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.

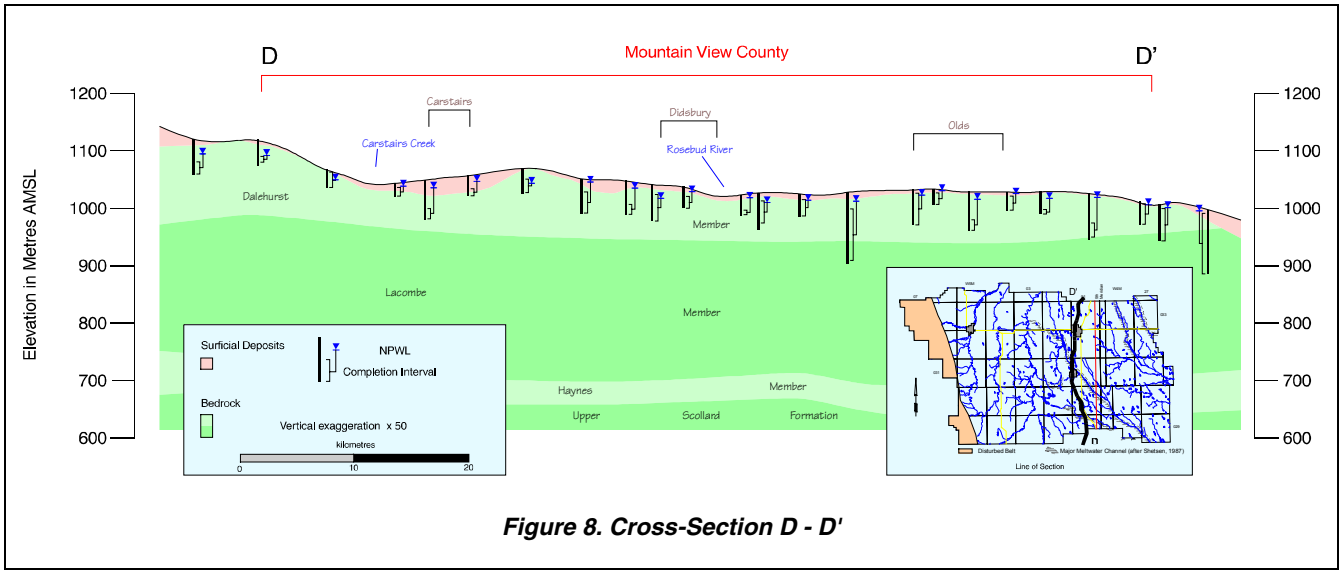

Figure 8. Cross-Section D - D'

[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.

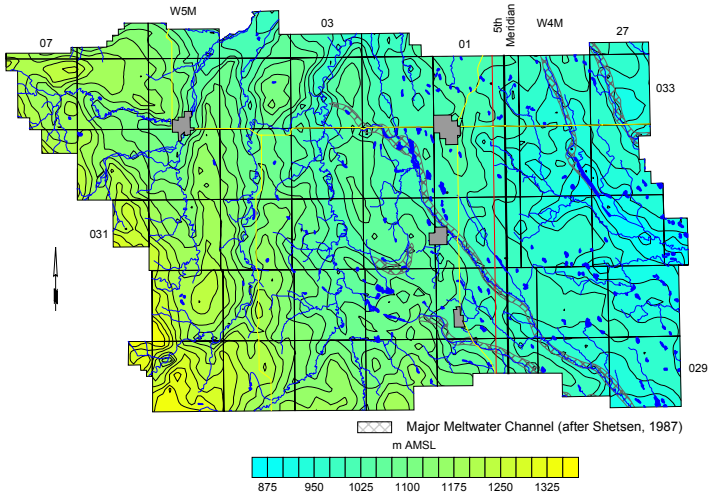

Figure 9. Bedrock Topography

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.

[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.

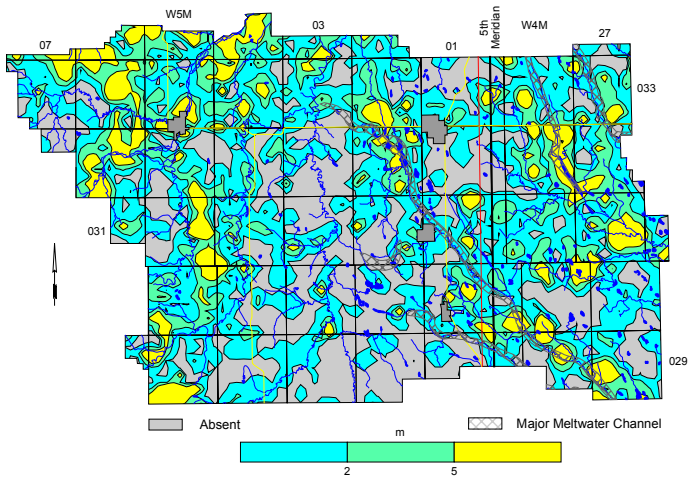

Figure 10. Thickness of Sand and Gravel Deposits

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.

