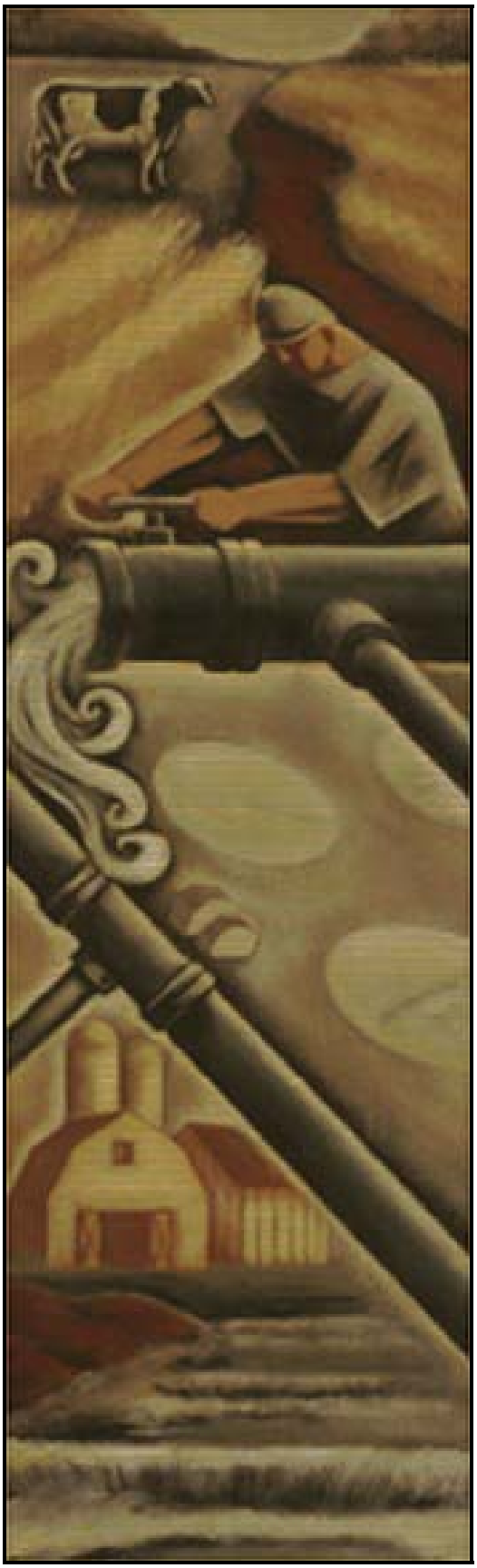

# Analysis of Water Supply Issues for the Agricultural Sector

## National Water Supply Expansion Program

## Province of Quebec

**Final Report**

**Prepared for:**

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**March 26, 2003**

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March 26, 2003

## SUMMARY

The National Water Supply Expansion Program (NWSEP), administered by Agriculture and Agri-Food Canada (AAFC), was established to help agricultural producers deal more effectively with agriculture-related water supply problems. The program, which is scheduled to run for four years (2002–2006), will provide a total of $60 million in funding, $10 million of which has already been allocated to the Prairies to deal with the problems created by drought conditions. Implementation of the $50 million three-year national component has required documentation of the water supply situation for agricultural production in each region of Canada. The present report reviews the situation in Quebec. It offers a quantitative assessment of the water requirements for the various production sectors, the problems and issues associated with water supply, and potential solutions and priorities for action.

The data provided by Statistics Canada's 2001 Census of Agriculture have been used as the basis for the assessment of water requirements. They have been complemented by data from the Quebec Department of Agriculture, Fisheries and Food on aquaculture, data from the Agro-Environmental Portrait of Quebec Farms on farm water management practices and various reference data specific to Quebec. The water requirements have been compiled by production sector and administrative region (census agricultural region).

*Analysis of current requirements*

Three major production sectors have been identified: crop production, livestock production and aquaculture. Total water requirements for all agricultural production in Quebec have been assessed at 174.1 million $m^3$ per year. Water requirements for aquaculture account for 42% of Quebec's total requirements, or 73.5 million $m^3$, although far fewer firms are involved than in the other production sectors. Livestock and crop production account for 32% and 26% of the total requirements respectively, or 56.0 million $m^3$ and 44.6 million $m^3$ per year.

Cattle production (dairy and beef) and hog production consume most (over 90%) of the water associated with livestock production. Irrigation of field-grown crops absorbs 33 million $m^3$ per year, or nearly 75% of all crop requirements. Irrigation of field-grown vegetable crops alone accounts for nearly half of the water requirements for crop production. Cranberry production (18%) and greenhouse farming (7%) require large quantities of water as well, despite the limited areas involved.

Compilation of the water requirements on a regional basis shows the Eastern Townships in the lead because of the heavy concentration of aquaculture operations within the region, which use 39.3 million $m^3$ per year. Aquaculture has a significant impact in the Mauricie, Chaudière-Appalachians, Laurentian and Outaouais regions as well. With the exception of this form of production, however, Montérégie is the region with the heaviest requirements for both crop and livestock production, at 14.6 million $m^3$ and 13.7 million $m^3$ per year respectively. Irrigation of field-grown vegetable crops accounts for over 10 million $m^3$ per year.

After Montérégie, the Lanaudière and Central Quebec regions show the largest water requirements for crop production, the latter because of its cranberry growing operations. Similarly, the Chaudière-Appalachians and Central Quebec regions have the largest water requirements, after Montérégie, for livestock production.

*Sectoral problems*

Water requirements for crop production vary over time in response to a number of factors. The processing industry, in an effort to ensure the quantity and quality of its supplies and more efficient planning of harvesting and processing schedules, is placing increasing pressure on its suppliers to maintain minimum irrigation standards. This fact, combined with the apparently greater frequency of extreme weather conditions, should result in an increase in irrigated areas and in the amount of irrigation required for a given crop. We can thus anticipate an increased demand for water.

In addition, the demand for improved food safety will place further pressure on groundwater, which is known to be of higher quality than surface water. The increased demand may be moderated by optimizing water management, particularly through improved conservation of precipitation water (infiltration, storage by means of watertable control or structural means), more effective irrigation systems (pipelines, irrigation techniques, irrigation management) and the adoption of soil and water conservation practices.

In contrast to livestock production, irrigation requirements are less predictable and more localized, and occur generally when river levels are low, thus limiting collection capacities and increasing storage requirements.

On the technical level, there are few well-documented studies available to permit systematic determination of the technical/economic viability of irrigation projects. Similarly, our knowledge of how irrigation can best be used to control spring and fall frost damage, particularly to blueberry crops, is limited.

Water requirements for livestock production vary essentially in relation to herd size. In fact, extensive efforts have been made in recent years to improve building water management and to reduce the volumes of manure to be dealt with. While dairy production is relatively stable as a result of the supply management system, hog production has shown wide fluctuations in growth rates over the past 25 years. Moreover, the concentration of pig farms and the observed increase in the size of hog production sites may have a long-term impact on the dynamics of the regional distribution of the water supply in the agricultural sector.

Quebec's aquaculture industry has experienced a slowdown in recent years as a result of financial problems or environmental constraints. The medium-term priority must be to stabilize the businesses in this sector. In the longer term, a significant increase in production is anticipated to meet domestic demand. Aquaculture operations are moving increasingly to groundwater for their water supply because of its physical and bacteriological qualities, which permit greater commercial efficiency.

*General Issues*

*Availability of water*

The documentation consulted and our discussions with resource persons indicate that some regions of Quebec are experiencing significant water supply problems, particularly with respect to irrigation requirements for field-grown crops. General problems in terms of the agricultural water supply have been observed in certain areas. In some cases, these may result in water use conflicts between different sectors.

Moreover, water management facilities for irrigation are non-existent in the majority of the regions most heavily involved in vegetable production. These regions also have large areas of organic soils that are subject to chronic water shortages and thus have shorter life expectancies.

*Storage and distribution of water*

In addition, while many medium-sized operations maintain water storage ponds for irrigation purposes, these ponds are not properly managed. In some sectors, their size, configuration and watertightness and the loss control measures applied to them fail to meet the quantitative requirements and imperatives of sound water management.

In the case of livestock production, programs further restricting direct access by livestock to waterways will necessitate measures to transport water to pasturing areas. This new issue creates practical problems, particularly for beef producers in regions like the Outaouais, where fragmented property ownership and the dynamics of pasture management will complicate this new form of management.

*Water quality*

There are few accurate data available on the quality of the water used for agricultural purposes in Quebec. While the general quality of this water appears to be good, a number of regional or sectoral problems have been noted. Contamination of groundwater as a result of natural hydrogeological conditions is normally handled by treating the water on the farm or by connecting the farm to an existing water supply system. However, a number of specific issues have been noted with respect to bacteriological or chemical contamination of the water as a result of human activities; these include irrigation from the Mille-Îles and Des Prairies rivers and by groundwater in the Ville Mercier region. In addition, the new provincial water policy will place additional constraints on agricultural activities by establishing a protective perimeter around wells in an effort to preserve groundwater quality.

*State of knowledge*

One of the study's important findings is the lack of detailed, accurate information on various aspects of the agricultural water supply. These aspects relate to:

- The limited information available on the characteristics of the aquifers used by rural communities;
- The type of agricultural water supply, actual water consumption by sector and types of water catchment and storage structures;
- The limited follow-up on characterizations of surface water and groundwater used for agricultural purposes;
- The limited support available for the development of knowledge on the technical/economic aspects of crop irrigation.

The need for more information is accentuated by the growing potential for water use conflicts between agriculture and other sectors of activity and by the demands of new environmental protection initiatives. This need is evident at two levels in particular: regional studies to improve our understanding of the overall water supply situation and local studies to resolve more specific problems.

*Elements to be included in the program*

The documentation compiled and our discussions with the advisory committee have identified a number of basic elements that may be useful in the development of a funding program appropriate to Quebec's needs.

These elements relate in particular to the sectors and regions of priority concern, the types of projects to be promoted and the type of clientele to be targeted.

Analysis of the agricultural water requirements has demonstrated that the crop production, livestock production and aquaculture sectors are all experiencing water supply problems, problems that vary from sector to sector but will require attention.

It is clear, however, that irrigation of field-grown crops, particularly vegetables, must be assigned priority in the short term within the program. The advisory committee feels that the program should be accessible to other sectors of production as well, but without the same level of priority.

In geographical terms, the section on issues has identified a number of areas in which the problems are particularly acute or well documented. Short-term support measures could be considered for these regions. The committee feels, however, that the program should be accessible to all regions, provided the projects are consistent with its general objectives.

In terms of types of projects, two major components have been identified and assigned priority:

- knowledge acquisition;

- development of community infrastructure projects for the supply, treatment, storage or distribution of groundwater or surface water for agricultural production.

The Knowledge Acquisition component would make it possible to initiate or, in partnership with other stakeholders (federal, provincial or local), to contribute to projects beyond the financial reach of individual enterprises, including the characterization of watertables used or available for agricultural purposes and the assessment or monitoring of the quality of groundwater or surface water used for agricultural production.

The Infrastructures component would make it possible to take into account the different stages of progress reached by the regions in defining their needs and mobilizing their stakeholders. There could be two levels of support:

- *Preparation of feasibility studies* dealing with regional supply problems;
- *Development and installation of infrastructures*.

For the Infrastructures component, the funds allocated should, in principle, increase with the project's stage of completion, from feasibility study to installation of infrastructures. In addition, co-funding of these projects should be required, with non-program funding increasing as the project nears completion.

The nature of the technical solutions proposed may vary with the problems and the regional context. The infrastructures concerned, for example, may include wells, surface water intakes, pumping stations, dikes, small dams, pipelines or conduits, ponds or any other measures considered appropriate for a given problem.

Only projects having a direct impact on the agricultural water supply should be eligible. Applicants to the program may include:

- Groups of agricultural producers, whether legally constituted (union, cooperative) or not;
- Not-for-profit organizations (e.g.: watershed groups, etc.);
- Local governments (municipalities, regional county municipalities).

These elements make up the proposed general outline, based on an analysis of the existing data and consultation of specific stakeholders. This analysis is by no means exhaustive, and Agriculture and Agri-Food Canada may choose to take other factors into consideration in developing its program. For example, a number of other more technical terms and conditions should be defined, including the categories of eligible expenses, the co-funding requirements for the various components, etc. The present document sets out relatively precisely, however, the broad outlines of a program designed to respond to Quebec's needs, problems and specific priorities with respect to the agricultural water supply.

# PROJECT TEAM

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# I. INTRODUCTION

The National Water Supply Expansion Program (NWSEP) is a four-year $60 million initiative administered by Agriculture and Agri-Food Canada (AAFC). The program is designed to help agricultural producers deal more effectively with agriculture-related water supply problems through the development of projects adapted to regional needs based on a co-funding approach.

An initial $10 million has been allocated for 2002-2003 to deal with water supply problems in drought-stricken regions of the Prairies. The remainder of the funds committed to NWSEP, totalling $50 million, will be made available at the national level over the next three years to fund additional infrastructure and strategic water supply studies, in an effort to identify long-term solutions to the water supply problems facing the agricultural sector.

Before the $50-million three-year national component comes into effect, it is essential to analyze the industry's water supply requirements in order to determine the nature and scope of the supply problems and the priorities for action.

This study is designed to determine the future options of the program for Quebec with respect to the remaining $50 million allocated to NWSEP. The results of the study will be used in negotiations and consultations with the provincial government and industry stakeholders.

# II. OBJECTIVES

In general, the study is designed to determine:

1. The water supply requirements of Quebec's agricultural sector;
2. The problems and issues associated with water supply in rural and agricultural areas;
3. Potential solutions designed to minimize the constraints observed and the strategic and technical priorities for action.

To meet these objectives, the project has been broken down into five (5) tasks, the first being determination of the needs and issues associated with water supply in Quebec's agricultural regions. These findings have been compiled in an *interim summary* for use as a working paper by an advisory group examining the activities, types of projects and regions to which funds are to be allocated on a priority basis (task 2). The third task set out in the work plan is submission of the draft final report.

# III. METHODS

## *A. Determination of Water Requirements*

### 1. Production data

Data from the 2001 federal Census of Agriculture, available on the Statistics Canada website, have been used to assess the water requirements necessary for the activities of the different agricultural sectors covered by this study. For example, data on livestock production, areas under cultivation, irrigated areas, sprayed areas, greenhouse areas and rural populations have been obtained from the database at the *census division* level, which corresponds to the *regional county municipalities* (RCMs) in Quebec. However, the results have been grouped by *census agricultural region* (*administrative region* in Quebec) in order to summarize the information and assist in providing an overview of the situation in Quebec.

To complement the production data information and provide further detail on certain sectors of activities, data have been drawn from the Agro-Environmental Portrait of Quebec Farms (BPR/GREPA, 1999), particularly as regards the proportion of irrigated and sprayed areas for each crop. In addition, data on manure dilution waters and sources of water supply for irrigation, spraying and greenhouses have also been obtained from MAPAQ and UPA, the co-administrators of the Portrait's database.

Sectors of agricultural activity that are more marginal in terms of area under cultivation or production volumes but that use significant quantities of water have been considered separately. These sectors are cranberry production and aquaculture. The production data for these sectors have been obtained from AAFC and MAPAQ respectively.

The compilations issued by the Quebec Department of the Environment in April 2000 on the distribution of the types of water supply used by the population were obtained from the Department's website. These data have been mathematically adjusted to provide a more detailed picture of the situation in rural areas. The distribution of urban and rural populations indicated in the 2001 Federal Census has been used for this purpose.

### 2. Water requirements for crop production

A number of technical guides published by the *Conseil des Productions Végétales du Québec* (CPVQ) and cited in the list of references have been used to establish the water requirements for crop production in Quebec. In addition, missing or more current information has been obtained from a number of industry specialists.

The 2001 Federal Census reports the areas treated with herbicides, insecticides and fungicides, without indicating the type of crop treated. The sprayed areas have therefore been broken down by crop in order to establish the water requirements for pesticide application. The unit water requirements for pesticide application, presented in Table III.1, are based on three (3) telephone

interviews, with Alain Côté, Agr., Field Crop Consultant, Patrice Thibault, Agr., Vegetable and Small Fruits Consultant, and Serge Menta, Apple Consultant. The data on the proportions of the areas treated and the number of applications were obtained from the Agro-Environmental Portrait of Quebec Farms.

**Table III.1**
**Volume of water applied per hectare and number of applications per growing season for pesticide application**

| Crops | Herbicides | | | Insecticides | | | Fungicides | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area treated[1] (%) | Quantity of water[2] (L/ha) | No. of applications[1] (n) | Area treated[1] (%) | Quantity of water[2] (L/ha) | No. of applications[1] (n) | Area treated[1] (%) | Quantity of water[2] (L/ha) | No. of applications[1] (n) |
| Grain corn | 93.6 | 159 | 1.3 | 3.4 | 159 | 1.1 | 1.5 | 159 | 1.0 |
| Grains | 67.2 | 159 | 1.1 | 0.4 | 159 | 1.1 | 0.2 | 159 | 1.2 |
| Soybeans | 90.4 | 159 | 1.2 | 0.4 | 159 | 1.3 | 0.3 | 159 | 1.0 |
| Other field crops | 85.0 | 159 | 1.5 | 0.1 | 159 | 1.0 | 15.9 | 159 | 1.3 |
| Forage crops | 13.6 | 159 | 1.1 | 0.1 | 159 | 1.1 | 0.0 | 159 | 1.0 |
| Vegetables | 77.7 | 280 | 1.9 | 57.4 | 280 | 3.0 | 33.7 | 280 | 3.5 |
| Potatoes | 90.4 | 380 | 2.1 | 82.9 | 750 | 2.4 | 87.7 | 750 | 5.1 |
| Small fruits | 49.4 | 250 | 2.0 | 7.8 | 750 | 2.6 | 6.7 | 750 | 3.5 |
| Apples | 52.0 | 250 | 2.3 | 85.7 | 750 | 4.0 | 85.1 | 750 | 8.0 |
| Tobacco | 27.4 | 374 | 1.2 | 83.3 | 374 | 1.9 | 24.8 | 374 | 1.9 |

[1] Agro-Environmental Portrait of Quebec Farms (BPR/GREPA, 1999)
[2] Telephone interviews (Alain Côté, Agr., Patrice Thibeault, Agr. and Serge Menta, Agr.)

These coefficients were then applied to the areas under cultivation in Quebec in 2001 (Statistics Canada, 2001), applying the necessary ratios to ensure consistency between the two (2) statistical sources.

The water requirements for greenhouse crops were divided into two (2) production sectors, ornamentals and vegetable crops. Obviously, the water requirements for these crops vary with the plant species, the stage of growth and the climate conditions recreated inside the greenhouses. Average values were therefore used to represent the water requirements of these crops. André Carrier, an agrologist with the Chaudière-Appalachians regional directorate of MAPAQ, provided the average values used to establish the water requirements. In addition, a study on fertigation in soil and in soilless media (Letard, 1995) found similar values for tomato production, at 1.02 L/plant/day. Assuming that there are 2.5 plants per m², water requirements average 9,308 m³ of water per hectare per year. During peak periods, however, this value rises to 36,865 m³/ha/yr. Ornamentals, primarily flat-grown plants, consume approximately twice as much water as vegetable crops, at 18,616 m³/ha/yr.

The data available to establish the water requirements for irrigation are less precise. In determining the volume of water to be applied per hectare for irrigation, annual variations in precipitation, soil types, exposure to wind and type of crop must be taken into consideration.

Some studies give average values for the optimal volume of irrigation water over the course of a normal growing season. For example, Gallichand (1993) has produced a complete assessment of

the water requirements for crop irrigation in southwestern Quebec. Water requirements (probability = 0.5) varied between 0 and 150 mm for different crops monitored in different types of soil. In another more general study, Beaulieu (2002) reports irrigation water requirements of 195 mm per season for celery, 120 mm for lettuce, 125 mm for onions and 60 mm for carrots, for an average of 100 mm for vegetable crops 1 year out of 2, with the requirements rising to 160 mm one year in 10. Telephone conversations with other industry stakeholders for other types of irrigated crops suggest that an average of 150 mm for all irrigated crops (vegetables, potatoes, small fruits and apples) would appear to be a good approximation, particularly in view of the fact that water requirements for irrigation were much higher during the summers of 2001 and 2002 as a result of prolonged dry periods.

The distribution of the irrigated areas was calculated by considering the irrigated areas reported for each production sector in the Agro-Environmental Portrait of Quebec Farms (BPR/GREPA, 1999). Ratios were calculated to adjust the irrigated areas for 1998 to those for 2001 while retaining the same proportions among the different sectors.

### 3. Water requirements for livestock production

Drinking water requirements for livestock production have been established on the basis of the guides prepared by the *Conseil des Productions Animales du Québec* (CPAQ). For each type of production, the water requirements are clearly defined in relation to the different stages of growth and livestock groups. The daily requirements were then determined on the basis of the classes of livestock listed in the 2001 Federal Census. To verify the values given in the CPAQ Guides, other studies, including *L'eau d'abreuvement des animaux* (Roy et al., 1993), have been consulted.

The other requirements relating to building management (cleaning), dairy water and manure dilution water have been grouped under the heading "other requirements" and are generally defined for each animal species. According to a study by Racine and Cournoyer (1994), wash water requirements for dairy farms, including dairy water and wash water in general, amount to 16 L/day per producing cow.

Water requirements for manure dilution have been assessed on the basis of the data published in AGDEX 538/400.27 (1999). The values used, 20 L/day per dairy cow and 12 L/day per beef cow, are averages for dairy and beef cattle. The data on cattle produced under liquid management systems using dilution water have been obtained from the database of the Agro-Environmental Portrait of Quebec Farms (1998). Province-wide, this practice affects 6.6% of all dairy cattle and 2.5% of all beef cattle, and uses approximately 200,000 m³ and 25,000 m³ of water annually.

