Red Deer River
MUNICIPAL USERS GROUP

EXECUTIVE COMMITTEE

Meeting with Dick Hart – Hart Water Management
September 14, 2015 - 1:00P M – 3:00 PM
Innisfail Town Office
4943 – 53 St.

1. Purpose of Meeting:

This meeting will be an opportunity for RDRMUG Executive to review and receive updates on the work that Dick Hart has completed and is working on to date. This information relates to the engagement that MUGs entered into with Hart Water Management in July 2014.

2. Summary of information

2.1. **Crown Reservation:**

- 2.1.1. Update all numbers and statistics that are in RDRMUG original application
- 2.1.2. Current water allocation of the Red Deer River
- 2.1.3. Compare to SSWMP allocation limits
- 2.1.4. Status of "major" water applications (e.g. Special Areas, Acadia Valley, others)
- 2.1.5. List of all municipal licenses with volume and date of license

2.2. **Water Sharing Strategy:**

- 2.2.1. Why would a water sharing strategy be important?
- 2.2.2. What could/should a water sharing strategy address?
- 2.2.3. What would be the process, and who should be involved, in drafting a water sharing strategy (i.e. potential terms of reference)
- 2.2.4. What circumstances would 'trigger' discussions regarding the need for water sharing?
- 2.2.5. What might be the different levels of concern that may affect the nature/level/degree of water sharing actions
- 2.2.6. How the Province might/would be involved in water shortages?
- 2.2.7. Are there examples of municipal water sharing agreements?

2.3. **River Characteristics:**

- 2.3.1. Review of Stantec Flood Mitigation Study
- 2.3.2. Red Deer River natural flows – high, medium, low (average and extremes)
- 2.3.3. Water Conversation Objectives and instream Flow Needs Objectives
- 2.3.4. Historical and current information on how the Red Deer River is doing.
- 2.3.5. Implications of flood planning and mitigation.
- 2.3.6. Implications of low flow cycles (historic)
- 2.3.7. Current licensed water storage
- 2.3.8. Update Dickson Dam
- 2.3.9. Identify future storage needs

2.4. **Red Deer River Contribution to SSRB Interprovincial Apportionment**

- 2.4.1. A full review of this agreement has been completed and is in DRAFT form for discussion (copy attached)

3. Adjournment

DRAFT August 7, 2015

Part D: Red Deer River Contribution to SSRB Interprovincial Apportionment

> ***Previous Submissions to RDRMUG***
> Part A: Crown Reservation and Meeting with AESRD
> Part B: Review of Stantec Flood Mitigation Report
> Part C: River Characteristics

Residents of the Red Deer River Sub-basin have long expressed concerns that, because of Alberta's apportionment commitments to Saskatchewan, continued development and use of the water resources of the Bow and Oldman Rivers may limit development and use of the water resources of the Red Deer River. The purpose of this document is to review past studies and decisions related to the respective contributions of the Red Deer, Bow and Oldman Rivers to meeting apportionment commitments, and to determine the implications for the future use of water from the Red Deer River.

D.1. The Apportionment Agreement

This section describes Alberta's apportionment commitment to Saskatchewan for the South Saskatchewan River and provides some insight on administration of the apportionment agreement and the Red Deer River's contribution.

> ***Apportionable flow*** of the South Saskatchewan River at the Alberta-Saskatchewan Border is the natural flow of the South Saskatchewan River downstream of its confluence with the Red Deer River, minus U.S. withdrawals from the St. Mary River system in Montana. Apportionable flow equals natural flow for the Red Deer and Bow Rivers. Apportionable flow is less than natural flow for the Oldman River.

The general principle of the 1969 Master Agreement on Apportionment is that the waters of eastward-flowing rivers are to be divided equitably between Alberta and Saskatchewan. Alberta is entitled to consume or store one-half of the total **apportionable** flow of the South Saskatchewan River and Red Deer River. Alberta has the option of considering the South Saskatchewan and Red Deer River basins as a single basin for apportionment calculations. Alberta has chosen that option. The agreement includes a clause that allows Alberta to take a minimum annual "prior allocation" volume of 2,590,000 dam^3 (2,100,000 acre-feet), even if that amount is more than 50% of the annual volume, provided that a minimum flow of 42.5 m^3/s (1500 cfs) or 50% of the instantaneous natural flow, whichever is less, is maintained at the provincial boundary. Apart from the instantaneous flow requirement, the apportionment agreement is administered on a calendar-year basis.

Apportionable flows, Saskatchewan entitlements, and actual deliveries to Saskatchewan from 1970 to 2013 are illustrated in **Figure D.1**. The required delivery shown in the figure is computed simply as 50% of the apportionable flow of the combined South Saskatchewan and Red Deer Rivers. The figure shows that Alberta has met its commitments and that surplus deliveries have been made each year since the agreement was implemented. Surplus deliveries have averaged 2,573,000 dam^3, varying from a low of 350,000 dam^3 in 2001 to a high of 5,498,000 dam^3 in 2005. On average, Alberta has passed 81% of the apportionable flow to Saskatchewan compared to the 50% required under the agreement. Surplus

deliveries are typically highest in June and lowest in August, and commonly occur throughout the winter.

