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EMPLOYING ECOLOGICAL DATA IN THE INTEGRATED MANAGEMENT OF LANDS AND NATURAL RESOURCES IN A RURAL ENVIRONMENT: THE PAPINEAU REGIONAL COUNTY MUNICIPALITY (RCM) DEVELOPMENT PLAN

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ABSTRACT

In their efforts to develop an integrated system for managing their municipality's lands and natural resources, Papineau RCM development plan architects soon realized that they would have to permanently divide the municipal lands in question according to the area's physical and biological features. With the technical assistance of the Québec Ministr of Environment (MENVIQ), the Papineau RCM is in the process of adopting "un cadre écologique de référence" (henceforth called an ecological reference framework). This basic tool will enable future

developers to base their recommendations on an overview of the intrinsic properties of the land and its resources. It will also enable elected officials to assess the impact of their land-use decisions more accurately. The success of such an approach is based largely on the fact that data acquired have been popularized and made available to technicians and decision-makers. Clearly, as long as data provided through the ecological reference framework are restricted to a small elite, it will be impossible to gauge utilization habits, the undertaking's ultimate goal.

INTRODUCTION

For a long time, activities aimed at exploiting natural resources have been equated with land development. However, a major distinction exists between the two; it is high time that this was recognized.

The goals of exploitation are solely economic in nature and are designed to draw from the land the highest possible revenues with a minimum of investment (Pinchemel, 1985). Such activities are never

based on global land-use concerns but are directed solely at the exploitation of a single resource, witness hydroelectrical, mining, industrial, tourism, and forestry development. Clearly, today the results of such activities are socially and ecologically unacceptable. Without espousing an utopic longing for development devoid of economic overtones, the time has come to apply a genuine, global land-use policy stressing the harmonious interaction between man, his activities and the environment (Domon et al., 1987; Naveh and Lieberman, 1984).

It would therefore be preferable to immediately embrace land-use planning which has a genuine ecological basis and in which land developers consider geographical space an essential development element (Pinchemel, 1985) in the same right as socioeconomic and political criteria. This outlook would avoid having actions excessively centred on exploitation and profitability and stress "development with a certain sense of responsibility towards future generations" (Domon et al., 1987, p. 15). The nature of ecological planning is to define the ecological and spatial framework of projects and decisions most consistent with the spirit of resource and environmental conservation. It is based on permanent options which differ greatly from mere economic options (which are necessarily short-term) and occurs in a higher, changing context (national and international).

In effect, ecological planning requires the development of a tool that Saint-Marc (1971) calls "inventaire du capital-nature", or ecological survey. This entails subdividing an area into well-defined units characterized by the most stable ecological parameters which reflect, as best possible, projected land uses for the natural environment (Jurdant et al., 1977). Over the past 20 years, this tool has been developed, tested and adapted to Quebec's specific needs, mainly through the work of Jurdant (Jurdant et al., 1972 and 1977; Jurdant and Ducruc, 1980; Gerardin, 1980; Bergeron et al., 1983). MENVIQ's ecological cartography team continues to develop methodologies and practical applications (Ducruc, 1985; Ducruc and Gerardin, 1985) as the University of Montreal (Bouchard et al., 1985). The implementation of the Act respecting land use planning and development allowed both of these teams to work hand-in-hand with regional county municipalities (Veillette and Ducruc, 1983 and Bouchard et al., 1985).

Following a series of experiments conducted in close collaboration with a number of RCMs, MENVIQ's ecological cartography team was gradually able to determine certain concepts and methods aimed at better defining the type of ecological data required for land-use planning. The current Papineau RCM experiment will serve as a framework for evaluating the type and form of ecological data required, the means of transmitting

these data to urban planners (and other environmental managers), and certain methods for ensuring that ecological imperatives become a permanent fixture in the daily management of our environment and natural resources.

PART I: ECOLOGICAL DATA: THE ECOLOGICAL REFERENCE FRAMEWORK

by Jean-Pierre Ducruc and Daniel Veillette

First proposed by Veillette and Ducruc (1983), the ecological reference framework is by no means intended to replace terms like "ecological survey" or its French equivalent "inventaire du capital-nature". Rather, it is an extension of these terms based on their underlying premises. It goes beyond ecological cartography and covers the entire body of documentation required to adequately meet the very real concerns of land-use planning and resource utilization.

We have proposed the term "ecological reference framework" since the ecological data it contains constitutes "the common denominator" on which all land-use managers and resource managers should base their interventions. It proposes a common, permanent spatial reference for

assessing the aptitudes, dangers, fragility and current usage of the environment through a unified image of the land in question, and terminology which is easily understood by all involved.

THE CONTENTS OF THE ECOLOGICAL REFERENCE FRAMEWORK

The concept of an ecological reference framework implies a set of complementary, closely related documents, namely:

The Ecological Map

This map corresponds to the spatial division and provides the geographic reference framework used to study and assess the land's intrinsic properties.

Ecological Classification

This classification entails determining and expressing the relations between the land's various abiotic and biotic components. Their enhancement is based essentially on the study of soil-plant relations

(both these variables are taken in their broadest sense) within a higher bioclimatic context. They are the basis for the study and assessment of the environment's intrinsic properties.

Note that only the elements essential to attaining these objectives are studied. We are not concerned, here, with carrying out an exhaustive ecological analysis of the region.

