5.3.4 Paskapoo Aquifer

The Paskapoo Aquifer is part of the Paskapoo Formation that mainly underlies parts of townships 056 and 057, ranges 08 and 09, W5M in the southwestern part of the County. The thickness of the Paskapoo Formation is generally less than 100 metres; in most of the County, the Paskapoo Formation has been eroded.

5.3.4.1 Depth to Top

The depth to the top of the Paskapoo Formation is mainly less than 20 metres below ground level.

5.3.4.2 Apparent Yield

The projected long-term yield for individual water wells completed through the Paskapoo Aquifer is mainly 10 to 100 m³/day. The areas where water wells with higher yields are expected within the Paskapoo Aquifer are mainly in the extreme southwestern part of the County.

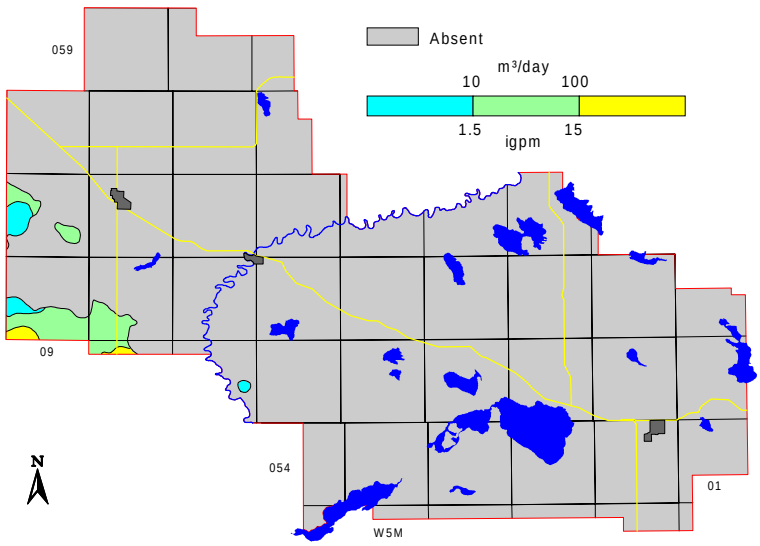

Figure 18. Apparent Yield for Water Wells Completed through Paskapoo Aquifer

5.3.4.3 Quality

The TDS concentrations for groundwater from the Paskapoo Aquifer are mainly more than 500 mg/L. The sulfate concentrations are less than 100 mg/L in over 60% of the County where the Paskapoo subcrops.

The chloride concentration from the Paskapoo Aquifer can be expected to be less than 10 mg/L.

5.3.5 Upper Scollard Aquifer

The Upper Scollard Aquifer is part of the Upper Scollard Formation that underlies the southwestern part of the County. The thickness of the Scollard Formation is generally less than 80 metres; in most of the County, the Scollard Formation has been eroded.

5.3.5.1 Depth to Top

The depth to the top of the Upper Scollard Formation is mainly less than 40 metres below ground level. The greatest depth is in the area(s) where the Paskapoo Formation is present.

5.3.5.2 Apparent Yield

The projected long-term yield for individual water wells completed through the Upper Scollard Aquifer is mainly 10 to 100 m³/day. The lower yields are expected where the Aquifer is thinner near its eastern edge.

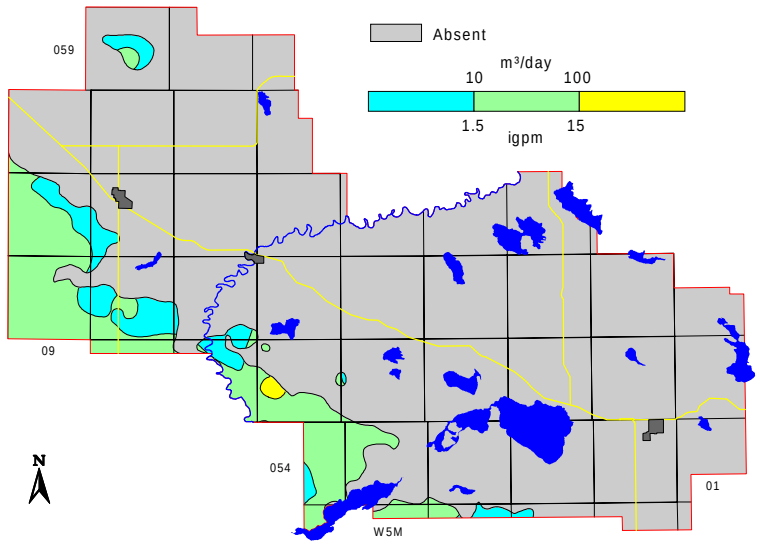

Figure 19. Apparent Yield for Water Wells Completed through Upper Scollard Aquifer

5.3.5.3 Quality

The TDS concentrations for groundwater from the Upper Scollard Aquifer are mainly less than 1,500 mg/L, with 50% of the values being less than 1,000 mg/L. The sulfate concentrations are generally less than 250 mg/L.

