

There are 1,381 records for bedrock water wells that have apparent yield values, which is 45% of the 3,051 bedrock water wells. In the County, yields for water wells completed in the upper bedrock aquifer(s) are mainly between 10 and 100 m³/day. Some of the areas with yields of more than 100 m³/day are in the western part of the County, and in association with the Buried Calgary Valley, as shown on the adjacent figure. These areas where higher yields are expected may identify locations of increased permeability resulting from the weathering process. In addition to the 1,381 records for bedrock water wells, there are 60 records that indicate that the water well is dry, or abandoned with “insufficient water”. In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to the 60 dry holes prior to gridding. The majority of the dry holes are in the Upper Horseshoe Canyon Aquifer.

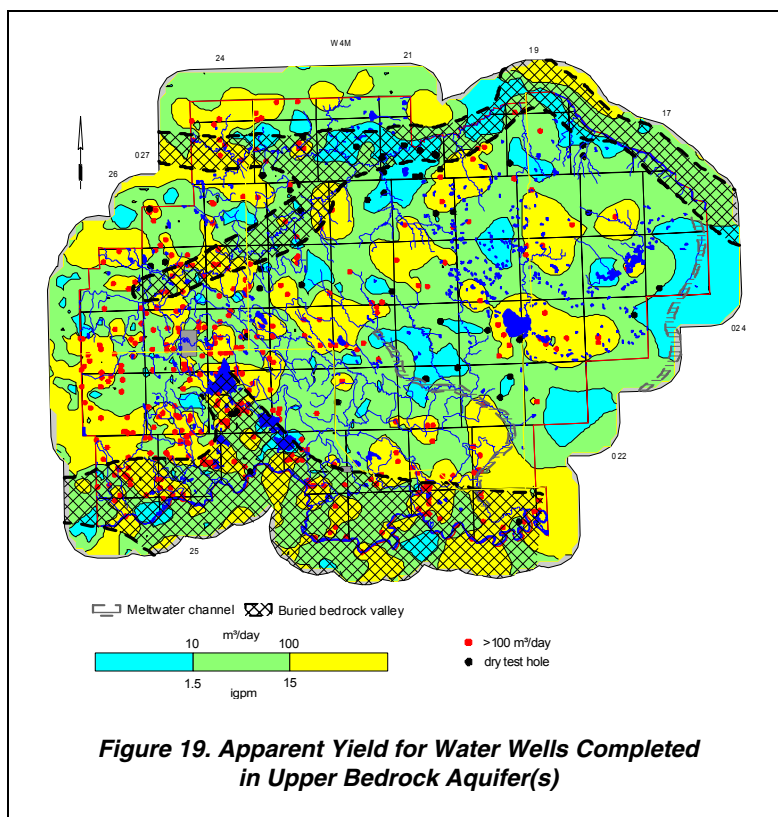


Figure 19. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Of the 1,381 water well records with apparent yield values, 1,053 have been assigned to aquifers associated with specific geologic units. Twenty-one percent (286) of the 1,381 water wells completed in the bedrock aquifers have apparent yields that are less than ten m³/day, 50% (690) have apparent yield values that range from 10 to 100 m³/day, and 29% (405) have apparent yields that are greater than 100 m³/day, as shown in Table 5. The water well records having higher apparent yield values are expected to be in areas of increased permeability resulting from the weathering process.

Aquifer	Water Wells with Values for Apparent Yield (*)	with Apparent Yields		
		<10 m ³ /day	10 to 100 m ³ /day	>100 m ³ /day
Lower Lacombe	97	22	43	32
Haynes	184	33	107	44
Upper Scollard	218	23	106	89
Lower Scollard	126	16	69	41
Battle	28	2	12	14
Upper Horseshoe Canyon	232	56	117	59
Middle Horseshoe Canyon	97	27	48	22
Lower Horseshoe Canyon	70	21	22	27
Bearpaw	1	0	0	1
Multiple Completions	328	86	166	76
Totals	1,381	286	690	405

* - does not include dry test holes

Table 6. Apparent Yields of Bedrock Aquifers

There are 28 water wells completed in the Battle Formation with apparent yield data. However, because very little significant permeability within the Battle Formation is expected, the apparent yields of greater than ten m³/day may be misleading. As a result, there will be no direct review of the Battle Formation in the text of this report. Any hydrogeological parameters that have been assigned to the Battle Formation will be included with the parameters associated with multiple completions.

5.3.3 Chemical Quality of Groundwater

The Piper tri-linear diagram for bedrock aquifers (page A-28) shows that all chemical types of groundwater occur in bedrock aquifers. However, the majority of the groundwaters are sodium-bicarbonate or sodium-sulfate types.

