CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 25

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF LONE TREE NO. 18 SASKATCHEWAN

By

B. R. MacKay, H. H. Beach and D. P. Goodall

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF LONE TREE, NO. 18 SASKATCHEWAN

INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Lone Tree comprises an area of 324 square miles in the southwestern part of Saskatchewan along the International Boundary. It is described as townships 1, 2, and 3, ranges 16, 17, and 18, west of the 3rd meridian. The Valmarie branch of the Canadian Pacific railway extends in an east-west direction through the north townships of the municipality and along it are situated the towns of Bracken, Canuck, and Climax.

The land surface is gently rolling and rises in a north and westerly direction from an elevation of 2,600 feet above sea-level in the bed of Cottonwood coulée in the southeast corner to elevations exceeding 3,225 feet above sea-level in the northwestern parts of the municipality. Numerous small coulées with southeast drainage offer splendid opportunities for conserving water during the spring run-off, through the construction of dams and reservoirs. The streams in the coulées are dry during most of the year, but owing to the impervious character of the soil large supplies of water can be conserved for use through the dry seasons. This method of conservation serves as the major source of water for stock raising in the municipality. Unfortunately in early summer the few small lakes and sloughs in this area usually become dry or the water becomes too "alkaline" for stock use.

Water-bearing Horizons in the Unconsolidated Deposits

Recent deposits of sand and gravel interbedded with yellow clay are found in the coulée bottoms and around the edges of the small lakes and sloughs. These deposits are usually encountered in wells not exceeding 20 feet in depth and produce a constant supply of hard, usable water throughout the summer months, but they cannot be depended upon for winter use. The permanency of these water supplies depend principally upon the following factors; the areal extent and depth of the aquifer, the presence of underlying impervious beds, the amount of surface water available, and the ease with which the

water can seep down into the aquifer.

A mantle of glacial drift varying from 150 to 200 feet in thickness overlies the bedrock throughout the entire municipality. This drift was deposited by the great continental ice-sheet which many thousands of years ago extended over the whole southern half of Saskatchewan. The drift is composed of dark to medium grey clays and silts and heavy boulder clay.

A few pockets of sand and gravel of limited extent are encountered in the drift within 20 feet of the surface throughout the municipality and are often found at the surface occupying low areas. Water occurring in these pockets is very hard and the mineral salt content varies in different localities so that water in one area may be drinkable whereas in others it is so high in Glauber's Salts (Na_2SO_4) and Epsom Salts ($MgSO_4$) as to be unfit for either human or stock consumption.

Only very small seepages of highly mineralized water can be expected from wells sunk into boulder clay that do not encounter gravel pockets. The clay, however, acts as a filter in wells dug beside artificially constructed dams and reservoirs. The water so obtained is quite satisfactory for household use when not contaminated by organic material.

Wells sunk to depths of 90 to 200 feet have encountered water in gravels over a large area extending southeast from the town of Climax to the International Boundary. This area occupies the southern sections of township 3, range 18, the greater part of township 2, range 18, and the northeastern half of township 1, range 18. A smaller area of gravels is known to occur at similar depths in the southeast corner of the municipality. These gravel deposits are believed to have been largely washed down from Cypress hills, forming the highlands to the northwest, and were subsequently covered by the drift of the advancing ice-sheet. No record has been obtained of wells having been drilled to tap this horizon in the

large area, approximately 50 square miles, lying in the south-central part of this map-area. Water-bearing gravels may, however, underlie part of this area at depths of 100 to 150 feet from the surface. Water from the deep gravels in the southwest of township 1, range 18, is hard and so strongly "alkaline" as to be unfit for stock use. Farther north, in township 2, and in the southern part of township 3, range 18, water from this aquifer becomes less "alkaline" and in many instances is used for domestic purposes.

In the southeast part of the municipality excellent supplies of hard, usable water are obtained from deep gravels. Nine wells, located in the northeast part of township 1, and the southeast part of township 2, range 16, tap this aquifer at depths ranging from 125 to 150 feet.

In the southwest corner of the municipality no water-bearing horizons have been encountered at depths exceeding 20 feet from the surface. Similar water conditions extend over a large area in the north and central parts of the municipality, with the exception of a few isolated localities where small supplies of generally highly "alkaline" water have been found at depths of 30 to 90 feet. Throughout this dry area many holes have been sunk to depths of 100 to 200 feet, and a few exceeding 500 feet deep, without striking water, and it is highly improbable that any supplies of water suitable for household use will be found at depths greater than 40 feet in this area or that supplies suitable even for stock occur below 90 feet from the surface.

Water-bearing Horizons in the Bedrock

The Bearpaw bedrock formation underlies the glacial drift throughout the entire municipality with the possible exception of small areas in township 1, range 16, where the deep coulées of Cottonwood creek may have cut through the Bearpaw to the lower

or Belly River formation. The Bearpaw formation is of marine origin and consists of dark clay shale with occasional bands or beds of fine sand. The fine texture of the greater part of this formation does not allow for water accumulation and the possibilities of finding suitable water supplies in it are quite remote. A drill hole at the town of Climax after penetrating 155 feet of drift encountered Bearpaw shale at an elevation of 2,905 feet above sea-level. Water-bearing sand in the lower part of the Bearpaw or in the underlying Belly River formation was struck at a depth of 990 feet, or 2,075 feet above sea-level. Farther east at the village of Bracken Bearpaw shales were encountered under 160 feet of drift, at an elevation of 2,755 feet above sea-level. They were drilled through at a total depth of 575 feet, or 2,340 feet above sea-level, giving a thickness of only 415 feet for the Bearpaw shale. The formation thins uniformly in a southeasterly direction. In the southeast corner of the municipality the base of the Bearpaw shale is believed to lie at an elevation of about 2,650 feet above sea-level, or at approximately the same elevation as the bed of Cottonwood coulee. The coulée in this locality is about 200 feet deep. Therefore, allowing for 160 feet of drift, the Bearpaw at this point cannot be more than 50 feet thick. From a knowledge of the depths to the base of the Bearpaw shale at these three points it is possible to estimate the elevation at which the water-bearing sands below the Bearpaw shale may be expected to occur in other parts of the municipality.

