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DEPARTMENT OF MINES

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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF LIPTON NO. 217 SASKATCHEWAN

By

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

WATER SUPPLY PAPER No. 162

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NOTE:

Because of difficulties involved in reproduction, the tables of well records referred to are not included with this report. Information regarding individual wells may be obtained by writing to the Director, Geological Survey of Canada, Ottawa.

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF LIPTON, NO. 217 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 ago.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cypress Hills Formation. The name given to a series of conglomerates and sand beds which occur in the southwest corner of Saskatchewan, and 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 Lipton is an area of approximately 316 square miles in southeastern Saskatchewan. It consists of township 22, range 15, and townships 23 and 24, ranges 14 and 15; fractional townships 22, 23, and 24, range 13; and part of township 22, range 14; all west of the Second meridian. A branch line of the Canadian Pacific railway traverses the southern part of the municipality and on it are located the villages of Dysart and Lipton and the hamlet of Patrick. The centre of the municipality lies 48 miles northeast of the city of Regina. Sections 3,4,5, and part of section 6, township 22, range 14, are occupied by Standing Buffalo Indian Reserve, No. 78.

Jumping Deer creek flows in a southeasterly direction through township 24, range 15, and then in a southerly direction through townships 23 and 22, range 14. In the northern part this creek is intermittent, but towards the south the flow is continuous. The creek disappears beneath the gravel at intervals over a distance of at least 3 miles in the southern part of township 22, range 14. Several small, intermittent tributary streams join Jumping Deer creek in the northern 11 miles of the municipality. A long belt of country, approximately one mile wide, running in a northwesterly direction from the southeastern corner of the municipality through Patrick and Lipton, is covered by glacial outwash sands and gravels. Five smaller areas scattered throughout the northern 12 miles of the municipality are also covered by glacial outwash sands and gravels. Glacial till or boulder clay mantles three areas--a narrow belt lying adjacent on the south to the glacial outwash sands and gravels in townships 22, ranges 13 and 14; a fairly wide strip of country running in a northwesterly direction through the east-central part of township 23, range 14, the southwestern part of township 24, range 14, and the southeastern part of township 24, range 15; and an area along the southern part of Jumping Deer Creek valley in township 22, range 14. The remainder of the municipality is covered by moraine. The ground surface is rolling throughout the municipality and it is especially rough in the vicinity of Jumping Deer creek. Undrained depressions are quite common, and in places the ground surface is very stony. The eastern half of the municipality is thickly wooded with poplar, but the western townships contain only small scattered clumps of poplar.

Water-bearing Horizons in the Unconsolidated Deposits

The supply of water obtained from wells in this municipality is small and it is estimated that 50 per cent of the farms were short of water during the drought of 1930 to 1934. Neither Lipton nor Dysart has a satisfactory water supply and water for the latter village is hauled from a well 1½ miles distant. Water is very difficult to locate at any depth in the glacial drift, especially in townships 22, ranges 13 and 15, township 23, range 15, and township 24, range 14.

Several flowing springs were reported and they are largely confined to the banks of Jumping Deer valley. The water from these springs is slightly mineralized and is suitable for drinking.

The glacial drift is estimated to be 400 to 500 feet thick. Yellow clay usually extends from the top soil to a maximum depth of 50 feet, and it is underlain by blue clay. Scattered deposits of sand and gravel are known to occur within the upper 280 feet of the drift, and they no doubt occur in the lower part as well. They do not form continuous water-bearing horizons.

Most of the wells in this municipality have been dug to depths of 40 feet or less and generally do not exceed a depth of 25 feet. The deposits of sand and gravel that they tap are not confined to the glacial outwash, but are widely distributed, especially over the moraine-covered areas. In township 23, range 14, and townships 24, ranges 13 and 15, a number of wells have tapped large pockets of sand that extend from the surface to the base of the wells. Occasionally these thick deposits of sand do not contain water, but generally a moderate to abundant supply is obtained from them, and some of the best wells in the municipality are dug in this type of deposit. The supply of water in these large deposits of sand was only slightly depleted by the drought of 1930 to 1934. The water is only slightly mineralized, since it does not come into contact with clay. Two wells that tap these deposits are located in the SE.$\frac{1}{4}$, sec. 4, tp. 23, range 15, and the NW.$\frac{1}{4}$, sec. 12, tp. 22, range 13. The village of Dysart derives its supply from the first well and many farmers hauled water from the second well during the drought.

Except in township 24, range 15, farmers experience difficulty in locating pockets of sand and gravel in the upper 40 feet of the drift. Some wells have been dug beside undrained depressions. During years of average rainfall an adequate supply for local needs can be obtained by using two or three of these wells, but during drought periods the wells become intermittent and yield only very small supplies of water. Other wells in the municipality tap pockets of sand and gravel beneath yellow clay and a few wells penetrated layers of blue clay beneath the yellow clay before they encountered deposits of sand. Numerous dry holes have been dug in an effort to locate these water-bearing deposits. The water from most of the shallow wells is not under pressure, but that from three or four wells is under considerable pressure. One of these wells, located in the NE.$\frac{1}{4}$, sec. 16, tp. 22, range 14, encountered a layer of hardpan beneath the yellow clay, and when this hardpan was pierced the water rose under pressure to a point 3 feet below the surface. Due to the pocket arrangement of the sand and gravel deposits in the upper 40 feet of the drift, it is not uncommon to find shallow wells on one section yielding an abundant supply of water, whereas no water can be located on an adjoining section. A test auger should be used to locate the pockets of sand or gravel prior to digging a shallow well.

