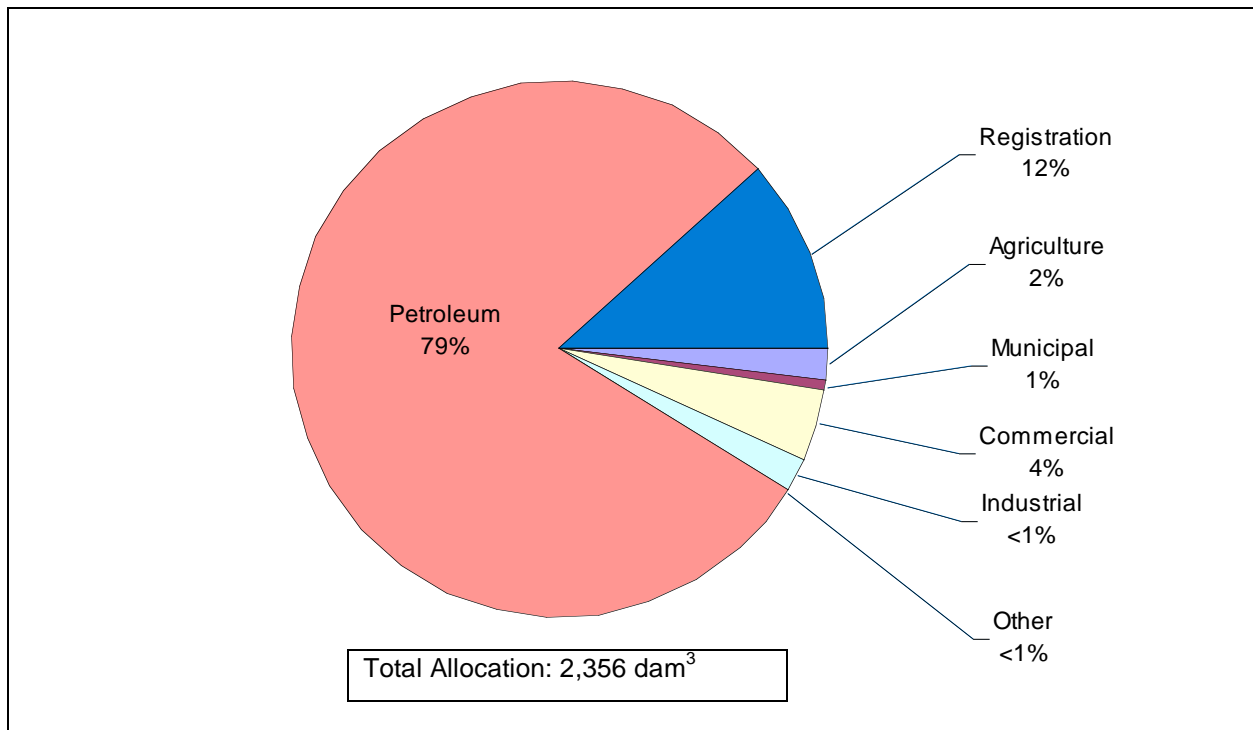


6.0 CLEARWATER

The Clearwater Sub-basin is about 2,800 km² in area and occupies approximately 5 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of 1,660 people, which represents less than 1 percent of the Basin population, with a population density of 0.6 people per square kilometer. The Clearwater Sub-basin consists all or parts of one urban municipality and one rural municipality.

An overview of current surface and groundwater allocations is provided in Figure 6-1. It shows that the petroleum sector accounts for 80 percent of total allocations or 1,872 dam³ in 2005. Registration accounts for 12 percent of total allocation or 272 dam³. The remaining allocations are for agriculture, commercial, industrial and other sectors. Total allocations in the sub-basin in 2005 were 2,356 dam³, including 776 dam³ of surface water and 1,580 dam³ of groundwater.

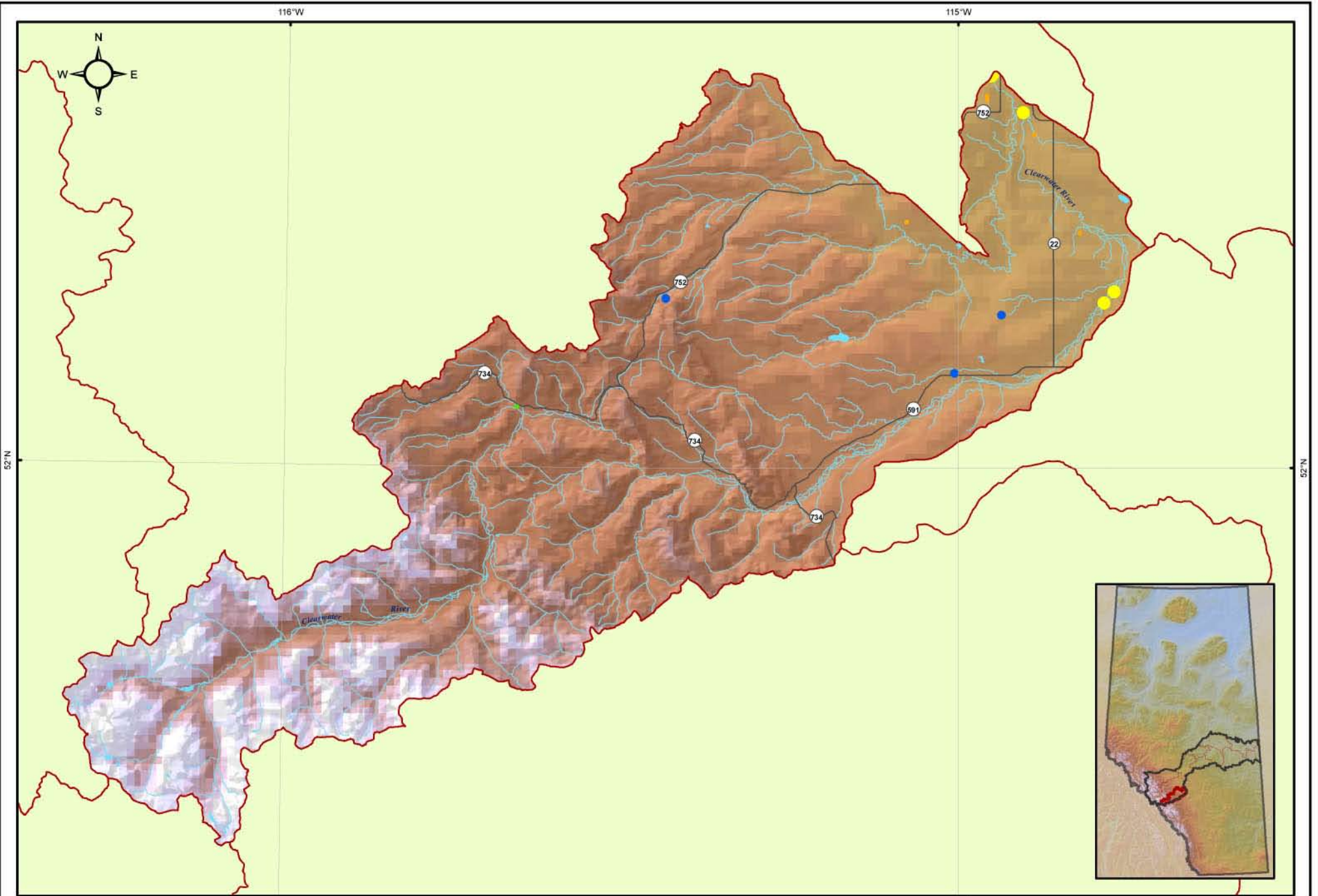
Figure 6-1 Distribution of Active Water Allocations in the Clearwater Sub-basin



Figures 6-2 and 6-3 show the location, allocation and sector of all active water licences in the Clearwater Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 6-4.



