CANADA
DEPARTMENT OF MINES

HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF .... No. 112 SASKATCHEWAN

BY

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

Water Supply Paper No. 121

OTTAWA
1936

CANADA

DEPARTMENT OF MINES

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY

OF ....

NO. 112

SASKATCHEWAN

BY

B.R. MacKAY, H.H. BEACH, and D.P. GOODALL

WATER SUPPLY PAPER NO. 121

CONTENTS

Illustrations

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY

OF .... NO. 112

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, Stansfied, 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 fine 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

---

[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 rt 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 th continental ice-sheet. Clay containing boulders forms part of the drift and is referred to as glacial till or boulder clay. The glacial drift occurs in several forms:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

<u>Belly River Formation</u>. 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.

<u>Marine Shale Series</u>. 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

Rural municipality No. 112 comprises an area of about 268 square miles in the southwestern part of southern Saskatchewan. The Alberta-Saskatchewan boundary (Fourth meridian) forms the western boundary of the area. The municipality consists of six full townships and three fractional townships, described as townships 10, 11, and 12, ranges 28, 29, and 30, W. 3rd mer. The fractional townships lie in range 30 adjacent to the Fourth meridian.

The main line of the Canadian Pacific railway enters the municipality from the east in sec. 12, tp. 12, range 28, and trends in a northwesterly direction over a lowland plain, through the hamlet of Kincorthy to Hatton, in sec. 36, tp. 12, range 29, on the northern border of the area, and then swings southwest through Cummings siding to cross the western border of the municipality in the southwest corner of sec. 2, tp. 12, range 30. A branch line of this railroad serving Golden Prairie, about 15 miles to the northwest of the municipality, extends for about a mile east of Hatton before it turns north and crosses the northern border of the municipality.

The northwestern and northeastern parts of the municipality consist of a gently undulating to nearly level lowland plain with surface elevations ranging from about 2,400 to 2,550 feet above sea-level. Southward from the edge of the lowland in the vicinity of the railway the surface rises rather abruptly to form an irregularly rolling, and, in some places, deeply eroded upland plain with surface elevations ranging in general between 2,650 and 2,800 feet above sea-level. This irregular plain rises gradually to the southwest to attain elevations as great as 3,400 feet in the southwestern part of the municipality.

Drainage in the western half of the area is carried northward by Boxelder creek, a small stream that enters the municipality from the south, in township 10, range 29, and flows to the northwestern lowlands, where it joins Mackay creek before it crosses the northern border in range 30. Most of the eastern half of the area is poorly drained, and shallow sloughs occupy many of the lower depressions between the hills. McCoy creek carries away part of the run-off, however, in the southeastern townships.

None of the streams maintain a permanet flow throughout the summer, although pools left in depressions in the stream channels and small springs that occur at places along the coulée banks provide some water for range stock during part of the grazing season. These water supplies have been augmented in places by the construction of small dams at strategic points in the stream channels.

Although surface waters are apparently the only readily available source of supply in some parts of the area, shallow wells sunk in the Recent deposits and glacial drift provide most of the water used in the municipality.

Water-bearing Horizons in the Unconsolidated Deposits

The unconsolidated deposits include the Recent sand sediments laid down by flood waters in the bottoms of the stream channels and the thick mantle of glacial drift that overlies the bedrock in all parts of the area.

The stream deposits consist largely of fine silts and clays that are interbedded with and underlain by discontinuous beds of sand and gravel. These deposits are usually less than 25 feet thick, but the porous beds form splendid aquifers for the retention of ground waters. Most of the water enters the porous beds as direct seepage from the stream and if the stream gradient is low there is little loss through underground flow, particularly if the aquifer is sealed at its lower end by clay. Although there may be considerable loss of water by surface evaporation, particularly in broad flats, the stream deposits as a rule yield a fairly constant water supply to wells even during periods of drought. These waters are usually hard, but are rarely reported to contain objectionable amounts of mineral salts in solution.

The glacial drift includes all deposits laid down by the great continental ice-sheet that many thousands of years ago spread in a general southwesterly direction over the province of Saskatchewan, and such deposits as were formed by flood waters resulting from the melting ice. As the ice-sheet advanced, and again as its front retreated northward due to the melting of the ice, it laid down a layer of compact, bluish grey boulder clay upon the bedrock. Much of the area covered by the boulder clay is only gently rolling, and is referred to as till plain in differentiating it from the more irregularly rolling, hillocky areas known as moraine. The moraines are thought to have been formed where the retreating ice front paused for a considerable period of time, thus allowing for a more irregular, and as a rule a greater, accumulation of drift in these areas. In this municipality a large moraine-covered area extends through the east-central part, with a smaller, isolated area occurring in the eastern part of township 10, range 28.

The till covering the remainder of the upland part of the municipality is in places deeply eroded, particularly in the western part. On the steeper slopes along Boxhelder creek and its tributaries the till is quite thin, and in some places it has been entirely eroded away leaving the bedrock exposed at the surface. The drift becomes much thicker toward the northern and eastern parts, however, where it may extend to depths of 100 feet or possibly more.

In the northern lowlands, including slightly more than the northeastern half of township 12, range 28, and the northeastern half of township 12, range 29, all of township 12, range 30, and the northern part of township 11, range 30, waters from the melting ice gathered in late glacial time to form a large lake. Sediments were washed into the lake and formed a layer of sand and clay over the lake bottom. The clays are confined largely to the lowest part of this area, in the northwestern part of the municipality, although they also occur interbedded with the lake sands that form the surface deposits in the adjoining areas, as indicated on Figure 1 of the accompanying geological map.

Ground waters from the glacial drift are obtained chiefly from wells sunk to depths of less than 25 feet. Shallow wells are particularly common in the area covered by lake deposits. Here the water tends to seep through the sands to collect upon the surface of the less pervious, underlying boulder clay. The sands do not form a continuous water-bearing horizon over large areas, however, as at most places they are thin or are interbedded with less pervious clay. Where the lake deposits are thick or exceptionally porous large supplies of water are in most cases obtained. It has been found a good paractice in all parts of the lake basin to test well locations with a small auger before undergoing the expense of sinking a well, as the character of the sediments at a depth of a few feet may be entirely different from the deposits exposed at the surface. Where only small yields are obtained the total supply is usually increased by sinking several wells in different parts of the farm. As the depth of these wells is rarely over 20 feet, the expense of digging them is relatively small, and several wells may be put down on a farm as an added convenience.

The quality of the water obtained from the glacial lake deposits varies greatly as to the amount of dissolved salts it contains, so that little prediction can be made as to the type of water that may be expected in any one locality. In most cases these waters contain appreciable amounts of the objectionable sulphate salts in solution, but few wells are reported to yield water that is undrinkable.

The glacial till underlying the lake deposits is also a source of water supply. In the uplands, where the till occurs at the surface, ground waters are concentrated in small, isolated pockets of sandy clay, sands, and gravels, which occur interspersed at irregular intervals through the less pervious boulder clay. Most of the wells drawing their supplies from these porous beds are situated in depressions where ground waters tend to collect. Such wells are usually less than 20 feet deep. The water is, as a rule, drinkable. The yield from individual wells is frequently inadequate for the requirements of the farms on which they are located. On many of the farms these shallow aquifers have not been located, or if located are inconveniently situated to farm buildings, and deeper wells have been put down to sand and gravel beds that occur sparsely scattered through the boulder clay at greater depths.

In the southern part of the municipality, particularly in the southwestern part, the drift is relatively thin and at least seven wells are reported to have been put down to the underlying bedrock without striking water. Although the thickness of the drift was recorded in only a few instances, it probably does not exceed 50 feet at most places in the southern townships. The drift becomes thicker toward the north, particularly on the western side of the area through range 28, as indicated by several wells sunk entirely in the drift to depths ranging from 50 to 120 feet. Even greater thicknesses of the drift are expected to occur in the northern part of the municipality. The individual areal extent of the deeper aquifers is not traceable over great distances owing to the scarcity of wells. It is quite probable, however, that most of them are of local occurrence, as at several places dry holes have been sunk in close proximity to producing wells. As a rule, the deeper wells yield moderately large supplies of water, although the quality of the water is usually inferior to that of the shallow wells. Nearly all waters from the deeper aquifers are reported to contain relatively large amounts of the objectionable sulphate salts in solution, the concentration of which in some places renders the water unsuitable for domestic use.

Water-bearing Horizons in the Bedrock

Two bedrock formations, known as the Bearpaw and Belly River formations, immediately underlie the glacial drift in different parts of the municipality. The uppermost, or Bearpaw formation, underlies the upland, till-covered area, and most of the lake basin in the northeastern part. In the western part of the area its base is thought to lie at an average elevation of approximately 2,500 feet above sea-level. Owing to a slight northeasterly dip of the bedrock the base of the formation occurs at progressively greater depths in that direction, so that on the eastern side of the municipality it may occur at elevations of 150 to 200 feet lower than on the western side. The Bearpaw formation is composed essentially of compact, dark grey marine shales, interbedded in some places with thin bands of ironstone. These shales may be distinguished from the overlying lake and boulder clays of the drift by their darker colour, their more friable character, and the entire absence in them of boulders or pebbles. The shale usually shows some indication of bedding, and when allowed to dry it breaks down into small, roughly cubical fragments. Owing to the widespread erosion to which the formation was exposed prior to the deposition of the glacial drift, the thickness of the Bearpaw varies greatly from place to place. It is probably 400 to 500 feet thick in the southeastern part of the municipality. It is known to thin perceptibly, however, toward the northwest, and in the lake basin north of the geological boundary indicated in Figure 1, of the accompanying geological map, it is entirely absent, and the underlying Belly River formation occurs immediately below the drift.

Little or no water that is suitable for farm use is obtained from the Bearpaw formation in the municipality. The Belly River formation, however, is known to be water bearing, although throughout a large part of the area it is buried under considerable thicknesses of Bearpaw and drift deposits, and is not of much practical value as a producer of water. In the northwestern part of the municipality, north of the geological boundary as indicated in the accompanying map, the depths to the top of this formation depend upon the thickness of the glacial drift.

