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Recommendations for Agricultural Sector Participation

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List of Acronyms

AAFC	Agriculture and Agri-Food Canada
ACAAF	Advancing Canadian Agriculture and Agri-Food
ACAP	Atlantic Coastal Action Program
AEGP	Agri-Environmental Group Plan
AEPA	Agri-Environmental Partnership of Alberta
AESB	Agri-Environment Services Branch
APF	Agricultural Policy Framework
ASB	Agricultural Service Boards
AURSA	Association of Users of Irrigation of San Jeronimo
BBEMA	Bedeque Bay Environmental Management Association
BBW	Black Brook Watershed
BBWMP	Bow Basin Watershed Management Plan
BCWWA	British Columbia Water and Wastewater Association
BMP	Beneficial Management Practice
BRBC	Bow River Basin Council
BRWA	Battle River Watershed Alliance
BSMS	Basin Salinity Management Strategy
CA	Conservation authority
CAPSA	Corporation d'Aménagement et de Protection de la Sainte-Anne
CARP	Clean Annapolis River Project
CCAE	Clubs-conseils en Agroenvironnment
CCIAP	Climate Change Impacts and Adaptation Program
CD	Conservation District
CIWM	Collaborative Integrated Water Management
COGEBY	Conseil de Gestion du Bassin Versant de la Yamaska
CSD	Commission for Sustainable Development
CVC	Credit Valley Conservation
DEEF	Department of Environment Energy and Forestry
DSM	Demand Side Management
DSWMA	Deerwood Soil and Water Management Association
DUC	Ducks Unlimited Canada
DWS	Drinking Water Strategy
EAEP	Equivalent Agri-Environmental Plans
ECW	Eastern Charlotte Waterway
EFP	Environmental Farm Plans
EGS	Ecosystem Goods and Services
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FBC	Fraser Basin Council
FESLM	Framework for Evaluating Sustainable Land Management
FPMS	Flood Plain Management Strategy
GBAP	Georgia Basin Action Plan
GRCA	Grand River Conservation Authority
GWP	Global Water Partnership
GWP-INBO	Global Water Partnership-International Network of Basin Organizations
ICM	Integrated Catchment Management

ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resource Management
JBIC	Japan Bank for International Cooperation
LSR	Lower Souris River
LSRWC	Lower Souris River Watershed Committee
MA	Millennium Ecosystem Assessment
MAPAQ	Ministry of Agriculture, Fisheries, and Food
MBSAP	Multi-barrier Strategic Action Plan
MPW	Master Plan for Water
NFS	National Fish Strategy
NGO	Non-governmental Organization
NSRBC	North Saskatchewan River Basin Council
NSWA	North Saskatchewan River Watershed Alliance
NY	New York
NZ	New Zealand
OBV	Organisations de Bassin Versant
OBWB	Okanagan Basin Water Board
OWSC	Okanagan Water Steward Council
PDE	Plan Directeur de l'Eau
PES	Payments for Ecosystem Services
PFRA	Prairie Food Rehabilitation Administration
PVCD	Pembina Valley Conservation District
PWSA	Protected Public Water Supply Area
QWP	Quebec Water Policy
RLLT	Rotorua Lakes and Land Trust
ROBVQ	Regroupement des Organizations de Basin Versant du Quebec
SBW	Steady Brook Watershed
SCARM	Standing Committee on Agriculture and Resource Management
SDWS	Safe Drinking Water Strategy
SLUIB	Sustainable Land Use Implementation Board
SNC	South Nation Conservation Authority
SPC	Source Protection Committee
SSRMP	South Saskatchewan River Management Plan
STELLA	Systems Thinking Experimental Learning Laboratory with Animation
SWA	Saskatchewan Watershed Authority
SWP	Source Water Protection
TCMW	Tobacco Creek Model Watershed
TMCD	Turtle Mountain Conservation District
TMDL	Total Maximum Daily Load
UNCED	United Nations Conference on Environment and Development
UPA	L'Union des Producteurs Agricoles
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
WAC	Watershed Advisory Committee
WAC	Watershed Agricultural Council
WBM	Watershed-based Management
WEBs	Watershed Evaluation of Beneficial Management Practices
WMC	Watershed Management Committees

WPAC	Watershed Planning and Advisory councils
WPAT	Watershed Planning Advisory Team
WPI	Watershed Planning Initiative
WPP	(New Brunswick's Surface) Water Protection Program
WRMS	Water Resources Management Strategy
WSG	Watershed Stewardship Groups
WSO	Watershed Stewardship Organizations
WUA	Water Users' Association

1.0 Introduction and Background

While there is no single accepted definition of Integrated Water Resources Management (IWRM), the international community, including key organizations, such as the Food and Agriculture Organization of the United Nations, has widely accepted the Global Water Partnership's definition of IWRM[1] as "a process that promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Practitioners agree that this requires a highly consultative process, engaging the watershed communities as well as stakeholders.

The underlying principles of integrated water resources management are based on the Dublin Principles[2] (adopted at the International Conference on Water and the Environment held in Dublin in 1992):

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment;
- Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels;
- Women play a central part in the provision, management and safeguarding of water; and
- Water has an economic value in all its competing uses and should be recognized as an economic good.

While these principles are intended to apply globally, the principle attributing women with the central responsibility in the management of water may not be as applicable in the context of North America as it would be in the context of developing countries. However, recognizing that this principle reinforces a need for multi-stakeholder representation through the IWRM process, with some emphasis on marginalized sectors, is important for our research in Canada.

In the Global Water Partnership description of IWRM, the first three principles are the same, while the last one is described as:

- Improving the social and economic value of water; and
- Integrating the three Es: economic efficiency in water use, equity, and environmental and ecological sustainability.

[1] IWRM is defined at: www.gwptoolbox.org/index.php?option=com_content&view=article&id=8&Itemid=3
[2] UN Documents: The Dublin Statement on Water and Sustainable Development. *Available at* http://www.un-documents.net/h2o-dub.htm

In its essence, IWRM integrates land, water and resource management, integrates social and stakeholder input towards commonly acceptable and implementable goals, and integrates economic, social and environmental aspects of water management for long-term benefits.

Canada has a relative abundance of land and water. In spite of this, we are threatened by water shortages and floods, as well as water quality issues. Management experience has shown that supply is stressed in certain regions and at certain times of year. In addition, projected trends due to climate change indicate that some of these problems will be exacerbated in the long run- more droughts *as well as* more floods and more resultant water quality problems. As IWRM offers integrated solutions towards sustainable development, its application is extremely relevant in resource-based sectors where water supply and quality are critical, such as the agricultural sector.

1.1 Water in Canada

Canada is a large country, occupying 7 per cent of the Earth's land mass and accounting for 7 per cent of the world's supply of fresh water. Canada also holds 25 per cent of global wetlands, the largest percentage of wetlands in the world, and has the longest marine coastline of any nation.[3] Whereas some parts of the country receive moderately heavy rainfall and are prone to seasonal and annual floods, other parts are semi-arid and prone to regular droughts. For example, Canada's Atlantic and Pacific coastal areas receive between 1100 and 1400 millimetres of precipitation each year, while the southern portions of Canada's Prairie Provinces receive less than 350 millimetres per year.

Canada has a number of water-related issues: water quality, water quantity, supply versus demand, water use versus consumption and water-related hazards. Threats to water quality stem from point and non-point source contamination. Point source contamination risks include municipal sewage discharges, waste water treatment capacity and storage and other industrial uses of water. Non-point source contamination risks include runoff from agricultural, forestry and urban storm water management. All risks pose important implications for the management and ecological health of working landscapes, as well as human health. Costs of water infrastructure, including risk mitigation components, are steadily increasing, and there is potential conflict in the not-so-distant future between competing users, including the agriculture and agri-food industry, power generation utilities, resource extraction industries, manufacturing, municipalities and recreational users. Floods and droughts are two of Canada's costliest disasters.[4]

As Canadian population increases and the corresponding need for water rises, the need for an integrated and equitable approach to managing these resources is being increasingly recognized

[3] Environment Canada. 2006. Unpublished CD: IWRM- Water and Canada.
[4] *Ibid.*

within and across federal, provincial and territorial jurisdictions. At the same time, the approach must balance the services provided by water between economic, social and environmental demands. IWRM is a multidisciplinary and iterative process that seeks to optimize the contribution of both aquatic and terrestrial resources to the social, environmental and economic welfare of Canadians, while maintaining the integrity of ecosystems health, both now and into the future. In Canada, it is being recognized as a plausible preferred approach to the management of natural and human resources on a landscape, and the watershed is being recognized as an appropriate planning unit for the process. This paper will focus on the use of IWRM in the primary agriculture sector.

Uses of Water for Agriculture's Needs:

- Drinking water and quality of life
- Crop production
- Crop health, farm chemicals and fertilization
- Livestock production
- Food and non-food agricultural processing
- Industrial uses in the agricultural sector
- Cleaning and waste management

Source: Corkal and Adkins (2008)

In Canada, water management is a responsibility that is shared between the federal, provincial/territorial and municipal governments, and in some instances, by Aboriginal governments under self-government agreements. This shared responsibility necessitates close co-operation and collaboration among all levels of government and all Canadians.

The Agri-Environment Services Branch (AESB) (formerly known as the Prairie Farm Rehabilitation Administration), one branch of Agriculture and Agri-Food Canada (AAFC), has a long history of working with partners, producers and the agriculture sector to manage land and water resources. PFRA was created in response to the drought of the 1930s and AESB continues to focus on improving the environmental performance of Canada's agricultural landscapes, with increased emphasis on watershed-based management approaches. While AAFC, Environment Canada, Fisheries and Oceans Canada, Natural Resources Canada and Health Canada have significant mandates in this area, approximately twenty federal departments have an interest in water management.

The Food and Agriculture Organization (FAO) of the United Nations, in its *State of Food and Agriculture Report of 2007 (p vii),* brings up the fundamental challenge that farmers face today: "how can farmers be encouraged to reduce negative [environmental] side-effects while meeting the growing demands for food and fibre?" At the same time, they claim that changes in agricultural practices may also contribute to addressing environmental problems generated outside agriculture, for example, by offsetting greenhouse gas emissions from other sectors. The report claims that farmers constitute the largest group of natural resource managers on the planet. They use, generate and transform a wide array of ecosystem goods and services (EGS). The report recommends payment for ecosystem services (PES) to farmers as a key policy to engage farmers in environmental stewardship. This policy recommendation was highlighted in the *Millennium Ecosystem Assessment,* an assessment of global ecosystem conducted by over 1300 scientists in 2005. First, the *Millennium Ecosystem Assessment* (MA) states that a future scenario consistent with improved provision of EGS[5] is one in which, "regional watershed-scale ecosystems are the focus of political and economic activity" (Millennium Ecosystem Assessment, 2003). Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems consistent with principles of Integrated Water Resources Management.

1.2 Understanding Agricultural Communities and IWRM

As a major net consumer of water, agriculture is a significant stakeholder in Canadian water management. With a large proportion of Canada's population residing in agricultural watersheds, the impact of agricultural practices on water systems and the impact of competing uses of water required by the agricultural sector are primary management concerns. This reinforces the need for active participation of the agricultural sector in resource management and programming. In addition to these explicit connections between agricultural land management and water management within an IWRM framework is the growing understanding of ecosystem goods and services provided by agricultural stewardship on private lands. The *State of Food and Agriculture 2007* (FAO, 2007) highlights the potential of agriculture for enhanced provision of ecosystem services that are not usually compensated for by the market, such as flood protection and groundwater recharge.

Another key relationship between agriculture and water management can be drawn from global climate change. Agricultural watersheds are more dependent on the hydrologic cycle than non-agriculture-use watersheds and are therefore particularly vulnerable to the impacts of climate change on these cycles. Exploring ways and means to increase capacity and resiliency through land management practices is another key driver for agricultural sector partnership in water resources management. According to FAO's *State of Food and Agriculture Report* (2007), agricultural ecosystems

[5] Ecosystem goods and services (EGS) are simply the benefits that people receive from ecosystems. These can be provisioning (e.g. provision of food and clean water), regulating (e.g. regulating floods and erosion), supporting (e.g. providing habitat to support wildlife) and cultural (e.g. aesthetic or tourism) services.

are by far the largest managed ecosystems in the world and responsible for the provision of numerous ecosystem services. Global Water Partnership-International Network of Basin Organizations (GWP-INBO) (2009) point out that technological advances in agriculture can reduce the risk to farmers, but often have negative side-effects, such as increased risk of pollution. Programming needs to take into account the overall impacts of actions on agricultural landscapes and provide appropriate incentives; particularly in cases where certain beneficial management practices (BMPs) are better for the environment but not necessarily better for the farmer from an economic standpoint. The consequences of biological and chemical pollution, and the alteration of river and lake flows and diminution of groundwater tables, can be dire. Rivers become over-rich in nutrients and aquatic weeds proliferate.

The main institutional challenge for IWRM in Canada, and in cases around the world, has been the creation of systematic and meaningful patterns of socio-political interaction within the geographical boundaries of watersheds (Kenney, 2000; Barham, 2001; Johnson *et al.,* 2001). Most administrative boundaries related to decision-making jurisdictions do not coincide with watershed boundaries. Reflecting this concern, IWRM has commonly involved the creation of multi-stakeholder watershed partnerships that rely on collaboration to develop a common environmental vision to be achieved through integrated watershed-based policies and programs (Singleton, 2002; Blomquist and Schlager, 2005).

The Agricultural Policy Framework (APF) constituted the architecture for Canadian Agricultural Policy from 2003–2008, and comprised a partnership of federal and provincial levels of government. The framework guided agricultural programming with a budget of nearly CDN $9.4 billion over five years. The broad components of the APF included business risk management programs, environment programs, food safety and quality programs innovation programs, renewal programs and international programs. As part of the National Environmental Farm Planning Initiative, provinces had the option to provide agri-environmental risk assessment programming on an individual (i.e., Environment Farm Plans) and/or group basis (i.e., Equivalent Agri-Environmental Farm Plan). In addition to individual processes, group planning activities were offered in Saskatchewan, Manitoba and Quebec, and on a pilot basis in British Columbia and Alberta. Equivalent Agri-Environmental Plans (EAEP) identified a single high-priority environmental risk common among a group of farmers who live in the same watershed or aquifer management area, or produce the same commodity. When landowners unite to adopt management practices intended to reduce a single targeted risk, rather than each landowner mitigating a different risk, cumulative environmental benefits can be realized and significant landscape level change may be initiated.

Like individual Environmental Farm Plans (EFPs), EAEPs had a strong agri-environmental awareness component. Each plan required that a resource inventory be prepared. Such an inventory required a scan of the area that identified physical features such as water resources, soil types,

geography and climate. Since agricultural risks are associated with how landowners manage their farms within the physical environment, the scan included information on tillage practices, land use and land cover, and other relevant farming practices in the area.

Growing Forward, the new Agricultural Policy Framework for Canada, delineates priorities for government spending in Canadian agriculture. While its primary focus is on improving agricultural competitiveness and productivity, it ensures that environmental sustainability is part of this agenda. The Growing Forward Framework Agreement[6] mentions the watershed being an appropriate geographical unit for planning and implementing on-farm sustainable agricultural practices (farm groups and individual farms are also options). The policy also highlights the watershed to be an appropriate unit to support program targeting, implementation and performance measurement. Growing Forward will also continue to support the Watershed Evaluation of Beneficial Management Practices (WEBS), which evaluates the environmental and economic costs and benefits of impacts of adoption on-farm BMPs. Final program details are under development.

Collaborative approaches in natural resources management have evolved over the past two decades, in part, due to the complex and uncertain characteristics associated with its requisite biophysical, economic and social elements (Ferreyra and Beard, 2007). These characteristics and elements manifest themselves as interrelated systems on the watershed landscape, interacting over space and time, and "continually evolving in response to changing climate patterns, land use practices, and the increasing intervention of humans" (Tidwell, *et al.,* 2004, p.357).

Outside of AAFC's programmed approaches to environmental management, Deerwood Soil and Water Management Association (DSWMA) in Manitoba provides an example of an informal farmer's group that started around 1982–1984 (Neudoerffer, 2008):

- To access particular programs;
- To provide the opportunity to share and learn with other farmers; and
- Because of a belief in the idea and the ideology behind it.

Despite the widespread promotion of collaborative and participatory approaches in natural resources and watershed planning/management, Fleeger (2008) has noted that some federal agencies with significant land management responsibilities (e.g., the U.S. Department of Agriculture) have been slow to embrace collaborative natural resources management efforts, preferring to rely on science-based decision-making by government experts. Even when mandated in legislation, concepts such as *meaningful participation* can be vague and open to interpretation. Legislative requirements for stakeholder participation imply that "both agencies and communities have the interest, capacity, and resources to participate," which is not always accurate (Fleeger, 2008, p. 1397). Provincial water

[6] http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1224167497452&lang=eng

policies and strategies reviewed as part of our research do play a significant role in initiating collaborative management approaches and devolving authority to appropriately lower levels.

Collaborative Integrated Water Management (CIWM) is analogous to IWRM and emerged "during the 1980s as part of the trend toward holistic and participatory approaches to natural resources management" (Lang [1986] and Margerum [1997], cited in Ferreyra, 2007, p. 271). Ferreyra continues:

> However, CIWM 'in action' exposed the need to incorporate landowners and other non-governmental actors, especially if water resources were to be protected through actions implemented on private lands (Bellamy & Johnson, 2000; Rickenbach & Reed, 2002). In this context, CIWM aims to address complexity and uncertainty by recognizing the interdependence of natural and socio-economic systems on a watershed basis, emphasizing stakeholder involvement in both decision-making and implementation (Heathcote, 1998; Margerum, 1999). (Ferreyra & Beard, 2007, p. 272)

Watershed-based partnerships requiring the involvement of private agricultural landowners and land managers must recognize the unique relationships that farmers have with the landscape. Fleeger notes that "decisions affecting the management of ecological systems are embedded in the social and institutional arrangements that greatly influence (if not determine) the management outcome" (2008, p. 1398). Long-term and short-term decisions taken by individual farmers—regarding cropping and conservation practices, water use and management, and removing land from crop production for biodiversity or other reasons—are all directly related to land management within a watershed, as is a decision to participate in a watershed planning and management process.

In attempting to understand the realities and complications associated with collaborative natural resource management approaches, Fleeger recommends application of a *policy sciences framework*. He employs a refinement of Laswell's model developed by Clark (2002, cited in Fleeger, 2008). Clark's approach categorizes the analysis process into three areas: 1) Problem Orientation (spatial and temporal boundaries, ecological threats); 2) Social Processes (key elements tat shape motivations and influence the behaviour of participants); and 3) Decision Processes (functions that contribute to the implementation of management policy). The analysis framework employed in this study generally follows this approach.

Fleeger's research (2008) in Ashland Watershed, Oregon suggests the active engagement of local governments may be the most effective means by which a variety of stakeholder interests can be represented in a collaborative or participatory natural resources initiative involving a major federal

agency (USDA). However, Parker *et al.* (2007) outlined the importance of clearly understanding several foundational variables related to the participation of farmers in watershed projects.

Parker has noted the need to consider key factors such as land tenure, farm type, farm succession, local knowledge, social networks and farmers' self-image in attempting to understand farmer participation in watershed planning and management, and the adoption of BMPs by agricultural producers. In 2000, the U.S. Environmental Protection Agency (EPA) designated Ohio's Sugar Creek Watershed as one of the most water quality-impaired waterways in the state and initiated action towards the implementation of a total maximum daily load (TMDL) plan for the river. As a result of this designation and due to some mistrust around EPA's planning and restoration, a group of farmers, universities and agencies formed a watershed alliance.[7] They took their own initiative to address their contributions to decreased water quality, forming the Upper Sugar Creek Partners group to conduct detailed scientific monitoring and determine optimal BMP approaches. The development of a nutrient trading framework was supported by increased regulatory interest in controlling nutrients as a result of increasing occurrences of eutrophication and hypoxia in U.S. water bodies, the U.S. EPA's endorsement of water quality trading, as well as availability of government funding to finance market-based water quality initiatives (Selman *et. al.*, 2009).

Such responses challenge conventional literature findings related to *innovation diffusion* and *farm structure* models, which suggest that most agricultural producers will only adopt BMPs if it is profitable to do so, based on historical technological adoption studies (Parker, 2007).

Parker reports that a continuum of farmer attitudes to land exists, from perspectives viewing land as merely a commodity to those that respect its intrinsic value and importance to future generations. His research suggests that *social embeddedness* (making economic decisions without referencing only economic goals and rational choice) may play a larger role in the watershed-based participation of agricultural producers (and their adoption of BMPs) than may be known. Also, farms on leased land appear less likely to implement BMPs, while larger farms have greater flexibility and financial capacity to remove land from production or to implement BMPs. Farms without family succession plans are less likely to be oriented toward agricultural conservation (Parker, 2007). Intuitively the loss of intergenerational land transfers would indicate a lower land stewardship rate. Unfortunately we have not seen any support for this in Canadian research but feel that it merits further research consideration.

Regardless of whether key drivers influencing the perceptions and decisions of farmers to apply BMPs on their land (or participate in watershed-based initiatives) are considered in IWRM, Ferreyra (2007) has noted that some questions exist as to the ultimate effectiveness of attempting to focus

[7] There is extensive literature on the need for comprehensive consultation, discourse and participation to build trust and get buy-in from all relevant sectors for effective IWRM planning and implementation.

stakeholder interests of local communities primarily on watershed boundaries. Some key issues regarding the practicality and effectiveness of watershed-based approaches have been raised as follows:

> According to some authors, the premise that CIWM actually contributes to resolving or ameliorating water quality and quantity issues has yet to be critically addressed (Bellamy et al., 1999; Ewing et al., 2000; Conley & Moote, 2003). Furthermore, even the feasibility of achieving deep consensus among the multiple communities of interest coalescing within the 'natural' boundaries of a watershed has been challenged (Kenney, 2000; Lane et al., 2004; Blomquist & Schlager, 2005). [Ferreyra 2007:272]

Through her analysis of the Maitland Watershed Partnerships process in southwest Ontario, Ferreyra (2007, pp. 283–290) offers the following lessons as important criteria to consider in the evaluation of effective watershed partnerships, planning and management (IWRM initiatives). We have incorporated many of these considerations in the analysis framework used in this report.

1. Define both technical and collaborative management targets.
2. Integrate different types of knowledge (scientific data as well as local and traditional knowledge).
3. Develop "collaborative advantage."
4. Build organizational leadership (for watershed-based planning and implementation).
5. Clarify ownership of actions.
6. Design communications strategy.
7. Address the differences between outputs and outcomes.
8. Negotiate indicators for evaluation among stakeholders.
9. Consider the individual and organizational levels for social outcomes.
10. Consider the spatial scale for ecological outcomes.

1.3 Climate Change and Agriculture

The potential impacts of climate change will have both positive and negative impacts on agriculture and agricultural production. While the negative impacts are more prominent in academic and policy debates, agriculture in some areas of Canada could potentially benefit from several aspects of the changing climate, including a longer and warmer growing season and a warmer winter. As agricultural producers have long looked at weather and climate projections for their planning, they already possess some adaptive capacity, or capacity to evolve practices with gradually changing climate. Increasing intensity and speed of change in climate will necessitate an even-greater coping capacity. Potentially negative impacts of climate change include changes in the timing and intensity

of precipitation, increased risks of droughts and associated pests, and excessive moisture (Lemmen *et. al.*, 2008).

According to Natural Resources Canada (Lemmen *et. al.,* 2008), one of the most important climate change impacts relates to changes in the availability of water for agriculture. All types of agriculture depend upon the timely availability of suitable water—quantity and quality. Changes in depth of snow-pack, amounts of spring runoff and the timing of rain events all impact agricultural production systems. Agricultural sectors most affected by water shortages are irrigated agriculture and livestock. Animals require more water during times of heat stress, and water stress during critical times for plants (e.g. flowering) is especially harmful. Alberta has about 60 per cent of Canada's irrigated cropland (Harker *et al.*, 1997) and in 2001 the Prairies comprised more than 67 per cent of the livestock production in Canada (Beaulieu and Bédard, 2003). The demand for water for irrigation and livestock is expected to increase with rising temperature and sectoral expansion as well as competition with other sector use due to growing populations.

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, Working Group 2, in its section on Freshwater, indicated that one way of dealing with the uncertainty associated with estimate of future climate change is to adopt management measures that are robust to uncertainty (Stakhiv, 1998). IWRM, for example, is based on the concepts of flexibility and adaptability, using measures that can be easily altered or are robust to changing conditions. They state that IWRM should be an instrument to explore adaptation measures to climate change, but, so far, it is in its infancy. According to the assessment report, successful IWRM strategies include, among others: capturing society's views, reshaping planning processes, co-ordinating land and water resources management, recognizing water quantity and quality linkages, conjunctive use of surface water and groundwater, protecting and resting natural systems, and including consideration of climate change.

As water shortages increase and hydrological variability becomes larger, dealing with changes brought about by development presents a formidable challenge. A basin manager now faces pressures, risks and conflicts in balancing economic development (such as increased production from agriculture and energy) with maintaining healthy land and water resources. GWP-INBO (2009) notes that developed countries face serious challenges associated with increasing need and overexploitation of water for its various uses. Basin managers often have to juggle highly complex interactions between upstream actions and downstream impacts on hydrological biochemical and biological processes.

1.3.1 Assessing agricultural sustainability and watershed impacts

Smith (1998) explains that agricultural sustainability involves "biophysical, economic, and social factors operating at the field, farm, watershed, regional, and national scales" (p. 15). Smith also suggests there is a need to understand exactly what agricultural practices are sustainable (i.e. conservation practices and other BMPs)—before they occur on the landscape (or in a watershed). This necessitates the consideration and analysis of sustainable agricultural practices at the planning stage of any land use or water conservation/management initiative.

It is important to consider the various dimensions of agriculture's interaction with ecosystems, economies and social networks across the scale continuum. Specific types of agricultural land use at the *field* level (whether related to crops, forages, or animal grazing) all have different soil quality, moisture, and nutrient requirements—as well as ecological impacts (mainly biophysical factors). Decisions on what to grow, when to plant or graze and when to harvest or terminate grazing all depend on a variety of socioeconomic factors at the *farm* scale. *Watershed* scale factors are, again, primarily biophysical given the cumulative nature of individual farm impacts at the ecosystem level. Finally, at the *regional* and *national* scales, the interrelationships between agricultural and other forces are mainly socioeconomic, given the national importance of farm incomes and community viability, and the competitiveness of one nation's agriculture sector within the global market. Smith (1998) generalizes these considerations (in terms of *micro*, *meso*, and *macro* scales) in Table 1-1.

Table 1-1: Dimensions and Scales of Agriculture (Smit and Smithers, 1993, cited in Smith, 1998, p. 17)

Dimension	Scale		
	Micro	**Meso**	**Macro**
Natural resource base	Field level soil fertility, moisture	Agroecosystems, regional land capability.	Continental water and land resources, global climate
Crop production	Field yield, management	Regional production, land use patterns	Global food and fibre supplies
Economic return	Farm level production costs, viability, capital outlay	Regional economy, value of production distribution	Trade marketing, policies, politics
Rural community	Farm level tenure, family involvement, communication	Rural economy size and function, access to food, facilities.	Global, poverty, hunger, equity, politics.

