CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 240

# GROUND-WATER RESOURCES
# OF THE
# RURAL MUNICIPALITY
# OF BUFFALO, NO. 409
# SASKATCHEWAN

Records collected by C. O. Hage
Compilation by G. S. Hume and C. O. Hage

OTTAWA

1947

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DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH
BUREAU OF GEOLOGY AND TOPOGRAPHY

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INTRODUCTION

Information on the ground-water resources of east-central
Alberta and western Saskatchewan was collected, mostly in 1935, during
the progress of geological investigations for oil and gas. The region
studied extends from Edmonton in the west to Battleford in the east,
and from township 32 on the south to township 59 in western Alberta,
township 63 in eastern Alberta, and in part as far north as township
56 in western Saskatchewan.

This region is crossed by North Saskatchewan and Battle
Rivers, and includes other more or less permanent streams. Most of
the lakes within the area, however, are alkaline, and water is
obtained in wells from two sources, namely, from water-bearing sands
in surface or glacial deposits, and from sands in the underlying bedrock.

A division has been made in the well records, in so far as
possible, between glacial and bedrock water-bearing sands. In
investigations for oil and gas, however, the bedrock wells were used to
trace the lateral extent of geological formations, with the result that
the records deal more particularly with this type of well. No detailed
studies were made of the glacial materials in relation to the water-supply,
nor were the glacial deposits mapped adequately for this purpose. In
almost all of the region investigated in Alberta, and in all but the
northeast part of the region studied in Saskatchewan, water can be
obtained from bedrock. In a few places, however, the water from the
shallower bedrock sands is unsatisfactory, and deeper drilling may be
necessary.

The water records were obtained mostly from the well owners,
some of whom had acquired the land after the water supply had been found,
and hence had no personal knowledge of the water-bearing beds that had
been encountered in their wells. Also the elevations of the wells were
taken by aneroid barometer and are, consequently, only approximate. In
spite of these defects, however, it is hoped that the publication of
these water records may prove of value to farmers, town authorities, and
drillers in their efforts to obtain water supplies adequate for their
needs.

In collecting this information several field parties were
employed. These were under the direction of Professors R. L. Rutherford
and P. S . Warren of the University of Alberta, C. H. Crickmay of
Vancouver, and C, O. Hage, until recently a member of the Geological
Survey. The oil and gas investigations of which these water records are
a part were undertaken under the general supervision of G. S. Hume.

## Publication of Results

The essential information pertaining to ground-water conditions
is being issued in reports that in Saskatchewan cover each municipality,
and in Alberta cover each square block of sixteen townships beginning at
the 4th meridian and lying between the correction lines. The secretary
treasurer of each municipality in Saskatchewan and Alberta will be
supplied with the information covering that municipality. Copies of the
reports will also be available for study at offices of the Provincial
and Federal GGovernment Departments. Further assistance in the
interpretation f the reports may be obtained by applying to the Chief
Geologist] Geological Survey, Ottawa. Technical terms used in the
reports are defined in the glossary.

## How to Use the Report

Anyone desiring information concering ground water in any
particular locality will find the available data listed in the well
records. These should be consulted to see if a supply of water is
likely to be found in shallow wells sunk in the glacial drift, or whether
a better supply may be obtained at greater depth in the underlying
bedrock formations. Tha wells in glacial drift commonly show no
regional level, as the sands or gravels in which the water occurs are
irregularly distributed and of limited extent. As the surface of the
ground is uneven, the best means of comparing water wells is by the
elevations of their water-bearing beds. For any particular well this
elevation is obtained by subtracting the figure for the depth of the
well to the water-bearing bed from that for the surface elevation at
the well. For convenience both the elevation of the wells and the
elevation of the water-bearing bed or beds in each well are given in
the well record tables. Where water is obtained from bedrock, the name
of the formation in which the water-bearing sand occurs is also listed
in these tables, and this information should be used in conjunction with
that provided on bedrock formations, pages 4 to 5, which describes
these formations and gives their thickness and sequence. Where the
level of the water-bearing sand is known, its depth at any point can
easily be calculated by substracting its elevation, as given in the
well record tables, from the elevation of the surface at that point.

With each report is a map consisting of two figures.
Figure 1 shows the bedrock formations that will be encountered beneath
the unconsolidated surface deposits. Figure 2 shows the position of
all wells for which records are available, the class of well at each
location, and the contour line or lines of equal surface elevation.
The elevation at any location can thus be roughly judged from the nearest
contour line, and the records of the wells show at what levels water
is likely to be encountered. The depth of the well can then be
calculated, and some information on the character and quantity of water
can be obtained from a study of the records of surrounding wells.

## GLOSSARY OF TERMS USED

Alkaline. The term "alkaline" has been applied rather loosely
to some ground waters that have a peculiar and disagreeable taste. In
the Prairie Provinces, water that is commonly described as alkaline
usually contains a large amount of sodium sulphate and magnesium sulphate,
the principal constituents of Glauber's salt and Epsom salts respectively.
Most of the so called alkaline waters are more correctly termed sulphate
waters, many of which may be used for stock without ill effect. Water
that tastes strongly of common salt is described as salty.

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 porous bed, lens, or
pocket in unconsolidated deposits or in bedrock that carries water.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 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.

(2) Wells in which the water is under pressure but does not rise to the surface.

(3) Wells in which the water does not rise above the water table.

BEDROCK FORMATIONS OF WEST-CENTRAL SASKATCHEWAN AND EAST-CENTRAL ALBERTA

The formations that outcrop in west-central Saskatchewan are an extension of similar formations that occur in east-central Alberta. They are of Upper Cretaceous age, and consist entirely of relatively soft shales and sands, with some bands of hard sandstone and layers of ironstone nodules. The succession, character, and estimated thickness of the formations are shown in the following table:

| Formation | Character | Thickness Feet |
|---|---|---|
| Edmonton | Grey to white, bentonitic sands and sandstones with grey and greenish shales; coal seams prominent in some areas, as at Castor, Alberta. | 1,000 to 1,150 |
| Bearpaw | Dark shales, green sands with smooth black chert pebbles; partly non-marine, with white bentonitic sands, carbonaceous shales or thin coal seams similar to those in Pale Beds; shales at certain horizons contain lobster claw nodules and marine fossils; at other horizons are abundant selenite crystals. | 300 to 600 thins rapidly to the north-west |
| Pale and Variegated Beds | Light grey sands with bentonite; soft, dark grey and light grey shales with selenite and ironstone; carbonaceous shales and coal seams; abundant selenite crystals in certain layers. | 950 to 1,000 in Czar-Tit Hills area; may be thinner elsewhere |
| Birch Lake | Grey sand and sandstone in upper part; middle part of shales and sandy shales, thinly laminated; lower part with grey and yellow weathering sands; oyster bed commonly at base. | 100 in west, but less to east and south |
| Grizzly Bear | Mostly dark grey shale of marine origin, with a few minor sand horizons; selenite crystals and nodules up to 6 or 8 inches in diameter | Maximum, 100 |
| Ribstone Creek | Grey sands and sandstones at the top and bottom, with intermediate sands and shales; thin coal seam in the vicinity of Wainwright; mostly non-marine, but middle shale in some areas is marine. | Maximum, 325 at Viking; thins eastward |
| Lea Park | Dark grey shales and sandy shales with nodules of ironstone; a sand 70 feet thick 110 feet below the top of the formation in the Rib-stone area, Alberta. | 950 to 1,100 |

### Edmonton Formation

The name Edmonton formation was first applied to the beds containing coal in the Edmonton area, and later to the same beds in adjoining areas. The formation has a total thickness of 1,000 to 1,150 feet, but is bevelled off eastward and the east edge of the formation

follows a northwest line from Coronation through Tofield to a point
on North Saskatchewan River about midway between Edmonton and Fort
Saskatchewan. No Edmonton beds occur northeast of this line, but
the formation becomes progressively thicker to the southwest due to
the fact that the beds incline in that direction and the surface
bevels across them.

The Edmonton formation consists of poorly bedded grey and
greenish clay shales, coal seams, and sands and sandstones that
contain clay and a white material known as bentonite. This material
when wet is very sticky and swells greatly in volume, and when dry
tends to give a white appearance to the beds containing it. Such
beds are relatively impervious to water, and at the surface produce
the "burns" of barren ground where vegetation is scanty or absent.

Water is relatively abundant in the Edmonton formation, which
contains much sand, commonly in the form of isolated lenses distributed
irregularly through the formation. Consequently, there is little
uniformity in the depth of wells even within a small area. Water also
occurs commonly with coal seams and, unlike the sand lenses, these beds
are much more regular and persistent. In contrast with the water from
the bentonitic sands, which is generally "soft", water from the coal
seams, as the water from the shallow surface deposits, may be "hard".
The basal beds of the Edmonton formation usually contain fresh water,
but this may become brackish locally where the underlying Bearpaw beds
contain highly alkaline or salty water.

### Bearpaw Formation

In southern Alberta, where the Bearpaw formation is thickest,
the beds composing it are mainly shales that have been deposited in
sea water. In the area north of township 32 the formation thins to the
northwest and becomes a shoreline deposit composed of shales containing
bentonite, impure sands, and thin coal seams. In some areas, as at
Ryley and near Monitor, and in the Neutral Hills, the Bearpaw contains
pebble beds. At Ryley these are consolidated into a conglomerate,
but mostly the pebbles are loosely distributed in shale or sandy beds.