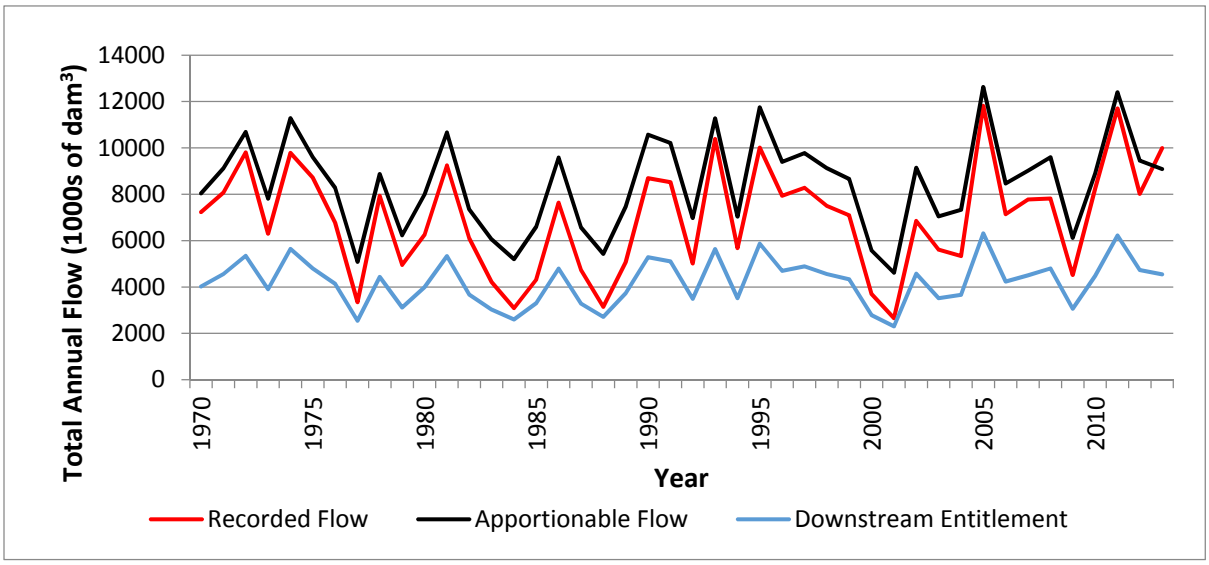


Figure D.1
South Saskatchewan River Apportionable Flow, Recorded Flow and Downstream Entitlement, 1970–2006

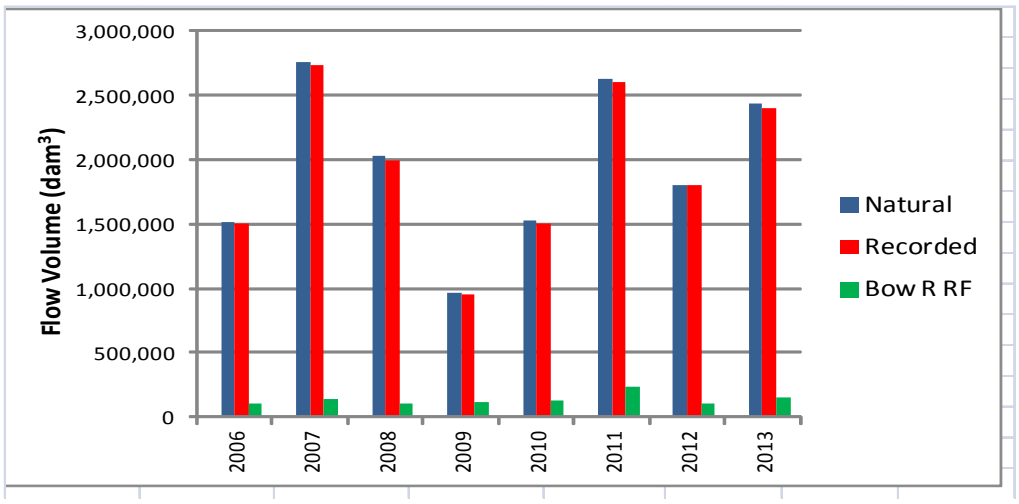
AESRD (2002) examined the recorded and naturalized flows of the major rivers in the SSRB to evaluate their relative contribution to Alberta's apportionment commitments. The analysis was based on the period 1975 to 1995, which was the latest 21-year period for which natural flow calculations were available at the time. AESRD drew the following conclusions:

- The Red Deer River Sub-basin passed a relatively constant 98% of its natural flow to Saskatchewan.
- The Bow River Sub-basin delivery to Saskatchewan varied from 58% to 86% of its natural flow, with an average of 72%.
- The Oldman River Sub-basin delivered between 41% and 92% of its apportionable flow, with an average of 69%.
- Alberta's surplus deliveries during low-flow years could increase in the future as a result of recently established In-stream Objectives (IOs) and Water Conservation Objectives (WCOs) (in-stream flow requirements) implemented for the Medicine Hat reach of the South Saskatchewan River, as well as other reaches of the system.

IOs are requirements where they are minimum flow conditions on licences; WCOs are primarily future targets for the South Saskatchewan River Basin.

To further examine the Red Deer River's contribution to apportionment, the Red Deer River contribution for 2006 to 2013 is shown on **Figure D.2** based on data taken from Prairie Provinces Water Board (PPWB) annual reports. The PPWB is the agency responsible for monitoring and administering the interprovincial Apportionment Agreement. As such, they estimate natural flow on the Red Deer River on a quarter-year

time basis. This is done by monitoring streamflow (recorded flow) and "major net uses" (withdrawals minus return flows) within the sub-basin. "Minor uses" are not included in the estimation of natural flow. A 1995 report on the computation procedure indicated that Red Deer River major licensed uses considered in the computations were Glennifer Lake Reservoir evaporation, Sheerness Diversion and Deadfish Diversion (Alberta Environmental Protection, 1995). The total of these three major licensed uses represent only 0.49 % of the mean natural flow of the South Saskatchewan River downstream of the Red Deer River confluence -- almost inconsequential to apportionment considerations. Furthermore, actual uses are usually less than licensed uses.



