CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

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WATER SUPPLY PAPER No. 133

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF BITTER LAKE NO. 142 SASKATCHEWAN

By

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

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CONTENTS

Illustrations

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF BITTER LAKE, NO. 142 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 Bitter Lake, No. 142, consists of six full and three fractional townships, and comprises an area of 241 square miles. The townships are described as tps. 13, 14, and 15, ranges 28, 29, and 30, W. 3rd mer. The centre of the municipality lies 167 miles north of the International Boundary line, and approximately 7 miles east of the Fourth meridian. A branch line of the Canadian Pacific railway enters the area in sec. 5, tp. 13, range 28, and traverses the southeastern part of the municipality, leaving in sec. 24, tp. 14, range 28. Tunstall, a siding located on the above branch, is the only railway station within the municipality.

The surface of this municipality is not rough, but most of it is moderately to gently rolling. Elevations over the greater part range between 2,450 and 2,550 feet above sea-level. The maximum difference in elevation however, amounts to more than 300 feet. The lowest elevation, approximately 2,334 feet above sea-level, occurs at Bitter lake and the maximum elevation of 2,650 feet is attained in the northeastern part of township 14, range 29; along the northern boundary of township 15, range 28; and in different parts of township 15, ranges 29 and 30. Bitter lake, a long, narrow body of water, occurs in a fairly deep valley and extends from the northwestern part of township 13, range 14, to near the southeastern corner of township 13, range 28. Other smaller lakes are scattered throughout the municipality, but only in very wet seasons do they contain water. The water from Bitter lake and many of the other undrained depressions is highly mineralized and is termed "alkaline". A small, intermittent stream flows from sec. 1, tp. 13, range 28, into Bitter lake, and another flows from sec. 36, tp. 15, range 30, into a marshy area located in sec. 29, tp. 15, range 29.

Almost all the northern three-quarters of the municipality is covered by boulder clay or glacial till. The higher areas in this section are mantled by moraine. With the exception of a small area of dune sand in the southern part of township 14, ranges 28 and 29, the remainder of the municipality is covered by glacial lake deposits. These lake deposits are sandy at most places, but along the southwestern corner of the area they consist of clay. The approximate boundaries of the different glacial deposits are shown on Figure 1 of the map accompanying this report. No continuous water-bearing horizons of large areal extent could be outlined and the discusssion that follows is based on the water-bearing conditions in the various types of glacial deposits.

Water-bearing Horizons in the Unconsolidated Deposits

The Recent dune sand deposits have not been extensively prospected, and only a few wells derive water from them. Probably only one of these wells, located in sec. 8, tp. 14, range 28, which is not used at present, is actually obtaining water from these Recent deposits; the others possibly derive their water from the underlying boulder clay. The dune sands are not thick, possibly nowhere more than 10 or 12 feet, and average only 3 or 4 feet, so that no large amount of ground water is stored within these porous deposits. Small supplies of water will no doubt be obtained where the deposits are thick, but over most of the area it will probably be found necessary to sink wells into the underlying boulder clay before water is encountered. The water from these Recent dune sands, however, should be moderately soft and suitable for all general farm purposes.

The glacial lake sands have proved productive over most of the area in which they occur, and little difficulty should be experienced in deriving small quantities of water from shallow

wells dug into these deposits. The lake sands are thought to be approximately 25 feet in thickness over most of the area and in only a few places has it been necessary to pass through them into the underlying boulder clay in order to obtain water. The supply from the wells varies considerably and the water-level in them lowers during periods of drought, but except in township 13, range 28, most of the wells yield sufficient water for local needs. In township 13, range 28, it is necessary in many places to use two or more wells to obtain an adequate supply. The water varies from moderately soft to hard, and that from some wells is so highly mineralized that its use is limited to stock.

The lake clay does not yield water. It is not thought to be more than 10 feet thick in most parts of the area, and water is obtained from scattered deposits of sand and gravel that occur at the contact of the lake clay and the underlying boulder clay. Although it cannot be said that these deposits form a continuous water-bearing horizon they appear to be fairly numerous and no difficulty has been experienced in obtaining ground water in this area at shallow depth. The supply from the wells is usually adequate for stock needs, but the water from some of the wells is too highly mineralized for domestic use.

The remaining wells in this municipality are sunk in those areas that are covered by glacial till and moraine. Approximately one-half these wells tap water-bearing sand and gravel deposits that occur at or near the base of the oxidized or yellow boulder clay at depths usually less than 30 feet. In no part of the area does a general water-bearing horizon appear to be present, and the pockets tapped by the wells are scattered, dry holes having been encountered in different parts of the municipality. The prospective well site should be tested by means of a small auger to locate a water-bearing pocket before a well is dug, since this eliminates the possibility of digging a dry hole.

The supply of water from the shallow wells varies considerably and depends on the size of the pocket tapped and on the amount of annual precipitation. On a number of farms it has been found necessary to sink two or more wells to obtain a sufficient supply. The water varies from moderately soft to hard, and that from a number of wells is so highly mineralized that it cannot be used for domestic purposes.

The other wells that have been sunk in the glacial till and moraine-covered areas tap water-bearing deposits in the unoxidized or blue boulder clay. The wells range from 30 to 122 feet in depth and in most parts of the municipality the deposits do not appear to form a continuous water-bearing horizon. In a small area in the northeastern part of township 14, range 29, and the southeastern part of township 15, range 29, a few wells derive water from a fine sand aquifer at depths of 75 to 122 feet, or at elevations of 2,490 to 2,469 feet above sea-level. This deposit of fine sand appears to be fairly continuous over this small area and other wells sunk to these elevations should obtain water. The supply from these wells is not large, however, due partly to the fact that the fine sand rises in the well and shuts off part of the available supply. In most cases the water is used for drinking, although it is hard and quite highly mineralized. A second area in which a fairly continuous aquifer appears to be present occurs in the southwestern part of township 15, range 29. In this area a few wells, sunk to depths of from 60 to 90 feet, tap what is described as "blue mud" at elevations of 2,515 to 2,490 feet above sea-level. It is possible that this "blue mud" may be of interglacial origin, and it may be located near the base of the drift. Its areal extent is not definitely known. The supply of water derived from these deposits is adequate for stock needs, but the water is highly mineralized and that from some of the wells is used only for stock. The supply

obtained from deep wells located outside the two above-mentioned areas varies considerably, and that from a number of wells must be supplemented from other sources. The water is hard and much of it contains a considerable amount of mineral salts in solution.

A number of wells in this municipality do not tap water-bearing deposits, but obtain water by direct seepage from surface water collected and stored in undrained depressions and dugouts. The supply from these wells is directly dependent on the amount of water in the natural or artificial reservoir, and the wells yield little or no water during drought periods and winters. In years of normal precipitation, however, the supply from such wells is generally sufficient for household needs and a few head of stock. Much of the water is moderately soft, and unless the well is sunk in or near an "alkali flat" the water should not be highly mineralized.

In many parts of the municipality where the subsoil is impervious, dugouts could be excavated and surface water collected for stock use. The dugouts should be excavated in natural depressions where the maximum amount of run-off water collects, and they should be dug at least 12 feet deep in order to retain water throughout the year.

Water-bearing Horizons in the Bedrock

To the east of the geological boundary shown on the accompanying map the glacial drift is immediately underlain by the Bearpaw formation. The Belly River formation underlies the Bearpaw formation and is thought to immediately underlie the glacial drift in the area west of the approximate geological boundary, shown on Figure 2 of the accompanying map. No outcrops occur and no wells have been drilled into these bedrock formations in this municipality. The Bearpaw formation is not thought to exceed 150 feet in thickness, and this formation, which is composed

of dark-coloured, compact, marine shales, is not thought to contain many water-bearing beds and any water derived from it will probably be highly mineralized. Drilling into this bedrock formation is not advised.

The Belly River formation usually contains a considerable amount of sandy beds and it should be a source of water in this municipality. The thickness of the overlying drift is not known, but in sec. 34, tp. 14, range 29, it is at least 122 feet, and in many parts of the area it may be considerably thicker. The "blue mud" that forms the aquifer for a few wells in the southwestern part of township 19, range 29, may be near the contact of the drift and the Belly River formation. In other municipalities in this part of Saskatchewan the Belly River formation yields large supplies of water, but no deep wells have been drilled in the municipality. It may be necessary to drill to depths exceeding 300 feet before water is encountered. The water-bearing deposits in the formation are often lenticular in shape, and dry holes may be drilled in the immediate vicinity of producing wells. Farmers in this municipality are advised to excavate dugouts rather than drill deep wells, although the drilling of a few deep test holes into the Belly River formation would be a worth-while undertaking.

