County of Forty Mile No. 8

Parts of the South Saskatchewan River and Missouri River Basins
Tp 001 to 013, R 05 to 14, W4M
Regional Groundwater Assessment

Prepared for County of Forty Mile No. 8

In conjunction with

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada
Prairie Farm Rehabilitation Administration | Administration du rétablisseme agricole des Prairies

Canada

Prepared by
hydrogeological consultants ltd. **(HCL)**
1.800.661.7972
Our File No.: **03-215**

December 2004

PERMIT TO PRACTICE
HYDROGEOLOGICAL CONSULTANTS LTD.
Signature_______________
Date_______________
PERMIT NUMBER P 385
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Table of Contents

List of Figures

List of Tables

Appendices

Acknowledgements

Hydrogeological Consultants Ltd. would like to thank the following people for their cooperation and helpful contributions on this project:

Mr. Terry Dash – AAFC-PFRA
Mr. Ryan Davison – AAFC-PFRA
Mr. Dale Brown – County of Forty Mile

For additional copies of the report/CD-ROM, please contact the following:

- 1-800-GEO-WELL
- The Groundwater Centre/Regional Groundwater Assessment

http://www.groundwatercentre.com/m_info_rgwa.asp

1. PROJECT OVERVIEW

“Water is the lifeblood of the earth.” – Anonymous

How a County takes care of one of its most precious resources - groundwater - reflects the future wealth and health of its people. Good environmental practices are not an accident. They must include genuine foresight with knowledgeable planning. Implementation of strong practices not only commits to a better quality of life for future generations, but also creates a solid base for increased economic activity. **Though this report’s scope is regional, it is a first step for the County of Forty Mile No. 8 in managing their groundwater. It is also a guide for future groundwater-related projects.**

1.1 Purpose

This project is a regional groundwater assessment of the County of Forty Mile No. 8 prepared by Hydrogeological Consultants Ltd. (HCL) with financial and technical assistance from the Prairie Farm Rehabilitation Administration branch of Agriculture and Agri-Food Canada (AAFC-PFRA) and the County of Forty Mile. The project study area includes the parts of the County of Forty Mile bounded by townships 001 to 013, ranges 05 to 14, W4M (herein referred to as the County). The regional groundwater assessment provides the information to assist in the management of the groundwater resource within the County. Groundwater resource management involves determining the suitability of various areas in the County for particular activities. These activities can vary from the development of groundwater for country residential, agricultural or industrial purposes, to the siting of waste storage. **Proper management ensures protection and utilization of the groundwater resource for the maximum benefit of the people of the County.**

The regional groundwater assessment will:

- identify the aquifers[1] within the surficial deposits[2] and the upper bedrock
- spatially identify the main aquifers
- describe the quantity and quality of the groundwater associated with each aquifer
- identify the hydraulic relationship between aquifers
- identify possible groundwater depletion areas associated with each upper bedrock aquifer.

Under the present program, the groundwater-related data for the County have been assembled. Where practical, the data have been digitized. These data are then used in the regional groundwater assessment for the County of Forty Mile.

1 See glossary
2 See glossary

1.2 The Project

This regional study should only be used as a guide. Detailed local studies are required to verify hydrogeological conditions at given locations.

The present project is made up of eight parts as follows:

Task 1 - Data Collection and Review
Task 2 - Hydrogeological Maps, Figures, Digital Data Files
Task 3 - Hydrogeological Evaluation and Preparation of Report
Task 4 - Groundwater Information Query Software
Task 5 - Review of Draft Report and GIS Data Files
Task 6 - Report Presentation and Familiarization Session
Task 7 - Provision of Report, Maps, Data Layers and Query
Task 8 - Provision of Compact Disk for Sale to General Public.

This report and the accompanying maps represent Tasks 2 and 3.

1.3 About This Report

This report provides an overview of (a) the groundwater resources of the County of Forty Mile, (b) the processes used for the present project, and (c) the groundwater characteristics in the County.

Additional technical details are available from files on the CD-ROM provided with the final version of this report. The files include the geo-referenced electronic groundwater database, maps showing distribution of various hydrogeological parameters, the groundwater query, ArcView files and ArcExplorer files. Likewise, all of the illustrations and maps shown in this report, plus additional maps, figures and cross-sections, are available on the CD-ROM. In order to avoid map-edge effects, all maps are based on an analysis of hydrogeological data from townships 001 to 013, ranges 05 to 14, W4M, plus a buffer area of 5,000 metres. For convenience, poster-size maps and cross-sections have been prepared as a visual summary of the results presented in this report. Copies of these poster-size drawings have been forwarded with this report, and are included as page-size drawings in Appendix D.

Appendix A features page-size copies of the figures within the report plus additional maps and cross-sections. An index of the page-size maps and figures is given at the beginning of Appendix A. A plastic County map outline is provided to overlay the maps, and contains information such as towns, main rivers, etc.

Appendix B provides a complete list of maps and figures included on the CD-ROM.

Appendix C includes the following:

1) a procedure for conducting aquifer tests with water wells[3]
2) a table of contents for the Water (Ministerial) Regulation under the *Water Act*
4) interpretation of chemical analysis of drinking water
5) additional information.

The Water (Ministerial) Regulation deals with the wellhead completion requirement (no more water-well pits), the proper procedure for abandoning unused water wells and the correct procedure for installing a pump in a water well. The *Water Act* was proclaimed 10 Jan 1999.

Appendix D includes page-size copies of the poster-size figures provided with this report.

Appendix E provides a list of water wells that have been field-verified and water wells that are recommended for field-verification.

2 INTRODUCTION

2.1 Setting

The County of Forty Mile is situated in southern Alberta. The northern boundary is the South Saskatchewan River; the County is bordered by the State of Montana to the south. The other County boundaries mainly follow township or section lines, which include parts of the area bounded by townships 001 to 013, ranges 05 to 14, W4M.

Regionally, the topographic surface varies between 690 and 1,230 metres above mean sea level (AMSL). The lowest elevations occur mainly in association with the South Saskatchewan River; the highest elevations are in the eastern and southern parts of the County, as shown on Figure 1 and page A-3.

The County is within the South Saskatchewan River and Missouri River basins (see page A-4). The area is well drained by the South Saskatchewan River and the Milk River, and numerous creeks and coulees.

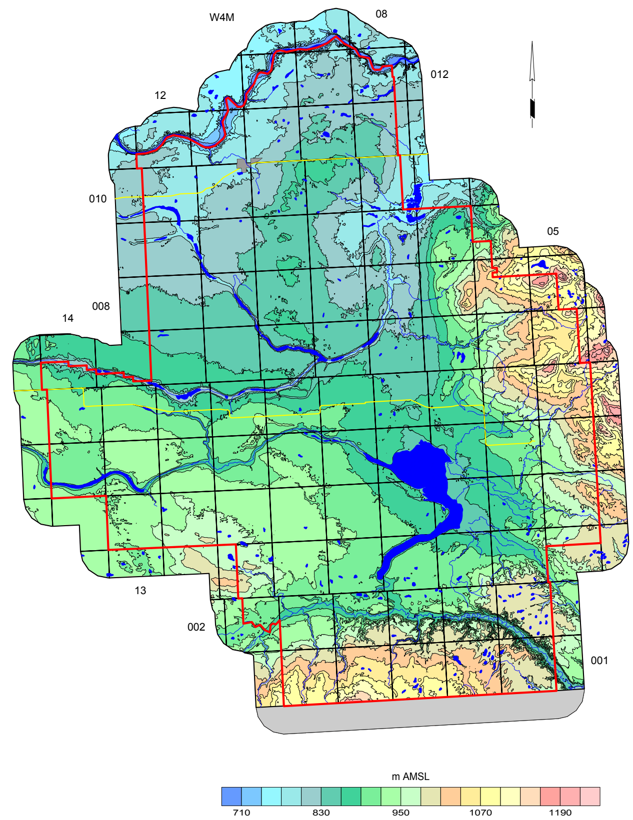


Figure 1. Surface Topography

2.2 Climate

The County of Forty Mile lies within the Bsk climate boundary. This classification is based on potential evapotranspiration [4] values determined using the Thornthwaite method (Thornthwaite and Mather, 1957), combined with the distribution of natural ecoregions in the area. The ecoregions map (Strong and Leggat, 1981) shows that the County is located mainly in the Dry Mixed Grass Region. At higher elevations in the southern part of the County, and at higher elevations in the eastern part of the County, the Mixed Grass Region is present.

A Bsk climate is characterized by its moisture deficiency, where mean annual potential evapotranspiration exceeds the mean annual precipitation.

The mean annual precipitation averaged from three meteorological stations within the County measured 344.9 millimetres (mm), based on data from 1971 to 2000. The mean annual temperature averaged 7.0° C, with the mean monthly temperature reaching a high of 21.1° C in July, and dropping to a low of -9.2° C in January. The calculated annual potential evapotranspiration is 625 millimetres.

[3] See glossary
[4] See glossary

2.3 Background Information

2.3.1 Number, Type and Depth of Water Wells

There are currently 3,169 records in the groundwater database for the County, of which 2,548 are water wells. Of the 2,548 water wells, there is a proposed use for 2,179 water wells. Of the 2,179 water wells, there are records for domestic (593), domestic/stock (1,062) or stock (404) purposes. The remaining 120 water wells were completed for municipal (30), industrial (27), observation (23) purposes, and other numerous categories (40). Based on a rural population of 3,168 (Phinney, 2003), there are 2.6 domestic/stock water wells per family of four. There are 1,996 domestic, domestic/stock or stock water wells with a completed depth, of which 773 (nearly 40%) are completed at depths of greater than 100 metres below ground surface. Details for lithology[5] are available for 939 water wells.

2.3.2 Number of Water Wells in Surficial and Bedrock Aquifers with Lithology

There are 367 water wells with completion interval and lithologic information, such that the aquifer in which the water wells are completed can be identified. The water wells that were not drilled deep enough to encounter the bedrock plus water wells that have the bottom of their completion interval above the top of the bedrock are water wells completed in surficial aquifers. Of the 367 water wells for which aquifers could be defined, 81 are completed in surficial aquifers, with 74 (91%) having a completion depth of less than 50 metres below ground surface. The adjacent map shows that the water wells completed in the surficial deposits are mainly concentrated north of township 007, W4M between the Buried Skiff and Medicine Hat valleys (see Figure 9 on page 16).

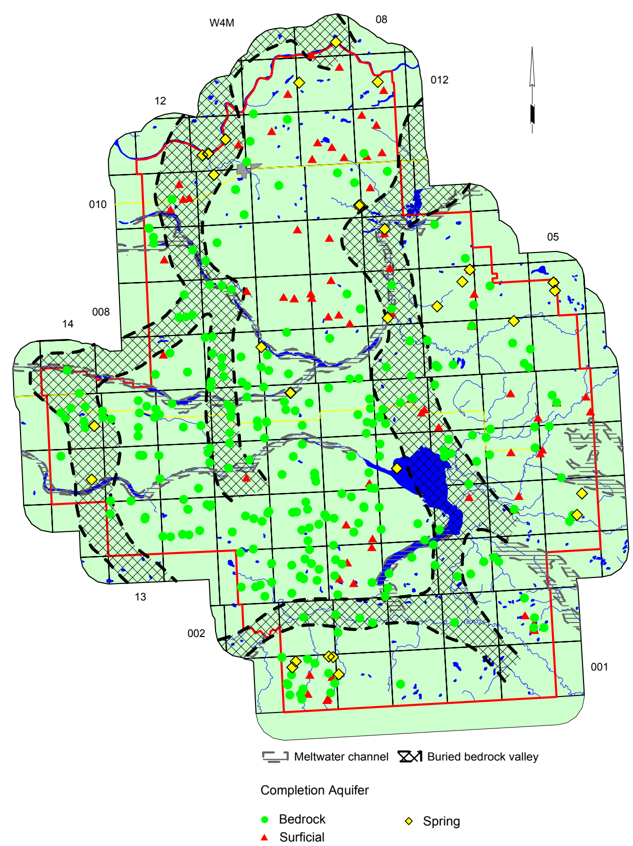


Figure 2. Locations of Water Wells and Springs

The data for 286 water wells show that the top of the water well completion interval is below the bedrock surface, indicating that the water wells are completed in at least one bedrock aquifer. From Figure 2 (also see page A-7), it can be seen that water wells completed in bedrock aquifers occur throughout the County but mainly south of township 008, W4M.

Within the County of Forty Mile, there are currently records for 37 springs in the groundwater database, including four springs that were documented by Borneuf (1983). There are 18 springs having at least one total dissolved solids (TDS) value, with 15 springs having a TDS of more than 500 milligrams per litre (mg/L). There are ten springs in the groundwater database with flow rates that range from one litre per minute (lpm) to 682 lpm. The dates the flow rates were measured are available for only one spring; the measurement date was June 1971.

5 See glossary

2.3.3 Casing Diameter and Type

Data for casing diameters are available for 1,558 water wells, with 980 (63%) indicated as having a diameter of less than 275 mm and 578 (37%) having a diameter of more than 275 mm. The casing diameters of greater than 275 mm are mainly bored, hand dug, or dug by backhoe water wells and those with a surface-casing diameter of less than 275 mm are mainly drilled water wells. The entire water well database for the County suggests that 1,028 of the water wells in the County were bored, hand dug or dug by backhoe and 1,247 are drilled water wells (see CD-ROM). From 1900 to 1939, water wells completed were mainly bored, hand dug or dug by backhoe and since the 1940s have mainly been drilled.

For a water well with a small-diameter casing to be effective in surficial deposits and to provide sand-free groundwater, the water well must be completed with a water well screen. Some water wells completed in the surficial deposits are completed in low-permeability aquifers and have a large-diameter casing. The large-diameter water wells may have been hand dug or bored and because they are completed in very low permeability aquifers, most of these water wells would not benefit from water well screens. Within the County, casing-diameter information is available for 70 of the 81 water wells completed in the surficial deposits, of which 37 surficial water wells have a casing diameter of less than 275 millimetres and are assumed to be drilled water wells. Within the County, casing-diameter information is available for 280 of the 286 water wells completed below the top of bedrock, of which 278 have a surface-casing diameter of less than 275 mm and have been mainly completed with either a perforated liner or as open hole; there are eight bedrock water wells completed with a water well screen.

Prior to 1960, drilled water wells were mainly completed with a surface-casing diameter of less than or equal to 76.2 mm (3 in). Since 1960, surface-casing diameters of more than 76.5 mm have been used in 98% of drilled water wells.

Of the 242 water wells that were completed with a small-diameter surface casing, a non-pumping (static) water level (NPWL) is available for 115 water wells, of which 74 (64%) had uncontrolled flow; only two of these 74 water wells have reportedly been reclaimed. Uncontrolled flowing water wells may provide a pathway for soluble contaminants to move downward into the groundwater.

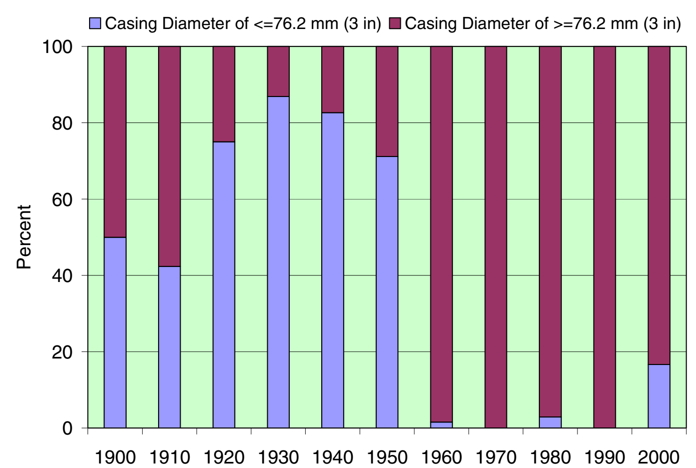


Figure 3. Surface-Casing Diameter Used in Drilled Water Wells

Where the casing material is known, steel surface casing materials have been used in 93% of the drilled water wells over the last 40 years. For the remaining drilled water wells with known surface casing material, six percent were completed with plastic casing, and one percent was completed with concrete casing. The main years where the type of surface casing was undocumented were prior to 1955 to the mid-1970s. Steel casing is still used in 80% of the water wells being drilled in the County. Plastic casing was first used in September 1980, but is only used in 20% of the water wells currently being drilled in the County.

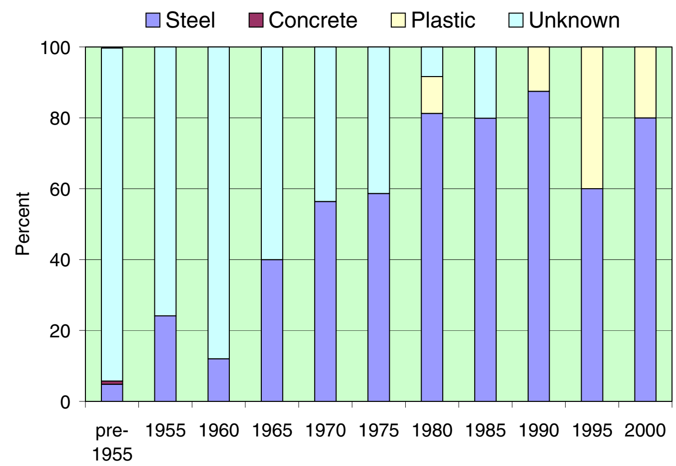


Figure 4. Surface Casing Types Used in Drilled Water Wells

Steel casing has been dominant in the County probably because it has resisted corrosion and also because water well drillers may be reluctant to use plastic (PVC) casing if there have been no documented problems with steel casing in the area.

2.3.4 Dry Water Test Holes

In the County, there are 3,169 records in the groundwater database. Of these 3,169 records, 71 (2%) are indicated as being “dry” or “abandoned” with “insufficient water”[6]. Of the 71 “dry” water test holes, 55 are completed in surficial deposits; the remaining 16 “dry” water test holes are completed in bedrock aquifers. Only about 5% of all water wells with apparent yield estimates were judged to yield less than 6.5 m³/day (1 igpm).

[6] “dry” can be due to a variety of reasons: skill of driller, type of drilling rig/method used, the geology encountered

2.3.5 Requirements for Licensing

With some exemptions, a diversion of groundwater starting after 01 Jan 1999 must have a licence. Exemptions include (1) the diversion for household use of up to 3.4 cubic metres per day (1,250 cubic metres per year [m³/year] or 750 imperial gallons per day[7]), (2) the diversion of groundwaters with total dissolved solids in excess of 4,000 mg/L, (3) the diversion from a manually pumped water well, or (4) a diversion of groundwater that was eligible for registration as "Traditional Agriculture Use" but was not registered can continue to be used for Traditional Agriculture Use but without the protection of the *Water Act*.

In the last update from the Alberta Environment (AENV) groundwater database, 253 groundwater licences and registrations were shown to be within the County, with the most recent groundwater user being registered in April 2003. Of the 253 licensed and/or registered groundwater users, 174 (69%) are registrations of Traditional Agriculture Use under the *Water Act*. These 174 registered users will continue to divert groundwater for stock watering and/or crop spraying. Typically, the groundwater diversion for crop spraying averages less than one m³/day so most registered groundwater diversion is for stock watering. Of the 174 registrations, 53 (30%) could be linked to the AENV groundwater database. Of the remaining 79 groundwater users, 41 are for agricultural purposes (mainly stock watering) and 38 are for municipal purposes (mainly urban). Of these 79 licensed groundwater diversions in the County, 47 (59%) could be linked to the AENV groundwater database. The maximum amount of groundwater that can be diverted each year from the water wells associated with these licences and registrations is 1,748 m³/day, although actual use could be less. Of the 1,748 m³/day, 313 m³/day (18%) is registered for Traditional Agriculture Use, 826 m³/day (47%) is licensed for agricultural purposes and 609 m³/day (35%) is licensed for municipal purposes, as shown below in Table 1. A figure showing the locations of the groundwater users with either a licence or a registration is in Appendix A (page A-8) and on the CD-ROM. Table 1 also shows a breakdown of the 253 groundwater licences and/or registrations by the aquifer in which the water well is completed. Approximately 81% of the total quantity of licensed and/or registered groundwater use is from the Milk River Aquifer. The water wells associated with the 35 licensed and/or registered use where a specific aquifer cannot be determined is because insufficient completion information is available.

Aquifer **	No. of Licences and/or Registrations	Registrations (m³/day)	Licensed Groundwater Users* (m³/day) Agricultural	Municipal	Total Quantity of Licensed and/or Registered Groundwater Diversion (m³/day)	Percentage
Upper Sand and Gravel	27	35	3	0	38	2
Lower Sand and Gravel	1	0	0	3	3	0
Mulitple Bedrock Completion	3	4	0	3	7	0
Foremost	6	10	0	0	10	1
Lea Park (Pakowki)	0	0	0	0	0	0
Milk River	179	218	670	534	1,422	81
Colorado	2	2	0	0	2	0
Unknown	35	44	152	68	264	15
Total	253	313	826	609	1,748	100
Percentage		18	47	35	100	

* - data from AENV ** - Aquifer identified by HCL

Table 1. Licensed and/or Registered Groundwater Diversions

[7] see conversion table on page 59

Based on the 2001 Agriculture Census (Statistics Canada), the calculated water requirement for 348,609 livestock for the County is in the order of 7,519 m³/day. This number includes intensive livestock use but not domestic animals and is based on an estimate of water use per livestock type. Of the 7,519 m³/day calculated livestock use, AENV has authorized a groundwater diversion of 1,139 m³/day (agricultural and registration) (15%) and licensed a surface-water diversion (stock and registration) based on consumptive use of 3,229 m³/day (43%) for a total diversion of 4,368 m³/day. Agriculture purpose includes water diverted and used for stockwatering and feedlot use. This assumes the majority of the groundwater and surface water authorized for diversion for Traditional Agriculture Use is for watering livestock. Using this assumption, 58% of the estimated total water requirements of 7,519 m³/day is accounted for.

Livestock Type	Number	Estimated Water Requirement (m³/day)
Total hens and chickens	150,486	31
Turkeys	0	0
Other poultry	6,076	1
Total cattle and calves	73,970	4,035
Bulls, 1 year and over	1,274	87
Total cows	23,340	1,273
Heifers, 1 year and over	18,266	830
Calves, under 1 year	21,377	292
Total pigs	50,144	912
Total sheep and lambs	2,813	26
Horses and ponies	662	30
Goats	162	1
Rabbits	0	0
Mink	0	0
Fox	0	0
Bison	0	0
Deer and elk	0	0
Llamas and alpacas	39	0
Totals	348,609	7,519

Table 2. Estimated Water Requirement for Livestock in the County of Forty Mile

The remaining 3,151 m³/day (42%) of the calculated water requirement for livestock use would have to be from other, including unlicensed, sources. The discrepancy may be partially accounted for in several ways. Based on some monitoring and reporting situations, the estimated water requirements for livestock, used by AENV, tend to be somewhat high. Some livestock water requirements would be made up from free-standing water following precipitation events, thus reducing the expected quantity needed. Also, it should be noted that ‘household use’, as defined in the *Water Act*, can provide sufficient water for about 75 head of cattle, with no need for a licence. It is possible that some such use may have been registered as Traditional Agriculture Use and would therefore be included in the registration quantity. Also, diversions of groundwater and surface water that were eligible for registration as Traditional Agriculture Use can continue to be used for traditional agricultural purposes without the need for authorization.

2.3.6 Base of Groundwater Protection

In general, AENV defines the Base of Groundwater Protection as the elevation below which the groundwater will have more than 4,000 mg/L of total dissolved solids. By using the ground elevation, formation elevations, and Alberta Energy and Utilities Board (EUB) information indicating the formations containing the deepest useable water for agricultural needs, a value for the depth to the Base of Groundwater Protection can be determined. These values are gridded using the Kriging[8] method to prepare a depth to the Base of Groundwater Protection surface. This depth, for the most part, would be the maximum drilling depth for a water well for agricultural purposes or for a potable water supply. If a water well has TDS concentrations that exceed 4,000 mg/L, the groundwater use does not require licensing by AENV. In the County, the depth to the Base of Groundwater Protection ranges from less than 150 metres in the southwestern part of the County to more than 450 metres in the eastern parts of the County, as shown on Figure 4 on the following page, on the cross-sections presented in this report and in Appendix A, and on the CD-ROM.

[8] See glossary

There are 2,381 water wells with completed depth data, of which 90 appear to be completed below the Base of Groundwater Protection. Of the 90 water wells completed below the Base of Groundwater Protection, there is a date of completion for 58 water wells, as shown on the adjacent table. Of these 58 water wells, 39 were completed before 1970 and may no longer be in use. Chemistry data are available for 33 of the 90 water wells, which provided groundwaters with TDS values. Of these 33 water wells, three had TDS concentrations that were greater than 4,000 mg/L. In the County, the Base of Groundwater Protection passes below the portion of the Milk River Formation that has been developed for water supplies (see pages A-13 to A-20).

	Water Wells Completed below the Base of Groundwater Protection	TDS of > 4,000 mg/L	TDS of < 4,000 mg/L
With a Completed Date	58	2	9
Without a Completed Date	32	1	21
Total Number	90	3	30

Table 3. Water Wells Completed below the Base of Groundwater Protection

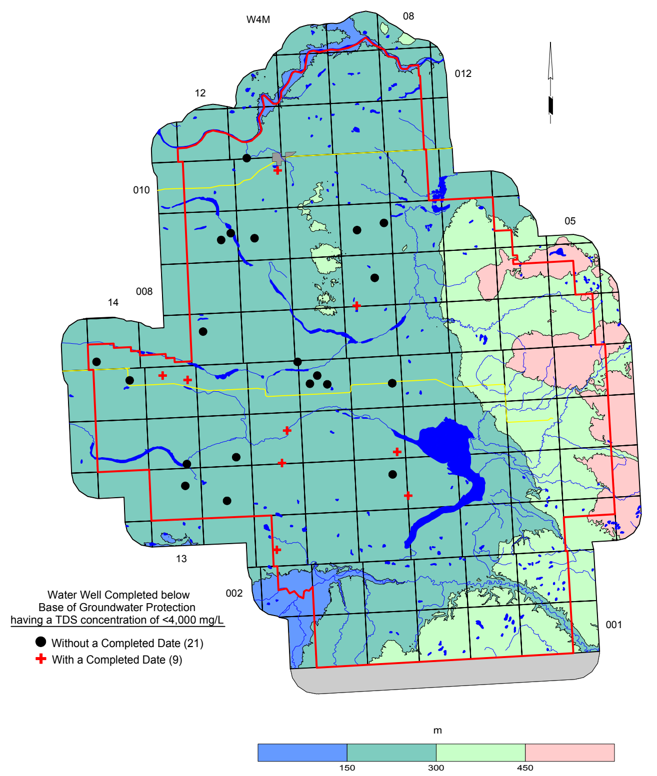


Figure 5. Depth to Base of Groundwater Protection (after EUB, 1995)

Proper management of the groundwater resource requires water-level data. These data are often collected from observation water wells. At the present time, there are four AENV-operated observation water wells within the County (see page A-48 for the observation water well locations). In the past, the data for authorized diversions have been difficult to obtain from AENV, in part because of the failure of the applicant to provide the data. Even with the available sources of data, the number of water-level data points relative to the size of the County is too few to provide a reliable groundwater budget (see section 6.0 of this report). The most cost-efficient method to collect additional groundwater monitoring data would be to have the water well owners measuring the water level in their own water well on a regular basis, as has been the case in the Wildrose Country Ground Water Monitoring Association and the M.D. of Flagstaff.

3. TERMS

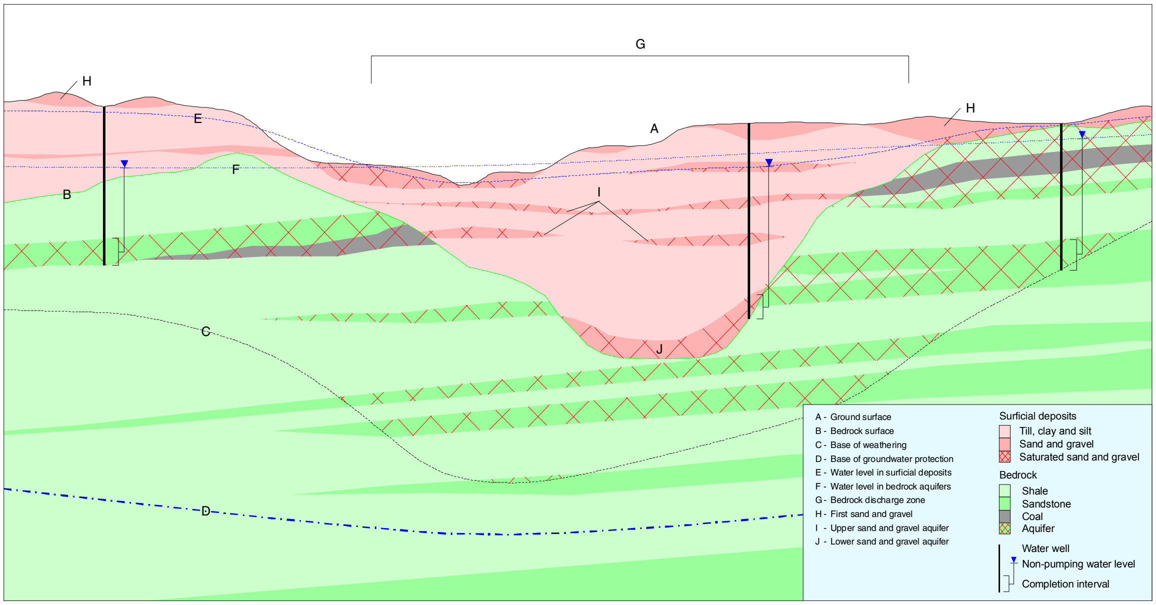


Figure 6. Generalized Cross-Section (for terminology only)

(for larger version, see page A-10)

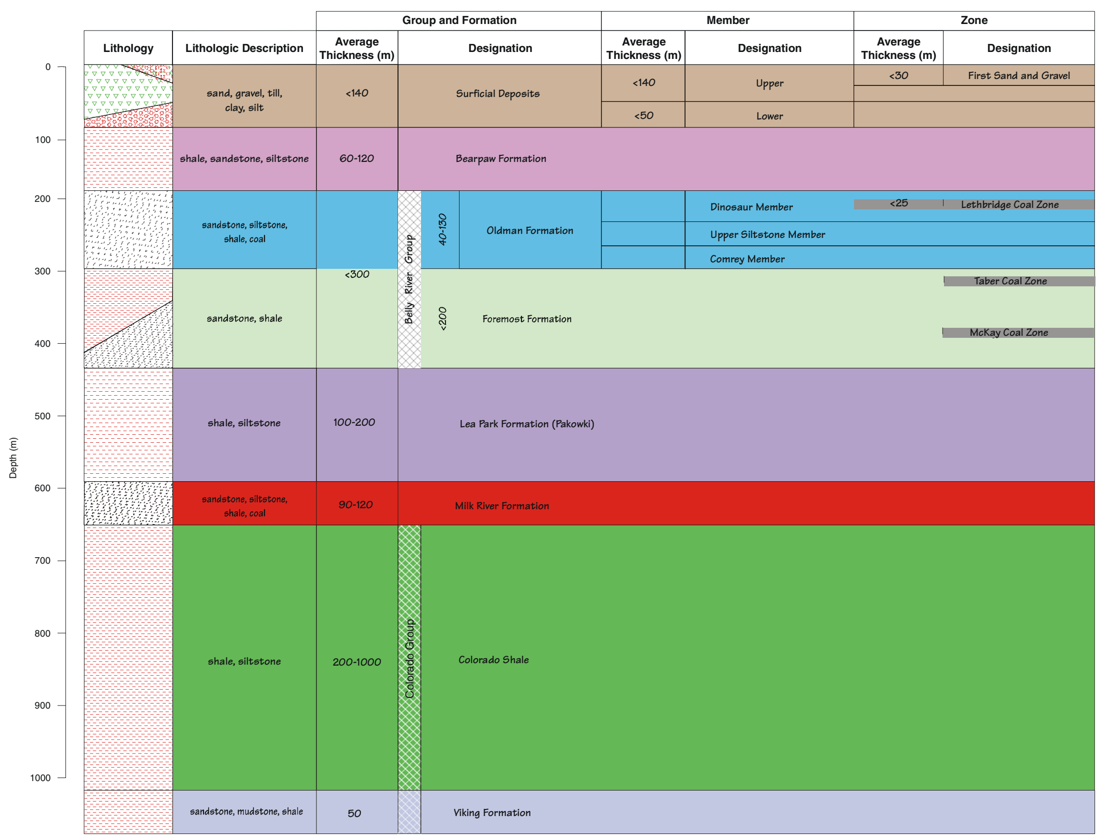


Figure 7. Generalized Geologic Column

(for larger version, see page A-11)

4. METHODOLOGY

4.1 Data Collection and Synthesis

The AENV groundwater database is the main source of groundwater data. The database includes the following:

1) water well drilling reports
2) aquifer test results from some water wells
3) locations of some springs
4) locations for some water wells determined during water well surveys
6) chemical analyses for some groundwaters[9]
7) locations of some flowing shot holes
8) locations of some structure test holes
9) a variety of data related to the groundwater resource.

The main disadvantage to the database is the reliability of the information entered into the database. Very little can be done to overcome this lack of quality control in the data collection, other than to assess the usefulness of control points relative to other data during the interpretation. Another disadvantage to the database is the lack of adequate spatial information. Any duplicate water wells that have been identified within the County have been removed from the database used in this regional groundwater assessment.

The AENV groundwater database uses an area-land-based system with only a limited number of records having a value for ground elevation. The locations for records usually include a quarter section description; a few records also have a land description that includes a Legal Subdivision (Lsd). For digital processing, a record location requires a horizontal coordinate system. In the absence of an actual location for a record, the record is given the coordinates for the centre of the land description.

The present project uses the 10TM coordinate system based on the NAD27 datum. This means that a record for the SW ¼ of section 33, township 008, range 11, W4M would have a horizontal coordinate with an Easting of 256,429 metres and a Northing of 5,507,558 metres, the centre of the quarter section. If the water well has been repositioned by AAFC-PFRA using orthorectified aerial photographs, the location will be more accurate, possibly within several tens of metres of the actual location. Once the horizontal coordinates are determined for a record, a ground elevation for that record is obtained from the 1:20,000 Digital Elevation Model (DEM); AltaLIS Ltd. provides the DEM.

At many locations within the County, more than one water well is completed at one legal location. Digitally processing this information is difficult. To obtain a better understanding of the completed depths of water wells, a digital surface was prepared representing the minimum depth for water wells and a second digital surface was prepared for the maximum depth. Both of these surfaces are used in the groundwater query on the CD-ROM. When the maximum and minimum water well depths are similar, there is only one aquifer that is being used at a given location.

After assigning spatial control for the ground location for the records in the groundwater database, the data are processed to determine values for hydrogeological parameters. As part of the processing, obvious keying errors in the database are corrected.

Where possible, determinations are made from individual records in order to assign water wells to aquifers and to obtain values for the following:

1) depth to bedrock
2) total thickness of sand and gravel below 15 metres
3) total thickness of saturated sand and gravel
4) depth to the top and bottom of completion intervals[10].

[9] Since 1986, Alberta Health and Wellness has restricted access to chemical analysis data, and hence the database includes only limited amounts of chemical data after 1986.

Also, where sufficient information is available, values for apparent transmissivity[11] and apparent yield[12] are calculated, based on the aquifer test summary data supplied on the water well drilling reports. Where valid detailed aquifer test results exist, the interpreted data provide values for aquifer transmissivity and effective transmissivity. Since the last regional hydrogeological map covering the County was published in 1976 (Borneuf), based on data collected in 1971, more than 200 values for apparent transmissivity and apparent yield have been added to the groundwater database. The median apparent yield of the water wells with apparent yield values in the County is 80 m³/day. Approximately 20 percent of the apparent yield values for these water wells are less than 30 m³/day. With the addition of the apparent yield values, including a 0.1-m³/day value assigned to "dry" water wells and water test holes, a hydrogeological map has been prepared to help illustrate the general groundwater availability across the County (Figure 8 and page A-12). The map is based on groundwater being obtained from all aquifers and has been prepared to allow direct comparison with the results provided on the Alberta Geological Survey (AGS) hydrogeological maps. In general, the AGS maps show lower estimated long-term yields. The differences between the two map renderings may be a result of fewer apparent yield values and the gridding method employed by the AGS.

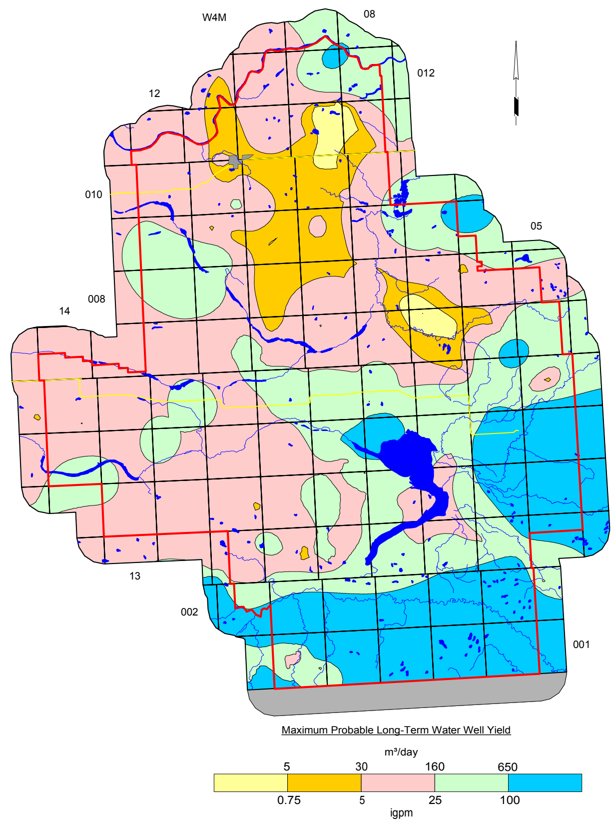


Figure 8. Hydrogeological Map

The EUB well database includes records for wells drilled for the oil and gas industry. The information from this source includes:

1) spatial control for each well site
2) depth to the top of various geologic units
3) type and intervals for various down-hole geophysical logs
4) drill stem test (DST) summaries.

Values for apparent transmissivity and apparent yield are calculated from the DST summaries.

Published and unpublished reports and maps provide the final source of information to be included in the new groundwater database. The reference section of this report lists the available reports. The only digital data from publications are from the Geological Atlas of the Western Canada Sedimentary Basin (Mossop and Shetsen, 1994). These data are used to support the geological interpretation of geophysical logs but cannot be distributed because of a licensing agreement.

---

10 See glossary
11 For definitions of Transmissivity, see glossary
12 For definitions of Yield, see glossary

4.2 Spatial Distribution of Aquifers

Determination of the spatial distribution of the aquifers is based on:

1) lithologs provided by the water well drillers
2) geophysical logs from structure test holes
3) geophysical logs for wells drilled by the oil and gas industry
4) data from existing cross-sections.

The aquifers are defined by mapping the tops and bottoms of individual geologic units. The values for the elevation of the top and bottom of individual geologic units at specific locations help to determine the spatial distribution of the individual surfaces. Establishment of a surface distribution digitally requires preparation of a grid. The inconsistent quality of the data necessitates creating a representative sample set obtained from the entire data set. If the data set is large enough, it can be treated as a normal population and the removal of extreme values can be done statistically. When data sets are small, the process of data reduction involves a more direct assessment of the quality of individual points. Because of the uneven distribution of the data, all data sets are gridded using the Kriging method.

The final definition of the individual surfaces becomes an iterative process involving the plotting of the surfaces on cross-sections and the adjusting of control points to fit with the surrounding data.

4.3 Hydrogeological Parameters

Water well records that indicate the depths to the top and bottom of their completion interval are compared digitally to the spatial distribution of the various geological surfaces. This procedure allows for the determination of the aquifer in which individual water wells are completed. When the completion depth of a water well cannot be established, the data from that water well are not used in determining the distribution of hydraulic parameters.

After the water wells are assigned to a specific aquifer, the parameters from the water well records are assigned to the individual aquifers. The parameters include NPWL, apparent transmissivity, and apparent water well yield. The NPWL given on the water well record is usually the water level recorded when the water well was drilled, measured prior to the initial aquifer test. In areas where groundwater levels have since fallen, the NPWL may now be lower and accordingly, the potential apparent yield would be reduced. The total dissolved solids, sulfate, chloride and total hardness concentrations from the chemical analyses of the groundwaters are also assigned to applicable aquifers. In addition, chemical parameters of Nitrate + Nitrite (as N) are assigned to surficial aquifers and fluoride is assigned to upper bedrock aquifer(s). Nitrate + Nitrite (as N) concentrations are often related to water-well-specific data and may not indicate general aquifer conditions.

Once the values for the various parameters of the individual aquifers are established, the spatial distribution of these parameters must be determined. The distribution of individual parameters involves the same process as the distribution of geological surfaces. This means establishing a representative data set and then preparing a grid. The representative data set included using the available data from townships 001 to 013, ranges 05 to 14, W4M, plus a buffer area of at least 5,000 metres. Even when only limited data are available, grids are prepared. However, the grids prepared from the limited data must be used with extreme caution because the gridding process can be unreliable; for the maps, the areas with little or no data are identified.

On some maps, values are posted as a way of showing anomalies to the underlying grid or as a means of emphasizing either the lack of sufficient data or areas where there is concentrated hydrogeological data control.

4.4 Maps and Cross-Sections

Once grids for geological surfaces have been prepared, various grids need to be combined to establish the extent and thickness of individual geologic units. For example, the relationship between an upper bedrock unit and the bedrock surface must be determined. This process provides both the outline and the thickness of the geologic unit.

Once the appropriate grids are available, the maps are prepared by contouring the grids. Appendix A includes page-size maps from the text, plus additional page-size maps and figures that support the discussion in the text. A list of maps and figures that are included on the CD-ROM is given in Appendix B.

Cross-sections are prepared by first choosing control points from the database along preferred lines of section. Data from these control points are then obtained from the database and placed in an AutoCAD drawing with an appropriate vertical exaggeration. The data placed in the AutoCAD drawing include the geo-referenced lithology, completion intervals and non-pumping water levels. Data from individual geologic units are then transferred to the cross-section from the digitally prepared surfaces.

Once the technical details of a cross-section are correct, the drawing file is moved to the software package CorelDraw! for simplification and presentation in a hard-copy form. Eight cross-sections are presented in Appendix A of this report and as poster-size drawings forwarded with this report; only two (C-C’ and D-D’) are included in the text of this report. The cross-sections are also included on the CD-ROM; page-size maps of the poster-size cross-sections are included in Appendix D of this report.

4.5 Software

The files on the CD-ROM have been generated from the following software:

- Acrobat 6.0
- AquaChem 3.6
- ArcView 3.2
- AutoCAD 2004
- CorelDraw! 12.0
- Grapher 3
- Microsoft Office 2003
- Surfer 8

5. AQUIFERS

5.1 Background

An aquifer is a permeable rock unit that is saturated. In this context, rock refers to subsurface materials, such as sand, gravel, sandstone and coal. If the NPWL is above the top of the rock unit, this type of aquifer is a confined or artesian aquifer. If the rock unit is not entirely saturated and the water level is below the top of the rock unit, this type of aquifer is a water-table aquifer. These types of aquifers occur in one of two general geological settings in the County. The first geological setting includes the sediments that overlie the bedrock surface. In this report, these sediments are referred to as the surficial deposits. The second geological setting includes aquifers in the upper bedrock. The geological settings, the nature of the deposits making up the aquifers within each setting, the expected yield of water wells completed in aquifer(s) within different geologic units, and the general chemical quality of the groundwater associated with each setting are reviewed separately.

5.2 Aquifers in Surficial Deposits

The surficial deposits are the sediments above the bedrock surface. These include pre-glacial materials, which were deposited before glaciation, and materials deposited directly or indirectly as a result of glaciation. The *lower surficial deposits* include pre-glacial fluvial[13] deposits. The *upper surficial deposits* include the traditional glacial sediments of till[14] and ice-contact deposits. Pre-glacial materials are expected to be present in association with linear bedrock lows. Meltwater channels are associated with glaciation.

5.2.1 Geological Characteristics of Surficial Deposits

While the surficial deposits are treated as one hydrogeologic unit, they consist of three hydraulic units. The first unit is the preglacial sand and gravel deposits of the lower surficial deposits. These deposits are mainly saturated. The second and third hydraulic units are associated with the sand and gravel deposits in the upper surficial deposits. The sand and gravel deposits in the upper surficial deposits occur mainly as pockets. The second hydraulic unit is the saturated part of these sand and gravel deposits; the third hydraulic unit is the unsaturated part of these deposits that occur close to ground surface. For a graphical depiction of the above description, please refer to Figure 6, page 10 and to page A-10. While the unsaturated deposits are not technically an aquifer, they are significant as they provide a pathway for soluble contaminants to move downward into the groundwater. Because of the significance of the shallow sand and gravel deposits, they have been mapped where they are present within one metre of the ground surface and are referred to as the “first sand and gravel” (see CD-ROM).

The base of the surficial deposits is the bedrock surface, represented by the bedrock topography as shown on Figure 9 on the following page. Regionally, the bedrock surface varies between 680 and 1,120 metres AMSL. The lowest elevations occur along the present-day South Saskatchewan River Valley, as shown on Figure 9 and page A-21. Over the majority of the County, the surficial deposits are less than 60 metres thick (see CD-ROM).

The main linear bedrock lows in the County are south-north-trending features that have been designated as the Buried Skiff Valley, Buried Medicine Hat Valley and Buried Foremost Valley (after Westgate, 1968). The Buried Foremost Valley is a tributary to the Buried Skiff Valley, and the Buried Skiff and Buried Medicine Hat valleys are tributaries to the Buried Lethbridge Valley in Cypress County.

The Buried Skiff Valley trends mainly southwest-northeast, and is present in the western part of the County. The Buried Skiff Valley is approximately six to ten kilometres wide, with local relief being up to 60 metres. Sand and

13 See glossary
14 See glossary

gravel deposits can be expected in association with the Buried Skiff Valley, where the thickness of the sand and gravel deposits is expected to be mainly less than 15 metres (see page A-22).

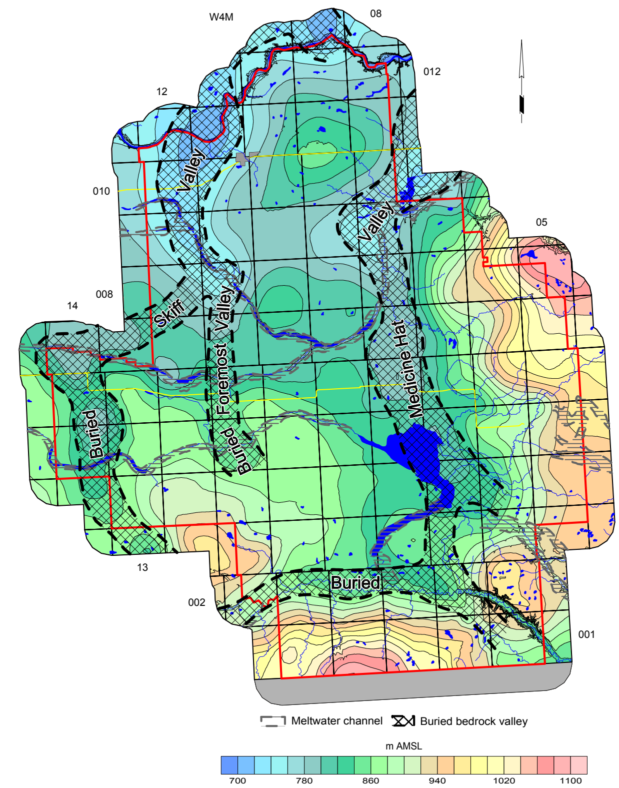


Figure 9. Bedrock Topography

The Buried Medicine Hat Valley trends mainly south-north, and is present in the east-central part of the County. The Buried Medicine Hat Valley is approximately six to ten kilometres wide, with local relief being mainly less than 40 metres. Sand and gravel deposits can be expected in association with the Buried Medicine Hat Valley, where the thickness of the sand and gravel deposits is expected to be mainly less than 15 metres. The areas where the greater thicknesses of sand and gravel deposits are expected are in the vicinity of Pakowki Lake and in township 002, ranges, 07, 09 and 10, W4M.

The Buried Foremost Valley trends mainly south-north, and is a tributary to the Buried Skiff Valley. The Buried Foremost Valley is mainly less than six kilometres wide, with local relief being less than 30 metres.

The lower sand and gravel deposits are composed of fluvial deposits. Lower sand and gravel deposits are identified mainly in association with linear bedrock lows, as shown below on Cross-Section C-C’. In these areas, the total thickness of the lower sand and gravel deposits can be more than ten metres (see CD-ROM).

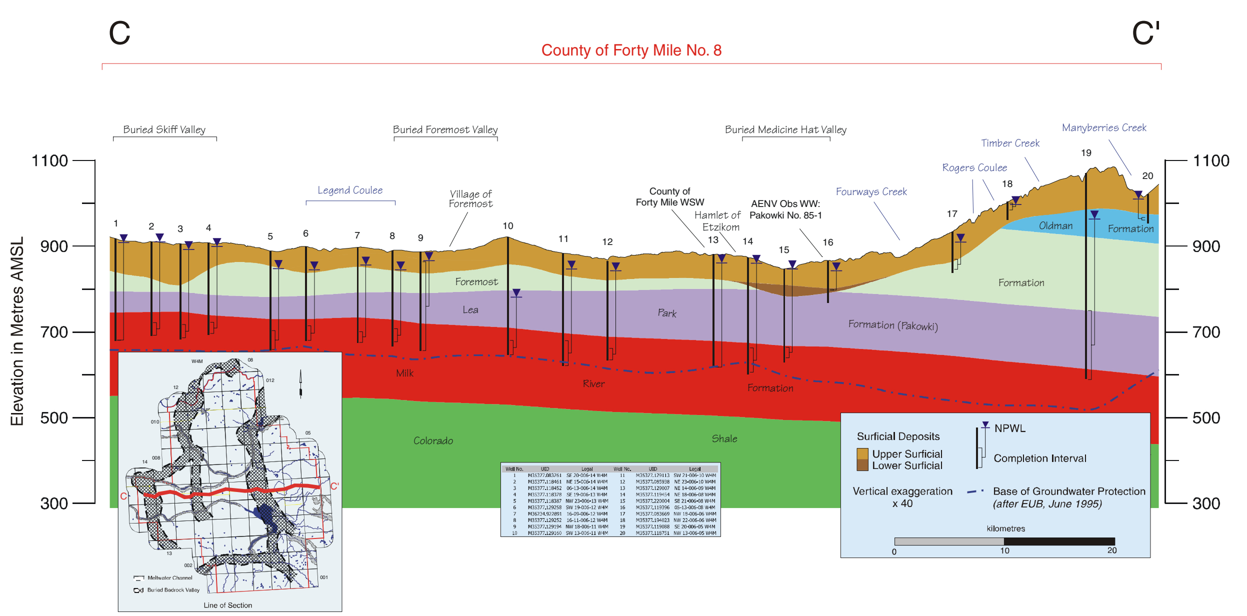


Figure 10. Cross-Section C - C'

In the County, there are several linear bedrock lows that trend west to east and are indicated as being of meltwater origin. Because sediments associated with the lower sand and gravel deposits are indicated as being present in parts of the meltwater channels, it is possible that the meltwater channels were originally tributaries to the buried bedrock valleys. The major meltwater channels in the County have been outlined by Shetsen (1990).

The upper surficial deposits are either directly or indirectly a result of glacial activity. The deposits include till, with minor sand and gravel deposits of meltwater origin, which are expected to occur mainly as isolated pockets. The thickness of the upper surficial deposits is mainly greater than 25 metres. Upper surficial deposits are present throughout most of the County (see CD-ROM). The upper sand and gravel deposits are mainly less than five metres thick (see CD-ROM).

Sand and gravel deposits can occur throughout the surficial deposits. The total thickness of sand and gravel deposits is generally less than five metres but can be more than five metres in association with linear bedrock lows.

The combined thickness of all sand and gravel deposits has been determined as a function of the total thickness of the surficial deposits. Over approximately 80% of the County where sand and gravel deposits are present, the sand and gravel deposits are less than 10% of the total thickness of the surficial deposits, as shown on the adjacent figure. The areas where sand and gravel deposits constitute more than 10% of the total thickness of the surficial deposits may be in areas of buried bedrock valleys or meltwater channels.

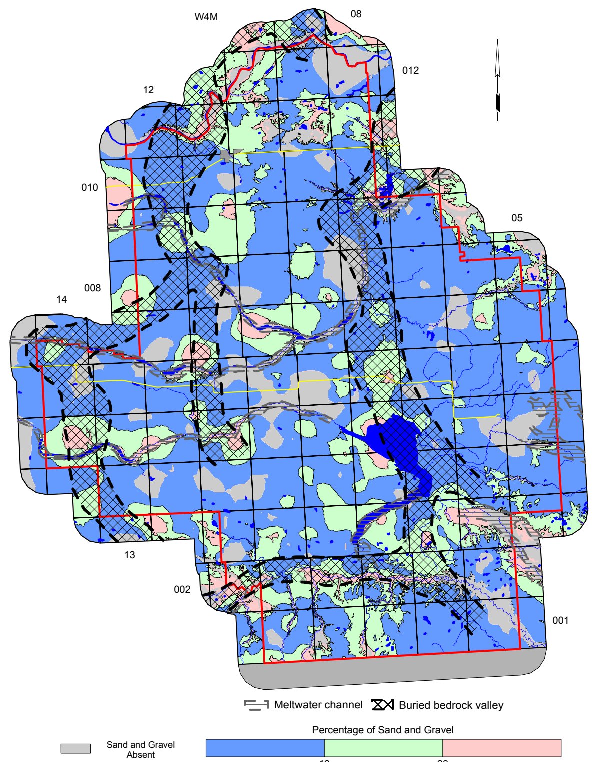


Figure 11. Amount of Sand and Gravel in Surficial Deposits

5.2.2 Sand and Gravel Aquifer(s)

The main aquifers in the surficial materials are sand and gravel deposits. In order for a sand and gravel deposit to be an aquifer, it must be saturated; if not saturated, a sand and gravel deposit is not an aquifer. The top of the surficial aquifers has been determined from the non-pumping water level in water wells that are less than 20 metres deep. The base of the surficial deposits is the bedrock surface.

Since the Sand and Gravel Aquifer(s) are not present everywhere, the actual aquifer that is developed at a given location is usually dictated by the aquifer that is present. Over more than 10% of the County, the sand and gravel deposits are not present, or if present, are not saturated; these areas are designated as grey on the adjacent map. In the County, the thickness of the Sand and Gravel Aquifer(s) is generally less than five metres, but can be more than five metres in linear bedrock lows, as shown in Figure 12, in Appendix A and on the CD-ROM.

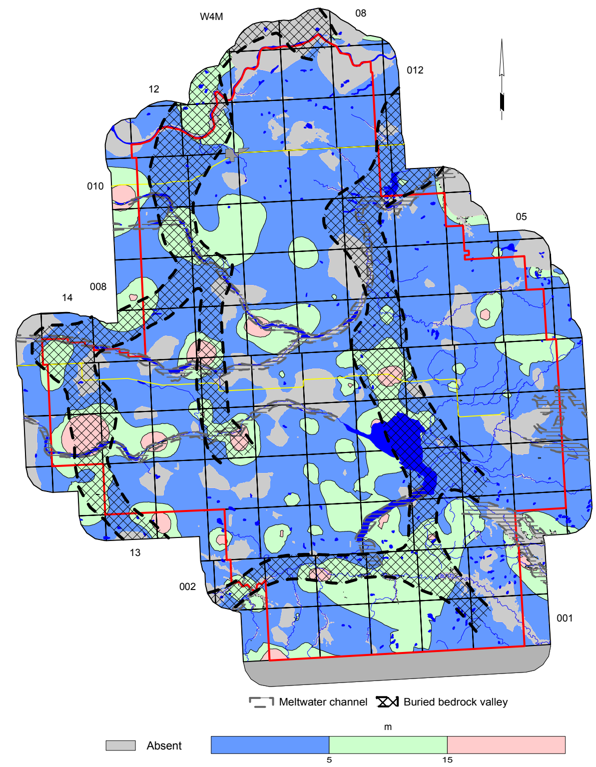


Figure 12. Thickness of Sand and Gravel Aquifer(s)

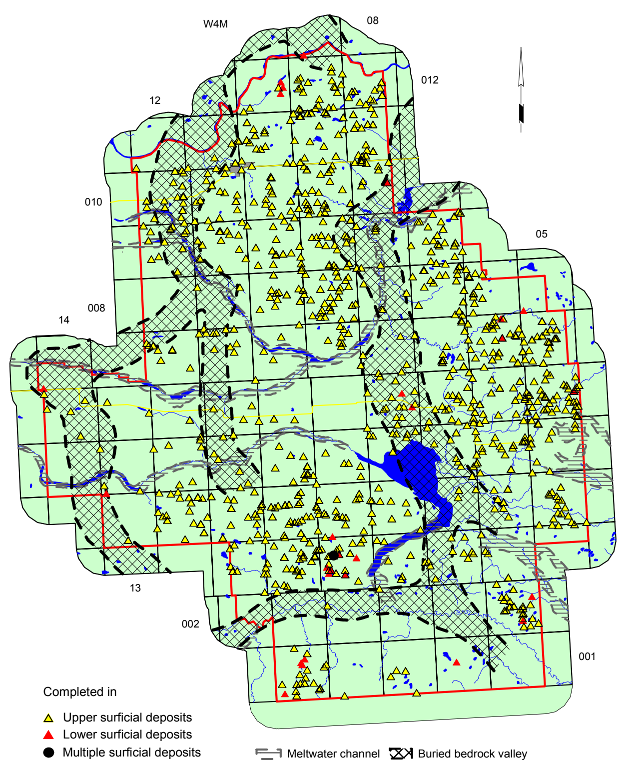


Figure 13. Water Wells Completed in Surficial Deposits

Of the 2,548 water wells in the database, 81 were defined as being completed in surficial aquifers, based on lithologic information and water well completion details. From the present hydrogeological analysis, 1,180 water wells are completed in aquifers in the surficial deposits. Of the 1,180 water wells, 1,148 are completed in aquifers in the upper surficial deposits, 31 are completed in aquifers in the lower surficial deposits, and one water well is completed in multiple surficial aquifers. This number of water wells (1,180) is 14 and a half times the number (81) determined to be completed in aquifers in the surficial deposits, based on lithologies given on the water well drilling reports. The larger number is obtained by comparing the elevation of the reported depth of a water well to the elevation of the bedrock surface at the same location. For example, if only the depth of a water well is known, the elevation of the completed depth can be calculated. If the elevation of the completed depth is above the elevation of the bedrock surface determined from the gridded bedrock topographic surface at the same location, then the water well is considered to be completed in an aquifer in the surficial deposits. Water wells completed in the lower surficial deposits appear to have been drilled in a few clustered areas mainly in the vicinity of linear bedrock lows, and water wells completed in the upper surficial deposits are located throughout the County, as shown above in Figure 13.

In the County, there are 39 records for surficial water wells with apparent yield data, which is 3% of the 1,180 surficial water wells. Eight (20.5%) of the 39 water wells completed in the Sand and Gravel Aquifer(s) have apparent yields that are less than ten m³/day, 23 (59%) have apparent yield values that range from 10 to 100 m³/day, and eight (20.5%) have apparent yields that are greater than 100 m³/day. In addition to the 39 records for surficial water wells with apparent yield data, there are 56 records that indicate that the water test hole is "dry". In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to each of the 56 dry test holes prior to gridding.

Aquifer	No. of Water Wells with Values for Apparent Yield (*)	Number of Water Wells with Apparent Yields <10 m³/day	10 to 100 m³/day	>100 m³/day
Upper Surficial	29	8	17	4
Lower Surficial	10	0	6	4
Totals	39	8	23	8

* - does not include dry test holes

Table 4. Apparent Yields of Sand and Gravel Aquifer(s)

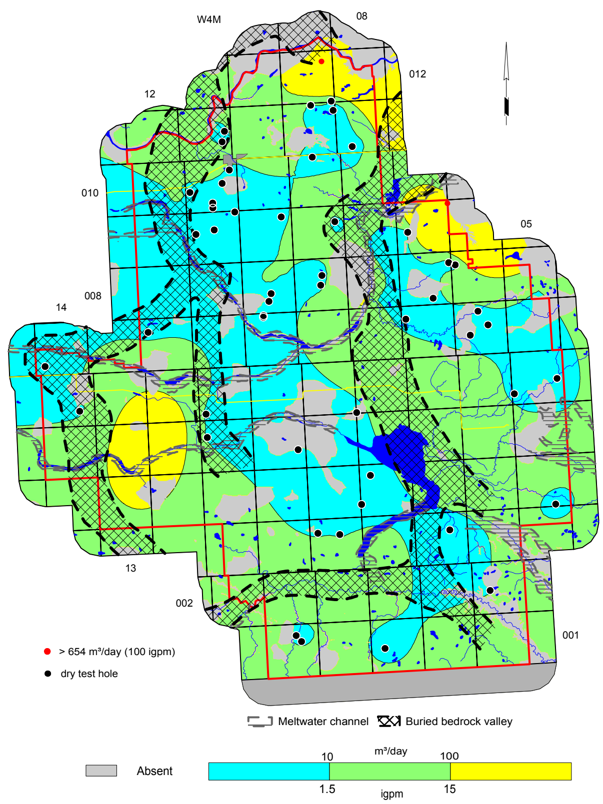


Figure 14. Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s)

The adjacent map shows expected yields for water wells completed in the Sand and Gravel Aquifer(s).

Based on the aquifers that have been developed by existing water wells, these data show that water wells with yields of more than 100 m³/day from the Sand and Gravel Aquifer(s) cannot be expected in most of the County where the Sand and Gravel Aquifer(s) are present.

Apparent yields for water wells completed in the Sand and Gravel Aquifer(s) are mainly less than 100 m³/day.

There is a significant number of dry water test holes that have been drilled or bored throughout the County. Of the 56 "dry" water test holes, 76% were drilled or bored to less than 30 metres below ground surface.

5.2.2.1 Chemical Quality of Groundwater from Surficial Deposits

Groundwaters from an aquifer in the surficial deposits can be expected to be chemically hard, having a total hardness of at least a few hundred mg/L, and a dissolved iron concentration such that the groundwater must be treated before being used for domestic needs.

In the County of Forty Mile, groundwaters from the surficial aquifers mainly have a chemical hardness of greater than 200 mg/L (see CD-ROM).

The Piper tri-linear diagram[15] for the surficial deposits (page A-31) shows that the groundwaters from the surficial deposits are a bicarbonate or sulfate-type with no dominant cation. Nearly 85% percent of the groundwaters from the surficial deposits have a TDS concentration of more than 500 mg/L. Seventy-three percent of the groundwaters from the surficial deposits are reported to have dissolved iron concentrations of less than or equal to the aesthetic objective (AO) of 0.3 mg/L. However, many iron analyses results are questionable due to varying sampling and analytical methodologies.

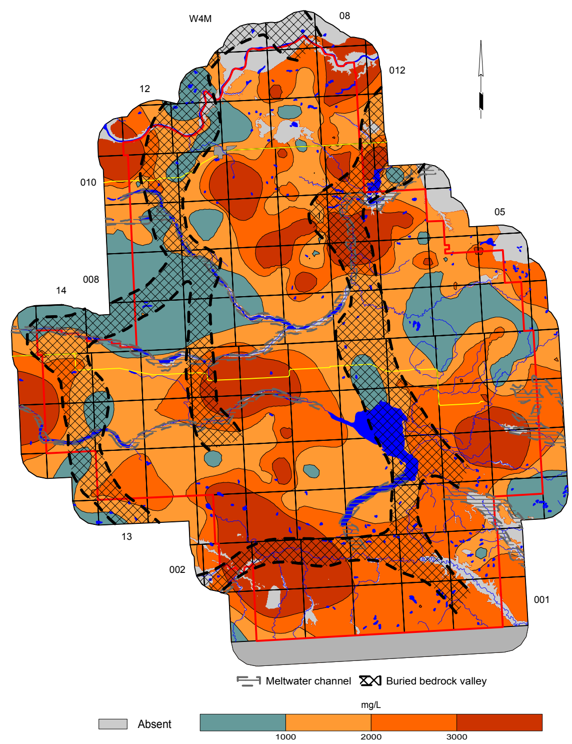


Figure 15. Total Dissolved Solids in Groundwater from Surficial Deposits

In some areas, the groundwater chemistry of the surficial aquifers is such that sulfate is the major anion[16]. The groundwaters with elevated levels of sulfate generally occur in areas where there are elevated levels of total dissolved solids. There are very few groundwaters from the surficial deposits with appreciable concentrations of the chloride ion; in more than 80% of the samples analyzed for surficial deposits in the County, the chloride ion concentration is less than 100 mg/L (see CD-ROM).

In the County, the Nitrate + Nitrite (as N) concentrations in the groundwaters from the surficial deposits exceed the maximum acceptable concentrations (MAC) of ten mg/L for the surficial aquifers in 28 of the 196 groundwater samples analyzed (up to about 1986). A plot of Nitrate + Nitrite (as N) in surficial aquifers is on the accompanying CD-ROM.

Constituent	No. of Analyses	Range for County in mg/L Minimum	Maximum	Median	Recommended Maximum Concentration SGCDWQ
Total Dissolved Solids	333	130	10,704	1,455	500
Sodium	238	1	570	197	200
Sulfate	335	2	10,509	413	500
Chloride	335	0	2,220	28	250
Nitrate + Nitrite (as N)	196	0	270	0.1	10

Concentration in milligrams per litre unless otherwise stated
Note: indicated concentrations are for Aesthetic Objectives except for Nitrate + Nitrite (as N), which is for Maximum Acceptable Concentration (MAC)
SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality Federal-Provincial-Territorial Committee on Drinking Water, April 2003

Table 5. Concentrations of Constituents in Groundwaters from Surficial Deposits

The minimum, maximum and median[17] concentrations of TDS, sodium, sulfate, chloride and Nitrate + Nitrite (as N) in the groundwaters from water wells completed in the surficial deposits in the County have been compared to the Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ) in the adjacent table. The range of concentrations shown in Table 5 is from values in the groundwater database; however, the extreme minimum and maximum concentrations generally represent less than 0.2% of the total number of analyses and should have little effect on the median values. These extreme values are not used in the preparation of the figures.

Of the five constituents that have been compared to the SGCDWQ, median concentrations of TDS exceed the guidelines.

15 See glossary
16 See glossary
17 See glossary

5.2.3 Upper Sand and Gravel Aquifer

The Upper Sand and Gravel Aquifer includes saturated sand and gravel deposits in the upper surficial deposits. Typically, these aquifers are present within the surficial deposits at no particular depth. Saturated sand and gravel deposits in the upper surficial deposits are not usually continuous over large areas but are expected over approximately 80% of the County.

5.2.3.1 Aquifer Thickness

The thickness of the Upper Sand and Gravel Aquifer is a function of two parameters: (1) the elevation of the non-pumping water-level surface associated with the surficial deposits; and (2) the depth to the bedrock surface or the depth to the top of the lower surficial deposits when present. In the County, the thickness of the Upper Sand and Gravel Aquifer is mainly less than five metres but can be more than 15 metres in the buried bedrock valleys.

5.2.3.2 Apparent Yield

The permeability of the Upper Sand and Gravel Aquifer can be high. The high permeability combined with significant thickness leads to an extrapolation of high yields for water wells; however, because the sand and gravel deposits occur mainly as hydraulically discontinuous pockets, the long-term yields of the water wells are expected to be less than the apparent yields. The long-term yields for water wells completed through this Aquifer are expected to be mainly less than those shown on the adjacent figure.

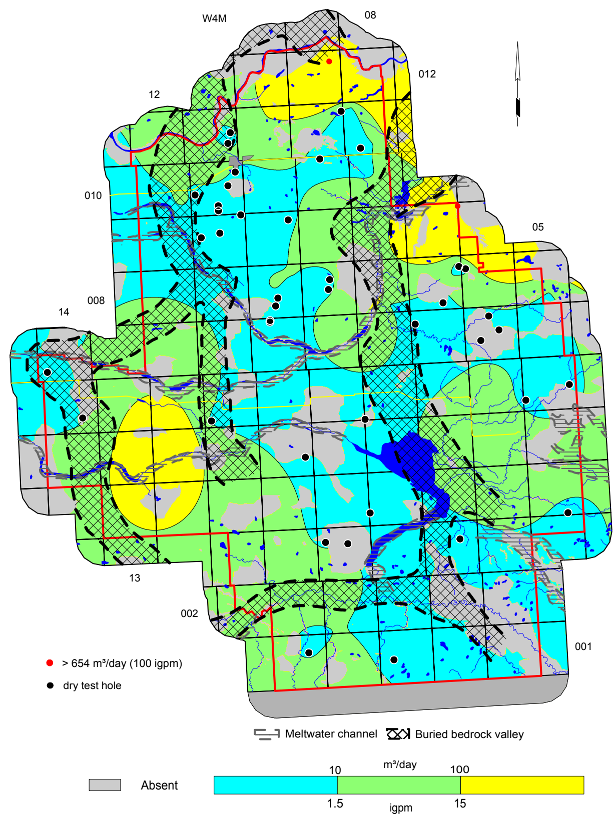


Figure 16. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

Where the Upper Sand and Gravel Aquifer is absent and where the yields are low, the development of water wells for the domestic needs of single families may not be possible from this Aquifer, and construction of a water supply well into the underlying bedrock may be the only alternative, provided that yields and quality of groundwater from the bedrock aquifer(s) are suitable.

Figure 16 indicates that in more than 80% of the County, water wells completed through the Upper Sand and Gravel Aquifer are expected to have apparent yields that are less than 100 m³/day. In the County, there are 42 "dry" water test holes completed in the Upper Sand and Gravel Aquifer.

In the County, there are 27 licensed and/or registered water wells that are completed through the Upper Sand and Gravel Aquifer, for a total authorized diversion of 38 m^3/day (Table 1, page 7). Fourteen of the 27 licences and registrations for water wells completed through the Upper Sand and Gravel Aquifer could be linked to a water well in the AENV groundwater database.

5.2.4 Lower Sand and Gravel Aquifer

The Lower Sand and Gravel Aquifer is a saturated sand and gravel deposit that occurs at the base of the surficial deposits in the deeper part of the linear bedrock lows. The top of the lower sand and gravel deposits is limited to areas where the base of the sand and gravel directly overlies the bedrock.

5.2.4.1 Aquifer Thickness

The thickness of the Lower Sand and Gravel Aquifer is mainly less than five metres (see CD-ROM).

5.2.4.2 Apparent Yield

The ten apparent yield values for individual water wells completed through the Lower Sand and Gravel Aquifer range from less than ten m³/day to more than 65 m³/day. The most notable areas where yields of more than 65 m³/day are expected are mainly in association with the Buried Medicine Hat Valley and the meltwater channels in the eastern part of the County.

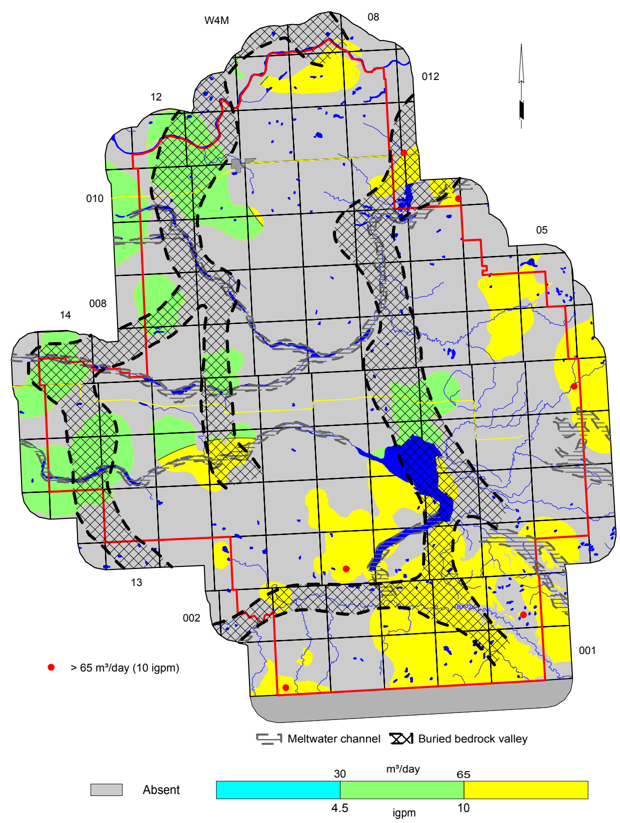


Figure 17. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

In the County, there is one licensed authorization for a water well that is completed through the Lower Sand and Gravel Aquifer, for a total authorized diversion of 3.4 m^3/day. This water well could not be linked to a water well in the AENV groundwater database.

From November 1993 to March 1995, drilling programs were conducted in four areas in the County by AAFC-PFRA under the Canada – Alberta Environmentally Sustainable Agriculture Agreement (CAESA) in order to determine if there was a potential for groundwater development in the Lower Sand and Gravel Aquifer. The four areas were: (1) Manyberries Area, (2) 003-09 W4M – Area North of Milk River, (3) Skiff Area, and (4) Etzikom Area (CAESA, Mar 1993, 1994, Apr 1994, 1995).

Based on the results of the drilling program and AAFC-PFRA's review of existing aquifer test and groundwater chemistry data, AAFC-PFRA indicated the following locations as having the best potential for groundwater development in the Lower Sand and Gravel Aquifer:

- AREA 1 (Manyberries)

Aquifer tests conducted with water test holes drilled in NW 13-006-05 W4M (NW 13) and in SE 24-006-05 W4M (SE 24) indicated that an apparent yield of in the order of 100 m³/day may be expected in NW 13 and an apparent yield in the order of 50 m³/day may be expected in SE 24.

A chemical analysis of a groundwater sample from the NW 13 water test hole indicates there is a TDS of 1,729 mg/L, a sulfate concentration of 425 mg/L, a chloride concentration of 15 mg/L, and a nitrate concentration of 1 mg/L (CAESA, March 1993).

A chemical analysis of a groundwater sample from the SE 24 water test hole indicates there is a TDS of 3,019 mg/L, a sulfate concentration of 954 mg/L, a chloride concentration of 62.3 mg/L, and a nitrate concentration of 0.05 mg/L (CAESA, April 1994).

- AREA 2 (003-09 W4M – North of the Milk River)

Previous aquifer tests conducted in 1980 with two existing water wells completed in the Lower Sand and Gravel Aquifer in NE 07-003-09 W4M (NE 07) and in SW 17-003-09 W4M (SW 17) indicated apparent yields ranging from 30 to 50 m³/day; however, the Lower Sand and Gravel Aquifer extent and potential in this area is expected to be limited. Groundwater samples were collected in 1994 from the NE 07 and SW 17 water test holes.

A chemical analysis of a groundwater sample from the NE 07 water test hole indicates there is a TDS of 1,262 mg/L, a sulfate concentration of 254 mg/L, a chloride concentration of 50.2 mg/L, and a nitrate concentration of 0.14 mg/L.

A chemical analysis of a groundwater sample from the SW 17 water test hole indicates there is a TDS of 1,355 mg/L, a sulfate concentration of 240 mg/L, a chloride concentration of 67 mg/L, and a nitrate concentration of 0.16 mg/L (CAESA, April 1994).

- AREA 3 (Skiff)

Numerous water test holes were drilled from 1993 to 1995 in the Skiff area in order to find an alternative water supply to the Milk River Aquifer for the Hamlet of Skiff. Following the drilling program, the water test hole drilled to 128 metres below ground surface into the Lower Sand and Gravel Aquifer in NW 36-006-15 W4M (NW 36) was considered to have the best potential for groundwater development and further exploration. An attempt to install a piezometer with a completion interval from 115 to 120 metres below ground surface in the lower sand and gravel deposits was unsuccessful because the drill hole collapsed. Instead, the piezometer was completed in the shallow upper sand and gravel deposits that were encountered from 30 to 40 metres below ground surface.

A chemical analysis of a groundwater sample collected in the Upper Sand and Gravel Aquifer from the NW 36 piezometer indicates there is a TDS of 438 mg/L, a sulfate concentration of 203 mg/L, a chloride concentration of 8.1 mg/L, and a nitrate concentration of 3.7 mg/L (CAESA, April 1994).

- AREA 4 (Etzikom)

In March 1995, seven water test holes were drilled in township 006 and ranges 08 and 09, W4M. None of these seven water test holes encountered a Lower Sand and Gravel Aquifer suitable for groundwater development. A water test hole drilled south of Pakowki Lake in SW 27-004-08 W4M (SW 27) was completed in the Lower Sand and Gravel Aquifer associated with the Buried Medicine Hat Valley. A two-hour aquifer test with the SW 27 water test hole produced more than 45 lpm. A field test of a groundwater sample collected from the SW 27 water test hole indicated a TDS of 1,300 mg/L (CAESA, March 1995).

In the groundwater database, there is no indication that there has been further drilling of water test holes completed in the Lower Sand and Gravel Aquifer in any of the four areas studied by CAESA.

5.3 Bedrock

5.1.2 Bedrock Aquifers

The upper bedrock includes formations that are generally less than 200 metres below the bedrock surface. In the County, the upper bedrock includes the Bearpaw, Oldman, Foremost, Lea Park (Pakowki) and Milk River formations, as shown below on cross-section D-D' (see page A-16). Also shown on cross-section D-D' is the Colorado Shale. Some of this bedrock contains saturated rocks that are permeable enough to transmit groundwater for a specific need. Water wells completed in bedrock aquifers usually do not require water well screens, although some of the sandstones may be friable[18] and water well screens are a necessity.

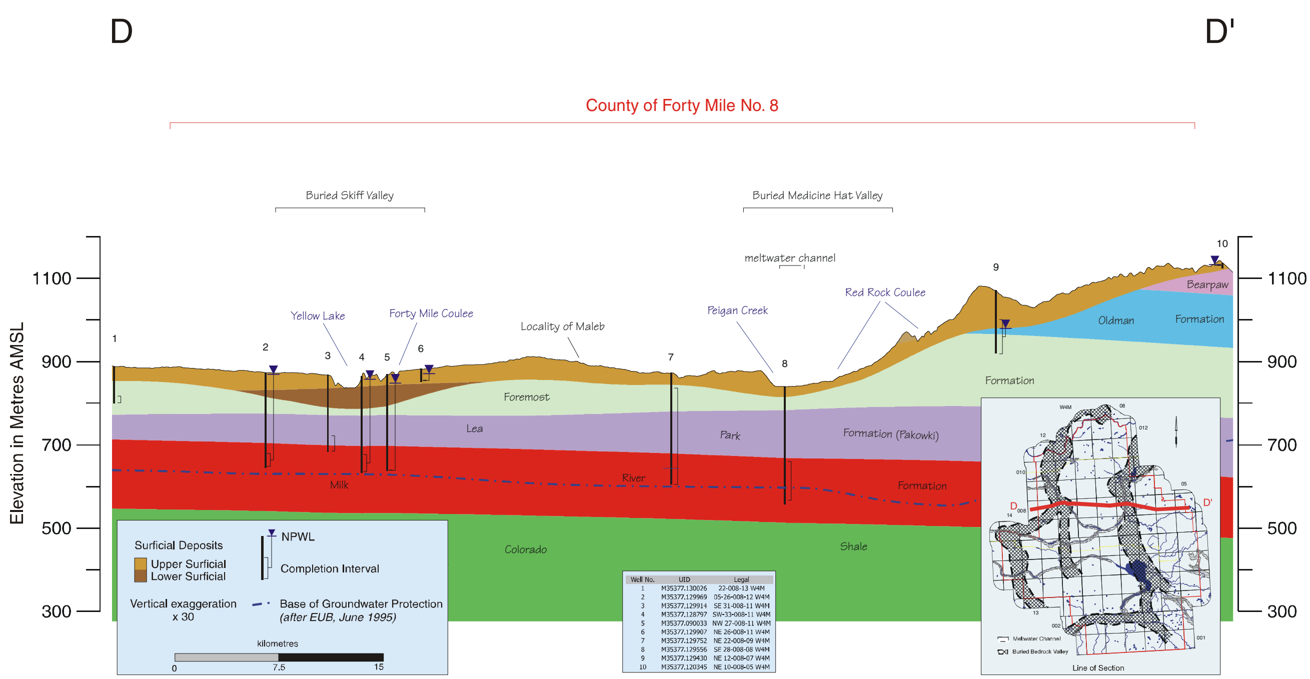


Figure 18. Cross-Section D - D'

In the study area, the Base of Groundwater Protection is variable, extending from a depth of 25 metres to a depth of over 450 metres below ground surface. In the County, the Base of Groundwater Protection is mainly below the completion interval of water wells completed in the Milk River Aquifer. A map showing the depth to the Base of Groundwater Protection is given in Figure 5 on page 9 of this report, in Appendix A (Page A-9), and on the CD-ROM.

[18] See glossary

5.3.1 Geological Characteristics

The upper bedrock in the County study area includes the Bearpaw Formation, the Belly River Group, the Lea Park (Pakowki) Formation, and the Milk River Formation. The Belly River Group includes the Oldman and Foremost formations. The adjacent bedrock geology map, showing the subcrop of different geological units, has been prepared in part from the interpretation of geophysical logs related to oil and gas activity.