The Belly River formation underlying the Bearpaw shale consists of soft grey shale with occasional hard bands and soft greensih grey sandstone. In the well at Climax water was found in a soft sandstone at a depth of 1,005 feet from the surface. The sandstone probably forms part of the Belly River formation. The water is soft but contains so much sodium carbonate that it

is unsuitable for human consumption, although it is used for stock and for washing. Sodium carbonate water containing also small amounts of other salts, was also encountered in a sandstone in this formation in the Bracken village well at a depth of 608 feet. The water from this well is quite suitable for washing and for stock. The results of these two attempts to obtain usable water from the Belly River formation in this municipality are not encouraging, and it is improbable that deeper drilling will yield better results. Fairly large supplies of water are obtainable from this formation but the great depth to which it is necessary to drill, particularly in the northern and central parts of the municipality, and the high "soda" content of the water make it questionable if drilling to the water-bearing horizon is worth the expenditure.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 1, Range 16

The main supplies of usable ground water in this township are obtained from shallow wells in gravel deposits in the bed of Cottonwood coulée and its tributaries. Dams placed at strategic places conserve some water for stock. On the plains above the coulées little if any water can be obtained from the heavy boulder clay. In a small area in the northwest corner of the township bounded by sections 22, 24, 34, and 36 adequate supplies of hard, usable water are found in a gravel aquifer under blue boulder clay, at depths of 125 to 150 feet. Where encountered the water is not under pressure but the supply is amply sufficient for farm requirements. Five wells south of Cottonwood coulée have been sunk to this aquifer.

Adequate supplies of usable water cannot be obtained from the glacial drift in this township, due to the general paucity in the boulder clay of sand and gravel pockets sufficiently large to

act as reservoirs for any large quantity of ground water. This condition has contributed to the abandonment of many of the farms.

The possibilities of obtaining ground water from the underlying Bearpaw and Belly River bedrock formations are not great and are discussed in the section dealing with the municipality as a whole. The productive sands of the Belly River formation will be encountered at depths varying from 200 to 300 feet in the uplands part of the township.

Township 1, Range 17

Adequate supplies of ground water are difficult to obtain in this township. Thin deposits of sand or gravel in the coulée bottoms throughout the central part of the township produce an adequate supply of hard, usable water during the summer months. Very few stream deposits occur north or south of this area. Wells dug near sloughs on the uplands usually produce adequate supplies of water during the winter or dry seasons of long duration. In the southwest corner of the township a fairly extensive gravel aquifer occurs at a depth of about 115 feet, but water obtained from this source is too high in "alkaline" salts even for stock use.

Little if any water suitable for farm requirements is to be expected from the Bearpaw shales underlying the drift. The Belly River formation occurs beneath the shale at 300 to 400 feet from the surface. No wells have been drilled into the formation in this township, but it will probably yield fairly large supplies of soda-bearing water.

Township 1, Range 18

Ground water is not plentiful in this township. The principal source of usable water lies in the shallow stream deposits or in small pockets of sand or gravel occurring within 20 feet of the surface in the low areas.

Small but constant flows of water from aquifers of this type appear at the surface as springs in sections 28 and 29. One

spring in NE. ¼, section 29, flows throughout the year and produces sufficient water for the stock in the neighbourhood. The water, however, is too "alkaline" for household use. In the east half of the township very few of these water-bearing deposits are to be found, and in many instances the residents have to depend upon shallow seepage wells dug near sloughs or beside artificial reservoirs of drinking water.

Water-bearing gravels of wide extent are known to underlie boulder clay at depths of 125 to 190 feet throughout slightly more than the north and eastern half of the township, as outlined on the accompanying map (Figure 1). Wells penetrating these gravels in the southeastern part of the township are capable of producing large supplies of water, but the high content of salts in solution renders it unfit for human consumption and in some wells the water is unfit for stock.

Better water conditions occur in the north half of the township. A well bored in NE. ¼, section 23, penetrated the water-bearing gravel bed at a depth of 193 feet and yields an adequate supply of hard, usable water. Several other wells located a few miles north of this township have encountered similar water conditions from what is believed to be a continuation of this aquifer. The gravels, however, do not appear to underlie the southwest and western parts of the township, as several dry holes have been sunk to depths of over 200 feet without striking them.

Little water can be expected from the Bearpaw shales underlying the glacial drift. The Belly River sands will not likely be encountered in drilling at depths less than 500 to 600 feet. No wells have been sunk to these depths in this area, so that its water-bearing possibilities at depth are unknown.

Township 2, Range 16

Large supplies of hard, usable water are obtained from wells bored to depths of 130 to 150 feet in the southeast corner of this township. This aquifer is a continuation of the water-bearing gravels described in the northeast part of township 1, range 16, lying directly to the south. The exact northern extent of these gravels is not known, as wells sunk in stream deposits in the coulées in sections 13, 14, and 16 supply sufficient water suitable for domestic purposes, thus obviating the necessity of exploring for water supplies in the deep gravels in this direction. The western limit of this gravel horizon is defined by a dry hole bored to a depth of 168 feet in NW. ¼, section 7.

There is a serious shortage of water in the northern half of the township. A well drilled at Bracken in section 4, in the township to the north, encountered water-bearing gravels at a depth of 125 feet, but this water was too highly "alkaline" for use. It is concluded, therefore, that should this aquifer occur in the northern part of this township the water would probably be unsuitable for farm requirements. The only apparent source of ground water supply for this district lies in the shallow deposits of sand or gravel in the draws or sloughs, and it is often necessary to dig a number of wells before even a small supply of water is encountered.

The uppermost bedrock aquifer is probably the sands at the top of the Belly River formation which occur between 400 and 500 feet from the surface. The only well in the district reaching this horizon was drilled at Bracken, in township 3, range 16. The findings have been summarized in the part of the report dealing with the municipality as a whole.

Township 2, Range 17

Stream deposits of sand and gravel in the coulée bottoms offer the only possibility of obtaining supplies of usable ground water in this township except in a narrow area along the western border. Numerous small draws tributary to Cottonwood coulée and the coulée itself offer an opportunity for the construction of dams for the conservation of surface water.

In the northwest corner of the township, including sections 28, 29, 31, and 32, a few shallow gravel deposits of limited extent produce a fair supply of soft to medium hard water suitable for domestic use. These deposits overlie the impervious boulder clay and are found only in the depressions between the low lying hills. Wells sunk in these areas usually encounter the gravel aquifer at depths of 15 to 20 feet after penetrating a few feet of yellow clay.

On the western border of the township, including sections 6 to 30, water-bearing gravels may be encountered at depths ranging from 100 to 150 feet. Water from this aquifer usually carries a small percentage of alkaline salts, but is suitable for the watering of stock and in some instances may be used for domestic purposes. Wells have been sunk to depths of 150 feet or more in the southeastern part of the municipality without encountering more than very small seepages of water.

