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EVALUATION OF PEAT SAMPLES AS PART OF A PEAT FUEL INVENTORY IN THE PROVINCE OF NEWFOUNDLAND

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Coal and Peat Resources Evaluation Section

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EVALUATION OF PEAT SAMPLES
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A PEAT FUEL INVENTORY IN THE PROVINCE OF NEWFOUNDLAND

by

T.E. Tibbetts*

ABSTRACT

In this report sixty-six samples of peat from thirty-five sites are evaluated at the request of the Province of Newfoundland as part of a reconnaissance of the peatlands in that province.

The broad objective is to assess the potential of peat as an alternate source of energy. With this in view, the parameters such as ash, volatile matter, sulphur, calorific value, degree of humification fusibility and chemical analysis of ash emphasized in this evaluation, are concerned with the use of peat as a fuel.

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EVALUATION D'ECHANTILLONS DE TOURBE
FAISANT PARTIE
D'UN INVENTAIRE DES COMBUSTIBLES DE TOURBE DANS LA PROVINCE DE TERRE-NEUVE

par

T.E. Tibbetts*

SOMMAIRE

Dans ce présent rapport, l'auteur évalue soixante-six échantillons de tourbe provenant de trente-cinq sites miniers différents et ce , à la demande de la province de Terre-Neuve dans le cadre d'une reconnaissance des tourbières de cette province.

L'objectif de principe est d'évaluer la tourbe pour connaître son potentiel comme autre source d'énergie. Par conséquent, le contenu en cendre, en matière volatile, en soufre, la valeur calorifique, le degré d'humification et de fusibilité et l'analyse chimique de la cendre sont tous des paramètres importants dans l'évaluation de la tourbe comme forme possible de combustible.

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TABLE OF CONTENTS

Abstract	i
Sommaire	ii
Introduction	1
Samples and Sampling Sites	2
Analytical Methods	6
Results of Analyses	8
Commentary on Analyses	18
References	21

TABLES

No.		
1	Location of Peat Sampling	3-5
2	von Post Degree of Decomposition	9
3	Analyses of Individual Peat Samples	10-14
4	Degree of Decomposition and Calorific Value	15-16
5	Analyses of Composite Samples	17
6	Suitability of Peat Samples by Location	20

MAPS

Stephenville 12B	- Sample Locations No. 1,2,3,4,5,6,7	22
Red Indian Lake 12A	- Sample Locations No. 8,9,10,11,12,13 14,15,15A,16,17,18	23
Sandy Lake 12H	- Sample Locations No. 19,20	24
Gander Lake 2D	- Sample Locations No. 21,22,23	25
Gander Lake 2D	- Sample Locations No. 24,25,26,27,28	26
Botwood 2E	- Sample Locations No. 30,31,32	27
Gander Lake 2D	- Sample Locations No. 21,22,23,29,33,34,35	28

INTRODUCTION

Peat is an unconsolidated hydrophilic carbonaceous sediment, formed by the accumulation of partially fragmented and decomposed, more-or-less altered and commonly heterogeneous plant remains. Peat deposits preserved by persistent moisture relationships may be buried and consolidated and eventually form coal.

Peat is organic matter in various stages of decomposition, with widely diverse physical and chemical properties. These properties determine the potential use of the peat and peat deposits (peatlands).

For all practical purposes, peat is regarded as a non-renewable resource. It has been used to a large extent in Europe for heating and electric power generation. The U.S.S.R. which has the lion's share of the world's peat resources, will consume an estimated 70 million tons of peat fuel in 1976. Ireland will consume 5.2 million tons. In Finland the annual consumption of peat for heating and electric power generation is expected to be about 3 million tons by 1980. Even though peat is of little importance in the overall world energy supply, it is of considerable local significance. It amounts to about one third of the energy supply in Ireland, to about 17 per cent in the Leningrad district of the U.S.S.R. and to about 2 per cent in the U.S.S.R. in general.

About 60 per cent of the world's peat resources are located within the boundaries of the U.S.S.R. About 80 per cent of these resources have been investigated. Canada is second to the U.S.S.R. in probable resources; however, only a small fraction of these resources has been investigated.

The use of peat fuel in Canada has not been significant because of economic factors, except during war-time when security of the energy supply to industrial Ontario was thought to be endangered. During these periods, considerable research and development were directed to peat production and processing technology as well as to peat combustion. The continuous increases in fuel prices and in forecast shortages of fossil fuels throughout the world, coupled with the development of peat utilization techniques, could place peat fuel in a much-improved economic position. In certain regions of Canada peat is the only indigenous energy resource and, as such, could provide a secure supply of fuel, particularly for small plants and industries, safe from international disturbance and disruption.

In November 1975, a request was submitted by the government of Newfoundland for the services of EMR to evaluate 66 peat samples as part of a peat fuel inventory being undertaken in Newfoundland (1). The evaluation of these samples is meant to serve as an indicator for a detailed assessment of the peat resources throughout that province.

The appropriate tests were carried out at the Energy Research Laboratories under Project ES1 - Resource and Reserve Assessment - Coal Quality and Peat; Element ES1.4 - Canadian Peat Resources - Inventory, Science and Technology.

The objectives of this ERL activity are: to add to the knowledge of the magnitude of Canadian peat deposits; to identify the types and properties of peat material; to increase the Canadian capability in utilizing a potentially significant and non-renewable energy resource.

SAMPLES AND SAMPLING SITES

The samples were collected from a cross-section of peat soils from locations in central and western Newfoundland as identified in Table 1. Locations are approximate as determined from maps provided by the field officers.

TABLE 1

Location of Peat Sampling

Sample No.	Location No.	Map Reference	Sample Area (See Map)	Latitude / Longitude	Sample Depth (m)
1 2 3	1	12B Ed.2 MCE Series A501	Grand Lake	48°39'55" 58°12'10"	1.00 2.00 2.50
4 5 6	2	12B Ed.2 MCE Series A501	Grand Lake	48°37'10" 58°14'25"	1.00 2.00 3.00
7 8 9	3	12B Ed.2 MCE Series A501	St. Georges River	48°32'40" 58°17'20"	1.00 2.00 2.25
10	4	12B Ed.2 MCE Series A501	Black Duck	48°35'00" 58°19'40"	1.00
11 12 13 14	5	12B Ed.2 MCE Series A501	Black Duck	48°33'50" 58°24'00"	1.00 2.00 3.00 3.50
15 16 17 18	6	12B Ed.2 MCE Series A501	Long Gull Pond	48°32'40" 58°26'40"	0.25 1.00 2.00 2.75
19 20	7	12B Ed.2 MCE Series A501	St. George's River	48°31'15" 58°25'45"	1.00 2.00
21	8	12A Ed.2 MCE Series A501	Buchans	48°54'30" 56°50'10"	0.25
22	9	12A Ed.2 MCE Series A501	Buchans	48°52'40" 56°45'40"	0.75
23 24	10	12A Ed.2 MCE Series A501	Buchans	48°53'05" 56°43'05"	0.50 1.00
25	11	12A Ed.2 MCE Series A501	Buchans	48°57'05" 56°43'10"	0.50
26	12	12A Ed.2 MCE Series A501	Buchans	48°50'20" 56°40'40"	0.25
27 28	13	12A Ed.2 MCE Series A501	Buchans	48°50'00" 56°40'10"	1.50 2.00
29 30	14	12A Ed.2 MCE Series A501	Buchans	48°49'25" 56°37'00"	0.50 1.00
31 32	15	12A Ed.2 MCE Series A501	Buchans	48°52'50" 56°34'35"	0.50 1.00
33	15A	12A Ed.2 MCE Series A501	Buchans	48°52'40" 56°34'35"	0.50

