ALBERTA WATER COUNCIL

NOVEMBER 2009

Provincial Ecological Criteria for Healthy Aquatic Ecosystems

Recommendations from the Alberta Water Council

About the Alberta Water Council

The Alberta Water Council is a multi-stakeholder partnership with members from governments, industry and non-government organizations. All members have a stake in water. The Alberta Water Council is one of three types of partnerships established under the *Water for Life* strategy: the others are Watershed Planning and Advisory Councils and Watershed Stewardship Groups.

The Alberta Water Council regularly reviews implementation progress of the *Water for Life* strategy and champions the achievement of the strategy's goals. The Council also advises the Government of Alberta, stakeholders and the public on effective water management practices, solutions to water issues and priorities for water research. The Council may advise on government policy and legislation. However, the Government of Alberta remains accountable for the implementation of the *Water for Life* strategy and continues to administer water and watershed management activities throughout the province.

Alberta Water Council
14th Floor, Petroleum Plaza South Tower
9915 – 108 Street
Edmonton, AB T5K 2G8

Tel: 780.644.7380
Fax: 780.644.7382

Email: info@awchome.ca
Web: www.awchome.ca

Contents

Introduction

> "Healthy aquatic ecosystems are vital to a high quality of life for Albertans and must be preserved."
>
> *Water for Life (2003)*

In December 2008, the Alberta Water Council (AWC) defined a *healthy aquatic ecosystem* as:

> "*…an aquatic environment that sustains its ecological structure, processes, functions and resilience within its range of natural variability.*"

This consensus definition and a supporting document were developed to guide further work to achieve the *Water for Life* outcome of "healthy aquatic ecosystems." The AWC next identified a number of projects that would benefit aquatic ecosystems in Alberta. (See *Recommended Projects to Advance the Goal of Healthy Aquatic Ecosystems*.) Recommendation #8 of the AWC report recognizes the need to identify areas within a watershed that are significant to the maintenance of aquatic ecosystem health. In June 2009, the AWC agreed to undertake work on the above recommendation.

Specifically, the project objective is to:

> *"Select, modify or develop up to ten provincial ecological criteria to aid and guide the identification of areas within Alberta's watersheds that substantially contribute to the maintenance of aquatic ecosystem health."*

The AWC focused on developing ecological criteria. Social, cultural and economic factors were not a consideration in this initial work but will be discussed in other planning processes.

Ecological criteria could include the presence of rare, sensitive species; high biodiversity or unique physical features. Key areas that supply the water quantity and water quality necessary to maintain these ecological features are also important. For example, Wagner Natural Area, a wetland fen northwest of Edmonton, has several unique physical and biological characteristics and is, potentially, a "significant aquatic ecosystem." The source of water that allows Wagner to exist (an underlying aquifer with a catchment basin to the south) may be an important "area contributing to aquatic ecosystem health."[1]

1 For more information on Wagner Natural Area, see http://wagner.fanweb.ca/.

Healthy aquatic ecosystems are important to everyone. Although this project to develop criteria is a first step, it will lead to the development of tools to highlight areas that substantially contribute to aquatic ecosystem health and possibly, areas requiring specific management actions. In turn, such tools can inform decision-making by governments, stakeholders, conservation groups, landowners and others living and working in the watershed. They can also inform large regional and watershed planning processes under the *Land Use Framework* and *Water for Life*, where decisions about growth and development will be made in fair, open and transparent processes and where social, environmental and economic factors will be considered. Finally, by developing these criteria, the AWC is acting to support the integration of land and water management in Alberta.

Process

To build on existing opportunities and work within the timelines and resources available, the AWC adopted the Systematic Conservation Planning (SCP) methodology used by the Government of Alberta (GOA) in their update of the Environmentally Significant Areas (ESA) program.[2] SCP is a process of identifying, prioritizing, implementing and managing areas that are important, through a scientifically rigorous, transparent and repeatable process, in order to achieve desired objectives (Figure 1).

With the objective of identifying *"areas in Alberta's watersheds that substantially contribute to aquatic ecosystem health"* (Step 1), the work of the AWC and content of this report is intentionally focused on building ecological criteria (Step 2). It does not include the subsequent steps of the SCP process (*e.g.*, the data, "rules" or other mapping considerations needed for Steps 3, 4 and 5). However, the GOA and other decision makers will be informed by these criteria in their subsequent work to produce and utilize a mapping tool for use in regional, watershed and other planning processes (Step 6).

