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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF LAKE JOHNSTON No. 102 SASKATCHEWAN

BY

B. R. MacKay & H. H. Beach

Water Supply Paper No. 16

OTTAWA

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF LAKE JOHNSTON, NO. 102, 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 purposes and the smaller supplies of ground water required for domestic and stock-raising purposes by settlers, villages, and Indian reserves. The drought conditions resulted in repeated crop failures, and in a large number of farms in the acute drought areas of Saskatchewan and Alberta being abandoned. In an effort to relieve the serious situation a number of special studies of the water problem were begun by both Federal and Provincial Governments and allied organizations. The Federal Department of Agriculture undertook among other phases of the drought problem an investigation into the existing supplies of surface water, their conservation by means of dams and dug-outs, and how they could be made more generally available for irrigation. The Geological Survey of the Federal Department of Mines began an extensive study of the underground water conditions of southern Saskatchewan, this water being used principally for domestic and stock-raising purposes. For many years past the water problems in this and other provinces of Canada have engaged the attention of the Geological Survey, and considerable information had already been collected. A number of short reports dealing with the ground water conditions of special areas in Manitoba, Saskatchewan and Alberta have been published by both the Federal and Provincial Geological Surveys, but no systematic study of the ground water resources has been made up to the present.

Field Work

The senior author was in charge of this investigation and was instructed to cover as much of the territory as possible in the season. To effect this it was decided to maintain an

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 wellsite is obtained by marking its position on the map, Figure 2, and estimating its elevation with respect to the two contour lines between which it lies and whose elevations are given on the figure. Where contour lines are not shown on the figure, the elevations of adjacent wells as indicated in the Table of Well Records accompanying each report can be used. The approximate elevation of the water-bearing horizon at the wellsite 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 wellsite.[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 wellsite 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.

GLOSSARY OF TERMS USED

Alkaline. The term "alkaline" has been applied rather loosely to some ground waters. In the Prairie Province 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 area.

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 Lake Johnston covers an area of 240 square miles, the centre of which is located 2 miles south of the town of Ardill or 35 miles southwest of Moose Jaw. The municipality is bounded on the east by Lake of the Rivers and the line between ranges 27 and 28, and on the west by the 3rd meridian. It is bounded on the south by the line between townships 9 and 10, and on the north by the line between townships 12 and 13. Part of the northern portion of the area is covered by Johnstone lake.

The municipality has a moderate relief rising from an elevation of 2,186 feet above sea-level at Johnstone lake to a maximum height of a little over 2,400 feet near the southwestern corner, and then falling away to 2,203 feet at the eastern boundary at Lake of the Rivers.

Water-bearing Horizons in the Unconsolidated Deposits

The character and quantities of the ground water available in the various parts of this municipality are closely related to changes in the character of the sediments throughout the area. The ground water occurs in the following deposits: Recent stream sands and gravels in the valley west of Ardill, and Recent lake sands bordering Johnstone lake; glacial sands and gravels in the central and northeastern parts of the area; and underlying bedrock formations.

Recent sands and silts cover the bottom of the valley extending along the northern edge of township 11, range 29, to depths not exceeding 40 feet. Thin beds of gravels occur irregularly interspersed in the silts. Wells penetrating coarse sand or gravel beds yield large supplies of hard, clear water. The yield from the silts is materially less and much of the water is "alkaline" salts. It may be necessary to sink several test holes before a productive gravel bed is encountered, as there is little or no

evidence on the surface of the existence of the gravel beds.

The lake sands cover a basin now occupied in part by Johnstone and Frederick lakes to depths of 20 to 40 feet. A layer of boulder clay of undetermined thickness underlies the lake sands. Little difficulty has been experienced in obtaining water from the sands at shallow depths. The Glauber's Salts content of the water is, however, very high. Many of the wells lying within half a mile of the lakes yield water which is unfit for human consumption and probably harmful to stock. Farther from the lake small supplies of water suitable for household use have been obtained in wells not exceeding 10 feet in depth. Below this depth, however, the "alkali" content of the water increases, rendering it unfit for drinking. Neither Johnstone nor Frederick lake can be used for watering stock, as the combined Glauber's Salt (Na_2SO_4) and Epsom Salts ($MgSO_4$) content of the water is in excess of 6,000 parts per million.

Glacial deposits showing marked variations in both composition and thickness cover the remainder of the municipality. The drift is composed largely of yellow boulder clay which grades into blue-grey clay at depth. Due to the impervious nature of the clay only small seepages are obtainable from it, and these are usually too "alkaline" to be used for household supply. In several places, however, the drift is thicker and its surface becomes more irregular, such deposits being generally known as terminal moraines. Fairly extensive pockets or beds of sand and gravel are interspersed through the clay in the morainic areas, thus forming reservoirs for large supplies of water that has seeped down from the surface. In the northeastern and central parts of the area the glacial deposits are the best source of water. To the south the sand and gravel pockets become fewer and less extensive and wells penetrating them yield only sufficient water for household use, the stock being watered from wells sunk through the drift into the underlying bedrock formations.

The thickness of the glacial deposits is extremely variable, being negligible along the Lake of the Rivers and increasing to more

than 60 feet over parts of the southern highlands. It is quite possible that more extensive drilling in the area will prove the existence of buried streams channels.

Water-bearing Horizons in the Bedrock

The Ravenscrag, Whitemud, Eastend, and Marine Shale bedrock formations occur beneath the glacial deposits in this municipality. The Ravenscrag, consisting of yellow-brown clays and shales, blue sand beds, and occasional coal seams, immediately underlies the drift throughout the southern and southeastern parts of the municipality. This formation extends downward to an approximate elevation of 2,220 feet above sea-level. Some 25 feet of white to light buff clays, known as the Whitemud, are found under the Ravenscrag along the Lake of the Rivers but its lateral extent throughout the area is not definitely known. The fine grey sands and silts of the Eastend underlie the Whitemud or Ravenscrag in the southeastern quarter of the municipality, and lie immediately beneath the drift throughout the remainder of the area, where the Ravenscrag has been eroded away. The Eastend becomes shaly below elevations of 2,180 feet and grades downward into the Marine Shale. This shale is easily recognizable by its very dark colour when wet, the roughly cubical shape of its small component fragments, and the lack of stones or gravel beds.

Large supplies of medium hard water suitable for stock use are obtainable from the lower part of the Ravenscrag between elevations of 2,260 and 2,220 feet throughout the entire area underlain by this formation. The water contains considerable amounts of iron and occasionally sodium sulphate which, in some cases, render it unfit for household use. The upper coarse sands of the Eastend formation yield similar quantities of a softer, usually soda-bearing, water. At greater depths into the Eastend the yield becomes smaller and highly "alkaline", and

resembles supplies from the underlying Marine Shale. The small seepages of water from the shale are usually too highly mineralized to be used either in the household or for watering stock. Deep drilling below an elevation of 2,170 feet above sea-level in any part of this municipality probably will not yield any water suitable for farm use.

GROUND WATER CONDITIONS BY TOWNSHIPS

Part of Township 10, Range 28, West of Lake of the Rivers

Ground water supplies of this township are derived from the glacial drift and from the Ravenscrag and Eastend bedrock formations.