The chloride concentration of the groundwater from the Upper Scollard Aquifer can be expected to be less than 10 mg/L except in the area(s) where the Paskapoo Formation is present.

5.3.6 Lower Scollard Aquifer

The Lower Scollard Aquifer is part of the Lower Scollard Formation that underlies the southwestern part of the County. The thickness of the Lower Scollard Formation is generally less than 40 metres; in most of the County, the Lower Scollard Formation has been eroded.

5.3.6.1 Depth to Top

The depth to the top of the Lower Scollard Formation is mainly less than 100 metres below ground level, increasing toward its southwestern extent.

5.3.6.2 Apparent Yield

The projected long-term yields for individual water wells completed through the Lower Scollard Aquifer range from less than 1.0 to more than 5.0 m³/day. An extended aquifer test conducted with a water test hole completed in the Lower Scollard Aquifer for the Town of Mayerthorpe (Hydrogeological Consultants Ltd., 1998) indicated a long-term yield of 325 m³/day. The water test hole site was chosen on the basis of a lineament analysis.

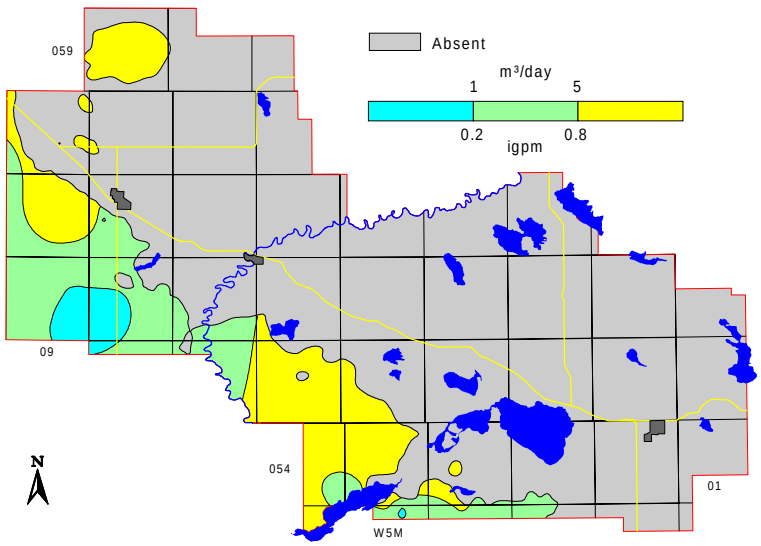

Figure 20. Apparent Yield for Water Wells Completed through Lower Scollard Aquifer

5.3.6.3 Quality

The TDS concentrations for groundwater from the Lower Scollard Aquifer are mainly less than 1,500 mg/L. Due to the paucity of data available, establishing meaningful trends between TDS and sulfate concentrations is not practical.

A groundwater sample collected from a water test hole in November 1997 (Hydrogeological Consultants Ltd., 1998) completed in the Lower Scollard Aquifer had a TDS concentration of 1,050 mg/L, a sulfate concentration of 58.4 mg/L, a chloride concentration of 1.2 mg/L, and a fluoride concentration of 1.03 mg/L.

5.3.7 Upper Horseshoe Canyon Aquifer

The Upper Horseshoe Canyon Aquifer is the upper part of the Horseshoe Canyon Formation and subcrops under the central part of the County. The thickness of the Upper Horseshoe Canyon Aquifer increases to the southwest and can reach 100 metres in the southern part of the County. In general terms, the permeability of the Upper Horseshoe Canyon Aquifer is very low. Higher local permeability can be expected when the depth of burial is less than 100 metres and fracturing or weathering has occurred.

5.3.7.1 Depth to Top

The depth to the top of the Upper Horseshoe Canyon Aquifer is variable, ranging from less than 20 to more than 220 metres. The largest area where the top of the Upper Horseshoe Canyon Aquifer is more than 80 metres below ground level is in the southwestern part of the County, where the Upper Horseshoe Canyon Aquifer underlies the Scollard Aquifer.

