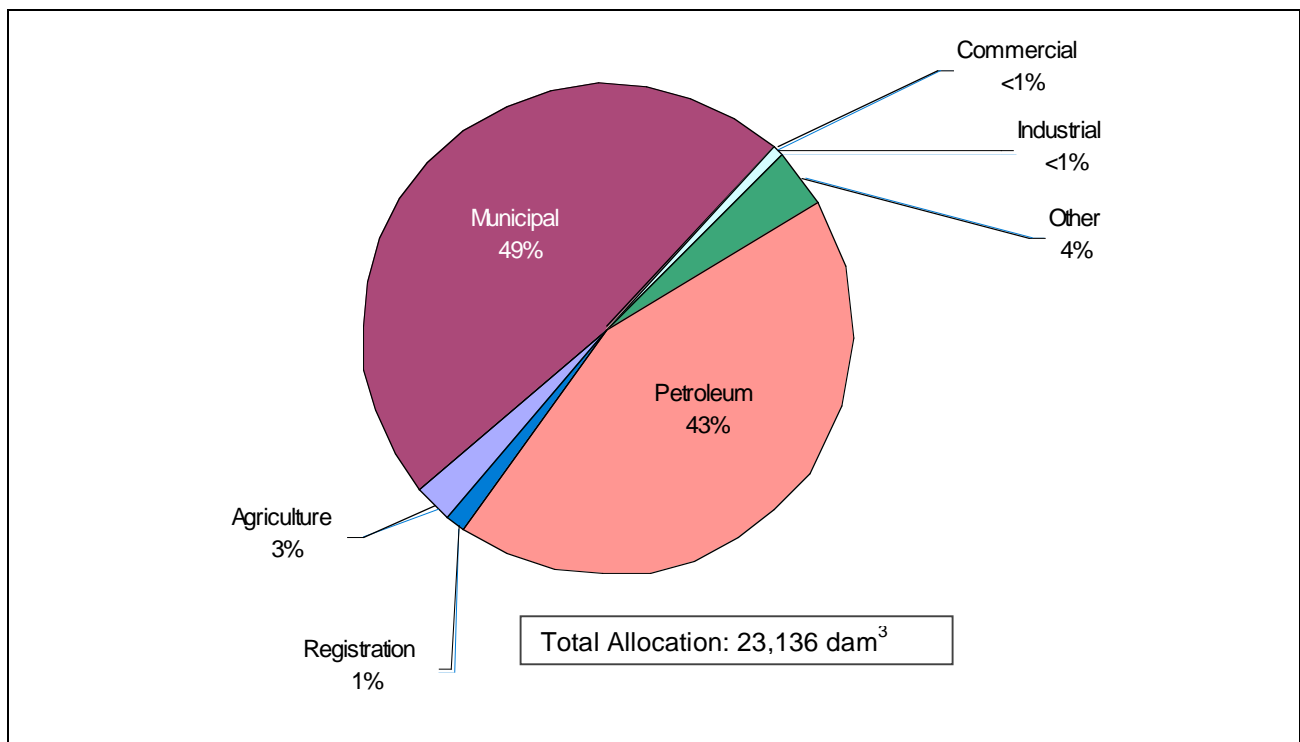


14.0 MONNERY

The Monnery Sub-basin is about 1,230 km² in area and occupies approximately 2 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of about 17,100 people, which represents more than 1 percent of the Basin population, with a population density of about 13.9 people per square kilometer. The Monnery Sub-basin consists all or parts of one urban municipality, one rural municipality and two Aboriginal settlements.

An overview of current surface and groundwater allocations is provided in Figure 14-1. It shows that the municipal sector accounts for 49 percent of total allocations or 11,175 dam³ while the petroleum sector accounts for 43 percent of total allocation or 10,035 dam³. The remaining allocations are for commercial, industrial, other and agriculture sectors and registration. Total allocations in the sub-basin in 2005 were 23,136 dam³ of which groundwater allocations (587 dam³) accounted for only 3 percent.

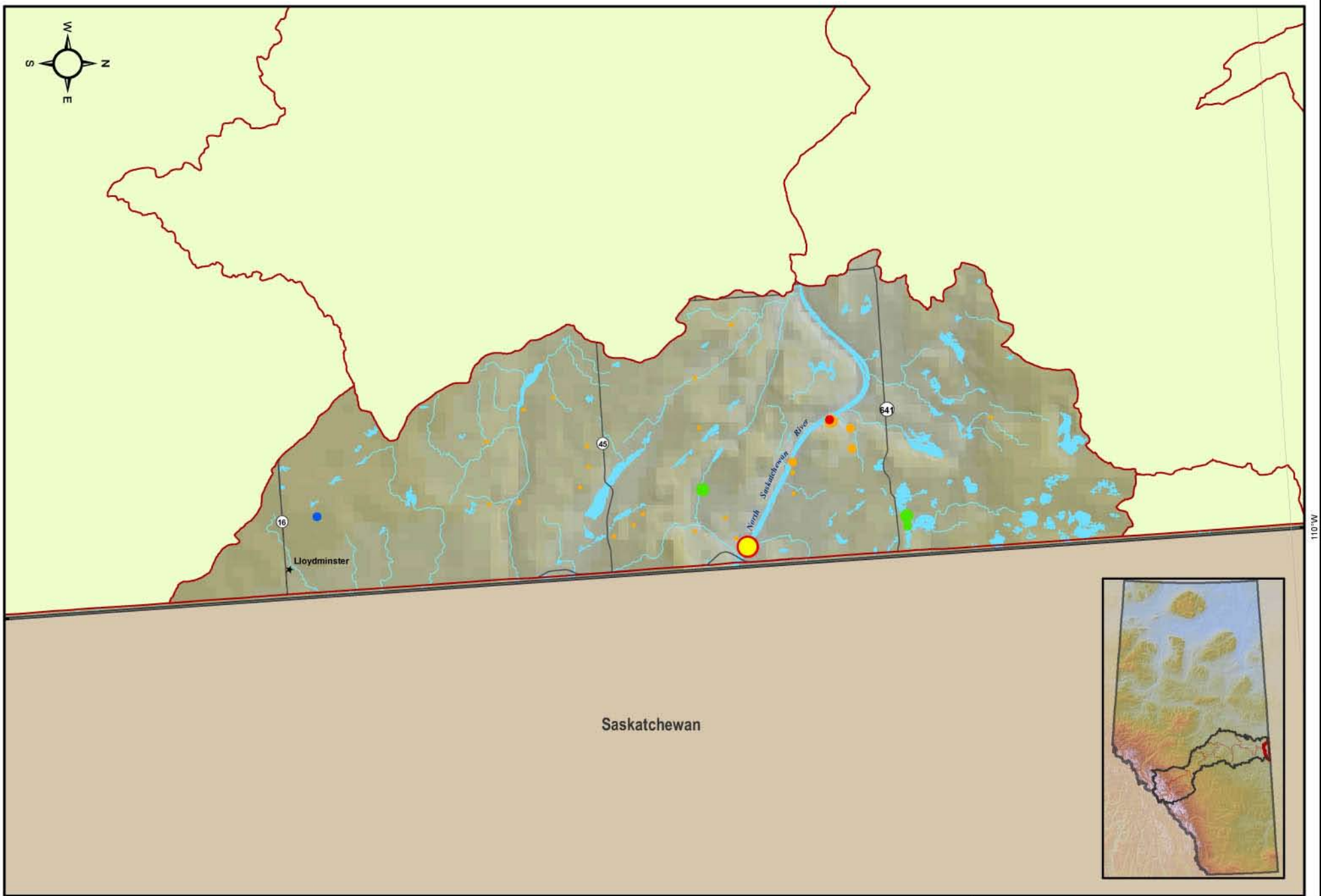
Figure 14-1 Distribution of Active Water Allocations in the Monnery Sub-basin



Figures 14-2 and 14-3 show the location, allocation and sector of all active water licences in the Monnery Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 14-4.