Interpretations

The ecological map and the classification elements are scientific documents drafted using very specialized technical terminology. Admittedly they are complex, even obtuse, and are not easy for thelayman to employ. For this data to be utilized, it must be translated into practical language that is easy to use in all operations related to land-use planning and resource management, including assessment of aptitude, dangers, restrictions, etc. This phase must be carried out in close collaboration with mapmakers, those individuals who determine the ecological classification, and land and resource managers. Results are first presented in the form of evaluation charts or interpretation keys which are subsequently generalized by cartographic means to apply to the area as a whole (Veillette and Gerardin, 1985).

Field Guide

As its name indicates, the field guide is designed for those working in the field. It uses the most simple language possible to convey the information contained on the ecological map, and is adapted to help the user (engineer, technician, municipal inspector, etc.) recognize the site's ecological and interpretative features and make decisions based on these data.

The field guide is a pocketbook-sized identification guide using topographical, geomorphological, and pedological parameters and and characteristics related to vegetation covering (Gerardin and Ducruc, 1987).

The information contained in this guide is often "rounded out" by "practical fieldwork" organized by the ecological mapmakers for users.

THE PAPINEAU RCM ECOLOGICAL REFERENCE FRAMEWORK: EXAMPLE USING THE MUNICIPALITIES OF SAINTE-ANGÉLIQUE AND PAPINEAUVILLE

Basic Principles

The ecological map for this area was drawn to a scale of 1:50 000 by interpreting panchromatic black-and-white photographs (1:40 000).

The ecological reference units do not change and are based on stable ecological parameters, that is, those of the physical environment (support or receiving environment) recognized as most important for reflecting the environment's ecological diversity. In this regard, several authors (Bertrand, 1968; Jurdant et al., 1977; Strong, 1979; Smalley, 1985 and Valentine, 1986) recognize the overriding importance of surface deposits (mineralogy, nature, form, thickness, texture, rockiness), slope (position, form, incline, length) and drainage (internal soil drainage).

Global Method

The global method has already been presented on numerous occasions in maps drafted to various scales (Ducruc, 1985; Ducruc and Guilbeault,

1987; Ducruc and Gerardin, 1987). It is also referred to in the approach described by Bertrand, 1968, Jurdant et al., 1977, Rowe and Sheard, 1981, Bergeron et al., 1983 and Bouchard et al., 1985. We feel that the enclosed ecological map and detailed key are explicit enough to warrant omitting a description of this method here.

Interpretations of the Ecological Characteristics of Municipal Lands and Natural Resources

The following interpretations are based on all data gathered to date on the Papineau RCM Lands. The results obtained are relative rather than absolute assessments in that they reflect a comparative assessment of the Papineau RCM cartographic (landscape) units.

Forest Growth Ability

- Definition

Taken in its broadest sense, forest growth ability means the capacity to produce wood supplies.

- Possible applications

  . assessment and spatial representation of the land's forest production;

  . basis for land-use allocation and urban-zoning decisions (in particular for public land, private woodlands and fallow-land use);

    . selection of cartographic units to be developed first;

- Basic principle

As defined above, forest growth depends on three main ecological factors: climate, richness of soil and its moisture regime(Gerardin 1983, Gerardin 1984).

The forest growth ability of each cartographic unit is assessed based on the following factors using the data sheet accompanying the map:

  . geomorphological types **with the highest forest growth ability** show combinations of the following characteristics:

- thick mineral deposit
- fine texture
- seepage-enriched, moderately well to well-drained soil

. geomorphological types **with the lowest forest growth ability** show one or more of the following characteristics:

- rocky outcropping
- excessive drainage
- very coarse texture
- slightly decomposed and very poorly drained peat moss.

Between these two extremes lies a range of moderately productive soils.

- Method

Assessment of the forest growth ability of Papineau RCM cartographic units is empiric. Until a systematic study of the relations between growth and forest stations is undertaken in Quebec, it cannot be otherwise.

The methodology used includes five steps. Any hypotheses and decisions made during these steps are obviously open to question as more is learned.

. Step 1: Order of geomporhological types

This step consists in classifying geomorphological types or type groups in decreasing order of productivity (Table 1).

Table 1: Order of geomorphological types based on forest growth ability

Forest growth ability		Geomorphological types
Highest	Group I	1a/2*, 1a/3*, 1ay/2*, 5a/23, 5e/23, 8c/2c*, 8c/3*, 9c/2*
	Group II	1a/3, 1a/4*, 1ay/2, 1ay/3, 1ay/4*, 1d/3, 1d/4*, 2bf/23*, 3a1/45*, 5a/45*, 5e/45*, 9c/2
	Group III	1a/2. 1a/4. 1ay/4. 1aR/2*, 1aR/3, 1d/2, 1d/4, 1f/4*, 2bf/23, 2bf/45*, 2bm/23, 2bm/45*, 3as/45*, 3bf/23, 3b1/45, 3bm/23, 4b1/45, 5a/45, 5e/45, 5sf/23, 8c/2, 8cR/2*
	Group IV	1a/5*, 1ay/1, 1aR/2, 1dR/2, 1f/4, 1f/5*, 2ag/23, 2bf/1, 2bf/45, 2bg/23, 2bg/45*, 2bm/1, 2bm/45, 3bf/45, 3bg/23, 5sf/45, 7pB/6*
	Group V	1a/1, 1a/5, 1aR/1, 2ag/1, 2bg/1, 2bg/45, 7pB/6
	Group VI	3a1/6*, 8a/2*, R1/12, R3/12
Lowest	Group VII	7p/6, 7p/6*

. Step 2: Weighting

This step consists in assigning a number rating the forest growth ability of geomorphological types. This contrived form of calculation is a further analysis of geomorphological type order and, as such, emphasizes the best assessments (Table 2).