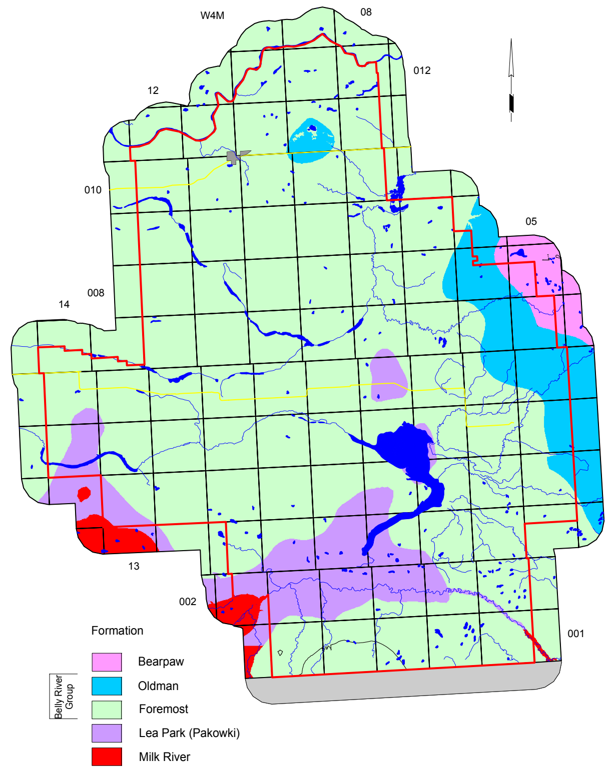


Figure 19. Bedrock Geology

The Bearpaw Formation is in the order of 70 metres thick and is the upper bedrock in the extreme northeastern part of the study area. The Bearpaw Formation includes transgressive, shallow marine (shoreface) and open marine facies[19] deposits. The Bearpaw Formation consists of marine shale, siltstone and minor sandstone layers except in some areas where the thickness of the sandstone layers can be significant. The Bearpaw Formation "represents the final widespread marine unit in the Western Canada Foreland Basin" (Catuneanu et al, 1997). In the study area, the Bearpaw Formation is composed mainly of shale and as such is a regional aquitard.

The Oldman Formation is present in the eastern parts of the County and has a maximum thickness of 100 metres. The Oldman Formation is composed of continental deposits, sandstone, siltstone, shale and coal. The Oldman Formation is the upper part of the Belly River Group.

There will be no direct review of the Bearpaw or Oldman formations in the text of this report; in the County, there are no water wells completed in the Bearpaw or Oldman aquifers and, therefore, there are insufficient or no hydrogeological data within the study area to prepare meaningful maps. The only maps association with the Bearpaw or Oldman formations to be included on the CD-ROM will be structure-contour maps.

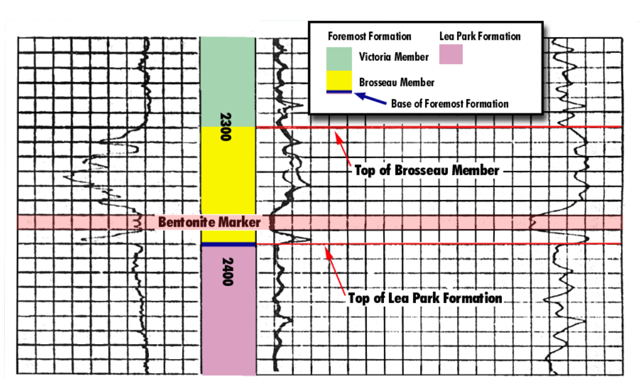


Figure 20. E-Log Showing Base of Foremost Formation

The Foremost Formation is the upper bedrock in most of the County. The Foremost Formation, composed of sandstone and shale units, is in the order of 130 metres thick and is between the overlying Oldman Formation and the underlying Lea Park (Pakowki) Formation. The Foremost Formation includes both sandstone and shale units. Coal zones occur within the Foremost Formation along with minor amounts of ironstone, a chemical deposit.

The Foremost Formation would not be possible without identifying a continuous top for the Lea Park (Pakowki) Formation. The top of the Lea Park (Pakowki) Formation is the bottom of the higher

[19] See glossary

resistivity layer that occurs within a few metres below a regionally identifiable bentonite marker, as shown in Figure 20. This marker occurs approximately 100 metres above the Milk River Shoulder. The Lea Park (Pakowki) Formation is mostly composed of shale, with only minor amounts of bentonitic siltstone present in some areas. Regionally, the Lea Park (Pakowki) Formation is an aquitard[20]. Because the Lea Park (Pakowki) Formation is an aquitard, there will be no direct review in this report. Structure-contour maps associated with the Lea Park (Pakowki) Formation are included in Appendix A and on the CD-ROM.

The Milk River Formation underlies the entire County but subcrops in the extreme southwestern part of the County and has an average thickness of approximately 150 metres. In southern Alberta, the Milk River Formation is composed mostly of thick-bedded sandstone with shale and is the main source of groundwater in the County of Forty Mile, and is also an important supply of natural gas. The portion of the Milk River Formation that has been developed for water supplies mainly occurs in the upper part of the Formation above the Base of Groundwater Protection, as shown on the cross-sections in this report, and on pages A-13 to A-16, and A-18 to A-20.

The Colorado Group, present under the entire County, includes mainly shale units between the Milk River Formation and the Mannville Group. The Viking Formation, a 50-metre-thick sandstone unit that sometimes can be distinguished near the base of the Colorado Group, is composed of well-washed and variable shaly, fine- to coarse-grained sandstone, with subordinate conglomerate and pebbly sandstone. In the southern part of the province, the Viking Formation is developed as a source of groundwater.

In Vulcan County, a water source well completed from 875.0 to 947.5 metres below Kb in the Viking Formation in 10-25-016-18 W4M is authorized to divert 67.6 m³/day for industrial purposes (HCL, December 1995).

5.3.2 Upper Bedrock Completion Aquifer(s)

Of the 2,548 water wells in the database, 286 were defined as being completed below the top of bedrock, based on lithologic information and water well completion details. However, at least a reported completion depth is available for 1,213 water wells completed below the bedrock surface. Assigning a water well to a specific geologic unit is possible only if the completion interval is identified. In order to make use of additional information within the groundwater database, it was assumed that the completion interval was the bottom 20% of the total completed depth of a water well. With this assumption, it has been possible to designate the specific bedrock aquifer of completion for an additional 814 bedrock water wells, giving a total of 1,100 water wells. The remaining 113 of the total 1,213 upper bedrock water wells are identified as being completed in more than one bedrock aquifer, as shown in Table 6. The bedrock water wells are mainly completed in the Milk River Aquifer.

Geologic Unit	No. of Bedrock Water Wells
Oldman	6
Foremost	216
Lea Park (Pakowki)	24
Milk River	845
Colorado	2
Viking/Saline	7
Multiple Completions	113
Total	1,213

Table 6. Completion Aquifer for Upper Bedrock Water Wells

The water wells shown to be completed in the Lea Park (Pakowki) Formation have been determined mainly based on completed depth only and without the benefit of lithologic description or any other supporting documentation, and therefore the completion Formation is suspect.

20

There are 189 records for bedrock water wells that have apparent yield values, which is 16% of the 1,213 bedrock water wells in the County.

Yields for water wells completed in the Upper Bedrock Aquifer(s) are mainly greater than 100 m³/day and have a median apparent yield of 90 m³/day. Many of the areas with yields of more than 300 m³/day are in association with the Buried Medicine Hat Valley and meltwater channels in the southern and southeastern parts of the County. The upper bedrock in these higher yield areas may identify areas of increased permeability resulting from the weathering process.

In addition to the 189 records for bedrock water wells with apparent yield values, there are 15 records that indicate that the water well/water test hole is “dry”, or abandoned with “insufficient water”. In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to the 15 “dry” water test holes prior to gridding.

Of the 189 water well records with apparent yield values, 163 have been assigned to the Milk River Aquifer. Five percent (10) of the 189 water wells completed in bedrock aquifers have apparent yields that are less than ten m³/day, 45% (85) have apparent yield values that range from 10 to 100 m³/day, and 50% (94) have apparent yield values that are greater than 100 m³/day, as shown below in Table 7.

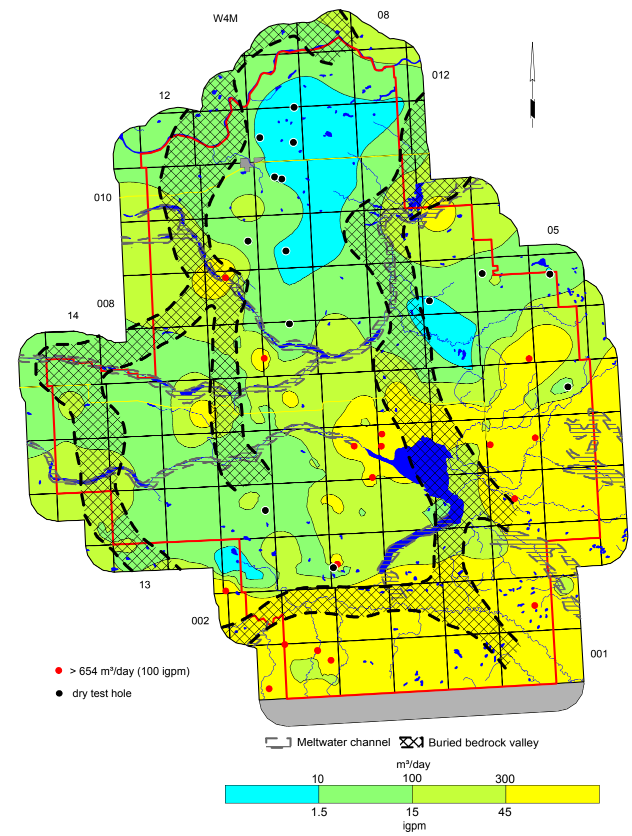


Figure 21. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Aquifer	No. of Water Wells with Values for Apparent Yield (*)	Number of Water Wells with Apparent Yields <10 m³/day	10 to 100 m³/day	>100 m³/day
Oldman	0	0	0	0
Foremost	14	5	6	3
Lea Park (Pakowki)	0	0	0	0
Milk River	163	3	74	86
Multiple Completions	12	2	5	5
Totals	189	10	85	94

Table 7. Apparent Yields of Bedrock Aquifers

5.3.3 Chemical Quality of Groundwater

The Piper tri-linear diagram for bedrock aquifers (page A-31) shows that groundwaters from bedrock aquifers are mainly sodium-bicarbonate or sodium-sulfate-type waters.

The spatial distribution of the water types has been studied and shows that in the northern part of the County, the groundwaters from bedrock aquifers are sodium-chloride-type waters, with the remaining part of the County having mainly sodium-bicarbonate or sodium-sulfate-type waters.

The TDS concentrations in the groundwaters from the Upper Bedrock Aquifer(s) range from less than 500 mg/L to more than 3,000 mg/L, with most of the groundwaters with higher TDS concentrations occurring in the northern part of the County.

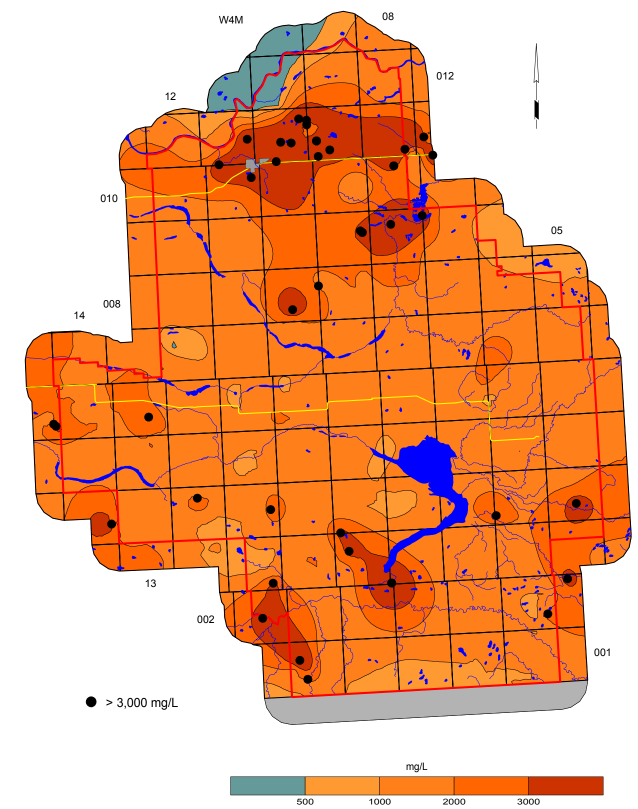


Figure 22. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

The relationship between TDS and sulfate concentrations shows that when TDS values in the groundwaters from the Upper Bedrock Aquifer(s) exceed 1,200 mg/L, the sulfate concentrations exceed 400 mg/L.

In the County, more than 75% of the chloride concentrations in the groundwaters from the Upper Bedrock Aquifer(s) are less than 250 mg/L.

In the County, there were four groundwater samples that had Nitrate + Nitrite (as N) concentrations that were greater than the SGCDWQ for the Upper Bedrock Aquifer(s). Approximately 85% of the total hardness values in the groundwaters from the Upper Bedrock Aquifer(s) are less than 200 mg/L.

In the County, approximately 16% of the groundwater samples from Upper Bedrock Aquifer(s) have fluoride concentrations that are too low (less than 0.5 mg/L) to meet the recommended daily needs of people. Approximately 23% of the groundwater samples from the entire County are between 0.5 and 1.5 mg/L and approximately 61% exceed the MAC for fluoride of 1.5 mg/L, with exceedances of greater than five mg/L occurring in the western part of the County (see CD-ROM).

The minimum, maximum and median concentrations of TDS, sodium, sulfate, chloride and fluoride in the groundwaters from water wells completed in the upper bedrock in the County have been compared to the SGCDWQ in Table 8. Of the five constituents compared to the SGCDWQ, median concentrations of TDS, sodium and fluoride exceed the guidelines.

Constituent	No. of Analyses	Range for County in mg/L Minimum	Maximum	Median	Recommended Maximum Concentration SGCDWQ
Total Dissolved Solids	587	115	12,557	1,402	500
Sodium	444	0	3,475	510	200
Sulfate	585	0	7,750	17	500
Chloride	583	0	3,377	107	250
Fluoride	447	0	11.8	2.2	1.5

Concentration in milligrams per litre unless otherwise stated

Note: indicated concentrations are for Aesthetic Objectives except for Fluoride, which is for Maximum Acceptable Concentration (MAC)

SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality Federal-Provincial-Territorial Committee on Drinking Water, April 2003

Table 8. Concentrations of Constituents in Groundwaters from Upper Bedrock Aquifer(s)

5.3.5 Foremost Aquifer

The Foremost Aquifer comprises the permeable parts of the Foremost Formation, as defined for the present program. The Foremost Formation is present under most of the County, being absent only in parts of the Buried Skiff and Medicine Hat valleys. The structure contours show that the Foremost Formation ranges in elevation from less than 725 to more than 1,100 metres AMSL and has a maximum thickness of 130 metres. The regional groundwater flow direction in the Foremost Aquifer is downgradient to the north and on the eastern and western sides of the County is downgradient inwards (see CD-ROM).

5.3.5.1 Depth to Top

The depth to the top of the Foremost Formation is mainly less than 60 metres and is a reflection of the thickness of the surficial deposits (page A-37).

5.3.5.2 Apparent Yield

The apparent yield values for individual water wells completed through the Foremost Aquifer range from less than ten to greater than 100 m³/day, and have a median apparent yield of 14 m³/day. The areas where data control points are present show that water wells with yields of greater than 100 m³/day are expected to be in the northeastern and southwestern parts of the County, as shown on Figure 23.

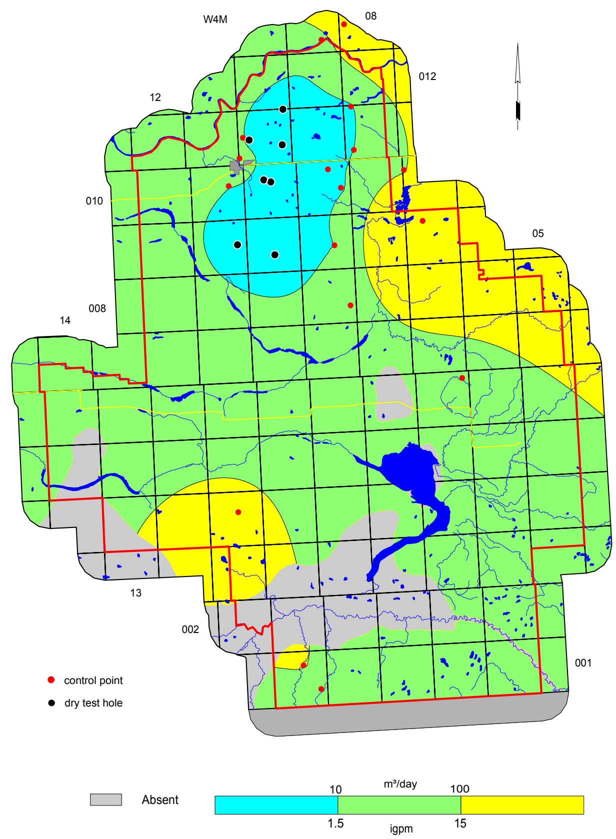


Figure 23. Apparent Yield for Water Wells Completed through Foremost Aquifer

In the County, there are seven "dry" water test holes completed in the Foremost Aquifer.

There are six registered groundwater users that have water wells completed through the Foremost Aquifer, for a total groundwater diversion of ten m³/day. All six registered groundwater users could be linked to a water well in the AENV groundwater database.

5.3.4.3 Quality

The groundwaters from the Foremost Aquifer are mainly a sodium-sulfate-type (see Piper diagram on CD-ROM). Total dissolved solids concentrations are mainly greater than 1,000 mg/L (page A-49), with more than 80% of the groundwater samples having TDS concentrations of greater than 1,000 mg/L. The sulfate concentrations are mainly greater than 100 mg/L, with 40% of the groundwater samples having sulfate concentrations of more than 500 mg/L. Nearly 70% of the chloride concentrations from the Foremost Aquifer are less than 100 mg/L.

5.3.4 Milk River Aquifer

The Milk River Aquifer comprises the permeable parts of the Milk River Formation, as defined for the present program (modified after AGS). The Milk River Formation is present under all of the County and is the upper bedrock in the extreme southwestern part of the County where it subcrops in parts of the Buried Skiff and Medicine Hat valleys. The structure contours show that the Milk River Formation ranges in elevation from less than 540 metres AMSL in the northeastern part of the County to more than 940 metres AMSL in the southwestern part of the County and has an average thickness of 150 metres. The regional groundwater flow direction in the Milk River Aquifer is downgradient to the north, and on the eastern and western sides of the County is downgradient inward, originating from the Sweet Grass Hills in Montana (see CD-ROM).

5.3.4.1 Depth to Top

The depth to the top of the Milk River Formation ranges from less than 50 metres in the southwestern part of the County to more than 300 metres in the eastern part of the County (see page A-41).

5.3.4.2 Apparent Yield

The apparent yields for individual water wells completed through the Milk River Aquifer range from less than ten to more than 300 m³/day, as shown on Figure 24. The areas showing water wells with yields of greater than 300 m³/day are expected to be in the southeastern parts of the County. However, in areas where groundwater levels have fallen (see section 6.4.2), the potential apparent yield would be reduced.

An aquifer test conducted with a water well completed in the Milk River Aquifer in NE 12-007-08 W4M indicated a projected long-term yield of 12 m³/day (HCL, June 2000).

As of March 2004, 98 water wells were reclaimed under the Milk River Aquifer Reclamation and Conservation (MRARC) program funded by AAFC-PFRA, AENV, and the County of Forty Mile. There are 58 of these reclaimed water wells shown on the adjacent map.

There are 179 licensed and/or registered groundwater users that have water wells completed through the Milk River Aquifer, for a total authorized groundwater diversion of 1,422 m³/day, with a median authorized amount of 2.4 m³/day.

Of the 1,422 m³/day authorized diversion, 534 m³/day (38%) has been licensed for municipal use, with a median authorized amount of 8.3 m³/day.

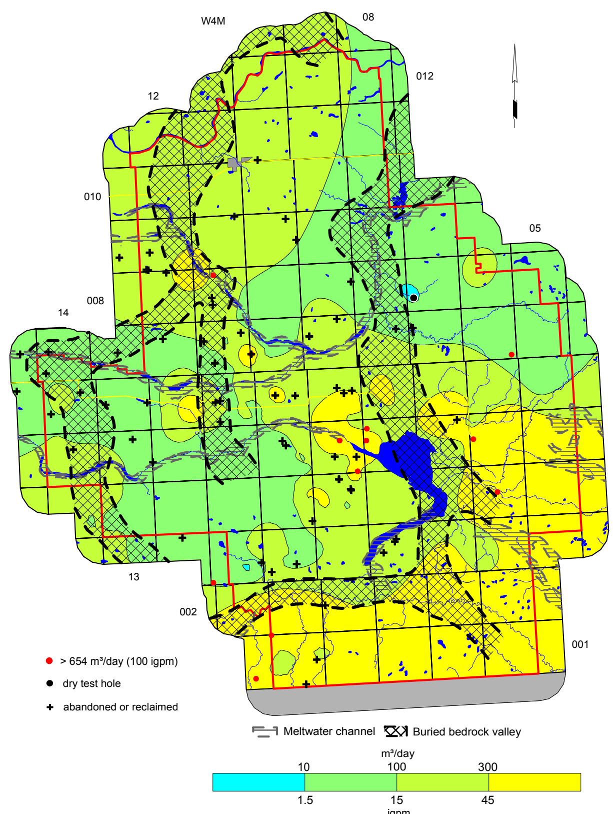


Figure 24. Apparent Yield for Water Wells Completed through Milk River Aquifer

The highest authorized groundwater use is for three water supply wells that are licensed to divert a total of 203 m³/day for the Village of Foremost and for three water supply wells that are licensed to divert a total of 176 m³/day for the Hamlets of Skiff, Etzikom and Manyberries.

Seventy-six of the 179 licensed and/or registered groundwater users could be linked to water wells in the AENV groundwater database.

5.3.4.3 Quality

The groundwaters from the Milk River Aquifer are mainly a sodium-bicarbonate-type water (see CD-ROM). In the south-central part of the County, the groundwaters from the Milk River Aquifer are mainly sodium-sulfate-type waters and in the north-central part of the County, are mainly sodium-chloride-type waters as shown on Figure 25.

Meyboom (1960) distinguished four chemical types of groundwaters from the Milk River Aquifer (Types A, B, C and D). Meyboom demonstrated that the degree of mineralization in groundwaters from the Milk River Aquifer increased to the north, east and west from the Sweet Grass Hills. Type A groundwaters are characterized by a moderate degree of mineralization, sodium-bicarbonate type-waters with TDS concentrations of less than 1,000 mg/L. In Type B groundwaters, the degree of mineralization has decreased and the sulfate concentrations have increased. Type D groundwaters are characterized by a high degree of mineralization, are sodium-chloride-type waters and believed by Meyboom to be unaltered connate[21] water. Type C groundwaters are transitional between Type A and Type D with alkalinity between 1,000 and 1,200 mg/L.

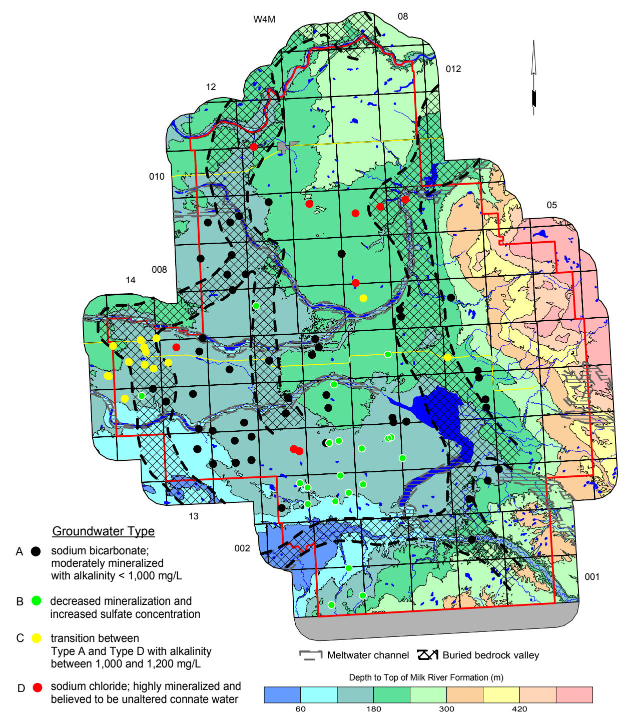


Figure 25. Types of Groundwaters from Milk River Aquifer (modified after Meyboom, 1960)

The four types of groundwaters from the Milk River Aquifer shown on Figure 25 were determined using Meyboom's criteria of varying concentrations of alkalinity, sulfate and chloride from chemical analyses of water wells completed in the Milk River Aquifer and have been compared to the depth to the top of the Milk River Formation. Although there are anomalies, there appears to be a consistent relationship between groundwater type and depth to top of Formation.

Type B groundwaters from the Milk River Aquifer are mainly near the Milk River Formation subcrop and where the depth to top of the Formation is less than 180 metres below ground surface. Type A groundwaters from the Aquifer are mainly where the depth to top of the Formation is between 120 and 180 metres below ground surface. Type C groundwaters from the Aquifer are in the same depth to top of Formation interval as Type A but are primarily located in the Buried Skiff Valley. Type D groundwaters from the Aquifer are mainly where the depth to top of the Formation is between 180 and 240 metres below ground surface.

The TDS concentrations in the groundwaters from the Milk River Aquifer range from less than 500 mg/L to more than 3,000 mg/L, with most of the groundwaters with higher TDS concentrations occurring in the northern part of the County (see page A-43). Nearly 80% of the sulfate concentrations in groundwaters from the Milk River Aquifer are less than 100 mg/L. Sixty percent of the chloride concentrations from the Milk River Aquifer are greater than 100 mg/L, and 75% of the fluoride concentrations from the Milk River Aquifer are less than 0.5 mg/L.

The fluoride concentrations in the groundwaters from the Milk River Aquifer range from less than 0.5 mg/L to more than 5 mg/L in the western part of the County (see page A-44). The median fluoride concentrations in groundwaters from the Milk River Aquifer have been compared to the median fluoride concentrations in groundwaters from the surficial deposits, the Foremost Aquifer and the Lea Park (Pakowki) Aquitard (see page A-45). The bar chart shows that the highest median fluoride concentration in the Milk River Aquifer of 2.54 mg/L is more than two milligrams per litre higher than the groundwaters in the Foremost Aquifer.

[21] Chemical composition of groundwater at time of rock formation and, therefore, not altered by meteoric water

6. GROUNDWATER BUDGET

6.1 Hydrographs

In the County, there are four observation water wells that are part of the AENV regional groundwater monitoring network where water levels are being measured and recorded as a function of time: 1) AENV Obs Water Well (WW): Forty Mile Coulee 86-1 (AENV Obs WW No. 86-1) in SW 33-008-11 W4M; 2) AENV Obs WW: Town of Foremost 2915E (AENV Obs WW No. 2915E) in 16-17-006-11 W4M; 3) AENV Obs WW: Smith Coulee 2469E (AENV Obs WW No. 2469E) in 08-25-003-11 W4M; and 4) AENV Obs WW: Pakowki No. 85-1 (AENV Obs WW No. 85-1) in 05-13-006-008 W4M (see page A-48).

AENV Obs WW No. 86-1 is located on the east side of the Forty Mile Reservoir and is completed from 189 to 230.1 metres below ground surface in the Milk River Aquifer. The water level in AENV Obs WW No. 86-1 has been measured since December 1989, as shown by the blue line in the adjacent graph. From 1989 to 1993, the water level rose in the order of 1.5 metres. From 1993 to early 2000, there was a net rise in water level of 0.3 metres. From early 2000 to early 2002, the water level declined three metres and since early 2002, the water level has risen nearly two metre.

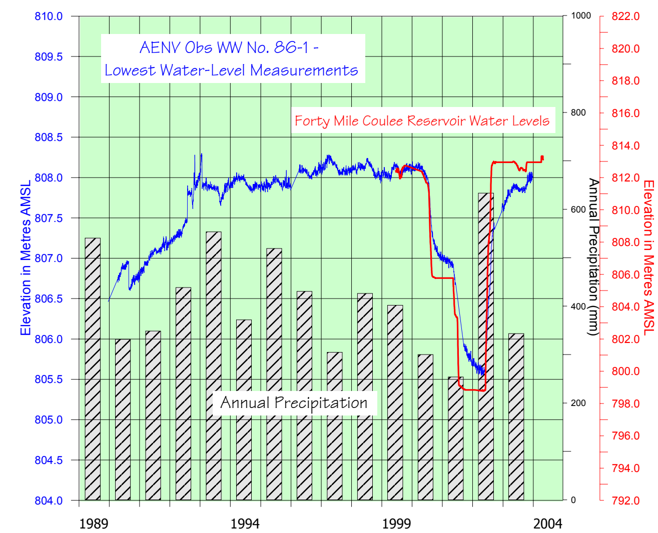


Figure 26. Comparison of Water Levels in AENV Obs WW No. 86-1 to Precipitation and Forty Mile Coulee Reservoir Water Level

The construction of the Forty Mile Coulee Reservoir East Dam was completed in 1986 and the West Dam was completed in 1987. The filling of the Reservoir was finished in late 1989. In order to determine if there is a hydraulic relationship with the Reservoir, the water levels in AENV Obs WW No. 86-1 were compared to the total annual precipitation measured at the Foremost weather station and to the Forty Mile Coulee Reservoir surface-water level. The annual precipitation totals are shown as bars on the graph. The surface water-level measurements from January 1999 to May 2004 were provided by AENV and are shown in the above graph by the red line.

From the data provided in Figure 26, there is a striking relationship between the changes in water level in the Forty Mile Coulee Reservoir and the water level measured in the Milk River Aquifer. The comparison shows that for every one metre change in the water levels measured in AENV Obs WW No. 86-1, the surface-water level in the Forty Mile Coulee Reservoir changes by 5.6 metres. The relationship does not indicate that there is a direct hydraulic connection between the water in the reservoir and the groundwater. Most likely the groundwater level is responding to the pressure being exerted on the confined aquifer by the weight of the water behind the reservoir.

From 1990 to 1993 and from 2000 to 2002, there appears to a close relationship between the annual precipitation and the water-level measurements in AENV Obs WW No. 86-1. For example, from June 8 to June 10, 2002, a total of 176 millimetres of precipitation was measured, and in response to this major recharge event, the water level in AENV Obs WW No. 86-1 rose in the order of two metres and the surface-water level in the Reservoir rose in the order of 13 metres.

AENV Obs WW No. 2915E is located in a Village of Foremost school and completed at a depth of 230 metres below ground surface in the Milk River Aquifer. The water level in AENV Obs WW No. 2915E was measured continuously from 1957 to 1975. Since 1984, manual water-level measurements have been recorded by the Village of Foremost; between 1975 and 1984, there is no record of water levels having been measured.

In 1957, the water level in AENV Obs WW No. 2915E was more than 90 metres above the top of the Milk River Aquifer; by 1987, the water level had declined 45 metres to a level that was 50 metres above the top of the Milk River Aquifer. However, since 1987 the water level has declined less than three metres.

In an area where there are no pronounced seasonal uses of groundwater, the highest yearly water level will mostly occur in late spring/early summer and the lowest yearly water level will be in late winter/early spring. In the adjacent figure, it is apparent that the highest yearly water levels occur in late winter/early spring and the lowest water levels are mainly during summer. This situation is a result of increased groundwater use by the Village of Foremost prior to and during the summer months.

Figure 27. Hydrograph – AENV Obs WW No. 2915E

The Village of Foremost is authorized to divert 74,010 m³/year of groundwater from three water supply wells for municipal purposes.

The past 11 years of monthly groundwater diversion from the three water supply wells were provided by the Village of Foremost. It was noted that the main months of groundwater diversion averaged over the 11 years occurred in May, June and October, as shown below in Figure 28.

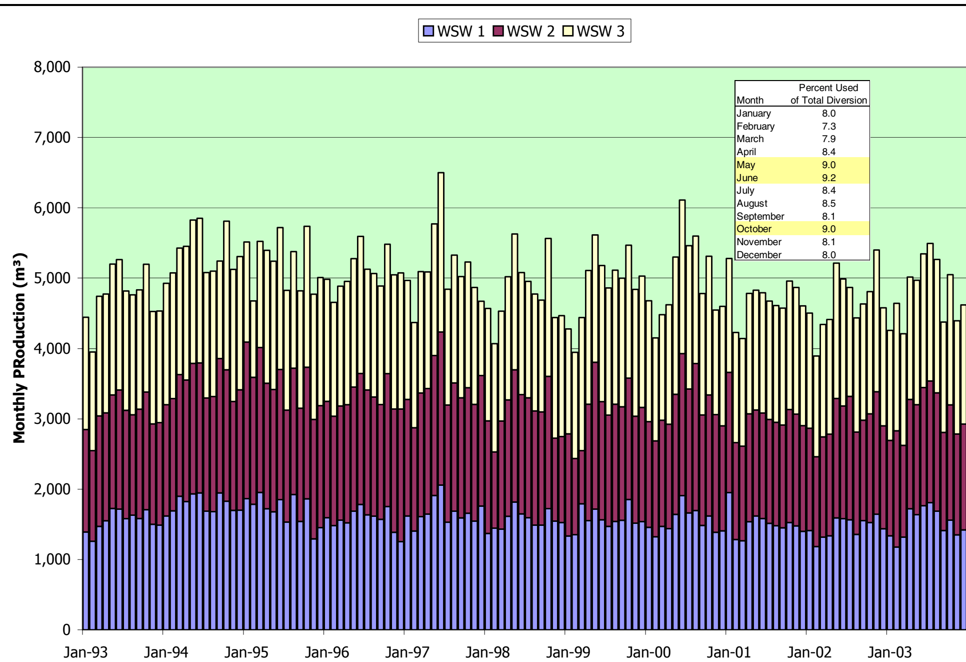


Figure 28. Monthly Groundwater Diversion – Village of Foremost WSW Nos. 1, 2, 3

In order to determine the aquifer parameters at the site of AENV Obs WW No. 2915E, a model aquifer (IAAM)[22] was used to calculate the water levels at a location corresponding to the AENV observation water well. The calculated water levels in the observation water well are based on estimated groundwater diversion from the three producing water supply wells from 1957 to 1992, and actual groundwater diversion data from 1993 to 2003 that were provided by the Village of Foremost. Meyboom (1960) indicated the average annual groundwater diversion from the Village of Foremost water supply wells was 31,430 m³. AGRA Earth & Environmental (June 1998) reported the groundwater diversion in 1987 and in 1997 to be essentially equal. For the remaining years, the annual groundwater diversion was estimated, as shown in Figure 29. In addition, monthly groundwater diversion was estimated by using the monthly groundwater percentages determined from the 1993 to 2003 reported groundwater diversions that were shown in Figure 28. There was no attempt to estimate the groundwater diversion from the individual water supply wells. The model aquifer has an aquifer transmissivity of 2.6 metres squared per day (m²/day) and a corresponding storativity of 0.00003.

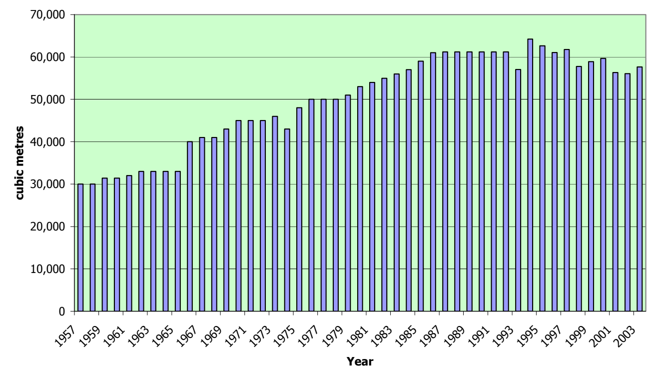


Figure 29. Estimated Annual Groundwater Diversion – Village of Foremost Water Supply Wells

The calculations are based on an aquifer that is homogeneous and isotropic and no allowance has been made for aquifer recharge. Therefore, if there were a decrease in recharge to the aquifer, a water-level decline could occur and the simulation would not account for the change. There is a reasonable match between the measured and the calculated water levels in AENV Obs WW No. 2915E, as shown in Figure 30.

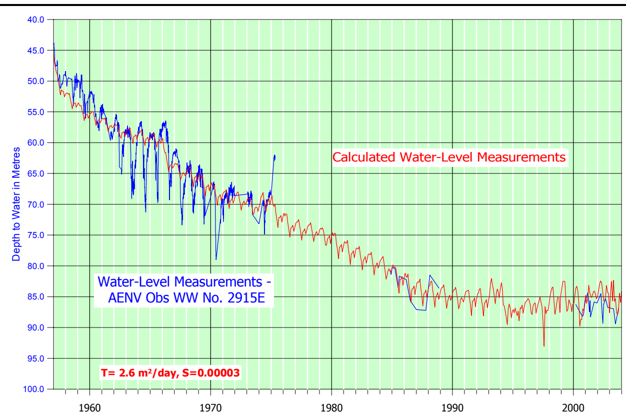


Figure 30. Water-Level Comparison – AENV Obs WW No. 2915E – Measured and Calculated

The above aquifer parameters, including a hypothetical increase in groundwater diversion to 275 m³/day from the three water supply wells in 2005, were used to determine approximately how many years before the calculated water levels in AENV Obs WW No. 2915E would decline below the top of the Milk River Aquifer. It is estimated the water-level decline would take another 180 years, as shown in the adjacent figure.

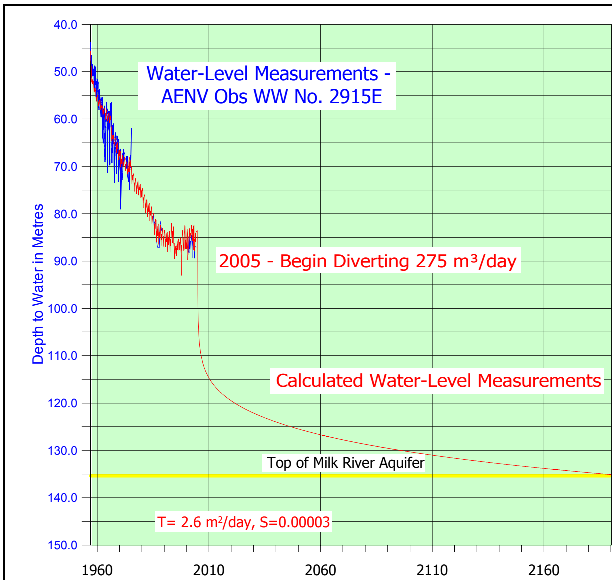


Figure 31. Water-Level Comparison – After 180 Years in AENV Obs WW No. 2915E

[22] See glossary

AENV Obs WW No. 2469E is completed from 158.5 to 165.2 metres below ground surface in the Milk River Aquifer. The water level in AENV Obs WW No. 2469E has been measured since March 1988. The hydrograph shows that there has been a net decline of four metres over the entire monitoring interval.

The closest registered or licensed groundwater user to AENV Obs WW No. 2469E in 08-25-003-11 W4M is a water well in NE 26-003-11W4M that is completed at a depth of 207 metres below ground surface in the Milk River Aquifer and is registered to divert 6.5 m³/day. The estimated water well use in townships 003 and 004, ranges 10 and 11, W4M is 370 m³/day (see section 6.2). It may be possible this groundwater use is contributing to the water-level decline shown on Figure 32.

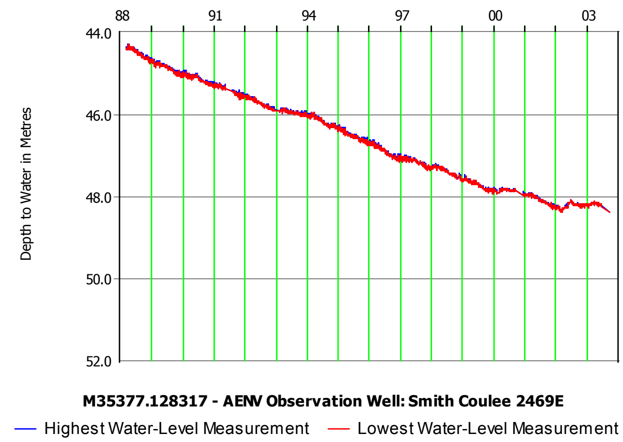


Figure 32. Hydrograph – AENV Obs WW No. 2469E

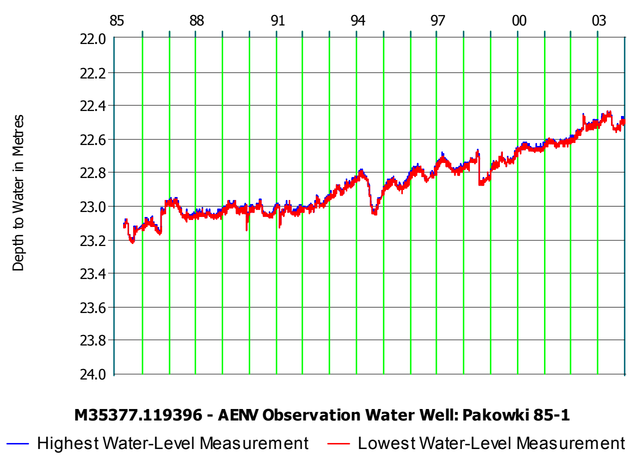


Figure 33. Hydrograph – AENV Obs WW No. 85-1

AENV Obs WW No. 85-1 is located north of Pakowki Lake and is completed from 65.8 to 68.2 metres below ground surface in the Lower Sand and Gravel Aquifer. The water level in AENV Obs WW No. 85-1 has been measured since April 1985. From 1985 to 1991, the water level in AENV Obs WW No. 85-1 rose in the order of 0.1 metres. From 1992 to 2002, the water level rose 0.5 metres, a net rise of 0.6 metres over the entire monitoring period. It is unclear why this water-level rise occurred. AGRA (June 1998) has indicated that the AENV Obs WW No. 85-1 is in an area of discharge to the aquifer and it may be possible that there has been leakage of groundwater from the Milk River Aquifer into the Lower Sand and Gravel Aquifer through leaky or corroded water well casings.

Five chemical analyses are available for the AENV Obs WW 85-1 from 1985 to 1991. There are no significant changes in the chemical quality that would indicate that leakage had occurred from 1985 to 1991. The main water-level rise in AENV Obs WW No. 85-1 has occurred since 1992 and additional chemical analyses would help to determine if there has been groundwater leakage from the Milk River Aquifer into the Lower Sand and Gravel Aquifer.

6.2 Estimated Groundwater Use in the County of Forty Mile

An estimate of the quantity of groundwater removed from each geologic unit in the County of Forty Mile must include both the groundwater diversions with licences and/or registrations and the groundwater diversions without licences and/or registrations. As stated previously on page 8 of this report, the daily water requirement for livestock for the County based on the 2001 census is estimated to be 7,519 cubic metres. As of late 2003, AENV has licensed the use of 4,368 m³/day for livestock, which includes both surface water and groundwater. To obtain an estimate of the quantity of groundwater being diverted from the individual geologic units, it has been assumed that the remaining 3,151 m³/day of water required for livestock watering is obtained from unauthorized groundwater use.

There are 1,466 water wells that are used for domestic/stock or stock purposes. There are 215 licensed and/or registered groundwater users for agricultural (stock) and registration (stock) purposes, giving 1,251 unlicensed and/or not registered stock water wells. (Please refer to Table 1 on page 7 for the breakdown of aquifer of the 215 licensed and/or registered stock groundwater users). By dividing the number of unlicensed and/or not registered stock and domestic/stock water wells (1,251) into the quantity required for stock purposes that is not licensed and/or registered (3,151 m³/day), the average unauthorized water well diverts 2.5 m³/day per stock water well.

Groundwater for household use does not require a licence if the use is less than 1,250 m³/year. Under the *Water Act*, a residence is protected for up to 3.4 m³/day. However, the standard groundwater use for household purposes (a family of four) is 1.1 m³/day. Since there are 1,655 domestic or domestic/stock water wells in the County of Forty Mile serving a population of 3,168, the domestic use per water well is 0.5 m³/day. It is assumed that these 1,655 water wells are active; however, many are very old and may no longer be in use or may have been abandoned.

To obtain an estimate of the groundwater from each geologic unit, there are three possibilities for a water well. A summary of the possibilities and the quantity of water for each use is as follows:

Domestic	0.5 m³/day
Stock	2.5 m³/day
Domestic/stock	3.0 m³/day

Because of the limitations of the data, no attempt has been made to compensate for dugouts, springs or inactive water wells.

Based on using all available domestic, domestic/stock, and stock water wells and corresponding calculations, the following table was prepared. Table 9 on the following page shows a breakdown of the 2,056 (592+402+1,062) water wells for which there is no licence and/or registration used for domestic, stock, or domestic/stock purposes by the geologic unit in which each water well is completed. The final column in the table equals the total amount of groundwater that is being used for both domestic and stock purposes from water wells for which there is no licence and/or registration. The data provided in Table 9 indicate that most of the 3,424 m³/day, estimated to be diverted from domestic, stock, or domestic/stock water wells for which there is no licence and/or registration, is from the Upper Sand and Gravel Aquifer.

Aquifer Designation	Groundwater Diversions from Water Wells With or Without Licences and/or Registrations							Groundwater Diversions With Licences and/or Registrations	Groundwater Diversions Without Licences and/or Registrations
	Number of Domestic	Daily Use (0.5 m³/day)	Number of Stock	Daily Use (2.5 m³/day)	Number of Domestic and Stock	Daily Use (3.0 m³/day)	Totals m³/day	Totals (m³/day)	Totals m³/day
Multiple Surficial Completions	1	0	0	0	0	0	0	0	0
Upper Sand and Gravel	292	140	187	471	481	1,442	2,052	38	2,014
Lower Sand and Gravel	9	4	7	18	10	30	52	0	52
Mulitple Bedrock Completion	23	11	19	48	49	147	206	4	202
Oldman	1	0	2	5	2	6	12	0	12
Foremost	51	24	46	116	75	225	365	10	355
Lea Park (Pakowki)	6	3	2	5	10	30	38	0	38
Milk River	168	80	121	305	416	1,247	1,632	888	744
Colorado Shale	1	0	0	0	1	3	3	2	1
Viking	0	0	1	3	1	3	6	0	6
Unknown	40	19	17	43	17	51	113	196	0
	592	281	402	1,014	1,062	3,184	4,479	1,138	3,424

(1) The values given in the table have been rounded and, therefore, the columns and rows may not add up equally

Table 9. Total Groundwater Diversions by Aquifer

By assigning 0.5 m³/day for domestic use, 2.5 m³/day for stock use and 3.0 m³/day for domestic/stock use, and using the total maximum authorized diversion associated with any licensed and/or registered water well, a map has been prepared that shows the estimated groundwater use in terms of volume per section per day for the County (not including springs).

There are 3,698 sections in the County. In 70% (2,607) of the sections in the County, there is no domestic, stock or licensed and/or registered groundwater user. The groundwater use for the remaining 1,091 sections varies from 0.5 m³/day to 205 m³/day (mainly the Village of Foremost), with an average use per section of 4.6 m³/day (<1 igpm). The estimated water well use per section can be more than 30 m³/day in 17 of the 3,698 sections. There are 56 of the total 253 licensed and/or registered groundwater users in areas where the groundwater use is greater than 30 m³/day.

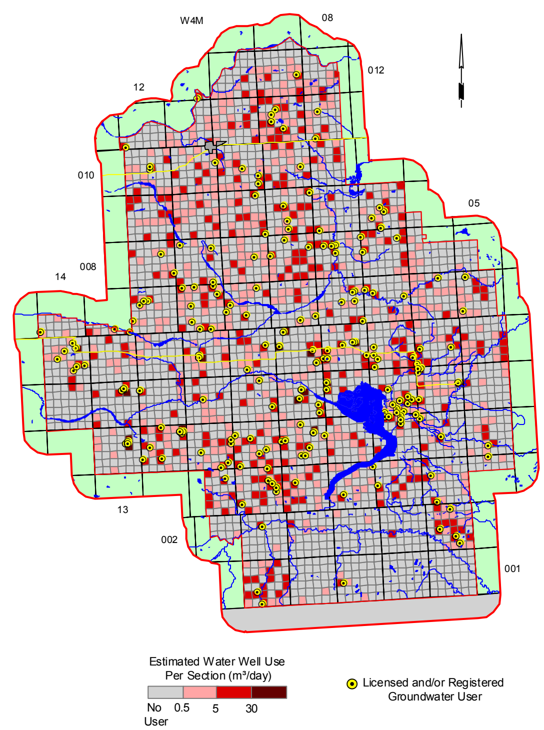


Figure 34. Estimated Water Well Use Per Section
(for larger version, see page A-54)

Groundwater Use within the County of Forty Mile (m³/day)		%
Domestic/Stock (including agriculture and registrations)	4,479	*88*
Municipal (licensed)	609	*12*
Total	5,088	*100*

Table 10. Total Groundwater Diversions

In summary, the estimated total groundwater use within the County of Forty Mile is 5,088 m³/day, with the breakdown as shown above in Table 10.

An estimated 4,907 m³/day is being withdrawn from a specific aquifer. The remaining 181 m³/day (4%) is being withdrawn from unknown aquifer units. Of the 5,088 m³/day, 65% is being diverted from bedrock aquifers and 35% from surficial aquifers. Approximately 34% of the total estimated groundwater use is from licensed and/or registered water wells.

6.3 Groundwater Flow

A direct measurement of groundwater recharge or discharge is not possible from the data that are available for the County. One indirect method of measuring recharge is to determine the quantity of groundwater flowing laterally through each individual aquifer. This method assumes that there is sufficient recharge to the aquifer to maintain the flow through the aquifer and the discharge is equal to the recharge. However, even the data that can be used to calculate the quantity of flow through an aquifer must be averaged and estimated. To determine the flow requires a value for the average transmissivity of the aquifer, an average hydraulic gradient and an estimate for the width of the aquifer. For the present program, the flow has been estimated for various parts of individual aquifers within the County.

The flow through each aquifer assumes that by taking a large enough area, an aquifer can be considered as homogeneous, the average gradient can be estimated from the non-pumping water-level surface, and flow takes place through the entire width of the aquifer; flow through the aquifers takes into consideration hydrogeological conditions outside the County border. Based on these assumptions, the estimated lateral groundwater flow through the individual aquifers has been summarized in Table 11.

Aquifer/Area	Trans (m²/day)	Gradient (m/m)	Width (km)	Flow (m³/day)	Aquifer Flow (m³/day)	Licensed and Registered Diversion (m³/day)	Not Licensed and Registered Diversion (m³/day)	Total (m³/day)
Upper Surficial					19,885	38	2,014	2,052
Pakowki Region								
Milk River north	11.4	0.01042	43.2	5,130				
Milk River southeast	11.4	0.0125	19.2	2,736				
Pakowki west	11.4	0.00833	38.4	3,648				
Pakowki Northeast	11.4	0.00357	16	651				
Pakowki east	11.4	0.00417	17.6	836				
Murray Lake Region								
north	11.4	0.00833	17.6	1,672				
east	11.4	0.00417	48	2,280				
Bow Island Region								
northeast	11.4	0.00417	43.2	2,052				
northwest	11.4	0.00536	14.4	879				
Lower Surficial					288	0	52	52
Medicine Hat Valley								
North	5	0.006	10	288				
Buried Skiff								
North	13	0.001	10	173				
Buried Foremost								
North	13	0.002	5	104				
South								
East	5	0.002	5	38				
Foremost Formation					7,884	10	355	365
Pakowki Region								
Westerly	5	0.005	60	1,636				
Northly component	5	0.006	90	2,769				
Murray Lake Region								
Northwest	10	0.006	20	1,273				
South	10	0.005	19	1,029				
southeast	10	0.005	16	857				
Bow Island Region								
North	2	0.005	19	175				
Northwest	2	0.005	16	145				
Milk River Formation					1,751	888	744	1,632
West	2.6	0.004	53	572				
Northwest	2.6	0.004	18	191				
north	2.6	0.004	34	364				
Northeast	2.6	0.004	58	624				

Table 11. Groundwater Budget

Table 11 indicates that there is more groundwater flowing through the aquifers than the estimated use. In the case of the Milk River Formation, the estimated use is close to the value for the calculated flow through the aquifer. However, even where use is less than the calculated aquifer flow, there can still be local impacts on water levels. The calculations of flow through individual aquifers as presented in Table 11 are very approximate and are intended only as a guide; more detailed investigations are needed to better understand the groundwater flow.

The database has a total of 565 records that indicate water wells completed in the Milk River Aquifer to be flowing and not abandoned. Of the 565 water wells, 156 have a flow rate and/or a NPWL above ground surface. Of the 156 flowing water wells, 66 have been field-verified. Of the 66 field-verified flowing water wells, a flow rate for 60 water wells is available. The average flow rate for the 60 flowing water wells is estimated to be 35.7 lpm. By applying the average flow rate of 35.7 lpm to the remaining six field-verified water wells, the total estimated flow from the 66 field-verified flowing water wells completed in the Milk River Aquifer is estimated to be 3,400 m³/day.

6.3.1 Quantity of Groundwater

An estimate of the volume of groundwater stored in the sand and gravel aquifers is 1.0 to 6.2 cubic kilometres. This volume is based on an areal extent of 4,160 square kilometres and a saturated thickness of 5 metres. The variation in the total volume is based on the value of porosity that is used for the surficial deposits. One estimate of porosity is 5%, which gives the low value of the total volume. The high estimate is based on a porosity of 30% (Ozoray, Dubord and Cowen, 1990).

The adjacent non-pumping water-level map has been prepared from water levels associated with water wells completed to depths of less than 20 metres in aquifers in the surficial deposits. The water levels from these water wells were used for the calculation of the saturated thickness of the surficial deposits and for calculations of recharge/discharge areas. In areas where the elevation of the water-level surface is below the bedrock surface, the surficial deposits are not saturate`d (indicated by grey areas on the map). The water-level map for the surficial deposits shows a flow direction toward the South Saskatchewan River and Seven Persons Creek.

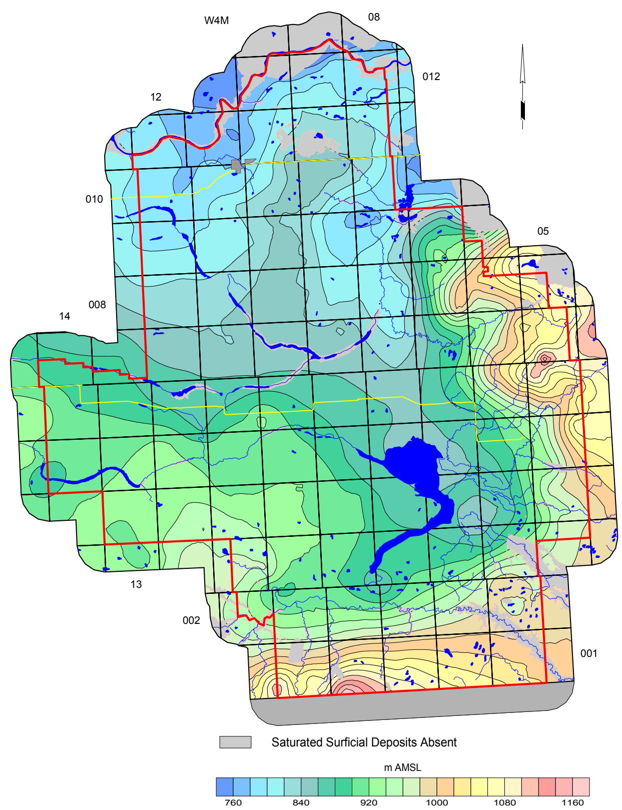


Figure 35. Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep

6.3.2 Recharge/Discharge

The hydraulic relationship between the groundwater in the surficial deposits and the groundwater in the bedrock aquifers is given by the non-pumping water-level surface associated with each hydraulic unit. Where the water level in the surficial deposits is at a higher elevation than the water level in the bedrock aquifers, there is the opportunity for groundwater to move from the surficial deposits into the bedrock aquifers. This condition would be considered as an area of recharge to the bedrock aquifers and an area of discharge from the surficial deposits. The amount of groundwater that would move from the surficial deposits to the bedrock aquifers is directly related to the vertical permeability of the sediments separating the two aquifers. In areas where the surficial deposits are unsaturated, the extrapolated water level for the surficial deposits is used.

When the hydraulic gradient is from the bedrock aquifers to the surficial deposits, the condition is a discharge area from the bedrock aquifers, and a recharge area to the surficial deposits.

6.3.2.1 Surficial Deposits/Bedrock Aquifers

Recharge to the bedrock aquifers within the County takes place from the overlying surficial deposits and from flow in the aquifer from outside the County. On a regional basis, calculating the quantity of water involved is not possible because of the complexity of the geological setting and the limited amount of data.

The hydraulic gradient between the surficial deposits and the Upper Bedrock Aquifer(s) has been determined by subtracting the non-pumping water-level surface associated with all water wells completed in the Upper Bedrock Aquifer(s) from the non-pumping water-level surface determined for all water wells in the surficial deposits. The recharge classification is used where the water level in the surficial deposits is more than five metres above the water level in the Upper Bedrock Aquifer(s). The discharge areas are where the water level in the surficial deposits is more than five metres lower than the water level in the bedrock. When the water level in the surficial deposits is between five metres above and five metres below the water level in the bedrock, the area is classified as a transition, that is, no recharge and no discharge.

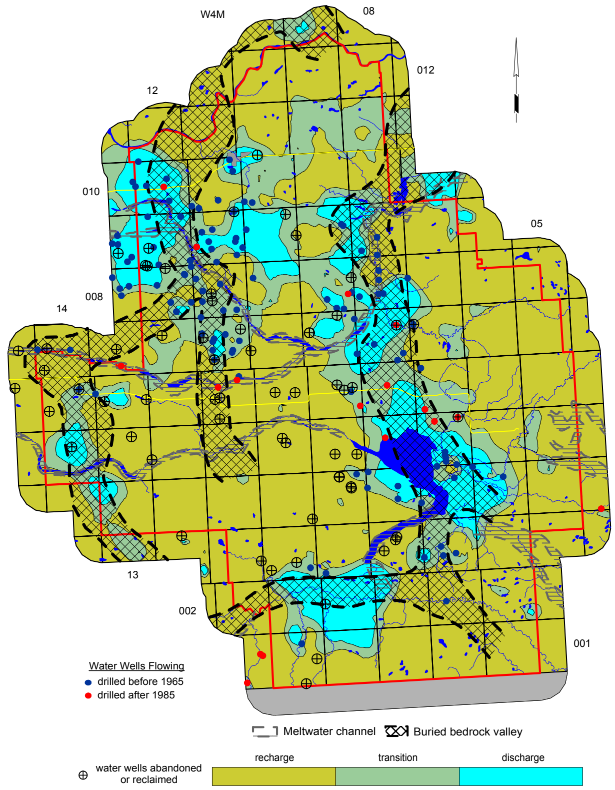


Figure 36. Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)

The locations of flowing water wells that were drilled before 1965 and the flowing water wells that were drilled after 1985 are shown on Figure 36. These locations would reflect where there is an upward hydraulic gradient from the bedrock to the surficial deposits (i. e. discharge). The groundwater database indicates that 35% of all bedrock water wells drilled before 1965 were flowing. In comparison, only seven percent of the bedrock water wells drilled after 1985 were flowing. The flowing water wells that were drilled after 1985 are mainly in meltwater channels and buried bedrock valleys. As a result of gridding limited non-pumping water-level data for the surficial deposits, flowing water wells expected to be in discharge areas are indicated on Figure 36 as being in recharge areas.

Figure 36 shows that, in 65% of the County, there is a downward hydraulic gradient (i. e. recharge) from the surficial deposits toward the Upper Bedrock Aquifer(s). The locations of water wells that have been abandoned or reclaimed are mainly in areas of recharge. Areas where there is an upward hydraulic gradient (i .e. discharge) from the bedrock to the surficial deposits are mainly in the vicinity of linear bedrock lows. The remaining parts of the County are areas where there is a transition condition.

With 65% of the County land area being one of recharge to the bedrock, and the average precipitation being 345 mm per year, 0.2 percent of the annual precipitation is sufficient to provide the total calculated quantity of groundwater flowing through the Upper Bedrock Aquifer(s).

6.4 Areas of Groundwater Decline

In order to determine the areas of possible water-level decline in the Sand and Gravel Aquifer(s) and in the Milk River Aquifer, the following approach was attempted. The available non-pumping water-level elevation for each water well was first sorted by location, and then by date of water-level measurement. The dates of measurements were required to differ by at least 365 days. Only the earliest and latest control points at a given location were used. The method of calculating changes in water levels is at best an estimate. Additional data would be needed to verify water-level change.

6.4.1 Sand and Gravel Aquifer(s)

With the absence of sufficient non-pumping water-level data at a given location for water wells completed in the Sand and Gravel Aquifer(s), the areas of groundwater decline in the Sand and Gravel Aquifer(s) have been calculated by determining the frequency of non-pumping water level control points per five-year period. Of the 815 surficial water wells with a non-pumping water level and date in the County and buffer area, 545 are from water wells completed before 1945 and 270 are from water wells completed after 1960.

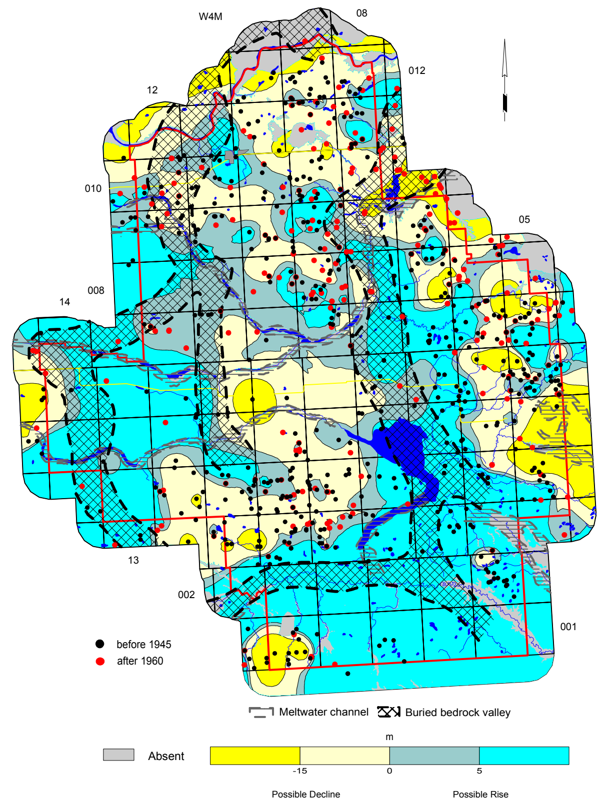


Figure 37. Changes in Water Levels in Sand and Gravel Aquifer(s)

The interpretation of the adjacent map should be limited to areas where both earliest and latest water level control points are present; these areas indicated on Figure 37 are mainly where a water-level decline of less than 15 metres and where a water-level rise of less than five metres may have occurred. The remaining areas showing a water-level decline of more than 15 metres and a water-level rise of more than five metres may reflect the nature of gridding a limited number of control points.

Where the earliest water level (before 1945) is at a higher elevation than the latest water level (after 1960), there is the possibility that some groundwater decline has occurred. The adjacent map indicates that there may have been a decline in the NPWL in 35% of the County.

Where the earliest water level is at a lower elevation than the latest water level, there is the possibility that the groundwater has risen at that location. The water level may have risen as a result of recharge in wetter years or may be a result of the water well being completed in a different surficial aquifer.

Estimated Water Well Use Per Section (m^3/day)	% of Area with a Projected Decline
<5	30
5 to 30	14
>30	1
no use	55

Table 12. Water-Level Decline in Sand and Gravel Aquifer(s)

In areas where a water-level decline is projected, 55% of the areas have no estimated water well use; 30% is less than five m^3/day, 14% of the use is between five and 30 m^3/day, and the remaining 1% of the declines occurred where the estimated groundwater use per section is greater than 30 m^3/day, as shown in Table 12.

The areas of groundwater decline in the Sand and Gravel Aquifer(s) where there is no estimated water well use suggest that groundwater diversion is not having an impact and that the decline may be due to variations in recharge to the Aquifer(s) or because the water wells are not on file with AENV.

6.4.2 Milk River Aquifer

The Milk River Aquifer is the main source of groundwater for domestic and stock purposes, for the Village of Foremost, and for the Hamlets of Skiff, Etzikom and Manyberries.

The AENV database indicates that there have been at least 1,230 water test holes in the County drilled into the Milk River Aquifer since January 1910, of which 260 appear not to be in use. The water-level decline in the Milk River Aquifer has been a subject of research since 1915, with the Meyboom (1960) study being the main source of reference and comparison.

Of the 612 water wells completed in the Milk River Aquifer with a non-pumping water level and a corresponding date, in the County and buffer area, there are 93 water wells with sufficient control to prepare the adjacent map. Of the 93 water wells, there are more than 15 years between water-level measurements in 37 water wells. The adjacent map indicates that in 50% of the County, it is possible that the non-pumping water level has declined. Of the 179 licensed and/or registered groundwater users completed in the Milk River Aquifer, 45% occur in areas where a water-level decline may have occurred. The Village of Foremost and the Hamlets of Skiff and Etzikom are in areas where a water-level decline in the Milk River Aquifer of more than 15 metres may have occurred; and the Hamlet of Manyberries is in an area where a water-level decline of up to 15 metres may have occurred.

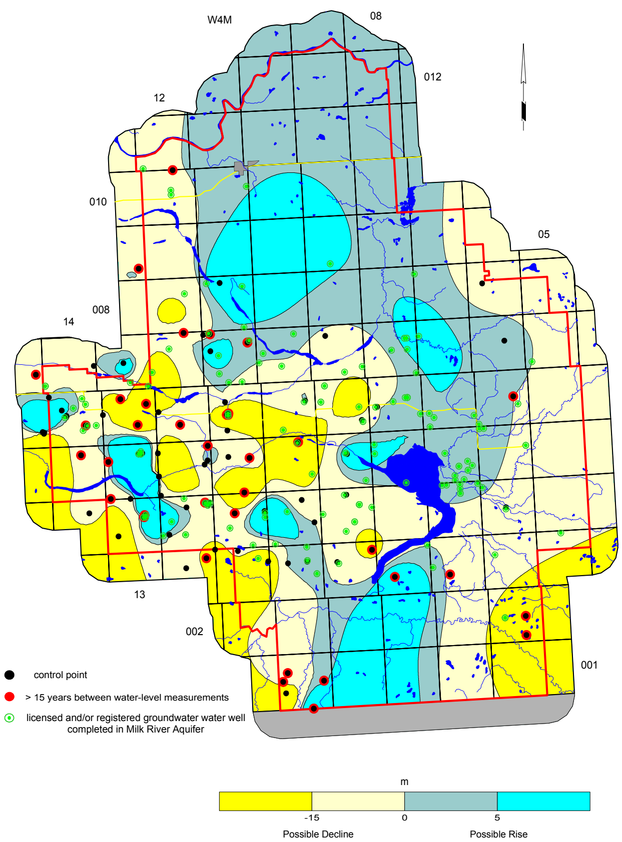


Figure 38. Areas of Potential Groundwater Depletion - Milk River Aquifer

Where the earliest water level is at a lower elevation than the latest water level, there is the possibility that the groundwater has risen at that location. The water level may have risen as a result of recharge in wetter years or may be a result of the water well being completed in a different bedrock aquifer.

In areas where a water-level decline of more than 15 metres is projected, 65% of the areas have no estimated water well use; 24% is less than five m³/day, 10% of the use is between five and 30 m³/day, and the remaining 1% of the declines occurred where the estimated groundwater use per section is greater than 30 m³/day, as shown below in Table 13.

Estimated Water Well Use Per Section (m³/day)	*% of Area with More than a 15-Metre Projected Decline*
<5	*24*
5 to 30	*10*
>30	*1*
no use	*65*

Table 13. Water-Level Decline of More than 15 Metres in Milk River Aquifer

The areas of groundwater decline in the Milk River Aquifer where there is no estimated water well use suggest that groundwater production is not having an impact and that the decline may be due to variations in recharge to the Aquifer(s), or due to uncontrolled, unused, flowing water wells, or because the water wells are not on file with AENV.

6.5 Discussion of Specific Study Areas

As per the Request for Proposal, the County requested that comments be made, where possible, on the following three study areas and issues. The issue is stated at the beginning of each of the following sections. Figure 39 shows the three specific study areas in the County; in Figure 40, the three specific study areas have been colour outlined on the bedrock geology map; Figure 41 shows the apparent yield for water wells completed in the Sand and Gravel Aquifer(s); and Figure 42 shows the apparent yield for water wells completed in the Upper Bedrock Aquifer(s).

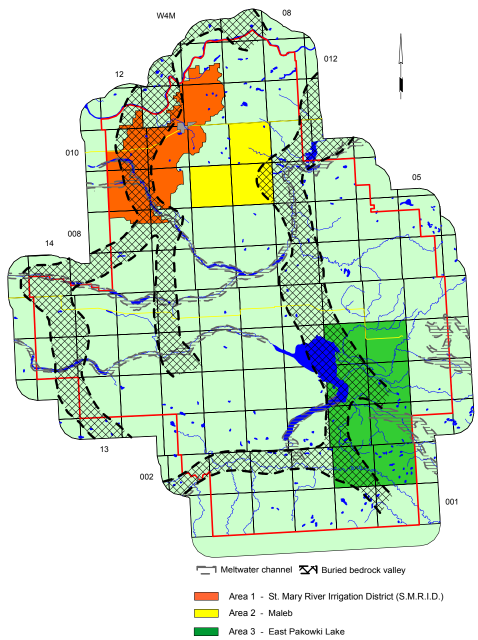


Figure 39. Specific Study Areas

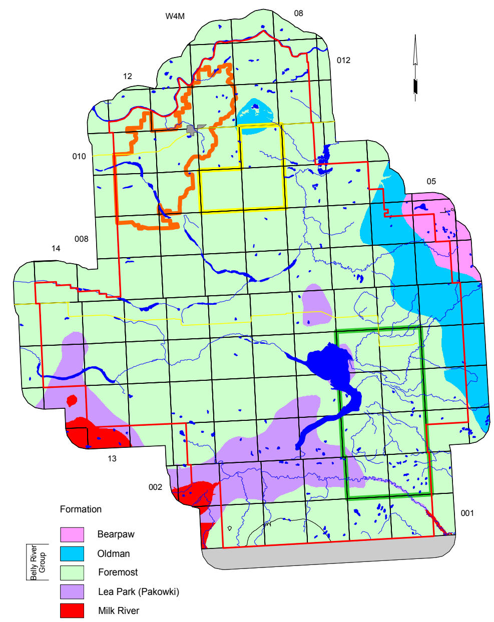


Figure 40. Bedrock Geology of Specific Study Areas

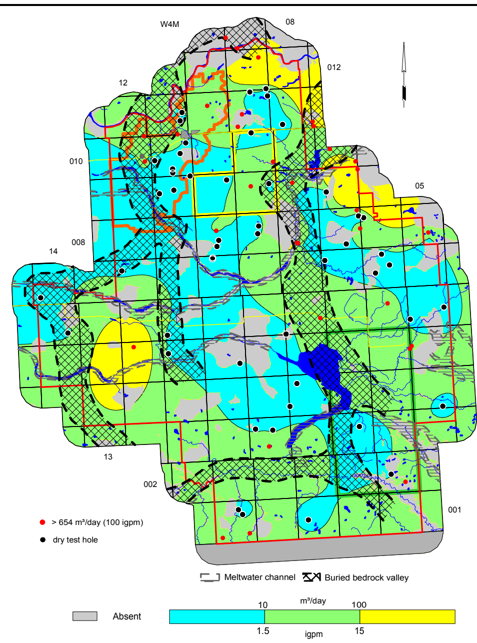


Figure 41. Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) – Specific Study Areas

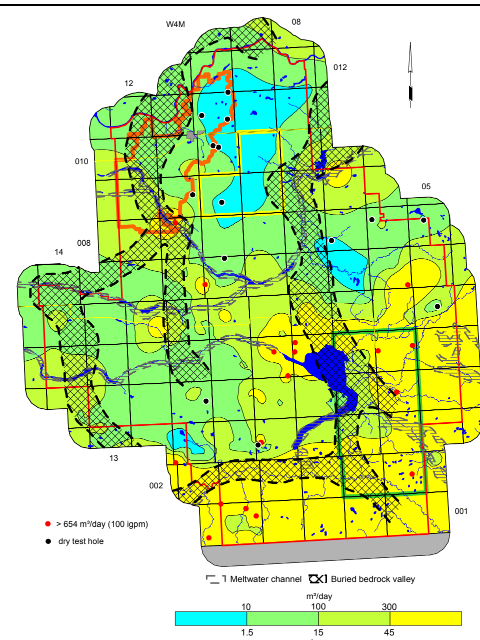


Figure 42. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Specific Study Areas

6.5.1 Area 1 – St. Mary River Irrigation District (S.M.R.I.D.)

What is the availability of groundwater and how suitable is it as an option to using surface water within the S.M.R.I.D.?

In Area 1, surface water provides up to 21 m³/day to the six licensed and/or registered surface-water users within the St. Mary River Irrigation District (an average use of 3.4 m³/day), and 20 m³/day for municipal purposes to the Hutterite Ponderosa Colony in NW 31-008-12 W4M, as shown on Figure 43.

The Upper Sand and Gravel Aquifer is expected to be present in most of Area 1. The upper sand and gravel deposits are expected to be mainly less than five metres thick. In the southern part of Area 1, the apparent yields in the Upper Sand and Gravel Aquifer are mainly less than two m³/day, as indicated by the dry water test holes shown on Figure 43. In these areas, water supply for stock use appears to be restricted to surface water. The potential higher apparent yields in the Upper Sand and Gravel Aquifer appear to be mainly in association with the buried bedrock valley.

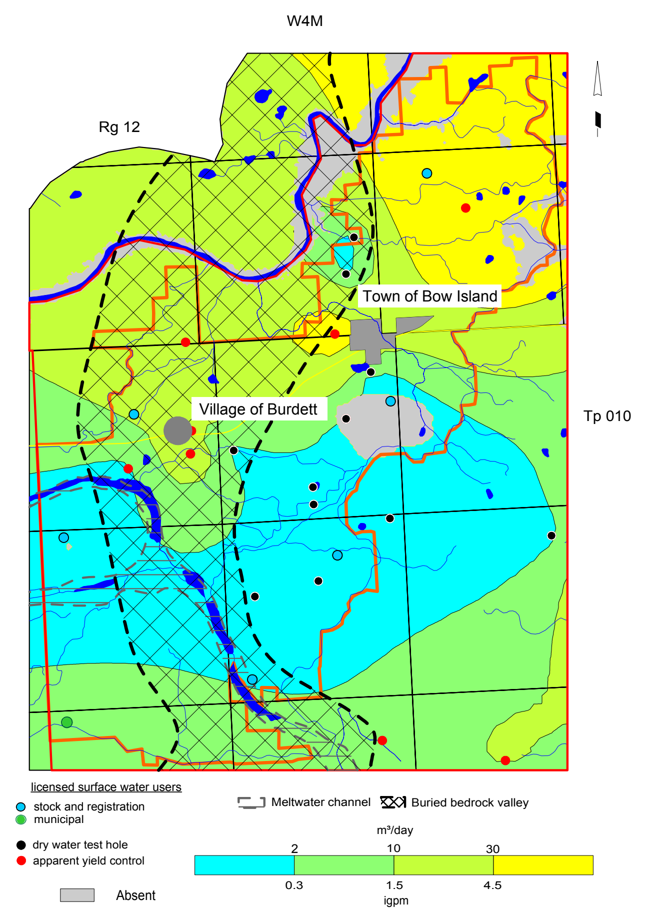


Figure 43. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 1

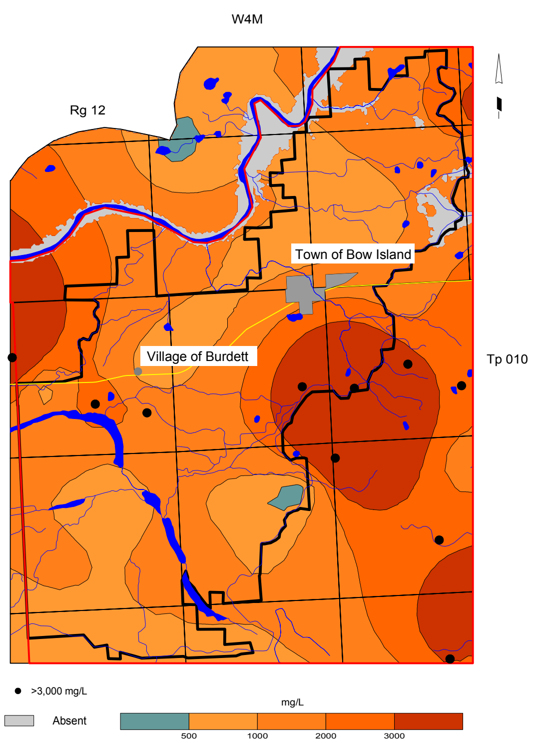


Figure 44. Total Dissolved Solids in Groundwater from Surficial Deposits – Area 1

The groundwaters from the surficial deposits in Area 1 are mainly a calcium-magnesium-bicarbonate or calcium-magnesium sulfate-type (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the surficial deposits are expected to have TDS concentrations of greater than 500 mg/L, as shown on the adjacent figure. The sulfate concentrations are mainly greater than 100 mg/L, Nitrate + Nitrite (as N) concentrations are less than ten mg/L, and the chloride concentrations from the surficial deposits are mainly less than 100 mg/L (see CD-ROM).

The apparent yields for water wells completed in Upper Bedrock Aquifer(s) range from less than ten m³/day in the northeastern part of Area 1 as a result of numerous dry water test holes to more than 100 m³/day in the southwestern part of Area 1, as shown in Figure 45.

The upper bedrock in Area 1 is the Foremost Formation. The apparent yields for water wells completed through the Foremost Aquifer are less than ten m³/day east of the Town of Bow Island and range between ten and 100 m³/day west of the Town of Bow Island (see page A-67).

The apparent yields for water wells completed through the Milk River Aquifer are expected to be greater than 100 m³/day (see page A-68).

In Area 1, there are four registered water wells completed in Upper Bedrock Aquifer(s) that are authorized to divert a total of 12.2 m³/day. The highest groundwater allocation of nine m³/day is for a water well in SW 23-010-12 W4M that is completed from 197 to 232 metres below ground surface in the Milk River Aquifer.

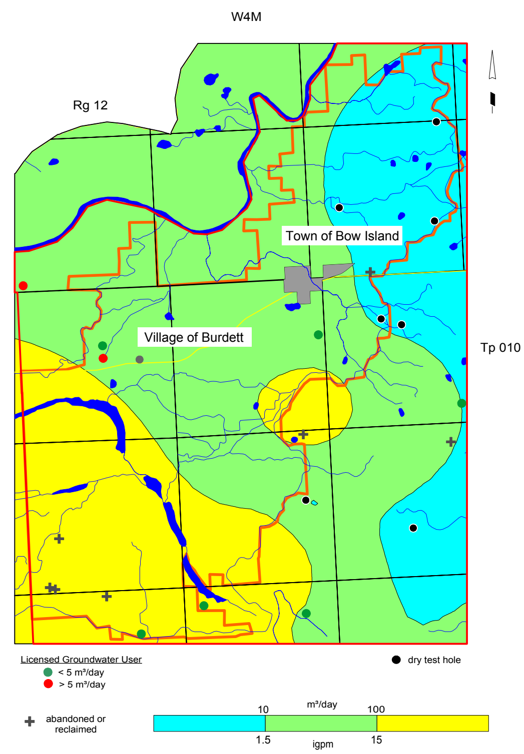


Figure 45. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Area 1

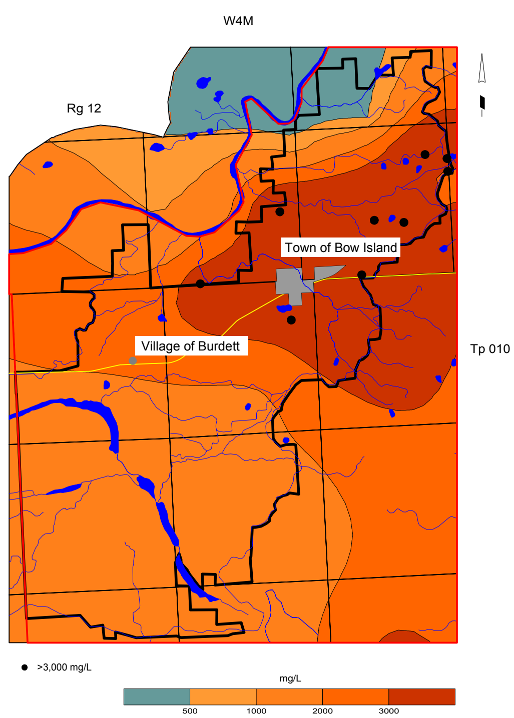


Figure 46. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) – Area 1

In Area 1, the groundwaters from the Upper Bedrock Aquifer(s) are mainly a sulfate-type with no dominant cation (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the Upper Bedrock Aquifer(s) are expected to have TDS concentrations that range from 500 to more than 3,000 mg/L. The TDS concentrations of greater than 3,000 mg/L occur northeast of the Town of Bow Island, as shown on the adjacent figure. The sulfate concentrations are mainly less than 100 mg/L, but can exceed 500 mg/L northeast of the Town of Bow Island. Fluoride concentrations range from less than 1.5 mg/L in the northeastern part of Area 1 to more than 1.5 in the southwestern part of Area 1; the chloride concentrations from the Upper Bedrock Aquifer(s) are mainly greater than 100 mg/L and can exceed 1,500 mg/L in the vicinity of the Town of Bow Island (see CD-ROM).

