CANADA
DEPARTMENT OF MINES

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

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF ..... No. 13 SASKATCHEWAN

BY

B. R. MacKay, H. H. Beach & J. M. Cameron

Water Supply Paper No. 59

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF No. 13, 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

Rural municipality No. 13 covers an area of 324 square miles, consisting of nine townships, described as tps. 1, 2, and 3, ranges 1, 2, and 3, W. 3rd mer. It borders the International Boundary and the centre of the municipality lies 10 miles west and 34 miles south of the town of Assiniboia. The area occupies a part of Wood Mountain plateau. The topography is rugged and the area has been deeply dissected by Poplar river, Coal creek, and numerous small tributary streams. The elevations of the surface range from less than 2,800 feet above sea-level in the valleys in the southeast corner to over 3,300 feet above sea-level at the tops of the highlands in the northern townships.

The water-bearing horizons of this municipality occur in the Recent stream deposits, in isolated patches of pre-Glacial gravels on the uplands, and in the Ravenscrag bedrock formation.

Water-bearing Horizons in the Unconsolidated Deposits

Sands, silts, and gravels of Recent origin, probably in no place exceeding a thickness of 15 feet, lie along the bottoms of the valleys of Poplar river, Coal creek, and some of their larger tributaries. These deposits contain small amounts of water that is usually of good quality. No wells have been sunk to tap these supplies but they form a possible source of domestic supplies.

The great continental ice-sheet that passed over the province many thousands of years ago laid down deposits of till or boulder clay over extensive areas. These deposits now form the source of much of the ground water throughout the province. In this municipality, however, the ice deposited little or no drift, with the result that over most of the area the bedrock is either exposed at the surface or is covered by only a thin veneer of soil. In the northern part of the area large boulders strewn over

the ground surface form the only evidence of the former presence of the ice-sheet. Along the western edge of the area the layer of glacial drift, composed largely of compact, bluish grey boulder clay, is nowhere more than 10 feet thick. This deposit is not a source of ground water.

Water-bearing Horizons in the Bedrock

Small areas of reddish brown, pre-glacial stream gravels occur at isolated localities on the uplands of the area. Several wells sunk to depths not exceeding 20 feet into these gravels yield small quantities of water that is quite suitable for household use. Some individual wells yield sufficient quantities for at least 25 head of stock.

The Ravenscrag bedrock formation, consisting of light brown clays and shales, coarse grey sandstones, and thin seams of lignite coal underlies the entire municipality to depths of not less than 150 feet in the lowest parts of the area. With the exception of the small supplies derived from the gravel patches on the uplands the water-bearing coal seams and sand beds in the Ravenscrag form the source of the entire ground water supply of the municipality. The individual coal seams and sand beds may not extend over large areas, but they are so numerous that in most parts of the municipality residents have been able to obtain an adequate ground water supply from them within 50 feet of the surface. Only in a few places in township 1, range 2, and in township 2, range 2, has it been necessary to sink wells to depths of 100 to 150 feet for water. The beds generally yield ample supplies of water for at least 10 head of stock, and in places for as many as 100 head. The years of drought caused little noticeable decrease in these supplies. In the few places where the actual well supplies are not sufficient no shortage is experienced, since additional supplies are readily available from the numerous springs and creeks throughout

the area. The absence of glacial drift, which is in many areas the source of mineral salts found in waters from the underlying bedrock, and the weathered character of the bedrock make the waters from the Ravenscrag formation in this municipality of excellent quality. The water in many places is soft and for household use is superior to supplies found in many other parts of the province.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 1, Range 1

Small yields of ground water may be obtained from the Recent sands, silts, and gravels in the small stream valleys. At present, however, the entire ground water supply of this township is being derived from the Ravenscrag bedrock formation. The water-bearing sand beds and coal seams that yield these supplies are encountered by wells generally less than 35 feet deep, and at the most 85 feet. These aquifers yield supplies generally ample for at least 10 to 20 head of stock. In two localities the actual well supplies are insufficient, but no shortage is experienced as additional supplies are available in one place from a spring and in the other from a small creek. The water is invariably of good quality and suitable for domestic use.

Township 1, Range 2

Small supplies of drinkable water are to be expected at shallow depths in the Recent sands, silts, and gravels in the bottom of the valley of Coal creek and along some of the larger tributaries.

