Alberta

Environment and Sustainable Resource Development

Approved Water Management Plan for the Battle River Basin (Alberta)

July 2014

ACKNOWLEDGEMENTS

Thank-you to all members of the Stakeholder Advisory Group, many of whom were volunteers, for the amount of time and energy you invested into learning about water and watershed management issues in the Battle River watershed. The recommendations developed by the Stakeholder Advisory Group were not easily reached. These recommendations form the basis of this plan.

Thanks also to the Steering Committee for your invaluable guidance and advice during the development of this plan. And finally, thanks to administrative and technical staff at the Government of Alberta who contributed considerable effort to the development of this plan.

EXECUTIVE SUMMARY

This plan is the Approved Water Management Plan for the Battle River Basin (Alberta) and provides direction for the management of surface water and groundwater that has hydrologic connection to surface water within the Battle River Basin. The recommended options and strategies presented in this plan were developed through a Stakeholder Advisory Group, and are designed to strike a balance between a healthy aquatic ecosystem, a vibrant economy, and sustainable communities. Primary emphasis is placed on the need to live within the *carrying capacity* of the watershed, and the need to improve the *health of the aquatic ecosystem*.

The principle recommendations contained in this plan include:

- A water allocation limit be set at 57,500 dam^3 of licenced water use, and that once this limit has been reached, the Battle River Basin be closed to new (junior) water licence applications;
- Water allocation transfers be enabled immediately to provide options for those requiring greater water security to meet their business needs;
- Water Conservation Holdbacks be enabled immediately;
- A Water Conservation Objective be set as a rate of flow that is 85% of the natural flow that is to be left in the watercourse; and during those times when natural flow approaches the lowest quintile (20%) flow reductions shall be applied based on the greater of either:
    a) 15% instantaneous reduction from natural flow or;
    b) The lesser of either the natural flow or the 80% exceedence natural flow based on available time step data.
- Improvements to water management administration processes be made to ensure the efficient management of the water allocation system.

This plan also provides guidance for the management of riparian areas, voluntary flow restrictions during water shortage periods, and the development of site specific water quality objectives. The achievement of the recommended options and strategies contained in this plan will require improved co-operation between all stakeholders. Moreover, the guidance of the designated Watershed Planning and Advisory Council for the Battle River Watershed, as well as stewardship groups working in the basin is essential to the long term success of the non-regulatory aspects of this plan.

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1.0 INTRODUCTION

This is the Approved Water Management Plan for the Battle River Basin (Alberta). This plan is the senior plan as it applies to the management of water within the Battle River Basin. All other water management plans and watershed management plans must be consistent with it. This plan is written in accordance with the *Framework for Water Management Planning*, which is enabled by section 11 of the *Water Act* and reflects the planning process, as described in the *Battle River Watershed Management Planning Process Phase One Terms of Reference*, which were approved on May 27, 2004.

This plan is organized into six main sections. Section 2.0 provides a description of the planning area in which this water management plan applies. A summary of issues considered during the development of the water management plan are described in Section 3.0, while Section 4.0 provides a summary of information assembled specifically for the development of this water management plan. Section 5.0 presents the recommended options and strategies for addressing issues of concern. Finally, in section 6.0 performance monitoring requirements are identified.

2.0 PLANNING AREA

2.1 Location

The planning area begins just west of Highway 2 at Battle Lake, and continues east to the Alberta - Saskatchewan border (Figure 2.4-1). The planning area boundary is defined as that portion of the Battle River Basin (or watershed) within Alberta that catches precipitation, draining it into the Battle River. Topography defines the entire basin, as it shapes the course and speed of water moving through the area. The boundaries of the basin are known as drainage divides (i.e. the height of land between adjoining watersheds). Within the Battle River Basin, there are five sub-basins, including Bigstone, Iron, Paintearth, Blackfoot and Ribstone.

2.2 Natural Landscape

The Alberta portion of the Battle River Basin is entirely within the province's settled "White Zone" spanning the Central Parkland and northern fringe of the Mixed Grass Natural Sub-Regions. The Battle River Basin drains approximately 40 per cent of greater North Saskatchewan River Basin; although the Battle River only contributes approximately 279,235 dam^3 (3 %) of the natural flows in the North Saskatchewan River[1]. There are two primary reasons for this: (1) the headwaters of the Battle River originate in the Western Plains at Battle Lake. This means water flowing in the Battle River originates as groundwater and surface water runoff from local snow melt and rains, rather than from mountain and foothills snowpack runoff. (2) The topography of the Battle River Basin is predominantly flat – the river's average gradient is less than 0.4 m/km— with large tracts of land that are considered non-contributing either naturally, or due to human influence (e.g., ditching and draining practices). Non-contributing means that water falling as snow or rain collects in small lakes and wetlands where the water will eventual either infiltrate into the ground, or evaporate before it ever reaches the Battle River. All of this results in very low flows in the Battle River, except for a short period of time annually in April and May, and periodically in summer months during major rain storm events.

2.3 Cultural Landscape

In 2006, the Battle River Basin had a population of about 116,000 people; this represents approximately 3.7% of the population of Alberta. Overall, 32% of the basin population lives in one of three cities (Camrose, Lacombe and Wetaskiwin), while 33% live in one of the 15 towns in the basin and a similar percentage (32%) live in one of 14 rural areas, including counties and municipal districts, and Special

Areas. The balance of the population lives in one of 28 villages (6%), 10 summer villages (1%), or four Indian reserves (5%).

Overall, 24% of the workforce was employed in agriculture and other resource-based industries, although this increased to 42% in the Ribstone Sub-basin. Other services industries accounted for 17% of employment in the Battle River Basin and this percentage was fairly consistent among the five sub-basins. Health care and social services industries provided 11% of basin employment, although this ranged from a high of 13% in the Bigstone sub-basin to 8% in the Ribstone sub-basin. Another 11% of basin employment was in the retail trade industries.

2.4 Administrative Context

The Battle River planning area lies primarily within the Red Deer – North Saskatchewan Region of Alberta Environment and Sustainable Resource Developments administrative units. The planning area also falls within two regional planning areas, as identified under *Land-use Framework*, including the North Saskatchewan and Red Deer Regional Planning areas. As well, fourteen counties, municipal districts and special areas find all or part of their administrative boundaries within the planning area. Three Cities (Lacombe, Camrose, Wetaskiwin), 15 towns, 27 villages, 10 summer villages and 4 First Nations Reserves (Pigeon Lake, Samson Cree, Montana, Ermineskin, Louis Bull) also have management jurisdiction within the planning area. As well, a number of provincially designated parks and protected areas, including: 3 provincial parks, 4 recreational areas, 11 crown reservations, 5 natural areas, and 1 ecological reserve are found within the planning area. Finally, Canadian Forces Base Wainwright is also located in the planning area.

[1] Estimated annual natural flows for the Battle River for the period of record 1912 - 2008.

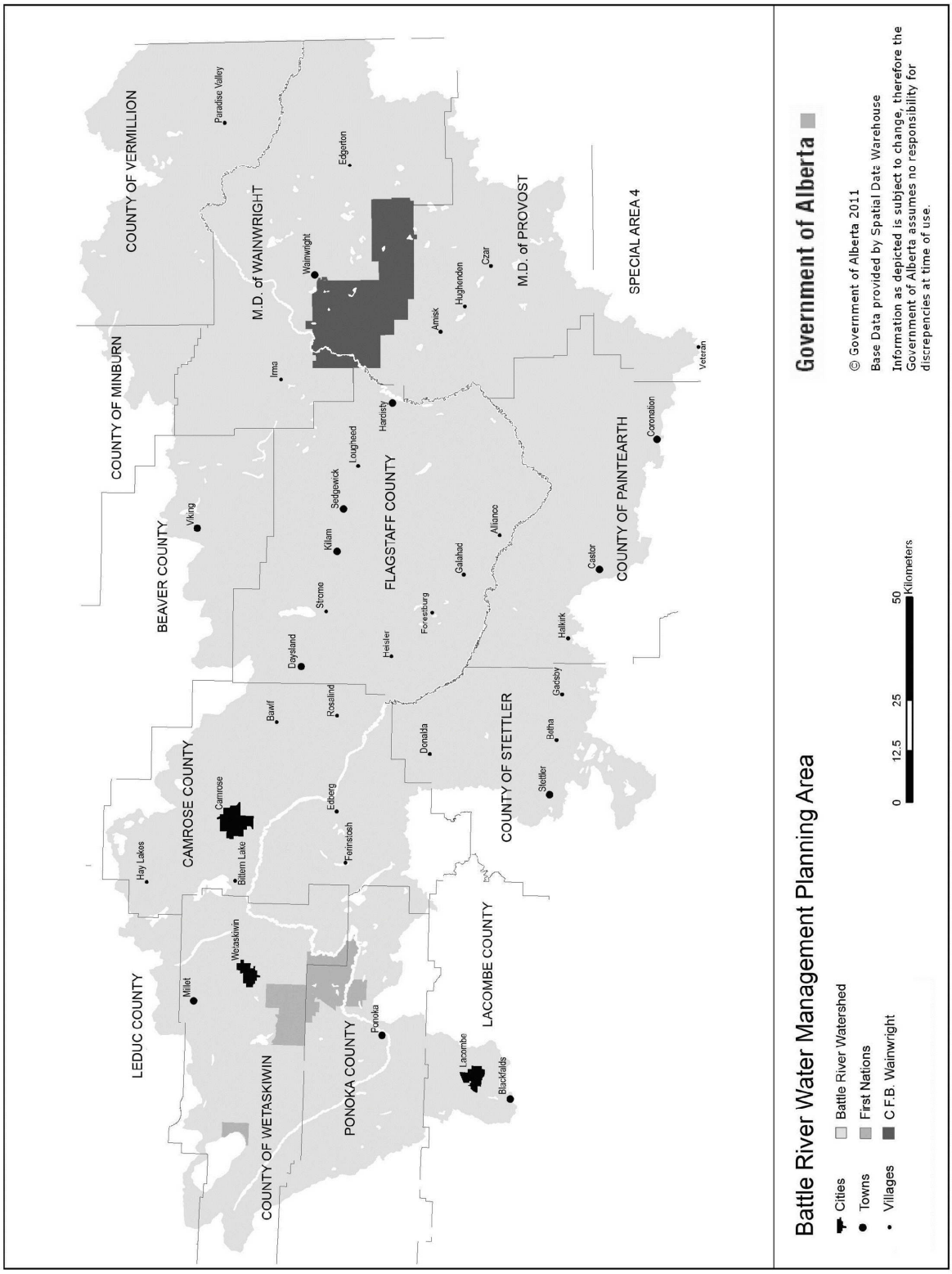


Figure 2.4-1 Battle River Water Management Planning Area

3.0 SUMMARY OF ISSUES CONSIDERED

The Approved Battle River Water Management Plan (this plan) was prepared with extensive public input, focusing first on a Stakeholder Advisory Group of representatives from rural and urban municipalities, First Nations, provincial and federal government, agriculture, industry, stewardship communities and private citizens. A complete listing of members of the Stakeholder Advisory Group is provided in Appendix 1. Common areas of concern that emerged during the planning process center on the need to *strike a balance* between economic, social and environmental values. To do this, the Stakeholder Advisory Group preferred to consider options that place primary emphasis on the need to live within the *carrying capacity* of the watershed, and the need to improve the *health of the aquatic ecosystem*.

3.1 Striking a Balance

Increasing pressure on available water supply is presenting an important management challenge for residents, business, industry, First Nations, and Government (Municipal, Provincial, Federal). With limited available water supply in the planning area when compared to other river basins in Alberta, and an expanding population, it is increasingly important that a balance be achieved between the need to maintain a healthy aquatic ecosystem, a vibrant economy, and sustainable communities in the planning area.

There is no correct answer when seeking to balance the needs of the economy, the aquatic environment, and the social fabric of communities in the Battle River Basin. Decision making requires all Albertans to make choices. Working with the Stakeholder Advisory Group, the direction taken during the development of this plan was to determine how flexibility can be encouraged when making water use decisions that promote a sustainable economy while simultaneously building a culture of stewardship that permeates through all sectors operating within the planning area. Thus, the overall objective of this plan is to improve the health of the aquatic ecosystem while balancing the needs of society.

Mapping out a path for establishing a balanced approach to water management in the planning area required the Stakeholder Advisory Group and the Government of Alberta to:

- Respect the Master Agreement on Apportionment (1969);
- Respect existing water licence agreements;
- Fully understand and utilizes options available under the Water Act;
- Fully understand and develop an approach to water management operations that promotes a healthy aquatic environment.

3.2 Carrying Capacity

Albertans enjoy a high quality of life. To sustain our quality of life often requires the import of goods and services that allow us to expand our populations beyond the natural carrying capacity of the environment we live in. For example, the creation of regional water lines, transmission of electricity and other activities, all support a high quality of life, but take us beyond the natural carrying capacity of the watershed while creating potential challenges in other areas.

Developing an approved water management plan that places emphasis on living within the carrying capacity of the watershed required the Stakeholder Advisory Group and the Government of Alberta to:

- Understand current and future water needs;
- Understand how water is used to support recreation today, and in the future;
- Consider the role of sector specific water use efficiency strategies.

3.3 Healthy Aquatic Ecosystems

The *Water Act* (Section 1(h)) defines the aquatic environment as "…the component of the earth relating to, living in, or located in or on water or the beds or shores of a water body, including but not limited to all organic and inorganic matter, and living organisms and their habitat, including fish habitat, and their interacting natural systems."[2]

Prior to the development of this plan, questions about the health of the aquatic ecosystem in the Battle River Watershed were emerging (See for example Christainsen 1977). The Stakeholder Advisory Group and the Government of Alberta recognize that healthy aquatic ecosystems need more than a reliable supply of water. The Stakeholder Advisory Group acknowledged early on that separating out water management from watershed management is difficult; one begets the other. Therefore, the Stakeholder Advisory Group and the Government of Alberta sought to:

- Understand the health of the aquatic ecosystem;
- Understand the role of Instream Flow Needs in supporting a healthy aquatic ecosystem;
- Consider the role of a water conservation objective as tool for supporting a healthy aquatic ecosystem;
- Consider the role of flow restoration for improving the health of the aquatic ecosystem.

To better understand the types of trade-offs that will be made to find a balance between the needs of society and the health of the aquatic ecosystem, the Government of Alberta commissioned several studies that provided context to the issues considered by the Stakeholder Advisory Group. A summary of information assembled is provided in section 4.0 of this plan.

4.0 SUMMARY OF INFORMATION ASSEMBLED

A wide range of technical information was assembled and considered during the development of recommended options and strategies presented in section 5.0 of this plan. A summary of information assembled is divided into three components, including: *Human Use of Water*, *Health of the Aquatic Ecosystem*, and *Modeling*. The information provided is a summary of key aspects of the research completed. A full listing of additional studies and information assembled to support the development of this water management plan is provided in the bibliography (Section 7.0).

4.1 Human Use of Water

Fresh water is a limited and precious resource. In the Battle River Basin water is critical to the economic and social wellbeing of its residents. During the development of this plan, two separate water needs assessments were completed to determine licenced water allocations, actual use of water and to forecast future uses.

4.1.1 Current Water Demand

Residents and businesses in the Battle River basin draw water from both surface and groundwater sources. Under the *Water Act* there are three ways a person can acquire the right to divert and use water:

1. Household purposes: People owning or occupying land adjacent to surface water or under which groundwater exists can use up to 1250 m^3/yr without requiring a licence
2. Traditional agricultural use: Farmers owning land adjacent to surface water or under which groundwater exists can register to use up to 6250 m^3/yr with priority based on date when water is first used.
3. All other uses: A licence is required for all other diversions and the priority is based on the date the complete application was received.

Since 1935 the Government of Alberta has approved nearly 7,500 licences and registration authorizing the use of surface water in the Battle River Basin. These licences allow for the diversion of 751,826 dam^3 of surface water (269% of mean annual flow). A summary of these allocations is provided in Table 4.1-1.

Table 4.1-1 Summary of Surface Water Allocation in the Battle River Basin

	No. of licences	**Gross Diversion** (dam^3)	**Licenced Water Use** (dam^3)	**Actual Water Use** (dam^3)	**Licenced Return Flow** (dam^3)
Power Generation licences (cooling)	3	691,737	13,741	9,620	677,996
Surface Water Licences	791	58,123	44,726	33,563	13,849
Traditional Agricultural Registration	6,674	1,966	1,966	1,966	0
TOTAL	**7468**	**751,826**	**60,433**	**45,149**	**691,845**

Three licences issued for thermal electric power generation account for the vast majority of water allocations in the Battle River watershed (92 %). Water allocations for power generation are used for cooling purposes, such that the return flow is very high (98%). By ignoring licences issued for power generation, the remaining surface water licences and traditional agricultural registrations allow gross diversions of 60,089 dam^3 per year, or 21 per cent of the natural flow. Licenced water use for surface water licences and traditional agricultural registrations totals approximately 46,692 dam^3, or 17 per cent of the natural flow. However, consideration must be given to licenced water use for power generation, which totals approximately 13,471 dam^3. By combining licenced water use for power generation with licenced water use for surface water licences and traditional agricultural users, approximately 60,433 dam^3 (22%) of the mean natural flow can be consumed without being returned to the Battle River.

Although water licence holders are permitted to divert a volume of water specified under the terms and conditions of the licence (licenced water use), many water licence holders actually use an amount of water that is somewhat less than what is permitted (actual use). In the Battle River Basin the difference between licenced water use and actual water use is 15,283 dam^3, shown in Table 4.1-1. This volume of water (15,283 dam^3), which is already permitted for use, may become eligible for transfer in accordance

with section 81, 82 and 83 of the *Water Act* and is an important factor in the recommendations presented in section 5.0 of this plan.

