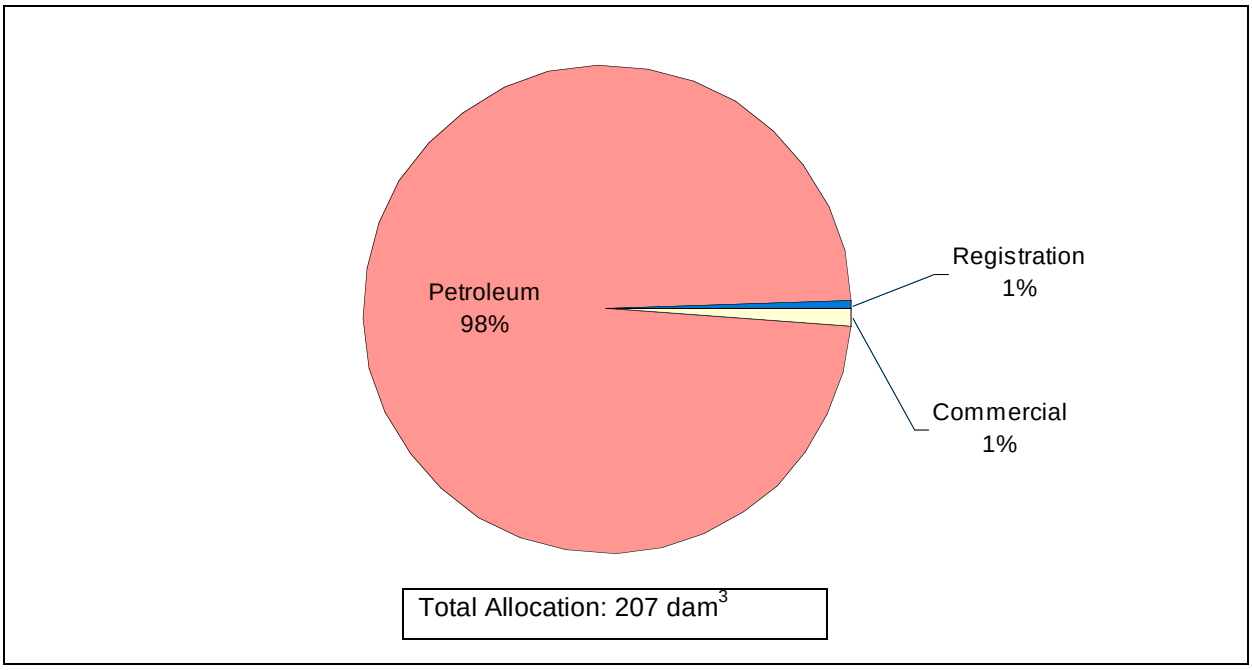
4.0 BRAZEAU

The Brazeau Sub-basin is about 5,760 km^2 in area and occupies approximately 10 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of 2,078 people, which represents less than one percent of the Basin population, with a population density of 0.4 people per square kilometre. The Brazeau Sub-basin consists all or parts of three rural municipalities and one Aboriginal Settlement.

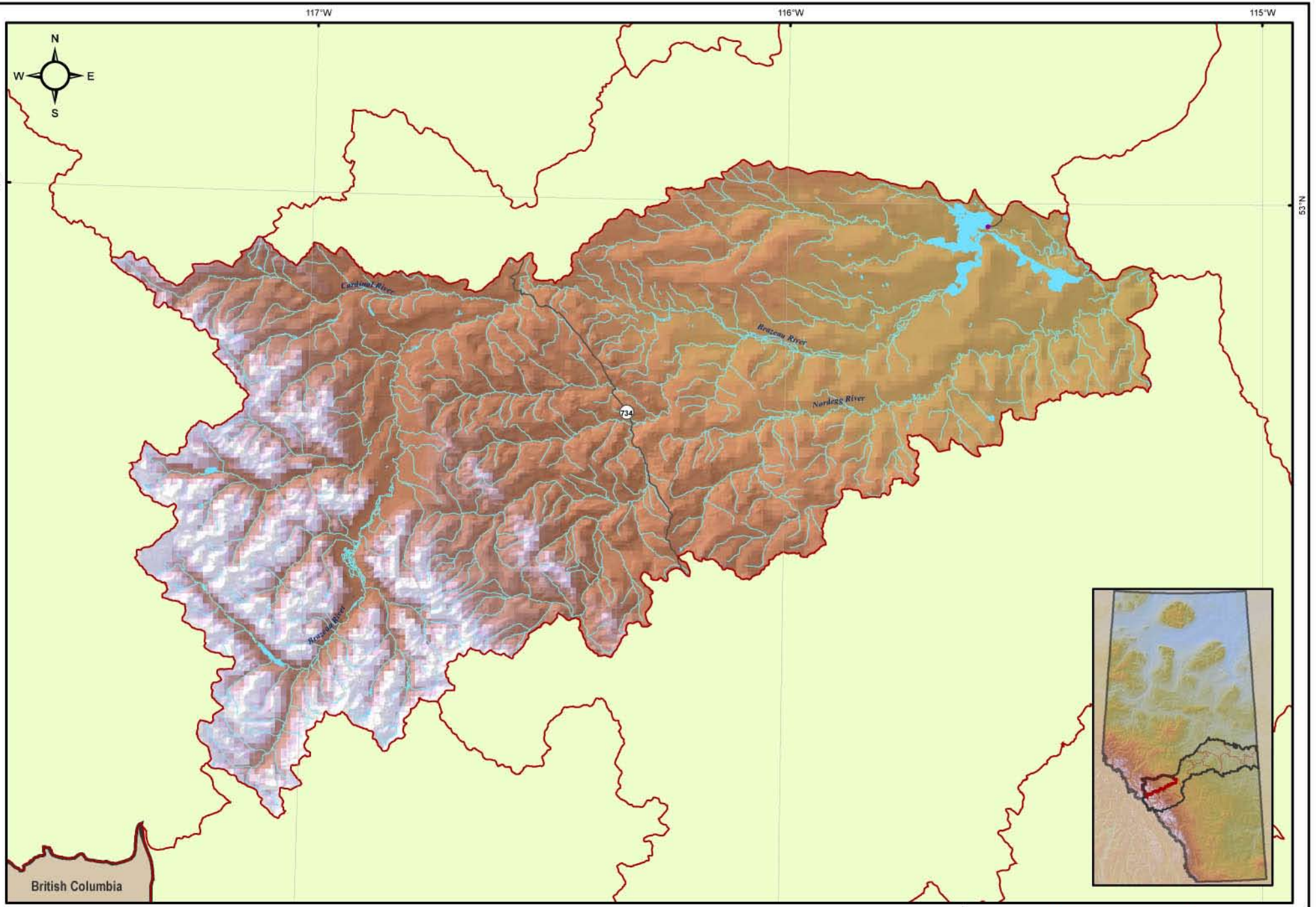
Total allocations in the sub-basin in 2005 were 207 dam^3. An overview of current allocations is provided in Figure 4-1. It shows that the petroleum sector accounts for 98 percent of total allocations or 203 dam^3 in 2005. The commercial sector and agricultural registrations account for most of the remaining allocations, totaling 2 dam^3 (1 percent) and 1 dam^3 (1 percent), respectively. These allocations are almost entirely groundwater; licences have been issued for less than 1 dam^3 of surface water.