### 4. Water requirements for aquaculture

"Aquaculture" is the commonly accepted term for freshwater fish farming on land. In Quebec, the majority of this production is intended for the table market and for stocking in natural waterways or fishing ponds. Brook trout and rainbow trout, both cold-water species, represented

more than 95% of all production in 2001. While aquaculture is not managed by the same federal government department as traditional agricultural production, it has been included in this analysis of water supply issues for the agricultural sector. Its inclusion is justified by its presence in the agricultural environment, the competition that it generates with other agricultural activities and the fact that it is managed by the same department at the Quebec level.

The product's destination (table, stocking), the species concerned, the characteristics of the available water sources and the management of the operation itself affect the quantities of water required for this form of production. It should be noted that, in contrast to conventional forms of livestock production, aquaculture operations use water but do not consume it. According to Ouellet (2002), a constant flow of approximately 5.0 $m^3$/h is required for the annual production of each tonne of fish. The water requirements for aquaculture have been determined on the basis of this flow and the annual production of all aquaculture operations within each region (Hébert, 2002). It should be noted, however, that actual water use by aquaculture operations appears to be higher than this value. In fact, according to Morin (2002), observations of a number of aquaculture operations indicate that they use a flow of approximately 9.4 $m^3$/h per tonne of annual production.

## *B. Identification of Problems*

As proposed in the work plan, the initial strategy focussed on consultation with sectoral and regional stakeholders working in the water sector. These consultations have provided us with access to unpublished information or identified relevant documents.

This verbal information has been considered in conjunction with the written documents obtained by standard research methods. For example, a number of documents submitted to the *Bureau d'audiences publiques sur l'environnement* (BAPE) in connection with the public consultation on water management in Quebec (BAPE, 2000) have been consulted, notably the regional water portraits produced by MENV.

As regards the types of water supply available in each geographical sector, the Quebec Department of the Environment has compiled data on this topic for all of Quebec for 2000, at the RCM level (MENV website). The proportion of the total population served by water supply systems supplied by surface or groundwater has been calculated from data provided by the municipalities, while the proportion of the population supplied by private wells has been determined by subtracting this figure from the total population. The latter category includes both private wells supplied by groundwater and private systems not listed by MENV, which are in most cases supplied by groundwater as well.

These basic data have been modified to take into account ratios that more accurately reflect the type of water supply used by the rural population. For instance, it has been hypothesized that the population served by private wells or private water systems is located primarily in rural areas, to a maximum of the total rural population of the RCM. The calculations were adapted for the rural population and the total population for 2001, which were obtained from the most recent Statistics

Canada census. This calculation may certainly be skewed in some areas but should provide a better reflection of reality than the overall figures for the population as a whole.

It is important too to recognize that these data are provided only as a general indication. The fact that a rural population is served by a water supply system does not necessarily mean that the livestock buildings are connected to the system as well. Similarly, irrigation requires large volumes of water that would be drawn from a water supply system only under exceptional circumstances. The data must therefore be interpreted with caution and reflect broad regional tendencies in the availability of surface water and groundwater.

A complete list of the individuals contacted is presented in Appendix A and the bibliographical references consulted are described in Section VI. In addition, an advisory committee has been formed to confirm the observations contained in the interim summary submitted in December 2002 and to identify lines of action. This committee met on January 27, 2003. Its membership and the minutes of the workshop are presented in Appendix B.

# IV. OBSERVATIONS

## *A. Analysis of Sectoral Requirements*

### 1. Total water requirements

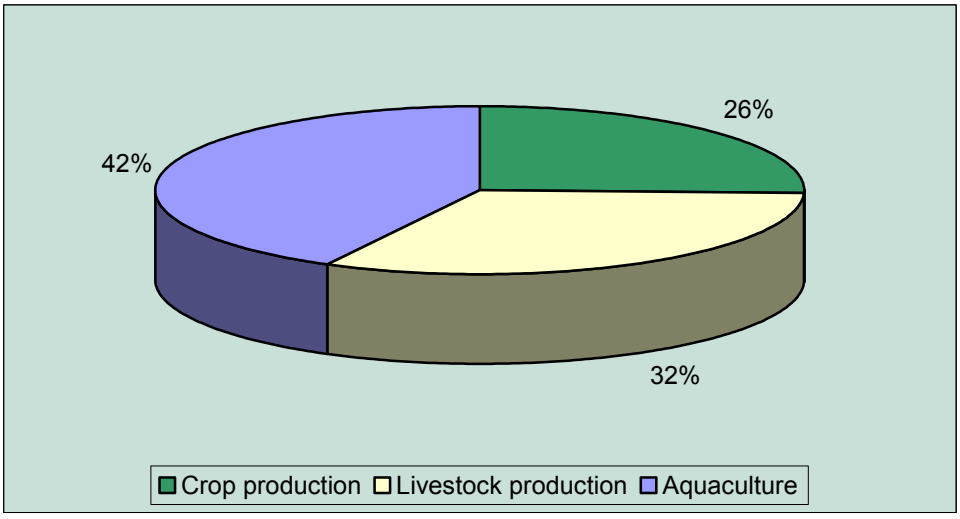
At the provincial level, annual water requirements for the primary sectors of agriculture in 2001 totalled just over 174 million $m^3$ (Table IV.1).

This consumption is broken down among three (3) major sectors: crop production, livestock production and aquaculture. While aquaculture involves only about 150 farms, this industry alone consumes 42% of all water used in agriculture (Figure IV.1). The crop production sector consumes the least, with 26% of the total.

**Table IV.1**
**Water requirements in Quebec by agricultural sector**

| Crop production ($m^3$/yr) | Livestock production ($m^3$/yr) | Aquaculture (kg/yr) | Total ($m^3$/yr) |
|---|---|---|---|
| 44,622,257 | 56,036,659 | 73,463,287 | **174,122,202** |

**Figure IV.1**
**Water use in Quebec by agricultural sector**



2. Water requirements for crop production

Crop-related water requirements represent approximately 45 million cubic metres (Table IV.2). This consumption can be broken down into four major sectors: water for spraying pesticides, water for use in greenhouses, water for irrigating field-grown crops and water for cranberry production. The latter sector of production accounts for only 2.5% of the areas under cultivation receiving water inputs, excluding sprayed areas, but consumes 18% of the water used for crop production (Figure IV.2). This crop is dependent on water at several stages of production, including harvesting, when the beds must be flooded.

Greenhouse production is another sector that uses a great deal of water (Table IV.2), although it accounts for only 1% of the areas to which water is applied to meet plant requirements. Irrigation is the only source of water available for these crops. Greenhouse-grown ornamental plants consume more water per hectare, because they are more densely planted.

Irrigation of field-grown crops is the major consumer of water (74%). In terms of area, irrigation is performed primarily on vegetable crops. On the other hand, the percentage of the areas under production that are irrigated is appreciably higher for small fruits, such as strawberries (Thibault, 2002). However, according to various experts in the area, water consumption for irrigation could be significantly higher.

In fact, according to the 2001 Federal Census, irrigated areas in Quebec (excluding cranberry production) total 21,998 ha. If we look at the census values for 1996 and 1991, we see that the figure for irrigated areas was 52% higher in 1996, at 33,391 ha. This significant decline reduces irrigated areas to the level recorded in 1991 (21,864 ha). According to the members of the advisory committee formed to assess the interim summary, it is unlikely that these areas have in fact declined so dramatically over the past 5 years, since a number of participants believe that the trend has been generally upward.

These data were therefore compared to those obtained by the Agro-Environmental Portrait of Quebec Farms (1998). The questionnaire used for the Portrait was completed by approximately 75% of all farms that might potentially use irrigation. The area calculated was 15,599 ha. If we increase this value by 25% to account for non-respondents, we obtain approximately 20,000 ha, which is consistent with the value given in the 2001 Federal Census.

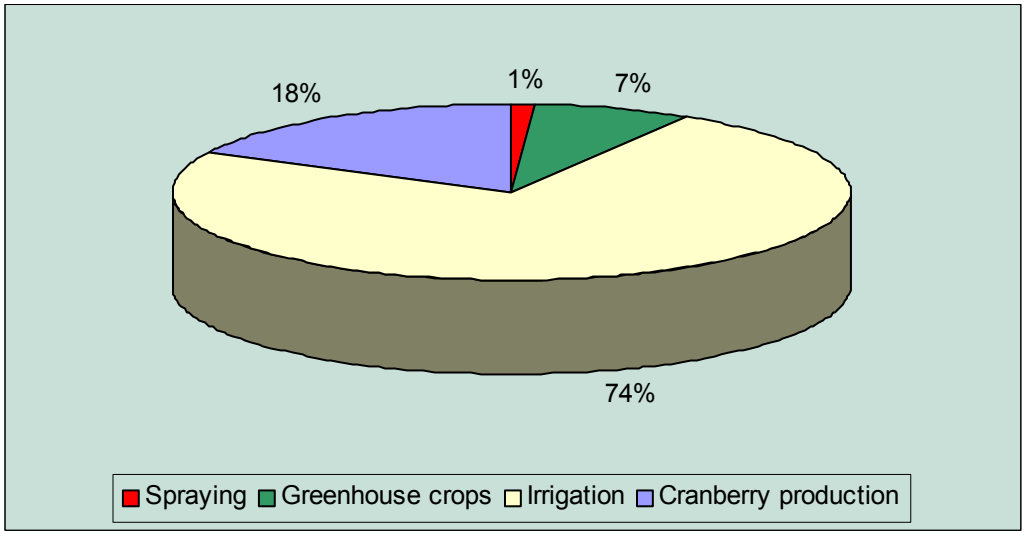
One hypothesis that may explain this reduction in irrigated areas is the abundant and well-distributed rainfall that marked the 1998 and 2000 growing seasons. In fact, the relevant question in the 2001 Federal Census of agriculture reads as follows: “Report the area of land on which [irrigation] was used in this operation…”. As a result, the response may not reflect the areas that might potentially be irrigated in the event of a prolonged drought, figures that may be higher than those actually reported as having been irrigated the year of the census.

**Table IV.2**
**Water requirements in Quebec by crop sector**

| Sectors | Areas concerned (ha) | Water requirements | |
|---|---|---|---|
| | | Unit ($m^3$/ha/yr) | Total ($m^3$/yr) |
| **Spraying** | **1,011,959** | | **463,591** |
| Herbicides | 848,220 | 0.225 | 191,906 |
| Insecticides | 90,416 | 1.103 | 98,375 |
| Fungicides | 73,323 | 2.458 | 173,310 |
| **Greenhouse crops** | **229.8** | | **3,334,666** |
| Ornamentals | 139.6 | 18,615 | 2,598,632 |
| Vegetables | 90.2 | 9,308 | 736,035 |
| **Irrigation** | **21,996** | | **32,994,000** |
| Vegetables | 13,915 | 1,500 | 20,872,500 |
| Small fruits | 2,867 | 1,500 | 4,300,500 |
| Potatoes | 3,614 | 1,500 | 5,421,000 |
| Apples | 1,600 | 1,500 | 2,400,000 |
| **Cranberries** | **580** | **13,500**[1] | **7,830,000** |
| **TOTAL** | | | **44,622,257** |

1 Approximately 25% of this water is actually consumed, while 75% is used for crop management.

**Figure IV.2**
**Distribution of water requirements in Quebec by crop sector**



As for sprayed areas, the water required to apply pesticides does not represent a large volume (1%), compared to the other sectors. For certain crops, however, such as apples and potatoes, water requirements at the individual farm level may be significant. In fact, these crops require between 9 and 15 applications of herbicides, insecticides and fungicides (Table III.1). In addition, the amount of spray required per hectare is greater for these crops, because of the quantity of foliage present during spraying periods.

### 3. Water requirements for livestock production

The total water requirements for livestock production are just over 55 million $m^3$ annually, including 79% for drinking water (Table IV.3). This water must be of good quality to ensure optimal livestock production and prevent the risk of disease. The standards for livestock drinking water are set out in the *Canadian Water Quality Guidelines* issued by the Canadian Council of Resource and Environment Ministers (1987).

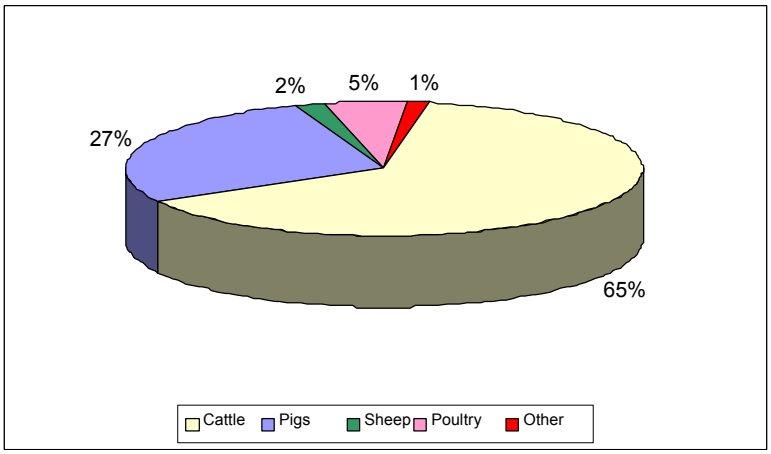
Cattle and hog production are the sectors responsible for the highest water consumption (Figure IV.3). Cattle production accounts for the highest proportion of drinking water and total consumption, with 65% and 56% respectively. Dairy cattle are responsible for this dominance, with an average daily consumption, including dairy water, of 126 litres per cow. In contrast, for uses other than drinking water, hog production exceeds cattle production by a wide margin, at 70% compared to 24%. The difference is attributable to the large quantities of wash water used in this production sector.

## Table IV.3
## Water requirements in Quebec by livestock sector

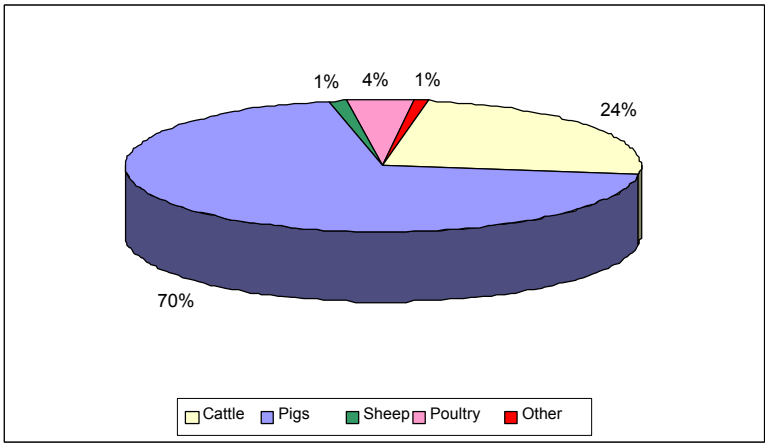
| Sector | Stock | Drinking water requirements | | Other water requirements | | Total water consumption |
|---|---|---|---|---|---|---|
| | (head) | Unit (L/day/head) | Total ($m^3$/yr) | Unit (L/day/head) | Total ($m^3$/yr) | ($m^3$/yr) |
| **Sheep** | **254,053** | | **891,228** | | **127,025** | **1,018,253** |
| Rams | 5,393 | 10 | 19,684 | - | - | 19,684 |
| Ewes | 149,305 | 12 | 653,956 | 1 | 54,496 | 708,452 |
| Lambs | 99,355 | 6 | 217,587 | 2 | 72,529 | 290,117 |
| **Cattle** | **1,362,788** | | **28,134,609** | | **3,170,230** | **31,304,839** |
| Dairy cattle | 407,206 | 110 | 16,349,321 | 17 | 2,541,576 | 18,890,897 |
| Beef cattle | 207,852 | 68.8 | 5,219,579 | 6 | 479,473 | 5,699,052 |
| Calves, under 1 year | 417,402 | 17.3 | 2,635,685 | - | - | 2,635,685 |
| Heifers, 1 year and over | 234,959 | 29.3 | 2,512,769 | - | - | 2,512,769 |
| Steers, 1 year and over | 81,743 | 40 | 1,193,448 | 5 | 149,181 | 1,342,629 |
| Bulls, 1 year and over | 13,626 | 45 | 223,807 | - | - | 223,807 |
| **Pigs** | **4,267,365** | | **12,041,347** | | **8,248,583** | **20,325,929** |
| Boars | 8,504 | 15 | 46,559 | - | - | 46,559 |
| Breeding sows and gilts | 401,562 | 17 | 2,491,692 | - | - | 2,491,692 |
| Feeder and finisher pigs | 2,521,943 | 9 | 8,284,583 | 9 | 8,284,583 | 16,569,166 |
| Unweaned and weaned piglets | 1,335,356 | 2.5 | 1,218,512 | - | - | 1,218,512 |
| **Poultry** | **33,576,806** | | **2,190,709** | | **490,266** | **2,680,975** |
| Broilers, roasters, Cornish | 22,575,068 | 0.16 | 1,318,384 | 0.04 | 329,596 | 1,647,980 |
| Pullets under 19 weeks | 2,299,377 | 0.15 | 125,891 | 0.04 | 33,571 | 159,462 |
| Laying hens, 19 weeks and over | 4,337,784 | 0.25 | 395,823 | 0.04 | 63,332 | 459,154 |
| Turkeys | 1,747,067 | 0.4 | 255,072 | 0.1 | 63,678 | 318,840 |
| Other poultry | 2,617,510 | 0.1 | 95,539 | - | - | 95,539 |
| **Other** | **241,184** | | **596,147** | | **110,514** | **706,661** |
| Horses and ponies | 22,284 | 45 | 366,015 | 5 | 40,668 | 406,683 |
| Goats | 27,337 | 8 | 79,824 | 7 | 69,846 | 149,670 |
| Bison | 4,192 | 35 | 53,553 | - | - | 53,553 |
| Deer | 15,813 | 8 | 46,174 | - | - | 46,174 |
| Llamas and alpacas | 348 | 8.9 | 1,130 | - | - | 1,130 |
| Rabbits | 96,213 | 0.22 | 7,726 | - | - | 7,726 |
| Foxes | 2,319 | 1 | 846 | - | - | 846 |
| Wild boars | 2,908 | 8 | 8,491 | - | - | 8,491 |
| Mink | 67,025 | 0.3 | 7,339 | - | - | 7,339 |
| Elk | 2,745 | 25 | 25,048 | - | - | 25,048 |
| **TOTAL** | | | **43,854,039** | | **12,182,619** | **56,036,659** |

**Figure IV.3**
**Distribution of water requirements in Quebec by livestock sector**

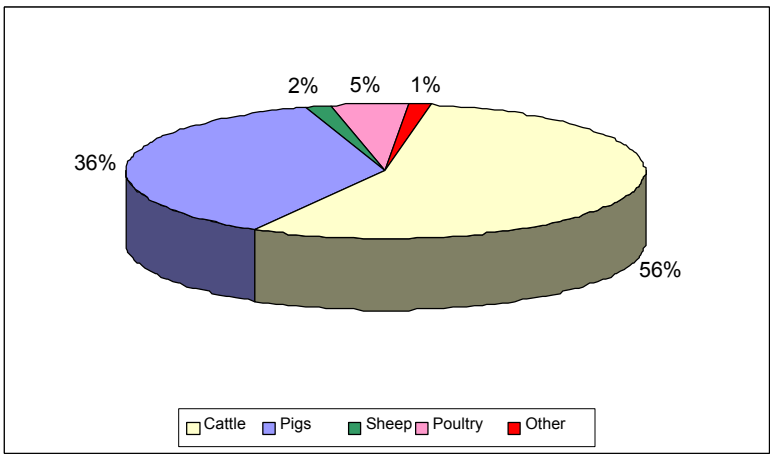
**Drinking water:**




**Other building requirements:**




**Total consumption:**



4. Water requirements for aquaculture

Annual production for all commercial aquaculture operations in Quebec was 1,677 tonnes in 2001. Consequently, the estimated water requirements for this sector of production are 73,500,000 $m^3$ (Table IV.4).

According to Morin (2002), 57% of these volumes are obtained from surface waters and 43% from groundwater. In addition, 23% of the operations use only surface water and 35% only groundwater, while 42% use both. Groundwater is generally more difficult to obtain but is of higher bacteriological quality and has a more constant temperature. Surface water, in contrast, is more readily accessible but lower in quality and varies in temperature with the season.

**Table IV.4**
**Water requirements for aquaculture in Quebec**

| Sector | Stock (kg produced/yr) | Water requirements | |
|---|---|---|---|
| | | Unit (L/day/kg produced/yr) | Total ($m^3$/yr) |
| Aquaculture | 1,677,244 | 120 | 73,463,287 |

## *B. Analysis of Regional Requirements*

1. Total water requirements

The total water requirements are not evenly distributed among the administrative regions of Quebec. The Eastern Townships and Montérégie regions alone consume 40% of the water used by the agricultural sector. The Eastern Townships heads the list because of the large number of aquaculture operations, which consume large quantities of water. Montérégie uses 16% of the water required by the agricultural sector, primarily for the irrigation of vegetable crops and livestock consumption. Abitibi-Témiscamingue, Northern Quebec, the Gaspé and the Magdalen Islands consume 1% of the water used for agriculture in Quebec. Table IV.5 presents the water consumption of the different regions of Quebec for each production sector. These data are illustrated in Figure IV.4.

