5.2.2.1 Chemical Quality of Groundwater from Surficial Deposits

The chemical analyses results of groundwaters from the surficial deposits indicate the groundwaters are generally chemically hard and high in dissolved iron. In Ponoka County, groundwaters from the surficial aquifers mainly have a chemical hardness of greater than 200 and less than 400 mg/L (see CD-ROM).

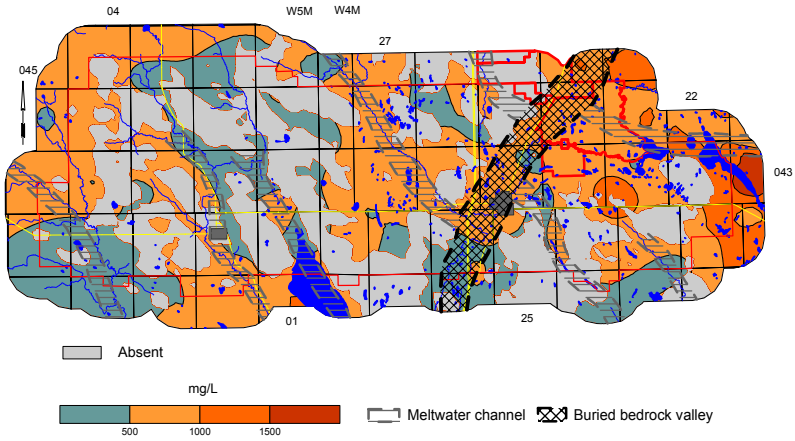

Figure 14. Total Dissolved Solids in Groundwater from Surficial Deposits

The Piper tri-linear diagram [19] for surficial deposits (page A-29) shows that the groundwaters from the surficial deposits are mainly calcium-magnesium-bicarbonate or sodium-bicarbonate-type waters. Sixty-two percent of the groundwaters from the surficial deposits have a TDS concentration of more than 500 mg/L. Groundwaters having TDS concentrations of less than 500 mg/L mainly occur in association with several of the meltwater channels, and in association with the southern part of the Buried Red Deer Valley. Sixty-seven percent of the groundwaters from the surficial deposits are reported to have dissolved iron concentrations of less than or equal to the aesthetic objective (AO) of 0.3 mg/L. However, many iron analyses results are questionable due to varying sampling and analytical methodologies.

In some areas, the groundwater chemistry of the surficial aquifers is such that sulfate is the major anion[20]. 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 90% of the samples analyzed for surficial deposits in the County, the chloride ion concentration is less than 20 mg/L (see CD-ROM).

Constituent	No. of Analyses	Range for County in mg/L Minimum	Maximum	Median	Recommended Maximum Concentration SGCDWQ
Total Dissolved Solids	114	25	1,776	542	500
Sodium	96	3	5,589	143	200
Sulfate	116	0	840	52	500
Chloride	115	0	79	3	250
Nitrate + Nitrite (as N)	92	0	336	0.0	10

Concentration in milligrams per litre unless otherwise stated
Note: indicated concentrations are for Aesthetic Objectives except for Nitrate + Nitrite (as N), which is for Maximum Acceptable Concentration (MAC)
SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality Federal-Provincial-Territorial Committee on Drinking Water, April 2002

Table 4. Concentrations of Constituents in Groundwaters from Surficial Deposits

In the County, the nitrate + nitrite (as N) concentrations in the groundwaters from the surficial deposits exceed the maximum acceptable concentrations (MAC) of ten mg/L in three of the 92 groundwater samples analyzed (up to about 1986).

The minimum, maximum and median 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 SGCDWQ in the adjacent table. Of the five constituents that have been compared to the SGCDWQ, the median value of TDS concentrations exceeds the guidelines.

[19] See glossary
[20] See glossary

5.2.3 Upper Sand and Gravel Aquifer

The Upper Sand and Gravel Aquifer includes saturated sand and gravel deposits in the upper surficial deposits. Typically, these aquifers are present within the surficial deposits at no particular depth. Saturated sand and gravel deposits in the upper surficial deposits are not usually continuous over large areas but are expected over approximately 15% of the County.

5.2.3.1 Aquifer Thickness

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

5.2.3.2 Apparent Yield

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

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

In the County, there are only three apparent yield values available for water wells completed through the Upper Sand and Gravel Aquifer (Table 3, page 17).

In the County, there are two authorized non-exempt water wells that are completed through the Upper Sand and Gravel Aquifer, for a total authorized diversion of five m^3/day (Table 1, page 6). The two non-exempt authorizations are for registrations for traditional agriculture use under the *Water Act*. One of the two authorized non-exempt water wells completed through the Upper Sand and Gravel Aquifer could be linked to a water well in the AENV groundwater database.

5.2.4 Lower Sand and Gravel Aquifer

The Lower Sand and Gravel Aquifer is a saturated sand and gravel deposit that occurs at or near the base of the surficial deposits in the deeper part of the linear bedrock lows. The top of the lower surficial deposits is based on more than 1,000 control points across Alberta.