In the area immediately north of township 32 the Bearpaw
occupies a widespread belt beneath the glacial drift, but farther
northwest the belt narrows, and at Ryley and northwestward it is only
a few miles wide. This belt crosses North Saskatchewan River about
midway between Edmonton and Fort Saskatchewan. Bearpaw beds form the
main bedrock deposits of the Neutral Hills. Farther south, where
they have an exposed thickness of at least 400 feet, they contain
green sands, and beds of marine shale interfinger with the bentonitic
shales and sands of the underlying formation. To the north, on the
banks of North Saskatchewan River, the division between the Bearpaw
and the overlying and underlying formations is indefinite, and the
thickness of beds of Bearpaw age is relatively small.

The water in the Ryley area is from the Bearpaw formation,
and is salty. In other areas to the south the marine Bearpaw
formation carries green sand beds that yield fresh water, but commonly
a much better supply is found by drilling through the Bearpaw into the
underlying Pale Beds.

In Saskatchewan, Bearpaw beds occur southeast of Maclin and
south of Luseland and Kerrobert. Only the basal beds are present, and
these contain green sands that are commonly water-bearing.

### Pale and Variegated Beds

Underlying the Bearpaw formation is a succession of bentonitic
sands, shales, and sandy shales containing a few coal seams. The upper
part of this succession, due to the bentonitic content, is commonly
light coloured and has been described as the Pale Beds, whereas the lower

part is darker, and is known as Variegated Beds. In part, dark shales are present in both Pale and Variegated Beds; others are greenish, grey, brown, and dark chocolate, carbonaceous types. The sands may also be yellow, but where bentonite is present it imparts a light colour to the beds. Both Pale and Variegated Beds are characterized by the presence of thin seams of ironstone, commonly dark reddish, but in part purplish. Selenite (gypsum) crystals are, in places, abundant in the shales.

The best sections of Pale Beds exposed in the region are in the Tit Hills, southwest of Czar. These hills carry a thin capping of Bearpaw shales, beneath which, and around Bruce Lake, more than 200 feet of Pale Beds are exposed. The total thickness of Pale and Variegated Beds in the Tit Hills area is about 970 feet. Variegated Beds outcrop near Hawkins on the Canadian National Railway west of Wainwright, but no area exposes the complete succession, which is considered to comprise about 200 feet of beds.

Records of wells drilled into the Pale and Variegated Beds do not, in general, indicate lateral persistence of sands for long distances, nor any uniform average depth to water-bearing sands in a local area. This points to the conclusion that the sands are mainly local lenses, but as such lenses are numerous, few wells fail to obtain water. In the Cadogan area many flowing wells have been obtained from sands about midway in the succession. In western Saskatchewan Paleland Variegated Beds occur over a wide area from Maclin and Kerrobert northeast through Wilkie to the Eagle Hills, south of Battleford. Numerous outcrops occur in the area south of Unity at Muddy Lake, but south and east around Biggar these beds are almost wholly concealed by glacial drift.

The water from the sands of the Pale and Variegated Beds is generally soft. The supply, apparently, is dependent in part on the size of the sand body that contains the water and in part on the ease with which water may be replenished in the sand. Small sand lenses surrounded by shales may be filled with water that has infiltrated into them, but when tapped by a well the supply may be very slowly replenished. In many instances such wells yield only a small supply, although this is commonly persistent and regular.

### Birch Lake Formation

The Birch Lake formation underlies the Variegated Beds, but in many areas the division is not sharp. The type area of the formation is along the north shore of Birch Lake south of Innisfree, where a section 65 feet thick, composed mostly of sand, is exposed. The total thickness of the formation in this area is about 100 feet, and although this is dominantly sand a central part is composed of alternating thin sand and shale beds. At the base of the formation, in a number of places, is an oyster bed, and this is exposed in a road cut in a section 73 feet thick on the east side of Buffalo Coulée in sec. 3, tp. 47, rge. 7, W. 4th mer. In both upper and lower parts of the formation the sand is commonly massive and outcrops tend to consolidate into hard, nodular masses from a foot to a few feet in diameter. Apparently these are formed through the deposition of salts from the water that finds an outlet at the outcrops. In fact, in some areas the sand may be traced along the side of a hill by the presence of small springs or nodular masses of sandstone.

The Birch Lake formation occurs under the drift and in outcrops in a large area south of North Saskatchewan River and northeast of a line from Willingdon to Innisfree and Minburn. East of this area the southwest boundary is more irregular, but outcrops are persistent on the banks of Battle River from a few miles north of Hardisty to and beyond the mouth of Grizzly Bear Coulée in tp. 47, rge. 5. It is believed, too, that a large area near Edgerton and Chauvin is underlain by the Birch Lake formation and that it extends southeastward into Saskatchewan around Manitou Lake and southeast to Vera.

It is thought that the Birch Lake formation thins eastward from its type section at Birch Lake, and that it loses its identity in western Saskatchewan. Deep wells drilled at Czar, Castor, and elsewhere no longer show the Birch Lake as a clearly recognizable sand formation, so that its southern limit beneath younger formations is unknown. Wherever it occurs as a sand, however, it is water-bearing, although in some areas the sand is apparently too fine to yield any considerable volume of water. In other areas, however, it persistently yields good wells. There is no apparent uniformity in the character of the water, which is either hard or soft in different wells in the same general area. Direct contact with surface waters that contain calcium sulphates may in time change a "soft" water well to a "hard" water well, and many wells are not sufficiently cased to prevent the percolation of water from surface sands into the well, and hence into the deeper, soft water producing sands. In part this accounts for the change in character of the water in a well, a feature that has been noticed by many well owners.

## Grizzly Bear Formation

The type locality for the Grizzly Bear formation, which underlies the Birch Lake beds, is near the mouth of Grizzly Bear Coulée, a tributary of Battle River with outlet in tp. 47, rge. 5. The formation is mainly composed of dark shales that were deposited in sea water. At the mouth of Grizzly Bear Coulée two shale sections, each about 100 feet thick, are separated by a zone of thin sand beds. It is now recognized that the upper section is the Grizzly Bear shale, and that the lower one, very similar in character and also deposited in sea water, occurs in the next lower formation, the Ribstone Creek. The Grizzly Bear shale contains a thin nodular zone about 50 feet above the base, that is, at about the centre of the formation. This zone is sandy, and is believed to yield water in various wells. Other thin sands, in places water-bearing, are also present. The impervious nature of the Grizzly Bear shales makes the overlying Birch Lake sand a strong acquifer, as water collects in the sand above the shale. The contact of the Birch Lake and Grizzly Bear formations can be traced in some places by the occurrence of springs issuing from the base of the Birch Lake sand even where this is not exposed.

Grizzly Bear shales occur in a road cut on the south side of Battle River near the highway bridge at Fabyan. The shales in this area are about 100 feet thick. It is thought they extend as far west as the Viking gas field, where they have been recognized in samples from deep wells. It is probable, however, that the shales thin westward and thicken eastward so that their general form is a wedge between both higher and lower sand beds. The position of the thin edge of the wedge to the west is unknown, but evidently the Grizzly Bear marine shale underlies a large area in east-central Alberta extending into Saskatchewan mainly in the area south of Battle River.

## Ribstone Creek Formation

The type area of the Ribstone Creek formation is on Ribstone Creek near its junction with Battle River in tp. 45, rge. 1, W. 4th mer. At this place the lower sand beds of the formation are well exposed. The upper part of the lower sand member of this formation outcrops on the north side of Battle River, in the northeast part of sec. 26, tp. 47, rge. 5, near the mouth of Grizzly Bear Coulée. Above it, higher on the bank and at a short distance from the river, there is a 12 foot zone of carbonaceous and coaly beds in two layers, each about 2 feet thick, separated by 8 feet of shale. Above this are 90 feet of dark shales that are thought to have been deposited in sea water, that is, they are marine shales. These marine shales in turn are overlain by a sandy zone about 20 feet thick containing oysters in the basal part. This sandy zone is the upper sand member of the Ribstone Creek formation.

It thickens to the east and west from the Grizzly Bear area but is probably at no place much more than 50 feet thick.

The lower sand member of the Ribstone Creek formation also varies in thickness from a minimum of about 25 feet. On the banks of Vermilion Creek, north of Mannville, the basal sand is at least 60, and may be 75,feet thick. It is overlain by shaly sand and sandy shale beds, which replace the shale beds in the central part of the formation as exposed at the mouth of Grizzly Bear Coulée. In the Wainwright area, where the formation has been drilled in deep wells, the basal sand is 60 feet thick, with the central part composed of shale containing sand streaks. The upper sand member is about 20 feet thick in this area. The total thickness of the formation in the Wainwright area is 100 to 200 feet, but this increases to the west and in the Viking area exceeds 300 feet.

The Ribstone Creek formation is widely exposed in a northwest-trending belt in east-central Alberta. The southwest boundary of this northwest-trending belt passes through the mouth of Grizzly Bear Coulée in tp. 47, rge. 5, and beyond to the Two Hills area in tp. 54, rge. 12, whereas the northeast boundary crosses North Saskatchewan River southwest of Elk Point and extends northwest to include an area slightly north of St. Paul des Metis and Vilna to tp. 60, rge. 14. Within this belt water wells are common in the Ribstone Creek sands, which are almost without exception water-bearing in some part of the formation. The limits of the belt to the northeast determine the limits of water from this source, but to the southwest of the belt, as here outlined, water may be obtained in this formation by drilling through the younger beds that overlie it. The Ribstone Creek sands are a prolific source of water in many places and hence the distribution of this formation is of considerable economic importance. Where the formation consists of upper and lower sands with a central shale zone only the sands are water-bearing, although thin sand members may occur in the shale. Where the formation is largely sand the distribution of water may be in any part of the formation, although the upper and lower sands are perhaps the better aquifers. To the east of Alberta, along Battle River and Big Coulée in Saskatchewan, the Ribstone Creek sands are marine. Marine conditions apparently become more prevalent to the southeast and it is believed that in this direction the sands are gradually replaced by marine shales. Thus at some distance southeast of Battleford the Ribstone Creek formation loses its identity and its equivalents are shales in a marine succession.