Figure 14-2 Monnery Sub-basin Surface Water Licences



110°W

110°W

Legend

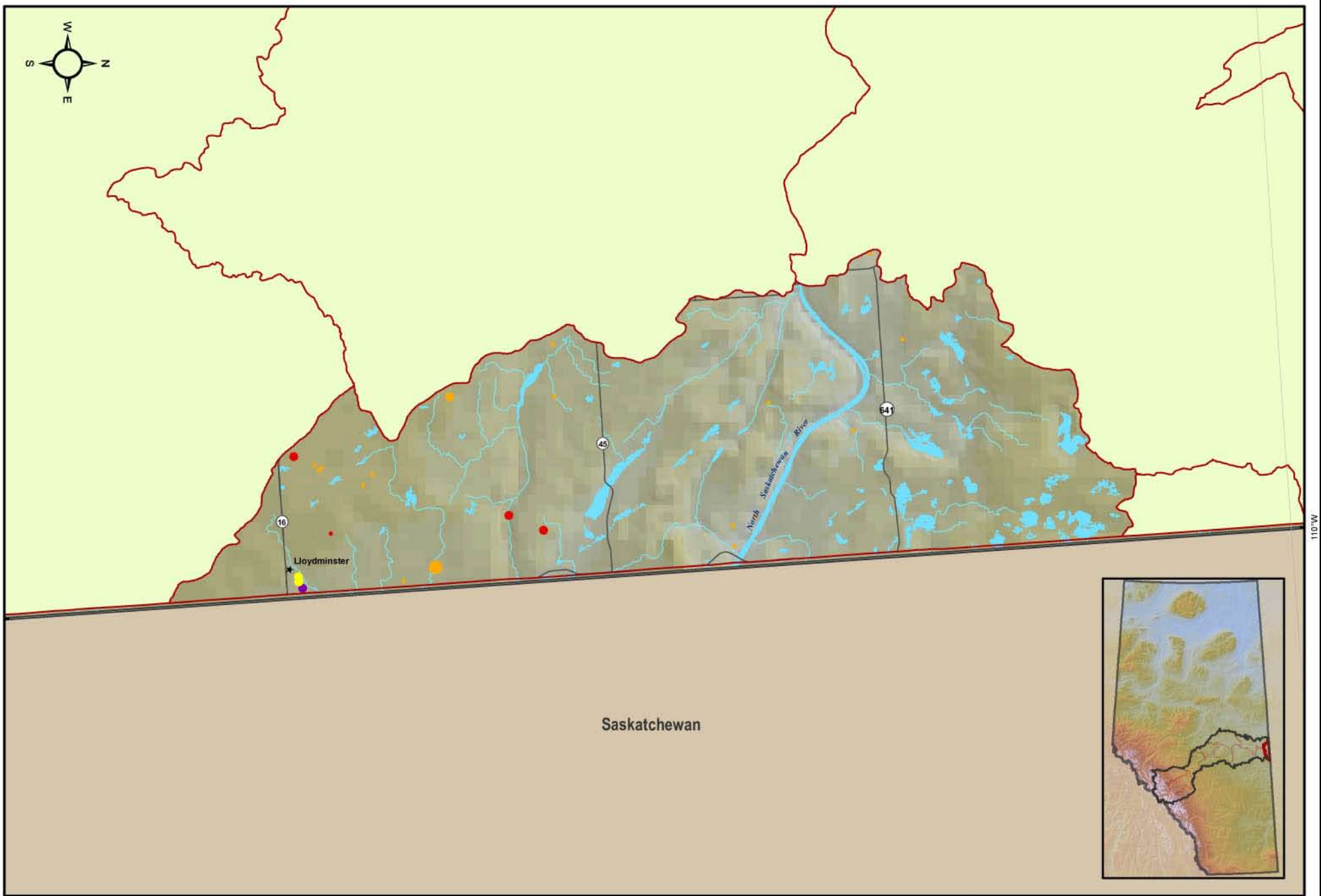
★ Settlement	Industry Category - Maximum Allowable Diversion (dam ³ /yr)						
— Major Road	Commercial	Other	Petroleum	Municipal	Industrial	Agriculture	
Watercourse	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00
Waterbody	10.01 - 100.00	10.01 - 100.00	10.01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

North Saskatchewan Watershed Alliance

MONNERY SUBBASIN SURFACE WATER LICENSES

DATE: May2007	0 1.5 3 4.5 6 8 10 Kilometers
AMEC PROJECT: EE27047	1:400,000
GIS FILE: SW_SB_MONNERY.MXD	PROJECTION: 10TM DATUM: NAD83
PDF FILE: SW_SB_MONNERY.PDF	FIGURE 14-2
PREPARED BY: amec	

Figure 14-3 Monnery Sub-basin Groundwater Licences



110°W

50.01

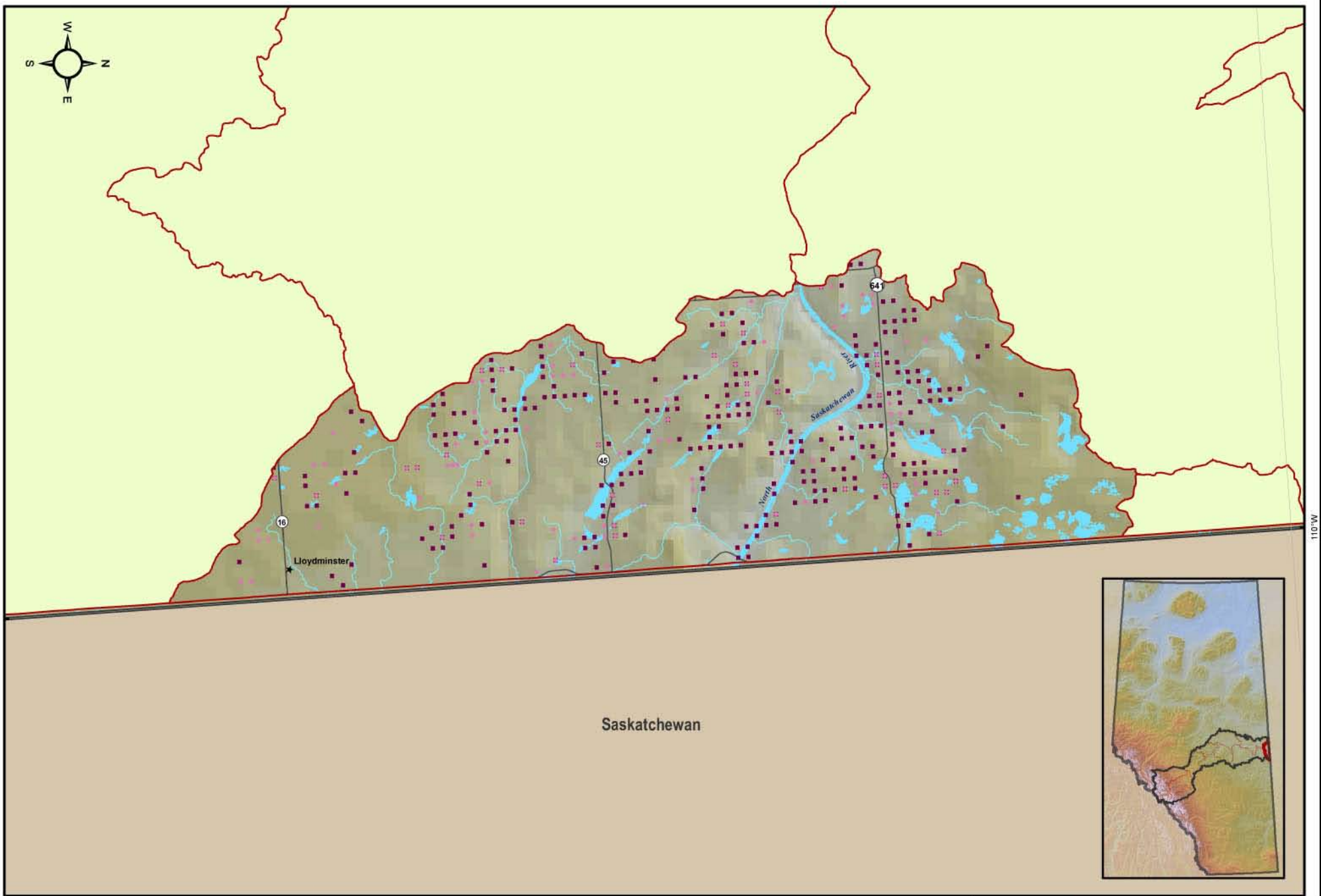
Legend		Industry Category - Maximum Allowable Diversion (dam ³ /yr)						
★	Settlement	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00	● 0.01 - 10.00
—	Major Road	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 10.01 - 100.00	● 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	● 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	● 1000.01 - 10000.00
□	Sub Basin	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01	● > 10000.01

