DEACTIVATION PROJECT
(CORE BURIAL)

BLIZZARD PROPERTY

BRITISH COLUMBIA

Norcen
Energy Resources Limited

NORCEN TOWER,
715 - 5th Avenue S.W.
CALGARY, ALBERTA T2P 2X7
Phone (403) 231-0111

1980 July 18

REGISTERED

Mr. W. C. Robinson
Chief Inspector of Mines
Ministry of Energy, Mines
and Petroleum Resources
Rm. 105, 525 Superior Street
Victoria, British Columbia
V8V 1T7

Dear Sir:

Re: Blizzard Uranium Project
Disposition of Drill Cores

Enclosed please find a report, "Deactivation Project (Core Burial) Blizzard Property, British Columbia" by Sawyer and Turner and dated July 6, 1980.

Yours sincerely,

NORCEN ENERGY RESOURCES LIMITED

D. A. Sawyer, P. Geol.
Manager - Minerals

DAS/lt

Enclosure

DEACTIVIATION PROJECT
(CORE BURIAL)

BLIZZARD PROPERTY

BRITISH COLUMBIA

Date: July 6, 1980

A. T. Turner, P. Geol.
D. A. Sawyer, P. Geol.

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APPENDIX

1. Correspondence from W. C. Robinson, P.Eng., Chief Inspector of Mines with the Ministry of Energy, Mines and Petroleum Resources to T. J. Neville, Project Manager, Engineering/Environmental, Norcen Energy Resources Limited dated June 9, 1980. Subject: Blizzard Uranium Project, Close down of Exploration.

2. Correspondence from M. B. Zgola, Uranium Mine Division, Atomic Energy Control Board to Don Sawyer, Norcen Energy Resources Limited dated June 5, 1980. Subject: Ore Removal Permit AECB - ORP - 125 - 0.

3. Inter-Office Correspondence, Reference Samples from Blizzard Drill Cores, memo from Glen McWilliams dated June 2, 1980.

4. Description of Urtec Spectrometer.

1. INTRODUCTION

This report describes a part of the deactivation of the Blizzard Project as a result of the moratorium placed on uranium exploration and mining by the province of British Columbia. In particular, core burial procedures are described.

On May 28 and 29, a representative from the British Columbia Department of Mines visited the Blizzard Property to select drill core from 44 drill holes representing lithologies and mineralization throughout the deposit for research purposes.

During the period June 11 to 13, 1980, diamond drill cores, percussion and rotary drilling chips, assay pulps and core sample rejects were removed from the metal core building at Lassie Lake and transported to a burial site at the south end of the Blizzard deposit. This work program was carried out under Ore Removal Permit AECB - ORP - 125 -0 authorized by the Atomic Energy Control Board dated June 5, 1980. The Ministry of Energy, Mines and Petroleum Resources of British Columbia was also consulted prior to the commencement of the program.

The core storage facility, trailors and equipment were removed from the Lassie Lake camp site on June 15.

An accurate survey of the core burial site and revegetation of both the Lassie Lake campsite and the core burial site are yet to be completed.

2. LOCATION AND ACCESS

The Blizzard Property is situated 53 air kilometres southeast of Kelowna, southern British Columbia in N.T.S. 82E/10W and is centered on 118°54' west longitude and 49°37' north latitude.

Access to the property from Kelowna is via Highway 33, the Trapping Creek logging road and the Lassie Lake forestry road. Total driving distance is about 80 kilometres and a oneway motor vehicle trip takes less than one and half hours. An alternate and slightly shorter route from Highway 33 is the Big White Ski resort road to the Big White - Trapping Creek link road. The property may also be approached from the south via the Beaver Creek road between Beaverdell and Christian Valley and the north - south Cup Lake - Lassie Lake forestry road. (See Figure 1)

3. WORK PROGRAM

On May 28 and 29, 1980, representatives from Norcen Energy Resources Limited (Glen McWilliams) and the British Columbia Department of Mines (John Kwong) visited the Blizzard Property to collect diamond drill cores from the Blizzard deposit for research by the B.C.D.M. Samples collected are described in the Appendix.

On June 11, 1980, the core burial program commenced and was completed on June 13, 1980. The following personnel assisted in the project:

1. E. Larabie, P.Eng., Field Superintendent, Blizzard Property, supervised loading drill cores at core storage facility.

2. T. Turner, P.Geol., Exploration Supervisor - Uranium, supervised unloading of drill cores at burial site.

3. Peter Olinger - John Deere tractor (fork lift) operator, loaded core boxes on flat bed trucks.

4. John Olinger - Catepillar 966C (front end loader) operator, core burial site.

5. Mike Larabie - assistant (loading and unloading).

6. Buster Dillon - catepillar TD 20C operator, preparation of burial site and covered core boxes with minimum of two metres of overburden.

7. Kevin Jenaway - temporary help, banding core boxes, loading and unloading.

8. Keith Cooper - temporary help, banding core boxes, loading and unloading.

9. Darel Barker - temporary help, banding core boxes, loading and unloading.

10. Eric Swinders - temporary help, banding core boxes, loading and unloading.

Initial work consisted of preparation of the burial site at the south end of the Blizzard Deposit using a Catepillar TD-20C. The excavation measured approximately 60 metres long and 10 metres wide and was approximately 3 metres deep. The selected site was centrally located at 2130 N, 60 W, on the surveyed grid on the Blizzard Property. This site was selected for the following reasons:

a) The southern end of the deposit is not overlain by the basalt cap and the mineralization as indicated in the radiometric logs in Rotary drill hole number 47 is within 4 metres of the surface. Therefore an excavation could be made by digging a trench in the loosely consolidated Tertiary sediments without disturbing the deposit and also ensure that the core boxes could be covered with a minimum of 2 metres of glacial overburden and Tertiary sediments.

b) This site lies within an area in which Norcen completed an environmental baseline study.

