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REPORT ON STRUCTURE TEST PROGRAM WITH WELL LOG, CHAMPLAIN PARISH

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REPORT ON STRUCTURE TEST PROGRAM

CHAMPLAIN PARISH

CHAMPLAIN COUNTY, QUEBEC

Prepared For

Laduboro Oil Limited

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Photos by G. V. Lloyd and H. A. Gorrell

REPORT ON STRUCTURE TEST PROGRAM

CHAMPLAIN PARISH

CHAMPLAIN COUNTY, QUEBEC

INTRODUCTION

During the summer of 1961 Mr. Henri Dubord, acting for Laduboro Oil Limited, requested J. C. Sproule and Associates Ltd. of Calgary, Alberta to recommend a suitable exploration program for Permit No. 164. As a result, a preliminary examination of the area, including a study of published and unpublished reports and a photogeological study of mosaics and individual photographs of the area, was carried out by our Company. The preliminary work indicated the probable presence of at least two major zones of tectonic activity within the area of the Permit. Because of the possibility of traps for oil or gas occurring along these zones, further studies of the zones were recommended. These studies included field examination of outcrops in and near the Permit and the drilling of a number of structure test holes to obtain more information on the probable zones of tectonic activity and determine their position as accurately as possible and to provide information on strata likely to be encountered by deep drilling in the area.

Field mapping and co-ordination of the photogeological interpretation in Permit No. 164 and adjacent areas was conducted intermittently from August 3 to August 26, 1961 by Mr. G. V. Lloyd, who also during this interval examined the files of unpublished information at the Quebec Department of Mines. The scarcity of outcrops in and close to the Permit made it necessary to extend the area of field study for some distance outside the Permit where rocks which are expected to underlie the subject area are exposed. The field studies were completed on August 26, 1961.

Regional field studies pertaining to the stratigraphy of the area in general but not affecting the Permit in particular were made in conjunction with similar studies for Vercheres Ore-Oil Corporation who hold lands to the west of the Company holdings and the cost was pro-rated between the two companies.

Because of the thick glacial cover and the scarcity of outcrops it was not possible to map any faults or other structural features within the Permit

using surface methods. As a result of the photogeological studies and field studies, it was recommended that a number of structure test holes be drilled in the southern part of the Permit along an interpreted feature referred to as the "Champlain fault." It was also recommended that if time permitted, a number of holes be drilled along a feature referred to as the "St. Prosper fault" in the northern part of the Permit.

Six structure test holes varying in depth from 416 to 780 feet were accordingly drilled in the southern part of the Permit under the supervision of G. V. Lloyd, and later of H. A. Gorrell. Drilling operations by Walter Oes Drilling Company of Valleyfield, Quebec, began on September 22, 1961 and were completed on November 11, 1961 by James Drilling Co. Ltd. of Sombra, Ontario. Because the first southern holes indicated the presence of structure considered worthy of further investigation, more holes than originally planned were drilled in this area and time did not permit the drilling of holes in the St. Prosper area.

Following the completion of the drilling program, samples and cores for a number of wells in and near the Permit were studied by Mr. Gorrell in the offices of the Quebec Department of Mines.

Following the structure drilling and sample study, a more detailed photogeological study was conducted by Mr. J. W. Bakhoven in the Calgary office of J. C. Sproule and Associates Ltd.

The information obtained from all phases of the project is combined to form the basis of the present report.

PHYSIOGRAPHY AND ACCESS

The Permit is located northwest of the St. Lawrence River and southeast of the St. Maurice River and is about midway between Montreal and Quebec. A good network of roads provides easy access to most parts of the Permit, but travel off the roads is difficult in wet weather, especially in areas where clay lies directly below the surface. Some parts of the Permit are wooded and must be cleared before roads can be built to well sites.

The maximum relief within the Permit is about 400 feet and occurs in the north part of the Permit several miles to the southwest of the village of St. Narcisse. Throughout most of the Permit the local relief is slight and chiefly represents minor topographic features controlled by surficial deposits. In some places the rivers are fairly deeply incised and their banks are fairly steep in most places.

The highest elevation in the Permit (600 feet above sea level) occurs on a broad hill located at the extreme northern limit of the Permit. This hill slopes gently southeastward across the Permit area to an elevation of about 200 feet near Radnor-des-Forges, and from there slopes even more gently to the southeast toward the St. Lawrence River which is only slightly above mean sea level adjacent to the Permit. The greater part of the Permit lies between elevations of 100 and 200 feet.

The Permit is characterized by sandy soil and is well drained by the Champlain River and its tributaries. Some clay soils occur in parts of the Permit. A small area in the west of the Permit drains into the St. Maurice River. Two fairly large, poorly drained and swampy areas are present in the Permit. The largest lies in the southeast, several miles north of Champlain station and extends from there toward Red Mill. A small swamp is situated in the west of the Permit several miles to the west of the village of St. Louis-de-France (called St. Louis-de-Champlain on certain maps).

ACKNOWLEDGMENTS

Acknowledgment should be made first to the staff of the Quebec Department of Mines in Quebec City for the use of their facilities and for information given in discussions of the geology of the area. Dr. T. H. Clark of McGill University generously provided much additional information concerning the area. Mr. Claude Robitaille, P. Eng., of Laduboro Oil Limited, surveyed a number of the structure test holes and acted as interpreter when necessary. He was most helpful in innumerable other ways.

REGIONAL GEOLOGICAL SETTING

Permit No. 164 lies within the geological sedimentary basin commonly referred to as the "St. Lawrence Lowlands." Near the Permit the northern side of the Lowlands is formed by hills of Precambrian crystalline rocks that comprise the Laurentian Uplands. To the south lie the Notre Dame Mountains of the Appalachian highlands which consist of tightly folded and faulted sediments south of the Logan fault or, as it is more commonly known, Logan's Line. The central part of the Lowlands contains sediments of Ordovician and probably Cambrian age which have been deformed into the long northeast-trending syncline, the axis of which lies a short distance south of and, approximately parallel to, the present course of the St. Lawrence River. The holdings lie on the north flank of the syncline, and strata exposed in the area are Precambrian to Ordovician in age. The regional setting is illustrated on Figure II, a regional-geological map. Regional dips in the area are approximately four feet to the mile to the southeast as indicated by our structure contour map on the Montreal formation, Figure III.

Deposition of the sediments of the St. Lawrence Lowlands was initiated in Cambrian time and continued throughout the Ordovician. Consolidated rocks younger than Ordovician are not known to exist in the Champlain area so that no comments can be made on the geological history of the area in the post-Ordovician Paleozoic time or in Mesozoic time. It is probable that at least some beds were deposited during these periods but these have been removed by erosion.

Pleistocene to Recent deposits include reworked tills and glacio-fluvial deposits, inter-glacial marine shales and silts and sands of both fluvial and aeolian origin. The marine clays and sand represent the advance of the Champlain Sea into the St. Lawrence Lowlands.

STRATIGRAPHY

Although the rocks exposed on the flanks of the St. Lawrence Lowlands have been the subject of study for many years, the relatively small number of outcrops and their limited lateral extent and thickness have, as yet, prevented geologists from obtaining a thorough understanding of the relationships of the various rock units underlying the area. It appears that there are very rapid changes in lithology taking place towards the centre of the basin as well as lateral facies changes within the basin.

The rocks available for study in outcrops are, for the most part, those which were deposited fairly close to the flanks of the basin and may differ considerably from those deposited in the deeper, central portions of the basin. Only a very small number of wells scattered over a large area have been drilled past the Black River-Trenton section and many more wells and much more study is required before any comprehensive picture of the lithologic variations which apparently occur in the deeper parts of the basin can be obtained. Many of the stratigraphic units which have been set up, using surface exposures, are based on paleontological evidence and adequate paleontological information is only rarely obtained from cuttings from wells. In particular, the Beekmantown and Chazy groups provide many problems in correlation in the subsurface with the Chazy-Potsdam contact also being problematic in many areas.

A detailed study of the subsurface stratigraphy of the area is not within the scope of the present project and would, in any case, be extremely difficult because of the relatively small number of deep wells available for study. Therefore, while the samples and cores from a number of wells in the general area of the Permit were studied in an attempt to determine the lithology of the rocks to be expected underlying the Permit, it is not possible at this time to predict details of thicknesses or lithology of these formations with any degree of accuracy.

Sample and core descriptions for the wells examined are appended to this report.

The table of formations and descriptions of formations which follow are based largely on evidence obtained from outcrops some distance from the Permit itself. These should not necessarily be regarded as indicative of what may be found underlying Permit No. 164, but they do provide the best information presently available. Because of the greater number of wells drilled to the Trenton, and because of the apparent greater uniformity in lithology, the stratigraphy down to the base of the Trenton may be regarded as fairly well understood.

In the table of formations a number of unconformities and disconformities are indicated. These stratigraphic breaks, like the lithologies of the rock units, are largely interpreted from evidence obtained from outcrops on the flanks of the basin. The unconformities and disconformities may not all extend into the deeper part of the basin where sedimentation may well have been continuous during periods of erosion or non-deposition on the flanks. Formational contacts which are reasonably well defined in the surface exposures may, therefore, be gradational in the deeper part of the basin adding to the difficulty in picking formational tops in well samples. Although we have spent

considerable time attempting to correlate wells in the area of the Permit, we have so far been unable to satisfy ourselves that formation tops can be picked with any accuracy below the Trenton and have, therefore, omitted these tops in our sample description.

Table of Formations

Age	Group or Formation	Lithology	Approximate Thickness Feet
CENOZOIC			
Pleistocene and Recent	Post-glacial Deposits	Sands, bog deposits	0-50
	Non-marine Glacial Deposits	Non-marine alluvial sands, aeolian sands, rarely fine gravel.	100
	Champlain Sediments	Blue-grey, laminated, silty clays; fine sands.	50-200
	Glacial Deposits	Boulder clays, reworked tills, fluvio-glacial sands and gravels.	10-25
		- UNCONFORMITY -	
PALEOZOIC			
Ordovician	Lorraine Group Upper Lorraine Nicolete River	Grey, fine-grained, argillaceous, micaceous, siltstone and sandstone with dark grey shale bands, gradational contact with underlying Leclercville.	0-300
	Lower Lorraine Leclercville	Dark grey to very dark grey shale, thin light grey siltstone stringers.	0-1000
		(The contact between the Lorraine and Utical is gradational)	
	Utica Group Lotbiniere	Dark grey to black shales, commonly graptolitic, becoming slightly calcareous in the basal part.	0-300
		- DISCONFORMITY? -	
	Trenton Group Upper Trenton Tetreauville	Dark grey to black, argillaceous, dense limestones; abundant dark grey to black calcareous shale.	0-450

Age	Group or Formation	Lithology	Approximate Thickness Feet
	Middle Trenton Montreal	Brownish grey and grey, fine to medium, crystalline limestones, predominantly fragmental in origin.	
	St. Casimir	Grey to black, dense and fragmental, cherty limestones.	
	Deschambault	Grey, thick-bedded, fragmental limestones.	
	Fontaine	Dark grey, crystalline, shaly and argillaceous limestones.	
		- DISCONFORMITY -	
	Black River Group Radnor Forge	Dark grey, rubbly weathering, shaly limestone	0-50
		- DISCONFORMITY? -	
	Chazy Group	Dark brown, brown and grey partly, argillaceous limestone, light and dark grey, fine- to medium-grained sandstones.	0-800
		UNCONFORMITY? -	
	Beekmantown Group	Dolomite, dolomitic sandstones and sandstones, usually light in colour; may be missing locally.	0-350
		- UNCONFORMITY -	
Cambrian	Potsdam	White, quartzitic sandstone	0-500?
		- UNCONFORMITY -	
PRECAMBRIAN	Grenville	Gneisses of the basement complex.	

Description of Formations

Precambrian Basement Complex

Grenville Series

The Precambrian "basement complex" in the area consists mainly of gneisses of the Grenville series. These are well exposed as rounded hills and ridges a short distance north of the Permit area. Exposures of the Grenville also occur along the St. Maurice River between Shawinigan Falls and La Gabelle station, notably near the village of St. Etinne-des-Gres. At the latter locality the gneisses form the foundation for the dam and crop out at elevations as high as 100 feet above sea level. Sandstones of early Paleozoic age are also exposed near at hand.

A study of the bore hole information in the general area of the Permit reveals that considerable relief is present on the Precambrian erosional surface. In some places, for example, Trenton limestones directly overlie the Precambrian, and in others apparent Beekmantown, Chazy, or Potsdam beds overlie the Precambrian. At Cap de la Madeleine, for instance, in two wells only a few hundred yards apart there is a difference of almost 700 feet in the elevation of the Precambrian surface. Presence of additional section in the deeper well shows that most of this relief existed before Trenton deposition.

Basement "highs" of considerable relief may have been present before and during deposition of the sub-Trenton formations due to differential resistance to erosion of the various rock types which comprise the gneissic Grenville series. These highs were subsequently buried by concordant deposition of the surrounding sediments. The high relief areas could also have been brought into existence by faults that were active before Paleozoic deposition. There is also a strong possibility that post-Trenton faulting has occurred, suggesting that structure on the Precambrian surface in some places may have this origin. It is likely that combinations of the above also occur and that later movements have taken place along faults that originated prior to Ordovician deposition.

Near the northern limit of the Permit area the outcrop pattern of the edge of the Precambrian basement complex is sinuous and discontinuous, suggesting the presence of a normal but unconformable stratigraphic contact. Further evidence of this is revealed to the northeastward where pockets of stratified sediments occur in the area of Grenville outcrops (Karrow, 1959)[1] in an area of fairly low topographic relief.

Cambrian

Potsdam Formation (Emmons, 1838)

Throughout a large part of the Quebec Lowlands area the oldest Paleozoic sedimentary formation is the Potsdam. Although units that could be correlated with the Potsdam were not seen during the field study, the exposures were sparse and small and it is probable that this unit, or its correlative, is present in the area, especially in low places on the flanks of areas of high paleotopographic relief.

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(1) Names and dates in brackets refer to bibliography at the end of this report.

The Potsdam has been studied in the Montreal area by Clark (1952, p. 17), who notes that throughout its extent it is essentially a dominantly white, crossbedded, quartz sandstone that varies in thickness from zero to several hundred feet. In a single place it was mapped as nearly 1,700 feet thick in the subsurface by Clark (1952, p. 22), but he regards this occurrence as a local development due to unusual conditions.

A marine origin is suggested for the Potsdam by Clark due to stratification, crossbeds, ripple marks, mud cracks, and Scolithus burrows. He also indicates that wind-blown sand grains comprise a large percentage of those present, especially near the top (Clark, p. 21). Frosted sand grains seen in well samples tentatively identified as Potsdam confirm the presence of wind blown sands. The Potsdam is generally placed in the Upper Cambrian on the basis of the occurrence of Linguella acuminata, but Clark (1952, p. 25) indicates that the Potsdam may have been deposited in earliest Ordovician time as the basal phase of an advancing sea.

Sandstones also occur in the overlying Beekmantown and Chazy beds and it is not possible to accurately pick the top of the Potsdam from well samples. Some 75 feet of siliceous sandstone occurring above the granite in the Cap de la Madeleine No. 2 well is regarded as Potsdam. Probably at least part of the thick sandstone section in the Imperial Champlain No. 1 well is Potsdam in age. It is particularly difficult to pick the top of the Potsdam where the dolomites of the Beekmantown Beauharnois formation are missing, as appears to be the case in many wells in the vicinity of the Permit.

Ordovician

Beekmantown Group (Clarke and Schuchert, 1899)

La Gabelle and March Formations

In several outcrop sections along the west side of the St. Maurice River between La Gabelle and Les Gres, sandstones are present a short distance above Precambrian gneisses. These sandstones are believed to represent part of the Beekmantown group in this area, although there is an equal possibility that they may represent equivalents of the Chazy group.

The outcrops between La Gabelle and Les Gres have been previously examined by Clark (Geol. Surv., Quebec, unpublished report), who correlates them with the Beekmantown on the basis of a poorly preserved, flat, coiled gastropod found at Les Gres. To these beds Clark has tentatively assigned the name "La Gabelle formation."

The following section was measured, described and sampled near the southwest end of La Gabelle dam.

La Gabelle Formation
(Lower Ordovician)

Outcrop Location: On side of hill below and east of railroad track, not far from southwest end of dam. Also on road that leads to base of dam.

Elevation 125 feet

Described by; G. V. Lloyd

	Description	Thickness Feet
	Overlying beds covered.	
La Gabelle Formation	Sandstone, arkosic, pale pinkish grey and rusty brown weathering, fine- to coarse-grained, very poorly sorted, sub-angular to sub-rounded, with white, clear, and smoky quartz and abundant very fine pinkish grains (feldspar?), poorly to medium well-cemented with silica, abundant intergranular silt and very fine quartz grains, thick but poorly bedded.	6.0
	Attitude: apparently horizontal	
	Covered by talus and vegetation	25.0

About one and one-half miles to the northwest, near the site of the former Les Gres railway station, several good outcrops of sandstones occur in small creek beds. The following section was examined here.

La Gabelle Formation
(Lower Ordovician)

Outcrop Location: On creek bed, at waterfall, on west side of road about 1,000 feet north of former site of Les Gres station.

Elevation 100 feet

Described by: G. V. Lloyd

	Description	Thickness Feet
	Overlying beds Pleistocene deposits	
La Gabelle	Sandstone, mainly light grey and pale brown, mostly medium-grained, but local thin grit and pebble and cobble conglomerate layers to four inches thick, mainly grey and clear quartz in white kaolinitic matrix, well cemented, well compacted, medium friable but with some thin, loose and easily friable beds, poorly medium (4 to 6 inches) bedded with irregular flaggy weathering.	25.0
	Attitude: apparently horizontal	
	Base of measured section: Exposures of gneiss located nearby.	

Features of the Beekmantown group in southern Quebec have been reviewed by Clark (1952, 1956), who notes that the group is comprised of two formations. At the base lies the March formation, a sequence of sandstone and dolomitic sandstones that varies in thickness from zero to 200 feet. Overlying this is the Beauharnois formation, which consists, according to Clark (1956) ". . . of a great variety of dolomites and dolomitic limestones, mostly fine to very fine-grained, and carrying in some beds a few open cavities now partially filled with druses and solid hydrocarbons. Fossils are scarce. Limestone and sandstone beds are not numerous, and are confined to the lower part of the formation . . ." The Beauharnois is stated by Clark to vary from zero to almost 1,100 feet in thickness and to be unconformably overlain by the Chazy group.

There is little current information concerning the areal extent of the Beekmantown in southern Quebec and a detailed study of sample cuttings from wells drilled in the Quebec Lowlands is considered beyond the scope of this report. Clark (1956) has noted that despite their great thickness in the Montreal area they thin rapidly not only northwest along the flank of the Precambrian gneisses but also northeastward so that in the central part of the Lowlands near Three Rivers they are 350 feet thick and are absent to the north on St. Maurice River. The suggestion that they may be absent on St. Maurice River points again to the indefinite correlation of the La Gabelle sandstones with part of the Beekmantown.

The presence of Beekmantown beds in or close to the Permit has not been confirmed from sample studies. The Imperial Lowlands Seaway Champlain well did not penetrate any beds regarded as Beekmantown in age but these could be present below the total depth of the well.

Dolomites and dolomitic sandstones from a depth of 2,540 feet to the total depth of 2,841 feet in the Canso-St. Maurice-Pointe du Lac No. 1-B well may be at least partly of Beekmantown age.

Dolomitic sandstones overlying siliceous Potsdam sandstones in Cap de la Madeleine No. 2 may be of Beekmantown age but there is a possibility that they may be of Chazy age, in part at least.

There is a thick dolomitic section from about 3,200 feet to about 3,850 feet which may be of Beekmantown age in Imperial Lowlands No. 2, about five miles southwest of the Permit boundary.

At the Bald Mountain Batiscan No. 3 well, a few miles east of the Permit, there is no evidence of typical Beekmantown beds, although, as in the case of the Imperial Champlain well, it is possible this well has not penetrated deep enough to encounter such beds if present.

As mentioned earlier, the Potsdam, Beekmantown and Chazy may, in the deeper part of the basin, be quite different than in the better known sections on the flanks, hence the difficulty in recognizing lithologic equivalents of the type sections. In the basin deposition may have been continuous with many facies changes which are not yet clearly understood.

