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 GLEN McPHERSON No. 46 SASKATCHEWAN

BY

B. R. MacKay, H. H. Beach & E. L. Ruggles

Water Supply Paper No. 94

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CONTENTS



Illustrations

# GROUND WATER RESOURCES OF THE RURAL MINICIPALITY OF GLEN McPHERSON, NO. 46

## SASKATCHEWAN

## INTRODUCTION

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

## Publication of Results

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

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

## How to Use the Report

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cypress Hills Formation. The name given to a series of conglomerates and sand beds which occur in the southwest corner of Saskatchewan, and 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 coteau. The thickness of the formation seldom exceeds 40 feet.

Bearpaw Formation. The Bearpaw consists mostly of incoherent dark grey to dark brownish grey, partly bentonitic shales, weathering light grey, or, in places where much iron is present, buff. Beds of sand occur in places in the lower part of the formation. It forms the uppermost bedrock formation over much of western and southwestern Saskatchewan and has a maximum thickness of 700 feet or somewhat more.

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

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

## WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Glen McPherson is an area of 324 square miles in the western part of southern Saskatchewan. It is comprised of nine townships, described as tps. 4, 5, and 6, ranges 10, 11, and 12, W. 3rd mer. The centre of the municipality is 27 miles north of the International Boundary and is approximately 60 miles south and 16 miles east of the city of Swift Current.

The surface of the area is quite rolling. A plateau area known as Pinto butte extends across the municipality from northwest to southeast and forms a well-defined drainage divide. The ground surface of the area rises gradually from approximate elevations of 2,700 and 2,500 feet above sea-level in the southwest and northeast corners toward the uplands, reaching heights exceeding 3,300 feet in the central part of the municipality. Many small intermittent streams have carved deep valleys on all sides of the butte. Several of the northerly flowing streams join in the municipality to the north to form Pinto creek. Wood river flows in an easterly direction from the central upland part of the township. Several branches of Breed creek drain the southeastern and southern territory, and in the western part of the municipality several unnamed creeks flow in a southwesterly direction from the butte. Breed creek and the latter streams join Frenchman river in municipalities to the south and west. Most of the creeks flow only for limited periods of time in the spring and early summer months.

Many residents have constructed dams across coulées and stream beds and thus conserve adequate supplies of water suitable for stock use for longer periods. Not less than twenty-five dams have been constructed in this municipality. Many of the small ponds thus formed go dry toward the end of the summer, but larger dams should conserve sufficient water for year round requirements. Such dams are of importance in areas where both the unconsolidated deposits and the bedrock have proved sparingly productive of ground water.

The ground water supplies of this municipality are derived from the Recent stream deposits, from the glacial drift that mantles the greater part of the area, and from the underlying bedrock formations.

Water-bearing Horizons in the Unconsolidated Deposits

Thin layers of Recent stream deposits occur in the valleys of Pinto creek, Wood river, and numerous other stream channels. The sands and gravels interbedded with silts probably are water bearing, and a few of the existing wells, reported to be in glacial drift, may tap these Recent alluvial deposits.

A great continental ice-sheet moved in a southwesterly direction across the province many thousands of years ago. In its advance andretreat it laid down a covering of glacial till or boulder clay over the greater part of the municipality. This till consists largely of light yellowish brown clay near the surface, grading into more compact bluish-grey clay at depth. Embedded in the clay are boulders and pockets of sand and gravel. The deposits are spread unevenly over the old bedrock surface and vary greatly in thickness, so that in parts of the municipality they are scarcely more than a foot or two thick whereas they exceed 50 feet at other points.

Ground water supplies have been obtained from the till at several points, but the deposits appear to be most productive in township 4, range 12, and in township 6, range 10. In most of the wells in other parts of the municipality aquifers have not been encountered in the drift and digging has been continued down to the bedrock. The wells range in depth from 7 to 42 feet and produce varying quantities of water, some wells yielding only enough water for household use and others sufficient water for 10 to 60 head of stock. The water varies in quality in the different wells, but as a rule is suitable for household use, Doubtless more ground water supplies could be obtained from the till if thorough testing were carried out to locate the sand and gravel pockets. Variations in the glacial deposits result from the different modes of deposition at the various stages of the glacial period. A greater accumulation and generally more porous phase of till called moraine has been deposited in four areas in this municipality. These areas are located in the south-central part of township 6, range 10; in the northeast corner of township 5, range 10, a more extensive belt about 2 miles wide running from the southeast corner of township 6, range 11, through township 5, range 10, to section 13, and eastward; and in the northeastern part of township 4, range 10. These areas are indicated on Figure 1 of the map accompanying this report. Areas of moraine are typified by irregular hills and undrained hollows. The deposits consist of sandy clay in which occur boulders and pockets of sand and gravel. These non-continuous sand and gravel beds act as reservoirs for ground water, and have been tapped by a few wells at depths ranging from 15 to 40 feet. Evidently the productive beds occur rather sparingly, as many of the wells in these regions have passed through the unconsolidated deposits into the underlying bedrock formations without striking any sands or gravels. Aquifers should be located fairly readily in the moraine, but considerable testing may be necessary in some places. Some of the wells in township 6, range 10, yield soft water, but in other localities the water is hard and has a fairly high content of dissolved mineral salts but is usable for all farm purposes.

The glacial lake clay in the northeast corner of the municipality was deposited on the bottom of a lake that was formed by waters from the melting ice-sheet. The lake clays in this region are sandy and three wells about 20 feet deep are drawing supplies of good water from them. The yield from each well is sufficient for at least 20 head of stock. Three other wells obtain supplies from beds of sand in the clay. Good water in quantities sufficient for more than 10 head of stock is derived from two of the wells, but the third yields only a small supply of highly mineralized water which is not satisfactory for domestic use. Better water supplies are usually to be expected from sand beds than from the clays, but supplies should be obtainable from one or the other at all points in this area.

Water-bearing Horizons in the Bedrock

Three bedrock formations, known as the Ravenscrag, Eastend, and Bearpaw, occur directly below the glacial drift in various parts of the municipality, as shown on the accompanying map, Figure 1. All three of these formations are water bearing, but show considerable difference in the quality and quantity of the water derived from them.

The Ravenscrag formation consists of beds of greenish grey and grey sands and sandstones or fine sands and silts interbedded with thin layers of ironstone. At upper levels it consists mostly of dark and light-coloured clays and silts. This formation is confined to the areas lying above an elevation of 3,000 feet above sea-level, and covers the great part of Pinto butte. It is found in the northern parts of township 4, ranges 10 and 11, the greater parts of township 5, ranges 10 and 11, the northeastern half of township 5, range 12, and the south-central and northwestern parts of township 6, range 12. Water-bearing beds of the formation are extensive and all wells penetrating the formation have obtained water in sand beds or in the clays and shales. It is probable that thin beds or lenses of sand interbedded with the clay constitute the aquifers rather than the clay itself. The water-bearing beds are believed to be continuous over fairly large areas, but as yet an insufficient number of wells have been drilled to make the accurate tracing of these horizons possible. These aquifers have been tapped by wells ranging in depth from 7 to 120 feet, with an average depth of 60 feet. The variation depends to a large extent on the difference in elevations of well sites, it being generally necessary to dig to greater depths in the areas of high relief than on the lower slopes. From most of the wells sunk into the Ravenscrag formation the supply is sufficient to water 10 to 50 head of stock, but in a few places the yield is smaller. The water is soft in a few wells, but generally is hard and contains considerable amounts of dissolved salts which in two wells makes the water unsuited for domestic use. Satisfactory water supplies should be obtainable at all points in the area in which the Ravenscrag occurs, at depths usually less than 100 feet regardless of the surface elevation.

The Eastend formation immediately underlies the Ravenscrag on the butte and due to its lower elevation, and thus slightly greater areal extent, it underlies the glacial drift in a narrow fringe around the lower slopes of the uplands. The thickness of the formation varies locally, but generally ranges between 45 and 65 feet. The upper beds are composed of massive, yellow-green, fine sands and coarse silts gradually becoming finer and less porous toward the base of the formation where fine sands, silts, grey, arenaceous shales, and grey shales predominate. Water is generally found in the Ravenscrag formation, so that drilling is seldom carried down to the Eastend formation. On secs. 5 and 33, tp. 6, range 12, however, wells have penetrated the Eastend formation. In the 40-foot well on section 5 hard sand beds were encountered 8 feet from the surface and continued below the horizon near the base of the well at which the water was found. This water is of good quality and the supply is ample for 16 head of stock. A 12-foot sand bed was encountered at a depth of 12 feet in the well on section 33, but the sand is not water bearing. Below the sands were found 33 feet of grey clays which were underlain by the basal beds of the Eastend formation, but water was not obtained until the well penetrated several feet into the clays of the underlying Bearpaw formation. The water here is hard and is usable for the household, but the supply is very small. Ground water supplies similar to that from the well on section 5 may be expected from the Eastend formation at most points, but there are small areas, as in section 33, where due to lateral variations in the porosity of the formation it is not water bearing.

Toward the base of the Eastend formation the sand beds become thinner, less porous, and more limited in their areal extent. The upper sandy phases of the Bearpaw are believed to underlie the Eastend beneath Pinto butte and to underlie the drift along the lower slopes. More remote from the uplands the upper part of the Bearpaw formation was removed by erosion before the deposition of the glacial deposits. Sand beds are almost entirely absent in this part of the area and little ground water can be expected from the shales. The upper sand beds and the weathered upper few feet of the shale are found to be productive in some areas. Many of the wells produce only sufficient water for household use, whereas the yield from others is ample for 10 to 40 head of stock. Larger supplies are obtained from a few wells in township 6, range 12, and two of the wells each yield sufficient water for 100 head of stock. The water is generally very hard and contains large amounts of dissolved mineral salts which in several wells render the water unfit for household use and in a few places also unfit for stock. In all wells it appears that the water has been found close to the top of the formation. Deep drilling for water in this formation is considered to be useless.

## GROUND WATER CONDITIONS BY TOWNSHIPS

### Township 4, Range 10

Settlement is confined almost entirely to the northern half of the township, the southern half being used as grazing land. Ground water supplies for domestic purposes in the north are derived from wells tapping the Ravenscrag formation, and in the south the stock are watered from the creeks and springs.

