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Commission parlementaire du Québec 26 novembre au 5 décembre 2013
Enbridge Line 9B reversal and line 9 capacity expansion project

ABOUT LES CITOYENS AU COURANT

1. Les Citoyens au Courant is a group of citizens principally from the villages of Très-Saint-Rédempteur, Sainte-Justine-de-Newton, Rigaud and Pointe-Fortune. Our group is made of village residents living close to Enbridge 9B pipeline and farmers who own and work on land crossed by the pipeline or near the pipeline. Our group also includes a small number of citizens (fewer than 10) from other municipalities who share the same concerns. Our group consists of 25 active members and some dozens who have given us their support informally. Furthermore, we feel our concerns represent those of the general population of the municipalities where we live, having spoken to several hundred residents.

2. Our group is not registered and has no legal status. We are citizens, not activists, with full-time jobs and families, and none of us has any experience in the area of parliamentary commissions or pipelines. Fortunately, three members of our group have considerable technical knowledge gained in their professional practices that has helped us understand the issues in question. These professionals are an engineer (Luc Falardeau), a chemist and physicist (Norman Molhant) and a micro-biologist (Michelle Poilly).

3. The members of our group rely directly on underground water sources close to the pipeline and all of us rely on water sources that could be severely affected in the case of a spill. The farmers in our group rely on underground water sources for commercial reasons in addition to private use.

4. We have read the documentation provided by Enbridge and the National Energy Board.

INTRODUCTION

5. We are concerned about the risks created by the age of the pipeline, the plan to use the pipeline to transport diluted bitumen and the increased volume. We consider this creates a risk that is unacceptable to our local economy, our livelihoods, our health and well-being. The contamination of our water would be devastating. Many members of our group have worked and lived in this area for many generations and we make up part of the living history of our municipalities. The personal loss caused by an oil spill would be immeasurable in terms of the deep connection we feel with the place we live. We are also concerned about the health of our families and animals (in the case of farmers with livestock) if there were a spill from the pipeline. All our concerns have been heightened by the way Enbridge has responded to our group and others during the Information Request period during the NEB public hearings. We feel the lack of transparency about the project is reflected by the vague and non-committal answers Enbridge has given to precise questions, and how difficult it has been in both conversations and the written exchange to get basic facts from the company. We are also concerned about the accident record of Enbridge.

6. Les CaC = Les Citoyens au Courant.
   IR = Information Request to Enbridge made during the NEB public hearings
   ILI = inline inspections
   V-S = Vaudreuil-Soulanges

Les retombées commerciales possibles du projet proposé

7. Les Citoyens au Courant note that there is little or no commercial gain for Vaudreuil-Soulanges from this project. There are no economic advantages for our region, only risks.

8. Even the pipeline integrity dig work is not being carried out by a local company. See response in IR1 to question 2.2. "*The pipeline integrity dig work is being carried out by Robert B. Somerville Co. Limited and Construction SIMDEV*." The company Enbridge refers to is located in Alberta and in Ontario, not in Quebec.

Recommendation No. 1
We recommend that Enbridge chooses a local company from our region (Vaudreuil-Soulanges) or at least a Quebecois company for any pipeline dig work in Vaudreuil-Soulanges.

Le caractère approprié du tarif des règles et règlements ainsi que de la méthode de tarification proposée

9. The National Academy of Sciences Report does distinguish between dilbit and heavy crude: http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=18381

10. This NRDC report has a table on page 6, which defines dilbit vs. conventional crude according to its chemical properties: http://www.nrdc.org/energy/tarsandssafetyrisks.asp

11. The Proposed Rules and Regulations defined diluted bitumen as indistinct from "crude petroleum". Yet we, Citoyens au Courant, are aware that the diluted bitumen, which Enbridge proposes to ship, is of different acidity, viscosity, sulphur content, and potentially corrosiveness to the crude petroleum products normally shipped under the category of "heavy crude". This lack of distinction within the Rules and Regulations Tariff (and the subsequent tolling methodology) is inconsistent with the engineering assessment in Enbridge's application.

Recommendation No. 2
We recommend a regulatory framework and subsequent tolling methodology which accounts for the different chemical properties of diluted bitumen.

Les effets environnementaux et socioéconomiques potentiels du projet proposé, y compris ceux causés par les accidents ou défaillances pouvant survenir, et les effets environnementaux cumulatifs éventuels que sa (9b) réalisation est susceptible de causer

12. In our IR 1 to Enbridge, les CaC asked the company if the results of their inline inspections would be released and Enbridge said yes: "*Enbridge will communicate the results of the in-line inspection tool runs to affected landowners and municipalities*".

13. When questioned in our IR 2 as to when, Enbridge replied as if we were asking about the integrity digs: "*When work on the pipeline is required on an affected landowner's property, an Enbridge representative will make reasonable efforts to contact the landowner a minimum of seven days in advance of any work being conducted. This includes integrity dig work. Therefore, information on integrity digs may not be communicated until after August 6, 2013 to the affected landowners if digs are not scheduled to begin until after that date. Quebec municipalities were informed of the number of digs in their areas in March 2013. The results of the integrity digs will be communicated to municipalities and affected landowners after all integrity work has been completed, likely in 2014*."

Recommendation No. 3
The results of the inline inspection carried out in 2012 should be communicated to an independent agency of experts and the NEB, along with the results of the integrity digs, and this information should be made public in order to reassure the public that Enbridge's statement that the pipeline is safe is true.

14. In our IR 1 4.11, les CaC asked Enbridge if they have data on groundwater in the V-S regional watershed (water composition, groundwater movements, recharge areas of the confined aquifer, etc.). The response: "*In the unlikely event of a release, Enbridge would have specialized resources ready for rapid deployment with processes at their disposal to quickly gather groundwater information specific to the area of the release*".

15. In our IR 2 we followed up with the assertion that it is not possible to gather groundwater data so quickly. This data is currently being established by Cobaver V-S. The study will be completed in 2015. In the absence of data, Enbridge said that "*if site specific data is not available, the groundwater information would be obtained from the groundwater monitoring wells that are installed as part of response activities*".

16. In IR 1 6.11 we asked Enbridge what methods are available to monitor the contamination of the water table, and Enbridge responded "*Groundwater monitoring wells are used to monitor groundwater levels and groundwater quality*". Yet later on in response to our IR 2 follow-up question 6.11 about groundwater monitoring wells, Enbridge states "*There are no groundwater monitoring wells in Vaudreuil-Soulanges*".

Recommendation No. 4
We recommend that groundwater data in Vaudreuil-Soulanges should be mapped and established before the project goes ahead, so that in the event of an oil spill, our water tables can be quickly and more efficiently protected.

Recommendation No. 5
Groundwater monitoring wells should be established at key points in Vaudreuil-Soulanges, in consultation with Cobaver V-S.

La conception technique du projet proposé

17. In its response to our IR 1 4.7, Enbridge states that it is not always possible to detect small leaks but that they can be detected by inline inspection tools. Considering that Enbridge intends to run inline inspection tool every 5 to 7 years (response to IR 2 4.16), we are concerned that oil may be leaking into the environment undetected for long periods of time.

Recommendation No. 6
The inline inspection tool should be run annually so remedial action can be taken to prevent and repair leaks.

18. "Temperature sensors are located throughout the Enbridge system, typically situated at locations where product is received into the pipeline and locations where product is delivered off the pipeline. Some midline pump stations locations are also equipped with temperature sensor." (Ref: Response to Toronto IR No. 2OH-002-2013 File-OF-Fac-Oil-E101-2012-10 02 Request:1.12)

19. Enbridge has no temperature gages on 9B in V-S. (Ref: CaC IR1 5.15) The operating system described by Enbridge factors temperature into the dosage of DRA into the system, as a correction factor for densitometry and viscosity, yet does not monitor temperature along the line except at entry and exit points of the pipeline. According to Enbridge, there are no significant modulations of temperature between pumping stations. Having no system in place to monitor temperature between stations, this statement would appear to be an assumption. In which case, it can be assumed that any fluctuation of temperature, or range of temperature experienced along the pipeline between pumping stations is ignored and the data is replaced by a corrective factor. There are apparently no real temperature checks along the line, yet there are many standard operational decisions that require the consideration of actual running temperature of the product in the pipeline, in real time. Moreover, there are new products or combinations of products proposed for transportation via this pipeline, of which only 3 have been tested, and all show their own profile with respect to wettability, weathering rate, density variation, viscosity, and emulsion formation. Since all 3 products tested show different physical behavior, it seems presumptive to dismiss the necessity of temperature monitoring along the pipeline during transportation as well as during batch mixing, entry and exit points until all the products proposed to be transported in Line 9 be properly characterized at the relevant operating temperatures. Therefore, the physical differences expected of the remaining, untested products or combinations of products that Enbridge proposes to transport in Line 9 are not known to Enbridge such that the assumption that the pipeline in its present condition is apt to receive such products is not adequately supported. Somewhat misleadingly, results from standard tests performed at temperatures much higher than the range of temperatures potentially experienced in nature where lies the pipeline, and relative behavior extrapolated from the above-stated tests have been given as assurance that there is no further environmental threat compared to the transportation of conventional crude. The point being overlooked is the critical value is that at which spilled material from the pipeline will lose its ability to float, creating an underwater spill. This would be determined by the difference between the absolute value of the density of the material spilled, and the absolute density of the water in which it is carried, and the degree of weathering of the material.

Recommendation No. 7 Add temperature monitoring systems along the pipeline, between pumping stations and points of entry/exit of material at regular intervals. Incorporate the temperature data with the standard operating system, including regulation of DRA. Include alarms and protocols to follow should the temperature rise above the stated 38.5˚C. Increase monitoring when transporting uncharacterized products, and in unusual climatic conditions.

Les volets sécurité, sûreté et plans d'urgence associés à la construction et à l'exploitation du projet proposé, notamment la planification des interventions et la prévention des dommages causés par des tiers

20. In our IR 2 (q5), Enbridge informed us that one of the valves in Vaudreuil-Soulanges (valve 38) is a manual valve. This contradicts what several of us were told by Enbridge staff very clearly at the public information meeting on 25th April in Rigaud, that "all valves in Quebec are automatic". Valve 38 is snow-bound in winter (see annex 2) and overgrown in summer (see annex 2).

21. Furthermore, we learn that the person who has the key to this valve (IR 1 6.2) is in Montreal and that the response time in a spill is between 1.5 and 4 hours (I.R. 1 6.6). Please note that this valve is close to a sandy soil (see annexe 1), and also close to a quarry and the drinking water sources of Ste-Justine-de-Newton (population approximately 1000) and St-Polycarpe (population approximately 2000). Furthermore, there are large farms close to this valve, some of which are livestock farms with several thousand animals to water.

Recommendation No. 8
Valve 38 must be replaced by a remote-controlled valve that can be operated from the Enbridge control center. Enbridge reassured us all on April 25th in Rigaud that all valves in Quebec were remote-operated, and this is not true. We urge the NEB to oblige Enbridge to correct this situation immediately, before the project is approved.

22. In answer to our IR 1 6.7, Enbridge states that it is "*not aware of any specific independent studies relating to the cleanup of diluted bitumen or any other heavy crude spill in a fast flowing river such as the Ottawa river*".

Recommendation No. 9
In view of the difficulties in Kalamazoo, an independent study should be carried out revealing how dilbit behaves in a fast-flowing river at different times of the year, and how this product can be contained and cleaned up in the event of a spill. The populations downstream of the pipeline, including Hudson and parts of Montreal, are dependent on this river and this information should be available before the project is approved.

23. In our IR 1 6.20 and 6.21 we asked Enbridge about the security and evacuation of farm animals in the event of a spill. In our IR 2 we asked how Enbridge could ensure fresh water would be available to those animals in the event of a spill. Enbridge responded that they would evacuate the animals if necessary and provide drinking water in the event of a spill. However, Enbridge also stated when asked that there are "*no preliminary agreements in place with suppliers of drinking water"* (for humans or animals), and that "*Enbridge has not established any preliminary agreements to transport farm animals*".

Recommendation No. 10
In an emergency, evacuation and drinking water contracts should be ready and easy to execute. We believe that the vast logistical difficulties of these operations would cause unnecessary delays and unacceptable danger to farm animals. Preliminary contracts for the evacuation of animals and provision of drinking water to humans and animals should be in place now, and not after an oil spill. We recommend that Enbridge establish those contracts before the project is approved.

24. In our IR 6.23 we asked Enbridge who orders the evacuation of people and /or animals. We also asked Enbridge about the dangers of exposure to benzene which is used in dilbit. Benzene can cause numerous

health problems and death (http://www.bt.cdc.gov/agent/benzene/basics/facts.asp). Enbridge responded that "*The Enbridge on scene commander in consultation with the City emergency response representative(s) would make that decision and have the police and fire departments lead the evacuation*".

Recommendation No. 11
In view of the fact that it would take Enbridge 1.5 to 4 hours to get to the scene, presumably further time to measure air quality and again more time to evacuate the population, we recommend that evacuation should take place immediately after a spill, and be instigated by the local emergency responders as a precaution, within minutes of the discovery of a spill.

Recommendation No. 12
Furthermore, we recommend that an Enbridge commander, who is qualified to fully manage a spill scenario, should be posted close to Vaudreuil-Soulanges. The maximum response time of 4 hours is far too long.

25. In our IR 2 we asked Enbridge about their response mechanisms in relation to the airborne chemicals used in dilbit, in the event of a spill, and in particular benzene. Exposure to benzene causes severe health problems and can be fatal. Enbridge answered "*When a release occurs, Enbridge monitors air quality to ensure the public is protected from both short term (acute) and long term (chronic) effects…if actions are required, Enbridge works with local officials and regulators to ensure those actions are acted upon*".

Recommendation No. 13
First responders from local emergency services should be equipped to test air quality, and provided with the necessary training and equipment from Enbridge so that the breathing of toxic substances can be kept to a minimum.

Les activités de consultation et les effets potentiels du projet proposé sur les propriétaires fonciers qui sont touchés ainsi que sur l'utilisation des terres :

26. In our IR 1 8.1 we asked Enbridge if they had explained their project to citizens from the villages crossed by the pipeline in Vaudreuil-Soulanges between Sainte-Justine-de-Newton and Pointe-Fortune. Enbridge said "*yes*", then proceeded to give details of activities that did not take place in Vaudreuil-Soulanges. A single activity has taken place in Vaudreuil-Soulanges, a meeting in Rigaud on April 25th 2013, which Enbridge acknowledges was organized after repeated requests by citizens and municipal councils to do so. We note that it was too late at this stage for citizens to participate in the NEB public hearings. When our group started working on this issue in March, we only met a tiny handful of citizens (less than 10) who had heard about it, amongst the hundreds with whom we spoke. We maintain that before April 25th 2013 when Enbridge came to Rigaud and held their PR event, there was NO engagement with citizens in Vaudreuil-Soulanges about the project (apart from mailings to landowners whose land has an Enbridge right of way).

27. When Enbridge came to Rigaud on 25th August, at the request of our municipal councils, they had promised the mayors that the meeting would have an open-mike format. Indeed, M. Lalonde, mayor of Très-St-Rédempteur, was so sure of this fact that he had told citizens it would be so. When Enbridge refused, he said his citizens would think he was a liar. We attach e-mails showing some consultations with mayors about this subject (annex 3).

28. The meeting itself on 25th April was highly unsatisfactory. Citizens wanted to ask questions using an open-mike format and when they discovered the format of the meeting (small or one-to-one conversations with Enbridge staff), one citizen suggested a vote should be held so that we could change the format. Every citizen present voted for an open-mike format, but this was refused. The local federal MP Mr. Nicholls asked a question in front of all present which the Enbridge representative refused to answer in front of everyone, and took Mr. Nicholls off to speak in private. This was the order of the day, private conversations. During those conversations, citizens received different answers to the same questions, and we were constantly referred on to different specialists who were already in conversation with someone else, or our questions could not be answered because they were in French. The general feeling amongst citizens was one of anger and frustration, as reported in this local newspaper:
http://www.journalpremiereedition.com/Actualites/2013-04-26/article-3228533/Les-portes-ouvertes-derapent/1

29. Lastly, in view of the complete lack of engagement, information or consultation with citizens in Vaudreuil-Soulanges before April 25th (since then we have been bombarded with advertisements), we asked Enbridge in IR 1 8.2 and again in IR 2 if they gave the mandate to explaining their projects to municipal councils, with whom they met on more than one occasion. In answer, Enbridge stated "*yes, Enbridge has engaged 48 municipal, provincial and federal government authorities from Quebec…*". However, this is not the same thing as asking councils to explain the project. As the attached e-mails reveal (annex 3), Enbridge did not ask or require municipal councils to explain their project for them. Instead, the municipal councils asked Enbridge to come and explain their project themselves with open-mike format, which they so spectacularly failed to do.

Recommendation No. 14

We conclude that the engagement Enbridge mentions has not taken place. Other than some very prominent advertising and a farcical PR event on 25th April, citizens have not been engaged at any level. We recommend that Enbridge should return to Rigaud and hold an open-mike meeting. This should be advertised at least 2 weeks beforehand, and citizens should be allowed to enter freely without being required to give their name. The open-mike format should not be a presentation by Enbridge, rather an opportunity for citizens to ask the questions *they* want to ask, and everyone should be able to hear the answers.

CRÉATION D'UN FOND DE PRÉVOYANCE

30. La ligne 9b d'Enbridge passe à travers des zones agricoles de Vaudreuil-Soulanges, ces terres riches sont utilisées pour l'agriculture et l'élevage. L'agriculture occupe une place importante dans l'économie locale et régionale. Dans un cas de déversement, nos fermiers se verraient privés de revenus importants et ces conséquences économiques toucheraient toutes les municipalités et ses populations.

31. Dans le cas du déversement dans la rivière Kalamazoo au Michigan, les coûts liés à la de décontamination et la restauration des milieux touchés atteignent presque 1 milliard de dollars.

Recommendation No. 15
Par mesure de prévention, nous demandons la création d'un fonds de prévoyance d'un minimum de 1 millard de dollars canadiens pour pallier au cout lié à un éventuel déversement pétrolier. Ce fond permettrait d'assurer la population que la décontamination et la restauration des milieux touchés par un tel sinistre seraient assumer sans qu'elle ait à faire appel aux tribunaux (comme dans le cas du Lac-Mégantic). Un tel fond éviterait à la population contribuable d'assumer la facture et forcerait les pétrolières de se comporter en citoyens corporatifs responsables.

Recommendation No. 16
Pour éviter de conflits d'intérêts évidents, ce fond de sécurité ne doit pas être géré par l'industrie pétrolière mais par une instance neutre afin que les sorties et entrées d'argent soient indépendantes de l'industrie pétrolière.

Recommendation No. 17
Nous recommandons que le fonds de prévoyance soit renfloué par l'entreprise Enbridge à raison de 10 cents par baril de pétrole traversant la ligne 9b et ce durant toute la vie opérationnelle du pipeline.

Recommendation No. 18
De plus, nous demandons que la compagnie Enbridge soit obligée de démontrer qu'elle possède une assurance financière pour le projet 9b pouvant couvrir un minimum de 1 millard de dollars et que cette assurance servira à la de décontamination et la restauration des milieux touchés dans le cas d'un déversement pétrolier sur la ligne 9b.

RENFORCEMENT DU POUVOIR PÉNAL DE L'ONÉ

32. En Octobre 2011, l'ONÉ a mené une inspection aux terminaux d'Edmonton, de Westover et de Sarnia, ainsi qu'aux stations de pompage de Westover et de Terrebonne de la compagnie Enbridge. Cette inspection a révélé des non-conformités aux systèmes d'arrêt d'urgence ainsi qu'aux stations de pompage (infraction à l'alinéa 12a) du RPT-99).

33. Parallèlement, l'Office a inspecté le projet de construction d'Enbridge Bakken Pipeline et a constaté que ce réseau ne respectait pas non plus l'alinéa 12a) du RPT-99.

34. Malgré la promesse d'Enbridge de se conformer et de remédier à l'infraction des normes, la compagnie n'a à ce jour pas apporté les mesures correctives pour tous les terminaux et stations de pompages non-conformes.

35. Référence : http://www.one-neb.gc.ca/clf-nsi/rsftyndthnvrnmnt/sfty/brdrdr/nbrdg_rft2013_001-fra.html

Recommendation No. 19
Nous demandons l'ONÉ d'obliger Enbridge à respecter tous les normes et règlements relatifs aux oléoducs et de, par conséquent, remédier à toute non-conformité de son réseau de pipeline en réalisant les travaux nécessaires et ceci, sans l'accord d'un délai supplémentaire.

Recommendation No. 20
Nous demandons que ces travaux soient effectués et complétés AVANT d'autoriser le projet 9b.

Recommendation No. 21
Nous demandons au gouvernement fédéral d'élargir et de renforcer les pouvoirs pénaux de l'ONÉ afin que l'Office soit en mesure de faire respecter, par les entreprises délinquantes, tel qu'Enbridge, les normes et règlements établis pour assurer la sécurité de tous les réseaux de pipelines traversant le territoire canadien.

Recommendation No. 22
Nous recommandons que l'ONÉ ait le pouvoir d'imposer des amendes très sévères aux entreprises délinquantes qui ne se conforment pas aux règlements et normes établis.

Recommendation No. 23
Le cas où une entreprise ne respecte pas le pouvoir pénal de L'ONÉ et qu'elle continue à transgresser, elle devrait pouvoir se faire imposer les travaux de corrections par l'ONÉ, même sans son aval. C'est-à-dire, l'ONÉ devrait pouvoir engager une autre entreprise pour effectuer les corrections nécessaire pour remédier à la non-conformité. Les dépenses liées à de tels travaux devraient alors être facturées à l'entreprise délinquante.

SOIL SURVEY

of

SOULANGES

AND

VAUDREUIL COUNTIES

in the

PROVINCE OF QUEBEC

by

P. LAJOIE and P. STOBBE

Experimental Farms Service
Canada Department of Agriculture
in Co-operation with the Quebec Department
of Agriculture and Macdonald College, McGill University

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EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
KING'S PRINTER AND CONTROLLER OF STATIONERY
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The soil survey of Soulanges and Vaudreuil counties was financed by the Experimental Farms Service of the Canada Department of Agriculture. Macdonald College provided the headquarters and laboratory facilities for the analytical studies. The soil map was prepared for publication by the Soil Survey Mapping Unit at the Central Experimental Farm, Ottawa.

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CONTENTS

CONTENTS—Concluded

SKETCH MAPS

INTRODUCTION

In order to study the nature and extent of the different soils in Soulanges and Vaudreuil counties of Quebec a reconnaissance soil survey of this area was undertaken in 1943 by the Dominion Experimental Farms Service in co-operation with Macdonald College.

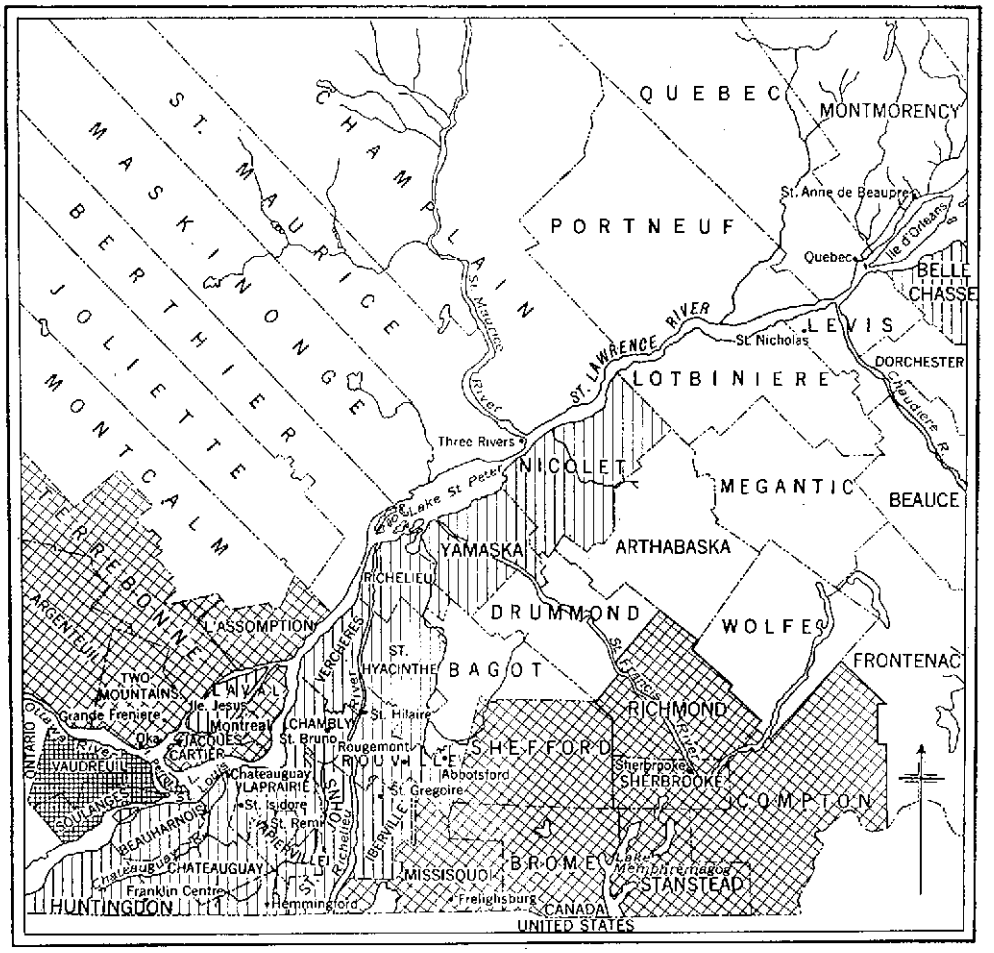
This report presents the information obtained by the survey. It gives a brief general description of the area and also discusses the climate, vegetation, topography, drainage and surface geology all of which have an important bearing on the soil and the soil developing processes.

