Report

Associated Engineering
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Red Deer River Municipal Users Group

Red Deer River Municipal Water Assurance Study

March 2008

Executive Summary

The Red Deer River has many unique characteristics that set it apart from other rivers in western Canada. It also is experiencing water use pressures in a rapidly developing economy. As a result, municipalities are concerned that their water availability will be constrained as other water use sectors acquire water allocations for various purposes. This possible constraint should also be of concern to other water use sectors because municipalities provide infrastructure and homes for the families who are employed by those sectors.

The South Saskatchewan River Basin (SSRB) Water Management Planning process that occurred between 2001 and 2006 provided a startling revelation that the limit of the water resource has been reached or exceeded in some sub-basins. The Red Deer River Basin was left in the unique situation of having the potential for continued allocations of water. However, the winter instream flow need now severely limits water availability in the winter. Water is available in other seasons only because society determined that the science-based recommended instream flow rates were to be partially met.

Despite the instream flow needs constraint, it was determined that existing allocations and current applications of 329,046 cubic decametres (dam^3) could be increased to a maximum of 550,000 dam^3 before constraints on further allocations would be considered. Municipalities in the basin understand that this provides room for more allocations but also recognize that under the Alberta “first in time - first in right” priority allocation system, there could be increased risk for their current residents and for future growth. As a result, the Red Deer River Municipal Users Group (RDRMUG) commissioned this study in 2007 to explore means of increasing water security for municipalities.

The RDRMUG decided to take a proactive approach to securing water for municipalities. They recognized that long-term water issues in the basin were complex and needed to be analyzed and presented in a credible manner to give their sector of water users every advantage in reducing the risk of not having sufficient water.

The study approach first evaluated the state of water in the basin, current water usage and municipal planning information. A survey of municipalities was conducted and Alberta Environmental staff were interviewed. As a result of the survey and review of provincial databases, population forecasts were made for 25 and 50 year periods. These projections were used to forecast municipal water demands. At the same time, forecasts of water demands for other sectors were conducted. These demands were then used to assess the magnitude and frequency of water supply deficits and the size and feasibility of water storage infrastructure required to eliminate the deficits.

The study then reviewed other water topics that are unique to municipalities. These evaluations and relevant data were presented in eight technical memorandums. Observations and conclusions from the technical memorandums were then grouped into four themes and recommendations were developed as an outcome of the study. Each recommendation was laid out in a concise briefing format with sufficient information so that it could be presented in any forum.

Water Management

The technical memorandum on water management reviews the unique characteristics of the basin. The smallest of the three main tributaries of the SSRB contributes 20% of the flow from 40% of the land area. It also is noteworthy that 30% of the sub basin does not contribute to mainstem Red Deer River stream flow due to the terrain, lack of drainage and climatic conditions. The historically low natural flow of the basin has been offset by the operation of the Dickson Dam since 1983. It stores spring runoff and releases it during low flow periods in the winter to provide an adequate flow of high quality water. The availability of water in the Red Deer River has led to potable regional water supply systems being developed to service rural and urban communities where groundwater and local surface water supplies have been depleted. Similar demands are expected in the future as climate change results in more variability in weather patterns and perhaps lower flows. Alternative physical means of accessing additional water could include investigating the use of deep groundwater and alluvial aquifers.

The study also identified means by which regulators can improve administrative processes. One of the most recent concerns was the need for public notification of both large and contentious water diversion applications. Use of electronic media for rapid information exchange with affected stakeholders is recommended. In addition, the study identified deficiencies in the water user databases for allocations and water use records. Based on this information and suspected dormant licences, a thorough review of allocations is recommended for the basin.

It was also concluded that there are provincial government administrative approaches that could be changed or improved to reduce the risk of insufficient allocations and supplies of water for municipalities. These include changes to governance processes such as reserving water for municipal use, allowing municipalities to access water from an instream need in an emergency, net diversion licencing and return flow markets. The study makes recommendations on how each of these changes in water management could be approached.

Return Flow Credit

Receiving credit for returning reclaimed water is recommended in this study because municipalities generally return about 80% of their diversion if there is a treatment plant with a continuous release. Seasonal release lagoon systems retain water too long to be eligible for this approach. A return flow credit could also evolve to a market system if a municipality retained ownership of returned water. The purpose of these proposed initiatives is to encourage the return of high quality water for instream needs and for further use downstream.

Population Projections

A significant portion of the study of future municipal water needs within the basin required an analysis of population projections. Several municipalities provided their own planning projections. Past growth rates based on census data since 1996 were used for other municipalities. In general, it is forecast that the basin will experience a 40% increase in population over the next 25 years and a further 10% increase in the following 25 years. Most of this growth will be in the Calgary-Edmonton corridor resulting in 61.5% of the population being in that part of the basin by 2031. The City of Red Deer is projecting significant growth. An annual growth of 4.11% for Red Deer was used over the next 25 years, which is higher than the average rate of 2.2% per annum for all municipalities.

Municipal and Rural Domestic Water Use

Alberta Environment statistics on the amount of surface water allocations for municipalities in the basin have varied over the last few years as databases have improved and as applications have been filed. This study found allocations total 61,673 cubic decametres (dam^3) and applications by municipalities have been filed for an additional 32,008 dam^3. Current municipal water use is 33,680 dam^3 and forecasted water withdrawals for 2031 and 2056 are 69,730 and 92,898 dam^3 respectively.

Not all municipalities have sufficient allocations and rural populations are expected to access water over time through regional pipelines. As a result, municipal allocations should be anticipated to increase. Modeling information shows four major users will need increases in allocation even with water conservation measures. Looking beyond the fifty-year study period and considering the need for a reservation of water, an ultimate municipal allocation total of 175,000 dam^3 is recommended. This increased volume of 82,000 dam^3 would accommodate an additional 300,000 persons as well as industrial users that could utilize municipal water for processing needs. This leaves 138,000 dam^3 for other users, before the 550,000 dam^3 limit is reached.

Even with a dedicated municipal allocation system and a maximum allocation volume for all users, a problem still exists. Water is not available on a seasonal basis in the winter and on occasion in the summer due to the need to maintain a minimum flow in the river for the aquatic environment. The minimum flow is as high as 16 cubic meters per second which corresponds to the flow out of Dickson Dam. As a result, additional strategies to facilitate increased licencing are recommended.

Non-Municipal Water Use

Surface water demands for other water use sectors were also evaluated. This included;

- Agriculture
- Commercial
- Petroleum
- Industrial
- Water Management and
- Habitat

About 48% of licenced allocations for these sectors are being used. Agricultural usage of water will continue to increase. This includes two large irrigation projects, Acadia and Special Areas whether they proceed or not. The Special Areas has now reduced its proposed project from 76,500 dam^3 to approximately 25,500 dam^3 and the MD of Acadia is requesting 56,700 dam^3 for its project. There will be a 70% increase in non municipal water use over the next 25 years to 233,000 dam^3 and a 100% increase by 2056 to 273,000 dam^3. These increases are primarily due to increased irrigation.

Storage Requirements

Providing additional water storage in the basin is a recommended strategy to manage water for economic and environmental benefit. It could capture water that does not have to be supplied to Saskatchewan. It also could be used to increase flow in the river during low flow periods so that licences are not affected by instream conditions. Off stream storage is anticipated to be most acceptable storage strategy from an environmental impact perspective. The most practical municipal storage option is on-site raw water storage close to where treatment occurs. However, providing storage at some locations such as the City of Red Deer is difficult due to physical constraints.

Alberta Environment is currently ranking possible storage sites as to feasibility and is prepared to partner with stakeholders to study potential options. Pursuing any of the feasible storage options is recommended and will require leadership from the Red Deer River Watershed Alliance. In the interim, it is recommended that operation of the Dickson Dam be optimized to deliver water in excess of minimum flows for municipal downstream users in the winter rather than leaving excess water in Gleniffer reservoir for spring runoff.

Water Conservation

Municipalities supply potable water to a diverse set of users and for a variety of purposes. One of the heaviest uses of potable water is for irrigating lawns. This can account for as much as 50% of water consumption in hot weather. This and other high water use practices support the development of water conservation plans in all municipalities. It is also recommended that a grant program be created to support implementation of plans and that infrastructure grant programs be structured to reward successful conservation plans.

Recommendations

The study recommendations are grouped into municipal water security themes as follows:

1. Water governance
2. Financial incentives
3. Technical studies
4. Water management administration.

Many of the recommendations call for the provincial government to make changes in policies, procedures and legislation. Others suggest municipalities take action with some actions to be in cooperation with the Red Deer River Watershed Alliance and other stakeholders.

Water Governance Recommendations

How water is managed in the Red Deer River Basin from a regulatory point of view is extremely important. Alberta Environment has the authority under the Water Act to manage the Province's water resources as a result of the Federal Government transferring this authority in 1932. Alberta has taken the position that a priority allocation system combined with instream flow conditions can ensure there is a strong base for controlling water management. It supplements this with legislative tools that allow controlled flexibility such as water licence transfers, water allocation assignments, temporary diversions and crown reservations.

This study concluded that there are five possible changes to water governance in the basin that are directly related to municipal water use as follows:

1. A Crown Reservation to reserve a block of water for municipal use
2. Water shortage emergency access to water
3. Net diversion or consumptive use licencing
4. A return flow market
5. Longer term municipal growth projections for allocations.

Each of the above initiatives would require public consultation on its acceptability prior to legislative changes being made. The recommendation for a Crown Reservation is specific to the Red Deer River Basin whereas the other recommendations could be applied on a provincial basis. If the opportunity was presented, the Red Deer municipalities would welcome pilot projects or studies to further expand knowledge on these topics. Each of them is specific to municipal water needs in the future. The Crown Reservation merely carves out a portion of the projected ultimate demand and makes it available to municipalities on an exclusive basis.

Another option for a municipality to access increased allocations is potentially available through a credit for the return of reclaimed wastewater to the aquatic environment. The resulting net diversion or consumptive use licence would provide assurance that water would be returned and that a municipality receives some reasonable increase in allocation. An alternative to a net diversion licence is creation of legislation to allow a means for municipalities to market their wastewater through arrangements with downstream users. This is an innovative concept that needs to be considered in concert with other water market concepts. Having an allocation does not guarantee access to water. It was concluded that there needs to be a legislated ability to obtain water in an emergency when a water conservation objective limits access to water. An emergency would be when a municipality has no reasonable options to accessing other water. There are emergency provisions in the Water Act to divert water from a senior priority licence to a junior priority licence with compensation but there is no provision in legislation to allow decision makers to provide relief when river conditions threaten a community.

Financial Incentives Recommendations

Municipalities are essentially non profit organizations that provide services to the public. The provincial government oversees municipal operations through many pieces of legislation. In addition, funds are returned to the public from income taxes and other provincial sources of revenue. Often, funding is provided to municipalities in the form of grants for essential services on an equitable basis depending on need and priorities. Water supply is an essential service for Albertans, and municipalities provide the infrastructure and operating ability to meet stringent water quantity and quality requirements set by the Province. The province recognizes many municipalities do not have a tax base for needed infrastructure improvements so a grant program is available for regional systems and treatment processes.

Additional financial incentives have been identified in reviewing how municipalities can secure long-term water supplies. The following are recommended in the study:

1. Water and wastewater grant programs should be enhanced.
2. A water conservation grant program.
3. Increased priority for raw water storage funding.
4. A grant for reclaiming wastewater for reuse.
5. A grant for non-municipal licences to be transferred to a municipality.

The above proposed financial incentives for municipal water supplies are seen as being necessary for most municipalities but especially in the Red Deer River Basin given the diversity of types of municipalities and their water access constraints.

There is a need for a trust fund type of funding for standalone regional systems due to the large rural population in the Red Deer River Basin. This funding needs to also consider how to address factors that prevent regional systems from being implemented. Closely tied to this is the need for greater priority to be given to funding of raw water storage reservoirs. A technical memorandum on simulation modeling and storage requirements shows that any new allocation off of the Red Deer River will require storage for a winter supply.

Two other grant programs are proposed to promote water conservation and water reuse. The water conservation grant should be linked to outcomes such as reduced leakage and full cost accounting. A water reuse grant could offset or reduce the need for increased infrastructure to obtain increased supply.

The last incentive proposed is a market based incentive aimed at retrieving water allocations from industry or agriculture for new municipal use through efficiencies or reduced need.

Technical Studies Recommendations

The South Saskatchewan River Basin Water Management Plan 2006 identified that further studies were necessary to understand the river better in order to revaluate 2006 decisions and to make more informed decisions in the future. These studies should include more information on the aquatic environment. However, during the course of this study, it became apparent that further study was needed on some hydrological aspects of the basin. In addition, it was concluded that storage of water should be studied but it is recognized that the Province of Alberta is going to continue to do that. The Technical Memorandum on Simulation Modeling and Storage Requirements provides information that will be of use to others who advance the topic. The studies that were recommended include:

1. Instream Flow Effects Study
2. Alluvial Aquifer Study
3. Dickson Dam Operations Study.

Other studies could be of benefit to improve knowledge of the river but these studies are directly related to water security for municipal supplies. The instream flow effects study would further assess the validity of the current water conservation objectives and conduct a quantitative assessment of withdrawals on water levels. A similar study is proposed for assessing the effects of withdrawing water from wells in the vicinity of a river on river drawdown.

The study that would provide the most relevant information for municipalities is an evaluation of the benefits of allowing a slightly higher flow of water out of the Dickson Dam in the winter. An increased winter flow of 0.5 m/s has the potential to allow municipalities to draw water as needed rather than creating on site storage to eliminate shortages.

Water Management Administration Recommendations

One impetus for this study was administrative issues regarding water allocations within the basin and issues regarding water diverted outside the basin. Alberta Environment has policies and procedures that provide consistency across the province and ensure that allocations are managed within the Water Act. Any management system can be improved and the RDRMUG feels there can be improvements in the following areas:

1. Consultation on Water Diversions Outside the Red Deer River Basin
2. Notification of all Water Allocation Applications and Transfers
3. Basin Wide Sharing Agreement
4. Water Allocation Administration.

Currently, the RDRMUG does not object to water leaving the basin for municipal users where there is a demonstrated need and where there are no viable alternatives for a water source. However, no matter what the need, they feel there should be an automatic public forum on any proposed intrabasin diversion to ensure everyone is informed and to ensure Alberta Environment receives appropriate feedback. Similarly, there needs to be a better notification system to ensure Red Deer residents have an opportunity to comment on any proposed allocation that would affect the basin. Several suggestions are made to improve electronic methods.

Two recommendations deal with ensuring water allocation records are accurate and then making arrangements for all users to come to an agreement on water allocation distribution during a serious water shortage. The Water Act allows for assignments of priority water which is essentially a sharing arrangement. A historic application of this procedure occurred in the St. Mary basin in 2001 between several hundred licence holders. This would allow water users to avoid using the priority system, which can be punitive, and ensure all participating users are able to function with a reasonable amount of water. This approach should be prearranged so water users are not in a panic situation when a widespread water shortage occurs.

A recommendation has also been made related to administration of licences and licensing databases. The recommendation recognizes that the accuracy of records goes beyond the database. It involves cancelling unused licences and licences not in good standing, periodic inspections of projects, and standardizing procedures for classifying licence purposes. A single decision maker for the Red Deer River Basin would also be beneficial.

Summary

As water management in the Red Deer River Basin advances over the next 50 years through research knowledge, appropriate decision making and adequate funding, it is anticipated that all water users will be proud of the foresight shown by the RDRMUG and action taken by all stakeholders to preserve the river while at the same time providing assurances for future water needs.

The following is a list of the recommendations provided in this Red Deer River Municipal Water Assurance Study:

Report Recommendations List

1. Crown Reservation

The RDRMUG recommends to Alberta Environment that a Crown Reservation be established for the Red Deer River to:

- Reserve all surface water in the Red Deer River that is not already allocated
- Specify that additional allocations for water may be granted for municipal purposes for a specified volume of 175,000 dam^3 for existing and future use
- Allow allocations for other purposes up to 375,000 dam^3 for existing and future use
- Identify that the priority for all municipal allocations issued after the Order (Reservation) is effective two days after the Order. (Water conservation objective licences have been prioritized one day after an order to reserve water for the aquatic environment. Future allocations for other uses would be junior in priority to all municipal users. Each municipal allocation would be consecutively numbered on that date)
- Restrict municipal licences to prevent reallocation or transfer to other purposes.

The RDRMUG enter into discussion with the Red Deer River Watershed Alliance, Alberta Environment and MLAs to garner support for a Crown Reservation.

2. Municipal Water Licence Terms

The RDRMUG should make Alberta Environment aware of the concern municipalities have about potential constraints placed on licences issued to urban and rural municipalities from both a licence term basis and volume forecast basis. Specific recommendations are:

- New municipal allocations should correspond to the 25 year design volume of infrastructure
- Incorporated municipal water licences should have no expiry date.

3. Net Diversion Licencing

It is recommended that Alberta Environment create a policy that permits net diversion licences for municipalities in the Red Deer River Basin. The licence should require:

- No change to licence conditions regarding instream objectives
- Wastewater reclamation on a site specific basis to the Province's requirements
- Continuous releases of return flow
- A minimum return flow volume and rate
- Flexibility as to impact on water quality and flow in the vicinity of the diversion and release point
- Reduction in allocation to a consumptive use that is based on forecasted needs.

4. Water Shortage Emergency Access to Water

It is recommended that Alberta Environment propose an amendment to the Water Act to exclude municipalities from having to pay compensation under Section 107 and to give the Director under the Act authority to:

- Issue a temporary diversion licence for emergency situations when water must be diverted below a WCO
- Allow a licencee to continue to divert beyond the point where a WCO restricts a licence.

5. Return Flow Market

It is recommended that Alberta Environment initiate a study to research the potential for municipalities to participate in a return flow market in exchange for compensation or increased allocation. It is expected that legislation and policy changes would be necessary.

6. Regional Water and Wastewater System Funding

It is recommended that the Alberta government allocate adequate funds to eligible projects with a trust fund process to hold funds for projects until constraints such as routes, sizing, availability of contractors, etc. are resolved.

It is also recommended that funding enhancements be put in place to deal with inhibitors to regional water supplies such as:

- Raw water supplies for farms (not subdivisions) be considered for a funding program
- Debt reduction for existing infrastructure subsidized regional operation of stand alone systems where a pipeline is too costly
- Subsidized rate structure for five (5) years where a supplier has a rate that is substantially higher than the newly serviced community
- Consideration of an incentive program for distribution systems for the core of villages and hamlets where a system did not exist before
- Inclusion of water licence transfer costs as an eligible cost for funding.

7. Water Licence Transfer Rebate Program

The RDRMUG should hold discussions with municipalities in other basins to explore the concept of a rebate program for licence holders who transfer water allocations to municipalities who have demonstrated need.

8. Water Conservation Grant Program

It is recommended that:

- Alberta Infrastructure and Transportation make an incentive grant available to municipalities to provide metering or if metering is available, to provide other water conservation methods. A condition of the grant would be the implementation of a long-term bylaw for an increasing block rate structure that is based on full cost accounting.
- The present municipal infrastructure grant program administered by Alberta Infrastructure and Transportation be upgraded to include leak detection and repair programs.

9. Water Reuse Grants

It is recommended that municipal organizations such as the Association of Urban Municipalities (AUMA) or Association of Municipal Districts and Counties (AMD&C) initiate discussions with the Department of Infrastructure and Transportation to explore a range of possible options for funding the reuse of water.

10. On-Site Raw Water Storage Grant System

It is recommended that the Department of Infrastructure and Transportation provide for a high priority special funding program for raw water storage reservoirs.

11. Instream Flow Need Effects Study

The RDRMUG should support the watershed Alliance in arranging to conduct research on required minimum river flows.

The RDRMUG should seek funding for an assessment of the level and volume in each river reach municipal withdrawals at various flow rates.

12. Alluvial Aquifer Study

It is recommended that Alberta Environment conduct studies on whether municipal supplies in alluvial aquifers affect instream flows in the vicinity of the withdrawal.

13. Dickson Dam Operations Study

It is recommended that the RDRMUG request that Alberta Environment conduct a study on the feasibility of:

- Modifying operation rules for Dickson Dam to allow additional outflow of water in the winter months. This would include an evaluation of water quality issues and consumptive needs along the river.
- Increasing storage at Glennifer Reservoir to meet minimal needs of municipalities.

14. Consultation on Water Diversions Outside the Red Deer River Basin

The RDRMUG should promote the creation of policies and procedures to ensure that the provincial government provides adequate notice and full public forums on any proposed water diversions out of the Red Deer River Basin.

15. Notification of Water Allocation Applications and Transfers

A phased approach to informing and seeking input from Albertans about water allocations licences and transfers should be taken by Alberta Environment as follows:

- An application site should be created on the AENV website similar to the Approval site where all applications are posted. This could also be the official time clock for postings.
- Basin planning and advisory councils should be given notice via e-mail about any significant applications (e.g. greater than 500 acre-ft or 617,500 m^3 and/or a diversion leaving a sub-basin).
- An electronic registry of applications and interested persons with notice provisions should be established. An enhancement would be the ability to file a statement of concern electronically.
- An electronic system that tracks water consumption for each licence initially on an annual basis then eventually on real time for larger users. An enhancement would be real time river conditions and advisories of potential shortages.

16. Basin Water Sharing Agreement

The RDRMUG should propose that the Red Deer River Watershed Alliance (RDRWA) be a forum for water users to arrive at water allocation options for a water shortage. The intent would be to have all the potential issues addressed and tentative agreements arranged such that final agreement can be reached quickly when needed between appropriate users.

The RDRWA should ensure that Alberta Environment's SSRB Interbasin Water Coordination Committee provides input to the process as well.

17. Water Allocation Administration

Administration of licences should be improved to provide accurate information on water use, licences and priority. In order to accomplish this, it is recommended that:

- A "virtual" office be integrated between the Red Deer and Calgary offices to administer applications for licences such that decisions are made by one director out of the Red Deer office
- A concerted effort be made to assess licences for lack of use and reduce allocations where appropriate e.g. stockwatering
- Allocation records be modified where duplicate entries have been made.

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1 Water Management

Technical Memorandum

Red Deer River Municipal Users Group

Water Management in the Red Deer River Basin

November 2008

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TECHNICAL MEMORANDUM

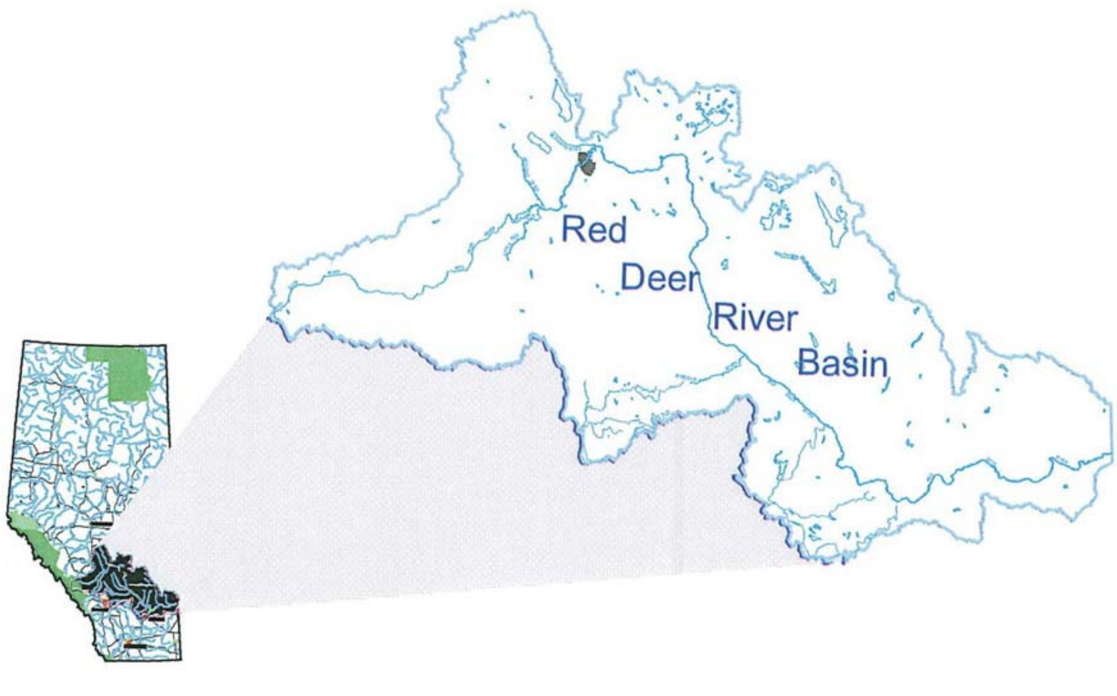
1 Introduction

The Red Deer River Basin is located within the province of Alberta as shown in Figure 1. Concern has been expressed by the Red Deer River Municipal Users Group (RDRMUG) about securing future water supplies for municipalities in the basin.

In order to assess how future municipal water needs can be satisfied in the Red Deer River Basin (RDRB) there must be an understanding of how the river basin functions and how it is regulated for aquatic environment protection, recreation, water withdrawals and overall management of the South Saskatchewan River Basin (SSRB).

This technical memorandum will describe variability in river flow and other characteristics, groundwater resources, operation of the Dickson Dam, provincial licencing requirements, water shortage implications and the South Saskatchewan River Basin Water Management Plan as it relates to the Red Deer River.

Figure 1
Basin Location



2 Water Use Conversions

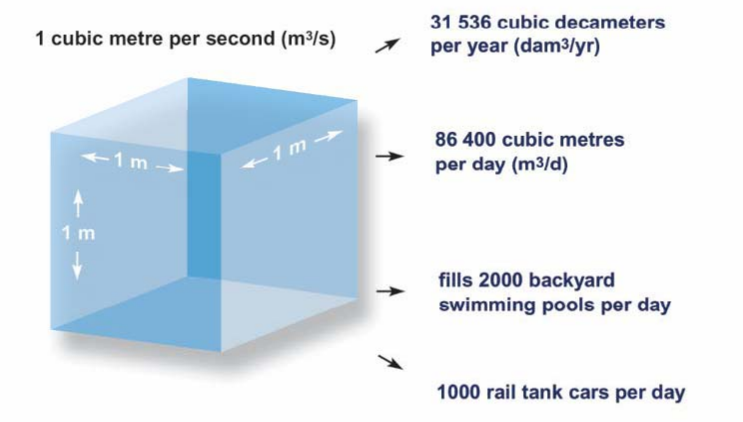
Terms used in this memorandum to quantify data relating to rate of flow and volume are as follows:

Table 1 – Water Use Conversions

Cubic metres (m^3)	× 1000 =	Litres (L)
Cubic metres (m^3)	× 220 =	gallons (Imperial)
Cubic metres (m^3)	× 264.17 =	gallons (U.S.)
Cubic metres (m^3)	× 6.29 =	US barrels (of oil)
Cubic metres per second (m^3/s)	× 35.31 =	cubic feet per second (cfs)
Cubic metres per second (m^3/s)	× 13198.1 =	imperial gallons per minute (Igpm)
Cubic decametres (dam^3)	× 1000 =	cubic metres (m^3)
Cubic decametres (dam^3)	× 0.81 =	acre-feet (ac-ft)
Hectares (ha)	× 0.01 =	square kilometres (km^2)
Hectares (ha)	× 2.47 =	Acres (ac)

(To convert in the opposite direction, **divide** by the factor shown (i.e. acres divided by 2.47 equals hectares).

Figure 2 – Water Flow Rate Equivalencies



3 River Characteristics

3.1 River Flows

The Red Deer River originates from Red Deer Lake and the Drummond Glacier in the Rocky Mountains. It descends 1,358 metres and travels 740 kilometres before entering Saskatchewan. Contributions to the Red Deer River come from a basin that encompasses 49,000 square kilometres and includes Rocky Mountain Boreal, Foothills, Parkland and Grassland Natural

Regions. However, this natural diversity is not equally balanced. More than 75% of the basin is parkland and grassland. The small amount of mountainous terrain means that snow melt is not a major contributor to water supply compared to the Oldman and Bow River basins. However, even though the mountainous portion of the Red Deer River Basin is small, it is a very high yielding area. For instance, the area above Burnt Timber Creek yields on average, 245 dam^3/km^2 while the basin as a whole, at Bindloss, yields about 40 dam^3/km^2. In total, the Red Deer River basin only contributes 20% of the flow originating in the SSRB despite having 40% of the land area.

The amount of water flowing in the Red Deer River on average is 42% less than the Bow River and over 70% less than in the North Saskatchewan River. Comparative flows are shown in Table 2.

Table 2 – Alberta River Flows

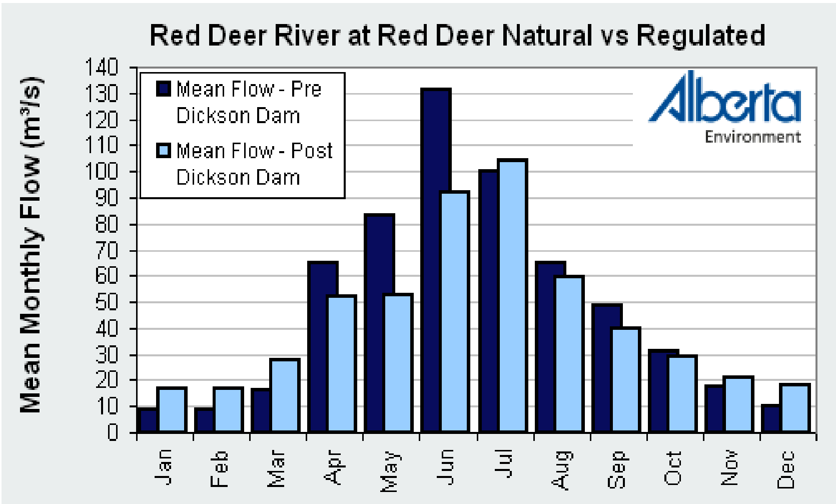
River Location	**Recorded Flow (m^3/s)**		
	Estimated Median	Peak Summer Median	Maximum
Red Deer River at Dickson Dam Outlet	37	87	1552
Red Deer River at Red Deer	55	95	1600
Red Deer River at Drumheller	60	100	1200
Red Deer River at Bindloss	70	110	1000
Bow River at Mouth	122	210	1530
Oldman at Mouth	105	200	4000
North Saskatchewan River at Edmonton	245	500	4650
Athabasca River at Ft. McMurray	900	1400	4750
Peace River at Peace River	1200	4000	16500

The river moves relatively slowly through Alberta with small tributaries providing increased flows on average between 2 – 10 m^3/s at each tributary. However, inflows are not significant in the winter. The proposed WCO of 16 m^3/s on licences means that any recent licences subject to a WCO will need to have storage to mitigate against shortages. Applications for licences for regional water supplies also will need to demonstrate to Alberta Environment how allocation needs will be met without incurring significant risk.

In the prairie reaches, the Red Deer River is wide and shallow with no sudden changes in elevation. This has implications for flooding, increased water temperature and lower dissolved oxygen. Flooding concerns have been reduced to some degree with the construction of the Dickson Dam, completed in 1983. However, flooding can still occur, as it did in 2005. This can be threatening to municipalities but it has the benefit of restoring riparian areas and vegetation such as cottonwoods which rely on seeds to be covered with sediment shortly after they are released by the tree.

Figure 2 illustrates the effect that regulating the flow in the Red Deer River has on previous natural flow. Flow downstream of the Dickson Dam is now almost double what it was prior to the dam construction in the winter and 30% lower during spring runoff. This had a significant effect on how instream flow conditions were developed in the South Saskatchewan River Basin Water Management Plan because the flow in the river is not natural. The minimum flow of 16 m^3/s that the dam was designed to pass was a baseline flow designed to protect water quality and fish habitat. This is now part of the WCO instantaneous flow condition on new licences in downstream reaches.

Figure 3



It is anticipated that the natural flow hydrograph (pre Dickson Dam) in Figure 2 will shift in time due to climate change. More precipitation is predicted to fall as rain in the winter months. The effect will be filling of the dam earlier than normal and an earlier than normal restriction on flow downstream to maintain enough water in the reservoir for winter minimum flows.

3.2 Intra-Basin and Inter-basin Water Diversions

The predominance of prairie, parkland and grassland terrain in the basin impacts water management in several ways. This type of terrain leads to less runoff in normal and low precipitation years due to retention in wetlands and natural depressions. These non-contributing drainage areas are estimated to be 30% of the basin at Bindloss. Another characteristic of the terrain in the SSRB is relatively flat basin slopes and indistinct drainage divides. As a result, it is attractive to use engineered solutions to move water between basins and sub-basins. Significant examples of this are water diversion structures on the Bow River. The Western Irrigation District diverts Bow River water at Calgary to supply water to irrigators in the Bow and Red Deer River Basins. The District has substantial return flows to the Red Deer River via the Rosebud River. The second diversion is at Bassano for the Eastern Irrigation District to supply water to irrigators in the Bow and Red Deer River Basins. Return flow via Matzhiwin Creek flows to the Red Deer River. Much of these two sub basins are non-contributing so return flow (unused water) from the irrigation supply supplements flow in the Red Deer River. There also are two proposed irrigation projects to draw water off of the Red Deer River. One is the Special Areas Water Supply Project (SAWSP) and the other is the MD of Acadia project. Each one is in the conceptual design stage with applications filed for allocations.

Another engineered diversion of water between basins occurs through pipelines for drinking water supply. The Mountain View Regional Water Services Commission supplies water to several communities in the RDRB and the Town of Crossfield in the Bow Basin. At the north end of the RDRB, the North Red Deer Water Supply Commission takes water to Lacombe, Blackfalds, Ponoka, Hobbema and other areas in the Battle River Basin which is an inter-basin transfer. In 2006, an application was also made to AENV to divert Red Deer water from the Drumheller Water Treatment Plant to a large mall, casino and horse racing complex at Balzac near Airdrie in the Bow River Basin. This was to be an extension to the Kneehill Water Commission system which serves several communities, including Beiseker and Irricana within the Municipal District of Rocky View. Opposition to the project was immediate because the location was in the Bow River Basin where there were other means to access water and there were concerns about depleting the resources of the Red Deer River. A solution involving the transfer of a licence from an irrigation district is now being considered. This case illustrates the importance of water in the Red Deer River Basin and the value it has for municipal growth.

3.3 Water Quality

The bulk of the population of the basin is located in the Parkland Natural Region along the Highway 2 corridor, which includes the City of Red Deer. This population draws on the surface water and groundwater resources and contributes to water quality concerns. Agricultural practices including unconfined livestock activity has a detrimental effect on the shallow rivers. Nutrients cause weed and algae growth which can foul intakes, decrease water quality and deplete oxygen through decomposition. Municipal effluent can cause the same effect especially if released continuously. The largest municipal effluent release is at the City of Red Deer. An improvement in effluent quality occurred in 2006 with the commissioning of tertiary wastewater treatment in the form of biological nutrient removal (nitrogen and phosphorus) as well as ultraviolet disinfection. This will significantly reduce the potential for weed growth in the shallow water over the next few years. The treatment plant will also reduce organic loading which will improve dissolved oxygen limits in the water downstream of Red Deer. Prior to the Dickson Dam construction in 1983, low dissolved oxygen levels under low flow conditions (less than 2.0 m^3/s) led to fish kills.

Water quality is generally good with the exception of spring runoff for the reasons mentioned above. Any diversions for municipal drinking water purposes that employ treatment processes required by Alberta Environment will be able to provide safe potable water to consumers. While municipal water treatment technology is robust and able to deal with bacteria, parasites and sediment, it is challenged by organics originating from decomposing vegetation and agricultural runoff. The challenge is that organic matter such as algae can release by-products that inhibit the water treatment coagulation process such that turbidity removal is compromised. Algae can also produce a higher pH in water which affects the coagulation and chlorination process. Of even more concernare the compounds formed when chlorine reacts with organic matter. Some compounds produce color, taste and odour problems. Other compounds are known as Trihalomethanes which includes carcinogens such as chloroform.

4 Climate Change

Most municipalities have experienced water shortages due to a prolonged dry period. Usually, the infrastructure is unable to continuously supply sufficient water to meet increased demand. This natural variability in climate can be anticipated and programs can be put in place to mitigate effects. In general, municipalities have flexibility in comparison to industrial or agricultural water users. With 50% of summer time water use occurring outside the home, many uses can be curtailed during a water shortage.

Extremes in natural variability in climate may occur with more frequency and with less predictability as global climate change occurs. As a result, municipalities must adopt strategies to adapt to changes in the hydrologic cycle. Some of the anticipated changes are:

- Warmer temperatures mean more evaporation but at the same time increased atmospheric moisture carrying capacity means more precipitation.
- Precipitation will likely be less frequent but more intense.
- Average annual runoff in Alberta is predicted to vary from a slight decrease to an increase.
- Warmer temperatures are predictable and as a result, lower snowpack and more winter runoff. This means an earlier runoff than April for the Red Deer River Basin which can increase the potential for floods.

Water supply implications for water utilities are vague so it is tempting to disregard climate change. However, it would be wise to begin to adapt by introducing flexibility into a utility operation. The 68 years of record on hydrology of the basin provides a good level of certainty about risk of water availability but additional information is needed. Scaling the records down or using worst case historical records are options for predicting risk.

An effective physical adaptation is new water storage. This has drawbacks in that society objects to damming of rivers and the diversion of large volumes of water that can evaporate. Multipurpose storage may help utilities decide to go this route. Operating procedures also will have to change to match runoff patterns.

Another approach to adapting to water shortages is to use tools from the Water Act for sharing water, transferring allocations and eventually having a market for water. However, the most effective approach is a process where demand management is facilitated through the use of technology, economies and communication. This relates to reducing system losses, pricing water correctly and educating users.

5 Groundwater

It is estimated that only 3% of all water allocations in Alberta come from groundwater. Data is limited because household wells are not required to be licenced. The area in the vicinity of the City of Red Deer for instance has a significant use of well water. The volume of water available is relatively good as there is an estimated 2.3 billion m^3 recharge of aquifers from precipitation in the SSRB. (Alberta Environment Website) The Red Deer River Basin receives more precipitation than southern basins and the formations beneath it can capture a significant amount. However, wells may be limited in quantity by pumping rates depending on hydrogeological conditions.

The primary water bearing geological structure in the Red Deer area is the Paskapoo bedrock formation of shale and sandstone with sands and gravels on the bedrock surface. Typically, water wells range in depth from 40 m in valleys to 200 m in higher elevations to access the thick bedrock formation between Calgary and Red Deer. It is estimated that there are 85,000 wells in this area. A bedrock well is typically confined by a layer of clay which protects it from contamination. Other wells may access water in overburden material considered to be unconfined.

