficient for 20 head stock. Sand often fills in and closes off the supply.
25	NW.	24	"	"	"	Dug	22	1,875	- 10	1,865			Glacial gravel	Hard		D	Uses a dam for stock; sufficient for 40 head stock.
26	SW.	26	"	"	"	Bored	60	1,900	- 35	1,865	60	1,840	Glacial sand and gravel	Hard, "alkaline"		D	Another similar well used for stock. Plenty of water.
27	NE.	27	"	"	"	Bored	40	1,920	- 15	1,905	18	1,902	Glacial sand and gravel	Hard		D, S	Abundant supply.
28	SW.	27	"	"	"	Dug	20	1,900	- 9	1,891			Glacial sand	Hard	44	D, S	Sufficient supply. 8 dry holes to a maximum depth of 90 feet.
29	NW.	28	"	"	"	Bored	60	1,925	- 40	1,885	60	1,865	Glacial fine sand	Hard	43	D, S	Abundant supply.
30	SE.	28	"	"	"	Bored	64	1,905	- 58	1,847			Glacial sand	Hard, cloudy	43	S	Good supply; uses 16-foot seepage well for the house.
31	SW.	29	"	"	"	Dug	16	1,900	- 13	1,887			Glacial drift	Hard, "alkaline"		D, S	Intermittent supply.
32	SW.	30	"	"	"	Dug	20	1,800	- 18	1,782			Glacial drift	Hard, "alkaline"	43	S	Several shallow seepage wells. Insufficient supply in winter.
33	NE.	31	"	"	"	Drilled	87	1,920	- 12	1,908	85	1,835	Glacial sand and gravel	Hard, "alkaline"	41	S	Abundant supply; uses 16-foot well for drinking water.
34	NE.	32	"	"	"	Bored	30	1,920	- 16	1,904	30	1,890	Glacial gravel	Soft	43	D, S	2 other wells 30 and 42 feet deep; plenty of water.
35	SW.	32	"	"	"	Dug	16	1,900	- 9	1,891			Glacial drift	Hard, "alkaline"	43	D, S	Intermittent supply.
36	SE.	32	"	"	"	Dug	20	1,915	- 17	1,898			Glacial drift	Hard	42	D	Another 10-foot well used for stock.
37	SE.	34	"	"	"	Bored	35	1,935	- 25	1,910	35	1,900	Glacial sand	Hard, iron	43	D, S	Sufficient supply.
38	SW.	35	"	"	"	Bored	40	1,940	- 25	1,915	40	1,900	Glacial sand	Hard, iron		D, S	Sufficient supply.
39	SE.	36	"	"	"	Dug	18	1,950	- 12	1,938			Glacial fine sand	Hard		N	A good well before it partially caved in.
40	SW.	36	"	"	"	Bored	32	1,950	- 24	1,926			Glacial fine sand	Hard	44	D, S	Well is seldom used; has not been cribbed.
1	NW.	1	21	14	2	Dug	20	1,850	- 17	1,833			Glacial fine sand	Hard		D, S	Intermittent and insufficient supply.
2	SW.	1	"	"	"	Dug	10	1,800	0	1,800			Glacial gravel	Hard		D, S	Freezes in winter. Fair supply for 15 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 .....

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
3	NE.	3	21	14	2	Dug	18	1,750	- 14	1,736			Glacial gravel	Hard		D, S	Insufficient supply.
4	NE.	5	"	"	"	Dug	20	1,855	- 14	1,841			Glacial sand	Hard, "alkaline".		D, S	Sufficient for 25 head stock.
5	SE.	9	"	"	"	Bored	60	1,870	- 43	1,827	60	1,810	Glacial fine sand	Hard, iron, "alkaline"		D, S	Good supply.
6	NW.	10	"	"	"	Bored	90	1,850	- 75	1,775			Glacial sand and gravel	Hard, iron, "alkaline"		D, S	Sufficient for 25 head stock.
7	SE.	10	"	"	"	Bored	100	1,860					Glacial drift				2 dry holes 75 and 100 feet deep.
8	NE.	13	"	"	"	Dug	15	1,590	- 8	1,582			Recent stream sand	Hard, iron, "alkaline"	42	D, S	Sufficient supply.
9	SW.	14	"	"	"	Dug	22	1,855	- 20	1,835	20	1,835	Glacial fine sand	Hard	42	D	Another 12-foot well used for stock.
10	SW.	16	"	"	"	Bored	30	1,885	- 25	1,860			Glacial gravel	Hard, "alkaline"	43	D, S	Varies with weather conditions.
11	SE.	16	"	"	"	Bored	75	1,860	- 50	1,810			Glacial drift	Hard, iron, "alkaline"	43	S	Good supply for 20 head stock.
12	NE.	17	"	"	"	Dug	13	1,800	- 9	1,791			Glacial gravel	Hard	43	D	Sufficient for house use; also owns a 15-foot well.
13	NW.	17	"	"	"	Dug	4	1,850	+ 4	1,854			Glacial sandy clay	Hard, iron	42	D, S	Abundant supply; a spring.
14	SW.	17	"	"	"	Dug	12	1,875	- 9	1,866			Glacial fine sand	Hard	44	D, S	Fair supply, insufficient in dry years. Hauls water from the lake.