North Saskatchewan Watershed Alliance

MONNERY SUBBASIN GROUNDWATER LICENSES

DATE: May2007	0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 375 390 405 420 435 450 465 480 495 510 525 540 555 570 585 600 615 630 645 660 675 690 705 720 735 750 765 780 795 810 825 840 855 870 885 900 915 930 945 960 975 990 1005 1020 1035 1050 1065 1080 1095 1110 1125 1140 1155 1170 1185 1200 1215 1230 1245 1260 1275 1290 1305 1320 1335 1350 1365 1380 1395 1410 1425 1440 1455 1470 1485 1500 1515 1530 1545 1560 1575 1590 1605 1620 1635 1650 1665 1680 1695 1710 1725 1740 1755 1770 1785 1800 1815 1830 1845 1860 1875 1890 1905 1920 1935 1950 1965 1980 1995 2010 2025 2040 2055 2070 2085 2100 2115 2130 2145 2160 2175 2190 2205 2220 2235 2250 2265 2280 2295 2310 2325 2340 2355 2370 2385 2400 2415 2430 2445 2460 2475 2490 2505 2520 2535 2550 2565 2580 2595 2610 2625 2640 2655 2670 2685 2700 2715 2730 2745 2760 2775 2790 2805 2820 2835 2850 2865 2880 2895 2910 2925 2940 2955 2970 2985 3000	1:400,000
AMEC PROJECT: EE27047	PROJECTION: 10TM DATUM: NAD83	
GIS FILE: GW_SB_MONNERY.MXD		
PDF FILE: GW_SB_MONNERY.PDF		
PREPARED BY: amec	FIGURE 14-3	

Figure 14-4 Monnery Sub-basin Registrations



110°W

50°N

Saskatchewan

- 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

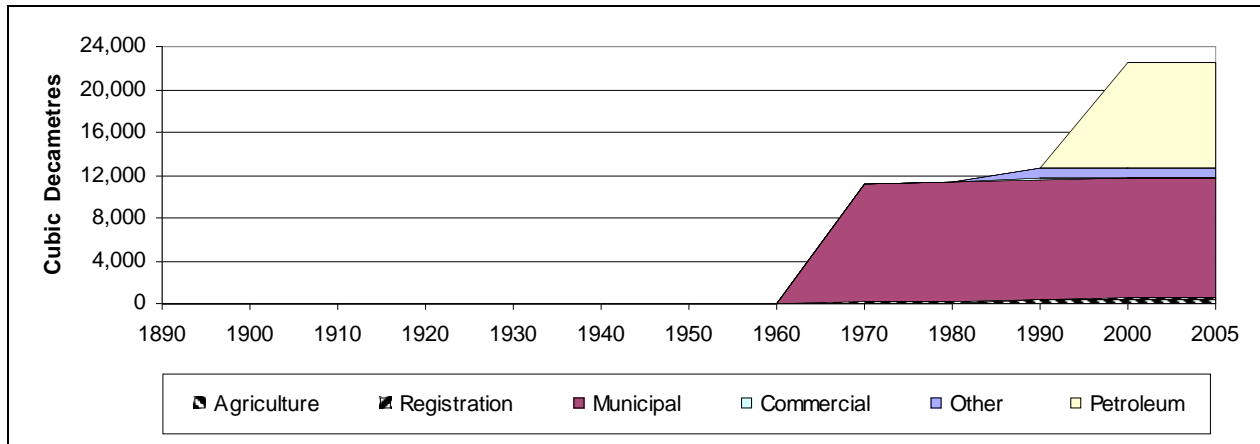
North Saskatchewan Watershed Alliance

MONNERY SUBBASIN REGISTRATIONS

DATE: May2007	Scale: 0 15 30 45 Kilometers 1:400,000
AMEC PROJECT: EE27047	PROJECTION: 10TM DATUM: NAD83
GIS FILE: RG_SB_MONNERY.MXD	
PDF FILE: RG_SB_MONNERY.PDF	
PREPARED BY: amec	FIGURE 14-4

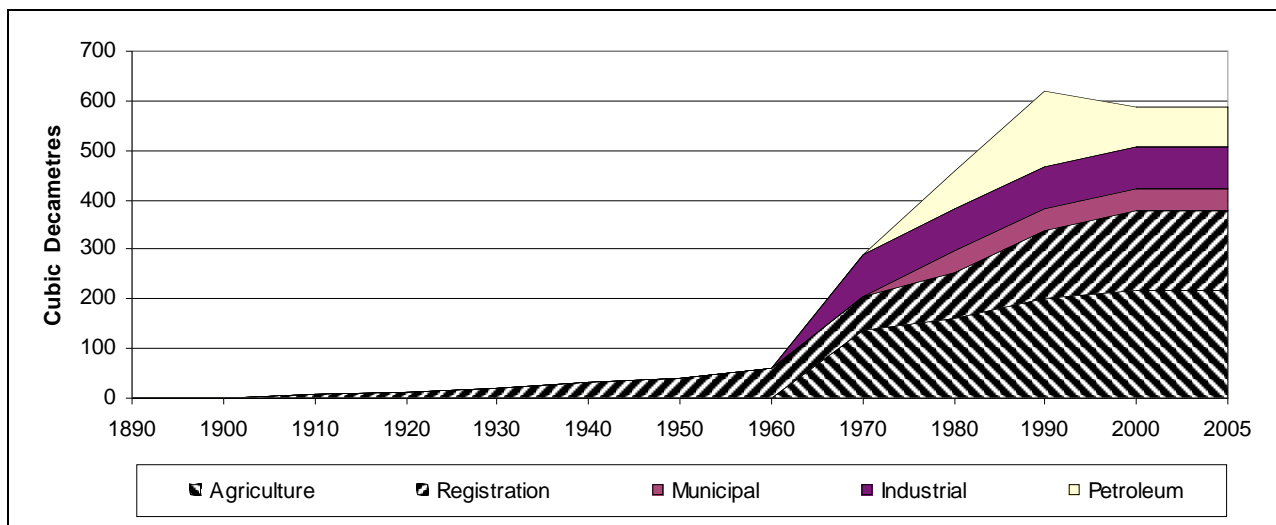
An historical perspective on water allocated among the sectors is provided in Figure 14-5 (surface water) and Figure 14-6 (groundwater). The two largest allocations for surface water in the Monnery Sub-basin are for the petroleum and the municipal sectors. Allocations for the petroleum sector were first issued in the 1990s and have remained unchanged since 2000. Allocations for the municipal sector were first issued in the 1960s, but have remained unchanged since.