1. Data source: PPWB Annual Reports
2. Bow R RF = Bow River Return Flow
3. Recorded flow excludes Bow R RF.

Figure D.2
Contribution of the Red Deer River to Apportionment, 2006 to 2013

A computation of the Red Deer River's contribution to apportionment, based on PPWB data, is provided in **Table D.1**. Note that recorded data at Bindloss contains WID and EID irrigation return flows from the Bow River. This return flow is not included in the computation of Red Deer River contribution.

The inferred water use in the Red Deer Sub-basin is the difference between natural flow and recorded flow plus Bow River return flow. Average inferred use for the eight year period is 22,400 dam^3, which is much lower than what is believed to be actual use. From the perspective of the PPWB, water uses in the Red Deer Sub-basin have a minor impact on apportionment. A more accurate estimate of actual use does not justify the monitoring cost and the computational effort for apportionment purposes.

Table D.1
Red Deer River Contribution to Apportionment, 2006 to 2013

Year	Natural dam^3	Recorded dam^3	Bow R RF dam^3	Rec minus Bow RF dam^3	Contribution % of Qnat	Inferred Use dam^3	Use % of Qnat
2006	1,519,833	1,604,923	100,120	1,504,803	99.0%	15,030	0.99%
2007	2,759,274	2,876,264	136,720	2,739,544	99.3%	19,730	0.72%
2008	2,030,000	2,100,000	108,000	1,992,000	98.1%	38,000	1.87%
2009	967,943	1,066,953	112,870	954,083	98.6%	13,860	1.43%
2010	1,531,834	1,626,884	123,730	1,503,154	98.1%	28,680	1.87%
2011	2,630,000	2,840,000	235,000	2,605,000	99.0%	25,000	0.95%
2012	1,800,000	1,910,000	110,000	1,800,000	100.0%	0	0.00%
2013	2,440,000	2,560,000	159,000	2,401,000	98.4%	39,000	1.60%
Mean	1,959,861	2,073,128	135,680	1,937,448	98.8%	22,413	1.18%

1. Data source: PPWB Annual Reports. Prior to 2006 PPWB did not document Bow R Return Flow to the Red Deer R.
2. Bow R RF = Bow River Return Flow
3. Recorded flow excludes Bow R Return Flow

D.2. Water Management Planning Studies

Beginning in the mid-1970s, the Planning Division of Alberta Environment conducted several water management planning studies in the SSRB, primarily to address water supply and demand issues and to explore development potential. All studies acknowledged Alberta's commitment to meet the terms of the 1969 Apportionment Agreement. However, individual contributions of the Red Deer, Bow and Oldman Rivers in early studies were hampered by the absence of a simulation model capable of modelling the entire SSRB. Following the development of a comprehensive model in the early 1980s, the apportionment issue was considered in more detail.

A brief review of the studies as they relate to apportionment follows.

D.2.1 **Red Deer River Flow Regulation Planning Studies: Main Report** (Alberta Environment, 1975)

Flow regulation planning studies were undertaken to determine the feasibility of developing a flow regulating reservoir, which considered:

- Costs and environmental impacts;
- The extent to which winter flows and water quality could be improved;
- Improvements in meeting current and future water demands;
- Reductions in flood and erosion damages; and
- Enhanced or new recreational opportunities.

The study focussed on Site 6 (near Dickson, AB) and Site 7 (the Raven Site). The general conclusion of the study was that a regulating reservoir at Site 6 would provide the optimum solution to water supply and water quality conditions in the sub-basin, and would provide additional benefits related

to erosion and flood control, improved fish habitat, lake-based recreation, and hydro electric energy production.

The study recognized the need to meet the terms of the Apportionment Agreement. It noted that in the winter months enhanced flows (above natural flow), to meet downstream water quality objectives, could be applied against deficits in delivery from the South Saskatchewan River. In effect, this would subsidize irrigation development in the southern parts of the SSRB. This benefit to the province would be achieved without any adverse effects on water development in the Red Deer Basin (Page 14, Main Report).

Planning studies were followed by public hearings conducted by the Alberta Environment Conservation Authority (AECA). The AECA report (June, 1977) recommended that neither Site 6 nor Site 7 be considered further. They favored either offstream storage or an onstream reservoir upstream of Sundre. The only mention of apportionment in the AECA report (Page 91) states:

> *"The 1969 PPWB agreement makes it necessary that in general, half of the flow of the Red Deer River be allowed to pass through into Saskatchewan ..... in the course of planning water consumption, it is prudent to assume that only half of what we have is available for provincial use."*

Alberta Environment conducted further studies of dam sites upstream of Sundre and offstream storage options (Alberta Environment, 1976). After the Government of Alberta (GOA) considered of all information before them, on July 18, 1977 the Minister of Environment announced the decision to, among other things, construct the Dickson Dam (Glennifer Reservoir) on the Red Deer River west of Innisfail. Construction began in 1980 and was completed in 1983. The project is licensed to the GOA for the purpose of *"Storage (flow control)"*. Releases to meet interprovincial apportionment is not specifically mentioned in the planning documents, the licence or operating conditions on the licence. *

D.2.2 Oldman River Final Report (Oldman River Study Management Committee, 1978)

The Oldman River planning studies were conducted in two phases. Phase 1 considered various means of meeting present and future water use requirements in the Oldman River Sub-basin. Public meetings were held following completion of Phase 1. The objective of the Phase 2 study was to assess the feasibility of providing water supplies of adequate quantity and quality to meet the socio-economic aspirations of basin residents. The Phase 2 study was managed by a committee comprised of basin residents and public servants, and chaired by Peter Melnychuk, Assistant Deputy Minister, Alberta Environment.