**Table IV.5**
**Water requirements in Quebec by agricultural sector and by administrative region**

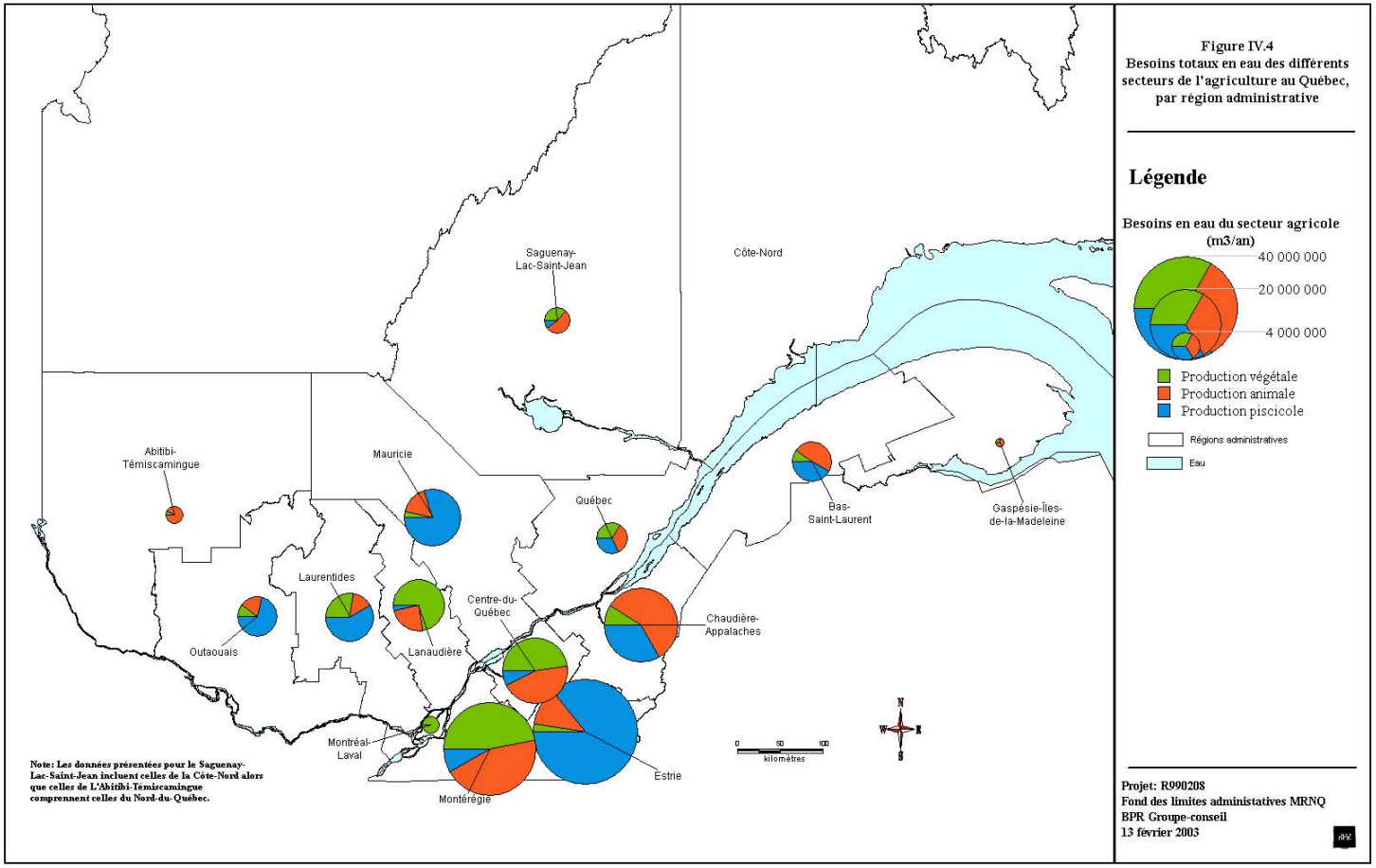
| Administrative region | Crop production ($m^3$/yr) | Livestock production ($m^3$/yr) | Aquaculture ($m^3$/yr) | Total ($m^3$/yr) |
|---|---|---|---|---|
| Lower St. Lawrence | 764,078 | 3,790,517 | 3,205,766 | **7,760,361** |
| Saguenay–Lac-Saint-Jean/North Shore | 1,277,340 | 1,754,576 | 377,074 | **3,408,990** |
| Quebec City | 1,547,223 | 1,481,366 | 1,424,683 | **4,453,272** |
| Mauricie | 449,123 | 2,422,252 | 11,394,833 | **14,266,208** |
| Eastern Townships | 862,828 | 4,763,261 | 33,941,014 | **39,567,103** |
| Montreal/Laval | 2,027,836 | 41,070 | x | **2,068,906** |
| Lanaudière | 8,760,175 | 2,962,462 | 415,969 | **12,138,606** |
| Outaouais | 797,539 | 1,491,678 | 5,540,306 | **7,829,523** |
| Laurentians | 2,606,370 | 1,365,198 | 5,493,746 | **9,465,314** |
| Abitibi-Témiscamingue/Northern Quebec | 121,669 | 1,426,619 | x | **1,548,288** |
| Gaspé-Magdalen Islands | 99,635 | 260,472 | x | **360,107** |
| Chaudière-Appalachians | 1,894,066 | 12,203,935 | 7,079,306 | **21,177,308** |
| Montérégie | 14,558,580 | 13,741,466 | 2,586,171 | **30,886,217** |
| Central Quebec | 8,855,793 | 8,171,003 | 1,453,240 | **18,480,037** |
| **Province of Quebec** | 44,622,257 | 56,036,659 | 73,463,287 | **174,122,202** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

2. Water requirements for crop production

Montérégie and Central Quebec are the largest water consumers for crop production, with 52.4% of the total for this sector. Central Quebec's position just behind Montérégie is attributable to cranberry production, which is concentrated in this region. The Lanaudière region is also a relatively large consumer of water for crops. It includes more than 25% of Quebec's irrigated areas, making it second to Montérégie (40%) for irrigation (Table IV.6). Table IV.7 presents additional information on water consumption for crop production. Consumption for the principal sectors of crop production is illustrated in Figure IV.5.

**Figure IV.4**
**Total water requirements in Quebec**
**by agricultural sector and by administrative region**



## Table IV.6
## Crop production areas receiving water inputs in Quebec, by administrative region

| Administrative region | Spraying | | | Greenhouse crops | | |
|---|---|---|---|---|---|---|
| | Herbicides (ha) | Insecticides (ha) | Fungicides (ha) | Vegetables (ha) | Ornamentals (ha) | Total (ha) |
| Lower St. Lawrence | 38,910 | 2,343 | 1,720 | 0.96 | 2.79 | 3.7 |
| Saguenay–Lac-Saint-Jean/North Shore | 35,803 | 3,437 | 3,022 | 3.82 | 3.98 | 7.8 |
| Quebec City | 19,664 | 6,348 | 4,911 | 2.30 | 3.84 | 6.1 |
| Mauricie | 39,623 | 1,439 | 1,692 | 0.82 | 2.96 | 3.8 |
| Eastern Townships | 225,898 | 5,057 | 2,198 | 3.97 | 5.27 | 9.2 |
| Montreal/Laval | 3,571 | 1,537 | 943 | x | 25.51 | x |
| Lanaudière | 72,407 | 12,016 | 10,583 | 4.76 | 7.66 | 12.4 |
| Outaouais | 9,521 | 860 | 555 | x | 3.43 | x |
| Laurentians | 28,263 | 4,416 | 3,670 | 23.41 | 23.09 | 46.5 |
| Abitibi-Témiscamingue/Northern Quebec | 9,816 | 755 | 512 | 2.41 | 1.40 | 3.8 |
| Gaspé-Magdalen Islands | 3,439 | 446 | 240 | x | 2.33 | x |
| Chaudière-Appalachians | 52,494 | 3,715 | 2,807 | 3.22 | 5.97 | 9.2 |
| Montérégie | 392,275 | 42,572 | 34,682 | 19.27 | 42.05 | 61.3 |
| Central Quebec | 116,536 | 5,475 | 5,788 | 14.15 | 9.30 | 23.4 |
| **Province of Quebec** | **848,220** | **90,416** | **73,323** | **90.2** | **139.6** | **229.8** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

## Table IV.6 (continued)
## Crop production areas receiving water inputs in Quebec, by administrative region

| Administrative region | Irrigation | | | | | Cranberries |
|---|---|---|---|---|---|---|
| | Vegetables (ha) | Potatoes (ha) | Small fruits (ha) | Apples (ha) | Total (ha) | (ha) |
| Lower St. Lawrence | 62 | 314 | 82 | 0 | 458 | 0 |
| Saguenay–Lac-Saint-Jean/North Shore | 25 | 70 | 397 | 0 | 492 | 30 |
| Quebec City | 380 | 165 | 376 | 26 | 947 | 0 |
| Mauricie | 147 | 0 | 92 | 10 | 249 | 0 |
| Eastern Townships | 14 | x | 192 | x | 476 | 0 |
| Montreal/Laval | 958 | 0 | 75 | 0 | 1,033 | 0 |
| Lanaudière | 3,502 | 1,978 | 196 | 0 | 5,676 | 0 |
| Outaouais | x | 73 | x | x | 486 | 0 |
| Laurentians | 901 | 18 | 275 | 93 | 1,287 | 0 |
| Abitibi-Témiscamingue/Northern Quebec | x | 0 | x | x | 48 | 0 |
| Gaspé-Magdalen Islands | x | x | x | x | 37 | 0 |
| Chaudière-Appalachians | 458 | 374 | 260 | 63 | 1,155 | 0 |
| Montérégie | 6,968 | 179 | 493 | 1,290 | 8,930 | 0 |
| Central Quebec | 290 | 89 | 235 | 110 | 724 | 550 |
| **Province of Quebec** | **13,916** | **3,615** | **2,867** | **1,601** | **21,998** | **580** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

## Table IV.7
## Water requirements for crop production in Quebec, by administrative region

| Administrative region | Spraying | | | | Greenhouse crops | | |
|---|---|---|---|---|---|---|---|
| | Herbicides ($m^3$/yr) | Insecticides ($m^3$/yr) | Fungicides ($m^3$/yr) | Total ($m^3$/yr) | Vegetables ($m^3$/yr) | Ornamentals ($m^3$/yr) | Total ($m^3$/yr) |
| Lower St. Lawrence | 7,302 | 3,170 | 5,775 | 16,247 | 8,925 | 51,906 | 60,832 |
| Saguenay–Lac-Saint-Jean/North Shore | 9,141 | 5,688 | 9.695 | 24,524 | 35,571 | 74,157 | 109,728 |
| Quebec City | 5,979 | 10,321 | 17,489 | 33,789 | 21,372 | 71,562 | 92,934 |
| Mauricie | 8,098 | 1,244 | 3,518 | 12,861 | 7,663 | 55,099 | 62,762 |
| Eastern Townships | 4,947 | 4,344 | 4,431 | 13,722 | 36,921 | 98,185 | 135,106 |
| Montreal/Laval | 1,202 | 1,258 | 934 | 3,394 | x | 474,941 | 474,941 |
| Lanaudière | 17,678 | 13,801 | 27,775 | 59,254 | 44,293 | 142,628 | 186,921 |
| Outaouais | 1,920 | 1,106 | 1,753 | 4,779 | x | 63,760 | 63,760 |
| Laurentians | 7,350 | 7,267 | 13,527 | 28,145 | 217,862 | 429,863 | 647,725 |
| Abitibi-Témiscamingue/Northern Quebec | 1,747 | 382 | 512 | 2,640 | 22,395 | 26,134 | 48,529 |
| Gaspé-Magdalen Islands | 743 | 719 | 870 | 2,331 | x | 43,304 | 43,304 |
| Chaudière-Appalachians | 10,212 | 3,484 | 6,742 | 20,439 | 30,000 | 111,128 | 141,128 |
| Montérégie | 91,574 | 41,225 | 68,606 | 201,405 | 179,325 | 782,850 | 962,175 |
| Central Quebec | 24,012 | 4,366 | 11,682 | 40,060 | 131,706 | 173,116 | 304,822 |
| **Province of Quebec** | **191,906** | **98,375** | **173,310** | **463,591** | **736,035** | **2,598,632** | **3,334,666** |

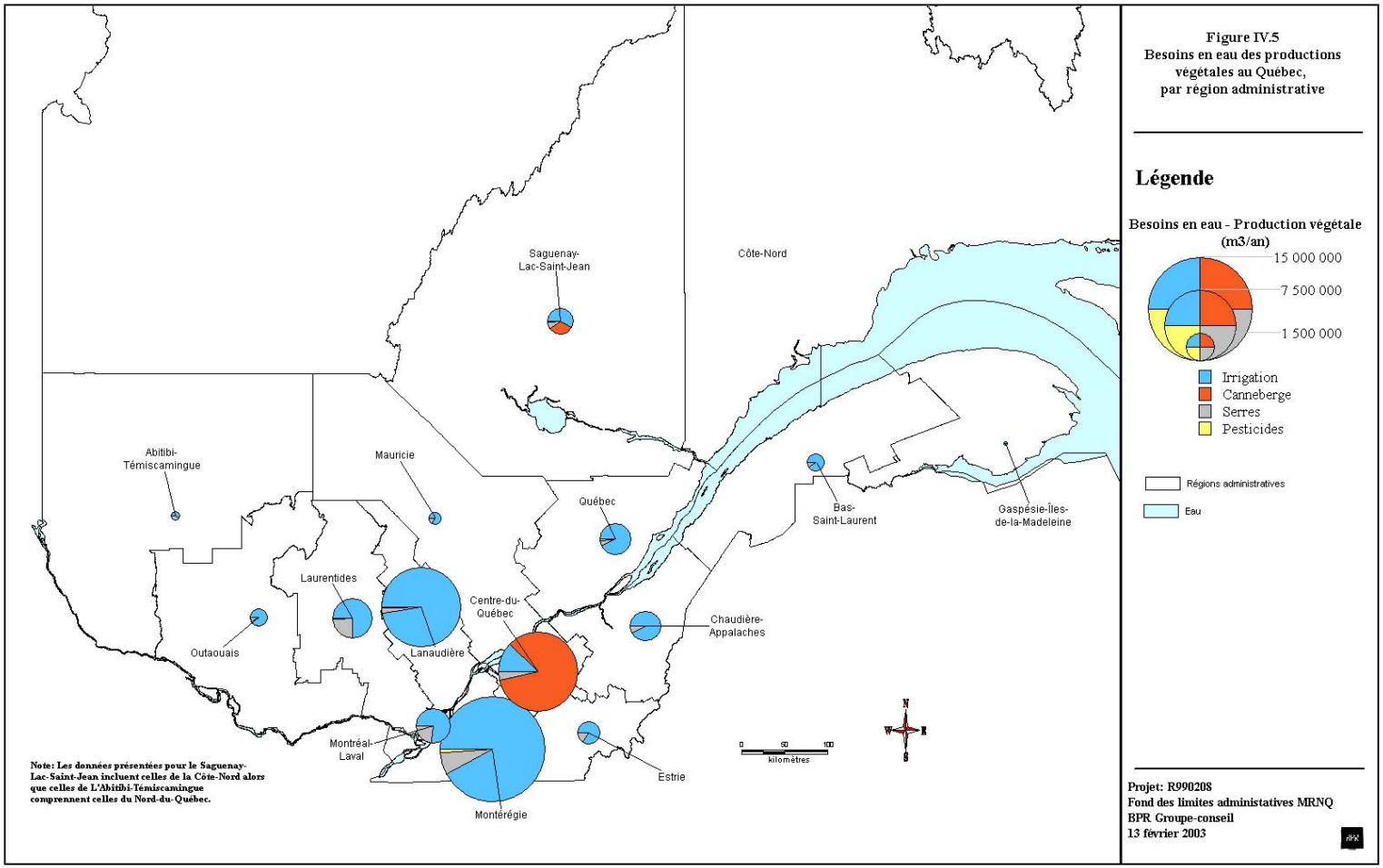
Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

## Table IV.7 (continued)
## Water requirements for crop production in Quebec, by administrative region

| Administrative region | Irrigation | | | | | Cranberries | Total crop requirements |
|---|---|---|---|---|---|---|---|
| | Vegetables ($m^3$/ha) | Potatoes ($m^3$/ha) | Small fruits ($m^3$/ha) | Apples ($m^3$/ha) | Total ($m^3$/ha) | ($m^3$/ha) | ($m^3$/ha) |
| Lower St. Lawrence | 93,000 | 471,000 0 | 123,000 | 0 | 687,000 | 0 | **764,078** |
| Saguenay–Lac-Saint-Jean/North Shore | 37,500 | 105,000 0 | 595,500 | 0 | 738,000 | 405,000 | **1,277,340** |
| Quebec City | 570,000 | 247,500 0 | 564,000 | 39,000 | 1,420,500 | 0 | **1,547,223** |
| Mauricie | 220,500 | 0 0 | 138,000 | 15,000 | 373,500 | 0 | **449,123** |
| Eastern Townships | 21,000 | x 0 | 288,000 | x | 714,000 | 0 | **862,828** |
| Montreal/Laval | 1,437,000 | 0 0 | 112,500 | 0 | 1,549,500 | 0 | **2,027,836** |
| Lanaudière | 5,253,000 | 2,967,000 0 | 294,000 | 0 | 8,514,000 | 0 | **8,760,175** |
| Outaouais | x | 109,500 0 | x | x | 729,000 | 0 | **797,539** |
| Laurentians | 1,351,500 | 26,000 | 412,500 | 139,500 | 1,930,500 | 0 | **2,606,370** |
| Abitibi-Témiscamingue/Northern Quebec | x | 0 0 | x | x | 70,500 | 0 | **121,669** |
| Gaspé-Magdalen Islands | x | x 0 | x | x | 54,000 | 0 | **99,635** |
| Chaudière-Appalachians | 687,000 | 561,000 0 | 390,000 | 94,500 | 1,732,500 | 0 | **1,894,066** |
| Montérégie | 10,452,000 | 268,500 0 | 739,500 | 1,935,000 | 13,395,000 | 0 | **14,558,580** |
| Central Quebec | 435,000 | 133,500 0 | 352,500 | 165,000 | 1,086,000 | 7,425,000 | **8,855,793** |
| **Province of Quebec** | 20,872,500 | 5,421,000 | 4,300,500 | 2,400,000 | **32,994,000** | **7,830,000** | **44,622,257** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

**Figure IV.5**
**Water requirements for crop production in Quebec,**
**by administrative region**



Information has been obtained from the database of the Agro-Environmental Portrait (1998) regarding sources of water supply for crop production in Quebec. Table IV.8 indicates that private farm wells are the principal sources of supply for greenhouse crops in virtually all regions, and in 60% of Quebec's greenhouses. In the Saguenay–Lac-Saint-Jean/North Shore and Central Quebec regions, however, water supply systems represent the primary source of supply. Rainwater collection is not a common practice, being used for only 2.0% of all greenhouses.

Water for pesticide spraying is also obtained from farm wells in the majority of the regions and throughout Quebec in a proportion of 51.9% (Table IV.9). Wells are the primary source for all regions with the exception of Saguenay–Lac-Saint-Jean/North Shore, Quebec City and Mauricie, where water supply systems are the primary source for this purpose.

Irrigation water is provided primarily by surface water (Table IV.10). Farm ponds, lakes and rivers meet 76% of the requirements, while farm wells provide irrigation water for 14.4% of all operations. Water supply systems are not widely used although they are available in a number of cases. In fact, water treated with chlorine (or other chemicals) may produce salt build-up on the soil surface and compromise the production capacity of the soil in the long term. In addition, relatively few farm wells have the capacity to supply a sufficient quantity of high-quality water for irrigation. On the other hand, these water sources are not as severely affected during dry summers. Pumping capacity may be unaffected while farm ponds and waterways dry up. The distribution of the sources of supply for farm irrigation water is illustrated in Figure IV.6.