Regional climate plays an important role in forest productivity. In our projects, regional climate is expressed by the definition and cartography of the growth region (Gerardin et al., 1984). When these are known, the forest growth ability of geomorphological types can be rated based on their location.

Table 2: Ratings for forest growth ability of geomorphological types

Forest growth ability of geomorphological types		Rating
Highest	Group I	21
	Group II	15
	Group III	10
	Group IV	6
	Group V	3
	Group VI	1
Lowest	Group VII	0

. Step 3: Calculation of forest growth ability for each landscape unit

The following formula is used to calculate forest growth ability:

$$ap = ((ap_{tg1} \times p_1) + (ap_{tg2} \times p2) + \ldots + (ap_{tgn} \times pn)/100$$

Where

ap = forest growth ability rating for landscape unit A

ap_{tgn} = forest growth ability rating for geomorphological type n^e of landscape unit A

pn = area covered by geomorphological type n^e in landscape unit A.

Forest growth ability was calculated for the entire Papineau RCM. The histogram in Figure 1 and ability classes in Table 3 are based on these results.

. Step 4: Analysis of the distribution of forest growth ability ratings

For Papineau RCM municipal lands as a whole, distribution of forest growth ability ratings is quite accurate in that the average weighting

is pretty much in the center of the distribution scale and relative frequencies decrease as they get farther away from this average (Figure 1).

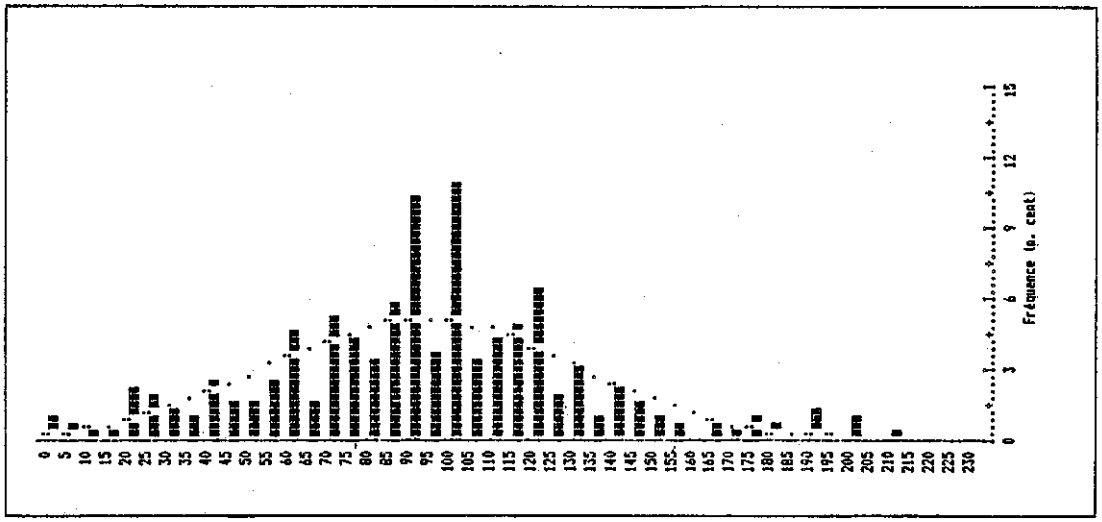

Figure 1. Distribution of forest growth ability ratings

. Step 5: Classification of forest growth ability weightings

Using the histogram in Figure 1, we wanted to create an intermediate class that would include the largest number of cases and the overall arithmetic average for the distribution. Classes outside of this intermediate class include fewer cases (Table 3).

Table 3: Limits and occurrences of the forest growth ability classes

Forest growth ability class	Range	Occurrence (%)
Very high (VH)	[126-210]	10
High (H)	[100-125]	27
Moderate (M)	[75-99]	37
Low (L)	[50-74]	17
Very low (VL)	[0-49]	9

- Results

To map the forest growth ability of Papineau RCM municipal lands, the ability classes in Table 3 and the average forest growth ability weighting calculated for each cartographic unit are used.

Figure 2 shows the spatial distribution of the forest growth ability on a portion of Papineauville and Sainte-Angélique municipal lands.

The developer or manager may add to forest growth ability assessment and cartography the identification and cartography of factors