Figure 6-2 Clearwater Sub-basin Surface Water Licences



Legend	Industry Category - Maximum Allowable Diversion (dam ³ /yr)					
★ Settlement	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00
— Major Road	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00
— Watercourse	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00
— Waterbody	● 1000.01 - 10000.00	● 1000.01 - 10000.00	● 1000.01 - 10000.00	● 1000.01 - 10000.00	● 1000.01 - 10000.00	● 1000.01 - 10000.00
□ Sub Basin	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01
	● Commercial	● Other	● Petroleum	● Municipal	● Industrial	● Agriculture

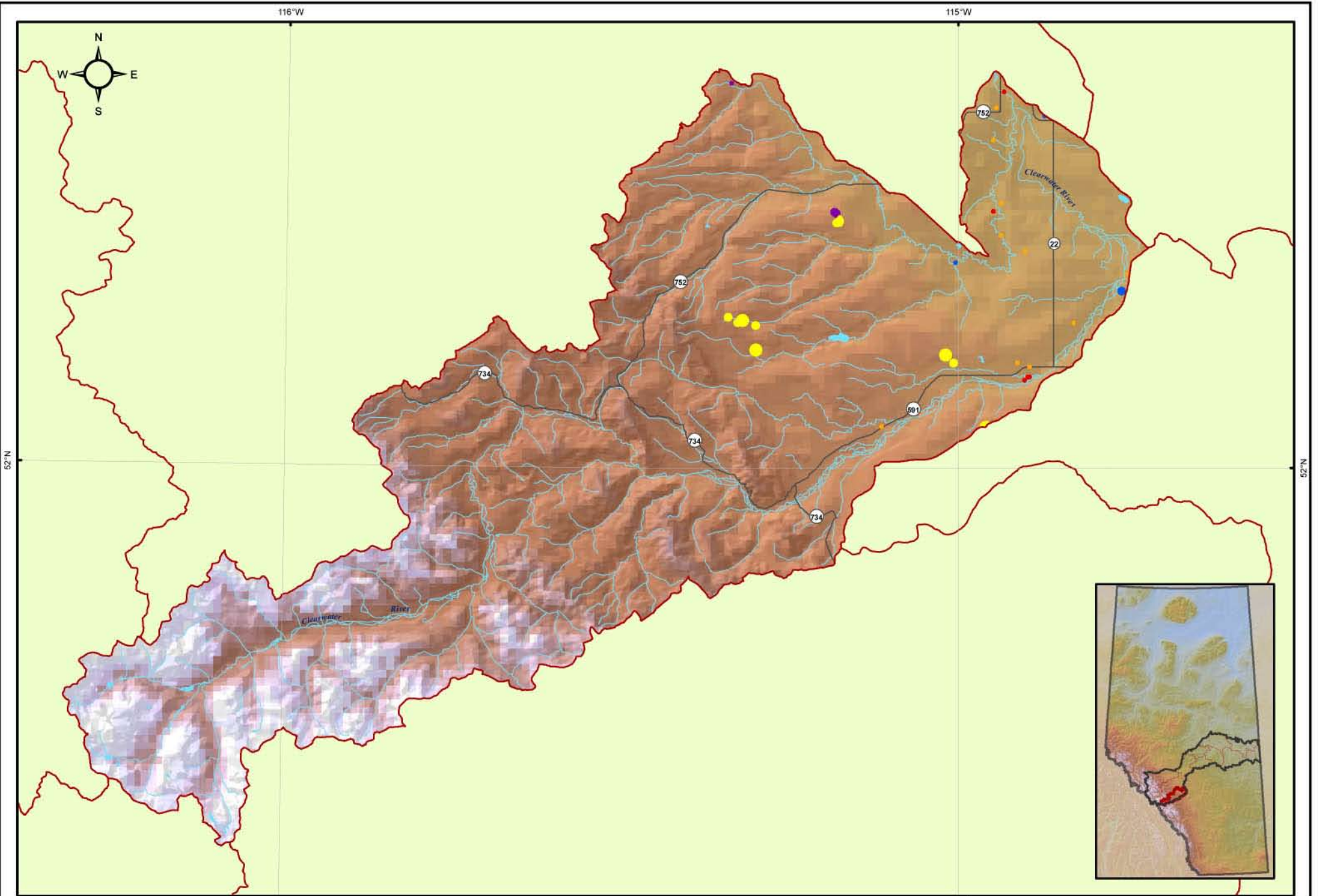
North Saskatchewan Watershed Alliance

CLEARWATER SUBBASIN SURFACE WATER LICENSES

DATE: MAY 2007
 AMEC PROJECT: EE27047
 GIS FILE: SW_SB_CLEARWATER.MXD
 PDF FILE: SW_SB_CLEARWATER.PDF
 PREPARED BY: amec

0 2 4 Kilometers 1:500,000
 PROJECTION: 10TM | DATUM: NAD83
 FIGURE 6-2

Figure 6-3 Clearwater Sub-basin Groundwater Licences



Legend

★ Settlement	Industry Category - Maximum Allowable Diversion (dam/yr)					
— Major Road	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00
Watercourse	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00
Waterbody	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00	● 100.01 - 1000.00
Sub Basin	● 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

