Mountain View County

Part of the Red Deer River Basin
Parts of Tp 029 to 034, R 26 to 29, W4M and R 01 to 07, W5M
Regional Groundwater Assessment

Prepared for

In conjunction with

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Prairie Farm Rehabilitation Administration | Administration du rétablisseme agricole des Prairies

Prepared by
hydrogeological consultants ltd.
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HYDROGEOLOGICAL CONSULTANTS LTD.

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The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

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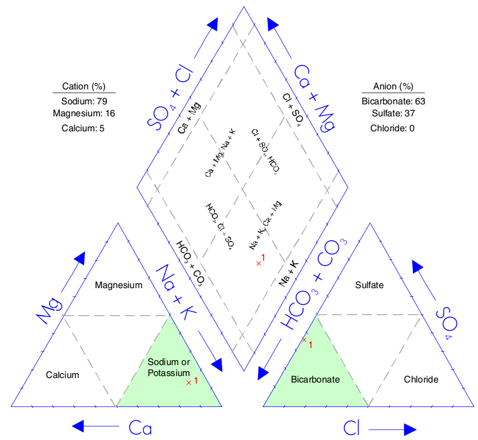
Glossary

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
Dewatering	the removal of groundwater from an aquifer for purposes other than use
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)
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
km	kilometre
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	metres
mm	millimetres
m^2/day	metres squared per day
m^3	cubic metres
m^3/day	cubic metres per day
mg/L	milligrams per litre
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
Thalweg	the line connecting the lowest points along a stream bed or valley; *longitudinal profile*
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” 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
AENV	Alberta Environment
AMSL	above mean sea level
DEM	Digital Elevation Model
DST	drill stem test

EUB	Alberta Energy and Utilities Board
GCDWQ	Guidelines for Canadian Drinking Water Quality
NPWL	non-pumping water level
PFRA	Prairie Farm Rehabilitation Administration
TDS	Total Dissolved Solids
WSW	Water Source Well or Water Supply Well

I. 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 Mountain View County in managing their groundwater. It is also a guide for future groundwater-related projects.**

A. Purpose

This project is a regional groundwater assessment of Mountain View County prepared by Hydrogeological Consultants Ltd. (HCL) with financial assistance from Prairie Farm Rehabilitation Administration (PFRA). 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 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 being used in the regional groundwater assessment for Mountain View County.

[1] See glossary
[2] See glossary

B. 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 Training 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.

C. About This Report

This report provides an overview of (a) the groundwater resources of Mountain View County, (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 to be 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, and ArcView files. Likewise, all of the illustrations and maps from the present report, plus additional maps, figures and cross-sections, are available on the CD-ROM. 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.

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 new Water Act
3) a flow chart showing the licensing of a groundwater diversion under the new 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 new 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 recommended for field verification.

[3] See glossary

II. INTRODUCTION

A. Setting

Mountain View County is situated in south-central Alberta. Most of this area is part of the Alberta Plains region, with the western part of the County being part of the Foothills Belt. The County is within the Red Deer River basin; a small part of the County's northern boundary is the James River. The other County boundaries follow township or section lines. The area includes parts of the area bounded by township 029, range 06, W5M in the southwest and township 034, range 27, W4M in the northeast.

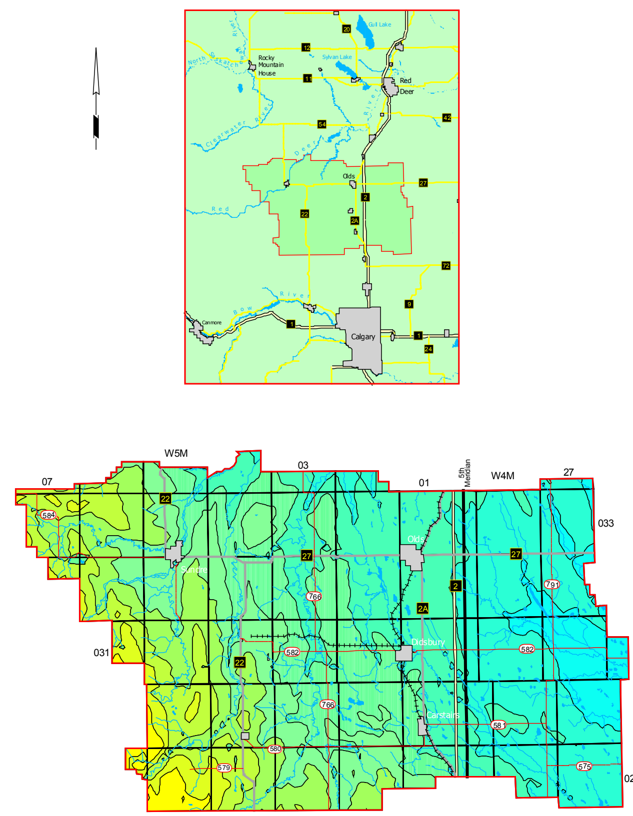


Figure 1. Index Map

Regionally, the topographic surface varies between 900 and 1,350 metres above mean sea level (AMSL). The lowest elevations occur mainly in the eastern part of the County in townships 030 and 31, range 27, W4M and the highest are in the western parts of the County as shown on Figure 1 and page A-2. The area is well drained by numerous streams.

B. Climate

Mountain View County lies within the Dfb 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 Leggatt, 1981) shows that the County is located in both Low and Mid Boreal Mixedwood regions and the Aspen Parkland region. Increased precipitation and cooler temperatures, resulting in additional moisture availability, influence this vegetation change.

A Dfb climate consists of long, cool summers and severe winters. The mean monthly temperature drops below -3° C in the coolest month, and exceeds 10° C in the warmest month.

The mean annual precipitation averaged from three meteorological stations within the County measured 483 millimetres (mm), based on data from 1962 to 1993. The mean annual temperature averaged 3.1° C, with the mean monthly temperature reaching a high of 15.0° C in July, and dropping to a low of -9.8° C in January. The calculated annual potential evapotranspiration is 495 millimetres.

4 See glossary

C. Background Information

1) Number, Type and Depth of Water Wells

There are currently records for 7,827 water wells in the groundwater database for the County. Of the 7,827 water wells, 6,908 are for domestic/stock purposes. The remaining 919 water wells were completed for a variety of uses, including industrial, municipal, observation, injection, irrigation, investigation and dewatering. Based on a rural population of 11,277 (Phinney, 1999), there are 2.7 domestic/stock water wells per family of four. It is unknown how many of these water wells may still be active. The domestic or stock water wells vary in depth from 0.60 metres to 177 metres below ground level. Details for lithology[5] are available for 4,882 water wells.

2) Number of Water Wells in Surficial and Bedrock Aquifers

There are 4,114 water well records with sufficient information to identify the aquifer in which the water wells are completed. 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 4,114 water wells for which aquifers could be defined, 431 are completed in surficial aquifers, with 80% having a completion depth of less than 30 metres. The adjacent map shows that the water wells completed in the surficial deposits occur mainly in the vicinity of the Town of Sundre in the northwestern part of the County.

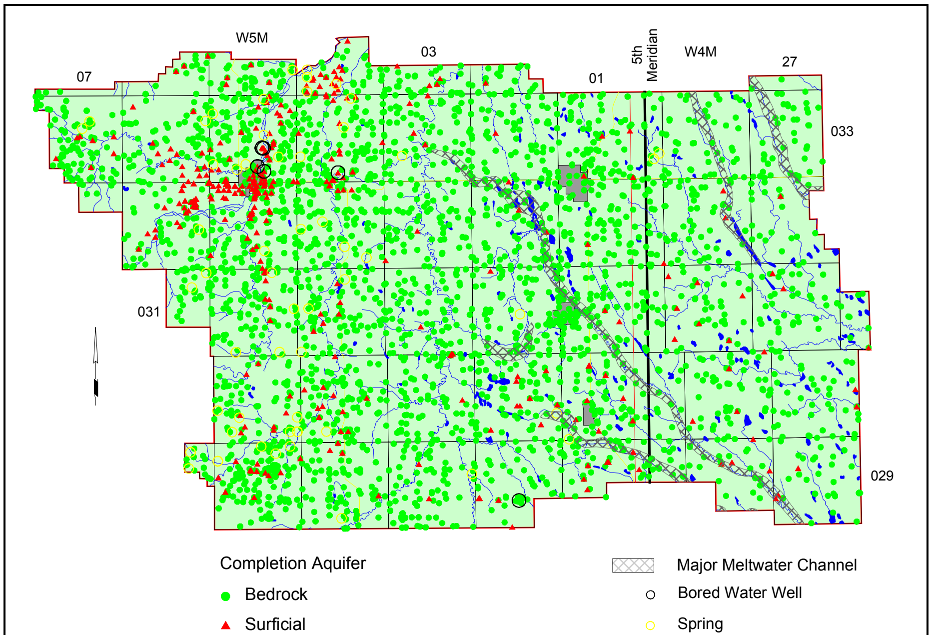


Figure 2. Location of Water Wells

The 3,683 water wells that have the top of their completion interval deeper than the top of the bedrock are referred to as bedrock water wells. From Figure 2, it can be seen that water wells completed in bedrock aquifers occur throughout the County.

There are currently records for 63 springs in the groundwater database, located mainly in the vicinity of the Red Deer River and the Little Red Deer River valleys. Two-thirds of the 27 available chemical values for springs have total dissolved solids (TDS) concentrations of less than 500 milligram per litre (mg/L).

[5] See glossary

3) Casing Diameter and Type

Data for casing diameters are available for 4,777 water wells, with 4,768 (99%) indicated as having a diameter of less than 275 mm and nine having a diameter of more than 275 mm. The casing diameters of greater than 275 mm are mainly bored or dug water wells and those with a surface-casing diameter of less than 275 mm are drilled water wells. There are only nine large-diameter or bored water wells in the County and they are mainly in the areas where major meltwater channels are present in association with major river valleys as shown on Figure 2.

In the County, steel, galvanized steel and plastic represent 99% of the materials that have been used for surface casing in drilled water wells over the last 40 years. Until the 1960s, the type of surface casing used in drilled water wells was mainly undocumented. Steel casing was in use in the 1950s and is still used in 98% of the water wells being drilled in the County in the 1990s. Steel is the main casing type used since surface casing type has been documented.

Galvanized steel and plastic surface casing have been used in less than 2% of the new water wells; galvanized steel was last used in September 1983.

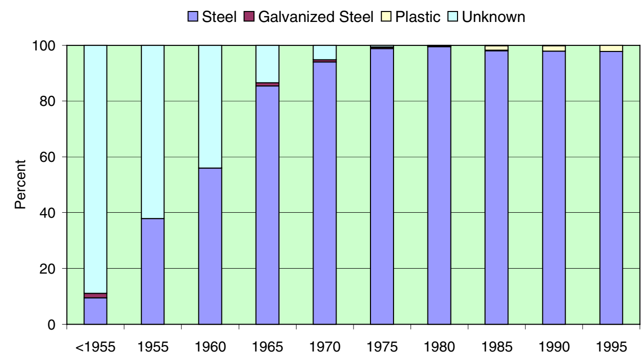


Table 1. Surface Casing Types used in Drilled Water Wells

4) Requirements for Licensing

Water wells used for household needs in excess of 1,250 cubic metres per year and providing groundwater with TDS of less than 4,000 mg/L must be licensed. At the end of 1999, 288 groundwater allocations were licensed in the County. Of the 288 licensed groundwater users, 193 could be linked to the AENV groundwater database. Of the 288 licensed groundwater users, 249 are for agricultural purposes, and the remaining 39 are for municipal, industrial, commercial, recreation, exploration and dewatering purposes. The total maximum authorized diversion from the water wells associated with these licences is 6,519 cubic metres per day (m^3/day), although actual use could be less. Of the 6,519 m^3/day, 51% is allotted for agricultural use, and 40% is allotted for municipal use. The remaining 9% has been licensed for industrial, commercial, recreation and dewatering use as shown in Table 2 on the following page; a figure showing the locations of the licensed users can be found in Appendix A (page A-4) and on the CD-ROM.

The largest potable groundwater allocation within the County is for the Town of Sundre, having a diversion of 1,352 m^3/day. The water supply well, used for municipal purposes, is completed in the Sand and Gravel Aquifer.

The following table shows a breakdown of the 288 licensed groundwater allocations by the aquifer in which the water well is completed. The largest total licensed allocations are in the Dalehurst and Lacombe aquifers; the majority of the groundwater is used for agricultural and municipal purposes.

Aquifer **	No. of Diversions	Licensed Groundwater Users* (m³/day) Agricultural	Commerical	Industrial	Municipal	Recreation	Dewatering	Total	Percentage
Sand and Gravel	13	116	0	0	1,352	0	64	1,532	23
Disturbed Aquifer	2	10	0	0	0	0	0	10	0
Dalehurst	137	1,207	124	159	1,233	27	0	2,750	42
Lacombe	99	1,744	27	37	24	0	0	1,832	28
Bedrock	7	66	0	122	0	0	0	188	3
Unknown	30	207	0	0	0	0	0	207	3
Total	288	3,350	151	318	2,609	27	64	6,519	100
Percentage		51	2	5	40	0	1	100	

* - data from AENV ** - identification of Aquifer by HCL

Table 2. Licensed Groundwater Diversions

Based on the 1996 Agriculture Census, the calculated water requirement for livestock for the County is in the order of 22,095 m³/day. Of the 22,095 m³/day average calculated livestock use, AENV has licensed a groundwater diversion of 3,350 m³/day (15%) and a licensed surface-water diversion of 1,227 m³/day (6%). The remaining 79% of the calculated livestock use would have to be mainly from unlicensed sources.

5) Groundwater Chemistry and Base of Groundwater Protection

Groundwaters from the surficial deposits can be expected to be chemically hard with a high dissolved iron content. High nitrate and nitrite (as N) were not evident in the available chemical data for the surficial or upper bedrock aquifer(s); a plot of nitrate and nitrite (as N) in surficial aquifers is on the accompanying CD-ROM. The TDS concentrations in the groundwaters from the upper bedrock in the County are generally less than 1,500 mg/L. Groundwaters from the bedrock aquifers frequently are chemically soft with generally low concentrations of dissolved iron. The chemically soft groundwater is high in sodium concentration. More than 15% of the chemical analyses indicate a fluoride concentration above 1.5 mg/L, with most the exceedances occurring in the eastern part of the County (see CD-ROM).

The minimum, maximum and average 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 Guidelines for Canadian Drinking Water Quality (GCDWQ) in Table 3. Of the five constituents compared to the GCDWQ, average values of TDS and sodium concentrations exceed the guidelines.

Constituent	Range for County in mg/L Minimum	Maximum	Average	Recommended Maximum Concentration GCDWQ
Total Dissolved Solids	102	6032	857	500
Sodium	0	1495	222	200
Sulfate	0	3800	217	500
Chloride	<1	1038	14	250
Fluoride	0	5.9	0.8	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)

GCDWQ - Guidelines for Canadian Drinking Water Quality, Sixth Edition Minister of Supply and Services Canada, 1996

Table 3. Concentrations of Constituents in Groundwaters from Upper Bedrock Aquifer(s)

Alberta Environment (AENV) defines the Base of Groundwater Protection as the elevation below which the groundwater is expected to have more than 4,000 mg/L of total dissolved solids. By using the ground elevation, and the elevation of the Base of Groundwater Protection provided by the Alberta Energy and Utilities Board (EUB), a depth to the Base of Groundwater Protection can be determined. These values are gridded using the Kriging[6] 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 total dissolved solids exceeding 4,000 mg/L, the groundwater use does not require licensing by AENV. In the County, the depth to Base of Groundwater Protection ranges from less than 300 metres to more than 1,100 metres below ground level, as shown on Figure 3.

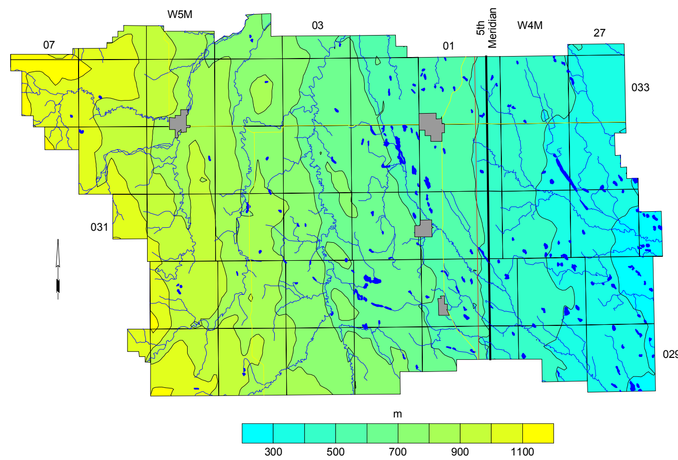


Figure 3. Depth to Base of Groundwater Protection (after EUB, 1995)

Of the 4,114 water wells with completed depth data, none are completed below the Base of Groundwater Protection and of the 2,418 values for TDS available, only two exceed 4,000 mg/L.

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 two AENV-operated observation water wells within the County. Additional data can be obtained from some of the licensed groundwater diversions. In the past, the data for licensed diversions have been difficult to obtain from AENV, in part because of the failure of the licensee to provide the data.

However, 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.

6 See glossary

III. TERMS

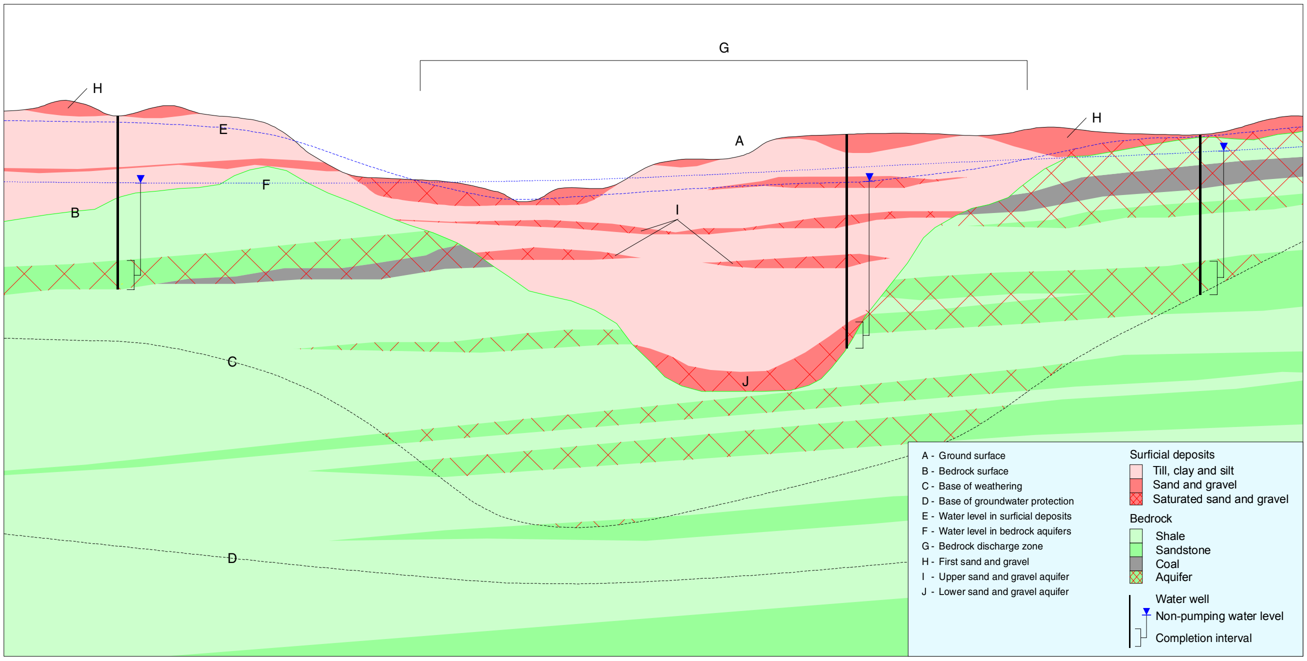


Figure 4. Generalized Cross-Section (for terminology only)

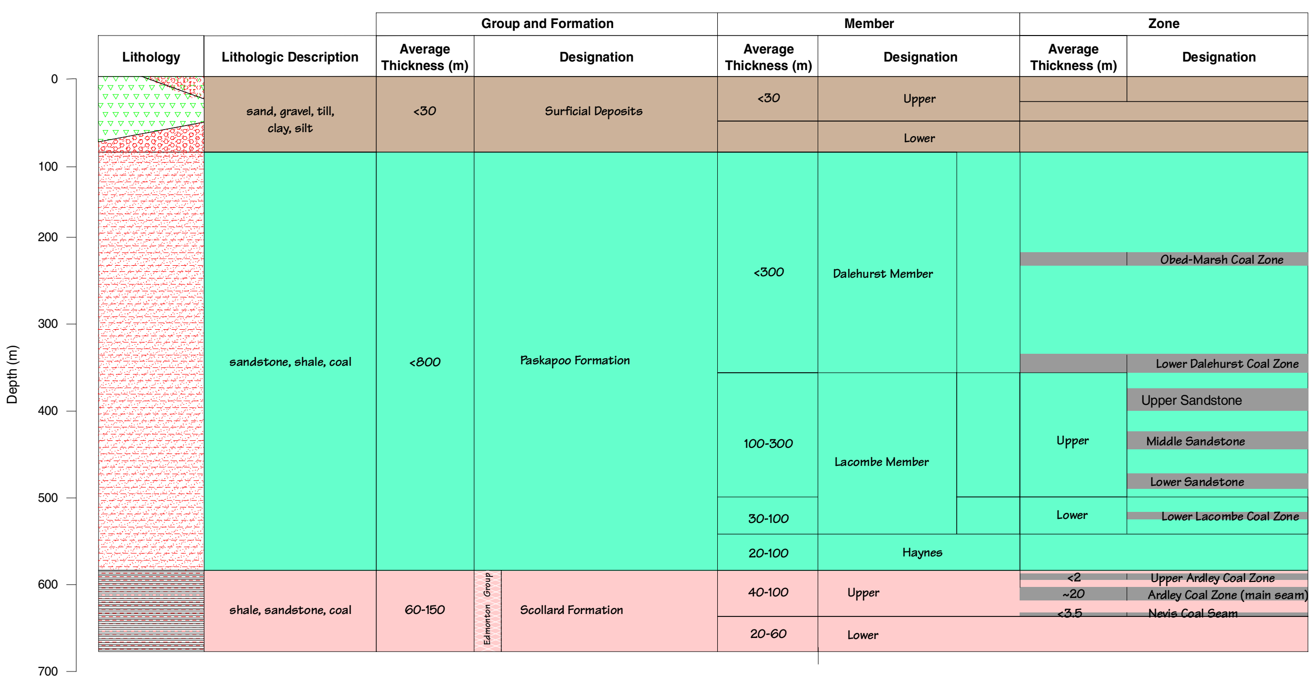


Figure 5. Geologic Column

IV. METHODOLOGY

A. 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) location of some springs
4) water well locations determined during water well surveys
6) chemical analyses for some groundwaters
7) location of flowing shot holes
8) location of structure test holes
9) a variety of data related to the groundwater resource.

The main disadvantage to the database is the absence of quality control. 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. The present database for the County contains a possible 200 duplicate water well IDs.

The AENV groundwater database uses a 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. This means that a record for the SE ¼ of section 04, township 033, range 05, W5M, would have a horizontal coordinate with an Easting of 24,512 metres and a Northing of 5,736,178 metres, the centre of the quarter section. If the water well has been repositioned by PFRA using orthorectified aerial photos, 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); the Resource Data Division of AENV 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 for the following:

1) depth to bedrock
2) total thickness of sand and gravel
3) thickness of first sand and gravel when present within one metre of ground surface
4) total thickness of saturated sand and gravel
5) depth to the top and bottom of completion intervals.

Also, where sufficient information is available, values for apparent transmissivity[7] and apparent yield[8] 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 hydrogeology map was published in 1978 (Ozoray and Barnes, 1978), 980 values for apparent transmissivity and 783 values for apparent yield have been added to the groundwater database. With the addition of the apparent yield values, a hydrogeological map has been prepared to help illustrate the general groundwater availability across the County.

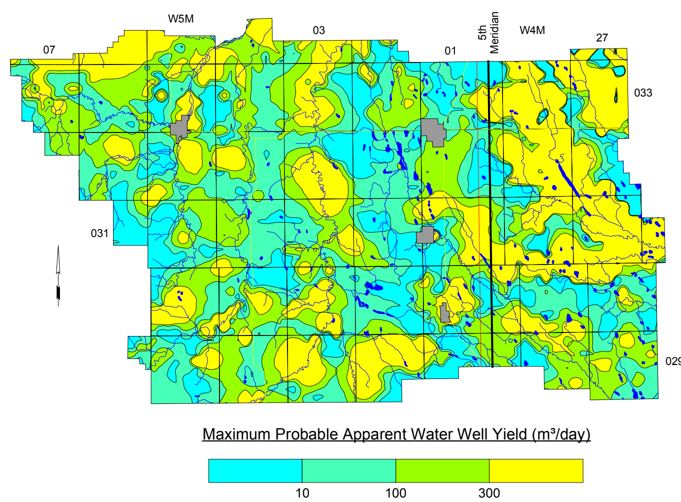


Figure 6. Hydrogeological Map

The EUB well database includes records for all of the wells drilled by 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, apparent yield and hydraulic conductivity 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.

7 For definitions of Transmissivity, see glossary
8 For definitions of Yield, see glossary

B. 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) 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.

C. 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 interval of a water well cannot be established unequivocally, 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 non-pumping (static) water level (NPWL), apparent transmissivity if neither aquifer nor effective volumes are available, and apparent water well yield. The total dissolved solids, sulfate and chloride concentrations from the chemical analysis of the groundwater 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). Since 1986, Alberta Health and Wellness has restricted access to chemical analysis data, and hence the database includes only limited amounts of chemical data since 1986.

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. Even when only limited data are available, grids are prepared. However, the data from these grids must be used with extreme caution because the gridding process can be unreliable.

D. 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. The areal extent of individual parameters is outlined by “masks” to delineate individual aquifers. 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 NPWLs. 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. These cross-sections are presented in this report and as poster-size drawings forwarded with this report. The cross-sections also are in Appendix A, and are included on the CD-ROM; page-size maps of the poster-size cross-sections are included in Appendix D of this report.

E. Software

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

- Acrobat 4.0
- ArcView 3.1
- AutoCAD 14.01
- CorelDRAW! 8.0
- Microsoft Professional Office 2000
- Surfer 6.04

V. AQUIFERS

A. Background

An aquifer is a porous and permeable rock that is saturated. If the NPWL is above the top of the rock unit, this type of aquifer is an artesian aquifer. If the rock unit is not entirely saturated and the water level is below the top of the 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 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.

1) Surficial Aquifers

Surficial deposits in the County are mainly less than 30 metres thick, except in areas of linear bedrock lows where the thickness of the surficial deposits can exceed 30 metres. There are no significant buried linear bedrock lows in the County; the linear bedrock lows are present in the form of meltwater channels. These meltwater channels are mainly located in the eastern third of the County and extend northwest to southeast. Cross-section A-A' passes through the towns of Sundre and Olds, and across parts of three meltwater channels, and shows a maximum thickness of surficial deposits of slightly less than 50 metres.

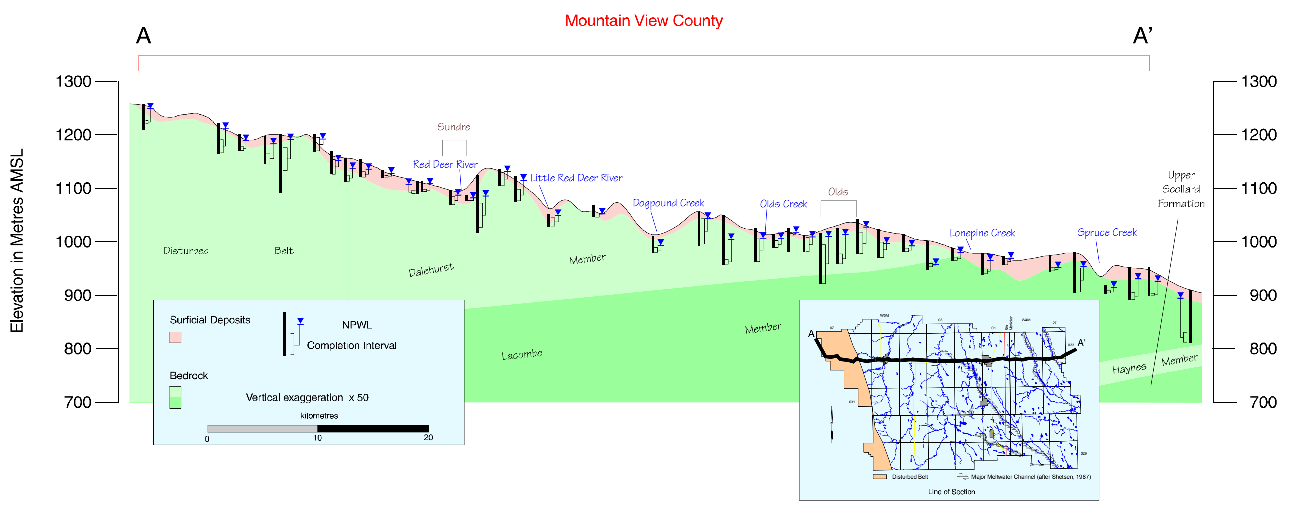


Figure 7. Cross-Section A - A'

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 NPWL in water wells that are less than 15 metres deep. Tshe base of the surficial deposits is the bedrock surface.

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. The groundwater from an aquifer in the surficial deposits usually has a chemical 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.

Within the County, casing-diameter information is available for 415 of the 431 water wells completed in the surficial deposits; two percent of these have a casing diameter of more than 275 millimetres, and are assumed to be bored or dug water wells.

2) Bedrock Aquifers

The upper bedrock includes the Disturbed Belt, and the Dalehurst and Lacombe members of the Paskapoo Formation. The Haynes Member and the upper part of the Scollard Formation underlie the Lacombe Member. The upper bedrock includes rocks that are less than 200 metres below the bedrock surface and above the Haynes Member. 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[9] and water well screens are a necessity. The groundwater from the bedrock aquifers is usually chemically soft.

The data for 3,683 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. Within the County, casing-diameter information is available for 3,584 of the 3,683 water wells completed below the top of bedrock. Of these 3,584 water wells, 99% have surface-casing diameters of less than 275 mm and these bedrock water wells have been mainly completed with either a perforated liner or as open hole; there are 39 bedrock water wells completed with a water well screen.

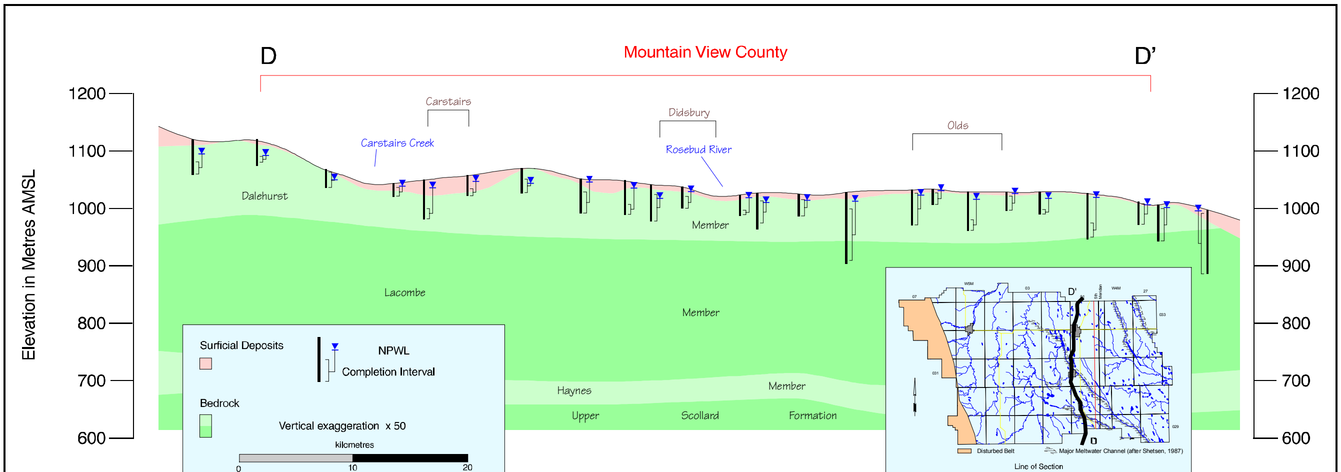


Figure 8. Cross-Section D - D'

9 See glossary

B. Aquifers in Surficial Deposits

The surficial deposits are the sediments above the bedrock surface. This includes 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[10] and lacustrine[11] deposits. The lacustrine deposits include clay, silt and fine-grained sand. The *upper surficial deposits* include the more traditional glacial deposits of till[12] and meltwater deposits. In the County, no lower surficial deposits have been defined to date and the upper surficial deposits include mainly till.

1) Geological Characteristics of Surficial Deposits

While the surficial deposits are treated as one hydrogeological unit, they are not usually one continuous unit. Sand or gravel deposits in the upper surficial deposits typically occur as pockets, except in linear bedrock lows where a sand or gravel deposit may be several hundred metres wide and continuous over a distance of several tens of kilometres. The sand and gravel deposits associated with linear bedrock lows are usually saturated, where present. The sand and gravel deposits that occur higher in the stratigraphic section, and tend to occur as pockets, may or may not be saturated. For a graphical depiction of the above description, please refer to Figure 4, Page 8. While the unsaturated deposits are not technically an aquifer, they are significant as they provide a pathway for liquid contaminants to move downward into the groundwater.

The base of the surficial deposits is the bedrock surface, represented by the bedrock topography as shown on the adjacent map. Over the majority of the County, the surficial deposits are less than 30 metres thick (page A-14). The exceptions are mainly in association with areas where major meltwater channels are present, where the deposits can have a maximum thickness of close to 50 metres.

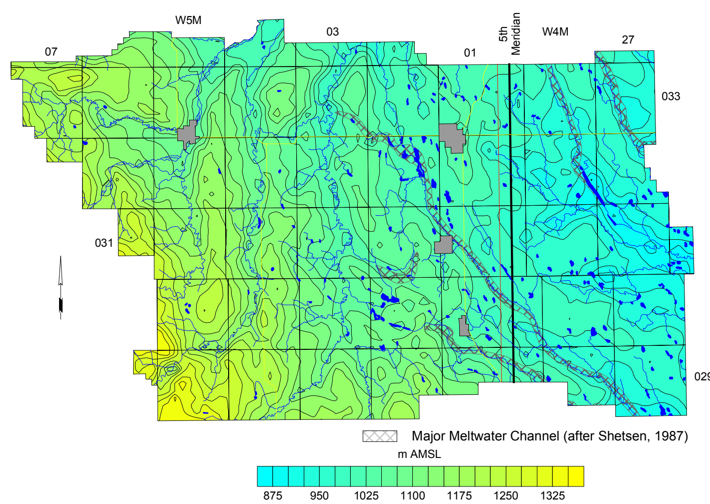


Figure 9. Bedrock Topography

There are no defined buried bedrock valleys in the County, but the major meltwater channels in the County have been outlined as per Shetsen (1987). These lows trend mainly northwest to southeast in the County and mainly occur along creek and river valleys.

Sand and gravel deposits can occur throughout the surficial deposits. The total thickness of sand and gravel deposits is generally less than two metres but can be more than five metres in the areas of major meltwater channels.

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10 See glossary
11 See glossary
12 See glossary

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 25% of the County, the sand and gravel deposits, where present, are more than 30% of the total thickness of the surficial deposits (page A-16). The areas where sand and gravel deposits constitute more than 30% of the total thickness of the surficial deposits are mainly in the western part of the County and in the areas of the major meltwater channels in the eastern part of the County.

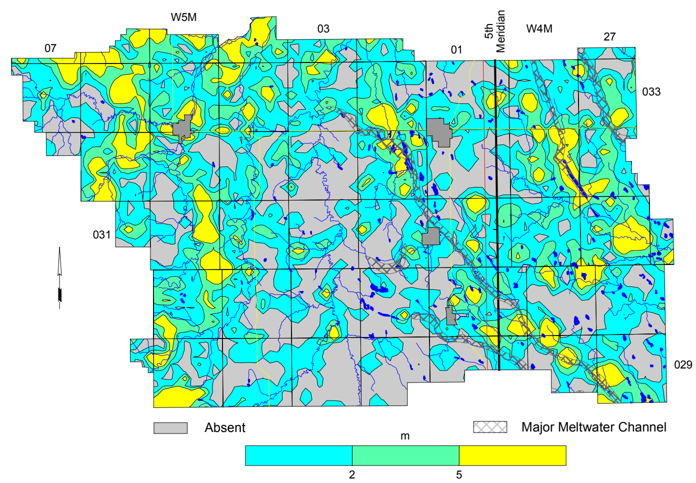

Figure 10. Thickness of Sand and Gravel Deposits

One source of groundwater in the County includes aquifers in the surficial deposits. Since the sand and gravel aquifer(s) are not everywhere, the actual aquifer that is developed at a given location is usually dictated by the aquifer that is present.

From the present hydrogeological analysis, 424 water wells are completed in aquifers in the surficial deposits. This number of 424 water wells is slightly less than the number (431), based on lithologies given on the water well drilling reports. This situation is unlike other areas in the Province. The main reasons for the difference are (1) there are very few water wells completed in surficial deposits; and (2) the lithologies have been re-interpreted on some drilling reports based on the data from other bedrock control.

Water wells completed in the surficial deposits are sporadic throughout the project area, but are mainly concentrated in the vicinity of the Town of Sundre as shown on the figures completed for the surficial deposits (see Appendix A and the CD-ROM).

a) Chemical Quality of Groundwater from Surficial Deposits

The chemical analysis results of groundwaters from the sand and gravel aquifers in the surficial deposits indicate the groundwaters are generally chemically hard and high in dissolved iron. In Mountain View County, groundwaters from the surficial aquifers mainly have a chemical hardness of less than 400 mg/L.

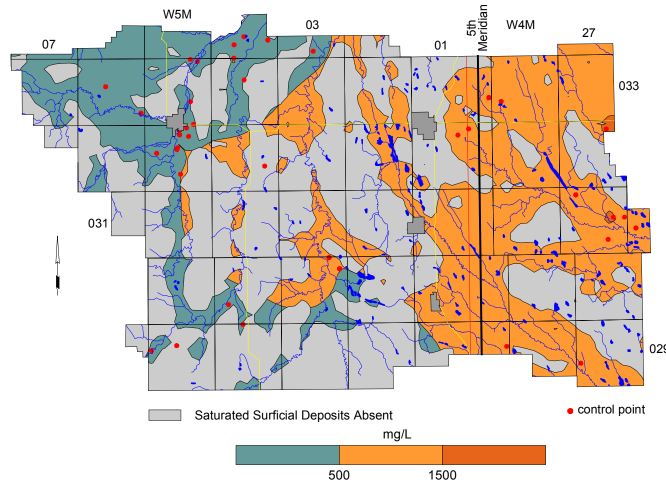

Figure 11. Total Dissolved Solids in Groundwater from Surficial Deposits

The Piper tri-linear diagrams [13] (see Appendix A) show the groundwaters from the surficial deposits are mainly calcium-magnesium-bicarbonate or sodium-bicarbonate-type waters. The records with the sodium-bicarbonate waters were individually checked in the database to confirm the completion aquifer. Sixty percent of the groundwaters have a TDS concentration of less than 500 mg/L. The groundwaters with a TDS concentration of less than 500 mg/L occur mainly near the Town of Sundre, where there are the greatest number of control points, as shown on Figure 10. The large expanse showing TDS concentrations ranging between 500 and 1,500 mg/L is a result of gridding a limited amount of data available for that area. Seventy-two percent of the groundwaters from the surficial deposits have dissolved iron concentrations of less than 1 mg/L.