A mantle of glacial drift varying from 25 to 65 feet in thickness covers the entire area, forming irregular morainic hills in the southwest corner and grading into a more level blanket over the northern part. The drift is largely composed of boulder clay with occasional isolated pockets of sand and gravel which do not form extensive water-bearing horizons. Due to the irregular distribution of the pockets, it is impossible to predict where water will be found in the drift, and several dry holes may be dug before a supply is obtained. Although the small seepages derived from the clay are usually too "alkaline" for farm use, water from the gravel and sand pockets is suitable for household needs. This later source in most cases yields the best drinking water to be obtained in the township, but the supply is insufficient for more than a few head of stock.

In general, the glacial deposits are to be regarded as the main source of well water for household use. When any large number of stock are to be watered, boring or drilling into the underlying bedrock seems advisable. Adequate supplies of water for local stock requirements are obtainable throughout the township from the blue sands and coal seams in the Ravenscrag bedrock formation at

elevations of 2,275 and 2,245 feet above sea-level. The water is hard and contains appreciable amounts of salts and iron, and is generally unsuitable for household use. Two wells located in NW. $\frac{1}{4}$, section 20, and SW. $\frac{1}{4}$, section 28 yield large supplies of slightly "alkaline," but drinkable water from a fine grey sand bed at elevations of 2,218 and 2,190 feet. This bed forms the upper part of the Eastend formation, which immediately underlies the Lower Ravenscrag at an approximate elevation of 2,220 feet throughout the western half of the township. It is probable that this extensive horizon will be found equally productive throughout all parts of the township. Below this elevation the yield is materially less and generally too highly mineralized for domestic use. The Marine Shale underlies the whole township at an approximate elevation of 2,175 feet above sea-level. Since only comparatively small seepages of "alkaline," and salty water can be expected from this formation, drilling should be confined to the glacial drift, and to the Ravenscrag and upper part of the Eastend bedrock formation.

Township 10, Range 29

A mantle of boulder clay, nowhere exceeding 70 feet in thickness, overlies the entire township. Although the boulder clay itself gives little water, wells penetrating isolated sand pockets form a source of small supplies of slightly "alkaline" but drinkable water. Since these sand pockets do not form a continuous productive horizon, several dry holes may be dug before an adequate supply is obtained. Larger supplies, usually sufficient for 25 to 50 head of stock, are found throughout the central and northern parts of the township, in blue sands underlying coal seams in the Lower Ravenscrag at elevations between 2,350 and 2,300 feet, or at depths varying from 65 to 110 feet from the surface. This water is not always suitable for household use, due to the high salt and iron content. A thick bed of

sand, forming either the base of the Ravenscrag or the upper part of the Eastend formation, immediately underlies the drift in the southeast corner and the northern sections of the township at depths of 80 to 100 feet from the surface. Individual wells sunk to this horizon yield sufficient water for about 25 head of stock, but the high Glauber's Salt content of the water makes it quite unfit for household use. The iron content of the water from the Eastend appears to increase with depth, as evidenced by the wells located in the northeast quarters of sections 4 and 14. The Eastend is believed to grade downward into the Marine Shale, which underlies the entire township, at about 2,225 feet above sea-level. The poor water conditions known to exist in the lower Eastend and in shale do not warrant wells being sunk deeper than 150 feet in any part of the area.

Two wells are generally necessary to meet the water requirements of the average farm in this district, a shallow well dug into the drift to provide the household, and a deeper bored or drilled well into the Lower Ravenscrag or Eastend bedrock formations for watering stock.

Township 10, Range 30

This township consists of a block of eighteen sections bounded on the west by the 3rd meridian. Water conditions throughout the area are very poor. Several wells are dry and many others give only small amounts of undrinkable, "alkaline" water. Supplies suitable for household use are confined to the small pockets of sand and gravel that are irregularly interspersed through the boulder clay that covers the entire area. The clay itself yields only small, highly "alkaline" seepages, but water from the sand pockets is usually potable and present in sufficient quantities to water a few head of stock. Since the sand pockets do not form a continuous water-bearing horizon over any large area it may be necessary to dig several wells before an adequate supply is obtained.

In the northern and central parts of the township wells sunk to depths of 40 to 90 feet reach the basal sands of the Ravenscrag or the fine grey sands of the underlying Eastend formation and produce sufficient water for stock requirements of the average farm. The water is, however, high in iron and "alkali" which makes it usually unfit for human consumption and not always suitable for stock. Several holes drilled in the southern part of the township were dry, indicating that the bedrock is not productive in this part of the township. The Marine Shale underlies the entire township below an elevation of about 2,230 feet above sea-level. Suitable supplies of water for farm use cannot be expected from this formation and drilling below 100 feet is not advisable in any part of the area.

Township 11, Range 28

Fairly large supplies of ground water may be derived from the glacial deposits and from the underlying Ravenscrag and Eastend bedrock formations in this township on both sides of the Lake of the Rivers. The glacial drift on the upland areas consists of some 50 to 60 feet of boulder clay. Throughout the southern and central parts of the township shallow wells penetrating small, irregular sand and gravel pockets in the drift yield sufficient quantities of hard, drinkable water for both household and stock requirements. The sand and gravel pockets become smaller and less numerous toward the northern boundary of the township and many of the shallow wells yield only enough water for household use; others, dug entirely in clay, are dry.

Much larger supplies of water suitable for stock use can be expected from the underlying bedrock formations. There are two productive horizons in the bedrock of this township. The first horizon consists of a bluish grey sand beneath a coal seam in the lower part of the Ravenscrag, encountered at elevations between

2,265 and 2,240 feet above sea-level in the two small areas in the south-central and northeastern parts of the township. Supplies obtainable are usually sufficient for local requirements, but a variable iron and "alkali" content occasionally renders the water unfit for drinking.

The second horizon is in the Eastend formation, which immediately underlies the drift throughout the remainder of the township. It is encountered at depths of 60 to 90 feet, depending upon the elevation of the ground surface. The supply available from this horizon is large, but the water contains large amounts of iron and sulphate salts and is rarely suitable for domestic use. One well, situated in SW. $\frac{1}{4}$, section 18, yields large quantities of "alkaline", but drinkable, water from sand below a coal seam. It is probable that the Ravenscrag extends over the Eastend formation over a small area in sections 16, 17, and 18, from which usable water can be expected at depths of 65 to 110 feet. Drilling below a depth of 125 feet in the highland parts, or 60 feet on the lower land of this township, is not advisable since the entire township is underlain at that depth by the non-water-bearing Marine Shale.

Township 11, Range 29

A layer of 35 to 50 feet of yellow and blue boulder clay interspersed with irregular pockets of sand and gravel covers the entire township with the exception of the most northerly part. Here sands and silts interspersed with thin layers of gravel have partly filled an east-west trending valley which at one time formed a water course joining lake Johnstone and Lake of the Rivers. Shallow wells sunk into the sands and silts yield small quantities of water of poor quality. The gravels form much larger reservoirs and yield large quantities of only slightly mineralized water. A mantle of glacial drift covers the entire

township, with the exception of the bottom of the northern valley. Shallow wells penetrating the small, irregular pockets of sand and gravel in the boulder clay provide water for domestic use in nearly all parts of the area. The gravel pockets in the drift are much larger and more extensive in the central and extreme northern parts of the township. Here wells sunk to depths not exceeding 60 feet yield adequate supplies of hard, slightly "alkaline" water for all farm requirements, and little is gained by sinking wells into the underlying Eastend formation.