GROUND-WATER CONDITIONS BY TOWNSHIPS

Township 13, Range 28

The surface of this township is gently rolling and the elevation ranges from 2,334 to 2,450 feet above sea-level. A wide, fairly deep valley trends from section 12 to section 31 and is occupied by Bitter lake. The water in this lake is "alkaline", and is not usable for stock. The northeastern corner of the area is mantled by glacial till or boulder clay, and the remainder of the area is covered by glacial lake deposits, most of which are quite sandy.

The lake deposits, especially the sands, contain water, and a number of wells to the south of Bitter lake obtain water from them at depths ranging from 6 to 20 feet. There should be little or no difficulty experienced in obtaining small supplies of ground water in this area. The supply from the shallow producing wells varies greatly, and that from some is not adequate for local requirements; in such cases a second shallow well can be used to augment the deficient supply. The water varies from moderately soft to hard, and that from some wells is highly mineralized and "alkaline", but most of it is used for domestic purposes as well as for stock.

In the area covered by glacial till or boulder clay, a few wells derive water at depths ranging from 14 to 43 feet. Most of these wells obtain their supplies of water by seepage, although some may be tapping water-bearing deposits. From the information at hand, however, water-bearing deposits in the weathered or yellow boulder clay appear to be very scattered, and difficulty may be experienced in locating them. The lower part of the drift has not been investigated, but it may contain scattered deposits of water-bearing sand and gravel. The wells that obtain water by seepage are easily affected by the amount of

precipitation and most of them yield an insufficient supply for local requirements. The water varies from moderately soft to hard and some of it is mineralized to such a degree that its use is confined to stock.

In areas where water is difficult to obtain and where the supply from producing wells is inadequate, it is advisable to excavate dugouts for the collection and retention of surface water for stock use. The dugouts should be located in natural depressions, where the maximum amount of run-off water collects, and they should be dug at least 12 feet deep in order to retain a sufficient supply of water throughout the year. Shallow wells sunk beside the dugouts should yield water that will be usable for domestic needs.

Township 13, Range 29

The surface of this township is level to gently rolling and the elevation increases from 2,334 feet above sea-level at Bitter lake to 2,500 feet above sea-level in parts of sections 7, 18, and 19. Bitter lake covers a considerable area in the north-central part of the township. The water from it is "alkaline". The area is covered by glacial lake deposits, and with the exception of a small area of glacial lake clay in the southwestern corner the deposits are very sandy.

Over most of this area ground water is fairly easily obtained from the glacial lake sands at depths of less than 25 feet. A few springs also yield a considerable amount of water. The supply from the shallow wells is usually adequate for local requirements and the water can as a rule be used for domestic purposes, although that obtained from a few wells near Bitter lake is rather highly mineralized and most of it is used only for stock.

Two wells located in sections 1 and 7 obtain water from sand and gravel deposits that occur in the boulder clay that underlies the lake sands. There is insufficient evidence at hand

to say that this part of the drift contains numerous water-bearing deposits, but no doubt other wells sunk into this zone of the drift will encounter similar aquifers. The deposits that form the aquifers, however, are not thought to be continuous, and several dry holes may be sunk before a producing well is obtained. The supply from the well in section 1 is inadequate for farm requirements, but the water from both wells is used for drinking. Adequate supplies for local needs should be obtained at shallow depth throughout this township.

Township 13, Range 30

The Fourth meridian, the boundary between Saskatchewan and Alberta, forms the western border of this fractional township which has an area of approximately 10½ square miles. The eastern part of this area is gently rolling and the total range in topographic relief is about 100 feet. The area is mantled by glacial lake deposits, glacial lake sands covering the northeastern part, and lake clays the remainder of the township.

No difficulty is experienced in obtaining ground water in this township. Producing wells range in depth from 6 to 14 feet and even in 1935 after a longer period of drought there was no need to dig to greater depths for water. Wells sunk in the glacial lake clay probably tap sand or gravel beds that occur at or near the contact of the lake deposits and the underlying boulder clay, as the lake clay is thought to yield little or no water. The supply from the wells is usually adequate for local needs. The water from most of the wells is moderately soft, but it contains a relatively large amount of mineral salts in solution and much of it is used only for stock. One well, located in the SW. ¼, section 24, taps a black sand aquifer at a depth of 10 feet and yields water that is moderately soft, but so highly mineralized that stock refuse to drink it. As an adequate supply of water can be derived at shallow depth, no deep wells have been sunk. It is

possible that water-bearing deposits occur in the lower part of the glacial drift and in the underlying Belly River formation.

Township 14, Range 28

The surface of this township is gently rolling. The maximum elevation of somewhat more than 2,550 feet above sea-level is attained in parts of sections 22, 23, 26, and 27, and the minimum of less than 2,350 feet occurs in the SW. $\frac{1}{4}$, section 6. Most of the township is covered by boulder clay or glacial till, but a narrow area extending across the southern part of the township is covered by a few feet of Recent dune sand and part of section 6 is mantled by glacial lake sands.

The glacial lake sands have not been prospected for water, but no doubt wells sunk in them will yield small amounts of moderately soft water. The deposit of Recent dune sands is so thin that water has not collected within it, and the wells in the dune sand-covered area obtain water from the underlying boulder clay. A few springs occur in the area covered by dune sands.

Approximately two-thirds of the wells in this township derive water from scattered deposits of sand and gravel that occur at or near the base of the weathered or yellow boulder clay. These wells are from 8 to 32 feet and the supply varies with the size of the deposit tapped and the amount of annual precipitation. The deposits do not form a general or continuous water-bearing horizon, as a few dry holes up to 30 feet in depth have been dug. In most parts of the township, however, no great difficulty should be experienced in obtaining at least a small amount of ground water. It is advisable to locate the water-bearing deposits by means of a test auger before a well is dug. The water from the shallow wells can be used for stock, but much of it is too highly mineralized for domestic use.

The remaining wells in this township derive water from scattered deposits of sand and gravel that occur in the unweathered or blue boulder clay at depths ranging from 40 to 112 feet. A few of the deeper wells of this group in the northern part of the area tap a sand aquifer at elevations ranging from 2,395 to 2,425 feet above sea-level. This aquifer may be general and continuous in this area, and it appears probable that other wells sunk to approximately the same depths may tap the same water-bearing sand. In no other part of the township is there sufficient evidence to indicate a general or continuous water-bearing horizon. The supply of water from the lower part of the glacial drift is adequate for local requirements, and the water, although quite hard and highly mineralized, is in most places used for drinking as well as for stock.

In areas where the supply from the wells is inadequate, surface water can be collected and retained by the use of dugouts. They should be located in natural depressions and dug to a depth of at least 12 feet in order to retain sufficient water to last throughout the winter months.

Township 14, Range 29

A fairly large area in the northeastern corner of the township and a small area in the northwestern corner are covered by moraine, but the remainder of the area is mantled by boulder clay or glacial till. In the southern 2 miles of the township the boulder clay is overlain by glacial lake sands. In parts of sections 1, 2, 3, 10, 11, and 12, the lake sands have been rearranged by wind action to form sand dunes. The ground surface of the moraine-covered area is rough, but in the other part of the area it is fairly level. The minimum elevation of 2,350 feet above sea-level occurs along the southern boundary and the

maximum elevation of more than 2,600 feet is attained in the northeastern corner. Part of Bitter lake occurs in the southern part of the township, and a few, fairly large, swampy areas are found in other parts of the area.

It should not be difficult to obtain small amounts of ground water from the glacial lake sands that occur in the southern part of the township, although little investigation of the ground water conditions in this area had been made up to 1935. The water obtained from the lake sands in this township is highly mineralized and it is not used for drinking. A number of springs occur in section 11, and the overflow from these springs is impounded by dams and the water used for stock.

In the glacial till and moraine-covered areas most of the wells derive water from scattered deposits of water-bearing sand and gravel that occur in the yellow boulder clay within 30 feet of the surface. In no specific area do the deposits appear continuous; no general water-bearing horizons are present, and a number of dry holes have been sunk in various localities. The supply from the shallow wells is dependant upon the amount of annual precipitation and also upon the size and porosity of the water-bearing deposit. Some of the wells yield a supply that is sufficient only for a few head of stock, whereas others yield an adequate supply for all farm needs. The water varies from moderately soft to hard, and some of it contains such a large amount of mineral salts in solution that its use is limited to stock.