The productive sands at the top of the Belly River formation lie approximately 600 feet below the surface in this township. The quality of the water to be expected makes drilling to this horizon a questionable venture.

Township 2, Range 18

A few shallow deposits of sand or gravel occur in the coulée bottoms and depressions throughout the township. These deposits yield small supplies of medium hard, drinking water during

the spring and early summer, but cannot be relied upon for water supplies during the winter months.

A few water-bearing gravel or sand pockets of limited extent are to be found in the boulder clay, at depths ranging from 45 to 90 feet, throughout the greater part of the township. The water present usually carries too high a percentage of salts in solution for human consumption.

Beds of water-bearing gravels have been encountered in wells drilled to depths of 90 to 165 feet from the surface in various parts of the township. The lowest aquifer lies at, or near the bottom of the glacial drift, under about 150 feet of compact boulder clay. Five wells distributed throughout the township have tapped this horizon. Those wells situated along a narrow belt trending northwest from section 12 to section 19 are producing constant supplies of hard, usable water suitable for household purposes. To the north and south of this belt where water is obtained near the borders of the aquifer the presence of large amounts of salts in solution renders the water unsuitable for domestic needs, but it is being used for watering stock. It would be advisable in drilling in the central and southeastern parts of the township to shut off unsuitable water encountered at depths of less than 100 feet and attempt to secure a water supply from the deeper gravel beds. The possibility of obtaining water suitable even for the watering of stock in the bedrock at depths less than 700 to 800 feet is very remote in this township.

Township 3, Range 16

A few shallow pockets of gravel or sand lie within 20 feet of the surface in the extreme northeast and southwest corners of the township. Wells sunk to these deposits may obtain small supplies of hard, usable water. Throughout the rest of the township no pockets suitable for ground water accumulation have been found in the glacial drift. Settlers in this area must

depend for drinking water upon seepage wells dug in clay beside sloughs or artificial reservoirs. Wells thus situated are not dependable for winter use.

An attempt has been made to obtain water from bedrock at the village of Bracken. Here a well drilled in 1930, to a total depth of 608 feet, encountered water in glacial drift at 125 feet. This water was too high in salts in solution to be of any use. Bearpaw shale was encountered at 160 feet and continued to a depth of 575 feet. In the Belly River formation, 33 feet below the base of the Bearpaw shale or at a total depth of 608 feet, water was encountered in a fine light grey sandstone. The water rose to within 360 feet of the surface. It was found to contain so much sodium carbonate as to render it unsuitable for human consumption. This water, however, is used for washing and for stock.

Township 3, Range 17

In the southeast corner of the township, including sections 1, 2, and 10, ground water carrying small amounts of salts in solution is found in gravel or sand deposits in the bottoms of the small coulées of this district. This source would yield small supplies of water for household use during the spring and summer months.

There is a marked scarcity of aquifers carrying usable groundwater in the glacial drift of this township. In a small area in the central part, including sections 21, 22, 23, 27 and 28, water-bearing sands or gravels are found to lie at depths ranging from 30 to 70 feet from the surface. Water from these aquifers usually contains enough salts in solution to render it unfit for human consumption and in some instances it is not even fit for stock.

Throughout the rest of the township wells have been sunk to depths of 200 feet or more without encountering more than small

seepages. Here the residents must depend upon supplies of seepage water from wells sunk in the clay beside sloughs or reservoirs.

Township 3, Range 18

Water conditions in the central and eastern parts of this township are similar to those described in township 3, range 17. In the extreme southwestern corner, including sections 5, 6, and 7, a gravel aquifer carrying a good supply of slightly "alkaline" water suitable for stock is found at depths of 60 to 80 feet. This aquifer does not extend north of the area outlined on the accompanying map, but deeper gravels carrying "alkaline" water suitable for stock may be found at a depth of about 125 feet from the surface in this area and in sections 8, 17, and 18.

In sections 31 and 32 in the northwest corner of the township a good supply of water is being obtained from a sandstone aquifer in the upper part of the Bearpaw shale or in the lower part of the Eastend formation. This water-bearing horizon may be reached at a depth of about 300 feet in this part of the area, but probably does not extend southward for more than a mile or two. The water carries small amounts of common salt but is quite satisfactory for stock.

Throughout the rest of the township no water, or at best only small seepages, has been encountered in wells sunk to depths of 100 to 570 feet. Deeper drilling is not recommended, as only sodium carbonate water can be expected from the Belly River sands at depths ranging from 850 to 1,200 feet. For a description of bedrock and analyses of water from the Belly River formation the reader is referred to the description of the village of Climax well in the sections dealing with the municipality as a whole and to the section on character of water in the bedrock.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF LONE TREE, NO. 18, SASKATCHEWAN

West of 3rd mer.	Township	1	1	1	2	2	2	3	3	3	Total No. in municipality
	Range	16	17	18	16	17	18	16	17	18	
Total No. of Wells in Township		6	20	21	21	22	24	49	27	37	227
No. of wells in bedrock		0	0	1	0	0	0	3	2	5	11
No. of wells in glacial drift		5	10	18	21	19	17	44	19	32	185
No. of wells in alluvium		1	10	2	0	3	7	2	6	0	31
Permanency of Water Supply											
No. with permanent supply		6	15	18	17	19	21	41	20	31	188
No. with intermittent supply		0	5	0	1	2	3	3	3	2	19
No. dry holes		0	0	3	3	1	0	5	4	4	20
Types of Wells											
No. of flowing artesian wells		0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells		0	1	3	1	0	8	7	6	15	41
No. of non-artesian wells		6	19	15	17	21	16	37	17	18	166
Quality of Water											
No. with hard water		5	17	14	15	15	23	42	17	29	177
No. with soft water		1	3	4	3	6	1	2	6	4	30
No. with salty water		0	0	0	0	0	0	2	0	1	3
No. with alkaline water		0	6	8	2	3	12	4	12	13	30
Depths of Wells											
No. from 0 to 50 feet deep		3	19	12	13	20	15	43	20	10	155
No. from 51 to 100 feet deep		0	0	1	3	1	4	3	4	11	27
No. from 101 to 150 feet deep		3	1	4	4	1	3	1	1	10	28
No. from 151 to 200 feet deep		0	0	3	1	0	2	0	1	2	9
No. from 201 to 500 feet deep		0	0	1	0	0	0	1	1	2	5
No. from 501 to 1,000 feet deep		0	0	0	0	0	0	1	0	1	2
No. over 1,000 feet deep		0	0	0	0	0	0	0	0	1	1
How the Water is Used											
No. usable for domestic purposes		6	17	12	16	19	19	37	15	28	169
No. not usable for domestic purposes		0	3	6	2	2	5	7	8	5	38
No. usable for stock		6	19	18	18	21	24	40	22	32	200
No. not usable for stock		0	1	0	0	0	0	4	1	1	7
Sufficiency of Water Supply											
No. sufficient for domestic needs		6	15	18	18	19	21	41	20	31	189
No. insufficient for domestic needs		0	5	0	0	2	3	3	3	2	18
No. sufficient for stock needs		5	11	13	8	14	16	17	11	15	110
No. insufficient for stock needs		1	9	5	10	7	8	27	12	18	97