A well located on section 1 is the only one drawing ground water from the glacial drift. A supply of water sufficient for only 21 head of stock is drawn from a gravel aquifer in this 16-foot well. Although information is indefinite it appears that the glacial drift in this township does not exceed 90 feet in thickness at any point. In most places it ranges from 10 to 30 feet in thickness and is absent in small areas where the Ravenscrag bedrock formation is exposed at the surface. The drift is mainly in the form of glacial till which consists of boulder clay in which are interspersed irregular pockets of gravel or sand. These pockets, such as encountered on section 1, are the only reliable source of ground water in the glacial drift. As these aquifers are not continuous careful testing will be necessary to locate them. The clays are more sandy in the moraine-covered area in the northern and northeastern part of the township, and are thus more permeable. Sand and gravel pockets probably are more numerous, so that less difficulty should be experienced in obtaining ground water supplies at shallow depths in this area.

A bed of coarse gravel interbedded with layers of sand is reported to underlie the glacial drift in section 1 on the southwest slope of Pinto butte. No wells have been sunk into those deposits, so that their water-bearing properties are as yet undetermined. The porosity of these beds, however, suggests that they are worthy of prospecting for ground water.

The Ravenscrag, Eastend, and Bearpaw formations are known to underlie the glacial deposits in various parts of the township, as shown on the accompanying map, Figure 1. The Ravenscrag formation, the uppermost of the three, extends over all but the southwestern lowlands corner of the township. The sand beds of this formation are considered to be the best source of ground water in the area. The majority of the wells tapping the Ravenscrag sand beds are less than 60 feet deep, but in sections 31 and 32 where the glacial drift overlying the Ravenscrag is thicker, it has been found necessary to sink to depths of 112 and 120 feet before water was encountered. The constancy with which wells in the northern third of this township have found water between elevations of 3,075 and 3,045 suggests that a fairly continuous aquifer exists at this elevation throughout at least the northern parts. This horizon may continue southward, to the edge of the butte. Two wells, located on sections 22 and 36, yield very small supplies, but all other wells tapping this formation give sufficient water for 10 to 30 head of stock. The water is hard. With the exception of the 65-foot well on section 22, all wells yield a water that is sufficiently low in dissolved mineral salts to be suitable for household use. Residents of the uplands area who have failed to obtain water at shallow depths in the drift are advised to continue wells down into the Ravenscrag formation.

Small supplies of water probably occur in the fine sand beds of the Eastend formation below the Ravenscrag. The greater depth necessary to tap this horizon and the fact that the overlying Ravenscrag has been found to be productive at all places where wells have penetrated into it makes it inadvisable to consider drilling to the Eastend beds.

In the southwest corner of the township the Bearpaw formation occurs immediately below the drift. No wells have been dug in this area. Sand beds occurring in the formation will contain water and where they are absent small quantities of water may be found in the shales at the top of the formation. The water will probably have a high dissolved mineral salt content which will render it unsuitable for drinking, and it may be unfit for stock use. Careful prospecting in the overlying glacial drift for water-bearing sand and gravel pockets or the construction of dams along the eastern branch of Breed creek is advisable rather than deep drilling into the compact shales of the Bearpaw formation.

Township 4, Range 11

Surface water in the creeks and stored by means of dams forms the main water supply of the township. Wells have been sunk at a few places, but in general the supplies derived from them are small. This ground water is derived largely from the glacial drift in the lowland parts of the township and from aquifers in the Ravenscrag bedrock formation in the upland areas.

The thickness of the glacial drift is not definitely known but is less than 10 feet over much of the area, and the bedrock is exposed at many points on the slopes. The boulder clay of which the glacial drift is largely composed is almost impervious, but sand and gravel pockets occur in the clay and act as reservoirs for ground water accumulation. Two wells, located on section 9, have tapped such aquifers and yield supplies of hard, "alkaline" water which is reported to be suitable for all farm purposes. The well on the N.E.$\frac{1}{4}$ yields sufficient water for only 8 head of stock, but a much larger supply is derived from the well on the N.W.$\frac{1}{4}$, indicating a more extensive gravel pocket. The gravels were found at depths of 8 and 12 feet in these wells. Careful prospecting in other parts of the township should locate supplies similar to these, but due to the irregular distribution of the porous beds and the thinness of the drift they are not to be expected at all points.

As shown on the map (Figure 1) the Ravenscrag formation occurs directly beneath the glacial drift in the northern part of the township. The covering of drift here is thin, so that the well on section 27 penetrated the Ravenscrag at a depth of less than 10 feet from the surface. The thickness of the drift may increase considerably, however, towards the northeast. Sufficient water for only 6 head of stock is obtained from the clay beds in the Ravenscrag formation in the well on section 27. It is believed that if this well were deepened slightly more productive sand beds might be found. These sand beds will doubtless occur at many places in the Ravenscrag formation and wells sunk at other localities in this township should tap them at depths probably nowhere greatly exceeding 60 feet. A number of springs occur along the outcrops of the Ravenscrag sand beds and the southern slopes of the uplands. These springs feed the numerous creeks and if suitable reservoirs were excavated would form a source of water for stock.

The Eastend formation underlies the Ravenscrag and extends immediately beneath the drift for a short distance beyond the southern limit of the Ravenscrag formation. No wells have as yet tapped this formation in this township, but its sandy members are probably water bearing. Some of the springs on the southern slopes may have their source in this formation. Water from the Eastend formation will probably be more highly mineralized than the Ravenscrag waters, and thus less desirable for household use. As the Eastend formation is overlain by the Ravenscrag throughout most of its extent, any wells that may be drilled will probably find water supplies in the overlying beds before reaching the Eastend.

The Bearpaw formation underlies the drift throughout the remaining parts of the township below an elevation of 3,050 feet above sea-level. Water-bearing sand beds are expected to occur either at the contact of the drift and the shale or in the sandy members and upper parts of the shale itself. Such a sand bed in the upper part of the formation has been tapped by an 18-foot well dug on section 4. This well yields only sufficient water for 17 head of stock. The amount of dissolved mineral salts present in the water is sufficient to render it unfit for household use, but it is being used for stock watering. Supplies of similar quality should be obtainable throughout this area from sand beds or from the shales at the top of the formation. Water from the shales will probably be inferior in quality to that from the sands, and the yield will undoubtedly be smaller. In order to obtain water of better quality in this area it will be necessary to locate water bearing sands or gravels in the overlying glacial deposits, and this may require considerable testing. Residents of the lowland areas having large herds of stock are advised to construct dams on the larger creeks, rather than to resort to deep drilling which cannot be expected to yield any large water supply.

Township 4, Range 12

Ground water supplies in this township are derived from the Recent stream deposits in the valleys and from the glacial till. A few of the wells yield adequate supplies of water, but several others fail to produce more than enough water for household requirements and a very few head of stock. Several such wells may be necessary to meet local requirements.

The Recent deposits consist largely of silts interspersed with pockets of gravel. Such deposits will be found adjacent to the watercourses only, and probably will not exceed 15 feet in thickness at any point. Gravel and sand have been encountered in wells close to the creek on sections 7 and 18, and large water supplies have been obtained; one well has sufficient water for 80 head of stock. In wells in the valleys in which only the silts have been found the yields are small. Sands and gravels are sufficiently plentiful, however, even in the draws to ensure at least a small supply of water. Many of the coulées offer suitable dam sites. With continued drought in this area it will become increasingly more important to store the spring surface run-off, as no large source of ground water can be expected by deep drilling.

The glacial drift covering the uplands is composed largely of boulder clay. Sand and gravel pockets are scattered through the clay. These pockets have been tapped at several points in the township at depths of from 7 to 20 feet, and supplies of good water have been obtained. The quantities yielded by individual wells range from that sufficient only for household use to quantities ample for 60 head of stock. The yield depends largely upon the lateral extent of the aquifer tapped. The average supply to be expected will water 10 to 20 head of stock. Due to the discontinuity of these aquifers water supplies will not be obtained at all points. These pockets are so numerous, however, that careful testing on any section should encounter one of them and a series of test holes sunk in the vicinity of some of the poorer wells might locate larger supplies.

The dark grey, largely impervious shales of the Bearpaw formation are believed to underlie the glacial drift in all parts of the township. Ground water probably occurs at the contact of the drift and the shale. The 30-foot well located on section 20 may be deriving its small supply of highly mineralized, undrinkable water from this horizon. Sand beds may be present in the upper part of the formation in the northeastern sections of the townships, but there can be no assurance that the water will be of essentially better quality than supplies from the well on section 20. It is probable that at depths below 25 feet, from the point where the formation is first encountered in wells, the supply will become very small and too highly charged with mineral salts in solution to be used either for the household or for stock. Deep drilling in any part of this township is not recommended.

Township 5, Range 10

Only one well has been sunk in the immediate vicinity of Wood river. This well is 8 feet deep and yields a sufficient quantity of hard, slightly "alkaline" water for household use and for 25 head of stock. The productive gravel beds are probably irregularly scattered through the silts and systematic prospecting will be necessary before they are encountered. Water found in deposits along this stream should be of better quality than supplies derived from stream deposits in the lowlands, as the presence of the Ravenscrag formation rather than the Bearpaw formation bordering the creek offers less opportunity for the waters, seeping from the uplands, to become charged with mineral salts.

Although the glacial drift covers the whole township its importance as a source of ground water varies in different parts of the area. Over the uplands the drift is thin and the gravel beds scattered through it are by no means numerous. Throughout the greater part of the uplands area residents are better advised to deepen wells through the glacial till, which may vary from 10 to 40 feet in thickness, to the productive beds of the underlying Ravenscrag formation. Only in the irregularly rolling, moraine-covered area of the uplands, which extends as a belt approximately $1\frac{1}{2}$ miles wide from east to west across the centre of the township, can the gravel pockets be considered to be sufficiently numerous to warrant prospecting at shallow depths in the drift.

