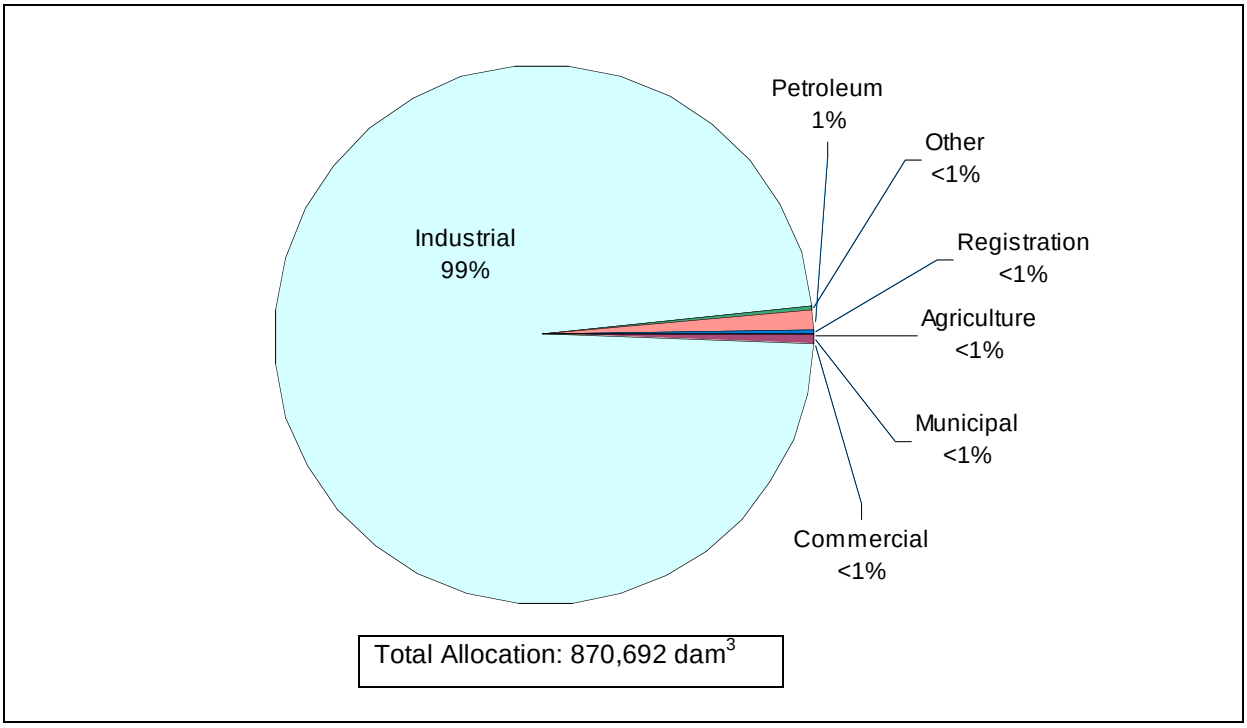
7.0 MODESTE

The Modeste Sub-basin is about 4,720 km^2 in area and occupies approximately 9 percent of the North Saskatchewan Basin. In 2005, the sub-basin had a population of 32,100 people, which represents about 3 percent of the Basin population, with a population density of 6.8 people per square kilometer. The Modeste Sub-basin consists all or parts of eight urban municipalities, six rural municipalities and one Aboriginal Settlement.

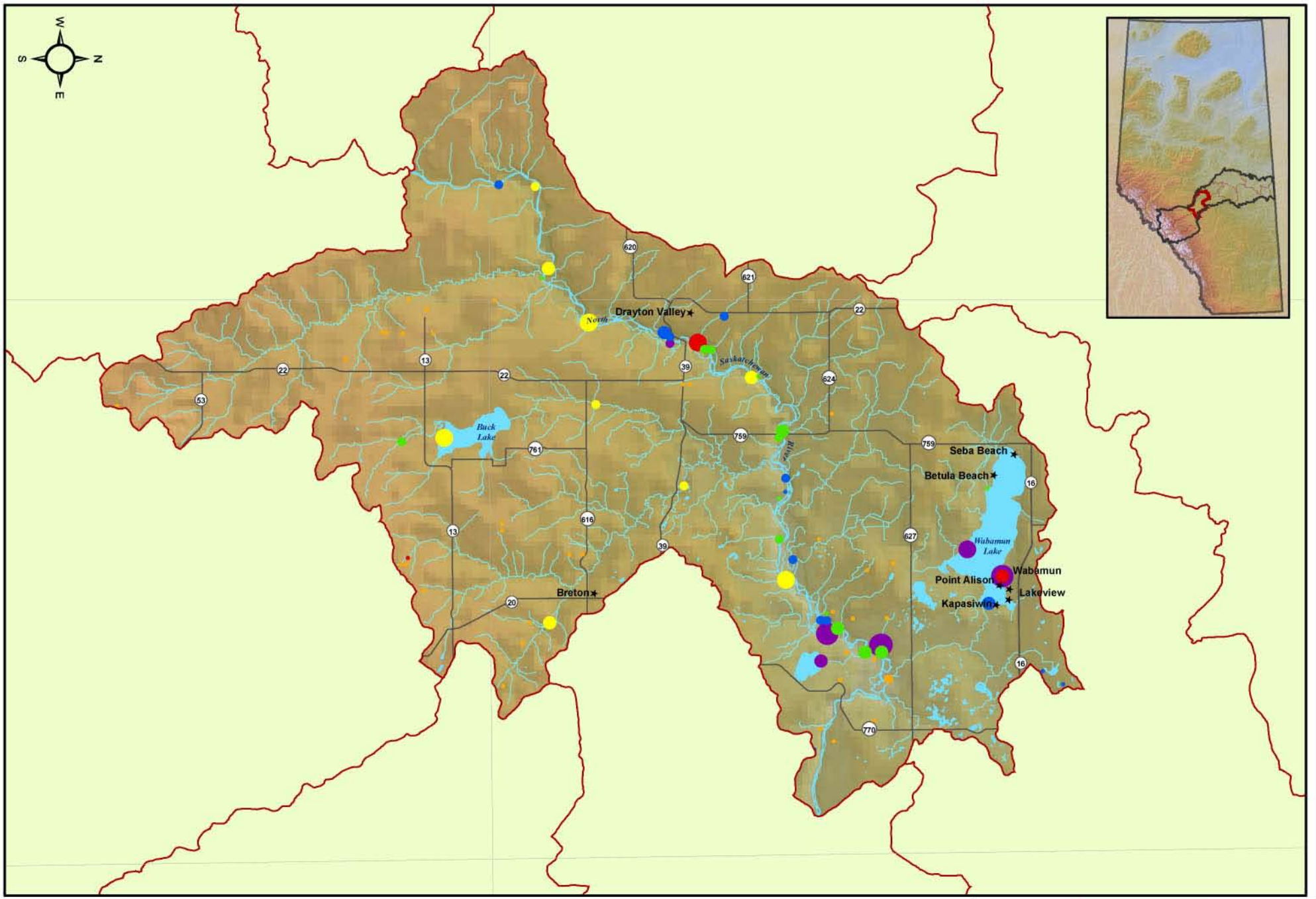
An overview of current surface and groundwater allocations is provided in Figure 7-1. It shows that the industrial sector accounts for 99 percent of total allocations in the Modeste Sub-basin, this sector has allocations of 851,255 dam^3 in 2005.. The remaining allocations are for agricultural (including registrations), municipal, commercial, petroleum and other sectors. Total allocations in the sub-basin in 2005 were 870,693 dam^3 of which groundwater accounted for only 3,147 dam^3 or 0.3 percent of the total.

Figure 7-1 Distribution of Active Water Allocations in the Modeste Sub-basin



Figures 7-2 and 7-3 show the location, allocation and sector of all active water licences in the Modeste Sub-basin. The locations of registrations issued in this sub-basin are provided in Figure 7-4.

Figure 7-2 Modeste Sub-basin Surface Water Licences



Legend

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

Industry Category - Maximum Allowable Diversion (dam³/yr)

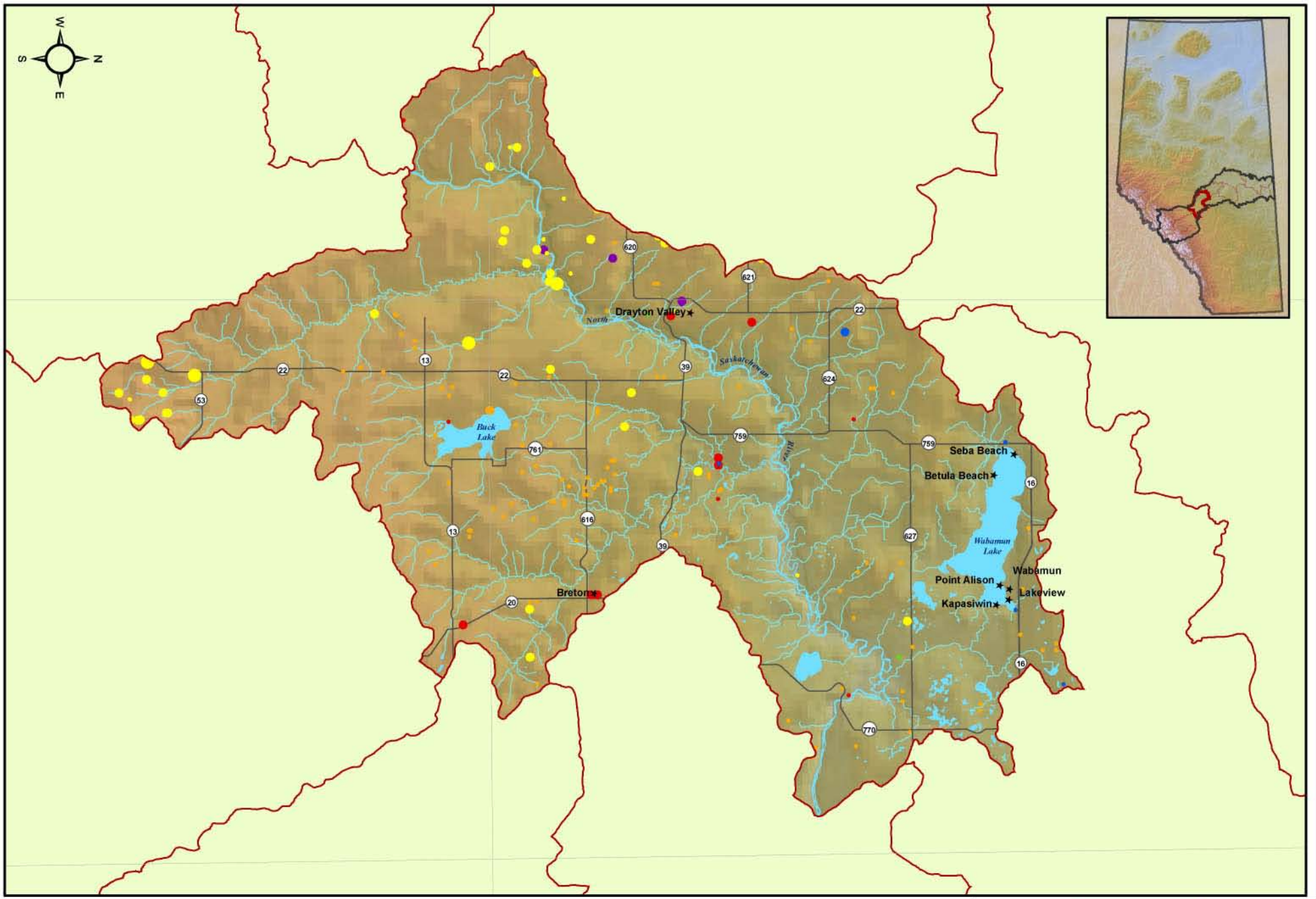
Commercial	Other	Petroleum	Municipal	Industrial	Agriculture
0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00
10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00
100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 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