Smith utilizes Hansen's conceptual considerations for assessing agricultural sustainability (Hansen, 1996, cited in Smith, 1998), referring to two perspectives for framing the agriculture-sustainability relationship. Sustainability can be viewed as an *approach to agriculture*, referring to its ideological and

strategic aspects generally relating to the use of organic, low-impact, and minimal resource use values—compared to conventional agricultural systems. Hansen also proposes that sustainability can also be a *property of agriculture*. This view is more discrete and holds that agriculture may be defined as sustainable if it can satisfy measurable environmental, food production, economic viability and social goals. Together, the achievement of these goals implies that agriculture can continue to occur over time (Smith, 1998).

A variety of biophysical, economic, and social indicators can be used to assess agricultural sustainability. Samples of these are outlined in detail by Smith, based on work by the Standing Committee on Agriculture and Resource Management (SCARM) (1993, cited in Smith, 1998) and Smyth and Dumanski (1993, cited in Smith, 1998). Smith notes that Canada and Australia appear to be leading in the identification and application of sustainability indicators for agriculture. Smith (1998) provides a simplified description of the application of these indicators at various scales in Table 1-2.

Table 1-2: Levels of Sustainability Assessment FAO 1989 in Smith (1998:23)

Levels of assessment	Typical characteristics of sustainability	Typical determinants (causes)
Field	Productive crops and animals; conservation of soil and water; low levels of crop pests and animal diseases	Soil and water management; biological control of pests; use of organic manure; fertilizers, pesticides, crop varieties and animal breeds
Farm	Awareness by farmers; economic and social needs satisfied; viable production systems	Access to knowledge, inputs and markets
Country	Public awareness; sound development of agroecological potential; conservation of resources	Policies for agricultural development; population pressure; agricultural education; research and extension
World	Quality of natural environment; human welfare and equity mechanisms; international agricultural research and development	Control of pollution; climatic stability; terms of trade; distribution

In assessing the sustainability of agriculture on a watershed basis, modelling has been used to assist in predicting the impacts of land use and land cover change, the application of BMPs, and the participation of agricultural producers in watershed-based initiatives. Tidwell *et al.* (2004) note that comprehensive, integrated watershed models can be helpful in understanding the complex

biophysical, economic and social interrelationships that define agricultural ecosystems, while model effectiveness can be improved substantially through the participation of relevant stakeholders. Local knowledge and perspectives can be incorporated into the models, as well as providing critical review of model assumptions, contributing data, and model application. Tidwell *et al.* (2004, p. 360) also note that models can:

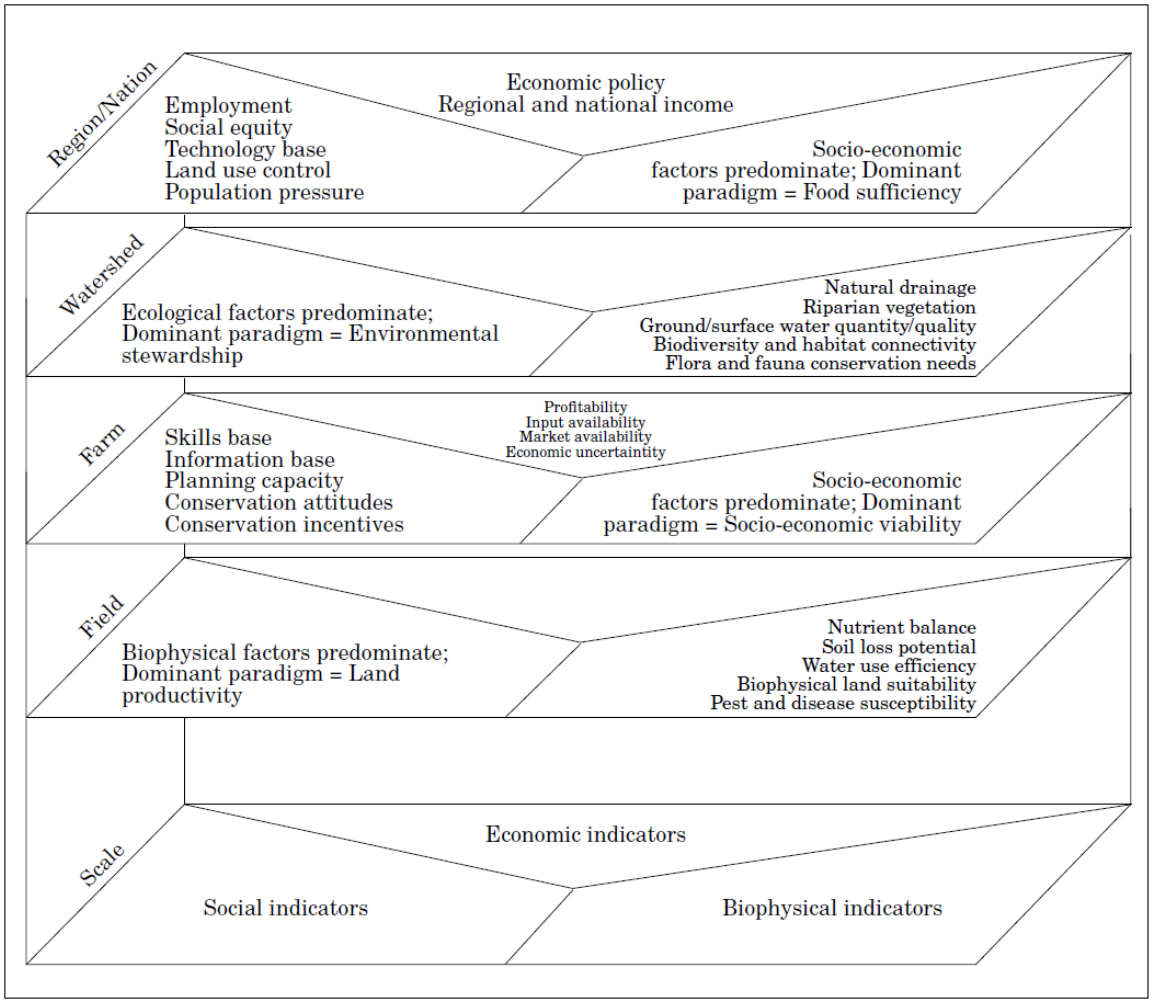
1. Provide a quantitative basis for comparing alternative water conservation strategies in terms of water savings and cost;
2. Help the public understand the complexity inherent to the regional water system; and
3. Engage the public in the decision process.

Watershed-based models focused on agricultural sustainability are increasingly being utilized to analyze current biophysical, economic and social conditions against agricultural indicators—and to predict a range of possible outcomes resulting from the application of individual or grouped BMPs, and/or the participation of agricultural producers in IWRM initiatives. Two recent examples have been documented by Mehaffey *et al.* (2005), involving an examination of land use changes in the Catskill/Delaware Watersheds, which are the source of 90 per cent of New York City's water supply, and Saroinsong *et al.* (2007), involving an analysis of erosion risk in the Ciajur Watershed in West Java, Indonesia. Mehaffey found that two land use variables accounted for 25–75 per cent of water quality impacts in these systems (2005, p. 29). Watershed lands were analyzed based on percent agriculture and percent urban development and compared with downstream water quality parameters (total nitrogen, total phosphorus, and fecal coliform). Saroinsong *et al.* (2007) found that erosion risk and total soil loss could likely be reduced by 75 per cent with the application of more environmentally sound (yet economically feasible) agricultural practices.

Smith notes that the recognized standard for assessing sustainability in agriculture is the International Framework for Evaluating Sustainable Land Management or FESLM (Smyth and Dumanski, 1993, cited in Smith, 1998). It incorporates assessment criteria in five key areas: agricultural productivity, risk security, environmental protection, economic viability and social acceptability. Various evaluation criteria and indicators exist for each assessment element, and temporal ranges are provided to assist in the determination of sustainable (occurring for at least 7–25 years) and unsustainable agricultural activities (0–7 years of operation).

Smith's contribution involves the articulation of a detailed framework for using key indicators to assess the interrelated biophysical, economic and social aspects of agriculture at various scales—prior to the implementation of agricultural BMPs or other watershed-based activities (Table 1-3). While the comprehensiveness of this planning/assessment framework precludes its detailed use in this report, we have considered its implications in reviewing the role of agriculture in IWRM initiatives across Canada.

Table 1-3: Assessing the Sustainability of agriculture (Smith, 1998, p. 33)



Our research reveals a strong link between agricultural sustainability and watershed management, as well as the need for effective adaptation and mitigation in light of climate change impacts. Our analysis and reporting is focussed on agricultural sector involvement in IWRM initiatives in Canada and the world. These cases then inform our recommendations for enhanced agricultural sector participation in watershed based resource management.

The next chapter highlights prominent IWRM cases in Canada and in the international context with an emphasis on agricultural sector participation.

2.0 Discussion of Canadian IWRM Inventory and Case Studies

Our review of watershed-based initiatives in Canada has found dozens of IWRM institutions, activities and projects of note. Based on our review of provincial, local government and community-based Web sites, we estimate that hundreds of unique and potentially IWRM-related efforts of varying scales and scopes currently exist in Canada. These range from very small, local stewardship initiatives led by volunteers in the community, to more formal activities (often based on financial and planning partnerships among local government units) at the sub-watershed and regional watershed scales, to larger, basin-scale efforts comprised of multiple stakeholders (typically with members appointed by the provincial government and significant budgeting and technical support).

Due to space, time, logistics and resource limitations, we have highlighted a series of projects that capture the essence of IWRM as it relates to agriculture in each province. This inventory is by no means exhaustive, but it is reflective of the range of initiatives currently in operation that have significant linkages to agricultural production and the sector in general. In the vast majority of cases, there are direct relationships to agricultural production and the role of private landowners. Any IWRM initiatives with limited agricultural connections are included because they represent important aspects of the IWRM experience in the province or region considered.

2.1 Key Analytical Themes

Based on key themes arising from the literature, and notably from Smith (1998), Ferreyra (2007) and Fleeger (2008), we reviewed more than 30 IWRM initiatives in detail to assess their progress generally, and to specifically probe how agricultural issues, stakeholders and interests have been considered, incorporated into IWRM plans, and/or otherwise addressed within each initiative. As presented in a detailed table in the Appendix (Table A-1), our analysis considers the following:

- Name and Web site: This provides a general reference for each initiative or organization, as well as an initial portal for the Internet-based review that was conducted. In all cases, several additional Web site and sources were reviewed, typically resulting in 20–30 unique Web links and/or discussion documents, strategies, policies, legislation and/or watershed plans that were considered.
- Scale and scope: This includes issues covered through IWRM processes and planning as well as some general descriptive background regarding each IWRM effort.
- Drivers for IWRM programming: This item refers to the main catalysts that have stimulated IWRM activities at the provincial policy or watershed scale. These may include issues such as: source water protection, legislation, provincial or local leadership, and/or socioeconomic issues, among others.

- Goals for IWRM initiative: In many cases, specific goals were stated and fairly easily discernable for each initiative. However, a significant number of these also did not contain clear goals. In these instances, they were inferred and articulated in accordance with obvious IWRM directions.
- Social operating environment: The basic organizational elements of each initiative are summarized, with a focus on the level of integration and decision-making approaches.
- Economic operating environment: This includes indications regarding the types of funding sources and means by which IWRM efforts are financially supported.
- Technical/scientific operating environment: The means by which IWRM research, information, and logistical requirements are supported is summarized in this item.
- Key elements of success: Apparent reasons for the success (or achievements to date) of each IWRM activity are discussed. These may include social, economic, technical and/or other factors.
- Other elements contributing to success (failure): Any additional elements of apparent success are discussed further, while possible vulnerabilities, conflicts, capacity limitations or other concerns are noted.
- Implementation level: A qualitative rating[8] (Low, Medium, High) is provided regarding the overall level of success, progress, or effectiveness for each IWRM initiative. Some discussion is also provided, based on insights from the research.
- Agricultural sector representation: A qualitative rating[9] (Low, Medium, High) for the degree to which the interests of the agriculture sector are represented through active participation and/or reflected in the IWRM activities and approach taken thus far. Additional discussion is provided to support each rating.
- Actual or potential agricultural contributions: A qualitative rating[10] (Low, Medium, High) is provided in relation to obvious benefits experienced by the agricultural sector (or which may benefit the sector in the future), which are summarized in this item. These insights are provided based on our understanding of each IWRM initiative and our review of its apparent progress.

And…

[8] In terms of implementation, a **Low** rating suggests progress to date has been limited or weak, or that it is simply too early to determine. Meaningful assessment at this point is premature. **Medium** implies that a significant degree of implementation progress has been achieved, consistent with the principles of IWRM. A **High** rating of implementation progress suggests a very impressive level of progress has been achieved. Further discussion is provided with each rating.

[9] The apparent degree of agricultural sector representation in IWRM processes is assessed, with a **Low** rating denoting an obvious lack of meaningful participation of agricultural industry or producer representatives. A **Medium** rating suggests that an appropriate level and scope of agricultural participation is occurring based on the nature of the project and in relation to the participation of other sectors. A rating of **High** refers to a substantial level of agricultural sector representation, if not leadership of the IWRM initiative.

[10] Actual or potential contributions, value, or benefits to the agricultural sector are rated. **Low** implies the IWRM activity does not appear to be valuable, at least not at this time. A **Medium** rating suggests the IWRM effort does provide significant contributions to agriculture, or could potentially provide benefits. **High** entails a very valuable contribution with excellent contributions and possible leadership from the agriculture sector.

- AAFC role of other assistance: Any known AAFC roles are noted and suggestions for additional forms of AAFC or other federal government support are proposed.

2.2 Provincial Summaries and Federal Roles

We now briefly discuss our broad findings from the inventory process for each province, with a focus on the interrelationships with agriculture, the federal government, and AAFC in particular. Our focus is on the last four columns of Table A-1 in the Appendix. Table A-1 summarizes key details emerging from the inventoried initiatives and provides a basis from which to compare these initiatives across Canada, beginning with a review of the most relevant water management strategy or policy supporting the advancement of IWRM in each province. Section 2.3 delves into further details associated with a representative range of IWRM case studies and/or particularly important or interesting elements of the IWRM experience across Canada. In Section 3, we present a number of potentially applicable case studies from several other countries. Our findings from this review are presented as our Conclusions and Recommendations to follow as Section 4.

2.2.1 *British Columbia*

British Columbia's Water Sustainability Action Plan recognizes the need to shift individual choices and behaviours toward more sustainable results, with cumulative benefits. The reality that local governments are in the best position to plan and implement watershed-based solutions through IWRM is also recognized. In terms of implementation, The B.C. Water and Wastewater Association (BCWWA) was funded by the province to lead public awareness, communication and strategy coordination. The BCWWA appears to have mobilized several key "communities of interest," around IWRM (later renamed as *water centric planning*) and water efficiency efforts in the Okanagan Basin representing key agriculture-related interests. AAFC and Environment Canada are identified as supporting partners of the BCWWA. However, their roles seem somewhat unclear at this time, given the recent announcement of a new B.C. water policy initiative (Living Water Smart) and its related communications. British Columbia's flagship IWRM initiative is the Fraser Basin Council, which has evolved into a major partnership-building force in the province's most important agricultural area. However, the agricultural sector is not well represented on its board. Consequently, its agriculture-related project activity is limited. Environment Canada and Fisheries and Oceans Canada are actively involved. AAFC and other agricultural stakeholders of agriculture sector are relatively more involved in the Georgia Basin Action Plan, although direct benefits to the land-based agriculture sector appear to be limited.

2.2.2 *Alberta*

Alberta's Water for Life strategy has provided a framework for the formation of several Watershed Planning and Advisory Councils (WPACs) with a substantial level of technical and financial support from Alberta Environment. Alberta has acknowledged the key roles that local volunteer Watershed Stewardship Groups (WSGs) will need to play in implementing IWRM solutions. Few IWRM plans have been finalized as yet, but most WPACs have initiated extensive IWRM planning and consultation efforts. An assessment of IWRM progress is premature at this time, but it is fair to say that agriculture sector has been actively involved and appropriately represented thus far. Alberta's Irrigation Districts appear as members of several WPACs, although, with only planning and consultation responsibilities, it is unlikely that decision-making on resource issues involving water allocation will become a WPAC responsibility. New regional planning authorities established under the Alberta Land Use Framework may become more relevant for the agricultural sector. Alberta WPACs would likely benefit from increased federal assistance in the area of water quality and quantity monitoring as IWRM plans are finalized and begin to be implemented. Implementation funding, particularly through agricultural BMPs deliverable at the watershed scale, would be welcome and appropriate. IWRM-related initiatives such as the Cows and Fish program and the supporting work by local government agricultural technicians (field men working with local producers and landowner associations) appear to represent some of the most effective agricultural efforts related to improved land, water and wildlife resources.

2.2.3 *Saskatchewan*

Saskatchewan's Safe Drinking Water Strategy (SDWS) was developed after a severe cryptosporidium outbreak in 2001. The Saskatchewan Watershed Authority (SWA) was subsequently formed from portions of existing Crown corporations and then augmented with additional technical capacity to support the application of IWRM planning in priority watersheds across the province. Local Watershed Advisory Committees (WACs) have been formed among municipal government partners and other community stakeholders. Most WACs have now completed SWP Plans for their watersheds, each of which received extensive logistical support from the SWA and technical support from a technical committee of federal and provincial staff. Some WACs have also worked together to coordinate *agri-environmental group farm planning* to better harness existing BMP funding from AAFC and Saskatchewan Agriculture and Food. Ducks Unlimited Canada has also provided extensive support for the IWRM planning process. Most WACs have strong agricultural producer representation owing to the fact that they are located in rural areas and are heavily comprised of elected municipal councillors, many of whom are farmers. While the SWA is using a scientific indicator framework to determine priority watersheds and assess IWRM progress, it is likely that long-term water quality monitoring assistance will be required.

2.2.4 *Manitoba*

Manitoba's Conservation Districts (CDs) are being strongly encouraged to plan and deliver their soil and water conservation programs on the basis of watersheds, and their strong foundation of local government leadership, legislative recognition of the fundamental importance of private agricultural landowners, and relatively stable provincial funding denotes a clear role for the agriculture sector. While CD activities have not historically been planned or managed along watershed boundaries, the Manitoba Water Strategy and the identified funding priorities of government are causing this to change rapidly, with many CDs currently in the process of completing integrated watershed management planning using IWRM approaches. Their challenge will be related to securing adequate resources to fully implement these plans. There may also be conflicts in some locations where provincial priorities related to water quality are at odds with the interests of local producers. There is a permanent moratorium on hog production in the Red River Valley, an area where the maintenance of an agricultural drainage network is also of prime concern. The ability of IWRM planning to effectively address the highest priorities of agricultural producers remains to be seen. The Environmental Farm Planning initiative supported by AAFC and Manitoba Agriculture, Food, and Rural Initiatives has had strong uptake, although efforts to implement an "equivalent farm plan option" have had less uptake. There is a growing need for long-term water quality and quantity monitoring to assess the effectiveness of Manitoba's IWRM progress, at the CD, watershed or sub-watershed level. The Tobacco Creek Model Watershed is attempting to develop a "living watershed laboratory" to demonstrate methods for fulfilling this need.

2.2.5 *Ontario*

Ontario's Clean Water Act has established a formal and well-funded SWP planning and management process delivered through partnerships of existing Conservation Authorities (CAs). All SWP planning has occurred on a watershed basis, with a high level of technical capacity provided by the CAs and strong political support from the Ontario government. It is clear that agricultural participation in the implementation of SWP plans will comprise a substantial portion of IWRM implementation, with substantial funding already committed under the Clean Water Act. Whether Ontario's planning BMP funding will be adequate remains to be seen. Ontario's CAs represent Canada's oldest and most advanced IWRM organizations, and some have a long history of solid working relationships with agricultural producers. The Grand River CAs Rural Water Program was developed in conjunction with the Ontario Federation of Agriculture and the Ontario Soil and Crop Improvement Association. The South Nation CA's Clean Water Program coordinates BMP delivery in conjunction with its Phosphorus Trading Program; South Nation is also the site of a WEBs project. The Credit Valley CA operates what appears to be the most comprehensive long-term watershed monitoring program of any watershed in Canada; while the loss of agricultural land has been extensive, its current range of agricultural programming is limited. It is clear that opportunities

exist for increased federal involvement in relation to the operation of Ontario's CAs. Further efforts should be explored for enhancing CA program and project delivery and relationships with the agricultural sector. AAFC could support this with focused BMP funding in conjunction with existing Clean Water Act initiatives, and increased monitoring assistance to any CA operating in significant agricultural regions. The dramatic and continued loss of agricultural land in the Metro Toronto region would benefit from increased federal attention.

2.2.6 *Québec*

The Québec Water Policy (QWP) is a very comprehensive strategy, which includes a major focus on the reformation of water governance in the province. Watershed-Based Management (WBM) is central to this shift. Since the QWP has been implemented, 33 priority watersheds have been identified, and Watershed Organizations or "Organisations de Bassin Versant" (OBVs) have been established. QWP implementation is guided by an interdepartmental co-ordinating and an implementation committee with participation from 11 provincial departments, including Executive Council. In all locations where agricultural activities comprise a significant portion of watershed land use, the sector is well represented on the OBV. Some OBVs are working very closely with agricultural producers and local associations in the scientific exploration of issues, demonstration of BMPs and collective action of individual producers within small watersheds. In these locations, impressive levels of producer co-operation and partnership have been established. Additional local organizations exist in the form of Les Clubs-conseils en Agroenvironnment (CCAEs), more than 80 of which have been in operation for the past 15+ years, facilitating information exchange among producers, providing extension opportunities and supporting environmental farm planning. These organizations have been supported by AAFC and key partners in Quebec, and some CCAEs appear to have good working relationships with some OBVs. Additional efforts should be supported to explore the potential of harnessing these powerful connections as potential BMP delivery bodies working in close association with Québec's OBVs.

2.2.7 *New Brunswick*

New Brunswick's Surface Water Protection Program (WPP) is encompassed within a legislative order under the province's Clean Water Act. The *Watershed Protected Area Designation Order* regulates development and zoning within three identified zones of a designated watershed: a) the watercourse; b) a 75m buffer zone; and c) any upstream portion of the watershed. While there appears to have been little public consultation with regard to the WPP, a very high level of interdepartmental planning and cooperation seems to have been effective in administering the program. Detailed guidelines exist regarding the types of agricultural practices that can occur in each zone, while clear land use and development directives are also provided with respect to wetlands, which also require a 30m buffer and cannot be altered without an approved permit. While these regulations may be

challenging for agricultural producers, they do provide a relatively unambiguous framework for continued agricultural operations. As local watershed planning continues to evolve in New Brunswick, there will likely be a need for long-term water quality monitoring, particularly in relation to the agricultural sector. AAFC should build on its WEBs work in the Black Brook watershed and explore future partnerships with the University of New Brunswick's Environment and Sustainable Development Research Centre, which has worked to establish two "living watershed laboratories." The Eastern Charlotte Waterways organization is part of a strong network of Atlantic Coastal Action Program (ACAP) sites initially supported by Environment Canada. These watershed-based initiatives represent a powerful foundation that would benefit from a stronger relationship with the agriculture sector.

2.2.8 *Nova Scotia*

The Nova Scotia Drinking Water Strategy has provided a framework for IWRM, supported by an interdepartmental management committee and guided by the designation of Source Water Protection (SWP) areas. SWP Advisory Committees are to support local municipalities in the coordination of SWP plans. Now a new Water Resources Management Strategy is being undertaken, perhaps in response to integration and stakeholder consultation concerns experienced with the SWP process. The Clean Annapolis River Project (CARP) may be Nova Scotia's leading IWRM initiative. It is also one of the early ACAP projects supported by Environment Canada. CARP's focus on science (including an extensive network of volunteer monitoring support) represents a powerful foundation for the monitoring and evaluation of agricultural sustainability efforts, such as those related to the application of BMPs. CARP had earlier completed a *comprehensive environmental management plan* which has provided an excellent background and experience in support of more detailed IWRM planning in the future. AAFC also supports other important agriculture-focused initiatives within the Annapolis River watershed. Given CARP's track record of success—combined with its emerging key IWRM planning role in the Drinking Water Strategy and/or the Water Resources Management Strategy—closer working relationships (i.e. project delivery) should be explored with the federal and provincial agriculture departments.

2.2.9 *Newfoundland and Labrador*

While the IWRM applications to agriculture are limited, this province's focus on local governments' ability to request *Protected Public Water Supply* designation offers some useful insights. An interdepartmental land use committee reviews each municipal application request and makes recommendation to the Minister of Environment as to whether a designation should occur and under what conditions (i.e. development regulations may be provided). Local Watershed Management Committees (WMCs) are also encouraged to form to participate in the preparation of watershed management plans. Local governments are then required to conduct ongoing water

quality monitoring and report on the health of their community water source. Newfoundland's most comprehensive IWRM process appears to have occurred at Steady Brook, where a detailed water quality risk assessment and prioritization process was conducted with the coordination assistance of the Western Newfoundland Model Forest. AAFC should explore the Steady Brook risk analysis and annual reporting process to consider its potential application in other IWRM initiatives in Canada where agricultural impacts are applicable.

2.2.10 *Prince Edward Island*

The Prince Edward Island Watershed Planning Initiative (WPI) was initiated in direct response to concerns related to nitrate contamination from agricultural fertilizer use. It builds on the volunteer initiative and work of Watershed Stewardship Organizations (WSOs) dating back to the 1970s. There is a very high level of political commitment to the WPI, and recent reports by the province's Environmental Advisory Council have been swiftly acted upon. Additional technical staff have been hired by the Department of Environment, Energy, and Forestry (DEEF), along with substantial funding increases to support the IWRM efforts of 30 local WSOs. Meanwhile, the Department of Agriculture also provides an impressive range of services and BMP funding related to reducing agricultural impacts on the environment. The level of interdepartmental co-operation between DEEF and the Department of Agriculture is not clear. The Eastern Canada Soil and Water Conservation Centre is currently assisting with the Bedeque Bay Environmental Management Association's Maple Plains sustainable agriculture demonstration and monitoring site. Undoubtedly, there are opportunities for improved co-operation, BMP implementation support, and long-term monitoring where the federal government could assist all WSOs in Prince Edward Island.

2.2.11 *Northwest Territories*

This initial review has not found any watershed planning relevant to agricultural management in the Northwest Territories at this time.

2.3 Canadian IWRM Case Studies

Private agricultural landowners and land managers are watershed community residents who have the ability to significantly shape the health and quality of the landscapes they reside in—for better or for worse. An expanding list of watershed-based initiatives is rapidly becoming part of the agricultural landscapes within every province in Canada. In developing new stewardship initiatives, there are many opportunities to follow the lead of innovative producers who are already adapting to changing realities and dealing with emerging watershed sustainability challenges. The key is to listen to their needs and meaningfully consider their grounded perspectives in the design of new policies and programs. Below are a few relevant stories in which this approach appears to be working.

2.3.1 *Tobacco Creek Watershed, Manitoba*

The South Tobacco Creek watershed is one of Canada's most extensively monitored agricultural watersheds, with scientific operations dating to 1991. All 44 agricultural landowners within this 76 km^2 drainage area are members of the Deerwood Soil and Water Management Association who annually and voluntarily provide all of their land use and management data for incorporation into a confidential global information systems managed by Agriculture and Agri-Food Canada. Long-term water quality, flow, and land use trends are being analyzed and reported by a variety of research partners, with improvements being implemented by a team community partners working with the Deerwood Association. Working with these many partners, Deerwood is currently focused on two major initiatives: Watershed Evaluation of Beneficial Management Practices (WEBs) and the Tobacco Creek Model Watershed (TCMW).

