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Agricultural Water Supply Issues: Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador

FINAL REPORT

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CBCL LIMITED
Consulting Engineers

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Contents

Appendices

Chapter 1 Introduction and Study Objectives

1.1 Introduction

CBCL Limited, in association with Atlantic Agritech Inc. and Acer Environmental Services Ltd., were contracted by Agriculture and Agri-Food Canada (AAFC), for professional services to analyze agricultural water supply issues in the four Atlantic provinces, i.e., Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador (Figure 1.1), as an integral part of the National Water Supply Expansion Program (NWSEP). This report presents the results of the research that has been undertaken on the subject, including input received through a structured consultation program and workshops in three of the four provinces. In the chapters that follow information is provided for each province with respect to the following:

- the water supply issues and constraints;
- the existing programming that is available with respect to agricultural water supply needs;
- the primary concerns that have been articulated in each province with respect to water supply to the agricultural sectors; and
- recommendations with respect to the types of projects that might be funded and where, within each province, funding should be targeted.

The study team presents, in the final chapter, a compilation of the provincial recommendations and provides some observations, based on the research and consultation, of how these might be prioritized in Atlantic Canada. It is the intent that this summation provides some rationale for prioritizing the distribution of support from the NWSEP in Atlantic Canada.

1.2 Background & Study Objectives

The NWSEP is a four year $60 million AAFC initiative that aims to improve the capacity of agricultural producers to deal with drought and other agriculturally related water constraints. Funding will provide support to provide water supply infrastructure, or to facilitate the undertaking of strategic studies to further delineate water supply needs and/or the more effective management of the water resource in specific areas. The challenge of this study was to focus on the identification of the agricultural water supply constraints, the water supply development priorities of the industry and the best approach, or approaches, to implement NWSEP in Atlantic Canada. More specifically the objectives of the current study undertaken by CBCL Limited were to:

i) identify the nature and extent of the water supply constraints on agriculture in Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador;

ii) determine the water supply development priorities; and

iii) prioritize factors that will provide the basis for the intended approach and strategy to implement NWSEP in Atlantic Canada.

In the summer of 2002, AAFC committed $10 million of the $60 million to initiate the implementation of the NWSEP. A portion of this funding was targeted to the determination of priorities across the country for the allocation of the $50 million balance of the NWSEP program. This report forms part of the latter studies.

1.3 Study Area

The study area included the four Atlantic provinces, namely Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador. The agricultural industry throughout this region has experienced profound changes over the past 20 years. The industry has modernised and intensified, trends which, in turn, have placed pressure on both the soils and the water that is necessary to sustain productivity. The types of farming practised, the land ownership patterns and the water related issues confronting producers in eastern Canada differ both by area and by province. Farmers in PEI, for example, rely to a large extent on ground water and are confronting challenges accessing a secure supply as well as water quality problems such as salinisation. The Provincial Department of Environment has put a hold on the drilling of wells for irrigation purposes until the impacts are more closely studied. On the Avalon Peninsula in Newfoundland the challenges relate more to competition from urban development for the surface waters that are available. In the Annapolis Valley in Nova Scotia, agriculture is striving to operate efficiently during dry summers and in proximity to expanding communities. In New Brunswick, agriculture has to compete for water with other users and has had to come to terms with depleting aquifers and more efficient means of protecting and conserving watersheds. There are inevitably problems that are common across the region, but some issues and factors weigh more heavily in one area than another. This study strives to define the issues and the factors contributing to water related problems in each of the provinces.

1.4 Report Organization

This report is structured in accordance with the Terms of Reference and to meet the stipulated preferences of the workshop participants and other contributors in each of the provinces, i.e., a format whereby the materials pertinent to each province could be readily extracted for review and distribution. To this end, Chapters 3, 4, 5 and 6 will provide the results of the research, including the consultation program, workshops and recommendations by province for each of the four Atlantic Canadian provinces. Chapter 1 provides a brief introduction of the intent of the NWSEP and to the structure of the report. Chapter 2 details the approach and methodologies that have been used by the study team, and Chapter 7 summarizes the provincial findings and recommendations to provide an Atlantic Canada overview. The following Appendices support the information provided in Chapters 1 – 7:

Appendix A: Bibliography
Appendix B: Survey Instrument

AGRICULTURAL WATER SUPPLY ISSUES

ATLANTIC CANADA

Data Source: Natural Resources Canada
http://geogratis.cgdi.gc.ca

File Name: 1_ac_1.mxd (1_ac_1.pdf)

Figure:	**1.1**
Scale :	NTS
Issue Date :	March, 2003
Cartography By :	Shiju Mathew

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Chapter 2 **Approach and Methodologies**

2.1 Approach and Methodologies

In June, 2002, Prime Minister Chretien and Agriculture and Agri-Food Canada Minister Lyle Vanclief announced the government's plan to strengthen Canadian agriculture by making Canada a world leader in food safety, quality, environmentally responsible production and innovation. This plan involves investing $5.2 billion into the sector over the next six years under the Agricultural Policy Framework (APF). Related to this initiative was a commitment of $60 million over four years to improve the industry's capacity to develop solutions to the water supply issues that are considered a priority for agriculture. The objective is to alleviate the risk of future water supply shortages due to drought and to improve the economic stability of Canada's agricultural areas.

The importance of this initiative to agriculture in eastern Canada in light of changing socio-economic and environmental circumstances in the region is recognised. The approach to this study, therefore, was to:

i) Identify the location and the nature of the key agricultural areas in each of the four Atlantic provinces;

ii) Attain as comprehensive an understanding as possible of the nature of, and the challenges confronting, agriculture in each of the provinces; and

iii) Review the resultant database in the context of parallel changes that are influencing demands on both land and water in each of the agricultural areas.

The approach to this study was both sequential and iterative. It involved:

- Discussion with the proponent and the clarification of project parameters;
- Data collection including the review of pertinent reports and associated documentation;
- Development and deployment of an unstructured survey instrument (questionnaire);
- Consultation with pertinent government officials and stakeholders;
- Team brainstorming and the identification of key issues;
- Workshops with government and agricultural representatives in three of the four provinces plus a conference call involving the study team and representatives from the fourth province; and
- Preparation of recommendations and priorities for each province.

The execution of the above has involved the completion of a number of distinct tasks. These are discussed briefly in the sections that follow.

2.2 Key Tasks Executed

2.2.1 Literature Review

Appendix A provides a bibliography by province of those texts, reports and articles that have been reviewed as part of the study. A synopsis of the literature reviewed is provided by province in Chapter 3, 4, 5, and 6.

2.2.2 Consultation Program

The study team approached the primary public and private sector agricultural agencies in each of the four provinces for input. To facilitate these consultations, an unstructured survey instrument (questionnaire) was prepared (see Appendix B) to ensure that a common framework of questions was posed at each interview. The survey instrument was never intended to provide a quantitatively valid survey, but rather to be a catalyst for discussion and to focus attention on key issues. Table 2.1 summarizes the number of consultations undertaken in each province. The questionnaire was provided to all; the number of responses varied, and it was completed to varying degrees by the respondents.

To the extent possible all interviews were conducted in person and the respondents were asked at the outset whether he/she would like to see the survey instrument prior to the meeting in order to facilitate more detailed responses and more comprehensive feedback. When scheduling or distance inhibited a face-to-face meeting, a telephone interview was scheduled and conducted.

Table 2.1 Consultations by Province

PROVINCE	Consultations			
	Government Representatives	Industry Representatives	Other[1]	TOTAL
Nova Scotia	10	4	5	**19**
New Brunswick	15	6	2	**23**
PEI	7	4	-	**11**
Newfoundland & Labrador	7	12	2	**21**
TOTAL Atlantic Region	**39**	**26**	**9**	**74**

[1] Other includes representatives from the universities/colleges/research institutes including the Nova Scotia Agricultural College, the Eastern Canada Soil & Water Conservation Centre and the Atlantic Coop Climate Research Centre.

2.2.3 Workshops

Given the nature of the study region and the fact that the issues and challenges confronting each of the four Atlantic provinces are different, the study team sought to facilitate a workshop in each province. The intent of these workshops was to:

- Discuss, review and confirm the issues identified during the initial consultations and as a result of the literature review;
- Identify the activities and types of projects that might best be supported by the NWSEP in light of the agricultural water issues being confronted in that specific area; and
- Prioritize the activities and the regions within each province where funding might be allocated.

All survey respondents in each province, and all who indicated that they would attend the workshop, were provided with a copy of an interim provincial working paper. The working paper provided reference to the literature that had been reviewed, a summary of the consultations executed and some concluding observations based on the work to that point in time.

Participants at the workshops were drawn from those consulted and who had shown an interest in participating. The following is a summary of the attendance in each province (excluding the study team and the proponent):

- Nova Scotia – 10 (five industry representatives and five government representatives)
- New Brunswick – 13 (nine industry representatives and four government representatives)
- Prince Edward Island – 18 (11 industry representatives and seven government representatives)

A record was maintained of all discussions, including the workshop proceedings, and of the recommendations that emanated from these discussions and proceedings. These records, together with the content of the interim report, provided the input necessary to compile this draft report.

The workshop in St. John's, Newfoundland and Labrador, was cancelled and replaced by a conference call, because the topic was not one of immediate priority to those who had been consulted and because of the distances involved. Apart from the proponent and the study team, one industry and two government representatives participated in this conference call.

The output of the workshops and the conference call are detailed in Chapters 3, 4, 5, and 6 for each of the provinces.

2.2.4 Analysis of Results

The Study Team had originally planned to use an analytical matrix in the workshops to facilitate the weighing of the project and/or program options and to provide a more objective mechanism by which to make recommendations. However, the workshop participants, particularly in Nova Scotia, were reluctant both to prioritize projects and to in any way distinguish between agricultural regions within a province. Recommendations were kept generic because there was also a widespread understanding that whatever funding would be available to Atlantic Canada through NWSEP would not meet the potential demand.

Chapter 3 **Nova Scotia**

3.1 Context

As indicated in Chapter 2, the work program in each province involved:

i) A survey of those in government, industry and associated institutions or groups with an interest in the subject matter;

ii) A review of pertinent literature; and

iii) A workshop or conference call.

The intent of each of these activities was to:

i) Identify the nature and extent of the water supply constraints on agriculture in each of the four Atlantic provinces;

ii) Determine the water supply development priorities; and

iii) Prioritize those factors that would provide the basis for the intended approach and strategy to implement NWSEP in Atlantic Canada.

This chapter presents the findings of the work undertaken in Nova Scotia. Figure 3.1 depicts the Census Agricultural Regions in the Province, the major watershed boundaries, the counties and key communities.

3.2 Consultation Results

3.2.1 Overview

A total of 19 individuals were consulted in Nova Scotia (see Annex 3-1). As a result of the information received, the study team concluded that the water supply problems experienced in Nova Scotia over the past three to five years are due to ineffective water management, rather than a lack of water. Traditionally agricultural water supply activities have focused on managing surplus water, and farmers have relied on rainfall and natural surface water bodies for all farm water needs. In recent years, these sources have been insufficient to maintain production, and alternate sources of water are being sought. It is recognised that the development of new sources of water must be done in a sustainable fashion and that water management plans must be put in place before water problems become acute. With the potential of increased agricultural development in many parts of the Province, and perhaps decreasing costs of production as watershed management plans are implemented, some were of the opinion that Nova Scotia could have a competitive advantage over much drier regions where the high cost of providing water is resulting in diminishing competitive ability.

There have been numerous changes in the agricultural landscape that have increased the demand for water. Consumer expectations with respect to both the quality and quantity of produce have increased, necessitating a reliable and predictable source of water for farms to maintain valuable market share. Concurrently, horticulture is increasing in the Province, particularly in the Annapolis Valley (located in Region 2, parallel to the Northwestern Shoreline between Annapolis and Kings counties) and in Cape Breton. Since horticulture crops have the highest need for irrigation, the growth in this industry results both in an increasing demand for

water and a greater susceptibility to water shortage. Prior to 1997, the level of irrigation and water supply that had been developed to accommodate these changes was considered to be adequate by most growers. Since 1997, there have been four record-setting summers for lack of rainfall. The existing infrastructure was not sufficient to meet the needs of agriculture during these periods, and many crops failed.

The dairy and beef industries have also been affected by water shortages, though not as severely as horticulture. These industries are largely concentrated within a hundred-kilometre radius of the town of Truro, and the majority of farms are found in a central corridor from the eastern end of the Annapolis Valley (in Region 2) through Colchester County to Pictou and Antigonish Counties (Figure 3.1). Dry summers impacted feed crops; and dry ponds and wells forced many producers to haul water for both livestock watering and milkhouse cleaning.

The perception among those consulted is that there is sufficient water in Nova Scotia to meet agricultural demands, as well as the demands of municipalities and industry. There is sufficient water on an annual basis, but it is not always available at the times of greatest need. Most agriculture in the Province relies on surface water sources such as ponds and streams, which can be limited in terms of both water quality and quantity during dry growing seasons. Although precipitation exceeds water demand on an annual basis, prolonged periods without rain during the growing season have been increasing in both severity and duration.

All respondents identified a lack of effective water management as an important constraint to both water supply and usage. More effective water management at both the individual farm scale and on a watershed scale is needed. The following sections address these factors.

3.2.2 Farm Scale Water Management

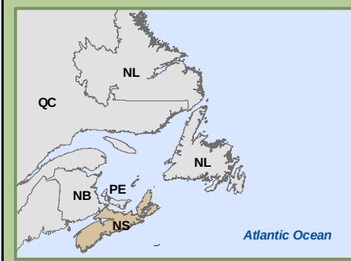
There was general agreement among those consulted that the first line of defence against future water shortages is the proper management of water within the farm operation. Several interviewees suggested that this was best achieved through education, agriculture extension services, infrastructure development, and improved record-keeping of land applications and water usage. The following paragraphs highlight the topics that were raised.

i) Education

Because water supply has not historically been a problem, producers have only recently had to manage water on their farms. Water was readily available, and it was used. Producers have neither the experience, nor the necessary information, to deal with the water constraints they are now confronting, and there is no consistent delivery mechanism for producers to learn of farm management practices and how to implement them on-site. Many parties, including water clubs in Cape Breton, the Central Region, and in the Annapolis Valley, producers and representatives of commodity groups, have expressed the desire to have better access to reliable information on best management practices for agricultural water use. In many cases, producers are not even aware of the permits required from the Nova Scotia Department of Environment and Labour for water supply development, use, and protection. Agricultural Representatives from the Department of Agriculture and Fisheries, as well as Dr. Robert Gordon, a researcher from the Nova Scotia Agricultural College, have also asserted that education is a crucial first step to solving water management problems. They suggest that education is best delivered through factsheets to raise awareness of issues and options, followed by demonstrations of new technologies and practices to build confidence in the techniques.

AGRICULTURAL WATER SUPPLY ISSUES

NOVA SCOTIA



- Cities / Towns
- Roads
- Rivers
- Census Agricultural Region Boundary
- Watersheds Boundary
- County Boundary
- Other Provinces

The following scale bar should measure 4 cm (70 km)

0 35 70 Kilometres

If not, the scale is not the same as stated and should be changed accordingly.

Data Source: Natural Resources Canada
http://geogratis.cgdi.gc.ca

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Nova Scotia

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Issue Date :	March, 2003
Cartography By :	Shiju Mathew

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ii) Agricultural Extension Services

Following from the above, education must be supported by access to expert advice to facilitate the implementation of new practices on farms. Farm extension services were cut significantly in 2000 because of a belief that these services should be provided at cost to the farmer. The private sector has not filled this void, because the density of agriculture is insufficient to sustain an independent consultant in any particular region and the project scale is often too small to be of interest to the consulting industry. Most importantly, farmers cannot afford to pay for such services. As a result, farmers have little access to good technical advice on well and pond location and design, or on which water supply system might be the most suitable to their product and soil needs. Many water supply wells are inappropriately located and constructed which results in a poor investment for the producer, and can put the groundwater supply at risk. Producers need technical and accurate information on water supply development methods, design and estimated costs.

Environmental Farm Plans, through the Department of Agriculture and Fisheries, have, to some extent, filled this role, though they deal primarily with pollution prevention and the management of land applications. Agrapoint provides production extension advice to producers, but they do not offer sufficient technical advice on water supply management and development. In most cases, the development and management of water resources is an engineering, hydrological and hydrogeological issue, but there are no in-house specialists with this knowledge base. The consultation process suggests that this is an easily rectified constraint; it requires at least one hydrogeologist, hydrologist or engineer to be hired by the Province to deal specifically with these issues.

iii) Infrastructure development

Better water management on farms and the use of water protection practices will necessitate investment in on-farm infrastructure that might be prohibitive to many producers. Many respondents suggested that producers could construct retention ponds to hold spring surplus to compensate for the summer deficit. Many believed that this would be a certain and sustainable source, preferable to the uncertainty of developing groundwater supplies. Others, however, were concerned about the quality of such surface water. Though surface water developments might meet present needs with low capital expenditures, groundwater developments could be more cost effective in the long term. There will be areas, however, where groundwater would neither be available nor licensable. Surface water development would be the only option in such areas.

Before 1997 (i.e., the beginning of the series of dry growing seasons), most irrigators had less than 25% of their land set up for irrigation. Since then, many irrigators have between 50% and 75% of their holdings under irrigation; in Cape Breton less than 10% of the agricultural land is set up for irrigation. It was estimated by a number of respondents that 80-100% of fruit and vegetable farmers in the Province would irrigate further if they had access to adequate water and funding. One example cited was in the area surrounding Boularderie, Cape Breton, where infrastructure is needed both to enlarge and/or improve the recharge to existing ponds and to distribute water to the fields. Others felt that the decision to irrigate was very farm specific, depending on soils, microclimate, and cropping profiles; and that in some cases irrigation infrastructure could be a bad investment. Respondents estimated that <5% of livestock farmers would irrigate if adequate funding were available, because it is currently uneconomical to irrigate feed crops.

The construction of large reservoirs and high capacity wells for a number of farms was suggested by several of those interviewed. In some regions, e.g., Stewiacke in Colchester County (Region 3), the development of groundwater resources is problematic due to saline intrusion and gypsum deposits. In other areas, the topography, the distribution of the better soils and the resultant land use pattern, including the location of farm units, is fragmented. These are circumstances that do not lend themselves to the economies of scale needed to install engineered high capacity deep-water wells, or large reservoirs for shared use. Most interviewees agreed that shared water systems are not really practical in much of Nova Scotia. Individual farm solutions are preferred over shared or group systems. A few shared water systems currently exist in conjunction with crop rotation. For example, some producers rotate their crops on land owned by another producer, and receive custom irrigation on the permit of the landowner for a fee. No interviewees were aware of any other existing shared water systems. In summary, there would be few regions where the population density would lend itself to the development of shared water distribution systems.

The primary concern of many was how to obtain reliable advice on how to develop and manage water on-farm and how to access the capital necessary to construct the required infrastructure. Meeting water quality standards requires investment in infrastructure. Dairy farmers in the central region of the Province, for example, are particularly concerned about pending regulations requiring potable water for the cleaning of milkhouse equipment. Many currently use pond water in combination with chemical disinfectants. The pending regulations may require substantive investments in water supply infrastructure to ensure quality as well as quantity.

iv) Improved Record-Keeping of Land Applications and Water Usage

Maintaining records of water use and land applications are not compulsory, yet understanding the demand for water resources in a watershed is imperative to the development of a sustainable resource. Attempts to use water withdrawal permits as an estimate of the water demand in the Annapolis Valley have proven unsuccessful. Many farmers have not obtained the required permits, and others who did could not provide an estimate of actual usage. To obtain an accurate estimate of water demand, an amnesty program was implemented that allowed farmers to report true water usage without prosecution for violations (AGRA Earth and Environmental, 2000). This has not been done in other agricultural regions. Some interviewees viewed the lack of record keeping as a concern, though none expressed the need to make water usage reporting mandatory. Others felt that accurate record keeping would evolve naturally as a part of business risk management if farmers became more aware of water management issues and benefits. It was generally felt that changes to existing and/or new regulations were not necessary at this stage.