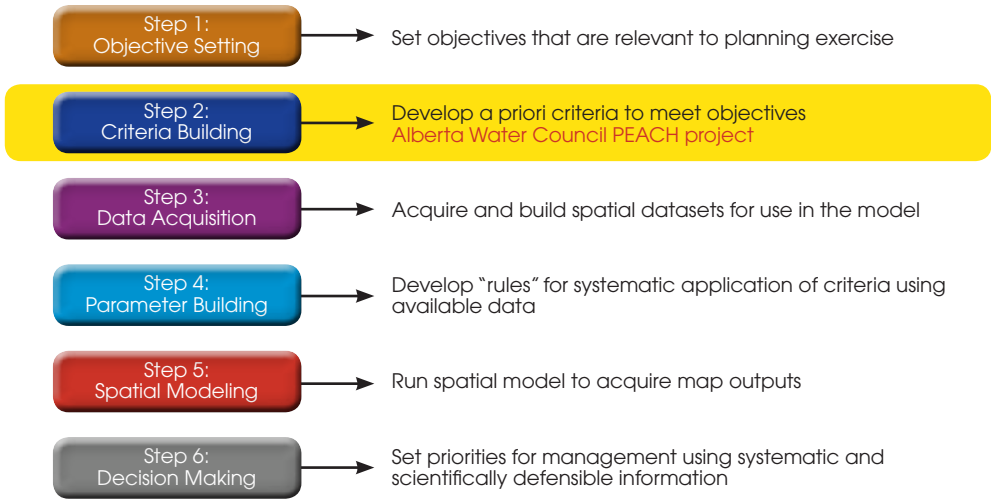

Figure 1 — Steps in the Systematic Conservation Planning Framework

2 For more information on the SCP program, see http://tpr.alberta.ca/parks/heritageinfocentre/environsigareas/default.aspx.

Before undertaking this work, the AWC benefitted from a review of the scientific literature and synthesis of similar work in other jurisdictions undertaken by Fiera Biological Consulting (2009). The objectives of the Fiera report included:

1. Providing a general overview of how aquatic values are included in land-use planning processes such as the Environmentally Significant Areas (ESA) in Alberta, as well as examples from Ontario and British Columbia;
2. Outlining the process of Systematic Conservation Planning (SCP);
3. Describing the application of SCP principles to aquatic ecosystems, with examples from Missouri and Australia; and
4. Describing nine potential criteria that may be used to identify Significant Aquatic Ecosystems in Alberta. These criteria, along with the GOA's ESA aquatic criterion, were considered through a multi-stakeholder consensus perspective as input to this AWC report.

Finally, an earlier draft of this AWC report was provided to member sectors for review and input before a final document was provided to the Board for approval. The primary audiences for this document are the GOA, members of the AWC and other *Water for Life* partnerships; however, other organizations or jurisdictions undertaking similar work may find this approach of interest.

Considerations for Building Criteria

Before developing a set of criteria, a number of issues involving the scope and scale of the project were discussed. To begin with, it was recognized that aquatic ecosystems are important in and of themselves. That is, they have intrinsic value and contribute to the overall function of Alberta's watersheds and landscapes. They are also valuable to the species found in and around them by performing tasks like water filtration or by providing habitat. To ensure these values are sustained, all aquatic ecosystems in Alberta should be managed appropriately. Currently, there are many processes for managing Alberta's aquatic ecosystems; however, to assist in planning and prioritization, the application of criteria can be used as an additional tool to help focus efforts and resources to where they are best utilized.

Water, by its very nature, percolates throughout the entire landscape and is difficult to separate from terrestrial ecosystems. For the purposes of this report, criteria would be applied to all aquatic ecosystems including mainstem rivers and their tributaries, lakes and ponds, wetlands, aquifers and other groundwater features, whether the duration of water cover is permanent or not. Also recognized are the connection of these water bodies with their bed and shore including the floodplain and riparian edge; the influence of uplands on aquatic ecosystems; and the influence of climatic factors (*e.g.,* snowpack). Together, these components of the hydrological cycle are all connected. The integrity of these connections is important for aquatic health and for the management of aquatic ecosystems.

The term "criteria" can have several definitions. In general, criteria are an important characteristic or accepted standard used in making a decision or judgment about something. In the SCP process, criteria are elements of biological and physical diversity that will be the focus of planning efforts. Since it is impractical (if not impossible) to plan for all elements of diversity, a broad range of criteria are generally selected to serve as surrogate measures of biodiversity and ecological function. Criteria should be measurable with targets and indicators and supported by data. However, criteria selection was not limited on the basis of whether or not data is currently available. While this report presents general guidance, further refinement of the criteria will occur in subsequent steps of the SCP process.