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

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

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 Lone Tree, No. 18, Saskatchewan

LOCATION					Depth of Well, Ft.	Total dis'vd Solids	Cl.	HARDNESS			CONSTITUENTS AS ANALYSED					CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS							Source of Water
Qtr.	Sec.	Tp.	Rge.	Mer.				Total	Perm.	Temp.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$CaCl_2$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	
NE.	31	3	16	3	54	13,860		3,000+	3,000+	undet.	270	960	1,584	6,560	2860	12,722	270	1,966		4,760		2,054	3,712	✱ 1
SW.	17	3	18	3	20	471											(3)	(1)	(4)	(2)				✱ 1
SE.	2	3	18	3	87	2,460	100	1,300	1,200	100	85	400	209	1,574	1180	2,422	85	855		623		694	165	✱ 1
SW.	17	3	18	3	1,005	2,031															(2)		(1)	✱ 2

Water samples indicated thus, ✱ 1, are from glacial drift or other unconsolidated deposits.
Water samples indicated thus, ✱ 2, are from bedrock Belly River formation.
Analyses are reported in parts per million; where numbers (1), (2), (3), and (4) are used instead of parts per million, they represent the relative amounts in which the four main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analyses Nos. 2 and 4 by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Ground water contained in deposits of sands and gravels which occur along the bottoms of the stream valleys and coulées is derived from the rainfall and by seepage from the streams and is generally not higly mineralized. Where the surface water has passed over or through boulder clay small amounts of salts are taken into solution, making the water slightly "alkaline." These salts are rarely in sufficient quantities, however, to render the water unsuitable for drinking.

Marked variations in the character of the glacial deposits occur within short distances and a correspondingly great variation in the character of the ground water derived from these deposits also occurs. This variation is noted not only in wells of different depths but even in the case of two wells drawing their supplies from the same aquifer and located only a few hundred feet apart. The mineral content of individual wells is known to change considerably over long periods of time. It does not necessarily follow, therefore, that because one well is producing an undesirable type of water, that groundwater in the area adjacent to this well will also be of poor quality. The small seepages of groundwater from the boulder clay or from small isolated pockets of sand interspersed through the clay is generally excessively hard and highly "alkaline." The first analysis given on the accompanying table is of the water from boulder clay. It shows an unusually high concentration of sodium sulphate (Glauber's Salts), magnesium sulphate (Epsom Salts), and common salt. This water is unfit for drinking or for stock. Generally, however, the water from the glacial drift in the area can be used for stock, but is unsuitable for household requirements. In places where more extensive sand and gravel beds are encountered a very hard, but not so highly "alkaline" water is to be expected, as indicated by the third analysis on the accompanying table. This type of

water would be laxative to persons unaccustomed to it, but continual use should not cause permanent ill effects. The second analysis is typical of water obtained at shallow depths in the gravel deposits in the drift. It is not highly mineralized and may be considered as an exceptionally good water so far as the mineral content is concerned.

Water from the Bedrock

No samples of water from the Bearpaw shales were collected. With the exception of water derived from the upper sands of the Bearpaw in the extreme northwest corner of the municipality, which probably is similar to water from the overlying drift, the water from the Bearpaw is usually very high in sulphates and common salt and therefore is not usable

The fourth analysis is of water from the 1,000-foot well at Climax deriving its supply from the Belly River formation. The analysis indicates the relative amounts of the constituents salts in the water as determined by the Provincial Government analyst. The high soda content of this water gives it a flat taste and makes it unsuitable for drinking, but it is used for stock. The water is soft and hence is used by many of the residents for washing purposes. The carbonate of sodium or "black alkali", in the water renders it unfit for irrigation. No other analyses were made of waters from the Belly River formation in this area. It is probable, however, that due to the uniformity of the formation over wide areas the water from it would be uniform in character throughout the municipality.

WELL RECORDS—Rural Municipality of LONE TREE, NO. 18, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NW.	7	1	16	3	Dug	7	2,750	- 4	2,746	4	2,746	Glacial gravel	Hard, iron, clear	45	D, S	Sufficient for local needs.
2	NE.	20	"	"	"	"	5	2,620	- 2	2,618	2	2,618	" "	" , " , sulphur	46	D, S	" " " " .
3	NW.	22	"	"	"	Bored	126	2,840	-112	2,728	112	2,728	" "	Hard, clear	45	D, S	" " " " .
4	NE.	22	"	"	"	Dug	16	2,830	- 15	2,815	15	2,815	Recent alluvial sand	" "	48	D, S	Insufficient for local needs.
5	NW.	24	"	"	"	Bored	124	2,850	-118	2,732	118	2,732	Glacial gravel	" "	44	D, S	Sufficient for local needs.
6	SW.	36	"	"	"	"	127	2,815	-118	2,697	118	2,697	" "	Soft, "	44	D, S	" " " " .
1	SE.	6	1	17	3	Dug	15	2,910	- 13	2,897			Recent alluvial clay	" "		D, S	Insufficient for local needs.
2	NW.	6	"	"	"	"	18	2,940	- 2	2,938			Recent alluvial clay	Hard, "		D, S	" " " " .
3	NW.	7	"	"	"	"	18	2,880	- 15	2,865			Recent alluvial clay	Soft, "		D, S	" " " " .
4	NE.	7	"	"	"	Bored	116	2,885			108	2,777	Glacial gravel	Hard, " , alkaline			Poor supply; poor quality.
5	NW.	9	"	"	"	Dug	15	2,870	- 13	2,857			Recent alluvial sand	Hard, clear		D, S	Sufficient for local needs.
6	NE.	9	"	"	"	"	12	2,900	- 7	2,893			Glacial gravel	" "		D, S	" " " " .
7	NW.	12	"	"	"	"	7	2,750	- 4	2,746	7	2,743	" "	" " iron	45	D, S	" " " " .
8	SW.	13	"	"	"	"	16	2,870	- 10	2,860	10	2,860	" "	Medium hard, clear		D, S	" " " " .
9	S½	14	"	"	"	"	12	2,850	- 7	2,843	5	2,845	" "	",med. "		D, S	" " " " .
10	NW.	14	"	"	"	"	14	2,880	- 10	2,870			" "	", " "		D, S	" " " " .
11	SE.	15	"	"	"	"	14	2,860	- 3	2,857			" "	", " "		D, S	" " " " .
12	NW.	15	"	"	"	"	14	2,870	- 9	2,861			Recent alluvial sand	Hard, clear		D, S	Insufficient for local needs.
13	NW.	16	"	"	"	"	13	2,850	- 9	2,841			Glacial gravel	" " alkaline		S	" " " " .
14	NE.	16	"	"	"	"	13	2,850	- 9	2,841			Recent alluvial sand	Hard, clear		D, S	Sufficient " " " .
15	SE.	17	"	"	"	"	8	2,850	- 3	2,847			Glacial gravel	" " alkaline		D, S	" " " " .
16	SE.	18	"	"	"	"	10	2,860	- 6	2,854			Recent alluvial sand, gravel	" , hard, clear		S	Insufficient for local needs.
17	SW.	18	"	"	"	"	23	2,885	- 19	2,866	22	2,863	Glacial gravel	" , " alkaline		D, S	Sufficient " " " .
18	NE.	21	"	"	"	"	24	2,850	- 8	2,842			Recent alluvial sand	Hard, clear		D, S	Small supply.
19	SE.	24	"	"	"	"	14	2,880	- 10	2,870			Recent " sand	Soft, "		D, S	Insufficient for local needs.
20	SE.	32	"	"	"	"	12	2,850	- 4	2,846			Recent " sand	Hard, "		D, S	Sufficient " " " .