4.1.2 Future Water Needs

Two separate water needs assessment studies were completed during this planning process. The first was completed in 2005 and is an assessment of future water needs for all sectors in the planning area. The second water needs assessment is specific to the water needs of the Maskwacîs Cree Nations.

4.1.2.1 Battle River Basin Water Use Assessment and Projections

The *Battle River Basin Water Use Assessment and Projections* study helped determined licenced water allocations and actual use of water in the planning area, and forecast future water use projections (Watrecon 2005). The analysis focuses on eight major water use sectors, applying three alternative growth scenarios to forecast future water needs, including: base case (medium growth), low and high growth scenarios. The assumptions used to estimate future water use are presented in Table 4.1-2 and are based on current policies and trends within each sector.

Table 4.1-2 Summary of Assumptions Used to Predict Annual Changes in Surface Water Use by Sector

Sector	Assumptions	Base (medium growth) Case	High Growth	Low Growth
Municipal Use	Water use is directly related to population growth	+0.8%	+1.2%	+0.6%
Stockwatering	Livestock populations in middle and lower basins will increase at historic rates but at half this rate for the upper basin.	+1.2%	+2.0%	+1.0%
Irrigation	No change from actual use in 2004	0.0%	0.0%	0.0%
Cooling (thermal power)	No change from actual use in 2004	0.0%	0.0%	0.0%
Oilfield Injection	Use will decline as oilfields age and production declines	-2.5%	0.0%	-5.0%
Other Industrial	Continuation of past trends will result in additional demands of 300 dam^3 per decade	+1.6%	+2.0%	+1.1%
Wildlife/Recreation	No change from actual use in 2004	0.0%	0.0%	0.0%
Water Management	No change from actual use in 2004	0.0%	0.0%	0.0%

Overall, the key sectors driving future growth in the Battle River Basin are population growth in municipalities (particularly in the upper basin), expansion of livestock populations, and industrial growth other than thermal power production and oilfield injection. It should be noted that in 2004 actual water use for oilfield injection amounted to two per cent of existing allocation and this is forecast to decline over time. Water use in all other sectors is predicted to remain relatively constant over the next 25 years.

Based on the assumptions Table 4.1-2, estimated future water use based on the base (medium growth) scenario is deemed the most feasible future scenario. The specific water use estimates were based on water use in 2004, and are summarized in Table 4.1-3.

Table 4.1-3 Current and Future Surface Water Use estimates in dam^3 for the Battle River Basin:

	2004 Licences and Registrations		2004 Actual Use	Forecast Actual Use	
	Gross Allocation	Licenced Water Use		2015	2030
Municipal	14,215	3,713	1,352	1,513	1,711
Stock watering	4,432	4,432	4,432	5,135	6,288
Irrigation	12,216	10,508	9,960	9,960	9,960
Cooling	691,737	13,741	9,620	9,620	9,620
Injection	7,529	7,389	153	116	79
Other Industrial	844	794	794	955	1,195
Wildlife	17,838	17,100	16,540	16,540	16,540
Recreation	1,445	1,195	1,195	1,195	1,195
Water Management	1,559	1,103	1,103	1,103	1,103
TOTAL	**751,815**	**59,975**	**45,149**	**46,137**	**47,691**

The forecast indicates that surface water use is expected to increase by 988 dam^3 (2.2 %) by 2015 and by 2,540 dam^3 (5.6 %) by 2030. These increases appear relatively small, but this is because there is predicted to be no change in uses of water for irrigation, thermal power or wildlife, which collectively account for 80 per cent of actual water use in 2004.

It should be noted that forecast use of surface water does not include surface water used for domestic purposes, which does not require a licence or reporting of water use. The forecasts also ignore the use of surface water imported into the Battle River Basin from other regions. At the present time about 1,183 dam^3 of water is imported from the Red Deer and North Saskatchewan River basins for municipal water use.

4.1.2.2 Maskwacîs Cree Nations Water Needs Assessment

Concerns raised by First Nations during the planning process regarding water needs estimates lead to the completion of a second water needs assessment that focused specifically on Maskwacîs Cree Nations water needs (Aquatic Resources Management, et al. 2011). While the 2004 water needs estimates presented in section 4.2.1.1 included on-reserve First Nations population estimates using Statistics Canada Census Data, the Maskwacîs Cree Nations water needs assessment uses INAC Indian Registry Data for 2009, with an adjustment to include new registries based on Bill-C3.

Based on 2009 population estimates from INAC of 10,071 people living on-reserve, three alternative population growth scenarios (trend, linear and exponential) were calculated. The trend based projection extrapolates based on growth trends derived from previous population data to project future population estimates and is calculated as: *current population + average growth rate*. Similarly, the linear projection method extrapolates based on previous population estimates, but assumes future population will change by the same number of people annually and is calculated as: *current population + average population change*. Finally, the exponential growth scenario assumes that the population will change by the same percentage each year, but is calculated as: *current population + (current population * Average Growth Rate).* The study used three alternative annual growth rates 1.5 percent, 2.8% percent and 3.5% percent to calculate the exponential growth scenario. A summary of the population estimates are provided in Table 4.1-4.

Table 4.1-4 Summary of Maskwacîs Population Projections (on-reserve)

Scenario:	Trend	Linear	Exponential		
			Low	Medium	High
2009 (Current)	10,071	10,071	10,071	10,071	10,071
2019 (10 years)	12,227	11,894	12,451	13,551	14,564
2034 (25 years)	15,278	14,628	17,236	21,167	25,366
2059 (50 years)	20,345	19,185	30,189	44,603	64,238

While the trend (20,345 people) and linear (19,185 people) population estimate methodologies yielded fairly similar population estimates, the exponential growth scenarios yielded populations estimates for the medium (44,603 people) and high growth (64,238 people) scenarios that were more than double the estimates from the first two methodologies when looking 50 years into the future. However, exponential growth rate estimates should only be used for short term forecasts because the population change eventually exceeds the carrying capacity of the community; suggesting the 50 year growth rate is less

reliable. Although each methodology has its limitations, the medium exponential growth calculation was deemed by Maskwacîs Cree Nations to be the most feasible option for estimating future water needs.

The assessment next determined current annual groundwater and surface water demands based on five major use categories, including: residential; industrial/commercial/institutional/recreational; ceremonial; agriculture; and finally supply system pipe losses. The estimates are provided in Table 4.1-5.

Table 4.1-5 Current Average Annual Water Demand (on-reserve)

Nation	Average Demand (dam3/year)					
	Residential	**ICIR**	**Ceremonial**	**Pipe Losses**	**Agriculture**	**Total**
Ermineskin Cree	229	50	3	46	3	331
Louis Bull	116	25	2	24	3	170
Montana	53	12	1	11	1	78
Samson Cree	448	97	5	92	11	653
Total	**846**	**184**	**11**	**173**	**18**	**1,232**

Overall, the key sector driving water use presently on Maskwacîs Cree Nations lands is residential use with almost 850 dam^3 of water demand annually. Second highest demand is from the industrial/commercial/institutional/recreational (ICIR) sector (184 dam^3), which is comparable to pipe losses at 173 dam^3. To calculate future water needs study authors used medium exponential growth calculation presented in Table 4.1-4 and current water use estimates in Table 4.1-5 to project future water needs 10, 25 and 50 years into the future. Future water need estimates are presented in Table 4.1-6.

Table 4.1-6 Current and Future Water Use estimates in dam^3 for Maskwacîs Cree Nations (on-reserve population) based on medium exponential growth forecasts:

Year	Ermineskin Cree	Louis Bull	Montana	Samson Cree	Combined Total
2009 (Current)	331	170	78	653	1,232
2019 (10 years)	454	234	178	860	2,726
2034 (25 years)	728	381	233	1,302	3,644
2059 (50 years)	1,608	858	399	2,604	6,469

The forecast suggests that water use is expected to increase by 1,494 dam^3 (221 per cent) by 2019 and by 2,412 dam^3 (295 per cent) over the next 25 years. It should be noted that the water use estimates for Maskwacîs Cree Nations does not separate ground water and surface water estimates, while the 2004 study does make this distinction. Given the limitations of the exponential growth scenario for long range forecasts, the 25 year water needs projection of 3,644 dam^3 was considered when developing the recommended options and strategies in Section 6.0.

4.1.3 Assessment of Existing Water Licences

Section 55 of the Water Act includes provisions for the assessment, suspension and cancellation of existing water licences. The Stakeholder Advisory Group recommended Alberta Environment review existing licences in accordance with section 55 of the Water Act prior to finalizing their recommendations. The purpose of the review is to identify any potential water that can be returned to the aquatic ecosystem as a result of cancellations of licences not in good standing, and to assess current standing of licences in the basin for the purpose of enabling transfers, in accordance with section 81, 82 and 83 of the Water Act. The review, completed in 2011, included 330 licences, equivalent to 95 per cent of the total volume of water allocated in the Battle River Basin. Table 4.1-7 presents the preliminary results of the licence review.

Table 4.1-7 Preliminary Results of Water Licences Subject to Review

	Gross Allocation (dam^3)	**Licenced Water Use (dam^3)**	**Number of Licences requiring Amendment**	**No. of Licences not in compliance with Water Use Reporting**	**No. of Licences Possibly Subject to Cancellation**	**Potential Water Savings (dam^3)**
Municipal	14,215	3,713	3	2	-	-
Stockwatering	4,432	4,432	1	3	2	18
Irrigation	12,216	10,508	15	59	5	250
Cooling	691,737	13,741	1	-	-	-
Injection	7,529	7,389	2	-	4	4943
Other Industrial	844	794	1	3	1	16
Wildlife	17,838	17,100	6	4	1	11
Recreation	1,445	1,195	-	7	1	110
Water Management	1,559	1,103	2	3	-	-
TOTAL	**751,815**	**59,975**	31	81	14	**5,348**

The license review identified 31 licenses that may require amendments to purpose and/or allocation, while 81 licences are currently not in compliance with water use reporting conditions specified in the licence. As well, 52 licences were flagged for additional investigation because they may not have the works in place to divert water. Pending the results of additional follow-up these licences may be subject to cancellation. Finally, a total of 14 licences were identified as being subject to immediate cancellation. Follow-up with these licences resulted in the cancellation of five licences, accounting for a total of 4986 dam^3 of water.

4.1.4 Water Management Infrastructure

An inventory and description of water control structures and their operation was completed to understand how water management infrastructure in the planning area is currently operated and what the limitations and opportunities for improvement to water operations might be. Within the planning area there are over 100 structures that regulate the movement of water. Of these, there are 10 major regulated lakes and reservoirs. The locations of these structures are shown in Table 4.1-1.

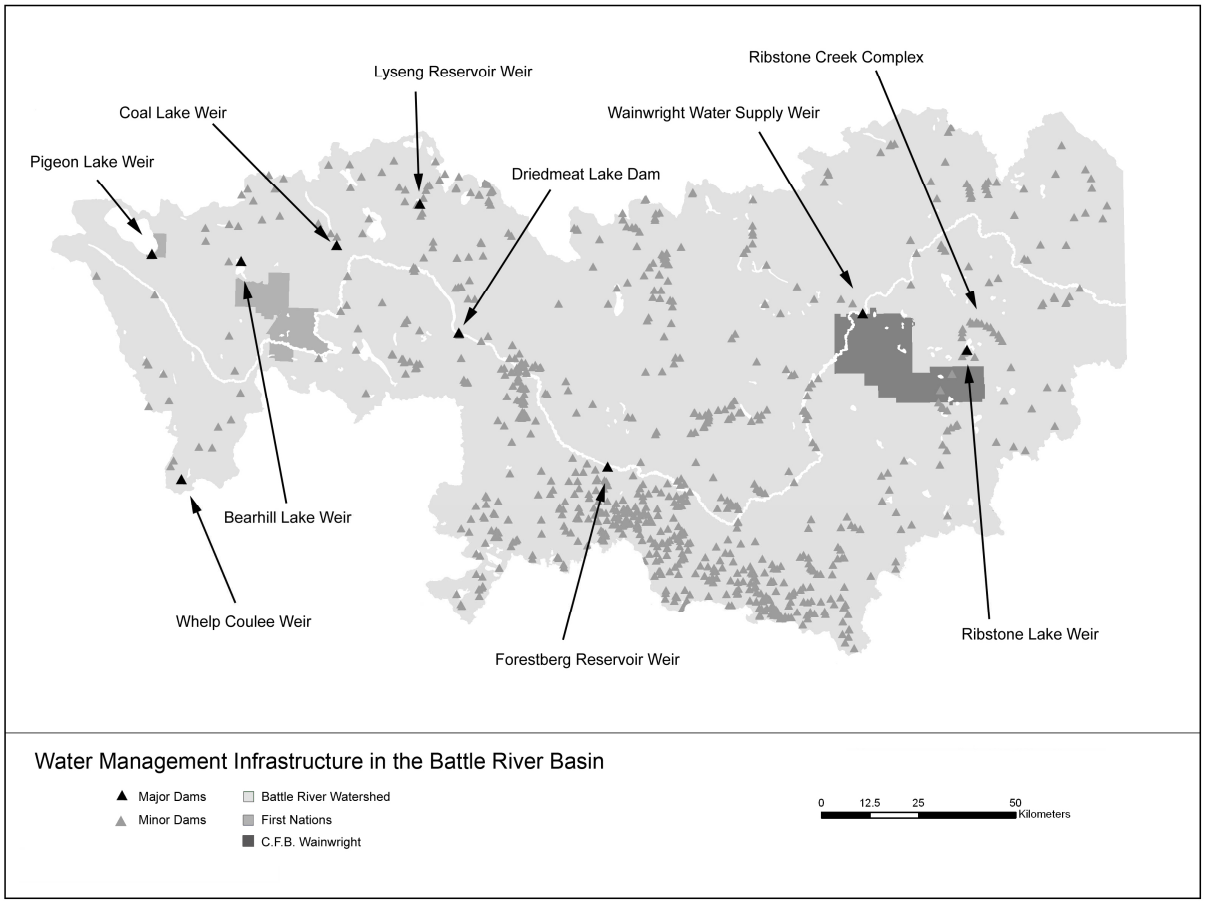


Figure 4.1-1 Water Management Infrastructure Projects in the Battle River Basin

A description of each major structure is provided in Table 4.1-8. Missing from the table are water management infrastructure projects operated by Ducks Unlimited Canada (DUC). There are over 100 licensed wetland projects in the Battle River Basin, including 27 structures in the Ribstone Creek area. A variety of structures are used to create wetlands, and backflood hay meadows for agriculture and habitat improvement. These wetland creation projects also help recharge groundwater and augment river and creek flows during low flow periods. There are no DUC structures on the main stem of the Battle River.

Table 4.1-8 Description of Major Water Management Infrastructure in the Battle River Basin

Location	Description
Pigeon Lake	Narrow stop log system with hand removal required. The sill elevation is 849.80 m. The fishway elevation is 849.65 m. Weir is operated to maintain full supply level of 849.95 m.
Coal Lake	An 8.2 m high earthen dam on Pipestone Creek. Spillway crest of 22.9 m and a 0.9 m diameter slide gate that allows for riparian flow. Although riparian gate is set approximately 3.6 m below full supply level (FSL), flow through this gate is limited to the upper 1.5 m of the reservoir due to siltation of the inlet channel. Spillway full supply level is 702.9 m, and emergency overflow level 705.6 m, dam crest elevation 705.9m. Used to store water for flow augmentation on the Battle River and to provide water supply for the City of Wetaskiwin.
Driedmeat Lake	Fixed elevation structure made of sheet piling, with an elevation of 684.58 m, with a variable crest stop-log fish ladder allowing the elevation to be lowered to 682.75 m. Original operations required hand removal of stop logs. Minimal riparian flow was directed through the Denil fishway to 0.15 m below full supply level. Weir is used primarily for stable water supply for the City of Camrose. Structure was rehabilitated in 2010. Additional information below.
Ribstone Lake	DUC operates this structure; operation requires hand removal of stop logs. Normally, DUC operates the lake at 0.15 m above FSL in early spring then draws down in April or May to promote backflood irrigation in the downstream floodplain through an additional 27 structures licensed to DUC.

	Ribstone Creek - Box weir with 2 – 1.4 m diameter corrugated steel pipe and stop log bay. Although licensed to Alberta Environment the project is operated by DUC by agreement.
Forestburg Reservoir	Weir crest elevation is 668.64 m, but raised to 669.25 m with gates installed in 1989. Gates are not able to resist ice forces; therefore every fall gates are opened to drop reservoir level to the spillway crest. Gates are closed in April for open water season. Operation of the dam is based on a spillway designed to release a base flow. When inflow to reservoir is greater then 0.142 m^3/s, the downstream release flow must be 0.142 m^3/s. When inflow is less than 0.142 m^3/s, the downstream release flow must be 0.057 m^3/s. The dam physically can't release any more water than this, unless it is spilling over the top of the dam during high flows.
Betty Lake	Operated by C.F.B. Wainwright, raw water is pumped from the Battle River into Betty Lake as water storage for Town of Wainwright.
Bearhills Lake	Bearhills Lake Drainage District operates a sheet pile weir with a 0.8 m deep stop log bay. Project provides stabilization of Bearhills Lake level at 787.91 m.
Lyseng Reservoir	Imperial Oil Resources Ltd. constructed a 3 m high dam and outlet control on Lyseng Reservoir. Project originally built by Imperial Oil to store water for well injection, but then transferred to DUC in 1994.
Whelp Coulee	Lacombe County operates a diversion weir, inlet canal, outlet control, and dam on Whelp Coulee. Project supplies domestic water to 30 farms southwest of the City of Lacombe.

