South Saskatchewan River Basin Adaptation to Climate Variability Project

Bow River Basin Integrated River Management Business Case

Final Report

January 2013

This study was commissioned for discussion purposes only and does not necessarily reflect the official position of the Climate Change Emissions Management Corporation, which is funding the South Saskatchewan River Basin Adaptation to Climate Variability Project. The report is published jointly by Alberta Innovates – Energy and Environment Solutions and WaterSMART Solutions Ltd.

This report is available and may be freely downloaded from the Alberta Water Portal website at www.albertawater.com.

Disclaimer
Information in this report is provided solely for the user's information and, while thought to be accurate, is provided strictly "as is" and without warranty of any kind. The Crown, its agents, employees or contractors will not be liable to you for any damages, direct or indirect, or lost profits arising out of your use of information provided in this report.

Alberta Innovates – Energy and Environment Solutions (AI-EES) and Her Majesty the Queen in right of Alberta make no warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in this publication, nor that use thereof infringe on privately owned rights. The views and opinions of the author expressed herein do not necessarily reflect those of AI-EES or Her Majesty the Queen in right of Alberta. The directors, officers, employees, agents and consultants of AI-EES and the Government of Alberta are exempted, excluded and absolved from all liability for damage or injury, howsoever caused, to any person in connection with or arising out of the use by that person for any purpose of this publication or its contents.

This report should be cited as: 2013. *Bow River Basin Integrated River Management Business Case.* Report prepared for the South Saskatchewan River Basin Adaptation to Climate Variability Project. 21 pages.

Contents

List of Tables

List of Figures

Acronyms and Abbreviations

ac-ft	acre-foot. An acre-foot is the volume of water required to cover one acre to the depth of one foot. One acre-foot = 1.23348 cubic decametres.
(A)ESRD	(Alberta) Environment and Sustainable Resource Development
Bow River Project (BRP)	The Bow River Project consisted of a consortium that was established to explore options for re-managing the Bow River system from headwaters to confluence. The final report was released in March 2011.
BROM	Bow River Operational Model
cfs	cubic feet per second
cms	cubic metres per second; one cms = 35.314 cfs
dam^3	cubic decametre. A cubic decametre is 1000 cubic metres.
HydroLogics	HydroLogics, Inc.
LKL	Lower Kananaskis Lake
SSRB	South Saskatchewan River Basin
WaterSMART	WaterSMART Solutions Ltd.

1 Executive Summary

In 2010, the Bow River Project Research Consortium was established to explore options for more integrated management of the Bow River system from headwaters to confluence. The Consortium published its work in March 2011 in the *Bow River Project Final Report*, online at www.albertawater.com/index.php/projects-research/bow-river-project. Various scenarios for possible water management were examined and a "Preferred Scenario" was selected as the scenario most beneficial to improved management of the Bow River watershed.

This document, the Bow River Basin Integrated River Management Business Case (the "Business Case"), identifies and, to the extent possible, measures net incremental benefits derived from implementing the Preferred Scenario. The impact(s) of potential climate change on the Preferred Scenario were not assessed in this Business Case.

As the Business Case describes in more detail, implementing the Preferred Scenario could provide the quantitative benefits noted below, recognizing that a) these benefits are not necessarily additive, b) this is not an exhaustive list of potential benefits, and c) new water or the potential for new water allocations is not in any way an implied benefit of the Preferred Scenario:

- The estimated annual incremental economic benefits of stabilizing Lower Kananaskis Lake are at least $2 million - $3 million with an estimated net present value between $30 million and $40 million.
- The estimated cost of securing a comparative amount of water equivalent to that managed by the Water Bank has a net present value range of $41 million - $313 million.
- The estimated avoided cost of building equivalent water storage is $51 million - $148 million.

The Preferred Scenario offers direct and indirect environmental benefits to the ecosystem through, for example, healthy aquatic and riparian environments, which are highly valued by many users. The Preferred Scenario also supports the *Water for Life* goal of providing a reliable, quality water supply for a sustainable economy with assurance of minimum flows (1,250 cfs) through Calgary. These assured minimum flows provide security of water quality standards, fisheries protection, and enhanced flows in the Bow River from Calgary to Bassano and beyond to the confluence with the Oldman River.

The Preferred Scenario and the Water Bank might also assist in mitigating risks associated with meeting future water demands and the potential environmental impacts attributable to population growth. The Preferred Scenario also has the potential to ensure year-round availability of water to meet the needs of junior licensees in the basin.

This Business Case outlines many of the substantial quantitative and qualitative benefits of the Preferred Scenario as described in the Bow River Project Final Report. The analysis set out in the Business Case makes clear the individual and overall benefits to be gained by implementing the Preferred Scenario and demonstrates that the Scenario's implementation would be in the best interests of the diverse water users in the Bow River Basin.

2 Introduction

Alberta's heritage and its social, economic and environmental history are directly tied to its water resources. While Alberta's economy is fuelled by hydrocarbons, it runs on water, and continued prosperity depends on sound water management decisions. In the face of climate variability and change, these decisions are becoming more complex and more critical.

Alberta is confronting important water challenges, including an expanding population, accelerating economic growth, and the increasing impact of this growth on the environment as the climate continues to shift.

Water supply varies considerably throughout Alberta. Water demand is also variable, particularly between southern and northern regions. The health of Alberta's natural resources and its economic vitality depend on an integrated understanding of natural climate variability as well as improved management capacity to confront the prospects and potential impacts of climate change.

These challenges present a timely opportunity to capitalize on the knowledge and experience of community and business leaders, government departments, environmental organizations and watershed groups. Water issues are complex and cannot be solved by any single initiative or sector. Alberta has a history of successfully meeting sustainability challenges through multi-sector collaboration and engagement, and the South Saskatchewan River Basin Adaptation to Climate Variability Project will further enhance that legacy.[1]

In 2010, the Bow River Project Research Consortium was established to explore options for re-managing the Bow River system from headwaters to confluence. The Consortium's work was described and published in the *Bow River Project Final Report* ("BRP Final Report"). This report reviewed new ways to manage water in the South Saskatchewan River Basin (SSRB), focusing on improved management of the Bow River system as an integrated watershed. Various scenarios for possible water management were explored and a "Preferred Scenario" was selected, based on that scenario being the most beneficial to improved management of the watershed.