The TDS concentrations in the groundwaters from the upper bedrock aquifer(s) range from less than 500 mg/L to more than 2,000 mg/L, with the poorest quality being in the central part of the County (page A-30).

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.

In the County, 90% of the chloride concentrations in the groundwaters from the upper bedrock aquifer(s) are less than 100 mg/L. Chloride values of greater than 100 mg/L are mainly in the Horseshoe Canyon aquifers.

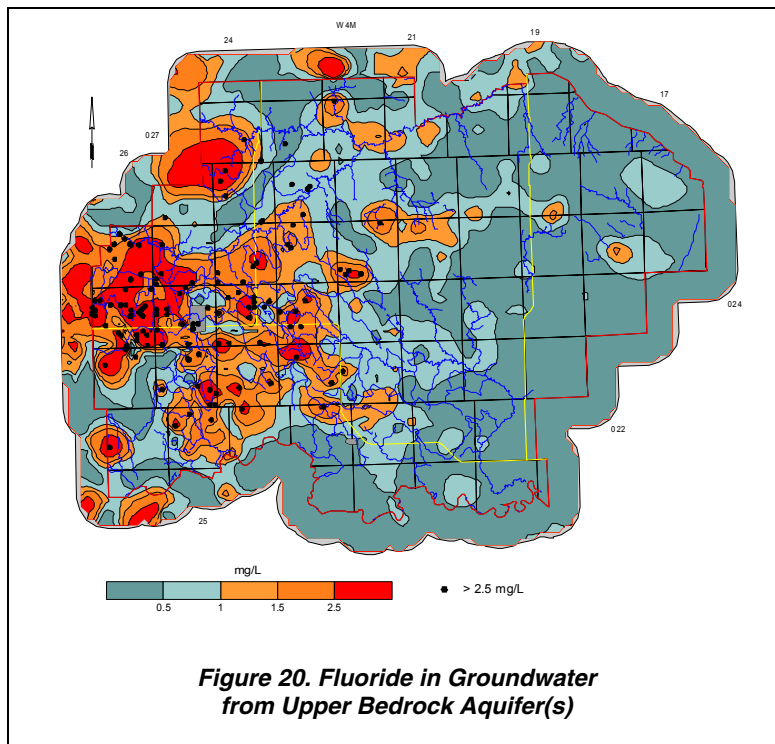


Figure 20. Fluoride in Groundwater from Upper Bedrock Aquifer(s)

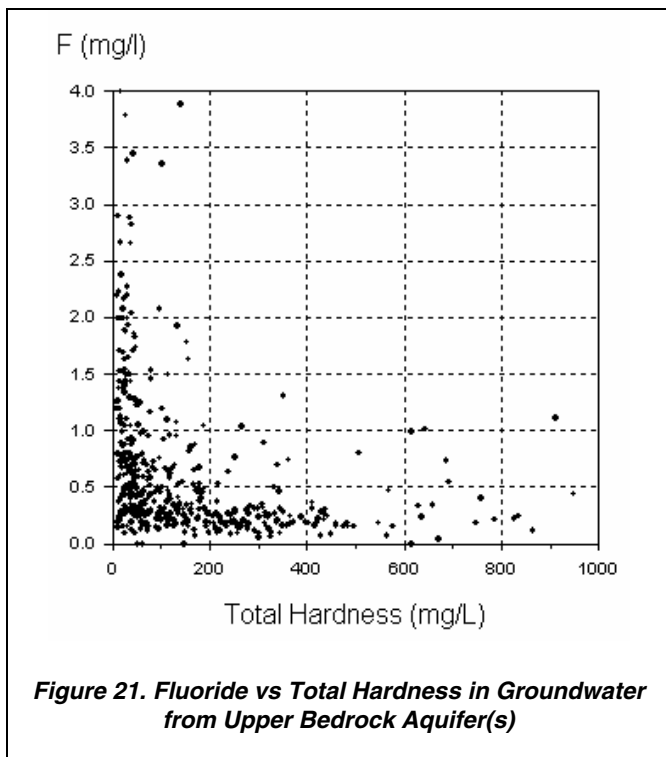


Figure 21. Fluoride vs Total Hardness in Groundwater from Upper Bedrock Aquifer(s)

The nitrate + nitrite (as N) concentrations are less than 0.1 mg/L in 75% of the chemical analyses for upper bedrock water wells. Eighty percent of the total hardness values in the groundwaters from the upper bedrock aquifer(s) are less than 200 mg/L.