Figure 4-1 Distribution of Active Water Allocations in the Brazeau Sub-basin



Figures 4-2 and 4-3 show the location, allocation and sector of all active water licences in the Brazeau Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 4-4.

Figure 4-2 Brazeau Sub-basin Surface Water Licences



Legend

- Settlement
- Major Road
- Watercourse
- Waterbody
- Sub Basin

Industry Category - Maximum Allowable Diversion (dam³/yr)

Commercial	Other	Petroleum	Municipal	Industrial	Agriculture
0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00
10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00
100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00
1000.01 - 10000.00	1000.01 - 10000.00	1000.01 - 10000.00	1000.01 - 10000.00	1000.01 - 10000.00	1000.01 - 10000.00
> 10000.01	> 10000.01	> 10000.01	> 10000.01	> 10000.01	> 10000.01

North Saskatchewan Watershed Alliance

Brazeau Subbasin Surface Water Licenses

DATE: May 2007	0 20 40 80 Kilometres 1:700,000
AMEC PROJECT: EE27047	
GIS FILE: SW_SB_Brazeau.mxd	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: SW_SB_Brazeau.pdf	
PREPARED BY: amec	FIGURE 4-2

Figure 4-3 Brazeau Sub-basin Groundwater Licences

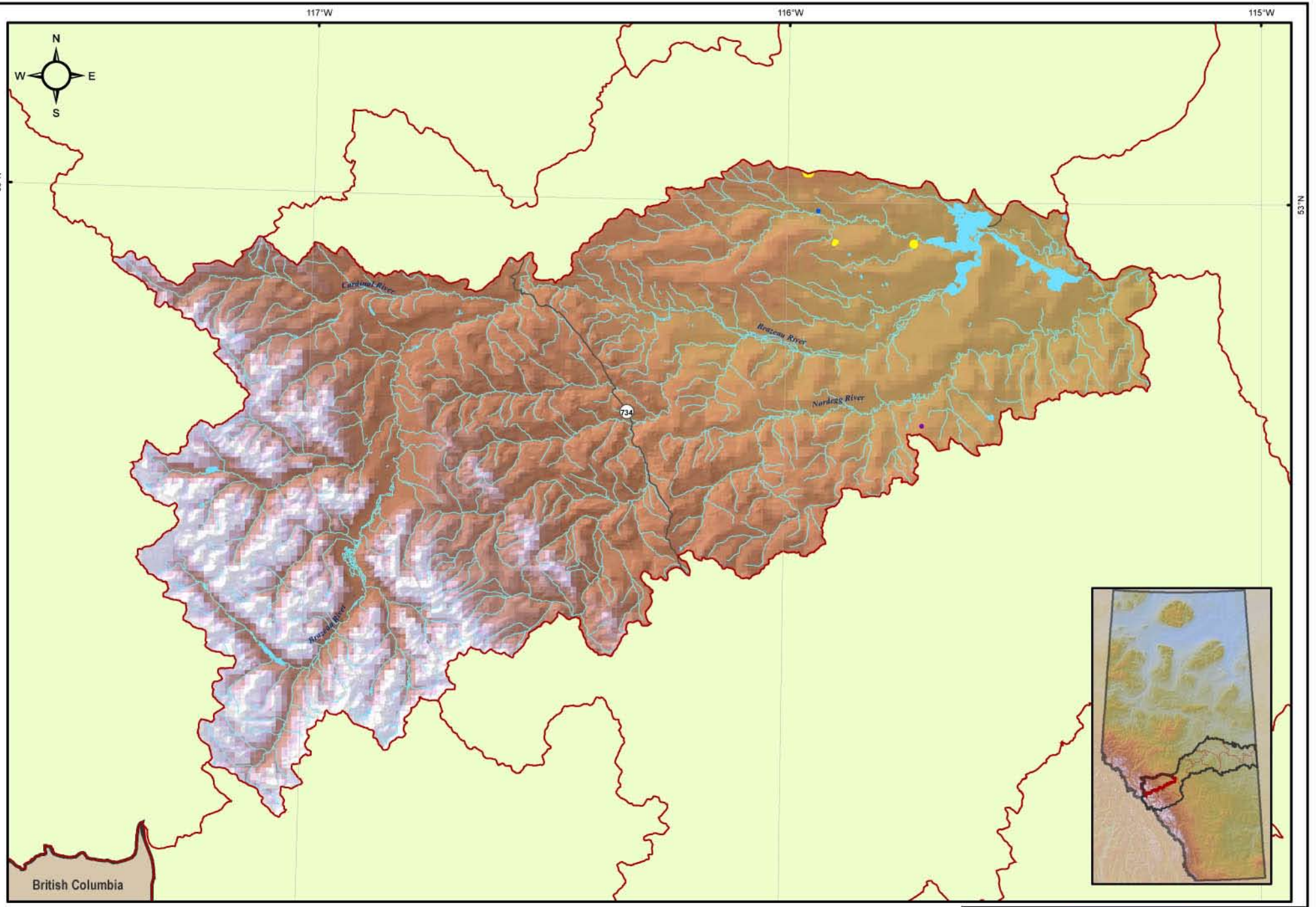
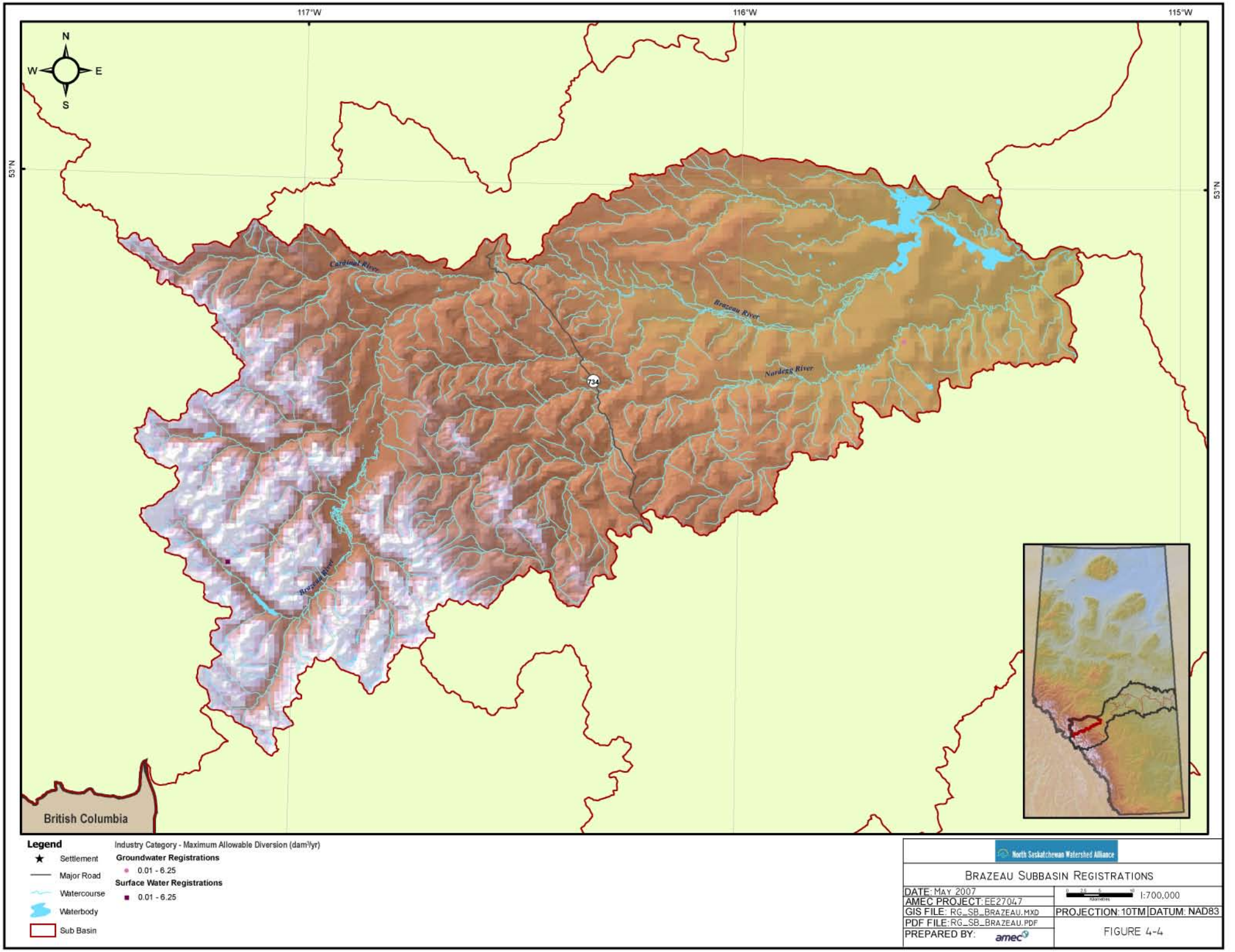

117°W
116°W
115°W
53°N
N
W
E
S
Carlyle River
Brazeau River
Nordegg River
Brazeau River
734
British Columbia
Legend
Settlement
Major Road
Watercourse
Waterbody
Sub Basin
Industry Category - Maximum Allowable Diversion (dam³/yr)
Commercial
Other
Petroleum
Municipal
Industrial
Agriculture
0.01 - 10.00
10.01 - 100.00
100.01 - 1000.00
1000.01 - 10000.00
> 10000.01
North Saskatchewan Watershed Alliance
BRAZEAU SUBBASIN GROUNDWATER LICENSES
DATE: MAY 2007
AMEC PROJECT: EE27047
GIS FILE: GW_SB_BRAZEAU.MXD
PDF FILE: GW_SB_BRAZEAU.PDF
PREPARED BY: amec
1:700,000
PROJECTION: 10TM | DATUM: NAD83
FIGURE 4-3

