Sukunka Coal Mine Project

SUKUNKA

EXPLORATION PROGRAMME

1979

VOLUME I

666

OPEN FILE

BP

BP Exploration Canada Limited

COAL DIVISION

PR - SUKUNKA 79(1)A.

BP Canada

BP Exploration Canada Limited
333 Fifth Avenue S.W., Calgary, Alberta T2P 3B6 • Telephone (403) 237-1234

December 18, 1979

CONFIDENTIAL

OPEN FILE

...COMMISSIONER
...VED and RECORDED
NOV 21 1979
M.R. #.....
VICTORIA, B.C.

Mr. P. Hagen
Office of the Administrator (Coal)
Ministry of Energy, Mines &
Petroleum Resources
Parliament Buildings
Victoria, British Columbia
V8V 1X4

Dear Mr. Hagen:

Re: B.C. Coal Licences #3089 to 3129 incl., 3014 to 3023 incl., 3025, 3026, 3028, 3033, 3038, 3554 to 3557 incl., and 3559.

Please find enclosed:

1) A report on the BP Canada 1979 Sukunka Exploration Programme.

2) Appendices to the above report:

- Appendix A, 'Notice of Work on a Coal Licence' forms (with accompanying plans).
- Appendix B, Reclamation Report.
- Appendix C, 'Application to Extend Term of Licence' form.
- Appendix D, Geologist Logs.
- Appendix E, Field and Trench Descriptions.
- Appendix F, Geophysical Logs.
- Appendix G, Maps, Plans and Sections (to follow).

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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3) 'Application to Extend Term of Licence' form detailing total 1979 exploration expenditure on the Sukunka licences; and, individual applications for each of the six coal licence groups.

Teck Corporation will be making application, in the interest of BP Canada, for the Bullmoose Licences 3022, 3023, 3033, and 3038.

The annual rental dues in connection with the above applications and report, BP Exploration cheque #8827 for $82,880, has been mailed to you by our Land Department.

Sincerely,

D. J. W. Mitchell
Project Geologist

DJWM/im
Encl.

BP EXPLORATION CANADA LIMITED

COAL DIVISION

B.C. GOVERNMENT REPORT ON THE 1979 SUKUNKA EXPLORATION PROGRAM

Coal Licence Numbers 3014-3023, 3025, 3026, 3028, 3033, 3038, 3089-3129, 3554 -3557, 3559.

NTS Map Sheet 93 P3, 4, 5

Lat. 55° 11' Long. 121° 31'

December, 1979

D.J.W. Mitchell
Project Geologist

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VOLUME I

I. INTRODUCTION

This report has been prepared for presentation to the British Columbia Department of Energy, Mines and Petroleum Resources, in accordance with the Coal Act Regulations. It describes the exploration programme carried out between May and August 1979on the BP Canada Sukunka Coal Property. The report should be read in conjunction with the enclosed 'Application to Extend Term of Licence' form (see Appendix C).

The work described in this report is encompassed by Part II, Section 8, of the Coal Act Regulations, 'Acceptable Work'.

It should be noted that, similar to the 1978 programme, drilling was, in the event, restricted to the BP designated 'Phase I' mining area, and was therefore reduced from that outlined in the 'Notice of Work on a Coal Licence', dated 7th March 1979 (see Appendix A).

Evaluation of 1979 exploration data is not complete at this time, therefore outstanding plans and cross-sections will be forwarded at a later date.

2. OBJECTIVES

The following objectives were established for the 1979 Exploration Programme:

(i) To provide additional structural, lithological and quality information on the Chamberlain Seams in the Phase I area.

(ii) To provide a complete geological map of the Phase I Area by carrying out extensive surface mapping.

(iii) To provide additional detailed structural, lithological and quality data, by outcrop trenching of seam exposures encountered during surface mapping.

The Phase I area referred to in the above objectives relates to an area adjoining the No. 1 and Sukunka Main Mines, where BP will mine 1 Mt of clean coal during initial development.

3. LOCATION, ACCESS AND TOPOGRAPHY

The Sukunka/Bullmoose property occupies an area of some 165 km^2 and is located approximately 60 km south of the town of Chetwynd in northeastern British Columbia. Figure 1 and Map #1 (Appendix A) show the location of the property, its relationship to other proposed coal developments and the existing infrastructure of the region.

Access to the property is from Chetwynd via the gravelled Sukunka Valley Road, maintained Provincially for the first 23 km and by B.C. Forestry for the remaining 37 km. Alternate access to the southern part of the property (Bullmoose area) is via the Sukunka Valley, Gwillim Lake and Bullmoose Valley Roads, a distance of 95 km from Chetwynd. Within the property there are approximately 320 km of exploration roads, the majority of which have been restored. Figure 2 illustrates the major geographic features of the area.