3.2.3 Watershed Scale Management

Though most of the commodity groups, growers, and water management groups expressed concern that an academic circle was forming around water supply issues, most participants agreed that there is a knowledge gap between the quantity and quality of the water available and the demand. To properly manage the resources at a watershed scale, this gap must be addressed.

i) Supply Assessment

With the exception of the watershed studies done in the Annapolis Valley (for example, AGRA Earth and Environmental, 2000; Harris, 2001; Brylinsky and Pindham, 2001; CBCL Limited, ongoing; and Dillon

Consulting, ongoing), water resources in the Province have not been assessed in nearly 20 years. Nor are there the resources, or plans, to complete such studies in the near future. Based on 30 years of experience, and a knowledge of the subsurface geology studies conducted from the late 1960s to the early 1980s, Andrew Cameron, Chair of the Water Task Group[1], believes that there is excellent bedrock and surface aquifers in Annapolis and Kings Counties, excellent bedrock aquifers near Truro (Region 3), and high potential for the development of groundwater in Pictou and Colchester Counties, and possibly in Cape Breton and Cumberland County. In Hants and Antigonish Counties, however, the potential for groundwater development would appear to be limited. There are currently productive surficial and bedrock aquifers in the Annapolis Valley that are supplying water for agricultural, commercial, industrial, domestic, and municipal purposes. The safe yields of these aquifers, however, have not been determined, and it is unknown whether further groundwater pumping can be sustained. In summary, there are opportunities for the development of additional water supplies in Nova Scotia, but further assessment is required.

A current project that is being conducted by the Nova Scotia Department of Environment and Labour is the digital mapping of provincial watershed boundaries; this initiative is expected to be completed within the next two years. This will provide some required reference points, but much more needs to be done to determine the surface and subsurface water resources that exist in each watershed and to determine the water usage and water demands by all users within each watershed.

ii) Demand Assessment/Allocation

To manage the resources at a watershed scale, an accurate assessment of water demand is required. This is the intended purpose of the permitting process for water use. Permits are required from the Nova Scotia Department of Environment and Labour if more than 23,000 L/day are diverted from any surface or groundwater source. Permits are also required for the storage of more than 25,000 L of water. Amidst the internal restructuring that has taken place within the department in the past decade, many records of permits have been lost, and the working database is not up to date. This results in the issuing of permits without a true knowledge of the amount of water being extracted from the source, or the amount of water available for extraction. Although there have been no reported incremental drawdowns of water tables, it is agreed that the approval of additional groundwater permits is not wise until more is known about the groundwater resource. Currently there is an effort being made by the Nova Scotia Department of Environment and Labour and AAFC to bring the groundwater well log database up to date.

iii) Monitoring

In 1965, a monitoring network that maintained records from wells around the Province was established. This initiative was federally funded and resulted in thirty years of records. In the early 1990s, internal restructuring shifted the responsibility of well monitoring to the regional offices of what is now the Nova Scotia Department of Environment and Labour. At that time, other issues took precedence; monitoring was no longer a priority. The Nova Scotia Department of Environment and Labour is currently compiling the available data into a

[1] The Department of Agriculture & Fisheries established an internal Water Task Group in early 2002 to address sustainable water management in the agricultural, fisheries and aquaculture sectors of Nova Scotia. The objectives of this group are; to provide a coordinated approach to address water issues; increase awareness for balancing resource development and environmental stewardship; create and deliver a strategy that ensures that department policies, programs and services are supportive of sustainable water management.

database. It was suggested that the monitoring of both water quality and quantity is necessary to generate the baseline data required to identify both acute and chronic deterioration.

iv) Regulation/Enforcement

There exists a widespread public perception that agriculture is a principal contributor to the deterioration in water quality. Until 1996, farmers were exempt from the requirements of the *Environmental Assessment Act*, and agriculture remains exempted from buffer strip regulations. Indeed, most environmental compliance in agriculture remains voluntary. Interviewees believed that producers with the appropriate support would voluntarily improve land management practices. To achieve environmental protection targets they require access to education, professional advice and funding, rather than stricter regulations. The demand for the Environmental Farm Plan program from Nova Scotian farmers is an indication of this willingness to make environmental improvements.

As discussed above, permitting has been a concern. The records are not easily accessed by decision makers, and in some cases records are incomplete. On the other side, producers are not aware of the requirement for a permit and cannot provide an estimate of the amount of water being used. New permits are often issued without a clear understanding of how much water is already being extracted from the source, or what the sustainable supply is. The commonly suggested solution is that the Nova Scotia Department of Environment and Labour begin to enforce the current regulations, but this would be an incomplete response; education and efficiently maintained recording systems are also necessary.

3.3 Literature Review

3.3.1 Review of Key Texts, Reports and Articles

The texts, reports and articles reviewed for this study are identified in Appendix A. The following provides a brief account of the key findings of the materials reviewed.

According to the most recent national Census of Agriculture, there are over 4,200 census farms in Nova Scotia (Statistics Canada, 2002a). The top field crops are alfalfa, corn and barley. The agricultural regions with the greatest land coverage of these crops are the Annapolis Valley, Cumberland, Colchester, Pictou and Antigonish Counties, which also correspond to the areas with the highest count of dairy and beef cows (Statistics Canada, 2002 a & b). Blueberries, apples, strawberries, carrots, beans (green and wax), and peas are the top five fruit and field-grown vegetables crops (Statistics Canada, 2002b). The regions with the greatest land coverage of these crops are the Annapolis Valley, Cumberland and Colchester Counties, and Cape Breton (Statistics Canada, 2002a).

The results of the Agricultural Census (2002) indicate that the agricultural landscape in Nova Scotia has changed in several respects since the 1996 Census. One significant difference is that the number of irrigated hectares in the Province has increased by 56%. This reflects changes that have occurred in a number of areas. For example, there has been a slight increase in the hectares of land being used for irrigation-sensitive horticulture, most notably a 24% increase in the highbush blueberry crop area. Though the number of dairy

and beef cows in the Province has decreased by 10% and 17% respectively, the hectares being cropped for corn, a more drought-resistant feed crop, have increased by 45% over the same period (Statistics Canada, 2002b). These changes might be indicative both of the agricultural water stress that Nova Scotia has experienced in recent years, and of other factors such as changes in commodity prices.

Since 1997, the Province has endured four record breaking dry growing seasons, three of which were in succession. The agricultural sector was not prepared for the severity of the resulting water shortages. It became apparent that there was a lack of knowledge of the water resources available to, and required by, agriculture. Furthermore, there was no plan in place for the effective management of water for the industry.

In the 1999 growing season, the Annapolis Valley experienced its driest growing season in 30 years. As a result, the Grower's Water Group[2], under Horticulture Nova Scotia, commissioned a study titled "Water Resources Needs of the Agricultural Industry of the Annapolis Valley". Among the findings, farmers reported that their irrigation needs exceeded the available water supply by an average of 63% (AGRA Earth and Environmental Limited, 2000). Irrespective of this finding, the study consultant also determined that many farmers did not know the volume of water they were using, did not have the required permits, and that the Nova Scotia Department of Environment and Labour did not have complete records of those that did. Two recommendations came out of this study: firstly, that the agricultural sector more accurately estimate their water demands; and, secondly, that the Nova Scotia Department of Environment and Labour improve their management and enforcement of the water permitting process.

The above referenced study also found that there are many opportunities for the development of surface and groundwater sources in the Annapolis Valley. These conclusions were based on recent river assessments, as well as historical investigations of the groundwater resources (e.g., Trescott, 1968 and 1969). Due to the landscape of the area, the options tend to be watershed-specific. It also appears that the options must be evaluated on an operation-by-operation basis due to the mix of agricultural practices. The principal recommendation was that more data would be required with respect to both water usage and the extent of supplies before effective watershed planning could be successfully developed. It was recommended that a watershed stewardship board be formed to ensure that water resources in the area are developed holistically and with respect to the interests of all stakeholders (AGRA Earth and Environmental Limited, 2000).

Following this study, a number of watershed studies designed to address the key recommendations were undertaken; one of these was the Canard River Irrigation Water Enhancement Study. The Canard River Watershed is 52.1 km^2 in area and encompasses a wide range of land use including suburban development, agriculture, and forestry. At the time of the study, the watershed included 1,200 hectares (2,900 acres) of cropland and 300 hectares (800 acres) of orchard, but estimates of potential agricultural land within the study area range from 2,000 to 3,000 hectares (5,000 to 8,000 acres) (38-62%). As the quantity of water available to current irrigators in the growing season is not sufficient to meet their needs, future development of the potential agricultural area may be constrained. The author recommended several options to meet the estimated agricultural water demand; these included impoundment of the river, the construction of reservoirs, and the further development of groundwater resources. The quality of the water in the Canard River,

[2] The Grower's Water Group was formed in 1998, with the help of Horticulture Nova Scotia, to address water resource issues specific to growers in the Annapolis Valley. The group's main priority is to identify specific limitations to water supply and develop plans of action to address them, according to the priorities of the members.

however, was identified as a primary constraint to the success of any of the identified options (Harris, 2001). The author further suggested year round river flow monitoring of the major rivers in the watershed as a critical component of similar studies, improved efficiencies of irrigation methods, and reviewing regulations and practices with respect to contaminant loading in the Canard River.

Early in the series of drought years, the Federation of Agriculture and Horticulture Nova Scotia recognized the need to develop a planned approach to water resource management, particularly in the Annapolis Valley. Several watershed studies were commissioned with aid from AAFC to assess the potential for water supply expansion to meet agricultural and watershed needs. The Habitant, Pereaux and Cornwallis watersheds studies will be completed in the spring of 2003. Based on estimates of the water demand and supply in each watershed, recommendations will be made for water resource development and management. The probable main conclusion common to the studies is that there are several options for water supply expansion in this region, but that all will require investment in infrastructure. The studies will likely also conclude that more information is required before accurate assessments of supply and demand can be made (CBCL Limited, ongoing; Dillon Consulting, ongoing).

Water shortages in the 2001 growing season were more severe than any experienced during the preceding years. In Cape Breton, August rainfall was only 30% of the 50-year average for that month. The average yield loss of irrigable crops in this region was between 20% and 70% (Bras D'Or Producers Co-Op, 2001). The Annapolis Valley, dominated by horticulture and livestock farming, lost 50-100% of the area's unirrigated crops. Grain and forage crops were also significantly reduced. In many cases second-cut hay was damaged by armyworm, and livestock was fed on first crop and silage. In Pictou and Antigonish Counties experienced similar problems with reduced second-cut hay. In this area, where the beef industry is prominent, herds were greatly reduced and the average weight per animal fell. It has been estimated that pasture replacement and extra feed in this area cost farmers an additional $30,000 for each herd of 60 cows (Agricultural Services Branch, 2001). The Cumberland-Colchester region, whose dominant agricultural industries are dairy and blueberry farming, had no second and third-cut hay crops in some areas to draw upon, and water for livestock watering was hauled from other sources. The additional cost of mitigating the effects of the water shortage was estimated to be $100 a head. The blueberry industry in the same year experienced a 75% decrease in yield (Agricultural Services Branch, 2001).

The recommendations of a Department of Agriculture and Fisheries study of the 2001 drought include both short-term and long-term recommendations for mitigating the effects of water shortage in Nova Scotia. The short-term options were primarily funding schemes; recommendations included grants for individual farm improvements and cost-sharing programs for infrastructure development, as well as expanding insurance to cover more types of crops and low interest loans for difficult crop years. One of the primary recommendations for a long-term solution was that the Province should develop a water management strategy for agriculture. This would involve working with industry, through such structures as the Growers Water Group, to ensure that the water resource challenges facing agriculture are considered in provincial water management strategies, and addressing specific agricultural water management needs in association with the recently created Water Task Group. Other recommendations suggested that the Province negotiate a safety net program nationally that is more specific to Nova Scotia's needs, invest in climate change research and its implications for agriculture, and develop and fund a water conservation grant program to aid producers to implement measures to conserve and protect water supplies (Agricultural Services Branch, 2001).

Agricultural regions outside of the Annapolis Valley also experienced water shortages in the late 1990s. In the Minas Basin, the watershed of the Bay of Fundy, agricultural activities include dairy and forage crops. In a series of Minas Basin community workshops organized by the Bay of Fundy Ecosystem Partnership, agricultural practices and water quality were among the priority issues identified by attendees. Agriculture in the area is important and employs more people than the forestry and fishery industries combined. Availability of adequate amounts of water for irrigation and livestock is perceived to be an ongoing problem, which climate change may further exacerbate. Water quality is also becoming an increasing concern to agricultural, residential and industrial water users in the area. The issue is of particular concern to the small, but expanding number of organic farmers in the region who need good quality water for their crops. Some of the solutions offered by the group were water quality education and awareness, development and enforcement of best management techniques, development of watershed stewardship plans, and partnerships with landowners to create wetlands, riparian buffers, and demonstration projects (Bay of Fundy Ecosystem Partnership, 2001).

The potential for water supply expansion in the Minas Basin area has not been studied recently, but several reports from 1970 to 1981 indicate the potential for groundwater development in this area. Test drilling in the northern part of the area indicated that properly constructed wells in the surficial and deep aquifers would yield sufficient water to provide for the future needs of all sectors in the area. The groundwater is considered to be of good quality, though it may require treatment for iron and manganese, and as of the late 1970s there were no activities identified that may have had an adverse effect on these water supplies (Vaughan and Somers, 1980). A 1972 study of the local groundwater resources in the Truro area (Region 3) indicated an adequate supply for the foreseeable future, but little subsequent research has been undertaken (Hennigar, 1972). In the Shubenacadie-Stewiacke River Basin, the potential for groundwater development is restricted due to the presence of the Windsor Group formation, which yields very low quality water (Bailey, 1981).

Cape Breton is the second largest producer of horticultural crops in Nova Scotia. Though there is very little historic documentation as to the effects, if any, of water shortages in this area, the Bras D'Or Producer's Co-Op, in partnership with the Department of Agriculture and Fisheries, documented the effects of four successive water shortage years and made recommendations on how to prevent future water shortages. The research team, for example, found that many irrigation ponds were undersized for the field area that they had to cover, and most had no means of recharge other than precipitation. Twenty to twenty-five percent of the fields under production have no means of irrigation. After several consecutive years of reduced yield due to persistent water shortages, many growers cannot afford to invest in new irrigation infrastructure, and cannot therefore stay viable in this competitive industry.

Though the examination of the impacts of the 2001 drought indicated that Pictou and Antigonish Counties were profoundly affected by water shortages, no documentation of the efforts to mitigate or prevent future occurrences could be found. Within the St. George's Bay Ecosystem Project Report, a partnership between St. Francis Xavier University, the Federal Department of Fisheries and Oceans and the Gulf Nova Scotia Bonefide Fishermen's Organization, there is an examination of the threats to water supply in the St. George's Bay South watershed area. This is a region of very good agricultural soils (Queens and Woodburne soils) and of intensive and extensive agriculture. The "Nova Scotia Ground Water Survey" conducted in 1972 and 1973 contains records of water quality and quantity for this area. Gibb and McMullin (1980) assessed the potential to expand ground and surface water supply in Pictou County; and Young (1971) published a surface water

quality report for the same region. Although landfill and urban runoff threaten the quality of water in the West River, which supplies water for the town of Antigonish, quantity is not an anticipated concern. In Antigonish County, where the primary agricultural practice is dairy farming, water supply issues are expected to centre on the contamination of groundwater from agricultural practices, rather than drought and competing uses for supply, particularly in the South River watershed (Davis et al., 2000).

Much attention since 1997 has revolved around the issue of water quantity, but given a year of sufficient rainfall, attention has turned back to the issue of water quality. The 2000-2001 annual report of the Nova Scotia Agricultural Services Branch indicates that water quality was given higher priority than water supply than in previous years in terms of both activity and research. The Resource Stewardship Division, for example, worked with many municipalities to develop agricultural land use activity standards that would reduce the risk of farming activities adversely impacting drinking water supplies. Wastewater treatment (e.g., milkhouse waste, manure effluent, etc.) and water management were priority research initiatives in 2000-2001 (Agricultural Services Branch, 2001). The Nova Scotia Department of Environment and Labour has also released the Nova Scotia Drinking Water Strategy, which focuses on source protection and long term planning for sustainability. Specific components include reference to inventory and the characterization of water sources as well as sources of pollution. In the strategy there was no clear indication of a plan of action to achieve the identified goals.

The documentation of water quality centers primarily around concerns in the Annapolis Valley. A 1994 study of 237 wells in Kings County found that nitrate-N and coliform levels exceeded Canadian drinking water limits in 13% and 9% of the wells, respectively. Historical records indicate that these results represent no significant change since 1974. Well type and depth both appeared to play significant roles in determining which wells met guidelines. Although 93% of the well owners surveyed reported that they knew the type of well that they had, only 24% actually knew the depth. Similarly, there is a general lack of knowledge among well owners about their water supply, in terms of both quantity and quality (Moerman and Briggens, 1994). Recommendations to improve these circumstances were not acted upon as the same findings were made in the "Water Resources Needs of the Agricultural Industry of the Annapolis Valley" study that was completed five years later (AGRA Earth and Environmental, 2000).

A study of the quality of surface water in the Eastern Annapolis Valley, which was conducted in the 2001 growing season, found that all rivers in the study area exhibited evidence of impaired water quality. The water analyzed was taken during the growing season; it did not include samples from the spring runoff. While the Pereaux, Habitant and Canard Rivers all experienced increased drawdown for agricultural irrigation during the dry summers, each exceeded the fecal coliform level permissible for the irrigation of produce for human consumption at least 50% of the time. Recommendations from this study included more monitoring and the enforcement of best management practices (Brylinsky and Pindham, 2001).

The effective management of water resources appears to be of greater concern than an overall lack of water in Nova Scotia. Clearly, there is water available on an annual basis, but there is concern both with respect to the sustainability of its long-term availability and its quality. The Atlantic Planners Institute argue that the main goal of developing a water resource management scheme is to build on the existing management and regulatory framework, and to do this, the focus must be placed on planning and prevention (API, 2000). The

institute identified four key issues to achieve this goal, which correspond with the recommendations made in the above studies; these are:

i) to improve water allocation between competing environmental, economic, and social needs – it is noted that the incremental cost of delivering a new water supply to the market is greater than managing the existing supply to extend its life, largely because available sources of water are frequently not co-located with the uses requiring them;

ii) to protect water resource quality - this issue had been addressed in the 1998 "State of the Environment Report" (Nova Scotia Department of the Environment, 1998) and the "Nova Scotia Drinking Water Strategy" (Department of Environment and Labour, 2002). Specific recommendations included the establishment of regulations for point-source pollution, enforcing codes of practice and water resource stewardship to control non point-source pollution;

iii) to encourage integrated resource management – while municipalities retain regulatory authority over land-use planning and development under the *Municipal Government Act* (formerly the *Planning Act*), the legislation does not enable control of the long-term management of developed areas, e.g., vegetation maintenance, use of chemicals, or other practices that may negatively affect water resources. Only education, improved awareness, and the initiation of land stewardship programs can change such practices; and

iv) to facilitate partnerships in water resource stewardship - Nova Scotians as individuals and communities have a significant effect on the water resource, but no clear role or responsibility for its sustainable management. The *Environment Act* is one vehicle that might enable such participation, but one that has not yet been used for this purpose.

It is apparent that the broad-based, large-scale water management plans that work elsewhere are not suited to the scale and nature of Nova Scotia's agricultural industry; the approach must be adapted to the particular circumstances within each agricultural region (Webster, 1999).

3.3.2 Existing Programs and Initiatives

The following sections identify existing programs and initiatives.

i) AWARD 2000

This program is targeted toward the identification of solutions to short and long term water and soil moisture management issues. It is designed to address both water quantity and quality through the cooperation of the agricultural industry, the Nova Scotia Department of Agriculture and Fisheries (formerly Agriculture and Marketing), and the Nova Scotia Department of Environment and Labour. The objectives of AWARD 2000 are to:

- Identify and utilise alternative or non-conventional sources of water;
- Encourage multi-purpose water uses (between agricultural and non-agricultural users); and
- Support co-operation in agricultural water management (among agricultural users).