The Milk River Aquifer is suitable for development of higher yields, but the groundwater would need to be treated before being used for most domestic uses.

6.5.2 Area 2 – Townships 009 and 010, Ranges 09 and 10, W4M (Maleb Area)

What is the approximate extent and potential (yield and water quality) of the aquifers in this area?

The Upper Sand and Gravel Aquifer is expected to be present in most of Area 2. The upper sand and gravel deposits are expected to be mainly less than five metres thick. In the eastern half of Area 2, there are two control points that indicate that the apparent yields in the Upper Sand and Gravel Aquifer are greater than ten and less than 100 m³/day, as shown on Figure 47. In the remaining part of Area 2, apparent yields in the Upper Sand and Gravel Aquifer are expected to be mainly less than ten m³/day, as indicated by the dry water test holes.

The groundwaters from the surficial deposits in Area 2 are mainly a bicarbonate or sulfate-type with no dominant cation (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the surficial deposits are expected to have TDS concentrations of that range from 500 mg/L to more than 3,000 mg/L (see page A-71). The sulfate concentrations range from less than 500 mg/L to more than 1,500 mg/L, Nitrate + Nitrite (as N) concentrations are mainly greater than one mg/L and the chloride concentrations from the surficial deposits are mainly less than 100 mg/L (see CD-ROM).

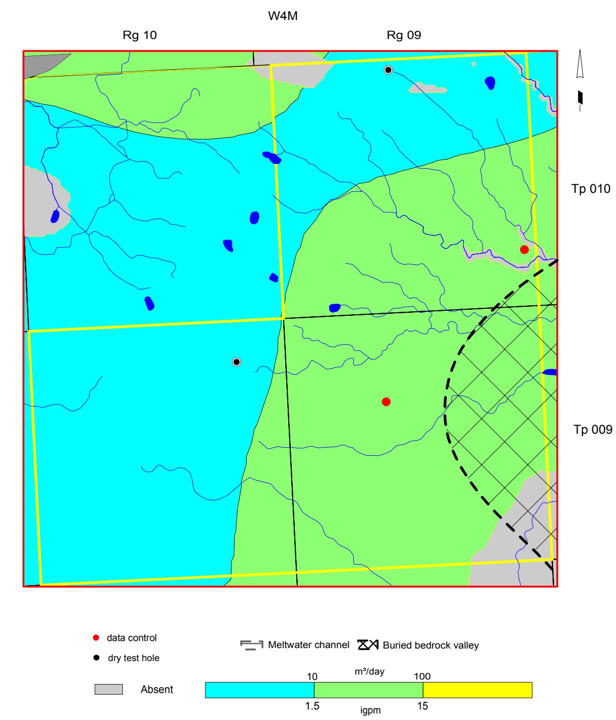


Figure 47. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 2

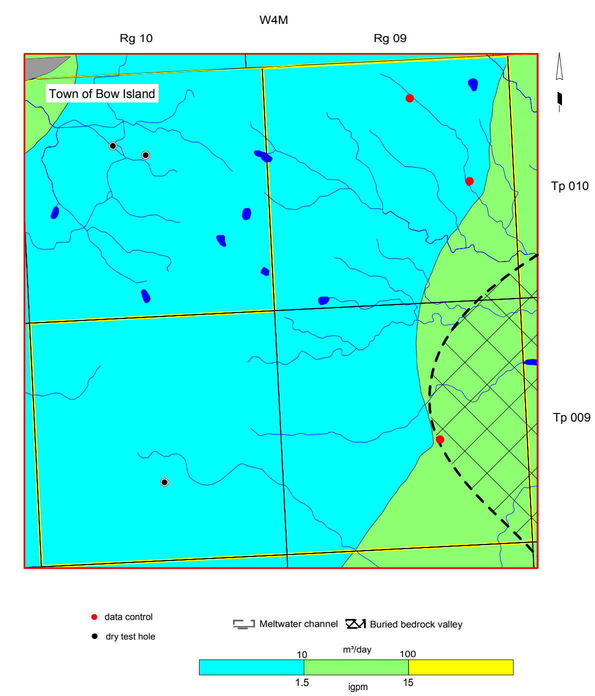


Figure 48. Apparent Yield for Water Wells Completed through Foremost Aquifer – Area 2

The upper bedrock in Area 2 is the Foremost Formation. In Area 2, there are three water wells completed in the Foremost Aquifer with apparent yield data. The apparent yields for water wells completed through the Foremost Aquifer are expected to be mainly less than ten m³/day. In addition, there are three "dry" water test holes in townships 009 and 010, range 10, W4M that are completed in the Foremost Aquifer.

In Area 2, the groundwaters from the Upper Bedrock Aquifer(s) are a sodium-chloride-type (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the Upper Bedrock Aquifer(s) are expected to have TDS concentrations that are mainly greater than 1,000 mg/L. The sulfate concentrations are mainly less than 100 mg/L, but can exceed 500 mg/L in township 010, range 09, W4M. In Area 2, fluoride concentrations range from less than one mg/L in township 010, range 09, W4M to more than 1.5 in township 009, ranges 09 and 10, W4M; the chloride concentrations from the Upper Bedrock Aquifer(s) are mainly greater than 500 mg/L and can exceed 1,500 mg/L in township 009, range 09, W4M (see CD-ROM).

6.5.3 Area 3 – Townships 002 to 004, Ranges 06 to 07, W4M

What is the approximate extent and potential (yield and water quality) of the aquifers in this area?

The Upper Sand and Gravel Aquifer is expected to be present in most of Area 3. The upper sand and gravel deposits are expected to be mainly less than five metres thick.

The indications are that the apparent yields in the Upper Sand and Gravel Aquifer are greater than 50 m³/day immediately south of the Hamlet of Manyberries, as shown on Figure 49. In the remaining parts of Area 3, apparent yields in the Upper Sand and Gravel Aquifer are expected to be less than ten m³/day in townships 002 and 003, ranges 06 and 07, W4M, and between ten and 50 m³/day in townships 004 and 005, ranges 06 and 07, W4M.

The Lower Sand and Gravel Aquifer is expected to be present in 50% of Area 3. Where present, the lower sand and gravel deposits are expected to range from less than five to more than ten metres, with the greater thicknesses occurring in the Buried Medicine Hat Valley, south of Pakowki Lake.

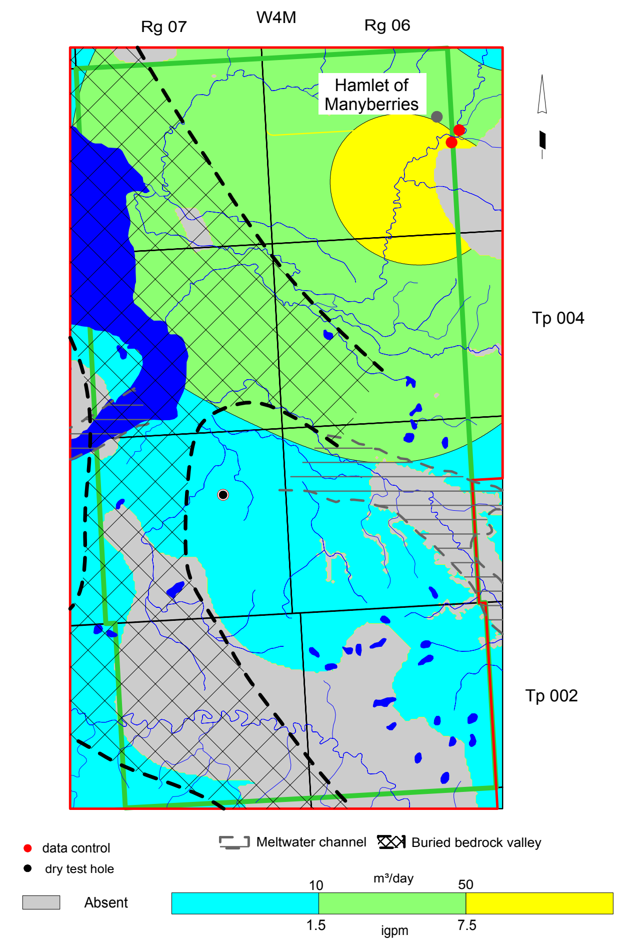


Figure 49. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 3

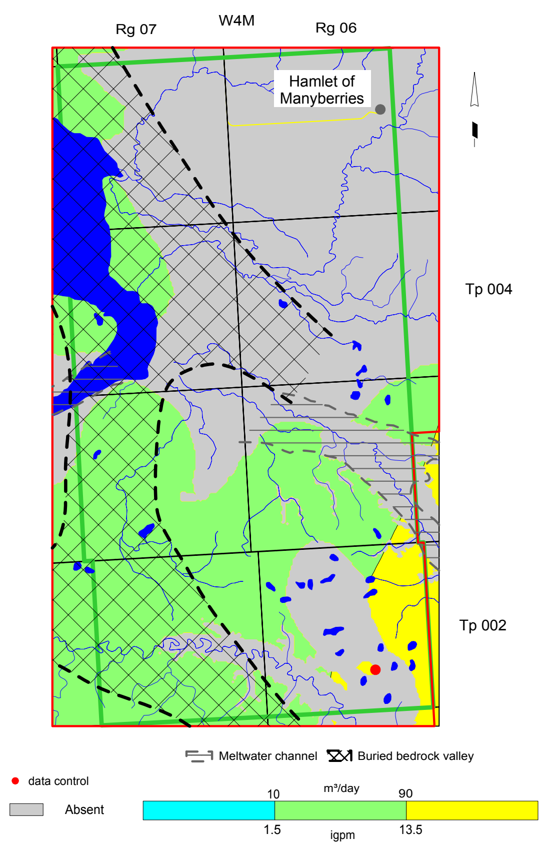


Figure 50. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

In Area 3, there is one water well completed in the Lower Sand and Gravel Aquifer with an apparent yield value, as shown on Figure 50. The apparent yield for the water well is 90 m³/day.

The groundwaters from the surficial deposits in Area 3 are mainly a bicarbonate or sulfate-type with no dominant cation (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the surficial deposits are expected to have TDS concentrations of greater than 2,000 mg/L (see page A-76). The sulfate concentrations range from less than 200 mg/L to more than 1,500 mg/L, Nitrate + Nitrite (as N) concentrations are mainly greater than one mg/L; the chloride concentrations from the surficial deposits are mainly less than 100 mg/L (see CD-ROM).

The upper bedrock over most of Area 3 is the Foremost Formation; however, there are no water wells completed in the Foremost Aquifer with an apparent yield value. The apparent yields for water wells completed through the Milk River Aquifer are expected to be greater than 300 m³/day. In SE 35-005-07 W4M, a water well completed in 1949 in the Milk River Aquifer was reclaimed in 2001 as part of the Milk River Reclamation program.

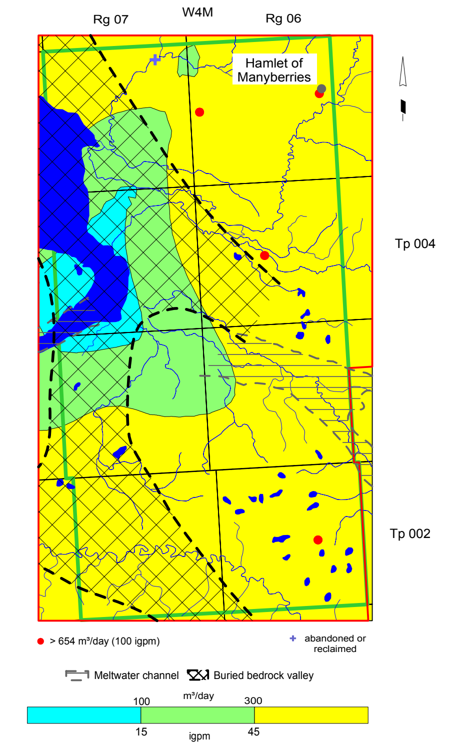


Figure 51. Apparent Yield for Water Wells Completed through Milk River Aquifer – Area 3

In Area 3, the groundwaters from the Upper Bedrock Aquifer(s) are a sodium-sulfate-type (see Piper diagram on CD-ROM). Groundwaters from water wells completed in the Upper Bedrock Aquifer(s) are expected to have TDS concentrations that are mainly greater than 500 mg/L, as shown below on Figure 52. The sulfate concentrations are mainly less than 100 mg/L in townships 002 to 005, range 07, W4M, and mainly greater than 100 mg/L in townships 002 to 005, range 06, W4M. In Area 3, the fluoride concentrations range mainly from 1.5 to five mg/L in townships 002 to 005, range 07, W4M, and are mainly less than 1.5 mg/L in townships 002 to 005, range 06, W4M. The chloride concentrations from the Upper Bedrock Aquifer(s) are mainly less than 100 mg/L (see CD-ROM).

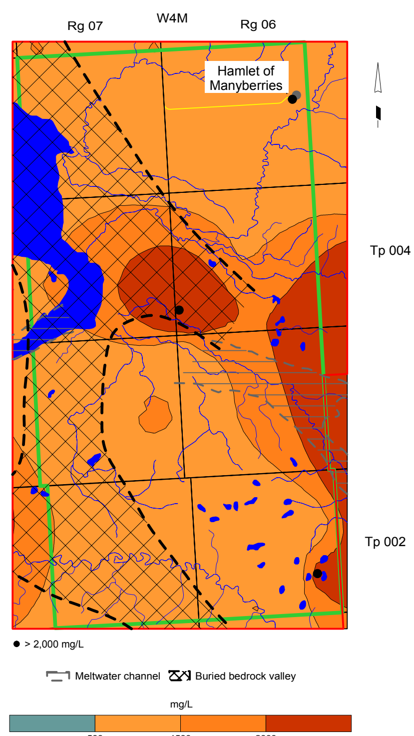


Figure 52. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) – Area 3

The groundwater from the Milk River Formation is expected to have a TDS concentration of less than 2,000 mg/L and a fluoride concentration of in the order of 1.5 to 5.0 mg/L.

7. RECOMMENDATIONS

The present study has been based on information available from the groundwater database. The database has three problems:

1) the quality of the data
2) the coordinate system used for the horizontal control
3) the distribution of the data.

The quality of the data in the groundwater database is affected by two factors: a) the technical training of the persons collecting the data, and b) the quality control of the data. The possible options to upgrade the database include the creation of a "super" database, which includes only verified data. From 1999 to 2002, the status of 668 water wells in the County was field-checked by AAFC-PFRA personnel (see Appendix E). This water well inventory program was one of several steps initiated by the Milk River Aquifer Groundwater Management Advisory Committee to protect the Milk River Aquifer (AAFC-PFRA, Oct 2003). Of the 668 field-checked water wells, 424 water wells were in use and 244 were inactive. A water level was measured in 108 water wells; 16 water-level measurements were from inactive water wells. The groundwater database indicates that of the 108 field-checked water wells where a water level was measured, there are 34 water well records (see Appendix E) with an available completion interval top and completion interval bottom, a NPWL and a calculated apparent transmissivity and apparent yield value.

In order to better quantify the groundwater resources, it is recommended that some additional water wells be field verified. Appendix E includes a list of 41 water wells where field verification is recommended. Twenty-six of the water wells in the list are water wells indicated as having a complete water well drilling report and the results of at least a partial chemical analysis; the list also includes 15 water wells for which the County has responsibility.

As part of the field verification of these 41 water wells there is a need to obtain meaningful horizontal coordinates for each water well and the verification of certain parameters such as water level, specific capacity, completed depth, and the collection of a water sample for at least a routine chemical analysis.

Before an attempt is made to provide a major upgrade to the level of interpretation provided in this report, the accompanying maps and the groundwater query, it is recommended that the 26 water wells listed in Appendix E for which water well drilling reports are available, the 15 County-operated water wells listed in Appendix E, plus the 108 water wells listed in Appendix E be subjected to the following actions (see pages C-2 to C-3):

1) The horizontal location of the water well should be determined within ten metres. The coordinates must be in 10TM NAD 27 or some other system that will allow conversion to 10TM NAD 27 coordinates.
2) A four-hour aquifer test (two hours of pumping and two hours of recovery) should be performed with the water well to obtain a realistic estimate for the transmissivity of the aquifer in which the water well is completed.
3) Water samples should be collected for chemical analysis after five and 115 minutes of pumping, and analyzed for major and minor ions.

This additional information would provide a baseline to be used for comparison to either existing chemical analyses or aquifer tests, or to determine if future monitoring would be necessary if significant changes in the aquifer parameters had occurred.

A list of the 149 water wells that could be considered for the above program is given in Appendix E and on the CD-ROM.

An attempt to link the AENV groundwater and licensing databases was 40% successful in this study (see CD-ROM); sixty percent of the 253 licensed and/or registered water wells do not appear to have corresponding records in the AENV groundwater database. There is a need to improve the quality of the AENV licensing database. It is recommended that attempts be made in a future study to find and add missing drilling records to the AENV groundwater database and to determine the aquifer in which the unlicensed and not registered water wells are completed.

While there are a few areas where water-level data are available at different times, on the overall, there are an insufficient number of water levels to set up a groundwater budget. One method to obtain additional water-level data is to solicit the assistance of the water well owners who are stakeholders in the groundwater resource. In the County of Rocky View and in the M.D. of Flagstaff, water well owners were being provided with a tax credit if they accurately measured the water level in their water well once per week for a year. A pilot project indicated that approximately five years of records are required to obtain a reasonable data set. The cost of a five-year project involving 50 water wells would be less than the cost of one drilling program that may provide two or three observation water wells. Monitoring of water levels in domestic and stock water wells is a practice that is recommended by PFRA in the “Water Wells That Last for Generations” manual and accompanying videos (Buchanan, Bob (editor). Alberta Agriculture, Food and Rural Development, 1996).

A second approach to obtain water-level data would be to conduct a field survey to identify water wells not in use that could be used as part of an observation water well network. County personnel and/or local residents could measure the water levels in the water wells regularly.

Communities that are concerned about apparent water-level declines in the aquifers in which their water supply wells are completed should implement a conscientious groundwater monitoring program.

There is also a need to provide the water well drillers with feedback on the reports they are submitting to the regulatory agencies. The feedback is necessary to allow for a greater degree of uniformity in the reporting process. This is particularly true when trying to identify the bedrock surface. One method of obtaining uniformity would be to have the water well drilling reports submitted to the AENV Resource Data Division in an electronic form. The money presently being spent by AENV to transpose the paper form to the electronic form should be used to allow for a technical review of the data and follow-up discussions with the drillers.

An effort should be made to form a partnership with the petroleum industry. The industry spends millions of dollars each year collecting information relative to water wells. Proper coordination of this effort could provide significantly better information from which future regional interpretations could be made. This could be accomplished by the County taking an active role in the activities associated with the construction of lease sites for the drilling of hydrocarbon wells and conducting of seismic programs.

In summary, for the next level of study, the database needs updating. The updating of information for existing water wells requires more details for the water wells listed in Appendix E; the additional information for new water wells is mainly better spatial control.

Groundwater is a renewable resource and it must be managed.

8. REFERENCES

1) AAFC-PFRA. Oct-2003. Milk River Aquifer Project. Milk River Aquifer Reclamation and Conservation Program Newsletter.

2) AGRA Earth & Environmental Limited. Jun-1998. County of Forty Mile No. 8 - Rural Water Development Task Force. Evaluation of Depletion of the Milk River Aquifer. Milk River Area. Tp 001-008, R 06-15, W4M. [72E .M5R5B3 1998/06]

3) Alberta Geological Survey. 1999. Alberta Geological Survey. Geology of Alberta - CD. [G 3501 C5 1999 A333-001]

4) Aqua Terre Solutions Inc. Apr-2002. County of Forty Mile/Warner County. Aden Area Groundwater Assessment.

5) Aqua Terre Solutions Inc. May-2002. Groundwater Assessment. County of Forty Mile. Peigan Creek Area.

6) Berg, T. E., and R. A. McPherson. 1972. Alberta Geological Survey. Surficial Geology of the Medicine Hat Area, Alberta. NTS 72L. [AGS MAP 142]

7) Borneuf, D. M. 1976. Alberta Geological Survey. Hydrogeology of the Foremost Area, Alberta. Foremost Area. [QE 186 P7 no. 74-04]

8) Borneuf, D. M. 1983. Alberta Geological Survey. Springs of Alberta. [QE 186 P7 No. 82-03]

9) Bowman, Don. 1973. University of Alberta. Geographical Significance of Groundwater in Alberta. [TD 403 B787 1973]

10) Buchanan, Bob (editor). Alberta Agriculture, Food and Rural Development. Engineering Services Branch. Alberta Environment, Licensing and Permitting Standards Branch, Canada. Prairie Farm Rehabilitation Administration. 1996. Water Wells … that Last for Generations.

11) CAESA. Mar-1993. Summary of Work. County of Forty Mile. Contract 1.

12) CAESA. 1994. Groundwater Exploration. County of Forty Mile No. 8. Skiff Area. Draft Copy.

13) CAESA. Apr-1994. County of Forty Mile. Summary of Test Drilling to Date. Contract 2.

14) CAESA. 1995. County of Forty Mile. Summary of CAESA Test Drilling. Contract 3.

15) CAESA – Soil Inventory Project Working Group. 1998a. AGRASID: Agricultural Region of Alberta Soil Inventory Database (Version 1.0). Edited by J. A. Brierley, B. D. Walker, P. E. Smith, and W. L. Nikiforuk. Alberta Agric., Food & Rural Development, publications.

16) CAESA. 1998b. Alberta Agric., Food & Rural Development for CAESA. Agricultural impacts on water Quality in Alberta. [TD 227 A3 A57 1998]

17) Carlson, V. A. 1970. Alberta Geological Survey. Bedrock Topography of the Medicine Hat Map Area, Alberta, NTS 72L. Medicine Hat Area. [AGS map 055]

18) Catuneanu, Octavian, Andrew D. Miall and Arthur R. Sweet. 1997. Reciprocal Architecture of Bearpaw T-R Sequences, Uppermost Cretaceous, Western Canada Sedimentary Basin. Bulletin of Canadian Petroleum Geology. Vol. 45, No. 1 (March, 1997), P. 75-94.

19) Farvolden, R. N., and J. W. Foster. 1958. Alberta Geological Survey. A General Outline of Groundwater Conditions in the Alberta Plains Region. [QE 186 P7 no. 58-01]

20) Farvolden, R. N., W. A. Meneley, E. G. LeBreton, D. H. Lennox, and P. Meyboom. 1963. Alberta Geological Survey. Early Contributions to the Groundwater Hydrology of Alberta. [QE 186 R415 no. 012]

21) Federal-Provincial-Territorial Committee on Drinking Water. 2003. Summary of Guidelines for Canadian Drinking Water Quality.]

22) Fitzgerald, D. A. 1997. CAESA. Alberta Farmstead Water Quality Survey. [TD 227 A3 I34 A33 1997]

23) Green, R. 1972. Alberta Geological Survey. Geological Map of Alberta. [AGS MAP 027]

24) Green, Robert. 1982. Edmonton: Research Council of Alberta. Geological Map of Alberta. [AGS map 27a]

25) Hamilton, W. H., W. Langenberg, M. C. Price, and D. K. Chao. 1998a. Alberta Geological Survey. Geological Map of Alberta (hardcopy). [AGS MAP 236]

26) Hamilton, W. H., W. Langenberg, M. C. Price, and D. K. Chao. 1998b. Alberta Geological Survey. Geological Map of Alberta (diskette). [AGS MAP 236A]

27) Hamilton, W. H., W. Langenberg, M. C. Price, and D. K. Chao. 1999. Alberta Geological Survey. Geological Map of Alberta (CD). [AGS MAP 236D]

28) Hendry, M. J., and F. W. Schwartz. Oct-1988. An Alternative View on the Origin of Chemical and Isotopic Patterns in Groundwater from the Milk River Aquifer, Canada. In Water Resources Research, Vol. 24, No. 10, pp 1747-1763.

29) Hudson, B. 1983. Alberta Geological Survey. Aggregate Resources of the Medicine Hat Map Area. NTS 72L. Medicine Hat Area. [AGS Open File Report 1984-02]

30) Hudson, B. 1984. Alberta Geological Survey. Aggregate Resources. Medicine Hat 72L. Medicine Hat Area. [AGS map A72L]

31) Hydrogeological Consultants Ltd. Jun-1985. Alberta Environment, Earth Sciences Division, Hydrogeology Branch. Emergency Groundwater Testing Program: Draft. Part of Alberta. — (unpublished contract report - Jun-1985.) [85-159.00] [AB .A42 1985/06]

32) Hydrogeological Consultants Ltd. Dec-1995. PanCanadian Petroleum Limited. Badger Area. 10-25-016-18 W4M. Water Source Well Licence Renewal. — (unpublished contract report) - Dec-1995.) [95-146.00] [82I08.B3 1995/12]

33) Hydrogeological Consultants Ltd. Jun-2000. Taiwan Sugar Corp. Groundwater Availability. Etzikom Area. NE 09 and NE 12-007-08 W4M. — (unpublished contract report - Jun-2000.) [00-148.00] [72E06 .E89 2000/06]

34) Hydrogeological Consultants Ltd. Nov-2001. Cypress County. Regional Groundwater Assessment. Parts of Tp 001 to 021, R 01 to 13, W4M. (unpublished contract report – Nov-2001 [01-149] [72L.C967H5 2001/11]

35) Klohn Leonoff Consulting Engineers. Sep-1986. Report: Forty Mile Coulee Project. West Dam Water Well Investigation for Alberta Environment. 27-008-11 W4.

36) Komex International Ltd. Feb-2003. Geophysical Surveys – Milk River, Alberta. Medicine Hat Buried Valley, Warner County and the County of Forty Mile.

37) Lorberg, E. F. May-1981. Milk River Basin. Environmental Overview. Groundwater.

38) Lorberg, E. F. Mar-1983. Groundwater Component. South Saskatchewan River Basin Planning Program.

39) Lorberg, E. F. Feb-1990. Water Supply Alternatives: Groundwater, Medicine Hat Area.

40) Meijer Drees, N. C., and D. W. Mhyr. Mar-1981. The Upper Cretaceous Milk River and Lea Park Formations in Southeastern Alberta. In Bulletin of Canadian Petroleum Geology, Vol. 29, No. 1, pp 42-74.

41) Meyboom, P. 1960. Alberta Geological Survey. Geology and Groundwater Resources of the Milk River Sandstone in Southern Alberta. Milk River Area. [QE 185 M5 No. 2]

42) Mitchell, P., and E. E. Prepas. 1990. University of Alberta. Atlas of Alberta Lakes. Alberta. [G 1166 C3 A84 1990]

43) Moell, C. E. Apr-1985. Hydrogeologic Profile of Area 3.

44) Mossop, G. and I. Shetsen (co-compilers). 1994. Geological Atlas of the Western Canada Sedimentary Basin. Produced jointly by the Canadian Society of Petroleum Geology, Alberta Research Council, Alberta Energy, and the Geological Survey of Canada.

45) Nelson, M. H., and R. L. Sindlinger. Aug-1973. Milk River Sandstone Water Well Survey. Prepared by Soils Branch of Department of Environment.

46) Nielsen, G. L., D. Hackbarth, and S. Bainey. 1972. Alberta Geological Survey. Bibliography of Groundwater Studies in Alberta 1912 - 1971. [QE 186 Op72-18]

47) Ozoray, G., M. Dubord, and A. Cowen. 1990. Groundwater Resources of the Vermilion 73E Map Area, Alberta. Alberta Environmental Protection.

48) Pawlowicz, J. G., and M. M. Fenton. 1995. Alberta Geological Survey. Bedrock Topography of Alberta. [AGS MAP 226]

49) Phillips, Fred M., et al. Dec-1986. Chlorine 36 Dating of Very Old Groundwater. Milk River Aquifer. Alberta, Canada. In Water Resources Research, Vol. 22, No. 13, pp 2003-2016.

50) Phinney, V. Laverne (Editor and publisher) (Hard Copy). 2003a. The Alberta List.

51) Phinney, V. Laverne (Editor and publisher) (Diskette). 2003b. The Alberta List.

52) Richardson, R. J. H. 1984. Alberta Geological Survey. Aggregate Resources. Seven Persons 72E/15. [AGS MAP A72E15]

53) Root, J. D. 1973. Alberta Research Council. Index to Current Geological, Soils, and Groundwater Maps of Alberta. [QE 186 P7 no. 73-04]

54) Root, J. D. 1978. Alberta Geological Survey. Index to Geological, Bedrock Topography, Soils and Groundwater Maps of Alberta. [QE 186 P7 no. 77-03]

55) Schwartz, F. W. Consultants Ltd. Mar-1985. Cross-Section 4 Report.

56) Schwartz, F. W., and K. Muehlenbachs. 1978. Geochemistry of Groundwaters in the Milk River Aquifer, Alberta.

57) Sham, P. 1984. Alberta Geological Survey. Aggregate Resources. Bow Island 72E/14. [AGS MAP A72E14]

58) Shawa, Monzer S. (ed.) & Canadian Society of Petroleum Geologists. Aug-1977. Cordilleran Geology of Southern Alberta and Adjacent Areas. Southern Alberta. [QE 186 C79 1977]

59) Shetsen, I. 1987. Alberta Geological Survey. Quaternary Geology, Southern Alberta. [AGS map 207]

60) Stalker, A. MacS. 1961. Geological Survey of Canada. Buried Valleys in Central and Southern Alberta. [QE 185 C213 P60-32]

61) Stalker, A. MacS. 1963. Geological Survey of Canada. Quaternary Stratigraphy in Southern Alberta. [QE 185 C213 P62-34]

62) Stanley Associates Engineering Ltd. Mar-1985. Observation Well Installation Program.

63) Statistics Canada. 2001 Census of Agriculture. (CD-ROM).

64) Stevenson, D. R., and D. M. Borneuf. 1977. Alberta Geological Survey. Hydrogeology of the Medicine Hat Area, Alberta. Medicine Hat Area. [QE 186 P7 no. 75-02]

83) Strong, W. L., and K. R. Leggat, 1981. Ecoregions of Alberta. Alta. En. Nat. Resour., Resour. Eval. Plan Div., Edmonton as cited in Mitchell, Patricia and Ellie Prepas (eds.). 1990. Atlas of Alberta Lakes. The University of Alberta Press. Page 12.

66) Thornthwaite, C. W., and J. R. Mather. 1957. Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance. Drexel Institute of Technology. Laboratory of Climatology. Publications in Climatology. Vol. 10, No. 3, P. 181-289.

67) Tokarsky, O. 1974. Hydrogeology of the Lethbridge-Fernie Area, Alberta. Alberta Research Council. Report No. 74-1.

68) Tokarsky, O. Jan-1987. Hydrogeological Cross-Sections. Southern Alberta.

69) Toth, J., and T. Corbet. Sep-1986. Post-Paleocene Evaluation of Regional Groundwater Flow-Systems and their Relationship to Petroleum Accumluations. Taber Area, Southern Alberta, Canada. In Bulletin of Canadian Petroleum Geology, Vol. 34, No. 3, pp 339-363.

70) Underwood McLellan (1977) Ltd. Feb-1978. Groundwater and Municpal Water Study. Oldman River Basin.

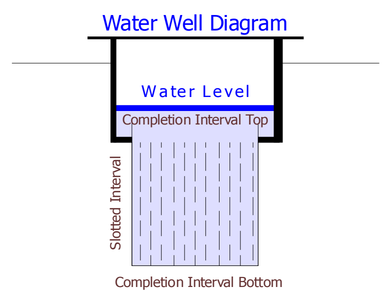
71) Underwood McLellan (1977) Ltd. Apr-1978. Groundwater in the Oldman River Basin.

72) Waterline Resources Inc. Mar-2003. Groundwater Investigation and Aquifer Testing. Milk River-Aden Area. Warner County and County of Forty Mile.

73) Westgate, J. A. 1968. Research Council of Alberta. Surficial Geology of the Foremost-Cypress Hills Area, Alberta. Foremost-Cypress Hills Area. [QE 186 R415 no. 022-001]

9 GLOSSARY

Anion	negatively charged ion
Aquifer	a formation, group of formations, or part of a formation that contains saturated permeable rocks capable of transmitting groundwater to water wells or springs in economical quantities
Aquitard	a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer
Available Drawdown	in a confined aquifer, the distance between the non-pumping water level and the top of the aquifer
	in an unconfined aquifer (water table aquifer), two thirds of the saturated thickness of the aquifer
Borehole	includes all "work types" except springs
Completion Interval	see diagram
Deltaic	a depositional environment in standing water near the mouth of a river
Dfb	one of the Köppen climate classifications; a Dfb climate consists of warm to cool summers, severe winters, and no dry season. The mean monthly temperature drops below -3° C in the coolest month, and exceeds 10° C in the warmest month.



Completion Interval

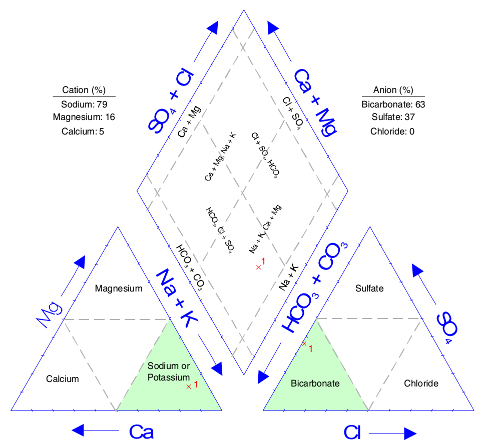
Evapotranspiration	a combination of evaporation from open bodies of water, evaporation from soil surfaces, and transpiration from the soil by plants (Freeze and Cherry, 1979)
Facies	the aspect or character of the sediment within beds of one and the same age (Pettijohn, 1957)
Fluvial	produced by the action of a stream or river
Friable	poorly cemented
Hydraulic Conductivity	the rate of flow of water through a unit cross-section under a unit hydraulic gradient; units are length/time
Kriging	a geo-statistical method for gridding irregularly-spaced data (Cressie, 1990)
Lacustrine	fine-grained sedimentary deposits associated with a lake environment and not including shore-line deposits
Lithology	description of rock material
Lsd	Legal Subdivision
m^2/day	metres squared per day
m^3	cubic metres
m^3/day	cubic metres per day

mg/L
milligrams per litre

Median
the value at the centre of an ordered range of numbers

Obs WW
Observation Water Well

Piper tri-linear diagram
a method that permits the major cation and anion compositions of single or multiple samples to be represented on a single graph. This presentation allows groupings or trends in the data to be identified. From the Piper tri-linear diagram, it can be seen that the groundwater from this sample water well is a sodium-bicarbonate-type. The chemical type has been determined by graphically calculating the dominant cation and anion. For a more detailed explanation, please refer to Freeze and Cherry, 1979



Piper Tri-Linear Diagram

Rock
earth material below the root zone

Surficial Deposits
includes all sediments above the bedrock

Till
a sediment deposited directly by a glacier that is unsorted and consisting of any grain size ranging from clay to boulders

Transmissivity
the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient: a measure of the ease with which groundwater can move through the aquifer

Apparent Transmissivity: the value determined from a summary of aquifer test data, usually involving only two water-level readings

Effective Transmissivity: the value determined from late pumping and/or late recovery water-level data from an aquifer test

Aquifer Transmissivity: the value determined by multiplying the hydraulic conductivity of an aquifer by the thickness of the aquifer

Water Well
a hole in the ground for the purpose of obtaining groundwater; "work type" as defined by AENV includes test hole, chemistry, deepened, well inventory, federal well survey, reconditioned, reconstructed, new, old well-test

Yield
a regional analysis term referring to the rate a properly completed water well could be pumped, if fully penetrating the aquifer

Apparent Yield: based mainly on apparent transmissivity

Long-Term Yield: based on effective transmissivity

AAFC-PFRA
Prairie Farm Rehabilitation Administration Branch of Agriculture and Agri-Food Canada

AENV	Alberta Environment
AMSL	above mean sea level
BGP	Base of Groundwater Protection
DEM	Digital Elevation Model
DST	drill stem test
EUB	Alberta Energy and Utilities Board
IAAM	*Infinite Aquifer Artesian Model.* The mathematical model is used to calculate water levels at a given location. The model has been used for more than 20 years by HCL for several hundred groundwater monitoring projects. The model aquifer is based on a solution of the well function equation. The simulation calculates drawdown by solving the well function equation using standard approximation methods. The drawdown at any given point at any given time uses the method of superposition.
NPWL	non-pumping water level
SGCDWQ	Summary of Guidelines for Canadian Drinking Water Quality
TDS	Total Dissolved Solids
WSW	Water Source Well or Water Supply Well

9. CONVERSIONS

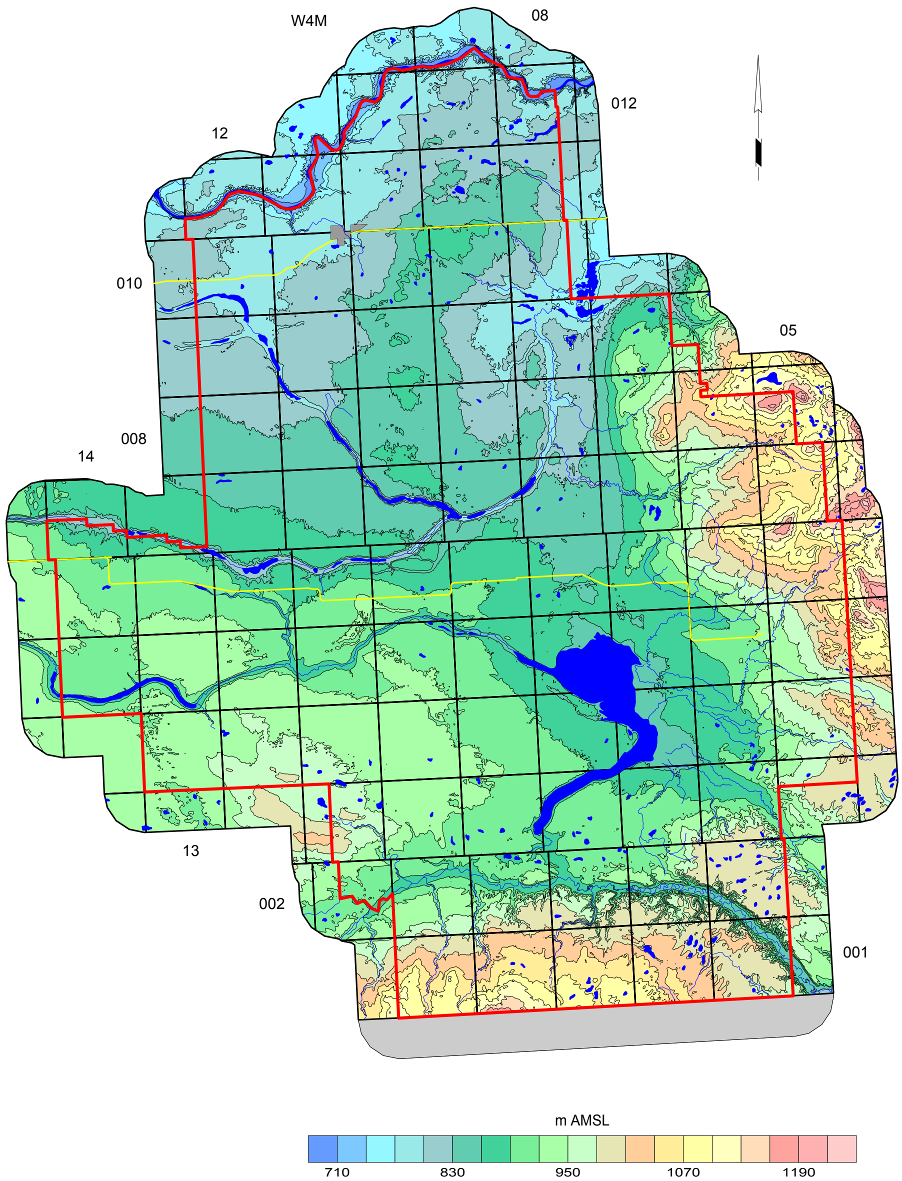
Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inchs	25.400 000	millimetres
miles	1.609 344	kilometres
kilometer	0.621 370	miles (statute)
square feet (ft^2)	0.092 903	metres (m^2)
metres (m^2)	10.763 910	square feet (ft^2)
metres (m^2)	0.000 001	kilometres (km^2)
Concentration		
grains/gallon (UK)	14.270 050	ppm
ppm	0.998 859	mg/L
mg/L	1.001 142	ppm
Volume (capacity)		
acre feet	1233.481 838	cubic metres
cubic feet	0.028 317	cubic metres
cubic metres	35.314 667	cubic feet
cubic metres	219.969 248	gallons (UK)
cubic metres	264.172 050	gallons (US liquid)
cubic metres	1000.000 000	litres
gallons (UK)	0.004 546	cubic metres
imperial gallons	4.546 000	litres
Rate		
litres per minute	0.219 974	ipgm
litres per minute	1.440 000	cubic metres/day (m^3/day)
igpm	6.546 300	cubic metres/day (m^3/day)
cubic metres/day (m	0.152 759	igpm
Pressure		
psi	6.894 757	kpa
kpa	0.145 038	psi
Miscellaneous		
Celsius	F° = 9/5 (C° + 32)	Fahrenheit
Fahrenheit	C° = (F°- 32) * 5/9	Celsius
degrees	0.017 453	radians

COUNTY OF FORTY MILE NO. 8

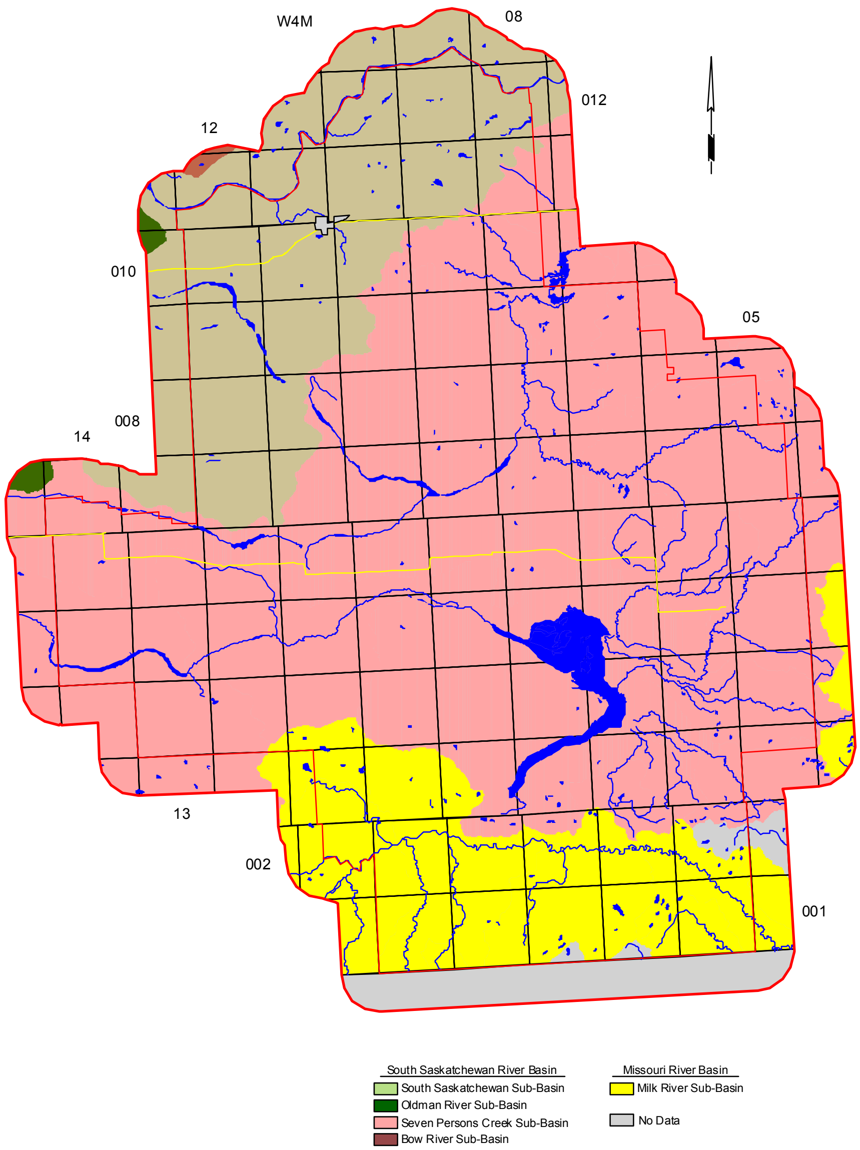
Appendix A

Hydrogeological Maps and Figures

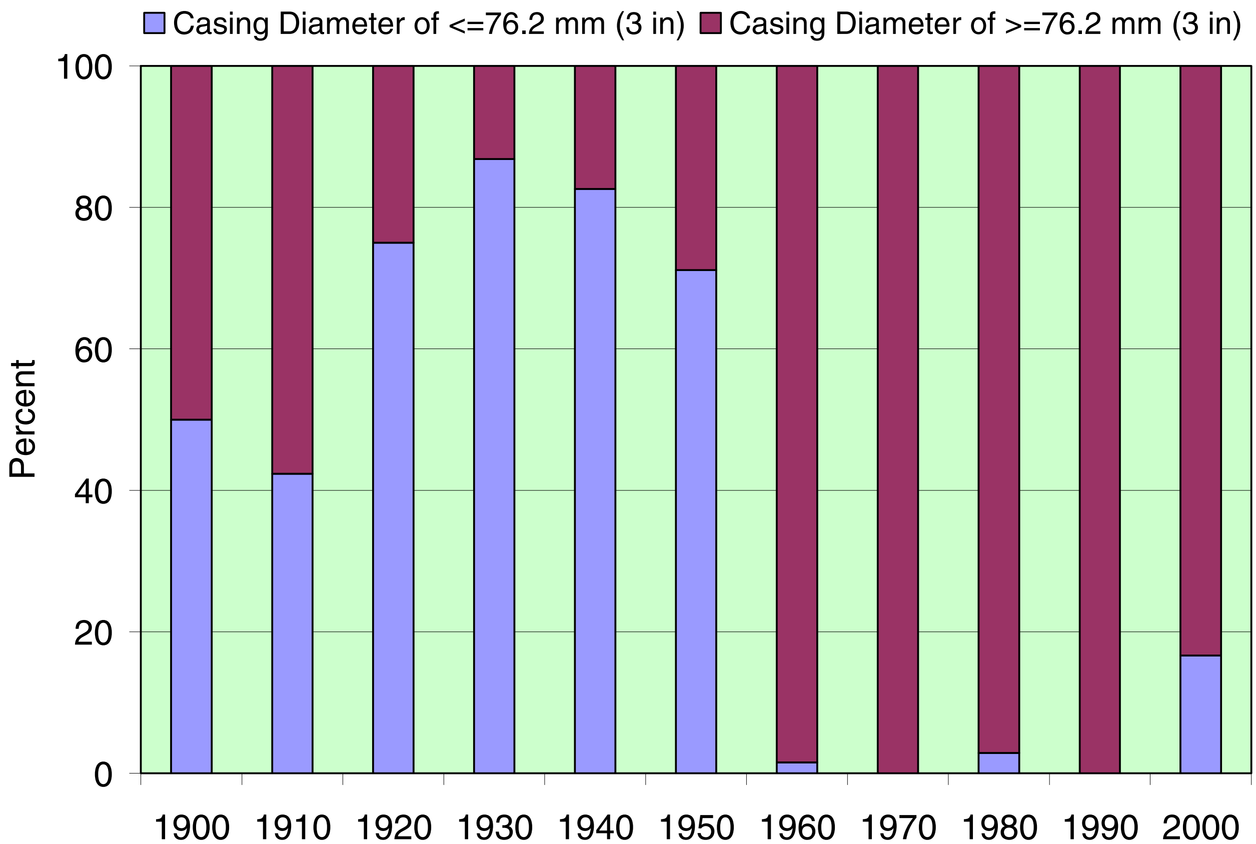
Surface Topography



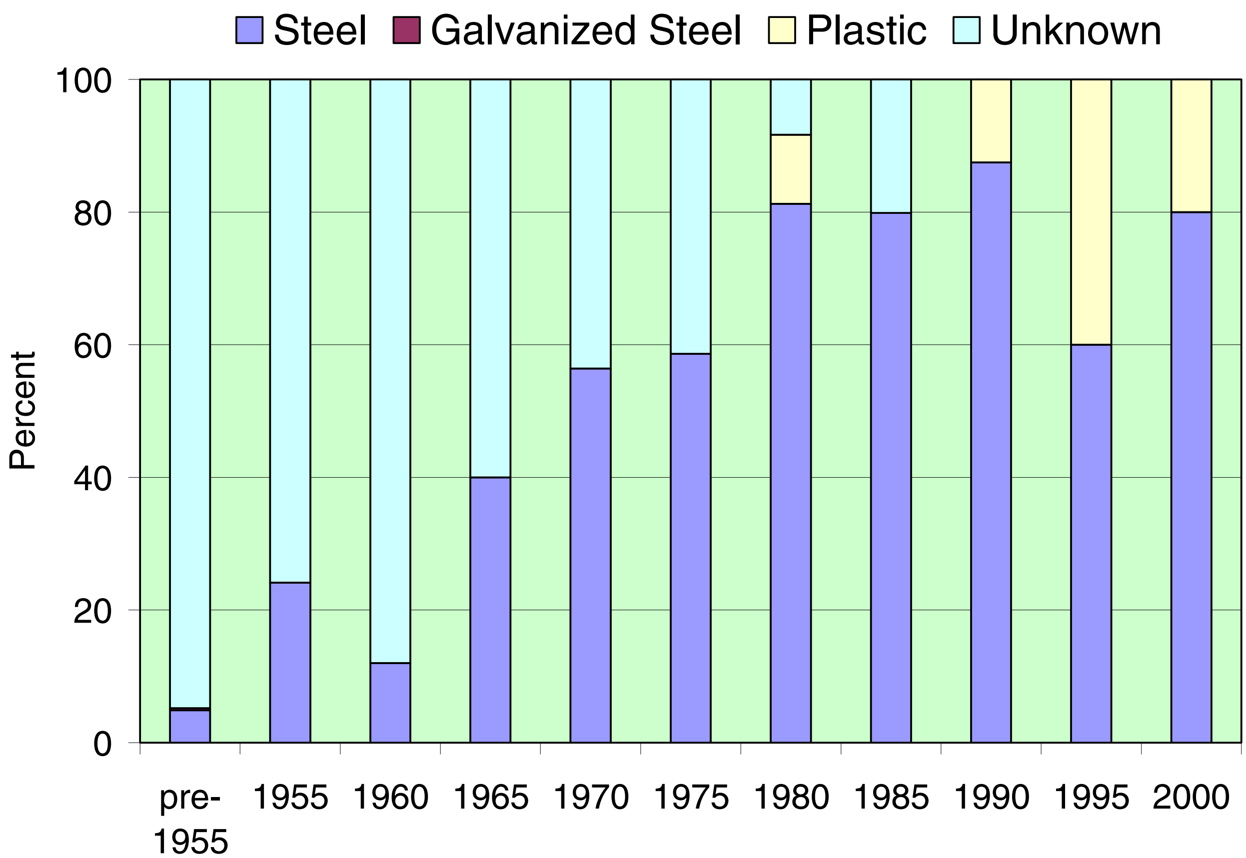
River Sub-Basins



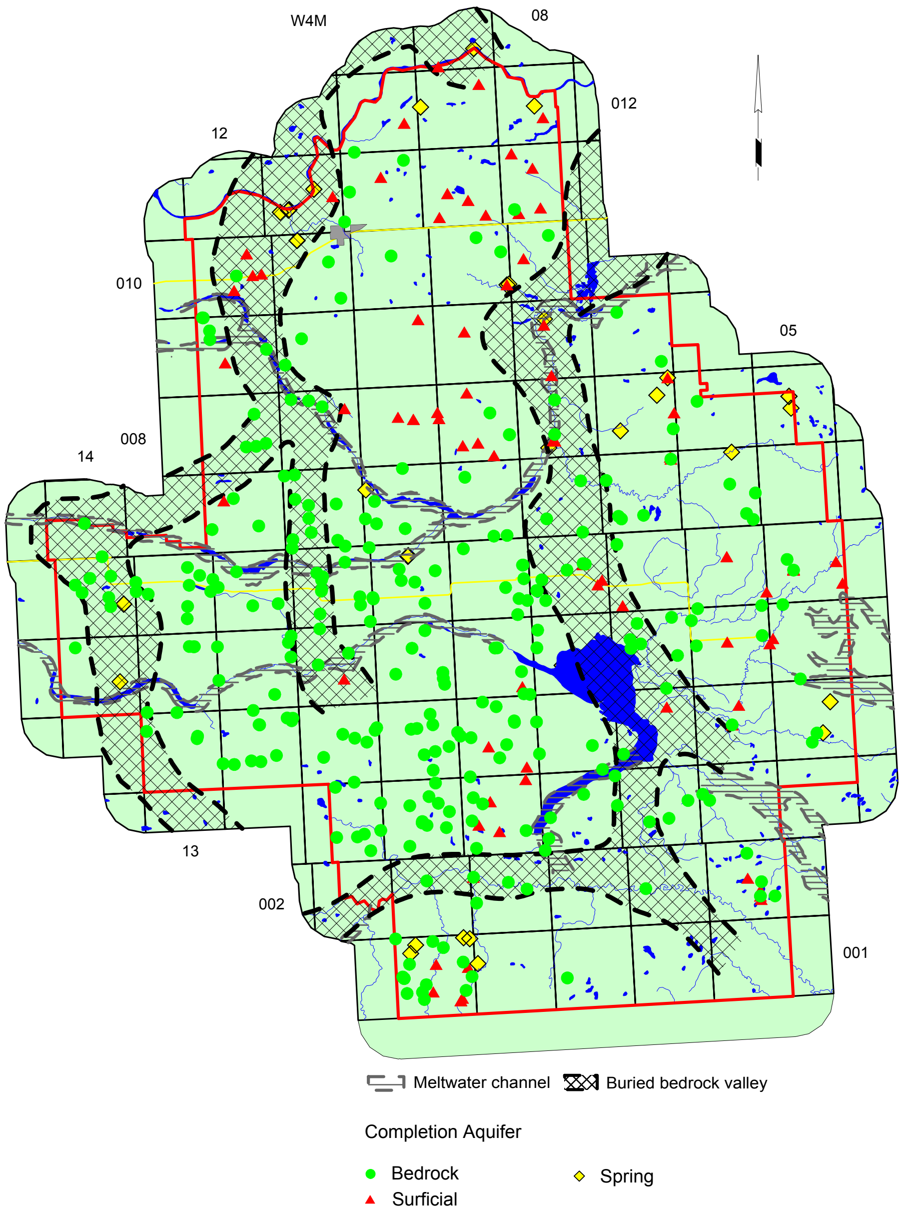
Surface-Casing Diameters Used in Drilled Water Wells



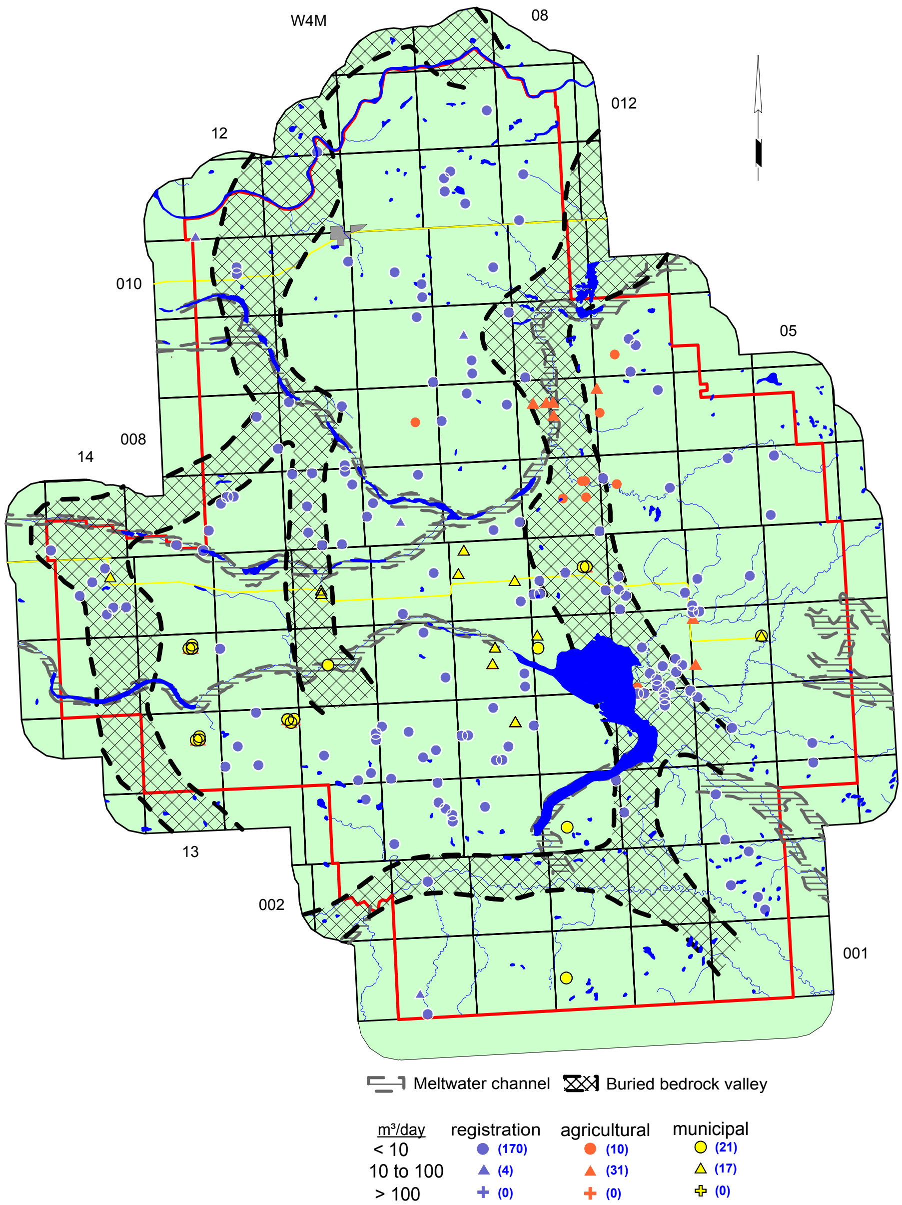
Surface Casing Types Used in Drilled Water Wells



Locations of Water Wells and Springs

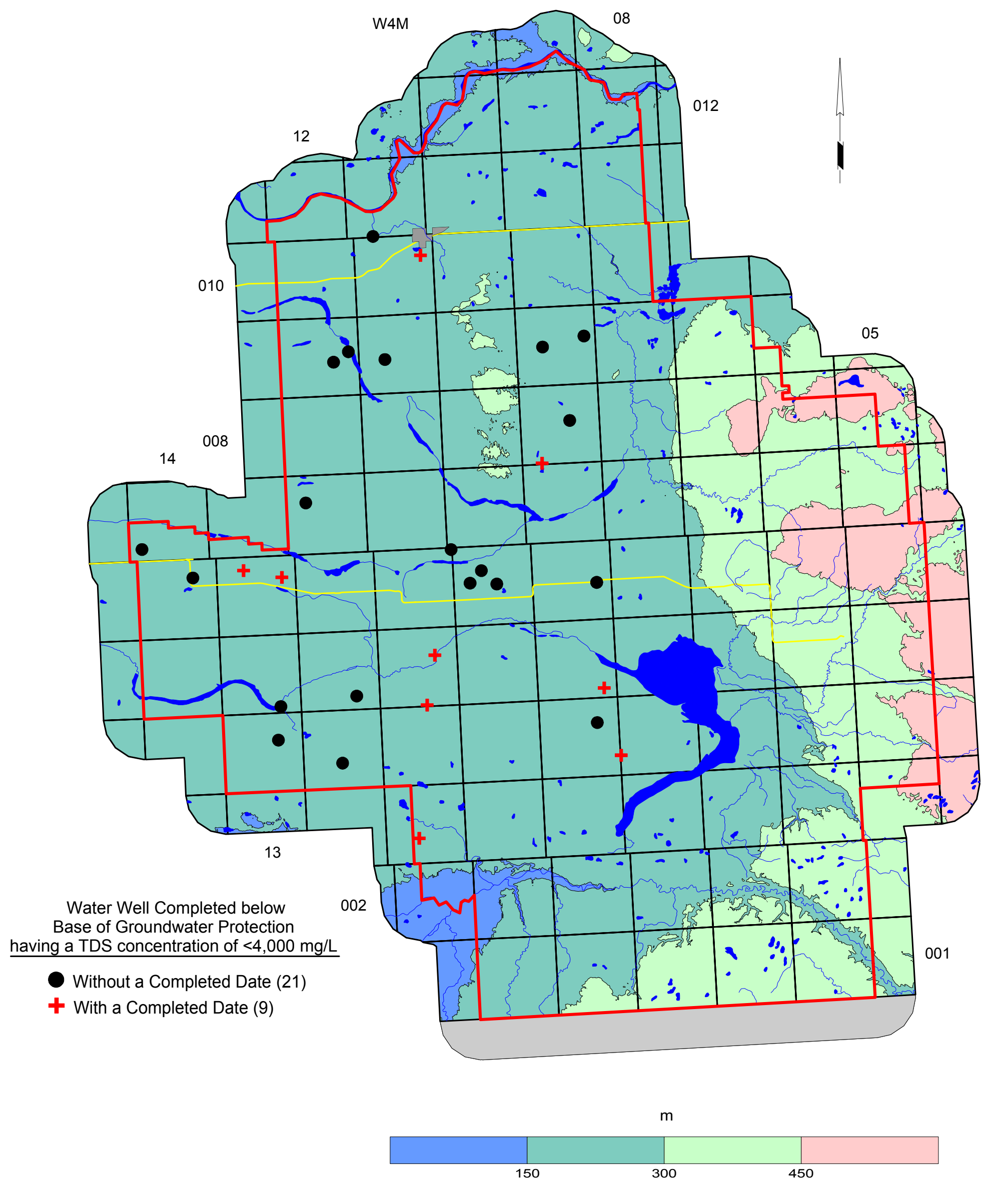


Licensed and Registered Groundwater Water Wells



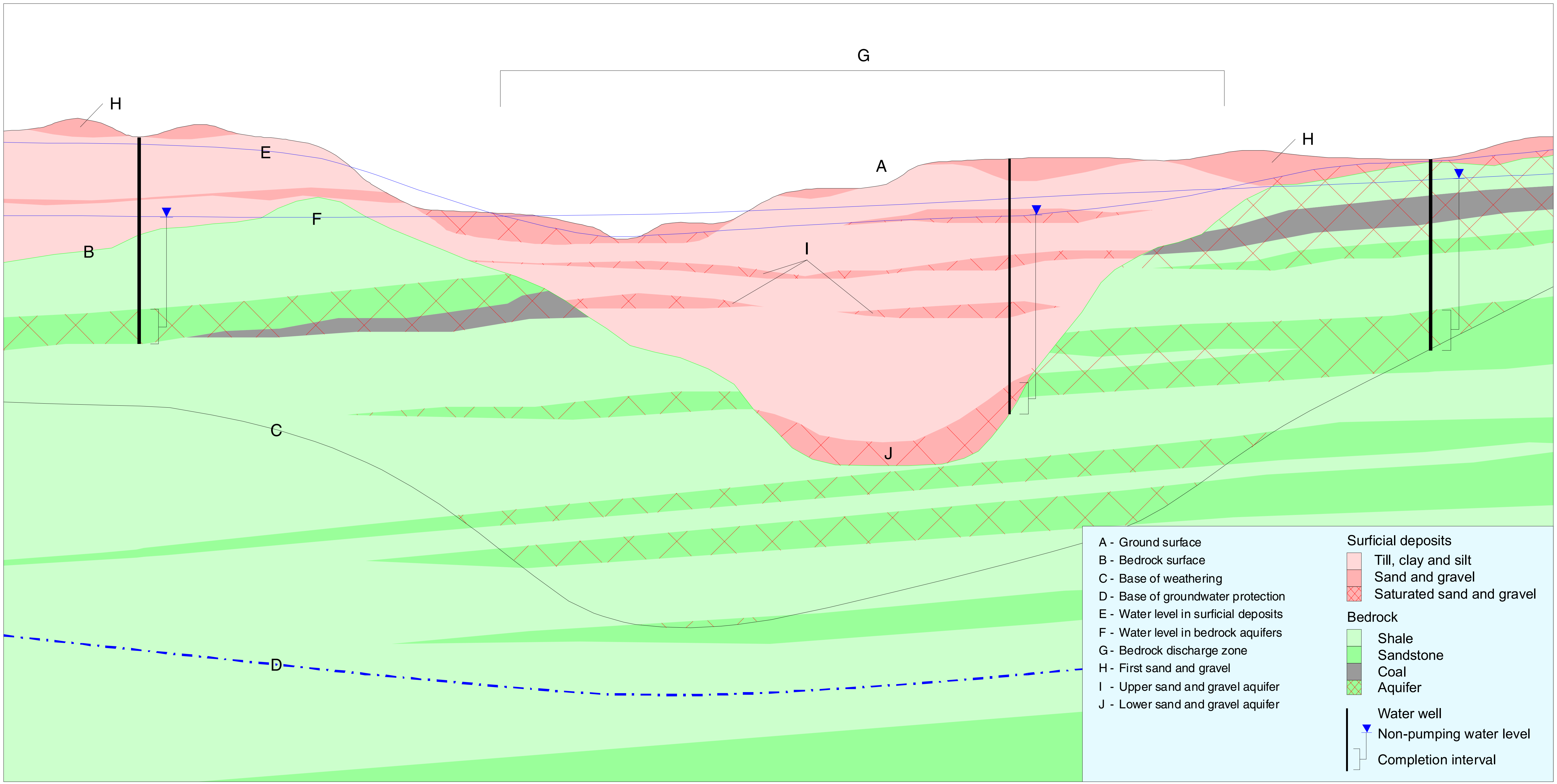
Depth to Base of Groundwater Protection

(modified after EUB, 1995)

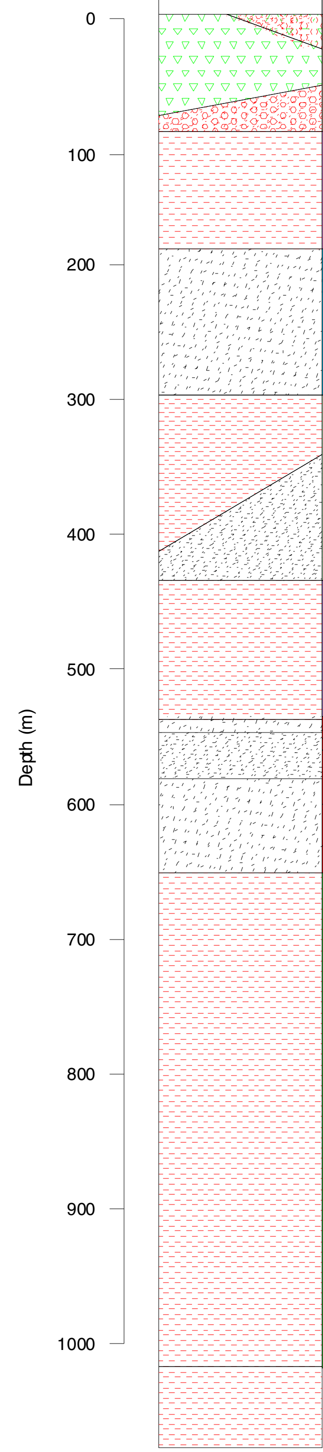


Generalized Cross-Section

(for terminology only)

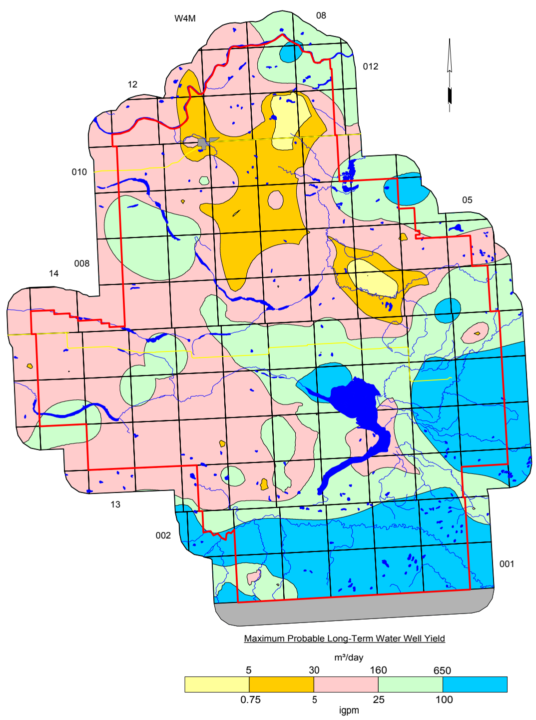


Generalized Geologic Column

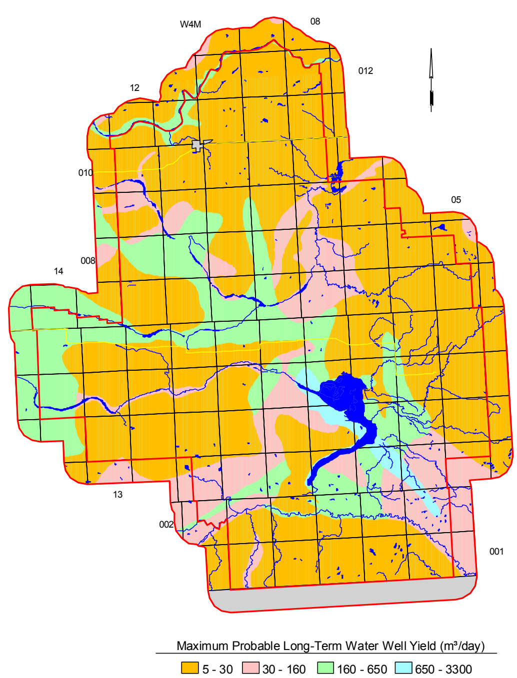


Lithologic Description	Group and Formation: Average Thickness (m)	Group	Group and Formation: Designation	Member: Average Thickness (m)	Member: Designation	Zone: Average Thickness (m)	Zone: Designation
sand, gravel, till, clay, silt	<140		Surficial Deposits	<140	Upper	<30	First Sand and Gravel
				<50	Lower		
shale, sandstone, siltstone	60-120		Bearpaw Formation				
sandstone, siltstone, shale, coal	<300 / 40-130	Belly River Group	Oldman Formation		Dinosaur Member	<25	Lethbridge Coal Zone
					Upper Siltstone Member		
					Comrey Member		
sandstone, shale	<200	Belly River Group	Foremost Formation	<70	Birch Lake Member		Taber Coal Zone
				<60	Ribstone Creek Member		
				<70	Victoria Member		McKay Coal Zone
				0-30	Brosseau Member		
shale, siltstone	100-150		Lea Park Formation (Pakowki)				
sandstone, siltstone, shale, coal	120-150		Milk River Formation	<50	Sandstone Unit		
shale, siltstone	200-1000	Colorado Group	Colorado Shale				
sandstone, mudstone, shale	50	Colorado Group	Viking Formation				

Hydrogeological Maps

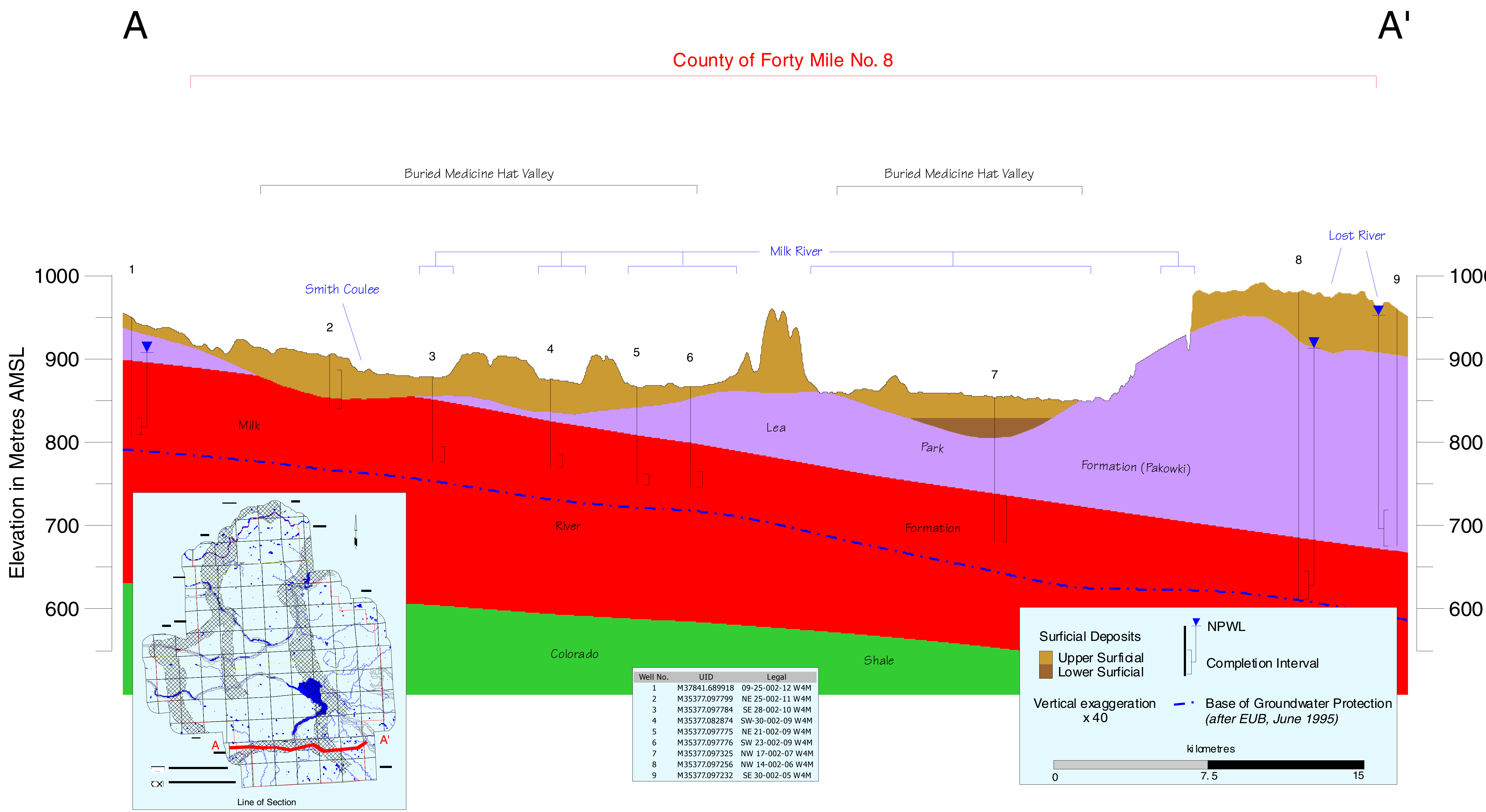


2004 Hydrogeological Consultants (HCL)



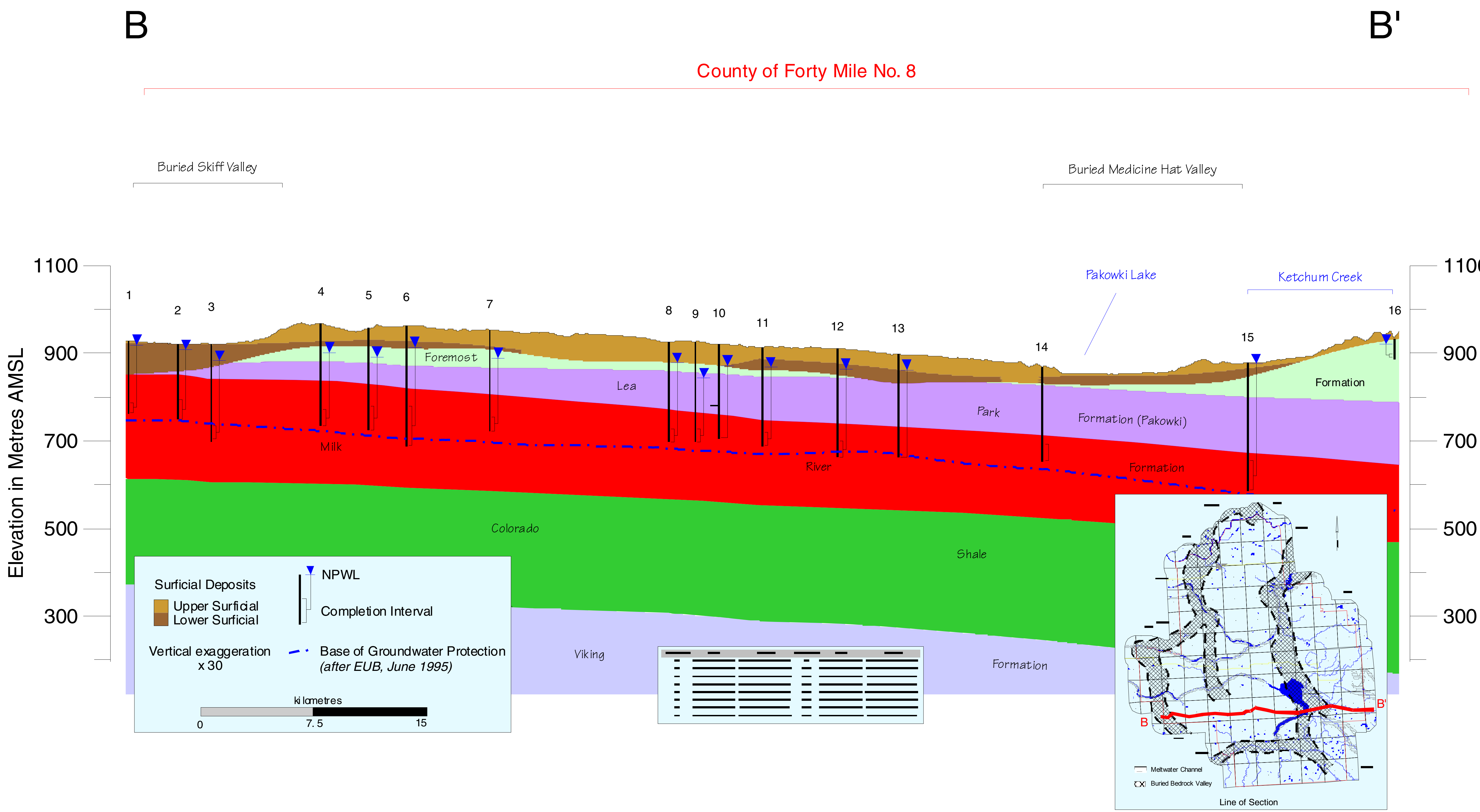
1976 Alberta Geological Survey

Cross-Section A - A'

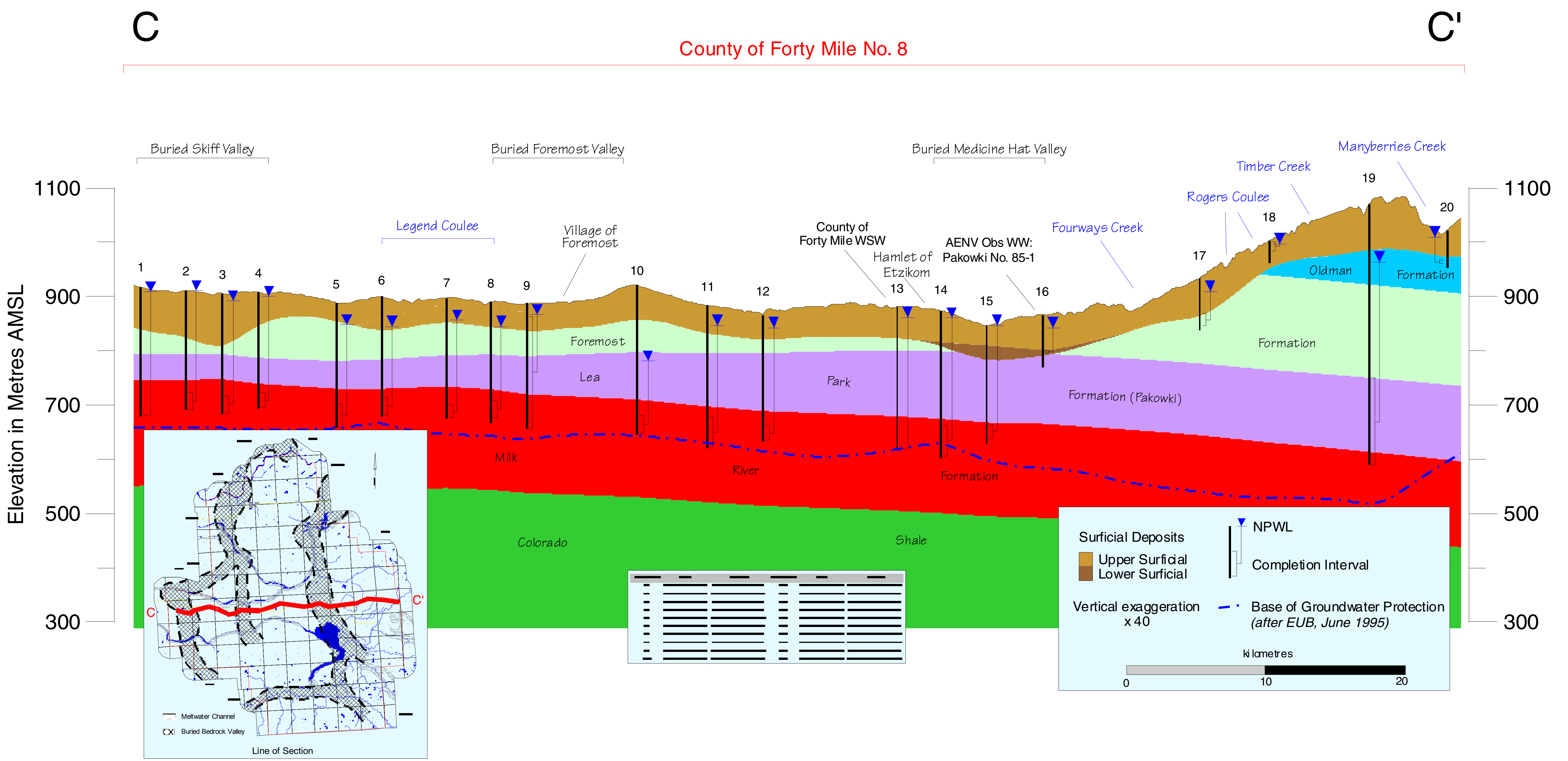


Well No.	UID	Legal
1	M37841.689918	09-25-002-12 W4M
2	M35377.097799	NE 25-002-11 W4M
3	M35377.097784	SE 28-002-10 W4M
4	M35377.082874	SW-30-002-09 W4M
5	M35377.097775	NE 21-002-09 W4M
6	M35377.097776	SW 23-002-09 W4M
7	M35377.097325	NW 17-002-07 W4M
8	M35377.097256	NW 14-002-06 W4M
9	M35377.097232	SE 30-002-05 W4M