With few specific operating plans in place, the overall approach to the operation of water management infrastructure in the planning area can be characterized as being limited to an "as required" basis. The one exception is the 2010 rehabilitation of the weir at Driedmeat Lake. As part of the rehabilitation of Driedmeat Lake weir, Alberta Environment Water Management Operations (WMO) has committed to an operations plan for Driedmeat Lake (the operations plan):

1) When Driedmeat Lake water level is at or above Minimum Operating Level (684.27 meters) and below the stabilized water level (685.2 meters), the riparian release shall ensure the following minimum downstream releases:
    a) During the months of November to March, the lesser of 0.71 m^3/s or inflow minus Camrose's current allocation (3084 dam^3, average flow of 0.1 m^3/s);
    b) During the months of April to October, the lesser of 1.42 m^3/s or inflow minus Camrose's current allocation (3084 dam^3, average flow of 0.1m^3/s), but not less then 0.28 m^3/s.

2) When Driedmeat Lake is below Minimum Operating Level (684.27 meters), there will be no release, except via the riparian gate there will be no release, except via the riparian gate with minimum flows of 0.28 m^3/s.

The operations plan is not based on the achievement of the recommended instream flow needs. However, the improvement to downstream flow is anticipated to have a positive impact on downstream aquatic and riparian habitat, as well as improvements in water security for downstream water licenses.

4.2 Health of the Aquatic Ecosystem

A healthy aquatic ecosystem is sustainable and resilient to stress, and is able to maintain its ecological structure and function over time and in a manner similar to the natural (undisturbed) ecosystems of the regions past. Moreover, a healthy aquatic ecosystem has the ability to recover from disturbance, while continuing to meet the needs of society. The Government of Alberta, during the development of this plan, reviewed historical studies and commissioned new research to assess the health of the aquatic ecosystem and determine instream flow needs for the Battle River. An *Instream Flow Incremental Methodology Scoping Study* (AMEC 2004) was completed in 2004 and documents specific information pertaining to hydrology, fisheries, riparian vegetation, water quality and channel geomorphology. Where data gaps exist, additional research was completed.

4.2.1 Hydrology

Natural flow is that quantity of water that would have been recorded under natural conditions prior to human interference, or anthropogenic impacts. Natural flows are calculated using the project depletion method, where surface water withdrawals within the basin's effective drainage area are added to the recorded flows to naturalize them.

Natural flow calculations for the Battle River have been completed several times (Figliuzzi 1983; DeBoer 1986; MPE 2004; Chamulak 2008; Optimal Solutions Ltd. 2010). Figure 4.2- shows the resulting natural flow datasets covers the period of record 1912 – 2008.

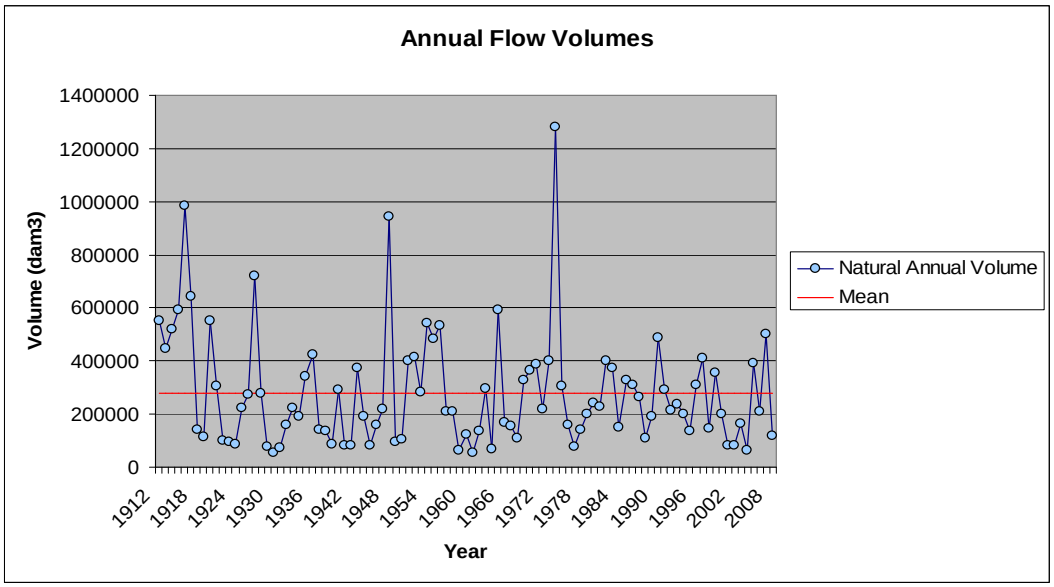


Figure 4.2-2 Naturalized Flows in the Battle River 1912 - 2008

During the period of record maximum annual natural flows occurred in 1974 at 1,282,252 dam^3 and minimum annual natural flows of 52,893 dam^3 occurred in 1930. Mean annual natural flows over the 96 year record are 279,235 dam^3.

4.2.2 Fisheries

An Index of Biological Integrity (IBI) is a multi-metric index reflecting important components of an ecosystem developed through bio-surveys, which can include such factors as land-use, water quality and fisheries abundance and composition (Stevens and Council, 2008). In the Battle River Basin, a fish-based IBI metric was developed as a tool for monitoring and evaluating ecological conditions of the Battle River without being confounded by natural factors such as stream size (Stevens and Council, 2008). Essentially, the IBI metric simplifies numerous fisheries components such as % top predators, % generalists, catch per unit effort, etc. into a number ranging between 1 and 5 for the Battle River. Other environmental variables (e.g., water quality, land-use, instream measurements) can then be evaluated to determine what influenced the IBI score and what effects may be mitigated.

Fish communities and water quality were sampled at a total of 80 sites along the Battle River in 2006 and 2007, representing the majority of the river, and covering all major land-uses and flow regimes (Stevens and Council, 2008). The study assessed three metrics (species richness, percent omnivores and percent carnivores).

The first step in the assessment was to build a profile of the fish community based on historical fisheries data collected in the basin. Significant fisheries data exists for the Battle River dating back to the 1970s (Christiensen 1977). In total, nineteen fish species representing nine families have been identified in the Battle River (Christensen 1977). Table 4.2-1 summarizes fish species identified based on Christiensen (1977) and Environmental Management Associates (1985).

Table 4.2-1 Species and Relative Abundance of Fish Found in the Battle River 1985 – 2007

Common Name	Scientific Name	Family	Relative Abundance	
			1985	2007
Burbot	*Lota lota*	Gadidae	Common in some areas (Pigeon and Battle Lake)	Collapsed populations in some areas (Pigeon and Battle Lake)
Lake Whitefish	*Coregonus clupeaformis*	Salmonoida	Abundant in restricted areas (Pigeon and Battle Lake)	Abundant in restricted areas (Pigeon and Battle Lake)
Goldeye	*Hiodon alosides*	Hiodontidae	Common	Rare
Mooneye	*Hiodon tergisus*		Rare	Rare, may be extirpated
Northern Pike	*Esox lucius*	Esocidae	Abundant	Common, populations appear to be declining
Yellow Perch	*Perca flavescens*	Percidae	Rare (Forestberg Resevoir)	Rare (Forestberg Resevoir): common Pigeon and Battle Lake
Walleye	*Stizostedion vitreum vitreum*		Abundant downstream of Forestberg, some upstream	Abundant downstream of Forestberg, some upstream
Iowa darter	*Etheostoma exile*		Common in some areas (Forestberg Reservoir)	Common in some areas (Forestberg Reservoir)

Emerald Shiner	*Notropis atherninoides*	Cypinidae	rare	rare
Fathead Minnow	*Pimephales promelas*		Abundant	Abundant
Lake Chub	*Couesius plumbeus*		Abundant	Abundant
Longnose Dace	*Rhinichthys cataractae*		Abundant	Abundant
Spottail Shiner	*Notropis hudsonius*		Abundant	Abundant
Trout-perch	*Percopsis omniscomaycus*	Percopsidae	Common in restricted areas	Common in restricted areas
Brook Stickleback	*Culea inconstans*	Gaesterosteidae	Common	Common
Longnose Sucker	*Catostomus catostomus*	Catostomidae	Abundant	Abundant
Quillback	*Carpiodes cyprinus*		Rare	Rare, may be extirpated
Shorthead Redhorse	*Moxostoma macrolepidotum*		Common	Common
White Sucker	*Catostomus commersoni*		Abundant	Abundant

Of the nineteen fish species known to have lived in the Battle River until the 1980s, fourteen species are still present, with only 6 species in abundance. Of the species caught during the study, white sucker (49%), Longnose Dace (15.8%), Lake Chub (11.5%), and Northern Pike (9.8%) were the most abundant. As a result, the fish biodiversity score for the Battle River was 42%, where a score of 100% would represent natural population structure, function, and taxonomic integrity.

Of the three metrics (species richness, percent omnivores and percent carnivores) selected from the study to represent the fish-based IBI, it was found that water quality index, percent upriver cropland cover (within 10km) and road density in the basin were critical parameters in predicting IBI scores. Particularly, it was theorized that road density may influence the integrity of fish populations (i.e.,

reduced species richness and percent carnivores) through contamination, pollution, hydrologic alteration, fragmentation and elimination of nursery habitat, and that the roads in themselves may be symptomatic of larger anthropogenic effects (i.e., more roads means greater cumulative human footprint; Stevens and Council, 2008).

4.2.3 Riparian Areas

Riparian areas are considered a component of the aquatic environment as defined in the *Water Act* and *Framework for Water Management Planning*. Degradation of riparian areas within the Battle River was first noticed as earlier as 1977 (Christiansen 1977). A more recent aerial photo interpretation exercise subjectively compared photos from 1963 and 1998 (scale 1:30,000) to determine general trends in riparian vegetation cover in the Battle River over the 35 year period (AMEC Earth and Environmental 2004). A second study used aerial videography to assess the health of riparian areas along the Battle River (Teichreb and Walker 2008).

4.2.3.1 Aerial Photo Interpretation

Aerial photo interpretation (scale 1:30,000) compared photos from 1963 and 1998 (AMEC 2004). The comparison assessed riparian vegetation within 100m of natural stream banks, and is based on reaches identified by Christiansen (1977). Sites were extensive alteration of the landscape outside the 100m assessment buffer are also noted. Findings by reach are provided in Table 4.1-12.

Table 4.2-2 Results of Air Photo interpretation (scale 1:30,000) comparing photos from 1963 and 1998, delineated by reach.

Reach 5: (Battle Lake to Ponoka)	Riparian vegetation observations made in 1998 suggest this reach is the most 'intact', having the most riparian vegetation when compared with the other reaches, although riparian vegetation has been drastically reduced relative to the 1963 photos.
Reach 4: (Ponoka to Driedmeat Lake)	Reviewing photos from 1963, very little riparian vegetation was observed. Thirty five years later a small amount of what was remaining after 1963 had been removed.
Reach 3: (Driedmeat Lake outlet to Donalda Bridge)	Much of the upland vegetation in this reach was already removed, although the areas within 100 – 300 metres of the stream course remained relatively intact. This observation may be attributed to the extensive meanders that may render the land less useful for agriculture.
Reach 2: (Donalda Bridge to Alliance)	Extensive reductions in the riparian vegetation both adjacent to the bank and upland from the channel occurred prior to 1963. By 1998, riparian vegetation near the riverbank was similar to observation made in 1963, with new locations being cleared

	right to the riverbank.
Reach 1 (Alliance to North Saskatchewan River)	By 1963 extensive riparian zone depletion occurred as a result of agricultural land clearing with much of the upland area being utilized for agriculture. In 1998, land clearing was more extensive, reaching right to the riverbank, with riparian areas adjacent to the river bank becoming narrower then what was observed in 1963.

Air photo interpretation shows a riparian environment that was already in decline by 1963, with additional degradation over the intervening 35 year period.

4.2.3.2 Aerial Videography

Aerial videography was collected for the Battle River in August 2007 during a 5.5 hour flight, covering approximately 234 kilometers of the Battle River (Teichreb and Walker 2008). The videography was later used to assess the health and integrity of riparian areas by applying a Good, Fair, Poor assessment of both the left and right banks. Table 4.2-3 provides a summary of the videography assessments.

Table 4.2-3 Results of Videography Assessment of Riparian Vegetation, delineated by reach.

Location	Rating
Battle Lake:	Good = 82% Fair = 12% Poor = 6%
Reach 1: (Battle Lake to 7.9 km west of Ponoka)	**Left Bank:** Good = 8% Fair = 16% Poor = 76% **Right Bank:** Good = 23% Fair = 21% Poor = 56%
Reach 2: (7.9 km west of Ponoka to 5.0 km south west of Gwynn –total distance 86.6 km)	**Left Bank:** Good = 34% Fair = 15% Poor = 51% **Right Bank:** Good = 43% Fair = 21% Poor = 43%
Reach 3: (5.0 km south west of Gwynn to 9.4 km upstream of HWY 53 Bridge west of Forestburg – total distance 67.2km)	**Left Bank:** Good = 22% Fair = 10% Poor = 68% **Right Bank:** Good = 25% Fair = 11% Poor = 64%
Reach 4: (9.4 km upstream of HWY 53 Bridge west of Forestburg to 10 km south of Hardisty	**Left Bank:** Good = 40% Fair = 17% Poor = 43% **Right Bank:** Good = 61% Fair= 17% Poor = 22%
Reach 5: (10 km south of Hardisty to HWY 41 bridge 19.2 km north of Wainwright – total distance 80.7 km)	**Left Bank:** Good = 24% Fair = 30% Poor = 48% **Right Bank:** Good = 46% Fair = 29% Poor = 25%

Reach 6 (HWY 41 bridge 19.2 km north of Wainwright to Alberta/Sask Border):	**Left Bank:** Good = 43% Fair = 18% Poor = 39% **Right Bank:** Good = 56% Fair = 15% Poor = 29%

The percentages shown indicate what proportion of each section received an overall health score of Good, Fair, or Poor. On average, 38% of the riparian areas assessed on Battle River were rated as good/healthy, 18% as fair/moderately impaired and 44% as poor/highly impaired in 2007

4.2.4 Water Quality

Water quality parameters of key importance are those that have the potential (in minimal amounts) to cause undesirable or even unacceptable changes in the health of the aquatic ecosystem (AMEC 2004). Key water quality parameters include dissolved oxygen, phosphorus, nitrogen, Chlorophyll, metals/semi-metals/metalloids, organic groups, specific organic groups, organic carbon and dissolved ionic substances. These water quality parameters are perhaps best illustrated through the annual assessment of river water quality at two Long-Term River Network (LTRN) Sites found on the Battle River, including the Battle River at Highway 53 and Battle River at Driedmeat Lake. The most current water qualities testing data available at LTRN locations for the Battle River is for 2007-08 and 2008-09. Index scores are presented in Table 4.2-4, summarized using the overall River Water Quality Index and three sub-indices, including Bacterial Index, Nutrient Index, and Pesticides Index.

Table 4.2-4 Water Quality Index Results: 2008-2009

Location	Sub-Index Values				Overall Index (average)
	Metals	Nutrients	Bacteria	Pesticides	
Hwy 53	90	31	72	93	72
Driedmeat Lake	91	29	100	78	75

Index Ratings

Excellent	Good	Fair	Marginal	Poor
96-100	81-95	66-80	45-65	0-45

Table 4.2-5 Water Quality Index Results: 2007-2008

Location	Sub-Index Values				Overall Index (average)
	Metals	Nutrients	Bacteria	Pesticides	
Hwy 53	97	60	71	83	78
Driedmeat Lake	92	46	91	64	73

Monitoring data gathered at LTRN sites and subsequent data information represents conditions upstream and downstream of the sites. For both LTRN locations, an overall rating of *fair*, meaning federal and provincial guidelines for metals, nutrients, bacteria, and pesticides were sometimes exceeded by moderate amounts, with water quality occasionally departing from desirable levels. Nutrients pose a significant water quality management challenge in the Battle River, with nutrient levels receiving a rating of *marginal* in 2007/08 and *poor* in 2008/09. A *marginal* rating means that guidelines are often exceeded, sometimes by large amounts, with water quality often departing from desirable levels. A *poor* rating indicates that guidelines are almost always exceeded by large amounts, and that water quality is impaired and well below desirable levels.

More detailed assessments of water quality were also completed in 2004-05 for eleven stations along the Battle River (Figure 4.2-2). Results of an assessment of compliance with surface water quality guidelines for 2004-05 are presented in Figure 4.2-2 Surface Water Quality Sampling Locations, Dec 2004 – Oct 2005.

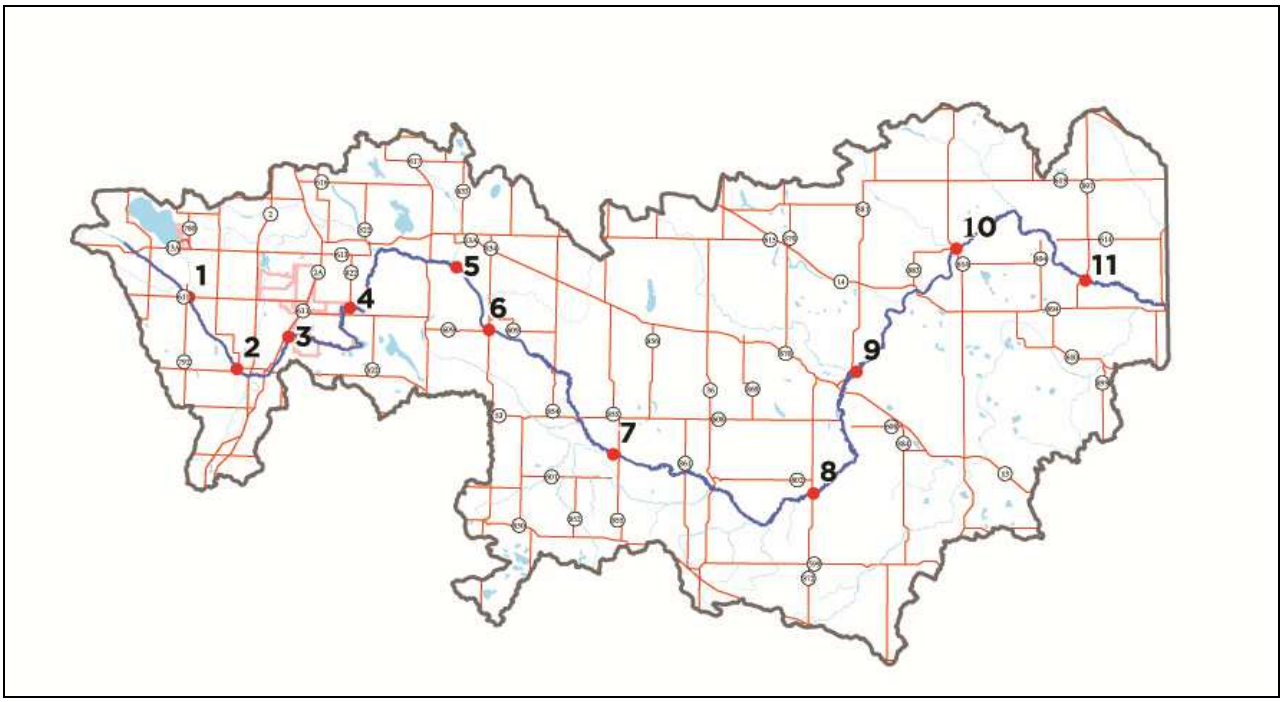


Figure 4.2-2 Surface Water Quality Sampling Locations, Dec 2004 – Oct 2005.