WEBs research partners are seeking to assess the environmental and economic values associated with applying a suite of several BMPs on agricultural land owned and operated by one farmer in the headwaters of Tobacco Creek. All Deerwood members understand the importance of reducing downstream nutrient loads, and they accept that part of the nutrient loading challenge is directly associated with agriculture, and perhaps with their own farms. It is for this reason that the organization's members vigorously support and assist WEBs researchers in designing and delivering intensive BMP evaluation research.
There is another reason this research is occurring on private agricultural lands at Tobacco Creek. It is because Deerwood's WEBs research partners understand the economic realities faced by local agricultural producers. They realize that the prime objective of most agricultural producers is to achieve positive returns of *net farm income*. A significant aspect of WEBs research at Tobacco Creek is exploring the economic impacts of BMP application, both at the individual level and within the broader community.

IWRM actions: During the early 1990s, it became clear that many area farmers and some local governments (rural municipalities) were experiencing measurable economic and environmental benefits from improved watershed management at Tobacco Creek. However, these benefits were decidedly local in nature. So beginning in 1999, efforts were increased to focus on exploring the potential for expanding Deerwood's South Tobacco Creek experience beyond its original boundaries. The TCMW initiative has been evolving as a "living watershed laboratory," and is a logical extension of Deerwood's community partnership-building and research progress associated with WEBs and the earlier South Tobacco Creek Pilot Project.

Members of the Deerwood Association knew there would be an eventual need for solid watershed science, and for scientific evaluation of the effectiveness of the various strategies, policies and

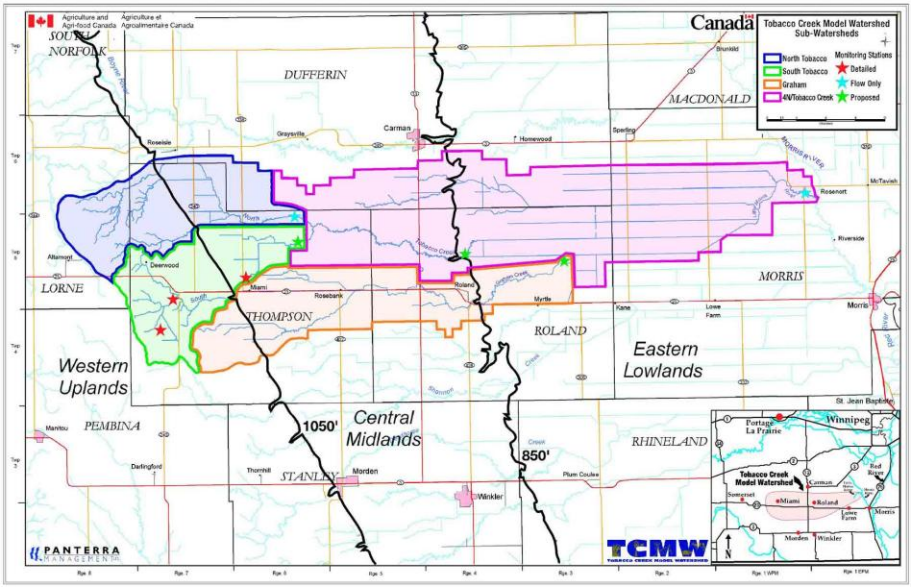
practices that may be employed to help stimulate and support agricultural sustainability progress on the agricultural landscape of Manitoba.

A community-based TCMW planning approach resulted in the early identification of "Farm Income" and "Water Management" as critical local priorities that would need to be highly prioritized if a Tobacco Creek watershed and research plan were ever to succeed. Ultimately, it was also realized that many inter-related priorities could be harnessed to assist in fulfilling multiple goals beyond those sought by local residents—those of interest to the provincial and federal governments, and to private funders. In time, these harmonized planning priorities evolved into the **TCMW Integrated Goals** of:

- *Improving* net farm income and landscape diversity;
- *Building* producer participation and scientific monitoring;
- *Planning* for drought, storage and water management;
- *Protecting* water quality and riparian areas; and
- *Addressing* drainage and fisheries habitat issues.

The Tobacco Creek Model Watershed (TCMW) is a 1,200km^2 community-scale watershed located within south-central Manitoba. It is comprised of four sub-watersheds (Figure 2-1). Efforts are underway to implement a long-term TCMW management and research plan.

Figure 2-1: Tobacco Creek Sub-watersheds



2.3.2 *Ag-environment group planning in the Lower Souris Watershed, Saskatchewan*

In Saskatchewan, integrated watershed management planning is driven by Saskatchewan's Water Management Framework, the Green Strategy and Source Water Protection (SWP) planning activities initiated by the Saskatchewan Watershed Authority. Local Watershed Advisory Committees (WACs) are formed to obtain community-based stakeholder guidance on plan formation and to build support for plan implementation. The first SWP plan in Saskatchewan was developed for the Lower Souris River (LSR) Watershed.

Three local WACs (Four Creeks, Pipestone, and Antler) formed a basin-wide organization called the LSR Watershed Committee (LSRWC) to collaborate on SWP planning and to take advantage of additional program funding opportunities. There is a strong foundation of local municipal government leadership from the 15 partner municipalities in the LSR Watershed. Many elected municipal officials are also farmers.

The unified LSR plan contains several areas of focus. Each action is supported by specific objectives, recommendations, key actions, timelines and agencies responsible. It also includes a commitment for regular state-of-the-watershed reporting. A technical committee comprised of federal and provincial government personnel, SWA staff and other external agencies worked to collect all required background information to support the watershed planning process. Two SWA staff members are assigned to coordinate watershed planning activities.

IWRM actions: The LSR partnership was the first of several WACs to have also participated in developing an *Agri-Environmental Group Plan* (AEGP), a planning option offered in addition to individual *Environmental Farm Plans,* The LSR AEGP represents a major component of LSR SWP plan implementation process. More than 400 individual BMP projects have been funded through the AEGP. LSR BMP funding has focused on agri-environmental improvements related to managing cattle over-wintering sites and improved riparian health management (e.g. off-site watering systems for cattle).

Following the successful AEGP experience in the LSR Watershed, nine additional watershed-based group planning processes were developed in Saskatchewan prior to 2008. Under the renewed Canada-Saskatchewan Growing Forward policy framework, the AEGP program will continue alongside the individual farm planning program (under the *Watershed Awareness Initiative*) delivered through the Provincial Council of Agricultural Development and Diversification Boards (PCAB).

The reasons for this success are not immediately clear, although a strong focus on watershed-based AEGP delivery appears to be one factor. Strong, local technical support to producers (including the hiring of dedicated extension staff who could also assist the host organization) seem to be other

contributors to this success, while the prioritization of water quality among all AEGP initiatives ensured a strong focus for all resulting projects. While it may be some time before measurable improvements in watershed health can be demonstrated, the continuation of the AEGP program through to at least 2013 would appear to be a positive development.

Saskatchewan released its *State of the Watershed Reporting Framework* in January 2006 and subsequently its first *State of the Watershed Report Card* in March 2007. This report card uses indicators to assess the current health of Saskatchewan's watersheds, provide information about human activities that impact the environment within watersheds and evaluate the effectiveness of the management activities. The indicators include "condition indicators" such as water quality and quantity based indicators, riparian buffer indicators; "stressor indicators" including human populations, roads, water use and water allocation; and "response indicators" including water conservation and water education based indicators. Monitoring and management of water quality and water quantity are also included in the response indicators.

Completion of regular LSR Watershed Report Cards will assist local decision-makers (and perhaps other downstream beneficiaries) in understanding the value of effective IWRM planning and management, including the effectiveness of specific watershed-based initiatives such as the AEGP process. Tracking the range of sustainability indicators necessarily involved with this process will also help determine and/or measure these management activities over time.

2.3.3 *Alberta Environmentally Sustainable Agriculture delivered through Alberta's local agricultural services boards*

In Alberta, a tremendous level of agricultural extension and support services are delivered through the province's local governments—counties and municipal districts. Provincial agricultural legislation calls for the creation of municipal Agricultural Service Boards (ASBs) comprised of a mix of councillors and appointed community members.

IWRM actions: ASBs are responsible for a range of agricultural services including weed control, shelterbelt planting, predator control, water supply and pilot demonstration projects. It is apparent that many ASBs are routinely exploring innovations and improved management methods. ASBs are also responsible for the delivery of extension programs funded by Alberta Agriculture and Food, in some cases extension programs are jointly delivered with AAFC. The Alberta Environmentally Sustainable Agriculture (AESA) program has been focused on the provision of soil, water, biodiversity and climate change adaptation programs since 1994, supported by a number of federal/provincial funding programs, most recently as part of Agricultural Policy Framework.

AESA promotes producer awareness of agricultural sustainability solutions that are readily adoptable to current and emerging environmental challenges faced by Alberta farmers. As an extension initiative, most programs are rooted in scientific research with demonstrated success in application elsewhere. AESA and various ASBs have also participated in applied research efforts, working with local producers.

There is a strong monitoring foundation for AESA program delivery, where tracking environmental change through interrelated soil, air, water and biodiversity indicators has been identified as key focus for the program and most projects. Through AESA, local ASBs and other agricultural industry participants have worked with Alberta producers towards their completion of Environmental Farm Plans, while many local ASBs have been central to the establishment of an increasing number of watershed-based producer groups to focus on targeted BMP adoption. BMPs related to source water protection and the reduction of cattle-related water quality impacts have been a major focus, as have local water quality monitoring initiatives.

Through their host municipal governments, local ASBs provide office space and technical support staff to work with area producers and watershed stewardship groups. This support demonstrates recognition of the realities and importance of agricultural production and sustainability at the community level, suggesting the strong likelihood of successful watershed-based BMP adoption by Alberta producers.

The AESA program's strategic direction and co-ordination was co-ordinated by AESA Council, a committee of 29 agriculture industry representatives from 1997–2007. In 2007, AESA Council ceased to exist, and in its place a new industry-led organization responsible for providing funding, strategic direction and co-ordination to the Institute for Agriculture, Forestry & Environment was formed called AEPA (Agri-Environmental Partnership of Alberta). Alberta Agriculture and Rural Development's AESA staff continues to coordinate programs and communications with AEPA rural extension staff in liaison with the ASB's and rural municipalities.

2.3.4 Participatory integrated assessment in the Okanagan Basin, British Columbia

The Okanagan Valley is approximately 160 km in length and encompasses approximately 8200 km^2 of land surrounding Okanagan Lake. In this project, the valley was divided into three sub-regions (Cohen *et al.*, 2004). The primary topics covered through IWRM based processes were: agriculture, climate change, economic performance, freshwater, housing and land use and population.

Rapid population growth in the Okanagan has exceeded even the highest projections and has led to substantial increases in water demand and land use, including loss of farmland. Furthermore, because of local climatic conditions, water supply and availability has decreased in the region.

Summer irrigation of agricultural land, residential outdoor and indoor water use, tourism, sensitive habitat areas and biodiversity are all demanding water, most of them at an increasing rate (Cohen and Neale, 2006). Future water availability in the regions under predicted climate change scenarios are of significant concern, and there is a need to understand the process of autonomous adaptation to climate change and the factors that must be considered during the development of agricultural water policy influencing the region.

Historical government policies have had a significant impact on local land-use and development patterns in the Okanagan. Policies in sectors as diverse as agricultural trade and regional planning have affected the size of individual properties, crop choices and business profitability in every agricultural industry and this has lead to both agricultural intensification and land-use conversion throughout the region. Interplay between these policies, climate change impacts and potential adaption options are discussed in the project.

IWRM actions: Detailed surveys of grape growers in the region were undertaken, given that these producers appear to be the most vulnerable to future water supply variability under projected climate change scenarios. Farmer perceptions of current and future water availability related to their crop production provided clues related to their use of various irrigation systems and production requirements, as well as the types of water policy interventions they may be willing to support. There is a strong awareness of water use efficiency concepts and technological options for increasing efficiency and reducing costs. Projected climate change scenarios are generally viewed to have both positive and negative impacts.

Through examination of the process of farm-level risk perception and management, this study informs adaptation policy development by providing decision-makers with an understanding of the ways in which water is used by grape-growers to manage market, climate and urban development risks. Project funding was provided by the Natural Resources Canada's Climate Change Impacts and Adaptation Program (CCIAP), Environment Canada, BC Ministry of Environment, and Agriculture and Agri-Food Canada

The project goals sought to:

1. Explore case study experiences on climate change and water resource management in the Okanagan;
2. Investigate how the potential changes in water balance (supply-demand) will influence water availability for activities such as agriculture, residential use and nature conservation in the region;
3. Investigate experiences with adaptation to water shortages and assess effectiveness and costs of potential future adaptation options; and

4. Synthesize the outcomes of the climate change impacts assessment on local water resources, expected development in the region and effectiveness of potential adaptation options in a way that it will help in moving towards strategic cross-sectoral approach to adaptation design.

The study may have originated as an assessment of climate change impacts on water resources, but as the project progressed, impacts on water supply and demand in the context of local development and future development priorities and choices became the focus. Development choices will also affect the region's water balance. Some development choices could exacerbate climate-related water problems and could increase vulnerability, while others could ameliorate them and help in developing adaptive capacities. For future research, development constraints, challenges of development choices and their impacts on local vulnerability should be identified and addressed at the early stages of projects. An economic assessment of cost and benefits were not directly included in the models. Consultants were hired to complete an economic assessment of impacts of climate change on involved sectors, including agriculture and the costs of analyzed adaptation options. The region's relatively high current rates of residential water use were compared against a range of future demand side management (DSM) scenarios.

In terms of technical applications, the *Okanagan Fish Water Management Tool* was linked with ongoing groundwater studies and an integrated Systems Thinking Experimental Learning Laboratory with Animation (STELLA) model developed by the research group**.** Since 1997, there has been a growing number research activities exploring water resources in the Okanagan. Previous research on climate change and Okanagan water resources provided information about supply and demand trends and identified a need for an integrated assessment model that would be developed in the close collaboration with local practitioners. Development of the integrated model was focused on expanding the dialogue on implications of adaptation choices for water management to include residential and agricultural users and in-stream conservation flows, for the basin as a whole as well as for particular sub-regions. This work strongly depended on collaboration with local stakeholders, their active participation and provision of data.

The project provided a cross-sectoral assessment of the climate change impacts on water availability, which helped in understating current and future trade-offs between water available for agriculture, residential development (including recreation) and nature conservation. It also provided assessment of effectiveness of potential adaptations, including actions targeting agriculture in the context of the whole region. The STELLA model was created through a participatory process involving local policy-makers and experts regularly reviewing and commenting the model development and also helping in the validation of the results. In this way the model has become not only a research tool, but the potential users of the models were involved in its development and consequently they have ownership of the project. Regular workshop and meetings between the policy-makers and researchers helped build foundation for effective future collaboration.

The research team learned that support of local water-users is absolutely crucial in order to get data, consult on and validate model results, make locally-relevant recommendations and finally for consultation after the project completion to help with implementation (if needed). Consulting with local stakeholders, even before the project proposal submission on what and how much they are willing to cooperate, would help in designing the methodology and completing the project (Cohen *et al.*, 2006). This project has helped stimulate stakeholder dialogue around the need for climate change adaptation. It has created an increased awareness among regional water managers, planners, political leaders and media. The project provided recommendations for water demand management as first priority, along with supply augmentation. The implications of climate change impacts on water availability based on the project outcomes were incorporated into the *Trepanier Landscape Unit Water Management Plan* (Cohen et al., 2006). Finally, the outcomes and recommendations developed in the model need to be linked with institutional challenges, because many of the great ideas and scenarios just will not be implemented if there is no clearly defined mandate to manage water quantity and very little integration between land use plans and long-term water management needs. This would also require collaborating with policy-makers at different scale not only at the local level.

2.3.5 *Atlantic Coastal Action Program, Canada*

In Atlantic Canada, the federal government's Atlantic Coastal Action Program (ACAP) is seen by many (e.g. de Loë and Kreutzwiser, 2007; Environment Canada, 2006; Hawboldt, 2004) as a best practice for water resources management at the local level. ACAP was initiated by Environment Canada as a community-based program focused on restoring and sustaining watersheds in Atlantic Canada; there are 14 sites, including five in Nova Scotia (Environment Canada, 2006). Each ACAP site has its own board of directors and has been designated as an incorporated, non-profit organization with a full-time paid co-ordinator and office. ACAP is premised on the idea that local community management is key to achieving sustainable development.

One of the successful ACAP projects with agricultural sector involvement is the Clean Annapolis River Project (CARP) in southwestern Nova Scotia. The Annapolis River water comprises two thousand square kilometres of communities, agriculture and natural resources. Initiating environmental change in the watershed has been the centre of operation for the CARP. CARP has formed partnerships with various levels of government, the agricultural community, community groups and stakeholders to deliver a variety of projects.

IWRM actions: Amongst the large variety of projects delivered are the Annapolis Ecological Engagement and Enhancement Project, the Riparian Habitat Restoration and Stewardship Project, the Annapolis Sustainable Agricultural Project, the Annapolis River Watershed Pesticide Inventory and the Annapolis Atmosfarm Outreach Pilot Project. These are summarized below.

Annapolis Ecological Engagement and Enhancement Project

The primary focus of this project is the engagement of citizens of the Annapolis River watershed in southwestern Nova Scotia in a series of activities that will lead to environmental improvement and enhanced stewardship in the communities in the region. There are three components to this project:

1. *Ecological Enhancement*
   - Riparian restoration and flood plain protection along the Annapolis River in the Middleton area owned by the town
   - Completion and, hopefully, implementation of a management plan for the highly invasive alien plant—garlic mustard, *Aliana petiolato*

2. *Environmental Monitoring*
   - To support the Annapolis River Guardians
   - To support a citizen scientist program aimed at identifying and mapping alien invasive plants

3. *Public Engagement*
   - To engage students in a range of environmental learning experiences
   - To support the environmental programs in development at Bear River First Nation

The Annapolis Atmosfarm Outreach Pilot Project

The Annapolis Atmosfarm Outreach Pilot project is geared towards commercial farms in the Annapolis Valley. The main portion of the project was to develop a workbook that can be given to farmers. This workbook is designed to provide easily accessible information to help with the operating process of the farm. Each section examines a different topic and how it applies to both the environment and the farmer. Project goals are to:

- Identify the greenhouse gases produced from agricultural practices;
- Reduce greenhouse gas emissions; and
- Increase carbon sequestration.

The project has identified 10 areas that can be looked at to reduce greenhouse gases and save the farmer money. These included: farm energy, farm electricity, fuel efficiency, soil organic matter, soil management, soil carbons, manure and methane, greenhouse gases, agri-forestry and riparian zones

Riparian Habitat Restoration and Stewardship

The health of the Annapolis River largely hinges on the quality of the land and water bodies that surround it. Because much of the surrounding land is used for agricultural purposes, there is the potential for fertilizers, pesticides and other agricultural chemicals to contaminate the river.

One effective and practical method of protecting the river is to allow natural, vegetated buffer zones to grow between the land and the water. These "green belts," called riparian buffer zones, are the natural transition areas between aquatic and terrestrial habitats, and perform several functions vital to the health of both habitat types.

By protecting and enhancing riparian buffer zones farmers can:

- Greatly reduce the impacts of their operations on the aquatic environment;
- Help control the flooding and erosion of their land; and
- Provide healthy habitat for many wildlife and fish species.

In 2003, CARP's Comprehensive Environmental Management Plan (CEMP) identified the establishment of riparian buffer zones on livestock grazing lands as one of the priorities for CARP's environmental restoration and pollution prevention activities in the Annapolis River watershed. Since 2003, annual projects funded through a variety of federal, provincial and private sources have been implemented with the participation of local farmers to limit livestock access to waterways and restore and enhance riparian buffers between pastures and watercourses. The Annapolis River Guardians volunteer monitoring network appears to have played a central role in building a sense of "community" among watershed stakeholders, and this has helped encourage agricultural producers to participate.

CARP's riparian habitat stewardship projects are designed to:

- Exclude livestock from waterways using fencing;
- Develop riparian zone protection and stewardship strategies; and
- Establish long-term stewardship of riparian habitat.

Local agricultural landowners are instrumental in the success of these projects. They contribute their time in planning individual projects; provide labour to install fencing, crossings and watering systems; and are committed to acting as stewards of riparian habitats on their land in the long term. CARP has applied a variety of methods and tools for the management of the Annapolis River and its watershed. While a few have been described here, its strength is demonstrated by its holistic

approach, incorporating education of stakeholders, developing management solutions and scientific analyses to determine the most relevant watershed issues and address them through effective stakeholder engagement. CARP runs an effective citizen-based water monitoring program that builds community capacity and augments water data for the region.

2.3.6 *Fraser Basin Council, B.C.*

The Fraser Basin contains an extraordinary range of ecosystems and spectacular natural beauty, and is considered one of the most productive areas of British Columbia. Activities in the basin contribute 80 per cent of the province's gross domestic product and 10 per cent of Canada's gross domestic product. During the 1980s, it became evident that industrial and agricultural pollutants, over-fishing and rapid urbanization were compromising the environmental health of the basin. As a result, challenges related to water management began to surface, including: water supply, pollution control, fisheries management, flood control, hydropower production, navigation and wetlands management.

The Fraser Basin Council (FBC), a non-governmental, not-for-profit organization has adopted four "directions for sustainability." These include understanding sustainability, caring for ecosystems, strengthening communities and improved decision-making. These four directions facilitate problem solving among the council and its partners. By bringing together the necessary people to make decisions and create solutions balancing social, economic and environmental considerations, engineered solutions are based on the needs of the entire basin. The council acts as a catalyst for solving inter-jurisdictional issues, as a conflict resolution agent, and as a sustainability educator. It therefore aims at a governance model that "brings together multiple sectors and interests in a collaborative, sustainability-centered context, to promote the common good" (Alexander *et al.*, 2006). To ensure that a broad diversity of perspectives is heard with respect to any sustainability issue, the Council's Board of Directors consists of representatives of four orders of Canadian government (federal, provincial, local and First Nations), the private sector and the general public.

IWRM actions: In all of its work, the FBC remains impartial, trans-partisan, independent and non-political in its primary role as an advocate for a sustainable basin (Alexander *et al.*, 2006). This consensus-based governance model provides a means to overcome the limitations of the traditional hierarchy of multiple jurisdictions operating independently in a common bioregion and "top-down" approaches to governing.

Primarily, the council conducts its business through the work of five standing committees: operations; staffing/financial operations/audit; constitution and council director recruitment; sustainability fund; and communications. Specific projects are overseen by five regional committees, and also by issue-specific task committees. These committees provide the implementation structure and decisions are by consensus.

The Fraser Basin Council is considered a model for participatory planning, with representation from all relevant stakeholders in the watershed. Effective communications and maintenance of a regional presence ensures basin-wide coverage of important issues. Effective place-based implementation is realized through focusing on watershed based management. Goals are achieved and measured through the state of the Fraser Basin Report that is published at regular intervals. Multiple water values are managed by the council, including flood events, controlling the spread of invasive plant species, managing the effects of climate change, strengthening rural communities, developing a sustainable fish and fisheries strategy, and building constructive Aboriginal and non-Aboriginal relationships. While participation from the agricultural sector may have been lacking somewhat during FBC plan development, today several agriculture-focused initiatives are in place, notably one related to the marketing of local food products and another focused on the development of a nutrient management planning strategy for the Fraser Valley, one of Canada's most important agricultural regions.

2.3.7 Grand River Watershed, Ontario

A number of environmental and water quality challenges faced the Grand River in the early- to mid-1900s. To deal with these issues, a group of eight municipalities banded together to form the Grand River Conservation Commission in 1932. In 1942, the commission completed the Shand Dam, the first multi-purpose dam in Canada, built for flood control and low flow augmentation to improve water quality in the dry summer months. The Conservation Authorities Act in 1946 gave rise to the Grand Valley Conservation Authority in 1948. After some debate about the practicality of two conservation organizations in the same watershed, to avoid potential conflict over roles and responsibilities and to eliminate duplication, the Grand River Conservation Authority (GRCA) was established in 1966 through the amalgamation of the two organizations. The GRCA was created to enable municipalities to jointly undertake water and natural resource management on a watershed basis. Senecal and Madramootoo (2005) explain that the GRCA management evolved from single-use planning in its infancy—essentially river channel improvement for transportation—to ecosystem-based multiple-use planning on a watershed scale that entailed the diversification of activities from primarily structural functions to the current mix of structural and non-structural.

IWRM Actions: The GRCA is involved in water quality management both directly and indirectly. Its key activities include land and water management, low flow augmentation through controlled reservoir releases, moderating low flows during the summer and early fall and ensuring adequate dilution of waste water entering the Grand River system. In addition, they also conduct monitoring and modeling of water quality, water temperatures, pH, conductivity and dissolved oxygen. The GRCA provides water supplies at its conservation areas and nature centres, most of which are not connected to the municipal water systems.

The GRCA has its own monitoring system that consists of real-time water level, water flow, rainfall, reservoir and water quality monitoring stations. The role of the monitoring system is to provide information to support water management decisions related to flood emergencies and day to day operations of the water control structures. The GRCA is also part of the provincial flood warning system and works in collaboration with the Province of Ontario and Environment Canada. Environment Canada also operates a portion of the stream gauges in the data collection network. Senecal and Madramootoo (2005) indicate that the success of the GRCA can be partly attributed to the relatively high level of direct control over water management and watershed resources. They also highlight the relative affluence of the CA and its capacity to generate revenue through activities such as hydroelectric production and property rental as a significant contribution to its success.

The GRCA's agricultural focus is through its Rural Water Quality Program, a stewardship funding initiative developed in conjunction with local farmers, the Ontario Federation of Agriculture, and the Ontario Soil and Crop Improvement Association. Through this program, the GRCA coordinates local, provincial and federal funding for water quality improvement projects related to agriculture. Funding for 80–100 per cent of project costs can be achieved.

2.3.8 Integrated management in the Yamaska watershed in Quebec

The Quebec Water Policy was launched in 2002 to support a reform in water governance. Its impetus was, in large part, the need to gradually implement watershed-based management for 33 major watersheds located primarily in the St. Lawrence plain.

IWRM actions: A template for a Master Plan for Water (MPW) or a Plan Directeur de L'eau (PDE) was created for use at the local and regional levels by basin organizations. The MPW included a cyclical process including the following steps:

1. Basin analysis and creation of baseline data.
2. Determine basin goals.
3. Determine objectives and choose indicators for measuring progress.
4. Develop a plan of action.
5. Implement.
6. Monitor and evaluate action plan.
7. Return to step 1: basin analysis and baseline creation.

Although the basis of the Quebec approach is designed to be non-regulatory, it is nonetheless supported by the Quebec Water Policy. Watersheds were chosen on the unit for addressing the province's water issues, which included pollution, protection and conflicts. The intention was to provide financial and technical resources to local-level institutions most able to manage watersheds at the most appropriate scale. Annual grants of CDN$65,000 would maintain the permanent

operations of each of the 33 OBVs. Technical support is provided through tools developed to help the OBVs carry out their planning and implementation and include a guide for management plan development,[11] a water atlas, GIS-based information kits, etc. The Regroupement des organizations de basin versant du Quebec (ROBVQ), a private non-profit association to which all OBVs must belong, is also funded by the Quebec Ministry of Environment (Ministère du Dévelopment durable, de l'Environment et des Parcs, MDDEP). The ROBVQ provides OBVs with assistance and information. The watershed organization is at the core of the Quebec approach to watershed management. OBVs are consultative organizations set up by local stakeholders that include representation from all public and private users, NGOs and water managers from within the watershed. The function of the OBVs is to initiate and ensure dialogue among stakeholders and develop and implement a watershed management plan.