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 LONE TREE, NO. 18, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	SE.	2	1	18	3	Bored	125	2,960	-105	2,855	120	2,840	Glacial gravel	Hard,clear, alkaline		S	Fair supply.
2	SW.	4	"	"	"	"	150	2,960					"			N	Dry hole.
3	SW.	5	"	"	"	Drilled	220	2,985					Bedrock			N	" " .
4	NW.	5	"	"	"	Dug	15	2,940	- 13	2,927	13	2,927	Recent alluvial sand	Hard,clear, alkaline	41	D, S	Insufficient for local needs.
5	SW.	6	"	"	"	"	16	2,960	- 10	2,950	10	2,950	Glacial sand	Soft,clear	46	D, S	Sufficient " " " .
6	NE.	7	"	"	"	"	22	2,962	- 20	2,942	20	2,942	" sandy clay	Hard, "	48	D, S	" " " " .
7	SW.	9	"	"	"	Bored	176	2,950								N	Dry hole.
8	NE.	9	"	"	"	Dug	20	2,910	0	2,910			Recent alluvial clay	" "		S	Insufficient for local needs.
9	NE.	10	"	"	"	Bored	160	2,940	-140	2,800	154	2,786	Glacial gravel	" " alkaline		S	" " " " .
10	SE.	12	"	"	"	"	135	2,900	-134	2,766	134	2,766	" sand	" ,hard, clear		S	" " " " .
11	SW.	13	"	"	"	Dug	12	2,870	- 9	2,861			" gravel	" , " alkaline		S	Sufficient " " " .
12	SW.	14	"	"	"	Bored	135	2,910					" "	" , hard,clear		S	" " " " .
13	NW.	14	"	"	"	Dug	10	2,880	- 8	2,872			" "	Medium hard, clear		D, S	" " " " .
14	SW.	16	"	"	"	"	12	2,910	- 2	2,908	2	2,908	" clay	Soft,clear	47	D, S	" " " " .
15	SW.	18	"	"	"	"	7	2,980	- 4	2,976	4	2,976	" gravel	" "	48	D, S	" " " " .
16	SW.	20	"	"	"	"	12	2,960	- 6	2,954	6	2,954	" "	Hard, " , alkaline	45	D, S	" " " " .
17	NE.	23	"	"	"	Bored	200	2,900	-160	2,740	197	2,703	" "	Hard,clear		D, S	" " " " .
18	NE.	28	"	"	"	Spring	0	2,930	0	2,930	0	2,930	" clay	" #	47	D, S	Continuous small flow.
19	NE.	29	"	"	"	"	0	2,970	0	2,970	0	2,970	" gravel	" " alkaline	47	D, S	" " " .
20	SW.	32	"	"	"	Dug	20	2,940	- 18	2,922	18	2,922	" clay	Soft,clear	45	D	Insufficient for local needs.
21	SE.	33	"	"	"	Bored	80	2,955	- 70	2,885	70	2,885	" "	Hard, ", alkaline	45	D, S	Sufficient " " " .
1	SW.	1	2	16	3	Bored	130	2,915	-125	2,790	125	2,790	" gravel	Hard,clear	46	D, S	" " " " .
2	NE.	1	"	"	"	"	138	2,920	-133	2,787	133	2,787	" "	" "	46	D, S	" " " " .
3	SW.	3	"	"	"	"	134	2,915	-127	2,788	127	2,788	" "	" "	46	D, S	" " " " .
4	NW.	3	"	"	"	"	148	2,925	-144	2,781	144	2,781	" "	" "	46	D, S	" " " " .
5	SW.	6	"	"	"	Dug	5	2,820	- 2	2,818	2	2,818	" "	" "	48	D, S	" " " " .