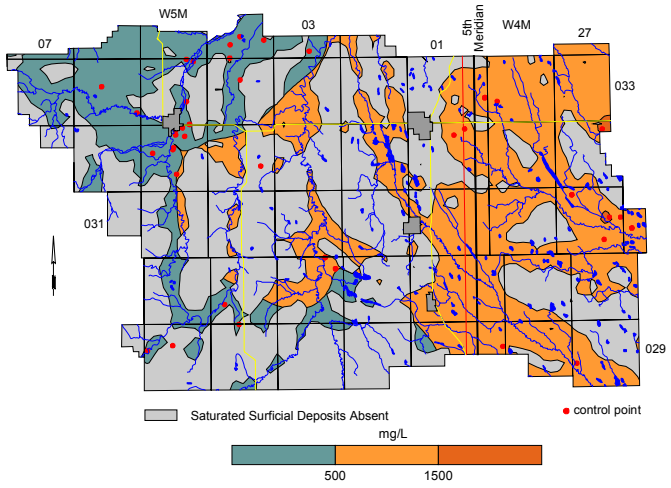

Figure 11. Total Dissolved Solids in Groundwater from Surficial Deposits

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.

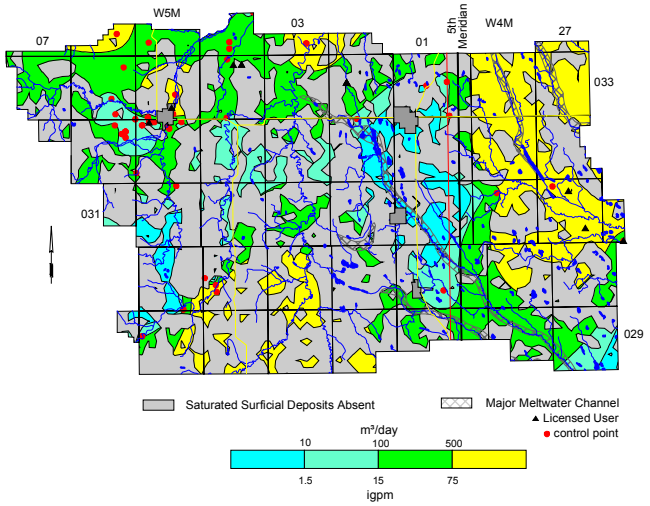

Figure 12. Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)

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, tablular 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.

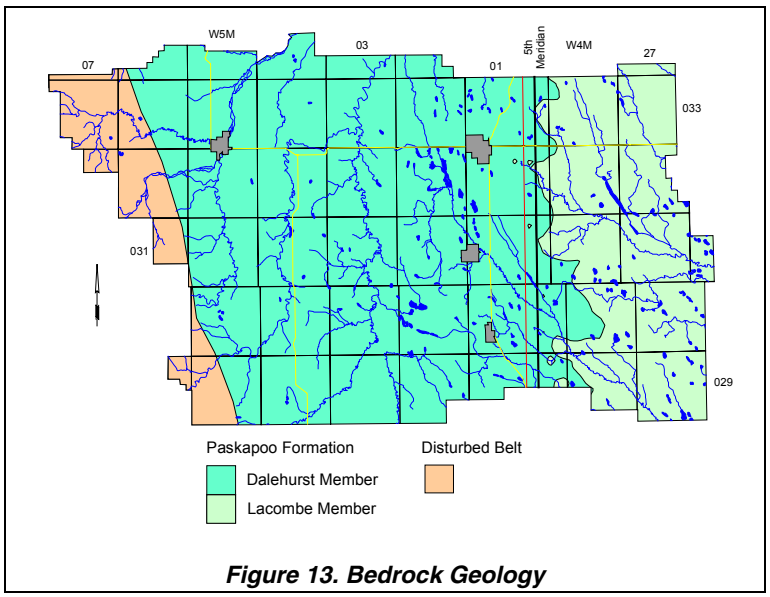

Figure 13. Bedrock Geology

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