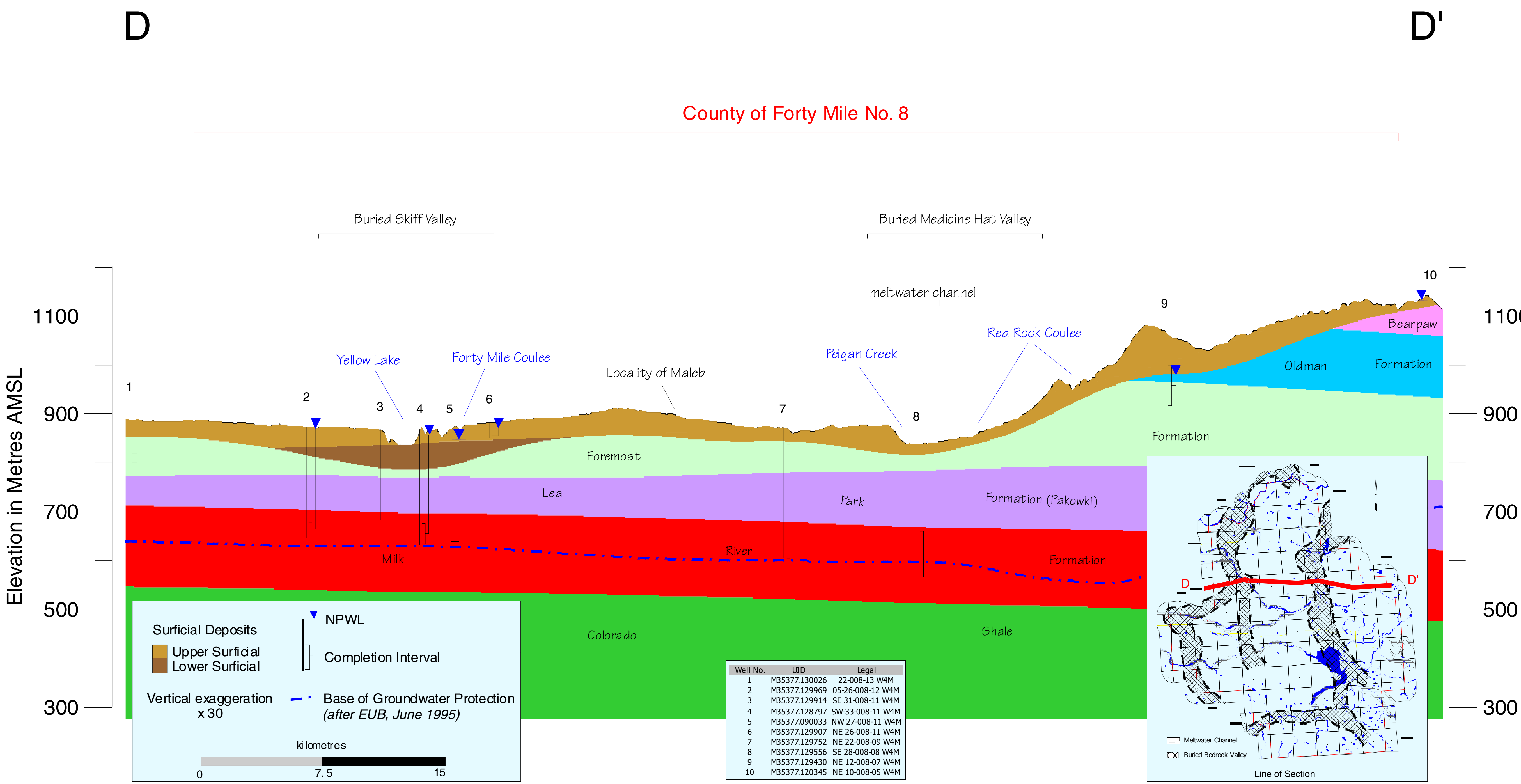
Cross-Section B - B'



Cross-Section C - C'

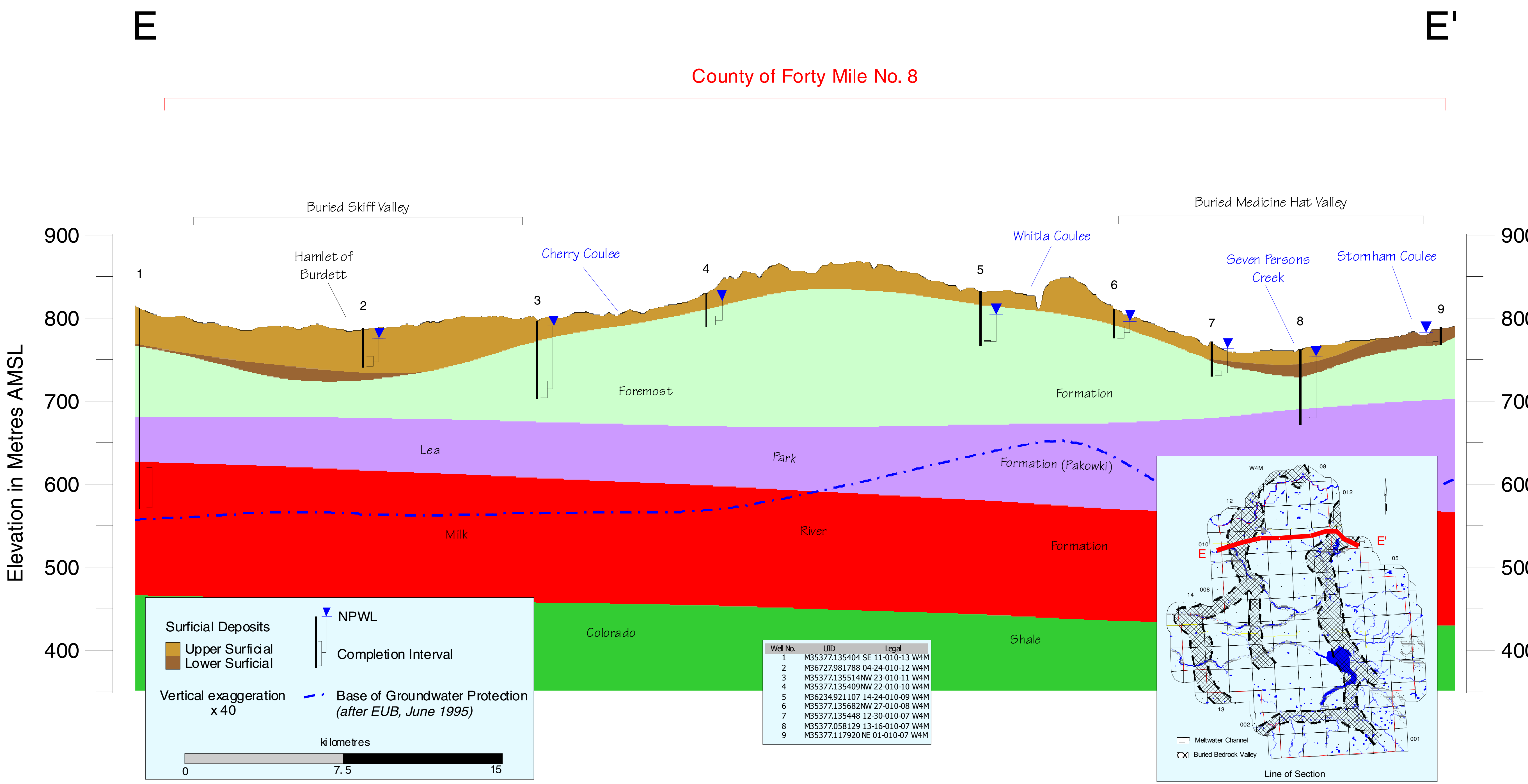


Cross-Section D - D'



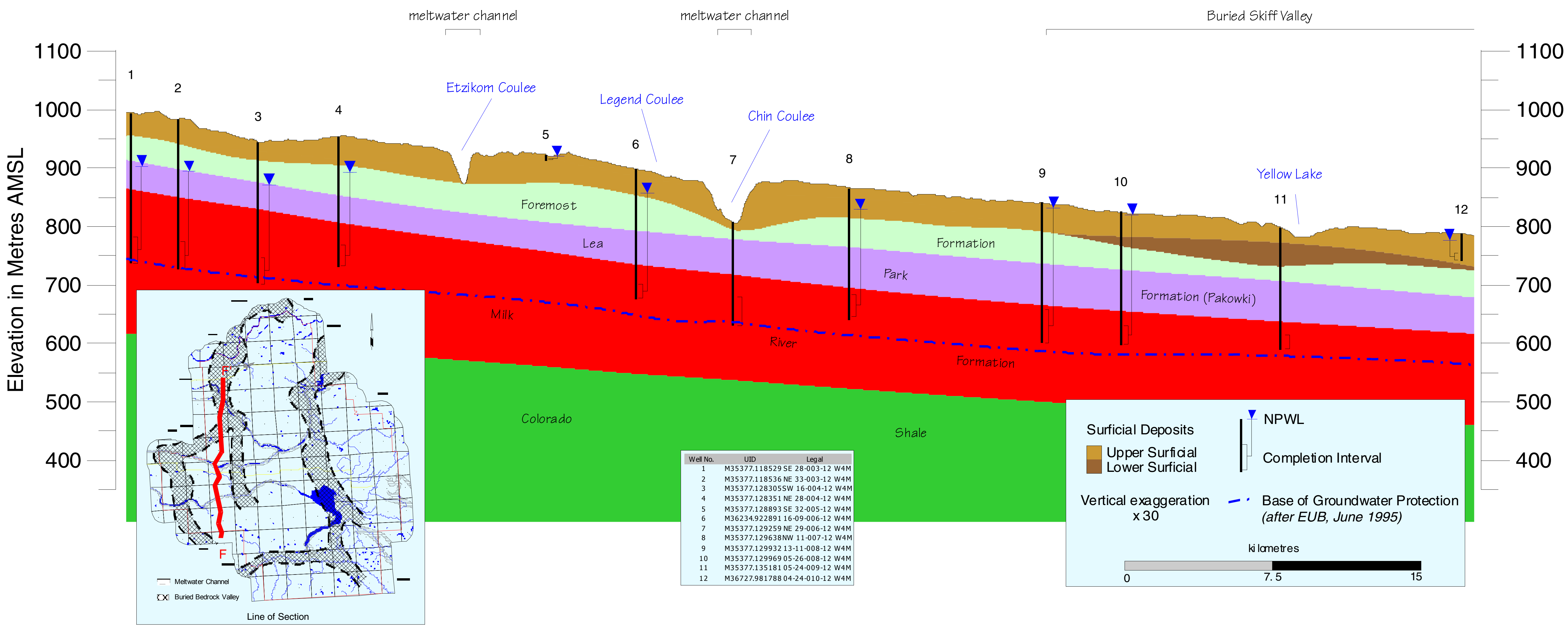
Well No.	UID	Legal
1	M35377.130026	22-008-13 W4M
2	M35377.129969	05-26-008-12 W4M
3	M35377.129914	SE 31-008-11 W4M
4	M35377.128797	SW-33-008-11 W4M
5	M35377.090033	NW 27-008-11 W4M
6	M35377.129907	NE 26-008-11 W4M
7	M35377.129752	NE 22-008-09 W4M
8	M35377.129556	SE 28-008-08 W4M
9	M35377.129430	NE 12-008-07 W4M
10	M35377.120345	NE 10-008-05 W4M

Cross-Section E - E'



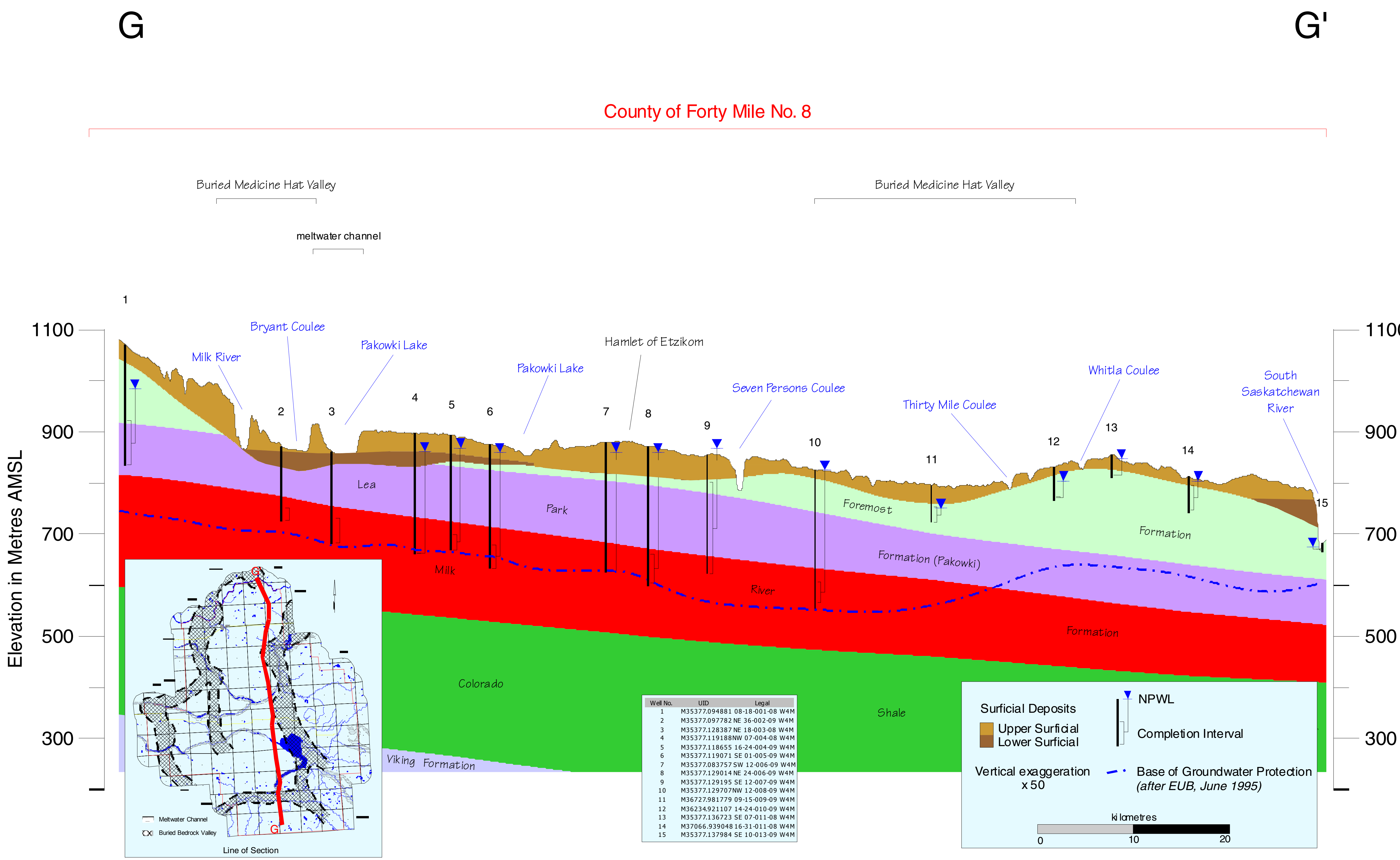
Well No.	UID	Legal
1	M35377.135404	SE 11-010-13 W4M
2	M36727.981788	04-24-010-12 W4M
3	M35377.135514	NW 23-010-11 W4M
4	M35377.135409	NW 22-010-10 W4M
5	M36234.921107	14-24-010-09 W4M
6	M35377.135682	NW 27-010-08 W4M
7	M35377.135448	12-30-010-07 W4M
8	M35377.058129	13-16-010-07 W4M
9	M35377.117920	NE 01-010-07 W4M

Cross-Section F - F'



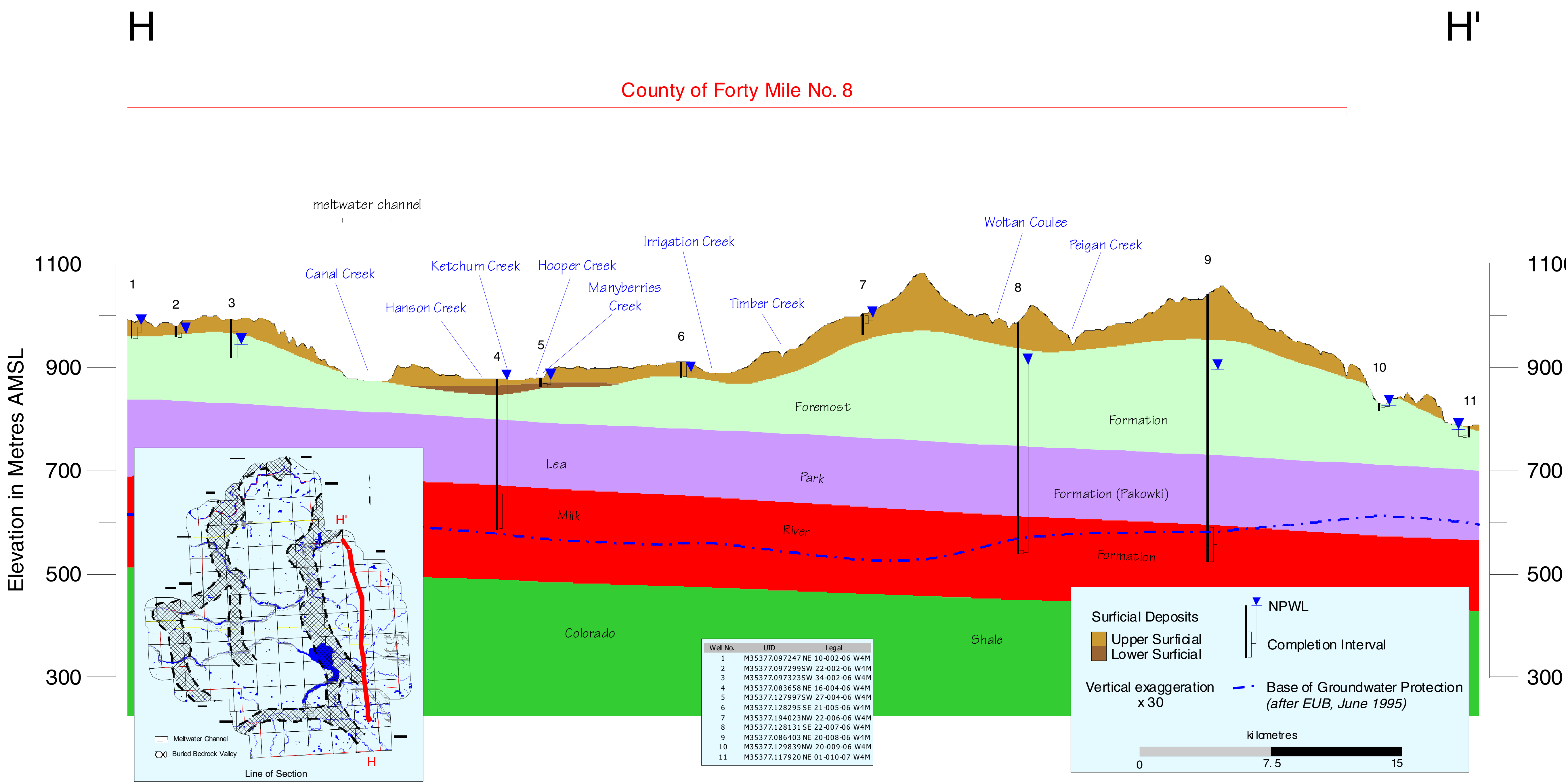
Well No.	UID	Legal
1	M35377.118529	SE 28-003-12 W4M
2	M35377.118536	NE 33-003-12 W4M
3	M35377.128305	SW 16-004-12 W4M
4	M35377.128351	NE 28-004-12 W4M
5	M35377.128893	SE 32-005-12 W4M
6	M36234.922891	16-09-006-12 W4M
7	M35377.129259	NE 29-006-12 W4M
8	M35377.129638	NW 11-007-12 W4M
9	M35377.129932	13-11-008-12 W4M
10	M35377.129969	05-26-008-12 W4M
11	M35377.135181	05-24-009-12 W4M
12	M36727.981788	04-24-010-12 W4M

Cross-Section G - G'



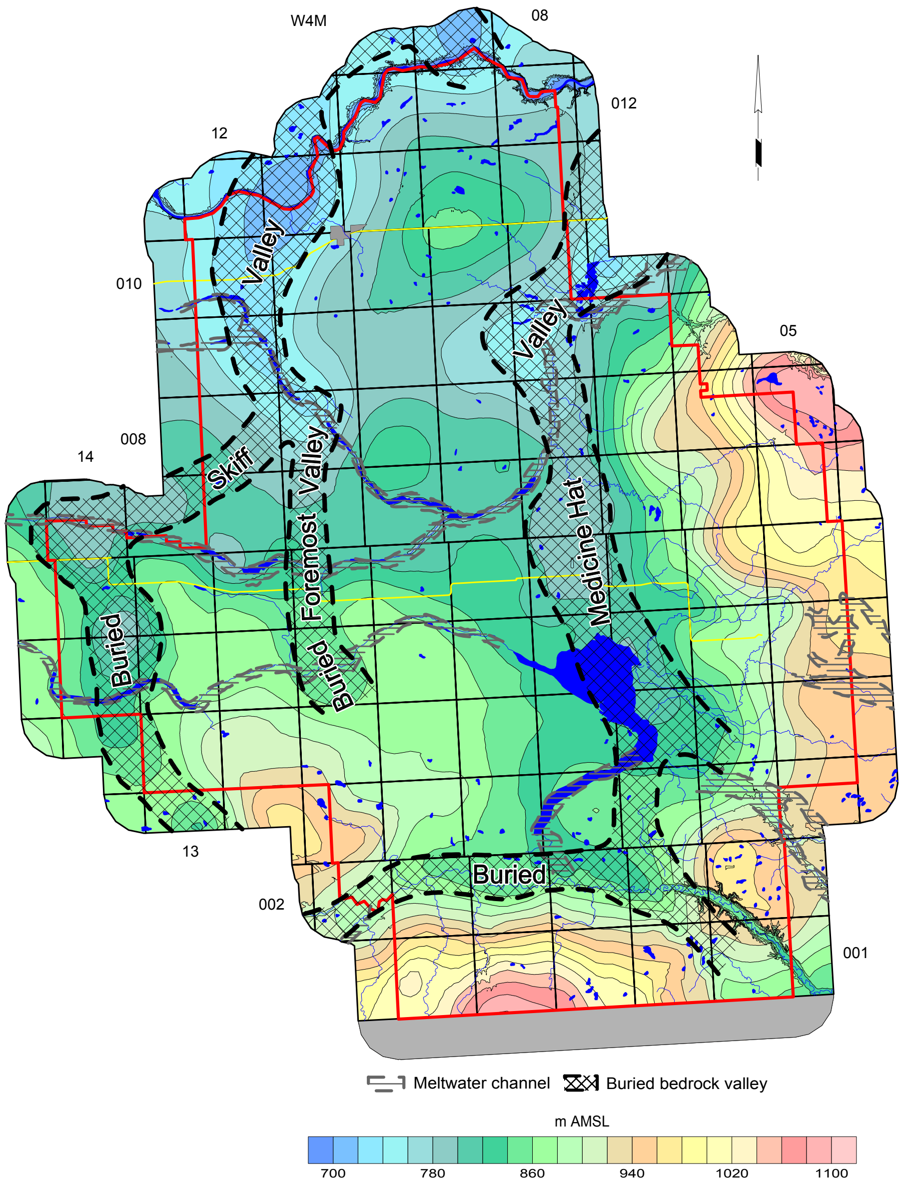
Well No.	UID	Legal
1	M35377.094881	08-18-001-08 W4M
2	M35377.097782	NE 36-002-09 W4M
3	M35377.128387	NE 18-003-08 W4M
4	M35377.119188	NW 07-004-08 W4M
5	M35377.118655	16-24-004-09 W4M
6	M35377.119071	SE 01-005-09 W4M
7	M35377.083757	SW 12-006-09 W4M
8	M35377.129014	NE 24-006-09 W4M
9	M35377.129195	SE 12-007-09 W4M
10	M35377.129707	NW 12-008-09 W4M
11	M36727.981779	09-15-009-09 W4M
12	M36234.921107	14-24-010-09 W4M
13	M35377.136723	SE 07-011-08 W4M
14	M37066.939048	16-31-011-08 W4M
15	M35377.137984	SE 10-013-09 W4M

Cross-Section H - H'

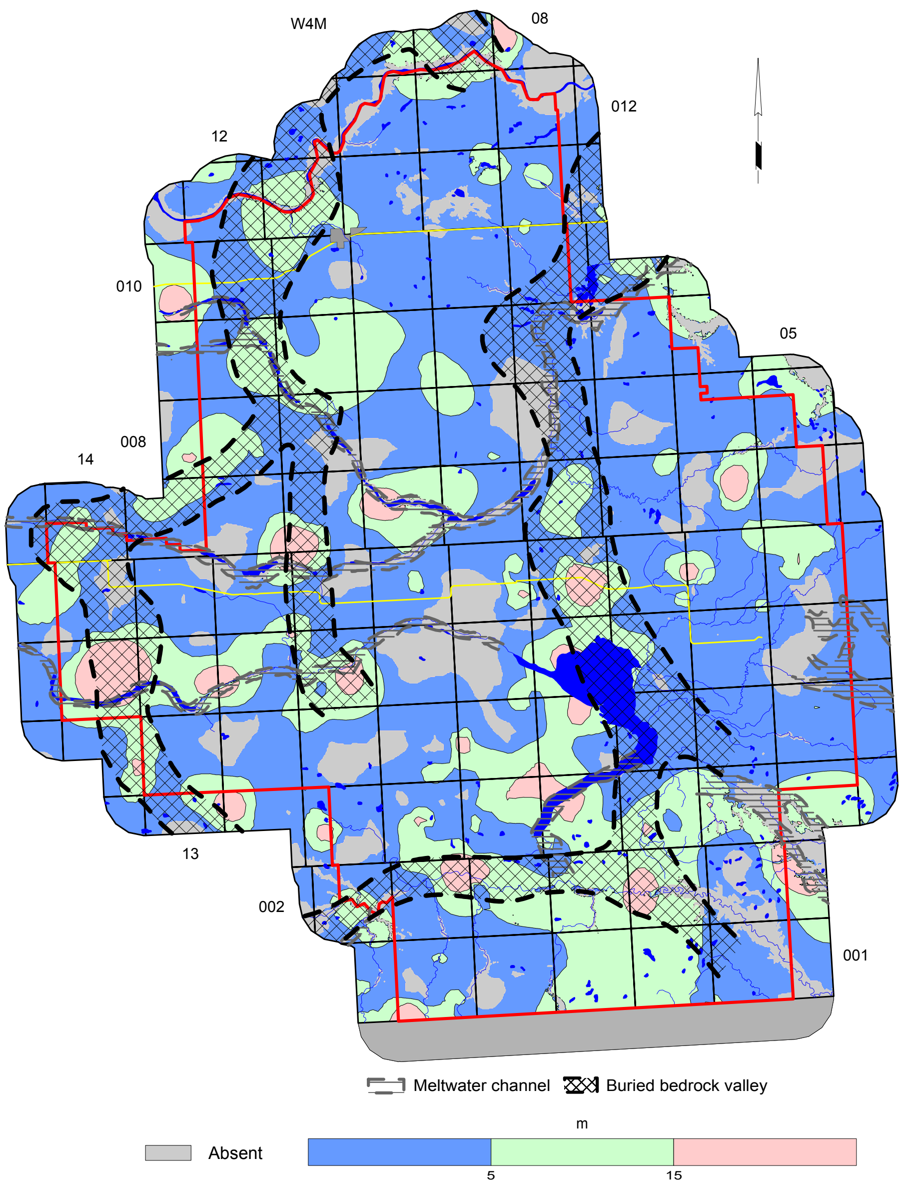


Well No.	UID	Legal
1	M35377.097247	NE 10-002-06 W4M
2	M35377.097299	SW 22-002-06 W4M
3	M35377.097323	SW 34-002-06 W4M
4	M35377.083658	NE 16-004-06 W4M
5	M35377.127997	SW 27-004-06 W4M
6	M35377.128295	SE 21-005-06 W4M
7	M35377.194023	NW 22-006-06 W4M
8	M35377.128131	SE 22-007-06 W4M
9	M35377.086403	NE 20-008-06 W4M
10	M35377.129839	NW 20-009-06 W4M
11	M35377.117920	NE 01-010-07 W4M

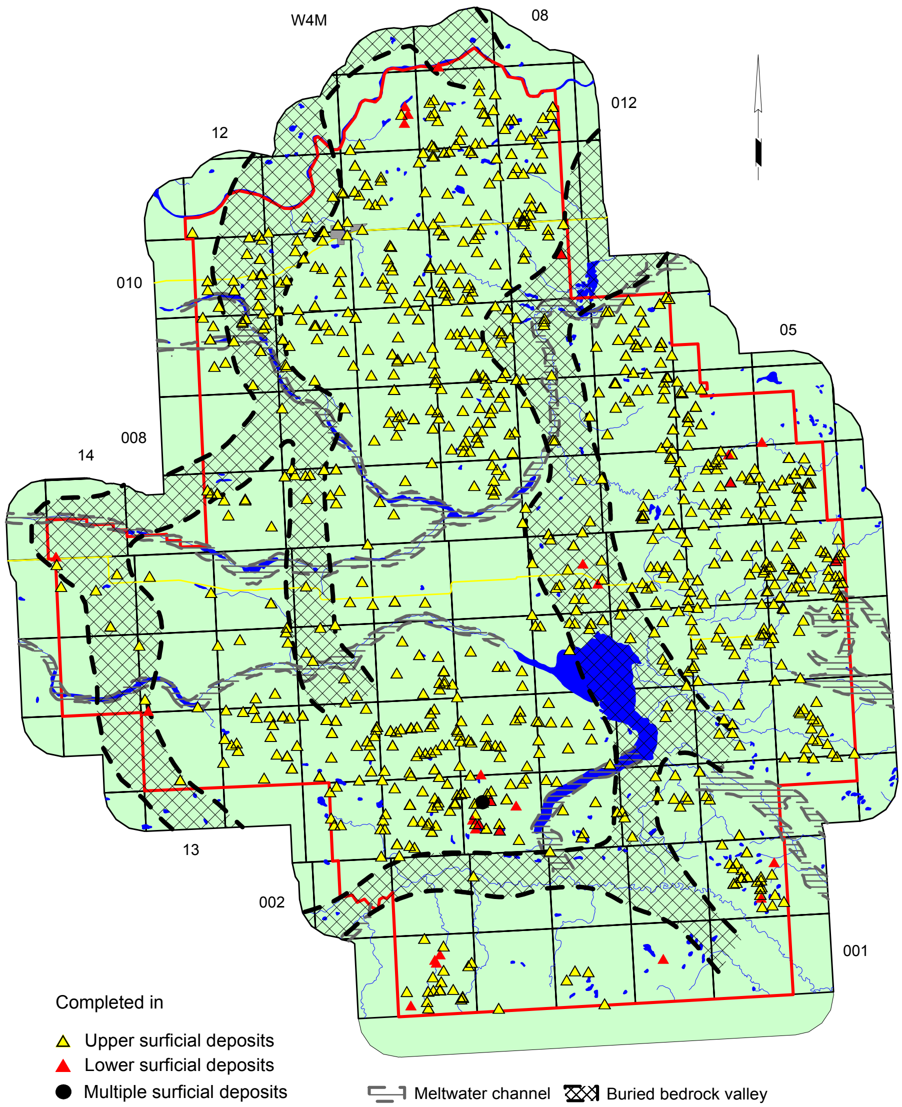
Bedrock Topography



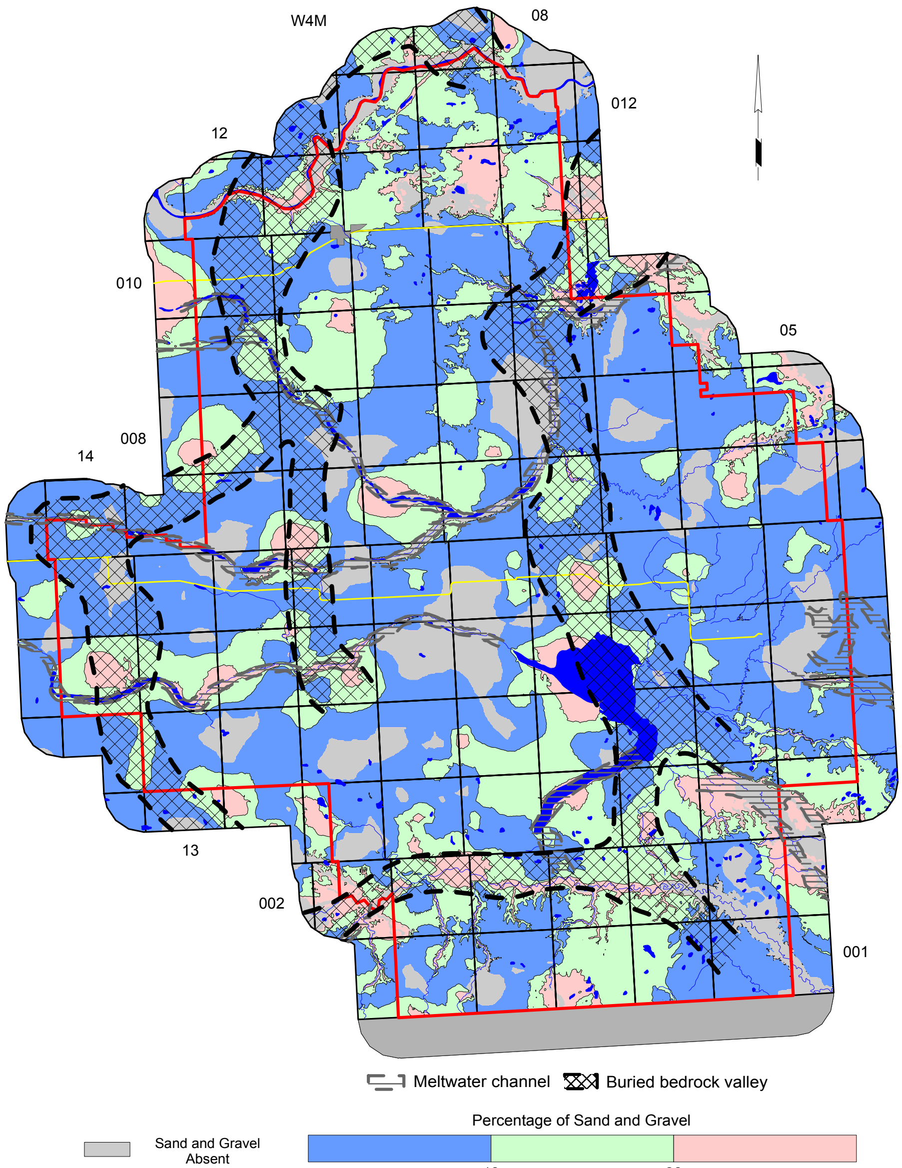
Thickness of Sand and Gravel Deposits



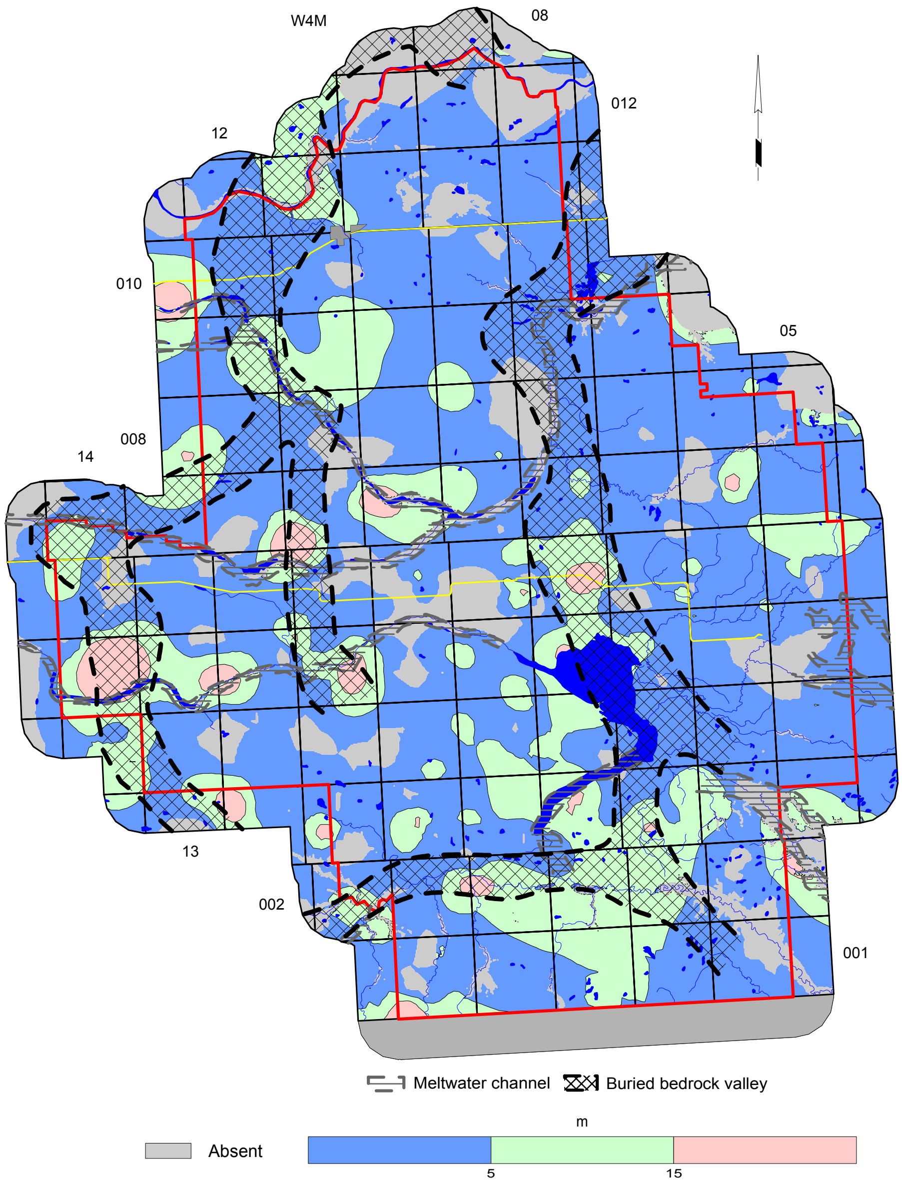
Water Wells Completed In Surficial Deposits



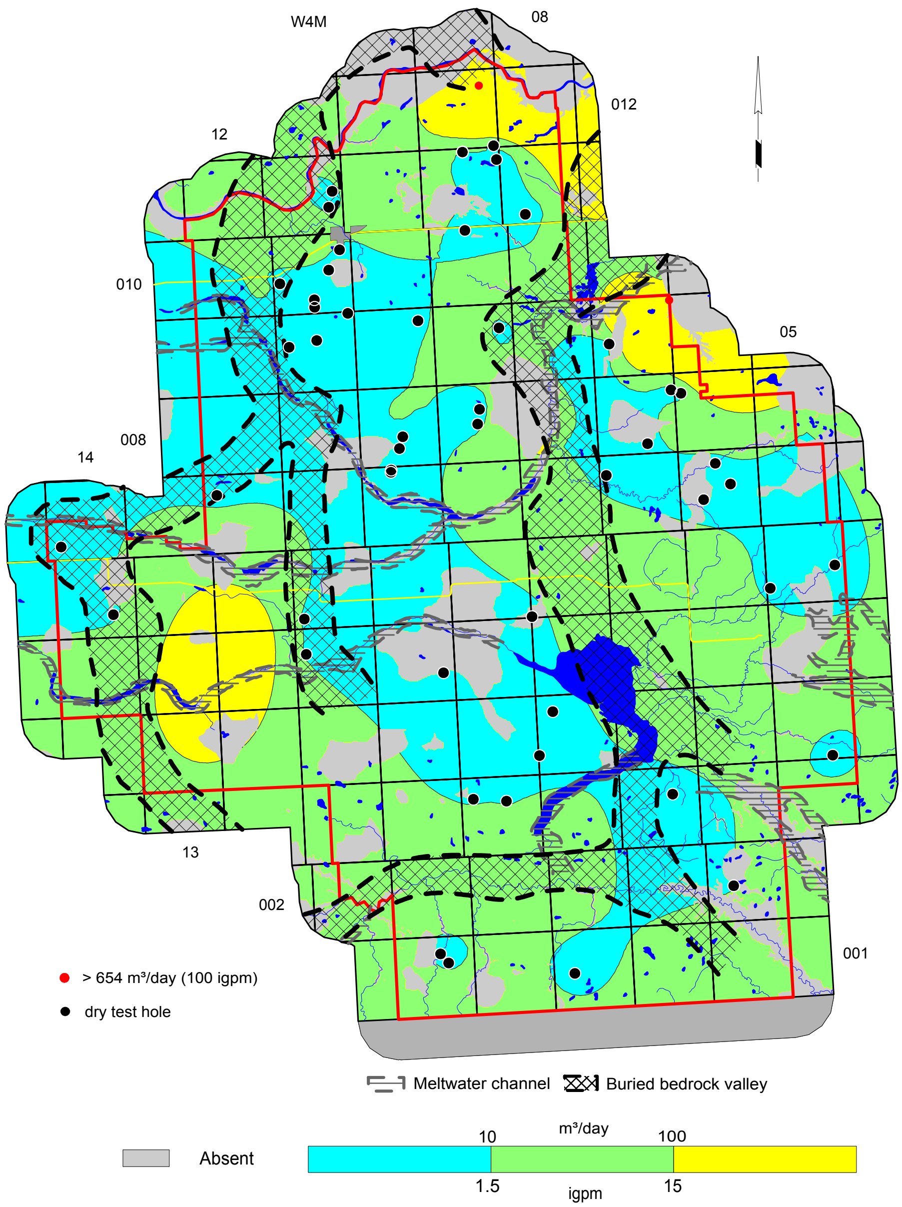
Amount of Sand and Gravel in Surficial Deposits



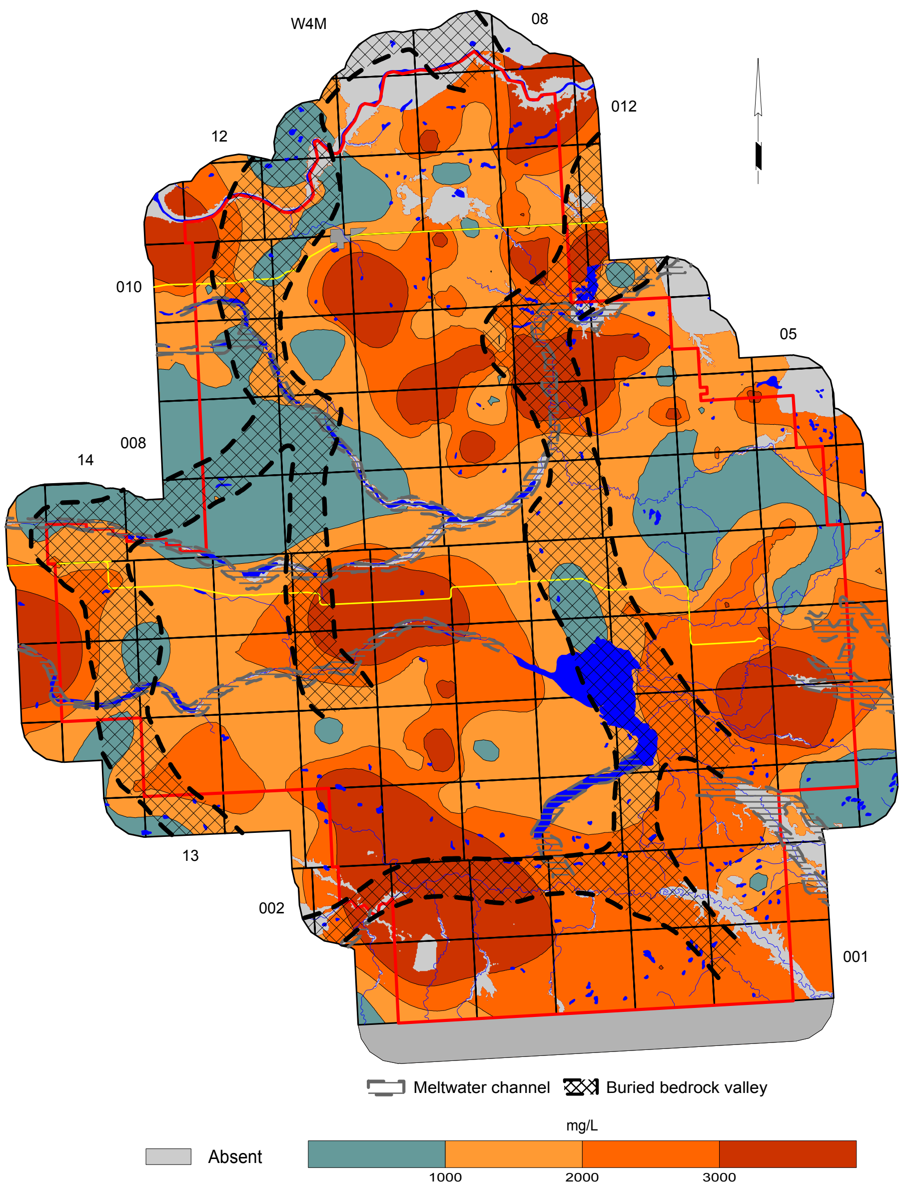
Thickness of Sand and Gravel Aquifer(s)



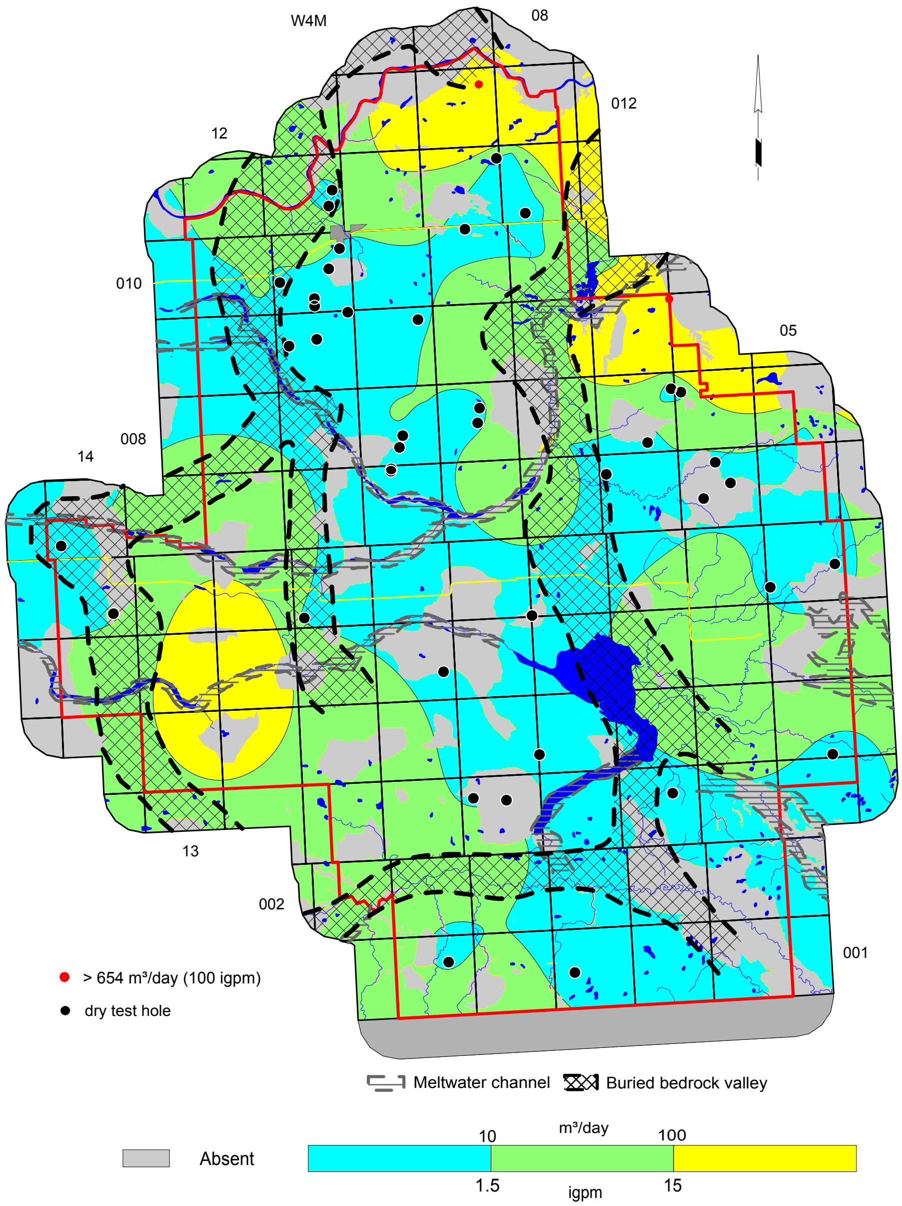
Apparent Yield of Water Wells Completed in Sand and Gravel Aquifer(s)



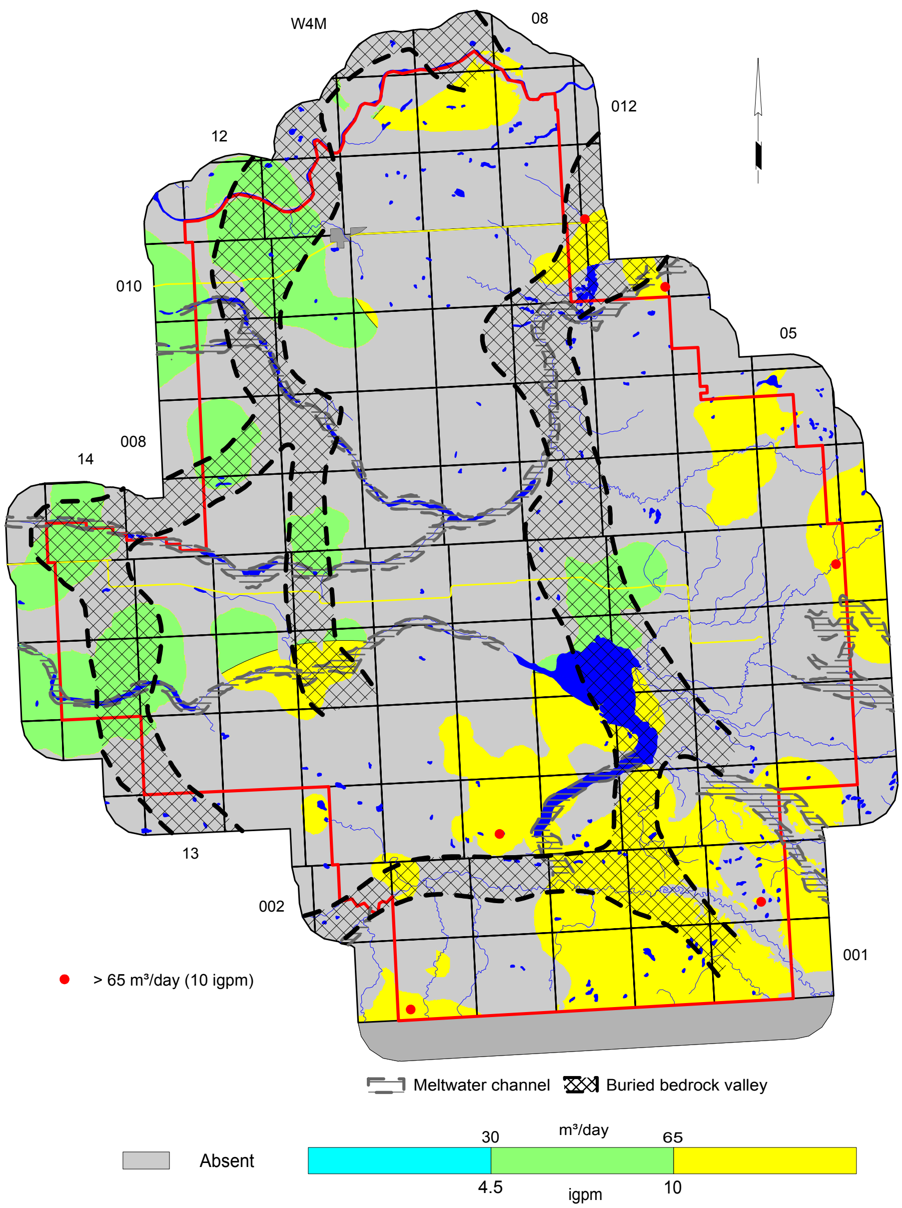
Total Dissolved Solids in Groundwater from Surficial Deposits



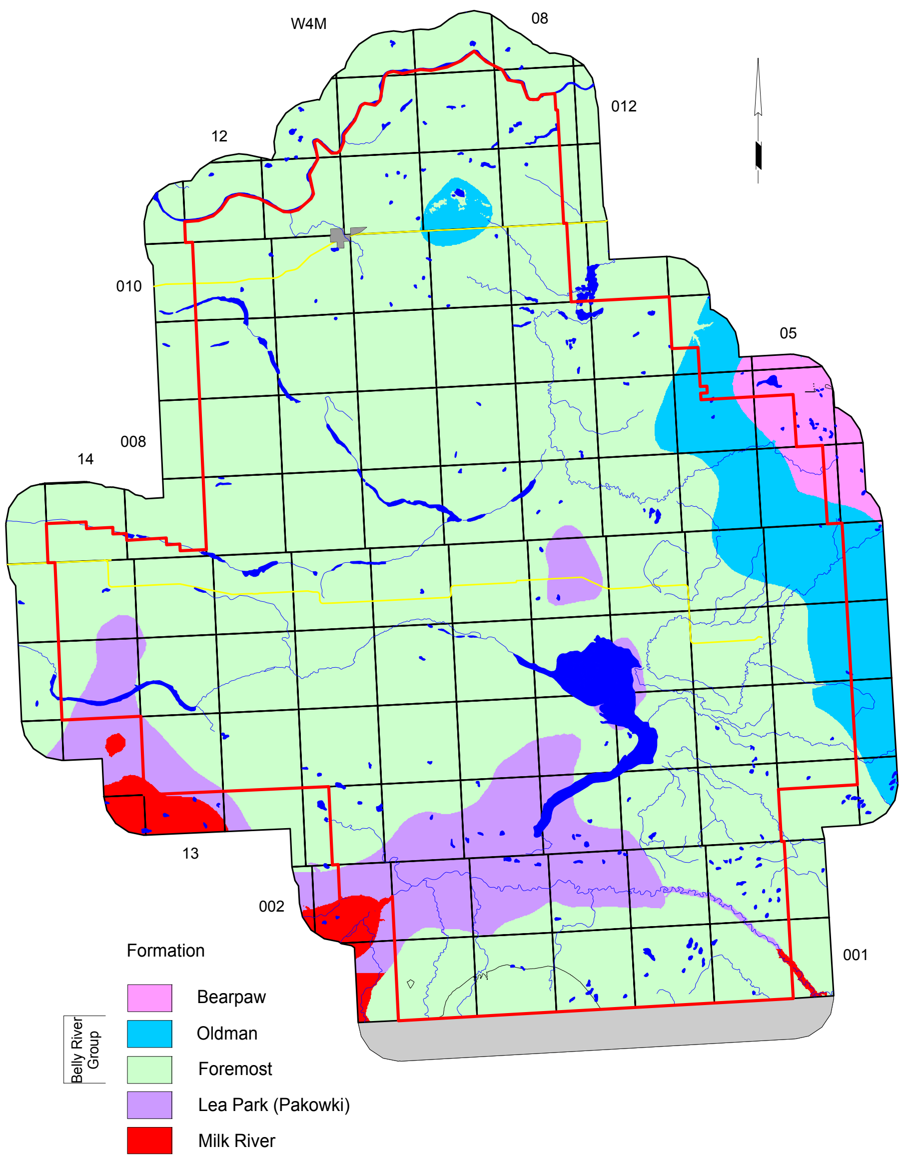
Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer



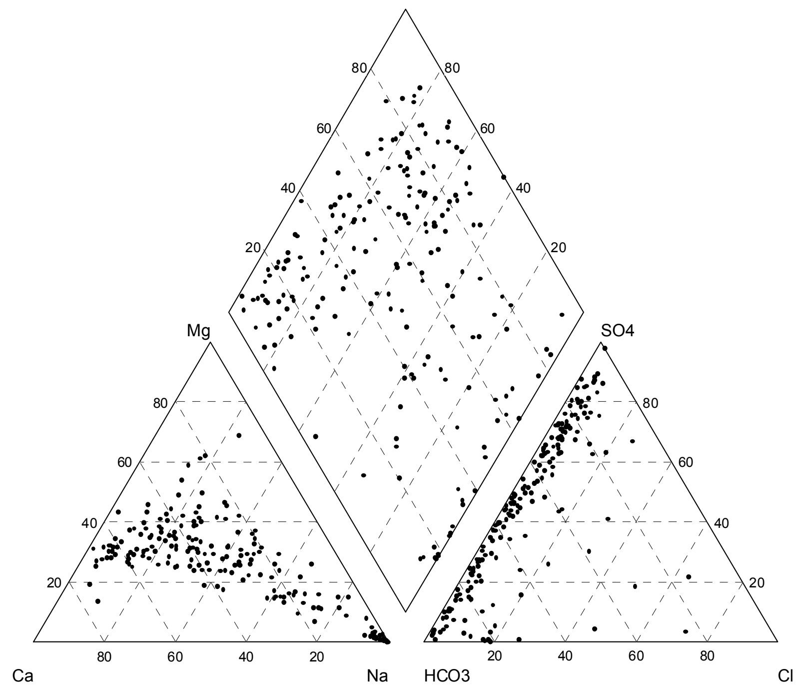
Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer



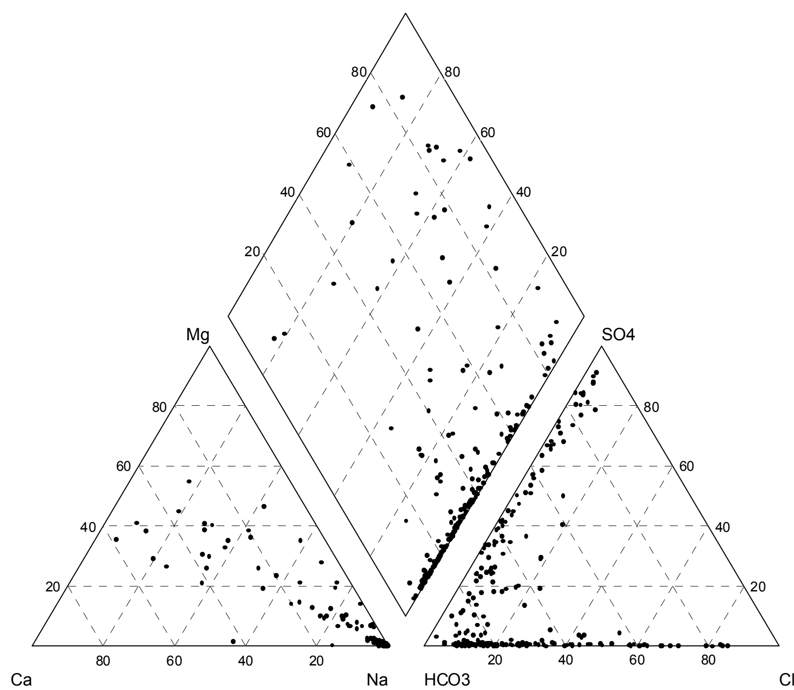
Bedrock Geology



Piper Diagrams

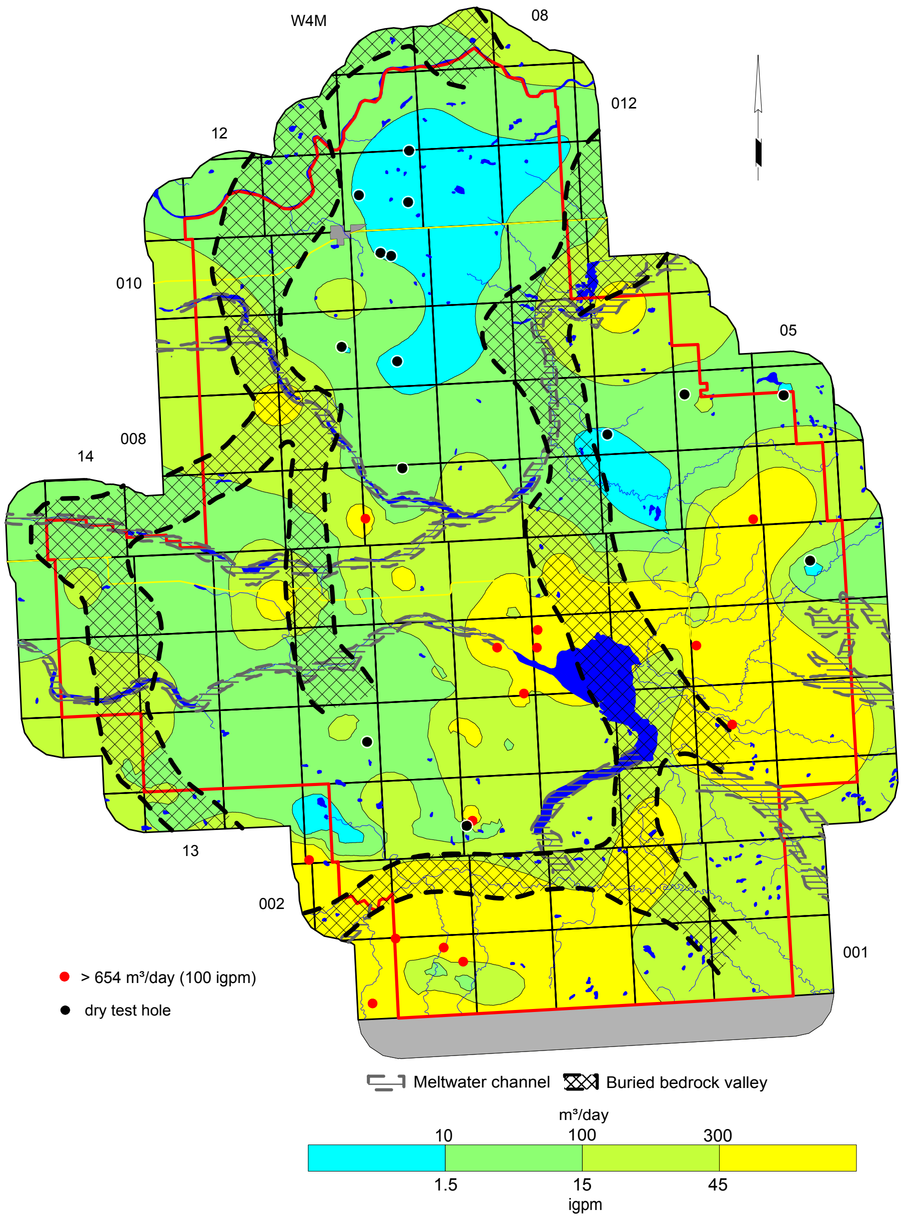


Surficial Deposits

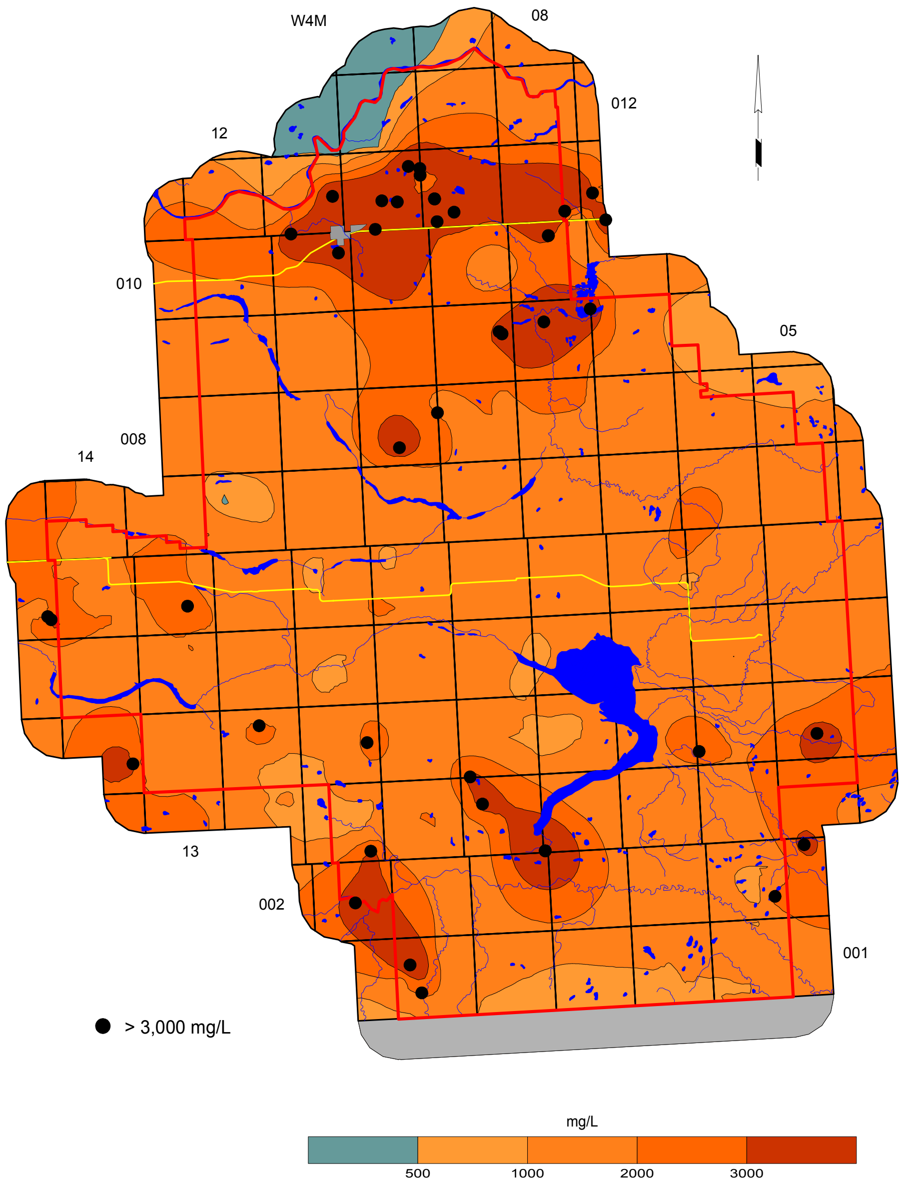


Bedrock Aquifers

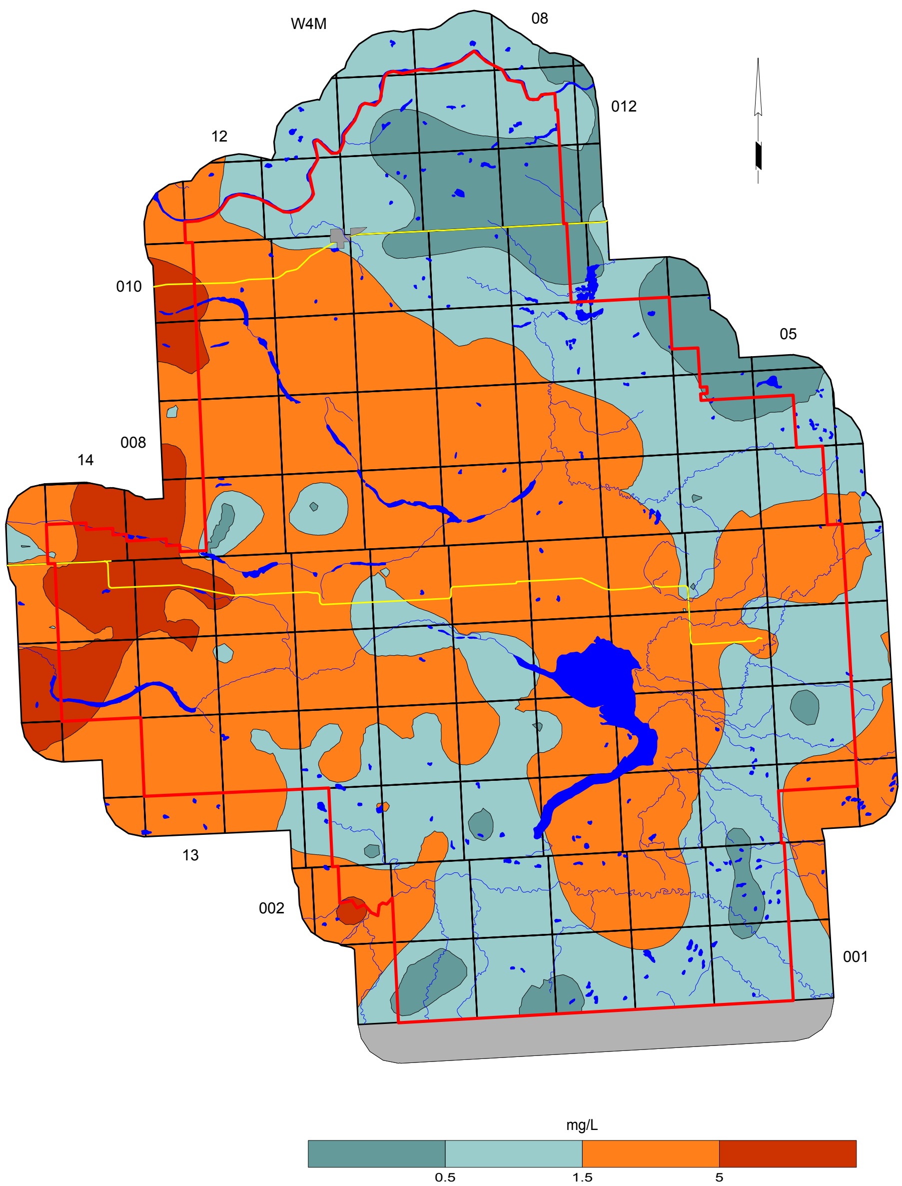
Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)



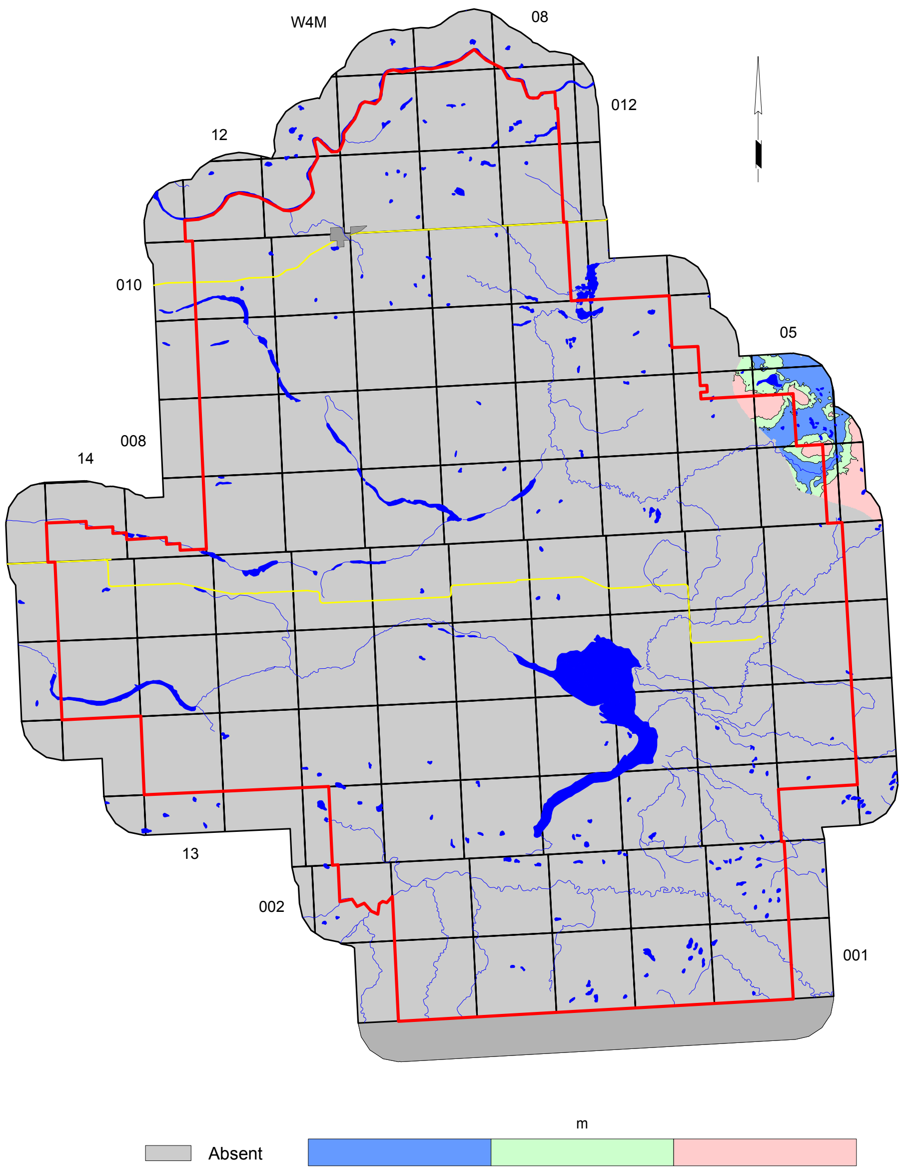
Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)



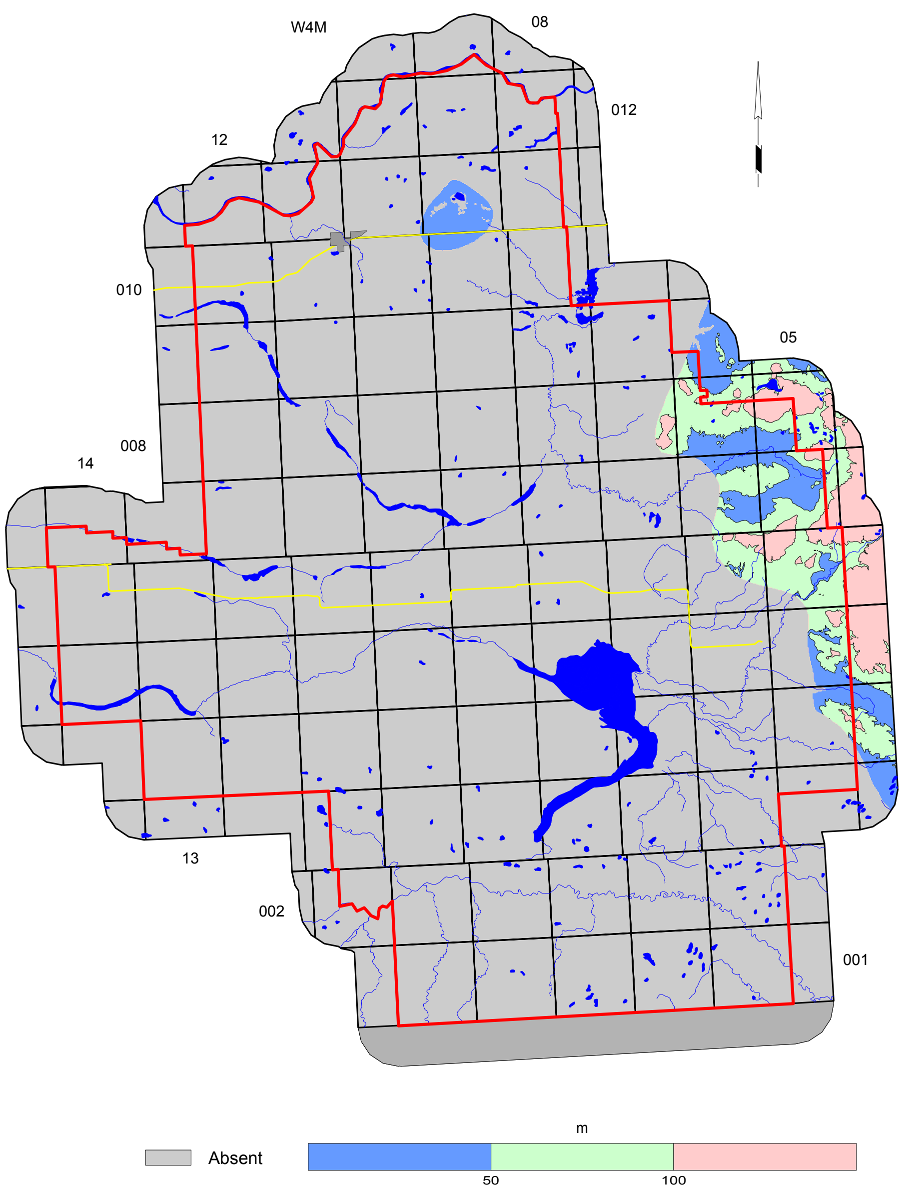
Fluoride in Groundwater from Upper Bedrock Aquifer(s)