Dip°	Depth m	Thickness m	DESCRIPTION
	85.33	3.24	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (50:30:20)-interbedded, fining-upward cycles of argillaceous, medium grey sandstone and siltstone and dark grey silty, mudstone. Abundant scouring, minor load casts. Beds of small-scale low-angle cross-laminated clean sandstone, up to 0.30 m thick. Abundant very small dark worm burrows in muddy phases, occasional larger sand-filled burrows. Common rusty joints at 0° to 30° CA; calcite (70° to 80° CA) at 82.53, slickensides and calcite (45° to 70° CA) from 83.45 to 83.61, and at 84.21 (85° CA). Unit strongly calcareous throughout. Abrupt.
	87.93	2.60	MUDSTONE/SILTSTONE/SANDSTONE-very fine-grained (70:25:5)-interbedded dark grey siltstone and silty mudstone with occasional wisps and laminae of medium grey, argillaceous sandstone. Common fining-upward cycles from thin sandstone to mud-
3° at	87.39		stone scoured at top. Abundant very small dark worm burrows; some slumping notably at top and base of unit. Core badly ground at top. Probable core loss. Slickensides and calcite: 85.45 to 85.47: 75° to 85° CA; 86.48: 78° CA. Strongly calcareous throughout. Gradational.
	92.57	4.64	MUDSTONE/SILTSTONE (95:5 at top grading to 100:0 at base)-dark grey silty mudstone with lenticles, medium to dark grey, argillaceous siltstone, and rare sandy laminae. Abundant pyritised worm burrows in basal 0.32 m. Scattered chert granules (well-rounded), marker in basal 0.08 m. Silty phases calcareous; otherwise non-calcareous. Abrupt.
	92.57	3.87	TOP OF "B UPPER" SEAM
	92.65	0.08	COAL-dull lustrous with occasional thin bright bands. Strong smell of H_2S. Stick.
	92.94	(0.29)	CORE LOST: COAL Position assumed.
	92.96	0.02	MUDSTONE-black, slightly silty, occasional thin bright coal streaks, occasional dull lustrous slickensided surfaces. Fragmented.
	93.02	(0.06)	CORE LOST: MUDSTONE, carbonaceous, position assumed.

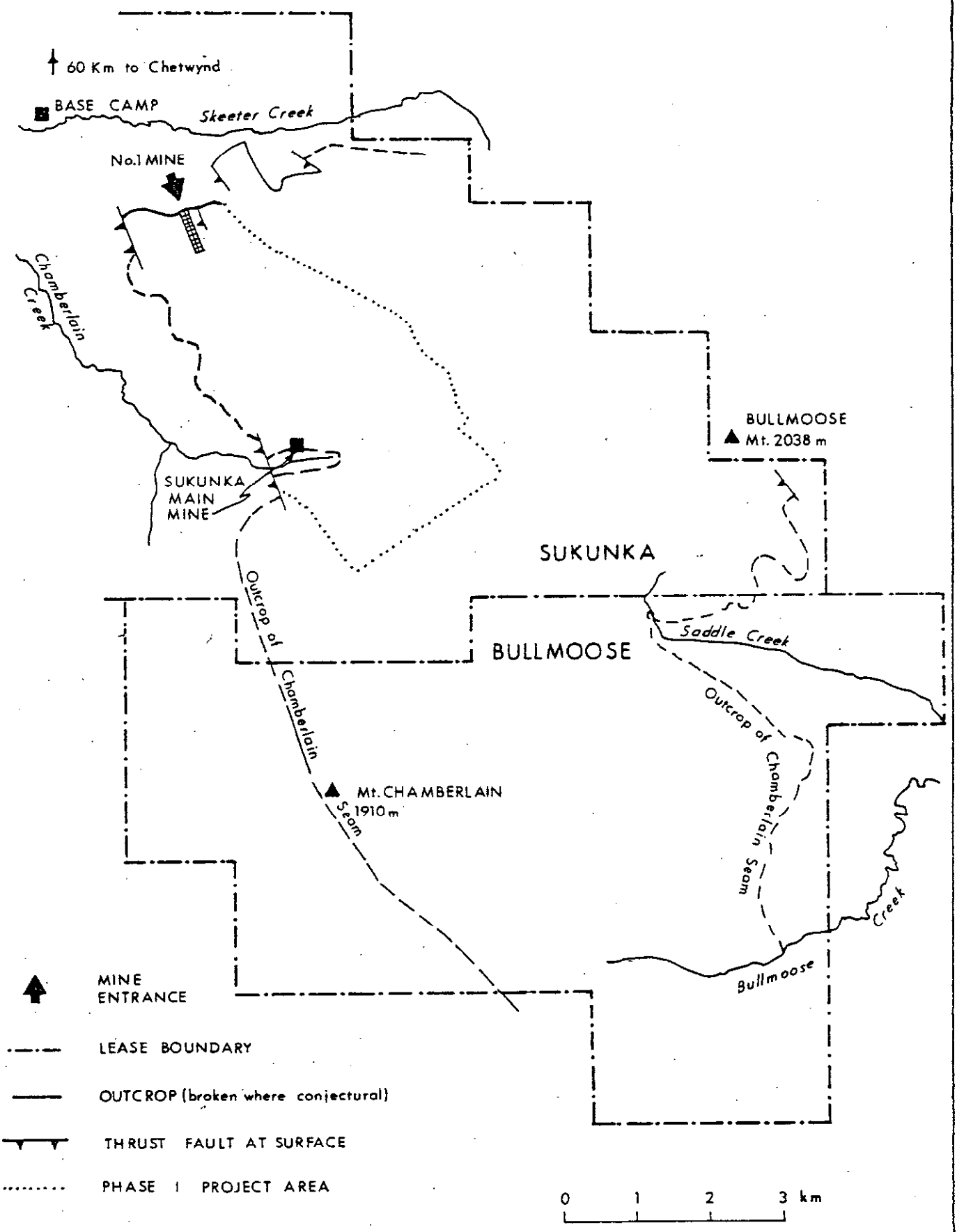


FIG. 2 GEOGRAPHY OF SUKUNKA - BULLMOOSE AREA

The Sukunka property comprises 61 coal licences. Table 1 illustrates their ownership and Figure 3 illustrates their distribution.