out

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of LONE TREE, NO. 18, 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	NW.	7	2	16	3	Bored	168	2,900					Glacial clay	[illegible]		N	Dry hole.
7	SE.	13	"	"	"	Dug	14	2,864	- 11	2,853	11	2,853	" gravel	" "	47	D, S	Insufficient for local needs.
8	NE.	14	"	"	"	"	16	2,890	- 8	2,882	8	2,882	" "	Soft, "	46	D, S	" " " " .
9	NE.	16	"	"	"	"	12	2,850	- 8	2,842	8	2,842	" "	" "	46	D, S	Sufficient " " " .
10	SE.	17	"	"	"	Bored	60	2,910	- 30	2,880	55	2,855	" "	Hard, "	46	S	Insufficient " " " .
11	NE.	20	"	"	"	Dug	22	2,890	- 16	2,874	16	2,874	" clay	" , " , alkaline	47	S	Very poor supply.
12	NW.	21	"	"	"	"	13	2,890	- 9	2,881	9	2,881	" gravel	Hard, clear	48	D, S	Sufficient for local needs.
13	SE.	24	"	"	"	"	16	2,905	- 12	2,893	12	2,893	" sand	Soft, "	48	D	Sufficient for household only.
14	SW.	28	"	"	"	Bored	27	2,920	- 19	2,901	19	2,901	" clay	Hard, " , alkaline	47	D, S	Insufficient for local needs.
15	NW.	28	"	"	"	Dug	20	2,920	- 10	2,910	10	2,910	" "	Hard, clear	47	D, S	" " " " .
16	SW.	32	"	"	"	"	40	2,910	- 22	2,888	22	2,888	" gravel	" "	48	D, S	" " " " .
17	NE.	32	"	"	"	Bored	30	2,910	- 12	2,898	12	2,898	" clay	" "	46	D, S	" " " " .
18	NW.	36	"	"	"	Dug	20	2,985	- 14	2,971	14	2,971	" gravel	" "	47	D, S	Sufficient " " " .
[illegible]	NW.	5	2	17	3	Dug	20	2,950	- 17	2,933	12	2,938	" "	" "		D ,S	" " " " .
2	SW.	7	"	"	"	"	20	2,940	- 14	2,926	6	2,934	Recent alluvial sand	Soft, clear		D, S	Insufficient " " " .
3	SE.	8	"	"	"	"	12	2,930	- 9	2,921	5	2,925	Glacial gravel	" "		D, S	" " " " .
4	NW.	9	"	"	"	"	16	2,955	- 6	2,949			Recent clay	Hard, " , alkaline		D, S	Sufficient " " " .
5	SW.	10	"	"	"	"	12	2,930	- 9	2,921	5	2,925	Glacial gravel	" , hard, clear		D, S	Insufficient " " " .
6	NE.	15	"	"	"	Bored	100	2,970	-100	2,870	100	2,870	" "	" "		N	Very poor supply; not good.
7	SW.	18	"	"	"	Dug	32	2,945	- 16	2,929			" clay	" "		D, S	Insufficient for local needs.
8	NE.	18	"	"	"	"	16	2,960	- 14	2,946	8	2,952	" gravel	" "	46	D, S	Sufficient " " " .
9	SE.	21	"	"	"	"	14	2,960	- 10	2,950	4	2,956	" "	Medium hard, clear		D, S	" " " " .
10	NW.	21	"	"	"	"	17	2,945	- 7	2,938	7	2,938	" "	" "		D, S	" " " " .
11	NW.	23	"	"	"	"	12	2,955	- 9	2,946	5	2,950	" "	Medium " , clear		D, S	" " " " .
12	SE.	25	"	"	"	"	12	2,910	- 8	2,902	4	2,906	" "	" "		D, S	" " " " .
13	SW.	28	"	"	"	Bored	14	2,955	- 8	2,947	5	2,950	" "	Soft, clear		D, S	" " " " .
14	SE.	31	"	"	"	Dug	11	2,960	- 7	2,953	4	2,956	" "	" "		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.

WELL RECORDS—Rural Municipality of LONE TREE, NO. 18, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
15	SW.	32	2	17	3	Dug	12	2,950	- 8	2,942	5	2,945	Glacial gravel	Soft,clear		D, S	Sufficient for local needs.
16	NW.	32	"	"	"	Bored	35	2,940	- 25	2,915	20	2,920	" "	Hard, " , alkaline		S	" " " " .
17	SW.	35	"	"	"	"	26	2,930	- 6	2,924			Recent alluvial sand	Soft,clear	48	D, S	" " " " .
18	NE.	36	"	"	"	Dug	6	2,950	0	2,950	1	2,949	Glacial gravel	Hard, "	48	D, S	" " " " .
1	NW.	6	"	18	"	Bored	165	2,980	- 42	2,938	161	2,819	" #	" " alkaline	44	S	" " " " .
2	NE.	9	"	"	"	Dug	12	2,910	- 8	2,902			Recent sand	Medium hard, clear		D, S	Insufficient for local needs.
3	NE.	12	"	"	"	Bored	150	2,940	- 90	2,850	150	2,790	Glacial gravel	" "		D, S	Sufficient " " " .
4	NE.	13	"	"	"	"	95	2,935	- 85	2,850			" clay	Alkaline, hard		S	Insufficient " " " .
5	SE	14	"	"	"	Dug	5	2,930	0	2,930			Recent sand	Hard,clear		D, S	Sufficient supply; mostly seepage.
6	SW.	14	"	"	"	Bored	160	2,940	- 90	2,850	160	2,780	Glacial gravel	Medium hard, clear		D, S	" for local needs.
7	NE.	15	"	"	"	Dug	16	2,940	- 6	2,934			" clay	Medium "		D	" " house use only.
8	SE.	16	"	"	"	"	14	2,890	- 8	2,882	8	2,882	Recent alluvial sand	Hard,clear, alkaline	47	D, S	" " local needs.
9	NW.	19	"	"	"	Bored	96	2,950	- 8	2,942	93	2,857	Glacial gravel	" ,hard, clear	44	D, S	" " " " .
10	NE.	19	"	"	"	"	135	2,950	- 18	2,932	121	2,829	" "	" , " , iron	46	D, S	" " " " .
11	NE.	20	"	"	"	Dug	10	2,900	0	2,900			" clay	Hard,clear		D, S	" " " " .
12	NE.	21	"	"	"	"	15	2,920	- 11	2,909	11	2,909	" "	" , " , alkaline	46	D	" " house use only.
13	SW.	24	"	"	"	"	15	2,940	0	2,940			Recent sand	Soft,clear		D, S	Insufficient for local needs.
14	NE.	25	"	"	"	"	92	3,010	- 20	2,990	92	2,918	Glacial gravel	Hard,alkaline		D, S	Sufficient " " " .
15	NW.	29	"	"	"	Spring	0	2,910	0	2,910	0	2,910	" "	" "		S	" " about 15 head stock.
16	NW.	31	"	"	"	Dug	25	2,980	- 17	2,963	17	2,963	Recent alluvial sand	" " clear	47	D, S	" " local needs.
17	SW.	32	"	"	"	"	10	2,940	- 2	2,938	2	2,938	Glacial gravel	" , " , hard	47	D, S	" " " " .
18	NE.	32	"	"	"	Bored	85	2,990	- 50	2,940	80	2,910	" sand	" , cloudy iron	46	S	" " " " .
19	SE.	33	"	"	"	"	128	2,970	-118	2,852	126	2,844	" gravel	Hard,clear, alkaline	44	S	" " " " .
20	SE.	33	"	"	"	Dug	12	2,970	0	2,970	0	2,970	" drift	Hard,clear	47	D, S	" " " " .
21	SE.	33	"	"	"	"	45	2,980	- 41	2,939	41	2,939	" sand	" "	46	D, S	Insufficient " " " .
22	NW.	34	"	"	"	"	14	2,950	0	2,950			" clay	alkaline Medium hard, clear		D, S	" " " " .