Chazy Group (Emmons, 1842)

Throughout a large part of the Quebec Lowlands the strata of the Beekmantown group are unconformably overlain by beds of the Chazy group, which is divided by Clark (1952) in the Montreal area into two units, the basal sandstones and the overlying upper limestone beds. The total thickness of the Chazy group is stated by Clark to be mainly in the order of 300 feet, although a maximum thickness of 890 feet is noted in Champlain Valley, and the unit thins to the north and west of Montreal. It is apparent that the beds of the group were deposited against areas of high Precambrian relief, particularly along the northwestern flank of the Quebec Lowlands, and that in these regions the Chazy may be thin or absent. The Chazy group is disconformably overlain by the Black River group.

Basal Chazy Sandstones

In his discussion concerning the Chazy group of the Montreal area, Clark (1952, p. 34) noted that in the subsurface of the Montreal area the basal, or lower parts of the Chazy sequence of rocks was formed of sandstone or sandy beds, in contrast to the upper part which consisted chiefly of limestones and minor amounts of shale. To the basal Chazy sandstones present near Montreal, Clark applied the name "Sainte-Therese member," and included them within his Laval formation which was applied by him to the Chazy beds at this locality. Subsequent work by Clark and others has led to the discovery of basal Chazy sandstones over a fairly wide area in the Quebec Lowlands, and to local occurrences of these sandstones such names as "St. Therese," "Joliette," and "St. Dominique" members or formations have been applied.

Clark (1956) has written that lithologically the sandstones ". . . for the most part are clean, well-washed, fine-grained quartz sandstones, in some outcrops very porous and with only a small amount of cement . . . ." In the Montreal area, Clark (1952, p.42) notes that in the subsurface the lower part of the Chazy consists of 42 feet of sandstone with shale and minor impure limestone. The sandstone is stated to occur in layers 2 to 27 inches thick and consists of light grey or white quartz sandstone, speckled with small flakes of black shale, and cemented by calcite.

Most of the Chazy strata that outcrop in the Ottawa area, particularly along the north shore of the Ottawa River, consist of shale and sandstone (Dresser and Denis, 1944, p. 258) and have been previously given the name "Aylmer formation" by Raymond. It is noted by Dresser and Denis that the Aylmer beds have some of the characteristic fossils of Chazy beds elsewhere but that their fauna is quite distinctive. For the shale and sandstone beds in the lower part of the Chazy in the Ottawa area the name "Rockcliffe formation" was applied by A. E. Wilson (1946), who also termed the overlying limestones the "St. Martin formation." According to Clark (1952, p.43), there are not enough similarities between the Chazy strata of Montreal area and the Ottawa area to apply the Ottawa nomenclature at Montreal.

There is, at present, very little detailed information concerning the extent and development of the basal Chazy sandstones in and near the subject acreage. With the exception of the sandstones which outcrop on the west bank of St. Maurice River near Les Gres and La Gabelle (discussed previously with the Beekmantown group), there are no exposures near at hand that can be readily correlated with the Chazy group.

Some additional information can be obtained from the bore holes previously drilled near the Permit, but due to strong variations in thickness and lithology a much more detailed study of samples is necessary before the correlations can be made with confidence. Such a study was not conducted because the exact age of sands thought to be present under the Permit is not of vital importance at this time.

At Imperial Lowlands Seaway Champlain No. 1, within the Permit, sandstone was encountered at about 2,540 feet and the section was predominantly sandstone to a total depth of 3,024 feet. At least part of this sandstone section is thought to be of Chazy age although, as previously mentioned, part of it may be correlated with the Potsdam.

Many wells in the area, both to the east and west of the Permit have thick sand sections underlying the Trenton-Black River section. Notable examples are Bald Mountain Batiscan No. 3 with over 600 feet of predominantly sand section and Great Sweet Grass Yamachiche No. 4 with at least 250 feet of sand. These sections are regarded as Chazy, in part at least. The most notable lithologic feature is that in many cases only loose sand grains are preserved as cuttings and only rarely are cemented fragments of sandstone seen. Normally this would be taken to indicate extremely good porosity, but it is possible that a matrix may be present which is removed in drilling or washing. In some cases where the best apparent porosity is seen no fluid is reported in the well, casting some doubt on the apparent porosity. The problem can only be solved when more wells are drilled and cored.

Upper Limestone Beds

Overlying the basal Chazy sandstones in the Quebec Lowlands, but separated from them by an interval of calcareous shales and beds of both limestone and sandstone, is a sequence of bedded carbonates that comprise the upper part of the Chazy group. For ease of reference and lack of a readily applicable name in the area, they are referred to herein as simply the "Upper Limestone beds." The term "Chazy limestone," used by some authors in southern Quebec, probably refers to all, or part, of the limestone beds discussed here.

In general, according to Clark (1956) the limestones are fine and coarse grained, fragmental with fossils and fossil debris. Clark notes that the limestones have been recrystallized and this process has deprived them of much of their original porosity and permeability. He also records the presence of dolomitic beds associated with biohermal reef developments but does not elaborate on this significant fact in this 1956 paper.

Dresser and Denis (1944, p.258) note also that ". . . reef structures are widespread. . ." in the Chazy limestones.

Due to variations in limestone development between the Montreal and the adjacent areas, such as Ottawa and Champlain Valley, Clark (1952, p.43) has introduced the term "Laval formation" for the Chazy limestones near Montreal. He notes the occurrence of shale and impure shales here and indicates that the Laval formation is characterized chiefly by calcareous shales and argillaceous limestones. The limestones are light to dark grey and mostly well to medium bedded (two inches to thirty inches) and crossbedded. He notes also irregular patches and streaks of dolomite in association with the reef developments, mentioned previously.

The upper contact of the Chazy group is apparently disconformable with the overlying Black River group because no angular unconformity can be seen between the Chazy and the Black River, although a very strong faunal difference is noted (Clark, 1952, p.46). The absence of Chazy strata in the Montreal area as old as Chazy beds in the Champlain Valley region tends to confirm that the Chazy rests unconformably on the underlying Beekmantown. Clark (1952, p.46), however, points out that there is ". . . no evidence of anything but weak erosion affecting the underlying Beekmantown beds. . . ."

The Laval formation is correlated by Clark with the St. Martin and Rockcliffe formations of the Ottawa area and with the Valcour formation of the Champlain Valley area.

Although it is apparent that the "Upper Limestone beds" of the Chazy group extend, and can be correlated, throughout a wide area in the Quebec Lowlands, there is little information to suggest their thickness and character within the Company's acreage holdings. In the subsurface we have so far not seen evidence of a disconformity between the Chazy limestone and the Black River group, although such a disconformity may exist. In samples the limestone section below the Trenton appears continuous with no pronounced lithologic breaks. Sandy limestones noted near the base of the Trenton-Black River section in a number of

wells may be equivalent to the Chazy Upper Limestone beds. The lower part of the limestone section in Imperial Lowlands Champlain No. 1 may be correlative with the Chazy limestone but this cannot be confirmed from the data available.

From our investigation of Chazy sediments and underlying beds it is apparent, as mentioned previously, that these beds were transgressively deposited across a Precambrian surface of considerable paleotopographic relief so that, although fairly well developed in some areas, they are thinner flanking the high areas and completely absent in places where the Precambrian relief projected above the Chazy depositional environment. It will be necessary to do much additional detailed study to locate accurately the Precambrian highs and determine their extent. Facies changes within the basin, which may be related in part to the topographic highs, complicate the problems.

Black River Group (Vanuxem, 1842)

The term "Black River" group is assigned to the strata lying between the Chazy group below and the Trenton group above. Although it is relatively thin, about 70 feet thick according to Clark (1956), it can, in outcrop, be divided into three distinct formations in Quebec (Okulitch, 1936). In ascending order these are: the Pamelia formation, which consists of orange-weathering dolomite with lesser amounts of shale; the Lowville, which is composed of highly fossiliferous, thin-bedded, compact, conglomeratic, shaly, or oolitic limestones; and the uppermost formation, the Leray, consisting mostly of dark, thick-bedded limestone, sparingly fossiliferous but carrying abundant chert (Dresser and Denis, 1944, p.260). These formations are conformable with each other, but the group is apparently unconformable on the Chazy and, in turn, unconformably overlain by the Trenton, according to Dresser and Denis (1944, p.260). Clark (1952, 1956) describes the upper and lower Black River contacts as probable disconformities and notes that there is a sharp faunal break with the underlying Chazy in contrast with the overlying Trenton with which the Black River fauna is more closely allied.

The Black River strata are fairly well known in the Montreal area, but less so in the vicinity of the Permit. In this regard, for example, Dresser and Denis (1944, p.260) write that the Black River beds probably pinch out and do not actually reach the St. Maurice River.

In regard to the latter point, however, a more recent, but as yet unpublished, work by T. H. Clark, on file in the Geological Survey Branch of the Quebec Department of Mines, indicates the presence of Black River outcrops northeast of the St. Maurice River, in the vicinity of Riviere-au-Lard, not far from Radnor-des-Forges. These outcrops consist of dark, dense limestones, dark and very fine-grained limestones and shaly siliceous limestones, collectively totalling some 30 feet in thickness. Clark notes that fossils from these beds represent a typical Leray (upper Black River) assemblage. In his unpublished manuscript Clark also indicates the possible presence of an outcrop of Black River limestone on the banks of the Yamachiche River some two miles west of the village of St. Etienne. A traverse of the river in the vicinity of this location failed to reveal a definite outcrop of Black River beds here; however, the

locality lies north of known Trenton exposures, and Black River strata could normally be anticipated to occur here either as outcrops or perhaps boulders of near-outcrop material. There are exposures regarded as Black River in age near Radnor-des-Forges within the Permit area.

In the subsurface the lower part of the Trenton frequently consists of fine-grained dark limestones which are difficult to distinguish from similar lithologies in the Black River. At Bald Mountain St. Genevieve de Batiscan No. 1 we have picked the top of the Black River at 640 feet, but in this case have been unable to pick the base of the unit with any certainty. It may be about 680 feet, giving a thickness of 40 feet.

It appears that not more than 80 feet of Black River beds are to be expected underlying the Permit, although there are indications of a southern thickening of the strata towards Imperial Lowlands No. 2 and it is possible that a thicker section will be present.

Trenton Group (Vanuxem, 1842)

The Trenton group consists mainly of brown, grey and dark grey, locally fossiliferous limestones. The upper part of the Trenton group is very argillaceous and grades to a very dark grey to black, calcareous shale. The Trenton is exposed at the quarries at St. Louis-de-France or, as it is called on the topographic maps of the area, St.Louis-de-Champlain, within the Permit area, but other exposures in the general area are rare. The Trenton dips gently to the southeastwards as indicated in our structure contour map on the top of the Middle Trenton, (Figure III) so it is exposed to form a broad area subcrop below the Pleistocene beds across much of the central and norther part of the Permit area. The Trenton forms the bedrock in the area of the northern Seawy-Almega-St. Maurice drill holes, as evidenced by the cores obtained from these wells.

In outcrop, beds of the Trenton group are interpreted as lying disconformably on the Black River group in most places but, locally, where the underlying sediments are absent, the Trenton unconformably overlies rocks as old as Precambrian. The Trenton is gradationally overlain by dark shales of the Utica group which are probably contemporaneous with certain upper beds of the Trenton in places. The Utica shales,are, however, usually chosen by most geologists as the boundary between the Champlain series below and the Cincinnati above. Because of the problems already discussed in differentiating the Trenton and the underlying Black River and the Chazy limestones, it is difficult to pick the base of the Trenton from samples. If the first argillaceous limestones below the fragmental brown limestones regarded as Middle Trenton are taken to mark the top of the Black River, then it appears that not more than 600 feet of Trenton can be expected underlying the subject Permit, except possibly in the most southern part. On this basis, Imperial Lowland Champlain No. 1 would have approximately 400 feet of Trenton, which would be regarded as representative of most of the Permit except, of course, for the northern parts where the Trenton has been subjected to erosion.

The thickness of the Trenton near the holdings is somewhat thinner than in the Montreal area where from 755 to 1,075 feet are reported (Clark, 1952, p.75).

The regional extent of the Trenton group has been reported on in general by Dresser and Denis (1944, p.263), and in detail by Clark (1952, 1956, 1959). Suffice it to say that the group is recognized in parts of New York and Ontario, over a wide area in southern Quebec, and as a belt along the north side of the St. Lawrence River from Montreal to Quebec City and beyond to the northeast as far as Murray Bay.

Based mainly on paleontology, and to a lesser degree on distinctive lithology, it has been possible for previous geologists to subdivide the Trenton into formations in local areas. In the Montreal area, for example, four formations can be recognized representing lower, middle and upper Trenton deposition. In the Grondines-Neuville area it is also possible to map four units (Clark, 1959, p.19). It is thought by Clark, however, that there it is not possible to separate the upper and middle Trenton depositional cycles. The following Trenton formations have been outlined by Clark.

Fontaine Formation

In the unpublished manuscript by Clark in the archives of the Geological Surveys Branch of the Quebec Department of Mines, mention is made of the Trenton beds exposed in the Three Rivers area. In this area he recognizes four units. The base of the Trenton is marked by a relatively thin unit, perhaps eight feet thick, of thin-bedded, dark, fine-grained, crystalline limestones associated with abundant, thin, shaly beds rich in bryozoa and brachiopod fragments. This basal unit is termed the "Fontaine" formation by Clark, who assigns a Rockland age to it, and has correlated it with the St. Alban, Pont Rouge and Ouareau formations. These lower Trenton beds outcrop within the Permit in the vicinity of the Riviere-au-Lard, a short distance south of Radnor-des-Forges. This unit is not recognized from well cuttings.

Deschambault Formation

The Fontaine is followed upward by the Deschambault formation which consists mainly of light grey, fragmental, fossiliferous limestone (Clark, 1959, p.15). The Deschambault strata outcrop near Bournival, about eight miles northwest of the Permit, and here the following section was measured.

Deschambault Formation
(Middle Ordovician)

Outcrop Location: In banks of the Yamachiche River, near Bournival bridge.

Described by: G. V. Lloyd

	Description	Thickness Feet
	Overlying Pleistocene deposits.	
Deschambault Formation	Limestone, very dark grey and dark grey weathering, finely crystalline to coarse-grained to fragmental in poorly defined	6+

Description	Thickness Feet
alternating layers, trace of irregular thin silty layers, common smoky and black weathering chert nodules in discontinuous thin layers and as irregular scattered walnut- to orange-sized nodules, with minor thin fossil fragment layers of gastropods, brachiopods, and onion-sized stromatoporoids, irregularly thin (two inches) and medium (five inches) bedded; weak petroleum odour on the freshly fractured surface.	
Attitude: Dips gently southward near bridge; south of bridge about 1,000 feet at site of old, small dam site the dips are much steeper, 12 or 14 degrees southwest, strike 100 degrees azimuth. Common irregular joints indicate that outcrop possibly lies near a fault zone.	

It is difficult to correlate this outcrop with the subsurface section in the adjacent areas, and consequently its thickness is not known. The Deschambault is stated by Clark to represent a remarkably persistent unit of Lower Trenton (Hull) age.

St. Casimir Formation

The Deschambault is reportedly overlain by the St. Casimir formation (Clark, 1959, p.17), which consists of a great variety of limestones that are as much as 180 to 190 feet thick in the Portneuf-Grondines area. These beds may represent the strata that outcrop along the St. Anne River, a short distance southwest of the village of St. Casimir. These strata are typically dark brown-grey and grey weathering, finely crystalline to medium fragmental, poorly medium-bedded limestones that differ only from the outcrops on the Yamachiche River near Bournival in that they lack chert. We have so far been unable to separate these beds from the overlying fragmental limestones of the Montreal formation in the subsurface.

Montreal Formation

In the subsurface area of the Permit, it is only possible to divide the Trenton into two major units with any certainty. The lower unit, which is here referred to as the Montreal formation, probably also includes the Fontaine, Deschambault and St. Casimir formations of Clark which are described above. These beds are overlain by dark, fine-grained, dense, argillaceous limestones and calcareous shales of the Tetreauville, and while the contact between the Montreal and Tetreauville is apparently gradational and probably transgressive, it can be picked in samples with some degree of accuracy, and the change from a

dense, argillaceous limestone to a fragmental limestone makes a useful marker bed in the area. As previously remarked, the change is probably transgressive but the transgression is probably not sufficient to preclude its use as a marker considering the distances between wells in the area.

The Montreal formation is of particular interest since gas has been reported from this unit and since re-crystallization and dolomitization of these beds could form porosity and resultant reservoirs. Beds thought to be equivalent to the Montreal formation are exposed in a quarry a short distance north of the village of St. Louis-de-France (St. Louis-de-Champlain) within the Permit. At this quarry, Lloyd measured 47 feet of outcrop which can be summarily described as a very thick, dark grey and medium grey weathering limestone, which is very fine-grained to coarsely crystalline and coarse-grained. It is poorly bedded with alternating layers of fine and coarse crystalline detrital zones that are one to one and one-half inches thick. Scattered, very fine chitinous fragments are present, as well as rare, poorly preserved, brachiopod impressions. Poorly developed, thin, argillaceous partings are also locally present along bedding planes.

As has been mentioned, the contact with the underlying Black River is problematic, but it would appear there are at least 150 feet of Montreal strata in Imperial Lowlands Champlain No. 1, and about 100 feet in Bald Mountain Batiscan No. 3. Some 60 or 70 feet of strata interpreted as probably being of Montreal age were drilled in Batiscan No. 1 and it was from these beds that gas production was obtained. The base of the Montreal was not reached in this well.

It should be mentioned that, due to the inability to separate Middle and Upper Trenton beds on lithologic evidence in the area to the northeast of the St. Maurice River, the strata that lie above the St. Casimir and below the Utica group are there collectively referred to by Clark (1959, p.18) as the Neuville formation. The St. Maurice River is, in fact, used by Clark (1959, p.18) as a geographic line to separate the Montreal and Tetreauville formations of the southwest from the laterally correlative Neuville of the northeast. In this report, we have followed the Montreal area usage because the Montreal and Tetreauville appear to be fairly readily distinguished in the subsurface.

Tetreauville Formation

As mentioned above, Clark has proposed dropping the term "Tetreauville" for the area northeast of the St. Maurice River, but the unit appears to be identifiable in the subsurface and is, therefore, retained herein. The Tetreauville consists of dark grey to black, dense, finely crystalline, argillaceous limestones grading upwards into dark grey calcareous shale with argillaceous limestone bands, the frequency of which decreases upward in the section. These dark grey calcareous shales appear to grade into the dark grey and black non-calcareous shales of the Utica but the contact is arbitrarily picked at the first appearance of argillaceous limestone or calcareous shales which give a strong reaction to weak hydrochloric acid. The Tetreauville beds form the bedrock in the vicinity of the southernmost Seaway-Almega-St. Maurice structure test holes.

In Imperial Lowlands Seaway Champlain No. 1, approximately 300 feet of argillaceous limestones and calcareous shales are assigned to the Tetreauville formation. At Bald Mountain-St. Genevieve de Batiscan No. 1, some 150 feet of section is regarded as of Tetreauville age, but the upper part of the section has been eroded in this area. Some 350 feet of section at Bald Mountain Batiscan No. 3 are assigned to the Tetreauville.

Utica Group (Eamons, 1842)

Lotbiniere Formation

As previously discussed, the black, non-calcareous shales of the Utica are regarded as passing gradationally into the underlying calcareous shales and argillaceous limestones of the Tetreauville formation of the Trenton in the deeper parts of the basin. A disconformity may be present on the flanks of the basin. The Utica shales are exposed in numerous places along the north shore of the St. Lawrence River from Montreal to Murray Bay. Near the western edge of the Permit, they are poorly exposed near the St. Maurice River, not far from the village of Les Vielles-Forges where they consist of thin-bedded, flaky weathering, black and dark grey weathering, easily frangible shales. Further west the Utica consists of a very dark grey to black petroliferous shale with a brown streak and usually has abundant graptolite remains. In and near the Permit area the Utica appears to lose its typical character and to become more dark grey than black and to develop silty bands. Graptolite remains do not appear to be as common in this area as further west. This change in lithology makes the Utica very difficult to distinguish from the dark grey shales and siltstones of the overlying Lorraine and from well samples this appears to be impossible in many cases in the vicinity of the Permit. To quote Belyea (1952), "The black Utica shales with a dark brown streak are gradually replaced upwards by black shales with a lighter brown streak and dark grey shales with a grey streak. Where the exact boundary lies between the Utica and the Lorraine cannot be determined in wells." Although some authorities do pick a Lorraine-Utica contact in the subsurface, we feel that such a pick is very nebulous and for practical subsurface work we prefer to group the Lower Lorraine and Utica sections.