The Red Deer River Watershed Atlas contains a map of well densities in the basin that illustrates that well water is accessed primarily in a band 50 km east and west of Highway 2. Many of the wells are for household or agricultural use. Agricultural registrations account for allocations of 29,802 dam^3. Larger licenced users are allocated 26,525 dam^3. The total groundwater allocation is only 13.4% of the surface water allocation. The potential for further allocations is difficult to predict; however, deep saline water may be a long-term source if treated.

Groundwater in the basin is generally of good quality with occasional occurrences of high iron, manganese and fluoride. The criteria used to identify freshwater is a total dissolved solids (TDS) concentration of 4000 mg/L. This is exceptionally high for human consumption which is usually limited to dissolved solids concentrations less than 500 mg/L; however, high concentrations can be treated or used for other purposes.

6 Alluvial Aquifers

Often wells are constructed near lakes and rivers because water quality is good and quantity is plentiful. An obvious conclusion is that the source is the adjacent water body. Hydrogeological investigations involving pump tests may confirm that there is a hydraulic connection. If so, then this confirms that the well is drawing from an alluvial aquifer. Alluvial aquifer is a United States geological survey term for an aquifer with geological materials (usually sand and gravel) deposited by a stream and that retain a hydraulic connection with the depositing stream. In Alberta, a well under these conditions is considered to be drawing surface water and is licenced as a surface water source by Alberta Environment. Further research may lead to different licencing considerations in the future because the degree of integration between water bodies and alluvial aquifers is poorly understood.

A special benefit of drawing water from an alluvial aquifer is the protection it provides from any pollutants or sediment loads carried in the adjacent stream. The term ”riverbank filtration” is used in Europe for acquiring water for municipal purposes.

7 Dickson Dam Operations

In June 1975, four years of Red Deer River flow regulation planning studies were completed with the primary conclusion being that a dam be built on the Red Deer River 20 kilometres west of Innisfail to:

- supplement winter low flow
- prevent low dissolved oxygen
- assimilate Red Deer City Wastewater
- provide more reliable water supply for downstream users
- provide side benefits such as small flood mitigation, erosion protection, recreation and power generation.

In addition, stored water is available in the event that water is required to be passed to Saskatchewan to meet the 1969 Master Agreement on Apportionment. In general, this agreement requires that 50% of the natural flow of the entire SSRB be passed to Saskatchewan each year (subject to some qualifications). To date, releases from the Oldman River Reservoir have primarily been used since operation began in 1990 to make up SSRB shortfalls in meeting apportionment commitments.

Construction of the Dickson Dam began in 1981. In 1983, filling of a 203,000 dam^3 reservoir known as Gleniffer Lake began. The reservoir is operated by Alberta Environment to meet the multiple needs previously cited. Typical operation begins in April when reservoir volume is at is lowest, mountain snowpack is substantially accumulated and the plains runoff has finished. Predictions can be made as to the potential mountain runoff based on snow pillow measurements. Once ice accumulations on the Red Deer River are gone, usually by the first week in May, the minimum winter outflow of 16 m^3/s is increased depending on the volume predicted for snowmelt. At the same time the reservoir level is raised to desired recreation levels of 946 – 946.5 m which is 2 m below the 948 m full supply level. Should a heavy rainfall be predicted, the reservoir can be lowered at no more than 0.5 m/d between elevations 944 and 946 m and 1.0 m/d between elevations 946 – 948 to protect the reservoir banks from sloughing.

Reservoir releases are also directed through up to three power generation tunnels operated by Algonquin Power since 1991. The three generators can each pass 16 m^3/s. Average annual inflow to the reservoir is 35.6 m^3/s and the June average inflow is 102 m^3/s with a high of 2372 m^3/s during the flood of 2005. The outflow in June 2005 was 1552 m^3/s which was carried by the power generation tunnel #2 (60 m^3/s), the bypass tunnel #1 (40 m^3/s) and the remainder through the spillway.

In mid August, the reservoir is brought to FSL to augment downstream flows to 16 m^3/s during the fall and winter months. Monitoring stations on the Medicine River and Little Red River provide information for accurate releases to pass 16 m^3/s throughout the winter. In summary, the general reservoir operating level targets are as follows:

April – May (maintenance)	940.5 m
June (runoff month)	946 m
Recreational season	947 m
Mid-August	948 (FSL) m

A graph illustrating reservoir levels is shown in Figure 3. Some downstream water users may look to the reservoir for their needs during the year. However the priorities for river operation are:

1. Flow augmentation
2. Recreational levels in the summer
3. Apportionment
4. Flood mitigation when necessary.

Other priorities such as supplying water to downstream users are unlikely to be applied unless there are special needs that the Minister of the Environment deems to be important. Apportionment needs would be met and possibly a widespread water shortage could trigger a change in policy in a particular year, however, that must be balanced with the need to have sufficient storage to provide 16 m^3/s downstream all winter.

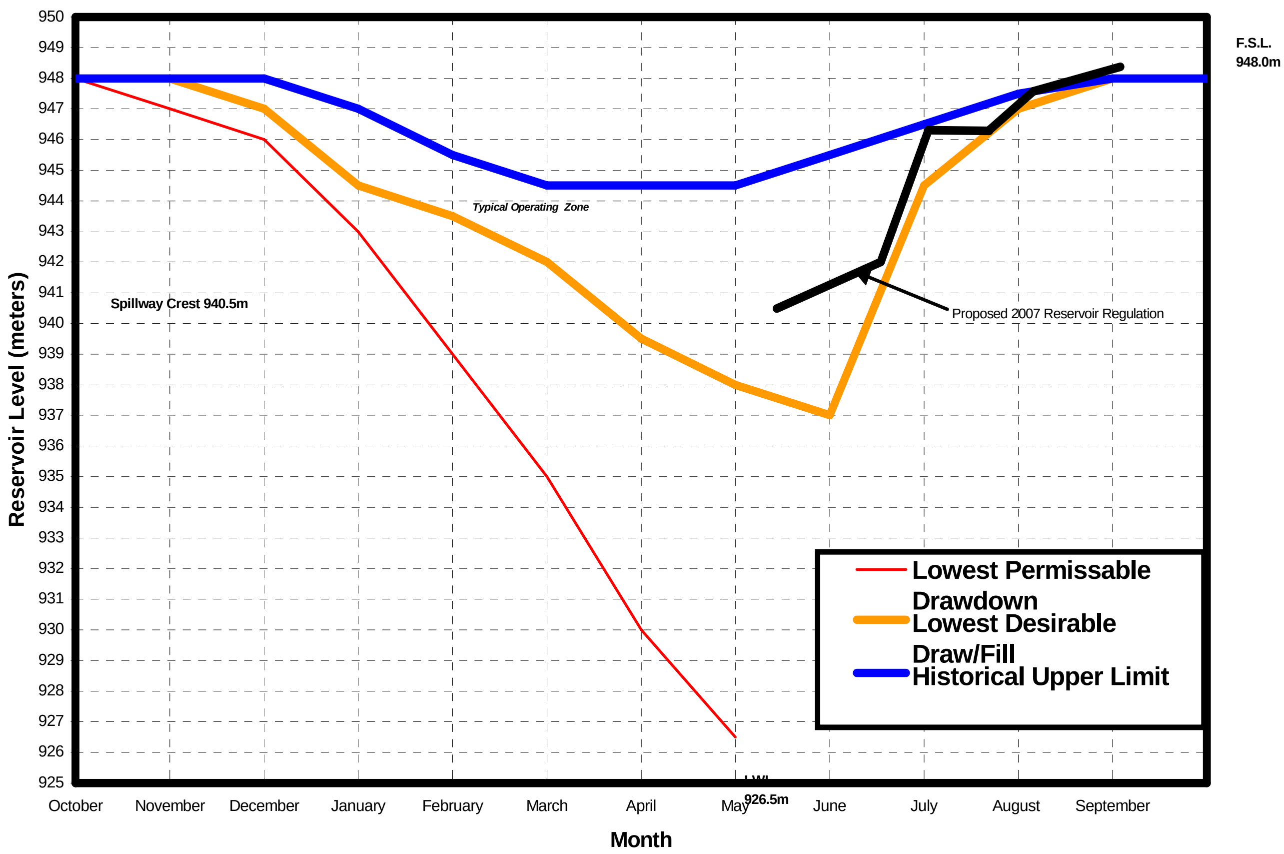
As noted in the introduction, flows out of the mountains and foothills can be significant during spring runoff and adequate for most of the summer and fall. However, winter flows can be extremely low. The Dickson Dam counters this problem by capturing flow into the reservoir until July, decreasing flow in the summer and releasing additional flows in the fall and winter.

It is likely that the river hydrograph will change as climate change takes effect. More rainfall in the winter means the dam will be filled earlier and be required to retain flow longer.

Dickson Dam Features

Constructed:	1980 – 1984
Height:	40 m.
Length:	650 m.
Storage:	203,000,000 m^3
Reservoir:	Gleniffer Lake 11 km long 2 km wide
Area:	1735 hectares
Spillway:	940.5 m elevation 60 m. wide 4800 m^3/s capacity doubling in 2008
Controls:	5 vertical roller gates
Crest Elev.:	952
Full Level:	948 m. FSL
Drawdown:	926.5 m.
Max. Inflow:	2372 m^3/s (2005)
Max. Outflow:	1552 m^3/s (2005)
Min. Outflow:	16 m^3/s
Avg. Inflow:	35.6 m^3/s
June inflow:	102.5 m^3/s
Tunnel #1:	40 m^3/s
Tunnel #2:	60 m^3/s (Power)
Power:	15 megawatts
Emergency Spillway:	5200 m^3/s

Figure 4 – Dickson Dam 2007 Proposed Reservoir Level Regulation Schedule



Desirable and Permissible lines taken from the Dickson Dam Flow Regulation Manual 1983/84.
Historical Upper Limit - average upper limit of reservoir elevations 1984-2000.

8 Water Allocation Management

8.1 Water Management Legislation in Alberta

With the passing of the *Northwest Irrigation Act* by the Dominion Parliament in 1894, the parts of western Canada now known as Alberta and Saskatchewan put in place the statutory tool needed to control the distribution and use of water in a manner that would minimize conflicts and encourage development. Responsibility for managing natural resources was transferred from the federal government to Alberta in 1930, and the early federal water management legislation gave way to *Alberta's Water Resources Act* in 1931. In 1999, the Water Resources Act was replaced by the *Water Act*. The *Water Act* provides greater flexibility for managing water and introduces new approaches for managing water short basins. However, all legislation since 1894 had the same four basic principles:

- Suppression of riparian rights and declaring Crown ownership of water (see sidebar)
- Government control of the allocation and use of water
- An allocation process designed to promote development
- A first-in-time, first-in-right priority system designed to protect existing development.

Riparian Rights – Prior to 1894, the allocation of surface water in western Canada was governed by the Doctrine of Riparian Rights. The doctrine was derived from court decisions in England where water is more abundant. It stipulates that only a riparian landowner (the owner of land adjacent to a stream or water body) has the right to divert water, and only in quantities that would not noticeably reduce flows or water quality available for use by other riparian landowners.

Riparian rights were considered to be a major deterrent to large-scale irrigation on the Canadian prairies, since only riparian landowners could divert, and in quantities insufficient for irrigation. Federal government officials of the day felt that large-scale irrigation was the key to rapid settlement of the west. Hence, the deterrent was removed with the passage of the Northwest Irrigation Act.

8.2 Water Act Licensing Procedure

The *Water Act* requires that a licence be obtained before diverting and using surface water or groundwater for all uses except statutory household, traditional agricultural, fire fighting, and other small quantity uses available primarily to riparian landholders. Licences identify the purposes of the projects, water sources, points of diversion, maximum allocations (withdrawal, diversion or storage), the rates of diversion or withdrawal, the operating periods and the priorities of the water right. The priorities are based upon the dates of complete applications which are known as "first in time, first in right" priority system.

Conditions under which diversions or withdrawals may take place will be noted. Conditions may also include monitoring and reporting requirements.

An application for a licence must be supported by engineering drawings accurately showing the location and key characteristics of the project. Depending on the scale and complexity of the project, reports may be required to describe engineering design and operating details, impacts on the stream and other water users, and environmental impacts.

Alberta Environment staff review the applications for impacts on the source, the aquatic environment, public safety and other users. The application may be referred to other agencies for comments and notice will be required to provide for public statements of concern. The applicant may be required to address concerns raised by government agencies or the public. In making a decision on the project, the Director (approvals manager appointed by the Minister) **must consider** licensing recommendations in an approved water management plan.

The Director may reject the application or issue a preliminary certificate for the project with conditions regarding such things as engineering plans. Upon successful completion of construction and certification that the works are in accordance with the application, a licence would be issued granting the allocation and use of water with conditions relating to instream needs, monitoring and reporting. The licence will have an expiry date. Decisions by the Director are subject to appeal to the Environmental Appeals Board.

Alberta Environment presently must have licences expire after up to twenty (20) years. This allows for a review of the licence conditions and an assessment of the volume. In the case of a municipal licence, there are very few cases where there is no prospect of additional use so cancelling a portion of a licence is unlikely. There is merit in not having an expiry date for licences for incorporated licences to reduce effort by both levels of government.

An additional concern is the potential for Alberta Environment to limit the forecast period for future demands. Their concern seems to be with private subdivisions reserving excess water with grandiose schemes. Municipalities have consistent growth rates and design their infrastructure on a twenty-five (25) year life cycle with much of it lasting 35 - 50 years. As a result, any reduction of forecast to less than twenty-five (25) years is not justified.

A summary of the Approvals and Licencing process follows in Figure 5.

Figure 5 - Alberta Water License Application / Approval / Appeal Process

Water Licence Application to AENV
Pre-consultation with First Nations and other affected users is encouraged

↓

AENV Reviews for Completeness and Demonstrated Need

↓

Notice of Application Advertised
Posted on AENV website, in a local newspaper and/or notification to stakeholders

↓

30 Day Period for Filing Statements Of Concern (SOC) by Directly Affected Persons
(Note: Agencies, municipalities or special interest organizations are not usually considered directly affected as they have no special interest beyond that of a resident in the area.)

↓

Issue Resolution
AENV requires public meetings, mediations or other action to resolve concern if possible

↓

Decision by Regional or District Approvals Manager
Copy sent to those persons who submitted an SOC

↓

30 day period for an SOC filer to appeal to the Environmental Appeals Board (EAB)

↓

Appeal Validation and Issue Resolution
Mediation service offered by EAB

↓

EAB Hearing
If not resolved by other means issues are heard

↓

Decision by Minister of Environment
Based on Recommendations from EAB whether hearing held or not

8.3 Approvals and EIAs

Approvals under the *Alberta Environmental Protection and Enhancement Act* are required for activities with a high potential to impair or damage the environment, property or human health and safety. Environmental Impact Assessments (EIAs) are mandatory for:

- Dams greater than 15.0 m high
- Diversion structures and canals with capacities greater than 15.0 m^3/s
- A reservoir with a capacity greater than 30,000 dam^3.

For non-mandatory projects, the Director decides (with public input) if potential impacts can be adequately addressed through the approval process, or if a more detailed environmental assessment is required. Full EIAs may be referred to the Natural Resources Conservation Board for public hearings and a decision on whether or not the project is in the public interest considering social, environmental and economic impacts.

Approvals from Federal Departments of Transport (Navigable Waters Act) and Fisheries and Oceans (Fisheries Act) are necessary if a diversion is proposed directly from the river. In addition, an environmental screening may be necessary if federal funding is involved or if the project is considered significant.

Other approvals may be required such as from Alberta Sustainable Resource Development for crossing public land.

8.4 Enforcement of Licence Priorities During Water-Shortages

Licences are given a priority number based on the date that a completed application was received by Alberta Environment. Higher or senior priority licences are entitled to divert full water requirements before licences with lower or junior priorities have any right to divert. Alberta Environment's watermasters have the difficult task of enforcing priorities in sub-basins where water demands could exceed supplies. The task is difficult because the livelihoods of water users are often at stake when they are asked to curtail diversions.

In water-short basins, all licences are reviewed and information is organized in a way that would facilitate determining the order in which licensees would be cut-off in the event that water demands exceed supplies. Minimum flow requirements are included in the database. Some licences may be subject to a minimum flow requirement; others may not depending on the time that the licence was issued. Minimum flow conditions began to be put in licences in about 1990 in anticipation of the new *Water Act* being enacted. The new act was issued in 1999 and contained the ability for the government to create a Water Conservation Objective (WCO) for a water body in consultation with stakeholders. This WCO was equivalent to an instream flow need and then became a limiting condition in licences. In fact, it could be retroactive if the licence prescribed that any future WCO or instream objective is to be subject to the licence. It should be noted that the term "instream flow need" (IFN) is considered to be a scientifically determined flow for maximum protection of the aquatic environment. A WCO is less protective because it is normally set in consideration of society deriving some economic benefit from diverting flows below the IFN value. The effect of a minimum flow condition on a licence is often not understood by the public. There is an assumption that licences cumulatively will drain a waterbody in times of water shortage. The flow condition or WCO ensures that any licences issued after 1990 will not be used when the river reaches a certain flow.

If a licencee has more than one licence, care must be taken to manage the licences in accordance with the Water Act. The Act considers that licences are being used concurrently. A licencee cannot claim that only the volume of the junior licence is used when water is plentiful. When a flow condition in the river requires a junior licence to be shut down then the more senior licence or licences continue to operate but the senior licences' annual volume can be a constraining factor depending how much volume was used in the concurrent licence operation prior to the shortage.

When stream flow and demand data indicate a trend toward deficits, the status of department-owned storage projects are reviewed to see if there is an alternative to restricting diversions. If no other options are available, the watermaster initiates restrictions on licensed diversions. The most junior licensee whose licence has an instream flow condition or WCO is ordered to stop diverting, or not to start diverting if the project is not in operation. Each licensee is direct in this way until minimum streamflow has been restored and the needs of all higher priority users can be met. If demands by senior licensees increase or flows decrease, additional licensees are ordered to shut down. This procedure can lead to user requests to waive certain conditions, make water-sharing arrangements, investigate other sources and take conservation measures to try to provide some relief. Alberta Environment will hold meetings with water user groups to share information and discuss options because emotions can run high.

8.5 Surface Water Allocations in the Red Deer River Basin

Licences allocating water to various users in the Red Deer River Basin have been issued since 1894. An allocation establishes the maximum volume, rate and timing for a licensee to withdraw, divert or store water. The median natural flow and current allocations at various locations in the Red Deer River Basin are shown in Table 3. It is common to express basin allocations as a percent of median natural flow to put them into perspective with the size of the stream. The breakdown by purpose for the basin as a whole is shown in Figure 5.

Figure 6 – Red Deer River Surface Water Allocations by Purpose

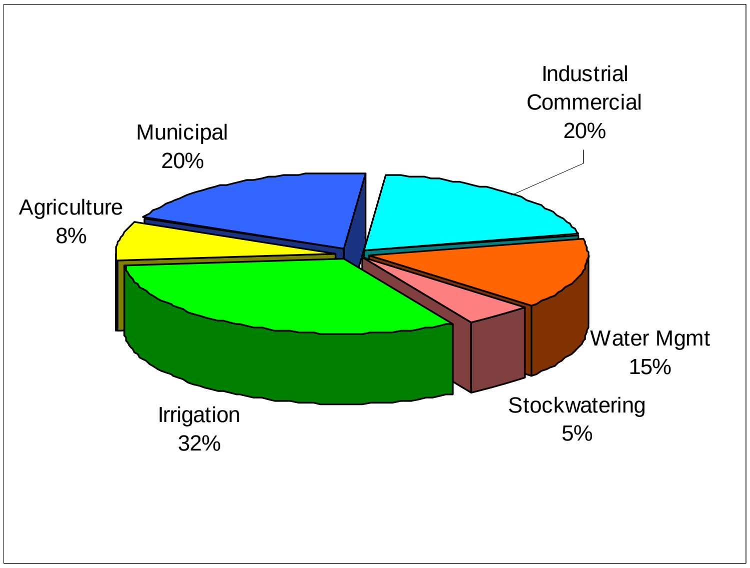


Table 3 – Red Deer River Basin
Municipal Surface Water Allocations

Surface Water Allocations	Allocation (dam^3)	2006 Diversion (dam^3)
Total	327,642	227,117
Municipal	92,277	32,058
Red Deer	27,529	16,124
Mountain View Regional	9,954	4,646
Drumheller	4,107	2,096
Stettler	1,696	1,128
Hanna	802	416

Large withdrawals or diversion licensees in the Bow River Basin that return some water to the Red Deer River include:

- The Western Irrigation District, with diversions from the Bow River at Calgary through the works of Alberta Environment. Excess water return occurs via the Rosebud River.
- The Eastern Irrigation District, with diversions from the Bow River near Bassano.
- Water return occurs via One Tree Creek and Matzhiwin Creek.

Allocations in the Red Deer River Basin are not considered to be high in relation to the median natural flow (23 percent), even recognizing that the 1969 Master Agreement on Apportionment commits Alberta to deliver to Saskatchewan approximately 50 percent of the natural flow of the South Saskatchewan River Basin, including the Red Deer River. However, to fully understand the implications of the allocations in the Red Deer River Basin, it is important to recognize that there are significant differences between "allocations" and the actual depletion of flow in the source streams or aquifers.

- The licensed water allocations are amounts of water that licencees are allowed to divert. They can be considered an upper limit of water use. The entire allocation will not be used every year, depending on many factors, such as weather conditions, water availability, crop rotations and economic circumstances.
- Some types of users have high return flows to the source stream. These return flows are available for reuse downstream, contributing to instream flow requirements and or contributing to meeting apportionment commitments. For instance, typical municipalities with a continuous wastewater release return 80% of the water withdrawn for drinking water purposes. Irrigation Districts also return significant amounts when irrigation demands are low due to rainfall events or other circumstances.
- Some licensees have allocations that will provide for considerable future growth and are currently using only a portion of their full allocation, even in a high demand year. This is particularly true of some (not all) municipalities. Some municipalities have allocations that could accommodate growth projections for the next 50 years or more. There are others that may use their full allocations within the next decade.
- Water storage could be used to supplement natural flows and to meet water demands in water-short years.

8.6 Relationship Between Water Supply and Demand

Because of the foregoing circumstances and the complexities of water management systems, simulation modeling is commonly used to determine the relationships between water supply and water demand.

Simulation modeling was used extensively in Alberta Environment's recent development of the South Saskatchewan River Basin (SSRB) Water Management Plan. A key component of Phase 2 of the plan was to find the appropriate balance between water consumption to support social and economic development, and the water needs to support the health of the aquatic eco-system. Extensive public involvement and numerous scenarios for future development and instream flow objectives were reviewed and evaluated to arrive at the recommendations. The recommended scenario and performance characteristics (predicted deficits) for junior non-irrigation licences and for meeting Instream Objectives in the Red Deer River Basin are indicated in Table 4. Junior non-irrigation licences are those issued after 1992 when Instream Objectives based on fish rule curves were established). These licences may be subject to new Instream Objectives or WCOs if "back-fit" provisions exist as a condition of the licence.)

When a licence is unable to access full allocation, the licence experiences a deficit. A deficit may be caused by lack of water, apportionment needs, a more senior licence needs, or an instream flow need. It also may mean that water can still be accessed but not at the rate or volume specified on the licence.

The magnitude of the deficit is expressed as percent of time access is restricted, number of days or years. For instance, Figure 6 shows that shortages to junior non-irrigation users in the Red Deer River reach between the Medicine and Blindman Rivers would be experienced in 18 years in the 68-year study period of hydrologic and climatic characteristics, 1928 to 1995. In low flow, high demand years such as 1984 and 1985, deficits would exceed 50 percent of demand.

Municipalities usually have more than one licence with different priorities for meeting their current and future water supply needs. Technical Memorandum 2 determined the water supply deficits that would be experienced as population and water needs grow in individual communities and determined when existing allocations would no longer meet their needs.

Table 4 – Projected Years of Deficits for Junior Non-Irrigation Water Users and for Meeting Instream Objectives in Various Reaches Along the Red Deer River (Recommended Scenario).

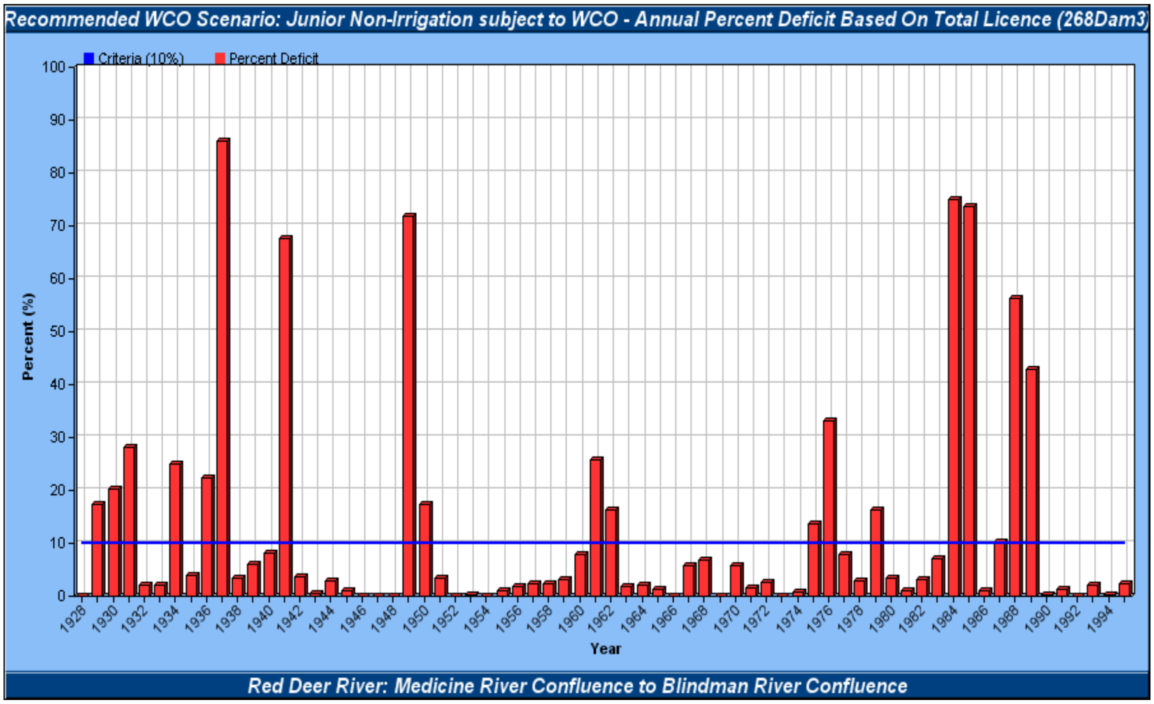
River Reach	Deficits to Junior Water Users[1]		Deficits to Instream Objectives[2]	
	No. of Years	% of Years	No. of Years	% of Years
Dickson Dam to Medicine River	21	31	59	87
Medicine River to Blindman River	19	28	54	79
Blindman River to Nevis	18	26	58	85
Nevis to Drumheller	NA	NA	58	85
Drumheller to Sheerness	17	25	62	91
Sheerness to Dinosaur Park	NA	NA	63	93
Dinosaur Park to Bindloss	NA	NA	60	88
Bindloss to Downstream	NA	NA	68	100

[1] Deficits greater than 10 percent of demand.

[2] Flows less than target flows for two or more weeks.

Figure 7 – Projected Annual Percent Deficits for Junior Non-Irrigation Water Users in the Red Deer River Reach, Medicine River to Blindman River, for the Recommended Scenario.

Based on Alberta Environment scenario results.



8.7 *Water Act* Provisions for Management in Water Short Basins

The 1999 *Water Act* introduced flexibility in how water in Alberta could be managed in times of shortages, and provided new tools to encourage water use efficiency and to acquire licences in fully allocated basins.

8.7.1 Recognition of the Role of Water Management Planning

The *Water Act* formalizes water management planning, and for the first time in Alberta provides the ability to manage water, recognizing specific characteristics of a river basin or aquifer, and local and regional issues. The *Act* authorizes the development of water management plans for both surface water and groundwater, and encourages an integrated approach to planning which considers water, lands, forests, fish, wildlife, petroleum extraction and minerals. Public consultation is a key component in developing plans. Water management plans that are approved by the Lieutenant Governor in Council or the Minister **must be considered** by the *Water Act* Director in issuing an approval, allocating water, approving an allocation transfer or closing a basin to new allocations. Other water management plans are authorized (endorsed) by a Director and **may be considered** by a

Director when making a decision. There is no real difference because a Director would be wise to consider any water management plan (that is why it was endorsed), otherwise a justified appeal of a decision is possible.

8.7.2 Crown Reservations

The Minister may reserve unallocated water where necessary to defer decision-making until a basin plan has been completed or to save water for any particular purpose, including instream protection. The Minister may prescribe a priority for water allocated from the reserved quantity. The priority must not be based on a date earlier than the date of the reservation.

8.7.3 Closure of a Basin to New Allocations

The Water Act provides the Director with authority to temporarily close a basin to additional application if further allocations are deemed to be inappropriate. This would be the case if the aquatic environment is severely affected or if the licences being applied for are at sufficient risk that they would not be useful to the applicant. A permanent closure may be recommended by a water management plan or it may be put in place by the Minister when a Crown Reservation is issued that specifies what purposes may be allocated specified quantities of water. For example, the Waterton, Belly and St. Mary River Basins were temporarily closed in 2002 by the Director until the entire Oldman and Bow River Basins were closed via a Water Management Plan in 2006 and formalized with a Crown Reservation in 2007.

8.7.4 Water Allocation Transfers

In areas of Alberta where a water body is at or near full allocation, the provision for transfer of all or parts of allocations from a willing seller to a willing buyer will allow new or alternative uses of water. Transfers may be temporary or permanent. They may be considered only where an approved water management plan or an Order in Council provides such transfers. Transfers have been authorized in the SSRB water management plan. It is expected that, over time, the transfer provision will shift licences to higher value uses as determined in the market place. It will also improve water use efficiency and prompt innovations since saved water will have a market value through the transfer provisions.

Applications for transfers are subject to review and approval by the Director. The Director's review may include:

- Confirmation that the transferred licence is in good standing
- The effects on the aquatic environment, the hydrology of the source and other users of the source stream or aquifer
- Effects on public safety

- Any other matters that the Director may consider relevant or that are specified in an approved water management plan.

The Director may withhold up to ten percent of the quantity of water being transferred if he/she is of the opinion that the water should be withheld in the public interest to protect the aquatic environment and if withholding water from transfers has been authorized in a water management plan or an Order in Council. Holdbacks have been authorized in the SSRB water management plan.

Public input will be sought on all applications for transfers. The Director may reject, approve with conditions or approve an application for a transfer, with or without a holdback. An approved transfer retains the priority of the seller's licence. Decisions made by the Director related to transfer applications are appealable to the Environmental Appeals Board.

8.7.5 Allocation Assignments

Although licensees with senior priorities have the first right to water, the *Water Act* has an assignment provision for sharing available supplies between senior and junior users who have access to the same water. The *Act* requires that a formal written agreement be developed between the two licensees. The agreement may be cancelled by the Director if there are adverse effects on the source stream or aquifer, the aquatic environment or other water users with a higher priority than the party with the lowest priority in the agreement. The caveat to this provision is that each party must have a licence and the receiving licence allocation cannot be exceeded. It may only be "topped up" to its maximum allocation.

Agreements to assign water were used in response to severe water shortages in the southern tributaries of the Oldman River (Waterton, Belly and St. Mary Rivers) in 2001. Based on water supply forecasts and the volumes of water in reservoirs, it was determined that, under the priority provision of the *Water Act*, there would be only enough water to meet the needs of users with licences having priorities of 1950 or earlier. This meant that about 336 licensees with priorities junior to 1950 would be faced with the prospect of having their diversions suspended. Seven irrigation districts with senior priorities jointly offered to use the assignment provisions of the *Water Act* to share available supplies with junior users provided there was a willingness to ration. Most of the water users in the southern tributaries decided to participate in the water sharing agreement, which affected about 540 licences. The agreement called for irrigators to apply not more than ten inches to their irrigated lands, and non-irrigators to restrict usage to about 60 percent of their requirements.

The 2001 drought was a learning experience for both water users and administrators of the *Water Act*. The cooperative arrangement was considered to be successful and is looked on with a source of pride in the ability of water users to come together and share, under difficult circumstances, for the good of all. It has given water users confidence in being able to withstand future periodic water shortages in a manner that would minimize impacts on the region as a whole. Administrators who were suddenly pressed into using a new provision of the *Act* will now be better equipped to deal with similar circumstances in the future.

8.7.6 Emergency Provisions

The *Water Act* has provisions for the government to declare an emergency, suspend diversions for all or any part of selected licences and designate the purposes for which available water can be used. Affected licensees may be eligible for compensation for losses incurred. These provisions of water management legislation have very rarely, if ever, been used in Alberta. Common practice in water shortage situations has been to suspend diversions in order of junior to senior priority until the water supply and use is in balance.

Although licensees with senior priorities have the first right to water, the *Water Act* has an assignment provision for sharing available supplies between senior and junior users who have access to the same water (as noted above). In this case, compensation is negotiated between a willing buyer and a willing seller, thus avoiding the difficult issue of government compensation under the emergency provisions.

9 SSRB Water Management Plan Requirements

The SSRB plan clearly states how the basin should be managed to maximize the amount of water to be flowing in rivers on an instantaneous basis and on how to manage allocations. It also provides rationale for each recommendation. Public consultations in the Red Deer River Basin indicated a desire for economic growth equivalent to other sub-basins (Bow and Oldman). However, it was clear that the low natural flow combined with the limited storage in Glennifer Reservoir results in a flow regime that is not able to provide as much flow for downstream needs as the Oldman dam. An assessment of environmental impact showed that if existing licences were used to their fullest, the aquatic environment would be stressed. However, with only 18% of the river allocated in 2001 (23 % allocated in 2007), there was a realization that additional stress would have to be put on the river. An instream flow condition of 45% of natural flow was arrived at that did not harm the river much more than the scientific IFN of 85% of natural flow determined for the SSRB.

NOTE: The following is extracted from the SSRB Water Management Plan, August 2006.

Recommendation:

A limit is not provided for allocations from the Red Deer River Sub-basin at this time, however, there is sufficient information to cause concern about the potential risk to both licences and the aquatic environment as increased volumes of water are withdrawn. It is recommended that an allocation volume of approximate 60,000 dam^3 (cubic decametres) be considered the initial total allocation target. When allocations reach 550,000 dam^3, a temporary closure to applications to permit a review of the aquatic environment and allocations should be undertaken. Once the review is complete, a Crown Reservation should be created for the Red Deer River Sub-basin to reserve water for the aquatic environment and other identified purposes. The identified purposes will determine the allocation limit. The review should consider:

- Present and projected state of the aquatic environment
- Present and projected reliability of licences (factoring in existing and potential water storage)
- Where there is a condition in the licences, the degree to which return flow from water users is benefiting the aquatic environment and licence reliability
- Future water demands
- The purposes allowed for future allocations in the Crown Reservation.

Rationale:

The Red Deer River has fewer allocations than other rivers in the SSRB and, hydrologically, has the healthiest aquatic environment. The recommended total allocation target of 600,000 dam^3 is predicted to support future growth for the next 40 years. The setting of a total allocation in the future will:

- Prevent the issuance of licences where there is an unacceptably high risk of full allocations not being available in drier years
- Limit or reduce possible future risks to existing licences
- Avoid the degree of environmental degradation that has occurred in other rivers in the SSRB.

Recommended Water Conservation Objectives (WCOs)

The WCOs recommended in this plan provide direction on opportunities to increase flows in the highly allocated rivers in the Bow, Oldman and South Saskatchewan River Sub-basins and permit allocations in the Red Deer River Sub-basin. They are subject to future review and refinement in light of improved knowledge and information about the aquatic environment and water quality.

It was determined that an implementation date for new WCOs needed to be incorporated into the plan as effects on the aquatic environment became clear and as the plan became common knowledge. There was a need to protect the aquatic environment and to prevent speculation on water allocations. This date was determined to be May 1, 2005, based on imminent plans at the time for the draft SSRB plan going out to public consultation.

Upstream WCOs

This plan was developed on the basis of recommending WCOs for the mainstem rivers, downstream of major dams or diversions. However, it became apparent during the planning process that mainstem WCOs should also apply to headwater reaches and tributaries. It is recommended that when a WCO is to be established for headwater reaches and tributaries to the mainstem that it not be less than existing instream objectives or the WCO downstream on the mainstem, whichever is greater. Given the recommendations in this plan, it is unlikely that further water management planning is needed to establish WCOs in any parts of the Bow, Oldman and South Saskatchewan sub-basins.

Red Deer River Sub-Basin WCOs

From the Dickson Dam to the confluence with the Blindman River, it is recommended that the WCO for any applications received or licences issued after May 1, 2005 and for existing licences with a retrofit provision be:

- A rate of flow that is 45% of the natural rate of flow, or 16 m^3/s (cubic metres per second as referenced in Table 1 of Section 2), whichever is greater at any point in time.

From the confluence with the Blindman River to the Saskatchewan border, it is recommended that the WCO:

- For future licences for withdrawals from November to March, inclusive, be:
  - A rate of flow that is 45% of the natural rate of flow, or 16 m^3/s, whichever is greater at any point in time
  - This is WCO apply to any applications received or licences issued after May 1, 2005.
- For future licences for withdrawals from April to October, inclusive, be:
  - A rate of flow that is 45% of the natural rate of flow, or 10 m^3/s, whichever is greater at any point in time
  - That this WCO apply to any applications received or licences issued after May 1, 2005.
- For existing licences with a retrofit provision, be:
  - A rate of flow that is 45% of the natural rate of flow, or 10 m^3/s, whichever is greater at any point in time.

It is recommended that renewed licences retain their previous conditions for instream objectives.

Rationale:

This WCO will permit water diversion for economic development in the Red Deer River Sub-basin, while limiting negative impacts on the aquatic environment.

Operating practices for the Dickson Dam continue to be improved and enhanced. The highest priority in the operation of the Dickson Dam is to provide a year-round minimum release of 16 m^3/s. This is the flow presently required for meeting water quality standards for dissolved oxygen during the winter and is necessitated by historic, natural, winter water quality problems and current nutrient loadings from point and non-point sources. This WCO will require future water allocation licences, particularly those requiring year-round diversion, to include water storage, as water is not likely to be available for diversion during the winter months.

A great deal of deliberation went into arriving at the above recommendations which were accepted by Cabinet.

10 Implications

This technical memorandum has summarized the unique characteristics of the Red Deer River Basin both from surface and groundwater management perspectives. How the basin is regulated under the Water Act was also described with an emphasis on issues related to water short years. Lastly, Sections of the SSRB Water Management Plan relating to the Red Deer River Basin were quoted because it provides direction for surface water allocations into the future.