Although the majority of the groundwaters are bicarbonate-type waters, there are groundwaters from the surficial deposits with sulfate as the main anion. 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 and in most of the County, the chloride ion concentration is mainly less than 50 mg/L.

In the County, the nitrate + nitrite (as N) concentrations in the groundwaters from the surficial deposits do not exceed the maximum acceptable concentrations (MAC) of 10 mg/L (see CD-ROM).

The minimum, maximum and average 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 Guidelines for Canadian Drinking Water Quality (GCDWQ) in the adjacent table. Of the five constituents that have been compared to the GCDWQ, only the average values of TDS concentrations exceed the guidelines.

Constituent	Range for County in mg/L Minimum	Maximum	Average	Recommended Maximum Concentration GCDWQ
Total Dissolved Solids	204	1671	650	500
Sodium	1	476	102	200
Sulfate	6	643	163	500
Chloride	<1	87	10	250
Nitrate + Nitrite (as N)	<0.05	5.7	0.5	10

Concentration in milligrams per litre unless otherwise stated
Note: indicated concentrations are for Aesthetic Objectives

GCDWQ - Guidelines for Canadian Drinking Water Quality, Sixth Edition
Minister of Supply and Services Canada, 1996

Table 4. Concentrations of Constituents in Groundwaters from Surficial Aquifers

[13] See glossary

2) Sand and Gravel Aquifer(s)

a) Aquifer Thickness

These aquifers can directly overlie or be close to the bedrock surface. Saturated sand and gravel deposits are not continuous but are expected over approximately 20% of the County. The thickness of the 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. Since the non-pumping water-level surface in the surficial deposits tends to be a subdued replica of the bedrock surface, the thickness of the Sand and Gravel Aquifer tends to be directly proportional to the thickness of the surficial deposits. In the County, the thickness of the sand and gravel aquifer(s) is generally less than two metres, but can be more than five metres in areas of major meltwater channels (page A-17).

b) Apparent Yield

The permeability of the 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 apparent yields of the water wells are limited. The apparent yields for water wells completed in this Aquifer are expected to be mainly less than 500 m³/day, except adjacent to parts of the Red Deer River in the northwestern part of the County as shown on Figure 12. Higher yields present in the eastern part of the County could be a result of the gridding procedure used to process a very limited number of data points. Licensed water wells completed in the Sand and Gravel Aquifer are also shown on the figure. Where the 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 yields and quality of groundwater from the bedrock aquifers are suitable.

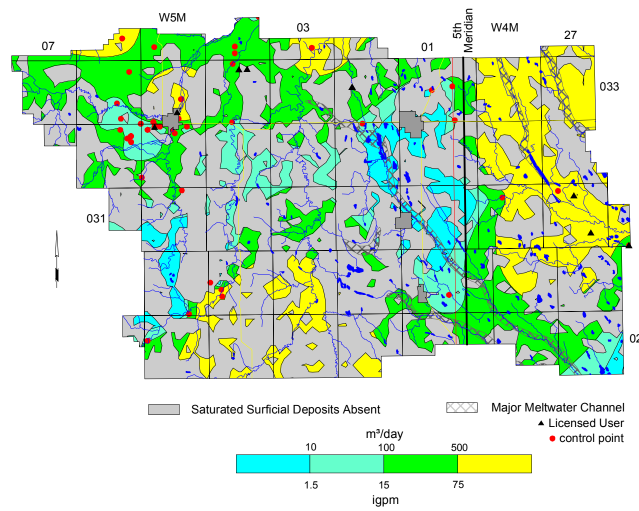

Figure 12. Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)

A Town of Sundre water supply well completed in the Sand and Gravel Aquifer in 03-10-033-05 W5M is authorized to divert a total of 1,352 m³/day. Although the Town is located adjacent to the Red Deer River, there are no data available to indicate that there is direct hydraulic continuity between the Sand and Gravel Aquifer and the Red Deer River.

A preliminary recovery-only aquifer test was conducted by Alken Basin Drilling with the new Village of Cremona Water Supply Well (WSW) No. 12 on 05 Apr 2000. The new water supply well is completed in the Sand and Gravel Aquifer in NW 08-030-04 W5M and was drilled in an attempt by the Village to find a suitable water source to meet the Village's needs. The results of the aquifer test conducted with WSW No. 12 indicated an apparent yield of more than 2,700 m³/day based on an apparent transmissivity of 465 m²/day. An extended aquifer test with WSW No. 12 will be completed by the end of October 2000.

Groundwater from the Cremona WSW No. 12 is a bicarbonate-type with no dominant cation, has a TDS concentration of 367 mg/L, a total hardness concentration of 211 mg/L, a sulfate concentration of 13 mg/L, and a chloride concentration of 1.3 mg/L.

C. Bedrock

1) Geological Characteristics

The upper bedrock in the County is the Paskapoo Formation. The Paskapoo Formation consists of cycles of thick, tabular sandstones, siltstone and mudstone layers (Glass, 1990). The maximum thickness of the Paskapoo Formation can be 800 metres, but in the County, the thickness is from 0 to 550 metres. A generalized geologic column is illustrated on Figure 5, Appendix A and on the CD-ROM.

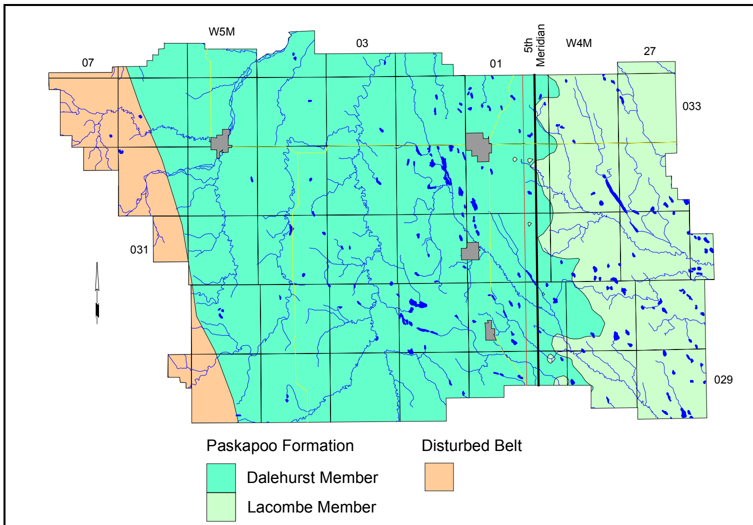

Figure 13. Bedrock Geology

The Paskapoo Formation is the upper bedrock and subcrops in all the County, with the exception of the area in the foothills region that is referred to as the Disturbed Belt.

The Disturbed Belt is the upper bedrock in the extreme western part of the County. The outline of the Disturbed Belt has been defined based on the Geological Map of Alberta (Hamilton et al, 1999 and Green, 1972). The Rocky Mountains and Foothills together form the Disturbed Belt, an area that has been deformed by folding and thrust faulting (Tokarsky, 1971). Water wells that were located within the Disturbed Belt boundary were defined as being completed in surficial deposits or in the Disturbed Belt Aquifer.

The Paskapoo Formation in central Alberta consists of the Dalehurst, Lacombe and Haynes members (Demchuk and Hills, 1991). In the County, only the Dalehurst and Lacombe members of the Paskapoo Formation are the upper bedrock. The Edmonton Group underlies the Paskapoo Formation. The Edmonton Group includes the Scollard, Battle, Whitemud and Horseshoe Canyon formations.

The Dalehurst Member is the upper bedrock and subcrops mainly west of the 5th Meridian. This Member has a maximum thickness of 300 metres within the County and is mostly composed of shale and siltstone with sandstone, bentonite and coal seams or zones. Two prominent coal zones within the Dalehurst are the Obed-Marsh Coal (up to 30 metres thick) and the Lower Dalehurst Coal (up to 50 metres thick). The bottom of the Lower Dalehurst Coal is the border between the Dalehurst and Lacombe members (Demchuk and Hills, 1991).

The Lacombe Member underlies the Dalehurst Member and subcrops east of the 5th Meridian, within the County border. The Lacombe Member has a maximum thickness of 350 metres. The upper part of the Lacombe Member is mostly composed of shale interbedded with sandstone and has a maximum thickness of 250 metres. The lower part of the Lacombe Member is composed of sandstone and coal layers. In the middle of the lower part of the Lacombe Member there is a coal zone, which can be up to five metres thick. The lower part of the Lacombe Member has a maximum thickness of 100 metres. The Lacombe Member has a maximum thickness of 250 metres within the County.

The Haynes Member underlies the Lacombe Member, has a maximum thickness of 100 metres and is composed mainly of sandstone with some siltstone, shale and coal.

The Scollard Formation underlies the Haynes Member, has a maximum thickness of 160 metres and has two separate designations: Upper and Lower. The Upper Scollard consists mainly of sandstone, siltstone, shale and coal seams or zones. Two prominent coal zones within the Upper Scollard are the Ardley Coal (up to 20 metres thick) and the Nevis Coal (up to 3.5 metres thick). The bottom of the Nevis Coal Seam is the border between the Upper and Lower Scollard formations. The Lower Scollard Formation has an average thickness of 40 metres in the County, and is composed mainly of shale and sandstone.

There will be no direct review of either the Haynes Member or the Scollard Formation in the text of this report because there are no water wells that extend into either the Haynes Member or the Scollard Formation; the only maps associated with the Haynes Member or the Scollard Formation to be included on the CD-ROM will be structure-contour maps.

In the County, the Base of Groundwater Protection extends below the Haynes Member. A map showing the depth to the Base of Groundwater Protection is given on page 7 of this report, in Appendix A, and on the CD-ROM.

2) Aquifers

Of the 7,827 water wells in the database, 3,683 were defined as being completed below the top of bedrock. However, at least a reported completion depth is available for the majority of water wells and assigning the water well to specific geologic units 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 if the total drilled depth of a water well was more than ten metres below the top of a particular geologic unit, the water well was assigned to the particular geologic unit. With this assumption, it has been possible to designate the aquifer of completion for 3,254 additional water wells. There are 78 water wells that have been identified as being completed in more than one bedrock aquifer.

Geologic Unit	No. of Water Wells
Disturbed Belt	520
Dalehurst	4,851
Lacombe	1,488
Multiple Completions	78
Total	6,937

Table 5. Completion Aquifer

The bedrock water wells are mainly completed in the Dalehurst and Lacombe aquifers, as shown in the above table.

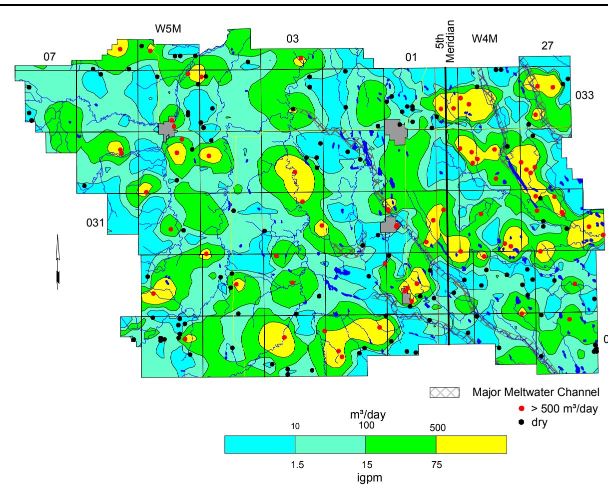

Figure 14. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

There are 866 records for bedrock water wells that have apparent yield values, or 12% of all bedrock water wells. In the County, yields for water wells completed in the upper bedrock aquifer(s) are mainly between ten and 100 m³/day. Some of the areas with yields of more than 100 m³/day indicated on the adjacent figure are in the vicinity of major meltwater channels. These higher yield areas may identify areas of increased permeability resulting from the weathering process. In addition to the 866 water wells, there are records for 150 dry or abandoned water wells due to insufficient water in many of these areas. In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to the 150 dry holes prior to gridding. Also included in these postings is any record that includes water well comments that state the well goes dry in dry years.

Of the 866 water well records with apparent yield values, 852 have been assigned to aquifers associated with specific geologic units that are being discussed. Forty-four percent (386) of the water wells completed in the bedrock aquifers have apparent yields that range from ten to 100 m³/day, 27% (237) have apparent yields that are less than ten m³/day, and 19% (163) have apparent yield values that range from 100 to 500 m³/day, as shown in the adjacent table.

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 to 500 m³/day	>500 m³/day
Disturbed Belt	45	10	27	8	0
Dalehurst	497	133	227	95	42
Lacombe	310	83	131	58	38
Multiple Completions	14	11	1	2	0
Totals	866	237	386	163	80

Table 6. Apparent Yields of Bedrock Aquifers

3) Chemical Quality of Groundwater

The TDS concentrations in the groundwaters from the upper bedrock aquifer(s) range from less than 500 to more than 1,500 mg/L, with most of the groundwaters with lower TDS concentrations occurring in the western third of the County.

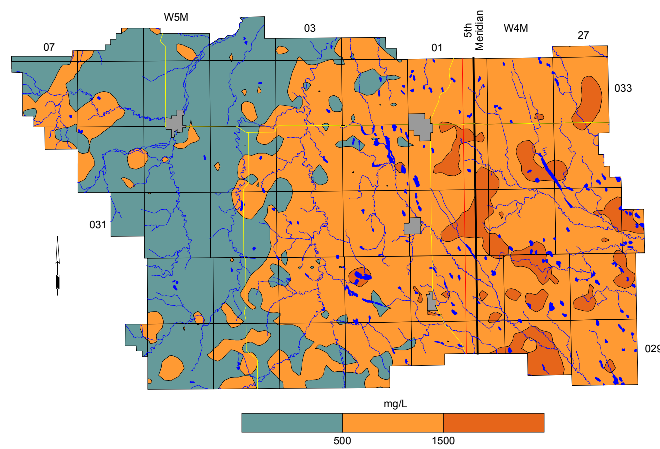

Figure 15. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

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. The sulfate concentrations in groundwaters from upper bedrock aquifer(s) were compared to the distance of completion depth from the top of the Lacombe Member. Groundwaters from bedrock water wells completed within 100 metres of the top of the Lacombe Member tend to have higher sulfate concentrations than groundwaters from water wells completed outside that range, as shown in Figure 15.

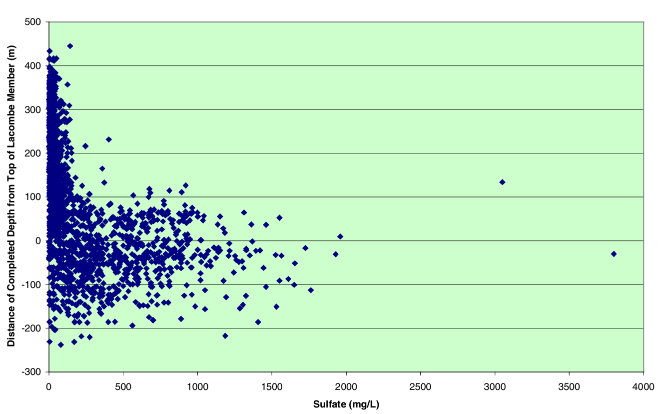

Figure 16. Distance from Top of Lacombe Member vs Sulfate in Groundwaters from Upper Bedrock Aquifer(s)

The chloride concentrations in the groundwaters from the upper bedrock aquifer(s) are less than 100 mg/L in more than 98% of the County. Groundwaters with chloride concentrations of less than ten mg/L can be expected in 90% of the western third of the County, where the Disturbed Belt and Dalehurst aquifers subcrop.

In the County, particularly in the western third, approximately 60% 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 25% of the groundwater samples from the entire County are between 0.5 and 1.5 mg/L and approximately 15% exceed the maximum acceptable concentration for fluoride of 1.5 mg/L, particularly in the eastern half.

The Piper tri-linear diagrams (see Appendix A) show that all chemical types of groundwater occur in the bedrock aquifers. However, the majority of the groundwaters are sodium-bicarbonate or calcium-magnesium-bicarbonate-sulfate types.

4) Disturbed Belt Aquifer

The Disturbed Belt Aquifer comprises the permeable parts of the Disturbed Belt, as defined for the present program. Structure contours have not been prepared for the top and bottom of the Disturbed Belt, which underlies the extreme western part of the County.

a) Apparent Yield

The apparent yields for individual water wells completed through the Disturbed Belt Aquifer are mainly in the range of ten to 100 m³/day. The areas where water wells with higher yields are expected are mainly in townships 032 and 033, range 07, W5M.

There are two licensed water wells for stock purposes completed in the Disturbed Belt Aquifer in SW 30-033-06 W5M that are licensed for a total of 10.2 m³/day.

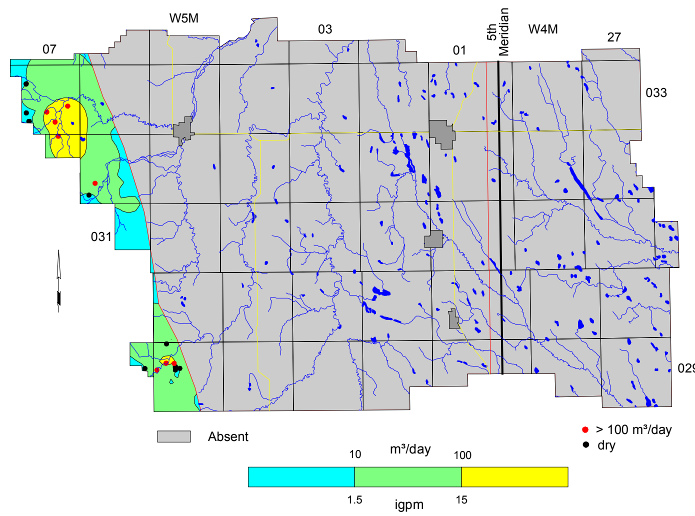

Figure 17. Apparent Yield for Water Wells Completed through Disturbed Belt Aquifer

b) Quality

The groundwaters from the Disturbed Belt Aquifer are mainly a bicarbonate type with no dominant cation (see CD-ROM), with TDS concentrations ranging from less than 200 to more than 500 mg/L. The higher values of TDS concentrations occur mainly in townships 032 and 033, ranges 06 and 07, W5M.

The chloride concentrations of the groundwaters from the Disturbed Belt Aquifer can be expected to be mainly less than ten mg/L.

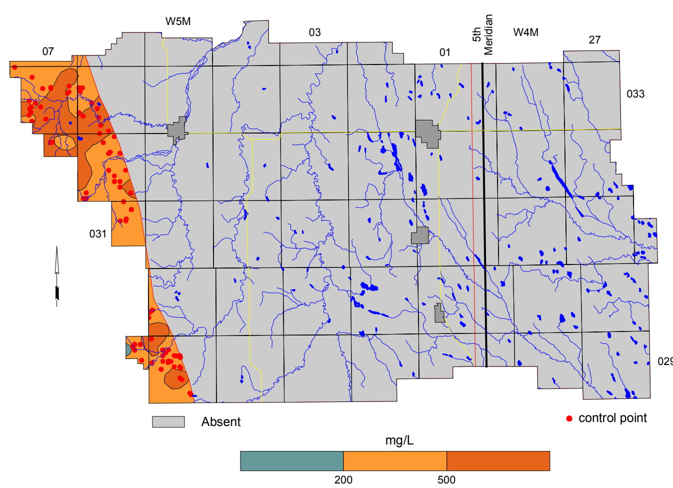

Figure 18. Total Dissolved Solids in Groundwater from Disturbed Belt Aquifer

5) Dalehurst Aquifer

The Dalehurst Aquifer comprises the permeable parts of the Dalehurst Member, as defined for the present program. The top of the Dalehurst Member is the bedrock surface where the Dalehurst Member is present under the western two-thirds of the County. The Dalehurst Member has a thickness that is less than 300 metres.

a) Depth to Top

The depth to the top of the Dalehurst Member is a function of the thickness of the surficial deposits, which ranges from less than five to more than 30 metres.

b) Apparent Yield

The apparent yields for individual water wells completed through the Dalehurst Aquifer are mainly in the range of ten to 100 m³/day, with 28% of the values being more than 100 m³/day. Also shown on the adjacent map are the locations of dry test holes. An apparent yield of 0.1 m³/day was assigned to the dry holes prior to gridding. Water wells with yields of less than ten m³/day also occur throughout the area where the Dalehurst Aquifer is present. The low yields may be variations in the permeability of the aquifer or the techniques used to complete the water wells.

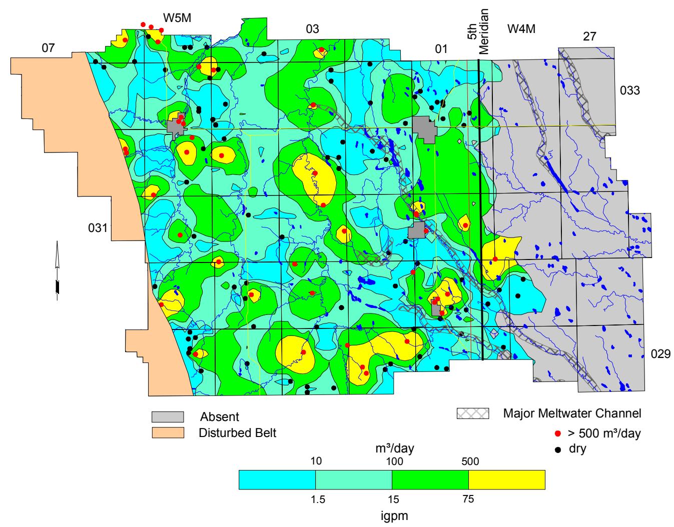

Figure 19. Apparent Yield for Water Wells Completed through Dalehurst Aquifer

c) Quality

The groundwaters from the Dalehurst Aquifer are mainly sodium-bicarbonate or calcium-magnesium-bicarbonate-sulfate types (see Piper diagram on CD-ROM). The TDS concentrations range from less than 500 to more than 1,500 mg/L. The TDS concentrations increase from west to east across the County, with higher TDS concentrations being associated with the edge of the Aquifer. The sulfate concentrations are mainly less than 500 mg/L, and also increase eastward. The sulfate concentrations in groundwaters from the Dalehurst Aquifer were compared to the distance of completion depth from the top of the Lacombe Member. Groundwaters from the Dalehurst Aquifer completed within 100 metres of the top of the Lacombe Member tend to have higher sulfate concentrations than groundwaters from water wells completed outside that range, as shown in Figure 19.

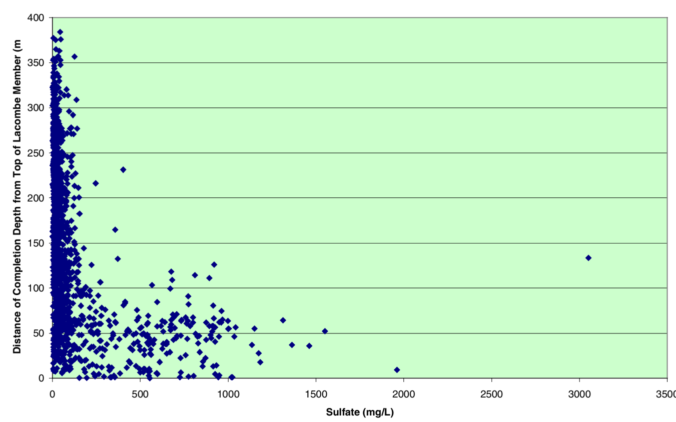

Figure 20. Distance from Top of Lacombe Member vs Sulfate in Groundwaters from Dalehurst Aquifer

Chloride concentrations in the groundwaters from the Dalehurst Aquifer are mainly less than ten mg/L.

6) Lacombe Aquifer

The Lacombe Aquifer comprises the porous and permeable parts of the Lacombe Member that underlies the Dalehurst Member, and subcrops under the surficial deposits in the eastern one-third of the County. Structure contours have been prepared for the top of the Member, which underlies most of the County. The structure contours show the Lacombe Member having a maximum thickness of in the order of 350 metres.

i) Depth to Top

The depth to the top of the Lacombe Member ranges from less than ten metres below ground level where the Member subcrops in the eastern part of the County to more than 350 metres in the western part of the County. The greatest depth is in areas where the Dalehurst Member is also present.

ii) Apparent Yield

The apparent yields for individual water wells completed through the Lacombe Aquifer range mainly from ten to 500 m³/day. The adjacent map indicates that water wells with apparent yields of more than 500 m³/day are expected mainly in association with areas where major meltwater channels are present. In these areas, weathering processes may be increasing the local permeability. There are no data from the groundwater database for the Aquifer west of the Town of Olds, and the maps prepared for the Lacombe Aquifer have been hatched to indicate this area.

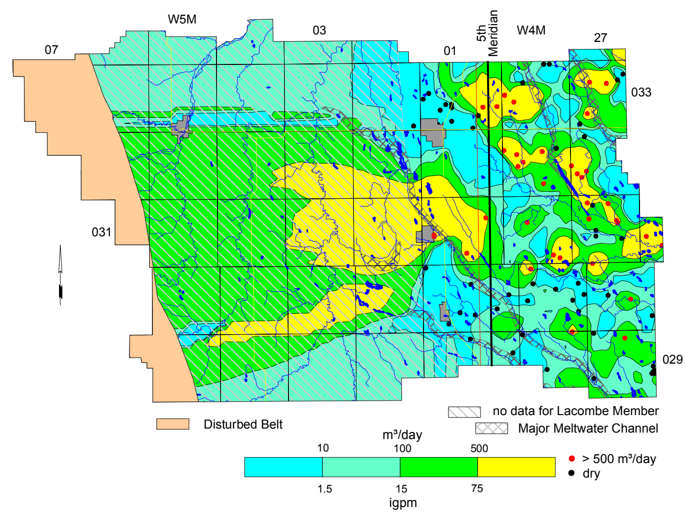

Figure 21. Apparent Yield for Water Wells Completed through Lacombe Aquifer

A groundwater monitoring report conducted by HCL for the Town of Olds indicated that two of their water supply wells in 24-032-29 W4M completed in the Lacombe Aquifer could be diverting a total of more than 1,200 m³/day (HCL, 1974).

A water supply well completed in the Lacombe Aquifer in 08-08-031-27 W4M is authorized to divert nearly 100 m³/day for agricultural purposes. A groundwater review conducted by HCL in 1996 indicated that a projected long-term yield for this water test hole was 80 m³/day (HCL, January 1997).

iii) Quality

The groundwaters from the Lacombe Aquifer are mainly sodium-bicarbonate or sodium-sulfate types (see Piper diagram on CD-ROM). Total dissolved solids concentrations are expected to range mainly from 500 to 1,500 mg/L.

When TDS values in the groundwaters from the Lacombe Aquifer exceed 1,200 mg/L, the sulfate concentrations exceed 400 mg/L. The indications are that chloride concentrations are expected to be less than ten mg/L, with the exception in the vicinity of the towns of Olds and Didsbury, where the chloride concentrations are expected to be greater than 100 mg/L.

VI. GROUNDWATER BUDGET

A. Hydrographs

There are three locations in the County where water levels are being measured and recorded with time. Two of these sites are observation water wells that are part of the AENV regional groundwater-monitoring network and the third site is a water supply well for the Village of Cremona. The two AENV observation water wells (Obs WW Nos. 126 and 227) are located in 04-30-032-28 W4M. The water-level record for Obs No. 126 is from 1961 to 1995 and the water-level record for AENV Obs WW No. 227 is from 1986 to 1999.

AENV Obs WW No. 126, formerly Olds Well No. 147, (Toth, 1966) was drilled to 212 metres in 1961, and is completed open hole from 46.0 to 212 metres below ground level in the Lacombe Aquifer. The adjacent hydrograph shows a water-level decline of in the order of six metres from 1966 to 1977 as a result of groundwater production from the Town of Olds water supply wells. In mid-1977, the Town of Olds developed an alternate water source and the water supply wells were taken out of service. Once the water supply wells were no longer used, the water level began to rise, and by 1995, the water level had risen more than nine metres above the 1977 level and more than three metres above the 1965 level. Toth first compared the water-level fluctuations in AENV Obs WW No. 126 in 04-30-032-28 W4M to the 1961 to 1964 summer precipitation. For the comparison, summer precipitation included the months of May, June, July and August. Toth noted that the correlation between precipitation data and groundwater levels in the Olds Well No. 147 indicated a direct recharge of the groundwater regime by precipitation. With the addition of 31 years of water-level data, HCL has compared the summer precipitation measured at the Olds weather station to the water-level fluctuations in AENV Obs WW No. 126. The comparison shows that the water-level fluctuation reflects the changes in summer precipitation. The impact of summer precipitation is most easily observed after Olds went to an alternate water supply in 1977. For example, from 1979 to 1981, the water level rose three metres as a result of three consecutive years with summer precipitation that was greater than 290 mm. In 1982 and 1983, summer precipitation was less than 200 mm, and the water level remained at a relatively constant elevation. The water-level fluctuations show two peaks for most years. The first peak would be associated with recharge when the frost leaves the ground and the second coincides with the end of the growing season. The low water level at the start of each year is a result of no recharge to the groundwater flow system during the time of ground frost.

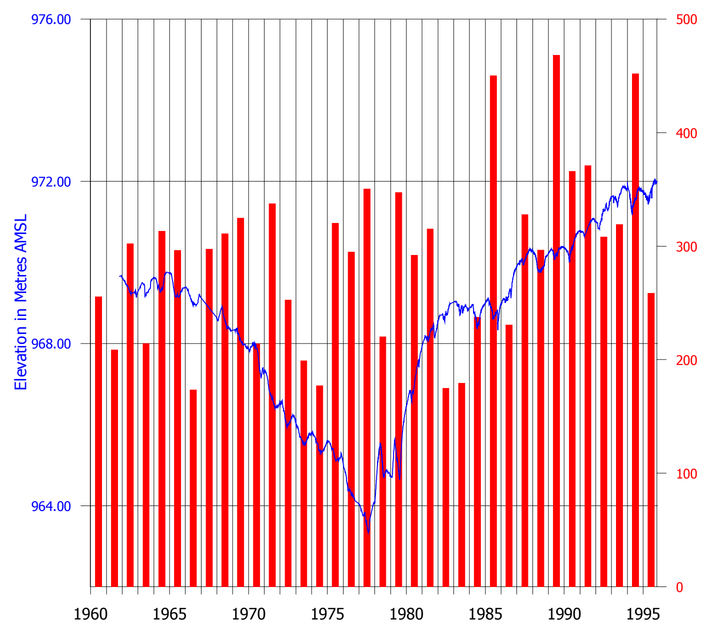

Figure 22. Summer Precipitation vs Water Level in AENV Obs WW No. 126

AENV Obs WW No. 227, drilled in 1985 but reconstructed in 1986, is screened from 45.1 to 48.2 metres below ground level and completed in the Lacombe Member. The hydrograph (see Appendix A) shows that the water levels in AENV Obs WW No. 227 appear to replicate the water levels measured in AENV No. 126 from 1986 to 1995, both showing a water-level rise of approximately 3.5 metres.

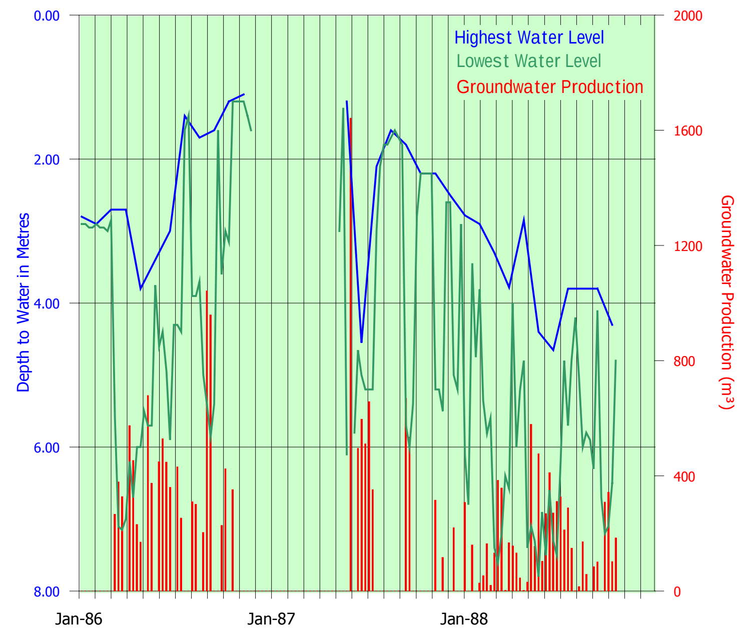

Figure 23. Groundwater Production vs Water Level in Cremona WSW No. 9

The Village of Cremona is licensed to operate six water supply wells, for a total groundwater diversion of 267 m³/day. Based on a current population of 380 (Phinney, 1999), the minimum quantity of groundwater required would be 418 m³/day. The six water supply wells are all completed in the Dalehurst Aquifer. Water Supply Well No. 9 is 18.3 metres deep and is the only location where the Village has collected continuous water-level data. Hydrogeological Consultants Ltd. obtained the water-level charts for WSW No. 9 from the Village. The charts include water-level and groundwater-production data between 1986 and 1997.

The charts from 1986 to 1988 have been processed. The processing included obtaining the highest and lowest weekly water level and the weekly production. From November 1986 to May 1987, there was no groundwater pumped from WSW No. 9 and no charts were used. Prior to the water well being taken out of service, the highest weekly water level was close to a metre below the measuring point, presumably the top of the casing. Between June 1987 and the middle of October 1988, the total quantity of groundwater pumped was 12,686 cubic metres. Over the same time interval, the highest weekly water level declined from 1.20 to 4.35 metres. The water-level decline as a result of groundwater production indicates an effective transmissivity of 20 m^2/day. Based on an effective transmissivity of 20 m^2/day, WSW No. 9 would have a long-term yield of 75 m³/day.

As a result of increased population and reportedly declining water levels in the Village of Cremona's water supply wells, a new water supply well, WSW No. 12, was drilled in April 2000. The new water supply well is completed in the Sand and Gravel Aquifer close to the Little Red Deer River. A recovery-only aquifer test was conducted at the time of the completion of WSW No. 12. The results of the test indicate the water supply well has an apparent yield of more than 2,700 m³/day. Additional aquifer tests are required to establish a more accurate long-term yield for WSW No. 12. Long-term monitoring of the water level in the Sand and Gravel Aquifer at the site of WSW No. 12 is recommended.

B. Estimated Water Use from Unlicensed Groundwater Users

An estimate of the quantity of groundwater removed from each geologic unit in Mountain View County must include both the licensed diversions and the unlicensed use. As stated previously on page 6 of this report, the daily water requirement for livestock for the County estimated to be calculated is 22,095 cubic metres. Of the 22,095 m³/day required for livestock, 4,577 m³/day has been licensed by Alberta Environment. To obtain an estimate of the quantity of groundwater being diverted from the individual geologic units, it has been assumed that the remaining 17,518 m³/day of water required for livestock watering is obtained from unlicensed groundwater use. In the groundwater database for the County, there are records for 6,908 water wells that are used for domestic/stock purposes. These 6,908 water wells include both licensed and unlicensed water wells. Of the 6,908 water wells, 968 water wells are used for stock, 1,572 are used for domestic/stock purposes, and 4,368 are for domestic purposes only.

There are 2,540 water wells that are used for stock or domestic/stock purposes. There are 249 licensed groundwater users for agricultural (stock) purposes, giving 2,291 unlicensed stock water wells. (Please refer to Table 2 on page 6 for the breakdown by aquifer of the 249 licensed stock groundwater users). By dividing the number of unlicensed stock and domestic/stock water wells (2,291) into the quantity of groundwater required for stock purposes that is not licensed (17,518 m³/day), the average unlicensed water well diverts 7.6 m³/day.

These calculations do not take into consideration the approximately 700 dugouts and more than 60 springs in the area nor do they take into account inactive water wells. However, in order to determine whether inactive water wells would have a significant effect on the calculations used, it was assumed that water wells older than 30 years would be inactive. Of the 6,908 water wells, 60% were completed after 1970, 9% were completed before 1970, and 31% have no completion date. A check was then made to see if the percentage of domestic to stock water wells, and domestic to domestic/stock water wells for water wells completed after 1970 is consistent to the water wells completed before 1970. The analysis indicated that in both scenarios, approximately 50% of the water wells were used for domestic purposes, 30% were used for domestic/stock purposes, and 20% were used for stock purposes only.

However, because of the limitations of the data no attempt has been made to compensate for dugouts, springs or inactive water wells and the average stock use of 7.6 m³/day per stock water well is a reasonable estimate.

Groundwater for household use does not require licensing. Under the Water Act, a residence is protected for up to 3.4 m³/day. However, the standard groundwater use for household purposes is 1.1 m³/day.

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	1.1 m³/day
Stock	7.6 m³/day
Domestic/stock	8.7 m³/day

Based on using all available domestic, domestic/stock, and stock water wells and corresponding calculations, the following table was prepared. The table shows a breakdown of the 6,908 unlicensed and licensed water wells 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 unlicensed groundwater that is being used for both domestic and stock purposes.

	Unlicensed and Licensed Groundwater Diversions							*Licensed Groundwater Diversions*		*Unlicensed Groundwater Diversions*
Aquifer Designation	Number of Domestic	Daily Use (1.1 m^3/day)	Number of Stock	Daily Use (7.6 m^3/day)	Number of Domestic and Stock	Daily Use (8.7 m^3/day)	Totals m^3/day	Number of Stock	Totals (7.3 m^3/day)	Totals m^3/day
Sand/Gravel	248	273	58	443	64	560	1,276	11	84	1,192
Bedrock	23	25	18	138	27	236	399	5	38	361
Disturbed Belt	314	345	55	421	87	761	1,527	2	15	1,512
Dalehurst	2,754	3,029	675	5,161	938	8,204	16,395	114	872	15,523
Lacombe	653	718	154	1,178	424	3,708	5,604	87	665	4,939
Unknown	376	414	8	61	32	280	755	30	229	525
Totals	4,368	4,805	968	7,402	1,572	13,749	25,956	249	1,904	24,052

Table 7. Unlicensed Groundwater Diversions

The data provided in the above table indicate that most of the 24,052 m^3/day, estimated to be diverted from unlicensed domestic, stock, or domestic/stock water wells, is from the Dalehurst Aquifer.

By assigning 1.1 m^3/day for domestic use, 7.6 m^3/day for stock use and 8.7 m^3/day for domestic/stock use, and using the total maximum authorized diversion associated with any licensed water well that can be linked to a record in the database, a figure has been prepared that shows the estimated groundwater use in terms of volume (licensed plus unlicensed) per section per day for the County.

In the vicinity of Sundre, Olds, Didsbury, Carstairs and Cremona, the estimated water well use per section can be more than 30 m^3/day as shown on the adjacent figure. The only AENV-operated observation water wells in the County are in close proximity to the Town of Olds. Since the Town's water supply wells were taken out of service in the 1970s, there has been a general rise in water levels in these observation water wells.