A few wells in this township derive water from deposits of sand or gravel that occur in the unweathered or blue boulder clay. These deposits have been tapped at depths ranging from 40 to 122 feet and with the exception of three wells located in sections 34 and 35 tap deposits of approximate elevations of

2,480 feet above sea-level. There does not appear to be any continuity in their occurrence. It should be possible to obtain water in the sections mentioned above, at depths ranging from 90 to 120 feet, and the aquifer that the wells tap probably extends beyond the area mentioned. The aquifer is composed of fine sand, and difficulty is experienced in keeping the sand from clogging the casing and reducing the supply of water. The water from the wells that tap deposits in the unweathered part of the drift varies from moderately to excessively hard, and that from some wells is so highly mineralized that its use is limited to stock.

In those sections in the moraine and till-covered areas where water cannot be derived from wells, the use of dugouts to collect surface water for stock is highly recommended. Water for domestic needs can usually be obtained by sinking wells beside the artificial reservoirs or beside undrained depressions.

Township 14, Range 30

This fractional township comprises an area of approximately 10½ square miles. With the exception of a small area in the extreme southwestern corner that is relatively level, the remainder of the surface is gently rolling and the elevation ranges from 2,400 feet above sea-level in the southern half of the township to more than 2,650 feet above sea-level in the northwestern corner. The southern part of the township is covered by glacial lake deposits, most of which are sandy. The area covered by clay is marshy and is reserved as a bird sanctuary. The remainder of the surface is covered by glacial till or boulder clay and moraine.

The ground water conditions in this township have not been fully investigated, but a few wells tap deposits of sand and gravel at depths of 16 to 70 feet. The shallow wells no doubt

tap deposits at or near the base of the yellow or oxidized boulder clay, whereas the deeper wells probably encounter deposits located wholly within the unweathered or blue boulder clay. There is no evidence to indicate that the aquifers are general or continuous, and each well appears to derive its water from a small, localized deposit. If only a shallow well is contemplated the well site should be prospected by means of a small test auger prior to digging a well. This eliminates the possibility of sinking a dry hole. The supply from the producing wells in this township is adequate for local requirements, and although the water is recorded as hard and "alkaline", it is, with one exception, used for drinking. The supply from the wells in this township can be supplemented by collecting surface water in dugouts for stock use.

Township 15, Range 28

With the exception of parts of sections 5 and 6, which are mantled by moraine, this township is covered by glacial till or boulder clay. The surface is quite rolling and a number of low, swampy areas occur throughout the area. The elevation increases from less than 2,450 feet above sea-level in a low area in the southern part to approximately 2,600 feet in two small areas along the northern boundary.

Most of the wells in this township derive water from the yellow boulder clay at depths of less than 30 feet. Some of the wells tap deposits of sand or gravel, whereas others obtain most of their supply by direct seepage. Deposits of water-bearing sand do not appear to be numerous, dry holes have been sunk in a few areas, and no continuous water-bearing horizon appears to be present. The seepage wells are dug in or near undrained depressions or sloughs, and in most areas it should be possible to obtain small quantities of water from such wells. The supply from the shallow wells varies greatly, but that from the

wells tapping deposits of water-bearing sand or gravel is generally sufficient for stock needs. The water ranges from moderately soft to very hard, and that from some wells is so highly mineralized that its use is limited to stock.

The other wells in this township derive water from scattered deposits of sand and gravel that occur in the lower part of the drift, which is usually composed of blue boulder clay.

The deposits occur at depths of from 30 to 110 feet, and over limited areas they appear to be fairly numerous, but there is no indication of a general water-bearing horizon. In most parts of the township it should be possible to tap one of the deposits within 75 feet of the surface, as the deepest dry hole recorded is 60 feet. The supply from the wells varies considerably, but only a few obtain more than required for local needs. The water is mostly quite hard and mineralized and that from a few wells can be used only for stock.

Township 15, Range 29

Most of the surface of this township is fairly level, especially in the northeastern half where the elevation varies from 2,450 to 2,550 feet above sea-level. In the southwestern part of the township the surface is more rolling and becomes quite hilly, and the elevation rises above 2,650 feet above sea-level. In the northern half of the township a few, swampy, low-lying depressions contain water in the spring and early summer. Most of the surface is covered by boulder clay or glacial till, but two small areas in the southwestern part of the township are covered by moraine. The water conditions in both the moraine and the glacial till-covered areas appear to be similar.

A few wells in this township obtain water within 30 feet of the surface, or within the yellow boulder clay. Only a few of

these wells tap pockets of water-bearing sand or gravel and the remainder are sunk near depressions or sloughs and obtain water more or less by direct seepage from the surface water. The supplies from these wells vary with the amount of annual rainfall, and in periods of continued drought they may become completely dry. The deposits of sand and gravel that form the aquifers for the other shallow wells are not numerous, in no area do they form a continuous water-bearing horizon, and dry holes have been dug in many parts of the area. If only a shallow well is contemplated the prospective well site should be tested by means of a small auger to locate a water-bearing deposit prior to digging the well. The water obtained from the shallow wells is usually moderately soft and only that from a few of the wells is too highly mineralized for domestic purposes.

Water-bearing deposits in the lower part of the drift, that is the blue boulder clay, supply most of the wells in this township. These deposits occur at depths of 38 to 120 feet and except within two small areas they do not appear to form general or continuous water-bearing horizons. An aquifer of fine sand supplies a few wells in sections 1 and 2; it is located at elevations of 2,445 to 2,465 feet above sea-level, and appears to be fairly continuous over this limited area. Other wells sunk in this vicinity will no doubt tap the same water-bearing sands. The supply from these wells, due to trouble experienced with the sand plugging the casings, is small, and with one exception it is inadequate for farm requirements. In the southwestern part of the township, in sections 5, 7, 8, 9, 16, and 17, a number of wells tap water-bearing deposits at depths ranging from 60 to 90 feet or at elevations ranging from 2,486 to 2,509 feet above sea-level. The aquifers of some of these wells are described as "blue mud", and it appears to be fairly continuous over most of this part of the township. No doubt it will be encountered by other wells sunk

in this part of the area, but the deposit appears to thin out or disappear both to the north and east of the described area. The supply of water from this deposit of "blue mud" is adequate for local needs, but the water is very hard and highly mineralized, and as a rule it is used only for stock. Over the remainder of the township no correlation can be established in the occurrence of the aquifers, and dry holes have been sunk near producing wells. The supply of water from the lower part of the drift in this township is fairly constant and is not greatly affected by periods of drought. The water should be suitable for stock, but may be too highly mineralized for domestic purposes. The conservation of surface water by the use of dugouts is recommended in this area.

Township 15, Range 30

This fractional township is bounded on the west by the Fourth meridian, and is less than 4 square miles in area. The surface is gently rolling and the elevation increases from less than 2,550 feet above sea-level in section 36 to more than 2,650 feet in section 13. A small part of section 13 is mantled by moraine and the remainder of the area is covered by glacial till or boulder clay.

Only a few wells are sunk in this area and most of them tap scattered deposits of sand and gravel at depths of 30 to 80 feet. In the southern part of the township a general aquifer may be present at elevations ranging from 2,540 to 2,555 feet above sea-level, as three wells in the NE. $\frac{1}{4}$, section 12, and one in the SE. $\frac{1}{4}$, section 13, tap deposits at these elevations. Other wells sunk in this immediate vicinity will probably encounter the same or similar water-bearing deposits. The supply from the wells in this township varies, and about one-half of the wells do not yield sufficient water for farm needs. The supply is augmented in many places by the use of a second well. The water is hard and usually quite highly mineralized, and that from a number of wells cannot be used for drinking.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF BITTER LAKE, NO. 142, SASKATCHEWAN