Modeste Subbasin Surface Water Licenses

DATE: May 2007	1:600,000
AMEC PROJECT: EE27047	
GIS FILE: SW_SB_Modeste.mxd	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: SW_SB_Modeste.pdf	
PREPARED BY: amec	FIGURE 7-2

Figure 7-3 Modeste Sub-basin Groundwater Licences



Legend

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

Industry Category - Maximum Allowable Diversion (dam³/yr)

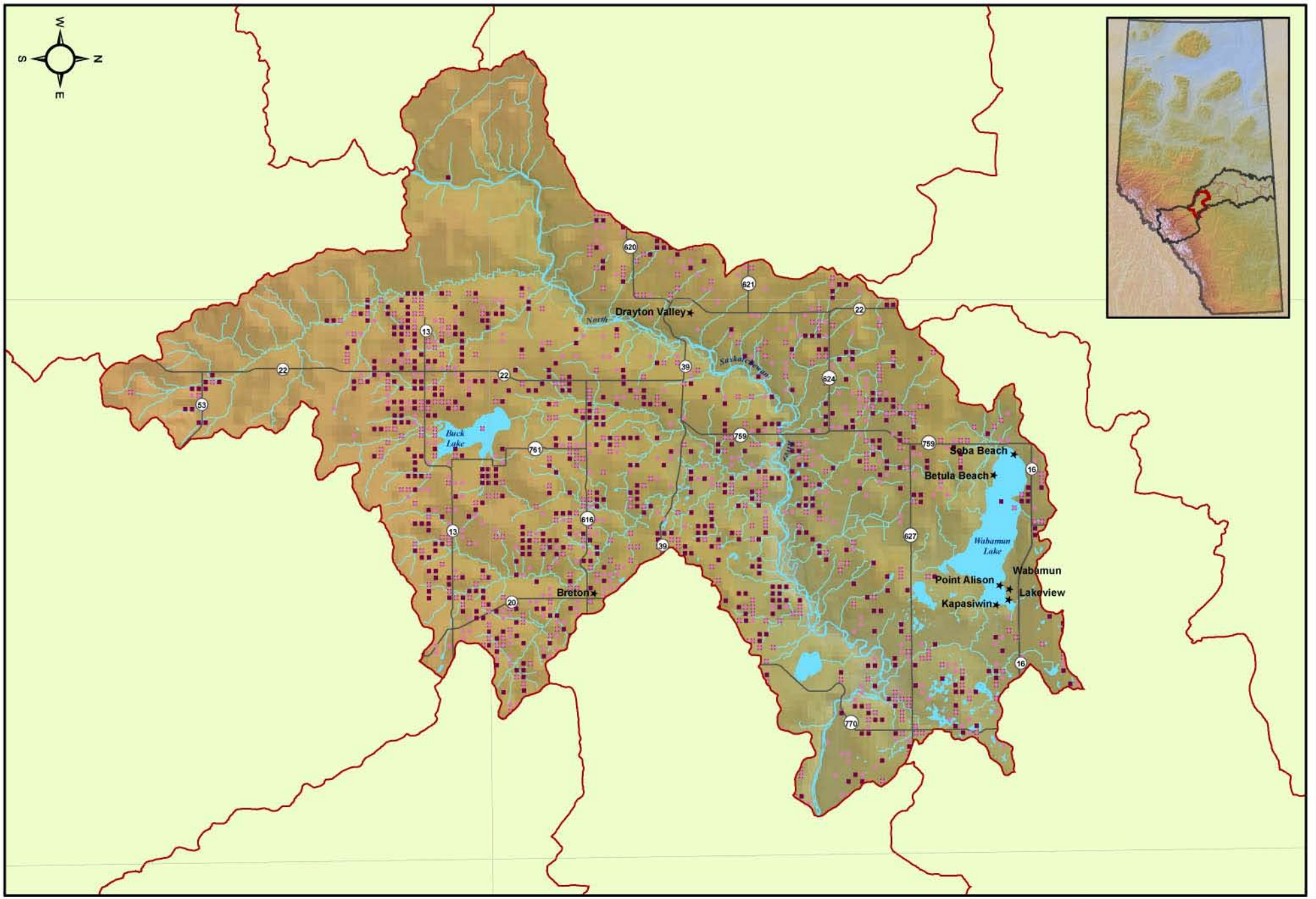
Commercial	Other	Petroleum	Municipal	Industrial	Agriculture
0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00	0.01 - 10.00
10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00	10.01 - 100.00
100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 1000.00	100.01 - 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

Modeste Subbasin Groundwater Licenses

DATE: May 2007	1:600,000
AMEC PROJECT: EE27047	
GIS FILE: GW_SB_Modeste.mxd	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: GW_SB_Modeste.pdf	
PREPARED BY: amec	FIGURE 7-3

Figure 7-4 Modeste 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

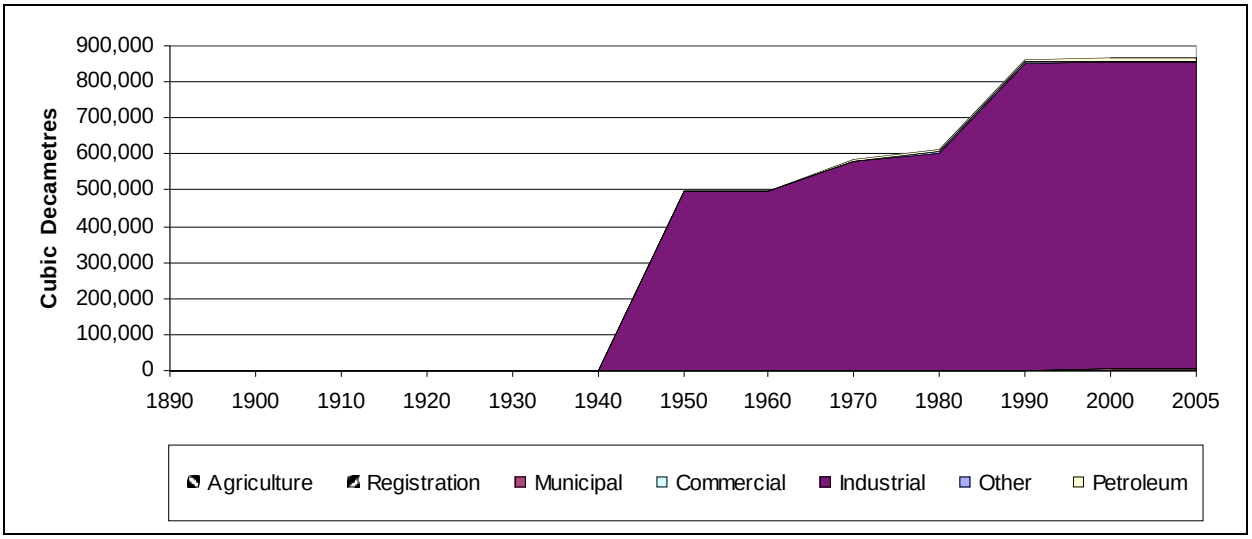
North Saskatchewan Watershed Alliance

MODESTE SUBBASIN REGISTRATIONS

DATE: MAY 2007	1:600,000
AMEC PROJECT: EE27047	
GIS FILE: RG_SB_MODESTE.MXD	PROJECTION: 10TM | DATUM: NAD83
PDF FILE: RG_SB_MODESTE.PDF	
PREPARED BY: amec	FIGURE 7-4

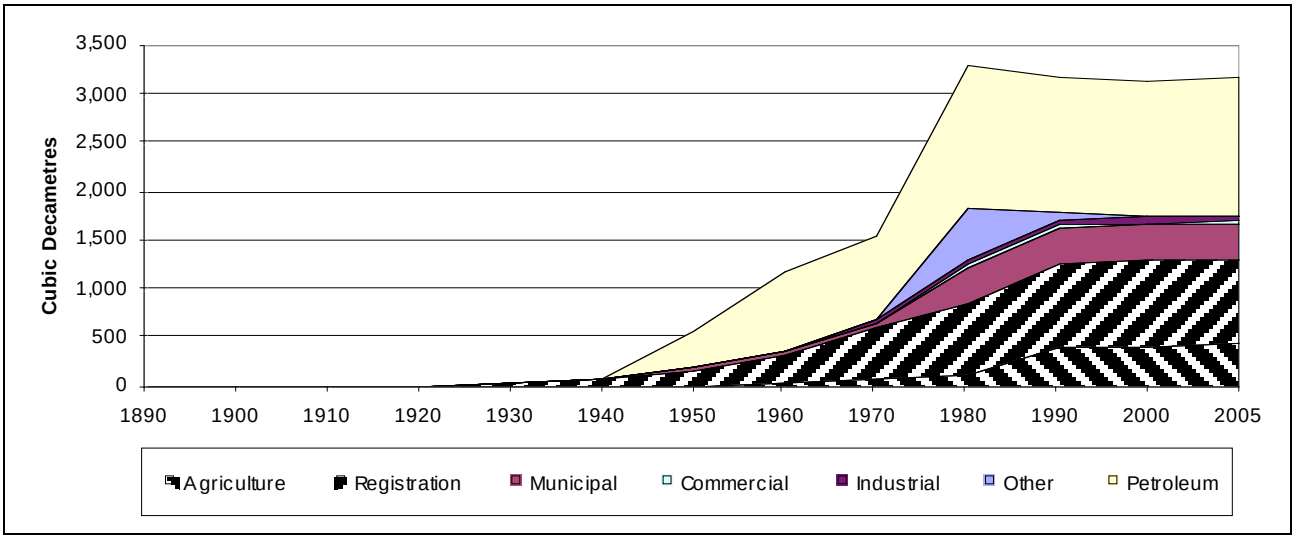
An historical perspective on water allocated among the sectors is provided in Figure 7-5 (surface water) and Figure 7-6 (groundwater). The largest allocations for surface water in the Modeste Sub-basin are for the industrial sector; these allocations were first issued in the 1940s and have undergone sharp increases followed by periods of relative stability, likely associated with requirements for thermal power cooling. Allocations have remained unchanged since the 1990s. Allocations for registrations were first issued in the 1890s and increased through to the 1990s but have remained unchanged since that time. Agriculture, municipal, commercial, other and petroleum sectors were also issued surface water allocations since the 1960s but since 2000 these allocations have remained unchanged except for the petroleum sector which declined slightly.