Table 4.2-6 Compliance with Surface Water Quality Guidelines, Dec 2004-Oct 2005

Parameter	Guideline	Station Number										
		1	2	3	4	5	6	7	8	9	10	11
Total Phosphorus	Aquatic life (0.05 mg/L)	100	100	100	100	100	100	100	75	63	67	89
Total Nitrogen	Aquatic life (1 mg/L)	33	67	78	89	90	100	89	75	75	33	44
Total ammonia	Aquatic life (calc.)	0	0	11	11	10	0	0	0	0	0	0
Nitrite	Aquatic life (0.06 mg/L)	0	0	22	11	0	0	0	0	0	0	0
Fecal Coliforms	Irrigation (100 # /ml)	22	27	10	0	0	30	0	30	40	20	10
Fecal Coliforms	Recreation (200 # /ml)	10	0	0	0	0	20	10	10	0	10	10
Dissolved Oxygen	Aquatic life (>5.0 mg/L)	0	18	30	10	27	40	30	0	20	30	30
pH	Aquatic life (0.06 mg/L)	0	0	40	40	27	50	10	0	0	0	0

	Canadian Water Quality Guidelines Exceeded more than 50% of the time
	Canadian Water Quality Guidelines Exceeded less than 50% of the time
	Canadian Water Quality Guidelines never Exceeded

Based on available water quality data, total phosphorus is likely the main parameter forming the basis for degraded water quality in the Battle River. High total phosphorus concentrations contribute to excessive algal growth with corresponding increases in dissolved oxygen levels, with exceedence being observed frequently throughout the sample period. More generally, the Battle River is fairly typical of other prairie fed river systems in that it sees increased demands for dealing with anthropogenic wastes. For example, pH levels and fecal coliform counts sometimes exceed guidelines. The end result is an impaired ability for the river to support a diversity of aquatic life generally associated with a healthy aquatic ecosystem.

4.2.5 Channel Geomorphology

Flows for channel maintenance are required to maintain and promote a healthy aquatic ecosystem. AMEC Earth and Environmental (2004) determined the required annual duration of channel maintenance discharge, which is the number of days minimum discharge is required to maintain channel form in its

current state. Three sites where bridges are located were used to calculate maintenance discharge requirements. Table 4.2-7 described the sites:

Table 4.2-7 Bridge File and WSC Gauge Information

Bridge File Number	Gauge Number	Gauge Name	Drainage Area (km^2)
278	05FA001	Battle River near Ponoka	1830
1062	05FC001	Battle River near Forestburg	7680
233	05FE004	Battle River near Saskatchewan Border	24800

For each bridge location, average channel slope was estimated from the channel profile. A relationship was then developed between average depth, discharge and shields number, which for this study was estimated at 0.045 (particle size was assumed to be 1 – 2 mm range (fine sands)), to calculate channel maintenance discharge.

Table 4.2-8 describes the calculated channel maintenance discharges volumes for the three sites.

Table 4.2-8 Calculated Channel Maintenance Discharges

Bridge File Number	Channel Maintenance Discharge (m^3/s)
278	2.2
1062	1.8
233	3.2

Channel Maintenance Flow durations necessary to maintain existing channel geomorphology at the three sites was also calculated. Using recorded daily flow data for Water Survey of Canada gauges, and the number of days discharge was greater than channel maintenance discharge, calculated in Table 4.2-8, the average number of days flow durations exceeded the Channel Maintenance Flow durations for each station (Method 1) were estimated. AMEC then calculated a flow duration curve (Method 2) based on daily discharge data. Finally, AMEC calculated a flow duration curve (method 3) for mean monthly natural flow data. The results, presented as the number of days when flows are greater than channel maintenance discharge, are provided in Table 4.2-9.

Table 4.2-9 Average Annual Duration of Discharge

Bridge File Number	**Method 1** Average from recorded daily hydrographs	**Method 2** Recorded daily flow duration curve	**Method 3** Mean natural monthly flow duration curve
278	92	88	84
1062	129	190	135
233	166	168	172

There is consistency between method 1 and method 3 for the estimated duration of channel maintenance discharges for each bridge site, although method 2 suggests some discrepancy exists based on daily flow calculations. Stolte and Herrington (1980) noted changes in the hydrologic function of the Battle River upstream of Ponoka when comparing the period of record 1914-1930 and 1967- 1976. Stolte and Herrington's observations may account for the change in daily flow duration (method 2). AMEC (2004) argues that the changes in hydrologic function observed by Stolte and Herrington are due in part to increasing water withdrawals in that reach. However, streamside vegetation also plays an important role in maintaining hydrologic function and stream channels (Jasckson et al. 1987; Mahoney and Rood 1993; Schmidt and Potyondy 2004) and likely is a compounding factor in changes observed by Stolte and Herrington.

4.3 Instream Flow Needs Determination

Generally, "instream flow" is the amount of water flowing in a stream or river at any given time. Instream flows vary widely due to season, snowmelt, rainfall, and temperature; and can also vary due to vegetative cover, characteristics of the soil and geology, and the amount of water moving through the soil (groundwater) that feeds the stream or river. Assessing instream flow needs (IFN) requires the use of scientific information on water quality, fisheries, riparian areas and channel maintenance, described in section 4.2, to identify an IFN recommendation. An IFN recommendation is scientifically defensible and identifies the amount of water necessary to afford the aquatic ecosystem a degree of protection that maintains a viable aquatic ecosystem.

IFN estimations for the Battle River conducted in 2005 use flow records for the period of record 1912 to 2001 from four stations (Paul and Locke 2005). The estimates are based on natural flow duration curves used to determine: (1) an *instantaneous reduction in natural flow*, which is the allowable diversion of water relative to natural, and (2) *ecosystem base flow*, which is a threshold value below which any reduction in flow should not occur.

Based on detailed modelling of fish habitat in the South Saskatchewan River Basin (SSRB), values for instantaneous reduction and ecosystem base flow for the Battle River were estimated as 15% reduction in natural flow at any time *provided* flow remains greater than the 80% exceedence value (termed the 15/80 rule). No diversion of water should reduce flow below 80% exceedence. These values are expected to maintain the long-term viability of aquatic communities.

An assessment of estimated natural flow, current flow and instream flow needs for the Battle River was completed for four reaches, including stations 106 and 108, located above Forestburg Reservoir, and stations 109 and 110, located below Forestburg Reservoir. Monthly flow duration curves developed for each station showed substantial differences above and below the Forestburg Reservoir. Thus, subsequent IFN estimations are split between the two reaches.

4.3.1 IFN Determination Upstream of Forestburg Reservoir

Monthly flow duration is the probability of observing a flow exceeding a particular value. Flow duration curves for Battle River upstream of Forestburg Reservoir including stations 106 and 108 are presented in Figure 4.3-1. Channel 108 station is located above Forestburg Reservoir but below Driedmeat Lake. Black lines are for natural flow, green lines for the IFN recommendation (15/80 rule) and red lines are observed flow. Scales are constant among graphs and the dashed lines are drawn at 1 m^3s^{-1}.

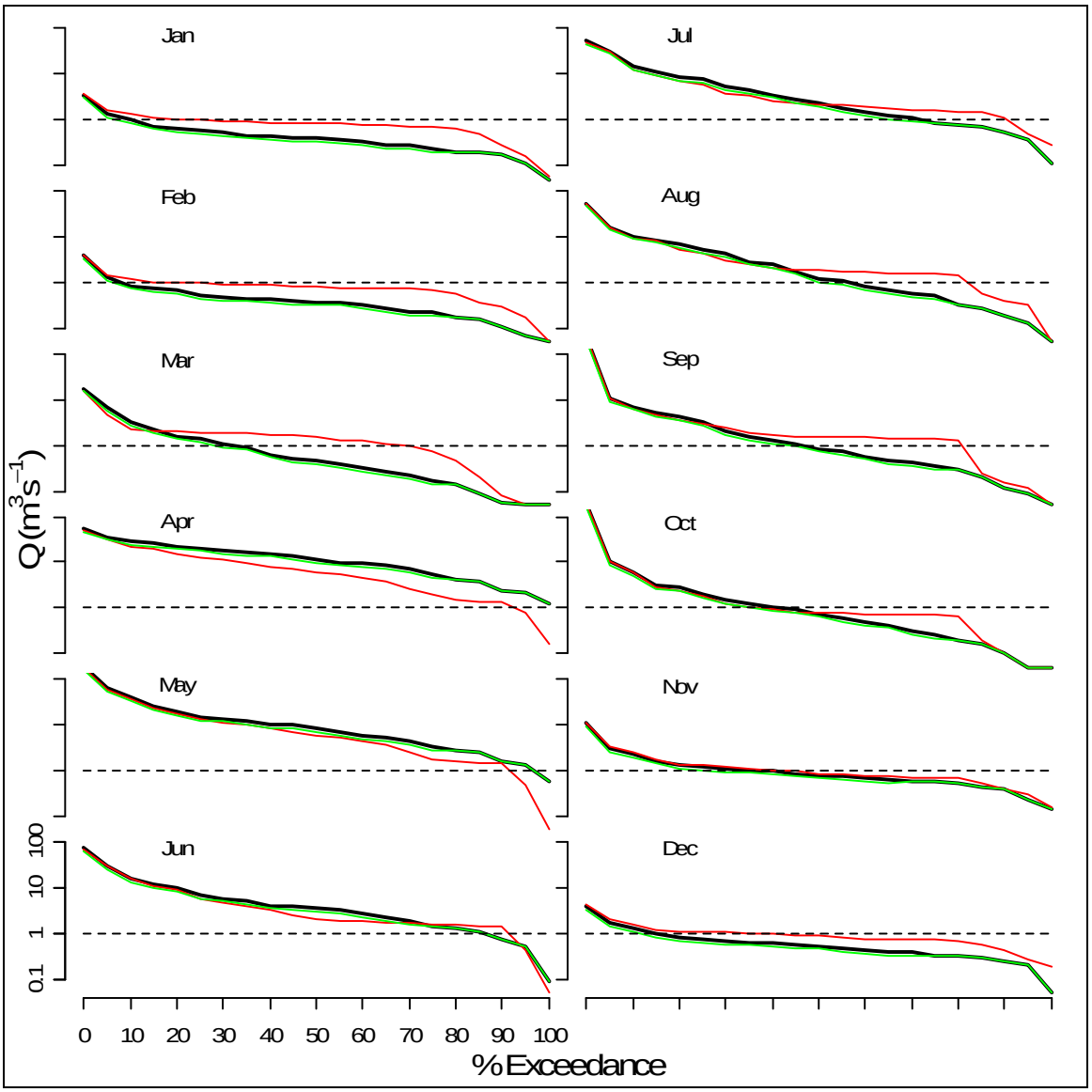
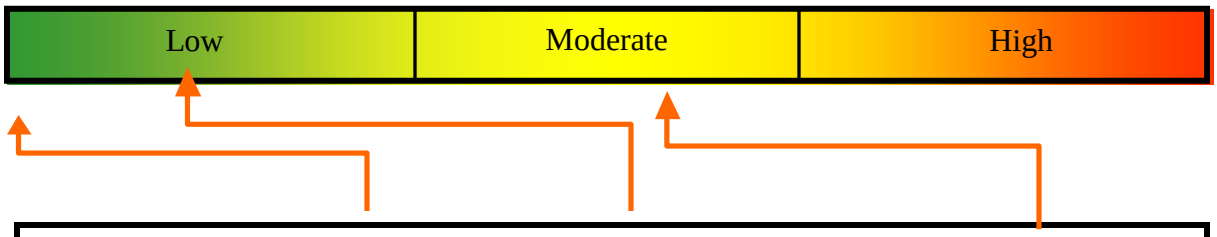


Figure 4.3-1 Monthly Flow Duration Curves for Channel 108 Station using flow records for the period of record 1912-2001

Flow duration curves show a clear pattern of storage during spring run-off (April and May) followed by release in the remaining months. During April and May, actual flows are below natural except for infrequent high-flow events. For remaining months, water stored during spring run-off is released thereby augmenting flow above natural. Even for months when flow is low (September to February), or dry years, upstream storage is sufficient to maintain flow conditions above natural.

Table 4.3-1shows the predicted effect of an IFN flow regime compared to current conditions, and contrasted against natural conditions for the overall health of the aquatic ecosystem, as well as key parameters of Water Quality, Fisheries, Riparian, and Channel Maintenance.

Table 4.3-1 Estimated Effect of River flow on Aquatic Ecosystems from Channels 106 and 108 above Forestburg Reservoir



	Natural Flow	Instream Flow Need	Current Conditions
Aquatic Ecosystem	Natural Populations, habitats and ecosystem functions are maintained at natural levels.	Some species measurably affected, ecosystem level functions are maintained.	
Water Quality	Naturally occurring levels of water quality. However, desired levels of water quality may not be met due to current and historic loading. Greater than natural flow required to meet desired levels.	Most water quality guidelines are met, with the exception of nutrients and oxygen due to current and historical loadings.	Nutrient guidelines are almost always exceeded year round, oxygen guidelines not met during winter ice covered periods.
Fisheries	Fish populations are at natural levels. Natural population structure, function, and taxonomic integrity preserved.	Undetectable changes to population structure and function. Similar to natural community. Fish populations are fully maintained.	Viability of sensitive populations threatened. Detectable changes in population structure and function for most species, but viability maintained. Some change in natural community composition.
Riparian	Natural rates of riparian regeneration and growth occur. Natural vegetation community supported by flow regime. Riparian condition may be affected by land-use activities.	Minor changes from natural riparian community attributable to flow modification over the long term. Current riparian condition may be below natural levels due to local land management.	Measurable reduction in recruitment of riparian species. Likely insufficient recruitment to support the riparian community over the the long-term. Riparian condition highly vulnerable to impacts of local land management.

Channel Maintenance	Sediment transport balanced to maintain natural channel shape and meandering process.	Sediment transport balance is maintained over the long term with limited effect on natural channel shape and meandering processes.	

Table 4.1-1 shows the Battle River having deviated from natural conditions. For example, actual (recorded) flows upstream of Forestburg Reservoir are believed to have contributed to degraded fish community health. The predicted impact of an IFN based flow regime is an improved ability to support all processes key to the long term sustainability of the aquatic ecosystem, and recruitment in riparian area specifically. Water quality and fish community, although still impacted when compared with natural conditions, are also predicted to improve.

4.3.2 IFN Determination downstream of Forestburg Reservoir

Flow duration curves are the probability of observing a flow exceeding a particular value. Flow duration curves for Battle River downstream of Forestburg Reservoir including stations 109 and 110 are presented in Figure 4.3-2. Black lines are for natural flow, green lines for the IFN recommendation (15/80 rule) and red lines are actual (i.e., observed) flow. Scales are constant among graphs and the dashed lines are drawn at 1 m^3s^{-1}.