In the lowland region the drift is underlain by the Bearpaw formation, from which little ground water can be expected. Hence, in these parts extensive prospecting at shallow depths within 40 feet of the surface is advisable rather than deep drilling. Wells located in valleys in the N.E.$\frac{1}{4}$'s of sections 25 and 35, and sunk to depths of 30 and 22 feet, respectively, yield the largest supplies of the shallow wells in the area. The well on the N.E.$\frac{1}{4}$, section 25, gives a supply of drinkable water sufficient for at least 40 head of stock. At other places in the coulées the shallow wells are less productive and dams are necessary to supplement the supply. Extensive testing at shallow depths may locate gravel pockets that will yield small supplies of water. Wells that have been sunk into the bedrock derive a part at least of their supply from sand beds occurring at the contact of the drift and the underlying Bearpaw shales. Two such wells are located on the S.E.$\frac{1}{4}$'s of sections 32 and 33. These wells are 40 and 30 feet deep, respectively, and yield sufficient quantities of hard water for 12 and 18 head of stock, respectively. As is to be expected of waters seeping through the overlying boulder clay and being concentrated on the surface of the shale, the water contains considerable amounts of mineral salts in solution, but is being used in the households. The bases of slopes, knolls, gravel ridges, and undrained depressions have all proved to be suitable well sites in till-covered areas in many parts of southern Saskatchewan, and such situations should be considered in attempting to find water at shallow depths in this area.

The Ravenscrag bedrock formation underlies the mantle of boulder clay at depths ranging from 10 feet or less on hill-slopes to 30 to 40 feet on some of the uplands throughout all but the north-central and northeastern sections of the township. The sand beds of this formation form the most reliable sources of ground water in this part of the township. The variation in elevation between 3,104 and 2,863 feet above sea-level at which the productive horizons have been encountered suggests that individual water-bearing beds may not cover large areas. They are sufficiently numerous, however, to ensure tapping an aquifer within 60 feet of the surface in practically all parts of this area. The wells range in depth from 12 to 65 feet. A few of the wells encountering only sandy shale yield only sufficient water for domestic needs, but in the majority the yield is sufficient for 10 to 20 head of stock. The water from these wells is hard and contains dissolved sulphate salts, and in some places iron. These impurities are not generally in sufficient concentration, however, to make the water unsatisfactory for household use.

The Eastend formation, composed of some 30 to 50 feet of fine sands and silts, underlies the Ravenscrag formation over the uplands region below an approximate elevation of 2,950 feet above sea-level. No wells have penetrated this formation, so that no information regarding its water-bearing properties can be given. It is probable that greater amounts of mineral salts in solution will be found concentrated in the water from this formation. Should the overlying Ravenscrag prove to be unproductive drilling to this formation for a stock water supply seems advisable.

Deeper drilling into the dark grey shales of the Bearpaw formation that underlies the Eastend on the upland is not recommended, as the supply to be expected will be doubtless small and the water will be of very poor quality. Both the Ravenscrag and the Eastend formations have been removed by erosion from the lowlands in the north and the glacial drift rests directly upon the surface of the Bearpaw shale. The upper few feet of the shale is in some places porous. A supply of good water sufficient for 18 head of stock is obtained from the well on the SE.$\frac{1}{4}$, section 33, but only small supplies are obtained from the other wells, and the water from one of these is unfit for household use. It is extremely improbable that wells sunk below the upper 25 feet of the shale will produce a supply of water suitable either in quality or quantity for any farm requirements. In view of the uncertainty of obtaining water that may be used for stock even in the upper part of the formation careful prospecting in the overlying drift is recommended. Should this source prove inadequate dams constructed in the coulées will retain a water supply for the greater part of the summer, but may prove inadequate toward autumn.

Township 5, Range 11

Although no serious lack of ground water has been experienced in this area several of the residents have had some difficulty in obtaining adequate supplies. Ground water conditions are to a large extent similar to those in other townships of the municipality, except that springs are not so numerous. Fewer dams have been constructed in coulées to conserve the spring run-off. If drought conditions recur dams and dugouts will be necessary, especially if a very large number of stock are to be watered.

Thin layers of Recent stream deposits consisting of silts, sands, and gravels occur along creek beds in the valleys. Shallow wells dug into these deposits should find supplies of water suitable for household use and for watering a few head of stock. A mantle of glacial till composed largely of yellowish brown boulder clay covers the bedrock to depths probably nowhere greatly exceeding 50 feet. As is usual in the drift, the water-bearing beds are irregularly interspersed and vary greatly in their areal extent, and hence in the amounts of water they will yield. Shallow wells located on the plains do not generally yield more than enough water for household use and at the most, for 10 to 12 head of stock. Undrained depressions and the bases of slopes providing larger catchment areas are better locations. Two wells sunk to depths of 35 feet in a depression on section 16 each yield sufficient quantities of hard, drinkable water for 50 head of stock.

If after careful prospecting in the glacial drift an adequate water supply is not obtained residents of the uplands area should sink wells through the boulder clay into the underlying Ravenscrag formation. Wells sunk to depths of 60 to 85 feet in sections 20, 27, and 28 have encountered supplies of water in blue-grey, sandy clay. The yield from each well is sufficient for 15 to 20 head of stock. Since the aquifers of these wells all occur at elevations between 3,000 and 2,970 feet above sea-level, it seems probable that the aquifer is fairly continuous in this part of the township. The water contains mineral salts in solution, but only in one well on the NE.$\frac{1}{4}$, section 20, was the water found to be too highly mineralized for domestic use.

In the south the ground water conditions in the Ravenscrag formation are poorer. Wells sunk to depths of 110 and 64 feet on sections 2 and 3 yield small supplies of water from sandy clay and from a sand bed. Since these wells are located near the height of land for the region, the catchment area for aquifers in the bedrock is small. Wells in the townships to the east, southeast, and south have encountered fairly large supplies of water from sands and sandy clays of the Ravenscarg, at elevations between 3,080 and 3,060 feet above sea-level. It is possible that had the well on section 2 of this township been extended some 40 to 60 feet deeper it would have encountered a larger supply. The water is not under pressure in the lower aquifer.

The Eastend formation underlies the Ravenscrag through the uplands area. No wells have been sunk through the Ravenscrag into the Eastend formation and hence no information was obtained regarding the ground water conditions of this formation. Since no large catchment area by which ground water could enter the Eastend formation is present in the upland area it is improbable that any large supply of water will occur in it.

Even less possibility of obtaining ground water exists in the Bearpaw formation underlying the Eastend beds. Four wells sunk to depths of 30 to 60 feet draw water from the Bearpaw formation where it is covered only by glacial drift, in two small areas in the northern lowlands part of the township. No water-bearing sand beds are recorded in these wells, but the water may occur in thin layers of sand interbedded with the dark grey shales. Individual wells are producing supplies sufficient for 10 to 40 head of stock. The water contains large amounts of dissolved mineral salts, but is being used in the household with no apparent ill effects. In these areas prospecting should be confined to the stream deposits to the glacial drift, and to the upper 50 feet of the underlying shales. Below this depth the shales probably become more impervious and the small supplies of water obtainable will be too highly charged with dissolved mineral salts to be used for domestic use or for watering stock.

Township 5, Range 12

The greater part of the township is used for cattle grazing, so that at the present time the amount of ground water required for domestic purposes is small. Numerous springs and several spring-fed creeks supply ample water for the stock.

No water is at present being derived from the till that covers the whole township, as the only wells in the area derive their supply from the Bearpaw formation. The thickness of the glacial till has not been definitely determined, but it is not believed to greatly exceed 25 feet at any point. Sand and gravel pockets occur in the impervious boulder clay and they should be productive of fairly good water supplies. However, these pockets occur rather sparingly and some difficulty may be experienced in locating them. Should further supplies of water for domestic purposes be needed in this area it would be advisable to test carefully in the glacial drift for sand or gravel aquifers, particularly in the southwestern half of the township.

Throughout the northeastern half of the township the Ravenscrag formation lies directly beneath the glacial drift. As no wells have been sunk in this locality, no information could be obtained as to its water-bearing characteristics, but the conditions are probably very similar to those in this formation in the township to the east. The water-bearing sand beds of this formation should be found at depths ranging from 20 to 50 feet. Good water may be expected from this source, and supplies should be sufficient for 10 to 30 head of stock. Many of the springs that occur on the slopes probably derive their supply from the Ravenscrag formation. This formation is to be regarded as the best source of ground water in the township.

The Eastend formation underlies the Ravenscrag throughout the northeastern half of the area, and since it occurs at a slightly lower elevation it extends beneath the drift a short distance beyond the boundary of the upper formation. Ground water probably occurs in the sandy beds of this formation, but is more inaccessible than the water in the overlying Ravenscrag beds, and is thus of less value. Some of the springs on the slopes may mark outcrops of water-bearing horizons in the Eastend formation.

The glacial drift throughout the southwestern half of the township is underlain by the Bearpaw formation, which is tapped by the wells on sections 2 and 7. On section 2 a sand bed was encountered which yields a supply of hard, "alkaline" water sufficient for 25 head of stock. On section 7 no sand was found and the water located in the shale is too highly mineralized to be used for stock. Evidently the sand beds are not continuous, but where they can be located water supplies may be obtained. Along some of the creek valleys springs issue from the Bearpaw formation. Throughout the lowland area three possible horizons exist in which ground water may be obtained at shallow depths. They are: the scattered sand and gravel pockets in the drift; beds of sand occurring at the contact of the drift, and the underlying Bearpaw formation; and thin beds of sand and sandy shale in the upper few feet of the Bearpaw formation. All of these horizons should be accessible within 35 feet of the surface. Deeper wells are not advisable in this half of the township, as only the compact grey shales will be encountered, from which at best only a bitter, undrinkable water, unfit even for stock use, can be expected.

Township 6, Range 10

The greater part of the ground water supply in this township is obtained from wells in the glacial drift. A few wells, however, obtain water from the underlying Bearpaw formation.

Adjacent to the stream channels in the valleys are layers of Recent stream deposited silts, in which are interspersed thin layers of sands and gravels. No wells have asyet been dug into these deposits, but little prospecting should be necessary before sand and gravel beds are encountered from which are to be expected moderately large supplies of good water. All other parts of the township are covered by glacial deposits of various types, the distribution of which is shown on the accompanying map, Figure 1. Glacial lake clays covering the small lowland area in the northeast corner of the township are probably quite sandy throughout this area, as wells on sections 24 and 35 are producing good supplies from these deposits at depths of 29 and 18 feet from the surface. Other wells in this area have located water at only slightly greater depths in sand beds that are believed to lie between the lake clay and the underlying boulder clay. Ground water supplies in sufficient quantities for local requirements should be available almost anywhere in this area.