In the County, approximately 35% 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 35% of the groundwater samples from the entire County are between 0.5 and 1.5 mg/L and approximately 30% exceed the maximum acceptable concentration for fluoride of 1.5 mg/L.

There appears to be an inverse relationship between fluoride and total hardness concentrations, as shown in Figure 20. In general, when total hardness is less than 150 mg/L, fluoride can be variable, but as total hardness increases, fluoride decreases. The higher values of total hardness occur mainly in the eastern part of the County and the higher values of fluoride

occur mainly in the western part of the County (see page A – 31 and the CD-ROM).

A comparison was made of fluoride concentrations in the groundwaters from water wells in the County completed in aquifers in the upper bedrock. The comparison was made to determine if there was a relationship between fluoride concentrations and the aquifer of completion. In addition, the comparisons were extended to compare the trends established within the County to trends throughout Alberta. The comparisons are summarized below in Table 7.

In both Wheatland County and throughout Alberta, there are no significant trends or variations in the median fluoride concentrations in the groundwaters from water wells completed above the Upper Horseshoe Canyon Aquifer. However, median fluoride concentrations decrease consistently in aquifers of greater depth. The percentages of analyses with fluoride concentrations of greater than 1.5 mg/L but less than 2.5 mg/L exhibit a similar trend. For fluoride concentrations of greater than 2.5 mg/L, the percentages also decrease below the Lower Scollard Aquifer, but the highest percentages of fluoride concentrations of greater than 2.5 mg/L are in the groundwaters from water wells in the County completed in the Haynes Aquifer.

Aquifer Name	Fluoride				Percentage of Analyses Greater than the SGCDWQ (1.5 mg/L)		Percentage of Analyses Greater than 2.5 mg/L	
	No. of Analyses		Median		County	All Alberta	County	All Alberta
	County	All Alberta	County	All Alberta				
Lower Lacombe	87	934	0.8	0.42	33.3	23.4	18.4	13.0
Haynes	146	681	1.0	0.56	37.0	23.5	26.0	14.7
Upper Scollard	160	638	1.1	0.49	38.8	20.8	15.0	6.6
Lower Scollard	81	764	1.0	0.56	28.4	16.2	16.0	3.1
Upper Horseshoe Canyon	319	4,163	0.7	0.61	22.3	22.3	7.5	4.7
Middle Horseshoe Canyon	149	2,130	0.4	0.50	5.4	16.1	0.0	2.2
Lower Horseshoe Canyon	79	6,340	0.3	0.43	0	7.0	0	0.8
Bearpaw	5	2,649	0.1	0.45	0	4.7	0	0.4

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 Federal-Provincial Subcommittee on Drinking Water, March 2001

Table 7. Fluoride Concentrations in Groundwaters from Upper Bedrock Aquifer(s)

5.3.4 Lower Lacombe Aquifer

The Lower Lacombe Aquifer comprises the permeable parts of the Lower Lacombe Member, as defined for the present program. The top of the Lower Lacombe Member is the bedrock surface where the Lower Lacombe Member is present. Structure contours have been prepared for the top of the Lower Lacombe Member. The structure contours show the Lower Lacombe Member ranges in elevation from less than 900 to more than 1,000 metres AMSL and has a maximum thickness of 135 metres. The non-pumping water-level surface in the Lower Lacombe Aquifer is a subdued replica of the bedrock surface (see CD-ROM).

5.3.4.1 Depth to Top

The depth to the top of the Lower Lacombe Member is mainly less than 15 metres and is a reflection of the thickness of the surficial deposits (page A-33).