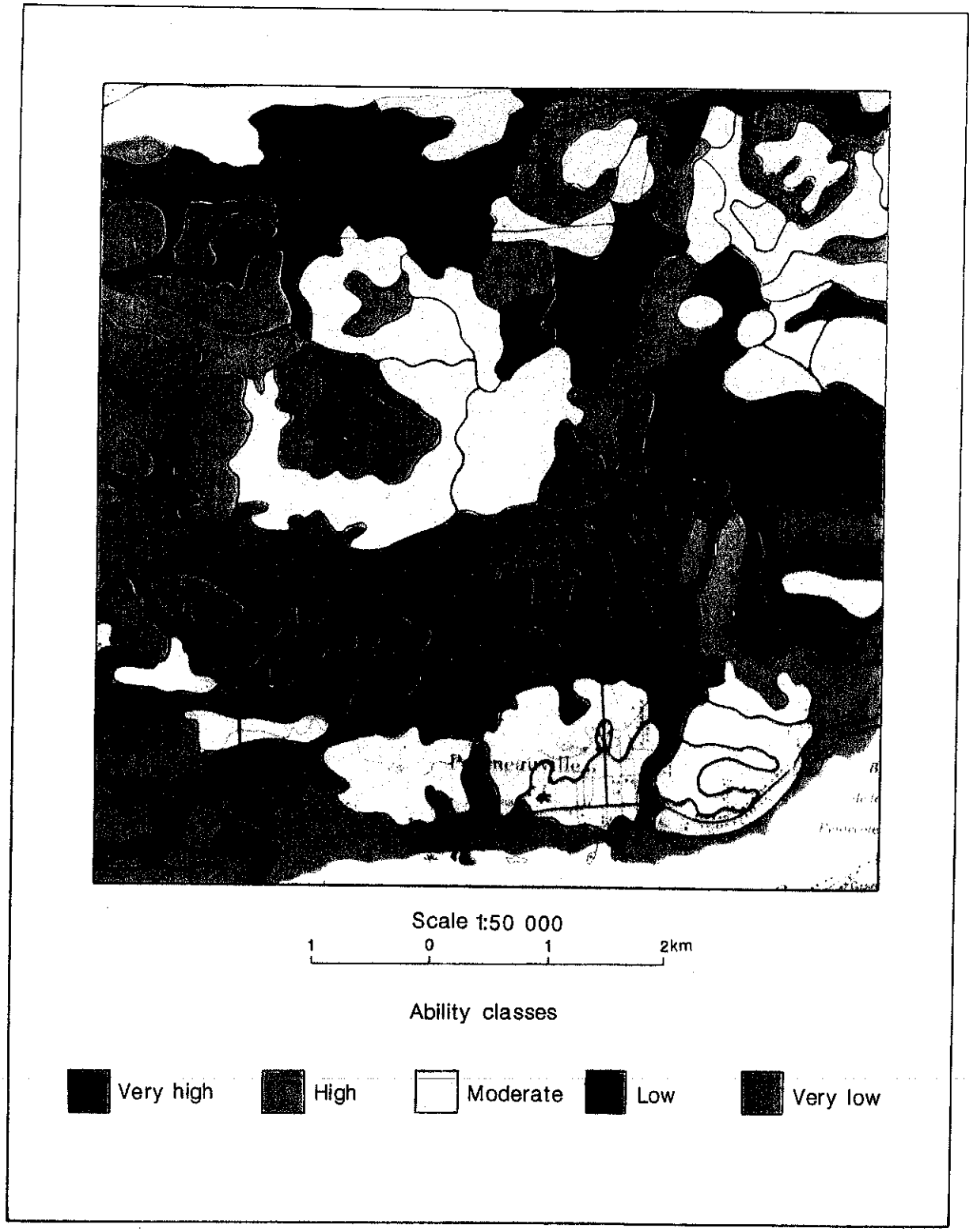

Figure 2. Forest growth ability (portion of the Papineauville and Sainte-Angélique municipal lands)

limiting harvesting of wood supplies, such as topography, machine-carrying capacity of the ground, erosion risks after deforestation, and so forth.

Once these limiting factors are known, the cartographic units most conducive to development can be identified. The developer or manager can also plan development or types of cutting which are adapted to the constraints of the environment in question.

Large-Scale Farming Ability

- Definition

Large-scale farming ability is the natural capacity of an environment to produce hay (timothy or clover), alfalfa, corn, oats or barley.

- Possible application

. assesment of the land's large-scale farming ability and cartography;

. basis for land-use allocation and urban-zoning decisions (in particular with respect to fallow land and requests for inclusion in or exclusion from the agricultural zone as regulated by the Act to preserve agricultural land;

. selection of cartographic units to be developed first.

- Basic principle

Aside from climate and soil richness and moisture regime, large-scale farming ability depends on physical constraints directly related to farm work such as ploughing and harvesting (rockiness and excessive sloping).

The large-scale farming ability of each cartographic unit is assessed based on the following factors using the data sheet accompanying the map.

. geomorphological types **with the highest ability** show one or more of the following characteristics:

- thick mineral deposit;
- fine texture;

- low rockiness;
- moderately well to well-drained soil.

. geomorphological types **with the lowest ability** show one or more of the following characteristics:

- rocky outcropping;
- excessive drainage;
- very coarse texture;
- slightly decomposed and very poorly drained peat moss.

Between these two extremes lies a range of moderately productive soils.

- Method

The steps used are the same as those used for forest growth ability. Table 4 shows the order of geomorphological types, Table 5, the weighted values and Table 6, the classification of weighted values.

Table 4: Order of geomorphological types based on their large-scale farming ability

Large-scale farming ability		Geomorphological type
Highest	Group I	5a/23, 9c/2, 9c/2*
	Group II	3bl/45, 4bl/45, 5a/45
	Group III	2bf/23, 2bf/23*, 2bm/23, 3bf/23, 3bm/23, 5sf/23
	Group IV	2bf/45, 2bm/45, 3bf/45, 5sf/45
	Group V	2ag/23, 2bf/1, 2bf/45*, 2bg/23, 2bm/1, 2bm/45*, 3al/45*, 3as/45*, 3bg/23, 5a/45*
	Group VI	1a/2, 1a/2*, 1a/3, 1a/3*, 1ay/2, 1ay/2*, 1ay/3, 2ag/1, 2bg/1, 2bg/45, 2bg/45*, 7pB/6, 7pB/6*
Lowest	Group VII	1a/1, 1a/4, 1a/4*, 1a/5, 1a/5*, 1ay/1, 1ay/4, 1ay/4*, 1aR/1, 1aR/2, 1aR/2*, 1aR/3, 1d/2, 1d/3, 1d/4, 1d/4*, 1dR/2, 1f/4, 1f/4*, 1f/5*, 3al/6*, 5e/23, 5e/45, 5e/45*, 7p/6, 7p/6*, 8a/2*, 8c/2, 8c/2*, 8c/3*, 8cR/2*, R1/12, R3/12