AWARD 2000 is a component of the Canada/Nova Scotia Technology Development 2000 Program. It is aimed at in-field testing, design and demonstrations at an applied level, and is not designed to fund capital works related to water management on individual farms. Up to 50 percent assistance is available for eligible project costs to a maximum of $30,000 per project per year for individual projects, or $40,000 per project per

year for community-based or multi-user projects. Past AWARD 2000 projects include the release of three Farm Fact Sheets on Soil Water Management, several assessments of watershed water quality and evaluations of groundwater resources in the Annapolis Valley. This program began in March 2000; the current closing date for claims is March 2003.

ii) TECH 2000

This program is designed to support the development and adaptation of new and leading agricultural technologies and knowledge that will enhance the competitive position of the Nova Scotia Agri-Food Industry. Assistance on eligible costs may be up to 75 percent of total project costs to a maximum of $20,000 per year per project. This program has the potential to be used for innovative ways of increasing production in drought conditions. It is unknown at this time whether this program will be continued in 2003.

iii) Farm Investment Fund

This fund provides public financial support for projects that enhance economic viability and farm and food safety and that promote environmental stewardship. It provides assistance of up to 50 percent of eligible project costs to a maximum of $10,000 per year or $20,000 over two years. Some interviewees believed that this money would be sufficient to construct necessary water supply and distribution infrastructure if there was appropriate advice available to ensure the applicability of the systems adopted.

iv) Environmental Farm Plan (EFP) Program

This is a voluntary program to help farmers identify and assess environmental risk on their property. It allows farmers to incorporate environmental considerations into their everyday business decisions, rather than addressing environmental issues in a reactive sense. Farmers work with the EFP Program Co-ordinator to develop a confidential environmental farm plan for their operation. This is a service provided by the Nova Scotia Federation of Agriculture with funding from Agriculture and Agri-Food Canada through Nova Scotia Agri-Futures and the Nova Scotia Department of Agriculture and Fisheries.

v) Factsheets

Numerous educational factsheets have been created through partnerships between the Department of Agriculture and Fisheries, Federation of Agriculture, Horticulture Nova Scotia, and the Nova Scotia Agricultural College. These are available free of charge to producers; topics include water, waste, and soil management, environmental compliance, and new technologies and techniques for production extension in water shortage conditions. To date, the Department of Agriculture and Fisheries, in partnership with the Nova Scotia Agricultural College, have released several factsheets. Agrapoint (formerly the Agricultural Development Institute) have also released factsheets on drought management strategies.

vi) Water Management Groups

In October 2002, a series of producer-based Water Management Groups were started in the Province to identify and address on-farm water issues. This pilot project, initiated by the Nova Scotia Federation of Agriculture, was funded by the province. Three groups (commonly called Water Clubs) have been established; these are located in the Annapolis Valley, Stewiacke, and Cape Breton agricultural regions, which represent the main agricultural regions in Nova Scotia. The intent is that producers from all agricultural sectors will meet with a facilitator to develop a set of priority issues, which will then be reviewed by an advisory committee comprising representatives of government, the Federation of Agriculture and AAFC. A set of actions items will be

developed to address the identified concerns. This project is in the early stages of development, but the results of these initiatives will be followed with interest as the process could lead to a better understanding by all of the agricultural water supply constraints that are experienced by the different agricultural sectors in Nova Scotia.

3.4 Workshop: Objectives and Findings

3.4.1 Objectives

An Agricultural Water Supply Workshop was held in Halifax, Nova Scotia, on the January 7, 2003. The objectives of the workshop were:

i) to discuss the primary water supply constraints facing agriculture in Nova Scotia; and

ii) to define the priorities for possible funding under the NWSEP.

As identified in Annex 3-2, a total of 14 people, including the proponent and representatives of the study team, participated in the workshop. The participants confirmed that the study team had accurately represented the agricultural water supply issues in the Province in the interim working paper that had been circulated. Attendees identified several additional reports that were subsequently accessed and incorporated into the above review.

Maps of the key agricultural areas in Nova Scotia were circulated to facilitate discussion of the water supply constraints in each region, but there was some consensus that the discussion should be open and that there should be no attempt to prioritize potential projects for funding by region.

3.4.2 Regional Water Supply Constraints

i) Cape Breton (Region 5)

Within Cape Breton, 90 percent of the horticulture takes place near Boularderie (see Figure 3.1). Other regions of Cape Breton, such as the area near Mabou, support pasture and dairy; the Mabou area also has the highest concentration of poultry farming in the Province. Surface water is the main source of water for both irrigation and barn water. A few of the poultry farming operations draw upon municipal supplies. Water distribution was given a high priority in this region. Inadequate irrigation infrastructure, i.e., equipment, and water storage are considered limiting factors to further growth by the agricultural community in Cape Breton.

Although water quality in Cape Breton's surface water resources were not generally seen as a concern, representatives suggested that this may be due to the lack of monitoring, rather than possible contamination. Bacterial contamination of agricultural ponds is a known problem. There is sufficient knowledge to enable the further development of groundwater resources in the region, but concern was expressed that this might be limited in some areas by the exclusive water rights held by Nova Scotia Power. It was the opinion of representatives from this region that the agricultural water supply issues in Cape Breton have been to date largely ignored.

ii) Central Region (Region 3)

Dairy farming dominates the Central/Stewiacke agricultural region. Surface water is used for livestock watering and barn cleaning, but water quality is a serious concern. The availability of groundwater is limited due to underlying gypsum formations and problems of saline water intrusion. Local soil conditions, however,

would allow for the construction of deep retention ponds. Pending regulations requiring the use of potable water for dairy farming activities has heightened the urgency to address water supply constraints in this region.

iii) Annapolis Valley (in Region 2)

The horticulture and livestock farming activities that characterize the Annapolis Valley are supported by surface water and on-farm wells. Unlike the circumstances in Cape Breton, the development of additional irrigation infrastructure to distribute and apply water appeared to be less of a priority by those attending the workshop than the determination and confirmation of water sources. Much of the discussion pertinent to this area focussed on the current inefficiency of the regulatory process. One specific problem was that decisions regarding access to water are not being made by the regulatory bodies fast enough in times of drought. The result is that farmers can be faced with a choice of non-compliance, or losing their crops. Another issue is that municipalities are allowing new rural residential development while simultaneously introducing wellhead protection zone regulations. This means that any well that is installed to meet the needs of new rural communities is constraining existing agricultural practices, without compensation to the producer. It was emphasized that there is a need for agreements between government agencies that share jurisdiction to prevent such conflicting activities.

Although certain regional differences were acknowledged, workshop participants did not wish to address problems on a regional basis. Indeed, it was pointed out that circumstances within a single agricultural region can differ more than the circumstances between regions. Moreover, past experiences with developing region specific programs, policies and funding schemes have resulted in unnecessary tensions, and have pitted farmer against farmer. For example, it is considered inequitable that the water issues confronting the industry in the Annapolis Valley have received a great deal of attention while similar circumstances in Cape Breton have been largely ignored. This imbalance most likely resulted from the substantial efforts of the Growers' Water Group and Horticulture Nova Scotia relative to other regions of the Province. A province-wide program with regional adaptability, and farm-specific applicability was strongly advocated.

3.4.3 Discussed Initiatives

The primary issue identified in the workshop was the need for a planned approach to watershed management. The groundwater assessments conducted between the late 1960s and early 1980s, in addition to recent and on-going watershed studies in the Annapolis Valley, may contain sufficient information to allow further development of the water resource. However, there remains a common perception that the sustainability of these resources is too uncertain to allow their development. For this reason, the need for an updated water resource database to enable watershed-scale management was identified as a priority. Both the quantity and quality of potential supplies should be assessed and documented in a form accessible to interested stakeholders, water clubs, watershed planners, stewardship associations and other interested parties.

As a part of assessing and managing the resource, the total demand must also be determined. This is generally achieved through the permitting process, but the nature of the current permitting process was criticized. The arbitrary and conservative nature of the criteria used in permitting, e.g., the standards with respect to coliform bacteria, require further research, verification and regulatory amendment. The existing regulatory requirements are not properly enforced, the process is costly and inefficient (workshop observations) and in many cases logistically impossible to comply with. For example, irrigation water must

be tested by an accredited laboratory within 24 hours prior to its application, but laboratories often take longer than 24 hours to provide the results. This results in the application of water of unknown quality. Another criticism is that due to overlapping jurisdictions between provincial and federal agencies, there is a difficulty associated with obtaining timely replies to applications for use of a water resource. It is critical for both the producer and government that permitting and regulatory issues be fine-tuned, made transparent (i.e. producers deal with one body), and procedures communicated effectively to resource users.

Producers also felt that many of the government regulations and guidelines they are required to meet require expensive farm improvements, costs which can seldom be fully recovered. The benefits associated with enhanced environmental practices, it was suggested, accrue primarily to the retailer and the consumer. If producers are continually forced to incur substantive costs to meet such policies and standards, it was suggested that many farmers may be forced to walk away from the industry.

Several solutions to the water constraint issue were discussed. Surface water retention appears to be an option in areas like Stewiacke, where groundwater resources are limited. This solution is, however, complicated by approval processes. Other items discussed included: accessing the technical resources necessary to determine the optimal size, design, and construction of retention ponds; options for coordinating shared infrastructure; options for water distribution; and requirements for water quality monitoring and control. Access to the technical knowledge necessary to evaluate various options is not readily available, and funding for extension and educational services was identified as a high priority. Farmers need to attain informed detail on optimal farm-specific water supply, distribution, and management practices. Moreover, the requirements of approval processes and monitoring regulations are not clear and must be better communicated to producers.

As indicated in Section 3.3.2, three water clubs were started in Nova Scotia to address on farm water sourcing problems. Their mandate as described by the facilitator is the establishment of on-farm infrastructure and local water supply management using a watershed management approach. These clubs act as education forums, communicating information relevant to farmers, including information pertaining to the permitting and approval processes. The clubs can also bring in expertise to address problems specific to an area; for example, an AAFC expert with experience in agricultural water supply might adapt his experience to the particular circumstances of a region of Nova Scotia. Current funding for the paid facilitator, however, will expire at the end of March, 2003, and it was unknown if the clubs would continue beyond this date. The workshop participants identified funding for the continuation of this program, and its expansion into other areas of the Province, as a high priority.

Farm improvements to meet environmental regulations, as well as to meet needed water demands, are costly. Funding for on-farm solutions to sourcing and distribution of water resources was identified as a high priority. Some participants saw funding for on-farm irrigation equipment as too expensive and as an inefficient use of limited funds, but others saw this as a priority. This, in part, reflects regional differences in circumstances. It was agreed that funds to supplement the capital costs of accessing water should be made available, and that this money should be eligible for individual farm developments in addition to group/shared projects to meet regional specific needs.

3.5 Key Issues

Severe growing season water shortages in Nova Scotia are largely a new phenomenon, and producers do not have sufficient experience to deal with the related issues. Based on the consultations undertaken, the literature reviewed and the workshop, the key issues and main constraints to accessing existing water supplies were identified as follows:

- A lack of access to the expert advice needed to implement new technologies or to expand water supplies;
- A need for education and information on:
  - water and soil management;
  - options for water expansion;
  - water permitting and approval processes; and
- A need for funds to offset the capital costs of farm water supply development to address environmental requirements and crop demands in times of inadequate growing season precipitation.

The agricultural industry is hesitant, however, to develop new water supplies in the absence of plans for its sustainable use. To address this deficiency requires work to determine the potential supply from groundwater and surface water sources and to quantify need. The latter requires more rigorous on-farm recording of water usage, the enforcement and improvement of the permitting process, as well as the efficient management of the resulting database by the Province.

Specific programs and activities that were identified during the workshop to mitigate agricultural water shortage were:

- *Funding for Extension and Educational Services to Farmers*: farmers need informed detail on optimal farm-specific water supply, distribution, and management practices, and access to expert advice to facilitate their correct implementation and execution;
- *Establishment of a Comprehensive Water Resource Database:* to enable effective watershed-scale management. Both the quantity and quality of potential supplies should be assessed and documented in an accessible form;
- *Funding for:*
  - on-farm solutions to sourcing and distributing water resources; and
  - obtaining and protecting water of suitable quality for agricultural purposes (these projects may include some regional/group projects where applicable); and
- *Support for the Existing Water Management Clubs:* Funding for the continuation of the current program and its expansion to other areas of the Province.

3.6 Recommendations

The following programs and activities are suggested for consideration for funding as part of the NWSEP in Nova Scotia:

- Support the Water Clubs to allow them to meet the specific educational needs of their region and circumstances. They may use supporting funding for such projects as informational sessions on permitting and approvals issues, funding research on new technologies and techniques, guidance on well and storage pond maintenance, or demonstrations of best management practices, etc.;

- Improve the extension services available to farmers. AAFC experience is greatly needed in Nova Scotia, and can be delivered in a number of different ways including:
  - the employment of provincial in-house specialists, e.g., engineers, hydrologists, hydrogeologists, etc. to provide advice for farm-specific water supply management and expansion plans;
  - the use of AAFC specialists to adapt prairie solutions to Nova Scotia conditions; and
  - the use of local consultants to provide technical assistance to address agricultural water supply expansion issues, possibly subsidised via NWSEP;
- Provide funding for the capital costs of on-farm water supply expansion:
  - this could be combined with existing provincial programs such as TECH 2000; or
  - establish new funding programs that could specifically target infrastructure development on both an individual farm basis and group/shared basis;
- Provide funding for monitoring initiatives, including pump-tests and other groundwater supply monitoring initiatives, the routine water quality testing of wells and streams, streamflow monitoring and developing a centralised database of both historical and recent records; and
- Provide funding for watershed studies.

Annex 3-1: Personnel Consulted

The following 19 individuals were consulted in Nova Scotia:

- Alexander MacDonald, Executive Director, Valley Watershed Stewardship Association;
- Andrew Cameron, Chair of the Water Task Group, Nova Scotia Department of Agriculture and Fisheries;
- Arthur Pick, Agricultural Resource Co-ordinator, Annapolis Valley Regional Representative, Nova Scotia Agriculture and Fisheries;
- Donna Crawford, Horticulture Nova Scotia;
- Dr. Rob Gordon, Department of Engineering, Nova Scotia Agriculture College;
- Gabriel Comeau, General Manager, Dairy Farmers of Nova Scotia;
- Gary Koziel, Resource Management Cape Breton, Nova Scotia Department of Agriculture and Fisheries;
- Greg Webster, Grower, Webster Farms;
- Hank Kolstee, Land Protection Supervisor, Nova Scotia Department of Agriculture and Fisheries;
- Ian Campbell, Regional Hydrogeologist (Truro, Amherst, Antigonish, Sydney), Nova Scotia Department of Environment and Labour;
- J. Bill MacLeod, Agricultural Resource Co-ordinator, Nova Scotia Department of Agriculture and Fisheries;
- John Theakston, Water and Wastewater Branch, Nova Scotia Department of Environment and Labour;
- Kevin Bekkers, Eastern Territory Regional Representative, Nova Scotia Department of Agriculture and Fisheries;
- Laurie Cochrane, Resource Stewardship, Environmental Farm Plans, Nova Scotia Department of Agriculture and Fisheries;
- Reg Newell, Stewardship Co-ordinator, Eastern Habitat Joint Venture and Wetland and Coastal Habitat Program, Nova Scotia Department of Natural Resources;
- Richard Melvin, Horticulture Nova Scotia, Growers Water Group, Grower, Melvin Farms;
- Steve Nielsen, Dairy Farmer and Member of Central Region Water Club;
- Yvonne Thyssen-Post, Water Clubs Facilitator, Thy*agri*ssen Consulting LTD; and
- Allie Craswell, Avon Foods Inc., Boularderie Island Water Club.

Annex 3-2: Workshop Attendees

The following 14 individuals attended the workshop held in Halifax, Nova Scotia, on January 7, 2003:

- Alexander MacDonald, Valley Watershed Stewardship Association
- Andy Cameron, Water Task Group Chair, Department of Agriculture and Fisheries
- Edward Rendall, Grower, Involved with Water Clubs
- Graham Fisher, Watershed Planning, Department of Environment and Labour
- Greg Webster, Grower, Horticulture Nova Scotia and Growers' Water Group
- John Drage, Head Hydrogeologist, Department of Environment and Labour
- Mike Langman, Resource Stewardship, Department of Agriculture and Fisheries
- Reg Newell, Eastern Habitant Joint Venture, Department of Natural Resources
- Stephen Nielsen, Grower, Involved with Water Clubs
- Yvonne Thyssen-Post, Facilitator of Water Clubs, Thyagrissen Consulting Ltd
- Glen Brandt, Agriculture and Agri-Food Canada (Client)
- Ann Wilkie, Project Manager, CBCL Limited
- Annabelle Singleton, Researcher, CBCL Limited
- Elizabeth Dowsett, Researcher, CBCL Limited

Chapter 4 **New Brunswick**

4.1 Context

As indicated in Chapter 2, the work program in each province involved:

i) a survey of those in government, industry and associated institutions or groups with an interest in the subject matter;

ii) a review of pertinent literature; and

iii) a workshop or conference call.

The intent of each of these activities was to:

i) identify the nature and extent of water supply constraints on agriculture in each of the four Atlantic provinces;

ii) determine the water supply development priorities; and

iii) prioritise those factors that would provide the basis for the intended approach and strategy to implement NWSEP in Atlantic Canada.

This chapter presents the findings of the work undertaken in New Brunswick. Figure 4.1 depicts the Census Agricultural Regions in the Province, the major watershed boundaries, the counties and key communities. The key agricultural areas in New Brunswick based on farm concentration, dominant cropping patterns and production, in order of importance, were identified as follows:

- The New Brunswick Potato Belt located in the upper Saint John River Valley in North Western New Brunswick - primarily potatoes and grain (corresponds to Agricultural Region 1);
- Central New Brunswick including Fredericton and Sussex – primarily dairy and vegetable farming, but with increasing cranberry production, (corresponds to Agricultural Region 2);
- Southeastern New Brunswick including Kent and Westmorland counties (corresponds to Agricultural Region 3) - mixed farming and vegetables; and
- Northeastern New Brunswick – primarily blueberries (corresponds to Agricultural Region 4).

The statistics also indicate that the same order of regional importance would apply if consideration was given to the value of the products produced.

4.2 Consultation Results

4.2.1 Overview

A total of 23 individuals were consulted in New Brunswick (see Annex 4-1). Traditionally agricultural water supply issues have focused on managing surplus water, and farmers have relied largely on rainfall and natural surface water bodies for irrigation. The perception among the consulted stakeholders is that there is sufficient moisture during the growing season in New Brunswick to meet agricultural demand, but that the distribution

pattern is such that moisture deficits may occur periodically. One solution would be the development of storage ponds with irrigation undertaken as required.

Water shortages in the Province have been addressed in the past through Federal and Provincial grants for the construction of irrigation ponds, with the primary area of improvement being in South-eastern New Brunswick. The cost of constructing irrigation infrastructure, in consideration of the return on investment, and the current irrigation permitting process have been identified as the primary factors limiting further irrigation development. Further assessment of the feasibility of irrigation systems that would demonstrate the short term recovery cost would likely encourage the development of more irrigation systems.

The Woodstock area of the potato belt (Region 1), the Sussex area (Region 2) and Region 3 have each suffered from several water shortages over the past decade. Most of Region 1 experienced water shortages in the early 1990s, and the 1995 drought caused significant impacts in the Woodstock area where an average growing season moisture deficit of 50 mm to 150 mm was noted. Although severe water shortage conditions have been experienced in central New Brunswick (Regions 2 and 3) in the last two years, the consequences have been more serious over a longer time period, i.e., three to five years, in the southern portion of Regions 2 and 3. In Region 4, i.e., northeastern New Brunswick, water shortages have been more frequent, but not as severe as those experienced in the central and southern parts of the Province.