Figure 4-4 Brazeau Sub-basin Registrations



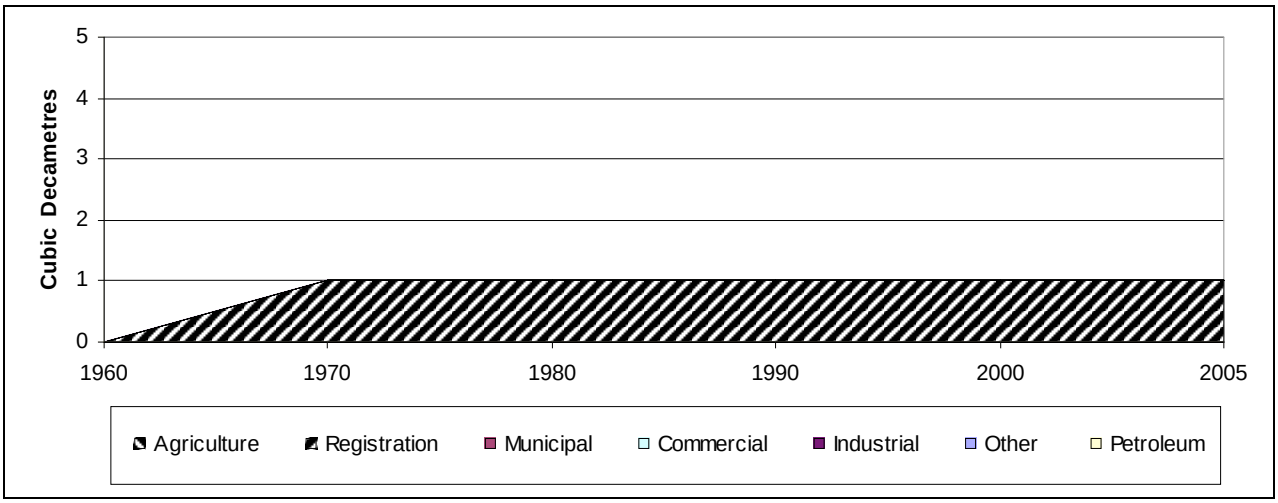
North Saskatchewan Watershed Alliance

Brazeau Subbasin Registrations

DATE: May 2007	1:700,000
AMEC PROJECT: EE27047	
GIS FILE: RG_SB_Brazeau.mxd	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: RG_SB_Brazeau.pdf	
PREPARED BY: amec	FIGURE 4-4

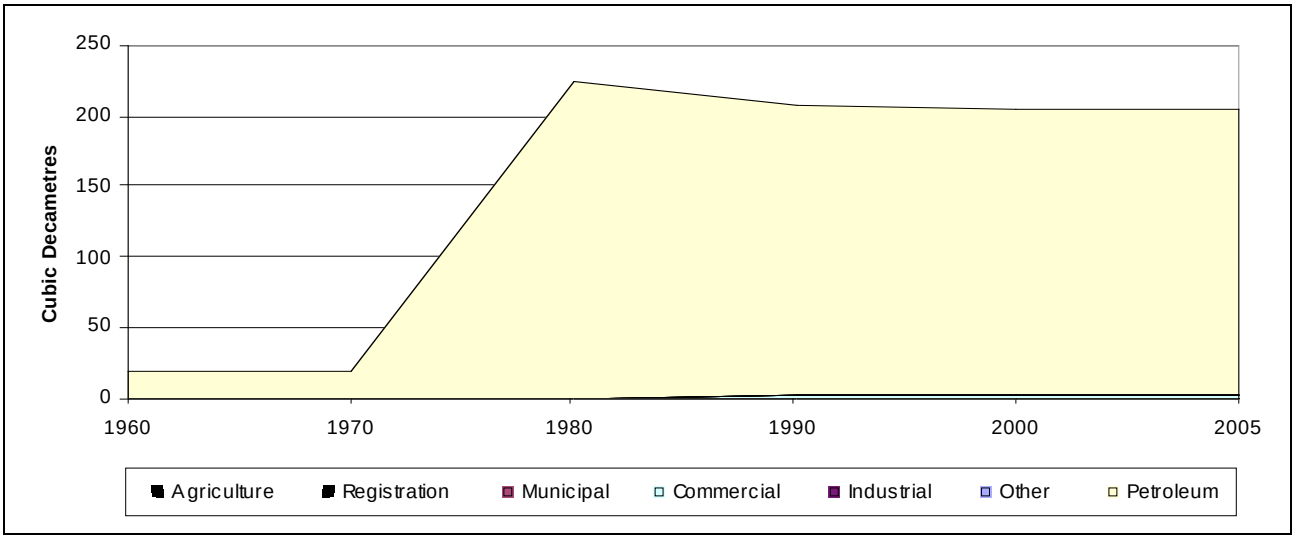
An historical perspective on water allocated among the sectors is provided in Figure 4-5 (surface water) and Figure 4-6 (groundwater). For surface water, the entire allocations are for registrations. These allocations were issued in the 1970s and have remained unchanged since that time.

Figure 4-5 Historical Trends in Surface Water Allocation in the Brazeau Sub-basin



For groundwater, the majority of the allocations are for the petroleum sector. These allocations began to be issued in the 1960s and increased substantially through the 1970s. There was a slight decrease in allocations in the 1980s but they have remained unchanged since that time. There are also some allocations for the commercial sector and registration that were issued from the 1980s for groundwater. Those allocations have remained unchanged since that time.