15	NE.	24	"	"	"	Drilled	90	1,665	- 15	1,650	47	1,618	Glacial sand and gravel	Hard	42	D, S	Delivers 60 to 120 gallons a minute; 2 other similar wells.
16	SE.	24	"	"	"	Bored	51	1,625	- 42	1,583			Glacial sand and gravel	Hard, "alkaline"	42	D	Sufficient supply.
17	NW.	25	"	"	"	Drilled	162	1,910	-156	1,754	156	1,754	Glacial gravel	Hard, iron	40	D, S	Abundant supply.
18	SW.	29	"	"	"	Drilled	250	1,850	-215	1,635	250	1,600	Glacial gravel	Hard	40	D, S	Good supply for 35 head stock.
19	NW.	30	"	"	"	Dug	27	1,905					Glacial drift				Dry hole; shallow seepage well used for drinking.
20	NE.	30	"	"	"	Dug	16	1,890	- 13	1,877			Glacial drift	Soft	43	D, S	Sufficient for 12 head stock.
21	SW.	30	"	"	"	Dug	12	1,885	- 9	1,876			Glacial sand	Hard	43	S	Poor and insufficient supply. Hauls water and uses sloughs.
22	NW.	31	"	"	"	Dug & Bored	90	1,910	- 50	1,860			Glacial clay	Hard, "alkaline"	43	N	Poor supply; hauls water for house and stock use.
23	NE.	35	"	"	"	Dug	20	1,915	- 14	1,901			Glacial sand	Hard	44	D, S	Seepage well; sufficient for only 9 months of the year.
24	SW.	36	"	"	"	Dug	16	1,905	- 11	1,894			Glacial fine sand	Hard	44	D, S	Sufficient supply.
25	NW.	36	"	"	"	Bored	16	1,910	- 12	1,898	12	1,898	Glacial fine sand	Hard	43	D, S	Good supply; another 10-foot well yields a good supply.
1	SW.	15	21	15	2	Spring		1,620	0	1,620			Glacial sand	Hard, "alkaline"		D, S	Sufficient supply.
2	NW.	16	"	"	"	Dug	12	1,590	- 7	1,583			Recent stream sand	Hard, "alkaline"		D, S	Seepage water from Qu'Appelle Lake.
3	NE.	22	"	"	"	Drilled	126	1,910	- 25	1,885	125	1,785	Glacial sand	Hard	42	D, S	Abundant supply.
4	SW.	23	"	"	"	Spring		1,800	0	1,800			Glacial sand	Hard		D, S	Good supply.
5	NE.	24	"	"	"	Bored	87	1,900	- 72	1,828			Glacial sand	Hard, "alkaline"	43	S	Poor supply since well has caved in at the base.

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 NORTH QU'APPELLE NO. 187, 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.	25	21	15	2	Bored	54	1,905	- 22	1,883	54	1,851	Glacial sand	Hard, "alkaline"	43	D, S	Barely sufficient in winter.
7	NW.	26	"	"	"	Bored	12	1,910	- 9	1,901			Glacial clay	Hard	43	D, S	Intermittent supply. Hauls water for stock.
8	NW.	27	"	"	"	Dug	9	1,915	- 6	1,909			Glacial clay	Hard, "alkaline"	43	D, S	Slough seepage, very poor supply; short of water.
9	SE.	30	"	"	"	Dug	16	1,910	- 13	1,897			Glacial clay	Hard	43	D, S	Fair supply; also uses a 20-foot well for stock.
10	NE.	30	"	"	"	Dug	15	1,915	- 12	1,903			Glacial clay	Hard, "alkaline"	44	D, S	Seepage well, poor supply.
11	NW.	32	"	"	"	Dug	15	1,905	- 11	1,894			Glacial clay	Hard, "alkaline"	44	D, S	Slough seepage water; very poor supply.
12	NE.	32	"	"	"	Dug	12	1,910	- 10	1,900			Glacial clay	Hard, "alkaline"		D, S	Very poor and insufficient supply. Several seepage wells.