Pockets of sand and gravel also occur in the drift below a depth of 40 feet. Abundant supplies of water under hydrostatic pressure are obtained from wells more than 40 feet deep in all parts of the municipality except townships 24, ranges 14 and 15. The water-bearing deposits are not continuous and numerous dry holes have been dug. In two districts in the municipality, however, the water-bearing horizons appear to be fairly continuous. In a district in the western half of township 23, range 13, eleven wells, ranging from 83 to 175 feet in depth, tap an aquifer composed of coarse sand and gravel at elevations of 1,905 to 1,990 feet, and three wells, 170 to 228 feet deep, tap an aquifer of fine sand at elevations of 1,875 to 1,890 feet. The water from these two horizons is highly mineralized and is under hydrostatic pressure. The second district in which a continuous water-bearing horizon appears to be present is in secs. 10 and 11, tp. 22, range 14. Three wells in these sections tap an aquifer of sand and gravel at depths of 70, 78, and 90 feet, or at elevations of 1,865 to 1,870 feet. The water is under little or no pressure, but the supply is abundant and constant. Some of the deep wells have been plugged or are becoming plugged with fine sand. The water from the deep wells is more highly mineralized than that from wells less than 40 feet deep. It is seldom used for drinking, but only in one or two wells is the water too highly mineralized for stock. The deepest producing well in the municipality is 280 feet deep and it is located in the NE.$\frac{1}{4}$, sec. 4, tp. 22, range 13. Dry holes have been drilled to a depth of 385 feet in the same township and a 600-foot dry hole was drilled in the village of Dysart.

Dugouts have not been used in this municipality, but they are an economical means of collecting and storing surface water for stock use. Slough basins are fairly numerous throughout the area and they offer excellent locations for the excavation of these reservoirs. The dugouts should be excavated at least 12 feet deep and a small, deep dugout is preferable to a large, shallow one. Boring or drilling operations are not advised since the uncertainty of obtaining water does not warrant the expense of drilling. The possibilities of obtaining water from the upper 40 feet of the drift are just as favourable as at greater depths. A test auger should be used to prospect the upper part of the drift prior to digging a shallow well. Drilling is preferable to boring with a large auger and should not exceed a depth of 400 feet.

Water-bearing Horizons in the Bedrock

The Marine Shale series underlies the glacial drift throughout the municipality. No well has definitely established the contact between the glacial drift and the Marine Shale, but the lower part of a 600-foot drilled well in Dysart is believed to be in the bedrock. This well is the deepest in the municipality. Water was struck in the glacial drift at depths of 80 and 250 feet, but it was too highly mineralized for drinking and was cased off and drilling continued to an elevation of 1,363 feet without striking another water-bearing horizon.

It is believed that the last 100 feet of drilling was done in the Marine Shale bedrock or "soapstone" as it is frequently termed. Water-bearing horizons seldom exist in the Marine Shale series in this part of Saskatchewan and drilling into it in search of water is not recommended.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 22, Range 13

The elevation of the ground surface in this township decreases gradually from 2,145 feet above sea-level at the northeastern corner to 1,930 feet in the southwestern corner. A belt of glacial outwash sands and gravels, approximately one mile wide, extends across the township in a southeast-northwest direction and roughly parallels the Canadian Pacific railway on the south. An area from 1 to 1½ miles wide on the south side of the glacial outwash-covered belt is mantled by boulder clay or glacial till. The remainder of the township is covered by moraine. The ground surface is undulating and is quite stony in some places.

The supply of water obtained in this township, especially in the central 2 miles, is small. At least twenty-one farmers in the township have not been able to obtain an adequate supply of water, and within sections 13 to 27, inclusive, only one well, located in the NW.¼, section 23, yields sufficient water to meet the owner's requirements. Permanent supplies of water are very difficult to locate, at depths less than 50 feet, in all parts of the township. Numerous dry holes, generally less than 30 feet deep, have been dug by hand or bored with test augers. Blue clay is struck at a depth generally less than 30 feet below the surface, but occasionally thick pockets of sand and gravel, which lie above the blue clay and separate it from the yellow weathered clay, are penetrated. These pockets of sand and gravel cannot be very extensive since the supply from wells that tap them is easily depleted in periods of drought and in winter. Approximately twelve wells in the township, all less than 40 feet deep, have tapped fairly extensive pockets of sand and gravel, and they will water from 10 to 30 head of stock in drought years. The water is usually hard and suitable for drinking. Many farmers depend entirely on surface water to meet both household and stock requirements. This water is obtained from sloughs and from seepage wells dug beside sloughs. Farmers have not adopted dugouts as a means of conserving surface water. These farmers haul water when the sloughs become dry, and also during the winter months. Most of these farmers haul water from a 6-foot well dug by the community in the NW.¼, section 12. Several shallow wells dug on this quarter section have yielded abundant supplies of water for the past thirty years. The 6-foot well that is used at present was dug through 2 feet of top soil and 4 feet of fine sand. The water is hard and suitable for drinking. As many as seventeen farmers have tanked from this well in one season. Apparently the aquifer is of considerable areal extent and although the water-level became lower during the drought years the supply was still abundant.

Drilling or boring to depths over 50 feet have been only partly successful in this township, and only five farmers have obtained permanent supplies of water by drilling. The five wells are located in the SW.¼, section 3, NE.¼, section 4, NW.¼, section 5, SW.¼, section 28, and SW.¼, section 33, and are 120, 230, 64, 170, and 68 feet deep, respectively. The aquifers are sand or gravel and the water rises under pressure. The supply is abundant and not easily affected by prolonged drought. The water is hard, highly mineralized, and not suitable for drinking. These five wells have tapped pockets of sand and gravel and not a continuous water-bearing horizon. At least forty wells have been bored and drilled to depths of 50 to 385 feet that were either dry or yielded very small supplies of water. Sixteen of these wells were in the SW.¼, section 14.

