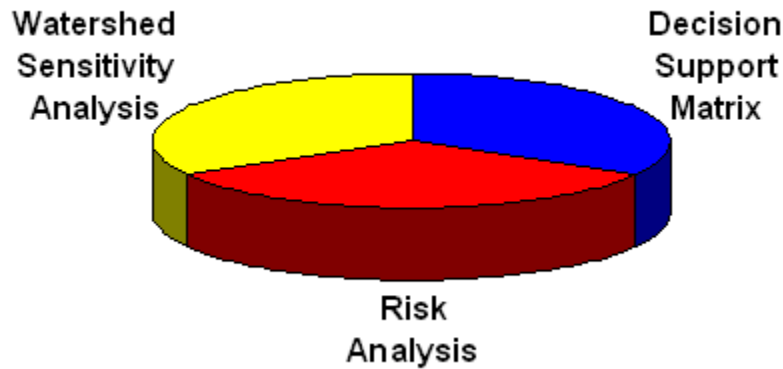




Future Planning Priorities for the Bow River Basin Council



Prepared by the
Bow River Basin Council
Strategic Watershed
Assessment Team

May 6, 2009

EXECUTIVE SUMMARY:

- ❑ The Bow River Basin Council (BRBC) is a multi-stakeholder, charitable organization dedicated to conducting activities for the improvement and protection of the waters of the Bow River Basin.
- ❑ The Strategic Watershed Assessment Team (SWAT) is a BRBC project team that was formed in late 2007 to provide long-term planning direction and advice to the BRBC Board of Directors (BOD). Using the Bow River Basin Council's 1) Decision Support Matrix and 2) Risk Analysis combined with Alberta Environment's 3) Watershed Sensitivity Analysis, the following planning priorities were identified for the years 2010 – 2016.

<u>Phase</u>	<u>Primary Focus</u>	<u>Details</u>	<u>Includes</u>	<u>Start</u>	<u>Finish</u>
One	Surface Water Quality	Water quality objectives and recommendations were developed for key rivers and/or reaches.	Completed. Released in September 2008. Currently being implemented.	September 2006	August 2009
On-Line State of Watershed	On-Line State of Watershed Report and Summary Booklet	As part of an adaptive management cycle, indicators and thresholds will be used to monitor the state of the watershed.	<input type="checkbox"/> Will build on existing information in the 2005 BRBC State of the Basin Report. <input type="checkbox"/> Once the base website is completed, ongoing maintenance will be required to keep the information current. <input type="checkbox"/> Summary booklets to be developed every second year or so.	May 2009	August 2010
Two	Land Use within the Entire Bow Basin, Headwaters, Wetlands and Riparian Areas	Key areas for consideration include irreversible changes to land use and loss of sensitive and/or important areas.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2010	August 2012
Three	Surface and Groundwater Quantity	Key areas for consideration include unacceptable water deficits, potential impacts from climate change, and low and high flow events.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2012	August 2014
Four	Surface Water Quality Revisited and Groundwater Quality	Will expand on the water quality objectives and recommendations developed in Phase One, and will also include groundwater quality.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2014	August 2016

Level of Effort	Pre or Post Project Phase or Continuous Effort (20% Effort)	Project Phase (80% Effort)	Implementation Phase (40% Effort)
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<u>Primary Focus</u>	<u>2009¹</u>	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>
On-Line State of Watershed Report and Summary Booklet							
Phase Two: Land Use within the Entire Bow Basin, Headwaters, Wetlands & Riparian Areas							
Phase Three: Surface and Groundwater Quantity							
Phase Four: Surface Water Quality Revisited and Groundwater Quality							

¹ All years shown are for the period from September 1 of the noted year to August 31 of the following year.

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OVERVIEW:

- ❑ The Bow River Basin Council (BRBC) is a multi-stakeholder, charitable organization dedicated to conducting activities for the improvement and protection of the waters of the Bow River Basin.
- ❑ The Strategic Watershed Assessment Team (SWAT) is a BRBC project team that was formed in late 2007 to provide long-term planning direction and advice to the BRBC Board of Directors (BOD).
- ❑ This project was initiated in two phases.
 - Phase One (completed in August 2008) identified potential planning priorities and methodologies for prioritizing the planning priorities.
 - Phase Two (completed in April 2009) applied the methodologies and developed a “road-map” providing long-term planning direction and advice to the BRBC BOD.

ACKNOWLEDGEMENTS:

- ❑ Over the duration of this project, SWAT members graciously committed several hundred hours to the process of building team capacity, sharing complex concepts, attending meetings and workshops, and creating the final report.

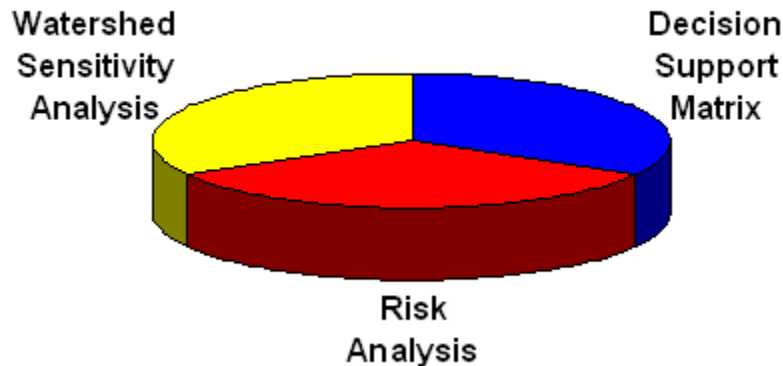
Danielle Droitsch (Phase One Co-Chair)	Heather Sinton (Phase One Co-Chair)	Lisa Fox (Phase One Coordinator & Co-Chair)
Rob Wolfe (Phase Two Coordinator & Chair)	Mark Bennett (Phase One & Two)	Kylana Rogers-Hambling (Phase One)
Meghan Beveridge (Phase One & Two)	Karen Natsukoshi (Phase One)	Rick Blackwood (Phase One)
Alan Pentney (Phase one & Two)	Jerry Hall (Phase One)	Heinz Unger (Phase One & Two)
Sheikh Ahmed (Phase One)	Catherine Shrier (Phase One)	Steve Meadows (Phase One & Two)
Hugh Pepper (Phase One & Two)	Tracy Scott (Phase One & Two)	Shirley Pickering (Phase Two)
Jon Fennell (Phase One & Two)	Brian Meagher (Phase Two)	Yin Deong (Phase Two)
Tim Dietzler (Phase Two)	Axel Anderson (Phase Two)	

- ❑ SWAT would also like to thank the following individuals for their support and contributions.

Dave Ardell	Alan Pryor	Norm Carlson
Cathy Ryan	Masaki Hyashi	Marilea Pattison-Perry
Francine Forrest	Gloria Wilkinson	Hans Schreier
Mary Metz	Jennifer Martin	Brian Hills

DECISION SUPPORT TOOLS AND PROCESS:

- ❑ Three decision support tools were used. These included:



	<u>Decision Support Matrix</u>	<u>Risk Analysis</u>	<u>Watershed Sensitivity, Values and Indicators Summary</u>
Overview	Thirteen potential planning priorities were determined. For each potential planning priority, respondents were asked to comment on five questions. Each questions was ranked on a scale from strongly disagree, to disagree, to neutral, to agree, to strongly agree. Each question was given a pre-determined weighting with higher priority questions given a higher weighting. When determining the potential planning priorities, water conservation, stewardship and water infrastructure management were discussed as tools that could be used to achieve desired goals.	Fourteen potential planning priorities were determined (source drinking water was added). For each of the fourteen potential planning aspects, the following two questions were asked: 1) For the specific potential planning aspect, if no action is taken within 2-5 years, the level of potential impact (environmental, social & economic) is insignificant, minor, significant, major, or catastrophic. 2) For the specific potential planning aspect, if no action is taken within 2-5 years, the likelihood of the aforementioned impact occurring is rare, unlikely, possible, likely, or almost certain.	A Geographic Information System (GIS) based analysis was developed for the Bow River sub-basin and selected sub-watersheds as an Alberta Environment pilot project to try and develop decision-support tools that can assist Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups (WSGs) to understand their watersheds and identify planning priorities. Further work is still required to review the analysis work done, refine some of the datasets used and consider some different or additional parameters that should be included.
Sample	Sample Question for Biodiversity. For the potential planning priority, I believe the potential benefit is high. Weighting: This question was given a 40% weighting.	Sample Risk Statement for Biodiversity: Loss of terrestrial biodiversity and richness. Weighting: All risk statements were given an equal weighting.	Sample GIS Layer: All groundwater layers. Weighting: All groundwater layers were given equal weighting.
Methodology	A web-based survey was administered between December 8 – 18, 2008 using Zoomerang (web-based survey software). SWAT developed the detailed questions and potential planning priorities. Azina Kanji (AENV) provided the technical expertise for the survey. BRBC BOD and SWAT were given the opportunity to revisit responses with high levels of deviation on January 15, 2009 but elected to keep the results “as is” (believing that the high level of deviation was a result of lack of knowledge for these particular planning priorities).	A full-day workshop (with all BRBC Board of Directors and all SWAT members) was held on January 15, 2009. Mary Metz (AENV) and Jennifer Martin (AENV) facilitated the workshop using Sharpe Decisions software to conduct the risk analysis.	The Watershed Sensitivity Analysis was developed by Brian Hills (AENV) in conjunction with Nivea de Olivea (AENV) and Don Page (AENV). The first draft was completed on April 14, 2009 with further refinement to follow by May 2009.
Suggestions for Improvement	If this method were to be re-utilized or duplicated, the following changes are suggested: <ul style="list-style-type: none"> <input type="checkbox"/> Given that all of the topics are important to some degree, a wider range of responses may have been achieved by encouraging voters to vote strongly for those areas they feel are the highest priorities. The lowest to highest range in our results was not as varied as the committee anticipated. 	If this method were to be re-utilized or duplicated, the following changes are suggested: <ul style="list-style-type: none"> <input type="checkbox"/> Enhanced discussion would have been beneficial for the following statement “if no action is taken within 2 – 5 years”, particularly with regard to “who” needs to take the action. <input type="checkbox"/> When voting, all “likelihood” statements should have been completed first, followed by all “impact” statements. The alternating method employed may have resulted in similar numbers for both categories. 	If this method were to be re-utilized or duplicated, the following changes are suggested: <ul style="list-style-type: none"> <input type="checkbox"/> Future work should include mapping of wetlands and lakes. It was not done for this project because there was not a good dataset for the entire Bow sub-basin of recent vintage. A ranking system would also need to be developed. <input type="checkbox"/> An alternative for the Code of Practice stream classification used should be explored with Sustainable Resource Development fisheries biologists using data from their Fish and Wildlife Information System

	Decision Support Matrix	Risk Analysis	Watershed Sensitivity, Values and Indicators Summary
			(FWMIS), particularly for more detailed reviews of tributary watersheds. <input type="checkbox"/> Further investigation should be done on the methodology used to define the sensitive zone around a municipal surface water intake. <input type="checkbox"/> Different ranking schemes, perhaps exploring weighting some layers higher than others should be explored.
More Information	Appendix C	Appendix D	Appendix E

- In order to evaluate planning priorities, an understanding of current and proposed planning processes is required. A table highlighting current and proposed planning processes is included in Appendix A.

RESULTS:

1. Risk Analysis Potential Actions

- The following table shows potential actions that can be undertaken depending on if the risks are identified as critical, high, moderate or low.

	<u>Potential Actions</u>
Critical	Immediate action required with a detailed plan
High	Specified and appropriate actions need to be taken
Moderate	Manage by specific monitoring or response procedures
Low	Manage by routine procedures

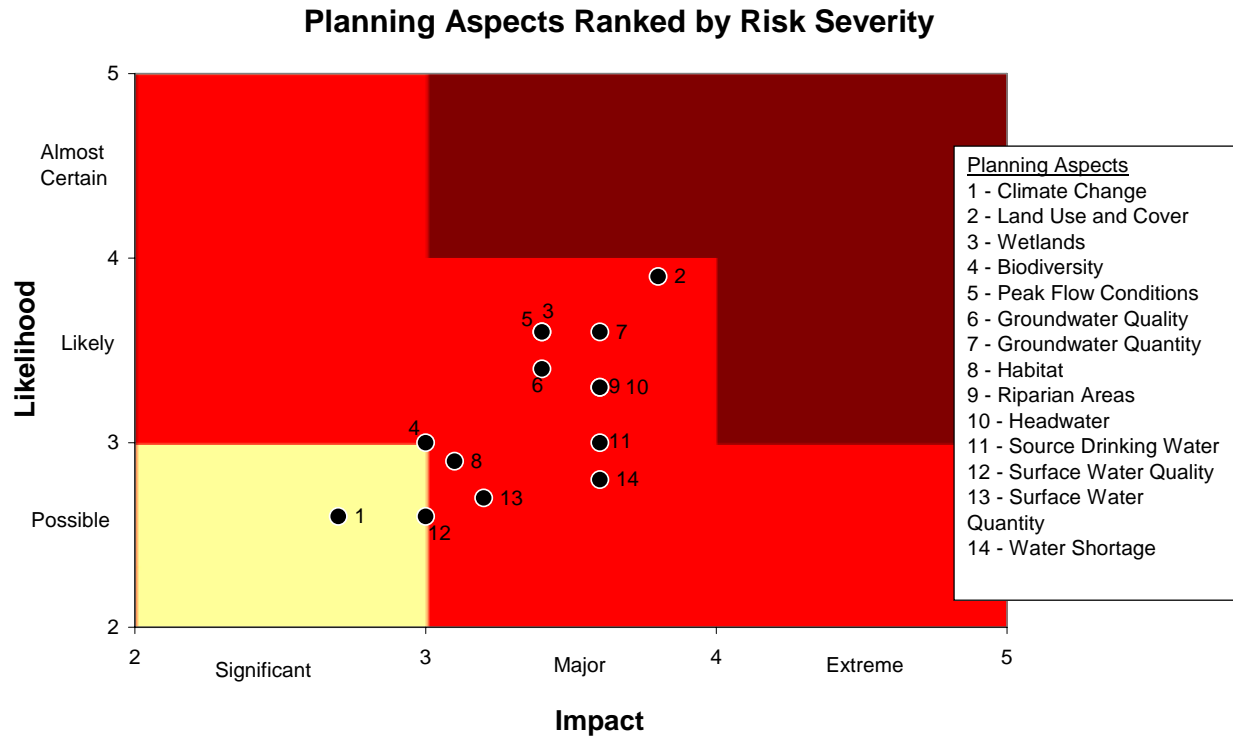
2. Risk Analysis Table

- The following table provides a sample of the risk analysis categories as defined by the likelihood and impact. The risk categories include low (L), medium (M), high (H) and critical (C).

Likelihood	Almost Certain (5)	M Monitor cumulative effects	M	H	C	C
	Likely (4)	L	M	H	H	C
	Possible (3)	L	M	M	H	H
	Unlikely (2)	L	L	M	M	H
	Remote (1)	L	L	L	M	H Requires contingencies
		Insignificant (1)	Minor (2)	Significant (3)	Major (4)	Extreme (5)
Impact						

3. Planning Aspects Ranked by Risk Severity

- The following diagram shows the various planning aspects ranked by risk severity (as identified during the risk analysis workshop).



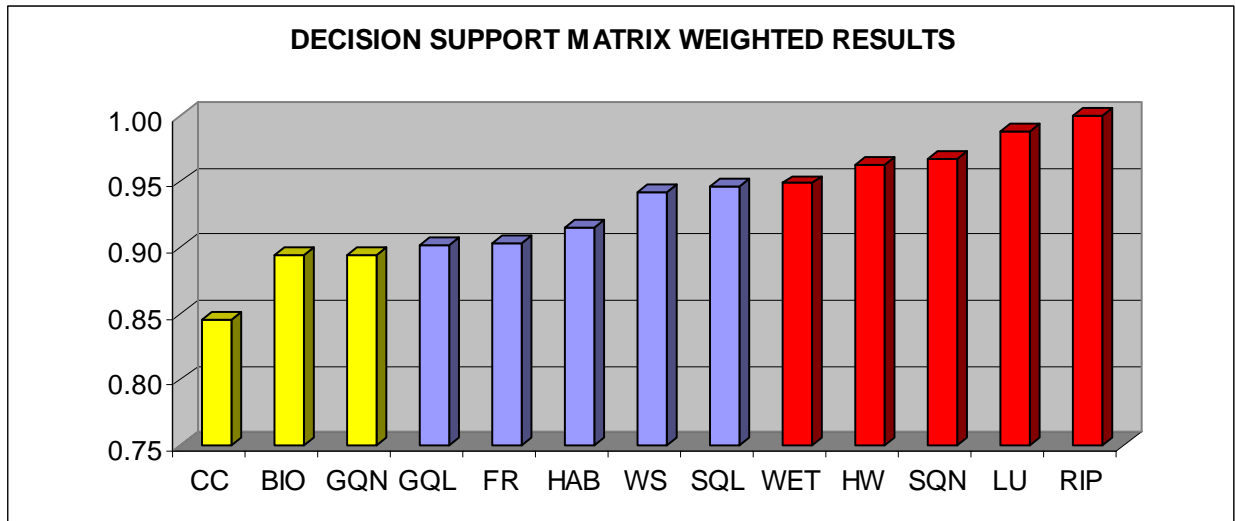
4. Risk Statements Identified as Critical

- The following two statements were identified as “critical” during the risk analysis workshop.