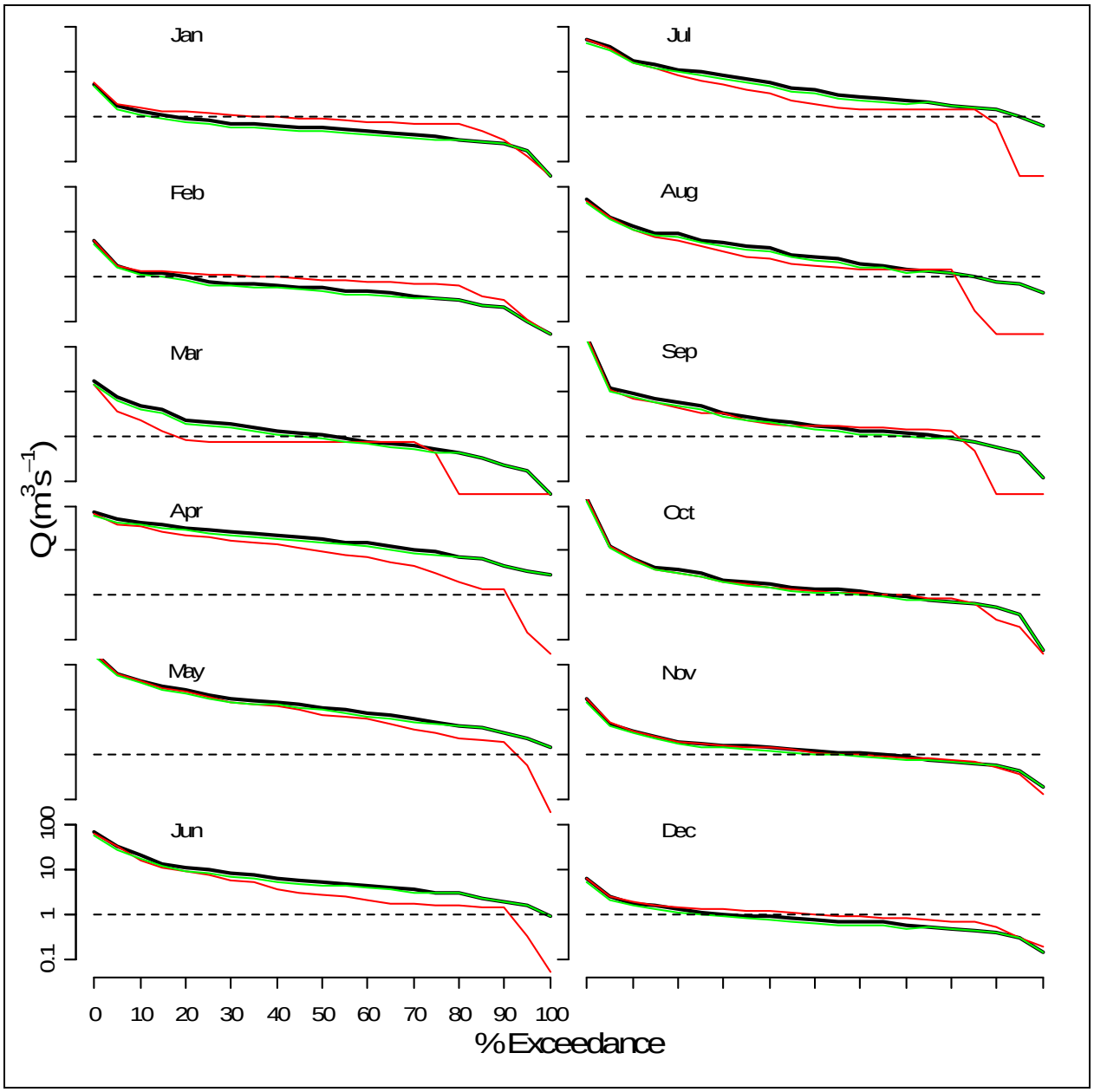
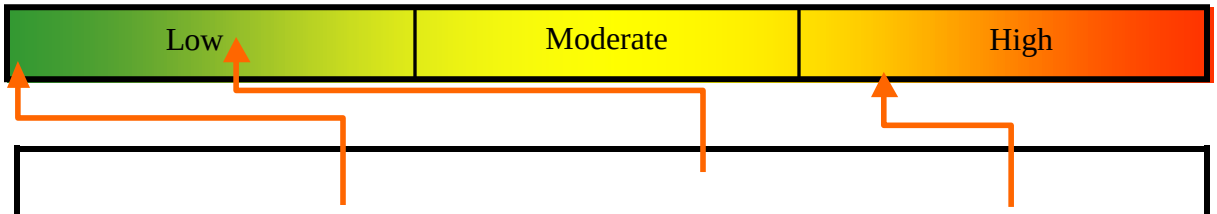


Figure 4.3-2 Monthly Flow Duration curves for Channel 110
using flow records for the period of record 1912-2001

Flow duration curves downstream of Forestburg Reservoir show a similar pattern of storage during April run-off followed by release through the remaining months (Figure 4.3-2). However, in contrast to the upstream reaches, upstream storage no longer maintains flow during dry years as actual flow drops well below natural during March, April, May, June, July, August and September. For instance, the 80% exceedence flow for March that occurs naturally is 0.42 m^3s^{-1}, this contrasts with the actual 80% exceedence flow for March of 0 m^3s^{-1}. In other words, on average, flow stops in March every 1 out of 5 years, whereas some flow should occur naturally.

Table 4.3-2 Estimated Effect of Riverflow on Aquatic Ecosystems from the Battle River below Forestburg (channels 109 and 110)



	Natural Flow	Instream Flow Need	Current Conditions
Aquatic Ecosystem	Natural Populations, habitats and ecosystem functions are maintained at natural levels.	Some species measurably affected, ecosystem level functions are maintained.	Many species measurably affected. Ecosystem functions are in decline
Water Quality	Naturally occurring levels of water quality. However, desired levels of water quality may not be met due to current and historic loading. Greater than natural flow required to meet desired levels.	Most water quality guidelines are met, with the exception of nutrients and oxygen due to current and historical loadings.	Nutrient guidelines are almost always exceeded year round, oxygen guidelines not met during winter ice covered periods.
Fisheries	Fish populations are at natural levels. Natural population structure, function, and taxonomic integrity preserved.	Undetectable changes to population structure and function. Similar to natural community. Fish populations are fully maintained.	Changes in birth and death rates lead to serious decline or extirpation for several fish populations. Wholesale changes in fish community composition. Organism condition will be poor
Riparian	Natural rates of riparian regeneration and growth occur. Natural vegetation community supported by flow regime. Riparian condition may be affected by land-use activities.	Minor changes from natural riparian community attributable to flow modification over the long term. Current riparian condition may be below natural levels due to local land management.	Measurable reduction in recruitment of riparian species. Likely insufficient recruitment to support the riparian community over the the long-term. Riparian condition highly vulnerable to impacts of local land management.
Channel Maintenance	Sediment transport balanced to maintain natural channel shape and meandering process.	Sediment transport balance is maintained over the long term with limited effect on natural channel shape and meandering processes.	

Table 4.3-2 shows the predicted effect of an IFN flow regime downstream of Forestburg Reservoir compared to current conditions, and contrasted against natural conditions for the overall health of the aquatic ecosystem. Assuming the IFN determination was applied to all downstream licences, including those for power generation, the IFN determination for downstream of Forestburg is predicted to return flow to near natural conditions, improve water quality, and provide conditions necessary for the viability of native fish populations. Moreover, (using the same assumption) it is predicted that the proposed IFN would support all processes key to long-term sustainability of the aquatic ecosystem.

4.4 Modeling Risks to Licence Holders

The Water Resource Management Model (WRMM) is a computer modeling tool used to simulate different flow regimes in a river system, with a river basin being the fundamental unit of study. It computes a steady state water balance over a sequential period of user-defined timesteps, which are multiples of one day (i.e. the minimum timestep is one day).

For each timestep the water balance is calculated in accordance with allocation priorities set by the user. These priorities are specified by a penalty point system and a Linear Programming algorithm is used to minimize the overall system penalty. This "allocation every timestep" feature uniquely empowers the modelling of water supply and demand where demands have priorities under licences e.g. first in time, first in right. In any timestep when total supply is less than total demand, the lowest priority demand (most junior licence) is cut off first - then the next lowest, and so on.

The model enables easy and repeated analysis of the response of the river basin to differing combinations of water supplies, demands and water management structures.

4.4.1 Scenarios Considered

The WRMM was calibrated to the Battle River mainstem to match historic natural flows at various locations with current levels of licensed water demands. The schematic for the WRMM model is show in Figure **4.4-1**. Working with the WRMM, various water supply scenarios were developed to investigate impacts of development or operational decisions on water supply conditions in the basin. Scenarios 4.1 through 8.0 were completed in 2006 (Optimal Solutions 2006), but later disregarded due to changes in the modeling schematic, including an update to the natural flow dataset and a reduction in the effective drainage area of 10 %. A second run of scenarios (scenarios 8.1 through 8.5) were completed in 2010 and report on the frequency and magnitude of water shortages (Optimal Solutions 2010). Scenarios 8.1 through 8.5 are described in Figure **4.4-1**.

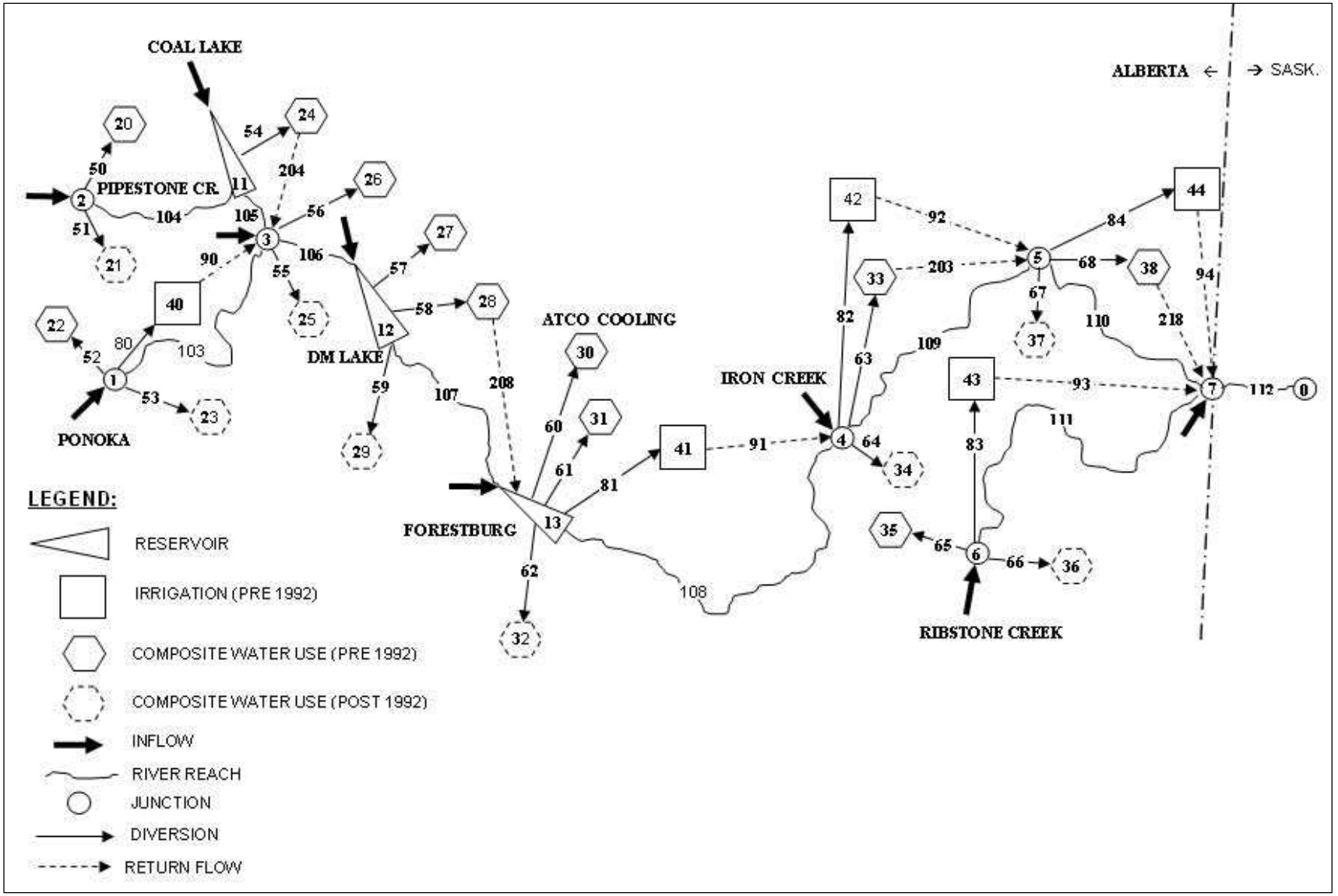


Figure 4.4-1 Battle River WRMM schematic

Table 4.4-1 Summary of Modeling Scenarios for WRMM

Scenario	Description of Input Options			
	Water Use Licence levels	**Water Conservation Objective (WCO) Targets**	**Storage Release based on:**	**Priority of Allocation**
8.1	Historic	old	Downstream demands & IFN	1. Pre-92 licenses 2. IFN = Instream Objective (IO) 3. Post-92 licenses
8.2	Max	old	Downstream demands & IFN	1. Pre-92 licenses 2. IFN =IO 3. Post-92 licenses
8.3	Max + 2500 dam^3	old	Downstream demands & IFN	1. Pre-92 licenses 2. IFN =IO 3. Post-92 licenses
8.4	Max + 2500 dam^3 - 4000 dam^3	old	Downstream demands & IFN	1. Pre-92 licenses 2. IFN =IO 3. Post-92 licenses
8.5	Max + 2500 dam^3	new (85:20)	Downstream demands & IFN	1. Pre-92 licenses 2. IFN = WCO 3. Post-92 licenses

Scenario 8.1 is based on the estimated actual water use. Scenario 8.2 assumes full use of licenced water with all licences issued until 2009. Scenario 8.3 is like Scenario 8.2 with additional 2500 dam^3 of water use, split equally among three locations (upstream of Driedmeat Lake, upstream of ATCO dam and upstream of the border with Saskatchewan). These three additional water demands are considered to have the lowest priority. Scenario 8.4 is the same as Scenario 8.3 except for the 4000 dam^3 reduction of the existing pre-1992 license below Iron Creek confluence (node 33 in the modeling schematic). Scenario 8.5 is the same as Scenario 8.3 except that the 15/80 IFN rule (described in section 4.3) is the in-stream instream flow target instead of the instream objective (IO) target, which is used in all other Scenarios. The IO targets are defined as 1.42 m^3/s from April to October and 0.71 m^3/s from November to March.

The IO targets in Scenarios 8.1 through 8.4 and the IFN targets in Scenario 8.5 are applied on the four main reaches of the Battle River represented by channels 106, 107, 108 and 110 in the modeling schematic. The 15/80 IFN rule as a management target can be described generally as 85% of natural flow

for a given month remaining in the river unless the natural flow is less or equal to the 20 percentile threshold for that month (which corresponds to 1:5 dry year return period), in which case the 20 percentile is set as the IFN target. Since four more years of natural flow data were added to the database, the 85/20 targets had to be recalculated for the latest scenarios, which cover the 1912 – 2008 period.

4.4.2 Modeled Risk to Licence Holders

Table 4.4-2 provides a comparison of annual consumptive use deficits for all five scenarios and for all consumptive use components.

Table 4.4-2 Mean Annual Consumptive Use Deficits (%)

Component number in Schematic	Scenario 8.1	Scenario 8.2	Scenario 8.3	Scenario 8.4	Scenario 8.5
40	12.45	14.02	14.29	14.18	14.54
41	0.01	0.02	0.02	0.01	0.02
42	0.00	0.00	0.00	0.00	0.19
43	14.44	14.82	14.82	14.82	14.82
44	0.00	0.00	0.00	0.00	0.27
20	11.21	11.62	12.08	11.76	12.71
21	24.81	25.64	26.19	26.46	27.70
22	11.21	13.33	13.65	12.91	12.48
23	21.02	23.01	23.33	23.55	66.96
24	21.86	24.28	25.06	24.21	20.89
25	28.12	29.69	30.44	30.92	41.60
26	10.09	14.94	15.41	14.86	13.66
27	7.96	9.52	9.54	8.97	9.44
28	13.14	14.46	14.95	14.83	13.87
29	10.88	11.85	11.87	11.69	12.62
30	1.37	2.04	2.07	1.60	2.35
31	3.20	6.34	6.40	4.82	5.31
32	8.71	10.71	10.85	9.64	83.46
33	1.41	2.16	2.24	2.44	2.15
34	10.30	13.13	13.59	11.65	65.02
35	7.80	11.90	11.91	11.85	11.56
36	26.64	41.24	41.24	41.24	41.24
37	13.40	18.34	18.77	15.52	76.65
38	17.18	22.13	22.55	19.99	54.10
150	–	–	28.86	28.99	68.75

151	–	–	18.69	14.37	27.36
152	–	–	23.89	21.06	66.85

Under scenarios 8.1 and 8.2 water deficits, although frequent, are fairly low in magnitude. However, under scenario 8.2 components 35 and 36 which represent the respective water use for licences issued before 1992 (component 35) and after 1992 (component 36) in Ribstone Creek show a significant increase in magnitude of deficits when full licence use is assumed. Also, it should be noticed that deficits in component 35 are significantly higher than deficits for groups of senior licences on the main stem of the Battle River (e.g. components 30, 31, 33 and 35), since these licences have three upstream storage reservoirs above them, while there is no water supply reservoir in Ribstone Creek. Because of this, the deficits in Ribstone Creek remain fairly uniform among Scenarios 8.2, 8.3, 8.4 and 8.5. They are somewhat lower in Scenario 8.1 due to the lower demand level for actual water use in Scenario 8.1, versus the licensed limit that is modeled for all other Scenarios.

Scenario 8.5 shows a significant increase in the magnitude of water deficits at specific components when an IFN objective is applied. For example, component 23 jumps from an average deficit hovering around 20 per cent under the existing instream objective (IO), jumping to 67 per cent water deficit when an IFN objective is applied. Similar increases are noted at components 32, 34, 37, 38, 150, 151 and 152. However, declines in water deficits, although negligible, are observed at components 24, 26 and 28.

4.4.3 Simulated Storage Levels (Driedmeat Lake and Coal Lake)

Modeling of storage is based on the ability of downstream water licence holders to demand releases when simulated natural runoff is insufficient to meet water demands. The simulations do not include efforts to create storage operating guidelines. Demands and releases were modeled for Driedmeat Lake, followed by releases from Coal Lake.

A comparison of scenarios 8.3 and 8.5 shows what the impact of switching from IO to IFN targets may have on the amount of available water for two main water supply reservoirs (Dreidmeat Lake and Coal Lake). Figure 4.4-2 and Figure 4.4-3 were generated using all available storage levels (i.e. all months for the entire 97 year record) while Figure 4.4-4 and Figure 4.4-5 were generated using only the simulated end of month levels from August to December inclusive.). The results are displayed in a probability format with values of probability shown between 0 and 100%.