Table 1 (continued)

Sample No.	Location No.	Map Reference	Sample Area (See Map)	<u>Latitude</u> Longitude	Sample Depth (m)
34	16	12A Ed.2 MCE Series A501	Buchans	48°52'50" 56°37'30"	0.50
35	17	12A Ed.2 MCE Series A501	Buchans	48°53'40" 56°32'50"	0.25
36	18	12A Ed.2 MCE Series A501	Buchans	48°56'50" 56°32'30"	0.50
37	19	12H Ed.1	Buchans	49°01'40" 56°34'05"	0.25
38	20	12H Ed.1	Buchans	49°04'10" 56°39'55"	0.25
39	21	2D Ed.2 MCE Series A501	Gambo Pond	48°34'50" 54°28'00"	1.00
40	22	2D Ed.2 MCE Series A501	Deer Pond	48°33'20" 54°34'40"	0.50
41	23	2D Ed.2 MCE Series A501	Deer Pond	48°29'55" 54°39'10"	0.25
42	24	2D Ed.2 MCE Series A501	Port Blandford	48°21'20" 54°16'20"	1.75
43	25	2D Ed.2 MCE Series A501	Shoal Harbour Pond	48°11'45" 54°10'50"	0.25
44	26	2D Ed.2 MCE Series A501	Tug Pond	48°05'15" 54°00'10"	1.00
45	27	2D Ed.2 MCE Series A501	Tug Pond	48°05'15" 54°11'10"	1.00
46	28	2D Ed.2 MCE Series A501	Clode Sound Pond	48°20'25" 54°23'35"	1.00
47					1.50
48	29	2D Ed.2 MCE Series A501	Gander Airport Bog	48°56'30" 54°30'40"	1.00
49					2.00
50					3.00
51					4.00
52	30	2E Ed.2 MCE Series A501	Indian Bay Pond	49°04'40" 54°26'40"	1.00
53					2.00
54					3.25

Table 1 (continued)

Sample No.	Location No.	Map Reference	Sample Area (See Map)	Latitude / Longitude	Sample Depth (m)
55	31	2E Ed.2 MCE Series A501	Weir's Pond	49°09'30" 54°23'50"	1.00
56					2.00
57					3.25
58	32	2E Ed.2 MCE Series A501	Indian Bay Pond	49°08'40" 54°08'40"	1.00
59					2.00
60					3.00
61	33	2D Ed.2 MCE Series A501	Caribou Lake	48°34'15" 54°50'50"	1.50
62	34	2D Ed.2 MCE Series A501	Caribou Lake	48°34'40" 55°01'05"	1.00
63					2.00
64					3.00
65	35	2D Ed.2 MCE Series A501	Gambo Pond	48°38'00" 54°53'00"	1.00
66					2.75

ANALYTICAL METHODS

The samples were received in small plastic bags and contained an average of 91.5% moisture as received.

Analyses conducted on all samples were proximate (moisture, ash, volatile matter and fixed carbon), calorific value and sulphur. These analyses were conducted by ASTM standard test procedures for the testing of coal as follows:

1. Moisture, ASTM D3173-73
2. Ash, ASTM D3174-73
3. Volatile Matter (VM), ASTM D3175-73
4. Fixed Carbon (FC), 100 - (Moisture + Ash + Volatile Matter)
5. Calorific Value, ASTM D2015-66 (1972)
6. Sulphur (S), ASTM D3177-75

Details of the test procedures are presented under the appropriate specification numbers in the most recent Annual Book of ASTM Standards (2) and summarized as follows:

Moisture: Moisture is determined by establishing the loss in weight of a sample when heated under rigidly controlled conditions of sample weight, temperature, time, atmosphere and equipment specifications.

Ash: Ash is determined by weighing the residue remaining after burning the peat under rigidly controlled conditions of sample weight, temperature, time and atmosphere.

Volatile Matter: Volatile Matter is determined by establishing the loss in weight resulting from heating a sample under rigidly controlled conditions. The measured weight loss, corrected for moisture as determined in Method D3173, establishes the volatile-matter content.

Calorific Value: Calorific Value is determined by burning a weighed sample in an adiabatic oxygen-bomb calorimeter under controlled conditions. The calorific value is computed from temperature observations made before and after combustion, making proper allowance for thermometer and thermochemical corrections.

The calorific value is the heat of combustion of a substance. In Canada it is usually expressed in British thermal units (Btu) per pound.

Degree of Decomposition: In addition to the standard test procedures outlined above, the peat samples were classified with respect to their degree of decomposition. This is very important in considering peat as a fuel since the higher the degree of decomposition the higher is the proportion of chemical substances of high heat content, e.g., humic acids (3).

The von Post (4) index is widely used as an approximation of the relative degree of decomposition of the organic substance in peat. In 1926, von Post (Sweden) introduced a scale with 10 degrees of decomposition as shown in Table 2. The scale starts at H1 for a completely undecomposed peat and proceeds to H10 for a completely decomposed peat. The location on the scale for a particular peat is determined by visual inspection of the colour of the water and the action of the peat substance as a result of pressing the substance in the hand. If only clear water comes from the hand when the peat substance is pressed, the peat is considered undecomposed and is classified as H1. As the water colour darkens (seemingly becomes more muddy) and peat substance exudes between the fingers, the scale increases. At H_{10} practically all of the peat substance passes between the fingers when pressed in the hand and it is considered completely decomposed. It is generally recognized that the best peat for fuel use, technically and economically, is well-decomposed dense peat classified as at least H5 on the von Post scale.

Fusibility and Chemical Analysis of Ash: As there was not a sufficient quantity of the individual samples to conduct fusibility determinations and chemical analysis of the ash, these tests were conducted on composite samples prepared by placing the individual samples into six arbitrary classes according to their ash content (Table 5).

Standard test procedures for the testing of coal were followed in making these determinations as follows:

(a) Fusibility of Ash, ASTM D1857-68(1974)

In determining the fusibility of ash, observation is made of the temperatures at which triangular pyramids (cones) prepared from ash attain and pass through certain defined stages of fusing and flow when heated at a specified rate in a controlled mildly reducing atmosphere.