**Table IV.8**
**Sources of water supply for greenhouse crops in Quebec, by administrative region**

| Administrative region | Farm well (%) | Water system (%) | River or lake (%) | Farm pond (%) | Collected rainwater (%) | Other (%) |
|---|---|---|---|---|---|---|
| Lower St. Lawrence | 71.8 | 16.2 | 11.1 | 0.0 | 0.0 | 0.9 |
| Saguenay–Lac-Saint-Jean/North Shore | 21.5 | 61.7 | 13.4 | 0.0 | 0.7 | 2.7 |
| Quebec City | 50.7 | 42.9 | 5.0 | 0.7 | 0.0 | 0.7 |
| Mauricie | 62.2 | 33.7 | 4.1 | 0.0 | 0.0 | 0.0 |
| Eastern Townships | 57.7 | 5.4 | 9.0 | 24.3 | 0.0 | 3.6 |
| Montreal/Laval | 48.1 | 47.6 | 0.3 | 1.1 | 2.9 | 0.0 |
| Lanaudière | 63.8 | 16.5 | 8.6 | 9.9 | 0.2 | 1.0 |
| Outaouais | 46.8 | 8.1 | 30.6 | 14.5 | 0.0 | 0.0 |
| Laurentians | 83.1 | 6.7 | 4.5 | 3.2 | 0.0 | 2.5 |
| Abitibi-Témiscamingue/Northern Quebec | 14.3 | 0.0 | 67.9 | 0.0 | 17.9 | 0.0 |
| Gaspé-Magdalen Islands | 46.8 | 27.4 | 0.0 | 22.6 | 3.2 | 0.0 |
| Chaudière-Appalachians | 55.3 | 3.2 | 21.6 | 12.3 | 0.0 | 7.6 |
| Montérégie | 63.1 | 17.0 | 5.2 | 7.9 | 4.3 | 2.5 |
| Central Quebec | 27.6 | 58.4 | 1.9 | 12.1 | 0.0 | 0.0 |
| **Province of Quebec** | **59.6** | **22.8** | **7.0** | **6.6** | **2.0** | **2.0** |

**Figure IV.6**
**Sources of water supply for irrigation of field-grown crops in Quebec, by administrative region**

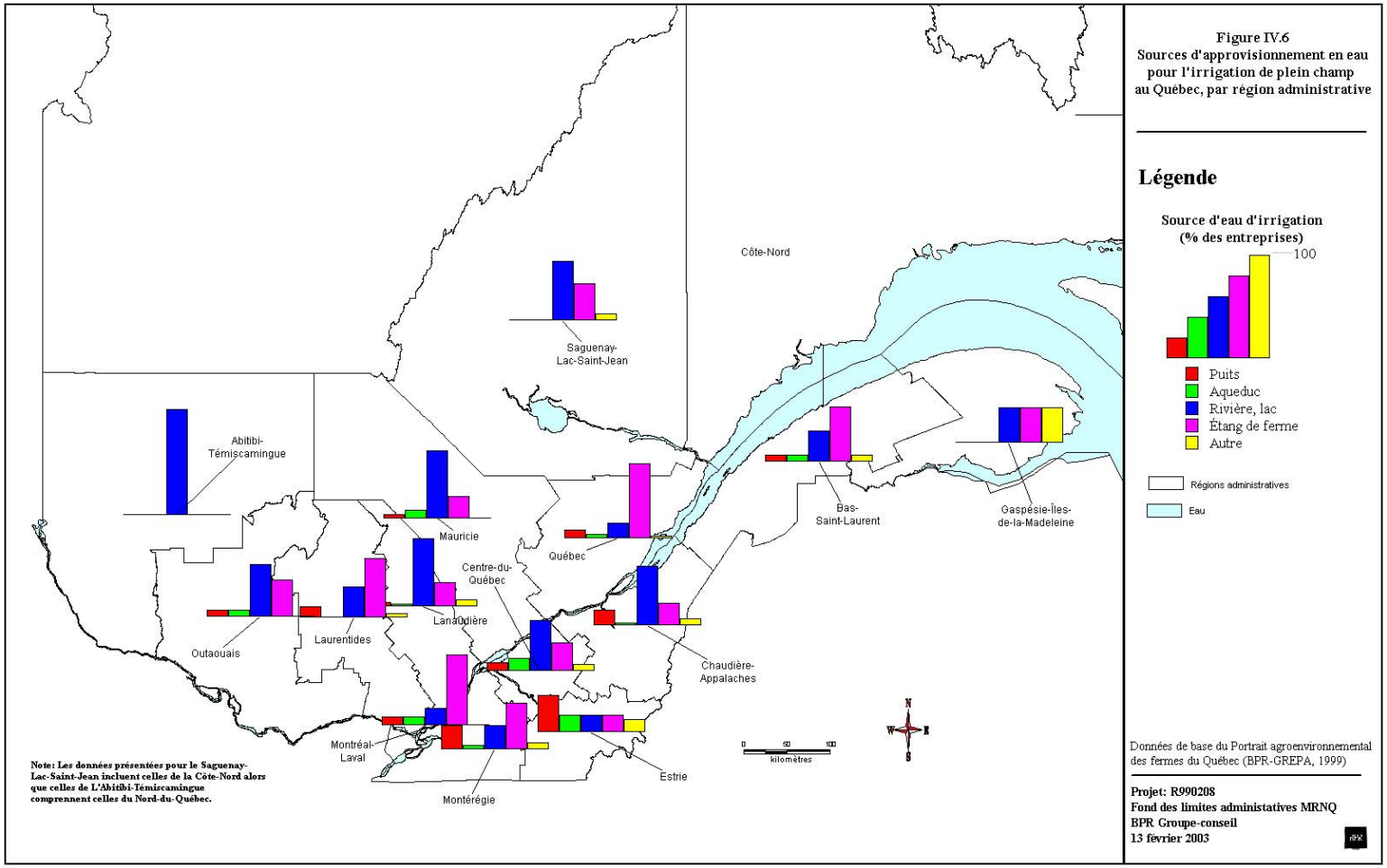


**Table IV.9**
**Sources of water supply for pesticide application in Quebec, by administrative region**

| Administrative region | Farm well (%) | Water system (%) | River or lake (%) | Farm pond (%) | Reservoir (%) | Other (%) |
|---|---|---|---|---|---|---|
| Lower St. Lawrence | 70.4 | 8.9 | 8.1 | 2.6 | 3.3 | 6.7 |
| Saguenay–Lac-Saint-Jean/North Shore | 9.5 | 79.0 | 5.1 | 0.2 | 5.1 | 1.0 |
| Quebec City | 36.0 | 42.3 | 2.9 | 15.3 | 2.9 | 0.5 |
| Mauricie | 21.0 | 59.5 | 0.9 | 0.5 | 16.1 | 2.0 |
| Eastern Townships | 76.6 | 3.0 | 6.4 | 2.7 | 3.2 | 8.1 |
| Montreal/Laval | 48.0 | 45.1 | 2.9 | 3.9 | 0.0 | 0.0 |
| Lanaudière | 56.3 | 25.5 | 7.5 | 3.4 | 4.2 | 3.0 |
| Outaouais | 72.8 | 11.6 | 9.2 | 2.9 | 0.0 | 3.5 |
| Laurentians | 62.8 | 4.7 | 6.4 | 9.1 | 10.5 | 6.4 |
| Abitibi-Témiscamingue/Northern Quebec | 81.3 | 7.9 | 5.8 | 1.4 | 0.7 | 2.9 |
| Gaspé-Magdalen Islands | 48.7 | 26.9 | 6.4 | 2.6 | 5.1 | 11.5 |
| Chaudière-Appalachians | 79.0 | 4.4 | 6.8 | 1.6 | 4.1 | 4.1 |
| Montérégie | 47.4 | 19.3 | 8.1 | 5.9 | 13.3 | 6.0 |
| Central Quebec | 42.1 | 20.7 | 5.3 | 1.5 | 19.0 | 11.3 |
| **Province of Quebec** | **51.9** | **21.4** | **6.7** | **4.1** | **10.1** | **5.8** |

**Table IV.10**
**Sources of water supply for irrigation in Quebec, by administrative region**

| Administrative region | Farm well (%) | Water system (%) | River or lake (%) | Farm pond (%) | Other (%) |
|---|---|---|---|---|---|
| Lower St. Lawrence | 5.9 | 5.9 | 29.4 | 52.9 | 5.9 |
| Saguenay–Lac-Saint-Jean/North Shore | 0.0 | 0.0 | 57.1 | 35.7 | 7.1 |
| Quebec City | 8.5 | 5.1 | 13.6 | 71.2 | 1.7 |
| Mauricie | 4.3 | 8.7 | 65.2 | 21.7 | 0.0 |
| Eastern Townships | 35.3 | 17.6 | 17.6 | 17.6 | 11.8 |
| Montreal/Laval | 8.3 | 8.3 | 16.7 | 66.7 | 0.0 |
| Lanaudière | 3.9 | 1.9 | 65.2 | 23.2 | 5.8 |
| Outaouais | 7.1 | 7.1 | 50.0 | 35.7 | 0.0 |
| Laurentians | 11.1 | 0.0 | 29.6 | 55.6 | 3.7 |
| Abitibi-Témiscamingue/Northern Quebec | 0.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| Gaspé-Magdalen Islands | 0.0 | 0.0 | 33.3 | 33.3 | 33.3 |
| Chaudière-Appalachians | 14.7 | 2.9 | 55.9 | 20.6 | 5.9 |
| Montérégie | 22.3 | 4.0 | 23.6 | 43.5 | 6.6 |
| Central Quebec | 8.8 | 11.8 | 47.1 | 26.5 | 5.9 |
| **Province of Quebec** | **14.4** | **4.1** | **35.4** | **40.6** | **5.5** |

In addition, sprinkler irrigation systems are used by 50% of all operations reporting irrigation of at least part of their crops (Table IV.11). Irrigation guns, at 23%, and drip irrigation systems, at 20%, are the other most popular systems. Underground irrigation is used by only 3.8% of these operations. It should be noted that this system requires specific conditions in terms of terrain (minimal slope and an impermeable layer immediately below the drains). The drip irrigation

system is the most efficient because it places the water where the plants need it and limits losses by evaporation. For areas where water is less abundant, this system should be promoted wherever it is applicable. The distribution of the types of irrigation systems by administrative region is shown on the map in Figure IV.7.

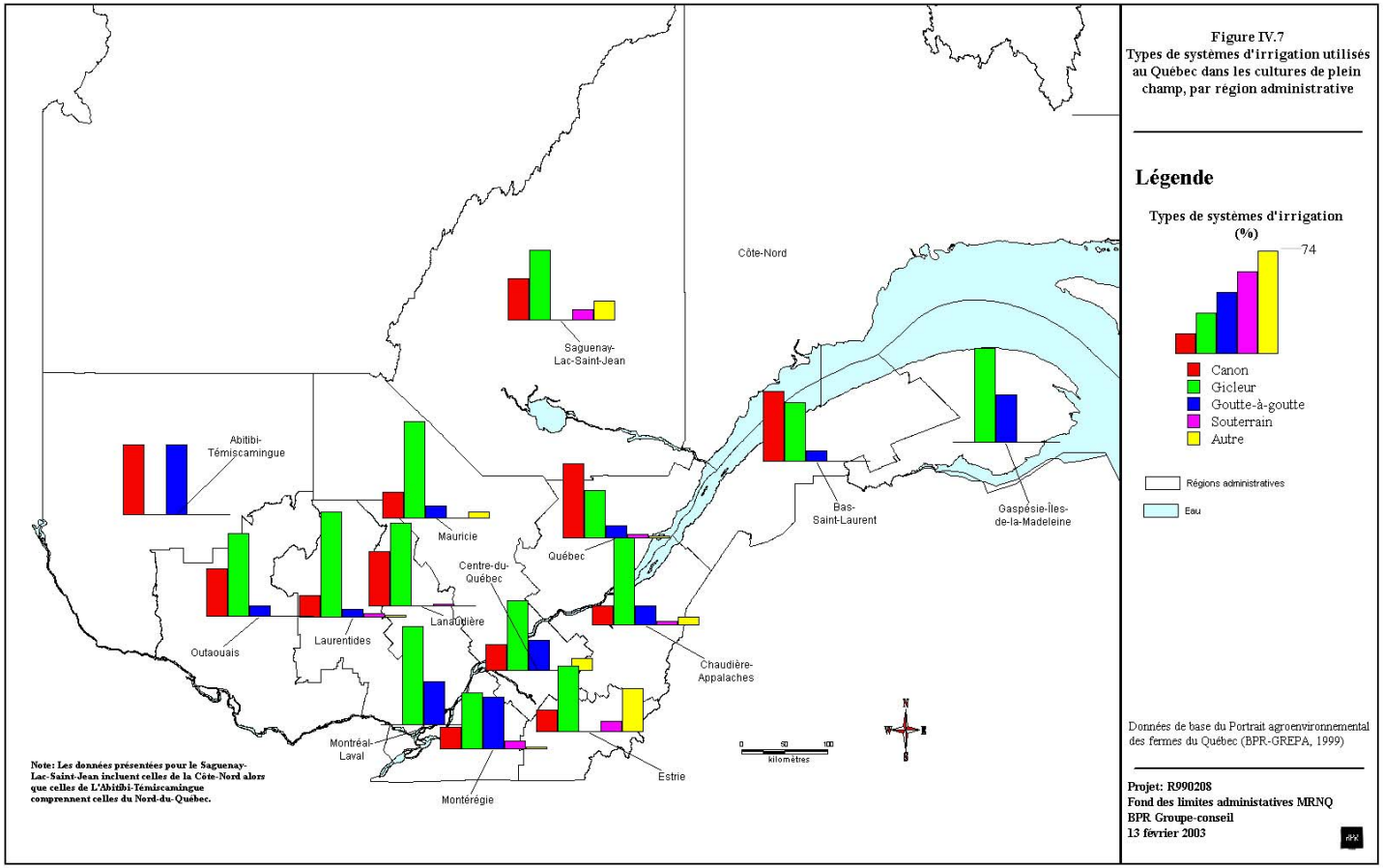
**Table IV.11**
**Irrigation systems used in Quebec, by administrative region**

| Administrative region | Gun (%) | Sprinkler (%) | Drip (%) | Underground (%) | Other (%) |
|---|---|---|---|---|---|
| Lower St. Lawrence | 50.0 | 41.7 | 8.3 | 0.0 | 0.0 |
| Saguenay–Lac-Saint-Jean/North Shore | 28.6 | 50.0 | 0.0 | 7.1 | 14.3 |
| Quebec City | 51.8 | 33.9 | 8.9 | 3.6 | 1.8 |
| Mauricie | 18.2 | 68.2 | 9.1 | 0.0 | 4.5 |
| Eastern Townships | 15.4 | 46.2 | 0.0 | 7.7 | 30.8 |
| Montreal/Laval | 0.0 | 69.6 | 30.4 | 0.0 | 0.0 |
| Lanaudière | 38.5 | 59.2 | 0.0 | 1.5 | 0.8 |
| Outaouais | 33.3 | 58.3 | 8.3 | 0.0 | 0.0 |
| Laurentians | 15.9 | 73.9 | 5.8 | 2.9 | 1.4 |
| Abitibi-Témiscamingue/Northern Quebec | 50.0 | 0.0 | 50.0 | 0.0 | 0.0 |
| Gaspé-Magdalen Islands | 0.0 | 66.7 | 33.3 | 0.0 | 0.0 |
| Chaudière-Appalachians | 13.3 | 63.3 | 13.3 | 3.3 | 6.7 |
| Montérégie | 15.5 | 40.3 | 36.8 | 6.1 | 1.3 |
| Central Quebec | 18.8 | 50.0 | 21.9 | 0.0 | 9.4 |
| **Province of Quebec** | **23.2** | **50.1** | **20.2** | **3.8** | **2.6** |

3. Water requirements for livestock production

Water consumption for livestock production is concentrated in three administrative regions: Montérégie, Chaudière-Appalachians and Central Quebec. These regions account for 61% of Quebec's total consumption, because of the large numbers of livestock on cattle and pig farms. Additional details on the distribution of the livestock and water requirements are presented in Tables IV.12 and IV.13. The geographical distribution of the requirements is illustrated in Figure IV.8. No figures are available on the sources of water supply for livestock production. In most cases, however, it is reasonable to assume that water for livestock is obtained from the same sources used for domestic purposes on the farm. This information is presented in section IV.D, "Analysis of Regional Problems".

**Figure IV.7**
**Types of irrigation systems used in Quebec for field-grown crops, by administrative region**



## Table IV.12
## Livestock production in Quebec, by type and by administrative region

| Administrative region | Sheep (head) | Cattle (head) | Pigs (head) | Poultry (head) | Other (head) |
|---|---|---|---|---|---|
| Lower St. Lawrence | 80,662 | 115,539 | 128,515 | 85,305 | 6,802 |
| Saguenay–Lac-Saint-Jean/North Shore | 19,084 | 59,480 | 8,087 | 795,139 | 3,041 |
| Quebec City | 4,552 | 38,856 | 81,188 | 1,456,321 | 2,893 |
| Mauricie | 5,320 | 60,798 | 169,107 | 1,766,435 | 3,584 |
| Eastern Townships | 26,649 | 138,848 | 261,201 | 255,785 | 11,769 |
| Montreal/Laval | 406 | 1,810 | 0 | 121 | 566 |
| Lanaudière | 6,255 | 44,097 | 272,579 | 5,745,139 | 17,862 |
| Outaouais | 10,615 | 71,485 | 4,119 | 15,228 | 3,738 |
| Laurentians | 4,241 | 45,603 | 35,764 | 576,707 | 12,057 |
| Abitibi-Témiscamingue/Northern Quebec | 23,214 | 60,544 | 5,811 | 338 | 3,206 |
| Gaspé-Magdalen Islands | 7,889 | 11,218 | 0 | 518 | 528 |
| Chaudière-Appalachians | 19,709 | 239,035 | 1,248,177 | 6,309,370 | 40,638 |
| Montérégie | 25,525 | 266,285 | 1,443,940 | 10,732,907 | 50,590 |
| Central Quebec | 19,932 | 209,190 | 600,410 | 4,962,884 | 50,039 |
| **Province of Quebec** | **254,053** | **1,362,788** | **4,267,365** | **33,576,806** | **241,184** |

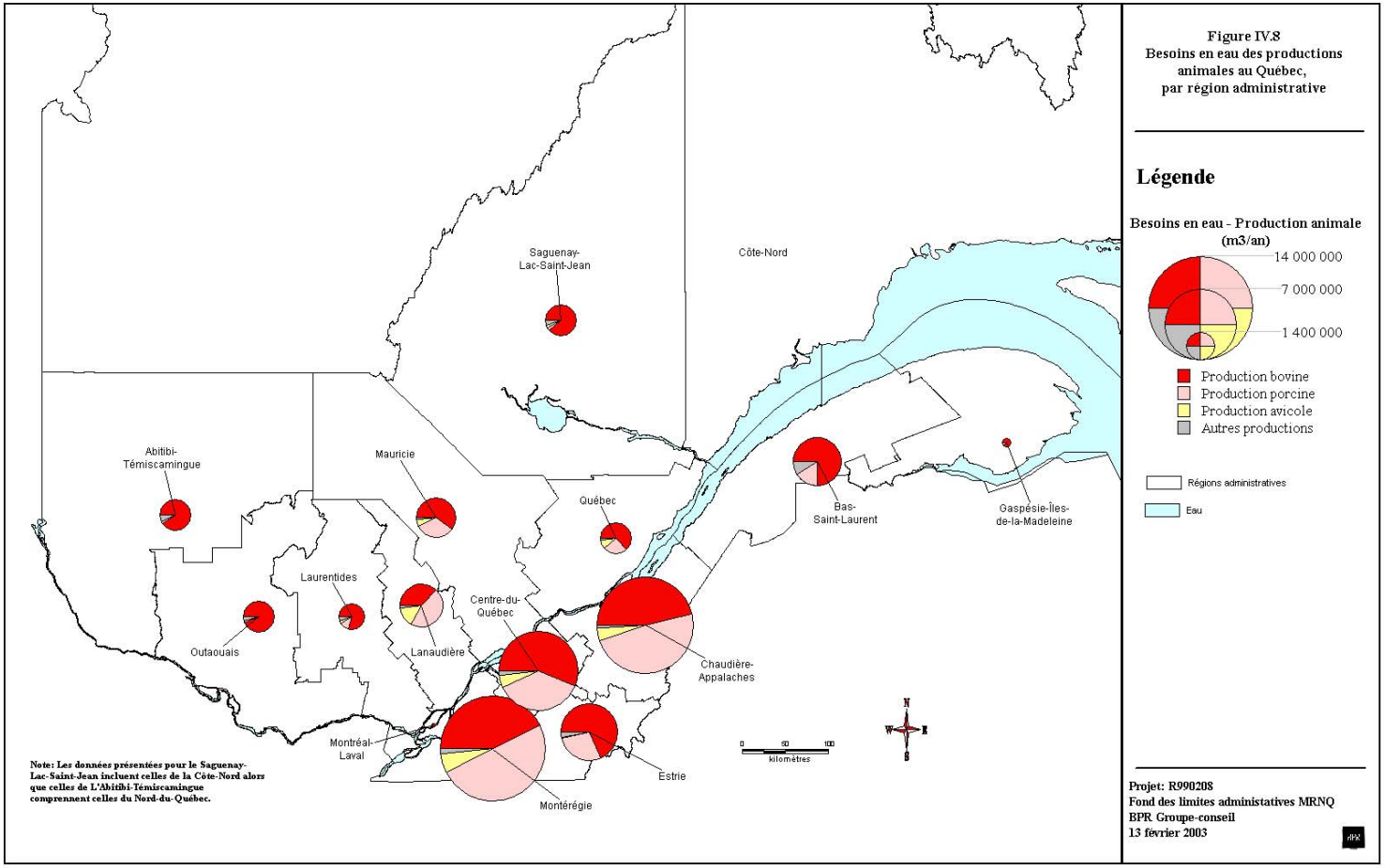
Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

## Table IV.13
## Water requirements for livestock production in Quebec, by type and by administrative region

| Administrative region | Sheep ($m^3$/yr) | Cattle ($m^3$/yr) | Pigs ($m^3$/yr) | Poultry ($m^3$/yr) | Other ($m^3$/yr) | Total ($m^3$/yr) |
|---|---|---|---|---|---|---|
| Lower St. Lawrence | 312,078 | 2,842,006 | 599,511 | 8,310 | 28,612 | **3,790,517** |
| Saguenay–Lac-Saint-Jean/North Shore | 73,823 | 1,540,711 | 52,650 | 62,859 | 24,533 | **1,754,576** |
| Quebec City | 17,181 | 932,000 | 373,523 | 138,908 | 19,754 | **1,481,366** |
| Mauricie | 21,641 | 1,457,838 | 775,333 | 139,766 | 27,674 | **2,422,252** |
| Eastern Townships | 103,252 | 3,259,209 | 1,321,107 | 18,727 | 60,965 | **4,763,261** |
| Montreal/Laval | 1,611 | 35,236 | 0 | 6 | 4,217 | **41,070** |
| Lanaudière | 24,296 | 1,111,245 | 1,339,016 | 447,388 | 40,516 | **2,962,462** |
| Outaouais | 38,611 | 1,383,034 | 27,025 | 1,110 | 41,898 | **1,491,678** |
| Laurentians | 16,552 | 1,075,340 | 161,947 | 42,355 | 69,004 | **1,365,198** |
| Abitibi-Témiscamingue/Northern Quebec | 89,777 | 1,280,769 | 36,966 | 12 | 19,095 | **1,426,619** |
| Gaspé-Magdalen Islands | 29,743 | 223,552 | 0 | 95 | 7,082 | **260,472** |
| Chaudière-Appalachians | 76,226 | 5,667,250 | 5,869,903 | 516,250 | 74,306 | **12,203,935** |
| Montérégie | 99,424 | 5,899,825 | 6,757,715 | 829,085 | 155,417 | **13,741,466** |
| Central Quebec | 77,775 | 4,596,825 | 2,998,465 | 402,540 | 95,399 | **8,171,003** |
| **Province of Quebec** | **1,018,253** | **31,304,839** | **20,325,929** | **2,680,975** | **706,661** | **56,036,659** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

**Figure IV.8**
**Water requirements for livestock production in Quebec, by administrative region**



4. Water requirements for aquaculture

Five regions of Quebec account for over 85% of the aquaculture operations in 2001 (Table IV.14). The Eastern Townships is the largest producer, with 775 tonnes of fish per year, 46% of the province's total production. It uses approximately 34,000,000 $m^3$ of water per year. Mauricie, Chaudière-Appalachians, the Outaouais and the Laurentians are, in order, the four next most important regions, with requirements varying from 5,500,000 $m^3$ to 11,400,000 $m^3$ of water per year.