Mr. Gilles Moreau, an Agrologist with McCain Foods in Grand Falls, suggested that there was no need or benefit to be derived from irrigation in the Grand Falls area, i.e., northern portion of Region 1. There was, in fact, some concern that too much water might be applied as a result of the variability in rainfall. Irrigation, for example, might be undertaken and followed immediately by a significant rainfall, thereby creating excess moisture conditions and potential delays in normal operations. At the same time Mr. Jean-Louis Daigle, a Director of the Eastern Canada Soil and Water Conservation Centre, indicated that there was a need for irrigation both in the Woodstock area (i.e., the southern portion of Region 2) and in Region 3.

Most respondents identified the absence of an effective water management strategy in the Province as a constraint to agricultural water supply development. It is, however, recognized that the development of new water sources must be sustainable and that water management plans should be prepared before water problems in some regions become acute. This requires consideration of more effective water management at both the individual farm scale and at the watershed scale. The following sections address these factors.

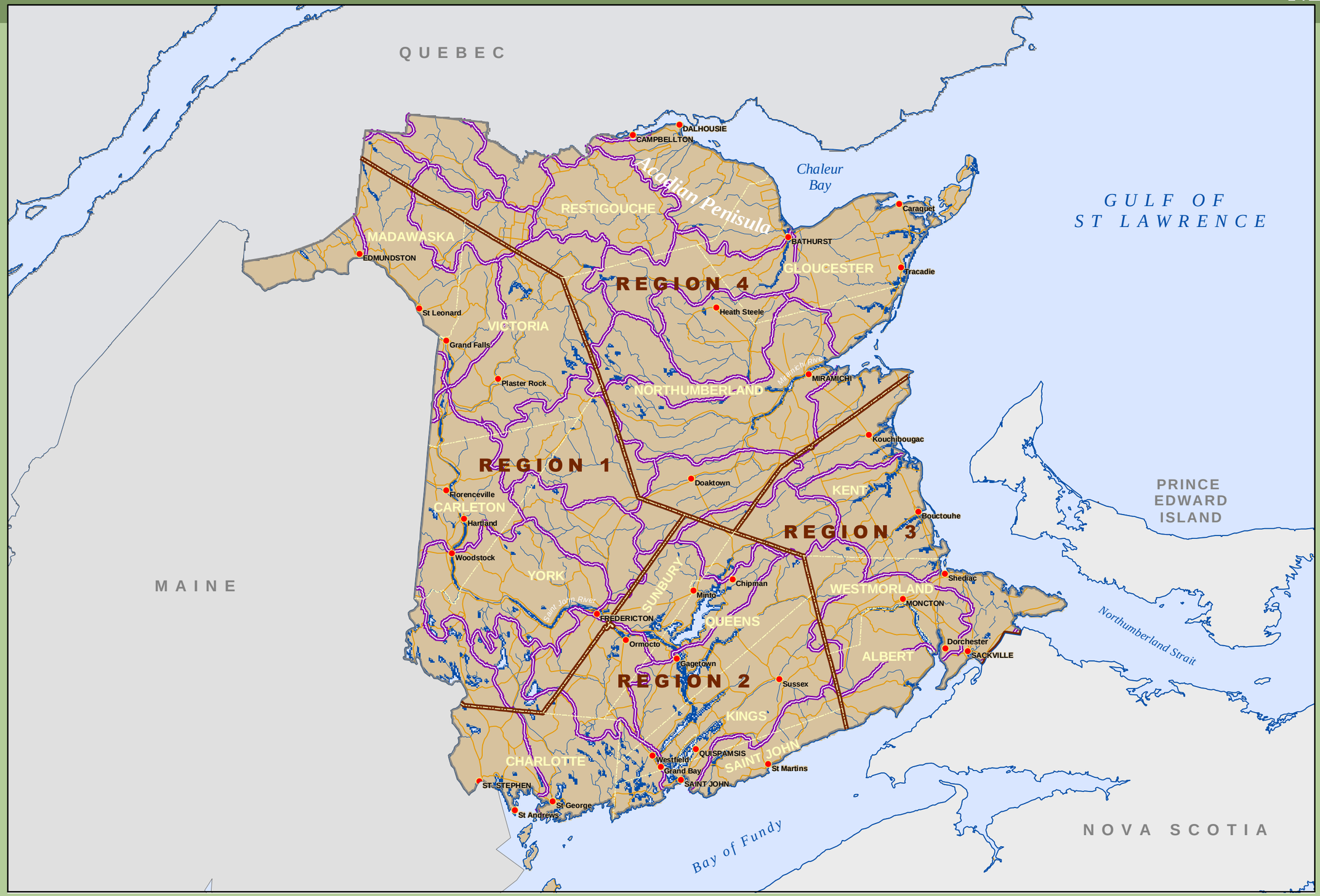
4.2.2 Farm Scale Water Management

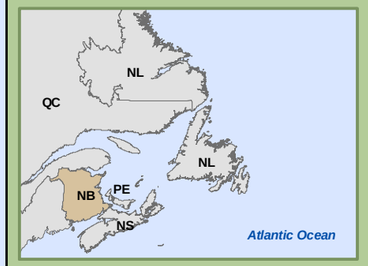
As indicated above, there would appear to be some potential in Region 1 to develop surface water resources including dugouts, bypass ponds and lake control structures to facilitate the storage of water for irrigation. High capacity wells in surficial aquifers might be possible (in the sand and gravel deposits associated with the river valleys), however high capacity wells may not be possible in the more regional bedrock aquifers. Such initiatives could serve groups of farms rather than individual farms, but the extent of the areas that might be served by group projects is probably limited due to the distances between farms and from source areas.

In Regions 2, 3, and 4 it appears that farm scale management is likely to be the more effective means to address water sourcing given that in each of these areas there are significant distances between farm operations. The potential, however, to adversely impact adjacent wells was a concern associated with the

AGRICULTURAL WATER SUPPLY ISSUES

NEW BRUNSWICK





- Cities / Towns
- Roads
- Rivers
- Census Agricultural Region Boundary
- Watersheds Boundary
- County Boundary
- Other Provinces

N

The following scale bar should measure 4 cm (70 km)

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Kilometres

If not, the scale is not the same as stated and should be changed accordingly.

Data Source: Natural Resources Canada
http://geogratis.cgdi.gc.ca

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New Brunswick

Figure:	4.1
Scale :	1:1 750 000
Issue Date :	March, 2003
Cartography By :	Shiju Mathew

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farm scale management approach due to the close proximity of other groundwater users and associated water quality issues. Therefore, a case by case assessment was generally advocated. The following paragraphs identify topics that were raised.

i) Education

Because water supply has not historically been a problem, producers have seldom had to manage water on their farms. In many cases, producers are not even aware of the permitting requirements for water supply development, use, and protection. They have neither the experience nor the knowledge base necessary to deal with the water constraints they are confronting. There is no consistent delivery mechanism by which producers might learn of farm management practices, or how to implement them on-site. Representatives from the Department of Agriculture and Fisheries, and most respondents, asserted that education is crucial to addressing water management problems. It was suggested that information packages and demonstrations of new technologies and practices should be available to producers. Lack of both funding and in-house expertise are seen as obstacles to the successful execution of water supply projects.

ii) Agricultural Extension Services

The provision of technical information to farmers must be supported by access to expert advice in how to implement new practices. Farmers have had limited access to advice on such matters as the location and design of ponds, or what water supply system might be the most suitable to specific soils and crops.

iii) Infrastructure Development

The percentage of agricultural land that is currently irrigated in each region, the demand for irrigation and the source of the water supply is summarized in the Table 4.1 based on in-house information provided by the Department of Agriculture and Fisheries in response to the survey instrument.

Table 4.1 – Water Supply Irrigation and Demand

Region	% of Total Agricultural Land Irrigated	% of Farmers Who Draw from the Public Water Supply	% of Farmers Who Draw from Private Wells	% of Farmers Who Use Drip Irrigation	% of Farmers Wanting to Irrigate
1	2.7	<25	<25	<25	60
2	20	<25	26-50	26-50	85
3	<1	<25	<25	<25	70
4	<0.5	<25	<25	<25	75

It was suggested by a number of the respondents that the construction of retention ponds to capture spring surplus flows to compensate for summer deficits was the most feasible method to meet water supply needs. There were, however, concerns expressed about the quality of the resultant water and the costs associated with implementation of such systems. These and other questions are currently the subject of study. Supplemental funding for certain environmental work has been available through a number of small government grants, but no significant funding has been available to facilitate the development of substantive new water supplies. The results of the current work may influence future funding programs.

4.2.3 Watershed Scale Management

Though most of the commodity groups, growers and water management groups expressed some concern that an academic circle was forming around water supply issues, most of those surveyed agreed that there is a knowledge gap between the quantity and quality of water available and the demand. To properly manage the resource at a watershed scale, this gap needs to be addressed.

i) Supply Assessment

With the exception of those watershed studies carried out in the Province to determine what needs to be done to protect the availability of drinking water, water resources as a whole have not been extensively assessed. Safe yields from certain aquifers have been determined for community use, but it is not known if further groundwater pumping could be sustained to meet additional demands for supplemental irrigation. A current initiative by the New Brunswick Department of Environment and Local Government is the certification of wells for residential use. This, together with historical permitting for commercial and industrial wells and watercourse withdrawals, provides an indication of demand and inherently provides some limited information on water supply.

ii) Demand Assessment/Allocation

To manage resources at the watershed level, an accurate assessment of the demand for the resource is required. This is the intended purpose of the Department of Environment and Local Government permitting process for water use. This Department involves and seeks input from both the Department of Fisheries and Oceans (DFO) and the New Brunswick Department of Natural Resources whenever any withdrawal from a watercourse is proposed.

iii) Monitoring

There is little monitoring of water supply, in the context of quantity, being undertaken in New Brunswick. There are hydrometric stations, operated by Environment Canada, that are located on a number of watercourses throughout the province for measurement of stream flow. This information is typically used to establish acceptable withdrawal rates as part of the operating permit approval. Over the last several years, the Department has also required that certificates be obtained for new residential wells. In order to withdraw water from a watercourse, or to construct a commercial or industrial well, an operating permit is required from the New Brunswick Department of Environment and Local Government. This operating permit stipulates the quantity of water that can be extracted.

With respect to water quality, the New Brunswick Department of Environment and Local Government is monitoring water quality at two locations in the potato belt in Region 1 to measure nitrate levels in groundwater that have exceeded the drinking water quality guidelines. A number of municipalities also monitor water quality on a regular basis to assess water quality for domestic purposes. The operating levels of the wells are normally noted and provide an indication of local groundwater level fluctuations. It is our understanding that the New Brunswick Department of Environment and Local Government and the AAFC are currently working together to increase the number of groundwater level monitoring stations.

iv) Regulation/Enforcement

The New Brunswick Department of Environment and Local Government requires that any proposed work that would alter a watercourse requires approval under the New Brunswick *Clean Water Act*. Any new well that involves the extraction of more than fifty cubic metres per day also requires approval from the Department under the *Clean Water Act*. With respect to withdrawal from a watercourse, it is important to also note that an approval is required from the Department of Fisheries and Oceans under the Fisheries act should it be determined that an alteration of fish habitat could occur as a result of the installation of a structure or other modification of the stream channel. In addition, should the project involve a federal funding source, an assessment would be required under the *Canadian Environmental Assessment Act* (CEAA).

4.3 Literature Review

4.3.1 Review of Key Texts, Reports and Articles

The texts, reports and articles reviewed for this study are identified in Appendix A. The following provides an account of the key findings of the material reviewed.

Table 4.2 provides information by Region on those operations reporting over $2,499 in total gross farm receipts. The 2,563 farms identified include 975 cattle ranching and farming operations, 30 oilseed and grain farms, 304 vegetable and melon farms, 304 fruit and nut farms, 251 greenhouse and floriculture operations, and 365 other crop operations; the balance (334) consists of hog, poultry, goat and other farming operations.

Table 4.2 - Agricultural Activities

ITEM	AGRICULTURAL REGION				
	1 York County Carleton County Victoria County Madawaska County	2 Saint John County Charlotte County Sunbury County Queens County Kings County	3 Albert County Westmorland County Kent County	4 Northumberland County Restigouche County Glouchester County	TOTAL
No. of Farms	940	679	608	336	2,563
No. with Irrigation	42	51	42	21	156
Area Irrigated in ha (acres)	416 (1,028)	367 (906)	280 (691)	82 (202)	1,145 (2,827)
Total Land in Crops in ha (acres) excludes Christmas trees	75,478 (186,509)	28,925 (71,475)	28,466 (70,341)	16,015 (39,573)	148,883 (367,898)
Summer Fallow in hectares (acres)	440 (1,088)	80 (197)	72 (178)	48 (119)	640 (1,582)
Vegetable Production in hectares (acres)	193 (478)	469 (1,158)	260 (641)	106 (263)	1,028 (2,540)
Fruits, Berries, Nuts in hectares (acres)	513 (1,267)	2,732 (6,752)	1,818 (4,493)	4,256 (10,516)	9,319 (23,028)
Nursery Products in hectares (acres)	26 (64)	117 (289)	19 (46)	3 (8)	165 (407)

There are approximately 8,500 hectares (21,000 acres) of wild blueberries produced in New Brunswick with approximately half of this area in production in any given year. Some 300 or so farm families are involved in this production in three major growing regions:

- Charlotte and Kings Counties (35% of production);
- Acadian Peninsula and Kent County (50% of production); and
- Southeast counties of New Brunswick (15% of production).

(Department of Agriculture, Fisheries and Aquaculture website, January 2003).

It should be noted that the area of land identified in Table 4-2 to be irrigated is not identical to the values associated with Table 4-2. As indicated previously, the information provided in Table 4-1 was based on estimates provided in the questionnaire response, based on general in-house familiarity, whereas the values identified in Table 4-2 represent detailed values based on information collected by Census Canada.

In an assessment of climate change carried out by Environment Canada for the Atlantic provinces, it was shown that the Atlantic Region has not followed the national warming trend of about 1 degree Celsius over the past century (Environment Canada, 1997a). Indeed, the temperature change experienced in the region was reported to be relatively insignificant and considered to have had little impact to date on agriculture. Precipitation rates, however, appear to have increased, and the rainfall is more variable. Some of the potential impacts identified include:

- Excess moisture;
- Unusually late springs and early fall frosts;
- Shortage of moisture during the growing season;
- Unusually severe storms;
- Unfavourable over-wintering conditions; and
- Exceptionally cool growing seasons.

It was further indicated that the agriculture industry should, in general, be able to adjust to any long term gradual changes in climate. Measures that were identified to address negative effects associated with climate change included the following:

- Increased use of irrigation and the wider adoption of soil management practices and crop rotations;
- Increased adoption of drainage practices and erosion control practices;
- Increased adoption of active and passive frost prevention methods;
- Increased efficiency in tillage, planting and harvesting operations; and
- Development of new crop varieties.

Irrigation trials were first undertaken in the Province in 1993 by the New Brunswick Department of Agriculture, Research and Development Branch, to assess potential benefits associated with supplemental irrigation (Eastern Canada Soil and Water Conservation Centre, 1999). This work concluded that the increase in yield resulting from irrigation was not sufficient to justify investment. Producers with irrigation equipment

had been cautious in its use over several years due to an increased probability of late blight, which can be aggravated by increased moisture. It was further noted that water sourcing for irrigation could be difficult given the limited rainfall that occurs during the growing season. The construction of reservoirs was identified as the most practical means of ensuring an assured water supply.

Studies to assess supplemental irrigation were also carried out in Carleton County in 1994 by the New Brunswick Department of Agriculture, Research and Development Branch. The findings indicated that yields varied depending on the potato variety involved. It was recommended that this should be taken into account in any assessment of the feasibility of supplemental irrigation (Eastern Canada Soil and Water Conservation Centre, 1995).

In 1993, the Agricultural Advisory Committee on the Environment (AACE) was established under the Green Plan to advise government on environmental issues associated with agriculture. AACE consists of representatives of the two New Brunswick Federations of Agriculture, the Soil and Crops Association, the Women's Institute, different commodity representatives, the Conservation Council, the Department of Environment, the Department of Agriculture and the Eastern Canada Soil and Water Conservation Centre. In 1995, specific issues associated with irrigation, including water supply, water quality, rights and permits, common water sourcing and accessibility, and education, became a focus of the group (Eastern Canada Soil and Water Conservation Centre, 1995). The Minister of Agriculture at that time requested input to develop a policy on irrigation. It was, however, suggested that irrigation was only one of a number of tools that might be applied to address concerns of moisture deficit. The maintenance of the organic content in the soil by means of crop rotation, the application of compost/manure, terracing, and residue management were all identified as alternative management tools.

Irrigation studies undertaken in Maine (USA) have shown that, in an average year, rainfall needs to be supplemented by only 50 to 75 mm per season in applications of 12 mm or less to have positive results (Eastern Canada Soil and Water Conservation Centre, 1999).

McCain Foods (Canada) carried out extensive research and commercial irrigation trials in the Grand Falls area, (Agricultural Region 1) between 1992 and 1998. The results varied widely from one year to another due to the variability in rainfall. During the driest years, an increase in yield of as much as 11 tonnes/hectare (100 cwt/acre) was obtained for the two potato varieties investigated (i.e., Russet Burbank and Shepody). Over the six years of testing, irrigation increased the total yield of Shepody by 5.6 tonnes/hectare (50 cwt/acre) and the total yield of Russet Burbank by 5.3 tonnes/hectare (47 cwt/acre). A return of $740/hectare ($300/acre) was determined to be necessary to break even on the capital and operating costs of the irrigation equipment. The costs of developing an adequate water source was considered to be an additional capital investment and was not included in the economic analysis. The study concluded that irrigation offers, at best, only limited benefits in the area for the varieties tested (Eastern Canada Soil and Water Conservation Centre, 1999).

A potato seed farm in the Grand Falls area started supplemental irrigation in 1979. Due to less snowfall and irregular rainfall, the irrigation system has been in operation every year over the past six years. Increased yields have been noted for several varieties including Russets, Superior, Goldrush and Chieftan. An improvement in species quality was also reported (Eastern Canada Soil and Water Conservation Centre, 1999).

With respect to groundwater quality, it has been shown that the presence of nitrates in wells in the potato belt appears to be closely related to farming (10 to 20 percent of the wells had concentrations that exceeded drinking water quality guidelines), and more specifically with respect to surface water runoff from agricultural operations. Health concerns were identified as the primary issue associated with agricultural chemical usage (AACE, 1996).

A feasibility study (JWEL, 1993) of supplemental irrigation in potato production was carried out in the early 1990s for existing and potential potato farming lands in the Edmundston, Grand Falls, Florenceville and Woodstock areas of the Province (Agricultural Region 1). It was shown that soil moisture levels varied significantly over the study area. Soil moisture levels in the Woodstock area, i.e., the southern portion of the study area, were shown to warrant the introduction of supplemental irrigation. Four potential water sources were considered; these were:

- direct withdrawal from existing surface water sources;
- groundwater;
- gravity-fed storage ponds; and
- pumped storage ponds.

On a *total* basin basis, the study concluded that there were sufficient quantities of surface water available to support the large scale introduction of supplemental irrigation in these areas. However, for a number of the sub-basins, representing approximately 29 percent of the total basin area, it was not physically feasible to support supplemental irrigation by surface water flows alone, due to insufficient quantities of surface water available within the smaller sub-basins. It is noted that this conclusion was based on a minimum aquatic habitat protection flow that is equal to the seven day low flow. It is also noted that this assessment did not consider the cumulative withdrawal of water from a watercourse. After the first water withdrawal is made, surface water availability should be re-evaluated for the areas that are downstream of the first point of withdrawal. It was further noted that other water use conflicts might exist during periods of low flow, and it was recommended that further work be carried out to assess this potential.

The feasibility of using groundwater for supplemental irrigation was related to the area irrigated by groundwater to the area of influence on a per well basis (JWEL, 1993). The depth to groundwater in the study area was reported to range from 7 to 50 metres, and water quality was expected to be suitable for irrigation purposes. Pumping rates in excess of 7.6 L/s (100 Igpm) were identified for the sand and gravel aquifers located along the river valleys, and yields in the order of 75 L/s (1,000 Igpm) were reported to be obtainable. On the other hand, yields from most bedrock wells were considered to be less than 0.8 L/s (10 Igpm). It was concluded that adequate water to meet irrigation requirements might be obtained from the sand and gravel deposits associated with the river valleys. This, however, represented a very limited portion of the total study area.