The material selected for burial consisted of diamond drill cores, percussion and rotary drilling chips and sample pulps and rejects which were being stored on the Blizzard Property in a modular steel structure at the north end of Lassie Lake. The total amount of core is 11 559 m and the total weight of pulps and rejects is 8 391 kg for a total combined volume of 93 cubic metres. The total length of uraniferous core is 1 354 metres and including the pulps and rejects contains 16.3 kg of U. The diamond drill cores were stored in conventional wooden core boxes which were sealed by metal banding. The remaining material (ie. pulps, rejects and drilling chips) were kept in plastic and/or kraft paper bags. The drill core boxes were taken from the custom made core racks and placed on pallets for transport. Numerous wall panels on the building were removed prior to the core removal for ventillation purposes.

A total of 35 boxes were placed on each pallet (5 flat and 7 high) and banded together using 5/8" metal stripping. The individual holes in each bundle were noted on the top of the bundle. Each bundle was placed on flat bed trucks for transportation by the John Deere tractor. A maximum of eight bundles were transported at one time from the core storage facility to the burial site, a distance of 3.2 kilometres (See Figure 2). At the burial site, each bundle was individually transported from the flat bed truck into the excavation by the Catepillar 966C front end loader. Two wire cables (chokers) with end fasteners were placed around each bundle and hooked to the teeth of the shovel of the Catepillar 966C. The shovel was raised vertically to lift the bundles from the flat bed truck. Each bundle was placed in the excavation as shown on Figure 4. The bundles were then wrapped with polyethylene. The pulps and rejects were placed in the shovel of the Catepillar 966 C and transported from the core storage facility directly to the excavation. Upon completion of the core bundle placement, radiometric measurements were taken over each bundle using an Urtec spectrometer. The readings are shown on Figure 4. The excavation was then filled in with the glacial overburden and loosely consolidated sedimentary rocks. All material

deposited in the excavation was covered by a minimum of two metres using the Catepillar TD 20C.

Radiometric measurements were taken over the burial site upon the completion of the program at 15 metre intervals. Spectrometer levels ranged from 125 to 175 counts per second. This is considered normal background levels since readings taken along the baseline where no radioactivity was encountered in drilling produced readings within this range. A more detailed description of the Urtec spectrometer is included in the appendix.

Upon completion of the placement of the core in the excavation, a large post was placed vertically in the center of the excavation prior to the burial. The position of this post was then measured from the surveyed baseline.

All equipment, the core storage facility, and two trailors were removed from the Lassie Lake campsite upon completion of the core burial program. The concrete foundations were covered with the surrounding glacial material.

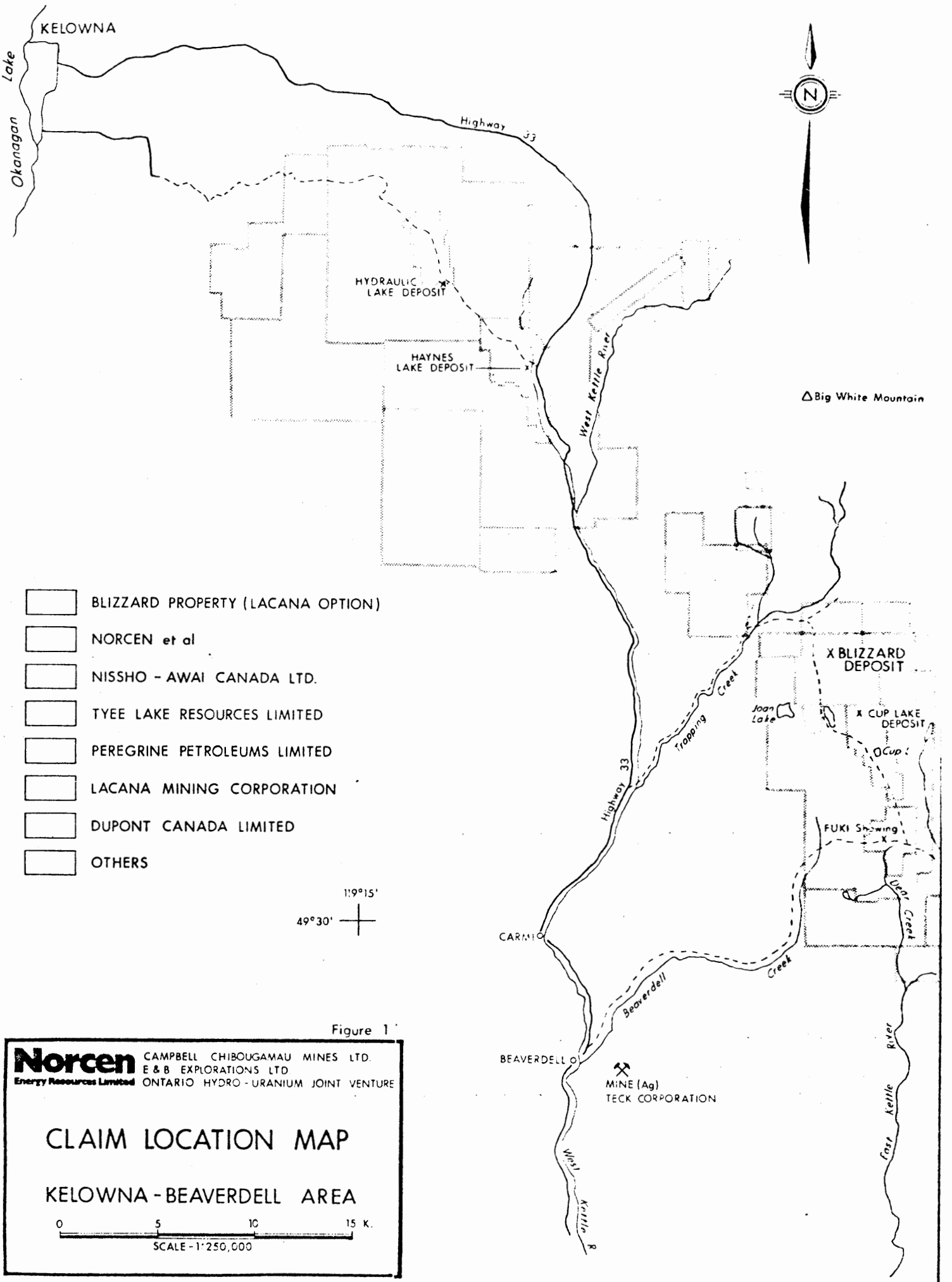


Figure 1

Norcen Energy Resources Limited

CAMPBELL CHIBOUGAMAU MINES LTD.
E&B EXPLORATIONS LTD
ONTARIO HYDRO - URANIUM JOINT VENTURE

CLAIM LOCATION MAP

KELOWNA - BEAVERDELL AREA

0 5 10 15 K.