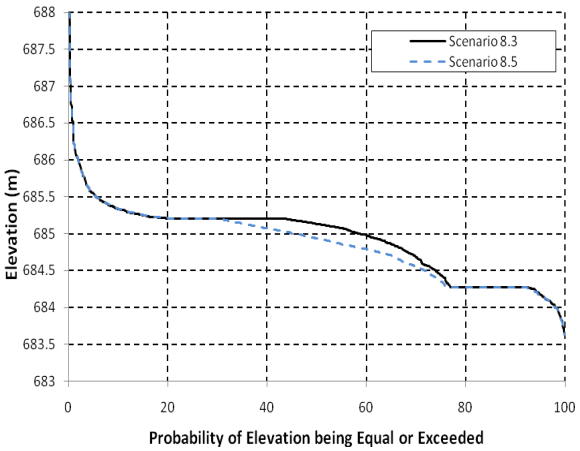


Figure 4.4-2 Driedmeat Lake Elevations (January – December)

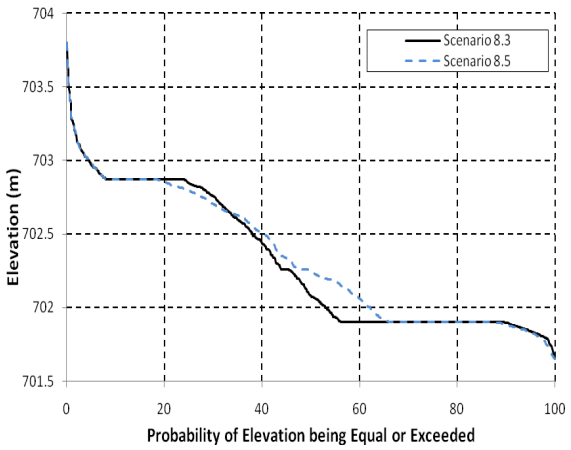


Figure 4.4-3 Coal Lake Elevations (January – December)

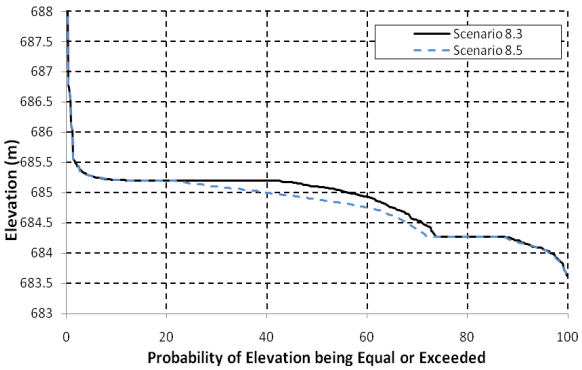


Figure 4.4-4 Driedmeat Lake Elevations (August – December)

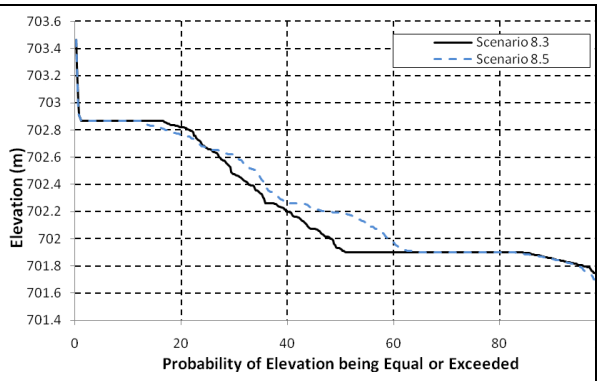


Figure 4.4-5 Coal Lake Elevations (August – December)

Generally, scenarios 8.3 and 8.5 showed quick depletion of storage and frequent deficits later in the year when natural runoff becomes insufficient to cope with water demands. More specifically, Driedmeat Lake levels show that storage is at full supply level about 45% of the time in Scenario 8.3 and about 32% of the time in Scenario 8.5, and that it is empty about 24% of the time in both Scenarios. If the same analysis is conducted only over the low flow months (August to December), storage is full 43% of the time in Scenario 8.3 and 23% of the time in Scenario 8.5. Moreover, water levels are generally lower in Scenario 8.5. For example, the median elevation throughout the year is about 685.1 m in Scenario 8.3, while in Scenario 8.5 it is at 684.8 m (about 0.3 m lower). The minimum operating level of 684.27 m is

violated up to 0.2 m in dry years mainly due to insufficient inflow and large evaporation losses in dry months.

Coal Lake is harder to refill following storage depletion in dry years. Modeling results show storage for Coal Lake being empty 44% of the time in Scenario 8.3 and about 35% of the time in Scenario 8.5 over the entire year, while it remains full only about 25% of the time in Scenario 8.3 and 20% of the time in Scenario 8.5. During the six low flow months (August to December) Coal Lake storage is empty 50% of the time in Scenarios 8.3 and 40% of the time in scenario 8.5. Because of the simplistic drawdown assumptions built into the model, it is suggested that future efforts to model demand impacts on reservoir supply levels in the Battle River basin should incorporate reservoir rule curves to test various operation approaches to prevent having empty reservoirs.

5.0 RECOMMENDED OPTIONS AND STRATEGIES

Stage two of the planning process requires the development of a series of stakeholder recommendations that form the basis of this plan. The Stakeholder Advisory Group was initiated early in the planning process to guide the development of these recommendations, undertaking a series of education forums during which existing and new research, presented in section 4.0, was assembled and presented to the group for their consideration. The culmination of this research and learning process was the creation of a set of draft recommendations, developed in January 2005. Over the following years the recommendations were revisited. In this section recommended options and strategies are presented.

5.1 Recommendations for Decisions Under the Water Act

Recommendations in this section represent advice to the Minister of Environment and the Director, who are solely responsible for making the below decisions under the *Water Act*.

5.1.1 Establish a Water Allocation Limit

A water allocation limit be set at 57,500 dam^3 of licenced water use, and that once this limit has been reached, the Battle River Basin be closed to new water allocations.

Rationale:

A 25-year medium growth projection, calculated in 2005, estimates 2,500 dam^3 additional water is required to support future growth in the Battle River Basin. A key aspect of the Stakeholder Advisory Group recommendation is that additional water be allocated only after a review of existing licences is conducted based on Section 55 of the Water Act. The licence review resulted in the cancellation of 5 licences accounting for 4986 dam^3 of water. By adjusting for licenced water used dating to January 2005, (491 dam^3) a water allocation limit is calculated as:

Water Allocation Limit = ((2005 licenced water use) – (2011 Section 55 review)) + (2500 dam^3 future growth)

57,500 dam^3 of licenced water use would permit approximately 2,000 dam^3 additional water for future use in the Battle River Basin (Watrecon 2005) while setting a limit on negative impacts to the aquatic environment resulting from flow degradation.

Application:

The *Water Act* contains provisions (sections 11(3) (a) and 51(4)) for an Approved Water Management Plan to identify Matters and Factors that must be considered by the designated Director under the *Water Act* when making decisions on applications for water licences, preliminary certificates or approvals. The Matters and Factors that must be considered when making decisions on applications for new water licences, preliminary certificates or approvals in the Battle River Basin are listed in Table 5.1-1.

Table 5.1-1 Matters and Factors for New Licences, Certificates or Approvals

Matters and factors that must be considered when making decisions on applications for a *new* water licence, preliminary certificate or approval in the Battle River Basin	
Matters and Factors	**Guideline**
Master Agreement on Apportionment (Alberta's commitments to Saskatchewan)	• The terms of the *Master Agreement on Apportionment* will be respected
Existing, potential and cumulative effects on the riparian environment	• No significant adverse effect on the riparian environment
Existing, potential and cumulative effects on the aquatic environment	• No significant adverse effect on the aquatic environment
Existing, potential and cumulative effects on any applicable instream objective and/or Water Conservation Objective	• No significant adverse effect on existing instream objectives and/or Water Conservation Objectives
Water use efficiency targets	• Where a sector specific water use efficiency plan exists and has been approved by Alberta Environment, current water use requirements shall be defined and a target set for improved water use efficiency that is in accordance with the approved sector specific water efficiency plan. • Where a sector specific water efficiency plan does not exist, current water use requirements shall be defined and a target set for improved water use efficiency that falls into an agreed upon timeline for achievement. • Annual reporting on achievement of water use efficiency strategy shall be required of the licence holder.
When efficiency of use targets are achieved	• As water use efficiency targets are achieved, the licence holder may request either: (1) retain water to allow for growth under the terms and conditions of the licence; (2) amend the licence directing water toward achievement

	of a WCO; (3) transfer the water for another purpose in accordance with section 81, 82 and 83 of the Water Act and 5.1.2 of this water management plan.
Net Diversion and Return Flow	• Applicants will be notified of the statistical risk associated with a new water licence prior to issuing licences, preliminary certificates or approvals. • Alberta Environment will report annually on the status of new water allocations relative to the water allocation limit to the designated watershed planning and advisory council for the Battle River Basin. • Water returned to the river shall be at a standard and with timing to be beneficial to the aquatic environment.
Existing, potential and cumulative hydraulic, hydrological and hydrogeological effects	• No significant adverse effect.
With respect to irrigation, the suitability of land for irrigated agriculture	• The land must be suitable for irrigated agriculture: Class 4 or better in accordance with the standards of Alberta Agriculture and Rural Development.
With respect to drainage, maintenance and restoration of wetlands is preferred	• Expansion of infrastructure to support drainage should not be permitted unless there is a compelling reason for expansion. • If expansion is permitted, no significant adverse effect on existing and cumulative hydraulic, hydrological and hydrogeological effects as a result of new drainage. • If expansion is permitted, the highest level of wetland compensation is recommended. • Wetland compensation must be applied within the Battle River Basin, and be located as near as is practical to the wetland where impact occurred.
The use, rate and timing of the diversion	• No significant adverse effect on aquatic environment.
Water quality (including public health and safety, and assimilative capacity)	• No adverse effect on public health and safety. • No significant adverse effect on assimilative capacity.
The linkages between surface and ground water and the effects or changes in the overall system of water use	• No significant adverse effect on groundwater quantity or quality.
Existing treaty rights and other interests of First Nations in Alberta.	• Government of Alberta *First Nation Consultation Policy* • Agreements with First Nations.

Rationale:

In general, applicants seeking new (junior) licences in the Battle River Basin must recognize the risk to water security is high. Analysis of flow requirements and relative seniority to other licences in the basin suggests that a new (junior) licence holder is likely to receive water 3 out of 10 years. The construction and use of off-stream storage can mitigate risks associated with junior licences because water stored in accordance with terms and conditions specified in the licence is not eligible for draw down during water deficit periods, unless the licencee agrees to release water. Finally, by reporting annually on status of water allocations, the Government of Alberta will ensure a transparent process for implementation of a water allocation limit, while supporting the objectives of *Water For Life: Alberta's Strategy for Sustainability*.

5.1.2 Secure Water for First Nations

Secure an allocation of water for First Nations, (Ermineskin Cree Nation, Louis Bull Tribe, Montana First nation, Samson Cree Nation) based on further consideration of either:

(1) extension of the North Red Deer Regional Water Services Commission water line, pursuant to licence no. 00189571-00-00;

(2) a gross diversion of water from the Battle River not to exceed 3729 dam^3.

Rationale: Two options exist for securing water for First Nations. (1) The North Red Deer Regional Water Services Commission water line has a volume of water allocated at a total of 13,391 dam^3 of which 3729 dam^3 are intended to supply First Nations at Hobbema (Hydroconsult 2001). Water security and water quality are much greater through the North Red Deer Regional Water Services Commission water line, when compared to an allocation from the Battle River. (2) The Battle River may be considered as an alternative water source if the extension of the North Red Deer Regional Water Services Commission water line does not prove feasible.

Application:

Should the Battle River option be realized, the volume of water identified can be secured through any of: a crown reservation, new (junior) licence, or registration. In either case, the water allocation limit shall increase in accordance with that portion of the licence(s) defined as consumptive use (licenced water use). Only that portion of the gross diversion identified for consumptive use (licenced water use) shall be eligible for transfer in the future. If this volume of water is secured through a transfer from an existing

licence, no adjustment shall be made to the water allocation limit. In either case, the matters and factors identified in this plan shall apply.

Should the Battle River option be realized, the 3729 dam3 is a separate volume of water that is in addition to the recommended water allocation limit. The recommended water allocation limit will then be adjusted based on the licenced water use to be determined. Moreover, this volume of water will be available only to First Nations. Finally, should the extension of the North Red Deer Regional Water Services Commission water line be completed, the 3729 dam^3 held for First Nations would expire upon construction of the works, with the water being returned to the Battle River for the health of the aquatic ecosystem.

5.1.3 Enable Water Allocation Transfers

The Director (as designated under the *Water Act*) is hereby authorized to consider applications for transfer of water under existing licences in the Battle River Basin in Alberta, subject to sections 81, 82 and 83 of the *Water Act*.

Rationale:

Generally, water transfers should be pursued by applicants requiring a greater degree of security relative to a new (junior) licence. In order for a transfer to proceed, an application for transfer of water must be submitted to Alberta Environment. The Director (as designated under the *Water Act*) shall decide whether the transfer will be allowed.

Application:

If a transfer of water is approved, the Director may attach conditions to the licence. Such conditions are enabled under section 82(5) of the *Water Act*. Matters and factors that must be considered for a water allocation transfer in the Battle River Basin are listed in Table 5.1-2.

Table 5.1-2 Matters and Factors for Transfers of Allocation

Matters and factors that must be considered in making decisions on applications for a *transfer* of an allocation of water under a licence in the Battle River Basin.	
Matters and Factors	**Guideline**
With respect to a transfer of all or part of an allocation	• Only that portion of a volume of water allocated and

of water from a licence	defined as *licenced water use* shall be eligible for transfer
Existing, potential and cumulative effects on the Riparian environment	• No significant adverse effect on the riparian environment resulting from the transfer
Existing, potential and cumulative effects on the aquatic environment	• No significant adverse effect on the aquatic environment resulting from the transfer
Existing, potential and cumulative effects on any applicable instream objective and/or Water Conservation Objective	• No significant adverse effect on existing instream objectives and/or Water Conservation Objectives resulting from the transfer
Efficiency of use objectives	• Where a sector specific water efficiency plan exists and has been approved by Alberta Environment, the applicant shall define current water use requirements and set a target for improved water use efficiency that is in accordance with the approved plan. • Where a sector specific water efficiency plan does not exist, the applicant shall define current water use requirements and set a target for improved water use efficiency that falls into an agreed upon timeline for achievement. • In either case, annual reporting on achievement of water use efficiency strategy may be required.
Efficiency of use achievement	• As water use efficiency targets are achieved, the licence holder may request either: (1) amendment to the licence, making water available for licencing to a new junior licence holder; (2) retain water to allow for growth; (3) amend the licence directing water toward achievement of a WCO; or (4) transfer the water for another purpose in accordance with section 81, 82 and 83 of the Water Act and this plan.
Degree of net consumption	• Water returned to the river shall be at a standard and with timing to be beneficial to the aquatic environment.
Existing, potential and cumulative hydraulic, hydrological and hydrogeological effects	• No significant adverse effect.
Existing, potential and cumulative effects on household users, traditional agriculture users and other licensees	• From the *Water Act*, Section 82(3)(b): *the transfer of the allocation, in the opinion of the Director, does not impair the exercise of rights of any household user, traditional agriculture user or other licensee other than*

	the household user, traditional agriculture user or other licensee who has agreed in writing that the transfer of the allocation may take place.
With respect to irrigation, the suitability of the land to which the allocation of water is to be transferred for irrigated agriculture (Class 4 or better)	• The land must be suitable for irrigated agriculture and be Class 4 or better in accordance with the standards of Alberta Agriculture and Rural Development
The historic use, rate and timing of the diversion under the original licence	• No significant adverse effect on aquatic environment.
The volume, rate and timing of the diversion under the proposed new licence	• No significant adverse effect on aquatic environment.
Location of the existing diversion and the proposed new diversion	• No significant adverse effect on aquatic environment.
Water quality (including public health and safety and assimilative capacity)	• No adverse effect on public health and safety. • No adverse effect on assimilative capacity.
The linkages between surface and ground water and the effects or changes in the overall system of water use	• No significant adverse effect on groundwater quantity or quality.
Existing, potential and cumulative effects on the operation of reservoirs or other water infrastructure	• No significant adverse effect on operations unless the reservoir or infrastructure licensee agrees it is feasible to adjust operations to mitigate effects.
Current conditions on the licence from which water is to be transferred	• Shall be maintained unless the transfer includes the construction of off-stream storage, in which case the Water Conservation Objective should replace the instream objective.
Master Agreement on Apportionment (Alberta's commitments to Saskatchewan)	• The terms of the *Master Agreement on Apportionment* will be respected.
Existing treaty rights and other interests of First Nations in Alberta.	• Government of Alberta *First Nation Consultation Policy on Land Management and Resource Development*, 2005, as amended. • Agreements with First Nations.
The *Water Act* (82)(5)(c)(iv) also provides that the Director may consider any other matters applicable to the transfer of the allocation that the Director considers relevant. Additional matters shall include: • Under section 81(6) of the *Water Act*, proposed transfers must undergo public review. The applicant for a transfer must also provide public notice of the application. Directly affected parties can submit statements of concern.	

5.1.4 Establish Water Conservation Holdbacks

The Director is hereby authorized to withhold up to 10 per cent of an allocation of water under a licence that is being transferred, if the Director is of the opinion that withholding water is in the public interest to protect the aquatic environment or to implement a Water Conservation Objective.

Rationale:

Water conservation holdbacks permit up to 10 per cent of the volume of a transferred allocation to remain in the river for the benefit of the aquatic environment, to implement a WCO, or the water being withheld may be reserved (section 35 of *Water Act*) or added to an existing reservation. The Director may withhold less than 10 per cent if the Director has evidence to demonstrate that a smaller amount of water is sufficient to protect the aquatic environment or to implement a WCO.