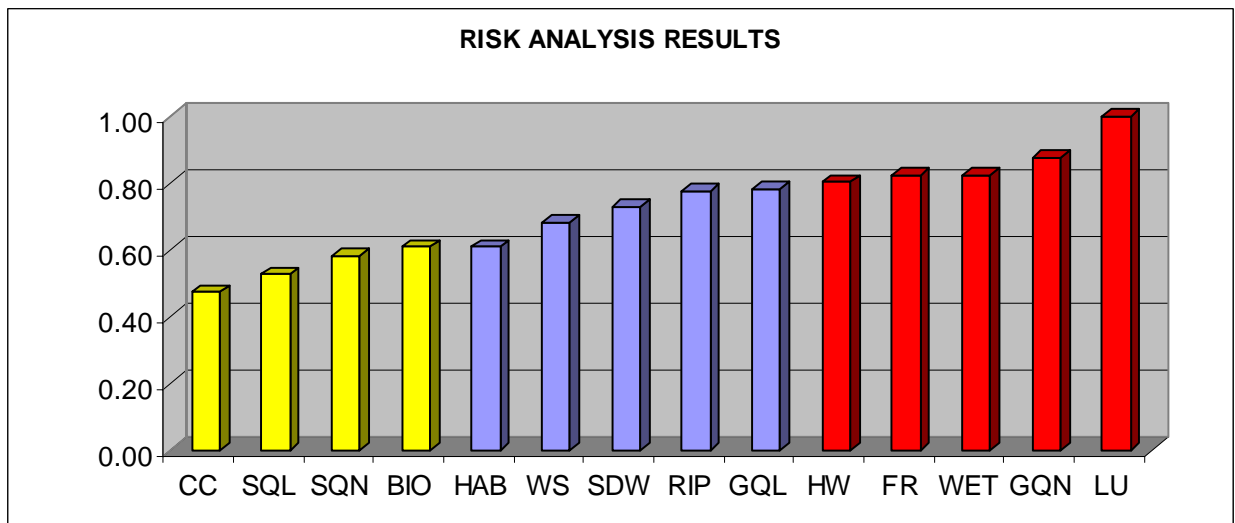
Risk Statements Identified as Critical	
Land use - Irreversible changes to land use (and resulting impacts to water quantity and quality).	Land use - Loss of sensitive and/or important areas (due to lack of information, poor land use planning or unanticipated cumulative effects).

5. Decision Support Matrix, Risk Analysis and Combined Results

- The following two diagrams show the results from the 1) decision support matrix and 2) risk analysis workshop.



Note: Red = Top Five, Blue = Next Five, Yellow = Remainder

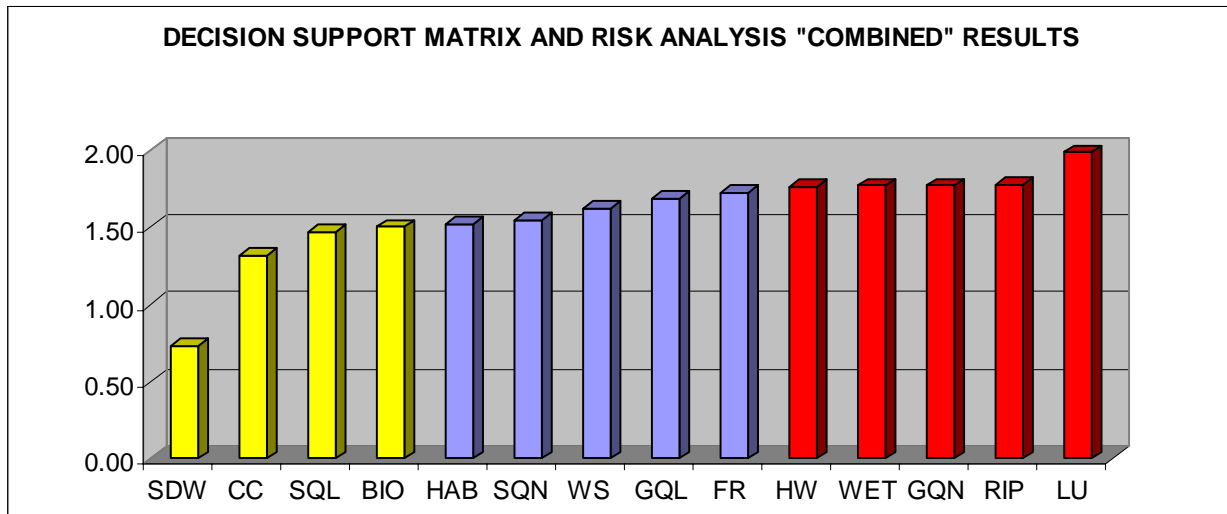


Note: Red = Top Five, Blue = Next Five, Yellow = Remainder

CC = Climate Change	BIO = Biodiversity	GQN = Groundwater Quantity	GQL = Groundwater Quality	FR = Flow Regime (Peak)
HAB = Habitat	WS = Water Shortage	SQL = Surface Water Quality	SDW = Source Drinking Water	SQN = Surface Water Quantity
HW = Headwaters²	LU = Land Use	RIP = Riparian	WET = Wetlands	

² Headwaters are the uplands areas that contribute the greatest portion of flow – somewhere in the range of 80 percent of total volume – in a basin. Headwaters areas are characterized by accumulation, storage, purification and gradual release of surface and groundwater flows.

- The following diagram shows the combined results from the 1) decision support matrix and 2) risk analysis workshop. For full details on how the results were combined, please refer to Appendix D4.

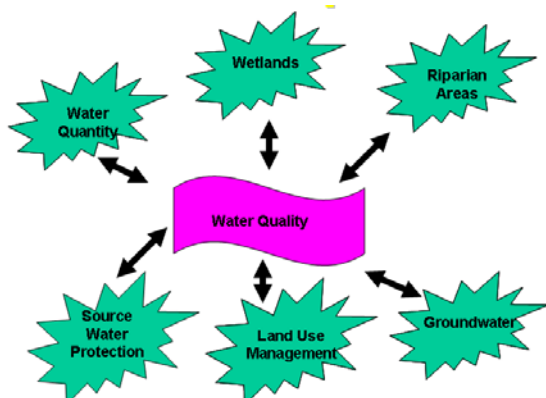


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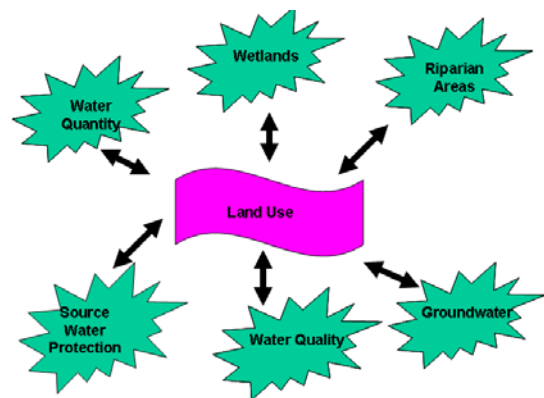
Note: Source drinking water (SDW) was not included in the original priorities in the decision support matrix, therefore, the value shown only includes the contribution from the risk analysis.

- | | | | | |
|----------------------------|----------------------------|------------------------------------|------------------------------------|-------------------------------------|
| CC = Climate Change | BIO = Biodiversity | GQN = Groundwater Quantity | GQL = Groundwater Quality | FR = Flow Regime (Peak) |
| HAB = Habitat | WS = Water Shortage | SQL = Surface Water Quality | SDW = Source Drinking Water | SQN = Surface Water Quantity |
| HW = Headwaters | LU = Land Use | RIP = Riparian | WET = Wetlands | |

Note: The diagrams below show how the identified planning priorities (centre of both diagrams) are inextricably linked to a variety of other ecosystem components. So although a particular planning priority will be identified, the scope of the project will inevitably extend beyond the specific topic of focus.



Water Quality as the Identified Planning Priority



Land Use as the Identified Planning Priority

FINAL RECOMMENDATIONS:

- The following table and diagram represent a seven year plan and timeline leading to the development of a comprehensive integrated watershed management plan (including implementation of all phases) by 2016.

<u>Phase</u>	<u>Primary Focus</u>	<u>Details</u>	<u>Includes</u>	<u>Start</u>	<u>Finish</u>
One	Surface Water Quality	Water quality objectives and recommendations were developed for key rivers and/or reaches.	Completed. Released in September 2008. Currently being implemented.	September 2006	August 2009
On-Line State of Watershed	On-Line State of Watershed Report and Summary Booklet	As part of an adaptive management cycle, indicators and thresholds will be used to monitor the state of the watershed.	<input type="checkbox"/> Will build on existing information in the 2005 BRBC State of the Basin Report. <input type="checkbox"/> Once the base website is completed, ongoing maintenance will be required to keep the information current. <input type="checkbox"/> Summary booklets to be developed every second year or so.	May 2009	August 2010
Two	Land Use within the Entire Bow Basin, Headwaters, Wetlands and Riparian Areas	Key areas for consideration include irreversible changes to land use and loss of sensitive and/or important areas.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2010	August 2012
Three	Surface and Groundwater Quantity	Key areas for consideration include unacceptable water deficits, potential impacts from climate change, and low and high flow events.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2012	August 2014
Four	Surface Water Quality Revisited and Groundwater Quality	Will expand on the water quality objectives and recommendations developed in Phase One, and will also include groundwater quality.	<input type="checkbox"/> Includes updated information to all previous versions of the BBWMP <input type="checkbox"/> The first year is set aside for developing the plan with the following year set aside for implementation.	September 2014	August 2016

Level of Effort	Pre or Post Project Phase or Continuous Effort (20% Effort)	Project Phase (80% Effort)	Implementation Phase (40% Effort)
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<u>Primary Focus</u>	<u>2009³</u>	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>
On-Line State of Watershed Report and Summary Booklet							
Phase Two: Land Use within the Entire Bow Basin, Headwaters, Wetlands & Riparian Areas							
Phase Three: Surface and Groundwater Quantity							
Phase Four: Surface Water Quality Revisited and Groundwater Quality							

³ All years shown are for the period from September 1 of the noted year to August 31 of the following year.

APPENDICES:

APPENDIX A: CURRENT AND PROPOSED PLANNING PROCESSES

In order to evaluate planning priorities, an understanding of current and proposed planning processes is required.

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Provincial Wetland Policy	<ul style="list-style-type: none"> <input type="checkbox"/> The Alberta Water Council (AWC) Wetland Policy Project Team developed a Provincial Wetland Policy and Wetland Implementation Plan. The AWC then recommended the plan to the Government of Alberta for consideration as new policy. 	June 2009 (TBD) ⁴ Final document completed and under consideration by GOA ⁵ .	HIGH This will meet many of the BRBC's needs although further work could still be beneficial.
Riparian Land Conservation & Management Project: Phase 1 Final Report	<ul style="list-style-type: none"> <input type="checkbox"/> The objective was to build a team to review the current riparian management system and identify system components that could most readily be changed to meet local (i.e., southern watershed) riparian objectives. The BRBC is currently trying to bring this topic to the attention of the AWC. <input type="checkbox"/> Phase 2 was scheduled (not commenced) to a) explore options for developing and implementing provincial riparian policy and to b) develop an action plan to address the priority work items identified in Phase 1. <input type="checkbox"/> A Waterbody Setbacks Guidebook Project is underway that could feed into revisions of the Phase 1 document. 	February 2007 Phase 1 is completed, but has not been implemented in any meaningful way. Phase 2 was suggested but has not yet proceeded.	HIGH The work from this team has the potential to be incorporated into future phases of the BBWMP.
Headwaters Implementation Workshop	<ul style="list-style-type: none"> <input type="checkbox"/> Bring together approximately 50 stakeholders from sectors including land owners, industry, municipal, provincial and federal governments and NGOs on May 1, 2009. <input type="checkbox"/> Discuss the most promising headwaters management ideas, informed by November 2008 Headwaters workshop science and participants' experience, and develop a strategy to carry those through to implementation. <input type="checkbox"/> Timeline for completion depends on strategy selected, but intention is to support/complement WPAC watershed management planning and South Saskatchewan (and other regions) Land Use Framework planning. 	September 2009 (TBD)	HIGH The work from this team has the potential to be incorporated into future phases of the BBWMP.
Bow Basin Watershed Management Plan Implementation	<ul style="list-style-type: none"> <input type="checkbox"/> Work closely with Alberta Environment in helping to guide implementation. <input type="checkbox"/> Encourage signatories to prepare and follow a specific Implementation Plan to address the recommendations they have accepted (an Implementation Planning Guide has been prepared). <input type="checkbox"/> Conduct one or more Implementation Planning Workshops for Key Stakeholders to share information and offer guidance. <input type="checkbox"/> Track and report on progress of implementation throughout the basin. <input type="checkbox"/> Work closely with the Monitoring and Modeling Committee to develop and measure performance indicators for successful implementation. <input type="checkbox"/> Wherever possible and necessary facilitate discussions on resource acquisition and sharing in support of BBWMP Implementation. <input type="checkbox"/> Follow the Implementation Principles as stipulated in the Implementation Committee Terms of Reference. 	It is anticipated that the Implementation Committee will stand-down sometime in 2010 (residual responsibilities will become a BRBC Core Activity).	HIGH The work from this team will be incorporated into future phases of the BBWMP.

⁴ TBD = To Be Determined

⁵ GOA = Government of Alberta

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Elbow River Water Management Plan Implementation	<ul style="list-style-type: none"> <input type="checkbox"/> Encourage signatories to prepare and follow a specific Implementation Plan to address the recommendations to maintain or improve water quality. <input type="checkbox"/> Identify key indicators that will measure success in achieving the stated watershed management outcomes for water quality. <input type="checkbox"/> Track and report on progress of implementation. <input type="checkbox"/> Work to develop partnerships and synergies in implementation actions. <input type="checkbox"/> Follow the Implementation Principles as stipulated in the Implementation Committee Terms of Reference. 	Unknown.	HIGH The work on this project directly impacts the targets set for water quality objectives in this reach.
Provincial Wetland Inventory	<ul style="list-style-type: none"> <input type="checkbox"/> Alberta is undertaking a provincial comprehensive wetland inventory which includes historically drained and altered wetlands. It will provide substantially better data than other inventory products which only capture existing basins and cannot detect previous loss and alteration. <input type="checkbox"/> This inventory tool will enable WPACs and other planning bodies to quantify wetland loss and identify areas where it has been most prevalent thereby enabling them to prioritize and target restoration efforts. <input type="checkbox"/> Sections of the Bow Basin have been inventoried and other areas are currently being considered as part of a priority setting exercise. A coarse scale inventory process is also underway as part of the South Saskatchewan Regional Plan. 	Ongoing. Variable depending on level of detail.	HIGH Important for setting future wetland outcomes and objectives.
Nose Creek Watershed Water Management Plan Implementation	<ul style="list-style-type: none"> <input type="checkbox"/> Stakeholders are to develop implementation action plans for recommendations that affect their jurisdiction. <input type="checkbox"/> Working Groups have been developed with members of the NCWP Technical Committee to link up stakeholders working on similar tasks for implementation. Other specialists from each jurisdiction may provide expertise on the working groups. 	September 2010? Date unknown. On-going	HIGH As one of the reaches identified in the Bow Basin, the NCWMP recommendations feed into the BBWMP.
Upper Bow Basin Cumulative Effects Study	<ul style="list-style-type: none"> <input type="checkbox"/> The goal of the study is to develop a scientific understanding of the potential cumulative effects on water quality and quantity of all types of land use within the Upper Bow Basin. Specifically, the intent is to apply this scientific information as an aid in the creation of a stewardship planning vision for the area. <input type="checkbox"/> The objectives of the UBBCES study are to: <ul style="list-style-type: none"> o create awareness, inform and engage Calgary and up-stream area residents regarding cumulative effects of land use on water quantity and quality; o generate scientific knowledge that will inform and assist government and other land use policy-makers; and o develop a planning tool for government and other decision makers to explore alternative land-use management options. 	April 2010 for Phase One.	HIGH The work from this team has the potential to be incorporated into future phases of the BBWMP.
Calgary Plan-It	<ul style="list-style-type: none"> <input type="checkbox"/> The Draft Municipal Development Plan (MDP) and the Draft Calgary Transportation Plan (CTP) were created as part of the Plan It Calgary project. Together, they determine and guide future decisions on land use and transportation in Calgary. <input type="checkbox"/> The MDP provides details on land use and growth policies. Additionally, the MDP is a legally required statutory plan, mandated by the provincial Municipal Government Act. <input type="checkbox"/> The CTP defines policies and actions to create a sustainable transportation system. The CTP, required by the City Transportation Act, will provide more detailed design and operational guidance for the city-wide transportation system. It also defines policies and actions to create a complimentary transportation system. 	July 2009	HIGH The work from this project has the potential to be incorporated into future phases of the BBWMP.