While the focus was on identifying areas that contribute to aquatic ecosystem health, several indicators of risk were also discussed as being important for informing mitigation and management. Thus, both aquatic ecosystem function, and conversely, risks to function may be reflected in the criteria or their indicators.

Criteria

Based on the above considerations, seven criteria are proposed below. Rationale for selecting these criteria is that, individually and collectively, the areas identified by these criteria will contribute to the following outcomes:

- Aquatic biodiversity is maintained through species-at-risk management and prevention.
- Aquatic ecosystem functions are maintained.
- The ecological and hydrological integrity of Alberta's watersheds are sustained.
- Rare and unique aquatic elements are maintained.
- A diversity of aquatic ecological benchmarks exists and provides areas for further research and understanding.
- The conservation and existence values of Alberta's aquatic ecosystems are recognized.

Criterion #1	Presence of focal aquatic species and their habitat
Description	An area with the presence of a "focal" aquatic species or its habitat. Focal aquatic species are generally common and wide-ranging and may include invertebrates, amphibians, fish, plants or birds. They are representative of their ecosystem or parts of their ecosystem (indicator species), are wide ranging with ecosystem requirements that encompass other species (umbrella species), or have a critical function in maintaining ecological structure (keystone species).
Rationale	Areas identified with focal species and their habitats will capture important elements of aquatic biodiversity, as well as ecosystem structures and processes that serve to maintain the broader function of the ecosystem. For example, the presence of young Cottonwoods along a river bank can be indicative of a fluctuating flow regime. Cottonwoods depend on early spring floods to create bare ground on riverbanks suitable for seedling establishment.
Possible Indicators and Data Sources	Focal species are a measure that the aquatic ecosystem they are a part of is functioning and healthy. Because there are a large number of focal species, but not a lot of population data, umbrella, keystone or indicator species may be used to identify areas important for all focal species. Potential focal species could include: • Umbrella aquatic species: Northern Pike • Keystone aquatic species: Beaver • Indicator aquatic species: Cottonwoods Data sources include the *General Status of Alberta Wild Species 2005*; Fish and Wildlife Management Information System (FWMIS); and Alberta Natural History Information Centre (ANHIC).
Further Guidance	The presence of focal species and their habitat may be too broad to identify discrete areas important to maintaining aquatic ecosystem health (*e.g.*, not all areas with a focal species will be significant). Therefore, to refine further this criterion, it should be used in conjunction with other criteria, or a combination of two or more focal species could be used. As a surrogate measure, the presence of an introduced or invasive species may be used in combination with, or to contrast with, focal species (*e.g.*, the introduced plant, purple loosestrife, out-competes native wetland plants). In addition, native species are a priority, but the role of naturalized species may need to be explored to understand their attributes and impacts on aquatic ecosystems.

Criterion #2	Presence of at-risk, rare or unique aquatic species and their habitat
Description	An area with the presence of an "at-risk" aquatic species or its habitat as identified by federal or provincial legislation. While at-risk species are the priority, other species that are rare, of concern, or otherwise unique as identified by provincial programs may also be considered.
Rationale	Some aquatic species only naturally occur in a localized area (*e.g.,* Banff Springs Snail), are at the edge of their range (*e.g.,* Western Blue Flag), or their populations have declined and are considered at risk of extirpation or extinction (*e.g.,* Lake Sturgeon). In most cases, these species are uniquely adapted to their conditions and are a key element of their ecosystem. They are indicative of Alberta's range of biodiversity and are important aspects of aquatic ecosystem structures, processes and functions. Although we may not understand their role completely, it is prudent to maintain them. This criterion also aligns with existing federal and provincial policy to protect species-at-risk. For example, the Banff Springs Snail is uniquely adapted to the hot springs in Banff National Park, the only location where this species occurs.
Possible Indicators and Data Sources	At-risk species are designated by federal *(Species at Risk Act)* and provincial *(Alberta Wildlife Act)* legislation or identified by COSEWIC and Endangered Species Conservation Committee reports and programs. Their habitat requirements are also usually identified in federal and provincial status reports and recovery plans. Some provincial programs like Adopt-a-Plant Alberta and the Alberta Biodiversity Monitoring Program (ABMP) identify rare and unique species. Provincial databases, such as ANHIC and FWMIS also have occurrence location data.
Further Guidance	This criterion could also include "unique" or less commonly known aquatic species where data is deficient. For example, stonecat are an aquatic species that are of interest to researchers and that require further information before a status assessment can be made. Areas with stonecat or their habitat present could be identified for their "uniqueness" and targeted for further management action.