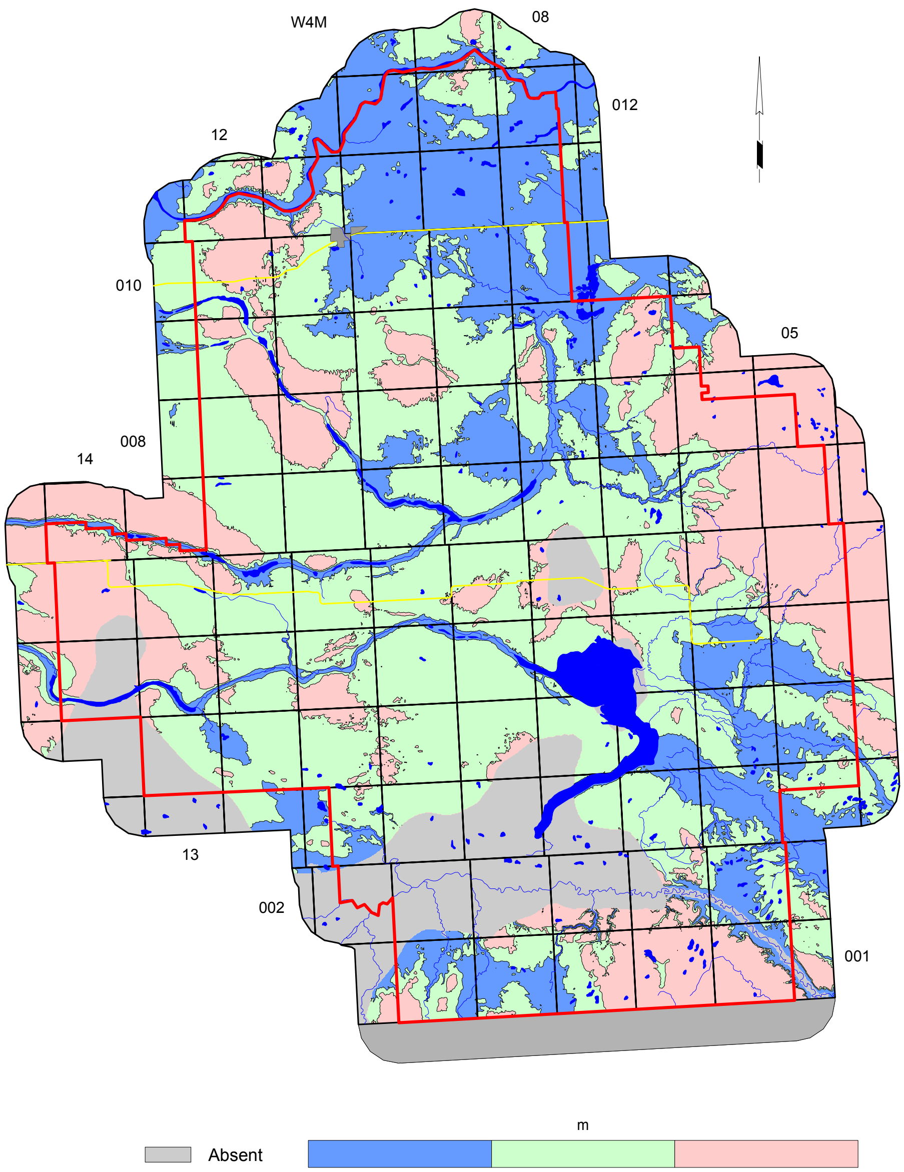
Depth to Top of Bearpaw Formation



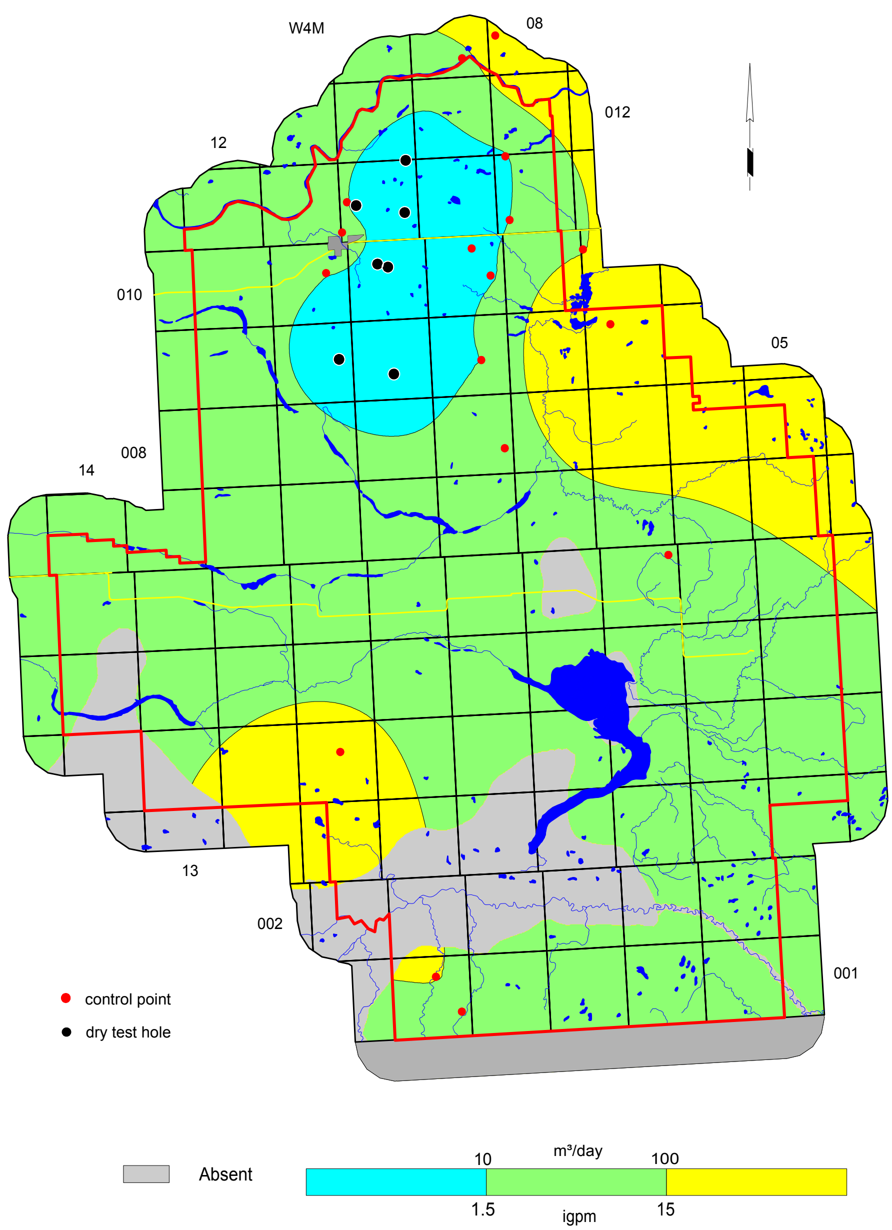
Depth to Top of Oldman Formation



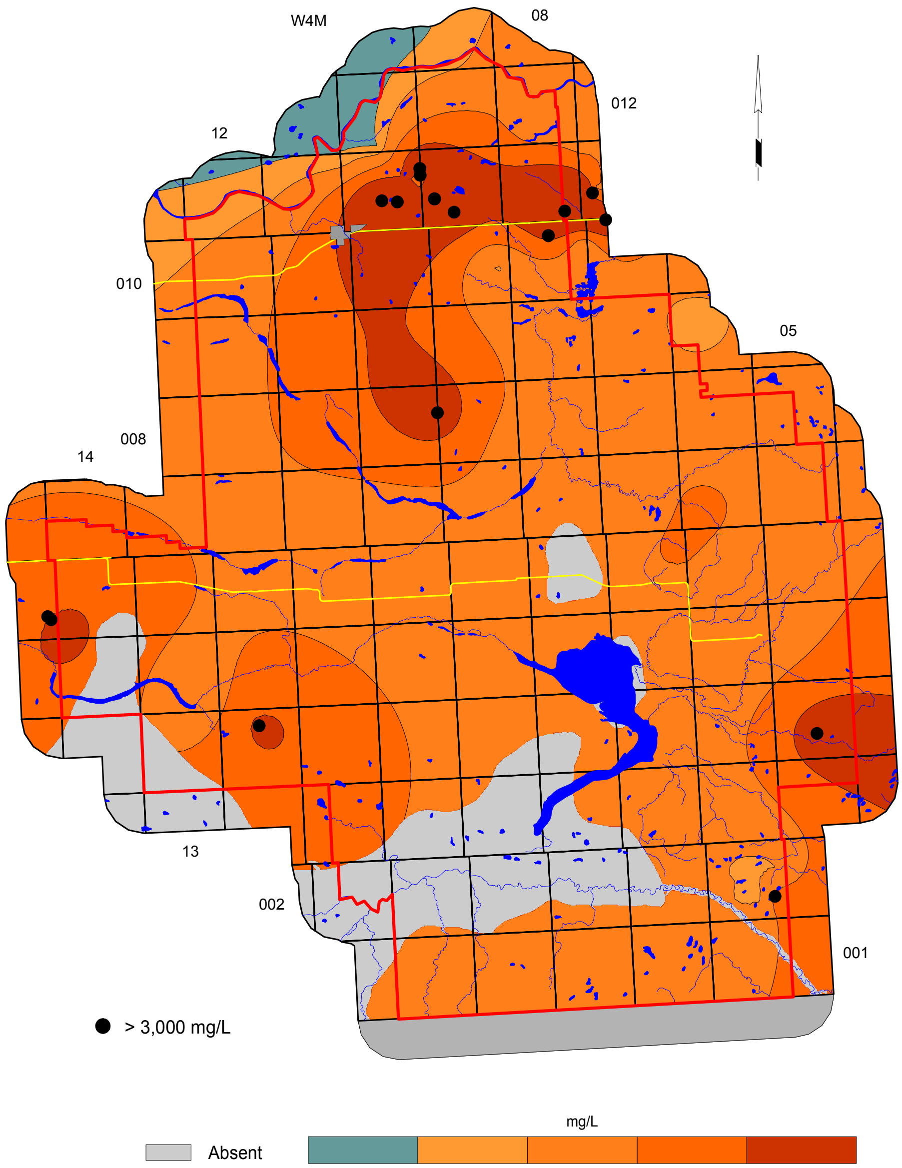
Depth to Top of Foremost Formation



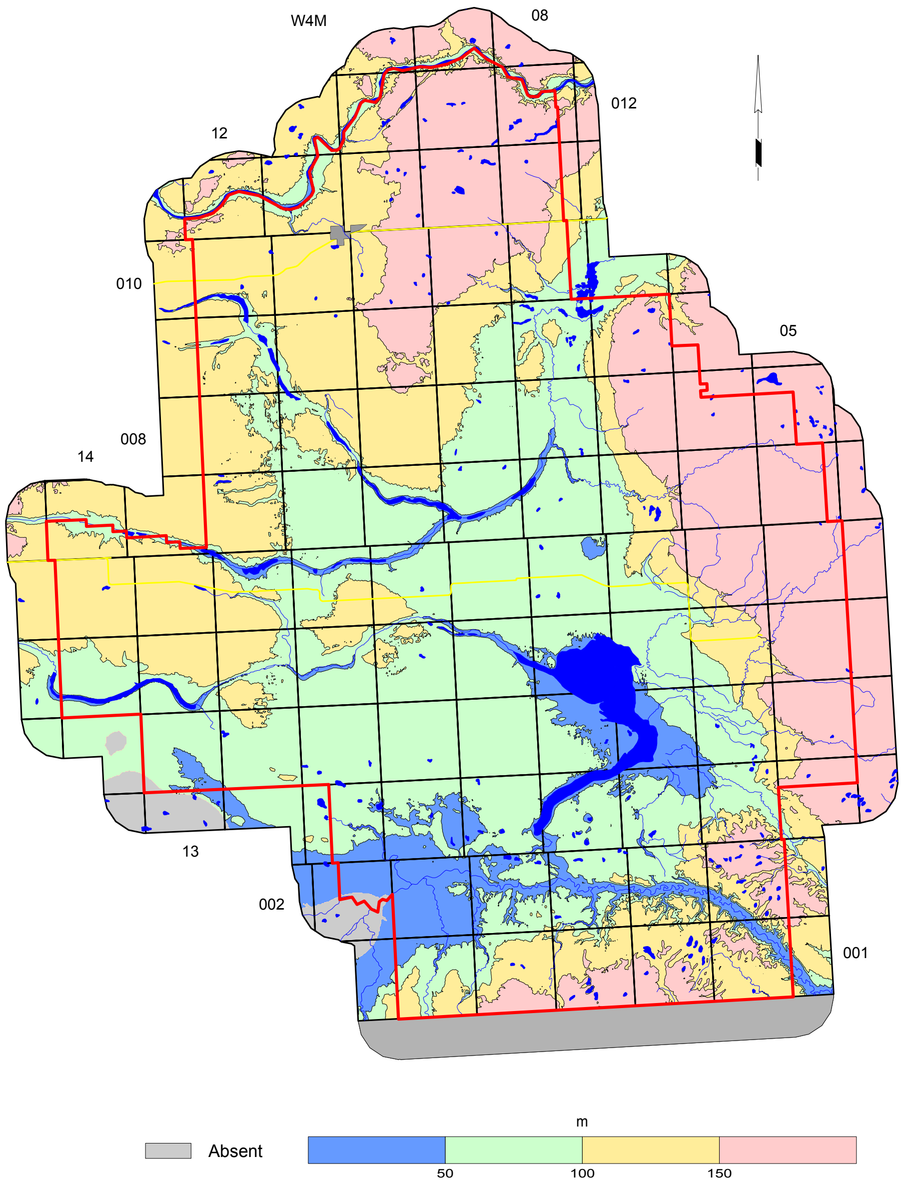
Apparent Yield for Water Wells Completed through Foremost Aquifer



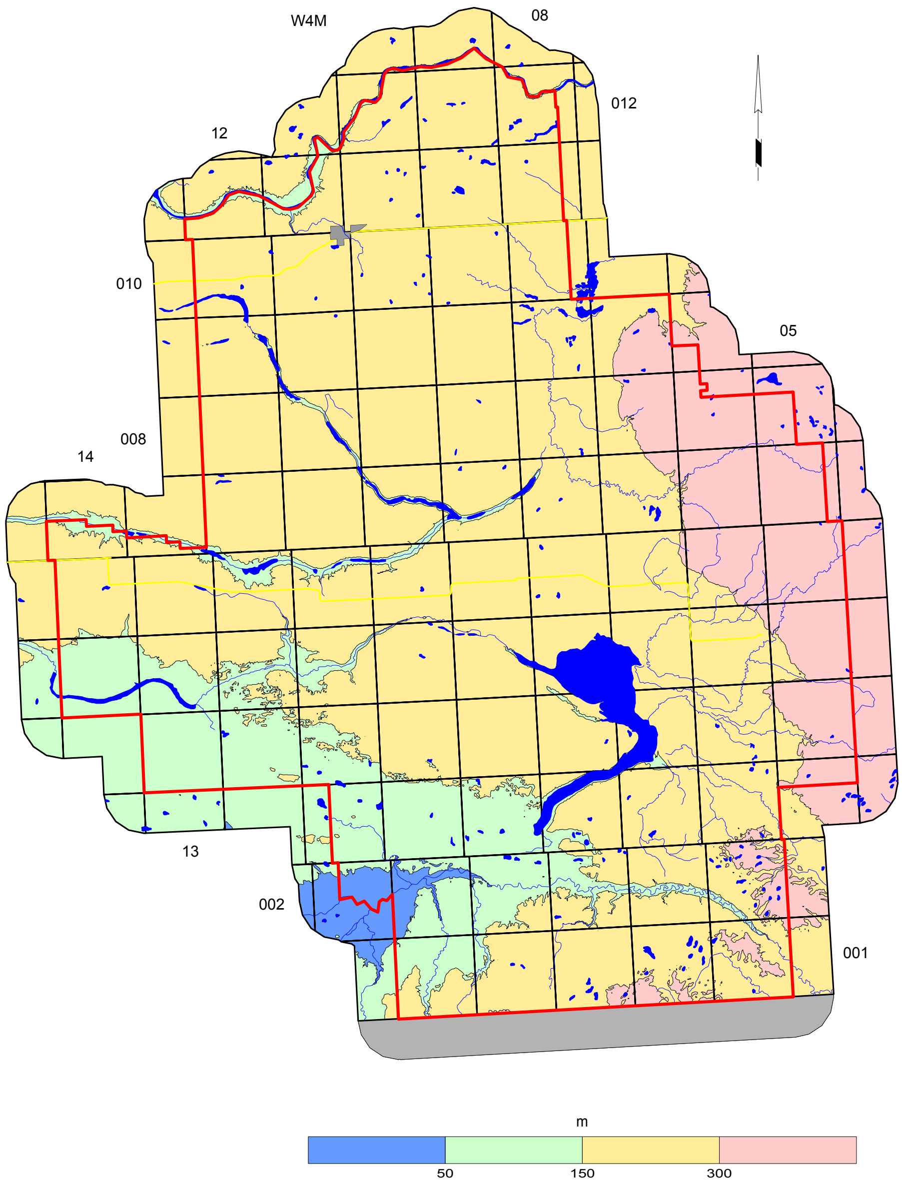
Total Dissolved Solids in Groundwater from Foremost Aquifer



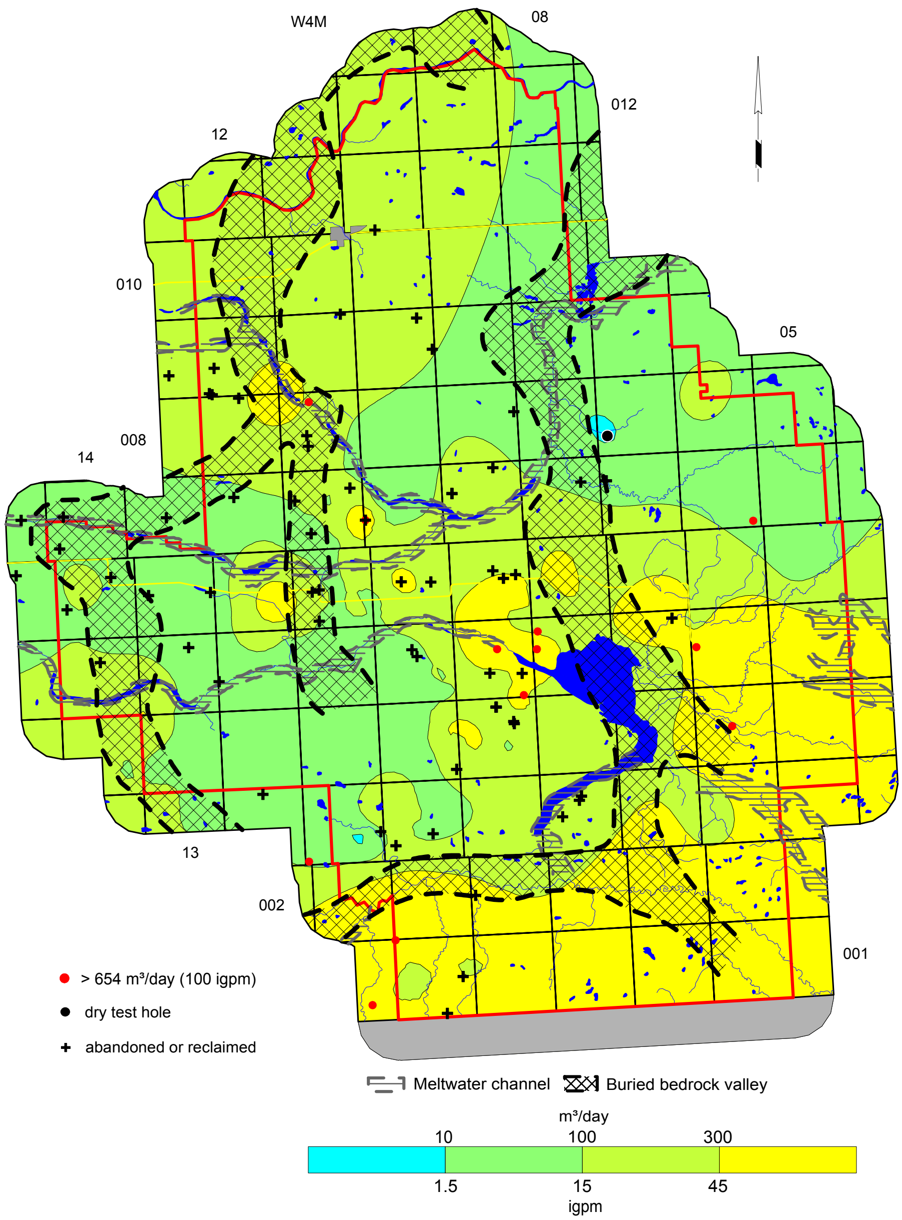
Depth to Top of Lea Park Formation



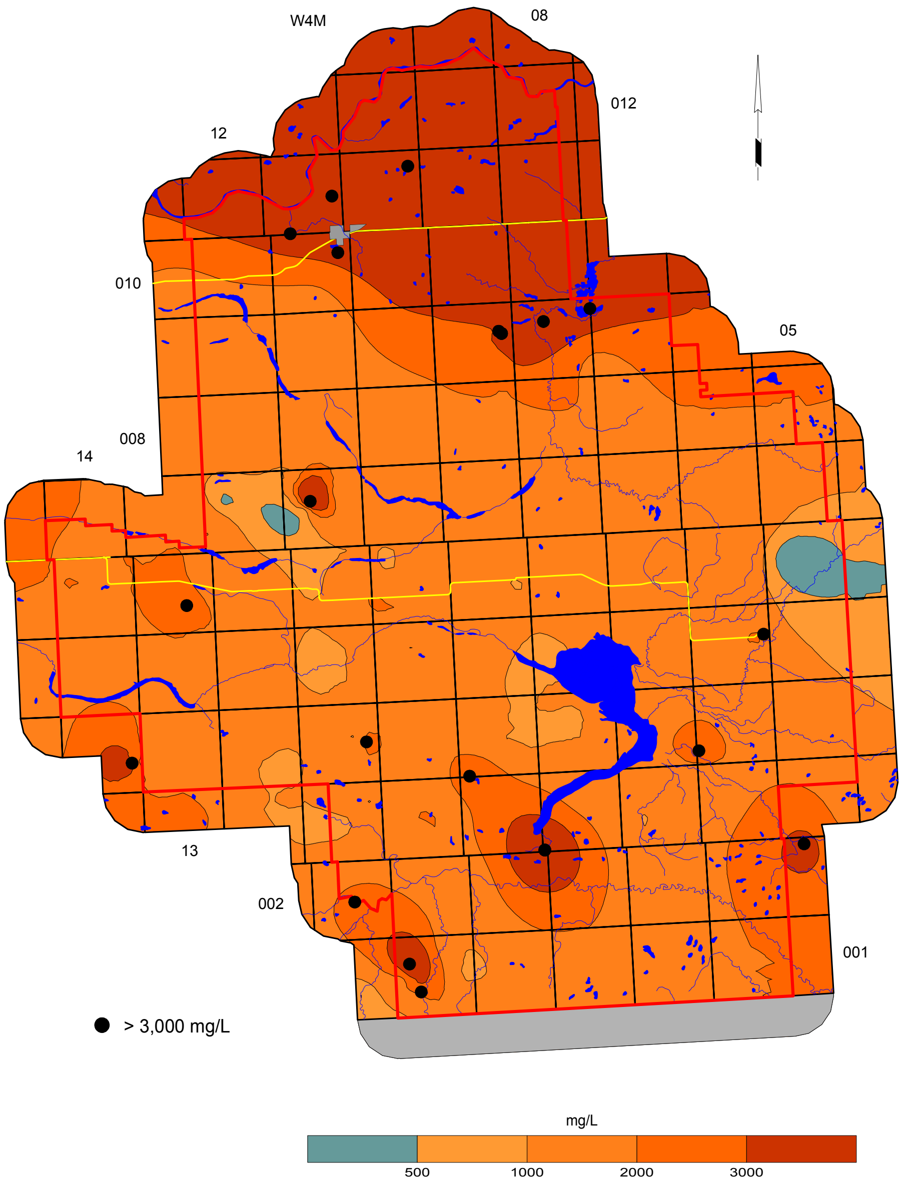
Depth to Top of Milk River Formation



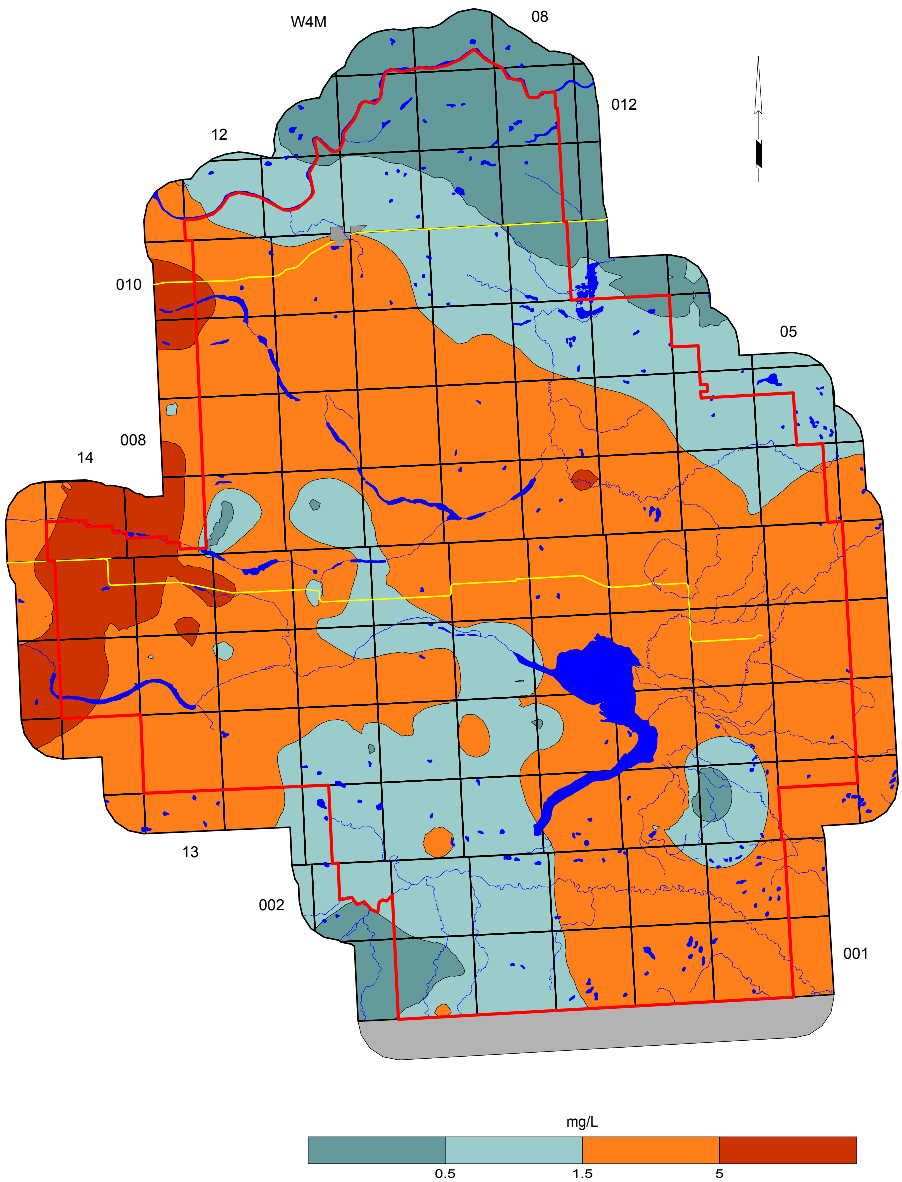
Apparent Yield for Water Wells Completed through Milk River Aquifer



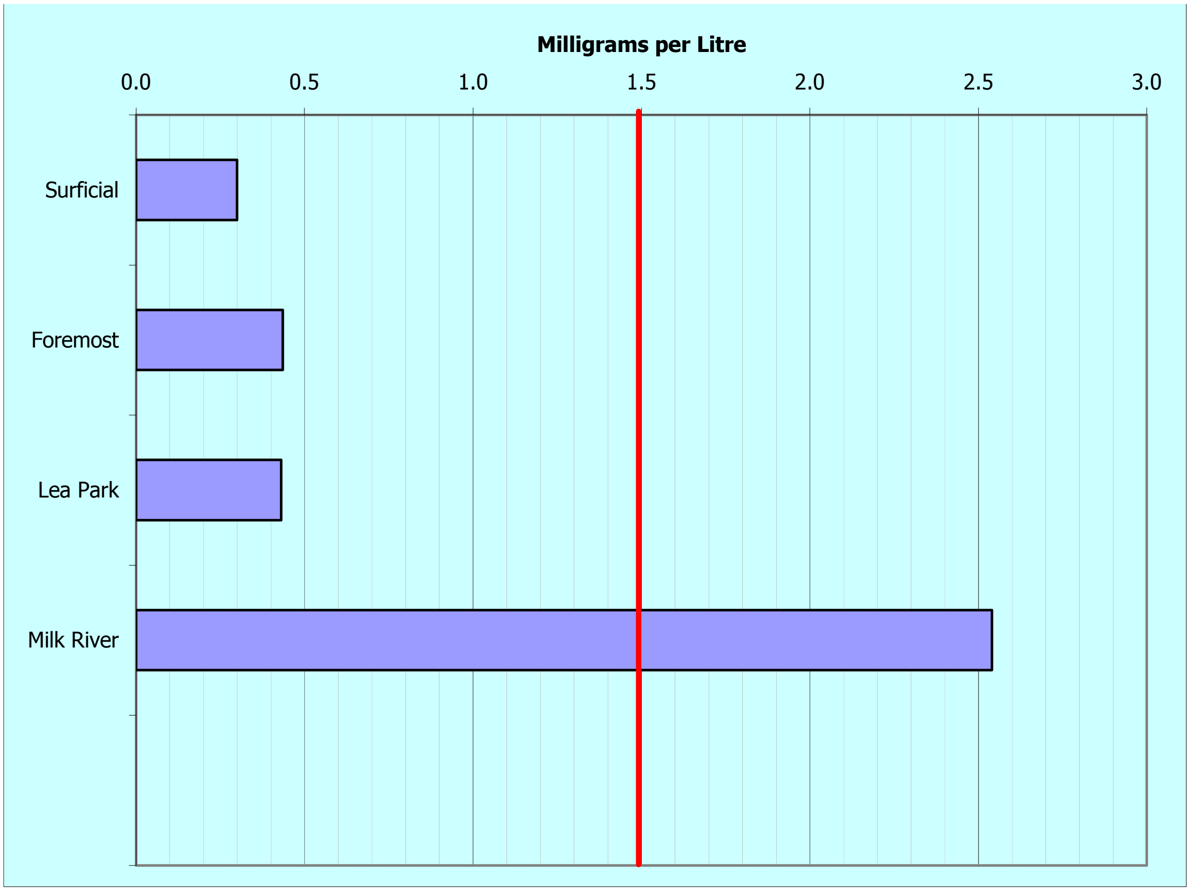
Total Dissolved Solids in Groundwater from Milk River Aquifer



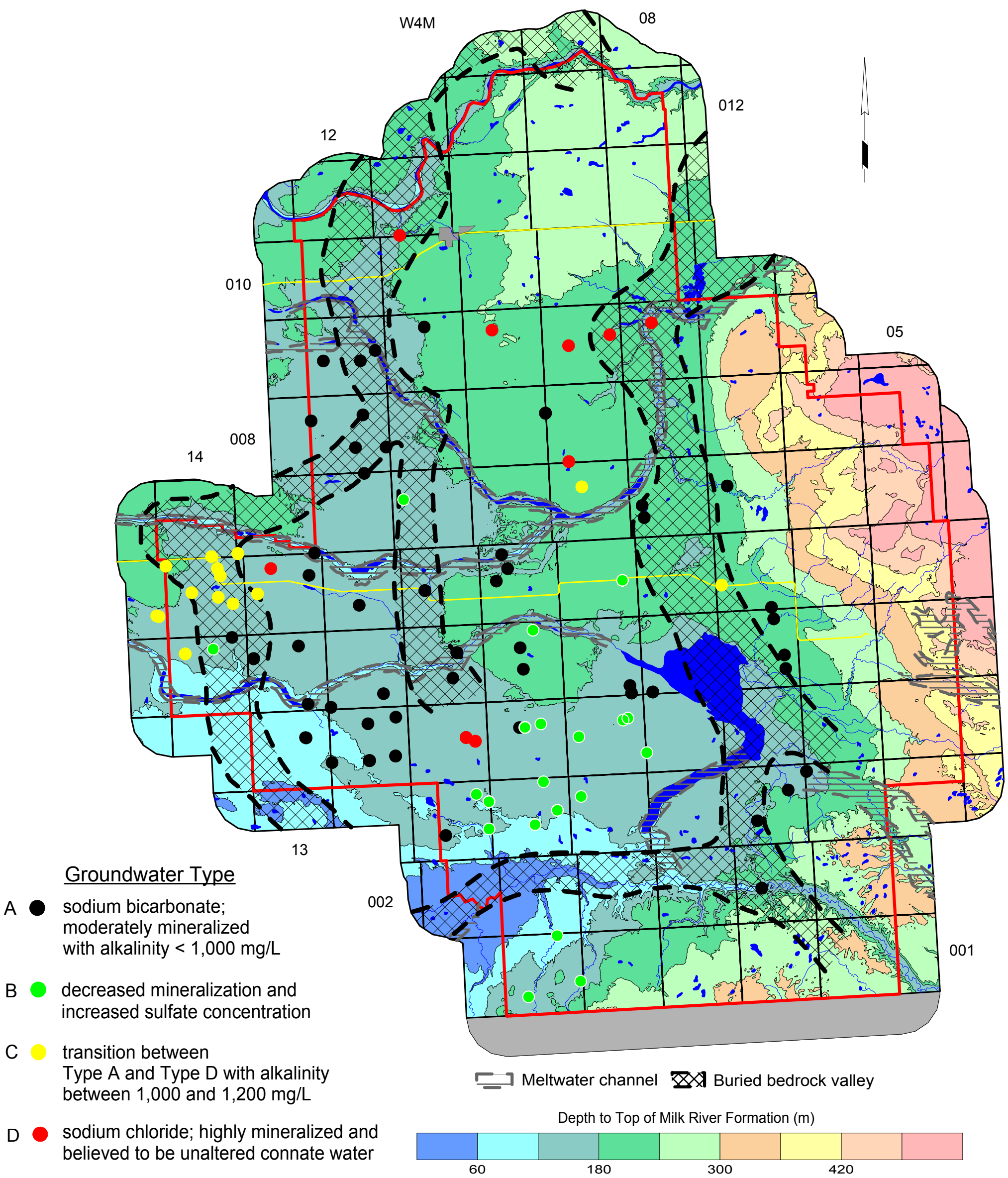
Fluoride in Groundwater from Milk River Aquifer



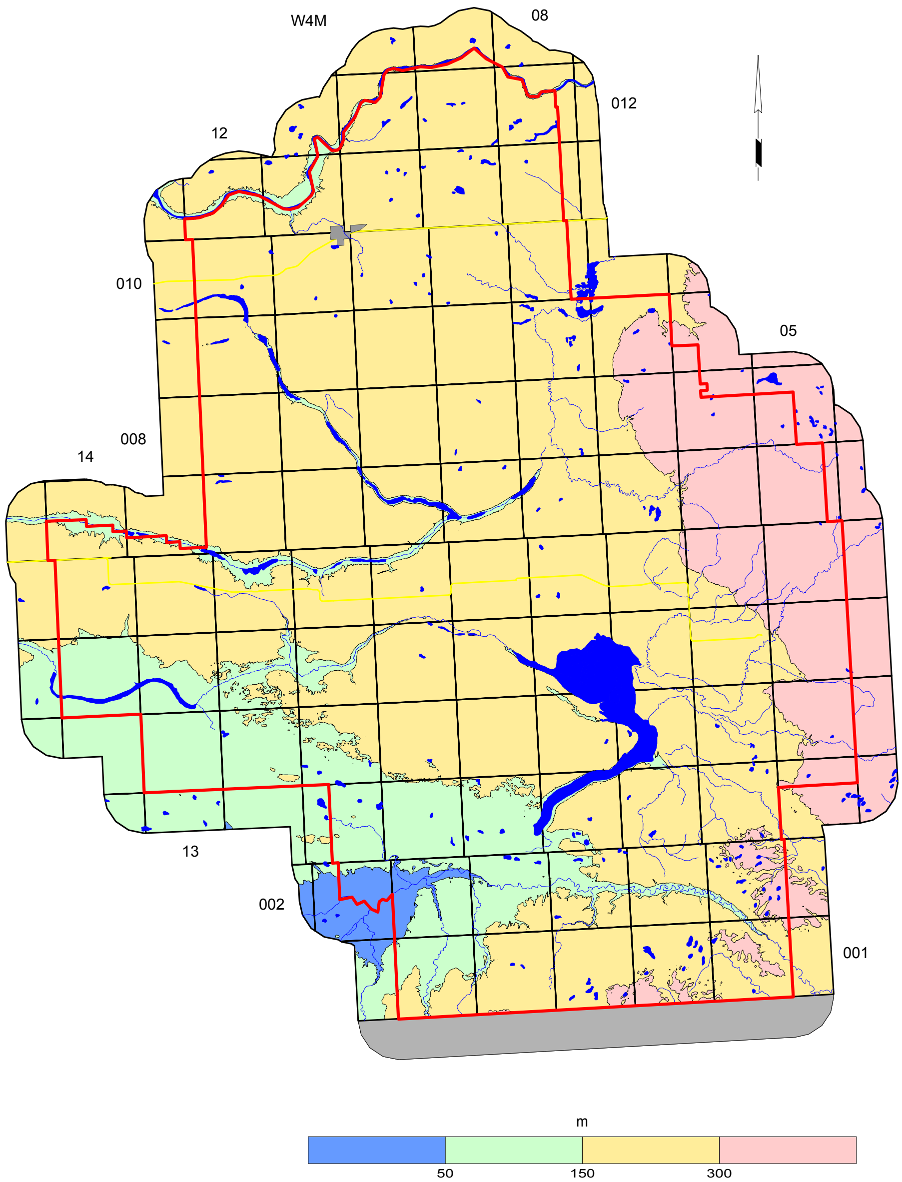
Median Fluoride Concentration



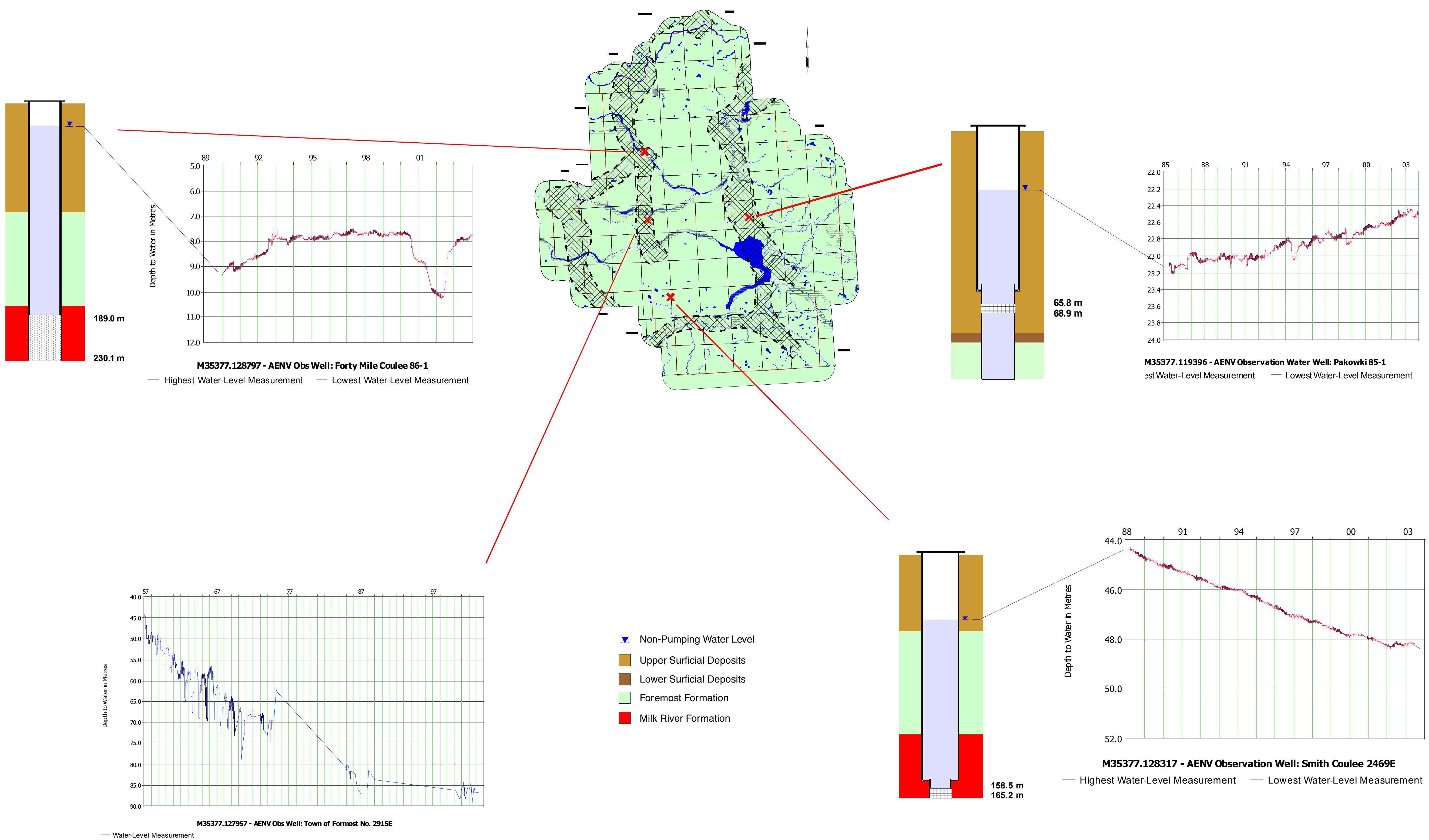
Types of Groundwater from Milk River Aquifer (modified after Meyboom, 1960)



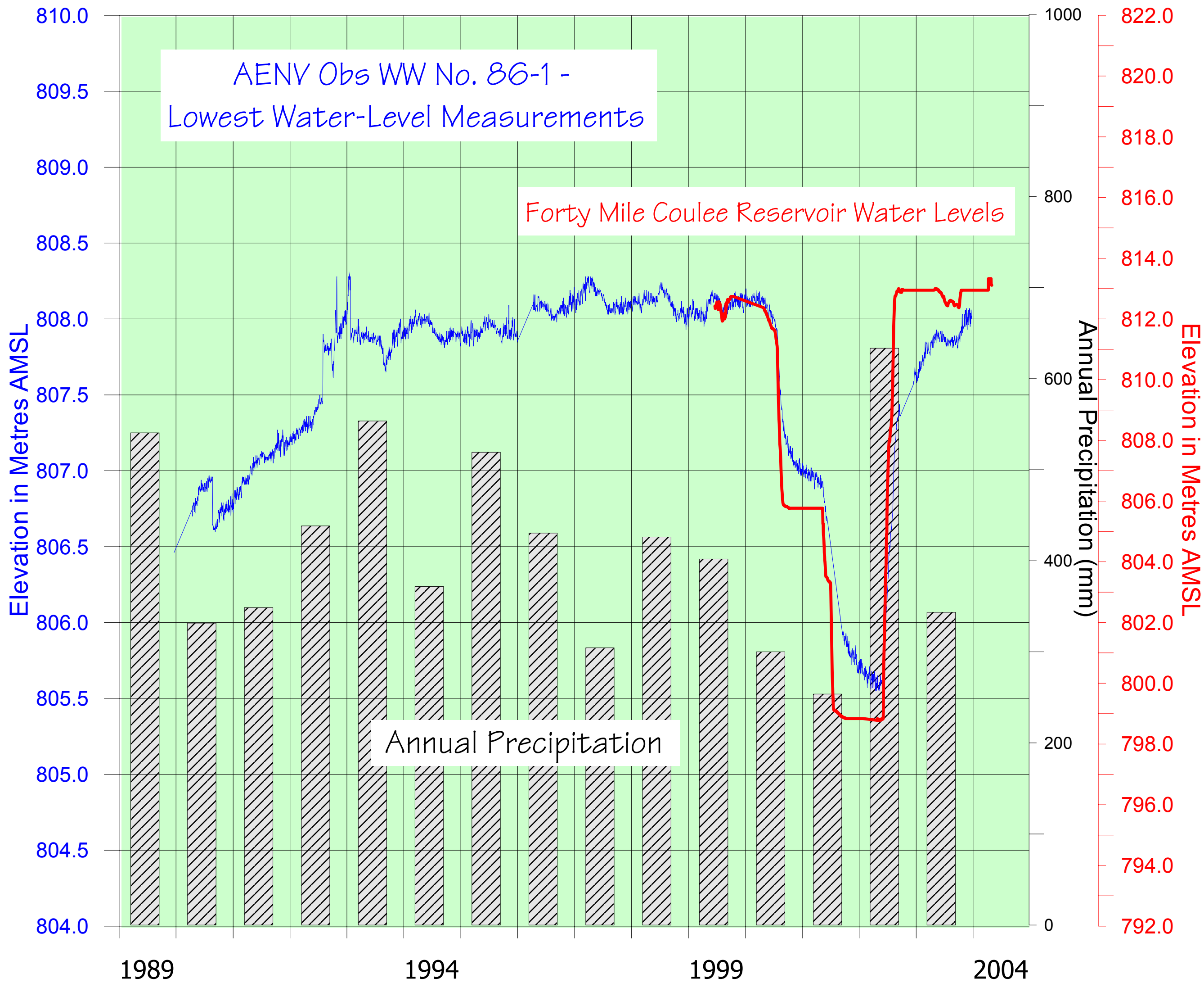
Depth to Top of Colorado Shale



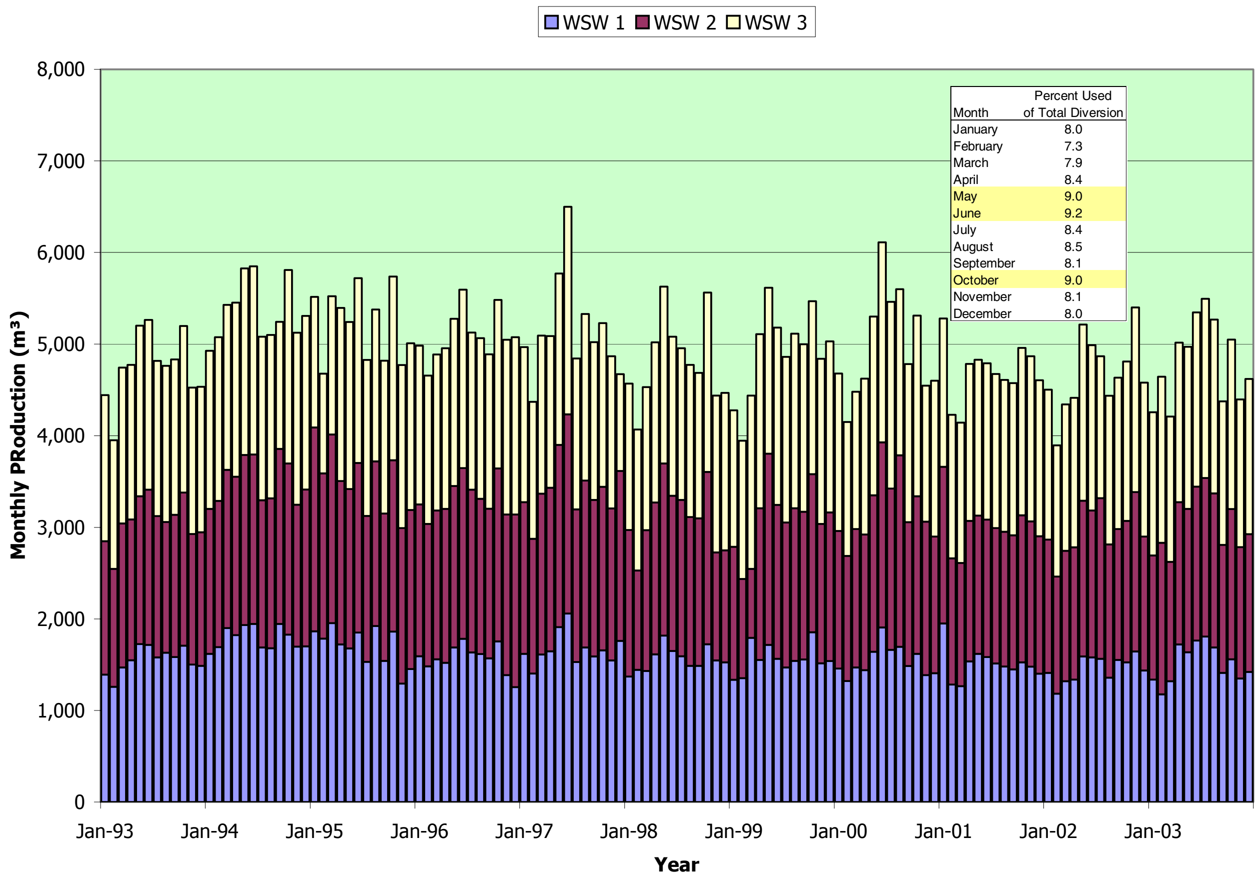
AENV Observation Water Wells



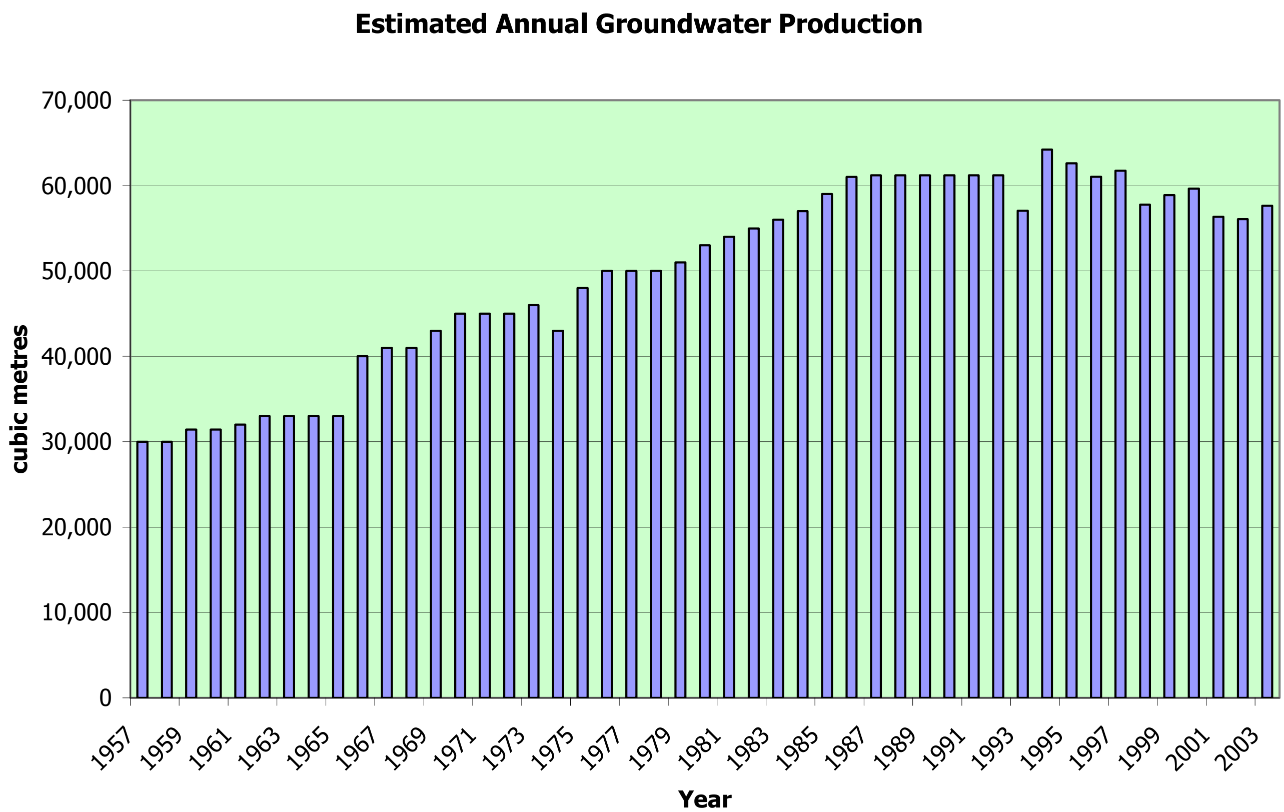
Comparison of Water Levels in AENV Obs WW No. 86-1 to Precipitation and Forty Mile Coulee Reservoir Water Level



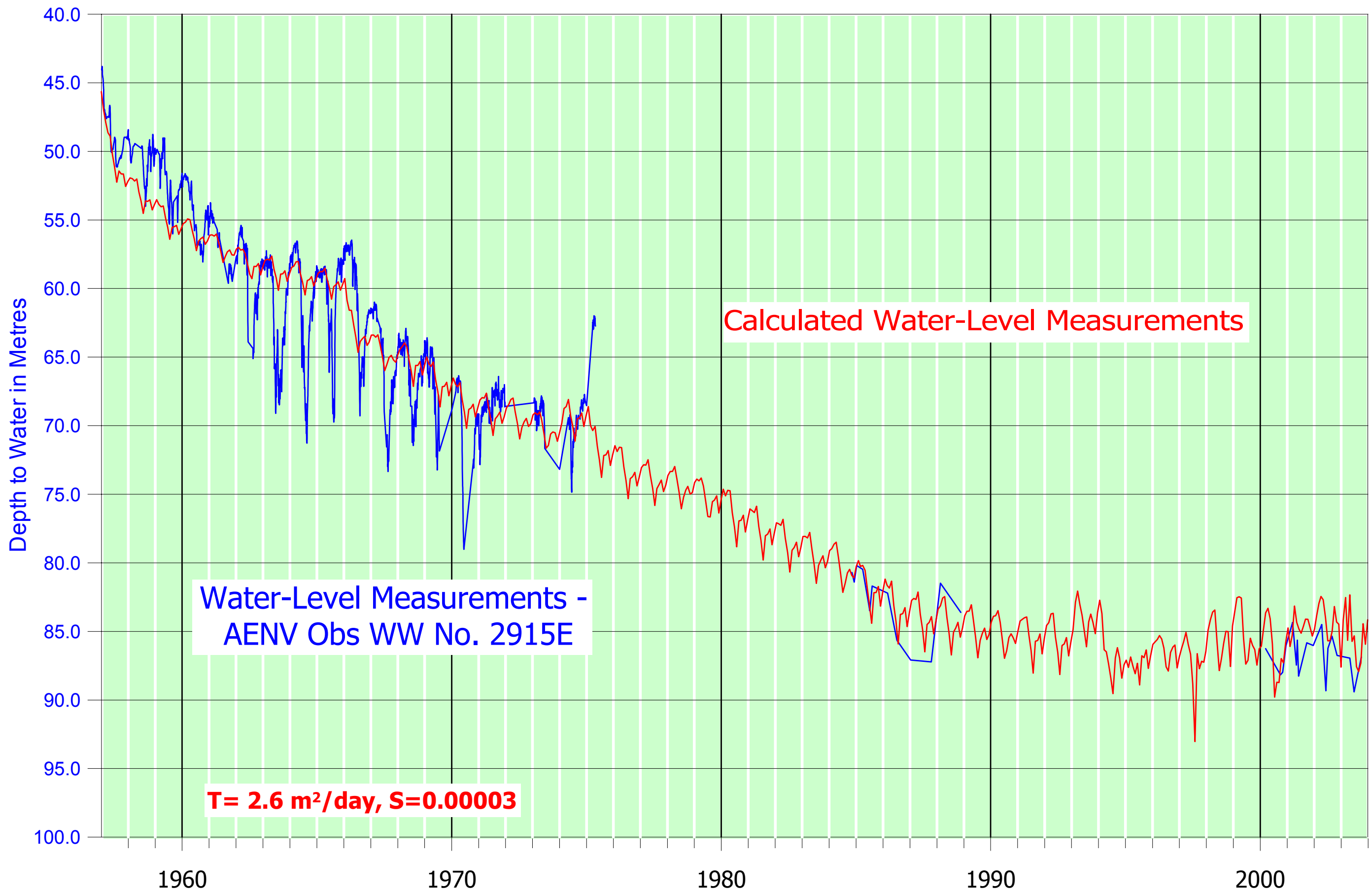
Monthly Groundwater Diversion – Village of Foremost WSW Nos. 1, 2, 3



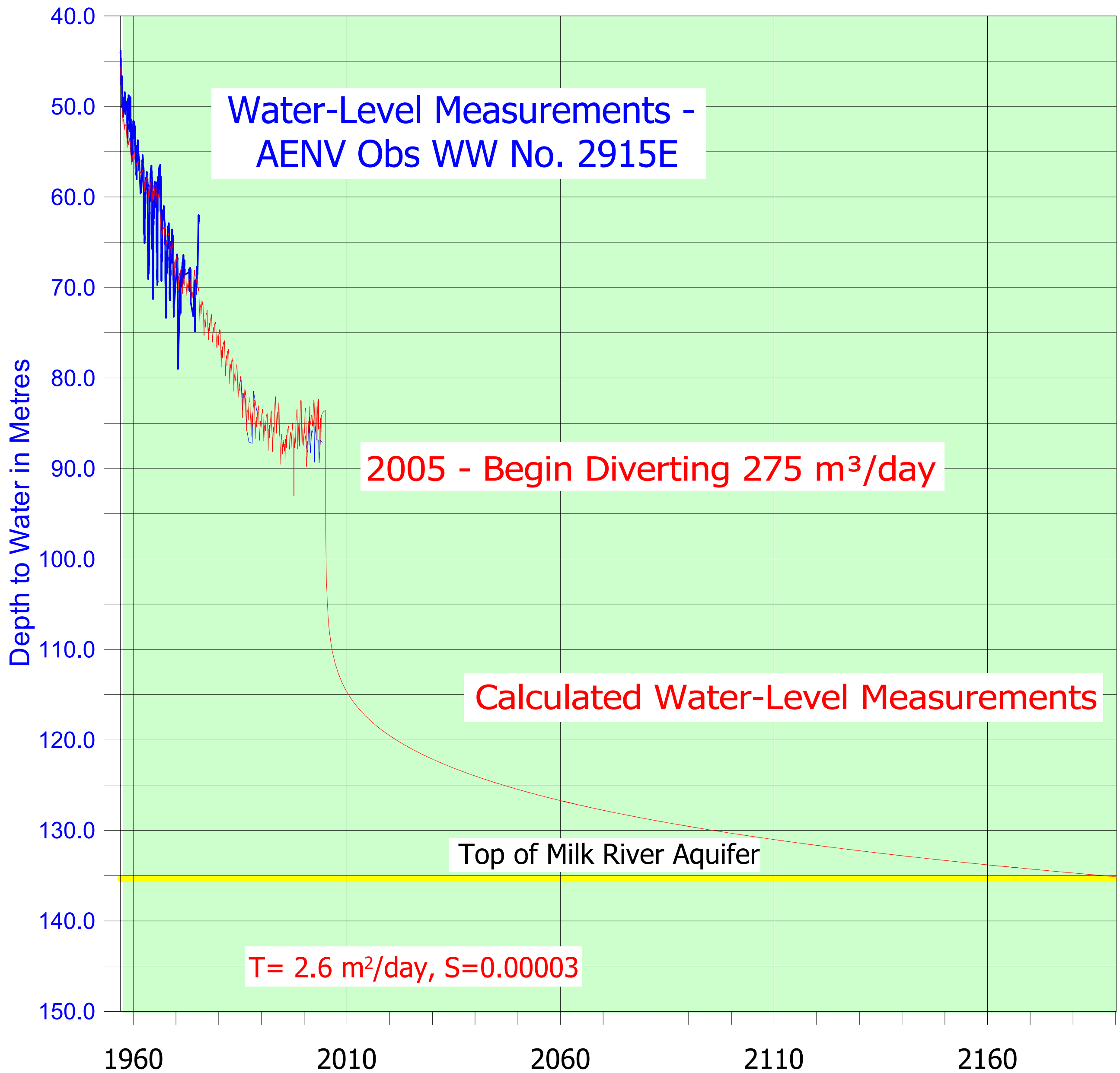
Estimated Annual Groundwater Diversion – Village of Foremost WSW Nos. 1, 2, 3



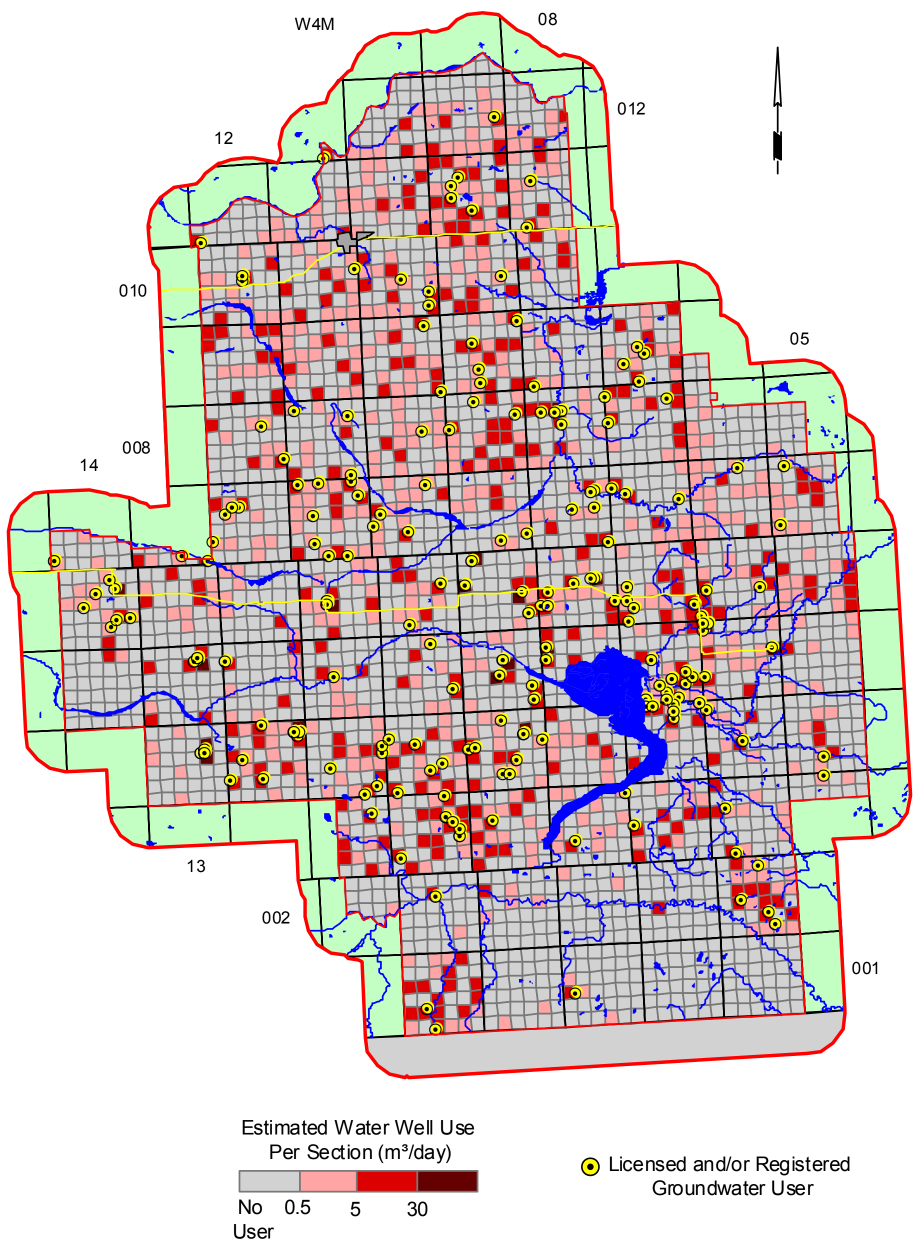
Water-Level Comparison – AENV Obs WW No. 2915E



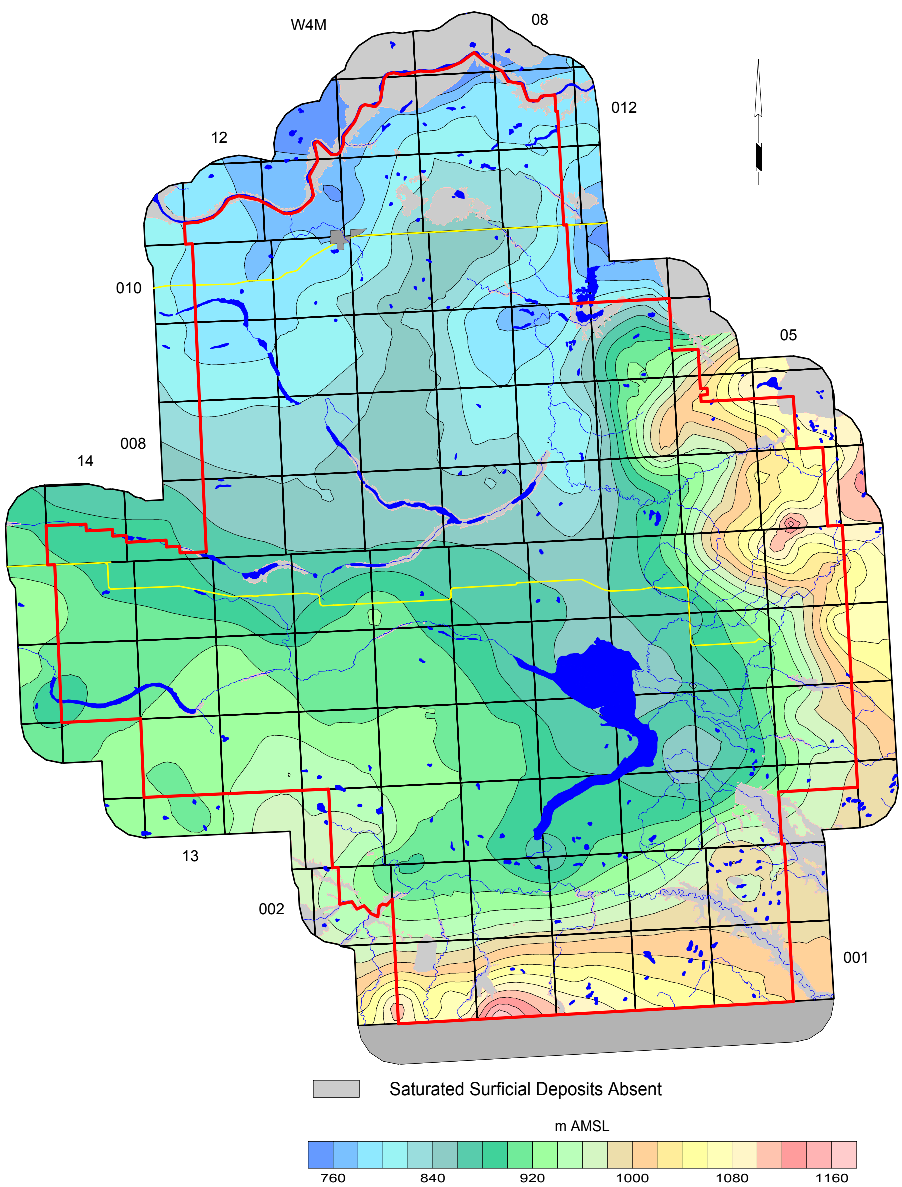
Water-Level Comparison – After 180 Years in AENV Obs WW No. 2915E



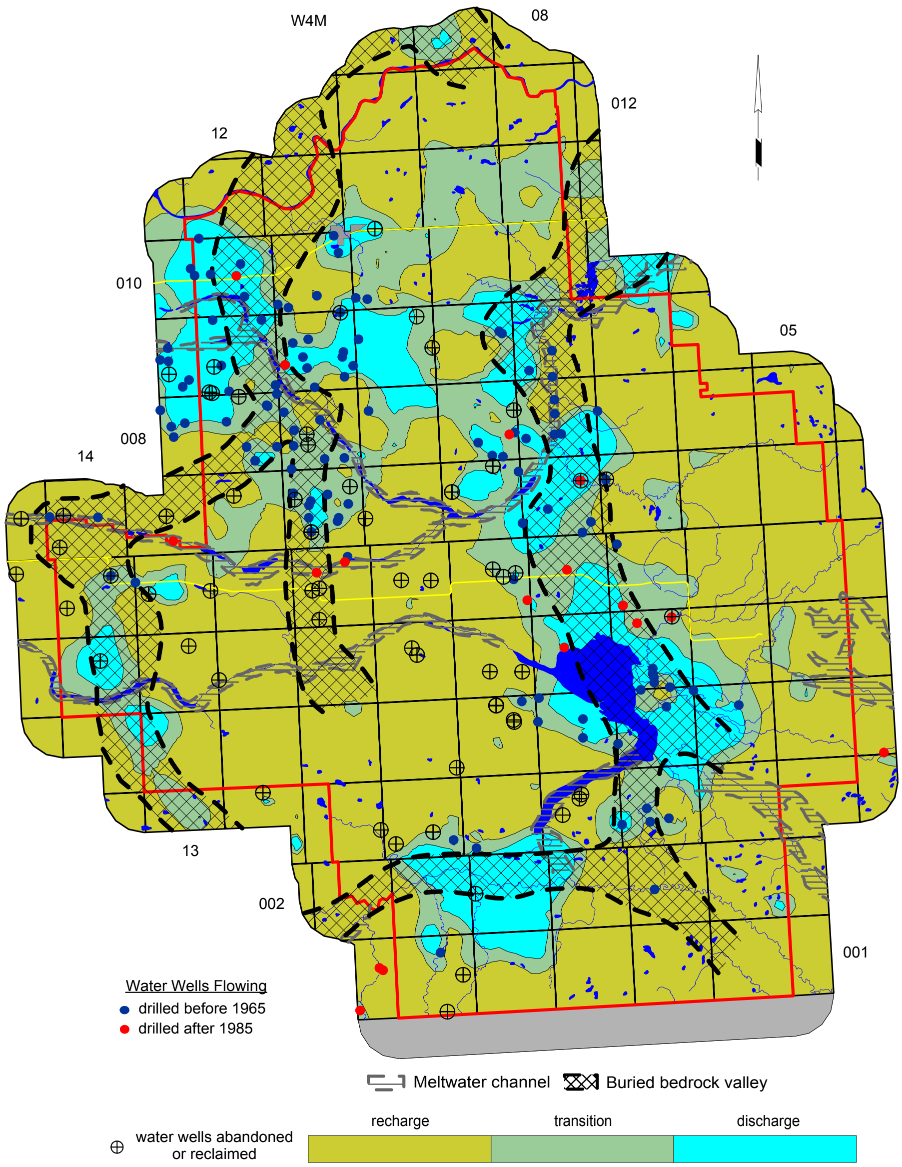
Estimated Water Well Use Per Section



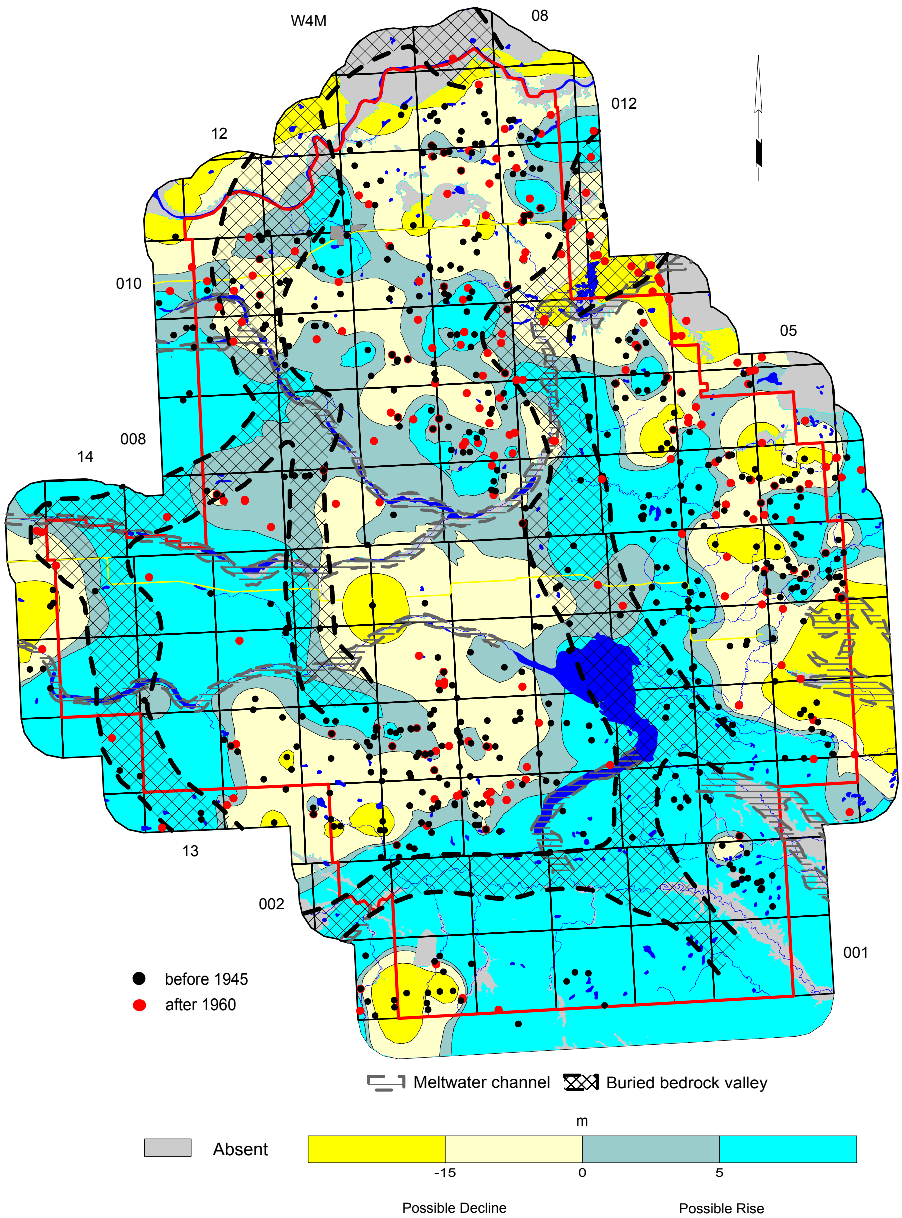
Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep



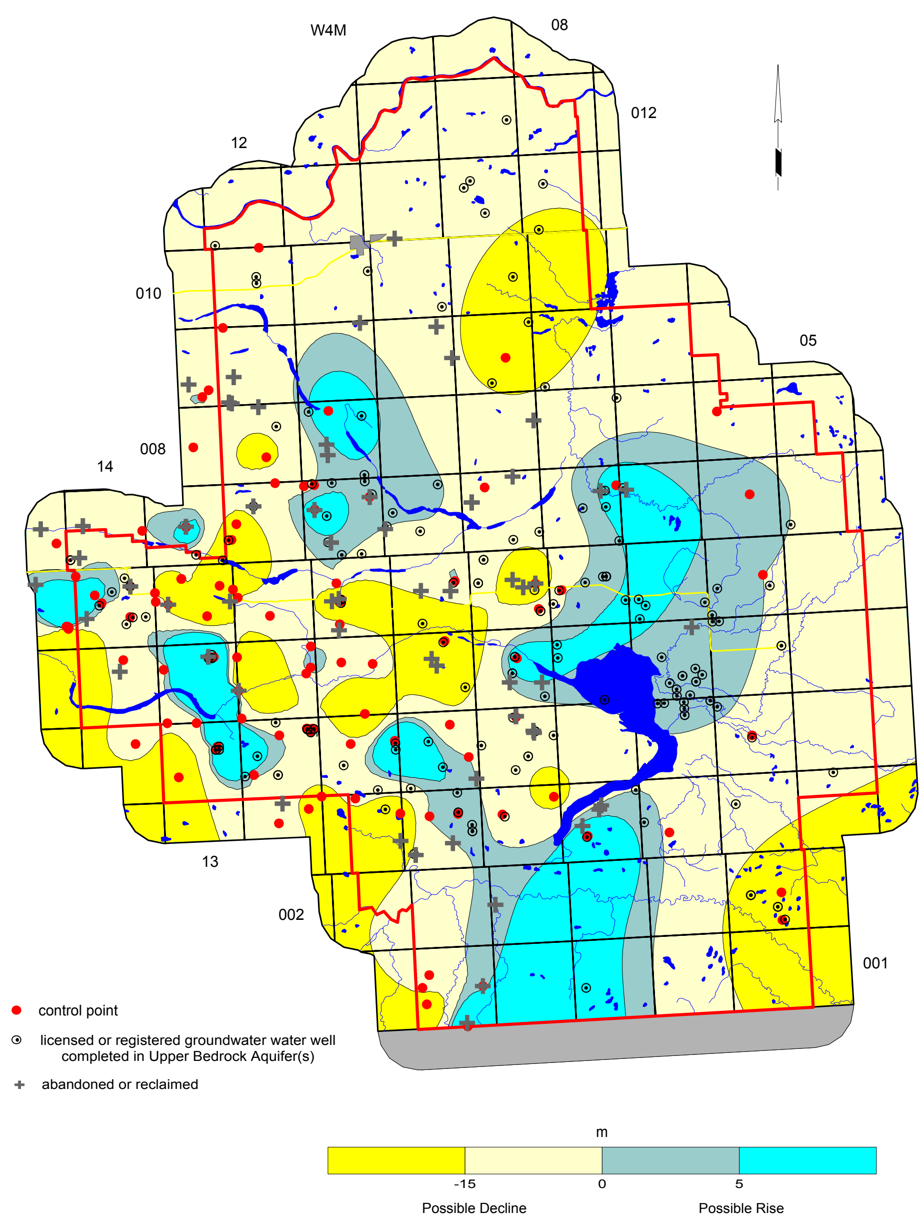
Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)



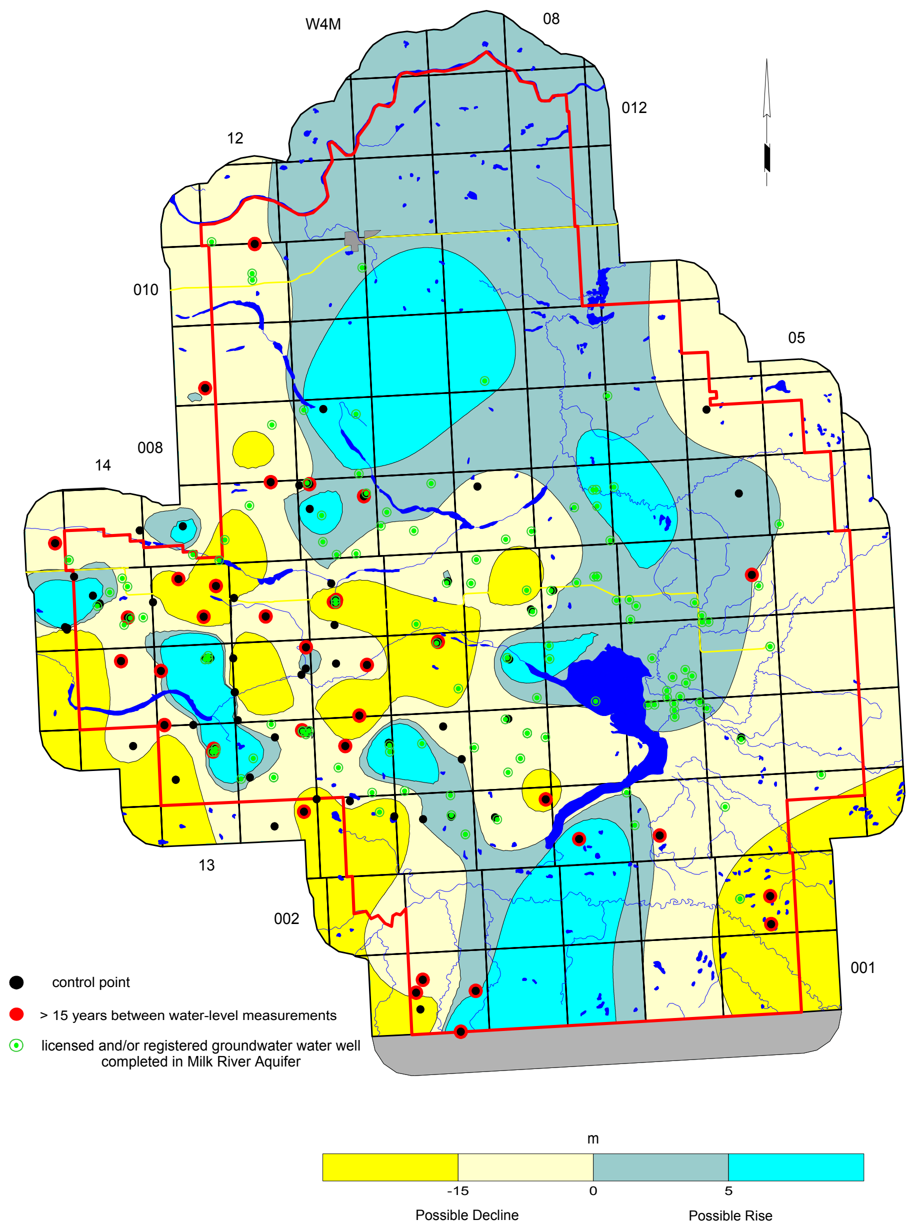
Changes in Water Levels in Surficial Deposits



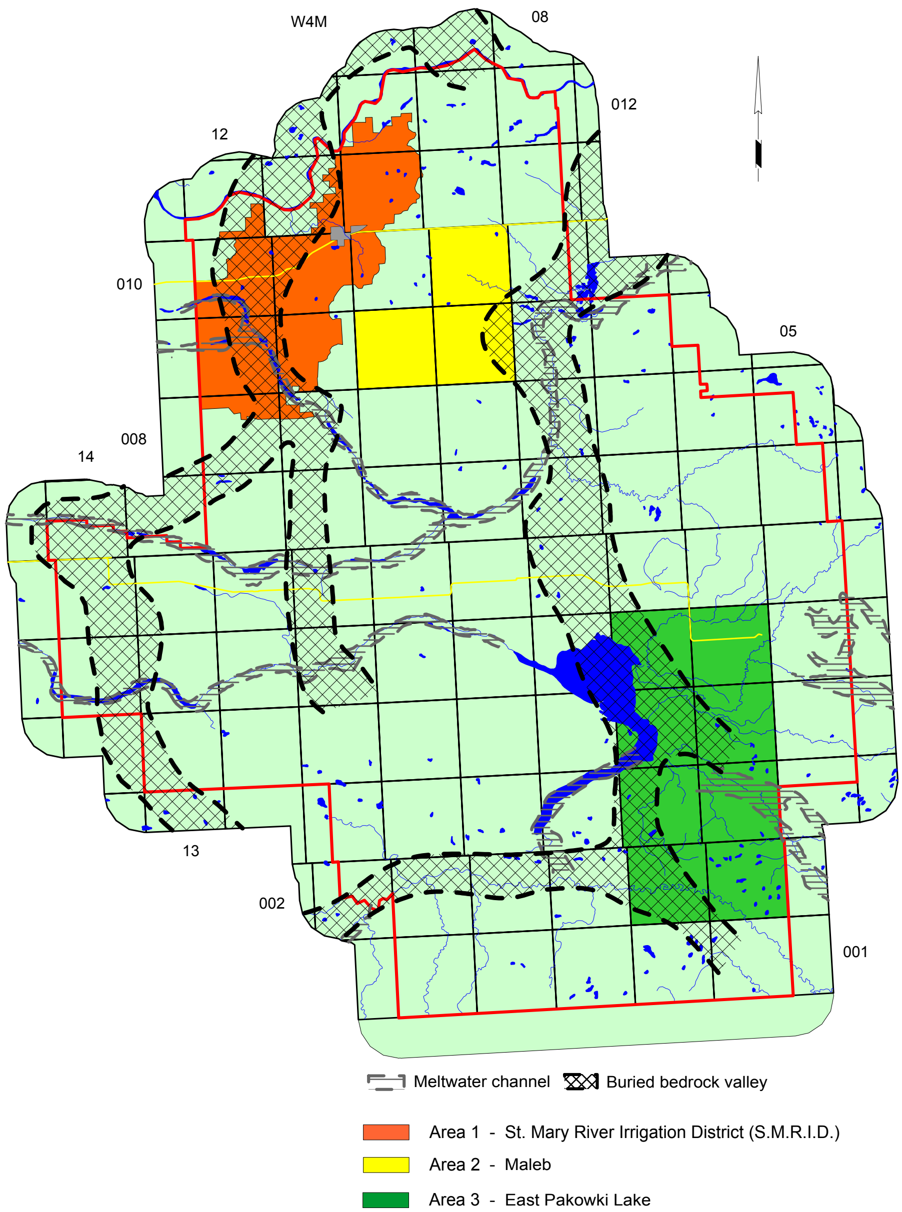
Areas of Potential Groundwater Depletion - Upper Bedrock Aquifer(s)