Figure 7-5 Historical Trends in Surface Water Allocation in the Modeste Sub-basin



The two largest allocations for groundwater are for the petroleum sector and registrations. Petroleum sector allocations were first issued in the 1940s but allocations have grown substantially, but have remained relatively unchanged since 1980. Registration allocations began in the early 1900s and have increased through to the 1990s but since that time the allocations have remained unchanged. Agriculture, commercial, industrial, and other sectors are also allocated groundwater in the sub-basin and some of these allocations were first issued in the early 1940s.

Figure 7-6 Historical Trends in Groundwater Allocation in the Modeste Sub-basin



7.1 Municipal and Residential Sector

7.1.1 Population

The population of Modeste Sub-basin is predominantly rural, as shown in Table 7-1. Just over a quarter of the population live in urban municipalities. There is one First Nation in the Modeste Sub-basin and it accounts for less than four percent of the population. Urban municipalities had the highest growth rate from 2001 to 2006 at almost 13 percent, followed by the sole First Nation, Paul Band, which grew by 11 percent. Rural municipalities grew more slowly over the inter-censal period: by less than seven percent.

Table 7-1 Population Distribution and Growth in the Modeste Sub-basin

	2006		2001	2001 to 2006 Population Change
	Population	Percent	Population	Percent
Urban Municipality	8,352	26.0%	7,423	12.5%
Rural Municipality	22,653	70.5%	21,254	6.6%
First Nations and Métis Settlements	1,108	3.5%	998	11.0%
Total	**32,113**	**100.0%**	**29,675**	**8.2%**

Table 7-2 lists all municipalities situated in the Modeste Sub-basin, their estimated 2006 sub-basin populations, and a summary of their water licence information. The major population centre is the Town of Drayton Valley (6,893 residents). The municipality with the largest population, however, is Parkland County (16,248 residents). Paul Band has a population of 1,108 residents.

7.1.2 Allocations

As of 2005, 25 active municipal water licences had been issued to 15 licensees in Modeste Sub-basin. These licences allow maximum withdrawals of 4,323 dam^3 per year. As shown in Figure 7-1, municipal sector account for less than one percent of all water allocations in the sub-basin. Eighty-four percent of the municipal allocation is for Drayton Valley.

Surface water licences account for 92 percent of total municipal water allocations. The maximum amount of surface water that can be withdrawn in Modeste Sub-basin by the municipal sector is 3,965 dam^3. Urban municipal licences account for the majority of surface water allocations (almost 3,960 dam^3). In contrast, surface water allocations for rural and other municipal uses amounted to less than 6 dam^3.

Groundwater licences represent 8 percent of total municipal water allocations. Licences allow withdrawals of up to 358 dam^3, of which urban users can withdraw up to 272 dam^3. Rural users can withdraw up to 65 dam^3 of groundwater and other users are allocated withdrawals of 20 dam^3.

Table 7-2 Municipal Populations and Water allocations within Modeste Sub-basin

Municipal Name		2006 Population	Source	2005 Allocation (dam^3)
Urban	TOWN OF DRAYTON VALLEY	6,893	SURFACE	3,632.7
	VILLAGE OF WABAMUN	601	SURFACE	326.9
	VILLAGE OF BRETON	550	GROUNDWATER	126.8
	SUMMER VILLAGE OF SEBA BEACH	203		
	SUMMER VILLAGE OF KAPASIWIN	39		
	SUMMER VILLAGE OF LAKEVIEW	36		
	SUMMER VILLAGE OF BETULA BEACH	15		
	SUMMER VILLAGE OF POINT ALISON	15		
Rural	PARKLAND COUNTY	16,248		
	BRAZEAU COUNTY	4,534	GROUNDWATER	31.8
	COUNTY OF WETASKIWIN NO. 10	1,582	GROUNDWATER	24.7
	CLEARWATER COUNTY	179		
	LEDUC COUNTY	109		
	LAC STE. ANNE COUNTY	0		
Aboriginal	PAUL BAND	1,108		

Licensees that are not municipalities but have municipal water use licences within the Modeste Sub-basin are shown in Table 7-3.

Table 7-3 Additional Municipal Water Use Licensees in the Modeste Sub-basin

Licensee	Water Source	Allocation (dam^3)
CONDOMINIUM CORPORATION NO. 882 0814	GROUNDWATER	120.9
LOOKMANJEE, PURVIZ	GROUNDWATER	30.8
ST JOHN'S SCHOOL OF ALBERTA	GROUNDWATER	16.0
ALBERTA LAND AND FOREST SERVICE	SURFACE	4.9
BEV SIEGEL DEVELOPMENTS INC.	GROUNDWATER	3.3
PARKLAND SCHOOL DIVISION NO. 70	GROUNDWATER	2.5
BOTSFORD, SHERWOOD	SURFACE	0.9
GASKELL, ALAN	GROUNDWATER	0.6
BURLINGTON RESOURCES CANADA LTD.	GROUNDWATER	0.1

7.1.3 Licensed Water Use

Table 7.3 summarizes licensed water use for the municipal sector in the Modeste Sub-basin. Under the terms of these licences, about 2,812 dam^3 is expected to be used with the balance (35 percent or 1,511 dam^3) expected to be returned. Seventy-six percent of allocated rural groundwater is designated as return flow, whereas 45 percent and 34 percent of allocated urban groundwater and surface water are assigned as return flow, respectively. All other allocations are expected to return flow.

7.1.4 Actual Water Use

Water use data from the MWWS is available for the town of Drayton Valley and Parkland County, the jurisdictions with the largest populations in the Modeste Sub-basin. However, there are data issues for each of these jurisdictions that make estimation of actual municipal water use in the sub-basin difficult. According to MWWS, Drayton Valley diverted 1,821 dam^3 of water and returned 5,947 dam^3 of water in 2004, which implies a water use of -4,127 dam^3. Discussion with Darcy Bryant at Drayton Valley Public Works (pers. comm. 2007) provided an explanation for this large negative water use value. In 2004, Drayton Valley was providing wastewater services to at least 1,200 homes in the outlying area that were not connected to Drayton Valley's water system. These homes were drawing water from private wells. Drayton Valley is progressively bringing more of these homes into the Town's water supply system through time, so the discrepancy between water and wastewater flows will correspondingly diminish. The second factor explaining the discrepancy is metering error. Drayton Valley has made adjustments to fix metering errors so that future flow data will be more reliable. In the case of Parkland County, its water distribution system (Acheson/Big Lake) only serves 4 percent of the municipal population so cannot be considered representative of Parkland County's municipal water use. Furthermore, according to the EMS database Parkland County does not possess a water licence. Therefore, flow data for Modeste Sub-basin municipalities cannot be used to estimate municipal water use in the sub-basin.

As an alternative, the per capita municipal water use for the North Saskatchewan Basin can be substituted and then multiplied by the Modeste Sub-basin population to estimate municipal water use in the sub-basin. In 2004, Information from the MWWS indicates that water use for municipalities with a combined population of 1,160,860, averaged 9 m^3 per capita. When

adjusted to account for stormwater and groundwater contributions to wastewater flows, municipal water use averaged 12 m^3 per capita. It should be noted, however, that there is uncertainty about the accuracy of this value given the prevalence of metering errors across municipalities, the degree to which municipalities are providing wastewater services to municipal users that have their own private wells and are therefore are not included in the water supply system flows, and the degree to which water services are supplied to users within and outside respective municipalities who in turn are not provided with wastewater services.

Assuming that the per capita municipal diversions, water use and returns for the Modeste Sub-basin are the same as those for the North Saskatchewan Basin as a whole, while accounting for groundwater and stormwater contributions to wastewater return flows and population growth from the MWWS 2004 data year, the estimated actual water use for the Modeste Sub-basin is 391 dam^3 during 2005 (14 percent of licensed use). This corresponds to withdrawals of 3,631 dam^3 and returns of 3,240 dam^3. These total estimates are apportioned according to the licensed ratios, as shown in Table 7-4, to derive groundwater and surface water estimates for urban, rural and other municipal uses.

Table 7-4 Licensed Municipal Allocations and Use and Estimated Actual Use, Modeste 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	4	3,959.6	2,618.8	1,340.8	3,326	364	2,875
	Groundwater	9	272.4	151.2	121.2	229	21	260
	Subtotal	**13**	**4,232.0**	**2,770.0**	**1,462.0**	**3,555**	**385**	**3,135**
Rural**	Surface	1	4.9	4.9	0.0	4	1	0.0
	Groundwater	3	65.0	15.7	49.3	55	2	106
	Subtotal	**4**	**69.9**	**20.6**	**49.3**	**59**	**3**	**106**
Other***	Surface	1	0.9	0.9	0.0	1	0	0.0
	Groundwater	7	20.2	20.2	0.0	17	3	0.0
	Subtotal	**8**	**21.0**	**21.0**	**0.0**	**18**	**3**	**0.0**
Total	Surface	6	3,965.3	2,624.5	1,340.8	3,331	365	2,875
	Groundwater	19	357.6	187.0	170.5	300	26	366
	Total	**25**	**4,322.9**	**2,811.6**	**1,511.3**	**3,631**	**391**	**3,240**