Criterion #3	Presence of rare or unique aquatic ecosystems
Description	An aquatic area with distinctive physical features that are themselves unusual or rare or that support significant biological communities or provide a significant aquatic ecosystem function. These areas may be provincially, regionally or locally significant as identified under federal or provincial legislation or internationally, nationally or provincially recognized programs. Some areas may not be recognized under a formal program but are included because they provide an outstanding example of a distinctive feature within the province. Some unique areas could be common in one part of the province but regionally rare elsewhere (*e.g.*, bogs in the prairies).
Rationale	These areas are important because they support important ecosystem functions or they represent the diversity of Alberta's aquatic ecosystems. This criterion aligns with provincial commitments to parks and protected areas and other programs for identifying important ecosystems in Alberta. The goal is to protect unique physical features and ecosystem functions, recognizing that some of these areas may be as large as a river reach, saline lake or delta or as small as a marl pond, hot springs or meltwater channel. For example, tufa springs are unique areas where porous rock is formed from the calcium carbonate found near mineral springs. This porous rock provides an excellent medium for the growth of a diversity of alpine plants.
Possible Indicators and Data Sources	Potential Data Sources: – National and Provincial Parks and Protected Areas – RAMSAR wetlands (Beaverhill Lake, Peace-Athabasca Delta) – Important Bird Areas (Utikima and Whitford Lakes) – Heritage Rivers (Athabasca, North Saskatchewan, Kicking Horse and Clearwater rivers) – Alberta Stream Code Classification Program (Class "A" Streams) – NAWMP Boreal Wetland Inventory (*e.g.*, occurrences of patterned fens) – ANHIC Ecological Communities Tracking List
Further Guidance	Many of these unique features, particularly those outside of national and provincial protected areas, are locally known but are not mapped on a provincial database. Watershed Planning and Advisory Councils and Watershed Stewardship Groups could play a strong role in collecting local information on these features.

Criterion #4	Key areas that contribute to water quantity
Description	Key areas within a watershed that contribute within the natural range of variability to the water required for maintaining river flow, groundwater recharge or wetland and lake levels. This includes where the majority of water originates or areas that are otherwise important for maintaining natural annual and seasonal surface water flow patterns (the hydrograph), groundwater base flows and other flow conditions or functions.
Rationale	The movement of water through the landscape provides a variety of functions. Aquatic organisms have adapted to water quantity conditions over time. Water quantity conditions also affect physical (*e.g.*, channel morphology) and chemical (*e.g.*, total suspended solids) conditions. Different parts of a watershed can affect the movement of water though the watershed. Some areas substantially contribute to flows by collecting precipitation or discharging groundwater. Other portions of the watershed store and slow water movement and help maintain annual flow patterns. For example, annual glacier snow accumulation and subsequent spring melt supplies many of Alberta's major rivers with a spring "freshet." Aquatic ecosystems in turn have adapted to this flow regime, which provide functions like overbank flooding, channel scouring, sediment transport, *etc.*
Possible Indicators and Data Sources	This criterion might be assessed by different levels of indicators that move from coarse to finer resolution, and that imply different levels of management actions. For example, within a watershed the following layers might be identified: – Glaciers, headwaters, areas of high snowpack, groundwater base flows and major tributaries providing substantial flow contribution. – Riparian areas, wetlands, groundwater recharge areas and floodplains that provide functions like water accumulation, storage and release, erosion control and flood attenuation. – Springs, seeps and other discrete areas which are unique. While surface water sources (*e.g.*, glaciers and headwaters) are generally well known, other aspects like flood attenuation, contribution of snowpack, *etc.* are less well documented. Similarly, groundwater sources have yet to be completely mapped. Surrogate indicators might be used to identify areas of risk to water quantity. These could include density of upstream barriers, areas of channel loss due to infilling (loss of flushing flows), cottonwood recruitment, woody debris transport, *etc.*
Further Guidance	Opportunities to work with industry, academia, watershed and conservation organizations and others to improve data collecting and sharing should be explored to benefit the application of this criterion.