Township	13	13	13	14	14	14	15	15	15	Total No. in municipality
West of 3rd meridian Range	28	29	30	28	29	30	28	29	30	
Total No. of Wells in Township	21	21	9	42	42	8	121	116	15	395
No. of wells in bedrock	0	0	0	0	0	0	0	0	0	0
No. of wells in glacial drift	21	21	9	38	40	8	121	116	15	389
No. of wells in alluvium	0	0	0	4	2	0	0	0	0	6
Permanency of Water Supply										
No. with permanent supply	16	21	9	29	29	7	56	57	7	231
No. with intermittent supply	5	0	0	5	4	0	10	17	2	43
No. dry holes	0	0	0	8	9	1	55	42	6	121
Types of Wells										
No. of flowing artesian wells	0	3	0	0	0	0	0	0	0	3
No. of non-flowing artesian wells	1	0	0	4	6	0	12	27	8	58
No. of non-artesian wells	20	18	9	30	27	7	54	47	1	213
Quality of Water										
No. with hard water	9	12	2	26	26	7	55	61	8	206
No. with soft water	12	9	7	8	7	0	11	13	1	68
No. with salty water	0	0	1	0	1	0	7	0	0	9
No. with "alkaline" water	4	5	2	8	16	4	25	30	4	98
Depths of Wells										
No. from 0 to 50 feet deep	21	20	9	35	31	5	92	52	8	273
No. from 51 to 100 feet deep	0	1	0	6	9	3	28	62	7	116
No. from 101 to 150 feet deep	0	0	0	1	2	0	1	2	0	6
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	0	0	0	0
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
How the Water is Used										
No. usable for domestic purposes	13	14	5	25	19	5	32	38	4	155
No. not usable for domestic purposes	8	7	4	9	14	2	34	36	5	119
No. usable for stock	19	19	8	32	32	7	61	69	6	253
No. not usable for stock	2	2	1	2	1	0	5	5	3	21
Sufficiency of Water Supply										
No. sufficient for domestic needs	18	21	9	28	23	7	48	55	6	215
No. insufficient for domestic needs	3	0	0	6	10	0	18	19	3	59
No. sufficient for stock needs	14	19	9	27	19	6	45	49	7	195
No. insufficient for stock needs	7	2	0	7	14	1	21	25	2	79

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

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

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

Analyses of Water Samples from the Municipality of Bitter Lake, No. 142, Saskatchewan

LOCATION						Depth of well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of water
No.	Qtr.	Sec.	To.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alka-linity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	
1	NW.	35	15	29	3	60	2,860	1,800	1,500	300	148	1,015	20	468	1,177	776	2,807	36		826	218		1,483	244	* 1

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

Water from the Unconsolidated Deposits

Only one sample of water from the unconsolidated deposits in the municipality of Bitter Lake was taken for analysis, and the results are listed in the accompanying table. The following discussion will, therefore, be based partly on the results of analyses of samples taken in adjoining municipalities and partly on the character of the water as observed and reported in the field.

No water from the Recent dune sands was analysed, but the water obtained from the springs that have their source in this area is used for stock, although it is not recorded if the water is suitable for drinking. Water from the Recent dune sands is mostly moderately soft and usable for all farm purposes.

The character of the water from the glacial deposits varies widely within narrow limits, and it does not follow that because the water from one well has been found unsuitable for use a second well sunk on the same quarter section will also yield unsuitable water. Generally speaking the water from shallow wells is less highly mineralized than that from the deeper wells. The mineral salts commonly found in solution are Na_2SO_4 (Glauber's salt), $CaSO_4$ (calcium sulphate), $CaCO_3$ (calcium carbonate), and $MgSO_4$ (Epsom salts). When the Glauber's salt and Epsom salts are abundant the water usually has a laxative effect upon those not accustomed to its continued use, and if these salts are highly concentrated they may cause scour in stock. The water that is being used only for stock in this municipality probably contains large amounts of Glauber's salt and Epsom salts in solution.

The water derived from the glacial lake sands, although obtained from shallow depth, is quite highly mineralized and much of it is used only for stock. The lake sands no doubt contain a considerable amount of "alkali salts" which the water takes into

solution. The water obtained at shallow depth in the other glacial deposits can generally be used for domestic purposes. The water obtained from deposits that occur at greater depth in the drift is mostly very hard and quite highly mineralized. The sample taken for analysis is from a 60-foot well and the high concentration of sodium sulphate, 1,483 parts per million, may cause the water to be laxative for those not accustomed to its use, but it should be suitable for stock.

The water obtained by direct seepage from impounded surface water should be moderately soft, slightly mineralized, and quite suitable for all farm needs. Care must be taken to see that the water does not become contaminated, and it should be tested regularly for bacteria content.

Water from the Bedrock

No wells in this municipality derive water from the bedrock. The water from the Bearpaw formation, if any is obtained, will be hard, highly mineralized, and probably unsuitable for drinking. It should be usable for stock. That from the Belly River formation may be either hard or soft, depending upon the amount of calcium and magnesium salts in solution. Water from depth in this formation may contain a large amount of sodium carbonate "black alkali", and sodium chloride or common salt. It will be unsuitable for irrigation, but can be used for stock.

WELL RECORDS—[1] Rural Municipality of BITTER LAKE NO. 142 SASKATCHEWAN

B 4-4
1860—10,000

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
1	SE.	4	13	29	3	Dug	50	2,460	- 30	2,450	50	2,430	Glaciel blue sand	Hard, iron	46	S	#
2	SE.	4	"	"	"	Dug	20	2,462	- 14	2,448	14	2,448	Glacial drift	Soft	48	D, S	Sufficient supply.
3	SW.	4	"	"	"	Dug	22	2,462	?		?		Glacial drift	Soft	48	N	Sufficient supply.
4	NW.	4	"	"	"	Dug	12	2,439	?		?		Glacial drift	Soft	54	S	Sufficient supply.
5	SW.	5	"	"	"	Dug	6	2,450	- 3	2,447	3	2,447	Glacial drift	Soft, "alkaline"	48	D, S	Sufficient supply.
6	NE.	5	"	"	"	Dug	12	2,435	- 9	2,426	9	2,426	Glacial sand	Soft	48	D, S	Sufficient supply.
7	NE.	6	"	"	"	Dug	8	2,435	- 4	2,431	4	2,431	Glacial drift	Soft	48	S	Insufficient supply.
8	NW.	6	"	"	"	Dug	8	2,430	- 5	2,425	5	2,425	Glacial black sand	Soft		D, S	Sufficient supply.
9	SE.	12	"	"	"	Dug	8	2,370	- 5	2,365	5	2,365	Glacial sand	Soft	50	S	Sufficient supply.
10	SE.	17	"	"	"	Dug	10	2,365	- 9	2,356	9	2,356	Glacial drift	Hard, iron, "alkaline"	48	S	Intermittent supply.
11	SE.	18	"	"	"	Dug	12	2,398	- 11	2,387	11	2,387	Glacial sand	Soft	48	S	Insufficient supply.
12	SW.	18	"	"	"	Dug	13	2,402	- 10	2,392	10	2,392	Glacial sand and gravel	Soft	47	D, S	Sufficient supply.
13	NE.	27	"	"	"	Drilled	30	2,455	- 10	2,445	10	2,445	Glacial drift	Soft		D, S	Intermittent supply.
14	NE.	27	"	"	"	Dug	14	2,460	- 10	2,450	8	2,452	Glacial drift	Hard, "alkaline"		D	Sufficient supply; but not suitable for drinking.
15	NE.	27	"	"	"	Bored	20	2,460	- 17	2,433	17	2,433	Glacial drift	Hard, "alkaline"	48	S	Insufficient supply; water hauled.
16	NE.	28	"	"	"	Bored	40	2,460	- 28	2,432	28	2,432	Glacial drift	Hard	48	N	
17	SE.	33	"	"	"	Dug	20	2460	- 10	2,450	10	2,450	Glacial drift	Hard	48	S	Intermittent supply.
18	SE.	33	"	"	"	Dug	43	2,470	- 35	2,435	35	2,435	Glacial drift	Hard	46	S	Sufficient supply.
19	SE.	33	"	"	"	Dug	25	2,456	- 10	2,446	10	2,446	Glacial drift	Soft	48	S	Intermittent supply.
20	SE.	33	"	"	"	Dug	18	2,455	- 8	2,447	8	2,447	Glacial drift	Hard	46	D, S	Sufficient supply.
21	NE.	33	"	"	"	Dug	16	2450	- 2	2,448	16	2,434	Glacial drift	Hard	48	N	
1	SE.	1	13	29	3	Bored	45	2,488	- 35	2,453	35	2,453	Glacial sand	Hard, iron	50	D, S	Insufficient supply.
2	SE.	1	"	"	"	Dug	9	2,480	- 5	2,475	5	2,475	Glacial sand	Hard	48	S	Insufficient supply.
3	SW.	1	"	"	"	Dug	10	2,435	- 10	2,425	10	2,425	Glacial sand	Medium hard	46	N	Sufficient supply; but not in use now.
4	SE.	2	"	"	"	Dug	8	2,430	- 4	2,426	4	2,426	Glacial sand	Hard, "alkaline"	56	D, S	Sufficient supply; spring waters 50 head stock.
5	NE.	7	"	"	"	Dug	45	2,460	- 29	2,431	29	2,431	Glacial gravel	Soft		D, S	Sufficient supply.
6	NE.	7	"	"	"	Dug	15	2,400	- 10	2,390	10	2,390	Glacial fine sand	Soft		S	Sufficient supply; 3 similar wells.

