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Hydrogeology of the Ribstone Creek Aquifer in Western Canada

by

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Saskatchewan Research Council
15 Innovation Blvd.
Saskatoon, SK S7N 2X8
SRC Publication No. 11500-1E02

Prepared for:
Agriculture and Agri-Food Canada
Prairie Farm Rehabilitation Administration
North Saskatchewan Region
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Funded by the Canada-Saskatchewan Farm Livestock Watering Program - Strategic Initiatives

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SUMMARY

The Ribstone Creek Tongue in western Saskatchewan covers an area of approximately 45,350 km^2 and occurs at depths ranging greater than 500 m beneath the Cypress Hills area to less than 25 meters in the Lloydminster area where the Ribstone Creek Tongue is near the ground surface.

The Ribstone Creek Tongue ranges in thickness from less than 3 meters along the edges of its extent to locally exceeding 35 m. However, throughout most of the study area it is between 5 and 25 m thick. The thickness of the Ribstone Creek aquifer is less than that of the Tongue since the sands and sandstones only comprise part of the sediments of the Tongue. The Ribstone Creek aquifer is a heterogeneous aquifer throughout its extent, due to the varying thickness and lithology of its sand/sandstone units. The Ribstone Creek aquifer south of Township 42 forms a continuous unit but north of it occurs as isolated pockets.

The transmissivity of the aquifer is low because the aquifer is relatively thin and the fine-grained sands/sandstones have a reported hydraulic conductivity which ranges from less than one to several meters/day. Over most of its extent the Ribstone Creek aquifer is overlain by the silts and clays of the Grizzly Bear Tongue which is typically between 20 and 60 meters thick. The Grizzly Bear Tongue forms an aquitard with a low vertical hydraulic conductivity. Because of the combination of a low aquifer transmissivity and low vertical hydraulic conductivity of the overlying aquitard it is estimated that the aquifer south of Township 42 at best will not yield more than 1,000 m^3/day. Drawdowns may extend over distances of several tens of kilometers. Drillers recommended pumping rates in the order of 50 ± 20 m^3/day provide an experience based guideline for the yield of individual wells in the aquifer north of Township 42.

South of Township 42 the aquifer yields water of the Na-Cl type with a sum of ions in the 3,000 to 15,000 mg/L range. Water in his portion of the aquifer is unsuitable as a water supply source for domestic and municipal purposes. North of Township 42 water in the Ribstone Creek aquifer is variable in term of both composition (water type) and concentration (*i.e.* sum of ions). Water is predominantly of the Na type, either Na- SO_4 or Na-HCO_3. The sum of ions ranges from 800 to 3,500 mg/L, but typically is less than 2,500 mg/L.

A more detailed study of the Ribstone Creek aquifer in the area covered by Ranges 23 – 28 and Townships 43 – 52 is recommended, as the aquifer in this area is a major source of domestic water supply.

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1. INTRODUCTION

1.1 Background

Sands and sandstones of the Late Cretaceous Ribstone Creek Tongue form a regional aquifer in western Saskatchewan and eastern Alberta (Figure 1). The aquifer, referred to in this report as the Ribstone Creek aquifer, is being used for domestic and municipal water supplies and as source water for secondary oil recovery.

Portions of the Ribstone Creek Tongue have been identified as part of various studies but the aquifer in its entirety has not been investigated. The current study describes and characterizes the Ribstone Creek Tongue throughout its occurrence in western Saskatchewan.

The Ribstone Creek study presented in this report was a project within the Canada - Saskatchewan Farm Livestock Watering Program - Strategic Initiatives, a joint Federal and Provincial government program. The project was administered by the Prairie Farm Rehabilitation Administration (PFRA), Agriculture and Agri-Food Canada, Saskatoon (PFRA File 4590-1-6-4-1).

1.2 Study Area

The study area is defined as the area covered by NTS map sheet areas: Cypress Lake (73F), Prelate (72K), Kindersley (72N), North Battleford (73C), and the southern half of St Walburg (73F).

The location of the study area is shown in Figure 2.

1.3 Objectives

The primary objective of the study is to evaluate the groundwater resources of the Ribstone Creek Tongue in western Saskatchewan. While the study focused on the Ribstone Creek aquifer, major aquifer units above the Ribstone Creek aquifer have been identified and are briefly described.

As part of the current study the following maps were prepared:

- Location of selected testholes and cross sections
- Bedrock surface topography and geology
- Thickness of Quaternary deposits
- Extent of Quaternary aquifers
- Extent of the Eastend – Ravenscrag aquifer
- Extent of aquifers within the Bearpaw Formation
- Extent and thickness of the Judith River Formation
- Extent and thickness of the Grizzly Bear Tongue
- Extent, depth to, and thickness of the Ribstone Creek Tongue

A total of nine (9) cross sections were prepared: seven (7) west - east sections, two (2) south - north sections. The cross sections have a horizontal scale of 1: 250,000 and a vertical scale of 1: 5,000, resulting in a vertical exaggeration of 50 times. The south - north cross sections, because of their length, were split into two parts. A map showing the extent of the Ribstone Creek Tongue in relation to the cross section lines, the cross section log index and the cross sections are included in Appendix A.

The current study is based on available information only.

1.4 Geology and Groundwater Data

Available maps and cross sections for the study area date back to 1990 (Millard, 1990a, b, c, d, e). These maps and cross sections are primarily based on testhole logs with a geophysical log (wildcat, oil and potash holes), and E-logs (spontaneous potential and single point resistance logs) obtained/collected by the Saskatchewan Research Council (SRC), and the Saskatchewan Water Corporation (SWC).

For the purpose of this report, the E-logs which have become available after the publication of the 1990 maps were reviewed and relevant information was used in updating the map information. The cross sections presented in this report were taken from Millard (1990a, b, c, d, e). They were prepared in AutoCAD 2000.

A review of the testhole dated contained in the SWC Water Well Drillers Report database was not conducted. The SWC database only provides lithological data for testhole/well sites and such data alone are in most cases not sufficient to determine if a well is completed in the aquifer formed by the Ribstone Creek Tongue.

The wildcat, oil and potash hole database of Saskatchewan Energy and Mines (SEM) was searched for Ribstone Creek Tongue picks. The search yielded tops and bottoms for the Ribstone Creek Tongue for about 18,400 sites. The tops and bottoms were determined by staff of SEM.

Water quality data used in this report were compiled from the following sources: Rutherford water quality database (Rutherford, 1967), SRC water quality database, SEM drillstem test water quality database, and water quality data in consultant reports.

Information regarding licensed withdrawals and actual withdrawals were obtained from the Saskatchewan Water Corporation and Saskatchewan Energy and Mines.

Water level information for the Ribstone Creek aquifer was obtained from information on the E-logs.

For plotting purposes Dominion Land Locations were converted to UTM coordinates (extended zone 13, NAD83). Locations were determined to the centroid of a Quarter or Legal Sub Division (LSD).

ArcInfo 8.1 was used to prepare many of the maps and figures in this report. Tabular data from a variety of sources were brought into ARCINFO in dbf file format. Point data were used to produce continuous surface grids and other graphic output. The procedure used in constructing grids consisted of compiling the point data in a database file format (*.dbf), converting this data to a shape file, and using the inverse distance weighted (IDW) interpolation method to produce a grid. All grids with the exception of the ground elevation data were prepared with a cell size of 500 meters. The ground elevation data, Canadian Digital Elevation Data (CDED), acquired from Natural Resources Canada (NRCAN), had a grid cell size of approximately 75 meters. These data sets consisted of 5 -1:250,000 scale NTS map areas. Those figures which indicate the depth to or thickness a particular unit were determined by performing various calculations on the grid files (*i.e.* Drift thickness = Ground elevation – bedrock surface). The resulting grids were then presented as color coded maps.

1.5 Previous Studies

As part of the first generation of NTS-based groundwater maps prepared by the Saskatchewan Research Council, the groundwater resources in the study area were initially mapped by Christiansen (1967), Christiansen and Whitaker (1973), Christiansen *et al.* (1980), David and Whitaker (1973), and Whitaker (1976). Bedrock aquifers and major buried valley aquifers were identified but not the aquifers in the glacial deposits. Each map was accompanied by four (4) cross sections. These cross sections show the Judith River Formation, and where present, the Ribstone Creek Tongue and Bearpaw sand members.

For the study area, Millard (1990a, b, c, d, e) prepared the second generation groundwater maps. NTS map sheets areas were divided into four (4) quadrants, and both bedrock as well as Quaternary aquifers were identified. The maps are accompanied by up to 10 cross sections. Maps showing the extent of the Ribstone Creek Tongue were prepared for the Cypress Lake (72F), North Battleford (73B), and St. Walburg (73F). The extent is based on cross sections and wildcat/oil/potash logs on file at SRC. SRC has only a limited number of logs for wildcat/oil/potash holes on file and no additional copies were obtained since the mid 1970s. Consequently, maps and cross sections were updated using the information available in the SEM database.

Relevant studies include those by Le Breton (1963), McLean (1971), Whitaker (1980, 1982a, b), Kewen and Schneider (1979), and Tokarsky (1985).

Le Breton (1963) described the Ribstone Creek aquifer in the vicinity of the City Of Lloydminster. He prepared a map showing the piezometric surface and discussed water quality and yields. McLean (1971) conducted a major study of the Judith River Formation in Alberta and Saskatchewan. He defined the extent of the Ribstone Creek Tongue in this area (McLean, 1971, Figure 16). The Ribstone Creek Tongue and Bearpaw sand members are shown in cross sections. A study by Kewen and Schneider (1979) focused on the Judith River Formation in west-central Saskatchewan but they mapped (extent, depth to and thickness) the Ribstone Creek in the Lloydminster area. Whitaker (1980; 1982a, b) described the Judith River Formation in southwestern Saskatchewan. The Ribstone Creek Tongue is shown in cross sections but is not further discussed. The extent of several of the Bearpaw sand members in that area were also defined as part of this study. Tokarsky (1985) prepared hydrogeological maps and cross sections along the Alberta – Saskatchewan border and shows the Ribstone Creek Tongue in cross sections.

The only study specifically focusing on the hydrogeology of the Ribstone Creek Tongue was conducted by the PRFA (1993). The PFRA studied the Ribstone Creek Tongue in an area in Alberta (Tp 21 - 40, Rg 1 - 14, W4), bordering Saskatchewan.

The areas covered by the studies mentioned above are shown in Figure 2.

1.6 Topography

The topographical setting of the study area is shown in Figure 3, in the form of a digital elevation map. The topographical elevation may range from 1385 m asl in the Cypress Hill area to 440 m asl in the North Saskatchewan River valley at the eastern boundary of the study area. The overall slope is from the south to the north. The main topographical features are the Cypress Hills and the valleys of the North and South Saskatchewan Rivers.

1.7 Groundwater Usage

For groundwater withdrawals other than for domestic use, the Saskatchewan Water Corporation requires a license for abstraction of groundwater and allocates a volume that can be withdrawn annually from the licensed well. For relevant geological units Figure 4 shows the distribution of groundwater allocations in the study area. The total volumes allocated are listed in Table 1.

Table 1 Allocated volumes of groundwater withdrawals from relevant geological units in the Ribstone Creek Tongue study area

Formation	Total volume allocated dam^3/annually
Glacial (undifferentiated)	18,210
Cypress Hills Formation	65
Ravenscrag Formation	460
Bearpaw Formation	145
Judith River Formation	8,640
Ribstone Creek	2,240
TOTAL	**29,760**

Source: Saskatchewan Water Corporation, February 2002
1 dam^3 equals 1,000 m^3

For a particular formation, the total groundwater allocations listed in Table 1 represent the maximum volumes which can be withdrawn from all the wells licensed. Typically, the actual volumes withdrawn annually will be significantly less than the allocated annual volumes.

From Table 1, it is evident that within the study area most of the groundwater for municipal and industrial use is being withdrawn from aquifers within the glacial deposits and the aquifer formed by the Judith River Formation. Of the licensed withdrawals from the glacial deposits 83% is for municipal purposes. In contrast, 71% of the licensed withdrawals from the aquifer formed by the Judith River Formation are for industrial purposes.

Withdrawals from the Ribstone Creek aquifer are further discussed in section 3.2.7.

The total volume of surface water allocated in the study area is 198,000 dam^3/annually. In contrast to licenses for groundwater, this figure includes allocations for domestic use.

1.8 Acknowledgements

B. Troyer, Saskatchewan Energy and Mines, provided data for the wildcat, oil and potash holes in the study area. He also provided data on water quality and water production from the Ribstone Creek aquifer.

The Saskatchewan Water Corporation (Nolan Shaheen, Melvyn Szabo, and Joanne Sketchell) provided well/testhole information, water quality data and groundwater and surface water use data.

H. Maathuis, hydrogeologist, Saskatchewan Research Council (SRC) led SRC's project team. Mark Simpson, geologist/GIS specialist prepared data for GIS use, prepared maps and contributed to the report. Terri Warkentin, AutoCad specialist, prepared the cross sections and a number of maps.

2. GEOLOGY

2.1 Introduction

The top of the Mannville Group was taken as the base of exploration for the present study. The stratigraphy and lithology of the formations between the ground surface and the Mannville Group is shown in Figure 5. Because of its complexity, the nomenclature of the Cretaceous sediments in western Saskatchewan is also shown in Figure 6.

The term bedrock applies to pre-Quaternary sediments. All the materials between bedrock and the ground surface are collectively referred to as "drift".

2.2 Bedrock Geology

2.2.1 Mannville Group

The Mannville Group occurs throughout the Western Sedimentary basin (Figure 7). The Mannville Group in southern Saskatchewan has been described by Christopher (1984). The Group consists of sand, silts and clays.

2.2.2 Lea Park Formation and Colorado Group

The Mannville Group is overlain by a sequence of overconsolidated marine clays and silts of the Colorado Group and the Lea Park Formation. The Colorado Group has been subdivided into Lower and Upper Colorado. The boundary between the Upper and Lower Colorado Group is formed by the bottom of the Second White Speckled Shale, a calcareous clay and silt unit which is a regional marker bed. Since the Lea Park Formation often cannot be separated from the Upper Colorado Group on electric logs the units are commonly combined. The Eagle Shoulder is a regional marker bed within this unit. Both the Lea Park Formation – Upper Colorado Group and the Lower Colorado Group are composed of marine silts and clays.

2.2.3 Judith River Formation

The Late Cretaceous Judith River Formation, also referred to as the Belly River or Oldman Formation, is an eastward thinning sedimentary wedge. The extent of this Formation (and its equivalents in Alberta) is shown in Figure 8.

The Formation is composed of non-marine and marine, multi-colored, sands (very fine to medium-grained), silts and clays, with carbonaceous and concretionary zones, deposited in a deltaic environment (McLean, 1971). The deltaic environment is a composite environment including alluvial, lacustrine, aeolian, lagoonal, swamp, beach and marine environments. Typically, individual units are heterogeneous, rarely are greater than 3 m thick and laterally can only be followed over a few kilometers (McLean, 1971).

Tongues splitting of from the top of the main body of the Judith River Formation are included in the Bearpaw Formation (see section 2.2.4), whereas the tongues splitting from the bottom of the main body are part of the Judith River Formation (see Figure 6).

Where present beneath the main body of the Judith River Formation, the Ribstone Creek Tongue is separated from the main body by the Grizzly Bear Tongue of the Lea Park Formation (see Figure 5). The Grizzly Bear Tongue is composed of non-calcareous marine silts and clays.

There are relatively few detailed descriptions of the sediments of the Ribstone Creek Tongue. In SRC testholes logs the Ribstone Creek Tongue is described as consisting of non-calcareous, very fine to fine grained sand, friable to very hard, locally with a clayey matrix and non-calcareous clays and silts. In drillers logs the sands are often described as sandstone and the silts and clays as shale. Within the Ribstone Creek Tongue the thickness of the sand unit(s) may vary locally.

A typical SRC testhole log and oil log showing the Ribstone Creek Tongue are shown in Figures 9 and 10, respectively. On oil logs the Ribstone Creek Tongue can be identified by its higher spontaneous potential and resistivity compared to the overlying Grizzly Bear Tongue and underlying silts and clays of the Lea Park Formation and Upper Colorado Group.

In parts of the study area the Victoria Tongue, also a tongue splitting from the bottom of the main body of the Judith River Formation, has been identified (McLean, 1971). The Victoria Tongue underlays the Ribstone Creek Tongue and is separated from it by the Vanesti Tongue of the Lea Park Formation (see Figure 10). This unit is not discussed further in this report.

2.2.4 Bearpaw Formation

In central Saskatchewan the sand tongues splitting off from the top of the main body of the Judith River Formations have been named and described by Caldwell (1968). The sand members are, in ascending order, named: Outlook Member, Matador Member, Demaine Member, Ardkenneth Member and Cruikshank Member. These sand members are separated by silt and clay members of the Bearpaw Formation (see Figure 5).

Beneath the Cypress Hills area additional sand members have been identified. These are stratigraphically higher than the Cruikshank Member and have been named the Oxarart, Belanger and Thelma units (Lomenda, 1973). Whitaker (1976) and Millard (1990a) identified these units in cross sections but spelled them differently than Lomenda (1973).

2.2.5 Eastend to Ravenscrag Formations

When the sea retreated from Saskatchewan during the Late Cretaceous, non-marine sands and silts were deposited in an advancing delta and in the following alluvial deltaic plain (Whitaker *et al.*, 1978).

The Eastend Formation is composed of grayish and greenish sand, silt and clay, with thin coal seams in the upper part. The Whitemud is composed of kaolinitized, white sand and clay, separated by a carbonaceous zone and overlain by a purplish shale of the Battle Formation. The

Frenchman Formation is composed of sand and clays. The Ravenscrag Formation is comprised of sands, silts, clays and coals. Since these formations can not be separated in the subsurface they have been lumped together into one unit (*e.g.* Whitaker *et al*., 1978; Christiansen, 1983).

2.2.6 Cypress Hills Formation and Tertiary Undifferentiated

The Tertiary Cypress Hills Formation is composed of conglomerate, gravel, sand and silt (Vonhof, 1965a, b; 1969). It unconformably overlies the Ravenscrag Formation (or Eastend to Ravenscrag formations), or directly overlies the Bearpaw Formation.

The youngest bedrock unit occurring in the study area is comprised of sands, silts and clays of Tertiary to Quaternary age. The extent of this undifferentiated Tertiary unit is limited to the Kindersley (72N) map sheet area.

2.2.7 Bedrock Surface Geology and Topography

The distribution of bedrock units outcropping at the bedrock surface is shown in Figure 11. The distribution is a function of the bedrock units in the Western Sedimentary basin gently sloping upward from south to north and preglacial and glacial erosion. The spatial distribution of bedrock units has also been influenced to some degree by structural disruption due to salt dissolution.

The bedrock topography is shown in Figure 12. The topography ranges from 398 meters asl in the Battleford Valley aquifer at the eastern boundary of the study area to 1350 meters asl in the Cypress Hills area. The major bedrock surface topography features are the Cypress Hills (bedrock surface high), and bedrock surface lows in the Tyner Valley, Battleford Valley and Bronston Lake Valley aquifer systems, and the valley of the North Saskatchewan River.

2.3 Quaternary Geology

The “drift” can be separated into the Empress Group, Sutherland and Saskatoon groups and their formations and subdivisions. Drift consists of till and stratified deposits. Till is an unsorted and unstratified material deposited directly by the glaciers and is comprised of a mixture of clay, silt, sand, gravel and boulders. Stratified drift consists of sand, gravel, silt and clay deposited by water.

The Empress Group is composed of sand, gravel, silt and clay of fluvial, lacustrine and colluvial origin that overlies Cretaceous bedrock and non-marine Tertiary bedrock and underlies till of Quaternary age (Whitaker and Christiansen, 1972). In preglacial valleys (such as the Tyner Valley), the Empress Group may include a preglacial unit identified by the presence of quartzite and chert gravel and the absence of carbonate and shield-derived material. The upper sands and gravels are of glacial origin and contain igneous, metamorphic and carbonate fragments (Christiansen, 1992).

The Sutherland Group, originally described by Christiansen (1968a), is defined as the drift between the Empress Group and Saskatoon Group or the drift between bedrock and the

Saskatoon Group (Christiansen, 1992). The Sutherland Group has been further subdivided, in ascending order, into the Mennon, Dundurn and Warman formations (Christiansen, 1992).

The Saskatoon Group includes, in ascending order: Floral and Battleford formations and surficial stratified deposits. The Floral and Battleford formations were initially described by Christiansen (1968a, b). Christiansen (1992) subdivided the Floral Formation into a lower and upper till, separated by the Riddell Member (stratified sands).

The term 'surficial stratified deposits' is an informal designation for sediments between the Battleford Formation and the present land surface (Christiansen, 1992).

In Figure 13, the thickness of the drift is shown. The drift thickness ranges from zero meters where bedrock units outcrop at the ground surface to about 270 meters. In the Cypress Hills area, bedrock units are exposed at the ground surface in part because parts of the Cypress Hills have not been glaciated (see cross section H – H1, Appendix A). Bedrock units in this area are also exposed in valley slopes (see cross section I – I1, Appendix A). Similarly, in the northern part of the study area the Ribstone Creek Tongue is exposed in river valley slopes (*e.g* cross sections A-A' and B-B', Appendix A). Bedrock may also be exposed as a result of glacial erosion. Drift is the thickest where preglacial valleys were deeply incised into the bedrock and where the present land surface represents topographical highs.

3. HYDROGEOLOGY OF THE RIBSTONE CREEK AQUIFER

3.1 Introduction

With respect to water supply, an aquifer is defined commonly as a saturated geological unit in which a well can be constructed which yields economic quantities of water. Aquifers are separated by aquitards which are layers which are sufficiently permeable to transmit water but not sufficiently permeable to allow completion of a production well. Typically, flow in aquitards is vertical whereas flow in aquifers is horizontal. Depending on the dimensions of an aquifer, flow is controlled by the large-regional, regional or local topographic setting.

Within the study area bedrock aquifers, in ascending order, are formed by sediments of the (see Figure 5): Mannville Group, the Ribstone Creek Tongue, the Judith River Formation, sand members within the Bearpaw Formation, the Eastend to Ravenscrag formations, Cypress Hills Formation, and undifferentiated Tertiary to Quaternary deposits. Major aquitards are formed by the silts and clays of the Lower Colorado Group, the Lea Park Formation – Upper Colorado Group, and the Bearpaw Formation (see Figure 5).

Aquifers within the Quaternary deposits are formed by sediments of the Empress Group, by sands and gravels within and between the Sutherland and Saskatoon groups and by surficial sands and alluvial deposits. Aquitards are formed mainly by tills.

The hydrogeology of the Ribstone Creek aquifer is discussed in more detail in the following sections. Other aquifers within the study area are briefly discussed in section 5.

3.2 Ribstone Creek Aquifer

3.2.1 Extent and thickness of the Ribstone Creek and Grizzly Bear Tongue

The extent and thickness of the Ribstone Creek Tongue is shown in Figure 14. The thickness of the Ribstone Creek Tongue is based mainly on the SEM data since only for the area north of Township 40 other testhole data are available (Figure 15).

In the area south of Township 43, the Ribstone Creek Tongue forms a virtual continuous geological unit with its eastern boundary being the depositional edge. North of Township 43 the Ribstone Creek Tongue is a discontinuous unit. The discontinuity in this area is caused by removal of the Ribstone Creek Tongue by fluvial erosion which formed the Battleford and Lloydminster bedrock valleys and the present Big Gully Creek and Battle River valleys. Glacial erosion may also have contributed to the removal of the Ribstone Creek Tongue in this area. As a result, the northern boundary of the Ribstone Creek Tongue is an erosional boundary. Although the Ribstone Creek Tongue occurs in isolated areas north or Township 43, within these areas the sediments of the Tongue are continuous.

The Ribstone Creek Tongue ranges in thickness from less than 3 meters along the edges of its extent to locally exceeding 35 m. However, throughout most of the study area it is between 5 and 25 m thick.

From a hydrogeological point of view, it is important to note that the extent of the Ribstone Creek aquifer likely will coincide with that of the Ribstone Creek Tongue. However, since only part of the Tongue is comprised of sand or sandstone, the thickness of the Ribstone Creek aquifer will be less than the thickness of the Tongue.

Despite the fact that the Ribstone Creek Tongue is continuous over its extent and because of the variability in the thickness and characteristics of its sands and sandstones, the Ribstone Creek aquifer is a heterogeneous aquifer.

The Ribstone Creek aquifer in western Saskatchewan covers an area of approximately 45,350 km^2 and occurs at depths ranging from greater than 500 meters beneath the Cypress Hills area (see cross section H – H1, Appendix A) to less than 25 meters in the northern part of the study area. The depth to the top of the Ribstone Creek Tongue is shown in Figure 16.

The Grizzly Bear Tongue is defined as the silt and clay unit between the bottom of the main body of the Judith River Formation and the top of Ribstone Creek Tongue. Consequently, the extent of the Grizzly Bear Tongue coincides with that of the Ribstone Creek Tongue, except in the narrow zone where the Ribstone Creek Tongue forms the bedrock surface.

The distribution of the thickness of the Grizzly Bear Tongue is shown in Figure 17. Similarly as with the Ribstone Creek Tongue, the thickness is based mainly on the SEM data as only for the area north of Township 40 other testhole data are available.

The Grizzly Bear Tongue ranges in thickness from less than 3 meters to about 125 m. However, typically, the thickness is in the 20 to 60 meter range.

3.2.2 Hydrogeological Models for the Ribstone Creek Aquifer

Based on the geological setting of the Ribstone Creek aquifer (see Appendix A: cross sections), three basic hydrogeological models can be distinguished (Figure 18). The models have in common that the top of the Lea Park Formation and Upper Colorado Group forms an impermeable base with respect to groundwater flow above it.

Model A is applicable to most of the area over which the Ribstone Creek aquifer occurs. The aquifer is overlain by an aquitard formed by the Grizzly Bear Tongue which in turn is overlain by the aquifer formed by the Judith River Formation. Recharge to the Ribstone Creek aquifer is controlled by the vertical hydraulic conductivity of the overlying aquitard formed by the Grizzly Bear Tongue. The source of the recharge is the Judith River aquifer.

Very little is known about the hydraulic conductivity of the Cretaceous silts and clays (Maathuis *et al.*, 1993). Unfractured Cretaceous silts and clays can be expected to have a vertical hydraulic conductivity of less then 8.6×10^{-6} m/day (10^{-10}m/s). Since vertical gradients greater than unity are unlikely to occur, recharge through an aquitard will be maximal when the head difference is equal to the thickness of the aquitard (*i.e.* a gradient of unity). It can be shown that in this case the recharge equals the vertical hydraulic conductivity. Consequently, for a hydraulic conductivity less than 8.6×10^{-6} m/day, the recharge will be less than 0.003 m/year. Similarly, any upward discharge from the Ribstone Creek aquifer into the Judith River aquifer will be small.

Model B is applicable to the area where the Judith River Formation is absent but sediments of the Grizzly Bear Tongue overlie the Ribstone Creek aquifer and, in turn, are overlain by an aquitard formed by tills. In this case the recharge is controlled by the bulk hydraulic conductivity of the Grizzly Bear Tongue and the tills.

In Model C, drift directly overlies the Ribstone Creek aquifer. Recharge to the aquifer is controlled by the bulk vertical hydraulic conductivity of the tills making up the drift aquitard. In particular in the area where the drift is thin, and characterized by fracture permeability, recharge to the aquifer might be appreciable.

The implications of the models with respect to aquifer yields are discussed further in section 3.2.8.

3.2.3 Wells in the Ribstone Creek Aquifer

Based on the extent of the Ribstone Creek Tongue, available E-logs, and wells documented in consultant reports, Table 2 lists wells known to have been completed in the Ribstone Creek aquifer. This Table also provides information on the top and bottom of the Ribstone Creek Tongue, well depth, depth to water, water level elevation, available drawdown and recommended pumping rate. Since the SWC Water Well Drillers Report database was not used in identifying wells completed in the aquifer, the actual number of wells completed in the aquifer will be greater than the 170 listed in Table 2. In addition to the wells listed, SEM records indicate that there are an additional 21 wells completed in the aquifer. The location of wells known to be completed in the Ribstone Creek aquifer is shown in Figure 19.

3.2.4 Water Quality in the Ribstone Creek Aquifer

Available water quality data for wells completed in the Ribstone Creek aquifer are listed in Table 3. In Table 4, water quality data obtained from drill stem tests are provided. The locations of the sample points are shown in Figure 20.

Inspection of the water quality data for the area south of Township 40 shows that the aquifer typically yields water of the Na-Cl type with a sum of ions in the range of 3,000 to 15,000 mg/L. This water is unsuitable for domestic, municipal and agricultural use, due to the high sodium (Na) and chloride (Cl) concentrations. However, it has been used by the oil industry for enhanced oil recovery.

The characteristics of the water quality in the Ribstone Creek aquifer in the area between Township 40 and 52 are shown in more detail in Figure 21. This Figure shows that in this area the quality of the water in the Ribstone Creek aquifer is variable in term of both composition (water type) and concentration (*i.e.* sum of ions). Water is predominantly of the Na type, either Na- SO_4 or Na-HCO_3. The sum of ions ranges from 800 to 3,500 mg/L, but typically is less than 2,500 mg/L.

3.2.5 Hydraulic Properties of the Ribstone Creek Aquifer

Reported transmissivity and hydraulic conductivity data for the Ribstone Creek aquifer are summarized in Table 5.

Table 5 Reported hydraulic properties for the Ribstone Creek aquifer

Location	Transmissivity m^2/d	Hydraulic Conductivity m/d	Reference
11-06-31-22-W3	2.5 - 6	0.2 – 0.4	UMA, 1964
01/02-19-33-27-W3	1.9 - 14	0.2 - 1.3	AGRA, 1995
NW-13-35-44-27-W3	21	5	Rohde and Lebedin, 1987
11-16-36-28-W3	33		Hydrogeological Consultants Ltd. ,1992
16-19-36-28-W3	22 - 33	1.3 – 1.8	Golder, 1996
16-27-35-28-W3	11.3 – 22.4	0.8 – 1.6	Campbell Geoscience, 1985

It is evident from Table 5 that the hydraulic conductivity of the aquifer ranges from less than one to several meters/day, consistent with the lithology of the aquifer sediments. Since the aquifer is relatively thin, it has a low transmissivity.

3.2.6 Groundwater Flow in the Ribstone Creek Aquifer

Point water level data are available only for the Ribstone Creek aquifer north of Township 42. South of Township 42 water level data are scarce and limited to a few sites where the oil industry uses the aquifer as a water supply source for enhanced oil recovery.

From a large-scale regional perspective, and based on the general topographical setting, and with the Cypress Hills area in the south being a topographical high, flow in the Ribstone Creek aquifer south of Township 42 will be in a northerly direction. Because of the absence of water level data, areas of recharge and discharge to and from the Ribstone Creek aquifer can not be identified.

Point water level data for the Ribstone Creek aquifer north of Township 42 are shown in Figure 22. Because of the large variability in the reported water level data, the data can not be used to determine flow direction within the various portions of the aquifer. The large variability in water levels is in part due to the fact that the reported depths to water data cover a time span of three decades. In addition, the depths to water measurements are subject to errors.

The Ribstone Creek aquifer north of Township 42 occurs as isolated portions and consequently, groundwater flow within these portions is controlled by and will reflect, the local topographical setting. Where the aquifer outcrops along the Big Gully Creek and Battle River valley slopes, springs can be expected since these outcrop areas represent discharges areas.

3.2.7 Withdrawals from the Ribstone Creek Aquifer

The Ribstone Creek aquifer is used as a water supply source for domestic, municipal and industrial purposes. The locations of wells licensed for withdrawals for municipal and industrial sources are shown in Figure 23. The industrial use is exclusive the use by the oil industry.

Throughout most of the study area the Ribstone Creek aquifer is either too deep or yields water which is unsuitable for drinking water purposes. Only in the area covered by Ranges 15 – 29, Twp 40 – 52, is the aquifer used as a source of domestic water supply.

The Town of Marsden uses water from the Ribstone Creek and Quaternary aquifers for its municipal water supply. Marsden wells No. 5 and 6 have been completed in the Ribstone Creek aquifer (Rohde and Lebedin, 1987). In the period 1985 – 2000, the Town withdrew a reported average annual volume of groundwater of about 30 dam^3 (Table 6). However, it is not known what percentage of this volume came from the Ribstone Creek aquifer.

The oil industry has been using the Ribstone Creek aquifer as a source of water for enhanced oil recovery (see Figure 23). Details about the water produced from the aquifer by the oil industry are provided in Table 7. At the end of 2001, water was being produced from eight (8) wells.

3.2.8 Yield of Wells in the Ribstone Creek Aquifer

Based on drillers recommended pumping rates (see Table 2), the yield of domestic wells is in the order of 50 ± 20 m^3/day (0.6 ± 0.2 L/s) The yield of wells currently used by the oil industry ranges from about 150 to 480 m^3/day (see Table 7).