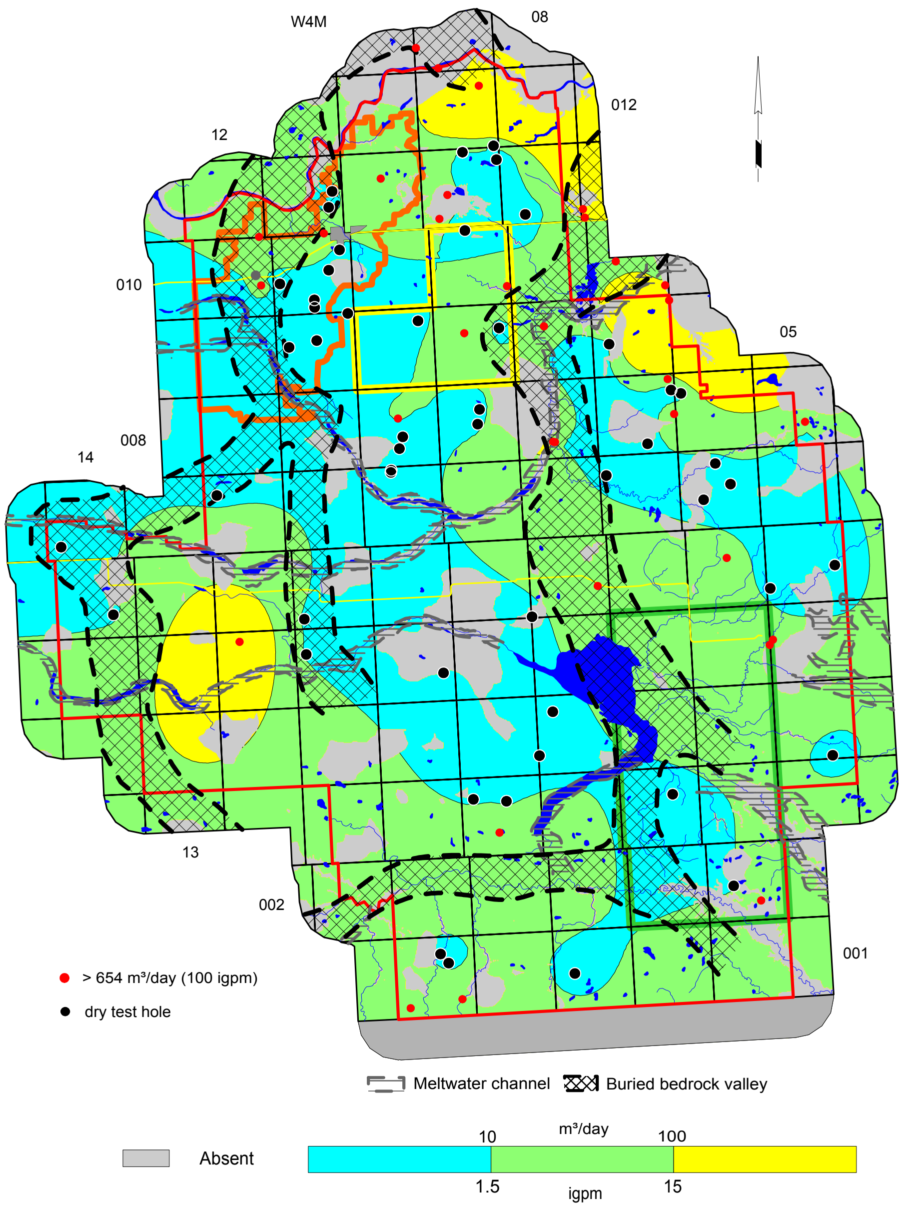
Areas of Potential Groundwater Depletion – Milk River Aquifer



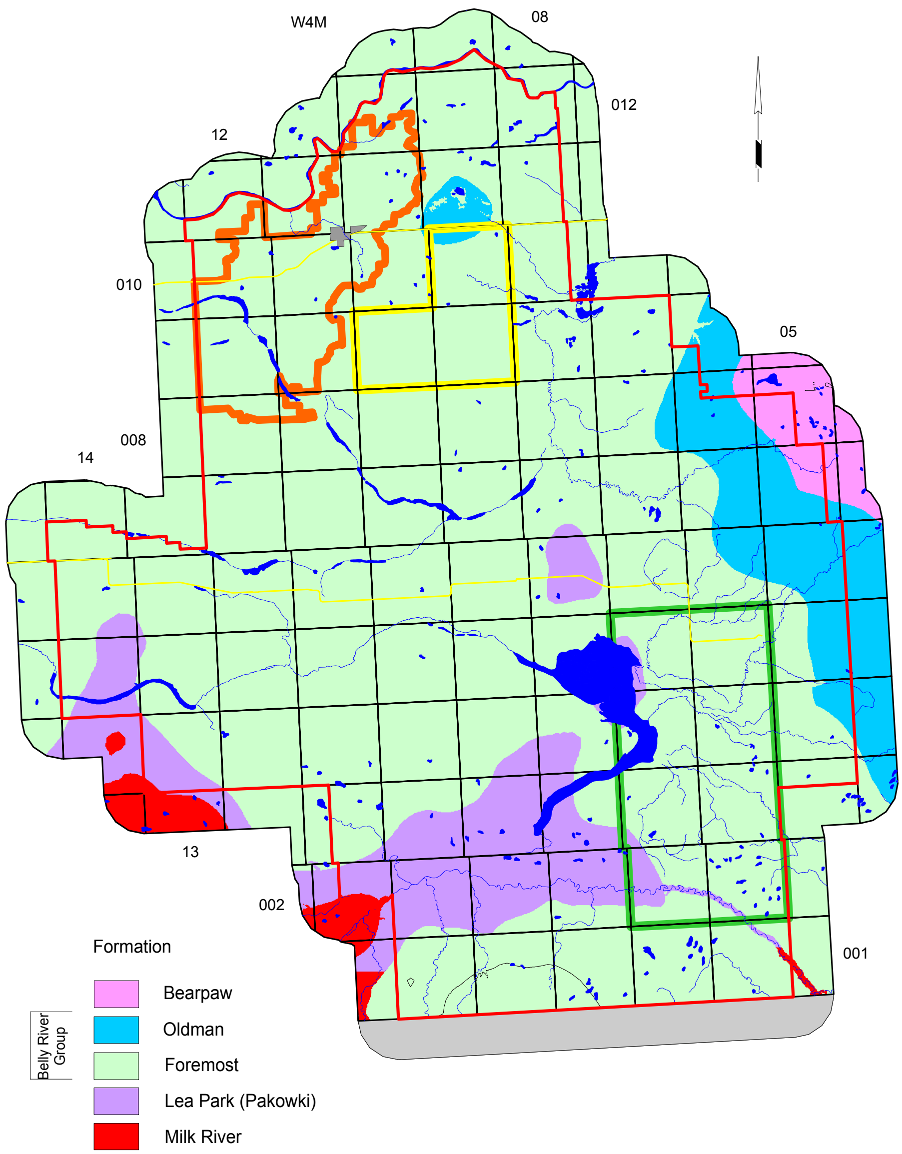
Specific Study Areas



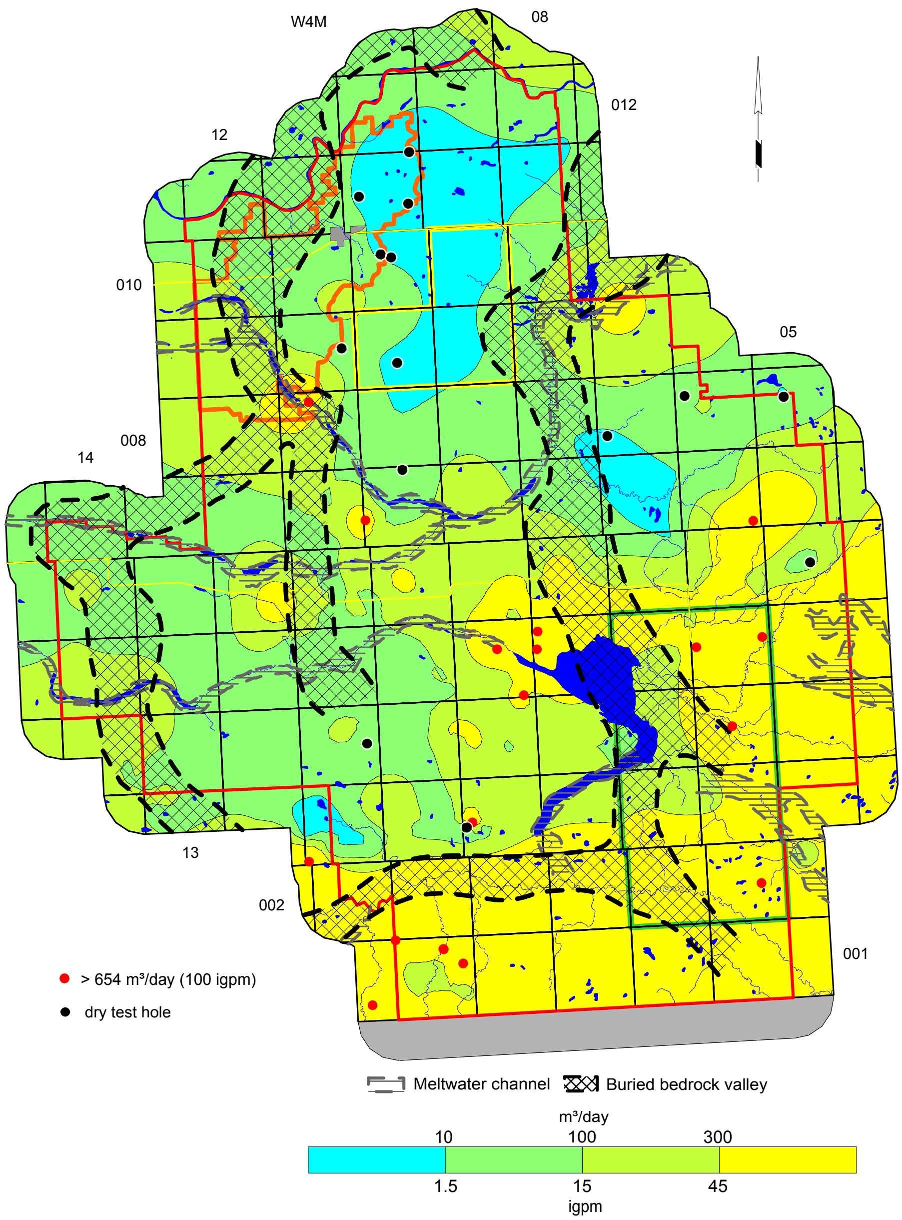
Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) - Specific Study Areas



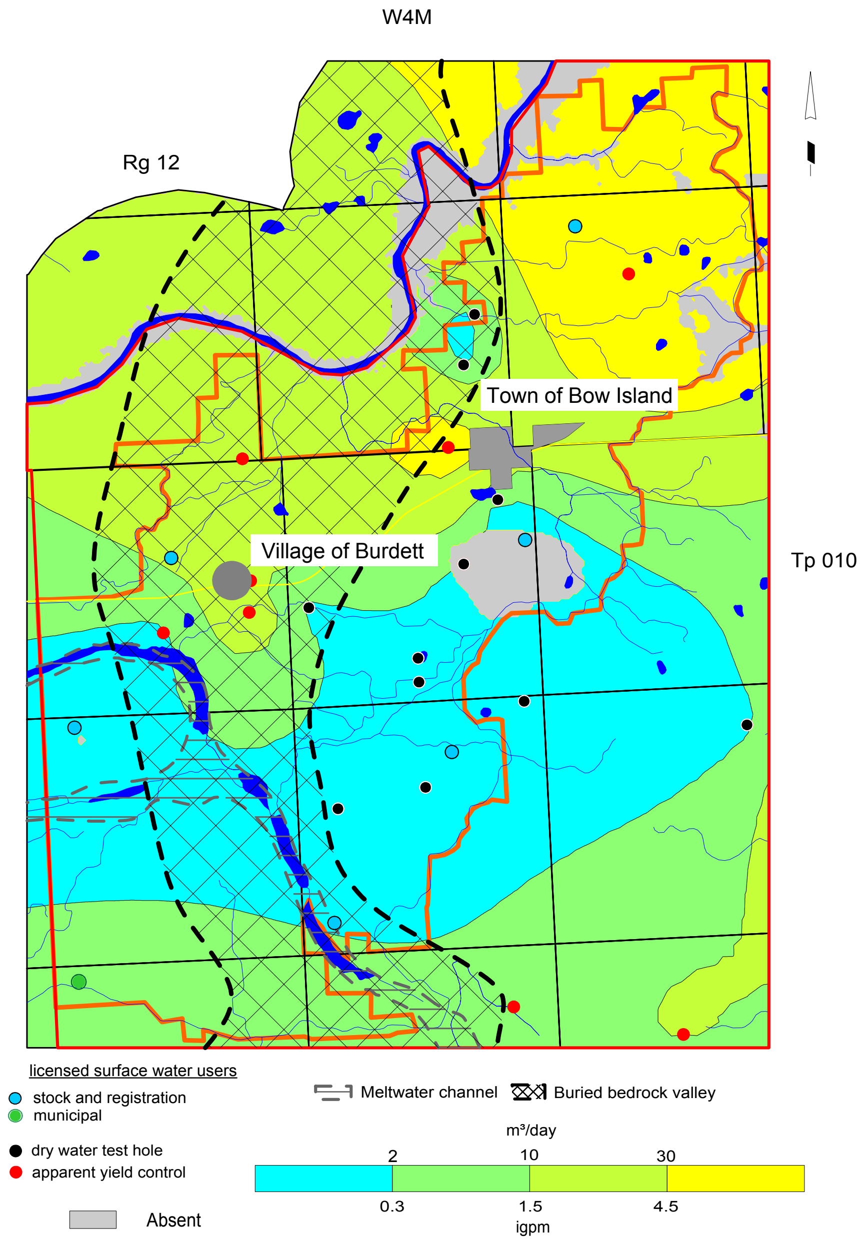
Bedrock Geology of Specific Study Areas



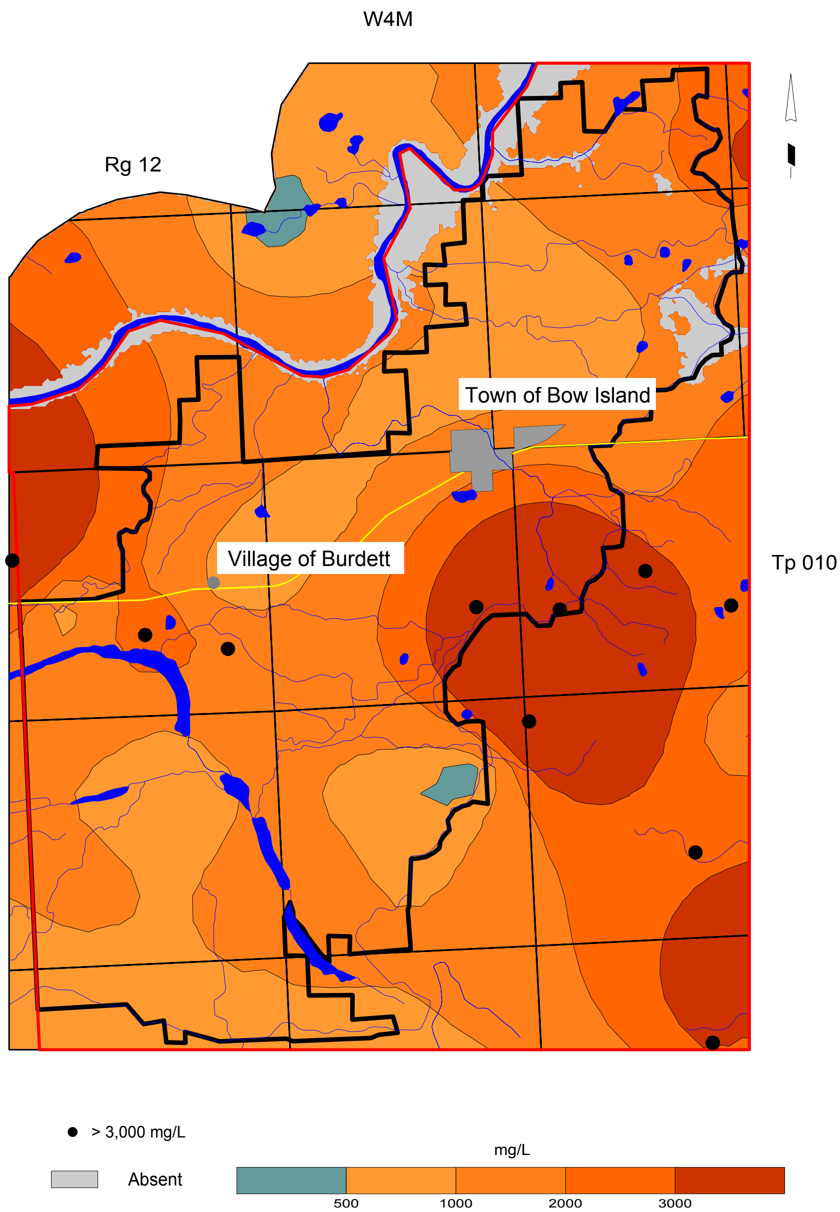
Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Specific Study Areas



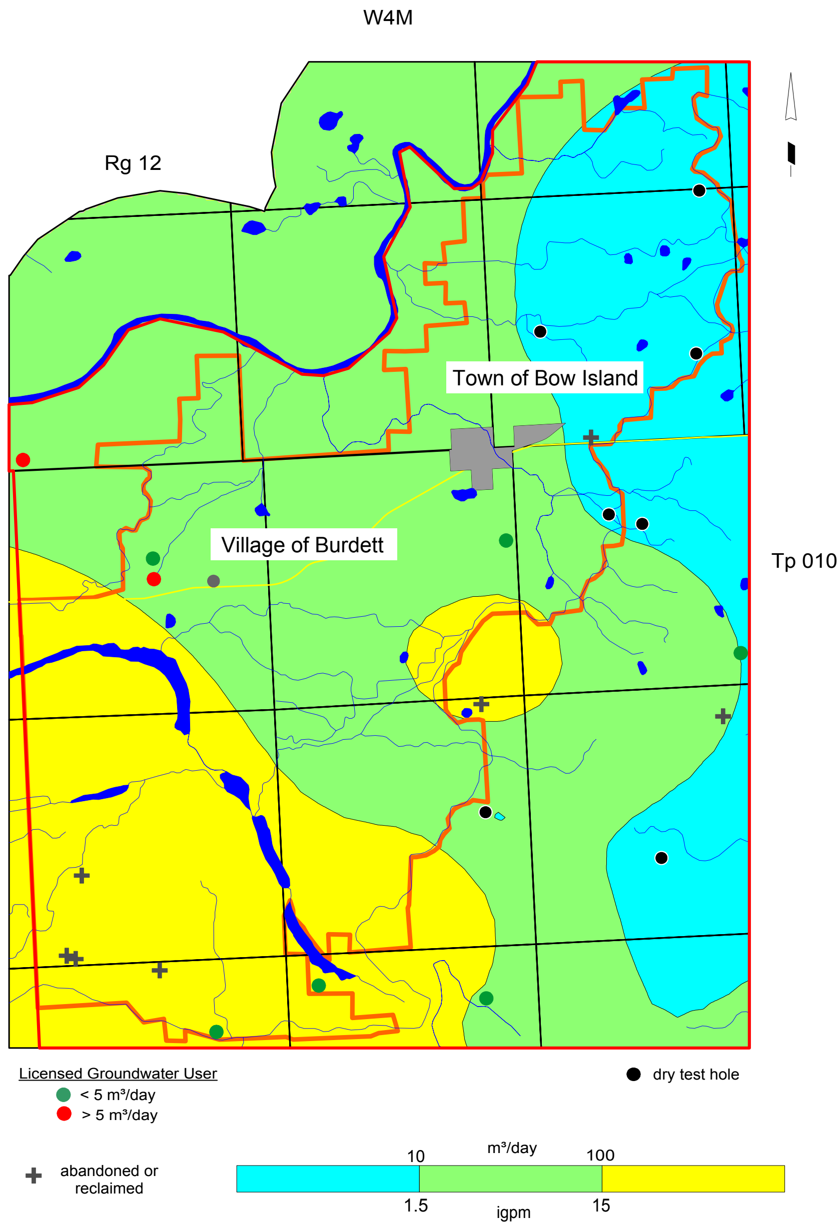
Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 1



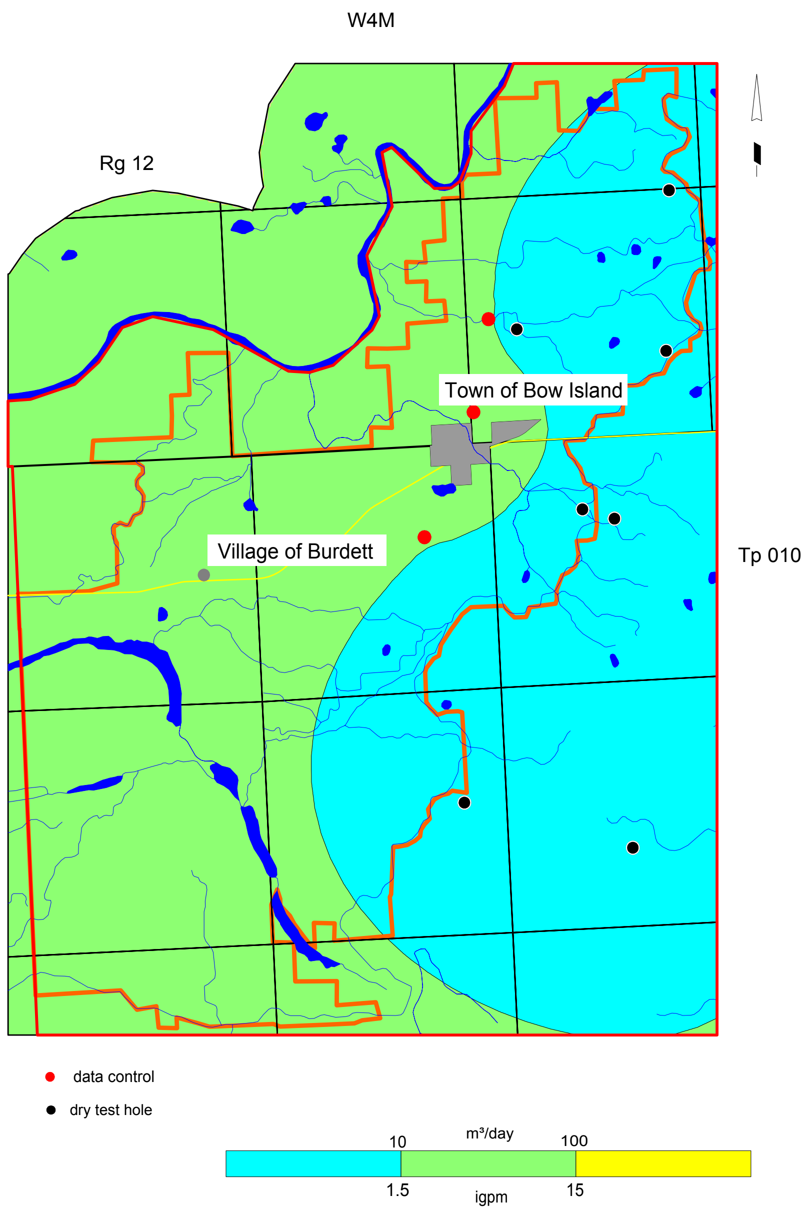
Total Dissolved Solids in Surficial Deposits – Area 1



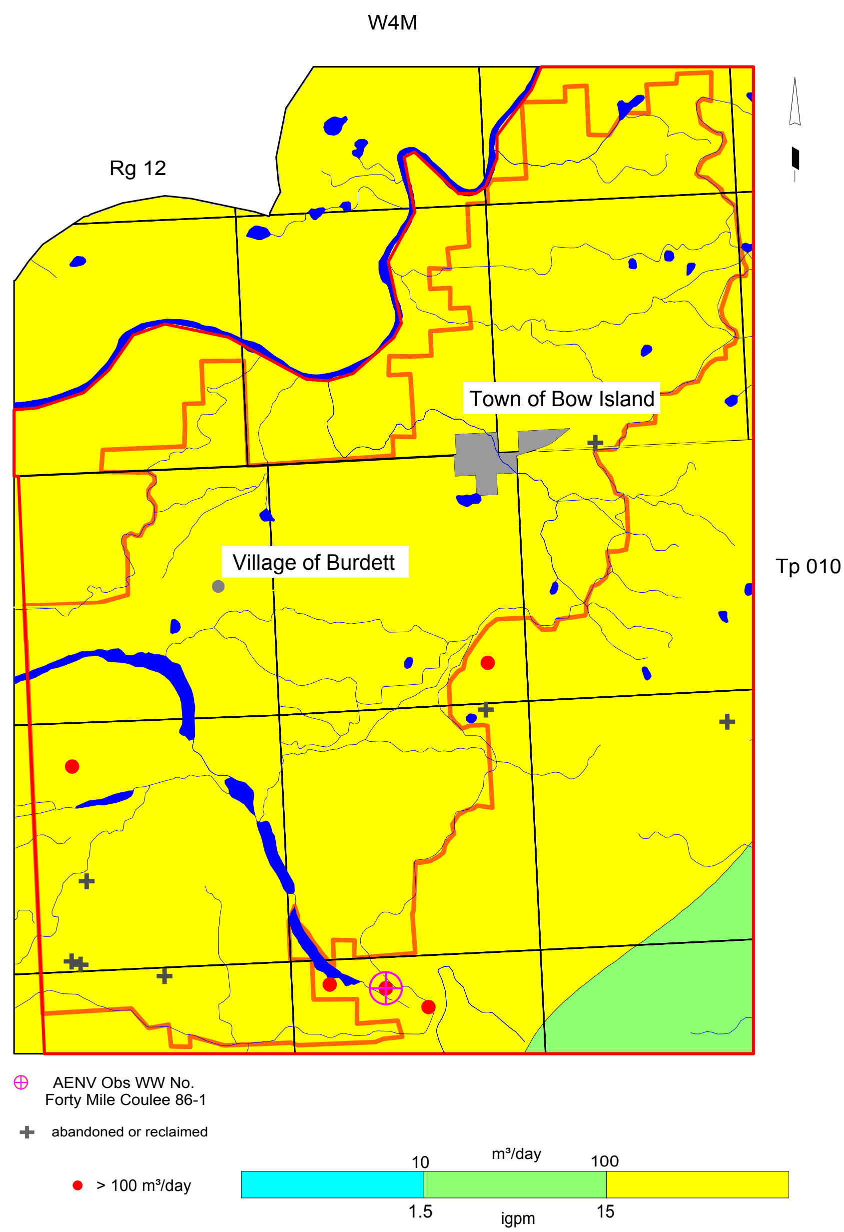
Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Area 1



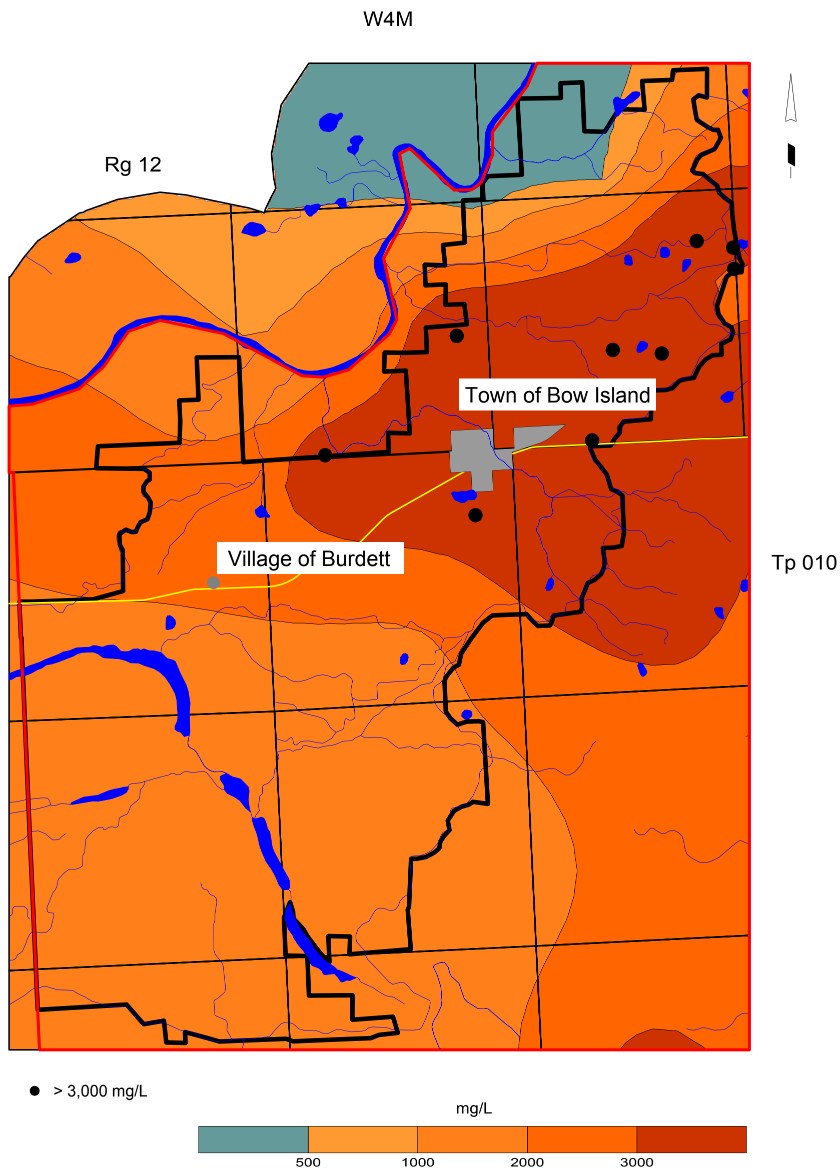
Apparent Yield for Water Wells Completed through Foremost Aquifer – Area 1



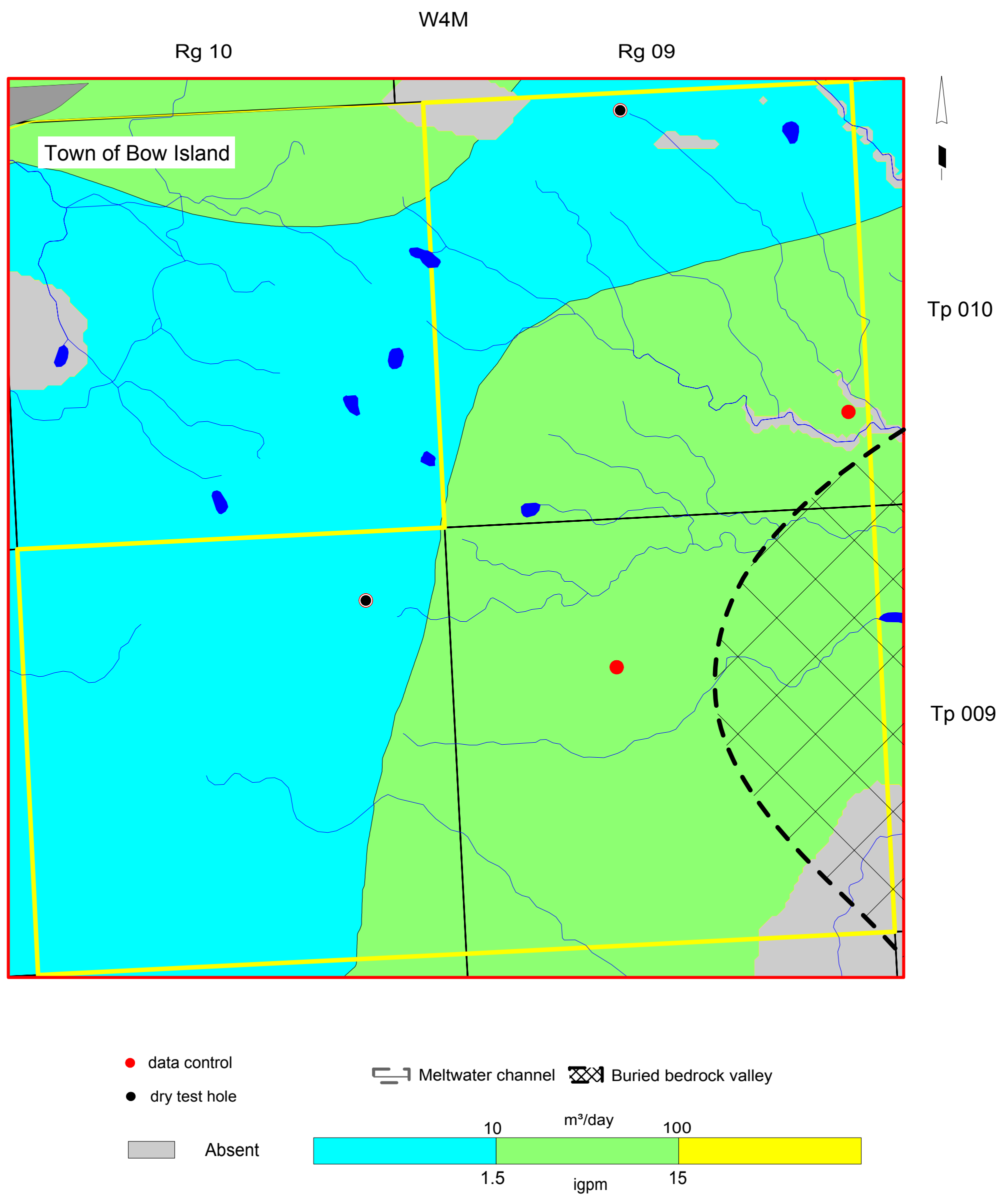
Apparent Yield for Water Wells Completed through Milk River Aquifer – Area 1



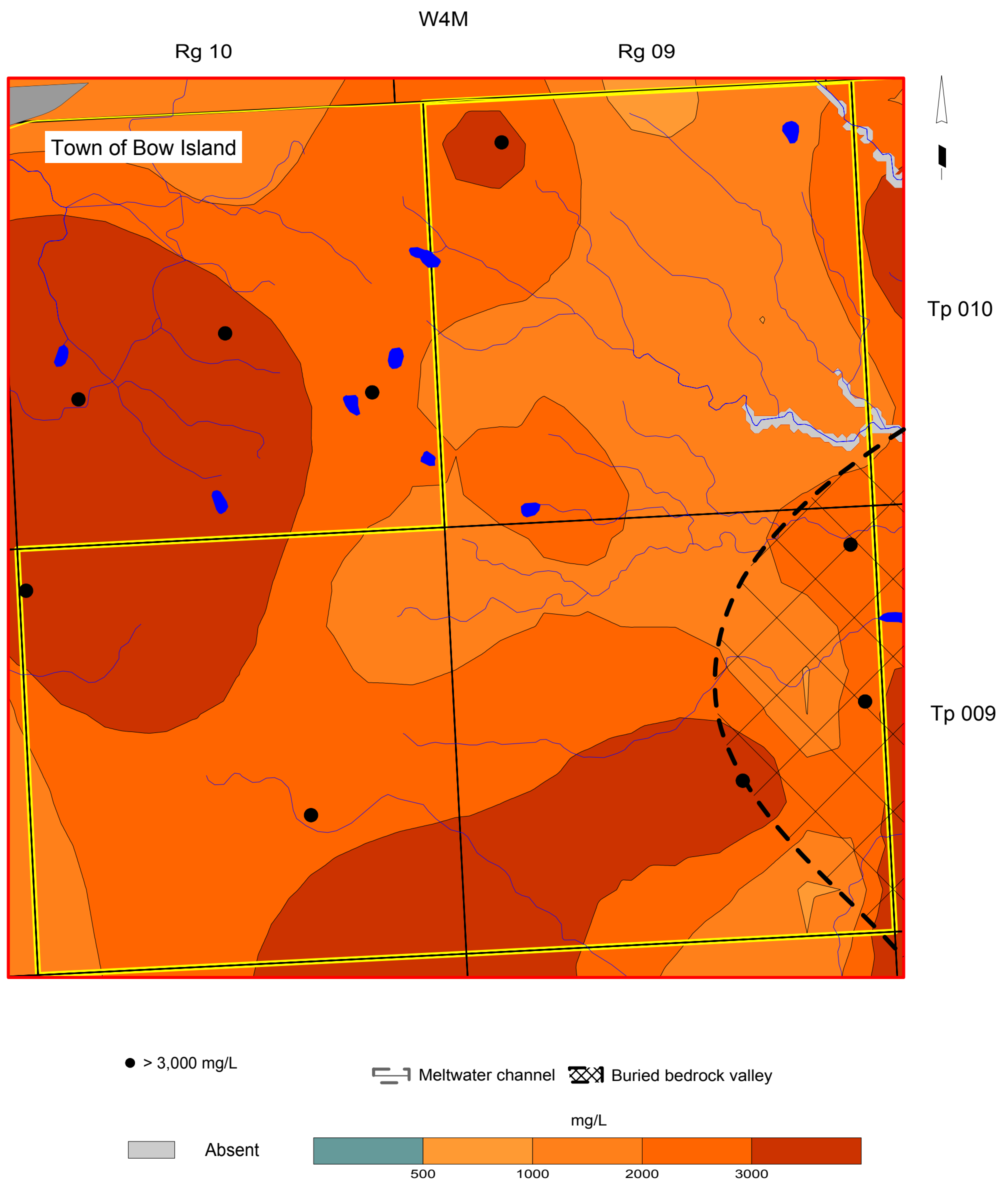
Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) – Area 1



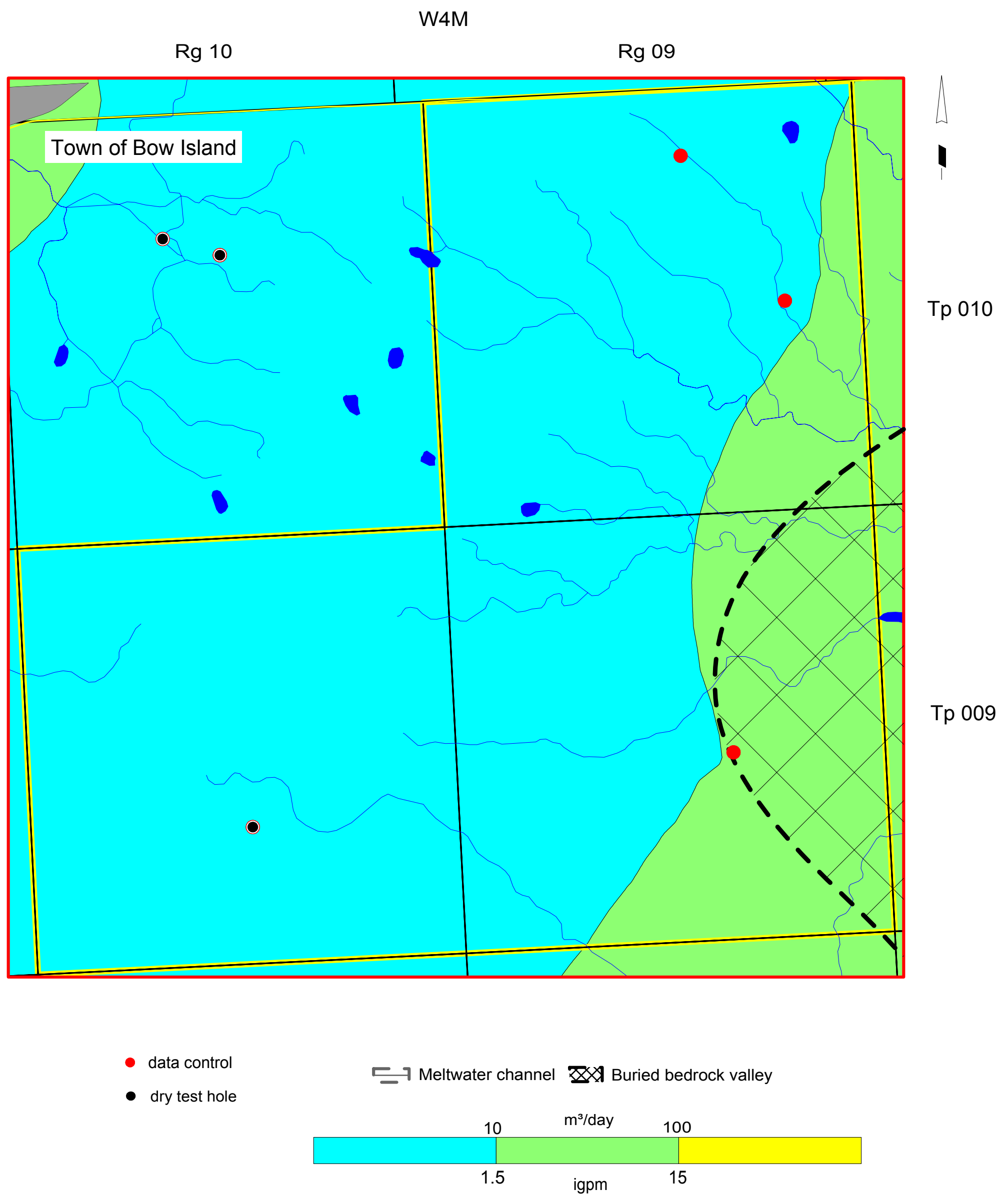
Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 2



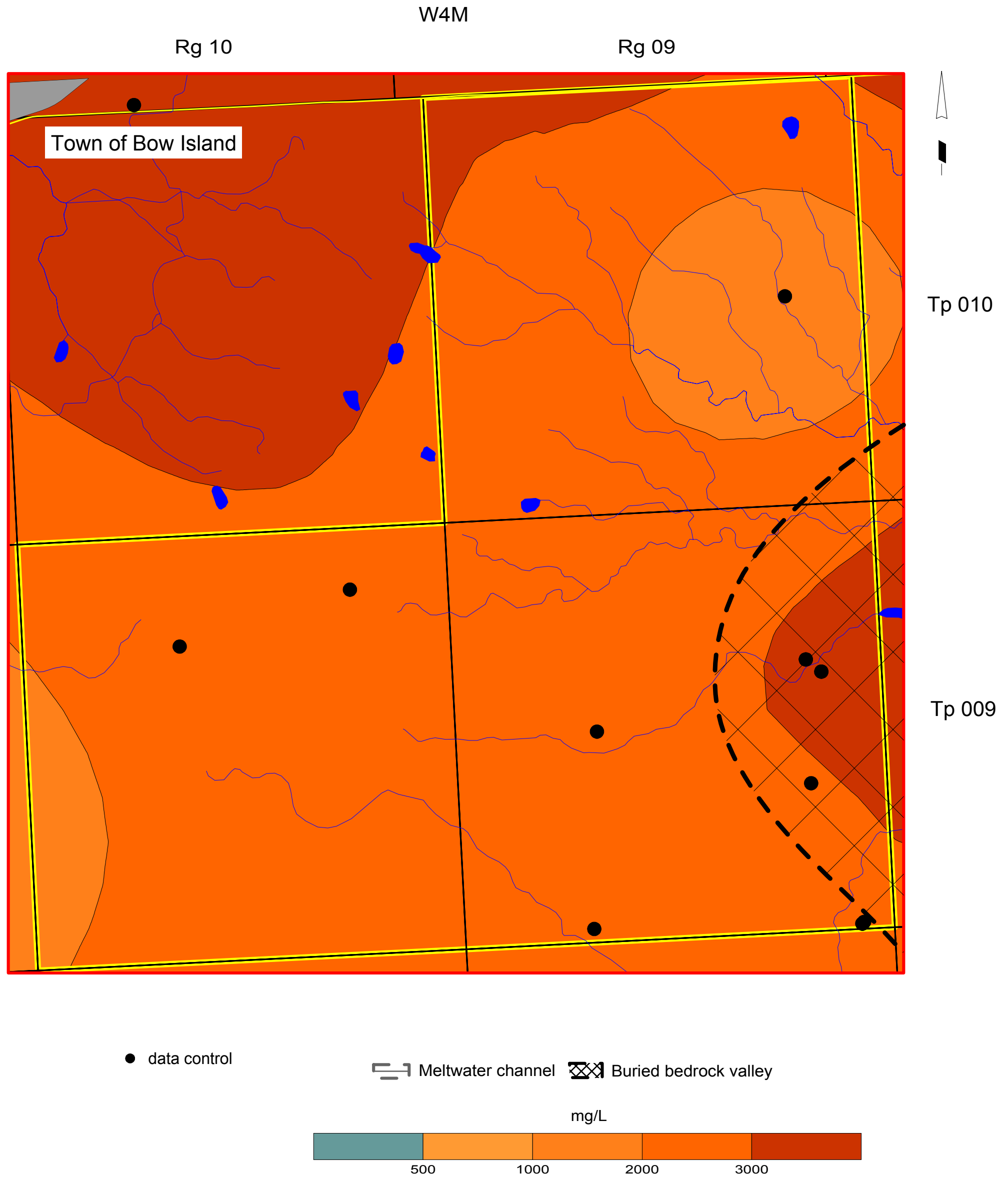
Total Dissolved Solids in Groundwater from Surficial Deposits – Area 2



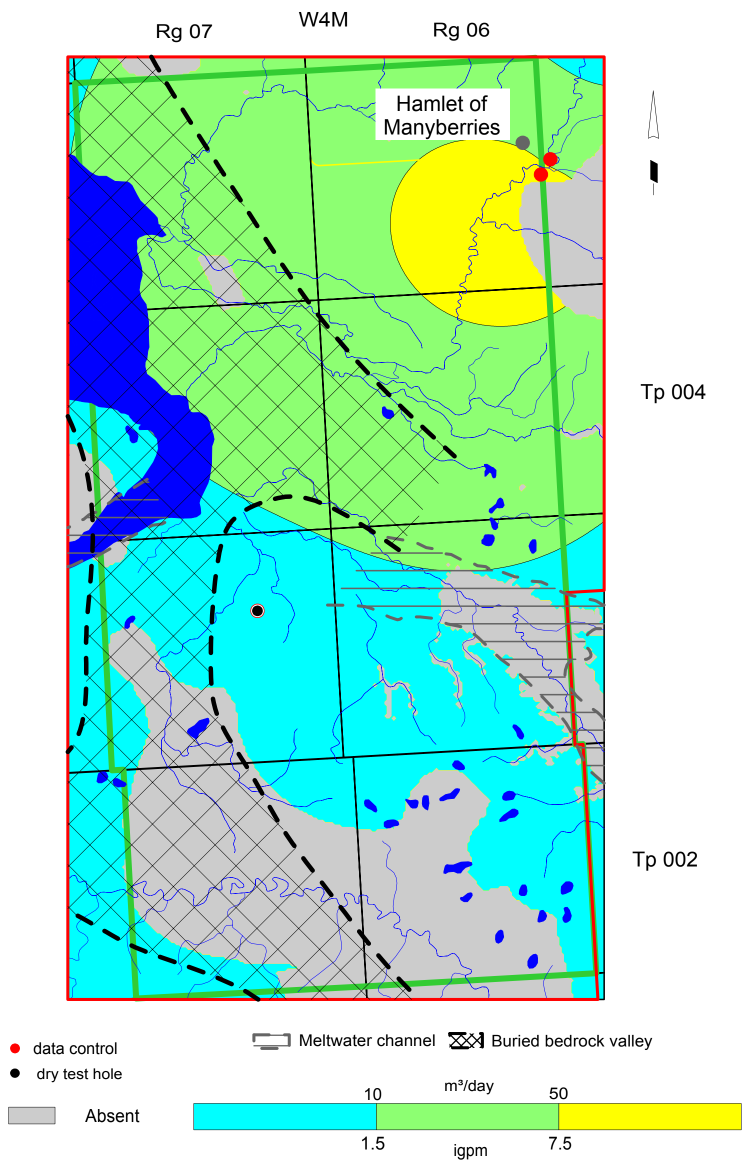
Apparent Yield for Water Wells Completed through Foremost Aquifer – Area 2



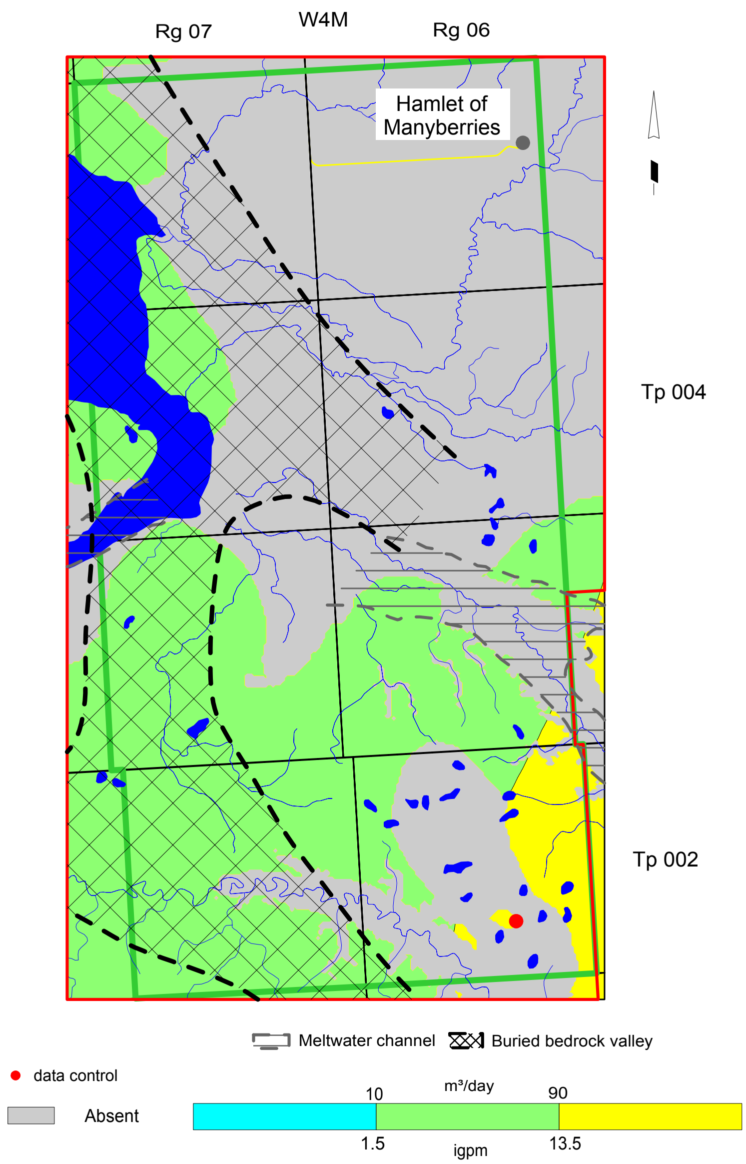
Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) – Area 2



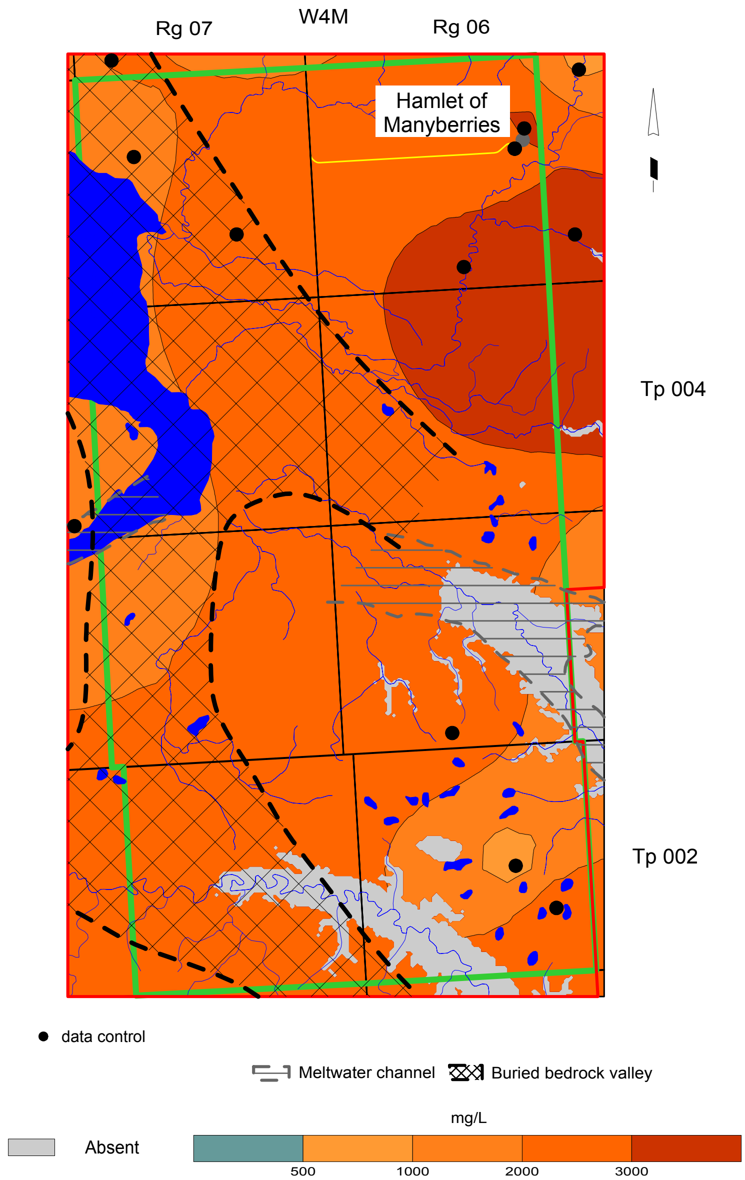
Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer – Area 3



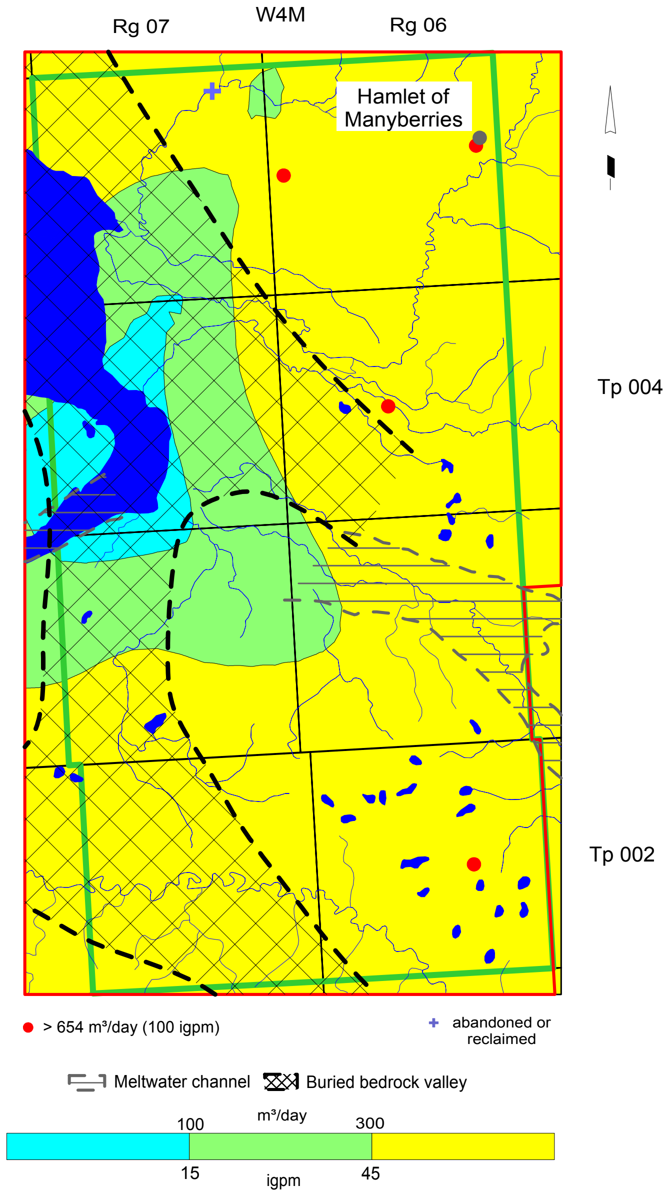
Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer – Area 3



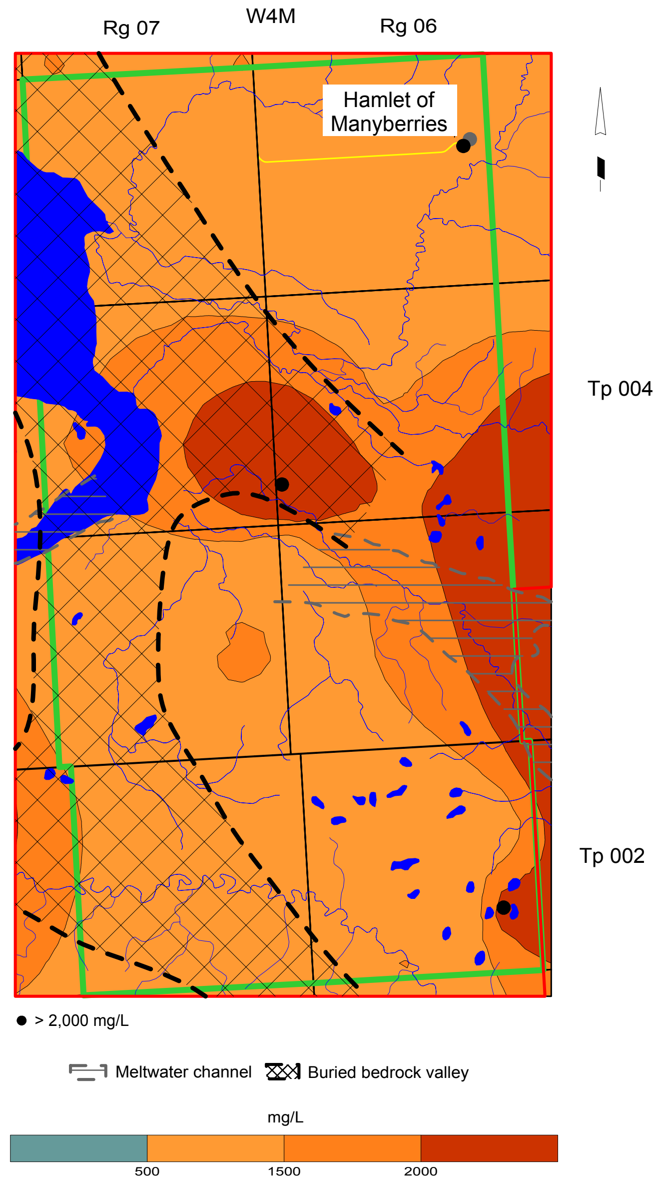
Total Dissolved Solids in Groundwater from Surficial Deposits – Area 3



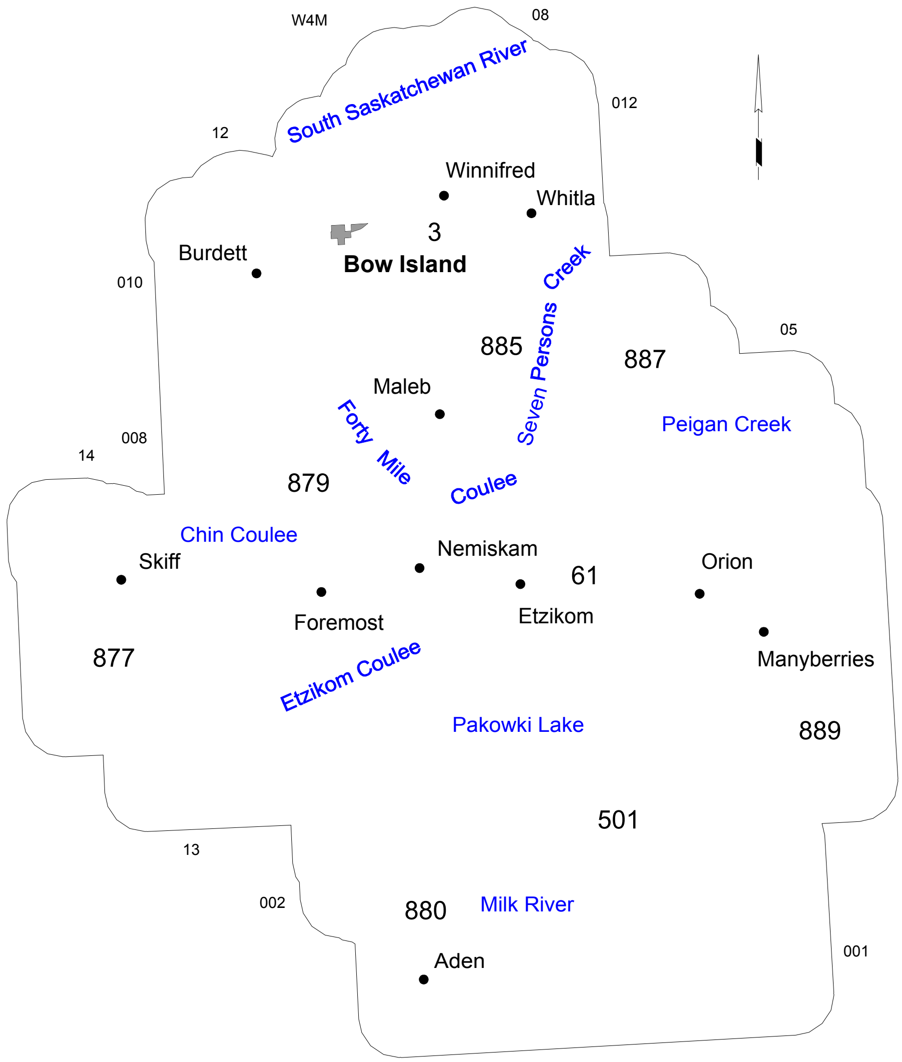
Apparent Yield for Water Wells Completed through Milk River Aquifer – Area 3



Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) – Area 3



Overlay


W4M
08
South Saskatchewan River
012
12
Winnifred
Whitla
3
Burdett
Bow Island
010
Seven Persons Creek
05
885
887
Maleb
Peigan Creek
Forty Mile Coulee
008
14
879
Chin Coulee
Skiff
Nemiskam
61
Orion
Foremost
Etzikom
Manyberries
877
Etzikom Coulee
Pakowki Lake
889
501
13
002
880
Milk River
001
Aden

COUNTY OF FORTY MILE NO. 8

Appendix B

Maps and Figures on CD-ROM

MAPS AND FIGURES ON CD-ROM

A **1) General**

A01	Surface Topography
A02	River Sub-basins
A27	Surface-Casing Diameters Used in Drilled Water Wells
A03	Surface-Casing Types Used in Drilled Water Wells
A04	Location of Water Wells and Springs
A05	Location of Drilled and Bored Water Wells
A06	Minimum Depth of Existing Water Wells
A07	Maximum Depth of Existing Water Wells
A08	Difference between Maximum and Minimum Depth of Existing Water Wells
A09	Depth to Base of Groundwater Protection
A10	Hydrogeological Maps
A11	Generalized Cross-Section (for terminology only)
A12	Generalized Geologic Column
A13	Cross-Section A - A'
A14	Cross-Section B - B'
A15	Cross-Section C - C'
A16	Cross-Section D - D'
A17	Cross-Section E - E'
A18	Cross-Section F - F'
A19	Cross-Section G - G'
A20	Cross-Section H - H'
A21	Bedrock Topography
A22	Bedrock Geology
A23	Relative Permeability
A24	Licensed and Registered Groundwater Water Wells
A25	Estimated Water Well Use per Section
A26	Water Wells that have been Field-Verified and Water Wells that are Recommended for Field-Verification

2) Surficial Aquifers

B **a) Surficial Deposits**

B01	Thickness of Surficial Deposits
B02	Depth to Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep
B03	Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep
B04	Total Dissolved Solids in Groundwater from Surficial Deposits
B05	Sulfate in Groundwater from Surficial Deposits
B06	Chloride in Groundwater from Surficial Deposits
B07	Nitrate + Nitrite (as N) in Groundwater from Surficial Deposits
B08	Total Hardness in Groundwater from Surficial Deposits
B09	Piper Diagram - Surficial Deposits
B10	Thickness of Sand and Gravel Deposits
B11	Amount of Sand and Gravel in Surficial Deposits
B12	Thickness of Sand and Gravel Aquifer(s)
B13	Water Wells Completed in Surficial Deposits
B14	Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s)
B15	Changes in Water Levels in Surficial Deposits

d) First Sand and Gravel

B24	Thickness of First Sand and Gravel Deposits

b) Upper Sand and Gravel

B16	Thickness of Upper Surficial Deposits
B17	Thickness of Upper Sand and Gravel (not all drill holes fully penetrate surficial deposits)
B18	Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

c) Lower Sand and Gravel

B19	Depth to Top of Lower Sand and Gravel Deposits
B20	Structure-Contour Map - Top of Lower Sand and Gravel Deposits
B21	Thickness of Lower Sand and Gravel Aquifer
B22	Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer
B23	Non-Pumping Water-Level Surface in Lower Sand and Gravel Aquifer

3) Bedrock Aquifers

C **a) General**

C01 Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)
C02 Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)
C03 Sulfate in Groundwater from Upper Bedrock Aquifer(s)
C04 Chloride in Groundwater from Upper Bedrock Aquifer(s)
C05 Fluoride in Groundwater from Upper Bedrock Aquifer(s)
C06 Total Hardness in Groundwater from Upper Bedrock Aquifer(s)
C07 Piper Diagram - Upper Bedrock Aquifer(s)
C08 Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)
C09 Depth to Non-Pumping Water-Level Surface in Upper Bedrock Aquifer(s)
C10 Non-Pumping Water-Level Surface in Upper Bedrock Aquifer(s)
C11 Areas of Potential Groundwater Depletion - Upper Bedrock Aquifer(s)

b) Bearpaw Formation

C12 Depth to Top of Bearpaw Formation
C13 Structure-Contour Map - Bearpaw Formation

c) Oldman Formation

C14 Depth to Top of Oldman Formation
C15 Structure-Contour Map - Oldman Formation

d) Foremost Formation

C16 Depth to Top of Foremost Formation
C17 Structure-Contour Map - Foremost Formation
C45 Depth to Non-Pumping Water-Level Surface - Foremost Aquifer
C18 Non-Pumping Water-Level Surface - Foremost Aquifer
C19 Apparent Yield for Water Wells Completed through Foremost Aquifer
C20 Total Dissolved Solids in Groundwater from Foremost Aquifer
C21 Sulfate in Groundwater from Foremost Aquifer
C22 Chloride in Groundwater from Foremost Aquifer
C23 Fluoride in Groundwater from Foremost Aquifer
C24 Total Hardness in Groundwater from Foremost Aquifer
C25 Piper Diagram - Foremost Aquifer
C26 Areas of Potential Groundwater Depletion - Foremost Aquifer

e) Lea Park Formation

C27 Depth to Top of Lea Park Formation
C28 Structure-Contour Map - Lea Park Formation

f) Milk River Formation

C29 Depth to Top of Milk River Formation
C30 Structure-Contour Map - Milk River Formation
C31 Depth to Non-Pumping Water-Level Surface - Milk River Aquifer
C32 Non-Pumping Water-Level Surface - Milk River Aquifer
C33 Apparent Yield for Water Wells Completed through Milk River Aquifer
C34 Total Dissolved Solids in Groundwater from Milk River Aquifer
C35 Sulfate in Groundwater from Milk River Aquifer
C36 Chloride in Groundwater from Milk River Aquifer
C37 Fluoride in Groundwater from Milk River Aquifer
C38 Median Fluoride Concentration
C39 Total Hardness of Groundwater from Milk River Aquifer
C40 Piper Diagram - Milk River Aquifer
C41 Types of Groundwaters from Milk River Aquifer (after Meyboom, 1960)
C42 Areas of Potential Groundwater Depletion - Milk River Aquifer

g) Colorado Shale

C43 Depth to Top of Colorado Shale Formation
C44 Structure-Contour Map - Colorado Shale Formation

4) Hydrographs and Observation Water Wells

5) Specific Study Areas

a) Generel

b) Study Area 1

c) Study Area 2

d) Study Area 3

COUNTY OF FORTY MILE NO. 8
Appendix C

General Water Well Information

Domestic Water Well Testing

Purpose and Requirements

The purpose of the testing of domestic water wells is to obtain background data related to:

1) the non-pumping water level for the aquifer - Has there been any lowering of the level since the last measurement?
2) the specific capacity of the water well, which indicates the type of contact the water well has with the aquifer;
3) the transmissivity of the aquifer and hence an estimate of the projected long-term yield for the water well;
4) the chemical, bacteriological and physical quality of the groundwater from the water well.

The testing procedure involves conducting an aquifer test and collecting of groundwater samples for analysis by an accredited laboratory. The date and time of the testing are to be recorded on all data collection sheets. A sketch showing the location of the water well relative to surrounding features is required. The sketch should answer the question, "If this water well is tested in the future, how will the person doing the testing know this is the water well I tested?"

The water well should be taken out of service as long as possible before the start of the aquifer test, preferably not less than 30 minutes before the start of pumping. The non-pumping water level is to be measured 30, 10, and 5 minutes before the start of pumping and immediately before the start of pumping which is to be designated as time 0 for the test. All water levels must be from the same designated reference, usually the top of the casing. Water levels are to be measured during the pumping interval and during the recovery interval after the pump has been turned off; all water measurements are to be with an accuracy of ± 0.01 metres.

During the pumping and recovery intervals, the water level is to be measured at the appropriate times. An example of the time schedule for a four-hour test is as follows, measured in minutes after the pump is turned on and again after the pump is turned off:

1,2,3,4,6,8,10,13,16,20,25,32,40,50,64,80,100,120.

For a four-hour test, the reading after 120 minutes of pumping will be the same as the 0 minutes of recovery. Under no circumstance will the recovery interval be less than the pumping interval.

Flow rate during the aquifer test should be measured and recorded with the maximum accuracy possible. Ideally, a water meter with an accuracy of better than ±1% displaying instantaneous and total flow should be used. If a water meter is not available, then the time required to completely fill a container of known volume should be recorded, noting the time to the nearest 0.5 seconds or better. Flow rate should be determined and recorded often to ensure a constant pumping rate.

Groundwater samples should be collected as soon as possible after the start of pumping and within 10 minutes of the end of pumping. Initially only the groundwater samples collected near the end of the pumping interval need to be submitted to the accredited laboratory for analysis. All samples must be properly stored for transportation to the laboratory and, in the case of the bacteriological analysis, there is a maximum time allowed between the time the sample is collected and the time the sample is delivered to the laboratory. The first samples collected are only analyzed if there is a problem or a concern with the first samples submitted to the laboratory.

Procedure

Site Diagrams

These diagrams are a map showing the distance to nearby significant features. This would include things like a corner of a building (house, barn, garage etc.) or the distance to the half-mile or mile fence. The description should allow anyone not familiar with the site to be able to unequivocally identify the water well that was tested. In lieu of a map, UTM coordinates accurate to within five metres would be acceptable. If a hand-held GPS is used, the post-processing correction details must be provided.

Surface Details

The type of surface completion must be noted. This will include such things as a pitless adapter, well pit, pump house, in basement, etc. Also, the reference point used for measuring water levels needs to be noted. This would include top of casing (TOC) XX metres above ground level; well pit lid, XX metres above TOC; TOC in well pit XX metres below ground level.

Groundwater Discharge Point

Where was the flow of groundwater discharge regulated? For example was the discharge through a hydrant downstream from the pressure tank; discharged directly to ground either by connecting directly above the well seal or by pulling the pump up out of the pitless adapter; from a tap on the house downstream from the pressure tank? Also note must be made if any action was taken to ensure the pump would operate continuously during the pumping interval and whether the groundwater was passing through any water-treatment equipment before the discharge point.

Water-Level Measurements

How were the water-level measurements obtained? If obtained using a contact gauge, what type of cable was on the tape, graduated tape or a tape with tags? If a tape with tags, when was the last time the tags were calibrated? If a graduated tape, what is the serial number of the tape and is the tape shorter than its original length (i.e. is any tape missing)?

If water levels are obtained using a transducer and data logger, the serial numbers of both transducer and data logger are needed and a copy of the calibration sheet. The additional information required is the depth the transducer was set and the length of time between when the transducer was installed and when the calibration water level was measured, plus the length of time between the installation of the transducer and the start of the aquifer test. All water levels must be measured at least to the nearest 0.01 metres.

Discharge Measurements

Type of water meter used. This could include such things as a turbine or positive displacement meter. How were the readings obtained from the meter? Were the readings visually noted and recorded or were they recorded using a data logger?

Water Samples

A water sample must be collected between the 4- and 6-minute water-level measurements, whenever there is an observed physical change in the groundwater being pumped, and 10 minutes before the end of the planned pumping interval. Additional water samples must be collected if it is expected that pumping will be terminated before the planned pumping interval.

Water Act - Water (Ministerial) Regulation

PROVINCE OF ALBERTA

WATER ACT

WATER (MINISTERIAL) REGULATION

Alberta Regulation 205/98

EXTRACT FROM THE
ALBERTA GAZETTE

© Published by
the Queen's Printer for Alberta

Queen's Printer Bookstore
11510 Kingsway
Edmonton, AB T5G 2Y5
(403) 427-4952
Fax: (403) 452-0668
Note: After Jan. 25/99 use area code (780)

Queen's Printer Bookstore
Main Floor, McDougall Centre
455 - 6th Street S.W.
Calgary, AB T2P 4E8
(403) 297-6251
Fax: (403) 297-8450

Shop On-line at http://www.gov.ab.ca/qp

ALBERTA REGULATION 205/98

Water Act

WATER (MINISTERIAL) REGULATION

Table of Contents

1

Chemical Analysis of Farm Water Supplies

Adapted from Agdex 716 (D04) Published April 1991

A routine chemical analysis tests the water for 15 chemical parameters. It will reveal the hardness and iron concentration as well as the presence of other chemicals such as chlorides, sulphates, nitrates and nitrites. Chemicals, other than those listed below, can be tested but arrangements should be made with the lab before the sample is submitted. These special requests' must be clearly specified on the request form. Your farm water supply should be analyzed whenever a new water source is constructed, or when a change in water quality is noticed.

Your local health unit can provide you with the necessary water sample containers. Water samples specifically for human consumption must be submitted to the health unit.

The water sample you take should be representative. Choose an outlet as close to the source as possible. For most domestic samples, allow the water to run through the faucet for about five minutes and then fill the sample container.

Once you have obtained a good water sample, take it to your local health unit for forwarding to the appropriate laboratory. After the laboratory analysis is completed, the health inspector or technologist will receive a copy of the analysis and will be able to help you interpret the results.

Water Quality Criteria
It is not essential for private supplies to meet these guidelines. People have different reactions and tolerances to different minerals. If any chemical in your water exceeds drinking water limits consult you family doctor or local health unit.

All levels listed below (except pH) are listed in parts per million (ppm). Many labs report results in milligrams/Litre (mg/L), which is equivalent to ppm.

Sodium
Sodium is not considered a toxic metal, and 5,000 to 10,000 milligrams per day are consumed by normal adults without adverse effects. The average intake of sodium from water is only a small fraction of that consumed in a normal diet.

Persons suffering from certain medical conditions such as hypertension may require a sodium restricted diet, in which case the intake of sodium from drinking water could become significant. Sodium levels as low as 20 ppm are sometimes a concern to them. A maximum level of 300 (200*) ppm sodium has traditionally been used as a guideline but the "Guidelines for Canadian Drinking Water Quality" list no maximum acceptable concentration.

Sodium is a significant factor in assessing water for irrigation and plant watering. High sodium levels affect soil structure and a plant's ability to take up water.

Potassium
Potassium is usually only found in quantities of a few ppm in water. There is no recommended limit for potassium but levels over 2,000 ppm may be harmful to human nervous systems. Alberta water supplies rarely contain more than 20 ppm.

Calcium
Calcium is one cause of "hardness" in water. Calcium is not a hazard to health but is undesirable because it may be detrimental for domestic uses such as washing, bathing and laundering. It also tends to cause encrustations in kettles, coffee makers and water heaters. 200 ppm is often considered an acceptable limit.

Magnesium
Magnesium is another constituent causing "hardness" in water. A suggested limit of 150 ppm is used because of taste considerations.

Iron
Iron levels as low as 0.2 to 0.3 ppm will usually cause the staining of laundry and plumbing fixtures. The presence of iron bacteria in water supplies will often cause these symptoms at even lower levels. Iron gives water a metallic taste that may be objectionable to some persons at one to two ppm. Most water contains less that five ppm iron but occasionally levels over 30 ppm are found. Iron and iron bacteria are not considered a health concern.

Sulphate (SO4)
Sulphate concentrations over 500 ppm can be laxative to some humans and livestock. Sulphate levels over 500 ppm may be a concern for livestock on marginal intakes of certain trace minerals. Very high levels of sulphates have been associated with some brain disorders in cattle and pigs.

Chloride
Due to taste considerations the suggested maximum level for chloride is 250 ppm. Most water in Alberta contains less than 20 ppm chloride, although chloride in the 2,000 ppm range can be found.

NO2 Nitrogen (Nitrite)
Due to its toxicity, the maximum acceptable concentration of nitrite in drinking water is one ppm. Nitrite is usually an indicator of very direct contamination by sewage or manure because nitrites are unstable and quickly become nitrates.

The concentration in livestock water should not exceed 10 ppm.

NO3 Nitrogen (Nitrate)
Nitrates are also an indicator of contamination by human or livestock wastes, excessive fertilization or seepage from dump sites. The maximum acceptable concentration in drinking water is 10 ppm. The figure is based on the potential for the nitrate poisoning of infants. Adults can tolerate higher levels but high nitrate levels may cause irritation of the stomach and bladder. The suggested maximum for livestock use is 1,000 ppm.

Fluoride
Fluorides occur naturally in most well waters and are desirable since they help prevent dental cavities. Between one and 1.5 ppm is desirable. As fluoride levels increase above this amount there is an increase in the tendency to cause tooth mottling.

Fluoride levels less than four ppm are not considered a problem for livestock.

TDS Inorganic (Total Dissolved Solids)
This is a measure of the inorganic minerals dissolved in the water. As a general rule less than 1,000 (500*) ppm TDS is considered satisfactory. Levels higher than this are not necessarily a problem; it depends on the specific minerals present.

The suitability for livestock deteriorates as TDS exceeds the 2,000 to 3,000 ppm range.

Conductivity

Conductivity is measured in micro Siemens per centimetre. It can be used to estimate the total dissolved solids in the water. Multiplying the conductivity by 0.65 will give a good approximation of the total dissolved solids. Conductivity tests are often used to assess water suitability for irrigation.

pH

pH is a measure of how acidic or basic the water is. The pH scale goes from zero (acidic) to 14 (basic) with seven being neutral. The generally accepted range for pH is 6.5 to 8.5 with an upper limit of 9.5.

Hardness

The harder the water is the greater its ability to neutralize soap suds. Hardness is caused primarily by calcium and magnesium, but is expressed as ppm equivalent of calcium carbonate. Hard water causes soap curd which makes bathroom fixtures difficult to keep clean and causes greying of laundry.

Hard water will also tend to form scale in hot water tanks, kettles, piping systems, etc.

Type of Water	**Amount of Hardness**	
	ppm	**grains per gallon**
Soft	0- 50	0-3
Moderately Soft	50 - 100	3-6
Moderately Hard	100 - 200	6-12
Hard	200 - 400	12- 23
Very Hard	400 - 600	23 - 35
Extremely Hard	Over 600	Over 35

Alkalinity

Alkalinity is not a specific substance but rather a combined effect of several substances. It is a measure of the resistance of a water to a change in pH. The alkalinity of most Alberta waters is in the range of 100 - 500 ppm, which is considered acceptable. Water with higher levels is often used. Alkalinity is a factor in corrosion or scale deposition and may affect some livestock when over 1,000 ppm.

Water Treatment

Water treatment equipment can often improve water quality significantly. Each type of water treatment equipment has its limitations and thus should be selected carefully. For more information on water treatment please refer to the Agdex 71 6 D series of fact sheets.

Helpful Conversions

1 ppm (part per million) = 1 mg/L (milligram per litre)

1 gpg (grain per gallon) = 17.1 ppm (parts per million)

References

Guidelines for Canadian Drinking Water Quality (1987) Health and Welfare Canada

*Federal-Provincial Subcommittee on Drinking Water of the Federal-Provincial-Territorial Committee on Environment and Occupational Health. March 2001. Summary of Guidelines for Canadian Drinking Water Quality.