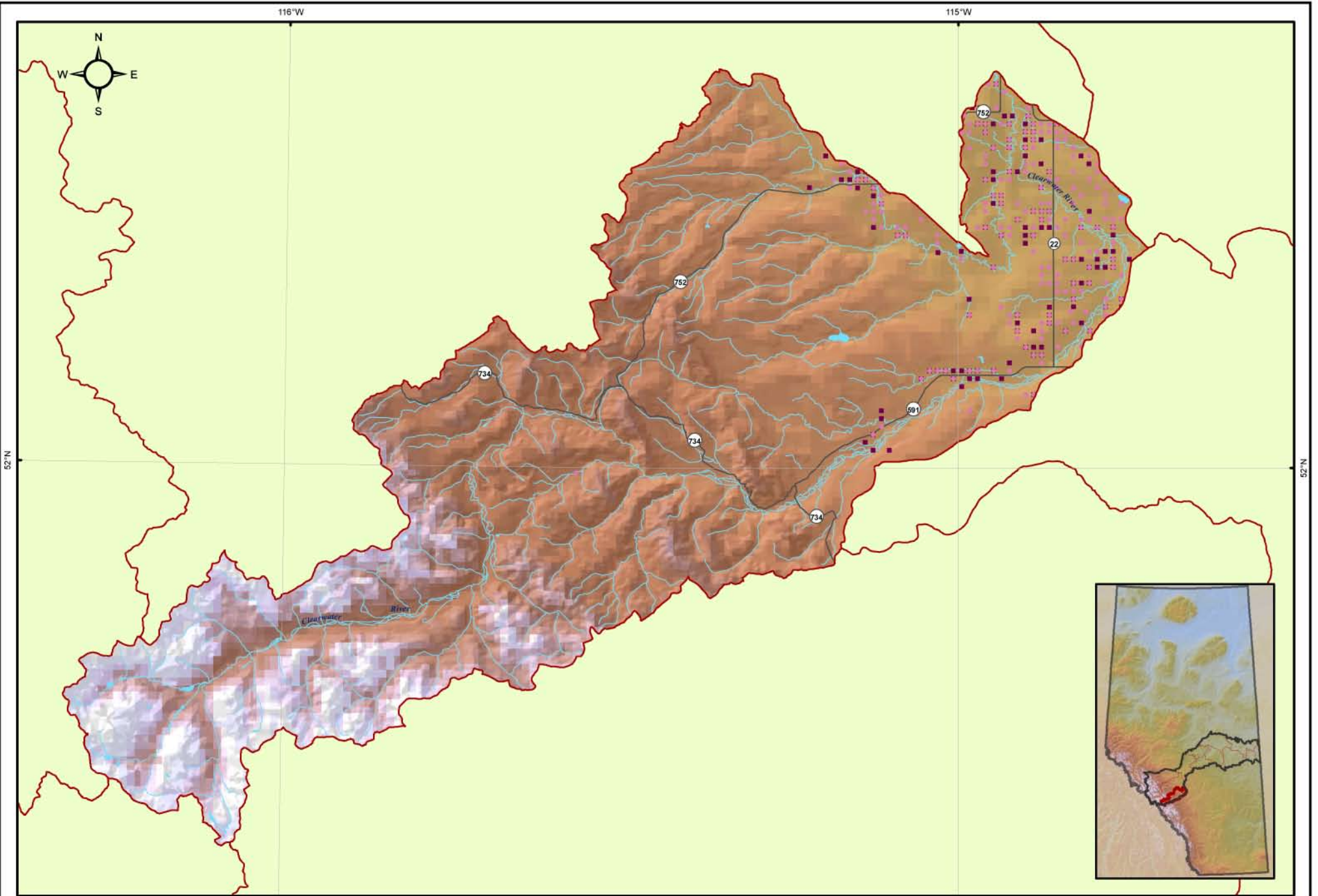
North Saskatchewan Watershed Alliance

CLEARWATER SUBBASIN GROUNDWATER LICENSES

DATE: MAY 2007
 AMEC PROJECT: EE27047
 GIS FILE: GW_SB_CLEARWATER.MXD
 PDF FILE: GW_SB_CLEARWATER.PDF
 PREPARED BY: amec

0 2 4 Kilometers 1:500,000
 PROJECTION: 10TM | DATUM: NAD83
 FIGURE 6-3

Figure 6-4 Clearwater Sub-basin Registrations

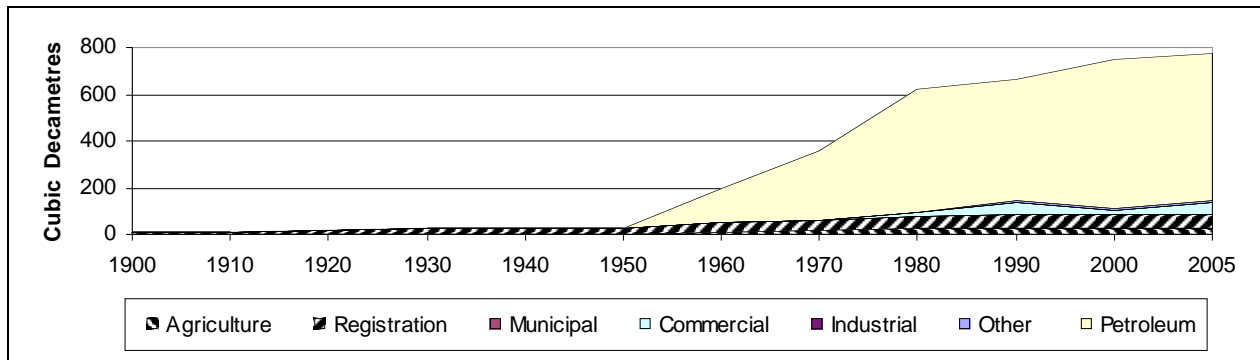


- Legend**
- ★ Settlement
 - Major Road
 - Watercourse
 - Waterbody
 - Sub Basin
- Industry Category - Maximum Allowable Diversion (dam³/yr)**
- Groundwater Registrations
 - 0.01 - 6.25
 - Surface Water Registrations
 - 0.01 - 6.25

CLEARWATER SUBBASIN REGISTRATIONS	
DATE: MAY 2007	1:500,000
AMEC PROJECT: EE27047	PROJECTION: 10TM/DATUM: NAD83
GIS FILE: RG_SB_CLEARWATER.MXD	PDF FILE: RG_SB_CLEARWATER.PDF
PREPARED BY:	FIGURE 6-4

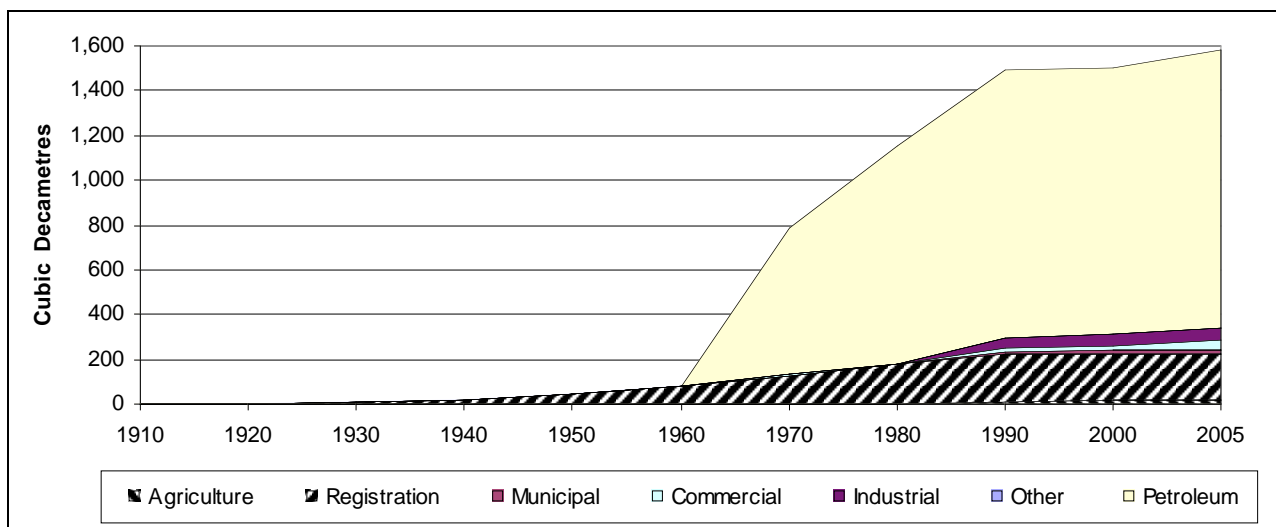
An historical perspective on water allocated among the sectors is provided in Figure 6-5 (surface water) and Figure 6-6 (groundwater). The largest allocations for surface water in the Clearwater Sub-basin are for the petroleum sector; these allocations were first issued in the 1950s and have been increasing since that time. Registration allocations began in the 1900s and have also increased over time, although the allocations have remained unchanged since the 1990s. Agricultural allocations began to be issued in the 1950s but have remained unchanged since the 1980s. Commercial sector allocations have also been issued since the 1980s.

Figure 6-5 Historical Trends in Surface Water Allocation in the Clearwater Sub-basin



Like surface water, the largest allocations for groundwater are also for the petroleum sector; these allocations were first issued in the 1960s and have been increasing since that time. Registrations for groundwater were first issued in the 1920s and have grown over time but since 1990s the allocations have remained unchanged. Allocations for the municipal, commercial, and industrial sectors began in the 1980s.

Figure 6-6 Historical Trends in Groundwater Allocation in the Clearwater Sub-basin



6.1 Municipal and Residential Sector

6.1.1 Population

The population of Clearwater Sub-basin is entirely rural, as shown in Table 6-1. Although a part of the Rocky Mountain House municipal boundary falls within the sub-basin, no people live within that part of the municipality. There are no First Nations or Métis settlements in the Clearwater Sub-basin. One hundred percent of the sub-basin population of 1,659 in 2006 lived in Clearwater County. With 2.8 percent growth over the 2001 to 2006 period, Clearwater County is growing slowly. Clearwater County holds licences for water from sources in the Clearwater Sub-basin.

Table 6-1 Population Distribution and Growth in the Clearwater Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	Percent	Population	Percent
Urban Municipality	0	0.0%	0	N/A
Rural Municipality	1,659	100.0%	1,614	2.8%
First Nations and Métis Settlements	0	0.0%	0	N/A
Total	1,659	100.0%	1,614	2.8%

6.1.2 Allocations

As of 2005, municipal water licences had been issued to four licensees in the Clearwater Sub-basin. None of the licensees is a municipality. These licences allow maximum groundwater withdrawals of 18 dam³ per year, of which 17 dam³ is for rural use and 1 dam³ is for other use. As shown in Figure 6-1 municipal allocations account for about 1 percent of total water allocations in the sub-basin.

Table 6-2 Municipal Water Use Licensees in the Clearwater Sub-basin

Licensee	Water Source	Allocation (dam ³)
LIVING FAITH EVANGELISTIC ASSOCIATION	GROUNDWATER	13.57
WOLF DANCE LODGE	GROUNDWATER	3.00
BLACKSTONE PROPERTIES LTD.	GROUNDWATER	1.25
ROCKY MOUNTAIN HOUSE CO-OP ASSOCIATION LTD.	GROUNDWATER	0.03

6.1.3 Licensed Water Use

Table 6-2 summarizes licensed water use for the municipal sector in the Clearwater Sub-basin. Under the terms of these licences, a maximum of 18 dam³ is assumed to be used (i.e. 100 percent of allocations is expected to be consumed and/or lost).

6.1.4 Actual Water Use

No information is available regarding actual municipal water use in Clearwater Sub-basin. For the purposes of this study, given the small municipal water allocation within Clearwater Sub-basin, it is assumed that the allocated amount is withdrawn and that licensed use is equal to the actual use. Thus, the estimated municipal water use by municipal licensees for Clearwater Sub-basin is 18 dam³. If unlicensed rural residents are assumed to use the same amount of water as residents in nearby Rocky Mountain House (26 m³ per capita per year), unlicensed rural residential use would be 43 dam³, and the total municipal water use in the sub-basin would be 62 dam³. As in the Ram Sub-basin, it is assumed that 75 percent of unlicensed rural residents rely on groundwater.