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Assessment of Mountain Pine Beetle Risks to City of Calgary's Water Supply	<ul style="list-style-type: none"> ❑ Forest disturbances caused by fire and Mountain Pine Beetle (MPB) can adversely affect the hydrology of forested landscapes. Increased stream flow can damage infrastructure; changes in the timing of peak flow can affect water storage in municipal catchments; and degraded water quality can result in increased water treatment costs and degradation of aquatic habitat. ❑ A modelling project commissioned by the BC Forest Practices Board, showed that MPB and the resulting salvage logging could substantially change the timing of the spring melt and increase the risk of flooding. These flow regime characteristics are major concerns for the Elbow River watershed because the City of Calgary relies on the timing of the spring melt to meet the water supply demands. However, the BC modelling project is specific to the interior of British Columbia and the results are not directly applicable to the Elbow River Watershed. ❑ An MSc graduate student will be funded through the Civil Engineering Department at University of Calgary. The student will use an appropriate model to investigate the potential impacts of MPB on Calgary's water supply. 	Ongoing.	HIGH The work from this project has the potential to be incorporated into future phases of the BBWMP.
Southern Saskatchewan Regional Plan	<ul style="list-style-type: none"> ❑ Key deliverables of the regional plan include: <ul style="list-style-type: none"> ○ Provide provincial policy direction ○ Defined environmental outcomes ○ Defined social and economic outcomes ○ Land-use direction: priorities and issue resolution ○ Delivery strategy: adaptive performance management system. ❑ Regional plans will provide a strategic context and workable direction for more detailed operational levels of land use planning and day-to-day administrative decision making. The regional plan will not direct the number of cows occupying a quarter section, or locations of subdivision development. It will provide strategic direction and indicators of ranges of activities that may occur within a region to meet provincial outcomes. 	December 2009	MODERATE Given the scope, timeline and higher level nature of this project, more detailed work by the BRBC will likely be warranted.
Jumpingpound Creek Watershed Management Plan	<ul style="list-style-type: none"> ❑ To guide individuals, groups and governments living and operating within the watershed to maintain and improve environmental function and ensure an ample supply of high quality water for future generations. ❑ The draft Terms of Reference for the integrated watershed management plan was presented to the MD of Rocky View, MD of Bighorn and the Town of Cochrane. All jurisdictions unanimously approved and supported the decision to develop the plan. 	September 2010? Date unknown.	MODERATE Will definitely help fill in the pieces for this particular watershed and provide direction for the rest of the upstream basins.
Highwood Management Plan Implementation	<ul style="list-style-type: none"> ❑ This project will specifically address the monitoring commitments arising from Phase 1 of the Highwood Management Plan and the Little Bow Project Mitigation Plan to determine the effectiveness of the existing monitoring program in achieving its intended purpose of informing land use and water management decisions related to meeting the outcomes of these plans. ❑ The project outcome includes the development of a monitoring program that supports cumulative effects performance assessment for adaptive management decisions regarding water or land use that can affect water or water bodies including groundwater in the Upper Highwood and Upper Little Bow watersheds as defined in Phase 1 Water Management Plan. ❑ Improved management of water quality and quantity on Highwood River will complement BBWMP Phase 1 implementation to protect water quality in Bow main stem downstream of Calgary. Will also improve health of Highwood fishery habitat that provides key spawning habitat for the Bow trout fishery. 	2010	MODERATE The work from this project has the potential to be incorporated into future phases of the BBWMP.

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Calgary Regional Plan	<ul style="list-style-type: none"> ❑ The draft Calgary regional plan will be presented to member municipalities in June of 2009. Once approved, implementation will begin. Each municipality will determine the best approach to implement the details of the plan at the local level and will have three years to align their individual municipal plans with the regional plan. Each municipality will work with the other municipalities and the Calgary Regional Partnership to implement regional components of the plan, such as implementing a regional transit plan and a regional water and wastewater servicing plan. The Calgary Regional Partnership will work with the province throughout implementation to ensure alignment with the emerging South Saskatchewan Regional Plan. ❑ The draft regional plan protects five key elements of our natural systems: wetlands, riparian buffers, regional corridors, natural vegetation and ridges and escarpments. The draft plan promotes environmental protection through conservation strategies and by directing growth away from sensitive natural areas. The seventeen CRP members will be responsible for incorporating outcomes of the regional plan into their municipal planning processes. 	June 2009	<p><u>MODERATE TO HIGH</u> The recommendations on land-use, wetlands and riparian buffers will be particularly important.</p>
South Saskatchewan River Basin Water Management Plan Implementation	<ul style="list-style-type: none"> ❑ The SSRB Intrabasin Water Coordinating Committee will increase awareness of WPACs of basin operations, water supply and demand, and Alberta's performance in meeting apportionment. The group will provide AENV with advice from WPACs on how to best meet apportionment in any given year. More intensive management will be needed in coming decades as existing allocations are used more completely and more allocations are made in Red Deer River watershed. The Committee will also strive for fairness in the degree to which each sub-basin contributes to apportionment. ❑ The SSRB Water Information Portal will consolidate all of AENV's water data and information on the website (on line, real time), so public can reach conclusions along with AENV about best decisions. ❑ Also looking at municipal water security including municipal allocations and needs. A basin inventory is being developed. There is also a province wide First Nations water needs assessment, with the intent is to conduct studies for Treaty 7 first. ❑ Final decisions on all outstanding applications will also be made. 	Ongoing	<p><u>MODERATE TO HIGH</u> The work from this team has the potential to be incorporated into future phases of the BBWMP.</p>
John Pomeroy Site	<ul style="list-style-type: none"> ❑ "Improved Processes and Parameterisation for Prediction in Cold Regions" (IP3) is a research network funded (\$2.5 million) by the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) for the period 2006-2010. ❑ The Marmot Creek Research Watershed study in Kananaskis is one of several watershed studies under the IP3 research network led by Dr. John Pomeroy, Canada Research Chair in Water Resource and Climate Change, from University of Saskatchewan. ❑ The Marmot Creek watershed project has world class infrastructure, which includes 10 hydro-meteorological stations, and 4 stream gauging stations to measure flow from alpine, clear-cut, thinned, small clearing and natural forest sub-basins. The site was operated in the 1970 and 80's by the Canadian Forest Service, but was disbanded until Dr. Pomeroy took the position at U of Saskatchewan. 	Ongoing.	<p><u>MODERATE TO HIGH</u> The work from this team has the potential to be incorporated into future phases of the BBWMP.</p>
Municipal District of Rocky View Riparian Policy Development:	<ul style="list-style-type: none"> ❑ Policy will provide guidance for development near watercourses for the conservation of riparian areas. 	Anticipated date for consideration by Council is fall, 2009.	<p><u>MODERATE TO HIGH</u> The work on this policy has the potential to be incorporated into future phases of the BBWMP.</p>

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Municipal District of Rocky View Wetland Conservation Policy Development	<ul style="list-style-type: none"> ❑ Policy will provide guidance for retention and compensation of wetlands when development is considered. 	Anticipated date for consideration by Council is fall, 2009.	<u>MODERATE TO HIGH</u> The work on this policy has the potential to be incorporated into future phases of the BBWMP.
Water for Life Renewal	<ul style="list-style-type: none"> ❑ In order to maximize the return on Albertans' investments, resources and adequate financial support should be focused in the areas outlined in this report in order to most effectively and efficiently advance the <i>Water for Life</i> strategy. These areas of renewed focus include: <ul style="list-style-type: none"> ❑ Safeguard our Water Sources <ul style="list-style-type: none"> ○ Address aquatic ecosystem degradation. ○ Integrate water and land management. ○ Create, enhance and use innovative tools and best practices. ❑ Accelerate Action <ul style="list-style-type: none"> ○ Clarify roles, responsibilities and accountabilities. ○ Enhance data collection, analysis and reporting. ○ Expand public awareness programs and build shared commitment. 	November 2008	<u>LOW TO HIGH</u> Variable depending on renewed focus.
Banff National Park Management Plan	<ul style="list-style-type: none"> ❑ The current management plan for Banff National Park of Canada was approved in 1997 and amended in 2004 to include a Human Use Management Strategy. ❑ This amendment completes the Human Use Management Strategy by incorporating the component for the Lands Adjacent to the Town of Banff (<u>in Section 5.6.4.3</u>). <u>Section 11.8</u> is a new section, providing the environmental assessment of this amendment. ❑ All sections of the 2004 amended management plan remain in force. 	July 2007	<u>LOW to MODERATE</u> A review of this document would be worthwhile prior to commencing the BBWMP.
Spray Lakes Forest Management Agreement	<ul style="list-style-type: none"> ❑ Alberta uses timber permits, timber quotas and forest management agreements (FMA) to manage the province's timber resources. An FMA is an area-based tenure agreement between a forest company and the Government of Alberta, and provides the forest company with the right to grow, harvest and remove timber. Area-based tenures give a company rights and obligations within a specified land area, while volume-based tenures set the amount or volume a company may harvest. Harvest volumes for area-based tenures are set through forest management plans. ❑ A new forest management plan for the Spray Lake Sawmill was recently approved. Operating Ground Rules are the rules and guidelines that forest companies follow to meet the objectives of the management plan. ❑ Operating ground rules for the Spray Lake Sawmills FMA are currently being updated and will be released in Spring 2009. 	Spring 2009	<u>LOW TO MODERATE</u> A review of these documents would be worthwhile prior to commencing the BBWMP.
Forest Land Use Zone	<ul style="list-style-type: none"> ❑ A Forest Land Use Zone (FLUZ) is an area of public land to which legislative controls apply to assist in the management of industrial, commercial, and recreational land uses and resources. ❑ The effectiveness of FLUZs in the Bow Basin to meet the management objectives is being reviewed. 	Ongoing.	<u>LOW TO MODERATE</u> More details from the proposed review would be necessary to determine relevancy.
Fish Sustainability Index	<ul style="list-style-type: none"> ❑ Looking at fish species community assemblage and impacts/risks from surrounding land uses; provide direction on appropriate mitigation measures. 	Ongoing.	<u>LOW TO MODERATE</u> The impacts from surrounding land uses could be useful.

<u>Project Name</u>	<u>Purpose</u>	<u>Estimated Timeline for Completion</u>	<u>Likelihood of Meeting BRBC Needs for this Planning Topic</u>
Alberta Plan for Parks	<ul style="list-style-type: none"> ❑ The Alberta government has released a new plan to guide the management of provincial parks over the next 10 years. The plan for parks will be supported this year with nearly \$85 million. Parks programs and operations are slated to receive just over \$67 million, and replacement and upgrading of facilities and infrastructure will continue with nearly \$18 million in capital investment. Since 2004, nearly \$225 million has been invested in park facilities and infrastructure. ❑ Aligned with the province's <i>Land-use Framework</i>, the <i>Plan for Parks</i> highlights the need to identify and develop opportunities and policies for safe and responsible recreation in Alberta's parks. ❑ To reduce impact on the land and ensure protection of the environment, the plan highlights the importance of science-based research, as well as regional and site specific management plans. 	February 2009	<u>LOW TO MODERATE</u> Information from this initiative can feed into future watershed initiatives.
Assessment of Potential Water Storage Sties and Diversion Scenarios	<ul style="list-style-type: none"> ❑ The purpose of this study was to assess and rank previously identified potential water storage sites and diversion projects in Alberta. The study was implemented by Alberta Environment to address "reliable, quality water supplies for a sustainable economy" as part of the provincial "Water for Life Strategy". 	January 2008	<u>LOW TO MODERATE</u> Information from this initiative can feed into future watershed initiatives.

Note: The noted project and/or initiatives were identified by SWAT at the time the final report was prepared. The list is by no means inclusive of all key project and/or initiatives that could have been included.

Bow Basin Watershed Management Plan



Phase Two: Land Use

Focus: Land Use within the Entire Basin,
Headwaters, Wetlands & Riparian Areas

Including: Updates to BBWMP Phase One

~ August 2011 ~

Bow Basin Watershed Management Plan



Phase Three: Water Quantity

Focus: Surface & Groundwater, Low & High
Flows, Potential Climate Change Impacts

Including: Updates to BBWMP Phase One
and BBWMP Phase Two

~ August 2013 ~

Bow Basin Watershed Management Plan



Phase Four: Water Quality Revisited

Focus: Surface Water Quality Revisited
and Groundwater Quality

Including: Updates to BBWMP
Phase One, Two and Three

~ August 2015 ~

APPENDIX C: DECISION SUPPORT MATRIX BACKGROUND MATERIALS AND DATA SHEETS:

1. Survey Questions

Weighting (In Percentages)	40%	20%	15%	15%	10%	SCORE
Potential Planning Priority (In Alphabetical Order)	For this specific aspect, I believe the level of potential benefit is high.	For this specific aspect, I believe there is enough information (data & knowledge) to proceed in a timely manner.	For this specific aspect, I believe that BRBC members will be actively engaged to warrant making this aspect a priority.	For this specific aspect, I believe that the external political will (outside of the BRBC) exists to warrant making this aspect a priority.	For this specific aspect, I believe there is a significant amount of supporting material suggesting that this aspect should be a priority.	
Biodiversity (enhanced understanding & management – includes terrestrial and aquatic environments)						
Climate Change (preparations for future climate changes related events)						
Flow Regime (preparations for future flood related events)						
Groundwater Quality (enhanced understanding & management – includes relationship with surface water)						
Groundwater Quantity (enhanced understanding & management – includes relationship with surface water)						
Habitat (enhanced understanding & management - includes terrestrial and aquatic environments)						
Land Use & Cover (enhanced understanding & management as it affects watershed health and function)						
Riparian Areas (enhanced understanding & management - includes lakes, rivers, creeks & wetlands)						
Headwaters (enhanced understanding & management)						
Surface Water Quality (enhanced knowledge & management - beyond Phase One of the Bow Basin Watershed Management Plan)						
Surface Water Quantity (enhanced knowledge & management - beyond Phase Two of the South Saskatchewan River Basin Water Management Plan)						
Water Infrastructure (enhanced understanding & management to help ensure that dams, diversions and canals are suitable for current and future needs)						
Water Shortage (preparations for future water shortage related events)						
Wetlands (enhanced understanding and management)						

2. Survey Results

QUEST	SUBMIT TIME	BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
Q1	12/11/2008 7:53	4	5	3	5	5	4	4	5	4	4	4	4	5
Q1	12/11/2008 7:59	3	3	4	5	5	3	3	4	5	2	2	4	5
Q1	12/11/2008 7:57	2	4	4	4	4	3	3	4	4	4	4	3	4
Q1	12/11/2008 12:09	5	4	5	4	4	5	5	4	5	5	4	5	5
Q1	12/11/2008 14:38	5	3	3	5	5	5	5	5	5	2	2	3	5
Q1	12/11/2008 17:15	4	3	3	4	5	4	5	3	3	3	3	3	5
Q1	12/12/2008 8:10	4	4	5	5	5	5	5	5	5	4	5	5	5
Q1	12/12/2008 14:00	5	5	5	5	5	5	5	5	5	5	5	5	5
Q1	12/13/2008 2:13	4	3	4	4	4	4	5	4	4	5	5	5	4
Q1	12/15/2008 7:09	4	4	5	5	5	4	5	4	5	5	5	5	4
Q1	12/15/2008 15:00	4	4	5	4	4	4	5	4	5	3	5	5	4
Q1	12/16/2008 15:27	5	4	5	5	5	5	5	5	5	4	5	4	5
Q1	12/18/2008 5:22	5	4	5	4	4	5	5	4	4	4	4	3	4
Q1	12/17/2008 8:30	4	4	5	5	5	4	5	4	5	5	4	4	5
Q1	12/17/2008 10:12	4	5	4	5	5	4	5	5	5	5	5	4	4
Q1	12/17/2008 12:12	4	4	4	5	5	4	3 ⁶	5	5	4	4	5	5
Q1	12/17/2008 19:14	3	4	2	2	2	4	4	4	5	5	5	4	1
Q1	12/17/2008 21:35	4	3	4	4	4	4	4	4	4	4	4	5	4
Q1	12/18/2008 10:11	4	4	5	5	4	4	4	5	4	4	4	5	4
Q1	12/18/2008 10:03	5	5	5	5	5	5	5	5	5	5	5	5	5
Q1	12/18/2008 10:18	5	4	4	5	5	5	4	5	5	5	5	4	5
Q1	12/18/2008 15:24	4	4	1	4	4	4	3	4	4	4	4	4	4
Q1	12/18/2008 18:02	5	2	2	5	4	5	4	5	5	4	4	2	5

QUEST	SUBMIT TIME	BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
Q2	12/11/2008 7:53	4	4	4	4	3	4	5	5	4	4	4	4	5
Q2	12/11/2008 7:59	3	3	5	5	5	3	4	4	5	5	5	4	5
Q2	12/11/2008 7:57	3	3	4	2	2	3	3	4	4	4	4	3	3
Q2	12/11/2008 12:09	5	3	3	3	3	4	4	4	4	4	4	4	4
Q2	12/11/2008 14:38	5	3	3	3	4	5	5	5	5	3	4	3	5
Q2	12/11/2008 17:15	3	5	5	3	3	4	5	4	3	5	5	3	3
Q2	12/12/2008 8:10	4	4	4	4	2	4	4	4	4	4	4	4	2
Q2	12/12/2008 14:00	2	1	2	1	1	1	1	1	1	1	1	1	1
Q2	12/13/2008 2:13	4	2	3	1	1	4	2	4	2	4	5	2	2
Q2	12/15/2008 7:09	3	3	4	2	2	4	4	4	4	4	4	4	4
Q2	12/15/2008 15:00	4	5	4	2	2	4	3	2	2	4	4	5	4
Q2	12/16/2008 15:27	5	4	5	3	3	5	5	5	5	5	5	4	5
Q2	12/18/2008 5:22	4	3	5	2	2	4	3	3	4	5	4	3	2
Q2	12/17/2008 8:30	4	4	5	2	2	4	4	4	4	4	4	4	4
Q2	12/17/2008 10:12	5	4	4	2	2	4	4	5	5	4	4	4	4
Q2	12/17/2008 12:12	3	2	2	2	2	2	2	3	3	3	3	2	2
Q2	12/17/2008 19:14	2	1	5	4	1	2	2	3	5	5	5	4	2
Q2	12/17/2008 21:35	4	3	2	2	2	2	3	4	4	4	4	2	4
Q2	12/18/2008 10:11	4	3	4	2	3	3	2	4	2	3	4	3	3
Q2	12/18/2008 10:03	5	5	5	5	5	5	5	5	5	5	5	5	5
Q2	12/18/2008 10:18	4	2	4	2	3	5	4	5	4	4	4	3	4
Q2	12/18/2008 15:24	3	2	4	4	2	4	3	4	4	2	4	4	4
Q2	12/18/2008 18:02	5	1	2	4	2	5	5	5	5	4	4	4	5

⁶ In order not to skew the interpretation of the results, a neutral value of 3 was added to the table where blanks existed (i.e., wherever the respondent did not respond).