With respect to apportionment, it was recognised that future water use in the Oldman Sub-basin would be constrained by uses in the Red Deer and Bow Basins, and uses in the Oldman Sub-basin could constrain uses in the other two basins. The Management Committee established four options for meeting Alberta's apportionment commitments:

Author's note: The only project that I am aware of in the SSRB that is specifically licensed for releases to meet interprovincial apportionment commitments is the Oldman River Reservoir.

1. The contribution of the Red Deer and Bow Rivers would be based on the 1975 level of demand in those sub-basins. The remaining requirement would be supplied by the Oldman River.
2. Contributions of 50% of the flow of each river.
3. Red Deer 75%; Bow 50%; the remaining apportionment requirement from the Oldman River.
4. The contribution of the Red Deer and Bow Rivers would be based on the 1985 level of demand in those sub-basins. The remaining requirement would be supplied by the Oldman River. The approximate contributions in this case would be:
   - Wet year -- Red Deer 97%; Bow 70%; and
   - Dry year -- Red Deer 86%; Bow 50%.

Simulation modelling for the Oldman Sub-basin assessed the four apportionment options, plus numerous infrastructure development and irrigation expansion options.

Regarding apportionment, the Management Committee recommended apportionment option number 3, but indicated that this recommendation should be confirmed in the subsequent SSRB Planning Program (Pages 29 and 30). In the meantime, the committee felt that there was sufficient flexibility in the proposed water management plan to ensure that proposed management measures developed in the short term would not constrain future development in the Bow or the Red Deer Sub-basins (Page 57). The development strategy included expansion of existing infrastructure and development of new facilities for a total cost of $324 million (1978 dollars) (Page 67).

Planning studies were followed by public hearings conducted by the Environment Council of Alberta (ECA). The ECA's report was issued in August 1979 (ECA, 1979). Several briefs expressed concern over the assumed contributions of 75% of Red Deer River water and 50% of Bow River water to apportionment. The Red Deer Regional Planning Commission argued that assuming a contribution greater than 50% of the Red Deer River represents an indirect form of inter-basin transfer (Page 43). The ECA concluded that (Pages 44 and 45):

- Development in the Red Deer Basin is unlikely to be hampered in the near future by a 75% allocation to apportionment;
- Unless the Red Deer's contribution to apportionment is greater than 50%, the infrastructure cost to support irrigation expansion in the Oldman Basin would not be feasible;
- For planning purposes, the ECA recommendations in this report assume 75% of Red Deer and 50% of Bow water would contribute to apportionment; and
- The SSRB study should be completed as quickly as possible to resolve the apportionment issue.

In general, the ECA supported the recommendations for infrastructure rehabilitation and development in the Oldman Basin. Two notable exceptions are the Chin pump (energy costs too high; Page 194), and onstream storage (not required in the foreseeable future; Page 196).

On August 29, 1980 the Ministers of Environment and Agriculture announced the Water Resources and Irrigation Development Program in Southern Alberta (Alberta Environment, 1980). The program included all components recommended by the Management Committee, including onstream storage on the Oldman River and the Chin pump. It added the Deadfish Diversion and upsizing the Sheerness Diversion pipeline for irrigation and other uses in the Red Deer River Sub-basin. Total cost of the program was $334 million, not including the cost of the Oldman River Dam,

the Chin pump and Chin Reservoir enlargement. All elements of the program have been implemented except the Chin pump, Chin Reservoir enlargement and Mud Lake offstream storage.

The announcement did not mention the apportionment issue or the SSRB Planning Program.

D.2.3 South Saskatchewan River Basin Planning Program: Summary Report (Alberta Environment, 1984)

The purpose of the four-year SSRB Planning Program (SSRBPP) was to develop a strategy for the use and management of water in the SSRB. Three major policy questions were considered.

1. How is the supply of water to be allocated among uses?
2. What are the priorities among the options for water management?
3. How much water will each of the three major rivers contribute to apportionment?

With respect to apportionment, since the signing of the Master Agreement on Apportionment in 1969, Alberta recognized that:

> *"To honour this commitment while at the same time ensuring the most beneficial use of water to which Alberta is entitled, the flow of the major tributaries to the South Saskatchewan River -- the Bow, the Oldman and the Red Deer -- must be managed equitably and in concert"* (Page 3).

A major component of the study was to develop a simulation model that could model the entire SSRB. For the first time, Alberta Environment had an analytical tool to identify the implications of water management measures and levels of usage among all three of the major rivers comprising the SSRB. This would resolve concerns in previous planning studies, where it was acknowledged that a policy on the volume contribution of each of the three major rivers, expressed in percent of natural flow, must be established to ensure orderly development, and beneficial and equitable water use in each of the three basins.

While a clearly defined policy on the contribution of each of the three streams to apportionment is essential for water management planning and water allocation decisions, operational decisions related to apportionment within each year must consider other factors, such as availability of water within each basin, the relative impacts of water supply deficits to users in each basin, and perhaps other factors that may vary from year to year.

The study team selected four scenarios to address alternative apportionment contributions from the three major rivers.