Table 1 - BP Canada Sukunka/Bullmoose Licences

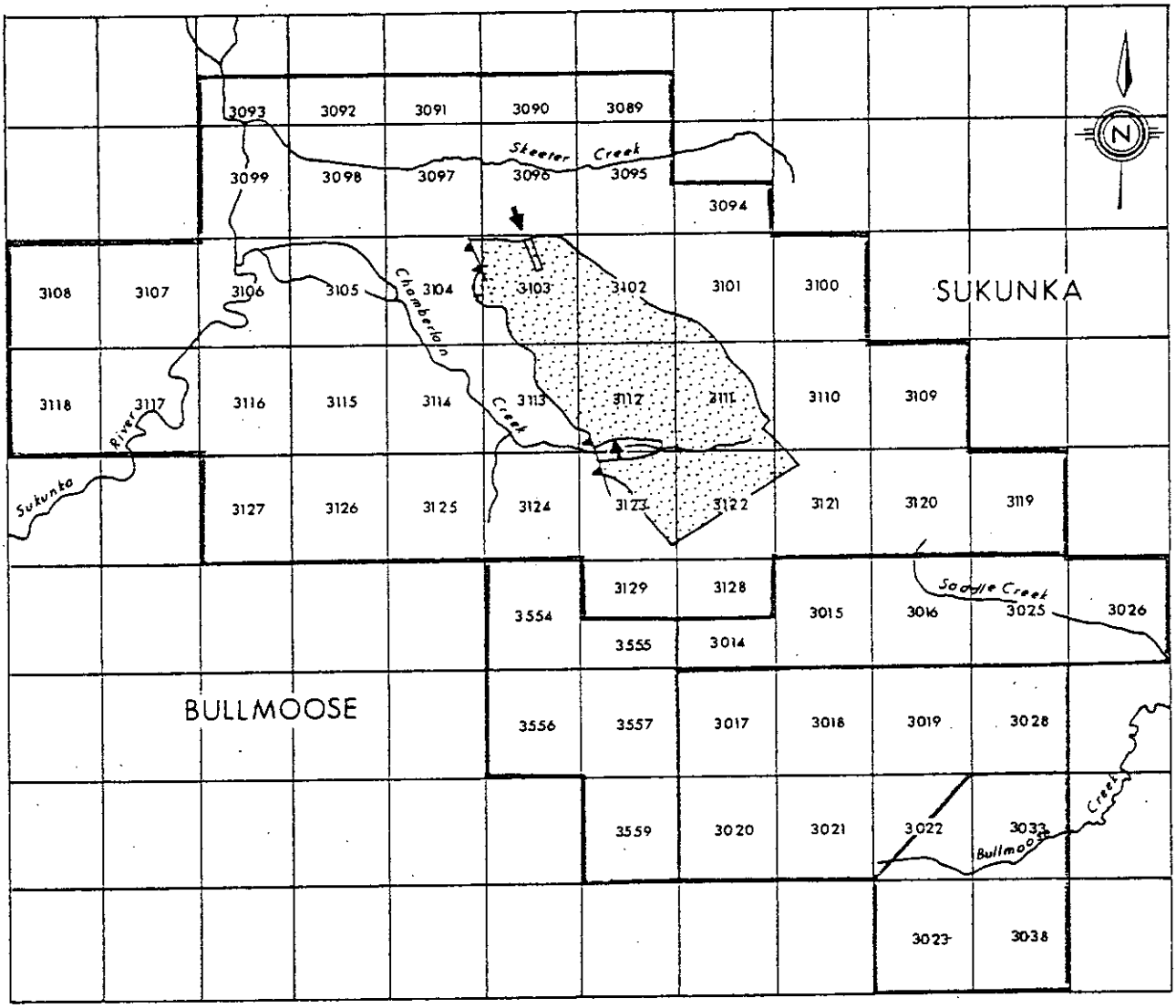
Licence Number	
3089-3129 (41 licences)	Former Sukunka property belonging to Brameda/ Brascan. Now owned BP 87½%, Brascan 12½%.
3554-3557, 3559 (5 licences)	Former Chamberlain property belonging to Teck Corp. Now owned BP 100%.
3014-3023 3025-3026 3028-3033 3038 (15 licences)	Former Bullmoose property belonging to Teck Corp. Now owned BP 100%, but with Teck retaining rights to: a) Gates series of coals from the surface down to 152.4 m (500 feet) in licences 3017-3023, 3028-3033, 3038; and b) Bird Seam in licences 3022 SE, 3023, 3028 and 3033.