**Table IV.14**
**Water requirements for aquaculture in Quebec, by administrative region**

| Administrative region | Aquaculture | |
|---|---|---|
| | Production (kg/yr) | Water requirements ($m^3$/yr) |
| Lower St.Lawrence | 73,191 | 3,205,766 |
| Saguenay–Lac-Saint-Jean/North Shore | 8,609 | 377,074 |
| Quebec City | 32,527 | 1,424,683 |
| Mauricie | 260,156 | 11,394,833 |
| Eastern Townships | 774,909 | 33,941,014 |
| Montreal/Laval | x | x |
| Lanaudière | 9,497 | 415,969 |
| Outaouais | 126,491 | 5,540,306 |
| Laurentians | 125,428 | 5,493,746 |
| Abitibi-Témiscamingue/Northern Quebec | x | x |
| Gaspé-Magdalen Islands | x | x |
| Chaudière-Appalachians | 161,628 | 7,079,306 |
| Montérégie | 59,045 | 2,586,171 |
| Central Quebec | 33,179 | 1,453,240 |
| **Province of Quebec** | **1,677,244** | **73,463,287** |

Note: The totals for each column and line are lower than or equal to those shown in the table because they include values that are not presented in the database of the 2001 Federal Census in order to preserve confidentiality.

## *C. Analysis of Sectoral Problems*

1. Water requirements for crop production

A number of elements may influence future quantitative and qualitative water requirements for crop production in Quebec. These factors include:

- The probable expansion of irrigated areas. Some traditionally irrigated crops (e.g. tobacco) may decline, while others expand. According to Statistics Canada, total irrigated areas in Quebec fell from 33,611 ha in 1996 to 22,578 ha in 2001, a drop of approximately 33%. However, according to the stakeholders consulted, interest in irrigation appears to have

increased in recent years, largely because of the real or presumed increase in the frequency of weather extremes;

- Changes in the management parameters influencing demand. Some of the factors determining the total water budget for irrigation include:
  - The effectiveness of precipitation or runoff conservation measures (e.g. watertable control);
  - The effectiveness of water storage structures (type of structures, watertightness, losses);
  - The effectiveness of water distribution structures or equipment;
  - The development and implementation of irrigation technologies to improve water efficiency (e.g. buried drip irrigation system) and reduce unit water requirements;
  - The adoption of soil and water conservation measures (mulch, organic matter, erosion control, etc.).

- Cultivar development. Later cultivars of certain crops (e.g. Russet Burbank potatoes) shift the timetable for water requirements and may increase the risks of water shortages. Similarly, some cultivars may be more or less drought-resistant or more or less responsive to irrigation in terms of yield;

- Evolution of technical and economic knowledge on irrigation. While suppliers are very familiar with the technical information on the irrigation systems themselves, they may be less familiar with a number of other parameters that determine the cost effectiveness of irrigation, in particular the concept of risk associated with the frequency and amount of irrigation in relation to its costs. Similarly, information on the optimal use of irrigation to control spring frost damage is limited, particularly with respect to blueberry production;

- The demands of the processing industry. Vegetable processing plants, in an effort to ensure the quantity and quality of their supplies and more efficient planning of harvesting and processing schedules, are placing increasing pressure on the producers with whom they contract to maintain minimum irrigation standards early in the season;

- The regulatory context with respect to water quality. The possible introduction of more stringent quality standards for irrigation water may increase the demand for groundwater, which is often of better quality. In addition, the introduction of the new *Quality of Drinking Water Regulation* may result in increased demand by municipalities, thus generating a higher risk of conflicts over the use of these waters.

In contrast to the water requirements for livestock production, which are distributed relatively uniformly through the year, irrigation requirements are less predictable and more localized, and occur generally when river levels are low, thus limiting collection capacities and increasing storage requirements.

Similarly, irrigated crops are, in most cases, intended directly for human consumption, and thus require increasingly stringent water quality standards as a result of consumers' demands for greater food safety.

2. Water requirements for livestock production

Most of the water requirements for livestock production are associated with cattle production (56%) and hog production (36%). Similarly, for all production sectors, drinking water requirements constitute nearly 80% of the total water requirements for the livestock sector. Modifications to water management practices associated with livestock buildings themselves (e.g. wash water, manure dilution) will thus have a limited impact on the extent of the requirements.

In addition, significant progress has been made in the hog industry in the past five (5) years with respect to the effectiveness of the methods used to supply drinking water, since these practices have a direct impact on the quantities of manure to be dealt with. For instance, the use of wet/dry feeders or water-saving bowl drinkers increased considerably between 1996 and 2001.

Consequently, trends in quantitative water requirements for livestock production will be strongly dependent on changes in livestock numbers over time, particularly in the case of cattle and hog production. While dairy production is relatively stable as a result of the supply management system, hog production has shown wide fluctuations in growth rates over the past 25 years. A long period of stagnation (1981-1994) occurred between two periods of growth, from 1976 to 1981 and from 1995 to 2001 (Morisset, 2002). Changes in production levels are influenced by numerous structural, regulatory and market factors that are difficult to predict. Similarly, environmental factors are assuming increasing importance in the evolution of production, as indicated by the BAPE hearings on *Sustainable Development of the Pork Industry in Quebec* currently being held in the province. The evolution of overall quantitative requirements thus remains difficult to predict.

In addition, there has been a general tendency to ever-larger livestock operations, particularly in the hog industry. This may lead inevitably to greater geographical concentration of the water requirements in specific areas. The concentration of these operations may eventually modify the dynamics of the regional water supply distribution in the agricultural sector.

3. Water requirements for aquaculture

Quebec's aquaculture sector has experienced a slowdown in recent years. After growing steadily from 1980 to 1999, from an annual production of 300 tonnes to 2,200 tonnes, it dropped to 1,677 tonnes in 2001. According to Lacerte (2002), production is expected to stabilize around this level over the next few years with the introduction of the Aqua-Blue Program, part of the National Water Policy announced by the Government of Quebec in November 2002. This program will enable aquaculture operations to upgrade their infrastructures to meet the discharge standards established by the Quebec Department of the Environment. This upgrading will also permit more efficient use of water in general.

The current market in Quebec is believed to be 3,500 tonnes per year. MAPAQ is aiming for increases in production that would eventually make it possible to achieve this market potential.

The Department also intends to promote the use of groundwater because of its bacteriological qualities and temperature, which permit year-round production.

In the past few years, aquaculture has faced two major problems. One is purely financial in nature while the other is environmental. These problems account for the decline in production since 1999. The Aqua-Blue Program and other programs already available to aquaculturists will make it possible to respond to the second problem and to stabilize production in the medium term (2 to 3 years). The new regulatory requirements, particularly the Groundwater Catchment Regulation, have complicated the operation of these businesses.

## *D. Analysis of Regional Problems*

### 1. Lower St. Lawrence administrative region (01)

Analysis of the regional requirements indicates that nearly 50% of the region's water requirements relate to livestock production, while 41% relate to aquaculture (Table IV.5).

Estimated figures for the types of water supply used by the rural population are presented as a general indication in Table IV.5. Assuming that the private wells are located primarily in rural areas, approximately 56% of the rural population are served by private wells. This proportion varies from 28% to 73%, depending on the RCM. Overall, nearly 72% of the rural population use groundwater, from water supply systems or private wells.

**Table IV.15**
**Sources of water supply used by rural populations**
**in the Lower St. Lawrence region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Kamouraska (14) | 22,494 | 13,447 | 59.8 | 1,711 | 12.7 | 2,513 | 18.7 | 9,223 | 68.6 |
| Matapédia (07) | 18,267 | 10,033 | 54.9 | 1,302 | 13.0 | 2,959 | 29.5 | 5,772 | 57.5 |
| La Mitis (09) | 19,326 | 10,150 | 52.5 | 4,398 | 43.3 | 2,892 | 28.5 | 2,860 | 28.2 |
| Les Basques (11) | 9,848 | 5,071 | 51.5 | 610 | 12.0 | 2,501 | 49.3 | 1,960 | 38.6 |
| Matane (08) | 26,900 | 10,440 | 38.8 | 4,737 | 45.4 | 296 | 2.8 | 5,407 | 51.8 |
| Rimouski-Neigette (10) | 52,289 | 14,330 | 27.4 | 3,553 | 24.8 | 319 | 2.2 | 10,458 | 73.0 |
| Rivière-du-Loup | 31,826 | 16,832 | 52.9 | 6,455 | 38.3 | 1,339 | 8.0 | 9,039 | 53.7 |
| Témiscouata (13) | 22,420 | 14,820 | 66.1 | 4,025 | 27.2 | 2,163 | 14.6 | 8,632 | 58.2 |
| **TOTAL FOR REGION** | **203,370** | **95,123** | **46.8** | **26,790** | **28.2** | **14,983** | **15.8** | **53,350** | **56.1** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

In general, the region is well provided with precipitation, and surface water and groundwater are abundant. Sectoral problems have been noted, however, by regional stakeholders.

The new regulatory context is encouraging a number of municipalities to use groundwater, which generally requires less treatment (e.g. Rimouski, Cabano). This transition may lead to water use conflicts in agricultural areas.

Some quantitative problems have been noted in the RCMs of Kamouraska (e.g. Kamouraska, Saint-Pascal and Sainte-Anne-de-la Pocatière) and Matapédia (e.g. Val-Brillant). According to MAPAQ's regional administration (Camille Morneau, pers. comm.), approximately 30 vegetable or small-fruit farms, in some 20 municipalities, are experiencing supply problems or require irrigation systems.

The Fouquette River presents serious problems in terms of surface water quality. Its watershed is relatively small (71 $km^2$) and the river probably supplies very few farms.

In addition, problems relating to groundwater quality have been noted in certain sectors:

- Nitrates and/or bacteriological contamination
  - RCM of Rivière-du-Loup (e.g. Isle-Verte, Saint-Modeste)
  - RCM of La Mitis (e.g. Sainte-Luce)
- Salinity and/or sulphur
  - RCM of Kamouraska (e.g. Kamouraska, Saint-Denis)
  - RCM of Rivière-du-Loup (e.g. Isle-Verte)
  - RCM of Matapédia (e.g. Amqui)
- Iron and manganese
  - RCM of Kamouraska (e.g. Saint-Alexandre, Sainte-Hélène)
  - RCM of Rivière-du-Loup (e.g. Saint-Arsène)
- Hardness
  - RCM of Matapédia (e.g. Amqui, Val Brillant, Sayabec)
- Fluorides
  - RCM of Kamouraska (e.g. Rivière-Ouelle, Sainte-Anne-de-la-Pocatière)

The total water requirements of the Lower St. Lawrence administrative region relate primarily to livestock production and aquaculture. Overall, they represent less than 5% of Quebec's total requirements. Given the relative abundance of surface water and groundwater, the quantitative problems are relatively limited, although qualitative issues are reported in specific sectors of the region.

2. Saguenay–Lac-St-Jean (2) and North Shore (09) administrative regions

The total water requirements of these two regions represent less than 2% of Quebec's overall requirements (Table IV.5). The consumption sectors are, in descending order, livestock production (51%), crop production (38%) and aquaculture (11%).

Cattle production accounts for approximately 88% of the total water requirements for livestock production. A total of 522 ha were reported as irrigated in 2001.

Estimated figures for the types of water supply used by the rural population are presented as a general indication in Table IV.16. Assuming that the private wells are located primarily in rural areas, approximately 30% of the rural population are served by private wells. This proportion varies, however, from 1% to 75%, depending on the RCM. Approximately 55% of the rural population use groundwater, from water supply systems or private wells.

**Table IV.16**
**Sources of water supply used by rural populations**
**in the Saguenay–Lac-Saint-Jean and North Shore regions**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Lac-Saint-Jean-Est (93) | 51,760 | 13,490 | 26.1 | 9,456 | 70.1 | 1,601 | 11.9 | 2,433 | 18.0 |
| Domaine-du-Roy (91) | 32,839 | 15,745 | 47.9 | 6,954 | 44.2 | 5,737 | 36.4 | 3,054 | 19.4 |
| Saguenay Fjord (94) | 166,780 | 38,240 | 22.9 | 18,535 | 48.5 | 3,861 | 10.1 | 15,844 | 41.4 |
| Maria-Chapdelaine (92) | 26,900 | 10,440 | 38.8 | 4,849 | 46.4 | 1,960 | 18.8 | 3,632 | 34.8 |
| Upper North Shore (950) | 12,894 | 7,373 | 57.2 | 2,375 | 32.2 | 4,650 | 63.1 | 348 | 4.7 |
| Manicouagan (960) | 33,620 | 7,152 | 21.3 | 1,693 | 23.7 | 114 | 1.6 | 5,346 | 74.7 |
| Minganie (981) | 12,321 | 9,403 | 76.3 | 216 | 2.3 | 9,101 | 96.8 | 86 | 0.9 |
| Sept-Rivières–Caniapiscau (971-972) | 38,931 | 6,621 | 17.0 | 5,442 | 82.2 | 167 | 2.5 | 1,012 | 15.3 |
| **TOTAL FOR REGION** | **376,045** | **108,464** | **45.7** | **49,520** | **45.7** | **27,190** | **25.1** | **31,755** | **29.3** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

In the Saguenay–Lac-Saint-Jean administrative region, drinking water systems are widely available and extend relatively frequently into rural areas. The proportion of the rural population served solely by private wells is thus relatively low. While irrigation virtually never relies on water from a water system, the same is not true of livestock buildings, which may be connected to such systems. A significant proportion of the region's livestock may thus be using treated water, and are thus guaranteed a high quality water supply. It is impossible, however, to quantify these data on the basis of the information currently available.

In general, the regions are well provided with precipitation, and surface water and groundwater are generally abundant and of good quality.

Irrigation is not highly developed in the vegetable, potato and small fruit sectors. Most farms that irrigate use spray systems (guns or sprinklers) and surface water from storage ponds. In the

case of small fruits, particularly blueberries, irrigation is used in response to both drought and frost. Technical optimization and the economics of irrigation remain important issues for blueberry producers.

No major quantitative problems have been noted by the stakeholders consulted. On the qualitative level, the *Portrait régional de l'eau* submitted by MENV (1999) during the public consultation on water management in Quebec indicated that little documentation is available on groundwater quality in the Saguenay–Lac-Saint-Jean region. Hardness (80-500 ppm) and alkalinity may be a problem in certain areas, and water obtained from marine clays is often very salty (sodium chlorides). High concentrations of iron, manganese and fluorine are also found in some locations. These conditions do not appear to have created serious agricultural water management problems, according to the stakeholders consulted.

The overall quantitative requirements of the two regions are relatively limited and, because of its abundance, the water resource has generated no quantitative problems under existing production conditions. Irrigation requirements for small fruits and potatoes may expand in the region. The foreseeable requirements in the medium term relate to the optimization of water distribution and the development of technical and economic expertise on irrigation.

### 3. Quebec National Capital administrative region (03)

The total water requirements of the Quebec National Capital administrative region represent 2.5% of the overall requirements for Quebec (Table IV.5). This consumption is evenly distributed among crop production (35%), livestock production (33%) and aquaculture (32%).

Cattle and hog production represent 63% and 25% respectively of the requirements for livestock production. Approximately 90% of the consumption for crop production is used to irrigate approximately 950 ha of field-grown crops.

Estimated figures for the types of water supply used by the rural population are presented as a general indication in Table IV.17. Assuming that the private wells are located primarily in rural areas, this table indicates that approximately 62% of the rural population are served by private wells. This proportion varies from 23% to 100%, depending on the RCM. In fact, all residents of Île d'Orléans use groundwater, and not municipal water supply systems.

**Table IV.17**
**Sources of water supply used by rural populations**
**in the Quebec National Capital region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Charlevoix (16) | 13,166 | 8,727 | 66.3 | 3,559 | 40.8 | 1,468 | 16.8 | 3,700 | 42.4 |
| Charlevoix-Est (15) | 16,624 | 9,384 | 56.4 | 5,839 | 62.2 | 586 | 6.2 | 2,959 | 31.5 |
| Quebec Urban Community (23) | 506,942 | 3,008 | 0.6 | 0 | 0.0 | 0 | 0.0 | 3,008 | 100 |
| Île-d'Orléans (20) | 6,779 | 6,779 | 100 | 0 | 0.0 | 0 | 0.0 | 6,779 | 100 |
| Côte-de-Beaupré (21) | 20,984 | 7,135 | 34.0 | 3,357 | 47.1 | 2,141 | 30.0 | 1,637 | 22.9 |
| Jacques-Cartier (22) | 26,459 | 19,450 | 73.5 | 639 | 3.3 | 1,454 | 7.5 | 17,357 | 89.2 |
| Portneuf (34) | 44,955 | 23,969 | 53.3 | 2,582 | 10.8 | 8,125 | 33.9 | 13,262 | 55.3 |
| **TOTAL FOR REGION** | **635,909** | **78,452** | **12.34** | **15,976** | **20.4** | **13,775** | **17.6** | **48,701** | **62.1** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

The MENV *Portrait régional de l'eau* (1999) identifies a number of hydrogeological units within the region.

Aquiferous complexes consisting of deltaic sands and gravels and the Saint-Narcisse moraine have high water-bearing potential and supply a number of municipalities in the RCMs of Portneuf, Jacques-Cartier, Côte-de-Beaupré and Charlevoix East. The water from these formations is not highly mineralized but pH levels are occasionally acidic (pH < 6.5). These deposits are not naturally well protected and nitrates and/or pesticides have been found in certain areas involved in intensive agricultural production, particularly the RCM of Portneuf. The hydrogeology of the Portneuf RCM has been studied in detail by Fagnan et al. (1998).

Sedimentary and igneous rocks offer lower-potential aquifers, as is the case, for example, on Île-d'Orléans. The water in these rocky units is highly mineralized, alkaline, often sulphurous and sometimes hard. These formations are also largely unprotected from contamination by the shallow unconsolidated deposits overlying them. On Île d'Orléans, bacteriological and chemical (pesticide, nitrate) contamination has been observed in a number of wells. The island's hydrogeological conditions have been analyzed by a number of authors, including Grenier (1977).

Finally, the silts and marine clays of the Champlain Sea are impermeable deposits with low water potential (aquitards). These waters are more highly mineralized than those in sandy deposits, their pH is higher and they often contain hydrogen sulphide.

The agricultural water supply on Île d'Orléans is problematic in terms of both quantity and quality. Nearly 88% of the irrigated areas in the Quebec National Capital region are located on Île d'Orléans, involving nearly 825 ha and some 50 farms.

Most farms on the higher parts of the island maintain irrigation ponds fed directly by rainwater. Few farms use groundwater for these ponds, because of the relative scarcity of aquifers.

Quantitative problems have been noted in recent years. The year 2002 was dry and particularly difficult for the island's vegetable and potato producers. According to the stakeholders consulted, any analysis aimed at a general solution for the agricultural industry in this sector must consider all aspects of water management, particularly:

- More precise temporal and spatial quantification of water requirements;
- Constraints (capacity, quality, distribution) on possible sources of supply (precipitation, groundwater, rivers);
- Optimization of water storage:
  - Pond management (depth and losses through evaporation or leaching);
  - Analysis of alternative solutions;
- Evaluation of water treatment requirements (e.g. water obtained from the St. Lawrence);
- Optimization of water use (irrigation techniques, monitoring tools, water conservation methods (e.g. mulch, organic matter, etc.));
- Technical/economic analysis of potential solutions.

The agricultural water supply on Île d'Orléans is thus an important regional problem. Two phases of a study on municipal water supply requirements have already been completed in 2000 and 2001 (SNC-Lavalin, 2000; BPR Consulting Group, 2001).

In addition, irrigation for potato production is still largely undeveloped in the Portneuf region. This practice could, however, become more widespread in the years to come.

A few irrigation projects are currently under development in the Charlevoix region, particularly for blueberry production. However, no major problems have yet been encountered in this sector.

### 4. Mauricie administrative region (04)

The total water requirements of the Mauricie administrative region represent slightly more than 8% of the requirements for Quebec as a whole (Table IV.5). This consumption is largely attributable, however, to aquaculture (80% of the region's requirements), which accounts for approximately 15% of the province's total water requirements for aquaculture.

Cattle and hog production represent 60% and 32% respectively of the requirements for livestock production. Consumption for crop production includes the requirements for the irrigation of greenhouse crops (14%) and field-grown crops (80%) and for pesticide spraying (3%).

Estimated figures for the types of water supply used by the rural population are presented in Table IV.18. Assuming that the private wells are located primarily in rural areas, approximately 29% of the rural population are served by wells. Approximately 66% of the rural population use groundwater.

