5.2.2 Sand and Gravel Aquifer(s)

One significant source of groundwater in the County includes aquifers in the surficial deposits. The actual aquifer developed will usually be dictated by whichever aquifer is present. From the present hydrogeological analysis, 648 water wells are completed in aquifers in the lower surficial deposits and 196 are completed in aquifers in the upper surficial deposits. This number of water wells is slightly more than double the number of water wells determined to be completed in aquifers in the surficial deposits, based on lithology given on the water well drilling reports.

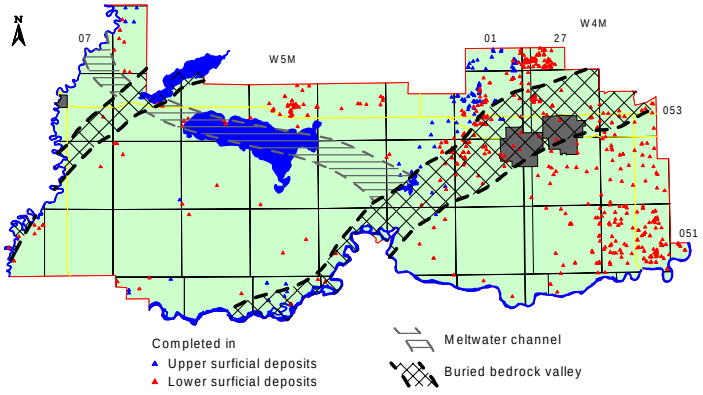

Figure 11. Water Wells Completed in Surficial Deposits

The majority of the water wells completed in the upper surficial deposits are located in or near the Buried Beverly Valley as shown in Figure 11. The majority of the water wells completed in the lower surficial deposits are located in the area of the Buried Beverly and Onoway valleys or the bedrock low southeast of the Town of Spruce Grove, between the Town and the North Saskatchewan River.

The adjacent map shows water well yields that are expected in the County, based on the aquifers that have been developed by existing water wells. These data show that water wells with yields of less than 100 m³/day from sand and gravel aquifer(s) can be expected in most areas of the County. The most notable areas where yields of more than 100 m³/day are expected are in the eastern half of the County. Over approximately 50% of the County, the sand and gravel deposits are not present or if present, are not saturated.

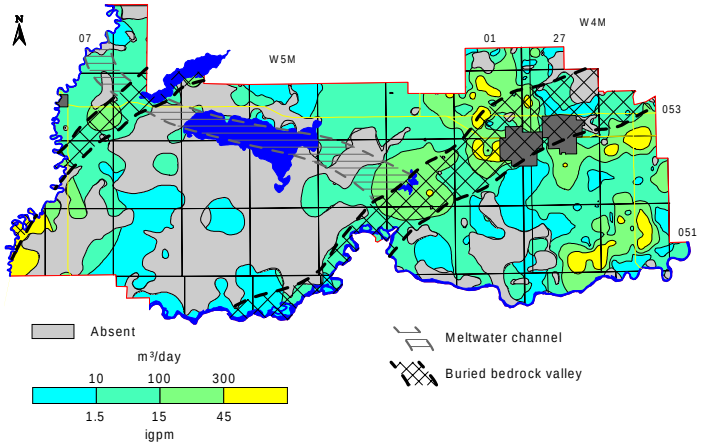

Figure 12. Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)

The Town of Stony Plain, Forest Green Subdivision groundwater dewatering system was established in 1976. The three dewatering wells are completed in a sand and gravel aquifer in the lower surficial deposits associated with the Buried Beverly Valley. These dewatering wells have diverted an average of 2,300 m³/day for the last 20 years, with no adverse effect on the water level in the aquifer. Since dewatering began in 1976, the water level has declined less than 2 metres in the observation water well completed in the same aquifer and less than 10 metres from the nearest dewatering well (Hydrogeological Consultants Ltd., 1998). The water level in the observation water well

completed in the upper bedrock aquifer was measured from 1977 to 1989. The water-level fluctuations in both observation water wells were similar from a graphical perspective. However, the water-level fluctuations in the bedrock observation water well were of a lesser magnitude, declining less than 0.5 metres between 1977 and 1989 (Hydrogeological Consultants Ltd., 1991).