The initial deformation temperature is the temperature at which the first rounding of the apex of the cone occurs.

The softening or spherical temperature is the temperature at which the cone has fused down to a spherical lump.

The hemispherical temperature is the temperature at which the cone has fused down to a hemispherical lump.

The fluid temperature is the temperature at which the fused mass has spread out in a nearly flat layer.

(b) Chemical Analysis of Ash, ASTM D2795-69(1974) and BS 1016: Part 14: 1963

The peat is ashed under standard conditions and ignited to constant weight. Two solutions are prepared from the ash. One solution is used for the analysis of SiO_2 and Al_2O_3 and the second for the remaining elements. The two solutions are analyzed by a combination of methods: (a) spectrophotometric procedures are used for SiO_2, Al_2O_3, Fe_2O_3, TiO_2 and P_2O_5; (b) chelatometric titration for CaO and MgO; (c) flame photometry for Na_2O and K_2O; (d) gravimetric method for SO_3 and (e) titration method for Mn_3O_4.

RESULTS OF ANALYSES

Table 3 presents the results of the tests on the 66 samples of peat following the ASTM standard test procedures previously outlined. The results are presented on a dry peat basis and on a 40 per cent moisture basis. The latter was chosen as the lowest practical and safe moisture content of peat fuel.

Table 4 presents the von Post indices of decomposition of the 66 peat samples together with the calorific values calculated to the dry, ash-free basis.

Table 5 presents the analyses of the six composite peat samples and the fusibility and chemical analysis of the mineral matter (ash) of each composite sample.

TABLE 2

von Post Degree of Decomposition

Degree of Decomposition - von Post's Scale	Description
H_1	Completely unconverted and mud-free peat which, when pressed in the hand, gives off only clear water.
H_2	Practically completely unconverted and mud-free peat which, when pressed in the hand, gives off almost clear colourless water.
H_3	Slightly converted or very slightly muddy peat which, when pressed in the hand, gives off markedly muddy water, but no peat substance passes through the fingers. The pressed residue is not thick.
H_4	Poorly converted or somewhat muddy peat which, when pressed in the hand, gives off markedly muddy water. The pressed residue is somewhat thick.
H_5	Fairly well converted or rather muddy peat; growth structure quite evident but somewhat obliterated. Some peat substance passes through the fingers when pressed but mostly muddy water. The pressed residue is very thick.
H_6	Fairly well converted or rather muddy peat with indistinct growth structure. When pressed, at the most 1/3 of the peat substance passes through the fingers. The remainder is extremely thick but with more obvious growth structure than in the case of unpressed peat.
H_7	Fairly well converted or markedly muddy peat but the growth structure can still be seen. When pressed, about half the peat substance passes through the fingers. If water is also given off, this has the consistency of porridge.
H_8	Well converted or very muddy peat with indistinct growth structure. When pressed, about 2/3 of the peat substance and at times a somewhat porridge-like liquid passes through the fingers. The remainder consists mainly of more resistant fibres and roots.
H_9	Practically completely converted or almost mudlike peat in which almost no growth structure is evident. Almost all the peat substance passes through the fingers as a homogeneous porridge-like material when pressed.
H_{10}	Completely converted or absolutely muddy peat where no growth structure can be seen. The entire peat substance passes through the fingers when pressed.

TABLE 3

Analyses of Peat Samples

Sample No.	Lab No. ERL	Properties of Dry Peat				Properties of Peat of 40% H_2O			
		Ash %	VM %	S %	CV Btu/lb Dry	Ash %	VM %	S %	CV Btu/lb
Location No. 1									
1	3622-75	1.25	68.52	0.24	9,000	0.75	41.11	0.14	5400
2	3623-75	1.00	69.32	0.20	9,110	0.60	41.59	0.12	5465
3	3624-75	1.08	69.28	0.20	9,100	0.65	41.57	0.12	5460
Location No. 2									
4	3625-75	1.09	67.45	0.22	9,320	0.65	40.47	0.13	5590
5	3626-75	1.18	67.28	0.27	9,190	0.71	40.37	0.16	5515
6	3627-75	3.29	67.38	0.45	9,850	1.97	40.43	0.27	5910
Location No. 3									
7	3628-75	1.43	68.56	0.30	9,190	0.85	41.14	0.18	5515
8	3629-75	1.61	69.54	0.30	10,340	0.97	41.72	0.18	6200
9	3630-75	2.11	69.14	0.33	10,160	1.27	41.48	0.20	6100
Location No. 4									
10	3631-75	1.07	73.59	0.23	8,850	0.64	44.15	0.14	5310
Location No. 5									
11	3632-75	1.32	72.76	0.16	9,090	0.79	43.66	0.10	5450
12	3633-75	1.65	70.28	0.28	9,440	0.99	42.17	0.17	5660
13	3634-75	1.63	66.99	0.29	9,920	0.98	40.19	0.17	5950
14	3635-75	1.92	67.62	0.32	9,980	1.15	40.57	0.19	5990
Location No. 6									
15	3636-75	1.51	70.53	0.26	8,680	0.91	42.32	0.16	5210
16	3637-75	1.46	69.29	0.25	8,910	0.88	41.57	0.15	5350
17	3638-75	1.25	67.68	0.26	9,130	0.75	40.61	0.16	5480
18	3639-75	1.47	67.75	0.23	9,780	0.88	40.65	0.14	5870
Location No. 7									
19	3640-75	1.36	69.60	0.22	9,070	0.82	41.76	0.13	5440

TABLE 3 (continued)

Sample No.	Lab No. ERL	Properties of Dry Peat				Properties of Peat of 40% H_2O			
		Ash %	VM %	S %	CV Btu/1b Dry	Ash %	VM %	S %	CV Btu/1b
Location No. 7									
20	3641-75	26.75	53.76	0.16	6,690	23.91	25.15	0.10	4015
Location No. 8									
21	3642-75	20.24	65.09	0.32	8,030	12.14	39.05	0.19	4820
Location No. 9									
22	3643-75	7.95	70.61	0.37	9,650	4.77	42.37	0.22	5790
Location No. 10									
23	3644-75	6.07	69.25	0.25	9,500	3.64	41.55	0.15	5700
24	3645-75	4.20	67.45	0.25	9,880	2.52	40.47	0.15	5930
Location No. 11									
25	3646-75			0.09		48.15	7.67	0.05	2560
Location No. 12									
26	3647-75	44.05	55.89	0.21	5,190	26.43	33.53	0.12	3115
Location No. 13									
27	3648-75	18.70	60.15	0.63	8,540	11.22	36.09	0.38	5125
28	3649-75	15.37	62.80	0.55	8,720	9.22	37.68	0.33	5230
Location No. 14									
29	3650-75	3.25	73.88	0.11	8,380	1.95	44.33	0.07	5030
30	3651-75	1.44	72.23	0.11	9,510	0.86	43.34	0.07	5705
Location No. 15									
31	3652-75	4.40	70.02	0.58	9,660	2.64	42.01	0.35	5795
32	3653-75	5.86	68.28	0.56	10,020	3.52	40.97	0.34	6010