The entire ground water supply being used at present is derived from the coal seams and sandy beds that form the aquifers in the Ravenscrag formation. Little difficulty has been experienced in obtaining an adequate supply from these beds. The aquifers are as a rule more deeply buried in this township than in the other townships of the municipality. The wells range in depth from 48 to 175 feet, the average depth being 75 feet. The deepest well, drilled to a depth of 175 feet, is on the NW.$\frac{1}{4}$, section 16. The yield from individual wells is sufficient for watering 10 to 20 head of stock. The water is hard and of very good quality, and quite satisfactory for all household and stock requirements.

Township 1, Range 3

No attempt has been made to obtain water from the Recent stream deposits that occur along the valley bottom of West Poplar river. It is probable, however, that supplies adequate for domestic use at least are obtainable at shallow depths. The glacial deposits overlying the bedrock throughout all but the extreme northeastern sections are too thin and impervious to be considered as a source of ground water.

A spring issuing from a bed of pre-Glacial gravel on the SW.$\frac{1}{4}$, section 23, yields sufficient quantities of water of good quality for watering 25 head of stock. It is believed that wells sunk to shallow depths in these isolated gravel patches on the uplands will prove similarly productive. With the exception of the spring mentioned above, and others, the entire ground water supply of the township is obtained from wells sunk into the Ravenscrag bedrock formation.

The water-bearing sand beds and coal seams that yield the supplies from the Ravenscrag are struck in wells at depths not exceeding 25 feet from the surface. The majority of these wells obtain a supply of water sufficient for 25 head of stock and numerous springs occurring along the valleys and hillsides furnish additional supplies where required. The water is invariably hard, and satisfactory for both household and stock use.

Township 2, Range 1

In this township, as in other parts of the municipality, deposits of Recent sands, silts, and gravels of sufficient thicknesses have accumulated along valley bottoms to form source beds for at least small supplies of ground water, but as yet no well have been sunk in these deposits.

A 14-foot well located on the uplands in the SE.¼, section 18, derives its pre-Glacial supply from an isolated area of reddish brown gravels of Tertiary age. The water is of good quality and is in sufficient quantities for watering at least 20 head of stock. Further search for such patches of water-bearing gravels on the uplands is recommended to residents having herds grazing on the uplands.

The coal seams and sand beds of the Ravenscrag formation provide a dependable source of water throughout the township at depths not exceeding 60 feet. The water differs slightly in quality in different localities, being soft in some places and moderately hard in others. In all cases it is quite satisfactory for domestic use and individual wells yield sufficient supplies for 10 to 20 head of stock.

A bed of buff white, sandy clay, in the Ravenscrag formation, outcrops in the valleys in the northeast corner of the township. Wells sunk to depths of 30 and 40 feet in NE.¼, section 33, and the NW.¼, section 36, obtain moderately large supplies of soft, drinkable water from this bed. This horizon is believed to be fairly continuous and may form a source of small supplies of water generally throughout the northeastern sections.

Township 2, Range 2

Two wells located in valley bottoms in this township are producing small supplies of water from thin sand beds of Recent origin located at depths not exceeding 20 feet from the surface. Part of the water may be derived from the silts and sands covering the bedrock in the valley, but the greater amount is believed to come from sand beds in the bedrock.

Beds of coarse sand interspersed through light yellowish brown clay in the Ravenscrag bedrock formation are the most

consistent aquifers in the township. Wells dug to depths of 92 and 80 feet in the SW.$\frac{1}{4}$, section 5, and the NE.$\frac{1}{4}$, section 19, have encountered such beds from which they obtain a soft, clear water. The yield from the well on section 5 is sufficient for 20 head of stock, but the well on section 19 has a much larger yield, estimated to be sufficient for at least 100 head of stock. Another well located on section 5 was sunk to a depth of 218 feet encountering sand from which it obtains a large supply of good water. Springs are common throughout the area and yield large quantities of moderately soft, drinkable water.

Beds of reddish brown gravels of Tertiary age are known to occur in small areas on the uplands, but as no wells have been sunk into them the possibilities of obtaining water from them are not known.

Township 2, Range 3

In this township all the ground water supplies are derived from the Ravenscrag formation. Neither the Recent sands, silts, and gravels in the small stream valleys, nor the thin coating of glacial drift that overlies the bedrock in the western half of the area are sufficiently thick to constitute sources of any large supplies of ground water. The water-bearing sand and gravel beds and coal seams, which form the water-bearing beds in the Ravenscrag, are encountered at many points in the area by wells less than 80 feet in depth. The supply obtained from individual wells is generally sufficient for at least 10 head of stock. In a few localities, however, the well supplies are insufficient, but even here the shortage is easily overcome by digging out springs or by sinking additional wells. The quality of the water obtained varies in different places, being soft in four of the wells investigated and hard in seventeen others. The water in two wells along the western border was reported by residents to be "alkaline".

