Sustainable Water Management and Economic Development in Alberta

"Finding the balance between development and conservation is the great challenge of our time."

Premier Ed Stelmach
Alberta - A Plan for the Future
October 24, 2007

December 15, 2008

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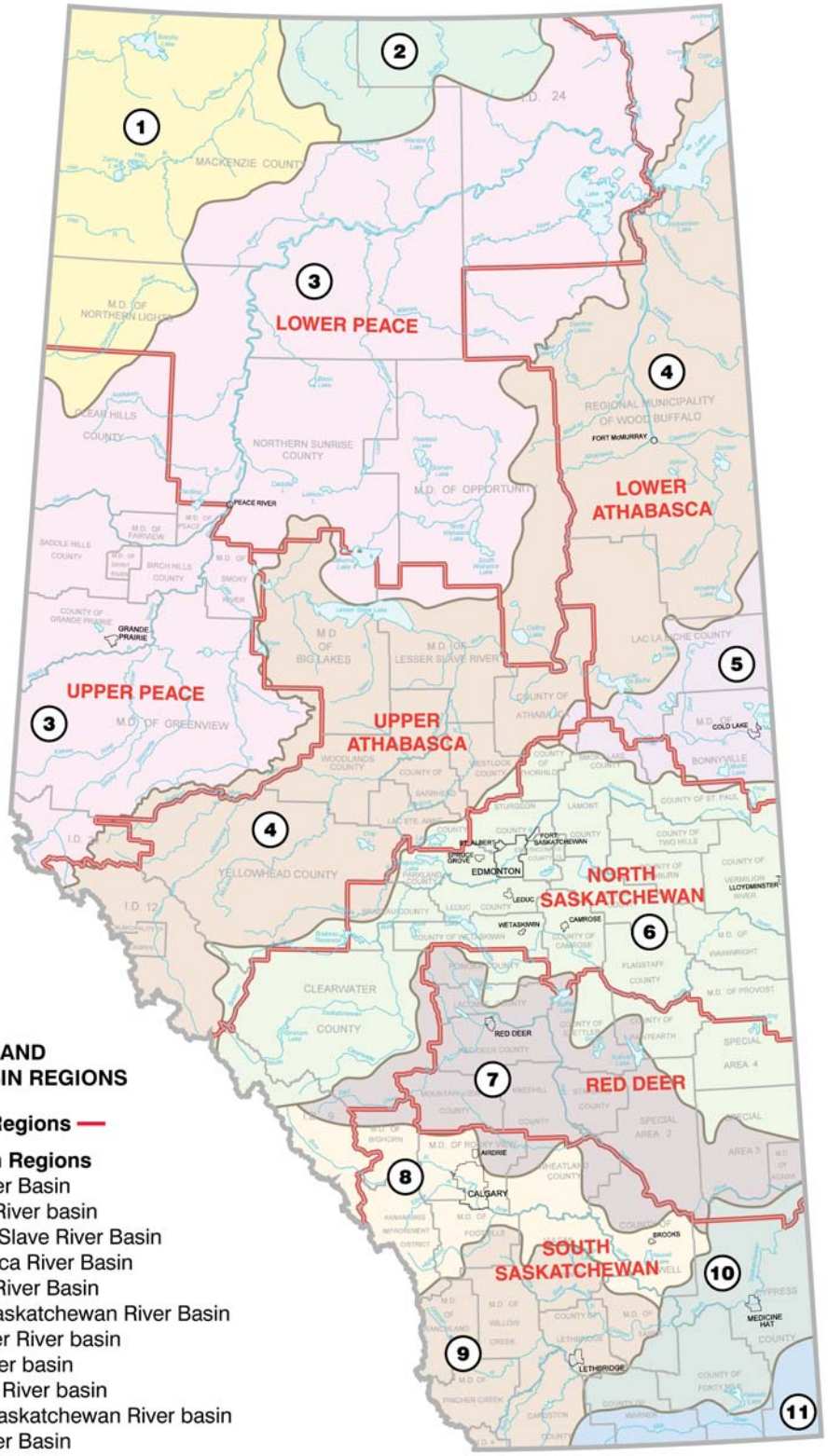

LAND USE AND RIVER BASIN REGIONS

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River Basin Regions

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3. Peace / Slave River Basin
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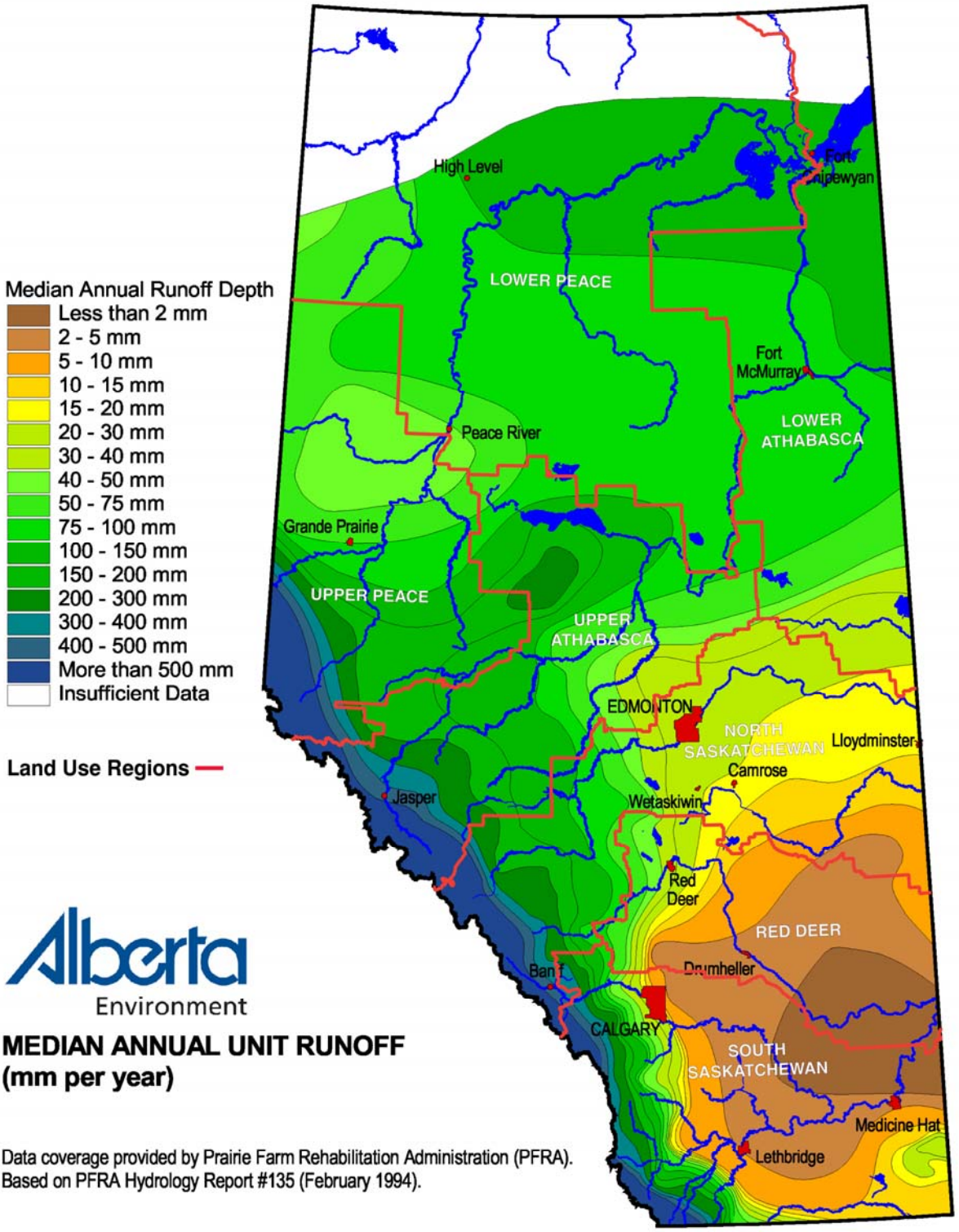


PREFACE

The Alberta Economic Development Authority (AEDA) has six standing committees which focus on the primary economic development challenges facing Alberta. One of these committees, the Sustainable Development Committee, has identified water conservation and water management as a high priority issue that has specific challenges requiring resolution. AEDA identified the following as main challenges for water conservation and management: the policy and regulatory environment regarding operating permits, licenses, allocation mechanisms and rules for transfer of water rights; the need to improve water efficiency and productivity through the use of technology and processes; and, improvement to water and wastewater treatment and transportation infrastructure.

The objective of this study was to research, develop and deliver a scoping document that identifies, examines and compares the current status of water characteristics, markets and issues facing Alberta across each of its major water basins, and how these are affecting sustainable economic development. In addition, some recommendations and next steps were identified.

Specifically, this study:

- reviews Alberta's water regulatory framework including Alberta's system of water allocation and management, permits, licensing, market mechanisms, water governance, and building codes;
- examines Alberta's water regulatory framework in the context of industrial operations, irrigation districts, and residential/commercial applications;
- provides a comparative analysis of Alberta's major river basins;
- identifies issues, attitudes, concerns, technologies, opportunities, rules and barriers to change;
- develops recommendations for change; and,
- proposes a plan of action.

EXECUTIVE SUMMARY

Alberta has a diverse range of watersheds, wetlands and riparian areas. The north is not like the south, and the east is not like the west. Each region and each industry sector has its own unique opportunities and challenges. Every industry sector in the province diverts and consumes different amounts of surface and/or groundwater from different sources and for different purposes, and then returns different amounts of this water in different forms back to different environments. This environmental and economic diversity has an environmental impact, but also presents an economic opportunity.

The current challenge involves balancing the province's economic and environmental commitments with:

- the significant historical water supply allocations to the rural agricultural sector;
- the demands for new water due to increasing urban population growth and economic development; and,
- the Government of Alberta's Water for Life goal of improving overall efficiency and productivity of water use in Alberta by 30 percent from 2005 levels by 2015.

Improved environmental and water policies are being developed, beginning with outcome based objectives that are focused on regional and cumulative impacts across the province's air, land and water resources. However, Alberta's regional water disparity is evident by looking at water usage, where water resources have been more highly allocated and consumed in the southern regions of the province.

- Water is least available in the South Saskatchewan Region, where irrigation and urban expansion have been competing for water resources since the area was settled. Under the South Saskatchewan River Basin (SSRB) Water Management Plan issued in August, 2006, no more new water licenses are being issued for the Bow, Oldman, and South Saskatchewan Rivers. The key issues in this region are the increasing demand for water due to population growth, outdated water allocation and license trading processes, sharing of water rights in shortages, and the variation in water flow across seasons. The Irrigation Districts can be incented to give up some of their water allocations to satisfy urban demands, but it will likely be at some cost. The infrastructure to support water conservation has to be engineered and constructed, and the costs to conserve this water should be paid by those who need new water allocations to support their proposed projects and future developments. The region must move into a new era of incentive-based water conservation. The large amount of water that is already allocated to relatively few users needs to be further recovered, recycled, reused, or stored in reservoirs, and made available to other users.

- Under the recently released Land Use Framework, the Red Deer Region is a distinct region for land-use purposes, but watershed management policy for the region will be aligned and set within the context of the SSRB Water Management Plan. The Red Deer River has fewer water allocations than other rivers in the SSRB, and although the River is under a water watch alert, Alberta Environment (AENV) is still accepting applications for new water allocations. The Red Deer River also plays an important role in meeting Alberta's water commitments to Saskatchewan under the existing Apportionment Agreements. The key issues in this region are ensuring that the Red Deer River does not become over allocated in support of increased economic development, and that enough flow is retained in the River to ensure that commitments are met under the Apportionment Agreements.

- Water quality is the key issue in the North Saskatchewan Region, primarily downstream of Edmonton. This issue manifests as an occasional failure to meet water quality standards at the Saskatchewan border under the Apportionment Agreements. Industrial development, including potential growth in heavy oil upgrading and refining, needs to be supported by regional water and wastewater treatment solutions. Increasing the use of recovered and recycled industrial and municipal waste water for industrial purposes will reduce overall demands on the River.

- In the Lower Athabasca Region, the key challenge is reducing the perception that disproportionately large amounts of fresh water are being consumed by oil and gas and industrial operations. Solutions to Alberta's water requirements for oil sands development need to specifically address the low flow period on the Athabasca River. Another key challenge is management of tailings. There is a requirement to immediately begin measuring and sharing baseline water usage data for all the region's operations, in order to benchmark actual water usage with future conservation targets. Water quality upstream and downstream of the oil sands operations also needs to be benchmarked and shared.

- In the Upper Athabasca Region, the water challenges are primarily a reflection of the same oil and gas sector issues found in the Lower Athabasca Region, albeit on a lesser scale. Watershed plans need to be developed for both the Upper Athabasca and Upper Peace Regions to ensure that water allocations for water management, flood control, and habitat maintenance continue to be preserved through future water and wetlands management initiatives.

- In the Lower Peace Region, there are challenges to implementing increased information sharing and consultation mechanisms with First Nations and Métis communities. The province must encourage the participation of these communities in the development of land use and water management plans to ensure the success of these plans.

The major recommendations of the study are summarized as follows:

- Policy solutions need to be developed and implemented on a region by region basis. There are very distinct regions across the province with very different water issues and province-wide policy solutions are likely not going to be practical.

- New policies and regulations around water management and land use must be clarified for industry to continue to invest and grow in Alberta. The policy changes that have been announced as part of the Water for Life strategy and the Land Use Framework quickly need to be reflected in the regulatory system to avoid confusion and uncertainty on the part of project developers and operators.

- *In the South Saskatchewan Region,* new market-based or tax incentives must be introduced to encourage the capture, storage and sharing of trapped and conserved water between rural and urban markets. New policies and programs should be introduced to encourage the recovery, recycle and reuse of produced water and reclaimed/grey water for industrial, municipal and agricultural purposes. Long-term solutions must provide for the capture and storage of additional water throughout the year. The return flow of treated municipal and industrial wastewater to the rivers must be optimized, balancing the desire for increased conservation and reuse with the need to maintain enough water in the river to ensure a healthy aquatic ecosystem.

- *In the Red Deer Region,* the Red Deer River should continue to be managed under the SSRB Water Management Plan. There is a need to implement monitoring and reporting of water use by private irrigators, who are the largest consumptive water users in the region, while also supporting water conservation programs by the region's largest municipal user, the City of Red Deer.

- *In the North Saskatchewan Region,* the regional framework and cumulative effects based planning in the Industrial Heartland region must be continued. New financial and tax-based capital cost incentives need to be developed to encourage upgraders to work collaboratively on the development of regional water and wastewater facilities.

- *In the Lower Athabasca Region,* implementation and sharing of independent monitoring and measuring of water flows and quality on the Athabasca River is vital. New pilot programs need to be encouraged through policy and financial incentives to test alternative technologies for reducing water consumption in the extraction process, cleaning up water produced in the extraction process, improving water recovery from tailings, and remediating existing tailings ponds. Oil sands mining operators should be encouraged through incentives and regulation to implement the water recycling and reuse programs contained in their Environmental Impact Assessments.

- *In the Upper Athabasca and Peace Regions,* AENV must continue its efforts to establish regional WPACs, and ensure that water allocations for the water and habitat management sector be preserved through future water and wetlands management initiatives. The Forestry sector is in the process of developing a Conservation, Efficiency and Productivity Sector Plan, and this work should be encouraged.

- *In the Lower Peace Region,* the Alberta government must continue its efforts to engage First Nations and the Metis communities in the development of land use and water management plans.

INTRODUCTION

Water is one of the most important and fundamental economic inputs to the global economy[1]. Investment opportunities in the $400 billion annual global market for water related equipment and services are significant and growing[2]. No other industry rivals the global water industry in the number of key drivers propelling the growth of the economy. The manifest drivers, which include water scarcity, regulatory change, and water quality, are each compelling and critical for sustainable communities and economies.

The water industry is one of the three largest industries in the world in terms of assets deployed, along with oil and gas, and electricity.

However, the water industry is not well understood by investors, and still has a minority of investor ownership. This 'under-owned' factor creates more investor opportunity than is present with other very large, but already investor-dominated, industries. The global water industry today resembles the world petroleum industry in 1920 in terms of investment potential.

Water is not a commodity like oil or natural gas because water prices tend to be decided locally, rather than on a global market. Also, there is a social imperative to set aside a certain amount of water for personal use as a basic human need, and for protection of wildlife and the environment. In addition, advanced technologies may play a much more disruptive role than in the traditional commodity industries.

Globally, the planet is facing significant pressures on its climate and water resources. Available fresh water is less than one percent of all water on Earth. However, the usable/accessible water supply is less than 1/100th of this already minute amount[3]. The world's water consumption rate is doubling every 20 years, outpacing by two times the rate of population growth[4].

This global theme of water insufficiency relative to increasing demand, along with all the related trends and opportunities it has spawned, continues to benefit the prospects of a broad range of new markets, technologies and startup enterprises focused on solutions to this supply/demand dilemma. Water-related investment funds grew almost 40 percent during 2007, versus an overall market growth of about 12 percent, with some individual water funds up more[5]. No other industry rivals the global water industry in the amount of key drivers propelling the growth of the industry.

Sustainable water management not only has an environmental benefit, it now presents an economic opportunity.

- There is no substitute for water and current users cannot postpone purchases, causing relatively price-inelastic demand.
- Demand is often unaffected by inflation, interest rates, changing preferences, or inventories.
- There is a history of strong and consistent demand growth under all market or economic conditions.

Water has generally been over-used across Canada and in Alberta. Most of the world is more effective at conserving its water resources[6]. With many global investment funds adopting some form of environmental sustainability as a central operating policy, the economic implications of sustainable management of our water resources is becoming a growing and significant issue.

It is important to remember that Nature is also a major user of water for recharging aquifers, forests and natural reservoirs. A follow up study should look at incorporating the loss of water due to recharging, transpiration and other losses in order to get the full perspective on water use and balances in the province.

ALBERTA'S WATER REGULATORY FRAMEWORK

This section consists of information on Alberta's water regulatory framework including Alberta's system of water allocation and management, permits, licensing, market mechanisms, water governance, and building codes.

WATER MANAGEMENT AND GOVERNANCE

Water management, regulation and governance in Alberta have a long and inter-related history involving public and private stakeholders. This history is a reflection of economic development and water conditions and watersheds across the province that can vary significantly from north to south, and west to east. Water is not located where it is most needed.

For the most part, AENV is responsible for provincial water policy and legislation to ensure the quality and quantity of the province's water resources. There are some federal and other exceptions, such as regulations for produced water from conventional oil and gas reservoirs, which require an ERCB-approved disposal scheme, usually involving deep well disposal. The Appendix contains some of the current major federal and provincial water regulations.

The ownership, allocation, management and protection of water is regulated under the Water Act (1999), which confirms that all water in Alberta is the property of the provincial government, and allows the province to grant rights to the diversion and use of this water. All withdrawals of surface water and groundwater under 4,000 parts per million (ppm) total dissolved solids (TDS), with the exception of traditional agricultural uses and household purposes up to 6250 cubic meters per year, require licensing under the Water Act. There is wide spread discussion of the possibility that this level could be increased to 10,000 ppm TDS in new legislation sometime in the next several years.

Currently, inter-basin transfers (i.e. between major water basins) are not permitted under the Water Act. There is a possibility that intra-basin transfers may be further scrutinized based on a recent report made by the Alberta Water Council on this topic. Under the 1969 Master Agreement on Apportionment, Alberta is committed to supply at least half of the natural flow of each watercourse that flows through Alberta into Saskatchewan, subject to certain exceptions and quality conditions[7]. Similar agreements are in place with the North West Territories and Montana.

In Alberta, water regulation has been based on the principle of prior allocation or "first in time, first in right". This principle, which has been in existence since 1894, means that, except for household water use, in a shortage situation the most senior licenses can take all of their allocation before the holders of licenses that were granted later are able to take any of their allocation. While earlier licenses were often issued in perpetuity, licenses issued since the Water Act have typically been for a fixed term.

The ability to discharge water is related to the quality of the water and is under the jurisdiction of the provincial Environmental Protection and Enhancement Act (EPEA). This is different from the granting of water licenses which is under the Water Act.

Water allocations are based on the expected maximum amount that an applicant may require annually. In the past, these allocations were typically granted under the presumption of total consumption; mandated return flow was often not a condition of a water license in the past but this is changing with new licenses. Also, the cost of the license, and therefore the water to the end user, as a rule has been based on the cost to collect, clean, store and/or distribute the water. The water itself has been essentially free. Until recently there have been few economic or other incentives to conserve water.

AENV is primarily guided by the Water Act, EPEA, and the Alberta Water for Life strategy. While AENV remains accountable to oversee overall water and watershed management activities in the province, there are now three key public and private partnerships integral to implementing the goals of Water for Life.

- *The Alberta Water Council*, a multi-stakeholder provincial water advisory council, was established to oversee the overall implementation of Water for Life. The Council also provides policy advice to the Alberta government using a consensus-based model.

- *Watershed Planning and Advisory Councils* (WPACs) lead in regional watershed planning, develop best management practices, foster stewardship activities within the watershed, report on the state of the watershed, and educate users of the water resource.

- *Watershed Stewardship Groups* are made up of local volunteer citizens, often supported by local businesses and industries, taking the initiative to protect their local creek, stream, river, or lake.

One of the primary goals of the Water for Life strategy is to ensure the overall efficiency and productivity of water use in Alberta improves by 30 percent from 2005 levels by 2015.

The Alberta Water Council, through the Conservation, Efficiency and Productivity (CEP) Sector Plan Project Team, is ensuring that water CEP Plans are developed consistently across sectors and watersheds in Alberta. The first CEP Plans are now being developed for the irrigation and small municipal sectors, with the intent that eventually each sector will do a CEP plan. Other priority sectors include oil and gas, power generation, mining (including oil sands mining), forestry, chemical and petrochemical, and agriculture.

WPACs have been tasked with developing water management plans by major river basin. While there have been growing pains in the development or support of these groups and plans, some WPACs have made good progress in developing their water management plans and having them approved by key stakeholders (e.g. Bow River Basin Council and the North Saskatchewan Watershed Alliance).

Since water use is closely linked to economic activity and land use development, it is expected the CEP Plans will be critical considerations for Alberta's draft Land Use Framework. Exactly how the two processes will integrate is still to be determined.

There are many other regulatory and water policy issues currently being reviewed by the Alberta Water Council, including recommendations to better utilize and enhance Alberta's water allocation transfer system, determining if the movement of water from one sub-basin for use in another sub-basin within the same major river basin can be improved, developing recommendations for a new wetland policy, and providing a foundation and direction for future work under the Healthy Aquatic Ecosystems goal of the Water for Life strategy.

It is evident that public expectations concerning environmental management are evolving, specifically around the quantity and quality of water and consistency of water management systems. Increased media attention on and public awareness about water has catalyzed demand for more information on the resource, and for the sharing of water data and knowledge. In parallel, there has been an increasing polarization between environmental groups, government and industry (for example, the CEMA process). Some groups consider regulation or penalties as the only solution for improving performance, while others believe incentives that reward water conservation will result in more innovative solutions and more cost-effective stewardship.

Success depends on collaboration between industry, municipalities, First Nations, and other stakeholders through new public-private partnerships and volunteer-based watershed initiatives. To date, many stakeholders have not become actively involved, but this is changing. Improving the stakeholder engagement process is a key focus of the Alberta government as the Water for Life strategy evolves and the Land Use Framework is implemented.