Criterion #5	Key areas that contribute to water quality
Description	Key areas within a watershed that provide the functions required to maintain or improve water quality within its natural range of variability. That is, areas that filter, purify, oxygenate, prevent erosion or otherwise significantly improve water quality.
Rationale	Water quality conditions determine the nature of the aquatic ecosystem and are critical to all life. Areas that provide a water quality function can reduce risks to water quality, keeping it within a range of natural variability. For example, the Athabasca River below Grand Rapids is rich in dissolved oxygen because of the mixing of the water and the atmosphere as water passes over the rapids. Higher levels of dissolved oxygen are required by some aquatic species.
Possible Indicators and Data Sources	This criterion might be assessed by different levels of indicators that move from coarse to finer resolution, and that imply different levels of management actions. For example, within a watershed, the following might be identified: – Large continuous areas like riparian buffer zones and floodplains along major river reaches. – Large but discrete areas like wetland complexes and lakeshores. – Smaller discrete areas like rapids. Risks to water quality, including measures of point and non-point pollutants, may be used as surrogates to indicate areas requiring priority for mitigative action. Surrogates might include road density, stream crossing density, pollutant loading (exceedences) or invertebrate community composition.
Further Guidance	Watersheds and landscapes are not stagnant; they change constantly. An area that is important for water quality function today may change in the future. Hence, significant areas identified by this criterion should be re-visited and updated from time to time.

Criterion #6	Key areas of biological connectivity
Description	Key areas of longitudinal (upstream-downstream) connectivity that substantially contribute to aquatic ecosystem health.
Rationale	Aquatic ecosystems are connected along the routes taken by flowing water. These longitudinal connections across a watershed form a network along which biological organisms can move or migrate both upstream and downstream. It is also where nutrients and sediment can be transported through the system. Biological connectivity is a key function of aquatic ecosystems that maintains biological diversity, ecological function and the hydrological integrity of an area. For example, water flow through a river reach can be critical to the movement of various fish species through different parts of their life cycle. Where a river reach is disconnected by dams without fish passage or improperly installed or maintained culverts, fish passage or upstream movement of aquatic species may be hampered with the result that biodiversity is impoverished.
Possible Indicators and Data Sources	Until important areas of longitudinal connectivity and their intactness are identified and mapped, "risks to connectivity" may be required as surrogate measures. Risks may include barriers to connectivity such as road density, stream crossing density, density of upstream barriers, *etc*. Identifying barriers provides a measure of both pristine areas (no anthropogenic footprint) for conservation and areas that may require mitigation.
Further Guidance	Note that in some areas, a physical barrier may be protecting a native species, or limiting harmful or excessive levels of nutrients or sediments from entering the system. Removing the barrier may increase harm to the population or aquatic ecosystem. For example, in some situations, an improperly placed culvert may prevent a non-native fish species from migrating up a stream to an area inhabited by native Westslope Cutthroat Trout. Connectivity via lateral movement of species between water bodies and immediately adjacent lands may also be significant to aquatic ecosystems and should be explored further.

Criterion #7	Key areas of intact complexity and/or biodiversity
Description	Key aquatic areas that support a high degree of intact complexity (made up of many interrelated parts that can be difficult to analyze, understand or solve) or biodiversity (*i.e.*, have a natural diversity of aquatic species, species assemblages, hydrological connectivity and other physical features or aquatic ecosystem functions). These areas, in turn, sustain aquatic ecosystem functionality or otherwise have a high conservation value.
Rationale	A large "intact" aquatic ecosystem is one that is connected. Highly intact ecosystems are more resilient to change and are therefore more likely to support and maintain their full range of complexity and ecological integrity. For example, the Grimshaw Gravel Aquifer is a shallow gravel aquifer that supplies water to many homes and businesses in an area of northwestern Alberta. The aquifer is a part of a complex ecosystem and interacts with the nearby Cardinal Lake, Whitemud Hills and several springs and seepage areas. The source of this aquifer is a drainage area of approximately 595 square kilometers in the north central Peace region. The connectivity between all of these elements is critical to the continued integrity of this system.
Possible Indicators and Data Sources	There are both direct (*e.g.*, intact rivers, water quality) and indirect (*e.g.*, land cover, road density) measures of ecosystem integrity. A surrogate (community indexes) or other tool could be developed to measure this criterion.
Further Guidance	This criterion may be data-limited. However, it may be captured to some degree through the application of the first six criteria.

Further Analysis and Challenges

Developing indicators and collecting and analyzing data to support the application of the seven criteria described above was beyond the scope of this project. However, where they were identified, potential indicators and data sources were provided in the tables above as guidance for future stages of the process.