The mineral salts in solution were probably derived from small seepages of water running into the well from the overlying glacial drift. The dissolved salts are not present in sufficient quantities, however, to render the water unsuitable for domestic requirements or unfit for use in steam boilers.

Township 3, Range 1

No difficulty has been experienced in obtaining an adequate water supply in this township. The glacial drift consists of patches of boulder clay resting upon the bedrock surface. These deposits are too thin, however, to form sources of ground water. Along the valleys springs flowing from outcrops of coal seams and beds of sand and gravel form the best source of supply for stock. Several individual springs yield a supply sufficient for 60 head of stock, and one spring located on section 27 is reported to give sufficient water for 100 head. At other places in the valleys and on the slopes beds of gravel have been encountered at depths not exceeding 25 feet from the surface. One well located on the SW.$\frac{1}{4}$, section 6, dug to a depth of 23 feet into these gravels, provides water for household use and for 75 head of stock. The presence of the springs along the hillsides and the supplies of the few wells that have been sunk into the Ravenscrag formation seem to indicate that water-bearing sand beds are plentiful in the formation. Wherever wells into the bedrock have been sunk fairly large supplies of soft to moderately hard, drinkable water have been encountered within 80 feet of the surface, and in most places within 35 feet of the surface.

Township 3, Range 2

In this township the entire ground water supply is being derived from the Ravenscrag bedrock formation which underlies the township. Neither the Recent sands, silts, and gravel lying along the valleys of Poplar river and its tributaries, nor the veneer of glacial deposits that covers the northern part of the area are

sufficiently thick or extensive to yield more than small seepages of water. The sand and gravel beds and coal seams forming the aquifers in the Ravenscrag formation are encountered by wells generally less than 35 feet deep and always less than 80 feet deep. Most individual wells yield enough water for at least 10 head of stock, but in several places the supply from one well has not been adequate and auxillary wells have been sunk. Springs increase the available supplies in a few places. The water both from the wells and the springs is invariably of good quality and quite suitable for household use.

Township 3, Range 3

In this township, as in the other townships of the municipality, aquifers in the Ravenscrag bedrock formation form the main source of ground water. The Recent stream deposits and the glacial drift covering the lower slopes of the hills in the north-western half of the area are of negligible thickness and do not yield more than small seepages of ground water. Two wells, one a 4-foot well located on the SW.$\frac{1}{4}$, section 1, and the other an 18-foot well on the SW.$\frac{1}{4}$, section 17, derive small supplies of water of good quality from beds of reddish brown gravels. These gravels occur in isolated patches over the uplands area, but do not appear to be confined to any one definite elevation. All other wells in the area derive their supply from sand beds and, in most places, coal seams in the Ravenscrag formation. The wells tapping these aquifers are in general less than 25 feet deep and all are less than 60 feet deep. The wells yield supplies generally sufficient for 10 or more head of stock. Springs are numerous along the valleys and on hillsides and in many places are used for watering stock where the well supply is inadequate. Both hard and soft waters are obtained from different wells throughout the area; all supplies are invariably of good quality and used for domestic purposes.

Two 25-foot holes on the SE.¼, section 19, and a 35-foot hole on the SW.¼, section 17, all struck dry sand horizons. It is probable that deeper drilling to depths not exceeding 100 feet will produce satisfactory water supplies.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF NO.13, SASKATCHEWAN