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

WELL RECORDS—Rural Municipality of LONE TREE, NO. 18, 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	NW.	36	2	18	3	Dug	18	3,000	- 16	2,984			Recent alluvial sand	Hard, clear, alkaline	46	D, S	Sufficient for local needs.
1	SE.	2	3	16	3	"	14	2,925	- 12	2,913	12	2,913	Glacial sand	Hard, clear	46	D	" " house use only.
2	NE.	2	"	"	"	Bored	30	2,970	- 25	2,945	25	2,945	" gravel	" , "	45	D, S	Insufficient for local needs.
3	SE.	4	"	"	"	Drilled	603	2,915	-360	2,555	608	2,307	Bedrock shale	Soft, soda			Used for washing only; 3 gallons a minute.
4	SW.	5	"	"	"	Bored	18	2,980	0	2,980			Recent sand	Hard, clear	46	D, S	Sufficient for local needs.
5	NE.	5	"	"	"	"	30	2,975	0	2,975			Glacial clay	" , "	48	D, S	Insufficient for local needs.
6	SW.	6	"	"	"	"	42	2,980	- 6	2,974	42	2,938	" gravel	Medium hard, clear		D, S	Sufficient " " " .
7	SE.	7	"	"	"	Dug	12	2,960	0	2,960	0	2,960	" clay	Hard, clear		D	" " house use only.
8	SE.	9	"	"	"	Bored	13	3,035	- 13	3,022	13	3,022	" sand	" , "	47	D, S	Insufficient " local needs.
9	SW.	10	"	"	"	Dug	15	3,020	- 12	3,008	12	3,008	" clay	" , "	47	D, S	" " " " .
10	SE.	12	"	"	"	"	13	2,930	- 9	2,921	9	2,921	" sand	" , "	45	D, S	Sufficient " " " .
11	NE.	15	"	"	"	"	18	2,975	- 12	2,963	12	2,963	" clay	" , "	47	D, S	Insufficient " " " .
12	SE.	16	"	"	"	Bored	30	3,040	- 25	3,015	25	3,015	" sand	" , "	46	D, S	" " " " .
13	SW.	16	"	"	"	Dug	24	2,985					" clay			N	Dry hole.
14	SE.	19	"	"	"	Bored	32	3,050	0	3,050			" "	" , "		N	Poor supply; poor quality; not used.
15	SW.	20	"	"	"	"	30	3,040	- 10	3,030			" "	Soft, "		D	Sufficient for house use only.
16	NE.	20	"	"	"	"	24	2,985	0	2,985			" "	Hard, "		D, S	Insufficient for local needs.
17	NE.	21	"	"	"	Dug	12	2,990	- 2	2,988	2	2,988	" "	" , " , alkaline	48	D, S	" " " " .
18	SE.	22	"	"	"	"	16	3,010	- 12	2,998	12	2,998	" gravel	Hard, clear	46	D, S	" " " " .
19	NE.	22	"	"	"	"	15	3,000	- 12	2,988	12	2,988	" clay	" "	48	D	" " " " .
20	SW.	23	"	"	"	"	16	2,970	- 13	2,957	13	2,957	" gravel	" "	46	D, S	Sufficient " " " .
21	NE.	23	"	"	"	"	20	2,975	- 15	2,960	15	2,960	" clay	" "	45	D, S	Insufficient " " " .
22	SW.	24	"	"	"	"	18	2,965	- 5	2,960	5	2,960	" "	" "	46	D, S	" " " " .
23	NE.	24	"	"	"	"	14	2,940	- 8	2,932	8	2,932	" sand	" "	46	D, S	Sufficient " " " .
24	NE.	26	"	"	"	"	13	2,945	- 10	2,935	10	2,935	" " , gravel	" "	47	D, S	" " " " .
25	NW.	27	"	"	"	"	17	2,995	- 16	2,979	16	2,979	" "	" "	45	D, S	Insufficient " " " .