Throughout the remainder of the drift-covered area the supply obtainable is not sufficient for any large number of stock. It then becomes advisable to sink wells down to an approximate elevation of 2,200 feet above sea-level into the fine sands of the Eastend formation. The supply to be expected is amply sufficient for all stock requirements, but the highly mineralized nature of the water makes it generally unfit for domestic use.

The poorly productive Marine Shale underlying the entire township is at an approximate elevation of 2,180 feet. Hence, it is inadvisable to sink wells to depths greater than 165 feet in the highest part of the township or much below 100 feet in the area bordering the valley.

Township 11, Range 30

This area consists of approximately twelve sections, bounded on the west by the 3rd meridian. A fairly uniform layer of glacial drift, composed of blue clay interspersed with irregular pockets of sand and gravel, covers the southern and central parts of the area. The northern part is covered by lake sands laid down when lake Johnstone was more extensive than it is at the present time.

Small seepages of hard, generally slightly "alkaline", but drinkable water are to be expected in shallow wells encountering sand pockets in the drift-covered area. The supply, however, is not generally sufficient for more than household needs and it

becomes necessary to sink wells into the underlying bedrock in order to obtain sufficient water for stock. Shallow wells sunk into the lake sands in the northern part can be expected to yield sufficient quantities of water for average farm requirements and deeper drilling into the bedrock is usually unnecessary. It seems advisable in the vicinity of the town of Mossbank to confine efforts to obtain drinking water to the glacial drift or lake sands within 40 feet of the surface. The Eastend formation underlies the glacial drift and lake sands at depths of about 50 feet. The supply from wells sunk to this horizon is generally large, but the water is highly mineralized and suitable only for stock use. Drilling much below a depth of 75 feet seems inadvisable in any part of this township.

Township 12, Range 28

A variable thickness of blue clay containing fairly extensive beds of sand and gravel forms the terminal moraine that covers all but the northwest corner of the area, occupied by Frederick lake and part of Johnstone lake. Lake sand deposits, to depths of not less than 25 feet, cover an area about ½ mile wide along the shore of Johnstone lake and form a much narrower band around Frederick lake.

Nearly all of the wells located in the lake sand area of the northwestern corner show a much higher concentration of sodium sulphate which in many cases renders the water unfit for household use. Springs situated along the railway tracks south of Frederick lake yield a very hard, highly "alkaline" water which should not be used for stock if better supplies are available. On the narrow strip of land between Johnstone lake and Frederick lake other springs exist. Water from this source is similar to supplies from the lakes themselves, being highly charged with Glauber's Salt and Epsom Salts and quite unfit for farm use.

Little difficulty is experienced in obtaining adequate supplies of water for farm use throughout the area covered by terminal moraine. It is improbable that the layers form continuous water-bearing beds throughout large areas, but wells sunk to depths of 25 feet or less have obtained fairly large supplies of drinkable water on nearly every section in this part of the area. Only in the extreme southwest corner where the gravel deposits are not so extensive has the water been found to be more than slightly "alkaline".

The generally good water conditions existing in the glacial deposits over the greater part of the township have made the sinking of wells into the underlying Eastend formation largely unnecessary. A very definite productive horizon is known to exist, however, at least over the central part of the area, at an elevation between 2,210 and 2,200 feet above sea-level. This horizon is in the fine grey sands of the Eastend formation. Several wells, situated in NE. ¼, section 7, NE. ¼, section 8, and NW. ¼, section 15, have encountered this horizon at depths varying from 35 to 75 feet depending on the elevation of the ground surface. The yield from the Eastend is large, but as in other areas in the municipality the water is unfit for human consumption although it is generally suitable for stock. The Eastend sands grade downward into the Marine Shale at approximately 2,180 feet above sea-level. Drilling below this elevation in any part of the township probably will not yield adequate supplies of water suitable for farm use.

Township 12, Range 29

A layer of lake sands of undetermined thickness covers the entire land area of the township with the exception of the southeast corner. Here the layer of glacial drift that underlies the lake clay in the central part of the township appears at the surface.

Water is obtainable from the lake sands within one mile from the lake. It is generally too highly "alkaline", however, to

be used for domestic purposes. More remote from the lake wells less than 20 feet deep yield a water that although "alkaline" is used for drinking.

Larger supplies are obtained at depths ranging from 20 to 40 feet, but the water is suitable only for stock. Several farms have two wells, a shallow one for household supply and a deeper well for stock. Many fairly extensive beds and isolated pockets of sands and gravels exist in the drift covering the southeastern corner of the township. Large supplies of hard, slightly "alkaline" water are derived from wells sunk to depths varying from 40 to 70 feet. This water is generally suitable for all farm requirements. Drilling below this depth in this part of the area does seem advisable, since the water from the underlying Eastend formation is likely to be more highly "alkaline". Throughout part of the township covered by lake sands wells sunk to depths of 40 to 50 feet, penetrating the Eastend, can be expected to yield sufficient quantities of water for local stock requirements. No water suitable for household use can be expected, however, at depths much greater than 30 feet.

Township 12, Range 30

Lake sands cover this entire area to an undetermined depth. All producing wells in this township derive sufficient water for local requirements at depths of less than 35 feet. This horizon is believed to be productive over practically the entire area. The water as a rule is of good quality, but toward the northern boundary, the "alkali" content increases. No information is available in regard to the water conditions of the underlying bedrock, due to the lack of deeper drilling. It is possible, however, that the fine grey Eastend sands which immediately underlie the lake sand deposits in the township to the east may yield fair supplies of water suitable for stock in this

area at elevations above 2,185 feet above sea-level. Drilling below this elevation will encounter the Marine Shale which does not yield a supply suitable for farm use.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF LAKE JOHNSTON, NO. 102, SASKATCHEWAN