West of 3rd meridian — Township / Range	1 / 1	1 / 2	1 / 3	2 / 1	2 / 2	2 / 3	3 / 1	3 / 2	3 / 3	Total No. in Municipality
Total No. of Wells in Township	24	12	7	16	8	21	13	24	18	143
No. of wells in bedrock	24	12	7	16	8	21	13	24	18	143
No. of wells in glacial drift	0	0	0	0	0	0	0	0	0	0
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply										
No. with permanent supply	24	12	7	16	8	21	13	24	15	140
No. with intermittent supply	0	0	0	0	0	0	0	0	0	0
No. dry holes	0	0	0	0	0	0	0	0	3	3
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	4	4	0	1	1	4	0	1	1	16
No. of non-artesian wells	20	8	7	15	7	17	13	23	14	124
Quality of Water										
No. with hard water	19	12	7	12	4	17	13	21	13	118
No. with soft water	5	0	0	4	4	4	0	3	2	22
No. with salty water	0	0	0	0	0	0	0	0	0	0
No. with "alkaline" water	1	1	0	2	0	2	0	0	3	9
Depths of Wells										
No. from 0 to 50 feet deep	21	1	7	15	5	18	13	23	17	120
No. from 51 to 100 feet deep	3	9	0	1	2	3	0	1	1	20
No. from 101 to 150 feet deep	0	1	0	0	0	0	0	0	0	1
No. from 151 to 200 feet deep	0	1	0	0	0	0	0	0	0	1
No. from 201 to 500 feet deep	0	0	0	0	1	0	0	0	0	1
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	24	12	7	16	8	21	13	24	15	140
No. not usable for domestic purposes	0	0	0	0	0	0	0	0	0	0
No. usable for stock	24	12	7	16	8	21	13	24	15	140
No. not usable for stock	0	0	0	0	0	0	0	0	0	0
Sufficiency of Water Supply										
No. sufficient for domestic needs	24	12	7	16	8	20	13	23	15	138
No. insufficient for domestic needs	0	0	0	0	0	1	0	1	0	2
No. sufficient for stock needs	22	12	7	13	6	17	12	18	14	121
No. insufficient for stock needs	2	0	0	3	2	4	1	6	1	19

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 No. 13, Saskatchewan.

No.	LOCATION					Depth of well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									Source of water
	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$MgCl_2$	
1	SE.	20	1	1	3	40	980	950	550	400	15	535	70	144	217	185	827	125		301		55	321	25		x 1
2	NW.	35	1	1	3	36	520	440	200	240	7	385	40	47	49	161	463	72		98		208	73	12		x 1
3	SW.	24	1	2	3	48	280	270	270		11	255	70	58	8	2	255	125		105	10			3	12	x 1
4	SE.	35	2	1	3	52	340	220	220		5	230	60	11	4	67	246	107		23		102	6	8		x 1
5	NE.	4	2	2	3	18	320	280	170	110	13	200	70	50	29		241	125		63	36				17	x 1
6	SE.	12	2	2	3	Spring	280	180	120	60	6	150	60	7	80	26	171	107		15		27	12	10		x 1
7	NE.	19	2	2	3	80	280	270	270		17	210	60	54	8	2	228	107		88	10			2	21	x 1
8	NW.	4	2	3	3	44	1,951											(3)	(1)		(2)	$CaCl_2$ (4)				x 1
9	SW.	14	3	1	3	Spring	380	360	320	40	9	290	50	22	12	106	323	90		46		154	18	15		x 1

Water smaples indicated thus x 1, are from bedrock, Ravenscrag formation.
Analyses are reported in parts per million; where numbers (1),(2),(3), and (4) are used instead of parts per million, they represent the relative amounts in which the four main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).

Analysis No. 8, by Provincial Analyste, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

No samples were taken for analyses of ground water from the thin beds of sands, silts, and gravels that occur at intervals along the bottoms of the larger creeks. Springs and seepages from the Ravenscrag formation are the main sources of the water in the Recent deposits of this area. Since the water from the Ravenscrag is of excellent quality, it is altogether probable that the supplies from the Recent deposits will be soft or only moderately hard, low in mineral salts, and generally quite satisfactory for all domestic requirements.

The very thin veneer of glacial drift present in the extreme northwestern part of the area cannot be regarded as a source of ground water.

Water from the Bedrock

Residents who have sunk wells into the isolated patches of reddish brown gravels occurring on the upland report the water to be only moderately hard, and of very good quality for domestic use.

Eight samples of ground water from the Ravenscrag bedrock formation in this municipality were collected and analysed. Another analysis made by the Provincial Analyst, Regina, is also included in the accompanying table. The following generalizations are based upon these analyses and upon analyses of waters from this formation in adjoining municipalities.