Table 5: Ratings for large-scale farming ability of geomorphological types

Large-scale farming ability of geomorphological types		Rating
Highest	Group I	21
	Group II	15
	Group III	10
	Group IV	6
	Group V	3
	Group VI	1
Lowest	Group VII	0

Table 6: Limits and occurences of large-scale farming ability classes

Large-scale farming ability classes	Range	Occurrence (%)
Very high (VH)	[150-210]	1
High (H)	[100-149]	2
Moderate (M)	[60-99]	5
Low (L)	[11-59]	7
Very low (VL)	[0-10]	85

. Résults

To map the large-scale farming ability of Papineau RCM municipal lands, the ability classes in Table 6 and the average large-scale farming ability calculated for each cartographic unit are used.

Figure 3 shows the spatial distribution of large-scale farming ability on a portion of the Papineau and Sainte-Angélique municipal lands.

To large-scale farming assessment and cartography the developer or manager add the identification and cartography of factors limiting

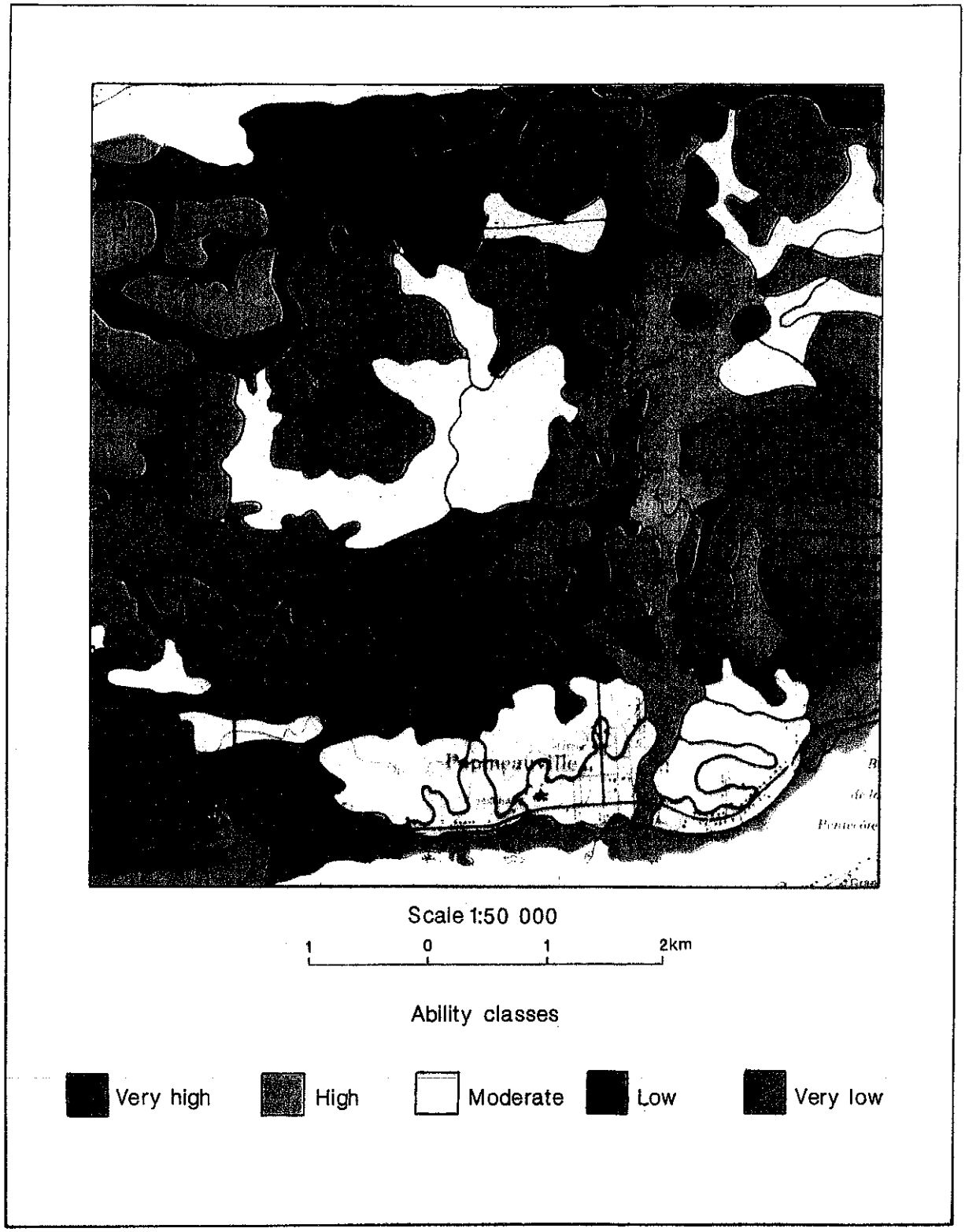

Figure 3. Large-scale farming ability (portion of the Papineauville and Sainte-Angélique municipal lands)

farming practices, such as the vulnerability of groundwater to pesticides pollution and soil erosion.

Once these factors are knowm the cartographic units most conducive to development can be identified. The developer or manager can also plan development or farming practices which are adapted to the constraints of the environment in question.