Some of the implications of the above observations are:

- Groundwater resources may become a more sought after source if sufficient investigation of availability is conducted
- Revisiting WCO limits based on improved wastewater treatment at Red Deer may have merit
- Municipal allocations should be granted for period of time greater than 10 years due to municipal infrastructure needs
- Further allocations outside the basin should be curtailed
- The creation of a Crown Reservation for municipal purposes could be advantageous in securing water prior to the 550,000 dam^3 milestone
- More public access to information about licence applications should be created
- Further research on water availability from alluvial aquifers should be conducted.

These implications will be reviewed in terms of recommendations.

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2 Population Projections

Technical Memorandum

Red Deer River Municipal Users Group

Population Projections

January 2008

Table of Contents

TECHNICAL MEMORANDUM

1 Issues

- What are the current Red Deer River Basin, sub-basin and municipality populations?
- What are the population projections for Years 2031 and 2056?

2 Introduction

The **Red Deer River Municipal Users Group (RDRMUG)** is an association of rural and urban municipalities within the Red Deer River Basin, and other communities near the basin, who receive water from the Red Deer River (Figure 1). The group provides a platform for members to work together towards common goals. The **RDRMUG** has retained the services of Associated Engineering and Hart Water Management Consulting to study the potential future municipal water needs within the Red Deer River Basin and make recommendations on policies and procedures to secure those needs for municipalities.

Population and per capita water uses are key factors in determining municipal and rural domestic water needs. This Memorandum deals solely with current populations and projections to Years 2031 and 2056. Subsequent Memoranda will relate to municipal and other water use projections.

Existing (2006) and historical populations (1996 and 2001) were taken from municipal profiles on Alberta Municipal Affairs website or from StatsCanada census data. Three factors that are generally considered in population projections are fertility, mortality and migrations to the subject area over the forecast period. In general, the fertility rate in Alberta has been gradually decreasing over the past 50 years, although in recent years this general trend has been reversed. Life expectancies have been increasing. However, in Alberta, both of these factors have been overshadowed by inter-provincial and international migrations in response to economic activity. Migration patterns in Alberta are volatile and difficult to predict. For this reason, population estimates beyond about 20 years are considered to be unreliable.

This study draws on methodology and assumptions used in two previous studies:

- Hydroconsult. 2002. South Saskatchewan River Basin Non-irrigation Water Use Forecasts. Alberta Environment. Calgary, AB.

- AMEC. 2007. Current and Future Water Use in Alberta. Water for Life, Alberta Environment. Edmonton, AB.

Population projections to 2031 and 2056 are required for the Red Deer River Basin as a whole, for six sub-basins within the basin, and for the urban and rural municipalities within each sub-basin. A three-step process was conducted for these projections:

LEGEND:

Municipal Boundary

Associated Engineering

RED DEER RIVER MUNICIPAL USERS GROUP

RED DEER RIVER BASIN MUNICIPALITIES
FIGURE 1

PROJECT NUMBER	REV. NO.	SHEET
2007–3432		

Step 1. Project basin populations based on recent regional projections undertaken by the province.
Step 2. Project populations for individual municipalities and sub-basins based on historical census data and projections made by (or for) the municipalities themselves for infrastructure planning purposes.
Step 3. Reconcile the two independent estimates by adjusting the municipal estimate (up or down) on a proportional basis to equal the basin estimate.

The methodology for each of these steps is discussed in turn below.

2.1 Step 1: Basin Population Projections

The Red Deer River Basin comprises an area of about 49,000 km^2 of central Alberta, extending from the Rocky Mountains in the west to the Alberta-Saskatchewan Boundary in the east. Table 1 shows a municipality and sub-basin breakdown of the 1996, 2001 and 2006 StatsCanada populations in the basin. The 2006 population of the basin has been estimated to be 256,106 (side bar). The historical annual growth rates for the basin as a whole are estimated to be 2.204 percent between 2001 and 2006, and, 2.105 percent between 1996 and 2006.

> In this memorandum, population estimates and growth rates are given with a large number of significant figures. This in no way should be interpreted as the accuracy of the numbers. The figures are carried forward solely to avoid round-off errors in subsequent computations.

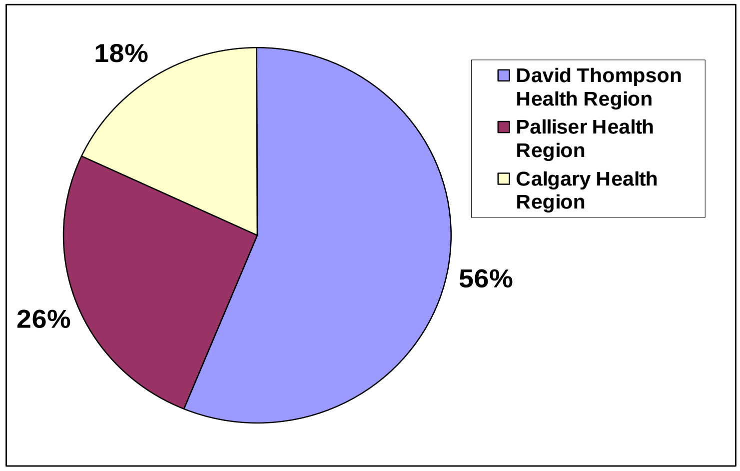
Two credible regional population projections were considered as the basis for projecting the basin population:

- Alberta Finance (2004) projections for the 19 Canada Census Divisions. Projections were made to 2026.
- Alberta Health and Wellness (2007) updated projections for its nine Health Regions. Projections were made to 2035.

For the purposes of this study, it was decided to use Alberta Health Region data as the basis for the population projections. The Health Region study is the most recent, it projects furthest into the future (2035), and its boundaries reasonably correspond with those of the basin. Almost 60 percent of the basin is within the David Thompson Health Region. Alberta Health and Wellness projects populations within its nine health regions to assist with planning for delivery of services. The Department continually monitors its projections and updates them when considered necessary. A review of previous projections by the Department (1996, 1998, 2000 and 2004) revealed that forecasts for 2004 and 2005 exceeded census data due to over estimation of in-migration and fertility rates. The most significant change in the 2007 Alberta Health and Wellness study from previous studies has been with respect to external migration. The new projections assume strong migration into Alberta for the short term with a gradual leveling off in the long term.

Portions of the Red Deer River Basin are within three health regions: David Thompson, Palliser and Calgary Health Regions (Figure 2). Average growth rates between 2005 and 2035 for these three regions were projected to be 1.144 percent, 1.314 percent and 1.687 percent, respectively. Population estimates for 2006 using the percentages of the Red Deer Basin in each region resulted in a 2006 population much higher than the census population, largely because of the high population in the Calgary Health Region. The population density characteristics of the Calgary Health Region are somewhat unlike those of the Red Deer River Basin, primarily because of the influence of the City of Calgary. However, the growth rate in the Calgary Health Region may be similar to growth rates in some parts of the Red Deer River Basin. It was decided to use the health region growth rates on a proportional basis to project the population, at one to five year intervals, from 2006 to 2031.

Figure 2 - Proportion of the David Thompson, Palliser and Calgary Health Regions Within the Red Deer River Basin.



The average annual growth rates for the Red Deer River Basin for periods ranging from one year to five years are shown on Figure 3. The growth rates are expected to be relatively high in the short term, but diminishing in the long term. Projecting growth beyond 2031 is highly speculative. It was decided to base these projections assuming a constant growth rate equal to the projected growth rate for the 2030 to 2035 period (0.778 percent).

Based on StatsCanada 2006 census data and Alberta Health Region projected growth rates, population projections for the Red Deer River Basin as a whole are as follows:

2006	256,106
2031	349,086
2056	423,756

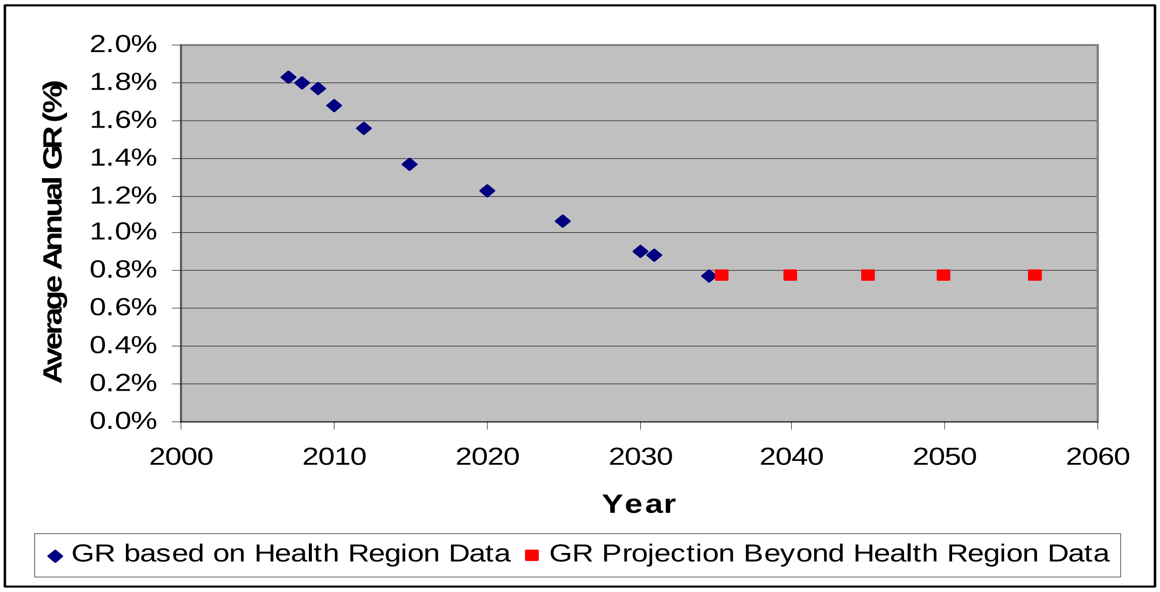
The population projections for the Red Deer River Basin compare with previous projections by Hydroconsult (2002) and AMEC (2007) as follows:

	Hydroconsult (2002)		Current Projections	
	2021	**2046**	**2021**	**2046**
Low Growth Rate Case	267,427	319,777		
Medium Growth Rate Case	286,673	375,696	317,052	391,747
High Growth Rate Case	305,919	431,615		

	AMEC (2007) 2025	Current Projections 2025
Low Growth Rate Case	285,000	
Medium Growth Rate Case	325,000	330,770
High Growth Rate Case	380,000	

The current projections exceed Hydroconsult's high growth rate projection for 2021, but are between the medium and high growth rate projection for 2046. These current projections reflect the recent high growth rate experienced in the two census periods (ten years) since the Hydroconsult study was done, and the expected decline in growth rate for the future. The current projection slightly exceeds AMEC's medium growth projection (about 2 percent higher). AMEC's projections were completed prior to information on the 2006 census was available.

Figure 3 - Average Annual Population Growth Rate Projections for the Red Deer River Basin Based on Projections for Alberta Health Regions



2.2 Step 2: Individual Municipality Population Projections

Census data indicate that urban and rural municipalities within the Red Deer River Basin are growing at different rates; some are not growing at all. Most urban municipalities and some rural municipalities have a water allocation to meet current water needs and needs for various future time horizons. Population projections for individual municipalities provide an indication of growth areas within the basin and future water needs.

> The population projections presented in this Technical Memorandum should not be interpreted as identifying which municipalities will grow or should grow. They are intended to identify growth areas within the basin, which will assist in determining rational measures to improve water supply security well into the future.

Populations from the 1996, 2001 and 2006 StatsCanada census data are listed for each municipality (Appendix table). Average annual growth rates were determined for periods 1996 to 2006, and 2001 to 2006. Growth rates from economic and utility planning studies or published Municipal Development Plans commissioned by individual municipalities were considered. Based upon this information, an average annual growth rate for each municipality was selected to project municipal populations to 2031. Municipalities with negative growth rates based on recent census data were arbitrarily given a growth rate equal to zero.

The selected growth rates and population projections for each municipality are shown in the Appendix table. The total 2031 population for the Red Deer River Basin as a whole based on the foregoing methodology is projected to be 420,053.

2.3 Step 3: Reconciliation of the Two Independent Estimates

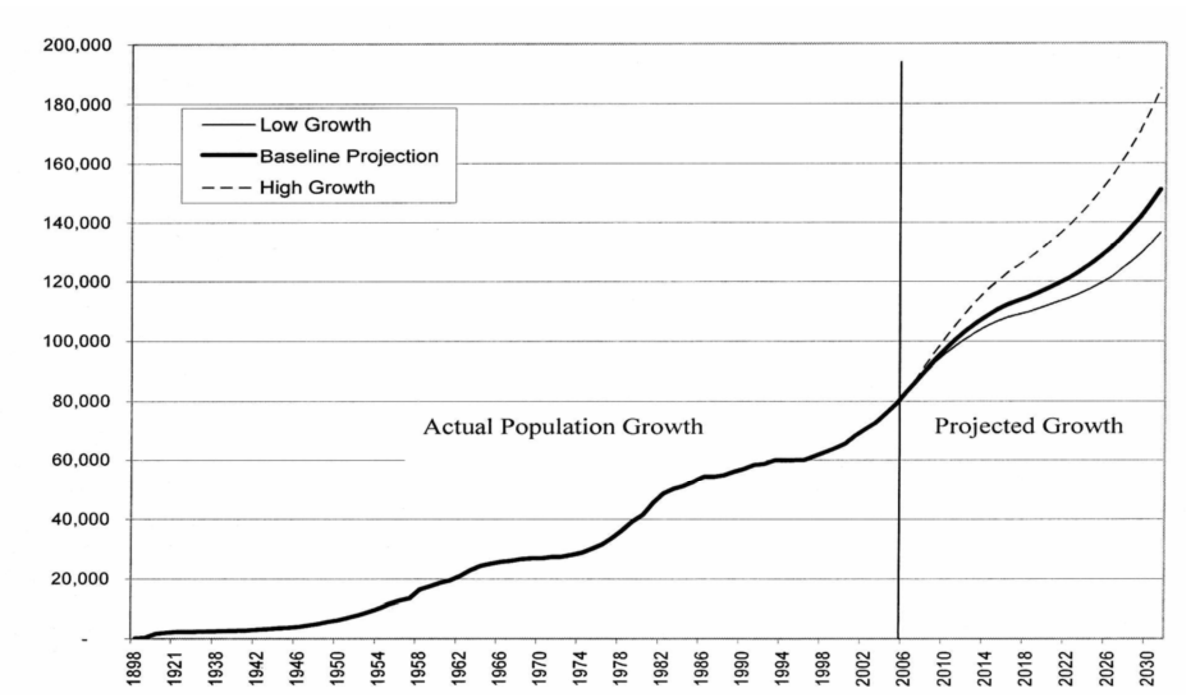
The estimate of basin population based on municipal projections (420,053) is about 20 percent higher than the basin projection based on the health region study (349,086). The intention was to adjust the individual municipality projections on a proportional basis to reconcile the two independent projections. However, the difference between the two estimates is too large to make the adjustment without creating negative growth rates for an unrealistically large number of municipalities.

Populations in parts of the Red Deer River Basin, particularly municipalities along the Highway No. 2 corridor, have experienced a high rate of growth over the past ten years. Municipalities looking ahead to plan infrastructure and land requirements to accommodate future growth have made population growth rate projections that are considerably higher than that of the regional studies conducted by the province. For instance, a projection of population for the City of Red Deer conducted by Schollie Research and Consulting (2006) for Parkland Community Planning Services projected an average annual growth rate of 2.43 percent for the period 2006 to 2031. This growth rate is considerably higher than that projected in regional studies and studies conducted for other large municipalities in southern Alberta, with exception of the City of Airdrie (Table 1). The rationale for the high growth rate is primarily based on the very positive economic growth outlook for Alberta forecasted by the Conference Board of Canada, an Ottawa-based research and policy organization, extension of this strong economic outlook to the future of the City of Red Deer recognizing past performance, and considering the historical cyclical nature of population growth experienced by the City of Red Deer (Figure 4). Other population projections have considered and accounted for the robust economy of Alberta. However, high growth rates are projected to sustain for the short term and then gradually decline over the long term. The cyclical nature of population growth does not appear to have been considered by other researchers, or even by Parkland Community Planning Services in earlier studies (Nichols Applied Management 2000; Parkland Community Planning Services Update 2005).

Table 1 - Published Growth Rate Projections for Municipalities and Regions in Southern Alberta

Municipality or Region	Projection Period	Average Annual Growth Rate	Reference
City of Red Deer	2006-2031	2.43%	Schollie Research and Consulting 2006
City of Red Deer	2003-2031	1.79%	Parkland Community Planning Services 2005
City of Calgary	2005-2030	1.596%	Calgary Region Economic Forecast
City of Edmonton	2003-2030	0.807%	Applied Management Consulting 2005
City of Airdrie	2005-2030	3.43%	Calgary Region Economic Forecast
City of Medicine Hat	2001-2031	1.116%	Urban Futures Inc.
City of Lethbridge	2001-2031	0.973	Urban Futures Inc.
David Thompson Health Region	2005-2035	1.062%	Alberta Health and Wellness 2007
Calgary Health Region	2005-2035	1.583%	Alberta Health and Wellness 2007
Palliser Health Region	2005-2035	1.237%	Alberta Health and Wellness 2007

Figure 4 - City of Red Deer Population History and Projections (Taken from Schollie Research and Consulting 2006)



Recognizing that municipal population projections are intended for land and infrastructure planning, and in the case of this study, securing future water supplies, high side projections may be logical and justified considering the consequences of underestimating populations and inadequate preparations for growth. It was decided to accept the municipal growth rate projections to 2031 for the purposes of this study.

Most professional demographers are reluctant to project beyond about 20 years because of uncertainties related to a large number of variables. For this reason, a very simple approach has been taken for projecting population from 2031 to 2056. The average annual growth rate determined from projection of the health region data for the period 2030 to 3035 was used for the entire 2031 to 2056 period for all municipalities. This growth rate is 0.778 percent. The projected basin population for 2056 is 509,856.

3 Sub-Basin Populations

A breakdown of water requirements for the six sub-basins (Figure 1) is required to determine how water supply security varies for various river reaches. Computer simulation modeling will be used for this purpose. Sub-basin populations for 1996, 2031 and 2056 were determined as the sum of the populations of the municipalities (and portions thereof) within the six sub-basins (Table 3). The percentage of the total population within each sub-basin is the same for the 2031 and 2056 projections.

Table 2 - Sub-Basin Population Projections in the Red Deer River Basin

Sub-basin		Current (1996)		Projected Population		
		Population	% of Total	2031	2056	% of Total
RD1	Upstream of Dickson Dam	8,754	3.42%	12,973	15,747	3.09%
RD2	Dickson Dam to Red Deer	132,387	51.69%	220,118	267,177	52.40%
RD3	Red Deer to Joffre intakes	15,230	5.95%	37,960	46,076	9.04%
RD4	Red Deer to SAWSP intake	12,398	4.84%	15,164	18,406	3.61%
RD5	SAWSP intake to Deadfish intake	63,541	24.81%	97,855	118,775	23.29%
RD6	Deadfish intake to RD mouth	23,796	9.29%	35,982	43,675	8.57%
Basin Total		**256,106**		**420,053**	**509,856**	

SAWSP = Proposed Special Areas Water Supply Project

As expected, the sub-basin that contains the City of Red Deer and a large portion of the Highway No. 2 corridor has the highest population (sub-basin RD2). This sub-basin currently contains about

52 percent of the total population of the basin. Sub-basins RD2 and RD3 are expected to grow at a faster rate than the other sub-basins in the future. By 2031, these two sub-basins will account for about 61.5 percent of the population of the basin.

4 Summary of Findings

- The Alberta Health and Wellness (2007) updated projections for its nine Health Regions provides the best available basis for population projections for the Red Deer River Basin.
- The current (2006) population of the basin is estimated to be 256,106 based on Alberta Municipal Affairs and StatsCanada 2006 census data.
- Basin population projections based on projections for individual municipalities to 2031 and 2056 are 420,053 and 509,856 respectively. The longer the projection period, the greater the potential for error in the population estimates. These estimates are considerably higher than population estimates for the basin based on provincial regional projections.
- Basin population is concentrated within the City of Red Deer and along the Highway No. 2 corridor. This is not likely to change in the foreseeable future.

J. R. Hart, P.Eng.
HART Water
Management Consulting

January 2008

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APPENDIX A - HISTORICAL AND PROJECTED POPULATION FOR MUNICIPALITIES AND SUB-BASINS

Appendix. Historical and projected population for municipalities and sub-basins (Page 1 of 4).

Municipality	Type	% in Sub-basin	Population (within sub-basin)			Annual Growth Rate		Selected GR	Population Projections	
			1996	2001	2006	01-'06	96-'06	06 - '31	2031	2056
Population -- Sub-basin RD1										Selected GR 2031-'56 = 0.778%
Bighorn No. 8	MD	31%	387	402	392	-0.529%	0.124%	0.124%	404	491
Burnstick Lake	SV	100%	4	10	43	33.873%	26.806%	2.000%	71	86
Caroline	V	100%	472	556	515	-1.520%	0.876%	0.876%	640	777
Clearwater No. 99	MD	13%	1452	1496	1537	0.552%	0.573%	0.573%	1773	2153
Mountain View No. 17	RC	21%	2361	2546	2602	0.437%	0.975%	2.000%	4269	5182
			County Projected GR = 2.00%							
Red Deer No. 23	RC	6%	1018	1110	1146	0.658%	1.195%	1.195%	1543	1873
Sundre	T	100%	2038	2277	2518	2.033%	2.137%	2.137%	4273	5186
Totals RD1			**7733**	**8397**	**8754**	**0.837%**	1.248%		**12973**	**15747**
Population -- Sub-basin RD2										
Bowden	T	100%	1014	1174	1205	0.523%	1.741%	2.970%	2505	3040
			Bowden MDP (2004) GR = 2.97%							
Cremona	V	100%	380	415	463	2.213%	1.995%	1.995%	759	921
			Cremona MDP GR = 1.03							
Olds	T	100%	5815	6607	7248	1.869%	2.227%	2.970%	15066	18286
			Olds MDP (2007) GR = 2.97%							
Red Deer No. 23	RC	47%	7975	8691	8981	0.658%	1.195%	1.195%	12086	14670
Bighorn No. 8	MD	16%	201	208	202	-0.529%	0.062%	0.062%	205	249
			CRP (2007) GR = 8.884%							
Birchcliff	SV	100%	102	105	125	3.549%	2.054%	2.054%	208	252
Clearwater No. 99	MD	7%	786	805	828	0.552%	0.520%	0.520%	942	1144
Eckville	T	100%	901	1019	951	-1.372%	0.542%	0.542%	1088	1321
Half Moon Bay	SV	100%	53	37	32	-2.862%	-4.920%	0.000%	32	39
Innisfail	T	100%	6116	6943	7438	1.387%	1.976%	2.000%	12203	14812
			Innisfail MDP (2007) GR = 2.00							
Jarvis Bay	SV	100%	83	124	183	8.095%	8.227%	2.000%	300	364
Lacombe No. 14	RC	16%	1628	1692	1672	-0.230%	0.269%	0.269%	1788	2171
Mountain View No. 17	RC	36%	4048	4365	4461	0.437%	0.975%	2.000%	7318	8883
			County Projected GR = 2.00%							
Norglenwold	SV	100%	281	267	270	0.224%	-0.399%	0.000%	270	328
Penhold	T	100%	1625	1729	1961	2.550%	1.897%	1.897%	3137	3808
Ponoka No. 3	RC	8%	660	703	691	-0.346%	0.464%	0.464%	776	942
Red Deer	C	100%	60075	67829	82971	4.112%	3.282%	2.429%	151182	183503
			RD Growth Study (Schollie. 2006) GR = 2.429%							
Rocky View No. 44	MD	7%	1579	2095	2392	2.689%	4.238%	3.742%	5993	7274
			CRP (2007) GR = 3.742%							
Sylvan Lake	T	100%	5194	7503	10208	6.351%	6.990%	5.000%	34568	41958
			Municipal Planning GR = 5.00%							
Wetaskiwin No. 10	RC	1%	105	107	105	-0.301%	0.065%	0.065%	107	130
Totals RD2			**98621**	**112417**	**132387**	**3.324%**	**2.988%**		**220118**	**267177**

Abbreviations: GR = Annual Growth Rate; HR = Health Region; T = Town; SV = Summer Village; RC = (Rural) County; CRP = Calgary Regional Partnership; SA = Special Area; C = City; VL = Village; MD = Municipal District

Appendix. Historical and projected population for municipalities and sub-basins (Page 2 of 4).

Municipality	Type	% in Sub-basin	Population (within sub-basin)			Annual Growth Rate		Selected GR	Population Projections	
			1996	2001	2006	01-'06	96-'06	06 - '31	2031	2056
Population -- Sub-basin RD3										Selected GR 2031-'56 = 0.778%
Bentley	VL	100%	998	1040	1094	1.018%	0.923%	0.923%	1376	1671
Blackfalds	T	100%	2075	3116	4741	8.756%	8.614%	6.990%	25671	31160
			Parkland Community Planning GR = 6.99%							
Gull Lake	SV	100%	149	143	204	7.364%	3.192%	3.192%	447	543
Lacombe No. 14	RC	27%	2747	2854	2822	-0.230%	0.269%	0.269%	3018	3663
Parkland Beach	SV	100%	97	97	135	6.835%	3.361%	2.00%	221	269
Ponoka No. 3	RC	32%	2640	2813	2765	-0.346%	0.000%	0.464%	3104	3768
Red Deer No. 23	RC	4%	679	740	764	0.658%	1.195%	1.195%	1029	1248
Rimbey	T	100%	2142	2154	2252	0.894%	0.502%	0.502%	2552	3098
Sunbreaker Cove	SV	100%	86	86	137	9.760%	4.766%	2.00%	225	273
Wetaskiwin No. 10	RC	3%	356	321	316	-0.301%	-1.183%	0%	316	384
Totals RD3			**11968**	**13364**	**15230**	**2.648%**	**2.439%**		**37960**	**46076**
Population -- Sub-basin RD4										
Alix	VL	100%	765	825	851	0.623%	1.071%	1.071%	1111	1348
Bashaw	T	100%	774	825	825	0.000%	0.640%	0.640%	968	1175
Camrose No. 22	RC	7%	532	509	501	-0.326%	-0.591%	0.00%	501	608
Clive	VL	100%	517	591	591	0.000%	1.347%	1.347%	826	1002
Delburne	VL	100%	641	719	765	1.248%	1.784%	1.784%	1190	1445
Lacombe No. 14	RC	45%	4578	4757	4703	-0.230%	0.269%	0.269%	5030	6105
Ponoka No. 3	RC	7%	577	615	605	-0.346%	0.464%	0.464%	679	824
Red Deer No. 23	RC	13%	2206	2404	2484	0.658%	1.195%	1.195%	3343	4058
Rochon Sands	SV	100%	86	58	66	2.618%	-2.612%	0.00%	223	271
Stettler No. 6	RC	17%	896	911	887	-0.532%	-0.103%	0.00%	887	1076
White Sands	SV	100%	49	73	120	10.452%	9.370%	2.000%	406	493
Totals RD4			**11621**	**12288**	**12398**	**0.178%**	**1.302%**		**15164**	**18406**

Abbreviations: GR = Annual Growth Rate; HR = Health Region; T = Town; SV = Summer Village; RC = (Rural) County; CRP = Calgary Regional Partnership; SA = Special Area; C = City; VL = Village; MD = Municipal District

Appendix. Historical and projected population for municipalities and sub-basins (Page 3 of 4).

Municipality	Type	% in Sub-basin	Population (within sub-basin)			Annual Growth Rate		Selected GR	Population Projections	
			1996	2001	2006	01-'06	96-'06	06 - '31	2031	2056
Population -- Sub-basin RD5										Selected GR 2031-'56 = 0.778%
Acme	VL	100%	600	648	656	0.246%	0.896%	0.896%	820	995
Beiseker	VL	100%	708	838	828	-0.240%	1.578%	1.578%	1225	1487
Big Valley	VL	100%	308	340	351	0.639%	1.315%	1.315%	487	591
Carbon	VL	100%	450	530	570	1.466%	2.392%	2.392%	1029	1249
Carstairs	T	100%	1909	2254	2656	3.337%	3.358%	3.358%	6064	7361
Delia	VL	100%	208	215	207	-0.756%	-0.048%	0.00%	207	251
Didsbury	T	100%	3553	3932	4275	1.687%	1.867%	1.867%	6789	8240
Drumheller	C	100%	7883	7785	7932	0.375%	0.062%	0.062%	8056	9778
Elnora	VL	100%	247	290	281	-0.629%	1.298%	1.298%	388	471
Hanna	T	100%	3001	2986	2986	0.000%	-0.050%	0.00%	2986	3624
Irricana	T	100%	828	1043	1243	3.571%	4.146%	3.742%	3114	3780
			CRP (2007) RV MD GR = 3.742%							
Kneehill No. 48	MD	100%	5064	5319	5218	-0.383%	0.300%	0.300%	5624	6826
Linden	VL	100%	565	636	660	0.744%	1.566%	1.566%	973	1181
Morrin	VL	100%	275	252	253	0.079%	-0.830%	0.00%	253	307
Mountain View No. 17	RC	43%	4835	5213	5328	0.437%	0.975%	0.975%	6791	8243
Munson	VL	100%	201	222	222	0.000%	0.999%	0.999%	285	345
Newell No. 4	RM	1%	83	71	69	-0.783%	-1.885%	0.00%	69	83
Paintearth No. 18	RM	18%	417	395	383	-0.610%	-0.852%	0.00%	383	464
Red Deer No. 23	RM	29%	4921	5363	5541	0.658%	1.195%	1.195%	7457	9051
Rocky View No. 44	MD	30%	6769	8978	10251	2.689%	4.238%	3.742%	25683	31174
			CRP (2007) GR = 3.742%							
Rockyford	VL	100%	346	375	375	0.000%	0.808%	0.808%	459	557
Special Area No. 2	SA	28%	704	653	581	-2.309%	-1.907%	0.00%	581	705
Starland No. 47	MD	100%	2075	2210	2371	1.416%	1.342%	1.342%	3309	4017
Stettler No. 6	RC	47%	2454	2518	2452	-0.532%	-0.010%	0.00%	2452	2976
Three Hills	T	100%	3022	2902	3554	4.137%	1.635%	1.635%	5331	6470
Trochu	T	100%	958	1033	1033	0.000%	0.757%	0.757%	1247	1514
Wheatland No. 16	RC	40%	2686	3156	3266	0.688%	1.973%	2.32%	5795	7034
			CRP (2007) GR = 2.321%							
Totals RD5			**55070**	**60156**	**63541**	**1.101%**	**2.903%**		**97855**	**118775**

Abbreviations: GR = Annual Growth Rate; HR = Health Region; T = Town; SV = Summer Village; RC = (Rural) County; CRP = Calgary Regional Partnership; SA = Special Area; C = City; VL = Village; MD = Municipal District

Appendix. Historical and projected population for municipalities and sub-basins (Page 4 of 4).

Municipality	Type	% in Sub-basin	Population (within sub-basin)			Annual Growth Rate		Selected GR	Population Projections	
			1996	2001	2006	01-'06	96-'06	06 - '31	2031	2056
Population -- Sub-basin RD6										Selected GR 2031-'56 = 0.778%
Acadia No. 34	MD	95%	506	486	518	1.257%	0.223%	0.223%	547	664
Bassano	T	100%	1272	1320	1345	0.376%	0.560%	0.560%	1546	1877
Brooks	C	100%	10093	11604	12498	1.495%	2.160%	2.160%	21325	25884 0
Cereal	VL	100%	211	187	160	-3.071%	-2.729%	0.000%	160	194 0
Cypress No. 1	MD	2%	114	122	135	1.935%	1.704%	1.704%	205	249 0
Duchess	VL	100%	693	836	978	3.187%	3.505%	3.187%	2143	2601 0
Empress	VL	100%	186	171	136	-4.477%	-3.082%	0.000%	136	165 0
Newell No. 4	RC	54%	3442	3854	3705	-0.783%	0.740%	0.740%	4456	5408 0
Oyen	T	100%	1009	1020	1099	1.503%	0.858%	0.858%	1361	1652 0
Rosemary	VL	100%	332	366	388	1.174%	1.571%	1.571%	573	695 0
Special Area No. 2	SA	61%	1544	1422	1265	-2.309%	-1.972%	0.000%	1265	1536 0
Special Area No. 3	SA	53%	844	779	671	-2.931%	-2.268%	0.000%	671	814 0
Wheatland No. 16	RC	11%	772 CRP (2007) GR = 2.321%	868	898	0.688%	1.526%	2.321%	1594	1934
Totals			**21018**	**23035**	**23796**	**0.652%**	**1.249%**		**35982**	**43675**
Basin Totals			**206031**	**229656**	**256106**	2.204%	2.199%		**420053**	**509856**

Abbreviations: GR = Annual Growth Rate; HR = Health Region; T = Town; SV = Summer Village; RC = (Rural) County; CRP = Calgary Regional Partnership; SA = Special Area; C = City; VL = Village; MD = Municipal District

3 Municipal and Rural Domestic Water Use

Technical Memorandum

Red Deer River Municipal Users Group

Municipal and Rural Domestic Water Use

February 2008

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TECHNICAL MEMORANDUM

1 Introduction

The **Red Deer River Municipal Users Group (RDRMUG)** is an association of rural and urban municipalities within the Red Deer River Basin, and other communities near the basin, who receive water from the Red Deer River. The group provides a platform for members to work together towards common goals. The **RDRMUG** has retained the services of Associated Engineering and Hart Water Management Consulting to study the potential future municipal water needs within the Red Deer River Basin and make recommendations on policies and procedures to secure those needs for municipalities.

Population and per capita water uses are key factors in determining municipal and rural domestic water needs. Current populations and projections to 2031 and 2056 were provided in Technical Memorandum – Population Projections. This memorandum deals solely with municipal and rural domestic water use in the basin. Subsequent memoranda will relate to other water use projections.

In this document, use of water for municipal purposes refers to withdrawing water from a surface or groundwater source, treating the water to comply with Health Canada's Guidelines for Drinking Water Quality, distributing it to homes, commercial and institutional establishments, and industrial users. Municipal water use often involves irrigation of parks and golf courses, and uses related to other recreational and aesthetic amenities. Water use records indicate that municipal use is usually highest in the summer months, primarily due to outside watering of lawns, gardens and parks. Not all water withdrawn from the source is consumed. The portion not consumed is usually treated to remove impurities and released to the source stream or other receiving body as wastewater effluent, commonly referred to as return flow. Good quality return flow can be used to supply downstream water demands. Poor quality return flow sometimes contributes to water quality problems in the receiving stream.

Population is a key factor in determining municipal water requirements. However, per capita consumptive use computed from records of withdrawals and return flows for urban centres often vary because of factors such as infrastructure design, unrecorded amounts of water provided for domestic and other uses outside the urban center, unrecorded amounts of treated effluent used for irrigation or wildlife projects, and groundwater seepage into sewerage systems (Hydroconsult, 2001).

In this document, rural domestic use refers to household, lawn and garden uses for individual dwellings that are not served by a distribution system. Groundwater aquifers are the primary sources for rural domestic water users. Wastewater is usually returned to the environment through septic fields constructed in compliance with standards. There are records of wells in the study area, but metered records of rural domestic uses and wastewater discharges are not normally kept.

2 Population

The current (2006) population of urban centers in the study area was obtained from 2006 StatsCan census data or Alberta Municipal Affairs community profiles. The rationale for projections to 2031 and 2056 are described in Technical Memorandum – Population Projections. The water supply sources and the recipient water bodies for return flow are also listed in Appendix A.

3 Municipal Licence Allocations

Municipal licence allocations and applications for water withdrawals from the Red Deer River, as of October 25, 2007, are shown in Table 1. Licence allocations total 61,673 cubic decameters (dam^3) and additional allocations totalling 32,008 dam^3 have been applied for. Licensed and applied for allocations in the basin total 93,681 dam^3. The Special Areas Water Supply Project initially had a municipal water supply component. This component has been replaced by the Shirley McClellan Regional Project.

Priorities vary from January 14, 1905 to July 10, 2007 (application). Significant priority dates are as follows:

- 19770802005 -- Dickson Dam priority. Licences with a lower priority number are considered to be senior licences. The lower priority number denotes that the project was in existence prior to the Dickson Dam, which gives it a higher priority for water diversions.
- 19770802005 to 19970200000 (approx) – Junior licences not subject to the Red Deer River Water Conservation Objectives (WCO). Licences with priority numbers between 19770802005 and 19970200000 are not subject to the WCO.
- 19970200000 -- Junior licences subject to the WCO. Licences with priority numbers higher than 19970200000 are subject to the WCO.

Water Conservation Objectives (WCO) are the amounts and quality of water established by the Director (the Director is designated under the *Water Act* by the AENV Minister) to be necessary for the protection of a natural water body or its aquatic environment, or any part thereof, and for protection of tourism, recreational, transportation or waste assimilation uses of water, or management of fish or wildlife. Red Deer River WCOs were established through the South Saskatchewan River Basin Plan. Licences that are subject to the WCO can divert only if river flows at the diversion point and downstream are in excess of the WCO.

The priority numbers and licensing conditions can have a significant impact on water availability from the source stream to meet the demands.

Table 1. Urban and Regional System Licence Allocations and Applications within the Red Deer River Basin.