The objective of this document – the *Bow River Basin Integrated River Management Business Case* (the "Business Case") – is to identify and quantify the net incremental benefits derived from implementing the Preferred Scenario. These incremental benefits were determined by comparing the effects on water management in the Bow River Basin of implementing the Preferred Scenario, against current water management methods and capabilities, referred to in the BRP Final Report as the "Base Case." Figures 1 and 2 illustrate the respective key components of the Base Case and Preferred Scenario as presented in the BRP Final Report.

[1] See Appendix A for more information on this project.

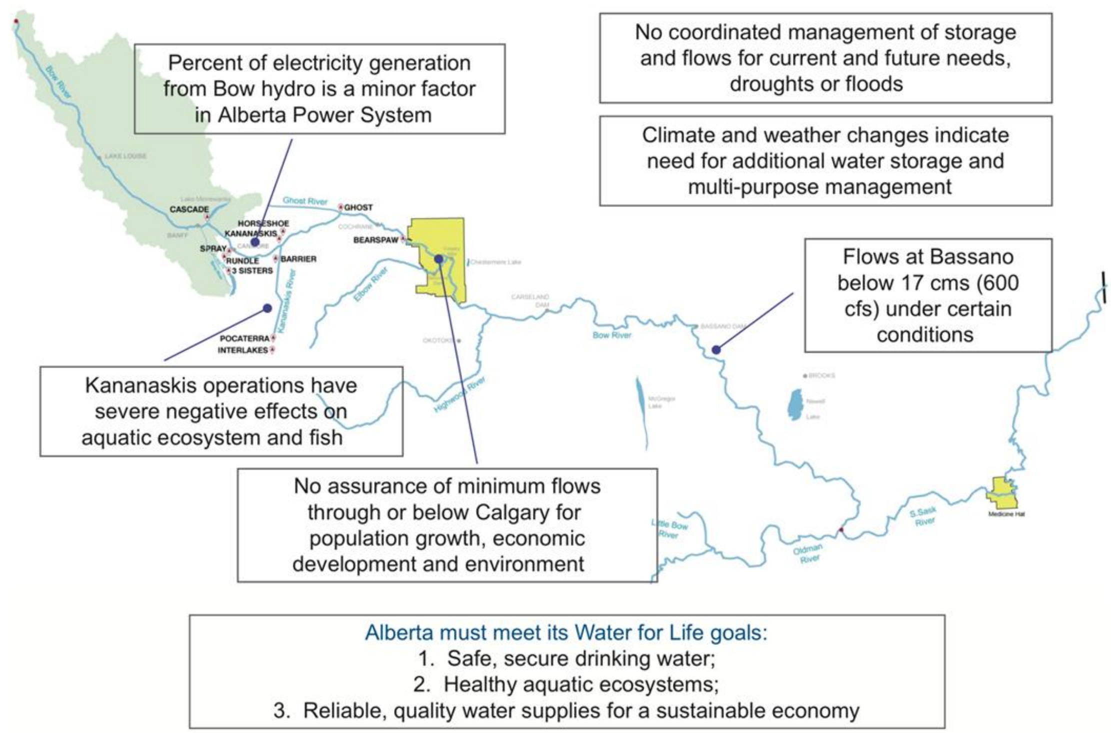

Figure 1. BRP Final Report Base Case (Current Situation) Summary and Map

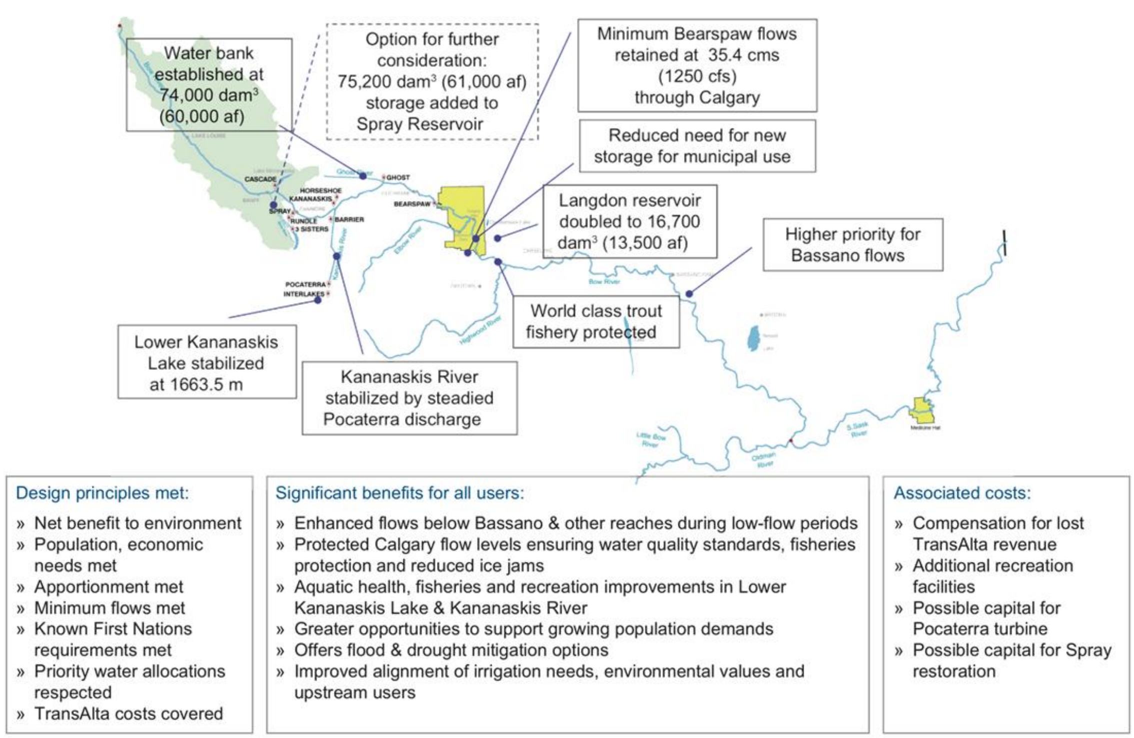

Figure 2. BRP Final Report Preferred Scenario Summary and Map

Most of the analysis undertaken in the Business Case was directed at quantifying the incremental benefits of the Preferred Scenario versus the Base Case, to the extent possible given available and identified information. Ascertaining the incremental benefits of the Preferred Scenario involved quantitative and qualitative measures, including, for example, analysis of relevant revenues, associated costs, cost avoidance, intrinsic values and other benefits that are known but could not be measured at this time.