The Belly River formation consists of a thick series of shales and sandstones interbedded with an occasional seam of lignite coal. The uppermost coal seam in many places occurs at the contact of the formation with the overlying Bearpaw. In a 2,095-foot well drilled for oil, in sec. 21, tp. 11, range 29, the upper coal seam was encountered at a depth of 140 feet, or at an elevation of about 2,360 feet above sea-level. No water was struck, however, until a depth of 350 feet was reached. Water may occur nearer the top of the formation in other parts of the municipality, and at most places throughout the northern lowlands water could probably be obtained at even shallower depths. Owing to irregularities in the surface relief, and to variations in the thickness of the overlying bedrock and drift deposits, only rough estimates can be given as to the depth to the uppermost Belly River beds in other parts of the municipality. Such estimates as are cited in later sections of this report should be regarded as only approximate.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 10, Range 28

The land surface of this township forms a rough to moderately rolling prairie land, with surface elevations ranging from 2,750 to 5,150 feet above sea-level. Drainage is to the northeast through McCoy creek, a small intermittent stream that traverses the northwestern part of the township. Some parts of the area are poorly drained, particularly in the southwest. The small, shallow sloughs that occur in the area usually become dry in early summer. A few dams have been constructed in coulées in order to conserve surface water for stock, but in general both domestic and stock water supplies are obtained from shallow wells sunk in the Recent deposits and glacial drift.

Stream deposits consisting chiefly of clays and silts occur in the bottoms of the stream channels, and in McCoy Creek valley they form a fairly extensive flood-plain in the southwestern and north-central parts of the township. The stream deposits are usually underlain by and interbedded with discontinuous layers of well-sorted sands and gravels. These porous beds are yielding water to wells in several places in the township. The water contains noticeable amounts of mineral salts in solution, but this condition may be quite variable as only a few wells are reported to have been put down in the stream sediments.

Most of the wells recorded from the area are drawing their water from isolated pockets of sand and gravel that occur interspersed through the boulder clay. Depths of these wells range from 8 to 66 feet, but the greater number are less than 20 feet deep. The quality of the water from the shallow wells varies considerably, so that it is impossible to predict the type of water that may occur in any one locality. Although most of these waters are drinkable, appreciable amounts of sulphate salts are reported to be present.

The yield from individual wells is also variable, and at many places only small seepages or no water have been located. Some of the residents have sunk shallow seepage wells beside dams in order to obtain drinking water, whereas others have put down deep wells in search of water in lower drift deposits and in the underlying bedrock. Fairly large yields of water are obtained from wells put down to depths of 50 to 66 feet in sections 19, 22, 32, and 35. The water occurs in beds of gravel and sand interbedded with the blue-grey boulder clay. The areal extent of the individual aquifers has not been determined, but it is doubtful if any two wells are drawing their supplies from the same water-bearing bed. These waters all are reported to be hard and "alkaline", and are not very suitable for drinking although some are used for the domestic drinking supply and all are used for stock. Similar water-bearing beds are expected to occur in other parts of the township, particularly in the north-eastern half where the drift is supposedly thicker. These aquifers are not everywhere present, however, as shown by dry holes drilled to depths of 152 feet in section 4, and 285 feet in section 5. Other residents in this vicinity also report difficulty in locating adequate water supplies, and have constructed dams in the bottoms of the small coulées in order to conserve surface water for stock.

The Bearpaw formation underlying the drift in this township can be expected to yield little if any water that is suitable for farm use. The above-mentioned wells in sections 4 and 5 may have penetrated these shales for some distances, as the drift is known to be relatively thin in this part of the township. Residents are advised to confine their search for water to the unconsolidated deposits unless they are prepared to drill through the Bearpaw to the underlying Belly River formation where conditions are more favourable for the occurrence of water. The top of this formation is not expected to occur at depths of less than 400 feet in the southwestern part of the township where surface elevations range higher than 3,000 feet above sea-level.

Township 10, Range 29

The surface of this township is an undulating to steeply rolling till plain, with elevations ranging in general between 3,000 and 3,200 feet above sea-level. The western half of the township is drained by Boxelder creek, an intermittent stream that runs northward through a deep coulée extending along the western side of the area. Drainage of the eastern half is carried to the east through branches of Boxelder and McCoy creeks.

Although the creeks carry water only during flood seasons these stream channels and the numerous tributary coulées offer splendid opportunities for the conservation of surface water for stock use, by the construction of dams and reservoirs. This method of conservation of surface water is widely used by the residents as suitable ground water supplies are difficult to locate. These surface supplies also provide household drinking water on some farms through seepage to shallow wells dug beside the reservoirs.

Recent sediments that occur in the coulée bottoms are probably the most reliable source of ground water at shallow depth. These deposits consist chiefly of clay and silt through which are interspersed discontinuous beds of well-sorted sands and gravels. The Recent deposits attain their greatest development along the bottom of Boxelder creek and in the wide valley of McCoy creek, in sections 12 and 13. As the coulée bottoms are remote from most of the existing farms in the area, this source of ground water is little developed to date. One well sunk to a depth of 11 feet near Boxelder creek in section 30 yields a moderately large supply of water that is reported to be slightly "alkaline". It is quite probable that waters from the stream deposits in other places will also contain appreciable amounts of the soluble mineral salts in solution, although the salt concentration is not expected to be sufficiently high to render the water unfit for drinking.

Considerable difficulty has been experienced in obtaining adequate water supplies from the drift deposits. Wells sunk to depths of less than 25 feet rarely yield sufficient water for more than household needs. Most of these waters seep from porous clay or from thin beds of sand that occur sparingly interspersed through the boulder clay. At most places the water is reported to be hard and "alkaline".

Few wells have been sunk to depths greater than 25 feet in the township. The deepest producing well reported in the area was sunk to a depth of 75 feet in the NE.$\frac{1}{4}$, section 28, where only a small yield of highly mineralized water was obtained. Wells have also been put down in sections 24 and 30, to depths of 53 and 47 feet, respectively. Waters obtained from these wells also contain fairly large amounts of mineral salts, but they are used for drinking.

In section 4 the Gem Dome Oil Company drilled to a depth of 300 feet, but no water was reported. Here the Bearpaw formation was encountered at a depth of 40 feet and continued down to where drilling was suspended at 300 feet.

The Bearpaw formation is not expected to be water bearing in any part of the township. Water-bearing beds may occur, however, in the more porous Belly River formation underlying the Bearpaw. The depth to the top of this formation has not been determined, but it probably lies at an elevation of 2,400 to 2,500 feet, or at depths greater than 400 feet, in most parts of the area. In a deep well drilled in the township bordering on the north the Belly River beds were penetrated for about 210 feet before water was struck. Although water may occur in the uppermost beds at some places in this township, drilling to this potential horizon is an expensive procedure.

Township 10, Range 30

Glacial drift mantling this fractional township forms an irregularly rolling till plain, the surface of which rises in a southerly direction from an elevation of about 2,750 feet above sea-level on the northern border to an elevation slightly greater than 3,400 feet in section 2, in the southern part of the township. There are no permanent streams flowing through the area, but numerous deep coulées offer splendid opportunities for the conservation of the spring run-off, through the construction of dams. As suitable ground water supplies are difficult to locate at moderate depths most of the residents have constructed small dams to conserve water for stock. In some places the dams also provide domestic water supplies by seepage to shallow wells sunk beside the reservoir. Springs are also a source of water on the sides of a high ridge that extends northward through sections 2 and 11, in the southern part of the township. Throughout the rest of the area water is obtained from shallow wells sunk in the unconsolidated deposits.

Recent deposits consisting of clay and silt interbedded with sand and gravel floor the bottoms of the coulées to varying depths, usually less than 20 feet. Wells sunk to the sand and gravel beds are yielding adequate supplies of hard, drinkable water on several farms. These sediments are not everywhere water bearing, however, but the productive beds may be readily located with a test auger.

The glacial drift deposits have also proved to be water-bearing on several farms, although the yield at most places is reported to be inadequate for more than domestic use. There are apparently few sand or gravel beds present in the clay as nearly all wells sunk in the drift are drawing water from porous, sandy boulder clay.

Deep drilling has proved unsatisfactory, as the unproductive Bearpaw shales are usually encountered at depths of less than 50 feet. Two wells, situated in sections 12 and 14, are producing highly mineralized waters from clay and shale at what is probably the contact of the drift with the underlying Bearpaw at depths of 69 and 45 feet, respectively. These waters are reported to be so highly charged with sulphate salts as to be undrinkable. A third well, dug to a depth of 25 feet in section 22, and a 5-foot well, in section 2, are also producing from the drift-Bearpaw contact. These waters are reported to be only slightly "alkaline" and are used for domestic purposes.

Sinking wells below this contact is not recommended unless the driller is prepared to drill through the Bearpaw formation to the underlying Belly River beds where conditions are more favourable for the accumulation of ground water. Depths to the top of the Belly River formation should increase perceptibly toward the south, as the surface elevations rise in this direction. It could probably be reached by drilling to a depth of 300 feet in the northern sections, however, although several hundred feet of additional drilling would probably be required to tap a water-bearing bed. In view of the expense in drilling to such depths it would seem advisable for residents of limited means to confine their search for water to the shallow, unconsolidated deposits or construct dams and reservoirs for the conservation of surface water.

Township 11, Range 28

An irregular moraine covers most of the northern half of the township, and in the central part it extends southward across the southern border in sections 3 and 4. With the exception of the north half of section 36, the rest of the area, comprising the southwestern and southeastern parts and a narrow belt on the northern border in sections 34 and 35, is overlain by a moderately rolling till plain. In the northern part of section 36 the boulder clay is overlain by a thin layer of glacial lake sand.