Licensee or Applicant[1]	Source	Priority	Allocation (dam^3)
City of Red Deer	Red Deer River	19050114001	571.1
City of Red Deer	Red Deer River	19570604002	13506.8
City of Red Deer	Red Deer River	19800620007	6891.6
City of Red Deer	Red Deer River	20011001003	6559.0
Henry Kroeger Regional Water Services Comm.[2]	Red Deer River	19810819001	1233.0
North Red Deer Water Services Commission	Red Deer River	20011001006	13391.0
Town of Three Hills	Red Deer River	19801223003	1578.9
Town of Stettler	Red Deer River	19821208001	1696.0
Town of Trochu	Red Deer River	20010824001	358.0
Town of Sundre	Red Deer River (GW)	20030806001	76.1
Starland County/Village of Munson	Red Deer River	20040608001	41.8
Mountain View Regional Water Services Comm.	Red Deer River	19750702001	9954.2
MVRWSC (Application)	Red Deer River	20060126000	14865.7
Highway 12/21 Regional Water Services Comm.	Red Deer River	20060317001	395.9
Stettler Regional (Application)	Red Deer River	20040608000	2941.0
Town of Drumheller	Red Deer River	19150722001	249.2
Town of Drumheller	Red Deer River	19580129001	8601.0
Town of Drumheller	Red Deer River	19800721005	2997.4
Kneehill Regional Water Services Commission	Red Deer River	20031128001	2350.0
Village of Morrin	Red Deer River	20040611001	49.2
Kneehill County/Equity Subdivision	Red Deer River	20050816001	146.0
County of Red Deer (MVRWSC) (Application)	Red Deer River	20070507002	3258.2
County of Red Deer (MVRWSC) (Application)	Red Deer River	20070507002	2920.0
Shirley McClellan Water Services Comm (App)	Red Deer River	20070710000	8023.0
Total Licence Allocations			61673.0
Total Application Allocations (Proposed Licences)			32007.8
Total Licence and Application Allocations			93680.88

Notes: 1. Table 1 excludes municipal groundwater licences (except those that may be directly linked to the Red Deer River), municipal licences on tributaries that do not normally contribute to Red Deer River flow, licences to water co-ops serving rural users, and licences specifically for rural subdivisions, schools, camps, institutions, and condo developments.
2. Henry Kroeger RWSC's allocation is by agreement with the licence-holder, Alberta Environment.
3. Priority grouping is indicated by colour: Green – senior priority; Yellow – junior priority subject to Dickson Dam; and Red – junior priority subject to the Red Deer WCO.
4. 1.0 $dam^3 = 1000\ m^3$.

4 Municipal Water Use

Water withdrawals for 2006 for communities in the basin were obtained from the communities themselves via a municipal survey document or from Alberta Environment's Water Use Reporting System. The data includes all domestic, commercial, institutional and industrial uses within the communities (Appendix A).The total estimated surface water withdrawals for urban and regional projects was 60,799 dam^3.

The 2006 average per capita withdrawals were computed based on the withdrawal volumes and 2006 population. The average withdrawal for all communities was computed to be 424 litres per capita-day (L/c-d). Note that the variations in per capita use among communities is not necessarily an accurate measure of water use efficiency because of the differences among communities in the non-household uses such as industrial, commercial, institutional and recreational uses, as well as unrecorded amounts provided for domestic use outside the urban area. The 2006 average per capita withdrawal for the Red Deer Basin is considerably less than the 2001 average for Alberta and Canada published by Environment Canada (2004). These values are shown below.

	Average Withdrawal (L/c-d)	Residential %	Commercial and Industrial (%)	System Losses (%)
Red Deer River Basin (2006)	424			
Alberta (2001)	519	56	35	9
Canada (2001)	622	56	31	13

5 Rural Domestic Use

About one third of the population within the study area resides in the rural areas (rural municipalities and hamlets). The primary source of water for rural domestic users is wells. However, rural water co-ops supplying surface water to rural residents have become popular in areas where groundwater is limited in quantity and quality. Rural domestic use includes household use and lawn and garden watering. There are few records of rural domestic water use in the study area. A per capita use of 350 L/c-d is often used for design of rural water co-ops or regional systems serving rural uses and hamlets. In this study, an average withdrawal of 350 L/c-d was assumed for all rural domestic users. Rural domestic water demands have been estimated (Appendix A). The total surface and groundwater withdrawals for rural domestic users is estimated to be 10,007 dam^3.

6 Regional Water Systems

There are six existing or proposed regional water service commissions that withdraw water from the Red Deer River:

1. Mountain View Regional Water Services Commission (Existing)
2. North Red Deer Regional Water Services Commission (Existing)
3. Kneehills Regional Water Services Commission (Existing)
4. Highway 12/21 Regional Water Services Commission (Under construction)
5. Shirley McClellan Regional Water Services Commission (Under construction)
6. Henry Kroeger Regional Water Services Commission (Existing).

Communities served by each commission, including hamlets, are listed in Appendix A. Most of the regional systems serve both urban and rural users, some of which are outside of the Red Deer River Basin. Water use (current or proposed) for communities is estimated based on municipal records or on design criteria for the regional systems.

7 Return Flow

All municipal and rural domestic water users return flow to the environment in a number of ways, such as direct discharges to the source stream or one of its tributaries, return to groundwater via a septic field or seepage from a holding pond, or return to atmospheric moisture via evaporation or transpiration. For purposes of this study, the return flow of interest is that which is returned to the Red Deer River and is available for downstream reuse. The discussion of return flows will be restricted to this category of return flows. Eleven communities in the basin have return flows to the Red Deer River. Communities that have both withdrawals and return flows from the river are Sundre, Innisfail, Bowden, Olds, Red Deer, Blackfalds and Drumheller. Four other communities withdraw from groundwater but return water to streams that contribute to flow in the Red Deer River. These communities are Eckville, Penhold, Bentley and Rimbey. Almost all other communities in the basin have lagoon wastewater treatment systems that discharge once or twice per year to locations on tributaries and intermittent streams that are distant from the Red Deer River. Most of the treated wastewater would be consumed in evaporation, transpiration, seepage and stream priming losses prior to reaching the Red Deer River.

The quantity of return flow can vary substantially from community to community. Some communities with high water tables return more water than they withdraw due to groundwater seepage into their sewerage systems. Others have unrecorded amounts of treated wastewater that is used for waterfowl or irrigation projects. Wastewater lagoons have evaporation and seepage losses that reduce the quantity of flow that is returned to the source stream. For planning purposes, an average of 80 percent return flow is commonly used for municipal systems. For this study, 80 percent return flow has been assumed for municipalities with continuous discharge (Sundre, Red Deer, Blackfalds, Penhold, Drumheller) and 70 percent for municipalities with lagoons that discharge once or twice per year (Innisfail, Bowden, Olds, Eckville, Bentley, Rimbey).

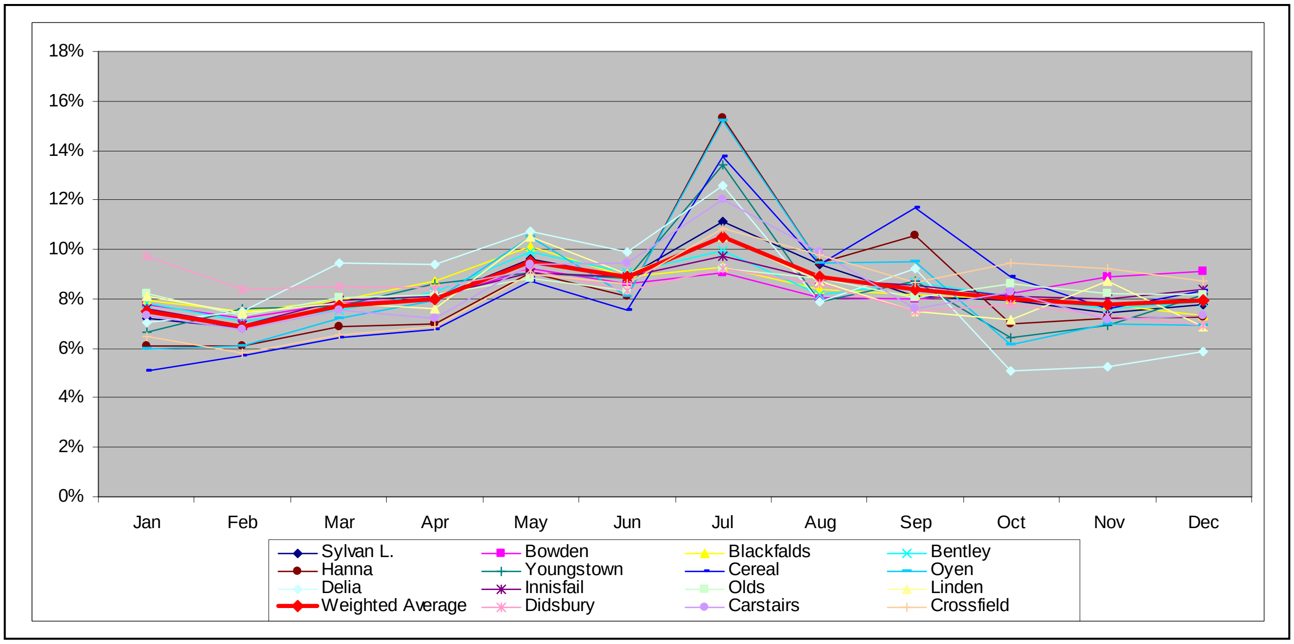
Estimated return flows to the Red Deer River are summarized in Appendix A.

8 Monthly Distribution of Withdrawals and Return Flow

The monthly distribution of withdrawals and return flows is important because the seasonal variations in water supply and water conservation objectives will affect water availability. The ability to match water supply to water demands is the essence of effective water management. Records and the literature show that the monthly patterns of urban and rural domestic demands (household plus outside watering) are similar in all communities. Typically, in the spring, fall and winter months, demands consist primarily of household cooking and sanitary requirements. In the summer months, lawn and garden watering becomes a factor and demand increases. Communities may have different commercial, institutional and industrial demands, and water storage facilities which could result in variations in the monthly distribution of total water uses among the communities. Also, the distribution may vary from year-to-year depending largely on climatic conditions. The 2006 monthly distribution of water withdrawals for fifteen (15) communities in the Red Deer River Basin is shown on Figure 1. A weighted average distribution was used for all communities and rural domestic users in the basin.

Wastewater volumes have considerably less monthly variation than withdrawals. Withdrawals increase significantly during the summer months primarily due to outside watering. Outside watering does not appreciably affect the volume of wastewater and, hence, return flows. All things considered, for those communities that have continuous return flows, it was decided to distribute wastewater volumes equally among all months. It was assumed that lagoon systems would decant in either April or November, or in both months.

Figure 1. Monthly Distribution of Water Withdrawals for 15 Communities in the Red Deer River Basin.



9 Future Municipal and Rural Domestic Water Demands

Future water demands for years 2031 and 2056 were estimated primarily based upon population projections and current per capita water consumption. The following assumptions were used:

- For regional projects serving rural domestic users and/or extending beyond the Red Deer River Basin, future water demands were based on design criteria for the project.
- Continuation of the current trend to alleviate water quantity and quality concerns by converting from groundwater to surface water sources for both urban and rural users was assumed.
- It was assumed that the recent trend of municipal and rural domestic water users supplied from groundwater to convert to surface water use supplied by regional projects. One such project currently under consideration centers around the Town of Sylvan Lake and nearby summer villages, communities and rural subdivisions. It was assumed that 15 to 30 percent of both urban and rural users currently supplied from groundwater would convert to surface sources by 2031, and 25 to 50 percent would convert by 2056. For rural municipalities with a significant amount of current surface water use, like Starland for instance, an additional 50 percent would result in close to 100 percent surface water use.
- It was assumed the future surface sources would be either the Red Deer River or a major tributary, and there would be insignificant return flow to the Red Deer River. With regard to

the latter point, there may be exceptions to the return flow assumption. However, without detail on the locations and nature of future regional projects, assuming insignificant return flow is a conservatively safe assumption. Recent constructed or proposed regional projects in the basin have very little return flow to the Red Deer River, Blackfalds excepted.

Projected water demand for years 2031 and 2056 are summarized in Appendix A.

Table 2 shows the projected year that some regional and municipal systems will reach their allocation capacity. A 20% reduction in consumption due to conservation measures was also considered and then allocation capacities were re-evaluated. The City of Red Deer, Shirley McClellan Regional Commission, Stettler and Sundre are projected to need increased allocations within 50 years even with conservation.

Table 2
Projected Municipal Surface Water Allocation Capacities – Red Deer River Basin

Municipality	Allocation (dam^3) (includes applications)	Year Allocation Capacity Reached	
		At Current Usage	20% Usage Reduction
Red Deer	27,529	2,028	2,051
Mountain View Regional	24,820	2,168	-
N. Red Deer Regional	13,391	2,075	-
Shirley McClellan Regional	8,023	2,053	2,063
Drumheller	4,107	2,070	-
Highway 12/21 Regional	3,337	2,067	-
Kneehill Regional	2,350	2,167	-
Stettler	1,696	2,044	2,059
Three Hills	1579	2,078	-
Sundre	815	2,024	2,052
Trochu	358	2,074	-

Capacity with 20% reduction is not provided where current consumption is beyond study projections.

10 Summary of Findings and Discussion of Results

1. Current licenced surface water allocations for municipalities and regional projects total 61,673 dam^3. Applications have been received for additional allocations totalling 32,008 dam^3.

2. Current (2006) annual municipal and regional project surface water withdrawals return flows and net depletions of Red Deer River flows are estimated to be as follows:

   - Withdrawals 33,680 dam^3
   - Return Flows 17,841 dam^3
   - Net Depletion 15,839 dam^3.

   These volumes include projects that have been applied for and are under construction. There are eleven (11) communities that have significant return flows to the Red Deer River. These include four communities that are sourced from groundwater and return to the Red Deer River or a tributary, representing a transfer from groundwater to surface water.

3. Year 2031 annual municipal and regional project withdrawals return flows and net depletions of Red Deer River flows are projected to be as follows:

   - Withdrawals 69,730 dam^3
   - Return Flows 33,257 dam^3
   - Net Depletion 36,474 dam^3.

   This demand projection assumes completion of all identified regional projects plus a conversion to surface sources for up to 30 percent of current groundwater demands for urban and rural municipalities.

4. Year 2056 annual municipal and regional project withdrawals return flows and net depletions of Red Deer River flows are estimated to be as follows:

   - Withdrawals 92,898 dam^3
   - Return Flows 40,366 dam^3
   - Net Depletion 52,532 dam^3.

   This demand projection assumes a conversion to surface sources for up to 20 percent of 2031 groundwater demands for urban and rural municipalities.

5. These water demand estimates are considerably larger than those projected in other recent studies (AMEC, 2007; HydroConsult, 2002) for the following reasons:

- Population projections for the current study are higher than those of previous studies primarily because population projections prepared for individual municipalities for infrastructure and land use planning were accepted for the purposes of this study.
- The current study included the water needs of all regional projects that are currently under construction. Regional projects have become very popular in recent years.
- The current study assumed continuation of regional project development for both urban and rural users currently relying on groundwater supplies.

J. R. Hart, P.Eng.
HART Water
Management Consulting

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APPENDIX A - PROJECTED WATER DEMAND FOR YEARS 2031 AND 2056

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Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 1 of 6).**

Municipality	Type	% in Sub-basin	Population			Water Source RF Recipient	Current Use (2006)		2031 Demand	2056 Demand
			2006	2031	2056		L/c-d	m^3	m^3	m^3
Water Use -- Sub-basin RD1										
Bighorn No. 8	MD	31%	392	404	491		350	50058	51637	62677
Burnstick Lake	SV	100%	43	55	67	GW	450	7063	9057	10994
Caroline	V	100%	515	640	777	GW	492	92511	115042	139637
Clearwater No. 99	MD	13%	1537	1773	2153		350	196400	226558	274993
Mountain View No. 17	RC	21%	2602	4269	5182		350	332420	545370	661964
Red Deer No. 23	RC	6%	1146	1543	1873		350	146463	197101	239239
Sundre	T	100%	2518	4273	5186	Red Deer R	554	508812	863348	1047923
						RF RDR (80%)		407049	690679	838338
						Net Diversion		101762	172670	209585
Sub-basin RD1 Summary						**Regional and Urban SW Withdrawal**		**508,812**	**863,348**	**1,047,923**
						Urban SW Return Flow		**407,049**	**690,679**	**838,338**
						Urban SW Net Use		**101,762**	**172,670**	**209,585**
						Urban GW Withdrawal		**99,574**		
						Rural Withdrawal (SW & GW)		**725,340**		
						GW/SW Conversion			**283,085**	**572,677**

Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 2 of 6).**

Municipality	Type	% in Sub-basin	Population 2006	Population 2031	Population 2056	Water Source RF Recipient	Current Use (2006) L/c-d	Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Water Use -- Sub-basin RD2										
Mountain View Regional										
Innisfail	T	100%	7438	12203	14812	Red Deer R	454	1231252	2019999	2451854
						RF RDR (70%)		861876	1615999	1961483
						Net Diversion		369376	404000	490371
Bowden	T	100%	1205	2505	3040	Red Deer R	340	149759	311287	377837
						RF RDR (70%)		104831	249029	302269
						Net Diversion		44928	62257	75567
Olds	T	100%	7248	15066	18286	Red Deer R	450	1190435	2474421	3003426
						RF RDR (70%)		833305	1979536	2402741
						Net Diversion		357131	494884	600685
Didsbury	T	100%	4275	6789	8240	Red Deer R	352	549920	873276	1059973
Carstairs	T	100%	2656	6064	7361	Red Deer R	311	301169	687647	834658
Crossfield		0%	2603	3850	4673	Red Deer R	458	434924	643280	780791
Other								788852	1555124	1887590
Total Mountain View Regional						Red Deer R	**SW W'dl**	**4,646,311**	**8,565,033**	**10,396,129**
							SW RF	**1,800,012**	**3,844,565**	**4,666,493**
							Net Div	**2,846,298**	**4,720,468**	**5,729,636**
North Red Deer Regional										
Blackfalds	T	100%	4741	25671	31160	Red Deer R	251	434080	2350441	2852940
						RF RDR (80%)		347264	1880352	2282352
						Net Diversion		86816	470088	570588
Lacombe	T	0%	10850	16694	24222		327	1295002	1992512	2891027
Ponoka	T	0%	6330	9184	13326		370	854867	1240365	1799701
First Nations	IR	0%	10308	21583	31315		180	729000	1526364	2214671
Other								367000	558331	754366
Total North Red Deer Regional						Red Deer R	**SW W'dl**	**3,679,948**	**7,668,013**	**10,512,705**
							SW RF	**347,264**	**1,880,352**	**2,282,352**
							Net Div	**3,332,684**	**5,787,660**	**8,230,353**
Cremona	V	100%	463	759	921	GW	286	48256	79076	95981
Red Deer No. 23	RC	47%	8981	12086	14670		350	1147292	1543958	1874040
Bighorn No. 8	MD	16%	202	205	249		350	25836	26236	31846
Birchcliff (Limited growth)	SV	100%	125	208	252	Private Wells	450	19874	33042	40106
Clearwater No. 99	MD	7%	828	942	1144		350	105754	120387	146125
Eckville	T	100%	951	1088	1321	GW	449	155771	178289	216406
						RF Med R (70%)		109039	124802	151484
						Net Diversion		-109039	-124802	-151484
Half Moon Bay (Limited growth)	SV	100%	32	32	39	Private Wells	450	5420	5420	6579
Jarvis Bay (Fully developed))	SV	100%	183	300	364	Private Wells	350	23378	38354	46554
Lacombe No. 14	RC	16%	1672	1788	2171		350	213618	228457	277298
Mountain View No. 17	RC	36%	4461	7318	8883		350	569862	934919	1134795
Norglenwold (Limited growth)	SV	100%	270	270	328	Private Wells	450	44348	44348	53829
Penhold	T	100%	1961	3137	3808	GW	292	208803	334039	405453
						RF RDR (80%)		167042	267231	324362
						Net SW Div		-167042	-267231	-324362
Ponoka No. 3	RC	8%	691	776	942		350	88301	99139	120334
Red Deer	C	100%	82971	151182	183503	Red Deer R	532	16124412	29380367	35661581
						RF RDR (80%)		12899530	23504294	28529265
						Net SW Div		3224882	5876073	7132316
Rocky View No. 44	MD	7%	2392	5993	7274		350	305574	765565	929235
Sylvan Lake	T	100%	10208	34568	41958	GW	328	1223128	4141945	5027450
Sunbreaker Cove (Limited growth)	SV	100%	137	225	273	Private Wells	450	22502	36917	44810
Wetaskiwin No. 10	RC	1%	105	107	130		350	13458	13678	16602

Sub-basin RD2 Summary		2006	2031	2056
	Regional and Urban SW Withdrawal	**24,450,671**	**45,613,412**	**56,570,415**
	Urban SW Return Flow	**15,322,888**	**29,621,245**	**35,953,956**
	Urban SW Net Use	**9,127,783**	**15,992,168**	**20,616,459**
	Urban GW Withdrawal	**1,751,480**		
	Rural Withdrawal (SW & GW)	**2,469,696**		
	GW/SW Conversion		**5,435,492**	**7,644,272**

Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 3 of 6).**

Municipality	Type	% in Sub-basin	Population			Water Source	Current Use (2006)		2031 Demand	2056 Demand
			2006	2031	2056	RF Recipient	L/c-d	m^3	m^3	m^3
Water Use -- Sub-basin RD3										
Bentley	VL	100%	1094	1376	1671	GW	340	135763	170819	207338
						RF B'man R (70%)		95034	119573	145136
						Net SW Div		-95034	-119573	-145136
Gull Lake (Limited growth)	SV	100%	204	447	543	Private Wells	450	33507	73493	89205
Lacombe No. 14	RC	27%	2822	3018	3663		350	360481	385521	467941
Parkland Beach	SV	100%	135	221	269	GW	450	22174	36378	44156
Ponoka No. 3	RC	32%	2765	3104	3768		350	353203	396557	481337
Red Deer No. 23	RC	4%	764	1029	1248		350	97642	131401	159493
Rimbey	T	100%	2252	2552	3098	GW	462	379693	430334	522335
						RF B'man R (70%)		265785	301234	365634
						Net SW Div		-265785	-301234	-365634
Wetaskiwin No. 10	RC	3%	316	316	384		350	40375	40375	49007
Sub-basin RD3 Summary						**Regional and Urban SW Withdrawal**			**-**	**-**
						Urban SW Return Flow		**360,820**	**420,807**	**510,771**
						Urban SW Net Use		**(360,820)**	**(420,807)**	**(510,771)**
						Urban GW Withdrawal		**571,137**		
						Rural Withdrawal (SW & GW)		**851,702**		
						GW/SW Conversion			**367,187**	**742,813**

Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 4 of 6).**

Municipality	Type	% in Sub-basin	Population 2006	Population 2031	Population 2056	Water Source RF Recipient	Current Use (2006) L/c-d	Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Water Use -- Sub-basin RD4										
Camrose No. 22	RC	7%	501	501	608		350	64028	64028	77717
Delburne	VL	100%	765	1190	1445	GW	370	103313	160755	195123
Lacombe No. 14	RC	45%	4703	5030	6105		350	600802	642535	779902
Ponoka No. 3	RC	7%	605	679	824		350	77263	86747	105292
Red Deer No. 23	RC	13%	2484	3343	4058		350	317336	427052	518351
Stettler No. 6	RC	17%	887	887	1076		350	113278	113278	137496
Stettler	T	0%	5226	8511	12066	Red Deer River	591	1127850	1406000	2029000
Highway 12/21 Regional										
Total Demand (Design Values)								1118000	1564000	2648000
Alix	VL	100%	851	1111	1348	Red Deer R	432	134186	175136	212579
Clive (future)	VL	100%	591	826	1002	GW		57670	80574	97799
Bashaw (future)	T	100%	825	968	1175	GW	382	114981	134862	163694
Ferintosh (future)	V		176							
New Norway (future)	V		293							
Edberg (future)	V		150							
Hamlets (future)										
Duhamel										
Mirror										
Tees										
Pelican Point										
Total Highway 12/21 Regional						Red Deer R	**SW W'dl**	**1118000**	**1564000**	**2648000**
							SW RF	**0**	**0**	**0**
							Net Div	**1118000**	**1564000**	**2648000**
Shirley McClellan Regional										
East Leg Total (Design Values)								1794000	2581000	4779000
Halkirk	V									
Castor	T									
Coronation	T									
Veteran	V									
Consort	V									
Hamlets										
Fleet	H									
Loyalist	H									
Monitor	H									
Kirriamuir	H									
Altario	H									
Compeer	H									
South Leg (Design Values)								185000	264000	482000
Big Valley	VL	100%	351	487	591	GW	381	48812	67673	82141
Future										
North Leg (Design Values)								1573000	2272000	3326000
Rochon Sands (Growth potential)	SV	100%	66	223	271	Private Wells	450	10841	36710	44558
White Sands (Growth potential)	SV	100%	120	406	493	GW	450	19710	66745	81014
Donalda	V									
Rosalind	V									
Bawlf	V									
Hamlets										
Red Willow	H									
Meeting Creek	H									
Kelsey	H									
Total Shirley McClellan Regional						Red Deer R	**SW W'dl**	**1,979,000**	**5,117,000**	**8,587,000**
							SW RF	**-**	**-**	**-**
							Net Div	**1,979,000**	**5,117,000**	**8,587,000**

Sub-basin RD4 Summary		Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
	Regional and Urban SW Withdrawal	**2,651,850**	**8,505,315**	**13,264,000**
	Urban SW Return Flow	**-**	**-**	**-**
	Urban SW Net Use	**2,651,850**	**8,505,315**	**13,264,000**
	Urban GW Withdrawal	**103,313**		
	Rural Withdrawal (SW & GW)	**1,172,708**		
	GW/SW Conversion		**418,315**	**846,244**

Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 5 of 6).**

Municipality	Type	% in Sub-basin	Population 2006	Population 2031	Population 2056	Water Source RF Recipient	Current Use (2006) L/c-d	Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Water Use -- Sub-basin RD5										
Drumheller	C	100%	7932	11509	13969	Red Deer R	724	2094929	3039627	3689468
						RF RDR (80%)		1675943	2431702	2951574
						Net SW Div		418986	607925	737894
Kneehills Regional										
Acme	VL	100%	656	820	995	Red Deer R	272	65128	81404	98808
Beiseker	VL	100%	828	1225	1487	Red Deer R	388	117261	173439	210519
Carbon	VL	100%	570	1029	1249	Red Deer R	257	53469	96551	117193
Irricana	T	100%	1243	3114	3780	Red Deer R	281	127386	319130	387384
Linden	VL	100%	660	973	1181	Red Deer R	211	50855	74973	91000
Other -- Rural							10%	39529	74500	90500
Total Kneehills Regional						Red Deer R	**SW W'dl**	**453,628**	**819,998**	**995,403**
							SW RF	**-**	**-**	**-**
							Net Div	**453,628**	**819,998**	**995,403**
Henry Kroeger Regional										
Delia	VL	100%	207	207	251	Red Deer R	583	44083	44083	53507
Hanna	T	100%	2986	2986	3624	Red Deer R	381	415611	415611	504464
Youngstown	VL		184	184	223	Red Deer R	616	41390	41390	50239
Cereal	VL	100%	160	160	194	Red Deer R	690	40274	40274	48832
Oyen	T	100%	1099	1361	1652	Red Deer R	537	215397	266689	323704
Hamlets	Total Hamlets except Byemoor and Endiang							29025	29025	35230
Craigmyle						Red Deer R		9519	9519	11554
Byemoor						Red Deer R	436	5566	5566	6756
Endiang						Red Deer R	436	6366	6366	7726
Chinook						Red Deer R		2286	2286	2775
Richdale						Red Deer R		1782	1782	2163
Stanmore								1029	1029	1249
Lanfine								326	326	396
Excel								1408	1408	1709
Scotfield								743	743	902
Other										
Co-ops and Individuals								35005	37200	45100
Total Henry Kroeger Regional						Red Deer R	**SW W'dl**	**849,809**	**903,296**	**1,096,306**
							SW RF	**-**	**-**	**-**
							Net Div	**849,809**	**903,296**	**1,096,306**
Elnora	VL	100%	281	388	471	GW	339	34795	48034	58303
Kneehill No. 48	MD	100%	5218	5624	6826		350	666600	718441	872036
Mountain View No. 17	RC	43%	5328	6791	8243		350	680669	867567	1053044
Morrin	VL	100%	253	253	307	Red Deer R	416	38416	38416	46628
Munson	VL	100%	222	285	345	Red Deer R	575	46592	59732	72502
Starland No. 47	MD	100%	2371	3309	4017		350	285725	398779	484034
CLV Co-op						Red Deer R		17170		
Total Starland								302895		
Newell No. 4	RM	1%	69	69	83	Bow R	350			
Paintearth No. 18	RM	18%	383	383	464		350	48887	48887	59339
Red Deer No. 23	RM	29%	5541	7457	9051		350	707904	952655	1156322
Rocky View No. 44	MD	30%	10251	25683	31174		350	1309604	3280993	3982435
Rockyford	VL	100%	375	459	557	GW	610	83551	102174	124017
Special Area No. 2	SA	28%	581	581	705		350	74187	74187	90047
Stettler No. 6	RC	47%	2452	2452	2976		350	313182	313182	380137
Three Hills	T	100%	3554	5331	6470	Red Deer R	565	732924	1099300	1334319
Trochu	T	100%	1033	1247	1514	Red Deer R	565	213030	257205	312192
Wheatland No. 16	RC	40%	3266	5795	7034		350	417180	740361	898642

Sub-basin RD5 Summary		Current (2006) m^3	2031 Demand m^3	2056 Demand m^3
	Regional and Urban SW Withdrawal	**4,429,327**	**6,217,573**	**7,546,818**
	Urban SW Return Flow	**1,675,943**	**2,431,702**	**2,951,574**
	Urban SW Net Use	**2,753,384**	**3,785,871**	**4,595,244**
	Urban GW Withdrawal	**118,346**		
	Rural Withdrawal (SW & GW)	**4,503,937**		
	GW/SW Conversion		**2,263,577**	**4,309,585**

Appendix Table **Municipal and rural domestic current water use and projections to 2031 and 2056 (Page 6 of 6).**

Municipality	Type	% in Sub-basin	Population 2006	Population 2031	Population 2056	Water Source RF Recipient	Current Use (2006) L/c-d	Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Water Use -- Sub-basin RD6										
Acadia No. 34	MD	95%	518	547	664		350	66143	69929	84878
Bassano	T	100%	1345	1546	1877	Bow R				
Brooks	C	100%	12498	21325	25884	Bow R				
Cypress No. 1	MD	2%	135	205	249		350	17193	26229	31836
Duchess	VL	100%	978	2143	2601	Bow R				
Empress	VL	100%	136	136	165	GW (RDR)	350	17374	17374	21088
Newell No. 4	RC	54%	3705	4456	5408	Bow R	350			
Rosemary	VL	100%	388	573	695	Bow R				
Special Area No. 2	SA	61%	1265	1265	1536		350	161622	161622	196175
Special Area No. 3	SA	53%	671	671	814		350	85718	85718	104043
Wheatland No. 16	RC	11%	898	1594	1934		350	114725	203599	247127

		Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Totals	**Regional and Urban SW Withdrawal**	**17,374**	**17,374**	**21,088**
	Urban SW Return Flow	**-**	**-**	**-**
	Urban SW Net Use	**17,374**	**17,374**	**21,088**
	Urban GW Withdrawal	**-**		
	Rural Withdrawal (SW & GW)	**283,777**		
	GW/SW Conversion		**164,129**	**332,029**

		Current Use (2006) m^3	2031 Demand m^3	2056 Demand m^3
Basin Totals	**Regional and Urban SW Withdrawal**	**32,058,034**	**61,217,023**	**78,450,245**
	Urban SW Return Flow	**17,766,700**	**33,164,432**	**40,254,640**
	Urban SW Net Use	**14,291,335**	**28,052,591**	**38,195,605**
	Urban GW Withdrawal	**2,643,851**		
	Rural Withdrawal (SW & GW)	**10,007,160**		
	GW/SW Conversion		**8,931,785**	**14,447,619**
	RDR Withdrawal	**32,058,034**	**70,148,808**	**92,897,865**
	Return Flow	**17,766,700**	**33,164,432**	**40,254,640**
	Net Withdrawal	**14,291,335**	**36,984,376**	**52,643,225**

4 Non-Municipal Water Use

Technical Memorandum

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

Red Deer River Municipal Users Group

Non-Municipal Water Use

February 2008

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TECHNICAL MEMORANDUM

1 Introduction

The Red Deer River Municipal Users Group (RDRMUG) is an association of rural and urban municipalities within the Red Deer River Basin, and other communities near the basin, who receive water from the Red Deer River. The **RDRMUG** has retained the services of Associated Engineering and Hart Water Management Consulting to study the potential future municipal water needs within the Red Deer River Basin and make recommendations on policies and procedures to secure those needs for municipalities.

Current and projected future municipal and rural domestic water needs are dealt with in the Technical Memorandum "Municipal and Rural Domestic Water Use". This memorandum deals with agricultural, commercial, petroleum sector, industrial and other water uses. While municipal and rural domestic water needs are the focus of this study, other water uses must be considered because all water users share the finite water supplies of the Red Deer River Basin. The magnitude and characteristics of non-municipal uses influence the security of water supplies for municipal and rural domestic users. Simulation modeling to determine the magnitude and frequency of insufficient water supplies for municipal users must consider the location, magnitude and seasonal distribution of other water uses. The main concern for municipal users in the basin is the ability of the Red Deer River to support increasing demands for growing municipal needs. For this reason, only **actual surface water use** will be considered in this analysis. Surface water use represents about 91 percent of total water use in the basin (AMEC, 2007).

Water licences define purpose, location, maximum allocation, and maximum rate of diversion of projects in the study area. The irrigated area is defined for irrigation projects. The allocations provide an indication of the size of the projects. The licensed water allocation can be considered an upper limit of withdrawal from the source for the project. However, the entire allocation may not be withdrawn every year, depending on many factors, such as weather conditions, water availability, crop rotations, and economic circumstances. A review of reported actual withdrawals submitted by licensees indicated that withdrawals are usually less than licensed withdrawals by varying degrees depending on user category (Hydroconsult, 1999). The licences also include **estimates** of consumptive use, losses and return flow. These are all non-enforceable quantities, but they provide an indication of the intent of the project when the licence application was made. In this document, the term "licensed water use" will refer to consumptive use plus losses, or withdrawal minus return flow as determined from information on the licence. "Actual water use" will refer to an estimate of average annual actual water use by the project. In other words, "actual water use" is the net impact on the source stream.

The task is to define "actual water use" using the licensing database to determine the location and relative size of the project, and to use Alberta Environment's Water Use Reporting System (WURS) and other relevant data to relate actual water use to licensed water use. The WURS is a relatively new database which contains actual water use data from a small percentage of water users for a few years.

This analysis draws heavily on the water demand database prepared by Alberta Environment for use in the SSRB Planning Program and a recently released study of actual water uses throughout Alberta, completed under the Water for Life program (AMEC, 2007). Alberta Environment based their demands primarily on licensing information (withdrawal minus return flow) and projected future uses. The AMEC study estimated current and projected **actual water uses**. This study updates and combines the two databases to provide estimated actual current and future demands distributed throughout the basin in a manner consistent with requirements for simulation modeling.

2 Agricultural Sector

The agricultural sector includes irrigation and stockwater, including feedlots.

2.1 Irrigation

Almost all of the irrigation in the Red Deer River Basin is done by private operators, primarily to irrigate forage crops to support the livestock industry. A small amount of irrigation is supported by provincial government storage and diversion projects, such as Deadfish Diversion and Deadfish Reservoir, and the Sheerness Diversion and Berry Creek Reservoir.

Licensing information for crop irrigation and a small amount of garden, park and golf course irrigation in the Red Deer River Basin is as follows. (Adjustments have been made for identified anomalies in the licensing listings.)

Number of Licences	520
Total Allocation (dam^3)	47,700
Licensed Water Use (dam^3)	47,590
Losses (dam^3)	1,309
Return Flow (dam^3)	1,910
Irrigated Area ha	13,972

Weekly irrigation demands were based on Alberta Agriculture and Food estimates of irrigation requirements for alfalfa, a high water use forage crop. Irrigation demands are variable from week to week and from year to year depending on weather conditions. In some parts of the Red Deer Basin, irrigation may not be required in years of high growing season precipitation. The average annual irrigation application (consumptive use plus losses) for the lower part of the basin is about 400 mm. In the upper part of the basin the average annual irrigation application would be about 300 mm. The current average annual irrigation demand for the basin has been estimated to be about 50,300 dam^3.

Projections for future irrigation expansion, including parks and golf courses, have been made based upon water licence applications for the Special Areas Water Supply Project (SAWSP) and the Acadia Project, historical trends for private individual agricultural and recreation projects. The pending Acadia project applications are for 56,700 dam^3. The SAWSP project was originally for 76,500 dam^3 but is currently being reduced in size from the 7.5 m^3/s diversion to 2.5 m^3/s diversion from the Red Deer River for multi-purpose use, including about 8000 acres of sprinkler irrigation. Private irrigation projects are most likely to be developed along valley lands in the lower reaches of the Red Deer River where the growing season moisture deficit is high and soils are irrigable (Acres 1988). Park and golf course irrigation is expected to increase at approximately the same rate as population. Future expansion to 2031 and 2056 is projected as follows.

	Current	Projection to 2031	Projection to 2056
Current Irrigated Area (ha)	13,972	13,972.0	13,972.0
Expansion			
SAWSP (ha)		3,237.5	3,237.5
Acadia (ha)		10,926.0	10,926.0
Other Projects (crop irrigation, gardens, parks, golf) (ha)		2,100.0	4,050.0
Total Irrigated Area (ha)	13,972	30,235.5	32,185.5
Average Annual Demand (dam^3)	48,000	120,572.0	129,347.0

2.2 Stockwater

Secure sources of good quality water are essential for the important livestock industry in the study area. Cow-calf operations and the feedlot industry have the largest livestock water requirement in the basin. Water supplies well distributed within grazing lands enable sound range management practices. Feedlots and winter-feeding areas must have ready access to secure water supplies.

Common sources of stock water in the study area are wells, dugouts, small stock water dams on intermittent streams, and the streams themselves. Well-managed use of riparian areas and controlled access to streams is important to maintain healthy streams and riparian vegetation.

Surface water licence allocations and registrations for livestock in the Red Deer River Basin are as follows.

		Number	Allocation (dam^3)	Water Use (dam^3)	Return Flow (dam^3)
Feedlots		10	355.5	355.5	0
Stock Water	Licences	1,717	13,079	13,075	4
	Registrations	9,676	9,397	9,397	0
Total		11,403	17,085	17,081	4

Groundwater uses account for about 54 percent of all allocations for livestock. There is no data in Alberta Environment WURS on actual uses of water for the livestock industry. AMEC (2007) estimated livestock populations in the basin and their water requirements using 2001 census data. Daily water requirements were taken from Alberta Agriculture and Food's guide for planning livestock watering facilities.

	Animal Population	Daily Needs (igal)	Annual Use (dam^3)
Bulls	30,990	9.0	463
Milk Cows	26,674	30.0	1,327
Beef Cows	571,825	9.0	8,534
Heifers	235,700	6.0	2,345
Steers	262,037	6.0	2,607
Calves	555,218	3.0	2,762
Total Use			18,039

Other livestock species would add about 15 percent to the requirement, for a total current use of 20,745 dam^3. Considering that 46 percent of total requirements are provided by surface water (based on licence allocations and registrations), surface water requirements would be about 9543 dam^3.