5.2.4.1 Aquifer Thickness

The thickness of the Lower Sand and Gravel deposits is mainly less than five metres, but can be up to ten metres in the linear bedrock lows (see CD-ROM).

5.2.4.2 Apparent Yield

Apparent yields for water wells completed in the Lower Sand and Gravel Aquifer range from less than 10 m³/day to more than 100 m³/day. The most notable areas where yields of more than 100 m³/day are expected are mainly in association with the Buried Red Deer Valley. In the County, there are no dry water test holes completed in the Lower Sand and Gravel Aquifer.

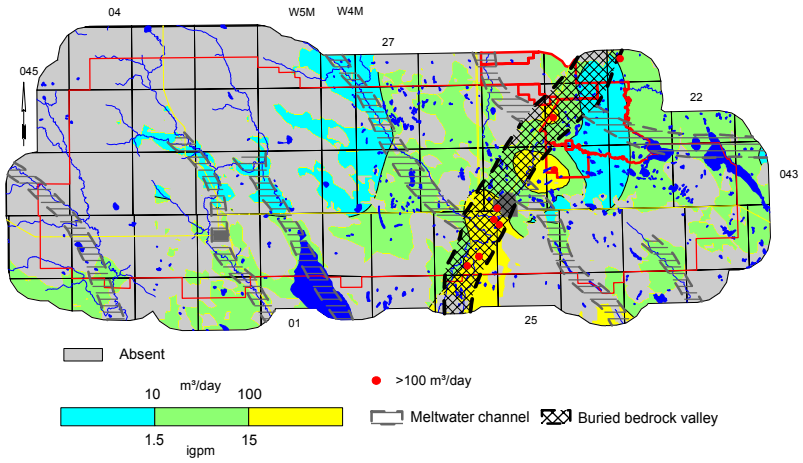

Figure 15. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

In the County, there are 15 non-exempt authorizations for water wells that are completed through the Lower Sand and Gravel Aquifer, for a total authorized diversion of 166 m³/day.

Of the 15 water wells, seven have been licensed for agricultural purposes, five are for registrations and are expected to be used for stock and/or crop spraying purposes, two are for municipal purposes and one is for commercial purpose. The highest groundwater allocation of 74 m³/day is for the Town of Ponoka Golf Course, licensed to divert groundwater for commercial purposes. This use occurs in the summer irrigation season and the groundwater would be diverted at much higher daily rates.

There are no chemistry data available in the groundwater database for the Town of Ponoka Golf Course water supply well.

5.3 Bedrock

5.3.1 Bedrock Aquifers

The upper bedrock includes formations that are generally less than 200 metres below the bedrock surface. In the County, the upper bedrock includes the Paskapoo Formation (Dalehurst, Upper and Lower Lacombe, and Haynes members), as well as the Scollard, Battle and Whitemud and Horseshoe Canyon formations, as shown below on cross-section H-H' (see page A-19). 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[21] and water well screens are a necessity.