QUEST	SUBMIT TIME	BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
Q3	12/11/2008 7:53	4	5	4	5	5	5	5	5	4	4	4	4	4
Q3	12/11/2008 7:59	3	3	4	5	5	3	4	4	5	2	2	4	5
Q3	12/11/2008 7:57	3	3	4	4	4	3	4	4	4	4	4	4	4
Q3	12/11/2008 12:09	4	4	4	3	4	4	5	5	5	5	5	4	5
Q3	12/11/2008 14:38	3	4	4	4	5	3	4	5	5	2	2	4	5
Q3	12/11/2008 17:15	4	3	3	3	3	4	5	4	4	4	3	3	4
Q3	12/12/2008 8:10	3	3	5	4	4	4	4	4	4	5	5	5	4
Q3	12/12/2008 14:00	3	4	4	4	4	4	4	4	4	4	4	4	4
Q3	12/13/2008 2:13	4	3	4	3	3	4	4	4	4	5	5	4	4
Q3	12/15/2008 7:09	3	4	4	5	5	4	5	4	5	5	5	5	4
Q3	12/15/2008 15:00	3	4	5	3	3	4	5	3	4	3	4	5	4
Q3	12/16/2008 15:27	4	5	4	4	4	4	4	4	4	4	4	4	4
Q3	12/18/2008 5:22	4	3	5	5	5	4	4	3	5	5	5	5	4
Q3	12/17/2008 8:30	3	3	3	5	5	4	4	4	4	5	4	4	4
Q3	12/17/2008 10:12	4	5	4	5	5	4	5	4	5	4	4	4	5
Q3	12/17/2008 12:12	4	4	4	4	4	4	4	4	4	4	4	4	4
Q3	12/17/2008 19:14	3	5	3	1	3	2	4	5	4	5	4	3	1
Q3	12/17/2008 21:35	4	3	4	4	5	4	4	4	4	5	5	4	3
Q3	12/18/2008 10:11	3	4	4	4	4	3	4	5	3	5	5	4	3
Q3	12/18/2008 10:03	4	3	3	2	2	5	3	4	4	2	2	4	2
Q3	12/18/2008 10:18	5	4	4	5	4	5	5	5	5	5	5	4	5
Q3	12/18/2008 15:24	3	3	1	4	3	2	4	4	4	4	3	4	4
Q3	12/18/2008 18:02	5	2	2	3	3	5	5	5	5	4	4	4	5

QUEST	SUBMIT TIME	BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
Q4	12/11/2008 7:53	4	4	4	4	4	4	4	5	5	5	5	5	5
Q4	12/11/2008 7:59	3	3	4	5	5	3	4	4	5	2	2	4	5
Q4	12/11/2008 7:57	4	4	4	4	4	4	4	4	4	3	3	4	4
Q4	12/11/2008 12:09	2	4	3	3	3	2	4	4	4	5	5	4	4
Q4	12/11/2008 14:38	3	4	4	4	5	3	5	5	5	2	4	4	5
Q4	12/11/2008 17:15	3	3	3	4	4	3	5	3	3	3	5	3	4
Q4	12/12/2008 8:10	3	4	3	4	4	4	4	4	4	4	4	4	4
Q4	12/12/2008 14:00	2	2	3	2	2	2	2	2	2	2	2	2	2
Q4	12/13/2008 2:13	4	3	4	4	4	4	4	4	3	4	4	4	4
Q4	12/15/2008 7:09	2	2	4	4	3	3	3	4	4	4	5	5	4
Q4	12/15/2008 15:00	2	4	5	3	3	4	5	4	4	3	4	5	4
Q4	12/16/2008 15:27	2	3	2	4	4	3	3	2	4	4	4	4	3
Q4	12/18/2008 5:22	2	3	4	4	4	2	3	4	4	5	5	5	3
Q4	12/17/2008 8:30	3	4	3	3	3	3	4	4	4	4	4	4	4
Q4	12/17/2008 10:12	3	5	3	4	4	4	5	2	4	4	4	5	4
Q4	12/17/2008 12:12	3	4	4	3	3	3	3	3	3	3	3	2	2
Q4	12/17/2008 19:14	3	4	5	2	4	1	4	5	3	5	5	4	1
Q4	12/17/2008 21:35	4	3	3	4	4	4	3	4	4	4	4	4	4
Q4	12/18/2008 10:11	3	5	4	4	4	3	4	5	4	4	4	5	4
Q4	12/18/2008 10:03	2	2	2	2	2	2	2	5	4	2	2	5	1
Q4	12/18/2008 10:18	5	5	5	5	4	5	4	4	5	5	5	5	5
Q4	12/18/2008 15:24	3	4	4	3	4	3	4	4	3	4	4	4	4
Q4	12/18/2008 18:02	5	2	3	2	2	5	4	4	5	5	5	4	4

QUEST	SUBMIT TIME	BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
Q5	12/11/2008 7:53	5	5	4	5	5	5	5	5	5	3	5	5	5
Q5	12/11/2008 7:59	3	3	4	5	5	3	4	4	5	3	3	4	5
Q5	12/11/2008 7:57	3	3	3	3	3	3	3	4	4	4	3	3	3
Q5	12/11/2008 12:09	5	4	4	4	4	5	5	4	5	5	5	5	5
Q5	12/11/2008 14:38	5	4	4	5	5	5	5	5	5	2	2	4	5
Q5	12/11/2008 17:15	3	3	3	3	4	3	5	4	3	3	5	3	4
Q5	12/12/2008 8:10	3	4	4	4	4	4	4	4	4	5	5	4	4
Q5	12/12/2008 14:00	5	5	4	5	5	5	5	5	5	5	5	5	5
Q5	12/13/2008 2:13	4	4	4	3	3	4	4	4	3	4	4	4	3
Q5	12/15/2008 7:09	3	3	4	3	2	4	4	4	4	5	4	5	4
Q5	12/15/2008 15:00	3	5	5	4	4	4	5	4	4	4	5	5	4
Q5	12/16/2008 15:27	4	5	5	5	5	4	5	5	5	5	5	4	5
Q5	12/18/2008 5:22	3	4	5	2	2	3	3	4	4	5	5	4	4
Q5	12/17/2008 8:30	3	3	3	4	4	4	4	4	4	5	4	4	4
Q5	12/17/2008 10:12	4	3	4	4	4	4	5	4	4	5	5	4	4
Q5	12/17/2008 12:12	4	4	4	4	4	4	4	4	4	4	4	4	4
Q5	12/17/2008 19:14	2	2	3	2	4	3	5	5	4	5	5	5	2
Q5	12/17/2008 21:35	4	3	4	4	4	4	4	4	4	4	4	4	4
Q5	12/18/2008 10:11	3	4	4	4	4	3	3	4	4	4	4	4	3
Q5	12/18/2008 10:03	4	4	2	1	1	2	2	4	4	2	2	5	4
Q5	12/18/2008 10:18	5	4	4	4	4	5	4	5	4	5	4	4	5
Q5	12/18/2008 15:24	3	4	4	2	3	3	3	4	4	4	3	4	4
Q5	12/18/2008 18:02	5	2	4	4	4	5	5	5	5	5	5	4	5

3. Consolidated Survey Results

<u>CONSOLIDATED RESULTS</u>		BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
ALL	AVER	3.68	3.56	3.81	3.67	3.67	3.78	4.04	4.16	4.17	4.02	4.10	4.01	3.95
ALL	STDEV	0.91	0.97	0.94	1.14	1.13	0.95	0.92	0.77	0.81	0.99	0.94	0.83	1.06
Q1	BENEFIT	4.17	3.87	4.00	4.52	4.48	4.30	4.39	4.43	4.61	4.13	4.22	4.17	4.43
Q1	WEIGHTED 40%	1.67	1.55	1.60	1.81	1.79	1.72	1.76	1.77	1.84	1.65	1.69	1.67	1.77
Q2	INFORMATION	3.83	3.04	3.83	2.78	2.48	3.70	3.57	3.96	3.83	3.91	4.09	3.43	3.57
Q2	WEIGHTED 20%	0.77	0.61	0.77	0.56	0.50	0.74	0.71	0.79	0.77	0.78	0.82	0.69	0.71
Q3	ENGAGED	3.61	3.65	3.74	3.87	4.00	3.83	4.30	4.22	4.30	4.13	4.00	4.09	3.96
Q3	WEIGHTED 15%	0.54	0.55	0.56	0.58	0.60	0.57	0.65	0.63	0.65	0.62	0.60	0.61	0.59
Q4	POLITICAL WILL	3.04	3.52	3.61	3.52	3.61	3.22	3.78	3.87	3.91	3.74	4.00	4.13	3.65
Q4	WEIGHTED 15%	0.46	0.53	0.54	0.53	0.54	0.48	0.57	0.58	0.59	0.56	0.60	0.62	0.55
Q5	SUPPORT MTL.	3.74	3.70	3.87	3.65	3.78	3.87	4.17	4.30	4.22	4.17	4.17	4.22	4.13
Q5	WEIGHTED 10%	0.37	0.37	0.39	0.37	0.38	0.39	0.42	0.43	0.42	0.42	0.42	0.42	0.41
ALL	WEIGHTED AVER	3.81	3.60	3.85	3.84	3.81	3.90	4.10	4.21	4.26	4.03	4.12	4.01	4.04
<u>RESULTS</u>		BIO	CC	FR	GQL	GQN	HAB	HW	LU	RIP	SQL	SQN	WS	WET
WEIGHTED AVER		3.81	3.60	3.85	3.84	3.81	3.90	4.10	4.21	4.26	4.03	4.12	4.01	4.04
<u>SORTED RESULTS</u>		CC	BIO	GQN	GQL	FR	HAB	WS	SQL	WET	HW	SQN	LU	RIP
WEIGHTED AVER		3.60	3.81	3.81	3.84	3.85	3.90	4.01	4.03	4.04	4.10	4.12	4.21	4.26
PERCENTAGE		0.85	0.89	0.89	0.90	0.90	0.92	0.94	0.95	0.95	0.96	0.97	0.99	1.00
<u>SORT RESULTS</u>		LU	RIP	WS	BIO	HW	SQN	FR	HAB	CC	SQL	WET	GQN	GQL
STDEV		0.77	0.81	0.83	0.91	0.92	0.94	0.94	0.95	0.97	0.99	1.06	1.13	1.14

4. Survey Comments

6. Please provide any additional comments, thoughts or suggestions in the space provided below!	
#	Response
1	Groundwater quantity and quality are practically inseparable, but there may be more will to proceed with quantity first. A concern with 'climate change' 'flow' and 'shortage' items is that they may be interpreted in a more narrow 'human engineering' fashion rather than an ecosystem-based fashion.
2	Do we consider cost-benefit, "public will", cost-benefit at a different stage in our process?
3	...interesting survey...thanks for the opportunity to participate
4	Thanks for putting it together and subtly goading us to respond :) I have a few comments. I can't remember who it will participate in the survey - just SWAT members or the Board? If it goes to the Board, I think there needs to be a preamble to describe the purpose of the survey and how it fits in with the other two foundation pieces for the evaluation process. I find even I need a little background to jog my memory. For example, the first question, "For this specific aspect, I believe the level of potential benefit is high." Benefit for whom or what? To answer these accurately, there needs to be more of this explanation. A comment box below each section would be nice too. Hmm...I'm not really sure about "Flow Regime (preparations for future flood related events)" To me, flow regime means how well are we mimicking the natural flow regime to maintain a healthy river system, not really about flood preparedness. Is flood preparedness what we decided on? I really have no idea what motivates BRBC members. I'm not sure the survey is phrased in such a way as to allow me to answer the survey in such a way as to rank what I think should be priorities.
5	a lot of politicians and decision makers need education on these topics.

APPENDIX D: RISK ANALYSIS BACKGROUND MATERIALS AND DIAGRAMS:

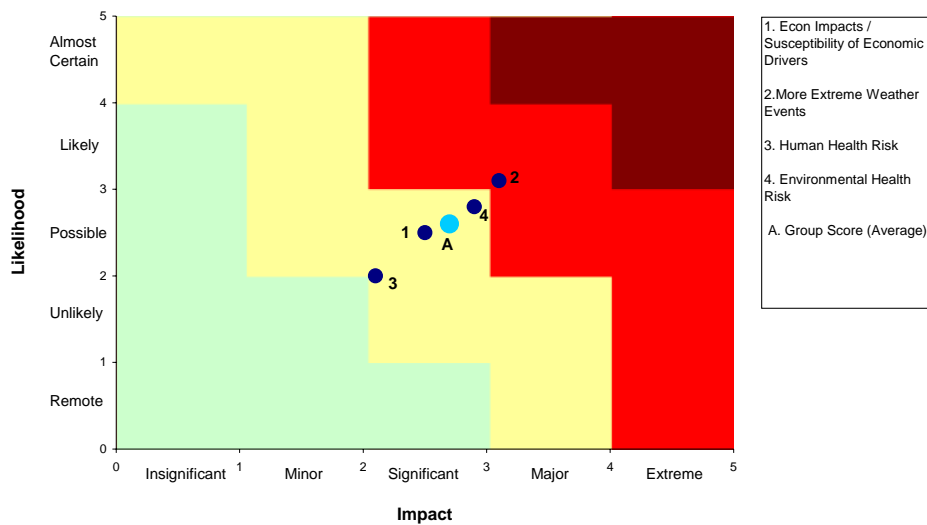
1. Risk Statements

Potential Planning Priority (In Alphabetical Order)	Risk Statements
Biodiversity (enhanced understanding & management – includes terrestrial and aquatic environments)	<input type="checkbox"/> Loss of terrestrial biodiversity and richness <input type="checkbox"/> Loss of aquatic (river and lake) biodiversity (an indicator of compromised aquatic ecosystem health) <input type="checkbox"/> Loss of ecosystem goods and services (as a results of loss of ecosystem functions) <input type="checkbox"/> Increased presence of invasive species
Climate Change (preparations for future climate changes related events)	<input type="checkbox"/> Economic impacts / susceptibility of economic drivers (e.g., sport fishery, dry-land farming, ski-resorts, water intakes for water treatment plants, etc.) <input type="checkbox"/> More extreme weather events / more variable river flows (both in magnitude and timing) <input type="checkbox"/> Human health risk <input type="checkbox"/> Environmental health risk
Groundwater Quality (enhanced understanding & management – includes relationship with surface water)	<input type="checkbox"/> Increased use and pathways into aquifers (which allows more opportunity for contamination) <input type="checkbox"/> Irreversible contamination <input type="checkbox"/> Contamination of surface water supply (e.g., Bragg Creek sewage leaking into Elbow River through groundwater seepage)
Groundwater Quantity (enhanced understanding & management – includes relationship with surface water)	<input type="checkbox"/> Increased use of groundwater resources exceeds the sustainability of basin without knowledge of capacity (due to closure of basin to surface allocations) <input type="checkbox"/> Decreased groundwater flows to surface water <input type="checkbox"/> Improper and/or excessive land use activities

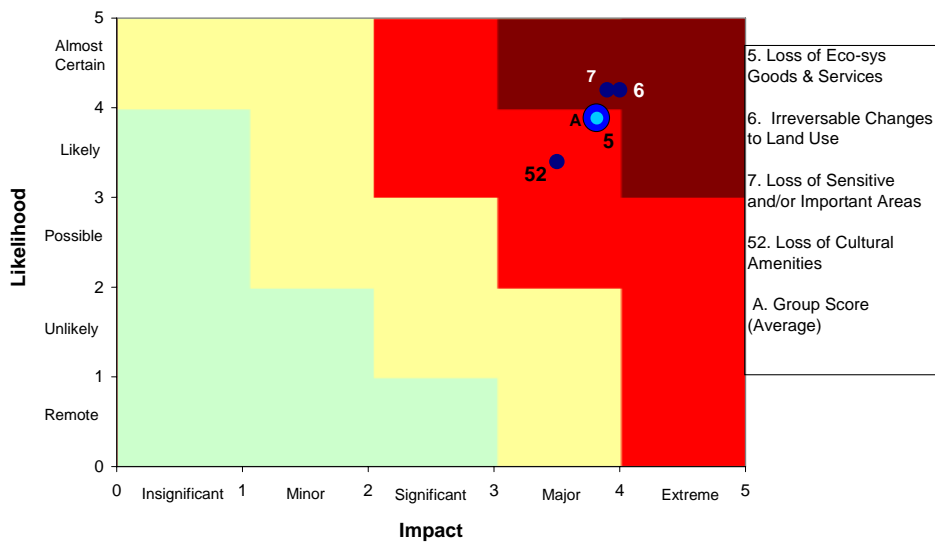
Potential Planning Priority (In Alphabetical Order)	Risk Statements
Habitat (enhanced understanding & management - includes terrestrial and aquatic environments)	<input type="checkbox"/> Degradation of habitat (function and connectivity) <input type="checkbox"/> Decline of aquatic and terrestrial populations including Species at Risk <input type="checkbox"/> Ecosystem thresholds may be crossed resulting in multiple unknown environmental impacts (domino effects and cumulative impacts may result)
Headwaters (enhanced understanding & management)	<input type="checkbox"/> Degradation of critical water quantity recharge areas <input type="checkbox"/> Degradation of source water quality <input type="checkbox"/> Reduction in groundwater reserves with increased use of groundwater in a closed basin <input type="checkbox"/> Impacts to water quality and quantity as a result of forest cover disturbance (e.g., forest fires, pine beetles, logging)
Land Use (enhanced understanding & management as it affects watershed health and function)	<input type="checkbox"/> Loss of ecosystem goods and services (e.g., from loss of recharge areas, alluvial aquifers, headwater areas) (as undeveloped or areas with limited development are developed) <input type="checkbox"/> Irreversible changes to land use (and resulting impacts to water quantity and quality) <input type="checkbox"/> Loss of sensitive and/or important areas (due to lack of information, poor land use planning or unanticipated cumulative effects) <input type="checkbox"/> Loss of cultural amenities
Peak Flow (preparations for future flood related events)	<input type="checkbox"/> Risks to human infrastructure from floods <input type="checkbox"/> Humans continue to build in high-risk areas (e.g., floodplains) <input type="checkbox"/> The risks to the aquatic ecosystem from current flow management
Riparian Areas (enhanced understanding & management - includes lakes, rivers, creeks & wetlands)	<input type="checkbox"/> Reduction of water quality and quantity timing (due to degradation of riparian areas) <input type="checkbox"/> Loss of riparian areas due to loss of wetlands <input type="checkbox"/> Change / loss of functionality (e.g., habitat, biodiversity, cultural and aesthetic amenities, etc.)
Source Drinking Water	<input type="checkbox"/> Drinking water supplies are threatened
Surface Water Quality (enhanced knowledge & management - beyond Phase One of the Bow Basin Watershed Management Plan)	<input type="checkbox"/> Impacts to aquatic life (e.g., impact to critical life stages with a corresponding economic effect on fishing and tourism industry) <input type="checkbox"/> Industrial and agricultural user challenges (e.g., due to weed growth, poor quality water, etc.) <input type="checkbox"/> Recreational use of water is hindered <input type="checkbox"/> Water conservation efforts fail to significantly diminish use (thus affecting quality)
Surface Water Quantity (enhanced knowledge & management - beyond Phase Two of the South Saskatchewan River Basin Water Management Plan)	<input type="checkbox"/> Inability to support aquatic life (due to decreased in-stream flows) <input type="checkbox"/> Inability to support riparian habitat (due to decreased in-stream flows) <input type="checkbox"/> Inability support wastewater assimilation (due to decreased in-stream flows) <input type="checkbox"/> Inability to support recreation (due to decreased in-stream flows) <input type="checkbox"/> Inability to meet demand (for life-sustaining and economic need such as drinking water, agriculture, and industry) <input type="checkbox"/> Water conservation efforts fail to meet agreed upon targets <input type="checkbox"/> Lack of adequate storage (constructed) for healthy basin functioning <input type="checkbox"/> Lack of adequate storage (natural) for healthy basin functioning
Water Shortage (preparations for future water shortage related events) (based on the knowledge that WCOs are protected)	<input type="checkbox"/> Unacceptable water deficits <input type="checkbox"/> Medium to long-term storage is virtually non-existent for a large part of the population (implications of a decadal drought) <input type="checkbox"/> Lack of adequate storage
Wetlands (enhanced understanding and management)	<input type="checkbox"/> Reduction of surface water quality and quantity (due to wetland loss and degradation) <input type="checkbox"/> Reduction of groundwater recharge, quality and quantity (due to wetland loss and degradation) <input type="checkbox"/> Loss of storage and increased flooding within the watershed