Management of the Territory and its Natural Resources

The ecological reference framework can be used to understand the physical and biological features of a given territory. It sheds light on the particular abilities and constraints of a given environment that should be taken into consideration in land-use and natural-resource planning and management. The ecological reference framework does not make management decisions, but rather is a valuable tool which can be used in the daily planning and management of development plans. It is useful when formulating a request according to the Act to preserve agricultural land for inclusion in or exclusion from a farming zone or when obtaining an analysis chart promoting the application fo a fallow-land development policy.

Allocation of Fallow Land

The fallow land issue leaves few people indifferent. Some want such lands to remain farmland, while others want to turn them into reforestation areas or, at the very least, into areas where silvicultural management plans may be implemented. However, everyone agrees on one thing: the status quo is in no one's best interest. Moreover, the farmers and foresters who wish to redevelop these lands, which have long been unproductive, will probably have to prepare the land first by clearing, then scarifying.

In the search for solutions to this situation on the Papineau and Sainte-Angélique municipal lands, it is interesting to note that the forest growth and large-scale farming abilities for the same portions of land (cartographic units) can be compared using the ecological reference framework (Figures 2 and 3). Of course, associating a forestry weighting with an agricultural weighting is not a solution in itself, but it does enable discussion between the parties involved within the same analysis framework, since assessment parameters and criteria are known to all.

For the purpose of our example, we will take into account forestry and agricultural allocations and the information obtained from the

forest growth and large-scale farming ability maps only. By comparing these two maps (Figures 2 and 3), the decision to give preference to an agricultural allocation in cartographic units where the large-scale farming ability is moderate to very high and the forest growth ability is low or very low is rapidly made. Similarly, preference is given to forestry allocation in cartographic units where forest growth ability is high or very high and large-scale farming ability is very low to moderate, and where both these abilities are low or very low. In cartographic units where these abilities are comparable at the moderate, high or very high levels, both allocations are possible and other factors (homogeneity of the community and farm operation, economic spin-off, socioeconomic considerations at stake, etc.) have to be considered in order for a judicious decision to be made. The result, then, is a composite map showing the cartographic units where ecological characteristics are conducive to agriculture, forestry, or both (Figure 4). Additional information on current soil use, such as the location of fallow lands, provides wood and farm producers with a tool conducive to reaching an agreement on a concrete basis. It also provides them with ecological arguments for modifying the allocation of certain lands, undertaking the steps necessary to changing the RCM development plan or submitting a request for inclusion in or exclusion from the agricultural zone as regulated by the Act to preserve agricultural land.