The moraine-covered area is poorly drained and many of the low depressions lying between the hills are occupied by shallow sloughs. McCoy creek, flowing northeastward across the southeastern corner of the township, and a branch of Boxelder creek that flows northwestward across the southwest corner, drain the small till plain areas. Both streams are small and flow only during flood seasons. Although the sloughs provide some water for stock the most dependable water supplies are obtained from wells sunk in the glacial drift. Springs issuing from the drift are also a source of water at many places in the southern and western sections.

Water in the glacial drift is concentrated mostly in isolated pockets of sand, gravel, and, occasionally, porous clay that occurs interspersed at irregular intervals through the less pervious boulder clay. These water-bearing beds are tapped by wells sunk to various depths, ranging from only a few feet to 120 feet. At places where these aquifers lie at or near the surface on the hill-sides or coulée banks small springs occur.

The shallow wells sunk to depths of less than 20 feet are usually located in the draws and depressions between the hills. Most of these wells are materially affected by drought and were yielding only sufficient water for household use, or a few head of stock, when visited in 1935. The yield from the deeper wells was more constant although the supplies derived are inadequate in some places. Dry holes have also been put down to depths greater than 50 feet on several farms in the central part of the township. The deepest dry hole recorded was drilled to a depth of 130 feet in section 20. Evidently the water-bearing beds are erratically distributed through the clay, as at several places water was later struck in close proximity to one of these deep test holes.

Most of the ground waters in the township are drinkable, although a few wells are reported to produce "alkali" water. The mineral salt concentration is relatively low in most of the deep wells, although this condition may not be prevalent throughout the entire area.

As no wells are reported to have reached the Bearpaw formation underlying the drift the depth to the shales remains undetermined. Little if any water that is suitable for farm use can be expected from this formation, but the Belly River formation underlying the Bearpaw may be water bearing at depths of 300 to 400 feet, or possibly deeper. Water obtained from this formation in the township bordering on the east is of good quality, and it is reasonable to suppose that drinkable waters might also be obtained from the Belly River aquifers in this township.

Township 11, Range 29

The general land surface rises in a southeasterly direction from an elevation of about 2,450 feet, in a lowland area in the northwestern corner of the township, to elevations of 2,700 to 2,800 feet, extending over most of the northern two-thirds of the area. Farther to the south the surface rises more rapidly to attain a maximum elevation of about 3,000 feet in section 2, on the southern border of the area. A few farms are located in the irregularly rolling southern part. The rest of the area is deeply eroded and dissected by two deep, flat-bottomed valleys that trend in a northwesterly direction through the central and northern sections. This part of the township is devoted almost entirely to grazing.

The township is drained to the north and west through Boxelder creek and an eastern tributary that joins the main stream on the edge of the lowlands in section 19. The creeks flow only during flood periods. Water retained in depressions in the stream channel may provide some water for stock during part of the grazing season. These supplies could be augmented by constructing dams at suitable places in the stream channels. Wells sunk to shallow depths in the unconsolidated deposits produce most of the water used on the farms, although the bedrock is also known to be water-bearing at moderate depths from the surface.

The stream deposits are possibly the most reliable source of ground water at shallow depths. In Boxelder Creek valley and on the western side of the township springs are reported to seep from the stream gravels. Some of these do not flow, but by excavating a shallow pit or digging a shallow well a permanent supply of water is obtained. In a 7-foot well dug in one of these springs in section 5 the water maintains a constant level at the surface. In section 18 an abundant yield is also obtained from a 16-foot well sunk in these sediments. Similar water-bearing beds undoubtedly occur interspersed with clays and silts along the bottoms of the smaller coulées and draws. No wells are reported to have been sunk in the wide, flat-bottomed coulée occupied by the eastern branch of Boxelder creek, in the central part of the area. At the surface the sediments flooring the bottom of this stream channel consist chiefly of fine silt and clay. Porous sands and gravels may also occur interspersed through these deposits at depths of less than 20 feet from the surface. Such waters as they may contain are expected to be more highly mineralized, however, than those of Boxelder creek and the small channels.

The glacial drift is composed largely of boulder clay through which are interspersed isolated pockets of well-sorted sands and gravels. In the northwestern part of the township the drift consists of an irregular moraine covering slightly more than sections 25, 34, 35, and 36. The moraine deposits are not expected to differ essentially from the till occurring throughout the rest of the area. Although only a few wells are reported to have been put down in the glacial drift very few extensive water-bearing beds are expected to occur. At most places on the steep slopes and ridges the drift is thin and can be expected to contain little if any water. Residents are advised to prospect with a test auger in the depressions and at the bases of steep slopes in preference to the points of higher elevations before sinking a well in search of water in the drift.

The unconsolidated deposits are underlain by the unproductive Bearpaw formation throughout most of the area, although in the absence of the Bearpaw, the Belly River formation may form the uppermost bedrock in the lowlands in the northwestern parts.

The Belly River beds are reported to have produced a large supply of water in a well put down in section 21 by the Twin Provinces Oil Company. At this location a coal seam at the top of the Belly River formation was encountered at a depth of 140 feet, after the well had passed through about 10 feet of drift and 130 feet of Bearpaw shale. Water is reported to have been struck at depths of 350, 360, 491, and 508 feet in this well. The character of the water-bearing beds and the quality of the water at each horizon were not recorded. As this well was drilled in a valley at an elevation of about 2,500 feet above sea-level, correspondingly greater depths will be required to reach these horizons at the points of higher elevation that occur throughout most of the township. No water was recorded at depths greater than 508 feet, although the well was sunk to a depth of 2,095 feet before drilling was suspended in 1934.

Township 11, Range 30

This fractional township consists of a 2-mile wide strip lying immediately east of the Fourth meridian. The northern part of the area, including most of the four northern townships, is situated in a glacial lake basin at an elevation of about 2,450 feet above sea-level. Toward the south the surface rises through a moderately rolling till plain to attain an elevation of about 2,750 feet on the southern border. In the northern lowlands the boulder clay is overlain by a layer of lake clay with a recorded thickness of about 20 feet.

No water is expected to occur in the compact lake clay. A well sunk to a depth of 43 feet in section 36 is reported to have struck water in a bed of sand lying below the lake clay, at a depth of 20 feet. Similar appearing water-bearing beds are tapped by several wells sunk through the lake clay in the township bordering on the north, but these aquifers may not form a continuous horizon throughout the lake basin.

In the till-covered area south of the lake basin wells are drawing water from isolated pockets of sand and gravel in the bottoms of the coulées. One of these wells, situated in section 24, is reported to have been sunk through 40 feet of gravel. The water is soft and is used for the domestic drinking supply. Drinkable waters are also obtained from the drift in sections 11 and 12. In the latter section a dry hole sunk to a depth of 53 feet penetrated a few feet of the Bearpaw shale at the base of the well. Greater thicknesses of drift are not expected to occur in other parts of the township.

The Bearpaw formation probably does not underlie more than the southern half of the area, where surface elevations range higher than 2,550 feet above sea-level. The underlying Belly River formation is believed to form the uppermost bedrock in the absence of the Bearpaw, in the northern half. The Bearpaw formation is not expected to be water bearing, but the Belly River sand beds and coal seams are known to contain an abundance of water in the township bordering on the east. Residents who contemplate drilling for these supplies are advised to read the preceding section dealing with township 11, range 29, in which are listed the water-bearing horizons encountered in the Twin Provinces Oil Company's well in section 21.

Township 12, Range 28

A gently undulating lowland area extends over slightly more than the northeastern half of the township. The lowest elevation of about 2,400 feet above sea-level occurs in parts of sections 35 and 36. The surface rises gradually to the southwest to an elevation of about 2,550 feet in the vicinity of the railway, then rises rather abruptly to an irregularly rolling plain extending southwestward between Kincorth and Hatton to the borders of the township, at elevations ranging between 2,650 and 2,750 feet above sea-level.

There are no large streams flowing through the area. Undrained depressions occupied by shallow "alkali" sloughs are of common occurrence on the eastern lowlands. Although some of these surface waters may be suitable for stock use most of them dry up or become too highly mineralized for use in seasons of drought. Dams have been constructed at a few places, but most of the residents depend upon shallow wells sunk in the glacial drift deposits for both stock and domestic water supplies.

In the northeastern lowlands the surface deposits consist of a thin layer of glacial lake sands and silts interbedded with layers of clay. These are underlain by less pervious boulder clay at depths usually less than 10 feet. On the uplands south of the railway the boulder clay occurs at the surface and forms a moderately rolling belt of till plain extending parallel with the railway between sections 3 and 19. An irregular hilly moraine covers the rest of the area.

There is apparently little difference in the ground water conditions existing in the moraine and till plain deposits. Shallow wells sunk beside sloughs and in draws are the most favoured locations. Small gravel pockets where tapped by wells yield variable amounts of water, depending largely upon the areal extent of the water-bearing beds. Springs are also reported to occur at several places on the hill-sides, but the flow is small or intermittent. Most of the residents in this part of the township dug several wells before an adequate water supply was located. As a rule, the water from the shallow gravel aquifers is of good quality and is being used for domestic purposes.

On the lowlands most of the wells are drawing water at shallow depths from the lake deposits or from sand and gravel pockets in the boulder clay immediately below the lake sediments. Few of these wells are over 75 feet in depth, although dry holes are reported to have been dug to slightly greater depths on some of the farms. As the yield is quite variable in different localities, it would seem advisable to prospect thoroughly with a test auger into the underlying boulder clay in order to locate the most favourable point for sinking a well. As a whole the waters obtained from the lake deposits are more highly mineralized than those from the till and moraine-covered areas, although at most places those waters are also reported to be drinkable.

Only three wells are reported to have been sunk to aquifers occurring at depths greater than 30 feet from the surface. These wells, situated in sections 9, 16, and 22, were put down to depths of 45, 80, and 50 feet, respectively, at which depths adequate yields were obtained. The water in the 80-foot well is reported to come from clay at the base of the well. It is hard and "alkaline" and is used only for stock. In the other two wells water was struck in pockets of gravel. Neither of these wells was being used in 1935, and the quality of their waters was not definitely determined. It seems probable that similar water-bearing beds may occur scattered through the boulder clay in other parts of the township at depths of less than 100 feet. No prediction can be made as to the quality of these waters, however, and the location of the aquifers can be determined only by sinking wells.