Table 6-3 Licensed Municipal Allocations and Use and Estimated Actual Use, Clearwater Sub-basin

Water Use	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Estimated Actual Water Use (dam ³)		
			Allocation	Water Use	Return Flow	Diversion	Estimated Use	Return Flow
Rural	Surface Water	0	N/A	N/A	N/A	10.	10	0
	Groundwater	2	16.6	16.6	0	50	50	0
	Total	2	16.6	16.6	0	60	60	0
Other***	Groundwater	2	1.4	1.4	0	1	1	0
Total	Surface Water	0	N/A	N/A	N/A	10	10	0
	Groundwater	2	18.0	18.0	0	51	51	0
	Total	4	18.0	18.0	0	62	62	0
** Rural includes condominiums / townhouses / mobile homes / complexes, hotels / motels, cooperatives, farmsteads, single-multi homes, colonies and subdivisions *** Other includes camps, institutions, senior/correctional centres, nursing/children's homes, hospitals								

6.1.5 Future Water Use Forecasts

Figure 6-7 shows low, medium and high population projection scenarios for the Clearwater Sub-basin based on Alberta Finance Census Division projections. The population forecasts in Figure 6-7 have been used to predict future municipal surface and groundwater use. The resulting forecasts of water use are provided in Table 6-4, and are based on the estimated per capita water use in 2005.

Figure 6-7 Clearwater Sub-basin Population Growth Forecasts

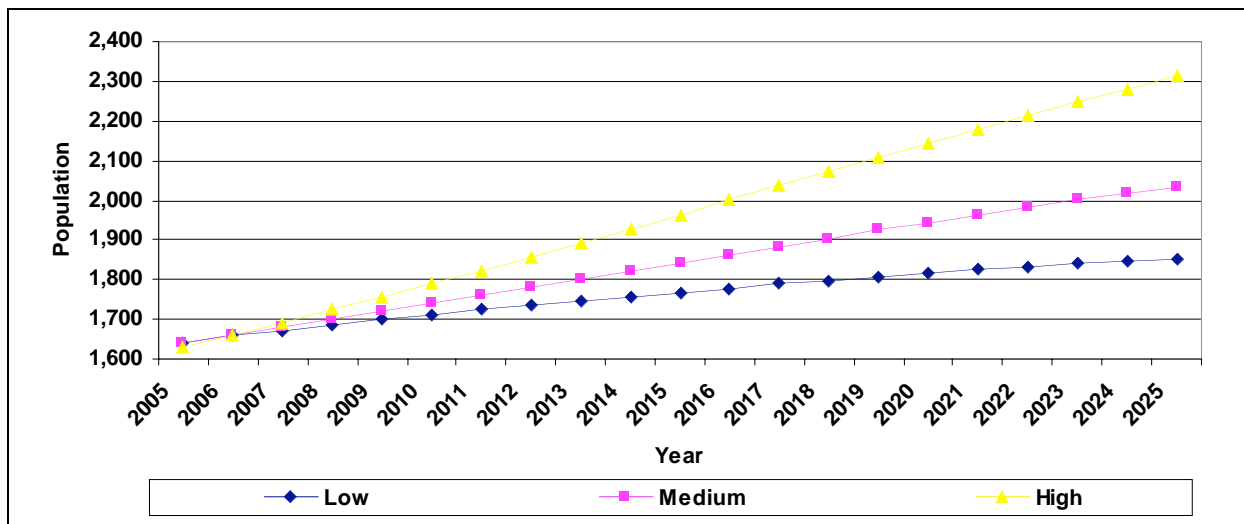


Table 6-4 Projected Municipal Water Use in the Clearwater Sub-basin (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	11	11	12	12	12
	Groundwater	51	53	55	56	58
	Total	62	65	67	69	70
Medium Population Growth	Surface	11	12	12	13	14
	Groundwater	51	54	57	60	63
	Total	62	66	70	74	77
High Population Growth	Surface	11	12	13	14	16
	Groundwater	51	56	61	67	73
	Total	62	68	75	82	88

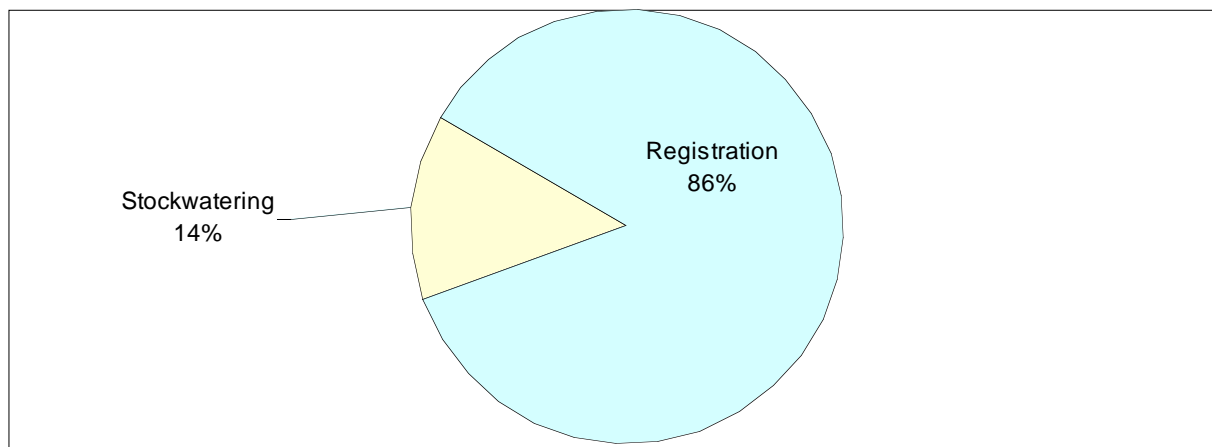
Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 13 percent greater than at present and actual water use will be 388 percent of the current licensed use amount. Under the High Population Growth scenario, water use will increase by 42 percent over current levels and water use is expected to be 490 percent of the amount presently allowed in the licences.

6.2 Agriculture Sector

As of December 2005 a total of 316 dam³ had been allocated to the agricultural sector in the Clearwater Sub-basin. This includes 428 registrations representing 272 dam³ and 18 licences representing 44 dam³ of water. Water allocated to agriculture accounts for 13 percent of all allocation in the Clearwater Sub-basin.

Figure 6-8 shows how this water is distributed among the different agricultural activities in the sub-basin. The largest allocation is for registrations (86 percent) while stockwatering accounts for the remaining 14 percent of total allocations.

Figure 6-8 Water Allocation for Agricultural Activities in the Clearwater Sub-basin, 2005



A total of 181 registrations and five licences allow withdrawal of up to 106 dam³ of surface water; this accounts for 28 percent of water allocations for the agricultural sector. Groundwater accounts for the other 72 percent of allocations, with 216 dam³ being allocated through 13 licences and 247 registrations.

6.2.1 Overview of Agriculture

Based on information from the 2001 Census of Agriculture, there were about 189 farms in the Clearwater Sub-basin (1.5 percent of North Saskatchewan total) with an average size of 627 acres. At the North Saskatchewan Basin level there are about 12,300 farms with an average size of 625 acres. Farms in the Clearwater Sub-basin cover an area of nearly 118,400 acres; this is equivalent to about 479 km² or about 15 percent of the sub-basin. As shown in Table 6-5, 26 percent of the land in the basin is used to raise crops. About 62 percent of agricultural land is pasture. The rest of the lands are for summer fallow or other uses.

Table 6-5 Agricultural Land Use in the Clearwater Sub-basin, 2001

Land Use	Acres	Percent
Crop Land	30,208	25.5%
Summerfallow	1,567	1.3%
Tame/Seeded Pasture	19,857	16.8%
Natural Pasture	53,623	45.3%
Other	13,110	11.1%
Total	118,365	100.0%

The types of farming activity vary within the sub-basin. Table 6-6 shows the classification of farms based on the commodity groups that accounted for 51 percent or more of total gross farm receipts. The table shows that the Clearwater Sub-basin accounts for 1.5 percent of total farms in the North Saskatchewan. About 67 percent of the farms in the sub-basin raise beef cattle and about 14 percent are speciality farms. Field crop farms make up about 10 percent of the

farms. Like the North Saskatchewan, cattle (beef) farms are the most common type of farm in the sub-basin, however, beef farms account for proportionately higher share. The general mix of other types of farms is different for both Clearwater and North Saskatchewan with most of the farms in the sub-basin focused on cattle, and speciality and field crops.

6.2.2 Stockwatering

As noted in Table 6-6 about 70 percent of farms in the Clearwater Sub-basin were classified as livestock operations, primarily cattle. Estimated livestock populations for major species are provided in Table 6-7. The table shows that there are about 20,000 cattle and calves which, together, accounted for about 65 percent of the livestock population. Other livestock in the sub-basin included poultry, pigs, sheep and lamb, horses and ponies, bison, deer and elk.