1. No fixed allocations.
2. An allocation approximating current (1980) conditions : Red Deer 75%; Bow 40%; Oldman 40%.
3. Equal allocation: Red Deer 50%; Bow 50%; Oldman 50%.
4. A lesser percentage from heavily allocated sub-basins: Red Deer 90%; Bow 30%; Oldman 30%.

The apportionment requirements are constraining only in low streamflow/high demand years. In most years the contributions from the individual streams would exceed the policy requirements, and Saskatchewan would receive more than their 50% share.

Numerous scenarios were assessed assuming variations in demand (primarily irrigation which has most influence on all other critical parameters), variations in water management, and variations in infrastructure. Seventeen scenarios were selected for documentation to demonstrate interrelationships among the variations in each river sub-basin. No recommendations were made in the planning reports. The reports were made available to the public for review and input.

Public hearings were conducted by the Alberta Water Resources Commission (AWRC). Their report and recommendations were made available in 1986 (AWRC, 1986).

With respect to apportionment, the AWRC indicated that the apportionment agreement must be honoured. The report presented arguments for and against a fixed apportionment arrangement among the three sub-basins. Arguments **for a fixed apportionment** formula included:

- Much needed stability and diversification of agriculture in east-central Alberta, the most arid part of the province (north of the Red Deer River).
- Balanced regional growth throughout Alberta. Fairness in GOA support of water development and investment equity within the SSRB.
- Comparing development costs within established irrigation areas with costs in new areas should include an accounting of past government expenditures.

Arguments **against a fixed apportionment** formula included:

- Approximately 81,000 ha (200,000 acres) of irrigation within the WID and EID, sourced from the Bow River, are located within the Red Deer River Basin.
- Higher apportionment allocations from the Bow and Oldman Rivers would have a negative impact on existing irrigation in those basins, with higher risks of water supply deficits.
- Remaining water supplies should be used in a manner that would get the best economic return considering soil quality, climate, farmer interest in irrigation expansion, low infrastructure costs, and secondary processing of agricultural commodities which already exist in the Bow and Oldman Basins.

In the final analysis, the AWRC recommended that a fixed allocation formula for apportionment should not be established; the government should continue to manage the SSRB as a single basin for apportionment purposes. Water should be managed to support and improve the economic viability of agriculture and industry, and to support regional initiatives in a fair and equitable manner. To guard against a bias toward continuing to develop in existing irrigation areas, water should be reserved for about 60,700 ha (150,000 acres) to be developed north of the Red Deer River, along the South Saskatchewan River in the Medicine Hat area, and on Indian Reserves, subject to suitable soils and climate conditions, and comparable servicing costs with that in other areas of the province.

The GOA accepted the foregoing AWRC recommendations. It was further decided by Alberta Environment to develop expansion guidelines for private and district irrigation in all SSRB sub-basins with due consideration for the needs of other uses of water, instream flows and apportionment.

Irrigation Expansion Guidelines were developed in two steps. Firstly, the irrigated areas within each sub-basin and each irrigation district were determined. Secondly, the annual volumes of water required to irrigate the areas were estimated, recognizing that *t*he *Water Act* controls the rates and volumes of diversions from source streams, not irrigated areas. Details on how volumes were estimated are outlined in SSRB: Irrigation in the 21st Century: Summary Report (Irrigation Water Management Study Committee, 2002; Pages 21-24). Following determination of annual volumes, irrigation districts applied for and were granted water licences accordingly.

The Water Management Policy and Irrigation Expansion Guidelines for the SSRB were announced by the GOA on May 28, 1990 (Alberta Environment, 1990). The Irrigation Expansion Guidelines were defined in the Water Act through the South Saskatchewan Basin Water Allocation Regulation (Alberta Environment, 1991). They called for an increase in irrigation area in the Red Deer River Basin from about 16,000 ha (40,000 ac) in 1988 to an upper limit of 39,000 ha (97,000 ac).

Since the closing of the Bow, Oldman and South Saskatchewan Sub-basins to new licence applications in August 2007, it was deemed that the 1991 Regulation was no longer needed and it has been rescinded (Alberta Environment, 2007).

D.2.4 SSRB: Irrigation in the 21st Century: Summary Report (Irrigation Water Management Study Committee, 2002)

In establishing the Irrigation Expansion Guidelines it was recognized that scientific information at the time was unreliable. A four-year research program was initiated to identify and quantify current and future irrigation demand and irrigation water management. A report on the research findings was released in 2002. Based on the updated demand data and projections for future efficiency improvements, simulation modelling indicated that the Bow River irrigation districts could expand their irrigation areas by 10% to 20% beyond the Irrigation Expansion Guidelines, with no increase in their water licence allocations. The Oldman River Sub-basin irrigation districts could expand by up to 10% beyond the Irrigation Expansion Guidelines with no increase in their licence allocations.

It was assumed that irrigation in the Red Deer River Sub-basin would expand to 39,000 ha (97,000 ac), as permitted in the Irrigation Expansion Guidelines. It was recognized that additional storage would be required to achieve that level of expansion. Apportionment was always met under these expansion scenarios, but the contribution of each of the three major rivers was not determined.

D.2.5 Approved Water Management Plan for the South Saskatchewan River Basin (Alberta Environment, 2006)

In 2001 Alberta Environment began working on a water management plan for the SSRB. The plan was to reflect a balance between protecting the aquatic environment and the amount of river water required for economic development in the SSRB. The plan involved extensive public input, on the direction water management should take. Their comments and concerns were carefully considered in the preparation of the plan.