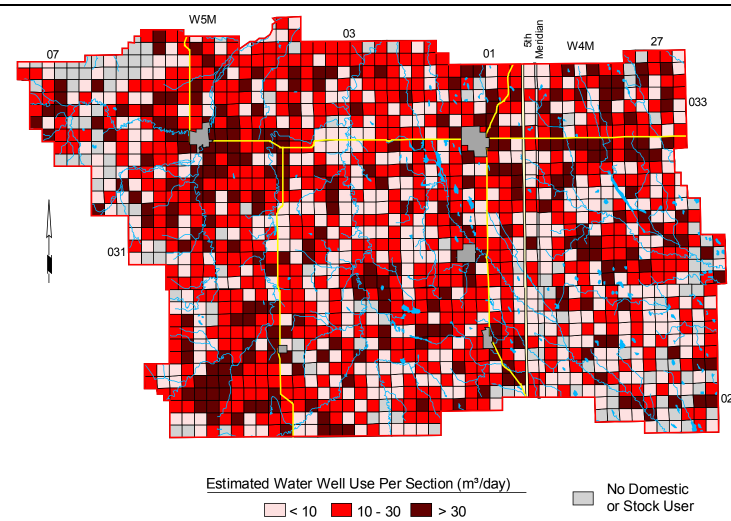

Figure 24. Estimated Water Well Use Per Section

C. 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 those parts of the various 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. Based on these assumptions, the estimated lateral groundwater flow through the individual bedrock aquifers can be summarized as follows:

Aquifer/Area	Trans (m^2/day)	Gradient (m/m)	Width (m)	Flow (m^3/day)	Aquifer Flow (m^3/day)	Licensed Diversion (m^3/day)	Unlicensed Diversion (m^3/day)	Total (m^3/day)
Sand and Gravel					942	1,532	1,192	2,724
Red Deer River								
north	90	0.008	1,000	675				
Little Red Deer River								
north	55	0.008	400	165				
East of Carstairs								
southeast	20	0.003	800	42				
East of Olds								
southeast	20	0.003	1,200	60				
Lacombe					11,573	1,832	4,939	7,419
Olds								
west	8	0.003	45,000	960				
east	8	0.004	45,000	1,440				
East Area								
west	8	0.013	25,000	2,667				
east	8	0.013	25,000	2,667				
Carstairs								
northeast	8	0.008	15,000	960				
East of Didsbury								
northeast	8	0.004	30,000	960				
southwest	8	0.008	30,000	1,920				

Aquifer/Area	Trans (m^2/day)	Gradient (m/m)	Width (km)	Volume (m^3/day)	Aquifer Volume (m^3/day)	Licensed Diversion (m^3/day)	Unlicensed Diversion (m^3/day)	Total (m^3/day)
Dalehurst					84,670	2,750	15,523	18,273
Northwest Area								
north	20	0.012	9,000	2,160				
south	20	0.017	9,000	3,060				
Westward Ho								
west	20	0.010	40,000	8,000				
east	20	0.010	40,000	8,000				
Harmatton								
west	20	0.010	50,000	10,000				
east	20	0.010	50,000	10,000				
Westcott								
west	20	0.017	50,000	17,000				
east	20	0.017	50,000	17,000				
Olds								
west	10	0.006	45,000	2,700				
east	10	0.006	45,000	2,700				
East Area								
west	15	0.003	45,000	2,025				
east	15	0.003	45,000	2,025				

Table 8. Groundwater Budget

The above table indicates that there is significantly more groundwater flowing through the aquifers than the total of the licensed and unlicensed diversions from the individual aquifers, except for the Sand and Gravel Aquifer. The calculations of flow through individual aquifers as presented in the above table are very approximate and are intended as a guide for future investigations. Because a significant aquifer cannot be delineated in the Disturbed Belt, no attempt has been made to calculate the flow through the Disturbed Belt Aquifer.

1) Quantity of Groundwater

An estimate of the volume of groundwater stored in the sand and gravel aquifers in the surficial deposits is 0.3 to two cubic kilometres. This volume is based on an areal extent of 1,200 square kilometres and a saturated sand and gravel thickness of five metres. The variation in the total volume is based on the value of porosity that is used for the sand and gravel. 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 water-level map has been prepared from water levels associated with water wells completed in aquifers in the surficial deposits. The water wells that post in the absent area are a reflection of the spatial control. The water levels from these water wells were used for the calculation of the saturated thickness of the surficial deposits. In areas where the elevation of the water-level surface is below the bedrock surface, the surficial deposits are not saturated. The water-level map for the surficial deposits shows a general flow direction toward the eastern part of the County, and in the vicinity of Sundre, the flow is toward the Red Deer River.

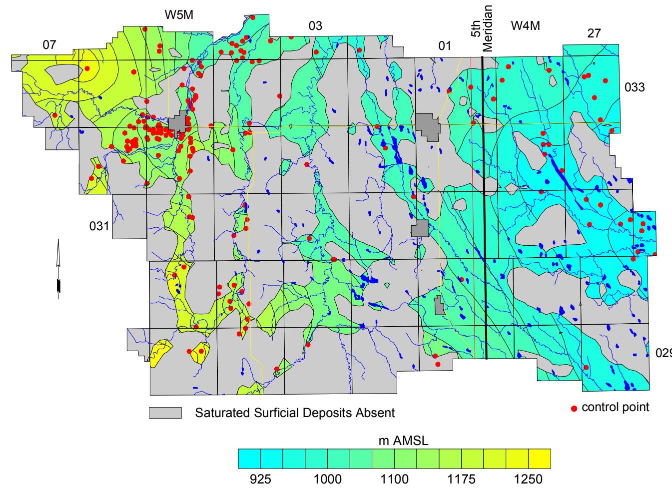

Figure 25. Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep

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 of the hydraulic units. 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.

a) 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.

In the absence of sufficient water-level data in the surficial deposits, a reasonable hydraulic gradient between the surficial deposits and the upper bedrock aquifer(s) could not be determined. Therefore, the first objective was to determine the location of flowing shot holes and any water wells that had a water level measurement depth of less than 0.1 metres. These locations would reflect where there is an upward hydraulic gradient from the bedrock to the surficial deposits (i. e. discharge). The depth to water level for water wells completed in 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 topographic surface. This resulting depth to water level grid was contoured to reflect the positioning of the flowing shot holes and flowing water wells (i. e. discharge). The recharge classification is used where the water level in the upper bedrock aquifer(s) is more than 15 metres below ground surface. The discharge areas are where the water level in the upper bedrock aquifer(s) is less than ten metres below ground surface. When the depth to water level in the upper bedrock aquifer(s) is between ten and 15 metres below ground surface, the area is classified as a transition, that is, no recharge and no discharge.

The adjacent map shows that, in more than 60% of the County, there is a downward hydraulic gradient from the surficial deposits toward the upper bedrock aquifer(s) (i. e. recharge). Areas where there is an upward hydraulic gradient from the bedrock to the surficial deposits (i. e. discharge) are mainly in the vicinity of creeks and river valleys and major meltwater channels. The remaining parts of the County are areas where there is a transition condition.

Because of the paucity of data, recharge/discharge maps for the individual bedrock aquifers have not been attempted.

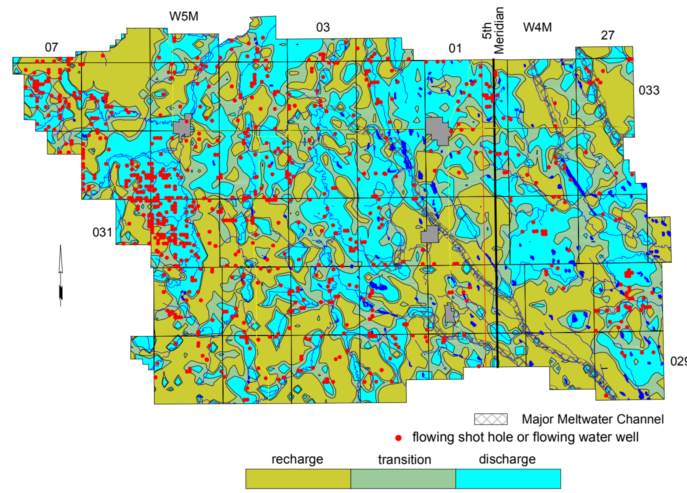

Figure 26. Recharge/Discharge Areas in Upper Bedrock Aquifer(s)

D. Areas of Groundwater Decline

The areas of groundwater decline in both the sand and gravel aquifer(s) and in the bedrock aquifers have been determined by using a similar procedure in both situations. The available non-pumping water-level elevation for each water well completed in the sand and gravel aquifer(s)/bedrock aquifer 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.

Of the 254 water wells completed in the sand and gravel aquifer(s) with a NPWL and test date, there were only 19 control points. Due to limited control points, the data were not contoured, only posted as shown on the adjacent map. The map shows that, in the vicinity of Sundre, there were approximately the same number of locations where the water level rose, as declined.

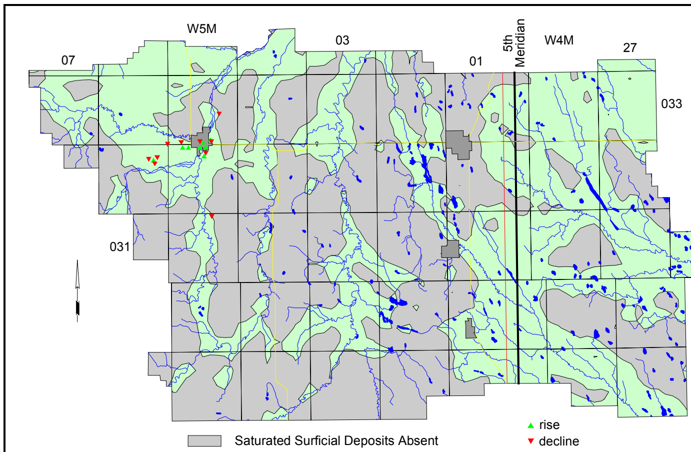

Figure 27. Changes in Water Levels in Sand and Gravel Aquifer(s)

Of the 6,571 bedrock water wells with a NPWL and test date, there were 809 control points. Where the earliest water level in bedrock water wells is at a higher elevation than the latest water level in the bedrock water wells, there is the possibility that some groundwater decline has occurred. Where the earliest water level in bedrock water wells is at a lower elevation than the latest water level in the bedrock aquifers, 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.

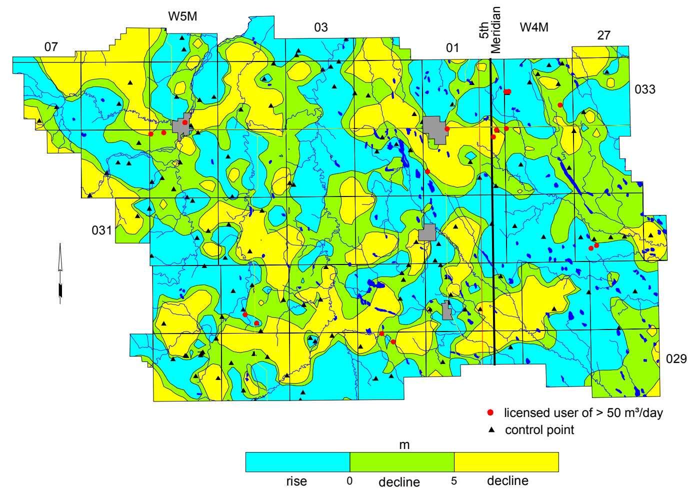

Figure 28. Changes in Water Levels in Upper Bedrock Aquifer(s)

The adjacent map indicates that in 60% of the County, it is possible that the NPWL has declined. However, the areas that indicate a decline of more than five metres are based on only one or two control points. In order to determine if the water-level decline is a result of groundwater use by licensed users, the licensed users that are authorized to divert more than 50 m³/day were posted on the above map. Of the 20 groundwater users authorized to divert more than 50 m³/day, 16 occur in areas where a water-level decline exists.

Nearly 50% of the areas where there has been a water-level decline of more than five metres corresponds to where the estimated water well use is between ten and 30 m³/day shown on Figure 24; only 21% of the decline occurred where the estimated water well use is more than 30 m³/day.

VII. 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. The first step would be to field-verify the more than 200 existing water wells listed in Appendix E. These water well records indicate that a complete water well drilling report is available along with at least a partial chemical analysis. The level of verification would have to include identifying the water well in the field, obtaining meaningful horizontal coordinates for the water well and the verification of certain parameters such as water level and completed depth. Even though the water wells for which the County has responsibility do not satisfy the above criteria, it is recommended that they be field-verified, water levels be measured, a water sample be collected for analysis, and a short aquifer test be conducted. There is one County-operated water well that is also included in Appendix E. An attempt to update the quality of the entire database is not recommended.

There is a need to establish a relationship between the AENV groundwater database and the AENV licensing database.

The present analysis shows the volume of water flowing through the Sand or Gravel Aquifer associated with the Little Red Deer River is less than 200 m^3/day. Therefore, additional information is needed for the Village of Cremona to establish a sustainable yield for WSW No. 12.

While there are a few areas where water-level data are available, 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 M.D. of Rocky View and in Flagstaff County, water well owners are being provided with a tax credit if they accurately measure 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 (Alberta Agriculture, Food And Rural Development, 1996)(Appendix E).

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.

In general, for the next level of study, the database needs updating. It requires more information from existing water wells, and additional information from new ones.

Before an attempt is made to provide a major upgrade to the level of interpretation provided in this report and the accompanying maps and groundwater query, it is recommended that all water wells for which water well drilling reports are available 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.

A list of the more than 200 water wells that could be considered for the above program is given in Appendix E.

In addition to the data collection associated with the existing water wells, all available geophysical logs should be interpreted to establish a more accurate spatial definition of individual aquifers.

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 and PFRA 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.

Groundwater is a renewable resource and it must be managed.

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IX. Conversions

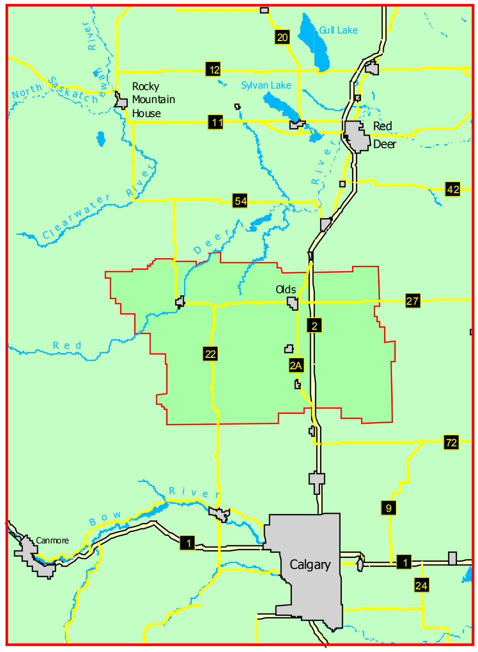
Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inchs	25.400 000	millimetres
miles	1.609 344	kilometres
kilometer	0.621 370	miles (statute)
square feet (ft^2)	0.092 903	square metres (m^2)
square metres (m^2)	10.763 910	square feet (ft^2)
square metres (m^2)	0.000 001	square kilometres (km^2)
Concentration		
grains/gallon (UK)	14.270 050	parts per million (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 (lpm)	0.219 974	UK gallons per minute (igpm)
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	0.152 759	igpm

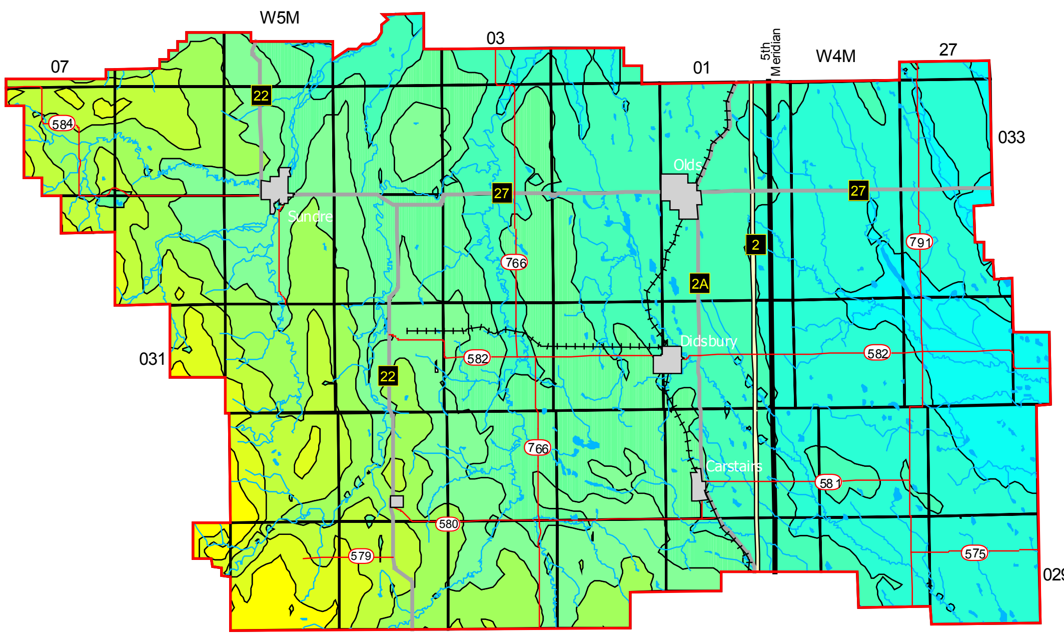
MOUNTAIN VIEW COUNTY

Appendix A

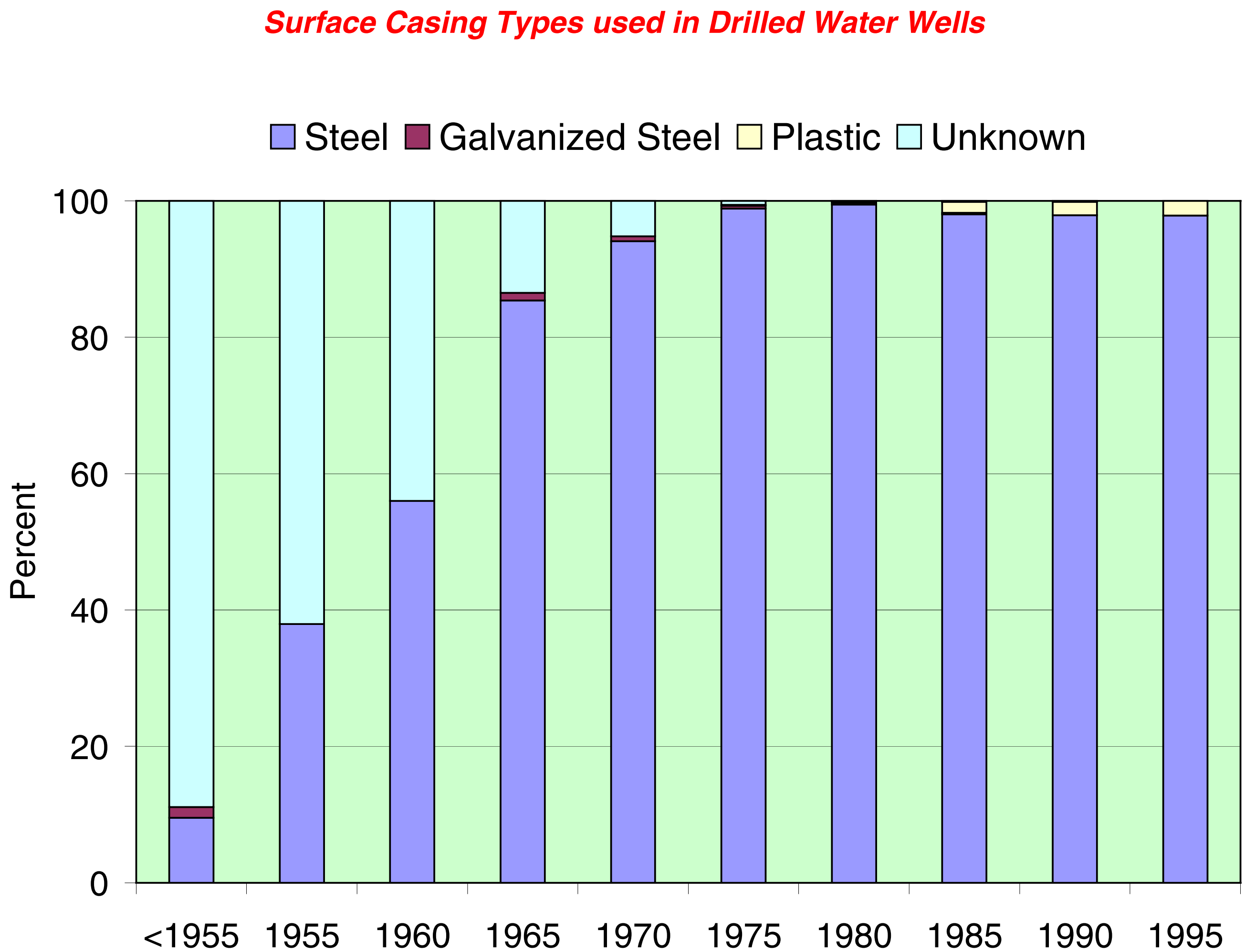
Hydrogeological Maps and Figures

Index Map / Surface Topography

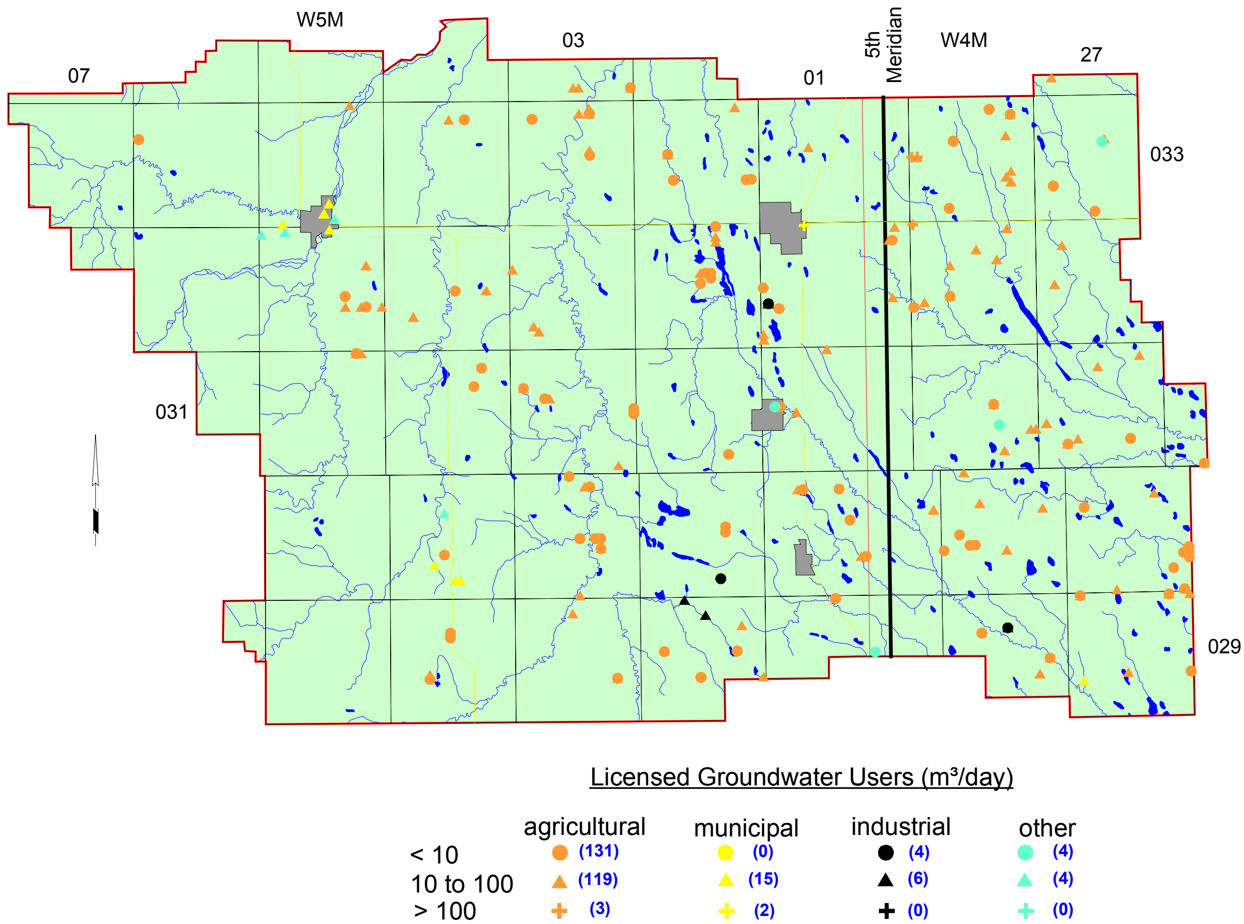




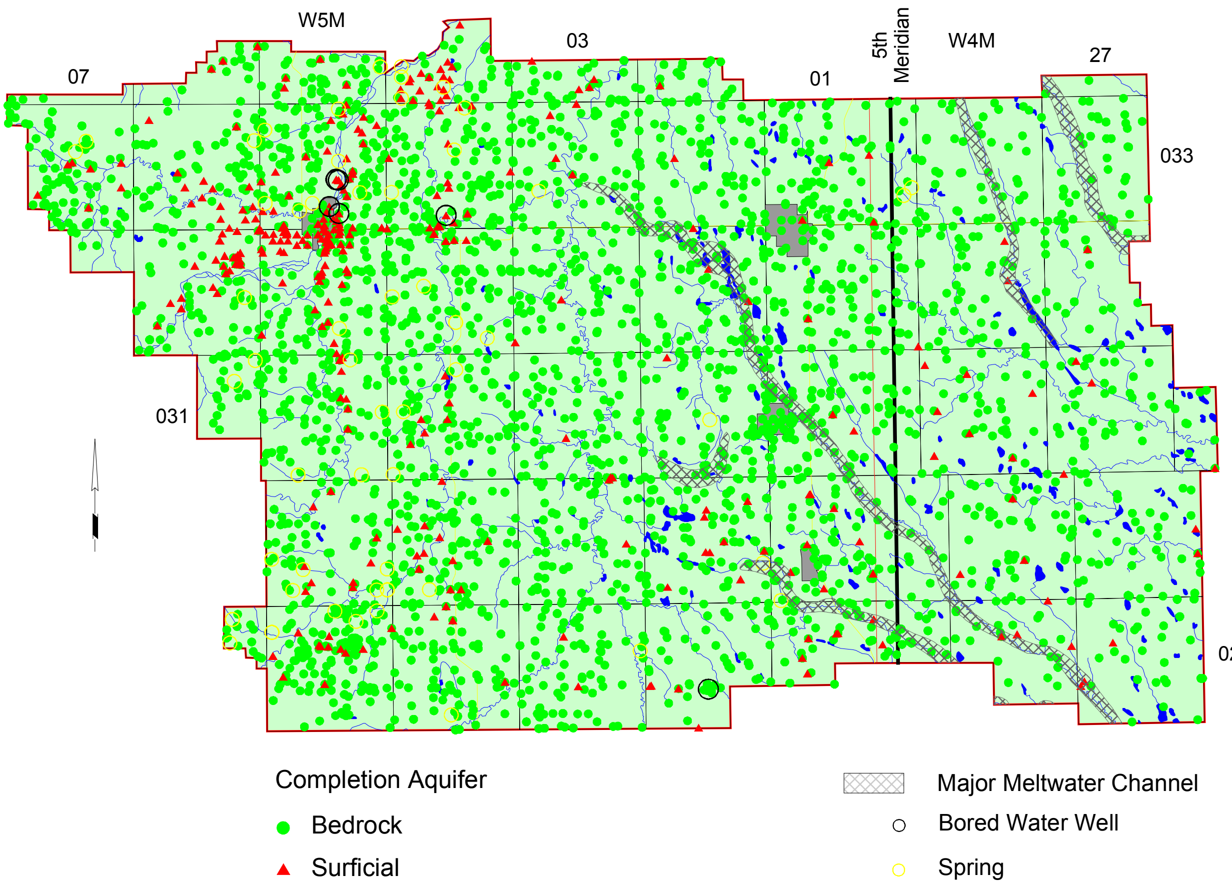
Mountain View County


Surface Casing Types used in Drilled Water Wells
Steel
Galvanized Steel
Plastic
Unknown
Percent
100
80
60
40
20
0
<1955
1955
1960
1965
1970
1975
1980
1985
1990
1995

Licensed Water Wells

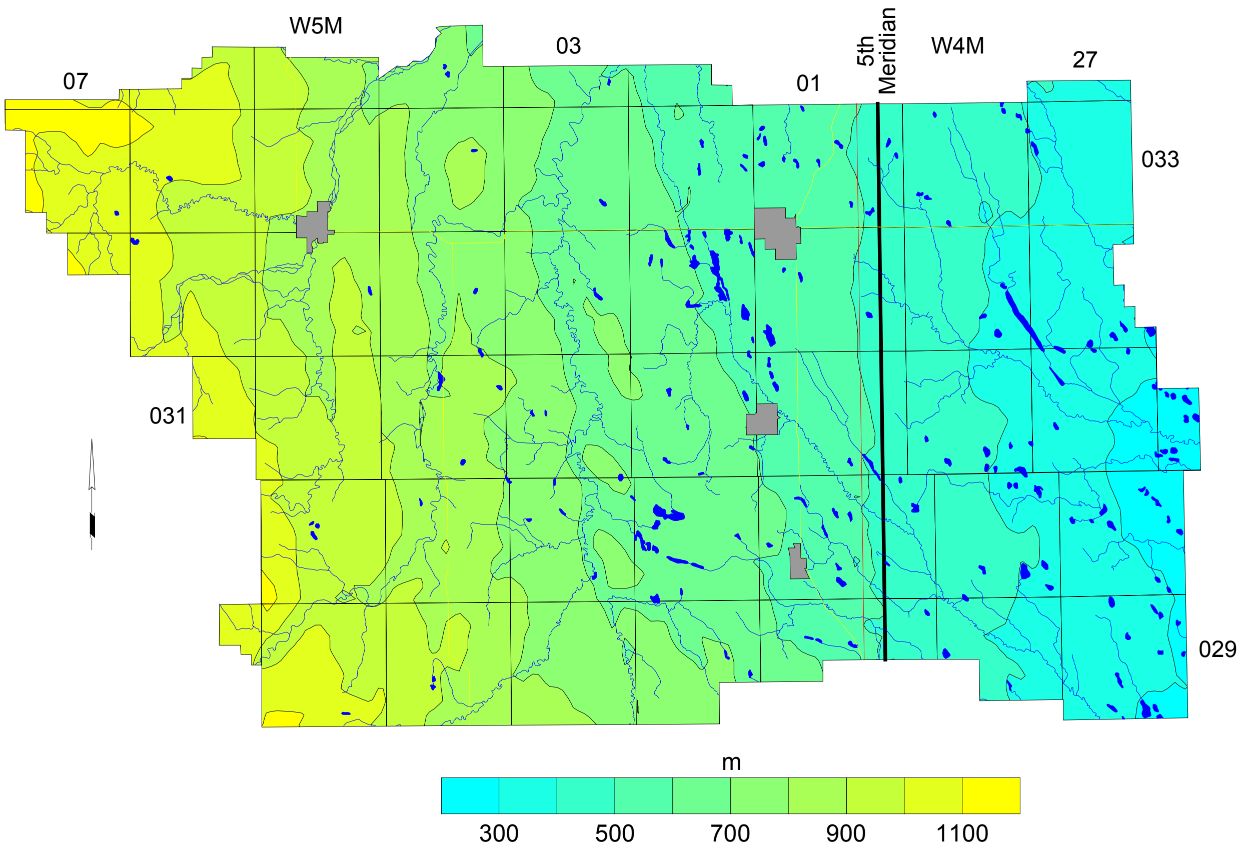


Location of Water Wells



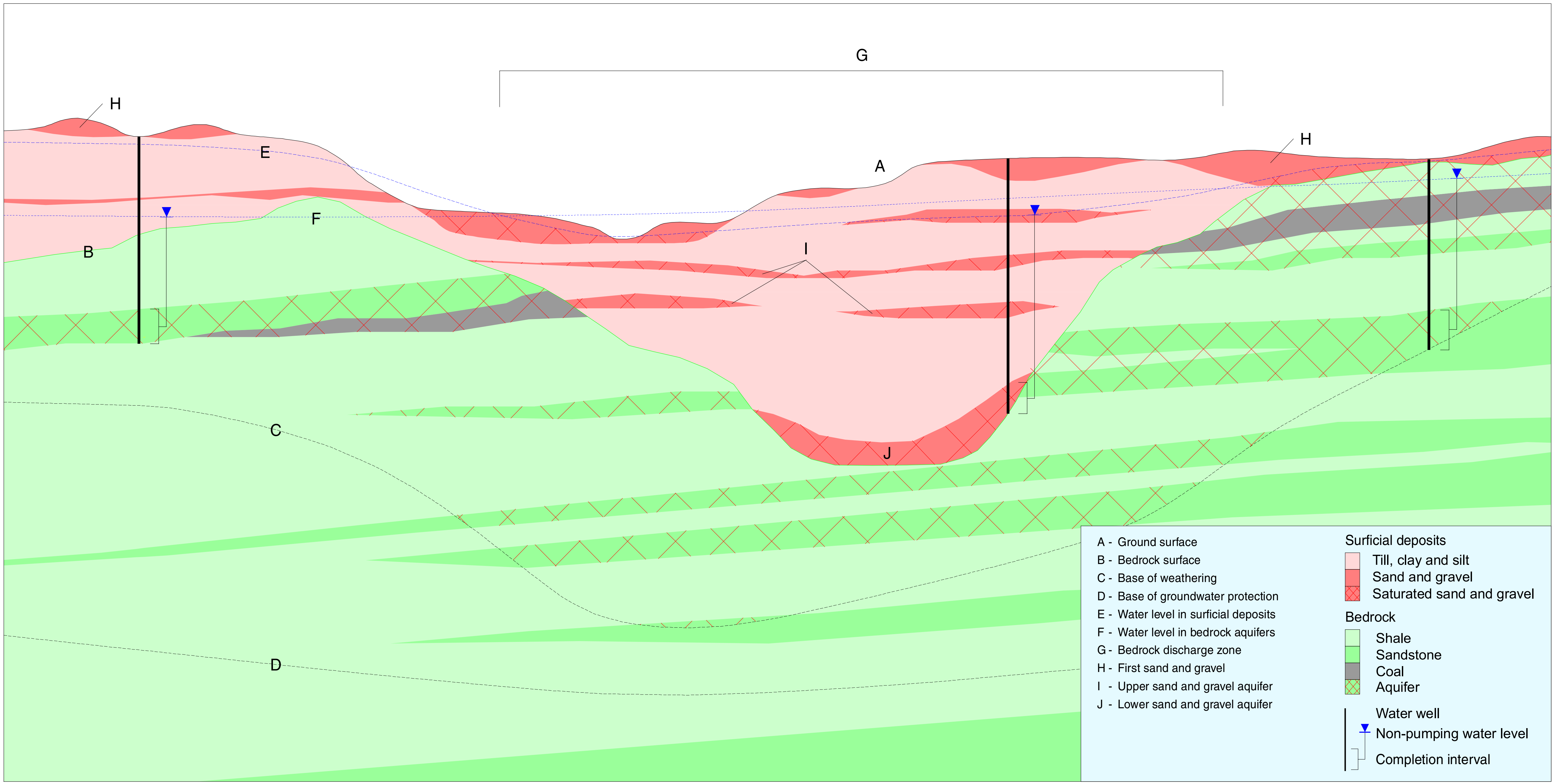
Depth to Base of Groundwater Protection

(modified after EUB, 1995)

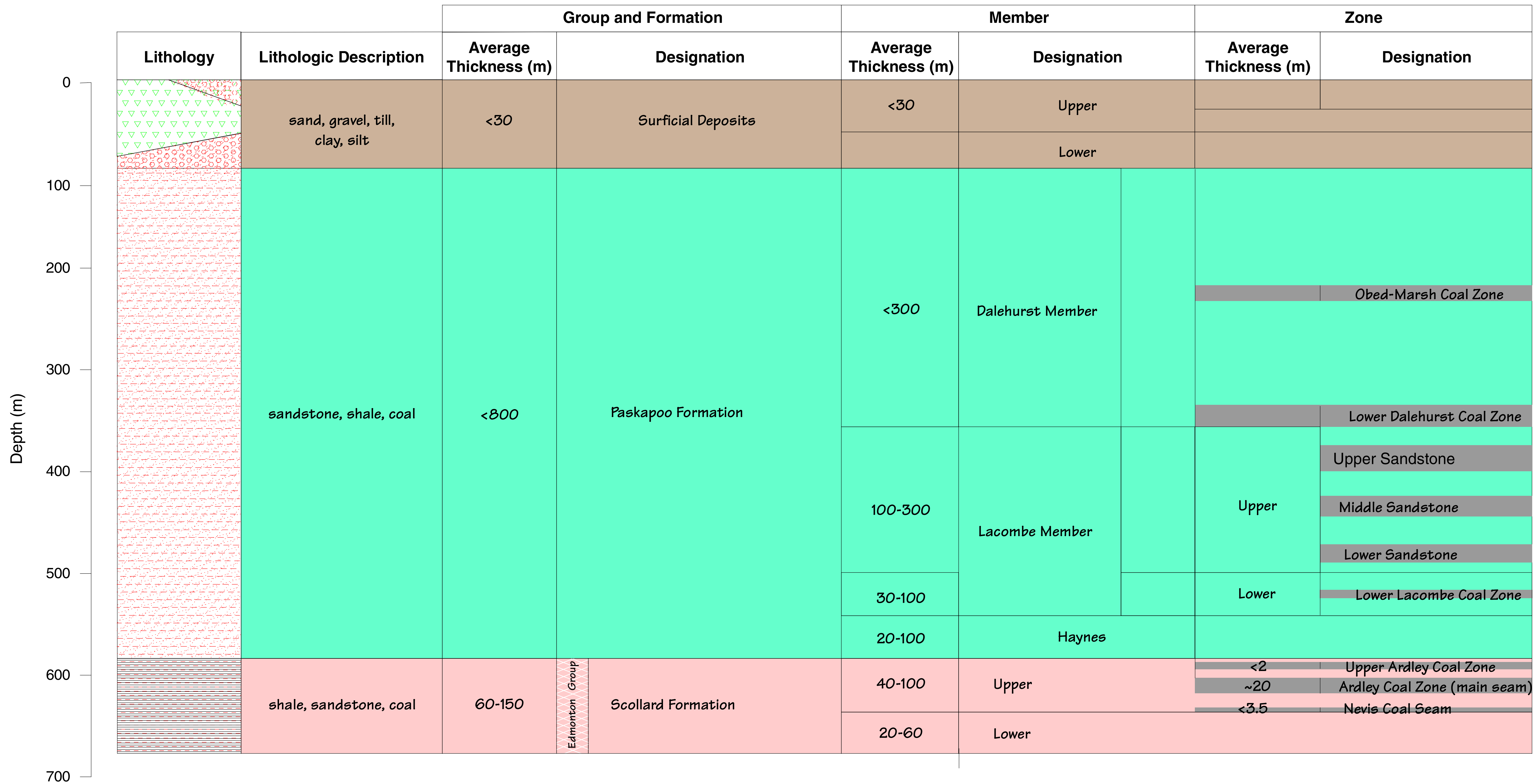


Generalized Cross-Section

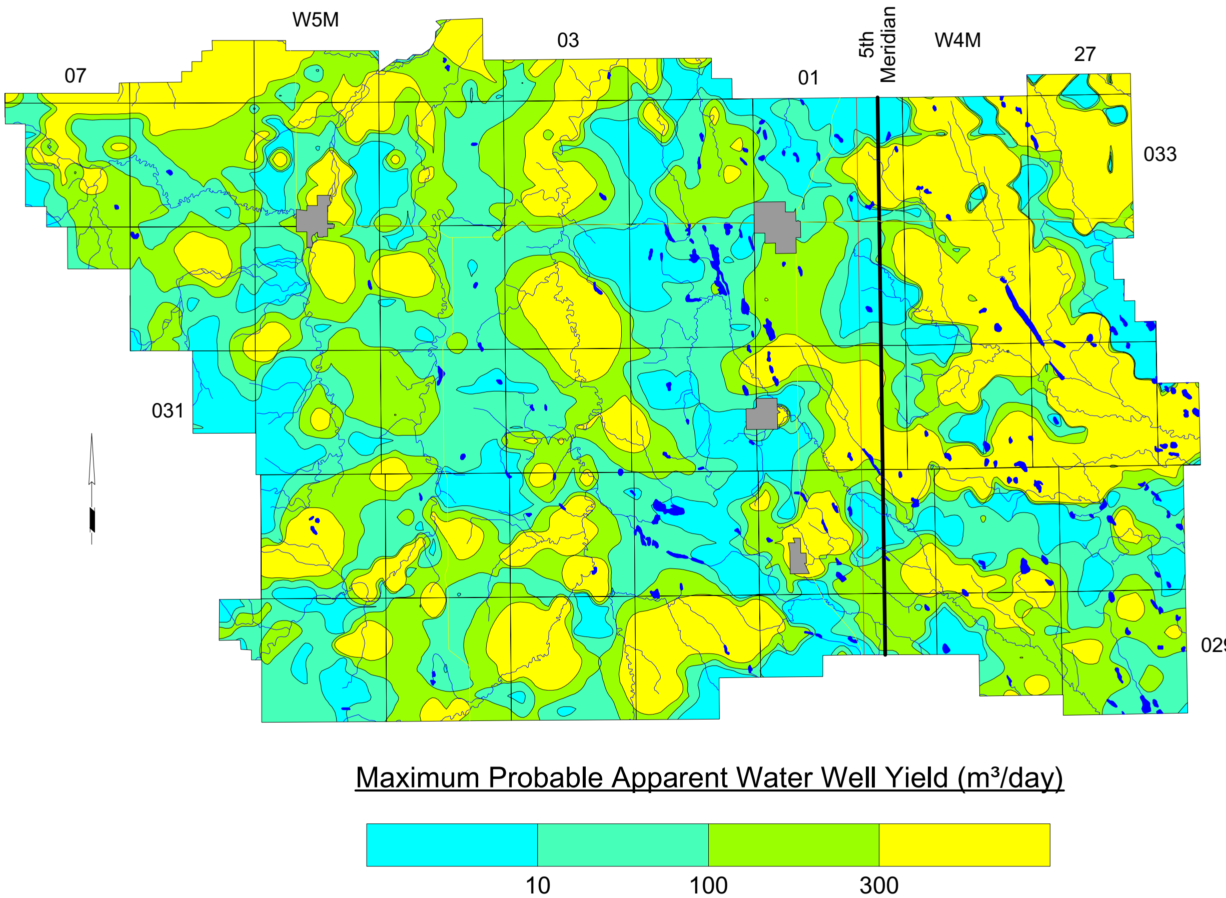
(for terminology only)