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 LONE TREE, NO. 18, 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
26	NW.	28	3	16	3	Dug	16	2,990	- 7	2,983			Glacial clay	Medium hard, clear		D, S	Insufficient for local needs.
27	NE.	31	"	"	"	Bored	54	3,000	- 34	2,966	50	2,950	" sandy clay	Hard, salty, alkaline		N	Good supply; poor quality; not used.
28	SE.	32	"	"	"	Dug	13	2,935	0	2,935			" "	Hard, clear		D, S	Insufficient for local needs.
29	SE.	35	"	"	"	Bored	23	3,020	- 16	3,004	16	3,004	" "	" "	46	D, S	Sufficient " " " .
30	NW.	35	"	"	"	Dug	22	3,050	- 19	3,031	19	3,031	" gravel	" "	46	D, S	" " " " .
31	SW.	36	"	"	"	"	15	3,020	- 11	3,009	11	3,009	" Sand	" "	47	D, S	" " " " .
32	NE.	36	"	"	"	"	22	2,985	- 17	2,968	17	2,968	" clay	" "	47	D, S	" " " " .
33	SE.	4	"	"	"	Drilled	608	2,915	-360	2,555	608	2,307	Bedrock shale	Soft, soda		S	Yields 3 gallons a minute.
34	SE.	4	"	"	"	Bored	100	2,915	- 40	2,875			Glacial clay	Alkaline		N	Not used.
35	SE.	4	"	"	"	Drilled	500	2,915	-125	2,790			Bedrock	Salty		N	" " .
1	SE.	1	3	17	3	Dug	28	3,040	- 12	3,028			Recent alluvial sand	Hard, clear, alkaline		S	Insufficient for local needs.
2	NW.	1	"	"	"	Bored	20	2,950	- 10	2,940			Glacial gravel	Hard, clear		D, S	Sufficient " " " .
3	NE.	2	"	"	"	Dug	40	3,020	- 20	3,000			" sand	" "		D	" " house use only.
4	SE.	3	"	"	"	Bored	99	3,000					"			N	Dry hole.
5	NE.	7	"	"	"	Dug	14	3,040	- 10	3,030	10	3,030	" sandy clay	" " alkaline	46	D	Sufficient for house use only.
6	SE.	9	"	"	"	Bored	20	3,000	- 18	2,982			Recent sand	Hard, clear		D	Insufficient for local needs.
7	SE.	10	"	"	"	"	16	3,070	- 11	3,059			Glacial gravel	" " alkaline	48	S	Sufficient for " " .
8	NE.	14	"	"	"	Dug	23	3,050	- 13	3,037			" clay	Hard, clear		D, S	" " " " .
9	NW.	15	"	"	"	"	18	3,000	0	3,000	18	2,982	" gravel	" " alkaline		D, S	" " " " .
10	SW.	16	"	"	"	Bored	200	3,020					Bearpaw shale			N	Dry hole.
11	SW.	18	"	"	"	Dug	12	3,055	- 6	3,049	6	3,049	Glacial clay	Soft, clear	47	D	Sufficient for house use only.
12	NE.	19	"	"	"	"	16	3,080	- 10	3,070	10	3,070	" drift	" "	46	D	" " " " " .
13	NW.	20	"	"	"	"	9	3,110	0	3,110	0	3,110	" "	" "	49	D	Insufficient for local needs.
14	SW.	21	"	"	"	Bored	50	3,080	- 16	3,064			" clay	Hard, clear, alkaline		S	" " " " .
15	NE.	21	"	"	"	"	70	3,110	- 25	3,085	60	3,050	" sand	" , hard clear	46	S	" " " " .
16	SE.	23	"	"	"	"	32	2,990	- 22	2,968	31	2,959	" gravel	" , " , alkaline		N	Unfit for use.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of LONE TREE NO. 18, 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	SW.	25	3	17	3	Dug	14	3,050	- [illegible]	3,040			Recent clay	Soft, clear		D	Insufficient for local needs.
18	NW.	25	"	"	"	"	20	3,090	- 10	3,080			" sand	Hard, " , alkaline		D	" " " " .
19	NW.	27	"	"	"	Bored	35	3,155	- 20	3,135	20	3,135	Glacial gravel	Hard, clear	46	D, S	Sufficient " " " .
20	SE.	28	"	"	"	"	50	3,110	- 20	3,090	50	3,060	" sand, "	", alkaline		S	" " " " .
21	SW.	28	"	"	"	"	62	3,110	- 50	3,060	62	3,048	" "	" " clear		S	Insufficient " " " .
22	NE.	32	"	"	"	"	125	3,170					" clay			N	Dry hole.
23	NW.	33	"	"	"	"	220	3,145					" "			N	" " .
24	NE.	35	"	"	"	Dug	11	3,080	0	3,080			Recent sand	Soft, clear	48	D, S	Sufficient for local needs.
25	NW.	36	"	"	"	"	15	3,050	0	3,050			" "	" "		D, S	" " " " .
1	SE.	2	3	18	3	Bored	87	3,060	- 25	3,035	80	2,980	Glacial gravel	Hard, " , alkaline	46	D, S	" " " " ; #.
2	NW.	2	"	"	"	"	145	3,065	- 70	2,995	135	2,930	" clay	" , hard, clear		S	" " " " .
3	NE.	6	"	"	"	"	75	3,025	- 71	2,954	71	2,954	" gravel	" , " , alkaline	45	D, S	" " " " .
4	SW.	7	"	"	"	"	60	3,015	- 54	2,961	54	2,961	" "	" , " clear	45	D, S	" " " " .
5	NE.	8	"	"	"	Drilled	120	2,940	-100	2,840	118	2,822	" "	" , " , alkaline		S	" " " " .
6	SE.	9	"	"	"	"	175	3,050	- 80	2,970	170	2,880	" sand	Hard, clear, iron	46	D, S	" " " " .
7	NE.	10	"	"	"	Dug	26	3,110	- 16	3,094	16	3,094	" "	Hard, "	47	D, S	" " " " .
8	SW.	12	"	"	"	"	12	3,055	- 9	3,046	9	3,046	" gravel sandy clay	Soft, "	48	D	" " house use only.
9	SE.	13	"	"	"	"	13	3,055	- 3	3,052	3	3,052	" clay	Hard, "	47	D	" " " " " .
10	NE.	14	"	"	"	Drilled	570	3,100					Bedrock			N	Dry hole.
11	NE.	16	"	"	"	Bored	53	3,145	- 33	3,112	51	3,094	Glacial gravel	" "	46	D, S	Sufficient for local needs.
12	SE.	17	"	"	"	Drilled	235	3,040					Bedrock shale				Poor quality; small quantity.
13	SW.	17	"	"	"	Dug	20	3,060	- 16	3,044	16	3,044	Glacial gravel	" , cloudy	46	D, S	Sufficient for local needs; ; #.
14	SW.	17	"	"	"	Drilled	1,005	3,070	-400	2,670	990	2,070	Bedrock	Soft, #		D, S	" " " " .
15	NE.	23	"	"	"	Bored	170	3,135	-110	3,025	165	2,970	Glacial sand	Hard, clear, alkaline	46	S	Insufficient for local needs.
16	NW.	24	"	"	"	"	80	3,125					" clay			N	Dry hole.
17	NE.	24	"	"	"	"	100	3,130					" "			N	" " .
18	SE.	25	"	"	"	"	60	3,165					" "			N	" " .
19	NW.	25	"	"	"	Dug	18	3,160	- 4	3,156	4	3,156	" sand	Soft, clear	47	D, S	Largely seepage from dam.
20	SW.	28	"	"	"	"	12	3,150	- 7	3,143	7	3,143	" clay	Hard, "	47	D	Insufficient for local needs.
21	NW.	32	"	"	"	Drilled	300	3,225	-250	2,975	295	2,930	Bedrock shale	Medium hard, salty		D, S	Sufficient " " " .
22	NE.	33	"	"	"	Bored	65	3,220	- 50	3,170	50	3,170	Glacial gravel	Hard, clear alkaline	45	S	" " " " .

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of LONE TREE, NO. 18 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	NW.	35	3	18	3	Bored	60	3,200	- 10	3,190			Glacial clay	Hard, clear, alkaline	47	D, S	Sufficient for local needs.
24	NE.	35	"	"	"	Drilled	120	3,190	-117	3,073			" "	" , hard, clear	46	S	Insufficient for local needs.
	SE.	17	"	"	"	"	235	3,040					Bedrock shale				Poor quality; small amount.

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

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