5.3.4.2 Apparent Yield

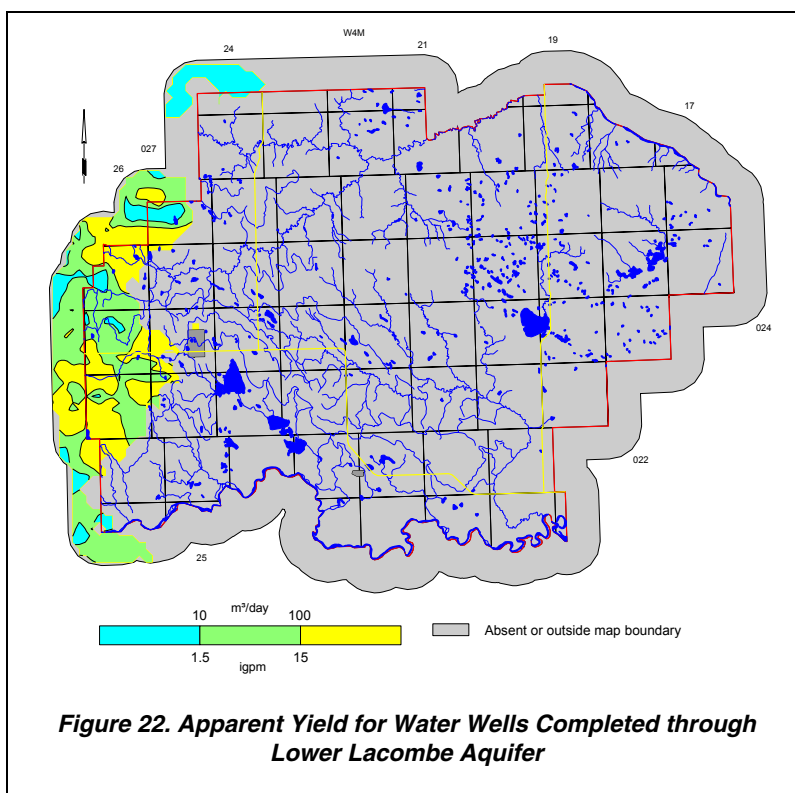
The apparent yields for individual water wells completed through the Lower Lacombe Aquifer are mainly in the range of 10 to 100 m³/day, with nearly 70% of the values being less than 100 m³/day (Table 5). The areas showing water wells with yields of greater than 100 m³/day are mainly associated with the eastern edge of the Aquifer.

There are five licensed water wells completed through the Lower Lacombe, for a total of 125 m³/day. Two water supply wells licensed for agricultural purposes in 05-02-023-26 W4M account for 85% of the total licensed diversions. All five licensed water wells could be linked to a water well in the AENV groundwater database. Four of the five licensed users are for agricultural purposes.

An extended aquifer test conducted with a water supply well completed in the Lower Lacombe Aquifer in NW 20-026-25 W4M indicated a long-term yield of 160 m³/day, based on an apparent transmissivity of 100 metres squared per day (m²/day) and an effective transmissivity of 25 m²/day after 1,000 minutes of pumping (HCL, October 1994).

5.3.4.3 Quality

The groundwaters from the Lower Lacombe Aquifer are mainly a bicarbonate-to-sulfate type, with sodium as the main cation (see Piper diagram on CD-ROM), with more than 50% of the groundwater samples having TDS concentrations of greater than 1,000 mg/L. The sulfate concentrations are mainly less than 1,000 mg/L. Chloride concentrations from the Lower Lacombe Aquifer are mainly less than 50 mg/L. The indications are that fluoride concentrations in the Lower Lacombe Aquifer are expected to be more than 2.5 mg/L where the depth to top of the Lower Lacombe Aquifer is mainly less than five metres below ground surface.



The groundwater from the water well in NW 20-026-25 W4M has a TDS concentration of 809 mg/L, a sulfate concentration of 222 mg/L, a chloride concentration of 1 mg/L, and a fluoride concentration of 1.1 mg/L (HCL, October 1994).

The minimum, maximum and median concentrations of TDS, sodium, sulfate, chloride and fluoride in the groundwaters from water wells completed in the Lower Lacombe Aquifer in the County have been compared to the SGCDWQ and median concentrations from all upper bedrock aquifer(s) in the adjacent table. Of the five constituents that have been compared to the SGCDWQ, the median values of **TDS** and **sodium** exceed the guidelines in all upper bedrock aquifer(s) and the Lower Lacombe Aquifer. The median concentrations of sulfate and fluoride from water wells completed in the Lower Lacombe Aquifer are greater than the median concentrations from water wells completed in all upper bedrock aquifer(s).

Constituent	No. of Analyses	Range for County in mg/L			All Bedrock Median	Recommended Maximum Concentration SGCDWQ
		Minimum	Maximum	Median		
Total Dissolved Solids	101	373	4220	1020	1069	500
Sodium	66	0	1250	288	350	200
Sulfate	101	0	2750	365	285	500
Chloride	100	0	98	15	13	250
Fluoride	87	0	7	0.8	0.7	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)
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 Federal-Provincial Subcommittee on Drinking Water, March 2001

Table 8. Apparent Concentrations of Constituents in Groundwaters from Lower Lacombe Aquifer

The elevated fluoride concentrations in the western part of the County from water wells completed in all upper bedrock aquifer(s) shown in Figure 20 (page 25) are mainly a reflection of the underlying Haynes Aquifer rather than of the Lower Lacombe Aquifer.

Although the median value of fluoride concentrations is 0.8 mg/L from water wells completed in the Lower Lacombe Aquifer is slightly higher than fluoride concentrations from water wells in the County completed in upper bedrock aquifer(s).

