Water Conservation, Efficiency and Productivity:

Principles, Definitions, Performance Measures and Environmental Indicators

Final Report

Prepared by:

Water Conservation, Efficiency and Productivity Definitions Project Team

For the Alberta Water Council

January 2007

Acknowledgements

The Alberta Water Council's Water Conservation, Efficiency and Productivity Definitions Project Team gratefully acknowledges the following individuals who provided information that helped the team advance its work:

Dr. Peter Apedaile, University of Alberta
Augustus Archampong, Alberta Environment
Tim Toth, Alberta Environment
Stephen Yeung, Alberta Environment

The team also very much appreciates the review comments and suggestions from individuals from the various sectors and stakeholder groups.

Contents

Recommendations

The Water Conservation, Efficiency and Productivity Definitions Project Team makes the following six recommendations, which also appear in the body of the report. Other issues became apparent to the team during the course of its work that were outside the team's terms of reference. Members nevertheless felt these matters were sufficiently important and urgent that they should be brought to the Council's attention, including the Statement of Need, which appears immediately following the recommendations and in context in the report.

Recommendation 1: Desired Outcomes

The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council accept the following as the desired outcomes of improvements in water conservation, efficiency and productivity:

- Demand for water is reduced.
- Water use productivity is increased.
- Resources are conserved to maintain healthy aquatic ecosystems.
- Water quality is maintained or enhanced.

Recommendation 2: Principles

The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following eight principles to guide improvements in water conservation, efficiency and productivity.

- Fresh water is a finite and vulnerable resource, essential to sustain life, economic development and the environment.
- Water has an economic value in all its competing uses.
- Water has non-monetary values that enhance the quality of life.
- Sectors are accountable for what they control.
- Sectors have different opportunities for making progress in conservation, efficiency and productivity and are not necessarily comparable against other sectors.
- Sector plans will make every reasonable effort to protect and enhance aquatic ecosystems and meet ecosystem objectives.
- All stakeholders will work collaboratively, resolve differences through consensus processes, and support Best Management Practices.
- The Alberta Government will assure that goals for water conservation, efficiency and productivity are achieved.

Recommendation 3: Water Conservation

The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definitions for **water conservation:**

1. Any beneficial reduction in water use, loss, or waste.
2. Water management practices that improve the use of water resources to benefit people or the environment.

Recommendation 4: Water Efficiency

The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definitions for **water efficiency:**

1. Accomplishment of a function, task, process, or result with the minimal amount of water feasible.
2. An indicator of the relationship between the amount of water needed for a particular purpose and the quantity of water used or diverted.

Recommendation 5: Water Productivity
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definition for **water productivity:**

> The amount of water that is required to produce a unit of any good, service, or societal value.

Recommendation 6: Data Collection
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that Alberta Environment:

a) Implement strategies to increase the use of its electronic data reporting system by licensed water users, and
b) Lead efforts to enhance and adapt data collection to ensure that it can provide the data needed by WPACs and sectors as they develop their management plans.

Statement of Need Regarding the Development of Watershed Management Plans
The team believes that watershed management plans are needed and that WPACs are the best mechanism to develop them. However, it became clear to the team that WPACs need to know very quickly:

a) how the Government of Alberta expects sector and watershed management plans to be integrated with other planning processes to protect and manage water, air and land, to ensure that outcomes are compatible and consistent; and
b) what role collaborative processes will play in developing these plans.

This is especially important given that the plans will be expected to describe implementation responsibilities and commitments by involved parties. The team was of the view that WPACs need clear authority and a mandate to develop their plans through a collaborative process and that a backstop is needed in the event that agreement on the plans and an implementation strategy cannot be reached. Alberta Environment has indicated that in some cases, legislation may need to be amended to ensure that implementation and ongoing management responsibilities can be carried out efficiently and effectively.

One option might be for Alberta Environment to look for an early opportunity to partner with an existing WPAC to pilot possible approaches.

1 Introduction

Alberta's *Water for Life* strategy was adopted by the Government of Alberta in November 2003. The strategy contained the following three goals and outcomes:

- Safe, secure drinking water supply
- Healthy aquatic ecosystems
- Reliable, quality water supplies for a sustainable economy

The strategy also contained three key directions to help achieve the outcomes; one of these was water conservation, specifically that "Albertans will be leaders in conservation by using water efficiently and effectively." The strategy goes on to say that, "fluctuating and unpredictable water supply in recent years has stressed the need to make some major shifts in how we use and allocate this renewable, but finite, resource." Albertans know that water conservation, combined with a focus on getting the most production possible from water that is presently in use is an important factor in helping to sustain water supplies now and into the future.

The Alberta Water Council acknowledged the fundamental need for more detailed work on water conservation, efficiency and productivity. In the near future, it is expected that sectors that use water will need to develop water conservation, efficiency and productivity plans, working with the Council and likely with the Watershed Planning and Advisory Councils (WPACs) in their area. The WPACs will also be preparing watershed management plans. Council members agreed it would be valuable to have a common and consistent understanding of key terms before work on the sector and basin plans proceeds.

In March 2006, the Council established the Water Conservation, Efficiency and Productivity Definitions Project Team to undertake initial foundational work in three areas:[1]

1. Provide clear, understandable definitions, principles and expectations for the terms "conservation", "efficiency" and "productivity."
2. Determine baseline information and information gaps on water conservation, efficiency and productivity. It is acknowledged that the volume and quality of information available is not the same for all sectors.
3. Determine appropriate methodologies for reporting progress on conservation, efficiency and productivity.

These three areas of work are the focus of this report. A schedule of the team's meetings and the meeting notes are available on request to the Council secretariat.

The team's work was founded on the *Water for Life* strategy, with the strategy's goals being primary assumptions for this work. All of the team's work has been undertaken with the overall aim of producing fundamental starting points on which the sectors and WPACs can build (see section 2). Members focused first on the most basic building blocks:

- **Desired outcomes** of improvements in water conservation, efficiency and productivity (that is, the key reasons why these improvements are needed and what they will achieve);
- **Principles** that reflect the fundamental beliefs and attitudes that should underpin efforts to improve water conservation, efficiency and productivity; and
- **Definitions** for water conservation, water efficiency, and water productivity.

[1] Members of the team are listed in Appendix A, and the team's full terms of reference are shown in Appendix B.

The next steps involved a general review of performance measures now in use by various sectors, with the aim of reaching agreement on measures that could potentially be used by sectors in developing their water conservation, efficiency and productivity plans (see section 3). The team also considered the availability of and access to baseline information, as well as information gaps on water conservation, efficiency and productivity (see section 5).

An important challenge for the team was considering how to address aquatic ecosystems and the environment, specifically whether "the environment" should be treated as a sector and whether performance measures are appropriate. Members agreed that the environment is not a sector (see section 4), but that an integrated framework is needed to ensure that impacts on aquatic ecosystems are considered when identifying measures to improve conservation, efficiency and productivity. Some environmental indicators are presented as examples for WPACs and sectors to consider.

The recommendations and ideas in this report are intended to help WPACs and sectors prepare their plans and to support them in the development of creative and innovative approaches to deal with their unique water management situations. During the course of its discussions, members were made aware of a range of other issues and potential barriers to the development and successful implementation of watershed management plans. Most of these issues were beyond the team's purview, but members felt a strong obligation to bring them to the Council's attention. These issues appear in several places through the report, including section 6.

2 Water Conservation, Efficiency and Productivity Foundations

The team agreed that efforts to improve conservation, efficiency and productivity, along with its work on principles, definitions and indicators, apply to both surface and groundwater throughout Alberta.[2] Members of the team wanted their work to be strategic and at a sufficiently high level that it could be used and adapted by others who are involved in water planning and management on a day-to-day basis, specifically the WPACs and those who will be doing the sector plans. The work on principles and definitions is expected to be of particular interest to WPACs when they are developing objectives for their watershed plans.

At the same time, the team wanted to ensure that its work recognized the realities facing water users and managers in Alberta. While the *Water for Life* strategy stresses the need for conservation, for example, the team is fully aware that some sectors have already made substantial progress in reducing water use and should not be penalized for taking early action. The team sought to provide guidance for future work by sectors and WPACs, and to illustrate potential options for improving conservation, efficiency and productivity.

2.1 Outcomes

The team began by reviewing work that had been done by groups and agencies in Canada and elsewhere. Members felt they should start by identifying the benefits or outcomes that would result from improved water conservation, efficiency and productivity. They agreed to adopt, with some modifications, the four outcomes informally developed and agreed to by the

[2] Some water uses, such as use of saline groundwater, do not require approval under the *Water Act.*

Canadian Council of Ministers of the Environment (CCME) Water Conservation and Economics Task Group.[3] The team recognized that:

- Not all outcomes may apply to all sectors.
- Achieving any one of these is a desirable outcome.
- The most desirable situation is to make progress on more than one outcome at the same time.

The four outcomes in recommendation 1 are not in any order of priority, and progress is needed on all of them.

Recommendation 1: Desired Outcomes
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council accept the following as the desired outcomes of improvements in water conservation, efficiency and productivity:

- Demand for water is reduced.
- Water use productivity is increased.
- Resources are conserved to maintain healthy aquatic ecosystems.
- Water quality is maintained or enhanced.