Additional Information

VIDEOS

Will the Well Go Dry Tomorrow? (Mow-Tech Ltd.: 1-800 GEO WELL)
Water Wells that Last (PFRA – Edmonton Office: 780-495-3307)
Ground Water and the Rural Community (Ontario Ground Water Association)

BOOKLET

Water Wells that Last (PFRA – Edmonton Office: 780-495-3307);
http://www.agric.gov.ab.ca/water/wells/index.html
Quality Farm Dugouts - http://www.agric.gov.ab.ca/esb/dugout.html

ALBERTA ENVIRONMENT

WATER - http://www3.gov.ab.ca/env/water.cfm

GROUNDWATER INFORMATION SYSTEM - http://www.telusgeomatics.com/tgpub/ag_water/

WATER WELL INSPECTORS
Jennifer McPherson (Edmonton: 780-427-6429)

WATER WELL LICENSING
Rob George (Edmonton: 780-427-6429)

GEOPHYSICAL INSPECTION SERVICE
Edmonton: 780-427-3932

COMPLAINT INVESTIGATIONS
Jerry Riddell (Edmonton: 780-422-4851)

UNIVERSITY OF ALBERTA – Department of Earth and Atmospheric Sciences - Hydrogeology
Carl Mendoza (Edmonton: 780-492-2664)

UNIVERSITY OF CALGARY – Department of Geology and Geophysics - Hydrogeology
Larry Bentley (Calgary: 403-220-4512)

FARMERS ADVOCATE
Dean Lien (Edmonton: 780-427-2433)

PRAIRIE FARM REHABILITATION ADMINISTRATION (PFRA) BRANCH OF AGRICULTURE AND AGRI-FOOD CANADA (AAFC)

Ryan Davison (Medicine Hat: 403-526-2429) - davisonr@agr.gc.ca
Terry Dash (Calgary: 403-292-5719) -dasht@agr.gc.ca

WILDROSE COUNTRY GROUND WATER MONITORING ASSOCIATION
Dave Andrews (Irricana: 403-935-4478)

LOCAL HEALTH DEPARTMENTS

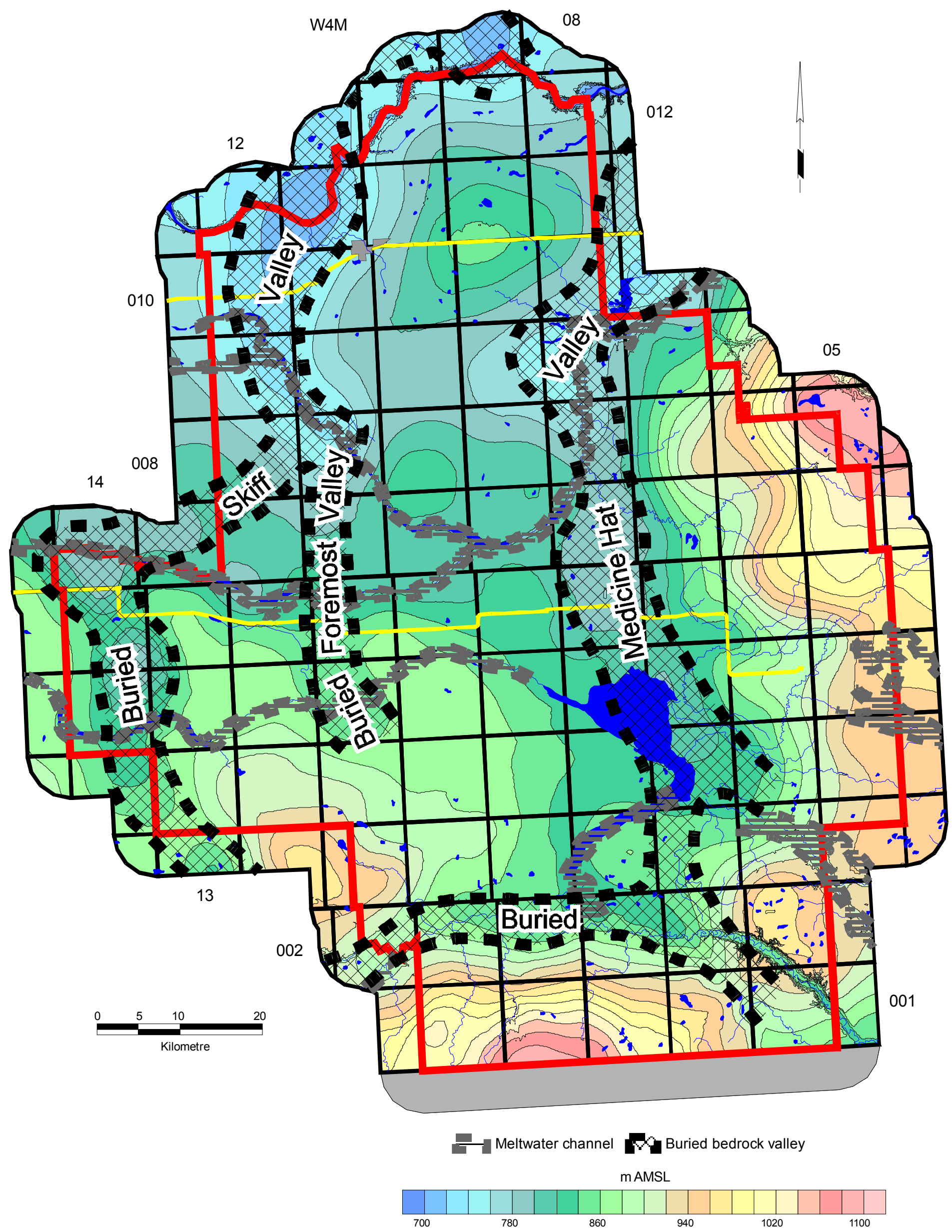
COUNTY OF CAMROSE NO. 22
Appendix D

Maps and Figures Included as Large Plots

Bedrock Topography

County of Forty Mile No. 8

Bedrock Topography

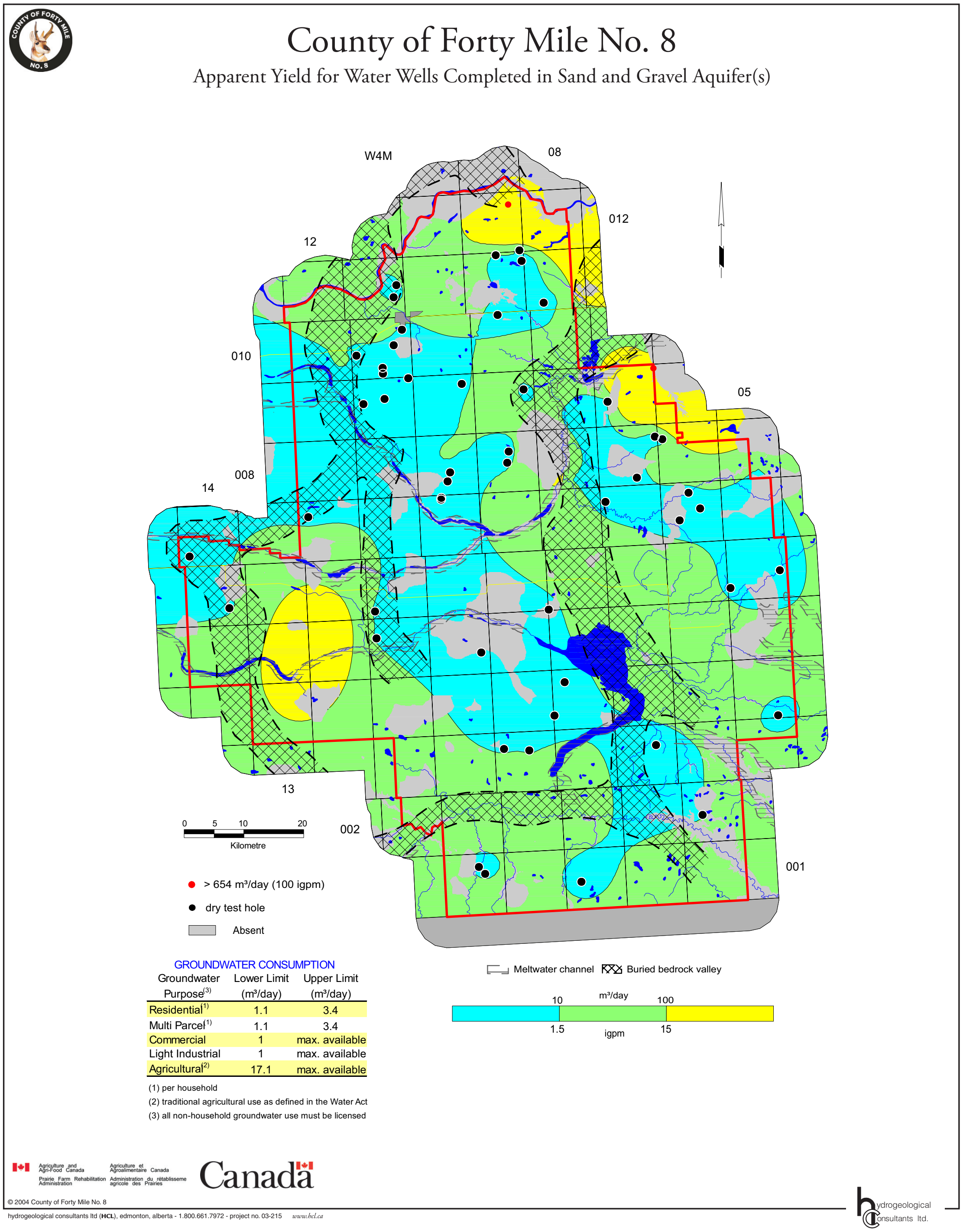


Agriculture and Agri-Food Canada — Agriculture et Agroalimentaire Canada
Prairie Farm Rehabilitation Administration — Administration du rétablissement agricole des Prairies
Canada

hydrogeological consultants ltd (HCL), edmonton, alberta - 1.800.661.7972 - project no. 03-215 — www.hcl.ca

hydrogeological consultants ltd.

Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s)

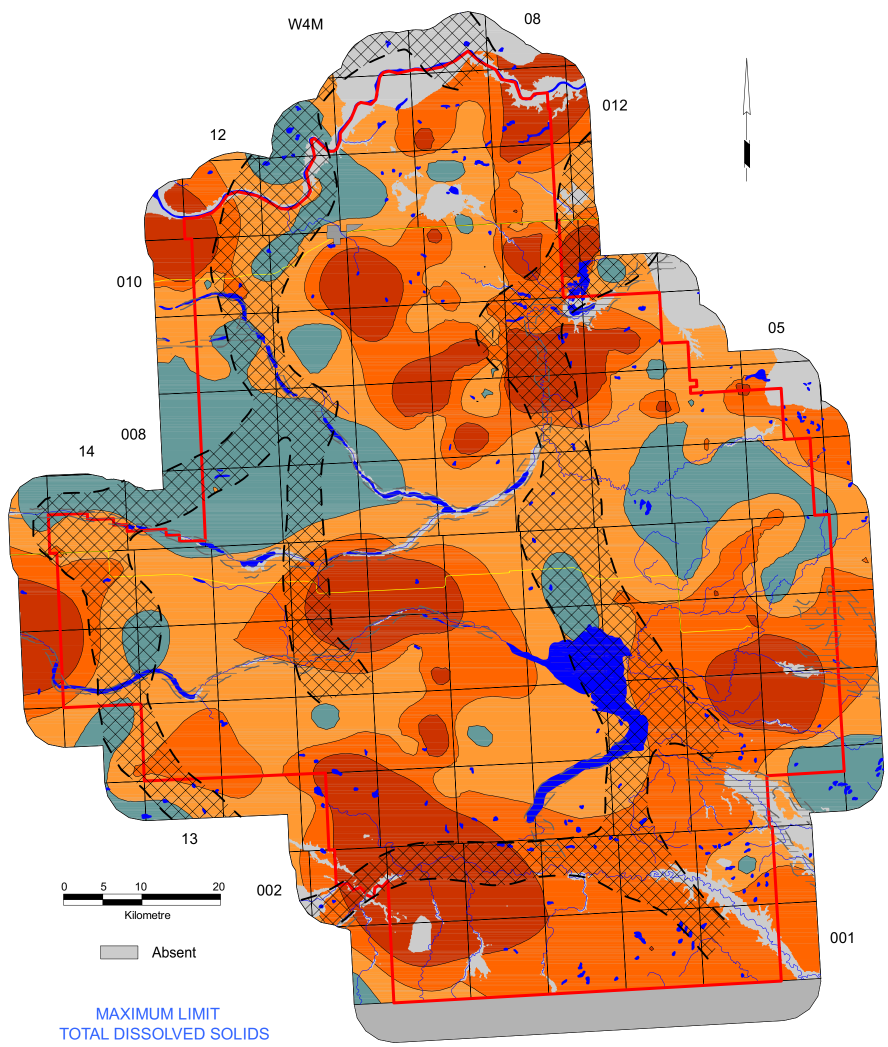


Groundwater Purpose[3]	Lower Limit (m³/day)	Upper Limit (m³/day)
Residential[1]	1.1	3.4
Multi Parcel[1]	1.1	3.4
Commercial	1	max. available
Light Industrial	1	max. available
Agricultural[2]	17.1	max. available

Total Dissolved Solids in Groundwater from Surficial Deposits

County of Forty Mile No. 8

Total Dissolved Solids in Groundwater from Surficial Deposits



MAXIMUM LIMIT
TOTAL DISSOLVED SOLIDS

Use	mg/L
Residential	500
Livestock	3,000
Irrigation	500 - 3,500
Commercial	Depends on Purpose
Industrial	Depends on Purpose

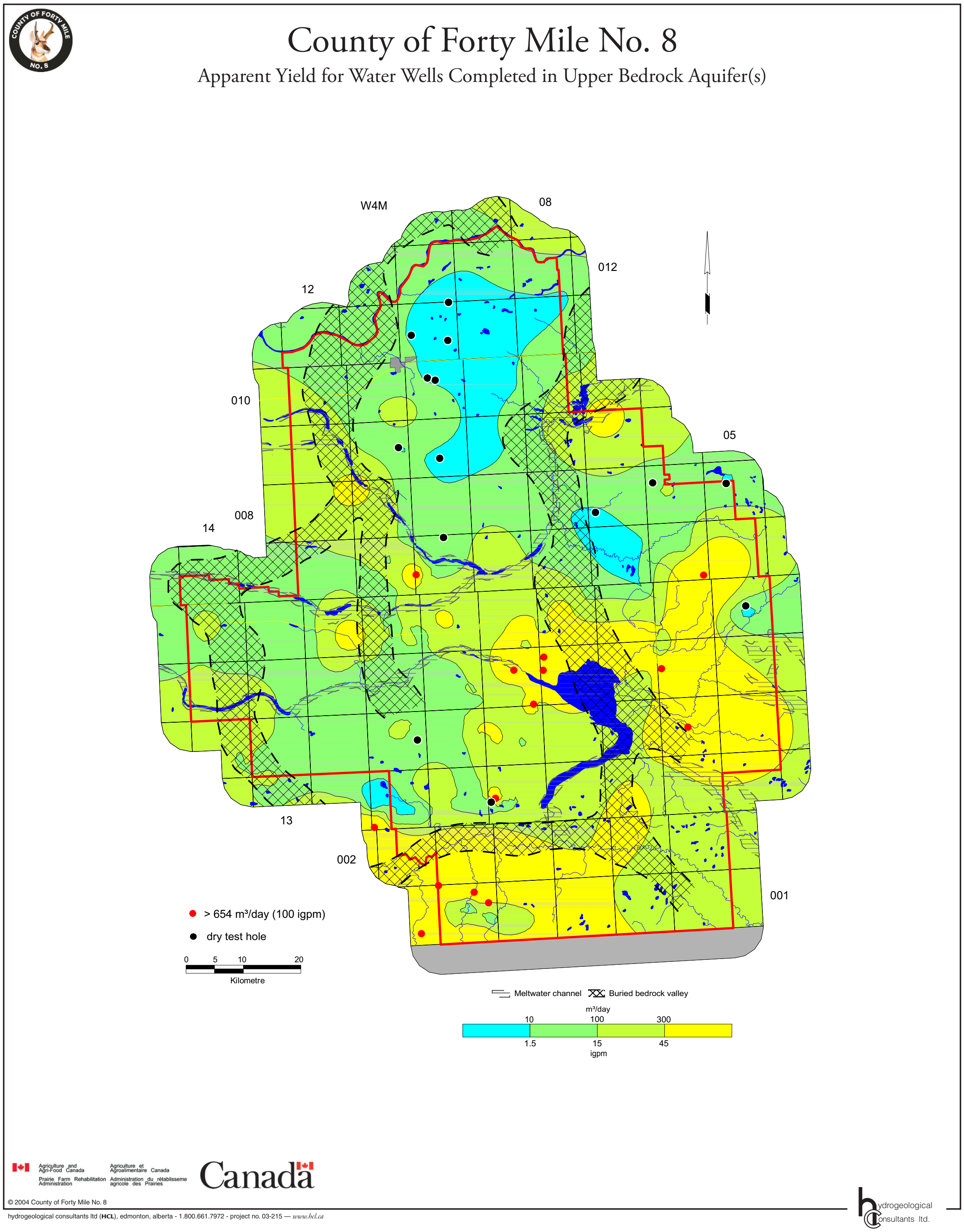
from: Canadian Water Quality Guidelines, 1992

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada
Prairie Farm Rehabilitation Administration / Administration du rétablissement agricole des Prairies
Canada

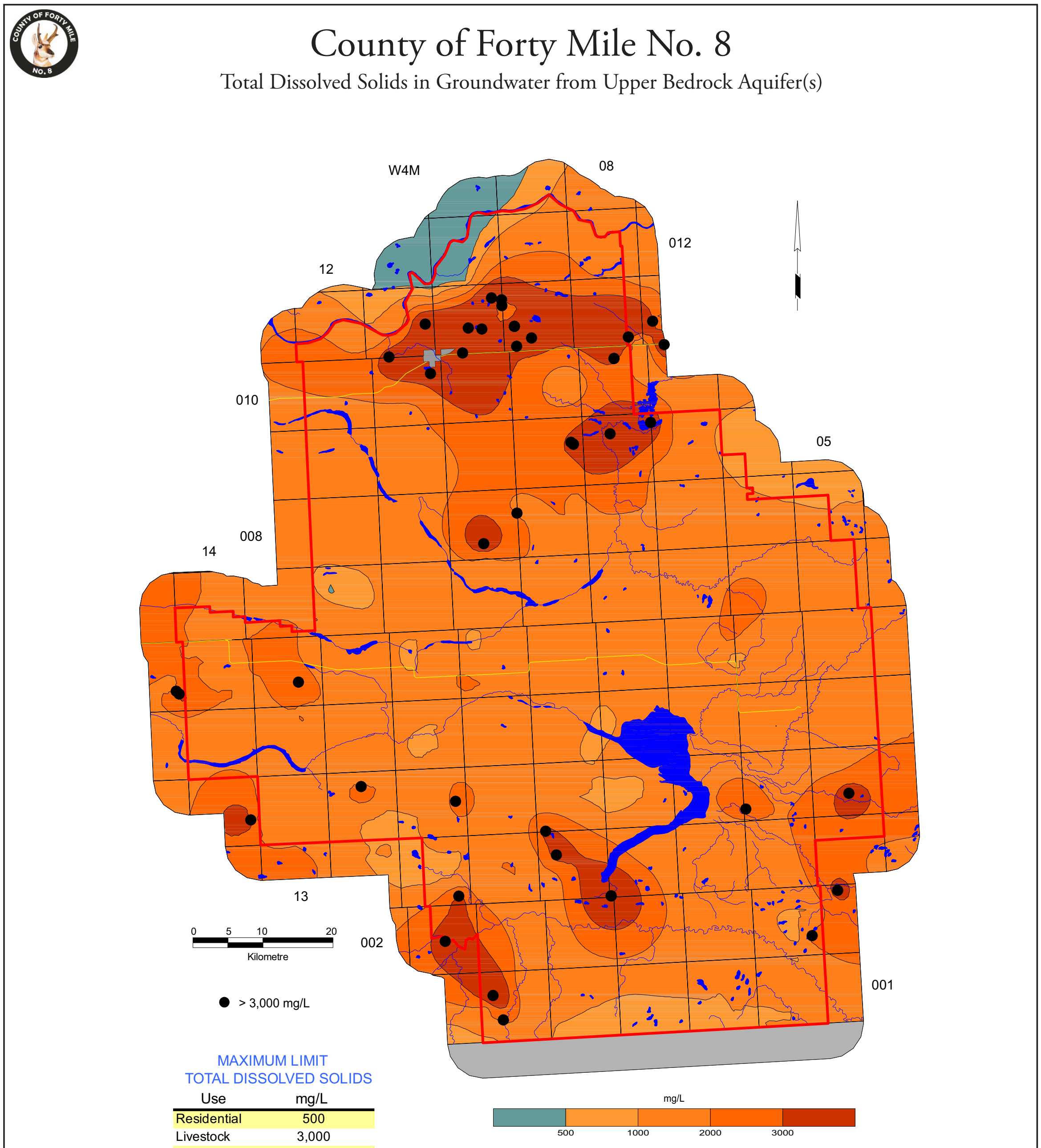
hydrogeological consultants ltd (HCL), edmonton, alberta - 1.800.661.7972 - project no. 03-215 — www.hcl.ca

hydrogeological consultants ltd.

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)



Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

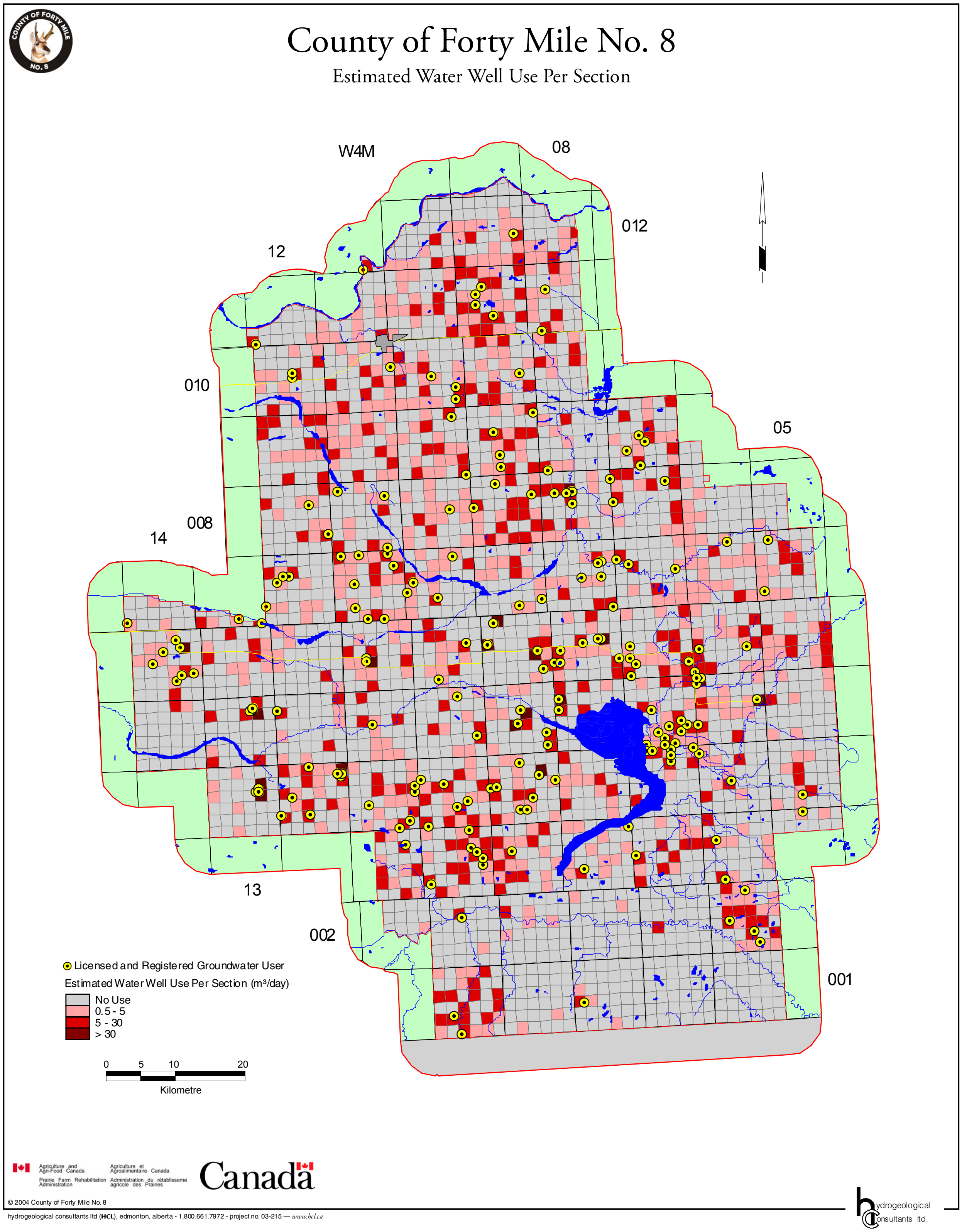


MAXIMUM LIMIT
TOTAL DISSOLVED SOLIDS

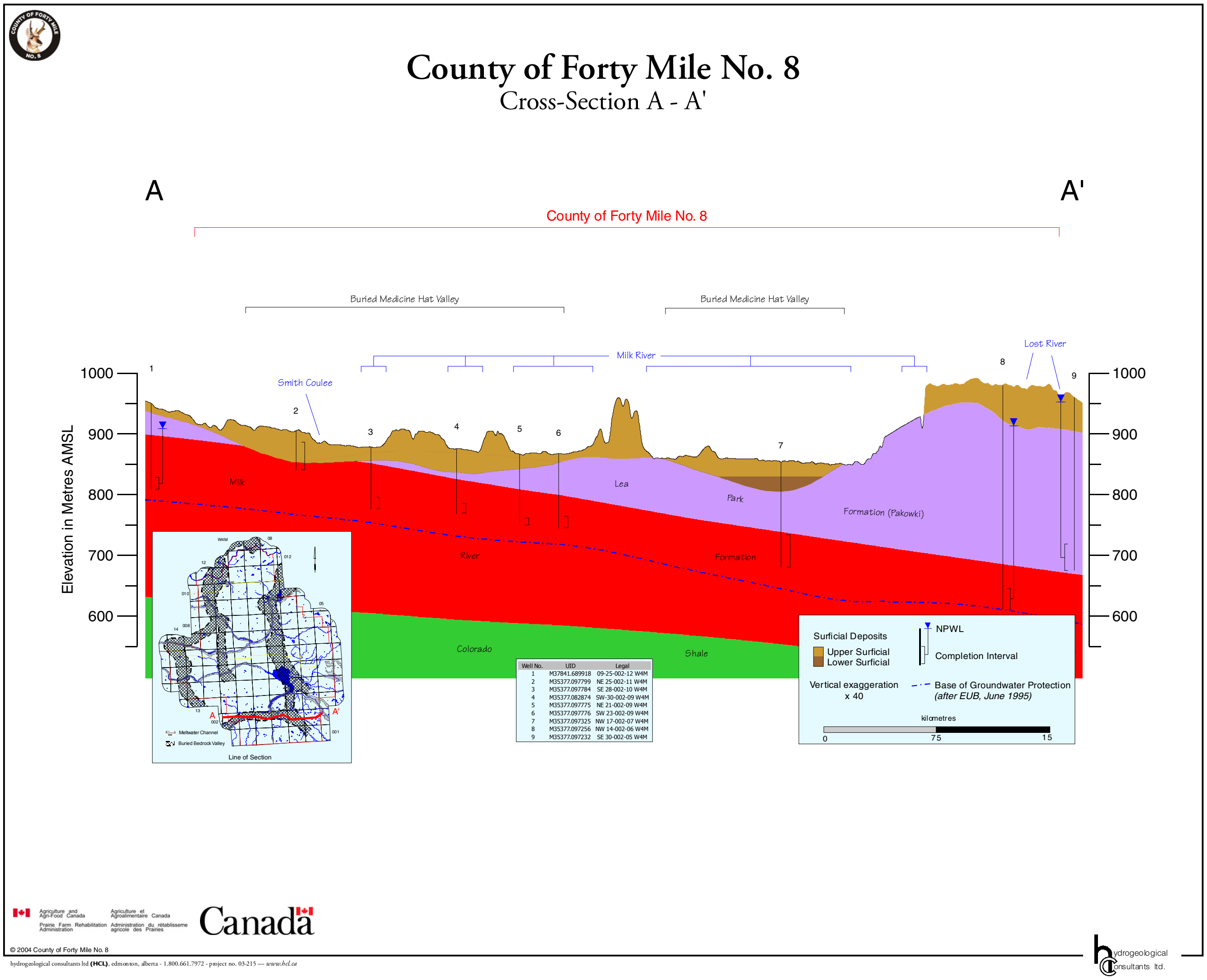
Use	mg/L
Residential	500
Livestock	3,000
Irrigation	500 - 3,500
Commercial	Depends on Purpose
Industrial	Depends on Purpose

from: Canadian Water Quality Guidelines, 1992

Estimated Water Well Use Per Section

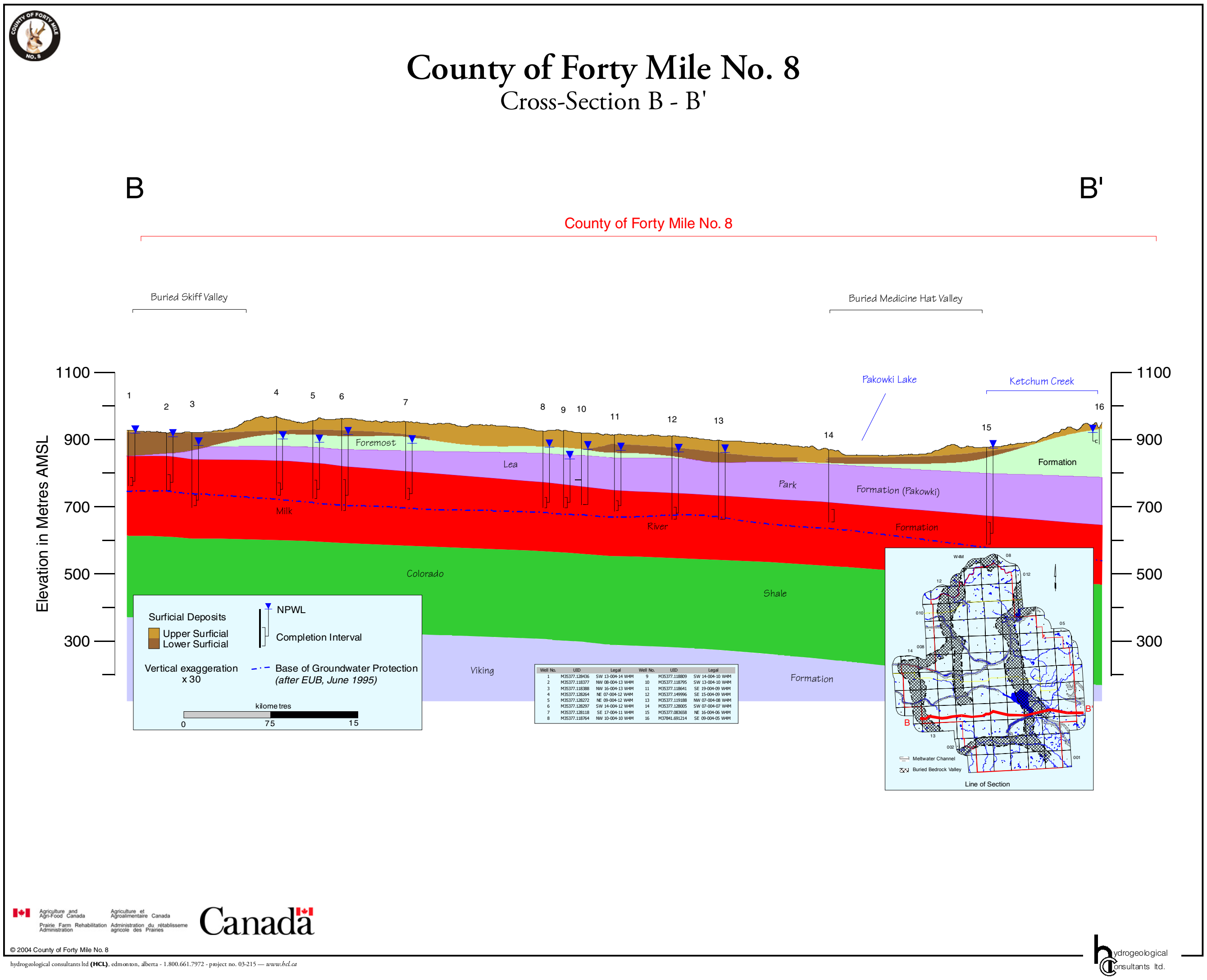


Cross-Section A - A'

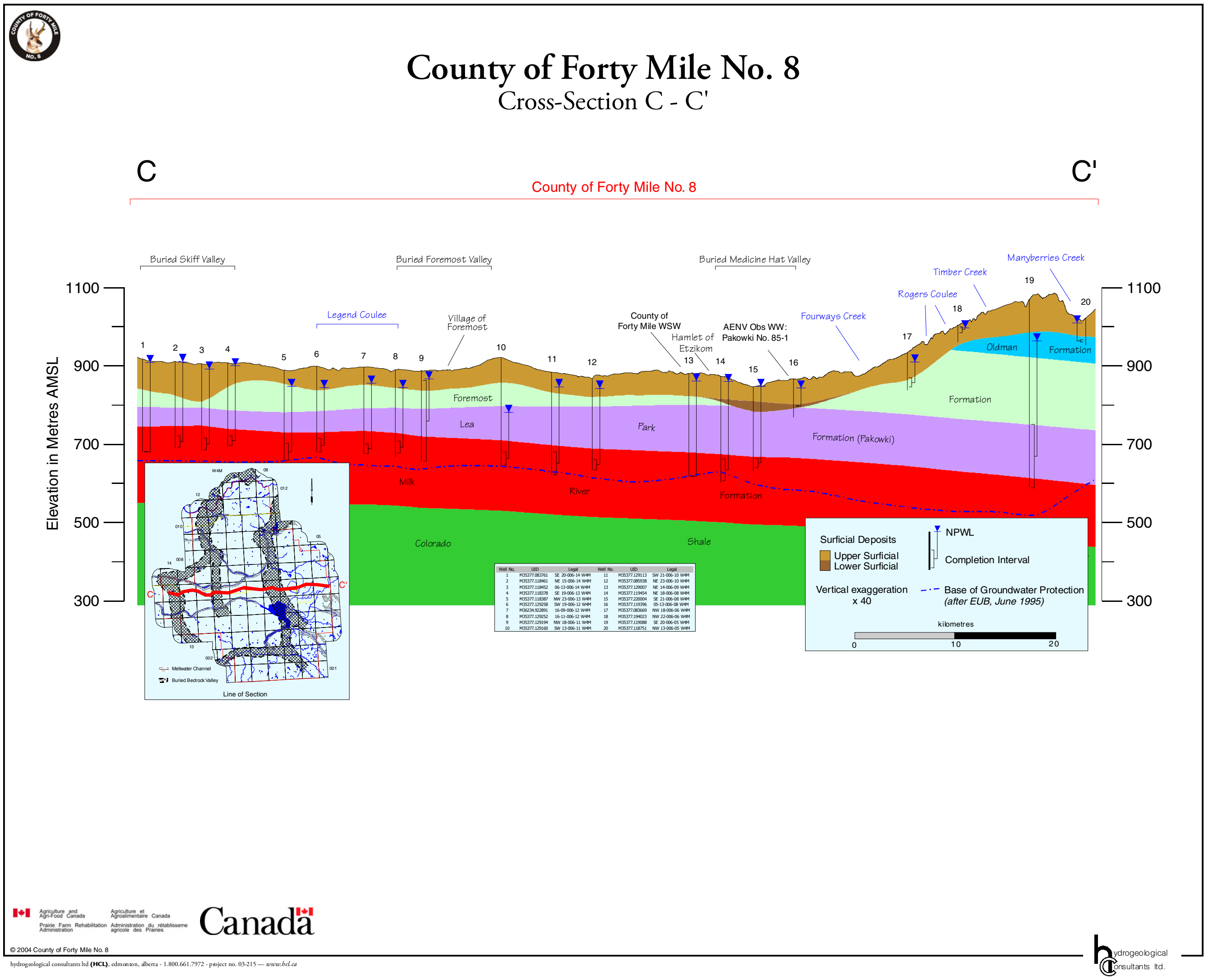


Well No.	UID	Legal
1	M37841.689918	09-25-002-12 W4M
2	M35377.097799	NE 25-002-11 W4M
3	M35377.097784	SE 28-002-10 W4M
4	M35377.082874	SW-30-002-09 W4M
5	M35377.097775	NE 21-002-09 W4M
6	M35377.097776	SW 23-002-09 W4M
7	M35377.097325	NW 17-002-07 W4M
8	M35377.097256	NW 14-002-06 W4M
9	M35377.097232	SE 30-002-05 W4M

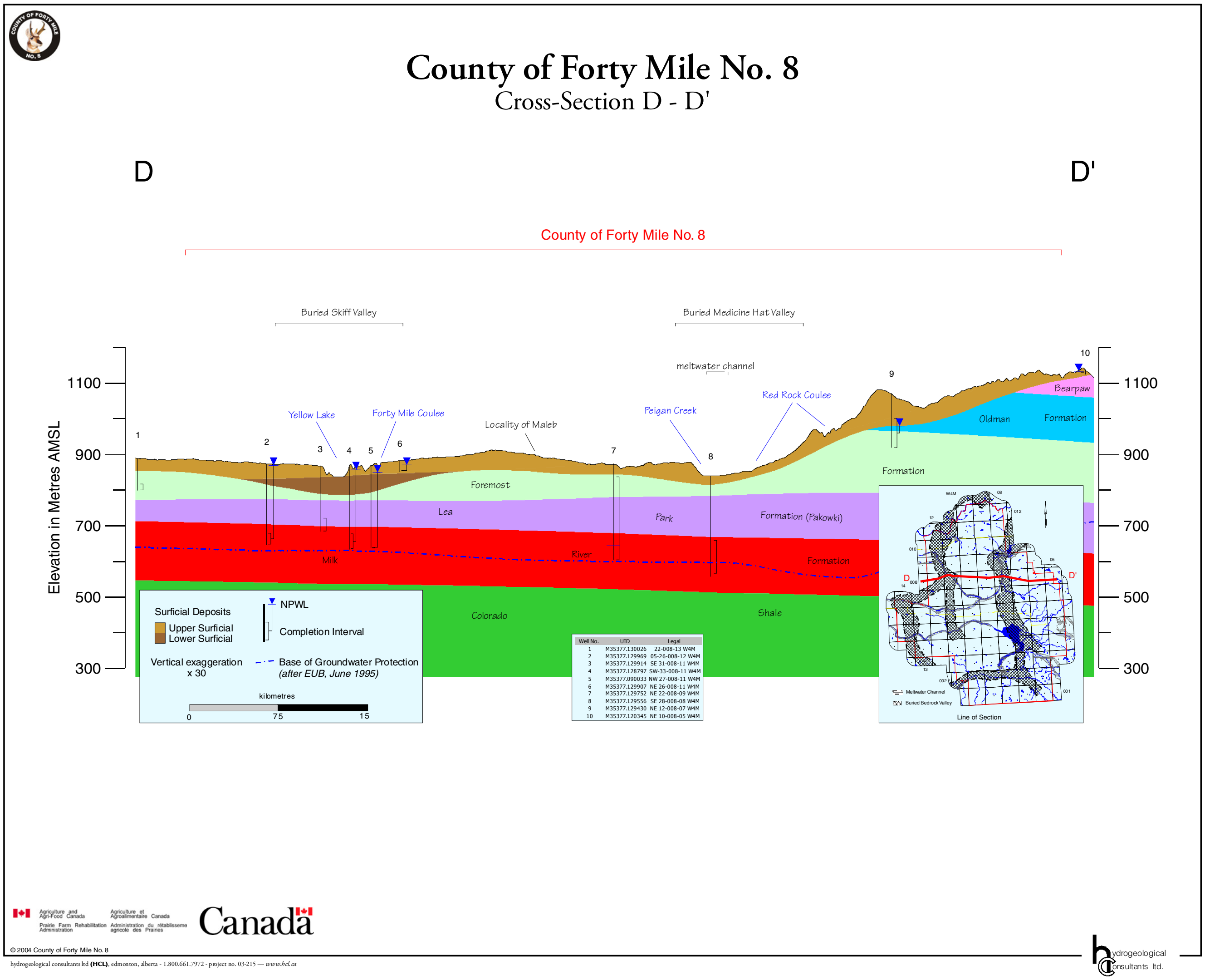
Cross-Section B - B'



Cross-Section C - C'

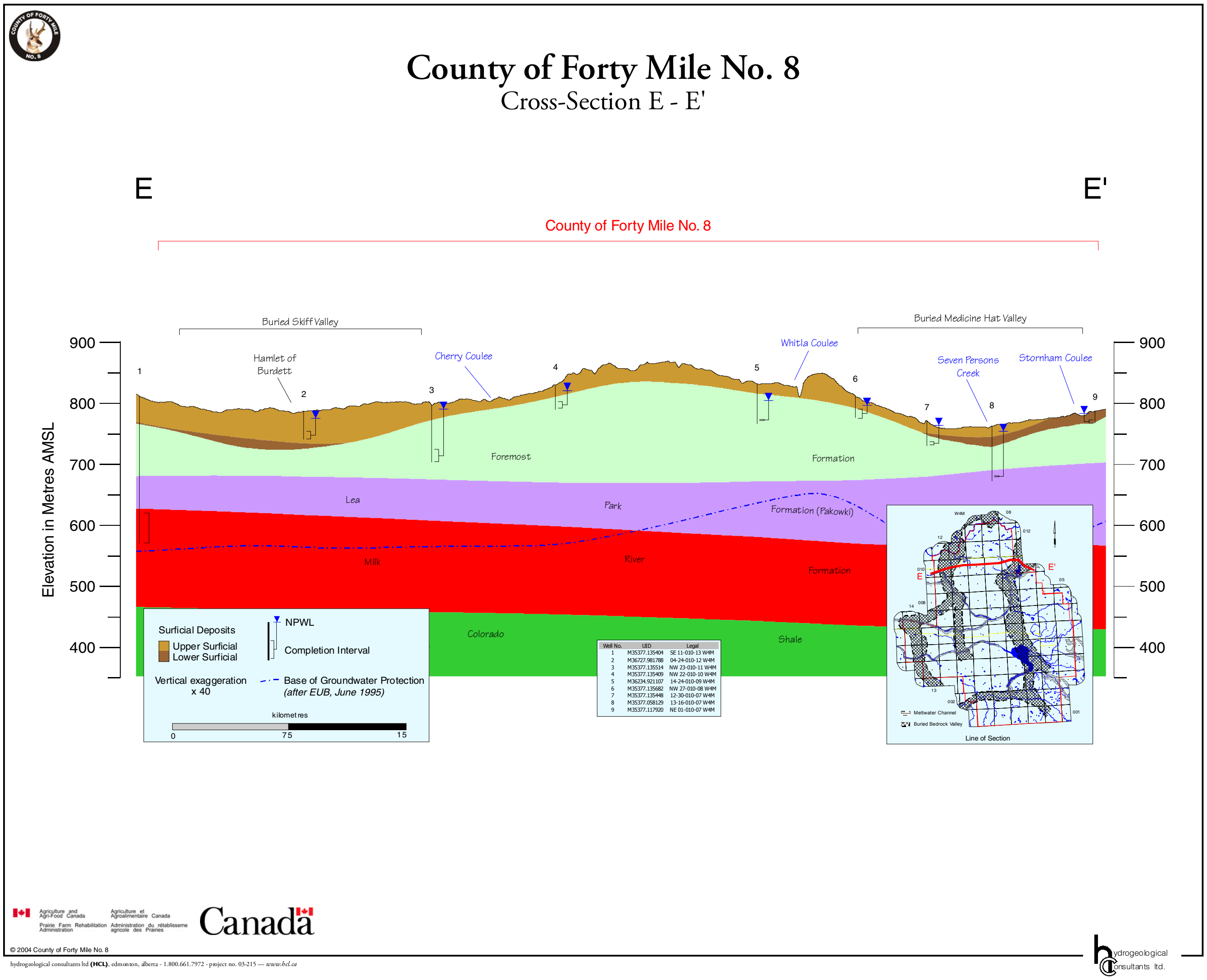


Cross-Section D - D’

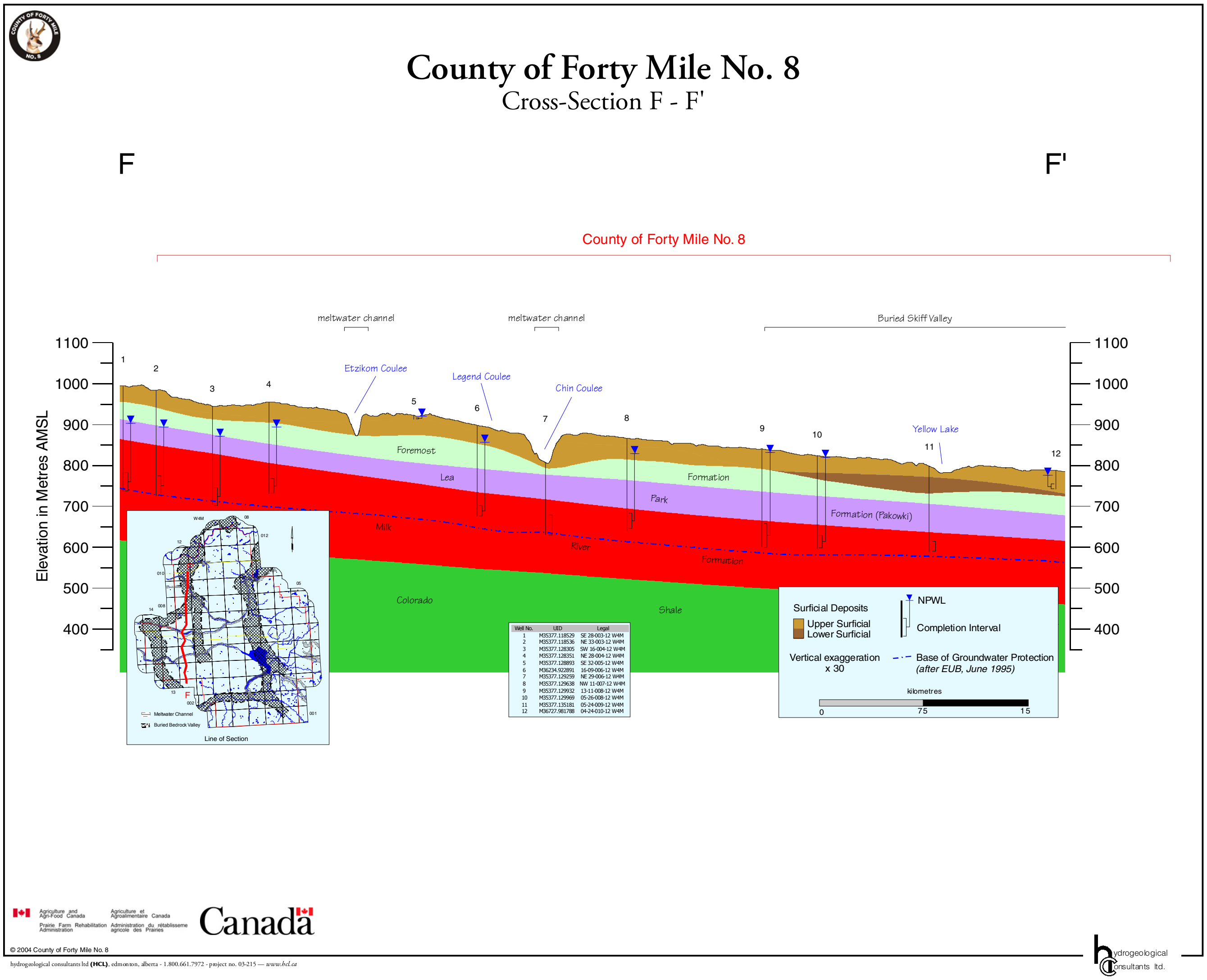


Well No.	UID	Legal
1	M35377.130026	22-008-13 W4M
2	M35377.129969	05-26-008-12 W4M
3	M35377.129914	SE 31-008-11 W4M
4	M35377.128797	SW-33-008-11 W4M
5	M35377.090033	NW 27-008-11 W4M
6	M35377.129907	NE 26-008-11 W4M
7	M35377.129752	NE 22-008-09 W4M
8	M35377.129556	SE 28-008-08 W4M
9	M35377.129430	NE 12-008-07 W4M
10	M35377.120345	NE 10-008-05 W4M

Cross-Section E - E'

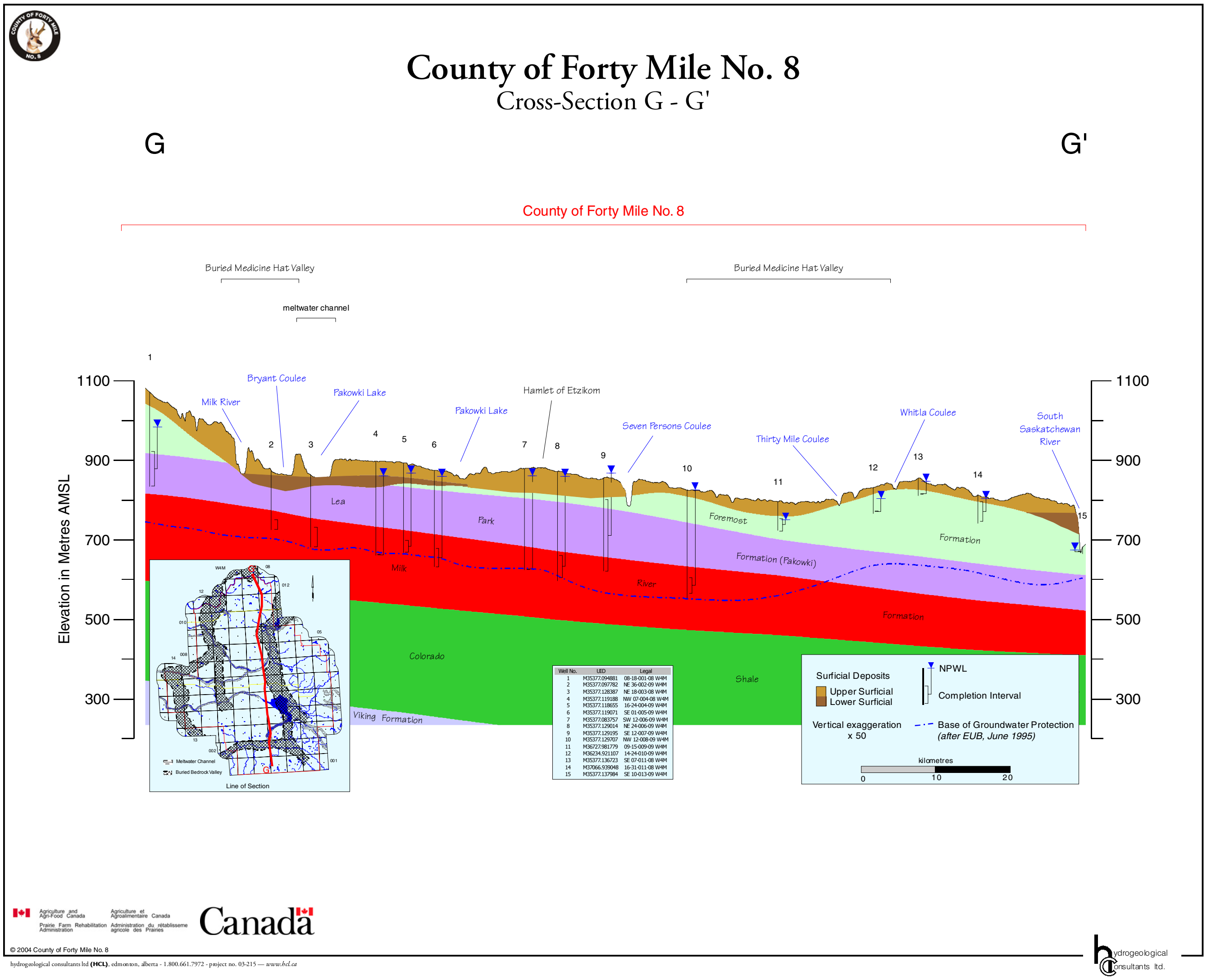


Cross-Section F - F'

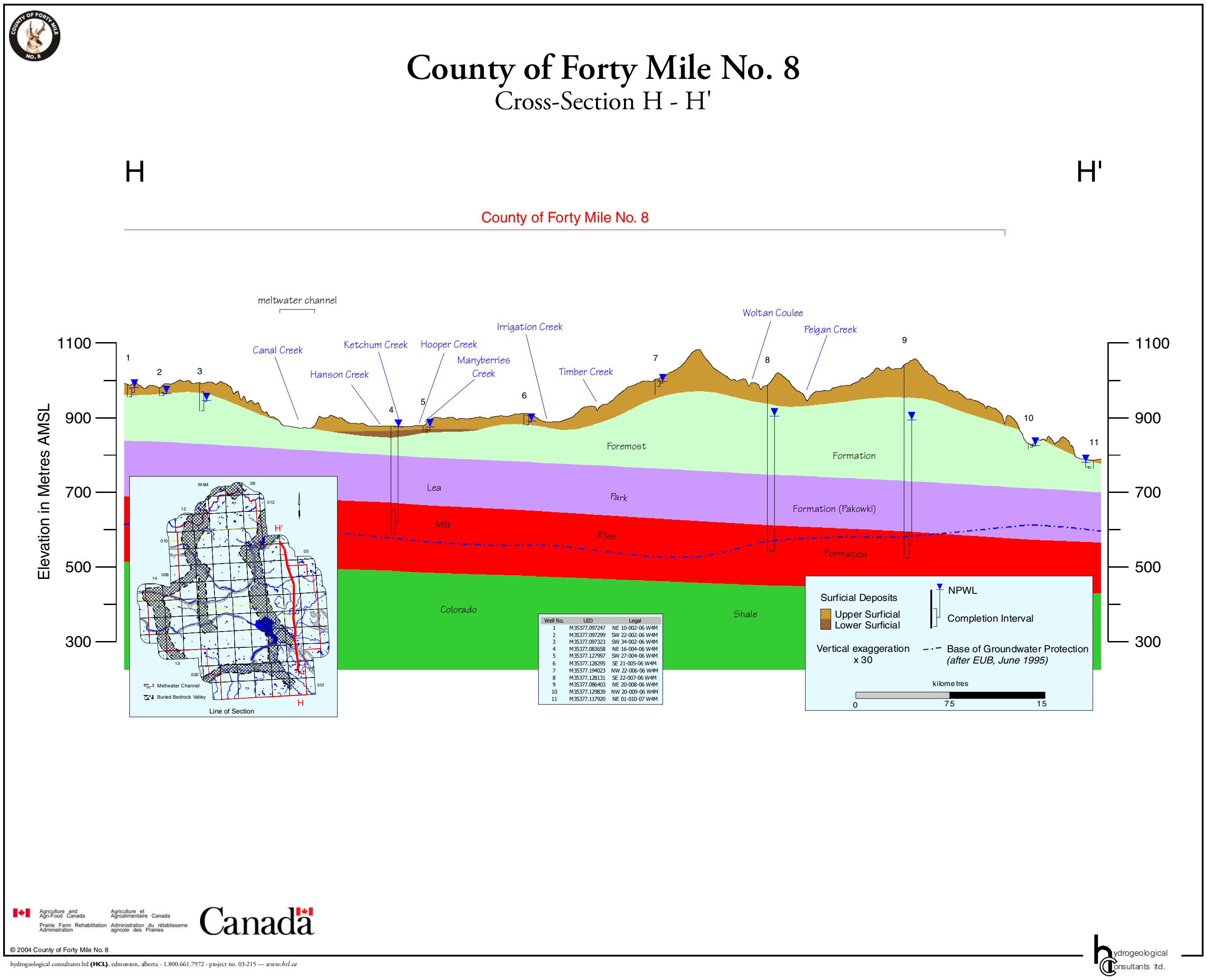


Well No.	UID	Legal
1	M35377.118529	SE 28-003-12 W4M
2	M35377.118536	NE 33-003-12 W4M
3	M35377.128305	SW 16-004-12 W4M
4	M35377.128351	NE 28-004-12 W4M
5	M35377.128893	SE 32-005-12 W4M
6	M36234.922891	16-09-006-12 W4M
7	M35377.129259	NE 29-006-12 W4M
8	M35377.129638	NW 11-007-12 W4M
9	M35377.129932	13-11-008-12 W4M
10	M35377.129969	05-26-008-12 W4M
11	M35377.135181	05-24-009-12 W4M
12	M36727.981788	04-24-010-12 W4M

Cross-Section G - G'



Cross-Section H - H'



Well No.	UID	Legal
1	M35377.097247	NE 10-002-06 W4M
2	M35377.097299	SW 22-002-06 W4M
3	M35377.097323	SW 34-002-06 W4M
4	M35377.083658	NE 16-004-06 W4M
5	M35377.127997	SW 27-004-06 W4M
6	M35377.128295	SE 21-005-06 W4M
7	M35377.194023	NW 22-006-06 W4M
8	M35377.128131	SE 22-007-06 W4M
9	M35377.086403	NE 20-008-06 W4M
10	M35377.129839	NW 20-009-06 W4M
11	M35377.117920	NE 01-010-07 W4M

COUNTY OF FORTY MILE NO. 8

Appendix E

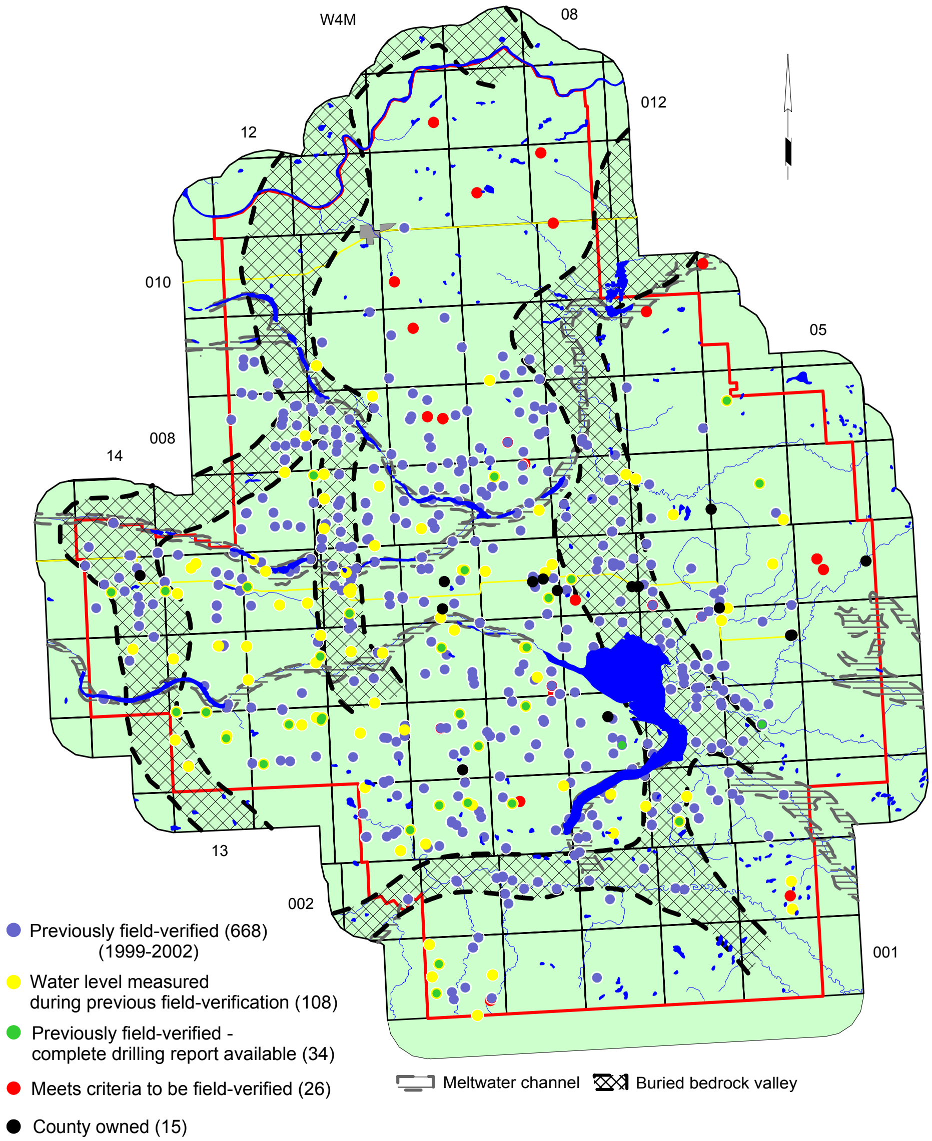
Water Wells That Have been Field-Verified
and Water Wells That Are Recommended for Field-Verification

including

County-Operated Water Wells

Water Wells That Have Been Field-Verified and Water Wells That Are Recommended For Field-Verification

(details on following pages)



WATER WELLS THAT HAVE BEEN FIELD-VERIFIED

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Acehoida, Kon	NE 03-006-14 W4M	Milk River	31-Mar-89	249.9	820.0	12.2	40.0	10-Jun-99	M35377.118436
Aden School Divison	···16-001-10 W4M	Milk River	09-May-40	115.8	380.0	18.3	60.0	13-Aug-01	M35377.094985
Alberta Environment	12-26-006-14 W4M	Milk River	18-Jan-85	213.4	700.0	2.3	7.5	24-Jun-99	M35377.118490
Alberta Environment	16-17-006-11 W4M	Milk River		216.4	710.0	57.9	190.0	03-Dec-00	M35377.127957
Als Farms Ltd.	SE 08-007-11 W4M	Milk River	25-Jan-90	234.7	770.0	24.4	80.0	03-Jun-99	M35377.083451
Anderson, Roy	SW 30-007-06 W4M	Milk River						07-May-01	M38022.504596
Ashley	NE 09-005-09 W4M	Milk River		213.4	700.0			30-Jul-99	M35377.119097
Ayers, Gordon L.	SE 26-003-07 W4M	Milk River	01-Jan-53	182.9	600.0	0.0	0.1	17-May-01	M35377.128418
Bailey, Carson, H.	02-06-005-13 W4M	Milk River	01-Jan-43	175.9	577.0	1.5	5.0	02-Jun-99	M35377.118418
Bailie, Carson	SW 06-005-13 W4M	Milk River	27-Mar-90	179.8	590.0	2.1	7.0	02-Jun-99	M35377.082849
Bailie, Dick	SE 34-006-14 W4M	Milk River		243.8	800.0			21-Jun-99	M35377.118509
Bailie, Laura	08-21-006-14 W4M	Milk River	01-Jan-43	216.7	711.0			21-Jun-99	M35377.118471
Baker, Claude	NH 06-007-11 W4M	Bedrock	09-Oct-54	237.7	780.0			16-Jul-99	M35377.129456
Ball, Adrianna	SW 03-007-15 W4M	Milk River						03-Jun-99	M35377.129668
Barrows, T.	SW 15-007-10 W4M	Milk River		202.7	665.0			09-Aug-99	M35377.129323
Beaver Oils Ltd.	08-24-002-11 W4M	Milk River		214.3	703.0			29-Dec-00	M35377.114348
Bechthold, A.	SE 22-007-11 W4M	Milk River	25-Nov-89	222.5	730.0	14.6	48.0	04-Aug-99	M35377.084193
Beisterfeldt, L.	SE 11-005-07 W4M	Milk River		218.5	717.0			13-Jun-01	M35377.118676
Bennett, E. C.	NW 03-005-07 W4M	Milk River		204.2	670.0	-6.1	-20.0	11-Jun-01	M35377.118633
Bennett, Ed. C.	NW 03-005-07 W4M	Milk River	14-May-49	237.7	780.0			11-Jun-01	M35377.118618
Bennett, Foster	SW 03-005-07 W4M	Milk River	20-May-49	225.5	740.0			13-Jun-01	M35377.118619
Bianchi, Nick	SW 19-001-10 W4M	Milk River	26-Sep-58	170.7	560.0	57.9	190.0	23-Apr-01	M35377.094997
Biesterfeldt, Terry	SE 11-005-07 W4M	Milk River	12-Aug-50	278.3	913.0			13-Jun-01	M35377.118669
Black, Barry	NE 10-003-10 W4M	Milk River		176.8	580.0			09-Sep-99	M35377.092617
Black, Sid	15-10-003-10 W4M	Milk River	01-Jan-61	152.4	500.0			09-Sep-99	M35377.128540
Bodnaruk, Betty	NE 18-006-08 W4M	Milk River	10-Jun-88	267.0	876.0	12.8	42.0	11-May-01	M35377.119454
Borden's	SE 16-008-10 W4M	[unknown]						10-Aug-99	M38022.504471
Britner Farms	15-33-004-12 W4M	Milk River	01-Jan-60	262.1	860.0	33.5	110.0	27-May-99	M35377.128360
Brustead, J.	NE 20-008-10 W4M	Milk River	01-Jan-20	274.3	900.0			10-Aug-99	M35377.129827
Brustead, M. O.	NE 20-008-10 W4M	Milk River		237.7	780.0			10-Aug-99	M35377.129828
Bullis, Herb	SE 36-005-12 W4M	Milk River						25-May-99	M38022.504410
Burbridge Farms Ltd.	SW 17-009-12 W4M	Upper Surficial						30-May-01	M35377.135061
C. M. C. Black Butte	08-18-001-08 W4M	Bedrock	30-Apr-60	236.2	775.0	87.5	287.0	25-Jun-01	M35377.094881
Campbell, D. M.	NW 01-007-08 W4M	Milk River	01-Jan-31	225.5	740.0	-2.4	-8.0	06-Jun-01	M35377.129064
Canada Customs/ Lamont Billingsly	02-03-001-10 W4M	Milk River	01-Nov-63	175.3	575.0	105.2	345.0	16-May-01	M35377.094900
Canada Montana Gas Company	NW 08-004-06 W4M	[unknown]						25-Jun-01	M38022.504633
Canada Montana Gas Company	NE 12-004-07 W4M	[unknown]						25-Jun-01	M38022.504634
Canadian Gulf Oil Company	13-19-008-08 W4M	Milk River	25-Nov-54	238.7	783.0			23-May-01	M35377.129541
Canadian Montana Gas Company Ltd.	NE 08-003-08 W4M	Milk River	04-Jul-51	245.1	804.0	35.7	117.2	30-Sep-00	M35377.087553
Canadian Natural Gas Company	NE 29-008-11 W4M	Milk River	01-Jan-26	192.0	630.0			04-Aug-99	M35377.129910
Carlson, T.	SE 09-008-09 W4M	Bedrock	01-Jan-35	281.9	925.0	-6.1	-20.0	25-May-01	M35377.129689
Chesney, Matt & Boyd	EH 27-007-09 W4M	Milk River	27-Dec-53	281.9	925.0			21-Sep-99	M35377.129291
Chin Valley Ranch Ltd.	NW 21-006-11 W4M	Milk River	20-Dec-81	155.4	510.0	14.0	46.0	21-May-99	M35377.129225
Chin Valley Ranch Ltd.	SE 19-006-11 W4M	Milk River	07-Jul-86	227.4	746.0	74.7	245.0	21-May-99	M35377.129201
Collin, Stewart	NE 33-004-12 W4M	Milk River	07-Jan-89	222.5	730.0	73.5	241.0	27-May-99	M35377.128367
Collin, Vincent	SW 14-006-14 W4M	Milk River	01-Jan-29	228.6	750.0	15.2	50.0	23-Jun-99	M35377.118453
Collins, John	SW 14-006-14 W4M	Milk River		249.9	820.0	7.8	25.5	23-Jun-99	M35377.118455
Collins, Loren	SW 14-006-14 W4M	Milk River	12-Jul-91	231.3	759.0	16.8	55.0	23-Jun-99	M35377.124485
Collins, Marvin	SE 21-006-08 W4M	Milk River	18-Mar-95	207.3	680.0	0.0	-0.1	14-Sep-99	M35377.220004
Conquergood, T. H.	SH 27-007-10 W4M	Milk River	01-Jan-44	223.7	734.0			11-Jun-01	M35377.129373
Conquerville School	NE 24-008-10 W4M	Milk River		243.8	800.0	7.6	25.0	03-Dec-00	M35377.129849
Conrade, Howard	SW 08-005-14 W4M	Milk River						30-Jun-99	M38022.504448
Cooke, J.	SE 17-007-11 W4M	Milk River	01-Jan-29	195.1	640.0	-0.6	-2.0	04-Aug-99	M35377.129497
County of Forty Mile	05-24-005-06 W4M	Milk River	01-Mar-73	335.3	1100.0	304.8	1000.0	28-May-01	M35377.128310
County of Forty Mile	NW 24-005-06 W4M	Milk River		304.8	1000.0			28-May-01	M35377.128330
County of Forty Mile	NE 14-006-09 W4M	Milk River	20-Sep-84	263.6	865.0	19.8	65.0	14-Sep-99	M35377.129007
County of Forty Mile	16-03-004-10 W4M	Milk River	01-Jul-67	225.5	740.0	38.1	125.0	16-Aug-01	M35377.118732
County of Forty Mile	SW 27-005-14 W4M	Milk River	07-Mar-00	243.8	800.0			25-Jun-99	M37066.938717
Courtney, Ralph	NW 23-006-09 W4M	Bedrock	11-May-50	256.3	841.0			18-Sep-99	M35377.129008
Courtney, Ralph	NE 18-006-08 W4M	Milk River						11-May-01	M38022.504629
Coverdale, Charles Claude	04-21-006-11 W4M	Milk River	01-Oct-72	213.4	700.0	61.0	200.0	21-May-99	M35377.129222
Coverdale, Todd	NW 08-004-13 W4M	Milk River	14-Jan-89	170.7	560.0			12-Jul-99	M35377.118377
Cowie, Bruce	SW 28-006-10 W4M	Milk River	17-Nov-89	224.3	736.0	18.3	60.0	07-Jun-99	M35377.129123
Cowie, Jack	10-08-006-10 W4M	Milk River	01-Jan-63	266.7	875.0	64.0	210.0	22-Jul-99	M35377.129098
Cowie, W.	NE 08-006-10 W4M	Milk River	01-Jan-23	274.3	900.0	30.5	100.0	22-Jul-99	M35377.129100
Craft, F. J.	NH 20-007-07 W4M	Bedrock	01-Jan-32	243.8	800.0	-3.1	-10.0	03-May-01	M35377.129048
Cunningham, Stan	SW 27-006-08 W4M	Milk River		240.8	790.0			14-Sep-99	M35377.119513
D'Agnone, Domenico	16-06-007-14 W4M	Milk River	11-Jul-50	229.8	754.0	6.1	20.0	02-May-00	M35377.118569
Dangerfield Farming & Ranching	NE 08-001-10 W4M	Milk River	24-Oct-75	182.9	600.0	37.5	123.0	16-May-01	M35377.094910
Dann, S. H.	···14-005-07 W4M	Milk River	10-Nov-49	295.6	970.0			13-Jun-01	M35377.118781

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Davis	SE 26-007-08 W4M	Milk River		222.5	730.0	-6.1	-20.0	04-May-01	M35377.129147
Davis, Sidney	SW 02-007-08 W4M	Milk River	01-Mar-90	290.2	952.0			08-May-01	M35377.082850
Department of Forestry	NW 17-002-07 W4M	Milk River	09-Dec-88	172.2	565.0			01-Jun-01	M35377.097325
Dillenbeck, Cecil	08-17-007-11 W4M	Milk River	24-May-72	222.5	730.0	8.2	27.0	04-Aug-99	M35377.129498
Dixon, H.	NW 05-003-10 W4M	Milk River	01-Jan-33	151.2	496.0	17.4	57.0	23-Sep-99	M35377.128443
Dixon, Ralph Lee	16-05-003-10 W4M	Milk River	20-Dec-65	156.4	513.0	4.6	15.0	23-Sep-99	M35377.128449
Dixson, Eldon	NW 10-004-10 W4M	Milk River	13-May-89	228.6	750.0	48.8	160.0	14-Sep-99	M35377.118764
Dlm Farms Ltd.	SW 12-005-10 W4M	Milk River	10-Apr-89	228.6	750.0	54.9	180.0	30-Jul-99	M35377.119220
Douglas, Gerald	SE 10-006-10 W4M	Milk River						30-Aug-99	M38022.504478
Dyck, John/ Pinhorn Reserve	NE 17-002-07 W4M	Milk River	01-Jan-25	167.6	550.0	-7.6	-25.0	01-Jun-01	M35377.097326
Egan, Hugh	NE 13-009-10 W4M	Milk River						31-Aug-99	M38022.504479
Ehnes, Bernie	SE 15-004-09 W4M	Milk River	10-Jan-90	246.9	810.0	45.7	150.0	18-Aug-99	M35377.149996
Ehnes, C.	SE 15-004-09 W4M	Milk River	01-Jan-29	244.7	803.0	3.1	10.0	18-Aug-99	M35377.118598
Elford, Dave	NE 07-008-11 W4M	Milk River		187.4	615.0	-0.6	-2.0	20-Jun-01	M35377.129894
Erdman, A.	SE 10-005-09 W4M	Milk River	01-Jan-34	217.0	712.0	12.2	40.0	30-Jul-99	M35377.119102
Erdman, Art	SE 10-005-09 W4M	Bedrock	17-May-51	256.0	840.0			30-Jul-99	M35377.119108
Erikson, A.	SE 01-008-10 W4M	Milk River	01-Jan-20	228.6	750.0			31-Aug-99	M35377.129789
Felatoff, N.	SE 15-006-13 W4M	Milk River		213.4	700.0	18.3	60.0	24-Jun-99	M35377.118358
Fiitterer, Alex	04-19-004-09 W4M	Milk River	27-Oct-70	222.5	730.0	33.5	110.0	09-Sep-99	M35377.118637
Filatoff, Dan	01-26-006-13 W4M	Milk River		229.5	753.0	48.8	160.0	20-Jun-02	M35377.118400
Filatoff, N.	SW 33-006-13 W4M	Milk River	01-Jan-26	214.0	702.0			14-Jun-99	M35377.118419
Finstad Ranching	07-15-003-07 W4M	Milk River	22-Sep-83	233.2	765.0	29.0	95.0	03-Sep-00	M35377.128325
Finstad, Henry	13-07-003-07 W4M	Milk River	06-Jun-49	220.1	722.0			03-Sep-00	M35377.128290
Finstad, Henry	SW 10-003-08 W4M	Milk River						03-Sep-00	M38022.504535
Finstad, John	SE 15-003-07 W4M	Milk River						03-Sep-00	M38022.504532
Finstad, L.	02-15-003-07 W4M	Milk River		231.6	760.0	-0.9	-3.0	03-Sep-00	M35377.128322
Finstad, Leonard W.	13-07-003-07 W4M	Milk River	21-Apr-98	198.1	650.0	192.0	630.0	03-Sep-00	M35377.128283
Finstad, O. & H.	NW 15-003-07 W4M	Milk River						03-Sep-00	M38022.504533
Fischer, Carl	SW 30-007-07 W4M	Milk River						07-May-01	M38022.504595
Flickinger, E. P.	12-31-006-14 W4M	Milk River	01-Jan-38	228.9	751.0	12.2	40.0	22-Jun-99	M35377.118501
Fonte, J. C.	NW 05-009-08 W4M	Milk River	01-Jan-30	257.9	846.0	-0.9	-3.0	16-May-01	M35377.129971
Foremost School Division	NW 24-008-10 W4M	Bedrock	14-Sep-51	266.1	873.0			13-Aug-99	M35377.129841
Foremost Stirling East Branch	···20-006-11 W4M	Milk River		231.6	760.0			20-May-99	M35377.129221
Foremost Water & Light Company	NW 16-006-11 W4M	Milk River	01-May-18	197.2	647.0	-4.9	-16.0	26-May-99	M35377.129169
Forty Miles, County	11-24-005-06 W4M	Milk River	01-Sep-98	298.1	978.0	44.6	146.2	28-May-01	M36727.981863
Foss, Earl	NE 07-004-12 W4M	Milk River	15-Sep-88	234.7	770.0			01-Jun-99	M35377.128264
Foster, H. H.	···09-008-08 W4M	Milk River		204.2	670.0	-6.1	-20.0	05-Jun-01	M35377.129535
Frankish Farms Ltd	01-08-006-11 W4M	Milk River	15-Apr-66	219.5	720.0	45.7	150.0	28-May-99	M35377.129149
Frankish Farms Ltd.	NE 05-006-11 W4M	Milk River	07-Mar-90	222.8	731.0	61.0	200.0	28-May-99	M35377.083759
Fred Wutzke Farms	NE 15-006-14 W4M	Milk River	05-Jul-82	218.8	718.0	0.6	2.0	25-Jun-99	M35377.118461
Freinberg, F.	SE 01-008-09 W4M	Milk River	01-Jan-34	227.1	745.0	-6.1	-20.0	06-Jun-01	M35377.129577
Friedenberg, K.	SE 06-008-09 W4M	Milk River						11-Sep-99	M38022.504481
Friedenberg, R.A.	SW 20-007-09 W4M	Milk River		295.6	970.0			03-Dec-00	M35377.129223
Fritzker, Richard	10-18-007-09 W4M	Milk River		182.9	600.0	-0.6	-2.0	19-Dec-00	M35377.129212
Fritzler, Richard	12-20-007-09 W4M	Milk River		274.3	900.0	18.3	60.0	03-Dec-00	M35377.129228
Gaetz, George	SW 14-004-10 W4M	Milk River	20-May-89	228.6	750.0	48.8	160.0	02-Sep-99	M35377.118809
Gajdostik Farms	01-28-005-10 W4M	Milk River	19-Sep-00	243.8	800.0	19.0	62.5	04-May-00	M35377.119274
Garber, Frank	NE 10-005-11 W4M	Milk River	30-May-81	196.6	645.0	44.2	145.0	20-May-99	M35377.128799
Garbor, Frank	NW 09-005-11 W4M	Milk River	25-Feb-90	222.5	730.0	39.0	128.0	20-May-99	M35377.083755
Gatz, Jacob	NE 26-008-11 W4M	Milk River						02-Sep-99	M38022.504480
Gaulan, Van	SW 24-008-12 W4M	Bedrock	05-Apr-50	235.6	773.0			14-Jun-01	M35377.129965
Gaydos, Mel	SW 06-005-12 W4M	Milk River	30-Apr-81	179.8	590.0	36.6	120.0	20-Jun-02	M35377.128832
Gazdug, Emrick	NH 21-003-07 W4M	Milk River	12-Jul-50	231.6	760.0			05-Jul-01	M35377.128404
Gegdos, Alan	SE 25-006-13 W4M	Milk River	23-Sep-48	229.2	752.0	21.3	70.0	02-Jun-99	M35377.118395
Gejdos, Bill	SE 05-007-13 W4M	Milk River						21-Jun-99	M38022.504440
Gejdos, Frank	SE 25-006-13 W4M	Milk River	12-May-89	223.1	732.0	54.9	180.0	02-Jun-99	M35377.118397
Gejdos, John	NE 07-004-12 W4M	Milk River						01-Jun-99	M38022.504413
Geldreich, Ronald	02-35-009-10 W4M	Milk River		213.4	700.0	-0.9	-3.0	22-Feb-01	M35377.130880
Gibson	NE 28-008-10 W4M	Lea Park						10-Aug-99	M38022.504470
Gjerlaug, Ola	NW 25-005-12 W4M	Milk River	29-Oct-88	207.3	680.0	36.6	120.0	19-May-99	M35377.128874
Gogolinski, Barney	NW 20-005-07 W4M	Milk River	23-Oct-87	214.9	705.0			17-May-01	M35377.118813
Gogolinski, Barney	SW 06-006-06 W4M	Milk River						17-May-01	M38022.504627
Gogolinski, Jim	SW 08-006-07 W4M	Milk River	22-May-84	245.4	805.0			15-May-01	M35377.119129
Gogolinski, Paul	SE 06-006-07 W4M	Milk River	22-Aug-88	268.2	880.0	-1.5	-5.0	15-May-01	M35377.119120
Gogolinski, Phil	SE 32-005-07 W4M	Milk River	28-Jun-85	211.5	694.0	-1.5	-5.0	17-May-01	M35377.118943
Gordon, Ruby	SE 03-007-11 W4M	Milk River	28-Nov-89	224.0	735.0	29.0	95.0	13-Aug-99	M35377.083673
Goundrey, J. I.	SW 34-005-09 W4M	Milk River	01-Jan-18	213.4	700.0	30.5	100.0	04-Jan-00	M35377.119182
Gracey, James	NE 03-005-06 W4M	Milk River						11-May-01	M38022.504626
Green / Johanson	SE 31-006-12 W4M	Milk River						19-May-99	M38022.504400
Greenberg, A.	NE 16-007-12 W4M	Milk River	06-Feb-01	106.7	350.0	7.5	24.6	03-Jun-99	M37490.029689