Although no wells are reported to have been sunk through the drift deposits, the Belly River formation is regarded as a potential source of water at moderate depths. Throughout most of the township this formation is thought to be overlain by the compact shales of the Bearpaw formation, but it may immediately underlie the drift in parts of the northern sections, north of the geological boundary as shown on Figure 1 of the accompanying map. Since the bedrock is known to dip perceptibly toward the east, the top of the Belly River formation is no doubt buried under considerable thicknesses of Bearpaw and drift deposits in the southeastern part of the township. As little definite information is available regarding the depths to the uppermost Belly River beds or depths to water, only rough estimates of these can be made. Water should be encountered at a maximum depth, in the southern part of the township, of about 300 feet. In the northern part the top of the Belly River formation may be reached at depths not greatly exceeding 100 feet.

Township 12, Range 29

The northwestern half of this township lies within a glacial lake basin. The land surface here is flat lying, with elevations varying only slightly from 2,400 feet above sea-level. From the edge of the lake basin southeastward the surface rises abruptly to form a steeply rolling to hillocky upland plain with elevations ranging in general between 2,700 and 2,800 feet above sea-level. As a large part of the area consists of range land the ground water resources have been developed in only a few isolated localities. Several small springs are reported to occur in the uplands, and fairly large supplies might be stored in some places by the construction of small dams. Throughout most of the area, however, both stock and domestic water supplies are obtained from shallow wells sunk in the glacial drift.

In the western lowlands, including most of the western third of the area, the surface is underlain by a layer of glacial lake clay. In some places this clay is interbedded with or underlain by discontinuous beds of fine sand. The lake clay is probably not sufficiently pervious to hold any large supplies of water. One well put down to a depth of 25 feet in section 7 encountered an adequate supply of hard, "alkaline" water in quicksand. This aquifer probably underlies the lake clay and may occur in other parts of the lake basin.

In the northeastern part of the lake basin the land surface is slightly higher and more irregular. The surface deposits here consist largely of fine sands and silts. In the hamlet of Hatton, in section 36, no water was encountered until wells were sunk for some distances through the sands into the underlying boulder clay. The deepest well in the village was put down to a depth of 60 feet, and others are between 30 and 48 feet deep. The water is reported to come from clay, although it is probably from thin sand beds or sandy clay. It is hard and contains noticeable amounts of mineral salts in solution, but is reported to be suitable for domestic use. The analyses of water from four of these wells are listed in a later section of this report. At other places in these lowlands water is obtained from pockets of sand at depths of less than 30 feet.

The surface deposits on the uplands, including most of the southeastern half of the township, consist of boulder clay forming an irregular till plain and moraine. Ground waters in these uplands are also concentrated in small pockets of porous clay and sand that occur interspersed at various depths through the less pervious boulder clay. The low depressions and draws are regarded as being more favourable for the accumulation of shallow ground water supplies than the points of higher elevations. The waters from the shallow aquifers are quite variable in character. A well situated in section 9 is reported to yield water that is so highly mineralized as to be undrinkable, although in some places the drift waters are used for domestic purposes.

The deepest well in the uplands was sunk to a depth of 42 feet, in section 2, and an adequate yield of hard, "alkaline" water was struck in a "blue mud" at 38 feet. Other water-bearing beds may occur at various depths down to the base of the drift, but these waters are expected to be, in general, more highly mineralized than the shallow drift waters.

Although all wells in the township are drawing water from the glacial drift the Belly River formation is regarded as a potential source of water throughout the area. This formation is thought to underlie the drift in the northwestern lowlands, but in the southeastern part it is overlain by a variable thickness of Bearpaw shale. At the hamlet of Hatton, in section 36, the top of the Belly River may be buried under 100 feet or possibly more of drift. In section 1, in the southeastern corner of the township, where the land surface is higher, wells may have to be dug, as deep as 250 foot to reach the top of this formation. No prediction can be made as to depth to water, however, as its presence depends largely upon the porosity and structural conditions existing in the bedrock.

Township 12, Range 30

This fractional township, consisting of a 2-mile wide strip lying adjacent on the east to the Fourth meridian, is entirely covered with a layer of lake clay. The surface is flat, with the exception of a few local undulations. Boxelder creek flows northward through the centre of the area and is joined in section 14 by Mackay creek, flowing in from the west. As these streams have only an intermittent flow the few residents situated in the area depend upon shallow wells and dams in stream channels for their water supplies.

Two wells, situated in sections 2 and 12, have been sunk to depths of 20 and 25 feet, respectively. Both wells are reported to produce moderate supplies of hard, drinkable water, from clay. Whether these aquifers are in the lake deposits or in the underlying boulder clay was not determined. In section 23 a small spring in Mackay Creek valley is also reported to yield water from a sand aquifer. It seems probable that beds of water-bearing sands similar to those tapped by wells situated immediately south and east of this township may underlie the lake clay at some places. Such sands if present should be readily located at shallow depths with a test auger.

The Belly River formation underlying the drift is also expected to be water bearing. Residents who contemplate drilling deep wells in the township are advised to read an earlier section of this report dealing with the bedrock in the municipality as a whole.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL
MUNICIPALITY OF NO. 112, SASKATCHEWAN

West of 3rd mer. Township / Range	10 / 28	10 / 29	10 / 30	11 / 28	11 / 29	11 / 30	12 / 28	12 / 29	12 / 30	Total No. in Municipality
Total No. of Wells in Township	83	38	24	108	21	6	46	32	6	364
No. of wells in bedrock	2	1	9	0	1	0	0	0	0	13
No. of wells in glacial drift	73	29	11	108	17	6	46	32	6	328
No. of wells in alluvium	8	8	4	0	3	0	0	0	0	23
Permanency of Water Supply										
No. with permanent supply	48	28	14	53	7	4	33	22	4	213
No. with intermittent supply	8	6	8	7	3	1	5	3	0	41
No. dry holes	27	4	2	48	11	1	8	7	2	110
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	2	1	0	3	2	0	0	0	0	8
No. of non-artesian wells	54	33	22	57	8	5	38	25	4	246
Quality of Water										
No. with hard water	47	29	18	46	9	3	28	19	2	201
No. with soft water	9	5	4	14	1	2	10	6	2	53
No. with salty water	0	0	0	0	0	0	0	0	0	0
No. with "alkaline" water	25	23	10	26	5	1	14	12	0	116
Depths of Wells										
No. from 0 to 50 feet deep	76	35	22	82	20	5	45	29	6	320
No. from 51 to 100 feet deep	5	2	1	17	0	1	1	3	0	30
No. from 101 to 150 feet deep	0	0	0	9	0	0	0	0	0	9
No. from 151 to 200 feet deep	1	0	0	0	0	0	0	0	0	1
No. from 201 to 500 feet deep	1	1	1	0	0	0	0	0	0	3
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	1	0	0	0	0	1
How the Water is used										
No. usable for domestic purposes	34	30	19	42	8	3	26	15	4	181
No. not usable for domestic purposes	22	4	3	18	2	2	12	10	0	73
No. usable for stock	52	34	19	56	9	5	35	22	4	236
No. not usable for stock	4	0	3	4	1	0	3	3	0	18
Sufficiency of Water Supply										
No. sufficient for domestic needs	47	28	14	53	7	5	33	21	4	212
No. insufficient for domestic needs	9	6	8	7	3	0	5	4	0	42
No. sufficient for stock needs	26	9	10	43	7	4	23	16	4	142
No. insufficient for stock needs	30	25	12	17	3	1	15	9	0	112

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

The term "total dissolved mineral solids" as here used refers to the residue remaining when a sample of water is evaporated to dryness. It is generally considered that waters that have less than 1,000 parts per million of dissolved solids are suitable for ordinary uses, but in the Prairie Provinces this figure is often exceeded. Nearly all waters that contain more than 1,000 parts per million of total solids have a taste due to the dissolved mineral matter. Residents accustomed to the waters may use those that have much more than 1,000 parts per million of dissolved solids without any marked inconvenience, although most persons not used to highly mineralized water would find such waters highly objectionable.

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and it represents the amount of mineral salts that cannot be removed by boiling. Temporary hardness is the differance between the total hardness and the permanent hardness and represents the amount of mineral salts that ban 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 excesss 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 No. 112 Saskatchewan

LOCATION						Depth of Well, ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of Water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	
1	NE	36	12	29	3	48	1,474												(3)		(4)	(2)	(1)	(5)	x 1
2	NE	36	12	29	3	60	1,194												(3)		(4)	(2)	(1)	(5)	x 1
3	NE	36	12	29	3	56	1,536												(3)		(4)	(2)	(1)	(5)	x 1
4		36	12	29	3	60	1,546												(4)		(5)	(2)	(1)	(3)	x 1

Water samples indicated thus, x 1, are from glacial drift.
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.
Analyses Nos. 1-4, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

WATER FROM THE UNCONSOLIDATED DEPOSITS

No samples of water were taken from this municipality for analysis by the Geological Survey in 1935. The four analyses listed in the accompanying table were made by the Provincial Analyst, and indicate the total amount of dissolved solids present in the water and the relative abundance of the five main constituent salts. The analyses are all of water from the glacial drift in the village of Hatton.

Although no analyses are available of water from the Recent stream deposits, the quality of those waters is not expected to differ essentially from that of the waters obtained in adjoining municipalities where the source beds are apparently similar.

As a rule waters from the stream deposits contain relatively small amounts of mineral salts in solution. These waters are derived chiefly by direct seepage from the stream, and, as the water-bearing beds are composed largely of sands and gravels containing only minor amounts of readily soluble salts, little opportunity is afforded the water to become more highly mineralized. On broad flats, such as occur on the branch of Boxelder creek in township 11, range 29, the concentration of mineral salts in the ground waters may be increased considerably due to excessive surface evaporation and to the prevalence of soluble salts in the finer sediments of which these deposits are usually composed.