To better understand the overall benefits offered by the Preferred Scenario, the Business Case analysis focused on benefits that appeared to be more substantial and could have a greater potential impact on individuals and organizations. This proved to be a challenging task as there were fewer published data and quantified examples than expected. The authors of the Business Case consulted a variety of printed materials, the most relevant of which are listed in the Bibliography, and spoke with many individuals and organizations (see Appendix B). Through this research, enough substantiated data and examples were gathered to demonstrate the nature and magnitude of the benefits of the Preferred Scenario.

Climate change and variability can alter, to a significant degree, the availability and use of water; however the possible effects of climate change and variability were beyond the scope of the Business Case and thus were not assessed. Information on other work being undertaken as part of the SSRB Adaptation to Climate Variability Project is noted in Appendix A.

The objective and ultimate scope of this Business Case were limited by: the practicality of methods available to measure and quantify the value of water and water management, the actual information available on valuing and managing water, and time. That being said, the Business Case is based on reasonable and transparent assumptions and provides a valid estimate of substantial benefits to be achieved by implementing the Preferred Scenario.

3 Methodology

3.1 Review of BRP Final Report

The final report from the Bow River Project (BRP) identified potential benefits from the Preferred Scenario, considerations with respect to measuring those benefits, and possible sources of information to assist in their measurement. It was a main source of information in compiling the Business Case. Specific sections on Project Results, Conclusions, Opportunities for Integrated Management of the Bow River System, and Appendix D: Performance Measure Results were key sources of information and were extensively consulted in determining which areas of the Preferred Scenario warranted further investigation and analysis. Individuals involved with the BRP Final Report provided interpretation and clarification of the report as required.

Performance measures set out in the body and in Appendix D of the BRP Final Report were derived from the Bow River Operational Model (BROM). The BROM is a mass-balance model of the Bow River system; it models river flows and the changes resulting from demands, return flows and infrastructure operations over a 67-year historical record. The model is an interactive tool that enables collaborative development of scenarios and management options for the river. The BROM was developed by HydroLogics, Inc. for use during the BRP. Interpretation of the performance measures was provided by WaterSMART and HydroLogics, Inc.

3.2 Publications, Documents and Approach

Many publications and documents are available on water valuation and water management, and a great deal of documentation was reviewed to identify information that could effectively and practically be used to measure the incremental benefits of the Preferred Scenario. As appropriate, information and methodologies from relevant publications and documents were incorporated into the analysis completed for the Business Case.

Information to assist in measuring, quantifying and valuing the net incremental benefits of the Preferred Scenario was not as readily available or as applicable to the Business Case as had been originally expected. Attempting to quantify Preferred Scenario benefits using strictly economic values was a challenge, and using only this method of measuring the benefits proved to be restrictive and not an entirely practical approach. Consequently, the methods used to measure the benefits of the Preferred Scenario were broadened.

The incremental benefits of the Preferred Scenario were quantified where possible. Where verifiable quantification and/or economic measurement of incremental Preferred Scenario benefits were not possible with available information, other means of measuring these benefits were sought. These included relating Preferred Scenario benefits to studies, publications, and/or other documentation that, although not specifically linked to the Bow River Basin and the Preferred Scenario, were considered reasonably similar to one or a number of the Preferred Scenario outcomes and therefore relevant for comparative purposes.

3.3 Interviews, Correspondence, Discussion and Analysis

Meetings, interviews and email correspondence were undertaken with a number of individuals representing various organizations in Alberta that have an interest or stake in effective water management. Specific individuals were sought out for their expertise, affiliation with a particular group or, in some cases, as a result of an expressed interest in being part of this project.

These meetings, interviews and emails were intended mainly to obtain suggestions, advice and perspectives on what methods or means were available to objectively measure the benefits of the Preferred Scenario. Individuals were also asked to suggest publications and documents that might offer relevant and useful information applicable to the Business Case, and to provide general information on the topic of integrated water management.

Detailed discussion and analysis of the Preferred Scenario also took place with participants in the Bow River Phase of the SSRB Adaptation Project during three of their regularly scheduled meetings in June, September and October 2012. This group, many of whom had been involved in the BRP, offered informed and constructive feedback on the overall goals of the Business Case; the selection, quantification and measurement of Preferred Scenario benefits; and the methodologies used, assumptions made and conclusions drawn during the compilation of the Business Case. A BRP Business Case Team was also formed, consisting of members from this group. This Team provided valuable input and guidance on the overall direction of the Business Case and on various specific topics throughout the progress of the Business Case.[2]

Representatives of WaterSMART provided advice on the direction and analysis of Preferred Scenario benefits throughout the Business Case process.

Input from all of these sources was invaluable and resulted in data, reports and other facts being reviewed and questioned for appropriateness and rigor. In certain instances this input resulted in new considerations for, and realigned direction and focus of, the Business Case. Completion of the Business Case would not have been possible without this knowledgeable input and advice.

[2] Organizations whose representatives provided contributions to and/or feedback on the Business Case are noted in Appendix B.

4 Findings

The information in this section was derived using the methodology outlined in Section 3. Benefits can be valued in many different ways. In arriving at the Preferred Scenario, Bow River Project participants examined a number of methods. They eventually selected five approaches for identifying potential benefits that were considered to be most relevant to water users and managers in the basin, noting that these benefits are not necessarily additive.