The aquifers in the Ravenscrag formation in this municipality, in general, yield a fairly soft water that is on the whole of better quality than waters obtained either from the glacial drift or from the bedrock in most parts of southern Saskatchewan. In areas in which the bedrock is covered by any considerable thickness of glacial drift, waters from the underlying bedrock are often charged with large amounts of dissolved mineral salts. These salts are believed to be taken into solution from the drift as surface

waters gradually percolate downward into the underlying bedrock. In the absence of any appreciable thickness of drift over this municipality, however, only relatively small amounts of mineral salts derived from the Ravenscrag formation itself are present in the waters. Much of the water is quite soft. Five of the analyses given show a total hardness less than 300 parts per million. The first two analyses listed indicate harder waters than the others, but in each case, since the hardness is to a considerable degree temporary, the waters may be softened by boiling. It is probable these figures indicate a somewhat higher permanent hardness than is actually present in waters fresh from the wells as the samples were stored for some time before analyses could be made. The figures for the total dissolved solids are low. With the exception of sample eight the waters are quite satisfactory for household and stock use. None of the salts that the waters contain in solution are in sufficient concentration to cause any harmful effects. Some of the waters may have a slight "soda" taste due to the presence of Na_2CO_3(black alkali). In only two of the waters analysed, however, is this salt present in sufficient quantities to have any harmful effects on vegetation. The small amounts of common salt (NaCl) found in nearly all of these waters would not cause a salty taste. The other salts present in solution are largely carbonates of calcium and magnesium and contribute only to the hardness of the water.

The 1,951 parts per million of total solids which sample No. 8 contains is much higher than is to be expected in waters from this area. This water comes partly from a coal seam, but for the greater part from a shale or blue clay bed lying below the coal. The salts, it is believed, are largely dissolved from the shale or blue clay. Such beds contain inherently more dissolved salts than do the sand beds or coal seams of the Ravenscrag. The amount of salts this water contains does not

prohibit its use in the household, but should the amount of magnesium sulphate (Epsom salts) constitute a large proportion of the total salts present, then the water will have a laxative effect on persons unaccustomed to its use. The other salts, calcium sulphate ($CaSO_4$), calcium carbonate ($CaCO_3$), and calcium chloride ($CaCl_2$), which this water contains, have little or no harmful effects other than to increase the hardness of this water. Iron forms an objectionable impurity in many of the waters, particularly those derived from coal seams. Much of this iron may be removed by allowing the water to stand for a period of time in a trough or container that permits a large water surface to be exposed to the air. Agitation of the water is also helpful in removing iron. One method that has proved successful in some districts is to allow the water to pass over a sheet of corrugated, galvanized iron suspended between the pump and the trough. The iron upon coming in contact with the air is oxidized and settles as a brown precipitate on the bottom of the trough.

No deep drilling has been done in this area. It is probable that the water from greater depths in the Ravenscrag will be even softer than waters nearer the surface, but it may contain fairly large amounts of "black alkali" in solution which would render it unfit for irrigation.