Surface evaporation is also an important factor in determining the concentration of mineral salts in waters contained in shallow aquifers in the drift deposits. The sediments with which the waters come in contact, however, have probably the greatest bearing on this concentration. The boulder clay is usually regarded as being the chief source of the objectionable sulphate salts. As a rule, wells sunk entirely in clay or encountering only thin sand beds yield water that is more highly mineralized than waters from thick beds of sand and gravel. It is to be noted also that, in general, the mineral salt concentration in drift waters increases with depth.

This is a noticeable feature in waters from most of the wells sunk below 30 feet in depth. With few exceptions, these deeper waters are reported to be "alkaline", and at some places they are used only for stock.

The so-called "alkali" waters usually contain sodium sulphate (Na_2SO_4), magnesium sulphate ($MgSO_4$), calcium carbonate ($CaCO_3$), magnesium carbonate ($MgCO_3$), and calcium sulphate ($CaSO_4$), with minor amounts of sodium carbonate (Na_2CO_3) and common salt ($NaCl$). These salts are listed in the decreasing order of their most frequent occurrence. The sulphates of sodium and magnesium are the most objectionable salts present. Waters containing in excess of 1,000 parts per million of both these salts tend to have a laxative effect when drunk by persons unaccustomed to highly mineralized waters, although waters containing concentrations of nearly twice this amount are in many places in different parts of the province used for drinking without imparting any noticeable ill effects. Stock are less affected by these salts, and have been reported to thrive on waters that are unfit for human consumption.

The four analyses listed, of waters from wells in the village of Hatton, are very similar as to the relative amounts of individual constituents and their total dissolved solids. Although the amounts of the individual salts are not known, it is doubtful if sodium sulphate, the salt present in the greatest concentration, occurs in sufficient quantity to be harmful. The hardness of these waters is probably due largely to the presence of the sulphates of calcium and magnesium.

Water from the Bedrock

No wells in the municipality are known to yield water from the Bearpaw formation. Such waters as may occur in these shales are expected to contain relatively large amounts of the laxative acting sulphate salts, rendering them unfit for human consumption.

Water from the Belly River formation is usually of much better quality than that from the Bearpaw, and it may also be superior to most of the glacial drift waters. A well drilled in this formation in the municipality of Maple Creek, bordering this municipality on the east, produces water containing a total of only 260 parts per million of dissolved solids, composed chiefly of the harmless carbonates. Although these waters may be more highly mineralized at some places it is doubtful if they will be found to be unsuitable for domestic use.

WELL RECORDS—Rural Municipality of NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NE.	3	10	28	3	Dug	8	2,910	- 6	2,904	6	2,904	Recent silt	Hard, clear	48	D, S	Sufficient for local needs; also a dam for stock needs.
2	SW.	4	"	"	"	Bored	152	3,085									Dry hole in Bearpaw shale.
3	NE.	5	"	"	"	Drilled	285	3,090									Dry hole in Bearpaw shale.
4	NE.	5	"	"	"	Dug	40	3,085									One of seven dry holes in glacial drift.
5	SW.	6	"	"	"	Dug	18	3,000	- 10	2,990			Glacial drift	Hard, clear, "alkaline"	48	S	Intermittent supply; another well 16 feet deep is used for domestic needs.
6	NW.	7	"	"	"	Dug	11	2,910	- 7	2,903	10	2,900	Glacial sand and gravel	Hard, clear, "alkaline"	48	D, S	Sufficient for local needs; also a 12-foot dry hole.
7	SE.	9	"	"	"	Dug	16	2,915	- 8	2,907			Glacial drift	Hard, clear, iron	47	D	Sufficient for domestic needs; also another well 12 feet deep for stock.
8	NE.	10	"	"	"	Dug	20	2,890	- 10	2,880			Glacial drift	Hard, clear, "alkaline", iron	47	D, S	Insufficient supply; also a 16-foot well with fair supply.
9	NE.	11	"	"	"	Dug	17	2,893	- 11	2,882			Glacial drift	Hard, clear, "alkaline"	40	S	Intermittent supply; also two other similar wells.
10	NE.	12	"	"	"	Dug	30	2,895	- 28	2,867	28	2,867	Glacial sand	Hard, clear, "alkaline"	47	D	Intermittent supply.
11	NE.	12	"	"	"	Dug	16	2,885	- 12	2,873			Glacial drift	Hard, clear, "alkaline"	46	S	Sufficient for local needs.
12	SE.	13	"	"	"	Dug	12	2,850	- 5	2,845			Glacial drift	Hard, clear, "alkaline"	46	S	Insufficient for local needs.
13	SE.	13	"	"	"	Dug	21	2,830	- 18	2,812	18	2,812	Glacial sand	Hard, clear, "alkaline"	46	D	Intermittent supply.
14	NW.	13	"	"	"	Dug	20	2,795	- 16	2,779	19	2,776	Glacial sand	Soft, clear		D, S	Sufficient supply; also a dry hole 28 feet deep.
15	SW.	14	"	"	"	Dug	12	2,880	- 9	2,871	9	2,871	Recent sand and gravel	Hard, clear	46	D	Insufficient supply.
16	SW.	14	"	"	"	Dug	10	2,884	- 5	2,879	9	2,875	Glacial gravel	Hard, clear, "alkaline"	46	S	Sufficient for local needs.
17	NE.	14	"	"	"	Dug	20	2,835	- 14	2,821	14	2,821	Recent sand and gravel	Soft, clear	46	D, S	Sufficient for local needs.
18	NE.	15	"	"	"	Dug	20	2,880	- 17	2,863	17	2,863	Glacial gravel	Hard, clear, "alkaline"	47	D, S	Sufficient for local needs.
19	SW.	16	"	"	"	Dug	11	2,925	- 6	2,919	6	2,919	Recent gravel	Hard, clear, "alkaline"	48	D, S	Sufficient supply; also a dry hole 11 feet deep.
20	NE.	16	"	"	"	Dug	9	2,900	0	2,900			Glacial drift	Hard, clear, "alkaline"	48	D, S	Intermittent supply; also an 11-foot well that is not used.
21	SE.	17	"	"	"	Dug	18	3,090	- 14	3,076	14	3,076	Glacial gravel	Hard, clear, iron	47	D, S	Sufficient for local needs.
22	NW.	18	"	"	"	Dug	12	2,900	- 8	2,892	8	2,892	Recent gravel	Hard, clear, "alkaline"	48	N	Sufficient supply, but not in use; also another similar well.
23	NW.	19	"	"	"	Dug	16	2,900	- 13	2,887		2,887	Glacial sand and gravel	Hard, clear	48	D	Sufficient for local needs.
24	NW.	19	"	"	"	Bored	66	2,900	- 36	2,864			Glacial drift	Hard, clear, "alkaline", iron	45	S	Sufficient supply; also fifteen dry holes 15 to 35 feet deep.
25	SE.	21	"	"	"	Dug	12	2,850					Glacial drift	Hard			Very little water.
26	SE.	22	"	"	"	Bored	52	2,820	- 36	2,784	50	2,770	Glacial gravel	Hard, clear, "alkaline"	46	D, S	Sufficient supply; also a 70-foot well with a poor 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 NO. 112, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
27	NW.	22	10	28	3	Dug	14	2,825	- 12	2,813	12	2,813	Glacial gravel	Hard, clear		S	Insufficient supply; also three other similar wells.
28	SE.	23	"	"	"	Dug	21	2,770	- 18	2,752	19	2,751	Glacial sand	Soft, clear	48	D, S	Sufficient for local needs.
29	NE.	23	"	"	"	Dug	20	2,780	- 15	2,765	15	2,765	Glacial sand	Soft, clear	47	D, S	Sufficient supply; another well 34 feet deep with poor supply.
30	SE.	24	"	"	"	Dug	20	2,885	- 16	2,869	16	2,869	Glacial sand	Hard, clear	47	D, S	Sufficient for local needs.
31	NW.	25	"	"	"	Dug	10	2,800	- 5	2,795	7	2,793	Glacial sand	Soft, iron, yellow	47	D, S	Sufficient for local needs.
32	SE.	27	"	"	"	Dug	28	2,770	- 22	2,748	22	2,748	Glacial sand	Soft, clear	47	D, S	Sufficient for local needs.
33	SE.	28	"	"	"	Dug	16	2,770	0	2,770	15	2,755	Recent gravel	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
34	SW.	28	"	"	"	Dug	10	2,840	- 7	2,833	7	2,833	Recent sand	Hard, clear, "alkaline"		S	Insufficient for local needs.
35	NE.	28	"	"	"	Dug	11	2,790	0	2,790			Glacial drift	Hard, clear, "alkaline"		S	Intermittent supply.
36	SW.	32	"	"	"	Bored	68	2,775	- 45	2,730	60	2,715	Glacial sand	Hard, clear, "alkaline"	46	D, S	Sufficient for local needs; two other wells 15 and 25 feet deep.
37	NE.	33	"	"	"	Dug	26	2,820					Glacial drift	Hard, clear	46	D, S	Sufficient for local needs.
38	NE.	33	"	"	"	Dug	26	2,850	- 22	2,828			Glacial drift	Hard, clear	46	S	Sufficient for local needs.
39	NE.	34	"	"	"	Dug	18	2,800	- 15	2,785	15	2,785	Glacial sand	Hard, clear	46	D, S	Sufficient forlocal needs.
40	SW.	35	"	"	"	Drilled	52	2,825	- 49	2,776	51	2,774	Glacial gravel	Hard, clear, "alkaline"	47	D, S	Insufficient for local needs.
41	NW.	35	"	"	"	Bored	50	2,740	- 21	2,719	47	2,693	Glacial gravel	Hard, clear, "alkaline"	45	S	Sufficient supply; also two other wells 15 feet deep.
42	SE.	36	"	"	"	Dug	8	2,735	- 3	2,732	3	2,732	Glacial sandy loam	Hard, clear	47	D, S	Insufficient for local needs.
43	NE.	36	"	"	"	Dug	14	2,740	- 9	2,731			Glacial drift	Hard, clear, "alkaline"	47	S	Insufficient for local needs.
1	NE.	1	10	29	3	Dug	10	2,985	- 5	2,980			Glacial drift	Hard, clear, "alkaline"	50	D	Insufficient for local needs.
2	SW.	1	"	"	"	Dug	15	3,045	- 7	3,038			Glacial drift	Hard, clear, "alkaline"	46	S	Intermittent supply; also use a dam for stock; haul drinking water.
3	NE.	2	"	"	"	Dug	18	3,090	0	3,090			Glacial drift	Hard, clear, "alkaline"	46	D, S	Insufficient for local needs.
4	NW.	2	"	"	"	Dug	25	3,140	- 0	3,140			Glacial drift	Hard, clear	45	D, S	Intermittent supply; another similar well 14 feet deep; a dam is used for stock.
5	SE.	4	"	"	"	Dug	8	3,150	- 5	3,145			Glacial drift	Hard, clear, "alkaline"	46	D	Sufficient supply; a dam is used for stock needs.
6	NE.	4	"	"	"	Dug	12	3,160	0	3,160			Glacial drift	Hard, clear, "alkaline"	46	D	Intermittent supply.
7	NW.	4	"	"	"	Dug	12	3,045	- 9	3,036	9	3,036	Recent sand	Hard, clear, "alkaline"	47	D	Sufficient for local needs.
8	SW.	4	"	"	"	Dug	19	3,050	- 16	3,034			Glacial drift	Hard, clear, "alkaline"	46	D	Sufficient supply; a creek is used for stock needs.
9	SW.	4	"	"	"	Drilled	300	3,050									Dry hole in Bearpaw; drilling was for oil.