Census data indicate that the cattle industry has grown at an average rate of 2.2 percent per year between 1958 and 2001 (AMEC 2007). Assuming continued growth at that rate, the same groundwater/surface water ratio, and a 15 percent allowance for other livestock, projected future surface water needs in the basin would be as follows.

Current	9,540 dam^3
Year 2031	16,400 dam^3
Year 2056	28,300 dam^3

2.3 Agricultural Sector Summary

Current agricultural surface water use is estimated to be 59,840 dam^3, of which about 84 percent is for irrigation. Projected water use to year 2031 is 136,970 dam^3, and to year 2056 is 157,750 dam^3, of which irrigation comprises 88 and 82 percent respectively.

	Irrigation (dam^3)	Livestock (dam^3)	Totals (dam^3)
Current	50,300	9,540	59,840
Year 2031	120,570	16,400	136,970
Year 2056	129,350	28,300	157,750

3 Commercial Sector

The commercial sector includes aggregate washing, food processing, water hauling and other activities. Golf courses, gardening and parks are sometimes included under the commercial sector. They have a similar demand pattern to crop irrigation, and in this study, they were considered with crop irrigation under the agricultural sector.

Surface water licences for commercial activities are summarized as follows.

	Number of Licences	Allocation	Water Use	Return Flow
Aggregate Washing	10	760	658	102
Food Processing	2	270	270	0
Other	10	172	111	61
Totals	22	1,202	1,039	163

There is no information in the WURS database on actual use for the three commercial activities. AMEC (2007) assumed that actual use was equal to licensed use. This assumption probably overstates actual use, but the commercial sector accounts for only a very small portion of total water use.

AMEC used the forecast of average long-term economic growth rates to project the growth in aggregate washing. The average growth rate of 2.2 percent was used for all three categories of commercial activities.

Current and projected surface water use for the commercial sector is summarized as follows.

	Aggregate Washing (dam^3)	Food Processing (dam^3)	Other	Totals (dam^3)
Current	658	270	111	1,039
Year 2031	1,133	465	191	1,789
Year 2056	1,952	801	329	3,082

4 Petroleum Sector

The petroleum sector includes gas and petrochemical plant processing, injection for secondary oil recovery and other. Surface water licensing data for the sector is as follows.

	Number	Allocation (dam^3)	Water Use (dam^3)	Return Flow (dam^3)
Gas/petrochemical	22	35,236	30,872	4,364
Injection	36	10,988	10,988	0
Other	2	16	16	0
Total	60	46,240	41,876	4,364

4.1 Gas/Petrochemical Plants

Twenty-two surface water licences for gas and petrochemical plants account for 76 percent of the total allocations in this sector. The WURS database indicates that petrochemical plants province-wide are using 48 percent of their allocation, and about 58 percent of their licensed water use. Actual water use in the Red Deer Basin was estimated to be 58 percent of licensed use, or 17,910 dam^3.

Gas and petrochemical plants are diverting and using considerably less water than they are entitled to use. Existing operators could undertake significant expansion of their current facilities without requiring new allocations. Projections to 2026 are made based on actual use increasing from their present 58 percent to 80 percent, and by 2056 to 100 percent.

Current and projected water use for gas and petrochemical plants is summarized as follows.

Current	17,910 dam^3
Year 2031	24,700 dam^3
Year 2056	30,870 dam^3

4.2 Injection

Thirty-six surface water licences have been issued for enhanced oil and gas recovery. Allocations total almost 11,000 dam^3. There is no return flow from injection projects. A detailed review of actual water use by injection projects indicated that actual use for surface water projects has averaged less than two percent of the allocation (AMEC, 2007), Actual surface water use within the Red Deer River Basin is estimated to be 182 dam^3.

Oil production in Alberta for conventional crude is expected to decline as existing fields become depleted and new discoveries become less frequent. Surface water use for injection purposes in the Red Deer River Basin is expected to follow the provincial trend in oil production and decline about 5.0 percent per year.

Current and projected water use for injection purposes is summarized as follows.

Current	182 dam^3
Year 2031	51 dam^3
Year 2056	14 dam^3

4.3 Other Petroleum Sector Purposes

There are two (2) licences for other petroleum activities, with allocations totalling 16 dam^3, and no return flow. There is no information on actual water use. In the absence of any information on actual use, it is assumed that these projects use their full entitlement of 16 dam^3. It is further assumed that this use will continue throughout the forecast periods.

Current and projected surface water use for the commercial sector is summarized as follows.

	Gas/Petrochemical (dam^3)	Injection (dam^3)	Other (dam^3)	Totals (dam^3)
Current	17,910	182	16	18,108
Year 2031	24,700	51	16	24,767
Year 2056	30,870	14	16	30,900

5 Industrial Sector

The industrial sector is dominated by water for cooling purposes. The four licences issued for cooling have total allocations of 22,195 dam^3, representing 99.4 percent of total surface water allocations.

	Number	Allocation (dam^3)	Water Use (dam^3)	Return Flow (dam^3)
Cooling	4	22,076	13,688	8,388
Other	4	135	135	0
Total	8	22,211	13,823	8,388

5.1 Cooling

Typically, water use for industrial cooling purposes involves a small amount of consumption for forced evaporation and natural evaporation if a cooling pond is involved, and high return flows. The four surface water licences issued for cooling assumed that 38 percent of the withdrawal would be returned. There is no information in Alberta Environment's WURS database on actual uses for cooling purposes. For purposes of this analysis, it is assumed that licensees are using the full amount of their licensed water use, or 13,688 dam^3.

AMEC (2007) projected that there would be no growth in water used for cooling for the next 20 years. For the purposes of this study, it is projected that there will be no growth to 2031 and one new plant by the year 2056, using 3,500 dam^3.

Current and projected water use for cooling purposes is summarized as follows.

Current	13,700 dam^3
Year 2031	13,700 dam^3
Year 2056	17,200 dam^3

5.2 Other Industrial Purposes

Other industrial purposes include activities such as mining, manufacturing, forestry and fertilizer plants. There are four surface water licences for other purposes, with allocations totalling 135 dam^3 and no return flow.

There is no information in Alberta Environment's WURS database on actual uses for other industrial purposes. It is assumed that licensees are using their full entitlement of 135 dam^3. It is further assumed that water use for these purposes would remain within current licensed amounts for the forecast period.

Current and projected surface water use for the industrial sector is summarized as follows.

	Cooling (dam^3)	Other (dam^3)	Totals (dam^3)
Current	13,700	135	13,835
Year 2031	13,700	135	13,835
Year 2056	17,200	135	17,335

6 Other Sectors

A total of 232 surface water projects in other sectors include water management projects, habitat enhancement projects and projects designated as “other” by the Water Act Director.

	Number	Allocation (dam^3)	Water Use (dam^3)	Return Flow (dam^3)
Water Management	32	77,554	30,000	47,557
Habitat	198	23,143	20,751	2,392
Director-Specified	2	230	230	0
Total	232	100,927	50,981	49,949

6.1 Water Management

Water management includes water level stabilization projects and storage development for multi-purpose use. Flood control projects (dykes, channel improvements, etc.) are often included as water management projects, but apart from temporary reservoir storage during high flow periods or diversions to other streams, they are generally not considered to be water use projects.

There are thirty two (32) surface water projects under the water management category, with total allocations of 77,554 dam^3. Return flow has been estimated to be 47,557 dam^3 or 61 percent of the allocation. Licensed net use is about 30,000 dam^3. There is a lack of information on actual diversions and water use for this activity. AMEC has assumed that licensees are using their full entitlement of 30,000 dam^3, and that water use will remain constant for the forecast period.

Current and projected water use for water management purposes is summarized as follows.

Current	30,000 dam^3
Year 2031	30,000 dam^3
Year 2056	30,000 dam^3

6.2 Habitat

A total of 198 surface water licences have been issued for habitat projects, most of which were developed by Ducks Unlimited Canada. These projects have allocations totalling 23,243 dam^3 and a return flow of 2,392 dam^3, for a net licensed use of 20,751 dam^3.

There are no records of actual water use for habitat enhancement projects. For purposes of this analysis it is assumed that licensees are using their full entitlement of 20,751 dam^3. Ducks Unlimited provided information to AMEC that suggested a 1.4 percent annual increase in wetland projects over the next 20 years. Assuming a 1.0 percent growth rate for the forecast periods, projected water use by 2031 would be 26,600 dam^3, and by 2056 would be 34,100 dam^3.

Current and projected water use for habitat purposes is summarized as follows.

Current	20,751 dam^3
Year 2031	26,600 dam^3
Year 2056	34,100 dam^3

6.3 Director-Specified Projects

Only two director-specified allocations have been issued for surface water. Total allocation is for 230 dam^3 with no return flow. It is assumed that licensees are using their full entitlement of 230 dam^3 and that use remains constant for the forecast period.

Current and projected water use for habitat purposes is summarized as follows.

Current	230 dam^3
Year 2031	230 dam^3
Year 2056	230 dam^3

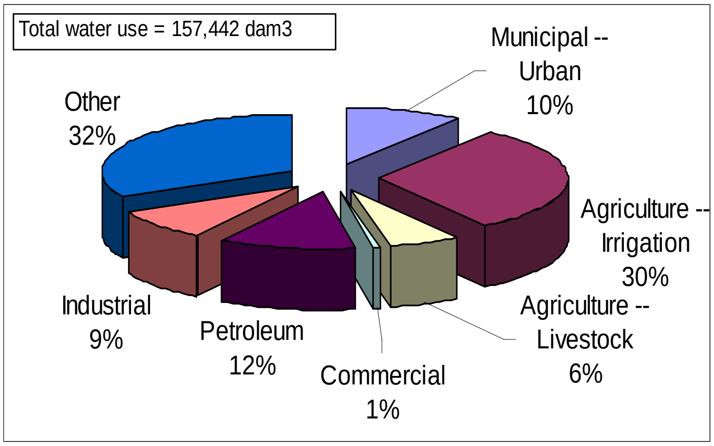
Current and projected surface water use for the Water Management sector is summarized as follows.

	Water Management (dam^3)	Habitat (dam^3)	Director-Specified (dam^3)	Totals (dam^3)
Current	30,000	20,751	230	50,981
Year 2031	30,000	26,600	230	56,830
Year 2056	30,000	34,100	230	64,330

7 Summary of Findings and Discussion of Results

1. A summary of estimated current and projected future surface water use for each sector, including the municipal sector (Technical Memorandum – Municipal and Rural Domestic Water Use), is provided in Table 1.

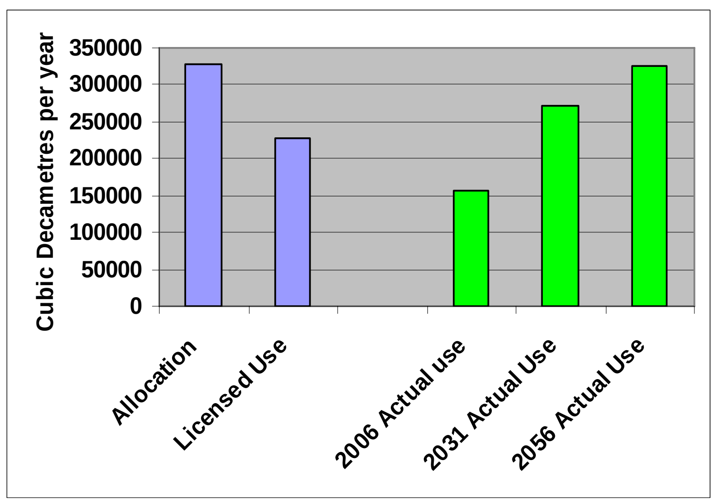
Figure 1 Distribution of Estimated Current Surface Water Use in the Red Deer River Basin Among Use Sectors.



2. Current actual surface water use in the Red Deer River Basin is estimated to be 157,442 dam^3, which is about 48 percent of the licensed allocation, and about 69 percent of the licensed use (allocations minus return flows).

3. The Agriculture Sector (irrigation and stockwater) is the largest user of surface water, followed by the other (water level stabilization, storage and habitat), Petroleum and Urban Municipal Sectors (Figure 1). The Urban Municipal Sector includes regional projects which serve rural needs as well as urban. The water use values presented represent the net impact on the source streams (withdrawal minus return flow). The estimated net use (15,839 dam^3) is half of the withdrawal (33,680 dam^3).

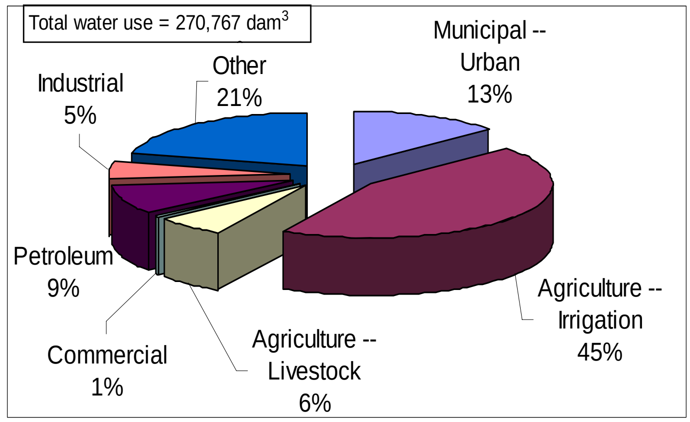
Figure 2 Current and Projected Future Water Use in the Red Deer River Basin.



4. Future actual water use is projected to increase by almost 72 percent over current use by year 2031 and by 100 percent by 2056 (Figure 2).

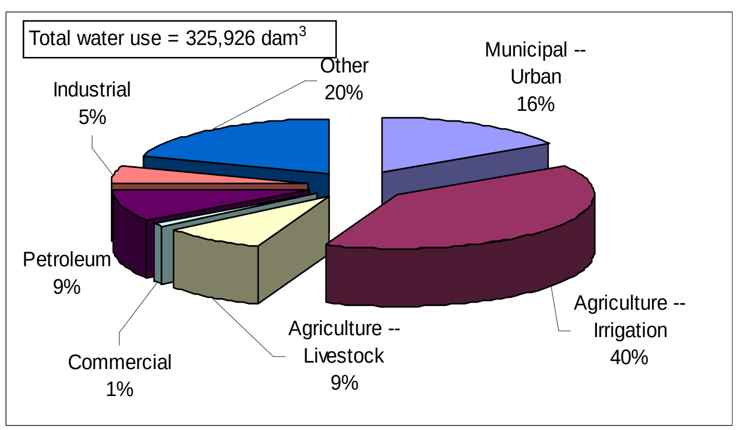
Agricultural uses (irrigation and livestock) comprise 51 percent of surface water use projections to year 2031. The agricultural projections assume that two relatively large irrigation projects, Acadia and Special Areas projects (currently in the application stage), will proceed to implementation. The irrigation sector also includes golf course, park and garden irrigation. Municipal water use represents 13 percent of the total projected use for 2031. This projection assumes completion of all identified regional projects and up to 30 percent of the population that is currently utilizing groundwater supplies will convert to surface water supplies.

Figure 3 Distribution of Projected 2031 Surface Water Use in the Red Deer River Basin Among Use Sectors.



6. Projections to 2056 are less reliable than projections to 2031. Indications are that agricultural uses will continue to dominate the water use sectors in projections to 2056. Municipal water use represents 16 percent of the total projected use for 2056. This projection assumes that up to 50 percent of the population that is currently utilizing groundwater supplies will be converted to surface water supplies.

Figure 4 Distribution of Projected 2056 Surface Water Use in the Red Deer River Basin Among Use Sectors.



J. R. Hart, P.Eng.
HART Water Management Consulting

January 2008

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APPENDIX A - CURRENT AND PROJECTED FUTURE SURFACE WATER USE AND DEMAND IN THE RED DEER RIVER BASIN

Table 1 Summary of Current and Projected Future Surface Water Use and Demand in the Red Deer River Basin.

Water Use Sector	Allocation Licenses (dam³)	Actual Water Use (dam³)		
		2006	2031	2056
Municipal – Urban	61,673	15,838 (Withdraw 33,680)	36,474 (Withdraw 69,730)	52,532 (Withdraw 92,898)
Municipal – Applications	32,008			
Agriculture -- Irrigation	47,700	48,000	120,572	129,347
Agriculture -- Livestock	17,085	9,540	16,400	28,300
Commercial	1,202	1,039	1,789	3,082
Petroleum	46,240	18,108	24,767	30,900
Industrial	22,211	13,835	13,835	17,335
Other	100,927	50,981	56,830	64,330
Totals	329,046	157,341	270,667	325,826

1. Municipal-Urban water use includes licensed urban municipalities and regional projects.
2. Municipal – Applications are for proposed regional projects.
3. Actual water use equals withdrawal minus return flow. Only return flows to the Red Deer River are considered.

5 Water Conservation

Technical Memorandum

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Red Deer River Municipal Users Group

Water Conservation

November 2007

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TECHNICAL MEMORANDUM

1 Introduction

Municipal water users in Canada consume more water than most urban users in other countries excluding the United States. There are some “North American” reasons for this, such as large properties, an obsession with lawns, water using appliances, waterworks systems capable of supplying high volumes of water and most importantly, a lack of concern about water availability. The lack of concern is due to the perception North Americans have that there is an abundance of water. This perception is partially due to the vast number of lakes and other water bodies.

However, there is a lack of understanding that the only surface water that is available is that which is moving. As a result, Canadians have gone to great lengths to capture water. Part of the reason for this is a combination of water only being available during periods of runoff and the need for water supplies to service communities through long winters.

The public began to be aware of water conservation during the environmental movements starting in the 1970s but an increased focus on water use in the urban home occurred in the 1990s. This increased knowledge led to general awareness and some reduction in water use. Now that climate change is a reality, water supplies are proven to have a finite limit and energy costs are increasing. Municipalities and other levels of government are forced to consider more concerted measures to make water supplies more efficient.

A reduction in water demand requires a long term multi pronged approach that makes physical changes and changes the habits of water utilities and users. This technical memorandum outlines structural, operational, economic and educational approaches that municipalities in the Red Deer basin can focus on.

2 Structural Changes for Water Conservation

One of the most valuable assets a municipality has is its waterworks system. Preventing upgrades through reductions in demand is recognized as a significant capital saving. One of the most effective means of structurally making a change is metering all users. Of equal importance is an effective rate structure based on metering. This will be elaborated on later. Universal metering can reduce demand by 30%.

Another significant physical change to waterworks systems is the use of more efficient fixtures. Some municipalities offer incentive programs to replace inefficient fixtures. The City of Vernon in BC replaced 3,000 toilets with dual flush low volume toilets in an eleven month period in 1998. Concerns about the performance of substandard dual flush toilets should not deter the use of the technology. Europe has had success with the low flush toilets for many years. Other fixtures that can be promoted are low flow showerheads, low flow faucets and high efficiency laundry washers (front loading). All of the above measures can save 30% of indoor water use. In addition to incentive programs, a mandatory use bylaw is necessary for new development. A building code requirement could also be effective.

Another significant water efficiency structural change is detecting and repairing leaks. The age of waterworks systems combined with climatic and soil conditions can lead to ongoing leakage problems. A proactive leak detection program that tracks the water balance and uses sophisticated detection can also be effective with a 5% savings realized when toilet tank leak detection kits are used and faucets are checked. Municipalities must budget for an ongoing leak detection program.

Less obvious structural changes can be applied where opportunities are presented. Some involve changing sources of water; others involve correcting deficiencies in the system and possibly within user's premises. Examples are as follows:

- Converting park and recreational field watering from potable water to raw water, stormwater or reclaimed water
- New water treatment processes that are less wasteful
- Recycling water at water parks and fountains
- Replacing water and sewer connections that require "bleeders" (continuous water flow to prevent freezing)
- Meter replacement when necessary
- Schools, hospital, hotels and motels which can have significant losses through inefficient urinals, toilets and wasteful practices
- High water user meter bypasses (e.g. laundries, car washes, industries, restaurants).

Water use outside a residence or business can be in excess of 50% of total demand. Special structural changes to consider mitigating this could include:

Xeriscaping: which is the use of combinations of drought resistant plants and non-plant structures to provide an aesthetic landscape while conserving water.

Rainwater harvesting: which is a means of collecting rainwater in barrels or other containments. Benefits are reduced consumption and less runoff to cause erosion or contamination.

Irrigation technology: which involves several means of making lawn or garden watering more efficient. Examples are soaker hoses, drip irrigation, rain sensors, soil moisture sensors, timers, automatic shut offs.

3 Operational Changes for Water Conservation

If a municipality wishes to make a significant change in water use for facilities that they have direct control over, there must be an educational process for municipal administration and operational staff. This will lead to a behavioural change. An internal audit of a municipal operation across various departments for water inefficiencies can prove to be a good starting point.

A key municipal facility is the water treatment plant. Aspects to explore are:

- Frequency and reason for backwashing filters
- Timing for filter to waste
- Use of flow through testing devices
- Continuously flowing taps
- Blowdown volumes for treatment processes
- Raw and treated water meter correlation and error
- Truck fill access.

The next step is examining the water distribution system and the efficiency of operations:

- Hydrant flushing program
- Water main swabbing program
- Fire fighting training activities
- Water pressure zones. Too high a pressure can waste water whenever a tap is turned on. A pressure of less than 400 kilopascals is recommended.
- Restricting access to hydrants by outside water users.

The last stage of an Operational Audit is to look for any water activity that could be siphoning water away from consumers; examples include assessing:

- Water usage in recreational facilities such as curling rinks, ice arenas, pools and water parks
- Water efficiency at outdoor facilities such as parks and golf courses
- Water use practices when street cleaning or watering trees.

4 Economic Measures for Water Conservation

Municipal waterworks systems supply a relatively inexpensive product. A cubic metre of water usually costs less than two dollars to produce. Water bills are extraordinarily low compared to electricity so there is little incentive to conserve. Water rates for communities in the Red Deer Basin and adjacent areas are shown in Table 4-1.

Municipalities should be pricing water to account for the true cost of water. Recovering expenditures is not enough. Future capital costs for upgrades, expansion and replacement need to be included. Pricing according to distance pumped and infrastructure required also would put municipalities in a better position to care for infrastructure as well as encourage conservation. A caution with this however is the concern that this may discourage regional systems. It may be appropriate to subsidize a small user on a regional system to some degree.

Table 4-1 – Water Rates Table

Waterworks	Monthly Water Rates in $			Comment
	Base Rate (20mm service)	Rate per m^3	Total Rate per 20 m^3	
Airdrie	27.55	0.694	41.35	From Calgary
Calgary	18.17	1.10	40.17	Annual declining base rate and increasing usage rate
Blackfalds	14.40	1.15	37.40	From Red Deer
Drumheller	27.00 (up to 18.2 m^3)	1.19 (above 18.2 m^3)	29.16	Double volume allowed for same rate May - August
Innisfail	0	1.25	25.00	10.25 minimum bill From Mountain View Commission
Lacombe	16.59	1.43	45.19	From Red Deer
Red Deer City	19.61	0.464	28.89	
Red Deer County Gasoline Alley	28.67	0.63	41.27	From Red Deer City
Red Deer County Benalto	17.92	0.65	31.92	
Sundre	8.00	1.08	29.60	Wells
Three Hills	16.00	1.25	40.00	
Edmonton	6.83	1.38	34.43	1.43/ m^3 over 60 m^3
AVERAGE	16.73	1.02	35.36	

Table 4-2 – Water Rate Options

Billing Method	Description	Conservation Effect
Flat Rate	Same rate per m^3 regardless of use.	Promotes water use depending on rate.
Two Tier Flat Rate	Minimum monthly charge plus a flat rate.	Similar to flat rate.
Declining Block	Charge for water declines in steps with increased use.	Promotes excess water use – only used where infrastructure and supply are adequate.
Two Tier Declining Block	Minimum monthly charge for first “block” then progressively lower rates.	Same as above.
Increasing Block	Rate per m^3 increases with increased used.	Best effect on water conservation.
Two Tier Increasing Block	Minimum charge for a specified quantity and excess use is charged at increasing rates.	Provides base revenue level.
Seasonal Rate	High rate during peak periods or drought.	Can be a water restriction bylaw tool.
Excess-Use Rate	Significantly higher price for above average use.	Reduce peak demand.
Rebate	High water users pay a premium that is distributed to low users.	Accounting may be too onerous.
Sector Based Rates	Residential, commercial or industrial rates vary.	May reward consistent demand versus fluctuating. Also may reward job creation and taxes.

How water rates are structured has a very critical effect on water conservation (see Table 4-2). A flat or base rate has no effect. A user rate has an effect but a declining rate for increased use or any rate that does not penalize excess use in the summer is not going to be effective at conserving water.

It is worth noting that low water rates reflect less expenditure on water quality improvements, operator salaries and maintenance of the system. This can result in turnover in qualified staff, a compromised system from a public health perspective and water inefficiencies.

In addition to a rate structure bylaw that encourages conservation, the following governance policies are recommended:

- Water restriction program and bylaw for water shortages. The bylaw is necessary to impose penalties for violators.
- Subdivision development bylaw to regulate water wastage by contractors and new homeowners.
- Water reuse policy.
- Budget for:
  - Leak detection and repair program
  - Household fixture replacement incentives
  - Educational Program
  - A rate structure that maintains revenue as water conservation reduces consumption.

More senior levels of government could also influence water conservation at a municipal level through policies, regulations and economic incentives. For example, conditional grants have been attempted in Alberta where 10% is added to a grant for a new or upgraded waterworks if water conservation is implemented. Government funding of water conservation programs may be more effective.

Building and plumbing codes could also be rewritten to support conservation.

5 Water Conservation Education

Water conservation education has historically focused on brochures in water bills, student education kits and public pleas to not leave taps running when brushing teeth. These and other advertisements have raised awareness but effective behavioural change requires more hands-on methods not only with water users but just as importantly with municipal water managers and elected officials. The results can be more significant than structural changes like meters and the results can be longer lasting.

A marketing approach ensures that the right information is given to the right people in the right context so real change can happen. This type of approach requires a dedicated coordinator to structure a comprehensive program. Okotoks and Cochrane have success with this approach in Alberta. Kelowna also undertook a direct contact with water users by auditing and providing training on home irrigation practices. In a test case, 27% savings in water use occurred. Similarly, a program where lawns were top dressed with compost, then watered at a reduced schedule showed a 35% savings in one month.

Education services need to pull other conservation methods together into an effective conservation program. Benefits of structural and operational changes need to be communicated and an economic penalty system ensures repercussions for not participating.

The water rates should include a budget for conservation measures. Part of the budget could be for a full time or part time coordinator depending on the size of the utility. A viable alternative is calling on volunteers to form a committee. This type of grassroots approach can generate a lot of support as well as be quite focused and innovative.

6 Soft Path Water Management

Most water supplies have been developed based on a maximum supply for predetermined need with factors of safety. This is reasonable when supplying fire protection and ensuring a treatment process is robust enough to meet challenges. Soft path water management takes a different approach from supply or demand management. It is a planning approach that uses innovative thinking to offset access to more water. Some of the concepts focus on recycling water; others require a mix of conservation approaches. As water becomes scarce and water rates increase, more soft path concepts will evolve. This will take time because the concepts require a radical change in thinking about the consumption of water.

7 Conclusion

Every municipality can become more efficient in water use. Tables 7-1 and 7-2 summarize physical and behavioural water conservation measures that can be taken. The challenge is overcoming water user habits and perceptions.

Another challenge will be pricing water at the appropriate rate for cost recovery and for water conservation. A stepwise approach is recommended as follows:

1. Conduct an audit of the waterworks system to determine where losses are occurring and where efficiencies can be found.
2. Conduct a review of the water rate structure and waterworks budget then plan for bylaw changes over time to address true water supply costs.
3. Conduct an outreach program to educate and provide incentives to water users to change habits and perceptions.
4. Regularly review progress on water conservation and over time include incorporate innovation, new technology and water reuse strategies.

A well delivered water conservation program can resecure water a municipality already has while at the same time saving money.

Implications for more senior governments is the creation of legislation and policies to regulate new technology, regulate plumbing and building codes and financially support municipal water conservation initiatives.

Table 7-1 – Physical Water Conservation Measures

Category	Conservation Measure
Structural	• Install water meters at all water users • Implement leak detection and repair program • Install efficient water treatment process • Water efficient household plumbing fixtures (dual flush toilets, efficient shower heads and faucets, dishwashers) • Residential landscaping (Xeriscaping, efficient sprinklers, soil sensors, rain sensors, drip irrigation, timers) • Convert park irrigation to non-potable water.
Operational	• Adjust water zones and water pressures • Monitor hydrant usage and flushing procedure • Audit and adjust water treatment plant operations for wastage • Monitor truck fill usage • Control water wastage at recreational facilities (arena, curling rink, water park, fountain) • Control park, golf course and recreational field irrigation

Table 7-2 – Behavioural Water Conservation Measures

Category	Conservation Measure
Economic	• Volume based • Water usage price structure (increasing block rate) • High rates for high consumption months • Bylaw for rates and penalties for over use • Incentives for installation of water efficient appliances and fixtures • Sewer charges based on water rates • Link grants to water conservation.
Mandatory Controls	• Bylaw for water restrictions • Bylaw for fixtures in new development • Bylaw for subdivision development • Updated Plumbing and Building Codes • Provincial Legislation • Require water reuse where practical • Prohibit water wasting.
Educational	• Hire or appoint volunteer Water Conservation Coordinator • Provide training on irrigation practices • Provide training on landscaping and water usage • Provide educational awareness material (utilize various media) • Educate staff and elected officials on water conservation • Distribute low flow devices • Market water conservation

8 References

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6 Municipal Water Reuse

Technical Memorandum

Red Deer River Municipal Users Group

Municipal Water Reuse

November 2007

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TECHNICAL MEMORANDUM

1 Introduction

All municipalities with wastewater collection systems release water to the environment. This indirectly provides water for reuse by the natural environment or other human needs. The following discussion will focus on water reuse in a municipal context to reduce water demand within the Red Deer River Basin. This may not be necessary or economical at present but over the next fifty years as the limited water supply of the basin is used up, there should be opportunities to maximize the reuse of municipal wastewater and stormwater. Individual rural water users can benefit from this approach as well.

2 Water Reuse Definitions

A discussion about water can get confusing without clarification of terms. For example, once water is put into a sewer, it is called wastewater, yet if the wastewater is reclaimed for another use it should be called water. Obviously the term wastewater reuse would not be appropriate.

Relevant definitions are:

Wastewater treatment: refers to biological, chemical and physical processes to bring wastewater to an acceptable level of quality for a particular purpose.

Wastewater reclamation: is the treatment of wastewater specifically for water reuse.

Primary Wastewater Treatment: is the physical removal of solids from wastewater through screening and settling processes. Forty per cent removal of organic matter and sixty percent removal of solids is achievable. An anaerobic lagoon cell or a primary clarifier are examples.

Secondary Treatment: is additional treatment of wastewater using a combination of aeration and solids retention to encourage bacteria to remove pollutants from the water and then subsequently settle the solids containing the biological growth. This process can remove ninety percent of organic matter and solids. A well designed lagoon with twelve months storage or an activated sludge treatment process can achieve these levels of treatment.

Tertiary Treatment: is a term applied to a variety of treatment processes that remove specific contaminants. These advanced treatment processes include filtration, chemical addition and disinfection among others. Table 2-1 illustrates the treatment methods necessary for various classes of contaminants.

Water recycling: is a term often used instead of water reuse, however, it technically means the reuse of reclaimed water for the same purpose. A water treatment plant or industrial process often reclaims process water and recycles it back to blend with raw source water.

Water reuse: is the use of reclaimed water for purposes other than the original purpose. (e.g. irrigation of a golf course).

Table 2-1 – Water/Wastewater Treatment Removal of Contaminants

Treatment Method	Contaminant Class						
		Pathogens					
	Particles	Bacteria	Viruses	Parasites	Inorganics	Organics	Radio-nuclides
Pretreatment	✓				✓	✓	✓
Primary Treatment	✓					✓	
Secondary Treatment	✓					✓	
Tertiary Treatment	✓	✓	✓	✓	✓	✓	✓
Microfiltration	✓	✓		✓			
Ultrafiltration	✓	✓	✓	✓		✓	
Reverse Osmosis	✓	✓	✓	✓	✓	✓	✓
Ion Exchange					✓		✓
Ozone		✓	✓	✓		✓	
UV + Hydrogen Peroxide		✓	✓	✓		✓	
Granular Activated Carbon						✓	
Wetlands	✓				✓	✓	
Chlorine Disinfection		✓	✓				

3 Water Reuse in Alberta

Over 70% of the water used in Alberta is for irrigation in southern Alberta. The rest of the allocations are for a variety of uses with municipal and industrial users being the only ones with significant wastewater to dispose of. Alberta's urban population is centered in two major cities on rivers that up until the 1990s, were considered to be able to supply sufficient water for future needs without employing extreme measures such as reusing wastewater. However, a combination of climate change, scientific advances on aquatic instream needs, water management planning and rapid economic growth has led to a realization that the rivers have reached or are near their capacity to supply long term source water. As a result, conservation measures are necessary and water reuse should be explored to reduce water demand.

Municipal water reuse has occurred in Alberta on a site specific basis since the 1980s. At least three golf courses near Calgary provide secondary treatment and then disinfect prior to reusing the water on fairways. Some municipalities such as Claresholm and Pincher Creek use lagoon effluent for irrigating agricultural crops. The most recent and innovative water reuse project involved reclaiming secondary wastewater effluent at the City of Edmonton Goldbar Wastewater Treatment Plant for use as process water at a petrochemical industry.

The Edmonton water reuse project is designed to reclaim up to 20 million liters (megaliters or ML) per day. The city wastewater undergoes advanced tertiary treatment with biological nutrient removal technology prior to release to the North Saskatchewan River. The city was interested in recycling water at the treatment plant for internal use as well as provide water to industrial customers. In addition, potential regulatory requirements for advanced treatment technology stimulated the City to consider membrane technology on a full scale basis. Associated Engineering Alberta Ltd. designed a phase one 5 ML/d membrane filtration plant with a 5.5 kilometer pipeline to a refinery. The plant is able to produce water with a turbidity of less than 0.3 NTU and suspended solids level of less than 1 mg/L. With disinfection, the water is as suitable as potable water for industrial processes.

In 2007, the City of Edmonton endorsed a plan to provide other industries with as much reclaimed water as possible. This was coincidental with the Alberta government's release of a Cumulative Environmental Management Framework that is to be applied to an industrial area North of Edmonton where petrochemical upgraders for the Alberta Oilsands are to be located. Industry, municipalities and the Province have put together a framework for the situation to determine the best way to mitigate river water quality concerns, address the potential for reclaiming water and meet the needs of users with regard to access to water.

4 Water Reuse Theory

The obvious benefit of reusing water is a reduction in the amount of source water needed and a corresponding reduction in operating costs. However, a reuse proposal stimulates debate on the negative effects to the environment. Initially, a reuse project appears beneficial because less water will be removed from the environment and contaminated water will not be released to a water body or aquifer. On the other hand, a reduction in return water means that downstream users have less water to access and the aquatic environment also receives less water.

This dilemma is difficult to address because the ability of the natural environment to assimilate wastewater will depend on the quality of the effluent and the condition of the water body while the ability of the aquatic environment to cope with less water will depend on the volume being permanently removed and the flow in the river in relation to the aquatic needs. The worst case scenario would be a reduction in flow due to a lack of return flow that affects fish habitat. The only way this scenario would not occur is if water reuse resulting in less water being diverted from the river. This offsetting flow would keep the river in equilibrium. This is unlikely to occur for long as most municipalities experience growth and need to access more water.

Each situation will need to be assessed on its own merit. The point to be made is that water reuse may not always be the best approach for protecting the environment.

5 Non Potable Water Reuse Options

There are several categories of water reuse for non potable application illustrated in Figure 5-1 for California. Specific uses within each category make the options even more varied. The volume of water reuse for the 35 million population of California was 680,000 dam^3 which is close to 50% of the median flow of the Red Deer River. Like Alberta, most of the reuse is for agricultural purposes. However, California regulates the effluent quality so that the reclaimed water can be used for a greater number of applications than in Alberta. Table 5-1 illustrates types of non potable uses and treatment required.

Figure 5-1 – 2001 California Recycled Water Use by Category

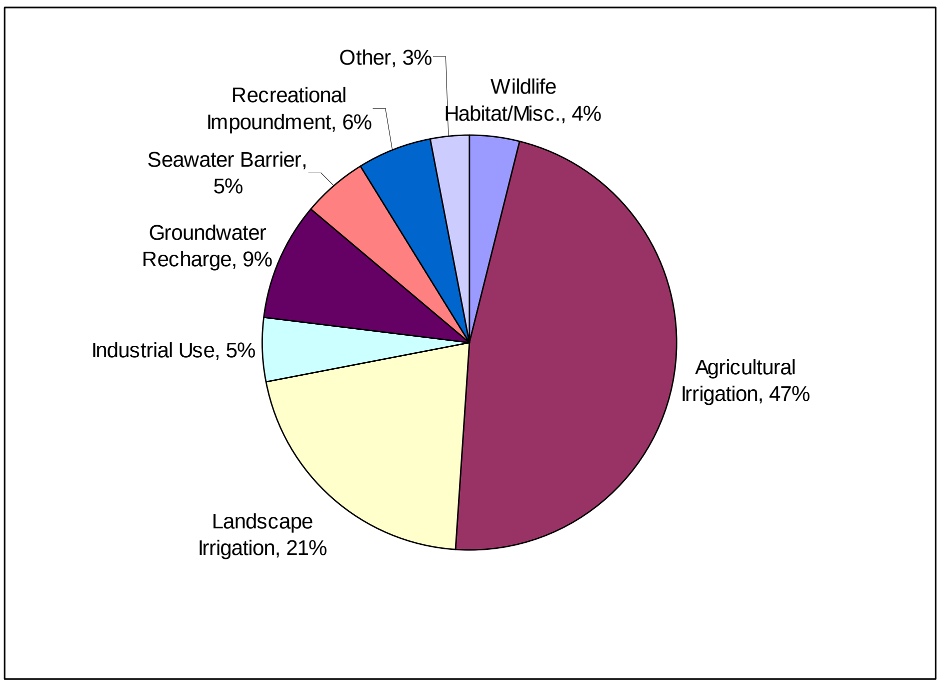

Table 5-1 Allowable Non-potable Uses in California

Types of Recycled Water Use	Recycled Water Treatment Level		
	Disinfected Tertiary	Disinfected Secondary	Undisinfected Secondary
Urban Uses and Landscape Irrigation			
Fire Protection and Fire Fighting	✓		
Toilet and Urinal Flushing	✓		
Irrigation of Parks, Schoolyards, Residential Landscaping	✓		
Irrigation of Cemeteries, Highway Landscaping, nurseries		✓	
Flushing Sewers			✓
Landscape Impoundment (pond) and fountains	✓	✓	
Agricultural Irrigation			
Pasture for Milk Producing Animals		✓	
Fodder and Fiber Crops			✓
Orchards (no contact between fruit and recycled water)			✓
Vineyards (no contact between fruit and recycled water)			✓
Non-Food Bearing Trees			✓
Food Crops Eaten After Processing		✓	
Food Crops Eaten Raw	✓		
Industrial/Commercial			
Commercial Car Washes	✓		
Commercial Laundries	✓		
Artificial Snow Making	✓		
Industrial Boiler Feed		✓	
Industrial Process Water – No Worker Contact		✓	
Industrial Process Water – Worker Contact	✓		
Soil Compaction, Concrete Mixing		✓	
Dust Control		✓	
Environmental			
Recreational Ponds with Body Contact (Swimming)	✓		
Wildlife Habitat/Wetland		✓	
Aquaculture	✓	✓	
Groundwater Recharge			
Replenishment of Potable Aquifers	✓		

In order to maximize the use of water, the City of San Diego has passed a bylaw requiring the mandatory reuse of water wherever it is feasible. This is a reasonable approach where the water is about to enter the Pacific Ocean so returning water to a river for environmental reasons is not required. The Bylaw requires dual plumbing to provide reclaimed water for toilets and urinals in buildings close to a Wastewater Treatment Plant as well as in school, government and industrial buildings.