At Bald Mountain Batiscan No. 3, we have assigned approximately 1,100 feet of strata to the combined Lower Lorraine-Utica. At Imperial Lowlands Champlain No. 1 a comparable thickness has been assigned to the Lower Lorraine-Utica. Within the Permit, Utica and Lower Lorraine beds are expected to subcrop in a northeast-southwest band across the central part of the Permit, extending from the St. Prosper fault in the vicinity of St. Maurice to a line a short distance south of Imperial Lowlands Seaway Champlain No. 1. The Laduboro Seaway Champlain No. 1 structure test hole is regarded as having encountered Lower Lorraine or Utica below the drift and it was still in these beds at the total depth of 416 feet. Some of the other structure test holes apparently bottomed in beds of Lower Lorraine age.

Lorraine Group (Eamons, 1842)

Leclercville Formation

As previously mentioned, the Utica group appears to be gradationally overlain by the Lorraine group which consists of a thick section of medium

grey shales with subordinate amounts of fine-grained, grey, argillaceous sandstone and siltstone. The sand and silt content increases upward and the predominantly shaly section at the base is considered to form the Leclercville formation while the overlying sandy, silty section is correlated with the overlying Nicolet River formation. The change is gradational and there is no sharp contact but the divisions may usually be roughly separated in well samples, especially when there is a fairly thick section available for study. The problem of the Utica-Lorraine contact has already been discussed under the heading of the Utica group and, as has been explained, in the subsurface it is necessary to combine the Utica and Lower Lorraine. Thicknesses of this combined unit to be expected in and near the Permit area have already been discussed.

Nicolet River Formation

The Nicolet River formation consists of interbedded shales, siltstones and fine-grained, argillaceous sandstones. As has been previously mentioned, the change is gradational but a separation can be made from well samples and forms a division useful in subsurface work.

The Nicolet River formation forms the bedrock in the Permit area in the extreme southern part. All of the Laduboro Seaway structure test holes, with the exception of No. 1, encountered Nicolet River below the drift. The dividing line between the Nicolet and the Leclercville is a short distance north of the Canadian Pacific Railway line between Montreal and Quebec City. Nowhere within the Permit is there a complete section of Nicolet River, the upper part having been eroded. Approximately 300 feet of strata regarded as Nicolet River were drilled in Imperial Lowlands Seaway Champlain No. 1 and a thicker section may be expected further south, closer to the river.

Pleistocene and Recent

Throughout the holdings there are many natural and man-made exposures of unconsolidated Pleistocene sediments. During the course of the field work these were noted only in a cursory way except where they directly overlay bedrock. In the following discussion concerning these unconsolidated beds we have drawn on the work of Karrow (1959) and Gadd (1960) who have previously mapped in close detail the surficial geology of the geologically similar adjacent area to the northeast.

Glacial Deposits

Directly overlying bedrock in exposures near the holdings are boulder clays, reworked tills, and fluvio-glacial sands and gravels that usually are about 10 feet thick but may be as much as 25 feet thick in places. Deposits are usually gently cross-bedded, stratified, very loose, and randomly scattered; small and medium-sized, well rounded igneous and metamorphic boulders are present. Mica flakes are a distinguishing constituent in these beds.

These deposits are important in that they form the main gas reservoir in the Pointe du Lac area to the southwest of the Permit. They were probably formed as beach and strand line deposits following the reworking of pre-Wisconsin tills by the transgressing interglacial Champlain sea.

Champlain Marine Sediments

The Champlain marine sediments represent a marine invasion that covered the St. Lawrence Lowlands during late glacial time. In the use of the term Champlain for these deposits we have followed Gadd (1960) rather than use the original terms "Leda" clay and "Saxicava" sand as defined by G. M. Dawson in 1893.

The chief component of these sediments is a soft, blue-grey, silty and non-silty clay that is locally interbedded with fine sands and thin, shaly siltstone beds. Its total thickness is in the order of 150 feet near the Company holdings.

Boulder erratics occur randomly throughout the shale and apparently were dropped into the marine environment from ice rafts. In addition to their noticeably plastic qualities they are of importance because they provide the cap-rock for the shallow gas zone in the Pointe du Lac area.

In local areas, thin marine sands are interbedded with the clay. These sands are usually very fine grained and grade to silts that are very commonly quite clayey. They are probably lenticular across fairly short distances.

The Champlain marine sediments contain an abundant marine fossil fauna that is characterized by Yoldia arctica Gray. Other forms including foraminifera are discussed by Gadd (1960, p. 19, 20).

Non-Marine Glacial Deposits

The marine Champlain deposits are overlain by light grey and ochreous, brown weathering, fine and medium-grained, loose sands that are commonly about 0 to 25 feet thick. They are generally horizontally bedded, or have small dips.

These sands correlate approximately with the High Terrace sands of Gadd (1960, p.21) who postulates that these sands ". . . were deposited in the St. Lawrence system while an estuary occupied this part of the Lowland. The period of deposition ended with a rejuvenation of this part of the area when scarps that limit the riverward extent of the High Terrace sands were cut. . ."

The aforementioned sands apparently grade locally upward into very well sorted, medium to fine-grained, wind-blown sands that probably represent large transverse dunes formed by accretion on pre-existing shore ridges (Gadd, 1960, p.20).

Post-Glacial Deposits

The post-glacial deposits include a thin veneer of aeolian and reworked alluvial sands as well as alluvial deposits in the low terraces of some of the streams, and peat and muck in the poorly drained bog areas.

STRUCTURE

From the st ndpoint of regional geological relationships, the area lies, as has been previously mentioned, within the St. Lawrence Lowlands, a name that is applicable both as a physiographic unit and a tectonic province. The St. Lawrence Lowlands area is underlain by predominantly Ordovician marine sediments which now form a northeast-trending syncline, the axis of which lies south of, and approximately parallel to, the St. Lawrence River. The syncline or basin formed by these sediments is bounded on the northwest by the Precambrian gneisses which comprise the rolling hills and ridges of the Laurentians. The southeastern limit of the Lowlands is placed at Logan's fault or Logan's Line which separates the strongly faulted and folded sedimentary beds of the Notre Dame Mountains to the southeast from the relatively undisturbed sediments of the Lowlands. It will be noted that the flanking structures of the Lowlands are approximately parallel near Lac St. Pierre but come together gradually northeastward of this point to intersect near Quebec City, as the syncline plunges out (see Figure II).

The dip of the beds on the northwest flank of the syncline in the vicinity of the Permit is approximately four degrees to the southeast as indicated by our structure contour map on top of the Montreal formation (Figure III). It is important to note that a broadening of the contours in the vicinicy of Lac St. Pierre is opposite an offset on the Logan fault. Transverse faults may extent to the Lac St. Pierre area and may be the cause of this broadening. Similar transverse faults may extend into the Company Permits. The dips on the southeast side are presumably of the same order; however, for several miles west of Logan's fault there is a zone of tightly folded and overturned beds which gradually dies out westward toward the synclinal axis. In general, the sediments thicken toward the southeast from the area of Precambrian outcrops so that the formations form wedge edges against the Precambrian surface on either side of the basin. The Precambrian surface was apparently one of considerable paleotopographic relief prior to the deposition of the overlying Cambro-Ordovician sediments and there are great variations in thicknesses of the sedimentary section due to this paleotopographical relief. Some of the relief may have been due solely to erosional features but at least part of the relief was due to faulting, with the resultant fault blocks modified by erosion. It is quite probable that repeated movement has taken place along these fault blocks during the deposition of Cambro-Ordovician beds and since that time.

Although the St. Lawrence Lowlands is an extensive, linear feature, the flanks and axial regions are locally modified by the presence of apparently high-angle, generally northeast-trending, normal or gravity faults in the vicinity of Lac St. Pierre, and of broad folds as well as faults in the Montreal area. In addition to these, there is a growing accumulation of data which suggest that minor, but locally important, oblique fault and other basement structural trends may be present.

Where the main faults are present along the northwest boundary of the Lowlands, they represent a series of sub-parallel steps leading downward to the axial portion of the syncline with the displacement of the faults generally being downward on the southeastern side, with different amounts of movement affecting different blocks. There will also be cases where the apparent displacement is

downward on the northwestern side. The general updip migration of hydrocarbons is likely to result in accumulation against faults and terraces. Sedimentary pinchouts against Precambrian high areas, faulted or otherwise, are considered to provide prospective reservoirs.

Details of local structure pertinent to the Permit are discussed under the headings of "Structure Test Drilling" and "Photogeological Interpretation."

STRUCTURE TEST DRILLING

Six structure test holes were drilled in the southern part of the Permit during 1961. The holes varied in depth from 418 to 780 feet. A Bucyrus Erie rig owned and operated Mr. Walter Oes of Valleyfield, Quebec, was engaged to drill the structure test holes. Due to the limited depth capacity of the rig and to mechanical difficulties, it was necessary to have the drilling program completed by a Failing 1500 rig owned by James Drilling Company, Sombra, Ontario. Drilling operations began on September 2nd, 1961 and were completed on November 11th, 1961. The locations of the holes are shown on the accompanying maps and cross-sections.

Several of the holes were suspended instead of being abandoned, since it is possible that these holes may later be deepened as production tests.

Ten-foot samples were collected during the drilling and these were washed and logged. Sample descriptions are appended to this report.

The program was kept flexible and locations for holes were picked on the basis of information obtained from the holes already drilled.

Because of correlation problems it was necessary to drill some of the holes deeper than originally planned. The presence of a structural feature made it desirable to drill additional holes in the Champlain area.

The locations, depths and status of the wells drilled are tabulated below:

Laduboro Seaway Champlain No. 1

Lot 533
Range 3
Champlain Parish, Champlain County
Co-ordinates - approximately 100' from west lot line
- approximately 1,900' from wouth lot line
Total depth - 418'
Status - Abandoned
Surface Elevation - 87'

Laduboro Seaway Champlain No. 2

Lot 518
Range - Picardie
Champlain Parish, Champlain County
Co-ordinates: - approximately 1,392' from road
- approximately 340' south of lot 535 (Lot 383 is irregularly shaped)
Total depth - 457'
Status - Suspended
Surface Elevation - 47'

Laduboro Seaway Champlain No. 3

Lot 383
Range - Grand Coteau
Champlain Parish, Champlain County
Co-ordinates: - approximately 3,504' from south lot line
- approximately 61' from west lot line
Total depth - 457'
Status - Suspended
Surface Elevation - 64'

Laduboro Seaway Champlain No. 4

Lot 383
Range - Grand Coteau
Champlain Parish, Champlain County
Co-ordinates: - approximately 1,844' from south lot line
- approximately 50' from west lot line
Total depth - 457'
Status - Suspended
Surface Elevation - about 80'

Laduboro Seaway Champlain No. 5

Lot 214
Range 1
Champlain Parish, Champlain County
Co-ordinates: - approximately 415' from east lot line
- approximately 200' from north lot line
Total depth - 780'
Status - Suspended
Surface Elevation - 40'

Laduboro Seaway Champlain No. 6

Lot 540
Range 3
Champlain Parish, Champlain County
Co-ordinates: - approximately 70' from east lot line
- approximately 1,163' from south lot line
Total depth - 774'
Status - Abandoned
Surface Elevation - 84'

A Welex logging truck from Sarnia, Ontario, was contracted to log all holes. Electrical and radioactivity logs were run on Laduboro Seaway Champlain No. 1. It was felt that the electrical log provided the best correlation log and only electrical logs were run on the remainder of the holes.

Laduboro Seaway Champlain No. 1 is regarded as having encountered Lower Lorraine beds below the glacial drift. All of the other wells found Middle Lorraine forming the bedrock. The sandstones, siltstones and shales of the Lorraine have marked lateral variations which make correlation unusually difficult. The change from Middle to Lower Lorraine is gradational and no sharp contact could be picked in the wells which penetrated this contact, although a general distinction can be made. There are no reliable marker beds which can be picked from samples. The logs do not provide as good a correlation as one would hope for and characteristic marker beds extending laterally over more than a small area appear to be rare. It is, however, possible to correlate thicker intervals with a fair degree of reliability. Good marker beds provide correlation between the Nos. 3 and 4 structure test holes, but in the case of the other holes a general correlation of a fairly thick section must be relied upon.

The structure test holes were located in two groups, one group near the southeastern corner of the Permit and one group in the south-central part of the Permit.

Both groups of holes are interpreted as straddling an important structural feature which trends along the regional strike approximately parallel to the St. Lawrence River. This feature may be a single fault but it is more likely that it represents a fault zone with a number of faults. The two cross-sections, Figures V and VI, show our interpretation of the data obtained from the structure test drilling. We will consider first Figure V, which shows the Laduboro Seaway Champlain Nos. 1, 2 and 6 wells in the southeastern part of the Permit area. This figure shows both plan and elevation of the wells and is drawn with an exaggerated vertical scale. The vertical exaggeration is 3 to 1. It will be noted that in order to obtain a straight line of cross-section approximately at right angles to the strike of the beds, the Laduboro Seaway Champlain No. 6 well has been projected along the regional strike, as interpreted from our structure contour map on top of the Montreal formation (Figure III), to a line running between Laduboro Seaway Champlain No. 1 and Laduboro Seaway Champlain No. 2. The actual strike in this area can only be approximated from the information available and the direction in which the Laduboro Seaway Champlain No. 6 well is projected may, therefore,

not be exact and changes in this direction would affect the interpretation to some extent but probably not enough to make any major difference in the interpretation.

It will be noted that, because of the dip of the beds and the interpreted fault, there is no one bed which can be correlated between all three wells. It is, therefore, necessary to use a higher bed for the No. 2 and No. 6 wells and a lower bed for the No. 1 and No. 6 wells. Using this cross-section, we interpret a true dip of approximately 7 1/2 degrees to the southeast between the projected position of the No. 6 well and the No. 2 well. If no fault were present between the No. 1 well and the No. 6 well, the correlation of logs would show a dip of about 14 degrees. This strong change in dip of approximately 7 degrees indicates the presence of a structural feature. On the cross-section we have interpreted the feature as a simple gravity fault dipping at about 65 degrees. This dip is purely arbitrary but is based on field observations and descriptions in the literature of other gravity faults in the St. Lawrence Lowlands. Using such interpretation, the movement on the fault would be approximately 200 feet. As previously mentioned, the feature is probably much more complex than shown but, from the information available at present, there is no way of interpreting more details regarding the feature.

Figure VI shows the south-central group of wells, Laduboro Seaway Champlain Nos. 3, 4 and 5, and we have drawn a similar type of cross-section through these wells. Because these wells are more nearly in a straight line than the previous group, it is not necessary to project the No. 4 well nearly so far along the regional strike so there is less chance for error in this projection. Between the northern and central wells, Laduboro Seaway Champlain Nos. 3 and 4, the dip is almost flat, about 1/2 degree in a generally northerly direction. Assuming no structural feature between Champlain Nos. 4 and 5, the dip would be approximately 7 1/2 degrees. It is important to note that this change in dip is approximately the same as the change of dip noted between the previously discussed wells. We have again shown a simple interpretation of a gravity fault dipping at approximately 65 degrees to the southeast.

The feature shown on these cross-sections as a simple fault is, as previously mentioned, more probably a much more complex zone of tectonic disturbance. It may represent tectonic movement initiated at any time during or since the deposition of these beds, but it may also represent a very early feature which was present before deposition of the beds and along which there would probably have been later movement. In this connection, it is very important to note that a straight line may be drawn between Laduboro Seaway Champlain No. 1 and No. 6, where we have interpreted the fault, between Laduboro Seaway Champlain No. 4 and No. 5, where we have also interpreted the fault, and extended into the Cap de la Madeleine area and between Chateauguay Gas & Oil Madeleine No. 1 and No. 2 which show a difference in elevation of approximately 600 feet on the Precambrian surface although the wells are only a very short distance apart. Such a line passes through the Seaway Almega Champlain holes between Nos. 1 and 3, where interpretation of core holes also indicates the presence of a fault. A strong feature approximately coincident with this line is indicated on the total gravity map of the area prepared by Radar Exploration.

The fact that four control points show a feature along this straight line is very strong evidence that it marks a zone of major importance. There are many possible interpretations of such a zone, some of which are discussed below:

1) It may be a simple fault such as that shown diagrammatically on the cross-sections, which may have originated at any time after the deposition of the Ordovician beds. If such were the case, the feature would have had no effect on sedimentation in the area.

2) It may represent a zone of faulting, rather than one major fault, which has occurred at any time subsequent to the deposition of the beds. As in case No. 1, such a fault zone would have had no influence on sedimentation.

3) It may represent either a simple fault or a complex zone of faulting originating at any time prior to the deposition of the youngest beds present in the area. If such were the case, it would have influenced sedimentation in all beds deposited subsequent to the period of the faulting but not in beds deposited prior to time of movement. In this case, the changes of dip as shown by the upper beds would be the result of draping over a faulted high rather than the result of actual movement of the beds.

4) The zone may represent an ancient line of tectonic activity present since the beginning of deposition of sedimentary rocks in this area and along which later movement may or may not have occurred. Such an interpretation is indicated by the Precambrian high in the Cap de la Madeleine wells and the absence of pre-Trenton beds in the northern well. If this were the case, sedimentation in the entire section would have been affected by the feature, providing excellent prospects for stratigraphic-type traps through the entire section. If later movement occurred along the zone, alteration of beds, particularly carbonates, in the vicinity of the trend would also be expected and would provide additional opportunities for the formation of reservoirs. Structural traps could also be formed by such movement.

From the structural evidence and the sedimentary evidence at Cap de la Madeleine we are inclined to favour the latter interpretation of an ancient Precambrian high, probably due to basement faulting, and along which there are very good chances of an additional movement having taken place. The strong changes of dip indicated by the structure test holes drilled during 1961 are interpreted as indicative of later movement since it is likely that a Precambrian high would have been sufficiently masked by deposition by Lorraine time that changes of dip along it in Lorraine beds would not be as great as indicated.

The interpreted fault zone is approximately parallel to Logan's Line and other major tectonic trends in the area.

PHOTOGEOLOGICAL INTERPRETATION

The area is underlain by a sequence of marine, glacial, alluvial and aeolian deposits, covering Precambrian and lower Paleozoic rocks.

A few outcrops of bedrock were found during previous field work, exposing Trenton and Black River formations, and Precambrian basement rocks. The photogeomorphological study did not reveal any Paleozoic beds, but the Precambrian rocks were easily recognizable. They occur in the northeastern and northwestern parts of the map-area, where they jut out through the Pleistocene and Recent sediments. A relatively low-lying area between the outcrop areas may have extended northward during the deposition of the Pleistocene sediments. There is no indication as to the direction of dip of the underlying Paleozoic rocks.

No attempt has been made to distinguish the different surficial deposits, the study was confined to the interpretation of the underlying structures.

Several structures have been postulated, as shown on the photogeological map (Figure IV). The major structure in the southern part of the Permit interpreted from structure test drilling, gravity interpretation and other evidence and known as the Champlain fault, could not be detected, probably due to the nature and thickness of the surficial deposits. A few alignments may indicate the structure, but they form no basis for a sound interpretation. A northeast-trending fault is, however, postulated about three miles off the mouth of the Champlain River, a few hundred yards northwest from the present escarpment. It is not known whether the fault has any relationship to the Champlain fault. It is assumed that the northwestern part is down-faulted, which is in contrast with the general assumption of the tectonics in this particular area. This may be a relative movement with some blocks moving down more than others.

Between the Champlain and the St. Lawrence rivers a structural northeast-trending high area is interpreted. This structure may extend to the Batiscan River.

Part of the course of the Champlain River south of St. Maurice and Vincennes is probably controlled by fracturing and faulting of the underlying bedrock. A pronounced fault zone could not be postulated.

Toward the Precambrian outcrop areas and in particular around the very winding part of the Batiscan River a succession of northeast-trending faults becomes apparent. They have obviously influenced the course of the Batiscan River. The mapped alignments in this part of the area may represent faults, although they are probably rather small. Faulting and jointing in the Precambrian basement rocks is a common occurrence. It is observed around the Batiscan River as well as along the St. Maurice River in the northwest corner of the map-area.

Two small structural high areas occur near the headwaters of the Champlain River. They have been indicated as separate units, but they may form part of a larger unit which extends farther to the northwest. The Precambrian basement here is probably very close to the surface.

OIL AND GAS PROSPECTS

Since the earliest days of exploration in the area gas seeps have been reported from this part of the St. Lawrence Lowlands. A large percentage of the wells drilled within the general area are reported to have obtained oil and gas shows of varying quality. Many of the early reports are very vague and estimates of flows, etc., cannot now be authenticated. There is, however, in our opinion, enough evidence that the area has good prospects for gas discoveries. Indicated commercial production from the base of the glacial beds has been obtained in the Pointe du Lac area some 20 miles to the southwest of the Company's lands. Bald Mountain Batiscan No. 1, about two miles from the southeast corner of the Company Permit, has been completed as a gas well in the Trenton with a reported flow of 3.5 MMcf. per day.