### Lea Park Formation

The Lea Park formation is largely a marine shale, and only in the upper 180 feet is there any water. In the Dina area south of Lloydminster the upper beds of the Lea Park consist of silty shales about 110 feet thick underlain by silty sands 70 feet thick. Below these sands are marine shales only, and these yield no fresh water either in east-central Alberta or west-central Saskatchewan. The sand in the upper Lea Park formation is thus the lowest freshwater aquifer within a very large area. The extent of this sand in the Lea Park, particularly to the northeast, is not known, but as the strata in east-central Alberta have a southwest inclination, progressively lower beds occur at the surface to the northeast. Thus at a short distance beyond the northeast boundary of the Ribstone Creek formation, as previously outlined, the sand in the upper Lea Park reaches the surface, and represents the last bedrock aquifer in that direction. Farther northeast water must be obtained from glacial or surface deposits only. In Alberta this area without fresh water in the bedrock includes the country north of North Saskatchewan River in the vicinity of Frog Lake and a large area extending to and beyond Beaver River. In this area, however, more fresh water streams are present than farther south, and bush lands

help to retain the surface waters. The area northeast of North
Saskatchewan River in Saskatchewan is almost wholly within the
Lea Park formation, where water can be found only in surface deposits.

## WATER ANALYSES

### Introduction

Analyses were made of water samples collected from a large
number of wells in west-central Saskatchewan. Their purpose was to
determine the chemical characteristics of the waters from different
geological horizons, and thereby assist in making correlations of the
strata in which the waters occur. Although this was the main
objective of the analyses, it was also realized that a knowledge of
the mineral content of the water is of interest and value to the
consumer. The analyses were all made in the laboratory of the Water
Supply and Borings Section of the Geological Survey, Ottawa.

### Discussion of Chemical Determinations

The dissolved mineral constituents vary with the material
encountered by the water in its migration to the reservoir bed. The
mineral salts present are referred to as the total dissolved solids,
and they represent the residue when the water is completely evaporated.
This is expressed quantitatively as "parts per million", which
refers to the proportion by weight in 1,000,000 parts of water. A
salt when dissolved in water separates into two chemical units called
"radicals", and these are expressed as such in the chemical analyses.
In the one group is included the metallic elements of calcium (Ca),
magnesium (Mg), and sodium (Na), and in the other group are the
sulphate ($SO_4$), chloride (Cl), and carbonate ($CO_3$) radicals.

The analyses indicate only the amounts of the previously
mentioned radicals, thus neglecting any silica, alumina, potash,
or iron that may be present. It will be noticed that in most instances
the total solids are accounted for by the sum total of the radicals as
shown by the analyses. Actually, the residue when the water is
completely evaporated still retains some combined water of crystallization,
so that the figures for the "total solids" are higher than the sum
total of the radicals as determined. TThese radicals are also
"calculated in assumed combinations" to indicate the theoretical amounts
of different salts present in the water. The same method was followed
in each analysis, so that the table presents a consistent record of
the different compounds present.

### Mineral Constituents Present

Calcium. Calcium (Ca) in the water comes from mineral
particles present in the surface deposits, the chief source being
limestone, gypsum, and dolomite. Fossil shells provide a source of
calcium, as does also the decomposition of igneous rocks. The common
compounds of calcium are calcium carbonate ($CaCO_3$) and calcium
sulphate ($CaSO_4$).

Magnesium. Magnesium (Mg) is a common constituent of many
igneous rocks and, therefore, very prevalent in ground water. Dolomite,
a carbonate of calcium and magnesium, is also a source of the mineral.
The sulphate of magnesia ($MgSO_4$) combines with water to form "Epsom
salts" and renders the water unwholesome if present in large amounts.

Sodium. Sodium (Na) is derived from a number of the important
rock-forming minerals, so that sodium sulphate and carbonate are very
common in ground waters. Sodium sulphate ($Na_2SO_4$) combines with water
to form "Glauber's salt" and excessive amounts make the water unsuitable
for drinking purposes. Sodium carbonate ($Na_2CO_3$) or "black alkali"
waters are mostly soft, the degree of softness depending upon the ratio

of sodium carbonate to the calcium and magnesium salts. Waters
containing sodium carbonate in excess of 200 parts per million
are unsuitable for irrigation purposes[1]. Sodium sulphate is less

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[1] "The extreme limit of salts for irrigation is taken to be 70 parts
per 100,000, but plants will not tolerate more than 10 to 20 parts
per 100,000 of black alkali (alkaline carbonates and bicarbonates)"
Frank Dixey in "A Practical Handbook of Water Supply", Thos. Murby
& Co., 1931, p. 254.

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harmful.

Sulphates. The sulphate ($SO_4$) salts referred to in these
analyses are calcium sulphate ($CaSO_4$), magnesium sulphate ($MgSO_4$),
and sodium sulphate ($Na_2SO_4$).

Chloride. Chlorine (Cl) is with a few exceptions, expressed
as sodium chloride (NaCl), that is, common table salt. It is found
in all of the analyses; most of the waters containing less than 200
parts per million, but some as much as 2,000 or 3,000 parts. These
waters have a brackish taste.

Alkalinity. The alkalinity determined in these water
analyses is based on the assumption that the only salts present in
the samples that will neutralize acids are carbonates, and that,
consequently, the degree of alkalinity is proportional to the amount
of the carbonate radical ($CO_3$) present.

Hardness. The hardness of water is the total hardness, and
has been determined by the amount of a standard soap solution required
to form a lather that will stand up (persist) for 2 minutes. Hardness
is of two kinds, temporary and permanent. Temporary hardness is
caused by calcium and magnesium bicarbonates, which are soluble in
water but are precipitated as insoluble normal carbonates by boiling,
as shown by the scale that forms in teakettles. Permanent hardness
is caused by the presence of calcium and magnesium sulphates, and is
not removed by boiling. The two forms of hardness are not distinguished
in the water analyses. Waters grade from very soft to very hard, and
can be classified according to the following system[2]:

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[4]
The "Examination of Waters and Water Supplies", Thresh & Beale,
page 21, Fourth Ed. 1933 .

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A water under 50 degrees (that is, parts per million) of
hardness may be said to be very soft.
A water with 50 to 100 degrees of hardness may be said to be
moderately soft.
A water with 100 to 150 degrees of hardness may be said to be
moderately hard.
A water with more than 200 and less than 300 degress of hardness
may be said to be hard.
A water with more than 300 degrees of hardness may be said to
be very hard.

Hard waters are usually high in calcium carbonate. Almost
all of the waters from the glacial drift are of this type, especially
those not associated with sand and gravel deposits that come close to
the surface.

In soft water the calcium carbonate has been replaced by sodium carbonate, due to natural reagents present in the sand and clays. Bentonite and glauconite are two such reagents known to be present. Montmorillinite, one of the clay-forming minerals, has the same property of softening water, owing to the absorbed sodium that is available for chemical reaction[1].

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[1]

Piper, A. M. "Ground Water in Southwestern Pennsylvania", Penn. Geol. Surv., 4th series.

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If surface water reaches the lower sands by percolating through the higher beds it may be highly charged with calcium salts before reaching the bedrock formations containing bentonite or glauconite. The completeness of the exchange of calcium carbonate for sodium carbonate will, therefore, depend upon the length of time that the water is in contact with the softening reagent, and also upon the amount of this material present. The rate of movement of underground water will, consequently, be a factor in determining the extent of the reaction.

The amount of iron present in the water was not determined, owing to the possibilities of contamination from the iron casings in the wells. Iron is present in most waters, but the amount may be small. Upon exposure to air a red precipitate forms, the water becomes acid, and, hence, has a corrosive action. When iron is present in large amounts the water has an inky taste.

WATER ANALYSES IN RELATION TO GEOLOGY

## Glacial Drift

The quality of the water from glacial drift depends largely on the nature of the deposit from which it comes and on the depth of the aquifer below the surface. Glacial deposits may be divided roughly into three types.

(1). Sand and gravel beds that form the surface deposit, such as outwash material and glacial lake sands.

(2). Buried outwash and interglacial deposits between two tills of boulder clay.

(3). Pockets or lenses of sand and gravel irregularly distributed through the till.

Water from surface sand deposits is normally low in dissolved salts, the total being generally less than 1,000 parts per million. Where large amounts of limestone occur in the glacial sand and gravel beds a characteristic constituent of the glacial water is calcium carbonate, the amount present varying from 300 to 700 parts per million.

Water from buried outwash deposits contains more dissolved salts than the surface sands, as the water in order to reach them has to percolate through overlying till. Rain water contains carbonic acid, which acts as a solvent and dissolves a great deal of calcium, magnesium, and sodium from the rock-forming minerals. Sulphate salts are commonly present, though their proportions vary greatly in the different waters. The shales that are incorporated in the drift are high in calcium sulphate, so that the amount of shale present will modify the quality of the water. The oxidized upper part of the drift contains less sulphate than the deeper, less oxidized boulder clay. The character of the water in the buried outwash deposits will, therefore, depend largely on the composition and amount of till that overlies it.