Every soil type in the area is described in considerable detail. The first part of each description deals with the physical characteristics of the soil by which it may be recognized, while the second part discusses the adaptability of the soil to crop production, its use and its fertility. The soils have been classified according to their pedological characteristics and also grouped in relation to their agricultural adaptability and management.

The soil map is an important feature of the report. It indicates the location and extent of the different soils and shows the most important physical features of the area, such as, roads, railways, rivers, houses, towns, etc.

The soils in the surveyed area differ significantly and this has an important bearing on the soil management practices required, on the kinds of crops which can be grown economically and on the yields which are obtained. Although tentative conclusions regarding the adaptability and productivity of the different soils have been reached from observations in the field and from studies in the laboratory, much accurate information regarding the management and fertility requirements is still needed for the best utilization of many soils.

The soil survey report, together with the accompanying map, provides a good guide for the investigation of basic soil problems the solution of which should be of great practical value. The information contained in this publication should also be useful to extension men whose duty is to advise the farmers on practical problems related to soil fertility and crop production. The soil map and report will enable the practical farmer to compare his experiences with the results obtained on similar soils on other farms which should lead to the adoption of better farm practices.



INDEX MAP

OF

CENTRAL QUEBEC

SHOWING LOCATION OF SURVEYED AREAS

LEGEND

International boundary.....

County boundary.....

Area discussed in this report.....

Counties surveyed by the Federal Department of Agriculture.....

Counties surveyed by the Provincial Department of Agriculture....

DESCRIPTION OF THE AREA

Location and Extent

Vaudreuil and Soulanges counties are situated in the southwestern section of Quebec between the Ottawa and St. Lawrence Rivers. The area is roughly triangular in shape, the base consists of the interprovincial boundary, with the sides formed by the two rivers which converge toward Lake St. Louis. The sides of the triangle are approximately 27 miles long.

The two counties cover an area of approximately 327 square miles or 208,836 acres of which 122,459 acres are found in Vaudreuil and the remaining 85,877 acres in Soulanges county. Vaudreuil county occupies the northern half of the triangle and all of Ile Perrot, while Soulanges county lies along the St. Lawrence River in the southern half of the area.

Physiography

The entire Vaudreuil-Soulanges area, excepting the top of Rigaud Mountain, has in the past been submerged by the Champlain Sea. The plaining and filling action of the sea waters and later of the waters of the Ottawa and St. Lawrence Rivers have had a great influence on the physiographic features of the area.

Topography

The entire area consists of a vast plain which is broken by the rocky mass of Rigaud Mountain and the sand plateau of St. Lazare. In the western part of the area the plain is broken by gently rolling morainic ridges which rise from 50 to 100 feet above the mean level of the plain. The largest part of the plain is flat to gently undulating and varies in elevation from 140 to 200 feet above the mean sea level and slopes very gently from Rigaud Mountain and the St. Lazare sand hills toward the St. Lawrence River to the south and southeast.

Rigaud Mountain rises to a height of over 700 feet and is the highest point in the area. The northern side of the mountain is very steep and in some places the rise is 500 feet in 500 yards. The St. Lazare sand plateau lies to the east of Rigaud Mountain but is completely separated from the latter by the Raquette River. It has an undulating to rolling topography and varies in elevation from 200 to 400 feet.

A very distinct clay bank, in some cases over 35 feet high, runs northwest from Pointe-Cascade at the eastern end of the area to Como, a distance of about 12 miles. The Montreal-Ottawa highway runs along the bottom of this embankment for a considerable distance before it crosses the sand plateau south of Como. The same bank recurs with less regularity north and west of Rigaud. Toward the east, it extends over Perrot Island where it is most pronounced on the northeastern and southern sides of the island and runs approximately parallel to the Pointe-Cascade-Como bank. The land below this escarpment is very flat and usually has an elevation of 100 feet or less above mean sea level.

Drainage

The drainage waters of the surveyed area flow either northward into the Ottawa River or southward into the St. Lawrence River. The divide runs approximately through the centre of the area from east to west, from Cascade Point to St. Lazare Station, Val des Sables and Ste. Justine. The streams of the northern watershed have carved their channels through uneven and comparatively higher land and as a result the banks are fairly abrupt and steep. The southern streams generally have a shallow bed and a slow rate of flow. This difference in the appearance of the streams is probably due to the fact that the water in the Lake of the Two Mountains is at least 75 feet lower than in St. Francis Lake. As a result the flow of the waters in the northern streams and their erosive action is much greater than in the southern streams. The drainage waters from the Ste. Justine area with an elevation of about 250 feet, flow north into the Rigaud River with an average fall of about 12 feet per mile for a distance of about 15 miles. The Riviere a Delisle which flows in a southerly direction from the same area for a distance of about 17 miles has an average fall of about 6 feet per mile.

The Rigaud, Raquette and Viviry Rivers are the main streams flowing north into the Lake of the Two Mountains. With their deep river beds, they provide good drainage outlets for the northwestern part of the area. A number of smaller streams flow northward and eastward into the same lake and drain the area southeast of the St. Lazare Plateau.

The main streams flowing into the St. Lawrence are: Riviere Baudette, Riviere a Delisle, Riviere Rouge and Riviere a la Graisse.

The Riviere Baudette flows mainly through Ontario and drains only a small section of southwestern Soulanges county. The Riviere a Delisle has fairly high banks west of St. Polycarpe but from there down to the St. Lawrence, the water is only a few feet below land level and the flow is very sluggish. The Riviere Rouge and Riviere a la Graisse are fed by many small streams which originate on the southern side of the sandy plateau. In some cases they have washed some sand over the clay plain. This erosion and deposition has caused considerable damage to some farms on the clay plain until the sands were reforested and gully control measures were introduced.

The flatness of the southern part of the area, the slight fall of the streams, and the sluggish flow of the water render the drainage of the cultivated land difficult. The strip of land, 4 to 5 miles wide along the St. Lawrence, from Riviere Baudette to St. Lazare Station, is the most difficult to drain because of its level topography and the high level of the water in Lake St. Francis.

Bedrock Geology

Almost everywhere in Soulanges and Vaudreuil counties, the bedrock is covered with a heavy mantle of unconsolidated material varying in thickness from a few feet to more than one hundred feet. Rock exposures are so infrequent that the mapping of the boundaries of bedrock formations is uncertain and unsatisfactory.

The underlying formations in Soulanges and Vaudreuil include the igneous and metamorphic Pre-Cambrian rocks, the Potsdam sandstone of Cambrian age and the Chazy, Beekmantown and Black River limestones of the Ordovician age. The composition of these formations is shown in Table I, and their distribution appears on the geological sketch map.

GEOLOGICAL FORMATIONS IN THE COUNTIES OF SOULANGES AND VAUDREUIL

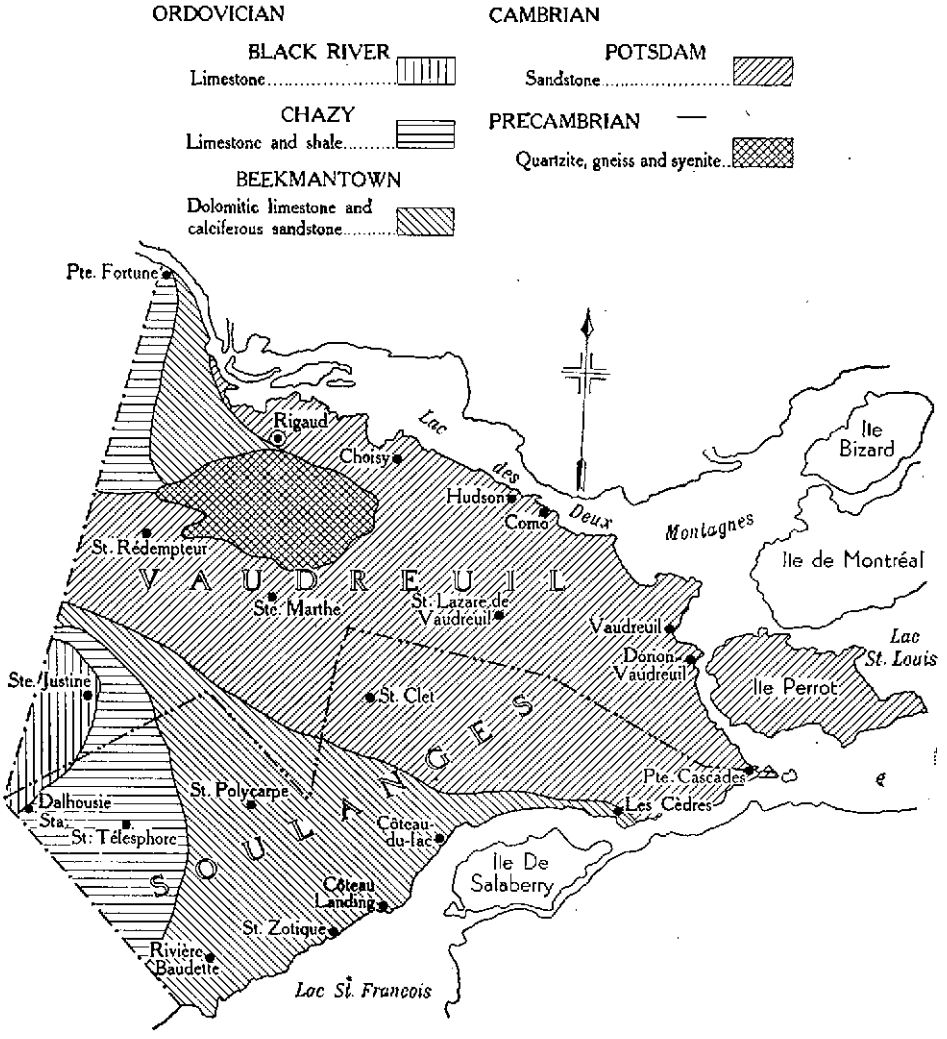


TABLE 1

GEOLOGICAL FORMATIONS IN SOULANGES-VAUDREUIL

		Rock Formation	*Composition*
Palaeozoic	Ordovician	Black River	Limestone.
		Chazy	Limestone, shale, sandstone.
		Beekmantown	Limestone, magnesian limestone, dolomite, calcareons sandstone.
	Cambrian	Potsdam	Sandstone.
Precambrian	Precambrian	.....	Quartzite and gneiss intruded by granite and syenite.

Surface Geology

The surface deposits in Soulanges and Vaudreuil show the effect of glaciation and of a subsequent sea submergence. Like the rest of Eastern Canada, this section of the province was at one time occupied by an ice cap, several hundred

feet thick at the maximum stage of glaciation. For many thousand years, the ice front advanced or receded under the influence of mass pressure or of rapid melting. The advancing ice front acted as an enormous bulldozer, scraping off preglacial soils and loose rocks and crushing the material into more or less fine particles.

The unsorted material deposited by the ice is generally referred to as till and is an accumulation of particles of all possible sizes from clay and silt to sand and gravel with a varying proportion of stones and boulders.

In the surveyed area, glacial till deposits occupy about 15 per cent of the area and are found mainly on the ridges near the Ontario border, on Rigaud Mountain and on the northern part of Ile Perrot. The deposits on the western ridges are generally of a sandy loam texture and are derived mainly from calcareous rocks. The tills of Rigaud Mountain and Ile Perrot contain a considerable amount of gravel and are derived mainly from non-calcareous material.

Fluvio-glacial outwash deposits consisting of roughly sorted sand, gravel and cobbles are found at Riviere Baudette and Point Fortune. These deposits occur as long narrow ridges which are generally referred to as eskers. The fluvio-glacial materials have been derived from a large variety of rocks, but calcareous fragments are generally dominant.

After the glaciers melted, under the influence of a warmer climate, the sea invaded the land. The whole of Soulagnes and Vaudreuil, with the exception of the highest summits of Rigaud Mountain, was covered with water. According to observations made on Rigaud Mountain (2), the water rose to a height of 670 feet above present sea level. In the depression south of the mountain there was at one time about 600 feet of water.

As a result of this sea invasion, most of the glacial deposits were covered with clay and silt sediments which filled in the depressions and covered the ridges so as to leave a level surface over the larger part of the area. These sediments, termed Champlain clays, vary in depth from 130 feet south of Rigaud Mountain (2) to a few feet over the till on the sides of the morainic ridges. In addition to Rigaud Mountain, only a comparatively small area of glacial till was left uncovered by clay. The claycy deposits of Vaudreuil and Soulanges generally contain about 65 per cent of clay. The material deposited between the western ridges is more silty and contains only about 50 per cent of clay. In some scattered areas the upper part of the marine deposits contains over 50 per cent of silt. These last mentioned deposits are probably due to periodical overflows of some rivers.

Fine sands were deposited along the main channel of the St. Lawrence, probably as the waters were becoming still shallower. In Soulanges these deposits form a rather regular band extending three to four miles inland between Riviere Baudette and St. Dominique. They contain a proportion of silt varying from 25 to 35 per cent or more and have an average depth of 3 feet over a clay substratum. These fine alluvial deposits become thinner inland, away from the river, and gradually merge into the marine clays.

The sand of the St. Lazare Plateau was probably deposited during the early stages of the sea recession. The deep porous sand deposits must have been supporting very scarce vegetation for some time, so that they were wind blown to take the dune topography which they now have.

A sheet of sand varying in thickness from 6 to 30 inches has been deposited over the clay south of the St. Lazare Plateau. This thin sandy deposit was probably washed from the Plateau onto the clay plain by stream or wave action. Seepage of water from the sandy plateau and lack of drainage, either vertical,

due to the impermeable clay substratum, or lateral, due to the flatness of the land and lack of deep stream channels, maintained the water-table at a permanent high level in the sand. Below the eastern slope of the Plateau, the permanent high water-table has favoured the development of deep organic deposits over sand or clay.

In many cases the clay immediately above the steep embankments is covered with sand which may vary from 1 to 5 feet in depth and has a gently undulating topography.

The different surface deposits found in the surveyed area are summarized in Table 2.

TABLE 2

SURFACE DEPOSITS IN SOULANGES AND VAUDREUIL COUNTIES

Deposits	Composition	Topography	Stoniness	Underlying Material
Glacial till	loams and sandy loams	undulating to rolling and hilly	many stones	bedrock
Fluvio-glacial outwash	gravelly and sandy loams	undulating to rolling	few stones but many cobbles	bedrock
Marine and lacustrine deposits	clays and silty clays	flat to gently undulating	stone-free or few erratic boulders	till
Alluvial deposits	silt loams, fine sandy loams and sands	gently undulating to flat	stone-free or some erratic boulders	clay (generally)

Climate

The climate has an important bearing on the growth of plants and is often a controlling factor in the varieties of crops which can be grown satisfactorily and of the yields which are obtained. But the climate is also a major factor governing the development of the soils.

In the surveyed area, the climate may be classed as humid temperate. It is probably as favourable for the production of general farm crops as in any other district in the province and more favourable than in most districts. The soils tend to become acid and more or less leached under the climatic conditions prevailing throughout the area.

Records of climatic conditions over a 15-year period (1923-37) are shown in Tables 3 and 4. The data in these tables have been compiled from records at two stations, namely: Cedars, which is situated near the St. Lawrence River between Lake St. Francis and Lake St. Louis, and Macdonald College, which is located just outside the area on the Ottawa River, between Lake St. Louis and Lake of the Two Mountains.

The mean annual temperature at both stations over the given period is 42°F. (This is about 2° higher than in the Eastern Townships of Quebec.) The mean monthly temperatures are almost identical at both stations. The winters are very cold with a mean temperature of about 16°F. and the summers are hot with a mean temperature of 66°F. The mean temperature for the growing season is 62°F. The extreme temperatures vary from −35°F. in January to 96°F. in July, and in the month of December an extreme range from 62°F. to −31°F. has been recorded.

The length of the frost-free period varies from 125 to 175 days with an average of 151 days at Cedars and 155 days at Macdonald College. The last spring frosts usually occur during the first week of May and the first fall frosts

in the first week of October. However, during the given period spring frosts have been recorded as late as May 24 and fall frosts as early as September 20. (See Table 4.)

The average annual precipitation at Cedars is 36·3 inches and at Macdonald College 38·9 inches, while the mean precipitation during the growing season is 15·4 and 16·1 inches respectively. Precipitation is fairly well distributed throughout the year. The lowest monthly average during the growing season, in the 15-year period, is 2·8 inches and the highest monthly average is 3·5 inches. However, in individual months and years the precipitation varies greatly from the average figures. The highest precipitation recorded in a single month during the growing season, in the 15-year period, is 7·78 inches and the lowest figure recorded is 0·88 inches. These figures are indicative of excessively wet conditions during growing seasons in individual years which may cause considerable damage to the crops on some soils of the area. Drought periods also occur occasionally causing damage to crops on some soils but on a number of poorly drained soils the crops thrive best in a relatively dry year.

A considerable amount of the 36 to 39 inches of precipitation which falls in the area is transpired by plants or is lost by evaporation, while the remainder, or surplus water, percolates through the soil or runs off the surface. According to calculations made by Marie Sanderson (3) for some of the meteorological stations in Western Quebec, it may be estimated that there are about 15 inches of surplus water in this area which percolates through the soil or runs off the surface. This surplus water, especially the water which percolates through the soil, has a great influence on the development of the soil.

TABLE 3

TEMPERATURE AND PRECIPITATION AT CEDARS AND MACDONALD COLLEGE STATIONS
(15 years average, 1923-1937)

Months	Temperature F°						Precipitation (inches)					
	Cedars			Macdonald College			Cedars			Macdonald College		
	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest
December	19.7	62	−31	19.0	57	−31	2.61	4.0	1.0	2.91	4.1	1.2
January	14.9	53	−31	14.4	51	−35	3.52	4.8	2.1	3.88	5.1	2.0
February	13.9	48	−27	14.0	46	−28	2.69	4.0	1.2	2.71	3.9	1.4
Winter	16.2			15.8			8.82			9.50		
March	25.8	57	− 8	25.9	55	− 8	2.97	4.5	0.8	3.27	4.4	1.3
April	40.1	80	8	40.4	81	1	2.85	4.2	1.0	3.40	5.6	1.4
May	53.1	87	25	54.0	87	27	2.81	4.7	1.1	2.81	4.8	1.0
Spring	39.7			40.1			8.63			9.48		
June	63.7	91	33	63.9	94	38	3.20	5.7	1.2	3.47	6.0	0.9
July	68.4	96	42	68.4	92	47	3.31	6.6	1.7	3.36	5.5	1.7
August	67.0	92	42	66.5	90	40	2.89	4.5	1.2	2.95	5.4	0.9
Summer	66.4			66.3			9.40			9.78		
September	58.8	89	27	58.9	89	31	3.22	7.8	1.0	3.51	7.6	1.2
October	46.7	81	17	46.5	80	18	2.93	5.8	0.3	3.03	5.6	0.8
November	34.4	72	− 4	34.2	72	− 8	3.27	9.0	1.8	3.62	9.8	2.3
Fall	46.6			46.5			9.42			10.16		
Annual	42.2			42.2			36.27			38.92		
May 1 to October 1	62.2			62.3			15.43			16.10		

Compiled from Meteorological Monthly Records, Dept. Transport.

TABLE 4

LENGTH OF FROST-FREE GROWING SEASON
(15-year average, 1923-37)

Stations	Latest frost recorded	Earliest frost recorded	Average dates		Number of days frost-free		
			Last frost	First frost	Average	Longest	Shortest
Cedars	May 23	Sept. 25	May 8	Oct. 6	151	175	125
Macdonald College	May 24	Sept. 20	May 5	Oct. 7	155	174	130

Compiled from Monthly Meteorological Records, Dept. Transport, Canada.

Vegetation

The natural vegetation of an area usually has an important bearing on the development of the soils. The type of vegetation which is found in any area depends on climatic conditions, the nature and properties of the soil, its drainage, topography, etc.

Before Vaudreuil and Soulanges counties were settled the entire area was covered with deciduous and coniferous trees. Although it is difficult to state with accuracy what type of trees prevailed before settlement, at the present time deciduous trees are generally dominant, while conifers predominate on certain soils. On the well drained till soils of the western section and on Rigaud Mountain hard maple and beech are dominant, while cedars are common in the poorly drained depressions. In the southern and central section on the smooth plain the wood-lots consist mainly of soft maple, elm and ash, with some red oak and basswood on the silty and clay soils and with some swamp oak and white birch on somewhat poorer drained sandy loams. The tree cover on the clay plain along the Ottawa River is made up chiefly of soft maple and elm with some pine, fir, and yellow and white birch. Pines thrive on the deep dry sands of the St. Lazare plateau, while mixed woods consisting of soft maple, pine, hemlock, white birch and poplar are common on the moist sandy soils. The stony till soils on Perrot Island have a tree cover consisting of a large variety of hardwoods, namely, hard maple, beech, yellow birch, oak, hickory, butternut and ironwood. The shallow soils over bedrock on the same island are mostly covered with red and white pine, maple, beech and birch.

Population

The population of the two counties in 1941 totalled 22,742 people of which 13,425 resided in Vaudreuil county and the remaining 9,317 in Soulanges county. The density of the population is close to 66 per square mile which is approximately the same as the density on the St. Lawrence plain in general.

TABLE 5

POPULATION IN SOULANGES AND VAUDREUIL COUNTIES*

Year	1861	1881	1911	1921	1931	1941
Soulanges	12,221	10,220	9,400	10,065	9,099	9,317
Vaudreuil	12,282	11,485	11,039	11,555	12,015	13,425
Total	24,503	21,705	20,439	21,620	21,114	22,742

*Canada Census and Statistical Year Book (Quebec) 1941.

Table V shows that the population in Soulanges county has decreased since 1861 by about 3,000 people, while in Vaudreuil county the population has been somewhat more stable and in 1941, it was about 1,000 greater than in 1861.

About 46 per cent of the total population in Soulanges and 35 per cent of the population in Vaudreuil county lived on farms in 1931. During the same year 94·4 per cent of the population in Soulanges and 86·6 per cent in Vaudreuil were of French origin. The rural population is almost exclusively French with the exceptions of the districts around Dalhousie, Como and Hudson where English speaking farmers are fairly numerous.

History and Development of Agriculture

The Vaudreuil-Soulanges area is one of the oldest settled districts in the province. After the signing of the peace treaty between the French and the Iroquois in 1700, which removed the threat of Indian aggression, the shores of the St. Lawrence and Ottawa Rivers were gradually cleared and settled. The area was first divided into two seigniories granted to Pierre Joybert de Soulanges and Philippe Rigaud de Vaudreuil to which the seigniories of Rigaud and Nouvelle Longeuil were added later on. Until 1763 land clearing progressed very slowly but at that time "Seigneurs" Lemoyne de Longeuil and Chartier de Lotbiniere favoured agricultural development and made a serious effort to find more settlers.

English speaking settlers were in the minority. However, settlers of Scottish, English and Irish origin were numerous around St. Polycarpe, St. Redempteur, Ste. Marthe, Ste. Justine, Hudson and Point Fortune.

The main occupation of the early settlers consisted of clearing and seeding new land. The families produced almost everything for their own need and wheat, peas and corn were the main crops. With the improvement of transportation facilities and with the appearance of the steam boat, trade with Montreal and later with England and the United States grew rapidly, and this favoured the production of crops for trade.