6 Indirect Potable Reuse

Recycling reclaimed water directly into a potable water treatment plant is not recommended or permitted in any known jurisdiction. Public perception is a major constraint, however, a precautionary approach has merit. There are significant concerns about pathogens, metals and other contaminants that even at extremely low levels should still undergo additional treatment through natural processes.

As a result, California will allow the recycling of reclaimed water to surface water impoundments of 12 months storage or more and to groundwater aquifers. A key requirement is a multibarrier approach with each barrier able to be monitored separately. In addition, short circuiting in the surface impoundment or aquifer must be prevented.

Concerns about pharmaceuticals requires a risk management strategy involving both pre-treatment and source control programs. Removal to acceptable levels is possible but expensive.

7 Water Reuse Costs

The variables that affect the cost of a water reuse project include volumes of water, type of use, degree of treatment and distance to deliver the product. In California, the cost has been estimated at over \$720 per dam^3 and could go as high as \$2,500 per dam^3 which means a Town of 3,000 persons would require \$700,000 per year in capital and maintenance fees when annualized over the life of the project. This is comparable to water storage costs. Government assistance for this type of project would be required.

The cost to manage residuals or waste products at the end user is difficult to quantify because each case would be different as to the degree of use and disposal options.

8 Alberta Water Reuse Regulatory Requirements

Alberta wastewater standards permit water reuse projects for irrigation of golf courses and certain agricultural crops. It also permits release of secondary treated effluent to wetlands and rapid infiltration to groundwater where appropriate. There is no regulation of industry using recycled or reclaimed water unless an external source is used. Licencing then becomes an issue.

9 Water Reuse Benefits and Constraints

The benefits to water reuse are well documented in the southwest United States. Table 9-1 summarizes pros and cons of water reuse. This is likely because water is either being drawn from aquifers, is on its way to the Pacific Ocean or is being accessed from impounded water. In Alberta, there are instream needs that may conflict.

Table 9-1 – Potential Water Reuse Benefits and Constraints

Benefits	Constraints
Prevents withdrawal of more water from sensitive streams.	Water is not released for reuse downstream.
Contaminants are not released to a sensitive water body or aquifer.	Additional treatment infrastructure and pumping is required.
No increased infrastructure on rivers such as intakes and water treatment plants.	Capital and operating costs are higher than an intake. Grant funds are necessary.
Public likes recycling.	Public perception if water used for public needs.
Outfalls can be smaller.	Regulatory process may not be in place or flexible enough.
Nutrients in reclaimed water can be of use for irrigation.	Risk of cross connection with potable water.
Reduces the need for new water allocations.	Accumulation or concentration of salts etc. with too many cycles of reuse.
Can be used to recharge aquifers faster.	Disposal of residual products becomes more difficult and expensive
Can be used to safely recharge wetlands or shallow streams.	More qualified personnel needed.
High industrial water users such as water cooling can get adequate supply.	Not economically viable if source water is still accessible.
Regulatory approval process can be routine or non-existent.	Increased occupational health precautions however they should be minor
Can offset the need for regional system or alternate sources.	Variability in flow from source may not meet requirements of the end user
Water reuse supply is reliable.	
Water reuse volumes increases with economic growth.	

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7 Return Flow Credits

Technical Memorandum

Red Deer River Municipal Users Group

Return Flow Credits

November 2007

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TECHNICAL MEMORANDUM

1 Introduction

In water allocation licencing terminology, any excess water released back to the environment after a diversion is called a return flow. The most common use of the term is in the irrigation industry. If water cannot be used on the land, it must continue through the delivery system to a watercourse because there is rarely a means of capturing it. The means of reducing return flow is a combination of efficient use and balancing diversion from storage with demand.

Municipalities also balance diversion with demand on a much finer scale because the entire system is piped and storage levels drive when withdrawal from a source occurs on a daily basis. Another significant characteristic of municipal water supply systems is that 50 - 80% of the water is released back into the environment. This high percentage is because most municipal water consumption is for residential use (52%). Commercial and industrial use accounts for 35% (Source: Environment Canada website www.ec.gc.ca). Of the residential use, as much as 90% goes back to the environment in the winter. The amount returned in the summer depends on climate. Yard watering can be 50% of residential water use in June to August. On an annual average in a non-arid area of Canada, average return flow is 80%. In the Red Deer Basin in 2006, Drumheller had 69% return and the City of Red Deer had 81% return.

These high rates of water return have significance for the river and for water reuse. There is no licencing requirement to return water primarily because there historically has not been any other way to dispose of wastewater other than through a treatment plant and back to a watercourse primarily because most rivers were considered to have an abundance of water. In addition, up until the turn of the century, Alberta Environment was not concerned about water being returned for reuse in a watercourse.

Now that stream need constraints are being placed on licences and new licences either being high risk or not available, municipalities are questioning why they are not eligible for a credit for returning wastewater instead of being penalized. The value of return flow is exemplified by municipal revenue generating schemes where water is not returned to rivers but reclaimed for industrial use (e.g. City of Edmonton). There are at least two concepts that could be considered to take advantage of the value of return flow to a receiving stream. One is known as net diversion licencing and the other is termed “return flow compensation”. The return of wastewater has been given consideration in some American jurisdictions. American terminology for the licencing approach includes conserved water credits or return flow credits.

2 Net Diversion Licencing

2.1 Theory

If a water balance approach was taken to water allocations, then the gross amount diverted minus the amount returned would equal the net diversion. In other words, a credit is given for returning water towards an additional allocation. On first examination, this sounds reasonable, however, there are factors that complicate application of this theory.

There are very few situations where return flow credits or net diversion licencing is applied. Diversions from Lake Mead in Utah is probably the most well documented case. A licencee may divert a predetermined amount of water on an annual basis but can divert additional amounts if reclaimed wastewater is returned to the lake. It should be noted that the return flow is directly back to the source and it must be reclaimed to an acceptable standard. Legislation in Arizona and Mexico also has provisions for return flow credits but on a limited basis depending on the approval engineer. In most cases, these are in highly regulated rivers such as the Colorado and subject to many conditions.

2.2 Conditional Factors

In an ideal net diversion licensing situation, the return flow would be back to the diversion point at the same rate as the diversion and of the same quality. In almost all cases, this is not practical without prohibitive energy and financial costs as a result. If a net diversion is to occur, there will be a section of the river between the diversion and the return where the water volume is reduced. The location of the return flow relative to the diversion should not be of concern unless the rate of flow approaches the instream objective or the water conservation objective.

There also may be a difference in rate of diversion, however, on a daily basis, this should not be a factor as long as the return is continuous. A continuous return condition excludes any municipality that utilizes a lagoon treatment process from a net diversion because lagoon return flow occurs on a seasonal or annual basis. However, there may be a role for this type of return as flow compensation to be discussed in Section 3.3.

Lastly, the quality of the reclaimed return flow water should be high enough to not affect aquatic life. This means meeting place based criteria on a daily basis. A formula can be created to take into account upstream quality and quantity in order to regulate the return.

There are two major concerns about net diversion licencing. The first is that there would be less flow moving downstream for the aquatic environment as a municipality takes more water through the credit system. Secondly, there would be less water available for junior licences because the senior licence would be using more water. In theory, this could be five times as much water if 80% was returned because each additional amount of water diverted could have a return. For example, under current licencing, if a municipality had a 100 acre ft allocation and typically returned 80% of the water, then when 100 acre feet is diverted (20 acre feet is consumed and 80 acre feet are returned). Using the same allocation under a net diversion licence, a municipality could divert 500 acre feet if 400 acre feet was returned for a net consumption of the licenced 100 acre feet.

The extreme case would be of concern but a reasonable approach would be a municipality reducing their allocation by 60% based on consumption and accepting a licence condition that requires a continuous return flow of 400% of the allocation. Table 2-2 summarizes advantages and disadvantages of net diversions.

It should be noted that the Water Act would not need to be amended for a new allocation because the original allocation would still apply under a net diversion approach. However, the licence would need to be amended for reducing the allocation, basing it on consumption, mandating return flow quantity and quality and any other condition the Director under the Water Act would need to apply.

Table 2-2 Net Diversion Advantages and Disadvantages

Advantages	Disadvantages
1. Water must be returned to the source for reuse downstream.	Less water is available downstream for the environment due to increased efficiency of use. This may only be a factor in water shortages.
2. Can require enhanced return flow quality.	Water quality downstream is somewhat degraded depending on quality requirements.
3. A licencee receives additional diversions for returning water.	Unless electronic reporting of volumes and quality is implemented, administration would be complex.
4. Downstream users are not affected under normal flow conditions.	The reach of river between diversion and return would need to be assessed and managed to prevent harm to the aquatic environment.
5. A total diversion cap of 125% of an allocation would protect upstream junior licencees and downstream environment.	Without carefully worded licence conditions, there could be less incentive for water conservation measures.
6. Increased monitoring of the river.	Increased cost for monitoring quality and quantity of upstream, downstream and return flow.

3 Return Flow Compensation

3.1 Introduction

Alberta Rivers have at least two seasons where low flow conditions are predictable. These occur in mid to late winter and also in mid to late summer. A municipality may be penalized for having a junior licence with a low flow rate condition even though they are returning 80% of the diversion. The instream objective or WCO is an instantaneous condition so just as in the net diversion case, a continuous return of high quality water could compensate for taking water when the flow is below the WCO.

It could be argued that the return flow is occurring in any event, so why give a municipality any credit? The counter argument is that the return flow could be diverted for reuse such as in industrial processes or for agricultural irrigation if there was no incentive to return it. This would result in a loss of flow in the river for other purposes.

3.2 Aquatera Return Flow Compensation Licence

Aquatera Utilities Inc. supplies a regional water system that includes the City of Grande Prairie and surrounding communities. As of December 2007 it had a temporary licence issued in November 2006 that required the following:

- Calculations or measurements of diversions, returns, river flows and instream objectives
- A continuous return of 65% of total monthly volume diverted when the instream objective is being met
- A continuous return of 100% of the rate of diversion when the instream objective is not met
- A diversion of no more than 5% of the river flow when the instream objective is not met
- An aquatic assessment program (annual monitoring) of the river between diversion and return and downstream
- A water conservation plan.

Several aspects of the licence are of interest. This was an additional licence to an existing licence which are typically not linked other than as a cumulative diversion volume. In this case the regulator wanted to negate the potential use of a more senior licence release to make up return flow for a junior licence. However requiring 100% rate of return flow requires storage, some of which the utility has, but of more concern is that balancing flows to meet a specified rate is onerous. An additional problem is that river flow measurements, especially in the winter, are not reliable so meeting a calculated instream objective and matching return flows has proven to be a problem.

The aquatic assessment has also proven to be a problem. The program proposed by the utility has not met with the regulators' approval because specialists in the fishery habitat field have a different standard for scientific evaluations than expected by a utility that originally planned to monitor water quality changes and provide baseline information on any change in indicators on the bed of the river.

3.3 Conditional Factors

As with net diversion licensing, a return flow compensation process should be limited to prevent excessive use. On the other hand expecting that there will be 100% compensation by wastewater returns is unrealistic especially when the river flow is below the instream objective. Allowing an excursion of withdrawing up to 10% below the instream objective of the natural flow may be an appropriate initial target depending on a risk analysis if there is no ready source of water to be returned. Difficulties with river flow monitoring and correlating return flow suggest that a weekly time step based on volume would seem more appropriate than an instantaneous rate for volume and rate regulation.

It would also be appropriate to incorporate a scientific assessment of the risk of the withdrawal causing harm to the aquatic environment. This outcome based approach would put river flows into perspective with withdrawals. At present the approach is no net loss of flow without consideration for what that means in terms of a change in water level and how that translates to aquatic effects if at all. This assessment should be applied primarily to the reach between the withdrawal and the return if there is going to be 100% return. If there is going to be a consistent excursion permitted then the same assessment should be made downstream to a predetermined point based on volume and risk. There is an interest in quality effects downstream but the regulator should regulate that through the emission limits and total loading approaches rather than through the diversion licencing process. Quality is important, but past the point of return the quantity is of primary importance if the quality for the emissions has been achieved.

Lastly, the overall effect on the river should be considered given there is a net loss of water either if wastewater is diverted away from the river or if additional diversion is permitted through compensation.

3.4 Stored Stormwater or Wastewater for Compensation

Many Alberta communities have large twelve month wastewater lagoon cells that are typically released in the Spring or Fall. They also may have large wet storm ponds. This type of infrastructure could be utilized to release water during low flow conditions to meet instream flow conditions.

An alternative is to provide wastewater treatment for the stored water to reclaim the water and reuse it for other purposes such as irrigation.

4 Conclusions

In an ideal basin a water management plan would have addressed what instream flows are desirable in consultation with stakeholders and arrived at a reasonable approach to managing flows when licences reach their limits either due to growth or natural conditions. In the absence of all of these conditions there is merit in municipalities working with regulators to arrive at a licencing scenario where continuously returned wastewater is given some credit for additional diversions. This requires consideration of a consumptive use licence that formalizes present practice where both water resources modeling and licencing recognize returned water as being available for reuse. Similarly, there should be some credit for returning water when instream flow conditions reach a stage where licences are affected.

Should return flow credits not be deemed appropriate by regulation, then an alternative could be that the licensee retains rights to the returned water and exchanges it under a market system with downstream users for compensation. Conversely, water could be purchased from upstream returns. This also could also be of concern to regulators and in any event significant changes to legislation would be necessary.

5 References

Town of Okotoks Return Flow Compensation Proposal 2006.

Southern Nevada Water Authority Water Management Plan, Chapter 4, Meeting Future Demands 2006.

Aquatera Utilities Inc. Licence to Divert Water Number 00227490-00-00, November 24, 2006.

8 Simulation Modeling and Storage Requirements

Technical Memorandum

Associated Engineering

GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Red Deer River Municipal Users Group

Simulation Modelling and Storage Requirements

February 2008

Table of Contents

TECHNICAL MEMORANDUM

1 Introduction

The **Red Deer River Municipal Users Group (RDRMUG)** is an association of rural and urban municipalities within the Red Deer River Basin, and other communities near the basin, who receive water from the Red Deer River (Figure 1). The group provides a platform for members to work together towards common goals. The **RDRMUG** has retained the services of Associated Engineering and Hart Water Management Consulting to study the potential future municipal water needs within the Red Deer River Basin and make recommendations on policies and procedures to secure those needs for municipalities.

Many municipalities in Alberta rely on diversions from storage projects to meet their daily water needs. Some communities have dedicated storage that is used solely to meet their own needs; others use provincial projects designed to meet a variety of needs including municipal water requirements. Dickson Dam (Glennifer Reservoir) is an example of the latter. Storage development can be either onstream or offstream. Each has advantages and disadvantages. This technical memorandum will examine the need for water storage in the Red Deer River Basin to fully meet current and projected water demands in light of the variability in natural flow and the recently established Water Conservation Objectives.

Simulation modelling has been used extensively to analyze various water management options (scenarios) and evaluate the performance of water management measures intended to address issues. This Technical Memorandum describes potential storage options identified in previous studies. It also outlines the principles and the key assumptions inherent in the simulation modelling conducted for the assessment of water availability for municipal users in the Red Deer River Basin and the need for storage development. Awareness of these principles and assumptions are important to the full understanding and interpretation of results, and performance evaluations based on simulation modelling.

2 Potential Storage Sites

Alberta Environment has commissioned two studies to examine potential storage sites throughout the province. The first study was completed in September 2005 titled Provincial Inventory of Potential Water Storage Sites and Diversion Scenarios (MPE Engineering, 2005). It documented historic assessment for thirty five (35) sites for off stream and on stream storage options. These options were for a variety of purposes including coal mining, petrochemical use and municipal needs. Hart Water Management Consulting has located a report that did not appear to be included in the 2005 report inventory. It is entitled An Assessment of Alternatives to a Dam on the Red Deer River, Alberta Environment, 1976. This report enumerated another twelve (12) off stream sites. The figure in the Appendix shows the locations of all the sites and a table in the Appendix describes characteristics of the storage options. The second Alberta Environment study is a follow-up to the 2005 study. The study was scheduled to be completed in January 2008, however, it is not yet available. It is intended to evaluate the storage sites identified in the 2005 study and rank them as to their potential for further study. It is likely that the Red Deer Watershed Alliance will be engaged to assist the province in determining what projects if any should be addressed.

The Alberta Water for Life Consultation initiative found that most Albertans are not in favour of large scale diversions of water or damming of rivers for storage purposes. The last major dam constructed in Alberta was the Twin Valley Dam on the Little Bow River in 2005. This project took over 30 years to plan, get through the regulatory process and construct. It is speculated that no on stream project would be embarked on in the foreseeable future due to the environmental implications and adverse public opinion.

This is not to say that on stream projects are not beneficial. The Oldman reservoir has proven invaluable for providing reliable water supplies for water users, instream needs and apportionment for the entire basin. Onstream reservoirs can capture water without the need for pumping or diversion works other than the dam itself. Generally, the environmental impact of onstream storage is more extensive than for offstream storage because of the aquatic and riparian impacts. The spillway and dam safety requirements can also be very costly for onstream projects.

Off stream storage is a viable option in many instances. A gravity fill situation is desirable but pumping may be necessary where topography is not conducive to gravity diversions. The Special Areas Water Supply Project is an example where pumping to storage is necessary. The most recent gravity-fill offstream project constructed in Alberta is the Pine Coulee project which is filled from Willow Creek.

When a project exceeds 25,000 dam^3 or 15 m in height, an Environmental Impact Assessment is required. This will ensure all environmental, economic and social concerns are addressed. But it also means a project can take a long time to develop.

3 Simulation Modelling – Why Model?

Modelling is an essential analytical technique for assessing water management options and optimizing the performance of complex water management systems. The approach is based on the premise that the performance of the system over a lengthy period of recorded conditions, that includes representative flood and drought periods, provides an insight into how well the system will perform in the future. Simulation modelling assists in developing an understanding of the issues and provides a basis for a rational discussion of alternatives.

4 What are the Basic Characteristics of the Model?

The physical configuration of streams, diversions, canals and reservoirs is represented in the model as a network of nodes and links. The nodes are locations in the physical system where there are reservoirs, stream or canal junctions, diversions or major withdrawals or inflows. Links are streams and canals. Modelling in the SSRB has been conducted using a weekly time step for the 68-year period of streamflow and climatic conditions, 1928 to 1995. Input data for the model includes the following:

- Weekly natural flow data at key locations in the study area.
- Consumptive water demands for various purposes, such as:
  - domestic
  - stock water
  - municipal
  - industrial
  - irrigation
  - recreation
  - waterfowl conservation.
- Weekly lake evaporation and precipitation data, to account for reservoir losses.
- Instream flow targets for key stream reaches.
- Reservoir storage characteristics and operating rules.
- The priority system for supplying water to the various users.

Water use priorities are input to the model through a penalty point system. Deficits to high priority uses have high penalties; deficits to lower priority uses would have lower penalties. The model contains an optimization procedure that minimizes the penalties throughout the entire system in each time step (week) to establish the perfect operational solution for that time step.

The model computes water deliveries to meet demands in accordance with the priorities and constraints, such as canal capacities within the system. It also computes the resulting stream and canal flows, and reservoir levels. Subject to assumptions and modelling limitations (discussed later), the model output represents the conditions that would have existed if the management scenario had been in place during the historical period of streamflow and climatic conditions simulated.

5 What is a Scenario? How are Scenarios Evaluated?

A scenario is a representation of existing or future water management options, including demands, priorities, operating policies, structural facilities, and non-structural water management measures.

The performance of a scenario is assessed by analyzing output data to determine how well objectives are met, or are not met. The magnitude, frequency and duration of failure to meet water needs are common measures of performance. Simplified tables or graphics targeted to highlight the performance in meeting specific objectives assist in evaluating the performance of one management scenario against others. Simulation modelling to explore various “what if” scenarios helps to understand the trade-offs and work toward a consensus on the best-possible alternative.

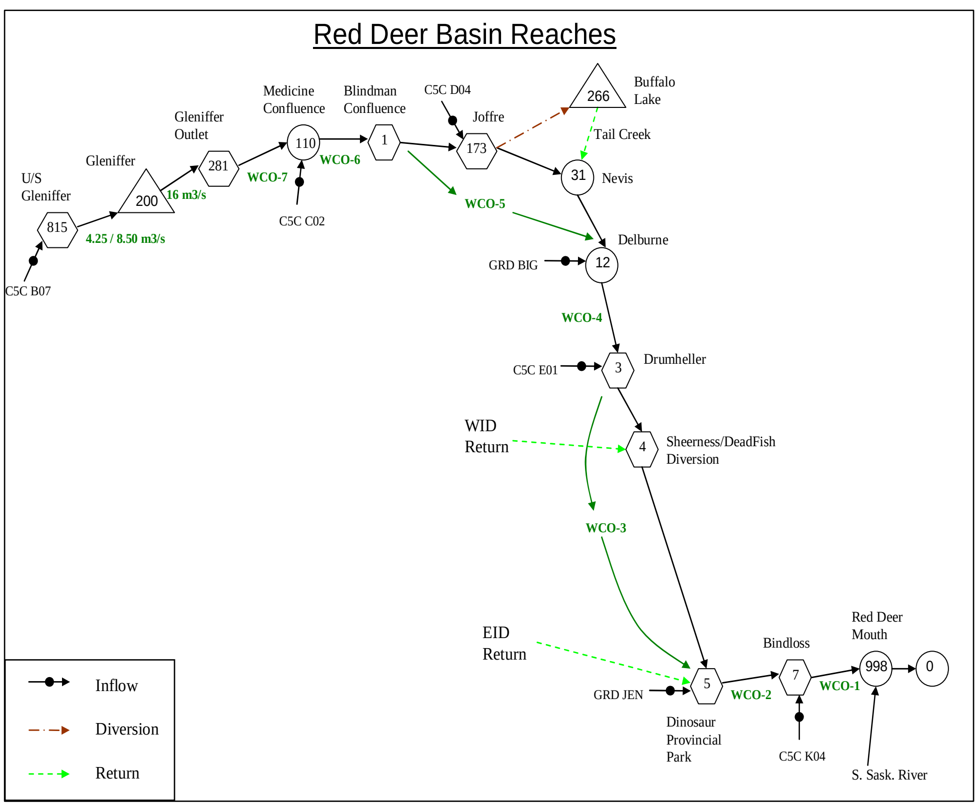
6 Modelling Assumptions

6.1 Configuration

The number of nodes and links define the resolution of the model in terms of computing flows in stream reaches and performance in meeting demands. A large number of nodes add to the complexity of the model, the extent of input data required and the difficulty in interpreting the results. The configuration of the model used by Alberta Environment for SSRB planning was used for this analysis. Figure 6.1 is a schematic showing the links and nodes for the Red Deer River Basin.

Local inflows and demands along stream reaches (between nodes) are totalled and input to the model at the nodes. Demands are modelled as "blocks of users" rather than as individual users. Demands are input at the upstream node; local inflow between nodes is input at the downstream node. This modelling process is somewhat conservative in that the local runoff within reach does not contribute to meeting demands within that reach.

Figure 1 – Schematic Showing Nodes and Links for Simulation Modelling Within the Red Deer River Basin



6.2 Natural Flows

Weekly natural inflow to the study area for the period 1928 to 1995 was estimated by adjusting recorded flows to account for historical diversions and some of the larger consumptive uses. Not all uses were considered in adjusting the recorded flow due to lack of water use data for the historical period. As a result, natural flow may have been slightly higher than that used for modelling purposes, particularly in the latter part of the study period. Underestimating the natural inflow would not have a significant impact on modelling results, but again, it represents a conservative approach.

6.3 Demands

Alberta Environment's licensing database was used to determine the location and relative size of projects in the basin. Actual water demands were estimated based on past performance and needs for the project. Estimated actual demands were often less than the licensed allocation for the project. As in SSRB planning, demands for the entire basin were input to the model. This is a limitation of the model as currently configured. Some of these demands may not impact the mainstem Red Deer River. Mainstem demands are those demands that have the potential to reduce Red Deer River flows in the critical instream flow (WCO) reaches along the river. Sorting the basin demands to those that would only impact the mainstem stream is beyond the scope of this study.

There are probably a number of licensed projects in the study area that are not being operated for a variety of reasons. This analysis assumes that all licensed projects are in good standing and operating. This reflects the possibility that whatever circumstances led to not operating the projects could be remedied and the licensee resumed operation, or the water allocation was transferred to a user that would operate the project.

Weekly irrigation demands for each irrigation block were estimated by Alberta Agriculture, Food and Rural Development based on the irrigated area, an assumed the mix of crops grown, weather conditions (precipitation and evapo-transpiration), and assumed on-farm irrigation management practices. Demands were variable from year to year, being lower in cool, wet years and higher in hot, dry years.

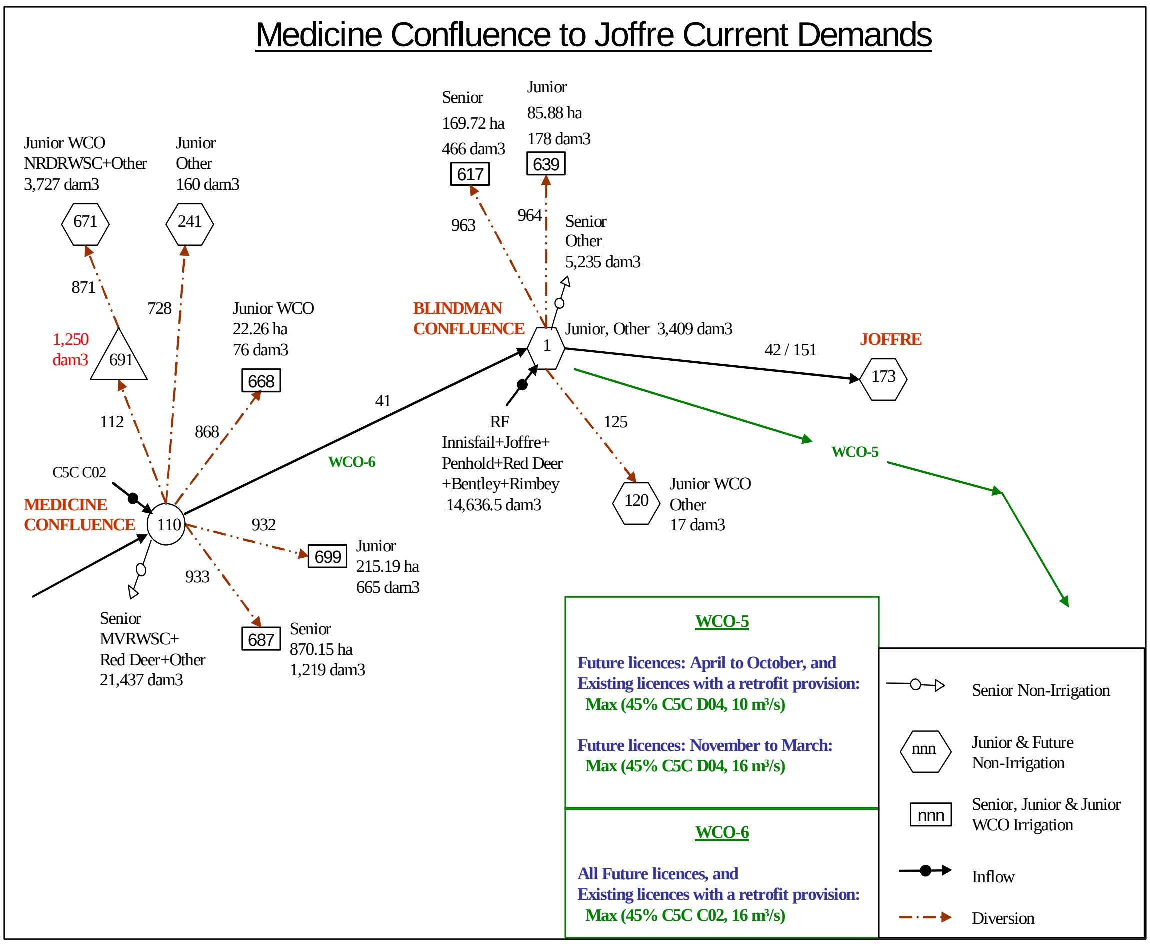
For most irrigation blocks, crop demand exceeds the licence allocation in some years. Modelling assumed that irrigation applications ceased when the full licensed allocation was withdrawn from the source of supply, even if crop requirements are not met.

Weekly non-irrigation demands (municipal, industrial, livestock, etc.) and return flows were estimated as average annual values at the 2006, 2031 and 2056 levels of development (Technical Memorandums on municipal and non-municipal water use. Demands were assumed to be the same every year regardless of weather, market conditions, water availability, etc.

6.4 Priorities

Water use priorities under the Water Act (as well as predecessor legislation) are based on the date of a completed licence application. Each licence issued in the Red Deer River Basin has a unique priority. In water-short years, uses would be cut off in order of junior to senior priority. Simulation modelling does not address the priority of each individual licence. Water demands of similar priority in relation to instream needs (WCO) are accumulated, assigned to a node, and treated as a single demand block. An example of this is shown in Figure 6.2. Assumptions were intended to reflect reality insofar as possible considering modelling practicality and convenience.

Figure 6.2 – Schematic of Typical Nodes Showing Typical Nodes Showing Water Demands at the Medicine and Blindman River Confluences



7 Model Limitations

7.1 Historical Climate Variability

Simulation modelling has been conducted over the historical period of weather and streamflow conditions from 1928 to 1995. How well does the 68-year period of recorded conditions represent the variability in water supply and demand that can be expected in the future? Studies of tree rings, lake sediments and other climatic indicators on the Canadian prairies have shed some light on the climate of past centuries (Sauchyn 1997; Case et al 2003). Researchers have concluded that streamflows were relatively high on the Canadian Prairies during the 20th Century compared with earlier centuries. Sauchon concludes that,
"…. the recent occupants of the Palliser triangle have not yet experienced the extremes of summer precipitation that occurred in the 19th and late-18th Centuries, and that could reoccur in the near future."

This conclusion suggests that modelling results using the 1928 to 1995 recorded period could present an overly optimistic picture of long-term water supply and demand.

7.2 Climate Change

How will climate change affect the performance of the water management system in the South Saskatchewan River Basin? There is evidence that the climate on the Canadian Prairies is changing. There appears to be agreement that temperatures are rising and will probably continue to rise. There is less certainty about precipitation, particularly on a regional level. At present, there is insufficient information to develop and analyze a credible water resource climate change scenario at a regional level. Work has been initiated by Alberta Environment toward that end.

8 The Scenarios

Three demand scenarios were simulated:

1. Current (2006) level of demand.
2. 2031 level of demand.
3. 2056 level of demand.

For each scenario, the magnitude and frequency of deficits to municipal users (and other users with similar priorities) were determined. For each scenario, an iterative process was used to determine the amount of storage required to eliminate the deficits. It was assumed that the storage would be dedicated specifically for meeting the estimated deficits.

9 Simulation Modelling Findings and Discussion

Municipal demands of greatest risk are those subject to the recently created WCOs for the Red Deer River, namely, the North Red Deer, Highway 12/21, Shirley McClellan and Kneehill Regional Projects and all recent and future allocations for communities and regional projects. This analysis will focus on Junior (WCO) demand Block 671 at the Medicine River Confluence, Block 807 at Node 31: Nevis, and Block 674 at Node 3: Drumheller. These three demand blocks contain most of the junior (WCO) licences along the river.

9.1 Node 110: Medicine River Confluence, Block 671 Junior (WCO)

The configuration of Node 110 is shown on Figure 6.2. The current, 2031 and 2056 demands for Block 671 are listed in Table 9.1. The performance in meeting the demands is also summarized in the table.

The **current level of demand** (3727 dam^3) would experience deficits in 52 out of 68 years, or 76 percent of the years (Figure 9.3). Most of the deficits would be less than 20 percent of the annual volume required, but in a few years ('36, '50, '84, '85) deficits approached 50 percent of the annual volume required. Almost all of the deficits occurred during winter. Subsequent analyses indicated that the deficits in Block 671 could be eliminated with 1250 dam^3 of dedicated storage.

The **2031 level of demand** for Block 671 (21,197) includes a junior (WCO) demand of 8441 dam^3 for the City of Red Deer and 4914 dam^3 for water users that are currently using groundwater to convert to surface water. The demand block would experience deficits in 76 percent of the years (Figure 9.4), about the same frequency as for the current scenario. The magnitude of the deficits would range from less than 20 percent to 50 percent of the total demand. Most of the deficits would occur in the winter months. The deficits could be eliminated with 12,000 dam^3 of live storage.

The **2056 level of demand** for Block 671 (33,241 dam^3) includes a demand of 442 dam^3 for the Mountain View Regional Project. The demand block would experience deficits in 82 percent of the years (Figure 9.5). The magnitude of the deficits would range from less than 25 percent to 60 percent of the total demand. Most of the deficits would occur in the winter months. The deficits could be eliminated with 19,000 dam^3 of live storage.