The 1979 Sukunka Exploration Program concentrated mainly on the Sukunka licences, with field mapping and drilling within the Phase I area (see Figure 3).

The Sukunka area is mountainous with deeply cut valleys and elevations mainly between 760 m and 2000 m above level. Dense coniferous forest covers most areas below 1350 m.

The area experiences a wide temperature range between the warmest and the coldest months, with peak precipitation in summer. In general, the summers are short but fairly warm considering the latitude, and the winters are long and cold.

SUKUNKA — BULLMOOSE LICENCES



SCALE 1:125,000

LICENCE NUMBER

SUKUNKA – 3089 - 3129 (41 LICENCES) ——— BP 87 1/2% BRASCAN 12 1/2%

BULLMOOSE – 3554 - 3557, 3559 (5 LICENSES) ——— FORMER CHAMBERLAIN PROPERTY - BP 100%*

3014 - 3023
3025 - 3026
3028 - 3033
3038
(15 LICENCES) ——— FORMER BULLMOOSE PROPERTY BP 100%*

* EXCLUDING THE GATES SERIES OF COALS FROM SURFACE DOWN TO 152.4 m (500') IN ALL BUT LICENCES 3014 - 3016, 3025 AND 3026 AND EXCLUDING THE GATES SERIES OF COAL AND BIRD SEAM IN LICENCES 3022 SE. 3023, 3033 & 3038.

FIG. 3

PHASE I PROJECT AREA

The total annual precipitation is in the range of 0.68 m, being split almost evenly between rain and snow. The average winter snowfall is about 2.54 m.

4. BASE PLANS AND SURVEYING

Metric topographic maps, 1:5000 scale with a 5 m contour interval, constructed by Burnett Resource Surveys from their 1977 aerial survey, provided the base for work record (*see appendix H1-H2 of the Sukunka 1977 Report for copies* of the 16 sheets covering the Sukunka/Bullmoose Property).

The 1979 drill holes and trenches were positioned by BP Canada staff, with locating and levelling being carried out by a team of 2/3 surveyors from C.N. Stables Associates of Dawson Creek. The U.T.M. coordinates and elevations in metres of the twelve 1979 boreholes, and trenches #53 and #54, are recorded overleaf. The locations of all 1979 boreholes, trenches and field observation points are plotted on the map sheets in Appendices A and G.

5. ROAD CONSTRUCTION - RECLAMATION (See Appendix B)

Prior to the construction of drill sites and access roads, BP Canada personnel sited all locations and alignments by helicopter and ground traverse. Approximately 0.62 km of new exploration access road was constructed and an additional 13.7 km of existing road reopened. The slashing and construction of roads and drill sites, which was contracted out in accordance with the B.C. Government document 'Guideline for Coal and Mineral Exploration', was monitored by the BP Environmental Group.

C.N. STABLES, P. Eng., B.C.L.S., A.L.S.

C.N. Stables

B.C. Land Surveyors

1136 - 103 AVE., Suite 114 DAWSON CREEK, B.C. V1G 2G7 TELEPHONE 782-5868

Our File: 5039

September 6, 1979

B. P. Canada Exploration Ltd.
Coal Division
335 Eighth Avenue, S.W.
Calgary, Alberta

Attention: Mr. Andy Bowler

Dear Sir:

Re: Sukunka Coal Property, Bore Holes and Trenches

The following is a list of the bore hole co-ordinates and trench co-ordinates.

POINT	U.T.M. CO-ODINATES (metres) N	E	ELEVATION (metres)	COMMENTS
B.P. E-1	6121704.4	586528.8	902.6	
B.P. E-2	6121329.5	587130.9	1070.8	
B.P. R	6121533.1	586723.1	921.7	
B.P. 69	6118919.3	591643.1	1624.1	
B.P. 69-A	6118931.6	591655.8	1625.3	
B.P. 70	6119262.4	590884.0	1551.2	
B.P. 71	6119514.3	591555.2	1605.7	
B.P. 72	6117087.3	589955.8	1187.7	Vertical Datum:
B.P. 73-A	6117370.6	591050.4	1204.2	Cristo; Elev. 1477.64
B.P. 74	6118097.7	592243.5	1273.8	From Underhill &
B.P. 75	6117982.4	592063.2	1252.4	Underhill Control
B.P. 76	6117555.6	591443.9	1229.3	(Assumed to be
B.P. 77	6117186.8	590725.2	1249.1	Relative)

POINT	U.T.M. CO-ORDINATES (metres) North	East	ELEVATION (metres)
Trench 53	6121148.1	587449.7	1139.0
	6121175.4	587509.3	1138.4
Trench 54	6121148.7	587490.3	1145.5
	6121160.5	587545.4	1148.4

I hope this meets with your approval.

Yours truly,

C. N. Stables & Associates

C. N. Stables, B.C.L.S.

CNS:hn

Light reclamation, which consisted of scarifying of trenches #53 and #54, roads and drillsites, seeding and construction of erosion bars,was contracted to North Star Fabricating Ltd. of Fort St. John. Equipment used consisted of a JD 350 'Cat'. Heavy plant hire, used for road construction, heavy reclamation and rig moving, was contracted to Tor Tor Trucking, also of Fort St. John. The heavy reclamation, pulling in or berms, filling of drill sumps, and restoration of roads to their original grade, was carried out by a D7 'Cat' and JD 550 backhoe/bulldozer. Additional equipment was supplied by Sukunka Mines Ltd.