The yield of individual wells completed in the Ribstone aquifer is a function of a number of variables, including: transmissivity of the aquifer, pumping rate, available drawdown and the characteristics of the overlying aquitard (thickness and vertical hydraulic conductivity).
For the Ribstone Creek aquifer south of Township 42 the theoretical yield of a well can by estimated by considering the steady-state drawdown model for an aquifer with leakage through an overlying aquitard (*e.g.* Kruseman and de Ridder, 1990):

$$s = \frac{Q}{2pT} K_0 \left(\frac{r}{L}\right) \qquad (1)$$

where:

s = drawdown (meters)
Q = pumping rate (m^3/day)
r = distance (meters)
T = transmissivity of the aquifer (m^2/day)
$L = \sqrt{Tc}$ = leakage length (meters)
$c = b'/K_v$ = vertical resistance (days)
b' = thickness of the overlying aquitard (meters)
K_v' = vertical hydraulic conductivity of aquitard (m/day)
K_0 = modified Bessel function of the second kind and zero order

Applying equation 1, assuming that the Grizzly Bear Tongue has a thickness ranging between 20 and 50 meters and a hydraulic conductivity of 8.64 $x10^{-6}$ m/day, an aquifer transmissivity between 10 and 30 m^2/day and a well diameter of 15.2 cm (6”), Figure 24 shows drawdowns near the well in the 7 to 180 m range for pumping rates between 100 and 1,000 m^3/day. The actual drawdown in the well itself will be greater than that directly adjacent because of well losses. Data on the available drawdown in the area south of Township 42 are extremely scarce but yields in excess of 1,000 m^3/day are unlikely except under very favorable conditions. Figure 24 also shows that the drawdowns may extend over significant distances, up to several tens of kilometers. Equation 1 assumes that the aquifer is homogeneous over these distances but this is unlikely the case considering the variable thickness and lithology of the aquifer. The heterogeneity will result in increased drawdowns and thus a lower well yield.

It is also noted that because of the low vertical hydraulic conductivity of the Grizzly Bear Tongue establishing steady state conditions may take years. Similarly, recovery of water levels after pumping ceased will also take years.

Theoretical analyses of well yields north of Township 42 have little meaning since the aquifer occurs as isolated pockets and boundary conditions would have to be taken into account. North of Township 42, the range in the drillers recommended pumping rates provides a practical guideline of potential well yields.

4. OTHER AQUIFERS

Other major aquifers in the study area include aquifers formed by sediments of the Judith River Formation, sand members within the Bearpaw Formation, the Eastend to Ravenscrag formations, and the aquifers within the glacial deposits. These aquifers are briefly discussed below.

4.1 Judith River Formation Aquifer

Within the Western Sedimentary Basin, the aquifer formed by the sediments of the Judith River Formation is a major regional aquifer (see Figure 8). The extent of the aquifer in the study area is shown in Figure 25. The aquifer occurs virtually throughout the entire study area but is absent in the area where the Tyner Valley cut through the aquifer and north of Township 42 where it has been removed by erosion except for two isolated remnants. Where it is present, it overlies the Ribstone Creek aquifer (see also cross sections, Appendix A).

4.2 Aquifers in the Bearpaw Formation

Based on the work by Whitaker (1982) and Millard (1990a), Figure 26 shows the area in which sand members of the Bearpaw Formation occur. Within this area one or more sand members may occur, but at different stratigraphical positions. In terms of a water supply source, sand members of the Bearpaw Formation do not appear to be a significant source. SWC records indicate that within the study area six (6) wells completed in a Bearpaw sand member area have been licensed, for a total allocation of about 110 dam^3/year.

4.3 Eastend to Ravenscrag Aquifer and Cypress Hills Unit

The extent of the aquifer formed by the Eastend to Ravenscrag formations in the study area is shown in Figure 27. This Figure also shows the extent of the Cypress Hills Formation. Where the Cypress Hills Formation overlies the Eastend to Ravenscrag formations, the Eastend to Cypress Hills formations form one aquifer unit.

The Eastend to Ravenscrag aquifer unit in the vicinity of the Town of Shaunavon has been referred to by Meneley (1983) as the Shaunavon aquifer system. Meneley (1983) estimated that the yield of individual wells from this system is in the 125 to 350 m^3/day range. Water from this system is of the $Na+K – HCO_3$ type and has an average sum of ions of about 1,050 mg/L. The Town of Shaunavon is a major user of groundwater from this system. In the period 1985 – 2000, the Town withdrew about 360 dam^3 annually (source: Saskatchewan Water Corporation).

4.4 Drift Aquifers

Aquifers within the Quaternary deposits occur at various stratigraphical levels and vary in extent and thickness. Figure 28 shows the extent of aquifers formed by sediments of the Empress Group and of alluvial, surficial, intertill (undifferentiated) aquifers. Within the study area, the drift aquifers form an important source of water for domestic, municipal and industrial purposes.

5. RECOMMENDATIONS

- A more detailed study of the Ribstone Creek aquifer in the area covered by Ranges 23 – 28 and Townships 43 – 52 should be considered as the aquifer in this area is a major source of domestic water supply.

- Characterization of the water quality in the Ribstone Creek aquifer north of Township 42 can be greatly improved by conducting a targeted water quality program based on the wells identified in this report as being completed in the aquifer. Water should be analyzed for major ions, trace elements, arsenic, selenium and selected isotopes such as deuterium and oxygen-18.

- Since long-term water level records are not available for the Ribstone Creek aquifer it is recommended to construct two groundwater level observation wells in the aquifer, one north and one south of Township 42. These wells should be incorporated into the provincial network of observation wells.

- The aquifer formed by the Judith River Formation, and its equivalents in Alberta, is a major aquifer within the Western Sedimentary Basin. Because it is an important source of water for domestic, municipal and industrial purposes, a study of this aquifer in its entirety is warranted.

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3	A-A'	FFIB	15-24-50-28-W3
4	A-A'	SRC Northminster	NW-13-19-50-27-W3
5	A-A'	OIL Husky Northminster STH 12	13-19-50-27-W3
6	A-A'	OIL Husky Northminster STH 22	13-17-50-27-W3
7	A-A'	FFIB	3-17-50-27-W3
8	A-A'	FFIB	1-17-50-27-W3
9	A-A'	OIL Husky Northminster STH 6	4-16-50-27-W3
10	A-A'	FFIB	1-16-50-27-W3
11	A-A'	FFIB	16-10-50-27-W3
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17	A-A'	OIL Husky McLaren STH 6	16-5-50-26-W3
18	A-A'	FFIB	NE-16-5-50-26-W3
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27	A-A'	FFIB	16-10-50-24-W3
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29	A-A'	FFIB	1-17-50-23-W3
30	A-A'	OIL Wilrich Trans Era Strat Test 8	14-11-50-23-W3
31	A-A'	FFIB	12-7-50-22-W3
32	A-A'	OIL Mobil Standard Hill	4-17-50-22-W3
33	A-A'	FFIB	9-14-50-22-W3
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35	A-A'	FFIB	10-10-50-20-W3
36	A-A'	OIL Battleford Mervin 1	1-15-50-20-W3
37	A-A'	OIL Rio-tinto Edam STH 4	4-14-50-20-W3
38	A-A'	EPD Mervin	12-16-50-19-W3
39	A-A'	OIL Husky Long Hope	13-21-50-18-W3
40	A-A'	FFIB	SE-9-14-50-18-W3
41	A-A'	EPD Glaslyn	14-20-50-17-W3
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44	A-A'	FFIB	NW-34-50-16-W3
45	A-A'	FFIB	3-13-50-15-W3
46	A-A'	FFIB	NE-1-13-50-15-W3
47	A-A'	FFIB	1-18-50-14-W3
48	B-B'	OIL Husky Buzzard STH 6	1-27-46-28-W3
49	B-B'	SRC Auger	13-23-46-28-W3
50	B-B'	OIL Husky Buzzard STH 7	4-25-46-28-W3
51	B-B'	SRC Unwin	NE-13-19-46-27-W3
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63	B-B'	OIL Sun Core Hole	4-15-46-25-W3
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83	B-B'	FFIB	S 15-45-17-W3
84	B-B'	FFIB	8-15-45-17-W3
85	B-B'	FFIB	15-12-45-17-W3
86	B-B'	SRC Hamlin	SW 4-17-45-16-W3
87	B-B'	FFIB	SW 4-23-45-16-W3
88	B-B'	OIL Texas Gulf Battleford	4-19-45-15-W3
89	B-B'	FFIB	13-17-45-15-W3
90	B-B'	OIL Total Jackfish Lake R/A 1	13-16-45-15-W3
91	B-B'	OIL Total Jackfish Lake R/A 2	13-36-45-15-W3
92	C-C'	OIL Superior Bata Manitou 3	6-2-42-28-W3
93	C-C'	FFIB	4-31-41-27-W3
94	C-C'	OIL Consumers Co-op STH 48	3-6-42-26-W3
95	C-C'	FFIB	12-34-41-26-W3
96	C-C'	FFIB	16-26-41-26-W3
97	C-C'	OIL Consumers Co-op STH 18	1-1-42-26-W3
98	C-C'	SRC Winter	NW-9-10-42-25-W3
99	C-C'	OIL Consumers Co-op STH 42	1-1-42-25-W3
100	C-C'	OIL Consumers Co-op STH 39	3-2-42-24-W3
101	C-C'	OIL BA Round Valley Watt ST	4-14-42-23-W3
102	C-C'	FFIB	4-18-42-22-W3
103	C-C'	FFIB	3-14-42-22-W3
104	C-C'	OIL Sun Cutknife SH	15-17-42-21-W3
105	C-C'	SRC Rockhaven	NW 13-22-42-21-W3
106	C-C'	EPD Rockhaven	16-24-42-21-W3
107	C-C'	EPD Wilkie	13-9-42-20-W3
108	C-C'	FFIB	1-15-42-20-W3
109	C-C'	OIL Can Oxy et al Wilkie	6-13-42-20-W3
110	C-C'	OIL Sun Core Hole	13-5-42-19-W3

Index No.	Cross Section	Name	Land Location
111	C-C'	OIL Jeff Lake Oxy Silver Park	12-4-42-19-W3
112	C-C'	OIL Husky Prongua SH	4-6-42-18-W3
113	C-C'	FFIB	NW 26-41-18-W3
114	C-C'	OIL Calstan S. Battleford Prov.	3-16-42-17-W3
115	C-C'	SRC Ibstone	SW 4-11-42-17-W3
116	C-C'	FFIB	2-8-42-16-W3
117	C-C'	OIL Calstan S. Battleford Prov.	14-11-42-16-W3
118	C-C'	FFIB	7-4-42-15-W3
119	C-C'	U of S Denholm No. 9A	SE 13-3-42-15-W3
120	C-C'	U of S Denholm No. 2	NW 2-10-42-15-W3
121	C-C'	U of S Denholm No. 6	SE 7-10-42-15-W3
122	C-C'	U of S Denholm No. 17	SW 12-11-42-15-W3
123	C-C'	U of S Denholm No. 4	SW 4-14-42-15-W3
124	C-C'	U of S Denholm No. 3	SW 4-20-42-14-W3
125	D-D'	FFIB	NE-35-26-28-W3
126	D-D'	FFIB	9-33-36-27-W3
127	D-D'	OIL Husky Cactus Lake R/A	4-36-36-27-W3
128	D-D'	FFIB	4-32-36-26-W3
129	D-D'	FFIB	13-23-36-26-W3
130	D-D'	FFIB	12-24-36-26-W3
131	D-D'	FFIB	SE-2-13-36-26-W3
132	D-D'	SRC Hearts Hill Obs.Well	NE-14-7-36-25-W3
133	D-D'	FFIB	5-8-36-25-W3
134	D-D'	FFIB	16-9-36-25-W3
135	D-D'	FFIB	1-15-36-25-W3
136	D-D'	FFIB	4-20-36-24-W3
137	D-D'	FFIB	13-27-36-24-W3
138	D-D'	FFIB	4-35-36-24-W3
139	D-D'	OIL Woodley Paramount Tramping Lake R/A	4-29-36-23-W3
140	D-D'	FFIB	13-27-36-23-W3
141	D-D'	FFIB	14-32-36-22-W3
142	D-D'	FFIB	1-3-37-22-W3
143	D-D'	FFIB	8-2-37-22-W3
144	D-D'	FFIB	1-17-37-21-W3
145	D-D'	FFIB	4-14-37-21-W3
146	D-D'	FFIB	NW-13-2-37-20-W3
147	D-D'	FFIB	15-31-36-20-W3
148	D-D'	SHT Trampling Lake No. 1	NW-15-32-36-20-W3
149	D-D'	FFIB	2-5-37-20-W3
150	D-D'	SHT Trampling Lake No. 2	NW-16-32-36-20-W3
151	D-D'	SHT Trampling Lake No. 3	NE-13-33-36-20-W3
152	D-D'	FFIB	NW-13-2-37-20-W3
153	D-D'	FFIB	NE-16-6-37-19-W3
154	D-D'	EPD Landis	2-18-37-18-W3
155	D-D'	OIL Albercan STH 2	13-13-37-18-W3
156	D-D'	OIL Albercan STH 9	4-31-37-17-W3
157	D-D'	OIL Albercan STH 11	1-22-37-17-W3
158	D-D'	FFIB	NW-13-37-17-W3
159	D-D'	OIL Albercan STH 47	4-17-37-16-W3
160	D-D'	OIL Albercan STH 46	16-11-37-16-W3
161	D-D'	EPD Oban	NE-1-17-37-15-W3
162	D-D'	OIL Albercan STH 40	13-14-37-15-W3
163	E-E'	OIL Phillips Husky Grattle	16-3-30-29-W3
164	E-E'	OIL Imperial Roslyn	10-35-29-28-W3
165	E-E'	OIL Alminex STH 5-57	4-36-29-28-W3

Index No.	Cross Section	Name	Land Location
166	E-E'	OIL Alminex STH 6-57	13-30-29-27-W3
167	E-E'	OIL Alminex STH 7-57	4-29-29-27-W3
168	E-E'	FFIB	SE 11-21-29-27-W3
169	E-E'	FFIB	SW 5-22-29-26-W3
170	E-E'	FFIB	3-13-29-26-W3
171	E-E'	OIL Phillips Husky Ormstown 1	1-32-29-25-W3
172	E-E'	OIL Phillips Husky Sawde 1	16-19-29-24-W3
173	E-E'	FF1B	1-23-29-24-W3
174	E-E'	OIL Phillips Husky Merrington	4-30-29-23-W3
175	E-E'	FFIB	1-21-29-23-W3
176	E-E'	EPD Kindersley	SW 12-19-29-22-W3
177	E-E'	EPD Kindersley	1-22-29-22-W3
178	E-E'	FFIB	SE 4-13-29-22-W3
179	E-E'	FFIB	NE 16-8-29-21-W3
180	E-E'	FFIB	NE 1-15-29-21-W3
181	E-E'	FFIB	10-11-29-21-W3
182	E-E'	OIL Imperial Brock	6-5-29-20-W3
183	E-E'	FFIB	8-15-29-20-W3
184	E-E'	OIL Imperial Netherhill	10-13-29-20-W3
185	E-E'	OIL Socony Sohio Netherhill	10-28-29-19-W3
186	E-E'	FFIB	16-36-29-19-W3
187	E-E'	OIL Sohio Standard Fiske 1	14-21-29-18-W3
188	E-E'	FFIB	4-32-29-17-W3
189	E-E'	FFIB	16-36-29-17-W3
190	E-E'	FFIB	SW 5-20-29-16-W3
191	E-E'	FFIB	1-33-29-16-W3
192	E-E'	FFIB	9-24-29-16-W3
193	E-E'	OIL Socony Sohio Ridpath	11-19-29-15-W3
194	F-F'	OIL United Canso Horsham	11-23-17-29-W3
195	F-F'	DOE	SE-21-17-28-W3
196	F-F'	OIL Can Exp Fox Valley	6-12-17-28-W3
197	F-F'	FFIB	NW-5-35-18-27-W3
198	F-F'	DOE	NE-26-17-26-W3
199	F-F'	DOE	NW-16-17-25-W3
200	F-F'	SRC Fox Valley	SW-13-11-17-25-W3
201	F-F'	SRC Fox Valley	NW-13-12-17-25-W3
202	F-F'	DOE	SE-20-17-24-W3
203	F-F'	OIL Socony Western CH 123-36	4-22-17-24-W3
204	F-F'	OIL Socony Western CH 123-29	6-1-18-24-W3
205	F-F'	SRC Freefight Lake	SW-14-3-18-23-W3
206	F-F'	OIL Socony West CH 123-23	16-36-17-23-W3
207	F-F'	OIL Socony Woodley Southern Bestville	3-33-17-22-W3
208	F-F'	OIL Socony Western CH 123-17	4-6-18-21-W3
209	F-F'	SE Hazlet JR.1	NE-3-4-18-21-W3
210	F-F'	SE Hazlet JR.9	SW-2-4-18-21-W3
211	F-F'	FFIB	1-4-18-21-W3
212	F-F'	DOE	NE-34-17-21-W3
213	F-F'	OIL Socony West CH 123-11	1-1-18-21-W3
214	F-F'	FFIB	NW-17-17-20-W3
215	F-F'	OIL Socony Western CH 124-50	13-15-17-20-W3
216	F-F'	FFIB	SW-23-17-20-W3
217	F-F'	OIL Socony Western CH 124-122	13-28-17-19-W3
218	F-F'	FFIB	16-28-17-19-W3
219	F-F'	OIL Socony Western CH 124-20	1-1-18-19-W3
220	F-F'	SRC Roseray	NW-16-31-17-18-W3

Index No.	Cross Section	Name	Land Location
221	F-F'	OIL Socony Western STH 124-24	4-4-18-18-W3
222	F-F'	OIL Socony Western CH 124-16	12-35-17-18-W3
223	F-F'	OIL Socony Western STH 124-80	1-2-18-18-W3
224	F-F'	OIL Sedco Fosterton Wildcat	3-1-18-18-W3
225	F-F'	OIL Socony Western STH 124-62	1-1-18-18-W3
226	F-F'	DOE	SW-4-18-17-W3
227	F-F'	OIL Socony Western CH 124-63	4-3-18-17-W3
228	F-F'	OIL Socony Western CH 124-64	13-31-17-16-W3
229	F-F'	OIL Socony Western CH 124-78	13-34-17-16-W3
230	F-F'	OIL Socony Western CH 124-79	1-1-18-16-W3
231	F-F'	OIL Tidewater Wildcat STH 339	4-5-18-15-W3
232	F-F'	OIL Garvey STH 1	7-5-18-15-W3
233	G-G'	SRC-RCA Green Lake	NE-2-8-6-30-W3
234	G-G'	OIL Can Delhi Cypress Hills 1	9-9-6-30-W3
235	G-G'	SRC Battle Creek	SW-2-15-5-29-W3
236	G-G'	OIL Texaco Battle Creek	14-11-5-29-W3
237	G-G'	OIL Imperial Senate	14-7-5-27-W3
238	G-G'	DOE	SW-13-5-27-W3
239	G-G'	OIL BA Oil Cypress Lake	12-10-5-26-W3
240	G-G'	OIL Imperial Robsart	1-1-5-25-W3
241	G-G'	OIL Socony STH 75-143	1-23-4-24-W3
242	G-G'	OIL Socony STH 75-96A	14-18-4-23-W3
243	G-G'	OIL Socony STH 75-93B	7-21-4-23-W3
244	G-G'	OIL Socony STH 75-87	16-13-4-23-W3
245	G-G'	FFIB	NW-28-4-22-W3
246	G-G'	SRC Clay Centre	NW-5-34-4-22-W3
247	G-G'	OIL Socony STH 75-142	14-13-4-22-W3
248	G-G'	OIL Socony STH 75-139	12-18-4-21-W3
249	G-G'	OIL Socony Woodley Southern Eastbrook	13-17-4-21-W3
250	G-G'	OIL Socony STH 75-138	4-16-4-21-W3
251	G-G'	OIL Socony STH 75-62	13-15-4-21-W3
252	G-G'	OIL Socony STH 75-66	13-18-4-20-W3
253	G-G'	SMDC 91-9	4-29-4-20-W3
254	G-G'	OIL Tidewater Frenchman Crown 1	8-29-4-20-W3
255	G-G'	OIL Tidewater Rapdan Crown	16-24-4-20-W3
256	G-G'	OIL Oliphant Tidewater Rapdan Crown	4-19-4-19-W3
257	G-G'	SRC Climax	NW-13-16-4-19-W3
258	G-G'	SMDC Frenchman S.2	4-18-4-18-W3
259	G-G'	SMDC Frenchman S.4	3-18-4-18-W3
260	G-G'	SMDC Frenchmand S.3	4-17-4-18-W3
261	G-G'	FFIB	13-31-3-17-W3
262	G-G'	OIL BA Oil Climax Foss	8-31-4-16-W3
263	G-G'	DOE	SW-1-5-16-W3
264	H-H1	OIL Can Exp Govenlock	10-20-1-30-W3
265	H-H1	OIL Can Exp Govenlock	10-23-2-30-W3
266	H-H1	SRC-RCA Altawan	NW-12-23-3-30-W3
267	H-H1	OIL Can Delhi Fox 1	2-23-7-30-W3
268	H-H1	OIL Can Delhi Husky Phillips Harris L	10-23-8-30-W3
269	H-H1	FFIB	NW-5-4-10-29-W3
270	H-H1	DOE	SW-19-10-29-W3
271	H-H1	OIL Albercan Boxelder Creek 1	4-12-11-30-W3
272	H-H1	OIL Cypress Nuco Cypress	10-17-11-29-W3
273	H-H1	OIL Can Southern Boxelder Creek	5-21-11-29-W3
274	H-H1	OIL Cypress Nuco Cypress	7-27-11-29-W3
275	H-H1	OIL Amurex Canso Cummings	10-17-12-29-W3

Index No.	Cross Section	Name	Land Location
276	H-H1	DOE	SE-16-13-29-W3
277	H-H1	OIL Amurex Hatton Unit	6-33-13-29-W3
278	H-H1	OIL Amurex Canso Bitter Lake	7-10-14-29-W3
279	H-H1	OIL Amurex Canso Hagel	10-33-14-29-W3
280	H-H1	OIL Inter-City Gas 4 Golden Prairie	4-16-15-29-W3
281	H-H1	OIL NCO Hatton	10-7-16-29-W3
282	H-H1	SRC-RCA Surprise	NW-13-7-16-29-W3
283	H-H1	OIL Amurex Canso Kuest	10-21-16-29-W3
284	H-H1	OIL NCO Horsham	11-3-17-29-W3
285	H-H1	OIL Boundary Horsham 1	10-26-17-29-W3
286	H-H1	SRC-RCA Burstall	SE-8-25-18-30-W3
287	H-H1	DOE	NE-33-19-29-W3
288	H-H1	OIL Inter-City Gas Burstall 5	7-4-20-29-W3
289	H-H1	OIL Inter-City Gas Burstall 1	10-21-20-29-W3
290	H-H1	SRC-RCA Gascoigne	SW-12-21-21-29-W3
291	H-H1	OIL Inter-City Gas Section Burstall 3	10-29-21-29-W3
292	H-H1	SRC Empress	SW-6-9-22-29-W3
293	H-H1	DOE	NW-9-22-29-W3
294	H-H1	SRC Empress	NE-2-20-22-29-W3
295	H-H1	OIL Charter Canadian Devonian #5-21	5-21-22-29-W3
296	H-H1	SRC Empress	SW-7-29-22-29-W3
297	H-H1	SRC Empress	SE-12-29-22-29-W3
298	H-H1	OIL American Climax STH 5-8	4-3-23-29-W3
299	H-H1	SRC-RCA Empress	SE-4-16-23-29-W3
300	H-H1	SRC-RCA Empress	NW-13-22-23-29-W3
301	H-H1	SRC Empress	SE-1-35-23-29-W3
302	H1-H2	OIL American Climax STH 3	13-3-24-29-W3
303	H1-H2	FFIB	SW 15-24-29-W3
304	H1-H2	OIL Phillips Husky Border 1	7-9-25-29-W3
305	H1-H2	SRC Cuthbert	SW 5-34-25-29-W3
306	H1-H2	FFIB	3-26-27-29-W3
307	H1-H2	FFIB	8-34-27-29-W3
308	H1-H2	FFIB	NW 11-28-29-W3
309	H1-H2	OIL Phillips Husky Saskal	7-2-29-29-W3
310	H1-H2	OIL Phillips Husky Grattle	6-25-30-29-W3
311	H1-H2	OIL Phillips Hoosier 1	13-11-31-28-W3
312	H1-H2	SRC Loverna	SE 3-5-32-28-W3
313	H1-H2	OIL Phillips Husky Antelope 2	2-19-32-28-W3
314	H1-H2	OIL Phillips Husky Compeer 1	13-18-33-28-W3
315	H1-H2	SRC Court	NE-8-15-34-28-W3
316	H1-H2	FFIB	NE-14-35-34-28-W3
317	H1-H2	FFIB	15-6-35-27-W3
318	H1-H2	FFIB	9-24-35-28-W3
319	H1-H2	SRC Cactus Lake	SW-4-32-35-27-W3
320	H1-H2	OIL Highwood Sarce Barryville	7-31-35-27-W3
321	H1-H2	FFIB	1-6-36-27-W3
322	H1-H2	FFIB	13-1-36-28-W3
323	H1-H2	FFIB	5-12-36-28-W3
324	H1-H2	FFIB	4-18-36-28-W3
325	H1-H2	FFIB	5-15-37-28-W3
326	H1-H2	FFIB	NW-13-2-38-28-W3
327	H1-H2	OIL Husky Macklin	10-17-38-28-W3
328	H1-H2	FFIB	14-31-38-28-W3
329	H1-H2	FFIB	14-3-39-28-W3
330	H1-H2	FFIB	9-9-39-28-W3

Index No.	Cross Section	Name	Land Location
331	H1-H2	FFIB	13-16-39-28-W3
332	H1-H2	OIL Murphy Canadian Res. Eye Hill	4-34-39-28-W3
333	H1-H2	FFIB	9-33-39-28-W3
334	H1-H2	FFIB	13-3-40-28-W3
335	H1-H2	FFIB	15-22-40-28-W3
336	H1-H2	FFIB	2-27-40-28-W3
337	H1-H2	FFIB	13-1-41-28-W3
338	H1-H2	OIL Canadian Res. Yonker R/A	4-18-41-27-W3
339	H1-H2	SRC Auger	4-7-42-27-W3
340	H1-H2	OIL Amerada Cr Reflex	13-7-42-27-W3
341	H1-H2	OIL King Triad Reflex	3-24-42-28-W3
342	H1-H2	SRC Auger	3-25-42-28-W3
343	H1-H2	OIL Kanata Reflex Lake STH 11	5-2-43-28-W3
344	H1-H2	OIL Kanata Reflex Lake STH 10	1-10-43-28-W3
345	H1-H2	OIL Kanata Reflex Lake STH 6	9-10-43-28-W3
346	H1-H2	OIL Kanata Reflex Lake STH 5	12-14-43-28-W3
347	H1-H2	FFIB	3-22-43-28-W3
348	H1-H2	OIL Husky Chauvin STH 10	1-27-43-28-W3
349	H1-H2	FFIB	16-28-43-28-W3
350	H1-H2	OIL Husky Chauvin STH 13	13-27-43-28-W3
351	H1-H2	OIL Husky Marsden SH	8-3-44-28-W3
352	H1-H2	OIL Husky Marsden	5-15-44-28-W3
353	H1-H2	OIL Husky Marsden	16-22-44-28-W3
354	H1-H2	OIL Husky Marsden STH 7	4-26-44-28-W3
355	H1-H2	OIL Husky Marsden SH	4-35-44-28-W3
356	H1-H2	FFIB	15-34-44-28-W3
357	H1-H2	FFIB	SW-2-45-28-W3
358	H1-H2	FFIB	12-2-45-28-W3
359	H1-H2	OIL Husky Marsden STH 14	5-11-45-28-W3
360	H1-H2	OIL Husky Marsden STH 2	4-13-45-28-W3
361	H1-H2	OIL Canadian Res. Unwin	12-19-45-27-W3
362	H1-H2	OIL Husky Marsden STH 4	4-25-45-28-W3
363	H1-H2	OIL Husky Unwin	4-36-45-28-W3
364	H1-H2	OIL Husky Maisden STH 3	12-36-45-28-W3
365	H1-H2	OIL Husky Marsden STH 9	13-1-46-28-W3
366	H1-H2	FFIB	3-13-46-28-W3
367	H1-H2	OIL Husky Marsden STH 19	4-24-46-28-W3
368	H1-H2	OIL Husky Marsden STH 19	5-30-46-27-W3
369	H1-H2	OIL Husky Wilton STH 8	4-35-46-28-W3
370	H1-H2	FFIB	8-2-47-28-W3
371	H1-H2	FFIB	4-18-47-27-W3
372	H1-H2	OIL Husky West Epping STH 1	8-23-47-28-W3
373	H1-H2	OIL Husky Silverdale STH 24	1-36-47-28-W3
374	H1-H2	OIL Husky Silverdale STH 23	13-31-47-27-W3
375	H1-H2	FFIB	SW-4-17-48-27-W3
376	H1-H2	OIL Husky Furness STH 1	13-17-48-27-W3
377	H1-H2	FFIB	14-20-48-27-W3
378	H1-H2	FFIB	NE-29-48-27-W3
379	H1-H2	OIL Husky Wilton STH 6	6-8-49-27-W3
380	H1-H2	OIL Husky Aberfeldy STH 3	13-8-49-27-W3
381	H1-H2	OIL Husky Wilton STH 4	12-17-49-27-W3
382	H1-H2	OIL Husky North Dulwich Slim Hole	14-20-49-27-W3
383	H1-H2	SRC Lloydminster	NW-5-32-49-27-W3
384	H1-H2	SRC Lloydminster	SE-2-2-50-28-W3
385	H1-H2	FFIB	8-11-50-28-W3

Index No.	Cross Section	Name	Land Location
386	H1-H2	FFIB	SE-26-50-28-W3
387	H1-H2	FFIB	16-35-50-28-W3
388	H1-H2	OIL Husky Northminster STH 11	4-6-51-27-W3
389	H1-H2	FFIB	13-6-51-27-W3
390	H1-H2	OIL Husky Northminster STH 17	1-12-51-28-W3
391	H1-H2	FFIB	SE-12-51-28-W3
392	H1-H2	OIL Texaco Northminster	4-18-51-27-W3
393	H1-H2	OIL Husky Fargo Lloyd	1-24-51-28-W3
394	H1-H2	OIL Husky Rex 1	5-28-51-27-W3
395	H1-H2	SRC Rex	SW-12-33-51-27-W3
396	H1-H2	OIL Lloydminster Rex 1	13-4-52-27-W3
397	H1-H2	OIL Husky Hewitt R/A	12-16-52-27-W3
398	I-I1	OIL Tidewater Imperial Climax 2	16-20-1-18-W3
399	I-I1	OIL TW Climax 3	9-7-2-18-W3
400	I-I1	OIL Imperial TW Climax 6	6-10-3-18-W3
401	I-I1	DOE	NE-32-3-18-W3
402	I-I1	SMDC Frenchman S.5	4-8-4-18-W3
403	I-I1	SHT Frenchman R. No. 01	NW-16-19-4-18-W3
404	I-I1	U of S Eagle No. 99 - Climax	SE-1-30-4-18-W3
405	I-I1	U of S Eagle No. 100 - Climax	NE-8-30-4-18-W3
406	I-I1	U fo S Eagle No. 101 - Climax	SW-16-30-4-18-W3
407	I-I1	SHT Frenchman R. No. 05	SW-2-31-4-18-W3
408	I-I1	U of S Eagle No. 105 - Climax	SE-7-31-4-18-W3
409	I-I1	SHT Frenchman R. No. 08	NE-14-31-4-18-W3
410	I-I1	SHT Frenchman R. No. 09	NW-3-6-5-18-W3
411	I-I1	FFIB	2-8-5-18-W3
412	I-I1	DMR-SRC-EMR Cypress No. 8	SE-1-16-5-18-W3
413	I-I1	OIL Imperial Tidewater Chambery	5-20-5-18-W3
414	I-I1	SMDC White Creek 5	3-10-6-18-W3
415	I-I1	FFIB	9-17-6-18-W3
416	I-I1	FFIB	14-20-6-18-W3
417	I-I1	SMDC 93-3	13-28-6-18-W3
418	I-I1	DMR-SRC-EMR Cypress No. 55	NW-12-4-7-18-W3
419	I-I1	OIL TW East Dollard Crown	13-18-7-18-W3
420	I-I1	DMR-SRC-EMR Cypress No. 67	SW-12-19-7-18-W3
421	I-I1	DMR-SRC-EMR Cypress No. 1	SW-12-32-7-18-W3
422	I-I1	DMR-SRC-EMR Cypress No. 42	NW-13-33-7-18-W3
423	I-I1	DMR-SRC-EMR Cypress No. 52	SW-12-4-8-18-W3
424	I-I1	OIL TW Shaunavon Crown 1	13-4-8-18-W3
425	I-I1	HRD Town of Shaunavon TH 2	NW-2-17-8-18-W3
426	I-I1	HRD Town of Shaunavon TH 1	SE-17-8-18-W3
427	I-I1	OIL TW Shaunavon North	11-33-8-18-W3
428	I-I1	DMR-SRC-EMR Cypress No. 64	1-1-9-18-W3
429	I-I1	DMR-SRC-EMR Cypress No. 60	SW-4-2-9-18-W3
430	I-I1	DMR-SRC-EMR Cypress No. 53	4-11-9-18-W3
431	I-I1	DMR-SRC-EMR Cypress No. 2	SW-4-14-9-18-W3
432	I-I1	DMR-SRC-EMR Cypress No. 56	SW-4-23-9-18-W3
433	I-I1	SIP Shaunavon 82-2-104	NW-2-28-9-18-W3
434	I-I1	OIL TW North Shaunavon	11-28-9-18-W3
435	I-I1	OIL TW Instow Crown	11-33-9-18-W3
436	I-I1	FFIB	1-7-10-18-W3
437	I-I1	SMDC 91-61	16-7-10-18-W3
438	I-I1	SMDC 91-42	4-28-10-18-W3
439	I-I1	SMDC 91-43	13-28-10-18-W3
440	I-I1	SMDC 91-44	13-32-10-18-W3