**Table IV.18**
**Sources of water supply used by rural populations**
**in the Mauricie region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Francheville (37) | 138,355 | 20,597 | 14.9 | 4,644 | 22.5 | 7,652 | 37.2 | 8,301 | 40.3 |
| Central Mauricie (36) | 64,841 | 15,431 | 23.8 | 8,765 | 56.8 | 1,609 | 10.4 | 5,058 | 32.8 |
| Upper Saint-Maurice (90) | 15,862 | 5,338 | 33.7 | 4,709 | 88.2 | 89 | 1.7 | 539 | 10.1 |
| Maskinongé (51) | 23,401 | 13,372 | 57.1 | 0 | 0.0 | 10,845 | 81.1 | 2,527 | 18.9 |
| Mékinac (35) | 12,809 | 9,075 | 70.8 | 3,843 | 42.4 | 3,118 | 34.4 | 2,113 | 23.2 |
| **TOTAL FOR REGION** | **255,268** | **63,813** | **25.0** | **21,961** | **34.4** | **23,313** | **36.5** | **18,539** | **29.1** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

Water resources are generally abundant and few problems of a quantitative nature are reported. Such problems do, however, exist in one portion of the Maskinongé RCM, where the *Régie d'aqueduc de Grandpré* is considering supplementing its groundwater supply with water from the Du Loup or Maskinongé rivers. A number of livestock producers are connected to this water supply system.

Problems in terms of quality have been encountered with surface water from a number of rivers, including the Saint-Maurice, Shawinigan, des Envies (a tributary of the Batiscan), Du Loup and Maskinongé. Local cases of nitrate contamination in groundwater have been observed in the RCMs of Central Mauricie (e.g. Shawinigan South), Mékinac (Notre-Dame-de-Montauban) and Maskinongé (Pointe-du-Lac). No major problems have been reported by the stakeholders consulted with respect to the quality of the water used for agricultural purposes.

Irrigated field crops (250 ha) are concentrated primarily in the southern part of the region, in the municipalities located on either side of the Saint-Maurice River, particularly the RCM of Francheville. The issues noted in this sector relate to the use of high-performance, cost-effective irrigation techniques and the anticipated new requirements for food safety and irrigation water quality.

### 5. Eastern Townships administrative region (05)

Agriculture in the Eastern Townships is dominated by livestock production, particularly dairy cattle, pigs and beef cattle. Consequently, forage crops and grasslands are the primary form of crop production. These agricultural activities are distributed throughout the entire region. In addition, the Eastern Townships has the highest number of commercial aquaculture operations and the largest such operations.

Analysis shows that over 85% of the region's water requirements, or 34,000,000 $m^3$/yr, relate to aquaculture. It should be noted that these water requirements involve utilization rather than consumption, since the fish live in a water environment. The aquaculture operations rely largely on groundwater, often from high-capacity aquifers in fractured rock.

The water requirements for livestock production are significant as well, accounting for 8.5% of the province's requirements in this area. Because dairy cattle and beef cattle are well represented in the region, a large proportion of the water requirements are met while the livestock are on pasture. Moreover, irrigated areas are relatively small, with orchards accounting for a large proportion. Irrigation water for orchards and small fruits is delivered by drip irrigation systems. The farm ponds used for irrigation are generally fed from shallow or artesian wells.

Estimated figures for the types of water supply used by the rural population (Table IV.19) indicate that approximately 74% of the rural population are served by private wells. This proportion varies from 52% to 100%, depending on the RCM. Overall, 83% of the rural population use groundwater, from water supply systems or private wells.

**Table IV.19**
**Sources of water supply used by rural populations**
**in the Eastern Townships region**

| Regional County Municipality<br>RCM (code) | Total population in 2001 (n) | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| | | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Asbestos (40) | 14,535 | 5,976 | 0.41 | 853 | 14.3 | 65 | 1.1 | 5,058 | 84.6 |
| Coaticook (44) | 16,595 | 9,688 | 0.58 | 3 | 0.0 | 806 | 8.3 | 8,878 | 91.6 |
| Sherbrooke Region (43) | 141,212 | 13,876 | 0.10 | 0 | 0.0 | 0 | 0.0 | 13,876 | 100 |
| Le Granit (30) | 21,830 | 17,247 | 0.79 | 4,814 | 27.9 | 3,505 | 20.3 | 8,928 | 51.8 |
| Upper Saint-François (41) | 21,394 | 15,090 | 0.71 | 3,088 | 20.5 | 2,439 | 16.2 | 9,563 | 63.4 |
| Saint-François Valley (42) | 28,176 | 17,015 | 0.60 | 2,051 | 12.1 | 1,158 | 6.8 | 13,806 | 81.1 |
| Memphrémagog (45) | 41,871 | 24,110 | 0.58 | 6,775 | 28.1 | 1,550 | 6.4 | 15,785 | 65.5 |
| **TOTAL FOR REGION** | **285,613** | **103,002** | **0.36** | **17,584** | **17.1** | **9,522** | **9.2** | **75,896** | **73.7** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

In general, the Eastern Townships region is well provided with precipitation, and surface water and groundwater are generally abundant. The presence of aquifers in fractured rock has encouraged the establishment of aquaculture operations in this region. However, despite the generous supply of water, the operation of some major fish farms has occasionally led to water use conflicts with the municipalities concerned. These problems have been resolved by drilling new wells, making more extensive use of surface water or, in some cases, by abandoning production.

In terms of surface water quality, improved manure storage on the farm has reduced contamination in several bodies of water. However, the problem has not been eliminated within the Eastern Township region as a whole. In addition, the pressure on surface water has been

exacerbated since 1995 by the significant increase in the swine population within the area (MENV, 2000).

Cases of groundwater contamination in rural areas are rare. Since this is the most common source of supply, groundwater quality poses no problems in terms of supply for agricultural production.

With the exception of the water use conflicts generated by the establishment of major aquaculture operations, and now resolved, the principal problems reported relate to providing water to cattle on pasture or minimum feed. Because the pastures tend to be remote, watering areas are provided on small waterways, with or without small dams. During periods of drought, these waterways dry up and the producer must either deliver water to the cattle or drill wells in each of the areas used for pasturing.

6. Montreal (06) and Laval (13) administrative regions

The water requirements for the Montreal and Laval administrative regions total approximately 2 million $m^3$, with 98% being used for crop production (Table IV.5). Crop consumption is divided essentially between irrigation for field-grown crops (77%) and greenhouse production (23%).

More than 99% of the total population of Montreal and Laval is served by a water system supplied by surface water, with fewer than 6,500 persons using groundwater from private systems or wells. According to Statistics Canada, these two regions have virtually no rural population. In 2001, however, there were 216 farms on the two islands. They reported 5,235 ha under cultivation, including over 1,000 ha of irrigated field crops.

Municipal water is not used for irrigation. At Laval, the largest operations generally rely on nearby rivers, particularly the Mille-Îles and Des Prairies rivers. These waters decline in quality as they move downstream, with urban wastes constituting the principal source of contamination.

Smaller farms often develop ponds in low-lying areas to collect precipitation water. These farms do not necessarily have the catchment or storage infrastructures required for optimum efficiency, a problem throughout the region. The proportion of farms that obtain their water supply from groundwater is not accurately known, but is believed to be in the 10% range (Table IV.10).

This region is an important vegetable-producing centre for the greater Montreal region. The problems associated with the quality of the available surface water and the anticipated tightening of the quality standards for irrigation water could create a significant problem for this sector in the short or medium term.

7. Outaouais administrative region (07)

Agricultural activities in the Outaouais are dominated by the production of beef cattle, particularly cow-calf operations. This type of production relies primarily on the minimum feed system, with livestock being kept on pasture in the summer and in enclosures during the winter. The crops grown are related to this form of production and consist of 80% grass and pasture. Pastureland represents nearly 35% of all areas under cultivation in the region, the highest proportion for all of Quebec's administrative regions. The Outaouais is also one of the five leading regions for aquaculture. Other sectors of production are not highly developed, although there is demonstrated potential for horticulture and aquaculture.

Analysis of the regional requirements indicates that over 70% of the region's water requirements are related to aquaculture. Requirements for livestock production are high as well because of the number of beef cattle. Because of the production system used in this region, a high proportion of the drinking water is brought in when the livestock are on pasture. In addition, irrigated areas are relatively limited. Where they exist, farm ponds are supplied primarily by surface water.

Estimated figures for the types of water supply used by the rural population (Table IV.20) indicate that approximately 88% of the rural population are served by private wells. This proportion varies from 69% to 100%, depending on the RCM. Overall, 92% of the rural population use groundwater, from water supply systems or private wells.

**Table IV.20**
**Sources of water supply used by rural populations**
**in the Outaouais region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Outaouais Urban Community (81) | 226,696 | 7,107 | 3.1 | 0 | 0.0 | 0 | 0.0 | 7,107 | 100 |
| Gatineau Valley (83) | 18,730 | 14,562 | 77.7 | 2,121 | 14.6 | 660 | 4.5 | 11,781 | 80.9 |
| Outaouais Hills (82) | 35,188 | 35,171 | 100.0 | 933 | 2.7 | 0 | 0.0 | 34,238 | 97.3 |
| Papineau (80) | 20,367 | 14,519 | 71.3 | 2,091 | 14.4 | 2,346 | 16.2 | 10,082 | 69.4 |
| Pontiac (84) | 14,565 | 10,119 | 69.5 | 1,069 | 10.6 | 558 | 5.5 | 8,491 | 83.9 |
| **TOTAL FOR REGION** | **315,546** | **81,478** | **25.8** | **6,215** | **7.6** | **3,564** | **4.4** | **71,699** | **88.0** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

In general, the Outaouais region is well provided with precipitation, and surface water and groundwater are generally abundant. However, the watertables in this area have not been characterized. While water is relatively easy to obtain in the Ottawa valley, this is not the case for sites located at the foot of the Laurentian Highlands or farther upstream (Gatineau and Lièvre river valleys), where the subsoil is much more heterogeneous.

In terms of surface water quality, a number of problems have been reported. For instance, 14.5% of the lakes in this region are believed to be acidic (MENV, 2000b). Some lakes have also been shown to contain potentially toxic algae; one example is Heney Lake, which was experiencing eutrophication in 1999 when the aquaculture operation located upstream was closed. In addition, there have been reports of cases of *E. coli* contamination from municipal wastewaters and septic systems that have affected cattle (both dairy and beef). This is a common situation because of the difficulty involved in installing septic tanks and beds for large numbers of homes on very thin soil (Gatineau River valley) or impermeable clays (Ottawa River valley, particularly the RCM of Pontiac).

The principal problem reported for this region relates to providing water for cattle on pasture or minimum feed. Because the pastures tend to be remote and, even more important, highly fragmented, watering areas are provided on small waterways. During drier summers, these small waterways dry up and it becomes difficult to water the cattle.

### 8. Abitibi-Témiscamingue (08) and Northern Quebec (10) administrative regions

The data presented below relate solely to the Abitibi-Témiscamingue administrative region, since no agricultural activity has been reported in Northern Quebec. Agricultural activities in Abitibi-Témiscamingue are dominated by extensive beef cattle production in the more northerly areas (RCMs of Abitibi West and Abitibi) and by dairy production (primarily the RCM of Témiscamingue). Consequently, forage crops and grasslands are the primary form of crop production. Agricultural production is particularly well developed near Lakes Témiscamingue (RCM of Témiscamingue) and Abitibi (RCM of Abitibi West) because of the microclimate found there, particularly in the basins of the Loutre and Dagenais rivers that feed these two lakes respectively.

Analysis of the regional requirements indicates that more than 92% of the region's water requirements relate to livestock production and 8% to crop production, primarily for the application of pesticides. These requirements represent only 1% of the figures for agricultural production in Quebec as a whole.

Estimated figures for the types of water supply used by the rural population (Table IV.21) indicate that approximately 52% of the rural population are served by private wells. This proportion varies from 45% to 100%, depending on the RCM. Overall, 66% of the rural population use groundwater, from water supply systems or private wells.

In general, the region is well provided with precipitation, and surface water and groundwater are abundant. The region is characterized by the presence of eskers, geological formations of highly permeable unconsolidated materials deposited below glaciers by rapidly flowing meltwater. They constitute excellent aquiferous formations and contain water of excellent quality. While they are vulnerable to contamination, they are rarely located in agricultural areas. In fact, shallow wells are located primarily in clay soils (61%).

**Table IV.21**
**Sources of water supply used by rural populations**
**in the Abitibi-Témiscamingue and Northern Quebec regions**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Abitibi (88) | 24,613 | 13,186 | 53.6 | 0 | 0.0 | 0 | 0.0 | 13,186 | 100 |
| Abitib West (87) | 21,984 | 13,361 | 60.8 | 642 | 4.8 | 3,640 | 27.2 | 9,079 | 68.0 |
| Rouyn-Noranda (86) | 39,621 | 15,986 | 40.3 | 6,424 | 40.2 | 727 | 4.5 | 8,835 | 55.3 |
| Témiscamingue (85) | 17,504 | 12,895 | 73.7 | 2,293 | 17.8 | 4,808 | 37.3 | 5,794 | 44.9 |
| Vallée-de-l'Or (89) | 42,375 | 10,607 | 25.0 | 462 | 4.4 | 3,068 | 28.9 | 7,077 | 66.7 |
| Northern Quebec | 38,575 | 18,841 | 48.8 | 18,841 | 100 | 0 | 0.0 | 0 | 0.0 |
| **TOTAL FOR REGION** | **184,672** | **84,876** | **33.8** | **28,661** | **33.8** | **12,244** | **14.4** | **43,971** | **51.8** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

With respect to surface water quality, waterways in the region are experiencing acidification, with more than 50% of those inspected being already acidified or in transition. In addition, the contamination by phosphorus and cyanobacteria of the Quebec portion of Lake Abitibi, which is fed by the Dagenais River, reflects the impact of agricultural activity on this watershed (DSP, 2002). Similarly, the Loutre River, which flows into Lake Témiscamingue, is subject to heavy agricultural pressure and is demonstrating erosion and eutrophication problems (MENV, 2002).

Problems relating to groundwater quality have been noted as well. Approximately 84% of the shallow wells located in clay and 48% of those in sand are believed to be contaminated by bacteria. In addition, the presence of heavy metals in artesian wells is a major concern in this region. Arsenic is the most important of these metals and is associated with certain gold deposits.

Because of the relative abundance of surface water and groundwater, quantitative problems are very limited. However, pressures are being felt in certain areas that are particularly appropriate for agriculture because of their microclimates. Pork and beef production are expanding and may increase this pressure within the watersheds of the Loutre and Dagenais rivers.

### 9. Gaspé – Magdalen Islands administrative region (11)

The water requirements for the livestock and crop sectors in this administrative region account for less than 0.5% of Quebec's overall requirements for these two consumption categories (Table IV.5). Consumption by aquaculture operations could not be calculated without violating the confidentiality of the producers' data. According to the stakeholders consulted, there are at least 2 aquaculture operations still in operation in the Gaspé Peninsula.

Livestock production accounts for more than 72% of the requirements for the livestock and crop sectors combined. Cattle and sheep production represent 86% and 11% respectively of the requirements for livestock production.

Crop-related requirements relate primarily to greenhouse production (43%) and irrigation of field-grown crops (55%). According to the stakeholders, the south shore of the peninsula has 5 or 6 field irrigation projects, supplied primarily by surface water.

Estimated figures for the types of water supply used by the rural population are presented in Table IV.22. Assuming that the private wells are located primarily in rural areas, approximately 28% of the rural population are served by private wells or water supply systems . Approximately 62% of the rural population use groundwater, from water supply systems or other sources. This proportion is 100% in the Magdalen Islands.

**Table IV.22**
**Sources of water supply used by rural populations**
**in the Gaspé–Magdalen Islands region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Avignon (060) | 15,268 | 11,780 | 77.2 | 3,834 | 32.5 | 3,595 | 30.5 | 4,351 | 36.9 |
| Bonaventure (050) | 18,267 | 14,634 | 80.1 | 4,834 | 33.0 | 4,557 | 31.1 | 5,243 | 35.8 |
| Upper Gaspé (040) | 12,722 | 5,769 | 45.3 | 3,348 | 58.0 | 2,116 | 36.7 | 305 | 5.3 |
| Gaspé Coast (030) | 18,545 | 11,623 | 62.7 | 5,672 | 48.8 | 2,928 | 25.2 | 3,023 | 26.0 |
| Magdalen Islands (010) | 12,824 | 11,165 | 87.1 | 0 | 0.0 | 9,895 | 88.6 | 1,270 | 11.4 |
| Percé Rock (020) | 19,298 | 14,997 | 77.7 | 8,945 | 59.6 | 437 | 2.9 | 5,616 | 27.4 |
| **TOTAL FOR REGION** | **96,924** | **69,968** | **72.2** | **26,632** | **38.1** | **23,529** | **33.6** | **19,807** | **28.3** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

### a) Gaspé

In general, the region is well provided with surface water and groundwater. The Gaspé's high-potential aquiferous zones are located in surface deposits of sand and gravel, notably at Sainte-Anne-des-Monts (RCM of Upper Gaspé), Bonaventure and in the area between Saint-Omer and New Richmond (RCMs of Avignon and Bonaventure).

Rocky aquifers are located in limestone, sandstone and conglomerate formations. These are found primarily in Chaleur Bay, where they occupy a large proportion of the inhabited area. The aquifer complexes in the southern part of the peninsula are generally more productive than those found on the North Shore.

A number of local problems have been reported by the stakeholders with respect to the groundwater in three areas, although relatively few operations are affected:

- The Anse-aux-Griffons area (town of Gaspé, adjacent to Forillon Park);
- A specific area between the villages of Anse-aux-Gascons and Newport;
- The Cap-Noir area, between New Richmond and Caplan.

The general quality of the groundwater is good, with the majority of the area having calcium bicarbonate type water, with a slightly alkaline pH of about 7.2. High concentrations of fluorides produced by local geological conditions have been reported in a particular area of Maria (RCM of Avignon). The individuals consulted did not feel that the quality of the groundwater posed any particular problem for agriculture.

### b) Magdalen Islands

The problem in the Magdalen Islands is more serious and requires closer attention. Groundwater is the island's sole source of drinking water. The Cap-aux-Meules formation, which consists of red sandstone, is the principal water-bearing formation. The region represents a special hydrogeological situation because of the high risk of saline intrusion into the aquifers when groundwater is pumped out. The geological formation is also highly permeable, making the entire area vulnerable to contamination.

A relatively detailed hydrogeological study, conducted by the Quebec Department of Natural Resources in the late 1970s (Sylvestre, 1979a, 1979b), led to the development of a groundwater management plan for the Magdalen Islands. More recently, a project financed by the Quebec Sustainable Development Action Fund (FAQDD) is expected to update the basic hydrogeological information on the island.

On the agricultural level, 17 farms reported 236 ha under cultivation in 2001. According to the stakeholders consulted, the decline in the fishing industry and the growing market for local products is reviving interest in agriculture on the island. A group of producers from the island has already informed the municipality of their desire to improve the water supply infrastructure for agriculture. The problem thus remains unresolved.

## 10. Chaudière-Appalachians administrative region (12)

The total water requirements of the Chaudière-Appalachians administrative region represent approximately 12% of the requirements for Quebec as a whole (Table IV.5). This regional consumption is distributed among livestock production (58%), aquaculture (33%) and crop production (9%). Water consumption for livestock production accounts for approximately 22% of Quebec's total requirements in this sector.

Pork and cattle production represent 48% and 46% respectively of the requirements for livestock production. More than 92% of the water requirements for crop production relate to irrigation of the 1,155 ha of irrigated land reported in the region.

Estimated figures for the types of water supply used by the rural population are presented as a general indication in Table IV.23. Assuming that the private wells are located primarily in rural areas, approximately 60% of the rural population are served by private wells or private water systems. This proportion varies from 36% to 100%, depending on the RCM. Overall, approximately 84% of the rural population use groundwater, a figure well above the provincial average.

**Table IV.23**
**Sources of water supply used by rural populations**
**in the Chaudière-Appalachians region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Beauce-Sartignan (29) | 47,873 | 19,576 | 40.9 | 2,187 | 11.2 | 1,304 | 6.7 | 16,085 | 82.2 |
| Bellechasse (19) | 29,570 | 22,080 | 74.7 | 1,569 | 7.1 | 11,285 | 51.1 | 9,226 | 41.8 |
| Desjardins (24) | 51,855 | 3,490 | 6.7 | 0 | 0.0 | 0 | 0.0 | 3,490 | 100 |
| Asbestos (31) | 43,247 | 15,296 | 35.4 | 6,682 | 43.7 | 3,122 | 20.4 | 5,492 | 35.9 |
| L'Islet (17) | 19,368 | 17,470 | 90.2 | 4,141 | 23.7 | 5,040 | 28.8 | 8,290 | 47.4 |
| Nouvelle-Beauce (26) | 25,850 | 16,060 | 62.1 | 3,021 | 18.8 | 1,845 | 11.5 | 11,193 | 69.7 |
| Chaudière Falls | 78,808 | 11,307 | 14.3 | 30 | 0.3 | 8 | 0.1 | 11,270 | 99.7 |
| Les Etchemins (28) | 17,745 | 11,294 | 63.6 | 1,166 | 10.3 | 3,101 | 27.5 | 7,027 | 62.2 |
| Lotbinière (33) | 26,851 | 18,938 | 70.5 | 0 | 0.0 | 6,774 | 35.8 | 12,164 | 64.2 |
| Montmagny (18) | 23,438 | 13,494 | 57.6 | 5,202 | 38.6 | 1,893 | 14.0 | 6,399 | 47.4 |
| Robert-Cliché (27) | 18,771 | 11,030 | 58.8 | 1,687 | 15.3 | 3,280 | 29.7 | 6,063 | 55.0 |
| **TOTAL FOR REGION** | **383,376** | **160,035** | **41.7** | **25,685** | **16.0** | **37,652** | **23.5** | **96,698** | **60.4** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

The Chaudière-Appalachians region is divided in two distinct hydrogeographic units, separated at the peak of the Appalachians along a southwest/northeast axis. To the north, water flows towards the St. Lawrence River, while in the smaller southern portion, it flows towards New Brunswick's St. John River. Most of the region's agricultural activity is located in the northern portion. The region includes more than 1,000 named waterways. The Chaudière, Boyer, Sud, Etchemins and Bécancour rivers, among others, are experiencing problems in terms of water quality.