Work activities commenced at the end of May. The utilisation of heavy plant and contractors is displayed in Table II.

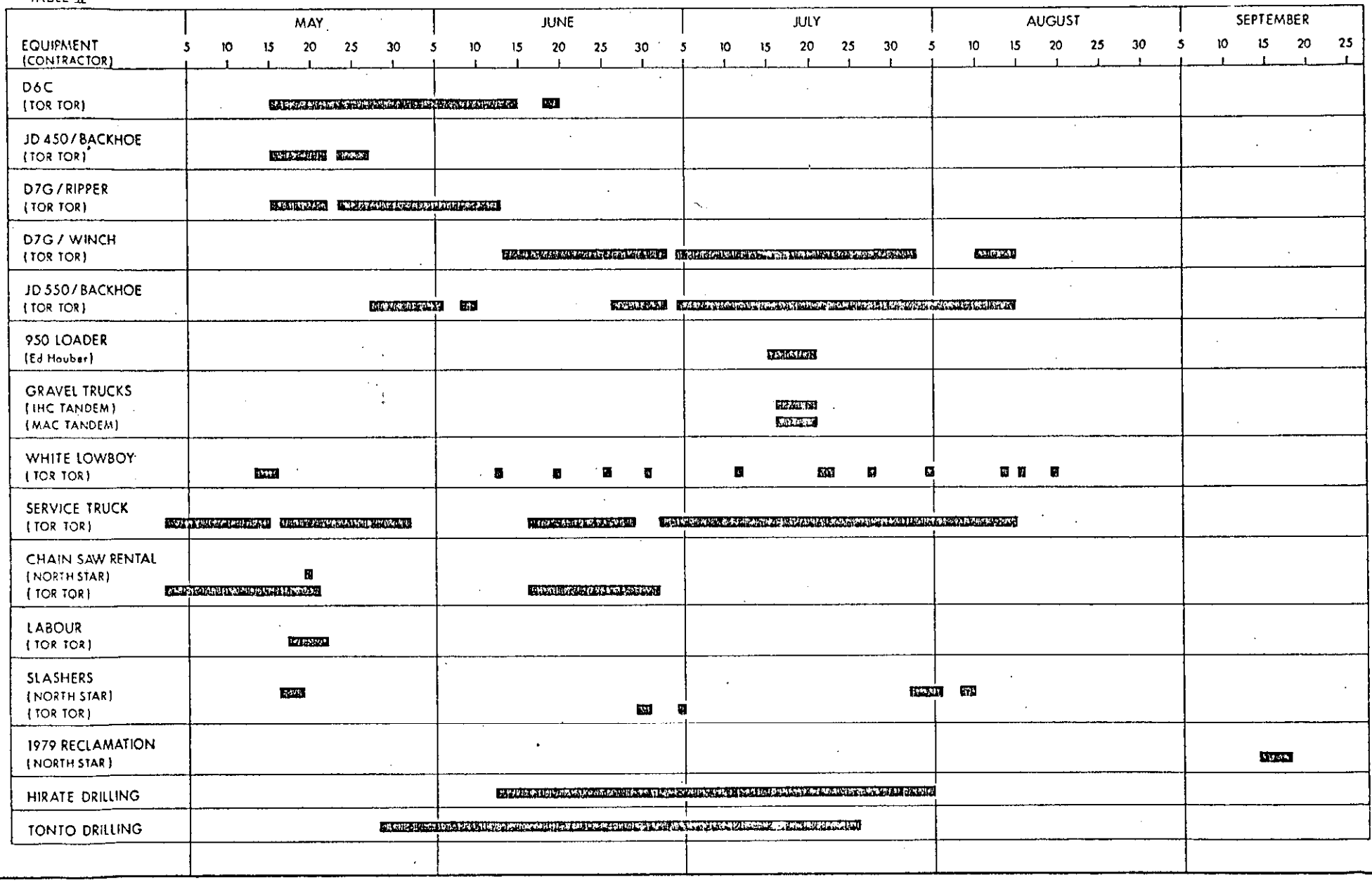
6. DRILLING (See Appendix A)

Twelve boreholes totalling approximately 2788 m of drilling were completed during the 1979 programme. This programme was reduced by 8 holes from the disclosure 'Notice of Work on a Coal Licence' submitted March 7, 1979, prior to the exploration programme.

Seven holes were drilled by Hi-Rate Drilling Company Ltd., using a Sanderson Cyclone drill. This rig was capable of operating in the air percussive or mud rotary mode using air hammer, button or rock bits. The maximum depth attained was 490 m in BP70.

TABLE II

HEAVY EQUIPMENT & CONTRACTOR TIMETABLE 1979



The percussive downhole hammer method of drilling achieved, as per specification, the greatest efficiencies. High water makes and hole sidewall caving restricted its use however, necessitating changeover to rotary rock bitting.

The remaining five holes were drilled by Tonto Drilling Ltd. using a unitized Longyear 38 rig.