TABLE 6

PRODUCTION OF THE MAIN CROPS FROM 1861 TO 1931 IN SOULANGES AND VAUDREUIL COUNTIES*

Years	Oats	Hay	Peas	Wheat	Barley
	bus.	tons	bus.	bus.	bus.
1861	513,583	10,350	151,006	154,090	116,402
1881	656,452	20,535	438,649	63,011	112,828
1911	930,480	93,770	4,365	18,072	85,765
1921	800,540	54,488	6,411	47,757	86,134
1931	802,024	61,276	1,661	18,647	67,522

*Canada Census.

Around 1861 the population in the area reached a maximum of 24,503. At the same time, as seen in Table VI, wheat and barley production were the highest in history. In more recent years wheat has become only a minor crop and barley production has been greatly decreased. In the early years peas were an important crop and in 1881 almost half a million bushels were produced, while in the later years only a few acres were devoted to the production of peas. The decrease in grain production was accompanied by an increase in the acreage

of hay and in 1931 and 1941 (Table 7) almost 50 per cent of the total crop land was in hay. Oats have been the most important grain crop at all times and in 1900 production exceeded 1,000,000 bushels.

The commercial production of fibre flax was introduced in 1927 and in recent years it has become the most important cash crop in Soulanges and Vaudreuil counties. In 1942, 10,981 acres of flax were harvested, yielding 500 tons of fibre, about 2,000 tons of tow and over 3 million pounds of seed. These products were handled by "la Societe Cooperative Agricole des Producteurs de lin de Vaudreuil et Soulanges", and brought a return of $884,569.(a)

TABLE 7

ACREAGES OF MAIN CROPS IN SOULANGES AND VAUDREUIL COUNTIES*

—	Total	Oats	** Fibre Flax	Barley	Buckwheat	Mixed Grain	Hay	Fodder Corn	Potatoes	Roots	Peas
Soulanges—											
1931	53,992	17,148	.....	1,888	2,941	862	28,337	706	626	54	76
1941	64,161	17,237	9,430	2,431	2,352	1,967	30,038	535	807	145	286
Vaudreuil—											
1931	66,756	22,647	.....	1,667	1,693	1,514	34,413	1,569	1,021	39	99
1941	57,309	17,900	6,700	1,926	1,094	2,795	25,802	1,445	862	98	267

*Canada census 1931 and Quebec Year Book 1941.
**Final estimate as of June 1, 1941, Quebec Bureau of Statistics.
(a) Information kindly furnished by Mr. E. Lalonde of the Vaudreuil-Soulanges Flax Co-operative and by Mr. R. DeBlois, agronome.

Table 8 shows that about 91 and 93 per cent of the land in Soulanges and Vaudreuil counties, respectively, is occupied. A larger percentage of the occupied land has been improved in Soulanges (88 per cent) than in Vaudreuil county (76 per cent). Most of the unimproved land is in forest and the largest tracts of woodland are on Rigaud Mountain and in the vicinity of Ste. Justine.

The average size of the farms is considerably larger in Vaudreuil than in Soulanges county but the acreage of improved land per farm is only slightly larger.

TABLE 8

LAND UTILIZATION IN SOULANGES AND VAUDREUIL COUNTIES, 1931*

—	Total Area (acres)	Occupied Land		No. of farms	Size of farms (acres)	Improved		Unimproved	
		Total (acres)	Per Cent			Total (acres)	Per Farm (acres)	Total (acres)	Wooded (acres)
Soulanges	86,037	78,828	91	866	91	69,383	80	9,445	7,386
Vaudreuil	125,940	117,430	93	970	121	89,583	92	27,847	29,712

*Quebec Statistical Year Book 1934.

The income from dairy products is an important factor in the farm economy of the two counties. The animal population has remained rather stable from 1861 to 1931 but during the last decade there has been a marked increase in the number of cows, hogs and poultry. A considerable percentage of the milk produced in the area, especially in Vaudreuil county, along the Ottawa River, is shipped directly to Montreal.

TABLE 9

BUTTER AND CHEESE PRODUCTION IN 1933 AND 1940*

—	Butter factories	Cheese factories	Number of patrons	Number of cows	Number cows per patron	Tons butter	Tons cheese	Total Value $
Soulanges—								
1933	6	2	842	5,529	6.6	314	91	161,163
1940	6	1	761	6,484	8.5	421	129	242,933
Vaudreuil—								
1933	3	5	418	3,059	7.3	146	151	87,555
1940	5	5	806	7,025	8.7	347	225	234,568

*Quebec Statistical Year Book 1934 and 1941.

The amount of dairy products manufactured in the counties has been increased by about 50 per cent from 1933 to 1940 as shown in Table IX. This is especially so in Vaudreuil county where this increase in production together with better prices have almost tripled the revenue received from dairy products.

Maple products, honey, eggs, vegetables and small fruits furnish an added income for many farmers.

Markets and Transportation Facilities

The Vaudreuil-Soulanges area is located near Montreal, which is the largest market for agricultural produce in Canada. However, the variety of products that the farmers of the surveyed area can sell on the Montreal market is restricted because of the limited number of crops to which the soils are adapted.

A considerable number of people from Montreal reside in the surveyed area and an additional large number come to their summer homes and to resorts especially in the vicinity of Hudson, Como, Vaudreuil, Dorion and Coteau Landing. These residents provide an excellent local market for such produce as milk, cream, butter, eggs, vegetables, small fruits and poultry.

Railways, highways and secondary roads offer first class transportation. The main lines of the Canadian National and Canadian Pacific railways from Montreal to Toronto and to Ottawa pass through the area. A railway from Coteau to Valleyfield gives an outlet to the south shore of the St. Lawrence River. Besides the main through traffic, many local trains provide travelling and shipping facilities within the area and to the City of Montreal.

The two main highways from Montreal to Ottawa and from Montreal to Toronto pass through the northern and southern sections of the area. These two main arteries of transportation are linked with a good network of secondary gravelled and paved roads. In view of the short distance to the Montreal market and the presence of a good road system, most of the produce is shipped by trucks. Such facilities, however, did not exist before the construction of the highway bridges between Vaudreuil and Ile Perrot and between Ile Perrot and the Island of Montreal (in 1922). Water transportation has ceased to be of any importance in the handling of agricultural goods and implements for some time.

CLASSIFICATION AND MORPHOLOGY OF SOILS

Soil Survey Methods

The method used for the mapping of soils, was to drive along every road of the district, making frequent stops to examine the soil. In order to trace soil boundaries, traverses at right angle were made by driving along farm lanes or by walking through fields. The soil profiles exposed by road cuts, gravel and sand

pits or any kind of excavation were also carefully examined. Notes were taken of the characteristics of the soil profile, external and internal drainage, topography, vegetation, stoniness and fertility.

The soil boundaries were plotted on maps of the National Topographic Series (Department of National Defence, Ottawa). These maps have a scale of 1 inch to 1 mile and show contour lines for every 25 feet of change in elevation. The elevation contours are reproduced on the soil map so that they may be used to estimate the relief of the land. All the soil boundaries shown on the map have not the same significance. Sometimes a soil boundary may represent a sharp and distinct break in soil features but more often, it represents transitional conditions such as a gradual change from a fine sandy loam to a silt loam or from a clay loam to a silty clay loam, etc.

Examination of the soil in the field has been supplemented by physical and chemical analyses. Representative composite surface samples of the cultivated soil, as well as samples representing the different soil profile horizons, were collected for laboratory study.

Soil Formation

The glacial, marine and alluvial deposits previously described, form the parent materials from which the present soils have developed. As left after glacier or sea recession, the surface of these deposits was not differentiated, as it is now, from the rest of the underlying mass, into a sequence of layers or horizons varying in colour, texture, structure and chemical composition. This differentiation is the result of the combined influence of climate, vegetation, micro-organisms and drainage on the parent materials.

The climatic conditions and the original tree cover in the area have favoured a natural tendency for acid conditions to develop and for the easily soluble elements to be leached out of the soil. The extent to which the soils in this area have been impoverished by the leaching processes depends largely on the drainage conditions and on the kinds of parent materials present.

The different layers which have developed in the soil during its process of formation can be observed in a vertical cross-section of the soil to a depth of about 3 feet. This cross-section including part of the underlying parent material is generally referred to as the soil profile and the individual layers are called the horizons of the profile. In the area under discussion the kinds of horizons found in the soil profile and the sequence in which they occur vary greatly among the different soils.

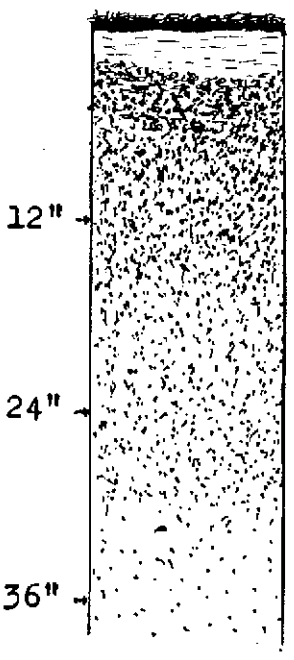
Great Soil Groups

At least 9 different kinds of soil profiles occur in Soulanges and Vaudreuil counties and each of these profiles represents, what is called, a Great Group of Soils some of which have a wide distribution in Eastern Canada and North America. Four of these soil groups have been developed under well drained conditions, while the remainder have formed under poor drainage. The four groups of well drained soils which occur in this area are known in Canada as: Podzol soils, Brown Podzolic soils, Grey Brown Podzolic soils and Brown Forest soils.

The soils of the first two groups have developed in the area under discussion from parent materials which do not contain limestone (free calcium and magnesium carbonate). The soils of both groups are generally strongly acid and they commonly require lime for satisfactory production of crops, especially legumes. Under natural conditions, the Podzol soils have a grey leached layer immediately

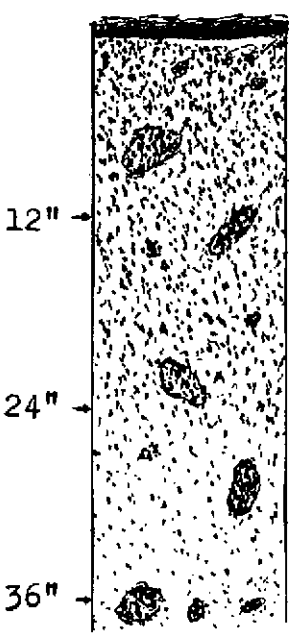
below the leaf mat or thin dark surface layer, which in turn, is underlain by a yellowish brown or reddish brown subsoil. A large proportion of the important bases (plant nutrients), as well as humus, iron and aluminum have been leached out of the grey layer and the latter three have accumulated in the underlying reddish brown subsoil. The Brown Podzolic soils lack the grey leached layer or have only a very thin trace of it in isolated pockets. The thin dark surface layer is underlain by a brown, yellowish brown or reddish brown loose and friable subsoil which gradually fades in colour and becomes firmer with depth. The Podzol soils are generally considered the poorer of the two in fertility. In the surveyed area they are found on sandy outwash materials or on till derived from non-calcareous sandstone, while the Brown Podzolic soils are found on till derived mainly from non-calcareous shale or from hard, igneous rock material. Hypothetical profiles of the Podzol and Brown Podzolic soils, as they occur in this area, are illustrated on Fig. 1 and 2 respectively.

The Grey Brown Podzolic soils and the Brown Forest soils in Vaudreuil and Soulanges counties have developed on calcareous (contain ground-up limestone fragments) parent materials. These soils are generally only slightly acid and may be slightly alkaline. They do not require lime for crop production. The Brown Forest soils under natural forested conditions have a friable, granular, dark surface layer up to 4 or 5 inches thick, which is underlain by a brown subsoil which crumbles into nuciform (nut-like) aggregates. The subsoil fades in colour and becomes more firm with depth. The Grey Brown Podzolic soils differ from the above in that they have at depths of 15 to 25 inches a brown horizon which is heavier and darker than the horizons above or below it. The Grey Brown Podzolic and Brown Forest soils are diagramatically illustrated and described in Fig. 3 and 4 respectively.



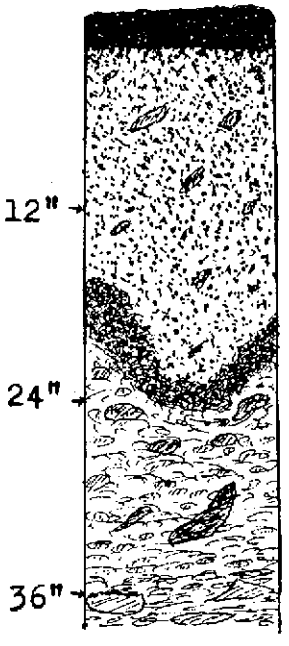
Aoo Leaf litter.
Ao Very dark brown semi-decomposed organic matter.
A2 Light grey leached layer.
B1 Reddish brown layer enriched with humus, iron and aluminum.
B2 Yellowish brown layer.
C Light brownish grey parent material.

FIG. 1—Podsol



Aoo Leaf litter.
Ao Very dark brown to black organic matter.
— A trace of leached A2 may be present occasionally.
B1 Brown to reddish brown layer.
B2 Yellowish brown layer.
C Light brownish grey parent material.

FIG. 2—Brown Podzolic



A1 Very dark brown to dark greyish brown mineralized humus layer.
A2 Greyish brown layer.
B2 Dark brown layer.
C Light greyish brown calcareous parent material.

FIG. 3—Grey Brown Podzolic

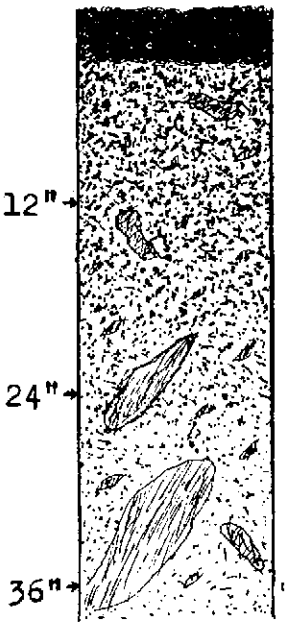


FIG. 4—Brown Forest

The largest proportion of the soils in the surveyed area have developed under poorly drained conditions. Although at present the drainage of many of these soils has been artificially improved, the effects of the original poor drainage are still unmistakably visible in the soil profile. One of the distinguishing features of these soils is the discoloration or mottling of the subsoil. Yellowish brown or rusty specks and streaks and bluish grey colours are usually found in such soils, whereas, the well-drained soils have more uniformly brownish or yellowish coloured subsoils. The poorly drained soils in Vaudreuil and Soulanges counties are representative of the following widely distributed great soil groups: Ground-water Podzols, Dark Grey Gleisolic soils (indicated on the map as Grey Hydromorphic soils), Half Bog soils, Bog soils and Alluvial (Azonal or young) soils.

The Ground-water Podzol soils under natural conditions have a light grey leached layer, which is generally mottled with rusty specks and streaks, under a mat of raw organic matter 4 to 10 inches thick. The underlying subsoil is reddish brown, generally strongly mottled and occasionally cemented into a hardpan. In the surveyed area these soils are generally found on flat or undulating sandy materials which are underlain by clay. They generally are very acid and low in fertility in addition to being poorly drained.

The Dark Grey Gleisolic soils have a dark, friable and granular surface layer, generally 4 or 5 inches thick, which is underlain by a mottled brownish grey subsoil that gradually grades into the parent material. These soils generally do not have a marked leached layer or a layer of accumulation. In the surveyed area they are generally found on the heavier types (clay, clay loam, silt loam), of parent materials. When properly drained the Dark Grey Gleisolic soils rate among the most fertile soils of the area.

The Half Bog soils have a dark brown to black surface soil, 4 to 12 inches thick, which is very rich in organic matter. The subsoil is bluish grey in colour and generally mottled with rusty specks and streaks. These soils have developed under very poorly drained conditions and unless artificial drainage has been provided they are too wet for cultivation.

The Bog soils consist of organic accumulations 1 to 5 feet and more in thickness. They may differ considerably depending on the type of vegetation from which the organic accumulation has been formed and on the degree of decomposition of the organic materials. The well-decomposed dark Bog soils are generally called "Muck" and the raw or poorly decomposed organic material is called "Peat". The Bog soils have formed under very poorly drained conditions and they frequently occupy old lake beds or are found in places which receive considerable seepage.

The Alluvial soils consist of recently deposited material which has not been in place long enough for definite soil horizons to develop. However, layers, differing in texture as a result of periodic flooding, can frequently be observed in the profiles of these young Alluvial soils.

Series, Types and Phases

The soils of each of the different great groups, discussed above, may vary considerably in their physical and chemical characteristics and in their productivity. As a result it is generally necessary to separate the soils of a great group into smaller and more specific units. The "Soil Series" is the unit used in the classification of the soils in the surveyed area. All the soils of a series have formed from similar parent materials. They have the same number and the same arrangement of horizons in the profile and have about the same colour, structure and drainage conditions. The texture in the lower part of the profile does not differ to any appreciable extent in a soil series but somewhat greater differences in texture may occur in the surface soil. The soil series is generally named after the place where it was first mapped or where it occurs extensively, i.e. Dalhousie, Vaudreuil, etc.

The range in texture permitted in the surface soil of a series, is limited, although two or three adjacent textural classes may occur in some soil series. The main textural classes which occur in the area are: sand, loamy sand, sandy loam, loam, silt loam, silty clay loam, clay loam and clay. On the basis of these textural differences the soil series may be subdivided into "Soil Types". The soil type is designated by the series name plus the textural class, i.e. Dalhousie clay loam, Dalhousie silty clay loam, etc.

A soil type in some cases may contain significant differences in external characteristics, such as stoniness, relief, extent of erosion, etc. These differences have been mapped as phases of the individual soil types. The phase differences may be of great importance in land use but generally they do not significantly affect the characteristics of the soil profile.

The soils of Soulanges and Vaudreuil counties have been classified and grouped on the bases of the different soil parent material and on their drainage conditions in the key below. The approximate acreage and distribution of the various soil types in the two counties is given in Table X.

Key to the Soils of Vaudreuil and Soulanges Counties

	Map Symbols
I. Soils Developed on Till	
Derived from limestone and sandstone	
Well drained (B.F. to G.B.P.)	
St. Bernard fine sandy loam	Bn
St. Bernard loam	Bnl
Derived mainly from quartzite and gneiss	
Well drained (B.P.)	
Rigaud stony gravelly loam	Rg

Derived mainly from Potsdam Sandstone

Well drained (P)

Perrot stony sandy loam	P
Perrot stony gravelly sandy loam	Pg
Perrot shallow sandy loam	P-a

Derived from underlying shale

Well drained (B.P.)

Leitrim shaly loam	L

II. Soils Developed on Water Deposited and Sorted Materials

A. Light Textured Soils on Outwash and Alluvial Deposits

From strongly reworked acid till and outwash

Well drained (P)

Ste. Justine sandy loam	J

From calcareous fluvio-glacial and terrace gravels

Well drained (G.B.P.)

Ste. Philomene gravelly loam	Ph

From deep sands reworked by wind

Excessively drained (P)

Upland sand	U
Upland sand, gravelly phase	Ug
Blow sand	e

From sandy alluvial deposits over clay (30″ or deeper)

Well drained (P)

Ste. Sophie loamy fine sand	Sp
Ste. Sophie sandy loam	Spl

Variable drainage, generally imperfect (G.W.P.)

St. Amable loamy sand	Am

From shallow sandy alluvial deposits over clay (30″ and less)

Imperfectly drained (G.W.P.)

St. Damase sandy loam	Dm

Poorly drained (H.B.)

Vaudreuil loamy fine sand	V

From fine sandy to silty loam alluvial deposits over clay

Well drained (P)

Coteau fine sandy loam	C

Imperfectly drained (G.W.P.)

Soulanges very fine sandy loam	S
Soulanges silt loam	Sl
Soulanges sandy loam, shallow phase (over clay)	S-a

Poorly drained (H.B.)

St. Zotique sandy loam	Z
St. Zotique sandy loam, shallow phase (over clay)	Z-a

B. Medium and Heavy Textured Soils on Alluvial, Lacustrine and Marine Deposits

From silt loam to clay loam alluvial and lacustrine deposits over clay

Imperfectly drained (G.H.)

Baudette clay loam	Bl
Baudette silt loam	B
Baudette sandy clay loam	Bs

From grey marine clay

Imperfectly to fairly well drained (G.H.)

Rideau clay	R
Rideau clay, sand spot phase	R-s

Imperfectly to poorly drained (G.H.)

Ste. Rosalie clay	Ro
Ste. Rosalie clay loam	Rol

From reddish brown and grey marine clay

Imperfectly drained (G.H.)

Bearbrook clay	B b

From grey marine clay with a thin (4" to 10") veneer of sandy loam on surface

Imperfectly drained (G.H.)

Courval sandy loam	Cv

From marine clay with some admixture from adjacent till ridges

Imperfectly drained (G.H.)

Dalhousie silty clay loam	D

From recent alluvial deposits

Imperfectly to poorly drained (A)

Undifferentiated alluvium	A

III. Organic Soils

Well decomposed, dark surface soil (B)

Muck	M

Poorly decomposed, brown surface soil (B)

Peat	T

IV. Miscellaneous Land Types

Swampy Land	*
Rough Stony Land	R S

Great Soils Group

A = Azonal Soils	P = Podzol Soils	B.F. = Brown Forest Soils
B = Bog Soils	B.P. = Brown Podzolic Soils	G.W.P. = Groundwater Podzol Soils
H.B. = Half Bog Soils	G.B.P. = Grey Brown Podzolic Soils	G.H. = Hydromorphic Soils (Dark Grey Gleisolic)

TABLE 10

ACREAGE AND DISTRIBUTION OF SOIL TYPES IN SOULANGES AND VAUDREUIL COUNTIES

Soils Types	Vaudreuil		Soulanges		Total	
	Acres	%	Acres	%	Acres	%
Alluvial soils, undifferentiated	858	0.8	128	0.1	986	0.5
Baudette silt loam	768	0.6	5,094	5.2	5,862	2.9
Baudette sandy clay loam	832	0.7	.....	.....	832	0.4
Baudette clay loam	425	0.4	2,976	3.5	3,391	1.6
Bearbrook clay	14,170	11.4	.....	.....	14,170	6.8
Coteau fine sandy loam	.....	.....	1,037	1.3	1,037	0.5
Courval sandy loam	1,075	0.9	3,418	4.0	4,493	2.4
Dalhousie silty clay loam	1,708	1.5	3,520	4.2	5,228	2.7
Lietrim shaly loam	51	0.1	.....	.....	51	0.0
Muck	660	0.6	583	0.7	1,243	0.6
Swamp	231	0.2	423	0.5	654	0.3
Peat	231	0.2	.....	.....	231	0.1
Perrot stony sandy loam	3,081	2.5	.....	.....	3,081	1.5
Perrot shallow sandy loam	1,061	0.9	52	0.1	1,113	0.6
Perrot gravelly sandy loam	1,280	1.0	.....	.....	1,280	0.6
Rideau clay	14,042	11.3	448	0.5	14,490	7.0
Rideau clay, eroded (steep banks)	2,976	2.5	1,350	1.6	4,326	2.1
Rideau clay, sand spot phase	2,368	1.9	.....	.....	2,368	1.2
Rigaud gravelly sandy loam	9,240	7.4	.....	.....	9,240	4.4
Rough stony land	2,771	2.3	.....	.....	2,771	1.3
St. Amable loamy sand	4,280	3.5	2,515	3.0	6,795	3.2
St. Bernard fine sandy loam	2,380	2.0	2,304	2.8	4,684	2.2
St. Bernard loam	870	0.8	531	0.6	1,401	0.7
St. Bernard-Dalhousie (Complex)	216	0.2	749	0.9	965	0.5
St. Damase sandy loam	2,591	0.5	640	0.7	1,231	0.6
St. Damase-Ste. Rosalie (Complex)	.....	.....	1,920	2.3	1,920	0.9
Ste. Justine light sandy loam	2,956	2.4	.....	.....	2,956	1.4
Ste. Philomene gravelly loam	1,596	1.4	218	0.3	1,814	0.9
Ste. Rosalie clay	27,972	22.8	27,674	32.6	55,636	26.6
Ste. Rosalie clay loam	691	0.6	2,112	2.5	2,803	1.3
Ste. Rosalie-Courval (Complex)	.....	.....	1,453	1.7	1,453	0.7
Ste. Sophie loamy fine sand	6,248	5.1	.....	.....	6,248	2.9
Ste. Sophie sandy loam	312	0.3	.....	.....	312	0.2
St. Zotique fine sandy loam	.....	.....	1,901	2.2	1,901	0.9
St. Zotique shallow sandy loam	.....	.....	4,493	5.4	4,493	2.2
Soulanges fine sandy loam	250	0.2	11,546	13.4	11,796	5.5
Soulanges silt loam	.....	.....	4,243	4.9	4,243	2.0
Soulanges shallow sandy loam	.....	.....	1,114	1.3	1,114	0.5
Upland sand	12,426	10.0	1,670	2.1	13,996	6.6
Upland sand, gravelly subsoil phase	.....	.....	416	0.5	416	0.2
Vaudreuil sand	3,853	3.2	1,344	1.2	5,197	2.5
Total	122,459	100.0	85,877	100.0	208,836	100.0

SOILS DESCRIPTIONS

Soils Developed on Till

ST. BERNARD (GRENVILLE) SERIES

The soils of the St. Bernard series occur at the western limit of the two counties. In Quebec these soils are confined to some low ridges extending eastward from the Ontario border to a maximum width of three miles and covering 7,050 acres or 3·4 per cent of the total area. In Ontario these soils are apparently more extensive. The elevation of the land varies from 200 to 275 feet above sea level. The St. Bernard soils occur on gently rolling to undulating ridges in close association with the Dalhousie soils found on the smooth areas between the ridges. Slopes are seldom steep enough to interfere with the use of heavy machinery.