WELL RECORDS—Rural Municipality of NO. 13, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NW.	1	1	1	3	Dug	35	2,985	- 25	2,960	35	2,950	Ravenscrag fine gravel	Hard, clear		D, S	Sufficient for local needs.
2	NW.	2	"	"	"	Bored	72	2,980	- 60	2,920	72	2,908	Ravenscrag sand	Hard, clear		D, S	Sufficient for 40 head stock.
3	SW.	9	"	"	"	Dug	35	3,044	- 32	3,012	35	3,009	Ravenscrag sand	Soft, clear		D, S	Sufficient for 12 head stock.
4	SW.	16	"	"	"	Bored	85	3,023	- 75	2,948	85	2,938	" (?) sand	Hard, clear	45	D, S	Sufficient for 10 head stock.
5	SE.	20	"	"	"	Dug	40	2,939			40	2,899	Ravenscrag sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs; #.
6	NW.	24	"	"	"	Bored	28	2,804	-20	2,784	20	2,784	Ravenscrag sand, coal	Hard, clear, iron	45	D, S	Sufficient for 20 head stock.
7	SW.	25	"	"	"	Dug	22	2,794	- 19	2,775	19	2,775	Ravenscrag sand	Soft, clear		D, S	Insufficient for 10 head stock.
8	SW.	26	"	"	"	Dug	14	2,814	- 13	2,801	14	2,800	Ravenscrag sand, gravel	Soft, clear		D, S	Insufficient for local needs.
9	SE.	27	"	"	"	Dug	12	2,820	- 4	2,816	8	2,812	Ravenscrag coal	Hard		D, S	Sufficient for local needs.
10	NW.	31	"	"	"	Dug	52	2,970	- 44	2,926	52	2,918	Ravenscrag coal	Hard, clear		D, S	Sufficient for 100 head stock.
11	NE.	31	"	"	"	Dug	17	2,863	- 11	2,852	17	2,846	Ravenscrag sand	Hard, clear	45	D, S	Sufficient for 25 head stock.
12	NE.	34	"	"	"	Spring		2,773	0	2,773	0	2,773	Ravenscfag coal	Soft		D, S	Sufficient for local needs.
13	NW.	35	"	"	"	Bored	35	2,808	- 24	2,784	35	2,773	Ravenscrag coal	Hard, iron		D, S	Sufficient for local needs: #.
1	NE.	13	1	2	3	Bored	75	3,100	- 55	3,045	55	3,045	Ravenscrag sand	Hard, clear		D, S	Sufficient for 15 head stock.
2	SE.	14	"	"	"	Bored	75	3,108	- 60	3,048	75	3,033	Ravenscrag sand	Hard, clear		D, S	Sufficient for 14 head stock.
3	SW.	14	"	"	"	Bored	125	3,108	-100	3,008	100	3,008	Ravenscrag clay	Hard, clear, "alkaline"		D, S	Sufficient for 18 head stock.
4	NE.	15	"	"	"	Bored	72	3,108	- 62	3,046	62	3,046	Ravenscrag sand	Hard, clear		D, S	Sufficient for 15 head stock.
5	NW.	16	"	"	"	Bored	175	3,100	-150	2,950	150	2,950	Ravenscrag coal?	Hard, clear, iron		D, S	Sufficient for 8 head stock.
6	SE.	17	"	"	"	Bored	75	3,086	- 65	3,021	65	3,021	Ravenscrag clay	Hard		D, S	Sufficient for local needs.
7	SE.	20	"	"	"	Bored	75	3,080	- 55	3,025	75	3,005	Ravenscrag sandy clay	Hard, clear		D, S	Sufficient for 15 head stock.
8	SW.	23	"	"	"	Bored	60	3,118	- 46	3,072	46	3,072	Ravenscrag sand	Hard, clear, iron		D, S	Sufficient for 10 head stock.
9	SW.	24	"	"	"	Bored	48	3,075	- 32	3,043	48	3,027	Ravenscrag sand	Hard, clear		D, S	Sufficient for 12 head stock: #.
10	SE.	27	"	"	"	Bored	65	3,106	- 55	3,051	55	3,051	Ravenscrag sand	Hard, clear		D, S	Sufficient for 20 head stock.
11	NE.	27	"	"	"	Drilled	93	3,103	- 73	3,030	93	3,010	Ravenscrag	Hard, clear		D, S	Sufficient for 12 head stock.
12	SW.	28	"	"	"	Bored	54	3,112					Ravenscrag sand	Hard, clear		D, S	Sufficient for 10 head stock.
1	SW.	23	1	3	3	Spring		2,948	0	2,948	0	2,948	Reddish brown gravel	Hard, clear		D, S	Sufficient for 25 head stock.
2	NW.	26	"	"	"	Dug	20	2,963	- 15	2,948	20	2,943	Ravenscrag sand	Hard, clear		D, S	Sufficient for 19 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 No. 13, 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
3	NE.	33	1	3	3	Bored	27	3,000			27	2,973	Ravenscrag sand	Hard, clear		D, S	
4	SW.	34	"	"	"	Dug	9	2,950	- 4	2,946	7	2,943	Ravenscrag sand	Hard, clear		D, S	Sufficient for 14 head stock.
5	SE.	36	"	"	"	Dug	28	3,028	- 24	3,004	24	3,004	Ravenscrag blue clay	Hard, clear, iron		D, S	Sufficient for 12 head stock.
1	NW.	1	2	1	3	Dug	36	2,779	- 28	2,751	28	2,751	Ravenscrag coal	Hard, "alkaline"		D, S	Sufficient for 20 head stock.
2	NW.	8	"	"	"	Dug	34	3,070	- 33	3,037	34	3,036	Ravenscrag sand	Soft, clear		D, S	Sufficient for 10 head stock.
3	NE.	10	"	"	"	Spring		2,870	0	2,870	0	2,870	Ravenscrag	Hard, clear, iron, "alkaline"		D, S	Sufficient for local needs.
4	SE.	17	"	"	"	Dug	15	3,000	- 10	2,990			Ravenscrag sand	Soft, clear		D, S	Sufficient for 8 head stock.
5	SE.	18	"	"	"	Dug	14	2,995	- 9	2,986			Brown gravel	Hard, clear		D, S	Sufficient for 21 head stock.
6	NE.	23	"	"	"	Bored	35	2,874	- 26	2,848			Ravenscrag sand	Hard, iron, clear		D, S	Sufficient for 30 head stock.
7	NE.	33	"	"	"	Bored	30	2,900	- 18	2,882			Ravenscrag white clay	Soft, clear		D, S	Sufficient for 15 head stock.
8	SE.	35	"	"	"	Dug	52	3,020	- 47	2,973	47	2,973	Ravenscrag sandy clay	Hard, clear		D, S	Sufficient for 15 head stock; #.