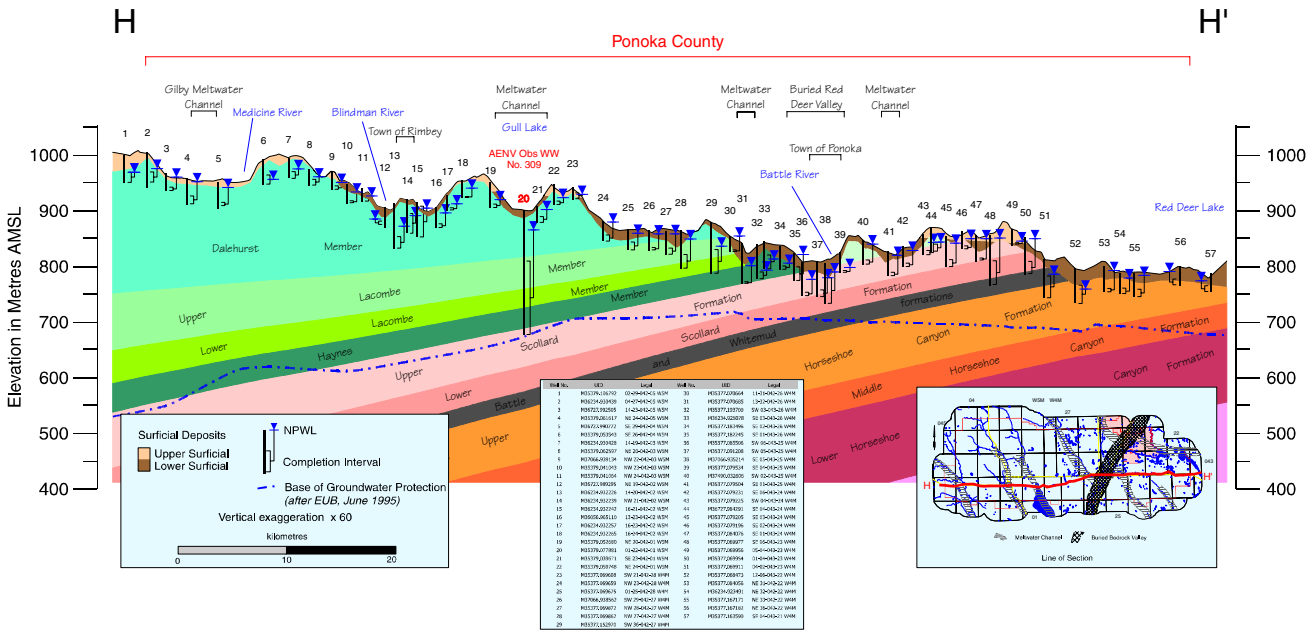

Figure 16. Cross-Section H - H'

In the western part of County, the Base of Groundwater Protection is mainly below the Haynes Member. On the eastern edge of the County, the Middle Horseshoe Canyon Formation is above the Base of Groundwater Protection. A map showing the depth to the Base of Groundwater Protection is given on page 8 of this report, in Appendix A, and on the CD-ROM.

[21] See glossary

5.3.2 Geological Characteristics

The Paskapoo Formation in central Alberta consists of the Dalehurst, Lacombe and Haynes members (Demchuk and Hills, 1991). The Edmonton Group underlies the Paskapoo Formation. The Edmonton Group includes the Scollard, Battle, Whitemud and Horseshoe Canyon formations. A generalized geologic column is illustrated in Figure 6, in Appendix A, and on the CD-ROM.

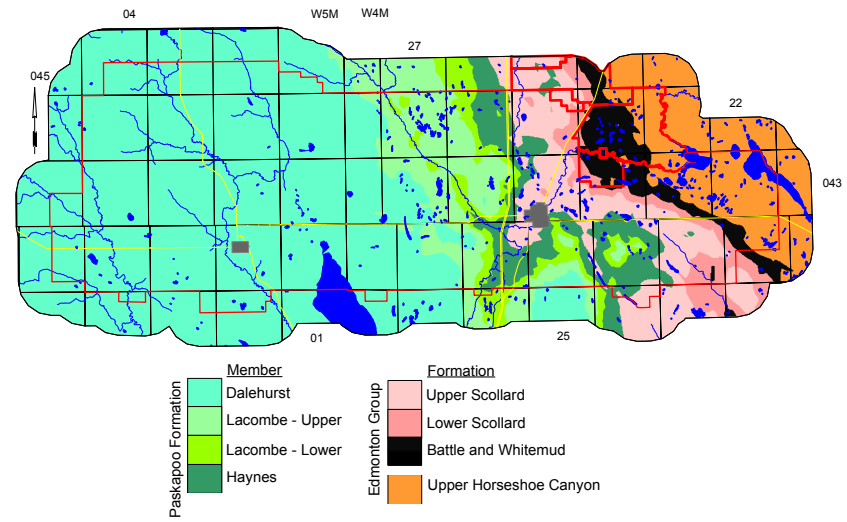

Figure 17. Bedrock Geology

The Paskapoo Formation is the upper bedrock and subcrops mainly west of range 25, W4M in the County. The Paskapoo Formation consists of cycles of thick, tabular sandstone, siltstone and mudstone layers (Glass, 1990). The maximum thickness of the Paskapoo Formation is generally less than 800 metres; in the County, the thickness is less than 500 metres.

The Dalehurst Member is the upper bedrock and subcrops in the western half of the County. This Member has a maximum thickness of 220 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 (Demchuck and Hills, 1991). In the County, the coal seams are not well developed. If the coal seams are not fractured, they are impermeable.

The Lacombe Member underlies the Dalehurst Member and has a maximum thickness of 245 metres in the County. The upper part of the Lacombe Member is mostly composed of shale interbedded with sandstone and has a maximum thickness of 130 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. In the County, the Lower Lacombe Member has a maximum thickness of 115 metres.

The Haynes Member underlies the Lacombe Member and is composed mainly of sandstone with some siltstone, shale and coal. In other parts of Alberta, the Haynes Member has a maximum thickness of 100 metres; in the County, the Haynes Member has a maximum thickness of 50 metres.

The Scollard Formation underlies the Haynes Member, generally 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. The Lower Scollard is composed mainly of shale and sandstone. In the County, the Scollard Formation has a maximum thickness of 170 metres.

Beneath the Scollard Formation are two formations having a maximum thickness of 30 metres; the two are the Battle and Whitemud formations. The Battle Formation is composed mainly of claystone, tuff, shale and bentonite, and includes the Kneehills Member, a 2.5- to 30-cm-thick tuff bed. The Whitemud Formation is composed mainly of shale, siltstone, sandstone and bentonite. The Battle and Whitemud formations are significant geologic markers, and were used in the preparation of various geological surfaces within the bedrock. Because of the ubiquitous nature of the bentonite in the Battle and Whitemud formations, there is very little significant permeability within these two formations and there will be no direct review of the Battle and Whitemud formations.