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Griffiths, George	NW 35-001-10 W4M	Milk River	22-Apr-88	169.5	556.0	3.7	12.0	13-Aug-01	M35377.095194
Griffiths, George	SE 34-001-10 W4M	Milk River	25-Jan-89	168.6	553.0	4.5	14.9	13-Aug-01	M35377.095188
Griffiths, George	02-34-001-10 W4M	Milk River	01-Apr-65	178.3	585.0	12.2	40.0	13-Aug-01	M35377.095191
Hall, P.	SE 28-002-10 W4M	Milk River						23-Aug-00	M38022.504525
Halvorson, Harold	SW 13-004-10 W4M	Milk River	28-Dec-84	214.0	702.0	48.8	160.0	30-Aug-99	M35377.118795
Halvorson, Selmer	NE 36-005-10 W4M	Milk River	21-Apr-51	213.4	700.0			19-Aug-99	M35377.119324
Hammel, Raphael	NW 02-008-09 W4M	Milk River		243.8	800.0			10-Jan-00	M35377.129591
Hammel, Theodosive	SE 01-009-09 W4M	Milk River	28-May-48	231.6	760.0			25-May-01	M35377.130022
Haraga, Arnold	04-06-007-13 W4M	Milk River	01-Jan-68	225.5	740.0			25-Jun-99	M35377.118522
Haraga, Arnold	SW 06-007-13 W4M	Milk River	01-Aug-78	231.6	760.0			25-Jun-99	M35377.118524
Haraga, John	06-13-006-14 W4M	Milk River	10-Dec-73	219.5	720.0	13.7	45.0	22-Jun-99	M35377.118452
Harms, E. F.	SW 02-005-07 W4M	Milk River		201.2	660.0			15-Jun-01	M35377.118609
Harms, E. P.	SW 01-005-07 W4M	Milk River	17-Aug-48	253.0	830.0			15-Jun-01	M35377.118603
Hartey, Ron	08-24-004-10 W4M	Milk River	01-Jan-71	222.5	730.0	36.6	120.0	09-Sep-99	M35377.118946
Harty, Alan	SW 26-003-10 W4M	Milk River	23-Mar-90	224.3	736.0	57.9	190.0	30-Aug-99	M35377.082877
Harty, Allan & Catherine	NE 11-003-09 W4M	Milk River	04-Dec-84	192.0	630.0			25-Jun-01	M35377.118724
Harty, Anton	NE 23-003-10 W4M	[unknown]						22-Aug-00	M38022.504519
Harty, Anton	NE 23-003-10 W4M	Milk River						22-Aug-00	M38022.504518
Harty, C.	13-23-003-10 W4M	Milk River	25-Oct-68	219.5	720.0	54.9	180.0	11-Jun-01	M35377.128597
Harty, Catherine	16-28-003-10 W4M	Milk River	01-Apr-72	228.6	750.0	47.6	156.0	03-Aug-99	M35377.128584
Harty, Frank	NE 16-003-10 W4M	Milk River	17-Mar-90	188.4	618.0	47.6	156.0	10-Aug-00	M35377.082876
Harty, Frank N.	NE 16-003-10 W4M	Milk River	05-Nov-81	187.4	615.0	32.0	105.0	10-Aug-00	M35377.128579
Harty, George	NE 24-006-09 W4M	Milk River	07-Sep-48	240.8	790.0			31-Aug-99	M35377.129013
Harty, Gordon	SW 28-003-10 W4M	Milk River	30-Mar-90	218.8	718.0	59.4	195.0	03-Aug-99	M35377.082878
Harty, Joe	SW 08-003-08 W4M	Milk River	29-Oct-85	152.4	500.0			03-Sep-00	M35377.118599
Harty, Joe	NW 06-003-09 W4M	Milk River	09-Oct-85	173.7	570.0	16.8	55.0	02-Sep-00	M35377.118693
Harty, Joe Jr.	SW 21-005-08 W4M	Milk River	22-Mar-90	231.6	760.0	-1.5	-5.0	03-Sep-00	M35377.083754
Harty, Joe Jr.	NE 18-003-08 W4M	Milk River	29-Jan-89	179.2	588.0			03-Sep-00	M35377.128387
Harty, John M.	SW 26-004-10 W4M	Milk River		256.0	840.0	225.5	740.0	07-Sep-99	M35377.119012
Harty, Kelly	SE 10-005-09 W4M	Milk River	03-Nov-89	249.9	820.0	25.9	85.0	30-Jul-99	M35377.086638
Harty, Marten	NW 35-003-10 W4M	Milk River	19-Sep-85	222.5	730.0	36.6	120.0	30-Aug-99	M35377.128666
Harty, Math	SW 15-003-10 W4M	Milk River	12-Mar-82	169.8	557.0	32.0	105.0	02-Aug-00	M35377.128549
Harty, Mike	04-26-004-10 W4M	Milk River	14-Jul-76	225.5	740.0	30.5	100.0	07-Sep-99	M35377.119034
Harty, Richard	SE 01-005-09 W4M	Milk River	08-Nov-89	242.3	795.0	15.2	50.0	30-Jul-99	M35377.119071
Harty, Richard J.	NW 01-005-09 W4M	Milk River	01-Jan-77	243.8	800.0			30-Jul-99	M35377.119077
Harty, Robert	SE 34-005-10 W4M	Milk River	25-Nov-69	262.1	860.0	76.2	250.0	03-Jun-02	M35377.095359
Harty, Ron	NE 13-006-09 W4M	Milk River	22-Oct-89	257.9	846.0	19.8	65.0	14-Sep-99	M35377.128995
Harty, William	SW 24-003-10 W4M	Milk River	02-Nov-79	194.5	638.0	36.6	120.0	14-Sep-99	M35377.128607
Haugan, Byron	SE 35-005-07 W4M	Milk River						07-May-01	M38022.504590
Haugan, Lars	---31-005-06 W4M	Milk River	25-Jun-49	304.8	1000.0			17-May-01	M35377.128364
Haugen, Byron	NW 35-005-07 W4M	Milk River	23-Nov-49	292.6	960.0			07-May-01	M35377.118973
Hazel, S.	NW 10-008-12 W4M	Milk River						12-Jul-99	M38022.504454
Hearn, Brad	SE 33-004-09 W4M	Milk River	12-Mar-75	225.5	740.0	15.2	50.0	16-Aug-01	M35377.118707
Hearn, Brad	SE 33-004-09 W4M	Milk River	30-Dec-89	243.8	800.0	48.8	160.0	16-Aug-01	M35377.083660
Hedley, T. R.	NE 16-004-06 W4M	Milk River	01-Jan-43	238.7	783.0			30-May-01	M35377.127993
Heidinger, Roger	NE 36-005-06 W4M	Milk River	14-Feb-86	359.7	1180.0	57.9	190.0	10-May-01	M35377.128379
Heitrich, Max	SE 18-007-08 W4M	Milk River	16-May-50	247.2	811.0			21-Sep-99	M35377.129129
Heitrich, Peter	NW 23-006-08 W4M	Milk River	27-Aug-47	198.1	650.0			17-May-01	M35377.119471
Heitrich, Richard	NW 14-006-09 W4M	Milk River	15-Mar-90	249.9	820.0	19.8	65.0	17-Aug-99	M35377.083758
Henline, Ed	08-31-001-10 W4M	Milk River		108.8	357.0			16-May-01	M35377.095152
Henline, George	NW 20-001-10 W4M	Milk River	10-Dec-78	183.5	602.0	58.8	193.0	16-May-01	M35377.095001
Henningsgard, John	NW 20-009-11 W4M	Milk River	01-Jan-19	196.6	645.0	-1.2	-4.0	29-May-01	M35377.135097
Herb Bullis Farm	SE 36-005-12 W4M	Milk River	24-May-82	221.9	728.0	45.1	148.0	25-May-99	M35377.128901
Herbst, Aubrey	SE 06-004-09 W4M	Milk River	27-Mar-90	219.5	720.0	48.8	160.0	07-Sep-99	M35377.082879
Herbst, Ed	SW 14-006-09 W4M	Milk River	27-Feb-75	256.0	840.0	10.7	35.0	12-Aug-99	M35377.129000
Herbst, Robert	SE 30-003-09 W4M	Milk River	10-Jan-74	225.5	740.0	30.5	100.0	06-Sep-00	M35377.119117
Hietrich, Rose	NE 13-006-09 W4M	Lea Park						14-Sep-99	M38022.504482
Higdon, Mack	NW 07-003-07 W4M	Milk River		203.0	666.0	-7.6	-25.0	03-Sep-00	M35377.128289
Hildebrand, John	NE 18-007-12 W4M	Milk River	04-May-84	228.6	750.0	30.5	100.0	16-Jul-99	M35377.129651
Hinch, Ed	08-16-005-10 W4M	Milk River	01-Nov-64	249.3	818.0	30.5	100.0	30-Jul-99	M35377.119250
Hinds, Tom & John	01-01-007-13 W4M	Milk River	01-Jan-19	182.9	600.0			13-Jul-99	M35377.118514
Hirche, Reid	SE 02-004-08 W4M	Milk River	01-Jun-89	208.8	685.0			09-Aug-01	M35377.119166
Hirche, Reid	NW 11-004-08 W4M	Milk River	25-May-89	228.6	750.0	0.9	3.0	09-Aug-01	M35377.119205
Hirche, Reid	NW 21-003-11 W4M	Milk River	28-Jan-85	212.4	697.0	73.2	240.0	08-Jun-99	M35377.128876
Hirsche, Alvin Samuel	11-33-003-11 W4M	Milk River	04-Aug-72	207.3	680.0	36.6	120.0	08-Jun-99	M35377.128917
Hirsche, Lyn	NE 26-003-11 W4M	Milk River	27-May-86	200.2	657.0	51.8	170.0	28-Jul-99	M35377.128887
Hirsche, Reid	NW 33-003-11 W4M	Milk River	20-Oct-88	225.5	740.0	54.9	180.0	08-Jun-99	M35377.128907
Hirsche, Roy	NW 19-004-13 W4M	[unknown]						14-Jun-99	M38022.504425
Hirsche, Roy J.	NW 19-004-13 W4M	Milk River	01-Jan-72	158.5	520.0	0.9	3.0	14-Jun-99	M35377.118392
Hobbs, Mr. H.	SE 06-005-08 W4M	Milk River		243.8	800.0			09-Aug-01	M35377.119062

WATER WELLS THAT HAVE BEEN FIELD VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Hofforth, Mett	SW 09-007-10 W4M	Bedrock	01-Jun-53	243.8	800.0			10-Aug-01	M35377.129313
Hogan, H.	NW 07-005-06 W4M	Milk River	12-Nov-89	228.3	749.0			03-May-01	M35377.083661
Hollihan, James	NE 28-004-12 W4M	Bedrock	16-Oct-53	245.7	806.0			27-May-99	M35377.128347
Hollingsworth, Bob	12-07-004-08 W4M	Milk River	28-Jul-50	250.2	821.0			09-Sep-99	M35377.119177
Hollingsworth, Bob	NW 07-004-08 W4M	Milk River	06-Jun-85	235.6	773.0	36.6	120.0	09-Sep-99	M35377.119188
Houden, C. R.	01-06-008-10 W4M	Milk River		208.5	684.0			12-Aug-99	M35377.129795
Hougan, Charles	NW 26-006-11 W4M	Milk River	10-Sep-89	163.4	536.0	-1.5	-5.0	21-May-99	M35377.129232
Hougen, Charles	SE 29-006-11 W4M	Milk River	10-Dec-89	160.9	528.0	-0.9	-3.0	21-May-99	M35377.083760
Hughson Farms	14-09-003-11 W4M	Milk River	01-Jan-60	275.8	905.0	54.9	180.0	28-Jul-99	M35377.128751
Hughson, Joan	SW 33-005-08 W4M	Milk River	12-Nov-89	225.5	740.0			28-Jul-99	M35377.083664
Hughson, Joan	NW 09-003-11 W4M	Milk River	25-Jan-90	256.0	840.0	56.4	185.0	28-Jul-99	M35377.082424
Hughson, Vane	SE 14-003-11 W4M	Milk River	17-Nov-89	219.5	720.0	76.2	250.0	28-Jul-99	M35377.128786
Huisman, Albert	13-31-007-11 W4M	Milk River	23-Mar-50	228.6	750.0			16-Jul-99	M35377.129550
Huisman, Lloyd	NW 31-007-11 W4M	Milk River	22-Nov-89	222.5	730.0	12.2	40.0	16-Jul-99	M35377.083677
Huisman, Lloyd	NE 06-007-11 W4M	Milk River	02-Dec-89	225.5	740.0	38.1	125.0	16-Jul-99	M35377.083675
Hutchinson, Lynden G.	SE 28-006-14 W4M	Milk River	21-Oct-80	207.3	680.0			15-Jun-99	M35377.118495
Hutchison, Dale	03-30-005-13 W4M	Milk River	01-Jan-63	213.4	700.0			01-Jun-99	M35377.118430
Hutchisons Farms Ltd.	03-34-005-14 W4M	Milk River		228.6	750.0	-3.1	-10.0	25-Jun-99	M35377.118479
Hutterian Brethren	NW 23-004-13 W4M	Milk River	10-Oct-73	286.5	940.0	31.7	104.0	26-May-99	M35377.118399
Ivanics, Ed	NE 33-004-13 W4M	Milk River	08-Oct-88	195.1	640.0	12.2	40.0	10-Jun-99	M35377.118403
Ivanics, Steve	SE 24-006-13 W4M	Milk River	17-May-89	219.5	720.0	51.2	168.0	02-Jun-99	M35377.087570
Jack	NE 24-005-12 W4M	Milk River						18-May-99	M38022.504399
Jdostik, G. A. Farms	01-28-005-10 W4M	Milk River		243.8	800.0	42.7	140.0	04-May-00	M35377.119277
Jetter, J.	14-07-006-08 W4M	Milk River	26-Oct-68	225.5	740.0	24.4	80.0	17-May-01	M35377.119367
Jetter, Kelly	NE 31-005-06 W4M	Milk River	07-Nov-88	267.0	876.0			10-May-01	M35377.128371
Jetter, Rodney	NE 07-006-08 W4M	Milk River	14-Jan-90	231.6	760.0	15.2	50.0	17-May-01	M35377.083670
Jetter, Werner	SW 23-006-06 W4M	Milk River	20-Mar-85	411.5	1350.0	106.7	350.0	11-May-01	M35377.119470
Johnson, Bill	13-13-001-10 W4M	Milk River	01-Jan-61	216.4	710.0	39.6	130.0	30-Nov-99	M35377.094975
Johnson, Harold	NE 07-007-10 W4M	Milk River	15-Jan-90	243.2	798.0	21.6	71.0	09-Aug-99	M35377.083450
Johnson, J. E.	02-03-005-11 W4M	Milk River	20-Aug-52	249.9	820.0	5.2	17.0	18-Jun-99	M35377.128819
Johnson, J. O.	NE 07-007-10 W4M	Milk River		206.3	677.0			09-Aug-99	M35377.129312
Johnson, Roy/ Mable	SE 12-006-07 W4M	Milk River	19-Jul-88	274.6	901.0			28-May-01	M35377.119169
Johnson, Tom	SE 11-001-10 W4M	Milk River	07-Dec-89	196.6	645.0	17.4	57.0	16-May-01	M35377.083653
Johnston, Oliver	SW 23-006-10 W4M	Bedrock	26-Jul-51	228.9	751.0			14-Jul-99	M35377.129119
Johson, M.	SW 30-008-11 W4M	Milk River		194.2	637.0	-2.4	-8.0	06-Aug-99	M35377.129912
Jordan, O.	SW 28-007-10 W4M	Milk River		208.8	685.0			21-Sep-99	M35377.129386
Jurkut, Julius	SW 13-007-09 W4M	Milk River	03-Jan-56	274.3	900.0			21-Sep-99	M35377.129211
Karl, George	NW 12-004-11 W4M	Milk River	09-Nov-85	214.9	705.0	61.0	200.0	01-Sep-99	M35377.128105
Karl, Gustav	04-24-004-11 W4M	Milk River	01-Dec-71	219.5	720.0	54.9	180.0	18-Jun-99	M35377.128162
Karl, Rienhold	SE 17-004-11 W4M	Milk River	10-Sep-88	231.6	760.0	64.3	211.0	01-Sep-99	M35377.128118
Keen, F.	SE 07-008-09 W4M	Milk River	01-Jan-27	225.5	740.0			31-Aug-99	M35377.129616
Kienle, C.	SE 04-006-10 W4M	Milk River	10-Aug-57	225.5	740.0			01-Sep-99	M35377.129093
Kiffiak, A.	12-18-005-12 W4M	Milk River	01-Jan-55	222.5	730.0	24.4	80.0	25-May-99	M35377.128838
Kiffiak, Ed	SW 18-005-12 W4M	Milk River	03-May-85	218.8	718.0	106.7	350.0	25-May-99	M35377.128837
Kiffiak, Edwin	NW 02-005-13 W4M	Milk River		222.5	730.0			17-Aug-99	M35377.118411
Kiffiak, Nick	SE 18-006-14 W4M	Bedrock	20-Sep-50	256.3	841.0			14-Jun-99	M35377.118464
Kimmett, J.	NE 17-008-11 W4M	Milk River	01-Jan-22	192.0	630.0	0.9	3.0	07-Jul-99	M35377.129898
Kimmett, W.	SW 20-008-11 W4M	Milk River	01-Jan-24	195.1	640.0	-1.2	-4.0	06-Aug-99	M35377.129901
Kimmit, J.	NE 17-008-11 W4M	Milk River	17-Sep-48	228.6	750.0	9.1	30.0	07-Jul-99	M35377.129899
Kimmit, T. B.	NE 17-008-11 W4M	Milk River	07-Sep-48	219.5	720.0	9.1	30.0	07-Jul-99	M35377.129900
Kimmit, Tom B.	NE 13-008-12 W4M	Bedrock		243.8	800.0			08-Jul-99	M35377.129945
Kimmitt, Harold	SH 04-011-10 W4M	[unknown]						23-Dec-00	M38022.504548
King Lake Hutterite Colony	NW 26-005-13 W4M	Milk River	01-Jan-75	243.8	800.0			28-May-99	M35377.118421
King, Eugene	SW 09-001-10 W4M	Milk River	17-Dec-73	170.7	560.0	13.7	45.0	15-May-01	M35377.094958
King, Gary	SW 19-004-09 W4M	Milk River	31-Mar-90	225.9	741.0	18.3	60.0	09-Sep-99	M35377.083752
King, Ken	SE 19-004-09 W4M	Milk River	26-Jan-86	224.3	736.0	45.7	150.0	09-Sep-99	M35377.118641
Kings Lake Colony	···26-005-13 W4M	Milk River		198.1	650.0	176.8	580.0	28-May-99	M35377.118427
Kings Lake Colony	NE 27-005-13 W4M	Milk River	22-Mar-89	249.9	820.0	29.9	97.9	28-May-99	M35377.118428
Kings Lake Colony	01-34-005-13 W4M	Milk River		198.1	650.0	91.4	300.0	19-May-00	M35377.118443
Kings Lake Colony	NE 26-005-13 W4M	Milk River	01-Jan-79	243.8	800.0	182.9	600.0	28-May-99	M35377.118426
King's Lake Hutterian Brethern	NW 26-005-13 W4M	Milk River	25-Sep-88	247.5	812.0	70.1	230.0	28-May-99	M35377.118424
Kirkvold & Green	13-23-003-06 W4M	Milk River	01-Jan-43	224.3	736.0			09-Aug-01	M35377.128261
Klatt, Glen	NW 21-004-10 W4M	Milk River		219.5	720.0			09-Jun-99	M35377.118912
Klatt, Ken	SW 06-007-11 W4M	Milk River	07-Dec-89	227.1	745.0	36.6	120.0	09-Jun-99	M35377.083674
Klaudt	SE 09-008-08 W4M	Milk River						05-Jun-01	M38022.504605
Klaudt	SE 09-008-08 W4M	Milk River						05-Jun-01	M38022.504606
Klaudt	NE 04-008-08 W4M	Milk River						05-Jun-01	M38022.504607
Klaudt	SE 30-007-08 W4M	Milk River						05-Jun-01	M38022.504608
Kolesar, Edmund	NE 07-001-10 W4M	Milk River	24-Oct-89	205.7	675.0	23.1	75.6	14-Jun-01	M35377.084694
Kraft, Delbert	SE 02-008-08 W4M	[unknown]						04-May-01	M38022.504591
Kraft, Delbert	NW 24-007-08 W4M	[unknown]						15-May-01	M38022.504594
Kraft, Delbert	NE 14-007-08 W4M	Milk River						15-May-01	M38022.504592
Kraft, Delbert	NW 15-007-08 W4M	Milk River						15-May-01	M38022.504593
Kraft, Delbert	SE 26-007-08 W4M	Milk River	25-Mar-88	232.9	764.0	-3.1	-10.0	15-May-01	M35377.129159

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Hofforth, Mett	SW 09-007-10 W4M	Bedrock	01-Jun-53	243.8	800.0			10-Aug-01	M35377.129313
Hogan, H.	NW 07-005-06 W4M	Milk River	12-Nov-89	228.3	749.0			03-May-01	M35377.083661
Hollihan, James	NE 28-004-12 W4M	Bedrock	16-Oct-53	245.7	806.0			27-May-99	M35377.128347
Hollingsworth, Bob	12-07-004-08 W4M	Milk River	28-Jul-50	250.2	821.0			09-Sep-99	M35377.119177
Hollingsworth, Bob	NW 07-004-08 W4M	Milk River	06-Jun-85	235.6	773.0	36.6	120.0	09-Sep-99	M35377.119188
Houden, C. R.	01-06-008-10 W4M	Milk River		208.5	684.0			12-Aug-99	M35377.129795
Hougan, Charles	NW 26-006-11 W4M	Milk River	10-Sep-89	163.4	536.0	-1.5	-5.0	21-May-99	M35377.129232
Hougen, Charles	SE 29-006-11 W4M	Milk River	10-Dec-89	160.9	528.0	-0.9	-3.0	21-May-99	M35377.083760
Hughson Farms	14-09-003-11 W4M	Milk River	01-Jan-60	275.8	905.0	54.9	180.0	28-Jul-99	M35377.128751
Hughson, Joan	SW 33-005-08 W4M	Milk River	12-Nov-89	225.5	740.0			28-Jul-99	M35377.083664
Hughson, Joan	NW 09-003-11 W4M	Milk River	25-Jan-90	256.0	840.0	56.4	185.0	28-Jul-99	M35377.082424
Hughson, Vane	SE 14-003-11 W4M	Milk River	17-Nov-89	219.5	720.0	76.2	250.0	28-Jul-99	M35377.128786
Huisman, Albert	13-31-007-11 W4M	Milk River	23-Mar-50	228.6	750.0			16-Jul-99	M35377.129550
Huisman, Lloyd	NW 31-007-11 W4M	Milk River	22-Nov-89	222.5	730.0	12.2	40.0	16-Jul-99	M35377.083677
Huisman, Lloyd	NE 06-007-11 W4M	Milk River	02-Dec-89	225.5	740.0	38.1	125.0	16-Jul-99	M35377.083675
Hutchinson, Lynden G.	SE 28-006-14 W4M	Milk River	21-Oct-80	207.3	680.0			15-Jun-99	M35377.118495
Hutchison, Dale	03-30-005-13 W4M	Milk River	01-Jan-63	213.4	700.0			01-Jun-99	M35377.118430
Hutchisons Farms Ltd.	03-34-005-14 W4M	Milk River		228.6	750.0	-3.1	-10.0	25-Jun-99	M35377.118479
Hutterian Brethren	NW 23-004-13 W4M	Milk River	10-Oct-73	286.5	940.0	31.7	104.0	26-May-99	M35377.118399
Ivanics, Ed	NE 33-004-13 W4M	Milk River	08-Oct-88	195.1	640.0	12.2	40.0	10-Jun-99	M35377.118403
Ivanics, Steve	SE 24-006-13 W4M	Milk River	17-May-89	219.5	720.0	51.2	168.0	02-Jun-99	M35377.087570
Jack	NE 24-005-12 W4M	Milk River						18-May-99	M38022.504399
Jdostik, G. A. Farms	01-28-005-10 W4M	Milk River		243.8	800.0	42.7	140.0	04-May-00	M35377.119277
Jetter, J.	14-07-006-08 W4M	Milk River	26-Oct-68	225.5	740.0	24.4	80.0	17-May-01	M35377.119367
Jetter, Kelly	NE 31-005-06 W4M	Milk River	07-Nov-88	267.0	876.0			10-May-01	M35377.128371
Jetter, Rodney	NE 07-006-08 W4M	Milk River	14-Jan-90	231.6	760.0	15.2	50.0	17-May-01	M35377.083670
Jetter, Werner	SW 23-006-06 W4M	Milk River	20-Mar-85	411.5	1350.0	106.7	350.0	11-May-01	M35377.119470
Johnson, Bill	13-13-001-10 W4M	Milk River	01-Jan-61	216.4	710.0	39.6	130.0	30-Nov-99	M35377.094975
Johnson, Harold	NE 07-007-10 W4M	Milk River	15-Jan-90	243.2	798.0	21.6	71.0	09-Aug-99	M35377.083450
Johnson, J. E.	02-03-005-11 W4M	Milk River	20-Aug-52	249.9	820.0	5.2	17.0	18-Jun-99	M35377.128819
Johnson, J. O.	NE 07-007-10 W4M	Milk River		206.3	677.0			09-Aug-99	M35377.129312
Johnson, Roy/ Mable	SE 12-006-07 W4M	Milk River	19-Jul-88	274.6	901.0			28-May-01	M35377.119169
Johnson, Tom	SE 11-001-10 W4M	Milk River	07-Dec-89	196.6	645.0	17.4	57.0	16-May-01	M35377.083653
Johnston, Oliver	SW 23-006-10 W4M	Bedrock	26-Jul-51	228.9	751.0			14-Jul-99	M35377.129119
Johson, M.	SW 30-008-11 W4M	Milk River		194.2	637.0	-2.4	-8.0	06-Aug-99	M35377.129912
Jordan, O.	SW 28-007-10 W4M	Milk River		208.8	685.0			21-Sep-99	M35377.129386
Jurkut, Julius	SW 13-007-09 W4M	Milk River	03-Jan-56	274.3	900.0			21-Sep-99	M35377.129211
Karl, George	NW 12-004-11 W4M	Milk River	09-Nov-85	214.9	705.0	61.0	200.0	01-Sep-99	M35377.128105
Karl, Gustav	04-24-004-11 W4M	Milk River	01-Dec-71	219.5	720.0	54.9	180.0	18-Jun-99	M35377.128162
Karl, Rienhold	SE 17-004-11 W4M	Milk River	10-Sep-88	231.6	760.0	64.3	211.0	01-Sep-99	M35377.128118
Keen, F.	SE 07-008-09 W4M	Milk River	01-Jan-27	225.5	740.0			31-Aug-99	M35377.129616
Kienle, C.	SE 04-006-10 W4M	Milk River	10-Aug-57	225.5	740.0			01-Sep-99	M35377.129093
Kiffiak, A.	12-18-005-12 W4M	Milk River	01-Jan-55	222.5	730.0	24.4	80.0	25-May-99	M35377.128838
Kiffiak, Ed	SW 18-005-12 W4M	Milk River	03-May-85	218.8	718.0	106.7	350.0	25-May-99	M35377.128837
Kiffiak, Edwin	NW 02-005-13 W4M	Milk River		222.5	730.0			17-Aug-99	M35377.118411
Kiffiak, Nick	SE 18-006-14 W4M	Bedrock	20-Sep-50	256.3	841.0			14-Jun-99	M35377.118464
Kimmett, J.	NE 17-008-11 W4M	Milk River	01-Jan-22	192.0	630.0	0.9	3.0	07-Jul-99	M35377.129898
Kimmett, W.	SW 20-008-11 W4M	Milk River	01-Jan-24	195.1	640.0	-1.2	-4.0	06-Aug-99	M35377.129901
Kimmit, J.	NE 17-008-11 W4M	Milk River	17-Sep-48	228.6	750.0	9.1	30.0	07-Jul-99	M35377.129899
Kimmit, T. B.	NE 17-008-11 W4M	Milk River	07-Sep-48	219.5	720.0	9.1	30.0	07-Jul-99	M35377.129900
Kimmit, Tom B.	NE 13-008-12 W4M	Bedrock		243.8	800.0			08-Jul-99	M35377.129945
Kimmitt, Harold	SH 04-011-10 W4M	[unknown]						23-Dec-00	M38022.504548
King Lake Hutterite Colony	NW 26-005-13 W4M	Milk River	01-Jan-75	243.8	800.0			28-May-99	M35377.118421
King, Eugene	SW 09-001-10 W4M	Milk River	17-Dec-73	170.7	560.0	13.7	45.0	15-May-01	M35377.094958
King, Gary	SW 19-004-09 W4M	Milk River	31-Mar-90	225.9	741.0	18.3	60.0	09-Sep-99	M35377.083752
King, Ken	SE 19-004-09 W4M	Milk River	26-Jan-86	224.3	736.0	45.7	150.0	09-Sep-99	M35377.118641
Kings Lake Colony	···26-005-13 W4M	Milk River		198.1	650.0	176.8	580.0	28-May-99	M35377.118427
Kings Lake Colony	NE 27-005-13 W4M	Milk River	22-Mar-89	249.9	820.0	29.9	97.9	28-May-99	M35377.118428
Kings Lake Colony	01-34-005-13 W4M	Milk River		198.1	650.0	91.4	300.0	19-May-00	M35377.118443
Kings Lake Colony	NE 26-005-13 W4M	Milk River	01-Jan-79	243.8	800.0	182.9	600.0	28-May-99	M35377.118426
King's Lake Hutterian Brethern	NW 26-005-13 W4M	Milk River	25-Sep-88	247.5	812.0	70.1	230.0	28-May-99	M35377.118424
Kirkvold & Green	13-23-003-06 W4M	Milk River	01-Jan-43	224.3	736.0			09-Aug-01	M35377.128261
Klatt, Glen	NW 21-004-10 W4M	Milk River		219.5	720.0			09-Jun-99	M35377.118912
Klatt, Ken	SW 06-007-11 W4M	Milk River	07-Dec-89	227.1	745.0	36.6	120.0	09-Jun-99	M35377.083674
Klaudt	SE 09-008-08 W4M	Milk River						05-Jun-01	M38022.504605
Klaudt	SE 09-008-08 W4M	Milk River						05-Jun-01	M38022.504606
Klaudt	NE 04-008-08 W4M	Milk River						05-Jun-01	M38022.504607
Klaudt	SE 30-007-08 W4M	Milk River						05-Jun-01	M38022.504608
Kolesar, Edmund	NE 07-001-10 W4M	Milk River	24-Oct-89	205.7	675.0	23.1	75.6	14-Jun-01	M35377.084694
Kraft, Delbert	SE 02-008-08 W4M	[unknown]						04-May-01	M38022.504591
Kraft, Delbert	NW 24-007-08 W4M	[unknown]						15-May-01	M38022.504594
Kraft, Delbert	NE 14-007-08 W4M	Milk River						15-May-01	M38022.504592
Kraft, Delbert	NW 15-007-08 W4M	Milk River						15-May-01	M38022.504593
Kraft, Delbert	SE 26-007-08 W4M	Milk River	25-Mar-88	232.9	764.0	-3.1	-10.0	15-May-01	M35377.129159

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Mclean, D.	SW 07-004-07 W4M	Upper Surficial		8.5	28.0	1.5	5.0	05-Jul-01	M35377.128003
Meadoug, John	NW 22-004-09 W4M	[unknown]						05-Jan-00	M38022.504484
Mehlen, Don	NE 28-004-12 W4M	Milk River	11-Nov-88	222.5	730.0	61.0	200.0	27-May-99	M35377.128351
Mehlen, Don	SW 16-004-12 W4M	Milk River	15-Jul-86	242.3	795.0	73.2	240.0	02-Sep-00	M35377.128305
Mehlen, Donald	16-28-004-12 W4M	Milk River	03-Apr-76	219.5	720.0			27-May-99	M35377.128345
Meroniuk Farms Ltd.	SE 15-006-13 W4M	Milk River	17-Feb-89	243.8	800.0	56.4	185.0	24-Jun-99	M35377.118359
Meroniuk, Mike	01-15-006-13 W4M	Milk River	14-Jun-66	219.5	720.0	25.6	84.0	24-Jun-99	M35377.118361
Metheral, Jack	NE 24-005-12 W4M	Milk River	05-Nov-88	201.2	660.0	31.1	102.0	18-May-99	M35377.128840
Methesal, Clark	SE 29-005-11 W4M	Milk River	10-Feb-90	243.8	800.0	42.7	140.0	18-May-99	M35377.084189
Methesal, Jack	SW 24-005-12 W4M	Milk River	26-Feb-90	198.1	650.0	9.1	30.0	18-May-99	M35377.084190
Meyer, Frank	SW 08-007-07 W4M	Milk River	06-Jul-89	311.2	1021.0			17-May-01	M35377.129033
Meyer, Frank & Mary	04-10-007-07 W4M	Milk River	05-Dec-89	353.6	1160.0			07-May-01	M35377.083671
Meyer, John	NW 06-009-10 W4M	Upper Surficial		0.3	1.0	-0.9	-3.0	30-May-01	M35377.130190
Milk River Cattle Company Ltd.	NW 30-002-09 W4M	Milk River	30-Jul-83	98.5	323.0			22-Aug-00	M35377.097781
Milk River Cattle Company Ltd.	SE 28-002-10 W4M	Milk River	04-Aug-83	102.4	336.0			23-Aug-00	M35377.097784
Milk River Cattle Company Ltd.	SW 30-002-09 W4M	Milk River	11-Jan-90	106.7	350.0			22-Aug-00	M35377.082874
Milk River Cattle Company Ltd.	NE 21-002-09 W4M	Milk River	22-Sep-88	117.3	385.0			23-Aug-00	M35377.097775
Milk River Cattle Company Ltd.	SW 23-002-09 W4M	Milk River	02-Oct-88	121.9	400.0			23-Aug-00	M35377.097776
Milk River Cattle Company Ltd.	NE 36-002-09 W4M	Milk River	14-Sep-88	146.3	480.0			23-Aug-00	M35377.097782
Miller, A.	SW 14-007-11 W4M	Milk River	01-Jan-20	196.9	646.0	-0.6	-2.0	04-Aug-99	M35377.129493
Miller, G.	SE 31-006-07 W4M	Bedrock	01-Jan-30	222.5	730.0	-1.8	-6.0	17-May-01	M35377.119273
Mitzel, Marg	NE 21-004-10 W4M	Milk River	17-Jul-81	226.8	744.0	44.2	145.0	22-Jul-99	M35377.118896
Morgan, Fred	14-23-005-11 W4M	Milk River	01-Jan-54	256.0	840.0	-0.9	-3.0	19-May-99	M35377.128820
Morgan, John	16-22-005-11 W4M	Milk River	14-Mar-81	205.7	675.0	22.9	75.0	19-May-99	M35377.128818
Mueller, D. O.	SE 31-003-10 W4M	Milk River	31-Jul-86	214.9	705.0	51.8	170.0	28-Jul-99	M35377.128652
Murray, J. G.	NW 06-008-10 W4M	Bedrock	01-Jan-17	215.5	707.0	-1.2	-4.0	11-Aug-99	M35377.129797
Mutachler, M.	16-16-004-06 W4M	Milk River	01-Jan-56	278.0	912.0	0.6	2.0	30-May-01	M35377.153216
Mutschler, Melvin & Estelle	NE 16-004-06 W4M	Milk River	23-Jan-90	289.6	950.0	3.1	10.0	30-May-01	M35377.083658
Nattrass, Lyle D.	SW 31-003-06 W4M	Milk River	12-Jul-50	225.5	740.0			05-Jul-01	M35377.128268
Neilson, A.	NW 07-004-07 W4M	Milk River	01-Jan-33	190.5	625.0	-1.2	-4.0	05-Jan-00	M35377.128004
Nelson, Walter J.	SW 02-007-14 W4M	Milk River		256.0	840.0			15-Jun-99	M35377.118553
Nemecek, John	10-10-006-14 W4M	Milk River		195.1	640.0			23-Jun-99	M35377.118441
Nesmo, Cecil	NW 02-002-06 W4M	Milk River	01-Jun-85	356.6	1170.0	42.7	140.0	17-May-01	M35377.097236
Newman, Alex	NE 32-008-12 W4M	[unknown]						06-Aug-99	M38022.504468
Newton, Don	SE 20-006-14 W4M	Milk River	07-Feb-90	237.1	778.0	9.1	30.0	11-Jun-99	M35377.083761
Newton, Don	SE 20-006-14 W4M	Milk River		243.8	800.0	15.2	50.0	11-Jun-99	M35377.118466
Norkoski, T.	NW 13-003-10 W4M	Milk River	01-Jan-25	152.4	500.0	1.8	6.0	30-Aug-99	M35377.128547
Novie, J. J.	NE 07-007-11 W4M	Milk River		198.1	650.0			09-Jun-99	M35377.129459
O. K. Coloney	NW 23-004-13 W4M	Milk River	01-Oct-73	195.1	640.0	36.6	120.0	26-May-99	M35377.118394
O'Hara, Elroy	SE 07-003-10 W4M	Milk River	19-Sep-58	152.4	500.0	29.0	95.0	12-Jul-00	M35377.128463
O'Hara, Elroy	SE 07-003-10 W4M	Milk River		176.8	580.0			12-Jul-00	M35377.128460
Oldenhof, L.	16-35-007-11 W4M	Bedrock	01-Jan-43	216.4	710.0	15.2	50.0	23-Jul-99	M35377.129593
Olson, Arvit	NE 18-007-12 W4M	Milk River	01-Jan-25	198.1	650.0	9.1	30.0	16-Jul-99	M35377.129650
Ondrick	SE 05-005-09 W4M	[unknown]						30-Jul-99	M38022.504463
Orman, Rudy	NW 30-005-12 W4M	Milk River	24-Apr-85	228.6	750.0			19-May-99	M35377.128888
Oss, Gene	SE 22-007-06 W4M	Milk River	24-Sep-88	448.0	1470.0	82.3	270.0	03-May-01	M35377.128131
Owen Bach Ranch	04-16-007-14 W4M	Milk River	03-Dec-73	182.9	600.0			17-Jun-99	M35377.118578
Paterson, Daniel	···-14-004-08 W4M	Milk River	22-Oct-55	243.8	800.0			30-Jul-99	M35377.119224
Pearson, C.	NE 21-003-08 W4M	Milk River	01-Jan-19	207.3	680.0	-3.1	-10.0	11-Jun-01	M35377.118649
Pearson, Carl	SW 27-003-08 W4M	[unknown]						25-Jun-01	M38022.504635
Pearson, Carl	NW 31-002-08 W4M	Milk River	23-Jul-47	183.8	603.0			05-Jul-01	M35377.097774
Pearson, Carl	NE 21-003-08 W4M	Milk River	29-Jul-47	213.4	700.0			25-Jun-01	M35377.118652
Pearson, Clayton	SE 29-004-06 W4M	Milk River						05-Jul-01	M38022.504637
Pearson, Raymond	SW 07-004-06 W4M	Milk River		213.4	700.0			25-Jun-01	M35377.127978
Pearson, Raymond	SW 07-003-08 W4M	Milk River	30-Nov-88	198.1	650.0			25-Jun-01	M35377.118601
Pearson, Raymond	SW 27-003-08 W4M	Milk River		213.4	700.0			25-Jun-01	M35377.118664
Perra Ranch	SW 02-005-13 W4M	Upper Surficial	25-Apr-84	135.0	443.0			17-Aug-99	M35377.118412
Peters	SE 27-006-13 W4M	[unknown]						24-Jun-99	M38022.504444
Pierson, Carl	SW 27-004-06 W4M	Milk River		311.2	1021.0			05-Jul-01	M35377.127998
Pilkingsrude, H.R.	NW 33-006-11 W4M	Milk River	01-Jan-17	197.8	649.0	3.7	12.0	03-Jun-99	M35377.129237
Pinhorn	SW 25-002-08 W4M	[unknown]						01-Jun-01	M38022.504603
Piper, J. C.	NE 10-007-11 W4M	Milk River	01-Jan-21	195.1	640.0	-0.6	-2.0	13-Aug-99	M35377.129464
Piper, John J.	SW 18-007-10 W4M	Milk River	01-Jan-28	195.1	640.0	10.7	35.0	13-Aug-99	M35377.129333
Piper, John J.	SW 18-007-10 W4M	Milk River	22-Jun-85	238.3	782.0	21.9	72.0	13-Aug-99	M35377.129329
Plainview Colony	SW 26-004-13 W4M	Milk River	25-Mar-84	209.7	688.0			26-May-99	M35377.118405
Plainview Colony	NW 23-004-13 W4M	Milk River	01-Jan-83	213.4	700.0			26-May-99	M35377.118396
Ponderosa Colony	SW 30-008-12 W4M	Milk River		228.6	750.0	121.9	400.0	04-Jul-00	M35377.129982
Porkka Farms	SW 36-004-12 W4M	Milk River	01-Jul-70	231.6	760.0	85.3	280.0	21-May-99	M35377.128397
Pozdnekoff, William	SE 03-007-14 W4M	Milk River						15-Jun-99	M38022.504427
Presky, J.L.	NE 09-009-09 W4M	Milk River		213.4	700.0			15-May-01	M35377.130056

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Prins, John	SE 08-008-11 W4M	Milk River		182.9	600.0			23-Jul-99	M35377.129896
Prins, Ryk	03-02-007-11 W4M	Milk River		207.3	680.0			23-Jul-99	M35377.129437
Prinse, Ryk	SW 02-007-11 W4M	Milk River	20-Sep-79	222.5	730.0	33.5	110.0	23-Jul-99	M35377.129433
Proud, Kenneth Dean	12-25-007-11 W4M	Milk River	01-Mar-73	219.5	720.0	6.1	20.0	23-Jul-99	M35377.129531
Prouty, Lloyd	NW 14-002-06 W4M	Milk River	12-Nov-61	370.3	1215.0			17-May-01	M35377.097256
Ray Simanton Holdings	SE 19-007-10 W4M	Milk River	12-Dec-89	228.6	750.0	14.6	48.0	11-Aug-99	M35377.083672
Reber, W.	12-17-009-12 W4M	Milk River	01-Jan-17	213.4	700.0	-0.9	-3.0	30-May-01	M35377.135065
Reierstad, Ray	NE 02-007-06 W4M	Milk River		472.4	1550.0			03-May-01	M35377.127812
Reynar, S. O.	SW 10-008-10 W4M	Milk River	01-Jan-25	228.6	750.0			10-Aug-99	M35377.129806
Riley, Charles	SE 29-007-09 W4M	Milk River	28-Mar-57	288.0	945.0			11-Sep-99	M35377.129296
Roan, G.	NW 30-008-08 W4M	Milk River	01-Jan-20	232.9	764.0			23-May-01	M35377.129562
Roas, Sever	NW 10-007-12 W4M	Milk River	01-Jan-26	207.3	680.0	4.6	15.0	03-Jun-99	M35377.129633
Roberts, E. L.	NE 27-004-07 W4M	Milk River	01-Jan-17	195.1	640.0	-9.1	-30.0	30-May-01	M35377.128013
Roberts, J. L.	NW 27-004-07 W4M	[unknown]						30-May-01	M38022.504599
Roneil, R.	NE 11-009-09 W4M	Bedrock	01-Jan-19	237.7	780.0			28-Jul-99	M35377.130057
Rosedale Colony	NW 29-004-08 W4M	Milk River	28-Oct-55	256.0	840.0			05-Jan-00	M35377.119357
Rosedale Colony	03-26-004-09 W4M	Milk River	01-Jan-56	243.8	800.0	61.0	200.0	05-Jan-00	M35377.118681
Rosedale Colony	SW 07-004-07 W4M	Milk River	30-Jun-88	214.3	703.0			05-Jan-00	M35377.128005
Rosedale Colony	03-26-004-09 W4M	Milk River		237.1	778.0			05-Jan-00	M35377.118690
Rosedale Huterian Colony	03-26-004-09 W4M	Milk River	01-Dec-72	225.5	740.0	32.0	105.0	05-Jan-00	M35377.118677
Rosedale Hutterian Brethren	04-26-004-09 W4M	Milk River	04-Feb-75	225.5	740.0	30.5	100.0	05-Jan-00	M35377.118662
Ross Ranches Ltd.	SW 30-002-09 W4M	Milk River	19-Nov-84	115.8	380.0			22-Aug-00	M35377.086637
Ross Ranches Ltd. (Kevins Well)	SW 30-002-09 W4M	Milk River	13-Dec-89	171.9	564.0			22-Aug-00	M35377.090005
Ross Ranches Ltd./ Bob Nickel	05-30-002-09 W4M	Upper Surficial	01-Mar-66	131.1	430.0	-0.6	-2.0	22-Aug-00	M35377.087015
Roth, J.	SE 32-008-10 W4M	Milk River	01-Jan-22	281.9	925.0	1.2	4.0	10-Aug-99	M35377.129874
Royalite Oil Company Ltd.	16-11-009-09 W4M	Milk River	21-Dec-56	218.2	716.0			22-May-01	M35377.130059
Rumpel, G.	02-25-006-08 W4M	Milk River	01-Jan-52	262.1	860.0			06-Jun-01	M35377.119511
Rumple, Pete	SW 34-006-08 W4M	Milk River	05-Sep-47	213.4	700.0			08-May-01	M35377.119529
Russel & Sawyer Ranch	SW 30-006-13 W4M	Milk River	01-Jan-27	204.2	670.0	-1.2	-4.0	03-Jun-99	M35377.118409
Russel, A.	SW 36-007-10 W4M	Milk River	01-Jan-29	237.7	780.0			13-Aug-99	M35377.129418
Russell, F.	SW 29-006-14 W4M	Milk River	15-Sep-77	217.9	715.0	8.5	28.0	07-Jul-99	M35377.118499
Salvang, Oscar	NW 07-007-12 W4M	Milk River		204.2	670.0	3.1	10.0	03-Jun-99	M35377.129602
Sauer, Louis	SW 25-008-09 W4M	Bedrock	02-Oct-51	235.6	773.0			11-May-01	M35377.129765
Schaafna, A.	NE 03-008-12 W4M	Milk River	01-Jan-28	196.6	645.0	-3.1	-10.0	14-Jun-01	M35377.129920
Schacher, Ken S.	SW 28-007-09 W4M	Milk River		289.6	950.0			11-Sep-99	M35377.129293
Schatz, Dennis	SE 31-006-12 W4M	Milk River	24-Oct-89	167.6	550.0			19-May-99	M35377.129260
Schatz, Dennis	NE 29-006-12 W4M	Milk River	26-Oct-89	176.8	580.0			19-May-99	M35377.129259
Schatz, Glenda	NW 32-006-12 W4M	Milk River	30-Oct-89	170.7	560.0			19-May-99	M35377.129265
Schatz, John J.	16-19-007-11 W4M	Bedrock	01-Jan-59	219.5	720.0	3.1	10.0	13-Jul-99	M35377.129510
Schatz, John J.	NE 19-007-11 W4M	Milk River	14-Mar-86	225.9	741.0	19.8	65.0	13-Jul-99	M35377.129508
Scherer, Henry	SE 06-004-09 W4M	Milk River		213.4	700.0	24.4	80.0	07-Sep-99	M35377.118590
Schile Poultry Farms	NW 12-008-09 W4M	Milk River	24-Sep-87	259.1	850.0	-0.6	-2.0	25-May-01	M35377.129707
Schile, Andrew	SE 23-008-09 W4M	Milk River	18-Sep-51	243.8	800.0			22-May-01	M35377.129757
Schile, Andrew P.	01-13-008-09 W4M	Milk River	01-Jan-52	259.1	850.0	-3.1	-10.0	15-May-01	M35377.129714
Schile, Joseph	---12-008-09 W4M	Milk River		229.2	752.0			25-May-01	M35377.129704
Schmidt, John L.	NE 29-007-09 W4M	Milk River	26-Jul-86	262.7	862.0	6.7	22.0	24-Aug-99	M35377.086804
Schussler, Dick	12-30-008-11 W4M	Upper Surficial		2.1	7.0	1.8	6.0	06-Aug-99	M35377.129913
Scott, Wesley	NW 23-005-11 W4M			4.0	13.0			19-May-99	M35377.089698
Scratch, Russell	SE 14-004-12 W4M	Milk River	22-Feb-90	221.6	727.0	48.8	160.0	14-Jun-99	M35377.083753
Sepp, Lea	NE 27-004-12 W4M	[unknown]						14-Jun-99	M38022.504426
Seward, Brian	NW 07-004-12 W4M	Milk River	07-Nov-85	239.3	785.0	64.6	212.0	27-May-99	M35377.128270
Seward, Dale	NE 09-004-12 W4M	Milk River	05-Sep-88	231.6	760.0	65.2	214.0	27-May-99	M35377.128272
Seward, Dale	NE 09-004-12 W4M	Milk River		286.5	940.0	67.1	220.0	27-May-99	M35377.128271
Shatz, M.	SW 15-008-11 W4M	Milk River		198.1	650.0			07-Jul-99	M35377.129897
Sidney, Davis	03-02-007-08 W4M	Milk River	01-Jan-24	213.4	700.0			08-May-01	M35377.129071
Siebens Oil Producers Ltd.	13-23-008-12 W4M	Milk River	10-Jan-56	182.9	600.0			14-Jun-01	M35377.129950
Simanton, Vern	SW 10-007-10 W4M	Milk River	10-Jul-89	230.4	756.0	20.7	68.0	09-Aug-99	M35377.090569
Simons, Louis	NW 34-007-10 W4M	Milk River	01-Jan-85	243.8	800.0	91.4	300.0	12-Aug-99	M35377.129415
Simonton, E. C.	SW 10-007-10 W4M	Bedrock	27-May-53	256.6	842.0			09-Aug-99	M35377.129321
Simpson, R.	12-21-005-08 W4M	Milk River		213.4	700.0			03-Sep-00	M35377.128384
Sjodin, Gust	NW 20-006-07 W4M	Milk River	19-Jul-51	253.9	833.0			31-May-01	M35377.119209
Slack, William	NE 03-006-14 W4M	Milk River		213.4	700.0			10-Jun-99	M35377.118432
Slacka, Rudy	SW 19-006-12 W4M	Milk River	29-Apr-89	219.5	720.0	54.9	180.0	25-Jun-99	M35377.129258
Slapper, C.	NW 02-009-09 W4M	Milk River	01-Jan-14					22-May-01	M35377.130034
Smith, Allan L.	WH 16-009-12 W4M	Milk River		213.4	700.0			30-May-01	M35377.135054
Smith, H.	NE 06-003-09 W4M	Milk River	01-Jan-28	151.2	496.0	-1.2	-4.0	02-Sep-00	M35377.118698
Snortland, Art	---24-003-07 W4M	Milk River	24-Jul-50	268.2	880.0			17-May-01	M35377.128414
Snortland, Floyd	SE 19-003-06 W4M	Milk River	15-Oct-88	226.2	742.0	4.6	15.0	30-May-01	M35377.128236
Snortland, Floyd	NW 19-003-06 W4M	Milk River	28-May-85	241.4	792.0			30-May-01	M35377.128234
Snortland, Roy	SW 24-003-07 W4M	Milk River	07-Oct-83	244.4	802.0	29.0	95.0	17-May-01	M35377.128411

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
Southerton, Carl	02-05-008-09 W4M	Milk River	01-Jan-55	298.7	980.0	-0.9	-3.0	12-Aug-99	M35377.129607
Stadleman, John	NE 02-003-11 W4M	Milk River						02-Sep-00	M38022.504529
Stappler, Joe	SW 32-006-09 W4M	Milk River	03-Apr-86	239.3	785.0	11.6	38.0	14-Jul-99	M35377.129018
Starbrite Colony	SW 36-004-12 W4M	Milk River	02-Jun-87	240.8	790.0	54.9	180.0	21-May-99	M35377.128399
Starbrite Colony	NW 25-004-12 W4M	Milk River	23-Jun-89	231.9	761.0	82.3	270.0	21-May-99	M35377.128338
Starbrite Colony	SW 36-004-12 W4M	Milk River	26-Apr-88	233.2	765.0	82.3	270.0	21-May-99	M35377.128400
Starbrite Colony	SE 36-004-12 W4M	Milk River	27-Sep-89	231.6	760.0	85.3	280.0	21-May-99	M35377.128395
Starner, W.	SE 08-007-11 W4M	Milk River	09-Feb-01			-0.6	-2.0	03-Jun-99	M37490.029688
Stauldine, John	09-31-007-11 W4M	Milk River	08-Jun-71	225.5	740.0	4.6	15.0	20-Aug-99	M35377.129557
Stephens, A.	NE 32-005-11 W4M	Milk River	01-Jan-18	224.0	735.0	6.1	20.0	18-May-99	M35377.128826
Stevens, Claude	NE 32-005-11 W4M	Milk River	17-Apr-89	242.3	795.0	65.2	214.0	18-May-99	M35377.128827
Stickel, David	NE 20-008-06 W4M	Milk River	22-Aug-89	518.1	1700.0	147.8	485.0	07-May-01	M35377.086403
Strain, Art	NW 12-005-10 W4M	Milk River	20-Apr-74	243.8	800.0			30-Jul-99	M35377.119229
Strain, Doug	04-13-005-10 W4M	Milk River	03-Jun-74	237.7	780.0	39.6	130.0	03-Aug-99	M35377.119233
Strain, Douglas	SW 13-005-10 W4M	Milk River	23-Mar-90	249.9	820.0	30.5	100.0	03-Aug-99	M35377.083113
Strain, G.	NW 12-005-10 W4M	Milk River	01-Jan-18	243.8	800.0	15.2	50.0	30-Jul-99	M35377.119226
Stringham	NW 35-005-08 W4M	Milk River		228.6	750.0			28-Jul-99	M35377.128455
Stringham, A.W.	SW 28-006-11 W4M	Milk River	07-Jun-49	243.8	800.0			21-May-99	M35377.129234
Stroman, Chester	NW 08-004-13 W4M	[unknown]						12-Jul-99	M38022.504455
Stronsmoe, Jerrom	SW 36-003-08 W4M	Milk River	01-Sep-73	182.9	600.0			18-Aug-99	M35377.118684
Stronsmoe, O.	SW 12-006-09 W4M	Milk River	01-Jan-29	222.2	729.0			18-Aug-99	M35377.128993
Stronsmog, Clays & Clint & Nyle	SW 12-006-09 W4M	Milk River	27-Mar-90	253.0	830.0	18.3	60.0	18-Aug-99	M35377.083757
Stryker, Earl S.	SE 05-005-07 W4M	Milk River	12-Aug-47	205.1	673.0			30-May-01	M35377.118645
Stryker, George	NE 36-004-07 W4M	Milk River	23-Aug-48	262.1	860.0			15-Jun-01	M35377.128024
Stryker, R.M.	NE 32-004-07 W4M	Milk River	01-Jan-16	195.1	640.0	-1.8	-6.0	30-May-01	M35377.128014
Stryker, R.M.	NW 33-004-07 W4M	Milk River		187.8	616.0			30-May-01	M35377.128015
Stuber, Stan	SE 04-003-06 W4M	[unknown]						01-Jun-01	M38022.504604
Stuber, Wilfred	NE 12-008-07 W4M	Milk River	19-Jun-89	486.1	1595.0	117.3	385.0	10-May-01	M35377.129434
Sun Rise Colony	NW 30-005-09 W4M	Milk River	26-Jul-88	262.1	860.0	3.1	10.0	04-Jan-00	M35377.119170
Sun Rise Colony	NW 22-005-09 W4M	Milk River	08-Aug-88	249.9	820.0	27.4	90.0	04-Jan-00	M35377.119155
Sunderland Real Estates	09-16-005-09 W4M	Milk River		213.4	700.0			04-Jan-00	M35377.119147
Sunrise Colony	NW 19-005-09 W4M	Milk River	02-Aug-88	246.9	810.0	4.6	15.0	04-Jan-00	M35377.119148
Sunrise Hutterian Brethren	13-22-005-09 W4M	Milk River		243.8	800.0			04-Jan-00	M35377.115742
Swanson, Lennard	SE 19-007-10 W4M	Milk River	25-Apr-54	262.1	860.0			11-Aug-99	M35377.129336
Syverson, Lorne	NE 23-006-10 W4M	Milk River	06-Jan-90	230.4	756.0	22.9	75.0	08-Jun-99	M35377.085938
Syverson, Wayne	NE 02-006-08 W4M	[unknown]						28-May-01	M38022.504630
Taylor, Arthur	NW 02-007-11 W4M	Milk River		195.1	640.0			13-Aug-99	M35377.129432
Taylor, B.	SW 02-007-11 W4M	Milk River	01-Jan-23	198.1	650.0			23-Jul-99	M35377.129435
Taylor, Ed	16-10-003-11 W4M	Milk River	02-Oct-60	225.5	740.0	65.5	215.0	28-Jul-00	M35377.128757
Taylor, Robert	03-14-003-11 W4M	Milk River	01-Jan-53	224.0	735.0	45.7	150.0	28-Jul-99	M35377.128791
Taylor, Robert	SE 14-003-11 W4M	Milk River		274.3	900.0			28-Jul-99	M35377.128781
Thiel, W.	NE 35-004-09 W4M	Milk River	01-Jan-28	204.2	670.0	-1.5	-5.0	05-Jan-00	M35377.118711
Thompson Oil Co.	---10-005-08 W4M	Viking	15-Jun-22	867.1	2845.0			03-Sep-00	M35377.128381
Thompson, H.	NW 07-006-10 W4M	Milk River	01-Jan-30	277.1	909.0	53.3	175.0	05-May-00	M35377.129096
Thompson, Stanley	NW 07-006-10 W4M	Milk River	22-Mar-86	263.6	865.0	73.2	240.0	05-May-00	M35377.129097
Thompson, Wayne	SW 18-006-10 W4M	Milk River						04-May-00	M38022.504487
Thompson, Wayne	SW 18-006-10 W4M	Milk River	20-Jan-90	249.9	820.0	54.9	180.0	04-May-00	M35377.084192
Thomson, H.	NW 15-004-08 W4M	Milk River	01-Jan-33	198.1	650.0	-1.2	-4.0	18-Aug-99	M35377.119231
Torscher, Ed & Sheila	NE 35-009-11 W4M	[unknown]						05-Aug-99	M38022.504467
Toth, Robert	NE 27-004-10 W4M	Milk River	20-Mar-89	225.5	740.0	42.7	140.0	21-Jul-99	M35377.119052
Town of Etzikom	NE 14-006-09 W4M	Milk River	01-Jan-18	228.6	750.0	-4.6	-15.0	14-Sep-99	M35377.129001
Town of Foremost	NW 16-004-13 W4M	Milk River	12-May-54	216.7	711.0			26-May-99	M35377.118388
Town of Foremost	NW 16-004-13 W4M	Milk River	05-Apr-54	220.1	722.0			26-May-99	M35377.118386
Town of Skiff	NW 26-006-14 W4M	Milk River	01-Jan-28	243.8	800.0			24-Jun-99	M35377.118483
Trace, Arthur	NW 21-004-11 W4M	Milk River		182.9	600.0	30.5	100.0	20-May-99	M35377.128120
Trace, Monica	NW 21-004-11 W4M	Milk River	08-Apr-86	217.9	715.0	51.8	170.0	20-May-99	M35377.128134
Tuttle, N. A.	SW 07-006-06 W4M	Bedrock	10-May-49	295.6	970.0	0.8	2.5	17-May-01	M35377.119341
Tuttle, Vincent	---12-005-07 W4M	Milk River	09-Aug-50	271.3	890.0			13-Jun-01	M35377.118714
Ully Brothers Farms Ltd.	SW 23-004-11 W4M	Milk River		243.8	800.0	38.1	125.0	02-Jun-99	M35377.128140
Ully, Joan C.	NE 24-004-11 W4M	Milk River	16-Jul-86	224.6	737.0	18.8	61.8	01-Sep-99	M35377.128165
Ully, Raymond	SW 23-004-11 W4M	Milk River	08-Oct-58	249.9	820.0	13.7	45.0	02-Jun-99	M35377.128159
Ulrich	NE 10-004-07 W4M	Milk River						05-Jul-01	M38022.504636
Unrau, Bill	SE 19-006-13 W4M	Lea Park	27-Nov-00	213.4	700.0	2.7	9.0	22-Jun-99	M35377.118374
Unrau, Bill	SE 19-006-13 W4M	Milk River	08-Aug-80	211.8	695.0	8.4	27.5	22-Jun-99	M35377.118378
Unrau, Don	SW 19-006-13 W4M	Milk River	08-Aug-89	229.2	752.0			02-Jun-99	M35377.095361
Unrau, Don	SW 19-006-13 W4M	Milk River	01-Jan-49	237.7	780.0			02-Jun-99	M35377.118383
Van Gaalen, David	NE 26-008-12 W4M	Milk River		243.8	800.0			14-Jun-01	M35377.129973
Van Goaler, Matthew John	13-11-008-12 W4M	Milk River	25-Feb-66	240.8	790.0	9.1	30.0	12-Jul-99	M35377.129932
Vandenberg, Steve	16-34-007-12 W4M	Milk River	01-Jan-56	253.0	830.0	9.1	30.0	14-Jul-99	M35377.129663
Vanfaraland, Matt	SW 28-007-12 W4M	Milk River	01-Sep-73	213.4	700.0	24.4	80.0	15-Jul-99	M35377.129654
Vos, Ed	NW 10-008-12 W4M	Milk River	08-Sep-77	228.6	750.0	24.4	80.0	12-Jul-99	M35377.129926
Vos, Gertrude	01-14-008-12 W4M	Milk River	13-Jun-76	231.6	760.0			12-Jul-99	M35377.129947
Vos, J.	SE 14-008-12 W4M	Milk River	01-Jan-37	222.5	730.0			12-Jul-99	M35377.129946
Vos, John	---02-008-12 W4M	Bedrock	05-Jul-50	260.3	854.0			13-Jul-99	M35377.129917
Vos, Roy	16-12-008-12 W4M	Milk River		243.8	800.0	56.4	185.0	05-Aug-99	M35377.129943
Vos, Roy	NE 12-008-12 W4M	Milk River	06-Oct-80	222.5	730.0			05-Aug-99	M35377.129941

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

		Aquifer	Date Water	Completed Depth		NPWL		Date	
Owner	Location	Name	Well Drilled	Metres	Feet	Metres	Feet	Field Verified	UID
Walters, R. C.	NW 02-005-12 W4M	Milk River						21-May-99	M38022.504409
Weber, S. C.	04-04-006-11 W4M	Milk River	30-Jun-69	221.9	728.0	48.8	160.0	18-May-99	M35377.129144
Weeks, Frank	NE 10-005-07 W4M	Milk River	10-Aug-48	246.9	810.0			15-Jun-01	M35377.118660
Weeks, Frank	NE 25-004-07 W4M							15-Jun-01	M38022.504616
Weeks, Paul & Robert	SW 20-005-07 W4M	Milk River	09-Jul-88	246.3	808.0			15-Jun-01	M35377.118862
Weeks, W. F.	NE 09-005-07 W4M	Milk River	01-Jan-29	198.1	650.0	-6.1	-20.0	15-Jun-01	M35377.118654
Wesley, Harold	NE 34-003-11 W4M	Milk River	15-Jun-85	209.7	688.0	45.7	150.0	28-Jul-99	M35377.128926
Wever, Norman	NE 07-009-11 W4M	Milk River		243.8	800.0			30-May-01	M35377.135030
Wiebe, Roger	SE 13-003-11 W4M	Milk River	30-Sep-00	167.6	550.0			11-May-00	M37490.029682
Wiebe, Roger	SE 13-003-11 W4M	Milk River	31-Mar-90	217.9	715.0	20.7	68.0	11-May-00	M35377.085401
Wolosiuk, A.	01-24-006-13 W4M	Milk River		243.8	800.0			02-Jun-99	M35377.118391
Wutzke, Bill	03-25-007-10 W4M	Milk River	10-Oct-67	231.6	760.0	36.6	120.0	09-Aug-99	M35377.129353
Wutzke, D.W.	···02-008-10 W4M	Milk River		243.8	800.0			23-May-01	M35377.129791
Wutzke, Ed	SW 25-007-10 W4M	Milk River						09-Aug-99	M38022.504469
Wutzke, Ed	SE 23-007-10 W4M	Milk River						10-Aug-99	M38022.504472
Yancie Farms Ltd.	NW 23-006-13 W4M	Milk River	28-Jan-89	230.1	755.0	41.2	135.0	09-Jun-99	M35377.118387
Yancie, Dave	NW 07-006-12 W4M	Milk River	06-Feb-89	249.9	820.0	61.0	200.0	25-May-99	M35377.129243
Yancie, R. & Sons	SE 10-006-13 W4M	Milk River	23-Feb-89	243.8	800.0	61.0	200.0	05-Jun-02	M35377.118356
Yancie, R. & Sons	SE 26-006-13 W4M	Milk River	10-Mar-89	246.9	810.0	62.5	205.0	20-Jun-02	M35377.118404
Yancie, Rudy	SE 10-006-13 W4M	Milk River	01-Jan-39	231.6	760.0			05-Jun-02	M35377.118355
Yanke, Albert	SW 23-006-07 W4M	Milk River	01-Jan-48	274.3	900.0	9.1	30.0	24-May-01	M35377.119235
Yeast, P. A.	NE 36-004-07 W4M	Milk River		243.5	799.0	-2.1	-7.0	15-Jun-01	M35377.128025
Yeast, P. A.	···30-004-06 W4M	Milk River		243.8	800.0	-2.1	-7.0	03-Sep-00	M35377.128002
Yezek, M. Mrs	SW 18-006-07 W4M	Milk River	19-Nov-54	299.6	983.0			10-May-01	M35377.119198
Yizek, Bruno / Yanke	NE 23-006-08 W4M	Milk River						24-May-01	M38022.504628
Young, F.	SE 06-009-12 W4M	Milk River		182.9	600.0			30-May-01	M35377.135039
[unknown]	NE 12-007-08 W4M	[unknown]				9.4	30.8	02-May-00	M36664.683716
[unknown]	SE 35-008-11 W4M	[unknown]						13-Aug-99	M38022.504475
[unknown]	SW 13-006-11 W4M	[unknown]						20-May-99	M38022.504401
[unknown]	NW 28-006-11 W4M	[unknown]						21-May-99	M38022.504408
[unknown]	NE 33-004-12 W4M	[unknown]						27-May-99	M38022.504412
[unknown]	SE 20-007-11 W4M	[unknown]						03-Jun-99	M38022.504414
[unknown]	NE 10-007-12 W4M	[unknown]						09-Jun-99	M38022.504418
[unknown]	NE 09-005-13 W4M	[unknown]						10-Jun-99	M38022.504423
[unknown]	NE 18-007-12 W4M	[unknown]						16-Jul-99	M38022.504458
[unknown]	NW 28-005-10 W4M	[unknown]						21-Jul-99	M38022.504460
[unknown]	SE 22-007-11 W4M	[unknown]						04-Aug-99	M38022.504466
[unknown]	NW 22-005-10 W4M	[unknown]						04-May-00	M38022.504486
[unknown]	NE 17-006-11 W4M	[unknown]						03-Dec-00	M38022.504543
[unknown]	SE 16-007-09 W4M	[unknown]						14-Aug-01	M38022.504622
[unknown]	NE 22-008-12 W4M	[unknown]						14-Jun-01	M38022.504631
[unknown]	SW 28-003-08 W4M	[unknown]						09-Aug-01	M38022.504639
[unknown]	SE 33-004-09 W4M	[unknown]						16-Aug-01	M38022.504640
[unknown]	SE 33-004-09 W4M	[unknown]						16-Aug-01	M38022.504641
[unknown]	NE 19-002-08 W4M	[unknown]						23-Aug-00	M38022.504523
[unknown]	SW 16-002-08 W4M	[unknown]						23-Aug-00	M38022.504527
[unknown]	NW 27-005-06 W4M	[unknown]						05-Aug-01	M38062.567385
[unknown]	SE 25-004-11 W4M	[unknown]						06-Feb-99	M38062.584851
[unknown]	SW 06-007-09 W4M	Milk River	01-Jan-24	207.3	680.0			11-Aug-99	M35377.129191
[unknown]	NE 24-008-09 W4M	Bedrock	01-Jan-29	236.2	775.0			22-Feb-01	M35377.129762
[unknown]	SW 01-007-06 W4M	Milk River						03-May-01	M38022.504585
[unknown]	NW 21-006-11 W4M	Milk River						21-May-99	M38022.504405
[unknown]	NW 26-006-11 W4M	Milk River						21-May-99	M38022.504406
[unknown]	NW 26-006-11 W4M	Milk River						21-May-99	M38022.504407
[unknown]	SW 28-006-10 W4M	Milk River						07-Jun-99	M38022.504416
[unknown]	NW 09-008-11 W4M	Milk River						07-Jul-99	M38022.504451
[unknown]	SE 05-007-11 W4M	Milk River						13-Jul-99	M38022.504456
[unknown]	NW 25-007-11 W4M	Milk River						23-Jul-99	M38022.504461
[unknown]	NE 11-007-12 W4M	Milk River						03-Aug-99	M38022.504464
[unknown]	NW 34-007-10 W4M	Milk River						12-Aug-99	M38022.504474
[unknown]	SW 18-002-09 W4M	Milk River						23-Aug-00	M38022.504524
[unknown]	NW 18-003-07 W4M	Milk River						03-Sep-00	M38022.504534
[unknown]	NE 10-005-07 W4M	Milk River						15-Jun-01	M38022.504614
[unknown]	SE 03-007-09 W4M	Milk River						14-Aug-01	M38022.504623
[unknown]	SE 11-004-07 W4M	Milk River						09-Aug-01	M38022.504638
[unknown]	SE 27-006-12 W4M	Lea Park						10-Jun-99	M38022.504421
[unknown]	09-09-007-10 W4M	Milk River	01-May-67	225.5	740.0	8.2	27.0	11-Aug-99	M35377.129317
[unknown]	NW 16-006-11 W4M	Milk River						26-May-99	M38022.504411
[unknown]	SE 33-006-13 W4M	Milk River						14-Jun-99	M38022.504424
[unknown]	NE 19-006-09 W4M	Milk River						14-Jul-99	M38022.504457

WATER WELLS THAT HAVE BEEN FIELD-VERIFIED (continued)

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	Date Field Verified	UID
[unknown]	NE 07-007-11 W4M	Milk River						09-Jun-99	M38022.504417
[unknown]	SE 24-003-08 W4M	Milk River						16-Sep-00	M38022.504538
[unknown]	SW 31-005-06 W4M	Milk River						03-May-01	M38022.504587
[unknown]	SE 29-006-11 W4M	Milk River						21-May-99	M38022.504402
[unknown]	NE 30-006-11 W4M	Milk River						21-May-99	M38022.504403
[unknown]	NE 30-006-11 W4M	Milk River						21-May-99	M38022.504404
[unknown]	SE 04-007-11 W4M	Milk River						03-Jun-99	M38022.504415
[unknown]	NW 23-006-13 W4M	Milk River						09-Jun-99	M38022.504419
[unknown]	NW 26-006-12 W4M	Milk River						10-Jun-99	M38022.504420
[unknown]	SW 36-006-12 W4M	Milk River						10-Jun-99	M38022.504422
[unknown]	SW 02-007-14 W4M	Milk River						15-Jun-99	M38022.504428
[unknown]	SE 24-004-11 W4M	Milk River						18-Jun-99	M38022.504439
[unknown]	NW 36-005-14 W4M	Milk River						24-Jun-99	M38022.504443
[unknown]	NE 07-005-14 W4M	Milk River						30-Jun-99	M38022.504449
[unknown]	SW 02-004-11 W4M	Milk River						28-Jul-99	M38022.504462
[unknown]	NW 19-007-11 W4M	Milk River						03-Aug-99	M38022.504465
[unknown]	SE 02-007-10 W4M	Milk River						11-Aug-99	M38022.504473
[unknown]	SW 05-004-08 W4M	Milk River						18-Aug-99	M38022.504476
[unknown]	NE 29-007-09 W4M	Milk River						24-Aug-99	M38022.504477
[unknown]	SE 30-002-09 W4M	Milk River						22-Aug-00	M38022.504520
[unknown]	SE 25-002-10 W4M	Milk River						22-Aug-00	M38022.504521
[unknown]	NE 20-002-09 W4M	Milk River						22-Aug-00	M38022.504522
[unknown]	SW 19-002-09 W4M	Milk River						23-Aug-00	M38022.504526
[unknown]	NE 27-003-10 W4M	Milk River						02-Sep-00	M38022.504528
[unknown]	NE 17-003-08 W4M	Milk River						03-Sep-00	M38022.504531
[unknown]	SW 12-003-10 W4M	Milk River						06-Sep-00	M38022.504539
[unknown]	SW 31-005-06 W4M	Milk River						03-May-01	M38022.504588
[unknown]	NW 07-005-06 W4M	Milk River						08-May-01	M38022.504589
[unknown]	NW 14-007-09 W4M	Milk River						14-Aug-01	M38022.504621

WATER WELLS RECOMMENDED FOR FIELD-VERIFICATION THAT MEET CRITERIA

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
Blanchard, Gordon	SE 31-011-08 W4M	Upper Surficial	13-Oct-86	22.6	74.0	13.7	45.0	M35377.136811
Calder, G.	01-18-010-10 W4M	Upper Surficial	01-Jan-31	31.7	104.0	17.4	57.0	M35377.135393
Calder, James V.	16-02-001-10 W4M	Upper Surficial	01-Jan-45	18.3	60.0	9.1	30.0	M35377.094896
Carlson, Harold	SE 09-008-09 W4M	Upper Surficial	12-Jul-77	7.3	24.0	3.1	10.0	M35377.129691
Ehnes, John	14-21-004-10 W4M	Milk River	26-May-69	218.2	716.0	39.6	130.0	M35377.118886
Flamme, D. E.	05-28-009-10 W4M	Milk River	01-Jan-20	288.3	946.0	6.1	20.0	M35377.130826
Gogolinski, Paul	SE 06-006-07 W4M	Upper Surficial	22-Nov-79	8.2	27.0	4.9	16.0	M35377.119104
Harty, Anton Nickolas	15-23-003-10 W4M	Milk River	01-Nov-68	237.7	780.0	51.8	170.0	M35377.128601
Harty, Richard	04-01-005-09 W4M	Milk River	31-May-77	219.5	720.0	12.2	40.0	M35377.119069
Harty, Richard	NW 01-005-09 W4M	Upper Surficial	02-Mar-73	13.1	43.0	6.1	20.0	M35377.119083
Haugan, Byron	07-35-005-07 W4M	Milk River	02-Dec-98	296.6	973.0	-0.3	-1.0	M36727.982579
Herbst, Charlie	SW 28-003-09 W4M	Lower Surficial	16-Sep-80	77.7	255.0	12.2	40.0	M35377.119101
Jetter, John	04-08-006-08 W4M	Milk River	01-Jan-71	227.1	745.0	-0.6	-2.0	M35377.119373
Klaudt, Herb	SE 09-008-08 W4M	Upper Surficial	17-Nov-78	12.2	40.0	4.6	15.0	M35377.129521
Lunseth, Gilbert	13-32-010-08 W4M	Upper Surficial	09-Jun-78	27.4	90.0	9.1	30.0	M35377.135696
Matson, Willie	SW 16-006-05 W4M	Upper Surficial	12-Dec-79	7.3	24.0	3.1	10.0	M35377.118897
Onody, A.	04-23-008-10 W4M	Upper Surficial	01-Dec-66	14.9	49.0	4.9	16.0	M35377.129840
Onody, Alex	SW 23-008-10 W4M	Upper Surficial	23-Jul-82	23.2	76.0	12.8	42.0	M35377.129838
Ost, Olander	NE 29-009-07 W4M	Foremost	01-Feb-86	103.6	340.0	33.5	110.0	M35377.129942
Rapson, H.	01-14-012-10 W4M	Lower Surficial	01-Jan-35	30.5	100.0	29.3	96.0	M35377.137446
Roeder, Gordon	09-17-011-09 W4M	Upper Surficial	11-Dec-79	8.5	28.0	6.1	20.0	M35377.136845
Solberg, Merlyn	NE 21-008-10 W4M	Upper Surficial	06-Oct-82	14.6	48.0	10.7	35.0	M35377.129833
Stuber, Emil	SE 20-006-05 W4M	Milk River	28-Feb-79	481.6	1580.0	106.7	350.0	M35377.119088
Stuber, Fred	NE 10-002-06 W4M	Foremost	30-Aug-69	51.8	170.0	21.3	70.0	M35377.097243
Verhaest, Fred	16-14-010-09 W4M	Foremost	31-Jul-81	24.4	80.0	91.4	300.0	M35377.135385
Webster, George	NW 30-007-06 W4M	Foremost	01-Jan-30	52.1	171.0	12.8	42.0	M35377.128171

FIELD-VERIFIED WATER WELLS RECOMMENDED FOR FURTHER TESTING

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
Bailie, Carson	SW 06-005-13 W4M	Milk River	27-Mar-90	179.8	590.0	2.1	7.0	M35377.082849
Bodnaruk, Betty	NE 18-006-08 W4M	Milk River	10-Jun-88	267.0	876.0	12.8	42.0	M35377.119454
Foss, Earl	NE 07-004-12 W4M	Milk River	15-Sep-88	234.7	770.0	67.1	220.0	M35377.128264
Frankish Farms Ltd.	NE 05-006-11 W4M	Milk River	07-Mar-90	222.8	731.0	61.0	200.0	M35377.083759
Gajdostik Farms	01-28-005-10 W4M	Milk River	19-Sep-00	243.8	800.0	19.0	62.5	M35377.119274
Halvorson, Harold	SW 13-004-10 W4M	Milk River	28-Dec-84	214.0	702.0	48.8	160.0	M35377.118795
Harty, Alan	SW 26-003-10 W4M	Milk River	23-Mar-90	224.3	736.0	57.9	190.0	M35377.082877
Harty, Gordon	SW 28-003-10 W4M	Milk River	30-Mar-90	218.8	718.0	59.4	195.0	M35377.082878
Hearn, Brad	SE 33-004-09 W4M	Milk River	30-Dec-89	243.8	800.0	48.8	160.0	M35377.083660
Henline, George	NW 20-001-10 W4M	Foremost	10-Dec-78	183.5	602.0	58.8	193.0	M35377.095001
Hirche, Reid	NW 11-004-08 W4M	Milk River	25-May-89	228.6	750.0	0.9	3.0	M35377.119205
Huisman, Lloyd	NW 31-007-11 W4M	Milk River	22-Nov-89	222.5	730.0	12.2	40.0	M35377.083677
Ivanics, Ed	NE 33-004-13 W4M	Milk River	08-Oct-88	195.1	640.0	12.2	40.0	M35377.118403
Kolesar, Edmund	NE 07-001-10 W4M	Foremost	24-Oct-89	205.7	675.0	23.1	75.6	M35377.084694
Krenzke, Ben	NW 09-003-07 W4M	Milk River	10-Jan-84	230.1	755.0	13.7	45.0	M35377.128311
Lee, David	NE 20-003-09 W4M	Milk River	24-Feb-89	223.1	732.0	45.7	150.0	M35377.119054
Mehlen, Don	NE 28-004-12 W4M	Milk River	11-Nov-88	222.5	730.0	61.0	200.0	M35377.128351
Metheral, Jack	NE 24-005-12 W4M	Milk River	05-Nov-88	201.2	660.0	31.1	102.0	M35377.128840
Mutschler, Melvin & Estelle	NE 16-004-06 W4M	Bedrock	23-Jan-90	289.6	950.0	3.1	10.0	M35377.083658
Newton, Don	SE 20-006-14 W4M		07-Feb-90	237.1	778.0	9.1	30.0	M35377.083761
O. K. Coloney	NW 23-004-13 W4M	Milk River	01-Oct-73	195.1	640.0	36.6	120.0	M35377.118394
Oss, Gene	SE 22-007-06 W4M	Milk River	24-Sep-88	448.0	1470.0	82.3	270.0	M35377.128131
Schmidt, John L.	NE 29-007-09 W4M	Milk River	26-Jul-86	262.7	862.0	6.7	22.0	M35377.086804
Slacka, Rudy	SW 19-006-12 W4M	Milk River	29-Apr-89	219.5	720.0	54.9	180.0	M35377.129258
Starbrite Colony	NW 25-004-12 W4M	Milk River	23-Jun-89	231.9	761.0	82.3	270.0	M35377.128338
Starbrite Colony	SE 36-004-12 W4M	Milk River	27-Sep-89	231.6	760.0	85.3	280.0	M35377.128395
Starbrite Colony	SW 36-004-12 W4M	Milk River	26-Apr-88	233.2	765.0	82.3	270.0	M35377.128400
Stickel, David	NE 20-008-06 W4M	Milk River	22-Aug-89	518.1	1700.0	147.8	485.0	M35377.086403
Stronsmog, Clays & Clint & Nyle	SW 12-006-09 W4M	Milk River	27-Mar-90	253.0	830.0	18.3	60.0	M35377.083757
Sun Rise Colony	NW 22-005-09 W4M	Milk River	08-Aug-88	249.9	820.0	27.4	90.0	M35377.119155
Syverson, Lorne	NE 23-006-10 W4M	Milk River	06-Jan-90	230.4	756.0	22.9	75.0	M35377.085938
Toth, Robert	NE 27-004-10 W4M	Milk River	20-Mar-89	225.5	740.0	42.7	140.0	M35377.119052
Unrau, Don	SW 19-006-13 W4M	Milk River	08-Aug-89	229.2	752.0	22.9	75.0	M35377.095361
Wiebe, Roger	SE 13-003-11 W4M	Milk River	31-Mar-90	217.9	715.0	20.6	67.6	M35377.085401

COUNTY OF FORTY MILE-OPERATED WATER WELLS

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
County of Forty Mile	16-15-006-09 W4M	Bedrock	14-Mar-95	37.2	122.0			M35377.076327
County of Forty Mile	NW 26-006-14 W4M	Bedrock	03-Mar-00	207.3	680.0	-3.1	-10.0	M35377.118480
County of Forty Mile	05-24-005-06 W4M	Bedrock	01-Mar-73	335.3	1100.0	30.5	100.0	M35377.128310
County of Forty Mile	04-10-006-10 W4M	Bedrock	01-Jan-59	231.6	760.0	19.8	65.0	M35377.129106
County of Forty Mile	06-07-007-06 W4M	Foremost	25-Mar-93	91.4	300.0			M35377.130850
County of Forty Mile	NE 12-006-08 W4M	Lea Park	10-Mar-95	92.4	303.0			M35377.076328
County of Forty Mile	04-27-004-08 W4M	Lower Surficial	15-Mar-95	48.8	160.0	11.3	37.0	M35377.076324
County of Forty Mile	16-03-004-10 W4M	Milk River	01-Jul-67	225.5	740.0	38.1	125.0	M35377.118732
County of Forty Mile	NE 14-006-09 W4M	Milk River	20-Sep-84	263.6	865.0	19.8	65.0	M35377.129007
County of Forty Mile	SW 22-006-10 W4M	Milk River	22-Jul-80	252.4	828.0			M35377.129114
County of Forty Mile	11-24-005-06 W4M	Milk River	01-Sep-98	298.1	978.0	44.6	146.2	M36727.981863
County of Forty Mile	NW 24-005-06 W4M	Surficial		33.5	110.0	22.9	75.0	M35377.128323
County of Forty Mile	13-13-006-05 W4M	Surficial	28-Mar-93	85.3	280.0	24.4	80.0	M35377.139612
County of Forty Mile	14-12-006-08 W4M	Upper Surficial	11-Mar-95	70.1	230.0	14.9	49.0	M35377.076329
County of Forty Mile	16-12-006-09 W4M	Upper Surficial	09-Mar-95	49.4	162.0	7.3	24.0	M35377.076330