WATER APPROVALS, LICENSES AND ALLOCATIONS

The Water Act defines both approvals and licenses. *Approvals* govern the construction of works, or the undertaking of an activity within a water body, such as the operation of a water or wastewater treatment plant. *Licenses* govern the diversion and use of surface water or groundwater. Licenses are given a priority number based on the date that the complete application was received by AENV. Licenses to divert water are not required for statutory household use or traditional agriculture use up to 6,250 cubic meters per year.

In general, three water use factors are considered in issuing licenses for water allocations. Allocations reflect the amount of water that the licensee is expected to consume, plus losses due to seepage or evaporation, and in some cases an allowance for returning water back to rivers and lakes after use. The term "licensed water use" reflects those components of the allocation that are expected to be consumed or lost.

- Allocation = Water Use + Return Flow
- Water Use = Consumption + Losses
- Return Flow = Diversion – Water Use

The return flow allowance is important because return flows represent water that can be available for use by other licensees. In the past, these return flows were taken into consideration by AENV when they assessed how much water was available for additional licensing specifically in the South Saskatchewan basin. However, the return flow allowances are often not enforceable. This represents a significant policy challenge: balancing the desire for increased conservation and reuse with the need to maintain flow levels in the river for downstream users and a healthy aquatic ecosystem.

To address this issue, the concept of Return Flow Credits has been debated for some time, particularly among some municipalities in the south of the province. Return flow credits would allow a water user to divert more water than its allocated licensed use, as long as they returned that additional water back to the river at a specified level of quality. For those municipalities that return a large portion of their water back to the river as highly treated wastewater or stormwater, this returned water would earn them return-flow credits, enabling them to expand their water withdrawls, without reducing the river's overall flow levels.

The other key policy issue that must be resolved regarding return flow is the ownership of municipal and industrial wastewater before the treated water is returned to the river by the municipalities. In a water-constrained environment, this recovered water has a value. Recovery, recycle and reuse of captured stormwater and treated wastewater will reduce return flow to the river on a per capita basis, and could reduce water available for downstream licensees.

In determining what percentage of allocations is currently being used, actual water use is compared (i.e., estimated) to licensed water use. The main source of information for determining actual water use is AENV's Water Use Reporting System (WURS). WURS is a new database and contains information for only a few years and for a small percentage of licensed water users. The province has introduced an electronic water-use reporting system, but submitting information is voluntary. Currently, less than one-third of water licensees submit their water use data[8].

One of the most significant water allocation decisions in Alberta was the *South Saskatchewan River Basin (SSRB) Water Management Plan* (August, 2006). As part of the plan, AENV no longer accepts new water license applications for the Bow, Oldman, and South Saskatchewan sub-basins. However, water allocations may still be obtained through transfers of existing water allocations.

Under the rules, a water license can be transferred to a different user (on an intra-basin basis only) at a mutually agreed price, but must reflect water that has been used under a license but is, or will be, no longer required due to water conservation or other planned reductions in need. The transfer application must also identify if a change in purpose or use of the water will occur.

With the hope of new promising water technologies, existing water license holders in southern Alberta now have the incentive to conserve water and the opportunity to trade their water license, or portions thereof, for an economic gain. In some cases, water currently being lost to evaporation or seepage could be conserved and used for expanded agricultural and economic development, without impacting existing allocations or current water license holders.

The SSRB restrictions have spawned a small but burgeoning private market for water licenses, but this market for the trading and transfer of water allocations is still very much in its infancy. AENV oversees and approves every transfer application. However, the terms, conditions and process for approval remain uncertain, and can be cumbersome, lengthy and expensive. For example, the province can require an applicant to hold open public hearings, withhold up to ten percent of an allocation of water being transferred, or require an applicant to submit significant amounts of detailed information during an application process. There is considerable latitude for discretion by AENV in their decision-making process.

The Alberta Water Council, through the Water Allocation Transfer System Project Team, is currently undertaking a comprehensive review of the province's water allocation transfer system within the existing legislative framework. An interim report will be presented at the March, 2009 meeting, with a final report and recommendations presented at the June, 2009 meeting.

Over the next 18 months, the provincial government will also be conducting public consultations to decide on changes to the way Alberta's water rights are allocated.

Background data, information and definitions relating to provincial water allocations, permits and licenses are included in the Appendix. The Appendix presents a comparison of the water allocation process in Alberta with other provincial and USA jurisdictions.

WATER MARKET MECHANISMS

The SSRB Water Management Plan states that AENV will support the development of water markets for transfers to re-distribute water that is allocated and conserved in the SSRB.

However, the effective reallocation of water, within the context of a finite and restricted supply is a complex task. Who decides the highest and best use between competing water needs?

Australia and the United States, as well as other jurisdictions, have trading markets for water; Alberta can look to these models for guidance.

Of critical relevance is the relationship between the economic valuation of the water resources and the incentives for capital-driven technological change. When resources are correctly valued, the incentive exists to use those water resources efficiently though the introduction of technological change. When traded water has little or no value, it will be over consumed or disposed of as a waste product.

One of the province's most pressing water policy issues will be establishing an economic value for the trading of water. It is difficult to estimate the value that water accounts for, as it does not have a measured economic value. In this regard, Phase I of a multi-phase "Value of Water to the Alberta Economy" study has been completed. The project was led by Alberta Employment, Immigration and Industry (now Finance and Enterprise) with guidance from a cross-ministry steering committee. The second phase of the Value of Water study has now scaled values up to the provincial level. Work on the study is continuing, in order to provide a more comprehensive picture of all the values Albertans hold for water and, to the extent possible, provide context around these values[(9)]. In addition, the contribution of water to the Canadian economy has been estimated at between $7.5 and $23 billion annually based on its key functions (source: Environment Canada 1992: Environment Canada 2004: Warren, 2004).

WATER AND BUILDING CODES

Some municipalities and developers are reducing water demand through water conservation measures such as water efficient appliances, rain barrels and low flow showerheads. In the East Balzac project, developers must maximize the use of precipitation for irrigation, as no potable water will be permitted for landscape irrigation. Ivanhoe Cambridge, as an example, has incorporated three underground cisterns into its retail development to capture and reuse storm water.

However, significant opportunities still exist to meet this increasing demand for water by using reclaimed water to replace potable water supplies for many non-potable uses.

In the municipal sector, the recovery and reuse of municipal wastewater (reclaimed water) for non-contact office, commercial, domestic and landscape purposes presents one of the greatest opportunities to better use and manage existing water supplies. Other jurisdictions like Australia, the United States and British Columbia have developed policy and legislation to safely manage these applications.

Current Alberta legislation prohibits the full exploitation these reclaimed water practices. These laws need to be improved to encourage the practice of wastewater recovery and reuse. Alberta's building codes and reclaimed water standards need to be updated to reflect the province's current economic and environmental requirements, and to take advantage of many of the proven water recycling and reuse technologies and practices commonly in use throughout the world today.

There is a sense of urgency in getting these actions underway, as a major component of the province's recycled water restrictions is under the jurisdiction of the Alberta Building Code, which is up for review and revision in 2010, and may not come up again for review until 2015.

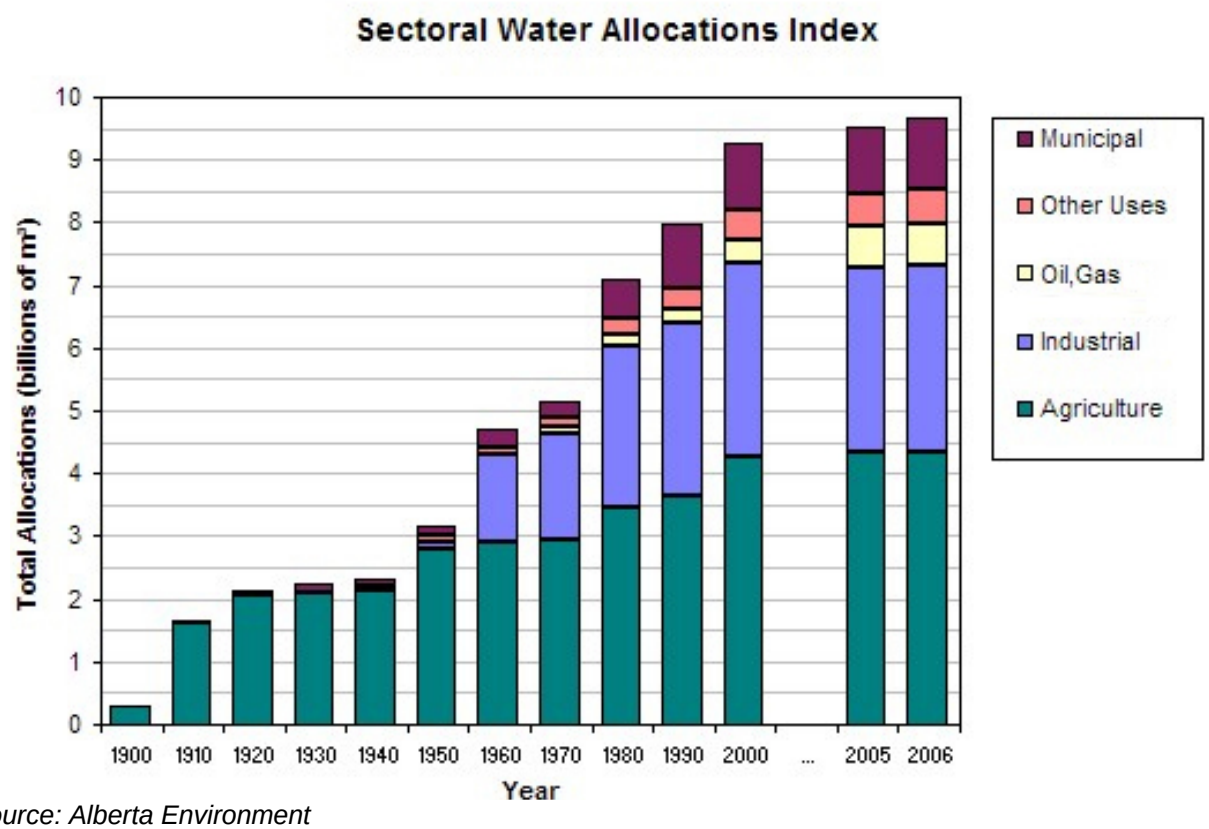
Changes to the building codes to allow reuse are of growing interest to existing communities that are currently at the limit of their existing licenses, and to the developers of new residential communities. The increased use of reclaimed and grey water, along with other conservation measures, has the potential to reduce fresh water demand in households by as much as 30 to 40 percent, without effecting current consumption patterns or life styles. Put another way, an existing water license might be able to serve hundreds or even thousands of additional homes. This provides a strong economic incentive for developers to implement these conservation measures.

ALBERTA'S WATER FLOWS, ALLOCATIONS AND USE

This section examines Alberta's water regulatory framework in the context of five general water use sectors. Implications of the province's regulatory framework in each area are discussed. Issues, opportunities, barriers, and recommendations for change are also identified.

Since the early 1990s, water allocations and use in southern Alberta primarily have been for agricultural purposes, mainly district irrigation. In contrast, industrial cooling accounts for the majority of allocations and use in the Edmonton and North Saskatchewan Region.

Water allocations in the northern regions account for about 12 percent of provincial allocations and consist primarily of water licenses issued to oil sands operators, as well as for general water management purposes.

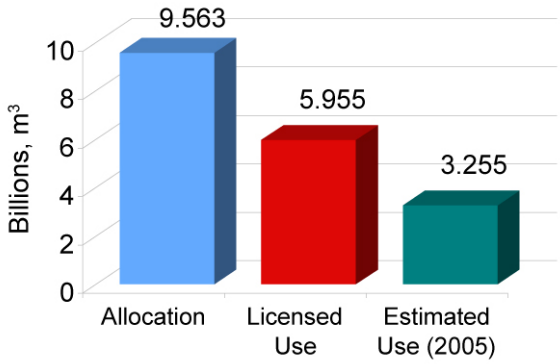


Source: Alberta Environment

The volume of water allocations has doubled since the 1960s, with allocations to agriculture increasing about 50%, while industrial allocations have doubled. As of 2006, the agriculture and irrigation sector accounts for 45% of the total 9.6 billion cubic meters of water allocations, while the industrial and commercial sector accounts for 29%, the municipal sector accounts for 11%, the oil and gas sector accounts for 8%, and other sectors account for the remaining 7% of surface and ground water allocations[(10)].

ALBERTA | TOTAL WATER FLOWS, ALLOCATIONS AND USE [11]

While approximately 131 billion cubic meters of water flows out of Alberta each year, more than 85% of this water flows north. All the river basins south of the Athabasca River summed together account for only 15% of Alberta's water supply, but account for 80% of water allocations[12].

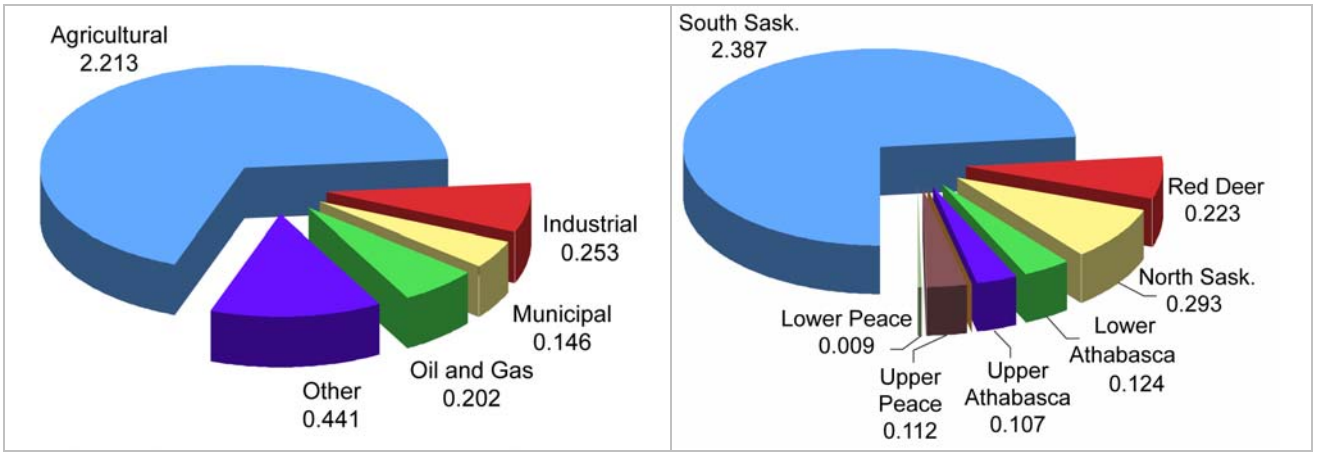


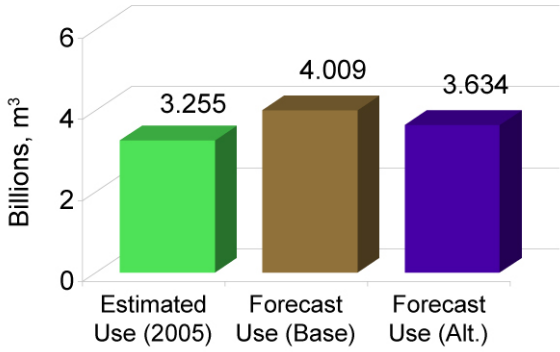
In Alberta, existing surface and ground water allocations allow for the diversion of up to 9.6 billion cubic meters annually. Of this allocated amount, 62% or about 6.0 billion cubic meters is licensed for use, while the remaining 38% is assumed to be return flow.

The major consumptive water uses in Alberta are irrigation and agriculture. Municipalities, industrial cooling and hydro power production are also very significant users, but are generally non-consumptive.

In 2005, it is estimated that about 3.255 billion cubic meters of surface and ground water, or 55% of the surface and ground water licensed to be used, was actually used.

ESTIMATED WATER USE (2005) | 3.255 billion cubic meters

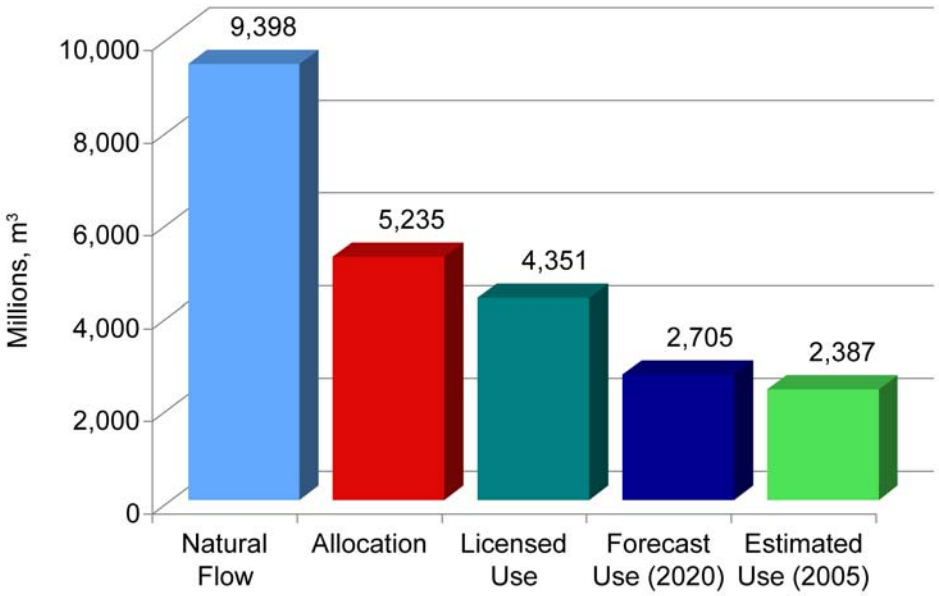




In the absence of any significant policy or conservation measures, this estimate of water use in 2005 is forecasted to grow by about 23% to 4.0 billion cubic meters by 2020 (base case, status quo scenario).

However, with some select water policy and conservation measures, this forecast of water usage could be reduced by 0.375 billion cubic meters to 3.6 billion cubic meters, resulting in a 12% growth rate in water use from 2005.

SOUTH SASKATCHEWAN REGION



Note: Natural Flow reflects average annual natural flow of South Saskatchewan River at Medicine Hat.

This region aligns with the South Saskatchewan Region in the Land Use Framework, and includes the Oldman River basin, the South Saskatchewan River basin, the Milk River basin, and the Bow River basin with the exception of areas that reside in Banff National Park, which are included in the North Saskatchewan Region.

In the South Saskatchewan Region, population growth and agricultural and industrial developments are increasing the demand and pressure on Alberta's water supplies and aquatic environments. Alberta's Land-Use Framework acknowledges that all of southern Alberta depends on the ecological integrity of the Eastern Slopes for its water supply. However, much of the Eastern Slopes are zoned for multiple-use, and it is not uncommon to find oil and gas operations, grazing leaseholders, and forestry operations all active on the same lands.

While the region occupies about 12% of Alberta's land area, it accounts for about 43% its total population. The region's average annual natural river flow accounts for only 6% of Alberta's total flow, but accounts for 22% of all active water licenses, 55% of total allocated water volumes, 68% of all municipal water allocations, and virtually all of the province's water allocations for irrigation. The annual river flows throughout the South Saskatchewan Region are no longer natural, and are being managed by reservoirs used for hydro-electricity generation.

The South Saskatchewan Region accounts for about 73% of all estimated water use in the province.

- On average, about 56% of the regions' average annual supply of water of 9.4 billion cubic meters has already been allocated to license holders. It is estimated that 2.4 billion cubic meters of water, or about 26% of the region's annual supply, is being used today, while another 50% of this water supply must be reserved for Apportionment Agreements. Up to 25% of the region's average annual flow, after apportionment obligations, flows to Saskatchewan because of lack of demand at the time and lack of storage facilities.

- In the South Saskatchewan Region, most of the water allocations are for just two sectors: irrigation-agriculture (77%) and municipal (14%). Only 17% of allocated water volumes in the region are assumed to be returned back to rivers and lakes after use, even though municipalities historically return 70% to 80% after use.

- While the region is relatively dry, over a third of the estimated water used for lake stabilization, flood control and habitat management in Alberta is based in the South Saskatchewan Region.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use from 2005 to 2020 is expected to show an overall 13% increase to about 2,705 million cubic meters, with increases across most sectors. The supply side is anticipated at best to remain flat over the same period, resulting in increased shortages of water. However, the introduction of additional on-stream and off-stream reservoir capacity could increase these supply levels significantly.

- With implementation of the proposed water policy and conservation measures, the South Saskatchewan Region's forecast of estimated water use, from 2005 to 2020, would be expected to show an overall 9% increase in demand to about 2,605 million cubic meters. This is a reduction in forecasted water use of an additional 100 million cubic meters. There is a strong probability that many of the Irrigation Districts will conserve more than this amount through planned operational efficiencies, as well as infrastructure works and reservoir upgrades.

The South Saskatchewan Region must move into a new era of water conservation, where the large amount of water that is used by relatively few users can be further recovered, recycled, reused, or potentially stored in off-stream reservoirs, and then transferred to other purposes, including wetland management. Irrigation accounts for not only the greatest volume of water used but, by and large, the most senior rights. The Irrigation Districts need to be viewed as part of the solution, and as the most significant opportunity to improve the region's overall efficiency and conservation of water. See the section on Irrigation and Agriculture for additional details.

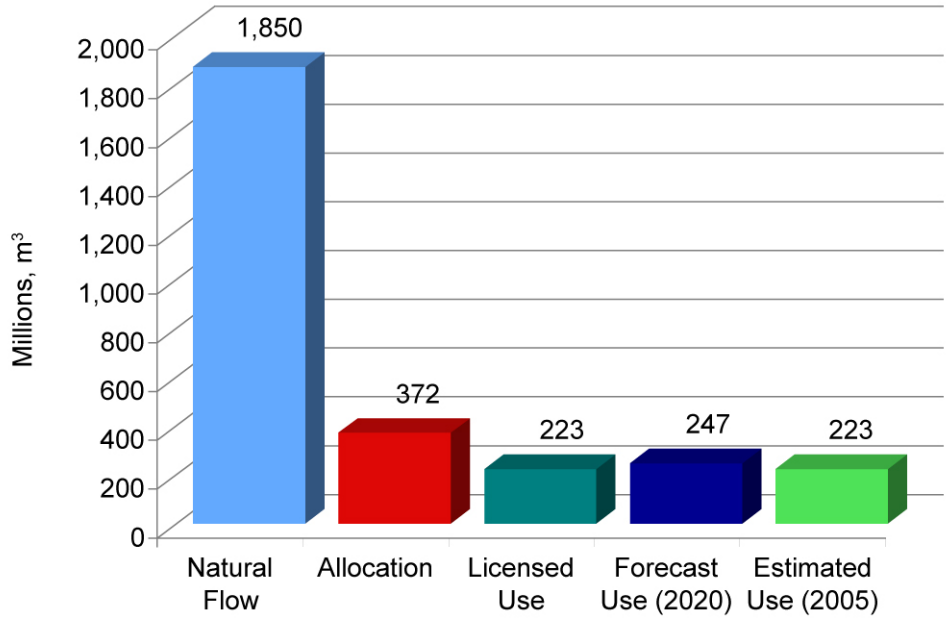
The South Saskatchewan Region has seen a small but burgeoning private market for water licenses, but this is not a free and open market for the trading and transfer of water allocations, and is still very much in its infancy. Existing water license holders in southern Alberta now have the incentive to conserve water, and the opportunity to trade at least some portion of this conserved water for economic gain. The province needs to facilitate the development of a more open and transparent market for licenses, including the ability to transfer licenses from one use to another.