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

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

WELL RECORDS—Rural Municipality of BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in°F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
7	SE.	11	13	29	3	Dug	14	2,380	- 9	2,371	9	2,371	Glacial sand	Soft	50	D, S	Sufficient supply.
8	SW.	11	"	"	"	Flowing spring		2,375					Glacial drift	Hard,"alkaline"	46		Abundant supply.
9	SE.	14	"	"	"	Dug	3	2,375	0	2,375			Glacial drift	Soft,"alkaline"	70	S	Sufficient supply; probably a spring.
10	SW.	16	"	"	"	Dug	12	2,425	- 10	2,415	10	2,415	Glacial coarse gravel	Soft	46	D, S	Sufficient supply.
11	SE.	22	"	"	"	Dug	9	2,430	0	2,430	0		Glacial gravel	Soft	48	D, S	Sufficient supply.
12	SE.	22	"	"	"	Dug	18	2,430	?		16	2,414	Glacial gravel	Soft	48	D, S	Sufficient supply.
13	NW.	23	"	"	"	Dug	18	2,425	0	2,425			Glacial sand	Soft	46	S	Sufficient supply.
14	SW.	23	"	"	"	Bored	77	2,400	- 71	2,329	71	2,329	Glacial sand	Hard,"alkaline"	50	N	
15	SW.	27	"	"	"	Dug	8	2,350					Glacial gravel	Hard,"alkaline"	48	S	Waters 140 head stock; is a flowing spring.
16	NW.	32	"	"	"	Flowing spring		2,360					Glacial drift	Hard,iron	48	D, S	Sufficient supply; besides house and cattle 3,500 sheep watered.
17	NW.	35	"	"	"	Dug	10	2,385	- 7	2,378	7	2,378	Glacial drift	Soft	50	N	
1	SW.	1	13	30	3	Dug	6	2,400	- 0	2,400	0	2,400	Glacial drift	Soft,"alkaline"	48	S	Sufficient supply.
2	NW.	12	"	"	"	Dug	10	2,500					Glacial drift			S	Sufficient for stock.
3	NE.	13	"	"	"	Dug	12	2,457	- 8	2,449	8	2,449	Glacial sand	Soft	50	I	Sufficient supply.
4	SW.	23	"	"	"	Dug	14	2,500					Glacial drift			S	Sufficient supply.
5	SW.	24	"	"	"	Dug	18	2,456	- 6	2,450	18	2,438	Glacial sand	Soft,salty	48	N	Sufficient supply; too salty, cattle will not drink it.
6	SW.	24	"	"	"	Dug	8	2,455	- 3	2,452	3	2,452	Glacial sand	Soft	50	D, S	Also two similar wells close by.
7	SW.	25	"	"	"	Dug	9	2,405	- 3	2,402	3	2,402	Glacial fine gravel	Soft,"alkaline"	50	S	Sufficient supply.
1	NW.	1	14	28	3	Dug	25	2,433	- 17	2,416	17	2,416	Recent dune sand	Hard,iron	44	D, S	Sufficient supply.
2	SW.	2	"	"	"	Bored	50	2,445	- 25	2,420	25	2,420	Glacial drift	Hard,iron	44	D, S	Sufficient supply.
3	NW.	2	"	"	"	Springs		2,428					Recent dune sand			S	Suitable only for stock.
4	NE.	2	"	"	"	Spring		2,428					Recent dune sand	Hard,iron	44	D, S	Sufficient supply; but suitable only for stock.
5	SE.	8	"	"	"	Dug	12	2,430	- 10	2,420	10	2,420	Recent dune sand	Hard	48	N	
6	SW.	9	"	"	"	Dug	48	2,490	- 33	2,457	33	2,457	Glacial sand	Hard,iron	48	D, S	Sufficient supply.
7	SW.	16	"	"	"	Bored	18	2,465	- 13	2,452	13	2,452	Glacial drift	Hard	48	D, S	Sufficient supply.
8	SE.	19	"	"	"	Bored	62	2,488	- 32	2,456	32	2,456	Glacial drift	Hard,iron, "alkaline"	46	D, S	Sufficient supply.

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

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

WELL RECORDS[3]—Rural Municipality of BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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
9	NE.	20	14	28	3	Dug	8	2,425	0	2,425			Glacial gravel	Soft	50	D, S	Sufficient supply; also 13-foot dry hole.
10	NW.	20	"	"	"	Bored	32	2,430	- 26	2,404	26	2,404	Glacial fine sand	Hard,"alkaline"			Sufficient; used to water chickens.
11	NW.	20	"	"	"	Dug	14	2,430	0	2,430			Glacial drift	Hard,"alkaline"	48	D, S	Sufficient supply.
12	NE.	21	"	"	"	Bored	86	2,500	- 50	2,450	86	2,414	Glacial drift	Hard,iron, "alkaline"	44	S	Sufficient supply.
13	NE.	21	"	"	"	Dug	24	2,500	- 22	2,478	22	2,478	Glacial drift	Hard	48	D, S	Sufficient supply.
14	NW.	21	"	"	"	Dug	20	2,473	- 8	2,465	8	2,465	Glacial drift	Soft,sulphur	44	S	Insufficient supply.
15	NW.	24	"	"	"	Dug	14	2,436	- 8	2,428	8	2,428	Glacial gravel	Hard	48	D, S	Sufficient supply.
16	SW.	25	"	"	"	Dug	15	2,445	- 4	2,441	4	2,441	Glacial gravel	Hard,"alkaline"	46	S	Sufficient supply.
17	SW.	25	"	"	"	Dug	10	2,440	- 4	2,436	4	2,436	Glacial gravel	Soft	44	D, S	Sufficient supply.
18	SW.	28	"	"	"	Dug	11	2,482	0	2,482			Glacial drift	Soft	49	D	Intermittent supply.
19	SW.	28	"	"	"	Bored	90	2,495	- 45	2,450	45	2,450	Glacial drift	Hard,"alkaline"	47	D, S	Insufficient supply; also a similar well and several shallow dry holes.
20	SW.	28	"	"	"	Dug	22	2,494	- 7	2,487	7	2,487	Glacial drift	Medium hard	42	D, S	Intermittent supply.
21	NW.	28	"	"	"		16	2,500									Dry hole; base in glacial drift.
22	SW.	29	"	"	"	Bored	25	2,496	- 20	2,476	20	2,476	Glacial drift	Medium hard, "alkaline," iron	47	S	Sufficient supply; also a 40-foot sub-artesian well and a dry hole.
23	NE.	30	"	"	"	Dug	10	2,485	- 4	2,481	4	2,481	Glacial gravel	Medium hard	48	D, S	Sufficient supply; similar well and 3 dry holes.
24	NE.	31	"	"	"	Dug	20	2,535	0	2,535			Glacial drift	Soft	48	S	Intermittent supply.
25	NE.	31	"	"	"	Bored	112	2,537	- 87	2,450	112	2,425	Glacial drift	Hard,cloudy, "alkaline," iron	46	D, S	Sufficient supply.
26	SE.	32	"	"	"	Dug	22	2,520	- 14	2,506	14	2,506	Glacial gravel	Soft	43	D, S	Sufficient supply.
27	NW.	32	"	"	"	Bored	28	2,480					Glacial drift	Soft	43	D, S	Insufficient supply; hauls water.
28	NE.	33	"	"	"	Dug	17	2,457					Glacial drift	Soft	46	S	Intermittent supply.
29	NE.	34	"	"	"	Dug	17	2,490	0	2,490			Glacial drift	Soft	44	D, S	Sufficient supply; also a 15-foot intermittent well.
30	NW.	34	"	"	"	Bored	100	2,490	- 50	2,440	100	2,390	Glacial drift	Hard,iron	48	S	Sufficient supply; not suitable for humans.
31	NE.	35	"	"	"	Dug	12	2,538	0				Glacial gravel	Hard	46	D, S	Sufficient supply.
32	SE.	36	"	"	"	Bored	55	2,460	- 25	2,435	25	2,435	Glacial drift	Odorous hard	48	N	
1	SW.	8	14	29	3	Dug	15	2,360	- 13	2,347	13	2,347	Glacial drift	Hard,cloudy, "alkaline"	48	N	Insufficient supply.