2.2 Principles

The principles reflect the fundamental beliefs and attitudes that underpin efforts to improve water conservation, efficiency and productivity. A number of important ideas and concepts form the context in which the principles were developed and agreed to by the team, and should also be considered by those who take guidance from the contents of this document. These ideas and concepts are.

- Not every water use has an easily determined economic value, and even though a use cannot be easily quantified or presented in economic terms, it may be just as important as a use to which an economic value can be assigned (e.g., Passive management of a wetland and use of the same area for off-stream storage).
- The water we use is part of the hydrologic cycle, which in the absence of human intervention governs the amount of water that is available for our use. The hydrologic cycle is an essential process for life and must be respected and protected.
- As stress on Alberta's finite water resources increases, it will be crucial to ensure that choices are presented and decisions are made on the basis of sound science and in an open and transparent manner.
- Alberta's existing water licences and authorizations, based on "first in time, first in right," will be respected.
- Water users should reuse and recycle water to reduce diversions.[4]

Further, water and energy conservation are often closely linked; thus, in many cases, one of the important benefits to conserving water will be a concomitant reduction in energy use.

[3] This Task Group, representing provincial and territorial governments and Environment Canada, used a consensus process to develop outcomes as the basis for their water conservation work in 2004.
[4] "Reuse" means using water for one purpose, then moving it to another use, possibly by another sector, with or without some form of treatment prior to reuse. "Recycling" is using the same water over again within one process or series of processes by the same user. A number of companies in Alberta have creatively and successfully implemented water reuse and recycling initiatives.

The principles on which consensus was reached are in fact a mix of statements, which the team agreed to refer to as principles because they represent the most basic starting points for moving forward. The eight principles agreed to by the team include statements of fact, as well as beliefs about the value of water, and declarations regarding the anticipated behaviour and actions of sectors as they prepare and implement their water plans.

Recommendation 2: Principles
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following eight principles to guide improvements in water conservation, efficiency and productivity.

- Fresh water is a finite and vulnerable resource, essential to sustain life, economic development and the environment.
- Water has an economic value in all its competing uses.
- Water has non-monetary values that enhance the quality of life.
- Sectors are accountable for what they control.
- Sectors have different opportunities for making progress in conservation, efficiency and productivity and are not necessarily comparable against other sectors.
- Sector plans will make every reasonable effort to protect and enhance aquatic ecosystems and meet ecosystem objectives.
- All stakeholders will work collaboratively, resolve differences through consensus processes, and support Best Management Practices.
- The Alberta Government will assure that goals for water conservation, efficiency and productivity are achieved.

2.3 Definitions

An essential part of the team's work was to propose clear, understandable definitions for the terms "conservation", "efficiency" and "productivity." Members agreed that the definitions should support and serve the outcomes noted in section 2.1. Definitions have been kept simple, straightforward and as concise as possible for clarity, but more than one definition might be appropriate for each term, depending on the context. The team reviewed definitions from other credible sources,[5] and modified them as appropriate, reaching consensus on the definitions indicated in recommendations 3-5 below.

Recommendation 3: Water Conservation
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definitions for **water conservation:**

1. Any beneficial reduction in water use, loss, or waste.
2. Water management practices that improve the use of water resources to benefit people or the environment.

Recommendation 4: Water Efficiency
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definitions for **water efficiency:**

[5] Key original sources were: (1) *Handbook of Water Use and Conservation – Homes Landscapes Businesses Industries Farms.* Amy Vickers. Waterplow Press, Amherst, Ma. 2001. 446 pp. (for conservation and efficiency definitions); and (2) "Principles of Water Use Efficiency," in *Principles of Water Use Efficiency*. Donald M. Tate. On-line: http://www.cepis.ops-oms.org/muwww/fulltext/repind48/principles/principles.html

1. Accomplishment of a function, task, process, or result with the minimal amount of water feasible.
2. An indicator of the relationship between the amount of water needed for a particular purpose and the quantity of water used or diverted.

Water conservation and efficiency are commonly used terms. "Productivity" as applied to water is a more complex term to interpret and describe. Although productivity is fundamentally an economic expression of the amount of output relative to the amount of input,[6] many of the outputs are environmental or social benefits that are hard to quantify or measure in terms of dollars.

All sectors regularly make decisions about the best use of water to yield a desired benefit, and about how to get the best return for a given amount of water. Productivity can be changed by changes to the input or output, and the productivity of water may change in the future depending on what uses society values most.

Recommendation 5: Water Productivity
The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that the Alberta Water Council adopt the following definition for **water productivity:**

> The amount of water that is required to produce a unit of any good, service, or societal value.

3 Performance Measures and Reporting Methodologies

Performance measures[7] enable water users to measure improvements and compare performance with others in their sector and to track performance within their own company or municipality from year to year. Compiling and developing performance measures for water conservation, efficiency and productivity will enable Alberta to compare itself with the rest of the world, ideally leading to improvements in areas that are not on par with the best. The team reviewed several of the major reporting protocols, and these are listed in Appendix C.

To be effective and meaningful, performance measures must be quantifiable and the parameter must be expressed in terms that enable comparisons. The team is confident that the performance measures noted in this report (see Appendix D) meet these criteria. These measures are not intended to be a comprehensive listing; the team's goal was to compile a sample list that could be used and adapted by sectors and WPACs as appropriate. Confidentiality concerns were also raised during the discussions on performance reporting, and the team took these concerns into account in the measures it identified.

The team was aware that many sectors already use performance measures and members discussed whether a small number were sufficiently generic that they could be applied across all sectors. Examples that were discussed included core water intensity, gross water

[6] In manufacturing, output refers to the goods that are produced, while input is the resources that are consumed in the process.
[7] In this report, the term "performance measure(s)" is used when referring to the way sectors assess their water conservation, efficiency and productivity performance. The term "indicator" is used when discussing environmental or aquatic ecosystem conditions (section 4).

consumption or consumptive loss, and the extent to which metering is used in the sector. The team noted that sectors collect data to meet their particular needs and recognized that in future, additional data sets may be needed to provide information for new performance measures.

Another approach was to look at sector-specific measures. Before it could propose performance measures for sectors, the team first needed to determine the sectors and sub-sectors to be considered, find out what performance measures sectors are already using, and identify any reporting protocols to which sectors already subscribe.

As it began to gather information to guide its decisions, the team agreed that:

- Information would be collected on both groundwater and surface water.
- Recreational facilities (e.g., pools, leisure centres, aquaria, zoos, golf courses) generally get their water from a municipal system, so would be considered as part of the municipal sector.
- Sector identification would start with the sectors represented on the Water Council, and team members from industry would take the lead in consulting those sectors not represented on the team.

To help the various sectors assemble and describe the performance measures now in use, the team developed a template. Members then completed the template for the irrigation, agriculture, oil and gas, municipal water and wastewater, and power generation sectors (see Appendix D). The goal was to limit the indicators to a reasonable number, with at least some that could potentially be used across all sectors. The list is not intended to be complete, but rather to illustrate sample performance measures that are already being applied and that could potentially be adopted by WPACs and sectors as they develop their management plans.

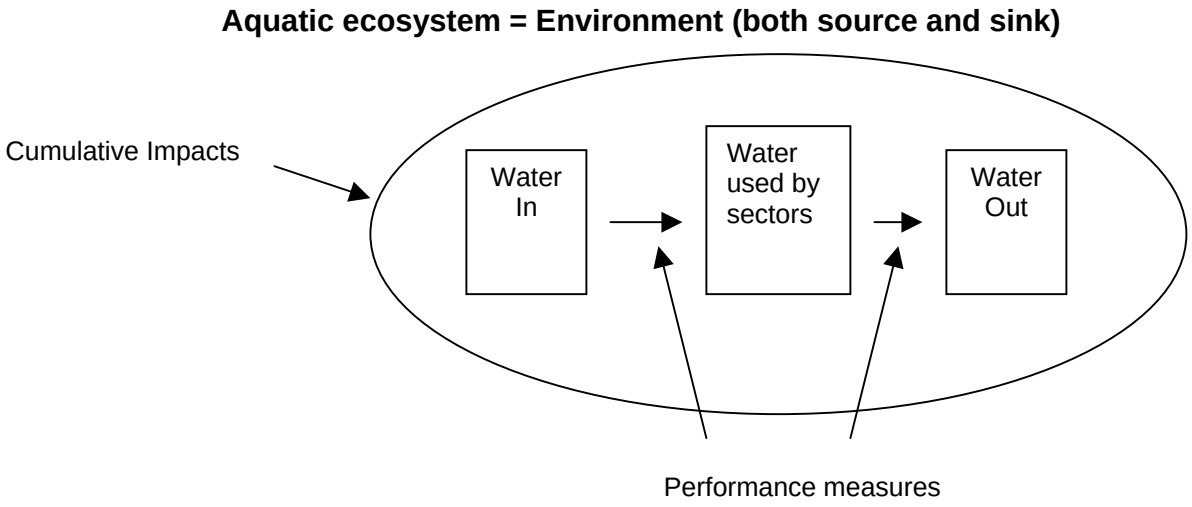
4 Healthy Aquatic Ecosystems

The protection of aquatic ecosystems[8] is one of the three goals of Alberta's Water for Life strategy, and thus needs to be a fundamental consideration as sector plans and watershed management plans are developed and as water conservation, efficiency and productivity measures are identified and adopted. By respecting the current allocation system, the team is not proposing that past water management decisions be re-opened. Instead, this report focuses on laying the groundwork that can enable sectors and WPACs to identify and explore ways to improve water use management and planning in their watersheds, particularly approaches that contribute to healthy aquatic ecosystems. As opportunities for better management and planning emerge, it is hoped that they will be implemented to the benefit of each watershed.