SCALE - 1:250,000

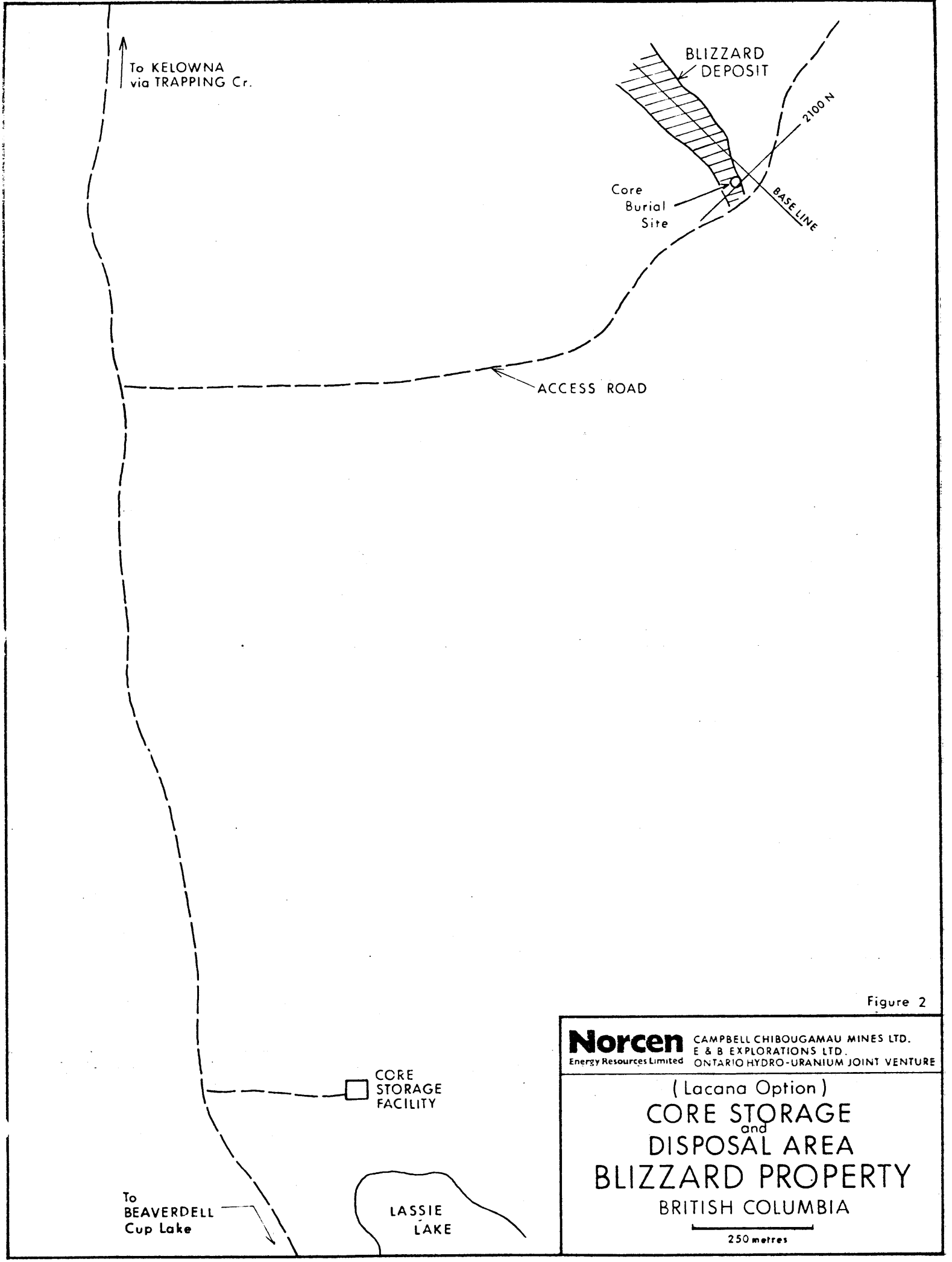


Figure 2

Norcen Energy Resources Limited

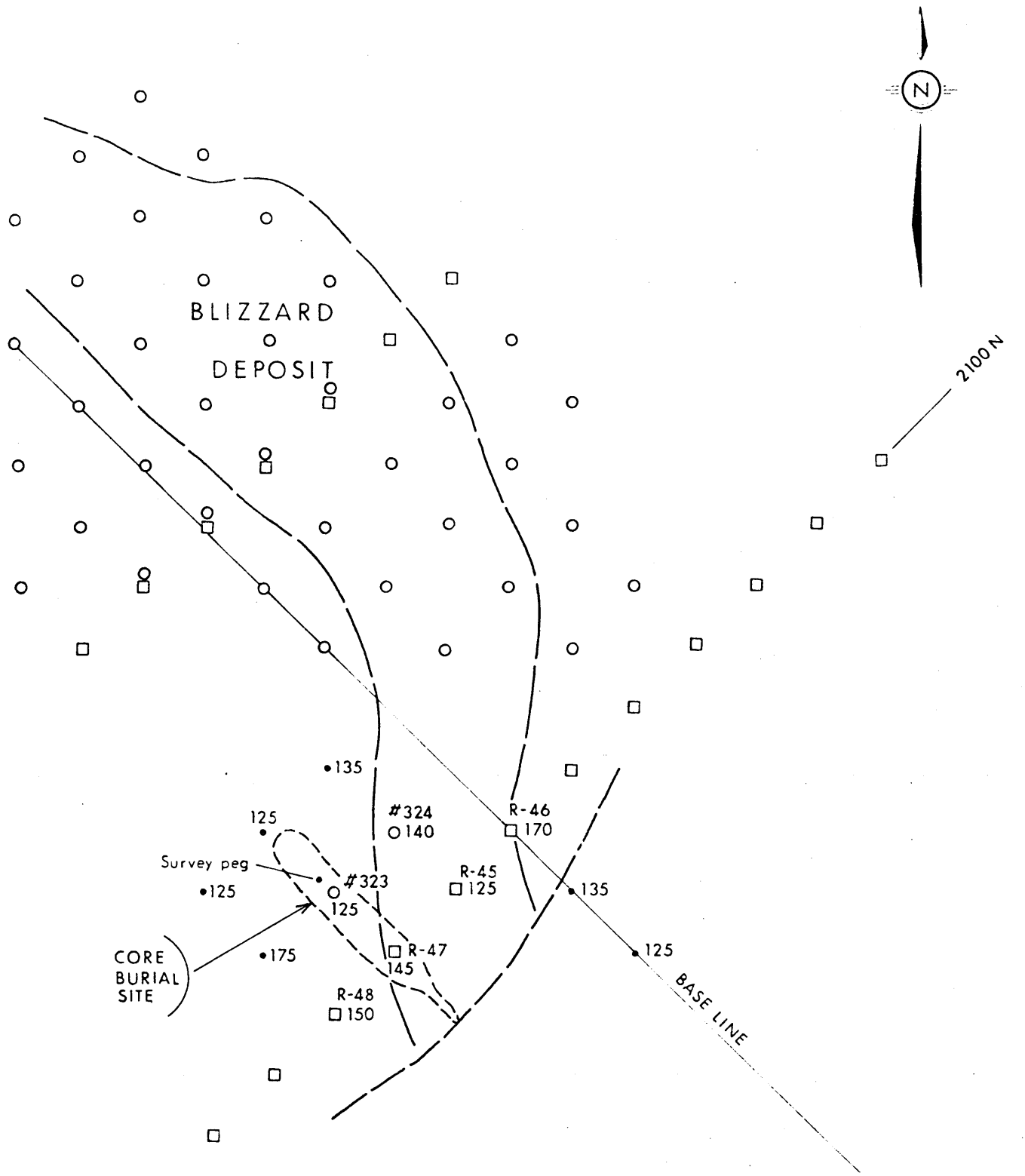
CAMPBELL CHIBOUGAMAU MINES LTD.
E & B EXPLORATIONS LTD.
ONTARIO HYDRO-URANIUM JOINT VENTURE

(Lacana Option)

CORE STORAGE and DISPOSAL AREA BLIZZARD PROPERTY

BRITISH COLUMBIA

250 metres



LEGEND

- ○#232 DIAMOND DRILL HOLE LOCATION
- □R-46 ROTARY DRILL HOLE LOCATION
- •125 URTEC SPECTROMETER READING (counts / second)
- ACCESS ROAD

Figure 3

Norcen Energy Resources Limited

CAMPBELL CHIBOUGAMAU MINES LTD.
E & B EXPLORATIONS LTD.
ONTARIO HYDRO-URANIUM JOINT VENTURE

(Lacana Option)