Table 6-6 Classifications of Farms in the Clearwater Sub-basin and North Saskatchewan, 2001

Farm Type (Farms with Gross Receipts >\$2,500)	Percent of Farms in the Sub-basin	Percent Share of North Saskatchewan	North Saskatchewan Farm Type (Percent)
Dairy Farms	2.4%	1.9%	1.9%
Cattle (beef) Farms	66.9%	2.2%	45.8%
Hog Farms	0.8%	0.9%	1.4%
Poultry & Egg Farms	0.3%	0.5%	1.1%
Wheat Farms	0.2%	0.1%	4.2%
Grain & Oilseed Farms	2.2%	0.2%	19.6%
Field Crop Farms	10.4%	1.8%	8.6%
Fruit Farms	0.0%	0.0%	0.2%
Misc. Specialty Farms	13.9%	1.7%	12.9%
Sum of Livestock Comb. Farms	1.4%	0.8%	2.6%
Sum of Vegetable Farms	0.0%	0.0%	0.1%
Sum of Other Comb Farms	1.5%	1.6%	1.5%
Total	100%	1.5%	100%

Table 6-7 Estimated Livestock Populations in the Clearwater Sub-basin, 2001

Livestock Species	Clearwater	North Saskatchewan	Percent of North Saskatchewan
Hens and Chicken	8,309	3,090,930	0.3%
Turkey	20	41,519	0.0%
Cattle	14,663	990,169	1.5%
Calves	5,730	365,725	1.6%
Pigs	1,825	232,169	0.8%
Sheep and Lamb	439	55,204	0.8%
Horse and Ponies	678	35,172	1.9%
Bison	123	18,906	0.6%
Deer	26	2,864	0.9%
Elk	94	6,426	1.5%

6.2.2.1 Water Allocation

Overall, 446 licences and registrations have been issued for livestock watering with total allocation amounting to 316 dam³. In addition to these allocations, farmers are able to obtain up to 1,250 m³ of water for household purposes. The numbers of such households in the sub-basin is not known. Furthermore, the numbers of “exempted agricultural” users are also not known in the sub-basin.

Table 6-8 summarizes current water licences and registrations issued for livestock according to the water source. It shows that surface water accounts for about 30 percent of allowable diversions for livestock and that registrations account for 86 percent of the allocations.

6.2.2.2 Licensed Water Use

Table 6-8 shows that the entire allocation is expected to be used.

6.2.2.3 Actual Water Use

There is no information in Alberta Environment's WURS that indicates the extent to which water allocations are actually being used in the Clearwater Sub-basin. However, a reasonable estimate of water use can be derived using the actual animal population in the basin shown in Table 6-7. Based on livestock populations for the Clearwater Sub-basin in 2001, the total water required for livestock was estimated to be 176 dam³, or about 55 percent of the licensed allocation.¹ The calculations for this estimate are provided also in Table 6-9 which shows livestock populations in the basin and the daily water requirements for various livestock species as provided by Alberta Environment in its “Guide to Calculate Quantities for Water for Raising Animals”.² In terms of water requirements by species, cattle accounts for about 90 percent of the total, about three percent is required by pigs, and all other species accounted for the remaining seven percent.

The estimated actual consumption (176 dam³) based on livestock populations shown in Table 6-9 do not include an allowance for the evaporative and seepage losses associated with storing water for livestock use. Typically, licensed consumption accounts for only 35 percent of surface water allocated for livestock use while losses account for 65 percent (Watrecon 2005).

¹ This approach to estimating water use for stockwatering was employed in the 1986 Battle River Basin water use study undertaken by Stanley Associates in 1985.

² http://www3.gov.ab.ca/env/water/Legislation/Approvals_Licences/CalculationChart.doc.



Table 6-8 Summary of Water Licences and Registrations Issued for Livestock Watering in the Clearwater Sub-basin,

Activity	Source	Number of Licences/ Registrations	Licensed Allocation and Use (dam ³)			Reported Actual Water Use	
			Allocation	Water Use	Return	Licenses Reporting	Reported Use (dam ³)
Registration	Surface	181	63.1	63.1	0.0	0	N/A
	Groundwater	247	209.2	209.2	0.0	0	N/A
	Subtotal	428	272.3	272.3	0.0	0	N/A
Stockwatering	Surface	5	25.9	25.9	0.0	0	N/A
	Groundwater	13	17.7	17.7	0.0	0	N/A
	Subtotal	18	43.6	43.6	0.0	0	N/A
Total	Surface	186	89.0	89.0	0.0	0	N/A
	Groundwater	260	226.9	226.9	0.0	0	N/A
	Total	446	315.9	315.9	0.0	0	N/A

Table 6-9 Estimated Livestock Water Requirements for 2001

Livestock Species	Animal Population	Daily Consumption (gallons)	Annual Use (dam ³)
Hens and Chickens	8,309	0.045	0.6
Turkey	20	0.15	0.0
Bulls	322	9.0	4.8
Milk Cows	140	30.0	7.0
Beef Cows	6,474	9.0	96.6
Heifers	1,461	6.0	14.5
Steers	534	6.0	5.3
Calves	5,730	3.0	28.5
Boars	8	6.5	0.1
Sows and Gilts - Breeding	174	6.5	1.9
Nursing and Weaner Pigs	723	0.5	0.6
Grower and Finishing Pigs	921	1.5	2.3
Sheep and Lambs	439	2.0	1.5
Horse and Ponies	678	10.0	11.2
Bison	123	2.0	0.4
Deer	26	10.0	0.4
Elk	94	3.5	0.5
Total			176.3

Since 70 percent of livestock water consumption comes from groundwater (no losses) and the balance comes from surface water with 65 percent losses, a total allocation of 203 dam³ would be required to support the animal populations in Table 6-9. This water requirement is about 64 percent of the water allocation through licences and registrations.

6.2.2.4 Forecasts of Future Stockwatering Water Use

Future water use is dependent on future livestock populations in the sub-basin. Information from the NRCB indicates that, as of December 31, 2005, there had been no applications from farmers throughout the sub-basin for cattle and dairy operations. A study undertaken by Alberta Agriculture in the late 1990s also provides some insights regarding the potential for expansion of cattle. Figures 2-3 and 2-4 in Section 2.3 show areas where there is capability of supporting a 5,000-head back grounding operation and a 20,000-head operation. The figures show that there are no townships that meet all of the criteria for both types of operations. For townships that meet some of the criteria limiting factors include groundwater and landscape for backgrounding operations. For finishing operations silage is a limiting factor. Based on Alberta Agriculture's assessment, it would appear that livestock expansion in the Clearwater Sub-basin is not likely. Livestock water use is expected remain unchanged at 203 dam³ for the duration of the forecast period across all growth scenarios (Table 6-10).

Table 6-10 Projected Water Use for Livestock in the Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low, Medium, High Growth	Surface	76	76	76	76	76
	Groundwater	127	127	127	127	127
	Total	203	203	203	203	203

6.2.3 Irrigation

No allocations for irrigation have been issued in the Clearwater Sub-basin.

6.2.4 Summary

In summary, current agricultural water use in the Clearwater sub-basin is estimated to be about 203 dam³, all for stockwatering. Agricultural water demand in the basin is expected to remain unchanged over the forecast period. A summary of future agricultural water demand is provided in Table 6-11.

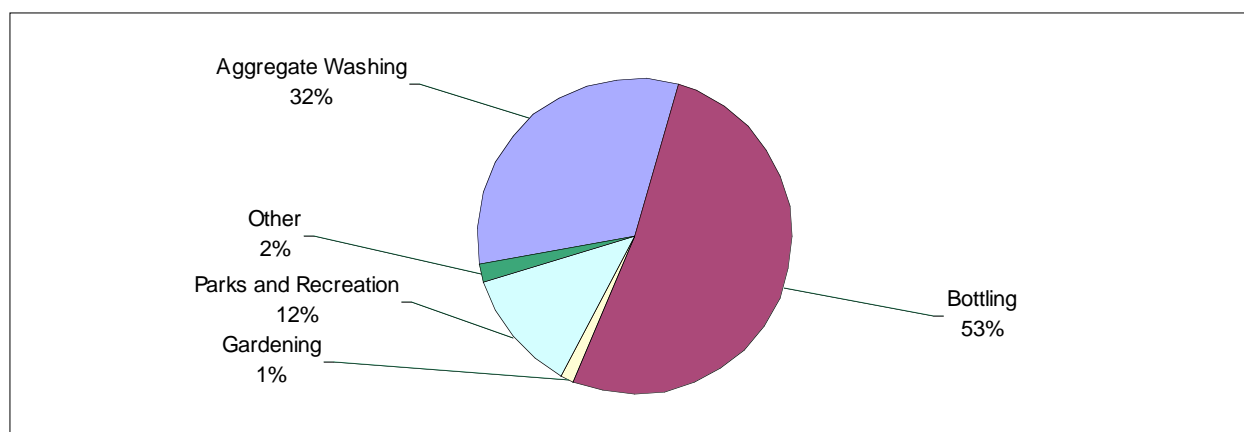
Table 6-11 Projected Water Use for Agriculture in the Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low, Medium, High Growth	Surface	76	76	76	76	76
	Groundwater	127	127	127	127	127
	Total	203	203	203	203	203

6.3 Commercial Sector

Eight licences that allow diversion of 93 dam³ of water have been issued for commercial purposes in the Clearwater Sub-basin. This allocation accounts for about 4 percent of total allocations in the sub-basin.