Figure 14-5 Historical Trends in Surface Water Allocation in the Monnery Sub-basin



The largest allocations for groundwater in the Monnery Sub-basin are for registrations and the agriculture sector. Registrations were first issued with priority date allocations in the 1900s, increased substantially between the 1960s and 2000, but have remained unchanged since then. Allocations for the municipal and the remaining sectors were first issued in the 1960s, increased over time, but have remained unchanged since 2000.

Figure 14-6 Historical Trends in Groundwater Allocation in the Monnery Sub-basin



14.1 MUNICIPAL AND RESIDENTIAL SECTOR

14.1.1 Population

The population of Monnery Sub-basin is predominantly urban, centred in the City of Lloydminster, which is home to 93 percent of the sub-basin population. Six percent of the sub-basin population lives in one rural municipality, the County of Vermilion River, while less than 1 percent of the population lives in the Aboriginal community of Makaoo, as shown in Table 14-1. From 2001 to 2006, the population of Lloydminster grew quickly (21 percent), while the County of Vermilion River declined slightly (1 percent), and Makaoo experienced a sharp population decline (11 percent).

Table 14-1 Population Distribution and Growth in the Monnery Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	Percent	Population	Percent
Urban Municipality (Lloydminster)	15,910	93.0%	13,148	21.0%
Rural Municipality (County of Vermilion River)	1,048	6.1%	1,056	-0.8%
First Nations and Métis Settlements (Makaoo)	155	0.9%	175	-11.4%
Total	17,113	100.0%	14,379	19.0%

14.1.2 Allocations

As of 2005, seven municipal water licences were issued to six licensees in to the Monnery Sub-basin. These licences allow maximum withdrawals of 11,175 dam³ per year. As shown in Figure 14-1, municipal water uses account for 48 percent of licensed water allocations in the basin. Surface water licences account almost all municipal water allocations in the sub-basin, including 11,101 dam³ for urban use and 30 dam³ for other municipal use. Groundwater licences represent less than 1 percent or 44 dam³ of total municipal water allocations. Urban and rural users can withdraw up to 21 dam³, respectively from groundwater sources. Other users can withdraw up to 3 dam³ of groundwater. Table 14-2 summarizes the water licence allocations of municipalities in Monnery Sub-basin.

Table 14-2 Municipal Water allocations within Monnery Sub-basin

Municipal Name		Source	2005 Allocation (dam ³)
Urban	CITY OF LLOYDMINSTER	SURFACE	11,101.3
Rural	COUNTY OF VERMILION RIVER	GROUNDWATER	21.0

Licensees that are not municipalities but have municipal water use licences within the Monnery Sub-basin are shown in Table 14-3.

Table 14-3 Additional Municipal Water Use Licensees in the Monnery Sub-basin

Licensee	Water Source	Allocation (dam ³)
HUTTERIAN BRETHREN CHURCH OF O.B.	SURFACE	29.6
CHERRY, DOUGLAS	GROUNDWATER	19.7
ALBERTA INFRASTRUCTURE AND TRANSPORTATION	GROUNDWATER	2.5
CORR, HARVEY	GROUNDWATER	1.2

14.1.3 Licensed Water Use

Table 14-4 summarizes licensed water use for the municipal sector in the Monnery Sub-basin. Under the terms of these licences, a maximum of 1,180 dam³ is expected to be used (i.e. 11 percent of allocations will be consumed and/or lost) with the remainder (89 percent or 9,996 dam³) being returned after use. Ninety percent of allocated urban surface water and 80 percent of allocated urban ground water is designated as return flow, whereas all other uses have no assigned return flow.

Table 14-4 Licensed Municipal Allocations and Use and Estimated Actual Use, Monnery 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
Urban*	Surface	1	11,101.3	1,122.5	9,978.9	4,194	398	3,796
	Groundwater	2	21.0	4.2	16.8	7	1	6
	Subtotal	3	11,122.3	1,126.7	9,995.6	4,202	400	3,803
Rural**	Groundwater	2	21.0	21.0	0.0	7	7	0
Other***	Surface	1	29.6	29.6	0.0	11	10	0
	Groundwater	1	2.5	2.5	0.0	0	0	0
	Subtotal	2	32.1	32.1	0.0	12	11	0
Total	Surface	2	11,130.9	1,152.1	9,978.9	4,205	409	3,796
	Groundwater	5	44.4	27.6	16.8	16	9	6
	Total	7	11,175.3	1,179.7	9,995.6	4,222	419	3,803
* Urban includes villages, summer villages, towns, cities, hamlets; ** 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								

14.1.4 Actual Water Use

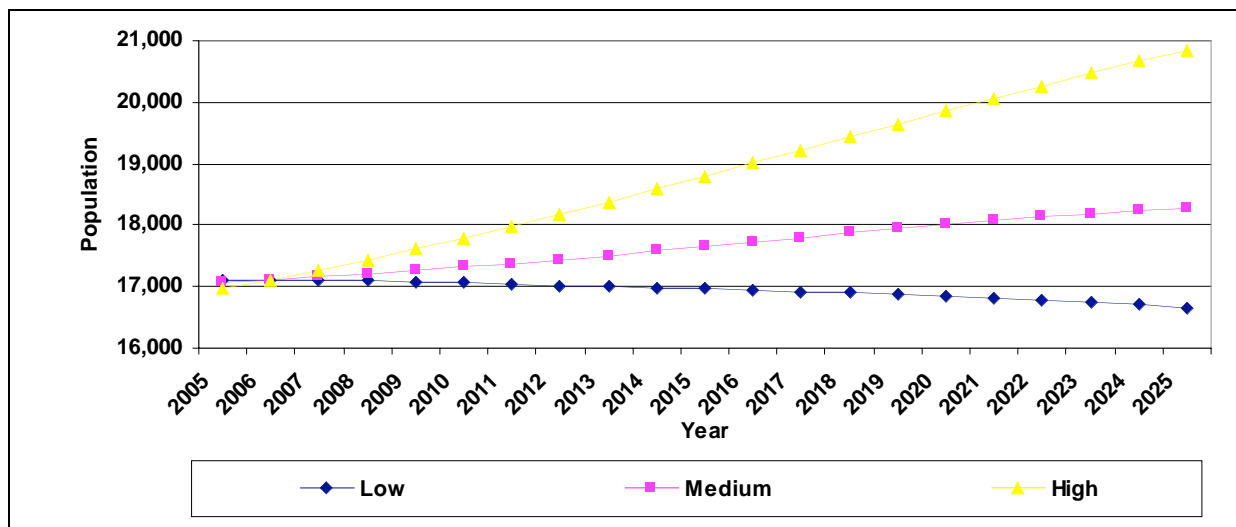
The City of Lloydminster reported its 2004 water and wastewater flows to MWWS. Lloydminster has a population of 15,910 or 93 percent of the sub-basin population. Assuming that its water use characteristics are similar to the remainder of the sub-basin population allows estimation of municipal water use for the whole sub-basin.

Per capita diversion in Lloydminster was 247 m³, per capita water use was 24 m³ and per capita return was 222 m³. Lloydminster's withdrawals were well within its licensed allocations (33 percent). When these per capita values are extrapolated for the entire population of the sub-basin, the results suggest water use to be 4,222 dam³ for water diversions (38 percent of licensed diversions), 3,803 dam³ for water returns (38 percent of licensed returns) and 419 dam³ for municipal water use (36 percent of licensed use). These total estimates are apportioned according to the licensed ratios, as shown in Table 14-4, to derive groundwater and surface water estimates for urban, rural and other municipal uses.