* 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

7.1.5 Future Water Use Forecasts

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

Figure 7-7 Modeste Sub-basin Population Growth Forecasts

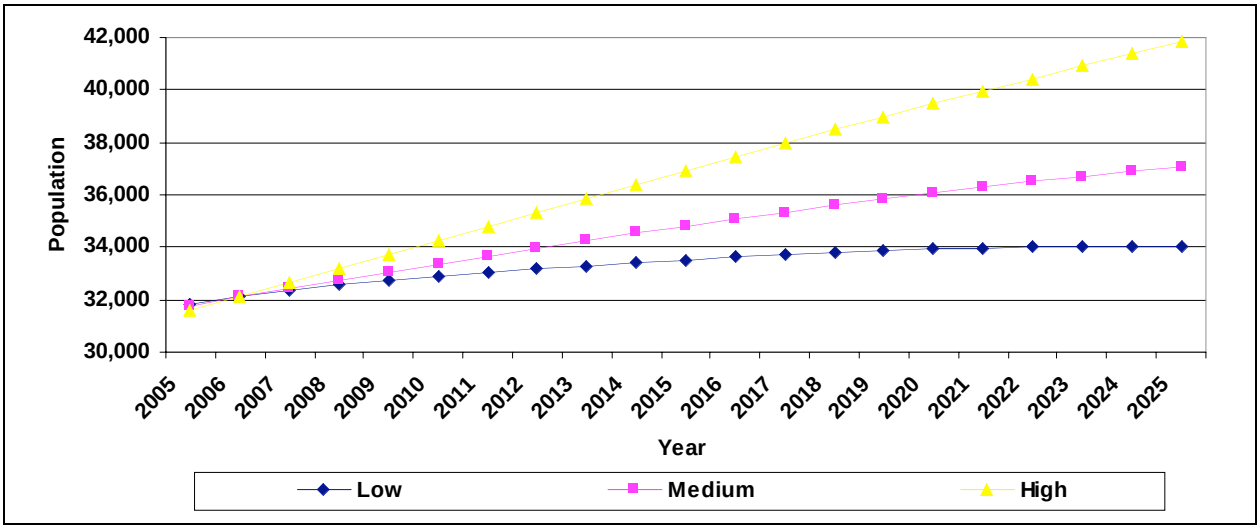


Table 7-5 Projected Municipal Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Population Growth	Surface	364	376	383	387	389
	Groundwater	26	27	27	28	28
	Total	**390**	**403**	**410**	**415**	**417**
Medium Population Growth	Surface	364	382	399	413	425
	Groundwater	26	27	28	30	30
	Total	**390**	**410**	**427**	**443**	**455**
High Population Growth	Surface	364	394	425	454	482
	Groundwater	26	28	30	32	34
	Total	**390**	**422**	**455**	**487**	**516**

Under the Low Population Growth scenario, municipal water use in 2025 is expected to be 7 percent greater than at present and actual water use will be 15 percent of the currently licensed use amount. Under the High Population Growth scenario, water use will increase by 32 percent over current levels and water use is expected to be 18 percent of the amount presently allowed in the licences.

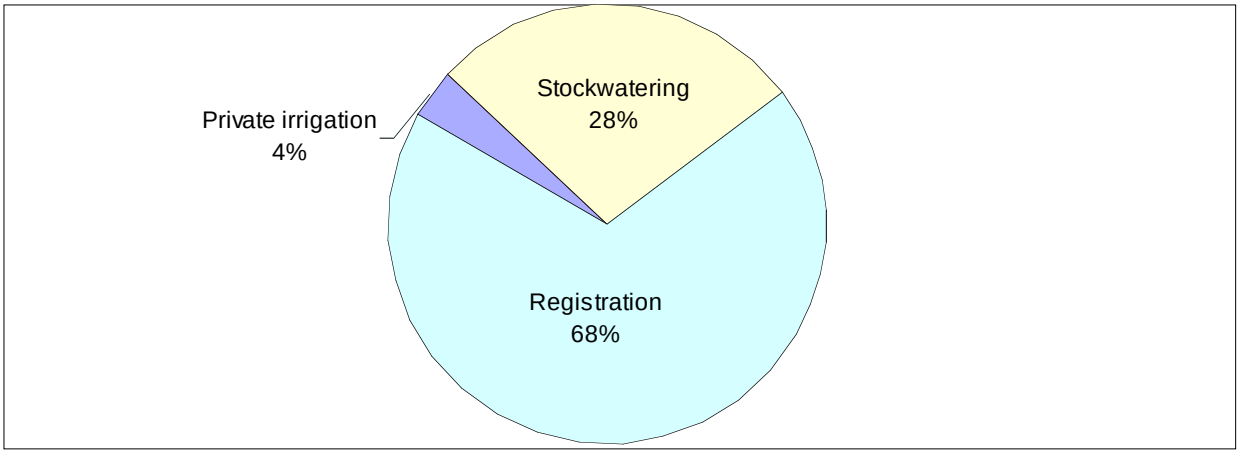
7.2 Agriculture Sector

As of December 2005 a total of 618 dam^3 had been allocated to the agricultural sector in the Modeste Sub-basin. This includes 2,492 registrations representing 1,342 dam^3 and 188 licences representing 618 dam^3 of water. Water allocated to agriculture accounts for less than one percent of all allocation in the Modeste Sub-basin.

Figure 7-8 shows how this water is distributed among the different agricultural activities in the sub-basin. The largest allocation is for registration (68 percent). Stockwatering accounts for 28 percent and private irrigation accounts for 4 percent of total allocations.

A total of 1,350 registrations and 42 licences allow withdrawal of up to 653 dam^3 of surface water; this accounts for 33 percent of water allocations for the agricultural sector. Groundwater accounts for the other 67 percent of allocations, with 1,307 dam^3 being allocated through 146 licences and 954 registrations.

Figure 7-8 Water Allocation for Agricultural Activities in the Modeste Sub-basin



7.2.1 Overview of Agriculture

Based on information from the 2001 Census of Agriculture, there were about 1,399 farms in the Modeste Sub-basin (11.4 percent of North Saskatchewan total) with an average size of 465 acres. At the North Saskatchewan Basin level there are about 12,300 farms with an average size of 625 acres. Farms in the Modeste Sub-basin cover an area of nearly 650,000 acres; this is equivalent to about 2,627 km^2 or about 54 percent of the sub-basin. As shown in Table 7-6, 45 percent of the land in the basin is used to raise crops. About 45 percent of agricultural land is pasture. The rest of the lands are in summer fallow or other uses.

Table 7-6 Agricultural Land Use in the Modeste Sub-basin, 2001

Land Use	Acres	Percent
Crop Land	292,603	45.1%
Summerfallow	12,447	1.9%
Tame/Seeded Pasture	136,236	21.0%
Natural Pasture	141,871	21.9%
Other	65,960	10.2%
Total	**649,116**	**100.0%**

The types of farming activity vary within the sub-basin. Table 7-7 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 Modeste Sub-basin accounts for 11.4 percent of total farms in the North Saskatchewan. About 54 percent of the farms in the sub-basin raise beef cattle and about 19 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 a proportionately higher share. The general mix of other types of farms is different for both Modeste and North Saskatchewan with most of the farms in the sub-basin focused on cattle, speciality, and field crops.

Table 7-7 Classifications of Farms in the Modeste 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	2.9%	16.5%	1.9%
Cattle (beef) Farms	53.5%	13.0%	45.8%
Hog Farms	1.1%	8.9%	1.4%
Poultry & Egg Farms	0.9%	9.0%	1.1%
Wheat Farms	1.3%	3.5%	4.2%
Grain & Oilseed Farms	7.8%	4.4%	19.6%
Field Crop Farms	9.5%	12.3%	8.6%
Fruit Farms	0.3%	18.3%	0.2%
Misc. Specialty Farms	19.0%	16.4%	12.9%
Sum of Livestock Comb. Farms	2.3%	9.8%	2.6%
Sum of Vegetable Farms	0.2%	12.5%	0.1%
Sum of Other Comb Farms	1.4%	10.3%	1.5%
Total	**100%**	**11.4%**	**100%**

7.2.2 Stockwatering

As noted in Table 7-7 about 57 percent of farms in the Modeste Sub-basin were classified as livestock operations, primarily cattle. Estimated livestock populations for major species are provided in Table 7-8. The table shows that there are about 120,000 cattle and calves which, together, accounted for about 43 percent of the livestock population. Other livestock in the sub-basin include poultry, pigs, sheep and lamb, horses and ponies, bison, deer and elk.

Table 7-8 Estimated Livestock Populations in the Modeste Sub-basin, 2001

Livestock Species	Modeste	North Saskatchewan	% North Saskatchewan
Hens and Chicken	116,201	3,090,930	3.8%
Turkey	21,161	41,519	51.0%
Cattle	83,124	990,169	8.4%
Calves	38,309	365,725	10.5%
Pigs	13,200	232,169	5.7%
Sheep and Lamb	4,907	55,204	8.9%
Horse and Ponies	4,449	35,172	12.6%
Bison	2,635	18,906	13.9%
Deer	191	2,864	6.7%
Elk	1,107	6,426	17.2%

7.2.2.1 Water Allocation

Overall, 2,490 licences and registrations have been issued for livestock watering with total allocation amounting to 1,889 dam^3. In addition to these allocations, farmers are able to obtain up to 1,250 m^3 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 7-9 summarizes current water licences and registrations issued for livestock according to the water source. It shows that surface water accounts for about 33 percent of allowable diversions for livestock and that registrations account for 71 percent of the allocations.

7.2.2.2 Licensed Water Use

Table 7-10 shows that licences and registrations issued for stockwatering assume that all water will be used and that there will be no return flow.

7.2.2.3 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 Modeste Sub-basin. However, a reasonable estimate of water use can be derived using the actual animal population in the basin provided in Table 7-8. Based on livestock populations for the Modeste Sub-basin in 2001, the total water required for livestock was estimated to be 1,219 dam^3, or about 65 percent of the licensed allocation.[1] The calculations for this estimate are provided also in Table 7-10 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 87 percent of the total, about 3 percent is required by pigs, and all other species accounted for the remaining 10 percent.

[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 7-9 Summary of Water Licences and Registrations Issued for Livestock Watering in the Modeste 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)
Registration	Surface	1,350	473.5	473.5	0.0	0	N/A
	Groundwater	954	868.9	868.9	0.0	0	N/A
	Subtotal	**2,304**	**1,342.4**	1,342.4	**0.0**	**0**	**N/A**
Stockwatering	Surface	40	108.0	108.0	**0.0**	0	N/A
	Groundwater	146	438.1	438.1	**0.0**	0	N/A
	Subtotal	**186**	**546.2**	546.2	**0.0**	**0**	**N/A**
Total	Surface	1,390	581.5	581.5	0.0	0	N/A
	Groundwater	1,100	1,307.0	1,307.0	0.0	0	N/A
	Total	**2,490**	**1,888.6**	**1,888.6**	**0.0**	**0**	**N/A**

The estimated actual consumption (1,219 dam^3) based on livestock populations shown in Table 7-10 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).