Discussion of the prospects of the various stratigraphic units expected to underlie the Permit follows. Because of the difficulties in stratigraphic correlation in the pre-Black River section, these beds have, for the purpose of discussion, been grouped, as have the Black River-Trenton beds which are lithologically similar.

Stratigraphic Considerations

Pre-Black River

In the section of this report dealing with stratigraphy, we have discussed at some length the problems of correlation in the pre-Black River beds in this part of the St. Lawrence Lowlands. The section contains abundant sandstones in many parts of the area, together with lesser thicknesses of carbonates, and it seems convenient to group this predominantly sandstone section for purposes of discussion. Very few wells in the area have been drilled to the Precambrian, but it is quite probable that the Precambrian is, in many places, overlain by arkosic sands equivalent to the Granite Wash of other areas. These sands, if not highly cemented, should form excellent reservoirs for gas or oil. With reference to the postulated Precambrian high passing through the southern part of the Permit, we feel there is a very strong possibility of Granite Wash sands being piled against the southern flank of this high and pinching out against the high. The postulated Granite Wash-type sands are probably overlain by a thick sandstone section which we regard as Potsdam in age but for which other interpretations are possible. This sandstone section is frequently highly siliceous and very well cemented as indicated by cores in the Cap de la Madeleine well, and this siliceous section is not an important reservoir. The siliceous sands grade upward into a non-siliceous sandy section. In many wells, these sands, which can be variously interpreted as Chazy or Potsdam or even Beekmantown in age, are recovered in samples only as loose sand grains which give every indication of extremely high porosities and permeabilities. Imperial Lowlands Champlain No. 1 showed such a sand section, as did Bald Mountain Batiscan No. 3, Bald Mountain St. Genevieve de Batiscan No. 1 and Sweet Grass Yamachiche No. 4. Although these loose sand grains would normally be considered indicative of a very porous sand, in many cases no fluid recovery is reported from them. This may be because the matrix which is actually present at depth is washed out during the drilling or the washing of samples. It would,

however, seem from the observation of samples that good reservoirs could be developed in them. The sandy section is expected to pinch out rapidly against Precambrian highs as at Chateauguay Gas and Oil Limited Cap de la Madeleine Nos. 1 and 2. In the case of the No. 1 well Trenton-Black River beds lie directly upon Precambrian, whereas in the No. 2 well, only a short distance away, a thick, predominantly sandy section is present. We feel that there are excellent prospects for stratigraphic pinchouts of sand beds in the southern part of the Permit along the fault zone indicated by the structure test holes and other data, and discussed under the section of this reported headed "Results of Structure Test Drilling."

At Imperial Lowlands Seaway Champlain No. 1, a flow of gas of 10 Mcf. per day is reported from these sandy beds. This blow apparently died shortly. In Imperial Lowlands No. 2, about 12 miles to the southwest of the Permit on the south shore of the river, a drill stem test of the upper part of the sandy section, regarded as probable Potsdam in age, gave a gas blow of 30 Mcf. per day. The shut-in pressure was 1,550 psi after 15 minutes. Salt water was obtained lower in the section but amounts are not specified. Small gas blows are reported from Bald Mountain Batiscan wells from the basal, predominantly sandy, section.

Given suitable porosity development and trapping conditions, this sandy section could contain large reserves of gas or oil, although no shows of oil have been reported.

Trenton-Black River Section

The Trenton-Black River, consisting predominantly of limestones, has given up shows of gas in many of the wells drilled in the general area. The only indicated production is at Bald Mountain Batiscan No. 1 with a reported flow of 3.5 MMcf. per day.

Primary porosity is not characteristic of the Trenton-Black River either in this area of the Lowlands or in other areas where these formations occur. Commercial production in Ontario is obtained from the Trenton-Black River section in areas where the beds have been dolomitized, with resultant secondary porosity development apparently along zones of faulting and fracturing. Some of the porosity and permeability is probably provided by the faults and fractures themselves, but the major part is considered to be due to dolomitization in the areas of fracturing.

In our study of samples from wells in and near the Permits, we have not noted any good porosity or permeability development in these beds although there are some traces of porosity. In Bald Mountain Batiscan No. 1, some finely granular limestone which appears in samples as loose granules could be interpreted as indicative of porosity, but the samples are too finely powdered to permit any accurate observations of porosity or permeability. In our opinion, there are excellent prospects for porosity and permeability developments in the lower part of the Trenton-Black River group (Montreal formation-equivalent and lower) along fault zones such as that interpreted as running across the southern part of the Permit. Such porosity developments would be expected to occur in elongate strips

parallel to trends of tectonic activity. The fragmental and medium to coarsely crystalline limestones of the lower part of the Trenton-Black River below the top of the Montreal formation are lithologically most susceptible to porosity developments. The upper part of the Trenton (Tetreauville-equivalent), being much more argillaceous and dense, is less likely to provide reservoirs, although these dark limestones and calcareous shales may well act as source beds. Any reservoirs found in the Trenton, as previously mentioned, are likely to be elongated and relatively narrow and probably would not contain reserves as great as those that could be held by sand reservoirs in the pre-Black River beds.

Lorraine and Utica

The Utica and the lower part of the Lorrain (Leclercville) contain only scattered thin stringers of argillaceous siltstones and very fine-grained sandstones which are not likely to contain major reservoirs, although local sand developments could form small reservoirs. The Leclercville and the Utica group are most important because of their potential as source beds. The dark grey and black shales of the Utica are reported as being petroliferous in many places and these beds would be expected to form excellent source beds. The upper part of the Lorraine (Nicolete River) contains more abundant sand than does the Leclercville, but these sands are normally tight and are not regarded as major prospects. Local accumulations of gas or oil might be found in local areas where clean sands have been deposited.

Glacial Beds

Production has been obtained from the lower part of the glacial beds in the Pointe du Lac area and shows of gas from these beds, usually very small, have been reported throughout much of the St. Lawrence Lowlands. At Pointe du Lac a trap is formed where clean sands at the base of the glacial deposits overlie an erosional high on the Paleozoic surface. The erosional high may represent a structural feature within the Paleozoic surface. The sands in turn are overlain by marine plastic blue clays of the Champlain sea deposits (Leda clay equivalent) which form excellent cap rocks. The source of the gas is interpreted as being in the Paleozoic beds and may be reaching the sand trap through faulted or fractured zones. The structure test holes drilled in the Champlain area indicate the presence of porous sand and gravel beds overlying the Paleozoic surface and these, in turn, are overlain by blue marine clays similar to those at Pointe du Lac. If suitable closed highs can be found in the Champlain area, traps similar to that at Pointe du Lac may be expected.

The best prospects lie in an area of tectonic activity where faulting may permit slow upward migration from the source beds into the Pleistocene sands.

Structural Considerations

The interpreted fault zone running through the southern part of the Permit from Cap de la Madeleine to the Laduboro Seaway Champlain Nos. 1, 2 and 6 holes has already been discussed in the section of this report dealing with Structural Geology and the best prospects for oil or gas accumulation in the area

are expected to occur along this trend. As has been mentioned, this probably represents an ancient Precambrian high along which later movement has also taken place. Sands of the pre-Black River, including the Chazy, Beekmantown, Potsdam and "Granite Wash" may be expected to pinch out against such a Precambrian high giving excellent trapping prospects. If post-depositional movements have occurred along the trend, then there should be very good chances of secondary porosity and permeability development in the lower part of the Trenton-Black River section. Fault traps may also have occurred in the upper part of the Lorraine (Nicolete River) and updip depositional pinchouts of local sand lenses within the Nicolete River may also be expected to occur along this trend. The Nicolete River beds are very shallow in this area and could not be expected to contain large reserves. The prospects for development of local highs on the Paleozoic surface are probably best along the fault zone and there are opportunities for gas to migrate upward through fault zones into the glacial sands in this area. The Champlain sea blue clay which forms the cap-rock over the glacial sands is also thicker in the southern part of the Permit than farther north.

Considering all the evidence, it appears that the best prospects for oil and gas accumulation are along the postulated fault zone in the southern part of the Permit.

Although the Trenton is known to be petroliferous in various parts of the Lowlands and the Utica should form a good source rock for oil, the only significant shows reported to date are gas shows. Tectonic activity in the area does not appear to have been intense enough to have caused in-place distillation of oil and there does not appear, from the information available, to be any reason why oil should not occur in the area. In spite of this, the lack of oil shows to date and the preponderance of gas shows leads us to the belief that the prospects are better for the occurrence of commercial gas deposits than for oil.

Near the central part of the basin a very thick sedimentary section is expected. Although no well data are available to indicate total thickness, at least 7,000 feet of sedimentary rocks are probably present. Such a thickness of sedimentary rocks would be expected to contain thick source beds from which oil or gas could migrate upward to the suggested fault traps at shallower depths.

SUMMARY AND RECOMMENDATIONS

Structure test drilling and other exploration work such as the previously conducted gravity survey provide strong evidence for the existence of a strong fault passing in a northeasterly direction across the southern part of Permit No. 164. There is a good possibility that this trend may have originated in pre-Ordovician time and Precambrian highs can be expected to occur along it. The pre-Black River sands, including the Potsdam, Beekmantown and Chazy, may pinch out against such Precambrian highs or scarps. Later movement on the feature may have caused secondary dolomitization with resultant porosity and permeability in the Trenton-Black River limestones. Traps may also occur in the Lorraine and in the glacial sands along this trend. The Trenton, Black River and Utica sections, as well as the lower part of the Lorraine, should form excellent source beds in the area.

We would recommend that a deep test be drilled down to the Precambrian or to penetrate undoubted siliceous Potsdam quartzites, in the southeastern part of the Permit, where a number of faults and suspected faults have been determined from aerial photographs in the vicinity of the fault zone mentioned above. The structure test program has shown strong dips up to 14 degrees to be present in this area. A major change in dip is indicated. We would recommend that the hole be drilled close to the location of Laduboro Seaway Champlain No. 6, as shown on Figure IV.

It is necessary to drill to the south of the surface expression of the fault zone in order to intersect the apparently southeastward-dipping zone at depth. A hole so located might also penetrate sands and other clastics along the fault scarp.

As previously mentioned, the prospects are best along a narrow band parallel to the fault zone. Any oil or gas pools discovered are, therefore, likely to be elongate in form. Because of the relatively narrow band involved and the impossibility of determining the exact position of the tectonic zone at depth, it may prove necessary to drill more than one hole to fully evaluate the zone. A location near Laduboro Seaway Champlain No. 6 is, however, regarded as the best that can be picked from the information available.

Before drilling a hole at this location we recommend that, if possible, additional protective acreage be acquired to the east of the Permit.

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January 31, 1962

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APPENDIX I

SAMPLE AND CORE DESCRIPTIONS

FOR SELECTED WELLS DRILLED IN AND NEAR PERMIT NO. 164

Seaway-Almega No. 1 Champlain B-71
Seaway-Almega No. 2 Champlain B-72
Seaway-Almega No. 3 Champlain B-73
Seaway-Almega No. 4 Champlain B-74
Seaway-Almega No. 5 Champlain A-66
Seaway-Almega No. 1 St. Maurice B-154
Seaway-Almega No. 4 St. Maurice B-155
Seaway-Almega No. 5 St. Maurice B-156
Seaway-Almega No. 6A St. Maurice B-157
Seaway-Almega No. 7 St. Maurice B-158
Seaway-Almega No. 8 St. Maurice A-159
Imperial Lowlands Seaway No. 1 Champlain A-74
Sweet Grass Yamachiche No. 4
Canso St. Maurice Pointe-du-Lac No. 1B
Madeleine No. 1
Madeleine No. 2
Bald Mountain Batiscan No. 1
Bald Mountain Batiscan No. 3
Bald Mountain St. Genevieve de Batiscan No. 1

Unless otherwise noted, wells logged by H. A. Gorrell.

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 1 Champlain
Lot:	No. 436
Range:	II
Parish:	Champlain
County:	Champlain
Co-ordinates:	400 feet from west Lot line; 1,400 feet from south Lot line
Ground Elevation:	100 feet
Rotary Floor Elevation:	102 feet

Depth Feet	Description
0-35	Sand, very fine-grained, brown
35-150	[illegible]y
150-170	Gravel and sand
170-180	Siltstone, light grey, fine-grained, argillaceous, slightly calcareous, micaceous; with shale, grey, micromicaceous, silty (Middle Lorraine)
180-190	As above
190-195	Siltstone, as above, grading to fine-grained, light grey, micromicaceous sandstone
195-200	Siltstone, light grey, fine-grained, slightly calcareous, finely sandy in part, micaceous, very argillaceous.
200-245	As above
245-296	Core not logged in detail but examined to determine formation.
	Predominantly siltstone, grey, fine-grained, argillaceous, slightly calcareous, shale bands and partings, some increase in shale percentage in lower part of core.

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 2 Champlain
Lot:	No. 436
Range:	II
Parish:	Champlain
County:	Champlain
Co-ordinates:	300 feet from west Lot line; 4,100 feet from south Lot line
Ground Elevation:	96 feet
Rotary Floor Elevation:	90 feet

Depth Feet	Description
0-20	Sand, fine-grained, brown
140-150	Sand and gravel
150-170	Sand, fine-grained
170-190	Sand and gravel
190-200	As above, with abundant shale pebbles, grey and dark grey, silty, slightly calcareous
200-210	Shale, dark grey, soft, micromicaceous, very slightly silty in part, very slightly calcareous in part; some grey shale and some grey siltstone (probably Lower Lorraine)
210-220	As above
220-230	As above
230-240	Shale, grey and dark grey, slightly silty in part, very slightly calcareous, micromicaceous.
240-250	Shale, as above, mostly dark grey
250-260	Shale, dark grey, firm, very slightly calcareous

Depth Feet	Description
260-270	Shale, as above, sample finely powdered
270-275	Shale, dark grey, hard, micromicaceous
275-280	Shale, dark grey, firm, trace graptolite fragments, some thin silty beds
280-285	As above
286-342	Core not logged in detail but only examined to determine formation. Predominantly shale, dark grey, firm.

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 3 Champlain
Lot:	No. 436
Range:	II
Parish:	Champlain
County:	Champlain
Co-ordinates:	300 feet from west lot line; 2,350 feet from south lot line
Ground Elevation:	96 feet
Rotary Floor Elevation:	98 feet

Depth Feet	Description
	Core not logged in detail but examined to determine formation.
162-195	Predominantly siltstone, fine-grained, grey, argillaceous, very slightly calcareous (Middle Lorraine)
195-231	Predominantly shale, grey to dark grey, firm (Lower Lorraine)

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 4 Champlain
Lot:	No. 436
Range:	II
Parish:	Champlain
County:	Champlain
Co-ordinates:	220 feet from west Lot line; 3,190 feet from south Lot line
Ground Elevation:	93 feet
Rotary Floor Elevation:	95 feet

Depth Feet	Description
	Core not logged in detail but only examined to determine formation.
155-197	Predominantly shale, grey to dark grey, fine-grained. (Lower Lorraine)

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 5 Champlain
Lot:	No. 436
Range:	II
Parish:	Champlain
County:	Champlain
Co-ordinates:	225 feet from west Lot line; 75 feet from south Lot line
Ground Elevation:	90 feet
Rotary Floor Elevation:	92 feet

Depth Feet	Description
	Core not logged in detail but examined to determine formation.
167-221	Predominantly siltstone, grey, fine-grained, argillaceous, very slightly calcareous (Middle Lorraine)

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 1 St. Maurice
Lot:	No. 339
Range:	St. Jean Cote N-O
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	320 feet from east Lot line, 750 feet from south Lot line
Ground Elevation:	146 feet
Kelly Bushing Elevation:	148 feet
Rotary Floor Elevation:	148 feet

Core not logged in detail but examined to determine formation.

Depth Feet	Description
214-226.5	Limestone, very dark grey, very argillaceous, dense; thick beds of very calcareous shale up to one foot thick (Upper Trenton).

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 4 St. Maurice
Lot:	No. 339
Range:	St. Jean Cote N-O
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	2,200 feet from south Lot line, 300 feet east Lot line
Ground Elevation:	162 feet
Kelly Bushing Elevation:	164 feet

Core not logged in detail but examined to determine formation.

Depth Feet	Description
69-79	Limestone, brownish grey, medium to finely crystalline, fragmental (Middle or Lower Trenton).

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Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 5 St. Maurice
Lot:	No. 211
Range:	St. Jean Cote S-E
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	250 feet from west Lot line, 950 feet from north Lot line
Ground Elevation:	143 feet
Kelly Bushing Elevation:	145 feet

Core not logged in detail but examined to determine formation

Depth Feet	Description
301-321	Shale, very dark grey, micro-micaceous, very slightly calcareous to non-calcareous, rare silty bands (Lower Lorraine).

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 6A St. Maurice
Lot:	No. 211
Range:	St. Jean Cote S-E
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	Missing
Ground Elevation:	144 feet
Kelly Bushing Elevation:	146 feet

Core not logged in detail but examined to determine formation

Depth Feet	Description
304-326	Shale, dark grey, micro-micaceous, very slightly calcareous to non-calcareous. (Lower Lorraine or Utica).

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No.7 St. Maurice
Lot:	No. 339
Range:	St. Jean Cote N-O
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	250 feet from east Lot line, 3,720 feet from south Lot line
Ground Elevation:	167 feet
Kelly Bushing Elevation:	169 feet

Core not logged in detail but examined to determine formation.

Depth Feet	Description
39-49	Limestone, brown, medium to finely crystalline, fossiliferous, tight (Middle Trenton).

Company:	Seaway Gas and Oil Ltd.
Well Name:	Seaway-Almega No. 8 St. Maurice
Lot:	No. 339
Range:	St. Jean Cote N-O
Parish:	St. Maurice
County:	Champlain
Co-ordinates:	325 feet from east Lot line, 1,459 feet from south Lot line
Ground Elevation:	152 feet
Kelly Bushing Elevation:	154 feet

Core not logged in detail but examined to determine formation

Depth Feet	Description
81-97	Limestone, brown, finely to medium crystalline, fragmental (Middle Trenton)

Company:	Imperial Oil Limited
Well Name:	Imperial Lowlands Seaway No. 1 Champlain
Lot:	No. 374
Range:	Grand Coteau
Parish:	Champlain
County:	Champlain
Co-ordinates:	76 feet from east lot line, 740 feet southeast of Canadian Pacific Railway
Ground Elevation:	74 feet
Kelly Bushing Elevation:	

Only intervals of particular significance were logged.

Depth Feet	Description
0- 10	Clay, pale brownish or pale black, slightly micro-micaceous, very soft, very easy frangible, trace very fine silt grains.
10- 20	As above, common "floating", subangular, very fine-grained sand grains and silt grains.
20- 30	As above, fairly common very fine, yellow, micaceous flakes.
30- 40	As above
40- 50	As above, less silty, firmer to small crumbly fragments
50- 90	As above
90-100	As above, fragmental mollusk shells
100-110	Sand, fine- to coarse-grained, poorly sorted, rounded to sub-rounded, varied quartz, quartzitic, etc., grains, very loose.
110-120	Sand, as above, but angular to rounded.
120-130	Sand, as above.
130-140	Sand to grit, very common interstitial clay and silty matrix.