5.2.2.1 Chemical Quality of Groundwater from Surficial Deposits

The chemical analysis results of groundwaters from the surficial deposits have not been differentiated based on aquifers in the upper or lower surficial deposits. The main reason for not separating the chemical analysis results is that there appears to be no major chemical difference between groundwater from the upper and lower sand and gravel aquifers. The groundwaters from these aquifers are generally chemically hard and high in dissolved iron.

The Piper tri-linear diagram shows that the majority of the groundwaters are calcium-magnesium-bicarbonate-type or sodium-bicarbonate-type waters; however, some groundwaters from the surficial deposits are sodium-sulfate-type waters.

Eighty-five percent of the groundwaters from the surficial aquifers have a chemical hardness of more than 50 mg/L. The TDS concentrations in the groundwaters from the surficial deposits range from less than 200 to over 1,500 mg/L. Groundwaters from the surficial deposits with a TDS of less than 500 mg/L occur in approximately 20% of the County. Sulfate concentrations of greater than 400 mg/L occur in areas where TDS values in the groundwaters from the surficial deposits exceed 1,200 mg/L.

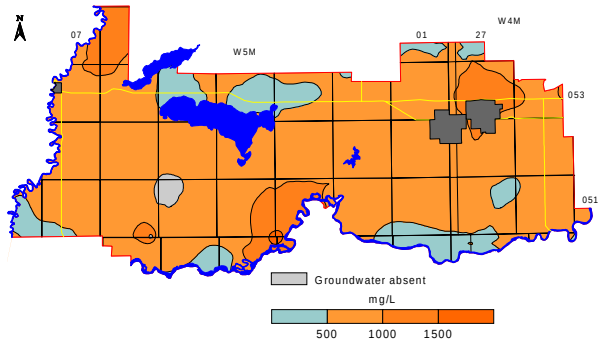

Figure 13. Total Dissolved Solids in Groundwater from Surficial Deposits

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 less than 50 mg/L.

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. These aquifers typically occur above an elevation of 660 metres AMSL. The saturated sand and gravel deposits are not continuous and are expected over approximately 60% of the County.

5.2.3.1 Aquifer Thickness

The thickness of the Upper Sand and Gravel Aquifer is in part a function of the elevation of the non-pumping water level associated with the upper surficial deposits and in part a result of the depth to the bedrock surface. Since the non-pumping water level tends to be a subdued replica of the bedrock surface, the thickness of the Upper Sand and Gravel Aquifer tends to be directly proportional to the thickness of the surficial deposits.

While the sand and gravel deposits in the upper surficial deposits are not continuous, the Upper Sand and Gravel Aquifer includes all of the aquifers present in the upper surficial deposits. The Upper Sand

and Gravel Aquifer is more than 10 metres thick in the Buried Beverly Valley, but over the majority of the County, is less than 10 metres thick or absent.

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 water wells with high yields; however, because the sand and gravel deposits occur mainly as hydraulically discontinuous pockets, the long-term yield of the water wells is limited. The apparent yields for water wells completed in this Aquifer are expected to be mainly less than 100 m³/day. Where the Upper Sand and Gravel Aquifer is absent and where the yields are low, the development of water wells for the domestic needs of single families may not be possible.