9	SW.	36	"	"	"	Dug	20	3,020	- 18	3,002	18	3,002	Ravenscrag sand	Hard, clear		D, S	Sufficient for 15 head stock.
10	NW.	36	"	"	"	Bored	40	3,010	- 16	2,994	22	2,988	Ravenscrag white mud	Soft, clear		D, S	Sufficient for local needs.
1	NW.	2	2	2	3	Dug	20	3,038	- 17	3,021	20	3,018	Ravenscrag sand	Hard, clear		D, S	Insufficient supply; waters 6 head stock.
2	NE.	4	"	"	"	Dug	18	3,090	- 15	3,075	14	3,076	Ravenscrag sandstone	Hard, clear, iron		D, S	Sufficient for 15 head stock; #.
3	SW.	5	"	"	"	Dug	92	3,132	- 85	3,047	74	3,058	Ravenscrag sand	Soft, clear		D, S	Sufficient only for 20 head stock. Another well 218 feet deep; large supply but not being used.
4	SE.	12	"	"	"	Spring		2,933	0	2,933	0	2,933	Ravenscrag sand	Soft		D, S	Sufficient for local needs; #.
5	NE.	19	"	"	"	Dug	80	3,200	- 65	3,135	65	3,135	Ravenscrag gravel	Soft, clear		D, S	Sufficient for 100 head stock; #.
1	NW.	4	2	3	3	Bored	44	2,985	- 36	2,949	40	2,945	Ravenscrag shale	Hard, clear		D, S	#.
2	SE.	5	"	"	"	Dug	25	2,968	- 21	2,947	21	2,947	Ravenscrag sand	Soft, clear		D, S	Sufficient for 50 head stock.
3	SE.	7	"	"	"	Bored	52	2,950	- 40	2,910	52	2,898	Ravenscrag sand	Hard, clear, iron		D	Sufficient for local needs.
4	SW.	9	"	"	"	Dug	12	3,004	- 9	2,995	9	2,995	Ravenscrag clay	Soft, clear		D, S	Sufficient for 10 head stock.
5	SW.	17	"	"	"	Bored	80	3,010	- 40	2,970			Ravenscrag clay	Hard, clear, iron, "alkaline"		D, S	Sufficient for 40 head stock.
6	SW.	23	"	"	"	Dug	30	2,990	- 27	2,963	27	2,963	Brown gravel	Hard		D	Insufficient for local needs.
7	NE.	25	"	"	"	Spring		3,180	0	3,180	0	3,180	Ravenscrag sand	Soft, clear		D, S	Sufficient for 20 head stock.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NO. 13, 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
8	NW.	27	2	3	3	Bored	57	3,000	- 51	2,949	51	2,949	Ravenscrag blue clay	Hard, clear, iron		D, S	Insufficient supply; enough for 8 head stock.
9	SW.	28	"	"	"	Dug	22	3,050	- 18	3,032	18	3,032	Ravenscrag yellow clay	Soft, clear		D, S	Sufficient for 12 head stock.
10	NW.	28	"	"	"	Bored	36	3,050	- 30	3,020	31	3,019	Ravenscrag coal seam	Hard, clear		S	
11	NE.	31	"	"	"	Bored	49	3,090	- 44	3,046	49	3,041	Ravenscrag coal	Hard, "alkaline"		D, S	Sufficient for 15 head stock.
1	NW.	2	3	1	3	Spring		2,994	0	2,994	0	2,994	Ravenscrag clay	Hard, clear		D, S	Sufficient for 20 head stock.
2	NE.	3	"	"	"	Bored	45	3,000	- 35	2,965	35	2,965	Ravenscrag sand			D, S	Sufficient for 15 head stock.
3	SW.	6	"	"	"	Dug	23	2,868	- 15	2,853	18	2,850	Ravenscrag gravel	Hard, clear		D, S	Sufficient for 75 head stock.
4	NE.	10	"	"	"	Spring		2,950	0	2,950	0	2,950	Ravenscrag coal	Hard, clear, iron		D, S	Sufficient for 30 head stock.
5	SW.	14	"	"	"	Spring		2,950	0	2,950	0	2,950	Ravenscrag coal	Hard, clear		D, S	Sufficient for 40 head stock; #.
6	SW.	17	"	"	"	Dug	20	2,980	- 16	2,964	16	2,964	Ravenscrag clay	Hard, clear		D, S	Sufficient for local needs.
7	SW.	20	"	"	"	Spring		2,960	0	2,960	0	2,960	Ravenscfag coal	Hard, clear		D, S	Sufficient for 60 head stock.
8	NW.	22	"	"	"	Bored	30	2,980	- 20	2,960	20	2,960	Ravenscfag sand			D, S	Insufficient supply; enough for 10 head stock.
9	SE.	22	"	"	"	Dug	10	2,970	- 7	2,963	7	2,963	Brown gravel	Hard, clear		D, S	Sufficient for 35 head stock.
10	SW.	27	"	"	"	Spring		2,960	0	2,960	0	2,960	Ravenscrag coal	Hard, clear		D, S	Sufficient for 100 head stock.
1	NE.	1	3	2	3	Dug	35	2,890	- 29	2,861			Ravenscrag sand	Hard, clear		N	Well not used at present.
2	SE.	2	"	"	"	Dug	18	2,860	- 14	2,846	15	2,845	Ravenscrag ? gravel	Hard, clear		D, S	Sufficient for 20 head stock.
3	NW.	2	"	"	"	Bored	30	2,920	- 20	2,900			Ravenscrag coal			D	
4	NW.	6	"	"	"	Dug	17	2,980	- 14	2,966	17	2,963	Brown gravel	Hard, clear		D, S	Insufficient for local needs.
5	SE.	9	"	"	"	Dug	17	2,945	- 14	2,931	11	2,934	Ravenscrag sand	Hard, clear		D, S	Sufficient for 27 head stock.
6	SW.	11	"	"	"	Dug	8	2,924	- 4	2,920			Brown gravel	Hard, clear		D, S	Sufficient for 12 head stock.
7	SE.	14	"	"	"	Bored	80	3,030	- 60	2,970	80	2,950	Ravenscrag gravel	Hard, clear		D, S	Sufficient for 40 head stock.
8	SW.	26	"	"	"	Dug	9	3,040	- 7	3,033	7	3,033	Ravenscrag sand	Hard, clear		D, S	Sufficient for local needs.
9	SE.	33	"	"	"	Dug	28	3,060	- 23	3,037			Ravenscrag yellow clay	Hard, clear		D	Insufficient for local needs.
10	NE.	33	"	"	"	Dug	18	3,104	- 15	3,089	15	3,089	Recent(?) sand	Hard, clear	45	D, S	Sufficient for local needs.
11	NE.	34	"	"	"	Dug	17	3,100	- 12	3,088	12	3,088	Ravenscrag sand	Soft, clear		D	Sufficient for local needs.
1	SW.	1	3	3	3	Dug	4	3,100	- 1	3,099	4	3,096	Reddish brown gravel	Soft, clear		D	Sufficient for local needs.