The report further noted that gravity fed and pumped storage ponds would require significant storage areas.

Other issues and the conclusion and recommendations associated with irrigation that were identified in the JWEL study included the following:

- Before the introduction of supplemental irrigation, an effective legislative, administrative and enforcement infrastructure to implement and monitor the process should be developed to ensure the fair allocation of surface water resources to users (i.e., farmers, industry, residents and electrical power generating facilities);
- Funding should be made available for feasibility studies and the implementation of supplemental irrigation; and
- Establishment of the appropriate administrative and enforcement infrastructure.

The environmental impacts associated with more widespread irrigation identified in the study were:

- Increased leaching of agricultural chemicals and nutrients into local groundwater;
- Increased surface runoff and associated erosion and sedimentation as well as increased leaching into surface water sources;
- Degradation of aquatic habitat due to over extraction of water from surface water resources; and
- Impacts of withdrawal on other users (primary operators identified included McCains operations, pulp and paper mill operations and hydroelectric operations located on the Saint John River system).

It would be possible to develop appropriate management practices to address the application of chemicals and to mitigate chemical leaching effects and erosion. The minimum fish habitat protection flow, for example, could define the flow below which no additional surface water could be withdrawn. No significant adverse effects were expected on fisheries resources and habitat from increased irrigation, provided the minimum fish habitat protection flow was maintained. The effects of water withdrawal on other users was not addressed in the JWEL 1993 study. The study concluded that the economic feasibility of introducing supplemental irrigation varied substantially across the study area. In the Woodstock area, for example, the economic projections were positive, and it was suggested that irrigation should be initiated on a farm-by-farm basis.

The Atlantic Planners Institute have argued that the main goal of developing a water resource management scheme is to build on the existing management and regulatory framework. To accomplish this, the focus should be placed on planning and prevention (API, 2000). The Institute identified the following four key issues to achieve this goal:

i) to improve water allocation between competing environmental, economic and social needs;

ii) to protect water resource quality - specific recommendations included the establishment of regulations for point-source pollution, and enforcing codes of practice and water resource stewardship to control non point-source pollution;

iii) to encourage integrated resource management – while municipalities retain regulatory authority over land-use planning and development control, the land use planning legislation does not enable control of the long-term management of developed areas, e.g., vegetation maintenance, use of chemicals, or other practices that may negatively affect water resources. Only education, improved awareness, and the initiation of land stewardship programs can change such practices; and

iv) to facilitate partnerships in water resource stewardship.

Federally there are several Acts that have relevance to water supply issues and surface water supplies; these include:

- *Fisheries Act* (habitat and maintenance of flow downstream of an intake);
- *Canadian Environmental Assessment Act* (should it be determined that fish habitat alteration, disruption or destruction will occur);
- *Navigable Water Protection Act* (instream structures and navigational considerations); and
- *Canadian Environmental Protection Act* (environmental protection in general).

At the Provincial Level, there is legislation that has relevance to the protection of water resources. The following acts are administered by the New Brunswick Department of Environment and Local Government:

- *Clean Environment* Act (Environmental Impact Assessment, Regulation 87-83);
- *Clean Water Act* (Potable Water Regulation, Water Well Regulation, Protected Areas Designation Order for Protection of Surface Waters, Watercourse Alteration Regulation); and
- *Clean Environment Act* (Water Quality Regulation).

The Protected Areas Designation Order is associated with the protection of surface and groundwater supplies and serves to limit activities in specific areas. Industrial approvals for the discharge of effluent from industrial/commercial operations are required to protect surface water quality.

The Province of New Brunswick has introduced a program to protect the quality and quantity of municipal groundwater resources under Section 14 of the *Clean Water Act*, administered by the New Brunswick Department of Environment and Local Government. In most parts of the Province, the contamination of groundwater and surface water from both agricultural practices and other sources was identified as a key water supply issue. In central and western New Brunswick, drought and competition from other water uses appear to be the key issues.

4.3.2 Existing Programs and Initiatives

Currently, there are no long-term programs or provincial initiatives in New Brunswick to assist farmers address water deficit issues. AAFC is currently delivering a portion of the NWSEP funding to address some of the information and irrigation feasibility questions noted herein.

4.4 Workshop: Objectives and Findings

4.4.1 Objectives

An Agricultural Water Supply Workshop was held in Fredericton, New Brunswick, on January 10, 2003. The objectives of the workshop were:

i) to discuss the primary water supply constraints facing agriculture in New Brunswick; and

ii) to define the priorities for possible funding under the NWSEP.

As identified in Annex 4-2, a total of 15 people including the proponent and representatives of the study team participated in the workshop.

4.4.2 Regional Water Supply Constraints

i) Region 1

Agriculture in the northern area consists largely of poultry and hog farming. The potato belt, comprising 23,500 registered hectares (58,000 acres), extends through the area on both sides of the Saint John River. It is estimated that an additional 400 hectares (1,000 acres) are being cleared for potatoes each year. In addition, approximately 80% of the grain grown in New Brunswick is grown in the potato belt as part of a crop rotation system. There area also dairy and beef operations in the area.

In the early 1990s water shortage was considered an issue, but with the exception of the Woodstock area, irrigation is still not a priority. Groundwater access is considered limited, and ponds are difficult and expensive to construct due to the shallow soils and vertical stratigraphy characteristic of the area. There has been some success in creating water storage impoundments using ephemeral streams within gullies and valleys where snowmelt is captured. There is need for a feasibility study to examine the use of watercourses as a source of irrigation water. The loss of soil from erosion/runoff is a major concern, and soil/water conservation management is considered to be an important factor in optimising conditions.

ii) Region 2

Agricultural operations in the eastern portion of this region consist predominantly of livestock farming. Activity in the western and central areas consists mainly of cranberry and blueberry production. Market gardening is also significant. Floriculture occurs, but water requirements for this activity are negligible. Approximately 240 hectares (600 acres) of potatoes are grown in this region. Opportunities for groundwater and surface water development, primarily from the Saint John River, are considered to be good. Most agricultural activity takes place in close proximity to the major surface water sources. It was suggested that water supply could be best dealt with on a farm by farm basis, but the infrastructure that would be necessary to move water from the source to the fields has not yet been proven to the producers to be economically feasible.

It was suggested that further study is not only required to establish whether there is a need for irrigation, but also whether it would be advantageous for this region. Producers need information on how to integrate soil and water conservation measures into their operations more effectively. New technologies could be introduced and infrastructure investments made in the light of expert advice. Competing user demands for water, and increased sources of potential pollutants, were identified as concerns. The expansion of urban areas on to, and highway development through, agricultural land is a growing concern. There was consensus that more research needs to be done to fill information gaps.

iii) Region 3

This area is characterized by diversified horticulture, potato, apple, mixed vegetables, and dairy farm operations. Compared to the other regions, Region 3 has experienced the most significant water deficit in the last three to five years, and there is need for immediate remedial action. Surface water, springs, ponds, and bypass ponds are all used for crop irrigation with some success. The larger rivers are tidal, and there is some concern whether or not this water can be used for irrigation as demand increases. Representatives of the DAFA present at the workshop indicated that water could be taken from these rivers due to intrusion layering, but further research was recommended to confirm river specific capabilities. With respect to groundwater

sourcing, there is a potential in some locations near the Bay of Fundy that too much groundwater could be drawn thereby causing saline intrusion to occur. There is little opportunity for shared systems, because of the dispersed distribution of farms. Further understanding of the groundwater resources in this region is required.

Soils in some parts are susceptible to erosion. A better distribution of information on soil-water management was considered to be an important first step that might benefit growers. Land leasing was identified as a factor impeding improved soil-water management practices, including irrigation, as there is a reluctance to invest on leased lands. Leasing seldom provides the opportunity for the control that is necessary to implement improvements in an effective manner.

iv) Region 4

Agricultural development in this region takes place along the coast, though there is development inland on the Acadian peninsula. The latter involves mainly blueberry operations. Another 400 hectares (1000 acres) could be brought into blueberry production on the Acadian Peninsula in the next few years. This would substantially increase the demand for water in this area. There is significant beef and dairy farming and market gardening along the coast and in the Miramichi. Potatoes are grown in the Bathurst area. There appears to be a shortage of existing surface water supplies in this area. Creating water storage in this area is also a concern, because the sandy soils do not provide a good basis for storage ponds, resulting in the need for pond liners.

There is some potential to construct dams on Crown land to create small reservoirs for shared water supplies. There was, for example, a pilot project undertaken where 650 hectares (1,600 acres) of cleared land was irrigated with some success. There are several other areas with similar conditions that have the potential for development of this nature. The productive use of Crown land can be restricted by the large wildlife buffers that bisect the area. These, and other management issues, need to be addressed before land is available for cultivation. Decisions also need to be made about the optimal size of market blueberries, soil fertilisation, soil organic matter content, and minimum yields per acre to determine whether it is economical to implement irrigation. As part of such an assessment, appropriate technology for frost protection, including optimal nozzles and irrigation rates, should also be addressed.

In general, a better research base and enhanced information dissemination are necessary for effective soil-water management. Soil improvement is a fundamental first step in improving farming operations. It is not just a question of putting more water on the land. The mapping of aquifers and the assessment of surface water resources were considered to be very important. It was concluded that the application of supplemental irrigation programs should be carried out on a farm by farm basis, but that there might be some opportunities for the development of irrigation on a regional, or shared, basis. Obstacles to the implementation of effective irrigation include the long time line necessary to obtain environmental approvals for water development projects, the high costs involved and the current poor implementation methods. It was agreed that a province-wide program with regional adaptability, and farm-specific applicability would be preferred.

4.5 Key Issues

Based on the consultation undertaken, the literature reviewed and the workshop proceedings, the following key issues were identified in New Brunswick:

- Need for education on water and soil management and associated pilot demonstrations;
- Need for Technical and Financial Assistance including expert advice through improved extension services to facilitate the implementation of new technologies or to access new water supplies;
- Need for information on water permitting and the time required to obtain permits;
- Need for funding to offset the excessive costs associated with the construction of irrigation systems, i.e., the need for the water supply infrastructure, which might in some areas be a shared cost, and the irrigation equipment. The former should have a higher priority for funding than the latter;
- Need for expertise to assess the minimum soil moisture levels that would not significantly affect yields. Research should be carried out in field trials in areas of high potential for supplemental irrigation to determine the level at which irrigation water should be applied. Such information is needed in portions of Regions 1 (Woodstock area) , Region 2 (Sussex area) and in Region 3 in its entirety;
- Need for farm based feasibility studies. It appears that there may be benefits associated with supplemental irrigation in the Woodstock area (Region 1) with respect to potato production. Such supplemental irrigation could be provided via surface storage methods, but the feasibility of such works requires evaluation on a farm-by-farm basis;
- Need for further study to determine the cumulative consequences of withdrawals from streams with respect to aquatic resources and other competing uses, should supplemental irrigation be pursued;
- Need for a study of the use of the sand and gravel aquifers associated with the river valleys to supplement irrigation; it was recommended that this be assessed on a farm-by-farm basis in Region 1;
- Need for better soil-water management practices to address water deficits, as a first step in identifying supplemental irrigation requirements;
- Need to carry out an assessment of surface and groundwater availability and quality; and
- Need to identify other major water users and to re-evaluate their demands on surface water flows in consideration of the cumulative withdrawals from the drainage system and the potential impacts on aquatic resources.

The priorities, identified with reference to the literature review, interviews with stakeholders, and the discussion that took place at the workshop, were identified as follows:

- Technical assistance for water management including advice on environmental regulations and obtaining the required approvals;
- Technical and financial assistance for water development for all sectors and crops on a farm-by-farm basis, and where possible on a group or shared basis;
- Funding to assess the availability of groundwater and surface water resources; and
- Making information available to producers on key research topics including conservation farming and the results of research studies that identify strategies, needs, and solutions for farm operations.

Programs considered important, though given a lower priority, included:

- Funding for potential regional-specific funding schemes, recognizing that drought issues are somewhat unique to each region and in consideration of the options available to address related concerns such as soil management techniques; and
- Financial assistance for irrigation equipment.

4.6 Recommendations

The following programs and activities are suggested for consideration for funding as part of the NWSEP in New Brunswick:

- Funding for education to meet needs associated with soil-water management practices, including pilot projects and information packages. This approach might be used for information sessions on permitting, funding research on new technologies and techniques, providing guidance on well and storage pond maintenance, or demonstrations of best management practices, etc.;
- Funding to employ specialists (e.g., engineer, hydrologist or hydrogeologist, etc.) to provide advice for farm-specific water supply management and expansion plans;
- Funding for the capital costs of on-farm water supply expansion, and where feasible, on a group or shared basis;
- Funding for monitoring initiatives, including pump tests, the routine testing of wells and streams, streamflow monitoring and developing a centralised database of both historical and recent records; and
- Funding for watershed studies.

Annex 4-1: Personnel Consulted

The following 23 individuals were consulted in New Brunswick:

- Susananah Banks, New Brunswick Soil & Crop Improvement Association;
- Ellen Barry, New Brunswick Department of Natural Resources and Energy;
- Joe Brennan, President, Agriculture Producers Association of New Brunswick;
- Brian Burrell, New Brunswick Department of the Environment and Local Government;
- Rick Butts, Agriculture and Agri-Food Canada (Research);
- Diane Coté, Fédération des Agriculteurs et Agricultrices Francophones du Nouveau-Brunswick;
- Jean-Louis Daigle, Director, Eastern Canada Soil & Water Conservation Centre;
- Robert Gareau, Potatoes NB;
- Denis Haché Department of Fisheries and Oceans;
- Dwayne Hicks, President, New Brunswick Soil & Crop Improvement Association;
- Bruce Kinnie, Land Development, New Brunswick Department of Agriculture, Fisheries and Aquaculture;
- Patton MacDonald, Executive Director, Potatoes NB;
- George MacLeod (Chair Environment Committee), APA Environment Committee;
- Bernard Mallet, Agriculture and Agri-Food Canada (MISB);
- Kevin McKendy, Director, Land Development, New Brunswick Department of Agriculture, Fisheries and Aquaculture;
- Terry Melanson, Fisheries and Oceans Canada;
- Paul Milburn, Agriculture and Agri-Food Canada (Research);
- Gilles Moreau (agrologists), McCain Foods Ltd.
- Ron Pond, Land Development, New Brunswick Department of Agriculture, Fisheries and Aquaculture;
- Darryl Pupek New Brunswick Department of the Environment and Local Government;
- Paul-Émile Soucy, Président, Fédération des Agriculteurs et Agricultrices Francophones du Nouveau-Brunswick;
- Roger Thériault, Provincial Environmental Agriculture Consultant, New Brunswick Department of Environment and Local Government; and
- Paul Vanderlaan, Manager, Water Sciences Section, New Brunswick Department of the Environment and Local Government.

Annex 4-2: Workshop Attendees

The following 15 individuals attended the workshop held in Fredericton, New Brunswick on January 10, 2003:

- Susananah Banks, New Brunswick Soil & Crop Improvement Association;
- Leopold Bourgois, Kentville Co-Op;
- Glen Brandt, Agriculture and Agri-Food Canada (Client);
- Annie Daigle, New Brunswick Department of the Environment and Local Government;
- Jean-Louis Daigle, Director, Eastern Canada Soil & Water Conservation Centre;
- Dwayne Hicks, President, New Brunswick Soil & Crop Improvement Association;
- Bruce Kinnie, Land Development, New Brunswick Department of Agriculture, Fisheries and Aquaculture;
- Patton MacDonald, Executive Director, Potatoes New Brunswick;
- Terry Melanson, Fisheries and Oceans Canada;

- Benoit Michaud, Kentville Co-Op;
- Gerald Pelkey, New Brunswick Project Manager, ACER Environmental Services Ltd.;
- Ron Pond, Land Development, New Brunswick Department of Agriculture, Fisheries and Aquaculture;
- Roger Richard, Rogersville Farmer;
- Paul-Émile Soucy, Président, Fédération des Agriculteurs et Agricultrices Francophones du Nouveau-Brunswick; and
- Ann Wilkie, Project Manager, CBCL Limited.

Chapter 5 **Prince Edward Island**

5.1 Context

As indicated in Chapter 2, the work program in each province involved:

i) a survey of those in government, industry and associated institutions or groups with an interest in subject matter;

ii) a review of pertinent literature; and

iii) a workshop or conference call.

The intent of each of these activities was to:

i) identify the nature and extent of the water supply constraints on agriculture in each of the our Atlantic provinces;

ii) determine the water supply development priorities; and

iii) prioritize those factors that will provide the basis for the intended approach and strategy to implement NWSEP in Atlantic Canada.

This chapter presents the findings of the work undertaken in Prince Edward Island (PEI). Figure 5.1 depicts the Census Agricultural Regions in the Province, the major watershed boundaries, the counties and key settlements.

5.2 Consultation Results

5.2.1 Overview

A total of 11 individuals were consulted in PEI (see Annex 5-1).

It is generally acknowledged that unpredictable changes in weather patterns are becoming more evident and wider variations in precipitation events make it more difficult to rely on rainfall alone to meet crop demands. It is not so much the lack of total rainfall received during the growing season that causes a problem, but more often the lack of moisture at critical times during crop growth and development. Initial consultations revealed that, in many cases, irrigation is becoming a more significant tool for managing the risks associated with crop production. While producers realize that irrigation may not be required every year, in light of the water shortages in recent years, farmers are looking closer at the options available to them to keep their crop yields up, since crop insurance programs are becoming less appealing. This is especially true for many cash crops, including lowbush blueberries, vegetables (broccoli, cauliflower, carrots) and processing potatoes.

In particular, growers who are producing crops for processing (i.e., broccoli and cauliflower for Island Quality Vegetables and potatoes for french fry plants) are required to provide a steady supply of high quality product to meet the requirements of the processors' contracts. For french fries, buyers expect a continuous supply of the product, whether or not it is a favorable year for the crop. This is particularly the case for Cavendish Farms, who conduct most of their global processing on PEI, as opposed to McCains who can source fries

from other areas in the world. The same is true of the buyers of processed cole crops produced by Island Quality Vegetables.

Recent studies (some unpublished) show that PEI has a large groundwater resource that could be utilized for irrigation purposes to a much greater extent than it is currently being used. From a resource management point of view, it is preferable to use groundwater rather than surface water (streams) for irrigation, due to the reduced environmental impacts. It is generally felt that the current regulatory process of groundwater allocation could adequately protect the groundwater resources as a whole, while allowing for the greater use of groundwater for irrigation in most watersheds.

There is, however, public (and political) opposition to the use of groundwater for irrigation purposes, and the Provincial Government has placed a moratorium on the drilling of high capacity wells for irrigation purposes for the past year or more. In response to this, some growers have constructed dugouts for irrigating their crops. The Provincial Department of Agriculture, Fisheries and Forestry has assisted in the construction of 12 dugouts for berry production, four bypass ponds and three dugouts for potato production and one dugout for vegetable production purposes. It is estimated that the total volume of these impoundments is approximately 150,000 cubic metres (33 million Imperial gallons) (S. Anderson, personal communication). These dugouts are filled through the collection of runoff by gravity from nearby streams or from low-capacity wells located near the dugout. Groundwater diversions less than 3.8 litres per second (50 Imperial gallons per minute) do not require a Ground Water Exploration Permit.

Although the preferred source of irrigation water for many growers and the Department of Environment is from groundwater, it is not known whether, or when, the government will lift the ban on high capacity wells. The Department of Environment is also cautious about increasing the level of irrigation that can take place from streams due to the immediate, direct effect on the stream flow. Many growers and some processors are calling on the provincial government to either lift the ban on wells, or to assist with costs of developing other methods of obtaining water for crop irrigation. Several alternative water sources have been proposed including use of wastewater from processing plants and the construction of dugouts that could be filled by small wells, stream diversions or springs. There has been to date no movement by the government to address this issue, but some processors insist that irrigation is crucial for the viability of their business and for the future of the agricultural sector.