2. Risk Diagrams by Potential Planning Priorities

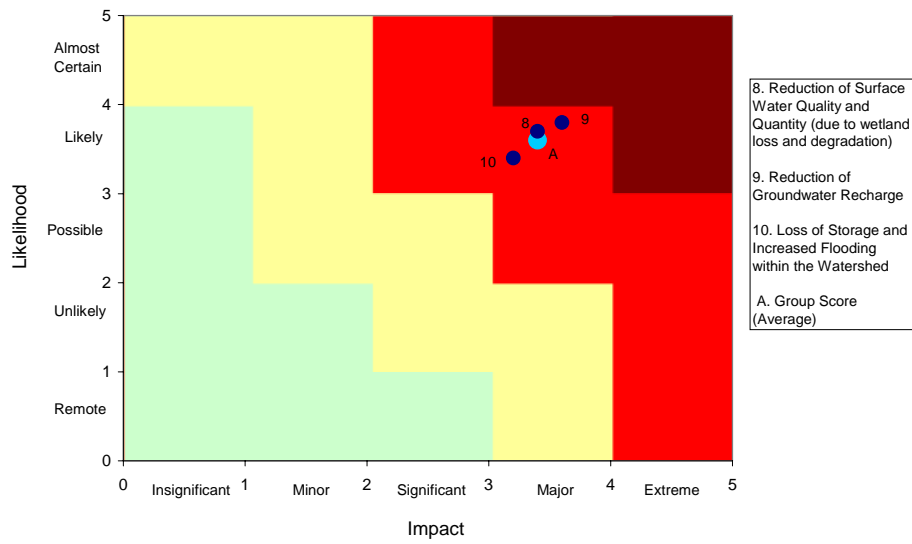
Climate Change



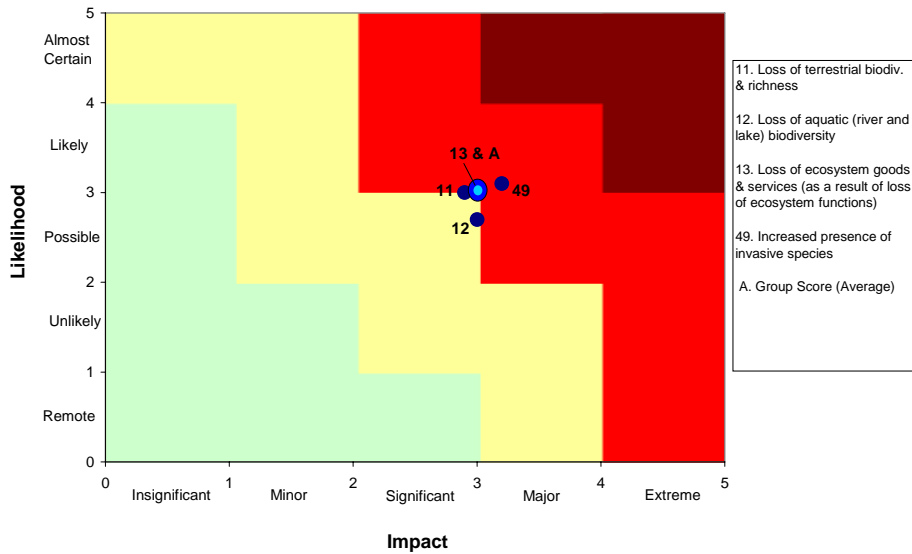
Land Use Aspect



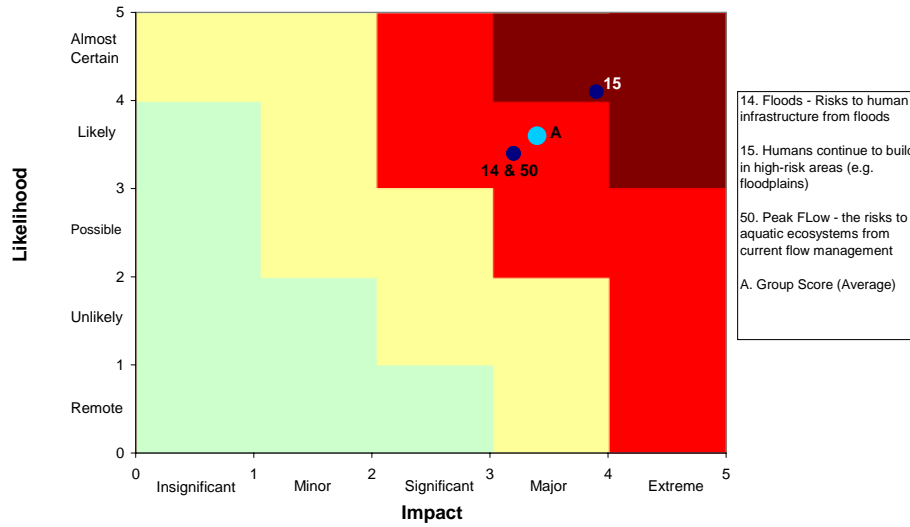
Wetlands



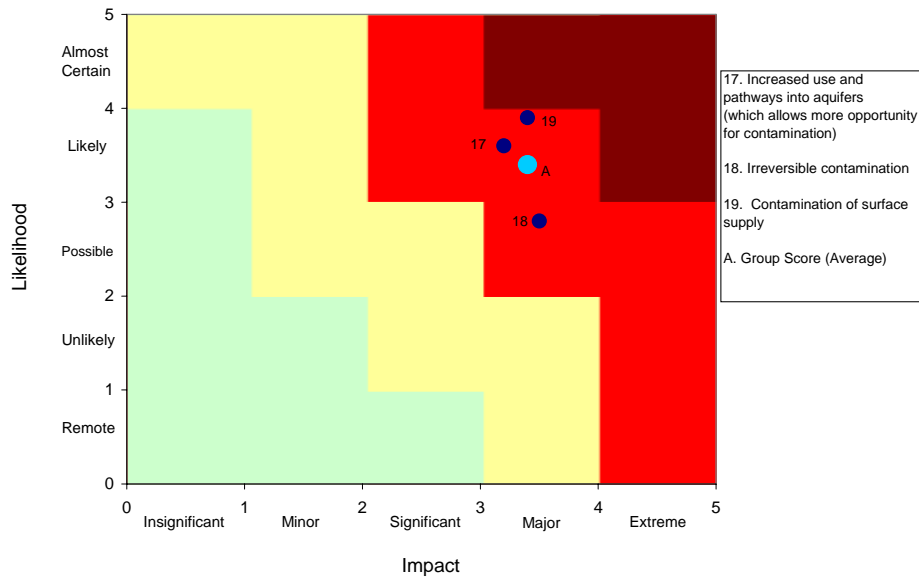
Biodiversity



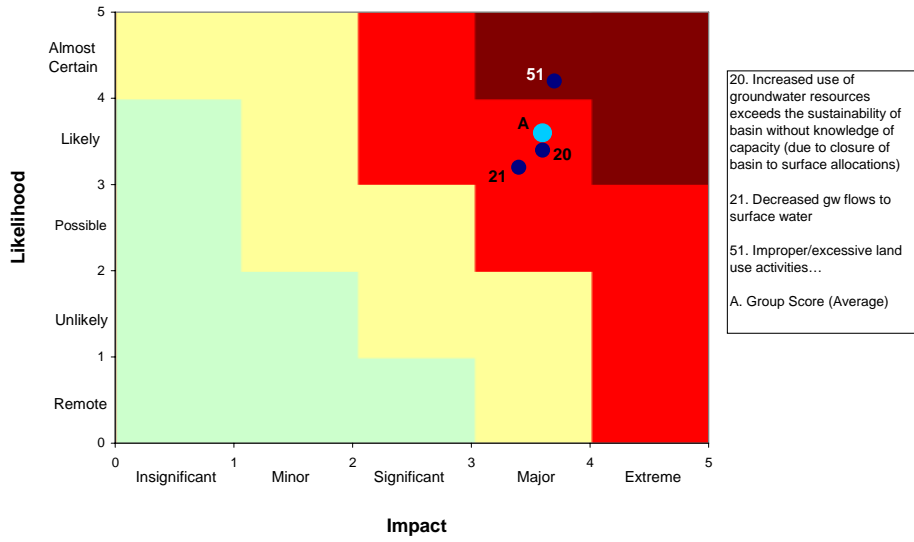
Peak Flow Conditions



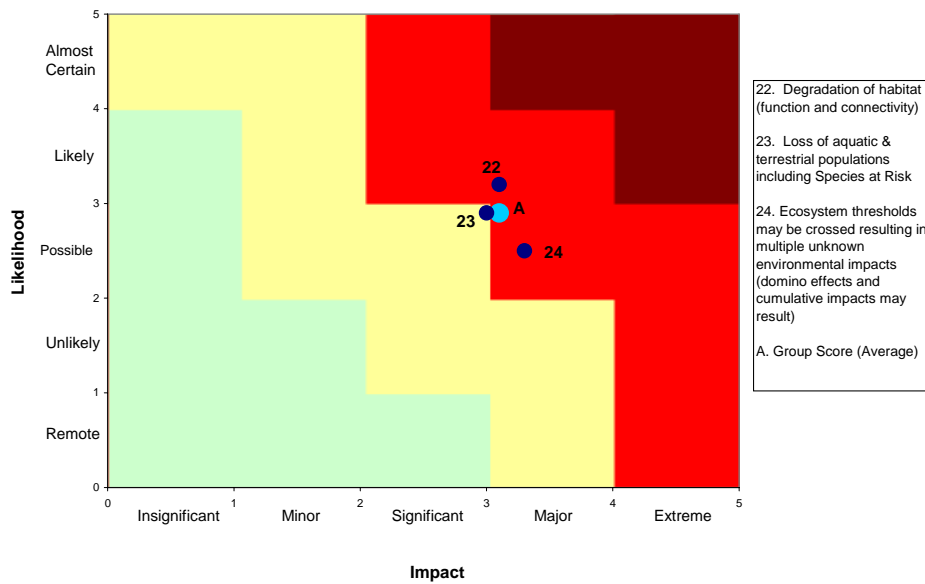
Groundwater Quality



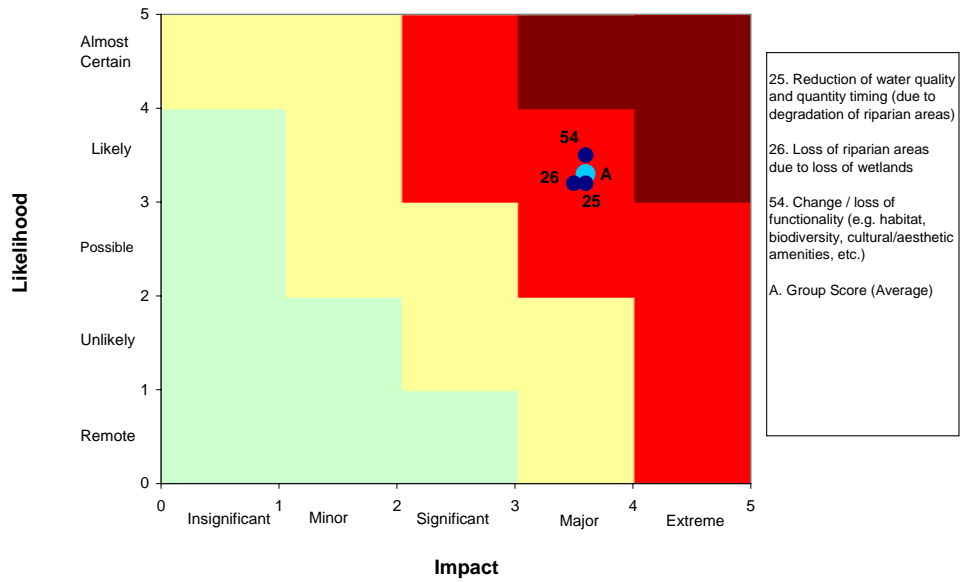
Groundwater Quantity



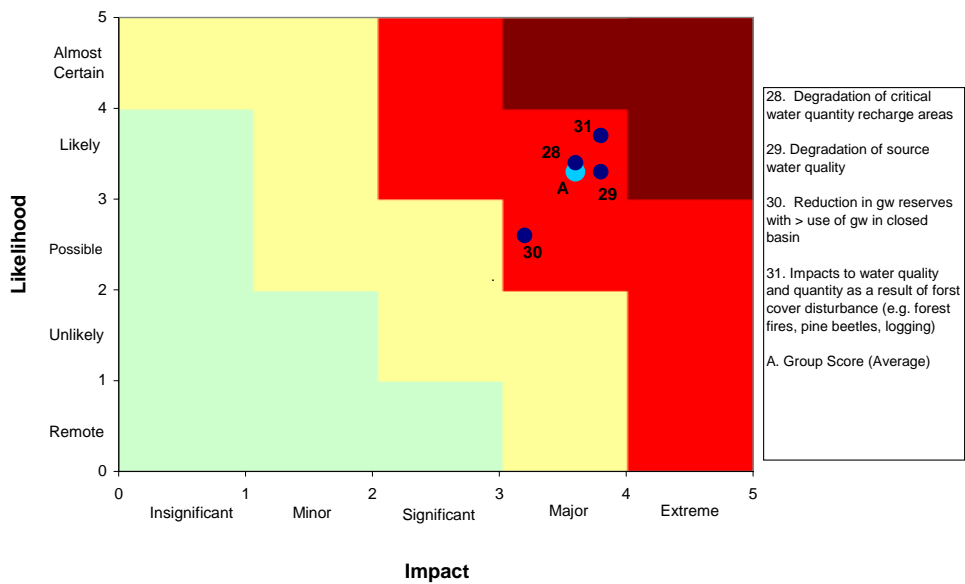
Habitat



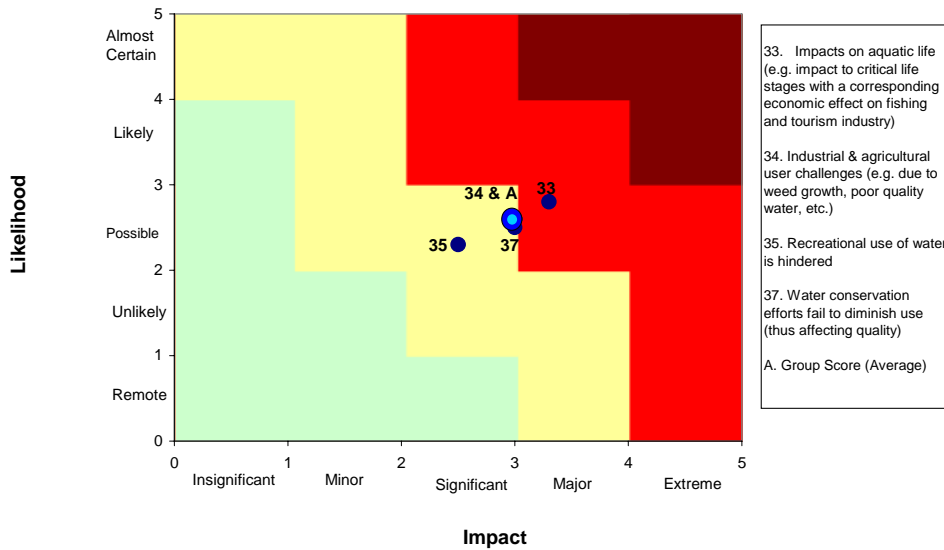
Riparian Areas



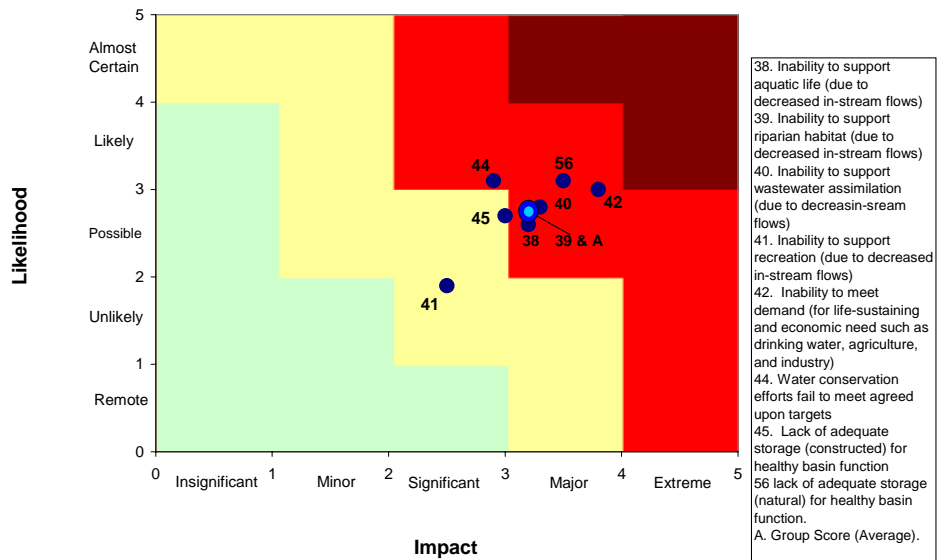
Headwaters



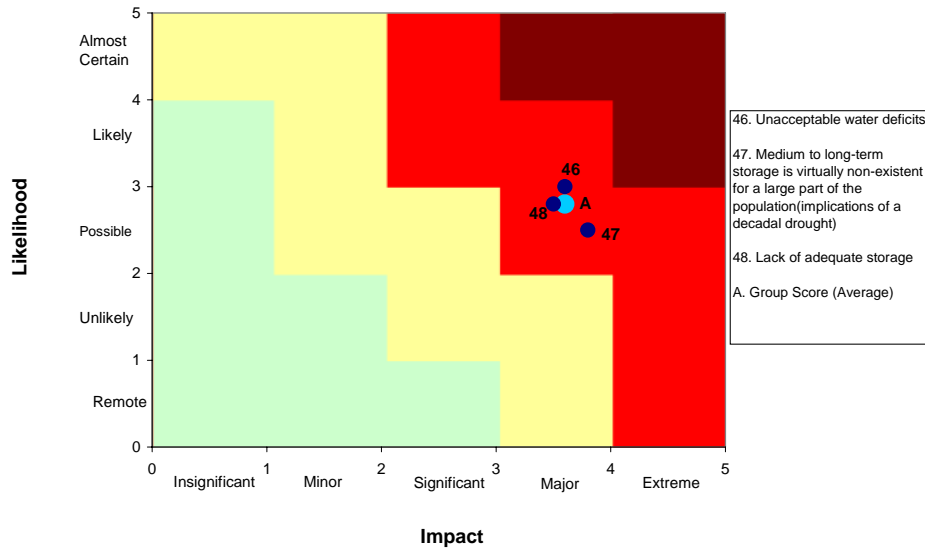
Surface Water Quality



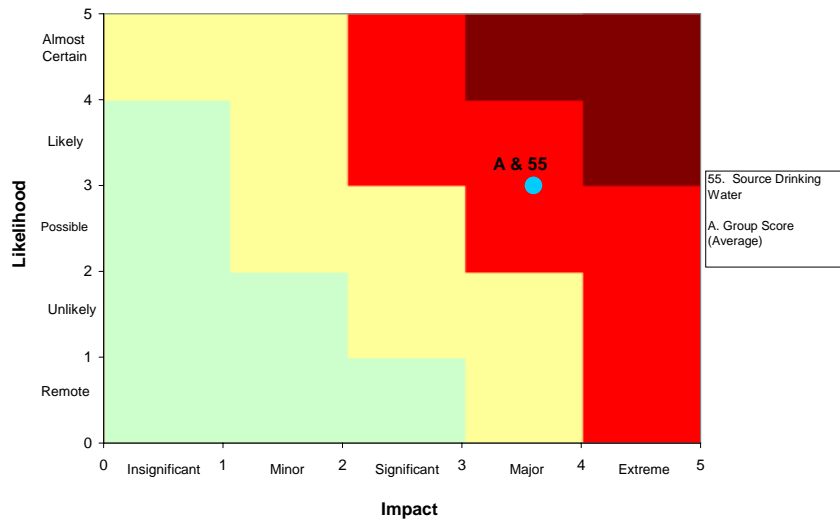
Surface Water Quantity



Water Shortage



Source - Drinking Water



3. Risk Statement Summary of Results

<u>Risk Number</u>	<u>Risk Statement</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Rating</u>	<u>Score</u>
Group: Climate Change		2.7	2.6	Medium	7.0
1	Climate Change - Econ impacts / susceptibility of econ drivers (e.g. sport fishery, dry-land farming, ski-resorts, water intakes for water treatment plants, etc.)	2.5	2.5	Medium	
2	Climate Change - More extreme weather events / more variable river flows (both in magnitude and timing)	3.1	3.1	High	
3	Climate Change - Human Health risk	2.1	2	Medium	
4	Climate Change - Environmental Health Risk	2.9	2.8	Medium	
Group: Land Use & Cover		3.8	3.9	High	14.8
5	Land use - Loss of Eco-sys Goods & Services (e.g. from loss of recharge areas, alluvial aquifers, headwater areas) (as undeveloped or areas with limited development are developed)	3.8	3.9	High	
6	Land use - Irreversible changes to land use (and resulting impacts to water quantity and quality)	4	4.2	Critical	
7	Land use - Loss of sensitive and/or important areas (due to lack of information, poor land use planning or unanticipated cumulative effects)	3.9	4.2	Critical	
52	Loss of cultural Amenities	3.5	3.4	High	
Group: Wetlands		3.4	3.6	High	12.2
8	Wetlands - Reduction of surface water quality and quantity (due to wetland loss and degradation)	3.4	3.7	High	
9	Wetlands - Reduction of GW recharge, quality & quantity (due to wetland loss and degradation)	3.6	3.8	High	
10	Wetlands - Loss of storage and increased flooding within the watershed	3.2	3.4	High	
Group: Biodiversity		3	3	High	9.0
11	Biodiversity - Loss of terrestrial biodiversity & richness	2.9	3	Medium to High	
12	Biodiversity - Loss of aquatic (river and lake) biodiversity (an indicator of compromised aquatic ecosystem health)	3	2.7	Medium to High	
13	Biodiversity - Loss of ecosystem goods & services (as a result of loss of ecosystem functions)	3	3	High	
49	Increased presence of invasive species	3.2	3.1	High	
Group: Peak Flow Regime		3.4	3.6	High	12.2
14	Peak Flow - Floods - Risks to human infrastructure from floods	3.2	3.4	High	
15	Peak Flow- Humans continue to build in high-risk areas (e.g. floodplains)	3.9	4.1	High	
50	Peak Flow - the risks to aquatic ecosystems from current flow management	3.2	3.4	High	
Group: Groundwater Quality		3.4	3.4	High	11.6
17	GW Quality - Increased use and pathways into aquifers (which allows more opportunity for contamination)	3.2	3.6	High	
18	GW Quality - Irreversible contamination	3.5	2.8	High	
19	GW Quality - Contamination of surface supply (e.g. Bragg Creek sewage leaking into Elbow River through groundwater seepage)	3.4	3.9	High	
Group: Groundwater Quantity		3.6	3.6	High	13.0
20	GW Quantity - Increased use of groundwater resources exceeds the sustainability of basin without knowledge of capacity (due to closure of basin to surface allocations)	3.6	3.4	High	

<u>Risk Number</u>	<u>Risk Statement</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Rating</u>	<u>Score</u>
21	GW Quantity - decreased gw flows to surface water	3.4	3.2	High	
51	Improper/excessive land use activities...	3.7	4.2	High	
Group: Habitat		3.1	2.9	High	9.0
22	Habitat - Degradation of habitat (function and connectivity)	3.1	3.2	High	
23	Habitat - Loss of aquatic & terrestrial populations including Species at Risk	3	2.9	Medium	
24	Habitat - Ecosystem thresholds may be crossed resulting in multiple unknown environmental impacts (domino effects and cumulative impacts may result)	3.3	2.5	High	
Group: Riparian Areas		3.6	3.3	High	11.5
25	Riparian Areas - Reduction of water quality and quantity timing (due to degradation of riparian areas)	3.6	3.2	High	
26	Riparian Areas - Loss of riparian areas due to loss of wetlands	3.5	3.2	High	
54	Change / loss of functionality (e.g. habitat, biodiversity, cultural/aesthetic amenities, etc.)	3.6	3.5	High	
Group: Headwaters		3.6	3.3	High	11.9
28	Headwaters - Degradation of critical water quantity recharge areas	3.6	3.4	High	
29	Headwaters - Degradation of source water quality	3.8	3.3	High	
30	Headwaters - Reduction in gw reserves with > use of gw in closed basin	3.2	2.6	High	
31	Headwaters - Impacts to water quality and quantity as a result of forest cover disturbance (e.g. forest fires, pine beetles, logging)	3.8	3.7	High	
Group: Surface Water Quality		3	2.6	Medium	7.8
33	SW Quality - Impacts on aquatic life (e.g. impact to critical life stages with a corresponding economic effect on fishing and tourism industry)	3.3	2.8	High	
34	SW Quality - Industrial & agricultural user challenges (e.g. due to weed growth, poor quality water, etc.)	3	2.6	Medium	
35	SW Quality - Recreational use of water is hindered	2.5	2.3	Medium	
37	SW Quality - Water conservation efforts fail to diminish use (thus affecting quality)	3	2.5	Medium	
Group: Surface Water Quantity		3.2	2.7	High	8.6
38	SW Quantity - Inability to support aquatic life (due to decreased in-stream flows)	3.2	2.6	High	
39	SW Quantity - Inability to support riparian habitat (due to decreased in-stream flows)	3.2	2.7	High	
40	SW Quantity - Inability to support wastewater assimilation (due to decreased in-stream flows)	3.3	2.8	High	
41	SW Quantity - Inability to support recreation (due to decreased in-stream flows)	2.5	1.9	Medium	
42	SW Quantity - Inability to meet demand (for life-sustaining and economic need such as drinking water, agriculture, and industry)	3.8	3	High	
44	SW Quantity - Water conservation efforts fail to meet agreed upon targets	2.9	3.1	High	
45	SW Quantity - Lack of adequate storage (constructed) for healthy basin function	3	2.7	Medium	
56	SW Quantity - lack of adequate storage (natural) for healthy basin function	3.5	3.1	High	
Group: Water Shortage		3.6	2.8	High	10.1
46	Water Shortage - Unacceptable water deficits	3.6	3	High	

<u>Risk Number</u>	<u>Risk Statement</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Rating</u>	<u>Score</u>
47	Water Shortage - Medium to long-term storage is virtually non-existent for a large part of the population(implications of a decadal drought)	3.8	2.5	High	
48	Water Shortage - Lack of adequate storage	3.5	2.8	High	
Group: Source - Drinking Water		3.6	3	High	10.8
55	Drinking Source water - drinking water supplies are threatened	3.6	3	High	

4. Risk Analysis and Decision Support Matrix Consolidated Results

<u>SORT RESULTS</u>	CC	BIO	GQN	GQL	FR	HAB	WS	SQL	WET	HW	SQL	LU	RIP	SDW
DSM %	0.85	0.89	0.89	0.90	0.90	0.92	0.94	0.95	0.95	0.96	0.97	0.99	1.00	
RISK %	0.47	0.61	0.88	0.78	0.82	0.61	0.68	0.53	0.82	0.80	0.58	1.00	0.78	0.73
TOTAL	1.32	1.50	1.77	1.69	1.73	1.52	1.62	1.47	1.77	1.77	1.55	1.99	1.78	0.73
<u>SORT RESULTS</u>	CC	SQL	SQL	BIO	HAB	WS	SDW	RIP	GQL	HW	FR	WET	GQN	LU
SORTED RISK %	0.47	0.53	0.58	0.61	0.61	0.68	0.73	0.78	0.78	0.80	0.82	0.82	0.88	1.00
<u>COMBINED RESULTS</u>	SDW	CC	SQL	BIO	HAB	SQL	WS	GQL	FR	HW	WET	GQN	RIP	LU
SORT TOTAL	0.73	1.32	1.47	1.50	1.52	1.55	1.62	1.69	1.73	1.77	1.77	1.77	1.78	1.99

APPENDIX E: WATERSHED SENSITIVITY, VALUES AND INDICATORS SUMMARY

1. Introduction

A Geographic Information System (GIS) based analysis is being done of the Bow River sub-basin and selected sub-watersheds as a pilot project to try and develop decision-support tools that can assist Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups (WSGs) to understand their watersheds and identify planning priorities. The summary tables and accompanying maps below are the first draft products of the analysis done to date. Further work is still required to review the analysis work done, refine some of the datasets used and consider some different or additional parameters that should be included. A more complete summary document will be written that will include recommendations and options for future work.