The greater part of the township is blanketed by glacial till which contains occasional pockets of water-bearing sand and gravel. Small supplies are sometimes obtained from the clays where they contain a large proportion of sand, but usually, however, distinct sand or gravel pockets must be located before any large supplies are obtained. These pockets have been encountered in a number of wells at depths ranging from 11 to 38 feet. In some places the yield of water is only sufficient for household use, but other wells produce enough water for 10 to 25 head of stock. Soft water is found in a few of the shallower wells, but in most places the water is hard and of good quality for drinking. The well on the SE.$\frac{1}{4}$, section 23, is the only one in the township that is reported to be deriving water that is unfit for household use from the glacial drift. Further testing in the glacial drift for sand and gravel aquifers is advisable when it becomes necessary to increase the present supply. Sands and gravels probably are more abundant in the more rolling and hillocky moraine covered area located in the central part of the township. Ground water supplies should be found with less testing in these deposits than in the till-covered areas.

A few wells penetrating the Bearpaw formation have obtained water supplies. The water is found in thin sand beds occurring in the shales, or from the weathered, more porous shales near the top of the formation. Continuous water-bearing horizons have not been traced, but the water is believed to be confined to the contact of the overlying boulder clay and the shale and to the upper few feet of the shale. The wells obtaining this water range in depth from 30 to 60 feet. Deeper drilling is not advisable. Only small quantities of water are usually obtained from the shale, but a well on section 12 produces ample water for 35 head of stock. This is the only well that is deriving good water from the Bearpaw formation, in the other wells the water is too highly mineralized even for stock use.

Township 6, Range 11

Creeks and small dams constructed along them provide an increasingly important source of water for stock in this area. The greater amount of the ground water being used in this township is derived from the Bearpaw formation, and the remainder is from the overlying glacial drift. In most places sufficient water is obtained to satisfy local requirements.

The thin layer of Recent deposits along the creek has not been tested for ground water supplies. Shallow wells dug in these deposits should obtain supplies of good water from sand and gravel aquifers buried in the silts.

A mantle of glacial drift, believed to range in thickness from 10 to 30 feet, covers the remainder of the township. A few wells have struck water-bearing sand and gravel pockets in the boulder clay and from them obtain enough water for household use, but little or no water is obtained from the boulder clay itself which forms the greater part of the glacial drift. An area of moraine covers the southeastern part of the township. In this area two wells, sunk to depths of 15 and 24 feet, have located good water supplies in gravel pockets. One well yields enough water for 20 head of stock, whereas the supply from the other is ample for 45 head. The clays comprising much of the moraine are more sandy, and gravel and sand pockets occur in greater abundance than in the till, so that ground water supplies should be found with less testing in this area. In the southeast corner of the township little difficulty should be experienced in locating suitable ground water supplies in the drift or in the underlying bedrock formations. Throughout the remainder of the area should testing for gravel pockets in the upper part of the drift prove unproductive there remains the possibility of obtaining water at the contact of the blue-grey boulder clay and the underlying dark grey shales of the Bearpaw formation. The depth to this contact varies in different places, but nowhere has it been necessary to sink wells deeper than 50 feet to encounter this horizon.

The sand and sandy clays of the Ravenscrag and Eastend formations occur immediately underlying the glacial drift in small areas in the southern part of the township. No wells have as yet been dug in these areas. As evidenced by wells in the townships to the south and to the west water-bearing horizons occur in both of these formations. Supplies of good water may be expected from wells less than 50 feet deep in these areas. Should the drift prove to be unproductive, the deepening of the wells down into these formations is recommended.

Many wells have been sunk into the Bearpaw formation which lies below the glacial drift throughout the remainder of the township. In all these wells the water is reported to be coming from the heavy clay or shales. It is probable that thin sand beds interbedded with the shales form the aquifers and have not been noticed in digging the wells. Continuous aquifers are not traceable, but the ground water seems to occur close to the top of the formation at all places. There is little uniformity in the quantity or quality of the waters obtained. Supplies from a few wells are sufficient only for household use, whereas other wells yield enough water for 10 to 40 head of stock. Large amounts of dissolved mineral salts are contained in the waters from all these wells, but although the water is used for drinking in most places the water from a few wells has a sufficient concentration of salts to prohibit its use for household purposes. Supplies of water suitable for stock are believed to be obtainable, however, from the upper 20 feet of the Bearpaw formation at nearly all points in the township. It is believed that the shales act as an impervious bed and thus trap water seeping downward through the drift. Hence, boring to depths much below the upper few feet of the shale cannot be expected to yield any large supply of water. It is also probable that, due to the quantities of mineral salts inherent in the shale, water from any great depth in this formation will be too highly mineralized for either domestic use or for stock. The increase in the amounts of mineral salts in solution with depth is illustrated by the undrinkable quality of the water from the 80- and 75-foot wells on sections 16 and 22, as compared with the comparatively good supplies from the 35- and 30-foot wells located on sections 5 and 17.

## Township 6, Range 12

Little difficulty has been experienced in obtaining adequate water supplies in this district, but during recent years the yield of many of the wells has decreased markedly. Few dams have been constructed to conserve the surface run-off in this area, but in several of the coulées and small stream valleys there are good dam sites. A few residents of the lowland plain have excavated dugouts and thus supplement the supply of stock water from wells. The glacial drift and the Ravenscrag, Eastend, and Bearpaw bedrock formations all form sources of ground water in this township.

Thin layers of Recent stream deposits occurring along the creek valleys are probable sources of ground water, particularly for household use. Shallow wells encountering sands or gravel buried in the silts may be expected to yield supplies of water less highly mineralized than from either the glacial drift or the shales of the Bearpaw formation. The greater part of the township is covered by glacial till which is believed to vary in thickness from place to place within a range of 10 to 50 feet. The only ground water supplies obtainable from these deposits will be found in sand or gravel pockets which are interspersed through the boulder clay. The sparsity of their occurrence is evidenced by the fact that nearly all of the wells in the township have passed through the drift into the underlying bedrock without encountering water in the drift. However, these pockets do occur in some localities and prospecting at shallow depths near the base of slopes and in undrained depressions should yield small supplies of water suitable for drinking and for stock.

Water supplies are obtained from the bedrock formations with little difficulty. The map, Figure 1, shows the areas in which the Ravenscrag, Eastend, and Bearpaw formations are found directly beneath the glacial drift. The Ravenscrag formation is largely untested for ground water in this township. A single well sunk to a depth of 55 feet on the SW.$\frac{1}{4}$, section 28, may be drawing its water from this formation, but the elevation of the aquifer suggests that the well has penetrated into sand beds in the underlying Eastend formation. Beds of sand which form the greater part of the Ravenscrag formation in this district have been found to be water bearing in adjoining townships. Prospects seem equally good of obtaining adequate supplies of water from this formation in this township by sinking wells to depths not exceeding 50 feet.

A 40-foot well on section 5 is drawing water from a sand bed in the Eastend formation, but another well on section 33 passed through the sands of this formation to obtain water in the underlying Bearpaw formation at a depth of 80 feet from the surface. The water derived from the well on section 5 is of good quality and the supply is ample for 16 head of stock. This water-bearing horizon is probably fairly continuous in the Eastend formation in the upland parts of this township, so that should the overlying

Ravenscrag beds be thin there remains a good possibility of obtaining water in the finer sand beds below. It is to be noted that no large catchment area occurs on the uplands whereby the bedrock supplies can be readily replenished, and hence large supplies of water are not to be expected there. Under the existing conditions the excavation of large dugouts or the construction of dams appear to be necessary if large herds of range stock are to be watered.

The Bearpaw formation underlies the Eastend beds of the uplands and extends immediately beneath the glacial drift throughout the remainder of the township. As in the other townships, the upper part of the Bearpaw formation is sandy whereas at greater depths dark impervious shales predominate. A number of wells are deriving good supplies of water from this formation throughout the lowlands plain area. The depth of wells ranges between 15 and 80 feet depending upon the thickness of the glacial covering. Individual wells produce sufficient water for 10 to 40 head of stock and two wells sunk to depths of 60 and 24 feet, in sections 23 and 24, each produce ample supplies for 100 head. Supplies this large are not to be anticipated in most places. It is possible that much of the water is derived from sand beds at the contact between the blue-grey boulder clay and the Bearpaw formation. In many of the wells this water horizon has been struck at depths of less than 40 feet, but occasionally it was found necessary to extend the wells down into the shales. The quality of the water varies from place to place. All supplies from this source contain a considerable concentration of dissolved mineral salts, which make the water inferior in quality for household use to supplies from Recent stream deposits or the sandy bedrock formations of the uplands. In only one well, situated on the NE.$\frac{1}{4}$, section 1, however, is the water considered to be too highly charged with sulphate salts in solution to be fit for drinking.