Figure 4-6 Historical Trends in Groundwater Allocation in the Brazeau Sub-basin



4.1 Municipal and Residential Sector

4.1.1 Population

The population of Brazeau Sub-basin is rural and aboriginal, as shown in Table 4-1. Clearwater County has the largest population among municipalities in the sub-basin (1,173), followed by Sunchild First Nation (435). Residents of Yellowhead County (414 people) and Brazeau County (55) also live in the basin. With almost three percent growth over the 2001 to 2006 inter-censal period, the rural municipal population is growing slowly. Sunchild First Nation experienced a rapid population decline (-19 percent) over the inter-censal period.

Table 4-1 Population Distribution and Growth in the Brazeau Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	**Percent**	**Population**	**Percent**
Rural Municipality	1,642	79%	1,600	3%
First Nations and Métis Settlements	435	21%	539	-19%
Total	**2,077**	**100.0%**	**2,140**	**-3%**

4.1.2 Allocations

There are no municipal water licences within the Brazeau Sub-basin.

4.1.3 Licensed Water Use

There are no municipal water licences within the Brazeau Sub-basin.

4.1.4 Actual Water Use

There is no information about municipal water use in Brazeau Sub-basin. If unlicensed rural residential water use is the same per capita as that estimated for the neighbouring Ram Sub-basin (26 m^3 per capita per year), and if the proportion of rural residents relying on groundwater is also the same as that estimated for Ram Sub-basin (75 percent), then municipal water use in Brazeau Sub-basin is estimated to be 54 dam^3, of which 41 dam^3 is estimated to be groundwater and 13 dam^3 is estimated to be surface water.

4.1.5 Future Water Use Forecasts

Figure 4-7 shows low, medium and high population projection scenarios for Brazeau Sub-basin based on Alberta Finance Census Division projections. The population forecasts in Figure 4-7 have been used to predict future municipal surface and groundwater use. The resulting forecasts of water use are provided in Table 4-2, and are based on the estimated per capita water use in 2005.

Figure 4-7 Brazeau Sub-basin Population Growth Forecasts

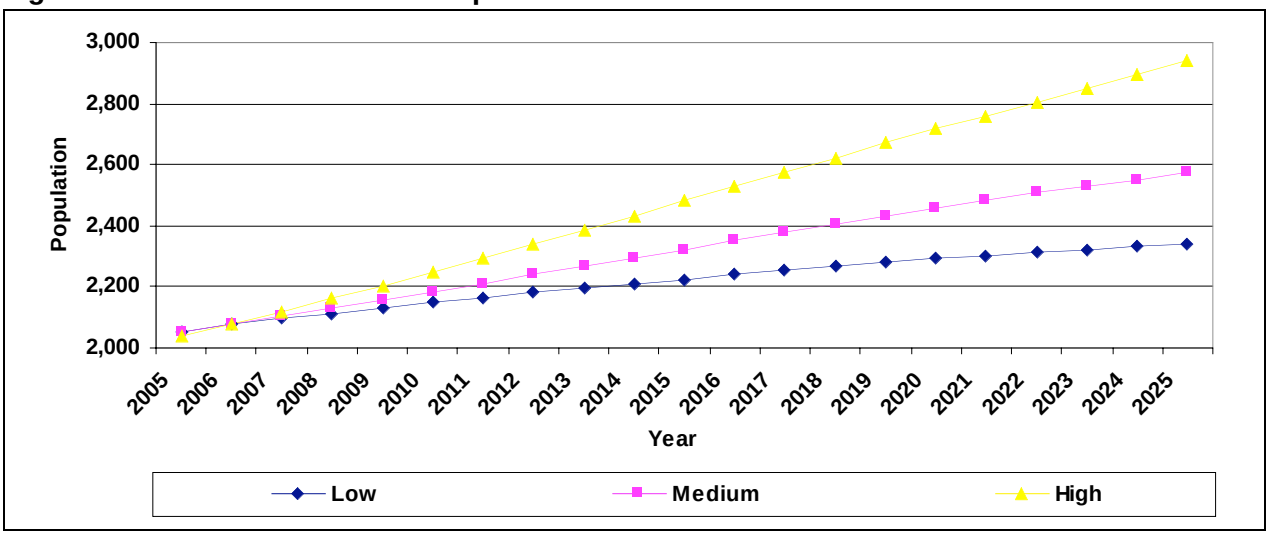


Table 4-2 Projected Municipal Water Use in the Brazeau Sub-basin

(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	13	14	14	14	15
	Groundwater	41	43	44	46	47
	Total	**54**	**56**	**58**	**60**	**61**
Medium Population Growth	Surface	13	14	15	16	16
	Groundwater	41	44	46	49	51
	Total	**54**	**58**	**61**	**65**	**68**
High Population Growth	Surface	13	14	16	17	19
	Groundwater	41	45	50	55	59
	Total	**54**	**60**	**66**	**72**	**78**

Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 14 percent greater than at present. Under the High Population Growth scenario, water use will increase by 44 percent over current levels.

4.2 Agriculture Sector

Allocations for the agriculture sector in the Brazeau Sub-basin are small, with only four registrations amounting to 1.3 dam^3, of which 46 percent comes from groundwater. However, when the Census of Agriculture animal population for the sub-basin is combined with typical water consumption per head of livestock, it is estimated that livestock would require about 395 dam^3 of water. It is assumed that this water use comes from groundwater sources and is domestic and/or exempted agricultural use. Based on AAFRD's assessment that future changes in livestock populations in this sub-basin, particularly cattle, are unlikely, livestock water use is expected to remain unchanged at 395 dam^3 for the duration of the forecast period. There is no irrigation water use; this is also expected to remain unchanged.