Some of the dry holes were made entirely in blue clay after the upper 20 to 30 feet of weathered, light-coloured clay had been penetrated. Two 385-foot dry holes in the NW.¼, section 22, passed through 20 feet of yellow clay, 180 feet of blue clay, 50 feet of fine dry sand, and 135 feet of blue clay. A 220-foot well in the SW.¼, section 14, penetrated two beds of dry sand. A 76-foot well in the NE.¼, section 15, struck 11 feet of dry sand that contained gas. A 210-foot well in the SW.¼, section 32, struck water in a fine sand aquifer, but the sand particles soon plugged the casing and shut off the water.

Farmers are advised to use testing augers as a means of locating pockets of water-bearing sand or gravel in the upper 30 feet of the glacial drift. Boring or drilling methods may possibly be successful but they are not advised, since the possibilities of obtaining water does not warrant the expense of drilling. The excavation of deep dugouts in slough basins for the retention of surface water is recommended. These reservoirs should be at least 12 feet deep and a small, deep dugout is preferable to a large, shallow one. A shallow well dug beside the reservoir will provide water for household purposes.

Township 22, Range 14

Sections 3, 4, 5, and that part of section 6 that lies east of Jumping Deer creek, are occupied by Standing Buffalo Indian Reserve, No. 78. Jumping Deer creek flows in a southerly direction through the western 2 miles of the township. The flow of the creek is continuous in the northern part of the township, but towards the south the stream disappears beneath the gravel. The valley through which the creek flows is wide and deep; in section 32 it is about 100 feet deep and in section 6 it attains a depth of 200 feet. An area, approximately one mile wide, in the northeastern corner of the township is mantled by glacial outwash sands and gravels. Glacial till covers an area along the southern part of Jumping Deer valley. A smaller glacial till-covered area occurs immediately south of the glacial outwash deposits in the eastern part of the township. The remainder of the township is covered by moraine. The ground surface is rolling and becomes quite hilly and rough near Jumping Deer valley. Small sloughs are fairly numerous and the township is thickly wooded.

The supply of water obtained from wells is quite variable, but it is much better than in township 22, range 13. Eleven of the twenty-eight farms visited are short of well water. One spring, located in the SW.$\frac{1}{4}$, section 18, on the bank of Jumping Deer valley, flows throughout the year. The water is hard and is used for drinking. All the producing wells have been dug or bored to depths of 6 to 96 feet. Five wells less than 13 feet deep, located in sections 17, 23, and 29, were dug entirely in deposits of sand that outcrop at the surface. These pockets of sand act as huge reservoirs for the storage of water. Rainfall passes directly into the sand without coming into contact with clay and as a result the water is only slightly mineralized. The supply from the wells is abundant and the drought years did not lower the water-level appreciably in any of the five wells. The 6-foot well in the SE.$\frac{1}{4}$, section 29, was made by the Provincial Government. In the other wells in the township yellow or reddish clay usually underlies the top soil to depths of 10 to 30 feet, although a 90-foot well in the NW.$\frac{1}{4}$, section 11, passed through 70 feet of hard brown clay. Blue clay generally underlies the yellow or red clay. Pockets of sand and gravel are apt to occur at any depth within the clays. These pockets of sand and gravel yield an extremely variable supply of water. For instance, a 10-foot well in the NE.$\frac{1}{4}$, section 16, derives water under pressure from a sand aquifer that lies beneath a 6-inch layer of hardpan. The water is soft and rises to a point 3 feet below the surface. In section 22, however, very small supplies of water under no pressure are obtained from 25- and 96-foot wells that tap aquifers of fine sand and gravel in the clay. Two comparatively shallow wells, 48 and 36 feet deep, in sections 25 and 36 also yield fairly abundant supplies of water under pressure.

A water-bearing horizon composed of sand and gravel was struck by three wells at elevations of 1,865 to 1,870 feet, in sections 10 and 11. The 70-foot well in the SE.$\frac{1}{4}$, section 11, delivers only 3 barrels of water a day, but the 90- and 78-foot wells in the NW.$\frac{1}{4}$, section 11, and the NE.$\frac{1}{4}$, section 10, yield an abundant supply of water. The water is under very little or no hydrostatic pressure and although it is highly mineralized it is used for drinking. These three wells, together with an 85-foot well in the NW.$\frac{1}{4}$, section 23, are the only wells in the township over 50 feet deep that yield permanent supplies of usable water. Many dry holes have been bored to a maximum depth of 115 feet and two drilled dry holes, 346 and 334 feet deep, were made in the SW.$\frac{1}{4}$, section 12. The village of Lipton has not a satisfactory water supply. Two bored wells 85 feet deep were made in the village, but the water was too highly mineralized for drinking and the wells were filled in. The village depends on a number of 15- to 20-foot wells each of which yields a small supply of hard, slightly "alkaline" water. These wells are readily affected by drought conditions.

Farmers are advised to use test augers to locate a lens of sand or gravel within the upper 40 feet of the glacial drift. The excavation of deep dugouts is preferable to boring or drilling. The glacial drift is at least 350 feet thick and it is possible that water will be obtained in pockets of sand and gravel at depth in the drift, but the uncertainty of obtaining a satisfactory supply of water does not warrant the expense involved. Jumping Deer creek is the usual source from which farmers tank water.

Township 22, Range 15

Except for a small strip on the eastern border of sections 12, 13, and 24, which is mantled by glacial till, this township is wholly covered by moraine. The ground surface is slightly rolling and the elevation increases towards the north. Undrained depressions are quite common and small clumps of poplar trees occur throughout the area.