The plan was approved by the GOA and a report was released in August 2006. The plan recognized and accepted that limits for water allocations had been reached or exceeded in the Bow, Oldman, and South Saskatchewan River Sub-basins. It also recognized that the limit of the water resource in the Red Deer River Sub-basin will be reached in the foreseeable future. Principal recommendations of the plan are as follows.

- Alberta Environment no longer accept applications for new water allocations in the Bow, Oldman and South Saskatchewan River Sub-basins until the Minister of Environment specifies, through a Crown Reservation, how water not currently allocated is to be used.

  A Crown Reservation is now in place (Regulation 171/2007; August, 2007). The Bow, Oldman and South Saskatchewan River Sub-basins Water Allocation Order stipulates that reserved water may be allocated as follows:
  - For use by First Nations;
  - To contribute toward meeting Water Conservation Objectives;
  - For meeting outstanding completed applications received as of the date of this reservation; and,
  - For storage of peak flows to mitigate impacts on the aquatic environment and to support existing licences.

- When allocations in the Red Deer River Sub-basin reach 550, 000 dam^3, a thorough review be conducted to identify the maximum allocation limit.

- AENV establish Water Conservation Objectives (WCOs) for the Bow, Oldman and South Saskatchewan River Sub-basins. The WCOs should be 45% of the natural rate of flow, or the existing in-stream objective plus 10%, whichever is greater at any point in time. Any licences issued for applications received after 1 May 2005 should be subject to the WCOs. Existing licences should retain their original conditions for in-stream objectives.

- AENV establish WCOs for the Red Deer River Sub-basin as follows:
  - For the Red Deer River between Dickson Dam and the confluence with the Blindman River,
    - for new licences issued after 1 May 2005 and for existing licences with a retrofit provision, a rate of flow that is 45% of the natural flow or 16.0 m^3/s, whichever is greater;
  - For the Red Deer River downstream of the confluence with the Blindman River,
    - for licences issued after 1 May 2005 with withdrawals in November to March, a rate of flow that is 45% of the natural flow or 16.0 m^3/s, whichever is greater;
    - for licences issued after 1 May 2005 with withdrawals from April to October inclusive, a rate of flow that is 45% of the natural flow or 10.0 m^3/s, whichever is greater; and,

Retrofit provision: water licences issued since about February 1997 usually contain a condition that indicates that the licence may be amended to include a WCO once one has been established. (Individual licences should be checked to determine if they contain the retrofit provision.) On amended licences, the licensee would not be permitted to divert when the river flow is less than the WCO.

- for existing licences with a retrofit provision, a rate of flow that is 45% of the natural flow or 10.0 m^3/s, whichever is greater.

Establishment of WCOs in the Red Deer River Sub-basin on January 16, 2007 (Alberta Environment, 2007) put recent licensees, and those seeking new water supplies to support an economic initiative, into new territory with respect to water supply security. Licensees subject to the new WCOs could encounter more frequent and larger deficits. Planners will need to determine how much storage would be required to fully meet WCOs, the requirements of existing water users, and how climate change may affect security of water supply and water-use practices.

With respect to apportionment, the plan states that the SSRB will continue to be managed as a single entity to meet apportionment requirements. The plan calls for establishing an Interbasin Water Coordinating Committee (IWCC)with representation from Alberta Environment and the Watershed Advisory and Planning Councils in the SSRB. The Committee would provide advice to Alberta Environment on managing water during periods of water shortages in any or all sub-basins. It would also advise Alberta Environment on how best to meet Alberta's apportionment commitment. Current members on the IWCC from the Red Deer River Watershed Alliance are Bill Shaw and Tom Daniels.

D.2.6 **SSRB Water Supply Study** (AMEC, 2009)

In light of decisions made following completion of the SSRB Plan, there was a desire to have a clear understanding of issues related to current and future water supply security, potential measures to increase security, and strategic direction for the future. An SSRB Water Supply Steering Committee, with representation from Alberta Agriculture and Rural Development, Alberta Environment, and the four Watershed Advisory and Planning Councils in the SSRB, commissioned a science-based study with the following objectives :

- Assess current and future water supply and demand in the SSRB;
- Identify constraints to water supply and economic growth; and
- Identify, analyze and evaluate structural and non-structural options to address constraints and issues.

Primary study findings were as follows.

- **Current actual surface water consumed by all water use sectors in the SSRB in Alberta is estimated to be about 1,981,000 dam^3. Irrigation is the highest water-use sector in the SSRB, representing 84% of the estimated total current actual water use.**

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  Current actual surface water use represents about 22% of the median natural flow of the South Saskatchewan River downstream of the Red Deer River confluence, and about 46% of Alberta's entitlement under the apportionment agreement (after adjusting the natural flow for uses of St. Mary River water in the United States).

- **Assuming full enforcement of legal priorities, the current frequency of deficits to the WCOs and junior non-irrigation water users would be high throughout most of the SSRB.**

  Junior water users are those subject to the recently established WCOs in the Red Deer River Sub-basin, and those subject to IOs established since the mid-1990s in the Bow and Oldman Sub-basins. The junior projects that are not supported by dedicated storage are particularly vulnerable to deficits. The various water-use sectors (municipal, stock water, irrigation, industrial, commercial, wetlands) have different tolerances to deficits. Deficits to irrigation district water users are minor for the current level of demands.