Index No.	Cross Section	Name	Land Location
441	I-I1	FFIB	3-16-11-18-W3
442	I-I1	SMDC 91-41A	13-22-11-18-W3
443	I-I1	OIL Mobil Southern Illerbrun	2-28-11-18-W3
444	I-I1	OIL Whitehall Illerbrun 62	1-32-11-18-W3
445	I-I1	OIL Whitehall Illerbrun	4-5-12-18-W3
446	I-I1	OIL Socony North Illerbrun	4-17-12-18-W3
447	I-I1	OIL Whitehall Illerbrun 64	10-18-12-18-W3
448	I-I1	OIL Anglo American Gridoil Gull Lake	15-33-12-19-W3
449	I-I1	FFIB	9-16-13-19-W3
450	I-I1	FFIB	10-27-13-19-W3
451	I-I1	OIL Socony Woodley Southern SE Midway	9-3-14-19-W3
452	I-I1	FFIB	1-22-14-19-W3
453	I-I1	FFIB	SW-35-14-19-W3
454	I-I1	OIL Socony Western CH 126-38	14-34-14-29-W3
455	I-I1	OIL Socony Western CH 126-41	13-15-15-19-W3
456	I-I1	OIL Socony Western CH 126-25	4-2-16-19-W3
457	I-I1	OIL Sedco Verlo	6-11-16-19-W3
458	I-I1	OIL Socony Western Tompkins STH 124-107	13-11-16-19-W3
459	I-I1	OIL Sedco Verlo	10-15-16-19-W3
460	I-I1	OIL Sedco Verlo	14-15-16-19-W3
461	I-I1	OIL Mobil Woodley Southern Verlo	8-28-16-19-W3
462	I-I1	FFIB	13-35-16-19-W3
463	I-I1	OIL Socony Western Tompkins CH 124-104	13-11-17-19-W3
464	I-I1	OIL Socony Western Ch 124-23	12-22-17-19-W3
465	I-I1	FFIB	8-28-17-19-W3
466	I-I1	OIL Socony Western CH 124-124	4-17-18-19-W3
467	I-I1	DOE	SW-31-18-19-W3
468	I-I1	OIL Tidewater South Shackleton Crown 1	1-5-19-19-W3
469	I-I1	FFIB	NW-13-8-19-19-W3
470	I-I1	FFIB	4-33-19-19-W3
471	I-I1	OIL Tidewater Cabri STH 143	4-3-20-19-W3
472	I-I1	OIL Tidewater Cabri STH 174	6-11-20-19-W3
473	I-I1	OIL Tidewater Cabri STH 129	1-21-20-19-W3
474	I-I1	OIL Tidewater Cabri STH 123	1-4-21-19-W3
475	I-I1	OIL Tidewater Cabri STH 118	4-22-21-19-W3
476	I-I1	OIL Tidewater Cabri STH 113	1-4-22-19-W3
477	I-I1	OIL Tidewater Cabri STH 108	6-15-22-19-W3
478	I-I1	OIL Tidewater Cabri STH 212	10-27-22-19-W3
479	I-I1	OIL Tidewater Cabri STH 104	1-3-23-19-W3
480	I-I1	OIL Tidewater Kyle STH 92	12-11-23-19-W3
481	I-I1	FFIB	5-13-23-19-W3
482	I-I1	SRC Lacadena	SE-1-36-23-19-W3
483	I1-I2	SRC Isham	NE-8-3-24-19-W3
484	I1-I2	SRC Isham	SE-1-15-24-19-W3
485	I1-I2	OIL Tidewater Imperial Plato Crown 1	9-22-24-19-W3
486	I1-I2	OIL Tidewater Elrose STH 350	1-27-24-19-W3
487	I1-I2	SRC Isham	NW-13-34-24-19-W3
488	I1-I2	OIL Tidewater Kyle STH 93	1-4-25-19-W3
489	I1-I2	SRC Richlea	NE 9-27-25-19-W3
490	I1-I2	OIL Socony Sohio Richlea	7-11-26-19-W3
491	I1-I2	FFIB	9-1-27-20-W3
492	I1-I2	OIL Pennant Penkill	9-31-27-19-W3
493	I1-I2	FFIB	7-1-28-20-W3
494	I1-I2	OIL Pennant Brock	14-19-28-19-W3
495	I1-I2	OIL Socony Sohio D'Arcy	2-31-28-19-W3

Index No.	Cross Section	Name	Land Location
496	I1-I2	OIL Socony Sohio Hutford	10-28-30-19-W3
497	I1-I2	FFIB	5-9-31-19-W3
498	I1-I2	FFIB	13-32-31-19-W3
499	I1-I2	OIL Royalite Plenty	11-10-32-19-W3
500	I1-I2	FFIB	13-15-32-19-W3
501	I1-I2	FFIB	15-21-32-19-W3
502	I1-I2	OIL Royalite Plenty	4-35-32-19-W3
503	I1-I2	EPD Plenty	12-35-32-19-W3
504	I1-I2	OIL Royalite Plenty	4-2-33-19-W3
505	I1-I2	FFIB	SW 10-33-19-W3
506	I1-I2	FFIB	1-21-33-19-W3
507	I1-I2	FFIB	12-32-33-19-W3
508	I1-I2	U of S Eagle No. 75	SW 12-24-34-20-W3
509	I1-I2	SRC Eagle Creek	NW 12-24-34-20-W3
510	I1-I2	SDH Eagle Creek 2	NE 13-24-34-20-W3
511	I1-I2	FFIB	NE 1-36-34-20-W3
512	I1-I2	FFIB	NE-8-26-35-20-W3
513	I1-I2	FFIB	SE-8-34-35-20-W3
514	I1-I2	OIL Arco Handle	6-22-36-20-W3
515	I1-I2	FFIB	14-22-36-20-W3
516	I1-I2	FFIB	2-26-37-20-W3
517	I1-I2	FFIB	1-34-37-20-W3
518	I1-I2	FFIB	1-15-38-20-W3
519	I1-I2	SRC Reford	SE-8-6-39-19-W3
520	I1-I2	FFIB	15-8-39-19-W3
521	I1-I2	EPD Wilkie	NW-13-32-39-19-W3
522	I1-I2	OIL Hunter Campana Wilkie	16-18-40-19-W3
523	I1-I2	FFIB	12-20-40-19-W3
524	I1-I2	OIL Murphy Wilkie	10-30-40-19-W3
525	I1-I2	OIL Murphy Wilkie	10-30-40-20-W3
526	I1-I2	FFIB	NW 7-41-19-W3
527	I1-I2	FFIB	12-30-41-19-W3
528	I1-I2	FFIB	1-35-41-20-W3
529	I1-I2	OIL BA Cutknife Finley	1-14-43-20-W3
530	I1-I2	EPD Gallivan	8-8-44-20-W3
531	I1-I2	OIL Sun Cutknife SH	5-14-44-20-W3
532	I1-I2	OIL BA Cutknife Bushy R/A	13-22-44-20-W3
533	I1-I2	OIL BA Cutknife Bushy R/A	4-27-44-20-W3
534	I1-I2	FFIB	SW 4-34-45-20-W3
535	I1-I2	FFIB	1-9-46-20-W3
536	I1-I2	OIL Texas Gulf Paynton	4-16-46-20-W3
537	I1-I2	FFIB	13-16-46-20-W3
538	I1-I2	FFIB	14-19-46-20-W3
539	I1-I2	OIL Husky Paynton SH	1-35-46-21-W3
540	I1-I2	FFIB	1-35-46-21-W3
541	I1-I2	FFIB	16-26-47-20-W3
542	I1-I2	FFIB	NW-24-48-20-W3
543	I1-I2	OIL Rio-tinto Edam STH 7	13-11-49-20-W3
544	I1-I2	OIL Rio-tinto Edam STH 5	1-27-49-20-W3
545	I1-I2	OIL BA Forsberg	2-11-50-20-W3
546	I1-I2	FFIB	SE-14-2-51-20-W3
547	I1-I2	OIL Husky Hartwell R/A	13-21-51-20-W3
548	I1-I2	DPW Thunderchild IR 01	SW-5-4-52-20-W3
549	I1-I2	DPW Thunderchild IR 03	SW-2-16-52-20-W3

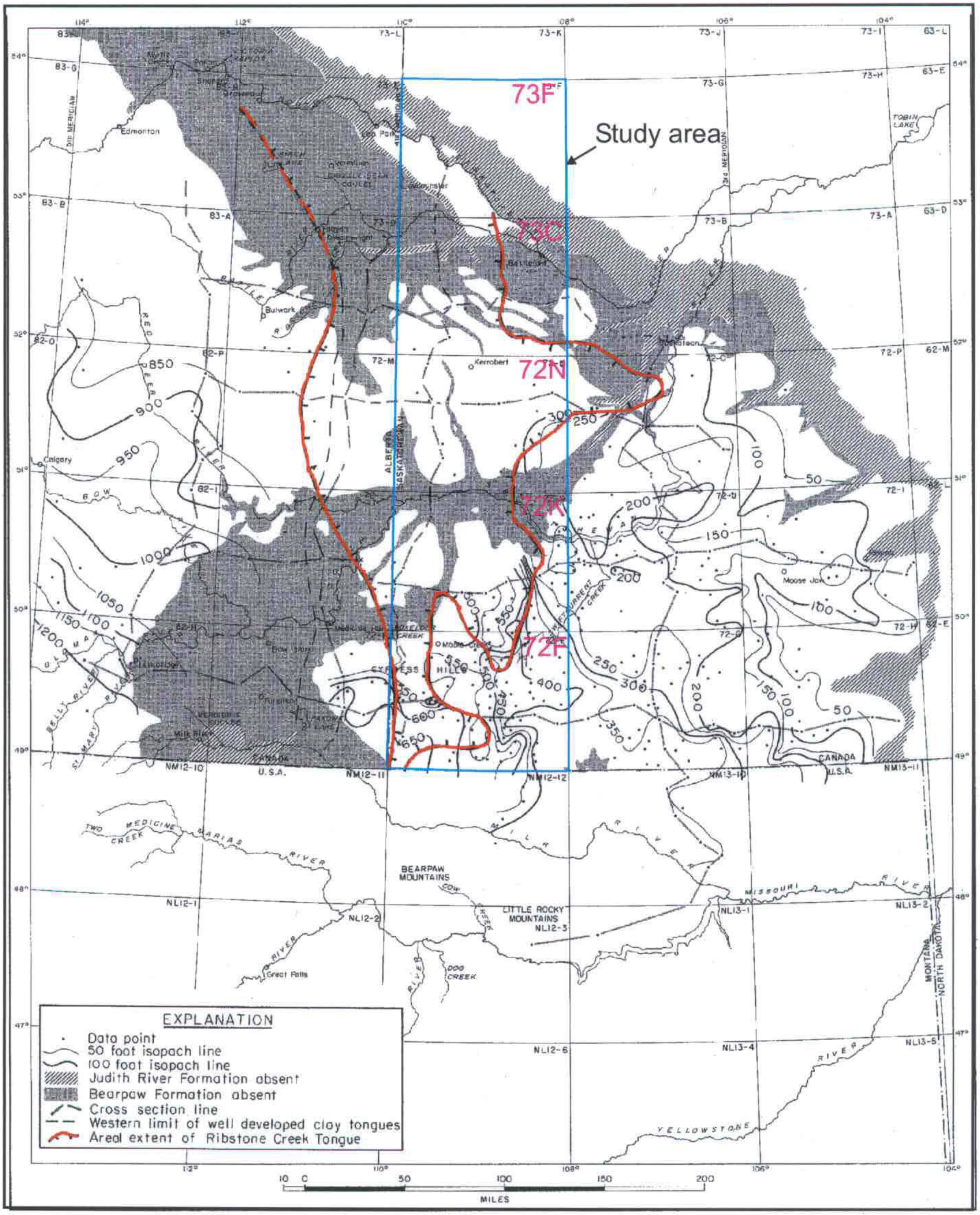

Figure 1 Extent of the Ribstone Creek aquifer in Alberta and Saskatchewan (McLean, 1971)

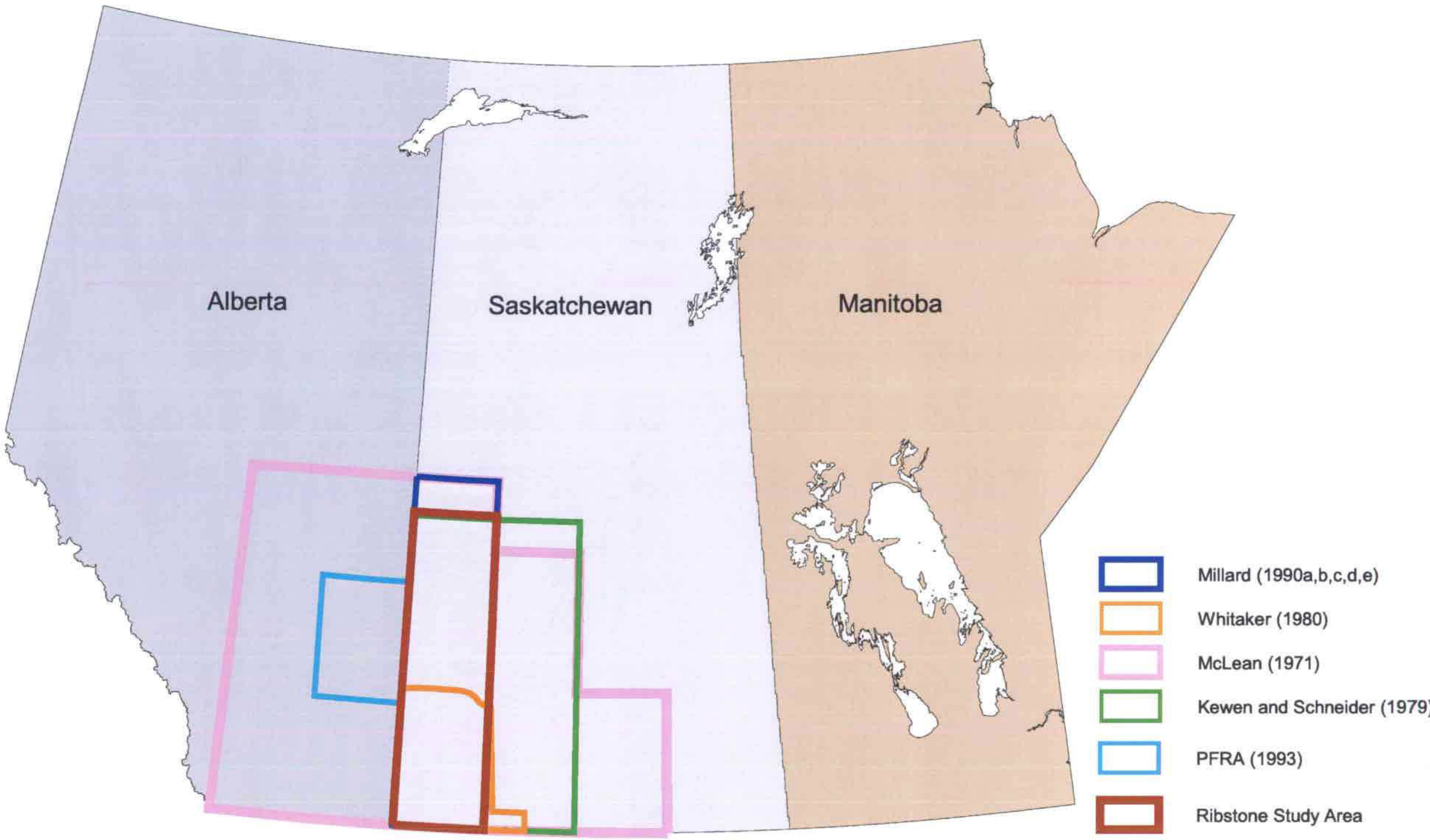

Figure 2 Extent of the Ribstone Creek Tongue study area.

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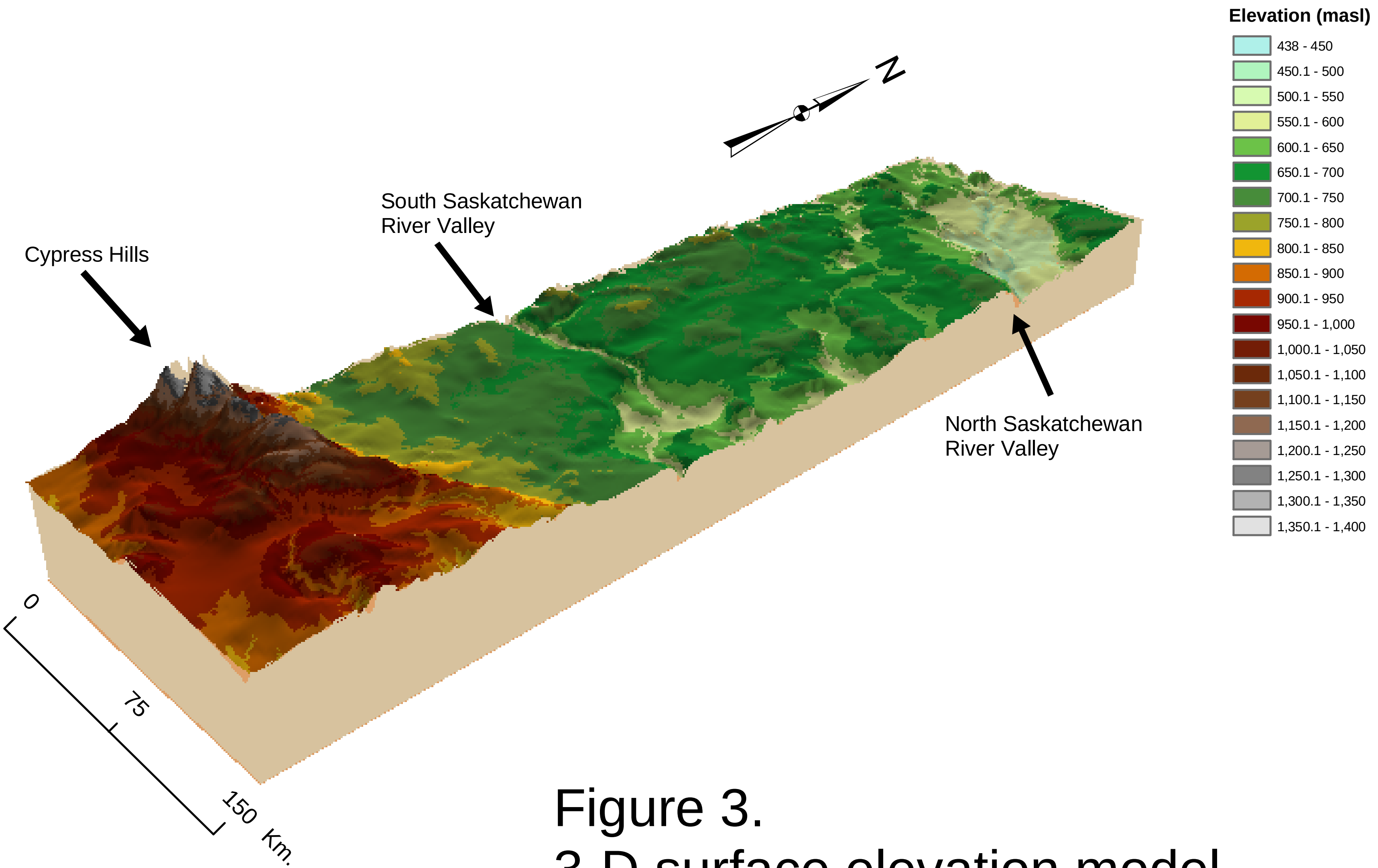

Figure 3.
3-D surface elevation model
of the Ribstone Creek study area

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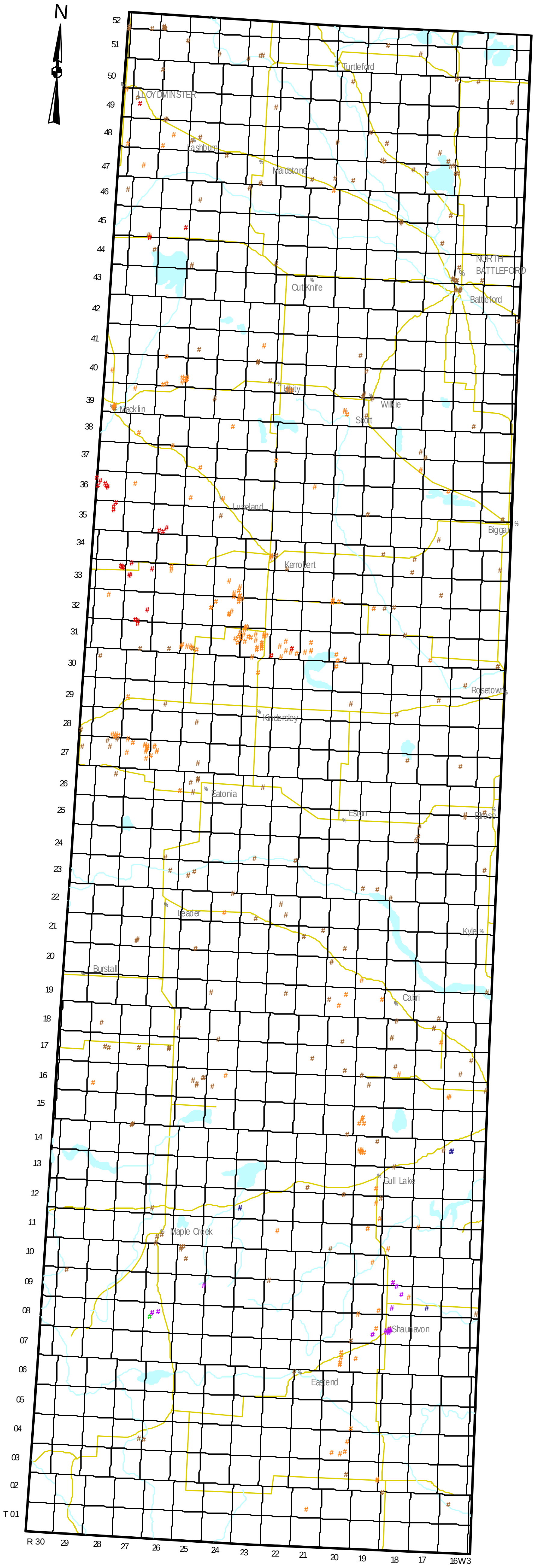


Data Sources:
data- Saskatchewan Water Corp. February, 2002.
base map- 2000 Government of Canada with permission from Natural Resource of Canada

50 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 Nad 83 Projection

Legend

- Bearpaw Formation
- Cypress Hills Formation
- Glacial deposits
- Judith River Formation
- Ravenscrag Formation
- Ribstone Creek Tongue

- study area
- range/township lines
- rivers
- lakes
- roads

Figure 4.
Location of licensed production wells, coded by formation in which the well is completed.

PERIOD	STRATIGRAPHY		LITHOLOGY	HYDROGEOLOGY
QUATERNARY	Drift (undifferentiated) (Saskatoon Group Sutherland Group)		Till and stratified sediments (sand, gravel, silt and clay)	Undifferentiated Quaternary aquifers and aquitards
	Empress Group	Upper unit Lower unit	Sand, gravel, silt, clay, Tertiary rocks in lower unit	Aquifer
TERTIARY	Undifferentiated		Sand and silt	Aquifer
	Cypress Hills Fm		Sand and gravel	Aquifer
	Ravencrag Fm		Sand, silt and coal	Aquifer (undifferentiated)
CRETACEOUS	Frenchman Fm		Sand and silt	
	Whitemud Fm		Sand and silt	
	Eastend Fm		Sand and silt	
	Bearpaw Formation		Silt and clay	
		Oxarart, Belanger, Thelma	Sand and silt	Aquifer
		Aquadell Mb	Silt and clay	Aquitard
		Cruikshank Mb	Sand and silt	Aquifer
		Snakebite Mb	Silt and clay	Aquitard
		Ardkenneth	Sand and silt	Aquifer
		Beechy Mb	Silt and clay	Aquitard
		Demaine	Sand and silt	Aquifer
		Sherrard Mb	Silt and clay	Aquitard
		Matador	Sand and silt	Aquifer
		Broderick Mb	Silt and clay	Aquitard
		Outlook	Sand and silt	Aquifer
			Silt and clay	Aquitard
	Judith River Fm (Belly River Fm)		Sand and silt	Aquifer
	Ribstone Creek / Grizzly Bear			
	Lea Park Fm & Upper Colorado Gr		Silt and clay	Aquitard
	Lower Colorado Gr		Silt and clay	Aquitard
	Mannville Group		Sand and silt	Aquifer

Figure 5 Schematic stratigraphical, lithological and hydrogeological settings of western Saskatchewan (after Caldwell, 1968; Lomenda, 1973; Christiansen, 1992)

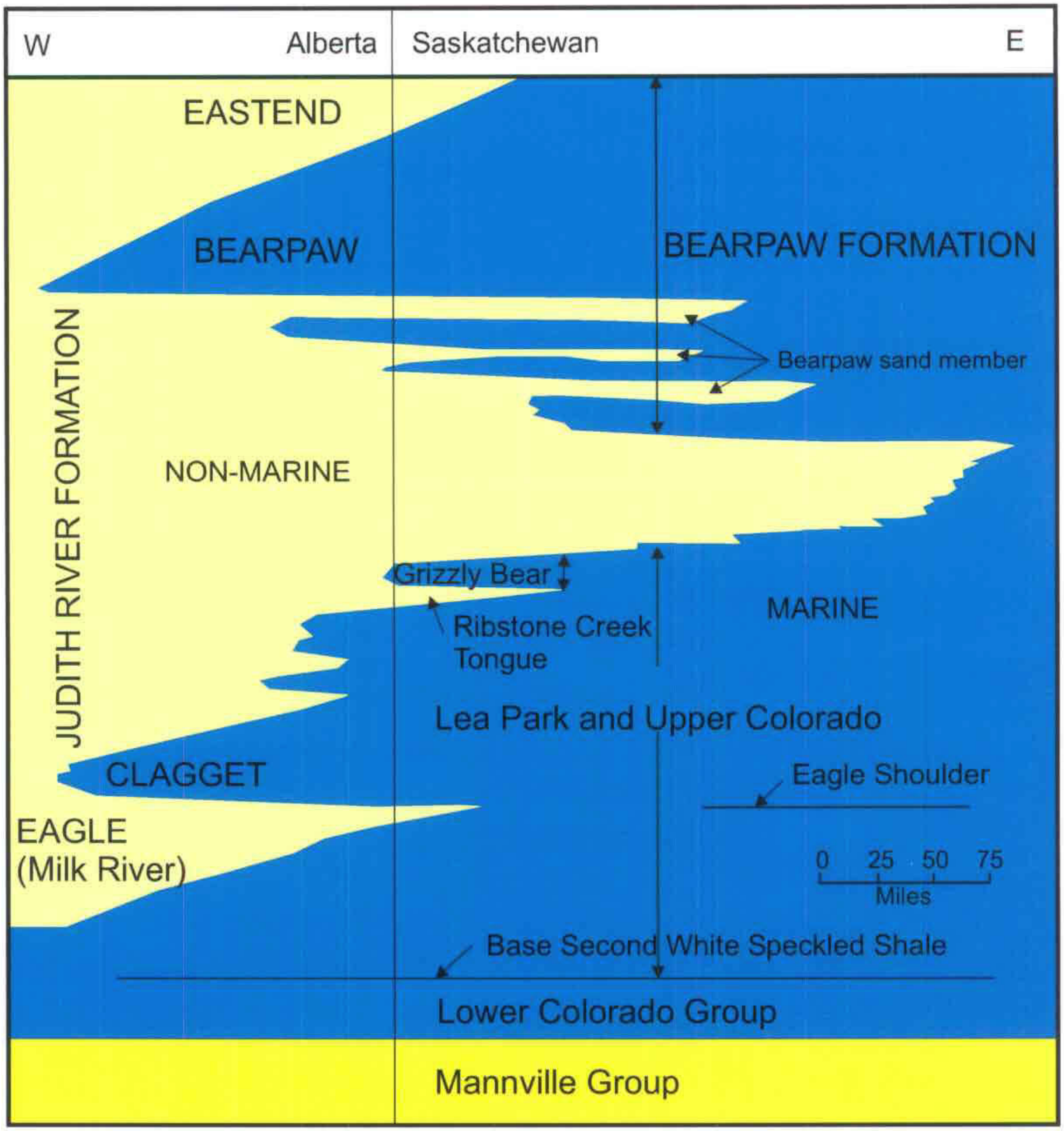


Figure 6 Schematic cross section through Late Cretaceous sediments in eastern Alberta and western Saskatchewan (after McLean, 1971)

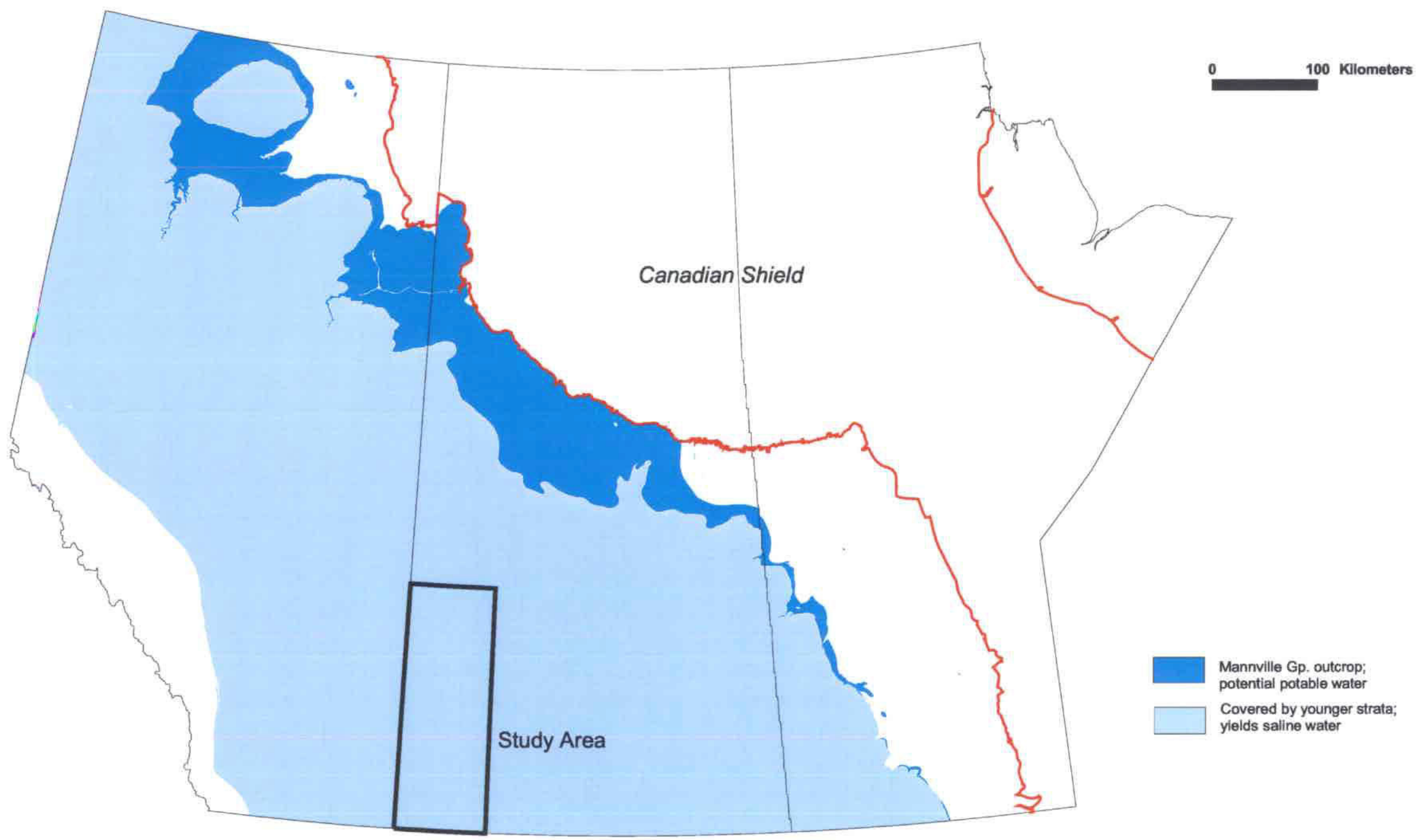


Figure 7 Extent of the Mannville Group in the Prairie Provinces

REFERENCES:

Viljoen,D. etal. 1999: Geology, magnetic, &gravity maps of Manitoba:
a digital perstective. Mem of99-12, cd. Manitoba Energy and Mines, Winnipeg, Manitoba
MacDonald, R. et al.1999: Geological atlas of Saskatchewan ver2. cd
Saskatchewan Energy and Mines, Regina Saskatchewan
Alberta Energy and Utilities Board 1999: Geology of Alberta, Map 236 ver2, cd.
Alberta Geological Survey, Edmonton Alberta

Figure 8 Extent of the Judith River Formation in the Prairie Provinces

REFERENCES:

Viljoen,D. etal. 1999: Geology, magnetic, &gravity maps of Manitoba: a digital perstective. Mem of99-12, cd. Manitoba Energy and Mines, Winnipeg, Manitoba
MacDonald, R. et al.1999: Geological atlas of Saskatchewan ver2. cd Saskatchewan Energy and Mines, Regina Saskatchewan
Alberta Energy and Utilities Board 1999: Geology of Alberta, Map 236 ver2, cd. Alberta Geological Survey, Edmonton Alberta