14.1.5 Future Water Use Forecasts

Figure 14-7 shows low, medium and high population projection scenarios for Monnery Sub-basin based on Alberta Finance Census Division projections. The population forecasts in Figure 14-7 have been used to predict future municipal surface and groundwater use. The resulting forecasts of water use are provided in Table 14-5, and are based on the estimated per capita water use in 2005.

Figure 14-7 Monnery Sub-basin Population Growth Forecasts



Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 3 percent lower than at present and actual water use will be 35 percent of the current licensed use amount. Under the High Population Growth scenario, water use will increase by 23 percent over current levels and water use is expected to be 44 percent of the amount presently allowed in the licences.

Table 14-5 Projected Municipal Water Use in the Monnery Sub-basin

(dam³)

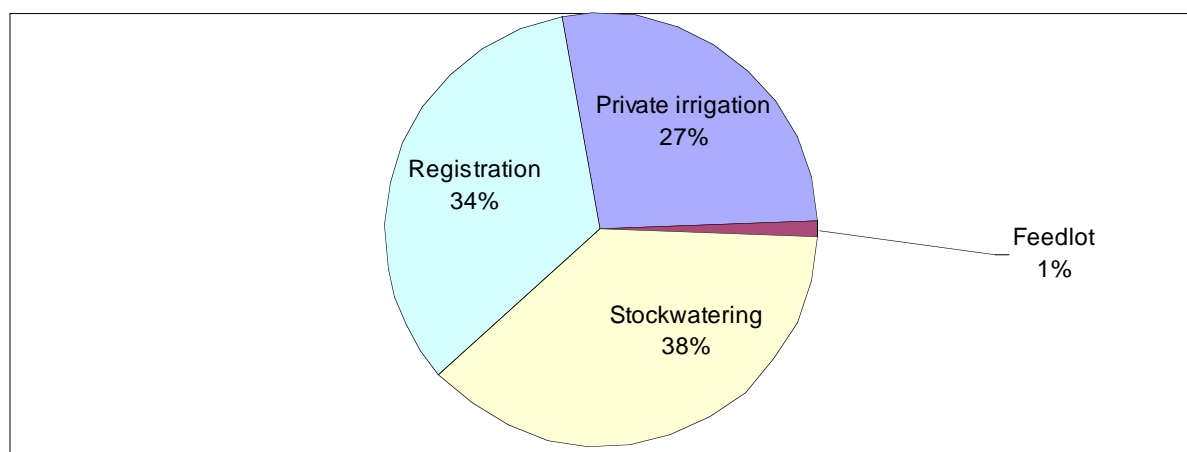
Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	409	408	406	403	398
	Groundwater	10	10	10	10	10
	Total	419	418	415	413	408
Medium Population Growth	Surface	409	415	423	432	438
	Groundwater	10	10	10	11	11
	Total	419	425	434	442	449
High Population Growth	Surface	409	429	453	479	503
	Groundwater	10	10	11	12	12
	Total	419	439	464	491	515

14.2 AGRICULTURE SECTOR

As of December 2005 a total of 920 dam³ had been allocated to the agricultural sector in the Monnery Sub-basin. This includes 504 registrations representing 313 dam³ and 51 licences representing 607 dam³ of water. Water allocated to agriculture, including registrations, accounts for 4 percent of all allocations in the Monnery Sub-basin.

Figure 14-8 shows how this water is distributed among the different agricultural activities in the sub-basin. The largest allocation is for stockwatering (38 percent). Registrations account for 34 percent, private irrigation accounts for 27 percent, and feedlots account for 1 percent of total allocations.

Figure 14-8 Water Allocation for Agricultural Activities in the Monnery Sub-basin, 2005



A total of 337 registrations and 26 licences allow withdrawal of up to 540 dam³ of surface water; this accounts for 59 percent of water allocations for the agricultural sector. Groundwater allocations account for the other 41 percent of allocations, with 380 dam³ being allocated through 25 licences and 127 registrations.

14.2.1 Overview of Agriculture

Based on information from the 2001 Census of Agriculture, there were about 266 farms in the Monnery Sub-basin (2.1 percent of North Saskatchewan total) with an average size of 1,091 acres. At the North Saskatchewan Basin level there are about 12,300 farms with an average size of 625 acres. Farms in the Monnery Sub-basin cover an area of nearly 280,000 acres; this is equivalent to about 1,130 km² or about 90 percent of the sub-basin. As shown in Table 14-6, 52 percent of the land in the basin is used to raise crops. About 40 percent of agricultural land is pasture. The rest of the lands are in summer fallow or other uses.

Table 14-6 Agricultural Land Use in the Monnery Sub-basin, 2001

Land Use	Acres	Percent
Crop Land	143,824	51.5%
Summerfallow	14,054	5.0%
Tame/Seeded Pasture	39,625	14.2%
Natural Pasture	68,475	24.5%
Other	13,197	4.7%
Total	279,176	100.0%

The types of farming activity vary within the sub-basin. Table 14-7 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 Monnery Sub-basin accounts for 2 percent of total farms in the North Saskatchewan. About 44 percent of the farms in the sub-basin raise beef cattle and about 33 percent are grain and oilseed farms. Like the North Saskatchewan, cattle (beef) farms are the most common type of farm in the sub-basin. The general mix of other types of farms is similar for both Monnery and North Saskatchewan except for grain and oilseed farms which are proportionately higher and speciality farms which are proportionately lower in the sub-basin.

14.2.2 Stockwatering

As noted in Table 14-7 about 47 percent of farms in the Monnery Sub-basin were classified as livestock operations, primarily cattle. Estimated livestock populations for major species are provided in Table 14-8. The table shows that there are about 140,000 cattle and calves which, together, accounted for about 60 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 14-7 Classifications of Farms in the Monnery 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	0.5%	0.6%	1.9%
Cattle (beef) Farms	43.6%	2.1%	45.8%
Hog Farms	1.8%	2.7%	1.4%
Poultry & Egg Farms	0.5%	1.0%	1.1%
Wheat Farms	5.4%	2.8%	4.2%
Grain & Oilseed Farms	33.4%	3.7%	19.6%
Field Crop Farms	3.6%	0.9%	8.6%
Fruit Farms	0.2%	2.0%	0.2%
Misc. Specialty Farms	6.3%	1.1%	12.9%
Sum of Livestock Comb. Farms	3.6%	3.1%	2.6%
Sum of Vegetable Farms	0.0%	0.0%	0.1%
Sum of Other Comb Farms	1.2%	1.8%	1.5%
Total	100%	2.1%	100%

Table 14-8 Estimated Livestock Populations in the Monnery Sub-basin, 2001

Livestock Species	Monnery	North Saskatchewan	% North Saskatchewan
Hens and Chicken	75,256	3,090,930	2.4%
Turkey	72	41,519	0.2%
Cattle	103,892	990,169	10.5%
Calves	34,147	365,725	9.3%
Pigs	15,678	232,169	6.8%
Sheep and Lamb	3,626	55,204	6.6%
Horse and Ponies	2,087	35,172	5.9%
Bison	1,772	18,906	9.4%
Deer	21	2,864	0.7%
Elk	457	6,426	7.1%

14.2.2.1 Water Allocation

Overall, 553 licences and registrations have been issued for livestock watering with the total allocation amounting to 670 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 14-9 summarizes current water licences and registrations issued for livestock according to the water source. It shows that surface water accounts for about 43 percent of allowable diversions for livestock and that registrations account for 47 percent of the allocations.