Table 7-10 Estimated Livestock Water Requirements for 2001

Livestock Species	Animal Population	Daily Consumption (gallons)	Annual Use (dam^3)
Hens and Chickens	116,201	0.045	8.7
Turkey	21,161	0.15	5.3
Bulls	1,757	9.0	26.2
Milk Cows	2,073	30.0	103.1
Beef Cows	40,861	9.0	609.8
Heifers	9,185	6.0	91.4
Steers	3,784	6.0	37.7
Calves	38,309	3.0	190.6
Boars	75	6.5	0.8
Sows and Gilts - Breeding	1,347	6.5	14.5
Nursing and Weaner Pigs	4,111	0.5	3.4
Grower and Finishing Pigs	7,667	1.5	19.1
Sheep and Lambs	4,907	2.0	16.3
Horse and Ponies	4,449	10.0	73.8
Bison	2,635	2.0	8.7
Deer	191	10.0	3.2
Elk	1,107	3.5	6.4
Total			1,219.0

Since 27 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 1,421 dam^3 would be required to support the animal populations in Table 7-10. This water requirement is about 75 percent of the water allocation through licences and registrations.

7.2.2.4 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 new or 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 for 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 factors include groundwater and landscape for backgrounding operations. For finishing operations the limiting factor is silage. Based on Alberta Agriculture's assessment, it would appear that there are some opportunities for backgrounding operations in the Modeste Sub-basin. Table 7-11 shows water use projections to 2025. By 2025, relative to 2005, water use is expected to be 11 percent, 30 percent and 60 percent higher under Low, Medium and High Growth Scenarios, respectively**.**

Table 7-11 Projected Water Use for Livestock in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	577	591	607	624	641
	Groundwater	844	864	888	912	937
	Total	**1,421**	**1,455**	**1,495**	**1,536**	**1,578**
Medium Growth	Surface	577	614	654	697	743
	Groundwater	844	898	957	1,020	1,087
	Total	**1,421**	**1,511**	**1,611**	**1,718**	**1,831**
High Growth	Surface	577	647	727	816	915
	Groundwater	844	946	1,063	1,194	1,339
	Total	**1,421**	**1,593**	**1,790**	**2,010**	**2,254**

7.2.3 Irrigation

The other major use of water for agricultural purposes is irrigation or crop watering. Irrigation in this 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 205 acres of land in the Modeste 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 60 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.

7.2.3.1 Water Allocation

There are two licences that allocate approximately 72 dam^3 for irrigation purposes. All of this allocation is from surface water.

7.2.3.2 Licensed Use

Table 7-12 shows that irrigation licences assume all withdrawals will be consumed and that no water will be returned after use.

Table 7-12 Irrigation Allocations and Use and Reported Actual Water Use, Modeste 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	71.9	71.9	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A
	Subtotal	**2**	**71.9**	**71.9**	**0.0**	**0**	**N/A**
Total	Surface	2	71.9	71.9	0.0	0	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A
	Total	**2**	**71.9**	**71.9**	**0.0**	**0**	**N/A**

7.2.3.3 Actual Water Use

Neither Alberta Agriculture nor Alberta Environment have 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 (1,421 dam^3) is 20 times the amount of water used for crop watering.

7.2.3.4 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 remain at 72 dam^3 over the forecast period.

7.2.4 Summary

In summary, current agricultural water use in the Modeste Sub-basin is estimated to be about 1,493 dam^3, of which 95 percent is for stockwatering and five 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 7-13 shows a summary of future agricultural water use.

Table 7-13 Projected Water Use for Agriculture in the Modeste Sub-Basin
(dam^3)

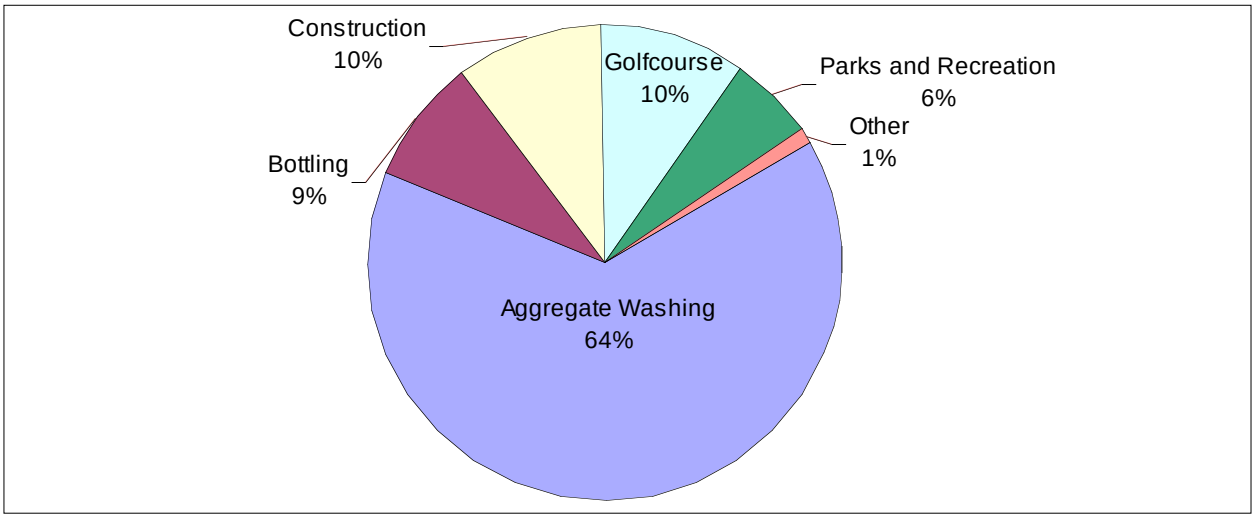
Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	649	663	679	696	713
	Groundwater	844	864	888	912	937
	Total	**1,493**	**1,527**	**1,567**	**1,608**	**1,650**
Medium Growth	Surface	649	686	726	769	815
	Groundwater	844	898	957	1,020	1,087
	Total	**1,493**	**1,583**	**1,683**	**1,790**	**1,903**
High Growth	Surface	649	719	799	888	987
	Groundwater	844	946	1,063	1,194	1,339
	Total	**1,493**	**1,665**	**1,862**	**2,082**	**2,326**

Agricultural water use in 2025 would be about 1,650 dam^3 (an increase of 11 percent from 2005) under the Low Growth. Under High Growth, water use is projected to be 2,326 dam^3 by 2025; this represents (an increase of 56 percent from 2005). For the Medium Growth, agricultural water use in 2025 is expected to increase by 27 percent over current levels.

7.3 Commercial Sector

There are 17 licences that allow diversion of 545 dam^3 of water in the Modeste sub-basin. This allocation accounts for less than one percent of total allocations in the sub-basin.

Figure 7-9 Water Allocation for Commercial Activities in the Modeste Sub-basin



7.3.1 Water Allocations

Figure 7-9 shows how this allocation is distributed among the various commercial sector activities, including aggregate washing (64 percent), construction (10 percent), golf course (10 percent), parks and recreation (6 percent), bottling (9 percent) and other (1 percent). Surface water accounts for 92 percent of allocations and the largest allocation is for aggregate washing. Groundwater accounts for the remaining 8 percent of allocations and the largest allocation is for bottling.

7.3.2 Licensed Water Use

Table 7-14 provides a summary of licensed allocations, use and return for various activities within the commercial sector in the Modeste sub-basin. The table shows that all of the allocations expect all withdrawals to be used with no return flow.

7.3.3 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 the commercial sector in the Modeste 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 they are allowed. Although this assumption will overstate the actual commercial sector water use, this sector accounts for less than 1 percent of total allocations in the sub-basin so overall water use estimates are not likely to be greatly affected

Table 7-14 Licensed Commercial Allocations, Reported and Actual Water Use, Modeste Sub-basin

Activity	Source	Number of Licences	Licensed Allocation and Use (dam^3)			Reported Actual Water Use (dam^3)		
			Allocation	Water Use	Return	Licensees Reporting	Reported Use	Percent of Allocation
Aggregate Washing	Surface	7	351.0	351.0	0.0	0	N/A	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A	N/A
	Subtotal	**7**	**351.0**	351.0	**0.0**	**0**	**N/A**	**N/A**
Bottling	Surface	1	16.0	16.0	0.0	0	N/A	N/A
	Groundwater	1	30.8	30.8	0.0	0	N/A	N/A
	Subtotal	**2**	**46.9**	46.9	**0.0**	**0**	**N/A**	**N/A**
Construction	Surface	1	55.0	55.0	0.0	0	N/A	N/A
	Groundwater	0	0.0	0.0	0.0	0	N/A	N/A
	Subtotal	**1**	**55.0**	55.0	**0.0**	**0**	**N/A**	**N/A**
Golf Course	Surface	1	51.8	51.8	0.0	0	N/A	N/A
	Groundwater	1	2.5	2.5	0.0	0	N/A	N/A
	Subtotal	**2**	**54.3**	54.3	**0.0**	**0**	**N/A**	**N/A**
Other	Surface	2	6.2	6.2	**0.0**	0	N/A	N/A
	Groundwater	0	0.0	0.0	**0.0**	0	N/A	N/A
	Subtotal	**2**	**6.2**	6.2	**0.0**	**0**	**N/A**	**N/A**
Parks and Recreation	Surface	1	20.5	20.5	**0.0**	0	N/A	N/A
	Groundwater	2	10.7	10.7	**0.0**	0	N/A	N/A
	Subtotal	**3**	**31.2**	31.2	**0.0**	**0**	**N/A**	**N/A**
Total	Surface	13	500.5	500.5	0.0	0	N/A	N/A
	Groundwater	4	44.0	44.0	0.0	0	N/A	N/A
	Total	17	544.5	544.5	0.0	**0**	**N/A**	**N/A**

7.3.4 Future Water Use Forecasts

Since most of the allocation (84 percent) is for three activities – aggregate washing, golf course, and construction, forecasts of future demand will be based on those activities.

7.3.4.1 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 changes 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). Water use projections using these assumptions are shown in Table 7-15. It is noted that although some of the licences are set to expire over the 2008 to 2013 period, it is assumed that the licences will be renewed for the duration of the forecast period under similar terms and conditions as at present.

Table 7-15 Projected Water Use for Aggregate Washing, Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	351	373	395	420	446
	Groundwater	0	0	0	0	0
	Total	**351**	**373**	**395**	**420**	**446**
Medium Growth	Surface	351	391	436	486	542
	Groundwater	0	0	0	0	0
	Total	**351**	**391**	**436**	**486**	**542**
High Growth	Surface	351	411	481	563	659
	Groundwater	0	0	0	0	0
	Total	**351**	**411**	**481**	**563**	**659**

By 2025, water use is expected to be 446 dam^3 under Low Growth and this is a 27 percent increase from 2005. Under High Growth water use is expected to 659 dam^3 which is 88 percent increase. Water use is expected to be 55 percent higher by 2025 under Medium Growth.