The St. Bernard soils are developed on a till which has been derived mostly from limestone and calciferous sandstone, however the influence of the limestone is far from being uniform and the depth at which free carbonates are

reached is variable. The open nature of the upper part of the soil and the rolling topography provide good drainage. Danger of harmful erosion is slight on these soils, so long as the steepest slopes remain covered with trees or grass. The tree cover on the virgin soils is made up largely of sugar maple with some beech, ash and elm.

The stony nature of the St. Bernard soils is the main handicap to their full utilization. The original amount of stones on the soil varied considerably and the less stony fields have been freed from stones to make them suitable for any kind of crops. Few fields are still covered with big boulders the removal of which would require much work. These fields, however, make excellent permanent pastures. The stones gathered along the fields to make fences include (Chazy) limestone, calciferous sandstone, sandstone, magnesian limestone and some gneiss and quartzite. Some boulders are rounded but most stones are of angular shape.

The soil types mapped in the St. Bernard series are the sandy loam and the loam. Over most of the till ridges, the soil is of a sandy loam texture and free carbonates are detected in the profile at an average depth of 30 inches. The loams are found where the till is derived largely from limestone rather than from calciferous sandstone. In the loams, the free carbonates are often found at a depth of about 18 inches.

Some small gravelly beaches, a few hundred yards wide and also of very limited length, have been found over some till ridges, but due to the small scale of mapping they have not been shown on the soil map. An example of such gravelly deposit among St. Bernard soils is found at the village of St. Telesphore.

Except for the differences in texture and depth to free carbonates, the sandy loam and the loam types have the same profile characteristics. A description of a virgin St. Bernard sandy loam, indicating the observed variations in the depth of each horizon, is given below.

Horizon	*Variation in depth*	*Description*
A1	2"- 4"	Dark brown sandy loam, friable, granular structure, pH 5·2.
B1	10"-18"	Brown sandy loam, friable, very soft, fine granular structure, pH 5.0.
B2	12"-16"	Dark yellowish brown sandy loam, with some gravelly fragments, soft, fine granular structure, pH 6.7.
C		Greyish brown to yellowish grey sandy loam till, which usually effervesces with acid. The till extends probably to a depth of 25 feet or more over the bedrock. pH at 36 inches 7.8.

There are boulders and stone fragments all through the profile. Freshly exposed surfaces of many of the stones effervesce with dilute acid. The gravel content in the profile is variable and is generally greater on top of the ridges.

Agriculture

The St. Bernard soils are well suited to dairy farming and they are more extensively used for this purpose than any other soil in the district. Due to good drainage conditions the soil warms up early in the spring and produces early grass. Good water for animals is easily supplied during the pasturing season by numerous streams or by abundant well-water. Clovers, alfalfa and silage corn, which provide roughage for milk cows, produce good yields on this soil.

The value of the St. Bernard soils for dairy farming is increased by the fact that they occur in close association with the heavy soils of the Dalhousie series. Many farmers have an almost equal proportion of the two kinds of soils. This enables the farmer to choose one soil or the other depending on its adaptability to a particular crop. For example, St. Bernard soils are preferred for altalfa, corn, potatoes and gardening, while grain, flax, timothy and clovers thrive better on Dalhousie soils. Two types of rotation are usually followed on the farms where both soils occur in sufficiently large tracts.

Fig. 5—Profile of St. Bernard fine sandy loam developed on calcareous till.

The association of the St. Bernard and Dalhousie soils is sometimes so intricate that they have been mapped as a complex over an area covering 965 acres. In the complex the St. Bernard soils are dominant and for that reason, these areas are shown on the map by the same colour as the St. Bernard series. The presence of Dalhousie soils in the complex is indicated by symbols (Bn-D).

On the St. Bernard soils, timothy and clover hay average $1\frac{1}{4}$ to $1\frac{3}{4}$ tons to the acre and alfalfa yields up to $3\frac{3}{4}$ tons in two or three cuttings. Corn produces 15 to 20 tons of silage, barley and oats average 30 to 40 bushels to the acre. (These yields and the ones given for each soil unit are based upon information gathered from some of the good farmers of the district.) Potatoes yield from 160 to 250 bushels and are usually free from scab. Manure is essential to maintain the fertility and to increase the humus content and the moisture-holding capacity of the surface soil. Good management practices should include the control of sheet erosion which may be severe on the steep cultivated slopes.

Fig. 6—St. Bernard soils on gently rolling topography are used for dairying. Note stone fences.

Rigaud Series

The Rigaud soils cover the top and the sides of Rigaud Mountain over an area of 10,520 acres or 5 per cent of the whole territory. The topography varies from rolling to hilly. These soils occupy the highest land in the area, the range of elevation being from 250 to 700 feet above sea level.

Rigaud soils have developed on a grey, stony, gravelly, sandy loam till which has been derived from hard rocks of gneiss and quartzite with an admixture of syenite. The drainage is good except in some small depressions, and at the foot of some long slopes. Sugar maples thrive on this stony soil and they form the dominant tree cover. A great variety of other trees is also found on the mountain, including yellow and white birch, ash, elm, hemlock and cedar.

On steep slopes the finer soil particles tend to wash off readily if the natural tree cover is removed. The result of such erosion is to leave an eroded surface made up almost exclusively of gravel and rounded stones of all sizes.

A profile description of the Rigaud stony gravelly sandy loam is given below.

Horizon	*Variation in depth*	*Description*
Ae	3"- 6"	Dark brown sandy loam, many rounded stones on the surface and in the upper horizon. pH 5.8.
A2	0"- 1"	Thin streaks of grey loamy sand, may occur interm ttently under virgin conditions.
B	16"-30"	Brown gravelly sandy loam with a soft fine granular structure between a skeleton of angular or semi-angular stones.
C		Brownish grey, firm, gravelly, stony till. The depth of the unweathered till over bedrock varies from few inches on the mountain top to many feet at the foot of the mountain. pH 6.5.

The Rigaud soil is moderately acid throughout the profile; the cultivated soil surface is about pH 5·8. There is often an accumulation of cobbles or rounded stones to a depth of 6 to 10 inches on the surface of the soil. These rounded stones and the gravel which accumulated at certain places on the mountain are apparently the materials of former beaches which formed by the wave action of the Champlain Sea. These gravelly beaches are of small extent and of shallow depth. In the central part of the mountain there are many bedrock exposures. These ledgy sections have been mapped as rough stony land. As mapped, the Rigaud soils include some small areas of wet land in some depressions and at the foot of some long slopes.

Agriculture

The Rigaud soils are generally too stony and too steep for cultivation and only some of the less stony and smoother areas have been cleared. Much of the cleared land is used as permanent pasture and only a small part is devoted to cultivated crops. Hay, grain, corn and potatoes apparently produce fair crops, but no definite yield data could be obtained for this soil. The less stony areas of deep soil are fairly well suited to orchards, as the fruit trees are of good size and appear to be healthy. Rigaud Mountain is the main source of hardwood for the farmers of the surroundings. Maple products are an important source of income for maple bush owners.

Perrot Series

The Perrot soils occupy 5,474 acres or 2·7 per cent of the whole area. They occur mostly on Perrot Island at 100 to 250 feet elevation. The topography is undulating to gently rolling. The surface soils is strewn with angular stones and big boulders of hard sandstone. Some boulders are also imbedded in the till which is derived mainly from sandstone but also from rocks of adjacent formations like limestone and calciferous sandstone.

The soil drainage is good and due to the porosity of the soil and the gentle slopes there is no danger of excessive erosion. Most of the land is covered with tree vegetation which is the most varied in the district. Sugar maple, beech, birch, hickory, butternut, basswood, ironwood and elm are seen where the till is deep, while very shallow soils over bedrock support a growth of white and red pine.

A description of the Perrot stony sandy loam is given below.

Horizon	*Variation in depth*	*Description*
Ao	0″- 2″	Semi-decomposed leaf mat.
A1	0″- 2″	Dark brown sandy loam, with some small stone fragments, soft granular structure. pH 4.9.
A2	¼″- 1″	Pinkish grey leached sandy loam.
B	22″-28″	Brown to yellowish brown sandy loam, slightly reddish in the upper part of the horizon, many stones of all sizes, mainly sandstone but also some limestone. Weak granular structure.
C		Brownish grey stony sandy loam till, fairly compact. The depth of the till over bedrock varies from 2 to probably 12 feet. pH 5.5.

The Perrot gravelly sandy loam which has been mapped south of St. Redempteur resembles the stony sandy loam but contains a considerably larger amount of gravel all through the profile.

Where the soil is shallow over sandstone bedrock it has been mapped as Perrot stony sandy loam, shallow phase. This soil is made up of a thin coat of dark brown sandy loam to a depth of 3 inches over a lighter brown sandy loam containing many stone fragments and varying in depth from a few inches to two feet. The flat bedrock is frequently exposed.

Agriculture

The Perrot soils are acid throughout their profile; the cultivated surface has a reaction ranging generally between pH 5·0 and pH 5·5. None of the shallow Perrot soil is used for cultivated crops, and nearly all of the deep types are still wooded. The cleared land is used for permanent pastures. The handicap to cultivation on Perrot soils is the excessively large number of stones or boulders on the soil surface. With power machinery which is now at the disposal of the farmer, some of this land could probably be improved but it is doubttul that such practice would be economical.

When left in forest, the deep Perrot soils produce a good stand of hardwoods, especially sugar maples. Fuel wood and maple products are the main returns from this land. The pastures produce a fair amount of grass but their management is considerably handicapped by the stoniness of the fields.

Leitrim Series

The Leitrim shaly gravelly loam occupies only 51 acres east of Pevril. It occurs on low ridges which are almost entirely under cultivation. Hard maples grow where the soil is not cleared. There are few boulders of gneiss and granite on the surface of the soil, however the soil is derived from the shaly material which is found a few feet below land surface. The soil is well drained; the solum is very permeable but retains a fair amount of moisture for plants.

A profile of the Leitrim soil may be described as follows:

Horizon	*Depth*	*Description*
Ac	0″- 5″	Very dark brown shaly gravelly loam, fine granular structure, friable.
B1	5″-20″	Dark brown loam with some shale fragments, weak granular structure, very friable.
B2	20″-28″	Brown shaly loam, fine granular to structureless, loose.
C	28″-	Yellowish grey fine sandy loam with many fragments of shale, loose.

Agriculture

The Leitrim soil is moderately acid in reaction. It is used for general farm crops and it is well adapted to hay crops and especially to clover and alfalfa, but corn, potatoes and garden crops also do well. Due to its good drainage the land warms up rapidly in the spring, but may suffer from lack of moisture during summer months. Liming may be found beneficial and complete chemical fertilizers should give rapid responses. Barnyard manure and green manure will improve the holding capacity of the soils for moisture and plant nutrients.

Light Textured Soils Developed on Water Deposited and Sorted Materials

Ste. Philomene (Kars) Series

The Ste. Philomene soils are developed on calcareous gravelly fluvio-glacial deposits and are found in long narrow ridges along the western shore of the lower reaches of Riviere Baudette in Soulanges county and along the Ottawa River below Point Fortune in Vaudreuil county.

The ridges have a gently rolling topography and occur at an elevation of 75 to 125 feet above sea level. The total area covered by the Ste. Philomene gravelly loam is 1,814 acres.

The soil is well drained to somewhat excessively drained due to free percolation and good run-off. The natural vegetation consist chiefly of hard maple with some pine on the sandier parts of the deposits.

A description of the Ste. Philomene gravelly loam profile is given below:

Horizon	*Variation*	*Description*
Ao	0"- 1"	Semi-decomposed leaf nat.
A1	1"- 3"	Dark greyish brown sandy to gravelly loam, friable, granular and single grained structure, pH 6.5-7.0.
A2	2"-30"	Yellowish brown, fading in colour with depth to pale yellowish brown or brownish grey sandy to gravelly loam, loose, single grained, contains some cobbles, pH 6.5-7.0.
B2	2"- 5"	Brown to dark brown gravelly loam to gravelly clay loam, somewhat firm, nuciform structure. This layer weaves up and down as a thin band; in extreme cases the crest of the waves may occur 4 inches below the surface and the trough may dip to a depth of 3 feet or more. pH 7.0-7.5.
C		Pale brownish grey sand and gravel irregularly stratified with many cobbles and some stones, the fragments are of mixed lithological origin but limestone fragments generally dominate; pH 7.5-8.3.

The cultivated soil is of a medium brown colour to plough depth and has a reaction of about pH 6·5. On bare fields a multitude of cobbles of an average size of 2 inches are seen covering the soil. The big stones are usually not very numerous on the surface and they can easily be removed. However there is a narrow strip along the Ottawa River which is too stony for cultivation. This very stony phase of the Ste. Philomene soils has probably been formed by the erosive action of the former Ottawa River which has washed away the finer material, leaving the big stones in place.

In the small gravelly ridges found between Rigaud and Choisy, the stones are almost exclusively acid rocks (gneiss, quartzite). However, the acid stones of the parent material are cemented or coated with calcium carbonate. These ridges were included with the Ste. Philomene soils although free carbonates are not found in the solum. Nearly all of these gravelly deposits have been or are being used for road building material, leaving very little that can be devoted to agriculture.

Fig. 7—Ste. Philomene soils on gravelly deposits at Riviere Baudette.

Along the interprovincial border, one mile south of Point Fortune, the soils vary considerably within short distances from gravelly to clayey or even to swampy land. It would appear that stream erosion has greatly modified the original deposits. Since most of that land is of gravelly nature, the soil has been classified as the Ste. Philomene gravelly loam—eroded phase and is shown on the map thus—Ph/E.4. It is of small extent (270 acres) and is not used for cultivated crops.

Agriculture

The soils of the Ste. Philomene series, where not used as gravel pits, are all under cultivation with the exception of some very stony areas. The soil is rich in lime, open, well drained to excessively drained and is well adapted to deep rooted plants like alfalfa. It may also be considered as a good soil for other field crops and for potatoes. Peas for soup are grown on similar soil in other counties of the province.

Acre-yields obtained on well managed farms are as follows: oats, 30 to 40 bushels; barley, 30 to 35 bushels; alfalfa, 2 to 3½ tons; clover with timothy, 1 to 1½ tons; silage corn, 12 to 15 tons. These yields were obtained with the use of manure supplemented with chemical fertilizers on corn and grain. Potatoes yield up to 280 bushels per acre when fertilizer is used. Small stones of the size of potatoes are a nuisance when harvesting with machinery.

The gravel underlying the Ste. Philomene soils is the main source of good road material for the whole region and huge gravel pits have been dug in many places. The material is passed through a crusher to break stones into gravel of the desired size.

Ste. Justine Series

The Ste. Justine soils occupy an area of 2,556 acres in the vicinity of the village of Ste. Justine. They occur on gently rolling topography at an elevation of 225 to 300 feet. The soil is droughty due to rapid internal drainage and free surface run-off. There is generally a fairly large quantity of stones on the soil surface, although their distribution is not uniform. About 75 per cent of the land is covered with trees among which hard maple predominates.

The soil is apparently developed from fluvio-glacial deposits and till which has been much reworked by water. The material on the ridges is very stony and made up largely of gravel, small stones and large boulders. A great variety of rocks is represented in the stones: gneiss, syenite, quartzite, sandstone and limestone. Sometimes the parent material shows some irregular stratification but occasionally it resembles a till. On smooth land between the ridges, the soil is a gravelly sand and not very stony. All the variations observed in the Ste. Justine soils will not be described because the materials are very heterogenous throughout. The most common soil consists of a medium to coarse sandy loam over gravel and gravelly sand overlying till-like material.

A description of an average Ste. Justine coarse sandy loam is given below:

Horizon	*Variation in depth*	*Description*
A1	2"- 4"	Dark brown coarse sandy loam; friable, weak crumb and single grain structure, pH 5.0.
A2	0"- ½"	Trace of leached, grey, coarse sandy loam sometimes present.
B1	6"-10"	Reddish brown coarse sandy loam, single grain structure, nearly loose, occasionnal stone fragments.
B2	8"-12"	Yellowish brown medium to coarse sandy loam, with some gravel, single grain structure, nearly loose.
C		Brownish grey gravelly sandy loam, reworked material with many stones of gneiss, syenite or granite and quartzite. pH 6.0-6.5.

Agriculture

A small percentage of the Ste. Justine soils is cleared and cultivated. General farming is commonly practised but there is a small acreage of the land devoted to small fruits and to potatoes. The general productivity is low because the soil has a coarse texture and a low moisture-holding capacity. The less stony areas can easily be cleared for cultivation.

The yields of field crops are low: hay gives about ¾ of a ton to the acre and grain about 25 bushels per acre. It is a fair soil for potatoes and small fruit, such as strawberries. Heavy applications of manure which are generally used on hoed crops improve the retentive power of the soil. However, the effect of barnyard manure is of short duration and it should be supplemented by green manure and chemical fertilizers. Liming should be beneficial on this acid soil especially for the growth of legumes.

Uplands Series

The Uplands sands occupy the St. Lazare sand plateau which has been frequently referred to in the first part of this report and the elevated sandy area southeast of St. Telesphore. It covers an area of 14,412 acres or 6·8 per cent of the total. The Uplands soils have been formed from grey water-worked, stratified, medium to fine sands which occasionally contain lenses or layers of coarse sand or fine gravel. In some places, especially on the rolling topography, the sand has been wind blown. The depth of the sand varies considerably; it is usually over 5 feet deep and it's maximum depth is not known but it probably is over 30 feet in some locations.

These soils have generally a gently rolling to rolling dune-like topography; however, there are also some gently undulating areas and in a section northwest of Val-des-Sables the land is almost level. Due to the open porous nature of the sand, the soil is excessively drained. A large percentage of the precipitation seeps through the soil and is lost in the subterranean waters which feed a number of springs along the edge of the plateau. On the level area of Uplands sand near Val-des-Sables the moisture conditions are somewhat better than usual.

The original vegetation on the Uplands sand probably consisted mostly of white pine and a few of them can still be seen. Most of the land, which at one time was cleared and cultivated has subsequently been abandoned and it is now

covered with a dense, scrubby growth of white birch or a mixed stand consisting of soft maple, pine, birch, poplar, oak, fir and some ash and hemlock. In a number of places, where the abandoned land is not completely protected by vegetation, serious drifting of the sand is taking place during the dry weather.

The Uplands soils have been considerably leached and are typical of the well-drained sandy podzols of the region. A generalized description of an undisturbed Uplands profile under forest cover is given below:

Horizon	*Variation in depth*	*Description*
Ao	1″- 2″	Dark brown raw humus and roots.
A2	½″- 3″	Ashy-grey, leached sand with some greyish brown specks, pH 4.9-5.5.
B1	10″-15″	Reddish brown, loose, medium sand. The upper part is often a very dark brown. (In exceptional cases this layer is cemented into a discontinuous hardpan.) pH 5.2-6.5.
B2	10″-12″	Pale yellow brown, loose, medium sand. The colour changes gradually from the B to the C horizon; pH 5.8-6.8.
C		Grey stratified, loose, medium sand with occasional lenses of coarse sand and gravel. pH 5.8-7.0.

The cultivated surface soil of the Uplands sand is generally greyish brown in colour, very loose and structureless. It contains very little organic matter and plant nutrients. On the smooth area near Val-des-Sables the surface soil is darker in colour and richer in organic matter which is probably due to somewhat better moisture relationships. As a rule the depth of the grey leached A2 horizon is somewhat greater in the smooth phase and occasionally, A2 horizons 10 inches thick have been observed.

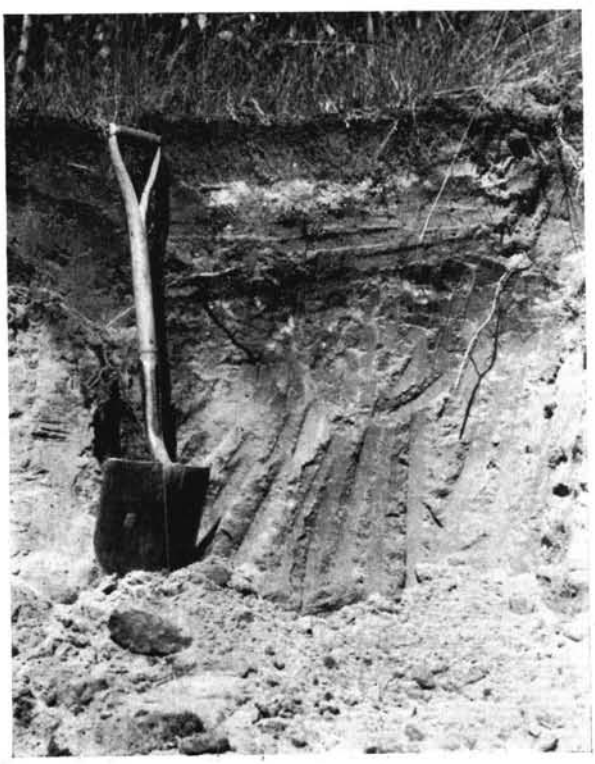


Fig. 8—A profile of the Uplands sand.

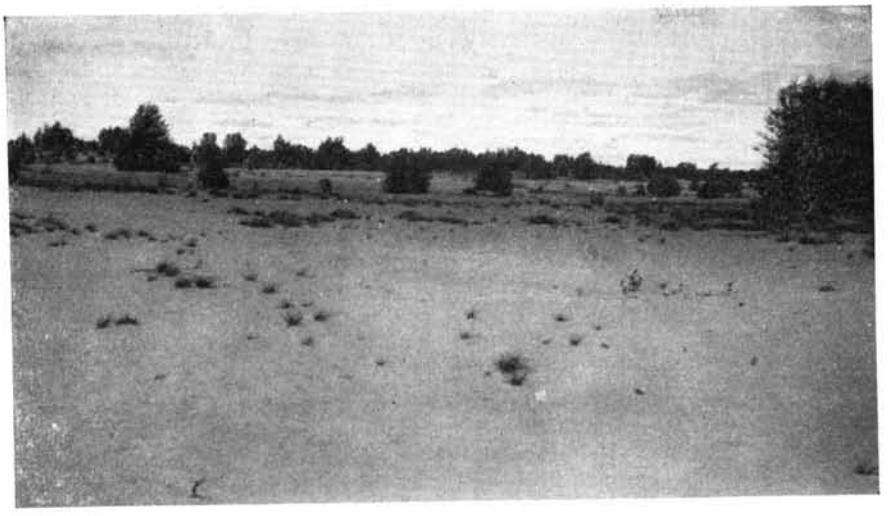


Fig. 9—Eroded Uplands sand on the St. Lazare Plateau.

The Uplands sand mapped southeast of St. Telesphore is a little coarser than near St. Lazare and in some places gravel is found at depths ranging from 24 to 60 inches below the surface. This gravel may be of the same origin as the fluvio-glacial deposits found further south along the Baudette River, but they have been covered with sand which appears to be similar to that on the St. Lazare Plateau. These areas have been mapped as a gravelly subsoil phase (Ug) of the Uplands sand. Some cobbles and occasional boulders may be found on this soil.

The areas of drifting Uplands sand have been mapped as "Blow Sand". In many cases the entire profile of the Uplands sand has been destroyed and the loose shifting sand contains very little or no organic matter. Every effort should be made to stabilize these drifting sand dunes.