The team agreed not to classify "the environment" ("healthy aquatic ecosystems") as a sector in the same way that industrial or municipal water users are sectors. The environment is the basis for all other processes, it is the larger system on which all other users depend, and it is vulnerable to cumulative impacts on both quality and quantity that can impair aquatic ecosystems as well as affect industrial and municipal users. The sector performance measures

[8] Alberta's *Water Act* defines the aquatic environment as "the components of the earth related to, living in, or located in or on water or the beds or shores of a water body." The *Water for Life* strategy defines "aquatic ecosystem" as "An aquatic area where living and non-living elements of the environment interact. These include rivers, lakes and wetlands, and the variety of plants and animals associated with them."

in Appendix D illustrate the complex interconnections between sector water use and the larger environment, and underscore the need to incorporate environmental considerations into all sector plans. The Water Council is taking a systems thinking approach, and the diagram below illustrates a broader systems view of water and the environment.



4.1 The Need for an Integrated Decision-Making Framework

While not a sector in the same way as other water users, aquatic ecosystems such as those associated with rivers and wetlands require a certain amount of water to be healthy and viable. Thus, sector plans should incorporate an analysis of environmental impacts, including both positive and negative effects, into the decision-making framework. For example, sectors can use water more efficiently or increase productivity as well as reduce total demand, but these improvements in efficiency or productivity do not necessarily lead to healthy (or healthier) aquatic ecosystems. Ideally, improving efficiency and productivity will also create environmental benefits by protecting or enhancing aquatic ecosystems and helping to achieve this Water for Life goal.

Achieving this key outcome necessitates a broad framework that has protection of aquatic ecosystems as an integral part of the decision-making process. Such a framework requires:

1. Identifying the environmental needs of aquatic ecosystems in each watershed.
2. Considering conservation, efficiency and/or productivity alternatives that benefit aquatic ecosystems.
3. Evaluating the potential impacts – whether positive or negative – of one or many water conservation, efficiency or productivity initiatives on a watershed.
4. Analysing the potential impacts of alternatives on aquatic ecosystems and their relative impact as compared with other economic and social benefits.

The framework also needs to have sufficient flexibility to enable adaptive management; in other words, to be able to accommodate and respond to changing circumstances.

4.2 Environmental Indicators

The environment is the source of water for human processes and in some cases, the sink for our wastes. Within the larger system, water comes in as a source, it is used, and it goes out, often with additional wastes in it. Indicators have been identified and applied for both source and sink processes by most water-using sectors. The bigger challenge is considering the impacts on the overall system, which tend to be much harder to quantify; for example, source protection is an important factor when looking at drinking water standards and can be difficult to assess. As well, groundwater systems are a critical part of the aquatic environment in Alberta and should not be neglected when indicators are being identified.

Environmental indicators depend on the nature of the water use and are specific to human land use activities surrounding and in contact with a specific body of water. Various environmental indicators are used for different purposes; for example, Alberta Environment's State of the Environment process contains a range of indicators that:

- Reflect environmental conditions,
- Measure environmental pressures, or
- Show what is being done about these conditions and pressures (stewardship indicators).

The first step in selecting an environmental indicator involves a scan of the watershed. Intensity of land use and type of land use as well as the nature of the uplands (biome) in the watershed will provide clues as to what indicators may be most useful, as well as the quality and quantity of information needed. When choosing indicators to assess the health of aquatic ecosystems, the following factors should be considered:

a) Sources of environmental concern (point and non-point sources)
b) Cumulative effects
c) Data availability (Does historical data exist?)
d) Knowledge of the system baselines (Do we know natural levels?)
e) Interaction between quantity and quality of water in the system
f) Timing of when the water is in the system (this may or may not be a critical element)
g) Natural variability of the system

The team assembled some sample environmental indicators in use in Alberta and elsewhere to illustrate the type and variety that could be considered in sector and watershed management plans. See Appendix E for examples and descriptions.

5 Baseline Information and Gaps

The team was also charged with determining baseline information and information gaps on water conservation, efficiency and productivity. Members noted that reliable data is needed for purposes other than just measuring performance; other important uses include overall environmental management in the watershed, assessing environmental conditions, and others. Such data should be collected in a coordinated and timely manner, with a clear purpose for how it will be used so that onerous or unrealistic expectations are not created. The data must also be easy to access and understand.

The team strongly supported the need for more work in this area. However, it recognized that detailed investigation and analysis were outside its purview and did not feel comfortable making a recommendation, but wanted the Council to be aware of its views on this matter.

5.1 Data Collection and Availability

A great deal of data and information is available from many sources on effective techniques and measures related to water conservation, efficiency and productivity, but pivotal to the task of determining baseline information and gaps is knowing what actual water use is in Alberta. Although some data is available, it is fragmented. The team noted that good data is generally available for rivers and lakes (less so for wetlands and groundwater), and that municipal and industrial withdrawals and discharges are well documented.

Alberta Environment is moving to an online reporting system, but submission is voluntary at this initial stage. Under provisions of the *Water Act*, the Director may impose conditions on licences requiring licensees to submit certain information, which may include water use reports. Some licences do not have water use reporting requirements, e.g. traditional agriculture use licences. In 1996, water information was added to Alberta Environment's Environmental Management System (EMS). The EMS retains a wide variety of data on water allocations and activities. The EMS water data represent allocations cited on licenses but not the actual water consumption.

The online water use reporting system was launched in March 2006 to collect data on actual water usage. The initial test scheduled for 2005 and 2006 targeted a few licensees who use most of the water allocations. Data from the online submissions show the total diversions made to date represent 23.4% of the total water allocated in the province. The department wants to improve on this record and is proposing the following options:

1. Make online reporting mandatory for all licensees who have licence conditions that require water use reporting;
2. For licences that have no condition requirements for reporting water use, send letters to the licensees asking them to voluntarily report their water use through the online system.
3. If licensees under item 2 fail to respond to the request, consider amending their licences to have them comply with online reporting.
4. Consider enforcement action on all licensees who fail to comply with online reporting after allowing a grace period for reports to be filed.

The team agreed that this approach is a good start and that all licensed water users should be reporting electronically. Having data in an electronic format greatly increases access as well as opportunities for using it efficiently and effectively. It should also enhance the efficiency for users in reporting.

Recommendation 6: Data Collection

The Water Conservation, Efficiency and Productivity Definitions Project Team recommends that Alberta Environment:

a) Implement strategies to increase the use of its electronic data reporting system by licensed water users, and
b) Lead efforts to enhance and adapt data collection to ensure that it can provide the data needed by WPACs and sectors as they develop their watershed management plans.

5.2 Conservation, Efficiency and Productivity Measures

Two kinds of measures are commonly used:

- Behavioural or management measures, which relate to changes in the approach to using water, and
- Technology, or hardware, measures.

A lot of information is available on successful measures, including much work done in Canada. For example, the Water Conservation and Economics Task Group of the Canadian Council of Ministers of the Environment commissioned an analysis of water conservation practices and initiatives in Canada and several other countries.[9] The report focused on how freshwater resources are used and managed in the dual contexts of geographic areas and water use sectors.

The team has assembled representative performance measures used by various sectors, and these appear in Appendix D.

5.3 Best Management Practices

Best Management Practices (BMPs) are well known in many sectors, with a great deal of work having been done particularly in Europe. The European Integrated Pollution Prevention and Control Bureau[10] is an excellent, comprehensive source of BMPs for a wide range of industry sectors, as is Envirowise in the United Kingdom.[11] As a first step, sectors may reference these sources when identifying techniques and measures for their sector.

5.4 Benchmarking Water Use for Alberta Industry

Some information is available on productivity values in use in some sectors in Canada. However, there is a lack of data on how well Alberta industries are performing relative to other industries in Canada and the world, and this data is needed to enable them to determine where they rank in relation to the best performers. Benchmarking allows an industry or an individual company to compare itself with others in the sector as well as against its own performance from year to year. Benchmarking is an important component of continuous improvement and is likely to be part of future activities to develop sector and watershed management plans.

[9] This report, entitled *An Analysis of Canadian and Other Water Conservation Practices and Initiatives: Issues, Opportunities and Suggested Directions*, is available online at http://www.ccme.ca/ourwork/water.html?category_id=84.

[10] http://eippcb.jrc.es

[11] http://www.envirowise.gov.uk/

6 Integration with Other Processes

The team agreed that its report should help a) WPACs in developing their objectives and their watershed plans, b) sectors in developing their plans, and c) the subsequent Water Council project team that will be tasked with the sector planning work.