The recommended criteria also provide a mixture of both coarse and fine filters. Because they can encompass large areas, coarse criteria may need to be combined with other criteria to ensure that the filter resolution is fine enough to be meaningful, without losing any significant elements. Fine-filter criteria account for the requirements of populations, species, ecosystems or other special features that have not otherwise been met under coarse filters. Future work in steps 3 and 4 of the SCP process will identify appropriate combinations and "rules" around the application of criteria to ensure the final product's resolution is meaningful. These "rules" will also help further define what is meant by *significant* and *substantially contributes* and will address issues of "appropriate geographic scale."

In addition to combining criteria, the quality of *representativeness* can be used to check the effectiveness of the recommended criteria. That is, once data acquisition and parameter building for the seven criteria is complete, a gap analysis should be undertaken to check that key representative areas (*e.g.*, stream types, wetland types, taxonomic groups, *etc.*) have been captured. The final map product showing all areas contributing to aquatic ecosystem health should be representative of all aquatic ecosystem elements in the province. Ecological representation ensures the persistence of biodiversity and ecosystem function. By ensuring that a representative sample of all aquatic ecosystem elements are present within the network of areas of aquatic significance, it is assumed most elements within the planning area, known and unknown, will be represented as well. In addition, analysis may identify the need to develop further criteria for defining the health for each aquatic ecosystem type.

The AWC identified a number of areas where it will be a challenge to assess criteria because of a deficiency of aquatic ecosystem information. Aquatic information falls into three categories: physical, chemical and biological. Physical information about Alberta's surface water is generally good, although sub-basin delineations and other information continue to be refined. Groundwater and wetland mapping, however, is incomplete for portions of the province and recharge and discharge areas are largely unknown. The province has good chemical (water quality) information for major river main stems and larger lakes; however, such information for some of the province's smaller tributaries and water bodies may not exist. Similarly, good information exists for the presence of fish and other large vertebrates, but details on the health of individual species, populations and communities, as well as the tolerance/cumulative impact of pollutants on these populations is less well known. Information for aquatic invertebrate and plant species is lacking in some basins.

Another concern is the approach to indicator selection and data availability. In some cases, data is available locally that might directly represent a criterion, but another, less directly relevant indicator might be selected because data is available at a provincial scale. Users want to employ the best data if it's available, and want to avoid the use of a coarse indicator when better local information is available. For example, if a measured buffer distance is used to represent floodplain complexes, users could replace the coarse measure with detailed floodplain complex mapping where it is available.

Opportunities

Throughout the AWC discussion and the development of this preliminary list of criteria, several next steps and opportunities were identified as follows:

1. To provide continuity and shared learning, the AWC should make a presentation of their work to the GOA staff leading the next stage of the project.
2. The quality of available data should be considered for future modeling work, as it will be critical to the quality of the final product. The use of poor data will typically produce poor results. Sources of data and information may include scientific, local and traditional ecological knowledge. Initiatives like the Alberta Biodiversity Monitoring Program, Regional Aquatics Monitoring Program, Long-term River Network Monitoring, Alberta Lake Management Society's *Lake Watch* and various wetland inventory initiatives may assist by providing information on Alberta's aquatic ecosystems. Improved resourcing of existing programs or the development of new programs could benefit future work. Other opportunities to share and collect information may also exist between government, industry, conservation organizations, academia and other partnerships.
3. A "complete picture" of the areas that significantly contribute to aquatic ecosystem health should be developed to depict surface, groundwater and other climatic conditions. That is, if possible, the final product should not reflect a surface water (two-dimensional) bias.
4. A map of aquatic areas that substantially contribute to aquatic ecosystem health should be completed as its own stand-alone product to inform aquatic managers, planners and decision makers. However, once completed, the aquatic map should be combined with the updated Environmentally Significant Areas map. This will serve to identify and amalgamate areas that are both terrestrially and aquatically important, identify synergies in potential use of aquatic and terrestrial criteria and highlight where aquatic ecosystems contribute to terrestrial ecosystem functioning and health.
5. To inform resource management decisions, a map of areas that substantially contribute to aquatic ecosystem health should also be combined with a similar product depicting stressors or threats to aquatic ecosystem health, as well as a current assessment of aquatic ecosystem status and trends in status.