Agriculture

Only a small percentage of the Uplands sand is under cultivation. Most of the land on the rolling topography has been abandoned and it is now gradually reverting to forest, but in most instances it is exposed to severe wind erosion. This rolling Uplands sand is unsuitable for farm crops. Grain and hay yields are very poor and generally prove to be unprofitable due to the droughty nature and low fertility of the soil. However, the smoother areas of Uplands sand may be used for special crops. Under optimum condition during wet seasons, this soil has yielded up to 300 bushels of potatoes and 10 tons of tomatoes per acre with heavy fertilization. Early sweet corn, strawberries and raspberries also do very well on this soil and yellow string beans have been grown with fair success during favourable years. In dry seasons the crops are poor and may be a failure. Tobacco growing has been tried in recent years on the Uplands sand in the St. Telesphore area but in 1943, the year of the survey, the entire crop was destroyed by insect pests. It is possible that this soil, especially on the smoother areas, is also suited for the growing of hops.

In the management of the Uplands soils for crop production organic matter must be given major consideration. This may be supplied in the form of manure, muck or peat (which occur east of the sand plateau) or by incorporating green crops, such as clovers, alfalfa, buckwheat or rye. The organic matter will not only add the needed nitrogen but will also help to bind the individual sand particles and thus reduce drifting and it will increase the moisture-holding capacity of the soil.

Complete commercial fertilizers are required for the successful production of most crops. The rate of application and the type of mixture to be used will vary greatly with the crops grown and the amount of manure used. As the soil is very acid, especially on the St. Lazare Plateau, the application of lime should produce good results with most crops.

Ste. Sophie Series

The Ste. Sophie soils occur as fairly large tracts of land on or around the St. Lazare sand plateau, where they occupy 6,560 acres on the slopes or lower positions of the plateau at elevations ranging from 100 to 350 feet. The topography varies from undulating to rolling. A large proportion of the land has a forest cover consisting of soft and hard maple, basswood, white and grey birch, ash, poplar and also pine and spruce. The soil is open, well drained and not subject to harmful erosion.

The sandy material from which the soil is developed rests on clay at an average depth of 3 feet. The presence of clay, however, has not been ascertained everywhere. Enormous boulders of igneous rocks are found imbedded in the sand and sometimes they are sunk half way into the clay. These boulders must have been brought in by huge blocks of floating ice.

The Ste. Sophie series consists of two types: the loamy fine sand and the sandy loam. The profile of the loamy fine sand is described below:

Horizon	*Variation in Depth*	*Description*
Ao	1½"-2½"	Dark brown to black loamy fine sand, raw humus and roots friable, fine granular structure; pH 4.5-5.0.
A2	½"- 3"	Grey to yellowish grey leached loamy fine sand.
B1	5"- 9"	Reddish brown loamy sand, loose, single grained; pH 5.0-5.5.
B2	8"-12"	Brownish yellow to yellowish brown fine loamy sand or sand, loose, single grained, slightly mottled; pH 5.0-5.8.
C	10"-20"	Light yellowish grey fine sand, mottled with rusty brown, loose, single grained; pH 5.0-6.0.
D		Brownish grey clay. There are often some thin strata or patches of sand and clay before continuous clay is reached.

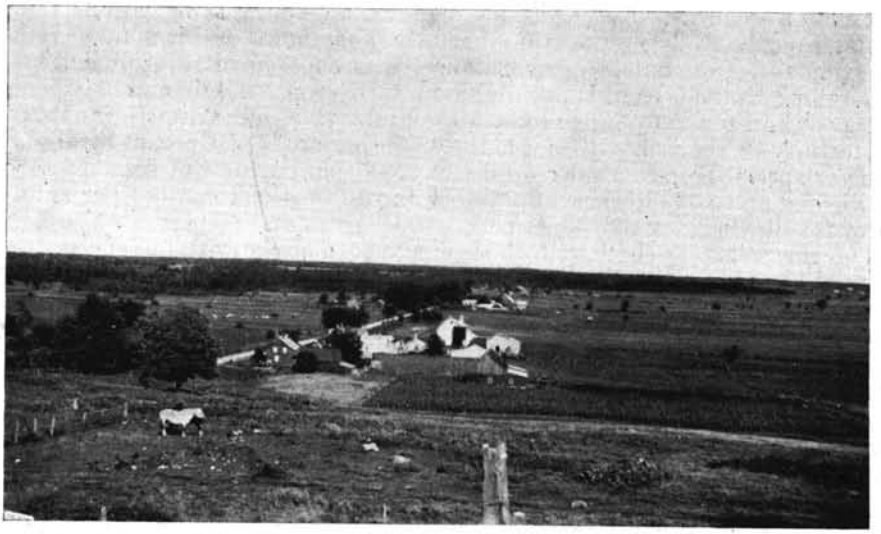


Fig. 10—Landscape of Ste. Sophie loamy sand (foreground); Uplands sand (background); Vaudreuil loamy sand (centre left); and Ste. Rosalie clay loam (centre right).

In addition to the large boulders, small stones are occasionally found in the profile of the Ste. Sophie loamy sand. The small areas mapped as sandy loam are excessively stony. Some of this stony sandy loam has been mapped as a complex with the Rideau clay on Ile Perrot.

Agriculture

The Ste. Sophie soils are dry, very acid and of low fertility. Less than 50 per cent of the land has been cleared and much of the cleared land is abandoned. It is mainly used as pasture land or for general farming with small areas devoted to garden crops.

Yields on the Ste. Sophie soils are low. Mixed hay produces from $\frac{3}{4}$ to 1 ton per acre; corn 8 to 12 tons of silage; oats and barley about 25 bushels per acre. It is, however, a fair soil for potatoes which may yield up to 250 or 275 bushels per acre with manure and chemical fertilizers.

The soil should be fertilized to produce profitable crops. Organic matter such as green manure, stable manure and muck, incorporated in the soil, will greatly benefit the plants. It should be possible to build up the organic matter of the soil so that it will retain enough moisture and plant nutrients to make it suitable for garden crops. Liming and probably light fertilization should make possible the establishment of alfalfa stands on Ste. Sophie soils. As the land is dry, good management should tend to conserve as much moisture as possible in the soil.

St. Amable (Rubicon) Series

The St. Amable soils cover 6,795 acres or 3·2 per cent of the surveyed area. Their elevation ranges generally from 150 to 200 feet above mean sea level but some tracts on Ile Perrot occur at 75 and 100 feet. The overall topography is usually fairly level and the surface of the soils is slightly higher than that of the surrounding clay flats, however, considerable micro-relief generally occurs on these soils with slight depressions and gently rising knolls.

As a result of the micro-relief and overall level topography the surface drainage is slow. The internal drainage of the soil varies greatly. The upper part of the profile on the gentle knolls is usually moderately well drained, while in the depressions it is imperfectly to poorly drained. The internal drainage of the soil is also adversely affected by the nature of the underlying clay.

The St. Amable soils have developed from sandy materials which have been washed over the grey Champlain clays to various depth. The thickness of the sand varies from $2\frac{1}{2}$ to 6 feet and is usually about 4 feet. Due to the porosity of the sand and the impervious nature of the underlying heavy clay, the water accumulates in the subsoil and causes a mottled and deoxidized layer above the clay.

The vegetation on the St. Amable sand which has not been cleared consists of a mixed forest of birch, poplar, hemlock, spruce, soft maple and some pine. Many of the once cleared fields have been abandoned and are rapidly reverting to a dense growth of birch.

The cultivated surface soil of the St. Amable series varies considerably. On the gentle knolls the soil consists of a medium to light brown loose loamy sand to sand. In the depressions the surface soil varies from a light grey to a dark grey loamy sand.

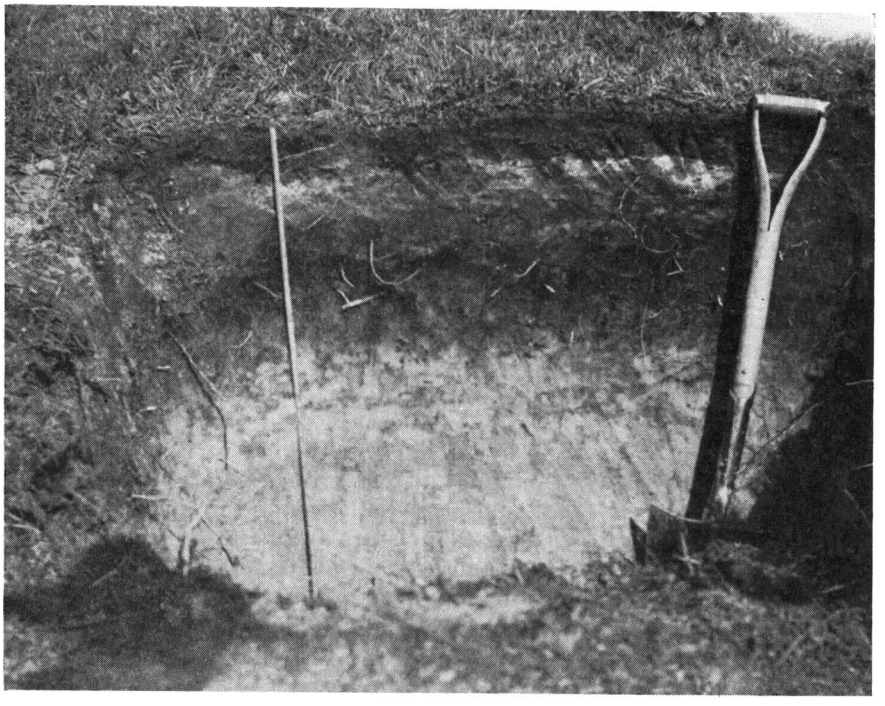


Fig. 11—Profile of St. Amable loamy sand—mottled subsoil—clay at about 40 inches.

The St. Amable sand is an acid, leached soil and belongs to the group of soils known as Ground-water Podsols. The common characteristics of an undisturbed St. Amable sand are given in the following profile description.

Horizon	*Variation in Depth*	*Description*
Ao	2″- 3″	Dark brown raw humus with some grey sand. pH 4.5.
A2	*1″- 7″*	*Grey or brownish grey leached light sandy loam to loamy sand, loose, single grained. pH 4.5.*
B1	4″- 8″	Dark reddish brown loamy sand, or sand sometimes indurated or with ortstein concretions, but generally loose and single grained, pH 5.0.
B2	15″-18″	Light to yellowish brown loamy sand, or sand, loose, single grain structure, sometimes slightly mottled with grey and orange yellow; pH 5.5.
B3	4″- 6″	Light yellowish grey fine sand containing dark micaceous particles. Usually mottled with rusty spots and streaks; pH 5.8.
C	10″-40″	Grey stratified sand, well packed but friable, single grain structure; pH 6.3.
D		Grey to bluish grey clay.

On the knolls the thickness of the Ao and A2 horizons is usually thinner and the B horizon is less often indurated than in the depressions but in the latter positions the mottling of the subsoil is more pronounced than on the knolls.

Agriculture

Most of the St. Amable soils have once been cleared and cultivated but, because of low fertility, many fields have been abandoned and have grown up into small birches and shrubs. The cultivated land is generally used for dairying and general farming.

Some areas are of little agricultural value because the drainage is not uniform. Due to micro-relief, fields are in some parts too dry and in other parts too wet for satisfactory plant growth.

The yields on St. Amable soils may be estimated as follows: hay ½ to 1 ton per acre; oats 15 to 25 bushels, potatoes grown with light applications of manure and chemical fertilizer, 125 to 175 bushels per acre. The soil is not naturally well suited to alfalfa and considerable difficulty is encountered in producing a crop of that legume. Clovers will do a little better but their growth is often patchy.

The improvement of St. Amable soils involves adequate drainage, proper liming, addition and maintenance of organic matter and fertilization with complete fertilizer. Good management should tend to make the surface soil more uniform in organic matter, moisture-holding capacity and general fertility.

St. Damase Series

The St. Damase soils occur in the eastern part of Soulanges and Vaudreuil counties where an area of 1,231 acres has been mapped as St. Damase sandy loam and another area of 1,920 acres has been mapped as a complex of St. Damase and Ste. Rosalie soils. These soils are found on the clay plain at elevations ranging from 100 to 150 feet above mean sea level. They are formed on sandy deposits, overlying clay and varying in depth from one to three feet. The land surface is level to gently undulating.

The drainage of the St. Damase sandy loam is moderate. The water percolates at a fair rate through the upper part of the solum but is slowed down by the impervious clay substratum. However, drainage waters do not remain stagnant above the clay but seep away to nearby drainage channels.

The external appearance of the St. Damase soils resembles that of the St. Amable soils, but in comparison the St. Damase soils have more uniform moisture conditions, more organic matter and they are less leached. The profile description of a cultivated St. Damase sandy loam of average depth is given below:

Horizon	*Depth in inches*	*Description*
Ae	0"- 7"	Dark reddish brown light sandy loam, weak crumb structure; pH 4.8.
B1	7"-10"	Yellowish red light sandy loam to loamy sand, very weak crumb structure and single grains, very friable.
B2	10"-18"	Yellowish brown loamy sand with low contrast coarse mottling of greyish brown, brown and some yellowish red, very weak crumb structure and single grains.
D	18"-	Greyish brown clay, mottled for few inches near the contact with the sand, uniform in colour below.

The whole solum is acid. In the virgin state, a thin leached layer (½ to 1½ inches) is observed. The main variations in this series are in the depth of sandy material over the clay. Generally the sandy loam is the deepest at the highest point of the undulations and tapers off on every side until it is so shallow as to become a Courval sandy loam or a Ste. Rosalie clay loam. North and west of Cedars, the St. Damase light sandy loam occurs as a complex with the Ste. Rosalie clay loam. The sandy type is dominant and covers about 75 per cent of the complex area.

Agriculture

The St. Damase soils are partly cultivated and partly in wood-lots. Where cultivated, they are used for general farming and sometimes for gardening. The natural fertility of the soil is low but it can be improved considerably. The ability of the soil to retain moisture and plant nutrients can be increased by adding manure or by ploughing under green crops such as buckwheat or clover.

The St. Damase sandy loam gives the following yields per acre: hay $\frac{3}{4}$ to $1\frac{1}{4}$ tons, oats 20 to 30 bushels, potatoes 150 to 200 bushels. The above yields are obtained with the use of some manure but without commercial fertilizer. Lime is necessary for the normal growth of clover and especially alfalfa. Good stands of alfalfa have been seen where the soil had been properly prepared for that crop.

Vaudreuil Series

The Vaudreuil soils occur mainly southeast of the St. Lazare sand plateau and cover an area of 5,197 acres or 2·5 per cent of the whole territory. The topography is generally level but sometimes gently sloping and the elevation above sea level ranges from 160 to 275 feet. The profile is developed in 18 to 36 inches of sand over clay. The drainage is poor and a highly organic black surface has formed on these soils. The natural tree vegetation is composed of soft maple, poplar, birch, willow and alder.

The soil profile below the organic layer, has only a faint vertical development. Only one type has been mapped in the Vaudreuil series, the loamy fine sand, which is described below:

Horizon	*Variation in Depth*	*Description*
A1	3″- 5″	Black or very dark grey organic, loamy fine sand, very soft crumb structure. pH 6.2-6.6.
A2	2″- 4″	Light grey loamy fine to medium sand, single grained.
G	7″-12″	Yellowish grey sand, saturated with water at most times. pH 6.8-7.3.
C	6″-10″	Grey sand usually of medium size, often containing many mica fragments, generally saturated with water, pH 6.8-7.3.
D	Grey	Grey clay.

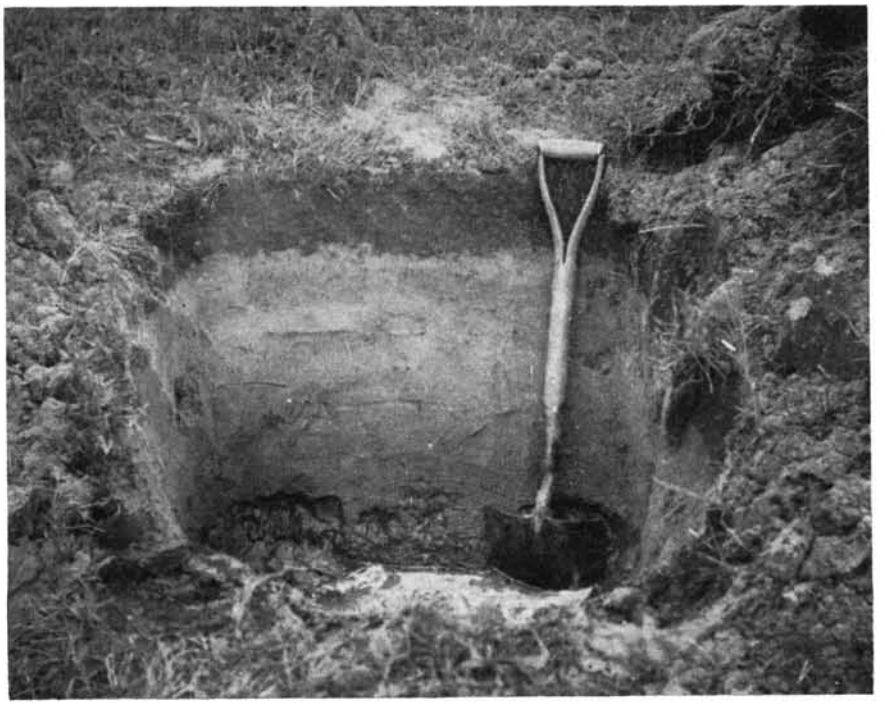


Fig. 12—Profile of Vaudreuil loamy sand: dark surface, light grey sandy subsoil, clay at about 28 inches.

Agriculture

The cultivated Vaudreuil soils have a very dark grey surface, and are slightly acid in reaction. The soil is cold due to excess moisture. The natural productivity of these soils is low. Hay yields from $\frac{3}{4}$ to 1 ton, buckwheat, 20 to 30 bushels, roots, 8 to 12 tons per acre. Potatoes are often scabby and yield about 175 bushels per acre. Tomatoes are grown with fair success on this soil and with the use of fertilizers yield about 15 tons per acre. Corn produces 8 to 10 tons of silage per acre. Flax yields about 150 pounds of fibre per acre when fertilized with 500 pounds of superphosphate. Oats or mixtures of oats and barley produce from 15 to 25 bushels per acre. Adequate drainage should be secured by numerous deep ditches before satisfactory results can be obtained.

Coteau Series

The Coteau fine sandy loam is not an extensive soil for it occupies only 1,037 acres in Soulanges county. It occurs as narrow bands along Riviere Baudette, Riviere a Delisle and Riviere Rouge. The topography is gently undulating and the elevation above sea level is about 160 feet. Good external drainage is secured by the proximity of the large streams and the fact that the land is slightly higher than the surroundings. The percolation of water through the solum is moderately rapid.

The Coteau, like the much more extensive Soulanges soils, have developed from fine sands which were deposited over the marine clays along the St. Lawrence and its tributaries. Different drainage conditions, on similar parent material, have resulted in the development of two different soils, imperfectly drained Soulanges soil and the well drained Coteau soil. The depth of the Coteau sand varies from three to seven feet over clay.

A description of a representative profile of the cultivated Coteau fine sandy loam is given below:

Horizon	*Depth*	*Description*
Ac	0"- 8"	Light brown fine sandy loam, very soft small granules among single grained material, very friable.
B1	8"-14"	Weak reddish brown fine sandy loam, single grain structure, very friable.
B2	14"-22"	Light yellowish brown loamy fine sand, single grain structure, loose.
B3	22"-30"	Yellowish grey very fine sand.
C	30"-50"	Grey fine sand.
D		Grey clay.

Agriculture

Practically all of the Coteau fine sandy loam is under cultivation. It is largely used for gardening and vegetable crops, especially potatoes which yield from 200 to 300 bushels per acre. The soil is generally well adapted to these crops, as it drains easily and yet retains enough moisture for plant needs. The land can easily be worked early in the spring and soon after heavy rains.

The maintenance of organic matter is very important for successful production and generally Coteau soils are in good state of fertility because they have been heavily manured and well taken care of, due to their proximity to the farm buildings and to the special crops grown on them. Ploughing down green crops such as legumes, buckwheat and rye is an excellent way to maintain the organic matter content of the soil when the supply of manure is limited. The use of commercial fertilizer to supplement barnyard manure or green manure should prove very satisfactory.

The Coteau fine sandy loam is quite acid and the reaction of the surface soil is approximately of pH 5·0. The use of lime would probably give satisfactory results but it should be used sparingly if potatoes are grown in the rotation and it should be applied after the potato crop.

Soulanges Series

The Soulanges soils cover a large area in the southern part of the territory along the St. Lawrence River. A total of 17,153 acres or 19·6 per cent of Soulanges county is occupied by these soils. The land is flat and only slightly above the level of Lake St. Francis, at an elevation of about 160 feet above mean sea level. These soils have developed from fine or very fine sands mixed with 35 to 55 per cent silt and about 10 per cent clay. This material is underlain by Champlain clay at an average depth of about 3 feet from the surface. As a result of the flat topography, high water-table and impervious substrata, the soil is imperfectly to poorly drained. The vegetation on the Soulanges soils consists mainly of soft maple, ash, elm, and swamp oak.

The fine sandy loam is the most important type in the Soulanges series. A shallow phase of the sandy loam has been mapped where the clay is at less than 18 inches from the surface. A silt loam type was also mapped in the Soulanges series where the upper part of the solum has a silt loam to loam texture. The silt loam type often makes the transition from the Soulanges series to the Baudette series. The delineation of the different types of the Soulanges series is difficult as they merge very gradually one into the other.

The Soulanges soils are acid; the more sandy the soil, the more acid it generally is. However, where they come in contact with the St. Zotique soils, the Soulanges soils are much less acid and sometimes nearly neutral. These conditions must be taken into consideration when lime is applied to Soulanges soils.

A description of a cultivated Soulanges fine sandy loam is given below:

Horizon	*Variation in Depth*	*Description*
A1	5″- 7″	Very dark brown to dark greyish brown fine to very fine sandy loam, very soft crumb structure, pH 4.7 to 5.7.
A2	2″- 4″	Light grey to brownish grey leached fine sandy loam to loam.
B1	8″-12″	Yellowish brown mottled with grey and rusty brown fine sandy loam, very friable, pH 5.0 to 6.0, some platy structure.
B2	10″-18″	Light yellowish brown, mottled with grey and rusty brown, fine to very fine light sandy loam, mica fragments, some thin platy structure, pH 5.5 to 6.5.
C	0″-15″	Bluish grey sand, platy, friable, pH 6.2 to 7.0.
D		Clay or silty clay.

Fig. 13—Profile of Soulanges fine sandy loam: dark brown surface. remains of the leached layer, mottled subsoil, clay at about three feet.

Agriculture

The absence of sufficient slope to drain excess water into the lake or the river is the main handicap to the full use of Soulanges soils which would have the most desirable physical properties with an efficient drainage system. As the flow of the drainage waters is very slow, more numerous, larger, and deeper ditches and outlets are necessary for satisfactory drainage. It would appear that more satisfactory drainage could be obtained if the Delisle River were used as the drainage outlet rather than Lake St. Francis, because the River empties below the rapids and thus provides more slope and more rapid flow.

Water is seldom seen on the surface of Soulanges soils as is often the case with clay soils, but nevertheless this does not mean that good ditches are not needed. Rain water rapidly penetrates into the subsoil. However, if there is no chance for the water to reach a nearby ditch or drain, the soil will remain water-logged, a condition which impedes the necessary aeration of the soil. Since subsoil drainage is the most important in these soils, deep ditches with good outlets are needed.

The Soulanges soils, when drained are adapted to a wide variety of crops, but the present yields are only fair and sometimes very low. The following yields per acre may be considered as good averages: hay, $\frac{3}{4}$ to $1\frac{1}{2}$ tons; oats and barley, 25 to 35 bushels; flax, 125 to 175 pounds of fibre; silage corn, 12 to 15 tons; roots, 18 to 20 tons; potatoes, 200 bushels.

There are possibilities for considerable improvement in these soils, the first condition being, as already mentioned, adequate drainage. The use of lime to correct the excess acidity and the application of manure and complete fertilizers, should considerably raise the fertility of these soils.

Two crops, potatoes and barley, seem to be particularly suited to efficiently drained Soulanges soils. Using 800 to 1,200 pounds of fertilizer per acre, this soil, provided with a good drainage system, has yielded 350 to 400 bushels of potatoes and the following crop of barley, 50 to 60 bushels per acre. Roots and silage corn also give good yields. Alfalfa can be introduced only when proper drainage is secured and excess acidity corrected by liming. Pastures are generally fair, but the excess acidity of the soil favours the rapid growth of weeds such as horsetail and sorrel. These soils, when improved and properly managed, should be suitable for dairying.

St. Zotique Series

The St. Zotique soils occur only in Soulanges county, where they occupy a total area of 6,394 acres or 3·1 per cent of the whole county. They occur as two main tracts of land, one situated in the parish of St. Zotique and the other east of the village of St. Clet. This land is level to depressional and is found at an elevation of about 170 feet. The drainage is excessively slow. The permanent high water-table has favoured the development of a very highly organic surface and the accumulation of free carbonates in the solum.