It is improbable that either the quantity or quality of the water will improve in this formation at greater depths. An 80-foot well located in the NW.$\frac{1}{4}$, section 23, yields water reported to be of good quality, from a sandy layer in blue clay, in sufficient amounts for watering 45 head of stock. It is improbable, however, that sinking wells much deeper than 100 feet in the lowlands area will yield a satisfactory water supply. Many springs occur in valley sides of this area. This water is believed to come from sandy beds of the Bearpaw formation. The occurrence of such springs suggests that at least the upper beds of the Bearpaw formation are sufficiently sandy to be water bearing.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF GLEN McPHERSON, NO.46, SASKATCHEWAN

| Township | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | Total No. in Municipality |
|---|---|---|---|---|---|---|---|---|---|---|
| West of 3rd meridian — Range | 10 | 11 | 12 | 10 | 11 | 12 | 10 | 11 | 12 | |
| Total No. of Wells in Township | 16 | 12 | 22 | 46 | 21 | 6 | 45 | 71 | 30 | 269 |
| No. of wells in bedrock | 15 | 4 | 0 | 28 | 13 | 6 | 11 | 64 | 27 | 168 |
| No. of wells in glacial drift | 1 | 8 | 20 | 17 | 8 | 0 | 34 | 7 | 3 | 98 |
| No. of wells in alluvium | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Permanency of Water Supply | | | | | | | | | | |
| No. with permanent supply | 11 | 9 | 17 | 40 | 21 | 6 | 45 | 47 | 28 | 224 |
| No. with intermittent supply | 1 | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 1 | 10 |
| No. dry holes | 4 | 1 | 0 | 6 | 0 | 0 | 0 | 23 | 1 | 35 |
| Types of Wells | | | | | | | | | | |
| No. of flowing artesian wells | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. of non-flowing artesian wells | 3 | 1 | 0 | 6 | 1 | 0 | 10 | 2 | 1 | 24 |
| No. of non-artesian wells | 9 | 10 | 22 | 34 | 20 | 6 | 35 | 46 | 28 | 210 |
| Quality of Water | | | | | | | | | | |
| No. with hard water | 9 | 11 | 17 | 38 | 18 | 6 | 33 | 47 | 27 | 206 |
| No. with soft water | 3 | 0 | 5 | 2 | 3 | 0 | 12 | 1 | 2 | 28 |
| No. with salty water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. with "alkaline" water | 1 | 7 | 5 | 13 | 4 | 4 | 11 | 16 | 10 | 71 |
| Depths of Wells | | | | | | | | | | |
| No. from 0 to 50 feet deep | 11 | 11 | 22 | 40 | 15 | 6 | 42 | 53 | 24 | 224 |
| No. from 51 to 100 feet deep | 3 | 1 | 0 | 6 | 5 | 0 | 3 | 15 | 6 | 39 |
| No. from 101 to 150 feet deep | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 6 |
| No. from 151 to 200 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. from 201 to 500 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. from 501 to 1,000 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. over 1,000 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| How the Water is Used | | | | | | | | | | |
| No. usable for domestic purposes | 11 | 11 | 19 | 36 | 18 | 3 | 33 | 37 | 27 | 195 |
| No. not usable for domestic purposes | 1 | 0 | 3 | 4 | 3 | 3 | 12 | 11 | 2 | 39 |
| No. usable for stock | 11 | 11 | 20 | 39 | 21 | 3 | 35 | 45 | 29 | 214 |
| No. not usable for stock | 1 | 0 | 2 | 1 | 0 | 3 | 10 | 3 | 0 | 20 |
| Sufficiency of Water Supply | | | | | | | | | | |
| No. sufficient for domestic needs | 10 | 9 | 17 | 40 | 21 | 6 | 45 | 45 | 28 | 221 |
| No. insufficient for domestic needs | 2 | 2 | 5 | 0 | 0 | 0 | 0 | 3 | 1 | 13 |
| No. sufficient for stock needs | 8 | 3 | 13 | 31 | 17 | 6 | 29 | 38 | 28 | 173 |
| No. insufficient for stock needs | 4 | 8 | 9 | 9 | 4 | 0 | 16 | 10 | 1 | 61 |

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

Analyses of Water Samples from the Municipality of Glen McPherson, No. 46, Saskatchewan

| LOCATION | | | | | | Depth of | Total | HARDNESS | | | CONSTITUENTS AS ANALYSED | | | | | | CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS | | | | | | | | | Source of |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Qtr. | Sec. | Tp. | Rge. | Mer. | Well, Ft. | dis'vd solids | Total | Perm. | Temp. | Cl. | Alka-linity | CaO | MgO | $SO_4$ | $Na_2O$ | Solids | $CaCO_3$ | $CaSO_4$ | $MgCO_3$ | $MgSO_4$ | $Na_2CO_3$ | $Na_2SO_4$ | NaCl | | Water |
| 1 | NE. | 32 | 4 | 10 | 3 | 27 | 2,840 | 800 | 600 | 200 | 14 | 575 | 260 | 166 | 1,583 | 842 | 2,855 | 405 | | 92 | 365 | | 1,910 | 23 | | * 2 |
| 2 | SW. | 16 | 5 | 10 | 3 | 47 | 1,609 | | | | | | | | | | | | (2) | | (3) | (4) | (1) | (5) | | * 2 |
| 3 | SE. | 28 | 5 | 11 | 3 | 60 | 780 | 200 | 50 | 150 | 13 | 520 | 20 | 40 | 152 | 346 | 772 | 36 | | 84 | | 407 | 224 | 21 | | * 2 |
| 4 | SW. | 33 | 5 | 11 | 3 | 50 | 300 | 260 | 160 | 100 | 12 | 170 | 30 | 50 | 37 | 30 | 225 | 54 | | 98 | 9 | | 44 | 20 | | * 3 |
| 5 | SE. | 28 | 6 | 11 | 3 | 45 | 4,200 | 700 | 500 | 200 | 35 | 375 | 60 | 144 | 2,444 | 151 | 3,988 | 107 | | 226 | 107 | | 3,490 | 58 | | * 3 |
| 6 | SE. | 23 | 6 | 12 | 3 | 60 | 2,860 | 1,400 | 950 | 450 | 35 | 345 | 170 | 227 | 1,747 | 833 | 2,868 | 304 | | 36 | 626 | | 1,844 | 58 | | * 3 |

Water samples indicated thus, * 2 are from bedrock, Ravenscrag formation.

Water samples indicated thus * 3 are from bedrock Bearpaw formation.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analysis No. 2, 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 ground water from the unconsolidated deposits of this municipality were collected for analysis. The few generalizations made regarding differences in the qualities of waters from the various types of Recent and glacial deposits are based upon observations at the well sites, upon the reports of the residents, and upon analyses of waters from adjoining municipalities in which the character of the unconsolidated deposits shows similarity.

Only three wells in the area, located on the NE.$\frac{1}{4}$, sec. 7, and SE.$\frac{1}{4}$, sec. 18, tp. 4, range 12, and on SE. sec. 12, tp. 5, range 10, are known to be deriving supplies from the Recent stream deposits. The first well yields a hard water that is reported to be "alkaline", whereas, water from the second is moderately soft. The quality of waters from these thin deposits is influenced by the following conditions: the character of the deposits on the uplands through which the surface waters have percolated before collecting in the stream valleys, and, to a more limited extent, to the porosity of the stream deposits themselves. In areas where surface water seeps through boulder clay or the dark grey shales of the Bearpaw formation large amounts of mineral salts are taken into solution. These salts create a bitter taste and give a laxative effect to the waters in the valleys. In those areas of the uplands in which the water supplies are derived from springs and seepages issuing from beds of the Ravenscrag and Eastend formations less opportunity is afforded the water of becoming charged with mineral salts. Supplies from the deposits near the headwaters of the creeks flowing from Pinto butte should be of good quality for household use, whereas more remote from the uplands larger concentrations of dissolved salts are to be expected.

Fine silts in addition to being relatively poor water reservoirs seem to lend to the concentration of mineral salts, whereas the more porous gravels allow a more rapid circulation of the water and less opportunity for the concentration of salts. Residents contemplating sinking wells in the stream deposits are advised to prospect for gravel beds that occur in the silts and to avoid areas where the dark bedrock shales are exposed along the valley sides. The concentration of mineral salts in the stream deposits in this area is seldom if ever sufficiently high to render the water unfit for watering stock.

Great variations in the character of waters from the glacial deposits are noted throughout the region and often in small areas. One well may yield a moderately soft, drinkable water, whereas another well sunk to a similar depth only a few hundred feet away may find water too highly charged with sulphate salts to be fit even for watering stock. It must not be inferred, therefore, that if water of poor quality is encountered in one well such conditions must, of necessity exist over an extensive area. The boulder clay is considered to be the source of the mineral salts, of which sodium sulphate (Glauber's salt) and magnesium sulphate (Epsom salts) are the most common and the most objectionable. In wells tapping extensive gravel deposits at shallow depths the water is being derived by direct seepage from the surface. It has little opportunity of encountering extensive thicknesses of boulder clay and is hence only slightly mineralized and in many places of excellent quality for domestic use. Wells deriving their supplies from small pockets lying beneath any considerable thickness of boulder clay yield a much more highly mineralized water. Water from wells sunk entirely in boulder clay may be too highly charged with mineral salts to be used for watering stock. Similar conditions exist in a few of the sloughs formed in undrained depressions. Water seeps in from the boulder clay, and in places from the bedrock, and constant surface evaporation tends to concentrate the mineral salts in solution. Water that is not considered to be suitable for drinking may in many cases be used for stock watering, and during the winter months when stock are fed on dry fodder a slight laxative effect of the water is not considered harmful.

## Water from the Bedrock

The analyses of two samples of ground water from the Ravenscrag formation that were collected in the municipality are given in the accompanying table of analyses, together with an analysis made by the Provincial Analyst. Of the three analyses given of waters from aquifers in the Ravenscrag formation it will be noted that two general types are represented, one essentially a sulphate water and the other a "soda-bearing" water. The first and second analyses given are of waters of the first type. They are in general characteristic of supplies from shallow wells in the Ravenscrag formation. The dominant salt present in solution in both waters is sodium sulphate ($Na_2SO_4$). The laxative effects of these waters depend upon the concentration of this salt and of magnesium sulphate ($MgSO_4$). Both waters are being used for drinking with no reported ill effects, although they would undoubtedly prove laxative to persons unaccustomed to their use. The first water is considered to approach the upper limit of sulphate salt concentration for potable waters. Both of these waters are hard. The hardness is largely permanent and cannot be removed by boiling. It is believed that the water from the well on the NE.$\frac{1}{4}$, sec.32, tp. 4, range 10, is more highly mineralized than is generally to be expected in waters found at shallow depths in this formation. The second analysis is probably more representative of the waters from the Ravenscrag.

The third water analysed is from a 60-foot well located on the SE.$\frac{1}{4}$, sec. 28, tp. 5, range 11. It is considered to be characteristic of waters from the deeper wells sunk into the Ravenscrag formation. The total solid content is lower than in the near surface waters, and this content is made up largely of sodium carbonate ($Na_2CO_3$) with only minor amounts of the sulphate salts. This water is hence much softer than waters from the upper part of the Ravenscrag or from the glacial deposits. The hardness may largely be removed by boiling. A slight flat taste may be noticeable due to the concentration of "soda", but the water is suitable for drinking and of excellent quality for laundry purposes. The sodium carbonate (black alkali) is harmful to vegetation and this water cannot be considered to be beneficial to garden or house plants. It is presumable that at greater depths in the Ravenscrag still larger amounts of sodium carbonate will be found, with correspondingly lesser amounts of the sulphate salts.