TABLE 3 (continued)

Sample No.	Lab No. ERL	Properties of Dry Peat				Properties of Peat of 40% H_2O			
		Ash %	VM %	S %	CV Btu/lb Dry	Ash %	VM %	S %	CV Btu/lb
Location No. 15a									
33	3654-75	6.21	70.20	0.34	9,210	3.73	42.10	0.20	5525
Location No. 16									
34	3655-75	2.49	73.01	0.30	9,320	1.49	43.81	0.18	5590
Location No. 17									
35	3656-75	20.77	63.93	0.30	7,830	12.46	38.36	0.18	4700
Location No. 18									
36	3657-75	2.00	73.32	0.23	10,010	1.20	44.00	0.14	6005
Location No. 19									
37	3658-75	8.00	70.39	0.41	9,550	4.80	42.23	0.25	5730
Location No. 20									
38	3659-75	6.86	72.41	0.24	8,930	4.12	43.44	0.14	5360
Location No. 21									
39	3660-75	2.72	69.07	0.42	10,320	1.63	41.44	0.25	6190
Location No. 22									
40	3661-75	1.59	72.32	0.28	9,290	0.95	43.39	0.17	5575
Location No. 23									
41	3662-75	1.46	74.25	0.16	9,080	0.88	44.55	0.10	5450
Location No. 24									
42	3663-75	3.67	72.30	0.20	10,310	2.20	43.38	0.12	6185

TABLE 3 (continued)

Sample No.	Lab No. ERL	Properties of Dry Peat				Properties of Peat of 40% H_2O			
		Ash %	VM %	S %	CV Btu/lb Dry	Ash %	VM %	S %	CV Btu/lb
Location No. 25									
43	3664-75	3.97	73.23	0.17	9,960	2.38	43.94	0.10	5975
Location No. 26									
44	3665-75	1.41	71.87	0.36	9,500	0.85	43.12	0.22	5700
Location No. 27									
45	3666-75	3.89	70.63	0.26	10,300	2.33	43.38	0.16	6180
Location No. 28									
46	3667-75	2.23	72.94	0.15	8,470	1.34	43.76	0.09	5080
47	3668-75	4.81	68.62	0.13	8,440	2.89	41.17	0.08	5065
Location No. 29									
48	3669-75	0.78	74.22	0.14	8,900	0.47	44.53	0.08	5340
49	3670-75	0.92	73.19	0.11	8,670	0.55	43.91	0.07	5200
50	3671-75	1.48	70.62	0.27	9,580	0.89	42.37	0.16	5750
51	3672-75	15.35	60.19	0.34	8,560	9.21	36.11	0.20	5135
Location No. 30									
52	3673-75	1.81	70.26	0.20	9,550	1.09	42.16	0.12	5730
53	3674-75	2.67	69.06	0.16	9,250	1.60	41.44	0.10	5550
54	3675-75	9.07	62.71	0.32	9,360	5.44	37.63	0.19	5615
Location No. 31									
55	3676-75	1.18	71.22	0.19	8,580	0.71	42.73	0.11	5150
56	3677-75	3.32	69.44	0.14	8,530	1.99	41.66	0.08	5120
57	3678-75	6.61	65.66	0.36	9,410	3.97	39.40	0.22	5645
Location No. 32									
58	3679-75	0.84	72.78	0.17	8,900	0.50	43.67	0.10	5340
59	3680-75	0.97	71.32	0.32	9,990	0.58	42.79	0.19	5995

TABLE 3 (continued)

Sample No.	Lab No. ERL	Properties of Dry Peat				Properties of Peat of 40% H_2O			
		Ash %	VM %	S %	CV Btu/lb Dry	Ash %	VM %	S %	CV Btu/lb
Location No. 32									
60	3681-75	2.20	68.80	0.46	10,100	1.32	41.28	0.28	6060
Location No. 33									
61	3682-75	2.55	70.59	0.20	10,280	1.53	42.35	0.12	6170
Location No. 34									
62	3683-75	0.53	73.13	0.17	9,190	0.32	43.88	0.10	5515
63	3684-75	0.73	70.83	0.13	8,910	0.44	42.50	0.08	5345
64	3685-75	1.35	69.43	0.24	9,170	0.81	41.66	0.14	5500
Location No. 35									
65	3686-75	0.75	72.81	0.30	8,530	0.45	43.69	0.18	5120
66	3687-75	0.83	71.17	0.15	8,950	0.50	42.70	0.09	5370

TABLE 4

Degree of Decomposition and Calorific Value

Sample No.	von Post Index	CV-Btu/lb Dry, ash-free
Location No.1		
1	7	9,110
2	7	9,200
3	7	9,200
Location No.2		
4	8	9,420
5	9	9,300
6	9	10,185
Location No.3		
7	8	9,320
8	10	10,510
9	9	10,380
Location No.4		
10	3	8,945
Location No.5		
11	5	9,090
12	8	9,440
13	10	9,920
14	10	9,980
Location No.6		
15	8	8,680
16	8	8,910
17	8	9,130
18	9	9,780
Location No.7		
19	7	9,070
20	6	9,130
Location No.8		
21	5	8,030
Location No.9		
22	6	9,650
Location No.10		
23	6	9,500
24	6	9,880
Location No.11		
25	8	10,070
Location No.12		
26	7	9,280
Location No.13		
27	9	10,504
28	8	10,300
Location No.14		
29	1	8,660
30	4	9,650
Location No.15		
31	4	10,100
32	6	10,640
Location No.15A		
33	7	9,820
Location No.16		
34	7	9,560
Location No.17		
35	7	9,880
Location No.18		
36	7	10,210
Location No.19		
37	8	10,380
Location No.20		
38	8	9,590
Location No.21		
39	8	10,610
Location No.22		
40	5	9,440

Table 4 (continued)

Sample No.	von Post Index	CV-Btu/lb Dry, ash-free	Sample No.	von Post Index	CV-Btu/lb Dry, ash-free
<u>Location No.23</u>			<u>Location No.33</u>		
41	4	9,210	61	8	10,550
<u>Location No.24</u>			<u>Location No.34</u>		
42	6	10,700	62	6	9,240
			63	5	8,980
<u>Location No.25</u>			64	6	9,300
43	6	10,370	<u>Location No.35</u>		
<u>Location No.26</u>			65	N.D.	8,590
44	8	9,640	66	N.D.	9,020
<u>Location No.27</u>					
45	6	10,720			
<u>Location No.28</u>					
46	4	8,660			
47	7	8,870			
<u>Location No.29</u>					
48	5	8,970			
49	5	8,750			
50	6	9,720			
51	7	10,110			
<u>Location No.30</u>					
52	7	9,730			
53	7	9,500			
54	8	10,290			
<u>Location No.31</u>					
55	6	8,680			
56	6	8,820			
57	6	10,080			
<u>Location No.32</u>					
58	6	8,980			
59	7	10,090			
60	7	10,330			