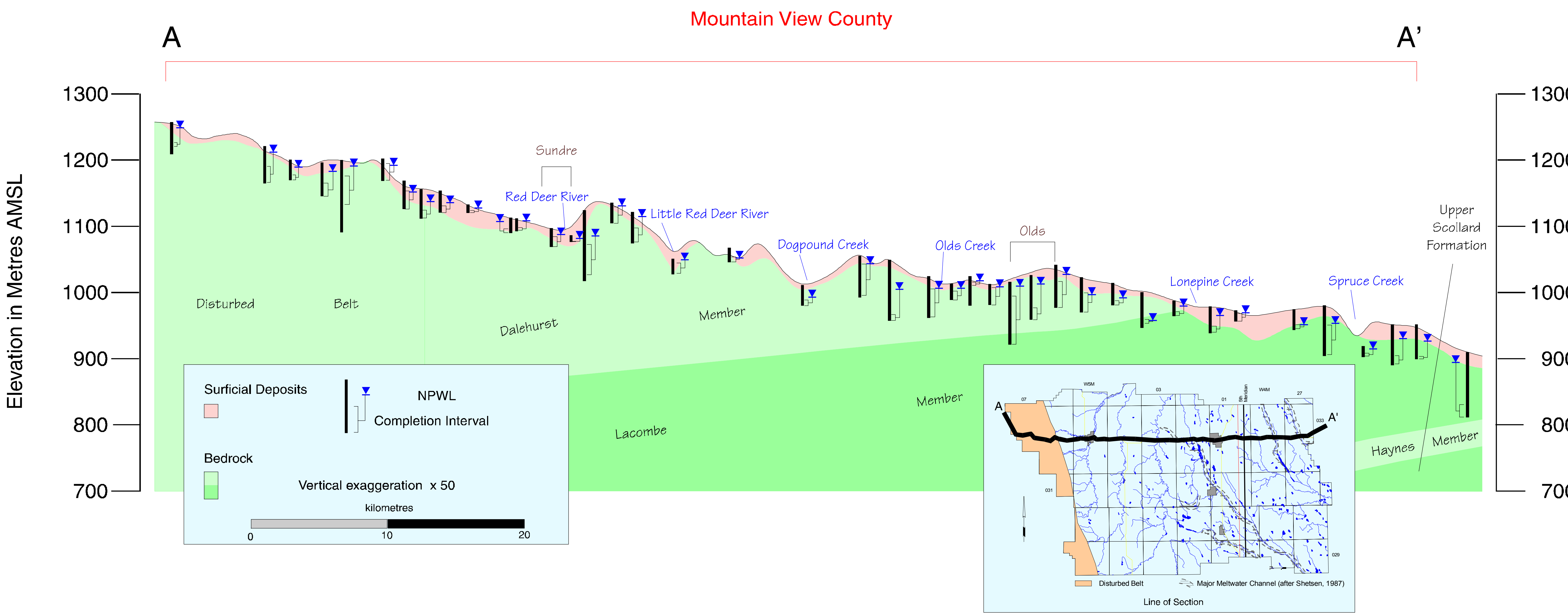
Geologic Column



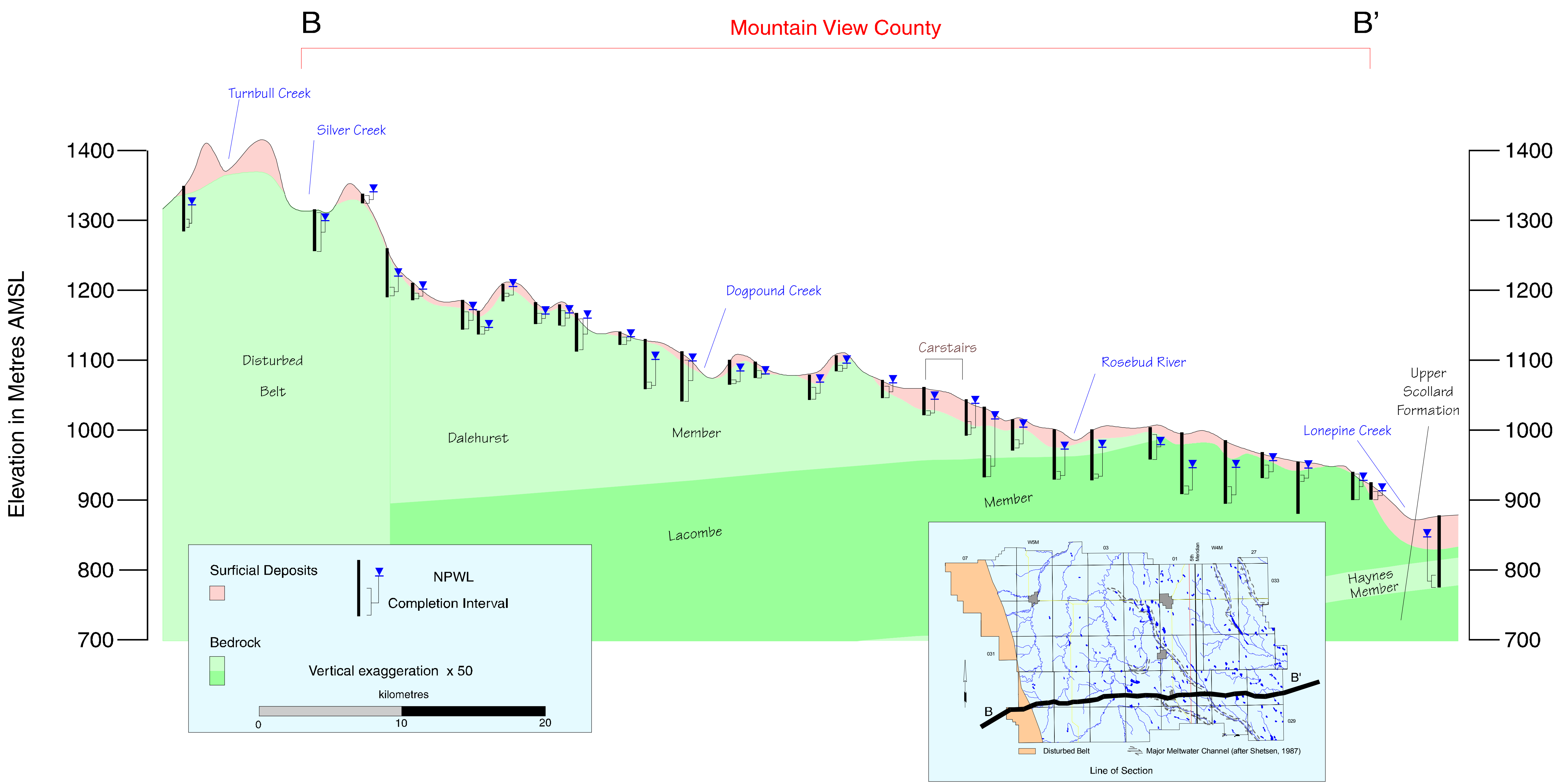
Hydrogeological Map



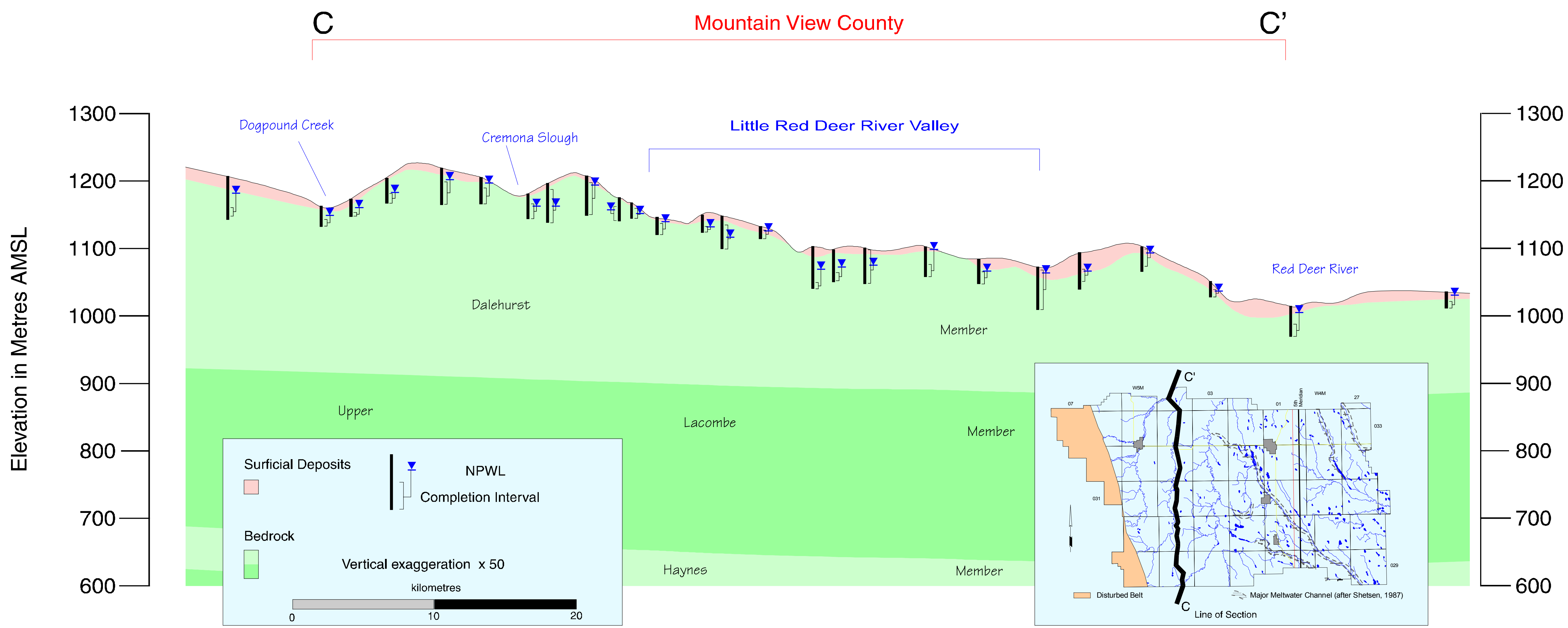
Cross-Section A - A'



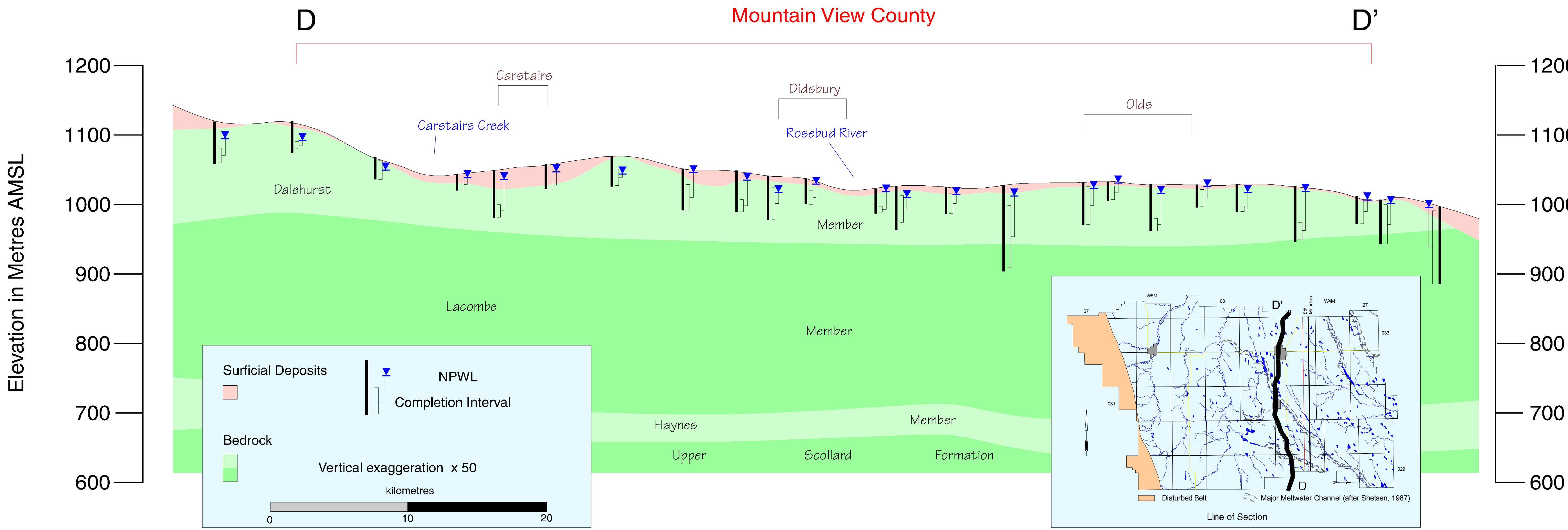
Cross-Section B - B'



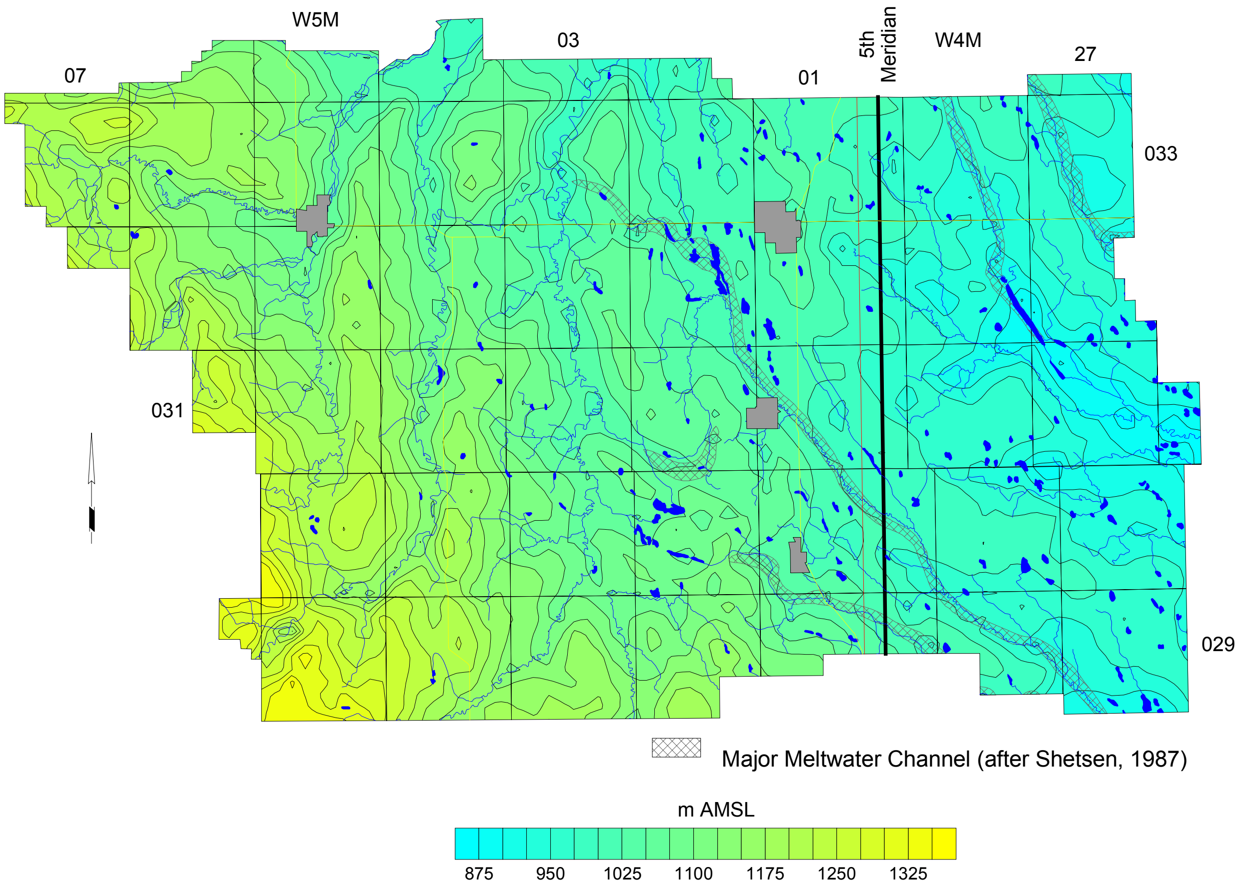
Cross-Section C - C'



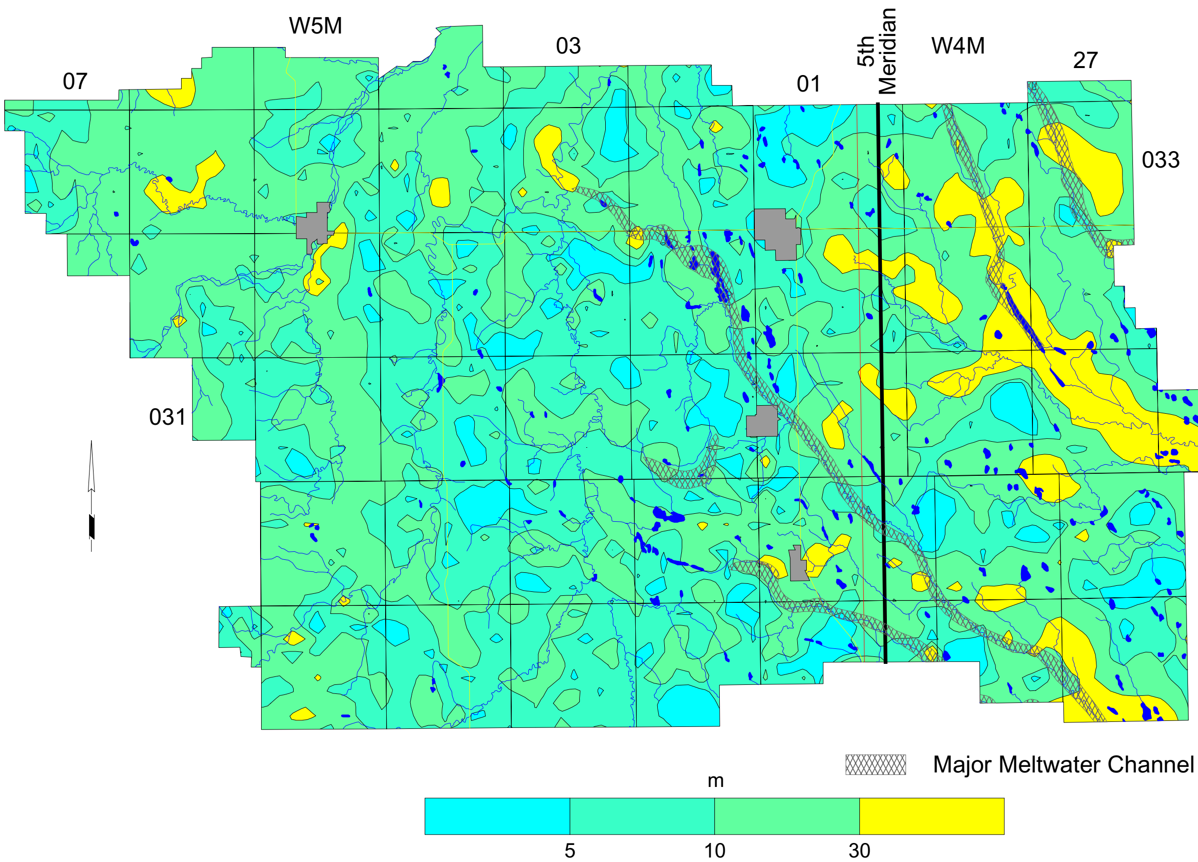
Cross-Section D - D'

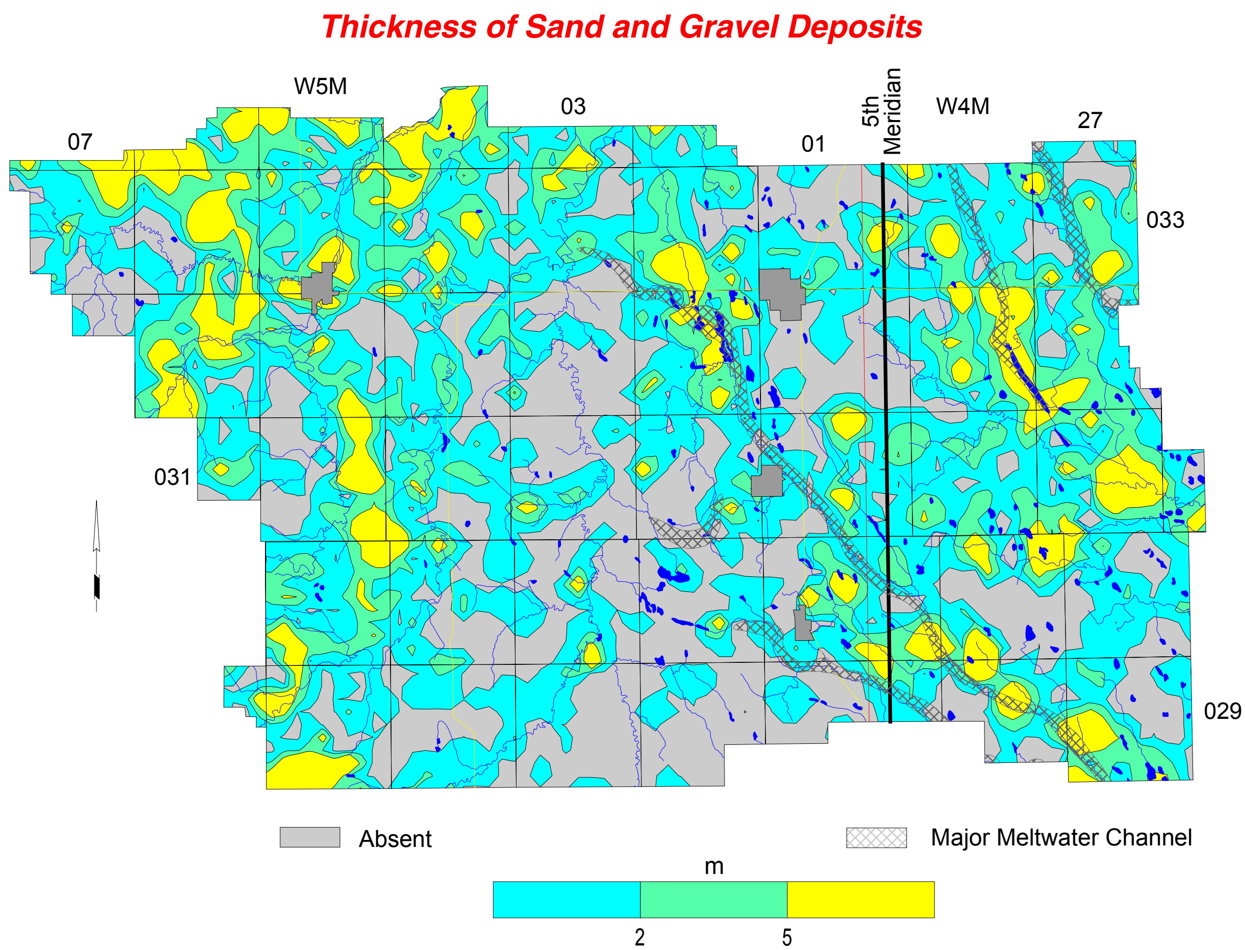


Bedrock Topography

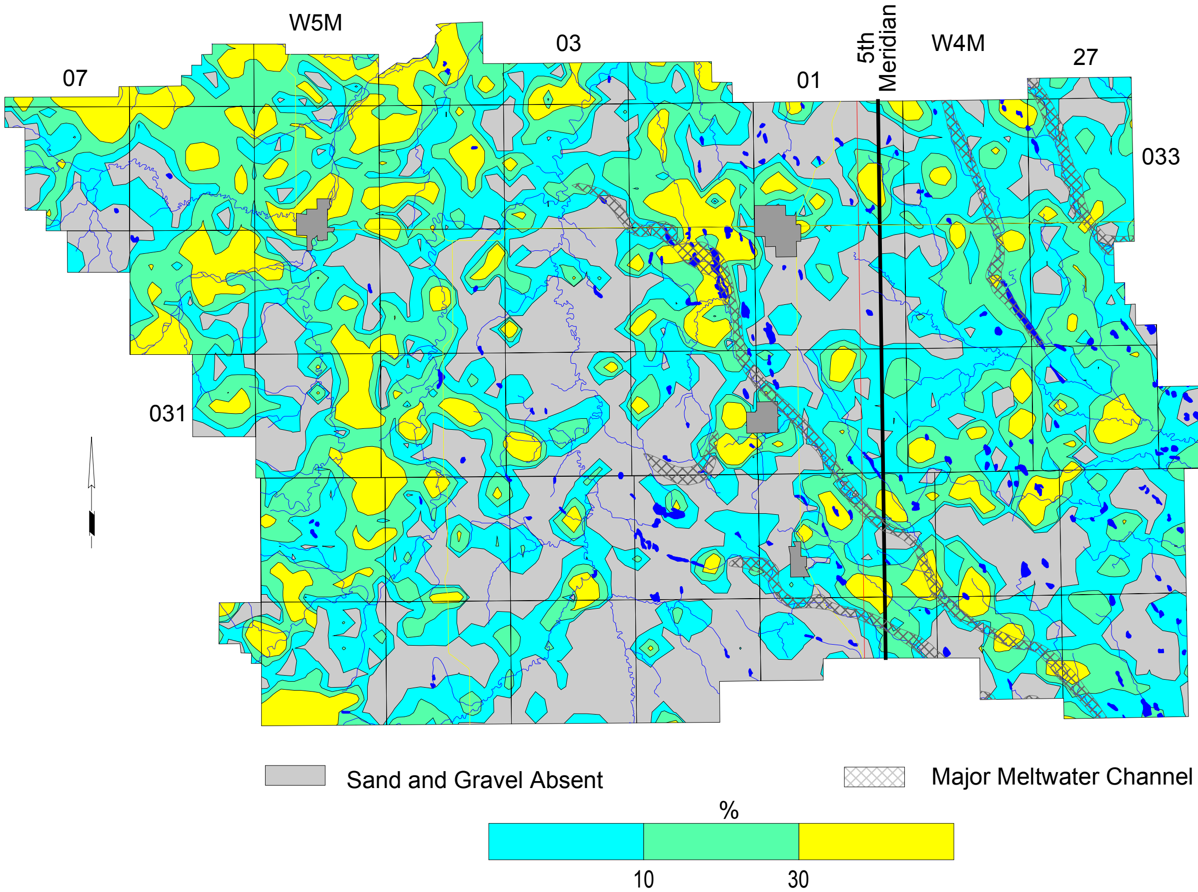


Thickness of Surficial Deposits

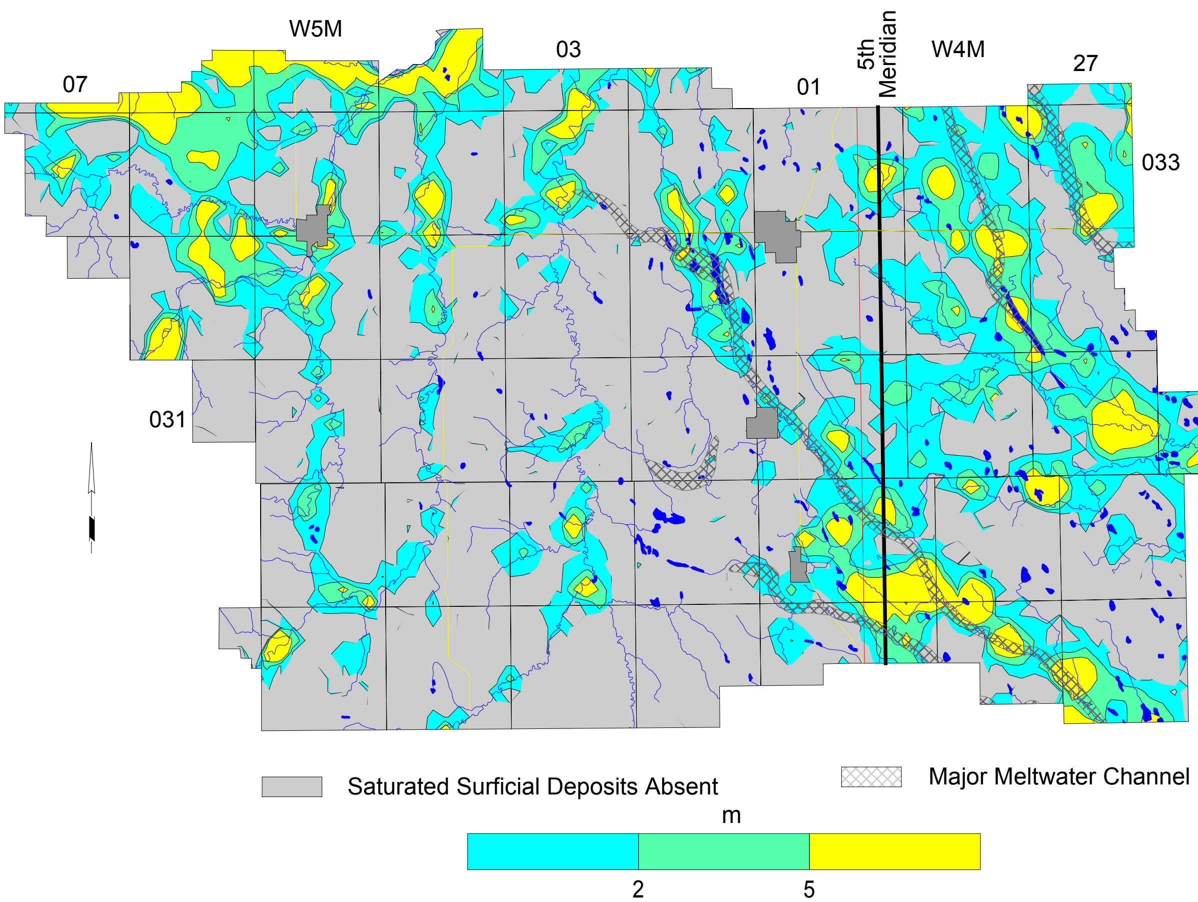



Thickness of Sand and Gravel Deposits
W5M
07
03
01
5th Meridian
W4M
27
033
031
029
Absent
Major Meltwater Channel
m
2
5

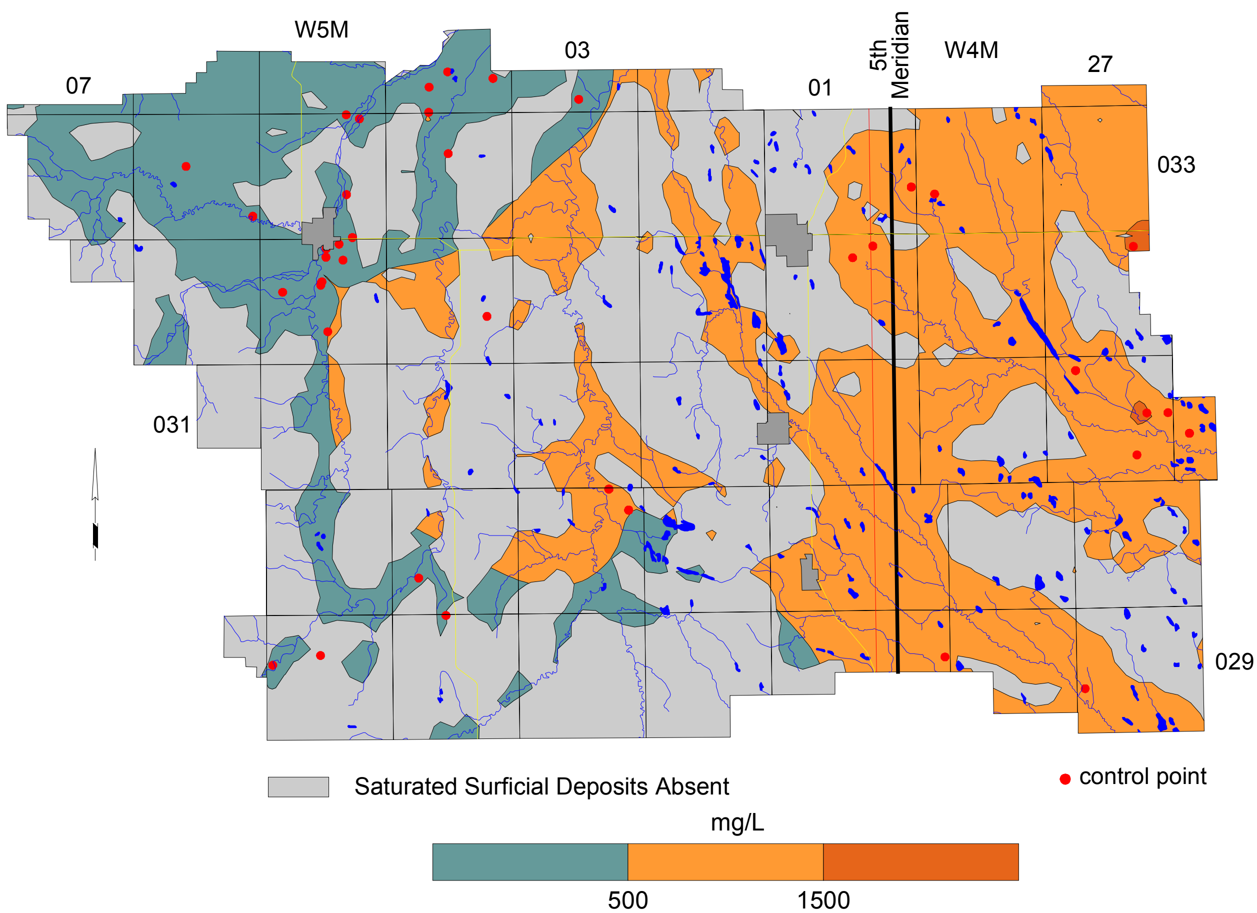
Amount of Sand and Gravel in Surficial Deposits



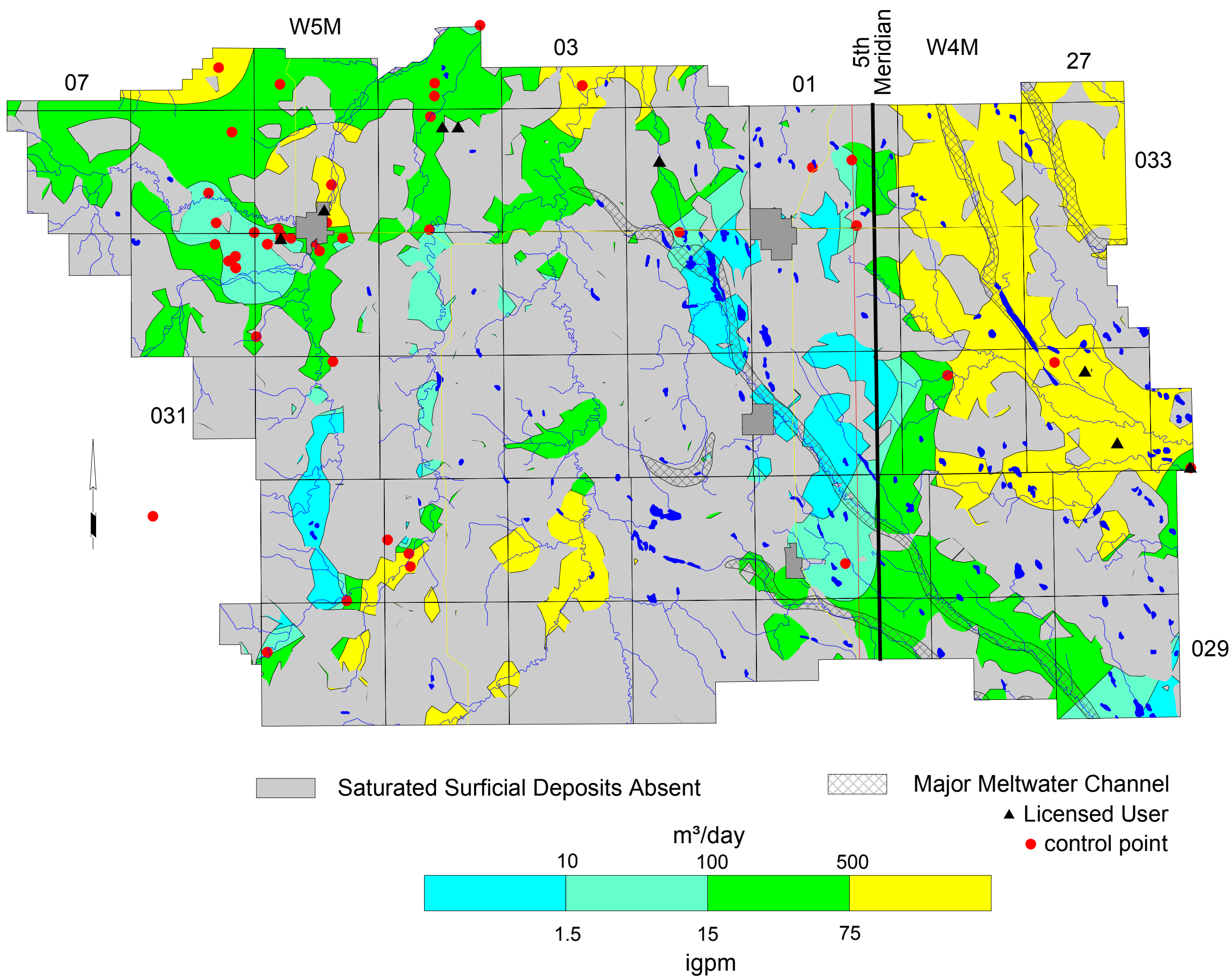
Thickness of Sand and Gravel Aquifer(s)