One of the OBVs implementing the MPW at the local level is the COGEBY (Conseil de Gestion du Bassin Versant de la Yamaska) on the Yamaska River). The Yamaska River has been facing declining water quality for some years now, and residents have noticed the increase in algae and recognized that it has caused illness, as well as skin irritation in swimmers.

COGEBY is working on the health of the river and has spent many years on public education and planning around the health of the river and its watershed. They are the local organization conducting the MPW for this basin and are following the plan as prescribed by the Quebec government. They have initiated a seven-year planning cycle to develop baseline data for the basin, identify the problems and develop actions for mitigating watershed problems. Stakeholders are included in the stages of discussion and decision-making and the organization believes that the watershed plan is a reflection of people's priorities in the watershed.

Agricultural participants have played a key role in this watershed planning process. Stakeholder representation appears to be appropriately represented on the COGEBY board, and two significant BMP research and demonstration projects are occurring in partnership with local associations of producers in two sub-watersheds. COGEBY has clearly established credibility with a substantial number of agricultural producers, a provincial association of producers (L'Union des producteurs agricoles, UPA), and three provincial departments. Their ability to facilitate BMP adoption appears to be strong.

While COGEBY is still undergoing their initial planning cycle, it is responding well to provincially set processes and funding for local administration. Stakeholder participation (including from the agricultural sector) is high and contributes to the effectiveness of the process, planning and implementation success. While impacts of actions based on monitoring are yet to be realized, the process has been deemed a success.

[11] Available at www.mddep.gouv.qc.ca/eau/bassinversant/plan-dir.pdf

3.0 Integrated Water Resources Management around the World

The notion of managing our natural resources in an integrated manner is a somewhat recent one, internationally and in Canada. Heathcote (1998) suggests that it was born, in large part, of experience showing that single-medium and single source management was not successful in meeting short- or long-term goals. She goes further in suggesting that, until the mid-1970s, for instance, most pollution control effort was directed at controlling point sources like sewage treatment plants and industrial discharges. The notion of managing our environment on systems, such as the ecosystem and watershed approaches, in balance with social and economic needs, has emerged and gained momentum in the last few decades.

IWRM emerged as a significant integrated systems management approach since the Earth Summit in 1992 and gained momentum through the Global Water Partnership. Mitchell (2005) highlights the key elements of IWRM, as well as its prominent strengths and weaknesses. He explains that there have been two interpretations of the holistic or systems approach and delineates these as the "comprehensive" and the "integrative" approaches respectively. The comprehensive approach emphasizes that the relevant ecosystem should be defined in the broadest possible way, such as an entire aquifer or river basin and management should involve understanding all variables and interactions. From a management perspective though, a nested approach is deemed more appropriate, with programming and implementation at the lowest appropriate watershed level.

The integrative approach, as in IWRM, maintains a systems perspective, but is more focused and more selective in its required understanding of components. In this approach, the key or selected variables and relationships are emphasized. The rationale is that a few variables and relationships cause most of the variability in a system, and therefore those are the ones deserving attention.

3.1 Evolution of IWRM as a Global Framework

As early as 1970,[12] the UN organized a seminar to discuss main issues for the integrated management of river basins. Through case studies of several countries, in particular, Hungary, Belgium, Czechoslovakia, France, United Kingdom, Germany, Switzerland, Union of Soviet Socialist Republics and United States of America, a comprehensive approach, with clearly defined priorities, was considered necessary. Refined economic system analyses were also considered important as a means for IWRM. Methods for evaluating social benefits were considered inadequate and special efforts were recommended in this area (Chéné, 2009).

The first United Nations Water Conference in Mar del Plata, Argentina in 1977 recommended that increased attention should be paid to the *integrated planning of water management* and that particular

[12] River Basin Management, UN Committee on Water Problems, ECE, London, UK, June 15–22, 1970.

consideration should be given not only to the cost effectiveness of planned water schemes, but also to ensuring optimal social benefits of water resource uses, as well as to the protection of human health and the environment as a whole (Chéné, 2009). The Mar del Plata recommendations for water management policy can be summarized as follows (Heathcote, 1998):

1. Each country should formulate and keep under review a general statement of policy relating to the use, management, and conservation of water as a framework for planning and implementation. National development plans and policies should specify the main objectives of water-use policy, which in turn should translated into guidelines, strategies, and programs.
2. Institutional arrangements adopted by each country should ensure that the development and management of water resources take place within the context of national planning, and that there should be real co-ordination among all bodies responsible for the investigation, development and management of water resources.
3. Each country should examine and keep under review existing legislative and administrative structures concerning water management and, where appropriate, should enact comprehensive legislation for a co-ordinated approach to water planning. It may be desirable that provisions concerning water resources management, conservation and protection against pollution be combined in a unitary legal instrument. Legislation should define the rules of public ownership of water and of large water engineering works, as well as the provisions governing land ownership problems and any litigation that may result from them. This legislation should be flexible enough to accommodate future changes in priorities and perspectives.
4. Countries should make necessary efforts to adopt measures for obtaining effective participation in the planning and decision-making process involving users and public authorities. This participation can constructively influence choices between alternative plans and policies. If necessary, legislation should provide for such participation as an integral part of the planning, programming, implementation and evaluation process.

IWRM has emerged as a significant integrated systems paradigm since the Earth Summit in 1992 and gained momentum through the global water partnership. In addition, the 2002 World Summit on Sustainable Development in Johannesburg developed a UN resolution around IWRM implementation on a global scale. The resolution prescribed the development of IWRM and water efficiency plans by 2005 for all major river basins of the world, as well as developing and implementing national/regional IWRM plans and programs.

IWRM promotes the management of water and related resources (land, biodiversity, etc.) on a watershed basis. IWRM applies to watersheds at any scale and can therefore be a relevant framework for small catchments to very large transboundary basins. The management of water within a basin context at national level is challenging; it is even more complex to do so within the context of

transboundary level, yet increasingly recognized as crucial. About 40 per cent of the world's population and 47 per cent of the world's land is found within the 261 transboundary river basins. The efficient and effective management of transboundary water bodies (rivers, lakes and aquifers) is critical for social, political and economic stability, as well as sustainable development. The importance of effective water resources management is highlighted for public health benefits, especially in light of the anticipated impacts of climate change on basins across the globe (Costello *et al.,* 2009, pp. 373, 1693–1733).

In 1992, in Rio de Janeiro, Brazil, during the United Nations Conference on Environment and Development (UNCED) delegates of this official UN intergovernmental meeting expressed clear recommendation on water issues and IWRM: "Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good [. . .] priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems. Beyond these requirements, however, water users should be charged appropriately (UN-Water, 2008)." In addition to defining specific targets for safe drinking water, and for basic sanitation, the World Summit for Sustainable Development (Johannesburg, 2002), decided to "develop integrated water resources management and water efficiency plans [. . .] through actions at all levels (UN-Water, 2008)." Progress was addressed during the 12th meeting of the UN Commission for Sustainable Development (CSD-12)[13] (2004 review session); CSD 13 (2005 policy options session); and particularly in 2008 (CSD-16) when the five-year review of the IWRM implementation was undertaken.

In 2005, the Millennium Ecosystem Assessment reaffirmed the value of integrated ecosystem management and integrated river basin management as appropriate frameworks for "intentionally and actively addressing ecosystem services and human well-being simultaneously" (Millennium Ecosystem Assessment, 2005). In May 2008, the CSD-16 confirmed, despite difficulties encountered in implementation and monitoring, that IWRM is an essential tool to effectively manage water resources and for improved delivery of water services.

While the value of integrated water resources management remains unchallenged, the understanding of IWRM and effective application of its principles has been challenging. According to the World Water Assessment Programme (2009), promotion of the broad feasibility and applicability of the "integrated" approach is important in widespread acceptance and application of IWRM. The report recommends case-history documentation to disseminate the cases of IWRM existing today with specific mention of scale of application (basin, sub-basin and aquifers are given as the relevant levels).

[13] http://www.un.org/esa/sustdev/csd/csd16/documents/chairs_summary.pdf

According to the United Nations International Network on Water Environment and Health the critical obstacles preventing better water management globally are financial and institutional. The water sector requires a much greater use of innovative financial and investment instruments that reinforce local and regional IWRM and restore natural capital. The water sector also urgently requires new institutional capacity that can merge the natural sciences, the social sciences, public health concerns with engineering innovation and public policy, and can overcome the jurisdictional fragmentation that characterizes water governance (Schuster-Wallace, *et al.,* 2008).

3.1.1 Conservation and management of Bhoj Wetlands, India

Bhopal city, the capital of the state of Madhya Pradesh in India contains several man-made lakes created through the centuries. The Upper Lake and Lower Lake are the most important. The Upper Lake has special significance since it has been a source of piped water supply to the city of Bhopal for over 75 years. Even now, the lake accounts for some 40 per cent of the city's water supply.

Issues: Until 1947 the water quality of Upper Lake was so good that it required no treatment before being supplied to the public. However, tremendous population growth of the city (about 70,000 in 1951 to about 1.4 mil. in 2001) and rapid urban development around Lower Lake and on the eastern and northern fringes of Upper Lake subjected both the lakes to various environmental problems resulting in deterioration of their water quality mainly due to inflow of untreated sewage. The Bhoj Wetlands of Bhopal comprises of the Upper Lake and the Lower Lake. These lakes are of immense importance since they are inseparably linked with the social, economical and cultural aspects of the people of Bhopal and are referred as lifelines of the city.

IWRM Actions: The Government of Madhya Pradesh implemented an integrated lake conservation program during 1995–2004 with the financial assistance of JBIC (Japan Bank of International Cooperation). The basic objective of the project was to improve the water quality as well as to increase the storage capacity of the lakes. The project activities involved both preventive and curative measures like increasing the storage capacity of the lake through de-silting, control of weeds through de-weeding, prevention of pollution in the lake through diversion and treatment of sewage, catchment area protection through creation of buffer zone, et cetera. The implementation of these activities resulted in increasing the water holding capacity of Upper Lake by 4 per cent. Post-project water quality monitoring confirms improvement in water quality of the lake when compared with the data of the pre-project implementation stage. During implementation of conservation measures, various types of administrative, social and legal issues have been encountered.

As most of the catchment is rural, the state government of Madhya Pradesh realized that it was vital to address rural issues in order to maintain water quality in Lake Bhoj. Farm BMPs, such as organic farming practices, are being encouraged for watershed management. While these initiatives are being

implemented by the state government with financial aid from the Government of Japan through the JBIC, payments for ecosystem services mechanisms are being considered for the long-term sustainability of these programs. These payments would be made by the residents of Bhopal and by industries and local tourism operators who would benefit from the maintenance of the lake and its water quality.

In the region, intensive cash crop farming had led to the use of inorganic pesticides and fertilizers. Additionally, there was the problem of waste from the large number of cattle. A drive to promote organic agriculture and to encourage farmers to use compost made from cow dung as fertilizer was initiated by the state government. Trials are also being conducted with earthworm-based vermi-composting, open stack composting and bacterial starter inoculants to see if these methods could speed the conversion of dung. Another affiliated program uses local prison inmates to round up stray cattle and produce manure for the prison nursery. Inmates are now training local farmers in manure production and organic farming. All these initiatives directly or indirectly affect water quality in the Bhoj Lake, as well develop livelihoods and manage waste in a sustainable manner.

Impacts and Lessons:

A. A catchment or watershed must be managed as a composite whole, as the management of lakes and reservoirs for their sustainable use is directly linked to their catchment. A number of measures must be taken to protect the catchment, including:

- Developmental activity that affects its green cover and landscape should be prohibited, and developmental activities associated with human settlements in the catchment should be restricted;
- Nonpoint source runoff (i.e., from the drains) must be trapped; and
- Agriculture activities in the catchment require an awareness generation, conducted via the government extension services machinery, especially to facilitate a change in fertilizer consumption patterns, from chemical to organic fertilizers.

B. Raising awareness, education and stakeholder participation are essential
Stakeholder involvement, including lake-dependent communities, farmers and communities, should be an integral part of any watershed management program. Their interest in the lake and related management actions need to be sustained through relevant education, monitoring and reporting.

C. Role of government
This project demonstrated government assistance through funding, education and a high

degree of innovation in involving prisons and necessary technology to create closed-loop systems that prove sustainable.

D. Continuity of project staff is essential
This lesson is of utmost importance when executing a time-bound conservation project. In the project, the technical staff involved in project preparation and execution remained with the project for long periods of time, thereby facilitating project continuity. However, frequent changes of the project head during the period when its execution was in full swing affected the project implementation progress.

E. Need to sustain measures
By their very nature, conservation measures are never one- time activities. The sustainability of the measures must be ensured for a long period, in order to achieve fruitful results.

3.1.2 Fergana Valley, Central Asia[14]

Water is the key resource in Central Asia. The region's main challenges lie in: poor public investment in water management, inter-sector competition (energy-irrigation), water scarcity due to shortage and waste and increasing downstream/upstream tensions.

Issues: Once the most fertile valley in Central Asia, Fergana Valley, with its approx 10 million inhabitants, is now subject to high soil salinization and crops no longer suffice to feed the population. State boundaries between Uzbekistan, Kirgizstan and Tajikistan make transboundary management problematic and cause constant internal and interstate disputes. More than 60 per cent of the inhabitants do not have access to safe drinking water and basic sanitation resulting in widespread water-borne diseases in the rural areas. Irrigation infrastructure is inadequate and the water use is inefficient.

IWRM Actions: Improved management of water resources based on IWRM principles emphasized higher program efficiency and more equitable watershed-based benefits. IWRM capacity building within river basin management among river commissions, provinces, municipalities, companies and water user associations were highlighted in the program. Program included demonstration of bottom-up approaches and increases in yields and water productivity by up to 30%. Swiss Agency for Development and Cooperation assisted the Interstate Commission for Water Coordination in the implementation.

[14] **Source:** SDC in Central Asia - IWRM.
www.swisscoop.uz/en/Home/Regional_Activities/Integrated_Water_Resources_Management

Impacts: The project mainly addresses the possibilities for saving water, improving agricultural productivity, organizing water administrations, promotion and institutional build-up of Water Users' Associations (WUA) and the improvement of water allocation mechanisms among the users and among the three countries. The program has resulted in a partnership among all water management actors across Fergana Valley. Safe drinking water is now provided to 28 villages with a population of 80,000 people and 320 ecological sanitation toilets have been constructed on a cost-sharing basis. Waterborne diseases have decreased by more than 60 per cent on average and infant mortality has been almost eradicated in all villages, despite prevailing poverty. Twenty-eight water committees have been created to operate and maintain water systems efficiently with more than 30 per cent participation by women. This has resulted in the expansion of improved irrigation practices; innovative solutions for irrigation canal management and sustainable water user associations; and sustainable financing at canal, water user association and farm levels.

The inception phase of the Integrated Water Resources Management Project in the Ferghana Valley started in September 2001. During this phase, a detailed analysis was carried out of the legal, institutional, economic-financial and managerial issues, as well as an analysis and evaluation of earlier experiences, methodologies and systems developed by other donors and regional and state organizations in the water management sector.

The major achievements of the project during Phase II include an increased awareness amongst policy makers about the principles of IWRM; improved water distribution along canals; a demonstration of a bottom–up approach; a demonstration of potential for increasing yields and water productivity by up to 30 per cent.

Phase III of the project has triggered considerable changes in governance and management across the water hierarchy, and has gained acceptance in all three countries of the hydrological water distribution. Its activities were aimed at improved efficiency of modern governance policies, management procedures and institutional arrangements introduced at the national, regional and local levels during the previous phases. The project also focuses on expansing improved irrigation management practices and strengthening co-operation with other IWRM projects in the region.

The main results of this phase are the adoption of innovative solutions for irrigated canal management and sustainable water user associations, as well as introduction of effective methods for sustainable financing of the system at the canal, WUA and farm level. These accomplishments have been acknowledged in an external review of the project.

Phase IV of the project will concentrate on strengthening the achievements of the previous phases and addressing the gaps and challenges identified by the external review of the project, through consolidation and scaled-up experience, together with the new, innovative institutional arrangements achieved during Phase III.

Lessons: While significant emphasis was laid on management practices and technology, governance issues surrounding water management in the region were considered to be key to resolving the regional water issues. Institutional capacity building for IWRM, education and awareness generation, as well as monitoring of impacts, was used to develop collective action plans and implementation schedules. Improved management procedures, governance policies, strengthened cooperation and the overall acceptance of IWRM goals and methods are key factors in the success of this program.

Detailed analysis of baseline data and ongoing monitoring—including not only water characteristics, but also related institutional, economic-financial and managerial issues—led to the overall success of this project. This project is currently ongoing.

3.1.3 The Catskills/Delaware Watersheds: New York City's drinking water supply[15]

Issues: Faced with deteriorating water quality, New York City had the choice of building a new water supply treatment plant at a cost of USD$6,000 million or taking comprehensive measures to improve and protect the quality of the source water in the Croton and Catskill/Delaware watersheds, which covers approximately 5,000 km^2 and delivers water for over 9 million people in New York City. Dual goals of protecting water quality and preserving economic viability of watershed communities were set out.

IWRM Actions: Partnerships were developed among many stakeholders: New York City, New York State, the EPA, watershed counties, towns and villages, environmental and public interest groups. Programs were developed to balance agriculture, urban and rural wastewater, storm drainage infrastructure, environment and the quality of water in the 19 reservoirs and three controlled lakes. A watershed agricultural program was supplemented by land acquisition, watershed regulations, environmental and economic partnership programs, wastewater treatment plant upgrades and protection measures at reservoirs.

The farmers signed a voluntary participation agreement with the watershed agricultural council (WAC) and agreed to develop a whole farm plan in conjunction with a planning and implementation team. Funding for BMPs comes from a variety of sources, and often farmers bear no cost but have to provide in-kind contribution by volunteering their time and labour towards BMP implementation. As part of the whole farm plan, potential pollutants are categorized and prioritized, and farm-level BMPs are identified and implemented accordingly. BMPs include stream buffers, agricultural easements and other specific waste management practices. In addition to the farm BMPs, the WAC conducts numerous programs for clean water; forest management; land stewardship; economic

[15] **Source:** New York City, Department of Environmental Protection, Bureau of Water Supply: 2006 Watershed Protection Program. Summary and Assessment. Retrieved from: www.ci.nyc.ny.us/html/dep/html/watershed.html

initiatives, including market development programs and farm to market programs; and education programs, including model forests and school tours.

Impacts: More than 350 farms within the watershed have embarked on the implementation of best management practices, reducing pollution loads, acquiring 280 km^2 of land for protection, enforcing effective watershed regulations, remedying 2000 failing septic systems and upgrading wastewater treatment plants with tertiary treatment. They have achieved more than a 50 per cent reduction in coliform bacteria, total phosphorus and several other major contaminants were achieved. Currently, New York City's water supply is exempted from filtration, the population of the watersheds enjoys an improved environmental quality and a total capital saving of USD$4,400 million was realized.

Lessons: Channelling government expenditure from infrastructure development to IWRM-based management solutions to resolve New York City's drinking water quality issues resulted in not only the water quality benefits, but also the added co-benefits of improved farm production and management, reduced livestock disease and overall enhanced quality of watershed. The key lesson here is recognizing the stewardship of land and water by farmers and landowners and its monetary value to them and other beneficiaries. This case is cited as a prominent example of successful watershed-based payments for conservation and provision of selected ecosystem services. This case also demonstrates that water quality objectives can be met in a cost-effective manner through incentives for actions at the farm level.

3.1.4 Integrated Catchment Management in the Murray Darling, Australia[16]

Issues: The Murray-Darling river basin in South Eastern Australia is one of the world's great food bowls. Covering 1,061,469 km^2, it spans five jurisdictions (Queensland, New South Wales, Australian Capital Territory, Victoria and South Australia) and corresponds to approximately 14 per cent of the Australian landmass (Thampapillai, 2006). It supplies 75 per cent of all domestic, industrial and agricultural water uses and the vast majority of Australia's agricultural production (50 per cent in 2001) originates from its landscape (Adamson, Mallawaarachchi, & Quiggin, 2007; Thampapillai, 2006). The basin has been experiencing extensive droughts and water quality issues such as rising algal blooms, salinization and water logging due to increasing water consumption, agricultural activity and loss of deep rooted native trees (McNamara, 2007; Thampapillai, 2006).

IWRM Actions: The implementation of an integrated catchment management (ICM) plan for the basin aims to maintain and restore its ecological sustainability. The plan has been endorsed by the basin community and government and is guided by the following doctrine: "We the community and governments of the Murray-Darling Basin commit ourselves to do all that needs to be done to manage and use the resources of the Basin in a way that is ecologically sustainable" (Murray-Darling

[16] MDBC website http://www.mdbc.gov.au/nrm/

Basin Commission, 2001b, p. i). Due to the importance of agriculture in the region, agricultural governments, industry and community organizations such as New South Wales Agriculture, Irrigation Research and Extension Committee and Cooperative Research Centre for Sustainable Rice Production, are actively involved in implementing the basin's ICM policy (Murray-Darling Basin Commission, 2001b). While the plans are being implemented at the landscape level—through the adoption of water quantity caps, measurements and mitigation of salt concentrations and loads—the planning at the Ministerial Council level has active involvement from the federal department of agriculture.[17]

The Basin Salinity Management Strategy (BSMS), Native Fish Strategy (NFS) and Flood Plain Management Strategy (FPMS) were developed under the ICM policy to address resource issues. Agriculture is an important component of these strategies, as there are great opportunities for water conservation, flood impact mitigation and water quality improvements within this sector.

The BSMS was established in 2001 to lower salinity in the basin's water bodies. Farming features prominently in the strategy as one of its pillars. The BSMS advocates for redesigning farming systems to improve groundwater recharge in selected grazing and cropping zones and to develop new industries to capitalize on saline resources (saltland agronomy, saline aquaculture and salt harvesting) (Murray-Darling Basin Commission, 2001a).

Established in 2003, the overall goal of the NFS is to "rehabilitate native fish communities in the Murray-Darling Basin to 60 per cent of their estimated pre-European settlement levels after 50 years of implementation" (Murray-Darling Basin Commission, 2004, p. i). Farming groups are identified in the strategy as having an important role in protecting rivers and fish habitat through land and water management (Murray-Darling Basin Commission, 2004).

The FPMS established in 2003 has been devised within an integrated catchment and risk management framework (Murray-Darling Basin Commission, 2006). People who live and farm within flood prone areas need to have a good understanding of the potential risks involved and must manage their activities with due consideration for potential flooding impacts (Murray-Darling Basin Commission, 2006).

The agricultural sector is an important water consumer and source of water quality impacts in the Murray-Darling Basin. The sector offers great opportunities to improve the water resources of the area both in quantity and quality. Farming groups have been involved in the implementation of the ICM policy for the basin. The salinity, native fish and floodplain management strategies devised under the ICM policy have considered the prominent role of agriculture in meeting their objectives.

[17] www.mdbc.gov.au/about/murraydarling_basin_ministerial_council

Targeted actions in agriculture include long-term vulnerability assessments of agriculture and regions dependent on agricultural productivity, as well as cross-sectoral cooperation and collaboration for research and development in agriculture. Other targeted actions in the Murray-Darling Basin include the integration of climate change into environmental management systems as well as concerted efforts to reduce emissions "intensity" of Australian land based primary industry.

Current drought in southeast Australia is an indication of "worst-case scenario" for projected climate change and has provided the impetus for mechanisms and policies to deal with climate change impacts in the region.

Facilitated by the current stresses in the region, the Murray-Darling Basin Authority formed in 2008 and provides integrated planning and management across the basin, including the following specific roles:

- Preparing the basin plan, including setting sustainable limits for water use;
- Facilitating water trading;
- Monitoring water resources;
- Undertaking strategic research;
- Community engagement; and
- Facilitating ongoing consultation with ministerial council, basin officials committee and basin community committee.

Lessons: Lessons for the agricultural sector in the integrated management of the Murray-Darling Basin have been plentiful due to the integral role of agriculture in the region. Increased stresses from droughts and resulting disasters such as wildfires have exacerbated the need for sound management of agricultural landscapes for production. Some of these lessons were presented at the Ag-Water Forum III in Saskatoon in March, 2009 and are summarized below:

- Whole basin approach to water accounting and management;
- Avoid over-allocation: understand the system and connectivity between surface and groundwater;
- Establish independent management arrangements: avoid parochial interests and recognize investment requirements;
- Establish a trading environment;
- Use market or other measures to address over-allocation;
- Build significant capacity within systems to adjust; and
- Recognize and manage trade-offs.

3.1.5 *San Jeronimo Basin, Baja Verapaz, Guatemala*

Issues: The overexploitation and pollution of water resources of the San Jeronimo River, together with the agricultural development and massive deforestation, have generated conflicts with bordering communities. These conflicts originated with the deterioration in the water quality and quantity. The creation of the San Jeronimo Basin Committee is aimed at contributing to this problem's solution. This committee is enabling both the recovery of the river basin and the creation of alternative sources of income for its inhabitants through more efficient use of the resource.

IWRM Actions: The San Jeronimo Basin Committee acts as a negotiating body among all the basin's users. The committee comprises main water users representing various functions, including agricultural irrigation, aquaculture, hydroelectric use, human consumption and tourism. Its mission is to implement integrated management of the sub-basin, as well as to preserve biodiversity to ensure the socioeconomic well-being of the population and of water consumers. The creation of the committee has allowed for strengthened co-ordination among all the different key players involved, and the development of joint activities aimed at preserving the river basin and promoting sustainable water use. Amongst other issue-based committees, the Association of Users of Irrigation of San Jeronimo (AURSA) groups 800 users of one of the country's older irrigation systems. These 800 families faced issues of inadequate water management, pollution, heavy investment for water transportation, and a need for more efficient irrigation and treatment of their waste waters. This situation motivated those families to self-organize, pool financial and other resources, and build infrastructure and to develop self-management processes. This group is now in charge of programs such as the reforestation of 30 hectares in the nucleus area of Sierra de las Minas, designated as Biosphere Reserve. Among other responsibilities, AURSA is also in charge of distributing water to each of the sectors in the region and ensuring that it is used appropriately.

Lessons: Through the incorporation of institutions, users and NGOs increased recognition of IWRM principles among local population. The social responsibility of organizations located in a specific area is a key factor in obtaining positive results in water conservation. The negotiating role of the committee has helped to establish co-ordinating mechanisms between different water resource users, and among its Board of Directors and co-ordination commissions through the development of joint operations.

This case shows that, through coordinated efforts between local key players, including the farm community, an appropriate atmosphere can be created to develop actions framed in an IWRM focus with the support of public and private parties. At the same time, this process also guarantees benefits for all the participants in efforts to protect and preserve a river basin.

3.1.6 *Lake Rotorua, New Zealand*[18]

Issues: Freshwater ecosystems have long been intrinsically linked to the health, livelihood and culture of New Zealand (NZ). The country's lakes and rivers have influenced patterns of settlement, supported economic development and helped to shape the national identity (Ministry for the Environment, 2005). However, intensive agricultural systems and resulting non-point nutrient discharges are adversely affecting water quality in these lakes. While eutrophication of water resources as a consequence of land development is an immediate and urgent issue, so is the enormous challenge of developing efficient agricultural production systems while minimizing the adverse impacts on the wider environment on which human survival depends.