Drilling and downhole problems lead to full redrills of BP69 and BP73, and a wedge diversion in BP72, termed BP69A, 73A and 72A (see appendix D for full details). On completion, boreholes were, by policy, grouted from the bottom of hole to above the Upper Chamberlain Seam, using standard Portland cement.

7. GEOPHYSICAL LOGGING (See Appendix F)

Geophysical logging and verticality surveys were contracted to BPB Instruments (Canada) Ltd. All twelve boreholes were geophysically logged. Table III records the suite of logs run in each hole (log prints can be found in Appendix F). Dipmeter logs are presently being processed by the BPB Instruments'computer in Leicestershire, England; all other logs were interpreted by BP Canada in-house.

8. CORE HANDLING (See Appendix D)

All core, of the HQ size, was placed into 3 x .75 m core boxes, and measured on site. For consistency, core was generally logged by two geologists only, one recording the Sukunka Member and above, the other, Moosebar and Gething Formations.

TABLE III - SUKUNKA 1979 EXPLORATION PROGRAM: UTILIZATION OF GEOPHYSICAL LOGGING

Borehole	Gamma		LSD		BRD		Neutron	Dipmeter	Directional
	General	Detail	General	Detail	Detail	Caliper	General	Survey	Survey
	G	Z	L	A	B	C	N		
BPE-1	X	X	X	X	X	X	X		X
BPE-2	X	X	X	X	X	X	X		X
BPER (cleanout)	X	X	X	X	X		X		X
BP69A	X	X	X	X	X	X	X	X	X
BP-70	X	X	X	X	X	X	X	X	X
BP-71	X	X	X	X	X	X	X	X	X
BP-72	X	X	X	X	X		X		X
BP-73A	X	X	X	X	X	X	X	X	X
BP-74	X	X	X	X	X	X	X		
BP-75	X	X	X	X	X	X	X	X	X
BP-76	X	X	X	X	X	X	X		
BP-77	X	X	X	X			X		X

All measuring was carried out in a weatherproofed fluorescently lit core shed.

Prior to programme commencement, it was decided that only coal recoveries in excess of 89% would yield a valid and acceptable analysis. Coal recoveries in the event were poor, ranging from 1% to 85%, seams were not sampled therefore.

Chip samples were retained and logged from rotary drill holes, at 5 m intervals in the Moosebar Formation and above, and at 2 m intervals in the Gething Formation.

In addition, AX core from Winky drill holes W12, 15, 16, and 17, drilled by Teck Corporation in 1974 and 1976, was re-logged (now designated BP-W12, etc.).

9. FIELD MAPPING (See Appendices E & G)

Primary duties were directed toward the drill rigs, however one, occasionally two, field parties mapped intermittently according to availability of personnel. Data was recorded on 1:5000 map cards. Work concentrated on the Gates Formation, and its contact with the Sukunka and Hullcross, on the Bullmoose Highway Plateau area. In addition, several days were spent in further interpretation of the Master 'A' area, on the north slope to Skeeter Creek. 354 field stations were recorded.

Eight hand trenches and three mechanized trenches were dug during the programme. Hand trenches #1 to #3 exposed the Chamberlain Seams in the region of Master 'A', and #4 to #8 the Gates coals.

Mechanized trench #53 in the Lower Chamberlain Seam, and #54 in the Upper Chamberlain Seam, exposed the roof and floor to determine the degree of structural disturbance at the projected exit location of the run-of-mine downhill conveyor; processing of this information is incomplete at this time, and will follow with Appendix G. Trench #55, a clearing of broken weathered material to expose a potentially faulted outcrop adjacent to the No. 1 Mine Road, revealed a small two metre displacement.

10. SERVICING OF PROGRAM

Sukunka Project personnel living on site for the full term of the programme totalled 27. An additional nine persons lived and/or worked on site intermittently.

Operations were based on the old Mine Camp situated in the northwest of the property at the confluence of Skeeter Creek and Sukunka River. Additional office trailers were rented from Territorial Leasing; catering services were contracted to Cal Van Canus.

BP Canada transportation consisted of three four-wheel drive 3/4 ton, one two wheel drive 3/4 ton truck, and a Jet Ranger 206B helicopter, supplied by Maple Leaf Helicopters Ltd. of Chetwynd, stationed on site.

11. GEOLOGICAL EVALUATION (See Appendix G)

Evaluation of 1979 exploration data is not complete at this time. Appendix G, including revised field maps, seam isopachs, structure plans and cross-sections, will therefore be forwarded for inclusion with this report in the near future.

12. FINANCIAL STATEMENT

The utilization of contractors and expenditures incurred during the 1979 Sukunka Exploration Program are detailed in Appendix C, the 'Application to Extend Term of Licence'.