Figure 6-9 Water Allocation for Commercial Activities in the Clearwater Sub-basin



6.3.1 Water Allocations

Figure 6-9 shows how this allocation is distributed among the various commercial sector activities, including bottling (53 percent), aggregate washing (32 percent), parks and recreation (12 percent), other (2 percent), and gardening (1 percent). Surface water accounts for 52 percent of the allocations, all for bottling. Groundwater accounts for 48 percent of the allocations and the largest allocation is for aggregate washing.

6.3.2 Licensed Water Use

Table 6-12 provides a summary of licensed allocations, use and return for various activities within the commercial sector in the Clearwater sub-basin. The table shows that all of the licences expect all withdrawals to be used and there is no expectation for return flow.

6.3.3 Actual Water Use

At the present time Alberta Environment's Water Use Reporting System contains no information on actual water use in 2005 by any of the licensees in commercial sector in the Clearwater sub-basin. Given the lack of information on actual water use, it is assumed that all licensees are withdrawing and using the full amount of water to which they are entitled. Although this assumption will overstate the actual commercial sector water use, this sector accounts for about four percent of total allocations in the sub-basin so overall water use estimates are not likely to be greatly affected.

6.3.4 Future Water Use Forecasts

Since most of the allocation (97 percent) is for three activities – bottling, aggregate washing and parks and recreation, forecasts of future demand are based on those activities.



Table 6-12 Licensed Commercial Allocations, Reported and Actual Water Use, Clearwater Sub-basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam ³)			Reported Actual Water Use (dam ³)		
			Allocation	Water Use	Return	Licenses Reporting	Reported Use	Percent of Allocation
Aggregate Washing	Surface	0	0.0	0.0	0.0	0	N/A	N/A
	Groundwater	1	30.0	30.0	0.0	0	N/A	N/A
	Subtotal	1	30.0	30.0	0.0	0	N/A	N/A
Bottling	Surface	2	48.3	48.3	0.0	0	N/A	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A	N/A
	Subtotal	2	48.3	48.3	0.0	0	N/A	N/A
Gardening	Surface	0	0.0	0.0	0.0	0	N/A	N/A
	Groundwater	1	1.2	1.2	0.0	0	N/A	N/A
	Subtotal	1	1.2	1.2	0.0	0	N/A	N/A
Other	Surface	0	0.0	0.0	0.0	0	N/A	N/A
	Groundwater	2	1.8	1.8	0.0	0	N/A	N/A
	Subtotal	2	1.8	1.8	0.0	0	N/A	N/A
Parks and Recreation	Surface	0	0.0	0.0	0.0	0	N/A	N/A
	Groundwater	2	11.6	11.6	0.0	0	N/A	N/A
	Subtotal	2	11.6	11.6	0.0	0	N/A	N/A
Total	Surface	2	48.3	48.3	0.0	0	N/A	N/A
	Groundwater	6	44.7	44.7	0.0	0	N/A	N/A
	Total	8	92.9	92.9	0.0	0	N/A	N/A

6.3.4.1 Bottling

Future water use is not expected to change from the current water use of 48 dam³, all from surface water, for all growth scenarios, for the duration of the forecast period.

6.3.4.2 Aggregate Washing

Demand for aggregate material (and water use) is related to the level of economic activity, particularly construction so the water use projections are related to change in economic activity (GDP growth rate). Although Alberta is experiencing higher than average rate of GDP growth relative to historic levels, the water use forecasts use long term annual growth rates of 1.2 percent (Low Growth), 2.2 percent (Medium Growth) and 3.2 percent (High Growth). Projections using these assumptions are shown in Table 6-13. It is noted that although one of the licences is set to expire by 2015, it is assumed that the licence will be renewed for the duration of the forecast period under similar terms and conditions as compared to currently.

Table 6-13 Projected Water Use for Aggregate Washing, Clearwater Sub-basin
(dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	0	0	0	0	0
	Groundwater	30	32	34	36	38
	Total	30	32	34	36	38
Medium Growth	Surface	0	0	0	0	0
	Groundwater	30	33	37	42	46
	Total	30	33	37	42	46
High Growth	Surface	0	0	0	0	0
	Groundwater	30	35	41	48	56
	Total	30	35	41	48	56

By 2025, water use is expected to be 38 dam³ under Low Growth which is a 27 percent increase from 2005. Under High Growth water use is expected to be 56 dam³ which is an 88 percent increase. Water use is expected to be 55 percent higher by 2025 under Medium Growth.

6.3.4.3 Parks and Recreation

Future water use is expected to increase as a result of regional population growth. Projections are based on 0.6 percent annual growth for the Low Growth scenario, 1.2 percent for the Medium Growth scenario and 2.1 percent for the High Growth scenario. The resulting projections are shown in Table 6-14.

Water use is expected to be 14 dam³ under Low Growth which is a 13 percent increase from current use. Under High Growth, water use is expected to be 18 dam³ which is a 52 percent increase. Water use is expected to be 27 percent higher by 2025 under Medium Growth.

Table 6-14 Projected Water Use for Parks and Recreation, Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	0	0	0	0	0
	Groundwater	12	12	13	13	14
	Total	12	12	13	13	14
Medium Growth	Surface	0	0	0	0	0
	Groundwater	12	13	14	14	15
	Total	12	13	14	14	15
High Growth	Surface	0	0	0	0	0
	Groundwater	12	13	15	16	18
	Total	12	13	15	16	18

6.3.5 Summary

A summary of the projected water demand for the commercial sector in the Clearwater Sub-basin is provided in Table 6-15. Note that this forecast combines the estimates for bottling, aggregate washing, and parks and recreation (which together account for 97 percent of allocation in the sub-basin), with the assumption that all of the water use allowed for the remaining commercial activities is being fully utilized.

Under the Low Growth scenario, water use is projected to rise to 103 dam³, a 10 percent increase from current levels. Under the High Growth scenario, water use by 2025 is projected to rise to 126 dam³, a 35 percent increase by 2025. Water use is projected to increase by 21 percent from current level by 2025 under the Medium Growth.

Table 6-15 Projected Water Use for the Commercial Sector, Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	48	48	48	48	48
	Groundwater	45	47	50	52	55
	Total	93	95	98	100	103
Medium Growth	Surface	48	48	48	48	48
	Groundwater	45	49	54	59	65
	Total	93	97	102	107	113
High Growth	Surface	48	48	48	48	48
	Groundwater	45	51	59	68	78
	Total	93	99	107	116	126

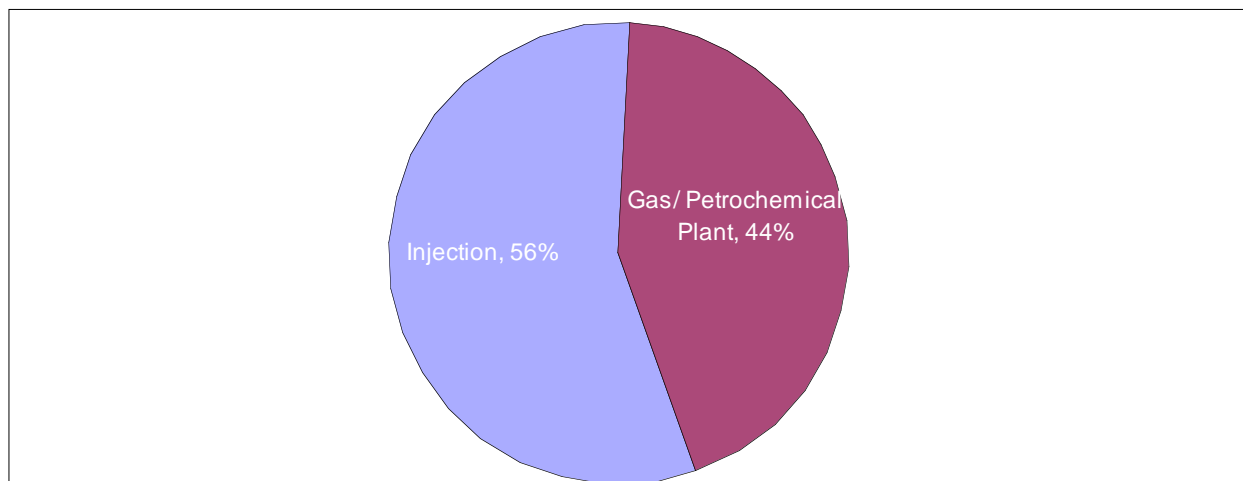
6.4 Petroleum Sector

In the Clearwater Sub-basin, there are 17 active licences which allocate 1,872 dam³ of water to the petroleum sector. Petroleum allocations accounts for almost 80 percent of total allocations

in the sub-basin and about 0.1 percent of the total allocations in the North Saskatchewan River Basin. Most of the water allocated (66 percent) is for groundwater (1,237 dam³).