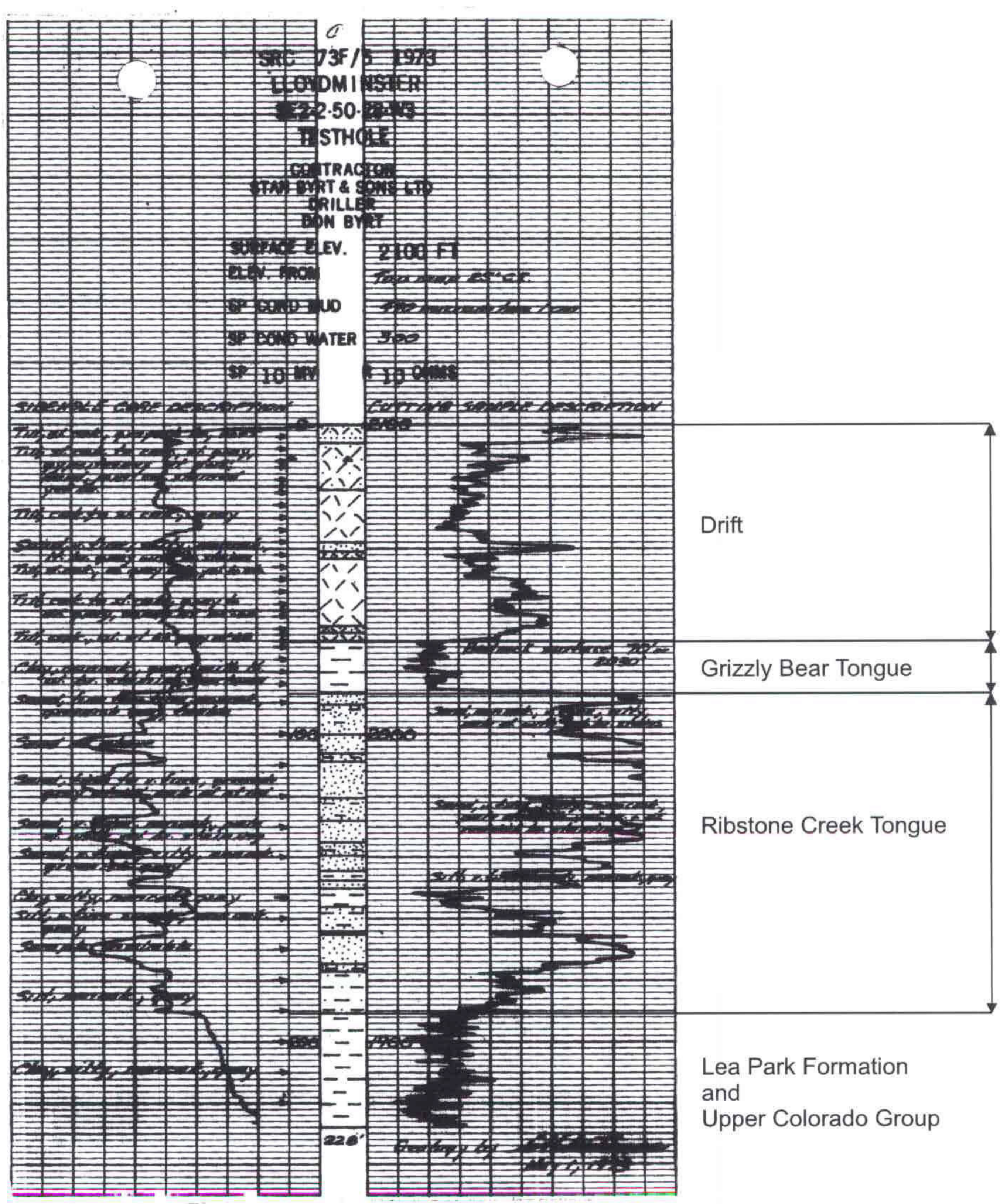


Figure 9 SRC testhole log showing lithological characteristics of the Ribstone Creek Tongue

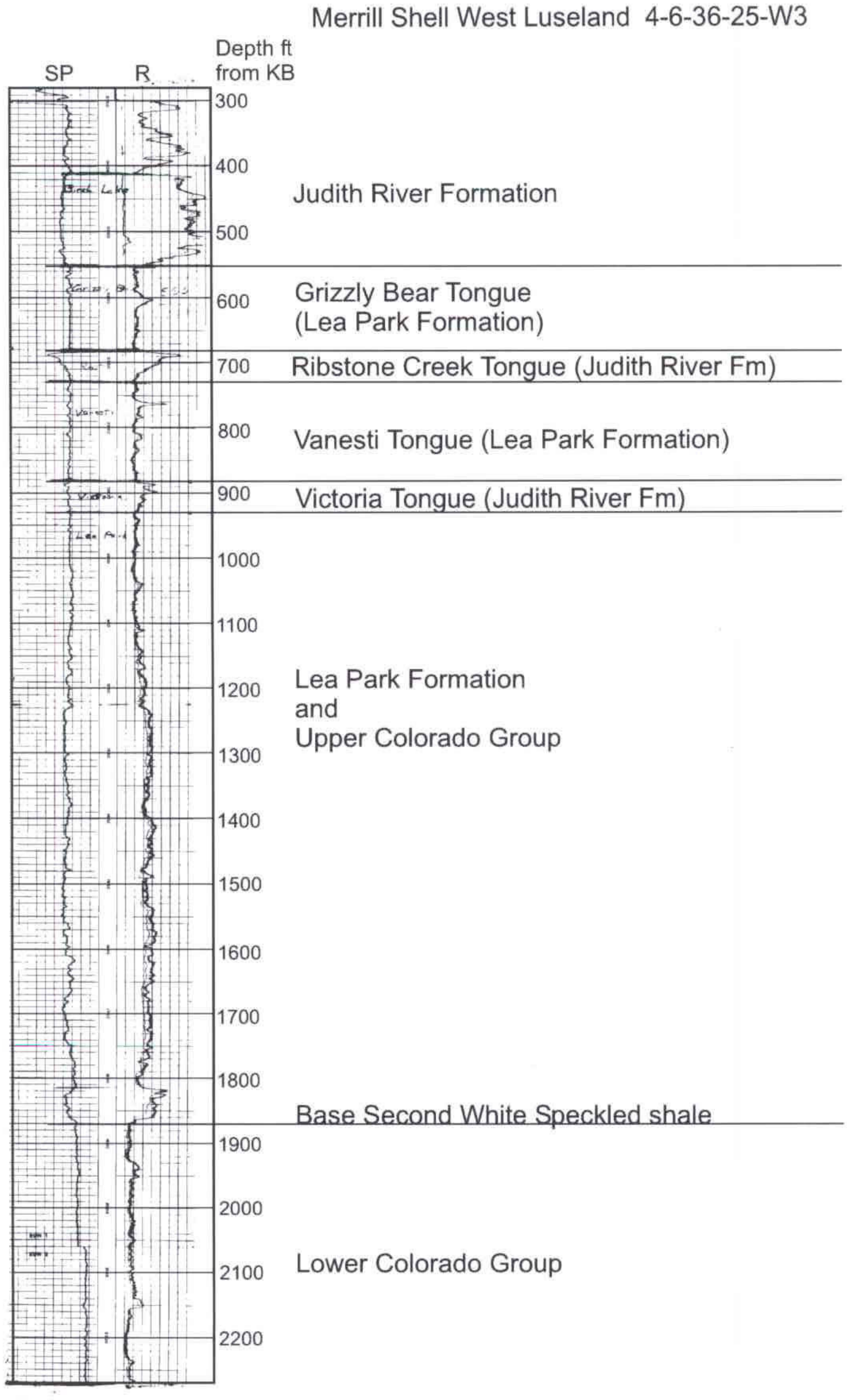
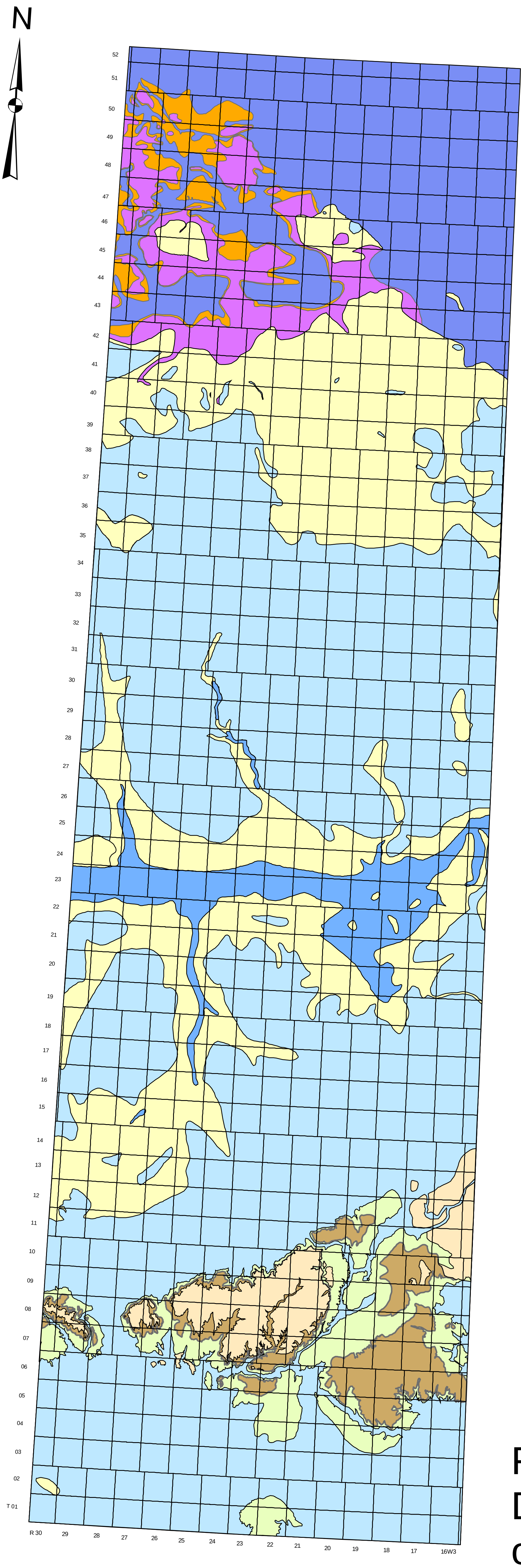


Figure 10 Oil log showing the geophysical characteristics of the Late Cretaceous sediments



Data Sources:
Base map 2000 Government of Canada with
permission from Natural Resources Canada

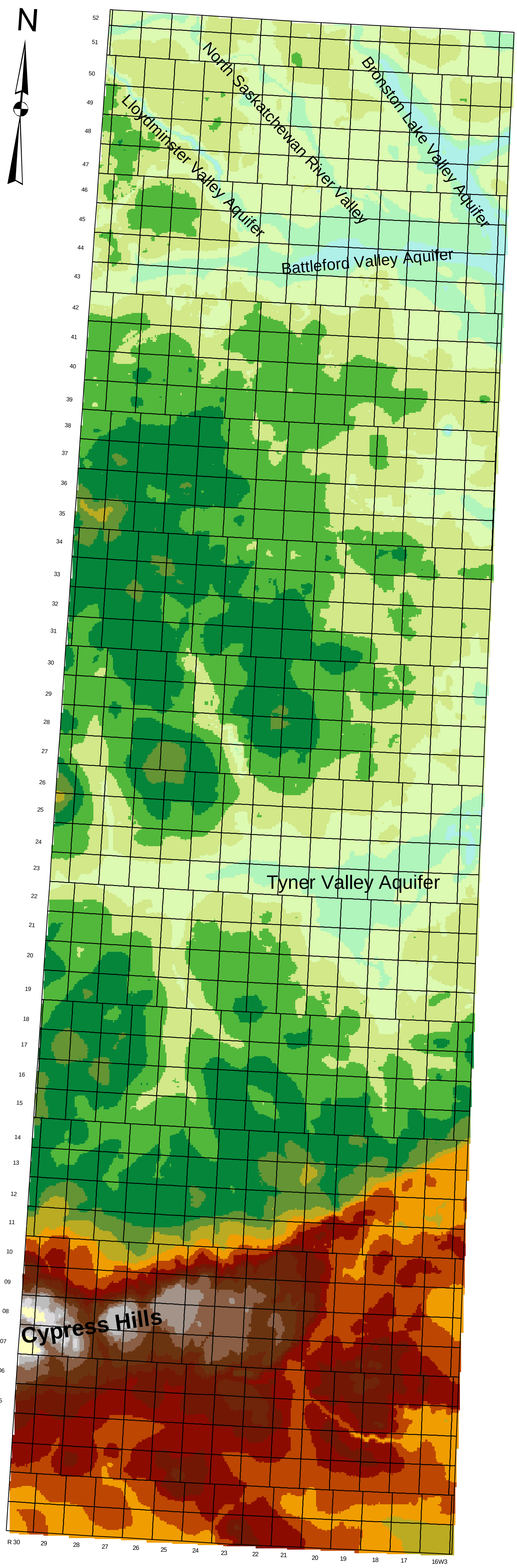
50 25 0 50
Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Bedrock Geology

- Tertiary Units (undiff.)
- Cypress Hills Fm.
- Ravenscrag Fm.
- Eastend-Frenchman Fms.
- Bearpaw Fm.
- Judith River Fm.
- Grizzly Bear Tongue
- Ribstone Creek Tongue
- Lea Park Fm.

Figure 11.
Distribution of bedrock units outcropping at the bedrock surface



Data Sources:
Base map 2000 Government of Canada with
permission from Natural Resources Canada

50 25 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Elevation (masl)

- 400.0 - 450
- 450.1 - 500
- 500.1 - 550
- 550.1 - 600
- 600.1 - 650
- 650.1 - 700
- 700.1 - 750
- 750.1 - 800
- 800.1 - 850
- 850.1 - 900
- 900.1 - 950
- 950.1 - 1,000
- 1,000.1 - 1,050
- 1,050.1 - 1,100
- 1,100.1 - 1,150
- 1,150.1 - 1,200
- 1,200.1 - 1,250
- 1,250.1 - 1,300
- 1,300.1 - 1,350

Figure 12.
Bedrock surface topography in the Ribstone Creek Tongue study area

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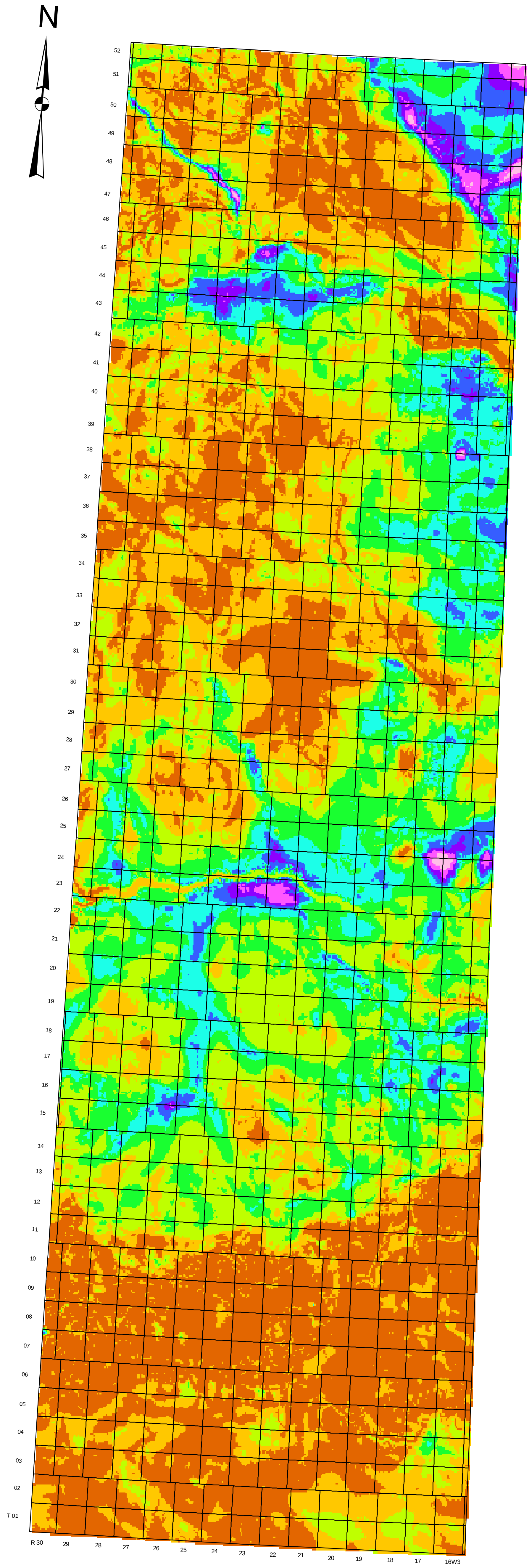


Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

50 25 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Thickness (m)

- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 180
- 181 - 210
- 211 - 240
- 241 - 270

Figure 13.
Thickness of Drift in the Ribstone Creek Tongue study area

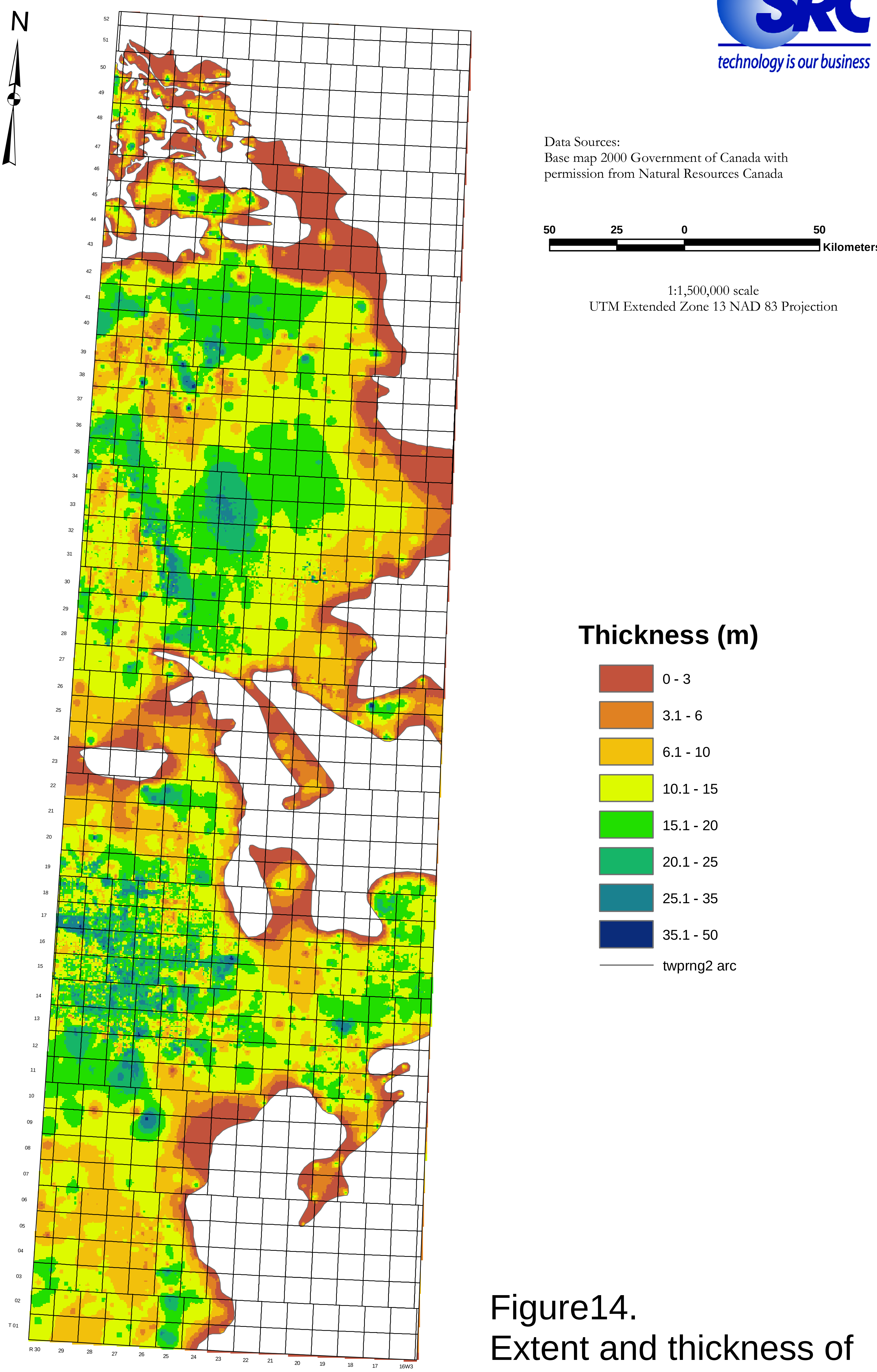
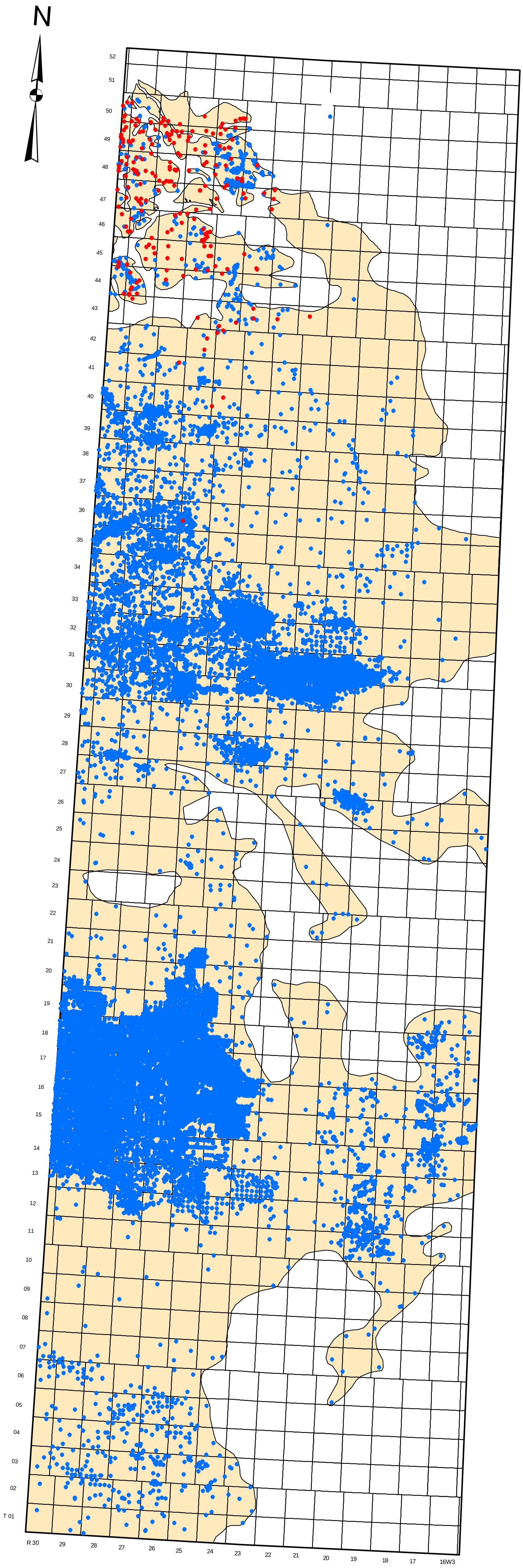


Figure14.
Extent and thickness of Ribstone Creek Tongue



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Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

50 25 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Legend

- SEM data
- Water well data
- Ribstone Creek Tongue extents

Figure 15.
Location of wells/testholes indicating presence of Ribstone Creek Tongue

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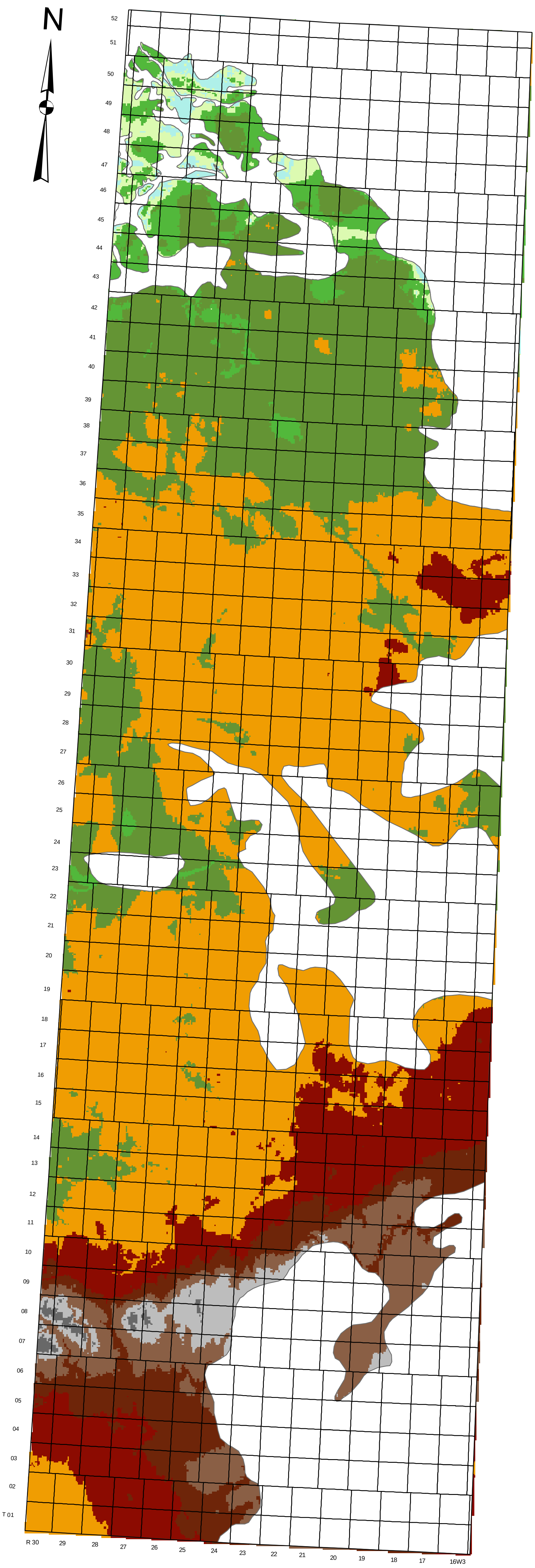

Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

50 25 0 50
Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Depth to Ribstone Ck. top

- 0 - 25
- 25.1 - 50
- 50.1 - 100
- 100.1 - 200
- 200.1 - 300
- 300.1 - 400
- 400.1 - 500
- 500.1 - 600
- 600.1 - 700
- 700.1 - 800

Figure 16.
Depth to top of the Ribstone Creek Tongue

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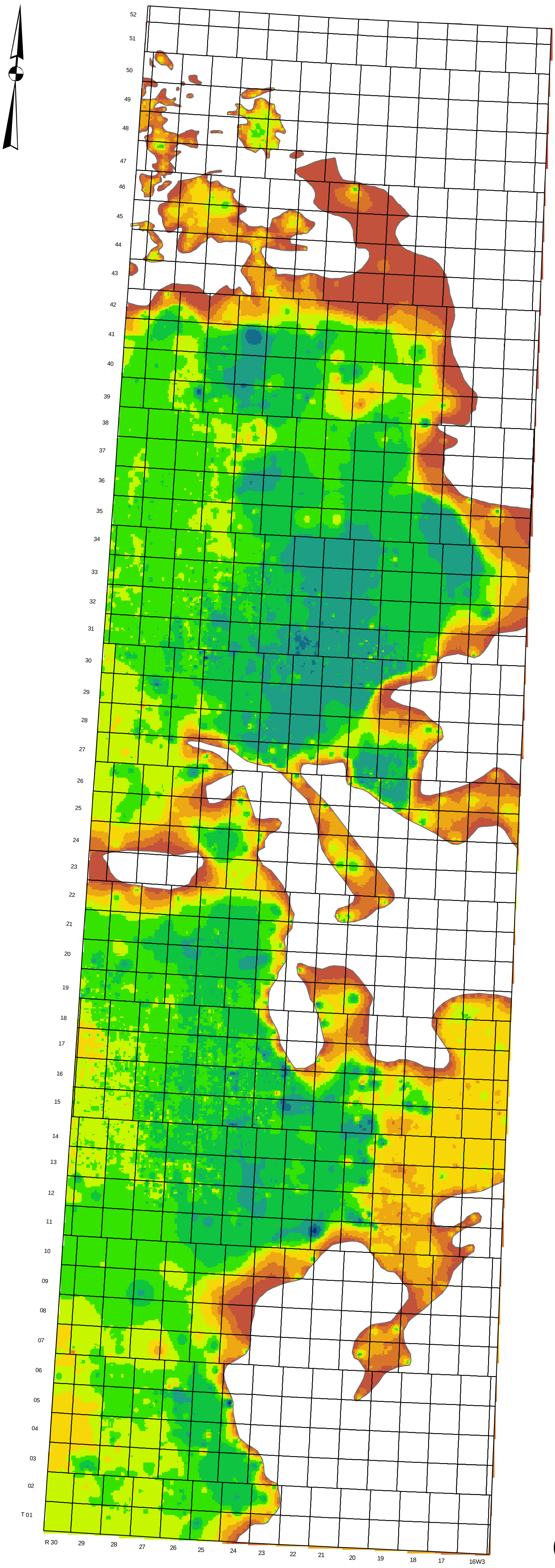
N



Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

50 25 0 50
Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Thickness (m)

- 0 - 3
- 3.1 - 10
- 10.1 - 20
- 20.1 - 30
- 30.1 - 40
- 40.1 - 50
- 50.1 - 60
- 60.1 - 75
- 75.1 - 100
- 100.1 - 125

Figure 17.
Extent and thickness of the Grizzly Bear Tongue

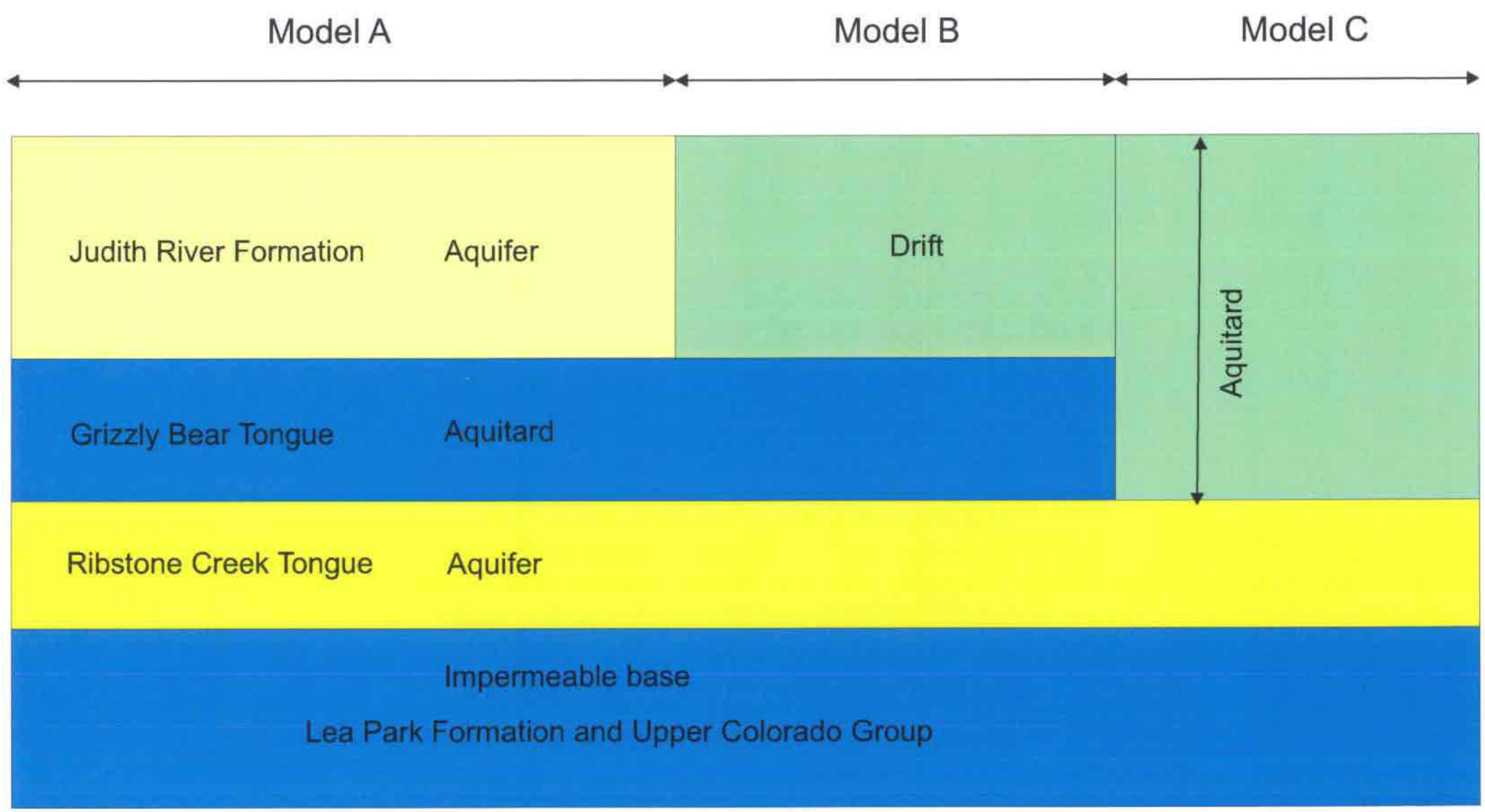
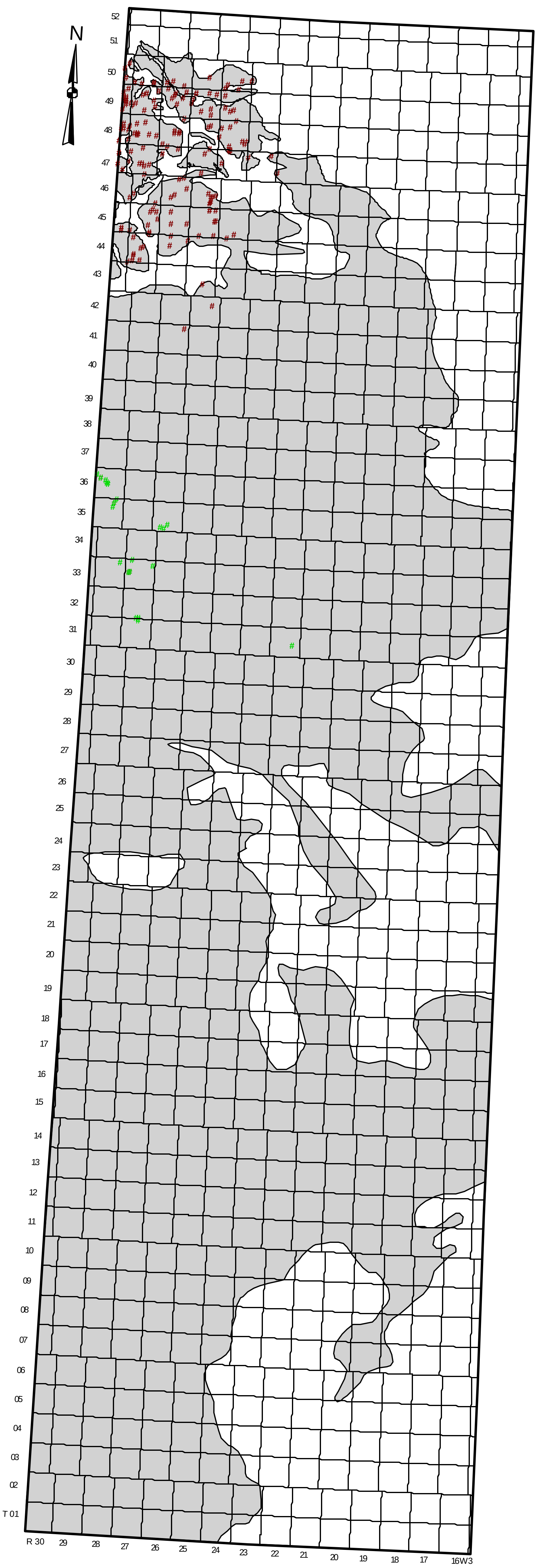