Water from irregularly distributed sand and gravel beds will vary in its content of dissolved salts depending upon the character of the material surrounding the reservoir beds. As the water in this type of deposit does not flow to any marked extent, it is apt to be more highly impregnated with soluble salts than where the underground movement is more rapid. Soft water in the drift is mostly confined to shallow wells in sands low in calcium carbonate. Waters from glacial lake clays are sometimes high in soluble salts.
The sample from a well in glacial lake clay on N.W. $\frac{1}{4}$ sec. 27, tp. 42, rge. 17, has 11,040 parts per million of soluble salts, largely magnesium sulphate and sodium sulphate. The sample from SE. $\frac{1}{4}$ sec. 13, tp. 42, rge. 16, which is believed to come from glacial lake silts, has a very different composition. The total solids in it are only 440 parts per million, of which 250 are calcium carbonate. The great difference in these waters is due to the high soluble salt content that is associated with the lake clays but absent in the silts. Average drift water contains between 1,000 and 3,000 parts per million of dissolved mineral salts.

## Bearpaw Formation

The Bearpaw formation consists of dark marine shales and beds of green sand. Water from these sands has a total solid count ranging from 300 to 1,600 parts per million and a hardness of more than 300 degrees. Calcium carbonate is very marked in all samples, due, perhaps, to the proximity of the water sands to the glacial drift. Sodium sulphate is the chief salt present, followed by calcium carbonate, magnesium sulphate, magnesium carbonate, and sodium chloride in decreasing amounts. These waters are distinguished from the overlying drift waters by being relatively low in total dissolved solids, and in containing no calcium sulphate and only moderate amounts of sodium sulphate, magnesium sulphate, and magnesium carbonate.

## Pale Beds

Pale Beds underlie the Bearpaw formation. Total solids in waters from these beds vary from 700 to 1,300 parts per million. The water is, in most instances, soft, as it contains sodium carbonate in excess of calcium and magnesium carbonates, but when mixed with surface water high in calcium carbonate, it will become hard. The high concentration of sodium salts, especially sodium carbonate, in contrast with the calcium and magnesium salts distinguishes this water from that in Bearpaw sands. The Pale Beds include much bentonite, and it is this mineral that acts as a water softener within the formation. The following analyses are typical of waters from the Pale Beds:

| Salts | SE. sec. 16, tp.38, rge. 21 | NE. sec. 3, tp.39, rge. 25, | SW. sec. 7, tp.37, rge.24, | SE. sec. 21 tp. 38, rge.23 |
|---|---|---|---|---|
| $CaCO_3$ | 73 | 18 | 53 | 35 |
| $CaSO_4$ | - | - | - | - |
| $MgCO_3$ | 52 | 14 | 45 | 38 |
| $MgSO_4$ | - | - | - | - |
| $Na_2CO_3$ | 297 | 679 | 464 | 562 |
| $Na_2SO_4$ | 297 | 158 | 266 | 437 |

| NaCl | 31 | 45 | 46 | 130 |
|---|---|---|---|---|
| Total solids | 760 | 1,020 | 940 | 1,260 |
| Hardness | 100 | 20 | 30 | 75 |

### Variegated Beds

In Senlac Rural Municipality, Saskatchewan, are a number of wells that have water very similar in character to that found in the Bearpaw formation. These wells tap an horizon that corresponds with the Variegated Beds in Alberta, although they have not been separated from the Pale Beds. They are less bentonitic than the Pale Beds and darker in colour. The water is hard and has a low dissolved solid content. The three analyses given below show a great deal of similarity and suggest a common horizon.

| Salts | NW. sec. 21, tp.41,rge.26 | NW. sec. 3, tp.41,rge.28 | SE. sec. 28, tp.40,rge.28 |
|---|---|---|---|
| $CaCO_3$ | 250 | 305 | 125 |
| $CaSO_4$ | - | - | - |
| $MgCO_3$ | 1109 | 80 | 155 |
| $MgSO_4$ | 149 | 104 | 69 |
| $Na_2CO_3$ | - | - | - |
| $Na_2SO_4$ | 98 | 132 | 386 |
| NaCl | 12 | 12 | 18 |
| Total solids | 640 | 640 | 780 |
| Hardness | 600 | 600 | 500 |

### Ribstone Creek Formation

Chemical analyses of water from the Ribstone Creek formation vary more than in the Pale Beds, the reason being that at several different horizons the sediments show considerable lateral variation. The formation includes both marine and non-marine beds, thin coal seams being present in the basal part of the formation around Paynton, whereas south of Lashburn, on Battle River, marine fossils were found in strata considered to be at approximately the same horizon. The water analyses show similarities within limited areas, but long distance correlations cannot be made safely except for the saline waters that occur in the flowing wells at Vera, Muddy Lake, and at the south end of Tramping Lake. Analyses of these waters are given in the following table:

| Salts | SE.sec.25, tp.41,rge.24 | SE.sec.22, tp.41,rge.24, | NE.sec.36, tp.41,rge.24, | SW.sec.7 tp.41,rge.24, | SE.sec.30, tp.38, rge.22, | SW.sec10, tp.35, rge.20, |
|---|---|---|---|---|---|---|
| $CaCO_3$ | 73 | 73 | 73 | 198 | 108 | 90 |
| $CaSO_4$ | - | - | - | - | m- | - |
| $MgCO_3$ | 38 | 38 | 38 | 52 | 69 | 52 |
| $MgSO_4$ | - | - | - | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| $Na_2CO_3$ | 129 | 119 | 129 | 11 | 106 | 125 |
| $Na_2SO_4$ | 55 | 55 | 61 | 61 | 49 | 43 |
| NaCl | 2,929 | 3,036 | 2,690 | 2,863 | 3,531 | 3,861 |
| Total solids | 3,840 | 3,460 | 3,120 | 3,200 | 3,860 | 4,460 |
| Hardness | 135 | 90 | 110 | 100 | 130 | 130 |

The similarity in these anlayses suggests a common source bed. The distance between the Tramping Lake well and the Vera wells is about 40 miles. This water, which is thought to come from the basal sand of the Ribstone Creek formation, is not typical of water from the same stratigraphical horizon in the vicinity of Battle River, one reason being, possibly, that at Battle River the stream has cut through the Ribstone Creek formation exposing the sand members along its banks. This may cause a more rapid movement of the underground water in this area than farther south, and it is known that the rate of flow is a controlling factor that governs the change of calcium carbonate to sodium carbonate when the softening reagents of bentonite or glauconite are present in the sand.

Some of the soft waters from the Ribstone Creek formation cannot be distinguished from those of the Pale Beds, whereas others are quite different. The following analyses illustrate some of the different types of water from this formation:

| Salts | Se.sec. 11, tp. 46, rge. 28 | Ind.Agent Little Pine I.R. | SW.sec. 24, tp. 46, rge. 21 | NE.sec. 36, tp. 43, rge. 18 | Se.sec. 26. tp. 43, rge. 18 | NE.sec. 36. tp. 41, rge 24 | NW.sec. 22. tp. 42. rge. 23 |
|---|---|---|---|---|---|---|---|
| $CaCO_3$ | 90 | 90 | 410 | 73 | 35 | 73 | 125 |
| $CaSO_4$ | - | - | - | - | - | - | - |
| $MgCO_3$ | 97 | 59 | 168 | 38 | 31 | 38 | 97 |
| $MgSO_4$ | - | - | 64 | - | - | - | - |
| $Na_2CO_3$ | 217 | 392 | - | 203 | 592 | 129 | 196 |
| $Na_2SO_4$ | 1,644 | 777 | 2,518 | 225 | 522 | 61 | 1,541 |
| NaCl | 249 | 63 | 76 | 12 | 83 | 2,690 | 71 |
| Total solids | 2,220 | 1,340 | 3,000 | 620 | 1,230 | 3,120 | 1,900 |
| Hardness | 280 | 160 | 750 | 110 | 35 | 110 | 600 |

The above chemical analyses show such a wide range in the dissolved salts present in the different waters in the Ribstone Creek formation that they cannot be used for correlation purposes over a large area.

## Conclusions

(1) In most instances water from glacial drift is quite different from water from bedrock.

(2) Some of the bedrock horizons carry waters that show definite chemical characteristics.

(3) Most waters from glacial till carry total solids amounting to between 1,000 and 5,000 parts per million.

(4) Bedrock waters are commonly low in dissolved salts. Exceptions to this are to be found in water from the Ribstone Creek formation.

(5) Water from the Bearpaw formation is hard. An average of ten wells gave a total solid content of 1,100 parts per million.

(6) Water from the Variegated Beds resembles that from the Bearpaw formation.

(7) Waters from the Pale Beds is mostly soft. An average of ten wells gave a total solid of 1,000 parts per million.

(8) All soft waters contain sodium carbonate ($Na_2CO_3$), which is present in water from the Pale Beds and Ribstone Creek formations but absent from the Bearpaw formation and Variegated Beds.

RURAL MUNICIPALITY OF BUFFALO, NO. 409, SASKATCHEWAN

## Physical Features

Most of this municipality comprises relatively level
prairie lands, with a slope to the northeast. The highest part
is in tp. 41, rge. 21, where elevations are above 2,300 feet,
and the land slopes gently from there to the northeast to
elevations below 2,050 feet in the northwest corner of tp. 42,
rge. 21.