No samples were taken of waters from the Eastend formation. It is presumable that the waters from the upper part of the formation, where it is overlain by the Ravenscrag, will be soft and contain large amounts of sodium carbonate. Waters from greater depths in the formation, however, will resemble supplies from the underlying Bearpaw formation to a large extent.

As is to be expected in a formation definitely known to be of marine origin, the Bearpaw shales contain inherently large amounts of dissolvable mineral salts. The sand beds found in the upper part of the formation are water bearing, but the water invariably contains large amounts of both sodium sulphate and magnesium sulphate in solution. Analyses 5 and 6 given on the accompanying table are believed to be representative not only of the salts generally found but also the relative proportions of their occurrence. Both waters are extremely hard. The sixth analysis is considered to be characteristic of supplies derived from the upper sandy beds of the formation. Due to the presence of 626 parts per million of magnesium sulphate, together with 1,844 parts per million of sodium sulphate, this water would undoubtedly prove to be laxative to persons not using it continually. It is being used for stock watering with no apparent ill effects. The fifth analysis is of water that is too "alkaline" for drinking, due to its content of 4,200 parts per million of total solids in solution. This water also lies near the upper limit of waters considered suitable for stock use. Sample No. 4, also representing water from the Bearpaw formation, is exceptionally good water, as shown by the analysis.

# WELL RECORDS—Rural Municipality of GLEN McPHERSON NO. 46, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NE. | 1 | 4 | 10 | 3 | Dug | 16 | 3,100 | - 12 | 3,088 | 12 | 3,088 | Glacial gravel | Soft, clear | | D, S | Insufficient for 21 head stock. |
| 2 | NE. | 20 | " | " | " | Dug | 7 | 3,008 | - 2 | 3,006 | | | Ravenscrag clay | Hard, clear | | D, S | Sufficient for 30 head stock. |
| 3 | NW. | 22 | " | " | " | Bored | 65 | 3,188 | | | | | Ravenscrag sand | Hard, clear, "alkaline" | | N | A spring is used for house and stock. |
| 4 | NW. | 27 | " | " | " | Dug | 30 | 3,110 | - 8 | 3,102 | 30 | 3,080 | Ravenscrag shale | Hard, clear | | D, S | Sufficient for 25 head stock. |
| 5 | SW. | 30 | " | " | " | Bored | 65 | 3,112 | - 48 | 3,064 | 65 | 3,047 | Ravenscrag shale | Hard, clear | | D, S | Sufficient for 20 head stock. |
| 6 | NE. | 31 | " | " | " | Bored | 112 | 3,150 | - 85 | 3,065 | | | Ravenscrag clay | Hard, blue | | D, S | Trace of oil present. Several dry holes. |
| 7 | NW. | 32 | " | " | " | Bored | 120 | 3,144 | - 90 | 3,054 | 90 | 3,054 | Ravenscrag shale | Hard, clear | | D, S | Sufficient for 10 head stock. |
| 8 | NE. | 32 | " | " | " | Dug | 27 | 3,100 | | | 27 | 3,073 | Ravenscrag | Hard, clear | | D, S | Sufficient for 10 head stock. # |
| 9 | NE. | 36 | " | " | " | Bored | 60 | 3,115 | | | 50 | 3,065 | Ravenscrag sand | Soft, clear | | D | Sufficient for domestic use only. |
| 1 | | 4 | 4 | 11 | 3 | Dug | 18 | 2,960 | - 14 | 2,946 | | | Bearpaw sand | Hard, clear, "alkaline" | | D, S | Sufficient only for 17 head stock. |
| 2 | NW. | 9 | " | " | " | Dug | 12 | 3,022 | - 5 | 3,017 | 12 | 3,010 | Glacial gravel | Hard, clear, "alkaline" | | D, S | Sufficient for local needs. |
| 3 | NE. | 9 | " | " | " | Dug | 8 | 3,110 | | | | | Glacial gravel | Hard, clear, "alkaline" | | D, S | Sufficient only for 8 head stock. |
| 4 | SW. | 27 | " | " | " | Dug | 15 | 3,232 | - 7 | 3,225 | | | Ravenscrag clay | Hard, clear | | D, S | Intermittent supply; sufficient for 6 head stock in wet years. |
| 5 | SW. | 27 | " | " | " | Bored | 63 | 3,252 | | | | | | | | | Dry hole in Ravenscrag sand and clay. |
| 1 | SW. | 4 | 4 | 12 | 3 | Dug | 14 | 2,833 | - 11 | 2,822 | 11 | 2,822 | Glacial sand | Hard, clear | | D, S | Insufficient for 6 head stock. |
| 2 | NE. | 4 | " | " | " | Dug | 14 | 2,845 | - 10 | 2,835 | 10 | 2,835 | Glacial gravel | Soft, clear | | D, S | Intermittent supply; sufficient for 30 head stock in wet years. |
| 3 | NW. | 5 | " | " | " | Dug | 12 | 2,850 | | | | | Glacial drift | Hard, clear | | D, S | Sufficient for local needs. |
| 4 | NE. | 7 | " | " | " | Dug | 14 | 2,710 | - 9 | 2,701 | 9 | 2,701 | Recent sand and gravel | Hard, cloudy, iron, "alkaline" | 45 | D, S | Sufficient for 80 head stock. |
| 5 | NE. | 9 | " | " | " | Dug | 20 | 2,805 | - 15 | 2,790 | | | Glacial gravel | Hard, clear | | D, S | Sufficient for 10 head stock. |
| 6 | NW. | 15 | " | " | " | Bored | 12 | 2,823 | - 7 | 2,816 | | | Glacial sand and gravel | Soft, clear | | D | Sufficient for domestic use only. |
| 7 | SE. | 17 | " | " | " | Dug | 7 | 2,766 | - 4 | 2,762 | 6 | 2,760 | Glacial sand | Hard, clear, "alkaline" | 45 | D | Sufficient for domestic use only. |
| 8 | SE. | 18 | " | " | " | Dug | 10 | 2,750 | | | | | Recent alluvium | Soft | | D, S | Sufficient for local needs. |
| 9 | NW. | 20 | " | " | " | Bored | 30 | 2,830 | - 20 | 2,810 | 20 | 2,810 | Glacial clay | Hard, clear, "alkaline" | | N | Small amount of seepage. |
| 10 | NW. | 20 | " | " | " | Dug | 7 | 2,820 | | | | | Glacial drift | | | D, S | Sufficient for local needs. |
| 11 | SW. | 21 | " | " | " | Dug | 15 | 2,775 | - 11 | 2,764 | 11 | 2,764 | Glacial sand | Hard, clear | | D, S | Sufficient for 2 head stock. |
| 12 | NW. | 23 | " | " | " | Dug | 15 | 2,820 | 0 | 2,820 | 15 | 2,805 | Glacial gravel and sand | Hard, clear | | D, S | Intermittent supply; sufficient for 15 head stock in wet year. |

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 GLEN McPHERSON NO. 46, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | NW. | 24 | 4 | 12 | 3 | Dug | 20 | 3,030 | - 15 | 3,015 | 15 | 3,015 | Glacial sand and gravel | Hard, clear | | D, S | Sufficient for 60 head stock. |
| 14 | SE. | 27 | " | " | " | Dug | 10 | 2,833 | - 4 | 2,829 | 10 | 2,823 | Glacial sand and gravel | Hard, clear, "alkaline" | | D, S | Intermittent supply; sufficient for 16 head stock in wet years. |
| 1 | SE. | 4 | 5 | 10 | 3 | Dug | 60 | 3,110 | - 45 | 3,065 | 20 | 3,090 | Ravenscrag soapstone | Hard, clear, iron | | D, S | Insufficient for local needs. |
| 2 | NW. | 4 | " | " | " | Dug | 12 | 3,110 | - 8 | 3,102 | 6 | 3,104 | Glacial gravel and Ravenscrag clay | Hard, clear, "alkaline" | | D, S | Sufficient for 15 head stock. |
| 3 | NW. | 4 | " | " | " | Spring | | 3,085 | 0 | 3,085 | | | Glacial drift | | | S | |
| 4 | NW. | 5 | " | " | " | Dug | 40 | 3,067 | - 34 | 3,033 | 10 | 3,057 | Ravenscrag sandy clay | Hard, clear, "alkaline" | | D, S | Sufficient for local needs. |
| 5 | SW. | 6 | " | " | " | Dug | 65 | 3,124 | - 47 | 3,077 | 54 | 3,070 | Ravenscrag clay | Hard, clear | | D, S | Sufficient for local needs. |
| 6 | SE. | 7 | " | " | " | Dug | 30 | 3,110 | - 27 | 3,083 | 25 | 3,085 | Ravenscrag clay | Hard, clear | | D, S | Sufficient for local needs. |
| 7 | NE. | 7 | " | " | " | Dug | 45 | 3,100 | - 41 | 3,059 | 15 | 3,085 | Ravenscrag clay | Hard, clear | | D, S | Sufficient for 12 head stock. |
| 8 | SE. | 12 | " | " | " | Dug | 8 | 2,890 | - 2 | 2,888 | 0 | 2,890 | Recent gravel | Hard, clear, "alkaline" | | D, S | Sufficient for 25 head stock. |
| 9 | SE. | 14 | " | " | " | Dug | 33 | 2,990 | - 26 | 2,964 | | | Ravenscrag sand | Hard, clear, "alkaline" | | D, S | Sufficient for 40 head stock. |
| 10 | NW. | 14 | " | " | " | Dug | 22 | 3,005 | - 10 | 2,995 | 7 | 2,998 | Ravenscrag clay | Hard, clear, "alkaline" | | D, S | Sufficient for 13 head stock. |
| 11 | SE. | 15 | " | " | " | Bored | 40 | 3,010 | - 17 | 2,993 | 16 | 2,994 | Glacial gravel | Hard, clear, "alkaline" | | D, S | Insufficient for local needs. |
| 12 | SW. | 16 | " | " | " | Dug | 47 | 3,014 | - 43 | 2,971 | 40 | 2,974 | Ravenscrag clay | Hard, cloudy, "alkaline" | | D, S | Sufficient for 9 head stock. # |
| 13 | SW. | 17 | " | " | " | Dug | 15 | 2,999 | - 7 | 2,992 | 12 | 2,987 | Ravenscrag clay | Hard, clear "alkaline" | | D, S | Sufficient for 10 head stock. |
| 14 | NW. | 20 | " | " | " | Bored | 40 | 3,013 | - 25 | 2,988 | 15 | 2,998 | Ravenscrag clay | Hard, clear | | D, S | Sufficient for 11 head stock. |
| 15 | NW. | 22 | " | " | " | Dug | 20 | 2,835 | - 16 | 2,819 | 20 | 2,815 | Glacial sand | Hard, clear | | D, S | Sufficient for local needs. |
| 16 | SE. | 22 | " | " | " | Bored | 63 | 2,945 | - 48 | 2,897 | 60 | 2,885 | Ravenscrag sandy clay | Hard, clear, "alkaline" iron | | D, S | Sufficient for 6 head stock. |
| 17 | SW. | 23 | " | " | " | Bored | 53 | 2,976 | - 23 | 2,953 | 40 | 2,936 | Ravenscrag sandy clay | Hard, clear, iron | | D, S | Sufficient for 50 head stock. |
| 18 | NE. | 25 | " | " | " | Bored | 30 | 2,875 | - 12 | 2,863 | 4 | 2,871 | Glacial sand | Hard, clear, "alkaline" | | D, S | Sufficient for 40 head stock. |
| 19 | SE. | 32 | " | " | " | Bored | 40 | 2,903 | - 30 | 2,873 | 40 | 2,863 | Ravenscrag sand? | Hard, clear, "alkaline" | | D, S | Sufficient for 12 head stock. |
| 20 | NW. | 33 | " | " | " | Bored | 60 | 2,853 | - 58 | 2,795 | 60 | 2,793 | Bearpaw clay | Hard, clear | | D, S | Sufficient for domestic use only. |
| 21 | SE. | 33 | " | " | " | Bored | 30 | 2,778 | - 16 | 2,762 | 30 | 2,748 | Bearpaw sand | Hard, clear, "alkaline" | | D, S | Sufficient for 18 head stock. |
| 22 | NW. | 34 | " | " | " | Spring | | 2,780 | 0 | 2,780 | | | Glacial drift | Hard, clear | | S | |
| 23 | SE. | 34 | " | " | " | Bored | 22 | 2,821 | - 12 | 2,809 | | | Glacial sandy clay | Hard, clear | | D | Sufficient for domestic use only. |
| 24 | NE. | 35 | " | " | " | Bored | 22 | 2,878 | - 18 | 2,860 | 18 | 2,860 | Glacial sand | Soft, clear | | D, S | Sufficient for 12 head stock. |