Imperial Lowlands Seaway No. 1 Champlain (Continued) - 2

Depth Feet	Description
140-150	As above, with sandstone, grey, salt and pepper, micromicaceous, hard to firm, small regular fragments, non-calcareous.
150-160	Sandstone, as above, probably very thin, grey, argillaceous sandstone stringers.
160-190	As above
190-200	Siltstone, as above, with 20 percent dark grey, argillaceous sandstone.
200-210	Siltstone, light greenish grey, dense, friable, slightly finer and more even textured than overlying sandstone.
210-220	As above, with 30 percent dark grey, argillaceous sandstone.
220-230	Siltstone, dark grey, salt and pepper, probably argillaceous, micromicaceous; with 40 percent light greenish grey sandstone.
230-240	Siltstone, sample as above.
240-250	Siltstone, very fine, dark grey, argillaceous; with sandstone, grey, salt and pepper, micromicaceous to micaceous (50 percent)
250-260	As above
260-270	Siltstone, medium to dark grey, salt and pepper, probably argillaceous, micromicaceous, frangible to slightly splintery.
270-280	Siltstone, as above, with 20 percent dense, argillaceous, dark grey sandstone.
280-290	As above
290-300	As above, with trace very fine-grained, grey, salt and pepper, micromicaceous, sandy.
300-310	Siltstone, medium greenish grey, salt and pepper, micromicaceous, fissile, small blocky, medium frangible

Depth Feet	Description
310-330	Siltstone, as above
330-340	Siltstone, as above; with 10 percent dark grey sandstone.
340-350	Sandstone, medium and dark grey (50 percent each).
350-360	Siltstone, medium grey, salt and pepper, micromicaceous medium frangible.
360-370	? Apparently mostly cavings
370-380	Siltstone, medium greenish grey, poorly salt and pepper, micromicaceous, firm, medium friable.
380-410	Siltstone, as above.
410-420	Siltstone, dark grey, micromicaceous, probably argillaceous, medium friable.
420-430	As above
430-440	Siltstone, as above (50 percent) with dark grey, argillaceous, micromicaceous sandstone (50 percent).
440-450	Siltstone, medium grey, poorly salt and pepper, micromicaceous, medium frangible, firm.
450-460	Siltstone, as above, (70 percent),with dark grey varieties (30 percent).
460-470	Siltstone, medium grey as last above (80 percent), with dark grey varieties (20 percent)
470-480	As above
480-490	Siltstone, medium-grained varieties (60 percent), with dark (40 percent)
490-500	Shale, medium brown-grey, subangular fragments, firm, somewhat splintery, slightly silty, slightly micromicaceous.
500-510	As above, trace pyritic plant spores, micromicaceous.

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Imperial Lowlands Seaway No. 1 Champlain (Continued) - 4

Depth Feet	Description
510-520	Shale, as above
520-530	Shale, micromicaceous, and as above
530-540	Shale, dark grey, micromicaceous, easy frangible
540-550	Shale, as above (80 percent), with siltstone, medium grey, salt and pepper, micromicaceous (20 percent)
550-560	Shale, as above (50 percent) with siltstone, dark grey, micromicaceous (50 percent).
560-570	Shale, as above
570-580	Shale, as above (90 percent), with siltstone, medium grey varieties (10 percent).
580-600	Shale, as above
600-610	Shale, as above (80 percent), siltstone, black, argillaceous (20 percent)
610-620	? As above
620-630	Shale, silty, black, firm, grading to shaly black siltstone.
630-640	Shale, dark grey, slightly silty, micromicaceous, firm.
640-730	Shale, as above
730-740	Shale, as above (50 percent), with siltstone, dark grey, slightly micromicaceous (50 percent).
740-750	Shale, dark grey as above; with dark grey siltstone (shaly).
750-760	As above
760-770	Shale, as above (50 percent), with siltstone, dark grey, shaly, slightly micromicaceous (50 percent).
770-800	As above

Depth Feet	Description
800- 810	Shale, very dark grey to black, silty, micromicaceous, medium frangible.
810- 820	Shale, as above.
820- 830	Shale, as above; with dolomite, medium brown, waxy, dense, finely crystalline (10 percent).
830- 840	Not logged
840- 850	Shale, very dark grey to black, micromicaceous, slightly silty; with trace medium brown, dense dolomite.
850- 890	Not logged
890- 900	Shale, very dark grey to black, slightly silty to silty in microlaminae, firm.
900- 910	Shale, as above
910- 940	Not logged
940- 950	Shale, very dark grey to black, micromicaceous, very slightly silty, with dark grey, poorly salt and pepper, well sorted siltstone.
950- 990	Not logged
990-1000	Shale, very dark grey to black, micromicaceous, firm.
1000-1010	Shale, as above
1010-1040	Not logged
1040-1050	Shale, very dark grey to black, slightly silty, micromicaceous; with trace brown, sugary, very fine dolomite.
1050-1090	Not logged
1090-1100	Shale, very dark grey to black, micromicaceous, firm.
1100-1110	Shale, as above, with trace very fine, grey, shaly sandstone in microlaminae.
1110-1140	Not logged

Depth Feet	Description
1140-1150	Shale, very dark grey to black, micromicaceous, firm.
1150-1190	No logged
1190-1200	Shale, as last (50 percent); with sandstone, very dark grey, argillaceous, micromicaceous, poorly salt and pepper (50 percent).
1200-1210	Shale, very dark grey to black, micromicaceous, firm, with trace siltstone, as last.
1210-1240	Not logged
1240-1250	Shale; with trace sandstone, as last description.
1250-1260	Not logged
1260-1270	Shale, very dark grey to black, micromicaceous, firm, very slightly silty in microlaminae.
1270-1290	Not logged
1290-1300	Shale, very dark grey to black, micromicaceous, firm.
1300-1310	Shale, as above.
1310-1340	Not logged
1340-1350	Shale, very dark grey, trace micromicaceous, firm.
1350-1390	Not logged
1390-1400	Shale, very dark grey, micromicaceous, slightly silty, firm.
1400-1410	Shale, as above; trace very fine, crystalline pyrite.
1410-1440	Shale, as above.
1440-1450	Shale, very dark grey, micromicaceous, firm.
1450-1460	Shale, as above; with trace very fine, grey silt
1460-1470	Shale, as above; with sandstone, grey, micromicaceous (30 percent)

Depth Feet	Description
1470-1480	As above
1480-1490	Shale, very dark grey, micromicaceous, firm.
1490-1500	Shale, as above
1500-1510	Shale, as above, but somewhat harder to splintery.
1510-1540	Shale, as above
1540-1550	Shale, as above; trace very small, dark, chitinous fragments.
1550-1560	Shale, very dark grey, micromicaceous, firm
1560-1570	Shale, as above
1570-1580	Shale, as above; with trace light grey sandstone.
1580-1590	Shale, very dark grey, micromicaceous.
1590-1600	As above
1600-1610	Shale, as above; with trace very fine, crystalline pyrite, calcareous.
1610-1620	Shale, very dark grey, micromicaceous, firm, very calcareous.
1620-1630	Shale, very dark grey, black, slightly micromicaceous, very calcareous.
1630-1640	Limestone, very dark grey to black, very argillaceous, dense, to microcrystalline.
1640-1680	Limestone, as above
1680-1690	Limestone, as above, but extremely argillaceous, grades to a calcareous shale.
1690-1700	As above
1700-1710	Limestone, very dark grey to black, very argillaceous, dense to microcrystalline.
1710-1740	As above

Depth Feet	Description
1740-1750	Limestone, dark brownish, slightly argillaceous, very finely crystalline to microcrystalline.
1750-1760	Limestone, very dark grey to black, argillaceous, dense (90 percent); with limestone, dark brown, as above (10 percent).
1760-1780	As above
1780-1790	As above (75 percent); with limestone, dark brown, as above (10 percent).
1790-1800	Limestone, very dark grey to black, very argillaceous, dense.
1800-1810	Limestone, as above (60 percent), with limestone, dark brown varigations (40 percent).
1810-1820	As above
1820-1830	Limestone, light brown-grey, microcrystalline, as above very slightly argillaceous.
1830-1840	Limestone, light brown-grey; microcrystalline (60 percent); limestone, very dark grey-black, argillaceous, dense (40 percent).
1840-1850	Limestone, dark brown-grey, argillaceous, microcrystalline.
1850-1860	Limestone, as above (80 percent), with limestone, black as before (20 percent)
1860-1880	As above
1880-1890	Limestone, as above (20 percent), with limestone, black as before (80 percent).
1890-1900	Limestone, black, very argillaceous, dense, approaches a very calcareous shale.
1900-1910	Limestone, as above (80 percent); with limestone, brown, fine crystalline, trace fossil fragments (20 percent)
1910-1920	Limestone, dark brown to black, fine crystalline, probably argillaceous.

Imperial Lowlands Seaway No. 1 Champlain (Continued) - 9

Depth Feet	Description
1920-1930	Limestone, medium dark brown-black, microcrystalline to fine crystalline, slightly argillaceous ?
1930-1940	Limestone, as above, with trace fossil fragments (ostracode type)
1940-1980	Limestone, as above
1980-1990	Limestone, very dark grey-black, argillaceous, micro-crystalline (80 percent); with limestone, as above (20 percent).
1990-2000	Limestone, medium to dark brown to black, micro to fine crystalline, slightly argillaceous ?; with trace light grey, fine crystalline limestone.
2000-2010	Limestone, as above, fine to medium crystalline.
2010-2020	Limestone, dark brown-grey, slightly argillaceous, fine crystalline to fine fragmental.
2020-2030	Limestone, as above
2030-2040	Limestone, light to medium brown-grey, fine to coarse crystalline, to fragmental, common comminuted fossil fragments.
2040-2080	Limestone, as above
2080-2090	Limestone, as above, with trace light greenish grey, micaceous, waxy shale.
2090-2100	Limestone, as above.
2100-2110	Limestone, light to medium brown-grey, fine crystalline to coarse crystalline to fine-grained to coarse fragmental, abundant fossil fragments.
2110-2150	Limestone, as above
2150-2160	Limestone, as above; with ten percent dark grey, micro-crystalline to dense, argillaceous limestone.
2160-2170	Limestone, dark brown, fine crystalline, even textured.

Depth Feet	Description
2170-2180	Limestone, as above, rare fossil impressions.
2180-2200	Limestone, as above
2200-2210	Limestone, dark brown to very dark brown, microcrystalline to dense, argillaceous, fossil fragments (brachiopods).
2210-2240	Limestone, as above
2240-2250	Limestone, medium brown, fine crystalline, probably slightly argillaceous.
2250-2260	Limestone, as above
2260-2270	Limestone, light to medium brown, and as above.
2270-2280	Limestone, as above (50 percent); with limestone, dark brown, microcrystalline, argillaceous (50 percent).
2280-2290	Limestone, dark brown, microcrystalline, probably argillaceous (80 percent); with limestone, light to medium brown (20 percent).
2290-2300	As above
2300-2310	As above, with common fossil fragments, brachiopods, crinoids(?)
2310-2320	Limestone, dark grey to black; and limestone, as above.
2320-2330	Limestone, very dark grey-brown to medium brown, argillaceous to slightly argillaceous, microcrystalline.
2330-2340	Limestone, as above; with trace fine crystalline pyrite
2340-2350	Limestone, as above
2350-2360	Limestone, very dark grey to medium brown, argillaceous, microcrystalline, rare fossil fragments.
2360-2370	Limestone, as above (60 percent); with limestone, light brown-grey, fine crystalline (40 percent)
2370-2380	As above.

Depth Feet	Description
2380-2390	As above, common fossil fragments, brachiopods, (ostracods?).
2390-2400	No sample
2400-2420	Limestone, as above
2420-2430	Limestone, pale brown-grey to medium brown to dark brown, microcrystalline to fine microfragmental, slightly argillaceous.
2430-2440	Limestone, as above, with dark varieties (10 percent).
2440-2460	Limestone, as above.
2460-2470	Limestone, as above; dark brown 40 percent, light brown 40 percent, with dark varieties 20 percent.
2470-2480	Limestone, very dark grey, fine to medium fragmental, probably argillaceous, common fossil fragments; with 20 percent light brown, medium to fine fragmental limestone.
2480-2520	Limestone, as above.
2520-2530	Limestone, very dark grey, argillaceous, fine crystalline (80 percent); with limestone, light grey, fine crystalline (20 percent).
2530-2540	Limestone, as above.
2540-2550	Limestone, as above (50 percent); with sandstone, white, fine to medium-grained, poorly sorted, angular to rounded, mostly frosted, clear quartz in white silty matrix, slightly calcareous, medium friable.
2550-2560	Sandstone, light to dark grey, very calcareous, to limestone and sandstone, as above (probably interbedded)
2560-2570	Sandstone, white as sandstone above, but fine- to coarse-grained to grit, angular and rounded, loose, (90 percent); with 10 percent dark grey, calcareous sandstone.
2570-2580	Limestone, white, fine crystalline (60 percent); with sandstone, as above (40 percent).

Depth Feet	Description
2580-2590	Dolomite ?, dark brown, fine crystalline to sugary; no apparent porosity.
2590-2600	Sandstone, white fine- to medium-grained, poorly sorted, sub-angular to sub-rounded, mostly clear, non-frosted quartz, well compacted, well cemented with $CaCO_3$, easily friable, very abundant rusty stained fragments.
2600-2610	Sandstone, as above
2610-2620	Sandstone, as before but poorly salt and pepper, very calcareous.
2620-2630	Sandstone, as above
2630-2640	Sandstone, medium grey, poorly salt and pepper, very fine-grained, well sorted quartz, very slightly calcareous, difficult friable to quartzitic.
2640-2650	Sandstone, as above
2650-2660	Sandstone, pale purplish grey, very fine- to fine-grained, fair sorted quartz, and as sandstone, above, with trace intergranular porosity.
2660-2670	Sandstone, light to white, sub-angular to sub-rounded, clear and frosted, poorly sorted, fine- to medium-grained, quartz, well compacted, poorly cemented, minor secondary SiO_2, very easily friable, common rusty weathering fragments or staining, probably very slightly porous, abundant rounded, fine, black shale grains, salt and pepper?
2670-2810	Sandstone, as above
2810-2820	As above, but finer-grained, better sorting.
2820-2830	As above
2830-2870	Sandstone, as described at 2660 feet.
2880-2890	Sandstone, loose, and as last described.

Depth Feet	Description
2890-2900	As above
2900-2910	Sandstone, (Very rusty stained?)
2910-2940	Sandstone, as above, but clean
2940-2950	Sandstone, as before, white kaolinitic interstitial material.
2950-2960	Sandstone, white, very fine-grained to fine-grained, poorly sorted, sub-angular to sub-rounded, clear and frosted, well compacted quartz, poorly cemented with white kaolinitic material.
2960-3010	Sandstone, as above.

Logged by G. V. Lloyd

Company:	Great Sweet Grass Oils (Quebec) Ltd.
Well Name:	Sweet Grass Yamachiche No. 4
Lot:	No. 603
Concession:	Des Terres de Travers
Parish:	Ste. Anne de Yamachiche
County:	St. Maurice
Co-ordinates:	110 feet south and 85 feet west of northeast corner of lot
Ground Elevation:	127 feet
Kelly Bushing Elevation:	129 feet

Only intervals of particular significance logged in detail. Samples very dirty.

Depth Feet	Description
0-261	Missing
261-270	Sand, coarse; with clay
270-277	Sand, coarse; with fine gravel.
277-300	Missing
300-316	Limestone, dark grey, mottled with light grey, argillaceous, mostly dense, trace pin-point porosity, some fossil fragments, mostly fragmental in origin.
316-323	Limestone, grey, mottled with light and dark grey, some fossil fragments, mostly fragmental in origin, some dark grey, argillaceous limestone.
323-367	As above
367-374	Limestone, lighter colored than above, mottled with dark grey, fragmental.
374-381	As above
381-391	Limestone, light grey, grading to dark grey, mostly fragmental but dense in part; some argillaceous, dark grey fragments.

Sweet Grass Yamachiche No. 4 (Continued) - 2

Depth Feet	Description
391-396	Limestone, light brownish grey, mostly fragmental.
396-402	Limestone, light brownish grey grading to dark grey, mostly fragmental.
402-412	Missing
412-435	As above
435-443	As above, abundant sand grains and igneous fragments. (cavings)
443-451	Limestone, brownish grey to dark brownish grey, mottled, fragmental.
451-460	Limestone, grey and dark grey, mottled, shell fragments, fragmental.
460-469	Limestone, mostly dark grey, mottled, fragmental.
469-487	As above (Samples extremely dirty)
487-500	Limestone, light grey (60 percent) and dark grey (40 percent), fragmental.
500-520	As above
520-530	Limestone, dark grey, dense (70 percent); with Limestone, light grey and cream, fragmental (20 percent) and shale, dark grey, calcareous (10 percent).
530-540	Limestone, light grey, fragmental; with dark grey limestone, as above.
540-550	Limestone, light and dark grey, mottled, fragmental, very highly fossiliferous.
550-560	Limestone, cream to light grey, fragmental.
560-570	As above
570-580	As above; with some grey and dark grey limestone.
580-600	As above (Sample extremely dirty 590-600').

Sweet Grass Yamachiche No. 4 (Continued) - 3

Depth Feet	Description
600-610	Limestone, dark grey mottled with light grey, mostly fragmental, shell fragments.
610-650	As above (Very dirty 630-650).
650-660	Sandstone, light grey and white, fine-grained, partly calcareous, abundant loose sand grains.
660-670	Sandstone, light grey, calcareous, very poorly sorted, fragments tight but abundance of loose sand grains indicates possible presence of porosity.
670-680	Siltstone, dark grey, arenaceous; with abundant coarse sand grains, calcareous. Sample very dirty.
680-690	Sand, loose, very fine to coarse sand grains, very poor sorting, many angular grains; some traces of calcareous cement, but most grains are loose. (This sample appears to have extremely good porosity and it seems impossible that it would not produce gas or water but none are reported.)
690-700	As above
700-706	As above, but more fine-grained, loose sand
706-715	As above
715-725	Sand grains, loose, very fine-grained, abundant finely ground calcareous material.
725-735	As above
735-745	Sandstone, fine-grained, light grey to white, slightly calcareous, tight.
745-752	Sand grains, fine-grained, loose; some fine-grained, tight, calcareous sandstone.
752-762	As above
762-770	Sandstone, grey, very fine-grained, calcareous, tight.
770-780	Sandstone, white, very fine-grained, calcareous, tight.
780-792	As above

Sweet Grass Yamachiche No. 4 (Continued) - 4

Depth Feet	Description
792-796	Sandstone, light grey and white, fine-grained, calcareous, tight.
796-805	Sand grains, fine-grained, white, loose.
805-815	Sandstone, fine-grained, white and light grey.
815-824	Sand grains, fine- to medium-grained; some sandstone white, siliceous, tight.
824-833	Sand grains, loose, white, fine- to medium-grained.
833-843	As above
843-853	Sand grains, loose, white fine- to medium-grained, poorly sorted but mostly well-rounded, should have excellent porosity; some sandstone, fine-grained, white, siliceous and slightly calcareous, tight.
853-863	As above
863-871	Sand grains, loose, fine-grained, white
871-876	Sandstone, white, mostly fine-grained, calcareous, tight; abundant loose sand grains.
876-882	As above, but more coarse grains.
882-892	Sand grains, loose, white, fine- to medium-grained, some coarse grains; traces of white, calcareous sandstone composed of grains as before. No visible porosity but loose grains indicate such unless matrix washed out.
892-898	Sand grains loose, fine-grained, white but with abundant iron staining (staining probably from tools).
898-903	Sand grains, loose, fine-grained; with sandstone, white, fine-grained, calcareous, tight.

Company:	Inter-City Propane Inc.
Well Name:	Canso St. Maurice Pointe-du-Lac No. 1B
Lot:	No. 265
Range:	Des Petites Terres
Parish:	Pointe-du-Lac
County:	St. Maurice
Co-ordinates:	1326' West of lot line 743' north of centre of roadway
Ground Elevation:	57 feet
Kelly Bushing Elevation:	65 feet

Only intervals of particular significance logged in detail.

Depth Feet	Description
0- 310	Clay
310- 320	Gravel, coarse
320- 330	Shale, grey, partly silty, much gravel.
330- 340	Shale, grey, slightly calcareous, silty; with grey, slightly calcareous siltstone.
340- 900	Shale, grey, slightly calcareous in part, micromicaceous, partly silty; with variable amounts of siltstone, grey, slightly calcareous, argillaceous.
900-1840	Shale, grey, grading to dark grey, micromicaceous, some small amounts of siltstone becoming increasingly rare downwards and shale becomes darker downwards; trace of calcite partings at 1780 feet.
1840-1850	Shale, as above, trace of grey, dense, argillaceous limestone (brown, bituminous residue?) (Top of Trenton 1840')
1850-1860	As above

Canso St. Maurice Pointe-du-Lac No. 1B (Continued) - 2

Depth Feet	Description
1860-1970	Limestone, dark grey, dense, argillaceous.
1970-2090	Limestone, dark grey, dense, mottled with lighter limestone, increase downwards in amount of lighter coloured limestone.
2090-2350	Limestone, grey and dark grey, mottled, tight, mostly fragmental in origin. (Top of Middle Trenton 2090')
2350-2400	Limestone, light grey, mottled with medium grey, mostly fragmental. (Somewhat lighter coloured than above.)
2400-2510	Limestone, light brownish grey, fragmental, highly fossiliferous.
2510-2520	Sandstone, white, mostly fine-grained, some coarse, frosted grains, very calcareous, tight.
2520-2530	Sandstone, light grey, fine-grained, very calcareous, tight (almost a sandy limestone).
2530-2540	As above
2540-2550	Dolomite, dark grey, dense.
2550-2560	Limestone, white, chalky, tight.
2560-2570	Dolomite, grey and dark grey, finely crystalline, dense.
2570-2580	Sandstone, medium-to coarse-grained, many large, frosted grains, very calcareous, no visible porosity.
2580-2590	Dolomite, grey and dark grey, finely crystalline, finely sandy in part; with 10 percent sandstone, medium-grained, calcareous.
2590-2600	As above
2600-2610	Dolomite, grey and dark grey, finely crystalline, finely sandy, dense.
2610-2620	Sandstone, grey, very fine-grained, very dolomitic, tight.
2620-2630	Limestone, grey and dark grey mottled, fragmental, tight.