In addition to work being done by the Alberta Water Council and its project teams, this team was informed about a project now underway in Alberta Environment to develop an integrated framework for watershed management planning. The existing guide (the *Framework for Water Management Planning*) was based on water allocation and in-stream flow needs planning. The new guide will be expanded to take a more complete view of watershed management planning. It will include elements such as source water protection, wastewater management, storm water management, wetlands objectives, and riparian objectives. It will also describe a process for undertaking that planning in Alberta, considering the roles, responsibilities and authorities involved. The aim is to ensure a consistent approach to watershed management planning across the province and guide WPACs in developing their plans. The Framework for Watershed Management Planning is being developed with input from key stakeholders. It will be stewarded by the Water Council's Shared Governance Project Team, which is now being established, and Alberta Environment will manage the project. The target date for approval of the new framework document is winter 2007.

Members were also aware of the emerging work to develop a provincial land use framework, being led by Alberta Sustainable Resource Development,[12] along with a number of other initiatives involving public consultation.

The team acknowledged the value of all of these initiatives, but expressed concerns about overall coordination to avoid duplication and ensure that the outcomes are compatible and consistent. Funding also needs to be considered to ensure that all parties agree on the priorities and that funding priorities are consistently applied. The team recognized that these issues were outside its terms of reference, but felt strongly that they should be brought to Council's attention. The team has thus identified the following Statement of Need regarding the development of watershed management plans:

The team believes that watershed management plans are needed and that WPACs are the best mechanism to develop them. However, it became clear to the team that WPACs need to know very quickly:

a) how the Government of Alberta expects sector and watershed management plans to be integrated with other planning processes to protect and manage water, air and land, to ensure that outcomes are compatible and consistent; and
b) what role collaborative processes will play in developing these plans.

This is especially important given that the plans will be expected to describe implementation responsibilities and commitments by involved parties. The team was of the view that WPACs need clear authority and a mandate to develop their plans through a collaborative process and that a backstop is needed in the event that agreement on the plans and an implementation strategy cannot be reached. Alberta Environment has indicated that in some cases, legislation

[12] See http://www.srem.gov.ab.ca/luf.html for information on the Land Use Framework.

may need to be amended to ensure that implementation and ongoing management responsibilities can be carried out efficiently and effectively.

One option might be for Alberta Environment to look for an early opportunity to partner with an existing WPAC to pilot possible approaches.

Appendix A: Members of the Water Conservation, Efficiency and Productivity Definitions Project Team

Member	Stakeholder Organization
Danielle Droitsch	Bow RiverKeepers
Les Gammie/ Melanie Gray	EPCOR (representing municipalities)
David Hill	Alberta Irrigation Projects Association
Scott Hillier	ConocoPhillips/ CAPP
Mike Kelly	TransAlta Corporation
Roger Hohm	Alberta Agriculture, Food and Rural Development
Tim LeClair	Métis Settlements General Council
Bunny Mah	Agriculture and Agri-Food Canada
George Murphy	Alberta Environment
Les Wetter	Ducks Unlimited

Former Member:
Gerald Cunningham, Métis Settlements General Council

Secretariat:
Neil Wandler, Alberta Environment
Kim Sanderson, Green Planet Communications

Appendix B: Terms of Reference

BACKGROUND / CONTEXT:

Water For Life has established three outcomes; safe, secure drinking water supply, healthy aquatic ecosystems, and reliable, quality water supplies for a sustainable economy. Improvements in water conservation, efficiency and productivity by all water users are necessary in meeting these outcomes.

In support of achieving this objective, the Alberta Water Council (AWC) established a working group (WG) to develop a Terms of Reference (ToR) to establish a project team that would address three areas:

1. Provide, clear, understandable definitions, principles and expectations for the terms "conservation", "efficiency" and "productivity".
2. Determine baseline information and information gaps on water conservation, efficiency and productivity. It is acknowledged that the volume and/or quality of information available is not the same for all sectors.
3. Determine appropriate methodologies for reporting progress on conservation, efficiency and productivity.

The AWC believes that by addressing the three areas noted above, sectors, Watershed Planning and Advisory Councils and the public will understand:

- What these terms mean to them and how they apply to their life and business;
- The type and level of detail of baseline information available (including gaps in information) on water conservation, efficiency and productivity for each sector;
- How information will be measured and reported to show progress towards achieving improvements in conservation, efficiency and productivity.

This work will be based on sound science and technical approaches already used or applied elsewhere. The project team will provide regular reports to the AWC.

This work is an important first step in setting the foundation for additional work to follow, including activities such as the development of water conservation, efficiency and productivity plans. It is anticipated each of the areas outlined above will require analysis and discussion to arrive at consensus-supported approaches. This work will include identifying the resources necessary to ensure sector implementation.

The Project Team will strive to ensure that the expectations and understanding surrounding these areas are consistent with the intent of the outcomes, and directions as described in *Water For Life* (environmental, economic and social objectives).

GUIDING PRINCIPLES:

Team members will support the following shared principles:

- Members will work in accordance with the AWC document, "Guidelines for Participating in Council Work".
- Teamwork relies on effective information sharing between project team members and their constituents. Team members will support this process by providing

relevant, timely and accurate information for consideration from sectors and report decisions made by the project team back to sectors.

- Principles of sound management will be followed such that the Secretariat, under the guidance of the co-chairs, will prepare agendas that are followed with minutes recorded and distributed to team members in a timely manner.
- Team members will ensure that relevant issues are brought to the table for discussion, with emphasis on resolving those issues by means of consensus. The process for consensus will adhere to the definition provided in the AWC's ToR.
- Failure to reach consensus on an issue by the project team will be referred to the AWC for discussion, with a summary of the issue and the differing viewpoints.

TEAM GOALS/ RESULTS / EXPECTATIONS:

The AWC expects the team to provide a written report and recommendations to the AWC that provides clear definition and understanding of the principles and expectations for "conservation", "efficiency" and "productivity" such that sectors, Watershed Planning and Advisory Councils, and the public have clear understanding of what these terms mean to them and how they apply to their life and business; the type and level of detail of baseline information available, including information gaps, on water conservation, efficiency and productivity for each sector; how information will be measured and reported to show progress towards achieving improvements in conservation, efficiency and productivity. The report will provide an understanding of these terms in the context of the implementation of the Water for Life strategy as a whole.

KEY TASKS:

The Team will:

1. Hold regular meetings to maintain involvement and momentum towards defining terms and providing context for conservation, efficiency and productivity to assist sectors.
2. Develop a workplan of key tasks/deliverables (including confirmation of the proposed budget), and the timeframes associated with completing the tasks. Project team will report regularly to the AWC.
3. Develop a set of principles governing performance measures and reporting.
4. Identify baseline information and information gaps related to conservation, efficiency and productivity.
5. Determine appropriate performance measures and reporting protocols for measuring progress on improvements in conservation, efficiency and productivity. Sector targets will be established at a later time by another process.
6. Consult with sectors to ensure issues are identified for discussion, and a common understanding of decisions made by the project team are relayed back to sectors.
7. Reference all products derived from the work of the team as those of the AWC.
8. The team will ensure that the materials it develops use language that is appropriate and understandable to a broader public audience.

These tasks will assist the AWC, sectors, Watershed Planning and Advisory Councils and the public in ensuring appropriate definition, information and guidance is provided for consistent, comprehensive planning, implementation and reporting of achievements that reflect improvements in conservation, efficiency and productivity. Project team members should rely on readily available definitions and other research in these areas to assist them.

The project team will be assisted by a Secretariat.

Communications and Publicity:

The co-chairs with support from the Secretariat will report to the AWC as indicated in the timeline below.

Information Gathering:

Information necessary for the team to complete its tasks may be obtained from any appropriate sources. In cases where critical information is not readily available, the team will explore options to fill these needs including contracting the services of consultants.

SCHEDULE OF KEY DELIVERABLES:

The team will report to the AWC at the specified intervals below to give the Council an opportunity to provide feedback and approval at key direction points before the team proceeds to the next stage. This will ensure the AWC is fully engaged and takes a leadership role in the project as it moves forward.

- Project team will provide a detailed workplan with key tasks/deliverables (along with confirmation of the proposed budget) for the May 2006 meeting of the AWC.
- Project team will provide a target date for completion of the tasks.
- Project team will provide a draft report for presentation to the AWC at their last meeting of the 2006 calendar year.
- Project team co-chairs will report on team progress at each Council meeting.

BUDGET:

It is the responsibility of the AWC to provide a budget to the team for items such as employing a professional minute taker, consultant costs for specific projects including information collection, workshop facilitation, and research to fill information gaps. Other costs may be incurred through team membership (e.g. travel costs, etc.).

A budget of $50,000.00 is required for fiscal year 2006-07. There is an expectation of substantial in-kind sector participation.

TEAM STRUCTURE and MEMBERSHIP:

Membership:

Members of the project team will represent the interests of their broad sector.

- Industry - 3 representatives
- Government (non-provincial) – 3 representatives
- ENGO – 2 representatives
- Government – 2 representatives

There is an expectation that this small project team will be hard-working, demanding a significant amount of time on the part of sector representatives. Project team representatives must clearly identify the sectors they will be representing and consulting throughout the project.

Depending upon agenda items to be discussed at meetings, sectors may request an individual that is not a regular member of the team to attend the meeting. This is acceptable provided the sector makes the request to the co-chairs or the Secretariat and obtains their approval ahead of the planned meeting.

George Murphy and David Hill will be co-chairs of the team.