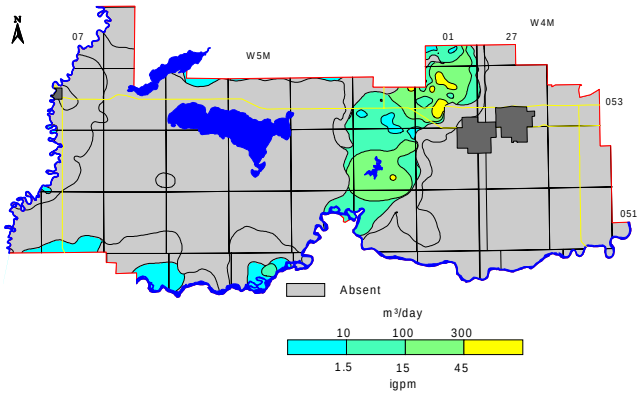

Figure 14. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

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 deepest part of the pre-glacial linear bedrock lows. Coal fragments are frequently associated with the Lower Sand and Gravel Aquifer in the eastern part of the County. During water well development, the presence of the coal deposits can create a problem by plugging the water well screen. The Lower Sand and Gravel Aquifer is present in most of the County, with a thickness of more than 10 metres in 50% of the area east of range 02, W5M.

5.2.4.1 Apparent Yield

Water wells completed in the Lower Sand and Gravel Aquifer may have yields in excess of 300 m³/day. The highest yields are expected in the Buried Beverly Valley. In this area, the projected long-term yields from individual water wells could be more than 500 m³/day. The yields for water wells completed in the Lower Sand and Gravel Aquifer are expected to be less than 100 m³/day in the majority of the County.

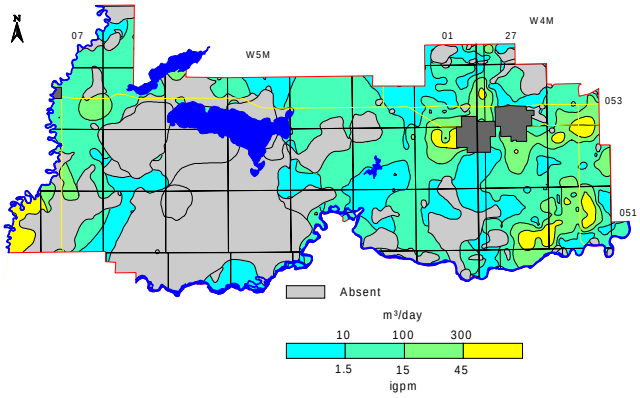

Figure 15. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

An extended aquifer test conducted with a water test hole completed in the Lower Sand and Gravel Aquifer for the Devonian Botanical Gardens (Hydrogeological Consultants Ltd., 1987) indicated a long-term yield of nearly 200 m³/day.

5.3 Bedrock

5.3.1 Geological Characteristics

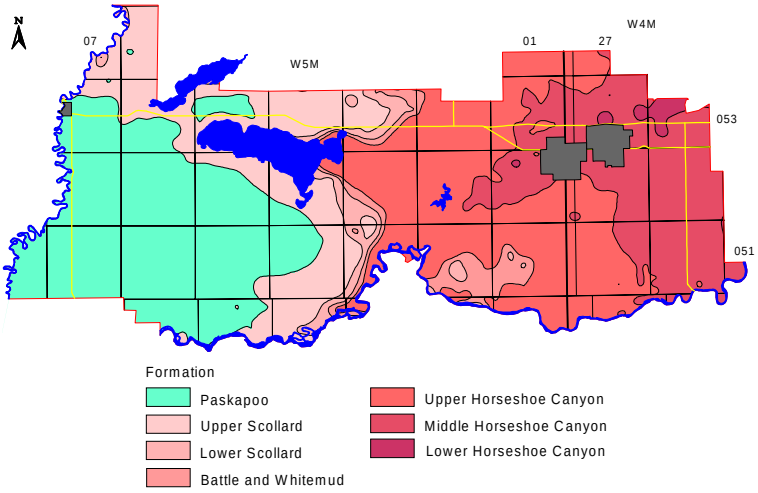

Figure 16. Bedrock Geology

The upper bedrock in the County is the Paskapoo Formation and the Edmonton Group. The Paskapoo Formation consists of cycles of thick, tabular sandstones, siltstone and mudstone layers (Glass, D. J. [editor], 1990). The Edmonton Group consists of fresh and brackish-water deposits of fine-grained sandstone and silty shale, thick coal seams, and numerous bentonite beds (Carrigy, 1971). The maximum thickness of the Paskapoo Formation can be up to 800 metres, but in the County, the thickness is from 0 to 250 metres. The thickness of the Edmonton Group varies from 300 to 500 metres and is underlain by the Bearpaw Formation. The Edmonton Group in the County includes the Scollard, Battle, Whitemud and Horseshoe Canyon formations.