Other areas where assistance would be useful have been identified as follows:

- support for the continued monitoring of water resources;
- support for the conduct of crop irrigation research for PEI crops; and
- support for the development and delivery of training courses in irrigation management for producers.

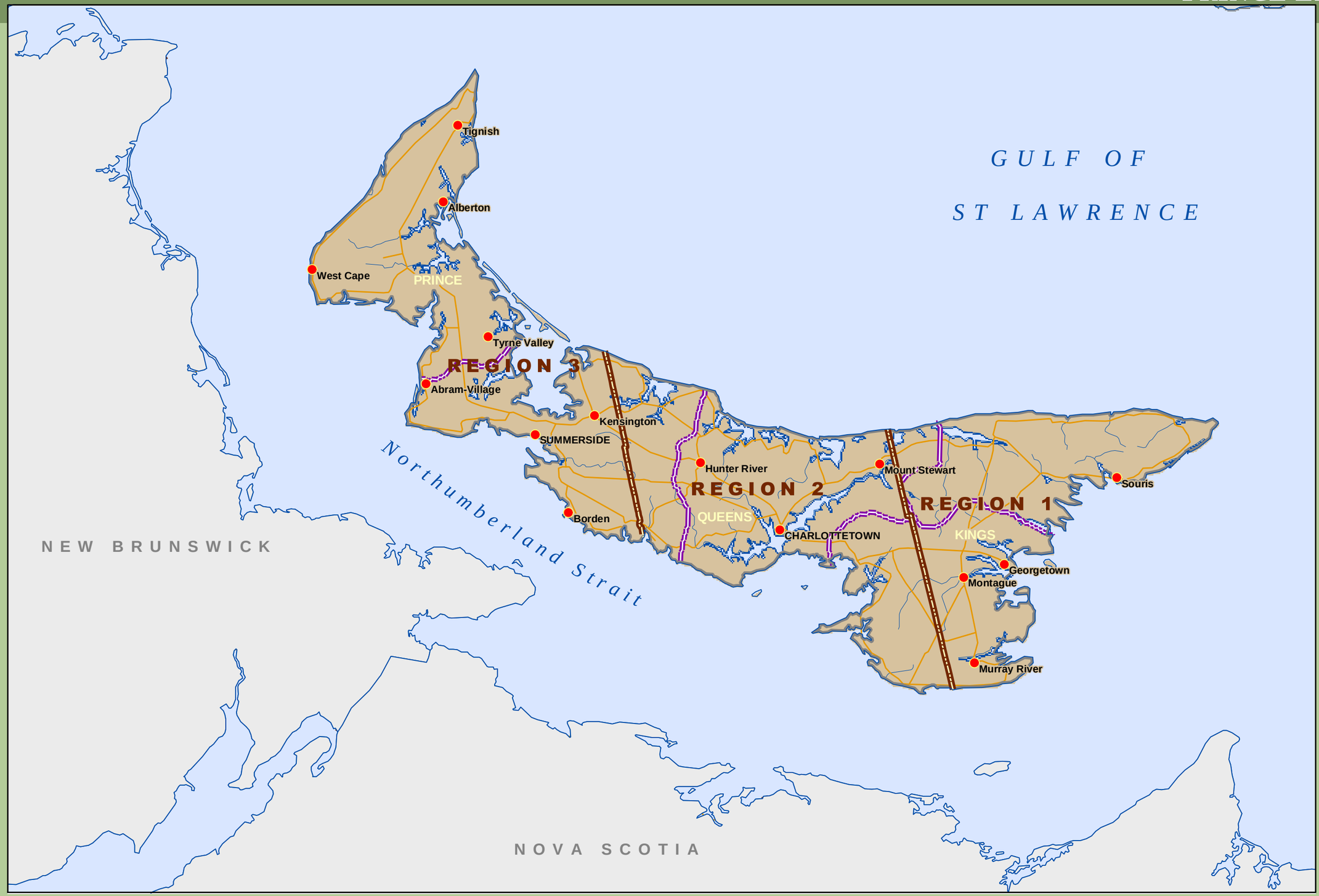
5.3 Literature Review

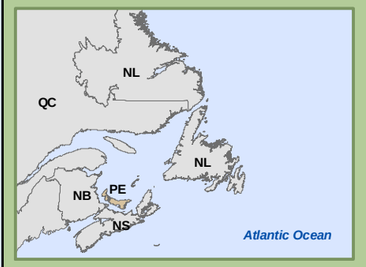
5.3.1 Key Texts, Reports and Articles

The texts, reports and articles reviewed for this study are identified in Appendix A. The following provides a brief account of the key findings arising from the materials reviewed.

AGRICULTURAL WATER SUPPLY ISSUES

PRINCE EDWARD ISLAND





- Cities / Towns
- Roads
- Rivers
- Census Agricultural Region Boundary
- Watersheds Boundary
- County Boundary
- Other Provinces

N

The following scale bar should measure 4 cm (30 km)

0 15 30 Kilometres

If not, the scale is not the same as stated and should be changed accordingly.

Data Source: Natural Resources Canada
http://geogratis.cgdi.gc.ca

File Name: 5_pe_1.mxd (5_pe_1.pdf)

10 5 0 10 20 30 40 Kilometres

Prince Edward Island

Figure:	5.1
Scale :	1:1 750 000
Issue Date :	March, 2003
Cartography By :	Shiju Mathew

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The 2001 census on agriculture counted 1,845 farms in PEI, down approximately 17% from 2,217 in 1996, with numbers declining in all three counties, i.e., Kings, Queens and Prince Counties. In 2000, farmers reported 261,593 hectares (646,137 acres) in farmland, a 1.4% decline. Total cultivated cropland, however, rose 3.0% to 175,563 hectares (433,641 acres). The average farm size increased from 120 hectares (296 acres) in 1996 to 142 hectares (350 acres) in 2001 (Statistics Canada, 2002).

PEI's total gross farm receipts were $396 million in 2000, while operating expenses reached $338 million. Five years earlier, at 1995 prices, receipts totalled $349 million and expenses $289 million. A total of 866 farms reported gross receipts of less than $50,000 in 2000, a 27.8% decline. These farms represented 46.9% of the farms and 3.4% of gross farm receipts reported for 2000. A total of 433 farms reported gross receipts of $250,000 or more, up 14.9%. They accounted for 24% of farms and 80% of gross farm receipts. The number of farms with gross receipts greater than $250,000 increased 11.3% in Kings County, 19.1% in Queens County, and 1.1% in Prince County. The number of farms in all other sales brackets declined in all three Counties. This indicates that farm size, in terms of gross receipts, is rising on the Island (Statistics Canada, 2002).

In 2001, cattle farms accounted for 26% of all PEI farms, while potato farms comprised 19%, and dairy farms, 17%. These figures represent the major commodity produced on the operation, but it should be noted that many farms consist of more than one enterprise. A total of 468 farms reported growing potatoes in 2001, down 28.2% from five years previously. Island farmers planted 43,275 hectares (106,889 acres) of potatoes in 2001, down 1.2% from 1996. Since 1981, however, total potato acreage in PEI has soared by 67.3%. Most of the increase in potato production can be attributed to increases in the processing capabilities on the island, primarily by Cavendish Farms and McCain Foods. In 2001, potatoes accounted for one-quarter of the Island's total cropland. Approximately 55% of the Island's total potato acreage is located in Prince County (Statistics Canada, 2002).

Other crops have also increased in acreage from 1996 to 2001. These include carrots and rutabagas, which increased moderately by 5% and 14% respectively, and cole crops, most notably cauliflower and broccoli which increased by over 300% in that time period. These increases are due mainly to the increased demand from processors. In addition, the reported acreage of lowbush blueberries increased in that 5 year period from 2,175 hectares (5,372 acres) to 3,149 hectares (7,778 acres), an increase of almost 45% (PEI Department of Agriculture and Forestry, 2000).

It has been observed by growers who currently have the capability to irrigate their crops that in PEI irrigation is not required every year for most crops. Due to an increase in the unpredictability of weather patterns, wider variations in rainfall and the trend to warmer growing seasons (Bootsma et al., 2001), irrigation is becoming more important to minimize crop losses caused by the lack of moisture at critical times during crop growth. Cavendish Farms, for example, has reported an average increase in total yield of over 11 tonnes/hectare (100 cwt/acre) in the Russet Burbank crop due to irrigation in 2001, a very dry year. In 2002, they found almost 11 tonnes/hectare (100 cwt/acre) increase in total crop yield of Russet Burbanks and almost 9 tonnes/hectare (80 cwt/acre) in the Shepody variety (Coffin, 2002). In response to this research and due to needs of their customers, Cavendish Farms has set a goal of having 4,860 hectares (12,000 acres), or 30% of their contracted crop, under irrigation. At the present time approximately 1,200 hectares (3,000 acres) are irrigated. In

another study, Sanderson and Howatt (2002, unpublished) observed a 50% increase in the marketable broccoli yield in 2002, due to irrigation. Growing season rainfall in 2002 was recorded at only 10% below normal, but it was not the total quantity received that was a factor so much as the timing of the rainfall that was received. Where it occurred, supplemental irrigation was able to ensure that crops had sufficient water at critical periods in their development, which is of particular importance for the Island's vegetable, blueberry and potato industries.

As documented in "Some Physical Facts About PEI", Prince Edward Island has some unique physical characteristics that have a direct impact on the water supply. Most of the Island has fine, sandy loam soils, plenty of rain, and a gently sloping terrain. Beneath the soil is a thick, fractured formation of sandstone bedrock, which stores a vast reservoir of readily available groundwater close to the surface. Because of the fractured nature of the bedrock, a relatively high proportion of the rainfall received seeps down to "recharge" the groundwater supply. Groundwater is the principal source of drinking water in PEI.

In PEI, the boundaries of the groundwater flow systems are virtually the same as those of the watersheds on the surface. The Provincial Government document, "Groundwater – Our Invisible Resource", states that approximately one third of the annual rainfall finds its way underground to recharge the aquifers. The greatest amount, approximately 60-70%, of recharge occurs in the spring when water from melting snow and precipitation soaks into the ground and when there is limited loss of water through evaporation or transpiration. Thus, the water table tends to be highest across PEI in the spring. Recharge rates are much lower in the summer when higher temperatures and vigorous plant growth result in more evaporation and transpiration of water. Thus, from spring through to fall, the water table gradually falls. In the fall, when growth slows and evaporation decreases, it is common to have a second, smaller, recharge event, which can last until the ground freezes or precipitation falls as snow. The water table levels then gradually decline until spring.

The degree of rise and fall of the water table varies from year to year and from one area of the Province to another, depending on weather conditions and topography. However, the greatest fluctuations generally occur in the higher regions of a watershed where the water table can fluctuate by five metres or more on an annual basis. In the lower areas of a watershed, which are closer to sea level, the level of the water table may change by a metre or less in the course of a year.

As described in "Monitoring the Groundwater on PEI" on the Provincial Government website, water table elevations are continuously monitored in Prince Edward Island. There are twelve observation wells across the Province that are maintained by the Water Resources Division of the Department of Fisheries, Aquaculture and Environment. These observation wells are instrumented and monitor fluctuations in the water table on a daily basis. Updated information from each of the sites is available from the PEI Government website.

All high capacity wells (those pumping greater than 3.8 L/s (50 imperial gallons per minute) and all wells to be used for a central water supply system must obtain a Groundwater Exploration Permit (GWEP), according to the provincial *Groundwater Exploration Permit* document. The GWEP, to be filled out by the proponent, identifies the proposed location, expected pumping rate, pumping schedule and other groundwater users in the area. Departmental staff reviews the application and, if approved, issues the permit specifying the testing and

monitoring requirements. The Groundwater Allocation is issued after assessing the test information collected in the GWEP and determining that the groundwater extraction will not have any significant impact on other groundwater users, or the environment.

It has been noted in "Groundwater – Our Invisible Resource" that although the levels of PEI's water tables vary, there is always an abundance of groundwater in PEI. On average, only about two percent of the total recharge to our groundwater system is ever used, with the unused amount contributing to stream discharge. In the few areas with heavy industrial or municipal water demands, withdrawals may be as high as 50 percent of recharge. As a general rule, this is the maximum level of withdrawal that is approved under the GWEP allocation procedure, so that enough groundwater is left to discharge into streams and maintain a healthy level of flow.

In 1995, the Province implemented an *Agricultural Irrigation Policy*. This document makes reference to two sources of water, namely groundwater and surface water. Considering the high rate of recharge for island aquifers and because water extraction for irrigation purposes is of a short term nature, it was concluded that water use for irrigation purposes would have a negligible impact on groundwater reserves. The Policy states "*The use of groundwater reserves as a source of water supply for agricultural irrigation purposes is considered to be a viable and sustainable option in terms of water availability and environmental impacts*". This has been verified in studies conducted in the Province (Somers and Mutch, 1999). A major concern associated with irrigation from groundwater reserves is the potential impact of groundwater extraction on discharge available for streams. Irrigating from streams is less preferable under the Agricultural Irrigation Policy, and requires a Watercourse Alteration Permit and a Water Withdrawal Permit. The construction of storage ponds adjacent to streams has been encouraged to reduce the withdrawal rate of water from the stream, but the indirect effects of these ponds on maintenance flow of the streams are being re-evaluated (G. Somers, personal communication).

5.3.2 Existing Programs and Initiatives

There are no specific funding programs available to PEI producers for aid in sourcing water for agriculture or for developing infrastructure related to irrigation.

The Sustainable Resource Conservation Program is a one year program designed to assist producers in making their farm operations more productive and sustainable, while at the same time achieving compliance with any new or existing environmental protection legislation. The goals of this program include the reduction in the risk of water contamination from agricultural practices, the improvement and protection of the quality of the soil of Prince Edward Island's agricultural land, and the reduction in the risk and use of pesticides. Funding is available on a cost-shared basis to a maximum of $35,000, and is limited to single-year projects. It is anticipated that a similar program will be instated in April, 2003.

Participation in the Environmental Farm Plan Program (EFP) is a prerequisite for obtaining funding through the Sustainable Resource Conservation Program. EFP is a voluntary program to help farmers identify and assess environmental risk on their property. The program allows farmers to incorporate environmental considerations into their everyday business decisions, rather than addressing environmental issues in a reactive sense. Farmers work with the EFP Program Co-ordinator to develop a confidential environmental

farm plan for their operation. This is a service provided by the Prince Edward Island Federation of Agriculture with funding from Agriculture and Agri-Food.

5.4 Workshop: Objectives and Findings

5.4.1 Objectives

An Agricultural Water Supply Workshop was held in Charlottetown, PEI, on January 8, 2003. The objectives of the workshop were:

i) to discuss the primary water supply constraints facing agriculture in PEI; and

ii) to define the priorities for possible funding under the NWSEP.

As identified in Annex 5-2, a total of 22 people including the proponent and representatives of the study team participated in the workshop.

The workshop participants confirmed that the study team had accurately represented the agricultural water supply issues in the Province in the interim working paper that had been circulated. The subsequent discussion was based upon the Island as a whole, with few distinctions being made between regions in relation to water supply concerns.

5.4.2 Water Supply Constraints

Within PEI, there is currently a moratorium on well development for irrigation. The Department of Fisheries, Aquaculture and Environment have been studying groundwater use over the past year as the basis for future policy decisions. Some of the main findings of their technical research were discussed. Overall, PEI has large groundwater resources, but fresh surface water is limited since stream flow on the Island is largely dependent on groundwater supplies. Groundwater discharge contributes 60-70% of stream flow on an annual basis; during the growing season this approaches 100%.

Due to the small land base, agricultural, municipal and industrial demands often take place in the same watershed, thus it is necessary to examine their needs simultaneously. In the past, surface water and groundwater resources were managed separately, and there tended to be a relatively low demand for groundwater. The allocation of surface water is based on detailed studies of the amount of water required in the streams to maintain fish habitat, and the amount available is based on the amount of water in stream in any particular month. The allowable extraction of groundwater from an aquifer cannot exceed 50% of annual recharge. Currently, in terms of groundwater to meet the irrigation demand, there is a very low-density distribution of high capacity wells. The recent increased demand and increased water shortage conditions indicate that this resource needs to be managed better. Many in the agricultural community feel that since surface water extractions must be limited during the growing season, groundwater is a much more reliable resource; it should also be a sustainable resource as long as less than 50% of recharge is allocated and used.

Specifically, the goals of the current research being conducted by the Department of Fisheries, Agriculture and Environment are to:

- develop a plan that would allow water resources to be allocated on a fair basis for all sectors;
- ensure that all people would have equal access to water despite distance from source;
- harmonise the technical considerations in terms of potential environmental impacts;
- determine current and future demands; and

- develop effective groundwater policies if fundamental to managing the resource for sustainability.

The existing network of observation wells has shown no significant drop in the water table since the early 1960s, and no impacts on wells from competing demands on the groundwater resource. There appears to be more of a potential for groundwater to meet current and future demands than surface water based on relative abundance and the hydrologic regime. Although there have been no acute problems resulting from the current situation, the Province wants to work towards a broad management plan for groundwater resources. Unlimited and unrestricted use could cause shortages, and the moratorium was put in place to prevent uncontrolled development before it could be assessed.

In addition to quantity, there has been a basic consideration of quality, mainly with respect to nitrate and salinization. With respect to agricultural water supply expansion, increased irrigation is anticipated to decrease the amount of nitrate entering the hydrologic cycle. This theory is based on the fact that plants are better able to uptake land applications of fertiliser when water is available, which means less of this fertiliser may be washed into the watercourses or might infiltrate to the groundwater. In dry conditions, fertilizers are not sequestered by the plants and may be washed into the watercourses during a precipitation event. It is expected that soil salinization will not become a problem through increased irrigation. In PEI the dissolved solids in the groundwater is comparable to areas that are experiencing salinization, however recharge rates are comparatively higher and evaporation rates comparatively lower therefore soil salinization in not considered an issue in the Province.

The need for a clear public policy regarding access to groundwater, and under what conditions it can be accessed, was identified. It was also felt that the Province needs experienced help to develop information and education on specific irrigation issues, e.g., sourcing water and applying it to crops. AAFC experience and technical support in this regard was considered essential.

5.5 Key Issues

Due to the water shortage conditions in recent years, the issue of water supply for agricultural irrigation purposes has gained much attention within the Province. While it is generally felt that there is a huge groundwater resource that, if carefully managed, could meet the water needs for agriculture, there is some hesitation on the part of the policymakers to allow for rapid expansion into this resource. Public perception is at the forefront with regards to the management of the groundwater resource. Based on a review of the literature and consultation with various stakeholders, the following were identified as the major constraints to water supply for agriculture on PEI:

- Current provincial moratorium on the drilling of high capacity wells for irrigation purposes which results in many producers having concern over their limited access to groundwater resources coupled with lack of moisture at critical times during crop growth and development;
- Irrigation is essential for crops such as blueberry and cole crops where a relatively short dry period at critical times could mean significantly reduced yields, or the loss of an entire crop;
- Public concern regarding the use of groundwater resources for irrigation purposes, i.e., the public is generally of the opinion that agricultural use of the groundwater aquifers would have an adverse impact

on both water quantity and quality including anticipation of dry wells, the draw-down of water tables, saltwater intrusion and nitrate contamination;

- Lack of access to technical expertise with respect to irrigation needs and system options, dugout construction and the nature of alternative irrigation systems; and
- Lack of available irrigation research, cost/benefit analysis and data on best management practises and alternative strategies such as soil husbandry and conservation techniques such as mulches, buffers and crop covers.

It was agreed that because the provincial government writes water management policy, it is their place to present and defend those policy decisions to the public with regards to concerns over usage. It is expected that future water management policies will have equitable access to water for all stakeholders as a fundamental component. Water allocation was seen as key to knowing what water is available to producers, although it was understood that this is a provincial issue, not one that could be addressed federally, or in this report.

Many believe that there is a need for a communication strategy to address the facts about irrigation and water quality and a need to create a broad-based public understanding of the issues. It was suggested that the distribution of monitoring well data, strategic alliances with communities and watershed groups, or the identification of a spokesperson for the agricultural industry might all help to counter public misconceptions. Increased funding for groundwater monitoring and/or stream gauging were also supported.