2. Methodology

The analysis work done was primarily a GIS-based overlay analysis that attempts to highlight areas within the Bow River sub-basin and selected watersheds that have high cultural, environmental, or social value and can potentially be affected by management decisions. The groups of features selected to be included covered three main themes: groundwater, land and surface water. One of the main criteria used in selecting the individual parameters was that digital data that could be used within a GIS had to be available for the entire Bow River sub-basin to allow comparisons between different areas and sub-watersheds. We were not entirely successful in meeting this criterion, because many of the provincial datasets do not extend into the headwaters portion located in Banff National Park.

The analysis work assigns each of the features with a sensitivity or value ranking from a value of one, the lowest sensitivity/value, to a maximum of three for the highest sensitivity/value. Map algebra was then used to sum all the layers to find the areas of the highest sensitivity or value in the basin. A short description of each dataset and their ranking is outlined below.

3. Groundwater Theme Datasets and Analysis

1. Density of domestic water wells drilled. The dataset used was a selection of all new wells drilled that listed the purpose of the well as being for domestic use in the Alberta Environment Groundwater Information Centre water well drilling database. Rankings were arbitrarily assigned as follows:
 - Less than 5 wells per square km = ranking of 1
 - Five to 20 wells per square km = ranking of 2
 - Over 20 wells per square km = ranking of 3
2. Buffer areas around water well locations licensed for municipal and other multi-party use. Water well locations were derived from the Alberta Environment Environmental Management System database that stores information on licensed water allocations made under the provisions of the provincial Water Act. Buffer area rankings were arbitrarily assigned around the well location as follows:
 - 0 to 500 metres = ranking of 3
 - 501 to 1,000 metres = ranking of 2
 - 1001 to 1,500 metres = ranking of 1
3. Groundwater vulnerability to contamination from the surface. A dataset existed that had assigned groundwater vulnerability rankings based on surficial geology characteristics that had been previously mapped by Alberta Geological Survey. It should be noted that the vulnerability mapping does not actually map aquifers, just that if groundwater was present it would be the overlying surficial geology would have the assigned potential for contaminants to reach the water.
 - Vulnerability Category of Low or Moderate = ranking of 1
 - Vulnerability Category of High = ranking of 2
 - Vulnerability Category of Extremely High = ranking of 3

4. Land Theme Datasets and Analysis

1. Remaining areas with patches of native land cover (derived from the Agriculture and Agri-Foods Commission land cover with land use footprints removed using provincial base features data). This feature was chosen because areas of native land cover provide higher quantities and qualities of ecosystem services that provide societal benefit. Larger patch sizes of native cover provide more of those services.
 - Two ha or less = ranking of 1
 - Greater than 2h to 100 ha = ranking of 2
 - Greater than 100 ha = ranking of 3
2. Parks and protected areas. Provincial base features dataset of Parks and Protected areas, including National Parks, Provincial Parks, Recreational areas, Heritage Rangelands, Natural Areas, Wilderness areas and Wildland Parks. Sensitivity/value rankings were assigned based on the types of developments and use that they allow as follows:
 - Recreation Areas = ranking of 1
 - National Parks, Provincial Parks and Heritage Rangeland = ranking of 2
 - Wildland and Wilderness Parks = ranking of 3
3. Slopes Unsuitable for Development. Using provincial 1:20,000 Digital Elevation Model (DEM), identified areas that may be unsuitable for municipal type development purposes using the following categories:
 - 0% to 7% = ranking of 1

- 7% to 15% = ranking of 2
 - Greater than 15% = ranking of 3
4. Potential bird and animal species richness. This feature assigns a value to a location based on a matrix table that links species range maps and associated coarse habitat land cover categories for 250 bird and animal species. If a suitable land cover is present and it is within a species known range, then potentially the species could occur there. Rankings were assigned as follows:
 - Potential species <50 = ranking of 1
 - Potential species 51-100 = ranking of 2
 - Potential species >100 = ranking of 3
 5. Land suitability rating for production of spring-seeded small grain crops. A rating system developed by Alberta Agriculture and Agriculture and Agri-food Canada that considers climate, soils and landscape for the production of spring-seeded small grain crops like wheat. The ratings are mapped based on Alberta Agriculture's AGRASID digital soil database polygons. Sensitivity/value rankings were assigned as follows:
 - Suitability Class 5 to 7 = ranking of 1
 - Suitability Class 4 = ranking of 2
 - Suitability Class 1 to 3 = ranking of 3

5. Surface Water Datasets and Analysis

1. Upstream areas contributing to surface water intakes for municipal water use purposes. Surface water intake locations were obtained from Alberta Environment's EMS database for licensed water allocations. A distance of 20 kilometres upstream and for 250 on either side of the watercourse was then designated as an intake buffer zone, such that the following ranking was assigned:
 - 20 kilometres and 250 m on each side of stream buffered = ranking of 3
 - Remainder of upstream watershed = ranking of 0
2. Code of Practice Fish-bearing Stream classification. A classification system of watercourses developed by Sustainable Resource Development for Alberta Environment's Codes of Practice under the provisions of the Water Act that regulate instream construction activities. A CoP dataset is available from SRD's Resource Information Management Branch. The CoP classifications were ranked as follows:
 - Class D (non-fish bearing) = ranking of 1
 - Class C (fish-bearing) = ranking of 2
 - Class A or B (sensitive fish-bearing) = ranking of 3
3. Riparian area buffering. A simple buffering of 30, 60 and 90 metres was completed on the base feature single line hydro network and hydro polygon datasets. Rankings were arbitrarily assigned as follows:
 1. 0 to 30 metres = ranking of 3
 2. 31 to 60 metres = ranking of 2
 3. 61 to 90 metres = ranking of 1

6. Other Datasets and Analysis

In addition to the analysis work done above, the data summary tables also include some additional watershed pressure indicator results: groundwater and surface water allocations, wetland density and road density. Datasets and analysis for these indicators were as follows:

1. Groundwater Allocations. Total volume of groundwater allocated from wells located within the indicated area or watershed from EMS database records.
2. Surface Water Allocations. Total volume of surface water allocated from EMS database records for a particular portion of the sub-basin or a sub-watershed as a percentage of the calculated mean natural flow. For Bow mainstem areas, the calculated percentage is based on the cumulative upstream allocations on the mainstem and tributaries.
3. Wetland Density. The summed area of wetlands (includes recurring lakes, oxbows and wetlands) in the SRD base feature hydro polygons dataset divided by the total area in a mainstem contributing area or tributary watershed area. It is acknowledged that this dataset is a very 'coarse' wetland dataset and is known to under represent wetlands, but such under representation should not be biased between different parts of the Bow sub-basin and the way the results are portrayed, should still be useful for this exercise.
4. Road Density. The summed lengths of all roads (including undesignated truck trails) in kilometers within the Base Features Access dataset, divided by the mainstem contributing area or tributary watershed area in square kilometers.