Role of Co-Chairs

- Chair meetings.
- Clarify the AWC's expectations of the team.
- Ensure the team has adequate support to efficiently and effectively carry out its Terms of Reference.
- Inform the team of other programs and initiatives so the team can avoid duplicating work being addressed elsewhere.
- Serve as liaison to the AWC and Government.

Role of Team Members

Members are expected to attend meetings regularly and provide relevant, timely and accurate information for the team's consideration. Team members should consult with sectors to ensure issues are identified for discussion by the Team, and decisions made by the Team are relayed back to sectors. Members missing more than 3 consecutive meetings without reasonable cause will be asked to be replaced through consultation with the respective agency/sector they represent.

Alternate Members

Team members may send an alternate in their place if they are unable to attend a meeting. The team member named as the formal designate to the team is responsible to remain informed about current discussions.

Role of Secretariat

Under the guidance of the co-chairs, the Secretariat will prepare agendas, coordinate meetings, record discussions and develop progress and final reports that reflect the teams' direction in a succinct and unbiased manner.

In co-operation with the Secretariat, a secretary will record meeting discussions and prepare a set of succinct written minutes, including Action Items to the team.

SIGNIFICANT PARAMETERS OR CONSTRAINTS:

Water users in Alberta are many and varied. This variability is coupled with the fact that the water supply is also variable (in time and space) across the province. Water conservation, efficiency, and productivity are multi-faceted complex concepts that require definition, understanding (on the part of sectors and the public), context, information, implementation, measurement and reporting. All of these aspects must be brought together in order to understand how improvements in water use can be achieved and progress is being made towards meeting the three outcomes of *Water for Life: Alberta's Strategy for Sustainability*; safe, secure drinking water supply, healthy aquatic ecosystems, and reliable quality water supplies for a sustainable economy.

This common understanding is essential to ensure Albertans are confident that the approaches taken by water users are the correct ones, and to ensure the successful achievement of the outcomes of *Water For Life.*

Appendix C: Reporting Protocols

The team reviewed four main protocols for environmental reporting:

- National Round Table on the Environment and the Economy – Calculating Eco-efficiency Indicators;
- Global Reporting Initiative – Sustainability Reporting Guidelines: Water Protocol;
- World Business Council on Sustainable Development – Measuring Eco-efficiency: A Guide To Reporting Company Performance;
- International Standards Organization – ISO 14031: 1999(E): Environmental Performance Evaluation, Guidelines.

Appendix D: Sample Sector Performance Measures and Charts

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Irrigation	Diversions Per Hectare Irrigated	Changes could indicate an increase in efficiency of delivery and on-farm water management systems	Measured Irrigation District AENV[13]	Irrigation District Watershed Provincial	Freshwater, Surface	Water supplied to wetlands should be a credit [and netted against diversions?]	Evaporation Seepage Deep Percolation Return Flow	Trend
Irrigation	Diversion vs Crop Requirement	Changes could indicate an increase in efficiency of delivery and on-farm water management systems and increased productivity	Measured Irrigation District AAFRD[14] AFSC[15] Modelled [IDM][16]	Irrigation District Watershed	Freshwater, Surface		Evaporation Deep Percolation	Trend
Irrigation	BMPs, Changes in Method of Irrigation	Would indicate adoption of BMPs resulting in increased efficiency and productivity	Irrigation District AAFRD	Irrigation District Watershed Provincial	Freshwater, Surface			Trend Quantitative
Irrigation	Return Flow as % of Diversion	Changes could indicate an increase in efficiency of delivery and on-farm water management systems	Measured Irrigation District AENV EC[17]	Irrigation District Watershed Provincial	Freshwater, Surface			Trend

[13] Alberta Environment
[14] Alberta Agriculture, Food and Rural Development
[15] Agriculture Financial Services Corporation
[16] Irrigation District Model
[17] Environment Canada

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Irrigation	Energy Per Unit of Water Diverted	Changes would indicate energy savings related to adoption of BMPs and changes in method of irrigation	AAFRD Modelled [IDM]	Irrigation District Watershed Provincial	Freshwater, Surface			Trend [Indirectly related to water use through energy requirements]
Irrigation	$/m^3	Increase in $/m^3 of primary and related value added production over time	AAFRD AFSC Irrigation District	Irrigation District Watershed Provincial	Freshwater, Surface			Trend
Irrigation	Concurrent Uses/Benefits of Water Related to Primary Use	Listing of concurrent water uses [licensed, non-licensed]	Irrigation District	Irrigation District Watershed Provincial	Freshwater, Surface			Listing for Qualitative Analysis
Agriculture	Watershed BMPs	An increase in adoption of BMPs by landowners in a watershed could result in improved water use efficiency and improved water quality	AESA[18]	Watershed Provincial	Freshwater, Surface			Trend
Agriculture	$/m^3	Increase in $/m^3 of primary and related value added production over time	StatsCan[19] AENV	Provincial	Freshwater, Surface, Groundwater			Trend
Oil & Gas (Common to all)	Total allocation	Number	Company (licence source)	Per licence condition (monthly/ yearly)	Freshwater (ground, surface)	Per licence condition		
Oil & Gas	% total allocation used	% allocation used as compared to the total allocation	Company AENV		Freshwater (ground, surface)	Per licence condition		Trend

[18] Alberta Environmentally Sustainable Agriculture Council
[19] Statistics Canada

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
		under licence						
Oil & Gas	Volume of surface water used	Volume used as compared allocation	Company AENV	Per licence condition (monthly/ yearly)	Freshwater (surface)	Per licence condition		Trend
Oil & Gas	Volume of fresh groundwater used	Volume used as compared to allocation	Company AENV	Per licence condition (monthly/ yearly)	Freshwater (ground)	Per licence condition		Trend
Oil & Gas	Volume of saline groundwater used	Volume used as compared to allocation	Company AENV	Per licence condition (monthly/ yearly)	Produced water (saline)	Saline water is recycled wherever possible		Trend
Oil & Gas	Volume of surface water returned to environment	Volume of surface water returned to environment as compared to allocation	Company AENV	Per licence condition (monthly/ yearly)	Freshwater (surface)	Surface discharge	Evaporation	Trend
Oil & Gas	Volume of fresh groundwater returned to environment	Volume of fresh groundwater returned to environment as compared to allocation	Company AENV	Per licence condition (monthly/ yearly)	Freshwater (ground)	Per licence condition Injection?		Trend
Oil & Gas	Volume of freshwater used per m^3 of oil or gas produced	Productivity measure	Company EUB	Per licence condition (monthly/ yearly)	Freshwater			Water productivity measure that can be used for comparison across the industry and geographically
Oil & Gas	Volume of freshwater used per m^3 of refined product produced	Productivity measure	Company EUB	Per licence condition (monthly/ yearly)	Freshwater			Water productivity measure that can be used for comparison across the industry and geographically

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Oil & Gas	Recycle rate	The volume of water recycled as per licence	Company AENV EUB	Per licence condition (monthly /yearly)	Freshwater (surface and ground) Saline??			Trend
Oil & Gas	Freshwater returned to environment as a % of total freshwater used	The volume of freshwater returned as per licence condition	Company AENV EUB	Per licence condition (monthly/ yearly)	Freshwater (surface and ground)			Trend
Oil & Gas	Freshwater disposed as a % of total freshwater used	The volume of freshwater disposed through various means	Company AENV EUB		Freshwater (surface and ground)		Deepwell injection	Trend
Utilities (Plants)	Water consumption (m^3) / unit of production (MWh)	Productivity measure	Measured	Per approval / licence condition (monthly/ yearly)	Freshwater (Surface)	Per approval / licence condition	Evaporation from on-site retention ponds. Ponds are used for treatment	Trend
Utilities (Plants)	Water consumption (m^3) / unit of production (coal combusted, tonnes)	Productivity measure	Measured	Per approval / licence condition (monthly/ yearly)	Freshwater (Surface)	Per approval / licence condition	Evaporation from on-site retention ponds. Ponds are used for treatment.	Trend
Utilities (Mines)	Water Discharge (m^3) / area of land disturbed (hectares)	Measure of water displaced	Measured	Per approval / licence condition (annual)	Freshwater (surface water, groundwater)	Per approval / licence condition	Evaporation from retention ponds	Trend
Utilities (Mines)	Water Discharge (m^3) / unit of production (coal production, tonnes)	Measure of water displaced	Measured	Per approval / licence condition (annual)	Freshwater (surface water, groundwater)	Per approval / licence condition	Evaporation from retention ponds	Trend

Notes to Utilities Performance Measures:

- The water consumption metrics of Alberta based natural gas powered plants are not readily tracked.
- Hydroelectric plants do not measure quantity of water throughput and would consume very minimal quantities.