The Paskapoo Formation is the upper bedrock and subcrops in the southwestern part of the County.

The Scollard Formation underlies the Paskapoo Formation and subcrops mainly in the east-central part of the County. The Scollard Formation has a maximum thickness of 120 metres within the County and includes the Upper and Lower Scollard formations. 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 a maximum thickness of 40 metres and is composed mainly of shale and sandstone.

Beneath the Scollard Formation are two formations having a maximum thickness of 30 metres; the two are the Battle and Whitemud formations. The Battle and Whitemud formations are also present only in the southwestern part of the County. 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 considered to be significant geologic markers, and were used to prepare the structural maps and hydrostratigraphy classifications. Because of the ubiquitous nature of the bentonite in the Battle and Whitemud formations, there is very little significant permeability within these two formations.

The Horseshoe Canyon Formation is the lower part of the Edmonton Group and is the upper bedrock in the remainder of the County. The Horseshoe Canyon Formation has a maximum thickness of 350

metres and within the County includes the Upper, Middle and Lower Horseshoe Canyon formations. The Upper Horseshoe Canyon, which can be up to 100 metres thick, is the upper bedrock in the east-central part of the County immediately east of the area where the Scollard Formation subcrops. The Middle Horseshoe Canyon, which is up to 80 metres thick, is the upper bedrock in the northeastern part of the County. The Lower Horseshoe Canyon, which is up to 180 metres thick, is the upper bedrock in a few areas of the northeastern part of the County.

The Horseshoe Canyon Formation consists of deltaic[11] and fluvial sandstone, siltstone and shale with interbedded coal seams, bentonite and thin nodular beds of ironstone. Because of the low-energy environment in which deposition occurred, the sandstones, when present, tend to be finer grained. The lower 60 to 70 metres and the upper 30 to 50 metres of the Horseshoe Canyon Formation can include coarser grained sandstone deposits.

The Bearpaw Formation underlies the Horseshoe Canyon Formation and is in the order of 80 metres thick within the County. The Bearpaw Formation includes transgressive, shallow marine (shoreface) and open marine facies[12] deposits. In Parkland County, the Bearpaw Formation is composed mainly of shale and as such is a regional aquitard.

5.3.2 Aquifers

Of the 3,107 water wells in the database, 1,617 were defined as being completed in bedrock aquifer(s). This designation is based on the top of the completion interval being below the bedrock surface. The completion depth is available for the majority of water wells. In order to make use of additional information within the groundwater database, it was statistically determined that water wells typically have completion intervals equivalent to one quarter of their completed depth. This relationship was used to increase the number of water wells identified as completed in bedrock aquifer(s) to 2,598 from 1,617. With the use of geological surfaces that were determined from the interpretation of geophysical logs, it has been possible to assign the water wells completed in bedrock aquifer(s) to specific aquifers based on their completion intervals. The bedrock water wells are mainly completed in the Upper and Middle Horseshoe Canyon Aquifers as shown in the adjacent table; 849 bedrock water wells are completed in more than one aquifer. The discussions related to specific aquifers, later in this report, do not include the Bearpaw Aquifer. However, maps associated with the Bearpaw Aquifer are included on the CD-ROM.