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

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

# WELL RECORDS—Rural Municipality of GLEN McPHERSON NO. 46, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | NE. | 36 | 5 | 10 | 3 | Bored | 35 | 2,853 | | | 25 | 2,828 | Glacial sand and gravel | Soft,clear | | D, S | Insufficient for local needs. |
| 1 | NE. | 2 | 5 | 11 | 3 | Bored | 110 | 3,220 | -105 | 3,115 | 110 | 3,110 | Ravenscrag clay | Soft,clear | | D | Insufficient for local needs. |
| 2 | NW. | 3 | " | " | " | Bored | 64 | 3,365 | - 50 | 3,315 | 50 | 3,315 | Ravenscrag sand | Hard,clear | | D | Insufficient for local needs. |
| 3 | SE. | 13 | " | " | " | Bored | 42 | 3,095 | - 17 | 3,078 | | | Glacial gravel | Soft,clear | | D | Insufficient for local needs. |
| 4 | SE. | 16 | " | " | " | Dug | 35 | 3,100 | - 7 | 3,093 | | | Glacial gravel | Hard,clear | | D, S | Sufficient for 50 head stock with aid of a similar well. |
| 5 | NW. | 20 | " | " | " | Bored | 80 | 3,080 | - 72 | 3,008 | 80 | 3,000 | Glacial clay | Hard,clear | | D, S | Sufficient for 15 head stock. |
| 6 | NE. | 20 | " | " | " | Bored | 85 | 3,080 | - 75 | 3,005 | | | Glacial clay | Hard,clear, "alkaline" | | S | Sufficient for 8 head stock. |
| 7 | SW. | 27 | " | " | " | Bored | 25 | 3,010 | - 22 | 2,988 | 25 | 2,985 | Ravenscrag clay | Hard,clear, "alkaline" | | S | Sufficient for 16 head stock. |
| 8 | SE. | 28 | " | " | " | Bored | 60 | 3,030 | - 40 | 2,990 | 60 | 2,970 | Ravenscrag | Hard,clear | 46 | D, S | Sufficient for local needs. |
| 9 | NW. | 31 | " | " | " | Bored | 27 | 2,910 | | | 27 | 2,883 | Bearpaw clay | Soft,clear | | D, S | Sufficient for 20 head stock. |
| 10 | NE. | 32 | " | " | " | Bored | 60 | 3,008 | - 45 | 2,963 | 60 | 2,948 | Bearpaw clay | Hard,clear | | D, S | Sufficient for 10 head stock. |
| 11 | SW. | 33 | " | " | " | Dug | 50 | 3,000 | - 40 | 2,960 | 50 | 2,950 | Bearpaw shale | Hard,clear, "alkaline" | 44 | S | Sufficient for 40 head stock. # |
| 12 | NE. | 33 | " | " | " | Bored | 40 | 2,920 | - 20 | 2,900 | 40 | 2,880 | Bearpaw clay | Hard,clear | | D, S | Sufficient for 25 head stock. |
| 1 | SW. | 2 | 5 | 12 | 3 | Bored | 24 | 2,920 | - 14 | 2,906 | 14 | 2,906 | Bearpaw sand | Hard,clear, "alkaline" | | D, S | Sufficient for 25 head stock. |
| 2 | SW. | 7 | " | " | " | Dug | 40 | 2,780 | - 37 | 2,743 | 40 | 2,740 | Bearpaw shale | Hard,"alka-line" | | N | |
| 1 | SE. | 2 | 6 | 10 | 3 | Bored | 30 | 2,873 | | | 30 | 2,843 | Glacial sand | Soft,clear | | D, S | Sufficient for 15 head stock. |
| 2 | NW. | 2 | " | " | " | Bored | 38 | 2,820 | - 20 | 2,800 | 20 | 2,800 | Glacial gravel | Soft,clear | | D, S | Sufficient for local needs. |
| 3 | SE. | 3 | " | " | " | Dug | 23 | 2,790 | - 17 | 2,773 | 22 | 2,768 | Glacial sand | Soft,clear | | D, S | Sufficient for 9 head stock. |
| 4 | SE. | 4 | " | " | " | Bored | 32 | 2,783 | - 20 | 2,763 | 16 | 2,767 | Glacial sandy clay | Hard,clear, | | D, S | Sufficient for 25 head stock. |
| 5 | NE. | 5 | " | " | " | Dug | 16 | 2,816 | - 13 | 2,803 | 14 | 2,802 | Glacial sand | Soft,clear | | D | Sufficient for domestic use only. |
| 6 | NE. | 6 | " | " | " | Bored | 35 | 2,822 | - 23 | 2,799 | 30 | 2,792 | Bearpaw soap-stone | Hard,oily, "alkaline" | | N | Insufficient supply. |
| 7 | NW. | 10 | " | " | " | Bored | 55 | 2,706 | - 41 | 2,665 | 48 | 2,658 | Glacial sand | Hard | | D, S | Insufficient for 22 head stock. |
| 8 | NE. | 12 | " | " | " | Bored | 40 | 2,680 | - 10 | 2,670 | 30 | 2,650 | Bearpaw clay | Hard,clear | | S | Sufficient for 35 head stock. |
| 9 | SW. | 13 | " | " | " | Bored | 60 | 2,660 | - 30 | 2,630 | 30 | 2,630 | Bearpaw soap-stone | Hard,clear, "alkaline" | | S | Insufficient for local needs. |
| 10 | SW. | 14 | " | " | " | Dug | 11 | 2,604 | - 9 | 2,595 | 11 | 2,593 | Glacial drift | Hard,clear, "alkaline" | | D, S | Sufficient for local needs. |
| 11 | NE. | 15 | " | " | " | Bored | 32 | 2,650 | - 20 | 2.630 | 28 | 2,622 | Bearpaw sand | Hard,clear, "alkaline" | | N | Water is not usable. |
| 12 | SE. | 16 | " | " | " | Dug | 29 | 2,765 | - 19 | 2,746 | 29 | 2,736 | Glacial gravel | Soft,clear | | D, S | Insufficient for local needs. |