Table 5

Analyses of Composite Peat Samples*

Composite Sample..	A	B	C	D	E	F
Number of Sub Samples ..	17	17	13	11	6	1
Range of Ash (per cent) of Sub Samples ...	0.53-1.81	1.00-2.11	2.00-3.97	4.20-9.07	15.35-26.75	44.05
Proximate Analysis						
Ash	1.28	1.41	2.85	6.21	17.25	44.05
Volatile Matter	72.24	67.27	69.18	67.18	61.02	55.89
Fixed Carbon	26.48	31.32	27.97	26.61	21.73	00.06
Sulphur	0.19	0.24	0.26	0.34	0.51	0.21
Calorific Value Btu/lb	9160	9260	9640	9260	8330	5190
Ash Fusibility						
Initial	2150	2350	2130	2120	2150	2110
Spherical	2210	2480	2210	2240	2220	2150
Hemispherical	2230	2520	2220	2300	2300	2160
Fluid	2360	2700+	2420	2550	2390	2370
Ash Analysis						
SiO_2	29.62	20.67	41.33	51.15	38.27	17.75
Al_2O_3	17.22	17.10	23.62	21.75	23.14	11.78
Fe_2O_3	20.00	11.21	16.61	14.87	25.83	62.50
Mn_3O_4	0.36	0.13	0.29	0.20	0.14	0.96
TiO_2	0.58	0.71	0.96	0.70	0.72	0.35
P_2O_5	1.75	0.00	2.55	2.27	1.35	1.37
CaO	11.45	14.82	6.55	5.86	6.27	1.13
MgO	9.78	18.40	2.87	1.88	1.27	0.40
SO_3	8.02	12.56	4.69	3.53	3.28	1.05
Na_2O	1.47	0.93	0.88	0.51	1.09	0.33
K_2O	0.73	0.94	0.89	0.57	0.96	0.24

*Composited from samples from locations no. 1 to 35 as follows:

Sample A	Locations No.7,14,22,23,26,29,30,31,32,34,35
Sample B	Locations No.1,2,3,4,5,6
Sample C	Locations No.2,14,16,18,21,24,25,27,28,30,31,32,33
Sample D	Locations No.9,10,15,15A,19,20,28,30,31
Sample E	Locations No.7,8,13,17,29
Sample F	Location No.12

COMMENTARY ON ANALYSES

Actual moisture content for optimum performance is dependent on the type of peat i.e., sod peat or milled peat and the type of boiler. Guidelines for best performance from milled peat in peat boilers in Ireland indicate a moisture content of 50-55 per cent (5).

The following units are used in Finland and elsewhere to evaluate peat in comparison with other fuels (6):

1MJ = 1MWs $\cong$ 0.239 Mcal= 947.74 Btu

1 toe = 1 ton oil equivalent $\cong$ 42GJ

1 ton milled peat MC40% $\cong$ 0.26 toe

1 ton peat dry matter $\cong$ 18.25 GJ $\cong$ 0.43-0.6 toe

In Newfoundland it would also be credible to compare peat with coal from the Sydney coalfield at 13,500 Btu/lb.

To place the analyses of the 66 samples in perspective, a comparison with the peat used in other countries to produce electricity may be helpful. Peat used in Ireland between 1964 and 1975 varied from about 2.8% to 4.1% ash (dry basis) and from about 21.8 MJ/kg (9370 Btu/lb) to 22.1 MJ/kg (9500 Btu/lb) on the dry, ash-free basis (5). In Finland, interim fuel-peat standards are established for two qualities of both sod peat and milled peat and these are partially reproduced below (7).

		Milled Peat		Sod Peat	
		I	II	I	II
Moisture content (min)	%	40	40	30	20
(max)	%	55	55	50	35
Ash (monthly average)	%	8	8	6	6
(maximum)	%	12	12	10	10
Net heating value (Hu′)	MJ/kg	8	11 ± 2	13 ± 3	15 ± 3
	Btu/lb	3440		5590	

The net or effective heating value of peat of known moisture content, Hu′, is defined as follows (7):

$$Hu' = Ho - 290 \times \frac{100-k}{100} - 5.83 \times K \text{ kcal/kg where}$$

Ho = heat of combustion of absolutely dry peat,

K = the moisture content of peat (% of wet weight).

Assuming a net heating value Hu′ = 8 for peat with 40% moisture and 8% ash, the following values are obtained for dry, ash-free peat:

		Milled Peat		Sod Peat	
Net heating value (Hu)	MJ/kg	8	11	13	15
Moisture content of peat (K)	%	40	40	30	20
Heat of combustion of dry peat (Ho)	MJ/kg	16.18	21.18	20.84	20.58
Average ash (moist basis)	%	8	8	6	6
Average ash (dry basis)	%	13.33	13.33	8.6	7.5
Heat of combustion of dry, ash-free peat,	MJ/kg	18.67	24.44	22.80	22.85
	Btu/lb	8026	10,507	9801	9565

Comparison of the quality of Irish fuel peat mentioned above with the interim standards for Finnish fuel peat indicates that similar types of peat are utilized, although higher ash is expected and tolerated in Finland.

Referring to Table 4, it is apparent that, with few exceptions, the calorific values of the Newfoundland peat samples fall within the limits of the fuel peat used in Ireland and Finland and meet the generally assumed minimum on the von Post scale. However, several of the locations are regarded as unlikely for fuel peat production because of high ash content. For the areas examined, some general comments concerning suitability for fuel peat are offered in Table 6.

TABLE 6

Suitability of Peat Samples by Location

Location No.	
1	suitable fuel peat.
2	suitable fuel peat.
3	suitable fuel peat.
4	unsuitable fuel peat; suitable peat moss.
5	suitable fuel peat below 1m
6	suitable fuel peat below 1m
7	suitable only to 1m; high ash.
8	unsuitable fuel peat; high ash.
9	unsuitable fuel peat; high ash.
10	may be suitable fuel peat; high ash.
11	unsuitable fuel peat; high ash.
12	unsuitable fuel peat; high ash.
13	unsuitable fuel peat; high ash.
14	unsuitable fuel peat; suitable peat moss.
15	may be suitable fuel peat at 1m; von Post low.
15A	unsuitable fuel peat; high ash.
16	suitable fuel peat.
17	unsuitable fuel peat; high ash.
18	suitable fuel peat.
19	unsuitable fuel peat; high ash.
20	unsuitable fuel peat; high ash.
21	suitable fuel peat.