IWRM Actions: National lakes are being classified as Water Bodies of National Importance to ensure appropriate recognition and protection of nationally important (iconic) values in the management of NZ's water bodies. However, the importance of farming to NZ's overall economy is substantial. Increasing intensification of farming in NZ is leading to increased productivity and profitability. This is creating tension between the economic returns from farming and the effects of intensified land use on the surrounding environment (Jay, 2004). A result of this is NZ's Water Programme of Action to "ensure that our rivers, lakes, wetlands and other freshwater resources are fairly used, protected and preserved—now and for future generations" (Ministry for the Environment, 2004). Projects are being identified to explore innovative ways to mitigate the impacts of land use on water quality and to evaluate the effectiveness of management techniques. Particularly, multidisciplinary scientific programs that take an integrated approach to water management issues were encouraged, from on-farm to catchment level. Pilot projects were identified for a number of lakes, including Lake Rotorua and Lake Taupo.

Lake Rotorua is a big, relatively shallow eutrophic lake that received a large amount of point-source discharge of sewage from Rotorua city until sewage outflows were diverted to land-based treatment in the early 1990s (Hamilton, 2003). The lake's water quality improved after sewage diversion but has declined again since then due to increased nitrate levels entering the lake. Much of the increase in nitrate load in recent years comes from streams that drain agricultural land. Agricultural land use accounts for 75 per cent of nitrogen and nearly 46 per cent of phosphorous entering Lake Rotorua (Parliamentary Commissioner for the Environment, 2006).

Due to the nature of the escalating problem, legislative initiatives have been largely focused on either mitigating the effects of existing land uses on water quality or identifying entirely new land-use practices that export lower amounts of nutrients into lake catchments. Nutrient reduction will involve a combination of: (1) modifying farm management systems and practices so that less nitrogen is leached from existing sheep, beef, deer and dairying land use and (2) increasing the

[18] Source: adapted from Edgar, 2009

amount of land use with low nitrogen leaching losses (such as forestry, silage crops or new horticultural crops).

Landowners have expressed concerns over the impacts of land-use restrictions on farming practices and potential loss of farm profitability as catchment land-use intensification is precluded. Research indicates that economic implications of nutrient management actions and land use changes would result in an estimated net loss of agricultural profitability of approximately NZ $25–85 million per year. As a result, the farming community has responded by establishing the Rotorua Lakes and Land Trust (RLLT) as a partnership between the Te Arawa Federation of Maori Authorities—representing indigenous landowners—and the Rotorua/Taupo federated Farmers—representing other agricultural landowner interests. The objective of the RLLT is to work with the Rotorua community and local agencies to "develop a planned approach to utilizing land and water resources in the Rotorua catchment in a sustainable and productive way (Edgar, 2009)." The RLLT has effectively been established to act as a cohesive voice from a farming community that feels it is being increasingly isolated and singled out as the cause of water quality decline in the Rotorua Lakes. The RLLT is responding to the challenge from regulatory authorities by investing in sustainable land management research (Menneer and Ledgard, 2005). The RLLT have contracted the NZ Landcare Trust to develop a research action plan for the Rotorua Lakes catchments (Edgar, 2005; Parliamentary Commissioner for the Environment, 2006). Research will identify land management practices and strategies that minimize the effects of land use intensification on lake water quality. Research will focus on developing practical, on-farm management options to reduce nitrogen and phosphorous losses to ground and surface waters. A range of management options have been identified in consultation with local farmers and include: the frequency and timing of nitrogen fertilizer application; the type of supplementary feed provided to cattle; pasture species and composition; stock type; nitrification inhibitors; feed pads and off-site grazing; water retention dams; vegetative filter strips; and constructed wetlands and harvesting of aquatic plants from farm streams and water courses. On-farm trials of a number of these options have commenced on a large Maori-owned farming property.

Impacts: The establishment of the RLLT and the participatory research work on the farm has not gone unnoticed. The Joint Lakes Strategy Committee has now recognized the valuable contribution that landowners can make in developing practical and sustainable land management solutions. Rather than perceiving the research initiative as farmers placating the urban community, or farmers attempting to delay regulation by undertaking yet more information gathering, **there is growing awareness that landowners are most likely to adopt pragmatic on-farm solutions when they are developed, trialed and evaluated from within their industry.**

As a result of this awareness, the Joint Lakes Strategy Committee has established a Sustainable Land Use Implementation Board (SLUIB). SLUIB is made up of land owners representing the main

agricultural and forestry industry sectors in the catchments. SLUIB will advise on relevant nutrient mitigation research; evaluate and recommend land management options including incentives that may assist in achieving land use management change; and identify actual or potential impediments to achieving nutrient reduction targets, including planning regimes planned by the catchment and local agencies. It is hoped that SLUIB will be able to improve the integration of policy, science, and landowner adoption of best management practices and mitigation options leading to more sustainable land management in the Rotorua Lake catchments. Clearly, the need for more integration in land use management and water quality management is more apparent now, as is the felt need for improving the catchment modelling work that links the lake trophic index targets with land-based nutrient reduction targets.

Identifying successful partnerships and collaborative initiatives in specific catchments in New Zealand is being viewed as a way of building momentum for successful management of watersheds. The challenge is to move public reaction away from a culture of blame, of identifying the farming sector as the target for control toward establishing effective collaborative partnerships among the many stakeholders engaged in sustainable natural resource management. Clearly, both the threat and the reality of land use control have also been catalysts for more genuine responses from the agricultural sector in seeking meaningful solutions to the problem.

4.0 Key Elements of Successful IWRM

Integrated water resources management is a framework that enables the management and development of water resources in a sustainable manner, taking into account social, economic and environmental interests. It recognizes the many different and competing needs for these resources and helps balance the use of water and the needs of the environment.

The integrated approach aims to co-ordinate watershed management across sectors and interest groups and appropriately links different scales. It emphasizes linkages from the local to the national, establishing good governance and creating effective institutional and regulatory arrangements as routes to more equitable and sustainable decisions. A range of social, environmental and economic tools and processes and information and monitoring systems support this process.

4.1 Social Elements of Success

The Comprehensive Assessment of Water Management in Agriculture analyzed river basin governance and management in the context of increasing competition for water between agriculture and other uses, pollution of water resources and degradation of ecosystems. This analysis showed that to cope with the diversity of competing values and political and economic interests in basins and increasing water scarcity, natural hazards, and climate change, we need adaptive, multi-level, collaborative governance arrangements. It also showed that progress in establishing such arrangements has been slow, often with undue emphasis on form over process and a lack of redistribution of decision-making power from centralized "hydro-bureaucracies" to users (Molle *et al.* 2007).

In Canada, water and agriculture management portfolios are shared between federal and provincial levels of government. While the role of federal government in inter-jurisdictional issues is somewhat clearer, the role it plays in enhancing the role of agricultural sector is a more complex one.
According to the Comprehensive Assessment, the main functions of basin organizations can be included in the following categories:

- Monitoring, investigating, co-ordinating and regulating (including collecting data, monitoring and enforcing water quality type mechanisms, co-ordinating among sectors, stakeholders and governance units, and resolving conflicts);
- Planning and financing (including informing water allocations, formulating plans and mobilizing resources); and
- Developing and managing (including constructing, maintaining facilities, operations and management, preparing against water disasters and protecting and conserving ecosystems).

These provide us with some lessons for recommendations for agricultural sector participation in effective IWRM for Canada.

Effective multi-sectoral participation came up in numerous case studies as the single most important criteria for IWRM success. This was demonstrated by effective interdepartmental agency representation in governmental involvement, diversity in board and committee membership, collaborative commitment and support resulting in broad-based support and buy in from relevant project stakeholders. GWP-INBO (2009) elaborate on this aspect of IWRM success:

> The approach to integration must be both vertical—across different levels of authority—and horizontal—across different water users and affected groups. A key element of horizontal integration is bringing together ministries responsible for activities that impact on water—ministries of finance, planning, agriculture, transport and energy—and those with social or environmental responsibilities—ministries of health and the environment. Within any basin there will inevitably be conflicting demands for water, for example for domestic use, irrigation, environmental protection, hydropower and recreation as well as issues such as pollution or modification in the flow regime.
> Ministerial co-ordination bodies, such as cabinet committees, councils of ministers, are useful for coordinating actions across portfolios. However, they only work well when ministers are committed and when they are backed up at the highest level (e.g. by the President, Prime Minister). These ministerial co-ordination bodies need to be established so that there are clear lines of reporting both to senior executives in government and to basin organisations, local government and water user organisations.
> (2009, p. 26)

The inventory of IWRM initiatives in Canada elucidated further details in this regard.

Effective participation has taken a variety of forms in Canada, including the use of a multi-stakeholder advisory council to oversee Alberta's Water for Life Strategy. Alberta is also fairly unique in recognizing that a multi-scalar range of organizations are required to support watershed-based solutions (provincial Alberta Water Council, regional Water Planning Advisory Councils, and volunteer Water Stewardship Groups). The Bow River Basin Council has had most of its multi-stakeholder participants sign its watershed plan, while the North Saskatchewan River Watershed Alliance seeks multi-stakeholder participation by encouraging its participants to sign on as members, as a means of building ownership in the planning process. British Columbia is proposing a multi-

stakeholder water sustainability roundtable, while the Fraser Basin Council also has a high degree of stakeholder participation and commitment.

Manitoba and Ontario have longstanding provincial/local government partnership programs and legislation focusing on watershed-based planning and management (Conservation Districts and Conservation Authorities respectively). Each province is working to support these local agencies in their source water protection plans. Strong multi-sectoral participation is occurring through Nova Scotia's Clean Annapolis River Project and New Brunswick's East Charlotte Waterways project. Both provinces are now working with local municipalities on source water protection. Québec's IWMP program fundamentally requires multi-sectoral participation through its regional watershed organizations. The Georgia Basin Action Plan in British Columbia also involves international partners in this trans-boundary drainage basin.

Agricultural participation in most IWRM initiatives appears to be reasonable, with a few highlights. Alberta's Cows and Fish program (based in riparian area management) has engaged that province's agriculture sector very heavily, with impressive results (at least in terms of program participation and producer awareness). Québec's IWMP program contains very strong levels of producer, industry, and government participation related to agriculture—as do some water quality programs among Ontario's Conservation Authorities, notably those within the Grand River and South Nation authorities. Saskatchewan's Watershed Advisory Committees and Manitoba's Conservation Districts naturally contain a high degree of agricultural producer participation, given that most participating local government officials are also farmers.

Local drive and participatory leadership were shown to be important aspects of IWRM in some case studies. While drive and leadership often evolve organically and in response to a problem, government policy and programming helps to build an enabling environment for leadership and drive. Adequate training and capacity building, resourcing and identifying opportunities can help build local drive and impetus for a program or developing IWRM plans and actions. In many cases, this leadership comes from local stakeholders at the community level or among particular industry sectors. In some cases, this impetus has come from farmers. However, in other instances, government leadership has been responsible for driving IWRM efforts toward watershed sustainability. Saskatchewan's Safe Drinking Water Strategy and the Saskatchewan Watershed Authority's strong support of community-based Watershed Advisory Committees' development of source water protection plans has played a significant role in continuing watershed based action in the province. Similarly, in Ontario, provincial government support of source water protection planning by Conservation Authorities is being supported with substantial amounts of funding, but the CAs are leading on implementation. Provincial leadership on IWRM activities is also evident Manitoba, Québec, Nova Scotia and New Brunswick

Numerous case studies have demonstrated that farmers are themselves interested in the impacts of their land management actions on the environment (Tobacco Creek, Manitoba; Broadview, California). Farmers in Tobacco Creek, for example combined a desire to know the impacts with a collective desire to be part of positive change so that they were not constantly "dealing with" regulatory limitations and were, instead, ahead of innovative practice. The drive for this came from a desire to maintain their ability to farm. This in itself was a driver for IWRM planning and implementation. To enhance this drive, relevant information on BMP adoption, impacts and implications is important for higher uptake and overall improvement in environmental impacts of agricultural sector actions. The Canadian IWRM inventory also includes important examples of producer leadership in watershed sustainability. Alberta's Cows and Fish program and Ontario's South Nation Conservation Authority is likely leading the country in the application of market-based instruments for water quality improvement through its Clean Water Program. The interests of local agricultural producers are a major motivation for the program.

4.2 Economic Elements of Success

Reliable and sustained resourcing for IWRM is a key element of the level of flexibility and ownership required for its effective implementation. Cost sharing between levels of government has shown shared responsibility and joint ownership of projects reviewed through case study research. In both the case studies and the Canadian IWRM inventory, it appears that adequate provincial and other funding is necessary to support watershed-based planning exercises. However, there seems to be an ongoing challenge in terms of securing adequate and reliable implementation funding.

In Canada, the only relatively firm funding appears to be through Manitoba's Conservation Districts Program, a 3:1 provincial: local government arrangement. It however, is beginning to change—with more funding available to support provincial priorities. Manitoba's funding model is based on the historical Conservation Authority (CA) framework from Ontario, which changed dramatically in the late 1990s. Today, virtually all core funding for CA operations is generated from local municipalities and direct levies administered to all taxpayers in the watershed. Base provincial funding no longer exists.

Most IWRM initiatives in Canada receive provincial funding for watershed planning and program efforts related to source water protection. This is the case in Ontario, where co-operating CAs are now responsible for major IWRM efforts, which are being supported with substantial (albeit project-based) funding. Saskatchewan's Safe Drinking Water Strategy administered by the Saskatchewan Watershed Authority is another example. It appears that adequate levels of funding are being provided to emerging local organizations arising from the original Watershed Advisory Committees. Similarly, in Alberta, core provincial funding, largely from Alberta Environment, has provided base levels of operating support and staffing.

However, in Alberta it is clear that multiple other sources of funding are supporting IWRM efforts. While the Battle River Watershed Alliance is primarily provincially funded at this point, it is working to build up its membership base. The Bow River Basin Council is heavily supported through memberships, while substantial funding and other forms of resource support are received from the City of Calgary. This is also the case for the North Saskatchewan Watershed Alliance, where City of Edmonton-based funding is a major source of core support.

In some provinces, federal support has been fundamental. This appears to be the case with some initiatives in British Columbia, most notably the Georgia Basin Action Plan, where several federal departments are involved. Club-conseils initiative in Québec is jointly funded by Agriculture and Agri-Food Canada, and the provincial Ministry of Agriculture, Fisheries, and Nutrition. Environment Canada's Atlantic Coastal Action Program has clearly been driven by the availability of federal project funding.

The need for **economic incentives** to be part of IWRM programming was highlighted through the New York City and other case studies. In Canada, this is a relatively nascent area. However, the South Nation Conservation Authority has shown important leadership in this area with its Clean Water Program, through which point source polluters in the watershed may purchase offsetting emissions credits by funding a variety of upstream conservation initiatives in the agriculture sector. The program is innovative because a substantial amount of funding is provided by two area agricultural processors, while several exchanges have in fact occurred.

The National Environmental Farm Planning Initiative, including the National Farm Stewardship Program, has been an important funding source for the adoption of various BMPs by agricultural producers, who in fact treat funding as economic incentives. While other factors can and do influence a farmer's decision to adopt various BMPs, the financial incentives cannot be understated. BMPs funded through the environmental farm plan process appear to play a key role in most IWRM initiatives where agriculture is a significant land use. Saskatchewan's Lower Souris Watershed Agri-Environmental Equivalent Farm Plan is one of the first group watershed-based environmental farm plans in Canada. The proponents in this watershed have also been successful in securing substantial funding from Agriculture and Agri-Food Canada to explore the potential for applying market-based instruments in this watershed.

4.3 Technical Elements of Success

Technical and related capacity elements for staffing are fundamental to support IWRM initiatives, whether internationally or in Canada. Larger regional efforts such as the Fraser Basin Council and the Georgia Basin Action Plan in British Columbia appear to be staffed with appropriate professionals who provide a wide range of technical, management, and communications

support. Alberta's Watershed Planning and Advisory Councils (WPACs) have significant capacity, but likely need more, especially for those that have been recently established. Technical support is important not only for development of plan, but equally, if not more, important for implementation of plans. Putting plans into practice often requires the greatest resources. Smaller watershed-based entities across the country seem able to secure some project staff for some projects, but continuity is a problem. In Manitoba, long-term, municipal-based agreements (with additional provincial project or other support) have provided for the fulfillment of fairly reliable staffing needs, although they are likely not strong enough. Currently—in their emerging Source Water Protection Planning role—Ontario's Conservation Authorities are relatively more stable and better staffed, through the provincial Clean Water Act's funding of Source Water Protection Planning in that province. Alternative approaches involve the engagement of external consultants to conduct detailed background reports and the use of in-kind support from key partners (i.e. North Saskatchewan Watershed Alliance).

Molle *et al.* (2007) recommend starting with an institutional inventory, or a clear understanding of who does what, where, to what end, and how well. Based on this analysis, gaps can be filled and co-ordinating mechanisms developed or strengthened. While this can start from the bottom up, this could also be potentially undertaken by a federal agency—with the resources and access to all levels of institutions and their information. A follow-up to this would be to ensure that roles are clear, redundant overlaps are avoided where possible, resources are optimized and responsibilities are supported by regulatory and other policy instruments.

In most provinces, strong **technical partner support** has been provided by the provincial government, with Quebec's Ministry of Sustainable Development, Environment, and Parks demonstrating leadership through its use of a water information atlas, GIS support for watershed governance, and IWRM planning guidelines. This support has been helpful in establishing indicators and web-based tools in the Montmorency watershed, among others. In the Maritime Provinces, Environment Canada's support through the Atlantic Coastal Action Program has been pivotal. Agriculture and Agri-Food Canada has also played a key technical role in Alberta, Saskatchewan and Manitoba. Ducks Unlimited Canada has been a major supplier of in-kind technical support in many locations across the country. In many locations, joint technical teams of staff from several provincial and federal departments have worked together to provide valuable background data, and for assembling technical reports.

The ongoing monitoring and interpretation of **watershed science information and data** is a key requirement if any meaningful performance measurement or assessment of IWRM planning is to occur. Producers have shared responsibility to provide ongoing proof of the effectiveness of actions on the ground, such as BMPs to access ongoing funding support for such initiatives. Ongoing monitoring and data provides the signals for adaptive management of the programs and determining

their overall effectiveness and efficiency. Ontario's Credit Valley Conservation Authority is likely the leading IWRM entity in Canada, where detailed long-term water monitoring is occurring and forms the foundation of all IWRM management decisions. Most CAs have the capacity to generate and utilize this data, and these capacities are now being increased through the Clean Water Act. The IWRM elements of Saskatchewan's Safe Drinking Water Strategy have used a standard suite of indicators to assess watershed health and determine priority watersheds for action. Similarly, New Brunswick's East Charlotte Waterways Inc. has developed a GIS-based water classification system along with comprehensive community and industrial profiles for its watershed. Many IWRM organizations are attempting to utilize internet-based tools, mapping, and other communication activities in planning and managing their activities, as well as reporting on progress (state of the watershed reports). However, the availability of long-term, reliable data is in question. Long term and robust monitoring programs that ensure appropriate science based measurements of watershed health indicators produce the most effective measure of environmental performance over time.

4.4 Conclusions and Recommendations

Based on our review of the apparent social, economic, and technical elements of IWRM success in Canada, we offer the following, with references to potential roles which could be fulfilled by Agriculture and Agri-Food Canada:

- Effective governance and co-ordination mechanisms are critical to IWRM implementation and success, and must be devolved to the most appropriate level, whether local or regional level. While operating at these scales, the management focus must be watershed-based. This may occur through watershed organizations or collaborative watershed partnerships. These IWRM organizations must include representation from all relevant sectors, including the agricultural sector (particularly landowners and land managers), in watersheds where agricultural land use is predominant. The actual implementation of watershed planning and management activities depends heavily on key individuals to lead the process and build partnerships. All stakeholders—whether farmers, NGOs, or government departments—have critical roles to play. In many locations across Canada, these roles are still being defined, and they are often far from clear. As noted by Molle, *et al.* (2007), there is a need for institutional inventories of all IWRM stakeholders, to help clarify which stakeholders can fulfill particular roles in the IWRM process. At present, several federal departments appear to be exploring where their capacities should best be applied towards watershed sustainability in Canada. **AAFC should work with other applicable departments to promote the establishment of a federal interdepartmental IWRM team to coordinate federal participation in local or regional watershed initiatives. Based on the range of identified IWRM issues to be addressed within each watershed, the lead federal contact for the initiative should work collaboratively with other federal departments as applicable. AAFC should**

work with other federal departments and provincial governments to support to completion of comprehensive stakeholder inventories for key local and regional watersheds.

- A wide spectrum of tools is necessary for effective IWRM. A combination of regulatory, economic and expenditure instruments are required for achieving local or regional watershed goals. Use of geospatial tools, modelling, information and data to inventory, monitor and measure is equally important. Achieving these goals requires ongoing reporting systems, progress indicators, and clear communication to all stakeholders. This all entails some degree of co-ordinated management, which requires staffing. The reality today is that very few local or regional IWRM initiatives can be assured of any long-term staffing support through their present funding arrangements. Where ongoing funding does exist, it does not appear to be adequate to fulfill all the requirements of effective IWRM. It is not clear whether formal watershed-based institutions are required for every watershed at the local and regional level, or whether long-term collaborative partnerships can be equally effective, but one fact is clear. Additional long-term staffing, technical and financial resources must be directed to IWRM initiatives at the local and regional watershed levels if these are to have reasonable opportunities for success. **AAFC should be working to direct more of its existing programming funds and staff in support of local and regional watershed-based efforts, and these commitments should be long-term (particularly where support to local watershed organizations is concerned). The importance of watershed-based programming has been recognized in the new Growing Forward agreements (AAFC, 2009), and it should be strengthened through AAFC's provision of increasing levels of staffing and program funding focussed on agricultural sustainability efforts where effectiveness is measured in terms of watershed-based indicators.**
- Water science is a key component of all IWRM activities. Scientific research and ongoing monitoring of watershed-based indicators play a key role in establishing watershed goals, clarifying watershed management actions, and measuring progress towards articulated goals. Sound watershed science and its communication are key components of success in IWRM and must be enhanced specifically in the agricultural sector where land and water-based data plays a key role in management and stewardship. Collaborative participation among all watershed stakeholders can be extremely useful in terms of data management, analysis, reporting, modelling and developing IWRM progress indicators. There is a dearth of useable watershed science in Canada, particularly in local and regional agricultural watersheds. This information would be highly effective in clarifying agricultural contributions to specific environmental challenges. In some locations, efforts are occurring to establish long-term watershed monitoring initiatives with the help of community, government and university science partners. AAFC's leadership through the WEBs project is also noteworthy. **AAFC should continue and expand its support of long-term watershed science and research at the local and regional watershed levels. This should include the provision of direct**

funding to support emerging watershed research where agricultural land use is predominant, and where measurable watershed goals and progress indicators have been articulated by local or regional organizations or partnerships. AAFC leadership will not be needed in all locations, although one clear area of federal jurisdiction and leadership opportunity relates to interprovincial watersheds, where AAFC could work with Environment Canada to assist IWRM organizations operating within/across these complex drainage systems.

- The quest for strong agricultural producer participation in IWRM initiatives varies across the country. Several IWRM efforts in Canada do have relatively strong farmer involvement, while some do not, even when it would be logical or appropriate. Some also involve partners from other elements of the agriculture industry sector. Where agricultural issues are involved, most IWRM activities engage the applicable provincial department of agriculture at a minimum. Where producer participation (or even leadership) is strong, beyond any other factor, it appears that genuine respect for the potential role agricultural landowners can play in support of improved watershed health or integrity is central to IWRM success. In Québec, the representative participation of farmers is fundamentally required by the Québec Water Policy (where significant portions of agricultural land comprise watersheds). Several watershed organizations in that province (OBVs) have also developed impressive watershed-based BMP application and demonstration projects in partnership with local associations of farmer-members of the provincial producer association (UPA). Additionally, Les Clubs-conseils en Agroenvironnement (CCAEs) appear to be influential forums for local producers to meet and share their experienced in applying BMPs and other sustainable agricultural practices. While seemingly lacking meaningful stakeholder participation, New Brunswick's Surface Water Protection Program provides very clear land use regulations and permitted agricultural practices within specific watershed areas. This approach is straightforward and provides a degree of certainly to agricultural producers in terms of their potential liabilities. Adequate BMP funding and useful technical support are additional clues regarding the means by which enhanced producers participation can occur. Alberta's local Agricultural Services Board (ASB) model appears to be an effective BMP program delivery system, conducted in partnership with local municipalities, many of which have technical agricultural "field men" on staff, while some local agricultural associations have formed on watershed boundaries. **AAFC should further analyze the various combinations of factors that appear to stimulate significant and meaningful IWRM-related participation of agricultural producers. The logic and feasibility of delivering more agricultural BMP and other sustainability programming at the watershed scale needs to be addressed with significant program delivery changes developed together with provincial departments of agriculture.**

5.0 Appendix – Provincial IWRM Highlights

Please see next page: *Table A-1: Provincial IWRM strategies and key IWRM initiatives*.

Table A-1: Provincial IWRM strategies and key IWRM initiatives

NAME & WEBSITE	SCALE & SCOPE (including issues covered through programming and planning)	DRIVERS FOR IWRM	GOALS FOR IWRM INITIATIVE	SOCIAL OPERATING ENVIRON-MENT	ECONOMIC OPERATING ENVIRON-MENT	TECHNICAL/ SCIENTIFIC OPERATING ENVIRON-MENT	KEY ELEMENTS OF SUCCESS (including social, economic, technical)	OTHER ELEMENTS CONTRIBUT-ING TO SUCCESS	IMPLEMENT-ATION LEVEL[1]	AGRICULTUR-AL SECTOR REPRESENTA-TION & PARTICIPA-TION[2]	ACTUAL OR POTENTIAL CONTRIBUTIO-NS, VALUE OR BENEFITS TO AGRICULTURE[3]	AAFC ROLE OR OTHER POTENTIAL FEDERAL ASSISTANCE
British Columbia IWRM Strategy and representative IWRM initiatives												
BC Water Sustainability Action Plan (BC) http://www.waterbucket.ca/cfa/index.asp?sid=4&id=1&type=single The BC govt. also has a website featuring its very general policy direction (also referred to as the BC Water Plan): http://www.livingwatersmart.ca/	This plan seeks to encourage province-wide implementation of fully integrated water sustainability policies, plans and programs. It appears to represent the most advanced thinking related to IWRM in BC	There is a strong recognition that individual choices and behaviours related to water management need to change (to harness the cumulative benefits of these actions). A multi-level approach is outlined, with local governments noted as the key level for planning and decision-making related to watershed sustainability.	Goals include forging links among watersheds, humans, buildings and landscapes towards integrated watershed management; developing a continuum of products, with policy at one end and pragmatic applications/tools at the other end; and promoting the watershed as a fundamental planning unit.	The BC Ministry of Environment funded the BC Water and Waste Assoc. (BCWWA) to develop the plan. Several other organizations also involved via the BCWWA Water Sustainability Committee. and several "Communities of Interest," each of which has extensive and detailed Web links under a main Web page managed by the BCWWA (waterbucket.ca)	BCWWA proposed a detailed implementation plan and budget (approx. $1M) to the BC govt., most of which is now in operation. BC is funding this work, featured at: http://www.waterbucket.ca/	The BCWWA Water Sustainability Committee and other partners have developed water conservation tool kits, a Web site, green infrastructure partnership and a water balance model (www.waterbalance.ca) BCWWA is playing a central coordination role in mobilizing key stakeholders to work in support of BC's water action plan, including a focus on watershed- and	The fact that BC has enabled the BCWWA to play a key coordinating role in developing and delivering BC's water plan is highly unique and potentially very innovative. While measurable improvements are not likely available, there are signs of significant progress.	BCWWA has developed an impressive range of partnerships and an extensive list of useful resources available via at: http://www.waterbucket.ca/ This impressive action may now be confused with BC's broad water plan messaging (Living Water Smart).	Medium: The apparent level of information flow and strategy coordination appears high, although it is difficult to assess the degree to which BCWWA's efforts are making a difference. Earlier efforts toward IWRM planning may be stalled (now called "Water-Centric Planning"), although agri-related efforts in the Okanagan Basin are a leading example in BC.	Medium: BCWWA's Water Sustainability Committee is comprised of members from several BC depts., municipalities, NGOs and the private sector. Aside from one dept. member, no agricultural sector members listed. However, there are strong connections to the agricultural sector in program activity, with extensive info and useful tools: http://www.waterbucket.ca/aw/	Medium: There are two "Communities of Interest" directly related to the agricultural sector featured on the Water Sustainability Committee's Web site, providing a powerful network for agricultural stakeholders to get information and participate (with general public awareness benefits also). These relate to Agri. and Okanagan Water Supply at: http://www.waterbucket.ca/aw/ and http://www.water	AAFC and Env. Can. are supporting partners of the BBWWA Water Sustainability Committee's work, with one Environment Canada representative on the Committee. AAFC is involved in several agriculture sector initiatives featured on the two agriculture-related Communities of Interest.