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Municipal Water & Waste-water	Full Metering – amount of water used (m^3)	All municipal water customers should be metered so that costs are directly linked to water usage. Residential water customers who are metered generally use less water due to monthly water bills, which correlate to amount of water used.	Meter – monthly meter readings	Municipal Watershed Province	Treated freshwater – surface and/or ground	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage Consumption	Trend over time and in comparison to other municipalities who are and are not metered
Municipal Water & Waste-water	Full Cost Accounting - utilities should adopt rates based on cost of service	Charges for water should include all costs related to the operation of the water and wastewater utilities including capital costs.		Municipal				Trend over time (yearly) and in comparison to other municipalities of similar size
Municipal Water & Waste-water	System Losses – amount of water lost in system (m^3) through: • WTP[20] and related network; • WWTP and related network	Keep system losses to less than 10%	Meter and estimate	Municipal Watershed Province	Treated freshwater – surface and/or ground Raw Sewage Storm Water		Seepage through leak prone piping	Trend over time (monthly or yearly) and in comparison to other municipalities

[20] WTP = Water Treatment Plant; WWTP = Wastewater Treatment Plan

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Municipal Water & Waste-water	Large Water Use Audits – amount of water used (m^3)	Large industrial and institutional water users to undertake regular audits	Meter	Municipal	Treated freshwater – surface and/or ground		Evaporation Seepage Consumption	Large water users to undertake regular (yearly) audits, encourage the re-use / recycle of water and compare yearly production numbers to amount of water used
Municipal Water & Waste-water	Promotion of Water Re-Use or Alternate Use – amount of non-potable water used per year (m^3)	Encourage non-potable water users to use untreated source water, treated wastewater and/or grey water	Meter and estimate	Municipal Watershed	Untreated source water Treated wastewater Grey water	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage	Conduct cost / benefit analysis. Some water re-use alternatives may only be viable during the spring, summer and fall months
Municipal Water & Waste-water	Water Use Targets (litres/person/ day)	Set goals for residential amount of water used per capita per day	Meter, production, numbers from WTPs and population	Municipal Watershed Province	Treated freshwater – surface and/or ground	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage Consumption	Trend over time, may have a reflection on the effort put into education and promotion of water conservation and efficiency

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Municipal Water & Waste-water	Water Use Restrictions (l/p/d)	Drought response plan	WTP production numbers	Municipal Watershed Province	Treated freshwater – surface and/or ground	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage Consumption	High demand and emergency demand restrictions need to be determined, usually during dry/drought times of the year when demand exceeds supply
Municipal Water & Waste-water	Consumptive Losses*	Water supply diversion against wastewater treatment flows returned to source	WTP and WWTP production numbers	Municipal Watershed Province	Treated freshwater – surface and/or ground Treated wastewater Temperature and rainfall data (Environment Canada)	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage Consumption	Provides a measure of how much water is being returned to the source; the goal is to have as much water going back to the source as possible

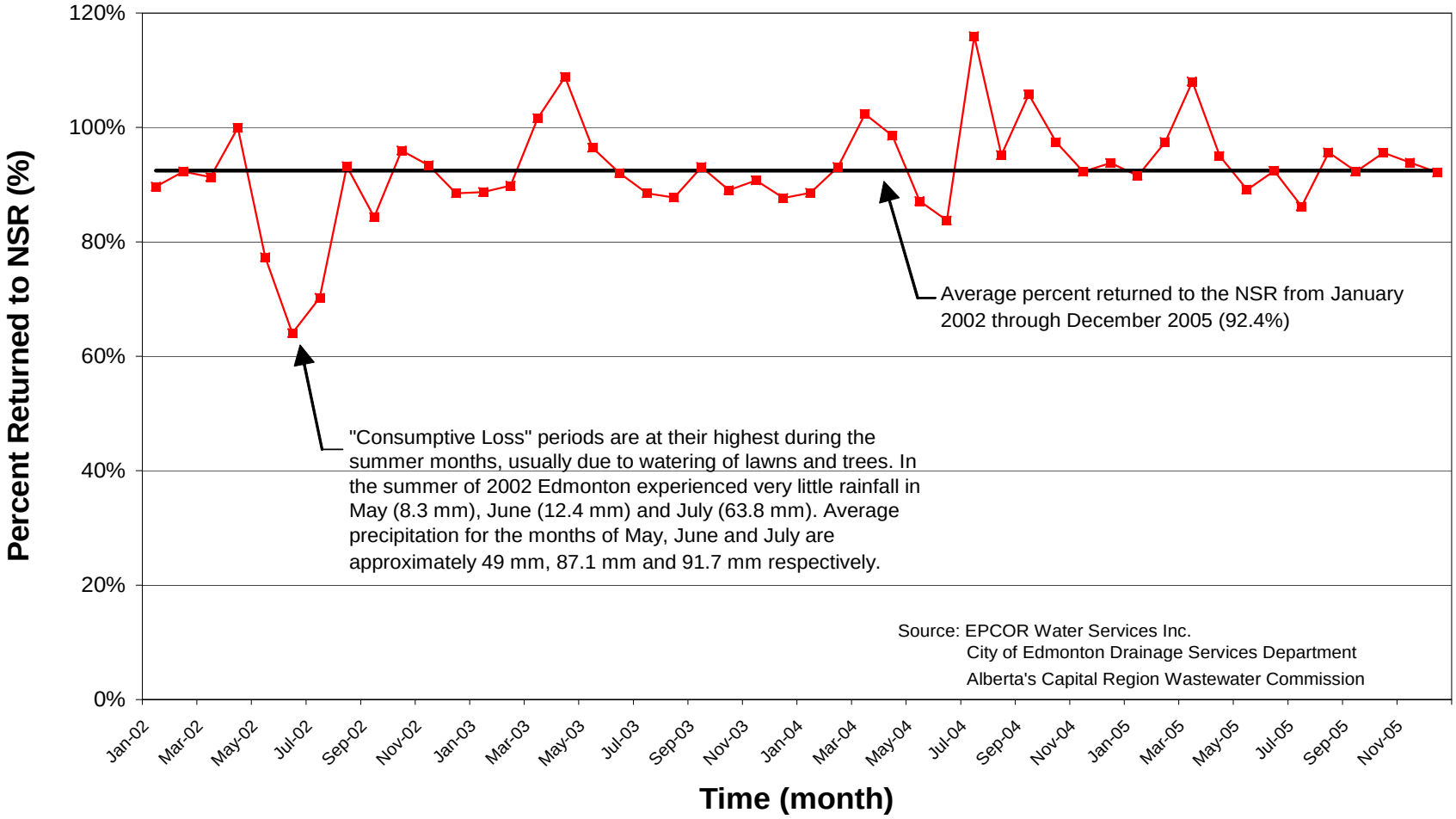
* This performance measure applies to large water users with continuous wastewater discharges. For small communities using wastewater lagoons, measuring monthly losses is difficult due to uncertainties in measuring evaporative losses from lagoons that discharge to source water on an infrequent basis.

Sector	Performance Measure	Description	Data Source	Reporting Scale	Source Type	Water Returned to the Environment (intentional)	Water Lost	Analysis
Municipal Water & Waste-water	Education / Promotion	Encourage non-potable water users to use untreated source water, treated wastewater or grey water instead of drinking water (e.g. for watering golf courses, city parks, road allowances, industrial process water, etc) and encourage the use of low flush toilets, low flow shower fixtures, etc.	Meter and estimate	Municipal Watershed Province	Untreated source water Treated wastewater Grey water Treated freshwater – surface and/or ground	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage	Conduct cost / benefit analysis. Some water re-use alternatives may only be viable during the spring, summer and fall months. Trend over time and observe per capita municipal water use decrease.
Municipal Water & Waste-water	Promote Efficient Outdoor Water Use, Landscape Planning and Efficiency	Encourage use of drought-tolerant natural vegetation, xeriscaping, proper lawn or park watering, etc. Encourage use of rain water (with rain barrels or cisterns)	Meter and estimate	Municipal Watershed Province	Treated freshwater – surface and/or ground Treated wastewater Grey water	Water returned to source if sewage treatment plants and storm water collection system are linked to source waters	Evaporation Seepage	Trend over time (yearly). May observe per capita municipal water use decrease in summer

The following figures show how performance measures could be illustrated graphically.