In the South Saskatchewan Region, the issue of optimizing return flow from upstream municipal users is particularly poignant. As noted in a previous section, policy decisions must be made regarding the introduction of return flow credits, the ownership of municipal and industrial wastewater, and the pricing of water to encourage conservation and reuse.

One potential solution to the concern over potential reduced return flows is the increased use of on- and off-stream storage. The three rivers in this region are all dammed and have capacity for more storage to improve water flow management through the yearly cycle of high and low flow. Some plans for additional storage capacity have already been announced (Bruce Lake Reservoir).

In the region, there are over 210 facilities involved in treating water and wastewater[13]. Many smaller communities are now seeking to regionalize these facilities and/or access the water of larger communities. The benefits of working together and sharing urban water services should include improved water quality, economies of scale and more effective regional water management.

RED DEER REGION



Note: Natural Flow reflects average annual natural flow of the Red Deer River at Red Deer.

The Red Deer Region was created during the final phase of the Land Use Framework to better address southern Alberta's significant population, its number and size of municipalities, and the diversity of its landscapes. The Land Use Framework recognizes that while the Red Deer Region will be considered a distinct region for land-use purposes, watershed management policy for the region will continue to be aligned and set within the context of the South Saskatchewan River Basin Water Management Plan. This is an important consideration, and allows for greater flexibility when considering future intra-basin water transfers between the Red Deer sub-basin and other SSRB sub-basins.

The Red Deer Region includes the vast majority of the Red Deer River basin, which forms the largest sub-basin of the SSRB, with a length of 708 km, a drainage area of 49,650 km² and 57 urban municipalities, 17 rural or regional municipalities and one First Nation. Farms in the Red Deer River Basin cover nearly 12 million acres or about 97 percent of the basin.

The Red Deer Region in the Land Use Framework generally aligns with the boundaries of the Red Deer River sub-basin, with the following exceptions:

- Areas of the Red Deer River sub-basin that reside in Banff National Park, which are included in the North Saskatchewan Region;
- Areas of the Red Deer River Basin that reside in the M.D. of Bighorn, the M.D. of Rocky View, the M.D. of Wheatland, and the County of Newell, which are included in the South Saskatchewan Region; and,
- All of Special Area 3 and Special Area 4.

The Red Deer River has fewer water allocations than other rivers in the SSRB and, hydrologically, has the healthiest aquatic environment. Under the SSRB Water Management Plan, the Red Deer River is not fully allocated, and AENV is still accepting applications for new water allocations for the Red Deer River. However, the region is under a water watch alert.

About 24,000 licenses and registrations currently allow a maximum of 372 million cubic meters of water to be withdrawn annually. About 72% or 268 million cubic meters of this allocation is licensed for use, with the remaining 28% assumed to be returned to the river. It is estimated that almost 223 million cubic meters, or 83% of the basin's allocation that is licensed for use is being used today.

When the allocation volume in the Red Deer Basin reaches 550 million cubic meters, under the SSRB Water Management Plan, a temporary closure to applications will likely be implemented by AENV in order to permit a review of the aquatic environment and to determine if additional allocations should be undertaken.

The region occupies about 8% of Alberta's land area, and also accounts for about 8% of its total population. The region's average annual natural river flow accounts for only 1% of Alberta's total flow, but accounts for 22% of all active water licenses, 4% of total allocated water volumes, 23% of all stock watering water allocations, and 35% of all the province's gas and petrochemical plant allocations. The annual river flows throughout the Red Deer Region are no longer natural, and since 1983, are being managed by the Dickson Dam for hydro-electricity generation.

The Red Deer Region accounts for about 7% of all estimated water use in the province.

- On average, about 20% of the region's average annual supply of water of 1.8 billion cubic meters has already been allocated to license holders. It is estimated that 0.2 billion cubic meters of water, or about 12% of the region's annual supply, is being used today, while at least another 50% of this water supply must be reserved for Apportionment Agreements. Up to 38% of the region's average annual flow, after apportionment obligations, flows to Saskatchewan because of lack of demand at the time and lack of storage facilities.

- In the region, water allocations are for agriculture (29%), municipalities (19%), oil and gas (13%) and the other sector, including flood control and habitat management (31%).

- Current agricultural water use is estimated to be about 95 million cubic meters, of which 72% is for irrigation and 28% is for livestock.

- Gas and petrochemical plants account for 74% of allocations in the region and, because of high utilization of groundwater allocations, they accounted for 98% of actual water use in the region's oil and gas sector.

- Four surface water licenses for cooling purposes, used for power generation, account for over 98% of the industrial water allocations.

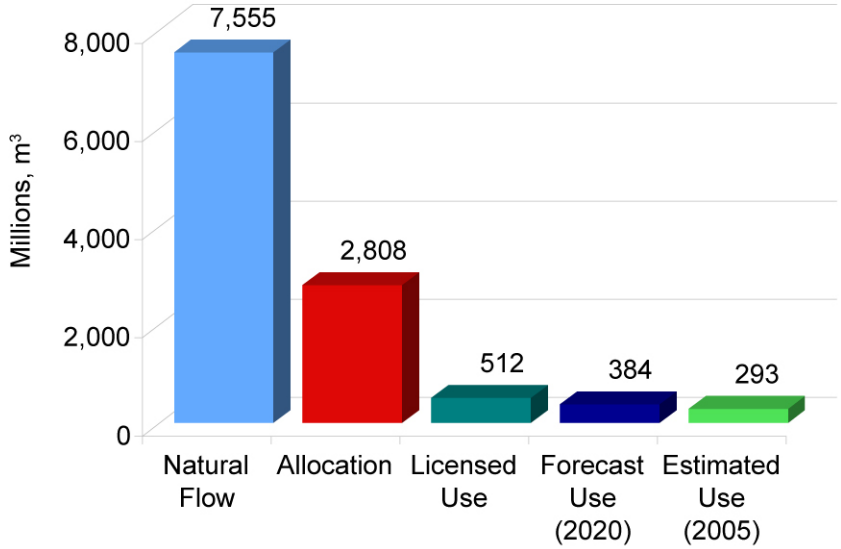
- About 14% of the estimated water used for lake stabilization, flood control and habitat management in Alberta is based in the Red Deer Region.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use from 2005 to 2020, is expected to show an overall 11% increase to about 247 million cubic meters, with increases across most sectors. Most of the growth in water use is forecasted to occur in the agricultural and industrial sectors. The supply side is anticipated at best to remain flat over the same period, which could result in shortages of water, but not to the level faced in the South Saskatchewan Region.

- With implementation of the proposed water policy and conservation measures, the Red Deer Region's forecast of estimated water use, from 2005 to 2020, would be expected to show an overall 8% increase in demand to about 241 million cubic meters. This is a reduction in forecasted water use of an additional 7 million cubic meters.

In a 2006 comparison of 16 municipalities, Red Deer had the fourth lowest water price rates in Alberta. In the region, there are over 112 facilities involved in treating municipal water and wastewater[13]. Many smaller communities are now seeking to regionalize these facilities and/or access the water of larger communities.

NORTH SASKATCHEWAN REGION



Note: Natural Flow reflects average annual natural flow of the North Saskatchewan River at Edmonton.

This region aligns with the South-Central Region in the Land Use Framework, and includes the North Saskatchewan River Basin and Battle River Basin. In contrast to the South Saskatchewan Region, this region accounts for only 9% of total estimated water use in the province, and most of the region's water allocation (82%) is assumed to be returned back to rivers and lakes after use.

The annual river flows throughout the North Saskatchewan Region are no longer natural, and are being managed by reservoirs used for hydro-electricity generation.

While the region only occupies about 14% of Alberta's land area, it accounts for about 38% of its total population. The region's average annual river flow of 7.6 billion cubic meters accounts for only 6% of Alberta's total flow, but accounts for 37% of all active water licenses, 29% of all the province's allocated water volumes, and 88% of all industrial water allocations.

- On average, about 37% of the region's annual supply of water has already been allocated to license holders. It is estimated that only about 293 million cubic meters of water, or about 4% of the region's annual supply, is currently being used while another 50% of this water supply must be reserved for Apportionment Agreements.

- Most of the region's water allocations are for two sectors, the industrial-cooling (81%) and the municipal (7%) sector. Both these sectors have significant return flows. The 28 licenses for industrial cooling located in the region account for 76% of all the estimated water used across the province for industrial cooling.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use from 2005 to 2020 is expected to show an overall 31% increase to about 384 million cubic meters, corresponding to increases in industrial and municipal use, especially once the proposed upgraders come on stream, and with other uses remaining constant. However, the supply side is anticipated at best to remain flat over the same period, resulting in increased stress on the quality of water downstream of the Industrial Heartland.

- With implementation of the proposed water policy and conservation measures, the North Saskatchewan Region's forecast of estimated water use from 2005 to 2020 would be expected to show an overall 19% increase in demand to about 350 million cubic meters. This is a reduction in forecasted water use of an additional 34 million cubic meters. There is a strong probability that the proposed heavy oil upgraders will conserve more than this amount through planned operational efficiencies, as well as infrastructure upgrades.

The most significant issue in the region are the proposed heavy oil upgraders and other oil and gas, petrochemical, industrial and chemical processing projects scheduled for the Industrial Heartland region. Each of these projects will have significant requirements for additional electric power generation and water use. Each upgrader is expected to use up to 150 megawatts of electricity, and 10 million cubic meters of water per year[14].

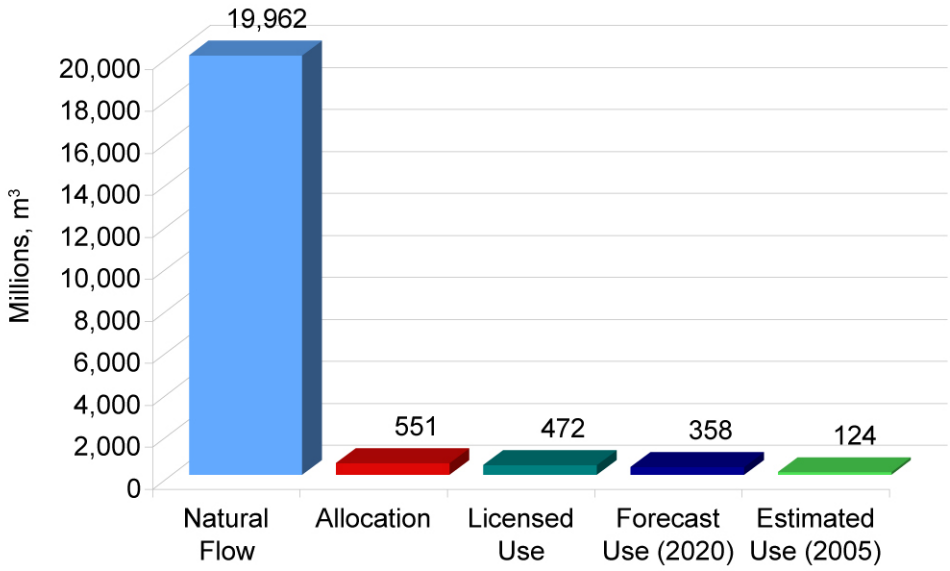
The river downstream of Edmonton is currently not under stress. However, as a result of discharges (primarily municipal) the river has not met water quality objectives under the Apportionment Agreements about 5% of the time at the Saskatchewan border. The challenge in the region is the cumulative loading of contaminants that cause excessive nutrient loading on the region's rivers and ground water.

Encouraging industry to adopt shared or regional solutions to their utility, waste and wastewater management will optimize the economic development and environmental sustainability in the region.

Some of the upgraders are considering expanding the use of treated municipal wastewater to help supply their operations. About 5.5 million cubic meters of recycled wastewater is now flowing annually from the Gold Bar Wastewater Treatment Plant to the nearby Petro-Canada refinery[15].

In addition, many municipalities are now considering whether their treated wastewater could be a potential new revenue source. The issue of who should control this treated and recycled municipal and industrial wastewater, and how it should be used, has now surfaced, and will have significant implications on future projects. It is vital that the province make a policy decision on the ownership of stormwater and treated wastewater.

LOWER ATHABASCA REGION



Note: Natural Flow reflects average annual natural flow of Athabasca River, downstream of Fort McMurray.

This region aligns with the Lower Athabasca Region in the Land Use Framework. It includes the Regional Municipality of Wood Buffalo (Fort McMurray), Lac La Biche County and the M.D. of Cold Lake, and reflects the downstream portion of the Athabasca River Basin, and the Beaver River Basin. Oil sands industry expansion is a major driver of economic activity in the Lower Athabasca Region.

While the region occupies about 20% of Alberta's land area, it accounts for only 4% of its total population. The average annual flow of the Athabasca River just downstream of Fort McMurray is about 20.0 billion cubic meters, or about 15% of the average annual water flow out of Alberta each year. The annual river flows throughout the Athabasca Basin are one of the few remaining natural flows not currently being managed by reservoirs used for hydro-electricity generation.

The Lower Athabasca Region accounts for 84% of all oil sands mining water allocations in the province, and 70% of all upstream petroleum allocations. Overall, the region accounts for only 4% or 124 million cubic meters of all estimated water use in the province.

- On average, only about 3% of the region's annual average natural supply of water has been allocated to license holders, although winter flow rates are typically about 10%[16] of summer flow rates. Between 1998 and 2002, winter low flow periods lasted up to 4 months and coincided with the lowest recorded flows during the 50 years of historical record.

- Only 14% of allocated volumes in the region are assumed to be returned to rivers and lakes after use.

- In addition to oil sands development in the immediate Fort McMurray region, there are also significant operations located in the Cold Lake area.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use, from 2005 to 2020, is expected to show an overall 188% increase to almost 358 million cubic meters, corresponding to increases in oil sands and industrial use, especially once proposed oil sands mining operations come on stream. However, the supply side is anticipated at best to remain flat over the same period.

- With implementation of the proposed water policy and conservation measures, the Lower Athabasca Region's forecast of estimated water use from 2005 to 2020 would be expected to show an overall 34% increase in demand to about 167 million cubic meters. This is a reduction in forecasted water use of an additional 192 million cubic meters. There is a strong probability that many of the oil sands mining operators will conserve more than this amount through planned process improvements and operational efficiencies.

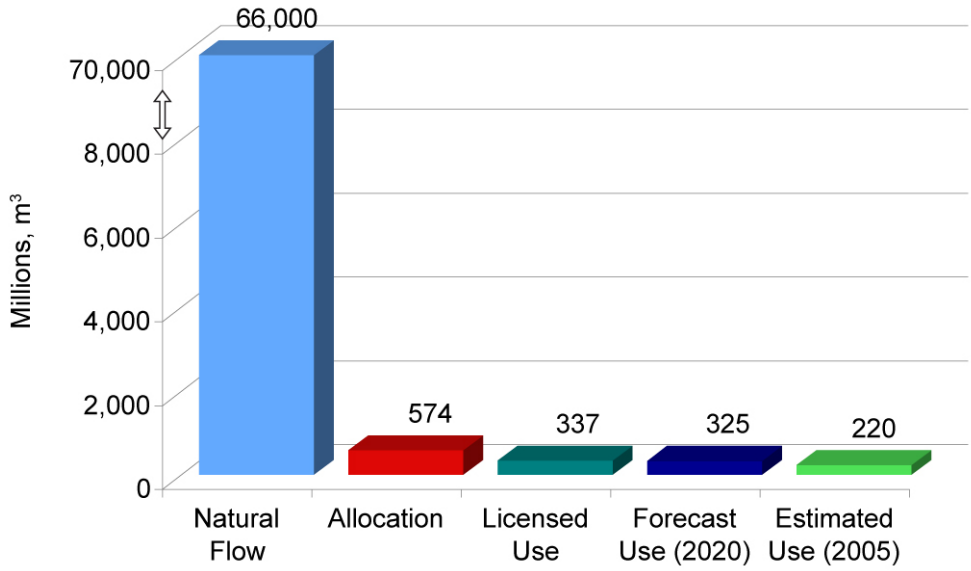
To date, there has been enough flow in the Athabasca River to meet environmental, human and oil sands operational needs. However, AENV is now setting limits on how much water oil sands companies can remove from the Athabasca River under a new two phased framework that sets maximum withdrawals based upon available year round water flow levels. While current oil sands water use has generally been below the most stringent limits identified within the Phase 1 Framework, current licenses have allowed for maximum amounts that could cumulatively exceed these limits. All oil sands operators, whether new or existing, will have to work together to share water within prescribed limits. The draft Framework requires that the oil sands industry provide AENV with a plan for water sharing and collectively meeting Phase 1 requirements by January 31, 2009. The issue is primarily one of timing of water withdrawals during the low flow winter season, not year round availability of these water flows.

The upstream petroleum industry is faced with the same social license to operate and environmental issues faced by other players in the non-renewable natural resources sector. To continue to operate and expand in the future, oil and gas producers will need to develop and implement new technologies and practices that will reduce the net consumption of fresh water by the industry to the lowest levels possible.

The oil sands projects present substantial opportunities to improve water management. Traditional mining and in situ methods consume between 2.5 to 3 barrels of water per barrel of bitumen, although some of the newer facility designs show promise of lower water consumption.

Going forward, one of the more significant issues in the region will be the management of the oil sands tailings ponds. The management and remediation of existing tailing ponds presents a considerable legacy issue and challenge to oil sands operators, as does the development of new technologies and processes to reduce the volumes of new tailings going forward. There are several public and private sector initiatives focused on the management and remediation of existing tailing ponds, including the Oil Sands Tailings Research Facility (OSTRF), the Canadian Oil Sands Network for Research and Development (CONRAD), the Petroleum Technology Alliance of Canada (PTAC), a recent research agreement between the Alberta Water Research Institute and GE, and specific tailings research by the Alberta Energy Research Institute (AERI).

UPPER PEACE AND UPPER ATHABASCA REGIONS



Natural Flow reflects average annual natural flow of Peace River, downstream of Peace River.

This region aligns with the Upper Peace and Upper Athabasca Regions in the Land Use Framework, and reflects the western portions of the Athabasca and Peace/Slave River Basins. The annual river flows throughout the Athabasca Basin are one of the few remaining natural flows not currently being managed by reservoirs used for hydro-electricity generation. However, the Peace River has a substantial reservoir and hydro-electricity generation facility located upstream of the Alberta-B.C. border.

Land uses in the region include forestry, resource exploration and extraction, and recreation. Water use in the region includes industrial, oil and gas extraction, water and habitat management, waste assimilation, and some agriculture. While the Upper Peace and Upper Athabasca Regions occupy about 24% of Alberta's land area, they account for only 4% of its total population. The average annual flow in the region is about 66 billion cubic meters. Overall, the region accounts for 6% of provincial water allocations, and for 7% or 220 million cubic meters of all estimated water use in the province.

- While the region accounts for 95% of all water allocations for the forestry sector in Alberta, the forestry sector only accounts for about 9% of the estimated water used in the region.

- About 59% of the estimated water use in the region is for other purposes (water and habitat management). Oil sands mining and thermal/injection operations in the upstream petroleum sector account for an additional 14% of estimated water usage.

- There is also some stock watering and agriculture in the region that accounts for an additional 7% of estimated water usage.

- About 41% of allocated volumes in the region are assumed to be returned back to rivers and lakes after use, with most of this return flow coming from the forestry sector.

- The region includes the head waters of both the Athabasca River and Peace River, and as such, preservation of these watersheds is critical to water management plans and oil sand operations located further downstream.

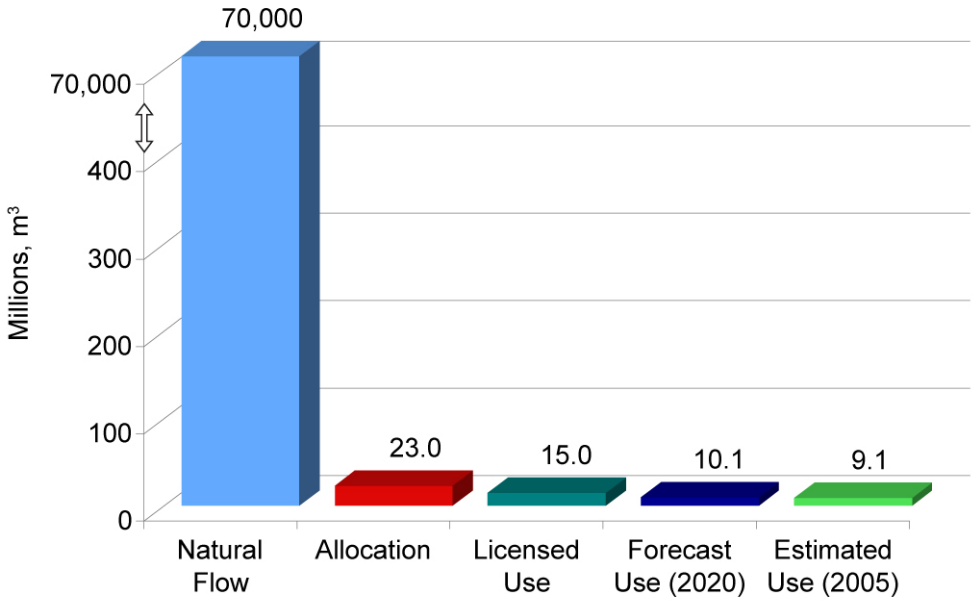
- In the absence of any significant policy or conservation measures, the base forecast of estimated water use from 2005 to 2020 is expected to show an overall 48% increase to about 325 million cubic meters. The supply side is anticipated at best to remain flat over the same period.

- With implementation of the proposed water policy and conservation measures, the Upper Peace and Upper Athabasca Regions forecast of estimated water use from 2005 to 2020 would be expected to show an overall 20% increase in demand to about 263 million cubic meters. This is a reduction in forecasted water use of an additional 61 million cubic meters.

The water issues and challenges in the Upper Athabasca Region are primarily the same as those found in the Lower Athabasca Region, particularly in regards to the upstream petroleum sector and oil sands operations. Water use in the Upper Peace Region is dominated by water management purposes such flood control and lake stabilization, and to a lesser degree the forestry sector.

The forestry sector is required to draft harvesting plans that include detailed reviews of corridor requirements to buffer lakes and streams, watershed and aquatic needs[17]. However, some forest management practices in the region have disrupted nutrient cycles, increasing runoff and concentrations of dissolved nutrients in adjacent streams and lakes, with a decrease in water quality[18].

LOWER PEACE REGION



Note: Natural flow reflects average annual natural flow of Peace River at Fort Vermilion (66M m^3), the Hay River (3.6M m^3), and Whitesand/Buffalo Rivers (1.3M m^3).

This region aligns with the Lower Peace Region in the Land Use Framework, and reflects the eastern portion of the Peace/Slave River Basin, as well as the Hay River Basin and Buffalo River Basin.

Land uses in the Lower Peace Region include forestry, resource exploration and extraction, and recreation. Water uses in the region include industrial, oil and gas extraction, other uses, waste assimilation, and some agriculture.