7.3.4.2 Golf Courses

The water demand forecast for golf courses follows the approach outlined in Watrecon (2005) which assumes that water demands will increase based on expansion of golf courses which will occur as a result of population growth. However, the population growth must be at a level that can, at a minimum, sustain one additional nine hole course before an expansion is expected to occur (*i.e.*. golf course expansion is not linearly related to population growth). Using this assumption, and given the population growth rate in the Modeste Sub-basin, golf course expansion is unlikely. Golf course water use is expected to remain unchanged at 54 dam^3 (96 percent from surface water) over the forecast period across all growth scenarios. This

method also assumes that the proportion of surface and groundwater will not change over the forecast period relative to 2005.

7.3.4.3 Construction

Future water use is not expected to change from the current water use of 55 dam^3, all from surface water, across all growth scenarios, for the duration of the forecast period.

7.3.5 Summary

A summary of the projected water demand for the commercial sector in the Modeste Sub-basin is provided in Table 7-16. Note that this forecast combines the estimates for aggregate washing, golf courses, and construction (which together account for 84 percent of allocation in the sub-basin), with the assumption that all of the water use allowed by licences issued to the remaining commercial activities is being fully utilized.

Under the Low Growth scenario, water use is projected to rise to 640 dam^3, a 17 percent increase from current levels by 2025. Under the High Growth scenario, water use is projected to rise to 853 dam^3, a 57 percent increase by 2025. Water use is projected to increase by 35 percent from the current level by 2025 under Medium Growth.

Table 7-16 Projected Water Use for the Commercial Sector, Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	501	523	545	570	596
	Groundwater	44	44	44	44	44
	Total	**545**	**567**	**589**	**614**	**640**
Medium Growth	Surface	501	541	586	636	692
	Groundwater	44	44	44	44	44
	Total	**545**	**585**	**630**	**680**	**736**
High Growth	Surface	501	561	631	713	809
	Groundwater	44	44	44	44	44
	Total	**545**	**605**	**675**	**757**	**853**

7.4 Petroleum Sector

In the Modeste Sub-basin, there are 54 active licences which allocate 10,414 dam^3 of water to the petroleum sector. Petroleum allocations accounts for 1 percent of total allocations in the sub-basin and about 0.5 percent of the total allocations in the North Saskatchewan River Basin. Most of the water allocated (87 percent) is for surface water (9,041.2 dam^3).

Almost all of the petroleum water allocations are for injection activities. Only a small amount of water has been allocated to gas and petrochemical activities (2.8 dam^3).

7.4.1 Injection

There are 51 water licences issued for injection activities in the Modeste Sub-basin. They allow withdrawals of up to 9,041 dam^3 of surface water and 1,370 dam^3 of groundwater. Injection water allocations commenced in the 1950s and have increased since then. Licensees are expected to consume 100 percent of the water they are licensed to withdraw.

7.4.1.1 Actual Water Use

A detailed summary of reported water used for injection in the Modeste Sub-basin was prepared by Geowa based on EUB data and presented in Table 7-17. In 2005, an estimated 1,619 dam^3 of fresh water was diverted for injection purposes. This volume includes 1,085 dam^3 of surface water and 534 dam^3 of groundwater. Based on the data, injection activities in the sub-basin are currently diverting and using approximately 16 percent of their total licensed allocations and use including 12 percent of their surface water allocations and 39 percent of their groundwater allocations About 15 dam^3 of saline water was also used for injection.

7.4.1.2 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, with 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 Modeste Sub-basin in Table 7-18 assumes declining rates of water use that match the rates at which oil production in Alberta is expected to decline.

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.

Table 7-17 Licensed Allocations, Estimated Actual Water Use for the Petroleum Sector, Modeste 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	16	9,041.2	9,041.2	0.0	1,085	12%	12%
	Groundwater	35	1,370.0	1,370.0	0.0	534	39%	39%
	Subtotal	**51**	**10,411.4**	**10,411.4**	**0.0**	**1,619***	**15%**	**15%**
Gas/ Petrochemical Plant	Surface	0	0.0	0.0	0.0	0		
	Groundwater	3	2.8	2.8	0.0	2	100%	100%
	Subtotal	**3**	**2.8**	**2.8**	**0.0**	**2****	**100%**	**100%**
Total	Surface	16	9,041.2	9,041.2	0.0	1,085	12%	12%
	Groundwater	38	1,370.0	1,370.0	0.0	536	39%	39%
	Total	**54**	**10,411.2**	**10,411.2**	**0.0**	**1,622**	**15%**	**15%**

* EUB water use data provided by GEOWA.
** Estimates assumes the licence holders are using the full entitlements of their licences.

Table 7-18 Forecast of Injection Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	1,085	1,085	636	636	379
	Groundwater	534	534	313	313	187
	Total	**1,619**	**1,619**	**949**	**949**	**566**
Medium Production	Surface	1,085	1,085	669	669	399
	Groundwater	534	534	329	329	197
	Total	**1,619**	**1,619**	**999**	**999**	**596**
High Production	Surface	1,085	1,085	760	760	454
	Groundwater	534	534	374	374	223
	Total	**1,619**	**1,619**	**1,134**	**1,134**	**677**

7.4.2 Gas/Petrochemical Plants

In the Modeste Sub-basin, there are three groundwater licences that has been issued for gas and petrochemical plant activities allowing for withdrawals of up to 3 dam^3. Gas and petrochemical plant water allocations commenced in the 1960s and increased only slightly overtime. Licensees are expected to consume 100 percent of the groundwater they are allowed to withdraw.

There is no information on the actual water diversions and consumption for the three gas and petrochemical plant licences. For purposes of this analysis, it is assumed that the licence holders are using their full entitlement. 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 Modeste Sub-basin will remain constant for the forecast period.

7.4.3 Summary

Relatively little water has been allocated to the petroleum sector in the Modeste Sub-basin. Of the water allocated almost all is for injection activities. Water use data shows that although water licences allow up to 10,411 dam^3 of water to be consumed for injection purposes, licensees are using about 16 percent of this amount.

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 Modeste Sub-basin are not expected to change in the forecast period. The overall water use projections for the petroleum sector are provided in Table 7-19. Under the Low Production scenario, water use for petroleum activities in 2025 will decline by 65 percent from current levels. Under the High Production scenario, the decline will be 58 percent.

Table 7-19 Forecast of Petroleum Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Production	Surface	1,085	1,085	636	636	379
	Groundwater	537	537	316	316	190
	Total	**1,622**	**1,622**	**952**	**952**	**569**
Medium Production	Surface	1,085	1,085	669	669	399
	Groundwater	537	537	332	332	199
	Total	**1,622**	**1,622**	**1,001**	**1,001**	**599**
High Production	Surface	1,085	1,085	760	760	454
	Groundwater	537	537	377	377	226
	Total	**1,622**	**1,622**	**1,137**	**1,137**	**680**

7.5 Industrial Sector

In the Modeste Sub-basin, there are 19 active licences which allocate 851,255 dam^3 of water to the industrial sector. Industrial allocations accounts for about 98 percent of total allocations in the sub-basin and 43 percent of the total allocations in the North Saskatchewan River Basin. Almost all of the water allocated is for surface water (851,190 dam^3) which accounts for 74 percent of the industrial licences.

The industrial sector in the Modeste Sub-basin includes mostly water allocations for cooling (99.9 percent), but there is also a small amount of water licensed to forestry and coal mining.

7.5.1 Cooling

Almost all of the allocations in the Modeste Sub-basin are for cooling purposes for thermal power generation (851,178 dam^3). Details of the licences issued to the industrial sector in the Modeste Sub-basin are provided in Table 7-20. The table shows that 13 licences have been issued for cooling purposes, all of this allocation being for surface water. Water use for cooling commenced in the 1950s but grew rapidly in the 1970s and 1990s.

7.5.1.1 Licensed Water Use

As shown in Table 7-20, the licences issued for cooling purposes expected that about 7 percent of surface water allocations will be used (62,364 dam^3) but the vast majority 788,814 dam^3 will be returned.

7.5.1.2 Actual Water Use

Actual water use data available for cooling is available from both the WURS database and data provided to AMEC by licence holders. There is water use information for nine of the 13 surface water licences issued for cooling plants in the Modeste Sub-basin. Analysis of the data indicates that there are two licence holders: EPCOR and TransAlta.

Table 7-20 Licensed Allocations and Estimated Water Use for the Industrial Sector, Modeste 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	13	851,177.6	62,364.0	788,813.6	64,387	103%	8%
	Groundwater	0	0.0	0.0	0.0	0		
	Subtotal	**13**	**851,177.6**	**62,364.0**	**788,813.6**	**64,387***	**103%**	**87%**
Forestry	Surface	0	0.0	0.0	0.0	0		
	Groundwater	3	33.9	33.9	0.0	800	2360%	2360%
	Subtotal	**3**	**33.9**	**33.9**	**0.0**	**800****	2360%	2360%
Mine-coal	Surface	1	12.3	12.3	0.0	12	100%	100%
	Groundwater	2	30.8	30.8	0.0	30	100%	100%
	Subtotal	**3**	**43.2**	**43.2**	**0.0**	**43****	**100%**	**100%**
Total	Surface	14	851,189.9	62,376.3	788,813.6	64,399	103%	8%
	Groundwater	5	64.7	64.7	0.0	830	1284%	1284%
	Total	**19**	**851,254.6**	**62,441.1**	**788,813.6**	**65,230**	**104%**	**8%**

***** Actual water use estimates based on WURS data.

** Actual water use estimates assume licence holders are using the full entitlement of their licences.

There is a fair bit of variability in how much of the licences are being utilities. EPCOR has five licences and is using 124 percent of the amount that its licences expected to be consumed. TransAlta has eight licences and is using about 98 percent of the water that its licences assume will be consumed. The water use estimates in Table 7-20 are based on the amount of water the companies have reported to WURS. The total water use by cooling plants in 2005 is estimated to be 64,387 dam^3 of surface water.

7.5.1.3 Forecasts of Future Water Use

For the forecast period, there two upgrades proposed for existing plants (Sundance and Keephills) and one plant is scheduled to retire (Wabamun). The forecast of future water use for cooling in the Modeste Sub-basin in Table 7-21 assumes water use will decline. The Low Growth scenario includes the retiring of Wabamun in 2010 but no increased water needs for Sundance and Keephills. The Medium Growth scenario includes the retiring of Wabamun in 2010 and the upgrades at Sundance and Keephills. The High Growth scenario includes Wabamun not retiring until 2015 and the upgrades for Sundance and Keephills occurring in 2010. The forecasts in Table 7-21 include the scheduled expiration of four surface water licences (708 dam^3 combined).