The St. Zotique soils are, on one hand, associated with mucks under the most poorly drained conditions and on the other hand with the Soulanges soils where the external drainage is more efficient. The St. Zotique soils are developed from 18 to 36 inches of alluvial very fine sandy loams to loams over layers of silty clay loam and clay.

A cultivated profile of the St. Zotique very fine sandy loam is described below:

Horizon	*Depth*	*Description*
Ac	0″- 6″	Black very fine sandy loam to loam, weak crumb structure, pH 6.8.
G1	6″-18″	Light olive grey to olive grey fine sandy loam some rusty brown spots, structureless or poorly developed nuciform structure, pH 7.5.
G2	18″-36″	Olive grey fine sandy loam with rusty brown spots, more frequent than above, effervesces with dilute hydrochloric acid, structureless or poorly developed nuciform structure, pH 8.1.
D		Silty clay or layers of silt and clay with some mottling, plastic, calcareous.

In the shallow sandy loam, the sandy material is only 10 to 18 inches thick over the clayey substratum which is not homogeneous, but contains layers or pockets of silt loam or fine sandy loam. The heavy material is mottled and has a moderately well developed granular to blocky structure. As in the case of the profile described above, the free carbonates are generally detected at or below 18″ from the surface.

Agriculture

The St. Zotique soils are cultivated wherever sufficient drainage can be secured. In some areas, drainage is so difficult that cultivation has been abandoned and the soil is now covered with a dense vegetation of spirea, alder, willow and birch. Areas of swamp or muck also occur among these soils.

The cultivated St. Zotique soils are very fine sandy loams to loams and occasionally silt loams, characterized by the black highly organic surface with a neutral to slightly alkaline reaction. They are considerably more fertile than the Vaudreuil soils but just as difficult, or even more so, to drain.

The soils are commonly used for general farming but are more adapted to garden crops, especially lettuce, cabbage and other green leafy vegetables. However, these soils are slow to warm up in the spring because of excess water in the solum.

Alfalfa could be grown where the drainage is improved. Some good stands of sweet clover have been seen which produce from $2\frac{1}{2}$ to $3\frac{1}{2}$ tons per acre. The acre-yields of the main field crops are as follows: mixed hay, $\frac{3}{4}$ to $1\frac{1}{4}$ tons; roots, 10 to 15 tons; silage corn, 8 to 13 tons; oats, 20 to 30 bushels.

The St. Zotique soils being very rich in organic matter are not well balanced in mineral nutrients. The nitrogen content is too high in comparison with the phosphorus and the potash and this causes lodging of the cereal crops. Fertilizers such as 0-16-6 and 0-16-10; are recommended to increase the quantity as well as the quality of the grains. Applications of manure should be light and the responses obtained are probably due more to increased activity of micro-organism than to increased supply of nitrogen.

Medium and Heavy Textured Soils on Alluvial, Lacustrine and Marine Deposits

Baudette Series

The Baudette soils occur mainly in the southwestern and south central part of the area. They occupy 10,085 acres or 4·9 per cent of the total acreage. These soils have a level to gently undulating topography and their elevation varies from 160 to 220 feet above sea level. The Baudette soils are developed on silty deposits overlying the Champlain clay. External drainage is slow and internal drainage is imperfect as the water is retained in the solum by the underlying clay which is found at a depth varying from 2 to 5 feet below the surface. The tree vegetation is composed mainly of soft maple, elm, and ash.

The Baudette soils are characterized by a lighter textured subsoil which contains a large proportion of silt and very fine sand. Three types have been mapped in this series; the silt loam, the clay loam and the sandy clay loam. A description of the Baudette silt loam follows, showing variations in the depth of the horizons.

Horizon	*Variation in Depth*	*Description*
Ac	5"- 7"	Brownish grey silt loam, fine granular structure, friable; pH 5.3-6.0.
A2	0"- 3"	Light brownish grey silt loam, friable (often absent).
Bg1	2"- 6"	Greyish brown loam to silt loam, with mottling of light grey and rusty brown, platy structure, friable; non plastic; pH 5.5.-6.2.
Bg2	7"-12"	Greyish brown silt loam alternating with layers of very fine micaceous sandy loam, slightly mottled with orange and rusty brown streaks or spots, platy structure; pH 5.7-6.5.
C	5"-10"	Grey silty clay, some mottling, granular structure, some plasticity; pH 5.8-6.5.
D		Grey clay (at a depth of 2 to 5 feet from the surface).

The sandy material in the subsoil resembles that of the Soulanges sandy loam. On the gently undulating areas of the Baudette silt loam and sandy clay loam, the soil on the top of the undulations is better drained, somewhat sandier and more acid than in the depressional positions.

The Baudette sandy clay loam is very similar to the silt loam described above but the Baudette clay loam has a darker surface horizon and its external characteristics generally resemble those of the Ste. Rosalie clay loam. However, the soft silty subsoil of the Baudette differs markedly from the plastic clayey subsoil of the Ste. Rosalie. The clay loam mapped along the Raquette River is very acid, whereas along the Ontario border it has been found only moderately acid.

Agriculture

The Baudette soils are productive and easy to cultivate, but like the other soils of the plain, they are difficult to drain. In normal years, the Baudette soils will yield 30 to 50 bushels of oats and 30 to 40 bushels of barley per acre. Timothy with clover produces $1\frac{1}{4}$ to $1\frac{3}{4}$ tons per acre. Roots grow very well and yield up to 20 tons per acre, while silage corn produces 12 to 15 tons per acre. Potatoes are grown in the lighter soil types and, with the use of fertilizers, yields of more than 275 bushels per acre have been reported. Flax is grown mostly on the clay loam and yields 300 to 450 pounds of fibre per acre. These yields were obtained with the use of barnyard manure after proper liming of the soil where the soil was originally too acid. A six-year rotation is generally practised and chemical fertilizers are used mainly on hoed crops and sometimes on grain.

Rideau Series

The Rideau soils occupy a total of about 21,184 acres or 10·3 per cent of the surveyed area and occur in the northern part of Vaudreuil county along the Ottawa River. South of Pointe Fortune these soils spread for several miles along the interprovincial border and extend to the east as far as Rigaud. Other tracts of the Rideau soil occur near Como and Pointe-Cascade and also on Isle Perrot.

The Rideau soils occur on undulating and frequently dissected clay plains at elevations ranging from 100 to 225 feet above mean sea level. The external drainage of these soils is sufficiently rapid to drain the surplus water from the cultivated land but percolation through the solum is slow, as in case of the Ste. Rosalie soils.

The Rideau soils have been formed from Champlain deposits which consist of a bluish-grey, massive, very plastic and slowly permeable clay. This parent material is similar to that of the Ste. Rosalie soils and contains about 65 per cent

clay, 25 per cent silt and 10 per cent sand. However, the upper horizons are generally heavier in the Rideau than in the Ste. Rosalie soils. The land is free from stone with the exception of ice-rafted boulders which are found on the surface in a few places, namely, northwest of Rigaud. At Pointe-Cavagnal, the surface horizon of the Rideau clay contains a large quantity of cobbles.

The Rideau soils are all cleared except for some small wood lots where elm, soft maple, ash, white birch, poplar, fir, pine and spruce are found.

Fig. 14—Profile of the Rideau clay on the edge of a recently eroded gully.

The virgin profile of the Rideau clay is described below:

Horizon	*Variation in Depth*	*Description*
A0	½"- 1"	Dark brown organic matter.
A1	3"- 4"	Dark greyish brown clay loam to clay; fine granular structure; friable; permeable; pH 5.1-5.8.
A2	½"- 4"	Grey leached clay with some rusty spots. On the average this horizon is only one inch thick.
Bg1	5"- 8"	Brownish grey clay; slightly mottled with rusty streaks; nuciform structure fairly well developed; plastic when wet; pH 5.4-6.2.
Bg2	8"-12"	Dull greyish brown clay; very slightly mottled; fine blocky to fine nuciform structure; plastic when wet; pH 6.0-6.8.
C		Grey clay; blocky to fragmental structure; very plastic; pH 6.6-7.3.

The cultivated soils of the Rideau series have generally a clay texture and a reaction ranging from pH 5·4 to pH 5·8, but soils of slightly higher pH and of clay loam texture are also found occasionally. The surface soil of the Rideau

clay is generally of a lighter colour than the corresponding horizon of the Ste. Rosalie soil. Due to some resemblance of these two soils, a very thorough examination is sometimes necessary to differentiate soils of the Rideau series from those of the Ste. Rosalie series. When the two types occur in the same area, as is the case near St. Redempteur, one soil merges gradually into the other so that it is impractical to determine the exact limit between these soils. In such a case, the boundary shown on the map marks the approximate transition from one soil series to another.

The steep clay banks along rivers, gullies and terraces are all subject to erosion and land slides. These areas have been mapped as the eroded phase of the Rideau clay. The eroded Rideau soils generally have a lighter coloured surface than the normal soil.

A "Sand Spot Phase" (R-s) of the Rideau clay has been mapped where the clay has been covered intermittently by sandy deposits which occur as small, low, rounded knolls, sometimes not more than 50 yards in diameter, or as elongated narrow bands. These small sandy spots form an intricate pattern with the clay and they can only be separated in a very detailed survey. The sand is seldom deeper than three feet at the centre of the knolls and tapers off toward the surrounding clay. The cultivated surface soil on the spots is six to eight inches deep and generally consists of a brown loamy sand to sandy loam and occasionally a loam. The B horizon, 10 to 15 inches thick, is a yellowish brown sand, sandy loam or loam. Sometimes grey sand occurs to a depth of a few inches immediately above the grey clay substratum. The texture becomes gradually heavier toward the edges of the sand spots. The soil between the sand spots is of the normal clay type if the spots are far apart, but of a clay loam type where the spots are close together.

In the central part of Ile Perrot knolls of stony, sandy loam are found associated with the Rideau soils. In that area, which has been mapped as a complex of Rideau clay and Ste. Sophie sandy loam (R + Spl) most of the clay soils are cleared and cultivated, while the sandy, stony knolls are wooded. On the knolls the surface soil is a brown sandy loam, while the B horizon is a light yellowish brown sandy loam (no appreciable leaching has been observed). The clay is reached at a depth of 30 to 40 inches. The stones, mostly sandstones, are very numerous on the surface as well as through the profile.

Agriculture

The Rideau clay soils are among the most fertile soils of the area. They are largely used for dairying and mixed farming but some fibre flax is also grown on these soils. The Rideau clay is especially well adapted for hay which produces on the average $1\frac{1}{4}$ to $1\frac{3}{4}$ tons of mixed hay per acre. Excellent stands of red clover have been observed but alfalfa is almost entirely missing although an occasional good stand can be found. It is believed that with the application of lime and with improved drainage where necessary, alfalfa should do well on this soil. Oats yield on the average 30 to 45 bushels and buckwheat 30 to 40 bushels per acre. Fodder corn produces from 10 to 16 tons of roughage, while flax yields 300 to 425 pounds of fibre per acre.

The Rideau clay soils, although quite productive, are usually somewhat low in organic matter and nitrogen. The use of barnyard manure or the ploughing down of green crops will help to increase the organic-matter and nitrogen contents and will also improve the physical conditions of the soil. Nitrogenous and phosphatic commercial fertilizers usually give beneficial results on the Rideau soils.

The most serious problems on the Rideau soil are connected with its physical conditions. Due to the heavy texture and its comparatively low organic-matter content, the soil is difficult to work and it must be cultivated at optimum moisture conditions. If the soil is worked when too wet it will puddle and bake, the

bad effect of which can not be overcome during the growing season. The tramping of cattle on the wet clay has similar effects. On the other hand, if the land is too dry, a great deal of power is required and the soil breaks into massive clods which are unsuitable for a seed-bed. It is best to plough this soil in the fall in order that the clay may be granulated by the frost.

The heavy texture and comparative impermeability of the soil also involve a drainage problem on the Rideau soils, especially on the smoother topography. Underdrains and rounded ploughing, with the provision of satisfactory drainage outlets, will greatly help to remove the surplus water in the spring and after heavy rains. Although the soil may be classed as imperfectly to moderately well drained, crops and pasture often suffer from drought during dry seasons when the soil cracks and bakes.

Erosion on the Rideau soils is a serious problem locally, in the vicinity of the deeper drainage channels and above steep banks. Deep gullies may form and dissect fields, thus causing serious obstacles to the management of the land. Sheet erosion is often also serious adjacent to and on steep slopes. Protective measures, such as seeding down of the sloping land and stream banks to grass and the construction of check dams should be introduced before the erosion damage becomes too widely spread.

The sand-spot phase of the Rideau clay presents some management problems, due to the wide variation in texture and general characteristics of the soil. On the sandy spots the moisture moves through the upper layers of the soil more readily than through the heavy clay. As a result the sandy spots will be ready for ploughing or seeding before the clay. Also the crops often mature earlier on the sandy knolls, causing uneven maturity of the stands. On the other hand, the subsoil moisture on the sandy soils is usually higher than on the clays during dry periods and as a result deep rooted plants on the sandy soil often suffer less from drought. The organic-matter and nitrogen contents are usually lower on the sandy soils than on the clays and it is therefore advisable to apply heavier dressings of manure to the sandy spots. Phosphate and potash fertilizers also give better results on the sandy spots than on the clay.

Ste. Rosalie Series

The Ste. Rosalie soils occupy 59,892 acres or 27·6 per cent of the total area of the two counties. The main body of these heavy soils extends from Ste. Marthe to St. Polycarpe and from St. Clet to St. Telesphore Station, while other

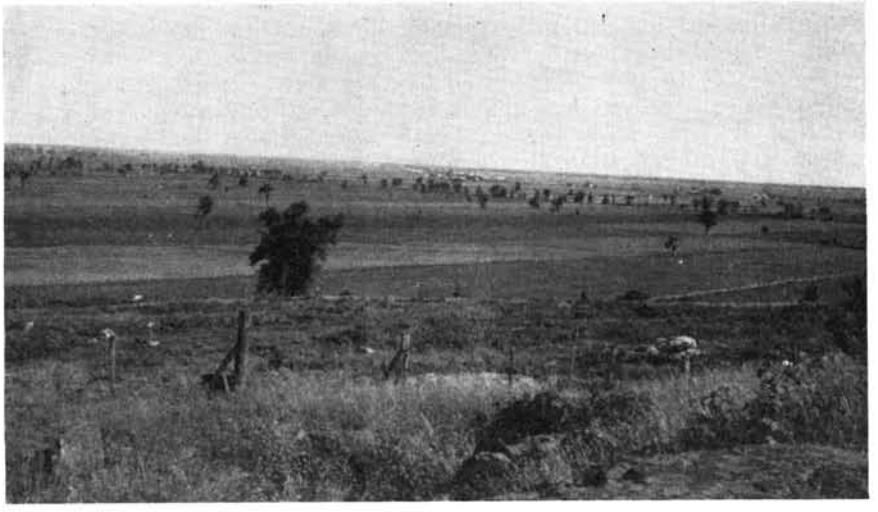


Fig. 15—General view of the level clay plain on which the Ste. Rosalie soils are dominant.

Fig. 16—Fibre flax is an important cash crop on the Ste. Rosalie soils.

important areas are situated in the vicinity of Cedars and St. Redempteur. The land is level and has an elevation of 140 to 230 feet above mean sea level. The depth of the clay deposits from which the Ste. Rosalie soils have developed varies from 50 to 130 feet. The percolation of water through the clay is slow and excess water runs off very slowly, due to the flatness of the land. As a result, the effective drainage of these soils is poor. The tree cover which may be observed in the few remaining wood-lots is chiefly composed of soft maple, elm, white ash, red oak and basswood.

Two types have been mapped in the Ste. Rosalie series, the clay and the clay loam, of these the clay is the dominant type. Some of the Ste. Rosalie soils have been mapped as a complex with Courval and St. Damase soils. A profile of a cultivated Ste. Rosalie clay is given below.

Horizon	*Variation in depth*	*Description*
Ac	5″- 8″	Very dark greyish brown to dark grey clay, granular structure, sticky when wet, friable when moist and hard when dry; pH 5.5. to 6.2.
A2	0″- 3″	Grey clay, somewhat mottled. Not generally present, but may occur in pockets or discontinuous layers 1 to 3 inches thick.
Bg1	4″- 8″	Brownish grey clay strongly mottled with rusty specks and streaks; fine blocky structure; very plastic and sticky when wet; firm when moist and hard when dry; pH 5.8 to 6.5. (Locally this layer is referred to as "argile rouillee".)
Bg2	8″-16″	Brownish grey clay, mottled with rusty brown; fine blocky structure. This layer differs from the one above in being less intensely mottled. pH 6.2 to 7.0.
C		Grey heavy clay; blocky to fragmental structure; very plastic and very slowly permeable; pH 6.8 to 7.4.

Samples of the cultivated surface soil, collected for mechanical analysis, contained an average of 30 per cent sand, 40 per cent silt and 30 per cent clay. The percentage of sand and silt decreases considerably with depth; the parent material contains about 10 per cent sand, 25 per cent silt and 65 per cent clay.

The humus content of the Ste. Rosalie clay is medium to fairly high and the cultivated surface soil has generally a very dark greyish brown colour when moist and grey to dark grey when dry. However, on some gently sloping knolls, where the drainage is somewhat better, the surface soil is lighter in colour. The

soils in these areas belong to the Rideau series, but due to their small size, such areas, locally referred to as "terre blanche", have been included with the Ste. Rosâlie series in the scale of mapping used.

Agriculture

Practically all of the Ste. Rosalie soils are under cultivation and only occasional small wood-lots can be found. Mixed farming is probably dominant on this soil type, although considerable dairying is also practised, while on many farms fibre flax has become a very important cash crop. During the first quarter of the present century a great proportion of these soils produced large quantities of hay and grain for sale.

The Ste. Rosalie soils are potentially fertile and they produce good yields if climatic conditions are favourable. Optimum climatic conditions are especially important on this soil which is difficult to drain because of the flat topography and the impermeability of the subsoil. There is usually only a short period in the spring when moisture conditions are optimum for the preparation of a good seed-bed and for seeding operations. If the soil is worked when too wet, it will puddle and bake on drying, the bad effects of which usually last throughout the entire season. On the other hand if the soil is cultivated when too dry, it will remain too lumpy for a satisfactory seed-bed.

After prolonged rainy periods, during the growing season, water often remains on the land and either drowns out the growing plants or retards them seriously. In order to overcome this danger, a type of ploughing, which is often referred to as the "Richard" type, has been widely adopted on this soil with variable success. This method consists essentially of ploughing the land up in ridges and leaving a dead furrow between the ridges. The excess water will run off the ridges into the furrows and down to the drainage outlet. Considerable skill is required in order to obtain good results. Good and bad types of "Richard" ploughing are shown in figures 5 and 6. In making a dead furrow, it is inevitable that a certain amount of the impermeable, sticky subsoil will be exposed with unfavourable effects on crop growth. For this reason, it is advisable to make the furrow as narrow as possible with sides rising at about 45 degree angles. The ridges should not be too rounded as this causes too great an accumulation of surface soil in the center of the ridges and exposes the subsoil in broad furrows. Fields with too rounded ridges and broad furrows give very uneven and patchy growth. The ridges should be broad and only slightly raised in the center, so as to permit free run-off and to provide a fairly uniform depth of surface soil. Heavy manuring along the furrows will result in a more even growth of the crops.

A more efficient way than the "Richard" ploughing to remove excess water from the Ste. Rosalie soils would be underdrainage. It is believed that a well installed tile drainage system, where outlets are available, would give beneficial

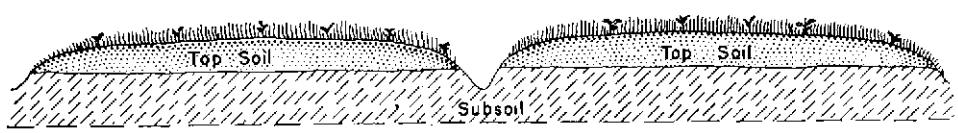


Fig. 17. Good ploughing; land slightly rounded; narrow dead furrow; exposing little subsoil; uneven growth.

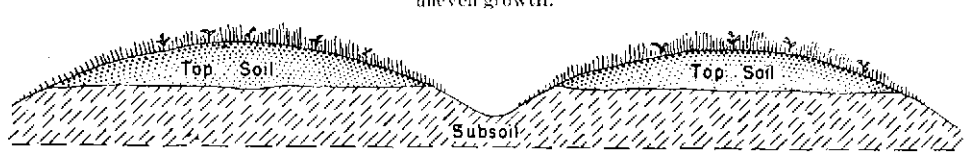


Fig. 18. Bad ploughing; land too rounded; dead furrow too wide and exposing too much subsoil; uneven growth.

results, as it would improve the structure of the subsoil, lower the water-table, increase the depth of root penetration and thus render the crops more resistant to drought.

The cultivated surface of the Ste. Rosalie clay soils is acid and has an average reaction of pH 5·6 in Soulanges and Vaudreuil counties. However, near the interprovincial border, along the Baudette River, these soils are generally less acid than over the main flat. The periodic application of lime on one part of the rotation is a practice which should be adopted. The lime greatly benefits clover and alfalfa which are the most important crops of dairy farms. It also improves the structure of the clay, rendering it more permeable to air and water, and favours better root development.

Phosphorus is generally the element most deficient in the Ste. Rosalie soils and applications of phosphatic fertilizers benefit most crops. Progressive farmers have considerably increased crop yields by the use of a complete fertilizer such as 2-16-6. Good barnyard manure supplemented by superphosphate is also beneficial. The use of "Stable-Phos" is recommended if the manure can be kept without appreciable loss of nutrients before being spread on the soil.

The yields obtained on the Ste. Rosalie soils are among the highest in the area. Mixed hay produces 1¼ to 2 tons per acre. Clover grows well but some difficulty is experienced in establishing alfalfa on these soils. Alfalfa is sometimes seeded alone but more often in a mixture with other hay seeds. Where the land is properly drained and limed, alfalfa yields up to 3 and 4 tons per acre. Corn produces 11 to 15 tons of silage to the acre. Barley yields 30 to 35 bushels and oats 35 to 45 bushels to the acre. Most of the fibre flax in Soulanges and Vaudreuil counties is grown on the Ste. Rosalie clay soils which yield from 350 to 500 pounds of flax fibre per acre.

Bearbrook Series

The Bearbrook soils are found on Ile Perrot and along the Lake of Two Mountains on the lower clay flats, at an elevation of 75 to 125 feet above mean sea level. Some of the lower lying land may be flooded in the spring, generally for a short period of time. The Bearbrook soils occur only in Vaudreuil county where they cover an area of 14,170 acres or 11·4 per cent of the county. The land is very flat and as a result the external drainage is slow. The percolation of water through the soil is also very slow due to the impermeability of the clay.

The parent material of Bearbrook soils consists of reddish brown and grey marine clays. These two kinds of clay may occur as definite bands or layers or as a heterogeneous mass of grey clay with pockets or spots of reddish brown clay. Compared with the parent material of the Ste. Rosalie and Rideau soils, the Bearbrook clay is slightly heavier in texture and generally has a clay content of about 70 per cent.

The land is generally free from stones except for ice-rafted boulders which have been deposited in fairly large numbers in some places. The soil profile description given below was taken in a cultivated field, under moist conditions, and is representative of the whole area of Bearbrook soils in Vaudreuil county.

Horizon	*Depth*	*Description*
Ac	0″- 6″	Dark greyish brown clay, firm, granular structure; pH 5.5.
Bg1	6″-10″	Greyish brown and reddish brown clays, irregularly mixed; slight mottling; poorly developed fine blocky structure; plastic.
Bg2	10″-26″	Grey heavy clay with spots of brown to purplish grey heavy clay; low contrast mottling of rusty brown; faintly developed fine blocky to nuciform structure; very plastic; pH 7.2.
C1	26″-36″	Purplish grey and grey heavy clays, mixed; moderately developed blocky to nuciform structure (aggregates of ¼″ to ½″ in size) together with some platy structure, very plastic.
C2		Reddish brown heavy clay in layers or in pockets with some grey heavy clay; massive to blocky structure; very plastic; pH 7.9.

Free carbonates are generally not found in the solum of Bearbrook soils in Vaudreuil county. However, free carbonates were detected in some instances, namely near Alstonvale Station, at depth of 3 feet and more in the grey clay.