While the Lower Peace Region occupies about 22% of Alberta's land area, it accounts for only 3% of its total population. The average annual flow in the region is about 70 billion cubic meters. Overall, the region accounts for only 0.2% of provincial water allocations and only 0.3% or 9.1 million cubic meters of all estimated water use in the province.

- About 60% of the estimated water use in the region is for other purposes (water and habitat management), with injection operations in the upstream petroleum sector accounting for an additional 18% of estimated water usage.

- There is also some stock watering and agriculture in the region that accounts for an additional 8% of estimated water usage.

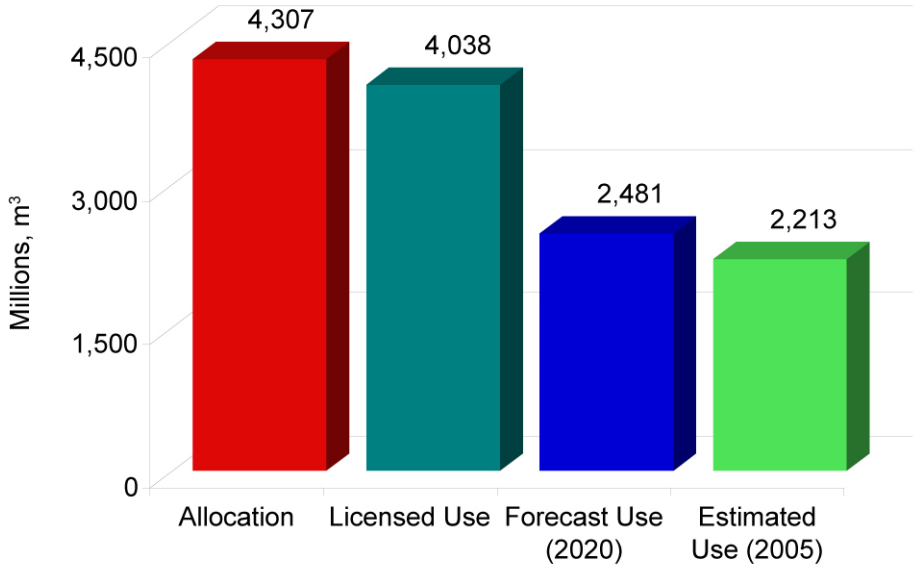
- About 34 percent of allocated volumes in the region are assumed to be returned back to rivers and lakes after use, with most of this return flow coming from the municipal and forestry sectors.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use from 2005 to 2020 is expected to show an overall 11% increase to about 10.1 million cubic meters. The supply side is anticipated at best to remain flat over the same period.

- With implementation of the proposed water policy and conservation measures, the Lower Peace Region's forecast of estimated water use, from 2005 to 2020, would be expected to show an overall 6% increase in demand to about 9.7 million cubic meters. This is a reduction in forecasted water use of an additional 0.4 million cubic meters.

The water issues and challenges in the region are primarily focused on increased information sharing and consultation mechanisms with First Nations and Métis communities that will encourage their participation in the development of land-use and water management plans. The Government of Alberta has an obligation to consult aboriginal communities where land and water management and resource development decisions may adversely impact their constitutionally protected Treaty and aboriginal rights.

IRRIGATION AND AGRICULTURE



The irrigation sector in Alberta involves 13 irrigation districts in southern Alberta (about 525,000 hectares), and "private irrigation" of more than 100,000 hectares of irrigated land as far north as the Peace River.

The history of southern Alberta is closely linked to the development of agricultural irrigation, which holds a dominant share of the water in the province. Irrigation has not only the greatest volume of water allocated and used but, by and large, the most senior rights. The sector is allowed to withdraw up to 4.3 billion cubic meters of water, or 45% of all water allocations in the province.

- In Alberta, irrigation accounts for 96% of total water allocations for the agricultural sector, while allocations for stock watering and feedlots make up the remaining 4%.
- Thirty-six percent of all the water allocations in Alberta (3.5 billion cubic meters) are managed by 13 Irrigation Districts. The Top 5 Irrigation Districts account for about 3.0 billion cubic meters, or more than 30% of all water allocations in Alberta[(19)].
- The irrigated area within the province represents 65% of the total irrigation area across Canada. With more than 8,000 kilometres of conveyance works, and more than 50 water storage reservoirs providing storage capacity of over 1 billion cubic meters of water, Alberta is the irrigation capital of Canada.
- In Alberta, it is estimated that the irrigation and agriculture sector uses about 2.2 billion cubic meters of water or 68% of all water used in Alberta. With irrigation, the majority of water that is applied to crops is taken up by the plants for growth or evaporated, and return flows can vary from 20% to 30%. There are virtually no allowances for return flow for any allocations granted to stock watering.
- Irrigation water fees are typically paid according to the amount of land area irrigated, not the volume of water that is applied to irrigated acres[(20)].
- In the absence of any significant policy or conservation measures, the base forecast of estimated water use to the year 2020 is expected to show an overall 12% increase to almost 2.5 billion cubic meters. In general, the greatest factor driving demand for water in the agriculture sector is weather during the growing season, although the type of crops being grown also influences demand. The volumes of water diverted for irrigation over the last five growing seasons has been less than historical amounts.

Proposed increases in the production of biofuels may require even more irrigation in drier southern water basins. The potential impact on water use from increased biomass energy production in Alberta and the strategies to mitigate these impacts remains uncertain.

The Irrigation Districts are now considering new innovative funding models, and new service offerings targeted at new markets. Their success hinges on some fundamental changes in irrigation policy and water management, including transferring some of the conserved and trapped irrigation water for uses beyond traditional agricultural and irrigation purposes.

In 2007, AENV announced a policy review of water license transfers involving a change in the purpose of a license. A recent draft policy statement is recommending that, subject to restrictions on the resale and speculation of water, up to 2% of an allocation could be transferred to a different purpose through amendments to a transfer application(21).

With the financial incentive to conserve and transfer at least 2% of their allocation, the Irrigation Districts' 2020 water use forecast could be further reduced by at least 4% or 83 million cubic meters. This amount of water is enough to support over 750,000 people. There is a strong probability that many of the Irrigation Districts will conserve more than this amount through planned operational efficiencies, as well as through infrastructure works and reservoir upgrades.

More regional on-stream and off-stream reservoir storage would further help to store more water for wetland management and other uses during the off-season, and to also better manage and conserve water for irrigation during growing season. Calgary does not have extensive reservoir storage, and there is very little water reservoir storage immediately east of Calgary today (see Appendix). (Note that this is a key concern of municipalities downstream of Calgary who depend on the return flow from Calgary to maintain the water level in the Bow River.) However, electricity producers have reservoir storage capacity west of Calgary, and new incentives should be considered to help the utilities and irrigators partner on the development of more sustainable water management and reservoir storage options in the region.

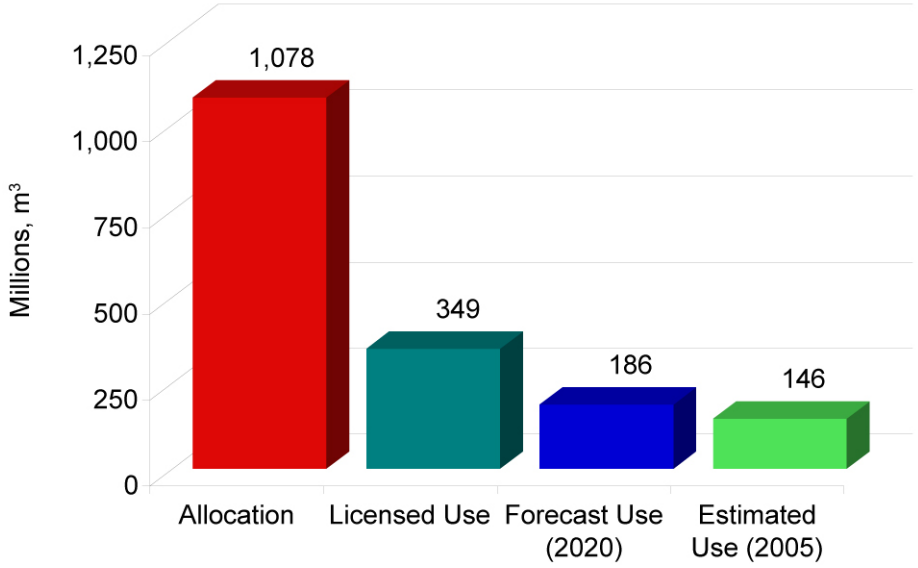
While each of the not-for-profit Irrigation Districts is unique, collectively about 40% of the province's irrigation works are currently classified as being in fair or poor condition. In some districts, almost 75% of the Irrigation District's water conveyance infrastructure has not been rehabilitated(22). Farming alone cannot generate the hundreds of millions of funding dollars needed to build new irrigation infrastructure and to maintain system integrity.

The Irrigation Districts have legislated limits on the number of expansion acres available for irrigation. Historically, they have been irrigating on average about 88% of their total available 1.4 million acres by using about 63% of their total water allocation(23). If they were to irrigate all remaining expansion acres, the Irrigation Districts would still be left with over 900 million cubic meters of (stranded) water allocations that could not practically be used for irrigation of existing lands.

There are many promising agricultural practices and technologies being used in Alberta that are increasing yield while reducing the impact of crops on water resources. Irrigators are becoming more efficient water users, and that provides options for the unused water allocated for a district, such as expanding the irrigated acreage. However, at some point the province might be faced with paying farmers not to irrigate. This practice of leaving the land fallow can be found in the United States, and elsewhere. This unused water could also meet the water needs of non-agriculture users. Another option is the creation of water trusts, which keeps water in trust for recreation, water management and fish habitat.

Any proposal to amend Alberta's irrigation policies and water allocations is certain to create public debate. The challenge is how to balance the economic value of our agricultural and water resources with the desire to promote conservation and maintain a healthy aquatic ecosystem. A possible solution is the use of market mechanisms to free up trapped water for other uses and to provide incentives for capital-driven infrastructure upgrades and implementation of new technologies.

MUNICIPALITIES



About 90% of Alberta's total population is concentrated in the South Saskatchewan Region (50%) and the North Saskatchewan Region (40%).

The municipal sector has the third largest volume of water allocations in Alberta, after irrigation and industrial, with almost 2,000 municipal licenses allowed to divert up to 1.1 billion cubic meters of water, or 11% of all water allocations in the province.

- Most municipalities return the vast majority of their treated water back to their local watershed, and the sector accounts for 20% of all estimated return flows in the province. With their large return flows, municipalities account for only 146 million cubic meters or just 4% of total estimated water use in Alberta.

- Industry experts estimate that about 70% of the total volume of municipal water treated and supplied in a year returns to the system as wastewater. Only the industrial sector has higher estimated return flows than municipalities. The remaining 30% is consumed through irrigation, evaporation, manufacturing processes, and leakage[24].

- It is assumed that municipalities in Alberta return about 68% of their allocation, typically as treated wastewater. However, when compared to the total annual demand for treated drinking water, sanitary sewage flows for the City of Calgary represent 93% of this volume. This suggests that a relatively small proportion of water (7%) is consumed by the city and as a result, the net loss to the local river system is fairly low[25]. This assumption does not account for storm water discharges, which can significantly and suddenly increase the amount of return flows to local waterways.

- Significant quantities of potable municipal water continue to be used for non-consumptive purposes, especially for lawn watering and landscaping. While most of this water ends up as return flow, there are significant economies and cost savings in infrastructure, operations and treatment still to be realized with additional conservation.

- There are over 600 municipal water treatment facilities across the province, but almost two thirds of Alberta's population is served by just 10 of these facilities[26]. While Alberta's major municipalities have excellent water and wastewater treatment facilities, many smaller and rural communities lack modern water treatment infrastructure and resources. The South Saskatchewan Region accounts for about 53% and the North Saskatchewan Region accounts for 24% of all municipal water treatment facilities in Alberta.

- Municipal water services are an excellent example of a policy area that calls for a regional approach. The government is encouraging municipalities to consider regional water and wastewater systems, public-private partnerships, and the contracting out of operations and maintenance.
- Typically, municipal water data does not distinguish between water used for residential purposes and water used by commercial enterprises and industries that draw their water from a municipality. However, residential customers comprise the vast majority (92%) of water service connections in Calgary and account for 52% of demand. In Calgary, industrial, commercial, and institutional (ICI) users represent only 7% of the total customer base, but use 34% of the water within the municipality[27].
- In the absence of any significant policy or conservation measures, the base forecast of estimated water use to the year 2020 is expected to show an overall 27% increase to more than 186 million cubic meters. In general, the greatest factor driving demand for water in the municipal sector is growth in population, although industrial and commercial development within municipalities also influences demand.

The recovery and reuse of municipal wastewater (reclaimed water) for non-potable commercial and industrial, domestic, landscape, and agricultural purposes presents a significant opportunity to better use and manage existing water supplies. Other jurisdictions like Australia, the United States and British Columbia have developed policy and legislation to safely manage these reclaimed water applications. Current Alberta legislation prohibits the full exploitation of these practices, and these laws need to be amended to encourage the practice of wastewater recovery and reuse.

The increased use of reclaimed and grey water, along with other water efficiency and conservation measures, has the potential to reduce fresh water demand from households by as much as 30 to 40%, without affecting current consumption patterns, volumes or life styles. Put another way, an existing water license might be able to serve hundreds or even thousands of additional more homes through improved efficiency and conservation practices.

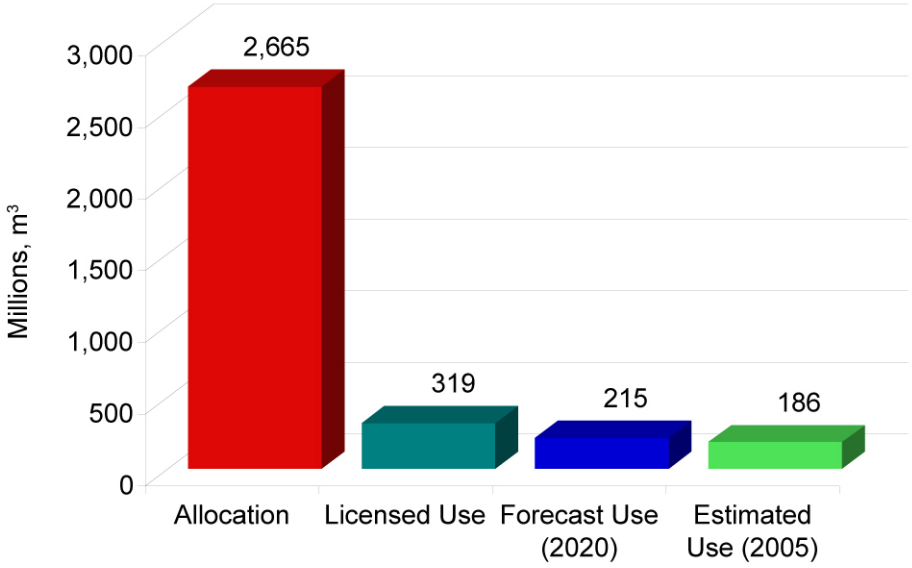
In addition, losses and leakage of water as it moves through the municipal distribution network can be relatively high, contributing to 3% to 30% loss rates[28]. Poorly maintained municipal water infrastructure contributes not only to problems with leakage but also contributes to poor water quality issues. As an example, the City of Calgary budgets approximately $500 million annually for water and wastewater treatment infrastructure management.

Municipal per capita water demand can be further reduced through additional investments into leak detection, mains replacement, metering, conservation tactics, and possibly line pressure management.

The return flow of treated municipal and industrial wastewater to the rivers must be optimized, balancing the desire for increased conservation and reuse with the need to maintain enough water in the river to ensure a healthy aquatic ecosystem. Return flow credit schemes need to be assessed, and the ownership of treated municipal effluent must be established.

With the financial incentive to conserve water through planned operational efficiencies and infrastructure upgrades, the municipal sector's water use forecast to the year 2020 could be further reduced by at least 6% or 11 million cubic meters. However, this forecast could be further reduced through the introduction of new policies supporting the recovery of stormwater and the reuse of municipal wastewater (reclaimed water) for non-potable and non-contact purposes. An innovative and simple option to encourage conservation and reduce waste, that has been adopted by many municipalities, are tiered municipal water rates, which provide for higher water usage rates after a certain amount of water had been consumed by a residential or commercial industrial user.

INDUSTRIAL AND COMMERCIAL



In general, water use indicators for the industrial and commercial sectors are under-reported by an estimated 10% to 20%. This is because water used by commercial enterprises and industries that draw their water from a municipality is reported under the municipal sector.

The industrial sector includes water allocations for cooling, forestry, chemical plants, fertilizer plants, manufacturing, mining other than coal, coal mining, hydroelectricity, and other industrial activities.

The commercial sector includes a variety of activities including parks and recreation, golf courses, food processing, and aggregate washing. A total 1,430 licenses have been issued for commercial purposes, accounting for less than 1% of total water allocations in Alberta.

- The industrial sector has the second largest volume of water allocations in Alberta after irrigation, with 210 water licenses allowed to withdraw up to 2.7 billion cubic meters, or 28% of all water allocations in the province. About 88% of the sector's allocations are for industrial cooling, with another 8% allocated to forestry.

- The sector accounts for 65% of all estimated return flows in the province, and for only 6% of total estimated water use in Alberta.

- About 88% of Alberta's industrial water allocations and 54% of the sector's estimated water use is located in the Edmonton area and North Saskatchewan Region.

Industrial cooling processes primarily use water to dump waste energy from power generation, pulp and paper, petrochemical and other energy-intensive operations. In Canada, more water is withdrawn for cooling, condensing and steam generation purposes than for any other purpose.

Cooling demands for water are very large. Though technology is improving and becoming more efficient, today's processes can only convert 40% of the fuel's energy into usable electricity[29]. The rest is wasted. This shows the double cost of inefficient energy use: first, in the wasted energy, and then in the water required to cool the wasted heat to the temperature where it can be released safely into the environment.

Taken together, significant water use and loss of energy into the environment add up to a high capital and environmental cost. There is a significant and growing opportunity to develop technology to recover more of this energy for useful purposes (e.g. co-generation) while also conserving water.

Since coal-fired plants provide the base load of the electricity for Alberta and are assumed to be operating more often than other types of generation, their technology selections and changes in capacity predominately influence the water consumption forecast by the power generation industry in Alberta.

The forecast of water consumed in coal-fired generation was largely driven by the type of technologies chosen, including the type of cooling technology, boiler selection, and, to a lesser extent, flue gas desulphurization technology. The type of boiler chosen has a significant impact on the amount of water consumed. A previous study indicated that, on average, coal-fired plants using a supercritical boiler can consume less than half of the water per kilowatt hour produced than a coal-fired plant using a subcritical boiler, regardless of the cooling and flue gas desulphurization technologies[30].

The choice of cooling technology also has a significant impact on water consumption. On average, coal-fired plants using once-through cooling technology can consume 0.102 gal/kWh of energy produced, while recirculating cooling technology can consume 0.461 gal/kWh of energy produced, and cooling pond technology can consume 0.405 gal/kWh of energy produced, regardless of the type of boiler and flue gas desulphurization technology. Once-through cooling technologies withdraw more water than either cooling ponds or recirculating cooling technology. Cooling ponds withdraw only 66.3 percent of the water that once-through technologies withdraw per kilowatt hour of energy produced, while recirculating technologies withdraw only 2.3 percent of the water once-through technologies withdraw[31].

The major reductions in water consumption in the forecast period are attributed to the decommissioning of three coal-fired plants which utilize subcritical boilers. During the forecast period, electricity demand continually increases. The addition of three new supercritical coal-fired plants compensates for the demand capacity of the decommissioned plants, however does not increase water consumption. While the chosen flue gas desulphurization technology does have an impact on water consumption values, cooling technology and boiler selection primarily influences water consumption values for coal-fired plants.

Natural gas-fired plants, both combined cycle and cogeneration, contribute to the water consumption forecast, but do not have as much influence as coal-fired plants. While new combined cycle and cogeneration plants slightly increase the amount of water consumption, this is overshadowed by changes in coal-fired generation technology.

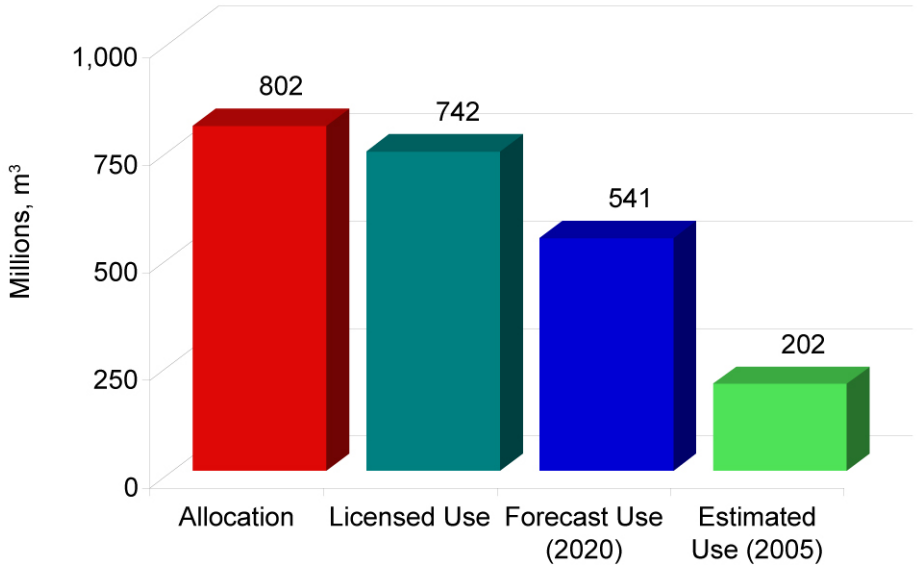
The majority of coal-fired generation, and thus the majority (72 percent) of water consumption for power generation, is located in the Edmonton region. The South Saskatchewan Region accounts for 25 percent of the water consumption for power generation. The remaining three percent of consumption is accounted for in the Northern regions. See the appending document for additional details on this study's research and analysis of industrial cooling use and technologies in Alberta.

The base forecast of water use across the industrial and commercial sector to the year 2020 is expected to show an overall 15% increase to more than 215 million cubic meters. Historically, the greatest factor driving demand for industrial water has been the growth in cooling for electrical power generation, although some of the other heavy water consumers are refineries, organic and inorganic chemical manufacturers, steel mills, and pulp and paper mills.

It should be noted that the base forecast of water use for industrial cooling already reflects the impacts of replacing older power generation plants in the province with much more water efficient cooling systems and technologies. As such, there is no additional planned reduction in water use for industrial cooling between the base case and the alternative conservation forecast.

However, the forestry, chemical and fertilizer plant, and manufacturing sectors have the financial incentive to reduce and conserve water through planned operational efficiencies and infrastructure upgrades, and as such, the industrial and commercial sector's water use forecast to the year 2020 could be further reduced by at least another 5 percent, or almost 10 million cubic meters.

OIL AND GAS



This sector requires water allocations for oilfield injection, thermal extraction, oil sands mining, gas and petrochemical plants, drilling, and various other activities.

There are a number of uses for water in the oil and gas sector that result in the water being removed from the hydrological cycle for a long period of time. These include the deep well disposal of industrial wastewaters, water used for washing salt caverns, and water used for the enhanced recovery of oil through water and steam injection processes. In general, the greatest factor driving demand for water in this sector is growth in oil sands mining, although thermal and steam assisted gravity drainage (SAGD), as well as oil and gas refinery development, also influence demand.