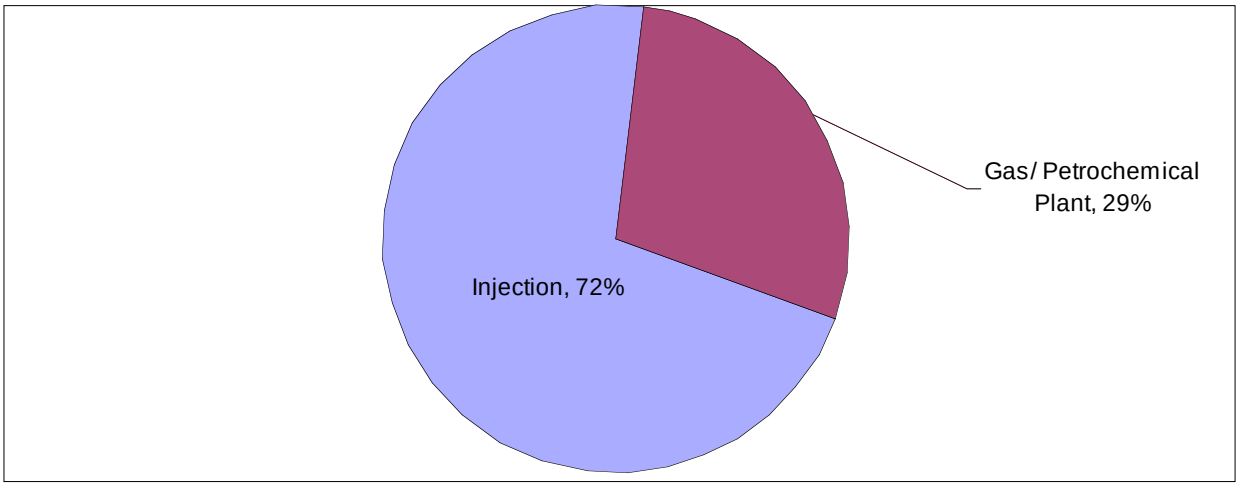
4.3 Commercial Sector

There is one licence that has been issued for commercial purposes in the Brazeau Sub-basin. This licence accounts for about one percent of the allocations in the sub-basin and allows withdrawals of up to 2.3 dam^3 of groundwater for food processing. The licence assumes that all of the water withdrawn will be consumed. However, there is no information regarding actual withdrawals. For the purposes of this analysis it is assumed that the licensee is using the full amount of their entitlement and will continue to do so for the duration of the forecast period.

4.4 Petroleum Sector

In the Brazeau Sub-basin, there are seven active groundwater licences which allocate 204 dam^3 of water to the petroleum sector. Petroleum allocations accounts for about 98 percent of total allocations in the sub-basin and less than one percent of the total allocations in the North Saskatchewan River Basin. The petroleum sector in the Brazeau Sub-basin includes mostly water allocations for injection (72 percent), but there is also a small amount of water licensed to gas and petrochemical plants (58 dam^3).

Figure 4-8 Petroleum Water Allocation by Use in the Brazeau Sub-basin



4.4.1 Injection

Two groundwater licences have been issued for injection activities in the Brazeau Sub-basin that allow withdrawals of up to 146 dam^3. Injection water allocations commenced in the 1980s and have increased only slightly over time. Licensees are expected to consume 100 percent of the water they are entitled to withdraw.

Table 4-3 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Brazeau Sub-basin

Water Use	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Estimated Water Use (dam^3)		
			Allocation	Water Use	Return	Water Use	Percent of Licensed Use	Percent of Allocation
Injection	Surface	0	0.0	0.0	0.0	0		
	Groundwater	2	145.6	145.6	0.0	1	1%	1%
	Subtotal	**2**	**145.6**	**145.6**	**0.0**	**1***	1%	1%
Gas/ Petrochemical Plant	Surface	0	0.0	0.0	0.0	0		
	Groundwater	5	58.0	58.0	0.0	46	79%	79%
	Subtotal	**5**	**58.0**	**58.0**	**0.0**	**46****	79%	79%
Total	Surface	0	0.0	0.0	0.0	0		
	Groundwater	7	203.6	203.6	0.0	47	23%	23%
	Total	**7**	**203.6**	**203.6**	**0.0**	**47**	**23%**	**23%**

* EUB water use data provided by Geowa

** Estimates based on WURS data, and assumes for those licences with no information the licensee is using the full entitlement of the licences.

4.4.2 Actual Water Use

Detailed summary of reported water used for injection have been prepared by Geowa based on EUB data and are presented in Table 4-3. In 2005, an estimated 1.4 dam^3 of fresh groundwater was diverted for injection purposes. Based on the data, injection activities in the sub-basin are currently diverting and using approximately 1.0 percent of their licensed allocations and use.

4.4.3 Forecasts

The general trend in Alberta is for conventional crude oil production to decline as existing fields mature and there are fewer new finds. The most recent forecast from the EUB and CAPP have oil production decreasing by between 30 and 38 percent between 2005 and 2015, and a further decline of about 23 percent by 2020. Oil production in the North Saskatchewan Basin is expected to follow the overall Alberta production trend since most of the basin's production is from existing wells. The forecast of future water use for injection in the Brazeau Sub-basin in Table 4-4 assumes declining rates of water use required that match the rates at which oil production in Alberta is expected to decline, but the overall reduction is too small to be observed.

Table 4-4 Forecast of Injection Water Use in the Brazeau Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	0	0	0	0	0
	Groundwater	1	1	1	1	1
	Total	**1**	**1**	**1**	**1**	**1**
Medium Production	Surface	0	0	0	0	0
	Groundwater	1	1	1	1	1
	Total	**1**	**1**	**1**	**1**	**1**
High Production	Surface	0	0	0	0	0
	Groundwater	1	1	1	1	1
	Total	**1**	**1**	**1**	**1**	**1**

No petroleum forecasts are available for 2010 and 2020, so for the purposes of this analysis it is assumed that production for these time periods is the same as the previous five years. Forecasts also assume that the current ratio of surface to groundwater consumption will remain the same. Under the Low Production scenario, water use for injection in 2025 will decline by 65 percent from current levels. Under the High Production scenario, the decline will be 58 percent.