Petroleum water allocations are split between injection and gas and petrochemical activities (Figure 6-10).

Figure 6-10 Petroleum Water Allocation by Use in the Clearwater Sub-basin



6.4.1 Injection

Seven water licences have been issued for injection purposes in the Clearwater Sub-basin. They allow withdrawals of up to 420 dam³ of surface water and 635 dam³ of groundwater. Injection water allocations commenced in the 1960s for surface water and the 1980s for groundwater, licences for both sources have increased slightly. Licensees are expected to consume 100 percent of the water they are allowed to withdraw.

6.4.1.1 Actual Water Use

A detailed assessment of reported water used for injection in the Clearwater Sub-basin was prepared by Geowa based on EUB data and the results are presented in Table 6-16. In 2005, an estimated 73 dam³ of groundwater was diverted for injection purposes. Based on the data, injection activities in the sub-basin are currently diverting and using approximately 7 percent of their total licensed allocations and 17 percent of their groundwater allocations.



Table 6-16 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Clearwater 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	4	635.0	635.0	0.0	0	0%	0%
	Groundwater	3	420.1	420.1	0.0	73	17%	17%
	Subtotal	7	1,055.1	1,055.1	0.0	73*	7%	7%
Gas/ Petrochemical Plant	Surface	0	0	0	0.0	0		
	Groundwater	10	816.8	816.8	0.0	375	46%	46%
	Subtotal	10	816.8	816.8	0.0	375**	46%	46%
Total	Surface	4	635.0	635.0	0.0	0	0%	0%
	Groundwater	13	1,236.9	1,236.9	0.0	448	36%	36%
	Total	17	1,871.9	1,871.9	0.0	448	24%	24%

* EUB water use data provided by Geowa.
 ** Estimates based on WURS data.

6.4.1.2 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 forecasts 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 Clearwater Sub-basin in Table 6-17 assumes declining rates of water use required that match the rates at which oil production in Alberta is expected to decline.

Table 6-17 Forecast of Injection Water Use in the Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	0	0	0	0	0
	Groundwater	73	73	43	43	26
	Total	73	73	43	43	26
Medium Production	Surface	0	0	0	0	0
	Groundwater	73	73	45	45	27
	Total	73	73	45	45	27
High Production	Surface	0	0	0	0	0
	Groundwater	73	73	51	51	31
	Total	73	73	51	51	31

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.

6.4.2 Gas/Petrochemical Plants

In the Clearwater Sub-basin, there are 10 groundwater licences that has been issued for gas and petrochemical plant activities allowing for withdrawals of up to 817 dam³ of groundwater. Gas and petrochemical plant water allocations commenced in the 1970s and increased slightly overtime. Licensees are expected to consume 100 percent of the groundwater they are allowed to withdraw.

6.4.2.1 Water Use

Of the 10 licences issued in the Clearwater Sub-basin, nine have water use information in WURS for 2005. These licence holders reported using 331 dam³ of the 772 dam³ they are allocated. The remaining licence has no use information and for the purposes of this report the licence holder is assumed to be using 100 percent of their licensed entitlement.

Thus water use by gas and petrochemical plants in the Clearwater Sub-basin in 2005 is estimated to be 375 dam³.

6.4.2.2 Future Water Use

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

6.4.3 Summary

Petroleum water allocations in the Clearwater Sub-basin are divided between injection and gas and petrochemical activities. Injection activities are responsible for 56 percent of the allocations but only account for 16 percent of the actual water use in 2005. Gas and petrochemical plants accounted 44 percent of the allocations and 84 percent of actual use.

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 decline. Water requirements for gas and petrochemical facilities in the Clearwater Sub-basin are not expected to change in the forecast period. The overall water use projections for the petroleum sector are provided in Table 6-18.

Table 6-18 Forecast of Petroleum Water Use in the Clearwater Sub-basin
(dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	0	0	0	0	0
	Groundwater	448	448	418	418	401
	Total	448	448	418	418	401
Medium Growth	Surface	0	0	0	0	0
	Groundwater	448	448	420	420	402
	Total	448	448	420	420	402
High Growth	Surface	0	0	0	0	0
	Groundwater	448	448	426	426	406
	Total	448	448	426	426	406

Under the Low Growth scenario, water use for petroleum activities in 2025 will decline by 11 percent from current levels. Under the High Growth scenario, the decline will be 10 percent.

6.5 Industrial Sector

In the Clearwater Sub-basin, there are four active groundwater licences that allocate 53 dam³ of water to the industrial sector (Table 6-19). Industrial allocations accounts for just over 2 percent of total allocations in the sub-basin.

There are two groundwater licences for forestry (52 dam³), one for a fertilizer plant (1 dam³) and one for other industrial activities (0.5 dam³). The three licences expect that 100 percent of withdrawals will be consumed.



Table 6-19 Licensed Allocations and Estimated Water Use for the Industrial Sector, Clearwater 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
Forestry	Surface	0	0.0	0.0	0.0	0		
	Groundwater	2	51.8	51.8	0.0	7	13%	13%
	Subtotal	2	51.8	51.8	0.0	7*	13%	13%
Fertilizer Plants	Surface	0	0.0	0.0	0.0	0		
	Groundwater	1	1.0	1.0	0.0	1	100%	100%
	Subtotal	1	1.0	1.0	0.0	1**	100%	100%
Other Industrial	Surface	0	0.0	0.0	0.0	0		
	Groundwater	1	0.5	0.5	0.0	0	100%	100%
	Subtotal	1	0.5	0.5	0.0	0**	100%	100%
Total	Surface	0	0.0	0.0	0.0	0		
	Groundwater	4	53.2	53.2	0.0	8	15%	15%
	Total	4	53.2	53.2	0.0	8	15%	15%

* Actual water use is based on WURS data.

** Assume 100 percent consumption of licensed water use.

There is no information on actual water use diversions or consumption for the fertilizer plant or other industrial water licences in the Clearwater Sub-basin. For the purposes of this analysis, it is assumed that these two licensees are using their full entitlement (1 dam³). The two forest licences report (WURS) that they used 7 dam³ of water in 2005. The total water use for 2005 is estimated to be 8 dam³.

6.5.1 Summary

In the absence of information about this sector, it is assumed that water used by industrial activities in the Clearwater Sub-basin will remain constant for the forecast period.

Table 6-20 Forecast of Industrial Water use in the Clearwater Sub-basin
 (dam³)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	0.0	0.0	0.0	0.0	0.0
	Groundwater	8.0	8.0	8.0	8.0	8.0
	Total	8.0	8.0	8.0	8.0	8.0

6.6 Other Sector

In the Clearwater Sub-basin, there is only one surface water licences that has been issued for habitat enhancement activities which allow withdrawals of up to 4 dam³ of water. Habitat enhancement allocations commenced in the 1980s. The licence allows all withdrawals to be consumed.

There is no information on the actual water diversions and consumption for habitat enhancement licences and, for purposes of this analysis, it is assumed that the licence holder is using their full entitlement. In the absence of information about this component of the other sector, it is assumed that water used by habitat enhancement projects in the Clearwater Sub-basin will remain constant for the forecast period.

6.7 Summary

Table 6-22 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Clearwater Sub-basin. In total, existing licences and registrations allow a maximum of 2,356 dam³ of water to be withdrawn and it is expected that all of the water will be used. Figure 6-11 shows the allocations, licensed use and actual use for the different sectors. Estimated actual use (818 dam³) is about 35 percent of licensed use. The largest water user is the petroleum sector. Figure 6-12 shows the forecasts to 2025 for all of the sectors under Medium Growth. By 2025 water use is expected to decrease by about 4 percent under Low Growth (Table 6-23), and about 2 percent under Medium Growth (Table 6-24). Under High Growth water use is expected to increase by about 2 percent (Table 6-25).