All the wells in the township have been dug or bored to depths of 9 to 150 feet, and the deepest producing well is 130 feet deep. The supply of water obtained is small and approximately half the farmers in the township have an inadequate supply of well water. Most of the wells are from 9 to 25 feet deep and they are almost invariably dug beside undrained depressions where the maximum amount of surface seepage water is obtained. The upper 25 feet of the glacial drift is composed of yellow boulder clay containing occasional small pockets of sand and gravel. A few wells, such as those in the SE.$\frac{1}{4}$, section 4, SE.$\frac{1}{4}$, section 14, and SE.$\frac{1}{4}$, section 27, obtain a fairly abundant and constant supply of water from these lenses of sand and gravel. Generally, however, shallow dug wells less than 30 feet deep yield small supplies and are easily affected by drought conditions. Farmers usually own more than one shallow well and by using them all sufficient water is obtained in years of average rainfall to meet the farmers' requirements. In prolonged periods of drought the sloughs and wells become dry and the farmers are forced to haul water. The water from the shallow wells is hard and "alkaline", but it is generally used for drinking as well as for stock.

Only four wells over 30 feet deep have struck permanent supplies of water. These wells are located in the SW.¼, section 18, NW.¼ and NE.¼, section 24, and NW.¼, section 34. The wells are 72, 51, 35, and 130 feet deep, respectively, and they tap pockets of sand and gravel that yield abundant and constant supplies of water. The water in the first three wells rises under hydrostatic pressure, but the water-level in the 130-foot well is at a point only 6 feet above the base of the well. The water is hard and mineralized, but with the exception of that from the 72-foot well it is used for drinking. Many dry holes 72 to 150 feet deep have been bored in the western half of the township.

Water in large quantities is very difficult to locate at any depth up to 150 feet in this township. Many of the bored and drilled wells have not encountered water as the sand and gravel deposits are of scattered occurrence. The uncertainty of obtaining large supplies of water, and the expense involved, do not appear to warrant deep drilling or boring in this township. Farmers are advised to use test augers in order to locate pockets of sand and gravel in the upper 30 feet of the glacial drift. Deep dugouts excavated in slough basins are strongly recommended. If deep drilling is contemplated it should be confined to the glacial drift, which is approximately 400 feet thick, as the Marine Shale series that underlies the glacial drift is generally non-water-bearing.

Township 23, Range 13

An area of approximately one square mile in sections 19, 20, and 30 is covered by glacial outwash sands and gravels, and the remainder of the township is covered by moraine. The ground surface is very undulating and thickly wooded with clumps of poplar. Several shallow draws or coulées drain the surface water towards the southwest. The largest coulée contains a small, intermittent creek that has its source in section 25. This creek traverses the township in a southwesterly and westerly direction and is a tributary of Jumping Deer creek.

Eleven farmers in this township do not obtain a sufficient supply of water for their local needs. Water is obtained from sand and gravel deposits in the glacial drift at depths of 6 to 240 feet. One spring was reported in the SW.$\frac{1}{4}$, section 30, but it flows only in wet seasons. This spring was dug out to a depth of 15 feet. The supply from it is sufficient for 60 head of stock, but the water-level was very low in the winters of 1933 and 1934. The water is soft and suitable for drinking. Five wells from 6 to 16 feet deep, which passed through thick deposits of sand and gravel extending from the surface to the base of the wells, were dug in the eastern part of the township. The supply of water varies from an insufficient supply during winters in the 12-foot well in the SW.$\frac{1}{4}$, section 26, to an abundant and constant supply in the 16- and 6-foot wells in the SW.$\frac{1}{4}$, section 13, and the NW.$\frac{1}{4}$, section 26. The water from the 16-foot well is soft, but that from the remaining four wells is hard. Other hand dug wells, all less than 36 feet deep, penetrate yellow, and occasionally red, boulder clay before the sand and gravel aquifer is reached. The quality and quantity of the water in these wells are also variable. For instance, a 31-foot well in the NE.$\frac{1}{4}$, section 1, that penetrated 22 feet of yellow, sandy clay, 5 feet of sand and gravel, and 4 feet of dark clay, yields a very small supply of water, whereas a 10-foot well in the NW.$\frac{1}{4}$, section 2, will water 75 head of stock. A 35-foot well in the NW.$\frac{1}{4}$, section 15, yields soft water, whereas a 24-foot well in the SW.$\frac{1}{4}$, section 30, yields water so hard and "alkaline" that stock refuse to drink it. All the farmers in the eastern half of the township, with the exception of one in the SW.$\frac{1}{4}$, section 10, depend on shallow wells to furnish water for all their farm requirements.

In the western half of the township a number of bored and drilled wells have struck two fairly continuous water-bearing horizons. The first aquifer is generally composed of coarse sand or gravel, and it has been encountered by eleven wells at elevations ranging from 1,905 to 1,990 feet above sea-level. Wells tapping this water-bearing horizon vary from 83 to 175 feet deep. The water is under sufficient hydrostatic pressure to rise to points 30 to 80 feet below the surface, and the supply is abundant. The water is invariably hard and that from some wells is used for drinking. The 83-foot well in the NE.$\frac{1}{4}$, section 18, yields water that cannot be used for either drinking or stock. The yield of water in one well in the SW.$\frac{1}{4}$, section 10, is decreasing as the casing is being gradually plugged by sand.

The second aquifer was tapped by three wells in the NW.$\frac{1}{4}$, section 20, SW.$\frac{1}{4}$, section 28, and SE.$\frac{1}{4}$, section 29. The wells are 170, 240, and 228 feet deep, respectively, and the aquifer is tapped at elevations of 1,890, 1,865, and 1,877 feet above sea-level. The aquifer in the 170- and 240-foot wells is composed of very fine sand, and both wells have been completely clogged with sand particles. The aquifer in the 228-foot well is composed of gravel, and the water rises under pressure to a point 90 feet below the surface. The supply is abundant, but the water has a laxative effect on people unaccustomed to its use. Several dry holes have been made between depths of 50 and 110 feet, but there have been no dry holes sunk deeper than the elevation of the first water-bearing horizon.