West of 2nd meridian — Township / Range	10 / 28	10 / 29	10 / 30	11 / 28	11 / 29	11 / 30	12 / 28	12 / 29	12 / 30	Total No. in Municipality
Total No. of Wells in Township	15	52	23	37	36	14	36	23	5	241
No. of wells in bedrock	11	20	10	21	15	2	15	9	0	103
No. of wells in glacial drift	4	32	13	16	21	12	21	14	5	138
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply										
No. with permanent supply	15	44	16	32	35	14	25	23	4	208
No. with intermittent supply	0	0	0	0	0	0	0	0	0	0
No. dry holes	0	8	7	5	1	0	11	0	1	33
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	11	20	5	17	15	2	4	13	0	87
No. of non-artesian wells	4	24	11	15	20	12	21	10	4	121
Quality of Water										
No. with hard water	12	41	14	30	34	13	22	22	4	192
No. with soft water	3	3	2	2	1	1	3	1	0	16
No. with salty water	1	0	0	1	0	0	0	0	0	2
No. with alkaline water	6	16	5	11	12	1	8	13	0	72
Depths of Wells										
No. from 0 to 50 feet deep	9	30	11	16	20	12	26	14	5	143
No. from 51 to 100 feet deep	3	18	10	16	12	0	8	9	0	76
No. from 101 to 150 feet deep	3	4	2	4	4	2	1	0	0	20
No. from 151 to 200 feet deep	0	0	0	0	0	0	0	0	0	0
No. from 201 to 500 feet deep	0	0	0	0	0	0	1	0	0	1
No. from 501 to 1,000 feet deep	0	0	0	1	0	0	0	0	0	1
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
How the Water is used										
No. usable for domestic purposes	10	32	7	25	21	9	19	13	4	140
No. not usable for domestic purposes	5	12	9	7	14	5	6	10	0	68
No. usable for stock	15	44	13	32	33	14	23	21	4	199
No. not usable for stock	0	0	3	0	2	0	2	2	0	9
Sufficiency of Water Supply										
No. sufficient for domestic needs	15	44	16	30	35	14	24	23	4	205
No. insufficient for domestic needs	0	0	0	2	0	0	1	0	0	3
No. sufficient for stock needs	10	30	12	18	30	9	22	15	4	150
No. insufficient for stock needs	5	14	4	14	5	5	3	8	0	58

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

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

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

Analyses of Water Samples from the Municipality of Lake Johnston, No. 102, Saskatchewan

LOCATION						Depth of Well, Ft.	Total dis'vd Solids	Cl.	HARDNESS			CONSTITUENTS AS ANALYSED					CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									Source of Water
No.	Qtr.	Sec	Tp.	Rge.	Mer.				Total	Perm.	Temp.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1.	SE.	23	10	30	2	42	2,374											(3)	(1)		(2)				(4)	* 1
2.	NW.	4	11	28	2	1	846											(3)	(1)		(2)		(4)		(5)	* 1
3.	SW.	25	11	29	2	65	1,724												(2)		(3)	(4)	(1)	(5)		* 2
4.	SW.	30	11	29	2	49	1,283											(3)	(1)		(2)		(4)		(5)	* 2
5.	SW.	21	12	28	2	Spring											1,548	310		210			969	514		* 1 MB.
6.	SW.	21	12	28	2	Spring											1,484	304		242			926	88		* 1 MB.
7.	S½	29	12	28	2	Spring											5,803		181		1,222		4,395			* 1 MB.
8.	From Lake Johnstone																6,265		126		1,288		4,842			* 1 MB.

Water samples indicated thus, * 1, are from glacial drift or other unconsolidated deposits.
Water samples indicated thus, * 2, are from bedrock, Eastend formation.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).

Analyses Nos. 1, 2, 3, and 4 by Provincial Analyst, Regina; Analyses No. 5, 6, 7, and 8, by Mines Branch, Dept. of Mines, Ottawa
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

The following discussion of the character of the ground water is based on the analyses given in the accompanying table and on analyses of water collected in adjoining municipalities in which the water-bearing deposits show a close similarity. Ground water from the Recent deposits in the valley along the northern boundary of township 11, range 29, shows considerable variation in character. Supplies obtained from the finer sands and silts are generally very hard and contain sufficient amounts of both Glauber's Salt and Epsom Salts to give the water a saline taste, and in some cases to render it unfit for household use. Water from the interbedded gravel deposits is likewise very hard, but generally lower in sulphate salts. In most cases it is usable for all farm requirements. Water obtained at shallow depths in the lake sands is hard, but not usually high in mineral salts. At depths greater than 30 feet, however, the water is found to increase both in Glauber's Salt and Epsom Salts, and due to its laxative effect is not suitable for human consumption. The water from the wells in the lower part of the lake sands is usable for stock except in the case of a few wells immediately south of Lake Johnstone. Even greater variation is noted in the character of waters from the glacial drift. One well may yield a hard, slightly "alkaline" but drinkable water, whereas another 100 feet away may give a supply too highly mineralized for any farm use. It must not be inferred, therefore, that because the water struck in one well is undesirable poor water conditions must necessarily exist over a large area in the district. In general the total solid content of the water from the drift increases with the depth of the wells, and the thickness of the overlying beds. It is materially less, however, in extensive sand or gravel beds than in small isolated sand pockets in the boulder clay. Ground water derived from the extensive sand or gravel beds at or within 30 feet of the surface generally has a total solid content not exceeding 1,000 parts per million. The hardness ranges from 300 to 700 parts per million and is largely permanent and not removed by boiling.

The sodium sulphate (Glauber's Salt) and magnesium sulphate (Epsom Salts) content is generally low and sometimes negligible. Such water is of good quality for farm use and for irrigation. Small sand pockets in the boulder clay and the boulder clay itself yield a very hard water, the total hardness often exceeding 2,000 parts per million. The combined sulphates of sodium and magnesium often exceed 2,000 parts per million, and in a few instances exceed 6,000 parts per million. Water from this source is usually undrinkable due to its laxative effect, and tends to create scour in stock. Springs situated along the Canadian Pacific railway tracks south of Frederick lake derive their supply from the glacial drift. The fifth and sixth analyses given on the accompanying table are of water from springs. The total hardness of this water is probably in excess of 500 parts per million. The sodium sulphate (Glauber's Salt) content is approximately 1,000 parts per million. This water would undoubtedly prove laxative to persons unaccustomed to it, but could be used both for drinking and for stock. The seventh analysis is of water from a spring drawing its supply from Lake Johnstone and is similar to the eighth analyses that of water taken from the lake. The total hardness in both instances is probably in excess of 2,000 parts per million. The combined sulphate content of approximately 6,000 parts per million makes this water quite unfit for farm use.

Water from the Bedrock

No analyses have been made of waters from the Ravenscrag formation in this municipality. Much of the supply is derived from coal seams or coarse sand beds. It is generally hard and "alkaline" and contains varying amounts of iron. The iron may be largely removed by exposing the water to the air. A simple arrangement which has proved effective is to let the water run over a sheet of corrigated, galvanized iron suspended between the pump and the trough. The iron becomes oxidized in the presence

of the air and settles in the bottom of the trough as a brown precipitate. The iron and the Glauber's Salts in the water from the Ravenscrag in the central and southwestern parts of the municipality tend to give it an objectionable taste and often limit its use to the watering of stock. Along the southern boundary and immediately west and north of the Lake of the Rivers the Ravenscrag water is obtained largely from sand beds and is of much better quality, and suitable for all farm requirements.

Ground water derived from the upper coarse sand bed of the Eastend formation is often soft and contains sodium carbonate. The presence of sodium carbonate tends to give water a flat taste and if present in large amounts render it unsuitable for household use and unfit for irrigation. It can be used, however, for stock. At greater depths in the formation the water is very hard and highly "alkaline", and although used for stock it is quite unfit for human consumption. Iron also proves to be objectionable in water from the lower Eastend. This type of water is found in nearly all wells sunk into the bedrock in the central and southwestern parts of the municipality where shallow wells in the glacial drift are depended upon for household supply. The third and fourth analyses given in the table are of water believed to be derived from the Eastend, they show a much lower total solid content than is generally present in waters from this formation. Water from the Marine shale shows less variation in character than supplies from the overlying beds. Many analyses made of waters from the shale in adjoining municipalities show it to be highly "alkaline" or salty. The total solid content is generally in excess of 2,000 parts per million and occasionally exceeds 4,000 parts per million. The combined sulphates of sodium and magnesium (Glauber's Salts and Epsom Salts) vary between 1,000 and 3,000 parts per million, and common salt (NaCl) between 500

and 1,400 parts per million, giving the water a bitter, saline taste. The water from the shale is quite unfit for household use and seldom fit for stock. For this reason deep drilling for water in any part of the municipality is not considered advisable.