[1] In terms of implementation, a **Low** rating suggests progress to date has been limited or weak, or that it is simply too early to determine. Meaningful assessment at this point is premature. **Medium** implies that a significant degree of implementation progress has been achieved, consistent with the principles of IWRM. A **High** rating of implementation progress suggests a very impressive level of progress has been achieved. Further discussion is provided with each rating.

[2] The apparent degree of agricultural sector representation in IWRM processes is assessed, with a **Low** rating denoting an obvious lack of meaningful participation of agricultural industry or producer representatives. A **Medium** rating suggests that an appropriate level and scope of agricultural participation is occurring based on the nature of the project and in relation to the participation of other sectors. A rating of **High** refers to a substantial level of agricultural sector representation, if not leadership of the IWRM initiative.

[3] Actual or potential contributions, value or benefits to the agricultural sector are rated. **Low** implies the IWRM activity does not appear to be valuable, at least not at this time. A **Medium** rating suggests the IWRM effort does provide significant contributions to agriculture, or could potentially provide benefits. **High** entails a very valuable contribution with excellent contributions and possible leadership from the agriculture sector.

Table A-1: Provincial IWRM strategies and key IWRM initiatives

NAME & WEBSITE	SCALE & SCOPE (including issues covered through programming and planning)	DRIVERS FOR IWRM	GOALS FOR IWRM INITIATIVE	SOCIAL OPERATING ENVIRON-MENT	ECONOMIC OPERATING ENVIRON-MENT	TECHNICAL/ SCIENTIFIC OPERATING ENVIRON-MENT	KEY ELEMENTS OF SUCCESS (including social, economic, technical)	OTHER ELEMENTS CONTRIBUT-ING TO SUCCESS	IMPLEMENT-ATION LEVEL[1]	AGRICULTUR-AL SECTOR REPRESENTA-TION & PARTICIPA-TION[2]	ACTUAL OR POTENTIAL CONTRIBUTIO-NS, VALUE OR BENEFITS TO AGRICULTURE[3]	AAFC ROLE OR OTHER POTENTIAL FEDERAL ASSISTANCE
						landscape-based planning.					bucket.ca/okw/	
Fraser Basin Council (BC) http://www.fraserbasin.bc.ca/	The FBC's activities include a range of basin-wide and regional watershed programs and projects designed to promote watershed sustainability and build IWRM planning capacity	The declining overall health of the river (pollution and fish stocks), resource conflicts, and flooding promote overall sustainability, including social, economic and environmental.	The FBC Charter is a general plan that guides the organization's operations with three broad goals related to understanding sustainability, caring for ecosystems, strengthening communities and improving decision-making.	There appears to be a high level of commitment among stakeholders who are represented on a 36-member board. First Nations and regional government districts are represented, along with several federal and provincial government departments and other individuals from several sectors.	FBC has a diverse and relatively secure funding base, between government funding, project-based fee-for-service, donations, membership, and through events such as the annual conference.	FBC has a large range of expertise and capacity, including management, technical, social development, communications, etc. Plans include the development of tools such as flood hazard information tools in the Flood Hazard Management program. FBC has installed 11 climate stations and 7 soil moisture stations to assist the agricultural community with their land and water decisions.	The diversity and commitment of a 36-member board of directors appears to be an important strength, and that the FBC was initially established with strong support from the federal and provincial governments has ensured long-term funding support.	The development of sustainability indicators and their annual reporting in the Sustainability Snapshot report (1, 2, 3 and 4 so far) which includes social, economic and environmental performance indicators.	Medium: The FBC has established itself as a significant partnership-building force in the basin, and it has many programs and initiatives underway. It is premature to determine if IWRM progress is being made (or if it can be attributed to FBC activities), although current water quality indicators appear stable.	Low: one rancher and one organic produce delivery service are represented on the board. No govt. agriculture departments are represented. However, several agriculture initiatives are featured among FBC's regional activities, including those related to marketing and nutrient management.	Medium: The Fraser Valley produces 75% of BC's agricultural products/income and is urbanizing rapidly, suggesting a strong potential for future land use conflicts. Agricultural data are used in the State of the Fraser Basin report (including Agricultural Reserve Lands and producer environmental farm plan uptake). The agricultural sector should participate and be seen as a strong proponent of improved watershed sustainability.	Stronger AAFC and other participation of agricultural sector on FBC board of directors, and greater participation in agriculture specific programming should be considered. Environment Canada and Fisheries and Oceans Canada are currently on the board and strongly support the FBC.
Georgia Basin Action Plan (BC) http://www.pyr.ec.gc.ca/GeorgiaBasin/index_e.htm	A partnership among three federal depts., BC Ministry of Env., and several First Nations to strengthen collective capacity to protect and restore ecosystem health through collaborative stewardship actions and governance	Growing concerns related to aquatic ecosystems and pollution and a need to understand environmental concerns related to the release of priority substances.	GBAP goals include collaborative stewardship; sustainable land, aquatic, and resource planning; scientific and indigenous knowledge; and protecting targeted ecosystems.	The GBAP coordination and management structure allows for collaborative planning and stakeholder involvement within and across individual mandates. The management structure is flexible, allowing for new partnerships as	Funding provided by three federal departments and BC Ministry of Environment. An extensive array of projects has been completed. Most appear to relate to technical research.	Implementation tools include information sharing, data management and sharing, mapping tools, Web-based water management tools, best management practices, education and outreach strategies, indicators, and	Continuous improvement arising from monitoring and performance evaluation. Trend monitoring data from selected watersheds in the basin will be compared to site-specific water quality objectives and reported using the Water Quality	Strengths include a collaborative approach, the commitment of governments, supportive mechanisms for collaboration, ability to be proactive, leveraging ability. There may be questions of overlap and duplication with	Medium: Substantial progress has been made in terms of scientific research. However, the degree to which this research has resulted in improved management and decision-making is unclear, although the intent to use report results	Medium: AAFC, BC Ag Council, Ministry of Ag and Lands, Ministry of Ag, Fisheries and Food re among non-signatory partners participating in various GBAP. Results of project implementation have been disseminated and shared with local	Low: At this point, there are a small number of research projects or other initiatives with direct agricultural connections. While a "basin" project, the watershed connections are somewhat nebulous, and the geographic scope (and range of projects) is very	AAFC should consider becoming more involved in this project, working with the BC Ministry of Agriculture and Lands to help engage more producers.

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				needs arise.		trend assessment monitoring.	Index developed by the Canadian Council of Ministers of the Environment.	the Lower Fraser.	exists. GBAP has supported alternative pest control strategies and nutrient survey work, among others.	farmers and interest groups in partnership with AAFC.	diverse. There is not a strong public awareness component.	
Okanagan Basin Water Board and Related Initiatives (BC) http://www.obwb.ca/index/ Participatory Integrated Assessment (PIA) of Water Mgmt. and Climate Change in the Okanagan Basin. http://adaptation.nrcan.gc.ca/projdb/pdf/a846_summary_e.pdf	The Okanagan Basin Water Board (OBWB) is a watershed partnership of municipalities. Three or these regional districts have also formed the Okanagan Water Steward. Council (OWSC) as a sub-committee with the task of devising a water strategy. From 2002–04 a major climate change study was conducted by researchers from UBC and other partners, which appears highly relevant to the agric. sector.	Drivers include water shortages, growing water demand and population growth, anticipation of negative impacts of climate on water availability in the region, which seems to have been quite variable (with a trend toward reduced flows in recent years).	OWSC's Okanagan Sustainable Water Strategy is comprised of broad goals (each including specific strategic initiatives) as follows: source water protection; land use planning and management; wastewater; water allocation; water management, conservation; storage; governance; collaboration and communication; funding. There is also a data/science and adaptation theme that runs through the plan.	The OWSC was formed at the request of three BC regional districts under the auspices of the OBWB. It includes a multi-stakeholder membership from provincial and federal levels, NGOs and resource users in the system.	The OBWB is seeking long-term funding to continue the work of the OWSC. Various options are being explored: expanded OBWM property tax assessments; volume-based water user fees; water license rentals; recreational user feels; and sales taxes	Commitments to science-based decision-making through data collection, interpretation and distribution are strong themes throughout the OWSC strategy. The PIA developed a number of water planning tools and models in its work.	It is premature to determine if the OWSC strategy will be successful, as it has only recently been completed. The PIA project success was attributed to multi-stakeholder consultation and consensus building with multiple meetings leading to sound data, development of scenarios, building capacity, validation of the model and the building of a STELLA model for improved decision-support.	Challenges with the PIA project included the fact that the program depended heavily on local collaboration and active participation of local stakeholders for provision of data.	Medium: The OWSC strategy has just been completed, so assessment is premature. The PIA project appears to have developed a useful decision-support tool.	Medium: OWSC membership included three agro- industry members and representatives from both federal and provincial agricultural departments. PIA research was conducted with the assistance of basin area farmers to understand the processes of adaptation to climate change and the factors that must be considered during the development of agric. water policy.	Medium: Through the PIA study's examination of the process of farm-level risk perception and management, this work informs adaptation policy development by providing decision-makers with an understanding of the ways in which water is used by growers to manage market, climate and urban development risks.	AAFC and Environment Canada are represented on the OWSC. AAFC should participate in strategy implementation with funding and technical support. Funding for the PIA project was from the NRCAN CCIAP program, with support from Environment Can. and assistance from AAFC others
Alberta IWRM Strategy and Representative IWRM initiatives												
Water for Life (AB) http://www.waterforlife.alberta.ca/	IWRM aspect focused on establishing partnerships where citizens and stakeholders have opportunities to actively participate	Water for Life Strategy developed in response to provincial concerns related to: water allocation, water supply, instream flows and	Water for Life is focused on: a safe, secure drinking water supply; healthy aquatic ecosystems; and reliable, quality water supplies for	Under overall guidance from a multi-sectoral Provincial Water Advisory Council, government strategy delivery facilitates the	$30M in IWRM-related funding is occurring through Water for Life and related initiatives coordinated by AB Environment. Most progress to date	WPACs develop plans, promote stewardship activities, and report on watershed health. Comprehensive background reports	There is some key indicator tracking through the AB Government's "Measuring Up" performance reporting process. Water for Life is a	The connections between Water for Life and a new (and highly promoted) Land Use Strategy are not yet clear.	Low. It is premature to determine strategy success. AB Water Advisory Council suggests progress may be weak, suggesting the	Medium. An appropriate level of agricultural participation appears to be involved with the Water for Life Strategy,	Medium. The needs of agriculture are fairly represented in the strategy. Implementation will occur via WPACs and WSGs.	Federal support would likely be welcome in the areas of IWRM implementation funding (AAFC) and scientific monitoring

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	in watershed planning and management on a provincial, regional, and community basis.	pollution.	a sustainable economy.	establishment of regional Watershed Planning and Advisory Councils (WPACs). Local Watershed Stewardship Groups (WSGs) are expected to deliver on-the-ground stewardship solutions in specific watersheds	relates to the preparation of state-of-the-watershed background reports. Some frustration seems to exist at the regional and local watershed levels around the lack of availability of implementation funding.	exist on several watersheds. These have generally been conducted by private consulting firms.	*Cross-Ministry Strategy* for which eight departments are jointly accountable. This represents an important opportunity for interdepartmental cooperation.		Water for Life Strategy goals should be streamlined into: 1) Safeguard Our Water Sources; and 2) Accelerate Action (including a focus on clarifying roles and accountabilities and enhancing data collection and reporting).	evidenced by Irrigation, Livestock, and AB Agriculture and Food Ministry representation on the Provincial Water Advisory Council.	Agricultural water use (particularly irrigation) will increasingly be challenged as supply and allocation concerns heighten with projected climate change scenarios. Water for Life may assist in preparing farmers for this reality.	(Environment Canada). At the WPAC level several AAFC staff have contributed tech assistance and expertise on watershed mgmt. planning, activities, modelling, and data/information
Bow River Basin Council (AB) http://www.brbc.ab.ca/	The Bow Basin Watershed Mgmt. Plan (Phase 1) includes broad objectives related to: improved surface water quality, riparian area and wetland management., aquatic vegetation management, management of human activities influencing riparian areas, source water protection and management and public outreach and education.	Three regional groups existed in southern Alberta before the Water for Life strategy was developed. One of these, the Bow River Basin Council (BRBC) has become a WPAC since strategy was announced. During this time, AB Environment was already conducting a planning process for the South SK River Basin.	The BRBC IWRM plan (Phase 1) is a research and monitoring plan with some mgmt. recommendations related to Stormwater and Wastewater management, pesticide management and land use management. The South SK River Mgmt. Plan (SSRMP) focuses on water allocation issues.	WPACs are multi-stakeholder groups used as a forum to share information; report on "state-of-the-watershed" indicators; and prepare management plans consistent with broad Water for Life policy direction and a clear provincial planning process. Plan signatories are expected to utilize the plan to inform their day-to-day operating decisions.	The BRBC is a membership-based charitable org. Members include municipalities, federal and prov. departments, industry, NGOs, academia, others. The City of Calgary appears to be a key funder, while project funds are also secured from various sources.	A Technical Committee comprised of BRBC member-developed water quality objectives and indicators for the primary Bow River channel (mainstem) as well as the Elbow and Nose Creek sub-watersheds. These considered unique natural features and user needs. Common biological, physical and chemical indicators used.	The range and intensity of the BBWMP Phase One: Water Quality plan's proposed research and monitoring activities suggests that future IWRM activities will be based on research results.	Interrelationships between the BBWMP and the SSRMP are not clear. The BBWMP includes somewhat vague implementation timelines: short-term (2008–10); medium-term (2011–12); and long-term (2013–14). There are many recommendations; not all may be achievable.	Medium. Actual implementation progress cannot be measured, although the apparent commitment among many partners appears to be substantial.	Medium: 3 irrigation districts and AB Agriculture and Food are members of the BRBC. The Cows and Fish NGO is a plan signatory. The participation of AAFC and large livestock operators appears to be lacking. AB Agriculture and Food and the Eastern Irrigation District provided staff to serve on the Technical Committee.	Medium: Greater clarity regarding water quality objectives through the Bow River system will help identify solution priorities (i.e. significance of agriculture's role). The SSRMP has identified the potential for water allocation trading to assist in managing supply needs. This has been identified as a helpful tool for irrigators.	Greater AAFC participation in the BRBC initiative seems warranted.
North Saskatchewan River Watershed Alliance (AB) http://www.nswa.ab.ca/	The North SK IWRM plan provides a framework for protecting, maintaining and restoring a healthy, natural watershed system within the context of	The NSWA is the designated WPAC for the SK River in Alberta, under the provincial Water for Life Strategy.	The main goals of the NSWA IWRM plan are focused on: land and water strategies; land Use issues; collaboration with watershed communities and the public.	NSWA is a non-profit society guided by a board comprised of member assoc. representatives. Members agree that a holistic approach to watershed	While there are more than 200 organizational and individual members participating, most funding and support comes from AB Environment,	Substantial levels of in-kind support are provided from the City of Edmonton, AB Environment, Trout Unlimited and municipalities. The NSWA engages consultants to	NSWA commitment to collaboration during the IWRM planning process is evident. Participation and membership are available to any stakeholder at no	A lack of consistent, broad-scale data on riparian conditions has been identified as a limiting factor for plan success. Efforts are underway to address this. There	Medium: Terms of Reference for the IWRM plan were finalized in 2005, initial research is underway and consultations with municipal members have begun. Reports	Medium: Alberta Beef Producers and AAFC are noted as NSWA funders, while several producer groups and an irrigation district are members. There is significant agric.	Medium. Land use impacts on water quality have been squarely identified as a key element of the IWRM planning process and its implementation. At this point, AB Beef Producers and	AAFC may wish to consider expanding its participation. AAFC could help increase the representation and participation of the crop sector.

Table A-1: Provincial IWRM strategies and key IWRM initiatives

NAME & WEBSITE	SCALE & SCOPE (including issues covered through programming and planning)	DRIVERS FOR IWRM	GOALS FOR IWRM INITIATIVE	SOCIAL OPERATING ENVIRON-MENT	ECONOMIC OPERATING ENVIRON-MENT	TECHNICAL/ SCIENTIFIC OPERATING ENVIRON-MENT	KEY ELEMENTS OF SUCCESS (including social, economic, technical)	OTHER ELEMENTS CONTRIBUT-ING TO SUCCESS	IMPLEMENT-ATION LEVEL[1]	AGRICULTUR-AL SECTOR REPRESENTA-TION & PARTICIPA-TION[2]	ACTUAL OR POTENTIAL CONTRIBUTIO-NS, VALUE OR BENEFITS TO AGRICULTURE[3]	AAFC ROLE OR OTHER POTENTIAL FEDERAL ASSISTANCE
	sustainable development. It will address surface water, groundwater, land use, social, cultural and economic issues. Land use issues will be identified.			management is essential for environmental, economic and social well-being. There is a focus on consensus, collaboration, integrity, respect.	EPCOR, and the City of Edmonton. Additional funding is received from AB Beef Producers, AAFC, and private foundations.	complete most IWRM planning elements including: issue identification, quality/quantity modelling, studies, assessments, etc.	cost.	appears to be a need for additional funding to support the implementation of NWSA goals.	include: water use and demand study; water quality indicators; groundwater assessment; in-stream flow; communications and consultation plan.	representation on the NSWA Board. Other studies include: Cumulative Effects Study, Naturalize Flow Study, Vermilion River Water Use and Demand Study	PFRA appear to be the major participants (as funders). It will be important to determine water quality impacts from the beef and crop production sectors.	
Battle River Watershed Alliance (AB) http://www.battleriverwatershed.ca/	The Phase 1 Terms of Reference were approved by AB Environment in 2004. It projected an initial focus on baseline data collection related to water flows, infrastructure, licenses, models, apportionment, future water demands, alternative supplies, climate change, aquatic environment, and recreation. The Battle River joins the North Saskatchewan River at North Battleford, SK.	Water quantity issues have been of significant concern for the towns of Camrose (Driedmeat Lake) and Wataskawin (Coal Lake) in recent years. A diversion from Coal Lake also supplies the industrial water needs of nearby oil injection activities. The Battle River is prairie-fed (vs. glacial fed), which is the primary reason for the IWRM focus on water supply. BRWA is a WPAC	The BRWA IWRM plan has been focused on: recommendations for resource managers to consider, as related to water supply, water quality and biodiversity. Rescheduled Phase 1 IWRM planning activities are focused on exploring licensed water use and riparian management along the Battle mainstem.	The BRWA IWRM planning process was co-ordinated by a govt. steering committee with guidance from stakeholder advisory group members. These groups joined in 2005 and now exist as a board. communities, associations, and companies are listed as partners. Two local watershed improvement associations have demonstrated local innovations.	98% of funding is provided by AB Environment. Total current budget = CDN$240k.	Most technical support provided by a government steering committee.	While the IWRM planning process is just beginning, collaborative arrangements among partners and local watershed stewardship groups (Iron Creek and Battle Lake) appear strong.	The support of county-based conservation technicians and agricultural fieldmen are noted as an important opportunity for action.	Low: Several Water Forums occurred in 2005–06. Research toward a State-of-the-Watershed Project has just begun. It is premature to assess significant progress.	Medium: Alberta Beef Producers and AB Agric. and Food are on the board, and AB Agriculture and Food is listed as a partner in the BRWA IWRM planning process. The support of county conservation technicians and agricultural fieldmen has been significant. Several agricultural watershed programs are also featured. Licensed water users include agric. interests, while water quality has also been identified as a key issue.	Medium: Livestock density and manure production intensity data are portrayed in graphic detail on the BRWA website, denoting the need to clarify agricultural water quality and supply impacts. The AB Agriculture and Food's BMP Evaluation Project (Whelp Creek) suggests strong future potential contributions in clarifying these impacts, although final results will not be available for several years.	AAFC is not directly involved or represented in the BRWA. Given this watershed's interprovincial significance, an increased federal presence seems warranted (re: water quality – Environment Canada), perhaps in association with related SK IWRM efforts.
Cows and Fish (Alberta Riparian Habitat Mgmt. Society) (AB) http://www.cowsandfish.org/	The Cows and Fish riparian health agri. extension initiative has been instrumental in stimulating improved riparian management among many cattle	Concerns over water quality impacts associated with poor grazing management suggested a need for better information and awareness of	The Cows and Fish process is focused on a cyclical process of: awareness, team-building tools, community action and monitoring.	The society is governed by a board comprised of representatives from AB Beef Producers, the CDN Cattlemen's Association, Trout Unlimited Canada,	Program funding is provided by federal and provincial agencies, private foundations and associations.	A series of technical reports, fact sheets and peer-reviewed publications have been produced. The society has collaborated intensively with the	A strong and producer-friendly extension-based focus, rooted in science.	Ongoing financial support from government, industry and foundations.	High: Cows and Fish workshops have been delivered to 47,000 producers since 1992. The society has won many awards and strong anecdotal support	High: The organization is comprised of ag-focused organizations and individuals wishing to demonstrate leadership in improving	High: Leadership by the agricultural sector on water quality and biodiversity issues (evidenced by much positive messaging associated with	AAFC is a partner and funding supporter of several projects.

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	producers. The organization is listed on most AB watershed organization Web sites as a key program partner.	riparian health among producers. Cows and Fish is not directly affiliated with the Water for Life Strategy, although it does work within many WPACs		and key federal and provincial departments.		University of Montana on a riparian health assessment index for AB, as well as a private Montana consulting firm. All extension material and workshops are rooted in the science of riparian health.			for their work exists. There may be a need for a watershed assessment of the program's actual impact on water quality.	agricultural impacts on the environment.	Cows and Fish) will build long-term support among other non-farm stakeholders, including politicians who must approve all resulting legislation and regulations aimed at addressing environmental issues.	
Saskatchewan IWRM strategy and representative IWRM initiatives												
IWRM aspects of the SK Safe Drinking Water Strategy and delivery efforts through the Saskatchewan Watershed Authority (SWA) (SK) http://www.swa.ca/	The SK Safe Drinking Water Strategy seeks to achieve a sustainable balance in water management. This requires maintenance of healthy, ecosystems, disturbing natural water systems as little as possible, and reducing pollutants as much as possible.	The strategy focus is on ensuring "safe, clean, and sustainable drinking water." The origins of this focus can be traced to a cryptosporidium contamination event in North Battleford (2001), where 7,000 people fell ill. This event occurred one year following the Walkerton contamination tragedy in ON.	IWRM-related goals are focused on: understanding source water quality risks, and maximizing watershed protection through natural purification and other means to minimize contamination potential.	SWA is responsible for facilitating the local development and implementation of Source Water Protection (SWP) plans, according to a clear Watershed and Aquifer Planning Model. Based on a comprehensive watershed health indicator framework, 7 priority watersheds have been identified for initial activity.	SWA provides basic operating support for the creation of Watershed Advisory Committees (WACs), comprised of local (primarily municipal) participants. A variety of IWRM program funds are available. SWA staff support has been effective in assisting in securing significant external project funding.	Two SWA staff serve as a planning team to coordinate IWRM planning activities, manage the public consultation process, document technical committee findings,and prepare the ultimate watershed plan. Technical Committees comprise government and agency staff who provide background information, and accountability measures for plan implementation.	As a designated *Key Cross-Government Strategy*, a coordinated accountability framework is in place for the Safe Drinking Water Strategy to ensure strong interdepartmental provincial support and cooperation.	Ongoing technical and facilitation support through the SWA promotes a standardized approach to IWRM planning. A science-based watershed indicator framework has been useful in prioritizing key watersheds. This framework will be useful in the future for assessing strategy progress and building stakeholder support.	Low. It is premature to evaluate SWP progress. Seven priority watersheds have now completed their plans, which highlight key issues identified by stakeholders and assign responsibility for addressing these issues through general strategies. A cursory review suggests plan goals and timelines are likely unrealistic. Implementation and funding will likely be of concern.	High. Most WACs are located in agric. regions of SK and contain high levels of farmer/landowner representation.	High. SWA and SK Agriculture and Food staff have greatly assisted in the development of external funding proposals focused on agric. sustainability SK Dept. of Agriculture support of SWA and local WACs helps in bringing a unified voice to Cabinet, where key decisions regarding the future of the agricultural sector are discussed.	SWA's watershed heath indicator framework would likely benefit from additional monitoring support. An analysis of SK's watershed planning progress will be required/useful in the near future. AAFC could support such a project.
Lower Souris River Watershed Source Water Protection	Three local Watershed Advisory	Watershed Advisory Committees	The Lower Souris SWP plan is focused on:	The LSRWC is a partnership of three WACS, each	Each WAC receives program funding from the SWA,	Significant provincial, federal, and other technical	A high level of governance and proposal	Local leadership and interest in capitalizing on the	Medium. The SWPP and related Agri-Environment	High. The Lower Souris Watershed is agricultural, and	Medium. There is strong potential for significant agric.	The LSRWC and SWA would likely benefit from

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Plan and Ag-Environmental Group (equivalent) Farm Plan prepared by Lower Souris River Watershed Committee (LSRWC) (SK) http://www.lowersourisriverwatershed.com/	Committees; Four Creeks, Pipestone, and Antler have come together as the Lower Souris Watershed Committee. 15 municipalities are involved, with a focus on watershed sustainability in response to SK government programs.	(WACs) have been formed in priority watersheds identified by the SWA. Their focus is on the formation of Source Water Protection Plans	education, groundwater threats and protection, community water supplies and Moosimin Reservoir, landfills, municipal sewage lagoon, agric. Activities, fish habitat, water supplies and Auburton Reservoir spillway.	of which is comprised of representatives appointed by local municipalities and the province. It has basic staff support with some program delivery support.	while the LSRWC has been very successful in securing additional external support. It has primarily focused on the development of a watershed-based pilot project for the valuation and payment of EGS to area landowners.	support was provided by a technical committee comprised of provincial, federal, and other partners (e.g. DUC).	development support from the SWA led to the funding of a CDN$500k ACAAF project related to EGS.	sustainable agriculture-related opportunities associated with the Safe Drinking Water Strategy, through the SWA, and through external funding partners (e.g. AAFC) may be the reason this IWRM initiative has advanced quickly.	Group Plan (with ACAAF EGS funding) appear comprehensive. An analysis of implementation progress is required.	many LSRWC Board members are farmers. Significant technical support from provincial and federal agricultural departments occurred.	contributions. However, actual plan progress to date is not clear. AAFC has supported LSRWC efforts to advance the EGS payments. Many conservation organizations and the provincial government are interested in this approach.	federal monitoring support. AAFC should consider its long-term commitment to the EGS concept.
Moose Jaw River Source Water Prot. Plan (SK) http://www.mjriver.ca/	Two major subwatershed planning units comprise this system: Thunder Creek and Moose Jaw River. Key issues relate to groundwater, surface water and ecosystem health.	Watershed Advisory Committees (WACs) have been formed in priority watersheds identified by the SWA. Their focus is on the formation of Source Water Protection (SWP) Plans.	The Moose Jaw River SWP plan is focused on groundwater, surface water quality, surface water quantity and ecosystem health.	Moose Jaw River Watershed Stewards Inc. has evolved from two WACs comprised of representatives appointed by local municipalities and the province. MJRWS has a basic staff complement with some program delivery support.	Each WAC receives funding from the SWA.	Support was provided by a technical committee comprised of provincial and federal staff and DUC.	Planning support from the SWA has been a key factor in assisting all WACs in completing plans.	The MJR SWP plan goals and timelines may be unrealistic. Securing adequate levels of implementation funding may be problematic.	Low: The SWPP is comprehensive, containing a series of key actions. Responsibilities for implementation are broadly assigned. It is not clear who is ultimately responsible for plan implementation, coordination or performance evaluation.	High: Many WAC members are farmers, and significant technical support from provincial and federal agricultural departments was provided.	Medium: There is strong potential for significant agric. contributions. However, actual plan progress to date is not clear. The agri-environmental group farm plan is progressing, with a funded staff position to assist with BMP planning and support to producers.	There is a need for long-term monitoring to assist in tracking plan progress. An analysis if implementation progress is req. AAFC could support this.
North Saskatchewan River Basin Council and Source Water Prot. Plan (SK) http://www.nsrbc.ca/	Four major sub-watershed planning units comprise this system: Battle River, West, Central, and East portions of the watershed. Key issues relate to urban water use, agric. impacts, riparian health, lake health and	Watershed Advisory Committees (WACs) have formed in priority watersheds identified by the SWA. Their focus is on the formation of Source Water Prot. (SWP) plans	The North SK River SWP plan is focused on water conservation, climate change, groundwater, surface water quality, inter-provincial flows, surface water supply and natural habitat	The NSRBC has evolved from four WACs. These were comprised of representatives appointed by local municipalities and the province. One coordinator is on staff, working to secure members and program partners.	Each WAC receives funding from the SWA.	Support was provided by a technical committee comprised of provincial and federal staff, DUC, the First Nations Agric. Council of SK, Partners for the SK River Basin, and the Prairie N. Health Region.	Planning support from the SWA has been a key factor in assisting all WACs in completing plans.	The NSRBC SWP plan goals and timelines may be unrealistic. Securing adequate levels of implementation funding may be problematic.	Low: The SWPP contains 145 key actions to be implemented by various partners. The responsibilities for plan implementation, coordination or performance evaluations are not clear. Plan implementation is just beginning.	High: Many WAC members are farmers, and significant technical support from provincial and federal agricultural departments was provided.	Medium: There appears to be strong potential for significant agricultural contributions. However, actual plan progress to date is not clear. The federal/provincial environmental farm planning program is being	There is a need for long-term monitoring and performance evaluation to assist in tracking plan progress. AAFC could support this.