The Business Case does not assume or suggest that the Preferred Scenario will address all environmental challenges or protect the entire Bow River system; it is one in a large set of tools. Further, it is likely there are trade-offs in implementing some of the Preferred Scenario recommendations; these would need to be carefully assessed and managed in the best interests of the whole system. Finally, in this analysis, it is not assumed that new water allocations would be available. Rather, existing allocations could be used more effectively without additional harm to the environment, due largely to enhanced flows during periods when otherwise low flows could reduce dissolved oxygen, inhibit fish spawning and impair other ecological functions.

The remainder of Section 4 describes the methods used to analyze each category of benefits. The findings are grouped into what were determined to be key quantifiable and qualitatively identifiable benefits of implementing the Preferred Scenario. This is not an exhaustive or all-inclusive list of the potential benefits; rather, it clarifies what are considered to be the more significant incremental benefits associated with the Preferred Scenario.

Analysis set out in this Business Case supports the findings that substantial incremental water management benefits can be attained by implementing the Preferred Scenario. Further analysis would strengthen the case for implementation but would not change the overall direction, tone or conclusions to be drawn from the Business Case.

Once the Preferred Scenario is implemented, the benefits noted in this Business Case would occur at and over different times depending, for example, on whether the components are implemented in stages, on changing circumstances surrounding water management and the Preferred Scenario, and on other unforeseen factors.

4.1 Fisheries and Business Gains from Stabilizing Lower Kananaskis Lake

<u>Finding:</u>
The estimated annual incremental economic benefits of stabilizing Lower Kananaskis Lake are \$2 million - \$3 million and the range of estimated net present value of those benefits is \$30 million - \$40 million.

<u>Support for the Finding:</u>
Stabilization of Lower Kananaskis Lake (LKL) at 1663.5 metres, 3.5 metres below the current 1667-metre full supply level, with a fluctuation of +/- 0.5 metres is a major benefit of the Preferred Scenario.

The estimated economic value of this incremental benefit, which includes the value of: i) expenditures directly attributable to sport fishing (food and lodging, transportation, fishing services); and ii) purchases and investments attributed to sport fishing (fishing and boating equipment, camping equipment, vehicles, land and buildings, and others) was determined as follows:

- The potential annual increase in number of Kananaskis angling days was estimated by extrapolating fishing pressure estimates from several creel surveys and assuming that a tripling of aquatic productivity would ultimately result in a tripling of fishing pressure.
- Estimates of the average value of an angling day in Alberta were obtained from Alberta Sustainable Resource Development's report, *Sport Fishing in Alberta 2010*.
- Estimates for one-time capital and annual operating and opportunity costs of stabilizing LKL were obtained from the March 2001 report of the Fisheries and Recreation Enhancement Working Group, *Kananaskis River System Assessment.*
- A range of possible incremental benefits was derived by assuming a lower range value between: i) a 25% increase in non-Alberta resident sport fishing (non-Alberta resident anglers make up less than 5% of the total angler population in Alberta) at LKL; and ii) an increase of 30,000 angling days in LKL, which is the high end of the value range being estimated.
- Based on these estimated increased revenues and related capital and operating and opportunity costs, the estimated incremental annual net benefits and net present value benefit over 20 years were calculated.

This estimate of economic benefits is considered to be a low range of the possible benefits to be derived from stabilizing LKL; although the net present value of estimated benefits is calculated over 20 years, the benefits of stabilizing LKL would certainly last much longer than 20 years.

Table 1 summarizes relevant data to support this finding, and the key assumptions appear below.

Table 1. Data Support for Stabilizing Lower Kananaskis Lake

Data	Explanation or Source
30,000 days	Potential annual increase in number of Kananaskis angling days extrapolated from fishing pressure estimates; assumes three times aquatic productivity results in three times fishing pressure
$137 - $273	Estimated value of an angling day; see *Sport Fishing in Alberta 2010*
$356,000	Estimated annual operating and opportunity costs; see *Kananaskis River System Assessment*
$500,000	One-time capital costs; see *Kananaskis River System Assessment*
$2 - $3 million	Potential annual benefit of increased angling, less operating costs, opportunity costs and year one capital costs based on a range of: i) an increase of 25% in sport fishing activities and related expenditures for non-Alberta residents; and ii) an increase in 30,000 angler days assuming an average dollar per angler day for Alberta residents
$30 - $40 million	Potential net present value (20 years @ 4%) of benefits, less annual operating, opportunity and one-time capital costs, assuming a five-year gradual ramp-up of benefits

Key assumptions:

- The Pocaterra power plant's operation will be altered to stabilize LKL;
- As noted in the March 2001 report by the Fisheries and Recreation Enhancement Working Group, a mid-range turbine installation at the Pocaterra plant is not required to stabilize LKL; and
- The increase in annual angling days and related value is due to new out-of-province anglers to LKL, additional Alberta anglers to LKL who previously fished out-of-province waters to obtain the quality fishing experience they desire, plus Alberta anglers who redirect their in-province fishing efforts to LKL because of the improved fishery.

Additional non-angling benefits to be gained from stabilizing LKL that are not reflected in the above calculations include:

- Re-establishment and protection of a world class fishery in LKL;
- Restoration of littoral and riparian zones, thus enhancing ecological functions and habitat for various aquatic and terrestrial species;
- Improved wildlife habitat for shorebirds, songbirds, raptors, swans, ducks, loons, threatened bull trout, and small and large terrestrial mammals;
- Improved opportunities for camping, adding to accommodation demand from skiers, anglers, and others in the spring and fall shoulder seasons;
- Intrinsic value of an improved environment around LKL; and
- Increased value of private property and commercial interests throughout the Kananaskis Valley.