5.3.7.2 Apparent Yield

The projected long-term yields for water wells completed through the Upper Horseshoe Canyon Aquifer are mainly less than 30 m³/day. The higher yields occur along the western side of the County and north of the Buried Onoway Valley. These higher yields may be related to a shallow depth of burial, fracturing or weathering.

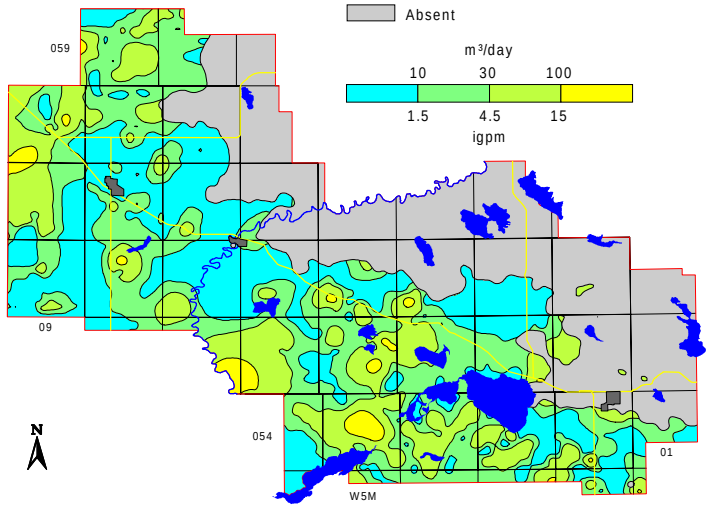

Figure 21. Apparent Yield for Water Wells Completed through Upper Horseshoe Canyon Aquifer

5.3.7.3 Quality

The Piper tri-linear diagrams show that sodium-bicarbonate and sodium-sulfate are the dominant types of groundwater that occur in the Upper Horseshoe Canyon Aquifer. The TDS concentrations in groundwater from the Upper Horseshoe Canyon Aquifer mainly range from 500 to 1,500 mg/L. The higher TDS values tend to be highest in the central part of the County. When TDS values exceed 1,200 mg/L, the sulfate concentrations exceed 400 mg/L.

Chloride concentrations in the groundwater from the Upper Horseshoe Canyon Aquifer are mainly less than 10 mg/L. The exceptions occur along the southwestern extent of the County. In this area, chloride concentrations can exceed 100 mg/L.

5.3.8 Middle Horseshoe Canyon Aquifer

The Middle Horseshoe Canyon Aquifer is part of the Middle Horseshoe Canyon Formation and subcrops under the northeastern part of the County. The thickness of the Middle Horseshoe Canyon Aquifer increases to the southwest and can reach 70 metres in the western part of the County. In general terms, the permeability of the Middle Horseshoe Canyon Aquifer is very low. Higher local permeability can be expected when the depth of burial is less than 100 metres and fracturing or weathering has occurred.

5.3.8.1 Depth to Top

The depth to the top of the Middle Horseshoe Canyon Aquifer is variable, ranging from less than 20 to more than 340 metres. The largest area where the top of the Middle Horseshoe Canyon Aquifer is more than 80 metres below ground level is in the southwestern part of the County, where the Middle Horseshoe Canyon underlies the Upper Horseshoe Canyon Aquifer.

5.3.8.2 Apparent Yield

The projected long-term yields for water wells completed through the Middle Horseshoe Canyon Aquifer are mainly less than 10 m³/day. The adjacent map indicates that apparent yields of more than 30 m³/day are expected mainly in the vicinity of the Village of Onoway.

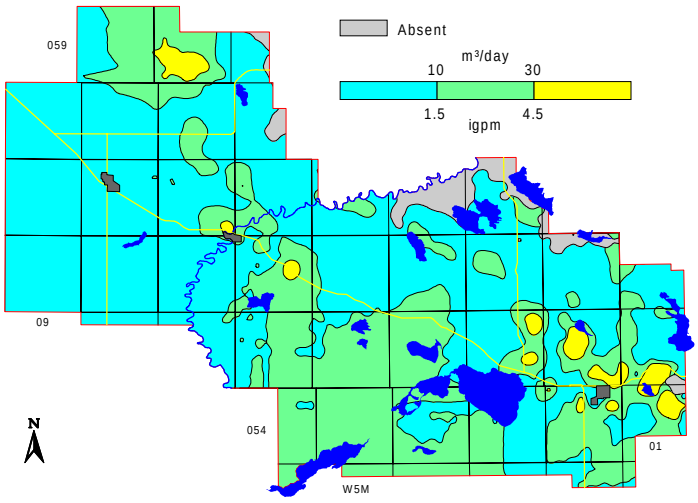

Figure 22. Apparent Yield for Water Wells Completed through Middle Horseshoe Canyon Aquifer