7. Results and Summary

Tables 1 and 2 below provide a summary of the feature results from the GIS analysis work. A colour code of red is assigned for the worst 20% of values for the 15 areas assessed. A colour code of yellow is assigned for the middle 60% of values and a colour code of green to the best 20% of values. An exception to this was used for surface water allocations, where red was used if allocations were more than 30% of mean annual natural flow, yellow if allocations were more than 15% of mean natural flow and green for less than 15% based on scientific literature describing the relationship between increasing water use and effects on the aquatic environment. Similarly, for road density, densities of more than 1.0 kilometre/kilometre² were colour coded red, between 0.7 and 1.0 km/km² were colour coded yellow and less than 0.7 km/km² were colour coded green based on published relationships between road densities and ecological integrity of watersheds.

Maps are also provided showing where the highest ranked areas are within the Bow River sub-basin for the three theme areas and all three combined. Lower spatial scale maps are included for the Elbow River watershed and similar maps are available in Adobe Acrobat pdf formats for the other watersheds.

8. Rankings for Bow River Mainstem Areas

Bow River Basin Watershed Sensitivity, Values and Indicator Rankings for Bow River Mainstem Areas

(See document text for feature descriptions.)

Features	Upper Bow	Seebe to Ghost	Ghost To Bearspaw	WID to Highwood	Highwood to Carseland	Carseland to Bassano	Bassano to Mouth
Groundwater							
GW Vulnerability	15 of 15	1 of 15	6 of 15	13 of 15	12 of 15	11 of 15	8 of 15
GW Municipal Well Buffer Area	11 of 15	13 of 15	6 of 15	1 of 15	12 of 15	8 of 15	14 of 15
GW Domestic Well Density	14 of 15	5 of 15	7 of 15	1 of 15	15 of 15	11 of 15	15 of 15
GW License	5 of 15	15 of 15	8 of 15	1 of 15	11 of 15	4 of 15	10 of 15

Allocations	15	15					
Surface Water							
Municipal Intake Buffer Area	9 of 15	14 of 15	2 of 15	8 of 15	7 of 15	13 of 15	12 of 15
CoP Fish-bearing streams ¹	10 of 15	14 of 15	11 of 15	13 of 15	12 of 15	9 of 15	12 of 15
Riparian Buffer Area	9 of 15	10 of 15	8 of 15	13 of 15	14 of 15	12 of 15	15 of 15
Wetland Density	8 of 15	5 of 15	4 of 15	3 of 15	9 of 15	7 of 15	1 of 15
Water License Allocations	0.4%	0.4%	2.6%	16.9%	20.5%	60.1%	60.7%
Land							
Natural Vegetation Patch Area	1 of 15	4 of 15	9 of 15	15 of 15	14 of 15	13 of 15	10 of 15
Park Area	2 of 15	7 of 15	14 of 15	10 of 15	9 of 15	13 of 15	11 of 15
Undevelopable Slope Area	2 of 15	8 of 15	10 of 15	11 of 15	14 of 15	15 of 15	13 of 15
Potential Number of Species Present	3 of 15	5 of 15	10 of 15	15 of 15	13 of 15	12 of 15	11 of 15
High Value Cropland Area	14 of 15	12 of 15	8 of 15	3 of 15	1 of 15	2 of 15	9 of 15
Road Density (km/km ²)	0.18	1.34	1.56	1.88	0.99	0.99	0.68

¹ AENV/SRD Code of Practice classification of watercourses for instream construction activities.

9. Rankings for Bow River Sub-Watersheds

Bow River Basin Watershed Sensitivity, Values and Indicator Rankings
for Selected Bow River Sub-watersheds

(See document text for feature descriptions.)

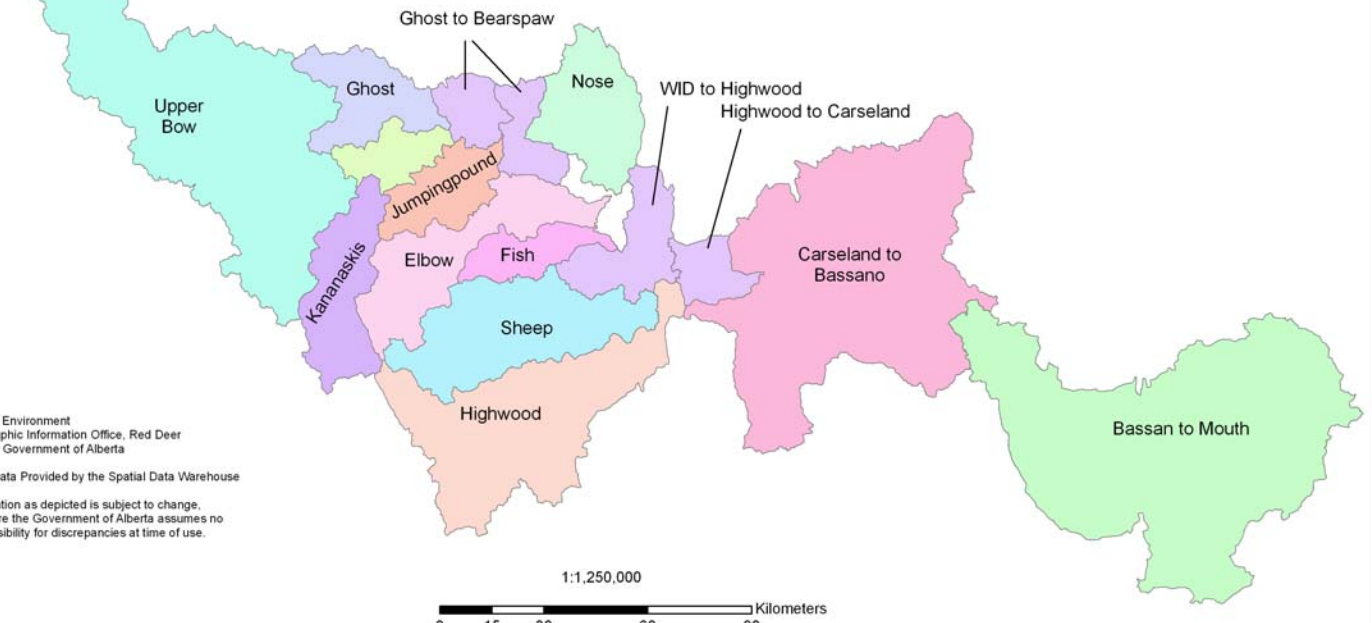
Features	Elbow River	Fish Creek	Ghost River	Highwood River	Jumping-pound Creek	Kananaskis River	Nose Creek	Sheep River
Groundwater								
GW Vulnerability	4 of 15	9 of 15	3 of 15	7 of 15	5 of 15	2 of 15	14 of 15	10 of 15
GW Municipal Well Buffer Area	4 of 15	2 of 15	14 of 15	9 of 15	10 of 15	7 of 15	3 of 15	5 of 15

GW Domestic Well Density	6 of 15	2 of 15	10 of 15	8 of 15	13 of 15	12 of 15	4 of 15	3 of 15
GW License Allocations	7 of 15	13 of 15	14 of 15	3 of 15	12 of 15	2 of 15	9 of 15	6 of 15
Surface Water								
Municipal Intake Buffer Area	3 of 15	1 of 15	6 of 15	5 of 15	15 of 15	10 of 15	11 of 15	4 of 15
CoP Fish-bearing streams ¹	4 of 15	9 of 15	8 of 15	1 of 15	7 of 15	6 of 15	15 of 15	3 of 15
Riparian Buffer Area	3 of 15	4 of 15	7 of 15	1 of 15	6 of 15	5 of 15	11 of 15	2 of 15
Wetland Density	12 of 15	15 of 15	13 of 15	11 of 15	6 of 15	10 of 15	2 of 15	14 of 15
Water License Allocations	42.9%	4.3%	18.9%	15.7%	1.5%	0.2%	11.9%	2.5%
Land								
Natural Vegetation Patch Area	6 of 15	11 of 15	2 of 15	5 of 15	7 of 15	3 of 15	12 of 15	8 of 15
Park Area	3 of 15	8 of 15	4 of 15	6 of 15	12 of 15	1 of 15	14 of 15	5 of 15
Undevelopable Slope Area	4 of 15	9 of 15	3 of 15	5 of 15	7 of 15	1 of 15	12 of 15	6 of 15
Potential Number of Species Present	6 of 15	9 of 15	1 of 15	8 of 15	2 of 15	4 of 15	14 of 15	7 of 15
High Value Cropland Area	10 of 15	5 of 15	15 of 15	7 of 15	11 of 15	13 of 15	4 of 15	6 of 15
Road Density	0.746	1.28	0.387	0.546	0.642	0.314	1.817	0.972

¹ AENV/SRD Code of Practice classification of watercourses for instream construction activities.

[10. Maps](#)

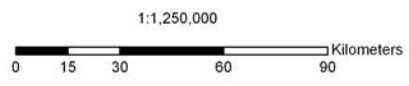
Bow River Watershed Sensitivity and Values Mapping Mainstem Areas and Tributary Watersheds



Alberta Environment
Geographic Information Office, Red Deer
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Base Data Provided by the Spatial Data Warehouse

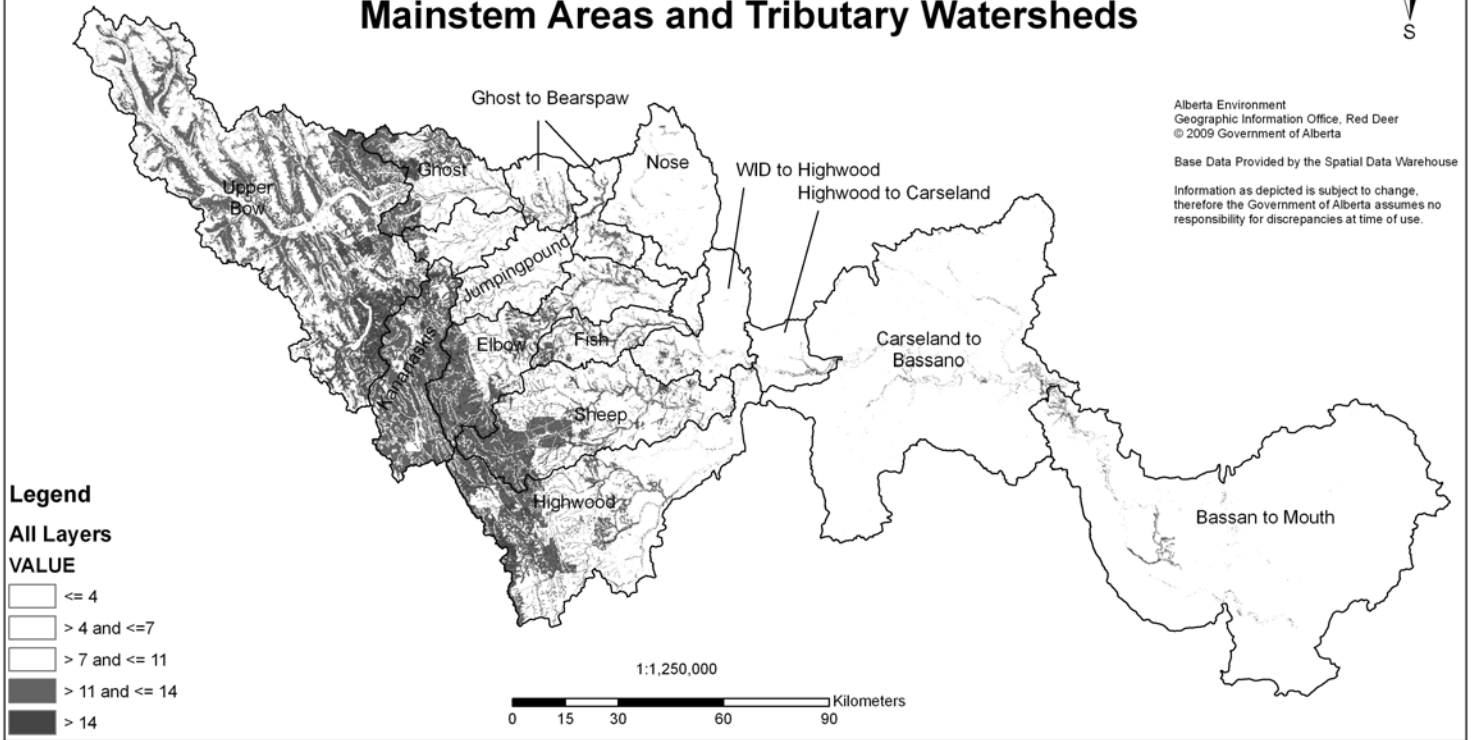
Information as depicted is subject to change,
therefore the Government of Alberta assumes no
responsibility for discrepancies at time of use.



Bow River Watershed Sensitivity and Values Mapping Mainstem Areas and Tributary Watersheds



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Legend
All Layers
VALUE

[Lightest Gray Box]	<= 4
[Light Gray Box]	> 4 and <=7
[Medium Gray Box]	> 7 and <= 11
[Dark Gray Box]	> 11 and <= 14
[Darkest Gray Box]	> 14

Maximum possible values = 9 for Groundwater layers, 9 for Surface Water layers, 12 for Land layers and 30 for all combined.