Location No.	
22	may be suitable fuel peat; low von Post.
23	unsuitable fuel peat; suitable peat moss.
24	suitable fuel peat.
25	suitable fuel peat.
26	suitable fuel peat.
27	suitable fuel peat.
28	suitable fuel peat at 1.50m.
29	unsuitable fuel peat; low von Post to 2m; high ash at 4m.
30	suitable fuel peat to 2m; high ash at 3.25m.
31	suitable fuel peat to 2m; borderline von Post.
32	suitable fuel peat.
33	suitable fuel peat.
34	may be suitable fuel peat although borderline von Post.
35	may not be suitable fuel peat; no sample for von Post; low heat value indicates low decomposition.

Suitable Areas

Fuel Peat: 1, 2, 3, 5, 6, 16, 18, 21, 24, 25, 26, 27, 28, 30, 31, 32, 33.

Peat Moss: 4, 14, 23.

Areas of Doubtful Value: 7, 8, 9, 10, 11, 12, 13, 15, 15A, 17, 19, 20, 22, 29, 34, 35.

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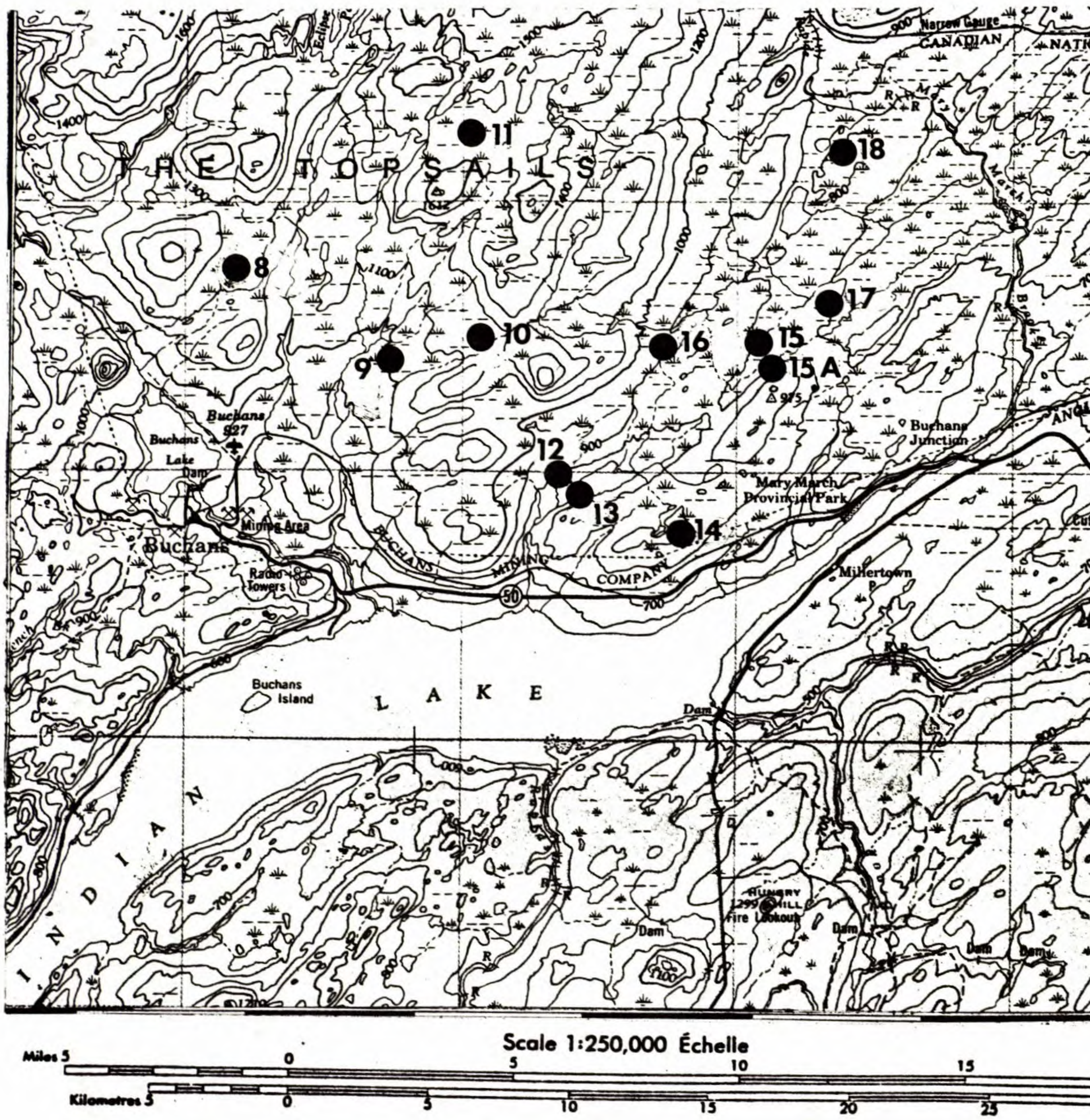

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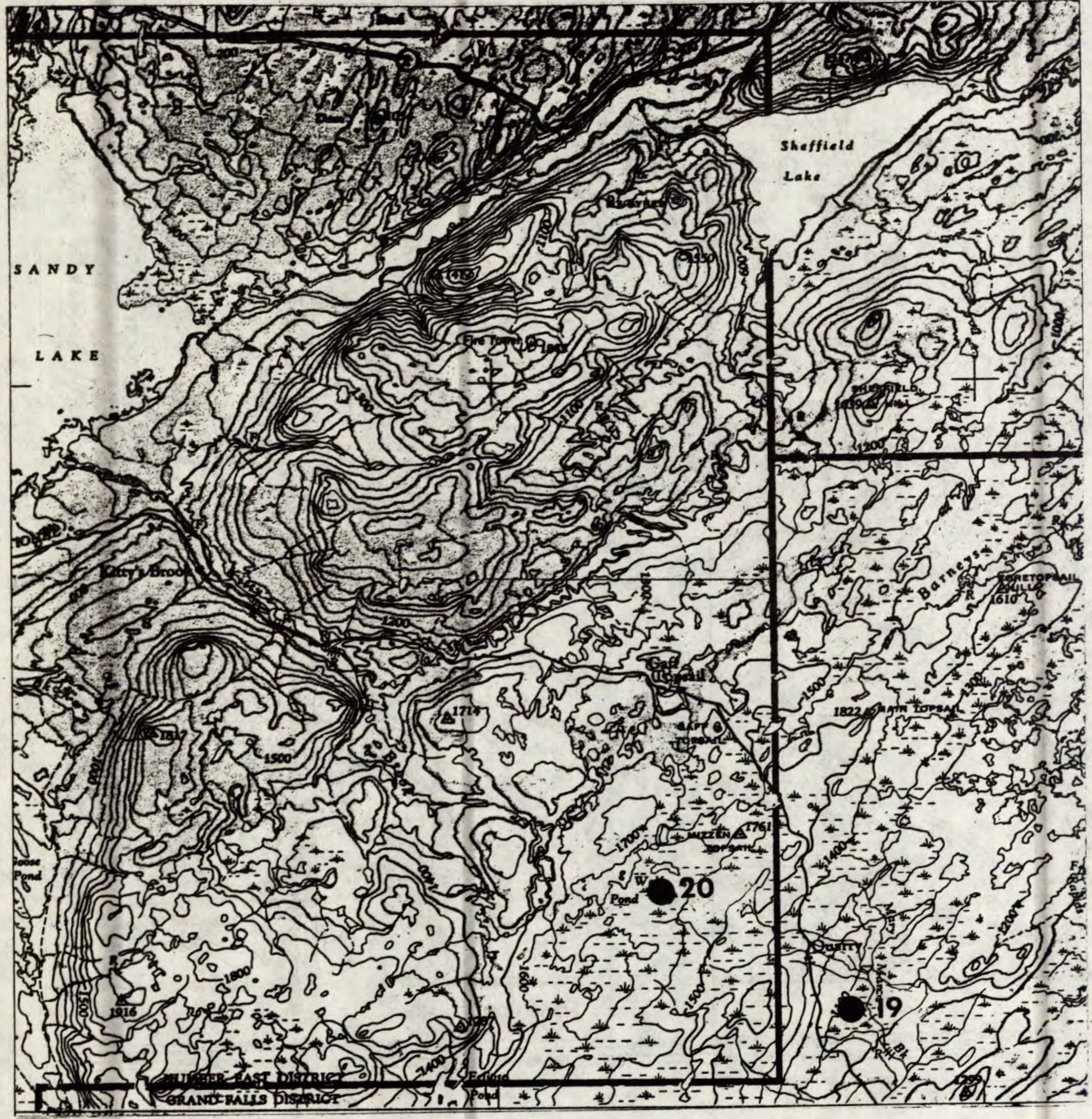