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	development impacts, and the oil and gas industry.										strongly promoted by the NSRBC, although it does not appear to provide programs or support directly.	
Manitoba IWRM Strategy and representative IWRM initiatives												
IWRM Elements of the Manitoba Water Strategy and Conservation Districts Program discussion document. (MB) http://www.manitoba.ca/waterstewardship/waterstrategy/index.html	Manitoba's water strategy seeks to develop watershed-based planning across the entire province to improve future management of specific water issues. Local Cons. Districts (water plan authorities) are viewed as the primary vehicle for IWRM implementation	The strategy mission is "To protect water for all life and lasting prosperity." There is an awareness of global water issues and concerns (especially source water protection), while declining Lake Winnipeg water quality is pressing the need for watershed-based approaches.	Emerging goals for the Manitoba Conservation Districts Program relate to: watershed-based boundaries; broad participation and local government; IWRM planning; source water protection; CDs given appropriate authority for water mgmt; support for aq. ecosystems; land-based program; demonstrated incentives; demonstration of measurable improvement for watershed health.	The CD program is a partnership between municipal governments and the Province of Manitoba. Efforts are occurring to increase the broadness of public participation in CD planning and decision-making. It has historically been limited to municipal officials and provincial staff.	Historic funding levels have been generally based on a 3:1 ratio of provincial: local funding, supplemented with external funds. Emerging mechanisms are expected to result in: a) consistent base levels of support; b) additional operating funds based on area and population; c) increased provincial support for prov. priorities; and d) decreased provincial support for non-priorities.	IWRM plans are developed with background support from provincial, federal, and other external staff (i.e. DUC). Internal provincial capacity has been growing, while CD-level staff capacity appears limited.	A lack of watershed-based monitoring and program evaluation to date has yielded limited results related to program effectiveness. There are concerns related to CDs' ability to fund the implementation of IWRM plans, as well as their technical capacity	A formal and ongoing funding relationship between local municipalities and the provincial government has been the foundation of the CD program since 1970.	Medium. The provincial: local partnership framework for the CD program is very valuable, and has placed more than $100M in IWRM related programs on MB's agricultural landscape. Unfortunately, performance measurement has been limited to program uptake (vs. measurable environmental quality results).	High. Most CDs are located in agricultural regions of MB, and most CD boards contain high levels of farmer/landowner representation.	High. The support and participation of farmers has been viewed as fundamental, and is enshrined within the MB Conservation Districts Act of 1976. CD program has been used by several government departments and other organizations to coordinate environment-related program delivery to farmers (i.e. DUC).	Joint provincial/fed agricultural funding has occurred through the CD program. There is a need for watershed-based monitoring assistance. AAFC and Environment Canada could explore this.
East Souris River Watershed Plan prepared by Turtle Mountain Conservation District (TMCD) (MB) http://www.tmcd.ca/	While covering a small watershed in SW Manitoba, the plan is comprehensive, with guiding principles focused on cooperation, respect, sharing, value for money, partnerships, leadership, pro-	TMCD wanted to demonstrate leadership on IWRM planning, while the East Souris River Watershed has faced major water management challenges related to agricultural and community	The East Souris IWRM plan is focused on: surface water management; water quality; water supply; ecosystems; soils; education and communication	The TMCD is a formalized provincial-municipal partnership, comprised of representatives appointed by local municipalities and the province. It has a basic staff complement with	The TMCD receives an annual operating grant from the province on a 3:1 basis to match municipal contributions. Initial funding was provided to support the East Souris IWRM plan, and some limited	Significant provincial, federal and additional technical support was provided by a watershed planning advisory team (WPAT). There is some capacity available from the CD, but it is limited.	A high level of technical support from government, as well as DUC. The plan envisions substantial use of ecosystem-services payments for farmers. Many conservation organizations and the provincial	Local drive and leadership is likely the reason this plan is very comprehensive. As with many plans, the challenge for successful implementation will hinge on available funding.	Low. Plan implementation has been very limited by available funding.	High. The East Souris Watershed is agricultural, and many TMCD Board members are farmers. Significant technical support from provincial and federal agriculture departments occurred.	Medium. Many conservation-minded farmers are involved on the TMCD Board, although wetland drainage continues to be a challenge in the community.	Expanded application of EGS payments would support IWRM plan implementation. AAFC should consider supporting this in partnership with MB Agric.

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	change and activism.	flooding. There are strong views held by the TMCD Board regarding the loss of wetlands due to agricultural development		some technical capacity (GIS and program delivery support)	implementation funding has been received. Higher levels of funding are likely required.		government are very interested in this approach					
Coleman Watershed Equivalent Farm Plan by Pembina Valley Conservation District (PVCD) (MB) http://www.pvcd.ca/	This initiative was heralded as the first equivalent option for the Environmental Farm Plan (EFP) program on the Prairies	The opportunity to address local water management concerns through an innovative federal/provincial BMP funding program was viewed to have great potential in addressing local IWRM issues.	Undefined, although there was a significant focus on small-scale headwater dam construction. No final EFP funding proposal was approved by federal/prov. EFP partners for project implementation.	PVCD received coordination support from Ducks Unlimited Canada. A steering committee of key stakeholders and producers is guiding the IWRM planning process	IWRM planning funding received from federal and prov. sources.	Technical support received from three provincial and two federal departments. A detailed watershed inventory was prepared.	Substantial coordination and other support received from Ducks Unlimited Canada.	Limitations associated with the equivalent EFP program in MB meant that group projects could not be funded; all project applications had to occur on an individual basis.	Low: An IWRM plan for Coleman Watershed has not been implemented.	High: the Steering Committee was largely comprised of agricultural producers. AAFC and MB Agriculture and Food participated in the IWRM planning process. No industry representation.	Low: Local producers had high hopes, but identified funding was not flexible enough to support local goals.	Watershed-based Group EFP options have worked well in SK and AB. For unclear reasons, it was not supported in MB. Applying BMPs on a watershed basis appears to be an effective approach for addressing water quality concerns.
Tobacco Creek Model Watershed Research and Management Plan (MB) http://www.tobaccocreek.com/	The TCMW is initiative focused on agricultural watershed research in MB and the Prairies. It is intended to be a "living watershed laboratory" in support of local, provincial, and federal goals.	Drivers include longstanding issues related to water management, erosion, and flooding. Emerging liabilities to agricultural producers related to water quality and fish habitat brought local governments together with producers concerned with their future. Farm income is a prime concern.	The TCMW's integrated watershed management and research goals are focused on: net farm income and landscape diversity; producer participation and scientific monitoring; water management and wetland rest.; water quality and biodiversity; and drainage and fisheries habitat.	The TCMW Partnership is guided by a Community Committee of five Rural Municipalities and two CDs, managed by the Deerwood Soil and Water Mgmt. Assoc. Three community meetings drove the goal-setting process.	The IWRM plan is funded primarily through private foundation support, with federal, provincial and municipal contributions.	Staff from three federal and three provincial depts. provided a substantial level of support. A joint scientific committee. comprised of govt. and university staff also provided key direction. The South Tobacco Pilot Project has collected detailed data in part of the watershed since 1991.	The TCMW's focus on watershed science as the basis for management is fairly unique. Its plans remain timely today. Its recognition of the importance of Net Farm Income in IWRM remains innovative and appropriate.	A lack of ongoing govt. program funding –and the inability to convince local governments to implement the TCMW plan w/o significant fed. and provincial support—remains the challenge. The TCMW is attempting to operate outside of the provincially-favored CD program.	Low: The TCMW management and research plan is complete and current, but currently non-implementable without significant federal and prov. financial support	High: 80 agric. producers participated in the goal-setting process, while most members of the Community Committee are producers. The Steppler-South Tobacco WEBs project is located in the watershed.	High: Several local agricultural businesses provided financial support, while federal and prov. technical support was strong. Scientific research into agriculture's impacts on water quality and quantity are needed to convince agric. producers to adopt BMPs and demonstrate leadership by the agricultural sector.	AAFC has been a major partner in key BMP evaluation and other research upstream in the South Tobacco Creek Watershed as well is in the TCMW. Ongoing support would help it thrive.
Ontario IWRM strategy and representative IWRM initiatives												
ON Clean Water	The Clean Water	The Act was	The SWP process	In most cases, a	CAs are being	The ToR outlines	There is a clear	Coordination by	Medium. All local	Medium: Most	SPC participation.	BMP program

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Act: Source Water Protection (ON) http://www.ene.gov.on.ca/envision/water/spp.htm	Act has established a Source Water Protection Plan (SWP) framework for all regions of ON. Concerns over recharge areas and vulnerable aquifers have been identified in many locations.	developed in response to the Walkerton tragedy. It supports most recommendations of the O'Connor inquiry report.	requires planning authorities to: identify and assess risks; develop a SWP plan; carry out the plan; and stay vigilant with monitoring and reporting. Implementation may occur at the municipal, CA, public health, or other level as applicable.	coalition of 2–3 watershed-based Conservation Authorities (CAs) have been designated as the SWP authorities for local SWP regions/areas. Each local authority establishes a Source Protection Committee (SPC), which develops a Terms-of-Reference document (ToR).	funded by the ON Ministry of Environment for coordinating local SWP Plans. A two-phase protection-stewardship program is in place to assist landowners (CDN$7M in 2007–08) and $21M from 2008–11). CAs also have their own direct levy powers to fund annual budgets from municipal taxpayers.	the SWP process, maps and background (including drinking water systems and water budgets), SPC members, key issues and a budget for task completion. The ToR is reviewed, amended and/or approved by the Minister of Environment. Local authorities (CAs) have the technical resources (or ability to get them).	sense the ON Government considers the SWP Planning process a major priority, and it can be anticipated that most budget requests will be met through a standardized SWP planning process for all communities, with expectations for multi-sectoral representation and participation across the SWP region or area.	Conservation Ontario (umbrella organization for all CAs) appears to be working well. One concern may lie in the fact that the SWP areas are quite large, typically involving areas which encompass two, three, or more CAs, which are already watershed-based organizations.	authorities (CAs) appear to be progressing well with their ToRs	ToRs appear to have appropriate agricultural representation	Identifying real or perceived water quality risks associated with agricultural activity will be helpful in focusing farm-based protection efforts. Substantial program funding is available through the 2007–08 Source Protection Program. (runoff, erosion)	support would likely be welcome
Grand River Conservation Authority (ON) http://www.grandriver.ca/	GRCA (GRCA) conducts watershed planning and applies regs. affecting areas in and near rivers, streams, slopes wetlands floodplains and along Lake Erie.	GRCA is responsible for regulating activities in “natural and hazardous” areas to prevent losses associated with flooding and erosion and conserve natural resources	The GRCA Strategic Plan guides all watershed-based activities with IWRM elements related to: flood mgmt. water quality; water supply; natural areas; and watershed planning	38 municipalities in the watershed manage the Grand River via the GRCA and appoint members to the Board. GRCA leads the Lake Erie Source Protection SWP planning process.	Operating funding is provided by the GRCA's member municipalities, while additional project funding is secured from federal, provincial, and private sources. The GR Foundation is an important source.	The GRCA has extensive internal technical capacity in terms of mapping, flow forecasting, dam infrastructure management, modelling and communications.	The GRCA as a long track record of success dating to 1932, through the formation of the GR Conservation Commission, led by local business with federal, provincial, and later, municipal support.	Today, the GRCA is driven and supported by its local member governments. Private fundraising via the GR Foundation has become very important.	High. The GRCA is likely the leading IWRM entity in Canada. Flooding damage has been dramatically reduced, while water quality continues to improve. The Grand River is a recognized fly fishery today.	Medium. There are no identified agric. members on the GRCA Board, but GRCA's Rural Water Quality Program has been recognized as very effective. Rural Water Quality Program was developed in conjunction with local farmers, the ON Federation of Agriculture, and ON Soil and Crop Improvement Association, with the goal of harmonizing environmental goals with the realities of agric. production.	High. The GRCA has been effective in working with producers to reduce negative environmental impacts. The Rural Water Quality Program is voluntary, while GRCA coordinates local, provincial, and federal funding. When combined with ON Farm Stewardship Program funding, BMP projects worth CDN$25k may be eligible for 80–100% funding.	There is an ongoing need for Increased BMP program support. AAFC could become involved.

Table A-1: Provincial IWRM strategies and key IWRM initiatives

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South Nation Conservation Authority (SNC) Clean Water Program (ON) http://www.nation.on.ca/	The Clean Water Program is SNC's top priority, as a proactive approach to addressing agric. water quality issues.	The program has been in place since 1993 to address rural water quality concerns, while ensuring sustainable water supplies for domestic, livestock, irrigation, recreation and fish habitat needs.	The Clean Water Program focuses on: local surface and groundwater quality through improved land use; extension, education, and tech. transfer; providing BMP grants to landowners and community groups; funding innovative projects with the potential to cost-effectively improve water quality.	A multi-stakeholder Clean Water Committee guides all aspects of the program. Most members are directly connected to the agric. sector as producers, industry or representatives from ON Ag, Food, and Rural Affairs.	Program funding is provided by SNC, several local municipalities and private businesses (incl. two dairy operations). Additional funding is provided through SNC's Total Phosphorous Management water quality trading program, which contributed almost 50% of program costs in 2006.	A series of BMPs eligible for program funding are offered, with cost-shared grants ranging from CDN$500 to $5,000. Est. Phosphorous (P) reductions for each project are calculated based on a series of algorithms accepted by ON Environment. Further research is required to est. P reductions for riparian mgmt. projects.	The existence of accurate and defensible P reduction estimates for most BMPs provides a sound basis for program delivery. Partnership funding, and a foundation for water quality trading through the TPM program is also critical. Most credit buyers are local municipalities (wastewater treatment and landfill point sources).	Confidential mgmt. of landowner contact info (and the sense of trust this has built among producers) appears to be an important factor. SNC also coordinates a strong water quality monitoring program to help measure progress. SNC is also the site for a WEBs project. There is an agr. extension component to the Clean Water Program, with SNC field reps. visiting interested farmers.	High: 35 projects funded in 2006 for a total program cost of CDN$47k. Total project value (incl. producer contributions) was $680k. More than 500 projects have been funded since 1993 (program costs of $1.8M and total value of $7.3M).	High: substantial program direction on Clean Water Committee. Funding for agricultural BMPs is being provided from 6 PS emitters at a 4:1 ratio. This suggests a strong linkage between BMP providers and downstream beneficiaries, who mostly represent the broader community.	High: There has been strong prod. participation with more than 11,000 kg/yr of P reduced in 2006, with 25% occurring through the TPM program. These positive results send strong positive messages to all stakeholders, both within and beyond the agricultural community.	AAFC's continued support of WEBs may be most valuable, although additional project funding would certainly be welcomed.
Credit Valley Conservation Authority Integrated Watershed Monitoring Program (IWMP) (ON) http://www.creditvalleycons.com/	The CVC Strategic Plan is a comprehensive document with strategies covering several priority issues including: climate change, educ., watershed rest., partnerships, groundwater, water mgmt., Lake ON, water quality, planning, monitoring, etc.	IWMP was established in 1999 to assess CVC progress toward sustainability. Upper forested regions are experiencing development pressure, while Middle watershed is dominated by the sensitive Niagara Escarpment, which is also threatened by development. The Lower watershed is intensively urbanized and populated.	Goals for the IWMP are derived from the CVC vision of "an environmentally healthy Credit River Watershed for present and future generations," and include: to protect and improve water quality and quantity; and to protect and improve biological diversity and productivity.	CVC is governed by a board comprised of elected officials who represent the municipal partners who are members of the CVC, as determined by area watershed boundaries of the Credit River. A CAO reports to the Board, while several directors are responsible for various aspects of CVC activity. The Director of Water Resources appears to be responsible for the IWMP.	IWMP funding is provided through the CVC base budget, which is primarily provided by CVC member municipalities. The CVC partners with the Province of Ontario on some elements of the IWMP.	CVC has established more than 150 monitoring stations within the Credit River Watershed. The IWMP is divided into several disciplines, which collect and report data, aggregate indicators and trends related to: meteorology, hydrogeology, hydrology, terrestrial, geomorphology, water quality, and biology. CVC works with ON Environment on	CVC has devoted a substantial focus of its efforts and resources on long-term monitoring and adaptation as a foundation for the organization's watershed-based programming. The IWMP has been incorporated into its base budgets.	The fact that adequate financial resources are available to support the IWMP demonstrates the priority CVC places on science-based decision-making. Ironically, a high level of development and urbanization in the watershed helps generate substantial funding through increasing tax revenues. This occurs largely at the expense of agricultural land.	High: CVC has established a central database to manage the information collected through the IWMP. Baseline conditions for all monitoring disciplines have been established based on data collected between 1999 and 2003. Two watershed report cards have been produced, with current status and trends reported on many tributaries within the Credit River	Low: Agricultural water quality concerns are noted in several instances in CVC materials. However, there are no farmers or agriculture industry personnel identified on the CVC Board. The number of operating farms within the Credit Watershed dropped by 35% between 1976 and 2006, mainly in the Lower watershed, which has become heavily urbanized. Current CVC agric.-	Medium: While "rural pollution" is noted in the 2006 CVC Plan as an issue, "protecting agricultural land" is listed among CVC's lowest priorities. The 2008 Plan Update sets "Building Community Partnerships," with references to agric. landowners. The availability of CVC's powerful dataset should be of great interest to area producers, who should seek to become more	AAFC could offer to support CVC's monitoring program as it relates to agric. contributions to water quality and other environmental conditions.

Table A-1: Provincial IWRM strategies and key IWRM initiatives

NAME & WEBSITE	SCALE & SCOPE (including issues covered through programming and planning)	DRIVERS FOR IWRM	GOALS FOR IWRM INITIATIVE	SOCIAL OPERATING ENVIRON-MENT	ECONOMIC OPERATING ENVIRON-MENT	TECHNICAL/ SCIENTIFIC OPERATING ENVIRON-MENT	KEY ELEMENTS OF SUCCESS (including social, economic, technical)	OTHER ELEMENTS CONTRIBUT-ING TO SUCCESS	IMPLEMENT-ATION LEVEL[1]	AGRICULTUR-AL SECTOR REPRESENTA-TION & PARTICIPA-TION[2]	ACTUAL OR POTENTIAL CONTRIBUTIO-NS, VALUE OR BENEFITS TO AGRICULTURE[3]	AAFC ROLE OR OTHER POTENTIAL FEDERAL ASSISTANCE
		Agricultural land use covers approx. 30% of the watershed.				some water quality, groundwater, and benthic invert. monitoring sites. Landowners assist.			system. A five year review (to 2008) is in progress.	related programs are limited to treeplanting and incentive programs related to forests and natural areas.	involved supporting the work of the CVC.	
Quebec IWRM strategy and representative IWRM initiatives												
Watershed Based Management (WBM) under the Quebec Water Policy (QC) http://www.mddep.gouv.qc.ca/eau/politique/index-en.htm	Recognizing future challenges and the fact that it has vast supplies, Québec pledged to reform the governance of water resources via the Québec Water Policy (QWP), a major strategic plan.	The QWP identifies WBM (IWRM) as the central reform. It is fundamentally based on: the consideration of local and regional issues; ecosystem-based management; and watersheds as the major units of resource mgmt. planning and action.	Reformed water governance under the QWP involves: a legal framework to support of WBM; gradual implementation of IWRM in 33 priority waterways; information assembly in support of water governance; inventory of aquifers; ongoing watershed data collection; support for riparian property owners; education and awareness; and a system of water use charges to pay for IWRM activities.	Interdepartmental Co-ordination and Implementation Committee (*Table interministérielle de mise en oeuvre de la Politique de l'eau*) includes participation from 11 departments, including Executive Council. Planning and implementation is through watershed orgs. (OBVs), which coordinate with public and private stakeholders. The process requires that OBVs have equal representation from env. groups and citizens, municipal government, and water-using sectors of the economy.	OBVs receive annual budgets from the province for their watershed planning activities. IWRM implementation is to be funded through a system of water use charges (for both withdrawal/ disposal), but no additional taxes are planned at the municipal level. Following the IWRM planning process, "basin contracts" are to be structured, committing all plan stakeholders to support an action plan for implementation.	The Ministry of Sustainable Development, Environment, and Parks (MDDEP) provides technical support to the OBVs, and the Association of Watershed Organizations of Québec (ROBVQ) provides coordination and community assistance, and reports on progress.	The WBM framework allows flexibility for OBVs to meet and dev. a *Master Plan for Water* (MPW), or Plan Directeur de L'eau (PDE), for their watershed. The process seems to be adaptable and does not impose the methods that are to be used, beyond the need to complete five key elements: overview, diagnosis, issues, direction, goals and an implementation plan. This allows for innovation at the local level.	The QWP is very comprehensive with its key elements considered in detail. By design, it is a broad, overarching plan intended to link and complement existing sector-focused water efforts related to rural/agriculture, marine issues, and water transp. It was also developed under a broader sustainable development framework.	Medium: 33 OBVs are in operation with staff and offices, all in varying degrees of MPW progress. There appear to be concerns that WO funding is not adequate, although each WO seems to be progressing.	Medium: In all locations where agric. comprises a significant portion of the watershed, there is representation from the sector. The Ministry of Agriculture, Fisheries, and Food (MAPAQ) is a member of the interdepartmental coordinating and implementation committee.	High: The 33 OBVs established under the QWP represent the lead agencies for community-level watershed planning and management. A high degree of internal govt. coordination suggests that addressing agric. issues related to the environment (esp. water quality) will occur through the OBVs. The agric. sector should be an active participant.	AAFC should explore its partnerships with the Ministry of Agric., Fisheries, and Food (MAPAQ) to determine if/how BMP-related funding could be more coordinated via the WO structure.
Corporation d'Aménagement et de protection de la Sainte-Anne (CAPSA)	CAPSA coordinates measures to improve river health, with a focus on	Water quality concerns led to CAPSA formation in 1987. 85% of St. Anne residents rely	The CAPSA Master Plan for Water seeks to: guarantee quality water supply; protect	CAPSA's board is composed of representatives from economic, municipal,	CAPSA has a broad range of federal and provincial govt. support, in addition to several private	CAPSA has significant technical resources on staff, while an expert committee	Continuous improvement arising from monitoring and performance	CAPSA's Master Plan for Water includes a series of detailed actions to help achieve	Medium: CAPSA appears to have a solid plan and has built a high degree of stakeholder and	Medium. Active participation by agricultural producers is implied in its	High: CAPSA contains appropriate board representation as well as project	AAFC could explore expanded partnerships with CAPSA, although it is likely this can

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(QC) St. Anne River watershed http://www.capsa-org.com/pages/accueilpag.html	watershed lands, wildlife and recreational use of the river.	on groundwater, while recurring problems assoc. with nitrate and pesticide contamination (in addition to inadequate residential sewage treatment) have stimulated strong local interest in CAPSA's OBV activity.	aquatic ecosystems; improve biodiversity; reduce the risk of water hazards; and support development of the recreo-tourism sector.	agriculture, forestry, outfitters, environmental groups, youth and shoreline residents, including farmers. Representatives from different govt. ministries attend but cannot vote.	foundations, and local government members.	comprised of staff from six prov. govt. depts. provides technical assistance and planning guidance. Several individuals provide volunteer scientific and technical support.	evaluation is CAPSA's ultimate goal. Seven sampling stations in the watershed help track changes in water quality. Effluents from filtering marshes for dairy waste waters are analyzed.	measurable objectives, which have been prepared to achieve the initial goals/directions.	financial support. The degree to which Master Plan progress has been achieved is difficult to assess.	description of work, including: field projects, fencing to keep cattle from water bodies, construction of purifying ponds and marshes; and improving water quality and shoreline habitat.	activity related to the agricultural sector. An impressive range of BMP efforts has occurred in the Chevrotière watershed, in partnership with a local body of the provincial assoc. of agri. producers (UPA), and three prov. depts.	only occur indirectly through the QC Ministry of Agriculture, Fisheries, and Food (MAPAQ).
Conseil de Gestion du Bassin Versant de la Yamaska (COGEBY) (QC) Yamaska River Watershed http://www.cogeby.qc.ca/	Conseil de Gestion du Bassin Versant de la Yamaska (COGEBY) is working to address issues related to soil erosion, eutrophication, wetland loss and deforestation.	COGEBY was formed as an OBV in response to the QWP.	COGEBY seeks to: improve water quantity, ensure adequate water supplies and restore aquatic habitat in the Yamaska watershed.	The COGEBY Board includes members representing local govt., industry, agriculture, environmental groups, representatives appointed from agriculture and forestry association and non-voting prov. govt. staff from six departments.	Beyond its base provincial funding, COGEBY secured some private and additional public sector support to complete its initial overview of the watershed.	A comprehensive basin profile has been completed, with both internal and external expertise, including participation from several government departments and industry reps.	The commitment of COGEBY's staff appears to be a key factor in this OBV's ability to complete an impressive level of work within a short amount of time.	It is unclear whether adequate funding exists to undertake the level of activity required to complete and then implement a Master Plan for Water for the Yamaska system.	Medium: A major basin profile report has been completed and two detailed agriculture projects are underway.	High: In addition to strong agric. sector participation on the COGEBY board, local farmer assocs. are actively supporting BMP research and demonstration projects in the Barbue and Aulnages sub-watersheds.	High: COGEBY has clearly established credibility with a substantial number of agricultural producers, a provincial assoc. of the agri. producers (UPA), and three prov. depts. Their ability to facilitate BMP adoption appears to be strong.	AAFC should explore why COGEBY has demonstrated some success in working with agric. producers on actual BMP projects. Funding and monitoring will be ongoing needs.
Les Clubs-conseils en Agroenvironnement (CCAE) (QC) http://www.clubsconseils.org/Accueil/affichage.asp?B=342	Les Clubs-conseils en Agroenvironnement (CCAE) are volunteer orgs. working to promote the adoption of sustainable agriculture practices and the preparation of environmental farm plans.	CCAEs began to be established in 1993 to provide the ability for individual producers to meet and share their knowledge and experiences with regard to the application of sustainable agriculture techniques.	CCAEs work to facilitate producer interaction related to sustainable agric., provide extension opportunities, promote BMP awareness and expose producers to BMP funding opportunities.	A prov. planning committee is comprised of members from the QC Agricultural Development Council, the Ministry of Agric., Fisheries, and Food (MAPAQ), AAFC, one local CCAE president, and one local CCAE producer. Local clubs are comprised of	CCAES are supported with financial contributions from AAFC, the QC Agricultural Development Council (CDAQ), and the Ministry of Agriculture, Fisheries, et Food (MAPAQ).	CCAE members undertake a four-stage process in the evaluation of their own operations : 1) a diagnosis of their farm ; 2) drafting an environmental farm plan ; 3) finalization of the plan ; and 4) individual evaluation. A central CCAE team assists with	CCAEs offer a non-threatening environment for farmers to openly communicate with their colleagues regarding sustainable agricultural approaches, which offer environmental improvements while simultaneously being cost-effective	CCAEs also provide appropriate forums for the presentation and discussion of new scientific research and the extension of new techniques to producers.	Medium: There is a significant level of program success in CCAE operations. However, most are not planned or implemented on a watershed basis.	Medium: More than 80 CCAEs exist in QC, and most have contributed to impressive rates of producer participation in the preparation of fertilizer plans, pesticide reduction plans, increased conservation practices, and riparian mgmt.	High: While not specifically focused on watershed boundaries, CCAEs are a fundamentally effective approach for working with individual producers to help improve their on-farm planning and decision-making related to sustainable agriculture. Many	There appears to be a substantial opportunity to harness the effectiveness of the CCAE program by focusing their activities on a watershed basis, or at least within existing OBVs.