## Geology

There are no outcrops of bedrock within this municipal-
ity, the entire surface being covered by glacial drift. One well
in tp. 40, rge. 21, reported gravel at a depth of 160 feet or
an elevation of 1,974 feet, whereas in the "Grainlands" well,
on sec. 34, tp. 40, rge. 20, the base of the drift is consider-
ed to lie at a depth of 126 feet or an elevation of 2,064 feet.
To the north, in tp. 42, rge. 20, two wells, 82 and 120 feet
deep respectively, get water at elevations of 1,973 and 1,967
feet, apparently in sands in the drift. The inference from this
information is that the Pale Beds beneath the drift form a
hill in the vicinity of the Grainlands well. Elevations of the
water-bearing horizon in the other three wells are so nearly
the same as to throw some doubt on the acceptance of the glacial
origin of the water-bearing sands, and suggest that they may
represent one widespread aquifer in the underlying Pale Beds.
This view seems to be supported by the evidence from Grainlands
well, where the water occurred at a depth of 222 feet and an
elevation of 1,968 feet in strata below coal-bearing horizons
of the Pale Beds. With one continuous aquifer, however, the
water level in the various wells would be expected to be about
the same. In the Grainlands well the water rose to 6 feet from
the surface, or to an elevation of about 2,184 feet; this is
50 feet above the top of the well referred to in tp. 40, rge. 21,
and about 100 and 130 feet above the surface elevations of the
other two wells in tp. 40, rge. 20. On this basis, therefore,
these three wells should have flowed, and the fact that they
failed to do so, and that the water in one of them was reported
to only rise to an elevation of 2,005 feet, strongly points to
the lack of continuity suggested by the equal elevations of the
water horizons.

## Water Supply

This municipality contains evidence of a buried outwash
sand and gravel deposit covering an area in tp. 40, rges. 19, 20,
and 21, and in tp. 41, rge. 20. The Canadian Pacific Railway
gravel deposit south of Phippen is part of this deposit. Where
it has been encountered by wells it has yielded water from a
zone 30 to 56 feet deep. On its edges the gravel and sand are
poorly sorted from clay, and in places do not allow sufficient
porosity for a water supply. In the municipality as a whole,
however, many lenses of gravel and sand appear to be scattered

through the drift, and these yield water. In certain areas an
abundance of these lenticular porous bodies of sand are con-
centrated into one zone between elevations of 2,000 and 2,100
feet, and in such areas, although the depth at any specific
location cannot be predicted, the probability is that the well
will encounter a water-bearing bed within this zone. If,
however, such a well passes through this zone without obtaining
water, deeper water-bearing horizons, either in the drift or in
the underlying Pale and Variegated Beds, will be encountered.
The water in the sands in the drift is thought to be entirely
derived from rain.

Township 40, Range 19. In this township only the Wilkie
town well, 168 feet deep, penetrates the drift at an elevation
of 2,017 feet. Below this depth Pale Beds were encountered,
and at a depth of 180 feet soft water in abundance was found in
a sand bed. All other wells in the township are in gravel or
sand, and most of them fall into a group between elevations of
2,160 and 2,190 feet. This water-bearing zone is undoubtedly
an outwash glacial deposit of sand and gravel in the drift.
At Phippen the Canadian Pacific Railway gravel pit is in this
deposit, which there has a thickness of at least 20 feet. In
the Wilkie well a gravel bed with some water was encountered at
an elevation of 2,035 feet. This bed undoubtedly belongs in the
zone that elsewhere produces water, and hence might be expected
to yield a certain amount in this township should any difficulty
be encountered in obtaining water at higher elevations. Also,
a further supply would undoubtedly be found in the underlying
Pale Beds.

Township 40, Range 20. The buried outwash plain deposit
of gravel and sand noted in tp. 40, rge. 19, is also present in
tp. 40, rge. 20. As might be expected from the fact that the
materials were spread out to the southwest in front of the ice
mass, the elevation of the outwash deposits decreases away from
the ice front. In this township, therefore, the elevations for
this aquifer are mostly between 2,140 and 2,170 feet, or about
20 feet lower on the average than in the range immediately east.
This outwash deposit is the principal water-bearing horizon in
the township, but it is probable that a zone of separate gravel
and sand beds occurs in the drift about 100 feet lower, as one
such bed yielding some water was encountered in the "Grainlands"
well on NW. section 34 at an elevation of 2,064 feet. Another
gravel bed about 20 feet higher, but probably in the same general
zone, was encountered in a well 92 feet deep on NW. section 30.
Below the drift in the "Grainlands" well water was found in sands
in the Pale Beds, and at a depth of 222 feet an abundant supply
was secured, which at first came within a few feet of the surface.
Thus it would seem that if the water supply in the higher aquifers
of this area were exhausted deeper wells could be depended upon
to yield what was required.

Township 40, Range 21. The outwash deposit of sand and
gravel in tp. 40, rges. 19 and 20, continues into range 21.
South of Phippen the Canadian Pacific Railway has opened a
large gravel pit in this deposit, which lies between elevations
of about 2,110 and 2,140 feet. The deposit apparently lacks
good porosity in certain areas as several wells have been drilled
through it without securing water. Presumably this means that
the coarser, more porous materials were deposited farther east
by the water originating from the melting ice-sheet. Wells that

passed through the upper part of the drift without securing water
appear to have been fairly successful in obtaining it in the
lower group of sand and gravel beds at elevations of 2,050 to 2,090
feet. The depth to the base of the drift is unknown. One well
on NE. section 9 was drilled to a depth of 160 feet and reported
gravel at an elevation of 1,974 feet, which is considerably lower
than the base of the drift in the Grainlands well on sec. 34, tp.
40, rge. 20. Undoubtedly, also, further water supplies are
available beneath the drift in the underlying Pale Beds.

Township 41, Range 19. The wells in this township appear
to lack the uniformity of elevation that characterizes the water-
bearing horizons in the township to the south. It would appear
that the irregularity may be due to a greater proximity to the
ice front during the time of deposition of the outwash deposit
referred to in previous townships. The sorting of gravel and
sand from the clay at any particular level does not seem to
have been as complete, with the result that clay is distributed
through a zone about 100 feet thick between elevations of 2,100
and 2,200 feet. Under such conditions it is probable that the
individual sand beds are thin and of no great lateral extent,
but probably fairly numerous. It is also probable that deeper
wells would find further water-bearing sand or gravel beds in
the drift and, from regional information, in the underlying
Pale Beds.

Township 41, Range 20. The outwash, gravel and sand
deposit is apparent from the records of the wells in this
township, and occurs at elevations mostly between 2,120 and
2,160 feet. The aquifer in one well, on SW. section 24, is
at an elevation of 2,180 feet and may be above the outwash
deposit; another, with its water horizon at an elevation of 2,091
feet is probably below the deposit; whereas a well 130 feet deep
on NW. section 13 encountered no water-bearing horizon whatever.
The outwash deposit, therefore, is somewhat irregular and dis-
continuous, and not entirely dependable at any particular
location. There is little doubt, however, that other, deeper
aquifers exist in the drift, or that, as in other neighbouring
areas, the underlying Pale Beds contain water-bearing sands.

Township 41, Range 21. Several wells, particularly in
the south part of this township, obtain their water from a zone
of glacial sand and gravel beds lying between elevations of 2,070
and 2,110 feet. This distribution of wells is an effect of the
surface topography. In the central part of the township the
elevation of the surface is more than 2,300 feet, and most wells
are not deep enough to reach the water zone. However, one well,
176 feet deep, drilled from a high point on SE. section 14,
reached this zone at an elevation of 2,103 feet. Another well,
on SE. section 6, drilled from a low elevation reached the same
zone at the comparatively shallow depth of 32 feet. Thus it
would appear that this zone underlies the whole township, but
that in the high areas only relatively deep wells can reach it.
The difficulty of obtaining water in these areas can, therefore,
be overcome only by drilling deeper wells, where a sufficient
supply is not available from irregularly distributed sands in
the upper part of the drift. One well, on NE. section 7, obtain-
ed water at a depth of 165 feet, at an elevation of 2,073 feet.
The well, however, has subsequently gone dry. This seems to be
proof that the sand beds in this zone are of no great lateral
extent, but are probably fairly numerous. In most wells,

therefore, one or more water-bearing sands would probably be
encountered within the limits of the zone, but in exceptional
cases a well may drill through the zone and not encounter water,
or only penetrate sands too thin to yield a continuous or adequate
supply. In such wells the still deeper sands of the Pale Beds
offer good prospects, although in some instances the fineness of
the sand has presented real mechanical difficulties due to the
tendency of the sand to flow with the water and plug the bottom
of the well casings.

Township 42, Range 19. The highest land in this town-
ship is in the southeast and southwest parts, and the surface
slope is northward. Most of the wells obtain their water from
elevations of 2,020 to 2,090 feet, with a few at higher altitudes
where the surface elevations are high. In no well was the base
of the drift reached, so that possible water-bearing sands in
the Pale Beds have not been tested. These, however, will prob-
ably yield water in relatively deep wells where a sufficient
supply is not available from sands within the drift.

Township 42, Range 20. Here again, as in the range to
the east, most of the wells fall into a zone with aquifers at
elevations between 2,020 and 2,100 feet. These aquifers are
evidently scattered through the drift as individual sand and
gravel lenses without any considerable lateral extent, and
their occurrence or depth at any specific location cannot be
predicted. Their abundance seems to be shown by the fact that
most wells have found water, but the yield is probably to a
large degree dependent on the size of the individual aquifers.
Two wells, one on NW. section 33 and the other on SW. section
35, obtain water at 1,973 and 1,967 feet respectively in what
is believed to be glacial sand. Probably in both these wells
the base of the drift is very little deeper, and below the
drift lie, presumably, the Pale and Variegated Beds. These
probably contain sands that will yield water, although, as no
well in this township has tested them, their capacity is unknown.