There may be one-time and ongoing costs associated with initiatives such as improved opportunities for camping and other tourist activities. These costs could include, but are not limited to, shoreline reclamation costs and campground construction or expansion costs. Estimates for such costs were not obtained. However, including these costs is not expected to even begin to approach the substantial economic benefits to be gained from stabilizing LKL or affect the analysis of benefits to be gained by LKL stabilization.

4.2 Comparative Cost of 60,000 Acre-feet of Water

Finding:
The estimated cost of securing a comparative amount of water equivalent to that managed by the Water Bank has a net present value range of $41 million - $313 million.

Support for the Finding:
The intent of this approach is to find a comparative cost of accessing water in the Bow River Basin through arrangements other than the proposed Water Bank. It is difficult to assign a cost to water without considering factors such as the water's location, the parties involved, the use and user of the water (e.g., a municipality or irrigation district), timing of valuation, and many other factors. For purposes of arriving at a reasonable cost per acre-foot of water for the Business Case, recent water transactions in, and information from, the Southern Alberta region were used.

Various examples of one-time up-front acre-foot costs for water transactions were obtained through information available from the municipalities of Rocky View, Balzac, and Okotoks, and the Irrigation Districts. These transaction amounts were then applied against what was considered to be a reasonable estimate of the Water Bank's average annual water flow of 60,000 acre-feet.

Table 2 summarizes data used to support this finding.

Table 2. Data Support for the Cost of 60,000 Acre-feet of Water

Data	Explanation or Source
$2,500 - $7,500/ac-ft (one-time cost)	Rocky View/Balzac arrangement regarding upgrading infrastructure
$5000/ac-ft (one-time cost)	Public transaction, Okotoks
$2,000 - $5,000/ac-ft (one-time cost)	Informal estimate, Government of Alberta
$550 - $1,250/ac-ft (one-time cost) $10 - $16/ac-ft (annual cost)	Irrigation Districts' estimates Annual fee applicable to Irrigation Districts
60,000 ac-ft	Assumed average annual water flow from Water Bank
$550 - $5,000/ac-ft	Estimate of cost range for an acre-foot of water
$33 - $300 million $8- $13 million	One-time up-front cost range based on 60,000 ac-ft of water with an estimated cost of $550 - $5,000 per ac-ft Net present value of annual fee applicable to Irrigation Districts (20 years @ 4%) based on 60,000 ac-ft of water with an estimated annual cost of $10 - $16/ac-ft

Key Assumptions:

It is assumed that the estimates obtained for the cost of an acre-foot of water and the estimated annual water flow from the Water Bank can be relied upon to provide a reasonable indication of the annual cost of water managed by the Water Bank.

This analysis does not in any way imply that the Preferred Scenario creates new water or the potential for new water allocations. It is also understood that the Water Bank will supplement existing water use when water is in short supply.

Costs of operating the Water Bank have not been determined. It was assumed that existing information and data are sufficient to facilitate the management of Water Bank operations, and that a formal or informal body could advise the Government of Alberta water manager on specific use of the Water Bank flows. The water manager in turn would instruct TransAlta on release of enhanced flows from the Water Bank and support the accounting mechanism for monitoring such releases.

4.3 Avoided Cost of Building Equivalent Water Storage

Finding:
The estimated avoided cost of building equivalent water storage is $51 million - $148 million.

Support for the Finding:
The Preferred Scenario's Water Bank approach of achieving integrated water management for the Bow River system provides approximately 60,000 ac-ft of water storage in the TransAlta reservoir system, as well as about 10% of the natural inflows to that system. One measure of costs avoided by using this integrated water management approach is to determine costs that would be incurred to enable the storage of an equivalent amount of water.

The costs of constructing the following reservoirs were derived from available information:

- Oldman
- Pine Coulee
- Twin Valley

An equivalent cost per acre-foot was then determined for each reservoir and applied against the 60,000 ac-ft capacity of the Water Bank. This method provided an estimate of the avoided cost of building equivalent water storage by using the Water Bank approach instead.

A significant value of having storage in the headwaters rather than downstream is that the water can then be used for many additional and beneficial purposes. Not included in the avoided cost of building equivalent water storage are the maintenance and repair costs that would be incurred by the operators of these facilities over the life of the reservoir. These costs would not be expected to affect the overall direction of this finding. Site-specific costs such as roads, relocation and land, which are included in the total costs noted in Table 3, vary across reservoir sites and can account for a significant portion of the overall cost.

Table 3 summarizes data used to support this finding.

Table 3. Data Support for the Avoided Cost of Building Equivalent Water Storage

Data	Explanation or Source
$990 million (~401,304 ac-ft[1])	Oldman – total cost[2]
Est. cost: $2,467/ac-ft	
$50.6 million (~41,022 ac-ft[1])	Pine Coulee - total cost[2]
Est. cost: $1,233/ac-ft	
$42.5 million (~49,210 ac-ft[1])	Twin Valley – total cost[2]
Est. cost: $863/ac-ft	
$863 - $2,467 per ac-ft	Estimated range of costs per acre-foot of water storage
$51 million - $148 million	Estimated range of costs for a 60,000 ac-ft off-stream reservoir

[1] at full capacity [2] Source: Alberta Environment and Sustainable Resource Development

Key Assumptions:
It is assumed that the estimated costs of the reservoirs noted above are reasonably accurate, and that this method is a reasonable method to estimate costs avoided by using the Water Bank approach to managing the Bow River system in an integrated manner.

4.4 Intrinsic Value of Improved Environment

Finding:

Overall improvement to the environment is one of the broadly appreciated benefits attributable to the Preferred Scenario, but one of the most difficult to measure. These benefits would accrue primarily in the Kananaskis region but also downstream, including the reach from Calgary to Bassano and beyond to the Bow's confluence with the Oldman River.

Support for the Finding:

The concept of "intrinsic value" can mean different things in different contexts. For example, in the field of environmental ethics, it refers to the subjective appreciation of the environment as interpreted by an individual.[3] This might occur as a result of cultural associations and recreational opportunities, as well as an appreciation of nature in general. In a financial context, "intrinsic value" is described as the difference between the price of something and its subjective worth, but this can often be very difficult to quantify in a meaningful way.