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

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

WELL RECORDS—Rural Municipality of BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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
2	NW.	11	14	29	3	Spring		2,410					Recent dune sand	Medium hard, "alkaline"		S	Sufficient supply.
3	NW.	11	"	"	"	Dug	12	2,380	- 3	2,377	3	2,377	Recent dune sand	Hard, "alkaline"	48	S	Sufficient supply.
4	SW.	13	"	"	"	Bored	40	2,400									Dry hole; base in glacial drift.
5	NE.	17	"	"	"	Bored	45	2,487	- 44	2,443			Glacial fine sand	Hard, iron, "alkaline"	44	S	Intermittent; drinking water hauled.
6	NE.	17	"	"	"	Dug	15	2,490	- 11	2,479	11	2,479	Glacial drift	Soft	48	D, S	Insufficient supply.
7	NW.	17	"	"	"	Bored	12	2,420	- 8	2,412	8	2,412	Glacial drift	Soft	48	D, S	Intermittent supply; three shallow dry holes.
8	SW.	19	"	"	"		28	2,400	- 20	2,380	20	2,380	Glacial drift	Hard, iron, yellow sediment	44	S	Sufficient supply.
9	NE.	20	"	"	"	Dug	12	2,500	- 7	2,493	7	2,493	Glacial drift	Soft	48	S	Sufficient supply.
10	SE.	21	"	"	"	Bored	89	2,530	- 84	2,446	84	2,446	Glacial drift	Hard, iron, "alkaline"	42	S	Insufficient supply; also similar well; haul water.
11	NW.	21	"	"	"	Bored	30	2,530	- 56	2,474	56	2,474	Glacial drift	Hard, iron, cloudy, "alkaline"	46	D, S	Insufficient supply; haul water in summer.
12	SE.	25	"	"	"	Bored	88	2,538	- 65	2,473	65	2,473	Glacial drift	Hard, iron, cloudy, "alkaline"	44	D, S	Sufficient supply.
13	NE.	25	"	"	"	Bored	59	2,480	- 42	2,438	59	2,421	Glacial gravel	Hard, "alkaline"		S	Sufficient supply.
14	SW.	26	"	"	"	Bored	14	2,575	- 11	2,564	11	2,564	Glacial gravel	Hard	48	N	
15	NE.	27	"	"	"	Dug	20	2,580	- 10	2,570	10	2,570	Glacial gravel	Hard	48	D, S	Insufficient supply; two 20-foot dry holes.
16	SW.	28	"	"	"	Bored	68	2,530	- 54	2,476	54	2,476	Glacial drift	Medium hard, slightly "alkaline"	46	D, S	Sufficient supply.
17	NW.	28	"	"	"	Dug	28	2,525	- 21	2,504	21	2,504	Glacial drift	Soft	46	D, S	Sufficient supply.
18	NW.	28	"	"	"	Bored	38	2,524	- 23	2,501	23	2,501	Glacial drift	Hard, "alkaline"	48	S	Sufficient supply; similar well.
19	SE.	29	"	"	"	Dug	18	2,465	- 8	2,457	8	2,457	Glacial drift	Medium hard	48	S	Sufficient supply.
20	SW.	31	"	"	"	Dug	40	2,512	- 30	2,482	30	2,482	Glacial drift	Hard, iron, "alkaline"	46	D, S	Sufficient supply.
21	SW.	31	"	"	"	Bored	36	2,515	- 25	2,490	25	2,490	Glacial drift	Hard, iron	46	D, S	Sufficient supply; also two dry holes.
22	NE.	31	"	"	"	Bored	60	2,553	- 32	2,521	32	2,521	Glacial drift	Soft, iron	44	D, S	Sufficient supply; also a dry hole.
23	NE.	34	"	"	"	Bored	112	2,580	- 82	2,498	112	2,468	Glacial fine sand	Hard, iron, "alkaline"	48	D, S	Insufficient; also similar well; water hauled at times.
24	NE.	34	"	"	"	Bored	122	2,600	- 90	2,510	122	2,478	Glacial fine sand	Medium hard, iron, "alkaline"	42	D, S	Insufficient supply.
25	SW.	35	"	"	"	Dug	12	2,585	- 8	2,577	11	2,574	Glacial gravel	Soft	48	S	Intermittent supply; also nearby similar well.

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

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

WELL RECORDS—Rural Municipality of BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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.	35	14	29	3	Dug	22	2,580	- 7	2,573	18	2,562	Glacial gravel	Hard, iron, "alkaline"	48	D, S	Sufficient supply.
27	NW.	35	"	"	"	Bored	85	2,570	- 60	2,510	80	2,490	Glacial fine sand	Hard, iron, cloudy, "alkaline"		S	Sufficient supply.
28	SW.	36	"	"	"	Bored	64	2,600	- 34	2,566	34	2,566	Glacial drift	Hard	45	S	Sufficient supply.
29	NE.	36	"	"	"	Bored	100	2,566	- 90	2,476	100	2,466	Glacial fine sand	Hard, salty, "alkaline" iron	42	S	Sufficient supply.
30	NE.	36	"	"	"	Dug	20	2,545	- 10	2,535	10	2,535	Glacial drift	Soft	44	D, S	Sufficient supply; also 30-foot well.
1	NW.	13	14	30	3	Bored	35	2,430	- 20	2,410	30	2,400	Glacial drift	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
2	NE.	23	"	"	"	Bored	70	2,460	- 50	2,410	60	2,400	Glacial drift	Hard, iron, "alkaline"	44	D, S	Sufficient supply; 58-foot well unused.
3	NE.	24	"	"	"	Dug	16	2,450			10	2,440	Glacial drift	Medium hard, iron	48		Sufficient supply; also 10-foot dry hole.
4	SW.	25	"	"	"	Bored	60	2,485	- 50	2,435	54	2,431	Glacial drift	Hard, iron, "alkaline" yellow	46	D, S	Sufficient supply.
5	NE.	35	"	"	"	Bored	32	2,590	- 20	2,570	25	2,565	Glacial drift	Hard, iron, "alkaline"	46	S	Sufficient supply; 32-foot similar well used for drinking.
1	SE.	1	15	28	3	Bored	70	2,500	- 30	2,470	70	2,430	Glacial drift	Hard, iron, "alkaline"	43	S	Sufficient supply; also a 32-foot well and a 60-foot dry hole.
2	SW.	2	"	"	"	Dug	22	2,520	- 16	2,504	16	2,504	Glacial sand	Soft	46	D, S	Sufficient supply; also 8 dry holes 75 to 90 feet in depth; hauls water every day.
3	NW.	3	"	"	"	Dug	16	2,435	- 11	2,424	11	2,424	Glacial drift	Hard	46	D, S	Also 16-foot well for stock.
4	NE.	4	"	"	"	Bored	31	2,428	- 9	2,419	30	2,398	Glacial drift	Hard, iron, "alkaline"	46	S	Sufficient supply; 3 dry holes; drinking water hauled; also 29-foot well for stock.
5	NW.	4	"	"	"	Dug	38	2,450	- 12	2,438	12	2,438	Glacial drift	Hard, iron, "alkaline"	48	N	Sufficient supply.
6	SE.	5	"	"	"	Bored	90	2,515	- 73	2,442	73	2,442	Glacial drift	Hard, iron, "alkaline"	42	S	Insufficient supply.
7	SE.	5	"	"	"	Dug	20	2,500	0	2,500			Glacial drift	Soft	48	D, S	Intermittent supply; also 110-foot well supplies stock.
8	SW.	6	"	"	"	Bored	32	2,550	- 20	2,530	10	2,540	Glacial drift	Soft	45	D	Intermittent supply; also 60-foot intermittent well; several dry to 60 feet in depth.
9	NE.	6	"	"	"	Bored	75	2,530	- 50	2,480	65	2,465	Glacial drift	Hard, iron, "alkaline"	44	S	Intermittent; two 35-foot dry holes.
10	SW.	7	"	"	"	Dug	35	2,508	- 26	2,482	26	2,482	Glacial drift	Soft	48		Sufficient supply.
11	NE.	9	"	"	"	Bored	72	2,481	- 40	2,441			Glacial drift	Hard, salty, "alkaline", iron	45	S	Also an 8-foot dry hole.
12	SW.	10	"	"	"	Dug	12	2,433	- 10	2,423	10	2,423	Glacial drift	Hard, salty, "alkaline"	48	S	Sufficient supply; two similar wells; very little water; unused.
13	SW.	11	"	"	"	Dug	12	2,440	- 10	2,430	10	2,430	Glacial drift	Hard	46	D, S	Sufficient supply; also similar well partly caved in.
14	NW.	11	"	"	"	Dug	18	2,460	- 10	2,450	10	2,450	Glacial drift	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
15	SE.	12	"	"	"	Bored	40	2,500	- 30	2,470	30	2,470	Glacial drift	Hard, "alkaline"	46	N	