Table 9.1 - Summary of Demands and Performance in Meeting Junior (WCO) Demands at Node 671: Medicine River Confluence

Demand Block No. 671 Node 110: Medicine River Confluence					
Priority: Junior (WCO)					
Projects			**Estimated Actual Demands (dam^3)**		
			Current	**2031**	**2056**
	North Red Deer Regional		3,680	7,668	10,513
	City of Red Deer			8,441	14,692
	Mountain View Regional				442
	Other		47	205	441
	GW to SW Conversions			4,914	7,153
	Totals		**3,727**	**21,197**	**33,241**
Deficits					
	No. of deficits (out of 68 years)		51	52	56
	% of years with deficits		75%	76%	82%
	Maximum deficit (% of total demand)		50%	50%	60%
	Comments	Almost all deficits are in the winter months. Winter deficits are generally less than 25 percent of the demand. Exceptions are very dry years ('36, '37, '41, '50, '84, '85, '88) when summer deficits would occur.			
Storage Requirements					
	Capacity required (dam^3)		1,250	12,000	19,000
	Offstream projects identified/capacity (dam^3)		(Reference: Alberta Environment 1976)		
		Blackfalds Lake	6,000		
		Unnamed Lake near Labuma	6,000		
		Coulee near Prentiss	6,000		
		Jones Creek (south of Joffre)	4,000		
		Sylvan Lake		variable	variable
		Buffalo Lake		variable	variable

Figure 9.1 - Annual Deficits for Demand Block 671 at the Medicine River Confluence for the Current Level of Demand

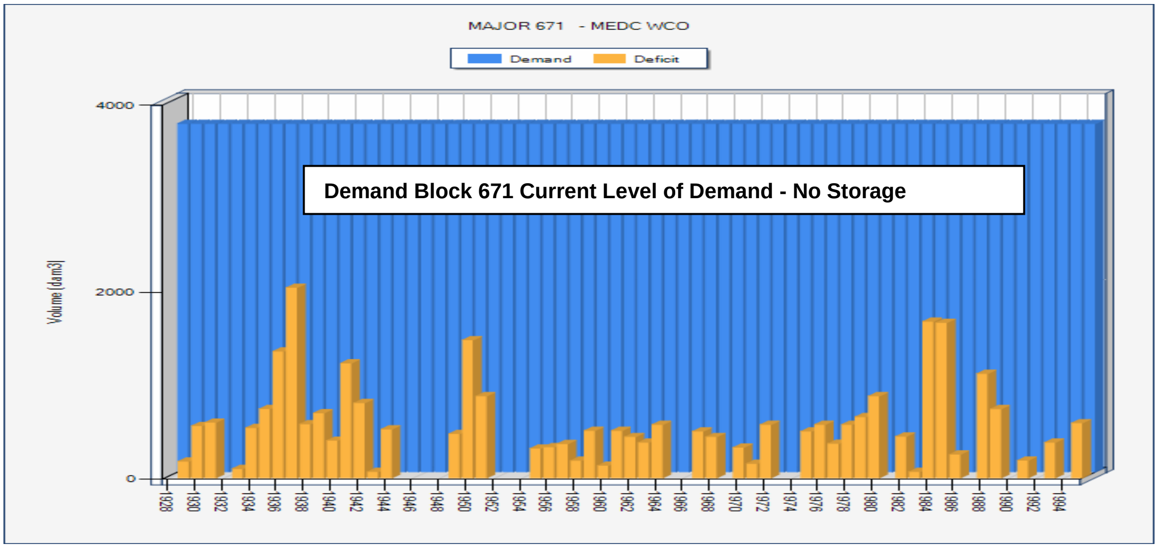


Figure 9.2 – Annual Deficits for Demand Block 671 at the Medicine River Confluence for the 2031 Level of Demand

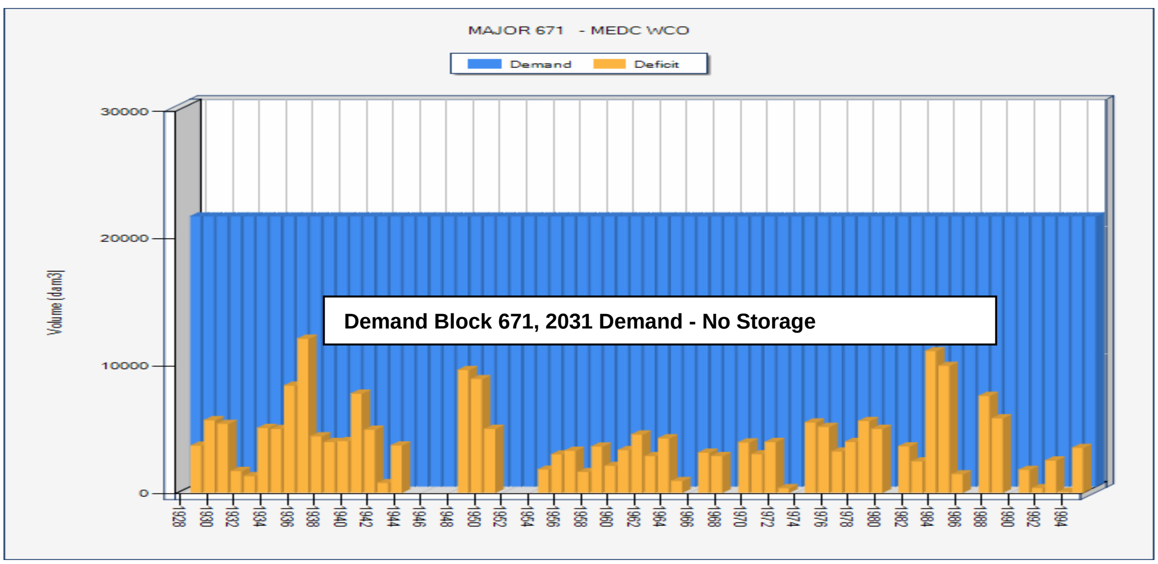
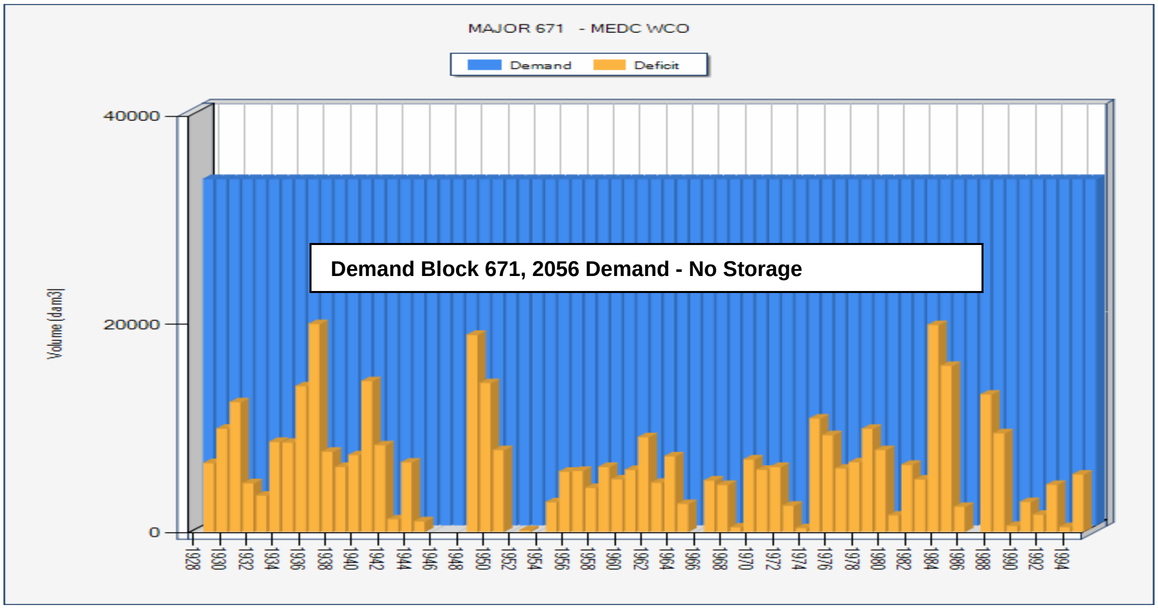


Figure 9.3 – Annual Deficits for Demand Block 671 at the Medicine River Confluence for the 2056 Level of Demand



Several offstream storage sites near the City of Red Deer were identified in a 1976 study (Alberta Environment 1976) that could be used to supplement water supplies and eliminate deficits (Table 9.1). All projects would require diversion works from the Red Deer River. The two largest projects, Sylvan Lake and Buffalo Lake, could probably meet the needs of several other users in addition to the Block 671 demands by releasing water back into the Red Deer River in times of instream or consumptive use deficits. Several issues, such as water quality, pumping costs and impact on recreational uses of the lakes, would have to be addressed to determine the feasibility of using the lakes to regulate Red Deer River flows. Alberta Environment owns and operates diversion works to assist in stabilizing the levels of Buffalo Lake. The capacity of these works would have to be increased.

9.2 Node 31: Nevis, Block 807 Junior (WCO)

The configuration of Node 31 is shown on Figure 9.2. The current, 2031 and 2056 demands for Block 807 are listed in Table 9.2. The performance in meeting the demands is also summarized in the table.

The **current level of demand** for the Highway 12/21 and Shirley McClellan Regional Projects (3097 dam^3) would experience deficits in 49 out of 68 years, or 72 percent of the years (Figure 9.6). Most of the deficits would occur in winter months and would be less than 25 percent of the annual volume required. However, in nine (9) low flow years, summer deficits would occur which would increase the deficits to up to 63 percent of the demand. Subsequent analyses indicated that the deficits in Block 807 could be eliminated with 1400 dam^3 of dedicated storage.

The **2031 level of demand** for Block 807 (7099 dam^3) includes a junior (WCO) demand of 418 dam^3 for water users that are currently using groundwater to convert to surface water. The demand block would experience deficits in 80 percent of the years (Figure 9.7). The magnitude of the deficits would range from less than 20 percent to 60 percent of the total demand. Most of the deficits would occur in the winter months. The deficits could be eliminated with 5700 dam^3 of live storage.

The **2056 level of demand** for Block 807 (12,414 dam^3) includes a demand of 333 dam^3 for the Town of Stettler. The demand block would experience deficits in 93 percent of the years (Figure 9.8). The magnitude of the deficits would range from less than 25 percent to 70 percent of the total demand. Most of the deficits would occur in the winter months. The deficits could be eliminated with 10,000 dam^3 of live storage.

Small storage sites in the vicinity of Nevis that could be used to eliminate deficits have not been identified in previous studies. Further investigations may reveal that some sites exist. Buffalo Lake operated as an offstream reservoir to regulate Red Deer River flows could be used to eliminate deficits at the Nevis location.

Table 9.2 – Summary of Demands and Performance in Meeting Junior (WCO) Demands at Node 31: Nevis

Demand Block No. 807 Node 31: Nevis			
Priority: Junior (WCO)			
Projects	**Estimated Actual Demands (dam³)**		
	Current	**2031**	**2056**
Highway 12/21 Regional Project	1,118	1,564	2,648
Shirley McClellan Regional Project	1,979	5,117	8,587
Stettler			333
GW to SW Conversions		418	846
Totals	**3,097**	**7,099**	**12,414**
Deficits			
No. of deficits (out of 68 years)	49	56	63
% of years with deficits	72%	80%	93%
Maximum deficit (% of total demand)	63%	60%	70%
Comments	Most deficits are in the winter months. Winter deficits are generally less than 25 percent of the demand. Exceptions are 9 very dry years when summer deficits would occur increasing the annual deficit to 70% of the annual demand.		
Storage Requirements			
Capacity required (dam^3)	1,400	5,700	10,000
Offstream projects identified/capacity (dam^3)	(Reference: Alberta Environment 1976)		
Buffalo Lake	variable	variable	variable
Comments	Buffalo Lake has the potential to serve as a water supply reservoir for meeting insteam and consumptive needs along the Red Deer River downstream of Tail Creek. Further investigations for smaller sites are needed.		

Figure 9.4 – Annual Deficits for Demand Block 807 at Nevis for the Current Level of Demand

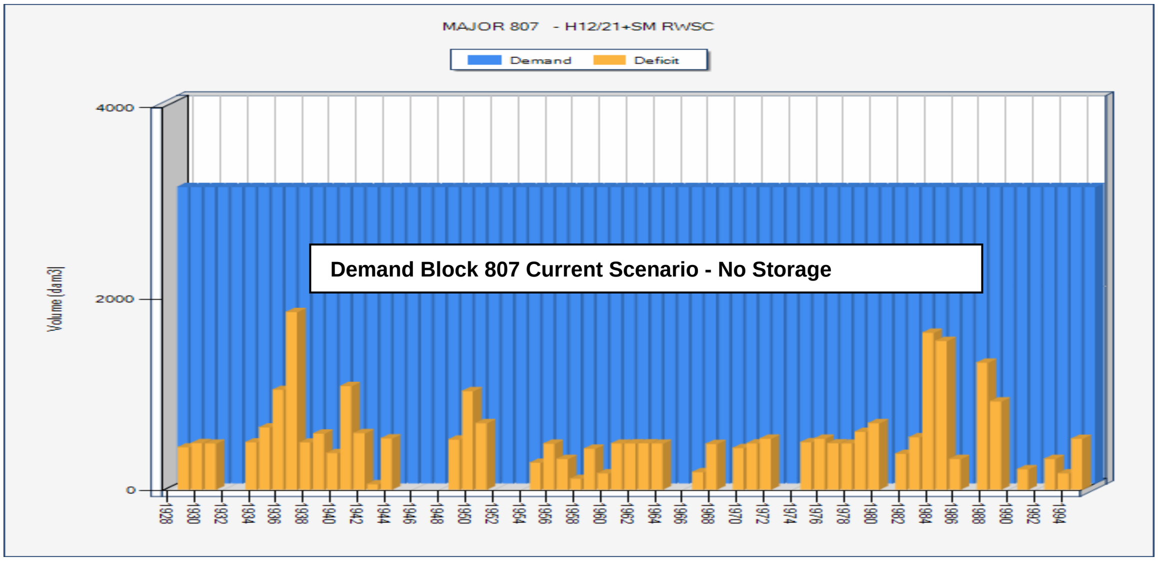


Figure 9.5 – Annual Deficits for Demand Block 807 at Nevis for the 2031 Level of Demand

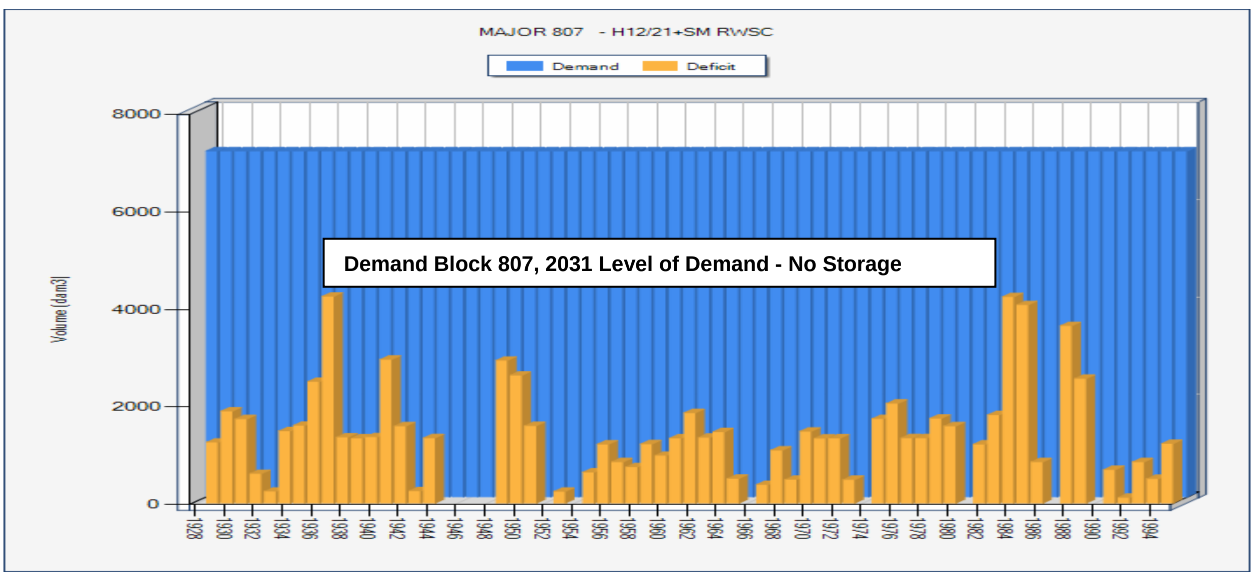
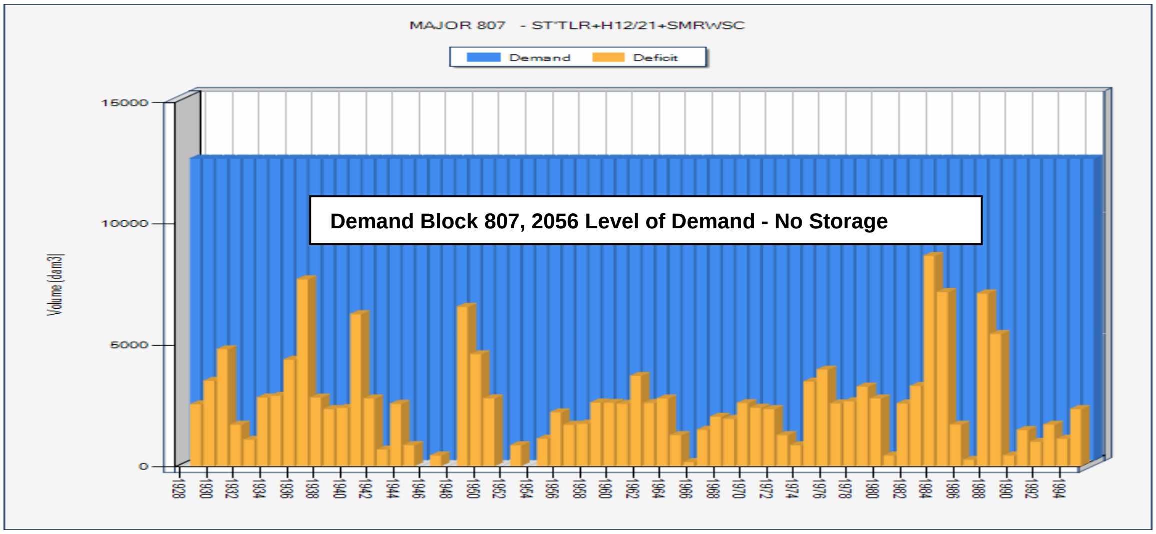


Figure 9.6 – Annual Deficits for Demand Block 807 at Nevis for the 2056 Level of Demand



9.3 Node 3: Drumheller, Block 674 Junior (WCO)

Current uses represented by Block 674 include the Kneehill Regional Project, the Morrin/Munson Waterline and other (non-municipal) users. The current, 2031 and 2056 demands for Block 674 are listed in Table 9.3. The performance in meeting the demands is also summarized in the table.

The **current level of demand** for the Block 674 (600 dam^3) would experience deficits in 6 out of 68 years, or 9 percent of the years (Figure 9.9). Deficits would occur in both summer and winter months and would range from 9 to 35 percent of the annual demand. Deficits could be eliminated with storage of about 215 dam^3.

Table 9.3 Demands and Performance Summary for Junior (WCO) Demands at Drumheller			
Demand Block No. 674 Node 3: Drumheller			
Priority: Junior (WCO)			
Projects	**Estimated Actual Demands (dam^3)**		
	Current	**2031**	**2056**
Kneehill Regional Project	454	820	995
Morrin/Munson Line	85	98	119
GW to SW Conversions		1,132	2,155
Other	61	568	1,330
Totals	**600**	**2,618**	**4,599**
Deficits			
No. of deficits (out of 68 years)	6	8	12
% of years with deficits	9%	12%	18%
Maximum deficit (% of total demand)	35%	35%	40%
Comments	Deficits occur in both summer and winter months.		
Storage Requirements			
Capacity required (dam^3)	1,400	5,700	10,000
Offstream projects identified/capacity (dam^3)	(Reference: Alberta Environment 1976)		
Buffalo Lake	variable	variable	variable
Comments	Buffalo Lake has the potential to serve as a water supply reservoir for meeting insteam and consumptive needs along the Red Deer River downstream of Tail Creek. Further investigations for smaller sites are needed.		

Figure 9.7 – Annual Deficits for Block 674 at Drumheller at the Current Level of Demand

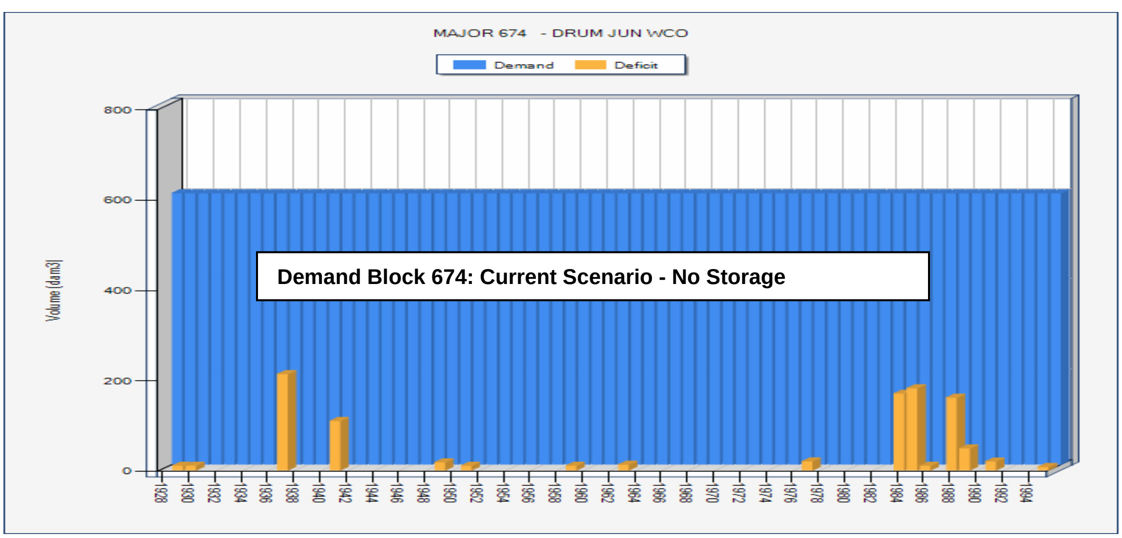


Figure 9.8 – Annual Deficits for Demand Block 674 at Drumheller for the 2031 Level of Demand

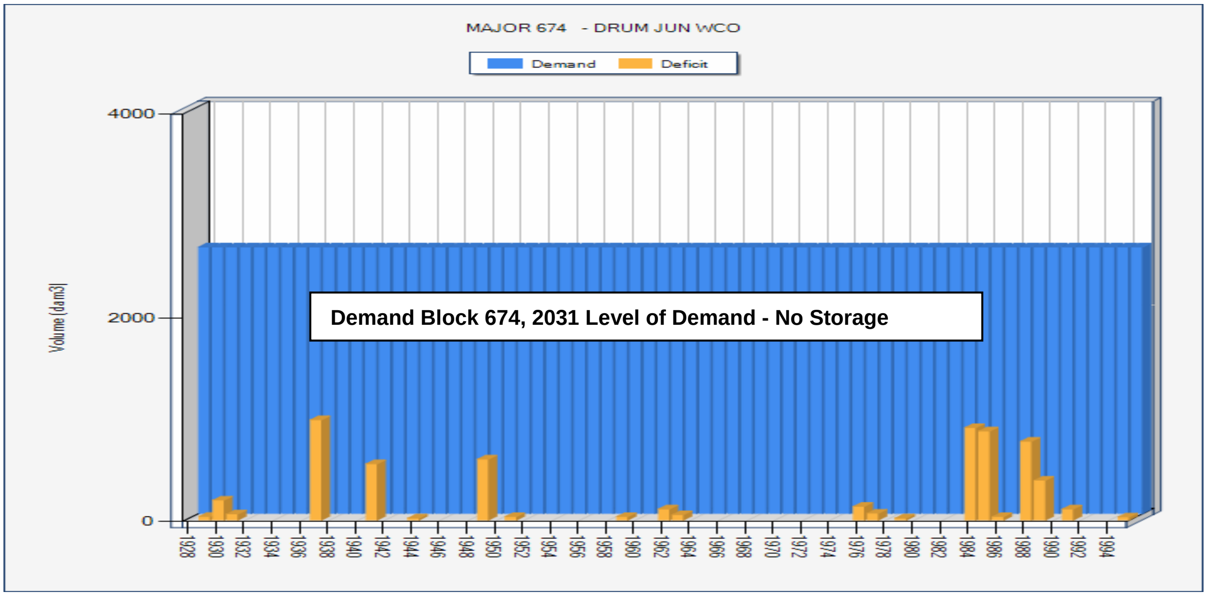
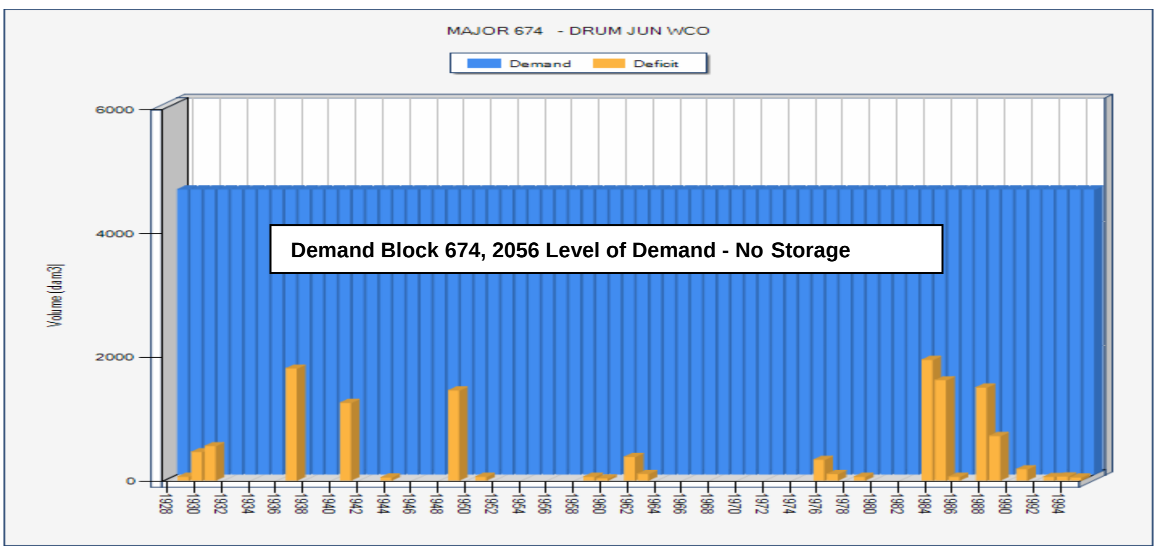


Figure 9.9 – Annual Deficits for Demand Block 674 at Drumheller for the 2056 Level of Demand



The **2031 level of demand** for Block 674 (2618 dam^3) includes a junior (WCO) demand of 1132 dam^3 for water users that are currently using groundwater to convert to surface water. The demand block would experience deficits in 12 percent of the years (Figure 9.10). The magnitude of the deficits would range from about 12 percent to 35 percent of the total demand. Deficits would occur in both summer and winter months. The deficits could be eliminated with 1070 dam^3 of live storage.

The **2056 level of demand** for Block 674 (4599 dam^3) would experience deficits in about 15 percent of the years (Figure 9.11). The magnitude of the deficits would be up to 43 percent of the annual demand. The deficits would occur in both summer and winter months. The deficits could be eliminated with 2200 dam^3 of live storage.

Small storage sites in the vicinity of Drumheller that could be used to eliminate deficits have not yet been identified in previous studies, which does not necessarily mean that they do not exist. Further investigations are required. Buffalo Lake operated as an offstream reservoir to regulate Red Deer River flows could be used to eliminate deficits at Drumheller.

10 Summary of Findings and Recommendations

Simulation modelling indicates that projects that are subject to the recently established WCO can expect frequent deficits primarily during the winter months, even at the current level of demand. Generally the deficits will be relatively small (less than 25 percent of the total demand that is subject to the WCO).

The deficits could be eliminated with a small amount of storage at the current demand level, but storage requirements increase as demand increases. Estimated storage requirements are as follows:

Level of Demand	Near Red Deer (dam^3)	Near Nevis (dam^3)	Near Drumheller (dam^3)
Current Demands	1,250	1,400	215
2031 Demands	12,000	5,700	1,070
2056 Demands	19,000	10,000	2,200

Additional investigations into storage requirements and options are required. Storage sites noted in this study were identified decades ago. Some sites may no longer be feasible options.

Other options for eliminating the deficits that should be explored include:

1. **Modifying the operation of Dickson Dam.** Operation rules for the dam have been developed to ensure late winter releases of 16.0 m^3/s from the dam to improve water quality in the river and ensure sufficient flow for wastewater assimilation. In most years there is surplus storage in the reservoir in late March that could have been used to meet instream flow needs and/or the needs of consumptive users. A review of the operating rules should be carried out to re-examine reservoir priorities, assess wastewater quality and river water quality conditions within the Red Deer River, and determine the impacts on

river water quality of increasing releases from Dickson Dam to meet instream and/or consumptive needs along the river. The study should include streamflow forecasting and variable operating rules triggered by runoff forecasts and probabilities of filling the reservoir in subsequent years.

2. **Increasing storage at Dickson Dam**. A minor increase in storage may be sufficient to meet the needs of current and future municipal consumptive users, and may be less costly than several small offstream storage reservoirs.

3. **The Dickson Dam operating policy** should include supplying water to municipal and rural domestic surface water users that are junior in priority to Dickson Dam even when storage in Glennifer Reservoir is below the minimum fill line. Depriving municipalities of a needed water supply to build storage in the reservoir that in most years will not be required to fully meet the operating objectives of the dam would cause undue hardships to some municipalities.

4. **Sharing the deficits** by allowing municipalities to encroach on the WCO for short periods of time providing that the community practices water conservation measures and invokes rationing during the period of encroachment. This measure would encourage municipalities to conserve water which would reduce withdrawals from the river on an ongoing basis. This would improve river flows most of the time in exchange for short-term encroachment on the WCO – a win-win scenario. It would also be in keeping with the philosophy of sharing deficits.

5. **Assignments and transfers.** The use of temporary assignment and allocation transfer provisions of the Water Act should be explored as a means of alleviating the impacts of short-term deficits. Perhaps standing agreements with other licencees could be negotiated to facilitate assignments in times of need.

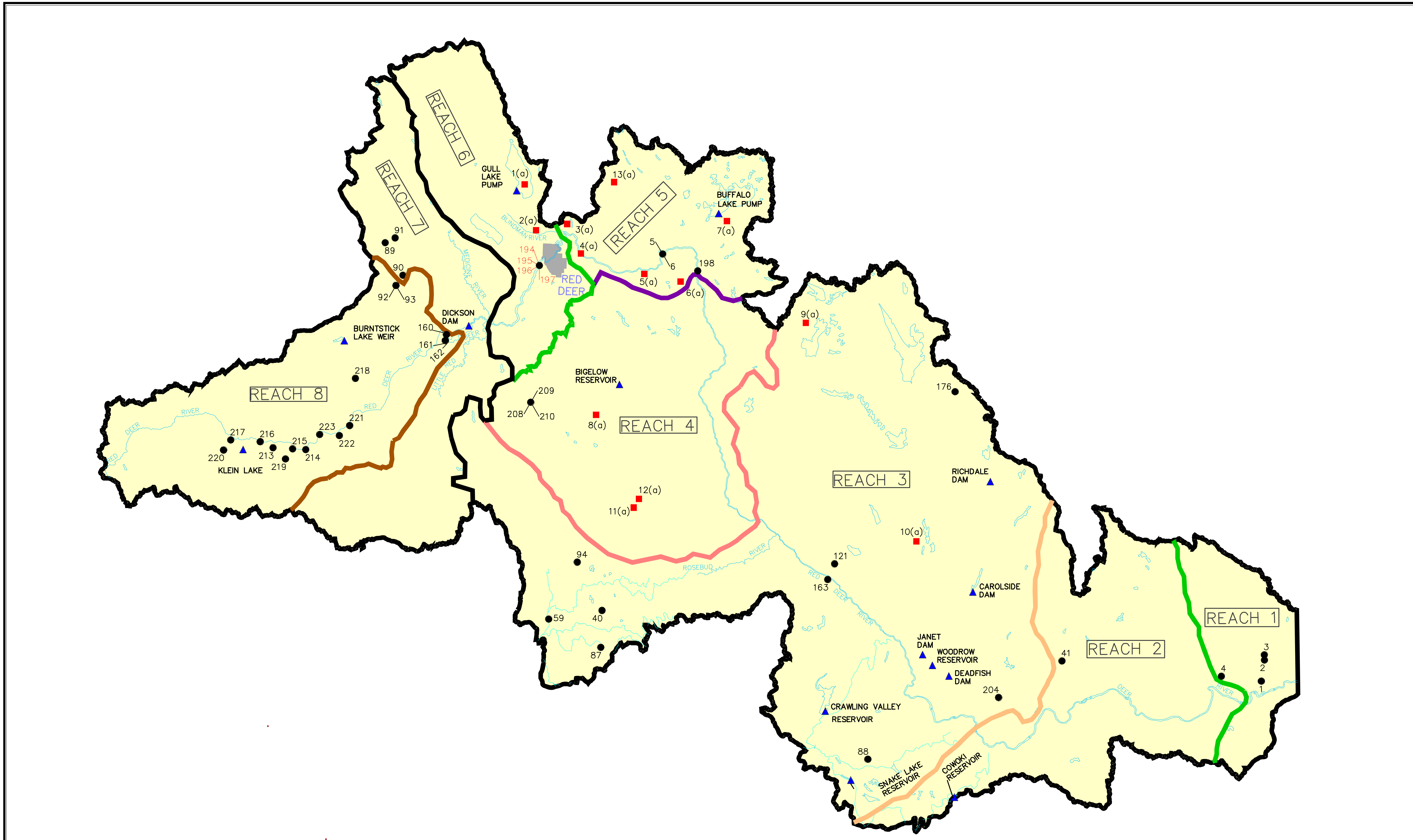
A few administrative recommendations are needed to recognize the potential future cap on water allocations in the Red Deer River Basin, as recommended in the SSRB plan.

1. It is recommended that Alberta Environment be requested to review the water allocations and water rights listings and licences to eliminate errors and duplications in allocations.

2. It is recommended that Alberta Environment be requested to inspect projects of significant size within the basin to determine whether or not the projects are operational and in good standing. Projects that are not in good standing should be cancelled (after due process). This recommendation does not necessarily apply to small stockwater projects and other projects with small allocations.

3. It is recommended that water demand estimates that are used for future simulation modelling to address Red Deer River water supply issues be restricted only to demands

that will impact flows in the Red Deer River in median flow years, rather than total basin demands. This could result in a realistic reduction in demands that are currently being used in modelling. The drainage boundaries defining the effective drainage area should be reviewed and corrected where necessary.



LEGEND:
- MPE REPORT
- ALBERTA ENVIRONMENT WATER STRUCTURES
- 1976 STUDY

Associated Engineering

RED DEER RIVER MUNICIPAL USERS GROUP

RED DEER RIVER BASIN POTENTIAL STORAGE SITES & REACHES

PROJECT NUMBER	REV. NO.	SHEET
2007-3432		

APPENDIX A - STORAGE OPTIONS

Red Deer River Basin Storage Options

Reach #	Map Ref #	Project name	Source	Primary Purpose	Storage Type	Capital Cost $Million	Capacity (dam^3)
1	1	Acadia Irrigation Dev (Reservoir I)	Oldman Creek	Flow Regulation	On Stream	61.6	2,318,946
1	4	Acadia Irrigation Development 2005 - Scenario 3	_	Hydro Power	On Stream	90	N/A
1	2	Acadia Irrigation Dev (Reservoir III)	_	Hydro Power	On Stream	N/A	N/A
1	3	Acadia Irrigation Dev (Reservoir IV)	_	Hydro Power	On Stream	28.8	N/A
2	41	Cabin Lake & Dirty Lake(Blood Indian Project)	_	Diversion System	_	37	N/A
3	121	Little Fish Lake Regulation	_	Hydro Power	On Stream	34.5	191,190
3	87	Hartell Coulee Reservoir	_	Hydro Power	On Stream	78	407,049
3	176	SAWSP (Special Areas) - Storch Reservoir	_	Hydro Power	On Stream	47.5	349,075
3	163	Red Deer - Crowfoot Pumped Diversion	West Arrowwood Creek	Irrigation	Off Stream	4	3,260
3	88	Hornberger Lake	_	Hydro Power	On Stream	9.5	N/A
3	59	Delacour Reservoir	_	Hydro Power	On Stream	15.7	N/A
3	94	Irricana Recreation Reservoir	_	Flow Regulation	On Stream	N/A	1,480,000
3	204	Sutherland Dam	Highwood	Diversion System	_	136	N/A
3	40	Bruce Lake Reservoir	_	Diversion System	_	90	N/A
3	9(a)	Gough Lake	Garden Plain	Coal Industry	Off Stream	1.4	26,794
3	10(a)	Sheerness Reservoir	Sheerness	Coal Industry	Off Stream	9.7	26,794
4	210	Torrington Reservoir to Bow River Diversion (4000cfs Diversion)	_	Hydro Power	On Stream	35	307,137
4	208	Torrington Dam	_	Diversion System	_	53	N/A
4	209	Torrington Reservoir to Bow River Diversion(2000cfs Diversion)	_	Diversion System	_	50.9	N/A
4	12(a)	West Bank	Red Deer River	Coal Industry	On Stream	7.1	12,950
4	11(a)	East Bank	Red Deer River	Coal Industry	On Stream	7.1	12,950
4	8(a)	Three Hills Reservoir	Red Deer River	Coal Industry	Off Stream	8.8	26,794
5	6	Ardley Reservoir Diversion	_	Hydro Power	On Stream	22	N/A
5	198	Special Areas Water Supply-Pumphouse & Pipeline	Elbow	Diversion System	_	500	N/A
5	5	Ardley Dam	_	Flow Regulation	On Stream	140	2,960,356
5	13(a)	Groundwater	Red Deer River	Municipal	Off Stream	N/A	132
5	6(a)	South Ardley Reservoir	Red Deer River	Coal Industry	Off Stream	2.2	26,794
5	7(a)	Buffalo lake (two thermal plants)	Red Deer River	Coal Industry	Off Stream	1.3	53,588
5	7(a)	Buffalo lake (coal and petrochemical)	Red Deer River	Petrochemical industry	Off Stream	16.5	151,830
5	3(a)	Blackfalds Lake	Red Deer River	Municipal & Industrial	Off Stream	14.6	6,173
5	5(a)	Coulee 1	Red Deer River	Petrochemical	Off Stream	N/A	4,197

Red Deer River Basin Storage Options

Reach #	Map Ref #	Project name	Source	Primary Purpose	Storage Type	Capital Cost $Million	Capacity (dam^3)
5	4(a)	Coulee 2	Red Deer River	Petrochemical	Off Stream	4.8	6,173
5	7(a)	Buffalo lake (one thermal plant)	Red Deer River	Coal Industry	Off Stream	0.7	26,794
5	7(a)	Buffalo lake (eight coal plants)	Red Deer River	Coal industry	Off Stream	9.6	134,171
6	1(a)	Sylvan Lake	Red Deer River	Municipal	Off Stream	10.5	6,173
6	2(a)	Unnamed Lake	Red Deer River	Municipal	Off Stream	11.4	6,173
6	195	Special Areas Water Supply-Canal & On-line Storage Alt #2b	Sounding Creek	Stockwatering	On Stream	0.0	817
6	194	Special Areas Water Supply-Canal & On-line Storage Alt #2a	Serviceberry Creek	Irrigation	Off Stream	6	64,511
6	196	Special Areas Water Supply-Canal & On-line Storage Alt #3	_	Hydro Power	On Stream	34	214,626
6	197	Special Areas Water Supply-Canal & On-line Storage Alt. #1	_	Flow Regulation	On Stream	N/A	1,200,000
7	91	Horseguard North Dam	Belly River	Irrigation	On Stream	49.2	N/A
7	90	Horseguard Dyke	Highwood	Diversion System	_	68	N/A
8	162	Raven Reservoir to Torrington Reservoir(4000cfs Diversion)	Blood & Indian Creeks	Stockwatering	On Stream	N/A	3,303
8	160	Raven Dam	_	Diversion System	_	34.4	N/A
8	161	Raven Reservoir to Torrington Reservoir(2000cfs Diversion)	_	Diversion System	_	89	N/A
8	93	Horseguard South Dam	_	Hydro Power	On Stream	21.4	N/A
8	218	Upper Red Deer -Site 18	Elbow	Diversion System	_	150	N/A
8	217	Upper Red Deer -Site 14	Tail Creek	Diversion System	_	29	1,072,883
8	219	Upper Red Deer -Site 19	_	Hydro Power	On Stream	134.4	N/A
8	223	Upper Red Deer -Williams Creek	Thelma Creek	Irrigation	Off Stream	0.3	N/A
8	222	Upper Red Deer -Site 9	_	Irrigation	On Stream	N/A	N/A
8	220	Upper Red Deer -Site 20	Elbow	Diversion System	_	600.0	N/A
8	213	Upper Red Deer - Logan Site	_	Diversion System	_	38	N/A
8	216	Upper Red Deer -Site 13	_	Diversion System	_	69	N/A
8	215	Upper Red Deer -Site 12	Brazeau	Flow Regulation	On Stream	8	N/A
8	214	Upper Red Deer - Site 11	_	Flow Regulation	On Stream	165.1	3,971,811

9 Recommendations

9.1 MUNICIPAL WATER SECURITY GOVERNANCE

9.1.1 Crown Reservation

Proposal

Create a Crown Reservation under the Water Act to reserve water allocations for municipal needs from surface water within the Red Deer River Basin.

Background

The South Saskatchewan River Basin Water Management Plan, August 2006 suggested that a maximum target for allocations from the surface water within the Red Deer River Basin be 600,000 dam^3. It also recommended that a Crown Reservation be created when allocations reached 550,000 dam^3 to distribute remaining water based on specified purposes. At the same time, concern was expressed in the plan about the risk to existing licences as more water is allocated. Of special concern is the water conservation objective constraint on water diversions both in the summer and winter downstream of the City of Red Deer. The SSRB plan identified that off stream storage will be necessary for municipal water needs. In addition, further research on instream needs may constrain access to allocations even further.