Despite the quantification challenges, society undoubtedly benefits from having access to healthy aquatic and riparian environments, which, along with other direct and indirect benefits, is an expected outcome of implementing the Preferred Scenario.

Implementing the Preferred Scenario is expected to increase the future value of the environment in the affected areas. Improving current environmental conditions increases the likelihood that future generations will be able to enjoy the region's lakes and rivers and the services and amenities they provide. Ecosystem functions would also be enhanced by, for example, supplementing flows and stabilizing Lower Kananaskis Lake. Some of these functions include ecosystem regulation, assimilation of organic and inorganic wastes, improved fish habitat, and enhanced recreation opportunities. The Preferred Scenario also offers intrinsic value by creating benefit for some specific areas (e.g., Lower Kananaskis Lake, the Bow River from Calgary to the confluence with the Oldman) without diminishing the value of other areas or functions.

To attempt to quantify intrinsic value, analysts often turn to the "willingness-to-pay" method. While this method of attaching price to value may have methodological concerns, it can illustrate how value, cost and price interact in environmental considerations. Examples of how others have valued the environment by a willingness to pay when making decisions about water management are shown in Table 4.

[3] Ronald Sandler. 2012. "Intrinsic Value, Ecology, and Conservation," *Nature Education Knowledge* 3(3):4

Table 4. Data Support Related to the Intrinsic Value of Improved Environment

Data	Explanation or Source
20% increase in price paid for real estate	Lots that are treed or are riparian lots with treed buffers command higher prices than those without trees or riparian proximity. This suggests that environmental improvements contribute to the potential price for real estate. (National Association of Home Builders cited in “Stepping Back from the Water”)
$600,000 for stream-side park	In Johnson County, Kansas, citizens voted in favour of developing a stream-side park over a $1.2 million stream control development. This suggests that citizens may value riparian access and recreational opportunities over infrastructure development.
$1.5 billion	New York City taxpayers spent this amount to support the protection of 80,000 acres in an upstate watershed.
$16 million	This is the estimated dollar value that can be attributed to the 70% of Calgary homes that use the Bow River and related water bodies for recreational purposes. This suggests there are peripheral and substantial benefits to having access to healthy aquatic and riparian areas.
$131 million	In Edmonton, studies demonstrate that proximity to riparian areas added this monetary value to associated real estate.
$300-$600 million/annum	It is estimated that the North Saskatchewan River Valley generates this amount in economic, social and environmental benefits.

*All data in this table are from Government of Alberta, 2012. *Stepping Back from the Water: A Beneficial Management Practices Guide for New Developments near Water Bodies in Alberta’s Settled Region.*

While these data might not be completely aligned with the benefits of the Preferred Scenario, the willingness-to-pay method shows the considerable potential value attached to environmental improvements.

4.5 Reliable Water Supply for Economic Growth

Finding:

In addition to the aforementioned findings and benefits, the Preferred Scenario also supports the *Water for Life* goal of providing reliable, quality water supplies for a sustainable economy.

Support for Finding:

Implementing the Preferred Scenario would assure minimum flows (1,250 cfs) through Calgary under the maximum future water demands forecast by municipalities around the City for the next 35 years. These assured minimum flows would, in turn, improve security of water quality standards, fisheries protection, and enhanced flows between Calgary and the Bassano dam and in other reaches.

As well, the proposed Water Bank would be expected to mitigate the consequences of the potential risk that estimates or assumptions about future water requirements and availability are not entirely accurate. In this respect, implementing the Preferred Scenario’s Water Bank approach to integrated water management would:

- Reduce the risk of not being able to meet future water demands for short periods;

- Reduce the risk of environmental impacts attributable to population and economic growth;
- Mitigate these potential risks under some conditions without additional environmental harm due to low flows; and
- Improve government and societal adaptive capacity to manage whatever changes to water availability that weather patterns and climate variability may bring to this watershed.

Finally, the Preferred Scenario assumed that junior licences in the basin would always be met and not shorted, demonstrating the ability of all licence holders in the basin to cooperate in times of short supply. This approach enables junior licences – in particular, licences for livestock, municipal and other human uses – to be used year-round, even under low-flow periods. While this is typically the practice in the basin today, the Preferred Scenario is beneficial in ensuring this approach is continued in the future.

Costs associated with implementing the Preferred Scenario and achieving integrated water management of the Bow River system would include the cost of operating the Water Bank. These costs have not yet been determined but were described earlier.

The five categories of benefits described in Section 4 capture most of the benefits attributable to the Preferred Scenario. The full array of benefits, as noted in the original Bow River Report, appears in Appendix C.

5 Conclusions

This Business Case demonstrates the type and magnitude of benefits associated with the Preferred Scenario, based on reasonable and transparent assumptions. This Business Case did not assess the impact(s) of potential climate change on the Base Case or on the benefits attributed to the Preferred Scenario.

In summary, the benefits of implementing the Preferred Scenario, as identified in this Business Case, are:

> The estimated annual incremental economic benefits of stabilizing Lower Kananaskis Lake are significant at $2 million - $3 million with an estimated net present value range of $30 million - $40 million. Furthermore, these estimates are considered to be a low range of the possible benefits to be derived from stabilizing Lower Kananaskis Lake and did not include additional non-angling benefits such as re-establishment and protection of a world class fishery in Lower Kananaskis Lake, improved wildlife habitat, improved opportunities for camping and other accommodations, or potential enhanced commercial and recreational kayaking and rafting below Barrier Lake.

> The estimated cost of securing a comparative amount of water equivalent to that managed by the Water Bank has a net present value range of

$41 million - $313 million. Although it is difficult to place a cost on water without considering many factors (e.g., application, the water user, timing of valuation), this estimate is considered to be a reasonable approximation of that comparative cost. This analysis is not meant to imply that the Preferred Scenario creates additional water or new water allocations, but rather that it enables these allocations to be used more effectively without undue environmental harm.