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 NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface	HEIGHT TO WHICH WATER WILL RISE: Elev.	PRINCIPAL WATER-BEARING BED: Depth	PRINCIPAL WATER-BEARING BED: Elev.	PRINCIPAL WATER-BEARING BED: Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
10	NE.	6	10	29	3	Dug	20	3,140	- 10	3,130			Glacial drift	Hard, clear, "alkaline"	46	D, S	Sufficient supply; a dam is also used for stock.
11	NW.	6	"	"	"	Dug	20	3,175	- 14	3,161			Glacial drift	Hard, clear, "alkaline", iron	47	D	Insufficient supply; also dry holes 12 to 14 feet deep; a dam is used for stock.
12		6	"	"	"	Dug	12	3,050	- 10	3,040			Glacial drift	Hard, clear, "alkaline"		D	
13	NE.	7	"	"	"	Dug	10	2,950	- 2	2,948			Glacial drift	Hard, clear, "alkaline"	50	D	Sufficient supply; a dam and a creek are used for stock needs.
14	SE.	8	"	"	"	Dug	10	2,980	- 5	2,975	5	2,975	Recent gravel	Hard, clear, "alkaline"	50	D, S	Intermittent supply; a creek is also used for stock needs.
15	NW.	12	"	"	"	Dug	17	2,975	- 7	2,968			Glacial drift	Hard, clear, "alkaline"	48	S	Sufficient supply; also another similar well.
16	SW.	13	"	"	"	Dug	16	2,975	- 6	2,969			Glacial drift	Hard, clear, "alkaline"	49	D	Sufficient supply; another similar well; also a dam for stock needs.
17	SW.	18	"	"	"	Dug	23	2,900	- 7	2,893	22	2,878	Recent gravel	Soft, clear	48	D	Sufficient supply; also several wells 5 to 7 feet deep for stock needs.
18	NE.	21	"	"	"	Dug	14	3,050	- 10	3,040	10	3,040	Glacial sand	Hard, clear, "alkaline"	48	D, S	Insufficient supply; also a similar well 10 feet deep and a dam for stock.
19	NW.	22	"	"	"	Dug	9	3,075	- 5	3,070	8	3,067	Glacial sand	Soft, clear		D	Sufficient supply; a dam is used for stock needs.
20	SW.	24	"	"	"	Dug	27	3,000	- 12	2,988			Glacial drift	Soft, clear	46	D, S	Insufficient supply; a dam is used for stock needs.
21	NE.	24	"	"	"	Bored	53	2,975	- 33	2,942	50	2,925	Glacial sand	Hard, clear, "alkaline"	46	D, S	Sufficient supply; also another well with poor supply.
22	SW.	27	"	"	"	Dug	8	2,980	- 0	2,980	0	2,980	Recent sand	Soft, clear	50	D, S	Sufficient supply; also a dam for stock; many farmers obtain water from here.
23	NE.	28	"	"	"	Bored	75	3,050	- 67	2,983			Glacial drift	Hard, clear, "alkaline"	46	S	Intermittent supply.
24	NW.	28	"	"	"	Dug	22	2,990	- 18	2,972	18	2,972	Glacial sand and gravel	Soft, clear	47	D	Sufficient supply; a dam is used for stock needs.
25		30	"	"	"	Dug	47	2,900	- 2	2,898			Glacial drift	Hard, iron, "alkaline"		D	
26	SW.	30	"	"	"	Dug	11	2,800	- 5	2,795	5	2,795	Recent gravel	Hard, clear, "alkaline"	48	D, S	Sufficient supply; also a dam and a creek for stock needs.
27	NE.	34	"	"	"	Dug	24	2,950	- 14	2,936			Glacial drift	Hard, clear, "alkaline"	48	D	Sufficient supply; a dam is used for stock needs.
1	NE.	1	10	30	3	Dug	7	3,220	- 4	3,216	4	3,216	Recent sand	Soft, clear	48	D, S	Insufficient for local needs.
2	SW.	2	"	"	"	Dug	5	3,300	0	3,300	0	3,300	Bearpaw shale	Hard, clear, "alkaline"	46	D, S	Sufficient supply; also five springs with an intermittent supply.
3	NE.	2	"	"	"	Dug	18	3,320	0	3,320			Glacial drift	Hard, clear, "alkaline"		D	Sufficient supply; a dam is used for stock needs.
4	NW.	11	"	"	"	Dug	5	3,100	- 1	3,099			Glacial drift	Soft, clear	50	D, S	Sufficient for local needs.
5	SE.	12	"	"	"	Dug	13	3,190	- 4	3,186			Glacial drift	Hard, clear, "alkaline"	48	D, S	Insufficient for local needs.
6	NW.	12	"	"	"	Dug	30	3,200	- 28	3,172	28	3,172	Glacial gravel	Hard, clear, "alkaline"	48	D, S	Insufficient supply; also a 22-foot well and a 69-foot well that is unfit for use.
7	SE.	14	"	"	"	Bored	45	3,100	- 15	3,085			Glacial drift	Hard, clear, "alkaline", iron		N	Unfit for use; two dams are used for stock needs.
8	NW.	15	"	"	"	Dug	26	3,030									Dry hole in glacial blue clay.

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 NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
9	SE.	22	10	30	3	Dug	25	2,980	- 22	2,958			Bearpaw shale	Hard, clear, "alkaline"	48	D	Intermittent supply; a dam is used for stock needs.
10	SW.	24	"	"	"	Dug	14	2,970	- 6	2,964			Glacial drift	Soft, clear	52	D	Intermittent supply; a dam is used for stock needs.
11	NW.	24	"	"	"	Drilled	276	2,935									Dry hole in Bearpaw shale.
12	SW.	25	"	"	"	Dug	12	2,920	0	2,920	10	2,910	Glacial sand	Soft, clear	50	D	Intermittent supply; a dam is used for stock needs.
13	SW.	27	"	"	"	Dug	9	2,925	- 6	2,919	6	2,919	Recent gravel	Hard, clear	48	D, S	Sufficient supply; another well that is unfit for use.
14	SE.	34	"	"	"	Dug	18	2,785	- 12	2,773			Glacial drift	Hard, clear	50	D, S	Sufficient for local needs.
15	NE.	35	"	"	"	Dug	5	2,770	0	2,770	0	2,770	Recent gravel	Hard, clear, "alkaline"	48	D, S	Sufficient supply; also another similar well.
1	SE.	1	11	28	3	Dug	22	2,740	- 18	2,722	18	2,722	Glacial gravel	Hard, clear, "alkaline"	46	D	Sufficient supply; also a spring on farm.
2	SE.	1	"	"	"	Dug	12	2,730	- 4	2,726	4	2,726	Glacial gravel	Hard, clear, "alkaline"	52	S	Sufficient for local needs.
3	NW.	1	"	"	"	Dug	2	2,660	- 0	2,680	0	2,680	Glacial sand	Soft, clear	57	D, S	Sufficient supply; also another similar spring.
4	NW.	2	"	"	"	Dug	8	2,770	0	2,770	0	2,770	Glacial sand	Hard, clear	49	D, S	Sufficient for 50 head stock; also another similar spring.
5	NW.	4	"	"	"	Spring		2,740	0	2,740	0	2,740	Glacial gravel	Hard, clear, iron		S	Sufficient for local needs.
6	SE.	5	"	"	"	Spring	3	2,730	0	2,730	0	2,730	Glacial gravel	Hard, clear, iron	48	D, S	Sufficient supply; two other similar springs.
7	NE.	5	"	"	"	Spring		2,730	0	2,730	0	2,730	Glacial drift	Hard, clear, iron		S	Sufficient supply.
8	NE.	7	"	"	"	Spring							Glacial drift	Hard, clear, iron		D, S	Sufficient for local needs.
9	SE.	8	"	"	"	Spring							Glacial drift	Hard, clear, iron		D, S	Sufficient supply.
10	NW.	12	"	"	"	Dug	15	2,700					Glacial drift	Soft		D, S	
11	SW.	13	"	"	"	Dug	13	2,690	- 10	2,680	12	2,678	Glacial sand	Soft, clear	46	D, S	Sufficient supply; also one dry hole.
12	NE.	13	"	"	"	Dug	16	2,685	- 13	2,672	13	2,672	Glacial sand	Hard, clear	48	D, S	Sufficient supply; also three dry holes 14 to 20 feet deep.
13	SW.	14	"	"	"	Bored	30	2,720	- 27	2,693	27	2,693	Glacial sand	Hard, clear, "alkaline"	45	D, S	Sufficient supply; also three dry holes from 20 to 46 feet deep.
14	NE.	14	"	"	"	Dug	16	2,730	- 10	2,720			Glacial sand and gravel	Hard, clear	46	S	Sufficient for local needs.
15	NW.	14	"	"	"	Bored	52	2,730	- 40	2,690			Glacial drift	Hard, clear, "alkaline", iron	46	S	Sufficient for local needs.
16	SW.	16	"	"	"	Bored	118	2,790	- 90	2,700	118	2,672	Glacial sand	Hard, clear, "alkaline", iron	44	D, S	Sufficient supply; also thirty-two dry holes 18 to 120 feet deep; and a dam for stock needs.
17	SE.	17	"	"	"	Bored	64	2,735	- 61	2,674	61	2,674	Glacial gravel	Hard, clear, iron	46	D, S	Sufficient supply; also three dry holes 14, 28, and 50 feet deep.
18	SW.	17	"	"	"	Dug	34	2,680	- 14	2,666			Glacial drift	Soft, clear		S	Sufficient for local needs.
19	NE.	17	"	"	"	Bored	70	2,685	- 49	2,636			Glacial drift	Soft, clear		D, S	Sufficient for local needs.