Bedrock Aquifer	No. of Water Wells
Paskapoo	290
Upper Scollard	216
Lower Scollard	30
Upper Horseshoe Canyon	640
Middle Horseshoe Canyon	485
Lower Horseshoe Canyon	79
Bearpaw	9

Table 2. Completion Aquifer

[11] See glossary
[12] See glossary

There are 1,340 records for bedrock water wells that have apparent yield values. In Parkland County, water well yields can be expected to be mainly less than 100 m³/day. The adjacent map shows that water well yields are generally higher in the southwestern and northeastern parts of the County. In these areas, projected long-term yields are greater than 100 m³/day. These higher yields may be a result of increased permeability that has resulted from the weathering process.

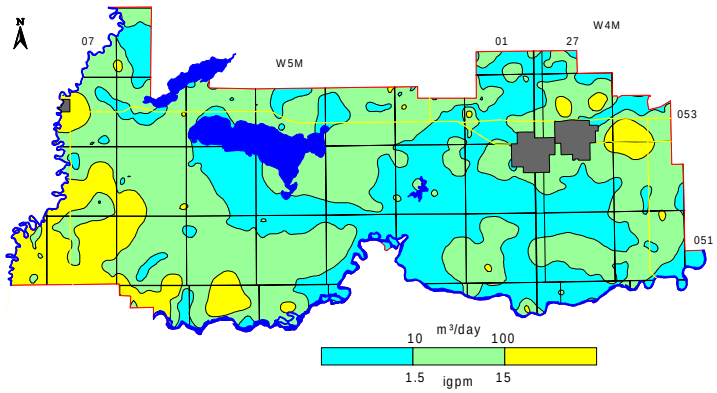

Figure 17. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Of the 1,340 records that have apparent yields, there are 869 bedrock water wells with apparent yields. With the exception of the Lower Horseshoe Canyon Aquifer, more than 50% of the bedrock water wells have apparent yields that range from 10 to 100 m³/day, as shown in the adjacent table.

Aquifer	No. of Water Wells with Apparent Yields	Percentage of Water Wells with Apparent Yield <10 m³/day	10 to 100 m³/day	>100 m³/day
Paskapoo	87	8%	66%	26%
Upper Scollard	65	23%	58%	19%
Lower Scollard	9	12%	66%	22%
Upper Horseshoe Canyon	366	23%	62%	15%
Middle Horseshoe Canyon	306	25%	58%	17%
Lower Horseshoe Canyon	36	36%	36%	28%
Bearpaw	0	#N/A	#N/A	#N/A

Table 3. Apparent Yields of Bedrock Aquifer(s)

5.3.3 Chemical Quality of Groundwater

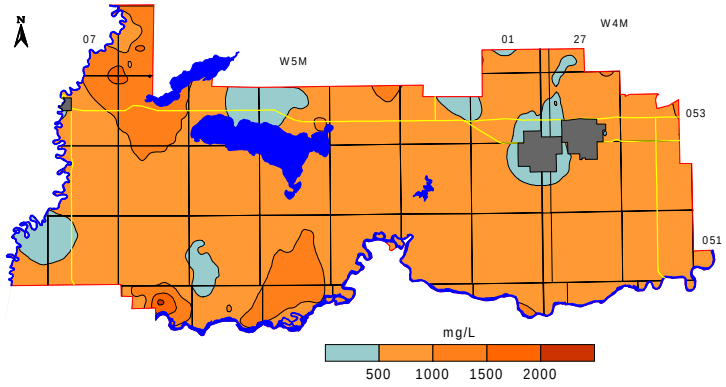

Figure 18. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

The TDS concentrations in the groundwaters from the upper bedrock aquifer(s) range from less than 500 to more than 1,500 mg/L. In more than 90% of the area, TDS values are less than 1,000 mg/L.

A relationship between TDS and sulfate concentrations shows that when TDS values in the upper bedrock aquifer(s) exceed 1,300 mg/L, the sulfate concentration exceeds 400 mg/L.

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

In 80% of the County, the fluoride ion concentration in the groundwater from the upper bedrock aquifer(s) is less than 1.5 mg/L.