Figure 18 Schematic hydrogeological models for the Ribstone Creek aquifer



Data Sources:
base map- 2000 Government of Canada with
permission from Natural Resource of Canada

50 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 Nad 83 Projection

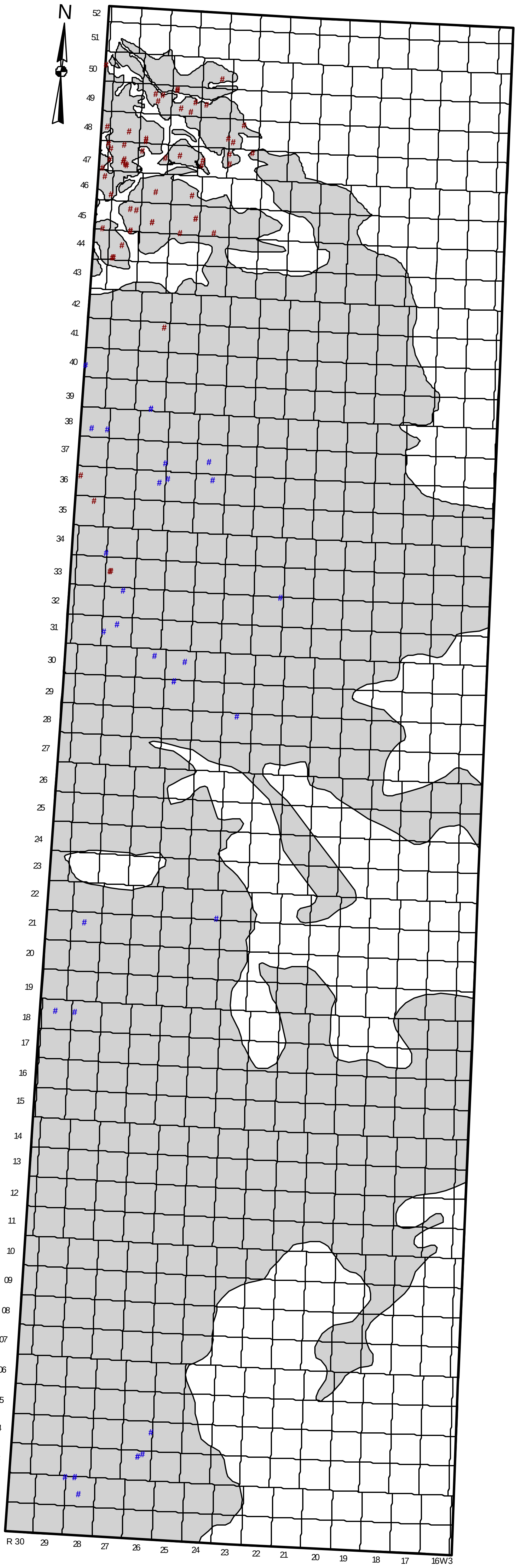
Legend

Ribstone Creek aquifer

Water well records with electric log

Well in SEM records

Figure 19.
Location of wells
completed in the
Ribstone Creek
aquifer.



Data Sources:
data- Saskatchewan Water Corp. February, 2002.
base map- 2000 Government of Canada with permission from Natural Resource of Canada

50 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 Nad 83 Projection

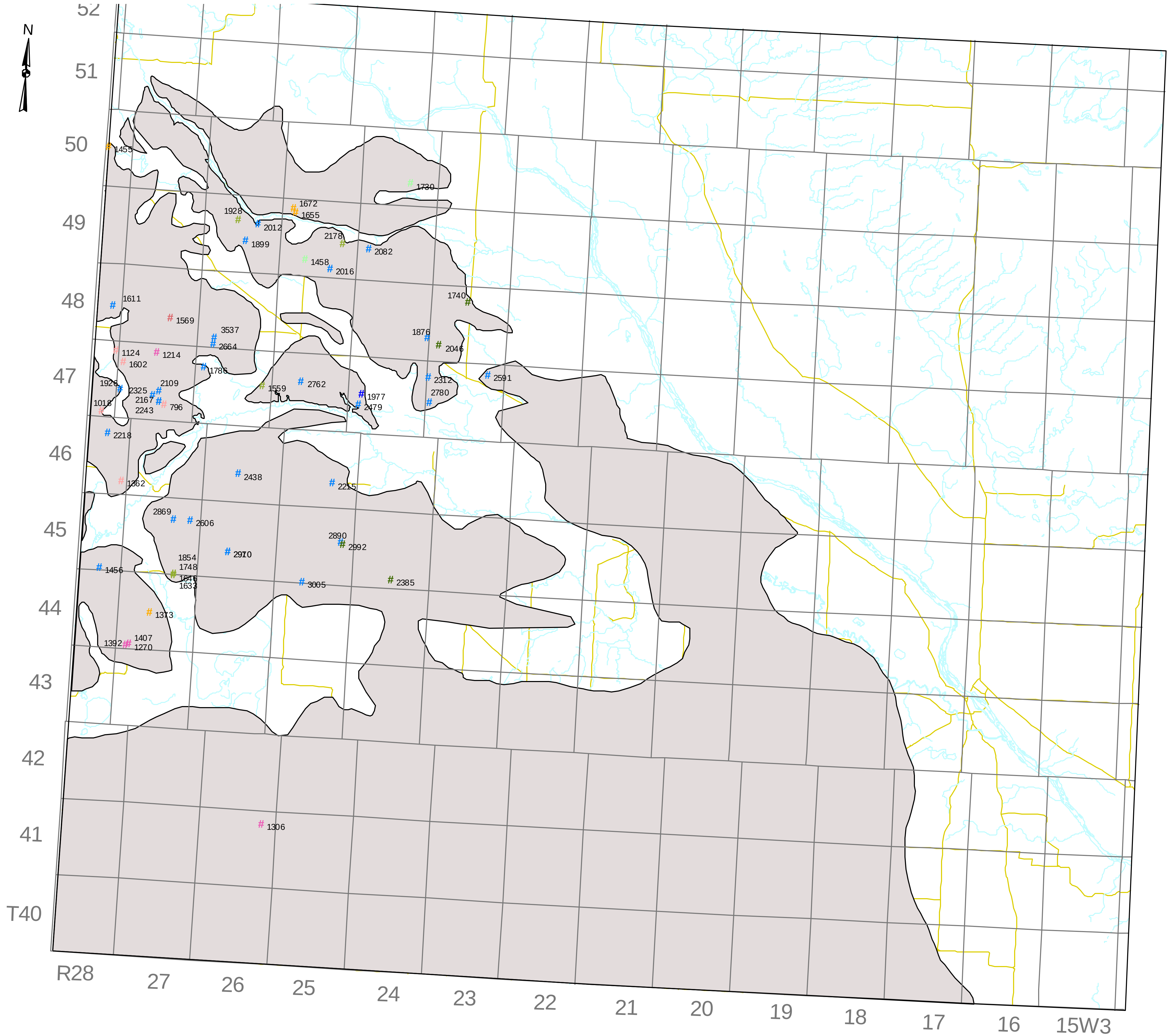
Legend

Ribstone Creek aquifer

SEM drillstem test water quality data

Water quality data for wells

Figure 20. Location of water quality data for the Ribstone Creek aquifer.



Legend

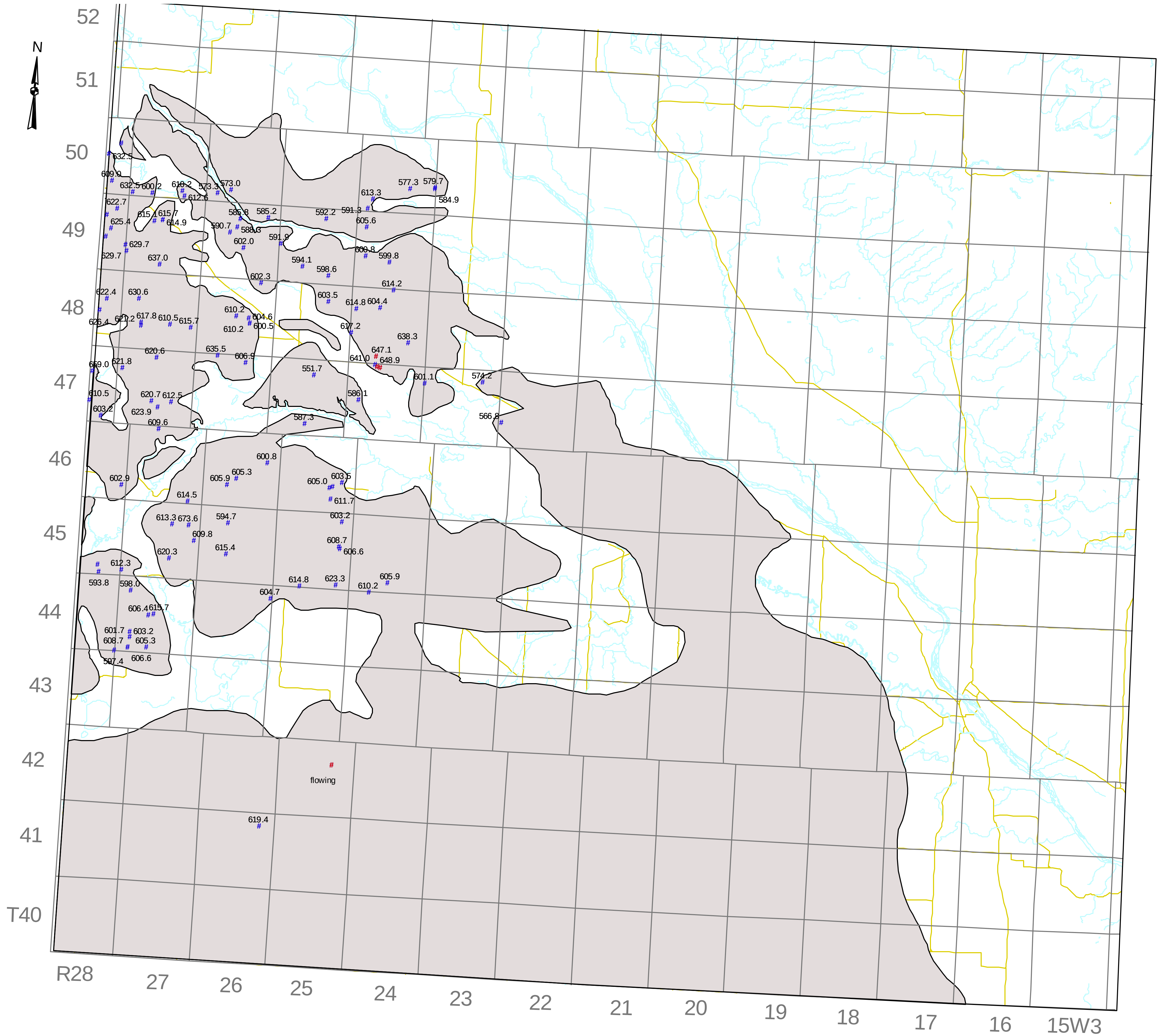
- Ribstone Creek aquifer
- 1200 # sum of ions, mg/L
- Ca/Mg-HCO3
- Ca/Mg-HCO3/SO4
- Ca/Mg-SO4
- Ca/Mg-SO4/Cl
- Ca/Mg/Na-SO4
- Na-HCO3
- Na-HCO3/SO4
- Na-SO4
- Na-SO4/Cl
- detailed area
- township/range lines
- rivers
- lakes
- roads

Figure 21.
Water quality in the northern part of the Ribstone Creek aquifer.

Data Sources:
base map- 2000 Government of Canada with permission from Natural Resource of Canada

10 0 10 Kilometers

1:500,000 scale
UTM Extended Zone 13 Nad 83 Projection



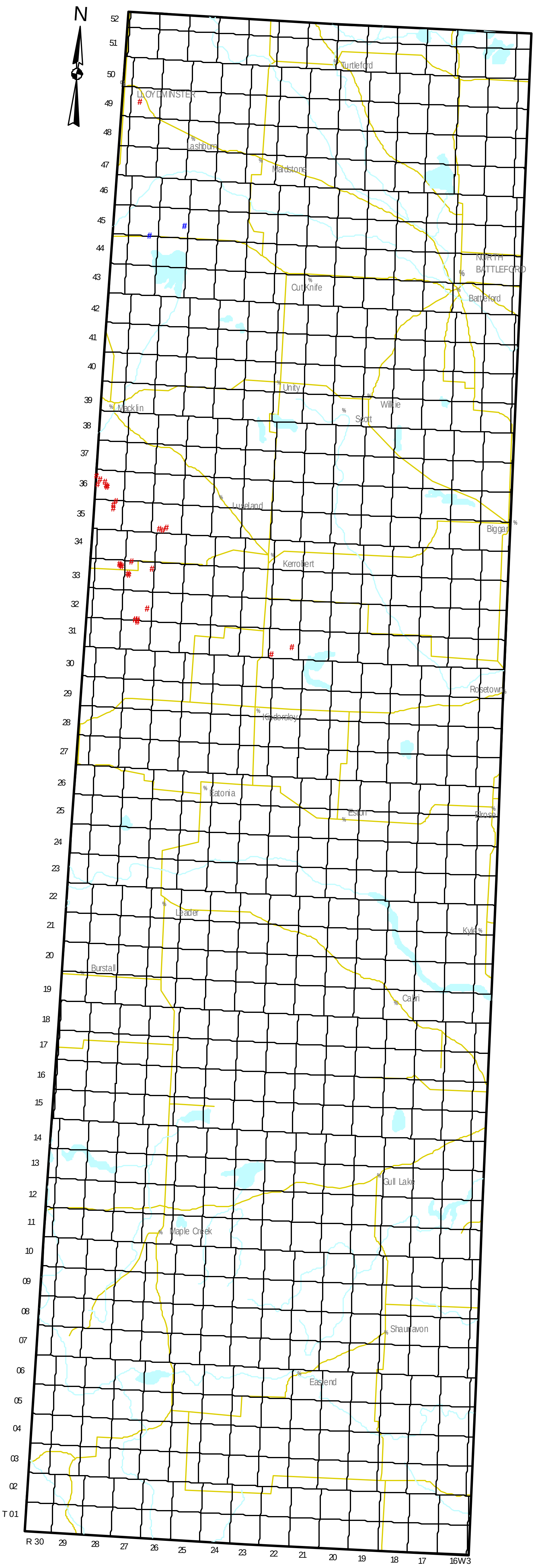
Legend
- flowing well
- 600.1 well - water level elevation (masl)
- Ribstone Creek aquifer
- detailed area
- township/range lines
- rivers
- lakes
- roads

Figure 22.
Water levels in the northern part of the Ribstone Creek aquifer.

Data Sources:
base map- 2000 Government of Canada with permission from Natural Resource of Canada

10 0 10 Kilometers

1:500,000 scale
UTM Extended Zone 13 Nad 83 Projection



Data Sources:
data- Saskatchewan Energy and Mines, February 2002 and Saskatchewan Water Corp. February, 2002.
base map- 2000 Government of Canada with permission from Natural Resource of Canada

50 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 Nad 83 Projection

Legend

- # industrial well
- # municipal well
- study area
- range/township lines
- rivers
- lakes
- roads

Figure 23.
Location of industrial and municipal withdrawals from the Ribstone Creek aquifer.

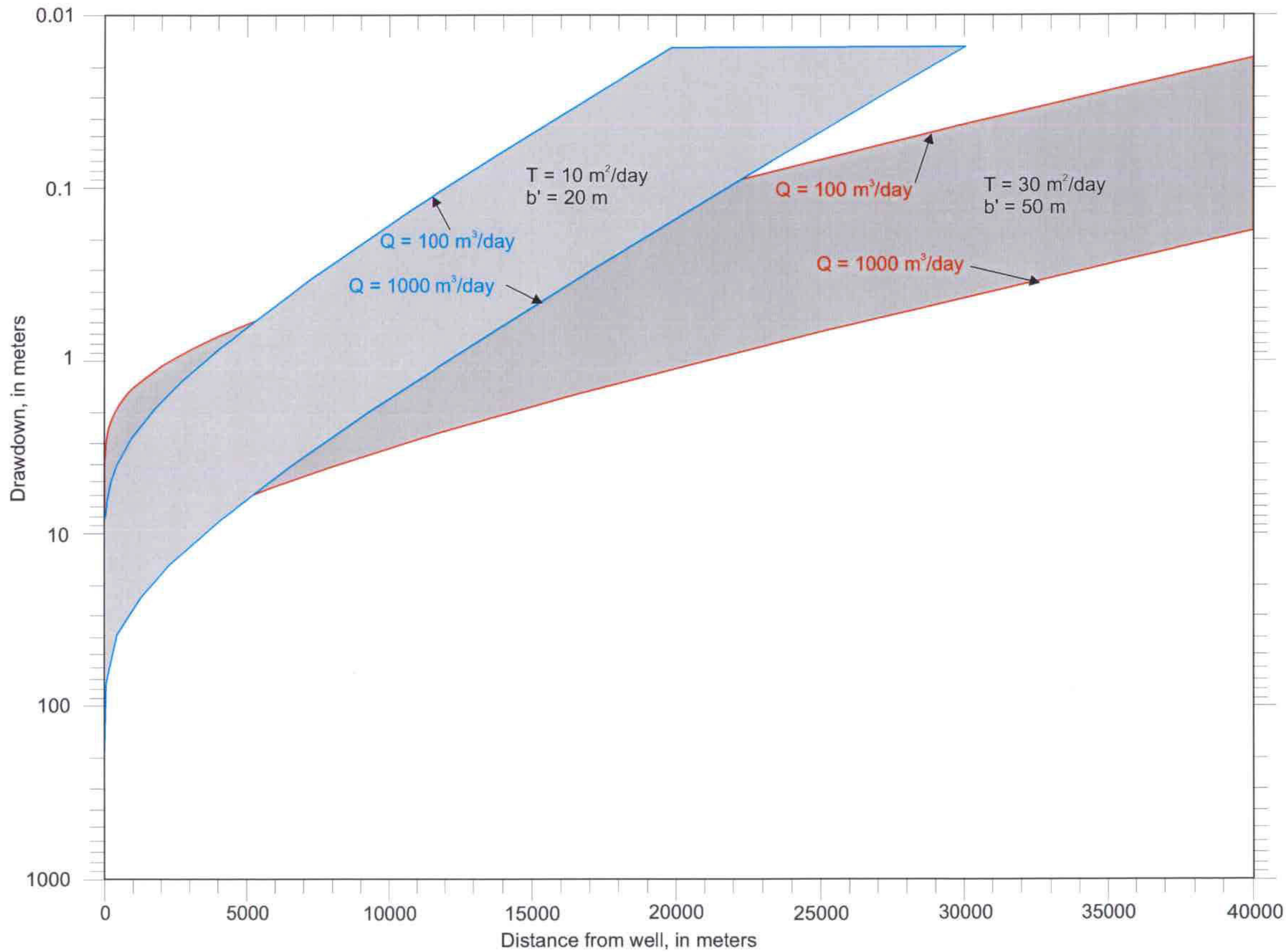
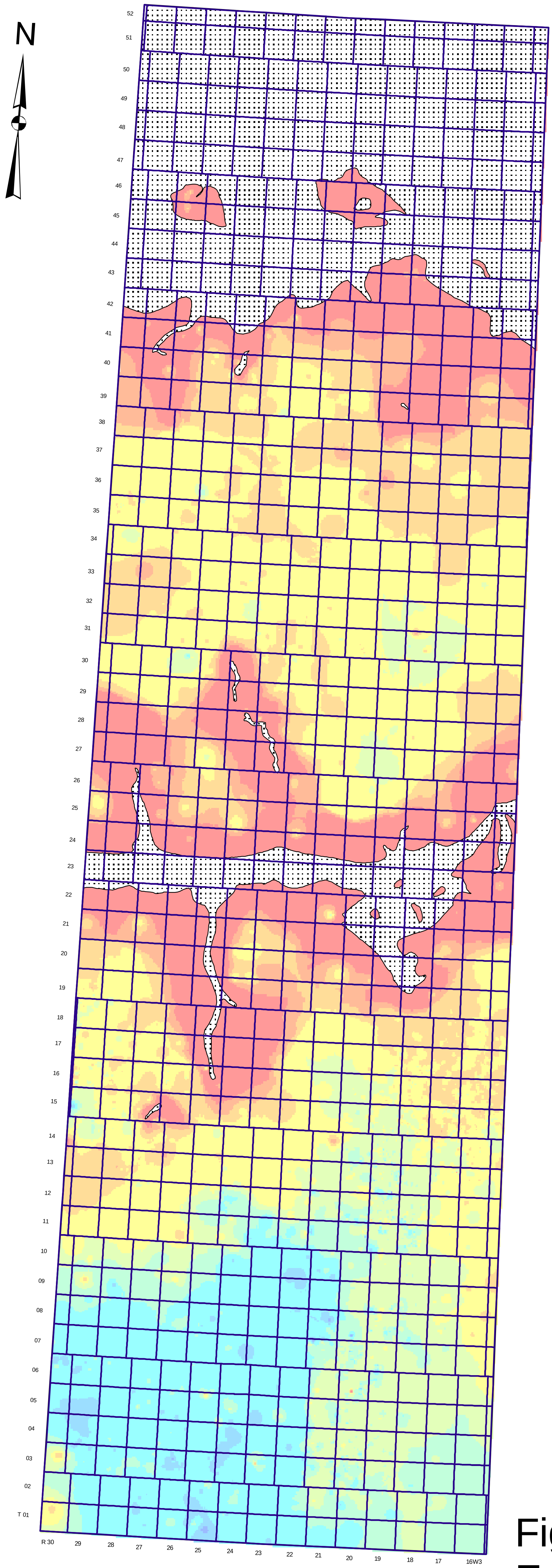


Figure 24 Hypothetical drawdowns in the Ribstone Creek aquifer, for representative aquifer and aquitard properties and pumping rates between 100 and 1,000 m^3/day



technology is our business

Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

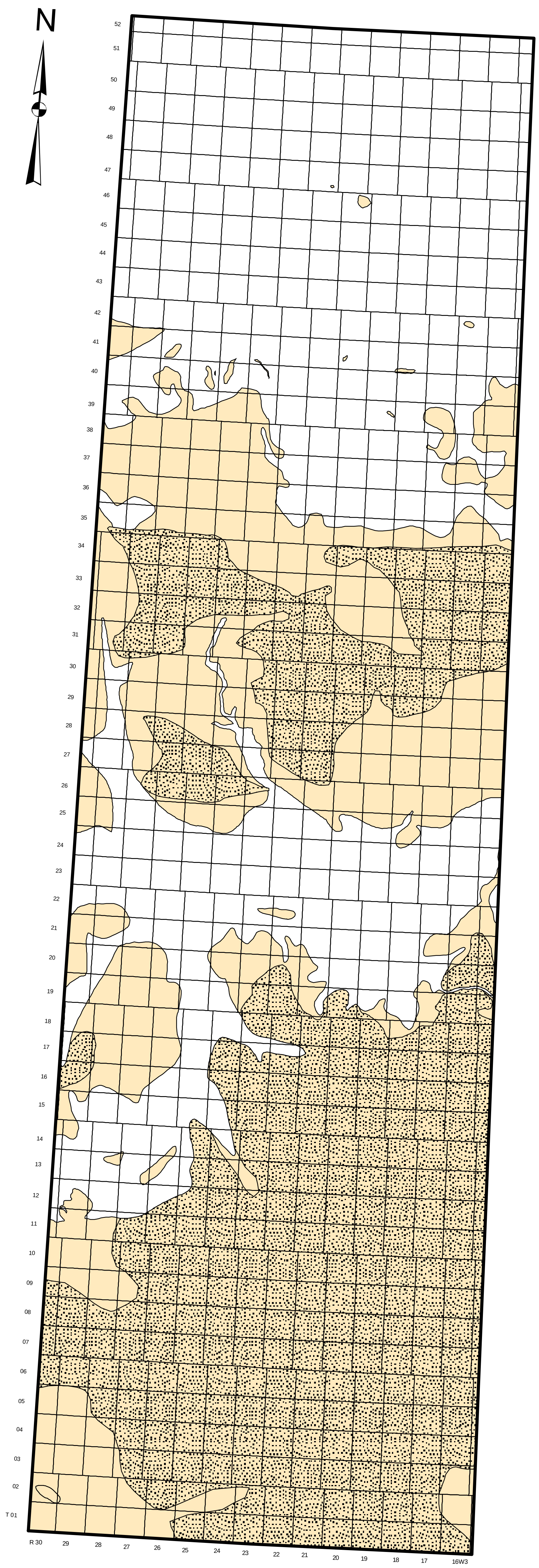
50 25 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Thickness (m)

- 0 - 25
- 25.1 - 50
- 50.1 - 75
- 75.1 - 100
- 100.1 - 125
- 125.1 - 150
- 150.1 - 175
- 175.1 - 200
- 200.1 - 225
- 225.1 - 250
- Judith River Fm. not present
- twprng2 arc

Figure 25.
Extent and thickness of the Judith River Formation in the Ribstone Creek study area



technology is our business

Data Sources:
Base map 2000 Government of Canada with
permission from Natural Resources Canada

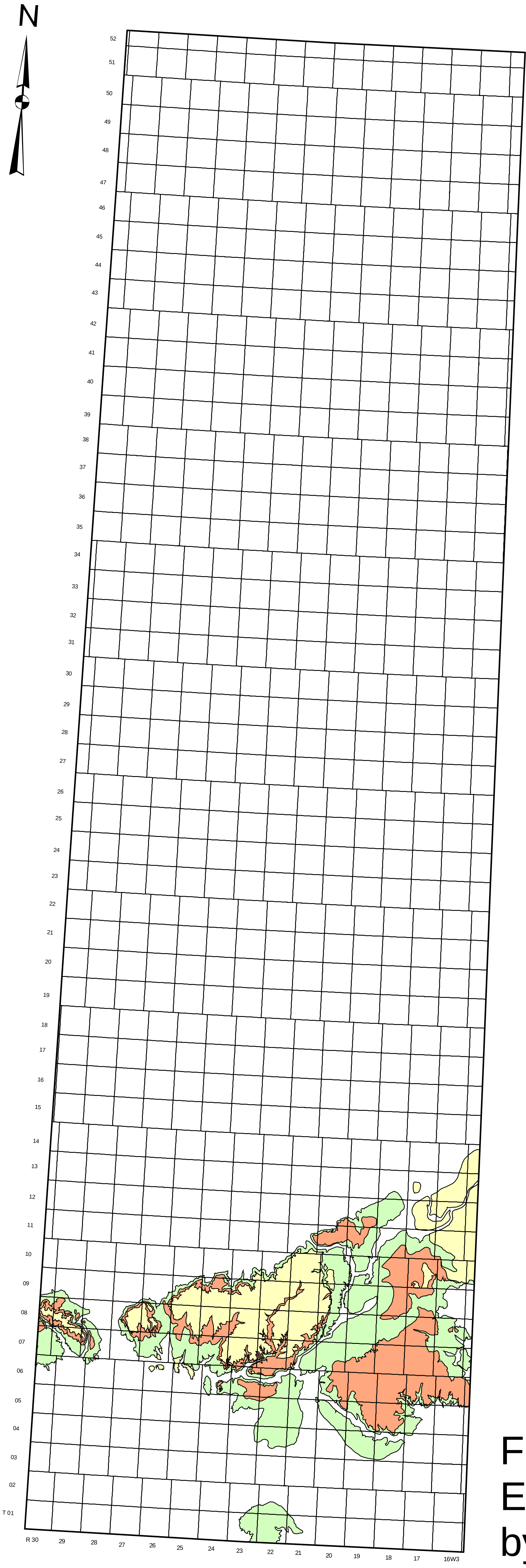
50 25 0 50
Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Legend

- Bearpaw sand extents
- Bearpaw Formation

Figure 26.
Extent of aquifers formed by sand members of the Bearpaw Formation



Data Sources:
Base map 2000 Government of Canada with permission from Natural Resources Canada

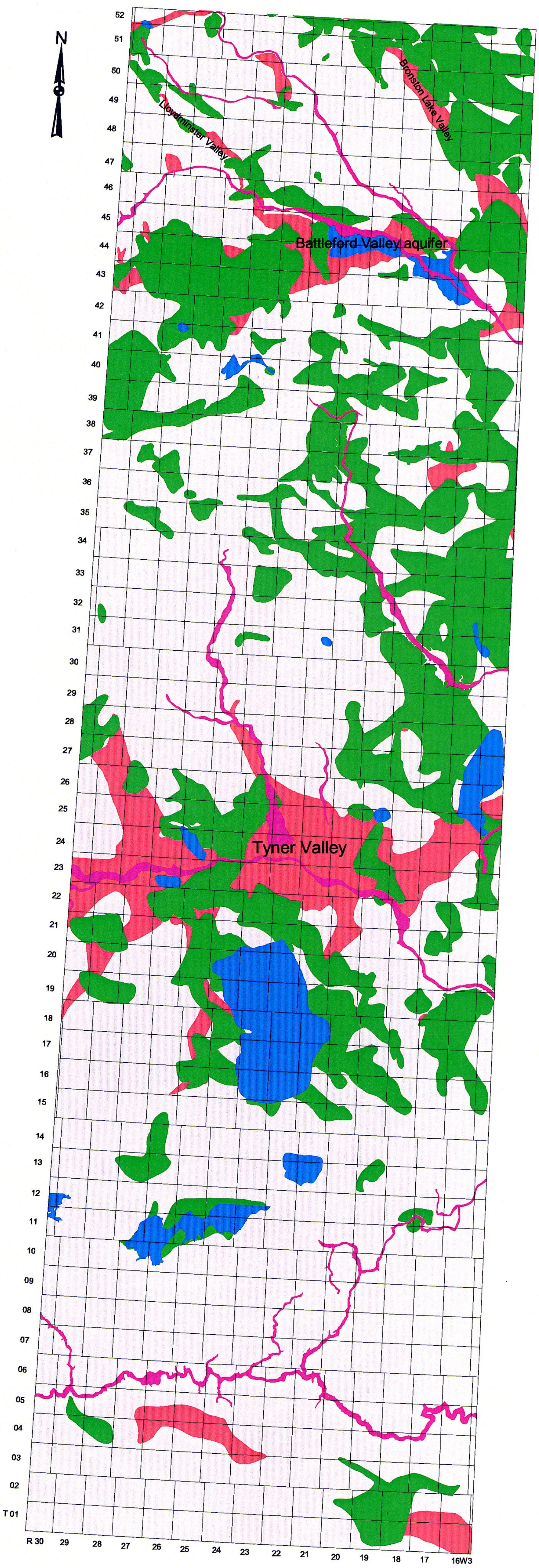
50 25 0 50 Kilometers

1:1,500,000 scale
UTM Extended Zone 13 NAD 83 Projection

Legend

- Cypress Hills Fm.
- Ravenscrag Fm.
- Eastend Whitemud, Battle, Frenchman Fms.