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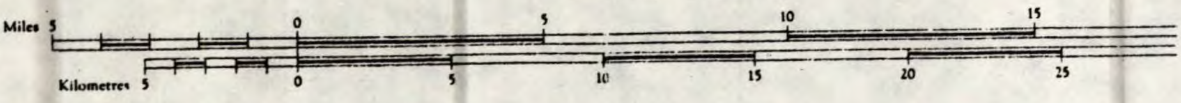

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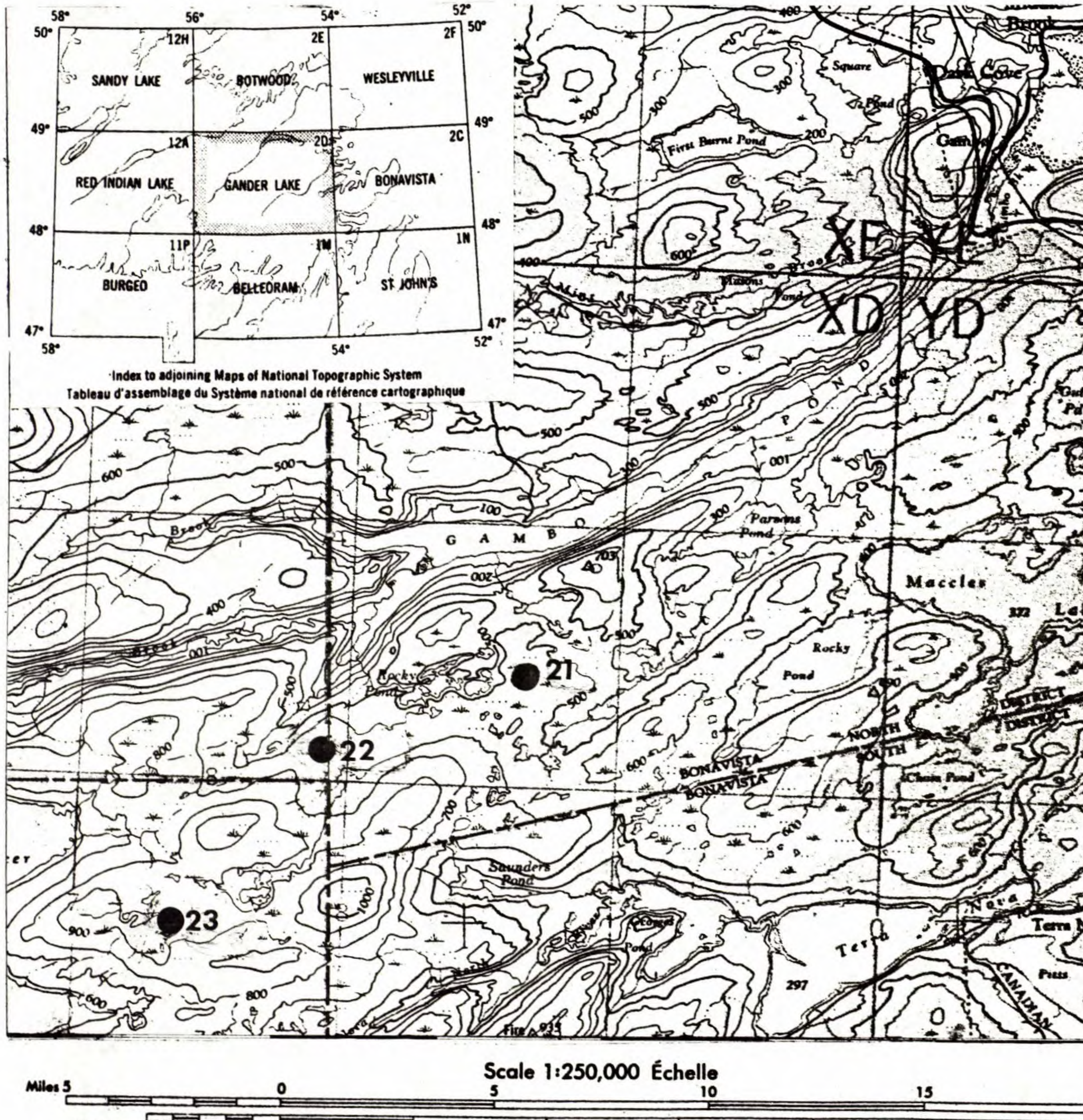