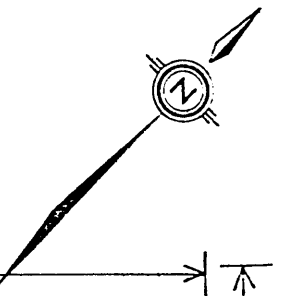
LOCATION MAP
CORE BURIAL SITE
BLIZZARD PROPERTY

BRITISH COLUMBIA

60 metres

Figure 4

CORE BOX PLACEMENT,
CORE BURIAL SITE,
BLIZZARD PROPERTY



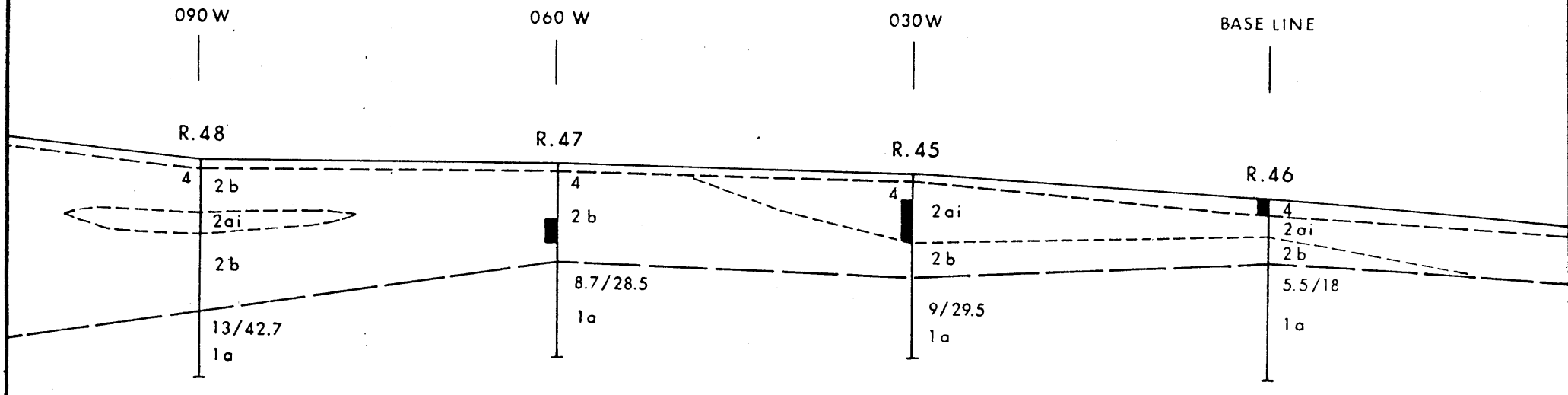
10 metres

48 - 52 (2300)	40 - 48 (850)	38 - 40 (600)	33 - 38 (400)	23 - 33 (320)
16 - 23 (1000)	1 - 10 (950)	10 - 16 (600)	83 - 86 (475)	86 - 91 (375)
74 - 79 (500)	79 - 83 (400)	63 - 69 (430)	69 - 74 (400)	52 - 59 (340)
59 - 63 (600)	110 -114 (325)	115 -118 (375)	100 -105 (325)	91 - 96 (300)
140 -144 (325)	125 -130 (350)	130 -135 (325)	118 -120 (300)	120 -125 (295)
161 -163 (350)	163 -171 (400)	159 -161 (300)	161 -164 (320)	150 -155 (310)
		● ← survey peg.		
155 -159 (310)	199 -204 (300)	193 -195 (300)	195 (335)	206 (330)
180 -185 (425)	185 -188 (375)	171 -175 (550)	175 -180 (475)	241 -248 (300)
230 -232 (325)	235 -233 (640)	214 -222 (350)	223 -230 (320)	237 -241 (275)
268 -269 (350)	260 -265 (425)	264 -268 (370)	249 -252 (260)	256 -257 (525)
245 -246 (460)	252 -256 (370)	283 -285 (340)	280 -283 (290)	272 -277 (325)
275 -280 (350)	269 -272 (380)	272 -275 (275)	300 -301 (380)	297 -298 (450)
312 -319 (385)	303 -305 (410)	283 -288 (425)	311 -309 (400)	Geotechnical holes (250)
288 -294 (325)	Pulps and Rejects (390)	Pulps and Rejects (670)	325 -327 (275)	Geotechnical holes (225)
Dupont (265)	Dupont (400)	Dupont (293)	Pulps and Rejects (240)	Pulps and Rejects (225)
Dupont (250)	Pulps and Rejects (250)	Pulps and Rejects (380)	Pulps and Rejects (420)	Pulps and Rejects (325)

35 metres

48 - 52 - Drill Hole Numbers
(1000) - Urtec Spetrometer Reading (counts/second)

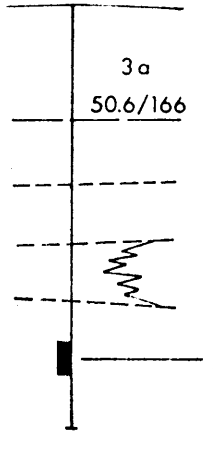
CROSS SECTION 2100 N



LEGEND:

5	RECENT SOIL
4	PLEISTOCENE GLACIAL TILL
3	PLIOCENE: a MASSIVE OLIVINE BASALT b VESICULAR OLIVINE BASALT
2	MIOCENE SEDIMENT: ai MUDSTONE AND SANDSTONE aii CARBONACEOUS MUDSTONE aiii CLEAN SANDSTONE b CONGLOMERATE
1	CRETACEOUS BASEMENT COMPLEX a FELSIC

KEY:



SURFACE

3a ROCK UNIT

50.6/166 METRES FEET, DEPTH OF MAJOR GEOLOGIC CONTACT

MINOR GEOLOGIC CONTACT

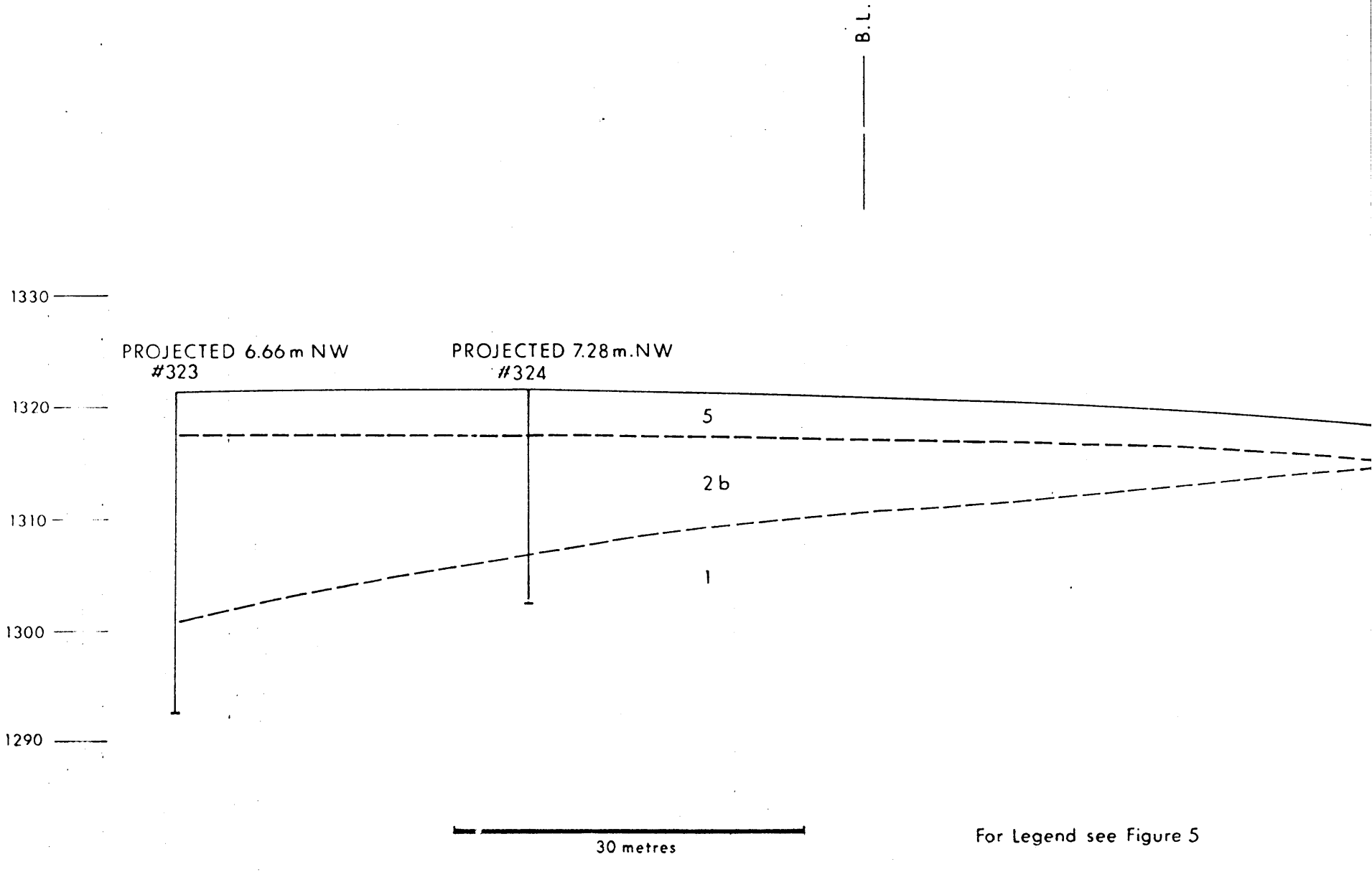
INTERBEDDED OR GRADATIONAL RELATIONSHIP

ZONE > 1700 CPS ON HIGH SENSIVITY GAMMA RAY TOOL

15 m.

Figure 5

CROSS SECTION 2130 N



For Legend see Figure 5

Figure 6

APPENDIX I

Province of
British Columbia

Ministry of
Energy, Mines and
Petroleum Resources

Parliament Buildings
Victoria
British Columbia
V8V 1X4

Rm.105, 525 Superior St., Victoria, B.C. V8V 1T7

June 9, 1980

BLIZZARD URANIUM PROJECT
DATE REC'D June-13/80

COPY		CIRC.	REC'D
	T. J. NEVILLE	1	
	G. H. FAUQUIER		

RETURN TO:
FILE NO.

Mr. T. J. Neville
Project Manager
Engineering/Environmental
Norcen Energy Resources Limited
715 - 5th Avenue S.W.
Calgary, Alberta T2P 2X7

Dear Sir: Re: Blizzard Uranium Project
Close Down of Exploration

In confirmation of your discussions and correspondence with Mr. J. D. McDonald, Senior Reclamation Inspector, Mr. D. Smith, District Inspector, Mr. P. Christopher, Geologist, and Dr. J. T. Fyles, Senior Assistant Deputy Minister, it is understood that the following requirements are to be followed.

A. Disposition of Core

1. All core will be buried with a minimum cover of two metres.
2. Burial site will be located at position which was agreed to at the on-site meeting of May 13, 1980 with Mr. McDonald and Mr. Smith. Location is shown on your map No. 200-05-106 Map 8. Burial site to be surveyed in on completion of core burial.
3. It is understood that the core boxes containing the core will be buried in sequence. It is noted that less than 10% of the core is radioactive.
4. It is understood that sampling the core for geological purposes has been done by your own geologists and Ministry of Energy, Mines and Petroleum Resources geologists.
5. Proper drainage to divert any water from the burial site will be completed.
6. Revegetation of the surface must be completed.
7. Scintillometer readings to be taken over burial area and checked with background counts.

B. Reclamation

1. Revegetation of disturbed areas must be completed on those areas not reclaimed last year.

. . . 2

2. Drainage of reclaimed areas are to be provided.

3. All buildings and equipment at the camp must be removed and the area revegetated. It will not be necessary to remove the concrete foundation for the core shed.

4. It is noted the clearance has been given by the Forest Service.

C. Environmental Monitoring

1. The Ministry of Energy, Mines and Petroleum Resources will take over the monitoring equipment and turn it over to the Ministry of Environment when suitable arrangements have been made.

2. Arrangements should be made with Mr. D. Smith in Kamloops to turn over keys and records.