It is recommended that the Director withhold the maximum of 10% allowable under the *Water Act*.

Rationale:

Water conservation holdbacks will increase the flows of highly-allocated rivers by a small amount, helping to offset increases in water use by new licence holders and transfers of unused portions of existing licences.

It is recommended that water withheld from a transfer be assigned to a WCO licence with the priority of its original licence, or through a crown reservation.

Rationale:

Securing water withheld through a transfer of water in either a WCO licence or crown reservation will provide a mechanism for ensuring water withheld is used for the intended purpose of protection of the aquatic ecosystem.

5.1.5 Establish Water Conservation Objective (WCO)

A Water Conservation Objective (WCO) shall be applied to all named and unnamed tributaries, and groundwater with hydrologic connection to surface water.

The WCO is defined as a rate of flow that is 85% of the natural flow that is to be left in the watercourse; and during those times when natural flow approaches the lowest quintile (20%) flow reductions shall be applied based on the greater of either:

a) 15% instantaneous reduction from natural flow or;

b) The lesser of either the natural flow or the 80% exceedance natural flow based on available time step data.

Rationale:

The recommended WCO reflects the scientifically based recommendation for meeting Instream Flow Needs and shall be applied across all four reaches of the Battle River. The four reaches are:

- Battle Lake to Driedmeat Lake Dam
- Driedmeat Lake Dam to Forestburg Reservoir Dam
- Forestburg Reservoir Dam to (upstream of) Iron Creek
- Iron Creek to the Saskatchewan border

Upstream and downstream boundaries of the mainstem reaches were established primarily by considering the physical location of existing streamflow gauging stations and significant structures, historic fisheries records, and at the junctions of major tributaries.

The WCO is also required to support the achievement of water quality standards for the flow dependent variables of dissolved oxygen and temperature (for fish), due to the present nutrient loadings from point and non-point sources. Moreover, the WCO will support the achievement of water quality objectives identified as part of the *Master Agreement on Apportionment*.

Application:

Achieving the WCO will require a process of flow restoration. Provisions to achieve flow restoration have been defined in the Matters and Factors for issuing new licences (Table 5.1-1), as well as Matters and Factors for authorizing transfers (Table 5.1-2). Water conservation holdbacks of 10 per cent will further facilitate the process of flow restoration in the basin.

Additional recommendations for the application of the WCO include:

Existing licences for which off-stream storage is not constructed should retain the original instream objective.

Renewed licences should be encouraged to develop off-stream storage. If off-stream storage is constructed, the WCO shall replace the existing instream objective. If off-stream storage is not constructed, conditions regarding instream objectives shall remain.

New (Junior) licences stemming from applications received before January 1, 2013 should be given conditions for instream objectives that existed prior to January 1, 2013.

New (Junior) licences stemming from applications received on, or after, January 1, 2013 shall be given conditions for the water conservation objective.

Transfers should carry the instream objectives condition of the original licence. However, if the transfer includes the construction of off-stream storage, the Water Conservation Objective should replace the instream objective.

The recommended WCO should not apply to current operating conditions of existing dams and weirs.

Rationale:

It is recognized that the probability of meeting the proposed WCO is low, but that it provides a flow management objective for improving the health of the aquatic ecosystem over time. Under the *Water Act* (Section 31(1)) water diverted and stored under the proper conditions of the licence for which the works are capable of carrying are not subject to release during periods of water shortage. Through the use of off-stream storage, it is possible to improve water security for junior licence holders during water deficit periods. In cases where off stream storage is utilized, a diversion window coinciding with peak flow events is preferred.

The achievement of the recommended WCO will require that future licences, particularly those requiring year round diversion, have off stream storage to minimize the licence holder's risks of not being able to divert the full allocation of water.

5.2 Recommended Watershed Management Planning Priorities

The provisions described in this section of the plan are actions outside of the *Water Act*. These provisions may be lead by the Government of Alberta, the designated watershed planning and advisory council for

the Battle River Basin, or any other organization with a specific interest in the management of water in the planning area.

5.2.1 Flow Restoration

Develop and implement reservoir management operation strategies to improve the health of the aquatic ecosystem while improving water supply security.

Rationale and Application:

Ensure existing reservoir operation strategies are achieved. Periodic review of existing operation strategies should occur in conjunction with future modeling exercises, with a view toward developing reservoir operating rules that support a shift toward real time water management infrastructure operations to meet Instream Flow Needs in the future**.**

Discussions should be held with senior licence holders regarding voluntary withdrawal restrictions to prevent withdrawals of restored flows. A strategy for voluntary flow restrictions should be developed within two years of the approval of this plan.

Rationale and Application:

The priority of senior licences would likely permit the withdrawal of restored flow water, which would increase water security for senior license holders, but negate any improvements to the health of the aquatic ecosystem. Any and all opportunities to restore flows should be taken, including encouraging licence holders to take voluntary flow restoration actions during critical periods.

All licence holders should be encouraged to undertake flow restoration measures, particularly during periods when natural flows approach the 80% exceedance value. A strategy for voluntary flow restrictions should be developed to guide these efforts.

Rationale and Application:

In order to facilitate voluntary flow restoration measures, a water shortage strategy should be developed in consultation with licence holders in the basin. A notification strategy should be a key element of the strategy, and should focus on ensuring all water users understand not only why flow restrictions are needed, but when they are necessary and how they can participate. As a starting point, lessons may be learned from experiences in other jurisdictions where, for example, Smog Alert Response Plans have been developed and implemented.

5.2.2 Riparian Areas Monitoring and Restoration Strategy

A Riparian Areas Monitoring and Restoration Strategy should be developed and implemented for the Battle River Basin within two years of the approval of this plan.

Rationale and Application:

The development and application of a riparian areas monitoring and restoration strategy should be undertaken jointly by the Government of Alberta and the designated watershed planning and advisory council for the Battle River Basin. Implementation of the strategy should be a shared responsibility, with specific tasks and timelines assigned accordingly. As the strategy applies to crown lands, all crown lands should be included in this strategy and active measures taken to ensure riparian areas on crown lands are healthy and not degrading.

5.2.3 Site Specific Water Quality Objectives

Development of site specific water quality objectives and a strategy for their achievement should be developed and implemented for the Battle River within two years of the approval of this plan.

Rationale and Application:

Canadian Standards for Water Quality are regularly exceeded in the Battle River. This is a result of the cumulative effects of natural, source and non-point source loadings in the Battle River, as well as its named and unnamed tributaries. Alberta Environment should lead the development of these objectives in a manner that guides matters and factors for both new (junior) licences and transfers from existing licences. Additional involvement by the designated Watershed Planning and Advisory Council for the Battle River Basin should occur in a manner that allows for non-point source loadings to be addressed.

5.2.4 Improvements to Water Management and Administration

Improve the administration of water management in the Battle River Basin

Rationale and Application:

Alberta Environment is committed to making improvements in water management and its administration in the Battle River Basin. Through the development of this Water Management Plan, the following actions are recommended to support this improvement:

- Track actual licensed water use
- Develop criteria for ensuring and monitoring no significant adverse effect on the aquatic environment
- Review Water Act section 55 files to ensure they are up-to-date
- Upgrade quantity monitoring capabilities to increase year round monitoring stations
- Upgrade computer modeling capabilities, including incorporating weekly flow data
- Explore innovations and improvements in water licencing and legislation in order to better match allocations with needs
- Store all water use files for the planning area in one location
- Develop capability of active forecasting for Battle River flows
- Develop and maintain a list of water licences deemed to be in good standing to assist parties in arranging transfers. This list should include the point of diversion, volume allocated and priority for each licence.

5.3 Proposed Change to the Water Act

The following is a possible amendment to the *Water Act* that was identified during the development of this plan. Inclusion of this suggestion in this plan does not imply that the legislature will make the amendment.

Allow part of a water licence to be cancelled.

Rationale and Application:

The Water Act only permits cancellation of a full allocation. This is an obstacle to the desired objective of being able to match actual water needs with allocations.

6.0 PERFORMANCE MONITORING REQUIREMENTS

6.1 Plan Review

This water management plan is the approved plan to which all subsequent plans that address water and watershed management must conform. For effectiveness, all water and watershed management plans in the Battle River Basin must be consistent with the intent of this plan. However, if improvements can be made to this plan, they should be made. To achieve this, the following review process is recommended:

This plan should be reviewed thoroughly at 5-year intervals, and include broad public consultation. The designated watershed planning and advisory council for the Battle River Basin should be the lead proponent of this review process, with support from the Government of Alberta.

Rationale:

The recommended options and strategies provided in this plan were developed using the best available information of the day. However, a complete understanding of key aspects of the economic, social and environmental components of water and watershed management planning are not claimed. As new information is developed, and improvements are gained, adjustments to key recommendations, including the water allocation threshold, water conservation objective and other key aspects of this plan may be warranted. A comprehensive review of this plan will enable future adjustments as necessary.

6.2 Monitoring Requirements

In addition to a five year review, regular monitoring of key elements of this plan are necessary to ensure achievement of recommendations and objectives. The following monitoring frameworks are designed to support the implementation of a water allocation limit and the achievement of the Water Conservation Objective.

6.2.1 Water Allocation Limit Monitoring Framework

A Water Allocation Limit Monitoring Framework, presented in Table 6.2-1, establishes regional management guidelines and management responses when specific triggers and limits are reached with respect to water allocations. Specifically, the framework will ensure timely review and identification of licences not in good standing and potential management actions for those licences. In the monitoring framework, water quantity limits and triggers are expressed in terms of licenced water use.

Table 6.2-1 Water Allocation Limit Monitoring Framework

Level	Description	Action
1	Surface Water Allocations remain below the allocation trigger.	Apply standard regulatory and non-regulatory approaches
Trigger		
2	Surface water allocations reach 57,000 dam^3 trigger.	Water Act files are reviewed in accordance with section 55 of the Water Act and appropriate actions are taken.
Limit		
3	The water allocation limit (57,500 dam^3) is reached.	Basin closed to new (Junior) licences. Basin may be re-opened pending results of actions pursuant to section 55 of the Water Act.

Table 6.2-1 shows what management actions are required once the recommended water allocation limit of 57,500 dam^3, presented in section 5.1.1 of this plan, is reached. However, efforts should be made to keep the Battle River basin open and allow new (junior) licence applications to be considered. One mechanism available to support keeping the basin open, presented in section 5.2.4 of this plan, is to review all water licences in accordance with Section 55 of the Water Act. The trigger for initiating a licence review is specified as that point when water allocations have reached reach 57,000 dam^3. Based on current growth in the basin, this should allow for five years completing the review, and completing any follow-up necessary to prevent reaching the limit. Moreover, water use efficiency targets provide a mechanism to support keeping the basin open to new (junior) licences, as specified in sections 5.1.1 and 5.1.2 of this plan.

6.2.2 Water Conservation Objective Monitoring Framework

In section 5.1.4, the recommended water conservation objective is defined as a rate of flow that is 85% of the natural flow that is to be left in the watercourse; and during those times when natural flow approaches the lowest quintile (20%) flow reductions shall be applied based on the greater of either (a) 15% instantaneous reduction from natural flow or; (b) the lesser of either the natural flow or the 80% exceedance natural flow based on available time step data.

As a first step toward monitoring the WCO, monthly time steps should be converted to weekly. The first part of the WCO monitoring framework applies to the *instantaneous reduction in natural flow*, which is the allowable diversion of water relative to natural. This diversion rate is set at 15 per cent. In other words, 85 per cent of the natural flow should be left in the watercourse. Table 6.2-2 establishes

management guidelines and responses when specific triggers and limits are reached with respect to instantaneous reductions in natural flow.

Table 6.2-2 Monitoring Framework for Assessing Instantaneous Reductions in Natural Flow

Level		
1	Reduction in natural flows are occurring but remain well within limits.	Apply standard regulatory and non-regulatory approaches.
Trigger		
2	10 per cent reduction in natural flows	Approaching a point at which impacts to the health of the aquatic ecosystem are observable. Voluntary flow restrictions are encouraged to enable junior licence holders with IO and WCO conditions to continue operating.
Limit		
3	15 per cent reduction in natural flows	The health of the aquatic ecosystem begins experiencing observable impacts. Water shortages are occurring for those licence holders with IO and WCO conditions. Flow restrictions are enforced for those licence holders with IO and WCO objectives. Voluntary flow restrictions are encouraged for those without specific IO or WCO conditions.

Ecosystem base flow are defined as an 80 per cent flow threshold value below which any reduction in flow should not occur. In other words, as natural flow approaches the lowest quintile, representing a 1 in 5 year drought event, water diversions should be stopped. This is applied to those licences subject to the recommended WCO. To reduce the impact on licence holders subject to the WCO, all licence holders in the basin should be encouraged to undertake voluntary flow restrictions Table 6.2-3 establishes regional management guidelines and management responses when specific triggers and limits are reached with respect to ecosystem base flows.

Table 6.2-3 Monitoring Framework for Assessing Ecosystem Based Flows

Level	Description	Action
1	Surface Water Allocations remain below the allocation trigger.	Apply standard regulatory and non-regulatory approaches
Trigger		
2	Reductions in water diversions shall be triggered based on the greater of either	Reduction in natural flow should be avoided. Water shortages are likely occurring and voluntary flow

	(a) 15% instantaneous reduction from natural flow or; (b) the lesser of either the natural flow or the 80% exceedance natural flow based on available time step data.	restrictions are encouraged to avoid calls of priority on water, and to protect the health of the aquatic ecosystem.
Limit		
3	80 per cent limit value is reached.	Any reduction in natural flow should not occur. Water shortages are occurring and calls on priority for water are enforced. Drought management plans are fully implemented.

Times when an 80% exceedence of natural flow is occurring is of particular importance for the health of the aquatic ecosystem. This management framework provides direction regarding the type of response needed to minimize the impact of these events on the health of the aquatic ecosystem while minimizing impacts to the economy. By undertaking voluntary flow restrictions it increases the likelihood of achieving the WCO and supports the long-term viability of aquatic ecosystem.

6.3 Implementation Responsibilities

The following are legislated responsibilities of Alberta Environment:

- Establish a Water Allocation Limit
- Enable Water Allocation Transfers
- Establish Water Conservation Holdbacks
- Establish a Water Conservation Objective
- Undertake improvements to Water Management Administration
- Consider proposed changes to the Water Act

The following are potential non-legislated responsibilities of partnerships:

- Flow Restorations
- Site Specific Water Quality Objectives
- Riparian Areas Management
- Plan Review

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APPENDIX 1: STAKEHOLDER ADVISORY GROUP

Name	Sector	Specific Affiliate
Wayne Richardson	Municipal Government	County of Paintearth
Brenda Shantz	Municipal Government	County of Wetaskiwin
Jeremy Enarson	Municipal Government	City of Camrose
Doug Fletcher	Municipal Government	M.D. of Wainwright
Bob Stauth	Municipal Government	City of Wetaskiwin
Vance Buchwald	Provincial Government	Alberta Sustainable Resource Development
Al Corbet	Provincial Government	Alberta Environment (WMO)
Barry Cole	Provincial Government	Alberta Sustainable Resource Development
Lorne Cole	Provincial Government	Alberta Sustainable Resource Development
Jamie Wuite	Provincial Government	Alberta Agriculture and Food
Mellissa Orr	Provincial Government	Alberta Agriculture and Food
Rick Friedl	Provincial Government	Alberta Environment (WMO)
Shane Mascarin	Federal Government	CFB Wainwright
Leonard Standing on the Road	First Nations	Montana First Nation
Wanda Baptiste	First Nations	Samson Cree Nation
Norine Saddleback	First Nations	Samson Cree Nation
Phil Taylor	Industry	ATCO Power
Barb Bosh	Industry	ATCO Power
Jim Geddes	Industry	Enerplus
Carol Wilson	Industry	Alberta Beef Producers
George Poruchnek	General Public	Land Owner
Wayne Ungstad	Stewardship	Ponoka Fish and Game
Hugh Sanders	Stewardship	Pigeon Lake Watershed Association
Andrew Schoepf	Stewardship	Alberta Fish and Game
Tracy Scott	Stewardship	Ducks Unlimited
Tim Belec	Stewardship	Battle Lake Watershed Enhancement Society

APPENDIX 2: RELATIONSHIP TO REGIONAL PLANS AND STRATEGIES

The development and implementation of this plan occurs within both a legislative and policy context. In this section existing legislation and policy that influence the development of a watershed management plan for the Battle River and Sounding Creek watersheds are describe. Table 1 illustrates where a watershed management plan 'fits' within the overall planning framework. The summaries contained in this section provide a brief overview of this influencing role.

Table 1. Legislative and Policy Context for Water and Watershed Management Planning.

<table>
<tr><th rowspan="2">Scale</th><th colspan="4">Description</th></tr>
<tr><th>Legislative Context</th><th colspan="3">Policy Context</th></tr>
<tr><td>National and International</td><td>Federal Provincial Legislation (i.e. Fisheries Act, SARA)</td><td colspan="3">UNESCO agreements (i.e. Kyoto Protocol)</td></tr>
<tr><td>Interprovincial</td><td></td><td colspan="3">Apportionment</td></tr>
<tr><td>Provincial</td><td>Provincial Legislation (i.e. ALSA, Water Act, EPEA)</td><td colspan="3">Wetland Policy</td></tr>
<tr><td>Regional</td><td>Land Use Framework (i.e. NSRP, RDRP)</td><td colspan="3">Water For Life</td></tr>
<tr><td>Watershed Specific</td><td>Approved Water Management Plan for the Battle River (Alberta)</td><td colspan="3">Battle River Watershed Management Plan phase two</td></tr>
<tr><td>Subwatershed/ Subregional</td><td>municipal development plans</td><td>Intermunicipal development plans</td><td>Battle Lake Plan</td><td>Pigeon Lake Integrated Watershed Management;</td></tr>
</table>

Legislative context

Alberta Land Stewardship Act

The Alberta Land Stewardship Act (ALSA) is the authorizing legislation for regional land-use planning in Alberta, as described in Land-use Framework. ALSA establishes how regional plans are created, amended and reviewed. Regional plans developed under ALSA are "legislative instruments and, for the purposes of any other enactment, are considered to be regulations" [Section 13]. In essence, regional plans developed under ALSA are binding on provincial and local governments and other decision makers, and will have an impact on industrial, recreational and other land users. To this end, the *Approved Water Management Plan for Battle River Basin (Alberta)* must conform to regional plans that encompass the Battle River Watershed. The plans include the North Saskatchewan Regional Plan and Red Deer Regional Plan.