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# WELL RECORDS—Rural Municipality of GLEN McPHERSON NO.46, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | NE. | 16 | 6 | 10 | 3 | Dug | 40 | 2,770 | - 30 | 2,740 | 39 | 2,731 | Glacial sand | Soft,clear | | D, S | Insufficient for local needs. |
| 14 | NE. | 18 | " | " | " | Dug | 32 | 2,746 | - 12 | 2,734 | | | Glacial clay | Hard,clear, "alkaline" | | D, S | Insufficient for 8 head stock. |
| 15 | NW. | 19 | " | " | " | Dug | 30 | 2,674 | - 14 | 2,660 | | | Glacial drift | Hard,clear | | D, S | Sufficient for local needs. |
| 16 | SW. | 21 | " | " | " | Bored | 30 | 2,710 | - 24 | 2,686 | 4 | 2,706 | Glacial clay | Hard,clear | | D, S | Sufficient for local needs. |
| 17 | NW. | 22 | " | " | " | Dug | 29 | 2,720 | - 24 | 2,696 | 4 | 2,716 | Glacial sand | Soft,clear | | D, S | Insufficient for local needs. |
| 18 | SW. | 23 | " | " | " | Bored | 33 | 2,558 | - 16 | 2,542 | 28 | 2,530 | Glacial sand | Soft,clear | | D, S | Sufficient for local needs. |
| 19 | SE. | 23 | " | " | " | Bored | 29 | 2,572 | - 23 | 2,549 | 24 | 2,548 | Glacial sand | Hard,clear, "alkaline" | | D | Sufficient for domestic use only. |
| 20 | NW. | 24 | " | " | " | Dug | 20 | 2,540 | - 10 | 2,530 | 10 | 2,530 | Glacial sand | Hard,clear | | D, S | Sufficient for local needs; large supply. |
| 21 | SW. | 26 | " | " | " | Dug | 16 | 2,552 | - 6 | 2,546 | 11 | 2,541 | Glacial sand | Hard,clear | | D, S | Sufficient for 10 head stock. |
| 22 | NE. | 28 | " | " | " | Dug | 12 | 2,572 | - 10 | 2,562 | 12 | 2,560 | Glacial sand | Hard,clear | | D, S | Yields 1 barrel a pumping,but comes in quickly. |
| 23 | SW. | 32 | " | " | " | Dug | 11 | 2,640 | - 10 | 2,630 | 11 | 2,629 | Glacial sand | Soft,clear | | D | Sufficient for domestic use only. |
| 24 | SE. | 32 | " | " | " | Dug | 20 | 2,650 | - 14 | 2,636 | 20 | 2,630 | Glacial sand | Hard | | D | Sufficient for domestic use only. |
| 25 | NE. | 32 | " | " | " | Bored | 25 | 2,615 | - 20 | 2,595 | | | Glacial clay | Hard,clear | | D, S | Sufficient for local needs. |
| 26 | NW. | 33 | " | " | " | Dug | 19 | 2,674 | - 16 | 2,658 | 19 | 2,655 | Glacial gravel | Hard,clear | | D, S | Sufficient for local needs. |
| 27 | NE. | 35 | " | " | " | Dug | 18 | 2,550 | - 13 | 2,537 | 18 | 2,532 | Glacial clay | Hard,clear, "alkaline" | | D, S | Sufficient for local needs. |
| 28 | SE. | 36 | " | " | " | Dug | 29 | 2,558 | - 19 | 2,539 | 23 | 2,535 | Glacial drift | Soft,clear | | D, S | Sufficient for 20 head stock. |
| 1 | SW. | 5 | 6 | 11 | 3 | Dug | 35 | 2,894 | - 17 | 2,877 | 17 | 2,877 | Bearpaw shale | Hard,clear, "alkaline" | | D, S | Sufficient for 10 head stock. |
| 2 | NE. | 11 | " | " | " | Dug | 15 | 2,894 | - 8 | 2,886 | 8 | 2,886 | Glacial gravel | Hard,clear | | D, S | Sufficient for 45 head stock. |
| 3 | SE. | 12 | " | " | " | Bored | 24 | 2,832 | - 12 | 2,820 | 15 | 2,817 | Glacial gravel | Hard,clear, "alkaline" | | D, S | Sufficient for 20 head stock. |
| 4 | SE. | 15 | " | " | " | Bored | 24 | 2,820 | - 21 | 2,799 | 24 | 2,796 | Glacial sand | Hard,clear | | N | Use creek for stock. |
| 5 | SE. | 16 | " | " | " | Bored | 80 | 2,900 | - 55 | 2,845 | 55 | 2,845 | Bearpaw clay | Hard,clear, "alkaline" | | S | Sufficient for 40 head stock. |
| 6 | NE. | 16 | " | " | " | Bored | 40 | 2,860 | - 22 | 2,838 | | | Bearpaw shale | Hard,clear, iron | | S | Sufficient for 15 head stock. |
| 7 | NW. | 17 | " | " | " | Dug | 33 | 2,900 | - 24 | 2,876 | 27 | 2,873 | Bearpaw shale | Hard,clear, "alkaline" | | S | Sufficient for 20 head stock. |
| 8 | NE. | 18 | " | " | " | Dug | 20 | 2,840 | - 12 | 2,828 | 10 | 2,830 | Bearpaw shale | Hard,clear, iron | | D, S | Sufficient for 30 head stock. |
| 9 | NW. | 19 | " | " | " | Dug | 30 | 2,740 | - 26 | 2,714 | 15 | 2,725 | Bearpaw clay | Hard,clear, iron | | D, S | Sufficient for 20 head stock. |
| 10 | SW. | 20 | " | " | " | Dug | 30 | 2,832 | - 28 | 2,804 | 30 | 2,802 | Bearpaw clay | Soft,clear | | D | Sufficient for domestic use only. |
| 11 | NE. | 20 | " | " | " | Bored | 48 | 2,840 | - 46 | 2,794 | 46 | 2,794 | Bearpaw sand | Hard,clear | | S | Sufficient for 4 head stock. |

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

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

# WELL RECORDS—Rural Municipality of GLEN McPHERSON NO.46, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | NE. | 21 | 6 | 11 | 3 | Bored | 45 | 2,762 | - 25 | 2,737 | 25 | 2,737 | Bearpaw clay | Hard,clear, "alkaline" | | S | Sufficient for 15 head stock. |
| 13 | SE. | 22 | " | " | " | Bored | 75 | 2,808 | - 40 | 2,768 | 50 | 2,758 | Bearpaw clay | Hard,clear, "alkaline" | | N | Creek used for stock. |
| 14 | NW. | 23 | " | " | " | Bored | 60 | 2,762 | - 40 | 2,722 | 40 | 2,722 | Bearpaw clay | Hard,clear | | D | Insufficient for local needs; several dry holes 30 to 125 feet deep. |
| 15 | NW. | 24 | " | " | " | Bored | 65 | 2,720 | - 35 | 2,685 | 42 | 2,678 | Glacial gravel | Hard,clear | | D, S | Sufficient for 40 head stock. |
| 16 | NE. | 27 | " | " | " | Bored | 15 | 2,775 | - 9 | 2,766 | 9 | 2,766 | Bearpaw shale | Hard,clear | | D | Insufficient for local needs. |
| 17 | SE. | 28 | " | " | " | Bored | 45 | 2,756 | - 41 | 2,715 | 21 | 2,735 | Bearpaw clay | Hard,clear, "alkaline" | | S | Sufficient for 15 head stock. |
| 18 | NW. | 29 | " | " | " | Bored | 40 | 2,700 | - 35 | 2,665 | 32 | 2,668 | Bearpaw shale | Hard,clear, "alkaline" | | S | Sufficient for 40 head stock. |
| 19 | SW. | 30 | " | " | " | Dug | 16 | 2,730 | - 13 | 2,717 | | | Bearpaw shale | Hard,clear, "alkaline" | | D, S | Sufficient for local needs. |
| 20 | NW. | 31 | " | " | " | Dug | 28 | 2,715 | - 24 | 2,691 | 12 | 2,703 | Bearpaw shale | Hard,clear | | D, S | Sufficient for 10 head stock. |
| 21 | SW. | 35 | " | " | " | Dug | 21 | 2,775 | - 19 | 2,756 | | | Bearpaw shale | Hard,clear | | D | Sufficient for 18 head stock. |
| 1 | NE. | 1 | 6 | 12 | 3 | Bored | 56 | 2,915 | | | | | Bearpaw shale | Hard,clear, "alkaline" | | S | Sufficient for 45 head stock. |
| 2 | NW. | 1 | " | " | " | Dug | 15 | 2,870 | - 12 | 2,858 | 12 | 2,858 | Bearpaw clay | Hard,clear | | D, S | Sufficient for 30 head stock. |
| 3 | SE. | 2 | " | " | " | Bored | 64 | 2,925 | - 40 | 2,885 | | | Bearpaw clay | Hard,clear, "alkaline" | | D, S | Sufficient for 15 head stock. |
| 4 | NW. | 2 | " | " | " | Dug | 15 | 2,936 | - 10 | 2,926 | 6 | 2,930 | Glacial sand | Hard,clear, "alkaline" | | S | Insufficient for local needs. |
| 5 | NW. | 5 | " | " | " | Dug | 40 | 2,940 | - 36 | 2,904 | | | Eastend sand | Hard,clear | | D, S | Sufficient for 16 head stock. |
| 6 | NE. | 13 | " | " | " | Dug | 21 | 2,870 | | | | | Bearpaw formation | Soft,clear | | D, S | Sufficient for 6 head stock. |
| 7 | NE. | 16 | " | " | " | Dug | 29 | 2,995 | - 20 | 2,975 | | | Bearpaw formation | Hard,clear, "alkaline" | | D, S | Sufficient for 15 head stock. |
| 8 | SE. | 21 | " | " | " | Dug | 45 | 3,000 | - 35 | 2,965 | 31 | 2,969 | Bearpaw clay | Hard,clear, "alkaline" | | D, S | Sufficient for 12 head stock. |
| 9 | NE. | 21 | " | " | " | Dug | 35 | 3,026 | - 30 | 2,996 | 30 | 2,996 | Bearpaw shale | Hard,clear, "alkaline" | | D, S | Sufficient for local needs; also a sumilar well. |
| 10 | SE. | 22 | " | " | " | Dug | 33 | 2,930 | - 17 | 2,913 | 30 | 2,900 | Bearpaw shale | Hard,clear | | D, S | Sufficient for 25 head stock. |
| 11 | NW. | 23 | " | " | " | Bored | 80 | 2,912 | - 65 | 2,847 | | | Bearpaw clay | Hard,iron, "alkaline" | | D, S | Sufficient for 40 head stock. |
| 12 | SE. | 23 | " | " | " | Dug | 60 | 2,810 | - 55 | 2,755 | 55 | 2,755 | Bearpaw clay | Hard,clear, "alkaline" | | D, S | Sufficient for 100 head stock. # |
| 13 | SW. | 24 | " | " | " | Dug | 24 | 2,780 | - 12 | 2,768 | | | Bearpaw clay | Soft,clear | | D, S | Sufficient for 100 head stock. |
| 14 | NE. | 25 | " | " | " | Dug | 20 | 2,735 | - 15 | 2,720 | 19 | 2,716 | Bearpaw formation | Hard,clear | | D, S | Sufficient for 10 head stock; also a spring. |
| 15 | SW. | 28 | " | " | " | Dug | 55 | 3,100 | - 50 | 3,100 | | | Ravenscrag clay | Hard,clear, "alkaline" | | D, S | Sufficient for 30 head stock; use a shallow well also. |
| 16 | NW. | 33 | " | " | " | Borod | 82 | 2,980 | - 73 | 2,907 | | | Bearpaw clay | Hard,clear | | D, S | Sufficient for 4 head stock. |

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

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