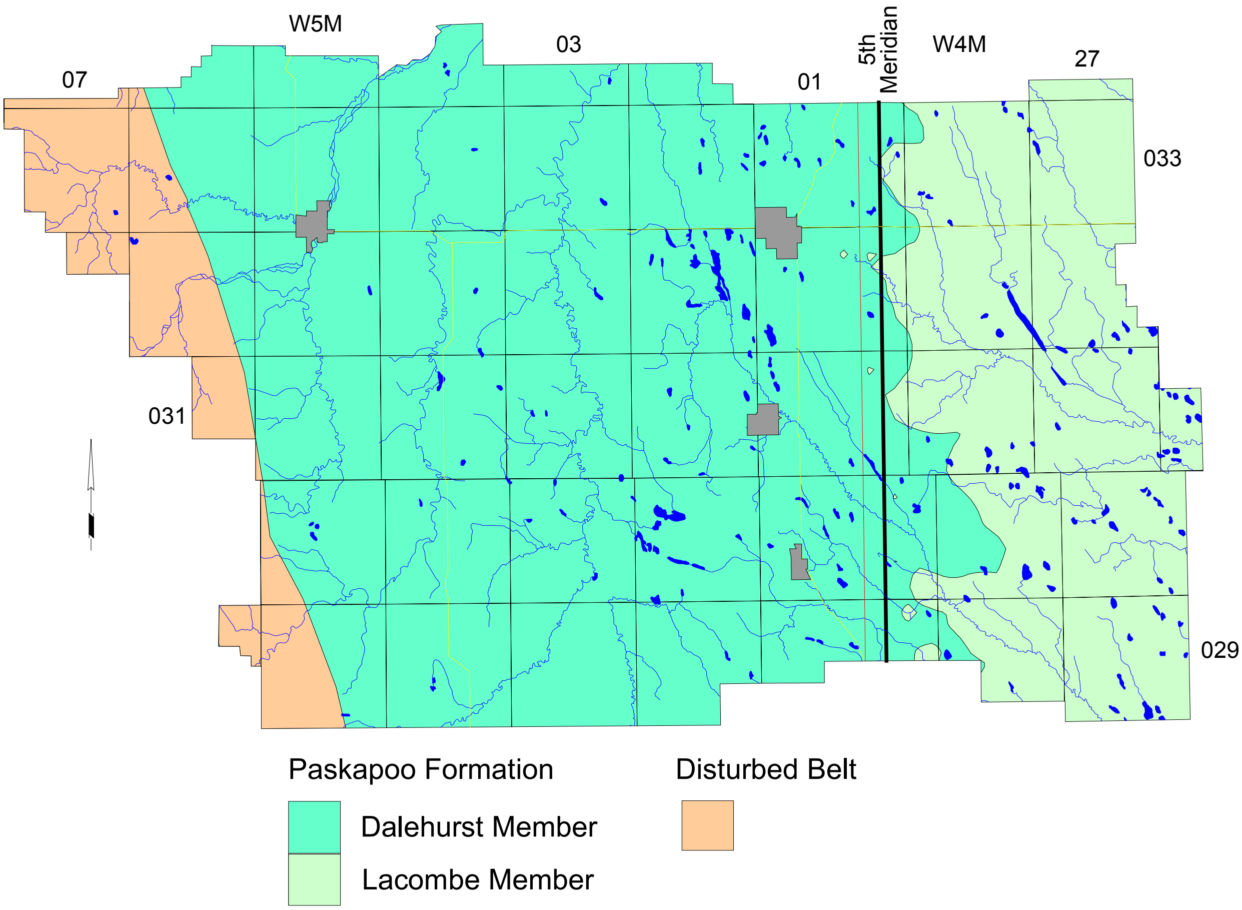
Total Dissolved Solids in Groundwater from Surficial Deposits



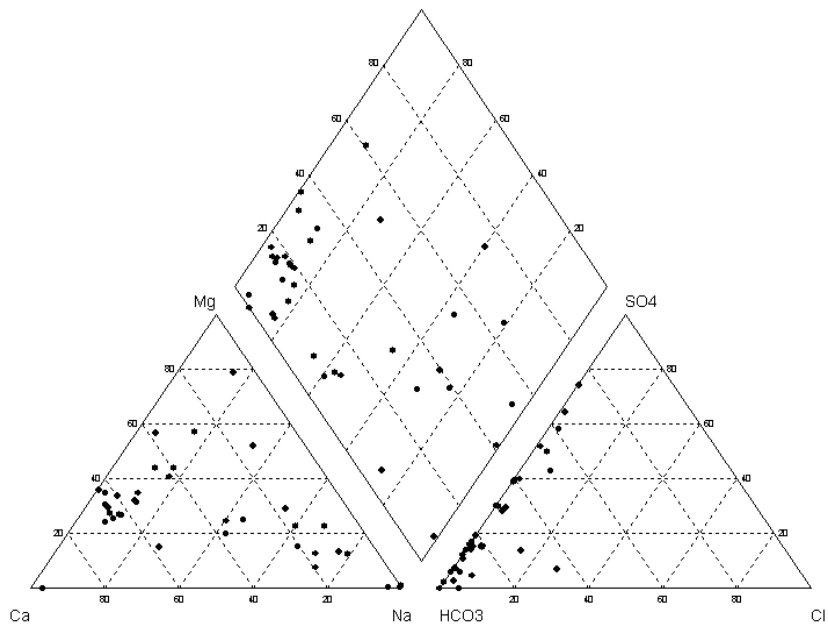
Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)



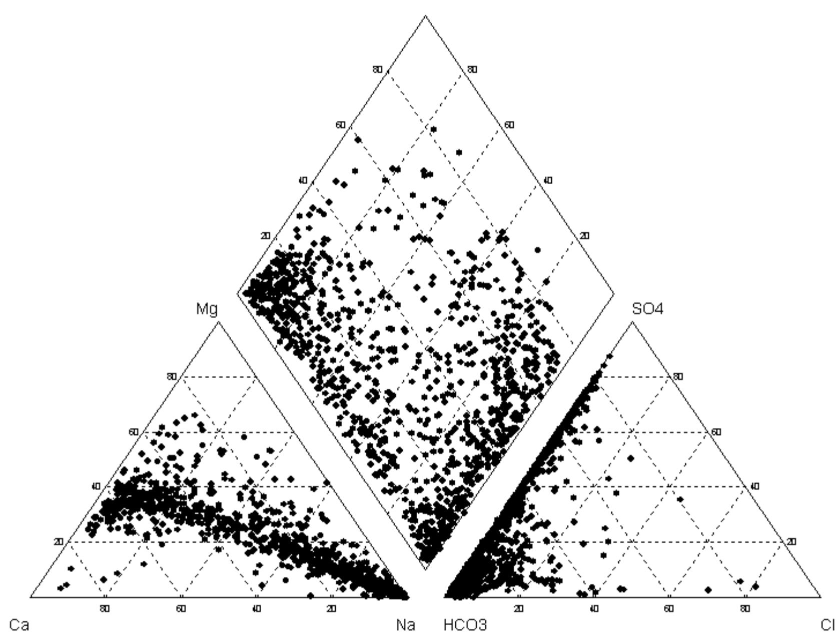
Bedrock Geology



Piper Diagrams

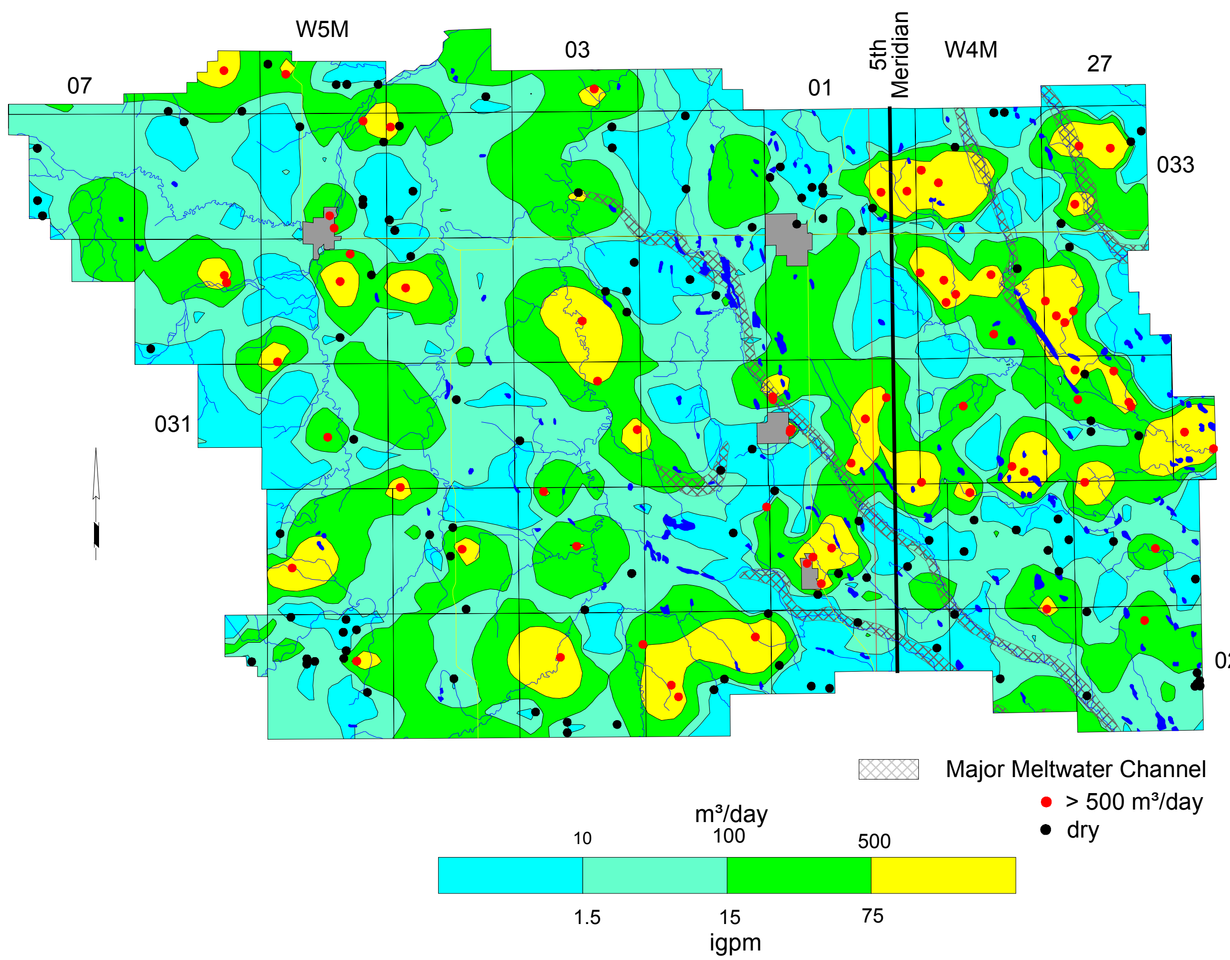


Surficial Deposits

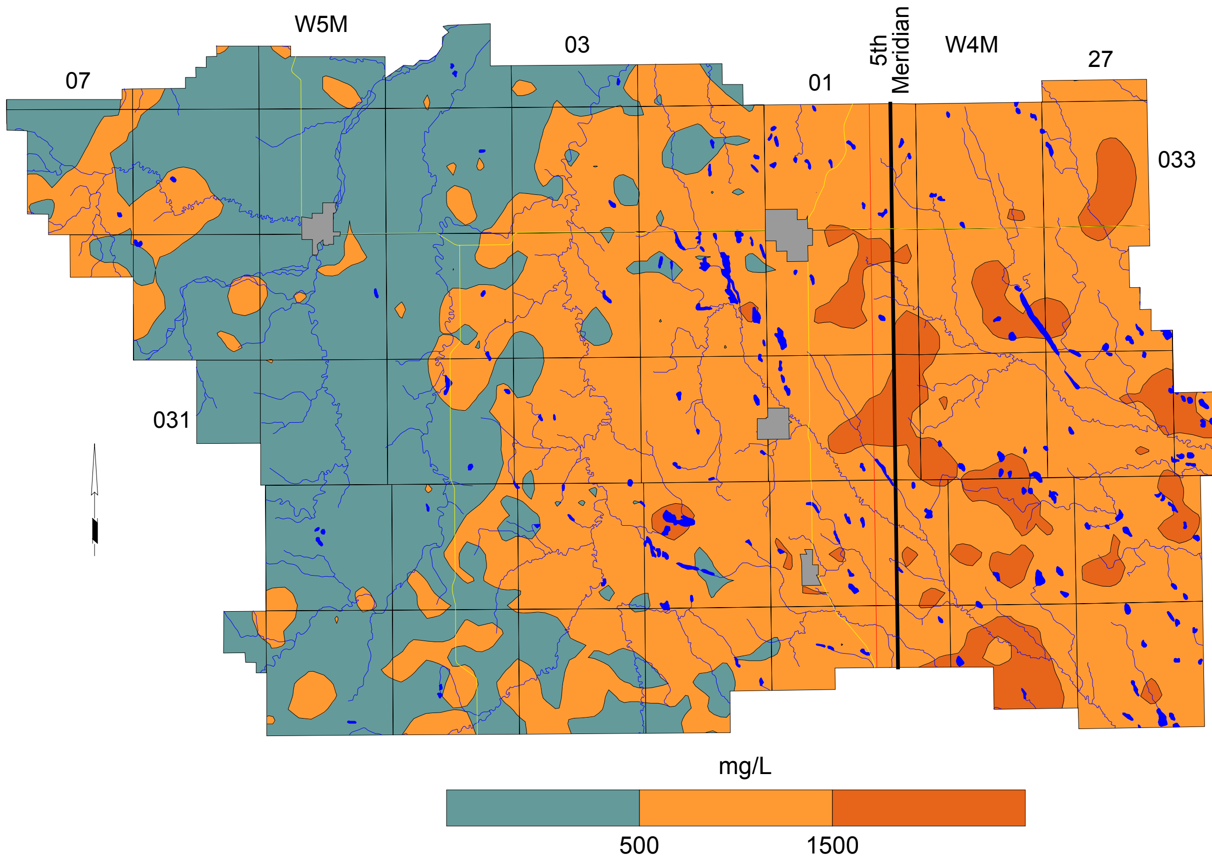


Bedrock Aquifers

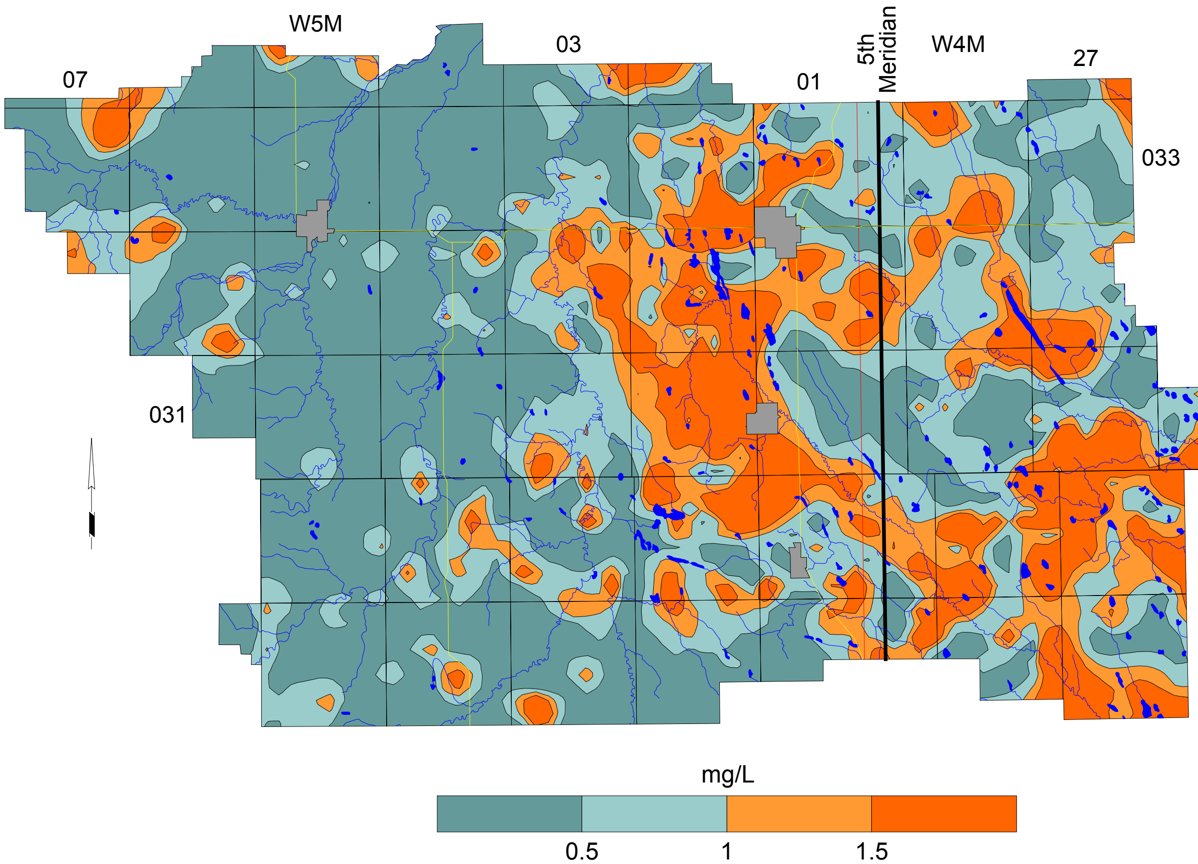
Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)



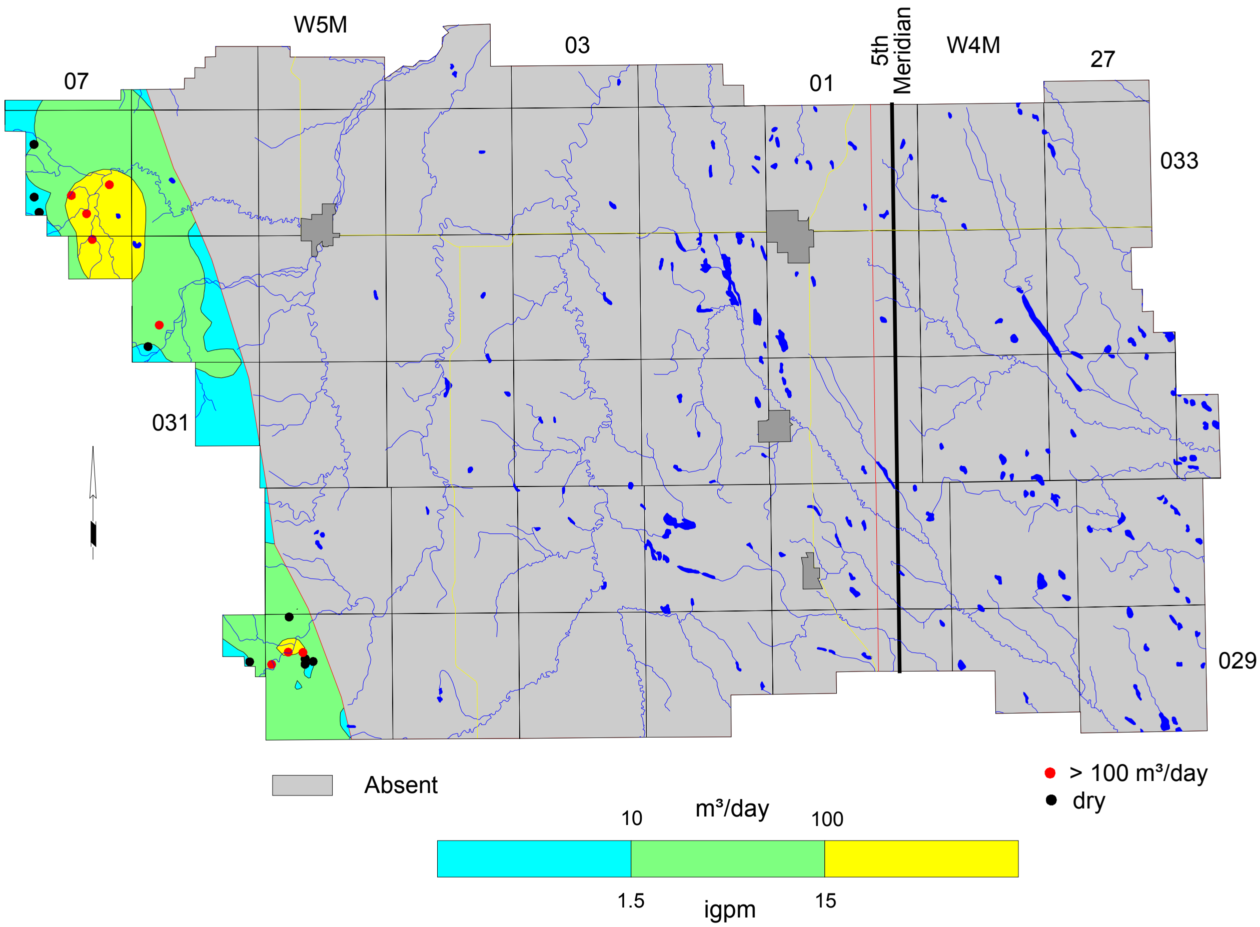
Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)



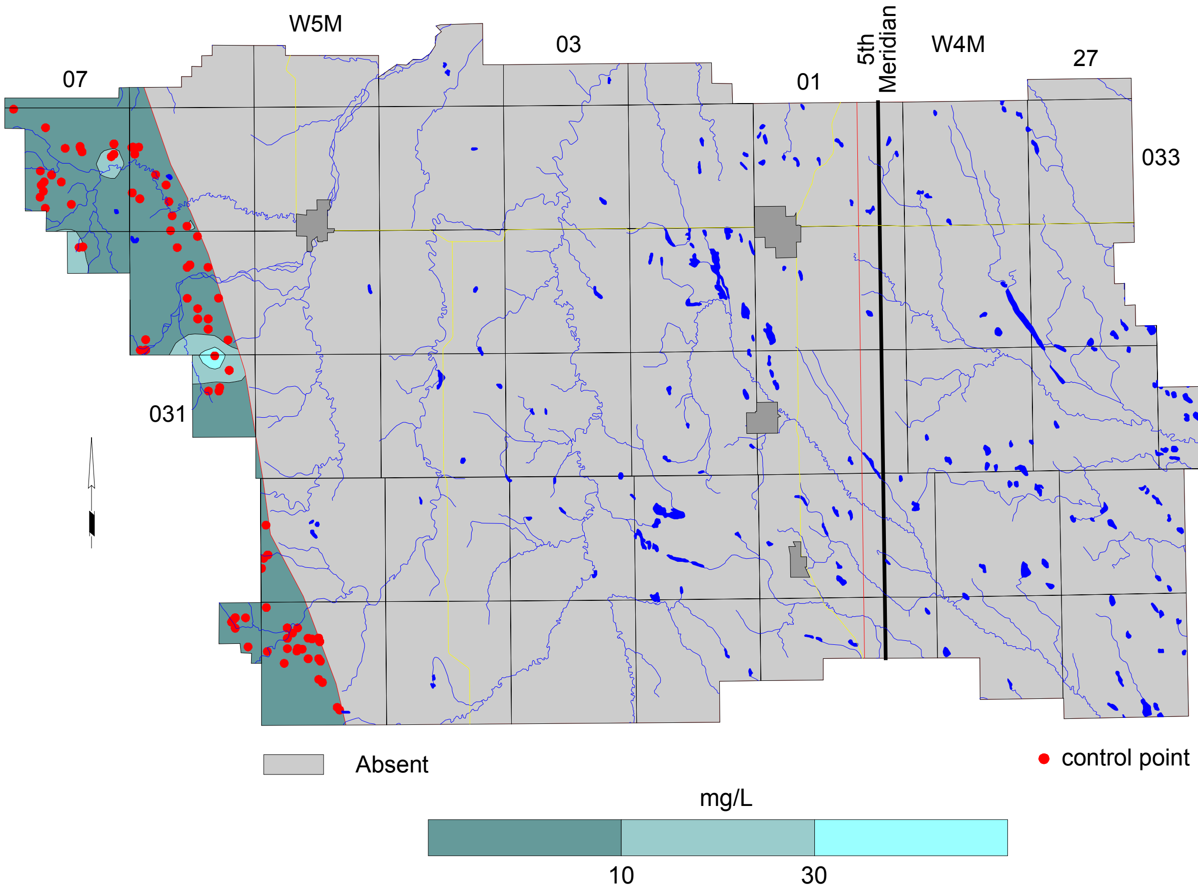
Fluoride in Groundwater from Upper Bedrock Aquifer(s)



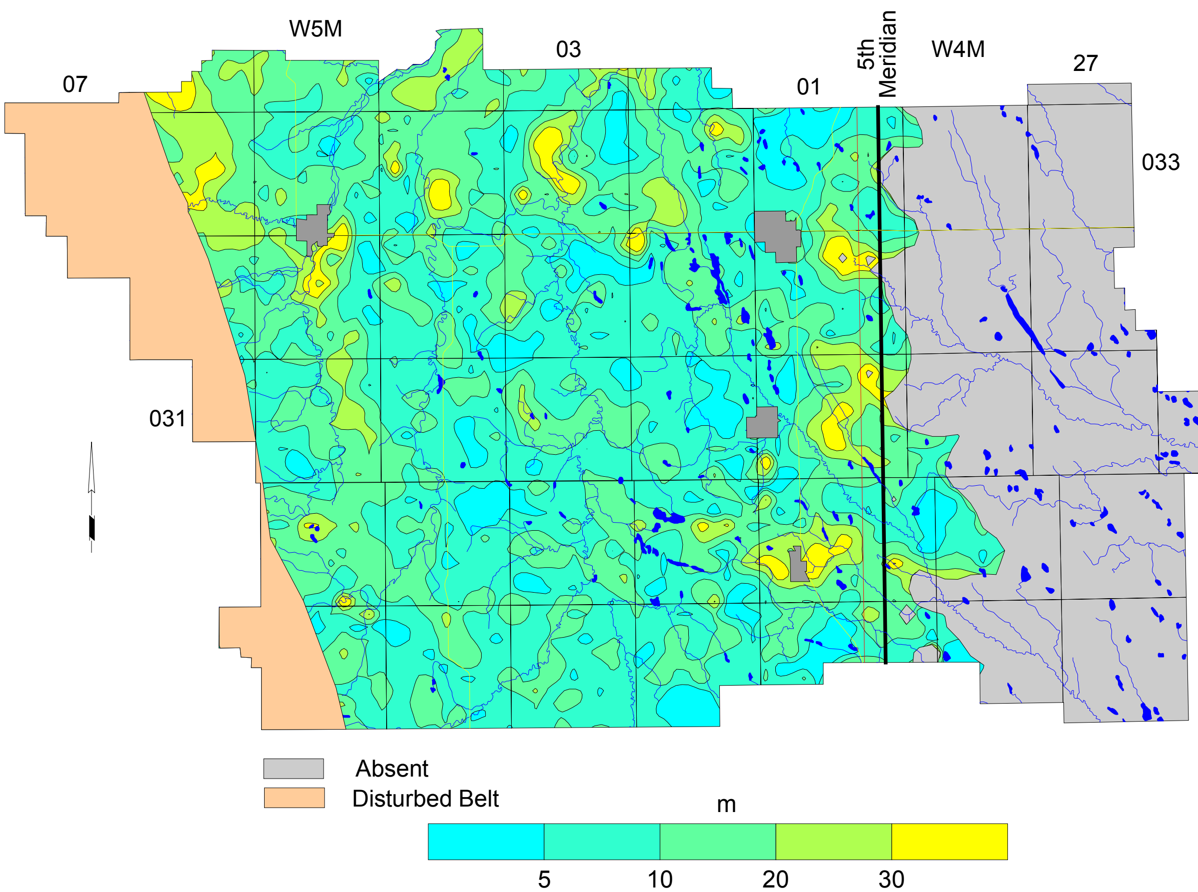
Apparent Yield for Water Wells Completed through Disturbed Belt Aquifer



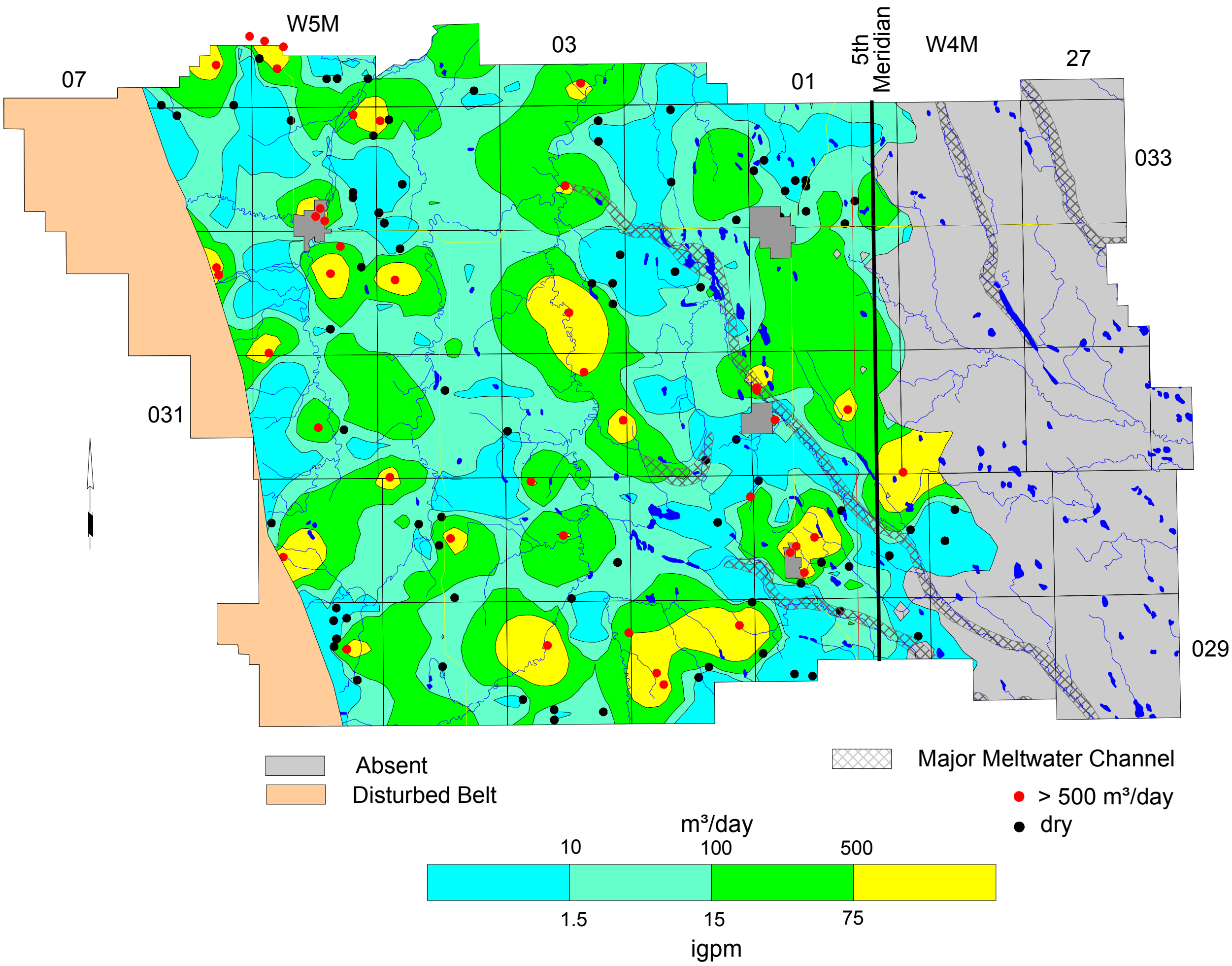
Chloride in Groundwater from Disturbed Belt Aquifer



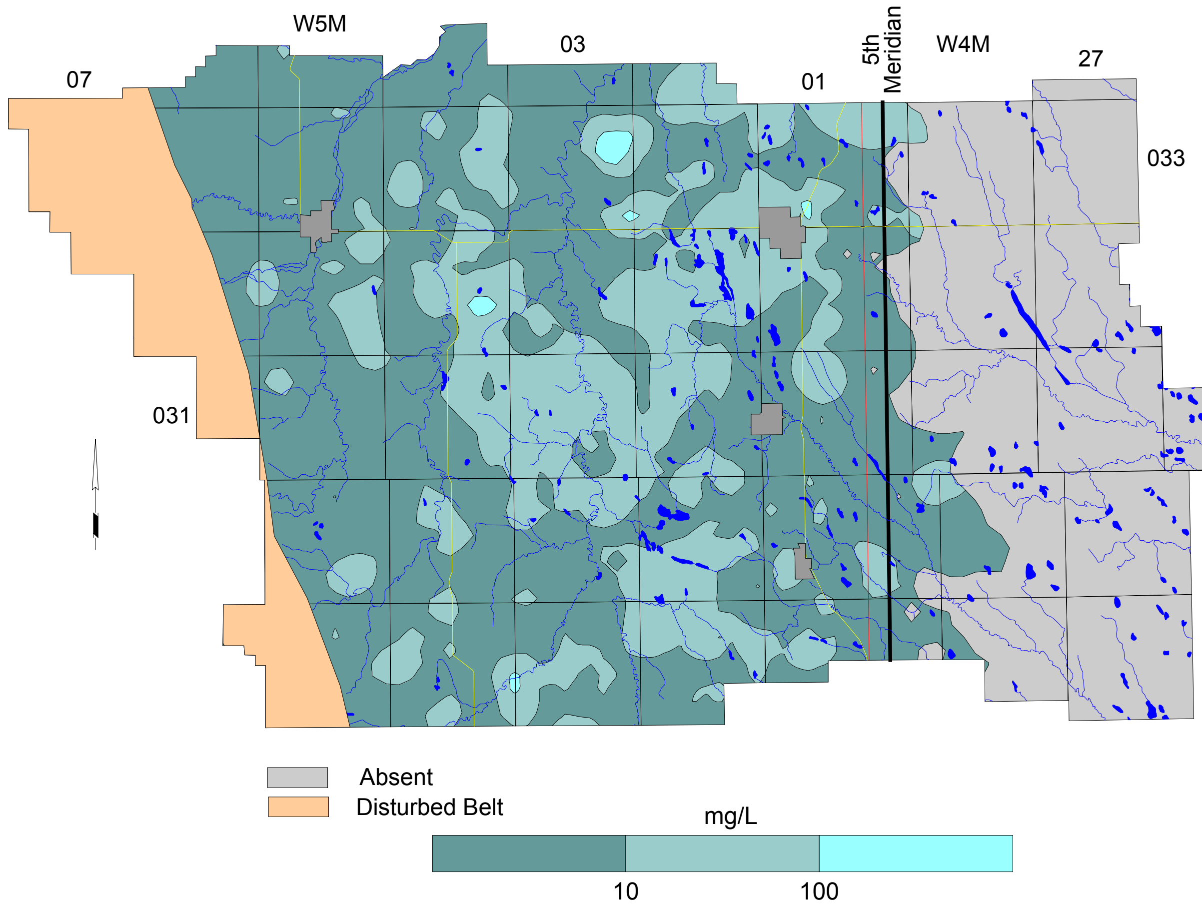
Depth to Top of Dalehurst Member



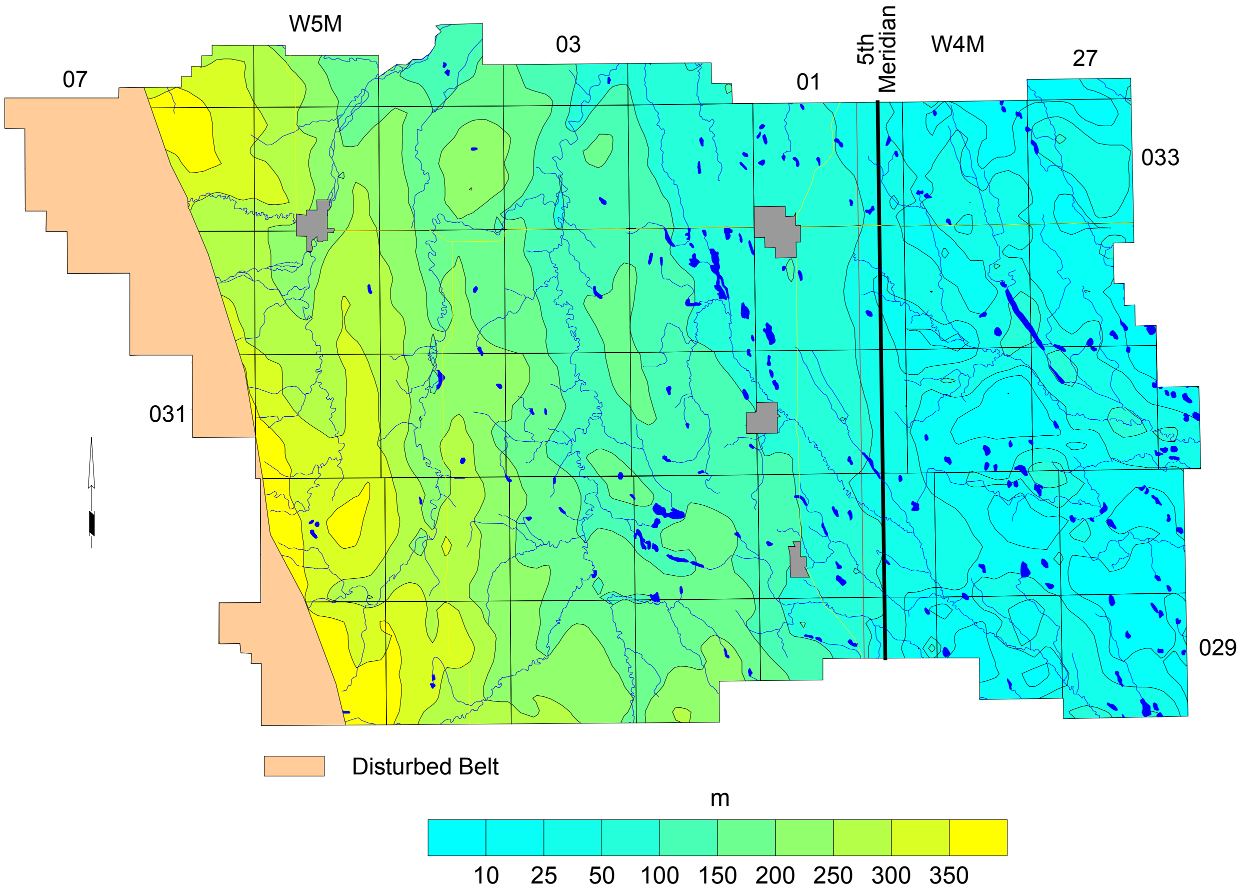
Apparent Yield for Water Wells Completed through Dalehurst Aquifer