Depth Feet	Description
2630-2640	As above
2640-2650	Sandstone, white, fine- to very coarse-grained, poorly sorted, some large, angular quartz fragments indicate very coarse sand. Slightly dolomitic, some siliceous matrix, no visible porosity.
2650-2660	Sandstone, as above; with black, dolomitic shale
2660-2670	Sandstone, very fine-grained, very calcareous, tight.
2670-2690	As above
2690-2700	Dolomite, dark grey, dense, argillaceous.
2700-2720	As above
2720-2730	Sandstone, white, fine- to coarse-grained, very calcareous, tight, very poor sorting.
2730-2740	As above
2740-2750	Dolomite, dark grey, very argillaceous, dense; with 40 percent sandstone, as above.
2750-2760	Sandstone, white to light grey, very fine-grained, with occasional coarse grains, calcareoux matrix, tight.
2760-2770	Sandstone, as above; with grey, dolomitic shale.
2770-2780	Sandstone, as above
2780-2790	Sandstone, as above; with grey, dolomitic shale.
2790-2800	Dolomite, dark grey, dense, very argillaceous.
2800-2810	Dolomite, grey, dense, argillaceous.
2810-2820	As above
2820-2830	Limy dolomite, grey, dense, argillaceous.

Company:	Chateauquay Gas & Oil Co. Ltd.
Well Name:	Madeleine No. 1
Lot:	No. 113
Range:	Cote de la Madeleine
Parish:	Cap de la Madeleine
County:	Champlain
Co-ordinates:	900 feet from de la Madeleine Blvd., 293 feet from side road.
Ground Elevation:	51 feet
Kelly Bushing Elevation:	52 feet

Depth Feet	Description
150- 275	Shale, grey, very slightly calcareous in part, with bands of fine grey argillaceous siltstone. Siltstone is slightly calcareous. Siltstone bands crossbedded. Siltstone bands up to 2 inches thick with rare bands up to 12 inches thick. Siltstone bands do not appear continuous. Siltstone forms about 20 percent of core. One thin calcite-filled vertical fracture from 270-272.
275- 380.5	Shale, slightly darker grey than above; siltstone bands less common. Siltstone forms about 10 percent of core.
380.5-520	Shale, grey to dark grey, firm non-calcareous, about 5 percent siltstone bands.
520- 712	Shale, as above, with only thin siltstone partings and bands up to 1/4 inch thick. Siltstone bands frequently have knotted or contorted appearance. At 664' one thin calcite-filled fracture dipping about 75°. From 680 feet calcite-filled thin fractures dropping 70° to 80°.
712-1028	Shale, grey and dark grey, irregularly banded. Some thin incipient fractures and calcite-filled fractures. Irregular thin siltstone bands. Shale and siltstone appear cross-bedded in part. Apparent dips about 5 degrees. Thicker, predominantly siltstone bands from 867 to 868, 908 to 909, 972 to 973.

Madeleine No. 1 (Continued) - 2

Depth Feet	Description
1028-1280	Shale, dark grey, some slightly lighter grey bands. Thin siltstone partings and bands up to 1/2 inch with rare bands up to 8 inches. Occasional thin calcite-filled fractures dipping at about 75 degrees. Apparent bedding dip flat.
1280-1292	Shale, as above but perhaps slightly darker, no sharp contact and difference is extremely slight. (May be top of Utica.)
1292-1359	Shale, dark grey, some siltstone partings and bands as before, occasional black carbonaceous spots on bedding planes which could be organic (perhaps graptolites, but not possible to be sure), some indication of slippage resembling slickensides, but no displacement of bedding planes.
1359-1419	Shale, dark grey, less silty than above; numerous carbonaceous bodies resemble graptolites but too poorly preserved to be sure. Some increase in silt from 1390 to 1419. Bedding dips (apparent) flat to 5 degrees. Small incipient fractures dip at about 75 degrees.
1419-1453	Shale, dark grey, slightly silty in part with thin silt bands, becoming slightly calcareous with some increase in lime content downwards.
1453-1525	Shale, dark grey, becoming very calcareous and very hard.
1525-1850	Limestone, dark grey, dense, very argillaceous. (Top Trenton 1525'). Contact is gradational from calcareous shale to argillaceous limestone; some incipient fractures and calcite-filled fractures dipping at about 75 degrees. Some bands of very calcareous shale up to 1 foot thick with rare graptol[illegible]
1850-1905	As above, but with some thin bands of brownish grey limestone and fossil fragments, mostly crinoids. Some bands of black, calcareous shale up to 6 inches thick. (Top of Middle Trenton about 1850 feet), but contact is very graditional and cannot be picked with any accuracy.
1905-1992	Missing

Depth Feet	Description
1992-1994	Quartzite, white.
1994-1996	Igneous or highly metamorphosed rocks, quartzites, micacaceous schistose rocks, greenstones. (Top of Precambrian 1992 feet).
1996-2092	Missing

Company:	Chateauguay Gas & Oil Co. Ltd.
Well Name:	Madeleine No. 2
Lot:	No. 113
Range:	Cote de la Madeleine
Parish:	Cap de la Madeleine
County:	Champlain
Co-ordinates:	Approximately 200 feet from Northeast lot line, approximately 350 feet from South lot line.
Ground Elevation:	55 feet
Kelly Bushing Elevation:	57 feet

Depth Feet	Description
0-1600	Missing
1600-1610	Calcareous shale, dark grey to black, mostly very calcareous with some non-calcareous bands, small brachiopods and poorly preserved questionable graptolite remains.
1610-1700	Missing
1700-1710	As above with 6 inch bands of black, dense, argillaceous limestone.
1710-1800	Missing
1800-1810	As above
1810-1900	Missing
1900-1910	Limestone, mostly dark grey to dark brownish grey, very argillaceous, a few fossil fragments, mostly crinoids, some bands of very calcareous shale. (Upper Trenton)
1910-1990	Missing
1990-1995	Limestone, coarsely to finely crystalline, dark greyish brown, fragmental in part, abundant crinoids in some bands. (Top of Middle Trenton 1900')

Depth Feet	Description
1995-2000	Limestone, very finely crystalline to dense, dark brownish grey, argillaceous; abundant argillaceous partingssand bands.
2000-2020	Missing
2020-2030	As above.
2030-2050	Missing
2050-2060	Limestone, as above.
2060-2080	Missing
2080-2098	Limestone, as above.
2098-2150	As above
2150-2170	Missing
2170-2175	As above
2175-2180	Limestone, as above, some fossil fragments, fossils becoming more common near base.
2180-2200	Missing
2200-2210	As above
2210-2267	As above (Most of core missing)
2267-2290	Missing
2290-2300	As above, becoming coarser grained downwards.
2300-2320	Missing
2320-2322	As Above
2322-2324.5	Missing
2324.5-2327	As above
2327-2350	Missing
2350-2360	As above
2360-2373	Missing

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Depth Feet	Description
2373-2390	As above
2390-2391	Missing
2391-2396	Limestone, dark greyish brown, medium to coarsely crystalline, fragmental, tight, argillaceous bands and partings.
2396-2429	Missing
2429-2431	As above, but argillaceous limestone has contorted appearance; trace slickensides.
2431-2452	Missing
2452-2460	Limestone, as above, becoming dolomitic near base.
2460-2482	Missing
2482-2485	Calcareous dolomite, dark brownish grey, argillaceous, dense.
2485-2510	Missing
2510-2520	As above, looks like Trenton but is mostly dolomite.
2520-2545	Missing
2545-2580	Dolomitic limestone, dark brownish grey, dense.
2580-2582	Dolomite, grey, fine-grained, dense, finely sandy with some coarse sand grains.
2582-2901	Missing
2901-2603	Sandstone, white, very fine-grained, dolomitic and calcareous in part, some bands have coarse grains.
2603-2616	Sandstone, white, fine-grained, very hard, dolomitic and calcareous in upper part, but mostly siliceous.
2616-2621	Missing
2621-2631	As above, but sandstone all siliceous.
2631-2660	As above.

Depth Feet	Description
2660-2672	Missing
2672-2678	Quartzite, red. (Top of Precambrian 2672')
2678-2684	As above
2684-2710	Quartzite, red and grey and other metamorphic rocks.
2710-2735	Missing
2735-2745	As above

Company:	Bald Mountain Oil Co.
Well Name:	Bald Mountain Batiscan No. 1
Lot:	No. 236
Range:	I
Parish:	St. Francois-Xavier de Batiscan
County:	Champlain
Co-ordinates:	150 feet South of No. 2 highway
Ground Elevation:	19 feet
Kelly Bushing Elevation:	21 feet

Depth Feet	Description
1700-1710	Shale, dark grey, slightly calcareous
1710-1730	As above
1730-1740	As above, trace pyrite
1740-1750	As above
1750-1760	As above, traces of hard, very dark grey to black, more calcareous shale. (Top of Trenton 1750')
1760-1780	As above
1780-1790	Shale, very dark grey, calcareous.
1790-1800	As above.
1800-2000	Not logged
2000-2010	Shale, grey to very dark grey, hard, calcareous.
2010-2070	As above
2070-2080	As above, traces of limestone, grey and dark grey, dense, argillaceous.
2080-2090	As above.
2090-2100	Shale, dark grey, very calcareous; with 10 percent limestone, grey and dark grey, dense, argillaceous.

Bald Mountain Batiscan No. 1 (Continued) - 2

Depth Feet	Description
2100-2110	As above with 20 percent limestone
2110-2120	As above
2120-2130	As above, traces of dark brownish grey, argillaceous, medium crystalline limestone.
2130-2140	Shale, dark grey, very calcareous with dark grey argillaceous limestone: 10 percent brown, medium crystalline, tight fossiliferous limestone which resembles Middle Trenton but not such a pronounced granular nature and not so fossiliferous as usual. (Top of Middle Trenton 2130?)
2140-2150	Limestone, grey and dark grey, dense, argillaceous.
2150-2160	Limestone, dark grey and brownish grey, dense, argillaceous. (Sample is much finer than previously and contains abundant argillaceous and calcareous powder, some of which leaves a fine silty residue. This might represent a Fault zone. Fine material includes fine brown limestone granules which could represent a porous zone, but no visible porosity.) Abundant grey, calcareous to very slightly calcareous shale.
2160-2170	As above
2170-2180	Shale, dark grey, calcareous, with grey and dark grey, dense, argillaceous limestone, traces of dark brown limestone with faintly granular texture.
2180-2190	As above
2190-2196	Limestone, dark grey, argillaceous, mostly dense, but with traces of granular texture, many fine loose granules of brown limestone.

Company:	Ba l Mountain Oil Co.
Well Name:	Bald Mountain Batiscan No. 3
Lot:	No. 236
Range:	I
Parish:	St. Francois-Xavier de Batiscan
County:	Champlain
Co-ordinates:	2500 feet from northwest and 3800 feet from southeast lot line.
Ground Elevation:	26 feet
Kelly Bushing Elevation:	28 feet

Only intervals of particular interest were logged.

Depth Feet	Description
1650-1660	Shale, dark grey, micromicaceous, slightly calcareous, traces siltstone.
1660-1720	As above
1720-1730	Shale, more calcareous than above and probably slightly darker in colour; traces black, argillaceous limestone. (Top Trenton 1730?)
1730-1760	As above
1760-1900	Not logged
1900-1910	Shale, dark grey, very calcareous, traces dense, black, argillaceous limestone.
1910-2000	Not logged
2000-2010	Shale, dark grey, dense, very calcareous, traces grey, argillaceous limestone and dark grey, argillaceous limestone.
2010-2020	As above
2020-2030	As above, with increasing amounts of limestone.
2030-2050	As above

Bald Mountain Batiscan No. 3 (Continued) - 2

Depth Feet	Description
2050-2060	As above, with abundant dark grey and dark brownish grey, dense, argillaceous limestone.
2060-2070	As above
2070-2080	Limestone, dark grey and brownish grey, argillaceous, dense, trace of fossil fragments, particularly crinoids, abundant dark grey, calcareous shale.
2080-2090	Limestone, dark brownish grey, mostly dense, fossil fragments becoming increasingly common, some soft, grey, dense, argillaceous limestone, traces brown, medium crystalline limestone (Top Middle Trenton 2090?)
2090-2100	As above
2100-2110	Limestone, brown, grading to cream, brown limestone is mostly cryptocrystalline while lighter coloured limestone is finely to medium crystalline and fragmental in origin, many fine fossil fragments.
2110-2120	As above
2120-2130	Limestone, light brownish grey grading to dark brown, finely crystalline; with dark portions which are dense.
2130-2140	Limestone, dark brownish grey, very finely crystalline to dense, mostly argillaceous, fossil fragments.
2140-2150	Limestone, light brown grading to dark brownish grey, lighter coloured parts finely to medium crystalline with fossil fragments, darker parts very finely crystalline, dense, argillaceous; abundant loose coarse limestone granules of fragmental origin.
2150-2160	Limestone, dark greyish brown, finely to medium crystalline with some coarse crystals, fragmental, argillaceous in part with some fragments extremely argillaceous, some soft, cream, chalky limestone containing fine limestone crystals.
2160-2180	As above
2180-2190	Limestone, light brown, finely crystalline, abundant loose, coarse crystals of calcite and fine limestone fragments.

Bald Mountain Batiscan No. 3 (Continued) - 3

Depth Feet	Description
2190-2200	Limestone, light to medium brownish grey, very finely crystalline, argillaceous in part, tight, a few white calcite crystals, rare fossil fragments.
2200-2230	As above
2230-2240	As above, but becoming more coarsely crystalline in part.
2240-2250	As above
2250-2260	Limestone, light to cream grading to medium and greyish brown, finely to medium crystalline.
2260-2290	As above
2290-2300	Limestone, cream, grading to dark greyish brown, some mottling, finely crystalline to dense, darker parts argillaceous. (Top of Black River 2290')
2300-2310	As above
2310-2320	Limestone, cream and dark greyish brown, very finely crystalline to dense, no sign of fossil fragments.
2320-2330	Limestone, medium to dark brownish grey, dense
2330-2340	Limestone, cream, finely crystalline with fossil fragments; some dark brownish grey limestone.
2340-2350	As above.
2350-2360	As above, with traces of brown, coarsely crystalline limestone.
2360-2370	As above
2370-2380	Limestone, dark grey, dense, with 20 percent cream, finely crystalline to dense limestone and 30 percent black, calcareous shale.
2380-2400	As above
2400-2410	Limestone, dark grey, dense, argillaceous; with light grey, soft, chalky, argillaceous limestone and dark grey, calcareous shale.

Depth Feet	Description
2410-2430	As above
2430-2440	Limestone, dark grey, dense, argillaceous, with 20 percent limestone, cream, soft, finely crystalline.
2440-2450	As above, some black, calcareous, soft shale.
2450-2480	Missing
2480-2490	Limestone, grading from cream to dark grey and dark brownish grey, light coloured portions finely crystalline, dark coloured portions dense, trace fossil fragments, some soft, black, calcareous shale.
2490-2520	As above
2520-2530	As above, but with some dark grey, coarsely crystalline fragmental limestone.
2530-2540	As above
2540-2550	Limestone, light cream grading to dark grey, fragmental, medium crystalline. (Sample ground very fine)
2550-2560	Limestone, as at 2570 feet
2560-2570	Limestone, as at 2590 feet, sample extremely fine - may indicate granular texture and porosity, but none visible.
2570-2580	As above
2580-2590	Limestone, light cream, fine to medium granular, probably fragmental in origin, sample very finely powdered.
2590-2600	As above
2600-2610	Limestone, cream grading to brown, medium crystalline, fragmental; sample very fine, may indicate granular texture.
2610-2700	As above
2700-2710	As above; sample very dirty
2710-2720	As above, trace fine-grained, grey, calcareous sandstone and rare coarse quartz grains.

Depth Feet	Description
2720-2730	Sand grains, loose, mostly coarse, but poorly sorted, angular; 5 percent sandstone, white, poorly sorted, very slightly calcareous.
2730-2740	Sand grains, loose, mostly coarse-grained, very poorly sorted, mostly very angular, numerous tabular fresh-looking quartz fragments give appearance of having been broken in drilling; 5 percent white limestone, finely crystalline; sand grains, as above; with 50 percent white, medium crystalline limestone.
2740-2750	Limestone, white, finely sandy, grading to fine, white calcareous sandstone; 20 percent dark grey, calcareous shale; abundant loose sand grains.
2750-2760	Sandstone, white, fine-grained, very calcareous; abundant fine to coarse, loose sand grains.
2760-2780	As above
2780-2790	Sand grains, white grains with brown, rusty stain, mostly fine-grained but scattered coarse grains; trace of slightly calcareous sandstone.
2790-2800	Sandstone, white, fine-grained, mostly siliceous but a few calcareous fragments; trace coarse, frosted grains.
2800-2810	Sandstone, white, fine-grained, mostly siliceous but a few calcareous fragments; abundant loose, fine, angular grains; a few large frosted grains.
2810-2820	As above
2820-2830	Sand grains, loose, fine to medium-grained, grains more rounded than previously but still many very angular grains; many well rounded frosted grains.
2830-2840	As above
2840-2850	As above, with 10 percent white, fine-grained, tight, siliceous sandstone.
2850-2860	As above
2860-2870	Sandstone, fine-grained, white, siliceous, tight; a few slightly calcareous fragments; abundant loose, angular to rounded sand grains.

Depth Feet	Description
2870-2880	Sand grains, loose, mostly medium-grained but many fine to medium sized grains, larger grains frequently rounded and frosted but many angular grains and fragments; few fragments of siliceous, white sandstone.
2880-2890	Sand grains, as above, but with slight rusty stain. (probably from tools)
2890-2900	As above
2900-2910	Sand grains, loose, fine-grained, angular grading to rounded and frosted, slight rusty stain.
2910-2957	As above

Company:	Bald Mountain Oil Co.
Well Name:	Bald Mountain St. Genevieve de Batiscan No. 1
Lot:	No. 132
Range:	Sud de la Riviere Batiscan
Parish:	Ste. Genevieve de Batiscan
County:	Champlain
Co-ordinates:	3000 feet from west lot line, 300 feet from south lot line
Ground Elevation:	98 feet
Kelly Bushing Elevation:	100 feet

Only intervals of particular significance logged in detail.

Depth Feet	Description
0- 260	Clay
260- 280	Gravel and coarse sand
280- 290	Limestone, dark grey, dense, very argillaceous; with dark grey, calcareous shale (Upper Trenton).
290- 300	Shale, dark grey, very calcareous; traces of grey and dark grey, dense, argillaceous limestone.
300- 330	As above
330- 340	As above, with increasing amounts of dense, argillaceous limestone to 10 percent.
340- 350	As above
350- 360	Shale, dark grey, very calcareous, traces of limestone, as above; traces of greyish brown, chalky limestone.
360- 370	As above
370- 380	Shale, as above, with 10 percent greyish brown, mostly soft, argillaceous limestone and traces of dark grey, dense, argillaceous limestone.

Depth Feet	Description
380- 410	As above
410- 420	Limestone, dark grey, dense, very argillaceous, with dark grey, calcareous shale, as above.
420- 440	As above
440- 450	Limestone, brown, medium crystalline, fossiliferous, fragmental; with 40 percent shale and argillaceous limestone, as above (Top of Middle Trenton 440')
450- 460	As above
460- 470	Limestone, medium brown, grading to dark brownish grey, medium to coarsely crystalline, fragmental.
470- 550	As above
550- 560	Limestone, light brown and brownish grey, somewhat finer grained than above, probably mostly fossiliferous but fossil fragments not so pronounced.
560- 570	As above
570- 580	As above, some limestone is finely silty
580- 640	As above
640- 650	Limestone, dark grey to dark brownish grey, dense, argillaceous (Top of Black River 640')
650- 680	As above
680- 690	As above, with 40 percent limestone, greyish brown, medium crystalline, fossiliferous.
690- 760	As above
760- 770	Limestone, brown, grading to light brownish grey, medium granular, fragmental; some dense, dark grey, argillaceous limestone.
770- 950	As above
950- 960	As above, trace of finely sandy limestone.