D.J.W. Mitchell
December 18, 1979

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES
MINERAL RESOURCES BRANCH
INSPECTION AND ENGINEERING DIVISION

NOTICE OF WORK ON A COAL LICENCE

Pursuant to section 7 of the *Coal Mines Regulation Act* this notice is to be completed by all companies or individuals carrying out exploration work prior to commencement of work, and within one month of cessation of work and one copy is to be sent to each of the following:

Senior Reclamation Inspector, Victoria
District Inspector of Mines
Regional Water Rights Engineer
District Forester or Forest Ranger
Regional Fish and Wildlife Office

PERMIT NO. C-117

1. NAME OF PROPERTY: Sukunka

Coal Licence Numbers: 3089-3129, 3014-3023, 3026, 3033, 3038, 3554-3557, 3559 3025

2. LOCATION: Mining Division 9 Prince George, B.C. NTS Map Sheet (e.g., 82E/9E) 93P/3,4,5
Lat. 55 ° 11 ' Long. 121 ° 31 ' Locality and Access Sukunka, access from Chetwynd via the Sukunka Valley Road to Mile 37.

3. OWNER: Name BP Exploration Canada Free Miner's Cert. No. 166491
Address 333 - 5th Avenue S.W. City Calgary Prov. Alberta

4. OPERATOR: Name as above Free Miner's Cert. No. as above
Company _____ Telephone No. (403) 237-1234
Address _____ City _____ Prov. _____

5. ESTIMATED DURATION OF WORK: From mid May/1979 to August 1979

6. ACTUAL DATE WORK COMPLETED: Day _____ Month _____ 19____

7. APPROXIMATE NUMBER OF MEN EMPLOYED: 45

8. EXPLORATION WORK: Proposed ☒ Completed ☐ (Use metric measure — 1 metre = 3.3 feet.)

Linecutting (distance, width, method) nil
(Requires approval of Forest Service. 'Licence to Cut' or 'Free Use Permit' may be withheld until Reclamation Permit approval.)

Drilling — No. of Sites 20 Total Area 10,000 square metres

Road Construction — Total Length 2,400 new road 17,700 re-opened roads Approximate Width 4 m top, 6 m cut metres

Underground Exploration nil (type)

Trenching — Number 20 Total Length 100 metres Width 1.00 metres

Test Pitting — Number nil Total Disturbed Area _____ square metres

Work by Self ☒ OR Name of Contractor _____
(Owner is responsible for ensuring the Contractor complies with pertinent regulations, *see* section 8, *Coal Mines Regulation Act*.)

9. DATE FOREST SERVICE ADVISED BY OPERATOR: March 7/79

Name and Title of Forest Official Chief Forest Ranger, Lorne McQueen

Address Chetwynd, B.C.

NOTE: Pursuant to section 8, subsection 2(a) of the *Coal Mines Regulation Act*, '...where the employment of mechanical equipment is likely to disturb the surface of the land in clearing, stripping, trenching...' the Application for a Reclamation Permit on the reverse side is also to be submitted.

SIGNATURE OF APPLICANT _____ TITLE Manager of Exploration

PRINT NAME Dr. J. K. Stobernack DATE March 7/79

COAL EXPLORATION FORM 7–8

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES
MINERAL RESOURCES BRANCH
INSPECTION AND ENGINEERING DIVISION

APPLICATION FOR A RECLAMATION PERMIT ON A COAL LICENCE

Pursuant to section 8 of the *Coal Mines Regulation Act*, this form is to be completed when applying for a Reclamation Permit, when renewing same, or when reporting exploration work to be done. When reporting on work which has been done, *see* instructions at the bottom of the page. For recommended methods of reclamation and environmental control, *see* booklet entitled, *Guidelines for Coal and Mineral Exploration*, which is available at the office of the District Inspector of Mines.

PERMIT NO. C117

1. THIS IS: An Initial Application ☐ Renewal ☐ Report of Proposed Exploration Work ☒

2. PRESENT STATE OF LAND ON WHICH EXPLORATION WILL BE DONE IS:

Canada Land Inventory (where possible) T2-an immature productive woodland, U2-non-productive on a non-productive site L-rock and other unvegetated surfaces.

Present Land Use (ranching, timber, etc.) Vacant Crown Land

Type of Vegetation Coniferous Forest - scrub, alpine meadows.

Access Roads (present use, condition) Sukunka Valley Road from Chetwynd to Mile 37 - logging - good condition

Campsites, Old Workings (location, condition) -

NOTE: Items shown above should be indicated on the NTS maps which are required for the following section.

3. PROPOSED SURFACE WORK: (Attach 7 copies of 1:50,000 NTS map with full extent of exploration work noted — Coal Titles Reference Maps.) (Use metric measure — 1 metre = 3.3 feet.)

Roads: Total length	2400 m new road 17700 m re-opened metres	Total disturbed area	14,400 106,200 square metres
Test Pits: Total No.	nil	Total disturbed area	- square metres
Trenches: Total No. (include ground slope at trench on NTS map)	20 (hand trenches where possible-otherwise backhoe)	Total disturbed area	100 square metres
Adits: Total No.	nil	Total disturbed area	- square metres
Drill Sites: Total No.	20	Total disturbed area	10,000 square metres
Other:	-	Total disturbed area	- square metres
Total Disturbed Area (square metres):			130,700 square metres
Total Disturbed Area (hectares): (1 hectare = 10 000 square metres)			13.7 hectares

4. EQUIPMENT TO BE USED (list size, capacity, and number):

(a) 1 Rotary Rig - truck mounted
(b) 2 wireline rigs - skid mounted
(c) 1 D7 and 1 D6 'Cat'
(d) 1 D4 Cat with backhoe
(e) -
(f) -