Water Act

In Alberta, the ownership of water is vested in the crown, as stated in the Water Act, which is the primary statute regulating the use of the water resource in Alberta. The Water Act supports the conservation and management of water in an integrated approach that allows for flexible administration and management through sound planning, regulatory actions, and market forces. The key components of the Water Act that guide water management planning are sections 7-15 and 35. As well, the *Framework for Water Management Planning*, which is enabled by the Water Act, provides important guidance in the development of water management plans as well as the development of strategies for the protection of the aquatic environment.

Public Lands Act

The Public Lands Act states that the bed and shore of all permanent and naturally occurring water bodies is vested in the crown. Bed is the land on which the water sits and the shore is the part of the bed which is exposed when water levels are below their normal fullest level. Use or disturbance of the bed and shore requires prior authorization under this legislation.

Environmental Protection and Enhancement Act

This is provincial legislation that takes an integrated approach to the protection of Alberta's air, land and water. One of the Act's cornerstones is the guarantee of public participation in decisions affecting the environment. This public involvement includes increased access to information, participation in the Environmental Assessment and Approval Processes and the right, when directly affected, to appeal certain decisions.

Fisheries Legislation

Alberta's fisheries are managed through the Alberta Fisheries Act, while fish habitat in Alberta is managed and protected through the federal Fisheries Act (Canada). Through these two pieces of legislation, the Fish Conservation Strategy guides the overall management and protection of the fisheries resource in Alberta. Its guiding principles include: no net loss of the productive capacity of fish habitat and the biological diversity of fish fauna is to be maintained.

Municipal Government Act

Land owners and managers, as determined in the provincial Municipal Government Act, administer the majority of land use practices within the Battle River watershed. Only small parcels of land are administered as Public Lands, Protected Areas or Indian Reserves.

Under this Act, Municipalities may plan for the development and use of land, and maintain and improve the quality of the physical environment. They therefore have the responsibility of determining land use zoning, which can impact water quality.

Policy context

Water For Life

Water for Life: Alberta's Strategy for Sustainability was finalized in November 2003 and promotes a watershed approach for water management, planning and decision-making. It was developed on the basis of extensive provincial consultation and outlines key directions, strategies and actions to manage Alberta's water resources into the future.

Two key principles are:

- Alberta's water resources must be managed within the capacity of individual watersheds
- Citizens, communities, industry and government must share responsibility for water management in Alberta and work together to improve conditions in their local watershed.

The Battle River watershed management planning process will be adaptive and flexible to ensure that it maintains congruence with the *Water for Life Strategy* as it is implemented.

Land-use Framework

Land-use Framework is a comprehensive strategy to guide the management of public and private lands and natural resources and is meant to provide a blueprint for land use management and decision-making in Alberta.

Wetlands Policy

In Alberta, wetland management decisions have been guided by the *Wetland Management in the Settled Area of Alberta - An Interim Policy (1993).* This policy calls for the conservation of slough/marsh wetlands in a natural state, to mitigate degradation or loss of slough/marsh wetland benefits as near to the site of disturbance as possible and to enhance, restore or create slough/marsh wetlands in areas where wetlands have been depleted or degraded. Alberta's *Water Act* (1999) regulates activities that might interfere with a wetland such as draining or filling. Alberta is presently developing a new wetland policy and supporting action plan to achieve sustainable wetlands in the province, based on a no net loss strategy. The use of inventories and mitigation will lead to significant progress toward achieving the principle of "no net loss". Currently, the *Water for Life Strategy* suggests that wetland objectives be set as part of the watershed planning process. Wetland Objectives will be addressed in Phase Two of this planning process.

Planning context

Battle River Watershed Management Plan: Phase two

Phase two of the Battle River Watershed Management Planning Process is lead by the Battle River Watershed Alliance, the designated watershed planning and advisory council under *Water for Life: Alberta's Strategy for Sustainability.* While phase two of the planning process is in its earliest stages, several of the management actions presented in section 5.2 of this plan will be included in the phase two process.

Battle Lake Management Plan

Battle Lake is fed by springs and surface water runoff from a small and relatively undisturbed watershed. The Battle Lake watershed has been protected by a County of Wetaskiwin bylaw, and the provincial government has established the Mount Butte and South Battle Lake Natural Areas to protect approximately one third of the shoreline and riparian zones, as well as some of the upland habitat.

Stakeholders in the Battle Lake watershed area are concerned about the effects of oil and gas development on the lake and have made their concerns known in regulatory processes. In Alberta Energy and Utilities

Board (EUB/Board) *Decision 2005-129: Review of Well Licence No. 0313083 and Application for Associated Battery and Pipeline Pembina Field*, the Board panel identified that "additional measures must be taken to ensure that future development continues to be conducted in an orderly, effective, and environmentally sensitive manner." Consequently in January 2006, the EUB worked with members of the Battle Lake Watershed Synergy Group to first define a terms of reference and then proceed with an area oil and gas development planning pilot project.

Its scope addresses oil and gas development in the Battle Lake sub-basin. The objectives of the project are (1) to protect the watershed from adverse and cumulative effects of oil and gas development, and (2) mitigate the potential adverse effects of oil and gas development on area residents, other land users and wildlife habitats.

Pigeon Lake Integrated Watershed Management Plan

The Pigeon Lake Integrated Watershed Management Plan (IWMP) is co-sponsored by the Pigeon Lake Watershed Association and the Battle River Watershed Alliance. The IWMP planning process will lead to the development of a watershed management plan that addresses all factors that directly or indirectly affect the lake water quality and maintenance of the aquatic ecosystems. It recognizes that all human activities, including water use, diversions and land use activities, can impact the quality and to some small amount the quantity of the Pigeon Lake's water resource. The plan is being developed by a partnership based on a shared understanding of water resources and environmental, economic and social demands on the resources, and its limitations. Plan recommendations are based on a consensus among sectors that use, affect or regulate the water resource, and sectors that are affected by related impacts.

Municipal Development Plans

Municipal Development Plans (MDP) are statutory planning documents adopted pursuant to the Municipal Government Act. MDPs guide and direct future growth and development for the municipality, ensuring orderly, economical and beneficial development while balancing the environmental, social and economic needs and desires of the community. To this end MDPs are primarily a policy document that serves as a framework for the physical development of the community. It is a guide within which both public and private sector decision making and investment can occur. Not only does the Plan address land use and development, it addresses matters related to the health of the environment, vitality of the local economy and social and cultural well-being of residents.

Other statutory plans adopted by municipalities such as area structure plans and area redevelopment plans developed at the municipal level must be consistent with the MDP and its policies. All statutory plans adopted by a municipality must also be consistent with each other. Additionally, the development and subdivision authorities must have regard to the MDP policies as one of the factors considered in making a decision.

Intermunicipal development plans

Intermunicipal Development Plans (IMD) are key planning documents that describe future growth directions beyond the current municipal boundaries. IMDs typically establish policies for the coordination of planning activities that lead to the identification of future growth areas in a collaborative manner. It also sets out policies and procedures for annexation of growth areas, the preparation of major area structure plans, the control of development and resolution of disputes.

While MDPs provide direction and a city-wide framework to guide more detailed plans and policies. The overall goals and objectives of this Plan will be incorporated in a more detailed manner in local area plans, specific policy documents and programs. In this way, the broad general concepts of the MDP, such as those shown on the accompanying map, are expected to be refined and made more precise as more detailed plans are prepared and adopted. While these plans must be consistent with the MDP, the precise application of the MDP direction must be sensitive to the location, timing and other conditions of the more specific and local context

APPENDIX 3: GLOSSARY OF TERMS

Acre-Foot: A unit of volume defined by the volume of one acre of surface are covered to a depth of one foot. An acre-foot is exactly 43,560 cubic feet, or 1.23348184 dam^3

Actual Water Use: The volume of water that is actually permanently removed from the aquatic ecosystem under authorization of the Water Act. Because there is a limited number of licence holders subject to water use reporting requirements, actual water use is generally an estimation, except where reporting is required.

AENV: Alberta Environment

AESRD: Alberta Environment and Sustainable Resource Development

Allocation: The volume, rate and timing of a diversion of water. When water is diverted for a use other than for household purposes (use by an owner of property adjacent to a water body or from an aquifer), it is referred to as an allocation. All water users (except for household users) apply to Alberta Environment for a licence to use a set allocation of water.

Apportionment: (see *Master Agreement on Apportionment*)

Approval: Under the *Water Act*, an approval provides authority for constructing works or for undertaking an activity within a water body. The approval includes conditions under which the activity may take place.

Aquatic Environment: (As defined in the *Water Act)* The components of the earth related to, living in or located in or on water or the beds or shores of a water body, including but not limited to all organic and inorganic matter, and living organisms and their habitat, including fish habitat, and their interacting natural systems.

Base Flow: Streamflows contributed solely from shallow groundwater in the absence of significant precipitation, runoff events or supplemental release from storage above the natural flow

Basin: see *River Basin*

cms: cubic metres per second

Condition on Licences: The terms of the licence that must be followed.

Crown Reservation: Section 35(1) of the Water Act states that "the Minister may by order reserve water that is not currently allocated under a licence or registration or specified in a preliminary certificate

(a) in order to determine how the water should be used, or
(b) for any other purpose."

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

Director: For purposes of administration of the *Water Act*, certain staff in Alberta Environment, such as Approvals Managers, are designated as "Directors". Under the *Water Act* a Director has sole authority to make decisions concerning a number of specified subjects, e.g., transfers, holdbacks and establishing WCOs.

Dissolved Oxygen: Amount of available oxygen contained in the water, but not including the oxygen that is part of the water molecule (H_2O). Expressed as milligrams per litre.

Ecosystem base flow: A threshold value below which any reduction in flow should not occur.

Geomorphology: The scientific study of landforms and the processes that shape them.

Groundwater: Water located beneath the ground surface in soil pore spaces and in the fractures of geologic formations. A formation of rock/soil is called an aquifer when it can yield a useable quantity of water. Groundwater that is in an aquifer that readily (drawdown cone for a well intersects a surface water body) flows naturally under the ground to surface water bodies is considered surface water for licencing purposes in Alberta.

Gross Diversion: The total volume of water licenced for diversion.

Instantaneous reduction in natural flow: the allowable diversion of water relative to natural

Instream Flow: The rate of flow in a river at any given time, without reference to its purpose.

Instream Needs / Instream Flow Needs (IFN): This is the scientifically determined amount of water, flow rate, water level, or water quality that is required in a river or other body of water to sustain a healthy aquatic environment or to meet human needs such as recreation, navigation, waste assimilation, or aesthetics.

IO: instream objective

Instream Objective (IO): Regulated flows that should remain in the river via dam operations or as a restriction on licences. In the battle river the instream objective is:

- *Ice-cover period (December 1 - March 31):*

The licensee shall only divert water from the Battle River between December 1 and March 31 when flows passing the point of diversion is equal to or exceeds 0.7 cubic meters per second (25 cubic feet per second). The licencee is responsible for determining the flow rate.

- *Open Water Period (April 1 November 30):*

The licencee shall only divert water from the Battle River between April 1 and November 30 when the flows passing the point of diversion is equal to or exceeds 1.42 cubic meters per second (50 cubic feet per second). The licencee is responsible for determining the flow rate.

- *All Tributaries of the Battle River:*

Diversions are permitted only between April 1 and June 30.

Licence In Good Standing: This term is used in Alberta's *Water Act*, but is not defined. One of the issues that must be determined by the Director is whether or not the allocation of water to be transferred is held "under a licence in good standing" (*Water Act*, s. 81(7)(c)). The licence has to be in good standing at the time the Director considers the application (that is, it already exists in good standing or the licence holder brings the licence into good standing prior to the time when the Director considers the application to transfer.) Examples of a licence not in "good standing" are a licence that is:

- In breach of the *Water Act*
- Subject to an investigation under the *Water Act*
- Subject to an enforcement tool or prosecution
- In breach of terms and conditions of the licence
- In non-compliance with the terms and conditions of the licence (e.g. did not build the diversion site within the specified period)

Licenced Water Use: The maximum allowable volume of water to be permanently removed from the aquatic ecosystem.

Licenced Return Flow: The required volume of water to be returned to the aquatic ecosystem under a water licence.

Master Agreement on Apportionment: Schedule A of the 1969 *Master Agreement on Apportionment* between Alberta and Saskatchewan allows Alberta to "divert, store or consume" from the river system each year, a volume of water equal to one-half of the apportionable flow at the Alberta-Saskatchewan boundary. The remaining volume of flow must be allowed to pass downstream into Saskatchewan.

Natural Flow / Natural Rate of Flow: Natural flow is the flow in rivers that would have occurred in the absence of any man-made effects on, or regulation of, flow. For purposes of water management, natural flow is a calculated value based on the recorded flows of contributing rivers; a number of factors concerning the river reaches (e.g. evaporation, channel losses, etc.); and water diversions. This is also known as “re-constructed flow” and “naturalized flow”.

Net Diversion: A licence that allows the licencee to receive credit for returning water to the source of the diversion. The water must be of a reasonable quality and be returned with suitable timing. The credit permits increased diversion equivalent to the volume returned, provided the net diversion does not exceed the total licence allocation.

Preliminary Certificates: An authorization issued by the Director to certify that a licence will be issued if certain conditions are met.

Retrofit Provision: Water licences issued in recent years contain a condition indicating that once a water conservation objective is established, the licence may be amended to include the WCO. The licence holder would then not be permitted to withdraw water when river flow is less than the objective.

Riparian Area: The area along streams, lakes, and wetlands where water and land interact. These areas support plants and animals, and protect aquatic environments by filtering out sediments and nutrients originating from upland areas.

Riparian Vegetation: The vegetation that exists in riparian areas and is supported by the interaction of the water and land.

River Basin: An area of land drained by a river and its associated streams or tributaries. Alberta's *Water Act* identifies seven major river basins within the province:

- Peace/Slave River Basin
- Athabasca River Basin
- North Saskatchewan River Basin
- South Saskatchewan River Basin
- Milk River Basin
- Beaver River Basin
- Hay River Basin

Sub-basin: A part of a river basin drained by a tributary or having characteristics that are significantly different from other areas in the basin.

Surface Water: Water bodies such as lakes, ponds, wetlands, rivers, and streams. It may also refer to sub-surface water or groundwater with a direct and immediate hydrological connection to surface water (for example, water in a well beside a river).

Voluntary Action: Performing an activity freely, without compulsion.

WCO: Water Conservation Objective

WPAC: Watershed Planning and Advisory Council (see *Water for Life: Alberta's Strategy for Sustainability*). In the Battle River Watershed (at the time of writing this plan), the designated WPAC is the Battle River Watershed Alliance.

Water Act: The purpose of Alberta's *Water Act* is to support and promote the conservation and management of water, including the wise allocation and use of water (s.2).

Water Allocation Transfer: A water allocation transfer occurs when the holder of an existing water licence agrees to sell all or part of the amount they are allocated to another person or organization. Alberta Environment must approve a transfer. When this occurs, the allocation is separated from the original land, and a new licence, with the seniority of the transferred allocation, is issued and attached to

the new location. Under the *Water Act*, Alberta Environment may place conditions on the new licence. Water allocation transfers may occur only if authorized under an approved water management plan, or by the Lieutenant Governor in Council. See Sections 81,82 and 83 of the *Water Act.*

Water Conservation Holdback: If the Director is of the opinion that withholding water is in the public interest to protect the aquatic environment or to implement a Water Conservation Objective, and the ability to withhold water has been authorized in an applicable approved water management plan or by order of the Lieutenant Governor in Council, the Director may withhold up to 10% of an allocation of water under a licence that is being transferred. The withholding occurs at the time the new licence created for the transferred allocation is issued (section 82(2) of the *Water Act*).

Water Conservation Objective (WCO): As defined in Alberta's *Water Act*, a Water Conservation Objective is the amount and quality of water necessary for the protection of a natural water body or its aquatic environment. It may also include water necessary to maintain a rate of flow or water level requirements.

From the *Water Act*: *"Water Conservation Objective" means the amount and quality of water established by the Director under Part 2, based on information available to the Director, to be necessary for the*

(i) protection of a natural water body or its aquatic environment, or any part of it;
(ii) protection of tourism, recreational, transportation or waste assimilation uses of water; or
(iii) management of fish or wildlife, and may include water necessary for the rate of flow of water or water level requirements.

A licence may be issued by the Director to the Government of Alberta for the purpose of implementing a Water Conservation Objective.

Water Licence: A water licence provides the authority for diverting and using surface water or groundwater allocation. The licence identifies the water source, the location of the diversion site, an amount of water to be diverted and used from that source, the priority of the "water right" established by the licence, and the condition under which the diversion and use must take place.

Water Management Plan: Alberta's *Water Act* and *Framework for Water Management Planning* outlines the process for water management planning and the components required for water management plans in the province.

Water Use Efficiency: To use the least possible water to accomplish an objective, such as growing a crop.

Water Use Effectiveness: To use water for purposes that provide the maximum desired benefits for society.

Watershed: An area of land that catches precipitation and drains into a body of water, such as a marsh, stream, river or lake.