Table 14-9 Summary of Water Licences and Registrations Issued for Livestock Watering in the Monnery Sub-basin,

Activity	Source	Number of Licences/ Registrations	Licensed Allocation and Use (dam ³)			Reported Actual Water Use	
			Allocation	Water Use	Return	Licensees Reporting	Reported Use (dam ³)
Feedlot	Surface	0	0.0	0.0	0.0		
	Groundwater	1	9.1	9.1	0.0	0	N/A
	Subtotal	1	9.1	9.1	0.0	0	N/A
Registration	Surface	377	149.0	149.0	0.0	0	N/A
	Groundwater	127	164.1	164.1	0.0	0	N/A
	Subtotal	504	313.0	313.0	0.0	0	N/A
Stockwatering	Surface	24	140.9	140.9	0.0	0	N/A
	Groundwater	24	206.6	206.6	0.0	0	N/A
	Subtotal	48	347.5	347.5	0.0	0	N/A
Total	Surface	401	289.9	289.9	0.0	0	N/A
	Groundwater	152	379.8	379.8	0.0	0	N/A
	Total	553	669.7	669.7	0.0	0	N/A

14.2.2.2 Licensed Water Use

Table 14-9 shows that licences and registrations issued for livestock watering assume that all withdrawals will be consumed or lost and that there will be no return flow.

14.2.2.3 Actual Water Use

There is no information in Alberta Environment's WURS that indicates the extent to which water allocations are actually used in the Monnery Sub-basin. However, a reasonable estimate of water use can be derived using the actual animal population in the basin shown in Table 14-8. Based on livestock populations for the Monnery Sub-basin in 2001, the total water required for livestock was estimated to be 308 dam³, or about 45 percent of the licensed allocation.¹ The calculations for this estimate are provided in Table 14-10 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 5 percent is required by pigs, and all other species accounted for the remaining 5 percent.

Table 14-10 Estimated Livestock Water Requirements for 2001

Livestock Species	Animal Population	Daily Consumption (gallons)	Annual Use (dam ³)
Hens and Chickens	21,969	0.045	1.6
Turkey	0	0.15	0.0
Bulls	671	9.0	10.0
Milk Cows	85	30.0	4.2
Beef Cows	10,522	9.0	157.0
Heifers	3,573	6.0	35.5
Steers	2,189	6.0	21.8
Calves	9,560	3.0	47.6
Boars	29	6.5	0.3
Sows and Gilts - Breeding	437	6.5	4.7
Nursing and Weaner Pigs	1,318	0.5	1.1
Grower and Finishing Pigs	3,776	1.5	9.4
Sheep and Lambs	805	2.0	2.7
Horse and Ponies	497	10.0	8.2
Bison	766	2.0	2.5
Deer	0	10.0	0.0
Elk	202	3.5	1.2
Total			308.0

The estimated actual consumption (308 dam³) based on livestock populations shown in Table 14-10 does 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.

Since 57 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 380 dam³ would be required to support the animal populations in Table 14-10. This water requirement is about 56 percent of the water allocation through licences and registrations.

14.2.2.4 Forecasts of Future Stockwatering Water Use

Future water use is dependent on future livestock population 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 large or new expanded 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 some townships that meet all of the criteria for backgrounding operations only. For townships that meet some of the criteria limiting factor is groundwater. Based on Alberta Agriculture's assessment, it would appear that there are some opportunities for backgrounding operations in the Monnery Sub-basin. Table 14-11 shows water use projections to 2025. By 2025, relative to 2005, water use is expected to 11 percent, 30 percent and 60 percent higher under Low, Medium and High Growth Scenarios respectively.

Table 14-11 Projected Water Use for Livestock in the Monnery Sub-basin

(dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	205	210	216	222	228
	Groundwater	175	179	184	189	194
	Total	380	389	400	411	422
Medium Growth	Surface	205	218	232	248	264
	Groundwater	175	186	198	212	225
	Total	380	404	431	459	490
High Growth	Surface	205	230	258	290	325
	Groundwater	175	196	220	247	278
	Total	380	426	479	537	603

14.2.3 Irrigation

The other major use of water for agricultural purposes is irrigation or crop watering. Irrigation in this sub-basin is done by private irrigators who have their own water licences and divert water using their own pumps and water distribution equipment.

When aggregate information from the 2001 Census of Agriculture for individual counties and municipal districts is modified to reflect river basin boundaries, the resulting estimates suggest that about 121 acres of land in the Monnery Sub-basin were irrigated in 2001. Another approach for estimating irrigated acres involves dividing water allocations by irrigation water

requirement of about 450 mm (18 inches) per acre. Based on this method it is estimated that water allocations are sufficient to support irrigation on about 206 acres. There is no information on the mix of crops grown by private irrigators; however, AAFRD has indicated that most private irrigation in Alberta is used to raise supplemental forages to feed livestock.

14.2.3.1 Water Allocation

Two licences allocate approximately 250 dam³ for irrigation purposes. All of this allocation is from surface water.

14.2.3.2 Licensed Water Use

Table 14-12 shows all licences issued for irrigation purposes assume that all withdrawals will be used and there will be no return flow.

14.2.3.3 Actual Water Use

Neither Alberta Agriculture nor Alberta Environment has any information on actual water use by private irrigators. For the purposes of this study it is assumed that actual use is equal to licensed water use. However, actual water use in any given year will depend on how much of the crop water demand can be satisfied by natural precipitation. It is noteworthy that actual stockwatering use in the sub-basin (380 dam³) is 1.5 times the amount of water used for crop watering.

14.2.3.4 Forecasts of Future Irrigation Water Use

With expansion of livestock, additional demand for livestock forage is expected. However, due to climatic conditions and poor returns on forage production, additional forage production is not expected. It is assumed that available forage will be able to support modest increases in livestock populations. Irrigation water use is projected to remain at 250 dam³ over the forecast period.

14.2.4 Summary

In summary, current agricultural water use in the Monnery Sub-basin is estimated to be about 630 dam³, of which 60 percent is for stockwatering, including feedlots, and 40 percent is for irrigation. In the future, agricultural water demand in the basin is expected to increase as a result of expansion of livestock populations. Irrigation water use is expected to remain constant. Table 14-13 shows a summary of future agricultural water use.



Table 14-12 Irrigation Allocations and Use and Reported Actual Water Use, Monnery Sub-basin

Activity	Source	Number of Licences/ Registrations	Licensed Allocation and Use (dam ³)			Reported Actual Water Use (dam ³)	
			Allocation	Water Use	Return	Licensees Reporting	Reported Use
Private irrigation	Surface	2	250.3	250.3	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0		
	Subtotal	2	250.3	250.3	0.0	0	N/A
Total	Surface	2	250.3	250.3	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0		
	Total	2	250.3	250.3	0.0	0	N/A

Table 14-13 Projected Water Use for Agriculture in the Monnery Sub-basin

(dam³)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	455	460	466	472	478
	Groundwater	175	179	184	189	194
	Total	630	639	650	661	672
Medium Growth	Surface	455	468	482	498	514
	Groundwater	175	186	198	212	225
	Total	630	654	681	709	740
High Growth	Surface	455	480	508	540	575
	Groundwater	175	196	220	247	278
	Total	630	676	729	787	853

Agricultural water use in 2025 would be about 672 dam³ (an increase of 7 percent from 2005) under Low Growth. Under High Growth, water use is projected to be 853 dam³ by 2025; this represents an increase of 35 percent from 2005. For Medium Growth, agricultural water use in 2025 is expected to increase by 17 percent over current levels.

14.3 COMMERCIAL SECTOR

There are no allocations for the commercial sector in the Monnery Sub-basin and this is not expected to change over the forecast period.

14.4 PETROLEUM SECTOR

In the Monnery Sub-basin, there are two active surface water licences and two active groundwater licences. These four licences allocate 9,955 dam³ of surface water and 80 dam³ of groundwater to the petroleum sector for gas and petrochemical plants. Petroleum allocations account for over 43 percent of total allocations in the sub-basin. Licensees are expected to consume 100 percent of the water they withdrawal.