Consumptive Losses - Edmonton and Capital Region

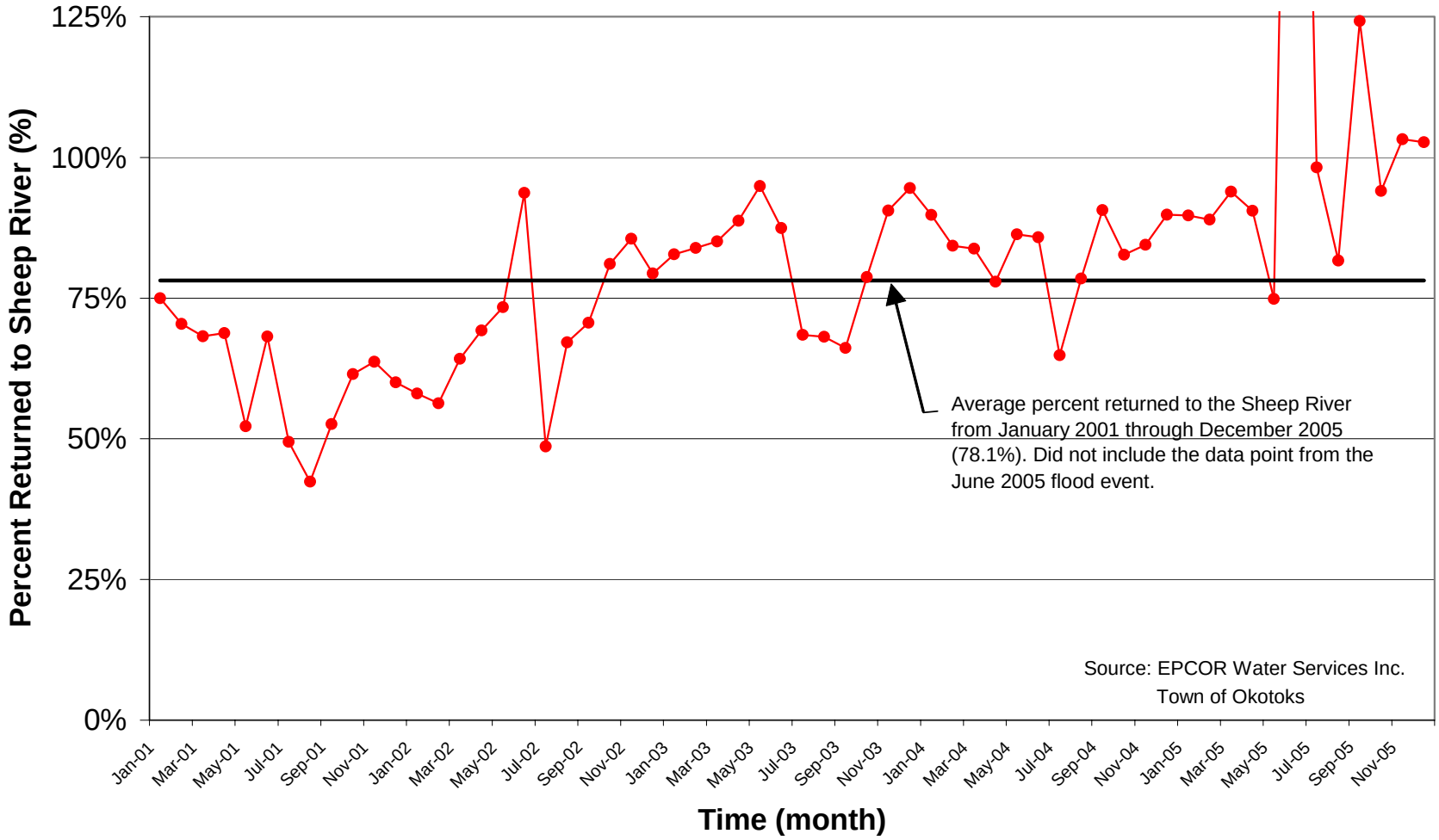
(Amount of Water Produced at EPCOR's WTPs and Returned to Source Through Goldbar and Capital Region WWTPs)



NOTES: Source data was presented based on monthly totals. Return flows include possible infiltration.
EPCOR currently diverts between 1.5 and 4.5% of the North Saskatchewan River flows (varies seasonally).
Residential customers make up approximately 60% of EPCORs customer base within the Edmonton region.

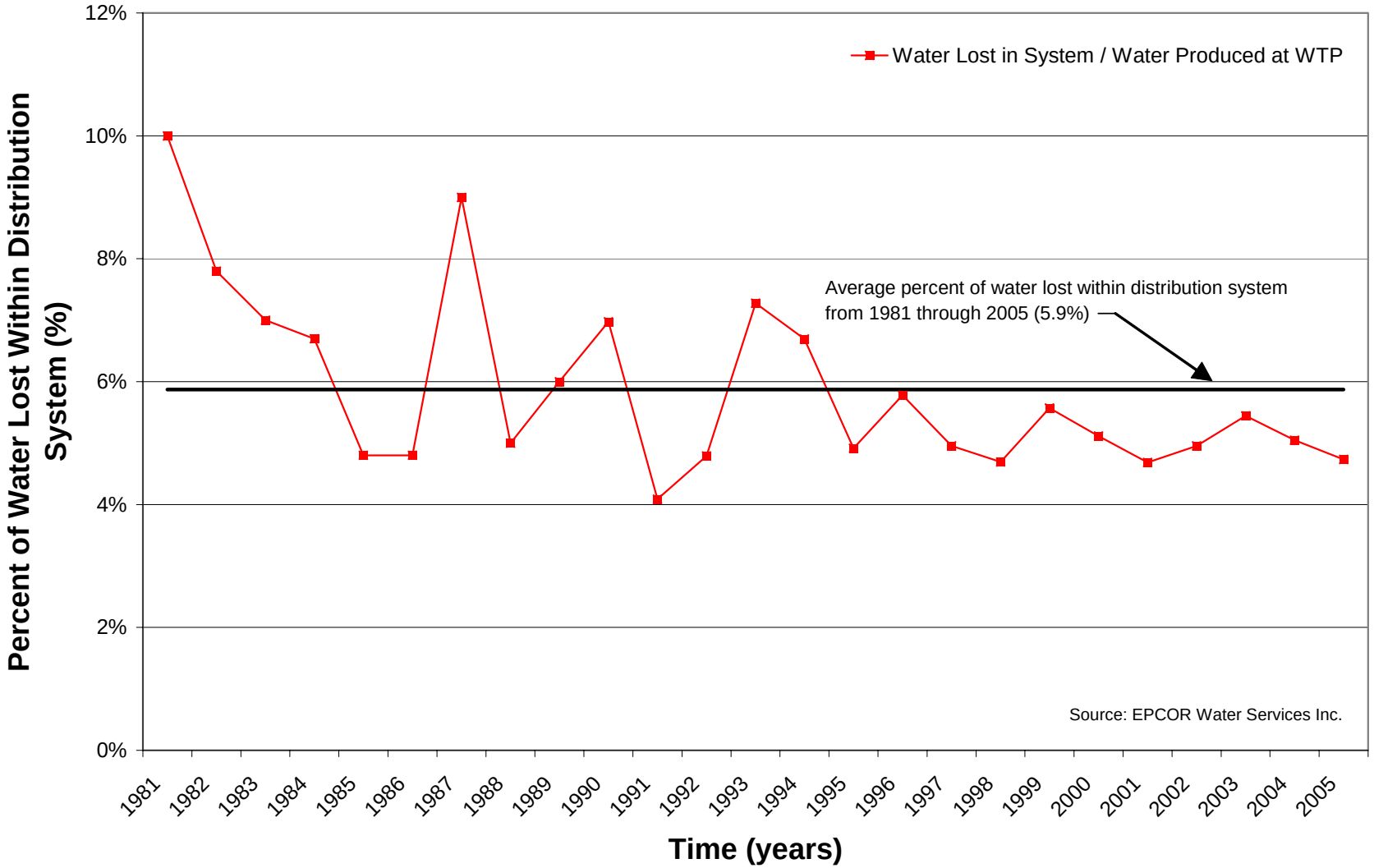
Consumptive Losses - Okotoks, Alberta

(Amount of Water Produced at WTP and Returned to Source Through WWTP)



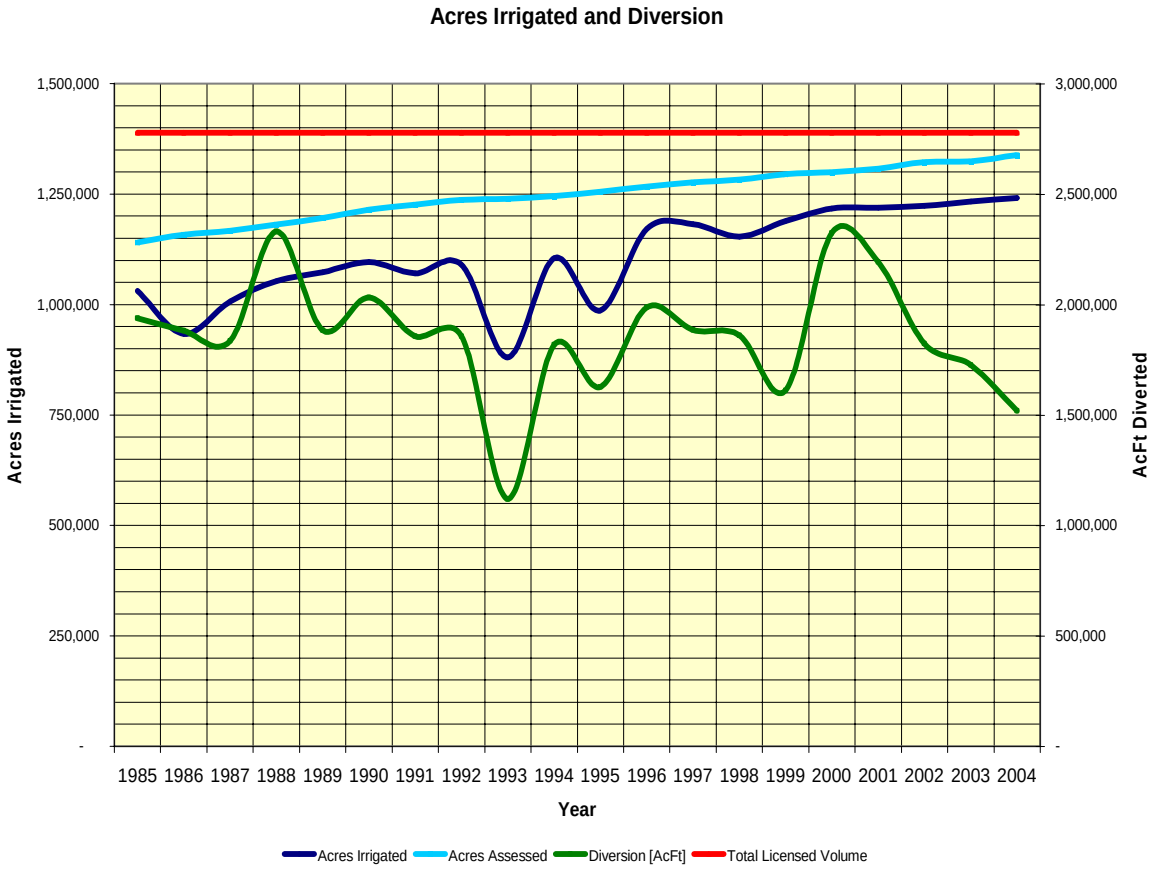
NOTES: Source data was presented based on monthly totals. Return flows include possible infiltration.
The large spike shown during the summer of 2005 was due to the flood which occurred in June. Percent Returned was approximately 275%.
EPCOR currently diverts between 1 and 6% of the Sheep River flows (varies seasonally).
Residential customers make up approximately 80% of EPCORs customer base within Okotoks.