Table 7-21 Forecast of Cooling Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	64,387	26,015	26,015	26,015	26,015
	Groundwater	0	0	0	0	0
	Total	**64,387**	**26,015**	**26,015**	**26,015**	**26,015**
Medium Growth	Surface	64,387	30,285	30,285	30,285	30,285
	Groundwater	0	0	0	0	0
	Total	**64,387**	**30,285**	**30,285**	**30,285**	**30,285**
High Growth	Surface	64,387	67,949	30,285	30,285	30,285
	Groundwater	0	0	0	0	0
	Total	**64,387**	**67,949**	**30,285**	**30,285**	**30,285**

Under the Low Growth scenario, water use for cooling in 2025 will decline by almost 60 percent from current levels. Under the High scenario, water use could decline by 53 percent.

7.5.2 Forestry

Three groundwater licences have been issued to Weyerhaeuser for forestry activities. The licences allow withdrawals of up to 34 dam^3 of groundwater. Forestry water allocations commenced in the 1990s and increased only slightly in 2005. Licensees are expected to consume 100 percent of the groundwater they are allowed to withdraw.

There is water use information for one of the three licences. In 2005, the company reported using 798 dam^3. There is a second licence issued to the same location and it assumed that the reported water use was for both licences. For the third licence there is no actual water diversion or consumption information so it is assumed that the licensee was using the full entitlement of their licence in 2005. It is therefore estimated that forestry activities in the Modeste sub-basin used 800 dam^3.

In the absence of information about this component of the industrial sector, it is assumed that water used by forestry activities in the Modeste Sub-basin will remain constant for the forecast period, except for one licence (2 dam^3) that is due to expire in 2015.

Table 7-22 Forecast of Forestry Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Medium Growth	Surface	0	0	0	0	0
	Groundwater	800	800	798	798	798
	Total	**800**	**800**	**798**	**798**	**798**

7.5.3 Coal Mining

Three licences have been issued for coal mining purposes. One surface water licence allows withdrawals of up to 12 dam^3. The two groundwater licences allow withdrawals of up to 31 dam^3. Coal mining water allocations commenced in the 1950s for groundwater and in the 1960s for surface water. Total allocation has remained the same since. Licensees are expected to consume 100 percent of the water they allowed to withdraw. There is no information on actual water diversions and consumption for the coal mining sector and, for purposes of this analysis; it is assumed that licensees are using their full entitlement (43 dam^3). In the absence of information about this component of the industrial sector, it is assumed that water used by coal mining activities in the Modeste Sub-basin will remain constant for the forecast period.

7.5.4 Summary

The industrial sector in the Modeste Sub-basin is dominated by water allocated for cooling plants. These plants account for almost all of the allocations and 99 percent of actual water use in 2005. Water use data shows that although water licences expects that up to 62,441 dam^3 of water to be consumed for industrial purposes with the balance of withdrawals being returned after use, licensees are actually using 65,230 dam^3 (105 percent of this amount).

In the future, there is expected to be a decline in water requirements for cooling plants as the Wabamun plant is retired. The forecasts in Table 7-23 assume that future water use by all industrial activities except for cooling will remain the same over the forecast period and includes the scheduled expiration one forestry groundwater licence (2 dam^3).

Table 7-23 shows that, for all three scenarios, the overall demand for water in the Modest Sub-basin is expected to decrease over the forecast period due to the decrease in water required for cooling.

Table 7-23 Forecast of Industrial Water use in the Modeste Sub-basin

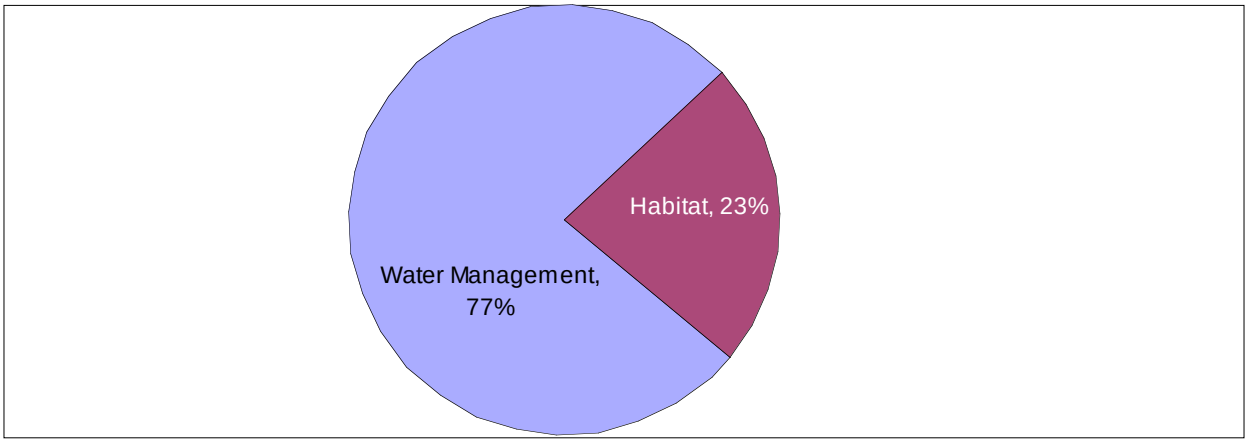
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Low Growth	Surface	64,399	26,027	26,027	26,027	26,027
	Groundwater	831	831	829	829	829
	Total	**65,230**	**26,858**	**26,856**	**26,856**	**26,856**
Medium Growth	Surface	64,399	30,297	30,297	30,297	30,297
	Groundwater	831	831	829	829	829
	Total	**65,230**	**31,128**	**31,126**	**31,126**	**31,126**
High Growth	Surface	64,399	67,961	30,297	30,297	30,297
	Groundwater	831	831	829	829	829
	Total	**65,230**	**68,792**	**31,126**	**31,126**	**31,126**

7.6 Other Sector

In the Modeste Sub-basin there are 21 active licences which allocate 2,197 dam^3 of water to the other sector, about 26 percent of which is expected to be returned after use. The other sector activities account for 0.2 percent of licensed water use in the Modeste Sub-basin. Almost all of the water allocated is for surface water (2,194 dam^3). Other sector uses include water management for flood control and lake stabilization, and fish, wildlife and habitat enhancement (Figure 7-10).

Figure 7-10 Other Sector Water Allocation by Use in the Modeste Sub-basin



Water licences have been issued to Alberta Environment (one), Alberta Infrastructure (one), Brazeau County (two), Burnco Rock Products Ltd (one), Dennis McGinn Holdings Ltd. (one), Ducks Unlimited (one), Highvale Thermal AquaFarm (one), KOS Trucking Ltd (one), Larfarge Canada Inc (one), Mixcor Aggregates Inc. (one), NewAlta Corp. (one), Parkland County (one), TransAlta (one), TRI M. Gravel Ltd (one), and private individuals (four).

Table 7-24 summarizes the water allocation, use, and return associated with the licences for each activity in the Modeste Basin.

Table 7-24 Licensed Allocations and Estimated Actual Water Use for the Other Sector, Modeste 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	11	1,691.3	1,130.4	560.9	1,130	100%	67%
	Groundwater	1	1.3	1.3	0.0	1	100%	100%
	Subtotal	**12**	**1,692.6**	**1,131.7**	**560.9**	1,132	**100%**	**67%**
Habitat	Surface	8	503.1	503.1	0.0	503	100%	100%
	Groundwater	1	1.2	1.2	0.0	1	100%	100%
	Subtotal	**9**	**504.3**	**504.3**	**0.0**	**504**	**100%**	**100%**
Total	Surface	19	2,194.4	1,633.5	560.9	1,634	100%	74%
	Groundwater	2	2.5	2.5	0.0	3	100%	100%
	Total	**21**	**2,196.9**	**1,636.0**	**560.9**	**1,636**	**100%**	**75%**

7.6.1 Water Management

In the Modeste Sub-basin, 11 surface water licences and one groundwater licence have been issued for water management activities including de watering of gravel pits. The licences allow for withdrawals of up to 1,691 dam^3 of surface water and 1 dam^3 of groundwater. Water management allocations commenced in the 1950s for surface water and the 1980s for groundwater both increased over time. Licences expect to use of up to 1,132 dam^3 and require 5610 dam^3 to be returned after use.

There is no information on the actual water diversions and consumption for water management licences and, for purposes of this analysis, it is assumed that the licence holders are using their full entitlement.

In the absence of information about this component of the other sector, it is assumed that water used by water management projects in the Modeste Sub-basin will remain constant for the forecast period. Although two surface water licences are scheduled to expire by 2010 and six more by 2015, it is assumed that these licences will be renewed.

Table 7-25 Forecast of Water Management Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	1,130	1,101	1,101	1,101	1,101
	Groundwater	1	1	1	1	1
	Total	**1,132**	**1,103**	**1,103**	**1,103**	**1,103**

Under the above scenario, water use for water management in 2025 will remain constant over the forecast period.

7.6.2 Habitat Enhancement

In the Modeste Sub-basin, eight surface water licences and one groundwater licence have been issued for wildlife and habitat enhancement projects. The licences allow for withdrawals of up to 503 dam^3 of surface water and 1 dam^3 of groundwater. Habitat enhancement allocations commenced in the 1980s, surface water allocations have increased since while groundwater licences have remained the same. Licensees are expected to use 100 percent of the water they are allowed to withdraw.

There is no information on the actual water diversions and consumption for habitat enhancement licences. For purposes of this analysis, it is assumed that licensees are 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 Modeste Sub-basin will remain constant for the forecast period. Although two surface water licences are scheduled to expire in 2010 and 2015, it is assumed that these will be renewed.

Table 7-26 Forecast of Habitat Enhancement Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
	Surface	503	500	500	500	500
	Groundwater	1	1	1	1	1
	Total	**504**	**501**	**501**	**501**	**501**

Under the above scenario, water use for water management in 2025 will remain constant over the forecast period.

7.6.3 Summary

The other sector in the Modeste Sub-basin is dominated by water allocated for water management. These projects account for 77 percent of the water allocation and 69 percent of the licensed water use.

In the absence of information about the other sector, it is assumed that water used for projects in the Modeste Sub-basin will remain constant for the forecast period.