WELL RECORDS—Rural Municipality of LA. E JOHNSTON NO. 102 SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NE.	4	10	28	2	Bored	85	2,250	- 73	2,177	85	2,165	Eastend sand	Hard, iron, alkaline	42	D, S	Sufficient for 12 head stock.
2	SW.	6	"	"	"	Dug	15	2,295	- 13	2,282	15	2,280	Glacial sand	Hard, clear, alkaline	43	S,	Variable supply.
3	NW.	8	"	"	"	Bored	40	2,275	- 38	2,237	40	2,235	" "	Hard, clear	42	D, S	Sufficient for 78 head stock.
4	NW.	19	"	"	"	"	75	2,355	- 60	2,295	75	2,280	Ravenscrag sand	Hard, iron, alkaline	43	S,	" " 10 " " .
5	NW.	20	"	"	"	"	122	1,2340	- 60	2,280	122	2,218	Eastend sand	Hard, cloudy alkaline,	42	D, S	" " 50 " " .
6	SW.	21	"	"	"	Dug	36	2,290	- 22	2,268	36	2,254	Ravenscrag sand	Soft, cloudy	43	D, S	Small supply.
7	NW.	21	"	"	"	"	24	2,260	- 16	2,244	24	2,236	" "	Hard, clear	44	D, S	" " ; sufficient for 15 head stock.
8	NE.	28	"	"	"	Bored	90	1,2325	- 80	2,245	90	2,236	" "	" "	43	D, S	Sufficient for at least 40 head stock.
9	SW.	28	"	"	"	"	120	2,295	- 40	2,255	120	2,175	Eastend sand	Soft, clear, salty	43	S,	" " 100 head stock.
10	NE.	31	"	"	"	"	46	2,300	- 26	2,274	30	2,235	Ravenscrag sand	Hard, iron, alkaline	43	S,	" " 15 " " .
11	NW.	32	"	"	"	"	120	2,325	- 60	2,265	120	2,205	" "	Hard, iron, alkaline	43	S,	" " 25 " " . Laxative.
12	NW.	35	"	"	"	Dug	20	2,250	- 17	2,233	17	2,233	Glacial sand	Hard, clear	42	D,	Sufficient for household needs only.
1	SE.	2	10	29	2	Bored	42	2,325	- 35	2,290	10	2,315	Glacial sand	Soft, clear	42	D, S	" " 22 head stock. Difficulty encountered in boring due to caving sand.
2	NE.	2	"	"	"	"	22	2,306	- 11	2,295	20	2,284	" "	Hard, clear	42	D, S	Sufficient for 22 head stock.
3	NW.	3	"	"	"	Dug	20	2,316	- 15	2,301	15	2,301	" "	" "	42	D, S	" " household needs only.
4	NE.	4	"	"	"	Bored	77	2,320	- 57	2,263	77	2,243	Ravenscrag sand	" iron	42	S,	" " 20 head stock.
5	NE.	5	"	"	"	"	65	2,350	- 20	2,330			" "	" alkaline iron	42	S,	Insufficient for local needs. Drinking water hauled.
6	SE.	6	"	"	"	Dug	16	2,380	- 12	2,368	16	2,364	Glacial clay	Med. hard, clear	43	D, S	Sufficient for 20 head stock. Several dry holes 90 to 100 feet deep.
7	SW.	6	"	"	"	"	15	2,380	- 10	2,370	15	2,365	" "	Hard, clear	44	D, S	Sufficient for not more than 15 head stock.
8	NE.	7	"	"	"	Bored	87	2,420	- 43	2,377	67	2,353	" sand	" alkaline	40	D, S	" " 25 head stock.
9	NE.	9	"	"	"	Dug	24	2,370	- 18	2,353	24	2,346	" "	Soft, clear	44	D, S	" " 15 " " .
10	NW.	12	"	"	"	"	8	2,290	0	2,290	8	2,282	" "	Hard, clear	43	D, S	" " 30 " " .
11	SW.	14	"	"	"	Bored	90	2,400					Ravenscrag sand	" " iron		S,	" " 9 " " . Drinking water hauled.
12	NW.	14	"	"	"	"	100	2,345	- 85	2,260			" "	Hard, iron, alkaline	43	S,	Sufficient for 11 head stock.
13	NE.	16	"	"	"	"	115	2,405	- 75	2,330	115	2,290	" "	Hard, iron, alkaline	43	S,	" " 17 " " . Drinking water is hauled.
14	SW.	19	"	"	"	Dug	18	2,405	- 9	2,396	18	2,387	Glacial clay	Hard, clear		D, S	Sufficient for local needs.
15	NE.	19	"	"	"	"	6	2,370	- 1	2,369	6	2,364	" gravel	" "	43	D, S	Sufficient for 10 head stock.
16	NE.	20	"	"	"	Bored	65	2,400	- 53	2,347	65	2,335	Ravenscrag sand	" "	41	D, S	Sufficient for 25 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 LAKE JOHNSTON, NO. 102 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	NE.	21	10	29	2	Dug	24	2,380	- 22	2,358	24	2,356	Glacial sand	Hard, clear	42	D, S	Sufficient for 20 head stock.
18	SW.	22	"	"	"	Bored	115	2,391	- 90	2,301	115	2,276	Ravenscrag sand	" alkaline, iron	42	D, S	" " 20 " " .
19	NE.	22	"	"	"	"	37	2,380	- 18	2,362	37	2,343	Glacial? sand	Hard, iron, alkaline	42	S,	" " 25 " " . Laxative.
20	NW.	23	"	"	"	"	100	2,360	- 60	2,300	100	2,260	Ravenscrag sand	Hard, clear, alkaline	42	S,	" " 30 " " . " .
21	SE.	23	"	"	"	Dug	20	2,400	- 18	2,382	20	2,380	Glacial sand	Soft, cloudy, iron		D, S	" " 11 " " . Decreasing supp
22	NW.	24	"	"	"	"	16	2,351	- 12	2,339	16	2,335	" "	Hard, clear, alkaline	42	D, S	" " 8 " " .
23	SW.	26	"	"	"	Bored	73	2,370	- 43	2,337	65	2,305	" gravel	Hard, alkaline	43	D, S	Small supply; water unfit for farm use.
24	SW.	26	"	"	"	"	25	2,375	- 23	2,352	45	2,330	" sand	" " iron		S,	Sufficient for local stock needs.
25	NE.	28	"	"	"	"	80	2,400	- 40	2,360	80	2,320	Ravenscrag sand	Hard, iron	43	D, S	" " 7 head stock.
26	SW.	28	"	"	"	"	60	2,410	- 48	2,362	60	2,350	" shale	" "	43	D, S	" " 30 " " .
27	NW.	30	"	"	"	"	92	2,410	- 77	2,333	90	2,320	" sand	" " alkaline	43	D, S	" " only 10 head stock.
28	NE.	31	"	"	"	"	42	2,340	- 30	2,310	30	2,310	" ? sand	Hard, iron, alkaline	42	S,	" " 25 head stock. Unfit for human
29	SE.	32	"	"	"	Dug	32	2,390	- 28	2,362	32	2,358	Glacial sand	Hard, clear, alkaline	42	S,	Very small supply; unfit for humans and stock
30	NE.	35	"	"	"	Bored	90	2,340	- 60	2,280	90	2,250	Ravenscrag sand	Hard, iron, alkaline	41	D, S	Sufficient for 15 head stock.
1	SE.	1	10	30	2	Bored	?										Several dry holes; all water hauled.
2	SW.	1	"	"	"	Dug	14	2,340	- 10	2,330	11	2,329	Glacial gravel	Soft, clear	42	D, S	Sufficient for 12 head stock.
3	SE.	2	"	"	"	"	12	2,300	- 10	2,290	12	2,288	" sand	Hard, clear	43	S,	Very small supply.
4	SW.	2	"	"	"	"	14	2,332	- 10	2,322	12	2,320	" gravel	" "	42	D, S	Sufficient for 30 head stock.
5	SE.	3	"	"	"	Bored	95	2,360					Probably Eastend				Several dry holes.
6	NW.	3	"	"	"	"	70	2,400					" "				" " " 55 to 70 feet deep.
7	NW.	12	"	"	"	"	28	2,340	- 20	2,320	28	2,312	Glacial clay	Hard, clear	42	D,	Sufficient for household needs only.
8	NE.	12	"	"	"	"	90	2,332	- 8[illegible]	2,248	90	2,242	" sand	" " alkaline	42	S,	Small supply; poor quality.
9	NW.	15	"	"	"	Spring		2,350	- 2	2,352			" "	Hard, clear	43	D, S	Sufficient for 150 head stock; supplies the district.
10	NE.	15	"	"	"	Bored	30	2,370	- 22	2,348	30	2,340	" "	" "	43	N,	
11	SE.	23	"	"	"	"	42	2,370	- 32	2,338	42	2,328	" "	" "		S,	Sufficient for local needs. #.
12	SE.	25	"	"	"	"	110	2,380	- 90	2,290	110	2,270	Eastend sand	Alkaline, sulphur		S,	Insufficient for local needs. Laxative.
13	SW.	34	"	"	"	"	70	2,380	- 60	2,320	70	2,310	" ? sand	Soft, clear	42	D, S	Sufficient for 6 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 LAKE JOHNSTON NO.102, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
14	SE.	34	10	30	2	Bored	60	2,400	- 41	2,359	35	2,365	Eastend sand	Hard, clear		D, S	Large supply.
15	SW.	35	"	"	"	"	33	2,340	- 30	2,310	33	2,307	Glacial sand	" "	42	S,	Sufficient for 20 head stock.
16	SE.	35	"	"	"	"	45	2,350	- 10	2,340	41	2,310	" "	" alkaline, cloudy		S,	Very small supply. Laxative. #.
17	NW.	36	"	"	"	"	51	2,340	- 40	2,300	51	2,291	" gravel	Hard, alkaline greenish	42	N,	Unfit for man or stock.
1	NW.	1	11	26	2	Dug	9	2,340	- 8	2,332	9	2,331	Glacial boulder clay	Hard, clear	42	D, S	Sufficient for local needs.
2	NW.	2	"	"	"	"	12	2,270	- 11	2,250	10	2,260	Stream gravel	" "		D, S	" " " ".
3	NW.	4	"	"	"	"	11	2,315	- 8	2,307	11	2,304	Glacial sand	" iron		D, S	" " " ".
4	NE.	7	"	"	"	Drilled	60	2,345	- 15	2,330	60	2,285	Ravenscrag sand	" alkaline clear		S,	Poor supply. Laxative. #.
5	SW.	8	"	"	"	Bored	90	2,280	- 50	2,230	63	2,217	Eastend sand	Hard, clear, alkaline	42	S,	Fair " " . Undrinkable.
6	NE.	9	"	"	"	"	72	2,320	- 32	2,288	68	2,252	Ravenscrag sand	Hard, iron	41	D, S	Large supply of good water.
7	NW.	10	"	"	"	"	50	2,305	- 30	2,275	50	2,255	" "	" clear	48	D, S	Sufficient for local needs.
8	NE.	12	"	"	"	Dug	44	2,280					" ? clay				Dry hole, stock watered at spring ½ mile east.
9	SE.	14	"	"	"	"	12	2,270	- 5	2,265	12	2,258	" sand	Hard, iron, cloudy	41	D, S	Sufficient for local needs. Very high in iron.
10	NE.	16	"	"	"	Bored	62	2,335	- 50	2,285	60	2,275	Glacial gravel	Hard, clear, iron	41	D, S	Small supply; insufficient for local needs.
11	SW.	16	"	"	"	"	55	2,315	- 40	2,275	55	2,260	Ravenscrag clay	Hard, clear, iron	43	D, S	" " ; vey ghigh in iron.
12	SE.	17	"	"	"	Drilled	75	2,315	- 55	2,260	75	2,240	" "	Hard, salty, alkaline			Large supply, unfit for local needs.
13	SE.	18	"	"	"	Bored	106	2,315	- 56	2,259	106	2,209	Eastend sand	Hard, alkaline iron	41	S,	" " filtered rain water used for drinking.
14	NW.	19	"	"	"	"	90	2,280	-,78	2,202	90	2,202	"	Hard, alkaline	42	S,	Small supply; use 15 foot well in gravel for household.
15	NE.	19	"	"	"	"	60	2,285	- 45	2,240	45	2,240	Ravenscrag clay	" " clear	41	D, S	Insufficient for local needs.
16		20	"	"	"	"	70	2,285	- 62	2,223	70	2,215	Eastend sand	Hard, clear, alkaline		D, S	Sufficient for local needs.
17	NW.	21	"	"	"	Dug	30	2,310	- 24	2,286	24	2,286	Glacial clay	Hard, iron	41	D, S	" " " ".
18	NE.	24	"	"	"	"	16	2,315	- 12	2,303	15	2,300	" sand	" alkaline	42	D, S	Insufficient for local needs.
19	NW.	24	"	"	"	"	70	2,300	- 40	2,260	70	2,230	Ravenscrag sand	" iron		D, S	Sufficient for local needs.
20	SE.	25	"	"	"	Bored	120	2,312	- 85	2,227	100	2,212	Eastend sand	" "	42	D, S	Large supply.
21	SE.	27	"	"	"	Dug	14	2,280	- 10	2,270	12	2,268	Glacial sand	" alkaline	42	S,	Sufficient for local stock needs.
22	SE.	30	"	"	"	Bored	70	2,285	- 60	2,025	60	2,025	Ravenscrag clay	" "	41	D, S	Small supply.
23	NW.	30	"	"	"	Drilled	692	2,302					Eastend sand	" "			Small seepage.