Figure 27.
Extent of the aquifer formed by Eastend, Whitemud, Battle, Frenchman, Ravenscrag and Cypress Hills Formations



50 0 50 Km

UTM Extended Zone 13 Nad 83 Projection

Source - Millard (1990 a, b, c, d, e)

Legend

- Intertill Aquifers
- Surficial Aquifers
- Alluvium
- Empress

Figure 28
Extent of drift aquifers in the Ribstone Creek study area.

Table 2 Listing of wells completed in the Ribstone Creek aquifer

	Land Location						UTM Extended Zone 13		Owner	Year	Elevation	Ribstone Creek Tongue			Well	Completion	Depth to	WL	Available	Pump test data				Recommended		Comment
							east83_13	north 83_13		Drilled		depth to	bottom	thickness	depth		water	elevation	drawdown	Drawdown	Duration	Pumping rate		pumping rate		
	Qtr	Lsd	Sec	Tp	Rg	M	m	m			m asl	m	m	m	m		m	m asl	m	m	hrs	L/s	m³/day	L/s	m³/day	
1	NE	13	7	47	22	W3	217221	5885509	Darrel Jurke	1984	573	21.3	32.6	11.3	29.0		6.25	566.8	15.1	10.4	0.5	0.80	69	0.76	65	
2	NW	12	30	47	23	W3	207492	5890565	Bob Stevenson	1986	610	50.6	59.4	8.8	55.5		8.53	601.1	42.1	36.6	3	0.91	79	0.91	79	
3	SW	2	35	47	23	W3	214868	5890732	Cal Ballan	1994	579	25.9	39.3	13.4	31.4		4.88	574.2	21.0	21.9	1.5	0.38	33			
4	NW	15	32	44	24	W3	200336	5863875	George Melchoir	1998	657	84.7	104.5	19.8	92.4		46.63	610.2	38.1	42.1	3	1.52	131	0.91	79	
5	NE	9	4	45	24	W3	202651	5864955	Jerry Ducherer	1982	646	68.9	88.1	19.2	82.3		40.23	605.9	28.7	1.3	1	0.76	65	0.76	65	
6	SE	1	19	47	24	W3	198967	5888458	Walter Campbell	1975	620	46.0	54.9	8.8	48.2	open	33.53	586.1	12.5	4.0	2	0.45	39			
7	NE	11	33	47	24	W3	201679	5892545	Bruce McFayden	1977	646	75.0	88.4	13.4	72.2	open										flowing
8	NW	13	33	47	24	W3	201093	5892985	Bill Snell	1982	645	75.6			76.5		3.66	641.0	71.9	15.2	5	0.38	33			
9	NW		33	47	24	W3	201380	5892665	Bruce McFayden	1997	646	75.0			80.5		-2.74	648.9	77.7	14.9	0.5	0.95	82			flowing
10	SW	12	4	48	24	W3	201156	5894002	Peter Donovan	1982	645	74.7			76.2	open	-2.44	647.1	77.1	7.0	20	0.95	82			flowing
11	SW	15	11	48	24	W3	205357	5895765	Jim Maxwell	1981	674	69.2	80.5	11.3	73.5		35.36	638.3	33.8							
12	NW	10	12	48	24	W3	206974	5895464	D. Brimacombe	1980	634	58.8			61.0	open				47.2	1	0.76	65			
13	SW		12	48	24	W3	206421	5894792	Daryl Young	1976	634	58.5	67.1	8.5	62.8	open				42.7	1	0.76	65			
14	SW	5	18	48	24	W3	198074	5897031	Dale Kramer	1977	674	88.7			93.3	open	56.39	617.2	32.3	3.4	2	0.53	46	0.76	65	
15	NE	5	28	48	24	W3	201751	5900254	Garry Benkendorf	1986	655	80.5	93.6	13.1	90.2		50.90	604.4	29.6	23.8	1	0.42	36	0.42	36	
16	NW	3	30	48	24	W3	198673	5900037	Ian Morrison	1984	661	76.5	97.2	20.7	85.6		46.63	614.8	29.9	24.4	1	0.45	39	0.45	39	
17		13	34	48	24	W3	203422	5902481	Alvin Pike	1974	666	66.4			68.6		51.82	614.2	14.6	9.1	6	0.38	33			
18	NE		8	49	24	W3	201374	5905650	Murray Blyth	1997		31.1	42.7	11.6	34.4		17.98		13.1	14.0	2	0.38	33	0.38	33	
19	SE	2	16	49	24	W3	202929	5906059	Keith Pike	1990	613	20.1	36.0	15.8	30.5		12.80	599.8	7.3	15.2	1	0.53	46	0.45	39	
20	NW	8	18	49	24	W3	199920	5906856	Art Pinder	1974	613	14.6	26.2	11.6	22.9	open	11.89	600.8	2.7							
21	NE		30	49	24	W3	200055	5910599	Jordy Fortin	1985	646	30.5	48.5	18.0	54.9		40.54	605.6	-10.1	4.3	3	0.45	39	0.45	39	
22		3	3	50	24	W3	204457	5912555	Irvin Carson	1978	648	30.2	41.8	11.6	35.7											
23	NW	13	5	50	24	W3	200786	5914105	Ernie Squiar	1988	617	3.7	14.0	10.4	13.1		3.93	613.3	-0.3		2	0.45	39	0.45	39	
24	NE	2	6	50	24	W3	200100	5912921	Kevin James	1989	610	2.7	32.9	30.2	24.1	open	18.29	591.3	-15.5	2.0	15	0.53	46	0.53	46	
25	NE	16	10	50	24	W3	205554	5915430	Ken Lundquist	1977	617	51.8	66.1	14.3	54.3		39.93	577.3	11.9	4.6	6	0.91	79	0.91	79	
26		1	13	50	24	W3	208718	5915543	Dan Lamont	1985	585	14.3	27.7	13.4	26.8		5.49	579.7	8.8	17.7	1	0.61	52	0.53	46	
27	S1/2	1	13	50	24	W3	208711	5915468	Dan Lamont	1985	585	7.0	15.5	8.5	14.0		0.30	584.9	6.7	11.0	0.5	0.61	52	0.45	39	
28	SE	4	26	42	25	W3	195536	5841675	Anna Middleton	1989	610	57.9	64.6	6.7	57.9	open										flowing
29	SW		15	43	25	W3	192340	5848655	Sask Wheat Pool	1997		100.9	123.1	22.3	109.7		42.67		58.2							
30	SE	8	2	45	25	W3	196104	5864749	George Hall	1977	678	97.5	122.8	25.3	108.2		54.86	623.3	42.7	15.2	1	0.61	52	0.38	33	
31	SW	4	4	45	25	W3	191413	5864639	Ted Klassen	1979	686	115.2	125.0	9.8	123.4		71.02	614.8	44.2	39.6	4	0.45	39	0.61	52	
32	SE	8	23	45	25	W3	196409	5869605	Norm Hallet	1976	687	94.5	123.1	28.7	118.9	open	78.64	608.7	15.8	18.9	6	0.91	79	0.45	39	
33	NW	4	24	45	25	W3	196600	5869391	Grant Doolittle	1976	683	109.1	115.8	6.7	110.3	open ?	76.20	606.6	32.9	15.2	6	0.45	39	0.45	39	
34	SE		34	45	25	W3	194684	5872861	Sask Wheat Pool	1997		117.0	130.5	13.4	129.1		92.05		25.0							
35	SE		34	45	25	W3	194684	5872861	Sask Wheat Pool	1997		114.6			118.9											
36	SE		34	45	25	W3	194684	5872861	Sask Wheat Pool	1997		114.0	128.6	14.6	126.2		93.27		20.7							
37	SW	5	36	45	25	W3	196816	5872826	Russel Goodfellow	1989	680	93.3	105.5	12.2	104.9		76.50	603.2	16.8	5.8	2	0.38	33	0.61	52	
38	NE		3	46	25	W3	194837	5875287	Sask Wheat Pool	1997		112.2	126.2	14.0	115.5		88.39		23.8	17.7	12	0.76	65			
39	NE		3	46	25	W3	194837	5875287	Sask Wheat Pool	1997		113.4	123.7	10.4	124.1		87.48		25.9							
40	NE	16	10	46	25	W3	195261	5877181	Gordon Goodfellow	1978	666	76.8	82.9	6.1	85.3		60.96	605.0	15.8	18.3	2	0.45	39	0.45	39	
41	SW	4	11	46	25	W3	195375	5875763	Norman Lindsay	1976	678	90.2	102.1	11.9	98.5		66.45	611.7	23.8	15.8	6	0.53	46	0.53	46	
42	SE	4	14	46	25	W3	195677	5877358	Sawtell Farms	1989	664	63.4	74.4	11.0	72.8		50.60	613.9	12.8	14.9	2	0.38	33	0.38	33	
43		8	14	46	25	W3	196822	5877796	Sawtell Farms	1976	655	67.1	73.2	6.1	73.2		51.82	603.5	15.2	6.4	6	0.53	46	0.53	46	
44	NW		15	46	25	W3	194231	5878574	Richard Toews	1996		74.4	84.1	9.8	76.2		51.51		22.9	21.6	2	0.68	59	0.61	52	
45		16	4	47	25	W3	192113	5885348	Grant Tarleton	1978	602	25.6	44.5	18.9	48.8		14.63	587.3	11.0	26.2	6	0.53	46	0.53	46	
46	SW	14	27	47	25	W3	193232	5891665	Greg Cressman	1988	610	57.9	64.0	6.1	63.1		57.91	551.7	0.0					0.45	39	
47			35	47	25	W3	194857	5893076	Fran Rodgers	1998		44.5	56.1	11.6	56.7		39.62		4.9	15.5	12	0.08	7	0.08	7	
48	W	12	26	48	25	W3	195177	5900981	Tighduin Farms	1977	639	57.9	75.9	18.0	65.2		35.05	603.5	22.9					0.76	65	
49	SE		27	48	25	W3	194507	5900406	Jack Alex & Lee E R	2040	622	48.8	61.6	12.8	57.0											
50	NE	9	3	49	25	W3	195064	5904331	Bruce Hardy	1977	637	48.2	77.7	29.6	71.6		38.40	598.6	9.8					0.45	39	
51	SE	8	8	49	25	W3	191875	5905550	Ed Winter	1981	626	46.3			54.9		32.31	594.1	14.0					0.76	65	
52	SE	1	15	49	25	W3	195205	5906546	Neil Reece	1977	619	23.5	35.4	11.9	25.0									0.38	33	
53	NW	13	18	49	25	W3	188998	5908378	Burt Napper	1989	607	14.6	27.4	12.8	22.6		14.63	591.9	0.0	5.2	3	0.76	65			
54	SE	12	19	49	25	W3	189266	5909371	Francis Harris	1978	607	28.3	38.1	9.8	25.9									0.53	46	
55	NW	13	25	49	25	W3	197332	5911078	Darrel Squair	1980	631	40.2			49.4	open								0.45	39	
56	NE	16	30	49	25	W3	190631	5911519	Harold & Frank Turvey	1989	619	46.9			47.9	open				2.1	2	1.14	98	1.14	98	
57	NE	16	30	49	25	W3	190631	5911519	Harold & Turvey Frank	1989	619	46.9			47.9	open				2.1	2	1.14	98	1.14	98	

Table 2 Listing of wells completed in the Ribstone Creek aquifer

	Land Location Qtr	Lsd	Sec	Tp	Rg	M	UTM Extended Zone 13 east83_13 (m)	north 83_13 (m)	Owner	Year Drilled	Elevation (m asl)	Ribstone Creek Tongue depth to (m)	bottom (m)	thickness (m)	Well depth (m)	Completion	Depth to water (m)	WL elevation (m asl)	Available drawdown (m)	Pump test data Drawdown (m)	Duration (hrs)	Pumping rate (L/s)	Pumping rate (m^3/day)	Recommended pumping rate (L/s)	Recommended pumping rate (m^3/day)	Comment
58	NW	2	34	49	25	W3	194921	5911641	Don Retzlaff	1982	632	40.2	54.3	14.0	49.7		40.23	592.2	0.0	4.9	1	0.19	16	0.19	16	
59	SW		15	50	25	W3	194732	5916621	Russel Waldron	1995		5.2	19.5	14.3	19.5		5.18		0.0	14.9	15	0.30	26	0.38	33	
60	NW	16	26	41	26	W3	186311	5833946	Viola Bowey		658	123.4	139.3	15.8	128.3		39.01	619.4	84.4	52.4	5	0.68	59	0.45	39	
61	NW		21	44	26	W3	181716	5861521	Bruce Graham	1998		78.3	82.9	4.6	80.5		48.77		29.6	23.8	2	0.98	85	0.91	79	
62	C	16	25	44	26	W3	187741	5862957	Brian Gibb	1977	672	111.3	119.5	8.2	117.7		67.36	604.7	43.9	39.6	2	0.76	65	0.76	65	
63	NW		33	44	26	W3	181927	5864750	Doug Graham	1998		85.3	88.4	3.0	87.2		38.40		46.9	33.8	2	1.59	137	0.91	79	
64	SW		13	45	26	W3	187075	5868473	Church of God	1998		109.1	113.4	4.3	111.3		68.88		40.2	22.6	2	1.14	98	0.61	52	
65	NE	4	16	45	26	W3	182084	5868698	Kerry Wells	1979	666	89.0	95.1	6.1	92.0		50.60	615.4	38.4	10.1	0.83	0.64	56	1.14	98	
66		12	28	45	26	W3	182243	5872651	Charann Farms	1979	680	92.7	107.0	14.3	105.2		85.04	594.7	7.6					0.68	59	
67	W	9	8	46	26	W3	182154	5877523	Joe Koch	1989	671	74.4	87.2	12.8	87.2		64.62	605.9	9.8	13.9	1.3	0.44	38	0.76	65	
68	NW	2	16	46	26	W3	183333	5878360	Rawlyn Thiessen	1981	671	78.6	90.2	11.6	89.3		65.23	605.3	13.4	6.4	3	0.30	26	0.38	33	
69	SE	9	23	46	26	W3	187332	5880333	George MacIvor	1978	663	75.6	82.9	7.3	81.4		62.18	600.8	13.4	15.2	4	0.45	39	0.45	39	
70	SW		34	46	26	W3	184772	5883237	Murray McDonnell	1990	643	54.3	58.2	4.0	54.9											
71	NW		35	46	26	W3	186445	5883917	Travis Minish	1996		18.3			22.6		13.26		5.0	5.8	1	0.95	82			
72	SE		30	47	26	W3	179203	5891662	Paul Mihalich	1977		14.6	27.7	13.1	24.4		10.67		4.0	5.5	4	0.91	79	0.76	65	
73	SE	15	32	47	26	W3	180901	5894088	Lorne Phipps	1988	652	38.4	45.7	7.3	44.2		16.76	635.5	21.6	19.8	2	0.61	52	0.61	52	
74	NE	8	34	47	26	W3	184530	5893242	Gordon E. Marlatt	1994	620	40.8	50.3	9.4	49.4		13.41	606.9	27.4	32.3	2	0.30	26	0.30	26	
75	SE		6	48	26	W3	179420	5894896	Melvin Oddan	1994		51.2			57.9		41.45		9.8	12.2	2	0.45	39	0.61	52	
76	SW	12	14	48	26	W3	185067	5898282	Bob Bower	1985	617	31.7	42.1	10.4	41.5	open	12.65	604.6	19.1					0.68	59	
77	SW	12	14	48	26	W3	185067	5898282	Gordon Kitching	1986	617	24.4	42.7	18.3	48.8		16.76	600.5	7.6	28.3	3	0.30	26	0.45	39	
78	NE	16	15	48	26	W3	184903	5898905	Abraham G. Shapansky	1982	616	31.7	42.7	11.0	42.1		5.49	610.2	26.2					0.61	52	
79	SE	9	16	48	26	W3	183234	5898403	Ed Lowe	1976		15.8	24.4	8.5	21.3	open	2.74		13.1	18.3	1	1.89	164	0.76	65	
80	SE	1	21	48	26	W3	183288	5899215	Al Weston	1981	616	16.2	28.3	12.2	24.1	open	5.49	610.2	10.7							
81	CNE		35	48	26	W3	186526	5903358	Paul Fisher	1980	605	22.9	42.7	19.8	28.3	open	2.74	602.3	20.1	0.8	1	1.10	95	0.91	79	
82	NE	5	15	49	26	W3	184271	5907875	Guy Pierce	1981	602	12.5	35.1	22.6	20.7	open		602.0	12.5							
83	SW	12	21	49	26	W3	182563	5909815	Harold Holtby Farms Ltd	1989	602	17.7			21.9	open	11.28	590.7	6.4	2.4	2	0.98	85	1.14	98	
84	NW		23	49	26	W3	186138	5909881	Tim McDougall	1984		10.7			40.2		25.60			9.4	2	0.23	20	0.15	13	
85	NE	16	26	49	26	W3	187382	5911733	Ronald Christie	1986	610	9.4	33.5	24.1	21.9	open?	24.38	585.2	-14.9	9.1	24	0.11	10	0.11	10	
86	SW	2	28	49	26	W3	183430	5910566	Sam Rollheiser	1989	604	13.4	25.6	12.2	23.5		15.24	588.3	-1.8	6.7	2	0.38	33	0.38	33	
87	NE		28	49	26	W3	183809	5911664	Grerg Lutes	1986	604	16.8	28.7	11.9	61.0		17.68	585.8	-0.9	28.0	3	0.68	59	0.53	46	
88	SW	12	32	49	26	W3	181155	5913157	Fred Hippe	1977		26.5	34.1	7.6	32.3	open	21.52		5.0	1.8						
89		3	2	50	26	W3	186595	5913706	Tanya Jensen	1979	652	52.4	82.6	30.2	72.8	open										
90	NE	16	5	50	26	W3	182724	5915291	W m Christie	1979	607	41.5			39.9	open	33.53	573.0	7.9					0.23	20	
91	W	9	6	50	26	W3	180974	5914895	Gordon Thiessen	1975	611	24.4	43.6	19.2	40.2	open	37.80	573.3	-13.4	1.8	2	0.30	26	0.15	13	
92		1	19	33	27	W3	168602	5754157	Norcen WSW B1-19	1995																
93		2	19	33	27	W3	168195	5754184	Norcen WSW B2-19	1995																
94	NE	6	4	44	27	W3	171881	5856802	Evelyn Paterson	1989	636	67.1	73.8	6.7	68.0		30.18	605.3	36.9	2.4	16	0.61	52	0.76	65	
95	SE	8	6	44	27	W3	169418	5856761	Artland Dairy	1998	648	69.5	75.9	6.4	75.6		39.01	608.7	30.5	29.3	2	0.61	52	0.53	46	
96	SE	8	6	44	27	W3	169418	5856761	Artland Dairy	1988	648	70.7	78.0	7.3	77.4		41.15	606.6	29.6	27.4	16	0.61	52	0.61	52	
97	NW	4	8	44	27	W3	169719	5858166	Bob Watson	1989	640	67.1	75.6	8.5	67.7	open	38.40	601.7	28.7	3.0	2	0.53	46	0.53	46	
98	SW	12	8	44	27	W3	169760	5858769	Wayne Bosch	1983	640	62.5	74.7	12.2	68.0		36.88	603.2	25.6	24.1	1	0.68	59	0.53	46	
99	NE	14	16	44	27	W3	172154	5860845	Thomas Gray	1977	631	56.7	66.8	10.1	63.7+		24.54	606.4	32.2	2.6	0.3	0.91	79	0.91	79	
100	SW	1	21	44	27	W3	172779	5861007	Leslie Graham	1974	642	62.5	73.2	10.7	76.8		25.91	615.7	36.6							
101	C	16	30	44	27	W3	169818	5864147	John Proctor	1975	646	66.4	79.6	13.1	71.6		48.16	598.0	18.3	3.7	6	0.53	46			
102	NW	13	35	44	27	W3	175126	5865506	Town of Marsden No. 6	1987														1.1	95.0	
103	SW	4	2	45	27	W3	175139	5865707	Town of Marsden No. 5															1.0	86.4	
104	NW	5	6	45	27	W3	168667	5866758	Alvin Scholin	1988	655	64.6	70.1	5.5	68.0		42.98	612.3	21.6	10.1	1	0.45	39	0.45	39	
105	SE	10	10	45	27	W3	174692	5868178	Hugh Polkinghorne	1985	646	46.9	65.8	18.9	61.6		25.91	620.3	21.0	32.0	1	0.45	39	0.45	39	
106	SW	2	24	45	27	W3	177906	5870402	John Gray	1985	661	70.1	83.5	13.4	83.5		51.66	609.8	18.4	14.3	1	0.61	52	0.68	59	
107	SW	5	25	45	27	W3	177229	5872472	Neil Tindall	1980	674	79.9	90.8	11.0	89.6	open		673.6						0.53	46	
108	NW		26	45	27	W3	175955	5873273	David Scott	1996		84.1	97.5	13.4	96.3		76.05		8.1	8.8	2	0.61	52	0.61	52	
109	SW	8	27	45	27	W3	175196	5872609	David Cunningham	1976	640	42.1	47.5	5.5	46.0		26.82	613.3	15.2	7.0	2	0.45	39			
110	C	1	2	46	27	W3	177120	5875422	Camil Lebreque	1986	671	72.5	82.9	10.4	76.8		56.08	614.5	16.5	2.6	86	0.45	39	0.45	39	
111	NW		7	46	27	W3	169784	5878560	W Savage	1989		43.9	50.6	6.7	51.8		44.81		-0.9	5.2	24	0.23	20	0.23	20	
112	NW		33	46	27	W3	173470	5884783	Ernie Kenyon	1976	671	69.2			78.0		60.96	609.6	8.2							
113	NW	16	9	47	27	W3	172525	5888357	William Findlay	1985	640	24.1			38.4		19.35	620.7	4.7	17.4	1	0.91	79	0.76	65	
114	NW	6	10	47	27	W3	173286	5887497	Gerald Lamb	1986	671	53.3			64.0		46.63	623.9	6.7	6.4	1	0.45	39	0.53	46	

Table 2 Listing of wells completed in the Ribstone Creek aquifer

	Land Location						UTM Extended Zone 13		Owner	Year Drilled	Elevation	Ribstone Creek Tongue			Well depth	Completion	Depth to water	WL elevation	Available drawdown	Pump test data				Recommended pumping rate		Comment
							east83_13	north 83_13				depth to	bottom	thickness						Drawdown	Duration	Pumping rate				
	Qtr	Lsd	Sec	Tp	Rg	M	m	m			m asl	m	m	m	m		m	m asl	m	m	hrs	L/s	m^3/day	L/s	m^3/day	
115	NW	14	11	47	27	W3	174973	5888189	F Lamb	1990	632	25.6			36.6		19.96	612.5	5.6	11.6	1	0.68	59	0.68	59	
116	SE	3	16	47	27	W3	171925	5888600	William Findley	1980	637	21.3	42.7	21.3	38.9	open								0.91	79	
117	SW		18	47	27	W3	168376	5889149	Blair Sarestsky	1998		36.9			40.8		13.11		13.4	0.6	8	0.61	52			
118		6	30	47	27	W3	168818	5892572	J.W. Anderson	1987	646	40.8	56.7	15.8	49.7		24.38	621.8	16.5					0.68	59	
119	SE	8	33	47	27	W3	173101	5893806	Murray Martin	1987	664	59.1			68.9		43.89	620.6	15.2	17.1	2	0.83	72	0.61	52	
120	NE	15	8	48	27	W3	171354	5898184	Blue Ridge Gardens	1995		51.8	58.5	6.7	56.1		24.99		26.8	14.6	3	1.06	92	0.76	65	
121	SW	15	8	48	27	W3	171137	5897997	Leonard Long	1986	649	49.4	61.3	11.9	61.0		28.04	621.2	21.3	17.4	1	0.61	52	0.68	59	
122	NE	14	12	48	27	W3	177464	5897766	David caruthers	1984	631	32.9			46.3		15.24	615.7	17.7	9.1	2	0.30	26	0.38	33	
123	SW	1	15	48	27	W3	174830	5898149	William Noyes	1987	640	43.6			51.8		29.57	610.5	14.0	6.7	1	0.53	46			
124	SW	2	17	48	27	W3	171165	5898400	Jim Long	1988	646	50.0			58.2	open	28.35	617.8	21.6	4.0	1	0.76	65	0.68	59	
125	SW	4	17	48	27	W3	170350	5898456	Joe Holden	1976		34.7			41.1		14.33		20.4	13.4	2	0.91	79	0.91	79	
126	NW	14	20	48	27	W3	170967	5901459	Donald Bartminas	1981	640	32.3	50.3	18.0	49.1		9.45	630.6	22.9	23.8	2	0.61	52	0.45	39	
127	NE	8	28	48	27	W3	173667	5902091	Maurice Young	1989	637	30.5			40.5									0.53	46	
128	NE	10	4	49	27	W3	173511	5905760	Wayne Burzinski	1980	637	37.8	53.6	15.8	49.4	open		637.0	37.8					0.91	79	
129	SW	12	7	49	27	W3	169338	5907463	Lorne Foot	1985	649	43.0	54.9	11.9	52.7		19.51	629.7	23.5	14.6	0.5	0.68	59	0.68	59	
130	NE		11	49	27	W3	176981	5907243	R Penny	1990		39.0	56.4	17.4	51.8	open	7.01		32.0	19.8	2	1.14	98	0.76	65	
131	SW	14	14	49	27	W3	176387	5909016	Norman Helm	1981	623	37.2			42.4									0.53	46	
132	SE		18	49	27	W3	170533	5908497	Dave Bryson	1996		36.0	51.2	15.2	50.3									0.76	65	
133	NW	14	25	49	27	W3	178245	5912342	All Test Land Livestock	1982	611	33.5	55.5	21.9	50.3									0.98	85	
134	SW	4	28	49	27	W3	172868	5911279	John Dzuz	1988	625	18.3			28.7		9.75	615.1	8.5	14.3	1	0.45	39	0.45	39	
135	SE		28	49	27	W3	174006	5911508	Jake Jacobson	1986	616	20.1	42.1	21.9	41.5		0.00	615.7	20.1	17.7	1	0.61	52	0.68	59	
136	SE		28	49	27	W3	174006	5911508	Dennis J. Noyes	1985	622	31.7	46.0	14.3	44.8		6.89	614.9	24.8	20.4	1	0.61	52	0.61	52	
137		12	2	50	27	W3	176501	5915199	Jim Krykowski	1980	617	38.4	42.7	4.3	40.5	open	7.01	610.2	31.4	19.5	2	0.61	52	0.45	39	
138	SW		2	50	27	W3	176663	5914575	Wilf Jurke	1978	613	21.3	33.5	12.2	30.5	open		612.6	21.3							
139	SE		5	50	27	W3	172604	5914853	Gary Lindquist	1987	616	37.5	42.1	4.6	41.5		15.54	600.2	21.9	15.2	0.5	0.38	33	0.38	33	
140	SW		6	50	27	W3	170168	5915020	Cliff Kenyan	1990		21.3	36.6	15.2	35.1		6.71		14.6	15.2	1	0.68	59	0.61	52	
141	SW		6	50	27	W3	170168	5915020	C. Fanthorpe	1990	632	23.5	38.4	14.9	36.3			632.5	23.5		3	0.53	46	0.45	39	
142		16	27	35	28	W3	163299	5776854	Petro-Canada PW	1985	730.4	228.7	241.3	12.7	242.9		65.08	665.34	163.6							
143		16	19	36	28	W3	158959	5785266	WSW 13D16	1996	728.5	221.9	238.0	16.2	234.7		83.79	644.75	138.1							
144	SE	1	1	44	28	W3	167756	5856461	Twilight Land	1978	622	49.7	56.1	6.4	51.8		24.38	597.4	25.3					0.76	65	
145	NW	3	2	45	28	W3	165786	5866515	Hen-Lea Farms	1982	620	38.7	41.8	3.0	39.3	open	26.52	593.8	12.2	6.4	1	0.23	20	0.19	16	
146	NE	12	2	45	28	W3	165638	5867340	Darrel Ostrom	1982	625	40.2	43.9	3.7	42.1	open	28.04	596.8	12.2	3.4	20	0.38	33	0.38	33	
147	SW	2	12	46	28	W3	168589	5877524	Kenneth Waring	1980	640	37.8	43.9	6.1	42.1		37.19	602.9	0.6	4.9	6	0.38	33	0.38	33	
148	NE	8	2	47	28	W3	166034	5886389	Charles/Raymond Knowlson	1973	634	49.7	60.4	10.7	57.9		30.78	603.2	18.9	6.1	2	0.42	36			
149	NE		10	47	28	W3	164577	5888391	Orest Andony	1985	634	20.1	40.2	20.1	38.1		23.47	610.5	-3.4	12.8	2	0.34	29	0.34	29	
150	NW	13	23	47	28	W3	164998	5892122	Allen N. Anderson	1978	668	35.4	50.0	14.6	39.3		8.53	659.0	26.8	11.9	0.5	0.76	65	0.76	65	
151	NE		1	48	28	W3	168065	5896486	Jason Plandowski	1996		21.9	44.2	22.3	44.2		7.01		14.9					0.61	52	
152	SE		3	48	28	W3	165099	5895887	Bill Mclennan	1976		37.2	57.0	19.8	55.5	open	15.85		21.3	2.4	2	0.91	79			
153	NE		13	48	28	W3	168289	5899721	Norbert Weinkauf	1994	664	32.3	44.2	11.9	41.8									0.53	46	
154	NE		14	48	28	W3	166661	5899834	Garry Gagnon	1997		26.5	49.1	22.6	48.2		12.80		13.7							
155	NW		14	48	28	W3	165847	5899890	Jim Martens	1987	640	31.7			43.9		13.72	626.4	18.0	13.7	3	0.68	59	0.61	52	
156	NE		23	48	28	W3	166773	5901446	Rick Lorenz	1986	646	36.3	56.7	20.4	53.0		23.77	622.4	12.5					0.76	65	
157		8	24	48	28	W3	168563	5900716	Art Wells	1980	648	37.2	65.8	28.7	52.7	open				6.4	2	0.45	39	0.45	39	
158	NW		2	49	28	W3	166299	5906359	Bexon Constr	1998		43.0			62.5		18.29		24.7	35.7	2	0.76	65	0.76	65	
159	NE		11	49	28	W3	167224	5907915	Len Oster	1998		49.4			58.5		24.69		24.7	30.2	2	0.68	59	0.61	52	
160	SE	1	13	49	28	W3	169190	5908283	Jim & Dorthy Hill	1990	646	36.6	50.0	13.4	46.9		16.46	629.7	20.1					0.76	65	
161		11	14	49	28	W3	166714	5909375	Edgar Blais	1989	646	42.4	64.9	22.6	60.0	open	26.52	619.7	15.8	7.0	1	1.14	98	0.76	65	
162	NE		14	49	28	W3	167337	5909536	Harold Petersen	1998		42.1			54.9		25.91		16.2	27.7	2	0.83	72	0.76	65	
163	SE		14	49	28	W3	167281	5908723	R. H. MCormick	1998		43.9	62.2	18.3	57.9		19.81		24.1	18.3	2	0.98	85	0.98	85	
164	SE		23	49	28	W3	167393	5910345	Erwin Harder	1989	655	38.4	57.3	18.9	55.8		29.87	625.4	8.5	21.9	3	0.76	65	0.53	46	
165	SW		23	49	28	W3	166582	5910401	E X L Millings	1997		40.8	62.8	21.9	57.3									0.61	52	
166		13	25	49	28	W3	168186	5912931	Justamere Farms	1987	643	31.1	51.5	20.4	45.7		20.42	622.7	10.7	16.5	2	0.91	79	0.83	72	
167	SW	6	26	49	28	W3	166803	5912108	Eric Salt	1978	649	38.7	61.0	22.3	54.9	open		649.2	38.7							
168	SW	2	11	50	28	W3	167520	5916533	Rick Graham	1988	632	45.7	56.7	11.0	52.7		23.47	609.0	22.3	4.6	2	0.53	46	0.38	33	
169		4	23	50	28	W3	167044	5919919	Water Tarapacki	1980	632	41.1	52.7	11.6	51.2			632.5	41.1					0.45	39	
170	SW	4	25	50	28	W3	168669	5921318	Ken Greenway	1988	617	52.4	55.5	3.0	55.5		32.61	584.6	19.8	16.2	2	0.45	39	0.45	39	