Table 7-27 Forecast of Other Sector Water Use in the Modeste Sub-basin
(dam^3)

Scenario	Source	2005	2010	2015	2020	2025
Medium Growth	Surface	1,634	1,634	1,634	1,634	1,634
	Groundwater	2	2	2	2	2
	Total	**1,636**	**1,636**	**1,636**	**1,636**	**1,636**

7.7 Summary

Table 7-28 provides a summary of licensed allocations and estimated water use for each of the water use sectors in the Modeste Sub-basin. In total, existing licences and registrations allow a maximum of 870,693 dam^3 of water to be withdrawn. Of this total about 9 percent (79 dam^3) is expected to be used. Figure 7-11 shows the allocations, licensed use and actual use for the different sectors. Actual use (70,916 dam^3) is about 89 percent of licensed use. The largest water user is the industrial sector, notably water used for cooling at thermal power plants. Figure 7-11 shows the forecasts to 2025 for all of the sectors under Medium Growth. By 2025 water use is expected to decrease by about 57 percent under Low Growth (Table 7-29), about 51 percent under Medium Growth (Table 7-30), and about 48 percent under High Growth (Table 7-31).

Table 7-28 Summary of Allocations and Estimated Water Use, Modeste 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		4,323	2,812	1,511	4%	390	14%	1%
Agricultural	Stockwatering	1,887	1,887	0	2%	1,421	75%	2%
	Irrigation	72	72	0	0%	72	100%	0%
Commercial		545	545		1%	545	100%	1%
Petroleum		10,414	10,414	0	13%	1,622	16%	2%
Industrial		851,255	62,441	788,814	78%	65,230	104%	92%
Other		2,197	1,636	561	2%	1,636	100%	2%
Total		**870,693**	**79,807**	**790,886**	**100%**	**70,916**	**89%**	**100%**

Figure 7-11 Water Allocations and Actual Use, by Sector, Modeste Sub-basin

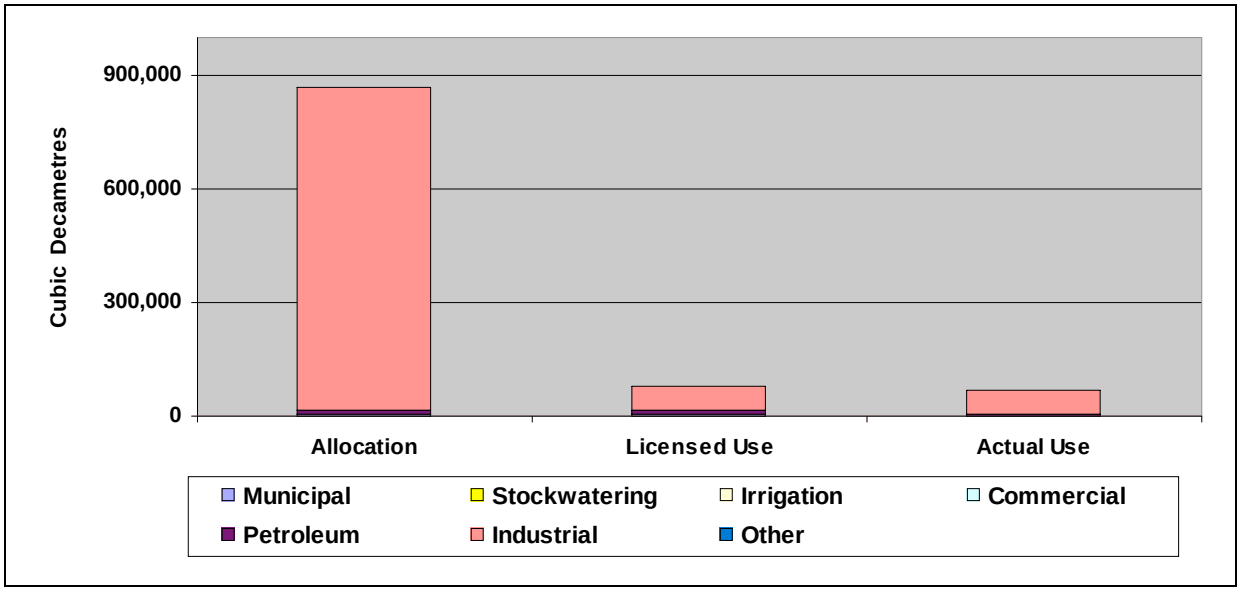


Figure 7-12 Forecast Water Use in Modeste Sub-basin: Medium Scenario

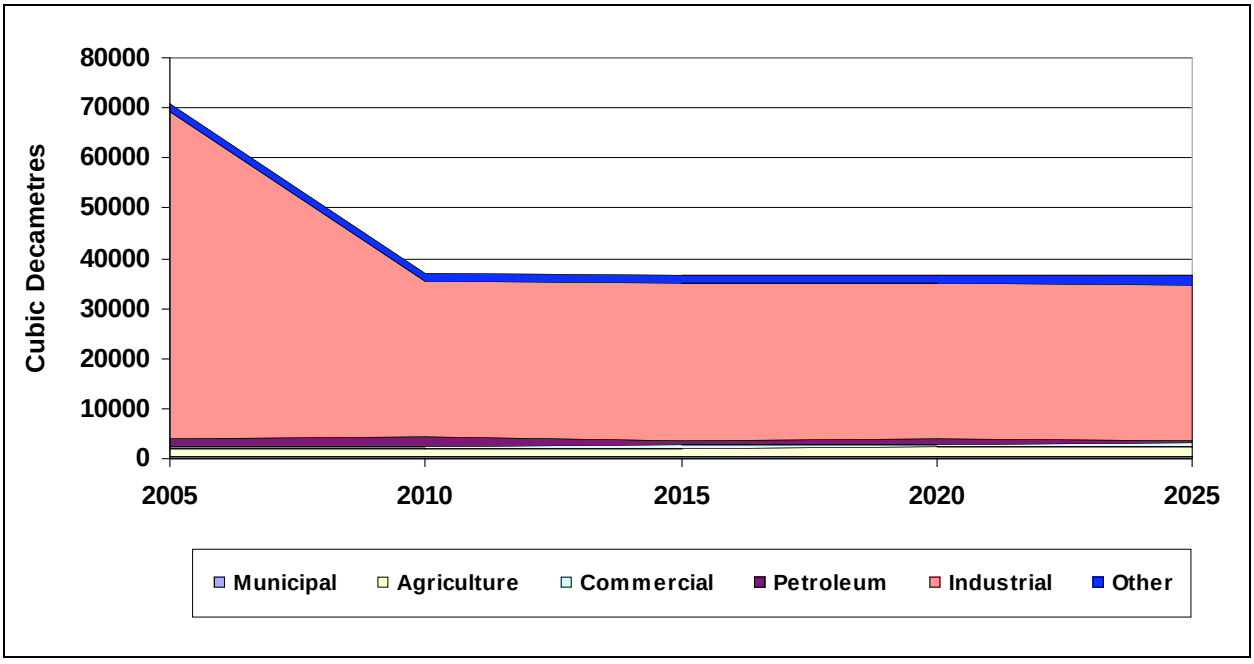


Table 7-29 Forecast Water Use, By Sector, Modeste Sub-basin: Low Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	364	376	383	387	389
	Agricultural	649	663	679	696	713
	Commercial	501	523	545	570	596
	Petroleum	1,085	1,085	636	636	379
	Industrial	64,399	26,027	26,027	26,027	26,027
	Other	1,634	1,634	1,634	1,634	1,634
	Total	**68,632**	**30,308**	**29,904**	**29,950**	**29,738**
Groundwater	Municipal	26	27	27	28	28
	Agricultural	844	864	888	912	937
	Commercial	44	44	44	44	44
	Petroleum	537	537	316	316	190
	Industrial	831	831	829	829	829
	Other	2	2	2	2	2
	Total	**2,284**	**2,305**	**2,106**	**2,131**	**2,030**
Total	Municipal	390	403	410	415	417
	Agricultural	1,493	1,527	1,567	1,608	1,650
	Commercial	545	567	589	614	640
	Petroleum	1,622	1,622	952	952	569
	Industrial	65,230	26,858	26,856	26,856	26,856
	Other	1,636	1,636	1,636	1,636	1,636
	Total	**70,916**	**32,613**	**32,010**	**32,081**	**31,768**

Table 7-30 Forecast Water Use, By Sector, Modeste Sub-basin: Medium Scenario
(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	364	382	399	413	425
	Agricultural	649	686	726	769	815
	Commercial	501	541	586	636	692
	Petroleum	1,085	1,085	669	669	399
	Industrial	64,399	30,297	30,297	30,297	30,297
	Other	1,634	1,634	1,634	1,634	1,634
	Total	**68,632**	**34,625**	**34,311**	**34,418**	**34,262**
Groundwater	Municipal	26	27	28	30	30
	Agricultural	844	898	957	1,020	1,087
	Commercial	44	44	44	44	44
	Petroleum	537	537	332	332	199
	Industrial	831	831	829	829	829
	Other	2	2	2	2	2
	Total	**2,284**	**2,339**	**2,192**	**2,257**	**2,191**
Total	Municipal	390	409	427	443	455
	Agricultural	1,493	1,584	1,683	1,789	1,902
	Commercial	545	585	630	680	736
	Petroleum	1,622	1,622	1,001	1,001	598
	Industrial	65,230	31,128	31,126	31,126	31,126
	Other	1,636	1,636	1,636	1,636	1,636
	Total	**70,916**	**36,964**	**36,503**	**36,675**	**36,453**

Table 7-31 Forecast Water Use, By Sector, Modeste Sub-basin: High Scenario

(dam^3)

Source	Sector	2005	2010	2015	2020	2025
Surface Water	Municipal	364	394	425	454	482
	Agricultural	649	719	799	888	987
	Commercial	501	561	631	713	809
	Petroleum	1,085	1,085	760	760	454
	Industrial	64,399	67,961	30,297	30,297	30,297
	Other	831	831	829	829	829
	Total	**67,829**	**71,551**	**33,741**	**33,941**	**33,858**
Groundwater	Municipal	26	28	30	32	34
	Agricultural	844	946	1,063	1,194	1,339
	Commercial	44	44	44	44	44
	Petroleum	537	537	377	377	226
	Industrial	831	831	829	829	829
	Other	2	2	2	2	2
	Total	**2,284**	**2,388**	**2,345**	**2,478**	**2,474**
Total	Municipal	390	422	455	486	516
	Agricultural	1,493	1,665	1,862	2,082	2,326
	Commercial	545	605	675	757	853
	Petroleum	1,622	1,622	1,137	1,137	680
	Industrial	65,230	68,792	31,126	31,126	31,126
	Other	833	833	831	831	831
	Total	**70,113**	**73,939**	**36,086**	**36,419**	**36,332**