Water Treatment Distribution System Losses - Edmonton and Capital Region



NOTE: Source data was collected and measured based on yearly totals from Edmonton and Capital Region. Does include losses in network from regional customers.

In the figure below, trends indicate that increases in acres irrigated are being accomplished within present allocations and that gross diversions per acre are decreasing or cyclical, depending on water availability, precipitation, and other factors.



Appendix E: Sample Environmental Indicators

In its State of Environment work,[21] Alberta Environment uses several indices to illustrate various water quality trends. Indices usually reflect a compilation and weighting of data to come up with one value that can be used to assess trends over a period of time. Other approaches involve looking specifically at physical or chemical parameters in water. These parameters, ranging from dissolved oxygen, nutrient levels, and pollutants to flow rates and recharge rates, all affect ecosystem health. Both approaches are included in the table below.

Environmental Indicator	Description or Significance	Source or Additional Information
Lake level index	Shows the status of lake levels for 27 selected Alberta lakes. The water level throughout the year is compared to historical patterns in recorded data. It is then ranked based on five possible categories, ranging from the highest classification of "much above normal" to the lowest, "much below normal." A mid-range classification is considered "normal." Lake levels are generally controlled by natural variability unless direct human withdrawals or withdrawals from feed sources such as rivers and groundwater occur.	AENV SOE Indicator
River water quality index	Provides a general assessment of water quality at Long-Term River Network sites in each of the six major river systems. In most cases, the sites represent conditions upstream and downstream from areas of significant human activity.	AENV SOE Indicator
River nutrient index	Rates river water quality based on nutrients and related variables, including phosphorus, nitrogen, pH, and dissolved oxygen, in an annual series of water samples. Data for the index are collected monthly at Long-Term River Network sites (April through March). The River Nutrient Index is a component of the general River Water Quality Index and rates water quality as "Excellent", "Good", "Fair," "Marginal" or "Poor."	AENV SOE Indicator
River pesticide index	Provides general information about the pesticide contamination of Alberta rivers. It does not attempt to measure the risk to aquatic life or drinking water sources. The index uses an annual series of pesticide data collected at Long-Term River Network monitoring sites (April through March). It takes into account the pesticides that were detected, how often, and at what concentration. Over 50 pesticides are routinely analyzed, including herbicides, insecticides and fungicides commonly used in agricultural and urban settings in Alberta. From these, a subset of 17 pesticides is used to generate this index. The River Pesticide Index is a component of the general River Water Quality Index rating quality as "Excellent", "Good", "Fair," "Marginal" or "Poor" based on the presence of pesticides.	AENV SOE Indicator
River bacteria index	Shows river water quality based on the abundance of bacteria at sites on each of the province's six major river systems. The index evaluates bacteria densities in an annual series of water samples. These are collected monthly at provincial Long-Term River Network sites (April through March). The River Bacterial Index is a component of the general River Water Quality Index. It rates the quality as "Excellent", "Good", "Fair," "Marginal" or "Poor", based on the presence of bacteria.	AENV SOE Indicator
Dissolved oxygen levels	One of the most easily monitored and important environmental indicators. Low oxygen levels are undesirable and may arise from excess nutrients in the system in question or water temperature. Wetlands can be both aerobic and anaerobic within a given year and oxygen levels are not a primary concern. Aerobic and anaerobic conditions may trigger secondary chemical and biological reactions.	

[21] See Alberta Environment's State of the Environment website at http://www3.gov.ab.ca/env/soe/water.html for more information.

Environmental Indicator	Description or Significance	Source or Additional Information
Nutrient levels	Closely correlated with dissolved oxygen. Primary limiting nutrients to biological growth are nitrogen and phosphorous. Most nutrients originate from non-point sources, so tracing their origin can be difficult. In flowing water and lakes, nutrient levels are a primary concern because of their ability to reduce oxygen through biological activity with a consequent negative effect on biological organisms such as fish. In wetlands high nutrient levels are expected and wetland systems have the ability to use high levels of nutrients through biological and plant activities under aerobic and anaerobic conditions. In ground water high levels of nitrates are a health concern due to effects of nitrates on human metabolism. Wetlands can remove excess nutrients before they enter shallow groundwater. Tests for nutrients such as Nitrogen and Phosphorous are relatively simple.	
Pollutants	May include man made pollutants as well as natural substances deleterious to human health and the aquatic environment. In this context salt or petroleum products such as natural gas in groundwater can be considered a pollutant. The nature of these pollutants will depend on the presence and scale of man-made disturbances and release in the watershed. In order of priority, pollutants in groundwater, lakes and rivers are most critical. Because of the high level of biological activity in wetlands many pollutants can be broken down before being released to other water sources. Specific tests must be made following an environmental scan and compared to control systems or historical data. Predicting safe upper limits may be very difficult.	
Abundance and diversity of specific aquatic organisms	In many cases variety of organisms is considered positive, an exception might be bacteria associated with fecal matter in groundwater. Data exists on many varieties of organisms and would indicate positive or negative environmental health when associated with control aquatic systems.	
Status of Bull Trout	Conservation Risk to Bull Trout in BC: Using a rating system (conservation risk, presumed conservation risk, conservation risk unknown, presumed health, no historical presence), BC evaluated risk data based on expert opinion. Bull trout was used as an indicator because it is widely distributed in BC and known to be sensitive to habitat changes.	BC Ministry of Water, Land and Air Protection www.env.gov.bc.ca/ soerpt/4fish/trout.htm
Sedimentation	Is generally considered negative. While recognizing that sedimentation is a natural process, human land use activities may increase this natural process exponentially. Sedimentation can be measured and compared to control systems.	
Water temperature	Water is less able to retain oxygen as it warms. Water temperature is of most importance where high oxygen levels are critical for sustaining aquatic life such as rivers or lakes. Generally not a concern in wetlands or groundwater.	
Flow magnitude and timing	Major changes in high and low flow in rivers and streams (compared with designated time period). This is the percentage of stream or rivers that experienced major changes in the magnitude or the timing of average annual 1-day high flows or 7-day low flows compared to a 20-year baseline period.	US Environmental Protection Agency
Flow restoration	Percent of watersheds that need flow restorations for aquatic ecosystems including fish.	Oregon Water Resources Department
Wetland levels	Generally controlled by natural variability in the hydrological regime. Human intervention is most often in the form of drainage. Where drainage occurs wetlands are lost or modified to another type. The indicator of most importance is the presence and current acreage of wetlands and wetland type compared to historical data. Data of this type can be generated from remote sensing (air photos) and analysis. Data of this type only exists on a limited basis.	

Environmental Indicator	Description or Significance	Source or Additional Information
Groundwater levels	Affected by climatic variability and the withdrawal of water or the removal of sources (such as wetlands). Data is available, but scattered with many gaps.	
Protection of Instream Water Rights	Ratio of stream regulated to protect instream water rights to all streams regulated.	Oregon Water Resources Department
Water allocations	Compared to Natural Flows: This indicator shows the proportion of water allocated for various uses in each of Alberta's main sub-basins.	AENV SOE Indicator
Wetland extent	Long-term change in wetland acreage. Breakdown by estuarine vegetation and estuarine non-vegetated.	
No-flow periods	Percentage of streams in which the duration of no-flow periods represents an increase or decrease.	US Environmental Protection Agency

Other Sources:

- British Columbia, State of the Environment Reporting. http://www.env.gov.bc.ca/soerpt/
- City of Kelowna. http://www.city.kelowna.bc.ca/CM/Page441.aspx.
- Environment Canada. http://www.ec.gc.ca/soer-ree/English/Indicator_series/default.cfm
- Environment Canada. Environmental Indicators: Pacific and Yukon Region: http://www.ecoinfo.org/env_ind/indicators_e.cfm
- Environmental Protection Agency. Environmental Indicators Program. http://cfpub.epa.gov/eroe/.
- Fraser Institute. *Environmental Indicators (5th Edition).* April 2002. http://www.fraserinstitute.ca/shared/readmore.asp?sNav=pb&id=314.