- The sector has the fourth largest volume of water allocations in Alberta, with almost 95 water licenses allowed to withdraw up to 802 million cubic meters of water, or 8% of all water allocations in the province. About 86% of the sector's allocations are for upstream activities, with 65% allocated to oil sands mining.

- Only about 25% of the water allocations are currently used by the sector.

- The upstream portion of the oil and gas industry accounts for an estimated 72 % of the sector's 202 million cubic meters of water use, while the downstream portion accounts for the remaining 28 % of this water use.

- Alberta's oil sands deposits contain approximately 1.7 trillion barrels of bitumen in-place, of which 173 billion barrels are proven reserves that can be recovered using current technology[32]. About 60% of the oil and gas sector's water allocation and its estimated water use are based in the Fort McMurray area and Lower Athabasca Region.

- Currently, the oil and gas sector in the Lower Athabasca Region is allocated about 2.2% of the Athabasca River's average annual natural flow, but is estimated to be using about 1% of this flow on average over the year. The Athabasca River's flow varies greatly across seasons because it is not managed (no dam), and winter flows can be as little as 10% of summer flows. The concern of many stakeholders is the potential withdrawal of water in the winter months that could potentially reduce flows below minimum levels required to maintain a healthy ecosystem.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use in the oil and gas sector from 2005 to 2020 is expected to show an overall 167% increase to about 541 million cubic meters. In general, the greatest factor driving demand for water in the oil and gas sector is growth in oil sands mining, although thermal and SAGD, as well as oil and gas refinery development also influences demand.

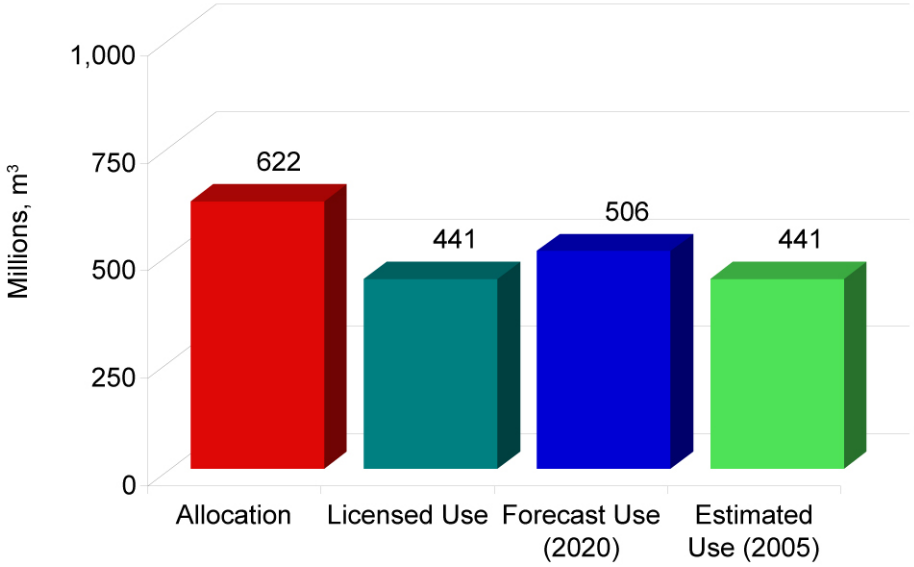
- With implementation of the proposed water policy and conservation measures, the oil and gas sector's forecast of estimated water use from 2005 to 2020 is expected to show an overall 41% increase in demand to about 284 million cubic meters. This is a reduction of an additional 257 million cubic meters in forecasted water use.

Media and public pressure continues for the oil and gas industry to implement higher levels of water reuse and recycling, increased saline water use, and keeping more water in the hydrogeological cycle. Water and tailings management in the oil sands region is a major focus of government and industry, with each group developing, leading and participating in several initiatives to address these issues. A sample of some of these initiatives is included in the Appendix. It is important that industry have a key role in leading and implementing these initiatives.

The AERI report titled "A 2020 Fresh Water Neutral Upstream Petroleum Industry" notes that the greatest increase in fresh water use in the upstream petroleum sector to 2020 is the growth in oil sands mining development using water-based extraction technologies.

Some technologies exist today to reduce water use in extraction. However, further industry collaboration, research, data analysis and project evaluation is required to increase water recovery and recycling, as well as recover water trapped in tailings ponds. More on-stream and off-stream reservoir storage would further help to manage and conserve surface and groundwater, especially during low flow winter periods in the oil sands regions.

WATER AND HABITAT MANAGEMENT, OTHER



This sector requires water allocations for drainage of gravel pits and mines, water remediation, flood control, stabilization of lake levels, fish farms, storage reservoirs for wildlife, wetlands management, other activities specified by AENV including water conservation holdbacks.

This sector has almost 1,200 water licenses that are allowed to withdraw up to 622 million cubic meters of water, or 7% of all water allocations in the province.

- About 72% of the sector's allocations are for water management for flood control and lake stabilization, with 27% allocated to fish, wildlife and habitat enhancement, and the balance for water conservation and other uses specified by AENV.

- There is no information on actual water diversions and consumption for any of the licenses issued to this sector. It is assumed that licensees are using their full entitlement. As such, about 70% of the sector's overall water allocation is assumed to be used, and about 30% is assumed to be return flow. There are no return flow requirements in licenses issued for water conservation purposes or for allocations of surface water for director–specified activities.

- About 50% of the sector's estimated water use is based in the relatively dry South Saskatchewan Region (34% in the Oldman basin) with another 30% based in the Upper Peace and Upper Athabasca regions.

- The majority of licenses for water management and habitat enhancement have been issued to Alberta Environment and Ducks Unlimited.

- In the absence of any significant policy or conservation measures, the base forecast of estimated water use to the year 2020 is expected to show an overall 15% increase to over 506 million cubic meters.

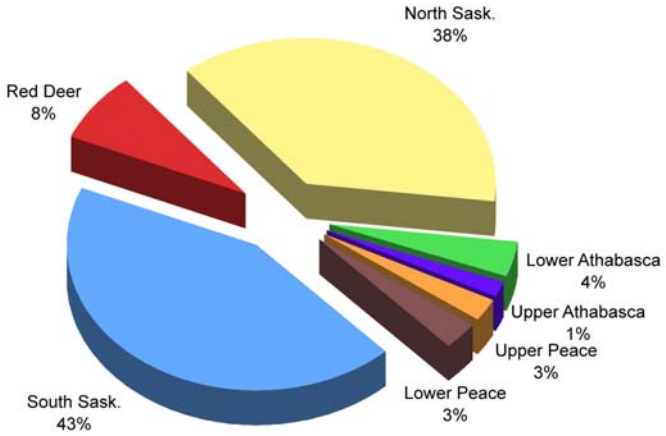
One of the most significant issues in the sector is wetlands management. The percentage of land base covered by wetlands increases as a gradient moving from the southeast to the northwest of the province, where wetlands may cover as much as 65% of the land base.

The scale of wetland loss across Alberta is only partially understood, but is estimated to be significant, with 64% of wetlands lost to date in the White Area (settled land), and current annual loss estimated at between 0.3% and 0.5% of remaining wetland areas[(g)].

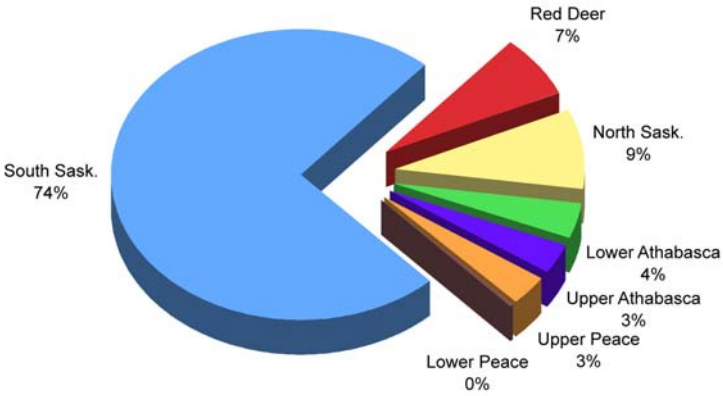
The Alberta Water Council recently submitted one of Canada's most comprehensive wetland policy and implementation recommendations. When development is proposed that affects a wetland, the policy could require the proponent to compensate, as a last resort, for loss of wetland area or for wetland degradation. In general, industry supports the need to establish a definitive policy to guide wetland planning and decision-making, but believes that work still remains on how to strike an appropriate balance on issues of compensation, and on defining appropriate implementation tools.

ALBERTA | COMPARATIVE ANALYSIS: SECTORS AND REGIONS

LAND USE REGION	RIVER BASINS	HISTORICAL INDICATORS (m^3)	WATER USE FORECASTS	COMMENTS
South Saskatchewan	**Bow, Milk, Oldman, South Saskatchewan Basins**	**Allocation:** *(% Use / % Return Flow)* 5,235 billion (83% / 17%) 55% Alberta Total **Estimated Use (2005)** 2,386 billion 73% Alberta Total	**Base Case (2020):** 2,705 billion (13% growth) **Conservation Scenario:** 2,605 billion (9% growth)	79% of Region's allocation and 86% of its water use is for Agriculture and Irrigation. About 56% to 72% of the average annual flow is allocated, and about 25% to 32% is being used.
Red Deer	**Red Deer Basin**	**Allocation:** *(% Use / % Return Flow)* 0.372 billion (72% / 28%) 4% Alberta Total **Estimated Use (2005)** 0.223 billion 7% Alberta Total	**Base Case (2020):** 0.246 billion (11% growth) **Conservation Scenario:** 0.240 billion (8% growth)	31% of Region's allocation and 28% of its water use is for Other Purposes. About 20% to 25% of the average annual flow is allocated, and about 12% to 15% is being used.
North Saskatchewan	**North Saskatchewan and Battle River Basins**	**Allocation:** *(% Use / % Return Flow)* 2,808 billion (18% / 82%) 29% Alberta Total **Estimated Use (2005)** 0.292 billion 9% Alberta Total	**Base Case (2020):** 0.383 billion (31% growth) **Conservation Scenario:** 0.349 billion (19% growth)	81% of Region's allocation and 25% of its water use is for Industrial Cooling. About 37% to 42% of the average annual flow is allocated, and about 4% is being used.
Lower Athabasca	**Athabasca River Basin (downstream) and Beaver River Basin**	**Allocation:** *(% Use / % Return Flow)* 0.551 billion (86% / 14%) 6% Alberta Total **Estimated Use (2005)** 0.124 billion 4% Alberta Total	**Base Case (2020):** 0.358 billion (188% growth) **Conservation Scenario:** 0.166 billion (34% growth)	80% of Region's allocation and 78% of its water use is for Oil Sands Mining. About 3% of the average annual flow is allocated, and about 1% is being used.
Upper Peace and Upper Athabasca	**Athabasca River Basin (upstream) and Peace - Slave River Basin (upstream)**	**Allocation:** *(% Use / % Return Flow)* 0.573 billion (59% / 41%) 6% Alberta Total **Estimated Use (2005)** 0.220 billion 7% Alberta Total	**Base Case (2020):** 0.324 billion (48% growth) **Conservation Scenario:** 0.263 billion (20% growth)	35% of Region's allocation is for Forestry and 59% of its water use is for Water Management. Less than 1% of the average annual flow is allocated or used.
Lower Peace	**Peace – Slave River Basin (downstream)**	**Allocation:** *(% Use / % Return Flow)* 0.023 billion (66% / 34%) 0.2% Alberta Total **Estimated Use (2005)** 0.009 billion 0.3% Alberta Total	**Base Case (2020):** 0.010 billion (11% growth) **Conservation Scenario:** 0.009 billion (6% growth)	30% of Region's allocation is for Municipal and 60% of its water use is for Water Management. Less than 1% of the average annual flow is allocated or used.

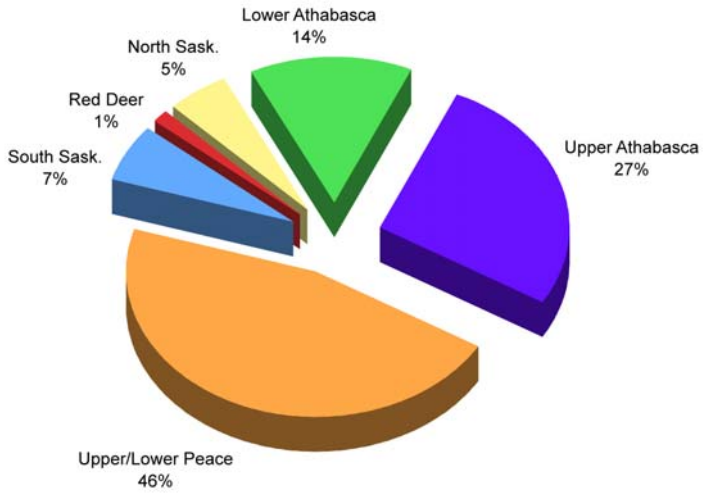


Alberta, Population (2006)



Alberta, Estimated Water Use (% Total, 2005)

Estimated water usage in the South Saskatchewan Region primarily reflects consumptive irrigation uses, while the North Saskatchewan Region reflects non-consumptive industrial and municipal use.



Alberta, Estimated Average Annual Flow (% Total)

MAJOR ISSUES AND RECOMMENDATIONS

The most important overall conclusion from the detailed analysis of water use in Alberta by region and by sector is that there are very distinct regions across the province with very different water issues. Province-wide policy solutions are likely not going to be practical. Different approaches are required in each region.

A second overall conclusion is that clarity of new policies and regulations around water management and land use is critical for industry to continue to invest and grow in Alberta. The policy changes that have been announced as part of the Water for Life strategy and the Land Use Framework quickly need to be reflected in the regulatory system to avoid confusion and uncertainty on the part of project developers and operators. This becomes even more important in the current uncertain economic climate.

Some of the more significant challenges, opportunities and recommendations by region are summarized below.

LAND USE REGION	SECTOR FOCUS AND MAJOR ISSUES	RECOMMENDATIONS
South Saskatchewan	**Sector Focus:** Irrigation and Municipal **Major Issue:** Water Availability Water availability, more than water scarcity, is the essence of the region's water dilemma. Irrigation and urban expansion have been competing for water resources since the area was settled. The key issues are increasing demand due to population growth, water allocation and license trading processes, sharing of water rights in shortages, and the variation in water flow between seasons.	The region needs to move into a new era of incentive-based water conservation and license transfers. Market-based incentives, possibly including tax changes, must be introduced to encourage the capture, storage and sharing of water between rural and urban markets. The government must expand the practice of and streamline the processes for the sharing of water in the region. The Irrigation Districts play the most critical role in managing water in the region, as evidenced by the transfer of conserved water for the Balzac development. The Irrigation Districts can be incented to develop innovative water management solutions and to share some of their water allocations to satisfy urban demands, but it will not be done without compensation. The infrastructure to support water conservation or move water from one place to another has to be engineered and constructed, and these costs should be paid by those who are demanding new water allocations to support their proposed projects and future developments. The expansion of the market for water licenses must be done recognizing the need to ensure that there is an amount of water that must be set aside to support human and animal life and a healthy aquatic ecosystem. This amount can be calculated and included in the assessment of water balances. New policies and programs should be implemented to encourage the recovery, recycle and reuse of produced water and reclaimed/grey water for industrial, municipal and agricultural use. Examples would include changes to Alberta's building codes, and changes to ERCB policies regarding down hole disposal of oilfield wastewater. There may be additional opportunities to secure new sources of water from abandoned oil and gas wells in the region.

MAJOR ISSUES AND RECOMMENDATIONS (CONTINUED)

LAND USE REGION	SECTOR FOCUS AND MAJOR ISSUES	RECOMMENDATIONS
South Saskatchewan (continued)		Municipalities need to be incented to optimize their return flows. Return flow credits should be investigated as one option. It is imperative that the government clarify the ownership of treated municipal wastewater. Long term solutions must provide for the capture and additional storage of water throughout the year. One option would be new financial incentives to encourage the region's utility providers, developers and irrigators to partner together on managing and optimizing water flows and reservoir storage across the region. An example of this approach is the proposed Bruce Lake Reservoir to be located east of Calgary.
Red Deer	**Sector Focus:** Private Irrigation, Gas and Petrochemical Plants, and Water Management purposes such flood control and lake stabilization **Major Issue:** Managing Growth Increases in economic development need to be managed within the limits of the river, since the Red Deer plays a critical role in ensuring Apportionment Agreements with Saskatchewan can be sustained.	As per the Land Use Framework, the Red Deer River sub-basin should continue to be managed under the SSRB Water Management Plan. There is a need to implement monitoring and reporting of actual water use by private irrigators, the largest consumptive users of water in the region. The City of Red Deer is aiming to reduce its use of treated water by 20 per cent over 2006 levels within the next five years, and should approve conservation initiatives such as increasing the unit price of water for excessive use, and relating residential wastewater charges to water use.

MAJOR ISSUES AND RECOMMENDATIONS (CONTINUED)

LAND USE REGION	SECTOR FOCUS AND MAJOR ISSUES	RECOMMENDATIONS
North Saskatchewan	**Sector Focus:** Industrial Cooling and Upgraders **Major Issues:** Optimizing economic development on a limited water resource The proposed development in the Industrial Heartland threatens the ability to meet Alberta's water apportionment and water quality commitments with Saskatchewan.	In late 2007, the Province articulated an approach to cumulative effects planning, and has published a framework for regional utilities for the Heartland. This approach should be supported and reinforced. With the provincial government having established the policy and framework for this development, these regional solutions will need to be adopted and driven by industry. New financial and tax-based capital cost incentives need to be developed to encourage the upgraders and associated value added industries to work collaboratively on the development of regional water and wastewater treatment facilities. Increasing the recycling and reuse of municipal and industrial wastewater by the upgraders and other regional industrial facilities is vital. The quality of the water returned to the North Saskatchewan River must be as good as or better than the quality of water withdrawn from the river. At the provincial level, a policy decision on return flow credits is required. The government must make a policy decision regarding the ownership and control of municipal and industrial wastewater. Recovered and treated wastewater has a value and users will pay for wastewater.
Lower Athabasca	**Sector Focus:** Oil Sands Operations **Major Issues:** Social License to Operate Oil sands operators need to continue to manage, reuse and recycle water; they also need to be perceived as good stewards of these water resources. The key challenge is reversing the public and media perception that large amounts of fresh water are being consumed or wasted.	There is an immediate requirement to implement independent monitoring and reporting of water flows and water quality on the Athabasca River. Although some measurement currently takes place (AENV and the Regional Aquatics Monitoring Program), independence of data collection and reporting is necessary to assure the public that the reporting is accurate and unbiased. Water quantity is primarily an issue of timing of water withdrawals during the low flow winter season, not the year round availability of these water flows. A profile is needed of the flows of the Athabasca River downstream of Fort McMurray that is accepted by the Government, the operators and the public. This work is in progress and should be supported. Water quality is complicated by a lack of historical and independent base line measurements on the Athabasca River. Independent collection and presentation of this baseline data is needed.

MAJOR ISSUES AND RECOMMENDATIONS (CONTINUED)

LAND USE REGION	SECTOR FOCUS AND MAJOR ISSUES	RECOMMENDATIONS
Lower Athabasca (Continued)	Another significant issue is the management and remediation of existing tailing ponds. A further challenge is the development of new technologies and processes to reduce the volume of water going into tailings in the future.	New pilot programs need to be encouraged and expanded through policy and financial incentives to test alternative technologies for reducing water consumption in the extraction process, cleaning up water produced in the extraction process, improving water recovery from tailings, and remediating existing tailings ponds. Examples would include the increased use of saline and brackish water, and pilot projects such as Petrobank's THAI technology that uses underground controlled combustion instead of steam to warm the bitumen, as well as Vapour Extraction, Liquid Addition to Steam for Enhanced Recovery, Solvent Assisted Production and Expanded Solvent SAGD which are new in situ technologies that replace all or a portion of the steam with a solvent which reduces water use. The solvent is then recovered, recycled and reused. Oil sands mining operators should be encouraged through incentives and regulation to implement the water recycling and reuse programs contained in their Environmental Impact Assessments, and possibly to benchmark their environmental performance with other industry sectors. The Government must continue to support public awareness, communication and education programs focused on demonstrating public and private sector commitment to responsible resource development in the oil sands.
Upper Peace and Upper Athabasca	**Sector Focus:** Oil and Gas, Forestry, Water Management **Major Issue:** Protection of Source Waters The water challenges primarily reflect the same oil and gas sector issues found in the Lower Athabasca Region, albeit on a lesser scale. The region includes the head waters of the Athabasca and Peace Rivers, and as such, preservation of these watersheds is critical to water management, communities, and oil sand operations downstream.	Water basin planning and management programs in the region must be encouraged. The region does not yet have a Watershed Planning and Advisory Committee established and operational. AENV must ensure that water allocations for the water and habitat management sector continue to be preserved through future water and wetlands management initiatives. The Forestry sector is in the process of developing a Conservation, Efficiency and Productivity Sector Plan, and this should be encouraged.

MAJOR ISSUES AND RECOMMENDATIONS (CONTINUED)

LAND USE REGION	SECTOR FOCUS AND MAJOR ISSUES	RECOMMENDATIONS
Lower Peace	**Sector Focus:** Oilfield Injection, Forestry, Other Uses **Major Issue:** Engagement of First Nations in Water Management	There are challenges in implementing increased information sharing and consultation with First Nations in order to encourage their participation in the development of land-use and water management plans. The Alberta Government needs to continue its efforts to engage First Nations in the development of land-use and water management plans.

PLAN OF ACTION

Alberta and Provincial

- Send a letter to the Government summarizing the recommendations contained in this report and ask for action on them.

- Support the Government's initiatives to integrate the Land Use Framework and the Water for Life Strategy. The uncertainty as to how the Framework will be rolled out slows business development activities.

- Determine how to provide AEDA input to the Water Council's Water Allocation and Transfer Team, in accordance with the recommendations included in this report. This is the group tasked with developing recommendations on changing the water allocation and transfer system in the province. Currently there is no representation of any economic development interests on this team.

- Initiate a follow up study on the value added to GDP from specific industry sectors and their relationship to water use. Some initial work was done on this topic as part of this study, but a more detailed review is warranted.

- The province needs to continue programs to survey and map our ground water resources.

By Region

- Establish a program for independent monitoring, measuring and reporting of water quantity and quality on the Athabasca River starting upstream of Fort McMurray and through to the border with the North West Territories, and publicly share the data and results.

- Initiate a follow up study to investigate the practicality of implementing off-stream storage on the Athabasca River.

- Initiate a follow up study with the irrigation districts and the large power license holders in the South Saskatchewan as to how they could restructure their operations to increase storage in their existing reservoirs.

By Sector

- Support a follow up study on the role of "Green Water" in the use and export of agricultural products. Such a study is being planned by the Alberta Water Research Institute and a joint project could be very instructive in assessing the value of water in the agricultural sector.

- Support a follow up study on the opportunities to reduce water consumption for power generation and other industrial and commercial cooling applications. An initial study on use patterns was completed as part of this project, but further study to assess reduction opportunities would help guide investments in research and pilot projects.