- **By 2030, water use could increase from the current (circa 2006) 1,981,000 dam^3 to about 3,040,000 dam^3, an increase of 53%. This magnitude of increase would occur if irrigation districts were to implement, under their existing licence allocations, the maximum level of expansion judged to be feasible in this study. The maximum expansion would be 32% of the irrigation district area in the Bow River Sub-basin and 19% in the Oldman River Sub-basin.**

  There is significant potential for expansion of irrigation districts in the Bow Sub-basin, but a more limited potential for expansion of districts within the Oldman Sub-basin. However, if southern Alberta's climate becomes warmer and drier, irrigation demand per unit of irrigated area would increase, which could significantly impact water supply risks to irrigation producers. A cautious approach to irrigation district expansion would be prudent until the full impacts of climate change on water supply are better understood.

- **Potential increases in future water use, primarily within the irrigation districts, will increase deficits to WCOs, junior private irrigation users, and junior non-irrigation users, particularly in the Bow, Oldman and South Saskatchewan Sub-basins.**

  Generally, the impact of future water demand on the WCOs would be a modest increase in deficits throughout the SSRB. The impact on junior water users in the Red Deer Sub-basin would also be a modest increase in deficits. The increase in deficits to junior users in some parts of the Bow, Oldman and South Saskatchewan Sub-basins would be substantial.

- **It is likely that climate change will increase winter mountain runoff and reduce streamflows in the SSRB. These factors could have significant impacts on potential irrigation district expansion in the Oldman Sub-basin.**

  If streamflow decreases, deficits in meeting district irrigation demands in the Bow Sub-basin would increase, but performance would still be acceptable for all expansion scenarios considered in this study. Deficits to district irrigators in the Oldman Sub-basin would be beyond the tolerable limits for the highest level of expansion considered in this study.

- **Non-structural measures such as refining operations of existing storage projects, improving irrigation efficiencies, reducing return flows, market-based water allocation transfers and deficit sharing, will all improve water management and reduce deficits. However, the collective benefits of all these measures would probably not fully address the future deficits identified in this study.**

- **A preliminary review of the hydrology of the Red Deer, Bow and Oldman Sub-basins indicates that there is unused flow available at various locations in each sub-basin. Additional storage and flow regulation can assist in reducing deficits to in-stream requirements (WCOs or IOs), and junior consumptive users.**

In the simulation modelling for this study, the apportionment commitment was always met. However, there was no final accounting of the contributions of each of the three major rivers. Major increases in irrigation demand in the Bow and Oldman Sub-basins could mean that the Red Deer River would be counted on to deliver a high percentage of its natural flow to apportionment. As a result, increased deficits to junior licenses could occur. This could be better assessed by examining results of simulation modelling for the previous studies. Additional storage in the Oldman or Bow Sub-basins could be operated to relieve the burden on the Red Deer River for meeting apportionment.

D.2.7 **Water Storage Opportunities in the SSRB** (AMEC, 2014)

This study was a follow up to the SSRB Water Supply Study (AMEC, 2009). The study focussed on the potential for new storage development in the Oldman River Sub-basin to assist in reducing deficits to instream flow requirements and junior licensees, and to enable development of committed irrigation projects on Indian Reserves and elsewhere under full development of district irrigation in the basin.

Numerous storage sites in the Oldman Sub-basin that were identified and analysed in previous studies were reviewed at a screening level. Five sites that were judged to be most promising for development were selected for more detailed evaluation.

- Upper St. Mary, just north of the International Boundary; 125,800 dam^3 capacity.
- Lower Belly, just upstream of confluence with the Oldman River; 493,400 dam^3 capacity.
- Chin Reservoir enlargement, offstream storage; 74,000 dam^3 capacity.
- Lower St. Mary, upstream of confluence with the Oldman River; 240,500 dam^3 capacity.
- West Raymond, offstream storage near Raymond, AB; 19,700 dam^3 capacity.

The modelling of the Chin, Belly and Upper St. Mary sites assumed maximum irrigation expansion within the irrigation districts, 2030 level of demand for all other uses (AMEC, 2009), and the current AESRD policy for instream flows downstream of new storage developments . That policy calls for instream flows downstream of the reservoir equal to the 45% of the natural flow or the current IO increased by 10%, whichever is greater. The results were analyzed to determine reductions in magnitudes and frequencies of deficits to junior licencees, WCOs, and First Nations. The model maintained irrigation district deficits at the acceptable levels observed in the Base Case (current level of development) scenario.

Developing storage by expanding Chin Reservoir does not appear justifiable. There is little improvement to the WCO or junior private projects with this offstream storage project. The modelling results for the Belly and Upper St. Mary sites, under AESRD's current instream flow policy, would rarely fill, have frequent low levels and be ineffective during periods of drought when they would be most needed. The lower St. Mary and West Raymond sites were therefore not

modelled because they would essentially realize similar (or worse) results as the Belly and Chin scenarios.

Additional modelling considered a change in the current AESRD policy. If the AESRD WCO policy was amended to require releases equal only to 1.1*IO, then the Belly River site may be viable. Under these conditions, the Belly Reservoir Site allows the Oldman Reservoir to better meet consumptive needs upstream of the Belly River confluence, including the committed Summerview and Piikani projects. Modelling indicates that a new Belly Reservoir, sized between 160,000 and 324,000 dam^3, would adequately meet the needs of existing junior users, future Piikani First Nation and Summerview projects. Oversizing the storage capacity could possibly contribute to flood mitigation along the Oldman and South Saskatchewan Rivers. The ramifications and required mitigation would need to be further explored if the WCO policy is amended and there is interest in developing this site.