5.3.8.3 Quality

The Piper tri-linear diagrams show that groundwaters in the Middle Horseshoe Canyon Aquifer are mainly a sodium-bicarbonate-type. The TDS concentrations in groundwater from the Middle Horseshoe Canyon Aquifer mainly range from less than 1,000 to more than 1,500 mg/L. The higher TDS values tend to be in the northeastern part of the County where the Middle Horseshoe Canyon is present as the upper bedrock. When TDS values exceed 1,300 mg/L, the sulfate concentrations exceed 400 mg/L.

Chloride concentrations in the groundwater from the Middle Horseshoe Canyon Aquifer are mainly less than 10 mg/L.

5.3.9 Lower Horseshoe Canyon Aquifer

The Lower Horseshoe Canyon Aquifer is part of the Lower Horseshoe Canyon Formation and subcrops under the northeasternmost part of the County. The thickness of the Lower Horseshoe Canyon Aquifer is generally 170 metres. Higher local permeability can be expected in the lowest part of the Lower Horseshoe Canyon Formation.

5.3.9.1 Depth to Top

The depth to the top of the Lower Horseshoe Canyon Aquifer ranges from less than 20 metres in the northeastern part of the County where the Aquifer subcrops, to more than 360 metres in the southwestern part of the County where the Paskapoo Formation is present.

5.3.9.2 Apparent Yield

The projected long-term yields for individual water wells completed in the Lower Horseshoe Canyon Aquifer are mainly less than 50 m³/day. The adjacent map indicates that apparent yields of more than 50 m³/day are expected mainly north and south of the Town of Mayerthorpe; however, there is little or no data for the Aquifer for the southern and western parts of the County due to the large depth to the Aquifer.

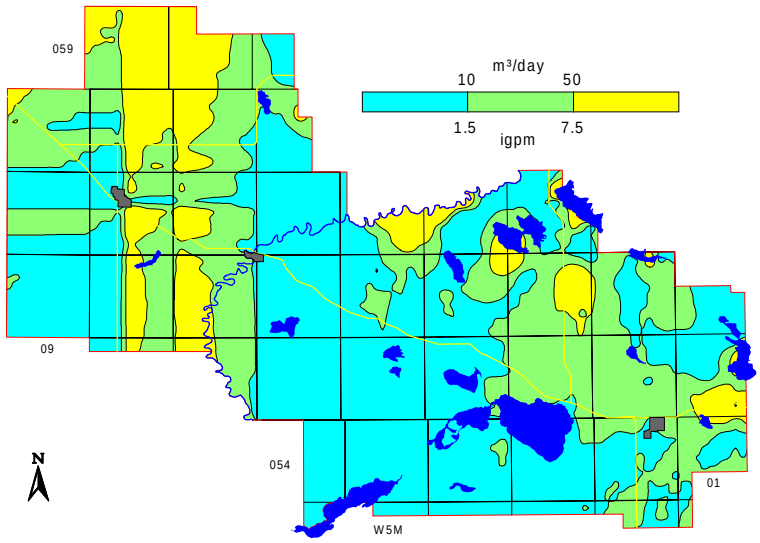

Figure 23. Apparent Yield for Water Wells Completed through Lower Horseshoe Canyon Aquifer

5.3.9.3 Quality

Groundwaters from the Lower Horseshoe Canyon Aquifer are mainly sodium-bicarbonate or sodium-sulfate-type waters. TDS concentrations are expected to be in the order of 500 to 1,500 mg/L where the Aquifer is present, although there is a paucity of data for the southern and western parts of the County.

Chloride concentrations in the groundwater from the Lower Horseshoe Canyon Aquifer are mainly less than 250 mg/L.

6 GROUNDWATER BUDGET

6.1 Hydrographs

There are two observation water wells in the County where water levels are being measured and recorded with time. These observation water wells are part of the AEP groundwater-monitoring network. Both of the observation water wells, located approximately 10 kilometres south of the Town of Mayerthorpe in the Paddle River Valley, are completed in the Lower Sand and Gravel Aquifer.