Since several wells less than 36 feet deep in the township yield moderate to abundant supplies of water, farmers are advised to prospect the upper 35 feet of the glacial drift with test augers. Pockets of sand and gravel are known to exist at shallow depths and if they are of large areal extent a satisfactory supply of water will no doubt be obtained from them. It is also probable that the water will not be so highly mineralized as the water obtained from deep drilled wells. Where water cannot be found at depths less than 36 feet farmers are advised to drill rather than to bore. The probability of striking either the first or second water-bearing horizon is considered good, and there may be other water-bearing horizons at elevations lower than 1,365 feet above sea-level. The glacial drift is believed to be 400 to 500 feet thick and several water-bearing horizons may exist in the lower 200 to 250 feet of it.

Township 23, Range 14

Parts of sections 2, 3, and 10, and of sections 6 and 7, are mantled by glacial outwash sands and gravels. The central part of the township is largely covered with glacial till, and the remainder of the area is overlain with moraine. Jumping Deer creek and its tributaries have eroded deep ravines in the central part of the township which is mainly covered by glacial till. The ground surface is rolling and becomes more hilly and rough in the vicinity of the ravines. Sloughs are fairly numerous and clumps of poplar trees are scattered throughout the township.

Flowing springs occur along the banks of the ravines and deliver abundant supplies of water throughout the year. Springs in the NE.$\frac{1}{4}$, section 14, yield soft water, whereas a spring in the NE.$\frac{1}{4}$, section 28, delivers hard, slightly "alkaline" water. All the producing wells in the township, with the exception of three drilled wells in sections 23 and 26, have been dug or bored to depths less than 54 feet. Twelve wells ranging from 6 to 23 feet deep were dug in thick deposits of sand and gravel that extend from the surface to the base of the wells. The water from these wells is usually only slightly mineralized, as it does not come into contact with clay. The supply obtained depends upon the amount of annual rainfall and upon the extent of the pocket tapped. An 18-foot well, dug entirely in sand in the NE.$\frac{1}{4}$, section 30, yields a constant supply of water that is sufficient for 50 head of stock, whereas a similar well in the NE.$\frac{1}{4}$, section 20, yields sufficient water for only 15 head of stock. The remaining wells in the township usually strike yellow boulder clay beneath the top soil, and in a bored well in the NE.$\frac{1}{4}$, section 7, 50 feet of yellow clay was passed through before blue clay was encountered. Usually the yellow or weathered clay seldom exceeds a thickness of 25 feet. Pockets of sand and gravel are often located between the yellow and blue clays. The supply of water from these pockets also depends largely upon the size and thickness of the sand and gravel deposit. The water is not under pressure and the quality is generally much better than water from an aquifer underlying a layer of blue clay. A 53-foot well in the SW.$\frac{1}{4}$, section 1, and a 50-foot well in the SE.$\frac{1}{4}$, section 12, yield water under pressure. The 50-foot well was bored through 35 feet of yellow clay, 10 feet of hard blue clay, and 5 feet of sand, and the water rises to a point 36 feet below the surface. A 50-foot well was also bored in the SE.$\frac{1}{4}$, section 14. This well penetrated 9 feet of sand and gravel at the bottom of the well and the water-level stands at a point 48 feet below the surface. The supply of water in these three bored wells is abundant and was unaffected by the drought years of 1930 to 1934. The water is highly mineralized, but suitable for stock. Dry holes 50, 80, and 92 feet deep have been bored at various places in the township and no wells have found water between depths of 54 and 159 feet.

A 160-foot drilled well in the NE.$\frac{1}{4}$, section 26, obtains water from a sand aquifer at an elevation of 1,890 feet. The water rises to a point 110 feet below the surface and the supply is constant and abundant, but it is not used for drinking. A 168-foot drilled well in the SE.$\frac{1}{4}$, section 26, failed to strike this aquifer and the supply obtained is small and insufficient for local needs. A third drilled well, 206 feet deep, was made in the NE.$\frac{1}{4}$, section 23. A 2-foot layer of hardpan was struck at a depth of 204 feet below the surface and when this layer was dynamited the water rose under pressure to a point 6 feet below the surface. This well was drilled in 1927 and the level of the water remained constant throughout the dry years. The water is hard and contains iron, but is used for drinking. The supply of well water in this township is fairly good and only fifteen farmers have an inadequate supply. These farmers generally haul water from Jumping Deer creek. Testing in numerous places to a depth of 30 feet with small hand augers is advisable before a well is dug. A pocket of water-bearing sand or gravel may be located by this means with minimum expense and effort. If deep wells are contemplated drilling is preferable to boring. The glacial drift is thought to be 400 to 500 feet thick and water-bearing horizons of sand and gravel may occur at any depth within it. The excavation of deep dugouts is recommended for retaining a supply of surface water for stock use.

Township 23, Range 15

Parts of sections 1, 2, 11, 12, 13, and 14 are mantled by glacial outwash sands and gravels; the northeastern corner of section 36 is covered by glacial till, and the remainder of the township is overlain by moraine. The ground surface is very undulating, contains many sloughs, and is thinly wooded with clumps of poplar.