Depth Feet	Description
960- 980	As above
980- 990	Sand grains, loose, fine to coarse, very poorly sorted; fine grains mostly angular, coarser grains rounded; traces of sandstone composed of grains as above, light reddish brown, slightly dolomitic, no visible porosity.
990-1000	Sand grains, medium-grained, mostly angular, much better sorting than above, no trace of consolidated sandstone; should have excellent porosity but porosity in place may be filled with matrix that washes out in drilling or siliceous cement may appear in samples as very angular quartz fragments.
1000-1013	As above

SAMPLE DESCRIPTIONS

FOR LADUBORO SEAWAY STRUCTURE TEST HOLES

Laduboro Seaway Champlain No. 1

Laduboro Seaway Champlain No. 2

Laduboro Seaway Champlain No. 3

Laduboro Seaway Champlain No. 4

Laduboro Seaway Champlain No. 5

Laduboro Seaway Champlain No. 6

Logged by H. A. Gorrell

Well Name:	Laduboro Seaway Champlain No. 1
Lot:	No. 533
Range:	III
Parish:	Champlain
County:	Champlain
Co-ordinates:	Approximately 100 feet from west Lot line and 1,900 feet from south Lot line. (See survey plat for exact location)
Total Depth:	416 feet
Status:	Abandoned
Surface Elevation:	+ 87 feet

Depth Feet	Description
0-10	Sand, fine-grained, wellsorted, angular fragments, mostly quartz, some dark minerals and mica.
10-20	As above
20-30	Sand, as above,but finer grained
30-40	Clay, light grey, pelecypod fragments
40-180	As above
180-190	Gravel, medium-grained, poorly sorted, intermixed igneous pebbles and shale pebbles
190-200	As above
200-210	Shale, dark grey, silty in part, micromicaceous; some soft grey shale
210-220	Shale dark grey, partly silty, grading to grey argillaçeous siltstone, slightly calcareous
220-230	As above
230-240	Shale, grey, micromicaceous, partly silty
240-250	As above, abundant cavings
250-260	As above.

Depth Feet	Description
260-270	Shale, grey, silty in part, micromicaceous
270-280	Shale, grey, firm, slightly silty in part, micromicaceous
280-300	As above
300-310	Shale, grey, slightly silty, very slightly calcareous in part, micromicaceous
310-320	As above, slight increase in silt content
320-330	Shale, grey, slightly silty, grading to fine argillaceous, siltstone in part, micromicaceous, very slightly calcareous in part.
330-350	As above
350-360	Shale, grey to dark grey, partly silty, micromicaceous, grading in part to fine-grained, argillaceous siltstone
360-410	As above

Well Name:	Laduboro Seaway Champlain No. 2
Lot:	No. 518
Range:	Picardie
Parish:	Champlain
County:	Champlain
Co-ordinates:	Lot is irregular in shape - see survey plat
Total Depth:	457 feet
Status:	Suspended
Surface Elevation:	47 feet

Depth Feet	Description
0- 10	Sand, light brown, medium-grained, angular, fair sorting, mostly quartz grains, some ferro-magnesian minerals and feldspar.
10- 30	As above
30- 40	As above, with clay, light brownish grey.
40- 50	Clay, light bluish grey, abundant pelecypod fragments.
50-150	As above
150-160	Gravel, consists of coarse fragments of igneous rocks and shale and coarse to medium sand grains, probably contains abundant clay when in place.
160-170	Gravel, as above
170-180	Siltstone, light grey, medium-grained, slightly calcareous, some fragments approach fine-grained sandstone size, micaceous; abundant gravel, as above.
180-190	Shale, light grey, silty, slightly calcareous, micromicaceous; with siltstones, as above.
190-200	Siltstone, light grey, calcareous, some fragments approach fine-grained sandstone size, micaceous; with light grey, calcareous, micromicaceous shale: traces of medium grey shale.

Laduboro Seaway Champlain No. 2 (Continued) - 2

Depth Feet	Description
200-220	As above
220-230	Siltstone, light grey, calcareous, varies from very fine-grained to almost fine-grained sandstone size, argillaceous, micaceous.
230-250	As above
250-260	As above; with 5 percent medium grey, non-calcareous shale.
260-270	Siltstone, light grey, slightly calcareous, argillaceous, mostly fine-grained with some coarser-grained fragments, micaceous.
270-280	As above
280-290	As above; some light grey and grey shale.
290-320	As above
320-330	Siltstone, as above, but slightly finer-grained, argillaceous, slightly calcareous, micaceous, traces of light grey and grey shale; traces of grey, argillaceous limestone.
330-350	As above
350-360	As above, with slight increase in amount of light grey, slightly calcareous shale.
360-370	Siltstone, as above, further increase in amount of light grey shale, slightly calcareous in part.
370-380	As above
380-390	Siltstone, fine-grained, light grey, slightly calcareous, argillaceous, micaceous; with light grey, silty shale grading to siltstone to dark grey, very argillaceous limestone.
390-430	As above
430-440	Siltstone, light grey, fine-grained, slightly calcareous, micaceous, argillaceous; some grey, partly silty shale grading to siltstone, as above; trace dark grey, argillaceous limestone.
440-457	As above

Well Name:	Laduboro Seaway Champlain No. 3
Lot:	No. 383
Range:	Grand Coteau
Parish:	Champlain
County:	Champlain
Co-ordinates:	3,504 feet from south lot line; 61 feet east of west lot line
Total Depth:	457 feet
Status:	Suspended
Elevation:	64 feet

Depth Feet	Description
0-130	Clay, light grey and brownish grey, pelecypod fragments
130-150	Gravel, composed of igneous fragments and very coarse sand grains.
150-170	Siltstone, ' ht grey, fine-grained, argillaceous, slightly calcareous; th 40 percent light grey, slightly calcareous, partly silty shale
170-210	Shale, light grey, slightly calcareous; 25 percent siltstone, as above
210-230	Siltstone, light grey to grey, fine-grained, argillaceous, slightly calcareous; with variable amounts of shale as above; traces of darker grey, silty, slightly calcareous shale.
230-270	Shale, light grey, slightly calcareous; partly silty, variable amounts of siltstone, as above
270-280	Shale, light grey, slightly calcareous or dolomitic
280-300	Shale, light grey, slightly calcareous, silty in part and micromicaceous in part; grading to siltstone, light grey and grey, slightly calcareous, argillaceous
300-310	As above, with trace of brown, dense, argillaceous dolomite
310-400	Shale, light grey to grey, slightly calcareous, silty in part and grading to siltstone, light grey and grey, fine-

	grained, argillaceous, slightly calcareous, micromicaceous; variable amounts of siltstone usually less than 25 percent.
400-420	As above, but with increasing silt content and traces of very fine-grained grey, argillaceous, sandstone.
420-457	As at 310-400, samples predominantly shale.

Well Name:	Laduboro Seaway Champlain No. 4
Lot:	No. 383
Range:	Grand Coteau
Parish:	Champlain
County:	Champlain
Co-ordinates:	Approximately 1,844 feet from south lot line, approximately 69 feet from west lot line
Total Depth:	457 feet
Status:	Suspended
Surface Elevation:	Approximately 80 feet

Depth Feet	Description
0- 30	Sand, light brown, fine-grained
30-130	Clay, light grey and brownish grey, pelecypod fragments.
130-140	Gravel, composed mainly of shale and siltstone pebbles; with siltstone, light grey, fine-grained, slightly calcareous, micaceous, argillaceous.
140-150	As above
150-160	Siltstone, light grey, slightly calcareous, fine-grained, argillaceous, micaceous; some light grey, slightly calcareous shale grading to siltstone, as above.
160-200	As above
200-210	As above, but somewhat finer-grained and with larger amount of light grey shale.
210-220	Shale, light grey, slightly silty, slightly calcareous; grading to siltstone, as above.
220-230	Siltstone, light grey, argillaceous, slightly calcareous, micaceous; with some shale, light grey, partly silty, grading to siltstone, as above.
230-320	As above

Well Name:	Laduboro Seaway Champlain No. 5
Lot:	No. 214
Range:	I
Parish:	Champlain
County:	Champlain
Co-ordinates:	Approximately 415 feet from east lot line, approximately 200 feet from north lot line
Total Depth:	780 feet
Status:	Suspended
Surface Elevation:	40 feet

Depth Feet	Description
0- 50	Sand, fine-grained to very fine-grained, brownish grey.
50- 70	Clay, light grey and brownish grey.
70- 80	Gravel, pebbles of shale and igneous material; sample mostly cement.
80- 90	Gravel, coarse, mostly shale and siltstone pebbles.
90-100	Gravel, igneous pebbles; with pebbles of grey shale and light grey, calcareous siltstone; some coarse sand grains.
100-110	Siltstone, light grey, argillaceous, abundant fine gravel and coarse sand grains, as above.
110-120	Siltstone, light grey, argillaceous, slightly calcareous, fine- to medium-grained; with shale, grey and light grey, partly silty, very slightly calcareous; sand grains, as above.
120-130	Siltstone, light grey, argillaceous, a large percentage slightly calcareous, micaceous, some of large fragments - fragments approach fine-grained sandstone size; with shale, grey, partly silty, slightly calcareous.
130-200	As above
200-210	As above, slightly coarser grained.

Depth Feet	Description
210-240	As above
240-250	Sandstone, light grey, very fine-grained; grading to siltstone, slightly calcareous, micaceous; some light grey, silty shale.
250-270	As above
270-280	Siltstone, light grey, fine-grained, slightly calcareous, micromicaceous; some light grey shale, as above.
280-330	As above
330-340	As above, some increase in percentage of shale to about 25 percent.
340-370	As above
370-380	Siltstone, light grey, slightly calcareous, micaceous; small amounts of light grey, micromicaceous, partly silty, shale.
380-530	As above
530-540	As above, some increase in shale content.
540-560	As above
560-570	Siltstone, light grey, slightly calcareous, micaceous, argillaceous; some grey, calcareous shale.
570-620	As above.
620-630	As above, some increase in shale content.
630-640	Shale, grey, slightly calcareous, micromicaceous, silty in part and grading to siltstone, as above; trace fine-grained, argillaceous, calcareous sandstone.
640-710	As above
710-720	Missing
720-780	As above

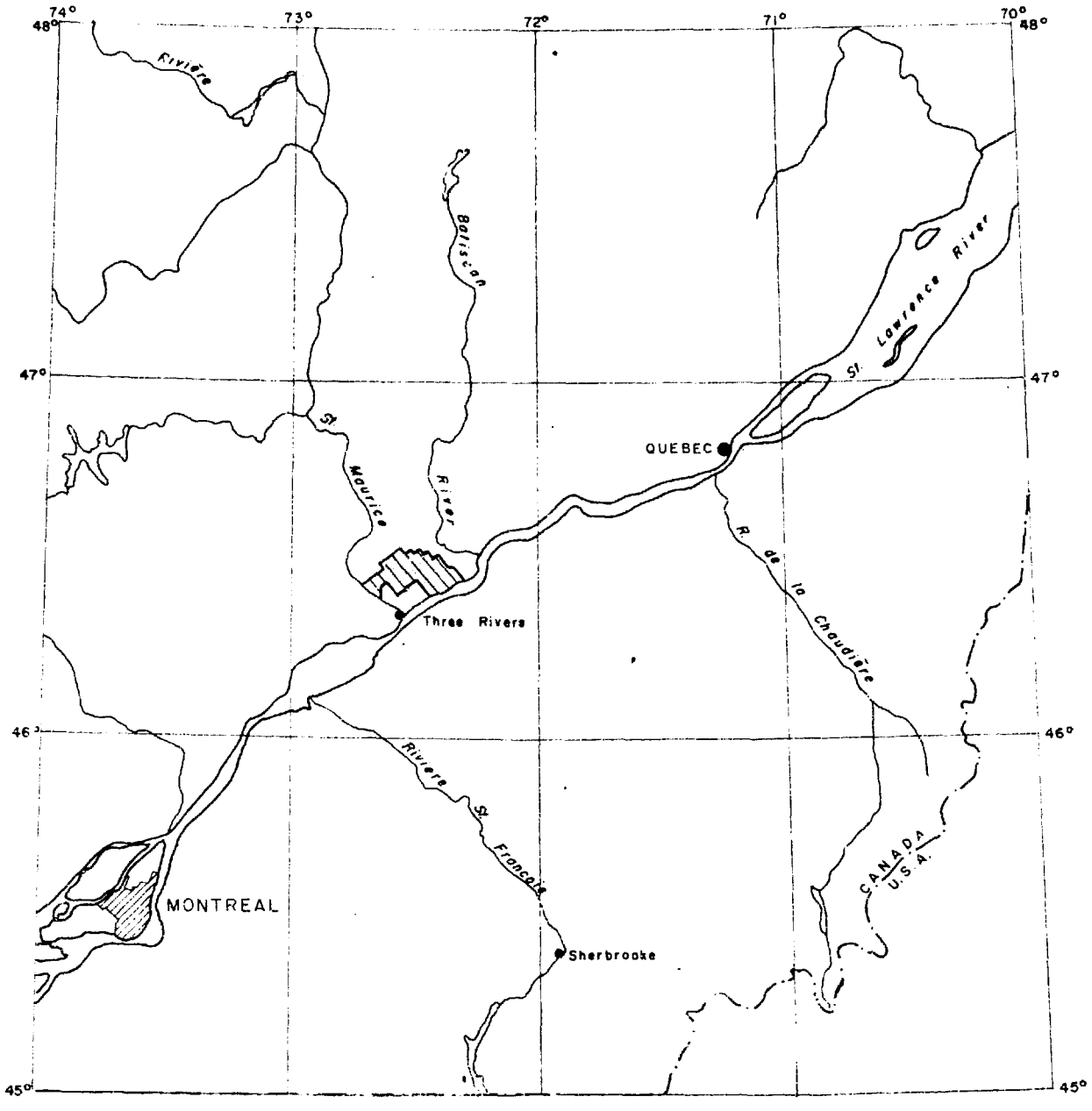
Well Name:	Laduboro Seaway Champlain No. 6
Lot:	No. 540
Range:	3
Parish:	Champlain
County:	Champlain
Co-ordinates:	Approximately 70 feet from east lot line, approximately 1,163 feet from south lot line
Total Depth:	774 feet
Status:	Abandoned
Surface Elevation:	84 feet

Depth Feet	Description
0- 20	Sand
20-180	Clay, light grey and brownish grey
180-190	Sandstone, light grey to light greenish grey, fine-grained, slightly calcareous; appears to contain much clay, tight, micaceous; some fine- to medium-grained, loose sand.
190-200	Sandstone, as above; some light grey siltstone and shale.
200-210	As above
210-220	Sandstone, light grey to light greenish grey, slightly calcareous, fine-grained, grading through very fine-grained to siltstone; appears to contain much clay (kaolinite?), micaceous, tight.
220-240	As above
240-250	As above, but with increase in amount of siltstone.
250-260	Siltstone, light grey to light greenish grey, contains abundant clay, slightly calcareous, micaceous, grades to fine-grained sandstone and silty shale.
260-300	As above
300-310	As above, some increase in amount of fine-grained sandstone.

Laduboro Seaway Champlain No. 6 (Continued) - 2

Depth Feet	Description
310-320	Siltstone, light grey, slightly calcareous, argillaceous, micaceous, tight; finely sandy in part.
320-350	As above
350-360	As above, with light grey, slightly calcareous shale and traces of medium grey, firm, micromicaceous shale.
360-370	As above
370-380	Shale, light grey, slightly silty, slightly calcareous, micromicaceous; with 40 percent siltstone, as before.
380-420	As above
420-430	Shale, grey (slightly darker than above), very slightly calcareous, micromicaceous, non-silty or only very slightly silty, softer than above.
430-480	As above
480-490	Shale, grey, very slightly calcareous to non-calcareous, soft, slightly silty in part, micromicaceous; variable amounts of siltstone, light grey, slightly calcareous, (less than 75 percent siltstone).
490-530	As above
530-540	Shale, grey, mostly soft, very slightly silty, in part very slightly calcareous to non-calcareous, slightly silty in part.
540-560	As above
560-570	As above; some fine-grained, light grey, slightly calcareous siltstone.
570-610	As above
610-620	Shale, grey, very slightly calcareous, micromicaceous, slightly silty in part.
620-630	As above
630-640	Shale, as above; with slight increase in silt content.

Depth Feet	Description
640-650	As above
650-660	Shale, as above; about 10 percent siltstone, light grey to grey, slightly calcareous, micaceous, tight.
660-690	As above
690-700	Shale, grey, micromicaceous.
700-710	Shale, as above; with about 10 percent siltstone, as above.
710-770	As above.



INDEX MAP

SOUTHERN QUEBEC

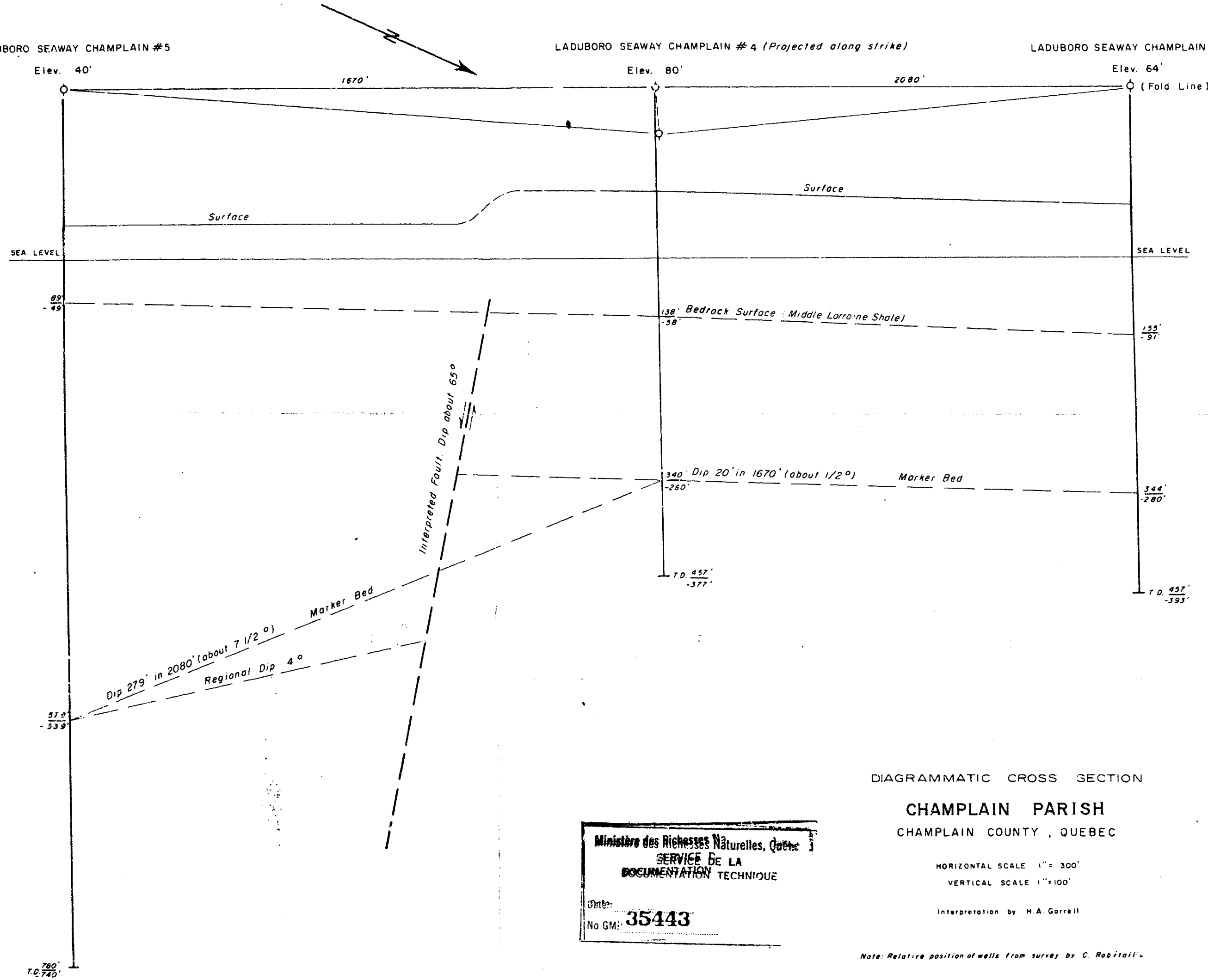
30 0 30 60

SCALE - 1" = 32 MILES

PERMIT OUTLINE

4508

J.C. SPROULE AND ASSOCIATES LTD, CALGARY



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DIAGRAMMATIC CROSS SECTION

CHAMPLAIN PARISH

CHAMPLAIN COUNTY, QUEBEC

HORIZONTAL SCALE 1" = 300'

VERTICAL SCALE 1" = 100'

Interpretation by H.A. Gorrell

Note: Relative position of wells from survey by C. Robitaille.