- Support the activities of the oil sands companies in researching and deploying improved water management and tailings recovery processes. Several of the oil sands companies are actively engaged in research and pilot testing. The Alberta Water Research Institute is providing funding for some of these activities and could be a partner in this work.

APPENDICES

ALBERTA | ADDITIONAL INSIGHTS

- The absence of reliable data monitoring on historical baseline water flows and actual water usage creates significant problems for developing effective basin or sector water management plans, making it difficult to measure the effects of efficiency or conservation programs.

  Some significant water data gaps that exist today:

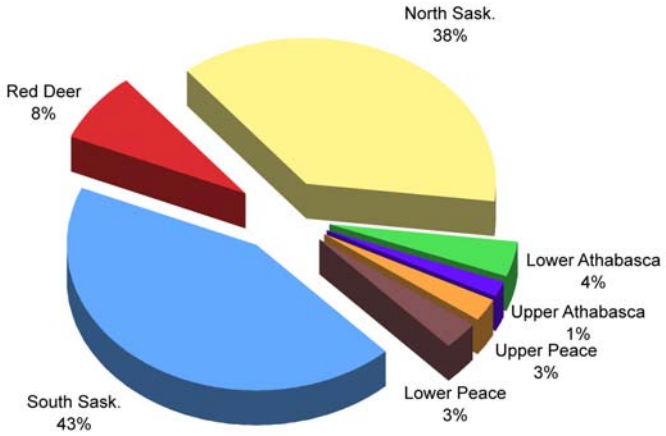
  - Withdrawal data is almost non-existent for municipalities in the Oldman, Battle and Peace basins;
  - Neither AENV nor AAFRD have any information regarding water use by private irrigators;
  - There is no actual water use information for stockwatering;
  - There is very limited water use information for the commercial sector;
  - The only information available for some oilsands mining operations is water withdrawal rates: no actual water use data is available;
  - Very little data exists for coal mining, manufacturing, hydroelectricity and other industrial activities;
  - There is no information about actual water use in the Other Sector.

- Alberta generated a Gross Domestic Product of $260 billion (2007, current dollars). Of this amount the agriculture sector accounted for 1.9% or $5 billion of GDP, and the energy/oil and gas sector accounted for 27.2% or $70.7 billion of GDP (source: Statistics Canada and Alberta Finance and Enterprise). It is estimated that water usage (2005) for these two sectors were 2.4 billion cubic meters and 0.261 billion cubic meters, respectively. As such, the agriculture sector generated about $2,200 of GDP for every cubic meter of water used, while the energy sector generated about $350,000 of GDP for every cubic meter of water used. When benchmarked with total agriculture farm receipts of $8.7 billion in 2007, the agriculture sector generated about $4,000 of revenue for every cubic meter of water used.

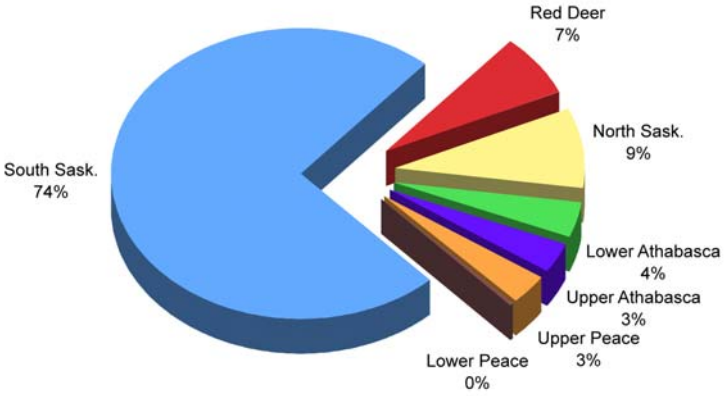
  Why is the agriculture sector more water consumptive than other sectors? While some of the applied water is incorporated into the crop, most of it leaves the fields as evapotranspiration and runoff to rivers, as well as infiltration to surficial aquifers.

  The export of Alberta's crops and livestock, estimated at $3.8 billion in 2007, also indirectly involves the export of water (source: Statistics Canada and Alberta Finance and Enterprise). For example, the amount of water needed to produce 1 kg of plant material (dry weight) ranges from 250 litres for Sorghum to 900 litres for Alfalfa. As a rule of thumb, ten times more water is needed per unit of energy from meat than from plants (source: Global Water Issues, Trends & Challenges for Alberta, Alexander J.B. Zehnder, 2008).

  The direct and indirect economic impact of irrigation in just the South Saskatchewan River Basin is estimated at $5 billion (source: Irrigation Development in Alberta, Water Use and Impact on Regional Development, St. Mary River and "Southern Tributaries" Watersheds, Alberta Agriculture, Food and Rural Development, International Joint Commission Submission, August 2004).

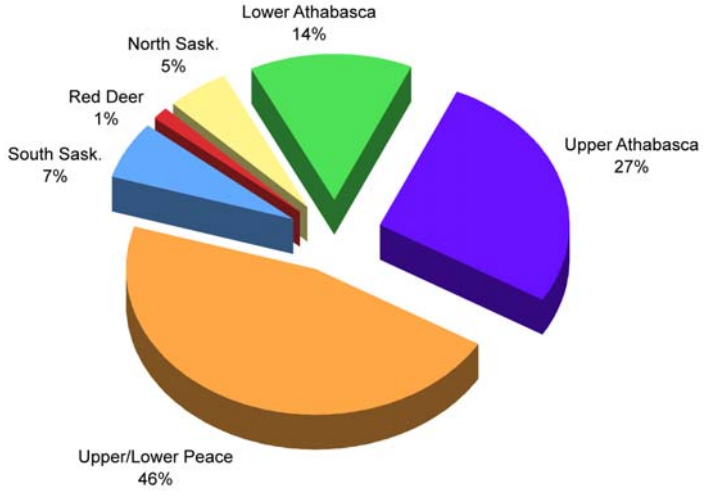


Alberta, Population (2006)



Alberta, Estimated Water Use (% Total, 2005)

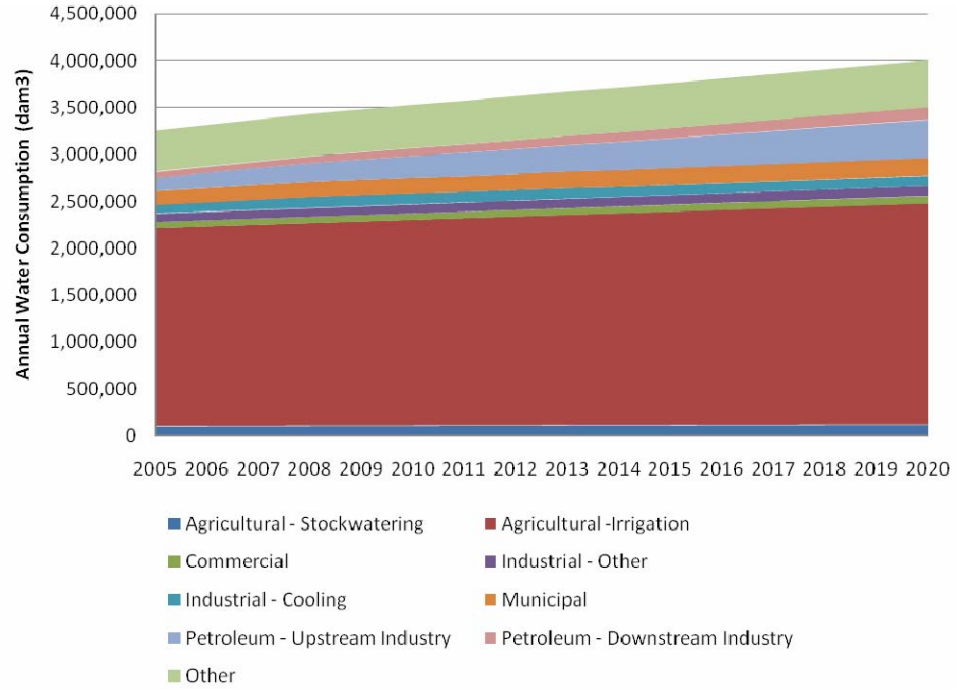
Estimated water usage in the South Saskatchewan Region primarily reflects consumptive irrigation uses, while the North Saskatchewan Region reflects non-consumptive industrial and municipal use.



Alberta, Estimated Average Annual Flow (% Total)

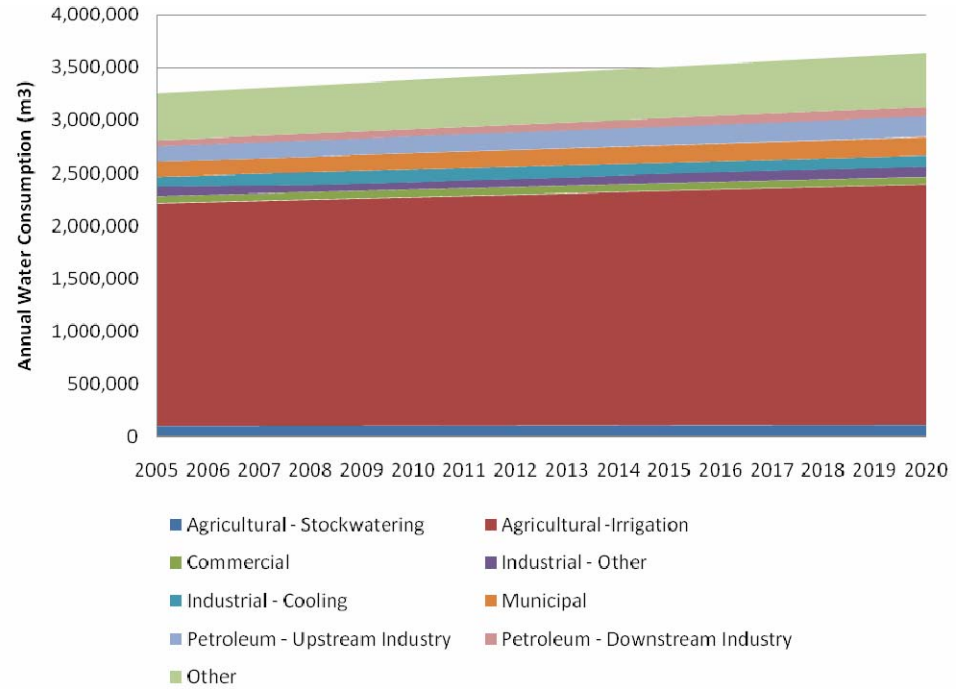
ALBERTA: FORECAST OF ESTIMATED WATER USE | STATUS QUO SCENARIO

In the absence of any significant policy or conservation measures, the estimate of water use in 2005 is forecasted to grow by about 23% from 3.25 billion cubic meters to over 4.0 billion cubic meters by 2020.

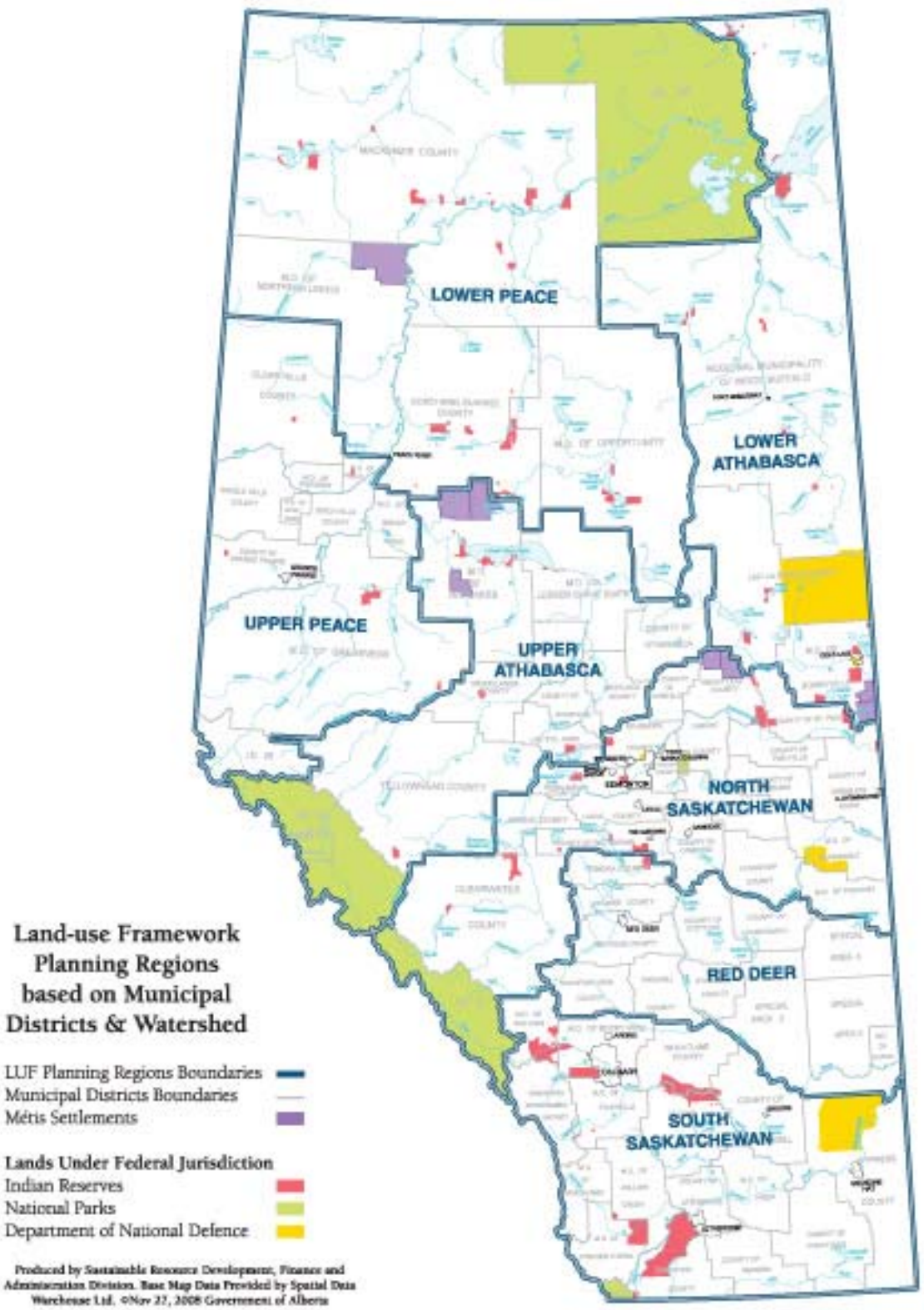


ALBERTA: FORECAST OF ESTIMATED WATER USE | CONSERVATION SCENARIO

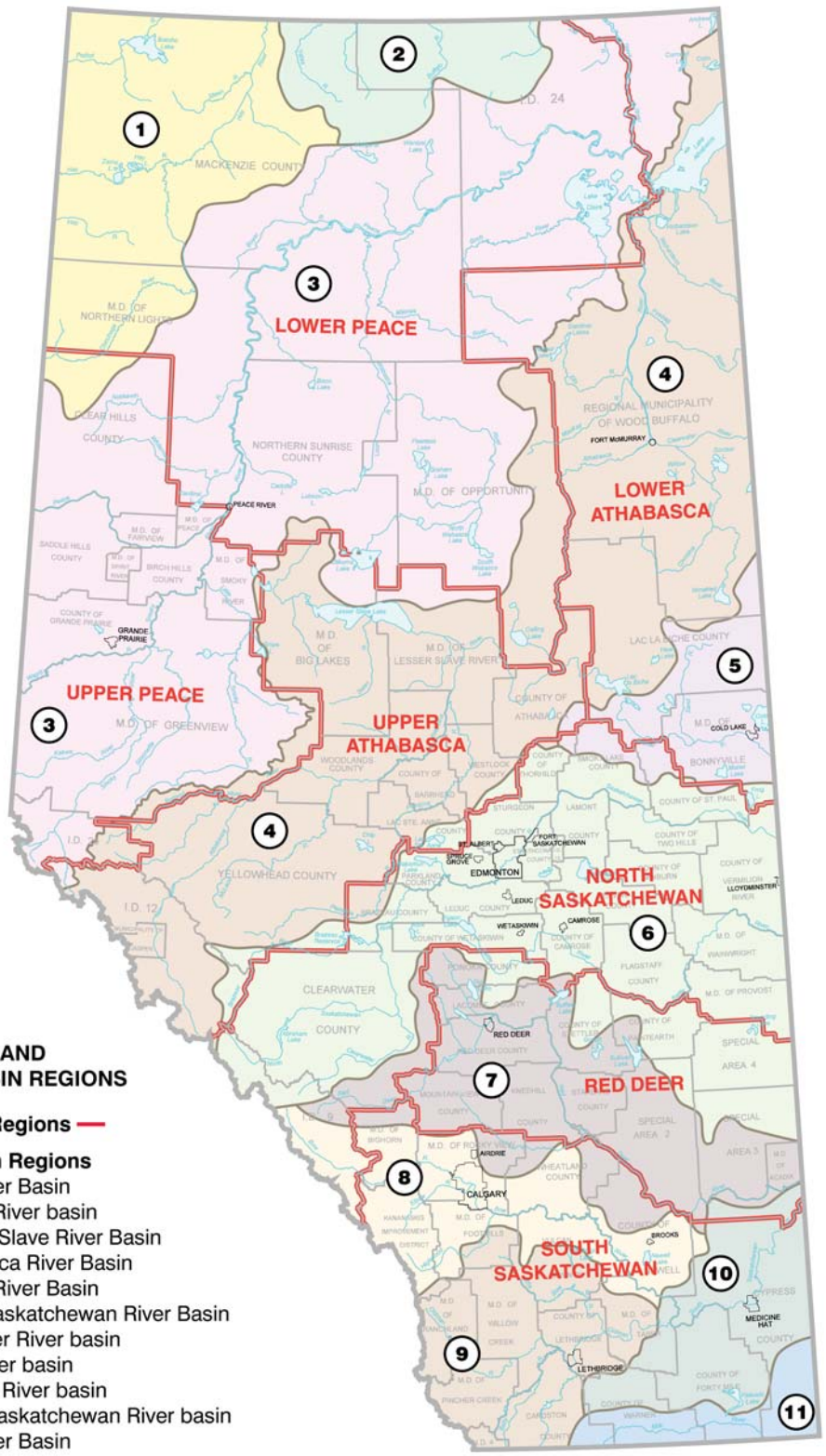
However, with water policy and conservation measures, the forecast of water usage could be reduced by 0.375 billion cubic meters to 3.634 billion cubic meters, resulting in a 12% growth rate in water use from 2005.



LAND-USE FRAMEWORK: PLANNING REGIONS



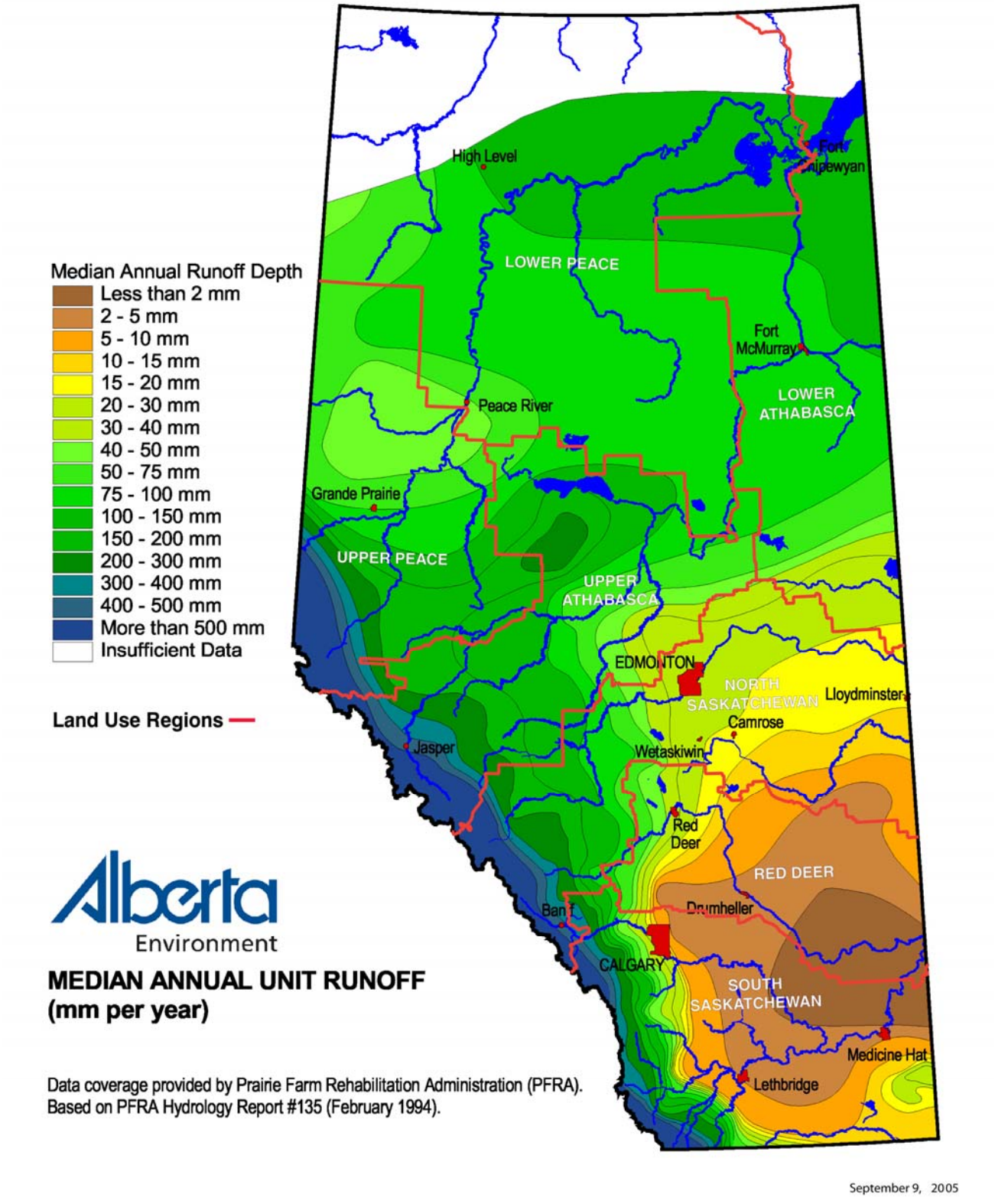
ALBERTA RIVER BASINS AND LAND USE REGIONS