The water level rose more than two metres from 1987 to 1989 in the two observation water wells, with one metre of water-level rise occurring in 1987. This rise in water level corresponds to the filling of the Paddle River Dam.

The Town of Mayerthorpe has been using groundwater from water supply wells completed in the Lower Sand and Gravel Aquifer since 1959. The available data indicate that between 1962 and 1996, the water level in the aquifer has declined more than 25 metres. The water-level decline indicates that recharge to the Aquifer is less than the 800 m³/day that is being used by the Town.

In general, the hydrographs show local hydraulic conditions and are not applicable to a regional groundwater budget analysis.

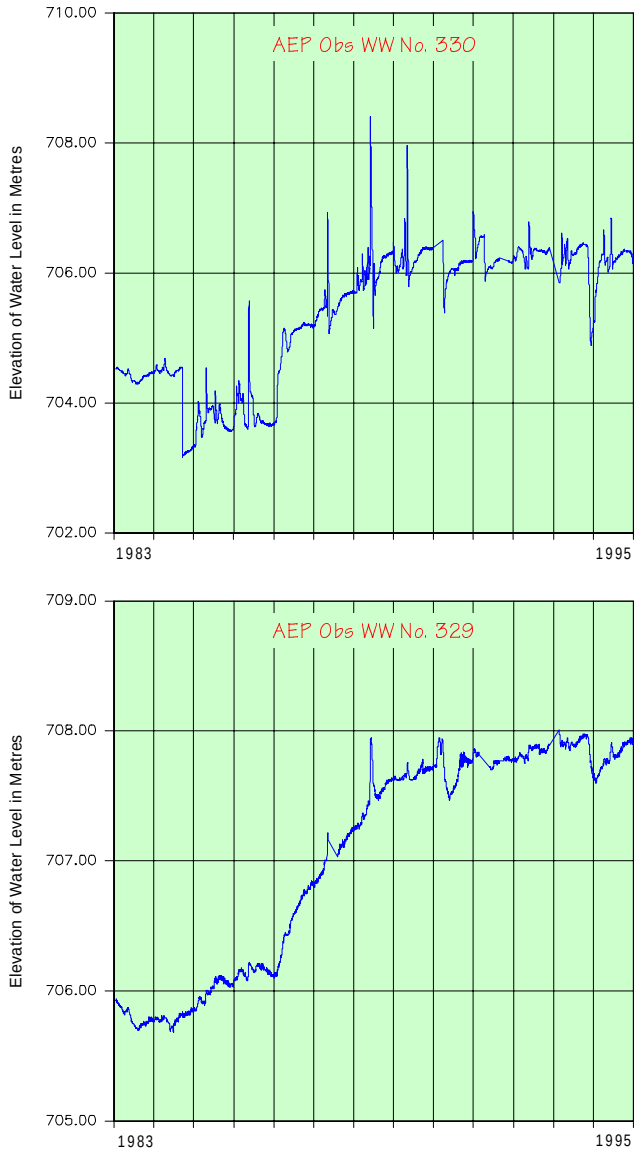

Figure 24. Hydrographs - AEP Observation Water Wells

6.2 Groundwater Flow

A direct measurement of groundwater recharge or discharge is not possible from the data that are presently available for the County. One indirect method of measuring recharge is to determine the quantity of groundwater flowing 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 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 aquifers include the Buried Onoway Valley, the Upper Scollard Aquifer, the Upper Horseshoe Canyon Aquifer, the Middle Horseshoe Canyon Aquifer and the Lower Horseshoe Canyon Aquifer. Due to the paucity of data from surficial water wells completed outside the Buried Onoway Valley, the groundwater flow has not been estimated from the surficial deposits.

The flow through each aquifer assumes that by taking a large 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 groundwater flow through the individual aquifers can be summarized as follows:

Aquifer Designation	Transmissivity (m^2/day)	Gradient (m/m)	Width (km)	Main Direction of Flow	Quantity (m^3/day)
Buried Onoway Valley	30	0.0035	4	East	420
Upper Scollard	3	0.003	70	Northeast	630
Upper Horseshoe Canyon	1.5	0.004	90	Southeast/North/Northeast	540
Middle Horseshoe Canyon	0.7	0.004	90	Southeast/North	250
Lower Horseshoe Canyon	1	0.003	90	Southeast/North/Northeast	270

The recharge to these aquifers would be restricted to Lac Ste. Anne County.