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 LAKE JOHNSTON NO. 102, 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
24	NE.	31	11	28	2	Bored	33	2,340	- 32	2,308	32	2,308	Glacial sand	Hard, clear	44	D,	Small supply.
25.	NW.	35	"	"	"	Dug	23	2,360	- 18	2,342	23	2,337	" gravel	Soft, iron	42	D,	Sufficient for household needs only; 74 foot well gives very alkaline water.
26	SE.	35	"	"	"	"	110	2,260					Ravenscrag ? clay				Dry hole; all water hauled, may be a glacial drift.
27	SW.	36	"	"	"	Bored	80	2,390	- 80	2,310	80	2,310	Glacial clay	Hard, alkaline			Well dry in 1935; all water hauled.
28	SE.	36	"	"	"	"	34	2,380	- 25	2,355	34	2,346	" "	" clear		D,	Yields only 20 gallons a day.
1	SE.	1	11	29	2	Bored	60	2,385	- 40	2,345	60	2,325	" sand	" iron		S,	Sufficient for local stock needs.
2	SW.	2	"	"	"	"	35	2,335	- 34	2,301	35	2,300	" "	" clear	41	D,	Fair supply; 70 foot well gives very alkaline water.
3	SE.	4	"	"	"	"	118	2,320	- 43	2,277	118	2,202	Eastend sand	" iron	42	S,	Poor drinking water; sufficient for stock needs
4	SE.	5	"	"	"	"	65	2,330	- 45	2,285	65	2,265	Ravenscrag sand	"		S,	Sufficient for local needs.
5	SW.	6	"	"	"	"	42	2,320	- 38	2,282	42	2,278	" "	" alkaline, iron	42	S,	Insufficient for local needs.
6	NW.	6	"	"	"	"	150	2,320					Marine shale				Dry hole.
7	NW.	7	"	"	"	"	43	2,270	- 12	2,258	43	2,227	Ravenscrag sand	Hard, clear, iron		S,	Large supply; poor drinking water.
8	SW.	8	"	"	"	"	56	2,310	- 50	2,260	56	2,254	" "	Hard, clear, alkaline	42	S,	Fair supply; poor drinking water. Use 30 foot seepage well for house.
9	NE.	9	"	"	"	Dug	47	2,340	- 23	2,317	47	2,283	" "	Hard, alkaline	42	S,	Large supply; poor drinking water.
10	NE.	12	"	"	"	Bored	125	2,350	-100	2,250	125	2,225	Marine shale ?	" " iron	41	S,	" " ; unfit for drinking.
11	NW.	14	"	"	"	"	85	2,330	- 55	2,275	85	2,255	Ravenscrag sand	Hard, alkaline iron	42	S,	Small supply; poor drinking water.
12	SW.	15	"	"	"	Dug	30	2,320	- 20	2,300	28	2,292	Glacial sand	Hard, clear	42	D, S	Large supply.
13	SE.	16	"	"	"	Bored		2,340	- 25	2,315	35	2,305	" beds	" alkaline iron	42	D, S	Fair supply.
14	SW.	18	"	"	"	"	114	2,270	- 50	2,220	94	2,176	Eastend sand	Hard, iron	42	S,	" " , poor drinking water.
15	SE.	19	"	"	"	"	50	2,320	- 40	2,280	50	2,270	Ravenscrag sand	" clear, alkaline	42	D, S	Sufficient for local needs.
16	NE.	20	"	"	"	"	58	2,325	- 29	2,296	32	2,294	Glacial gravel	Hard, clear	44	D, S	" " " " .
17	NW.	21	"	"	"	Dug	24	2,320	- 21	2,299	24	2,296	" sand	" "		D, S	" " " " .
18	SW.	22	"	"	"	"	60	2,290	- 55	2,235	60	2,230	" "	" " alkaline	38	D, S	" " " " .
19	NW.	23	"	"	"	"	85	2,310	- 75	2,245	85	2,225	Eastend sand	Hard, iron	41	D, S	" " household needs only.
20	SW.	23	"	"	"	Bored	50	2,270	- 38	2,232	50	2,220	Glacial sand	" clear		D, S	" " local needs.
21	SW.	25	"	"	"	"	45	2,235	- 37	2,198	40	2,195	Eastend sand ?	Soft, clear, iron	42	D, S	" " " " .
22	SW.	25	"	"	"	"	65	2,255	- 51	2,204			" "	Hard, alkaline ~~iron, cloudy~~	42	D, S	" " " " , poor drinking water. #.