Producers are interested in source development. Any funding arranged, however, should be available both to the individual producer and to groups of producers. The underlying concern is that there is a real lack of technical expertise with regards to pond design, construction, water quality issues and pond maintenance.

It was noted that there is some limited potential for Island farmers to work together to address water supply issues. The main concerns in PEI include a lack of land for the development of large ponds, as well as problems associated with the potential need to run irrigation pipelines across various property lines. However, pending the lifting of the moratorium, there may be some potential for the establishment of water co-ops where the capital costs could be shared between producers for well development. Currently some 30-35 deep-water well permits have been issued, with almost twice that many applications pending removal of the moratorium.

The priority areas and activities identified by the workshop participants to aid in agricultural water supply issues were:

i) *Irrigation Education for Farmers*: i.e., information on best management practises for irrigation and applied research initiatives in various parts of the Island at the field level. Research should be multi-stakeholder;

ii) *Technical Assistance for Source Development*: particularly if the moratorium remains in place, there would be a requirement for assistance in developing by-pass ponds and other alternatives to deep wells; and

iii) *Financial Assistance for Source Development*: although it is not expected that the funds available through NWSEP will be sufficient, workshop participants felt strongly that they do require assistance

for source development, whether the moratorium on drilling of wells is lifted or not. The cost of source development, and therefore demand for financial assistance will be much lower should the moratorium be lifted as, typically, high capacity wells are less expensive than surface water storage options.

5.6 Recommendations

The use of irrigation systems in PEI is still limited. Approximately 3-4% of producers irrigate, and irrigation on the Island is needed only on occasion. The investment in such systems can be looked at from a risk management perspective, i.e., it is there when you need it; or as an economically wise investment, i.e., it is guaranteed to increase profit margins. Producers are trying to attain a balance between the standards that they need to meet to satisfy the processor versus the investment they can afford while still making a profit.

It was acknowledged that there was little or no publicly funded research with respect to irrigation on PEI. The research that is taking place on the Island is processor driven which was thought to be potentially biased towards irrigating, because irrigating has been seen to increase the size of the potato grown which, in turn, provides the desired market product. This argument was countered by the fact that it is difficult to obtain public funds for irrigation research when it is in such limited use on the Island. What is needed is multi-stakeholder research, which may change public perceptions.

Based on the materials compiled and the discussions that occurred at the workshop, the following priorities have been identified:

- Irrigation education for producers;
- Technical assistance for source development; and
- Financial assistance for source development.

The estimated project costs for source development were discussed. Given the many unknowns, it was acknowledged by all that such estimates are very coarse. The following are estimates generated through discussion:

- The estimated costs for the development of a surface water source per 40 to 50 hectares (100-125 acres) is $60 000;
- The estimated irrigation required on PEI is 8,000 hectares (20,000 acres) which is equivalent to 200 irrigation systems of 40 hectares (100 acres) each; and
- The total cost estimate for surface water source development was therefore estimated at $10-20 million, not including technical assistance, irrigation equipment, and labour costs.

Annex 5-1: Personnel Consulted

The following 11 individuals were consulted in Prince Edward Island:

- Scott Anderson, Soil and Water Engineer, PEI Department of Agriculture and Forestry;
- Robert Barry, Project Engineer, Cavendish Farms;
- Robert Coffin, Research Agronomist, Cavendish Farms;
- Nancy Lovering, PEI Horticultural Association;
- Christine MacKinnon, Director, Sustainable Agriculture Section, PEI Department of Agriculture and Forestry;
- Andrew MacLeod, Project Engineer, Cavendish Farms;
- Paul MacPhail, Potato Specialist, PEI Department of Agriculture and Forestry;
- Jamie Mutch, Hydrogeologist, PEI Department of Fisheries, Aquaculture and Environment;
- Bruce Raymond, Rivers and Estuaries Section Head, PEI Department of Fisheries, Aquaculture and Environment;
- Brian Sanderson, Research Scientist, AAFC, Charlottetown; and
- George Somers, Groundwater Section Head, PEI Department of Fisheries, Aquaculture and Environment.

Annex 5-2: Workshop Attendees

The following 22 individuals attended the workshop held in Charlottetown, Prince Edward Island on January 8, 2003:

- Stuart Affleck, Seed Potato Grower, PEI Potato Board;
- Scott Anderson, Soil and Water Engineer, PEI Department of Agriculture and Forestry;
- Glen Brandt, Agriculture and Agri-Food Canada (Client);
- Mark Butcher, Crop Consultant, Phoenix Agriculture Services;
- Robert Coffin, Research Agronomist, Cavendish Farms;
- Merle Ellis, Potato Grower, PEI Potato Producers Association;
- Dwight Gardiner, Processing Potato Grower, PEI Potato Board;
- Steve Howatt, Project Researcher, Atlantic AgriTech Inc.
- Yefang Jiang, Hydrogeologist, PEI Department of Fisheries, Aquaculture and Environment;
- Robert MacDonald, Potato Grower, Member of the PEI Federation of Agriculture;
- Kenny MacLellan, Dairy/Potato grower, President of PEI Federation of Agriculture;
- Paul MacPhail, Potato Specialist, PEI Department of Agriculture and Forestry;
- Teresa Mellish, Manager of Sustainable Agriculture Section, PEI Department of Agriculture and Forestry;
- Karen Murchison, PEI Federation of Agriculture;
- James Mutch, Hydrogeologist, PEI Department of Fisheries, Aquaculture and Environment;
- Chris Pharo, Market Information Service Branch, AAFC;
- Brian Sanderson, Soil and Water Research Scientist, AAFC Charlottetown;
- Annabelle Singleton, Project Researcher, CBCL Limited;
- George Somers, Groundwater Section Head, PEI Department of Fisheries, Aquaculture and Environment;
- Rose Viaene, Vegetable Grower representing PEI Horticultural Association;
- David Viaene, Vegetable Grower representing PEI Horticultural Association; and
- Ann Wilkie, Project Manager, CBCL Limited.

Chapter 6 Newfoundland and Labrador

6.1 Context

As indicated in Chapter 2, the work program in each province involved:

i) a survey of those in government, industry and associated institutions or groups with an interest in subject matter;

ii) a review of pertinent literature; and

iii) a workshop or conference call.

The intent of each of these activities was to:

i) identify the nature and extent of the water supply constraints on agriculture in each of the our Atlantic provinces;

ii) determine the water supply development priorities; and

iii) prioritize those factors that will provide the basis for the intended approach and strategy to implement NWSEP in Atlantic Canada.

This chapter presents the findings of the work undertaken in Newfoundland and Labrador. Figure 6.1 depicts the Census Agricultural Regions in the Province, the major watershed boundaries, the census enumeration areas and key settlements.

6.2 Consultation Results

6.2.1 Overview

A total of 21 individuals were consulted in Newfoundland and Labrador (see Annex 6-1). As a result of these consultations, it has been concluded that water supply in Newfoundland and Labrador is not considered a serious or priority issue. The Province does, occasionally, experience short dry periods during the summer months, but agriculture is generally maintained by rainfall, access to surface water and soil moisture retention. Irrigation systems are used primarily for frost protection for strawberry crops and often only require the periodic use of a garden hose or pump from a nearby surface water source. Further investment in irrigation infrastructure is unlikely to be an attractive option due to the added cost that would be incurred by individual farmers for limited gain. Farmers experiencing a poor crop season are more likely to seek support through crop insurance.

Since there are distinctions between agricultural practices on the island of Newfoundland and Labrador, these areas are addressed separately.

i) *Island of Newfoundland*

The main agricultural areas on the island of Newfoundland, in decreasing order of importance, were identified as:

- Avalon Peninsula;
- Codroy and Humber Valleys;

- Lethbridge; and
- Wooddale.

The principle agricultural issues identified in Newfoundland were as follows:
- Poor drainage of farm land;
- Suitability of soils for agriculture;
- Limited access to the necessary land base; and
- Potential water supply contamination and manure management issues.

Much of Newfoundland is not suitable for farming due to poor soils, or lack of topsoil, and the lack of adequate drainage. Soils throughout much of the island are extremely stony, and often have a high mineral content. Because the water table is often close to the surface, improper field drainage means reduced crop yields. Studies have shown that proper field drainage could improve forage yields by 50% on average (Coote and Gregrich, 2000). Until recently, however, farmers have had limited access to drainage technology and appropriate equipment. Farmers therefore often opt to clear additional lands, when available, instead of working to increase yields from poorly drained fields. Federal funding is now facilitating both an expanded agricultural drainage program and research into the installation of subsurface drainage systems; the costs of which are shared between the producer and government (AAFC – Atlantic Cool Climate Crop Research Centre 2001).

Farmers in Newfoundland are challenged by having limited access to an adequate land base. While certain areas have been identified as having soils suitable for arable purposes, much of this land remains forested and under government lease to private forestry companies. As many of the 100 year leases granted to the forestry industry are due to expire in the coming years, the agricultural community is lobbying to increase their share of this land base.

Soil suitability and urban encroachment are the principal concerns on the Avalon Peninsula. In the St. John's Urban Region there has been a freeze on the sale of land zoned for agricultural purposes since 1973 to prevent urban encroachment onto productive farmland. Infringement and the inability of farm operations to expand in this area remain key issues. Some additional land for agricultural use has been identified within the St. John's region, but it is still forested. Further study of these areas is necessary, particularly with respect to their susceptibility to flooding and to consequences associated with clearing them for agricultural use.

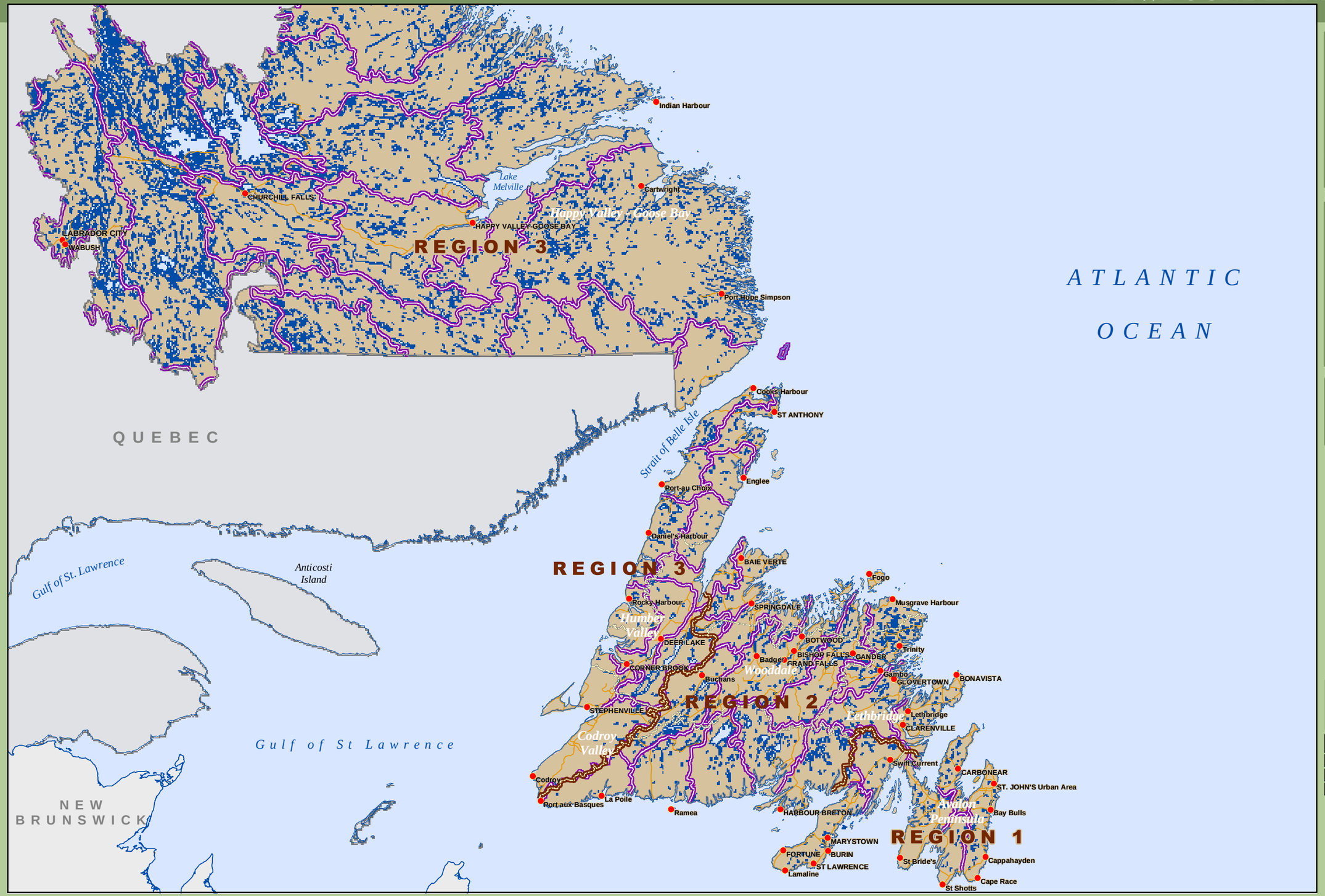
Contamination and manure management were identified by a number of respondents as concerns in the St. John's Urban Region. Several of the dairy farm operators within the region, who have attempted to expand their operations, have found manure management to be an increasingly challenging task. In this region, farmers have no option, but to transport liquid manure to a limited number of designated outlying forage lands. This can increase the farm's overhead costs considerably.

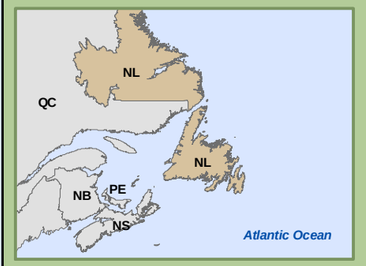
ii) *Labrador*

Labrador has a small agricultural community and limited availability of productive soils. Approximately 40 hectares (100 acres) of land are in production in the Lake Melville area around Happy Valley-Goose Bay. The sandy soils in this area lend themselves to improvement and can be efficiently worked. Commercial production in this area includes potatoes and fur farming of fox and lynx, as well as limited production of

AGRICULTURAL WATER SUPPLY ISSUES

NEWFOUNDLAND & LABRADOR





- Cities / Towns
- Roads
- Rivers
- Census Agricultural Region Boundary
- Watersheds Boundary
- Census Division & Boundary
- Other Provinces

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The following scale bar should measure 2 cm (80 km)

0 40 80 Kilometres

If not, the scale is not the same as stated and should be changed accordingly.

Data Source: Natural Resources Canada
http://geogratis.cgdi.gc.ca

File Name: 6_nl_1.mxd (6_nl_1.pdf)

Newfoundland & Labrador

Figure:	6.1
Scale :	1:1 750 000
Issue Date :	March, 2003
Cartography By :	Shiju Mathew

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mixed vegetables, fruit, livestock, and poultry. The produce is either sold to local markets, or used for family subsistence. With improved communication to central Labrador, producers in this area may increasingly be able to market beyond the local area.

The primary agricultural issue in Labrador is limited access to the necessary land base governed by the provincial *Lands Act, Form of Tenures and Agriculture Policy.* This policy was established to protect the limited lands deemed suitable for agriculture within the Province. The policy allows 50-year agricultural leases to farmers on Crown land, but does not give them the option to buy the land. Nor does the policy make provision for the zoning of a section of land for homesteading until after an extensive period of time in the lease (approximately 15 years) has elapsed. This means that many farm families must manage two properties: one where they live and the other where they farm. This policy is currently under review. Another issue limiting agriculture, particularly in Labrador, is access to farm equipment.

6.3 Literature Review

6.3.1 Review of Key Texts, Reports and Articles

The text, reports and articles reviewed for this study are identified in Appendix A. The following provides a brief account of the key findings of the materials reviewed.

According to the latest statistical analyses of agriculture in Newfoundland and Labrador, the industry involves 643 farms and 100 food manufacturers, employing approximately 4,000 people. The dairy sector is the largest component of the industry constituting 33% of the farm cash receipts. Chicken and egg production are also important accounting for 30 and 14% of the receipts respectively. Floriculture and nursery crops account for 11%. In 2001, there were 8,438 hectares (20,843) acres of land in crops, an increase of almost 35% from ten years earlier (NL Department of Forest Resources and Agrifoods, 2001).

Although most agricultural sectors in the Province have expanded over the last decade, the growth in the dairy sector is the most notable. The provincial dairy industry has expanded to the point where the Province is not only self-sufficient, but is an exporter of liquid milk. This growth is expected to continue. Milk production, for example, is expected to double over the next 15 years as a result of the 2001 government negotiations with the Canadian Milk Supply Management Committee which will support milk production for value-added products such as yogurt, butter and ice cream. The new quota will be gradually phased in to allow farmers the opportunity to upgrade their facilities and to develop new farmland (NL Department of Finance 2002).

The study team did not identify government documentation that clearly outlined either the challenges confronting farming in the Province or the key agricultural issues. The government, however, has been proactive in providing guidance to, and standards for, the industry. The provincial Department of Forest Resources and Agrifoods has established voluntary environmental guidelines (agricultural Best Management Practices) for livestock, poultry and horticultural producers that focus on soil, nutrient and pesticide management as well as water quality protection.

Provincial regulations pertaining to water as a resource were also reviewed. The *Water Resources Act* and the *Policy on Land and Water Related Development in Protected Public Water Supply Areas,* regulate the use of

water for agricultural purposes. The *Water Resources Act* defines water used for agricultural purposes under both "domestic use" and "municipal use". Under "domestic use" a person owning land adjacent a waterway may use a quantity of that water for the watering of domestic livestock and the irrigation of a garden that adjoins a dwelling house (riparian right) without a license. This would be the case for most mixed-production farmers using surface water for their watering needs. While many of the dairy producers have invested in drilled wells to meet their needs, the watering of animals and gardens may also be considered as a "municipal use" for which a license is required. This would apply to irrigation systems where the diversion of water used might be considerable.

The provincial *Policy on Land and Water Related Development in Protected Public Water Supply Areas* cites, "the development of farm lands for crop production, forage production, vegetable production, and blueberry and other fruit production" as permitted activities, regulated through the use of buffer zones within designated public water supply area. The storage and disposal of pesticides and manure, application of manure and chemicals in specified buffer zones, extensive land clearing, and the installation of pipelines for transmission of water for agricultural activities are not permitted in a designated area.

It is noted that water supply does not appear to be a limiting factor for agriculture in Newfoundland and Labrador. The agricultural growing season in Newfoundland and Labrador is June 1 to September 30. It is characterized by a cool wet spring, warm summer with ample rainfall, and a cool wet fall. 1995 records indicate that all areas of the Province received an average annual precipitation that ranges from a low in proximity to Happy Valley – Goose Bay of 600 mm to a high in the Avalon Peninsula, Codroy and Humber Valleys of over 1,700 mm (Environment Canada, 2003). The average precipitation "normals" for selected weather monitoring stations in the vicinity of Newfoundland and Labrador's main agriculture areas during the expected growing season are provided in Table 6.1.

Table 6.1: Average Precipitation During Newfoundland and Labrador's Growing Season

Weather Stations	***May***	***June***	***July***	***Aug***	***Sept***
St. John's A Precipitation (mm)	100.9	101.9	89.4	108.1	130.9
Deer Lake A Precipitation (mm)	72.9	80.3	91.6	100.1	96.2
Wooddale Bishop's Falls Precipitation (mm)	76.5	84.2	84.1	98.2	98.6

Source: Environment Canada, Canadian Climatic Normals 1971-2000

Despite the identified averages, the Province did experience periods of dry conditions which reduced agricultural yields in both 1999 and 2001 (AAFC 1999, 2001).