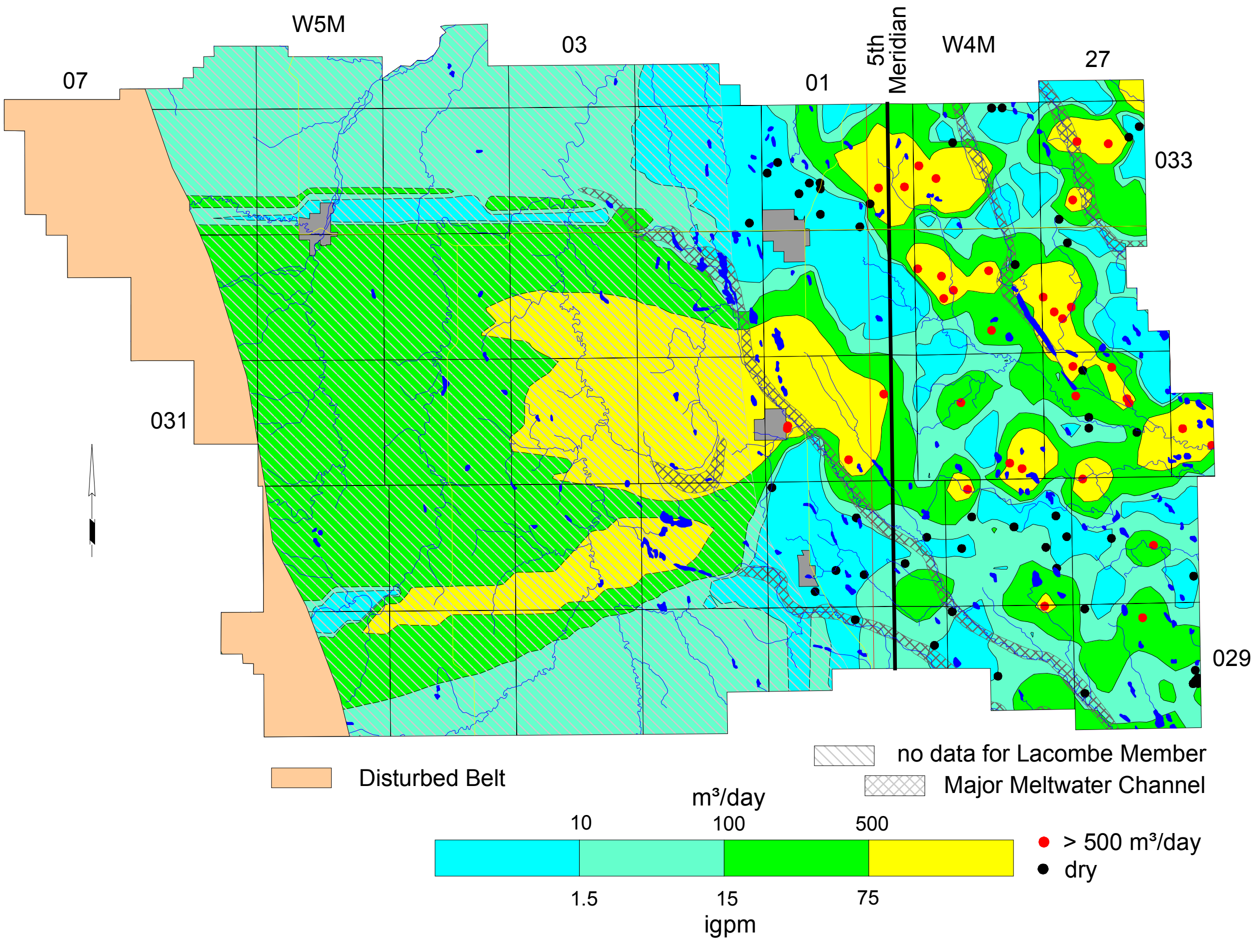
Chloride in Groundwater from Dalehurst Aquifer



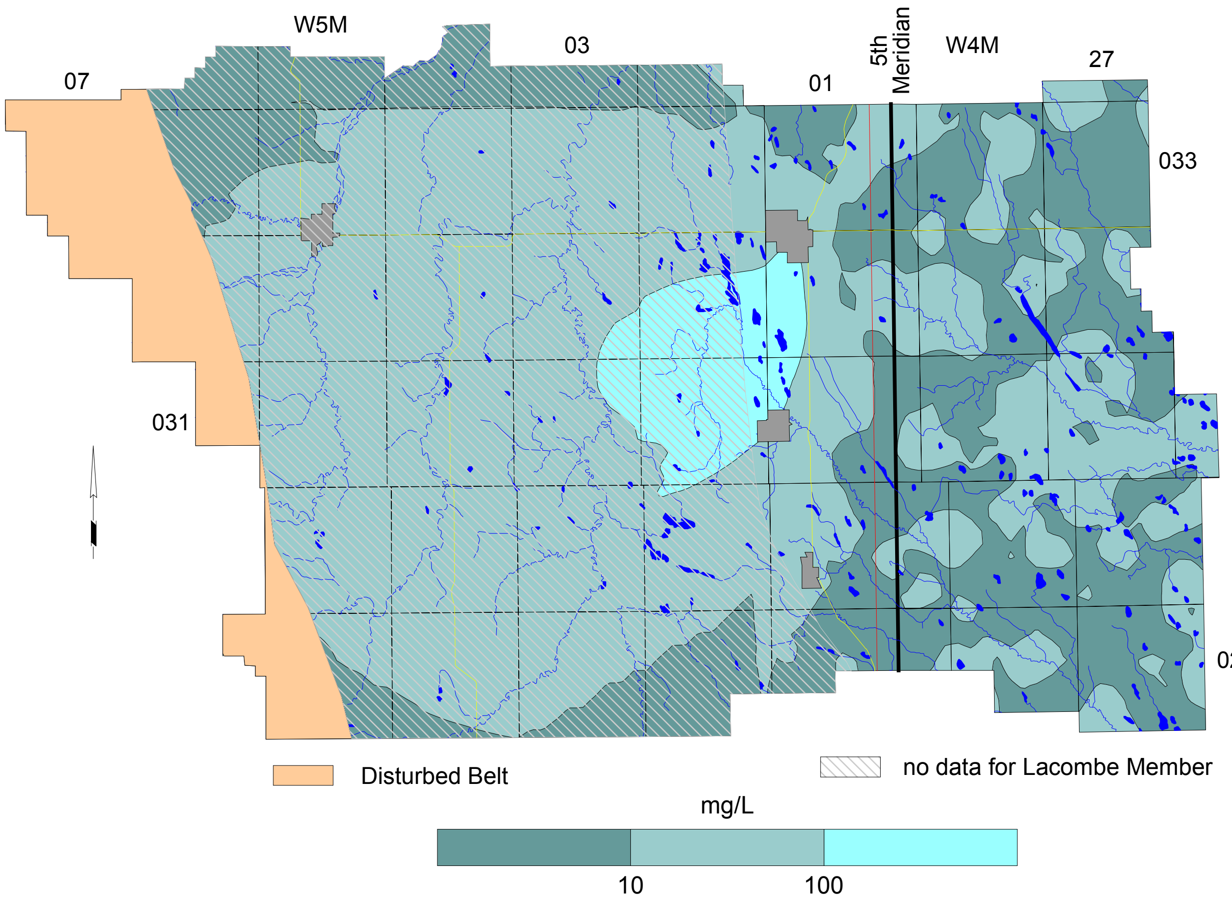
Depth to Top of Lacombe Member



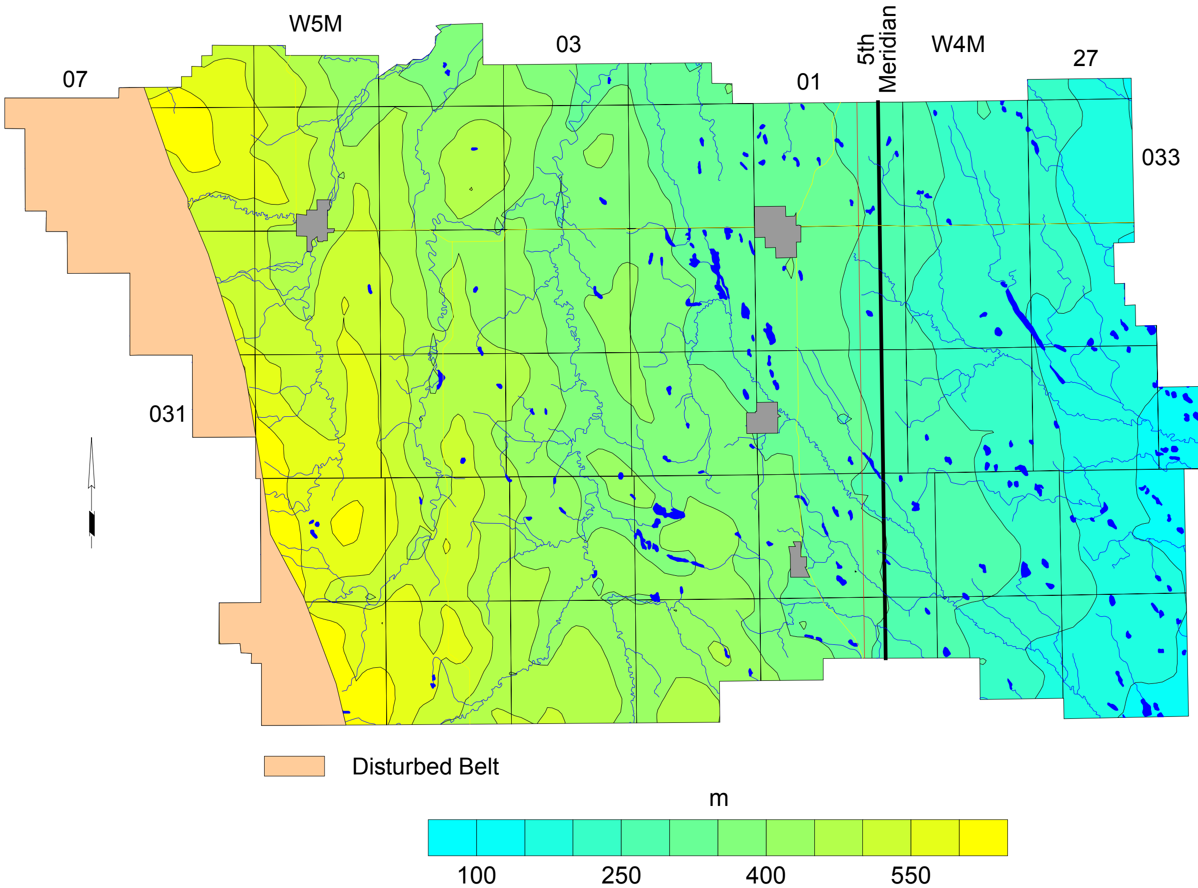
Apparent Yield for Water Wells Completed through Lacombe Aquifer



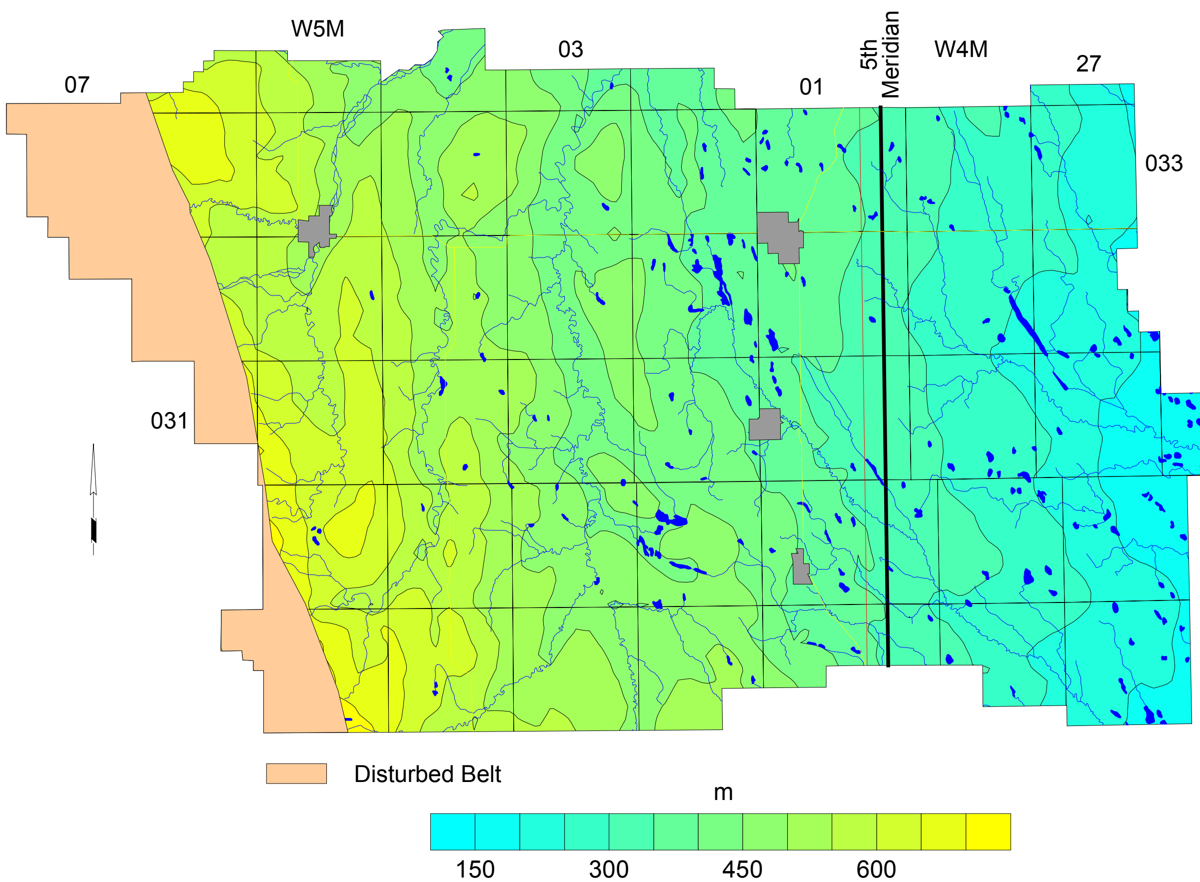
Chloride in Groundwater from Lacombe Aquifer



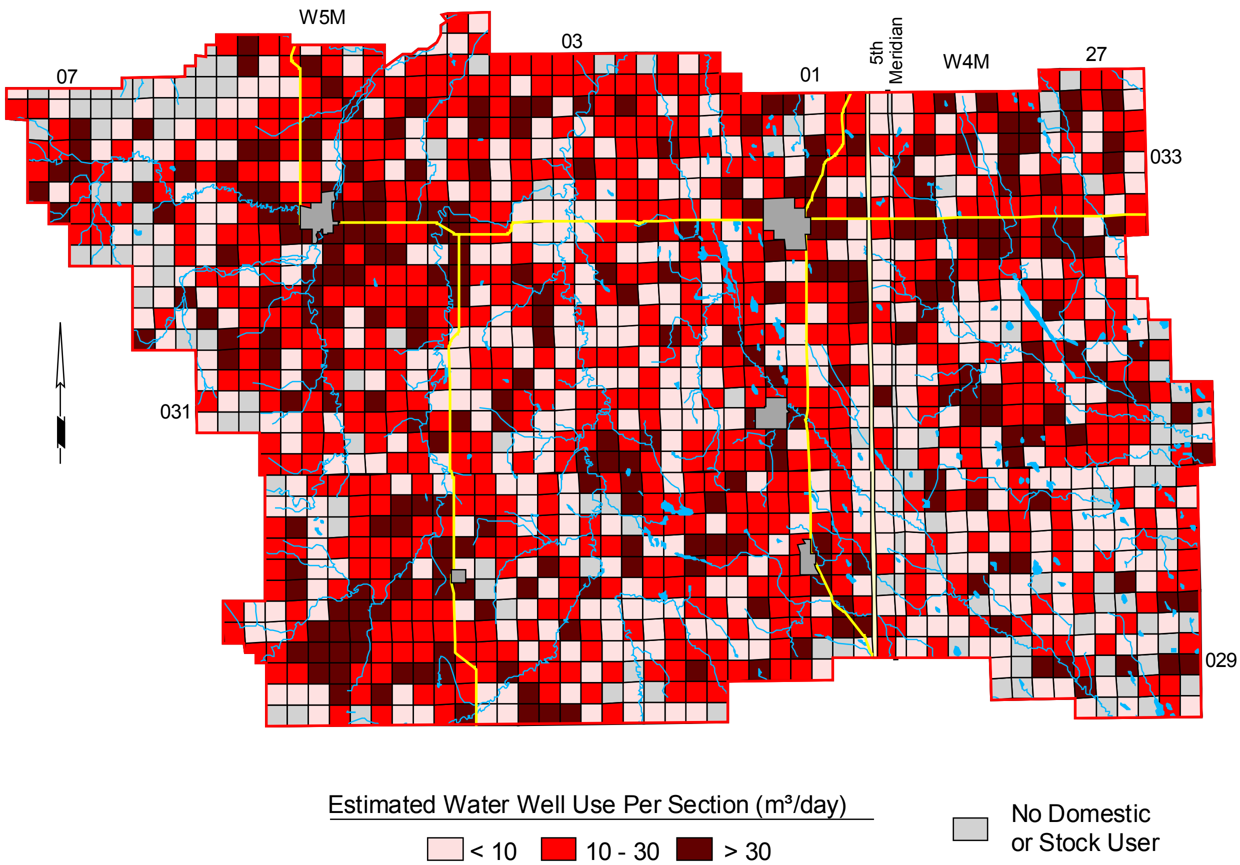
Depth to Top of Haynes Member



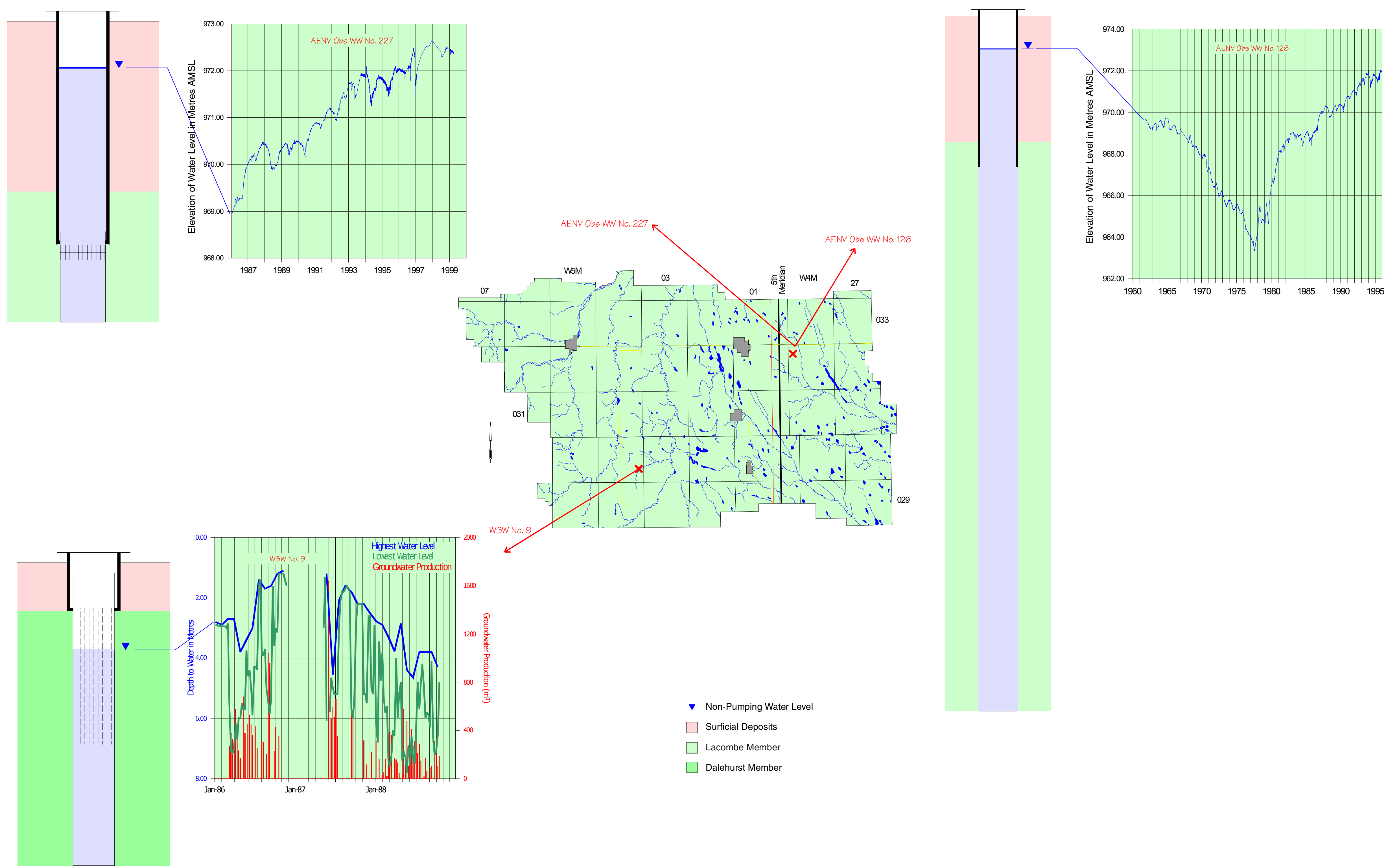
Depth to Top of Upper Scollard Formation



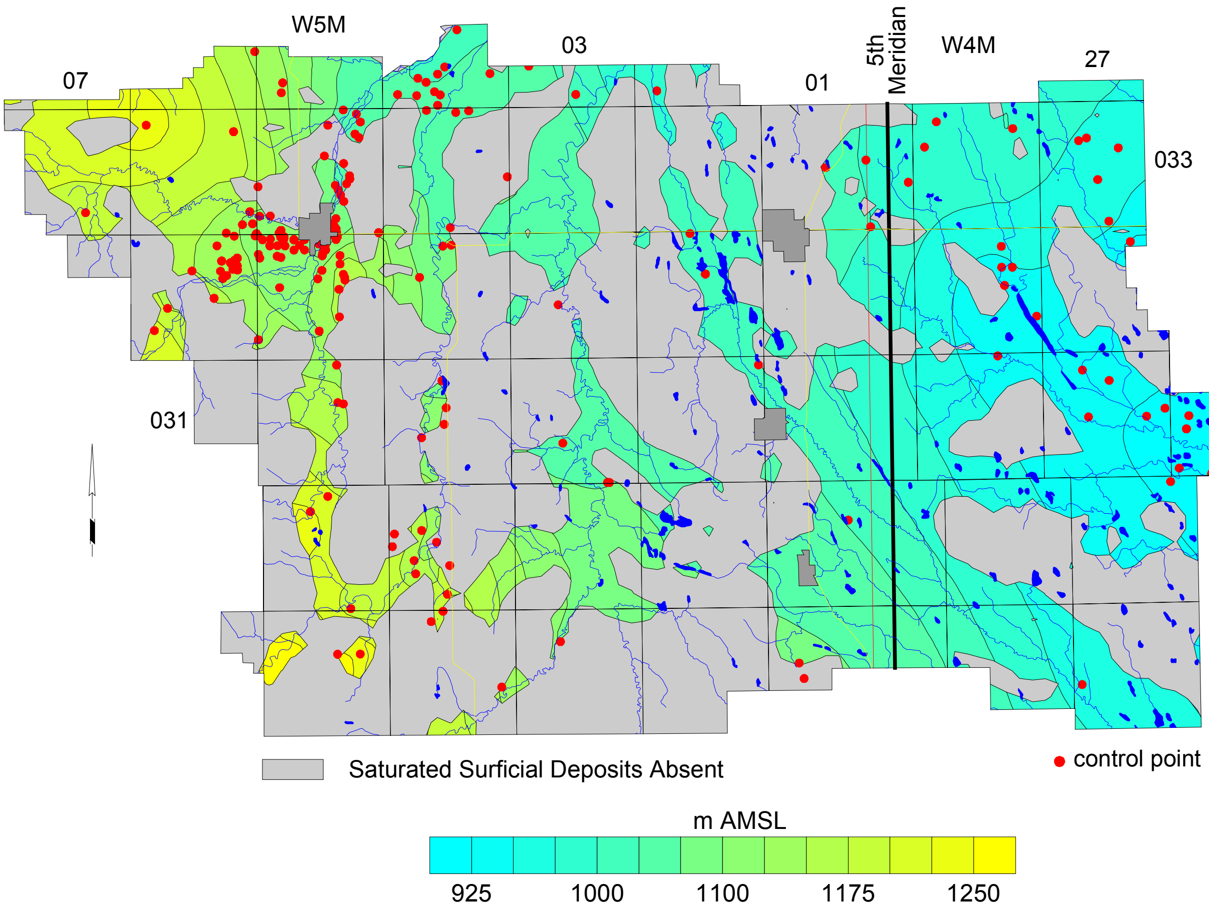
Estimated Water Well Use Per Section



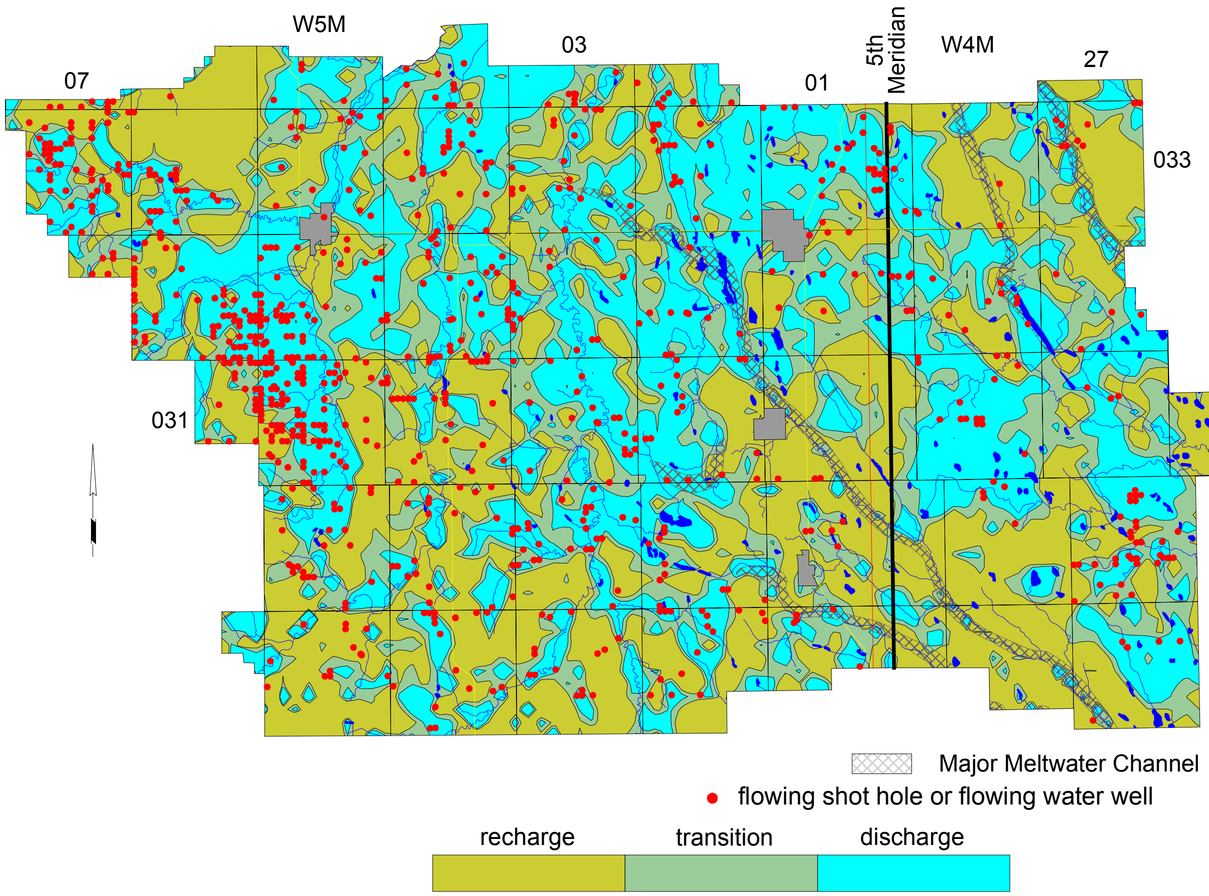
Hydrographs - AENV Observation Water Wells and Cremona WSW No. 9



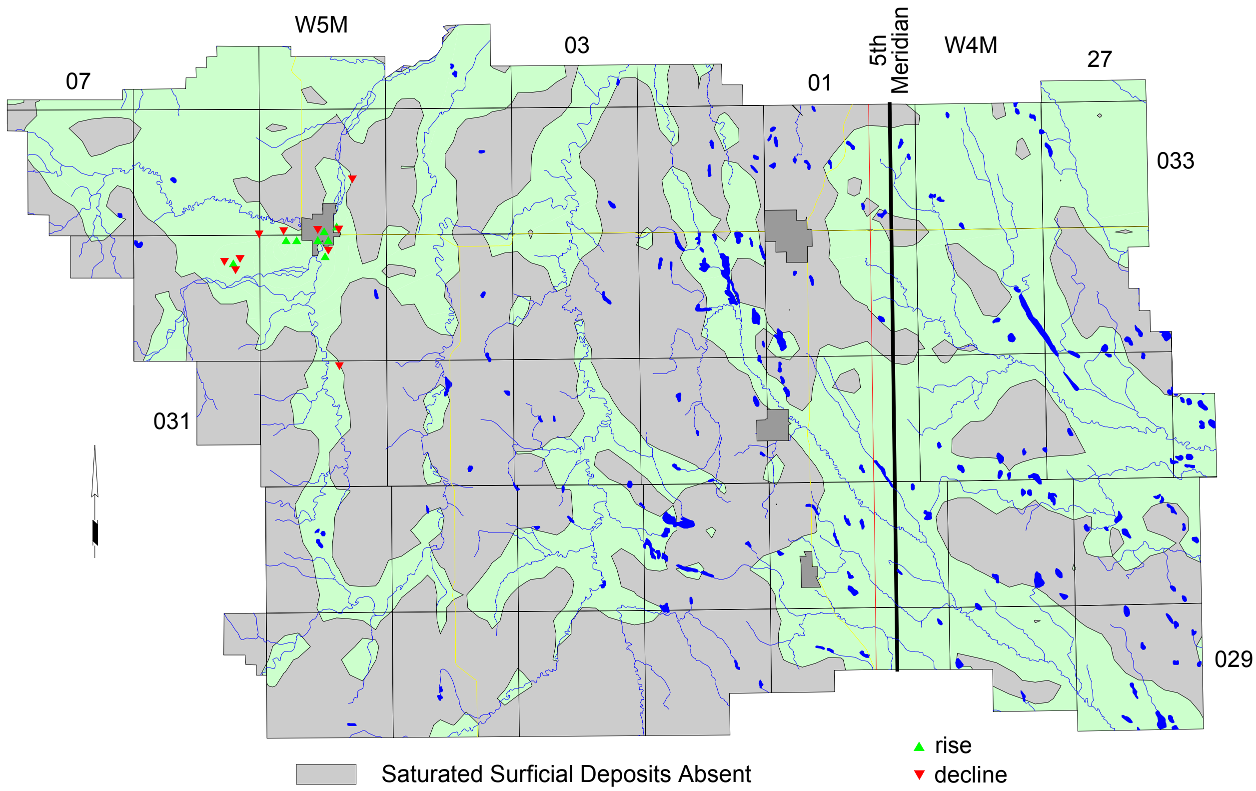
Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep



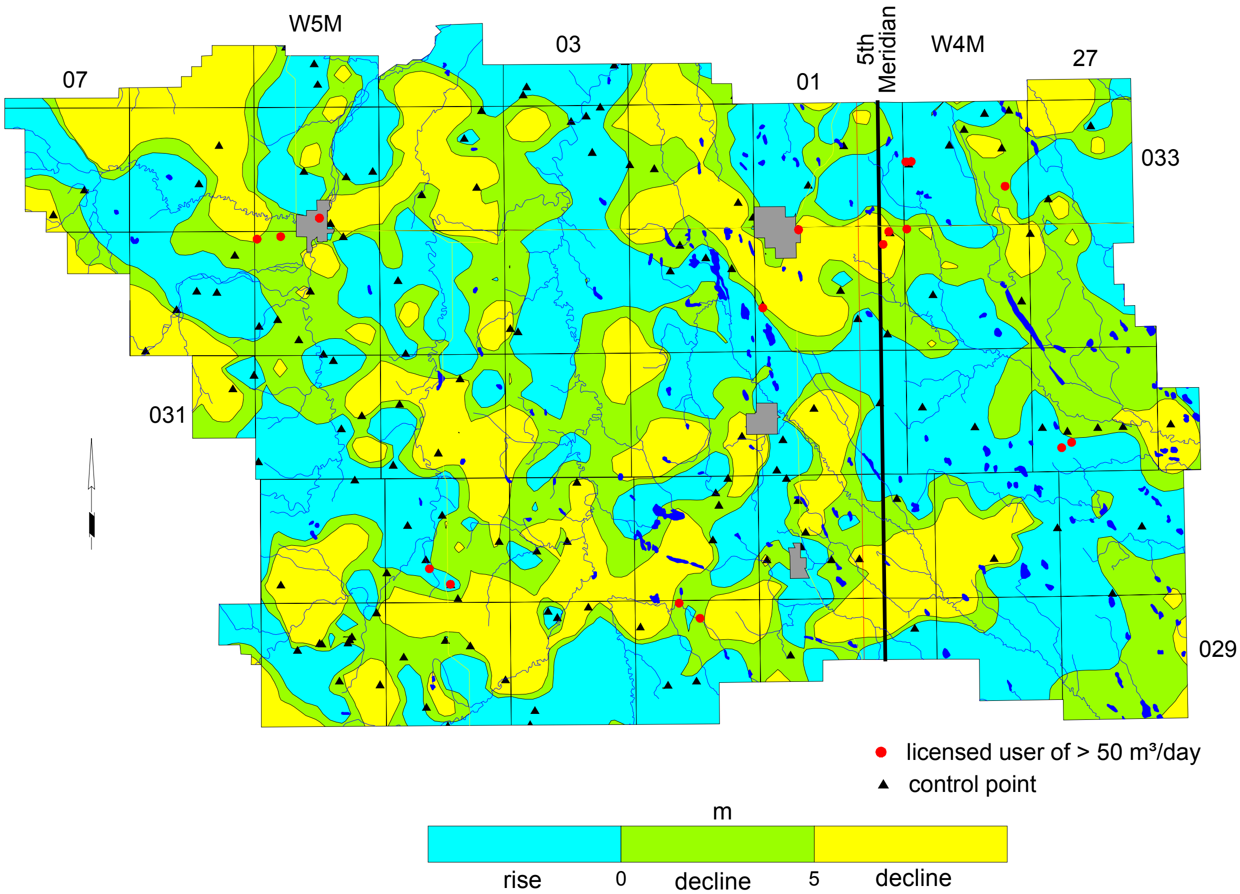
Recharge/Discharge Areas in Upper Bedrock Aquifer(s)



Changes in Water Levels - Sand and Gravel Aquifer(s)



Changes in Water Levels - Upper Bedrock Aquifer(s)



MOUNTAIN VIEW COUNTY
Appendix B

Maps and Figures on CD-ROM

1) General

Index Map
Surface Casing Types used in Drilled Water Wells
Location of Water Wells
Depth of Existing Water Wells
Depth to Base of Groundwater Protection
Generalized Cross-Section (for terminology only)
Geologic Column
Hydrogeology Map
Cross-Section A - A'
Cross-Section B - B'
Cross-Section C - C'
Cross-Section D - D'
Bedrock Topography
Bedrock Geology
Relative Permeability
Licensed Water Wells
Estimated Water Well Use Per Section
Water Wells Recommended for Field Verification

2) Surficial Aquifers

a) Surficial Deposits

Thickness of Surficial Deposits
Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep
Total Dissolved Solids in Groundwater from Surficial Deposits
Sulfate in Groundwater from Surficial Deposits
Fluoride in Groundwater from Surficial Deposits
Nitrate + Nitrite (as N) in Groundwater from Surficial Deposits
Chloride in Groundwater from Surficial Deposits
Total Hardness in Groundwater from Surficial Deposits
Piper Diagram - Surficial Deposits
Thickness of Sand and Gravel Deposits
Amount of Sand and Gravel in Surficial Deposits
Thickness of Sand and Gravel Aquifer(s)
Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)
Changes in Water Levels - Sand and Gravel Aquifer(s)

MOUNTAIN VIEW COUNTY
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

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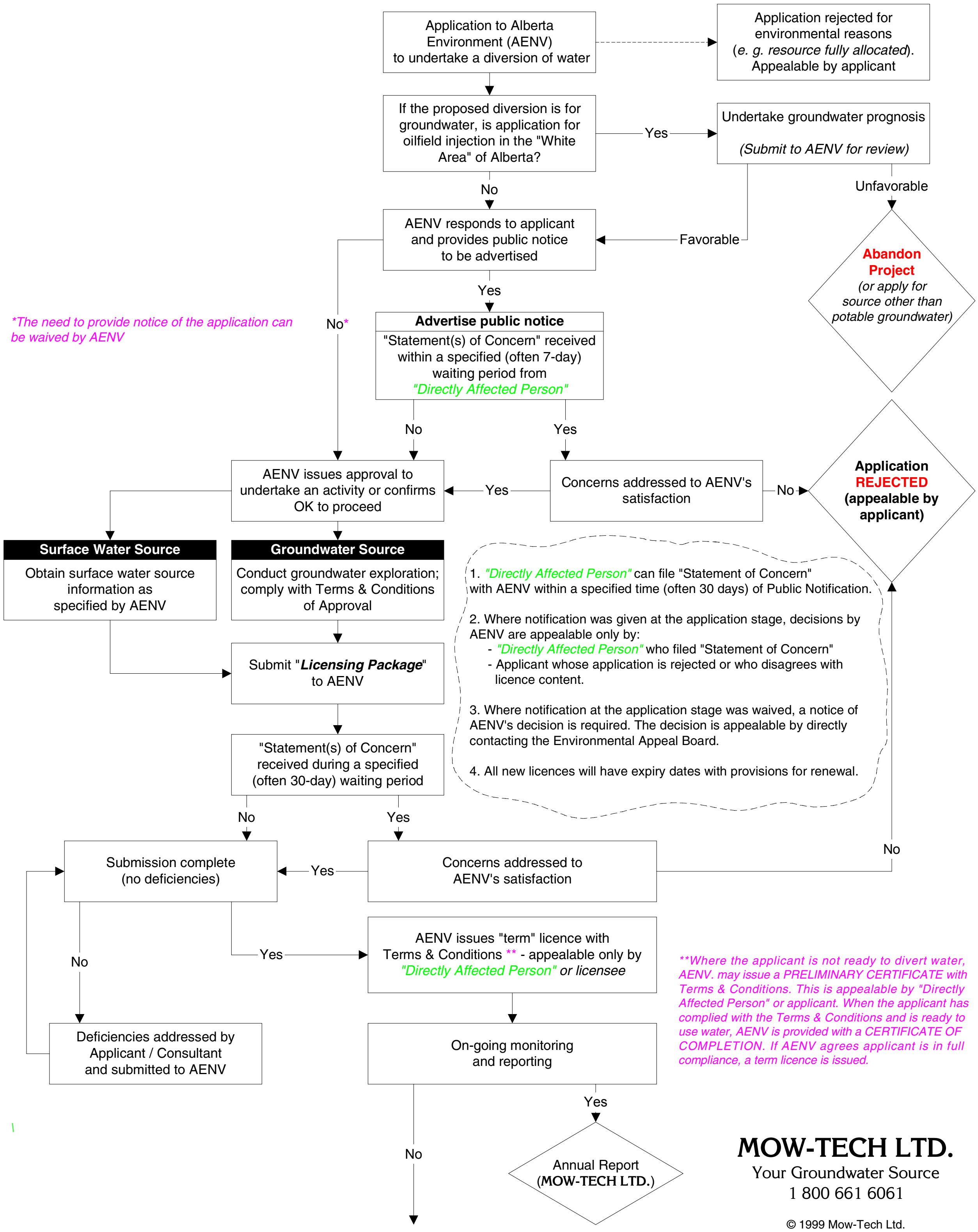
ALBERTA REGULATION 205/98

Water Act

WATER (MINISTERIAL) REGULATION

Table of Contents

Water Act – Flowchart



*This flow chart was developed by Mow-Tech Ltd. and is provided as a guide **only** to Alberta's new **Water Act.** Mow-Tech Ltd. accepts no responsibility for the information provided.*

Interpretation of Chemical Analysis of Drinking Water

Stony Plain - Lac Ste. Anne Health Unit

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Fax: 963-7612

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Box 430
Fox Creek, Alberta
T0H 1P0
Telephone: 622-3730

HOME CARE:
Box 210
Stony Plain, Alberta
T0E 2G0
Telephone: 963-3366

INTERPRETATION OF CHEMICAL ANALYSIS OF DRINKING WATER

1. TOTAL DISSOLVED SOLIDS (TDS) - The recommended limit is 1000 mg/L for untreated and 500 mg/L for treated waters. TDS indicates the approximate organic and inorganic substances in the water. It will be high if other components of the analysis are high.