There is considerable variation in the amount of reddish brown clay mixed with the grey clay. Sometimes the reddish clay is almost absent, but occasionally it forms the whole body of the soils. Some variations in drainage also occur. Under the poorer drainage conditions the soil surface is very dark, and the upper part of the subsoil is very strongly mottled (rusty) for about 8 inches, like in the Ste. Rosalie soils. In the better drainage positions, along drainage channels and river banks, there is very little mottling apparent, especially in the reddish brown clay.

Agriculture

The entire area of Bearbrook soils is under cultivation. Dairying and general farming are the types of agriculture practised on these heavy clays. Field crops generally include silage corn, oats, mixed hay and some fibre flax.

Bearbrook soils are moderately acid, fertile, but extremely difficult to handle. They are the heaviest soils of the area surveyed and consequently the most plastic and sticky. Ploughing and other cultivation practices require much power and can be carried out only when the land has the optimum amount of moisture.

Due to the bad physical properties of the Bearbrook soils, cultivated plants may suffer considerably from excess moisture during prolonged rainy periods. The crops may also suffer much during droughty periods because the soil surface becomes excessively hard on drying. It is difficult to maintain a good structure in the cultivated surface soil. Apart from cultivating at proper moisture conditions, the granulated structure can be maintained or improved only by draining, by liming and by generous addition of organic matter.

Drainage problems are even more serious on Bearbrook soils than on Rideau, Dalhousie and Ste. Rosalie clay soils. The clay is comparatively more impervious and the land is also very flat. Rounded ploughing or underdrainage are the methods used to get rid of excess water as quickly as possible.

The yields on Bearbrook soils are more dependent on the proper amount of rainfall than those on any other clay soil of the district. Silage corn yields from 8 to 14 tons per acre; oats 30 to 45 bushels; hay of clover and timothy, 1 to 1¾ tons. These yields are on a six-year rotation with the use of manure but without fertilizers. Red clover may do very well some years, but alfalfa is difficult to establish and maintain on Bearbrook soils.

Courval Series

Soils of the Courval series occur mostly in the vicinity of Cedars Station but also in many small scattered areas and usually mark the transition from the clay soils to the light sandy soils. The total area occupied by these soils is 4,493 acres. They occur on level land at elevations varying from 150 to 230 feet.

The Courval soils have developed from marine clay deposits the surface of which has been covered with a veneer of sand from 4 to 10 inches thick. Both the internal and external drainage are slow; the mottling of the subsoil is the result of imperfect drainage as in the case of the Ste. Rosalie soils.

Only one soil type, the Courval sandy loam, has been mapped in this series and it is described below:

Horizon	*Variation in depth*	*Description*
Ac	5"- 7"	Dark brown to greyish-brown sandy loam, fine granules among single sand grains, very friable, pH 4.9. The texture of this horizon may vary considerably depending on the depth of the original sandy layer and its degree of mixing with the underlying clay.
A2	0"- 3"	Grey leached sand among claycy material.
Bg	8"-12"	Brownish grey clay, mottled with grey and rusty streaks; poorly developed granular structure; plastic; pH 5.0 to 6.3.
C		Grey clay; blocky structural aggregates among massive material; very plastic; pH 6.7 to 7.3.

Around Cedars Station the Courval sandy loam occurs as a complex with the Ste. Rosalie clay loam. This area is shown on the map with the symbols of the two series represented, i.e. Ro and Cu.

Agriculture

The Courval soils are nearly all under cultivation. They are used for dairying, for general crops and to a certain extent for the growing of vegetables, such as tomatoes and cucumbers. The Courval soils resemble the Ste. Rosalie soils in many respects but they are much less fertile. In some cases, deep ploughing has brought about considerable mixing of the underlying clay with the sand and thus has improved the soils and has increased the resemblance between the Courval soils and the Ste. Rosalie clay loam.

Although no definite data have been obtained on the yields of the different crops, the following estimates may be given: mixed hay, $\frac{3}{4}$ to $1\frac{1}{4}$ tons per acre; corn, 10 to 14 tons of silage per acre; oats, 20 to 30 bushels per acre; potatoes, 150 to 200 bushels per acre.

The surface soil is very acid and crops, especially legumes, would benefit by applications of lime. A good drainage system is essential on these soils to drain away rapidly the excess water which tends to accumulate on the land in the spring and after heavy rains. The land should give good response to the use of complete fertilizers and to applications of organic matter in the form of barnyard manure or green manure.

Dalhousie Series

The Dalhousie soils are geographically associated with the St. Bernard soils and occupy the depressions between the ridges at a mean elevation of 225 feet. They are located in the western part of the area where they occupy 5,228 acres. The land usually has a gentle slope from the foot of the till ridges toward the center of the depressions. The external drainage is moderately rapid on the upper part of the slope and moderately slow on the lower part. The internal drainage is slow, except in the transition zone to the St. Bernard soils where water percolation is fairly rapid.

The Dalhousie soils are almost entirely under cultivation; the non-cleared areas are covered with soft maple, elm and some cedar. The surface is entirely free from stones. The deposits from which the soil has developed are composed mostly of marine and lacustrine clay with a large proportion of silt. This clay has been influenced to various degrees by the calcareous material in the surrounding till ridges and as a result the parent material may be somewhat calcareous in the proximity of the ridges.

A description of a virgin Dalhousie silty clay loam is given below:

Horizon	*Depth*	*Description*
A0	½"- 0"	Semi-decomposed leaf mat.
A1	0"- 5"	Dark greyish brown silty clay loam, well developed granular structure, slightly friable. pH 6.2.
A2	5"- 6"	Light brownish grey silty clay (this horizon occurs as pockets, one or two inches thick), granular to nuciform structure, slightly firm.
B	6"-15"	Yellowish grey slightly mottled silty clay to clay, well developed structure, slightly firm. pH 6.6.
C	15"-	Grey clay with few rusty streaks or spots, well developed fine blocky structure. pH 6.9.

The most important variations in soil profile occur in the transition zones with surrounding soils. Near the ridges, the cultivated surface soil is of a brown colour and the subsoil assumes a greyish brown colour instead of a yellowish grey as in the profile described above.

The texture of the surface varies from a silty clay loam to a clay loam. The textural changes are very gradual and no differentiation of surface texture could be made on the mapping scale used.

Agriculture

The Dalhousie soils are among the best agricultural soils in the surveyed area and for this reason practically all the land is under cultivation. Dairying is the most common type of farming practised on these soils and on the associated St. Bernard soils. The Dalhousie soils are well adapted to the production of clover hay, grain, corn and flax. Alfalfa yields up to 3 tons per acre, while mixed hay averages from 1¼ to 2 tons; oats produce 40 to 50 bushels; corn 15 to 18 tons of silage and flax 350 to 450 pounds of fibre per acre.

The Dalhousie soils are most productive in moderately dry years and they seldom suffer from drought. During wet years their productivity is considerably decreased but the crops on these soils do not suffer to the same extent from excessive moisture as on most of the other heavy soils in the area.

Under natural conditions, the Dalhousie clay soil possesses good physical properties. The maintenance of organic matter should not be neglected, otherwise the soil will gradually become more massive and less productive.

Undifferentiated Alluvial Soils

The undifferentiated alluvial soils cover an area of 986 acres and occur as narrow bands along streams and rivers. These soils are the most recently deposited and deposition may still take place during periodical flooding. The tree vegetation consists of elm, ash and willows. The profile is only faintly developed. The surface soil is a greyish brown sandy loam to silty loam to a depth of 3 to 6 inches. The B horizon is a grey to light yellowish brown sandy loam to silty loam with occasional rusty spots and is 10 to 16 inches thick. The C horizon is a grey fine sand or sandy loam, often containing mica particles and sometimes thin bands of clay and sand.

These soils are generally not cultivated and are used as pasture during the driest part of the growing season. The soils are moist at all times and grass grows abundantly.

Organic Soils

Muck

Muck soils occupy an area of 1,243 acres. These organic deposits are formed mainly by the decomposition of grasses, sedges and wood debris. The upper 12 to 15 inches are well decomposed. The black muck rests generally over a coarse grey sand, but there is often some brown undecomposed woody material between

the sand and the muck. The muck is, in some places, 4 to 5 feet deep, but it is generally not more than 12 to 18 inches deep. The deepest well decomposed muck was found northwest of St. Lazare along the edge of the plateau.

Agriculture

The muck soils are not used extensively for cultivated crops. However, they are well suited to intense farming and to gardening when fertilizers are used to supplement the phosphorus and potash deficiencies. The areas which are particularly difficult to drain may be used as a source of organic matter to enrich the surrounding mineral soils.

Without the use of fertilizers, the acre-yields of field crops are low, mixed hay producing from $\frac{3}{4}$ to 1 ton, while cereals yield from 15 to 25 bushels. The use of fertilizers such as superphosphate and 0-16-6 or 2-16-6 mixtures is very profitable and makes it possible to attain yields as high as in the good mineral soils.

In Soulanges-Vaudreuil, the muck soils have not been used for the production of market-garden crops but if they were used for that purpose, advantage could be taken of the numerous springs which are found at the foot of the plateau, to irrigate the land during summer drought.

PEAT

The peat areas, comprising 231 acres, occur in depressions where the drainage is ponded and where plant remains have accumulated for a considerable period of time. The organic material of these deposits is only partly decomposed and has a brown colour but in some instances a few inches of black material may be found at the surface. Because these soils are very difficult to drain and have a very low natural fertility, they are generally not used for cultivated crops.

Swampy Land

About 650 acres were mapped as swampy land where the land remains under water for the larger part of the growing season. Often trees cannot grow on these wet areas and the vegetation is composed mainly of sedges, rushes and scirpus. These lands are not only of no agricultural value but they are often an obstacle difficult to cross with heavy farm machinery.

Rough Stony Lands

In the central part of Rigaud Mountain, 2,771 acres have been mapped as rough stony land. This land has very rough topography and where the bedrock is not exposed, the surface is literally covered with boulders of all sizes. The section of the Mountain called Devil's Garden, which is an amazing accumulation of stones, has been included in this type.

AGRICULTURAL METHODS AND MANAGEMENT

Under the climatic conditions prevailing in Soulanges and Vaudreuil counties, the wide variety of soils permits the production of a relatively large number of different crops. Mixed farming is generally practised and timothy, clover, alfalfa, oats, barley, silage, corn and pasture are the main crops grown. Most of these crops are used to feed the dairy cattle, while some of the milk by-product and some of the grain are fed to hogs and poultry. Vegetables and small fruits are

grown for family needs and the surplus is sold on nearby markets. Flax for fibre or green tow is the main cash crop of many farmers, especially on the heavy soils. Sugar beets are being introduced as another important cash crop. Some farmers concentrate on dairying or livestock raising and derive their income mainly from the selling of milk and meat, while others keep only a small number of cows and draw the larger part of their income from the sale of hay, flax, potatoes and small fruits.

The crops are generally grown in a six-year rotation. The first year of the rotation includes: flax, oats, barley-oats mixture, or hoed crops, such as potatoes, roots and corn. The second year, oats or barley are seeded down with a mixture of red clover, alsike clover, timothy and sometimes alfalfa. Hay is harvested during the two following years and hay aftermaths are generally used to supplement the pasture, or two cuttings are made where the legumes grow well. During the two last years of the rotation, the fields are used as pastures.

On farms where there is a permanent pasture, the rotation is shortened by two years. Fertilizers are generally applied during the first year of the rotation in which practically all cash crops are grown. The same is true for lime, however, where potatoes or flax are grown, the lime is applied during the second year of the rotation.

All the farm manure is spread on the land, either as top dressing on hay fields or applied to garden and hoed crops. The quantity of manure used varies greatly depending on the number of cattle kept. On farms where large quantities of manure are used annually the soils are richer in humus, have a higher fertility level and better physical properties.

Commercial fertilizers are used by many farmers. However, the practice of annual fertilization on a part of the rotation is far from being a general one. Superphosphate, 0-16-6, 2-12-6 and 2-12-10 mixtures are commonly used for flax, grain and pastures, while 4-8-10 is used for potatoes, corn, roots and gardens.

Liming has been practised to some extent on the most acid soils, but sometimes the material used has been too coarse. An application of $1\frac{1}{2}$ to 2 tons of ground limestone per acre is often made to prepare the land for alfalfa.

Land Use

The soils of Soulanges and Vaudreuil counties may be separated into six different classes in respect to their adaptability and management: (1) the well drained, medium textured soils; (2) the well to excessively drained, light textured soils; (3) the imperfectly to poorly drained, light textured soils; (4) the imperfectly to poorly drained, heavy soils; (5) the excessively stony soils; and (6) the organic soils.

The soils of the first group include the Coteau, Ste. Philomene, St. Bernard and Leitrim series, and cover 8,140 acres or 4 per cent of the two counties. These soils are well drained, gently undulating to gently rolling and vary in texture from loams to gravelly loams. In this group, the St. Bernard has the most accentuated relief and the largest amount of stones. The Coteau is very smooth and stone free, while the other two soils are only slightly stony and have moderate relief.

The soils of this first group are adapted to a wide range of field crops, such as alfalfa, clover, corn, pasture, oats and barley. They are also suited to such special crops as potatoes and small fruits, market garden crops and to orchards.

This land is adapted to early as well as to late crops. Variations in yields from year to year are not so great as on the other soils and in wet years, they are the most productive soils of the area.

These soils are all easy to cultivate once the stones have been cleared from the stony types. Their fertility is fair to moderate and the best fertilizer responses are obtained with superphosphate and some nitrogen on most farm crops, while legumes respond also to potash fertilization. The St. Bernard and Ste. Philomene soils are well supplied with lime, but the Coteau and Leitrim soils may benefit from liming. These four soils do not occur in large areas and often form an intimate pattern with the heavy soils, on individual farms. Under such conditions, the farms may need two kinds of rotations but they are adapted to more diversified farming. Artificial drainage is not generally needed for most farm crops. Water erosion is commonly not a serious problem but may be quite harmful on the steeper slopes of the St. Bernard soils if control measures are not used.

The second group of soils includes the excessively drained Uplands sand, the well drained St. Sophie fine loamy sand and the well drained Ste. Justine light sandy loam which altogether cover 23,930 acres or 11 per cent of the total area surveyed. These soils have developed from moderately deep sandy deposits and as a result are droughty and low in fertility. The land is generally not favourable for successful crop production unless the general fertility of the soil has been built up and the organic matter increased in order to improve the moisture-holding capacity. The occasional stones which are found on or in the soil are not a serious handicap to cultivation and the land has a smooth topography which permits the use of heavy machinery.

General farming is, as a rule, not successful on this group of droughty soils, but the production of special crops on well managed small areas may be profitable. Hay, grain, silage corn and pastures are generally very poor. However, in the most favourable locations, alfalfa may be grown successfully, if it can be established in a wet year on land which has been fertilized and limed.

Special crops such as early potatoes and sweet corn, strawberries and other small fruits, as well as some of the early vegetables may be produced quite successfully, where the supply of organic matter and the general fertility has been built up. Cigarette tobacco has not been grown extensively but might be a profitable special crop in the better areas. The land produces the best yields in wet years and crop failures may be expected in dry years.

Wind erosion is a serious hazard on the Uplands sand and crops should be protected by windbreaks, grass strips or other measures for the control of soil drifting. The ploughing under of rye, buckwheat or crop residues and the use of manure, muck and peat to increase the organic-matter content of the soil help to improve the retentive power for moisture and the resistance to drifting. Areas of blow-sand should be stabilized by vegetative cover in order to prevent the spread of soil drifting to the adjacent farm land.

At the best, the soils of this second group constitute only marginal land and planting to forest may prove more profitable than farming. This would prevent erosion and conserve water, thus acting as a moisture reservoir for adjacent land.

The imperfectly to poorly drained soils of the third group include the Courval, St. Damase, St. Amable, Soulanges, St. Zotique and Vaudreuil series, which cover 40,070 acres or 20 per cent of the total area. These soils consist of gently undulating to level, stone-free land with a light textured solum overlying a

heavy impervious substratum which impedes free natural drainage during a large part of the growing season. The productivity of the soils is mainly governed by the provision of satisfactory drainage. All these soils need artificial drainage but the degree of poor drainage varies considerably within the group. The St. Zotique and Vaudreuil soils are very poorly drained and, as a result of their depressional position, they are very difficult to drain. The Courval and the St. Damase soils are somewhat better drained than the Soulanges and St. Amable soils. The provision of satisfactory drainage outlets, although difficult and costly, is essential for the best utilization of all these soils.

The kind of crops and the success with which they can be grown depend upon improvement in drainage. General farming is commonly practised and the main crops are hay, grain and pastures. Timothy, alsike clover and to a lesser extent red clover produce satisfactory crops. The yield of grain varies considerably from year to year and the best crops are obtained in dry years, whereas in wet years they may be a failure. The carrying capacity of the pastures is not very high as they are often weedy or tend to revert rapidly to grass of low feeding value. Alfalfa is very difficult to establish and maintain on the land except on the St. Zotique soils which have been drained efficiently. Where artificial drainage is adequate all these soils are suitable for special crops such as potatoes, tomatoes, carrots and some other garden crops. The St. Zotique and Vaudreuil soils are well suited to market gardening and especially to green vegetables, such as lettuce and cabbages.

Early crops cannot be produced on any of these soils because the land is slow to dry and warm up in the spring. The organic-matter supply and the acidity of the surface layer vary considerably within this group of soils. The St. Zotique soils do not need liming and are generally well supplied with organic matter, whereas the St. Damase and St. Amable soils should be limed and enriched with organic matter. The Soulanges and Courval soils have reactions and organic matter supplies which are intermediate between the two above sub-groups and may also need liming and additions of organic matter. Although superphosphate is the main fertilizer required on these soils, potash may also give favourable response, whereas nitrogen is required mainly on the St. Amable and St. Damase soils. Manure will benefit greatly all crops, especially on the St. Amable and St. Damase soils.

The imperfectly to poorly drained heavy soils of the fourth group include the Ste. Rosalie, Rideau, Bearbrook, Baudette and Dalhousie series, which cover 110,560 acres or 53 per cent of the total area. These soils are level to nearly level with the exception of the Rideau which is very gently undulating and dissected by deep gullies. They have developed from stone-free clays or thin silty deposits over clay. Their natural fertility is high, but due to some undesirable physical characteristics, their productivity level is much influenced by climatic conditions. Artificial drainage is needed in all soils but much less in the Rideau and Dalhousie soils than in the Ste. Rosalie, Baudette and Bearbrook.

These heavy soils have a narrow range of crop adaptability but they are well suited to dairy farming for which they are commonly used. The field crops generally grown are oats, silage corn, clover and timothy, and roots, while the main cash crop is fibre flax. Alfalfa may be grown on land properly drained and limed but due to difficulties in establishing and maintaining the stands it is seldom grown alone but rather in mixtures with clovers and timothy. The soils are not suited to market gardening but some vegetable crops for canning, such as tomatoes, sweet corn, cucumbers and string beans may be grown profitably.

The crop yields on the heavy soils are best in years of average rainfall. Crop failures are due mainly to rainy spring weather which delays seeding time, germination and growth, or may cause drowning of crops, especially of newly seeded plants.

These heavy soils have the advantage of being level and free from stones, facilitating the use of any type of farm machinery. On the other hand, the establishment of an efficient drainage system is difficult and the cultivation of the land requires much power. These soils should be worked at optimum moisture conditions in order to maintain a satisfactory soil structure. This period of optimum working conditions is often very short and unless adequate machinery and labour is available to perform the task quickly, much of the land will have to be handled under unfavourable conditions. The response to chemical fertilization depends much on the climatic conditions. Phosphatic fertilizers are most commonly used and give favourable responses. The use of barnyard or green manure which helps to maintain the organic matter and the general fertility of the soil, also favours granulation and improves the permeability of the surface soil. Liming is beneficial on Ste. Rosalie and Rideau soils. Bearbrook and Baudette soils may also respond to liming, but the Dalhousie soils are generally well supplied with lime.

The excessively stony soils of the fifth group are the Rigaud and Perrot series as well as the undifferentiated stony land (RS) which altogether cover 17,490 acres or 9 per cent of the total area surveyed. These soils have developed from till and are well-drained but due to the excessively large number of stones, large boulders and rock outcrops, they are considered as submarginal agricultural land. However, in the better areas where the stones have been removed and the land has been limed and enriched with organic matter, the soils are adapted to a wide range of crops and they may be classed with the soils of the first group. Some small areas of the less stony soils are used for cultivated crops, while the largest part remains wooded. Many cleared areas have been left with most of their original stones and they are used as rough pasture which is very difficult or impossible to improve on account of stoniness. The best use of the stony land is probably forestry as it produces excellent stands of hard maple which provide maple sugar and fuel wood for the farmers of the surrounding district.

The organic soils form a very small percentage of the total acreage—1,470 acres, or less than one per cent—and are not used extensively for farm crops. These areas are often wooded or where they have been cleared the land frequently is left idle. The muck soils are suited to intensive farming and especially to market gardening. Their productivity depends largely upon good management. The most productive organic soils are those that can be irrigated as well as drained. The muck soil is very rich in nitrogen but lacks the mineral elements such as phosphorus and potash which must be supplied as commercial fertilizer. The response to fertilizers is excellent when the soil is kept at proper moisture conditions by draining or irrigating.

Estimated Yields, Productivity Ratings and Grades

It is impossible to fix an exact productivity rating for all the soils of the surveyed area because exact yield records over a long period of years are not available for each soil type. Although crop yields vary considerably from year to year and from farm to farm on the same soil type, an attempt has been made to arrive at an average yield of the main crops grown on each soil type in the area surveyed. These average acre-yields which are based on information

obtained from the farmers and on personal estimates are compiled in Table 11. They represent average estimated yields for a number of years, under prevailing farm practices. No rating has been given where a crop is not commonly grown or where incomplete information has been obtained. Productivity ratings for pasture, vegetables and small fruits are given only in descriptive terms due to the lack of definite information on yields.

In Table 12, the yields are converted into a productivity index, where 100 represents the standard yield for a given crop. These standards represent the average acre-yield obtained on the better soil types of the region on which the particular crop is extensively grown. The standards are: 40 bushels for oats, 15 tons for silage corn and 2 tons for hay of clover and timothy. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index of 100. The average of the productivity index of the main crops (hay, corn and oats) is used to find a grade for each soil type. An average productivity index of 90 to 100 corresponds with a grade of 1, an average of 80 to 90, with a grade of 2, and so on. Since the gradings are given for hay, corn and oats, they do not apply to any of the other crops. It should be understood that a soil classed in grade 2, in Table 12, might fall in grade 4 if the grading were based on such crops as apples, potatoes and small fruits. On the other hand, a soil classed as grade 5 in Table 12 might, under similar conditions, fall into grade 2.