4.4.4 Gas/Petrochemical Plants

Five groundwater licences have been issued for gas and petrochemical plant activities allowing for withdrawals of up to 58.0 dam^3 of groundwater. Gas and petrochemical plant water allocations commenced in the 1960s and increased only slightly in the 1980s. Licensees are expected to consume 100 percent of the groundwater they are entitled to withdraw.

4.4.4.1 Water Use

There are two licence holders in the Brazeau Sub-basin. One licence holder who has two licences reported using 16 dam^3 out of their total 28 dam^3 (about 57 percent of their licensed use). The other licence holder has three licences for a total of 30 dam^3. No use information is available for this licence holder. Assuming this licence holder is using their full entitlement, the 2005 estimated water use by gas and petrochemical plants in the Brazeau Sub-basin is 46 dam^3.

4.4.4.2 Forecast

In the absence of information about this component of the petroleum sector, it is assumed that water used by gas and petrochemical plants in the Brazeau Sub-basin will remain constant for the forecast period.

4.4.5 Summary

Relatively little water has been allocated to the petroleum sector in the Brazeau Sub-basin. The majority of the water allocated is for injection activities. These activities account for 72 percent of allocations but less than 3 percent of actual water use in 2005. Water use data shows that although water licences allow up to 145.6 dam^3 of water to be consumed for injection purposes, licensees are only using less than 1 percent of this amount. Most of the petroleum water use in 2005 was actually for gas and petrochemical facilities.

It is expected that in the future there will be a slight decline in water requirements for injection activities as oil production from existing oilfields declines, but this may be offset by water demands in new oilfields that are being developed. Overall, it is assumed that water requirements for gas and petrochemical facilities in the Brazeau Sub-basin will not change over the forecast period. The overall water use projections for the petroleum sector are provided in Table 4-5.

Table 4-5 Forecast of Petroleum Water Use in the Brazeau Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	0	0	0	0	0
	Groundwater	47	47	47	47	47
	Total	**47**	**47**	**47**	**47**	**47**
Medium Growth	Surface	0	0	0	0	0
	Groundwater	47	47	47	47	47
	Total	**47**	**47**	**47**	**47**	**47**
High Growth	Surface	0	0	0	0	0
	Groundwater	47	47	47	47	47
	Total	**47**	**47**	**47**	**47**	**47**

Under the Low Production scenario, water use for petroleum activities in 2025 will decline by 1.9 percent from current levels. Under the High Production scenario, the decline will be 1.7 percent.

4.5 Industrial Sector

There are no industrial water licences in the Brazeau Sub-basin. No industrial water use is expected for the forecast period.

4.6 Other Sector

There are no active other sector water licences in the Brazeau Sub-basin. Other sector water demand is not expected to change over the forecast period.

4.7 Summary

Table 4-6 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Brazeau Sub-basin. In total, existing licences and registrations allow a maximum of 207 dam^3 of water to be withdrawn, with the expectation that all of the water will be used. Figure 4-9 shows the allocations, licensed use and actual use for the different sectors. Actual use (498 dam^3) is 2.4 times the licensed use, and this is because there are large numbers of rural households and small agricultural water users who are not required to obtain water licences or registrations. The largest water user is the agriculture sector (stockwatering). Figure 4-10 shows the forecasts to 2025 for all of the sectors. By 2025 water use is expected to increase by about 1 percent under Low Growth (Table 4-7), about 2 percent under Medium Growth (Table 4-8), and about 5 percent under High Growth (Table 4-9).