2. IRON - Amounts over 0.3 mg/L, usually stain laundry and plumbing fixtures and cause undesirable tastes. Iron filtration can be utilized. Iron bacteria may also be the cause of increased iron content.

3. CALCIUM - This is a constituent of hardness. Excessive calcium in drinking water may be a factor in disorders of the kidneys, bladder and urinary system.

4. MAGNESIUM - This is a constituent of hardness.

5. HARDNESS - A maximum acceptable concentration has not been established. Hardness is caused mainly by calcium and magnesium. Levels between 80 and 100 mg/L are satisfactory: 100 to 200 mg/L are less acceptable: more than 200 mg/L are considered to be poor and in excess of 500 mg/L are unacceptable for most domestic purposes. Softening can be helpful in given circumstances.

6. SODIUM - Ideally, there should be no more than 200mg/L. The average intake of sodium from water is only a small fraction of that consumed in a normal diet. Persons suffering from hypertension or congestive heart failure may require a sodium-restricted diet, in which case the intake of sodium from drinking water could become significant. Your physician should be informed of the sodium content.

7. NITRITE-NITROGEN & NITRATE-NITROGEN (NO2 + NO3) - The maximum acceptable concentration is 10 mg/L. Any amount over that may be harmful to children up to 12 months of age, causing a condition known as methaemoglobinaemia. Presence may indicate a contaminating source although other instances, e.g. fertilizer and decomposing vegetation can cause an elevated figure.

8. NITRITE-NITROGEN - The maximum acceptable concentration is 1.0 Mg/L. Nitrite is unstable in water and converts to nitrate. An elevated figure may indicate a pollution problem.

9. FLUORIDE - Approximately 1 mg/L of fluoride is recommended in drinking water in order to give developing teeth some protection against decay. If the fluoride is higher than 1.5 mg/L you should talk to the dental staff of the Health Unit about the possibility of mottled enamel; if the fluoride is lower than 0.7 mg/L please ask about fluoride supplements for your children.

10. SULPHATE - The maximum acceptable concentration is 500 mg/L. Taste becomes noticeable between 250 and 600 mg/L and a laxative effect may be noticed by new users when sulphate combines with sodium or magnesium.

-2-

11. CHLORIDE - The recommended limit is 250 mg/L. Chloride content is usually low and an increase may indicate a nearby source of pollution (particularly if NO2 and NO3 and nitrite are high). Some wells contain naturally occurring chlorides. A salty taste may be evident.

12. ALKALINITY T (Total) - Alkalinity below 500 mg/L is generally accepted. Excessive alkalinity may result in incrustations on utensils, service pipes and water heaters.

13. BICARBONATE _ Upper limit not established. Relates to alkalinity as bicarbonate of sodium, calcium and magnesium.

NOTE: mg/L = milligrams per litre.

The preceding notes and standards are for your guidance only based on an intake of 2 litres of water per day. The figures may be interpreted in a variety of ways and the public health inspector for your area can be contacted for further advice.
Telephone: Stony Plain - 963-2206; Spruce Grove - 962-4072; Whitecourt - 778-5555.

For stock water and other agricultural uses the requirements are not necessarily the same as for domestic use. Please consult your District Agriculturalist for that kind of advice.

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)

ALBERTA ENVIRONMENTAL PROTECTION

WATER WELL INSPECTORS

Jennifer McPherson (Edmonton: 780-427-6429)

GEOPHYSICAL INSPECTION SERVICE

Edmonton: 780-427-3932

COMPLAINT INVESTIGATIONS

Blair Stone (Red Deer: 403-340-5310)

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

Paul Vasseur (Edmonton: 780-427-2433)

PRAIRIE FARM REHABILITATION ADMINISTRATION

Bill Franz (Red Deer: 403-340-4290)
Terry Dash (Calgary: 403-292-5719)

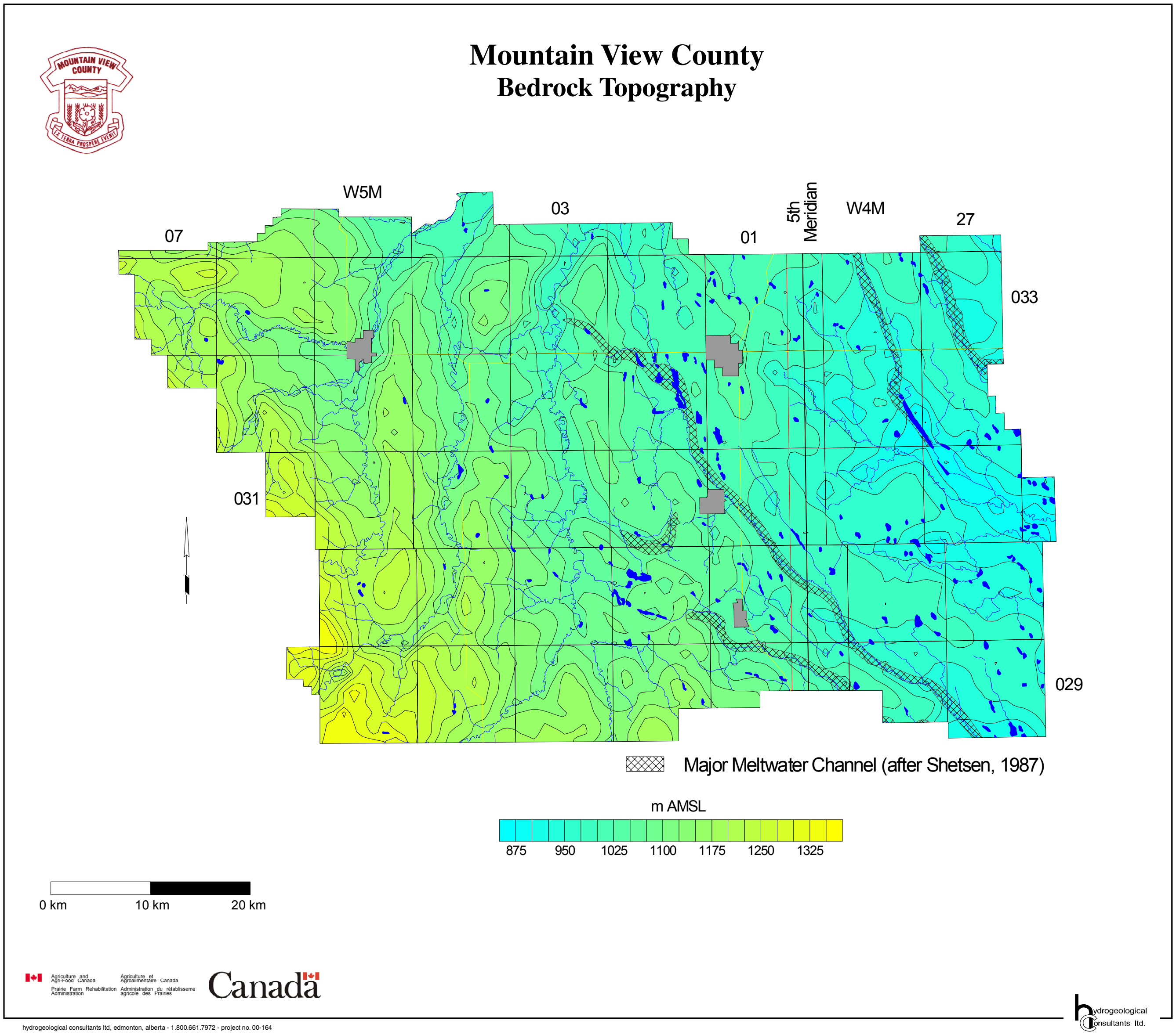
LOCAL HEALTH DEPARTMENTS

MOUNTAIN VIEW COUNTY

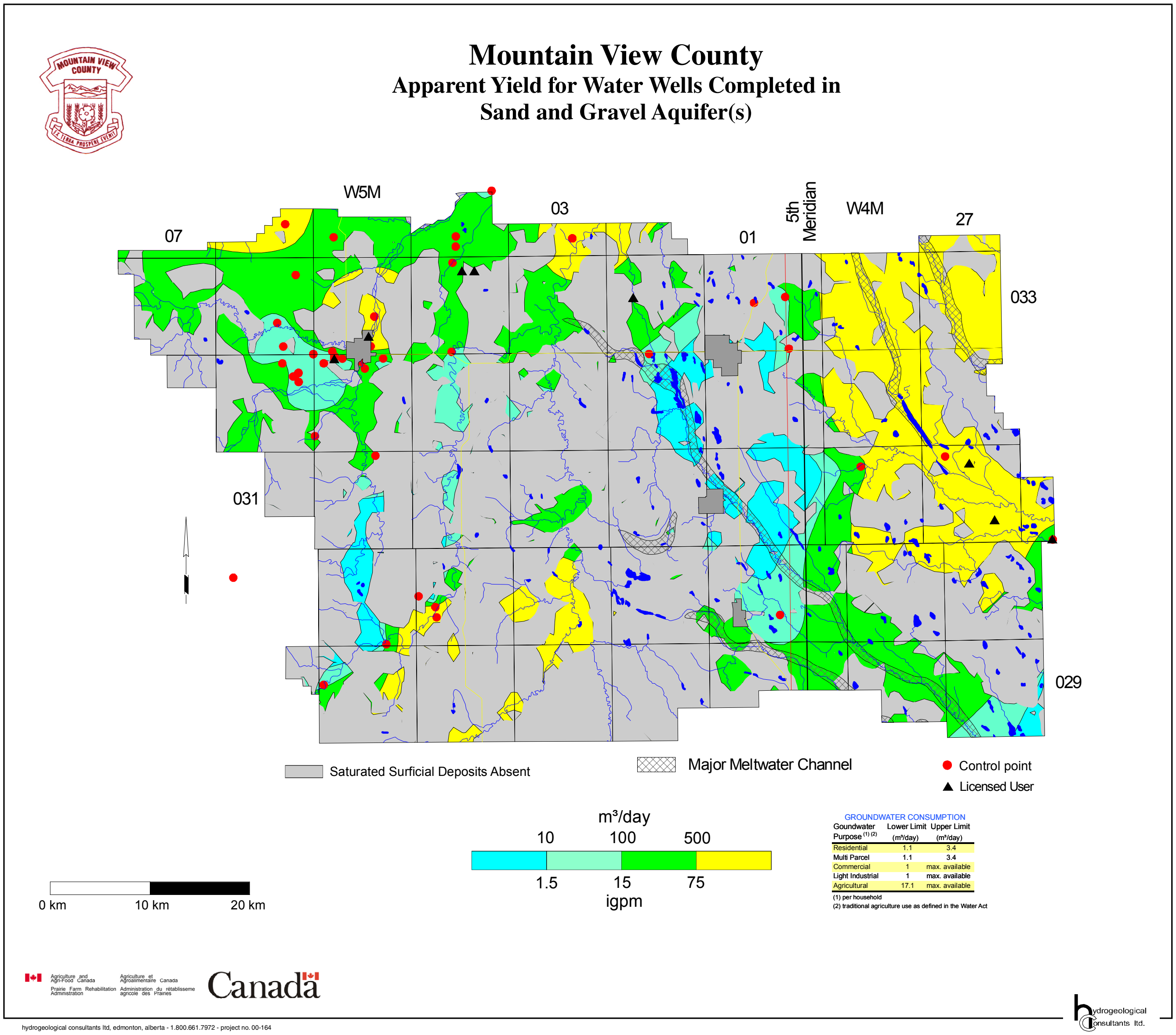
Appendix D

Maps and Figures Included as Large Plots

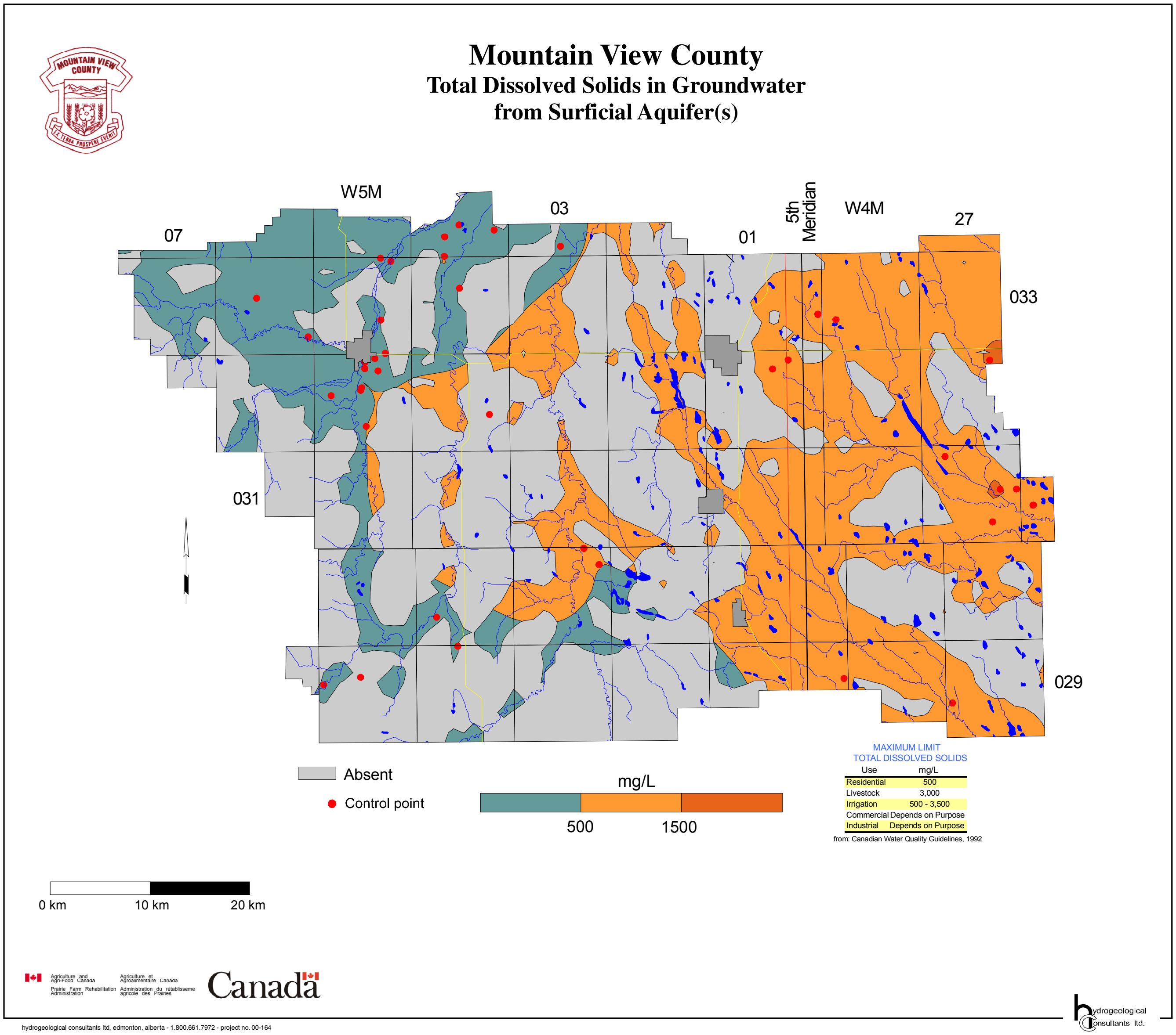
Bedrock Topography



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



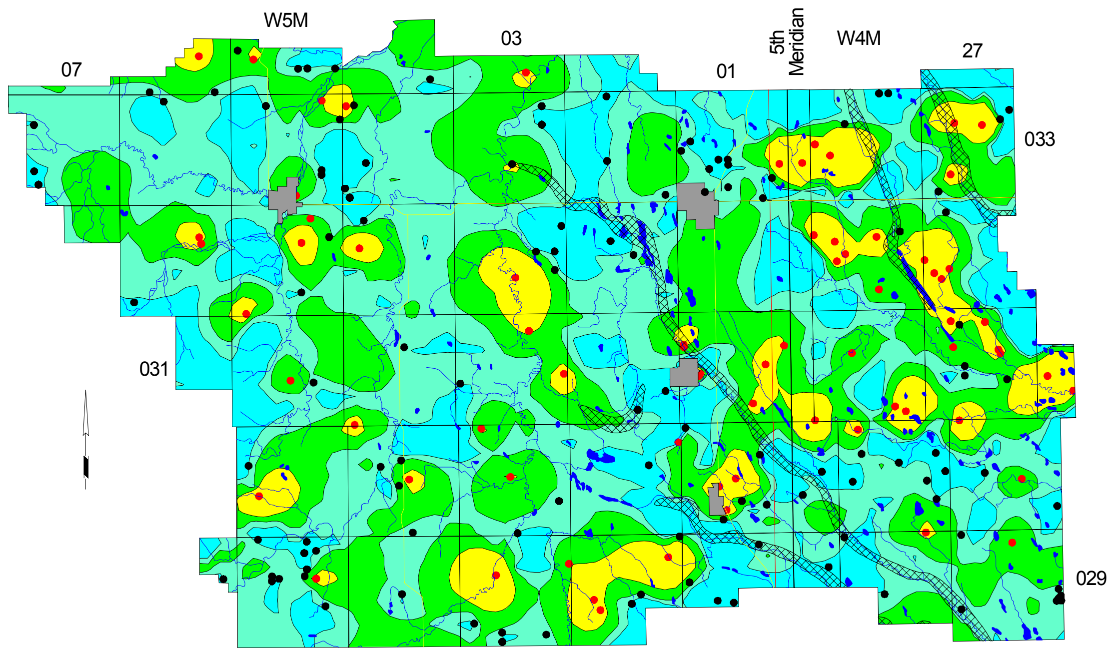
Total Dissolved Solids in Groundwater from Surficial Deposits

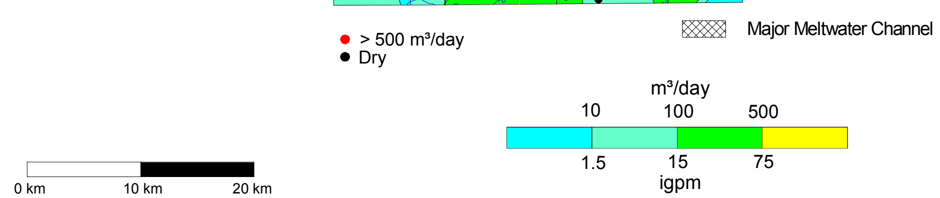


Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Mountain View County

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





GROUNDWATER CONSUMPTION

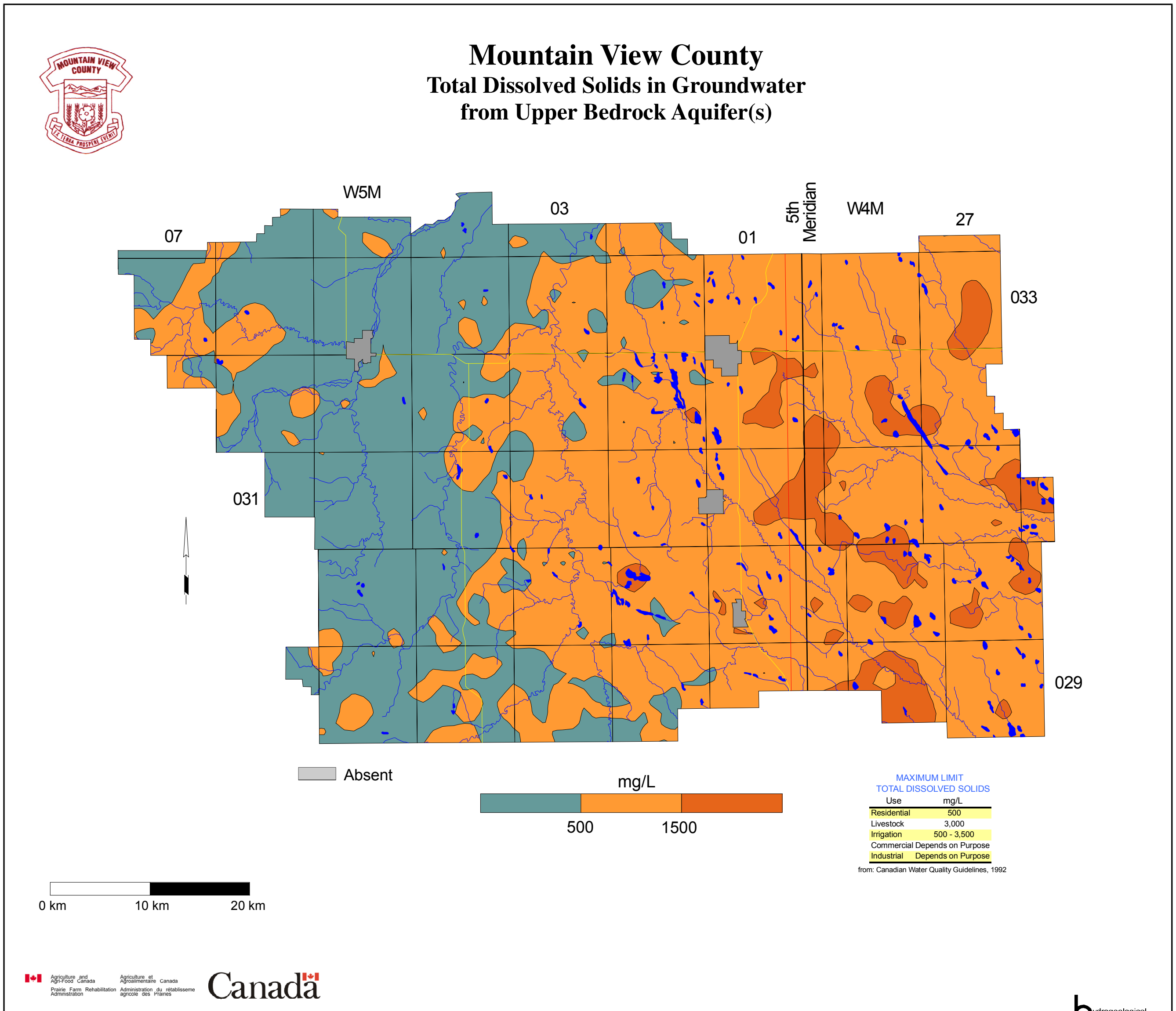
Goundwater Purpose (1) (2)	Lower Limit (m³/day)	Upper Limit (m³/day)
Residential	1.1	3.4
Multi Parcel	1.1	3.4
Commercial	1	max. available
Light Industrial	1	max. available
Agricultural	17.1	max. available

(1) per household
(2) traditional agriculture use as defined in the Water Act

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

hydrogeological consultants ltd.

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



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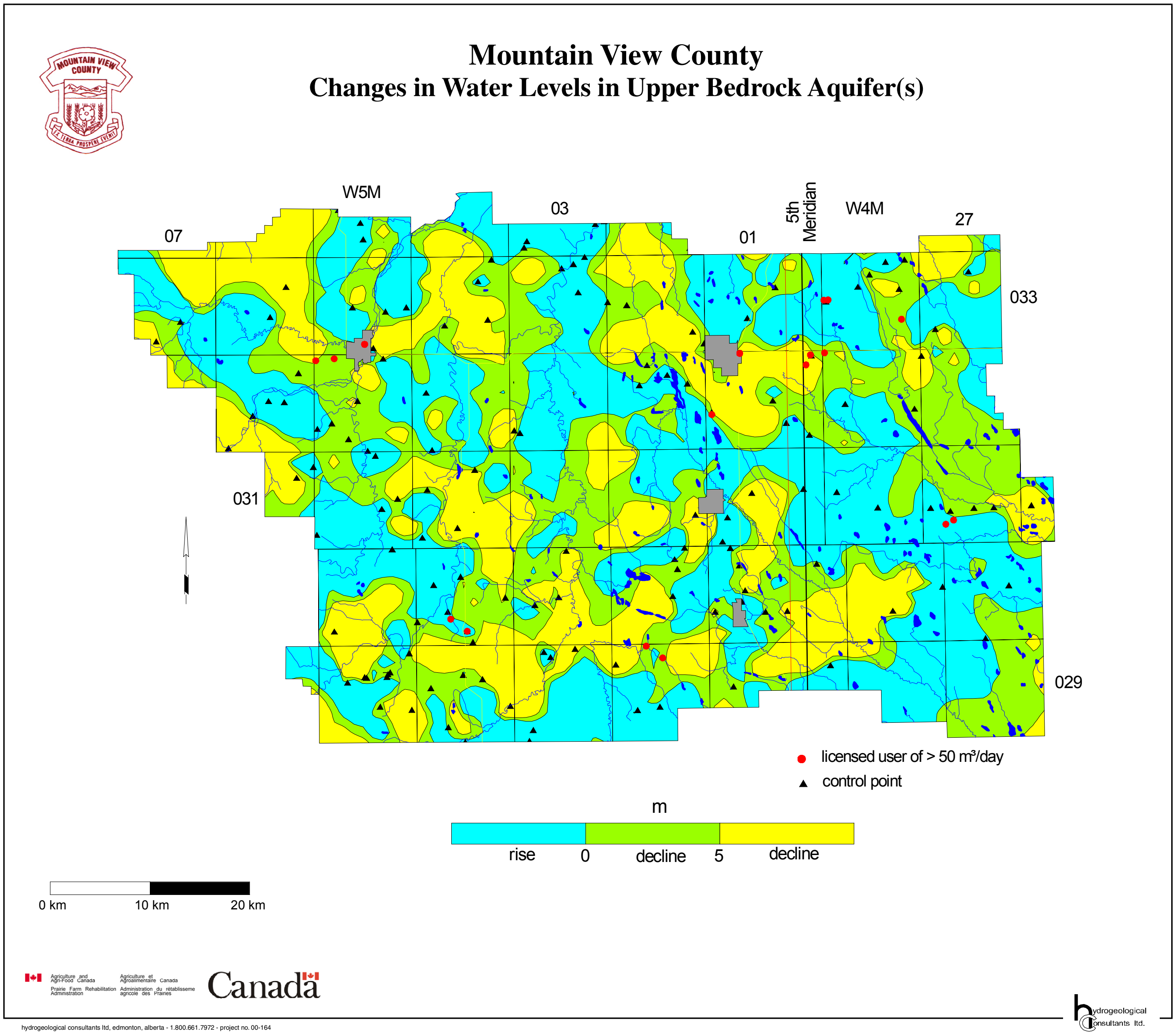
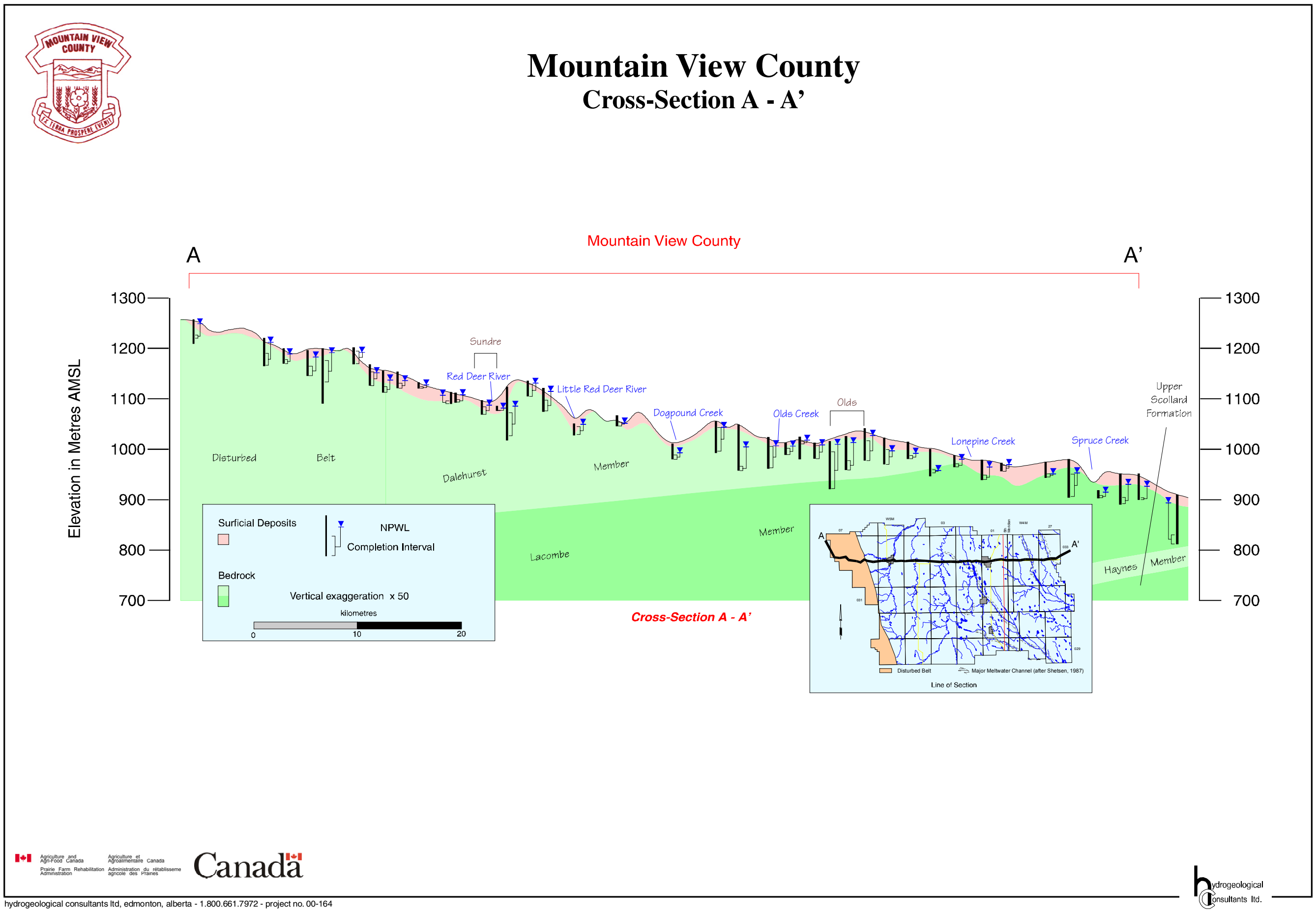
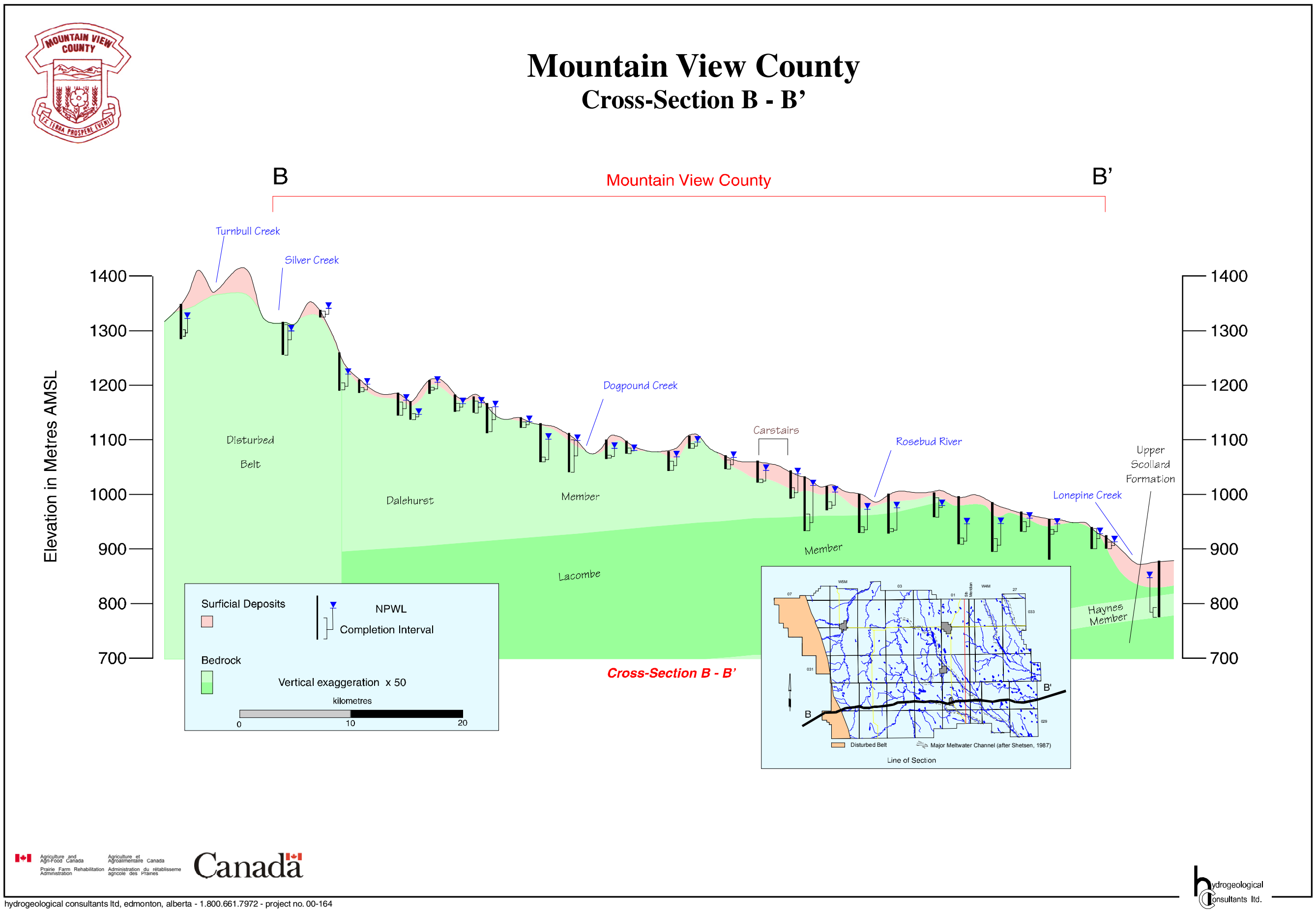
Changes in Water Levels – Upper Bedrock Aquifer(s)



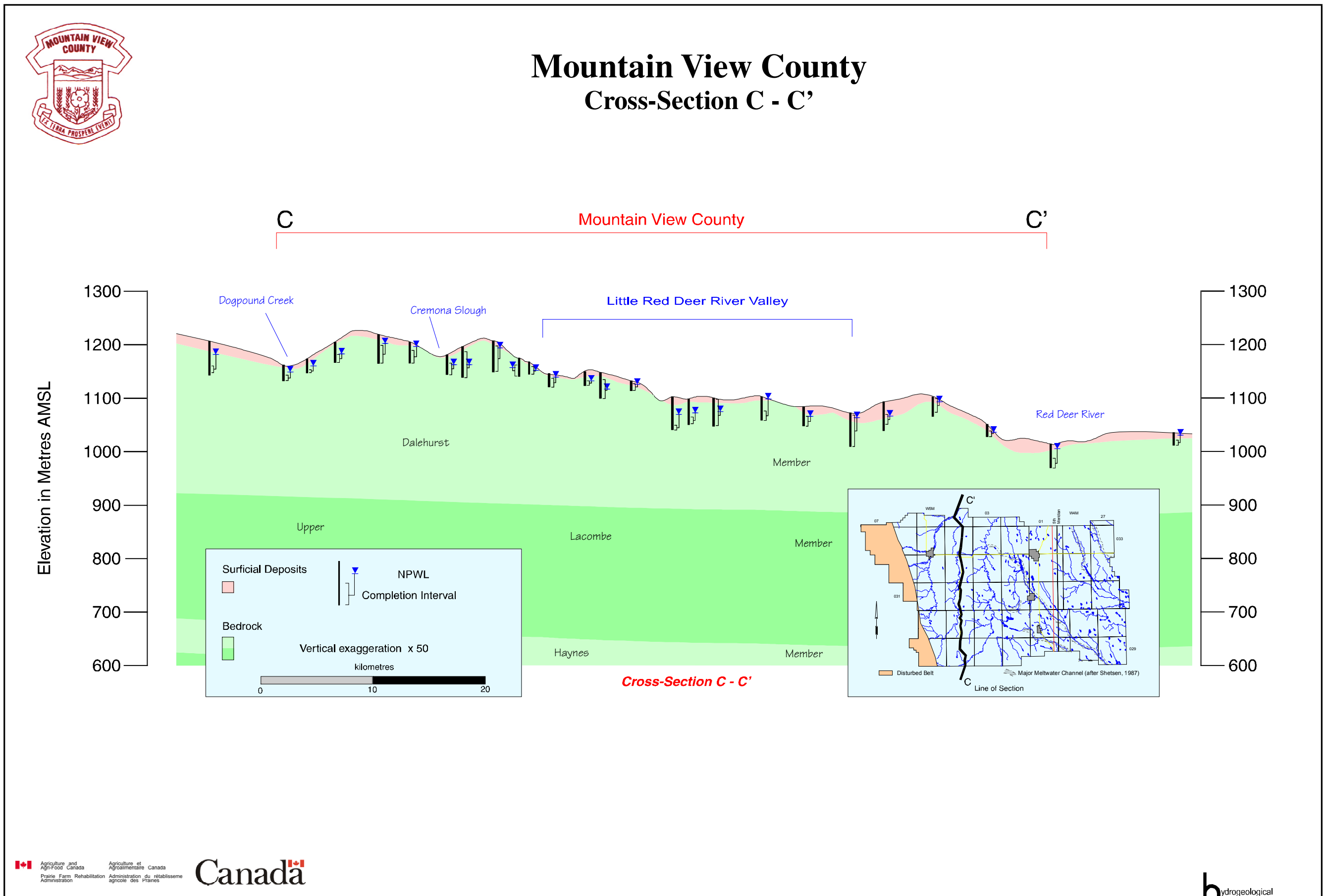
Cross-Section A - A'