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 NO. 112, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface	HEIGHT TO WHICH WATER WILL RISE: 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	SW.	19	11	28	3	Spring	3	2,595	0	2,595	0	2,595	Glacial drift	Hard, clear, "alkaline", iron	46	D, S	Sufficient supply; yields one gallon a minute.
21	NE.	19	"	"	"	Spring		2,650	0	2,650	0	2,650	Glacial drift	Hard, clear, "alkaline", iron		S	Sufficient supply; also two other similar springs.
22	NW.	19	"	"	"	Dug	4	2,592	0	2,592			Glacial drift	Hard, clear, "alkaline", iron		S	Sufficient for local needs.
23	NW.	20	"	"	"	Dug	11	2,600	- 7	2,593			Glacial drift	Hard, clear, "alkaline"	50	D, S	Sufficient supply; also a dam for stock needs.
24	NW.	20	"	"	"	Dug	6	2,600	- 3	2,597			Glacial drift	Hard, clear, "alkaline"	51	D, S	Sufficient for local needs.
25	NE.	20	"	"	"	Bored	73	2,680	- 30	2,650			Glacial drift	Hard, clear, "alkaline", iron	45	D, S	Sufficient supply; also a 130-foot dry hole; and a dam for stock needs.
26	NW.	21	"	"	"	Bored	74	2,735	- 50	2,685	72	2,663	Glacial sand	Soft, clear		S	Sufficient supply; also a 30-foot dry hole.
27	SE.	22	"	"	"	Dug	21	2,725	- 17	2,708	17	2,708	Glacial sand	Soft, clear	48	D, S	Sufficient for local needs.
28	NE.	22	"	"	"	Dug	26	2,730	- 20	2,710			Glacial gravel	Hard, clear, iron, sulphur, "alkaline"	48	D, S	Sufficient supply; also a 20-foot dry hole.
29	NW.	22	"	"	"	Dug	40	2,735	- 37	2,698	37	2,698	Glacial gravel	Soft, clear	46	D, S	Intermittent supply.
30	SW.	23	"	"	"	Dug	12	2,740	- 6	2,734	6	2,734	Glacial gravel	Soft, clear	48	D, S	Sufficient for local needs.
31	NE.	24	"	"	"	Dug	36	2,630	- 30	2,600	30	2,600	Glacial sand	Hard, clear	46	D, S	Sufficient supply; also two other wells 33 and 20 feet deep; very poor supply and unfit for use.
32	SW.	27	"	"	"	Dug	22	2,740									Dry hole in glacial gravel.
33	SW.	27	"	"	"	Dug	32	2,700	- 29	2,671	29	2,671	Glacial gravel	Soft, clear, iron	48	D, S	Sufficient for local needs.
34	SE.	28	"	"	"	Dug	20	2,680	- 14	2,666	18	2,662	Glacial gravel	Soft, clear, iron	48	D, S	Sufficient supply; also a 20-foot dry hole.
35	SW.	28	"	"	"	Dug	16	2,680	- 13	2,667	13	2,667	Glacial sand	Soft, clear, iron		D, S	Sufficient for local needs.
36	NE.	29	"	"	"	Dug	20	2,630	- 7	2,623	7	2,623	Glacial sandy clay	Hard, clear, "alkaline"	46	D, S	Insufficient for local needs.
37	SE.	30	"	"	"	Bored	120	2,615	- 84	2,531			Glacial drift	Hard, clear, "alkaline", iron		D, S	Insufficient supply; also a 115-foot dry hole.
38	NW.	30	"	"	"	Dug	26	2,625	0	2,625			Glacial drift	Hard, clear, "alkaline", iron	46	N	Insufficient supply.
39	SW.	31	"	"	"	Dug	18	2,638	- 8	2,630			Glacial drift	Hard, clear	43	S	Intermittent supply.
40	SW.	31	"	"	"	Dug	18	2,620	- 12	2,608			Glacial drift	Hard, clear, "alkaline"	44	S	Intermittent supply.
41	SW.	31	"	"	"	Dug	30	2,625	- 26	2,599	28	2,597	Glacial sand	Hard, clear	43	D	Intermittent supply.
42	NE.	31	"	"	"	Bored	28	2,645	- 14	2,631			Glacial drift	Hard, clear	45	S	Insufficient for local needs.

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 NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
43	NE.	32	11	28	3	Dug	20	2,580	− 4	2,576	20	2,560	Glacial sand, and gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
44	NE.	32	"	"	"	Dug	18	2,592	− 13	2,579	13	2,579	Glacial sand and gravel	Hard, clear, "alkaline"	47	D	Insufficient supply; also another similar well.
45	NE.	34	"	"	"	Dug	10	2,540	− 7	2,533	7	2,533	Glacial sand and gravel	Hard, clear, "alkaline", iron	48	D, S	Intermittent supply; also two other similar wells 20 feet deep.
46	SE.	35	"	"	"	Dug	16	2,560	− 10	2,550	10	2,550	Glacial sand	Hard, clear, "alkaline"	47	D, S	Insufficient supply; also another well 10 feet deep.
47	NW.	35	"	"	"	Dug	8	2,570	− 2	2,568	2	2,568	Glacial sand	Hard, iron, yellow	48	N	Sufficient supply.
48	NW.	36	"	"	"	Bored	14	2,560	− 10	2,550	10	2,550	Glacial sand	Hard, clear, "alkaline"	48	D, S	Sufficient for local needs.
1	SW.	1	11	29	3	Dug	10	2,880	− 3	2,877			Glacial drift	Hard, clear, "alkaline", iron	48	D, S	Sufficient supply; also a dam on farm.
2	SW.	1	"	"	"	Dug	20	2,885	− 12	2,873	20	2,865	Glacial sand	Hard, yellow, "alkaline", iron	48	D, S	Sufficient for local needs.
3	SW.	2	"	"	"	Dug	18	2,942	− 5	2,937	16	2,926	Glacial gravel	Hard, clear	48	D, S	Sufficient supply; also three dry holes to a depth of 20 feet; also a dam on farm.
4	SW.	5	"	"	"	Dug	7	2,720	0	2,720	0	2,720	Recent gravel	Soft, clear, soda	52	D, S	Sufficient for 100 head stock.
5	NE.	7	"	"	"	Spring		2,560	0	2,560	0	2,560	Recent sand and gravel	Hard, clear	45	S	Spring used only during winter.
6	NW.	10	"	"	"	Dug	14	2,735	− 2	2,733	2	2,733	Glacial gravel	Hard, clear, "alkaline"	58	D, S, I	Intermittent supply; also a dam on farm.
7	NE.	18	"	"	"	Dug	16	2,550	− 10	2,540	10	2,540	Recent sand	Hard, clear, iron	42	D, S	Sufficient for 3,000 head sheep.
8		21	"	"	"	Drilled	2095	2,500					Base in Alberta shale	Hard		N	
9	SW.	24	"	"	"	Dug	16	2,635	− 11	2,624	11	2,624	Glacial sand	Hard, clear, "alkaline"	46	D, S	Intermittent supply; also eight dry holes 18 to 25 feet deep.
10	SW.	24	"	"	"	Dug	15	2,650	− 5	2,645			Glacial drift	Hard, clear, "alkaline"	46	D, S	Intermittent supply.
1	SE.	11	11	30	3	Dug	16	2,625	− 12	2,613			Glacial drift	Hard, clear	46	S	Sufficient for local needs.
2	NE.	12	"	"	"	Bored	37	2,575	− 7	2,568	17	2,558	Glacial sand	Hard, clear	46	D, S	Insufficient supply; also a 53-foot dry hole and a dam on farm.
3	SW.	24	"	"	"	Dug	40	2,530	− 37	2,493	37	2,493	Glacial gravel	Soft, clear	42	D, S	Sufficient for local needs.
4	NW.	24	"	"	"	Dug	9	2,450	− 3	2,447	7	2,443	Glacial gravel	Soft, clear	48	S, I	Sufficient for local needs.
5	SW.	36	"	"	"	Dug	43	2,440	− 33	2,407	33	2,407	Glacial sand	Hard, iron, "alkaline", cloudy	44	D, S	Sufficient supply; also used creek for stock uses.
1	NW.	2	12	28	3	Dug	14	2,540	− 10	2,530			Glacial drift	Hard, clear, "alkaline"	48	S	Sufficient for local needs.
2	NW.	3	"	"	"	Dug	12	2,538	− 11	2,527	11	2,527	Glacial gravel	Hard, clear	48	D, S	Sufficient for local needs.
3	NW.	4	"	"	"	Spring		2,590	0	2,590	0	2,590	Glacial gravel	Soft, clear	50	D, S	Intermittent supply.
4	SW.	5	"	"	"	Dug	7	2,685	− 4	2,681	4	2,681	Glacial gravel	Soft, clear	48	D	Insufficient supply; also a spring and a 25-foot dry hole.