Table 6-21 Licensed Allocations and Estimated Actual Water Use for the Other Sector, Clearwater 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
Habitat	Surface	1	3.7	3.7	0.0	4	100%	100%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	1	3.7	3.7	0.0	4	100%	100%
Total	Surface	1	3.7	3.7	0.0	4	100%	100%
	Groundwater	0	0.0	0.0	0.0	0		
	Total	1	3.7	3.7	0.0	4	100%	100%



Table 6-22 Summary of Allocations and Estimated Water Use, Clearwater 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		18	18	0	1%	62	344%	8%
Agricultural	Stockwatering	316	316	0	13%	203	64%	25%
	Irrigation	0	0	0	0%	0	0%	0%
Commercial		93	93		4%	93	100%	11%
Petroleum		1,872	1,872	0	79%	448	24%	55%
Industrial		53	53	0	2%	8	15%	1%
Other		4	4	0	0%	4	100%	0%
Total		2,356	2,356	0	100%	818	35%	100%

Figure 6-11 Water Allocations and Actual Use, by Sector, Clearwater Sub-basin

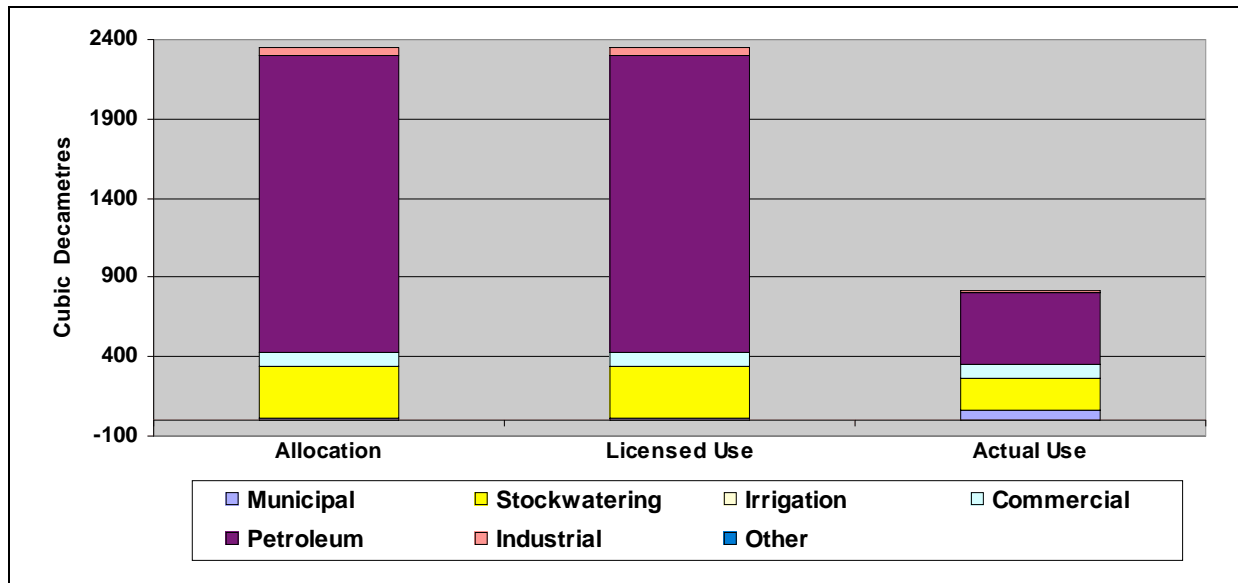


Figure 6-12 Forecast Water Use in Clearwater Sub-basin: Medium Scenario

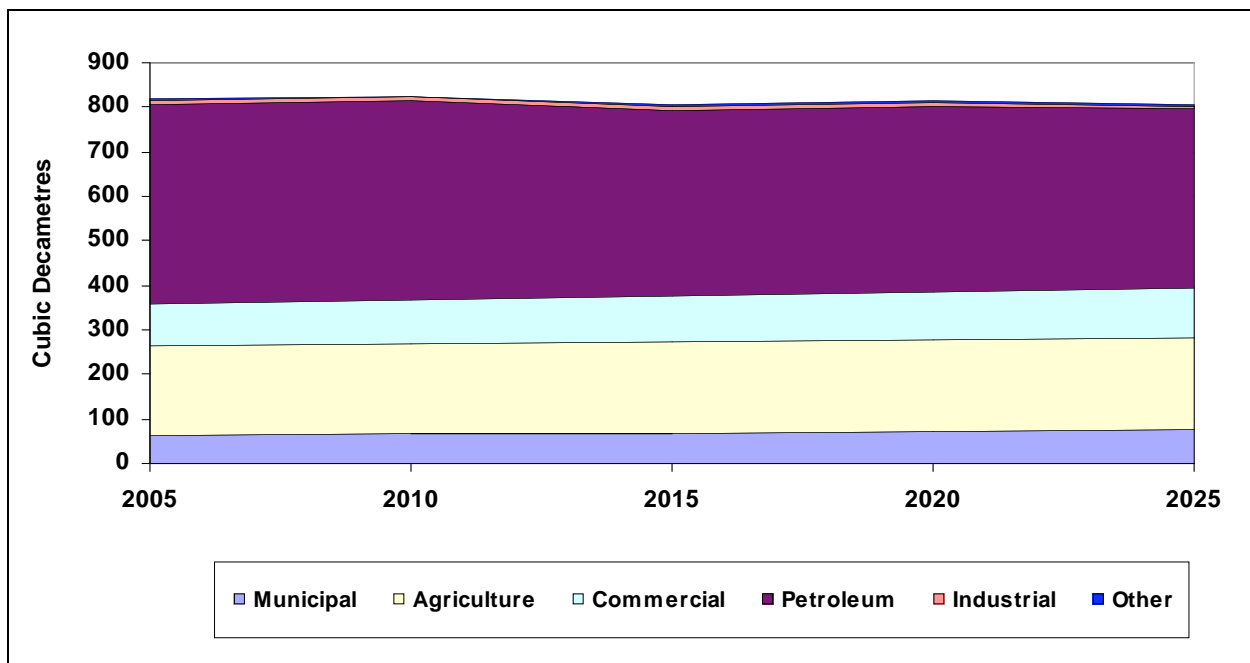


Table 6-23 Forecast Water Use, By Sector, Clearwater Sub-basin: Low Scenario
(dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	11	11	12	12	12
	Agricultural	76	76	76	76	76
	Commercial	48	48	48	48	48
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	4	4	4	4	4
	Total		139	139	140	140
Groundwater	Municipal	51	53	55	56	58
	Agricultural	127	127	127	127	127
	Commercial	45	47	50	52	55
	Petroleum	448	448	418	418	401
	Industrial	8	8	8	8	8
	Other	0	0	0	0	0
	Total		679	683	658	661
Total	Municipal	62	64	67	68	70
	Agricultural	203	203	203	203	203
	Commercial	93	95	98	100	103
	Petroleum	448	448	418	418	401
	Industrial	8	8	8	8	8
	Other	4	4	4	4	4
	Total		818	822	797	801

Table 6-24 Forecast Water Use, By Sector, Clearwater Sub-basin: Medium Scenario
(dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	11	12	12	13	14
	Agricultural	76	76	76	76	76
	Commercial	48	48	48	48	48
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	4	4	4	4	4
	Total		139	140	140	141
Groundwater	Municipal	51	54	57	60	63
	Agricultural	127	127	127	127	127
	Commercial	45	49	54	59	65
	Petroleum	448	448	420	420	402
	Industrial	8	8	8	8	8
	Other	0	0	0	0	0
	Total		679	686	666	674
Total	Municipal	62	66	69	73	77
	Agricultural	203	203	203	203	203
	Commercial	93	97	102	107	113
	Petroleum	448	448	420	420	402
	Industrial	8	8	8	8	8
	Other	4	4	4	4	4
	Total		818	826	806	815

Table 6-25 Forecast Water Use, By Sector, Clearwater Sub-basin: High Scenario
(dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	11	12	13	14	16
	Agricultural	76	76	76	76	76
	Commercial	48	48	48	48	48
	Petroleum	0	0	0	0	0
	Industrial	0	0	0	0	0
	Other	4	4	4	4	4
	Total		139	140	141	142
Groundwater	Municipal	51	56	61	67	73
	Agricultural	127	127	127	127	127
	Commercial	45	51	59	68	78
	Petroleum	448	448	426	426	406
	Industrial	8	8	8	8	8
	Other	0	0	0	0	0
	Total		679	690	681	696
Total	Municipal	62	68	74	81	89
	Agricultural	203	203	203	203	203
	Commercial	93	99	107	116	126
	Petroleum	448	448	426	426	406
	Industrial	8	8	8	8	8
	Other	4	4	4	4	4
	Total		818	830	822	837