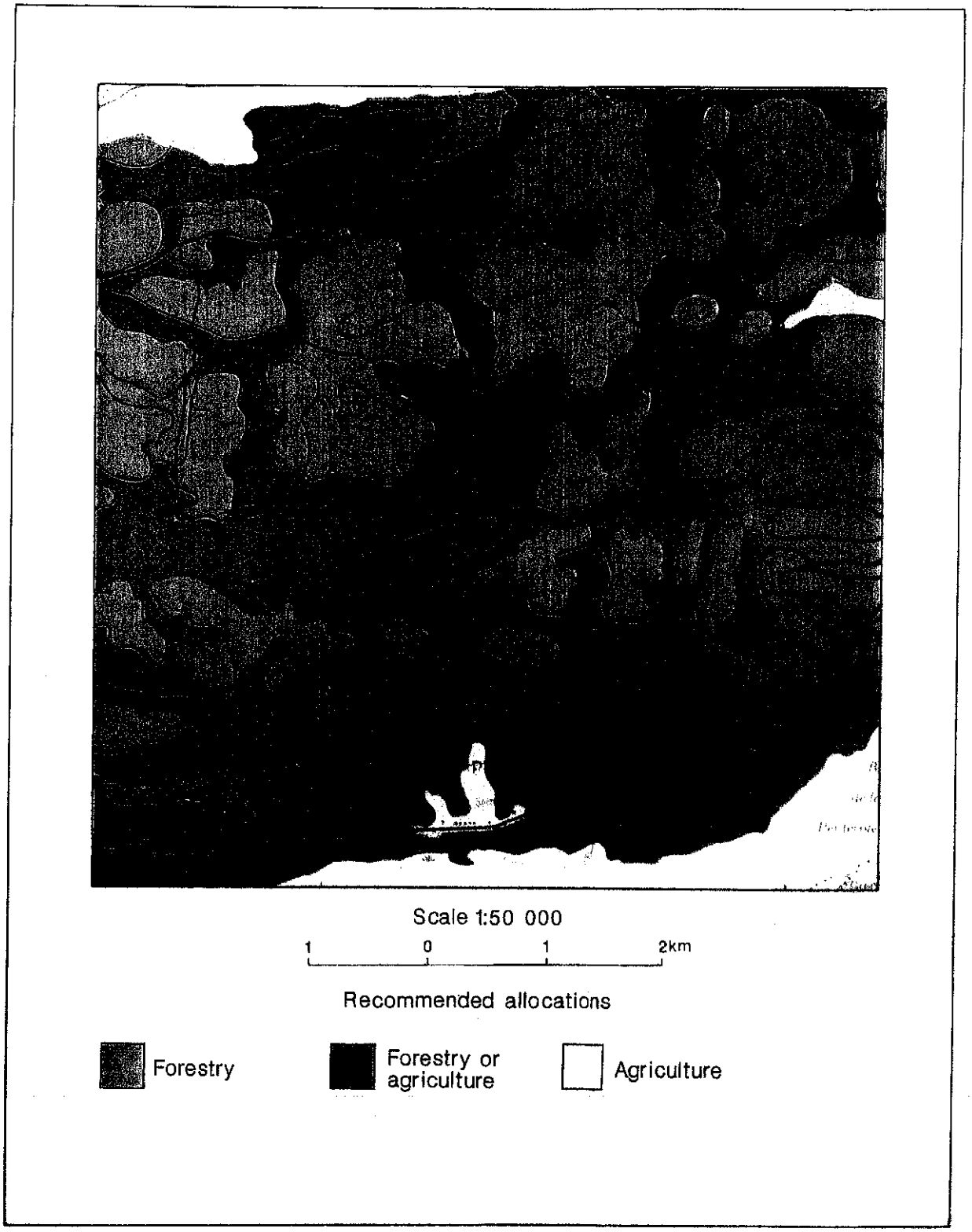

Figure 4. Recommended fallow-land allocations (portion of the Papineauville and Sainte-Angélique municipal lands)

Other Roles in the Area of Land and Natural Resource Development and Management

Aside from its contribution to the fallow land issue, the ecological framework plays other roles in the area of land and natural resource development and management. The following are some examples:

- preliminary identification of the zones exposed to land shifts and flooding so as to prevent public safety hazards;

- identification of zones subject to soil erosion in order to protect lands and resources through soil conservation and by reducing the chances of pollution spreading to watercourses;

- identification of sand and gravel pits with a view to facilitating localization of borrow pits for road construction and to planning land development, so as to avoid conflict between exploitation of this mineral resource and other possible uses of these sites and the surrounding area;

- preliminary identification of zones conducive to sanitary landfill in order to direct the search for such sites and plan land development

so as to avoid conflict between this use and other possible uses of these sites and the surrounding area;

- identification of zones where groundwater is vulnerable to pollution so as not to use these zones for drinking water sources and limit activities that could contribute to the contamination of such waters;

- identification of representative ecosystems for conservation;

- detailed description of wildlife habitats in order to better protect and develop them so as to ensure perpetuity of the different species.

Clearly, the ecological reference framework can provide answers to a series of management concerns, thereby making it a valuable tool for integrated planning of land and resource use.

PART II: DEVELOPMENT OF PAPINEAU RCM LANDS USING THE ECOLOGICAL REFERENCE FRAMEWORK

by Jean Falardeau

INTEGRATING ECOLOGICAL FACTS INTO DEVELOPMENT DECISIONS

The Development Plan

Regional county municipalities were created under the Act respecting land use planning and development, adopted by the Quebec Gouvernment in 1979, and were given the mandate to draw up their own development plans. This document was designed to provide a global representation of regional concerns and take into account the natural and human characteristics of each region, the main objective being to promote integrated land and resource management on a regional scale. Inevitably, this required joint action planning by the regional departments, major Crown corporations and municipalities.

Based on the principle that the natural environment is the backdrop for any municipal activity or development, the papineau RCM decided that a document integrating the intrinsic properties of the natural environment would be worthwhile.

Starting From Zero

The newly created RCMs had basically nothing on which to base a development plan. Work groups had to be set up very rapidly and ready to produce immediately. In conditions such as these, existing documents, studies and analyses are naturally put to good use.

The Canada land inventory maps are only one such example. Unfortunately, all too often the available documents and maps provided only a partial or sector-based view of the land. Worse yet, because they were used to functioning with such tools, the RCMs naturally requested other sector-based studies to meet their needs.

Without denying the validity of this type of study, it nonetheless has certain inadequacies in an integrated planning context. First of all, the developer has to deal with multiple land divisions, yet logically, integrated land-use planning should be based on a single division.

Moreover, such studies are often conducted on a smaller scale than those used for implementing development plans. We are not challenging the validity of the data collected from these studies; however, their

accuracy and pertinence are nevertheless affected by their limited scope. Lastly, the criteria used for assessing potentials and constraints cannot be adapted to regional particularities. Moreover, classification criteria are not often general knowledge.

The second generation of development plans should be implemented using land division based on the intrinsic and permanent physical features of the land. In fact, all assessments and data should be weighted according to these subdivisions. Moreover, it would be beneficial if specialists from the various land-use fields actively collaborated in working out land interpretation keys. Uniform land division, together with the contribution of specialists, make it possible to adapt potential and constraint analysis to the specific needs of a given land unit.

Choosing a Basic Map

Logically, the choice of a basic map or land division must take into account the permanent, physical characteristics of the environment. In this sense, the ecological map, as developed by Quebec Ministry of Environment, is extremely useful, since it is designed to give a global picture of a given physical space. Thus, municipal representatives can base their decisions on a global understanding of this space.

These decisions may run counter to the physical characteristics of the land, but only because development concerns related to socioeconomic factors will have been taken into account. Moreover, the biases of human analysis have already left their mark on the assessment of potentials and constraints.

THE PAPINEAU RCM CASE IN RETROSPECT BACKGROUND

Background

Until now, action taken by the Papineau RCM toward integrated land management has always been largely dependent on the willingness of technocrats. Although receptive to the idea of using the ecological reference framework, elected officals have not yet had the opportunity to take full advantage of its potential. However, they are sufficiently convinced of the validity of their action to feel justified in allocating money to make the system truly operational. More specifically, the RCM contributed financially and technically to the realization of a project in conjunction with the federal Job Development Program. This was a six-month project designed, among other things, to accelerate and

improve the action undertaken. Of course, the majority of funds came from the federal government, but the financial contribution of Papineau RCM officials is nonetheless a concrete gesture indicative of real interest. In such a context, it is essential that the expectations of those who believe in the idea not be disappointed.