A number of documents were reviewed with regards to water resources in Newfoundland and Labrador (Appendix A). Most of the documentation, however, was written to address issues of community drinking water quality. This reinforces the position that water supply and the use of water for agricultural purposes may not be critical issues in Newfoundland and Labrador. The most common sources of contamination to drinking water, as identified in the NL Department of the Environment Report, "Source to Tap – Water Supplies in Newfoundland and Labrador" (2001) were:

- sewage effluent due to the improper use of, or lack of, disinfecting/chlorinating systems; and

- Thihalomethane (THM) contamination, which is considered as a "chlorination disinfection by-product" and is produced when water containing natural organic matter (i.e., the decay products of living things such as leaves, human and animal wastes, etc.) is chlorinated.

Contamination from cryptosporidium was identified as an emerging issue. Although commonly arising from either human or animal fecal contamination, no link to current farming practices in Newfoundland and Labrador has been determined.

Aesthetically, Newfoundland and Labrador's surficial geology also impacts on the Province's drinking water. Although the naturally occurring high iron and copper mineral content is not significant from a safety viewpoint, when it is combined with a low pH water supply and copper piping, oxidation can occur; in turn this may cause a disfavouring of milk products which may be of concern to farmers processing milk (NL Department of Forest Resources and Agrifoods Branch, 1998).

Access to potential agricultural land is an issue of increasing importance in Newfoundland and Labrador. According to government statistics, of the Province's 643 farms, 301 are on the Avalon Peninsula. This is also where 47% of the Province's population lives, the majority living within 1.5 hours travelling time of St. John's. Although several dairy farms are located within St. John's planning area, only 66 km^2, or 13.7% of the land area, is reserved for agricultural use. Given both the increasing population and competition for land on the Peninsula, it may be that further consideration should be given to the agricultural potential of other areas of the Province.

6.3.2 Existing Programs and Initiatives

As previously noted, water supply does not appear to be a limiting factor for agriculture in Newfoundland and Labrador. Flooding in many areas is more likely to be the issue than drought. Several Canada-Newfoundland Agricultural Safety Net programs, however, offer support related to the management of water resources. These are referenced below.

i) Land Based Development

Land base development assistance is provided to producers to expand and/or improve their developed or developing land base for the purpose of expansion, better rotation or the introduction of new crops. A maximum of 4 hectares (10 acres) of land may be cleared and/or improved in any given year of the program. The program has the following two components:

- *Land Drainage* - This includes ditching, tile drainage, the installation of culverts and other improvements associated with farm drainage on both mineral and peat soils. Assistance is available for up to 75% of actual costs to a maximum of $2,500/hectare ($1,000) per acre for general drainage work and $3,000/hectare ($1,200 per acre) for tile drainage work. Reimbursement for drainage work will be based on the Department's assessment of costs and the approval of the Drainage Specialist; and
- *Land Improvement* - This activity includes rock removal, minor drainage, land levelling, wind breaks, initial application of fertilizer, seed and limestone, and other land improvements required to bring land previously cleared up to its full production potential and into production. Reimbursement for on-farm access roads will be based on the provincial Department's assessment of costs. Assistance on land improvement activities is available for up to 75% of actual costs to a maximum of $1,100/hectare ($450 per acre).

ii) Canada-Newfoundland Crop Insurance

Farmers may purchase crop insurance as a risk-based management tool against uncontrollable natural threats. For Basic Disaster Coverage there is no cost to the farmer for insuring to a level of 60%. This is cost shared 60:40 between Federal and Provincial governments. If farmers then opt to contribute funds, to a maximum of 80 percent coverage to meet their anticipated risk, then the cost of the additional coverage is cost-shared on a 50:30:20 basis (Farmer:Federal:Provincial). Producer investments are "protected against the effects of drought, excessive moisture, wind, frost, hail, snow, wildlife, disease and insects", except in the case of farmer negligence. Producers are required to follow certain government-recommended quality control practices.

iii) Human Resource Development

This activity may provide funding to improve knowledge and skills in the areas of farm business, production management, and Agrifood processing. Eligible projects include: training; information; travel and exchange; and organizational development. Applications are available from the area agricultural representative or the program manager.

iv) Canadian Farm Income Program

The Canadian Farm Income Program (CFIP) has been in place for the 2000, 2001 and 2002 taxation years. The purpose of the program was to provide financial assistance to actively farming producers who have experienced an extreme reduction in their farming income for reasons beyond their control. Although reactive, as opposed to proactive, this program may offer funding for disasters related to agricultural water constraints, were they to arise.

6.4 Workshop: Objectives and Findings

6.4.1 Objectives

As a result of the initial consultations, the results of the survey, which indicated that water supply is not the primary concern of the agricultural sector in the Province of Newfoundland and Labrador, no workshop was held in the Province. Instead, a number of individuals who expressed an interest in the subject matter were invited to participate in a telephone conference. Each participant was provided with copy of an interim working paper, which provided a reference to the initial discussions and a foundation on which recommendations could be based. In total eight people including the client and representatives of the study team participated in the conference call. These participants are identified in Annex 6-2.

Conference call participants confirmed that the study team had accurately represented the agricultural water supply issues in the Province in the interim working paper that had been circulated.

The objectives of the conference call were:

i) to consult with stakeholders in the identification and prioritization of the primary water supply constraints facing the agricultural industry; and

ii) to propose projects that could be supported under NWSEP in Newfoundland and Labrador.

6.4.2 Main Issues

There is currently no concern with regards to a shortage of water for agricultural use in Newfoundland and Labrador, due to the ample number of rivers, lakes and streams in all agricultural regions. Certain crops may occasionally encounter stress due to a lack of moisture, but not often enough for farmers to invest in irrigation systems. Irrigation is used, but primarily to address frost protection as opposed to water shortage. It is currently estimated that approximately 180 hectares (440 acres) are irrigated. Dairy and poultry are the main agricultural activities, for which there is no apparent shortage of water.

Concern was raised with respect to water quality and with respect to limited access to clean water year round. There is little concrete information as to the extent that producers are concerned with water quality, but the potential cause of the concern is from producers whose water supply comes from surface water which may have fluctuating quality depending on seasonal variations in precipitation and suspended sediment loads. Predictions for an expanding agricultural base may mean an increased level of concern with respect to water quality, and potentially concern with respect to water quantity in the future. Surface water sources may also be unreliable, freezing up in the winter and drying up in the summer, therefore decreasing producers dependants on surface water sources through the development of deep water wells was recommended.

The fact that there is so little known as to the water related agricultural constraints in Newfoundland and Labrador was itself considered an issue. The conference call participants agreed that there was need to carry out a more extensive review, possibly a survey of producers, to better assess agricultural water constraints within the Province.

Not only are there several distinct regions involved in agriculture, but farmers within the same agricultural area are often disbursed throughout. In other words, farms are more likely to be isolated activities than to share common boundaries with other productive farms. Given the geographical and topographical reality of farming in the Province, therefore, any assessment of agricultural water constraints, or the identification of the means to address them, such as the establishment of water storage systems or groundwater wells, would need to be carried out on a farm-by-farm basis.

Another concern raised was that of urban encroachment and the challenges of manure management, particularly in the context of potential contamination to drinking water sources. A primary public issue is the potential for contamination from agricultural lands in surface water run-off into streams and associated watersheds. As a result, the authorities in both the St. John's and Wooddale areas have initiated increased monitoring and sampling of agricultural run-off within the protected watersheds. Municipal water supply in both areas is taken from surface sources. Conference call participants agreed there was a need for additional monitoring.

6.5 Key Issues

The key issues in Newfoundland and Labrador were identified as follows:

- Although there is currently no shortage of water, there may be a quality issue with respect to year round access to clean water;
- There is a definite lack of information as to the current water needs, uses and management practices of producer (and processor) within the Province;

- Due to the distances between farms, water constraint evaluations and solutions, such as the establishment of storage systems, need to be addressed on a farm-by-farm basis;
- Irrigation is not currently a requirement for crop growth, but it is used for frost protection (currently 180 hectares);
- An expanding agricultural base will increase public concern with respect to water quality and potentially generate a concern with respect to future water quantity; and
- Concern about urban encroachment and the challenges associated with manure management, particularly in the context of the potential contamination of drinking water sources, will need to be addressed through planning and monitoring.

6.6 Recommendations

As previously stated, the agricultural sector in Newfoundland and Labrador has a small, but committed group of producers and processors whose main development constraints include access to suitable agricultural land and urban encroachment. In spite of these issues, agriculture, specifically the dairy industry, is expected to grow significantly over the next 15 years. This growth will place additional pressure on the agricultural land base and potentially generate concern between user groups with respect to issues including access to water and potential contamination. Because there is still little known as to how the industry currently manages its water resources and the extent of the concerns with respect to water quality, a proactive water management strategy is recommended. This includes:

- Survey of producer needs, i.e., suitability and availability of water supply, both surface and groundwater;
- Water quality monitoring, especially where agricultural activities access water from the same watershed as municipalities; and
- Support to develop groundwater wells as needed, on a farm by farm basis, as opposed to a shared basis ($5,000 – $15,000 per well depending on the location in the Province).

Annex 6-1: Personnel Consulted

The following 21 individuals were consulted in Newfoundland and Labrador:

- Ian Bell, Land Management Specialist Soil & Land Management Division, Newfoundland and Labrador Department of Forestry Resources and Agrifoods;
- Gary Bishop Agricultural Engineer, Atlantic Cool Climate Crop Research Centre;
- Mike Bland/Chairperson, Egg Producers of Newfoundland and Labrador;
- Norma Collett, Manager, Newfoundland and Labrador Livestock Council;
- George Greening, Egg Producers of Newfoundland and Labrador;
- Martin Hammond, Manager, Dairy Farmers of Newfoundland and Labrador;
- Marty Howlett, Chair Person, Newfoundland and Labrador Chicken Marketing Board;
- Hasseen Khan, Manager, Department of Environment;
- Eugene Legge, President, Newfoundland and Labrador Federation of Agriculture;
- Michelle Lester, President, Provincial Farm Women's Association;
- Albert Molloy, President, Newfoundland and Labrador Pork Producers Association;
- Howard Morry, President, Sheep Producers Association of Newfoundland and Labrador;
- Bob Murphy, President, Newfoundland and Labrador Cattleman's Association;
- Robert Newhook, Manager Planning and Design, Newfoundland and Labrador Department of Provincial and Municipal Affairs;
- Ruth Noseworthy, Manager, Egg Producers of Newfoundland and Labrador;
- Frank Pye, Secretary, Lake Melville Agriculture Association;
- Sandy Todd, P.Ag. Agronomist, Atlantic Cool Climate Research Centre, AIC Director, Newfoundland and Labrador Institute of Agrologists;
- Mary Walsh, Admin. Assist, Newfoundland and Labrador Federation of Agriculture;
- Jeff Whalen, Director, Soil & Land Management Division, Newfoundland and Labrador Department of Forestry Resources and Agrifoods;
- Melvin Wheaton, Marketing & Trade Officer - Agriculture and Agrifoods Canada; and
- Christa Wright, Manager, Newfoundland and Labrador Chicken Marketing Board.

Annex 6-2: Participants in Conference Call

The following eight individuals participated in the December 17, 2002 Conference Call:

- Ian Bell, Land Management Specialist, NL Department of Forest Resources and Agrifoods;
- Gary Bishop, Agricultural Engineer, AAFC - Atlantic Cool Climate Crop Research Centre;
- Norma Collett, Manager, Newfoundland and Labrador Livestock Council;
- Elizabeth Dowsett, Project Researcher, CBCL Limited, Halifax;
- Sharon Reedyk, Acting Regional Water Management Specialist, AAFC;
- Annabelle Singleton, Project Researcher, CBCL Limited, Halifax;
- Bob Walsh, NL Project Lead, CBCL Limited, St. John's; and
- Ann Wilkie, Project Manager, CBCL Limited, Halifax.

Chapter 7 **Regional Recommendations**

7.1 Context

Over the past 20 years the agricultural industry in Atlantic Canada has modernized in response to both technological changes and market demands. The industry also strives to keep pace with changing regulatory requirements that impose new and often increasingly rigorous standards on how a specific operator manages his enterprise. This is certainly true with respect to the use and management of water both for purposes of irrigation and for livestock. In most years, for the majority of producers, irrigation is not cost effective. Rather it is needed for short periods of time either to ensure that a crop, such as broccoli, is ready for market, as frost protection for specific crops, e.g., strawberries or, in some areas of Atlantic Canada, is needed for the potato crop to meet processor demands, higher yields and improved quality. The work that was done for this study, including the many consultations that were conducted, would suggest that there is more of a concern about the effective management of the water than a concern about the total quantity of water that is available. Many farmers in the Atlantic provinces have incurred real hardship as a consequence of water shortages at certain periods over the past decade, but at least some of these hardships could have been addressed through more effective management of the water on an annual basis. In defined circumstances, however, irrigation would be a cost effective component of a comprehensive farm management strategy.

Though there may not be a net shortage of water for agriculture on an annual basis in Atlantic Canada, there is competition for, and substantive concerns associated with, the allocation of the resource. These can perhaps be summarized as follows:

i) its availability at key growing periods for specific crops;

ii) increasing demands from other users;

iii) concern with respect to its quality for irrigation, for livestock and for use in the diary sector;

iv) frustration at the absence of regulatory consistency and efficiency; and

v) the public perception that the agricultural demand for water is jeopardizing the supply of water, in terms of both quantity and quality for other purposes, i.e., the perception that the agricultural sector is the despoiler of the resource for other users.

Each of the above concerns is substantive and worthy of research and mitigative action. What was acknowledged by all who participated in the workshops was that the NWSEP could contribute support to only a fraction of the work and investment that was required. NWSEP might, if support was carefully allocated, be a catalyst of further appropriate action by both the provinces and the agricultural sector, but in and of itself NWSEP would make a limited, but hopefully, a meaningful contribution to the actions and effective management that was required.

7.2 Provincial Issues Summarized

7.2.1 Issues: Nova Scotia

Based on the research undertaken and the input received through stakeholder consultation, the principal constraints or impediments in Nova Scotia to accessing sufficient water for agricultural use, or managing available water resources efficiently, can be summarized as follows:

- the inability of the individual farmer to readily access information with respect to new technologies or to attain the expertise necessary to implement the best technology to meet the water requirements of his enterprise;
- the lack of funds to offset the capital costs of farm water supply developments; and
- incomplete databases with respect to both groundwater and surface water sources by watershed, insufficient monitoring programs and ineffective water permitting and approval procedures.

The above constraints focus on two distinct parties: firstly the needs of the individual farmer, and secondly the role that government might play in so far as it is necessary to have accurate information available with respect to water sources, water quantities and water quality. The establishment of three water management clubs in the Province, located in the Annapolis Valley, the Central Stewiacke Region and in Cape Breton, had been welcomed by the agricultural sector and there was some consensus at the workshop that these clubs should be supported and the initiative extended to other areas. These clubs also appeared to have the potential to serve as a conduit between the individual farmers and the different levels of government on key water related issues.

7.2.2 Issues: New Brunswick

Based on the research undertaken and the input received through stakeholder consultations, the principal constraints or impediments in New Brunswick to accessing sufficient water for agricultural use, or managing available water resources efficiently, can be summarized as follows:

- the lack of information available to individual producers on key research topics including conservation techniques and the absence of meaningful pilot demonstration projects;
- the lack of technical and financial assistance available to individual farmers, or in certain locations to groups of individual producers, to facilitate access to water resources;
- the lack of technical support for effective water management including advice on environmental regulations and on how to obtain the requisite approvals to access and use water sources efficiently;
- the absence of funding assistance for irrigation equipment; and
- incomplete information on the extent and availability of groundwater and surface water sources.

It became apparent during the workshop in Fredericton that there are significant regional variations within New Brunswick with respect to irrigation requirements. Some of these are referenced in Section 4.4.2. For example, there may be benefits associated with supplemental irrigation in the Woodstock area of Region 1, but not elsewhere in Region 1. Comparable situations exist in other agricultural regions reflecting both the hydrological and hyrogeological profiles of specific watersheds and the nature of the agriculture taking place. Despite such area specific considerations, no initiative was taken by the workshop participants to prioritize areas that should receive funding through NWSEP. Rather, attention was placed on ensuring that all

practising farmers would be eligible should an individual determine that his operations would benefit from irrigation.

7.2.3 Issues: Prince Edward Island

While there would appear to be some consensus that there is a huge groundwater resource that, if carefully managed, could meet both the needs of agriculture and other user needs on the Island, there is public and, therefore, political hesitation to allow for expansion into this resource. As a result, the principal constraints or impediments to accessing sufficient water, or managing the available water resources efficiently, can be summarized as follows:

- the provincial moratorium on the drilling of high capacity wells for irrigation;
- public concern regarding the use of groundwater for irrigation systems;
- lack of access to expertise with respect to both the technicalities of irrigation systems and best management practices and conservation techniques; and
- the lack of financial assistance for irrigation water sourcing.

Given the involvement of many island producers in crops, such as blueberry and cole crops, where a relatively short dry period at a critical point in the growth cycle can mean significantly reduced yields or the loss of an entire crop, reliable irrigation is increasingly critical to many. Irrigation is also necessary to those involved in the production of potatoes to ensure the size and quality of product required by the major producers. Irrigation is therefore an important tool for the effective use of water in key agricultural sectors in PEI.

7.2.4 Issues: Newfoundland and Labrador

The availability of sufficient water for agriculture in Newfoundland and Labrador is not an issue. There is, however, a general lack of information available as to the current and future water needs, uses and management practices of both the producer and the processor. As the demands of the farmer and others for water expand, this lack of basic information may become a serious impediment to effective water management. Other factors referenced during the consultations and the conference call include the following:

- the perception of the public that more intensive agriculture might adversely impact water quality (e.g., inappropriate manure management) and the quality of the water that is available to individual farms (e.g., sediment loading during high rainfall events); and
- given the scattered nature of the productive farm holdings, solutions to problems of water availability and quality need to be addressed on a farm by farm basis, not on a group or area basis.

Expansion of the agricultural sector in the Province will be constrained more by limited access to suitable agricultural land and urban encroachment than by a lack of water.

7.3 Recommended Programs and Projects

Although there are problems and challenges that are unique to each province, a number of themes common to the Atlantic Region were identified as a consequence of the work and consultations undertaken.

Based on consideration of the above issues and as a result of the input received, including the workshops and conference call, it is recommended that the following programs and activities be considered for funding support through the NWSEP in the Atlantic provinces:

- *Extension and Education Services:* farmers need an avenue to attain informed technical information on optimal farm-specific water supply, distribution, and management practices, and access to expert advice to facilitate their correct implementation given the nature of a specific farming operation;
- *Establishment of Comprehensive Water Resource Databases:* the provinces and farmers in each province need accurate information to support effective watershed-scale management; in most regions, both the quantity and quality of potential supplies need to be further assessed and the results documented in a form that can be readily accessed by all involved parties; and
- *Funding for:*
  - on farm solutions to water sourcing and the distribution of water resources;
  - the protection and conservation of water of suitable quality for agricultural purposes; and
  - water resource monitoring, e.g., pump tests, routine testing of wells and streams, streamflow monitoring, etc.

In addition to the above activities, which would be subject to further detailing during negotiations with the individual provinces and the agricultural sector to reflect the particular needs and circumstances of each province, the following specific initiatives were identified in one or other of the provinces:

- support for the continuation and expansion of the Water Management Clubs in Nova Scotia;
- support for multi-stakeholder research in PEI specifically with respect to the safe and conservative use of groundwater for agricultural purposes; and
- support in Newfoundland and Labrador to instigate with the Province a survey of producer needs.

With changing demands on the resource and changing patterns of precipitation in the region over the past decade, the quantity and quality of water is of increasing concern both to the agricultural sector and to other users. Compared to other parts of the country, current annual precipitation in Atlantic Canada is high and quite well distributed; however shortages of precipitation during key times of the growing season for various crops has resulted in financial hardships for producers. There are, therefore, circumstances, where selective irrigation would not only save crop losses, but also ensure the quality sought by the market. In order to implement measures to avoid these crop losses and ensure product quality, producers in Atlantic Canada are facing significant expenditures in water sourcing and irrigation equipment. Enabling such investment should be an integral component of a comprehensive water management strategy in Atlantic Canada. The selective implementation of NWSEP could contribute to the development of such a strategy in the region while, at the same time, recognizing the needs of the individual provinces.

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Appendix B

Survey Instrument