Well water conditions in the township are poor, and approximately 60 per cent of the farmers have no dependable source of water on their land. A spring situated in a depression in the SE.$\frac{1}{4}$, section 33, delivers sufficient water for 50 head of stock during the summer months, but this spring flows only in wet seasons. Permanent supplies of water are very difficult to locate at any depth in the glacial drift. Most of the wells have been dug by hand to depths less than 50 feet. The site usually chosen for these wells is beside an undrained depression. Deposits of sand and gravel are sometimes struck beneath the yellow clay, but the supply of water obtained from them usually is small and insufficient for local needs. Most of the farmers in the township depend upon this type of well for their supply of water, and in years of average rainfall when the sloughs hold water the supply is sufficient. During the prolonged drought of 1930 to 1934, however, the sloughs were dry and many farmers had to haul water. Only ten wells less than 50 feet deep were recorded that yield permanent supplies of water, and these wells range from 12 to 26 feet deep. They usually tap thick beds of sand and gravel that underlie the top soil and extend to the base of the well. The water from these thick beds of sand and gravel originates from rainfall, but the deposits are so extensive that large quantities of water are stored within them and drought years only slightly deplete the supply. The water is moderately hard, but not highly mineralized. The village of Dysart has no satisfactory water supply. Numerous wells 30 to 40 feet deep yielded water that was too "alkaline" for drinking and the wells were filled in. All water for the village is hauled from a 20-foot well in the SE.¼, section 4.

Numerous dry holes have been dug, bored, and drilled in all parts of the township, and only four wells, 60, 80, 70, and 120 feet deep, have struck permanent supplies of usable water at depths greater than 50 feet. These four wells are located in the SW.¼ and NE.¼, section 6, NW.¼, section 12, and SW.¼, section 14. The wells tap pockets of sand and gravel and not continuous layers, since dry holes 90 and 135 feet deep have been sunk in adjacent quarter sections. The water is under pressure and the supply is abundant and constant, but it is highly mineralized. The water from the 70-foot well is used for drinking, but that from the other three wells is used only for stock. A 90-foot well in the NW.¼, section 16, yields a permanent supply of water, but the well is not used as the water has become contaminated.

The village of Dysart has drilled three wells, 330, 537, and 600 feet deep. Water was obtained from gravel at depths of 80 and 250 feet in the 600-foot well, but it was too "alkaline" for drinking. The base of the well is at an elevation of 1,363 feet above sea-level. The 330- and 537-foot wells did not yield usable water. The bedrock Marine Shale series underlies the glacial drift throughout the municipality. The shale is frequently termed "soapstone" and is often confused with glacial blue clay. A well in the municipality of Abernethy, southeast of this municipality, struck the bedrock at an elevation of 1,470 feet. It is, therefore, possible that the base of the 600-foot well in Dysart is in the Marine Shale series, and it is shown on the map as having encountered bedrock. Farmers are advised to excavate dugouts as a means of collecting and conserving surface water. These reservoirs should be at least 12 feet deep and located so that a maximum amount of water will be collected in the freshet season. Slough basins which are common in the township are usually the best sites for a dugout. Test augers should always be used before a shallow well is dug. Pockets of sand and gravel in the glacial drift may be struck by drilling or boring, but the risk does not justify the expense involved.

Township 24, Range 13

Except for a small area in parts of sections 8, 9, 16, and 17, which is covered by glacial outwash sands and gravels, this township is wholly mantled by moraine. The ground surface is very undulating, and it is particularly rough in the southeastern part and in the northern 2 miles of the township. The township is thickly wooded with poplar. The drainage is towards the southwest.

All but four wells in the township have been dug or bored to depths less than 36 feet. The water supply from these shallow wells is exceedingly variable. A 35-foot well in the NW.$\frac{1}{4}$, section 32, was dug through 18 feet of yellow clay and 7 feet of sand that overlies blue clay. In some wells, however, the sand and gravel underlies the yellow clay, whereas in others sand and gravel extends from the surface to the base of the well without any clay being encountered. The variable water supply in the sand and gravel beds that lie within 35 feet of the surface is shown by three wells. A 12-foot well in the SE.¼, section 11, dug entirely in gravel, yields sufficient water for 200 head of stock. A 16-foot well in the SW.¼, section 9, dug entirely in red sand, yields barely sufficient water for 37 head of stock. A 16-foot well was bored entirely in dry gravel in the SE.¼, section 29. It was not possible to deepen this well by boring because of the presence of boulders. The water from the shallow wells is not highly mineralized and is used for drinking. At least ten farmers have no reliable source of water and use sloughs or haul water. The cheapest method of ascertaining the possibilities of striking water in the upper 35 feet of glacial drift is to use a test auger. Lenses of sand and gravel, some of which yield very little or no water and others that yield abundant supplies of water, exist within 35 feet of the surface. These pockets should be located before a well is dug.

Two wells, 148 and 116 feet deep, obtain permanent supplies of water from sand and gravel aquifers in the glacial drift. These wells, located on the SW.¼, section 6, and the NW.¼, section 32, yield highly mineralized water, and that from the 116-foot well is too "alkaline" for stock. The water in the 148-foot well rises under pressure to a point 78 feet below the surface, and the supply is abundant and constant. A dry hole 165 feet deep was made in the SW.¼, section 19.

Farmers are advised to excavate dugouts in preference to drilling or boring deep wells. Abundant supplies of highly mineralized water can possibly be obtained from pockets of sand and gravel that exist at depth within the blue clay, but the uncertainty of encountering them does not warrant the expense involved. A supply of water is more readily obtained by deep dugouts and the quality is much better than that of the water from deep, bored or drilled wells.

Township 24, Range 14

The southwestern part of the township is mantled by glacial till, whereas the remainder is covered by moraine. The elevation decreases gradually from 2,150 feet at the northeastern corner of the township to approximately 2,000 feet above sea-level at the southwestern corner. Jumping Deer creek flows intermittently in a southeasterly direction through a wide valley in section 6, and re-enters the township in the southern part of section 4. The ground surface is very rough and rolling over the entire township, especially in the vicinity of Jumping Deer valley. It is quite hilly and stony in the northern sections, and the northeastern half of the township is thickly wooded with poplar.