3. In the event that the monitoring equipment is not used the equipment will be returned to Norcen Energy Resources Ltd. The piezometer holes will be a responsibility of the Ministry of Energy, Mines and Petroleum Resources. Dr. J. T. Fyles is working on arrangements for monitoring with the Ministry of Environment.

D. Atomic Energy Control Board

1. We have been advised by the A.E.C.B. that they have given permission to Norcen for burial of the core as specified.

Should further clarification be required, please contact myself or Mr. McDonald or Mr. Smith. Thank you for your co-operation in this programme.

Yours very truly,

W. C. Robinson, P. Eng.
Chief Inspector of Mines

WCR:JDMcD:lr

c.c. J. T. Fyles
E. R. Macgregor
A. J. Richardson
V. E. Dawson
D. Smith
J. D. McDonald
A. Dory (A.E.C.B.-Ottawa)
A. Boydell (Ministry of Environment)
A. Sutherland-Brown
A. O'Bryan

APPENDIX II

Atomic Energy Control Board
Commission de contrôle de l'énergie atomique

Operations Directorate
Fuel Cycle Branch

Your file Votre référence

Our file Notre référence

1980 06 05

22 N 65

Mr. D.A. Sawyer
Norcen Energy Resources Limited
715 - 5th Avenue S. W.
Calgary, Alberta
T2P 2X7

Dear Mr. Sawyer:

Re: Norcen Energy Resources Limited Ore Removal Permit
AECB-ORP-125-0

Attached please find the permit authorizing Norcen Energy Resources Limited to remove for the purpose of burial approximately 100 cubic metres of drill core, assay pulps and rejects.

Any questions, comments or requests for clarification relating to issues raised in this permit should be directed to Mr. M.B. Zgola or Mr. A.B. Dory of this office.

Yours sincerely,

M.B. Zgola
Uranium Mine Division

MBZ/mk

Attach.

P.O. Box 1046
Ottawa, Canada
K1P 5S9

C.P. 1046
Ottawa, Canada
K1P 5S9

Atomic Energy Control Board
Commission de contrôle de l'énergie atomique

Operations Directorate
Fuel Cycle Branch

Norcen Energy Resources Limited
Blizzard Uranium Deposit
British Columbia
Ore Removal Permit
AECB-ORP-125-0

Your file Votre référence

Our file Notre référence
22-N-65

Norcen Energy Resources Limited
715-5th Avenue S.W.
Calgary, Alberta
T2P 2X7

The Atomic Energy Control Board hereby authorizes Norcen Energy Resources Limited (The Company) to remove for the purpose of burial approximately 100 cubic metres of drill core, assay pulps and rejects containing approximately 20 kg of uranium from storage in the metal core building at Lassie Lake at the south end of the Blizzard Uranium Deposit. The Blizzard Uranium property is located in the Okanagan Highlands of South-Central British Columbia approximately 53 km southeast of the city of Kelowna at latitude 49°37'N., longitude 118°56'W.