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 LAKE JOHNSTON NO. 102, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
23	NE.	25	11	29	2	Dug	20	2,308	- 10	2,298	10	2,298	Glacial sand	Hard, clear	42	D,	Sufficient for household needs.
24	SE.	29	"	"	"	Bored	94	2,310	- 94	2,216	94	2,216	Ravenscrag ?	" " alkaline	42	S,	Small supply; drinking water hauled.
25	W½.	30	"	"	"	Dug	49	2,309	- 33	2,276	29	2,280	Glacial sand	Hard, clear		D, S	Several small wells in the village of Mossbank. #.
26	NE.	30	"	"	"	Bored	80	2,300	- 50	2,250	80	2,220	Eastend sand	" alkaline, iron	42	D, S	Sufficient for local needs; poor drinking water
1	NW.	1	11	30	2	Drilled	146	2,310	- 96	2,214	131	2,179	" "	Hard, clear, alkaline	42	S,	Fair supply; 35 foot well used for drinking water.
2	SW.	12	"	"	"	Dug	20	2,260	- 10	2,250	22	2,238	Sand pocket in clay	Hard, clear	41	D,	Good drinking water; use 125 foor well into Eastend bed for stock.
3	SW.	13	"	"	"	Bored	?	2,270						" iron	42	S,	Drinking water hauled.
4	NW.	13	"	"	"	Dug	16	2,240	- 14	2,226	16	2,224	Glacial clay	" clear	41	D,	35 foot well used for stock.
5	SE.	35	"	"	"	"	24	2,240	- 20	2,220	24	2,216	" sand	Soft, clear	43	D, S	Large supply.
6	NE.	35	"	"	"	"	20	2,250	- 17	2,233	20	2,230	" clay	Hard, clear	42	D, S	Sufficient for 12 head stock.
7	NE.	36	"	"	"	"	18	2,240	- 15	2,225	18	2,222	" gravel	" "	43	D, S	" " 6 " " .
8	SE.	36	"	"	"	"	20	2,260	- 10	2,250	20	2,240	" blue clay	" "		D, S	Poor supply; similar well also used.
1	NE.	2	12	28	2	Bored	50	2,385	- 12	2,373	45	2,340	Glacial gravel	" "	42	D, S	Sufficient for local needs
2	SW.	2	"	"	"	"	45	2,350	- 41	2,309	45	2,305	" sand	" "	43	D, S	" " " " .
3	NW.	4	"	"	"	"	16	2250	- 12	2,238	16	2,234	" "	" "	43	D, S	Fair supply.
4	SW.	6	"	"	"	"	27	2,300	- 26	2,274	26	2,274	" "	alkaline Hard, clear, alkaline	43	D, S	" " .
5	SW.	7	"	"	"	"	36	2,250	- 27	2,223	34	2,216	Eastend sand	Hard, clear	43	D, S	Large supply.
6	SE.	7	"	"	"	"	70	2,260					Marine shale ?				5 dry holes 70 feet deep.
7	NE.	7	"	"	"	"	45	2,250	- 20	2,230	45	2,205	Eastend sand	Hard, alkaline iron		S,	Unfit for drinking; sufficient for stock needs
8	NW.	9	"	"	"	Dug	35	2,275	- 28	2,247	35	2,240	Glacial sand	Hard, clear	41	D, S	Sufficient for local needs.
9	NW.	15	"	"	"	Bored	75	2,310	- 65	2,245	70	2,240	Eastend sand	" "		S,	Poor drinking water; ggod supply for stock.
10	SE.	16	"	"	"	"	51	2,300	- 49	2,251	49	2,251	" "	alkaline Hard, clear	42	D, S	Sufficient for local needs.
11	SW.	16	"	"	"	"	35	2,270	- 25	2,245	35	2,235	" "	" iron, cloudy	41	N,	Large supply.
12	SE.	18	"	"	"	"	90	2,280	- 40	2,241	55	2,225	Glacial gravel and sand may be Ravenscrag	Hard, clear, alkaline	41	S,	Sufficient for local stock needs.
13	NW.	18	"	"	"	Dug	16	2,200	- 10	2,190	10	2,190	Glacial sand	Hard, clear	40	D, S	Many farmers haul water from this well.
14	SW.	21	"	"	"	"	18	2,252	- 12	2,240	18	2,234	" "	" "		D, S	Sufficient for local needs. Two springs near railroad tracks. #.
15	SW.	21	"	"	"	Drilled	300	2,232	- 45	2,187	290	2,142	Marine shale	" alkaline		N,	20 per cent sodium sulphate; unfit for boilers