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 BITTER LAKE NO.142, SASKATCHEWAN

B 4-4
1860—10,000

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	SE.	15	15	28	3	Bored	40	2,473	- 25	2,448	25	2,448	Glacial drift	Hard,iron, "alkaline"	44	S	Sufficient supply; also 30-foot well, used D, S; sufficient supply,
17	SW.	15	"	"	"	Bored	60	2,477	- 40	2,437	60	2,417	Glacial drift	Hard,iron, "alkaline"	44	D, S	Sufficient supply; also similar well.
18	NE.	15	"	"	"	Bored	65	2,480	- 30	2,450	65	2,415	Glacial drift	Hard,iron, "alkaline",	43	D, S	Sufficient supply.
19	NW.	16	"	"	"	Dug	20	2,488	- 14	2,474	14	2,474	Glacial sand	Soft	48	D, S	Insufficient supply.
20	SE.	17	"	"	"	Bored	65	2,500	- 37	2,463	65	2,435	Glacial drift	Hard,iron, "alkaline", cloudy	44	S	Sufficient; hauls drinking water.
21	NW.	17	"	"	"	Dug	20	2,500	- 7	2,493	7	2,493	Glacial fine sand	Soft		S	Sufficient supply.
22	NW.	17	"	"	"	Bored	80	2,478	- 74	2,404	74	2,404	Glacial drift	Hard,salty, "alkaline", iron	44	D, S	Sufficient supply.
23	NW.	18	"	"	"	Bored	80	2,500	- 70	2,430	80	2,420	Glacial drift	Hard,iron, "alkaline"	44	D, S	Sufficient supply; 10-foot dry hole.
24	SE.	19	"	"	"	Dug	22	2,461	- 10	2,451	10	2,451	Glacial drift	Soft	46	D, S	
25	SE.	19	"	"	"	Bored	92	2,495	- 47	2,448	47	2,448	Glacial gravel	Hard,iron	42	S	Sufficient supply.
26	SE.	20	"	"	"	Bored	35	2,471	- 25	2,446	25	2,446	Glacial drift	Hard,cloudy, iron	43	D, S	Insufficient supply; also 6-foot intermittent well.
27	SW.	20	"	"	"	Bored	70	2,482	- 30	2,452	70	2,412	Glacial drift	Hard	44	D, S	Sufficient supply; 5 dry holes to 30 feet deep.
28	NW.	23	"	"	"	Bored	40	2,478	- 10	2,468			Glacial drift	Hard,iron, "alkaline"	42	S	Sufficient supply; six wells nearly dry.
29	NW.	24	"	"	"	Dug	20	2,500	- 9	2,491	16	2,484	Glacial gravel	Hard,"alkaline"	46	D, S	Sufficient supply.
30	NW.	24	"	"	"	Bored	30	2,500	- 10	2,490	10	2,490	Glacial drift	Soft	47	D, S	Sufficient supply.
31	SW.	25	"	"	"	Bored	42	2,525	- 26	2,499	30	2,495	Glacial drift	Hard	44	D, S	Intermittent supply.
32	NE.	26	"	"	"	Dug	6	2,525	0	2,525			Glacial drift	Soft	48	S	Intermittent supply.
33	NE.	26	"	"	"	Bored	30	2,536	- 25	2,511	25	2,511	Glacial drift	Hard,iron, "alkaline"	46	S	Intermittent supply; hauls drinking water.
34	NW.	36	"	"	"	Bored	25	2,515	- 13	2,502	13	2,502	Glacial drift	Hard,salty	46	N	
35	SE.	27	"	"	"	Bored	38	2,520	- 18	2,502	18	2,502	Glacial drift	Hard,salty, "alkaline"	44	S	Sufficient supply.
36	NE.	27	"	"	"	Dug	20	2,520	- 18	2,502	18	2,502	Glacial drift	Hard,iron, salty	46	N	
37	SW.	30	"	"	"	Bored	96	2,525	- 56	2,469	56	2,469	Glacial drift	Hard,iron, "alkaline"	42	D, S	Insufficient supply.
38	SW.	30	"	"	"	Dug	20	2,520	- 6	2,514	6	2,514	Glacial drift	Soft	46	D, S	Intermittent supply.
39	NW.	30	"	"	"	Bored	16	2,502	- 11	2,491	11	2,491	Glacial drift	Hard,iron, odorous	48	D, S	Insufficient supply.
40	SW.	31	"	"	"	Dug	35	2,515	- 30	2,485	30	2,485	Glacial drift	Hard,salty, "alkaline"	46	S	Sufficient; laxative; domestic supply hauled.