One operator (Husky Oil Operations Ltd) owns all four water licences. It reported water use for three of its four licences. For the three licences, it reported using 3,682 dam³ in 2005 of which 3,614 dam³ is surface water and 68 dam³ is groundwater. Assuming Husky used the full entitlement of its fourth licence, water use by the petroleum sector is estimated to be 6,885 dam³.

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 Monnery Sub-basin will remain constant for the forecast period.



Table 14-14 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Monnery 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
Gas/ Petrochemical Plant	Surface	2	9,955.0	9,955.0	0.0	6,817	69%	69%
	Groundwater	2	80.2	80.2	0.0	68	84%	84%
	Subtotal	4	10,035.2	10,035.2	0.0	6,885*	68%	68%
Total	Surface	2	9,955.0	9,955.0	0.0	6,817	69%	69%
	Groundwater	2	80.2	80.2	0.0	68	84%	84%
	Total	4	10,035.2	10,035.2	0.0	6,885	68%	68%

* Estimates based on WURS data, and assumes for the licences with no data available that the licence holder is using the full entitlement of their licence.

14.5 INDUSTRIAL SECTOR

In the Monnery Sub-basin, there is one active groundwater licence that allocates 83 dam³ of water to the industrial sector for cooling activities (Table 14-14). This industrial allocation accounts for less than 1 percent of total allocations in the sub-basin. The licence assumes that less than 3 dam³ will be consumed, 80 dam³ will be returned.

There is no information on actual water use diversions or consumption for the cooling plant or in the Monnery Sub-basin. For the purposes of this analysis, it is assumed that the licensee is using their full entitlement and will continue to do so for the duration of the forecast period.

14.6 OTHER SECTOR

In the Monnery Sub-basin there are three active surface water licences which allocate 923 dam³ of water to the other sector. These licences assume that all diversion will be consumer or lost and there will be no return flow. The other sector activities account for about 4 percent of licensed water use in the Monnery Sub-basin. Other sector uses in the Monnery Sub-basin include water management for flood control and lake stabilization, and fish, wildlife and habitat enhancement.

All three water licences have been issued to Ducks Unlimited. Table 14-15 summarizes the water allocation, use, and return associated with the licences for each activity while Figure 14-9 illustrates water use by other sector activities in the Monnery Sub-basin.

Figure 14-9 Other Sector Water Allocation by Use in the Monnery Sub-basin

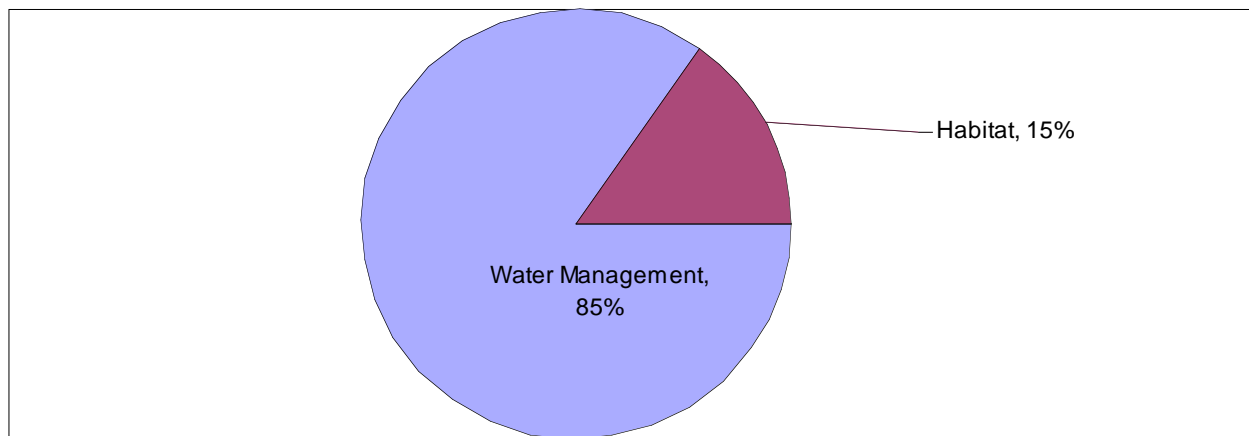


Table 14-15 Licensed Allocations and Estimated Water Use for the Industrial Sector, Monnery Sub-basin

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
Cooling	Surface	0	0.0	0.0	0.0	0.0		
	Groundwater	1	82.6	2.5	80.2	2.5	100%	3%
	Subtotal	1	82.6	2.5	80.2	2.5*	100%	3%
Total	Surface	0	0.0	0.0	0.0	0.0		
	Groundwater	1	82.6	2.5	80.2	2.5	100%	3%
	Total	1	82.6	2.5	80.2	2.5*	100%	3%

* Actual water use is assumed to be 100 percent of licensed consumption.

Table 14-16 Licensed Allocations and Estimated Actual Water Use for the Other Sector, Monnery 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
Water Management	Surface	2	782.0	782.0	0.0	782	100%	100%
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	2	782.0	782.0	0.0	782*	100%	100%
Habitat	Surface	1	140.6	140.6	0.0	140	100%	100%
	Groundwater	0	0.0	0.0	0.0			
	Subtotal	1	140.6	140.6	0.0	140 *	100%	100%
Total	Surface	3	922.6	922.6	0.0	922	100%	100%
	Groundwater	0	0.0	0.0	0.0			
	Total	3	922.6	922.6	0.0	922	100%	100%

* Estimated water use assumes licence holders are using the full entitlement of their licences.

14.6.1 Water Management

In the Monnery Sub-basin, two surface water licences have been issued for water management activities. The licences allow for withdrawals of up to 782 dam³ of water. Water management allocations commenced in the 1990s. Ducks Unlimited is expected to consume all of the water it's entitled to withdrawal.

There is no information on the actual water diversions and consumption for water management licences. For purposes of this analysis, it is assumed that the licence holder is using its full entitlement. In the absence of plans to undertake additional water management projects, it is assumed that water used by water management projects in the Monnery Sub-basin will remain constant for the forecast period.

14.6.2 Habitat Enhancement

In the Monnery Sub-basin, only one surface water licence has been issued for wildlife and habitat enhancement projects. The licence allows for withdrawals of up to 141 dam³ of surface water and was issued in the 1980s. Ducks Unlimited is expected to consume all of the water it is entitled to withdrawal.

There is no information on the actual water diversions and consumption for habitat enhancement licences. For purposes of this analysis, it is assumed that the licence holder is using their full entitlement. In the absence of plans to undertake additional water management projects, it is assumed that water used by habitat enhancement projects in the Monnery Sub-basin will remain constant for the forecast period.

14.6.3 Summary

All allocations to the other sector in the Monnery Sub-basin have been issued to Ducks Unlimited for a combination of water management and habitat enhancement projects.

It is assumed that water used by habitat enhancement projects in the Monnery Sub-basin will remain constant for the forecast period (Table 14-17).

Table 14-17 Forecast of Water Use for the Other Sector in the Monnery Sub-basin

(dam³)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	923	923	923	923	923
	Groundwater	0	0	0	0	0
	Total	923	923	923	923	923

14.7 SUMMARY

Table 14-18 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Monnery Sub-basin. In total, existing licences and registrations allow a maximum of 23,136 dam³ of water to be withdrawn. Of this, it is expected that licensees will consume or lose 56 percent (13,061 dam³) and return the remainder. Figure 14-10 shows the allocations, licensed use and actual use for the different sectors. Actual use (8,860 dam³) is about 68 percent of licensed use. The largest water user is the petroleum sector, which accounts for 78 percent of actual water use.