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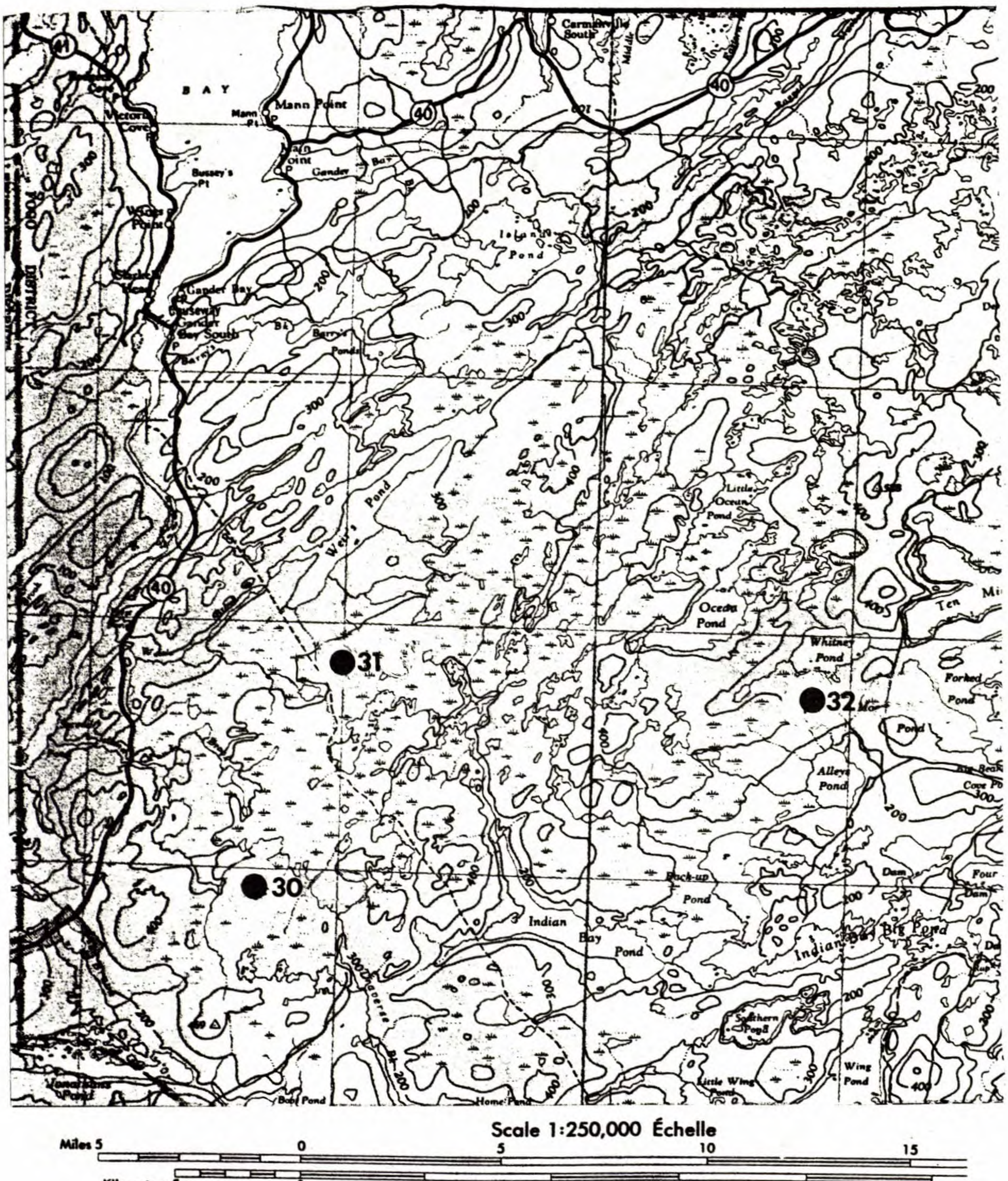

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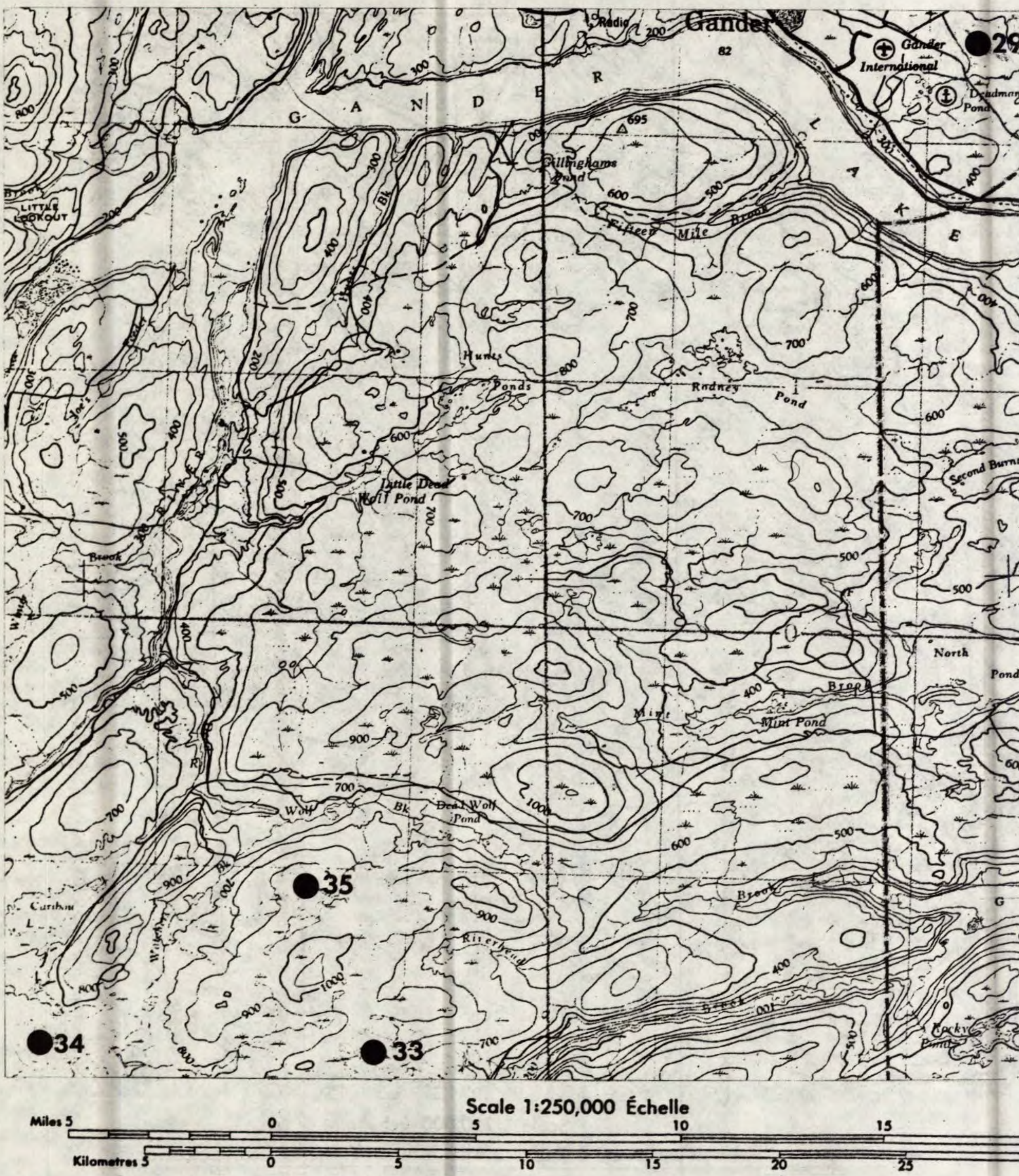

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