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 NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (—) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
5	NE.	6	12	28	3	Dug	8	2,680	0	2,680	4	2,676	Glacial gravel	Soft, clear	48	S	Insufficient for local needs.
6	NE.	9	"	"	"	Bored	45	2,638					Glacial gravel	Hard, clear	46	D, S	Sufficient supply; well is not used now.
7	NE.	10	"	"	"	Dug	23	2,558					Glacial drift	Hard, clear, "alkaline"	48	D	Sufficient for local needs.
8	NW.	11	"	"	"	Dug	15	2,538					Glacial drift	Hard, clear, "alkaline"	48	D	Sufficient for local needs.
9	NW.	12	"	"	"	Dug	12	2,535	- 10	2,525	10	2,525	Glacial sandy clay	Hard, clear, "alkaline"	48	D, S	Sufficient for local needs.
10		13	"	"	"	Spring							Glacial gravel	Soft, clear		S	Sufficient supply.
11	NW.	14	"	"	"	Dug	10	2,530	- 7	2,523			Glacial drift	Hard, clear	48	D, S	Sufficient for local needs.
12	SW.	14	"	"	"	Dug	20	2,555	- 19	2,530			Glacial drift	Hard, clear, "alkaline"	47	D	Intermittent supply.
13	SW.	14	"	"	"	Dug	15	2,540	- 12	2,528	12	2,528	Glacial sand and gravel	Hard, clear, "alkaline"	48	D	Sufficient supply; another similar well and a dry hole 30 feet deep.
14	SW.	14	"	"	"	Dug	14	2,550	- 12	2,538	12	2,538	Glacial gravel	Hard, clear, "alkaline"	50	D	Sufficient for local needs.
15	SE.	15	"	"	"	Dug	12	2,590	- 7	2,583			Glacial drift	Hard, iron, yellow	46	D, S	Sufficient for local needs.
16	NE.	15	"	"	"	Dug	12	2,539	0	2,539	8	2,531	Glacial sand	Hard, clear, "alkaline"	48	S	Sufficient for local needs.
17	NE.	15	"	"	"	Dug	15	2,542	- 9	2,533	11	2,531	Glacial sand	Hard, clear	48	D, S	Intermittent supply; also a spring on farm.
18	SE.	16	"	"	"	Bored	80	2,650	- 75	2,575			Glacial drift	Hard, iron, "alkaline", yellow	45	S	Sufficient supply; also two dry holes 30 and 20 feet deep.
19	NE.	16	"	"	"	Dug	20	2,625	- 16	2,609	16	2,609	Glacial sand	Soft, clear	46	D, S	Sufficient for local needs.
20	SW.	17	"	"	"	Dug	17	2,680	- 10	2,670			Glacial drift	Soft, clear		D, S	Intermittent supply; also several dry holes 15 to 22 feet deep.
21	NE.	18	"	"	"	Dug	30	2,735	- 20	2,715	20	2,715	Glacial gravel	Hard, clear, "alkaline"	46	D, S	Sufficient supply.
22	NE.	21	"	"	"	Dug	10	2,500	- 6	2,494	6	2,494	Glacial gravel	Hard, clear, "alkaline"	48	D, S	Sufficient for local needs.
23	SW.	22	"	"	"	Bored	50	2,545	- 15	2,530	15	2,530	Glacial gravel	Hard, clear	46	D, S	Sufficient supply; also a spring for stock needs.
24	NE.	23	"	"	"	Dug	8	2,486	0	2,486	0	2,486	Glacial sand	Soft, clear	45	S	Sufficient for local needs.
25	NE.	24	"	"	"	Dug	8	2,437	- 2	2,435	- 2	2,435	Glacial sand	Hard, clear, iron	45	S	Sufficient for local needs.
26	NE.	24	"	"	"	Dug	20	2,440	- 12	2,428	12	2,428	Glacial gravel	Hard, clear, sulphur, iron	46	D, S	Sufficient for local needs.
27	NE.	27	"	"	"	Dug	16	2,490	- 14	2,476			Glacial drift	Hard, clear	50	N	
28	NW.	27	"	"	"	Dug	5	2,488	0	2,488	0	2,488	Glacial sand	Soft, clear, "alkaline"	54	D, S	Sufficient for local needs.
29	SW.	28	"	"	"	Dug	10	2,480	- 8	2,472	8	2,472	Glacial gravel	Soft, clear, iron	52	D, S	Sufficient supply; also a 20-foot dry hole.
30	NW.	30	"	"	"	Dug	15	2,485	0	2,485			Glacial sand	Hard, clear	48	D, S	Sufficient for local needs.
31	NW.	31	"	"	"	Dug	30	2,460	- 25	2,435	25	2,435	Glacial sand	Hard, clear	46	D, S	Sufficient for local needs.

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 NO. 112, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	HEIGHT TO WHICH WATER WILL RISE Elev.	PRINCIPAL WATER-BEARING BED Depth	PRINCIPAL WATER-BEARING BED Elev.	PRINCIPAL WATER-BEARING BED Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
32	NW.	31	12	28	3	Dug	30	2,489	- 26	2,463	26	2,463	Glacial sand	Hard, clear, "alkaline"	46	S	Intermittent supply.
33	SE.	34	"	"	"	Dug	12	2,485	- 10	2,475			Glacial drift	Hard, clear	48	S	Sufficient for local needs.
34	NE.	35	"	"	"	Dug	10	2,480	- 4	2,476			Glacial drift	Soft, clear	48	N	
35	NW.	35	"	"	"	Dug	14	2,465					Glacial drift	Hard, clear	48	N	Insufficient supply.
1	NE.	2	12	29	3	Bored	42	2,710	- 20	2,690			Glacial drift	Hard, clear, "alkaline"	44	D, S	Sufficient supply; also two dry holes.
2	NW.	3	"	"	"	Spring	4	2,590	0	2,590	0	2,590	Glacial drift	Soft, clear, "alkaline"	45	S	Sufficient for local needs.
3	SW.	5	"	"	"	Dug	30	2,500	- 20	2,480			Glacial drift	Hard, clear	44	D, S	Sufficient supply; also one dry hole.
4	SW.	7	"	"	"	Dug	25	2,430	- 20	2,410	23	2,407	Glacial sand	Hard, clear, "alkaline", iron	45	D, S	Sufficient for local needs.
5	NW.	9	"	"	"	Dug	12	2,425	- 8	2,417			Glacial drift	Hard, clear, "alkaline"	45	S	Insufficient supply; also another well with mineralized water.
6	SW.	12	"	"	"	Dug	16	2,680	- 11	2,669	11	2,669	Glacial sand	Hard, clear	46	D, S	Sufficient for local needs.
7	NE.	12	"	"	"	Dug	20	2,780	- 23	2,757			Glacial drift	Hard, clear	48	N	Well partly caved in.
8	NE.	15	"	"	"	Spring	1	2,543	0	2,543	0	2,543	Glacial sand	Hard, clear	52	D, S	Insufficient for local needs.
9	NW.	17	"	"	"	Dug	5	2,438									Dry hole in glacial drift.
10	NE.	21	"	"	"	Bored	15	2,405	- 5	2,400			Glacial drift	Hard, clear, "alkaline"	48	N	Sufficient supply.
11	NW.	22	"	"	"	Dug	8	2,475									Dry hole in glacial drift.
12	SE.	25	"	"	"	Dug	22	2,587	- 14	2,573	14	2,573	Glacial sand	Soft, clear		S	Sufficient supply; also another well 16 feet deep.
13	NW.	25	"	"	"	Dug	26	2,535	- 25	2,510	25	2,510	Glacial sand	Soft, clear	44	D, S	Insufficient for local needs.
14	SW.	26	"	"	"	Spring	4	2,510	0	2,510	0	2,510	Glacial sand	Hard, clear	44	S	Sufficient for 900 head sheep.
15	NW.	31	"	"	"	Spring	2	2,395	0	2,395	0	2,395	Glacial sand	Hard, clear	52	S	Sufficient supply; also a 10-foot dry hole.
16	NE.	34	"	"	"	Dug	28	2,430	- 24	2,406	24	2,406	Glacial sand	Hard, clear, "alkaline"	46	D, S	Sufficient for local needs.
17	SE.	35	"	"	"	Dug	15	2,495	- 9	2,486	9	2,486	Glacial sand	Soft, clear	48	D, S	Intermittent supply; also two other similar wells.
18	NW.	36	"	"	"	Dug	20	2,460									Dry hole in glacial sand.
19	NE.	36	"	"	"	Dug	30	2,460	- 28	2,432	28	2,432	Glacial drift	Hard, clear, "alkaline"	46	S	Sufficient supply; also another similar well.
20	NE.	36	"	"	"	Bored	48	2,464	- 44	2,420			Glacial drift	Hard, clear, "alkaline"	44	D	Sufficient for local needs; #.
21	NE.	36	"	"	"	Bored	60	2,462	- 54	2,408			Glacial drift	Hard, clear, "alkaline"	44	D	Sufficient supply; #. Also another similar well, depth 56 feet deep; #.
22		36	"	"	"		50	2,462	- 50	2,412			Glacial sand and gravel	Hard, clear			#.
1	NE.	2	12	30	3	Dug	20	2,420	- 10	2,410			Glacial drift	Hard, clear	46	D, S	Sufficient for local needs.
2	SW.	12	"	"	"	Dug	25	2,410	- 15	2,395			Glacial drift	Hard, iron, yellow	46	D, S	Sufficient supply; also a dam with an intermittent supply.
3	SW.	23	"	"	"	Spring	2	2,450					Glacial sand	Soft, clear, iron		D, S	Sufficient supply; another similar spring; and two dry holes 15 feet deep.

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.