Understanding the Ecological Reference Framework: an Essential Factor

The ecological reference framework is a complex tool and understanding it can prove arduous, especially for those with little knowledge of physical geography. Thus it soon became apparent that a major popularization campaign was of fundamental importance. Essentially, it was a matter of providing elected officials with accurate, easy-to-understand data, the various components of which could be easily compared.

Popularization Through Computers

To ensure that the data in the interpretation keys fulfilled these criteria, full advantage was made of computers. More specifically, in conjunction with the job development project, a software program was developed using the D-Base III+ model. The following pages show the format adopted for the presentation of results.

First, the computer displays the entire set of available interpretation keys and asks which one the user wishes to call up (see Table 7).

Table 7: Main interpretation menu

Potential	Physical characteristic	Zone with public safety risks
1. Agriculture - large-scale farming - potato 2. Forestry 3. Industrial 4. Sanitary landfill 5. Aqueducts and sewers 6. Septic tank installation	7. Rocky outcropping 8. Rockiness 9. Swamp 10. Clayey soil 11. Drainage 12. Slope 13. Quarry and sand pit	14. Risk of land-slides 15. Periodic flooding

Once this step has been completed, the computer asks the user which municipality he wishes to select, then displays the potential rating key. The user has only to indicate the number of ratings desired and then specify which ones (See Tables 8 and 9).

Table 8: Number of rating requested: (large-scale farming)

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MUNICIPALITY OF SAINTE-ANGÉLIQUE

Key of ratings used

A = Excellent
B = Very good
C = Good
D = Fair
E = Poor

How many ratings do you want to search for at a time?
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Table 9: Rating values requested: (large-scale farming)

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Key of ratings used

A = Excellent
B = Very good
C = Good
D = Fair
E = Poor

Enter the desired letter(s)
```

Once these step have been completed, the computer is ready to do the search requested. Table 10 gives an idea as to how the results are presented. As shown, these are classified either by increasing unit order (left-hand columns) or by potential rating (right-hand columns).

Table 10: Display of requested ratings for each cartographic unit: (large-scale farming)

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The A.B. possibilities are:

Classified by order of unit		Classified by order of rating	
# unit	Rating	# unit	Rating
001	A	001	A
002	B	013	A
005	B	002	B
006	B	005	B
012	B	006	B
013	A	012	B
020	B	020	B

The user can then ask the computer to indicate the relationship between the requested analysis and different potential or constraint keys, or certain intrinsic environmental features (slope, rockiness, etc.). The results are displayed as shown in Table 11.

Table 11: Table of interpretation comparisons

SAINTE-ANGÉLIQUE							
	Large-scale farming	Potato	Septic tank	Aque. & Sewer	Sanitary landfill	Clayey soil	Per. flooding
# Unit	Rating	Rating	Rating	Rating	Rating	Rating	Rating
024	A	B	B	B	A	B	E
001	A	C	D	C	B	A	E
039	A	C	C	C	B	A	E
065	A	C	E	C	B	A	E
013	A	C	D	C	B	A	E
012	B	C	C	C	B	A	E
020	B	B	B	A	A	E	E
022	B	A	A	A	A	E	E

In short, it is possible to obtain integrated knowledge of a given physical space. In addition, because different basic criteria can be selected for interpretation keys, it can easily be said that this is a highly versatile tool.

THE PAPINEAU RCM CASE: FUTURE PROSPECTS

Appropriation by Elected Officials: Step One Toward Establishing a Tradition

As previously indicated, elected officials are not generally familiar with the action undertaken by their technical services. Their motivation to make progress in this regard depends far more on their confidence in employees than on their confidence in the scientific document itself. The product will therefore have to be "sold" to elected officials for them to be motivated to use the available documents. Various factors will facilitate this. First, now that more and more municipalities are equipped with microcomputers, diskettes can be exchanged. Second, the easiness of data processing will be a positive factor. And last, motivation will be increased when the RCM technical services start using the available data. In the long run, use of the available data will hopefully become a tradition that will persist despite replacement of elected officials or technical services. Once this tradition is firmly established, rural development will hinge on ecological considerations, the very focus of decision making.

Diversified and Increased Knowledge

Ecological cartography is currently done to a scale of 1:50 000, which often means extensive generalization. Hence, it is currently being tested on a larger scale (1:20 000) in one of our 28 municipalities. Mapping done to such a scale definitely takes more time, but the advantages are undeniable.

Furthermore, it is important that certain aspects of soil use be integrated into the potential and constraint analysis. With this in mind, then, the Quebec Ministry of Energy and Resources and the Quebec Ministry of Environment undertook a joint project aimed at assessing the possibility of combining ecological cartography and remote sensing for soil-use analysis from satellite pictures, following the basic land division. Again, the Papineau RCM was chosen as the target of this pilot project.

Finally, integral digital cartography of this data would certainly be advantageous. However, this would be a long-term project and as yet no step has been taken in this direction.

CONCLUSION

Integrated land and resource development is a recent phenomenon, especially in Quebec, where government departments and municipalities are used to working in relative isolation. To establish dialogue between these parties, it is essential that a common analysis framework and data base be developed and tested.

In this respect, the ecological reference framework is promising, since it is centered on a global approach to the natural environment rather than on a single factor or specific resource.

Current efforts, particularly on Papineau RCM lands, will enable the strength and weaknesses of this approach to be identified over the next few years and will hopefully promote united action in the area of land and resource management.

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