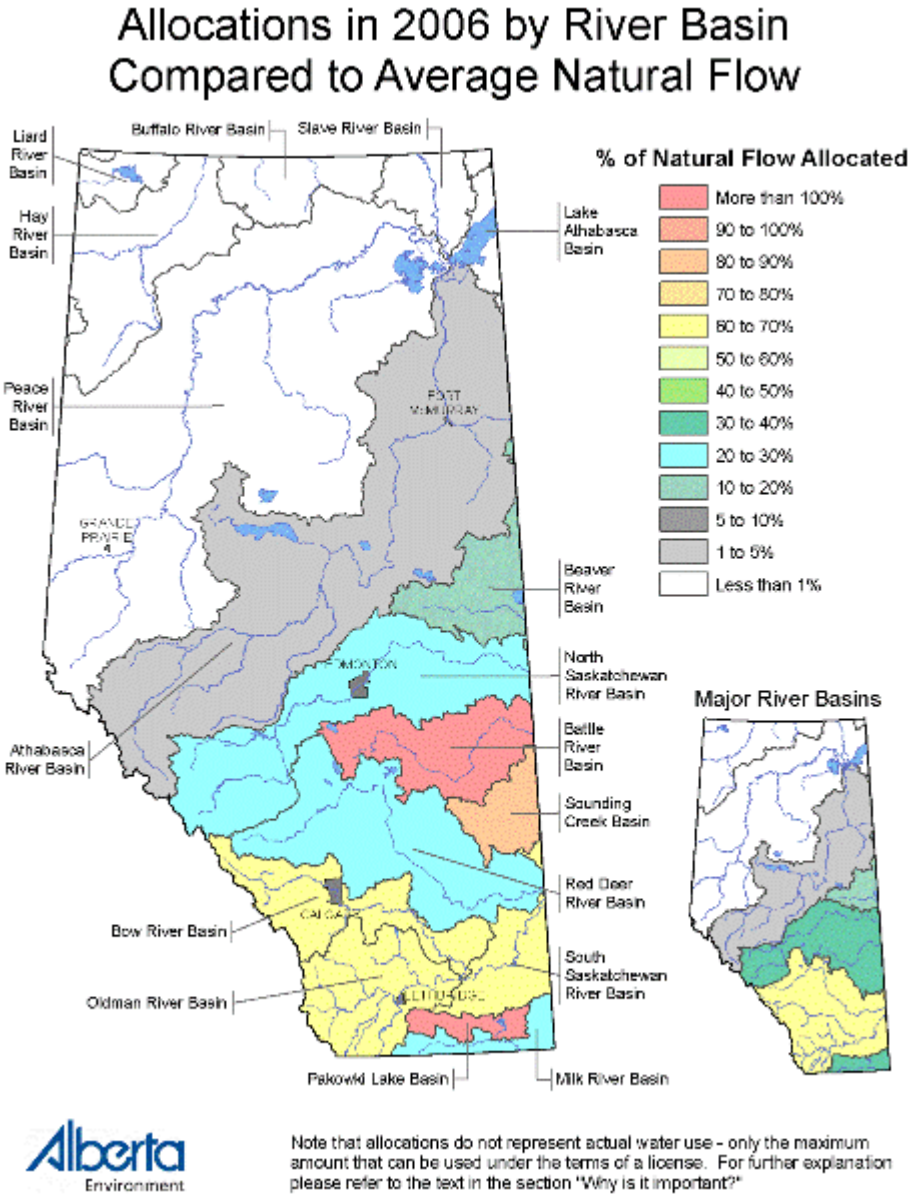
ALBERTA RIVER BASINS AND LAND USE REGIONS

Major River Basins (Water Act)	Land Use Framework (Draft)
1. Athabasca	**1. Lower Peace** — Peace (downstream), Slave, Hay, Liard, Buffalo
Lake Athabasca	
2. Beaver	**2. Upper Peace** — Peace (upstream)
3. Hay	**3. Upper Athabasca** — Athabasca (upstream)
Liard	
Great Slave Lake	**4. Lower Athabasca** — Athabasca (downstream), Beaver, Great Slave Lake, Lake Athabasca
Buffalo	
4. Milk	**5. North Saskatchewan** — North Sask., Battle, Sounding Creek
5. North Saskatchewan	**6. Red Deer** — Red Deer
Battle	
Sounding Creek	**7. South Saskatchewan** — South Sask., Bow, Oldman, Milk
6. Peace	
Slave	
7. South Saskatchewan	
Oldman	
Red Deer	

MEDIAN ANNUAL WATER RUNOFF (LAND USE REGIONS)

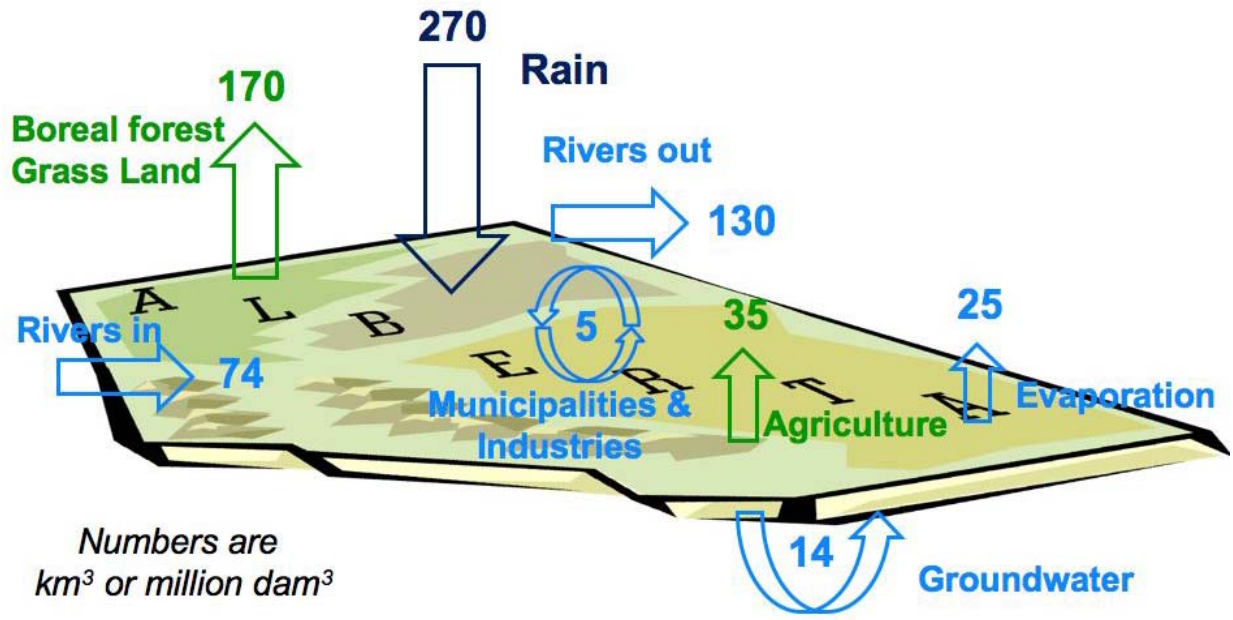


WATER ALLOCATIONS IN 2006 COMPARED TO AVERAGE NATURAL FLOWS



WATER FLOW IN ALBERTA

Flows of water vapour in the form of transpiration, interception and evaporation from the soil and vegetation is considered GREEN WATER and runoff and groundwater recharge is considered BLUE WATER. This has been an extremely useful illustrative concept in many situations where the role of land use in water resources management needs to be highlighted



The concept of green and blue water describes the partitioning of precipitation into a vertical return flow to the atmosphere by evapo-transpiration processes, and a horizontal return flow, defined by surface runoff, flow to aquifers, river discharge, but also by irrigation water use.

Source:
Global Water Issues:Trends & Challenges for Alberta
Alexander J.B. Zehnder, November, 2008

Alberta Water Numbers (averaged over the Province)

- Precipitation: ~510 mm (ranges from 300 mm to more than 1000 mm)
- Evaporation: ~650 mm (ranges from 550 mm to 800 mm)
- Runoff: ~90 mm, or about 60.6 billion m^3

Average annual precipitation exceeds average evaporation/evapotranspiration demand in most of Alberta.

Source:
Impact of Drought on Water Supplies in Alberta
January 11, 2007, Ray Keller Team Leader, Flow Forecasting

RESERVOIR STORAGE IN CALGARY AREA AND SOUTH REGION

More regional on-stream and off-stream reservoir storage would further help to store more water for wetland management and other uses during the off-season, and to also better manage and conserve water for irrigation during growing season.

Calgary does not have extensive reservoir storage, and there is very little water reservoir storage immediately east of Calgary today. However, electricity producers have reservoir storage capacity west of Calgary, and new incentives should be considered to help the utilities and irrigators partner on the development of more sustainable water management and reservoir storage options in the region.

WATER USE ESTIMATES (2005) AND FORECASTS (2020) | ASSUMPTIONS

AGRICULTURE

Stockwatering

About 10 times more water is needed per unit of energy from meat than from plants. There are several industry programs and technologies to reduce water use per unit, including the use of new RFID tags to monitor the real-time health and condition of livestock, which can reduce the over watering of animals. *Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 5%, or by 6 million cubic meters by 2020.*

Irrigation

With the financial incentive to conserve and transfer at least 2% of their 4.1 billion cubic meter allocation, the Irrigation District's water use forecast to the year 2020 could be *reduced by at least 4%, or by 83 million cubic meters.* There is a strong probability that many of the Irrigation Districts will conserve more than this amount through planned operational efficiencies, infrastructure upgrades, and improvements in crop yields.

COMMERCIAL

There are water recycling and reuse technologies and processes to reduce water use among green houses, sod and tree farms, golf courses, parks, commercial bottling, construction, gravel mining and washing operations. Some of these include improved irrigation and sprinkler watering practices, increased use of soil moisture sensors, collection and storage of rain water and surface runoff, upgrades to capture leaks and seepage, as well as improved strategic planning and design of water management systems.

Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 10%, or by 8 million cubic meters by 2020.

INDUSTRIAL

Cooling

The forecast of water consumption by industrial cooling was based the Alberta Electric System Operator (AESO) forecast of electricity demand. Further discussions and information provided by AESO permitted a breakdown of the electricity forecast into the types of generation likely to make up the electricity demand.

The electricity forecast was assumed to be comprised of the following types of generation:

- Coal-fired generation
- Natural gas-fired generation – simple cycle
- Natural gas-fired generation – combined cycle
- Natural gas-fired generation – cogeneration
- Wind power
- Hydropower
- Biomass and other

Electrical power generation capacities and capacity factors were provided by AESO. Capacity factors account for the time a facility is generating electricity as a percentage of its total generation capacity. Capacity factors are significant as all facilities do not operate at maximum capacity and capacity factors vary among types of facilities.

Cooling (continued)

The capacity factors used for the power generation cooling forecast are as follows:

- Coal-fired generation: 90%
- Natural gas-fired generation – simple cycle: 10% to 25%
- Natural gas-fired generation – combined cycle: 60%
- Natural gas-fired generation – cogeneration: 69% to 70%
- Wind power: 30%
- Hydropower: 25%
- Biomass and Other: 60%

Forecasts of the likely changes in power generation capacity from 2008 to 2020 were based on AESO information. Within the forecast period, the following facilities are decommissioned: Wabamun 4, Battle River 3, and Battle River 4. Within the forecast period the following facilities are added: Genesee 4, Keephills 4, Enmax (1,200 MW) natural gas combined cycle facility, as well as additional natural gas cogeneration, additional natural gas simple cycle, and additional wind power.

Water Consumption Values
Water consumption values were based on recently published values.

Coal-fired Plants:

Water consumption values for coal-fired plants were determined by the following information: type of cooling technology (once through, re-circulating, pond, tower); type of boiler (subcritical, supercritical); and type of flue gas desulphurization (FSD) (wet, dry, none). When the required information was not readily available, assumptions were made or averages were used.

All coal-fired plants were assumed to use cooling pond technology. This assumption was confirmed for the majority of coal-fired plants.

Supercritical pulverized coal plants were not used in Canada until the construction of Genesee 3, therefore all previous coal plants were assumed to utilize subcritical boilers. All future coal plants were assumed to use the same technology as Genesse 3.

Genesee 3 was the only coal fired plant for which flue gas desulphurization (FSD) technology information was available. Genesee 3 lists dry FSD technology as its choice, however an average of wet, dry, and no FSD were used for the remaining plants. Dry FSD was assumed for all new coal-fired plants.

Natural Gas-fired Plants:

Combined Cycle
The previous study from which the water consumption values were taken discusses the assumptions of combined cycle plants which use both gas and steam turbines. The assumption was made that only one third of the capacity of a combined cycle plant was attributed to steam turbines, therefore only one third of the plant generating capacity consumes water. In alignment with that study, for the purposes of this study water consumption values were applied to only one third of the combined cycle capacity.

Cogeneration
Cogeneration plants use only 70 percent of the water that a combined cycle plant uses. Since water consumption values for cogeneration plants were not readily available, water consumption was assumed to be 70 percent of combined cycle plants of the same capacity. Cooling technology?

Cooling (continued)

Simple Cycle
Based on the assumptions for combined cycle plants, it is inferred that gas turbines do not consume any water. For the purposes of this study, simple cycle plants were not assigned water consumption values.

Wind power, Hydropower, Biomass and Other
Wind power and hydropower were assumed to consume no water. Since details of the biomass and other generation facilities were not obtained in this study, they were not assigned water consumption values. Due to the relatively small capacity contributed by biomass and other plants, it was assumed that exclusion of their water consumption would not significantly alter the forecast.

Water Consumption Forecast
The power generation water consumption forecast is determined by coal-fired, natural gas combined cycle, and natural gas cogeneration generation and their respective technologies.

The base forecast of water use for industrial cooling already reflects the impacts of replacing older power generation plants in the province with much more water efficient cooling systems and technologies. As such, there is relatively little additional planned reduction in water use for industrial cooling between the base case and the alternative conservation forecast.

Forestry

Several factors are able to influence water use by forest plantations, and there are opportunities to design and manage these plantations deliberately for water use efficiency. Some of these include the influence of vegetation on the distribution of rainfall; the effect of air turbulence from plantation edges, firebreaks and streamlines; the potential to modify atmospheric coupling of forest plantations through plantation design, including the use of mixed species plantations, and by softening hard edges by thinning and pruning plantation edges. In addition, proper forestry road construction and maintenance not only conserves water, but helps to protect water quality in the region.

Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 6%, or by 1.4 million cubic meters by 2020.

Chemical Plants

With highly energy-intensive processes, chemical companies can be among the largest consumers of water. Volumes vary considerably from plant to plant, but water is essential throughout the production process for cooling, cleaning, dissolving, diluting, as well as generating steam.

Energy costs and a wave of environmental pressure may encourage chemical plants to reassess their consumption, and scrutinize their reclamation and reuse of water. Chemical producers can employ various measures to improve their water efficiency, including thorough reviews of production processes, improved maintenance programs to reduce leaks and blockages, enhanced treatment of effluent and waste water, and investment in improved water- treatment facilities.

Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 8%, or by 1.1 million cubic meters by 2020.

Fertilizer Plants

In fertilizer plants, water is consumed through ineffective water recycling and reuse processes, drainage of blow down and evaporation.

Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 12%, or by 6 million cubic meters by 2020.

Manufacturing

In manufacturing, water is used as a raw material, a coolant, a solvent, a transport agent, and as a source of energy. Some manufacturing sectors, chiefly the pulp and paper, chemical and metallurgical industries, use large amounts of freshwater, and consequently must dispose of significant amounts of waste.

The manufacturing sector, as a whole, has the highest water reuse rates relative to the other consumptive sectors (thermal, municipal, agricultural and mining; source: http://www.nwri.ca/threats2full/ch6-1-e.html). *As such, it is estimated that new conservation programs would help reduce the sector's forecast of annual water use, by about 8%, or by 0.2 million cubic meters by 2020.*

Mine-Other

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 11%, or by 0.8 million cubic meters by 2020.

Mine-Coal

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 10%, or by 0.6 million cubic meters by 2020.

Industrial-Other

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 11%, or by 0.1 million cubic meters by 2020.

MUNICIPAL

2005 Estimated Water Use - Municipal (North Saskatchewan Basin)

The figure provided in the "Current and Future Water Use in Alberta" report (March, 2007) for the North Saskatchewan Basin of 10 million cubic meters appears extremely low. For example, it is less than the estimated municipal water use for the Red Deer Basin of 17 million cubic meters, and less than the municipal water use estimate of 60 million cubic meters for the Bow River Basin (Calgary).

Assumption: Water use for the North Saskatchewan Basin (Edmonton) will be approximately the same percentage of licensed and total use as that of the Bow Basin (Calgary) at 55% and 5% respectively. As such, the estimated municipal water use (2005) used in this study is 25.442 million cubic meters.

2020 Municipal Forecast

The Calgary Regional Partnership, Regional Servicing Study of 30-Year Water Usage and Wastewater Generation Projections, prepared March, 2007 by CH2M Hill, provided three different municipal water conservation scenarios for a 2005 population base of over 1.1 million people, reflecting the City of Calgary and 18 nearby municipalities.

- Scenario 1 (30% Reduction in Average Per Capita Usage Rates by 2015)
- Scenario 2 (15% Reduction in Average Per Capita Usage Rates by 2030)
- Scenario 3 (30% Reduction in Average Per Capita Usage Rates by 2030)

Under a status quo scenario, where average per capita water usage rates in each community remained constant at 2005 levels, total water usage was forecast to increase 21% by 2020, driven by only population growth. *For purposes of this study, it was assumed that total province-wide municipal water usage would increase 27% by 2020 under a status quo scenario, driven by both population growth as well as increased usage from industrial, commercial, and institutional users located within municipalities.*

Under Scenarios 1 to 3, the forecasted population growth within the region was then balanced by reductions in average per capita water usage rates due to various conservation programs, resulting in forecasted increases in total water usage of 13%, 18%, and 16% respectively by 2020. The blended increase in total water usage across all these three conservation scenarios reflects a 17% average increase in usage by 2020. *For purposes of this study, it was estimated that total province-wide municipal water usage would increase by 20% by 2020 under the conservation scenario.*

As such, the Municipal sector's water use forecast to the year 2020 in this study was reduced from 27% to 20%, or by approximately 11 million cubic meters. However, this forecast of water use could be further reduced through the introduction of new policies supporting the recovery and reuse of municipal wastewater for non-contact purposes, as well as additional incentives to conserve and share treated municipal water with industry and agriculture, achieved through new operational treatment efficiencies and infrastructure upgrades.

OIL AND GAS

Water is used in association with many oil and gas activities, including use as a supplemental fluid in enhanced recovery of oil and gas resources; during drilling and completion of an oil or gas well; during workover of an oil or gas well; during solution of underground salt in brine mining or hydrocarbon storage cavern creation; as gas plant cooling and boiler water; as hydrostatic test water for pipelines and tanks; as rig wash water; as coolant for internal combustion engines for rigs, compressors, and other equipment; for sanitary purposes; and for laboratory purposes.

Injection

Fresh water could be conserved for conventional deep well injection through the increased use of non-potable (saline) water, in combination with changes in ERCB policy allowing for the use of treated industrial, municipal and produced water.

Collectively, it is estimated these conservation programs would help reduce the sector's forecast of annual water use, by at least 25%, or by 3 million cubic meters by 2020.

Thermal

In situ projects are moving away from the usage of fresh water with alternatives such as deep non-potable water aquifers (brackish or brine not suitable for drinking) and enhanced recycling. Over the forecast period, it is assumed saline water use continues to increase and freshwater use declines. There are several projects using or experimenting with new lower water use technologies and using alternative sources of water. Some projects in the immediate future will use no fresh water for their operations.
http://www.capp.ca/raw.asp?x=1&dt=NTV&e=PDF&dn=135721

Collectively, it is estimated these programs will help reduce the sector's forecast of annual water use, by at least 64%, or by 24 million cubic meters by 2020.

Oilsands Mining

2005 Estimated Water Use - Oilsands Mining (Athabasca Basin)
The "Current and Future Water Use in Alberta" report (March, 2007) indicated that actual water use information was not available. As such, its estimate of 170.302 million cubic meters was based on reported withdrawal information for the Athabasca River from Suncor, Syncrude and Albian Sands projects, and then assumed these licence holders were using the full capacity of their licences from other sources (ie: 98.942 million cubic meters from the Athabasca River, and 22.777 million cubic meters from other surface water sources, and 36.359 million cubic meters from surface run-off, and 12.224 million cubic meters of groundwater).

Oilsands Mining (continued)

2005 Estimated Water Use - Oilsands Mining (Athabasca Basin)
Assumption: This study excludes the 22.7 million cubic meters from other surface water sources, and 36.3 million cubic meters from surface run-off, since surface runoff amounts are not typically included in any other sectors, and since some of this water source is associated with one time applications, including the de-watering of muskeg. As such, the estimated water use (2005) used in this study is 111.1 million cubic meters.

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 53%, or by 188 million cubic meters by 2020.

Oil and Gas Plants

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 33%, or by 41 million cubic meters by 2020.

Drilling

The base forecast of water use for the drilling sector already reflects the impacts of more water efficient recovery, reuse and recycling practices and technologies. As such, there is no additional planned reduction in water use between the base case and the alternative conservation forecast.

Other

Collectively, it is estimated conservation programs will help reduce the sector's forecast of annual water use, by at least 10%, or by 0.8 million cubic meters by 2020.

Upstream

The 2020 forecast volumes differ between the Alberta Environment and the forecasts used in this report primarily due to the differences in the base assumptions. The Alberta Environment forecast was built using actual water usage reported at a point in time and an assumption that level of use will continue. The forecast used in this report is based on a prediction of UPI activity and recognition of the trend to more responsible fresh water management. However, both forecasts show an overall similar trend and relative magnitude of the areas of greatest future water consumption, which is in oil sands mining and in situ operations.

Collectively, it is estimated conservation programs will help reduce the oil and gas upstream sector's forecast of annual water use, by at least 53%, or by 215 million cubic meters by 2020.

Downstream

Collectively, it is estimated conservation programs will help reduce the oil and gas downstream sector's forecast of annual water use, by at least 31%, or by 42 million cubic meters by 2020.

OTHER SECTORS

The base forecast of water use for wetlands and water management, and other sectors already reflects the impacts of more water efficient recovery, conservation, reuse and recycling practices and technologies. As such, there is no additional planned reduction in water use between the base case and the alternative conservation forecast.

TERMINOLOGY AND DEFINITIONS

Sustainable Development

- A pattern of resource use that aim to meet human needs, while preserving the environment, so that these needs can be met not only in the present, but in the indefinite future. (*source: Wikipedia)*
- A set of values wherein development meets the needs of the present without compromising the ability of future generations to meet their own needs. (*source: Diana Purdy, Alberta Department of Energy)*

Rewarding water conservation caters to everyone's best interests, rather than imposing penalties for inefficiencies.

ENGO

Environmental Non-Government Organization

dam^3

decametres cubed (1,000 cubic metres); 1 dam^3 = 0.81 acre feet.

SSRB Basin

Comprised of the Bow, Oldman, Red Deer and South Sask. River sub-basins

North Saskatchewan River Basin

Comprised of 18 smaller sub-watersheds including the Cline, Brazeau, Ram, Clearwater, Modeste, Sturgeon, Strawberry, Bigstone, White Earth, Beaverhill, Paintearth, Vermilion, Frog, Iron, Monnery, Blackfoot, Ribstone, and Sounding.

Alberta Water Products and Services Sector

In Alberta, water services includes the treating and distributing of drinking water, removing wastewater, ensuring water quality meets specified standards, managing the available supply of water, managing the demand for water, allocating water use, protecting water from contamination, ensuring protection of the environment and natural habitats, reclamation of wetlands, flooding and drainage issues, maintaining infrastructure, public education regarding water use, management and conservation, planning for future water uses, and mitigating possible risks to the water supply.

Generally, water is divided into two types of uses:

- **Offstream use** involves the withdrawal or diversion of water from a source, treatment, distribution, and use; and the collection, treatment, and return flow of wastewater;
- **Instream use** is water that is used, but not withdrawn, from a surface or ground-water source.