13	NE.	34	"	"	"	Dug	20	1,915	- 16	1,899			Glacial clay	Hard	42	D, S	Barely sufficient for 10 head stock.
14	SW.	35	"	"	"	Drilled	335	1,920					Glacial drift?				Dry hole.
15	NW.	36	"	"	"	Bored	30	1,915	- 22	1,893			Glacial clay	Hard, "alkaline"	40	D, S	Sufficient for 10 head stock.
16	SE.	36	"	"	"	Bored	84	1,910	- 59	1,851	84	1,826	Glacial gravel	Hard, "alkaline"	41	N	Plenty of water that is too mineralized for use.
1	NE.	19	21	16	2	Dug	15	1,840	0	1,840	9	1,831	Glacial gravel				Well dried up in 1933. Water is hauled and stock watered at river.
2	NE.	22	"	"	"	Dug	12	1,870	0	1,870			Glacial drift	Hard		D	Seepage from a dugout; hauls water. Tests to 30 feet reveal no water.
3	SW.	22	"	"	"	Dug	14	1,625	- 8	1,617			Glacial sand	Hard, "alkaline"		D, S	Sufficient supply; uses the river for watering stock.
4	NE.	25	"	"	"	Bored	100	1,900					Glacial drift				The deepest of several dry holes.
5	NW.	25	"	"	"	Bored	70	1,905	- 30	1,875	70	1,835	Glacial fine sand	Hard, "alkaline"		S	Well has never been pumped dry. Neighbours haul from here.
6	SE.	26	"	"	"	Bored	90	1,895	- 60	1,835	90	1,805	Glacial gravel	Hard, "alka-		S	Sufficient for 25 head stock only. Seepage well used for house.
7	NW.	27	"	"	"	Dug	20	1,875	- 16	1,859			Glacial drift	Hard, "alkaline"		D, S	Intermittent supply; hauls water ½ a mile.
8	NE.	28	"	"	"	Dug	16	1,900	- 8	1,892	12	1,888	Glacial gravel	Hard		D, S	Sufficient for 35 head stock.
9	SW.	29	"	"	"	Dug	24	1,915	0	1,915			Glacial sand	Hard		D, S	Intermittent supply; hauls water from a spring in the valley.
10	NW.	29	"	"	"	Dug	20	1,905	0	1,905	12	1,893	Glacial gravel	Hard		D, S	Intermittent supply; owns 2 other shallow wells, melts snow in winter.
11	SE.	29	"	"	"	Dug	22	1,910	- 12	1,898			Glacial gravel	Hard		D, S	Very poor supply; waters stock in Qu'Appelle valley.
12	NW.	30	"	"	"	Dug	72	1,900	- 48	1,852	72	1,828	Glacial gravel	Hard, iron		D, S	Abundant supply for 25 head stock.
13	SE.	30	"	"	"	Dug	12	1,915	0	1,915			Glacial sandy clay	Hard		D, S	3 similar wells yield enough water for 18 head stock.
14	SW.	30	"	"	"	Dug	17	1,910	0	1,910			Glacial clay	Soft		D, S	Barely sufficient for 8 head stock.
15	SE.	31	"	"	"	Bored	65	1,880	- 49	1,831	55	1,825	Glacial sand	Hard, iron		D, S	Sufficient for 25 head stock; 1 dry hole 115 feet deep.
16	SW.	31	"	"	"	Dug	18	1,905	0	1,905			Glacial clay	Hard		D, S	Intermittent supply; melts snow in winter for 17 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 NORTH QU'APPELLE NO.187, 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
17	NW.	32	21	16	2	Dug	14	1,900	0	1,900			Glacial drift	Hard		D, S	Several shallow seepage wells supply the farm; hauls water.
18	SE.	32	"	"	"	Bored	60	1,870	- 38	1,832	60	1,810	Glacial gravel	Hard, iron		N	Not in use; uses sloughs and seepage wells for 7 head stock.
19	NW.	34	"	"	"	Bored	76	1,850	- 14	1,836	76	1,774	Glacial fine sand	Hard, "alka-		S	Abundant supply; seepage well used for the house.
20	SE.	35	"	"	"	Bored	140	1,885					Glacial drift				Dry hole; 4 other dry holes on this quarter section.
21	NE.	35	"	"	"	Bored	70	1,870	- 37	1,833			Glacial coarse sand	Hard, iron, "alkaline"		S	Good supply, uses a shallow well for household purposes.
22	SE.	36	"	"	"	Dug	16	1,885	0	1,885			Glacial clay	Soft		D, S	Several wells in sloughs together supply 30 head stock.
23	NW.	36	"	"	"	Bored	78	1,870	- 48	1,822	78	1,792	Glacial sand	Hard, "alkaline"		S	Good supply.
								PASQUA INDIAN RESERVE NO. 79.									
1		1. R.				Drilled	315	1,950					Glacial drift?				Dry hole.
2		1. R.				Drilled	200	1,950					Glacial drift	Hard		D, S	One other 200-foot drilled well in use. 3 deep drilled wells are abandoned.

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