Groundwater resources are generally relatively abundant but may differ from one sector to another. The aquifer complexes with the highest potential are often associated with sand/gravel deposits of various origins, at altitudes below 150 metres. The sedimentary rocks of the Lowlands and Appalachians offer lower potential, with flows rarely exceeding 10 $m^3$/h. As a result, a number of wells are often required to supply a single municipality or large private consumer. Finally, glacial deposits (till) and marine clays are relatively impermeable and unproductive (aquitards), adequate at best to meet the water requirements of a single family.

A number of quantitative problems related to hydrogeological conditions or water use conflicts have been reported in certain areas:

- Water use conflict over the water from Sauvage Creek, in the Saint-Eugène-de-l'Islet area of the municipality of L'Islet (RCM of L'Islet);
- Quantitative problems in a number of municipalities in the RCM of Bellechasse (e.g. Sainte-Claire, Saint-Anselme, Honfleur, Saint-Charles).

On the qualitative level, the groundwater is generally the calcium bicarbonate type and is considered good throughout the area. A number of local problems, however, require attention:

- Iron and/or manganese
  - RCM of Beauce-Sartigan (e.g. Saint-Martin, Sainte-Hélène)
  - RCM of Robert-Cliche (e.g. east of Beauceville)
  - RCM of Nouvelle-Beauce (e.g. north of Saint-Bernard)
- Hardness (> 180 ppm) and/or sulphur
  - RCM of Nouvelle-Beauce (e.g. Saints-Anges, Scott, Sainte-Hénédine)
- Nitrates
  - RCM of Bellechasse (e.g. Saint-Gervais, Saint-Michel-de-Bellechasse, Saint-Charles-de-Bellechasse)

According to regional stakeholders, a number of farms that use wells are installing water softeners and, in some cases, air treatment systems for sulphur.

Overall, quantitative problems of supply are local and limited in scope. Qualitative problems vary from one area to another and can be dealt with in some cases by the installation of small treatment facilities on the farm. By the spring of 2003, MENV should have the results of a campaign to characterize groundwater wells in the region. The findings from this study will help to clarify the current regional portrait.

### 11. Lanaudière administrative region (14)

The total water requirements of the Lanaudière administrative region represent approximately 7% of Quebec's overall requirements (Table IV.5). This consumption is attributable primarily to crop production (72%) and livestock production (24%).

Regional requirements for crop production represent nearly 20% of the province's requirements in this sector. Approximately 97% of the regional consumption for crop production is attributable to the water requirements of approximately 5,700 ha of irrigated field crops.

Lanaudière's water requirements for livestock production constitute almost 5% of Quebec's total requirements in this sector. Consumption is distributed among hog production (45%), cattle production (37%) and poultry production (15%).

Estimated figures for the types of water supply used by the rural population of Lanaudière are presented as a general indication in Table IV.24. Assuming that the private wells are located primarily in rural areas, approximately 68% of the rural population are served by private wells or

private water systems. This proportion varies from 42% to 100%, depending on the RCM. The RCMs of Montcalm and Les Moulins, for instance, rely entirely on groundwater from private wells or private water systems. Overall, approximately 80% of the rural population use groundwater, a figure well above the provincial average. Groundwater vulnerability maps have been prepared for a number of areas within the region (McCormack, 1986a, 1986b; Champagne, 1990).

**Table IV.24**
**Sources of water supply used by rural populations**
**in the Lanaudière region**

| Regional County Municipality<br>RCM (code) | Total population in 2001 (n) | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| | | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| D'autray (52) | 38,347 | 20,558 | 53.6 | 6,560 | 31.9 | 5,331 | 25.9 | 8,666 | 42.2 |
| Joliette (61) | 54,167 | 17,745 | 32.8 | 4,783 | 27.0 | 70 | 0.4 | 12,892 | 72.7 |
| Assomption (60) | 103,977 | 8,829 | 8.5 | 5,658 | 64.1 | 156 | 1.8 | 3,015 | 34.2 |
| Les Moulins (64) | 110,087 | 5,779 | 5.2 | 0 | 0.0 | 0 | 0.0 | 5,779 | 100 |
| Matawinie (62) | 43,177 | 31,702 | 73.4 | 5,048 | 15.9 | 7,138 | 22.5 | 19,516 | 61.6 |
| Montcalm (63) | 38,740 | 24,557 | 63.4 | 0 | 0.0 | 0 | 0.0 | 24,557 | 100 |
| **TOTAL FOR REGION** | **388,495** | **109,170** | **28.1** | **22,049** | **20.2** | **12,695** | **11.6** | **74,426** | **68.2** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

On the hydrographic level, the region cuts across, from west to east, all or part of the watersheds of the Mascouche, Assomption, Chaloupe, Bayonne, Chicot and Maskinongé rivers. Water quality problems are known to exist in certain parts of all these rivers.

In addition, a number of small dams were built in the 1970s for farm irrigation. The areas primarily affected are segments of the following rivers:

- Point du Jour Creek (a tributary of the Assomption River)
- The Saint-Antoine, Saint-Joseph and Saint-Jean rivers (outlet at Lavaltrie)

The stakeholders concerned recognize that the storage capacity of these structures has declined to some extent over time, primarily as a result of sediment accumulation, and that extensive work will be required in view of the area's importance for horticulture. Preliminary estimates suggest that work will be required over a distance of approximately 30 kilometres (Bernard Arpin, MAPAQ, technical note dated September 23, 2002).

More closely defined problems exist as well in certain areas. Farms in the northern portion of RCM of Montcalm rely primarily on surface water for their irrigation requirements. In the central and southern portions (particularly Saint-Lin and Saint-Esprit), the aquifers are less

productive and the existing ponds do not meet all the current and anticipated requirements. Storage ponds appear to be a problem in a number of areas within the region.

12. Laurentian administrative region (15)

Agricultural production in the Lower Laurentians, the southern portion of this region, is intensive and extremely varied. The topography, the quality of the soil and the climate combine to promote this diversity. In the Middle Laurentians, the central portion of the region, production is generally extensive and holiday and tourist activities are highly developed. The Upper Laurentians are dominated by forestry. Dairy and beef production predominate, while hog production is limited to a few municipalities. Vegetable, apple and greenhouse production are very important sectors for the region. They are concentrated in the RCMs of the Lower Laurentians: Two Mountains, Thérèse-de-Blainville and Mirabel. In addition, the Laurentians are one of the five leading regions for aquaculture, which is found primarily in the Middle and Upper Laurentians.

Water requirements for agricultural production in the region are estimated at 9,500,000 $m^3$ annually. Aquaculture accounts for 58% of these volumes, while vegetables and greenhouse production absorb 20% and 7% respectively. Aquaculture operators and vegetable producers rely primarily on surface water.

Estimated figures for the types of water supply used by the rural population (Table IV.25) indicate that approximately 66% of the rural population are served by private wells. This proportion varies from 22% to 100%, depending on the RCM. Overall, 76% of the rural population use groundwater, from water supply systems or private wells.

## Table IV.25
## Sources of water supply used by rural populations in the Laurentian region

| Regional County Municipality<br>RCM (code) | Total population in 2001 (n) | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| | | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Antoine-Labelle (79) | 33,456 | 23,341 | 69.8 | 7,010 | 30.0 | 440 | 1.9 | 15,892 | 68.1 |
| Argenteuil (76) | 28,931 | 14,761 | 51.0 | 2,046 | 13.9 | 391 | 2.6 | 12,325 | 83.5 |
| Two Mountains (72) | 81,417 | 7,946 | 9.8 | 0 | 0.0 | 0 | 0.0 | 7,946 | 100 |
| Rivière-du-Nord (75) | 90,419 | 33,615 | 37.2 | 3,544 | 10.5 | 323 | 1.0 | 29,748 | 88.5 |
| Laurentians (78) | 38,433 | 26,454 | 68.8 | 14,171 | 53.6 | 6,441 | 24.3 | 5,842 | 22.1 |
| Pays-d'en-Haut (77) | 30,866 | 20,697 | 67.1 | 4,004 | 19.3 | 4,717 | 22.8 | 11,976 | 57.9 |
| Mirabel (74) | 27,330 | 10,154 | 37.2 | 2,104 | 20.7 | 2,393 | 23.6 | 5,657 | 55.7 |
| Thérèse-de-Blainville (73) | 130,514 | 4,206 | 3.2 | 0 | 0.0 | 0 | 0.0 | 4,206 | 100 |
| **TOTAL FOR REGION** | **461,366** | **141,174** | **30.6** | **32,879** | **23.3** | **14,704** | **10.4** | **93,591** | **66.3** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

A number of waterways drain the agricultural portion of this region, the largest being Rivière du Nord. The quality of the water deteriorates significantly as it flows from the Middle to the Lower Laurentians, as a result of untreated urban wastes and agricultural production. Most of the waterways are relatively small and dry up during prolonged low-water periods.

The Lower Laurentians have access to the Mirabel aquifer, one of the largest in Quebec. A study performed by the Geological Survey of Canada (GSC, 2002) in the Lower Laurentians (RCMs of Argenteuil, Two Mountains and Thérèse-de-Blainville) indicates that the water is of good quality throughout most of the region, and exceeds health quality criteria. The primary recharge areas cover approximately 35% of the territory studied. The vulnerable areas, as assessed by the DRASTIC method, overlap the primary recharge areas. Groundwater use by the population is equivalent to 14% of the annual recharge volume, with 17% going to agricultural production. However, increased pumping by a number of wells has lowered the watertable and generated water use conflicts.

The principal water supply problem observed in this region relates to the supply available for irrigation systems during prolonged periods of low water. According to Caron (2002), a number of new ponds have been constructed in recent years. However, they are not large enough to meet irrigation requirements during periods of prolonged drought, since they are fed primarily by surface waters. Furthermore, a significant portion of the areas used for vegetable production is not yet irrigated. Consequently, demand can be expected to increase over the coming years, particularly if the trend towards more pronounced weather extremes continues.

13. Montérégie administrative region (16)

Montérégie is the region of Quebec with the most intensive and diversified agricultural production. Because of its geographic location, it enjoys favourable climate conditions and the topography and soil quality required to support intensive agriculture. Pork, dairy, poultry and beef cattle are, in order, the region's leading types of livestock production. Livestock production is concentrated primarily in Montérégie East, particularly in the watershed of the Yamaska River. Montérégie is also the province's breadbasket, with over 70% of its area used for grain production. Corn and soybeans alone account for more than 60% of the region's areas under cultivation. In addition, over 70% of Quebec's vegetable production is centred in Montérégie, which contains approximately 6,000 ha of organic soil (black soils, Southwest of Montreal region).

The region's water requirements for agricultural production are estimated at 31 million $m^3$ annually. These requirements are divided almost equally between livestock and crop production, with 13.7 and 14.6 million cubic metres respectively. Pork production and irrigation of vegetable crops are the two sectors with the highest water requirements. With the exception of aquaculture, Montérégie is the region with the highest water requirements.

Estimated figures for the types of water supply used by the rural population (Table IV.26) indicate that approximately 72% of the rural population are served by private wells. This proportion varies from 0% to 100%, depending on the RCM. Overall, 77% of the rural population use groundwater, from water supply systems or private wells.

## Table IV.26

## Sources of water supply used by rural populations in the Montérégie region

| Regional County Municipality RCM (code) | Total population in 2001 (n) | Rural Population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| | | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Acton (48) | 15,167 | 8,761 | 57.8 | 0 | 0.0 | 0 | 0.0 | 8,761 | 100 |
| Beauharnois-Salaberry (70) | 59,137 | 7,421 | 12.5 | 2,305 | 31.1 | 89 | 1.2 | 5,027 | 67.7 |
| Brome-Missisquoi (46) | 46,165 | 26,202 | 56.8 | 14,081 | 53.7 | 2,288 | 8.7 | 9,833 | 37.5 |
| Champlain (58) | 311,838 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Upper Yamaska (47) | 79,175 | 19,177 | 24.2 | 0 | 0.0 | 0 | 0.0 | 19,177 | 100 |
| Richelieu Valley (57) | 119,993 | 15,907 | 13.3 | 0 | 0.0 | 0 | 0.0 | 15,907 | 100 |
| Lajemmerais (59) | 100,263 | 5,127 | 5.1 | 0 | 0.0 | 0 | 0.0 | 5,127 | 100 |
| Lower Richelieu (53) | 50,066 | 13,280 | 26.5 | 12,829 | 96.6 | 0 | 0.0 | 451 | 3.4 |
| Upper Richelieu (56) | 100,753 | 28,795 | 28.6 | 0 | 0.0 | 0 | 0.0 | 28,795 | 100 |
| Upper St. Lawrence (69) | 21,851 | 17,221 | 78.8 | 1,099 | 6.4 | 1,023 | 5.9 | 15,099 | 87.7 |
| Jardins-de-Napierville (68) | 22,820 | 15,623 | 68.5 | 0 | 0.0 | 128 | 0.8 | 15,495 | 99.2 |
| Les Maskoutains (54) | 78,917 | 25,604 | 32.4 | 11,784 | 46.0 | 799 | 3.1 | 13,021 | 50.9 |
| Roussillon (67) | 138,172 | 9,121 | 6.6 | 0 | 0.0 | 0 | 0.0 | 9,121 | 100 |
| Rouville (55) | 29,980 | 15,003 | 50.0 | 4,063 | 27.1 | 1,796 | 12.0 | 9,144 | 60.9 |
| Vaudreuil-Soulanges (71) | 102,100 | 25,946 | 25.4 | 7,334 | 28.3 | 5,237 | 20.2 | 13,375 | 51.5 |
| **TOTAL FOR REGION** | **1,276,397** | **233,188** | **18.3** | **53,496** | **22.9** | **11,359** | **4.9** | **168,333** | **72.2** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

Because of the intensity of agricultural activities in this region, the importance of the industrial sector and the size of the population, surface water and groundwater are experiencing increasing pressure. The region is generally well provided with rivers and streams. However, throughout the region as a whole, these surface waters have deteriorated in quality as a result of contaminations directly linked to activities within the watersheds. The pressure is particularly high in the Yamaska basin, where livestock (primarily pigs), crops (particularly corn and soybeans), industry and municipalities are found in close proximity. Contaminants include suspended particulates, nitrogen and phosphorus, pesticide residues, heavy metals, pathogens, etc. A number of lakes are also experiencing eutrophication, particularly in the Missisquoi Bay area.

The groundwater is generally of good quality and widely used for municipal drinking water, agriculture and some commercial operations. In rural areas, however, contamination by nitrates and certain persistent pesticides has been observed.

Because of the intensity of agricultural production in this region, a number of problems have been identified:

- Water supply

Although annual precipitation exceeds potential evapotranspiration, there is a significant deficit during the growing months, particularly from June to August throughout Montérégie, particularly the western sector, where irrigated crops predominate. The water supply is thus a limiting factor for agriculture in several parts of the region. The water flow in the rivers draining the black soils of Chateauguay and Acadie is not sufficient to meet the irrigation requirements for vegetable crops. The development of individual or collective water storage structures (reservoirs, waterway level controls, etc.) could improve the situation.

The use of groundwater for irrigation could help to resolve this problem. There is already heavy pressure on these waters, however, because of their high quality, and their levels drop regularly during low water periods. According to Demars (2002), lack of information on the characteristics of the watertables is limiting their use because of persistent uncertainty as to their true potential (dimensions, recharge area, depth, etc.).

It should also be noted that the processing industry is increasingly demanding irrigation of vegetable crops that are not traditionally irrigated, such as cucumbers. The pressure on water resources is thus expected to increase in years to come.

- Organic soils

Montérégie includes a dozen deposits of organic soils, varying from 300 to 5,000 ha, which are extremely productive areas for vegetable production. However, intensive working and aeration of these soils results in accelerated consumption of organic matter and leads to settling of approximately 2.0 cm per year (Papineau et al., 1993). Because the organic deposits are shallow, approximately 0.5% of the total area of organic soils is lost every year (Barrington, 1991). By keeping the watertable near the surface of the soil (60 to 75 cm) and maintaining moist conditions throughout the soil profile, the rate of settlement can be brought down considerably by reducing oxidation of organic matter, wind erosion and soil compaction.

Maintaining the watertable level, however, requires significant water input over the entire growing season. This means developing structures to control waterway levels and collect significant quantities of surface water or groundwater, which may or may not then be stored in farm ponds or collective water storage structures.

- Flooding of vegetable lands

The organic soils of the Southwest of Montreal region are generally located in low-lying areas. Consequently, the waterways draining them slope gently and cannot readily discharge meltwater or runoff from heavy precipitation. Consequently, the vegetable crops are flooded, a situation that may well recur more and more frequently as a result of the climate changes observed in recent years. This is the case in the watershed of the Acadie River, which drains 1,200 ha of black soils near Napierville and Sherrington (Papineau et al., 1993). The work performed on Norton Creek in the 1990s has considerably reduced the frequency and impact of this flooding on the black soils of Sainte-Clothide. Other structures to direct and control flooding are currently being planned for the watersheds of the Acadie River and Norton Creek.

- Contamination of surface waters

Producers use surface water to meet irrigation requirements, at least in part. The poor quality of this water has led to restrictions on its use, primarily because of the presence of pathogens. The gradual application of HACCP standards to crop production may gradually restrict such use.

- Groundwater salinity

A number of aquifers in Montérégie show specific and relatively localized contaminations. In the municipality of La Présentation and neighbouring municipailites, the water from artesian wells is nearly 10‰ saline in some cases (seawater being 30‰). This level of salinity is toxic for some small fruits (Laplante, 2002). As a result, producers are forced to use water from the municipal water system. Other instances of salinity are found in the far western section of the region, at Côteau-du-Lac. Irrigation requirements in these cases are met by surface waters, which must be stored in ponds. This means developing infrastructures, which are costly because of the low relief of the region (excavation, fill, etc.).

In general, the major problems facing Montérégie are:

- Inadequate information on the aquifers and their recharge areas;
- Insufficient irrigation water for vegetable crops;
- Flooding of vegetable crops in the lowlands southwest of Montreal;
- Settlement of organic soils, in part because of water shortages during dry periods;
- Poor general quality of surface waters for irrigation purposes.

### 14. Central Quebec administrative region (17)

The Central Quebec region is the third most important region in terms of agricultural production. Dairy and hog production are highly developed and represent approximately 15% of Quebec's production in these two areas. The RCM of Arthabasca is Quebec's milk-producing centre. As in other regions, hog production is expanding in this region and the pressure on water is increasing in some of the region's RCMs, including Drummond and Bécancour. Crops consist mainly of forages, corn, soybeans and small grains. Cranberry production is characteristic of this region, which contains more than 95% of Quebec's cranberry-growing areas, with 550 ha.

Total water requirements for agricultural production are estimated at 18.4 million $m^3$ annually. Crop production accounts for 8.9 million $m^3$, or almost 50% of the region's requirements, including over 80% for cranberries alone. It should be noted that cranberry production, properly managed, requires 1.35 $m^3$ of water per $m^2$ under cultivation. This water is used primarily for crop management, however, and is only partially consumed. Cranberries are also spray-irrigated, either to prevent late frost damage to the buds (May-June) or frost damage to the fruit prior to harvesting (September). Irrigated areas for crops other than cranberries total approximately 750 ha, with 235 ha in small fruits, 290 ha in vegetables and 110 ha in apples.

Estimated figures for the types of water supply used by the rural population (Table IV.27) indicate that approximately 60% of the rural population are served by private wells. This

proportion varies from 28% to 86%, depending on the RCM. Overall, 70% of the rural population use groundwater, from water supply systems or private wells.

**Table IV.27**
**Sources of water supply used by rural populations**
**in the Central Quebec region**

| Regional County Municipality | Total population in 2001 | Rural population[1] | | Water supply used by rural population[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water system | | | | Private wells | |
| | | | | Surface water | | Groundwater | | Groundwater | |
| RCM (code) | (n) | (n) | (%) | (n) | (%) | (n) | (%) | (n) | (%) |
| Arthabaska (39) | 64,089 | 22,195 | 34.6 | 5,541 | 25.0 | 2,234 | 10.1 | 14,420 | 65.0 |
| Bécancour (38) | 19,088 | 15,792 | 82.7 | 6,552 | 41.5 | 2,540 | 16.1 | 6,700 | 42.4 |
| Drummond (49) | 87,808 | 24,460 | 27.9 | 2,673 | 10.9 | 713 | 2.9 | 21,074 | 86.2 |
| L'érable (32) | 24,021 | 11,616 | 48.4 | 3,163 | 27.2 | 958 | 8.3 | 7,495 | 64.5 |
| Nicolet-Yamaska (50) | 23,496 | 16,187 | 68.9 | 9,125 | 56.4 | 2,527 | 15.6 | 4,535 | 28.0 |
| **TOTAL FOR REGION** | **218,502** | **90,250** | **41.3** | **27,055** | **30.0** | **8,972** | **9.9** | **54,223** | **60.1** |

[1] The total population and rural population are taken from the 2001 Federal Census (Statistics Canada, 2001).
[2] The types of water supply used by the rural population are estimated on the basis of initial data compiled by MENV (2000). See calculation methods in section III.B.

Several relatively large waterways flow through this region (Saint-François, Nicolet, Bécancour). A number of municipalities obtain their water from these surface waters and the critical threshold for water withdrawals from the Bécancour River has been reached at certain locations during periods of low water. Agricultural activities are exerting severe pressure on these rivers and all their tributaries, as indicated by the excessive levels of phosphorus and suspended particulates in the water. Signs of eutrophication are evident wherever hog production is highly developed. No pesticide residues have apparently been observed to date.