Table 3 Water quality data for wells completed in the Ribstone Creek aquifer

Owner	QTR	LSD	SEC	TWN	RNG	MER	Extended Zone 13 Easting NAD83	Northing NAD83	Date Sampled	Depth	Ca	Mg	Na	K	Fe	Mn	CO_3	HCO_3	SO_4	Cl	NO_3 - NO_3	PO_4 - PO_4	F	pH	Cond	Sum	TH	TA	Cations	Anions	Error	Water Type	Source
										m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		µS/cm	mg/L	mg/L as $CaCO_3$		epm	epm	%		
	NW		18	47	23	3	207606.3	5887413		51.2	222	92	493					459	1358	156						2780	933	370	40.09	40.20	-0.11	Na-SO_4	GSC pre1964
Bob Stevenson	NW	12	30	47	23	3	207492.2	5890565	1/11/1996	55.5	111	64	470	8.7	7.1	0.14		709	815	127	0.01			7.70	2780	2312	541	581	31.47	32.17	-1.10	Na-SO_4	SRC
Cal Ballan		2	35	47	23	3	214976.8	5890826	1/11/1996	30.8	37	18	747	6.8	0.19	0.01		494	1130	158	0.17			7.99	3390	2591	167	405	36.00	36.08	-0.12	Na-SO_4	SRC
	SE		7	48	23	3	208866.2	5894643		57.9	179	81	300					657	721	108						2046	780	530	28.65	28.83	-0.33	Ca/Mg-SO_4/Cl	GSC pre1964
Bob Bullock	NE		28	48	23	3	212466.2	5900107	11/24/1998	27.7	138	75	237	8.8	1.2	0.13	1	639	535	108	0.04			7.96	2030	1740	653	524	23.59	24.69	-2.28	Ca/Mg-SO_4/Cl	SWC
Jerry Ducherer	NE	9	4	45	24	3	202651.2	5864955	11/29/1984	82.3	257	133	218	7.4	8.9	0.12		673	1050	37	0.03	0.01	0.25	7.21	2520	2385	1180	552	33.44	33.95	-0.75	Ca/Mg-SO_4/Cl	SRC
	SE		18	47	24	3	198580.6	5887156		51.2	100	57	573					552	1090	107						2479	484	445	34.61	34.76	-0.22	Na-SO_4	GSC pre1964
Walter Campbell	SE	1	19	47	24	3	198967.1	5888458	10/9/1996	48.2	131	82	302	12	0.17	0.03		570	852	28				7.31	2320	1977	665	467	26.73	27.87	-2.09	Ca/Mg/Na-SO_4	Husky/SRC
	NE		12	48	24	3	207285.7	5895545		64	67	46	438	10	1.4		27	440	712	136				8.4		1876	356	406	26.44	26.77	-0.64	Na-SO_4	ARDA 1964-65
Brent/Art Pinder	NW	8	18	49	24	3	199919.6	5906856	10/9/1996	22.9	107	39	428	7.4	0.1	0.04		669	766	56	9.48			7.47	2570	2082	428	549	27.36	28.65	-2.30	Na-SO_4	Husky/SRC
	NE		10	50	24	3	205231.2	5915148		50.3	183	62	208	9	6.2			687	565	16				7.71		1730	712	563	23.51	23.47	0.09	Ca/Mg-HCO_3/SO_4	ARDA 1964-65
Ted Klassen	SW	4	4	45	25	3	191413.5	5864639	11/29/1984	123.4	124	68	676	9.8	3.6	0.03		527	1480	116	0.005	0.01	0.27	7.59	3480	3005	586	432	41.44	42.74	-1.54	Na-SO_4	SRC
Norman Hallet	SE	8	23	45	25	3	196408.9	5869605	1/11/1996	118.9	213	104	508	12	5.6	0.11		483	1440	124	0.01			7.36	3380	2890	961	396	41.59	41.40	0.24	Na-SO_4	SRC
Grant Doolittle	NW	4	24	45	25	3	196599.9	5869391	11/26/1986	110.3	269	108	438	12	0.98	0.31		550	1540	74	0.03	0.09		7.41	3320	2992	1120	451	41.67	43.17	-1.77	Ca/Mg-SO_4/Cl	SRC
Gordon Goodfellow	NE	16	10	46	25	3	195260.8	5877181	11/26/1986	85.3	114	46	451	9.3	2	0.03		644	905	44	0.03	0.06		7.58	2570	2215	473	528	29.33	30.64	-2.19	Na-SO_4	SRC
	NW		21	47	25	3	191389	5890051		37.5	29	20	767					937	980	30						2762	155	755	36.46	36.61	-0.21	Na-SO_4	GSC pre1964
Bruce Hardy	NE	9	3	49	25	3	195064.2	5904331	11/4/1996	71.6	65	54	477	7.8	0.82	0.05		688	682	41				7.91	2430	2016	385	564	28.64	26.63	3.63	Na-SO_4	Husky/SRC
Darryl/Ed Winter	SE	8	8	49	25	3	191874.7	5905550	10/9/1996	54.9	138	61	160	6.4	0.1	0.3		620	459	11	1.76			7.86	1750	1458	596	508	19.03	20.06	-2.63	Ca/Mg-HCO_3/SO_4	Husky/SRC
	NE		14	49	25	3	196599	5907577		30.5	186	87	322					602	939	43						2178	822	485	30.45	30.63	-0.29	Ca/Mg-SO_4	GSC pre1964
Frank Turvey	NE	16	30	49	25	3	190630.9	5911519	10/9/1996	47.9	92	39	324	6.6	0.2	0.08		625	522	38	7.83			7.72	1990	1655	391	513	22.06	22.31	-0.56	Na-HCO_3/SO_4	Husky/SRC
Frank Turvey	SE		31	49	25	3	190358.5	5912042	10/9/1996	49	81	34	355	8.5	0.04	0.05		624	508	49	12.4			7.74	1980	1672	343	512	22.50	22.39	0.25	Na-HCO_3/SO_4	Husky/SRC
Viola Bowey	NW	16	26	41	26	3	186311.4	5833946	11/26/1986	128.3	6	1	404	2	0.38	0.01	79	572	1	239	0.03	1.44		8.59	1750	1306	172	492	18.01	18.82	-2.20	Na-HCO_3	SRC
Kerry Wells	SE	4	16	45	26	3	182069.9	5868495	11/2/1984	92	22	20	818	5.7	2.8	0.052		790	1230	81	0.005	0.06	0.16	7.91	3430	2970	648	142	38.47	40.85	-3.00	Na-SO_4	SRC
Kerry Wells	SE	4	16	45	26	3	182069.9	5868495	4/13/2000	96.6	22	19	844	3.9	2.1	0.058	25	750	1140	106	0.04			8.59	3610	2910	657	133	39.48	39.85	-0.47	Na-SO_4	SWC
Rawlyn Thiessen	NW	2	16	46	26	3	183332.6	5878360	11/2/1986	89.3	88	34	559	8.7	12	0.15		644	1080	12	0.03	0.01	0.14	7.7	2990	2438	384	528	31.73	33.39	-2.55	Na-SO_4	SRC
	SW		24	47	26	3	186441.6	5889564		30.5	183	98	99	12	9.6			568	590	9				7.7		1559	860	466	21.81	21.85	-0.07	Ca/Mg-SO_4	ARDA 1964-65
Paul Mihalich		7	30	47	26	3	179013.5	5891879	1/10/1996	22.6	91	43	365	8	1.2	0.054		601	648	29	0.06			7.63	2190	1786	405	493	24.16	24.16	0.00	Na-SO_4	SRC
	NW		5	48	26	3	180289.2	5895656		45.7	65	38	960	11	1			642	1800	21				8.1		3537	319	546	48.41	48.59	-0.20	Na-SO_4	ARDA 1964-65
	SW		5	48	26	3	180234.9	5894843		50.9	82	47	655	11	3.7			555	1290	24				7.8		2664	398	455	36.73	36.63	0.12	Na-SO_4	ARDA 1964-65
Guy Pierce	NE	5	15	49	26	3	184271.3	5907875	1/10/1996	20.7	87	46	402	5.8	0.31	0.037		631	692	34	1.20			7.79	2180	1899	407	517	25.76	25.73	0.07	Na-SO_4	SRC
Tim McDougall	SW	13	23	49	26	3	185839.7	5910001	1/11/1996	40.2	121	59	367	7.8	4.4	0.092		715	725	13	0.02			7.43	2300	2012	546	586	27.06	27.18	-0.23	Na-SO_4	SRC
Sam Rolheiser	SW	2	28	49	26	3	183429.7	5910566	1/10/1996	23.5	190	84	226	8.8	1.4	0.028		692	718	8	0.02			7.27	2100	1928	821	567	26.45	26.52	-0.13	Ca/Mg-SO_4	SRC
Norcen Energy Resources WSW B1-19		1	19	33	27	3	168602	5754157	7/25/1995	243.2	20	4	1010	5			19	278	3.05	1700	13.9		0.5	8.79	5700	3039	66	228	45.39	53.46	-8.16	Na-Cl	AGRA
Norcen Energy Resources WSW B2-19		2	19	33	27	3	168195	5754184	8/28/1995	235.1	15.9	3.7	1140	6.8	0.2	<0.05	10	361	1.2	1520	12.4		0.5	8.4	5880	3059	55	296	50.86	49.38	1.48	Na-Cl	AGRA
	SE		6	44	27	3	169104.9	5856679		87.5	4	1	385	4			44	803	142	9				8.43		1392	14	732	17.13	17.84	-2.03	Na-HCO_3	ARDA 1964-65
Arlayne Dairy	SE	8	6	44	27	3	169418.2	5856761	11/1/1984	75.6	5	1	362	2.2	12	0.09	29	738	136	12	4.43	0.46	0.09	8.31	1500	1270	17	653	16.14	16.32	-0.58	Na-HCO_3	SRC
Arlayne Dairy	SE	8	6	44	27	3	169418.2	5856761	10/23/1970	75.6	6.4	1	383	4	0.2	0	22	783	195	12	1	1	0	8.35	1490	1407	20	678	17.16	18.01	-2.41	Na-HCO_3	SRC
Thomas/James Gray	NE	14	16	44	27	3	172154.2	5860845	11/26/1986	63.7	39	25	310	6.2	0.25	0.01		579	357	56	0.02	0.06		7.82	1690	1373	204	474	17.65	18.50	-2.37	Na-HCO_3/SO_4	SRC
Town of Marsden Well No.6	NW	13	35	44	27	3	175126.4	5865506	3/31/1987	73.5	99	95	215		6.2	<0.01		653	580	4				7.5		1646	639	535	22.11	22.89	-1.74	Ca/Mg-SO_4	PFRA
Town of Marsden Well No.6	NW	13	35	44	27	3	175126.4	5865506	4/1/1987	73.5	93	93	216		1.7	<0.01		655	570	6				7.6		1633	616	537	21.69	22.77	-2.43	Ca/Mg-SO_4	PFRA
Town of Marsden Well No.5	SW	4	2	45	27	3	175139.2	5865707	4/15/1981	68.2	146	83	205		4.3	0.01		625	675	14				7.6		1748	707	513	23.03	24.69	-3.48	Ca/Mg-SO_4	PFRA
Town of Marsden Well No.5	SW	4	2	45	27	3	175139.2	5865707	4/15/1981	68.2	155	86	225		2.9	<0.01		654	720	14				7.5		1854	742	536	24.60	26.10	-2.97	Ca/Mg-SO_4	PFRA
Neil Tindal	SW	5	25	45	27	3	177228.9	5872472	1/11/1985	90.1	63	41	640	8.1	2.9	0.07		666	1140	44	0.04	0.03	0.56	7.73	3060	2606	323	546	34.56	35.92	-1.93	Na-SO_4	SRC
David Cunningham	SW	8	27	45	27	3	175195.8	5872609	11/29/1984	46	80	36	739	7.4	4.4	0.62		615	1360	26	0.03	0.01	0.12	7.6	3590	2869	346	504	39.29	39.14	0.20	Na-SO_4	SRC
William Findley	NW	16	9	47	27	3	172524.5	5888357	10/2/1996	38.4	82	49	558	6.1	0.04	0.01	38	595	983	12	1.50			8.20	2930	2325	407	488	32.55	31.85	1.10	Na-SO_4	Husky/SRC
Gerald Lamb	NW	6	10	47	27	3	173286.3	5887497	1/11/1996	64	37	18	620	5.5	0.32	0.003		619	928	15	0.06			8.00	2730	2243	167	508	30.44	29.89	0.91	Na-SO_4	SRC
Gerald Lamb	NW	6	10	47	27	3	173286.3	5887497	10/2/1996	64	31	19	612	5.5	0.16	0.01	29	585	871	14	0.50			8.18	2800	2167	156	480	29.87	29.09	1.32	Na-SO_4	Husky/SRC
	SE		10	47	27	3	173979.4	5887147		39.6	86	50	43					546	66	5						796	420	440	10.28	10.46	-0.92	Ca/Mg-HCO_3	GSC pre1964
	SW		15	47	27	3	173273.3	5888814		29	29	11	592					589	877	11						2109	118	475	28.10	28.22	-0.23	Na-SO_4	GSC pre1964
Blair Saretzky/Bill Sinfield	SW		18	47	27	3	168375.9	5889149	10/2/1996	36.9	89	50	390	7.3	0.08	0.02		658	709	9	13.3			7.81	2350	1926	429	540	25.71	26.01	-0.59	Na-SO_4	Husky/SRC
J.W. Anderson		6	30	47	27	3	168818.1	5892572	1/10/1996	49.7	132	66	210	7.1	2	0.013		698	480	7	0.08			7.43	1800	1602	602	572	21.33	21.63	-0.69	Ca/Mg-HCO_3	SRC
Murray Martin	SE	8	33	47	27	3	173100.7	5893806	1/10/1996	68.9	14	7.1	330	2.9	0.17	0.008		592	261	7	0.03			8.07	1470	1214	64	485	15.71	15.33	1.21	Na-HCO_3	SRC
Bill Noyes	SW	1	15	48	27	3	174830	5898149	10/2/1996	51.8	16	7.5	429	3.6	0.05	<0.01		580	474	55	4.30			7.92	2000	1569	71	476	20.17	21.00	-2.01	Na-SO_4/Cl	Husky/SRC
Petro Canada Cactus LK Prod Well		16	27	35	28	3	163298.7	5776854	7/21/1985	232.3	28.1	5.7	1320	4.3	0.1			390	2	1850				8.1	6370	3600	94	320	59.40	58.62	0.66	Na-Cl	CGL
Murphy Oil WSW-13D16		16	19	36	28	3	158958.8	5785266	11/10/1996	238.1	22.2	5.8	1360	5.3				359	1.5	1950	0.05			8.2	6320	3704	79	294	60.88	60.93	-0.04	Na-Cl	Golder
Hen Lea Farms	NW	3	2	45	28	3	165786.1	5866515	11/26/1986	39.3	6.3	1.4	425	2.5	0.03	0.01	38	461	510	8	3.54	0.25		8.3	1810	1456	21	442	18.98	19.73	-1.94	Na-SO_4	SRC
Kenneth/J Waring	SW	2	12	46	28	3	168589.4	5877524	11/29/1984	42.1	108	66	167	6.6	2.3	0.04		615	392	5	0.04	0.01	0.24	7.47	1630	1362	528	504	18.25	18.40	-0.39	Ca/Mg-HCO_3	SRC
	NW		26	46	28	3	166867.1	5883610		51.8	64	20	604					509	800	221						2218	242	410	31.11	31.23	-0.21	Na-SO_4	GSC pre1964
Charles Raymond Knowlson	NE	8	2	47	28	3	166034.1	5886389	10/2/1996	58.1	136	57	32	7.6	0.04	0.73		522	256	6.5				7.35	1163	1018	575	428	13.06	14.07	-3.71	Ca/Mg-HCO_3	Husky/SRC
	SE		36	47	28	3	167897.1	5894062		36	122	59	98					509	328	8						1124	547	410	15.21	15.40	-0.65	Ca/Mg-HCO_3	GSC pre1964
	NW		13	48	28	3	167475.1	5899777		35.7	14	9	460					496	595	37						1611	72	400	21.45	21.56	-0.26	Na-SO_4	GSC pre1964
Walter Tarapacki	SW	4	23	50	28	3	166935.4	5919825	10/9/1996	51.2	86	38	279	4.2	0.08	0.84		571	409	65	1.89			7.64	1790	1455	372	468	19.66	19.74	-0.19	Na-HCO_3/SO_4	Husky/SRC

TH = Total Hardness

TA = Total Alkalinity

Table 4 Drillstem test water quality data for the Ribstone Creek aquifer

LSD	Sec	Tp	Rg	M	Extended Zone 13 Easting	Northing	DST #	QUALITY	COMMENTS	TOP m	Bottom m	FORMATION	Ca mg/L	Mg mg/L	Na mg/L	Na+K mg/L	K mg/L	Fe mg/L	CO3 mg/L	HCO3 mg/L	SO4 mg/L	Cl mg/L	pH	Sum mg/L	Water Type	Temp C	SP.Gr	Comments
11	36	32	22	3	224440.39	5745091.7	2	GOOD	Bottom	229.8	235.9	RIBSTONE CK.	34	2	1194			1	19	381	64	1617	8.4	3312	Na-Cl	23.3	1.001	Filtrate recovered from sample containing approx. 5% sediment
1	33	28	23	3	210098.70	5706229.49	3	GOOD	Bottom	210.3	217	RIBSTONE CK.	41	56	1780			1	10	366	132	2658	8.5	5044	Na-Cl		1.0035	
1	2	22	24	3	203159.45	5640063.45	1	GOOD	10' above tool	216.4	231.6	RIBSTONE CK.	26	10		1019		1		537	13	1323	8.25	2929	Na-Cl		1.003	
11	27	36	24	3	202193.48	5783705.64	2	GOOD	Top of Tool	228.6	237.7	RIBSTONE CK.	273	6		1404		1	29	39	40	2580	8.9	4372	Na-Cl		1.0037	
6	16	37	24	3	200931.58	5789865.69	2	GOOD	Top of Tool	182.9	191.1	RIBSTONE CK.	18	8	1003		9	1		366	135	1298	8.2	2838	Na-Cl	23	1	Filtrate recovered from muddy water containing trace hydrocarbons
10	32	29	25	3	189166.83	5718014.59	2	GOOD	60' above test tool	233.5	239.3	RIBSTONE CK.	37	9		1779			50	285	15	2600	8.7	4775	Na-Cl		1.006	Sample appears to be a mud filtrate contaminated with fresh water
10	32	29	25	3	189166.83	5718014.59	2	GOOD	Just above tool	233.5	239.3	RIBSTONE CK.	30	8		1735			67	260	31	2500	3.9	4631	Na-Cl		1.006	Sample appears to be a mud filtrate contaminated with fresh water
10	22	30	25	3	192812.57	5724287.62	2	GOOD	Bottom	216.1	225.9	RIBSTONE CK.	16	15	1425		5	1		598	184	1875	8.2	4119	Na-Cl	24	0.998	Filtrate recovered from sample containing approx. 50% sediment
6	30	36	25	3	187513.87	5784194.29	4	GOOD	Top	191.1	199	RIBSTONE CK.	12	7		891		1	54	488	357	805	8.6	2615	Na-Cl	24	0.998	Filtrate recovered from watery mud
12	27	3	26	3	177349.40	5463782.1	3	GOOD	Top of Tool	424.6	440.4	RIBSTONE CK.	8	8	1983			1		776	54	2605	8.2	5435	Na-Cl	25.5	1.008	Filtrate recovered from water containing approx. 5% sediment
12	27	3	26	3	177349.40	5463782.1	8	GOOD	Bottom	431.6	435.9	RIBSTONE CK.	17	8	1891			1	29	500	16	2634	8.4	5096	Na-Cl	24.4	1.008	Filtrate rec'd fr water cont thin layer of sediment
4	35	3	26	3	179029.19	5464497.1	1	GOOD	Bottom hole sampler	449.8	465	RIBSTONE CK.	58	8	1850		21	1	24	317	126	2540	8.25	4945	Na-Cl	25	1.001	
10	24	4	26	3	181896.56	5471629.08	1	GOOD	Top of Fluid	560.8	614.2	RIBSTONE CK.	10	1	3476				1	6408	1500	550	8.5	11946	Na-Cl	25	1.017	Filtrate recovered from mud
7	27	30	26	3	183148.18	5726099.45	2	GOOD	Middle	229	234	RIBSTONE CK.	9	3	850		38			362	93	1087	7.8	2442	Na-Cl		1.0036	
10	23	36	26	3	184587.50	5783162.11	6	GOOD	At tool	199.9	205.1	RIBSTONE CK.	20	7	1114		1	1		451	245	1488	8	3327	Na-Cl	25	1	Filtrate recovered from sample containing approx. 50% sediment
10	12	37	26	3	186625.30	5789529.68	2	GOOD	Bottom hole sampler	210	215	RIBSTONE CK.	16	3	1000		40	2		415	22	1220	7.68	2718	Na-Cl	25	0.997	
5	3	39	26	3	181847.79	5807339.54	1	GOOD	Mud Tank	171.9	182.9	RIBSTONE CK.	28	10	1099		31	1	336	1202	463	393	9.3	3563	Na-Cl	23	0.997	Filtrate recovered from muddy water
5	3	39	26	3	181847.79	5807339.54	1	GOOD	Middle	171.9	182.9	RIBSTONE CK.	8	8	1122		31			1068	303	828	8.9	3368	Na-Cl	24	0.997	Filtrate recovered from muddy water
11	18	31	27	3	166447.63	5733990.38	2	GOOD	Top	230.1	235.9	RIBSTONE CK.	14	24	1460		1	1		360	127	2198	8.3	4185	Na-Cl	23	1	Filtrate recovered from sample containing approx. 70% sediment
8	28	31	27	3	170723.44	5736550.59	1	GOOD	Bottom hole sampler	205	211.1	RIBSTONE CK.	7		1600		9		24	374	69	2144	8.8	4227	Na-Cl		0.9994	
7	34	32	27	3	172688.51	5747795.17	5	GOOD	Bottom	242.9	253.9	RIBSTONE CK.	14		869		3	1	60	586	38	965	8.9	2536	Na-Cl	24	0.998	Filtrate recovered from muddy water
7	16	2	28	3	158021.35	5451552.11	1	GOOD	Bottom hole sampler	330	331	RIBSTONE CK.	621	90	2140		12100	305		3	1000	13900	4.57	30159	K-Cl	25	1.02	
10	32	2	28	3	156725.22	5456909.55	3	GOOD	Bottom	340.5	345	RIBSTONE CK.	65	14	1520		25			596	2550	1740	7.61	6510	Na-SO_4	25	0.992	
10	32	2	28	3	156725.22	5456909.55	1	GOOD	Bottom	342	346.5	RIBSTONE CK.	69	19	1740		28			442	2810	1670	8.01	6778	Na-SO_4	25	0.997	
11	19	18	28	3	156647.67	5609620.75	1	GOOD	Top	228.6	239.6	RIBSTONE CK.	20	1		676			48		86	955	9.4	1786	Na-Cl	24	1.006	Filtrate recovered from sample containing approx. 50% sediment
14	21	21	28	3	159884.61	5639063.4	1	GOOD	Bottom hole sampler	203	219	RIBSTONE CK.	373	0.5	217		55.1	0.1	0	30.5	1290	110	7.92	2076	Ca-SO_4	25	0.994	Opening pressure was nil and the recovery was 1l of water.
10	1	34	28	3	166942.96	5759949.91	1	GOOD	Top of Tool	259.1	265.2	RIBSTONE CK.	16	9	1323			1	54	433	91	1713	8.9	3640	Na-Cl	22.2	1.002	Filtrate recovered from sample containing trace sediment
11	9	38	28	3	162480.26	5800870.15	1	GOOD	Bottom	167.6	176.8	RIBSTONE CK.	16	4	1289			1	18	390	109	1700	8.6	3527	Na-Cl	26.7	1.003	Filtrate recovered from sample with thin layer of sediment
11	12	38	28	3	167351.88	5800537.86	2	GOOD	Bottom hole sampler	198	203	RIBSTONE CK.	4	2	380		7		12	274	133	399	8.5	1211	Na-Cl		0.9974	NaCl EQUIV. 949
4	17	40	28	3	160197.00	5821496.00	1	GOOD	Bottom	137	171	RIBSTONE CK.	4	1	707		17		99	383	113	765	9.23	2089	Na-Cl	25	0.999	
10	36	2	29	3	153479.58	5457111.21	2	GOOD	Bottom hole sampler	312.5	316.6	RIBSTONE CK.	328	73	2400		4880			355	106	8520	7.92	16662	Na-Cl	25	1.01	
10	21	18	29	3	150560.80	5610023.92	1	GOOD	Top	224	231	RIBSTONE CK.	48	32	2827		1134	1	60	885	2111	3525	8.9	10623	Na-Cl	24	1.004	Filtrate recovered from watery mud

Source: Saskatchewan Energy and Mines

Table 6 Reported water comsumption data for the Town of Marsden

Year	Jan m^3	Feb m^3	Mar m^3	Apr m^3	May m^3	Jun m^3	Jul m^3	Aug m^3	Sep m^3	Oct m^3	Nov m^3	Dec m^3	Annual m^3
1985	2540	2480	2890	4010	3170	3090	4370	3900	2540	2960	2460	2190	36600
1986	2130	2450	2440	2490	2630	3270	3380	2840	2990	2590	2470	2140	31820
1988	2269	2121	2422	3520	4663	4610	3025	2425	2506	1880	1999	1930	33370
1989	2017	2071	2247	2132	3344	2557	3255	0	2261	2317	1776	2196	26173
1990	1718	1469	1653	1865	11625	3373	2851	2316	2544	3585	1677	1987	36663
1991	2468	2008	2085	2600	2476	3256	3419	4789	3252	2758	2296	2248	33655
1992	2254	1945	2200	2274	3049	4099	3915	3814	2705	3203	2359	2613	34430
1993	2416	2456	2317	2282	3341	3279	2139	2560	3203	2705	2055	2037	30790
1994	2076	1765	2063	2004	3257	2823	3304	3390	3831	2694	2283	2362	31852
1995	2300	1993	2290	2359	3771	4020	3393	2767	3310	3190	2087	2239	33719
1996	2415	2385	2469	2375	2599	2792	2368	3702	2529	2278	2145	2196	30253
1997	2395	2105	2678	2434	2350	2714	3890	3167	2353	2193	2038	3046	31363
1998	2232	1927	2272	2651	3951	3932	3315	4761	3598	2683	2933	2502	36757
1999	2414	2272	2225	2516	2891	3727	2673	2628	2847	3130	2372	2520	32215
2000	2522	2660	2416	2692	3507	3307	3033	2968	2706	2965	2715	2980	34471
											Annual average		32942

Source: Saskatchewan Water Corporation, February, 2002

Table 7 Withdrawals from the Ribstone Creek aquifer by the oil industry

LSD	Sec	Twp	Rge	M	UTM Coordinates Easting	Northing	Year	january	february	march	april	may	june	july	august	september	october	november	december	Total m³	Cumulative m³	Hours Pumped	Rate m³/day
					Ext Zone 13 Nad83																		
6	14	31	22	3	221984.2	5730216.5	1972	95.4	0	0	0	0	0	0	0	0	0	0	0	95.4	95.4	480	4.8
5	4	35	26	3	179554.9	5768474.2	1990											67	190	257	257		
							1991	0	0	0	0	103	8750	7450	3150	1133	3707	5100	9223	38616	38873		
							1992	4509	5260	2529.7	3727	7193	9320	9318	8781	7601	8399	7748	7322	81707.7	120580.7		
							1993	7654	6860	7283	6918	6952	2268	335	81	111	2777.5	241	8935	50415.5	170996.2		
							1994	5008	7062	6160	9584	9641	8319	10156	8976	9218	9554	8275	7271	99224	270220.2		
							1995	8936	8148	8685	7748	8318.3	7383	8062	7132	7249	8148	7679	7698	95186.3	365406.5		
							1996	8293	8029	8746	7832	6517	7575	8838	9109	9160	9091	8141	5991	97322	462728.5		
							1997	6155	8597	8327	6496	8720	8220	9042	7881	6857	7314	8723	9109	95441	558169.5		
							1998	8887	8064.9	8558.9	8546.9	8052.6	7841.1	8319.6	7600.1	7767.6	8523	8092.8	8420.6	98675.1	656844.6		
							1999	7824	7394.6	8197.5	8165.8	8771.4	7785.7	8414.3	7614.9	8481.4	9101.6	8659.1	8887.2	99297.5	756142.1		
							2000	8846.2	8074.5	8725.7	7695.4	8900.9	7961	7748.6	7692.4	8599.2	8902.5	7551.2	8655.1	99352.7	855494.8		
							2001	8318.8	7935.7	6616.2	7494.7	8335.9	8563.6	8505.1	8548.2	8416				72734.2	928229	78330	284
11	5	35	26	3	178355.9	5768954.2	1989										745	0	0	745	745		
							1990	0	2911.5	1138	36	0	0	0	0	0	67	0	0	4152.5	4897.5		
							1991	0	0	0	0	9974	6763.5	15424.2	4836.3	3787	7288	14668	7156	69897	74794.5		
							1992	3267	6821	15687.9	10739	2601	5793.8	11298	6611.5	8461.3	4798	3774.5	1063	80916	155710.5		
							1993	2406	3607	3204	1490	2770	8863	9356	8906	9206	7069	9998	1182	68057	223767.5		
							1994	4176	1617	3671	615	587	760	530	737	1086	1116	1274	1620	17789	241556.5		
							1995	61	0	202	594	498	425	96	0	176	0	386	298	2736	244292.5		
							1996	28.5	0	190	0	0	577	1196	1939	1725	1781	1166	1359	9961.5	254254		
							1997	1428	1550	1887	958	839	498	938	1105	1445	1391	1459	1059	14557	268811		
							1998	2214	2765.4	2078.3	999.4	1781.1	1549.8	1438.4	1624.4	1471.7	1439.4	896	524.1	18782	287593		
							1999	484.4	736.8	1810.8	877.2	840.3	588	1082.3	5681.9	5800.1	4801.3	2372.9	3631.5	28707.5	316300.5		
							2000	3791.8	3777.9	2702.3	6181	3854.6	5998	3815.2	3734.3	4081.4	4015.5	5205.1	4733.4	51890.5	368191		
							2001	5558.3	4485.4	10286.6	9226	8136.1	7329.9	8466.1	8002.6	7396.2				68887.2	437078.2	48990	214
1	9	35	26	3	180856.5	5769600.2	1989			548.2										548.2	548.2	96	137
12	34	31	27	3	171264.7	5738546.4	1973		1214.9	2938.1	4368	3722.5	3486.9	4720.9	5179.4	5522.2	4081.8	4390.2	3275.8	42900.7	42900.7		
							1974	4702.6	4551.6	4360.2	4875.8	5740	2023.8	2244.8	932.4	0	0	0	0	29431.2	72331.9		
							1975	0	0	0	0	2713.2	481.6	1013.5	0	0	0	914.1	0	5122.4	77454.3		
							1976	0	0	0	230.5	2364.4	0	0	0	1903.5	4359.4	3952.4	0	12810.2	90264.5		
							1977	0	0	0	0	0	1012.1	0	134.7	295.2	250.6	0	0	1692.6	91957.1		
							1978	0	0	0	52.3	967.9	235.8	0	0	470.9	0	0	0	1726.9	93684	19584	115
4	3	32	27	3	171318.1	5739352.7	1970								1801.4	5592.3	5664.6	5665.1	5737.7	24461.1	24461.1		
							1971	6706.3	5967.3	5871.4	4327	4962.4	4236.2	4404.2	2338.1	1517.3	203	1247.8	4844.3	46625.3	71086.4		
							1972	5576.1	4338.2	4652.9	3907.1	2930.6	2324.3	1461.5	1497.6	1171.5	1093.8	329.4	618.8	29901.8	100988.2		
							1973	427	3529.4	3591	3615	3699.6	3606.3	5115.8	4088	4480.1	4385.5	3735.2	493.6	40766.5	141754.7		
							1974	0	1085	3534.6	4199.8	5019.6	1729.7	1469	3179.1	442.8	0	0	0	20659.6	162414.3		
							1978	0	0	0	0	0	0	0	0	0	0	81.9	0	81.9	162496.2		
							1993				2611	5179	5048	4783	4903	3884	5345	3635	4575	39963	202459.2		
							1994	4813	4374	4059	4817	4346	3635	4290	4292	3772	4795	2907	3801	49901	252360.2		