Cross-Section B - B'



Cross-Section C - C'



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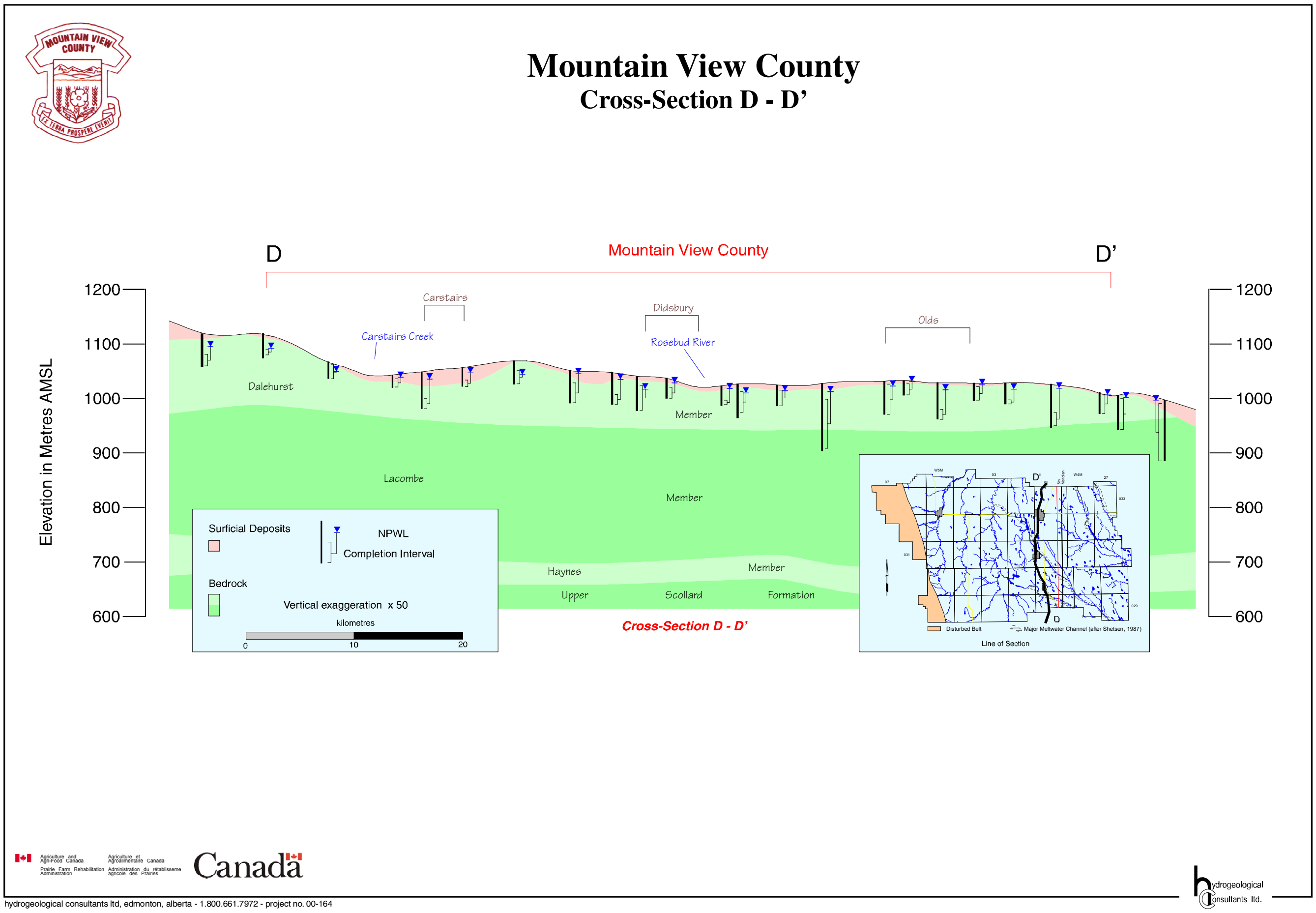
Cross-Section D - D’



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MOUNTAIN VIEW COUNTY

Appendix E

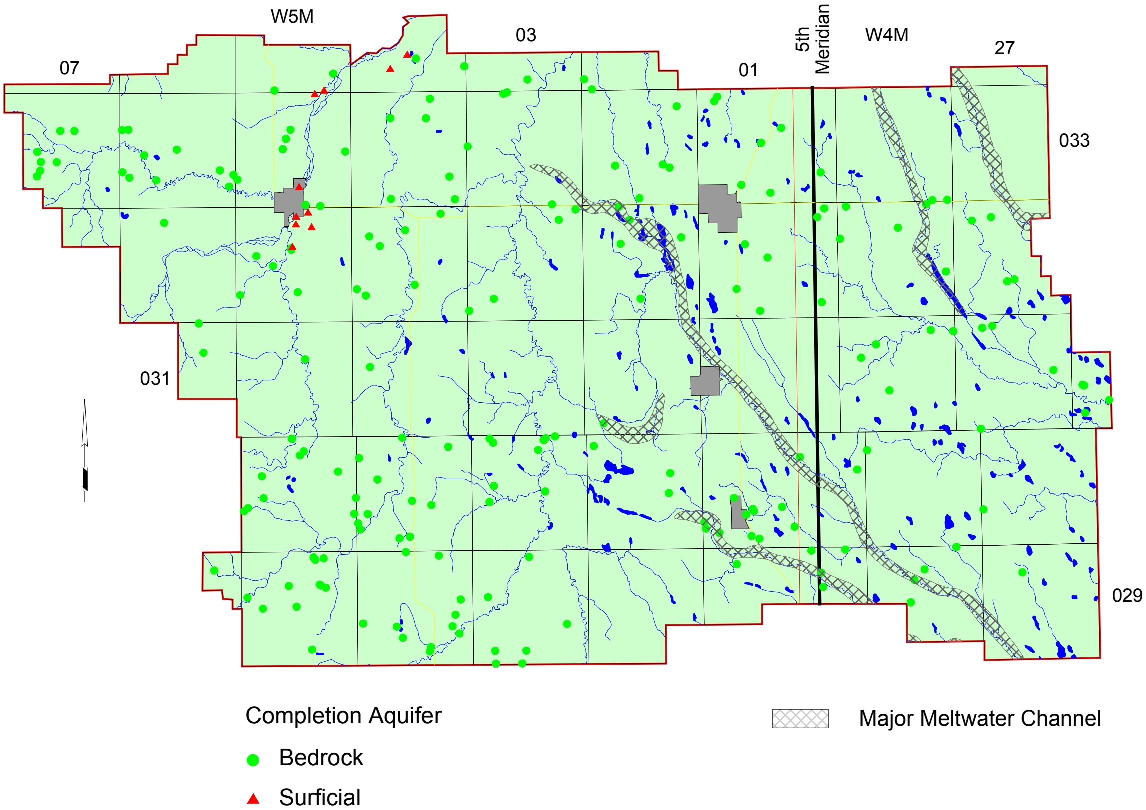
Water Wells Recommended for Field Verification

and

County-Operated Water Wells

Water Wells Recommended for Field Verification

(details on following pages)



WATER WELLS RECOMMENDED FOR FIELD VERIFICATION

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
	NE 06-030-01 W5M	Dalehurst	May-54	29.9	98.0	12.2	40.0	M35379.106755
	14-21-032-01 W5M	Dalehurst	Oct-77	18.0	59.0	7.8	25.6	M36369.479291
Alberta Department of Highways	NE 33-029-03 W5M	Dalehurst	May-61	9.1	30.0	2.1	7.0	M35379.116886
Alberta Environment	04-30-032-28 W4M	Lacombe	Aug-86	48.2	158.0	9.5	31.0	M35377.130499
Allison, Grace	SW 33-032-06 W5M	Disturbed Belt	Sep-81	22.9	75.0	2.4	8.0	M35379.114570
Archer, Gerald	NE 29-031-28 W4M	Lacombe	Jun-72	63.1	207.0	17.1	56.0	M35377.090587
Archer, Gerald	NE 29-031-28 W4M	Lacombe	Jul-72	77.1	253.0	17.7	58.0	M35377.224562
Ardiel, Leonard W.	14-20-032-04 W5M	Dalehurst	Sep-85	29.0	95.0	26.5	87.0	M35379.114107
Armitage, Don	16-21-032-05 W5M	Dalehurst	Jun-81	35.7	117.0	23.8	78.0	M35379.113965
Atkinson, Ernest	SW 26-031-06 W5M	Disturbed Belt	Jul-73	28.4	93.0	19.8	65.0	M35379.117043
Babcock, G.	16-27-032-05 W5M	Surficial	Sep-71	18.3	60.0	1.5	5.0	M35379.114158
Bakken, G.	NW 04-033-01 W5M	Dalehurst	Apr-79	33.5	110.0	7.6	25.0	M35379.114903
Baudistel, R.	NE 34-030-03 W5M	Dalehurst	Feb-78	17.4	57.0	5.2	17.0	M35379.107649
Bell, Stan	15-09-030-01 W5M	Dalehurst	Jun-62	41.2	135.0	9.1	30.0	M35379.106797
Bellamy, H.H.	09-16-030-04 W5M	Dalehurst	Nov-84	35.1	115.0	19.2	63.0	M35379.107764
Bennett, George	02-27-033-07 W5M	Disturbed Belt	Jun-78	18.3	60.0	12.2	40.0	M35379.130025
Bergesen, L.	04-25-030-05 W5M	Dalehurst	May-85	16.8	55.0	8.8	29.0	M35379.108110
Bergeson, Robert	NE 04-030-04 W5M	Dalehurst	Jul-74	18.3	60.0	4.9	16.0	M35379.107697
Bergeson, Robert	NE 04-030-04 W5M	Dalehurst	Jul-75	14.3	47.0	1.8	6.0	M35379.107698
Bidinger, Eugene & Ron	02-16-030-01 W5M	Dalehurst	Apr-82	34.1	112.0	12.2	40.0	M35379.107233
Bieber, Carl	NW 01-032-29 W4M	Lacombe	Nov-72	54.9	180.0	5.5	18.0	M35377.229674
Billings, George & Wilf	13-33-033-03 W5M	Dalehurst	Mar-69	44.5	146.0	36.6	120.0	M35379.032945
Bird, Charlie	NE 19-029-03 W5M	Dalehurst	Jun-81	17.7	58.0	10.7	35.0	M35379.116841
Bird, Grant	NE 18-030-03 W5M	Dalehurst	Sep-74	16.8	55.0	6.1	20.0	M35379.107590
Blockson, Kenneth M.	SE 17-033-07 W5M	Disturbed Belt	Sep-82	12.2	40.0	5.8	19.0	M35379.129854
Bolton,Earl	12-12-033-04 W5M	Dalehurst	Jun-80	21.3	70.0	8.2	27.0	M35379.033065
Borton, J	SW 18-029-04 W5M	Dalehurst	Feb-77	18.3	60.0	4.6	15.0	M35379.114357
Bracken, Frank	13-30-030-04 W5M	Dalehurst	Nov-81	23.5	77.0	10.7	35.0	M35379.091094
Brassard, Norm	05-20-032-05 W5M	Dalehurst	Feb-81	8.8	29.0	3.4	11.0	M35379.113914
Braun, Harold	NW 06-032-03 W5M	Dalehurst	Jun-84	24.4	80.0	8.5	28.0	M35379.113415
Brechtel, Fred	NE 28-032-04 W5M	Dalehurst	Jun-70	34.1	112.0	32.9	108.0	M35379.114382
Britan, Dave	SW 21-029-28 W4M	Lacombe	Apr-75	27.4	90.0	6.1	20.0	M35377.223999
Brown, J	SW 24-029-04 W5M	Dalehurst	May-83	18.3	60.0	12.2	40.0	M35379.114558
Buschert, C	SE 14-029-04 W5M	Dalehurst	Nov-78	29.9	98.0	18.3	60.0	M35379.114210
Camp Evergreen	02-27-031-05 W5M	Dalehurst	Nov-83	16.8	55.0	10.7	35.0	M35379.116900
Campbell, Sheldon	13-12-033-06 W5M	Dalehurst	Mar-79	30.5	100.0	25.9	85.0	M35379.033505
Caspell, Lloyd	12-10-032-05 W5M	Dalehurst	Jun-74	30.5	100.0	21.9	72.0	M35379.113704
Chant, H.	NE 32-032-02 W5M	Dalehurst	Apr-67	36.6	120.0	19.5	64.0	M35379.113959
Chmillar, Mike	14-33-030-04 W5M	Dalehurst	Sep-74	45.7	150.0	27.4	90.0	M35379.107894
Christensen, H.	SW 08-032-03 W5M	Dalehurst	Sep-73	21.0	69.0	18.9	62.0	M35379.113425
Clarke, Douglas R.	13-20-031-28 W4M	Lacombe	Jun-80	25.0	82.0	6.4	21.0	M35377.224518
Colling, Rick	06-32-031-27 W4M	Lacombe	Jun-76	65.5	215.0	9.1	30.0	M35377.161815
Day, William	04-07-030-01 W5M	Dalehurst	Apr-75	30.5	100.0	9.1	30.0	M35379.106758
Day, William T.	05-07-030-01 W5M	Dalehurst	Apr-80	22.9	75.0	15.5	51.0	M35379.106759
De Graaf, Peter	NE 19-031-04 W5M	Dalehurst	Feb-78	29.0	95.0	18.3	60.0	M35379.115227

WATER WELLS RECOMMENDED FOR FIELD VERIFICATION

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
Degelder, Peter	SW 26-029-05 W5M	Dalehurst	Jul-84	32.9	108.0	25.3	83.0	M35379.106469
Dehner, Joe G.	04-20-029-05 W5M	Disturbed Belt	Aug-77	27.1	89.0	21.3	70.0	M35379.106314
Degelder, Peter	SW 26-029-05 W5M	Dalehurst	Sep-70	21.3	70.0	17.4	57.0	M35379.114085
Dehner, Joe G.	04-20-029-05 W5M	Disturbed Belt	Oct-63	15.6	51.0	13.4	43.9	M35379.036685
Degelder, Peter	SW 26-029-05 W5M	Dalehurst	Oct-56	9.8	32.0	9.4	30.9	M35377.229648
Duff, John	SW 02-033-03 W5M	Dalehurst	Jul-84	33.5	110.0	18.9	62.0	M35379.032829
Dykstra, Albert	08-32-031-27 W4M	Lacombe	Apr-84	57.9	190.0	10.5	34.5	M35377.161813
Dziadek, Frank	SW 30-033-06 W5M	Disturbed Belt	May-71	47.2	155.0	42.7	140.0	M35379.033565
Dziadek, Frank	03-30-033-06 W5M	Disturbed Belt	Jul-73	50.3	165.0	47.2	155.0	M35379.033567
Eckstrand, Roy	01-14-029-03 W5M	Dalehurst	Apr-85	39.6	130.0	24.4	80.0	M35379.116824
Edwards, Don	03-34-030-03 W5M	Dalehurst	Aug-84	18.3	60.0	9.1	30.0	M35379.107643
Erickson, Norman	SW 07-032-05 W5M	Dalehurst	Jul-85	16.8	55.0	2.1	7.0	M35379.113612
Fair, Carole/Robin\Woods, Carl	NE 22-029-29 W4M	Dalehurst	Aug-74	29.0	95.0	6.4	21.0	M35377.093461
Fairbairn, R	16-03-029-04 W5M	Dalehurst	Jul-71	12.2	40.0	1.8	6.0	M35379.114079
Felalta Farms Ltd	SW 24-031-27 W4M	Lacombe	May-86	41.2	135.0	14.9	49.0	M35377.161765
Freeborn, B	NW 13-029-04 W5M	Dalehurst	Apr-81	29.9	98.0	21.3	70.0	M35379.114195
French, Bryan	NE 04-029-03 W5M	Dalehurst	Nov-77	14.0	46.0	4.0	13.0	M35379.093769
French, Irven	08-30-032-04 W5M	Dalehurst	Sep-80	35.1	115.0	10.7	35.0	M35379.114419
Frick, Albert W.	01-21-033-06 W5M	Dalehurst	Sep-75	54.0	177.0	42.7	140.0	M35379.033539
Geiger, Harland	NE 12-033-06 W5M	Dalehurst		31.7	104.0	23.8	78.0	M35379.033509
Glubrecht, G.	04-34-032-05 W5M	Surficial	Aug-79	9.8	32.0	2.9	9.4	M35379.114569
Goetzen, H.	NE 35-029-28 W4M	Lacombe	Dec-73	39.6	130.0	17.4	57.0	M35377.224048
Good, Earnest	NE 33-029-04 W5M	Dalehurst	Dec-72	13.7	45.0	6.4	21.0	M35379.091946
Gregg, Sally	01-21-029-05 W5M	Disturbed Belt	Jun-76	16.8	55.0	7.3	24.0	M35379.106365
Grunau, H	SE 13-032-28 W4M	Lacombe	Aug-74	76.2	250.0	12.8	42.0	M35377.205448
Guiltner, Lionel	NE 33-030-05 W5M	Dalehurst	Mar-74	14.9	49.0	5.2	17.0	M35379.108128
Gunderson, Donald W.	NW 19-029-05 W5M	Disturbed Belt	Jul-60	29.0	95.0	9.1	30.0	M35379.106313
Hall, I.H./ Linda	NW 06-034-02 W5M	Dalehurst	May-77	45.7	150.0	32.0	105.0	M35379.036389
Hammer Farms	NW 31-032-28 W4M	Lacombe	Dec-67	29.0	95.0	8.4	27.7	M35377.205370
Hammer Farms	NW 36-032-29 W4M	Lacombe	Feb-77	48.8	160.0	24.6	80.6	M35377.229725
Hanneman, Carl	NE 04-030-01 W5M	Dalehurst	Oct-73	51.8	170.0	16.2	53.0	M35379.106748
Harms, W.	NE 08-032-01 W5M	Dalehurst	Aug-75	33.5	110.0	8.2	27.0	M35379.102378
Harper, Jim	16-32-033-03 W5M	Dalehurst	Aug-82	42.7	140.0	31.7	104.0	M35379.032940
Haynes, Guy	SW 07-033-05 W5M	Dalehurst	Jul-65	15.2	50.0	3.1	10.0	M35379.033293
Haynes, J.D.	NE 20-032-02 W5M	Dalehurst	May-80	18.3	60.0	7.6	25.0	M35379.113679
Haynes, John	SE 07-032-04 W5M	Dalehurst	Oct-80	30.5	100.0	22.6	74.0	M35379.113832
HB Oil & Gas	02-02-034-05 W5M	Surficial	Oct-65	4.9	16.0	2.3	7.4	M35379.130336
Heine, Bernard	SW 28-029-28 W4M	Lacombe	Jun-62	36.6	120.0	6.1	20.0	M35377.224023
Henderson, John	02-11-030-01 W5M	Dalehurst	Dec-82	35.1	115.0	9.8	32.0	M35379.106814
Henry, Chester	16-09-034-04 W5M	Surficial	Jun-61	15.2	50.0	8.2	27.0	M35379.036689
Hickey, Mike	NW 35-029-04 W5M	Dalehurst	Aug-75	15.2	50.0	6.1	20.0	M35379.114761
Hildebrandt, Henry	16-31-030-03 W5M	Dalehurst	Aug-84	25.9	85.0	4.6	15.0	M35379.107634
Hoeppner, Jake	NE 34-032-05 W5M	Surficial	Dec-73	8.5	28.0	3.7	12.1	M35379.114649
Hoggarth, D.	04-14-030-01 W5M	Dalehurst	Nov-83	24.4	80.0	7.6	25.0	M35379.107225
Holmes, Ross C.	04-14-033-02 W5M	Dalehurst	Oct-70	16.8	55.0	14.3	47.0	M35379.032760
Hommy, Lincoln	16-17-032-05 W5M	Dalehurst	Aug-79	43.9	144.0	9.1	30.0	M35379.113864

WATER WELLS RECOMMENDED FOR FIELD VERIFICATION

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
Horvath, John	NE 12-030-05 W5M	Dalehurst	Sep-73	25.9	85.0	6.1	20.0	M35379.068723
Hughes, David	08-35-030-04 W5M	Dalehurst	Apr-82	31.1	102.0	21.6	71.0	M35379.107905
Hunter, Ross G.	NE 13-033-05 W5M	Dalehurst	Dec-78	30.5	100.0	21.6	71.0	M35379.033342
Hunter, William	SW 28-029-05 W5M	Disturbed Belt	Oct-73	35.7	117.0	27.4	90.0	M35379.106541
Jackson, Harvey	04-34-030-05 W5M	Dalehurst	Oct-76	13.7	45.0	4.6	15.0	M35379.108130
Jackson, Harvey	SW 34-030-05 W5M	Dalehurst	Sep-75	12.2	40.0	3.7	12.0	M35379.108132
Jackson, J	SW 04-034-05 W5M	Dalehurst	Jul-74	12.2	40.0	5.2	17.0	M35379.130469
Jasman, Hugh	16-08-033-07 W5M	Disturbed Belt	Jun-78	12.2	40.0	6.4	21.0	M35379.129571
Jeffery, Bob	12-35-033-04 W5M	Dalehurst	Jun-83	30.5	100.0	15.2	50.0	M35379.033189
Jensen, Darrold	08-08-033-06 W5M	Disturbed Belt	Oct-79	47.2	155.0	9.1	30.0	M35379.033490
Jensen, Eric	NE 27-033-04 W5M	Dalehurst	May-74	18.3	60.0	7.6	25.0	M35379.033146
Jensen, Everett	16-21-032-05 W5M	Surficial	Jun-81	29.0	95.0	3.7	12.0	M35379.113981
Johnson, Keith	09-34-029-05 W5M	Dalehurst	Apr-84	40.5	133.0	33.8	111.0	M35379.106615
Johnston, Glen	SE 15-030-04 W5M	Dalehurst	Aug-63	13.7	45.0	5.5	18.0	M35379.107748
Jones, Doug	08-04-033-02 W5M	Dalehurst	Jun-78	39.6	130.0	2.7	9.0	M35379.032670
Kamp, John	NE 27-029-29 W4M	Dalehurst	Jun-76	21.3	70.0	16.8	55.0	M35377.224086
Kemna, Almut S.	10-21-033-05 W5M	Dalehurst	Aug-82	20.4	67.0	14.3	47.0	M35379.033390
Kilgour, Glen	SE 16-033-07 W5M	Disturbed Belt	May-72	40.5	133.0	29.9	98.0	M35379.129826
Kohert, J.E.	01-36-031-28 W4M	Lacombe	Sep-78	30.5	100.0	17.1	56.0	M35377.224591
Kohut, John E.	01-36-031-28 W4M	Lacombe	Oct-81	29.6	97.0	17.4	57.0	M35377.224593
Kohut, Wayne	NW 17-033-06 W5M	Disturbed Belt	Aug-78	32.0	105.0	9.1	30.0	M35379.067617
Lahring, Heinjo	11-07-033-06 W5M	Disturbed Belt	Jan-82	32.0	105.0	9.5	31.0	M35379.033488
Lahring, Henry	13-07-033-06 W5M	Disturbed Belt	Sep-75	32.0	105.0	14.0	46.0	M35379.033487
Larsen, Jens	SE 22-030-03 W5M	Dalehurst	May-73	21.3	70.0	15.2	50.0	M35379.107603
Leach, Don	NW 27-032-28 W4M	Lacombe	Jun-79	36.6	120.0	6.8	22.3	M35377.205449
Leask, D	NW 12-029-04 W5M	Dalehurst	May-84	18.3	60.0	7.9	26.0	M35379.114177
Leischner, R.	SE 32-032-27 W4M	Lacombe	Aug-73	21.3	70.0	11.9	39.0	M35377.161423
Loewen, H.	SW 05-031-27 W4M	Lacombe	Nov-74	73.2	240.0	28.0	92.0	M35377.161464
Lowe, W.M.	SE 09-032-02 W5M	Dalehurst	Mar-85	15.2	50.0	6.1	20.0	M35379.113485
Luellen, Ben	15-35-032-28 W4M	Lacombe	Jan-82	48.8	160.0	21.6	71.0	M35377.205439
Maccallum, George	SW 18-030-05 W5M	Disturbed Belt	Mar-81	24.4	80.0	10.7	35.0	M35379.107995
Macdonald, John	01-01-033-28 W4M	Lacombe	Apr-78	32.0	105.0	26.5	87.0	M35377.225508
Maetche, A.A.	NE 09-032-27 W4M	Lacombe	Jul-65	27.7	91.0	10.4	34.0	M35377.161065
Maffitt, Walter	NW 09-030-01 W5M	Dalehurst	Jan-74	42.7	140.0	15.2	50.0	M35379.106784
McCoy, Janet	NW 05-029-03 W5M	Dalehurst	Nov-75	48.8	160.0	41.2	135.0	M35379.093774
McInnis, M.	SW 25-032-02 W5M	Dalehurst	Jul-80	22.9	75.0	13.7	45.0	M35379.102377
McLaren, Stewart	SE 04-029-03 W5M	Dalehurst	Mar-86	11.3	37.0	3.7	12.0	M35379.093757
McLeary Farms Ltd	02-06-034-02 W5M	Dalehurst	Aug-81	21.3	70.0	4.0	13.0	M35379.036387
McWilliam, Thomas C.	15-03-029-05 W5M	Disturbed Belt	Jul-85	53.3	175.0	44.2	145.0	M35379.106206
Mjolsness, R.	16-21-032-05 W5M	Dalehurst	Jun-81	33.5	110.0	27.4	90.0	M35379.113970
Morph, R	SE 35-032-03 W5M	Dalehurst	Aug-73	13.7	45.0	2.4	8.0	M35379.113973
Morris, George R.	NW 35-029-05 W5M	Dalehurst	Aug-73	8.2	27.0	5.8	19.0	M35379.106630
Moser, A.	03-21-033-05 W5M	Dalehurst	Apr-77	54.9	180.0	48.5	159.0	M35379.033386
Moser, Wilhelm	03-21-033-05 W5M	Dalehurst	Apr-74	44.2	145.0	35.3	115.8	M35379.033385
Mullen, Larry & G.A.	05-03-032-01 W5M	Dalehurst	Jun-69	45.1	148.0	18.3	60.0	M35379.117166
Murphy, Frank	NE 06-031-02 W5M	Dalehurst	Mar-77	24.4	80.0	5.2	17.0	M35379.102382

WATER WELLS RECOMMENDED FOR FIELD VERIFICATION

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
Myram, A	05-09-029-04 W5M	Dalehurst	Jul-77	30.5	100.0	23.5	77.0	M35379.114170
Nash, Harold	04-18-030-05 W5M	Disturbed Belt	Jul-84	30.5	100.0	11.6	38.0	M35379.108041
Newsham, Cyril	SE 28-033-07 W5M	Disturbed Belt	Jul-89	25.9	85.0	14.6	48.0	M35379.130080
Notley, W D	SE 17-033-02 W5M	Dalehurst	Feb-74	29.0	95.0	4.6	15.0	M35379.067904
Nuefeld, Walter	02-16-031-28 W4M	Lacombe	Oct-80	15.2	50.0	7.3	24.0	M35377.224485
Oberle, Lynn	NE 36-029-01 W5M	Dalehurst	Jul-79	27.4	90.0	14.0	46.0	M35379.092697
Odersky, Klaus	NE 11-033-02 W5M	Dalehurst	Jan-86	21.3	70.0	13.7	45.0	M35379.032651
Olds Mens Golf Club	NE 03-033-01 W5M	Dalehurst	Feb-77	24.4	80.0	6.5	21.3	M35379.114894
Olsen, Neil J.	12-32-033-01 W5M	Dalehurst	Mar-80	42.7	140.0	5.2	17.0	M35379.032739
Orriss, Norval	16-34-030-03 W5M	Dalehurst	Mar-79	48.8	160.0	9.8	32.0	M35379.107650
Overwater, George	16-35-029-29 W4M	Dalehurst	Oct-78	18.3	60.0	9.1	30.0	M35377.224092
Owsley, Jay R.	NW 17-030-05 W5M	Dalehurst	Jul-79	30.5	100.0	14.6	48.0	M35379.107994
Page, Derrick	SE 18-031-26 W4M	Lacombe	Jul-74	65.5	215.0	45.7	150.0	M35377.162722
Page, Derrick	07-18-031-26 W4M	Lacombe	Aug-77	54.9	180.0	13.0	42.7	M35377.162724
Page, R.J.	NE 06-031-26 W4M	Lacombe	Jan-86	54.9	180.0	20.9	68.4	M35377.162641
Parker, Bill	NW 07-032-04 W5M	Dalehurst	Aug-82	19.2	63.0	4.6	15.0	M35379.113833
Paton, Donald	NW 03-034-03 W5M	Dalehurst	Jan-77	9.8	32.0	0.3	1.0	M35379.036520
Pawson, John	NE 13-030-05 W5M	Dalehurst	Jun-73	21.3	70.0	9.1	30.0	M35379.102385
Pederson, Paul/ Ken	06-01-033-04 W5M	Dalehurst	Sep-77	43.3	142.0	35.4	116.0	M35379.032993
Penner, Ben	SE 32-029-01 W5M	Dalehurst	Mar-78	30.5	100.0	22.9	75.0	M35379.092669
Philipchuk, Art	13-35-031-06 W5M	Disturbed Belt	Apr-72	23.5	77.0	21.9	72.0	M35379.117055
R.V. Excavation	12-34-032-05 W5M	Surficial	Nov-74	7.9	26.0	2.7	9.0	M35379.114622
Rasmussen, Warren A.	02-16-030-01 W5M	Dalehurst	Oct-73	42.7	140.0	38.1	125.0	M35379.107232
Reid, Ed	SE 12-034-04 W5M	Dalehurst	Jun-76	18.3	60.0	6.7	22.0	M35379.036697
Robertson, Donald	SW 05-029-03 W5M	Dalehurst	Jun-76	31.7	104.0	22.6	74.0	M35379.116795
Romanowski, Sy	NW 28-029-27 W4M	Lacombe	Jun-73	24.4	80.0	23.2	76.0	M35377.223941
Rowell, K E	NE 36-032-03 W5M	Dalehurst	Sep-78	43.0	141.0	29.7	97.5	M35379.114012
Royston, C.A.	08-31-033-01 W5M	Dalehurst	Nov-79	16.8	55.0	4.6	15.0	M35379.032725
Satellite Drilling	10-08-033-07 W5M	Disturbed Belt	Jul-78	19.8	65.0	9.5	31.0	M35379.129740
Sautter, Henry	16-28-029-28 W4M	Lacombe	Nov-67	42.7	140.0	27.3	89.5	M35377.224033
Sayer, Richard	NW 14-030-02 W5M	Dalehurst		32.0	105.0	21.3	70.0	M35379.107422
Scarrott, Bill	04-19-033-03 W5M	Dalehurst	Jun-77	18.3	60.0	4.9	16.0	M35379.032888
Schmick, Sam	13-07-030-27 W4M	Lacombe	Feb-76	51.8	170.0	32.0	105.0	M35377.224117
Schmidt, Josef B.	15-34-029-05 W5M	Dalehurst	Jul-76	48.8	160.0	35.1	115.0	M35379.106608
Schmitt, Richard	08-04-030-01 W5M	Dalehurst	Dec-78	30.5	100.0	6.7	22.0	M35379.106739
Schrader, Dennis	04-31-030-28 W4M	Dalehurst	Jun-75	10.7	35.0	3.1	10.0	M35377.224396
Sharman, C.E.	NE 33-030-05 W5M	Dalehurst	Oct-80	13.4	44.0	1.8	6.0	M35379.108129
Shaw, Edward J.	NW 25-030-01 W5M	Dalehurst	Sep-54	36.6	120.0	26.8	88.0	M35379.107309
Shields, Doug	SW 31-030-02 W5M	Dalehurst	Aug-97	13.7	45.0	6.4	21.0	M36234.930003
Siddon, Elsie	01-28-033-05 W5M	Dalehurst	Mar-77	25.9	85.0	12.8	42.0	M35379.033410
Silver Creek Ranch Camp	01-35-029-06 W5M	Disturbed Belt	Oct-83	18.3	60.0	5.8	19.0	M35379.106686
Smith, Don	03-22-033-01 W5M	Dalehurst	May-85	16.8	55.0	3.1	10.0	M35379.032690
Solinas, Richard	03-26-029-05 W5M	Dalehurst	Aug-83	27.4	90.0	23.8	78.0	M35379.106464
Spence, Gary	12-04-030-04 W5M	Dalehurst	Feb-86	22.6	74.0	6.4	21.0	M35379.107696
Spicer, Clarence	10-17-030-01 W5M	Dalehurst	May-81	46.3	152.0	27.1	89.0	M35379.107263
Spraakman, Herman	05-04-033-04 W5M	Dalehurst	Jul-80	18.3	60.0	7.0	23.0	M35379.033020
St. Clair, Earl	SE 35-031-28 W4M	Lacombe	Feb-73	54.9	180.0	53.6	176.0	M35377.224585

WATER WELLS RECOMMENDED FOR FIELD VERIFICATION

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
St. Clair, Warren	NW 23-033-01 W5M	Dalehurst	Dec-85	18.3	60.0	8.2	27.0	M35379.032696
St. Germaine, Don	SE 35-033-02 W5M	Dalehurst	Aug-72	24.4	80.0	9.8	32.0	M35379.032986
Steeves, F.E.	SW 26-029-05 W5M	Dalehurst	Jul-79	32.9	108.0	11.3	37.0	M35379.106455
Stoddard, Don	NE 17-033-07 W5M	Disturbed Belt	Jun-86	15.2	50.0	12.8	42.0	M35379.129856
Sundre Golf Club	03-02-033-05 W5M	Dalehurst	Oct-81	33.5	110.0	14.3	47.0	M35379.033209
Tall Timber Rec & Dev Ltd	02-03-033-05 W5M	Dalehurst	Apr-79	33.5	110.0	15.8	51.9	M35379.033222
Tansley, Marvin D.	11-10-034-04 W5M	Dalehurst	Apr-84	45.7	150.0	17.4	56.9	M35379.036694
Thiessen, Vic	SE 08-031-26 W4M	Lacombe	Nov-84	64.0	210.0	18.9	61.9	M35377.162643
Thompson, H.L.	SW 33-032-02 W5M	Dalehurst	Apr-75	29.0	95.0	20.4	66.9	M35379.113974
Thompson, Howard	02-22-032-01 W5M	Dalehurst	Sep-82	13.7	45.0	21.9	71.9	M35379.117254
Thurn, A.W./ Dacallen Ent	12-28-033-04 W5M	Dalehurst	Apr-81	30.5	100.0	23.4	76.9	M35379.033150
Town of Sundre	SW 10-033-05 W5M	Surficial	Aug-80	27.7	91.0	25.0	81.9	M35379.033318
Tracey, Kent	04-07-030-04 W5M	Dalehurst	Jun-82	18.9	62.0	26.5	86.8	M35379.107714
Tracy, Ted	SW 07-030-04 W5M	Dalehurst	Jun-78	13.7	45.0	28.0	91.8	M35379.068717
Turnbull, Ken	13-01-034-05 W5M	Dalehurst	Aug-80	44.2	145.0	29.5	96.8	M35379.130329
Unber, Harry	SE 02-033-28 W4M	Lacombe	Jun-74	32.0	105.0	31.0	101.8	M35377.225513
Unger, Walter	NE 30-032-27 W4M	Lacombe	Oct-85	16.8	55.0	32.6	106.8	M35377.161415
Van Arnam, Jim	05-20-030-03 W5M	Dalehurst	Feb-86	22.3	73.0	34.1	111.8	M35379.107598
Vass, Mark & Pearson, S.C.B.	15-07-030-04 W5M	Dalehurst	May-74	13.1	43.0	35.6	116.8	M35379.107716
Vennard, Robert	SE 12-033-06 W5M	Dalehurst	Aug-74	16.8	55.0	37.1	121.8	M35379.033504
Viney, Keith	SE 35-032-29 W4M	Dalehurst	Oct-79	32.0	105.0	38.6	126.7	M35377.229717
Wackett, Don	NW 10-032-04 W5M	Dalehurst	Aug-79	21.3	70.0	40.2	131.7	M35379.113845
Weidner, W.	12-32-030-03 W5M	Dalehurst	Jul-85	30.5	100.0	41.7	136.7	M35379.107637
West Zion Mennonite Church	14-23-030-02 W5M	Dalehurst	Jun-76	48.8	160.0	43.2	141.7	M35379.107466
Westlund, Neal	SE 25-030-29 W4M	Dalehurst	Oct-84	30.5	100.0	44.7	146.7	M35377.224624
Whitlow, Randy	NW 20-030-04 W5M	Dalehurst	Dec-82	29.9	98.0	46.2	151.7	M35379.107799
Widmer, H.	NW 10-032-27 W4M	Lacombe	Nov-81	38.1	125.0	47.8	156.7	M35377.161207
Wiens, Rudie	NW 35-030-03 W5M	Dalehurst	May-91	20.7	68.0	49.3	161.7	M35379.059562
Wigg, J	SW 16-029-04 W5M	Dalehurst	Jun-63	17.4	57.0	50.8	166.6	M35379.114273
Wright, Fred	10-35-032-04 W5M	Dalehurst	Aug-79	21.3	70.0	52.3	171.6	M35379.114670
Young, Elgin	NW 20-030-05 W5M	Dalehurst	Oct-75	29.6	97.0	53.8	176.6	M35379.108090
Zurowski, Garry	NW 35-033-05 W5M	Surficial	Aug-82	6.4	21.0	55.4	181.6	M35379.033446

MOUNTAIN VIEW COUNTY-OPERATED WATER WELLS

Owner	Location	Aquifer Name	Date Water Well Drilled	Completed Depth Metres	Completed Depth Feet	NPWL Metres	NPWL Feet	UID
County of Mountain View	NW 33-032-04 W5M	Dalehurst	Aug-76	25.9	85.0	1.5	5.0	M35379.102354