This permit is subject to the following conditions:

1. removal of the material shall be according to the methods and procedures, and for the purposes described in the letter dated May 22, 1980 from Mr. D.A. Sawyer, P. Geol, Manager- minerals to Mr. J.H. Jennekens, President, Atomic Energy Control Board;

2. loading and transport of the material must be done in compliance with safe industrial practice and applicable transport regulations;

3. tests, analyses, inventories, inspections and reports deemed necessary and requested by the Board are to be carried out or submitted at or within the time stipulated by the Board;

4. the material is to be buried in the Blizzard ore body and covered by a minimum of two meters of compacted local overburden and all reasonable measures must be taken to minimize leaching of the material due to water action;

5. upon completion of the proposed work, a report detailing the location and method of burial must be filed with the Atomic Energy Control Board;

6. persons appointed under section 12 of the Atomic Energy Control Regulations shall at all reasonable times be provided access to the property and to all plans, drawings, documents and records pertaining to the design, construction, testing and operation at the site;

7. subject to terms and conditions of this permit, all laws of general application from time to time in force in the province of British Columbia are applicable to and in respect of the authorized activities and must be complied with except to the extent that such laws conflict with any federal statute or order, rule or regulations made thereunder;

8. there shall be sufficient qualified personnel in attendance to ensure the safe conduct of the authorized work at all times.

This licence comes into effect 5th of June 1980 and unless sooner suspended or revoked, expires on 30 August, 1980.

DATED at OTTAWA, this 5th day of June, 1980.

ATOMIC ENERGY CONTROL BOARD

President

APPENDIX III

Norcen
Energy Resources Limited

INTER-OFFICE CORRESPONDENCE

CALGARY

TO D. A. Sawyer, T.J. Neville, A. T. Turner DATE 1980 June 02

FROM G. McWilliams

SUBJECT Reference Samples From Blizzard Drill Cores

The following list of samples were selected from the Blizzard drill cores. These 144 samples were selected to represent the various lithologies present in and adjacent to the ore zone. A complimentary set of samples from the same locations was collected by John Kwong of the British Columbia Department of Mines and Petroleum Resources for research purposes.

G. McWilliams

GMcW/lt

Attachment

BOX 1

266	7	- 7.6
	9.15	- 9.65
	11.15	- 12.2 (Section of)
	21.35	- 21.65
	24.4	
	25.8	
264	4	- 4.25
	8.55	- 8.75
	12	- 12.2
	15	- 15.25
54	29	- 29.25
	32.2	- 32.4
	41.7	- 41.9
	44.8	- 45.1
78	41.2	- 41.6

BOX 2

74	42.95	- 43.4
	45.4	- 45.7
72	34.9	- 35.2
	36.45	- 36.75
	39.45	- 39.90
	46.35	- 46.65
	47.85	- 48.15
62	28.65	
	35	- 35.2
	43.15	- 44.05
	51.7	- 51.9
	61.3	- 61.8
249	35.5	- 35.8

BOX 3

249	40.55	- 41.55
	47.75	
	60.8	
64	32	- 32.45
	37.75	- 37.95
	39.1	- 39.3
	42.4	
45	36.7	- 36.9
	41.43	- 41.75
	49.05	- 49.25
129	76.3	- 76.5
	77.7	- 78
	87.7	- 87.9
115	72.25	- 72.45

BOX 4

115	78.95	- 79.25
	80.8	- 81
274	82.9	- 83
	86.6	- 86.67
105	65.85	- 66.05
	67.85	- 68
84	47.75	- 48
	50	- 50.3
	55.25	- 55.45
	59.75	- 60.05
	61.6	- 61.8
80	41	- 41.3
	45.4	- 45.85
	48.15	- 48.45
	51.90	- 52.1
	55.15	- 55.35

BOX 5

124	72.5 - 73.0
	74.05 - 74.7
	77.7 - 78
	79.80 - 80.05
19	60.15 - 65.35
	65.75 - 65.95
	70.65 - 70.85
13	58.75 - 58.95
	61.75 - 61.95
	64.2 - 64.4
21	42.45 - 42.65
	47.7 - 48
48	38.60 - 38.80
	41.85 - 42.05

BOX 6

41	44 - 44.2
	44.6 - 44.8
	53.65 - 53.85
	55.80 - 56
	56.10 - 56.25
235	36.6 - 36.8
	40.55 - 40.85
	49.70 - 49.9
	53.65 - 53.95
	55.15 - 55.45
236	49.7 - 50
	53.35 - 53.65
	55.45 - 55.75
148	41.45 - 41.75
	42.70 - 43

BOX 7

148	46.30 - 46.60
	49.70 - 50
	61.60 - 61.90
	63.70 - 64
146	37.6 - 37.85
	38.10 - 38.40
	41.15 - 41.45
	44.50 - 44.80
	24.4
145	33.85 - 34.05
	37.80 - 38.10
	50.30 - 50.60
	54.25 - 54.45

BOX 8

157	24.25 - 25.45
	27.90 - 28.80
	33.35
189	41.80 - 42
	43.25 - 43.50
	58.95 - 59.15
	60.3 - 60.5
	60.5 - 60.7
166	36.55 - 36.75
	56.70 - 57.00
	57.90 - 58.20
169	28.75 - 29.25
	30.80 - 31.10
	35.35 - 35.55
159	21 - 21.65

BOX 9

180	29.25 - 29.90
	29.90 - 30.10
	30.60 - 30.80
	34.75 - 35.05
154	31.9 - 32.1
	30.3 - 32.8
194	22.45 - 22.85
	24 - 24.40
	25.80 - 26.20
	29.25 - 29.75
306	21.10 - 21.40
	21.65 - 21.85
	23.15 - 23.45