Township 42, Range 21. Information on very few wells
was collected in this township, but from regional data it is con-
sidered that all wells in it obtain water from sands in glacial
drift similar to those in the range immediately east. Sand and
gravel beds may be expected to occur at varying depths in the
drift, but without any widespread, continuous aquifers. It is
probable that Pale and Variegated beds underlie the drift, but,
so far as known, their productive capacity has not been tested.

## ANALYSES OF WATER SAMPLES FROM RURAL MUNICIPALITY OF BUFFALO, NO. 409, SASKATCHEWAN

| No. | ¼ Sec. | Tp. | Rge. | Depth in feet | Elev. of Aquifer | Total dissolved solids | Ca | Mg | Na | SO₄ | Cl. | Alk. | Total Hardness | CaCO₃ | CaSO₄ | MgCO₃ | MgSO₄ | Na₂CO₃ | Na₂SO₄ | NaCl. | Source of Water |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Constituents as Analysed | | | | | | | Constituents as Calculated in assumed Combinations | | | | |
| 120 | SE 5 | 40 | 19 | 209 | 2005 | 760 | 7 | 15 | 233 | 209 | 14 | 350 | 90 | 18 | | 52 | | 286 | 509 | 23 | Pale Beds |
| 121 | NW 34 | 40 | 20 | 226 | 1968 | 540 | 36 | 28 | 40 | 53 | 21 | 205 | 220 | 90 | | 97 | | | 79 | 34 | Pale Beds - water with coal |
| 122 | NE 14 | 40 | 21 | 126 | 2055 | 1420 | 179 | 118 | 86 | 627 | 32 | 420 | 1300 | 420 | 37 | | 584 | | 200 | 53 | Glacial drift |
| 42 | NW 4 | 41 | 21 | 109 | 2104 | 320 | 64 | 31 | 13 | 53 | 8 | 250 | 320 | 160 | | 75 | 45 | | 25 | 13 | quite similar to No.121 |
| 31 | NE 26 | 41 | 19 | 80 | 2094 | 1720 | 236 | 124 | 138 | 894 | 24 | 435 | 1700 | 435 | 211 | | 614 | | 377 | 40 | Glacial drift |
| 55 | SW 35 | 42 | 20 | 120 | 1967 | 1560 | 214 | 139 | 69 | 804 | 38 | 365 | 1500 | 365 | 251 | | 688 | | 135 | 63 | glacial drift |
| 56 | NW 2 | 42 | 21 | 125 | 2093 | 3760 | 522 | 283 | 152 | 2132 | 25 | 545 | 3000+ | 545 | 1033 | | 1403 | | 420 | 41 | do |

# RECORD OF WELLS IN RURAL MUNICIPALITY OF BUFFALO, NO. 409, SASKATCHEWAN

| Well No. | LOCATION ¼ Sec. Tp. Rge. Mer. | Type of Well | Depth of Well Ft. | Altitude of Well | WATER LEVEL Above (+) or Below (-) Surface | WATER LEVEL Elev. Above Sea Level | PRINCIPAL WATER-BEARING BED Depth ft. | PRINCIPAL WATER-BEARING BED Elev. | PRINCIPAL WATER-BEARING BED Geol. Horizon | Character of Water | Use to Which Water is put x | Yield & Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N.E. 2 40 19 3 | Dug | -28 | 2194 | -17 | 2177 | 28 | 2166 | Glacial gravel | Hard | D.S. | Sufficient |
| 2 | S.W. 3 40 19 3 | " | -38 | 2163 | -20 | 2143 | 38 | 2125 | " clay | Hard | " | Limited |
| 3 | S.E. 5 40 19 3 | Drilled | -209 | 2185 | | | 150 | 2035 | " gravel | Hard | | Wilkie town well |
| | | | | | | | 168 | 2017 | | | | Base of Drift |
| | | | | | | | 180 | 2005 | | | | Coal at 190' |
| 4 | S.E. 9 40 19 3 | Dug | -32 | 2200 | -20 | 2180 | 32 | 2168 | Pale Beds | Soft | D.S.M. | Sufficient |
| 5 | N.W. 9 40 19 3 | " | -27 | 2179 | | | 27 | 2152 | Glacial gravel | Hard | D.S. | Limited |
| 6 | N.W.12 40 19 3 | Bored | -35 | 2195 | -40 | | 35 | 2160 | " sand | " | " | Sufficient |
| 7 | S.E.12 40 19 3 | Dug | -50 | 2220 | | | 50 | 2170 | " " | " | " | " |
| 8 | S.W.12 40 19 3 | " | -28 | 2205 | -20 | 2185 | 28 | 2177 | " " | " | " | " |
| 9 | N.E.14 40 19 3 | " | -24 | 2196 | -20 | 2176 | 24 | 2172 | " " | " | " | " |
| 10 | S.E.15 40 19 3 | " | -25 | 2205 | | | 25 | 2180 | " " | " | " | " |
| 11 | S.E.18 40 19 3 | " | -28 | 2187 | | | 28 | 2159 | " " | " | " | " |
| 12 | N.E.20 40 19 3 | " | -33 | 2179 | | | 33 | 2146 | " " | " | " | " |
| 13 | N.W.24 40 19 3 | " | -40 | 2219 | -34 | 2185 | 40 | 2179 | " " | " | " | Limited |
| 14 | N.E.27 40 19 3 | Bored | -50 | 2227 | -47 | 2180 | 50 | 2177 | " " | Soft | " | " |
| 15 | N.W.28 40 19 3 | Dug | -33 | 2212 | | | 33 | 2179 | " " | Hard | " | Sufficient |
| 16 | S.W.28 40 19 3 | Bored | -40 | 2215 | | | 40 | 2175 | " " | " | " | " |
| 17 | S.E.31 40 19 3 | " | -66 | 2210 | -16 | 2194 | 66 | 2144 | " " | " | " | " |
| 18 | S.W.33 40 19 3 | " | -60 | 2231 | | | 60 | 2171 | " " | " | " | Limited |
| 19 | N.W.33 40 19 3 | Dug | -60 | 2247 | -52 | 2195 | 60 | 2187 | " gravel | " | " | Poor supply |
| 20 | S.E.34 40 19 3 | Bored | -70 | 2247 | | | 70 | 2177 | " sand | " | " | Limited |
| 21 | N.W.35 40 19 3 | " | -64 | 2274 | -50 | 2224 | 64 | 2210 | " gravel | " | " | Sufficient |
| 1 | N.E. 2 40 20 3 | Dug | -22 | 2143 | -10 | 2133 | 22 | 2121 | Glacial sand | | D.S. | Sufficient |
| 2 | S.E. 5 40 20 3 | " | -30 | 2170 | | | 30 | 2140 | " gravel | Hard | " | " |
| 3 | N.W. 4 40 20 3 | Bored | -45 | 2193 | | | 45 | 2148 | " " | " | " | " |
| 4 | S.W. 6 40 20 3 | " | -65 | 2212 | -43 | 2169 | 65 | 2147 | " gravel | " | " | " |
| 5 | N.W. 6 40 20 3 | " | -76 | 2237 | -73 | 2164 | 76 | 2161 | " sand | " | " | " |
| 6 | N.W. 7 40 20 3 | " | -60 | 2212 | | | 60 | 2152 | " " | " | " | " |
| 7 | S.W. 9 40 20 3 | " | -75 | 2195 | -50 | 2143 | 75 | 2118 | " " | " | " | " |
| 8 | S.W.10 40 20 3 | Dug | -36 | 2192 | -26 | 2166 | 36 | 2156 | " " | " | " | Good supply |

x,- D.- Domestic, S.- Stock, M.- Municipal, Alk.- Alkaline, Fe.- Iron.