5.3.5 Haynes Aquifer

The Haynes Aquifer comprises the permeable parts of the Haynes Member that underlie the Lower Lacombe Member, and subcrops under the surficial deposits in the western quarter of the County. Structure contours have been prepared for the top of the Member. The structure contours show the Haynes Member ranges in elevation from less than 870 to more than 990 metres AMSL and has a thickness of in the order of 50 metres. The non-pumping water level in the Haynes Aquifer is downgradient to the north toward the Rosebud River and downgradient south toward the Bow River.

5.3.5.1 Depth to Top

The depth to the top of the Haynes Member ranges from less than ten metres below ground surface at the eastern extent to more than 50 metres in the western part of the County (page A-36). The greatest depth is in areas where the Lower Lacombe Member is also present.

5.3.5.2 Apparent Yield

The apparent yields for individual water wells completed through the Haynes Aquifer range mainly from 10 to 100 m³/day. The adjacent map indicates that water wells with apparent yields of more than 100 m³/day are expected in a number of areas.

In the County, there are 24 licensed water wells that are completed in the Haynes Aquifer, with a total authorized diversion of 883 m³/day; the two highest allocations are 113.3 m³/day for a water supply well licensed for commercial purposes in NE 23-021-26 W4M and 114.9 m³/day for a water supply well licensed for agricultural purposes in 05-02-024-25 W4M. Twenty of the 24 licensed water wells could be linked to a specific water well in the AENV groundwater database.

5.3.5.3 Quality

The groundwaters from the Haynes Aquifer are mainly a bicarbonate-to-sulfate type, with calcium-magnesium or sodium as the main cation (see Piper diagram on CD-ROM). Seventy-five percent of the TDS concentrations are between 500 and 1,500 mg/L. The sulfate concentrations are mainly below 500 mg/L and the chloride concentrations are mainly less than 50 mg/L. The indications are that fluoride concentrations in the Haynes Aquifer are expected to be more than 2.5 mg/L where the depth to top of the Haynes Aquifer is mainly greater than 30 metres, with lower values occurring mainly along the edge of the Aquifer.

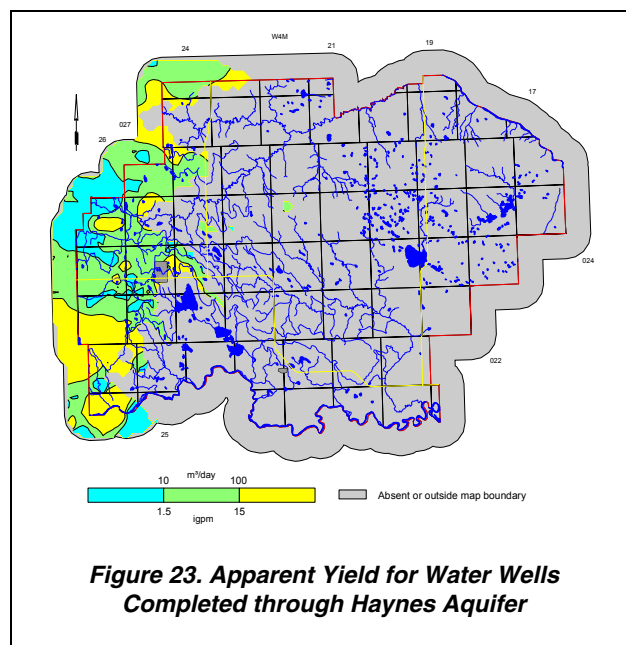


Figure 23. Apparent Yield for Water Wells Completed through Haynes Aquifer

Constituent	No. of Analyses	Range for County in mg/L			All Bedrock Median	Recommended Maximum Concentration SGCDWQ
		Minimum	Maximum	Median		
Total Dissolved Solids	172	160	4492	777	1069	500
Sodium	109	0	700	269	350	200
Sulfate	169	0	2152	223	285	500
Chloride	167	0	479	6	13	250
Fluoride	146	0	8	1.0	0.7	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)
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 Federal-Provincial Subcommittee on Drinking Water, March 2001

Table 9. Apparent Concentrations of Constituents in Groundwaters from Haynes Aquifer

The minimum, maximum and median concentrations of TDS, sodium, sulfate, chloride and fluoride in the groundwaters from water wells completed in the Haynes Aquifer in the County have been compared to the SGCDWQ and median concentrations from all upper bedrock aquifer(s) in the adjacent table. Of the five constituents that have been compared to the SGCDWQ, the median values of TDS and sodium exceed the guidelines. The median concentration of fluoride from water wells completed in the Haynes Aquifer is greater than the median concentration from water wells completed in all upper bedrock aquifer(s).

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