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 LAKE JOHSTON NO. 102, 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	E½.	21	12	28	2	Dug	16	2,320	- 12	2,308	16	2,304	Glacial sand	Hard, iron	38	D, S	Sufficient for local needs.
17	SW.	22	"	"	"	"	15	2,250	- 15	2,235	15	2,235	" "	" clear	42	D, S	" " " " . 14 foot dry hole i clay.
18	NE.	25	"	"	"	"	16	2,280	- 13	2,267	16	2,264	" "	" "	42	D, S	Sufficient for local needs.
19	NE.	28	"	"	"	"	20	2,230	- 16	2,214	20	2,210	" clay	" " alkaline	43	D, S	Small supply; use two similar wells.
20	NW.	34	"	"	"	"	25	2,270	- 23	2,247	25	2,445	" "	Hard, clear	41	D,	Spring between lakes in section 29. Small supp #
21	SE.	34	"	"	"	"	20	2,250	- 18	2,232	18	2,232	" sand and gravel	" "	41	D, S	Sufficient for local needs.
22	SE.	35	"	"	"	"	10	2,200	- 7	2,193	10	2,190	Glacial gravel	Soft, clear	50	D, S	" " " " .
23	NE.	35	"	"	"	"	8	2,200	- 5	2,195	5	2,195	" "	" "	58	D, S	" " " " .
24	SW.	36	"	"	"	"	125	2,230	- 90	2,140	90	2,740	Marine shale	?		N,	Not used for many years.
1	NE.	2	12	29	2	Bored	36	2,240	- 14	2,226	36	2,204	Glacial gravel	Hard, clear	41	D, S	Large supply.
2	SW.	3	"	"	"	"	80	2,280	- 60	2,220	75	2,205	Eastend sand	" " alkaline		N,	Sufficient for local needs.
3	NW.	3	"	"	"	"	90	2,285	- 60	2,225	85	2,200	" "	Hard, clear, alkaline	42	D, S	" " " " .
4	NE.	4	"	"	"	"	70	2,290	- 68	2,222	62	2,222	Ravenscrag ? sand	Hard, clear, alkaline	42	D, S	Small supply; sufficient for only 4 head stock
5	SW.	4	"	"	"	"	75	2,290	- 60	2,230	75	2,216	Ravenscrag sand	Hard, clear	43	D, S	Large supply.
6	NW.	4	"	"	"	"	72	2,260	- 47	2,213	70	2,190	Eastend sand	" "	43	D, S	" " .
7	SE.	5	"	"	"	"	68	2,230	- 64	2,146	64	2,204	Lake "	" " alkaline	43	D, S	Adequate supply; use 20 foot well in clay for drinking water.
8	SW.	6	"	"	"	"	21	2,225	- 19	2,206	21	2,204	" "	Hard, clear, alkaline	44	D, S	Sufficient for local needs.
9	NE.	8	"	"	"	"	12	2,245	- 10	2,235	12	2,233	" "	?		N,	Not used for many years.
10	SE.	10	"	"	"	Bored	56	2,275	- 48	2,227	56	2,219	" "	Hard, alkaline	42	D, S	Sufficient for local needs.
11	NE.	10	"	"	"	"	30	2,255	- 27	2,228	28	2,227	" "	Med. hard, clear		D, S, M	Used by town of Expanse for drinking.
12	NW.	12	"	"	"	"	40	2,232	- 20	2,212	40	2,192	" "	Hard, clear, alkaline		N,	Unfit for srinking; derives alkaline salts fro near surface seepage.
13	NW.	12	"	"	"	Drilled	208	2,250				2,042	Marine shale				Dry hole.
14	NE.	15	"	"	"	Bored	44	2,245	- 24	2,221	38	2,207	Lake sand	Hard, clear, alkaline	42	S,	Sufficient for local stock needs.
15	NW.	17	"	"	"	"	35	2,225	- 30	2,195	30	2,195	" "	Hard, clear, alkaline	41	S,	" " " " " , unfit for drinking.
16	NE.	17	"	"	"	"	40	2,232	- 20	2,212	40	2,192	" "	Hard, clear, alkaline		D, S	Sufficient for local needs.
17	NW.	21	"	"	"	Dug	12	2,235	- 7	2,228	7	2,228	" clay	Soft, clear	44	D, S	Fair supply.
18	NW.	21	"	"	"	Bored	96	2,245	- 21	2,224	96	2,139	Marine shale	Hard, clear, alkaline	44	S,	Large supply too alkaline to drink.

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 LAKE JOHNSTON NO. 102, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	19	SE.	23	12	28	2	Dug	20	2,225	- 18	2,207	20	2,205 Lake sand	Hard,		42 D	Sufficient for household needs only.
	1	SE.	1	12	30	2	Dug	20	2,225	- 16	2,209	20	2,205 " "	"	clear	44 D, S	" " local needs.
	2	SW.	1	"	"	"	"	14	2,225	- 11	2,214	11	2,214 " "	"	"	41 D, S	" " " " .
	3	SE.	2	"	"	"	"	16	2,220	- 14	2,206	14	2,206 " "	"	"	41 D, S	" " " " .
	4	SE.	14	"	"	"	"	34	2,225	- 29	2,196	29	2,196 " "	"	"	41 D, S	" " " " .

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.