6. Healthy aquatic ecosystems are not static; they are always changing. Additionally, natural variation and directional climate and other changes need to be considered. The SCP process is iterative and the final output, a map, can be reproduced when new information becomes available. In addition, criteria to identify significant areas may change over time as new knowledge is acquired. Criteria, data and the map should be reviewed and updated at regular intervals.
7. The iterative SCP process fits well with, and will inform, the adaptive management and cumulative effects approach promoted by both *Water for Life* and the Land Use Framework. To support these initiatives, both old and new legislation and policy should be aligned such that aquatic definitions and shared objectives are the same and support the *Water for Life* goal of "healthy aquatic ecosystems."
8. The AWC is made up of several sectors that would like to continue to be involved in the next steps of the process. As the process gets closer to planning activities (with social and economic implications), sectors will continue to be interested in how it may impact municipal development, transportation, industry, environmental objectives, *etc*. The indicators, how they are analyzed, and how decisions are made as to which categories constitute "significant" could have implications that at present are not understood. In addition, sectors may be able to make beneficial use of the tool in their own planning processes and may be able to provide useful advice on mitigation, technology and practices that can further benefit the SCP process. Similarly, academic and research institutions, such as the Alberta Water Research Institute, may be able to provide assistance with the data collection and analysis.

Conclusion

The Alberta Water Council undertook the development of ecological criteria to identify areas significant to maintaining aquatic ecosystem health. The Council describes seven criteria in this report As well, a number of potential indicators, data sources and other guidance are provided for each criterion.

The development of these criteria is only the first step. This information will be provided to the Government of Alberta who in turn, may use it to inform the development of mapping and other tools for land use and watershed planners and decision-makers. Other governments, industry, conservation organizations and collaborative partnerships like Watershed Planning and Advisory Councils may also find this advice useful.

Resources

Alberta Biodiversity Monitoring Institute http://www.abmi.ca/abmi/home/home.jsp

Alberta Environment Surface Water Quality Monitoring Program http://environment.alberta.ca/3223.html

Alberta Instream Flow Needs Program http://srd.alberta.ca/fishwildlife/fishingalberta/instreamflowneedsprogram.aspx

Alberta Lake Management Society's *Lake Watch* Program http://www.alms.ca/content.php?content=1

Alberta Species-at-Risk Program http://srd.alberta.ca/fishwildlife/speciesatrisk/default.aspx

Atlas of Alberta Lakes http://alberta-lakes.sunsite.ualberta.ca/

Aquatic Invertebrates of Alberta http://sunsite.ualberta.ca/Projects/Aquatic_Invertebrates/index.php

Fiera Biological Consulting. 2009. Draft *Environmentally Significant Aquatic Ecosystems in Alberta: Overview for Developing Systematic Criteria. In preparation* for Alberta Environment. Edmonton.

Regional Aquatics Monitoring Program http://www.ramp-alberta.org/RAMP.aspx

River Watch http://www.riverwatch.ab.ca/

Glossary

TERM	DEFINITIONS (Developed by the team unless source otherwise noted.)
Aquatic Ecosystem	Those ecosystems occurring in or on water or its beds and shores, including its biological organisms and communities. This includes the physical, chemical and biological characteristics of rivers, lakes and wetlands and the plants and animals associated with them. (Alberta Water Council)
Aquatic Species	A species dependent on the aquatic ecosystem for all or a part of its life cycle.
Biodiversity (Biological Diversity)	The variability among living organisms from all sources and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. (Adapted from the Alberta Biodiversity Monitoring Institute)
Criteria	An accepted standard used in making a decision or judgment about something.
Complexity	Made up of many interrelated parts that can be difficult to analyze, understand or solve.
Environmentally Significant Areas	Areas that are vital to the long term maintenance of biological diversity, physical landscape features and/or other natural processes. (Jennings and Reganold 1991 as per Fiera Report 2009)
Focal Species	Main and most important, or most representative, species in an ecosystem.
Function	An action or use for which something is suited or designed; or to operate normally, fulfilling a purpose or role.
Healthy Aquatic Ecosystem	An aquatic environment that sustains its ecological structure, processes, functions and resilience within its range of natural variability. (Alberta Water Council)
Indicator	Any living or nonliving feature of the environment that can be measured or estimated and that provides insights to the state of the ecosystem. (Alberta Biodiversity Monitoring Institute)
Indicator Species	Those species that by their presence and/or abundance are associated with some distinctive environmental conditions or processes. (Fiera 2009)
Keystone Species	Species that have an effect on an ecosystem that is disproportionate to their abundance or biomass. (Fiera 2009)
Objective	A broad statement describing a desired future state or condition of a value. (Canadian Standards Association: Sustainable Forest Management: Requirements and Guidance)
Risk	The danger that injury, damage or loss will occur: to incur the chance of something harmful, dangerous or detrimental.