Bow River Watershed Sensitivity and Values Mapping Mainstem Areas and Tributary Watersheds

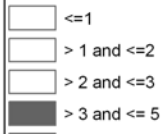


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Legend

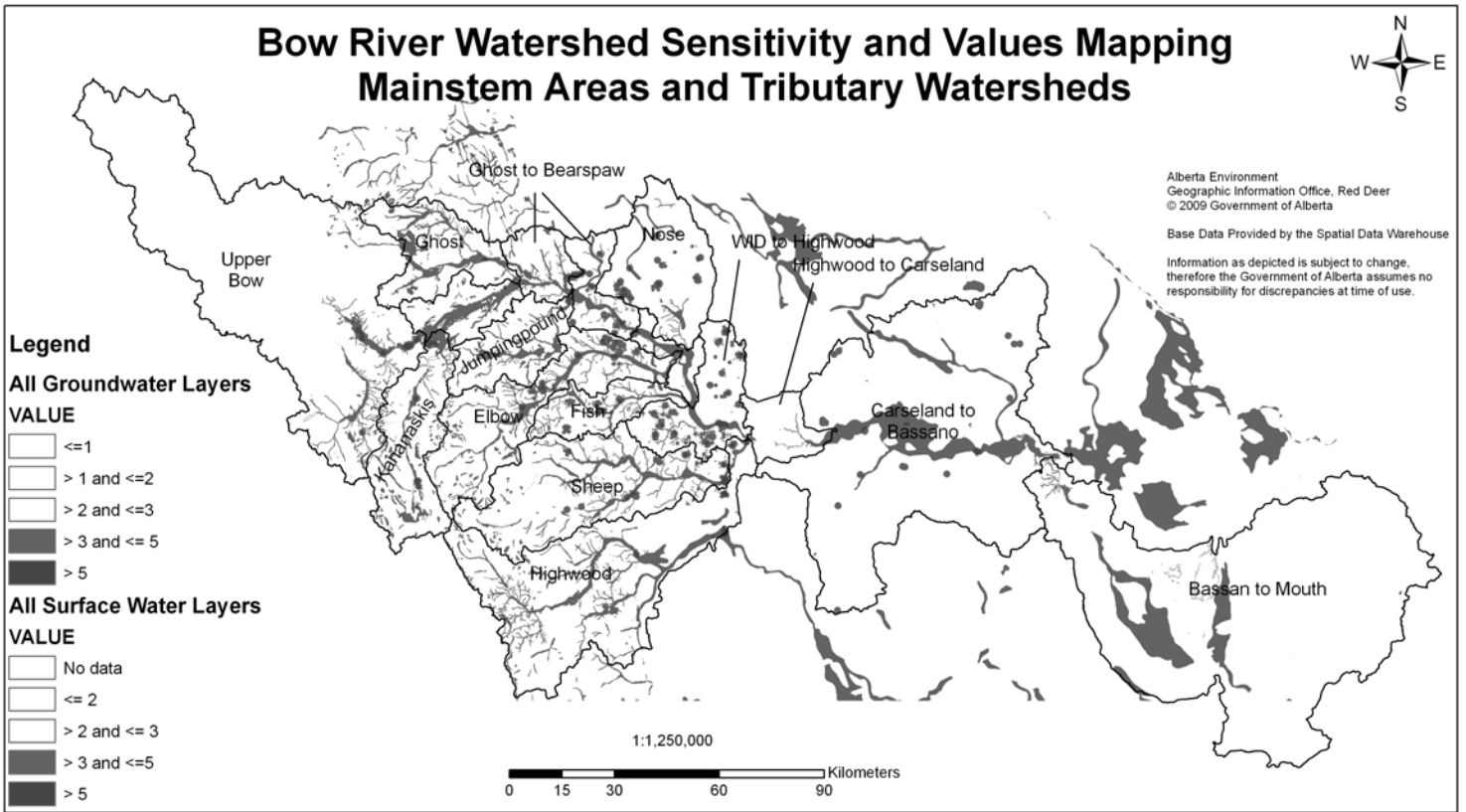
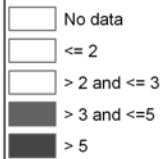
All Groundwater Layers

VALUE



All Surface Water Layers

VALUE

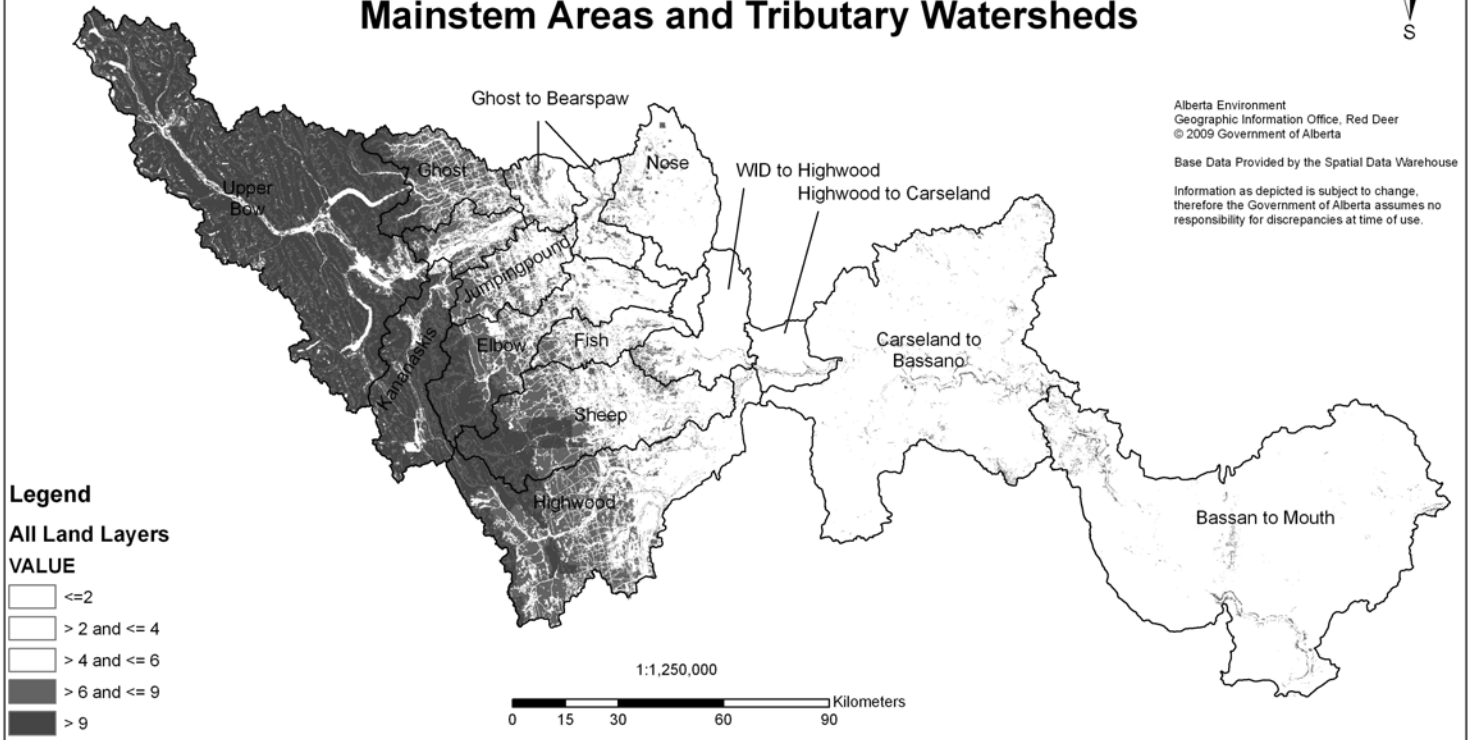


Maximum possible values = 9 for Groundwater layers, 9 for Surface Water layers, 12 for Land layers and 30 for all combined.

Bow River Watershed Sensitivity and Values Mapping Mainstem Areas and Tributary Watersheds



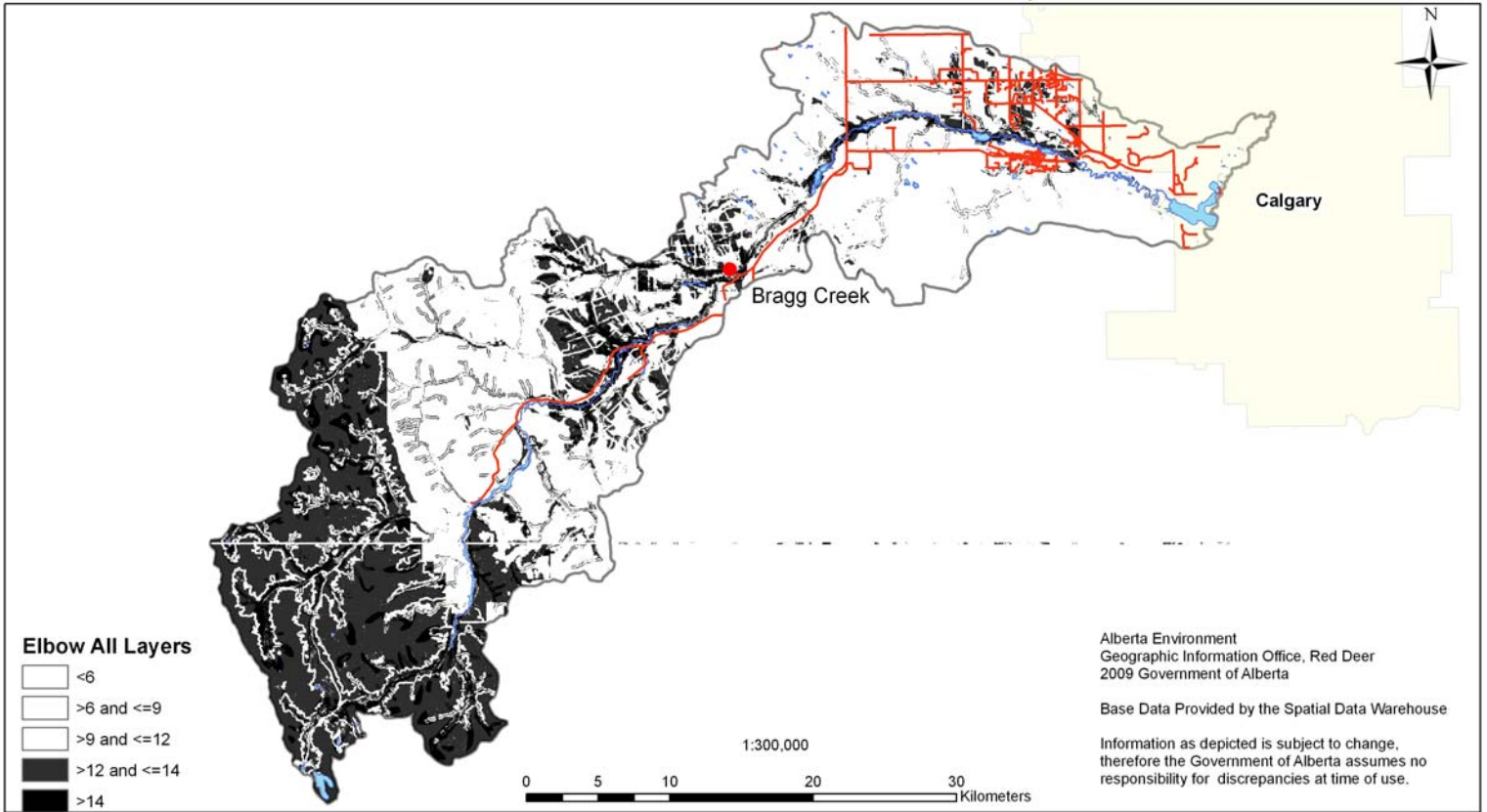
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- Legend**
All Land Layers
VALUE
- <=2
 - > 2 and <= 4
 - > 4 and <= 6
 - > 6 and <= 9
 - > 9

Maximum possible values = 9 for Groundwater layers, 9 for Surface Water layers, 12 for Land layers and 30 for all combined.

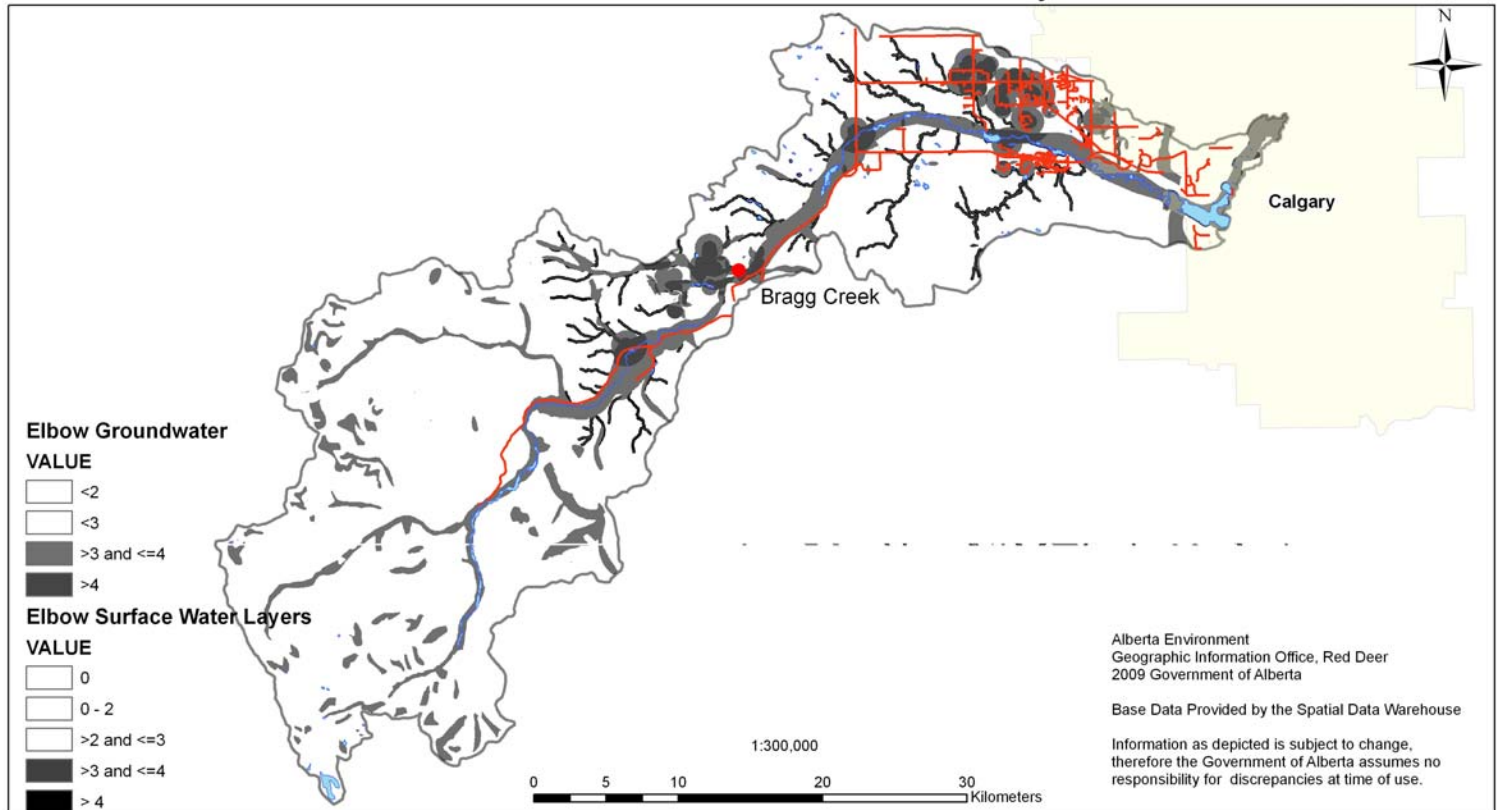
Elbow River Watershed - Watershed Sensitivity and Values



Maximum possible values = 9 for Ground Water, 9 for Surface Water, 12 for Land and 30 for all combined.

* Road highlighted in red for reference purposes.

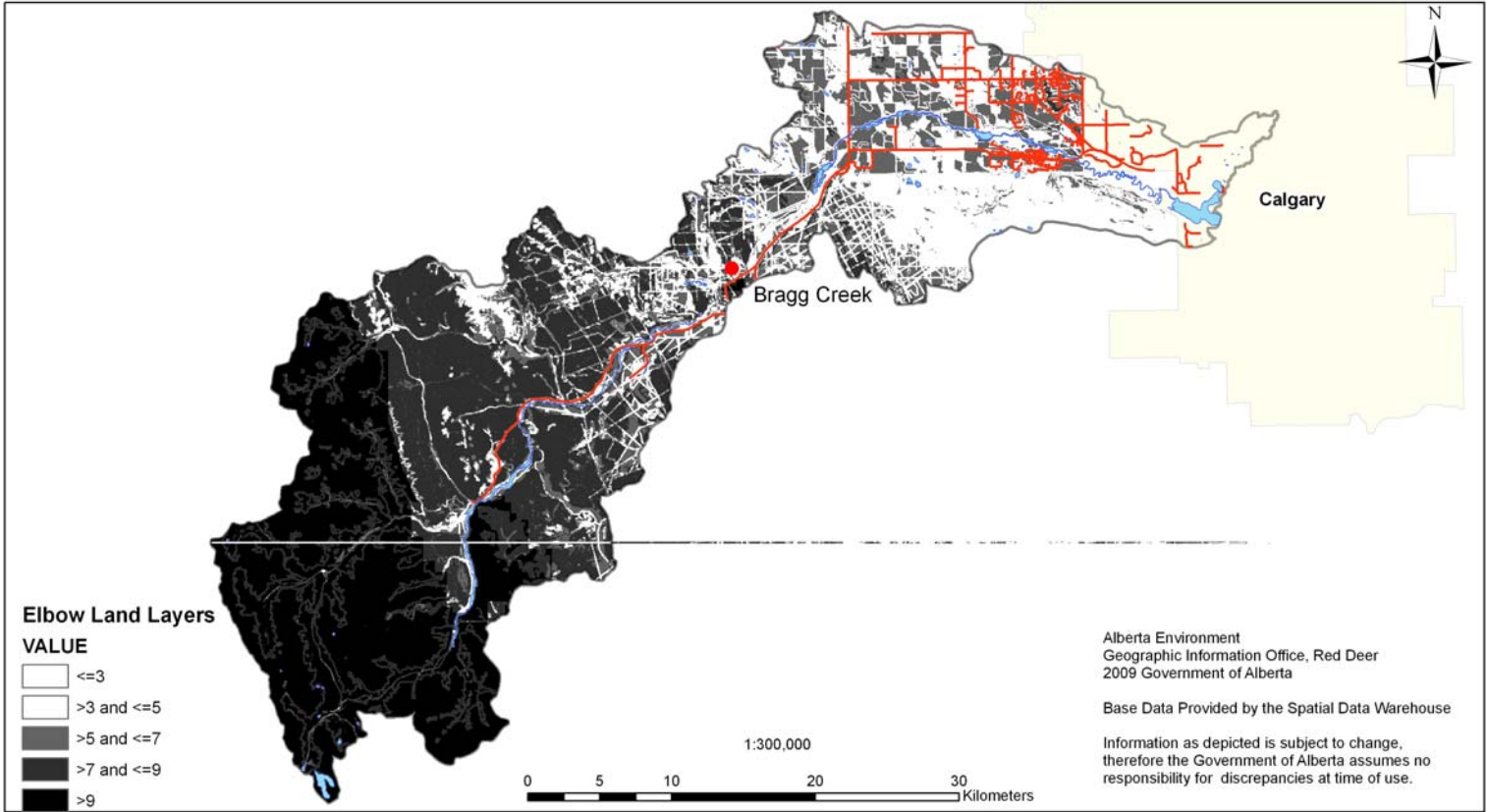
Elbow River Watershed - Watershed Sensitivity and Values



Maximum possible values = 9 for Ground Water, 9 for Surface Water, 12 for Land and 30 for all combined.

* Road highlighted in red for reference purposes.

Elbow River Watershed - Watershed Sensitivity and Values



Maximum possible values = 9 for Ground Water, 9 for Surface Water, 12 for Land and 30 for all combined.

* Road highlighted in red for reference purposes.

The full Watershed Sensitivity, Values and Indicators Summary report is scheduled for release by Alberta Environment by the end of June 2009. Additional maps and information for other sub-basins will be included in the full report.