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				interested farmers.		program development.	or even profitable for producers.				initiatives have direct watershed benefits.	
New Brunswick IWRM strategy and representative IWRM initiatives												
NB Surface Watershed Protection Program (NB) http://www.gnb.ca/0009/0373/0001/0002-e.asp	The WPP is a focused land use planning and dev. reg. established under the NB Clean Water Act. Phase 1 of the WPP involved the reg. for dev. within 75m of a "protected watercourse." Under Phase 2, dev. activities can now be regulated throughout any upstream area in a protected watercourse.	40% of NB's water supply comes from surface watersheds. Concerns over potential health hazards such as Walkerton stimulated the NB govt. to search for proactive, integrated planning and management solutions. There was a need to protect community water supplies from commercial, industry, agric., residential, and forestry.	Drinking water quality protection through the regulation of development and zoning of protected water courses. Three zones or protections are utilized: a) watercourse; b) 75m buffer zone; and c) all remaining watershed area. The Dept. of Environment and local governments encourage land users (including agriculture and forestry) to adopt BMPs in their operations.	The WPP is administered by the NB Dept. of Env., which has 6 regional offices across NB with inspection officers on staff. Thirty-one watersheds are designated in 21 municipalities. The Clean Water Act provides for a *Potable Water Advisory Committee*. comprised of staff from the Depts. of Health and Environment. An interdepartmental *Land and Water Advisory Committee* is mandated to share information, resolve conflicts, and make recommendations.	Clear guidelines and legal direction is provided within the *Watershed Protected Area Designation Order* regarding the econ. dev. activities that can occur within zones a, b and c. This is likely useful to individuals and firms pursuing these activities. Clear land use and dev. guidelines are also provided by the *Watercourse and Wetland Alternation Order,* which provides additional details governing 30m around these water bodies.	The 31 watersheds identified as designated watersheds under the plan were determined through scientific research. The University of NB's Environment and Sustainable Development Research Centre is support watershed planning with scientific research using two "living watershed laboratories" with a focus on the relationship between socioeconomic and biophysical inter-relationships.	The apparent level of interdepartmental planning and cooperation is impressive and will likely contribute to effective admin. of the WPP. The fact that the NB government appears to have provided some clear direction is noteworthy. The bottom line for individual agric. producers and corporate entities relates to a need for clarity and simplicity in the application of regulations relating to agric. producers.	Beyond the water quality testing authorities held by inspectors appointed by the Env. Dept., there does not appear to be any long-term or ongoing water monitoring provisions directly associated with the WPP or the Clean Water Act. The degree to which other watershed stakeholders are supporting NB's leadership in this area is unclear and may be of concern.	Medium: A number of local watershed planning initiatives have been undertaken.	Medium: The Dept. of Agriculture and Aquaculture is represented on the Land and Water Advisory Committee. The level of public or sectoral consultation that occurred is unknown, but appears to be minimal. There are, however, fairly detailed guidelines for the types of agric. practices that can occur within zones b and c.	High: Despite the apparent lack of stakeholder consultation employed in developing it, the *Watershed Protected Area Designation Order* appears to provide clear direction to agric. producers regarding the types of activities and practices that can occur within the 75m buffer around or along watersheds, and in locations upstream. This clear direction is helpful to agric. producers by providing a degree of certainty. The directives are not complicated.	AAFC and Env. Can. could offer to assist with long-term and/or detailed water quality monitoring within agric. watersheds.
Black Brook Watershed WEBs Research Project (NB) http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=122	The BBW is one of seven micro watershed research initiatives across Canada, designed to evaluate the effectiveness of agric. beneficial	The need to more fully understand the environmental and economic impacts and effectiveness of BMPs led to the establishment of the WEBs program.	The BBW project is focused on assessing the effectiveness of two BMPs: runoff diversion/grassed waterways and the use of buffer strips/vegetated	The study team includes partners from AAFC, USDA, NB Dept. of Agric. and Aquaculture, NB Dept. of Environment, UNB, Fisheries and Oceans Can., DUC,	WEBs funded by through the Ag. Policy Framework by AAFC with national support from DUC. Additional provincial funding occurs within each	Lead researchers on the study team are responsible for the direction of particular projects, while the team as a whole internally evaluates results. A national WEBs	Leadership by AAFC and the commitment of all project partners is a central element of success to date. DUC has also been a key partner, both in terms of funding	The degree to which local landowners and local governments are involved in the BBW is unclear. It appears that no results are available as yet. It	Medium: The fact that intense watershed-scale research is occurring to learn more about agricultural impacts (and BMP responses) in	Medium: The BBW and WEBs has been led by AAFC with strong support from the NB Dept. of Agriculture and Aquaculture. The BBW also contains independent	High: Scientific research into agriculture's impacts on water quality and quantity are needed to convince agri. producers to adopt BMPs and	AAFC could work to increase the role of local agricultural producers in this project, particularly around its results and implications for the agric. sector. It is not

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8435786342&lang=eng	management practices at the watershed scale. This system is a productive potato growing area where water erosion is a major concern.	The BBW was first established as an experimental watershed in 1990. Extensive background data exists for this site.	riparian zones. As part of WEBs, related economic, hydrologic, and integrated modelling research will occur.	Potatoes NB, Eastern Can. Soil and Water Cons. Ctr., local govt. and agric. producers.	province hosting a WEBs site. There may also be specific project funding from other partners.	committee also reviews and discusses research findings.	and technical support.	is not yet clear what funding commitments exist to continue the BBW or the WEBs project under Growing Forward.	relation to the environment and economy is very appropriate and the results will be valuable when they are released.	representation from the potato sector. It is implied that individual producers are also involved, although the degree to which this occurs (and to what extent they helped shape the BBW project) is unclear.	demonstrate leadership by the agricultural sector.	clear why Environment Canada does not appear to be involved in the BBW project.
Eastern Charlotte Waterways Inc. (NB) http://www.ecwinc.org/	ECW is a research-focused NGO working in southwest NB. Sustainability of the soft shell clam industry appears to be threatened from overharvest, coastal development and pollution, agric. runoff, and invasive species.	Env. Can.'s Atlantic Coastal Action Program (ACAP) is a means of mobilizing local communities to address their own env. and dev. goals. Eastern Charlotte Waterways Inc. (ECW) is one of 14 ACAP sites in Atlantic Canada. An earlier *Comprehensive Environmental Management Plan* was developed.	ECW seeks to serve as a catalyst to help improve community well-being by guiding the adoption and implementation of integrated planning and management efforts focused on environment, economy and quality of life outcomes that are sustainable. ECW has an emerging IWRM project as well as ICZM efforts.	ECW is governed by a Board of Directors elected by members and composed of 15 volunteers drawn from across the watershed. Projects are run with active stakeholder participation, including various levels of govt., the community and sectors such as agriculture.	ECW receives project funding through federal, prov. and private funding sources, while also offering an impressive range of fee-based GIS mapping and scientific laboratory services.	The GIS aids in the planning and mgmt. of all ECW initiatives. Extensive water quality data has also been collected for its IRWM project. Tools such as resource mapping, aerial photographs, cost-benefit analysis and education have been used in support of a comprehensive env. management plan.	ECW's focus on scientific research provides a sound base for their initiatives. The IWRM program appears to have a strong focus on integrated assessment for land use planning and management, development of watershed indicators, and determining the socioeconomic value of watersheds.	While its range of programs and its overall approach are impressive, it may be possible that ECW is attempting to accomplish too much too fast without the resources required.	Medium: ECW has established itself as a significant contributor in southwest NB, and its integrated, science-based approaches appear solid. It is premature to determine if the IWRM progress is being made (or if it can be attributed to ECW activities).	Low: It is premature to assess ECW's progress in terms of IWRM at this point.	High: Agricultural sources has been identified as a contributor to declining soft shell clam stocks along the coast, and ECW's strong focus on science represents a solid opportunity to better understand and address these impacts. The agricultural sector should be very involved in supporting it.	AAFC should become actively involved in ECW, particularly its IWRM efforts. AAFC should work closely with the NB Dept of Agriculture and Aquaculture on ICZM, along with Fisheries and Oceans Canada. Environment Canada is already involved via ACAP.
Nova Scotia IWRM strategy and representative IWRM initiatives												
Nova Scotia Drinking Water Strategy (NS) http://www.gov.ns.ca/nse/water/drinkingwater.asp	The Drinking Water Strategy for Nova Scotia (DWS) is based on principles of sustainability, partnership, stewardship and valuing water. It is coordinated by the Dept. of	There has been growing support for the need for increased protection of water resources since 1991. A *Water Resources Protection Act* was passed in 2000,	The DWS has sought to move from "self-motivated, single purpose mgmt. decisions to an integrated framework for water mgmt. on a broad, watershed	The Interdepartmental Mgmt. Committee developed a detailed four-year action plan with an initial step of working with municipalities and local groups to	Municipal drinking water supply areas were prioritized and the process of dev. protection plans was begun. A *Source Water Guide* and a list of BMPs for improved land use mgmt.)	Several technical staff was hired by the NS Dept. of Environment and Labour to support the DWS. Municipalities were advised to establish a multi-stakeholder *SWP Advisory*	The establishment of an Interdepartmental Mgmt. Committee under the coordination of the Dept. of Environment and Labour appears to have been effective	The degree to which adequate funding has been directed to support emerging SWP implementation efforts is unclear. Also, the recent announcement for a WRMS seems	Low: There appears to be a significant level of internal govt. coordination, and some clear direction has been provided to municipalities. However, the new WRMS process	Medium: The Interdepartmental Mgmt. Committee included two representatives from the Dept. of Agric. and Aquaculture. In terms of the emerging WRMS,	Medium: Municipalities are encouraged to form SWP Advisory Committees among community stakeholders. The identification of potential contamination risks	AAFC should discuss and clarify the relationships between SWP planning and the new WRMS and then help ensure that NS producers are participating to the greatest degree

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	Environment and Labour.	while a *Water Resources Mgmt. Strategy* (WRMS) is now in development.	basis." It intends to: clarify roles and responsibilities of all stakeholders; implement a multi-barrier approach; and create an inter-departmental mgmt. committee for implementation of the strategy.	improve drinking water facilities and to designate key Source Water Protection (SWP) areas. Awareness, standards, and reg. protocols were developed.	were prepared for municipalities. There appears to be little coordinated info regarding funding. It seems most funding is to be provided by municipalities.	*Committee*, to include tech. staff from several depts. The municipal *SWP Guide* is quite comprehensive.	in building internal prov. govt. support for the DWS. The *SWP Guide* appears to have been useful to municipalities toward initiating their planning processes.	confusing. Public consultation responses appear to suggest that the DWS may not be as effective as hoped. Poorly integrated land use and watershed planning has been noted.	suggests most stakeholders do not feel involved or aware of the DWS process, which may be a reason for the new strategy.	the NS Federation of Agriculture has suggested the discussion material to date is lacking in its consideration of the relationships between agric. and water, also noting extensive water-related efforts undertaken by the agric. sector.	and SWP prep. should logically involve participation from the agricultural sector. However the status of the SWP process relative to the new WRMS needs to be clarified.	possible in the most appropriate one.
Clean Annapolis River Project (CARP) (NS) http://www.annapolisriver.ca/	CARP is a charitable corp. working with community to promote conservation, restoration and sustainable use of the freshwater and marine ecosystems of the Annapolis River watershed.	The Annapolis River system was rejected as a candidate for Canadian Heritage River designation in 1990, but was selected by scientists as a demonstration site for an innovative environmental management. The availability of project funding from Environment Canada's Atlantic Coastal Action Program (ACAP) was another key factor.	A *Comprehensive Environmental Management Plan* had earlier identified key goals related to water quality and quantity, air quality,and climate change. Area of focus within the watershed planning effort include: environmental monitoring, habitat cons., pollution prevention, climate change, energy cons. and environmental education.	CARP is governed by a Board of Directors elected by members and composed of 15 volunteers drawn from across the watershed. Projects are run with active stakeholder participation, including various levels of govt., community and sectors such as agriculture.	CARP receives project funding through federal, prov. and private funding sources	CARP has a science coordinator and a water quality analyst on staff who work with university and other science partners on most projects, which typically have a monitoring or measurement component. A volunteer team of water quality monitoring personnel known as the Annapolis River Guardians has been collecting data in the watershed for 20 years.	The individual and community-based support for CARP is typified by the ongoing success of the Annapolis River Guardians network (with 100 trained volunteers). Seven sites are monitored regularly, while data exists on another 50 sites. This data facilitates the prep. of an annual water quality report card.	CARP appears to be well-managed and reasonably funded, completing a broad range of increasingly watershed-focused projects. Most projects contain a fairly complete background on the CARP website.	High: CARP has a solid track record of science-based project completion, along with a strong volunteer base working across the spectrum of IWRM planning. It now has a distinct IWRM project, which is just beginning.	Medium: The CARP board contains agric. representation, while the Annapolis River Guardians promoted BMP application. Several CARP projects have a strong agric. focus, including a riparian hab. stewardship program. The Thomas Brook WEBs site is also located in the watershed.	High: The degree of science-based and watershed-based activity occurring in the Annapolis watershed is a major opportunity for the agric. sector to demonstrate its ability to contribute to improved water quality, water quantity management and watershed health.	AAFC is actively involved in the Annapolis River watershed through WEBs and the Pereau Watershed monitoring project (working to assist farmers to increase irrigation efficiency), and other efforts (i.e. farm planning). AAFC should explore why CARP and other related IWRM efforts seem to be working.
Newfoundland and Labrador IWRM strategy and representative IWRM strategies												
Management of Protected Water Supply Areas Using a *Multi-barrier Strategic Action*	Section 39 of the Water Resources Act authorizes the Minister of Environment and	Many communities in Nfld. and Labrador own their water sources. Local governments	The MBSAP aims to provide: source protection for drinking water, monitoring,	A water management specialist from the Dept. of Environment and	Local municipalities pay a fee to apply for the PWSA designation. WMCs may apply to the	After PWSA designation has occurred, local communities are required to fulfill	The coordination provided by the Dept. of Environment and Conservation	The fact that local governments are in the best position to protect their water sources is strongly	Medium: Several dozen PWSAs have been designated, and 12 WMCs have been established.	Low: It is premature to assess this condition given the early stage of	Low: The limited role of agriculture within the Nfld. and Lab. economy suggests that	AAFC should conduct a review of existing PWSAs and explore whether there are

Table A-1: Provincial IWRM strategies and key IWRM initiatives

NAME & WEBSITE	SCALE & SCOPE (including issues covered through programming and planning)	DRIVERS FOR IWRM	GOALS FOR IWRM INITIATIVE	SOCIAL OPERATING ENVIRON-MENT	ECONOMIC OPERATING ENVIRON-MENT	TECHNICAL/ SCIENTIFIC OPERATING ENVIRON-MENT	KEY ELEMENTS OF SUCCESS (including social, economic, technical)	OTHER ELEMENTS CONTRIBUT-ING TO SUCCESS	IMPLEMENT-ATION LEVEL[1]	AGRICULTUR-AL SECTOR REPRESENTA-TION & PARTICIPA-TION[2]	ACTUAL OR POTENTIAL CONTRIBUTIO-NS, VALUE OR BENEFITS TO AGRICULTURE[3]	AAFC ROLE OR OTHER POTENTIAL FEDERAL ASSISTANCE
Plan (MBSAP) (NL) http://www.env.gov.nl.ca/env/Env/water_resources.asp	Conservation to designate a *Protected Public Water Supply Area* (PWSA), triggering an interdepartmental review. Future dev. in the PWSA may only occur by dept. approval in certain zones.	wishing to formally protect these lakes, streams and groundwater sites (and contributing watersheds) can request the Minister to designate a PWSA. Contamination concerns have arisen from agric., mining, forestry, tourism and other forms of development.	inspection, enforcement and training to ensure system safety; and legislative and policy support, public awareness, and research.	Conservation reviews the municipal application, which is forwarded to the *Interdepartmental Land Use Committee*. It may recommend PWSA designation approval and dev. regulations. The Dept. of Environment encourages local communities to form Watershed Mgmt. Committees. (WMCs) to improve long-term watershed health via IWRM.	Dept. of Municipal Affairs for funding to support their IWRM planning efforts. Other agencies can assist with cash and in-kind support for plan implementation.	ongoing monitoring functions, with support from the Department. of Environment. An IWRM planning guide outlines the tech. considerations for WMCs. Several policy directives are included under the Water Resources Act, related to development, infilling of water bodies, floodplain management, wetlands, and monitoring.	(under the auspices of the Water Res Act) provides clear direction to local governments in the protection of their source water supplies via IWRM. The existence of the Interdepartmental Land Use Committee suggests a high degree of govt. coordination.	recognized in Nfld. and Lab., in part due to their ability to influence local land use. The current range of funding sources to support IWRM planning by WMCs appears to be somewhat limited.		IWRM process development combined with the relatively small amount of agric. land in Nfld. and Lab.	IWRM planning will have limited implications for this sector.	significant agric. relationships among the 12 WMCs.
Steady Brook Watershed Monitoring Committee (NL) http://www.steadybrook.com/	The Steady Brook Watershed (SBW) Monitoring Committee (WMC) formed to assist in the protection of the Town of Steady Brook's water supply source. The Steady Brook Watershed Management Plan has been recognized as a model for future IWRM processes.	The Nfld. and Lab. *Protected Public Water Supply Area* (PWSA) process has stimulated many local governments, but the initiative to form a watershed committee came from local residents. Area watershed concerns relate primarily to natural sources of contamination, road construction and transportation, mining, recreation and forestry.	The SBW Mgmt. Plan is focused on: BMP evaluation for improved land use practices; providing water quality recommendations; improving long-term water quality monitoring; and providing policy guidelines for IWRM.	The WMC includes: elected officials and residents from the Town of Steady Brook, staff from four provincial depts., the local economic dev. corp., a paper company, and the W. Nfld. Model Forest.	Funding for plan development appears to have been provided by the Dept. of Municipal Affairs and Natural Resources Canada. A number of actions are outlined within the SBM Mgmt. Plan. Many tasks are the responsivility of govt. depts. The degree to which additional funding is available for WMC operations is unclear and may be only the town's responsibility.	The SBW Mgmt. Plan contains detailed scientific background on the watershed, as provided by prov. staff on the WMC. A comprehensive risk assessment and risk prioritization process also occurred. It was coordinated by the W. Nfld. Model Forest. There are plans for a monthly watershed report and an annual SBW Report Card.	Commitment by local residents was quickly supported by the town council, most of whom also participated on the WMC. It appears the W. Nfld. Model Forest may have developed a funding proposal to assist the WMC and town in preparing a comprehensive plan.	It is not clear that adequate funding is in place to fully implement the SBW Mgmt. Plan. The development and resource use indicators proposed for the annual SBW Report Card seem simplistic and may not reflect actual watershed health or integrity.	Medium: It is premature to assess the degree of success for implementation of the SBW Mgmt. Plan, but its comprehensiveness and the commitment of WMC partners appears to offer a strong opportunity for progress.	Low: There were no agricultural sector participants is this plan, as there are no agric. activities in the SBW. This initiative was included for review because it appears to be the model now being followed for other IWRM efforts.	Low: However, the focus on scientific background used for watershed characterization and the risk assessment and prioritization process are noteworthy.	AAFC should explore the risk assessment and prioritization process used in the SBW Mgmt. Plan for potential application in other IWRM initiatives where agric. operations are involved.

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Prince Edward Island IWRM strategy and representative IWRM initiatives												
Watershed Planning Initiative (PEI) http://www.gov.pe.ca/envengfor/index.php3?number=1006719&lang=E	The Watershed Planning Initiative (WPI) was announced in 2007 by the Premier and Min. of Environment, Energy, and Forestry (DEEF). The predominance of agric. land use on PEI denotes a strong agricultural focus for the WPI.	Several volunteer watershed groups had been active on PEI since the early 1970s. In 1997, the *Round Table on Resource Land Use and Stewardship* recommended more support for Watershed Stewardship Orgs. (WSOs)	While no formal strategy document appears to exist, the WPI goals relate to: formalizing a standard approach for IWRM; providing WSOs with technical and financial support; and reducing the environmental impacts of agriculture development, especially from nitrogen fertilizer and soil erosion.	The DEEF is leading the WPI with strong support from the Premier. Existing WSOs are being encouraged to go through the IWRM process. An *Environmental Advisory Council* report called for additional prov. efforts and funding to support WSOs.	Increased levels of financial support have been provided from the *Water Management Fund* to support the IWRM planning and other project activities of 30 WSOs , in response to the *Environmental Advisory Council* recommendations. Current direct IWRM funding is CDN$750k.	The DEEF has four full time watershed planners, with a strong departmental orientation to support watershed-based operations. A comprehensive *Guide to Watershed Planning on PEI* has been produced.	There is a high level of political, technical, and financial commitment to IWRM, led by the Premier, with the DEEF providing a high level of support to local WSOs, who are logically recognized as being in the best position to achieve results.	The degree of interdepartmental cooperation around IWRM is not clear. The PEI Department of Agriculture has extensive info. and funding related to reducing environmental impacts through BMPs (composting, buffers, nutrient mgmt., and environmental farm planning). The Alternative Land Use Services (ALUS) program is also active on PEI.	Medium: 30 WSOs are already active in PEI and have received project funding. Four groups have initiated or completed formal IWRM plans. The *Guide to Watershed Planning on PEI* notes that "large landowners" are the primary audience for IWRM planning processes.	Medium: AAFC has been active in providing funding support to several WSOs. The degree to which PEI's Dept. of Agri. supports the WPI is not clear. A *Commission on Nitrates in Groundwater* has identified significant concerns related to agric. fertilizer.	High: PEI's WPI has strong support from the highest levels in govt. as well as the local community level. The key role of agricultural producers is recognized, while the Dept. of Agric. has an impressive range of agri-environmental services and funding. Greater agricultural program delivery on a watershed basis (and support to WSOs) would increase IWRM effectiveness.	AAFC should continue supporting WSOs and agric. program funding at the watershed scale. This could involve greater cooperation with PEI's Dept. of Agric. The degree to which Environment Canada's ACAP program is operating on PEI and the linkages with AAFC/Dept. of Ag. initiatives should be explored.
Bedeque Bay Environmental Mgmt. Assoc. (PEI) http://www.bbema.ca/bbema/info.php?id=1	Bedeque Bay Environmental Mgmt. Assoc. (BBEMA) is a local charitable org. working to improve watershed health of several systems draining into Bedeque Bay	BBEMA was formed under the ACAP program. An initial *Comprehensive Environmental Management Plan* was prepared in 1992.	BBEMA activities are focus on: reducing soil erosion, improving water quality, conserving nat. habitats, working to address/adapt to climate change, and maintaining strong public awareness and participation.	BBEMA is governed by a community board elected from the community, along with additional representatives appointed from three levels of govt.	Annual project funding is generated from a variety of federal, provincial, and private sources. Env. Can. appears to be BBEMA's most consistent source.	BBEMA has a small staff complement, relying heavily on partnerships with govt. agencies, industry associations, schools, volunteers and farmers to undertake projects. It is collaborating with the Eastern Canada Soil and Water Conservation Centre based at the Université du Moncton.	BBEMA appears to have built strong relationships with a network of local supporters, through sound community and transparency in its operations.	The current range of activities (including climate change and a project related to reducing greenhouse gas emissions from heavy duty diesel vehicles) seem to be beyond BBEMA's watershed mandate. These may reflect funding challenges.	Low: BBEMA is a strong community entity attempting to work on IWRM projects, but a lack of stable funding and limited technical capacity have limited progress thus far.	Medium: BBEMA's Maple Plains sustainable agric. demonstration and monitoring site is an impressive site where scientific research is being conducted in conjunction with a local landowner and the Eastern Can. Soil and Water Cons. Ctr.	Medium: Actual progress to date toward implementation of BMPs and other efforts at a watershed appears limited at this time, but BBEMA is a PEI WSO currently undertaking an IWRM plan. Future implementation related to the agricultural sector will likely improve substantially.	AAFC should explore the opportunities assoc. with increased support to BBEMA and similar WSOs. There are likely future opportunities for BMP program delivery on a watershed scale with the PEI *Watershed Planning Initiative* (WPI).

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