The estimated avoided cost of building water storage equivalent to that managed by the Water Bank is $51 million - $148 million. The Water Bank approach of achieving integrated water management for the Bow River system provides for the management of 60,000 acre-feet of water without this cost.

An intuitively obvious benefit of the Preferred Scenario is the overall improvement to the environment. The Preferred Scenario offers an increase in the environment's future value and, by improving environmental conditions now, increases the likelihood that future generations will be able to enjoy the lakes and rivers that the scenario serves.

The Preferred Scenario supports the *Water for Life* goal of providing a reliable, quality water supply for a sustainable economy. This includes assurance of minimum flows (1,250 cfs) through Calgary under the maximum forecast future water demands by municipalities for the next 35 years. These assured minimum flows will improve security of water quality standards, fisheries protection, and enhanced flows between Calgary and the Bassano dam and in other reaches.

The Preferred Scenario using the Water Bank approach to integrated water management will help mitigate risks associated with possible inaccuracies in estimates or assumptions about water requirements and availability such as not being able to meet future water demands for short periods and environmental impacts attributable to population and economic growth. The Preferred Scenario's Water Bank approach to integrated water management also has the potential to ensure the year-round availability of water to meet the needs of junior licensees in the basin.

Costs associated with implementing the Preferred Scenario and obtaining certain of the benefits noted above would include the costs of operating the Water Bank. These costs have not yet been determined.

This Business Case has clearly and succinctly presented what are considered to be the major benefits of implementing the Preferred Scenario, quantifying some of these benefits and convincingly describing benefits that are more qualitative in nature. The conclusion of this analysis is that it is in the best interest of water users in the Bow River Basin to implement the Preferred Scenario described in the BRP Final Report.

Bibliography

Alberta Society for Sustainable Water Management and Related Technologies (Alberta WaterSMART). 2010. *Water Management in Southern Alberta: Key Opportunities for Water Storage, Allocation, Flood and Drought Management,* http://www.ww7b.org/userfile/file/water%20management-southern%20alberta.pdf

Alberta Sustainable Resource Development, Fisheries Management Branch. March 2012. *Sport Fishing in Alberta 2010.*

Alberta WaterSMART. 2010. *Water Management in Southern Alberta: Key Opportunities for Water Storage, Allocation, Flood and Drought Management.*

Aquality Environmental Consulting Ltd. 2010. *Valuation of the Kananaskis River Water Management Strategy.*

Bow River Project Research Consortium. 2010. *Bow River Project Final Report,* www.albertawater.com/index.php/projects-research/bow-river-project

Bow River Project Research Consortium. 2010. *Bow River Project Summary Report.*

Calgary Regional Partnership. March 2009. *Regional Water Storage Project Business Case (Draft).*

Colby, B.G. 1989. "Estimating the Value of Water in Alternative Uses," in *Natural Resources Journal* **29**:511.

Collins, A.A. and T.M. Horbulyk. 2008. "The Potential and Promise of Water Pricing," *Journal of International Affairs*, **61**(2).

DeGroot, R.S. 1994. "Environmental Functions and the Economic Value of Natural Ecosystems," in *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*, AnnMari Jansson *et al*. Washington: Island Press.

Fisheries and Recreation Enhancement Working Group (FREWG). March 2001. *Kananaskis River System Assessment.*

Government of Alberta. 2012. *Stepping Back from the Water: A Beneficial Management Practices Guide for New Developments near Water Bodies in Alberta's Settled Region,* http://environment.gov.ab.ca/info/library/8554.pdf

Green, C. 2003. *Handbook of Water Economics: Principles and Practice.* John Wiley and Sons Ltd.: Sussex.

Lutzig, P. and B. Schwab. 1977. *Managerial Finance in a Canadian Setting.* Butterworth & Co. (Canada) Ltd.

Renzetti, S., D.P. Dupont, and C. Wood. 2011. "Running through Our Fingers: How Canada fails to capture the value of its top asset," http://www.blue-economy.ca/report/running-through-our-fingers-0

Sandler, R. 2012. "Intrinsic Value, Ecology, and Conservation" *Nature Education Knowledge,* Volume 3, Issue 10:4, http://www.nature.com/scitable/knowledge/library/intrinsic-value-ecology-and-conservation-25815400

Winpenny, J.T. 1994. *Managing Water as an Economic Resource*. Routledge: New York

World Business Council for Sustainable Development. "Water Valuation: Building the Business Case," p.14, http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15099&NoSearchContextKey=true. Accessed: 12 November 2012

Glossary

Base Case ~ The Base Case is used to indicate no change from the current Bow River Basin water management methods and capabilities.

Cost ~ For the purpose of this Business Case, *cost* generally "incorporates the procurement price and includes water-related operating costs such as: treatment, mitigation of water pollution, expansion of available water supplies, [and] charges imposed by suppliers."[4] This broad scope is occasionally reduced to refer more specifically to infrastructure-related capital costs.

Preferred Scenario ~ Scenario 3 in the *Bow River Project Final Report*, which sees the stabilization of Lower Kananaskis Lake and Kananaskis River, and a Water Bank of 60,000 ac-ft.

Price ~ Price figures attached to water do not always reflect its value. For example, the cost of 60,000 acre-feet of water represents the *price* or the amount paid for that water and does not include calculations around the value of the end product or use (e.g., water used for sanitation vs. water used to irrigate crops).

Value ~ This Business Case assumes a holistic interpretation of value that considers environmental, economic, social, and cultural perspectives on worth.

[4] World Business Council for Sustainable Development, "Water Valuation: Building the Business Case." http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15099&NoSearchContextKey=true [Accessed: 12 November 2012]: 14.

Appendix A: SSRB Adaptation Project Introduction Memo

South Saskatchewan River Basin Adaptation to Climate Variability Project
May 2012

A new project being launched this spring will harness the energy and creativity of southern Albertans to explore practical options for adapting to climate variability and change. Water is fundamental to community sustainability and growth, and the way water is managed in the South Saskatchewan River Basin (SSRB) will become even more important in the face of changing weather patterns and climate.