Table 7 Withdrawals from the Ribstone Creek aquifer by the oil industry

LSD	Sec	Twp	Rge	M	UTM Coordinates Easting Ext Zone 13 Nad83	Northing	Year	january	february	march	april	may	june	july	august	september	october	november	december	Total m^3	Cumulative m^3	Hours Pumped	Rate m^3/day
							1995	3177.8	2475.9	3146.2	6742	9803	10886	11750	10233	11991.1	10516	8231.8	4973	93925.8	346286		
							1996	4824	3965.1	3907	2004.6	1242.3	3278.4	5780.7	3271.1	2185.1	0	0	0	30458.3	376744.3	64152	141
2	4	32	27	3	170500.7	5739406.1	1973										3981.7	4013.5	3891	11886.2	11886.2		
							1974	5151.7	3295.7	2818.7	4545.2	4086.1	1200.8	2937.2	2338.6	1019.9	428.8	109.2	591.1	28523	40409.2		
							1975	2327	3886.6	3690.4	3776.4	973.6	1862.3	2085.7	778.2	1313.5	1181.7	1025.1	236.1	23136.6	63545.8		
							1976	0	63.1	979.5	2962.8	3356.7	1728.4	2096.9	897.3	1473.4	3468.8	294.7	0	17321.6	80867.4		
							1977	0	0	0	0	2461.5	2576.1	0	3168.6	2701.5	1244.2	3227.1	3858.8	19237.8	100105.2		
							1978	2771.3	3133.3	2292.5	3211.2	2561.2	2291.7	2466.4	1598.1	2206.6	918.7	625	0	24076	124181.2		
							1981	0	0	0	0	0	0	0	12	0	30	0	0	42	124223.2		
							1982	0	0	0	0	0	0	0	0	20	0	0	0	20	124243.2	29256	102
1	19	33	27	3	168602.4	5754157.4	1996		3898.3	3898.3	2029.5	1791.9	1197	654.3	633.6	1311.3	1005.6	866.2	3630.4	20916.4	20916.4		
							1997	3090.3	766.6	1482.9	636.5	205.2	63.6	156.9	267	1261.6	20	442.7	452.6	8845.9	29762.3		
							1998	31.2	209.8	485.4	753.4	1673.2	1374.5	1150.1	974.7	331.3	399.4	520.9	988.2	8892.1	38654.4		
							1999	1560.6	1535.7	2321	2622.4	2496.9	3043.5	3303	1570.7	490.3	2432.7	2236.9	1932	25545.7	64200.1		
							2000	2395.1	1734.8	1746.6	610.8	762.9	1339.3	1589.8	1506.7	710.3	0	0	0	12396.3	76596.4		
							2001	0	0	0	0	157	816	668	215	68				1924	78520.4	12781	147
2	19	33	27	3	168194.7	5754184.1	1996		2873.9	2873.9	4231.8	4573.8	3266.1	1375.2	1743.3	3084.3	3161.2	2082.5	1116	30382	30382		
							1997	217.6	343.4	3.4	6.8	0	10.2	28.9	11.1	131.8	0	69.7	5.8	828.7	31210.7		
							1998	0	19.4	5.7	9.9	15.2	21.1	10.4	24.5	0	0	43.1	0	149.3	31360		
							1999	0	0	0	0	11.5	0	0	0	0	0	0	0	11.5	31371.5		
							2001	0	0	0	0	903	2342	2263.8	1889	1184				8581.8	39953.3	8514	113
12	32	33	27	3	169277.3	5758168.6	2000								1432	5073	9782	11754	12601	40642	40642		
							2001	10749	5429	6416	5030	3857	3946	2289	2334	3212				43262	83904	8920	226
11	25	33	27	3	176093.7	5756100.5	1988							823	207	0	0	0	1939	2969	2969		
							1989	2680	2466	2656	2715	4798	5988	6034	6006	4882	4882	4354	4570.9	52031.9	55000.9		
							1990	5320	1476	5657	2636	5336	4516	3269	2336	2573	5426	3393	4732	46670	101670.9		
							1991	3594	2928	2080	65	0	0	0	0	0	0	0	0	8667	110337.9		
							1994	0	0	0	0	3367	793	3856	4164	780	3693	0	0	16653	126990.9		
							1995	0	334	0	0	0	2743	991	0	0	0	0	0	4068	131058.9		
							1996	2084	3788	3787	3611	3645	3021	4334	3679	2384	2506	1825	1310	35974	167032.9		
							1997	1743.7	0	0	496	208	0	34	0	0	0	0	0	2481.7	169514.6		
							1998	0	0	0	0	772	4547	348	0	0	0	0	0	5667	175181.6		
							1999	0	0	0	0	0	0	0	0	0			4343	4343	179524.6		
							2000	3611.5	4233.2	3045.7	2894.3	1500	2791.5	1941.8	14051.1	158.2	1595	2019	291	38132.3	217656.9	40789	128
1	35	33	28	3	165562.9	5757608.4	1988						1091	19341.7	18149.3	21077.6	22936.8	22815.2	27509.7	132921.3	132921.3		
							1989	18413.1	20472.5	21090.6	25507.2	21925.1	15330.7	14881.4	18861.4	16228.7	22320.9	18160.8	19481.5	232673.9	365595.2		
							1990	16842.6	12868	13635	14094	14800	16191	17473	19391	17314	15898	15783	18019	192308.6	557903.8		
							1991	14266	14990	16666	12877	10100	13495	14640	14679	13529	14751	14927	14725	169645	727548.8		
							1992	13092	14338	16842	14930	15521	10560	9384	13312	14390	11725	7575	13922	155591	883139.8		
							1993	9830	5080.9	5013.4	8760	11918.5	12761.4	8169.4	10150.7	9818.2	12030.2	9238.4	16156.9	118928	1002067.8		

Table 7 Withdrawals from the Ribstone Creek aquifer by the oil industry

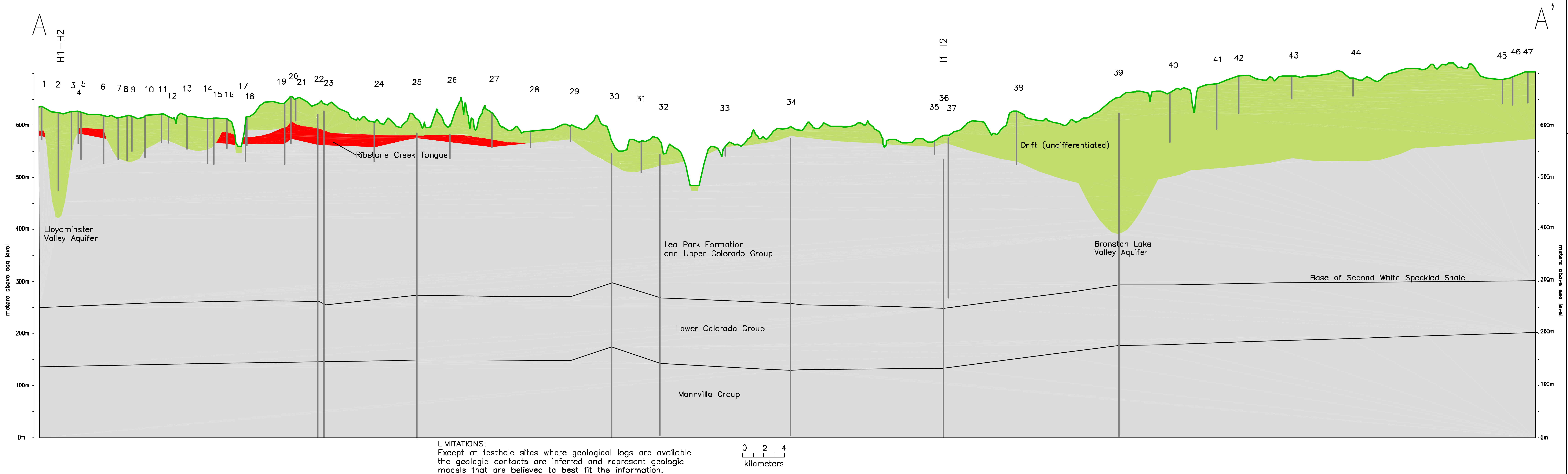
LSD	Sec	Twp	Rge	M	UTM Coordinates Easting Ext Zone 13 Nad83	Northing	Year	january	february	march	april	may	june	july	august	september	october	november	december	Total m^3	Cumulative m^3	Hours Pumped	Rate m^3/day
							1994	5326.3	6783.4	10532.2	20869	21394	18721	14672	18617.2	17980	15635	12875	17015	180420.1	1182487.9		
							1995	15005	17340	22131	21885	24824.2	17681	12593	23533.5	21559	19932	19784.8	20706.9	236975.4	1419463.3		
							1996	21861	10804	9638	21667	17896	7389	7408	5533	5729	15960	4336.3	4953	133174.3	1552637.6		
							1997	8530.3	4296	6374	7702	0	8762.4	7909	0	0	5419	3669.4	0	52662.1	1605299.7		
							1998	6945	4371	7611	8639	4215	7736	18128	9299.2	3333	1774	0	0	72051.2	1677350.9		
							1999	11516	16076	10856	11668	12490	13477	10870	2875	14843.8	18174.6	21174.8	21720.1	165741.3	1843092.2		
							2000	21386.5	14719	13334.1	14810.7	13182.8	18351.1	15967.8	0	10183.2	9197.6	13803	536	145471.8	1988564		
							2001	0	0	0	2278	2862	5899	6354	7676.2	13907				38976.2	2027540.2	101345	480
1	27	35	28	3	163216.8	5775633.5	1998								4596	3509	0	0	0	8105	8105	964	202
16	27	35	28	3	163298.7	5776853.5	1988						6821	7761	0	10838	21297	20830	21953	89500	89500		
							1989	22033	19437	21827	20614	22172	21612	21464	21093	20313	21612	20630	21575	254382	343882		
							1990	21595	19276	21025	20752	20609	20023	19047	16997	18738	17104	17780	18531	231477	575359		
							1991	19323	17178	19381	18440	17987	17776	18616	15999	17012	17237	15980	15147	210076	785435		
							1992	12322	16784	16037	13175	0	8756	17371	16654	16497	16851	16811	17513	168771	954206		
							1993	17391	14747	15977	17119	17098	15084	17130	16719	16321	16971	7651	16265	188473	1142679		
							1994	13163	8773	13551	13838	13329	11911	12338	12379	11280	10461	11889	10635	143547	1286226		
							1995	10361	8859	11218	10017	6488	5353	2581	1876	1332	0	910	4171	63166	1349392		
							1996	4328	3169	3157	3584	7446	5301	6986	7067	4039	933	0	2911	48921	1398313		
							1997	2695	4378	6167	8470	6173	8868	6493	3204.2	2045	65	0	3977	52535.2	1450848.2		
							1998	15842	7102	5234	5989	9154	7790	4192	0	3939	381	0	0	59623	1510471.2		
							1999	0	771	0	0	0	0	0	0	0	0	0	0	771	1511242.2		
							2001							877	6173	0				7050	1518292.2	82379	442
11	35	35	28	3	164195.9	5778006	1988		55	845	0	418	0	6909.5	7240.4	5191.1	5462.9	7082.1	6960.9	40164.9	40164.9		
							1989	6663.7	5334.5	5748.5	5360.6	5100.5	4892.1	5079.5	4826.8	4049.1	4334.6	3783.2	3730.7	58903.8	99068.7		
							1990	4254.9	3608.9	3918.8	3863.8	4356.8	4260.2	1803.9	2534.1	2405.7	2639.1	2415.8	2865.9	38927.9	137996.6		
							1991	2742.7	1901.8	3700.9	3273.8	3142.3	3100.7	2792.9	2294.8	2251.2	1678.8	1572.2	2436.4	30888.5	168885.1		
							1992	2189.8	1984	2407.7	2281.5	2118.5	1904.2	1258.3	1654.1	2120.1	1813.1	1309.4	2503.7	23544.4	192429.5		
							1993	2894.1	1908.9	1923.9	3644.6	1331.6	743.1	321	30.8	7.8	283.6	603.9	359.1	14052.4	206481.9		
							1994	449	320.6	762.3	926.2	0	0	0	0	0	0	0	0	2458.1	208940	49987	100
11	16	36	28	3	161264.7	5783082.8	1993				5263.7	6115.4	5241.2	5572.5	5727	5143	5698.8	3842.5	2853	45457.1	45457.1		
							1994	3402	5070.6	5153	6118	7454.9	7647	7267	6356.3	6152	6727.8	6562.8	7343.7	75255.1	120712.2		
							1995	6553	6667.9	6419	6860	7522	7418.2	7634.8	8096.3	7735.7	7161	3459	0	75526.9	196239.1		
							1996	0	0	0	0	0	0	0	0	0	0	4689	5313	10002	206241.1		
							1997	4338	4493	1107	0	0	0	0	0	0	0	0	0	9938	216179.1	26379	197
11	16	36	28	3	161264.7	5783082.8	1992						2478.3	4519	5501.5	6289.5	6561	6050	6570	37969.3	37969.3		
							1993	6560.7	5910.4	6643.6	6488.4	5612	3210.9	2789.5	0	0	0	0	0	37215.5	75184.8		
							1994	0	0	0	0	1778.1	2884	2739	4083.7	3928	4139.2	3932.2	3902.3	27386.5	102571.3		
							1995	3619	4367.1	4100	4086	4797	4477	2435.3	0	0	0	0	0	27881.4	130452.7	20123	156
13	16	36	28	3	160885.8	5783518.2	1995	2135.7	2247.3	2821	2721	2663	2720.5	2409	2699	2921	3045	3587	3381	33350.5	33350.5		
							1996	3937	2465	4820	5449	5362	5755	4453	2928	5155	3923	4068	4270	52585	85935.5		

Table 7 Withdrawals from the Ribstone Creek aquifer by the oil industry

LSD	Sec	Twp	Rge	M	UTM Coordinates Easting Ext Zone 13 Nad83	Northing	Year	january	february	march	april	may	june	july	august	september	october	november	december	Total m^3	Cumulative m^3	Hours Pumped	Rate m^3/day
							1997	4994	2825	2781	3290	3522	3082	2941	3157	3097	3237	0	3186	36112	122047.5		
							1998	1992	0	0	0	0	0	0	0	0	0	0	0	1992	124039.5	25279	118
16	19	36	28	3	158958.8	5785266.5	1997				3506.9	7477.1	8820.3	9408.1	21319	21556	22124	8939	14594	117744.4	117744.4		
							1998	14375	8612	0	0	0	0	0	0	0	0	0	0	22987	140731.4		
							1999	0	0	0	0	0	0	0	0	0	0	7310	10949	18259	158990.4		
							2000	11114	13135	15523	12989	13012	12692	12935	12865	15472	9166	3130	0	132033	291023.4	16680	419
8	20	36	28	3	160532.9	5784352.2	1996						988	7419	7396	6847	7008	5592	6062	41312	41312		
							1997	4591	4612	2737	3603	3834	3781	3730	3157	3027	2928	0	3761	39761	81073		
							1998	3799	962	0	0	0	0	0	0	0	0	0	0	4761	85834	13218	156
12	30	36	28	3	157821.8	5786568.5	1997					882.3	0	2817.9	0	0	1748	0	0	5448.2	5448.2		
							2000	0	0	0	0	0	0	0	0	0	13536	13617	7035	34188	39636.2		
							2001	14500	0	0	0	0	0	0	0	0				14500	54136.2	2880	451

Source: Saskatchewan Enegy and Mines, February 2002

Map A-1
Extent of the Ribstone Creek Tongue and location of cross section lines.
Cross section line and log index number
Extent of the Ribstone Creek Tongue
0 5 10 20 30 40 50 km
A A'
B B'
C C'
D D'
E E'
F F'
G G'
H H1 H2
I I1 I2
T 01
R 30
16W3



LIMITATIONS:
Except at testhole sites where geological logs are available the geologic contacts are inferred and represent geologic models that are believed to best fit the information.

Hydrogeology of the Ribstone Creek Aquifer.

Maathuis, H. and Simpson, M., 2002

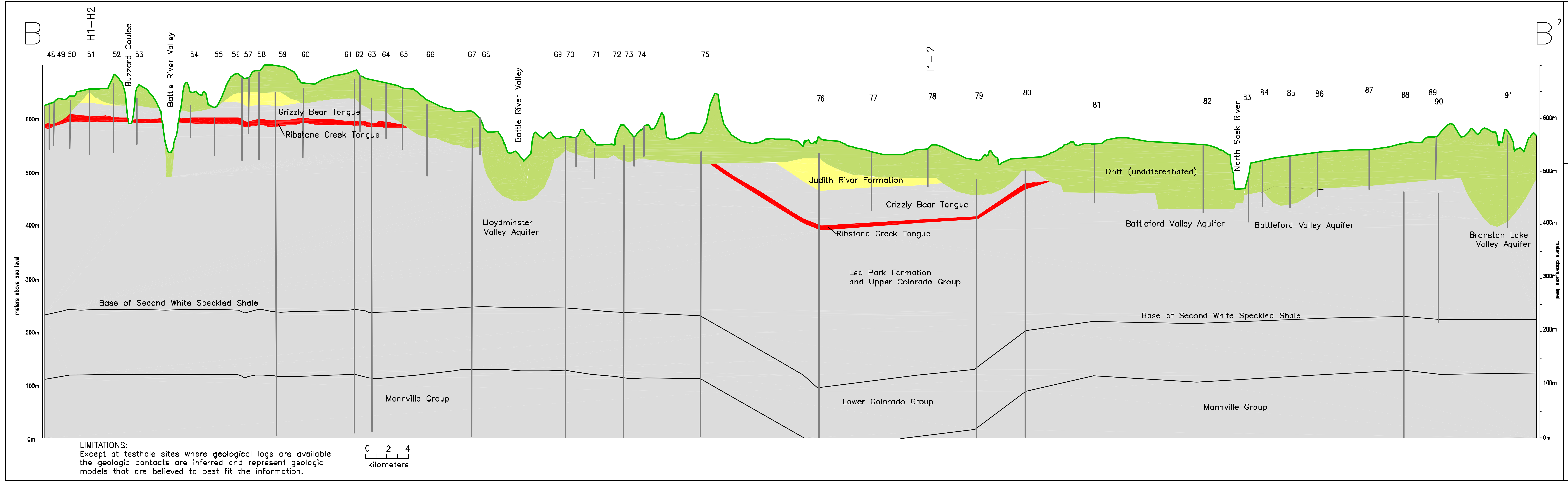
SRC Publication 11500-1E02

Cross Section A–A'

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the St.Walburg Area (73F), Saskatchewan. Saskatchewan Research Council Report No.R1210-7-E-90.



Hydrogeology of the Ribstone Creek Aquifer

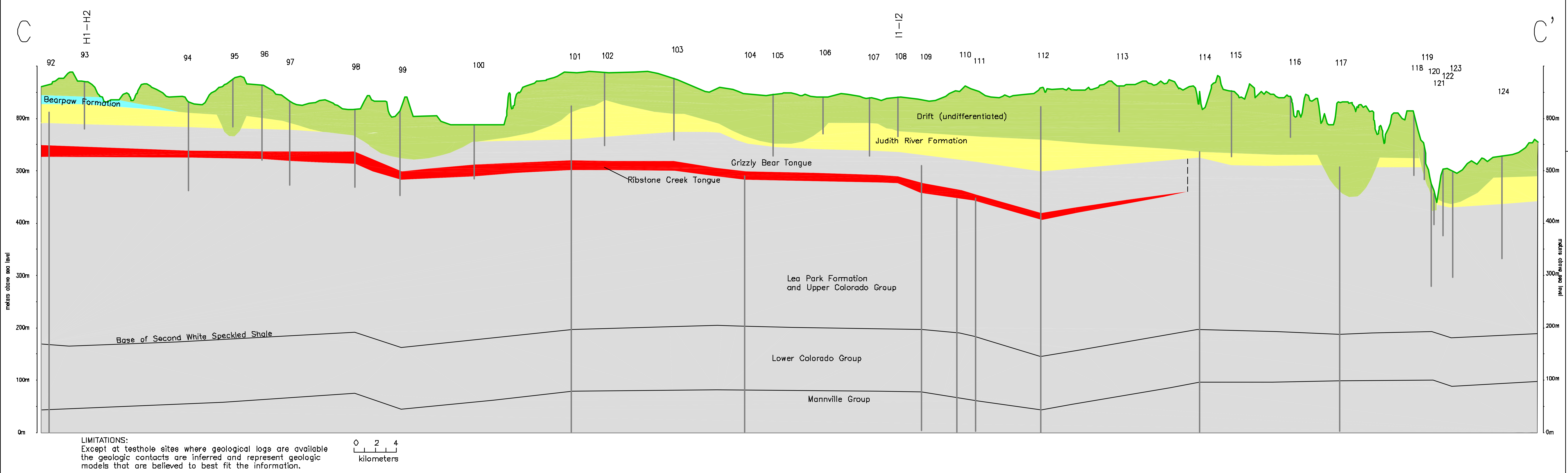
Maathuis, H. and Simpson, M., 2002

SRC Publication 11500-1E02

Cross Section B–B'

- Testhole or Well
- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Battleford Area (73C), Saskatchewan. Saskatchewan Research Council Report No.R1210-5-E-90.



Hydrogeology of the Ribstone Creek Aquifer.

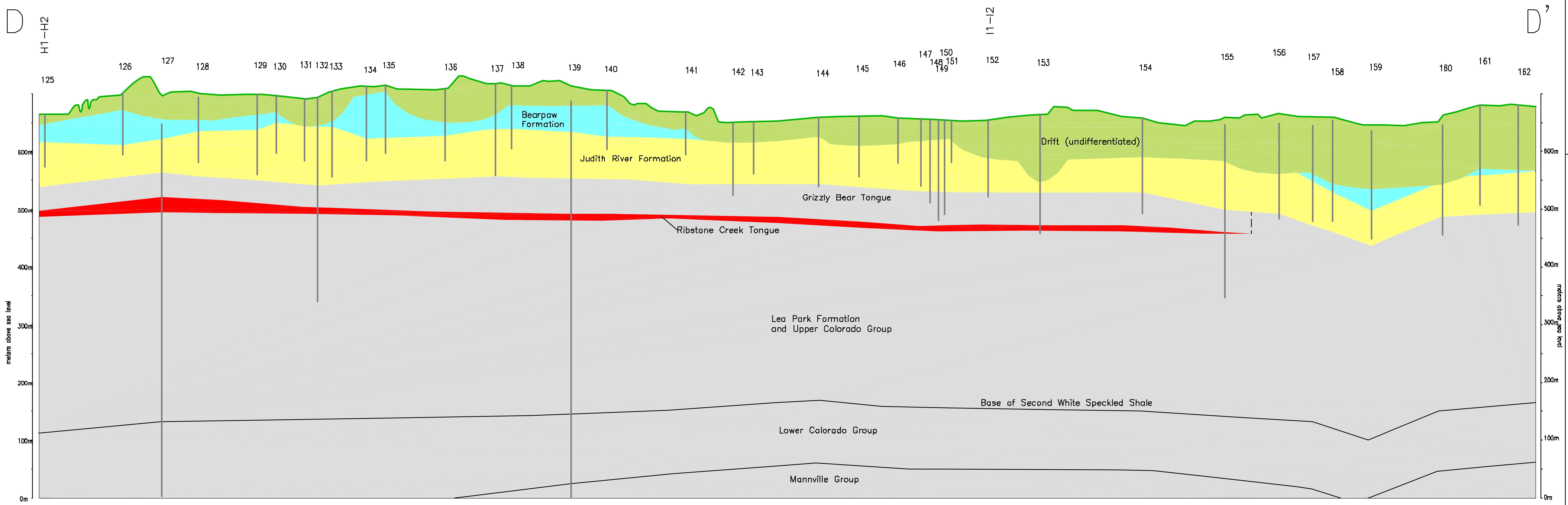
Maathuis, H. and Simpson, M., 2002

SRC Publication 11500-1E02

Cross Section C–C'

- Testhole or Well
- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Battleford Area (73C), Saskatchewan. Saskatchewan Research Council Report No.R1210-5-E-90.



LIMITATIONS:
Except at testhole sites where geological logs are available the geologic contacts are inferred and represent geologic models that are believed to best fit the information.

0 2 4
kilometers

Hydrogeology of the Ribstone Creek Aquifer.

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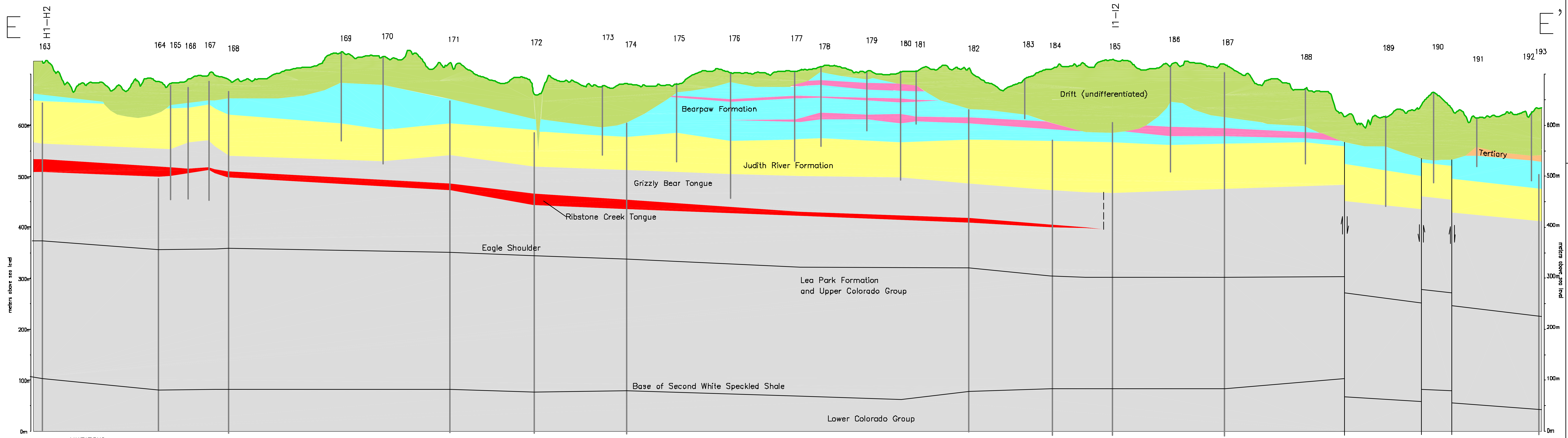
SRC Publication 11500-1E02

Cross Section D–D'

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Battleford Area (73C), Saskatchewan. Saskatchewan Research Council Report No.R1210-5-E-90.



LIMITATIONS:
Except at testhole sites where geological logs are available the geologic contacts are inferred and represent geologic models that are believed to best fit the information.

0 2 4
kilometers

Hydrogeology of the Ribstone Creek Aquifer.

Maathuis, H. and Simpson, M., 2002

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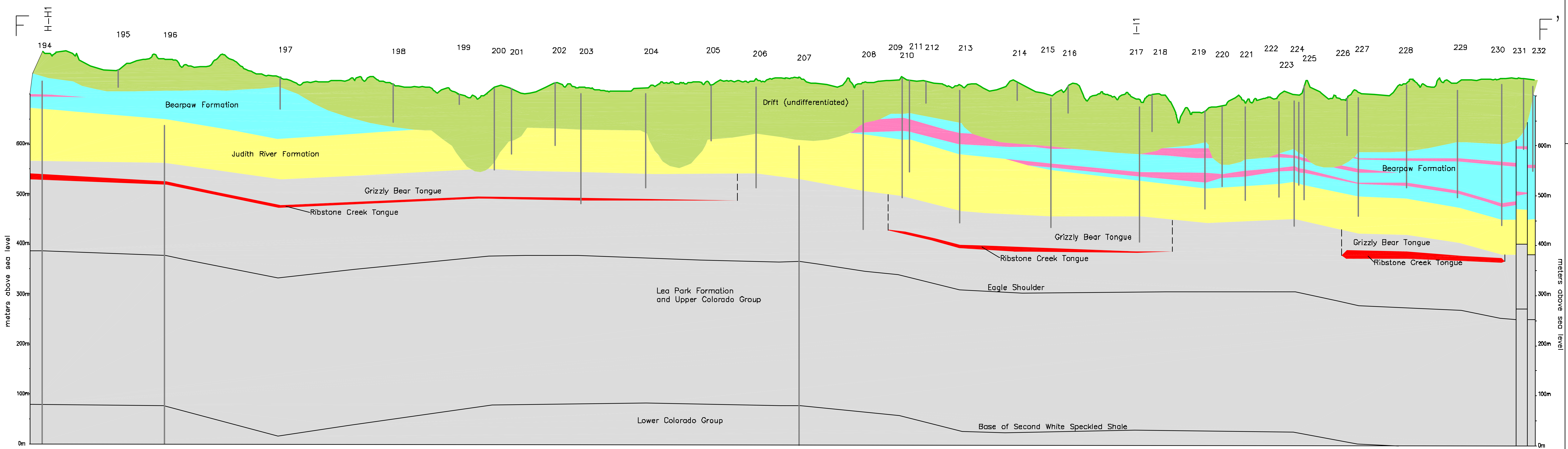
Cross Section E–E'

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Kindersley Area (72N), Saskatchewan. Saskatchewan Research Council Report No.R1210-9-E-90.



LIMITATIONS:
Except at testhole sites where geological logs are available the geologic contacts are inferred and represent geologic models that are believed to best fit the information.

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Cross Section F–F'

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990; Geology and Groundwater Resources of the Prelate Area (72K), Saskatchewan. Saskatchewan Research Council Report No.R1210-12-E-90.

LIMITATIONS:
Except at testhole sites where geological logs are available the geologic contacts are inferred and represent geologic models that are believed to best fit the information.

0 2 4
kilometers

Hydrogeology of the Ribstone Creek Aquifer.

Maathuis, H. and Simpson, M., 2002

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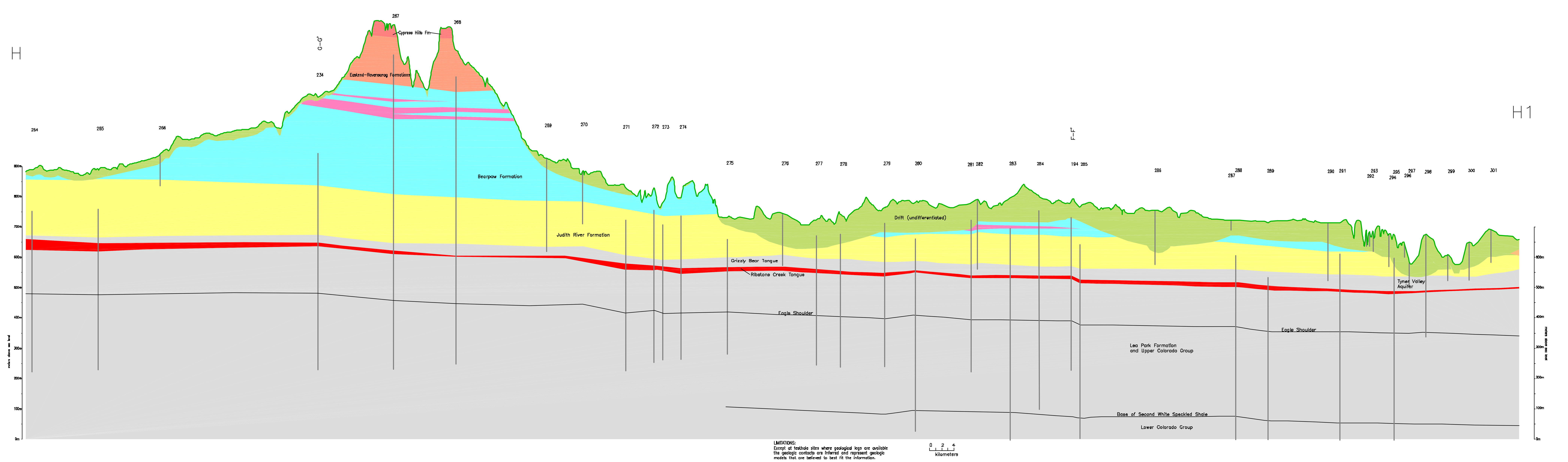
Cross Section G–G'

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Cypress Lake Area (72F), Saskatchewan. Saskatchewan Research Council Report No.R1210–11–E–90.



Hydrogeology of the Ribstone Creek Aquifer.

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Cross Section H–H1

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Cypress Hills Formation
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
Millard, M.J., 1990: Geology and Groundwater Resources of the Prelate Area (72K), Saskatchewan. Saskatchewan Research Council Report No.R1210-12-E-90.

Millard, M.J., 1990: Geology and Groundwater Resources of the Cypress Lake Area (72F), Saskatchewan. Saskatchewan Research Council Report No.R1210-11-E-90.

Hydrogeology of the Ribstone Creek Aquifer.

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Cross Section H1–H2

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:
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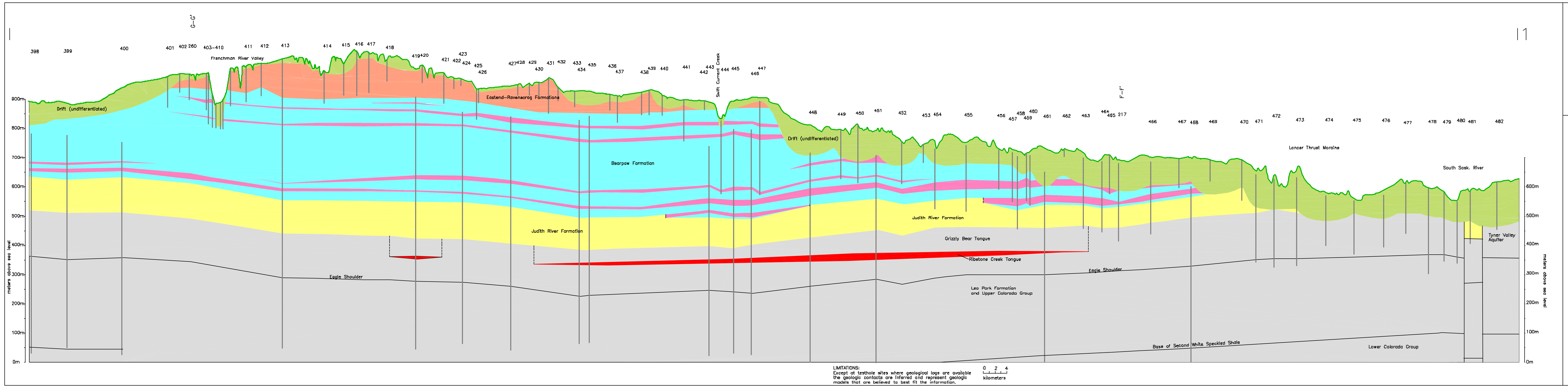
Millard, M.J., 1990: Geology and Groundwater Resources of the Battleford Area (73C), Saskatchewan. Saskatchewan Research Council Report No.R1210-5-E-90.

Millard, M.J., 1990: Geology and Groundwater Resources of the Kindersley Area (72N), Saskatchewan. Saskatchewan Research Council Report No.R1210-9-E-90.



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Cross Section I–I1

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
- Ribstone Creek Tongue
- Lea Park Fm and Colorado Gp. and Mannville Gp.

After:

Millard, M.J., 1990: Geology and Groundwater Resources of the Prelate Area (72K), Saskatchewan. Saskatchewan Research Council Report No.R1210-12-E-90.

Millard, M.J., 1990: Geology and Groundwater Resources of the Cypress Lake Area (72F), Saskatchewan. Saskatchewan Research Council Report No.R1210-11-E-90.

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Cross Section I1–I2

Testhole or Well

- Drift (undifferentiated)
- Tertiary
- Eastend–Ravenscrag Fms.
- Bearpaw sands (undifferentiated)
- Bearpaw silt and clay
- Judith River Formation
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Millard, M.J., 1990: Geology and Groundwater Resources of the Kindersley Area (72N), Saskatchewan. Saskatchewan Research Council Report No.R1210-9-E-90.