Figure 14-10 Water Allocations and Actual Use, by Sector, Monnery Sub-basin

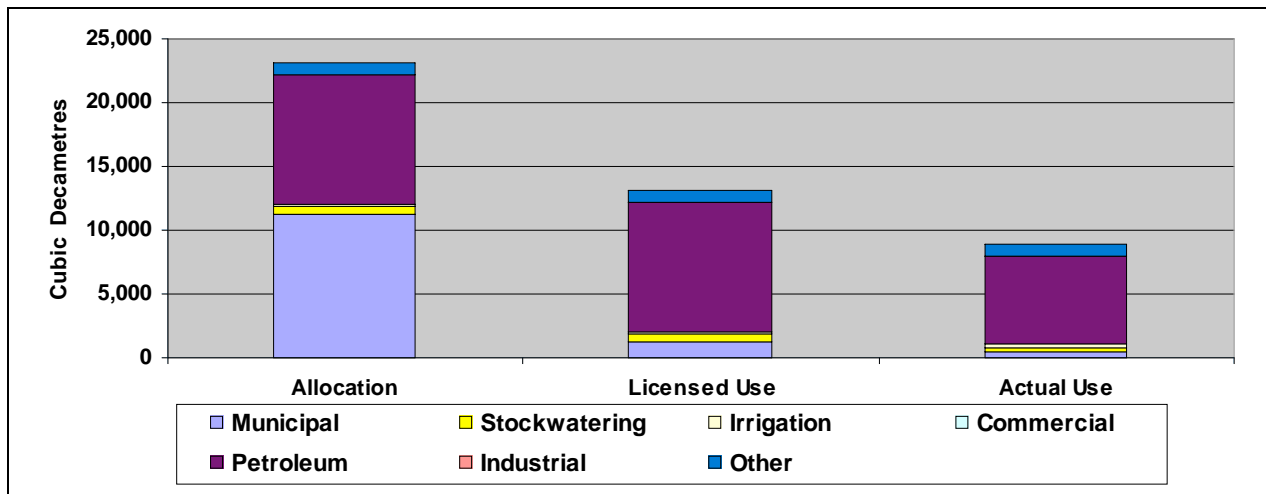


Figure 14-11 shows the forecasts to 2025 for all of the sectors under Medium Growth. By 2025 water use is expected to increase by less than 1 percent under Low Growth (Table 14-19), about nearly 2 percent under Medium Growth (Table 14-20), and nearly 4 percent under High Growth (Table 14-21).

Figure 14-11 Forecast Water Use in Monnery Sub-basin: Medium Scenario

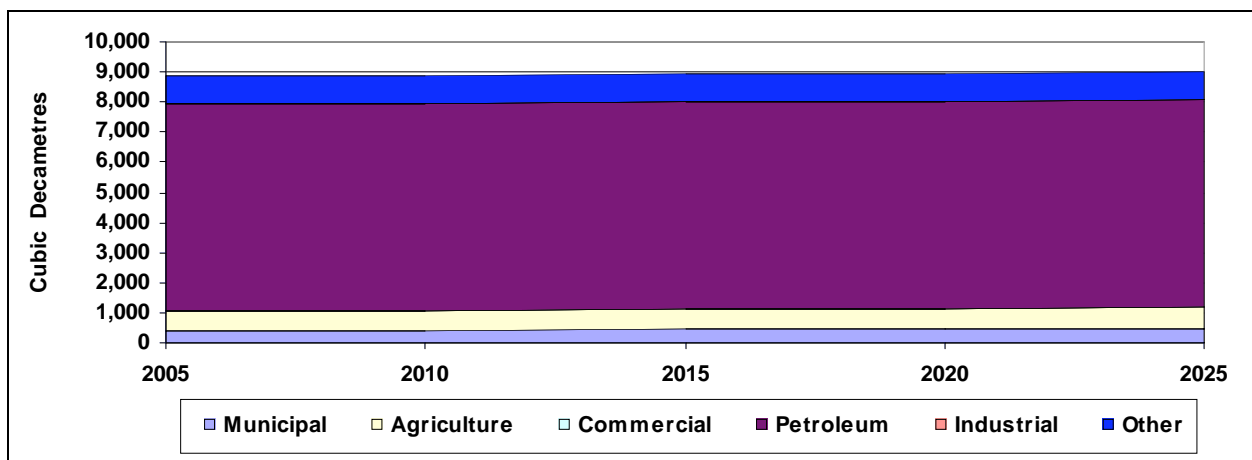




Table 14-18 Summary of Allocations and Estimated Water Use, Monnery Sub-basin

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		11,175	1,180	9,995	9%	419	36%	5%
Agricultural	Stockwatering	670	670	0	5%	380	57%	4%
	Irrigation	250	250	0	2%	250	100%	3%
Commercial		0	0	0	0%	0	N/A	0%
Petroleum		10,035	10,035	0	77%	6,885	69%	78%
Industrial		83	3	80	0%	3	100%	0%
Other		923	923	0	7%	923	100%	10%
Total		23,136	13,061	10,075	100%	8,860	68%	100%

Table 14-19 Forecast Water Use, By Sector, Monnery Sub-basin: Low Scenario
 (dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	409	408	406	403	398
	Agricultural	455	460	466	472	478
	Commercial	0	0	0	0	0
	Petroleum	6,817	6,817	6,817	6,817	6,817
	Industrial	0	0	0	0	0
	Other	923	923	923	923	923
	Total		8,604	8,608	8,612	8,615
Groundwater	Municipal	10	10	10	10	10
	Agricultural	175	179	184	189	194
	Commercial	0	0	0	0	0
	Petroleum	68	68	68	68	68
	Industrial	3	3	3	3	3
	Other	0	0	0	0	0
	Total		256	260	265	270
Total	Municipal	419	418	416	413	408
	Agricultural	630	639	650	661	672
	Commercial	0	0	0	0	0
	Petroleum	6,885	6,885	6,885	6,885	6,885
	Industrial	3	3	3	3	3
	Other	923	923	923	923	923
	Total		8,860	8,868	8,877	8,885

Table 14-20 Forecast Water Use, By Sector, Monnery Sub-basin: Medium Scenario
 (dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	409	415	423	432	438
	Agricultural	455	468	482	498	514
	Commercial	0	0	0	0	0
	Petroleum	6,817	6,817	6,817	6,817	6,817
	Industrial	0	0	0	0	0
	Other	923	923	923	923	923
	Total		8,604	8,623	8,645	8,670
Groundwater	Municipal	10	10	10	11	11
	Agricultural	175	186	198	212	225
	Commercial	0	0	0	0	0
	Petroleum	68	68	68	68	68
	Industrial	3	3	3	3	3
	Other	0	0	0	0	0
	Total		256	267	279	294
Total	Municipal	419	425	433	443	449
	Agricultural	630	654	680	710	739
	Commercial	0	0	0	0	0
	Petroleum	6,885	6,885	6,885	6,885	6,885
	Industrial	3	3	3	3	3
	Other	923	923	923	923	923
	Total		8,860	8,890	8,924	8,964

Table 14-21 Forecast Water Use, By Sector, Monnery Sub-basin: High Scenario
 (dam³)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	409	429	453	479	503
	Agricultural	455	480	508	540	575
	Commercial	0	0	0	0	0
	Petroleum	6,817	6,817	6,817	6,817	6,817
	Industrial	0	0	0	0	0
	Other	923	923	923	923	923
	Total		8,604	8,649	8,701	8,759
Groundwater	Municipal	10	10	11	12	12
	Agricultural	175	196	220	247	278
	Commercial	0	0	0	0	0
	Petroleum	68	68	68	68	68
	Industrial	3	3	3	3	3
	Other	0	0	0	0	0
	Total		256	277	302	330
Total	Municipal	419	439	464	491	515
	Agricultural	630	676	728	787	853
	Commercial	0	0	0	0	0
	Petroleum	6,885	6,885	6,885	6,885	6,885
	Industrial	3	3	3	3	3
	Other	923	923	923	923	923
	Total		8,860	8,926	9,003	9,089