| No. | Location | Twp Rge Mer | Type | Depth | Surface elev. | D. to water | Water elev. | Depth | Bottom elev. | Formation | Hardness | D.S. | Supply |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | N.W.10 | 40 20 3 | Dug | 50 | 2202 | -36 | 2166 | 50 | 2152 | Glacial | Hard | D.S. | Sufficient |
| 10 | S.E.14 | 40 20 3 |  | 28 | 2192 | -13 | 2179 | 28 | 2164 | Blue clay |  | " | " |
| 11 | S.E.16 | 40 20 3 | Bored | 63 | 2194 | -38 | 2156 | 63 | 2131 | Glacial and | Soft | " | " |
| 12 | S.E.23 | 40 20 3 | " | 50 | 2220 | -48 | 2172 | 50 | 2170 | " gravel | Hard | " | Insufficient |
| 13 | N.E.24 | 40 20 3 | Dug | 35 | 2201 | -17 |  | 35 | 2166 | " | " | " | Insufficient |
| 14 | N.W.26 | 40 20 3 | Bored | 20 | 2173 |  | 2156 | 20 | 2153 | " | " | " |  |
| 15 | N.E.28 | 40 20 3 | " | 35 | 2179 |  |  | 35 | 2144 | " | " | " |  |
| 16 | N.W.30 | 40 20 3 | " | 92 | 2174 |  |  | 92 | 2082 | " | Salty |  | Poor supply |
| 17 | N.W.33 | 40 20 3 | " | 65 | 2229 | -50 | 2179 | 65 | 2164 | " | Hard |  | Sufficient |
| 18 | N.W.34 | 40 20 3 | Drilled | 226 | 2190 | -6 | 2184 | 126 | 2064 |  | Bottom of Drift |  | Water with Coal |
|  |  |  |  |  |  |  |  | 188 | 2002 | Pale Beds | Sand |  | Good supply, water with Coal. |
|  |  |  |  |  |  |  |  | 195 | 1995 |  | " |  |  |
|  |  |  |  |  |  |  |  | 222 | 1968 |  | " |  |  |
| 19 | N.E.36 | 40 20 3 | Bored | 30 | 2173 | -12 | 2161 | 30 | 2143 | Glacial gravel | Hard | D.S. | Waters 100 head of stock. |
| 1 | N.E. 2 | 40 21 3 | Bored | 85 | 2209 | -82 | 2127 | 85 | 2124 | Glacial gravel | Soft | D.S. | Sufficient |
| 2 | S.E. 3 | 40 21 3 | " | 100 | 2195 | -50 | 2145 | 100 | 2095 | " " | Hard | " | " |
| 3 | N.E. 4 | 40 21 3 | Dug | 40 | 2154 | -36 | 2118 | 40 | 2114 | " " | " | " | Poor supply |
| 4 | S.W. 7 | 40 21 3 | " | 26 | 2102 | -24 | 2078 | 26 | 2076 | " sand | " | " | Sufficient |
| 5 | S.E. 9 | 40 21 3 | Drilled | 160 | 2134 | -100 | 2034 | 160 | 1974 | Blue clay | " | " |  |
| 6 | N.W.10 | 40 21 3 | Bored | 56 | 2144 | -14 | 2130 | 32 | 2112 | Glacial with gravel? | Hard | " | Waters 80 head of stock. |
| 7 | S.E.14 | 40 21 3 | " | 86 | 2192 | -36 | 2156 | 86 | 2106 | " sand | " | " | Good supply |
| 8 | S.E.14 | 40 21 3 | " | 40 | 2189 |  | Low | 40 | 2149 |  | " | " | Sufficient |
| 9 | N.E.14 | 40 21 3 | " | 126 | 2179 | -56 | 2123 | 126 | 2053 | Sand |  | " | " |
| 10 | N.W.18 | 40 21 3 | Drilled | 80 | 2130 | -8 | 2122 | 80 | 2050 |  | Soft | " | " |
| 11 | S.E.20 | 40 21 3 | Dug | 50 | 2169 | -20 | 2149 | 50 | 2119 | Glacial gravel | Hard | " | Poor supply |
| 12 | N.W.21 | 40 21 3 | Bored | 75 | 2188 | -73 | 2115 | 75 | 2113 | " sand | Soft | " | Poor supply |
| 13 | N.E.22 | 40 21 3 | " | 60 | 2184 |  | Low | 60 | 2124 | " " | Hard | " |  |
| 14 | S.W.24 | 40 21 3 | " | 128 | 2170 | -58 | 2112 | 128 | 2042 | Sand |  | " | Good |
| 15 | S.E.27 | 40 21 3 | " | 138 | 2204 | -68 | 2136 | 138 | 2066 |  | Hard | " | " |
| 16 | N.W.28 | 40 21 3 | " | 84 | 2197 | -67 | 2130 | 84 | 2113 | Glacial sand |  | D. | Sufficient |
| 17 | S.E.29 | 40 21 3 | " | 87 | 2207 | -80 | 2127 | 87 | 2120 | " " | " |  | Limited |
| 18 | S.E.32 | 40 21 3 | " | 114 | 2200 | -68 | 2132 | 114 | 2086 | Sand | " | D.S. | Good supply |
| 1 | S.E. 2 | 41 19 3 | Bored | 40 | 2285 |  |  | 40 | 2245 | Glacial clay | Hard | D.S. | Good supply |
| 2 | S.W. 4 | 41 19 3 | " | 90 | 2110 | -50 | 2060 | 90 | 2020 |  |  | " | Waters 50 head of stock. |
| 3 | S.E. 4 | 41 19 3 | " | 65 | 2252 |  |  | 65 | 2187 | Glacial sand | Hard | " | Limited |
| 4 | S.W. 6 | 41 19 3 | " | 65 | 2178 | -25 | 2153 | 65 | 2113 | " " | " | " | Sufficient |
| 5 | N.W. 7 | 41 19 3 | " | 76 | 2222 | -70 | 2152 | 76 | 2146 | " " | " | " | Waters 50 head of stock. |

| Well No. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | N.W. 9 | 41 19 3 | Bored | 45 | 2151 | | | 45 | 2106 | Glacial clay | | D.S. | Good supply |
| 7 | N.E.10 | 41 19 3 | " | 50 | 2271 | -20 | 2251 | 50 | 2221 | " sand | Hard | " | Sufficient |
| 8 | S.W.14 | 41 19 3 | Dug | 60 | 2248 | | | 60 | 2188 | " " | " | " | " |
| 9 | S.E.14 | 41 19 3 | Bored | 60 | 2259 | -20 | 2239 | 60 | 2199 | " sand | " | " | " |
| 10 | N.E.15 | 41 19 3 | " | 60 | 2248 | | | 60 | 2188 | " gravel | " | " | " |
| 11 | S.W.16 | 41 19 3 | Dug | 17 | 2162 | | | 17 | 2145 | Sand & " | " | " | Poor supply |
| 12 | N.W.18 | 41 19 3 | Bored | 51 | 2215 | -29 | 2186 | 51 | 2164 | Brown clay | " | " | Abundant supply |
| 13 | S.E.22 | 41 19 3 | " | 60 | 2194 | | | 60 | 2134 | Glacial gravel | " | " | Sufficient |
| 14 | N.E.22 | 41 19 3 | " | 65 | 2196 | | | 65 | 2131 | " sand | " | " | " |
| 15 | N.E.24 | 41 19 3 | " | 28 | 2208 | | | 28 | 2180 | Blue clay | " | " | Poor supply |
| 16 | S.E.25 | 41 19 3 | " | 85 | 2214 | -45 | 2169 | 85 | 2129 | Glacial sand | " | " | Sufficient |
| 17 | S.W.26 | 41 19 3 | " | 65 | 2179 | | | 65 | 2114 | " " | " | " | " |
| 18 | N.E.26 | 41 19 3 | " | 80 | 2174 | | | 80 | 2094 | Fine sand | " | " | " |
| 19 | N.W.32 | 41 19 3 | " | 80 | 2210 | -50 | 2160 | 80 | 2130 | Glacial clay | " | " | " |
| 20 | S.E.32 | 41 19 3 | " | 35 | 2156 | -25 | 2131 | 35 | 2121 | " " | " | " | " |
| 21 | N.E.36 | 41 19 3 | Dug | 23 | 2163 | -16 | 2147 | 23 | 2140 | " sand | " | " | " |
| 22 | S.E.36 | 41 19 3 | Bored | 60 | 2203 | -32 | 2171 | 60 | 2143 | " " | " | " | " |
| 1 | N.W. 3 | 41 20 3 | Bored | 80 | 2171 | -40 | 2131 | 80 | 2091 | Glacial gravel | Hard | D.S. | Sufficient |
| 2 | S.W. 5 | 41 20 3 | " | 65 | 2228 | -53 | 2175 | 65 | 2163 | " " | " | " | " |
| 5 | S.E.12 | 41 20 3 | " | 80 | 2206 | -35 | 2171 | 80 | 2126 | " sand | " | Fe. | Waters 30 head of stock. |
| 4 | N.E.13 | 41 20 3 | " | 51 | 2215 | -30 | 2185 | 51 | 2164 | Blue clay | " | " | Sufficient |
| 5 | S.W.13 | 41 20 3 | " | 89 | 2209 | -30 | 2179 | 89 | 2120 | Glacial gravel | " | " | Poor supply |
| 6 | N.W.13 | 41 20 3 | " | 130 | 2220 | | | 130 | 2220 | | | | Dry hole in blue clay. |
| 7 | S.E.14 | 41 20 3 | " | 80 | 2217 | | | 80 | 2137 | | | | Good supply |
| 8 | N.W.19 | 41 20 3 | " | 76 | 2196 | | | 76 | 2120 | Glacial clay | " | " | Limited supply. |
| 9 | N.E.24 | 41 20 3 | " | 83 | 2221 | -50 | 2171 | 83 | 2141 | " " | " | " | 6-7 barrels per day. |
| 10 | S.W.24 | 41 20 3 | " | 37 | 2220 | | | 37 | 2183 | " sand | " | Fe. | Poor supply |
| 11 | N.E.26 | 41 20 3 | " | 30 | 2180 | | | 30 | 2150 | " " | Hard | " | Waters 100 head of stock. |
| 12 | S.W.36 | 41 20 3 | " | 35 | 2194 | -30 | 2164 | 35 | 2159 | " " | Poor | " | Poor supply |
| 13 | N.W.36 | 41 20 3 | " | 34 | 2174 | -21 | 2153 | 34 | 2150 | " " | Hard | " | " |
| 1 | S.W. 2 | 41 2B 5 | Bored | 80 | 2176 | -70 | 2106 | 80 | 2096 | Glacial gravel | Hard Alk | D.S. | Sufficient Dry hole 120'. |
| 2 | S.W. 4 | 41 21 3 | " | 109 | 2179 | -69 | 2110 | 109 | 2070 | Sand | " Fe. | D.S. | Sufficient |
| 5 | N.W. 4 | 41 21 3 | " | 86 | 2195 | -76 | 2119 | 86 | 2109 | " " | Soft | " | Sand trouble |