TABLE 11

ACRE-YIELDS OF THE MORE IMPORTANT CROPS OF SOULANGES-VAUDREUIL

Soil Types	Counties on the different soil types									
	Hay of clover and Timothy	Silage corn	Oats	Alfalfa	Roots	Potatoes	Flax (fibre)	Pastures	Vegetables	Small fruits
	Tons	Tons	Bu.	Tons	Tons	Bu.	Lb.	Good Fair Poor	Good Fair Poor	Good Fair Poor
Baudette clay loam	1¾	15	40	.....	18	.....	350	G	F	F
Baudette silt loam	1½	15	40	.....	18	250	.....	G	G	G
Baudette sandy clay loam	1¼	12	30	.....	.....	250	.....	F	G	G
Bearbrook clay	1½	11	38	.....	.....	.....	300	G	P	P
Coteau fine sandy loam	1¼	12	30	2¾	.....	250	.....	G	G	G
Courval fine sandy loam	1	12	25	.....	.....	175	.....	F	F	F
Dalhousie silty clay loam	1¾	15	40	.....	.....	.....	350	G	F	F
Perrot stony sandy loam	¾	14	20	.....	.....	175	.....	F	P	F
Rideau clay	1½	13	40	.....	.....	.....	350	G	P	F-P
Rigaud gravelly sandy loam	¾	14	20	.....	.....	200	.....	F	F	G
St. Amable loamy sand	¾	9	20	.....	.....	150	.....	P	F	G
St. Bernard fine sandy loam and loam	1½	17	35	3¾	.....	225	.....	G	G	G
St. Damase light sandy loam	1	12	25	.....	.....	225	.....	F	F	G
Ste. Justine light sandy loam	¾	10	20	.....	.....	175	.....	P	F	G
Ste. Philomene gravelly loam	1½	14	35	3½	.....	250	.....	G	F	G
Ste. Rosalie clay to clay loam	1½	15	40	.....	.....	.....	400	G	F-P	F
Ste. Sophie loamy fine sand	1	11	25	.....	.....	200	.....	P	F	G-F
St. Zotique fine sandy loam	1	10	25	.....	12	175	.....	F-P	F-G	F
Soulanges fine sandy loam	1¼	11	25	.....	16	200	.....	F	G	F-G
Soulanges silt loam	1¼	13	30	.....	18	200	160	F	G	F-G
Soulanges shallow sandy loam	1¼	13	25	.....	18	200	.....	F	G	F-G
Upland sand	½	.....	10	.....	.....	150	.....	P	P	F
Vaudreuil loamy sand	¾	8	15	.....	10	150	.....	P	F	F

TABLE 12

PRODUCTIVITY RATINGS FOR COMMON FIELD CROPS ON SOILS OF SOULANGES AND VAUDREUIL COUNTIES

Soil Type	Timothy and clover (hay) 100=2 tons	Silage corn 100=15 tons	Oats 100=40 bushels	Grade*	Soil Grouping and Remarks
Baudette clay loam	88	100	100	1	High fertility. Heavy flat land free from stones: hard to cultivate, difficult to drain. Suitable to the most common farm crops. Special crops: flax and sugar beets.
Baudette silt loam	75	100	100	1	
Dalhousie silty loam	88	100	100	1	
Ste. Rosalie clay loam and clay	75	100	100	1	
Rideau clay	75	87	100	2	
Bearbrook clay	75	73	95	2	
St. Bernard fine sandy loam and loam	75	100	88	2	Good fertility. Good physical condition of the land. Certain unfavourable characteristics: either low water-holding capacity, great difficulties with drainage, stoniness or susceptibility to erosion. Suited to all common farm crops. Special crops: alfalfa seed, potatoes, barley.
Ste. Philomene gravelly loam	63	93	88	2	
Coteau fine sandy loam	63	84	75	3	
Baudette sandy clay loam	63	84	75	3	
Soulanges fine sandy loam and silt loam	63	87	75	3	
Courval sandy loam	50	84	63	4	Fertility only fair. Flat land easy to work. Needs drainage and heavy fertilization
St. Damase light sandy loam	50	84	63	4	
St. Zotique sandy loam	50	67	63	4	
Ste. Sophie loamy sand	50	73	63	4	
Perrot stony sandy loam	38	93	50	5	Fair to low fertility. Unfavourable conditions may be one or more of the following: steepness of slopes, excessive stoniness, very low retentive power for moisture and fertilizers or poor drainage. Some make good pastures. Special crops: potatoes, small fruits.
Rigaud gravelly sandy loam	38	93	50	5	
St. Amable loamy sand	38	60	50	6	
Ste. Justine coarse sandy loam	38	66	50	6	
Vaudreuil loamy sand	38	48	38	6	
Uplands sand	25	.....	25	8	Very low fertility. Subject to drought and wind erosion.

*A grade of 1 corresponds to an average productivity rating of 100-90
" 2 " " " " 90-80
" 3 " " " " 80-70
" 4 " " " " 70-60
" 5 " " " " 60-50
" 6 " " " " 50-40
" 7 " " " " 40-30
" 8 " " " " 30-20

SUMMARY

Soulanges and Vaudreuil counties are situated in the southwestern part of Quebec, near the Ontario border, between the Ottawa and the St. Lawrence Rivers. According to the 1941 census, the population of the two counties was 22,742 persons of which 90 per cent were of French origin. In 1931, about 40 per cent of the population was living on farms. The settlement of the land began in the first part of the 18th century and was completed around 1860. At that time wheat and barley production was the highest in the history of these counties. Around 1900, the bulk of agricultural production in Soulanges and Vaudreuil had turned to oats and hay. Then, the hay was the main cash crop but more recently, hay has been replaced by other cash crops, among which the most important is fibre flax. The dairy industry is becoming more and more important and many farmers draw the largest part of their income from dairy products.

The climate in the area surveyed is of the humid temperate type. Rain is abundant during the growing season, the average monthly fall being about 3·2 inches. The surrounding three lakes seem to have a tempering influence on climatic conditions and the frost-free period is from 151 to 155 days on the average.

With the exception of Rigaud Mountain, the St. Lazare Plateau and few low ridges near the Ontario border, most of the land in Soulanges and Vaudreuil counties is flat with some small undulating areas. The major problem which faces the farmers on this flat land is drainage. The most difficult tract to drain is the land extending along the St. Lawrence River from Riviere Baudette to St. Lazare Station.

Subsequent to glaciation, this area was covered by marine water and as a result most of the till and fluvio-glacial materials have been covered by marine clays. In many places, and especially along the St. Lawrence River, alluvial sands and silts have been deposited over the clay to an average depth of 3 feet. The glacial, marine and alluvial deposits form the variety of parent materials from which the soils have been derived.

The distribution of 20 soil series and of 5 land types is shown on the accompanying map and the individual soils are described in detail in the report. These soils are representative of 9 different Great Soil Groups.

The use, adaptability and management of the soils have been discussed under a separate heading. For this purpose the soils have been grouped into six land use classes, namely: (1) the well drained, medium textured soils; (2) the well to excessively drained, light textured soils; (3) the imperfectly to poorly drained, light textured soils; (4) the imperfectly to poorly drained, heavy soils; (5) the excessively stony soils; and (6) the organic soils.

The productivity of the different soils has been estimated in terms of acre-yields for the most important crops grown in the area, under average farm practices. On the basis of the average productivity index for hay, oats and silage corn, the soils have been rated and placed into different grades.

Physical and chemical analysis of some samples of surface soil and of profile horizons are presented in the appendix of this report.

REFERENCES

1—Correction des ravins.
M. R. Delisle, I.F.
Agriculture, Vol. I, No. 3, 1944.

2—Report on structural material along the St. Lawrence between Prescott, Ont. and Lachine, Que.
H. Keele and H. Cole.

3—The climates of Canada according to the new Thornthwaite classification.
Marie Sanderson.
Scientific Agriculture, Vol. 28, No. 11, Nov. 1948, p. 501-517.

APPENDIX

Tables 13 and 14

Analytical Methods

Mechanical Analysis	Bouyoucos Hydrometer Method. Ref.: Soil Science Vol. 42, 1936, p. 225. NOTE: Organic matter not destroyed prior to dispersion. Sand fractions determined by wet sieving on No's 40-60-140 and 270 sieves.
Reaction (pH)	Glass electrode.
Loss on ignition	In muffle furnace at 550°C.
Total Nitrogen	Kjeldahl method.
Total Phosphorus	Magnesium nitrate method. Ref.: Methods of Analysis, A.O. A.C. NOTE: HNO_3 not used; quantity of P determined by colorimetric method.
Total Potassium	Chloroplatinic method. Ref.: Methods of Analysis A.O.A.C.
Exchangeable Potassium	Calcium and Magnesium—Ref.: Chemical Methods of Soil Analysis. Division of Chemistry, Science Service, Dept. of Agriculture, Central Exp. Farm, Ottawa. Feb. 1946.
Available Phosphorus	Truog method. Ref.: J.A.S.A., Vol. 22, 1930, p. 879.

TABLE 13

PHYSICAL AND CHEMICAL COMPOSITION OF HEAVY TEXTURED SOILS FROM SOULANGES-VAUDREUIL COUNTIES

Soil Type and Location	Horizon	Depth in inches	Mechanical Composition			pH	Loss on ignition	Total N	Total P_2O_5	Avail. P_2O_5	Total K20	Exchangeable		
			Sand	Silt	Clay							K_2O	CaO	MgO
			(1.0-05mm) %	(.05-002mm) %	(Less than 002mm) %		%	%	%	p.p.m.	%	%	%	%
Rideau clay loam..... Pincourt, Ile Perrot,	Ac	0- 6	46	30	24	6.5	11.15	0.37	0.37	76	2.42	0.006	0.600	0.070
Rideau clay..... ½m. W. Rigaud	Ac	0- 6	20	36	44	5.9	6.45	0.19	0.13	16	2.41	0.016	0.329	0.082
Rideau clay..... 2m. W. Rigaud	Ac	0- 6	23	38	39	5.8	7.62	0.21	0.18	52	2.31	0.019	0.357	0.062
Rideau clay..... Center of Ile Perrot	Ac	0- 6	32	32	36	5.2	10.70	0.33	0.35	22	2.27	0.024	0.279	0.067
Bearbrook clay.. ..... 1m. S.W. Dorion	Ac	0- 6	20	31	49	5.8	11.12	0.31	0.25	56	2.56	0.021	0.513	0.185
Baudette silt loam..... 2m. E. St. Polycarpe	Ac	0- 6	31	51	18	6.7	6.31	0.23	0.22	30	2.23	0.010	0.232	0.057
Baudette silt loam..... .. Riv. Baudette	Ac	0.6	27	56	17	6.0	5.88	0.22	0.21	18	2.20	0.007	0.244	0.054
Baudette clay loam..... 1½m. S.W. St. Telesphore	Ac	0- 6	26	50	24	6.5	10.12	0.36	0.25	120	2.27	0.010	0.668	0.039
Baudette clay loam..... ..... Martigny	Ac B_1 B_2	0- 7 7-14 14-	32 38 26	47 33 56	21 29 18	5.1 6.1 6.1	8.43 2.29 2.60	0.26 0.02 0.02	0.20 0.12 0.14	20 48 460	2.32 2.15 2.24	0.009	0.164	0.033
Ste. Rosalie clay loam..... ..... 1½m. N.W. St. Polycarpe	Ac	0- 6	34	39	27	6.0	7.78	0.23	0.23	28	2.30	0.024	0.308	0.055
Ste. Rosalie clay..... 1m. W. Coteau Station	Ac	0- 6	20	47	33	5.5	8.68	0.25	0.21	16	2.37	0.008	0.316	0.055

Ste. Rosalie loam.....	A_1	0– 7	40	45	15	5.0	17.50	0.72	0.48	36	1.94	0.024	0.191	0.051
1m. N. St. Polycarpe.	A_2	7– 9	32	41	27	5.3	3.75	0.07	0.16	6	2.01			
	Bg_1	9–18	19	23	58	5.5	5.83	0.06	0.11	8	2.52			
	Bg_2	18–	9	26	65	6.9	3.56	0.02	0.15	960	2.14			
Ste. Rosalie clay.....	Ac	0– 8	27	40	33	5.3	10.18	0.31	0.30	38	2.77	0.011	0.206	0.053
2m. N.W. Les Cedres	Bg_1	8–18	22	33	45	5.6	4.69	0.06	0.11	10	2.28			
	Bg_2	18–30	11	27	62	6.3	3.44	0.03	0.14	460	2.33			
	C	30–	11	27	62	7.3	3.09	0.02	0.14	920	2.33			
Dalhousie silty clay loam.....	Ac	0– 8	18	53	29	6.7	14.90	0.48	0.32	128	2.16	0.009	0.960	0 098
1½m. S.E. Dalhousie Station	B	8–30	15	50	35	7.1	2.62	0.03	0.17	428	2.13			
	C	30–	8	41	51	7.4	3.19	0.03	0.16	480	2.42			

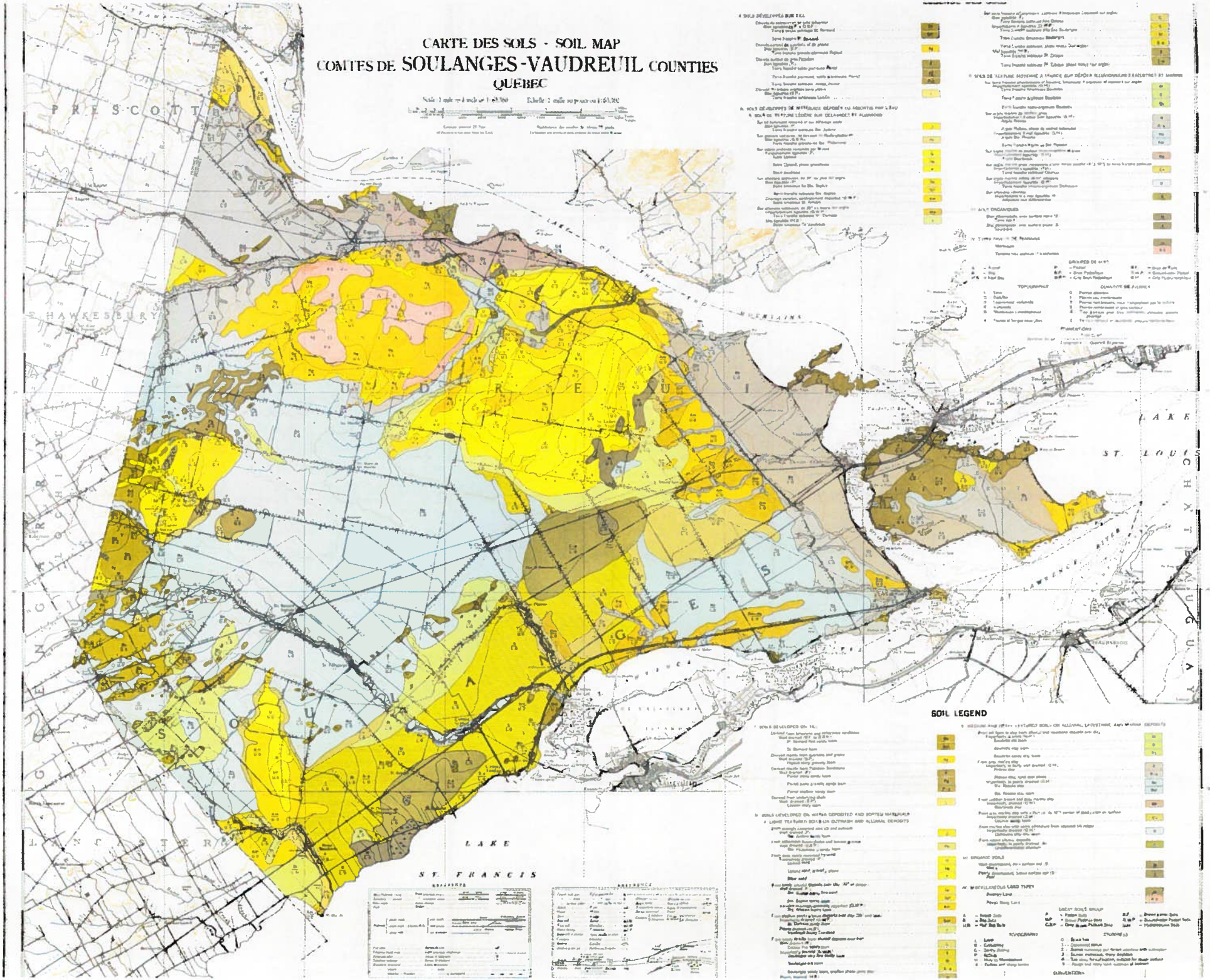
TABLE 14

PHYSICAL AND CHEMICAL COMPOSITION OF LIGHT AND MEDIUM TEXTURED SOILS FROM SOULANGES AND VAUDREUIL COUNTIES

Soil Type and Location	Horizon	Depth (inches)	Gravel	Sand %					Silt	Clay	pH	Loss on ignition	Total N	Total P_2O_5	Avail. P_2O_5	Total K_2O	Exchangeable		
				Coarse	Medium	Fine	V. Fine	Total									K_2O	CaO	MgO
			% (1mm-1 inch)	(1.0-5mm)	(0.5-.25mm)	(0.25-10mm)	(0.10-.05mm)	(1.0-.05mm)	(0.05-.002) %	(less than .002mm) %		%	%	%	p.p.m.	%	%	%	%
Upland sand..... 3m. S.E. St. Telesphore.	Ac	0- 6	7	37	24	20	8	89	8	3	6.0	2.47	0.11	0.21	136	2.09	0.005	0.087	0.007
Upland sand..... 1½m. N.E. Val-des-Sables	Ac	0- 6	10	15	25	38	9	87	10	3	5.7	2.42	0.08	0.14	42	1.89	0.003	0.082	0.002
Upland sand.....	Ac	0- 6	2	14	33	33	10	90	8	2	5.5	2.12	0.07	0.14	36	1.76	0.004	0.032	0.002
2m. W. Hudson	B_1	6-14	1					94	5	1	6.2	0.45	0.03	0.10	8	1.89			
	B_2	14-36	2					97	2	1	6.5	—	0.01	0.09	40	1.85			
	C	36-	4					98	1	1	6.5	—	0.01	0.10	24	2.12			
St. Zotique fine sandy loam... 3m. E. St. Clet	Ac	0- 6	0	1	5	23	30	59	31	10	7.4	10.15	0.25	0.23	8	1.84	0.005	0.445	0.056
Vaudreuil fine loamy sand....	Ac	0- 5	2	7	15	33	25	80	15	5	6.5	2.85	0.15	0.18	20	1.77	0.006	0.129	0.032
2m. E. St... Lazare	C	5-10	1					83	11	6	6.8	0.37	0.01	0.19	12	2.16			
	C	10-24	0					97	1	2	6.8	0.19	0.01	0.13	44	2.12			
Ste. Sophie fine loamy sand....	Ac	0- 3	0					75	20	5	4.7	9.28	0.38	0.11	6	1.56	0.013	0.115	0.015
2½m. W. St. Lazare	B_1	3-12	7	14	10	26	30	80	17	3	5.3	7.28	0.13	0.16	2	1.80			
	B_2	12-20	9					90	8	2	5.3	2.37	0.03	0.17	6	1.89			
	C	20-30	0					89	8	3	5.5	0.47	0.01	0.17	48	2.23			
St. Damase light fine sandy loam..... 1m. N.E. St. Lazare Station	Ac	0- 6	2	2	5	36	27	70	22	8	5.3	5.59	0.17	0.15	20	2.10	0.008	0.124	0.024
St. Amable loamy fine sand....	Ao	0-2½	0					69	29	2	4.5	48.85	1.20	0.17	16	0.99	0.025	0.260	0.049
1m. S.E. St. Lazare Station	A_2	2½- 3	0					86	11	3	4.4	2.60	0.07	0.04	30	1.77			
	B_1	3- 6	0	1	4	71	14	90	7	3	5.5	6.12	0.11	0.06	18	1.86			
	B_2	6-26	0					91	6	3	5.7	1.13	0.03	0.10	132	1.99			
	C	26-46						91	7	2	6.9	0.24	0.00	0.20	58	2.10			
Soulanges fine sandy loam..... 2m. S.W. St. Thomas	Ac	0- 6	0	0	3	18	34	55	36	9	6.2	6.02	0.21	0.28	14	2.11	0.008	0.172	0.010
Soulanges fine sandy loam.....	Ac	0- 9	0	0	1	17	50	68	30	2	5.7	6.66	0.45	0.28	72	1.87	0.016	0.230	0.037
1m. S. St. Thomas	B	9-12	0					72	25	3	6.0	0.90	0.03	0.25	92	2.10			
	C	12-30	0	0	0	4	59	63	32	5	7.2	0.81	0.01	0.23	20	2.21			
Soulanges fine sandy loam..... 1m. W. St. Zotique	Ac	0- 6	0	0	3	27	28	58	32	10	6.7	3.88	0.12	0.18	26	2.10	0.015	0.365	0.034
Rigaud gravelly sandy loam... Mount Oscar	Ac	0- 6	33					52	42	6	6.3	8.27	0.33	0.21	38	2.70	0.010	0.166	0.030

St. Bernard fine sandy loam.... 1m N.E. Dalhousie	A_1 B_1 B_2 C	0- 3 3-15 15-28 28-	29 45 33 38	7 1	8 14	15 23	28 17	58 55 60 66	31 29 28 26	11 16 21 8	6.0 5.9 7.3 7.9	18.30 4.08 2.41 1.93	0.69 0.12 .006 0.03	0.37 0.26 0.32 0.23	12 12 38 40	2.30 2.78 3.09 2.93	0.009	0.574	0.045
Ste. Philomene gravelly loam.. Pointe Fortune	Ac	0- 6	30	13	5	13	15	46	37	17	7.1	8.97	0.36	0.31	56	3.13	0.009	0.398	0.070
Courval fine sandy loam..... Les Cedres Station	Ac	0- 6	0	4	4	36	29	73	18	9	5.9	4.22	0.13	0.14	68	2.11	0.006	0.103	0.014

CARTE DES SOLS - SOIL MAP
COMTÉS DE SOULANGES-VAUDREUIL COUNTIES
QUÉBEC

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Hearing order: OH-002-2013
File : OF-Fac-Oil-E101-2012-10 02
Enbridge Line 9B reversal and line 9 capacity expansion project
Written Evidence
Annex 4

Bonjour M.Lalonde, Mme Domingos, M.Daoust et M.Brazeau

Je m'appelle Katherine Massam et je suis résidente de Très-St-Rédempteur.

J'espère que vous allez bien et que vous passez un bel été. J'espère aussi que mon message n'arrive pas pendant vos vacances.

Vous le savez peut-être, notre groupe de citoyens "Les Citoyens au Courant" (qui est composé de citoyens des 4 municipalités que vous représentez) participe comme intervenant dans les audiences publiques de l'Office National de l'Énergie concernent le projet Line 9B Reversal and Line 9 Capacity Expansion Project .

Je travaille sur la question numéro 8, qui concerne la consultation faite par Enbridge avec les citoyens des 4 municipalités concernées.

J'aimerais vous poser cinq questions formellement (même si c'est par courriel!) concernant cette question pour déterminer le rôle des élus. Les questions demandent pour la plupart des réponses oui ou non donc j'ose espérer qu'elles ne prendront pas trop de temps.

1. Durant les rencontres que vous avez eues avec Enbridge, est-ce que la compagnie vous a chargé de communiquer avec les résidents de votre municipalité concernant leur projet d'inversion?

2. Est-ce que vous avez compris d'Enbridge que la diffusion d'informations sur le projet d'inversion était votre responsabilité?

3. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique concernant leur projet?

4. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique *à micro-ouvert*?

5. Si oui, quelle était la réponse d'Enbridge?

Je vous remercie d'avance de répondre à mes questions. Comme vous le savez, nous travaillons avec des dates limites serrées et j'aurais besoin de vos réponses le plus rapidement possible. Vous pouvez cliquer sur "répondre", inscrire vos réponses, puis "envoyer".

Merci beaucoup de votre collaboration.
Katherine Massam

Hearing order: OH-002-2013
File : OF-Fac-Oil-E101-2012-10 02
Enbridge Line 9B reversal and line 9 capacity expansion project
Written Evidence
Annex 4

Réponses de la Ville de Sainte-Justine-de-Newton (en rose)

1. Durant les rencontres que vous avez eues avec Enbridge, est-ce que la compagnie vous a chargé de communiquer avec les résidents de Ste-Justine-de-Newton concernant leur projet d'inversion? NON

2. Est-ce que vous avez compris d'Enbridge que la diffusion d'informations sur le projet d'inversion était votre responsabilité?NON

3. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique concernant leur projet?
OUI
4. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique *à micro-ouvert*?OUI

5. Si oui, quelle était la réponse d'Enbridge?QU'ELLE ALLAIT LE FAIRE

Réponses de la Ville de Rigaud (*Chantal Lemieux, Directrice générale et trésorière)*

1. Durant les rencontres que vous avez eues avec Enbridge, est-ce que la compagnie vous a chargé de communiquer avec les résidents de Rigaud concernant leur projet d'inversion? Non

2. Est-ce que vous avez compris d'Enbridge que la diffusion d'informations sur le projet d'inversion était votre responsabilité? Non

3. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique concernant leur projet? Oui, on a indiqué que nous souhaitions et que cela serait souhaitable que des rencontres d'information publique aient lieus

4. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique *à micro-ouvert*? Nous n'avons pas indiqué à Enbridge ce que les rencontres d'informations devaient avoir comme format, ne sachant pas au préalable comment allait se tenir les

Hearing order: OH-002-2013
File : OF-Fac-Oil-E101-2012-10 02
Enbridge Line 9B reversal and line 9 capacity expansion project
Written Evidence
Annex 4

rencontres.

Hearing order: OH-002-2013
File : OF-Fac-Oil-E101-2012-10 02
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Written Evidence
Annex 4

Réponse de la ville de Très-St-Rédempteur (Jean Lalonde, Maire)

Bonjour madame Massam,

Voici les réponses à vos questions;

1. Durant les rencontres que vous avez eues avec Enbridge, est-ce que la compagnie vous a chargé de communiquer avec les résidents de TSR concernant leur projet d'inversion? Non

2. Est-ce que vous avez compris d'Enbridge que la diffusion d'informations sur le projet d'inversion était votre responsabilité? Non

3. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique concernant leur projet? Oui

4. Est-ce que vous avez demandé à Enbridge de tenir une séance d'informations publique *à micro-ouvert*? Oui

5. Si oui, quelle était la réponse d'Enbridge? À la MRC lors d'un grand conseil à huis clos, ils avaient mentionné que la séance d'information serait à micros ouverts.

Bien à vous.

Jean Lalonde, Maire