As with all other projects, apportionment was always met in simulation modelling runs. However, there was no accounting of the contribution from each of the three major rivers. In some low runoff years, releases from Glennifer Reservoir would be required to meet apportionment commitments when there have been deficits in the Red Deer Basin. The following issues were related to that.

- In simulation modelling, apportionment has a higher priority than consumptive uses. Hence, in the model, water released from storage for apportionment is not available for use by consumptive users. In reality, it is probably not practical to prevent users from withdrawing water intended for apportionment.
- The purposes of Dickson Dam do not include releases for apportionment. (The purposes of the Oldman River Dam do include releases for apportionment.)
- The potential for increased water use in the Oldman River Subbasin, and possibly the Bow River Sub-basin, to inadvertently preclude economic development in the Red Deer Basin will probably raise concerns of Red Deer Sub-basin residents. Releasing water from Glennifer Reservoir to meet apportionment requirements and potentially increase deficits to existing development in the Red Deer Basin will also raise concerns of Red Deer Basin residents.

"We can no longer implement significant water use or management undertakings in the SSRB without seriously impacting present and future use in the entire basin. Were we to proceed as in the past to plan specific projects to meet specific needs, we would eventually evolve a "strategy" by default or administrative decision. While such specific developments might be very worthwhile, the resulting water use and management might not be what the people of Alberta want or need and there might remain little flexibility to change this pattern."
(Alberta Environment 1984; Page 43)

D.3 Conclusions and Follow-up Investigations

Over 30 years ago Alberta Environment planners were aware of the issues related to meeting water apportionment commitments to Saskatchewan. In the early 1980s concern was expressed that the lack of a strategy for meeting the inter-provincial apportionment requirements would eventually lead to establishing a

"strategy" by the accumulation of individual administrative decisions (inset). This concern could become reality if future water diversions and use, primarily in the Oldman River Sub-basin, increase to the extent that greater than 50% of the natural flow of the Red Deer River is required to meet apportionment commitments. Continued irrigation expansion in the Bow and Oldman Sub-basins is possible without new licence allocations . If this takes place, increased contributions from the Red Deer River will likely be required to meet apportionment. This could limit economic development and possibly increase deficits to existing licensees in the Red Deer Sub-basin.

It appears that the Alberta Water Resources Commission (AWRC), which held hearings on the SSRB Planning Study of the 1980s, understood the issues related to apportionment. However, many of the interveners probably did not realize the potential implications to the Red Deer River Basin. The AWRC discussed the pros and cons of specifying the amount of water to be delivered by each of the three major rivers for development planning purposes. Their deliberations are well documented (AWRC, 1986). They made a considered and informed recommendation to continue to "manage all three rivers in concert", and the GOA agreed. Since that time, the issue has never been discussed in subsequent planning studies.

Follow Up Recommendations

- Determine the contributions to apportionment of the Red Deer, Bow and Oldman rivers under "current" demand conditions based on WSC recorded data and natural flow data developed by Alberta Environment or PPWB. Base this on the past 20 years to reflect current conditions. Determine maximum, average and minimum contributions.

- Determine the potential contributions to apportionment of the Red Deer, Bow and Oldman rivers under maximum irrigation development conditions determined from simulation modelling conducted in AMEC (2009 and 2014). Determine maximum, average and minimum contributions. This will give an indication of what could result from continuation of the current policy of meeting interprovincial apportionment commitments by managing the Red Deer, Bow and Oldman Rivers *"equitably and in concert".*

- Determine the frequency of potential releases from Glennifer Reservoir that were intended to assist in meeting apportionment commitments under full irrigation development conditions. This may require some new model runs if this information cannot be obtained from past model runs.

- Determine the reasonable full level of water use in the Red Deer River Sub-basin considering building on the strengths of the region, including the following:
  - Development of the natural resources of the sub-basin.
  - Population growth and municipal and rural domestic water use.
  - Expansion of industrial water use.
  - A reasonable level of irrigation development.

- Determine the volume of new storage required in the Red Deer River Sub-basin to meet demands considering various contributions from the Red Deer River to meet apportionment commitments, such as 65%, 75% and 85% of the Red Deer River natural flow. Simulation modelling would be

required to make this determination. While the primary purpose of this storage would be to meet water supply and instream flow needs in the basin, and assist in meeting SSRB apportionment commitments, it could also assist in flood mitigation.

- Determine the volume of new storage required in the Oldman and/or Bow Sub-basins to limit the future contribution of the Red Deer River to 65%, 75% and 85% of natural flow. Simulation modelling would be required to make this determination. While the primary purpose of this storage would be to assist in meeting apportionment, it could also provide additional water to meet WCO and consumptive water needs in the Oldman, Bow and South Saskatchewan Sub-basins, and assist in flood mitigation. For instance, in the Oldman Sub-basin, storage developed downstream of Lethbridge could be used for apportionment, meeting instream and consumptive needs along the Oldman and South Saskatchewan Rivers, and perhaps support expansion of irrigation in the St. Mary Project by pumping into Chinn Reservoir or other offstream reservoirs. Note that the Chin Pump was part of the 1980 announcement of projects to be implemented in the Oldman basin following completion of the Oldman Management Committee Report (Oldman River Study Management Committee, 1978.) The Chin Pump, Chin Lake Enlargement and Mud Lake Reservoir are the only components from that development announcement that were not implemented. (Mud Lake would be inefficient storage and probably should not be implemented.) The storage could also be located on the South Saskatchewan River. However, the further downstream locations would have lesser water supply benefits.

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