The supply of water obtained in this township is small and about twenty-four farmers have an inadequate supply for their local needs. The depths of the wells vary from 4 to 100 feet, most of the producing wells being less than 35 feet deep. Pockets of sand and gravel that yield moderate to abundant supplies of water are very difficult to locate and these pockets, when found, generally underlie yellow clay. Some of them extend from the top soil to the blue clay, which is usually located at a depth of 25 feet below the surface. A 32-foot dry hole in the SE.$\frac{1}{4}$, section 2, was dug through 7 feet of loam and yellow clay, 1 foot of dry sand, 12 feet of yellow clay, and 12 feet of blue clay. The farmer that dug this well has tested to depths of 16 to 30 feet in many places on his quarter section without encountering water, and at the present time he hauls a tank of water a day for his domestic and stock needs. Many other farmers in the township experience the same difficulty in locating water, and numerous dry holes have been dug and bored to depths of 99 feet throughout the township. Occasionally a pocket of sand and gravel is tapped in the upper 35 feet of the glacial drift that yields sufficient water for 25 to 70 head of stock. The water is generally hard, is not under pressure, and is suitable for drinking. Three shallow wells in the township yield soft water.

The only well in the township over 35 feet deep that yields a permanent supply of water is located in the SW.¼, section 21. The well is 100 feet deep and derives its supply of water from a bed of gravel 20 feet thick. The water does not rise under pressure, but the supply is constant and sufficient for local needs. The water is highly mineralized, bitter, and has a laxative effect on humans.

Farmers are advised to prospect the upper 35 feet of the drift with test augers in order to locate a lens of sand and gravel that will yield a permanent water supply. If these tests fail to encounter water-bearing deposits, dugouts should be excavated to collect and conserve surface water. Drilled or bored wells may encounter pockets of water-bearing sand and gravel that will yield a permanent and abundant supply of highly mineralized water, but the probabilities are not good. Dugouts, if made at least 12 feet deep and located in a suitable place such as a slough basin, will prove a satisfactory means of conserving water for stock use.

Township 24, Range 15

Jumping Deer creek meanders in a southeasterly direction across the township. It is joined in section 14 by a tributary creek that flows in a southerly direction through sections 36, 35, 25, 24, and 23. Both creeks flow intermittently and the valley that contains Jumping Deer creek is approximately one-half mile wide and 40 to 50 feet deep. An area in the eastern part of the township is mantled by glacial till. The remainder of the township, except for two small areas in parts of sections 11 and 12, and parts of sections 16, 17, 20, and 21, which are covered by glacial outwash sands and gravels, is mantled by moraine. The ground surface is very rolling and uneven, and becomes quite hilly in the vicinity of Jumping Deer valley. Sloughs are common and clumps of poplar trees are scattered over the township, the growth becoming more dense in the north-central sections.

Eleven of the thirty-seven farmers interviewed in this township are unable to obtain an adequate supply of water. The wells range in depth from 5 to 85 feet, and no well yields water under hydrostatic pressure. Every producing well is 35 feet or less in depth. At least seventeen wells in the township tap thick beds of sand and gravel that extend from the surface to the base of the well, and with one exception the supply of water is abundant. The water is generally soft, but a few wells yield hard water that is used for farm purposes. The drought of 1930 to 1934 lowered the water-level in some of these wells, but the supply did not become intermittent or insufficient for local needs. The water in these thick deposits of sand and gravel originates from the rainfall, but the pockets are so extensive that enormous quantities of water are stored within them. Other shallow producing wells tap pockets of sand and gravel that underlie the yellow or weathered clay. These pockets of sand and gravel are more extensive and numerous in this township than they are in any other part of the municipality, and, consequently, moderate to abundant supplies of slightly mineralized water are not so difficult to obtain. An 85-foot bored dry hole in the NW.$\frac{1}{4}$, section 7, which penetrated 30 feet of yellow clay and 55 feet of blue clay, is the only dry hole that was dug to a depth greater than 30 feet.

Farmers are advised to refrain from deep boring and drilling as a means of obtaining water. Pockets of sand and gravel that yield good supplies of water exist in the upper 35 feet of the glacial drift, and the possibilities of striking one of these are considered good. Test augers should be used to prospect the upper 35 feet of the glacial drift before a well is dug. If blue clay is struck the test hole need not be continued. The glacial drift is believed to be 400 to 500 feet thick and water-bearing horizons of sand and gravel probably exist within it at depths greater than 35 feet, but the uncertainty of obtaining water does not warrant the expense of drilling.

Standing Buffalo Indian Reserve, No. 78

Only the northern mile of Standing Buffalo Indian Reserve lies within the borders of the municipality. This part of the reserve occupies sections 3, 4, 5, and that part of section 6 lying east of Jumping Deer creek, in township 22, range 14. The southwestern part of the area is mantled by glacial till and the northeastern part is covered by glacial moraine. The ground surface is undulating and wooded with poplar.