OVERVIEW OF CURRENT MAJOR FEDERAL AND PROVINCIAL WATER REGULATIONS

Federal Acts:

- Canada Oil and Gas Act
- Canadian Health Act
- Canadian Water Act
- Canadian Environmental Protection Act
- Coastal Fisheries Protection Act
- Fisheries Act
- Forestry Act
- Navigable Waters Protection Act
- Water Power Act

Provincial Alberta Acts:

- Water Act
- Environmental Protection & Enhancement Act
- Fisheries Act
- Forests Act
- Hydro and Electric Energy Act
- Mines and Minerals Act
- Oil and Gas Conservation Act
- Oil Sands Conservation Act
- Public Health Act

WATER ALLOCATIONS, USE AND RETURN FLOWS

(source: Alberta Environment, Current and Future Water Use in Alberta, March 2007)

Water allocation refers to the amount of water that can be diverted for use, as set out in water licenses or the Water Act. These allocations include maximum amounts of water that can be withdrawn, as well as the rate of withdrawal. An allocation is generally based on the maximum amount of water that an applicant expects will be required over the licensing period. Since 1999, water licenses issued under the Water Act are for a fixed term, while earlier licenses were often issued in perpetuity.

In Alberta, water is allocated under the Water Act in terms of licenses and registrations. AENV's Environmental Management System has a complete list of all active, cancelled, and expired ground and surface water licenses (about 32,000) and registrations (about 90,000)[(7)].

Three water use factors are considered in issuing water allocations. Allocations reflect the amount of water that the licensee is expected to consume, plus losses due to seepage or evaporation, and a possible allowance for returning water back to rivers and lakes after use. The term "licensed water use" reflects those components of the allocation that are expected to be consumed or lost.

Allocation = Water Use + Return Flow

Water Use = Consumption + Losses
Return Flow = Diversion – Water Use

While understanding the return flow allowance is important because return flows represent water that can be available for use by other licensees, the return flow allowances only form part of the overall allocation, and are often not enforceable.

In determining what percentage of allocations is currently being used, actual water use is compared (ie: estimated) to licensed water use. The main source of information for determining actual water use is AENV's Water Use Reporting System (WURS). WURS is a new database and contains information for only a few years for a small percentage of licensed water users. Reporting to WURS is voluntary at this time.

WATER ALLOCATIONS, PERMITS AND LICENSES

(source: Alberta Environment, Current and Future Water Use in Alberta, March 2007)

Sector	Current Environmental Management System (EMS)			Revised Water Use Classifications
	Activity	Specific	Specific Activity Name	
Municipal and Residential	WDMUN	URBAN	Urban, villages, summer villages, towns, cities, hamlets	Municipal
		SUBVDIVID	Subdivisions	
		CONDOD	Condominium/townhouses/mobile homes/complexes, hotels, motels	
		COOPD	Cooperatives, farmsteads, single-multi homes, colonies	
		CAMPS	Camps	Municipal Institutional/Other
		INSTITUT	Institution, senior/correctional centres, nursing/children's homes, hospitals	
		SCHOOLS	Schools, training centres	
		MOTHER	Other (fire protection)	
Agricultural	WDAGR	FEEDLT	Feedlots	Agriculture – Feedlot
		STCKWT	Stockwatering	Agriculture – Crops & Stockwatering
	WDIRR		Crops	Agriculture – Irrigation
	WDREG	REGISTRY	Traditional Agriculture User Registration	Agriculture – Traditional use
Commercial	WDCOM	GRDN	Gardening, market gardens, sod and tree farms	Commercial – Gardening & Sod
		GLFCRS	Golf courses	Commercial – Golf Courses
		PRK	Parks	Commercial – Parks & Recreation
	WDREC	RCRTN	Recreation	
	WDCOM	AGGWSH	Aggregate washing	Commercial – Gravel Mining & Washing
		CNSTRCT	Construction	Commercial – Construction
		BTTLNG	Bottling	Commercial - Bottling
		GWHAULING	Groundwater well – water hauling	Commercial – Water Hauling
		SWHAULING	Surface water – water hauling	
		OTHR	Other (dust controls, abattoirs, bridge washing, hydroseeding)	Commercial – Other
Petroleum	WDIND	INJECTN	Oilfield injection	Industrial- Oil & Gas – Injection
		GAS/PTRO	Gas/petrochemical plants	Industrial – Oil & Gas Plants
	WDCOM	OIL/GAS	Drilling (developing oil/gas wells	Industrial – Oil & Gas Drilling
	NEW			Industrial – Oil and Gas Thermal
				Industrial – Oil Sand Mining
Industrial	NEW			Industrial – Forestry
				Industrial – Chemical Plants
				Industrial – Fertilizer Plants
	WDPOWER	HYDRPWR	Hydro-power	Industrial – Hydropower/ Non-thermal
	WDCOM	COOLING	Cooling	Industrial –Cooling
	NEW			Industrial – Mining - Coal
				Industrial – Mining - Other
Other	WDDEWAT	DRAINAGE	Drainage (gravel pits, mines)	Other – Water Management
		REMEDIA	Remediation	
		FLOODCNT	Flood control	
	WDWMNGT	STBLZTN	Stabilization (lake level)	
	WDFISH	FISHERY	Fish, fish farms/hatcheries	Other – Fish, Wildlife & Enhancement
	WDWILD	SRWILD	Storage reservoir for wildlife	
	WDHBTENH	WTLANDS	Wetlands	
	WDOTHER	SOTHER	Specified by the Director	Other –Specified Use
	WDWCO	WDC	Water conservation holdback	Other – Water Conservation Objective

POLICY STATEMENT: WATER LICENSE CHANGE OF PURPOSE (DRAFT)

The Water Act provides for the following:

a) A change to the purpose identified in a license may be considered, subject to the terms of the applicable section of the Water Act, through an application for an amendment where there are no changes to the appurtenance of the license (land or undertaking)

b) A change to the purpose identified in a license may be considered, subject to the terms of the applicable section of the Water Act, through an application for transfer where there are changes to the appurtenance of the license (land or undertaking)

c) The Water Act requires that the appurtenance of a license to land or undertaking is described in each license. Therefore a licensee is restricted to using or delivering water only within the lands or undertaking described in a license, and may not apply for an amendment to deliver water to any other lands or through any other undertaking.

As an interim measure, during further discussions on second order allocations. The Director under the Water Act will use the following guidance when applications are filed that include a change of purpose within an existing license:

a) The public must be aware: Applicants for an amendment or a transfer must describe how the water that is the subject of the application will be used; including specifics of the location of the end use and the means to deliver the water to that use.

b) Limits to "resale": Where multiple purposes are proposed for a license, the end user of the water must take delivery of the water from the licensee's works or works contracted by the licensee as part of the undertakings identified in their license. The end user is the first consumer of the water or the producer of a product that contains the water.

c) Water volume of additional multiple purposes: Directors will only consider an amendment application, where new purposes are added, for a maximum of 2% of the original license allocation. A Transfer application must be filed for additional amounts.

d) To promote conservation of water: An application for amendment or transfer may only apply to water that is being used under the license at the time of application and has been used by the licensee in the previous 3 years, or, to promote conservation of water. is identified as a quantity of water that has been used and subsequently conserved by an identified project initiated after January 1, 1999.

e) Prevent speculation: For the purpose of determining water use for d) above, wasting of water to increase the water used is not eligible for inclusion. Water is considered wasted for the purpose of this guideline if any part of the licensed water is used for any purpose in an amount exceeding the median water use for similar purpose licensees in the area by 10% or that exceeds any standards accepted by the Minister.

Does not include delivery of another licensed allocation: This policy does not apply to the circumstance where a licensee delivers water for another licensee which may have a different purpose through their works, or undertaking.

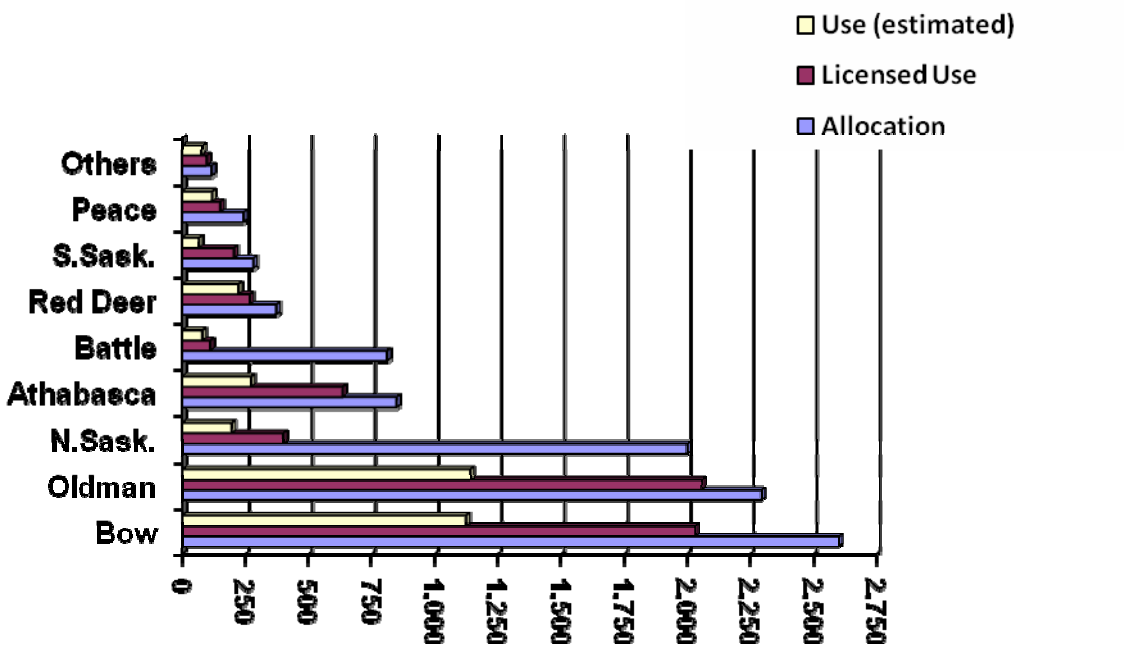
SUMMARY OF WATER ALLOCATIONS AND ESTIMATED USE, BY BASIN

In 2005, a total of about 9.6 million dam^3 of water has been allocated in Alberta through licenses and registrations. Of this total, 9.3 million dam^3 or 97% was for surface water.

Water allocations in the Bow (27%), the Oldman (24%) and the North Saskatchewan river basins (21%), together accounted for more than 70% of total water allocations in Alberta.

Summary of Water Allocations and Estimated Use, by Basin
(millions, cubic meters, 2005)

Total Allocation: 9.6 billion cubic meters



(source: Alberta Environment, Current and Future Water Use in Alberta, March 2007)

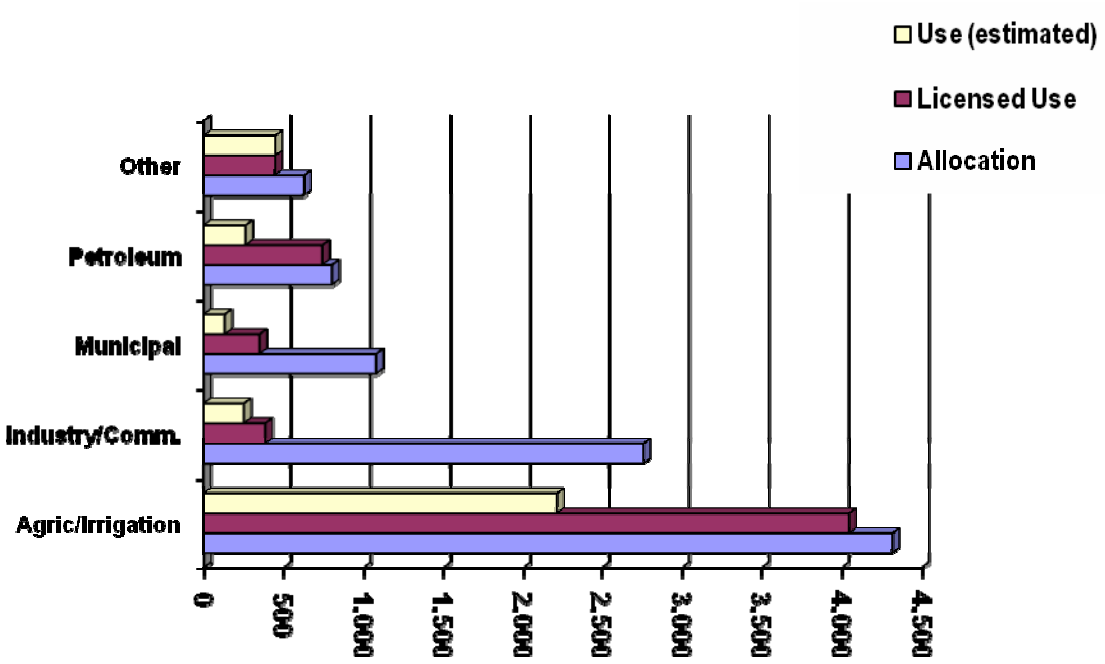
Water allocations in the Bow and Oldman river basins are dominated by allocations for agricultural sector, mainly district irrigation, whereas industrial water allocations accounts for the majority of allocations in the North Saskatchewan River Basin. Water allocations in the northern basins, which include the Athabasca, Peace/Slave, Hay and Liard basins, only accounted for 12% of provincial allocations and consist primarily of water licenses issued to the oil and gas sector. In contrast, water allocations in the Milk, Red Deer and the South Saskatchewan river basin in southern Alberta are primarily for agricultural purposes.

SUMMARY OF WATER ALLOCATIONS AND ESTIMATED USE, BY SECTOR

Across Alberta, the agric-irrigation sector is allocated the most water (45% of the total). The industrial-commercial sector accounts for the next highest allocation (29%), followed by the municipal sector (11%), oil and gas sector (8%), the other sector (7%).

Summary of Water Allocations and Estimated Use, by Sector
(millions, cubic meters, 2005)

Total Allocation: 9.6 billion cubic meters



(source: Alberta Environment, Current and Future Water Use in Alberta, March 2007)

SUMMARY OF MAJOR OIL SANDS INITIATIVES

The following provides an overview of some of the major political, regulatory and industry initiatives surrounding water and tailings management in the oil sands industry.

In addition to Oil Sands Branches within Alberta Energy and Sustainable Resource Development, the Alberta Government has created two new government departments and introduced several management frameworks to address Alberta's growth. Since August 2007, the following government departments have been formed:

- *Oil Sands Environmental Management Division, Alberta Environment:* responsible for managing the legislative enforcement of environmental requirements in the oil sands and supporting the responsible development of the resource.

- *Oil Sands Sustainable Development Secretariat, Government of Alberta:* provides organizational and administrative support to the Oil Sands Ministerial Strategy Committee, and is responsible for the creation of a short term action plan and long term strategic plan for the sustainable development of the oil sands that addresses social, infrastructure, environmental and economic impacts. They are to review and consider the recommendations resulting from the *Multi-stakeholder Committee Final Report, and the Aboriginal Consultation Final Report, and Investing in our Future: Responding to the Rapid Growth of Oil Sands Development*. Specific recommendations from each of these reports have the potential to affect oil sands operations.

  The recommendations in these reports have common themes. The need for regional planning, assessment of cumulative effects, and the involvement of multiple stakeholders in the development of policies, standards, and performance criteria in the oil sands region are common recommendations in these reports.

Several frameworks have been released by Alberta Environment which have implications on oil sands development, including:

- Cumulative Effects Management Framework;
- The Water Management Framework for the Industrial Heartland and Capital Region;
- Athabasca River Water Management Framework; and
- Draft land-use Framework.

On June 25, 2008, the ERCB and Alberta Environment issued a proposed *Draft Directive: Requirements for Water Measurement, Reporting, and Use for Thermal In Situ Oil Sands Schemes*. The intent of this draft directive is to provide an improved, clear and comprehensive document that deals with a number of issues that exist with respect to the current regulations. On June 26, 2008 the ERCB released the proposed *Draft Directive: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes*. The intent is to establish industry wide criteria for managing oil sands tailings and to enable enforcement action if performance targets are not met.

There are several industry- lead programs and initiatives to research and implement changes in technologies and processes for oil sands water use and tailings management, including CAPP, CEMA, CONRAD, AERI, PTAC, among others. The Innovative Energy Technologies Program offers royalty adjustments of up to $10 million per pilot project that demonstrates the use of new or innovative technologies to increase environmentally sound recovery of reserves and responsible development.

Several scientific and research reports regarding oil sands development and environmental protection have been published by the Pembina Institute, and other ENGO's, which support the focus on cumulative effects management, regional planning, multi-stakeholder processes, and outcomes-based management, along with many additional recommendations.

SUMMARY OF WATER MANAGEMENT LEGISLATION

Province/ State	Nature of Right	Instrument	Exemptions (expressed as annual volume)	Priority	Instream Protection
Riparian Systems					
Ontario	Can take water for use as long as rights of other users are not impaired (common law right)	Permit	Domestic and small Agriculture<1380 dam^3	Shortages shared	Considered when issuing permits
North Carolina	Can take water for use as long as rights of other users are not impaired (common law right)	Registration	Agriculture <1380 dam^3 Other<138 dam^3	Shortages shared	Deny permits in capacity use areas
		Permits (capacity use areas)	Users<138 dam^3		
Tennessee	Can take water for use as long as rights of other users are not impaired (common law right)	Registration	Users <13.8 dam^3 Agriculture	Shortages shared	Managed for water quality
Prior Allocation					
Alberta	**Right to Divert**	**License and Registrations (agriculture)**	**Domestic <1.25 dam^3**	**FITFIR**	**Conditions in licenses.** **Crown reservation** **Instream licenses**
British Columbia	Right to Divert	License	Short terms uses need approval	FITFIR	Conditions in licenses. Crown reservation Instream licenses
Saskatchewan	Right to Divert	License	New First Nation reserves	Equal	Only allocates 50% of natural flow
Manitoba	Right to Divert	License	Domestic (<9 dam^3)	FITFIR	Conditions in licenses
Prior Appropriation					
Arizona	Appropriate for beneficial use	Permit	None	FITFIR	Appropriate for instream flows
California	Appropriate for beneficial use	Permit, converts to license when project completed	Riparian use Pueblo rights	FITFIR	Appropriate for instream flows
Colorado	Appropriate for beneficial use	None. Affirmed by courts	None	FITFIR	Appropriate for instream flows
Montana	Appropriate for beneficial use	Permit	Use<8 dam^3	FITFIR	Appropriate for instream flows
North Dakota	Appropriate for beneficial use	Permit	Domestic and livestock use <10 dam^3	FITFIR	None
Utah	Appropriate for beneficial use	Water Right	None	Domestic, Agriculture, FITFIR	Transfers Review of applications
Wyoming	Appropriate for beneficial use	Permit converts to Certificate of Appropriation	None	FITFIR	Appropriate for instream flows

SUMMARY OF WATER MANAGEMENT PROVISIONS FOR WATER TRANSFERS BETWEEN AND WITHIN BASINS

Province/ State	Continental Basins		Major Basins/Watersheds		Exceptions	Instrument	Sub-Basins	
	Number	Transfers Allowed	Number	Transfers Allowed			Number	Transfers Allowed
Riparian Systems								
Ontario	2	No	5 (Great Lakes)	Prohibited	Grandfathered projects	Permit	Not defined	Not prohibited
North Carolina	2	Allowed	18	Allowed		Small-registrations Large-approvals	38 sub-basins	Allowed
Tennessee	2	Allowed	10	Allowed		Registration (water) Permit to transfer	Not defined	Not prohibited
Prior Allocation								
Alberta	**3**	**No**	**7**	**Prohibited**	**Special act of legislature**	**Water license**	**Not defined**	**Not prohibited**
British Columbia	2	No	9	Prohibited	Small volumes	Water license	Not defined	Not prohibited
Saskatchewan	2	No	As yet undefined	Prohibited	Allowed within Saskatchewan	Water license	As yet undefined	Not prohibited
Manitoba	1	No	As yet undefined	Prohibited	In the public interest	Water license	As yet undefined	Prohibited
Prior Appropriation								
Arizona	2	Allowed	14	Allowed	Out of state	Permit	Not defined	Allowed
California	2	Allowed	10	Allowed	Out of state Wild Scenic River systems	Permit and License	Not defined	Allowed
Colorado	2	Allowed	4	Allowed	Out of state	Voluntary negotiated agreements	Not defined	Allowed
Montana	3	Allowed	4	Allowed	Department only > 4,000 acre-feet	Permit	85 sub-basins	Allowed
North Dakota	2	Allowed	13	Allowed		Permit IJC approval	Not defined	Allowed
Utah	2	Allowed	11	Allowed		Approval of State Engineer	Not defined	Allowed
Wyoming	3	Allowed	13	Allowed		Permit Certificate of Appropriation	Not defined	Allowed

WATER PRICES BY STATE AND BY SECTOR (1987 TO 2005; PER ACRE FOOT)

	All Sectors			Agriculture-to-Agriculture			Agriculture-to-Urban		
	One-year			One-year			One-year		
	Leases	Sales	ICR	Leases	Sales	ICR	Leases	Sales	ICR
Arizona	$43.12	$786.16	5.50%	$33.03	$721.65	4.6*	$54.81	$182.57	30.0%*
California	$44.53	$641.45	6.90%	$39.11	$864.35	4.5%*	$83.41	$641.45	13.00%
Colorado	$12.54	$2,693.38	0.50%	$13.67	$1,487.55	0.9%*	$28.70	$3,687.12	0.80%
Idaho	$4.43	$59.70	7.40%	$4.43	$59.76	7.4%*	$2.40	$106.37	2.3%*
Montana	$8.14	$100.22	8.1%*	$3.49	n/a	n/a	$17.60	n/a	n/a
New Mexico	$28.94	$1,250.00	2.30%	$13.69	$1,150.00	1.2%*	n/a	$1,592.86	n/a
Nevada	$23.77	$1,992.28	1.2%*	n/a	n/a	n/a	$23.77	$1,952.55	1.2%*
Oregon	$7.49	$111.37	6.7%*	$4.88	n/a	n/a	$6.49	n/a	n/a
Texas	$18.87	$461.79	4.10%	$17.42	$217.29	8.0%*	$18.82	$465.41	4.00%
Utah	$4.63	$356.22	1.30%	$4.29	$681.87	0.6%*	$92.15	$331.29	27.8%*
Washington	$20.21	$289.93	7.0%*	$10.30	n/a	n/a	$25.01	$417.85	6.0%*
Wyoming	$27.27	$1,073.22	2.5%*	$2.38	$121.85	2.0%*	$45.10	$1,440.41	3.1%*
TOTAL	**$27.69**	**$1,752.06**	**1.60%**	**$10.68**	**$1,235.39**	**0.90%**	**$41.00**	**$2,642.70**	**1.60%**

Implicit Capitalization Rate [ICR]

The annual discount rate that will equate the average Sales price with the average one-year Lease price

The "*" denotes where the number of sales or one-year leases with price data in the given state is less than 10, whereas "n/a" denotes where there were no sales and/or leases with price data for that given state.

While the median prices vary across states and sectors for both sales and one-year leases, there is significantly more variation across states than across sectors.

The variation in price across the states reflects differences in demand and supply characteristics, transaction type, as well as transaction costs – all of which are primarily state driven (e.g. population, weather, water endowments, conveyance potential, political and legal institutions) and the regulatory restrictions that prevents arbitrage across the states.

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