| No. | Loc. | T | R | M | Type | Depth | Elev. | D.W. | Elev. | Depth | Elev. | Bed | Character | | Supply |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | N.W. 4 | 41 | 21 | 5 | Bored | 109 | 2213 | -47 | 2116 | 109 | 2104 | Sand | Soft | D.S. | Sufficient |
| 5 | S.W. 6 | 41 | 21 | 5 | " | 77 | 2163 | | | 77 | 2086 | " | Hard Alk. | " | |
| 6 | N.W. 6 | 41 | 21 | 5 | " | 83 | 2178 | -80 | 2098 | 83 | 2095 | Glacial gravel | " " | | Limited |
| 7 | N.E. 7 | 41 | 21 | 5 | | 165 | 2238 | | | 165 | 2073 | | | | Well is now dry. |
| 8 | N.E.12 | 41 | 21 | 5 | Dug | 18 | 2234 | -35 | 2251 | 18 | 2216 | Glacial sand | Hard | D.S. | Sufficient |
| 9 | S.E.13 | 41 | 21 | 5 | Bored | 67 | 2258 | | | 67 | 2191 | " gravel | " | " | " |
| 10 | N.W.14 | 41 | 21 | 5 | Dug | 45 | 2286 | -102 | 2139 | 45 | 2241 | | " Alk. | S. | Waters 40 head. |
| 11 | N.W.18 | 41 | 21 | 5 | Bored | 106 | 2241 | | | 106 | 2135 | Fine sand | " | " | Abundant supply |
| 12 | S.E.22 | 41 | 21 | 5 | Drilled | 176 | 2279 | -30 | 2249 | 176 | 2103 | " " | Soft | D.S. | Sufficient |
| 13 | S.W.25 | 41 | 21 | 5 | Bored | 56 | 2224 | -10 | 2214 | 56 | 2168 | Glacial sand | Hard | " | " |
| 14 | N.W.33 | 41 | 21 | 5 | " | 50 | 2248 | -40 | 2208 | 50 | 2198 | " gravel | " | " | " |
| 15 | S.E.36 | 41 | 21 | 5 | Dug | 32 | 2119 | | | 32 | 2087 | " " | " Alk. | " | " |
| 1 | N.E. 1 | 42 | 19 | 5 | Bored | 48 | 2197 | -40 | 2157 | 48 | 2149 | Glacial gravel | Hard | D.S. | Sufficient |
| 2 | S.W. 1 | 42 | 19 | 5 | Dug | 35 | 2152 | -25 | 2127 | 35 | 2117 | " sand | " | " | " |
| 3 | N.E. 2 | 42 | 19 | 5 | " | 26 | 2149 | -21 | 2128 | 26 | 2123 | " gravel | " | " | " |
| 4 | S.E. 6 | 42 | 19 | 5 | Bored | 108 | 2194 | -73 | 2121 | 108 | 2086 | Sand | " | " | " |
| 5 | N.W. 7 | 42 | 19 | 5 | " | 60 | 2082 | -45 | 2037 | 60 | 2023 | Glacial gravel | " | Fe. | |
| 6 | N.W.10 | 42 | 19 | 5 | " | 50 | 2084 | -10 | 2074 | 50 | 2034 | Sand | " Alk. | S. | Good supply |
| 7 | S.W.14 | 42 | 19 | 5 | " | 61 | 2109 | -35 | 2074 | 61 | 2048 | Gravel | " | D.S. | Limited |
| 8 | N.W.16 | 42 | 19 | 5 | Dug | 40 | 2119 | -32 | 2087 | 40 | 2079 | Glacial gravel | " | " | Sufficient |
| 9 | S.E.18 | 42 | 19 | 5 | Bored | 45 | 2101 | -40 | 2061 | 45 | 2061 | " " | " Alk. | " | Poor supply |
| 10 | N.W.19 | 42 | 19 | 5 | " | 86 | 2099 | | | 65 | 2034 | " " | " | " | " |
| 11 | S.W.20 | 42 | 19 | 5 | " | 60 | 2080 | -48 | 2032 | 60 | 2020 | Coarse sand | " | " | Sufficient |
| 12 | N.E.23 | 42 | 19 | 5 | " | 60 | 2128 | -20 | 2108 | 60 | 2068 | Sand | " | " | Hauls drinking water from |
| 13 | N.E.24 | 42 | 19 | 5 | " | 50 | 2147 | -20 | 2127 | 50 | 2097 | Sand | " | S. | Sufficient. Sloan. |
| 14 | N.W.27 | 42 | 19 | 5 | Dug | 20 | 2100 | -10 | 2090 | 20 | 2080 | Glacial gravel | " | D.S. | " |
| 15 | S.W.30 | 42 | 19 | 5 | Bored | 35 | 2086 | -30 | 2056 | 35 | 2051 | " " | " Alk. | " | Poor supply |
| 16 | N.W.30 | 42 | 19 | 5 | " | 55 | 2091 | | | 55 | 2036 | Gravel & clay | " | " | Sufficient |
| 17 | N.W.33 | 42 | 19 | 5 | " | 25 | 2068 | -12 | 2056 | 25 | 2043 | Gravel & clay | " | " | " |
| 18 | N.E.34 | 42 | 19 | 5 | " | 80 | 2100 | -40 | 2060 | 40 | 2060 | Sandy clay | " | " | " |
| 19 | N.W.34 | 42 | 19 | 5 | " | 45 | 2100 | -17 | 2083 | 40 | 2060 | " " | " | " | " |
| 20 | S.E.36 | 42 | 19 | 5 | Dug | 42 | 2070 | -29 | 2041 | 42 | 2028 | Fine sand | " Alk. | " | Limited |
| 21 | N.E.36 | 42 | 19 | 5 | " | 22 | 2096 | | | 22 | 2074 | " " | " | " | Sufficient |
| 1 | N.W. 6 | 42 | 20 | 3 | Bored | 50 | 2135 | -25 | 2110 | 50 | 2085 | Sand | Hard | D.S. | Sufficient |
| 2 | N.W. 7 | 42 | 20 | 3 | " | 43 | 2148 | | | 43 | 2105 | Glacial | " | " | " |
| 3 | N.W.10 | 42 | 20 | 3 | Dug | 24 | 2104 | | | 24 | 2080 | " gravel | " Alk. | " | " Well 83' in gray- |
| 4 | N.E.10 | 42 | 20 | 3 | " | 35 | 2115 | -30 | 2085 | 35 | 2080 | Fine | " | " | " ey. |

| Well No. | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | N.W.11 | 42 | 20 | 3 | Dug | 23 | 2118 | | | 23 | 2095 | Sand | Soft | | D.S. | Sufficient |
| 6 | N.W.11 | 42 | 20 | 3 | " | 25 | 2118 | | | 22 | 2096 | " | " | | " | " |
| 7 | S.W.12 | 42 | 20 | 3 | Bored | 25 | 2142 | -23 | 2119 | 25 | 2117 | Glacial sand | Hard | | " | Poor supply |
| 8 | N.W.14 | 42 | 20 | 3 | Dug | 24 | 2118 | -20 | 2098 | 24 | 2094 | " gravel | " | Alk. | " | Sufficient |
| 9 | S.W.15 | 42 | 20 | 3 | Bored | 20 | 2094 | -10 | 2084 | 20 | 2074 | " " | " | " | " | Good supply |
| 10 | S.E.16 | 42 | 20 | 3 | Dug | 34 | 2889 | | | 34 | 2055 | Sand | " | " | " | Sufficient |
| 11 | S.E.22 | 42 | 20 | 3 | " | 26 | 2113 | | | 26 | 2087 | Glacial gravel | " | Alk. | " | |
| 12 | S.W.26 | 42 | 20 | 3 | " | 32 | 2099 | -25 | 2071 | 32 | 2064 | Coarse sand | " | " | " | |
| 13 | N.E.26 | 42 | 20 | 3 | Bored | 30 | 2079 | | | 30 | 2049 | Fine sand | Soft | | " | |
| 14 | S.E.28 | 42 | 20 | 3 | Dug | 40 | 2089 | | | 40 | 2049 | Sand | Hard | Alk. | " | |
| 15 | N.W.28 | 42 | 20 | 3 | Bored | 36 | 2075 | -25 | 2050 | 36 | 203 | Glacial gravel | " | " | " | Good supply |
| 16 | S.W.30 | 42 | 20 | 3 | " | 60 | 2120 | | | 60 | 2060 | " " | " | | " | Sufficient |
| 17 | N.W.31 | 42 | 20 | 3 | " | 69 | 2111 | -50 | 2061 | 69 | 2042 | " " | . | | " | " |
| 18 | N.W.33 | 42 | 20 | 3 | " | 82 | 2055 | -50 | 2005 | 82 | 1973 | Sand | " | Alk. | " | " |
| 19 | N.E.34 | 42 | 20 | 3 | " | 52 | 2072 | -32 | 2040 | 52 | 2020 | Coarse sand | " | Fe. | " | " |
| 20 | S.W.35 | 42 | 20 | 3 | " | 120 | 2087 | -20 | 2067 | 120 | 1967 | Yellow " | " | Fe. | " | " |
| 1 | S.W. 2 | 42 | 21 | 3 | Bored | 125 | 2218 | -75 | 2143 | 125 | 2093 | Coarse sand | Hard | Fe. | D.S. | Good supply |
| 2 | N.E. 6 | 42 | 21 | 3 | Dug | 38 | 2210 | | | 38 | 2172 | Glacial sand | " | Alk. | " | Sufficient |
| 3 | S.W.18 | 42 | 21 | 3 | " | 20 | 2143 | -2 | 2141 | 20 | 2123 | Glacial sand | " | " | " | |