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 BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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
41	NE.	31	15	18	3	Bored	55	2,500	- 27	2,473	55	2,445	Glacial drift	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
42	NW.	32	"	"	"	Bored	50	2,508	- 30	2,478	50	2,458	Glacial drift	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
43	SW.	33	"	"	"	Bored	76	2,550	- 62	2,488			Glacial drift	Hard, cloudy, "alkaline"	46	D, S	Insufficient supply; 35-foot dry hole.
44	SE.	34	"	"	"	Bored	35	2,550	- 20	2,530	35	2,515	Glacial drift	Hard, iron	44	D, S	Sufficient supply of "alkaline" water.
45	NW.	34	"	"	"	Bored	20	2,555	- 6	2,549			Glacial drift	Hard	48	D, S	Sufficient supply; also 10-foot well waters stock.
46	SE.	35	"	"	"	Dug	10	2,550	- 8	2,542	8	2,542	Glacial sand	Soft		N	
47	NW.	36	"	"	"	Bored	73	2,563	- 63	2,500	73	2,490	Glacial drift	Hard	43	D, S	Sufficient supply; 30 dry holes 12 to 35 feet deep.
48	NW.	36	"	"	"	Bored	94	2,578	- 80	2,498			Glacial fine sand	Hard	45	D, S	Sufficient supply.
1	SW.	1	15	29	3	Bored	75	2,550	- 60	2,490	60	2,490	Glacial fine sand	Hard, iron, "alkaline"	43	S	Intermittent supply; many dry holes to 50 feet deep; also 58-foot intermittent well for house.
2	SW.	1	"	"	"	Bored	92	2,550	- 60	2,490	60	2,490	Glacial fine sand	Hard, iron, "alkaline"	42	S	Insufficient supply.
3	SE.	2	"	"	"	Dug	16	2,532	- 11	2,521			Glacial drift	Soft	48	S	Intermittent supply; also 18-foot intermittent well; used D, S.
4	NE.	2	"	"	"	Bored	75	2,550	- 45	2,505			Glacial fine sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply; also 90-foot sub-artesian well unused.
5	NW.	2	"	"	"	Dug	18	2,555	- 8	2,547			Glacial drift	Soft	46	S	Sufficient supply.
6	SE.	3	"	"	"	Dug	10	2,550	0	2,550			Glacial sand	Soft	46	N	Intermittent supply; also 20-foot intermittent well, used D, S.
7	NE.	3	"	"	"	Dug	12	2,588	0	2,588			Glacial sand	Soft	46	N	Intermittent supply; also a similar well.
8	NW.	3	"	"	"	Bored	52	2,600	- 37	2,563	52	2,548	Glacial gravel	Soft	44	D, S	Insufficient supply; also 68-foot well for stock.
9	NW.	3	"	"	"	Bored	95	2,598	- 73	2,525	95	2,503	Glacial gravel	Hard, iron, "alkaline"	44	S	Insufficient supply.
10	SE.	4	"	"	"	Bored	45	2,575	- 15	2,560			Glacial drift	Hard, iron, "alkaline"	44	D, S	Intermittent supply; 6 dry holes around 60 feet deep.
11	SE.	5	"	"	"	Bored	73	2,565	- 53	2,512	73	2,492	Glacial drift	Hard, yellow iron	44	D, S	Sufficient supply; also 73-foot well for stock.
12	SW.	6	"	"	"	Bored	38	2,543	- 18	2,525	38	2,505	Glacial drift	Hard, "alkaline"	45	D, S	Sufficient supply.
13	NE.	6	"	"	"	Bored	90	2,555	- 60	2,490	66	2,490	Glacial drift	Hard, iron, "alkaline"	46	S	Sufficient supply; also two 90-foot dry holes.
14	NE.	7	"	"	"	Bored	60	2,560	- 30	2,530			Glacial drift	Hard, iron, "alkaline"	46	S	Intermittent supply; also 60-foot well used D, S.
15	NW.	7	"	"	"	Bored	90	2,600	- 70	2,530	90	2,510	Glacial drift	Hard, iron, "alkaline"	46	S	Sufficient supply.
16	SE.	8	"	"	"	Bored	85	2,594	- 65	2,529	85	2,509	Glacial drift	Hard, iron, "alkaline"	44	S	Also 60-foot well, but water unfit for use; and 40-foot well for house use.
17	SE.	9	"	"	"	Bored	94	2,600	- 76	2,524	94	2,506	Glacial gravel	Hard, iron	44	S	Sufficient supply; also a 45-foot well, used D, S.
18	NE.	10	"	"	"	Dug	22	2,570	0	2,570			Glacial gravel	Soft	46	D, S	Insufficient supply; also a 16-foot well not in use.
19	SE.	12	"	"	"	Dug	15	2,533	0	2,533			Glacial drift	Soft	46	D, S	Intermittent supply; 102-foot sub-artesian well for 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 BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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
20	NE.	13	15	29	3	Bored	120	2,523	- 90	2,433	120	2,403	Glacial drift	Hard,iron, "alkaline"	42	D, S	Sufficient supply; also 70-foot dry hole.
21	SE.	14	"	"	"	Bored	15	2,520	- 10	2,510			Glacial drift	Soft	46	D, S	Insufficient; intermittent supply; also 49-foot well for stock.
22	NW.	14	"	"	"	Dug	15	2,540	- 9	2,531			Glacial drift	Soft	47	S	Sufficient supply; 12-foot well unused.
23	SW.	15	"	"	"	Bored	60	2,575	- 52	2,523	52	2,523	Glacial drift	Hard,iron, "alkaline"	44	D, S	Insufficient supply; water hauled; also a 60-foot well for stock.
24	SW.	16	"	"	"	Bored	79	2,565	- 65	2,500	79	2,486	Glacial drift	Hard,iron, "alkaline"	44	D, S	Sufficient supply; also a dry hole.
25	NW.	17	"	"	"	Bored	60	2,575	- 30	2,545	60	2,515	Glacial drift	Hard,"alka-line"	46	D	Sufficient supply; also 5 dry holes to 80 feet deep.
26	SE.	17	"	"	"	Bored	66	2,575	- 56	2,519	66	2,509	Glacial drift	Hard,iron, "alkaline"	46	D	Sufficient supply.
27	SW.	17	"	"	"	Bored	80	2,570	- 70	2,500	70	2,500	Glacial drift	Hard,iron, "alkaline," soda	45	S	Insufficient; also an 80-foot intermittent well for stock use.
28	NE.	18	"	"	"	Bored	32	2,600	- 22	2,578	22	2,578	Glacial gravel	Hard	44	D, S	Sufficient supply; 5 dry holes to 50 feet deep.
29	NW.	19	"	"	"	Bored	40	2,572	- 26	2,546	40	2,532	Glacial drift	Hard,iron, "alkaline," cloudy	46	S	Also 45-foot well for stock; 32-foot dry hole.
30	SW.	20	"	"	"	Dug	22	2,562	- 18	2,544	18	2,544	Glacial sand	Hard,iron, "alkaline"	44	D, S	Sufficient supply.
31	NE.	20	"	"	"	Bored	47	2,518	- 25	2,493	47	2,471	Glacial drift	Hard,iron, "alkaline"	45	S	Sufficient supply; similar 53-foot well, used D, S; twelve dry holes 50 to 100 feet deep on SE.¼, section 20.
32	NW.	21	"	"	"	Dug	56	2,518	- 30	2,488	30	2,488	Glacial drift	Hard,iron, yellow	46	S	Sufficient supply.
33	SE.	22	"	"	"	Dug	18	2,500	- 13	2,487			Glacial gravel	Soft,iron	47	D, S	Sufficient supply.
34	NW.	22	"	"	"	Bored	42	2,515	- 20	2,495	42	2,473	Glacial drift	Hard,iron	44	S	Sufficient supply.
35	SW.	23	"	"	"	Bored	6	2,500	- 4	2,496			Glacial drift	Soft	48	N	Intermittent supply.
36	NE.	23	"	"	"	Bored	70	2,515	- 50	2,465	70	2,445	Glacial drift	Hard,iron, "alkaline"	44	D, S	Sufficient supply.
37	NW.	23	"	"	"	Dug	18	2,502	- 12	2,490			Glacial drift	Soft,cloudy	47	D, S	Sufficient supply.
38	SW.	24	"	"	"	Bored	80	2,517	- 50	2,467	80	2,437	Glacial drift	Hard,iron, "alkaline"	43	D, S	Sufficient supply; also a 12-foot dry hole.
39	SW.	25	"	"	"	Bored	60	2,495	- 22	2,473	60	2,435	Glacial drift	Hard,iron, "alkaline"	44	S	Poor quality.
40	NE.	25	"	"	"	Bored	58	2,498	- 38	2,460	58	2,440	Glacial drift	Hard,"alka-line"	45	D, S	Sufficient supply.
41	SE.	27	"	"	"	Bored	78	2,530	- 64	2,466	64	2,466	Glacial drift	Hard,iron,	44	D, S	Sufficient supply; similar well, caved in.
42	NW.	27	"	"	"	Dug	64	2,520	- 52	2,468	52	2,468	Glacial drift	Medium hard	44	D, S	Sufficient supply.
43	SW.	28	"	"	"	Bored	50	2,535	- 40	2,495	40	2,495	Glacial drift	Hard,iron	46	D, S	Sufficient supply.
44	SW.	31	"	"	"	Bored	45	2,543	- 39	2,504	39	2,504	Glacial drift	Hard,"alka-line"	44	D, S	Intermittent supply; also 32-foot similar well.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of ..... BITTER LAKE NO. 142, SASKATCHEWAN

B 4-4
1860—10,000

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
45	NE.	31	15	29	3	Dug	26	2,512	- 10	2,502			Glacial drift	Hard, "alkaline", odorous	42	N	Intermittent supply; a 40-foot well used for stock.
46	SE.	32	"	"	"	Bored	48	2,540	- 28	2,512			Glacial drift	Hard, iron, "alkaline"	46	S	
47	SW.	33	"	"	"	Bored	56	2,534	- 28	2,506	56	2,478	Glacial drift	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
48	NE.	34	"	"	"	Bored	80	2,514	- 60	2,454	80	2,434	Glacial drift	Hard, iron, "alkaline"	45	N	
49	NE.	35	"	"	"	Dug	40	2,495	- 20	2,475	40	2,455	Glacial drift	Hard, "alkaline"	46	S	Sufficient for stock; drinking water hauled.
50	NW.	35	"	"	"	Bored	60	2,492	- 50	2,442	50	2,442	Glacial drift	Hard, "alkaline"	44	D, S	Insufficient supply. #
51	SW.	36	"	"	"	Bored	42	2,475	- 20	2,455	42	2,433	Glacial drift	Hard, cloudy, iron, "alkaline"	46	D, S	Sufficient supply.
52	SW.	36	"	"	"	Dug	18	2,468	0	2,468			Glacial drift	Soft	45	S	Sufficient supply.
1	NE.	12	15	30	3	Bored	80	2,605	- 60	2,545	80	2,525	Glacial drift	Hard, iron, "alkaline"	46	S	Sufficient supply; also a 72-foot well unused at present; 64-foot intermittent well for house use.
2	SE.	13	"	"	"	Bored	60	2,610	- 50	2,560	50	2,560	Glacial drift	Hard, iron, "alkaline"	43	S	Sufficient supply; a 68-foot well, used D, S; sufficient supply; 6 dry holes.
3	SW.	24	"	"	"	Bored	70	2,600	- 60	2,540	60	2,540	Glacial drift	Hard, iron, "alkaline"	46	S	Insufficient supply.
4	NW.	24	"	"	"	Bored	60	2,600	- 10	2,590			Glacial drift	Hard, iron	46	D, S	Intermittent supply.
5	NE.	25	"	"	"	Dug	30	2,550					Glacial drift	Soft, iron, yellow	48	S	Sufficient supply; also a dugout.
6	NE.	36	"	"	"	Bored	60	2,560	- 40	2,520			Glacial drift	Hard, cloudy, "alkaline"	48	N	

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(#) Sample taken for analysis.