Riparian Area	Any land that adjoins or directly influences a waterbody including floodplains, areas that would be affected by a 1-in-100 year flood and land that affects alluvial aquifers. (Alberta Water Council)
Significant	Having a major or important effect.
Species at Risk	In Alberta and Canada, a species identified as in danger of becoming extinct.
Substantially Contributes	An area or other factor that gives/adds to an event/condition in an ample or sizeable way.
Target	A measurable and time-limited amount to be achieved. Typically, a target is set for an indicator.
Tributaries	A stream, river or glacier that joins a larger stream, river or glacier or a lake.
Umbrella species	Species with resource requirements that encompass the needs of many other species therefore, by managing for the life requisites of umbrella species it is assumed that the requirements of other elements will be met as well. (Fiera 2009)
Uplands	Land that has a high elevation (and dry soils), or a region of such land, as opposed to wet land that is influenced by water.
Waterbody	Any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood. (Partial definition as per the *Water Act*)
Watershed	An area of land that catches precipitation and drains it to a common point such as a marsh, lake, stream or river and recharges groundwater. A watershed can be made up of several sub-watersheds that contribute to the overall drainage of the watershed. (Alberta Water Council)
Wetland	Land having water at, near, or above the land surface, or which is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained hydric soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to the wet environment. (Alberta Water Council)

Appendix 1 – Project Team Members

The following individuals were active members of the Provincial Ecological Aquatic Criteria for Health Project Team during the development of this report.

Member	Sector / Member
Rick Bonar	Forestry / Alberta Forest Products Association
Matt Cohen	Mining / Alberta Chamber of Resources
Jerry Cunningham	Métis Settlements / Métis Settlements General Council
Mark Dubord	Oil and Gas / Canadian Association of Petroleum Producers
James Guthrie	Power Generation / TransAlta Generation Partnership
Kate Hovland	Rural / Alberta Association of Municipal Districts and Counties
Dug Major	Watershed Planning and Advisory Councils / Watershed Planning and Advisory Council Collective
Bernd Manz	Small Urban / Alberta Urban Municipalities Association
Ron McMullin	Irrigation / Alberta Irrigation Projects Association
Brian Meagher	Fish Habitat Conservation / Fish Habitat Collective
Scott Millar, Co-chair	Alberta Sustainable Resource Development
Doug Sawyer	Livestock / Intensive Livestock Working Group
Chris Spytz	Alberta Environment
Judy Stewart	Lake Habitat Conservation / Alberta Lake Management Society
Jason Unger, Co-chair	Environmental / Environmental Law Centre

The AWC would like to thank the Government of Alberta for the opportunity to provide input on this important provincial topic. The Board would also like to acknowledge project team members and their sectors for their work and input into developing this report.

Appendix 2 – Criteria Summary

Criteria	Description
1. Presence of focal aquatic species and their habitat.	Focal aquatic species are generally common and wide-ranging and may include invertebrates, amphibians, fish, plants or birds. They are representative of their ecosystem or parts of their ecosystem (indicator species), are wide ranging with ecosystem requirements that encompass other species (umbrella species), or have a critical function in maintaining ecological structure (keystone species).
2. Presence of at-risk, rare or unique aquatic species and their habitat.	An area with the presence of an "at-risk" aquatic species or its habitat identified as such by federal or provincial legislation. While at-risk species are the priority, other species that are rare, of concern, or otherwise unique as identified by provincial programs may also be considered.
3. Presence of rare or unique aquatic ecosystems.	An aquatic area with distinctive physical features that are themselves unusual or rare or that support significant biological communities or provide a significant aquatic ecosystem function.
4. Key areas that contribute to water quantity.	Key areas within a watershed that contribute within the natural range of variability to the water required for maintaining river flow, groundwater recharge or wetland and lake levels.
5. Key areas that contribute to water quality.	Key areas within a watershed that provide the functions required to maintain or improve water quality within its natural range of variability. That is, areas that filter, purify, oxygenate, prevent erosion or otherwise significantly improve water quality.
6. Key areas of biological connectivity.	Key areas of longitudinal (upstream-downstream) connectivity that substantially contribute to aquatic ecosystem health.
7. Key areas of intact complexity and/or biodiversity.	Key aquatic areas that support a high degree of intact complexity (made up of many interrelated parts that can be difficult to analyze, understand or solve) or biodiversity (*i.e.* have a natural diversity of aquatic species, species assemblages, hydrological connectivity and other physical features or aquatic ecosystem functions). These areas, in turn, sustain aquatic ecosystem functionality or otherwise have a high conservation value.

ALBERTA WATER COUNCIL
Website: www.awchome.ca