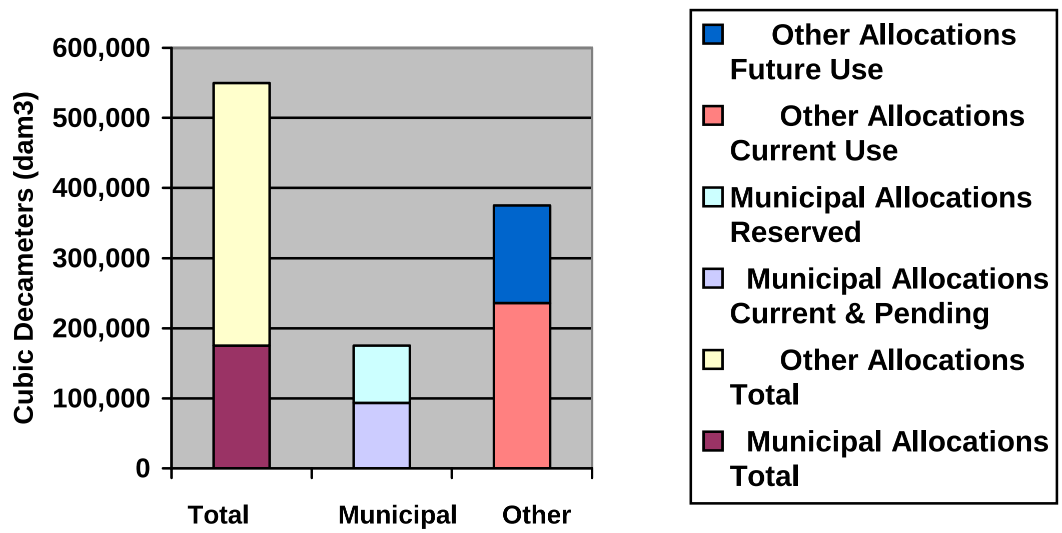
Red Deer River Municipal Users Group 2008 Technical Memorandums on municipal and non-municipal water use showed total pending and existing allocations as of November 2007 were 328,000 dam^3. This is comprised of 93,000 dam^3 for municipalities and 236,000 dam^3 for other purposes. Municipal water needs by year 2056 (50 years) based on an approximate population of 510,000 has been forecasted at 92,000 dam^3. This is slightly higher than existing and pending applications; however, allocation increases will be needed for some municipalities.

Analysis

It is in the best interest of the Red Deer River Basin to have sufficient allocations for municipal needs for the future. Municipalities typically have low growth rates that are relatively steady. In contrast, an industrial or irrigation project can have need of a large amount of water in a short period of time. Municipalities are also the home for most other water use sectors. As a result, Municipalities should not have to compete for water. Reserving water for municipal use would eliminate competition with large volume water users who can impose demands relatively quickly. Figure 9.1.1 illustrates the proposed arrangement.

Even though a volume of water may be reserved, the priority of that water may be in question unless the reservation specifies how it is to be managed. In this case, special status should be requested and implemented through a priority numbering system that puts municipal allocations ahead of all other allocations once the reservation is put in place. The volume of this reservation is difficult to establish, however a future growth of 300,000 persons and associated industrial growth after 2056 would suggest a cap of 175,000 is reasonable.

Figure 9.1.1 Proposed Allocation Reservation for Municipal Needs



Urban Municipalities have industrial users within their boundaries and water often is distributed outside their boundaries for other purposes. These arrangements can complicate a restrictive allocation process based on purpose because the municipal purpose encompasses industrial water use. In addition some industries outside urban municipal boundaries connect to regional water supply systems.

If Red Deer River Basin municipalities have the ability to access water within a reservation, there also should be a constraint within the reservation to prevent a formal transfer of a municipal allocation to another purpose in order to preserve the intent of the reservation. It also would be desirable from a municipal perspective to require that allocations that become available from other purposes, such as oil and gas operations ceasing operation, be made available to municipalities as well as the aquatic environment. This would require a policy change by Alberta Environment.

Recommendation

A Crown Reservation is given authority through a ministerial order as a regulation under the Water Act. This is a significant undertaking that requires public input. The most appropriate venue from initial discussion is the Red Deer River Watershed Alliance. However, discussions should be held with Alberta Environment and MLAs to garner support for the initiative. The key components of the Reservation should be as follows:

- Reserve all surface water in the Red Deer River that is not already allocated.
- Specify that additional allocations for water may be granted for municipal purposes for a specified volume of 175,000 dam^3 for existing and future use.
- Allow allocations for other purposes up to 375,000 dam^3 for existing and future use.
- Identify that the priority for all municipal allocations issued after the Order (Reservation) is effective two days after the Order. (Allocations for other uses would be junior in priority to municipal uses. Each municipal allocation would be consecutively numbered on that date so that municipal users would have priority among themselves. Water conservation objective licences have been prioritized one day after an order to reserve water for the aquatic environment.)
- Restrict municipal licences to prevent reallocation or transfer to other purposes.

9.1.2 Municipal Licence Growth Projections and Licence Terms

Proposal

Municipal water allocations should be based on forecasted 25-year needs and incorporated municipality allocations should have no expiry date.

Background

Municipal infrastructure for diverting, treating, storing and distributing water is typically designed for 25 years based on the life of the equipment. Infrastructure that does not involve machinery such as pipelines, buildings and storage reservoirs can last in excess of fifty years. Historically, municipalities have been able to acquire licences with no restriction on renewal and for volumes that supported 25-year long-term growth. There is also a reasonable prospect that growth will occur so there is no need to cancel portions of municipal licences.

Since the enactment of the Water Act in 1999, all licences are to have an expiry date. This is normally 20 years for municipalities. With increased concern about water availability in southern Alberta and poorly defined growth projections by private developers, Alberta Environment may be decreasing the forecast period to as low as 10 years.

Analysis

Based on past history, the province may have concerns about municipal water allocations. They have had concerns about large allocations being granted for private subdivision developments that did not proceed or were downsized. This should not reflect on the orderly planning that municipalities conduct. Municipalities also have access to provincial funding for water conveyance infrastructure so long-term planning is necessary for those that are experiencing growth to properly utilize public funds. Some municipalities have not experienced sudden growth but will reach a point where demand will exceed both the allocation and infrastructure capacity. When that happens, a 25-year design will be applied to new infrastructure. As a result it is reasonable to assume that a new allocation should correspond to the infrastructure capacity.

Recommendation

The RDRMUG should make Alberta Environment aware of the concern municipalities have about potential constraints placed on licences issued to urban and rural municipalities from both a licence term basis and volume forecast basis. Specific recommendations are:

- New municipal allocations should correspond to the 25-year design volume of infrastructure.
- Incorporated municipal water licences should have no expiry date.

9.1.3 Net Diversion Licensing

Proposal

The return of reclaimed water to the environment should be encouraged through innovative consumptive use licencing.

Background

The following brief is based on the RDRMUG Technical Memorandum on Return Flow Credits, November 2007. Historically, legislation for water allocations in Alberta has not required the return of any of the water. This is due in part to the difficulty in assessing when and how much water would be returned due to several variables for different water use sectors. Most sectors have low water return volumes on average in comparison to their allocation. Municipalities have a high return flow potential where continuous releases occur from treatment plants. An average 80% return flow rate occurs. Even municipalities with seasonal release from lagoons can return 50% of their allocation.

The priority allocation system in Alberta means that new licences are less likely to obtain water during water shortages. In addition, instream flow needs are applied on an instantaneous basis to newer licences so there is an incentive for reuse of reclaimed municipal water to avoid risk. However, returning water to a river system provides water and nutrients for the aquatic environment and allows other users to access water downstream.

Analysis

It is reasonable to consider an allocation credit for returning water to the source. It is especially important to consider a credit for municipalities because they are capable of treating wastewater to a high level of quality and a municipality is generally considered a high priority user.

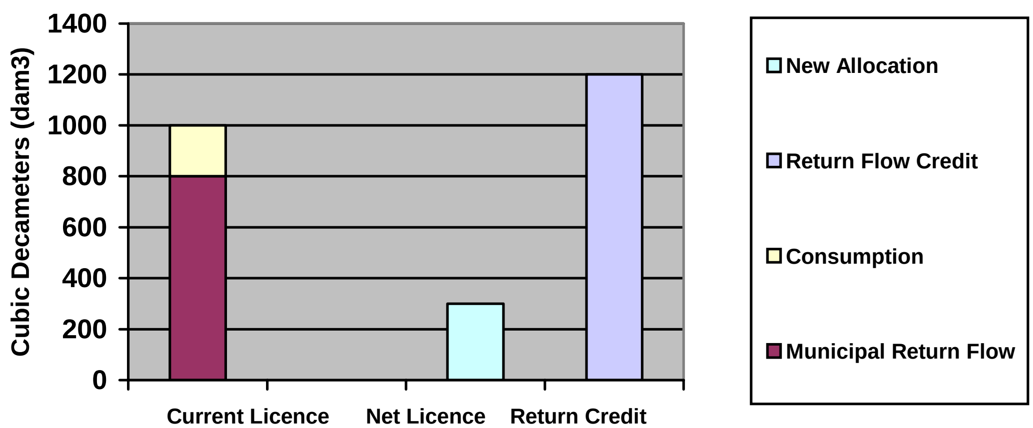
An initial reaction by regulators could be that credit for returned water should be conditional on the water being returned at close proximity, at the same rate and the same quality as it was diverted at. Expecting no net change in river conditions is unrealistic given that there is a desire to restore water, the affected river reach is usually short and assimilation in a river is accomplished in a defined recovery zone. In addition, the cost of the technology required to meet these unrealistic expectations does not justify the outcome which is a guaranteed return of wastewater for reuse in the river. Reclaimed municipal water also can be non-toxic and as a result, beneficial to the aquatic environment from a volume and nutrient point of view.

Partial credit for returned water would be a reasonable approach to consumptive or net diversion licencing. This could offset some issues regarding assimilation, rate of return and location of the return. It also would recognize the potential for a reduced flow regime downstream if a full net diversion licence was in place. As an example, if reclaimed municipal water was returned at 80%, then a full net diversion licence could use five times more water than under the current licencing process. This could have an effect on instream flow conditions and impact downstream users. However, a more reasonable approach would be a situation where a municipality agreed to reduce their allocation as long as the licence is consumptive and the river is not adversely affected. The primary condition of the licence should be a return flow to ensure water is returned in a significant volume. Very few municipalities would be involved in this due to the relatively low number of places that have continuous releases. However, this is another reason for endorsing the concept because the impact will not be significant.

The flow regulated Red Deer River also poses a problem for net diversion licences because the winter flow conditions can limit water availability for a new allocation or a net diversion allocation. The only exception is if there are no conditions on the licence regarding instream flow objectives. This is likely the case for a senior licence but the regulator would have to agree to let the condition remain.

Figure 9.1.3 illustrates an example of a municipality with a 1000 dam^3 licence and a 800 dam^3 return flow (80%). If a net diversion allocation was created at 300 dam^3 with a return of 1,200 dam^3, their consumption could increase from 200 to 300 dam^3 (50%).

Figure 9.1.3 Net Diversion Licence Example



In summary, a net diversion of a consumptive licence will only apply to the few municipalities that have a wastewater reclamation treatment process and a continuous release. Of these facilities, only the senior licences without an instream flow requirement would benefit. The only other scenario where a net diversion licence would be beneficial is where there is no possibility of getting a new allocation.

Recommendation

In order to recognize the benefits of returning water to the environment and to allow eligible municipalities in the Red Deer River Basin to secure water allocations, it is recommended that Alberta Environment create a policy that permits net diversion licences for municipalities in the Red Deer River Basin. The licence should include :

- No change to licence conditions regarding instream objectives
- Wastewater reclamation on a site specific basis to the Province's requirements
- Continuous release of return flow
- A minimum return flow volume and rate
- Flexibility as to impact on water quality and flow in the vicinity of the diversion and release point
- Reduction in allocation to a consumptive use that is based on forecasted needs.

9.1.4 Water Shortage Emergency Measures

Proposal

Municipalities should be allowed to encroach on water conservation objectives or instream objectives when source water supplies reach levels that threaten public health and safety.

Background

The RDRMUG Technical Memorandum on Water Management, November 2007 was used as a basis for this proposal. There are two primary causes of water shortages for diversions in Alberta. One occurs when there is insufficient water to meet the needs of all users with licence allocations, registration and household rights. At that time, a senior licence holder may call priority, a sharing (assignment) arrangement may be implemented or the Lieutenant Governor in Council may intercede to override the priority system. The later case requires compensation to senior licencees. The second water shortage situation may occur when a flow rate or water level of a river or other water body drops to a point where the instream flow need on a licence restricts access to water. The only immediate alternative available under the Water Act in this urgent case is an assignment from another licencee without an instream objective on a licence. In some cases, there may be no licence to assign.

Analysis

Rarely if ever has the government declared an emergency by evoking section 107 of the Water Act to override the priority system. Usually, conservation measures and sharing arrangements meet urgent needs. However, the potential exists for serious short-term shortages for municipalities with junior licences even with extreme water restrictions. In this case, it would be appropriate for the government to be able to temporarily waive the instream flow licence condition. The remedy for future incidents could be an order to construct storage facilities or find an alternate supply.

In some cases, it may be necessary to re-evaluate the in stream water conservation objective under a water management planning process. In addition, municipalities have a high capacity for conserving water so planning decisions should be linked to water conservation and rationing in a community.

Recommendation

Alberta Environment should propose an amendment to the Water Act to exclude municipalities from having to pay compensation under Section 107 and to give the Director under the Act authority to:

i) issue a temporary diversion licence for emergency situations when water must be diverted below a WCO, and
ii) allow a licencee to continue to divert beyond the point where a WCO restricts a licence.

9.1.5 Return Flow Market

Proposal

The rights to water returned to a water course should be retained by the licence holder and may be designated to another user under a market system.

Background

RDRMUG Technical Memorandum on Return Flow Credits, November 2007 was used as a basis for this proposal. The Water Act does not require the return of unused or non-consumed water. Municipalities typically return 80% of their diversion volume if they have a continuous reclaimed water return. There also is no credit for returning water in the form of additional allocations such as could be available under a net diversion licence. The Water Act allows the sharing of water licence allocations and the use of reclaimed water for other purposes by other water users. An assignment (sharing) requires an agreement between water users. The use of reclaimed water requires an amendment to the licence to document where the water is used.

Using a watercourse as a conveyance system for moving return flow from a licence holder to another user has not been employed in any known jurisdiction but it has been considered in lieu of return flow credits. The concept is that reclaimed wastewater is released to a river for the express purpose of delivering it to a designated user who wishes to increase their diversion beyond their allocation. This differs from an assignment which can only bring a licence up to its allocation limit.

Analysis

Allowing return flow to continue to be owned by a licencee even after release can provide a source of revenue and become an incentive to return even more water. The longer the travel distance to another user, the more beneficial it is to the river. Potential exists to combine this approach with a net diversion licence so that there is an incentive to get a greater allocation in exchange for moving return water downstream. The degree of increased allocation could be prorated based on the distance that water stays in the river before being reused.

A true market approach could be a return flow market where compensation for returning water would be made by a purchaser. As in the previous approach, the benefit to the environment is water being returned and remaining in the river over a given distance. Concern about the increased efficiency of use of water and corresponding reduction in river flow could be offset by a balancing of water for purchaser and river (e.g. holdback). Also the distance water would remain in the river could be taken into consideration as well.

Alberta Environment, as the water master, would have to be aware of this occurrence and have a notification process for other users. Alberta Environment would also need to create legislation regarding assignments of this type to increase allocations.

Recommendation

It is recommended that Alberta Environmental initiate a study to research the potential for municipalities to participate in a return flow market in exchange for compensation or increased allocation. It is expected that legislation and policy changes would be necessary.

9.2 FINANCIAL INCENTIVES FOR MUNICIPAL WATER SECURITY

9.2.1 Regional Water and Wastewater System Funding

Proposal

Funding for regional water and wastewater grant programs should be enhanced on a long-term basis.

Background

The Alberta Government has administered a grant program for municipal infrastructure for over 30 years. It has been instrumental in providing adequate volumes of safe water to many Albertans. However, funding has been limited at times due to fiscal reasons. Concern about the viability and safety of small water systems has recently led to a regional water supply program that provides capital grants of as much as 90%. This makes lengthy pipelines possible but construction costs are high and funding for the program continues to be limited.

Issues that have arisen about the program include retiring debt for existing systems, fear of the water rate structure from the provider and the lack of distribution systems in some small communities that may receive a regional system.

Another grant program that goes under a new title each time a program is initiated involves funding from the federal and provincial governments as well as the user on a 33.3% basis from each. This also applies to rural water co-operatives whose farm users have dwindling supplies due to lack of runoff for dugouts or depleting groundwater supplies. However, there could be a special fund for this situation. Rural users often supply most of their water to cattle, gardens, shelter belts, etc. The minor amount for consumption does not justify the expense of a water treatment plant designed for all uses. On site treatment is usually provided at farms in any event.

Analysis

The provision of regional water supplies makes a great deal of sense. It is expensive but it is difficult to put a value on survival of the farming community, human health and reliability of a water system. Central Alberta has benefited from the Mountain View regional system originally constructed by the Province. More recent systems include Kneehill and North Red Deer with others being proposed. Concern about short term capital cost must be overcome because the Mountain View Commission system demonstrates the long-term benefit. A fifty-year outlook is appropriate for pipelines to justify the investment.

Viewing these pipelines as equivalent to roads may help put their importance in perspective. The small percentage of funding going to water and sewer systems needs to be increased for the next 15 years to clear up a deficit of old infrastructure. Sufficient projects can be envisioned to occupy that much time for construction. However, construction cannot proceed due to timing for allocation of funds and lack of contractors. The very successful Regional landfill funding program has demonstrated that allocating funds in advance of a project can work. There are always concerns about accountability but this timing for water projects can be long, so assured funding is appropriate.

Recommendation

The Alberta Government should allocate adequate funds to eligible projects with a trust fund process put in place to hold funds for projects until constraints such as routes, sizing, availability of contractors, etc. are resolved.

It is also recommended that funding enhancements be put in place to deal with inhibitors to regional water supplies such as:

- Raw water supplies for farms (not subdivisions) be considered for a funding program
- Debt reduction for existing infrastructure subsidized regional operation of stand-alone systems where a pipeline is too costly
- Subsidized rate structure for five (5) years where a supplier has a rate that is substantially higher than the newly serviced community
- Consideration of an incentive program for distribution systems for the core of villages and hamlets where a system did not exist before
- Inclusion of water licence transfer costs as an eligible cost for funding.

9.2.2 Water Licence Transfer Rebate Program

Proposal

A provincial funding program should be created to provide an incentive for water allocations to be transferred to municipalities from other water use sectors such as industry or irrigation.

Background

The RDRMUG Technical Memorandum on Water Management, November 2007 provides additional background to this topic. The ability to transfer a water allocation licence was authorized in the SSRB Water Management Plan, Phase One. Since then, almost twenty transfers have been applied for. Increased numbers of transfers could be possible because the Bow and Oldman Rivers have been closed to new applications for water. A constraint will be reluctance by existing licence holders to relinquish their right to some of their water even if there is a chance it may be taken away from them for non-use. In southern Alberta, over 70% of the water allocations are held by irrigation projects. Industry holds a much lower portion but some projects, especially in the Oil and Gas sector, will be winding down operations and have water allocations to cancel, return to the river or transfer.

A recent transfer of an allocation from an irrigation district to a municipal development in the Calgary area cost $7,500 per acre-foot. This was an exceptionally high fee compared to similar transactions in Alberta and North America. However, it was in an area of rapid growth.

Analysis

At present, the market value of water allocations depends on the amount, the location and the need. The government does not intercede or monitor these private transactions. However, there may be a need to stimulate the transfer of water from industry and agriculture to municipal use within the next 50 years.

Funding is already available for municipalities to purchase an allocation but there is no incentive for industry to cooperate with a municipality versus another water user. A rebate program to industry from the government would allow normal compensation negotiations to occur. Once a deal is completed, a flat rate per unit water could be eligible to the seller if the sale was to an incorporated municipality with a demonstrated need.

Recommendation

The RDRMUG should hold discussions with municipalities in other basins to explore the concept of a rebate program for licence holders who transfer water allocations to municipalities who have a demonstrated need.

9.2.3 Water Conservation Grant Program

Proposal

Provincial grants should be made available to municipalities to implement water conservation measures.

Background

Provincial grants are available for municipal waterworks infrastructure. There are no grants available for operational or maintenance related work on waterworks systems. For instance, infrastructure grants may be reduced by 10% if water metering is not implemented.

Analysis

A water conservation program will be necessary for all municipalities as water availability becomes more critical over time. An effective program includes a combination of structural, economic and educational measures. Economic measures involve rate structures and incentives, educational programs can be expensive but very effective if door to door programs are utilized. Structural measures are very expensive because of the capital costs to optimize water treatment plants, install metering systems, conduct leak detection and repair.

Smaller municipalities do not have the tax base to install meters or upgrade.

Recommendation

a) An incentive grant should be made available to municipalities to provide metering or if metering is available, to provide other water conservation methods. A condition of the grant would be the implementation of a long-term bylaw for an increasing block rate structure that is based on full cost accounting.

b) The present municipal infrastructure grant program administered by Alberta Infrastructure and Transportation should be upgraded to include leak detection and repair programs.

9.2.4 Water Reuse Grants

Proposal

Municipalities should be eligible for grants to reclaim water from wastewater for reuse to reduce water consumption.

Background

The provincial municipal water and wastewater infrastructure program funds water and wastewater treatment plants as well as major trunk mains, transmission and storage facilities. Funding of disposal systems such as agricultural irrigation equipment is also included. However, any treatment of wastewater to a high degree for reuse is not eligible. Part of the reason is that there is a market for industrial uses of the water and the perception that industry should be able to afford the cost of treatment.

Analysis

There are many uses for wastewater such as irrigating public areas, recharging aquifers and supplying alternate water to industries already connected to the water supply.

There is a lack of pressure to recycle or reuse water so the development of a funding program may not be attractive; however, this should not inhibit a municipality from making a submission for funding when its water supply is in jeopardy.

Recommendations

Municipal organizations such as the Alberta Urban Municipalities Association (AUMA) or Association of Municipal Districts and Counties (AMD&C) should initiate discussions with the Department of Infrastructure and Transportation to explore a range of possible options for funding the reuse of water.

9.2.5 On Site Raw Water Storage Grant Program

Proposal

Enhance existing municipal grant programs to provide 90% funding for raw water storage reservoirs.

Background

Alberta Infrastructure and Transportation provides a grant program for municipal waterworks that includes intakes and raw water storage reservoirs as eligible projects. The amount that the project is funded is dependent on the population. If the population is less than 1000 persons, then there is a 75% grant. The percent funding decreases in proportion to increasing population to a population of approximately 45,000.

The instream flow objective established for the Red Deer River restricts the ability for new licences to access water downstream of Red Deer during the winter. Water storage is necessary for at least six (6) months to provide security of supply. Very few municipalities have storage because there always has been sufficient flow for their needs. Some, like Drumheller, have storage to protect against high sediment periods.

Analysis

Supplying water to Albertans is an essential service. The Red Deer River Basin contains significant areas that are sparsely populated due to economic conditions. However, these centers should still be able to grow. The constraint of limited source water during the winter must be addressed with additional storage or regional pipeline systems. Both of these solutions are beyond the economic means of rural residents. As a result, a flat grant funding rate that is not prorated by population would be appropriate to address a common issue for a basin where most municipalities are less than 5000 persons.

In addition, the priority for funding programs needs to be reviewed. At present, water treatment followed by treated water storage has the highest priority for funding. It should be recognized that the supply of raw water is essential for supply and as such a priority after water treatment is appropriate.

Recommendation

The Department of Infrastructure and Transportation should provide a high priority special funding program for raw water storage reservoirs.

9.3 TECHNICAL STUDIES FOR MUNICIPAL WATER SECURITY

9.3.1 Instream Flow Effects Study

Proposal

Conduct studies on instream flow needs with regard to quality and quantity of the Red Deer River that both assesses the effect of flow on the aquatic environment and the degree that flow is affected by municipal diversions.

Background

The South Saskatchewan River Basin (SSRB) Water Management Plan, August 2006 (see RDRMUG Technical Memorandum Water Management, November 2007) noted that more research is necessary on the Red Deer River to assess the instream flow criteria and its effects on the aquatic environment. This was due to the lack of scientific information available at the time. For example, water quality information was based on 1990 effluent quality at Red Deer, prior to upgrades to move the plant to tertiary status. Fisheries information also was limited and all factors were affected by the regulation of flow at the Dickson Dam.

In addition, there is question as to how much effect a small water allocation has on the river over an annual basis. In relative terms, most municipalities in the basin have low demands.

Analysis

Most municipalities in the Red Deer River Basin are relatively small. The two largest users are the City of Red Deer and Town of Drumheller. Both also supply water to regional systems. However, each municipality returns reclaimed water to the river so the decrease in water level in the river is low. Similarly, small municipalities will have a limited effect on water levels and even less of an effect if water storage is employed.

Section 2.8.6 of the SSRB Water Management Plan recommends further research on the impact of additional water allocations and recommends assessments of the minimum flows to determine if they are still appropriate. These studies are best initiated by the Red Deer River Watershed Alliance (RDRWA) so that implementation of recommendations can be steered by stakeholders.

Recommendation

a) The RDRMUG should support the Watershed Alliance to arrange for research on minimum river flows.

b) The RDRMUG should seek funding for an assessment of the level and volume in each river reach in comparison to municipal withdrawals at various flow rates.

9.3.2 Alluvial Aquifer Study

Proposal

Conduct a study of the dynamics of water movement in alluvial aquifers in relationship to adjacent surface water and groundwater.

Background

The RDRMUG Technical Memorandum on Water Management provides the basis for this proposal. Many municipal water supplies in the foothills of the Rocky Mountains are drawn from sands and gravel aquifers adjacent to rivers and lakes. These aquifers are termed alluvial due to the type of material deposited by glaciers and water movement over millions of years. Alberta Environment licences these supplies as surface water because they can be shown to be hydraulically connected (also known as groundwater under the influence of surface water or GUDI). As a result, even though water originates from wells, it is treated as though it is a river intake and instream flow requirements are applied. This may be appropriate for an infiltration gallery on the edge of a river; however, there is little if any science to make any assumptions about the effect on adjacent water bodies when drawing water at depth from reasonable distances from a river. Some work has been done at Sundre but it appears to be in a true groundwater situation.

Analysis

Water being drawn from a well even in an alluvial aquifer is going to have a cone of depression and be influenced by the hydraulic gradient. As a result, it is questionable whether some GUDI diversions have any effect on adjacent water bodies. It also is questionable where there may be an effect. Is it immediately adjacent as assumed by regulators, is it a matter of kilometres downstream or is there any effect? This is important if return flow credits are involved. It also is important if instream flow conditions are involved because a licence can be required to stop diversions during low flow conditions even if the well is not affecting the adjacent watercourse directly. Very few municipal water supplies are drawn from alluvial aquifers in comparison to other basins but future supplies may be possible.

It may not be possible to draw conclusions from one study for all alluvial aquifer well supply systems but at a minimum some general conclusions under specific circumstances should be achievable. As well, information on water quality effects from surface water on alluvial aquifer wells can be gathered.

Recommendations

It is recommended that Alberta Environment conduct studies on whether municipal supplies in alluvial aquifers affect instream flows in the vicinity of the withdrawal.

9.3.3 Dickson Dam Operations Study

Proposal

Conduct a study on the potential for Glennifer Reservoir and the Dickson Dam to be operated differently or modified to provide more water supply assurance for downstream municipalities.

Background

Information for this brief is provided in RDRMUG Technical Memorandums on Water Management as well as Simulation Modeling and Storage Requirements. The Dickson Dam was completed in 1983 to provide a number of benefits to the basin. One of these was to provide a more reliable water supply to downstream users. The 200,000 dam^3 storage has primarily been used to supply recreational levels in the reservoir, to supply assimilative flow for the Red Deer wastewater and to prevent low flows in the winter.

The full supply level for the reservoir is 948 m above sea level. The lowest possible level is 926.5 m. However, the typical reservoir level after winter is over 940 m. This can drop to as low as 937 m by June 1 when the mountain snowmelt is expected. These levels are based on the Dickson Dam Flow Regulation Manual 1983/84.

Analysis

Operation rules for the dam have been developed to ensure late winter releases of 16.0 m^3/s from the dam to improve water quality in the river and ensure sufficient flow for wastewater assimilation. In most years, there is surplus storage in the reservoir in late March that could have been used to meet instream flow needs and/or the needs of consumptive users. A review of the operating rules should be carried out to re-examine reservoir priorities, assess wastewater quality and river water quality conditions within the Red Deer River, and determine the impacts on river water quality of increasing releases from Dickson Dam to meet instream and/or consumptive needs along the river. The study should include streamflow forecasting and variable operating rules triggered by runoff forecasts and probabilities of filling the reservoir in subsequent years. The increased flow necessary may be as low as 0.5 m^3/s.

The Dickson Dam operating policy should include supplying water to municipal and rural domestic surface water users that are junior in priority to Dickson Dam even when storage in Glennifer Reservoir is below the recommended minimum operating level. Depriving municipalities of a needed water supply to build storage in the reservoir that in most years will not be required to fully meet the operating objectives of the dam would cause undue hardships to some municipalities. A minor increase in storage is another approach to supply sufficient water to meet the needs of consumptive users, and may be less costly than several small offstream storage reservoirs.

Recommendations

The RDRMUG should request that Alberta Environment conduct a study on the feasibility of:

1. Modifying operation rules for Dickson Dam to allow additional outflow of water in the winter months. This would include an evaluation of water quality issues and consumptive needs along the river.
2. Increasing storage at Glennifer Reservoir to meet minimal needs of municipalities.

9.4 WATER MANAGEMENT ADMINISTRATION

9.4.1 Consultation on Water Diversions outside the Red Deer River Basin

Proposal

Withdrawal of water from the Red Deer River for use outside the basin will reduce the volume available to users within the basin, so an open consultation process with adequate public notice and hearings is required.

Background

The South Saskatchewan River Basin (SSRB) Water Management Plan, August 2006 resulted in the Oldman and Bow rivers being closed to further applications for new allocations of water except for First Nations and measures to protect the aquatic environment. This resulted in a municipal development in the M.D. of Rocky View applying for water from the Red Deer River in 2007. There were significant concerns about the proposed diversion because there appeared to be adequate water available from the City of Calgary.

Recently, regional water supply systems have also accessed Red Deer Water for municipalities in the Battle River Basin. The Battle River Basin has a shortage of both surface and groundwater. It also is outside the SSRB so special legislation was created following public consultation acceptable to Alberta Environment. There was little opposition to diversions to the Battle River Basin due to a demonstrated need.

The SSRB water management plan also identified that the Red Deer River has a projected limit of 550,000 dam^3 for total allocations from the basin. Present allocations and applications are approximately 340,000 dam^3. Projected increases in population for rural regional systems will draw an estimated 21,750 dam^3 by 2056.

Analysis

A ban on diversions outside the basin would provide more assurance of water availability for Red Deer River Basin residents. However, the river has some capacity and there is merit in providing water to municipalities with a demonstrated need. This approach has been considered appropriate to date. No policy is in place and each project is being dealt with on its own merit.

The issue of prior notification and full public disclosure is very relevant to the issue of water leaving the basin as the merit of a diversion needs to be assessed by all stakeholders. Obviously, a preference would be given to potable water supply for municipal use.

The Red Deer River Watershed Alliance is supportive of public forums on water diversions out of the basin.

Recommendation

The RDRMUG should promote the creation of provincial policies and procedures to ensure that the provincial government provides adequate notice and full public forums on any proposed water diversions out of the Red Deer River Basin.

9.4.2 Notification of Water Allocation Applications and Transfers

Proposal

Alberta Environment should initiate an open notification process for all proposed applications or transfers within the Red Deer River Basin.

Background

The RDRMUG Technical Memorandum on Water Management, November 2007 forms the basis for this topic. The Water Act requires than an application for a water diversion or transfer be advertised so that directly affected persons may file statements of concern. The legislation is not clear on where the advertisement is to be conducted or how large or extensive the advertisement must be. Usually, the advertisement is in the newspaper closest to the proposed intake and is often only a one column wide classified advertisement.

There is a great deal of sensitivity to new water allocations in the South Saskatchewan River Basin. Even those persons not directly affected want to be informed.

Alberta Environment has a website; however, there is not a readily accessible site where applications may be viewed. The legislation also indicates that notice may be provided in a registry if one is available. There is none available. However, the public has been calling for a registry for transfers.

Recent concerns about water diversions out of the Red Deer River Basin as well as amendments to licences in other sub-basins of the SSRB have heightened concerns that there is not sufficient notification for all residents of the SSRB.

Open access to all information on water licences should be publicly available on the internet. One of the hindrances is the collection of water use information on an annual basis from water users. Annual reports are supposed to be submitted but receipt is sporadic and often it is in paper form and in different units of measurement. Attempts are being made for electronic submission; however, there are security and enforcement issues.

Analysis

Most Albertans are not interested in details about water licences; however, licenced water users are intensely interested because every licence is linked via the priority allocation system. Even licences in another basin can be affected. As a result, there is a need for a publicly accessible internet site similar to the approval viewer where even lists of applications can be viewed. An even better system would be one where a person could register to be notified electronically whenever an application is posted for a particular geographic area or water body. The Alberta Purchasing Connection has an e-notification process for registered persons when interest is expressed in a contract.

A related notification issue is the need for public meetings when a diversion of water is proposed out of a sub-basin like the Red Deer River Basin.

Recommendation

A phased approach to informing and seeking input from Albertans about water allocation licences and transfers should be taken by Alberta Environment as follows:

a) An application site should be created on the AENV website similar to the Approval site where all applications are posted. This could also be the official time clock for postings.

b) Basin planning and advisory councils should be given notice via e-mail about any significant applications (e.g. greater than 500 acre-ft or 617,500 m^3 and/or a diversion leaving a sub-basin).

c) An electronic registry of applications and interested persons with notice provisions should be established. An enhancement would be the ability to file a statement of concern electronically.

d) An electronic system that tracks water consumption for each licence initially on an annual basis then eventually on real time for larger users should be provided. An enhancement would be real time river conditions and advisories of potential shortages.

9.4.3 Basin Water Sharing Agreement

Proposal

Red Deer River Watershed Alliance should be a forum for basin-wide water sharing arrangements.

Background

Section 33 of the Water Act gives permission to a licence holder to assign or share their water allocation with another licence or registration holder. The allocation may not be assigned if the person to receive the assignment does not have a licence. The limit of the assignment is that it can only be used by the receiving licence, only if water is available and only up to the capacity of the receiving licence.

In 2001, over six hundred water users in the St. Mary River Basin shared their allocations as a result of a water shortage. The sharing was necessary because there was going to be a 60% shortfall in snow melt runoff and if the most senior water licence called for priority on the water, many other licences including those for municipalities would have been without water.

Analysis

Educating water users on water shortage issues and at the same time attempting to negotiate agreements to avoid water shortages can be difficult if done at the time of a pending water shortage. Alberta Environment can provide technical information on water availability from runoff and storage according to hypothetical scenarios. However, decisions on sharing must be made by the water users.

In the Red Deer River Basin, most senior licences are held by small users. Some exceptions are the City of Red Deer with a 1905 Priority, the Town of Drumheller with a 1914 Priority and some large farming units. There are 41 licences with allocations in excess of 1,000,000 cubic meters and 285 licences with allocations in excess of 100,000 cubic meters.

Some of the larger licences are held by Alberta Environment, Ducks Unlimited and industry. In order to avoid sorting through details of priority, flexibility and need during a crisis, it would be prudent to conduct a water shortage planning exercise and arrive at a strategy for maximizing the use of available water under different water shortage scenarios. These could be due to natural causes or artificial situations such as the Dickson Dam requiring maintenance.

Recommendation

a) The RDRMUG should propose that the Red Deer River Watershed Alliance (RDRWA) be a forum for water users to arrive at water allocation options for a water shortage. The intent would be to have all the potential issues addressed and tentative agreements arranged such that final agreement can be reached quickly when needed between appropriate users.

b) The RDRWA should ensure that Alberta Environment and the SSRB Interbasin Water Coordination Committee provide input to the process as well.

9.4.4 Water Allocation Administration

Proposal

Alberta Environment should designate one Director to administer licences under the Water Act for the Red Deer River Basin. Each office should update records on water use and allocations in the basin, as well as address issues regarding contributing portions of the basin and non-use of licences.

Background

Alberta Environment regulates all water diversions in the Red Deer River Basin under the Water Act from both the Calgary and Red Deer offices. These offices are in separate regions with boundaries based on municipal boundaries. Their authority involves making decisions on the amounts of water to be allocated, collecting annual information on water use, administering the priority use system (water mastering) and negotiating reductions in water allocations where water is not being used for any reason.

Water allocations are tracked via an environmental management system database (EMS) that is somewhat obsolete so accuracy of data is in question in some cases. Water use returns (reports) are usually submitted in hard copy and may or may not be submitted on a consistent basis. An electronic system is being contemplated. Assessing the viability of existing licences requires site visits and data analysis both of which requires resources the government is short on. Many licences are also not reviewed on a regular basis for a number of staff resource reasons.

Analysis

Alberta Environment regional boundaries allow the department to allocate resources for programs such as approval of licences, inspections, and enforcement. These boundaries are not likely to change soon. The problem with communication from two offices to residents of the basin is not easily resolved because the department still relies on hard copy data for records. If licencing was done out of one office, inspection or investigation staff out of the other office would not have access to the files. This problem can be corrected by going to an electronic database and even better, to an electronic file system. In the interim a seamless one-office approach could be arranged with one window for stakeholders which means there is one decision maker for licences. Each office could continue to use staff for updating information and administering other aspects of legislation.

When electronic records were reviewed for the Red Deer River Basin municipalities in 2007, some inconsistencies were noted. For example:

- A farming unit had an exceptionally large allocation
- Shearness / Deadfish projects seemed to have duplicate licencing
- Unrealistic allocations were found for flood control works
- Some ground water supplies are considered to be surface water sources yet are listed as ground water sources.

The above issues should be critically evaluated because the basin allocation status will need to be accurate for aspects such as a crown reservation, net diversion licencing and a cap on licencing.

In addition the administration of licences requires a review of actual use to ensure licenced allocations are still current. Reduction in allocations would be appropriate if water in licences have no reasonable prospect of using all this allocation.

Recommendation

Administration of licences should be improved to provide accurate information on water use, licences and priority. In order to accomplish this it is recommended that:

a) A “virtual” office be integrated between the Red Deer and Calgary offices to administer applications for licences such that decisions are made by one Director out of the Red Deer office.

b) A concerted effort be made to assess licences for lack of use and reduce allocations where appropriate e.g. stockwatering.

c) Allocations be modified where duplicate entries have been made.