Groundwater is used primarily for human consumption and to a lesser extent for bottling. Few conflicts have been reported in connection with groundwater use.

The large quantities of water required for cranberry production have not created excessive pressure on surface water. In fact, the majority of these operations maintain large natural or man-made reservoirs that allow them to collect and store surface water when it is abundant. The irrigation water required for plant growth during dry periods is then drawn from these reservoirs.

While problems of natural groundwater contamination occur within the region, they are relatively localized. The contaminants concerned are arsenic, barium, fluorine, iron and manganese. While non-toxic, iron and manganese contaminations cause problems primarily with the pipes used to carry drinking water to livestock and gradually affect water quality.

Small fruits are irrigated primarily by drip irrigation systems. The water supply appears adequate for the great majority of producers.

# V. ISSUES, LINES OF ACTION AND PROGRAM PARAMETERS

## *A. Water Supply Issues*

Discussions with local and regional stakeholders and analysis of the documentation consulted have identified the following major water supply issues for the agricultural sector:

### 1. Availability of water

While Quebec is generally well provided with water resources and precipitation, certain regions have significant problems, relating primarily to the irrigation requirements of field-grown crops. The sectors most seriously affected are:

- Montérégie region
  - Non-optimal management of water sources for irrigation of vegetable crops, in organic (black) and mineral soils;
  - Inadequate water control structures in the watersheds of the Acadie River and Norton Creek.

- Lanaudière region
  - Non-optimal management of water sources for irrigation of the black soils used for vegetable production;
  - Inadequate water control structures in the watersheds of Point du Jour Creek and the Saint-Antoine, Saint-Jean and Saint-Joseph rivers.

- Quebec City region
  - General problem of water supply for agricultural purposes on Île d'Orléans.

- Magdalen Islands region
  - General problem of water supply for agricultural purposes on the Magdalen Islands and vulnerability of groundwater to contamination.

It is in these regions that the problems are most urgent. Other quantitative regional problems have also been noted in section IV–D (Analysis of Regional Problems). In some areas, new individual or collective catchment structures may be required to meet the needs of the different types of production.

### 2. Storage and distribution of water

While this problem is not well documented, it seems clear that water storage management is not optimal under existing conditions. In addition to larger storage structures for river water, many medium-sized operations maintain ponds to collect water for irrigation. In some cases, their size, configuration and watertightness and the loss control measures applied to them fail to meet the quantitative requirements and imperatives of sound water management.

This problem relates in particular to:

- The development of new ponds in specific areas;
- Optimal pond location and supply;
- Adequate pond development and operation;
- Water delivery and distribution from these ponds to crops.

In the case of livestock production, providing water for livestock on pasture represents a real problem, but it is not well documented. The growing economic desirability of this type of livestock feeding system (dairy cattle, beef cattle, sheep and goats) and programs further restricting direct access by livestock to waterways will necessitate measures to transport water to pasturing areas.

### 3. Water quality

Few accurate data are available on the quality of the water used for agricultural purposes in Quebec. The principal figures available for each administrative region have been presented in the preceding sections. While the general quality of the water used appears to be good, some regional or local problems may be noted:

- Inadequate groundwater quality as a result of natural hydrogeological conditions (hardness, salinity, iron, sulphur, fluorine, etc.). A number of these problems can be resolved by installing water treatment systems on the farm.
- Inadequate water quality as a result of human activities (coliforms, hydrocarbons, nitrates, etc.). A number of specific issues have been noted in this connection:
  - Management of the bacteriological content of irrigation water obtained from surface waters (e.g. use of water from the Mille Îles and Des Prairies rivers at Laval and potential use of water from the St. Lawrence on Île d'Orléans);
  - Limitations on the development of irrigated crops in specific areas where the groundwater is known to be contaminated (e.g. agricultural areas south of Ville Mercier, where the water is contaminated by the Mercier lagoon).

### 4. State of knowledge

One of the study's most important findings is the lack of complete and accurate information on the agricultural water supply. The apparent relative abundance of the water resource contributes to the lack of interest in this matter.

Several aspects of this problem have been noted:

- The limited information available on the watertables used by communities and farms (capacity, extent, characteristics, vulnerability, etc.), both regionally and locally;

- The limited information available, in responding to specific problems, on the types of water supply used by farms, on actual water use within each sector and on the types of water catchment and storage structures;

- The limited monitoring performed, in responding to specific problems, on the quality of the surface water and groundwater used for agricultural purposes;

- The limited support available for the development of information on irrigation risk management, and for the transfer of knowledge and use of diagnostic tools (e.g. support for the development of advanced technologies, demonstration of water conservation techniques, development of sectoral expertise (e.g. blueberries)).

## *B. Lines of Action and Program Parameters*

### 1. Priority sectors

Analysis of the water requirements of the agricultural sector has demonstrated that the crop production, livestock production and aquaculture sectors are all experiencing significant water supply problems, related to their respective dynamics.

In the context of the study, an advisory committee has been formed to discuss some of the problems identified in the first phase of the study and to assist in developing criteria for project selection. This committee met at Drummondville on January 30, 2003. A list of the participants and the minutes of this meeting are presented in Appendix B. The following criteria were identified by the participants as being of priority importance in achieving the objectives of the program:

- The value of the project to the community;
- The potential expansion of the activities to the agricultural community;
- The scope of the proposed activities in relation to the operations' ability to obtain funding;
- The involvement of stakeholders from different levels of government, institutions or the general public;
- Changes in the regulatory requirements for water management.

In this context, it was agreed that **irrigation of field-grown crops, particularly vegetables,** should receive priority attention within the program in the short term. The advisory committee believes that other sectors of production should have access to the program but not the same level of priority.

In geographical terms, determination of the issues (section V.A) has made it possible to identify a number of regions in which the problems are the most acute or the best documented. However, as in the case of the production sectors, the committee feels that the program should be accessible to all regions, provided that the proposed projects are consistent with the general objectives.

2. Types of projects

Following examination of the requirements and of the sectoral and regional problems, the advisory committee identified a number of components to be financed by the program on a priority basis. These components are:

1. Knowledge acquisition

   - Projects to characterize groundwaters used or available for agricultural purposes (extent, recharge, capacity, vulnerability, etc.);
   - Projects to characterize the quality of the groundwater or surface water used for agricultural production in the context of a specific problem.

The new regulatory context for water, including the *National Water Policy*, the *Quality of Drinking Water Regulation* and the *Groundwater Catchment Regulation*, establishes new responsibilities with respect to the management of surface water and groundwater. In addition, adequate planning for the development and growth of sectors that use large quantities of water for irrigation or production requires basic information in order to assess the availability of this resource over the medium and long term. The acquisition of knowledge on water-related issues implies significant investments that are often beyond the reach of individual producers. In this sense, studies of a more regional nature would permit more accurate identification of the potential of given sectors and reduce the additional information needed by producers or groups of producers using or seeking to use these waters. This component of the program could thus help to support projects involving knowledge acquisition.

At the same time, a number of knowledge acquisition activities in this field have already been carried out or initiated by provincial or federal stakeholders (e.g. MRN, MENV, Geological Survey of Canada). As far as possible, the program should support joint projects with organizations that are already active or target sectoral or regional niches not covered by projects that are already under development.

2. Community infrastructure projects designed to improve the supply (quantity, quality), storage or distribution of groundwater or surface water for agricultural production:
   - Preparation of feasibility studies
   - Development of infrastructures.

The advisory committee noted that the state of knowledge, definition of the problems and mobilization of agricultural producers around common objectives have reached different stages in different regions and sectors of intervention. It was therefore proposed that the program be available to assist all groups that are experiencing similar water supply problems, regardless of stage.

Two possible types of financial support can thus be considered:

- The *feasibility studies* component is aimed at documenting a given problem relating to the agricultural water supply for a group of producers and at analyzing a set of possible approaches to a solution. It permits the identification of an optimal solution and the type of investments required to implement it. At this stage, the best combinations of different possible infrastructures will be identified for the project. In principle, the *feasibility study* component makes it possible to bring together all the elements required for a structured application for infrastructure funding.
- The *infrastructure development* component relates to the implementation of field projects involving the supply, storage, delivery and distribution of groundwater or surface water for agricultural production. In principle, only projects demonstrating technical/economic and environmental relevance should be funded by this component.

The funding allocated under this component should, in principle, increase with the project's stage of advancement, from the feasibility study to infrastructure development. The program should also require increasing levels of co-funding for the project, depending on the type of financial support sought.

The nature of the technical solutions proposed may vary with the problems and regional contexts. The proposed infrastructures, for example, may include wells, surface water intakes, pumping stations, dikes, small dams, pipelines or conduits, ponds or any other measure considered appropriate for a given problem.

3. Eligible clientele

Only projects having a direct impact on the agricultural water supply should be considered eligible. Suitable applicants may include:

- Groups of agricultural producers, whether legally incorporated (union, cooperatives) or not;
- Not-for-profit groups (e.g. watershed groups, etc.);
- Local governments (municipalities, RCMs).

These elements constitute the major orientations proposed, based on analysis of the existing data and consultation of identified stakeholders. This analysis is by no means complete and Agriculture and Agri-Food Canada may well choose to consider other factors in developing its program. For example, a number of other more technical terms and conditions must be defined

for the program, including the types of eligible expenditures, the co-funding requirements for each component, etc. The present document, however, outlines relatively precisely the general outlines of a program designed to meet Quebec's specific needs, problems and priorities with respect to the agricultural water supply.

## 4. Existing programs and partnership opportunities

Quebec already has a number of programs and initiatives relating to water supply. A minority of these can respond independently to the requirements of agricultural producers with respect to water supply. Most of the existing programs require contributions from complementary programs to meet producers' needs. The following list is not exhaustive, but offers a brief overview of the principal initiatives of interest for the new program.

### Federal initiatives

*Natural Resources Canada – Geological Survey of Canada*

The Geological Survey, a division of Natural Resources Canada, has carried out numerous hydrogeological studies in different regions of the country, the most recent of which dealt with the aquifers of the Lower Laurentians. In carrying out these studies, the Survey may act as the contractee, as a contributor or as a funding agency. Because of the scope of these studies, technical and financial assistance is normally sought from a number of agencies.

*Economic Development Canada (EDC): IDEA – SME*

The programs supported by EDC do not generally involve direct assistance to producers dealing with water supply problems. In some specific instances, the IDEA – SME program may apply. This is true of projects submitted under the Strategic Regional Initiatives (SRI) program. In this case, a water supply project must correspond to SRI objectives and involve the coordination of regional stakeholders (often at the RCM level). To date, no water supply problems have been submitted to SRI.

In addition, EDC participates in funding various projects to support regional economic development. For instance, EDC contributed financially to the preparation of the hydrogeological study of the Lower Laurentians.

### Provincial initiatives

*Quebec Department of Agriculture, Fisheries and Food (MAPAQ): Regional Agriculture and Agri-Food Development Assistance Program (2000-2003)*

This program is supported by the Regional Affairs Branch of MAPAQ and includes four components. The Agriculture and Agri-Food Development and Adaptation Assistance

component is designed to support projects that help to resolve specific problems relating to the adaptation and development of agriculture and agri-food on a regional basis. This component is thus well adapted to the problems associated with agricultural water supply.

*Quebec Department of the Environment*

In a new approach to watershed-based water management and integrated management of the St. Lawrence and the adoption of the new National Water Policy in the fall of 2002, the Government of Quebec has committed itself to developing knowledge on water. Three commitments are particularly relevant to the requirements of agricultural production:

- To perform an inventory of Quebec's major aquifers over the next 15 years, including hydrogeological mapping, vulnerability, area and recharge rates;
- To expand and extend knowledge on Quebec's major watersheds and to assist in the on-going updating of related information;
- To compile and develop information on water and aquatic systems for water management.

In addition, the Department has already participated in a number of hydrogeological studies, primarily in collaboration with the Geological Survey of Canada.

*Quebec Department of Municipal Affairs and Greater Montreal (MAMMQ): Quebec-Municipalities Infrastructure Program.*

The Quebec-Municipalities Infrastructures Program is directed entirely at Quebec's municipal corporations and some of their subsidiary agencies. Sub-component 3 of this program (Infrastructures for regional economic development) is designed to enable municipalities to carry out the construction, expansion or repair of infrastructures required for the establishment or maintenance of a regional enterprise. Water system infrastructures (for catchment, supply, treatment, storage and distribution), for example, are covered by this subcomponent. This program applies, however, only to very specific projects affecting only a limited number of producers.

Federal-provincial initiatives

*Environment Canada – Quebec Department of the Environment: St. Lawrence Action Plan (SLAP)*

The federal and provincial governments have been working together in Quebec for over 15 years to reduce the different types of pollution affecting the St. Lawrence and its tributaries. A number of SLAP components have related to water, particularly industrial wastes and agricultural activities. SLAP is currently entering its fourth five-year phase. Water management is central to the program's projects for sustainable development.

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# APPENDIX A: Individuals Contacted

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**Dubreuil, Luc**. Chaudière-Appalachians Regional Directorate

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**Gosselin, Bruno**. Quebec City Regional Directorate

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**Lapointe, Raynald**. Saguenay—Lac-Saint-Jean Regional Directorate

**Laroche, Richard**. Environment and Sustainable Development Directorate, Quebec City

**Leclerc, Michel**. Mauricie Regional Directorate

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**Manceau, Jocelyn**. Quebec City Regional Directorate

**Morneau, Camille**. Lower St. Lawrence Regional Directorate

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**Robert, Louis**. Chaudière-Appalachians Regional Directorate

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**Roy, Louis**. Gaspé and Magdalen Islands Regional Directorate

**Savard, Joseph**. Saguenay—Lac-Saint-Jean Regional Directorate

**Tremblay, Laurier**. North Shore Regional Directorate

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**Côté, Paul**. Lower St. Lawrence Regional Directorate

**Dionne, J. Marie**. Lower St. Lawrence Regional Directorate

**Ellis, Donald**. Municipal Policy Directorate

**Lachance, Jean-Marc**. Quebec City Regional Directorate

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**Pierre, Gilbert**. Lower St. Lawrence Regional Directorate

**Robert, Serge**. Chaudière-Appalachians Regional Directorate

**Rousseau, Michel**. Chaudière-Appalachians Regional Directorate

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**Girard, Jean-François**. Comité de bassin de la Rivière Rimouski, Lower St. Lawrence

**Groleau, Hugues**. Pursol Club agroenvironnemental (Écosphère), Lower St. Lawrence

**Lajoie, François**. GIRB, Chaudière-Appalachians

**Menta, Serge**. Technical consulting agronomist (apple production), Club conseil de l'Île d'Orléans.

**Paquet, J. M.** Club de fertilisation 2000, Lower St. Lawrence

**Rodrigue, Françoise.** Groupe d'encadrement technique en horticulture, Saguenay—Lac-Saint-Jean

**Thibault, Patrice**. Consultant agronomist (vegetable production), Quebec City.

- **Fédération de l'UPA**

**Chagnon, Eric**. Secretary, Fédération des Producteurs en Serre du Québec, Longueuil

**Coulombe, Paul**. Ferme Coulombe, Île d'Orléans

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- **Municipalities and RCMs**

**Hubert, Jean.** Municipality of the Magdalen Islands

# Appendix B Minutes of the Meeting of January 27, 2003

| BPR Consulting Group | **Agriculture and Agri-Food Canada**<br>**National Water Supply Expansion Program**<br>**Project R 99-02-08** | MINUTES | **Date issued: January 30, 2003**<br>**Version: 01** |
|---|---|---|---|

DATE & TIME : Monday, January 27, 2003, 10 a.m. – 4:30 p.m.
LOCATION : Hôtel Le Dauphin, Drummondville

PRESENT :
Robert Beaulieu, MAPAQ, Montérégie West Regional Directorate
Robert Broughton, Consultant
Marc Chenier, Agriculture and Agri-Food Canada (AAFC)
Paul Coulombe, Agricultural producer, Fédération des Producteurs Maraîchers du Québec
François Cousineau, Agricultural producer, Fédération des Producteurs Maraîchers du Québec
Marcel Desgroseillers, Agricultural producer, Fédération des Producteurs Maraîchers du Québec
Jean-Yves Drolet, BPR Consulting Group
Charles Fortier, BPR Consulting Group
Alain Fournier, MAPAQ, Central Quebec Regional Directorate
Maurice Hénault, Fédération des Producteurs de Pommes de terre du Québec
Richard Laroche, MAPAQ, Environment and Sustainable Development Directorate (DEDD)
Louis Ménard, UPA
Alain Moor, AAFC
Luc Proulx and Michel Ouellet, MENV
Jacques Painchaud, MAPAQ, Central Quebec Regional Directorate
Sylvain Pigeon, BPR Consulting Group
Isabelle Proulx, AAFC

Prepared by : Charles Fortier, Jr. Eng., Agr.

PURPOSE OF THE MEETING: To confirm the information contained in the interim summary of the Analysis of Water Supply Issues for the Agricultural Sector and to define NWSEP guidelines for Quebec.

***Please advise the editor as soon as possible of any errors noted in the minutes of this meeting or telephone conversation.***

- 10 a.m.: Opening of the meeting

- Introduction of all participants

- Reading of the agenda by Jean-Yves Drolet

- Presentation of the National Water Supply Expansion Program (NWSEP) (Isabelle Proulx, AAFC)
  - Total of $80 million in grants to be awarded between 2002 and 2005
    - $60 million for NWSEP
    - $20 million for the development and consolidation of a water database
  - $10 million was allocated to the Prairies in 2002 for drought assistance
  - $50 million will be made available beginning in April 2003
    - Infrastructure development projects will probably require co-funding by the provincial government on a suggested 60/40 basis.
    - Knowledge acquisition projects may be funded entirely by the federal government.

- Review of the water management context in Quebec (Luc Proulx and Michel Ouellet, MENV).
  - Presentation of aspects of the Groundwater Catchment Regulation and the National Water Policy that may affect the NWSEP guidelines for Quebec.
  - MENV is currently in discussions with Natural Resources Canada and the Geological Survey of Canada regarding the development of a knowledge acquisition program on groundwater resources. The Montérégie region is considered a priority area.
  - According to MENV, groundwater withdrawal in some parts of Quebec is approximately equivalent to the recharge volume. It is important, under these circumstances, to develop knowledge on groundwater potential in order to avoid conflicts and to ensure sound management of the resource.

- Presentation of the interim summary prepared by BPR Consulting Group (Jean-Yves Drolet, BPR Consulting Group).
  - The stakeholders are generally in agreement with the assessment of the requirements and the observations presented on the different problems. However, they question the reduction in irrigated areas between 1996 and 2001 (33,391 vs 21,998 ha) reported by Statistics Canada and suggest further investigation into this point. In addition, they recommend that the figure for the quantity of water used for irrigation (100 mm) be increased to 150 mm per year to allow for drier seasons.

- They note the lack of information on the amount of water required to meet irrigation needs during drought periods recurring at irregular intervals.

- 12:00 noon: Lunch

- Presentation of the major issues and lines of action suggested in the interim summary (Jean-Yves Drolet, BPR Consulting Group).

- 1:15 p.m.: Discussion workshop and plenary session.
  - It was immediately agreed that all projects funded by NWSEP should benefit the community rather than a specific producer or firm, since the available funds are limited.
  - Acquisition of knowledge on the aquifers of Quebec's rural areas should be a priority for NWSEP. Knowledge of this kind would provide guidance for the medium- and long-term development of agriculture and would benefit the municipalities and the industry in general. Projects of this type should therefore be carried out in partnership with the other sectors concerned. The acquisition of knowledge on aquifers requires major investments in terms of time and money. Such projects should not absorb all the funding made available through NWSEP, given the time factor, for example. However, a portion of the funds could be devoted to this aspect to complement the financial packages available in partnership with MRN, MENV, GSC, etc., provided that the study zones are located in agricultural areas.
  - It was suggested that specialists be trained to provide advice on irrigation (cost effectiveness, choosing appropriate systems, managing irrigation water, etc.), but the stakeholders concluded that similar resources were already available from agricultural equipment suppliers.
  - The program should not fund irrigation research and development projects since provincial stakeholders and private industry are already available to do so.
  - Greenhouse farming and cranberry production consume large amounts of water per hectare under cultivation. Methods of optimizing water management, such as recirculation, are already well known and do not require research and development activities that might benefit a group of producers. While it is possible to save water by introducing these systems, such projects are individual in nature and less consistent with the objectives of the program.
  - Another point raised during the discussion related to providing water for beef cattle on pasture. Since producers are not permitted to allow their livestock free access to waterways, they are obliged to install pumping systems or other sometimes costly equipment. However, one of the participants noted that this problem is already covered by the *Prime-Vert* program (MAPAQ).
  - On several occasions in the course of the discussions, the stakeholders concluded that the program should fund feasibility studies relating to the establishment of supply

infrastructures designed to serve the community. These studies could analyze the potential solutions to a given problem and identify the optimal solution.

- The state of knowledge, identification of the problems and mobilization of agricultural producers around a common objective are at different stages in each region. In some areas, a great deal of energy may be required to mobilize stakeholders and to prepare an application for financial assistance. Some stakeholders feel that part of the funds should be available to assist producers to group together and to develop a coherent project for the establishment of collective water supply structures.
- Problems relating to water supply for crop production, particularly horticulture, should be assigned priority, given the production context and the increasingly stringent requirements of the processing industry and the market. However, if applications from other agricultural sectors are submitted and meet the program's criteria, including that of serving the community, they should be given equal consideration.

Recommendations

- Eligible projects should meet the needs of a group of producers.
- Some funds should be reserved to assist groups of producers in performing feasibility studies.
- All sectors of agriculture should be eligible, but projects relating to the water supply for horticultural irrigation should be assigned priority.