Figure 4-9 Water Allocations and Actual Use, by Sector, Brazeau Sub-basin

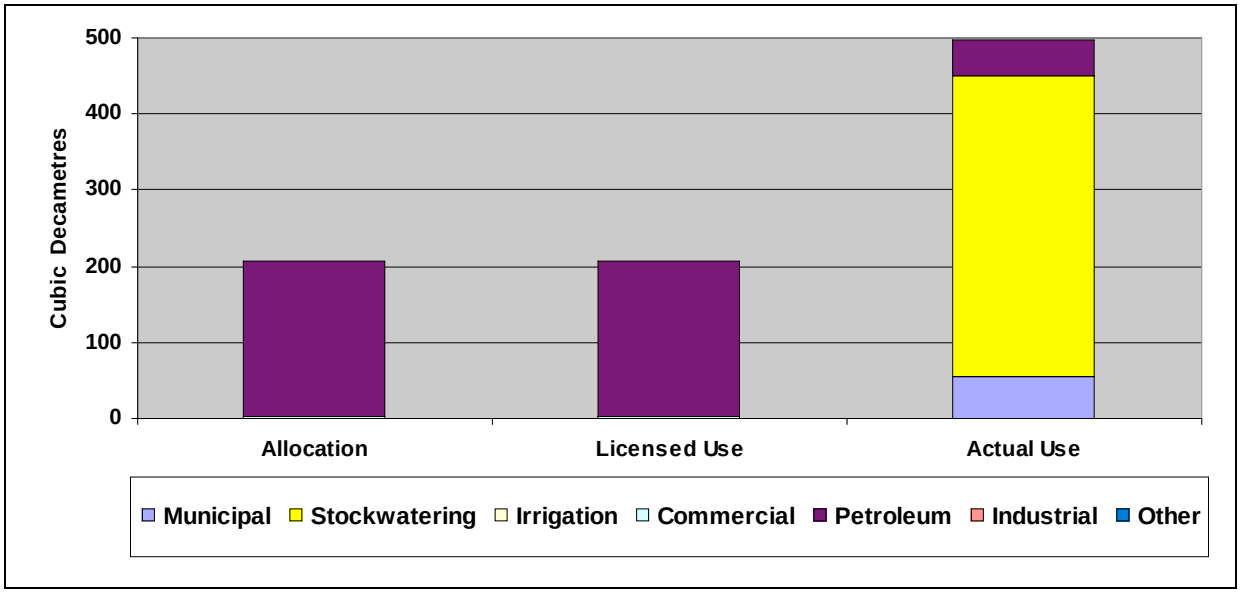


Table 4-6 Summary of Allocations and Estimated Water Use, Brazeau Sub-basin

Sector		Licensed Allocation and Use (dam^3)				Estimated Water Use (dam^3)		
		Allocation	Water Use	Return	Percent of Total Use	Use	Percent of Licensed Use	Percent of Total Use
Municipal		0	0	0	0%	54	N/A	11%
Agricultural	Stockwatering	1	1	0	1%	395	30385%	79%
	Irrigation	0	0	0	0%	0	0%	0%
Commercial		2	2	0	1%	2	1%	0%
Petroleum		204	204	0	98%	47	23%	9%
Industrial		0	0	0	0%	0	N/A	0%
Other		0	0	0	0%	0	N/A	0%
Total		**207**	**207**	**0**	**100%**	**498**	**240%**	**100%**

Notes:
Rural households and small agricultural users can take water without having to acquire licences or registrations

Figure 4-10 Forecast Water Use in Brazeau Sub-basin: Medium Scenario

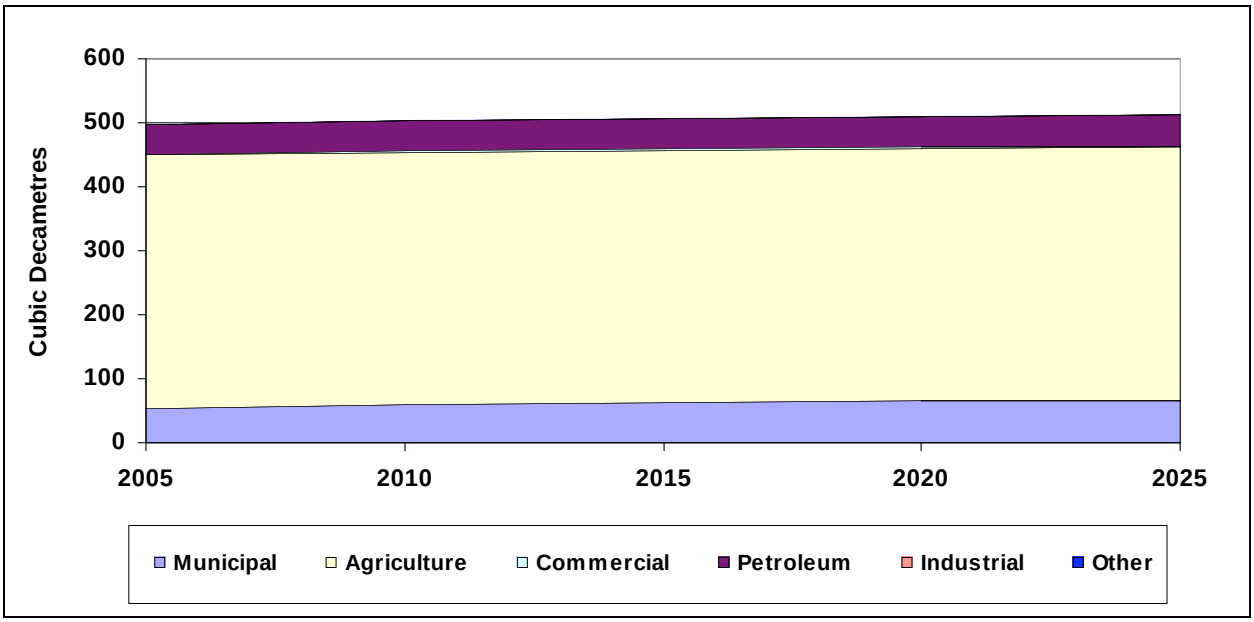


Table 4-7 Forecast Water Use, By Sector, Brazeau Sub-basin: Low Scenario

(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	13	14	14	14	15
	Agricultural	0	0	0	0	0
	Commercial	0	0	0	0	0
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**13**	**14**	**14**	**14**	**15**
Groundwater	Municipal	41	43	44	46	47
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**485**	**487**	**488**	**490**	**491**
Total	Municipal	54	57	58	60	62
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**498**	**501**	**502**	**504**	**506**

Table 4-8 Forecast Water Use, By Sector, Brazeau Sub-basin: Medium Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	13	14	15	16	16
	Agricultural	0	0	0	0	0
	Commercial	0	0	0	0	0
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**13**	**14**	**15**	**16**	**16**
Groundwater	Municipal	41	44	46	49	51
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**485**	**488**	**490**	**493**	**495**
Total	Municipal	54	58	61	65	67
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**498**	**502**	**505**	**509**	**511**

Table 4-9 Forecast Water Use, By Sector, Brazeau Sub-basin: High Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	13	14	16	17	19
	Agricultural	0	0	0	0	0
	Commercial	0	0	0	0	0
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**13**	**14**	**16**	**17**	**19**
Groundwater	Municipal	41	45	50	55	59
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**485**	**489**	**494**	**499**	**503**
Total	Municipal	54	59	66	72	78
	Agricultural	395	395	395	395	395
	Commercial	2	2	2	2	2
	Petroleum	47	47	47	47	47
	Industrial	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**498**	**503**	**510**	**516**	**522**