In January 2012, the Climate Change Emissions Management Corporation awarded funding for the *SSRB Adaptation to Climate Variability Project*. The funds were provided to Alberta Innovates-Energy Environment Solutions and WaterSMART Solutions Ltd. to support the first stage of this adaptation work.

This initiative will build on and integrate existing data, tools, capacity and knowledge of water users and decision makers to improve understanding and explore how to manage for the range of potential impacts of climate variability throughout the SSRB's river systems. This understanding will support collaborative testing and development of practical and implementable adaptive responses to climate variability, from the local community scale to the provincial scale. Using existing analytical and decision-support tools, the project will engage many people and groups to build:

- a common understanding of feasible and practical mechanisms for adapting to climate variability and change, and
- increased capacity for an informed, collaborative and adaptive approach to water resource management throughout the SSRB. This will enable organizations, communities and individuals to assess their risks in near real-time and determine their most suitable responses to climate variability within the physical realities of SSRB river flows, requirements and infrastructure.

The first stage of the project is divided into four coordinated phase:

Foundational Blocks: Initial Assessment

The first phase of the work is an initial assessment of the data, tools, capabilities, processes and frameworks that already exist and could form elements of the foundational blocks to support integrated water management by water users, decision makers and other interested parties over the long term. This work will identify the core resources for the project, identify critical gaps to be addressed, and ensure existing knowledge, tools, and experiences are leveraged, while avoiding duplication of work already completed or underway.

Bow River Basin: Adaptation and Live Test Year

The second phase will re-engage Bow River Project participants and engage new participants with an interest in the Bow River Basin to: advance climate adaptation decision making related to water resources, explore climate variability scenarios, identify impacts and risks to the river system and its users, and identify adaptation options. Participants will also document the net benefits of re-managing flows in the Bow River and identify infrastructure options that could assist with adaptation strategies. All of this work will provide support for a 'virtual' river test year, or perhaps an actual test year of modified flow, to better match the three Water for Life goals

Oldman River Basin and South Saskatchewan River Modelling

In the third phase, participants will model the Oldman River Basin (Oldman River and Southern Tributaries, including the Belly, St. Mary and Waterton Rivers), and the South Saskatchewan River to the Alberta border. Users, decision makers and others in the Oldman and South Saskatchewan River (OSSK) Basins will form a river consortium and set principles to guide and inform the model-based work, incorporating an environmental and climate adaptation focus. A comprehensive river system model for the OSSK Basins will be developed. Inputs to the SSRB from the Milk River will be part of this data, but the Milk will not be explicitly modelled. Throughout the model building, participants will discuss work that has been or is being done, and possible next steps in building the capability and capacity for adaptation around river management in the SSRB.

Foundational Blocks: Development

The final phase will see development of new adaptation foundational blocks. This work will be based on the gaps identified in the initial assessment, which may include acquiring, updating, or purchasing useful data and tools for future work to develop adaptation options for integrated river management.

This project will take approximately two years to complete. It should significantly advance climate adaptation resilience in the SSRB, leave a legacy of data, information and tools, and inform similar future work throughout the rest of the SSRB. We hope, with subsequent support, to then expand the work to encourage climate adaptation throughout the entire SSRB.

Project updates and reports can be accessed through the Alberta WaterPortal at: www.albertawater.com

If you have any specific questions regarding this work, please contact AI-EES or WaterSMART Solutions Ltd.

Appendix B: Contributions and Input to the Business Case

Numerous individuals contributed their expertise and feedback as this Business Case was being developed. These contributions came through individual discussions on specific aspects of the Business Case, comments provided at three SSRB project meetings where the Business Case was discussed, comments provided by the BRP Business Case Team, and comments provided by Alberta WaterSMART. Representatives from the following agencies and organizations are thanked for their input:

Alberta Agriculture and Rural Development
Alberta Environment and Sustainable Resource Development
Alberta Innovates – Energy and Environment Solutions
Alberta Tourism, Parks and Recreation
Alberta WaterSMART Solutions
Alberta Whitewater Association
Alberta Wilderness Association
BRBC Bow River Basin Council
Bow River Irrigation District
Calgary Regional Partnership
City of Calgary
Eastern Irrigation District
Kananaskis Improvement District
Municipal District of Bighorn
Municipal District of Rocky View
Sheep/Highwood PAC
SEAWA South East Alberta Watershed Alliance
TransAlta Corporation
Trout Unlimited Canada
Western Irrigation District

Appendix C: Benefits and Costs Balance Sheet for the Preferred Scenario

BENEFITS of Preferred Scenario over Base Case	**COSTS** of Preferred Scenario over Base Case
DIRECT BENEFITS: • Greater achievement of WCOs below Bassano and along the Bow River • Protected Calgary flow levels ensure water quality standards and protect fisheries • Aquatic health and fisheries improvements in Lower Kananaskis Lake and Kananaskis River • Opportunity to monetize significant fish habitat offsets in Kananaskis • Enhanced recreation and tourism, specifically in the Kananaskis region but also throughout the Bow Basin. • Adequate, quality raw water supply for growing population demands in Calgary and region • Improved alignment of irrigation needs, environmental values and upstream users • Potential to explore and implement further flood and drought mitigation options AVOIDED COSTS: • Reduced infrastructure damage from ice dams in parks and municipalities • Reduced damage from flood events • Reduced damage from drought events • Reduced need for high-cost new reservoirs	CAPITAL COSTS: • Replacement of Pocaterra turbine to accommodate steadied flows into Kananaskis River: preliminary estimate of $5-6 million based on 1998 estimate for Ghost Unit #1 replacement (FREWG) • Option for consideration: Restoration of Spray Lakes Reservoir to original full supply level, adding 75,200 dam^3 (61,000 acre feet); preliminary estimates range from $20-100 million • Other costs may be identified OPERATING COSTS: • Compensation for lost TransAlta revenue: preliminary estimate from BROM suggests lost revenue from power generation would be $2-$2.5 million. • Other costs may be identified

Source: The Bow River Project Research Consortium. 2010. Bow River Project Final Report.