LADUBORO OIL LTED

PLAN

DE LOCALISATION D'UN PUITS SUR LE LOT

Nº 540

CADASTRE DE LA PAROISSE DE LA VISITATION DE

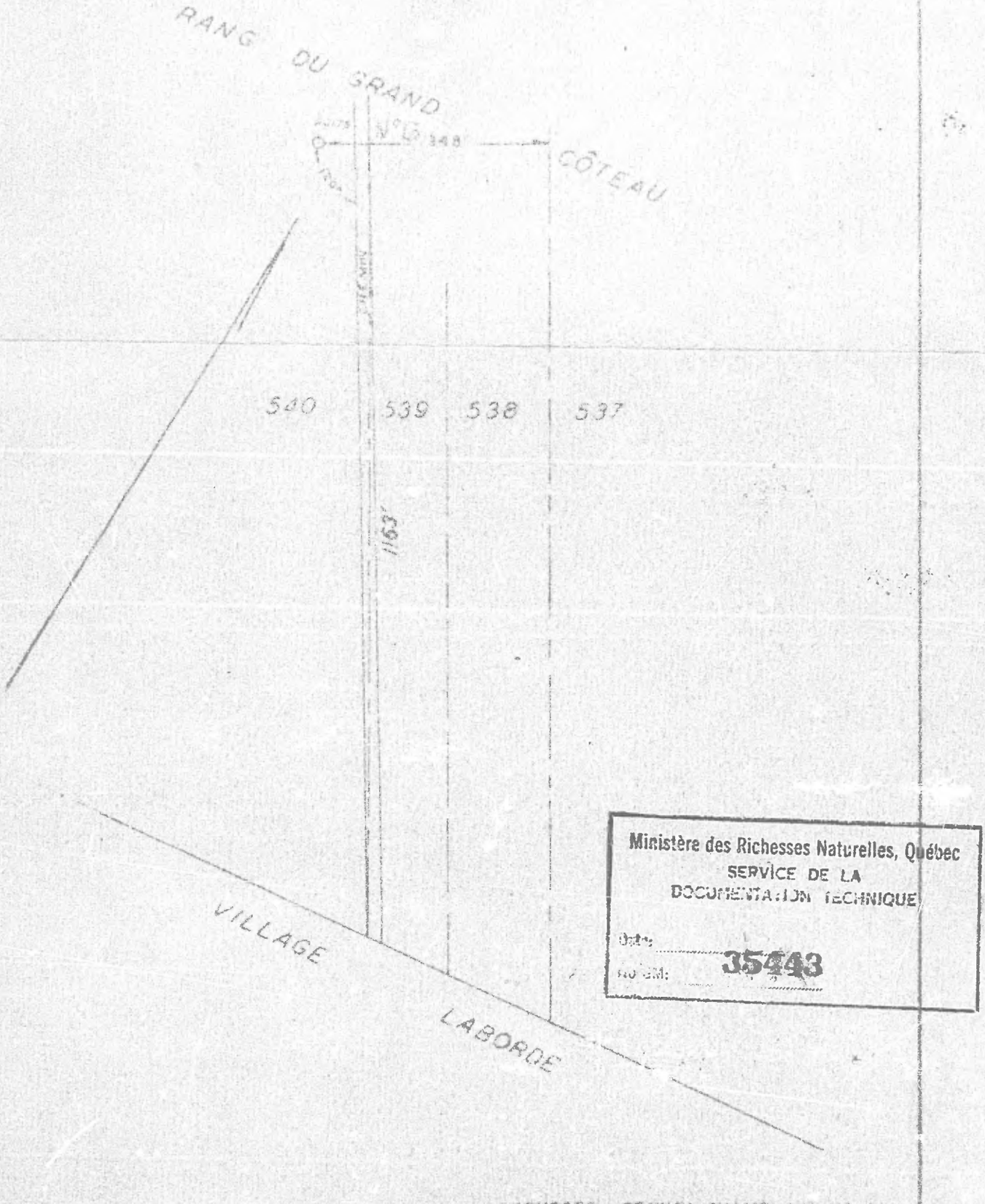
CHAMPLAIN

CTÉ CHAMPLAIN

ÉCHELLE: 200' = 1"

TROIS-RIVIÈRES
4 DÉCEMBRE 1961

Ernest L. Kreppeltree
ARPENTEUR-GÉOMÈTRE



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LADUBORO - SEAWAY CHAMPLAIN NO. 6

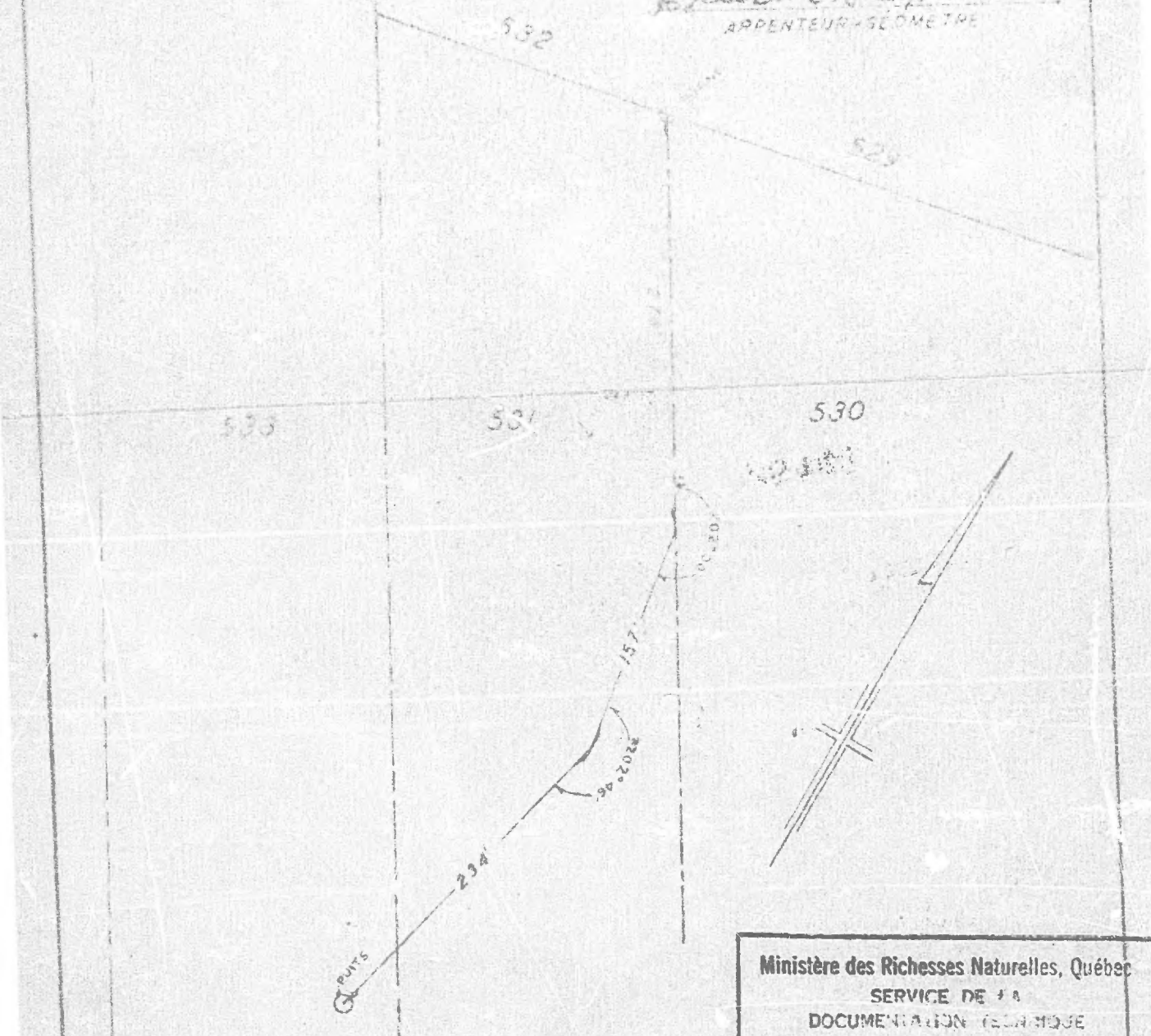
LADUBORO OIL LTÉE

PLAN

DE LOCALYSATION D'UN PUITS
SUR LE LOT N° 533
CADASTRÉ DE LA PAROISSE DE LA
VISITATION DE CHAMPLAIN
CTÉ CHAMPLAIN
ÉCHELLE 100' [illegible]

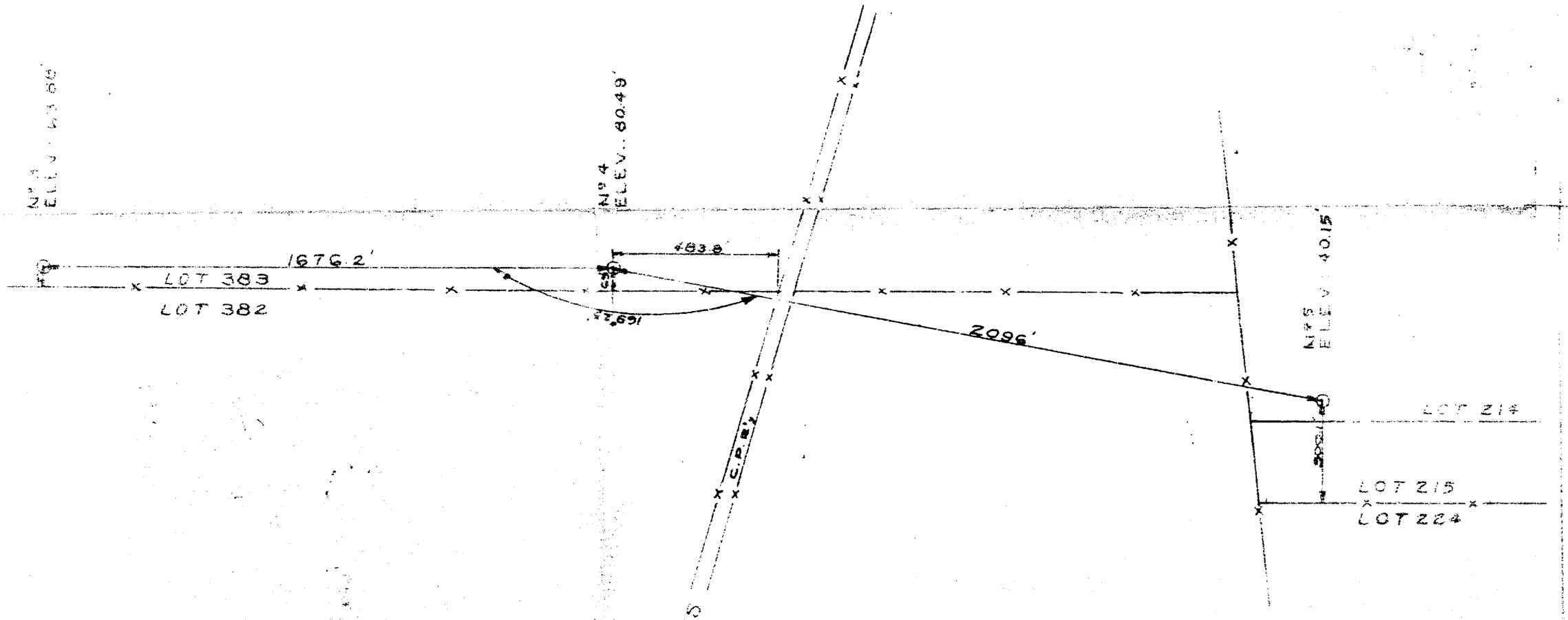
TROIS-RIVIÈRES,
14 NOVEMBRE 1961

Brunel Duperron
ARPENTEUR-GÉOMÈTRE



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No GM: 35443

LADUBORO - SEAWAY CHAMPLAIN NO. 1



Ministère des Richesses Naturelles, Québec
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DOCUMENTATION TECHNIQUE
Date
No Cm: 35443

LADUBORO OIL LTD

LOCATION AND ELEVATION

LADUBORO - SEAWAY - ALMEGA

Nos 3, 4, 5 - CHAMPLAIN

SCALE : 1" = 330'

LADUBORO OIL LTD.

PLAN

MONTRANT LE SITE D'UN PUITS SUR LE LOT
Nº 518
CADASTRE DE LA PAROISSE DE LA VISITATION DE
CHAMPLAIN
ÉCHELLE: 200' = 1"

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TROIS-RIVIÈRES,
9 OCTOBRE 1961

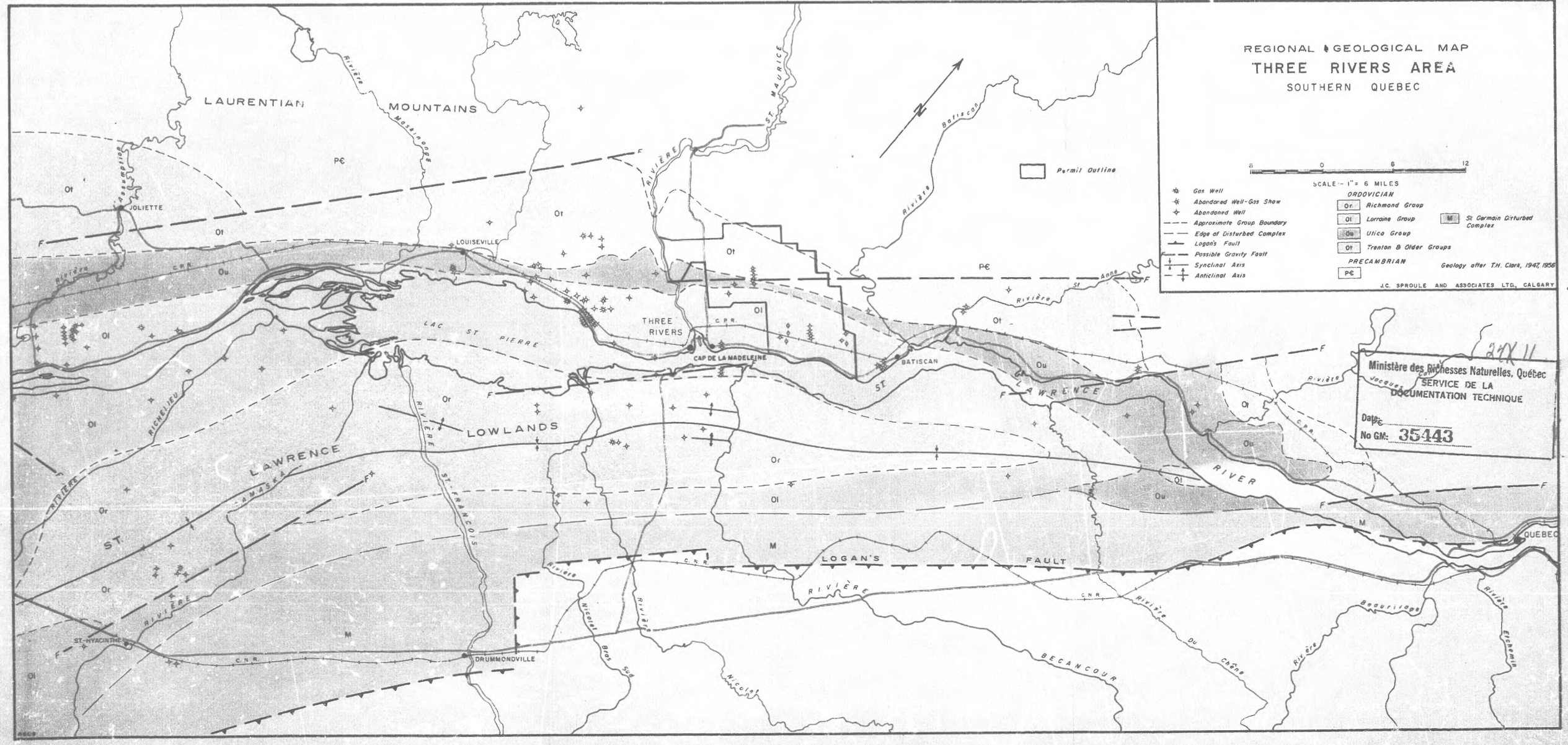
Brueil L. Duplessis
ARPENTEUR-GÉOMÈTRE



LADUBORO - SEAWAY CHAMPLAIN NO. 2

To accompany Report to Laduboro Oil Limited, January 1962

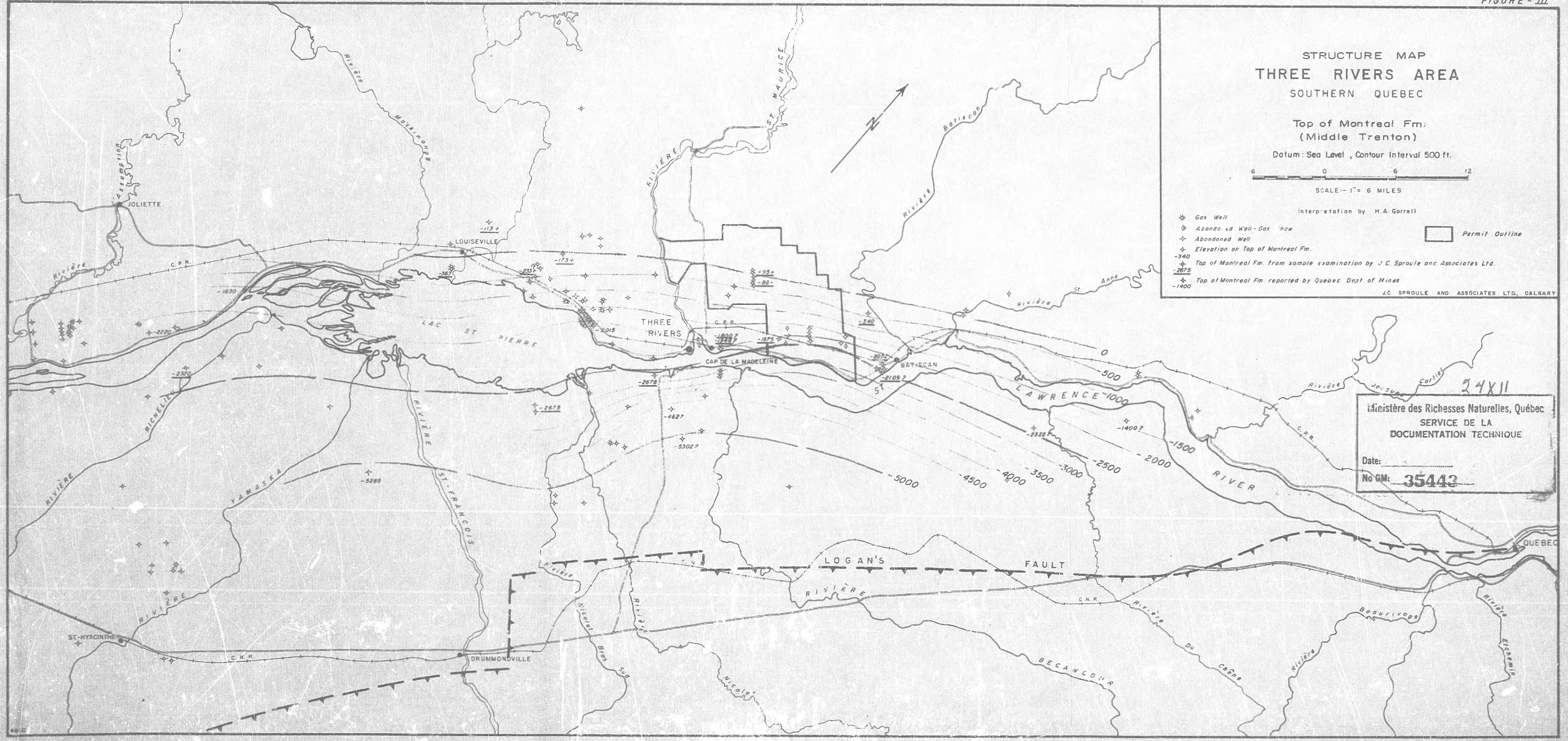
FIGURE - II



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FIGURE - III



24 X II
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