No wells were reported in the small area. The residents derive most of their water from Jumping Deer creek, from Echo lake, located in the municipality of North Qu'Appelle, and from sloughs.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF LIPTON, NO. 217, SASKATCHEWAN

Township	22	22	22	23	23	23	24	24	24	Total No. in muni-
West of 2nd mer. Range	13	14	15	13	14	15	13	14	15	cipality
Total No. of Wells in Township	140	104	85	83	87	111	52	93	86	841
No. of wells in bedrock	0	0	0	0	0	1	0	0	0	1
No. of wells in glacial drift	140	104	85	83	87	110	52	93	86	840
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply										
No. with permanent supply	46	36	31	43	44	46	33	32	37	348
No. with intermittent supply	19	6	37	7	18	21	5	26	16	155
No. dry holes	75	62	17	33	25	44	14	35	33	338
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	8	5	4	14	4	6	1	0	0	42
No. of non-artesian wells	57	37	64	36	58	61	37	58	53	461
Quality of Water										
No. with hard water	62	35	67	44	50	59	33	53	41	444
No. with soft water	3	7	1	6	12	8	5	5	12	59
No. with salty water	0	0	0	0	0	0	0	0	0	0
No. with "alkaline" water	10	15	33	14	15	30	6	7	15	145
Depths of Wells										
No. from 0 to 50 feet deep	93	87	70	61	80	90	47	86	84	698
No. from 51 to 100 feet deep	33	14	10	7	4	15	0	7	2	92
No. from 101 to 150 feet deep	4	1	5	7	0	3	2	0	0	22
No. from 151 to 200 feet deep	1	0	0	6	2	0	3	0	0	12
No. from 201 to 500 feet deep	9	2	0	2	1	1	0	0	0	15
No. from 501 to 1,000 feet deep	0	0	0	0	0	2	0	0	0	2
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	51	30	59	40	51	52	32	52	34	401
No. not usable for domestic purposes	14	12	9	10	11	15	6	6	19	102
No. usable for stock	64	39	67	46	61	66	36	57	44	480
No. not usable for stock	1	3	1	4	1	1	2	1	9	23
Sufficiency of Water Supply										
No. sufficient for domestic needs	44	33	31	41	42	45	31	32	36	335
No. insufficient for domestic needs	21	9	37	9	20	22	7	26	17	168
No. sufficient for stock needs	23	21	25	33	33	14	21	23	31	224
No. insufficient for stock needs	42	21	43	17	29	53	17	35	22	279

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 Lipton, No. 217, Saskatchewan

LOCATION						Depth of Well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									Source of Water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1		11	22	13	2		294	Bacteria in 1 c.c. too numerous to count. Bacteria coli present.									294	(1)	(2)	(3)					(4)	ӿ1
2	SW.	16	23	13	2	90	1,400	1,400	1,300	100	11	485	340	187	590	28	1,266	485	165		557		41	18		ӿ1
3	NE.	28	23	14	2	3	2,223	Bacteria in 1 c.c. too numerous to count. Bacteria coli present.									2,223	(4)	(1)		(2)		(3)		(5)	ӿ1
4	NW.	2	23	15	2	45	729	Bacteria in 1 c.c. too numerous to count. Bacteria coli present.									729	(3)	(1)		(2)		(4)		(5)	ӿ1
5	SE.	4	23	15	2	20	354	Bacteria in 1 c.c. too numerous to count. Bacteria coli present.									354	(3)	(1)		(2)		(4)		(5)	ӿ1
6	SE.	4	23	15	2	20	423	Bacteria in 1 c.c. too numerous to count. Bacteria coli present.									423	(3)	(1)		(2)		(4)		(5)	ӿ1
7	SE.	6	24	15	2	7	300	240	140	100	7	145	40	54	60	6	220	72		61	75			12		ӿ1

Water samples indicated thus, ӿ1, are from glacial drift or other unconsolidated deposits.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analyses Nos. 1,3,4,5, and 6, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Seven samples of water from wells that tap aquifers in the glacial drift were analysed, and the results are shown on the accompanying table. The waters from wells indicated by samples 2, 3, 4, 5, and 6 are almost identical insofar as the constituent salts that compose the total dissolved solid is concerned. The salts analysed in order of comparative quantity are usually calcium sulphate, magnesium sulphate, calcium carbonate, sodium sulphate, calcium chloride, and sodium chloride. The salts magnesium sulphate and sodium sulphate are the most undesirable of the mineral salts in drinking water, because of their laxative producing qualities. The total dissolved solid content of 1,400 and 2,223 parts per million in samples 2 and 3 is fairly high, and the proportionally high content of magnesium sulphate and sodium sulphate may cause a slight laxative effect on some individuals. The water shown by these two samples is also very hard. The water shown by sample 3 comes from a spring that has been cribbed, and it might have no bad effects on persons in normal health. The total dissolved solid content of 1,400 parts per million in the water from the 90-foot drilled well shown by sample 2 is not considered excessive for water from a well drilled to this depth in this municipality. The water should be usable for drinking. The total dissolved solid contents of 729, 354, and 423 parts per million, shown by samples 4, 5, and 6, are very low for water from the glacial drift in southern Saskatchewan. The waters are medium hard, and are exceptionally good for drinking. The two 20-foot wells were dug almost entirely in sand and gravel. This type of well is quite common in the municipality. These wells are used as sources from which water is tanked into the village of Dysart. The 7-foot well, the water from which is indicated by sample 7, was also dug entirely in sand and gravel. The total dissolved mineral salt content of 300 parts per million is also very low, and the water is used for washing as well as for drinking. The water shown by sample 1 is the best in quality of the seven samples indicated. The total dissolved salt content of 294 parts per million is exceptionally low and the laxative producing salts, magnesium sulphate and sodium sulphate, are absent.

Care must be taken that the water in shallow wells dug entirely in sand and gravel does not become contaminated, as the water-bearing beds are near the surface and have no covering of clay. The water in such wells is easily polluted by surface water containing animal refuse.

Water from the Bedrock

No well in the municipality is obtaining water from the bedrock. Water when found in the Marine Shale series in this part of Saskatchewan is usually so highly mineralized that it cannot be used for drinking or stock. The main constituent salts in the water are generally the sulphates of magnesium and sodium, and sodium chloride or common salt.