BOX 10

306	24.70 - 24.90
196	15.55 - 16.15
	18 - 18.6
198	13.5 - 13.7
	17.50 - 17.70
200	12.50 - 12.80
	13.70 - 14
	15.25 - 15.55
208	11.3 - 11.7
	12.8 - 13.2
224	4.15 - 4.55
	4.55 - 4.85
	6.10 - 6.40
221	3.7 - 3.95
	3.4 - 3.7
	5.3 - 5.5

APPENDIX IV

DESCRIPTION OF URTEC SPECTROMETER

The UG 135 unit is a high-performance, differential spectrometer for measuring all gamma radiation within five selectable energy channels. Each selectable channel may be sampled at either one or ten second time intervals. The count rate displayed on the ruggedized five digit liquid crystal display is normalized to CPS (counts per second) regardless of the selected sample rate. When operated in the ten second sample mode, a decimal point is displayed automatically. UG 135 may be operated in two different total count modes or in a differential mode for the measurement of Uranium, Potassium and Thorium.

The unit is a ruggedized, compact portable field instrument with simplified operational controls. The main enclosure is a single piece aluminum casting with sealed controls and battery compartment. The unit can be operated safely in the rain or in high humidity environments.

The detector is a custom designed ruggedized NaI (Tl) crystal detector which has a volume of 66 cm^3 (4 cu in.). The geometry of the crystal has been optimized to provide a greater detection sensitivity compared to other similar units. An audio signal generator has been incorporated which may be operated in a continuous mode or in an adjustable count rate threshold mode. The frequency response of the audio is five times the actual displayed count rate in CPS. This feature allows for a greater audio response to low intensity anomalies.

The UG 135 is equipped with a unique calibration source. Supplied with the unit are two sets of alkaline batteries, two carrying handles, genuine leather case with shoulder strap, operating manual and shipping container.

PRICIPLES OF GAMMA RAY DETECTION

Scintillation Theory

A scintillation phosphor is a material which is able to convert energy lost by ionizing radiation into impulses of light. Ionizing radiation may be in the form of gamma rays, alpha, or beta particles.

The impulses produced by the phosphor may be detected by the use of a photomultiplier tube. The photomultiplier tube then converts the light impulses into electrical impulses.

The electrical impulses are then processed by electronic circuitry. As a scintillation phosphor, thallium-activated sodium iodide, NaI (Tl) material is used. The material has a high atomic number, which results in good gamma ray stopping power and has a high luminescent efficiency which results in large pulse heights or amplitudes for low energy gamma ray interactions.

The spectral emission characteristics of NaI (Tl) matches that of the photomultiplier tube.

NaI (Tl) is an inorganic material which is extremely hygroscopic and is relatively fragile, especially, when subjected to mechanical shocks or large sudden temperature changes.

NaI (Tl) is produced in a crystal form, packaged and sealed in a moisture proof container, together with the photomultiplier tube. The entire package is called: 'the detector'.

The characteristic of the electric impulses is that they vary in amplitude. The amplitude of the electrical impulse is directly proportional to the incident gamma ray energy that has been deposited into the crystal.

The detector detects virtually all gamma radiation to which it is exposed. In the natural environment, the gamma ray range is from zero to 3000 KeV. This range accommodates all naturally occurring radio isotopes, such as Th^{232} and U^{238} and K^{40}. Th^{232} and U^{238} have very complex decay series. The probability of a gamma ray being absorbed by crystal is a function of detector geometry. The probability of gamma ray detection is greater when the source emits low energy gamma rays or photons, than high energy photons, using the same geometry detector. An analysis of the gamma photon spectrum from high to low energy indicates that the count rate increases from the high energy to the low energy end. The count rate versus the energy curve (spectrum) is in general exponential.

When a gamma photon enters the crystal and it happens to collide with an electron in the crystal, it may impart a portion of its energy to the electron. Because of the collision, the gamma photon loses some of its initial energy.

The gamma photon with a lower energy level has more probability now to be fully absorbed by the crystal. This phenomenon is identified as a 'Compton scatter'.

Th^{232}, U^{238} and K^{40} are the three natural occurring radio isotopes. The Th^{232} and U^{238} have very complex decay chains. K^{40} on the other hand emits only one single energy gamma photon at 1.47 MeV.

The standard energy line for U^{238} has been set at 1.76 MeV which is produced by a daughter decay product; Bi^{214}.

The standard energy line for Th^{232} has been set at 2.62 MeV which is produced by a daughter decay product; Tl^{208}.

The UG 135 utilizes selectable channels to detect the presence of Th^{232}, U^{238} or K^{40}. Once a channel has been selected the instrument will only process gamma photons which have energies within the channel.

The UG 135 is capable of differentiating between channels, hence the instrument is identified as a differential spectrometer. The UG 135 instrument has five basic energy levels from which to select (not including the CAL position). Selections are made by using the MODE switch.

(1) Total Count 1 (TC1) - Processes all energies above 80 KeV (usually the most sensitive position but also the most critical, as far is geometry and source detector distance is concerned).

(2) Total Count 2 (TC2) - Processes all energies above 400 keV (less sensitive than the TC1 position but provides more reliable data).

(3) K - Process all energy within 1.36 MeV - 1.58 MeV. Indicates the presence of K^{40} but also the compton scattered photons from higher energy photopeaks of Bi^{214} and Tl^{208} and Ac^{228}.

(4) U - Processes all energy within 1.65 MeV - 1.86 MeV. Inidcates the presence of U^{238} but also the compton scattered photons from the higher energy photopeak of Tl^{208}.

(5) T - Processes all energy within 2.46 MeV - 2.78 MeV. Indicates the presence of Th^{232} only.

Additionally, the MODE switch contains a CAL (BAT) position. Once set in this position, the instrument may be calibrated. (Refer to calbration procedures). In this position, and with the calbration source in place, the instrument measures all radiation between 300 KeV and 400 KeV.

Data may be obtained at one of the five basic selectable sample interval mode the count rate displayed has been automatically normalized to counts per second by placing a decimal point on the display.