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

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NO. 13, 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
2	NW.	7	3	3	3	Dug	60	3,100	- 52	3,048	52	3,048	Ravenscrag sandstone	Hard, clear		D, S	Sufficient for 15 head stock.
3	SW.	17	"	"	"	Dug	18	3,260	- 16	3,244	4	3,256	Reddish brown gravel	Hard, clear		D, S	Sufficient for 10 head stock. 35-foot dry hole.
4	SE.	19	"	"	"	Dug	25	3,212					Ravenscrag sand				Dry hole.
5	NW.	20	"	"	"	Dug	22	3,250	- 18	3,232	22	3,228	Ravenscrag sand	Hard, clear		D, S	Sufficient for 10 head stock.
6	SW.	23	"	"	"	Dug	7	3,076	- 3	3,073	7	3,069	Ravenscrag sand	Hard, clear		D, S	Sufficient for 50 head stock.
7	NE.	30	"	"	"	Dug	10	3,210	- 5	3,205	10	3,200	Ravenscrag sand	Soft, clear		D, S	Sufficient for 10 head stock.
8	SE.	32	"	"	"	Dug	20	3,242	- 18	3,224	20	3,222	Ravenscrag sand	Hard, clear, "alkaline"		D, S	Sufficient for 15 head stock.
9	SW.	33	"	"	"	Dug	14	3,250	- 12	3,238	14	3,236	Ravenscrag sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
10	SE.	33	"	"	"	Dug	22	3,260	- 19	3,241	22	3,238	Ravenscrag sand	Hard, clear, "alkaline"		D, S	Sufficient for 20 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.