5. GOVERNMENT CLEARANCES INITIATED AT REGIONAL/DISTRICT LEVEL:

	Forestry	Fish and Wildlife	Water Rights
Name of Official	Lorne McQueen	Dave King	John Dyke
Title	Chief Forest Ranger	Habitat Protection Biologist	Regional Engineer
Location	Chetwynd, B.C.	Prince George B.C.	Prince George, B.C.
Date Notified	March 6/79	March 6/79	March 6/79

SIGNATURE OF APPLICANT [signature] DATE March 7/79

Title Manager of Exploration Company BP Exploration Canada Limited

FOR DEPARTMENT OF MINES USE ONLY

Terms and Conditions other than Guidelines -

Bonding Required (Permit is issued on receipt of bonding.) -

Approved by Advisory Committee - Date -

Approved by Sr. Reclamation Inspector - Date -

Date of Minister's Approval - Order-in-Council -

Date Permit Issued -

NOTE: When geotechnical and reclamation work have been completed for the calendar year, a Reclamation Report should be submitted to the Senior Reclamation Inspector in Victoria. For a sample of the format to be used *see* the Appendix of the booklet entitled, *Guidelines for Coal and Mineral Exploration*. The Reclamation Report will describe all work done and the details of the reclamation which was achieved. Two 1:50,000 NTS maps are required for the Report.

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES
MINERAL RESOURCES BRANCH
INSPECTION AND ENGINEERING DIVISION

NOTICE OF WORK ON A COAL LICENCE

Pursuant to section 7 of the *Coal Mines Regulation Act* this notice is to be completed by all companies or individuals carrying out exploration work prior to commencement of work, and within one month of cessation of work and one copy is to be sent to each of the following:

Senior Reclamation Inspector, Victoria
District Inspector of Mines
Regional Water Rights Engineer
District Forester or Forest Ranger
Regional Fish and Wildlife Office

PERMIT NO. 117

1. NAME OF PROPERTY: Sukunka
Coal Licence Numbers: 3014 - 3023, 3025, 3026, 3033, 3038, 3089 - 3129, 3554-3557, 3559

2. LOCATION: Mining Division 9 Prince George NTS Map Sheet (e.g., 82E/9E) 93 P/3, 4,5
Lat. 55 ° 11 ' Long. 121 ° 36 ' Locality and Access Sukunka, access from Chetwynd via the Sukunka Valley Road to Mile 37½

3. OWNER: Name BP Exploration Canada Free Miner's Cert. No. 171977
Address 333 - 5th Avenue S.W. City Calgary Prov. Alberta

4. OPERATOR: Name as above Free Miner's Cert. No. as above
Company Telephone No. (403) 237-1234
Address City Prov.

5. ESTIMATED DURATION OF WORK: From to

6. ACTUAL DATE WORK COMPLETED: Day 14 Month September 1979

7. APPROXIMATE NUMBER OF MEN EMPLOYED: 35

8. EXPLORATION WORK: Proposed ☐ Completed ☒ (Use metric measure — 1 metre = 3.3 feet.)
Linecutting (distance, width, method) Nil
(Requires approval of Forest Service. 'Licence to Cut' or 'Free Use Permit' may be withheld until Reclamation Permit approval.)
Drilling — No. of Sites 12 - Total Area 6000 square metres
Road Construction — Total Length .62 km new metres Approximate Width 4 m top metres
13.7 km re-open 6 m cut
Underground Exploration Nil (type)
Trenching — Number 2 Total Length 100 (x2) metres Width 10 (x2) metres
Test Pitting — Number Nil Total Disturbed Area square metres
Work by: Self ☒ OR, Name of Contractor
(Owner is responsible for ensuring the Contractor complies with pertinent regulations, see section 8, *Coal Mines Regulation Act*.)

9. DATE FOREST SERVICE ADVISED BY OPERATOR: March 7 and September 24, 1979
Name and Title of Forest Official Lorne McQueen - Forest Ranger
Address Chetwynd, B.C.

NOTE: Pursuant to section 8, subsection 2(a) of the *Coal Mines Regulation Act*, '...where the employment of mechanical equipment is likely to disturb the surface of the land in clearing, stripping, trenching...' the Application for a Reclamation Permit on the reverse side is also to be submitted.

SIGNATURE OF APPLICANT A. R. Bowler TITLE Project Geologist
PRINT NAME A. R. Bowler DATE September 25/79

CHETWYND TO PRINCE GEORGE
197 MILES

PROPOSED RAILWAY

CHETWYND TO TUMBLER RIDGE
63 MILES

ALTERNATIVE ROUTE
49 MILES

PROPOSED PARK

CHETWYND TO TUMBLER RIDGE
63 MILES

PROPOSED TUMBLER RIDGE
TOWNSITE

PROPOSED AIRPORT

SUKUNKA

TECK

QUINTETTE PROPERTY

PROPOSED PARK

BELCOURT

SAXON

NATURAL GAS PIPELINE

COAL LAND HOLDINGS

1. PAN OCEAN OIL LTD.
2. BRAMEDA RESOURCES LTD.
3. MASTER EXPLORATIONS LTD. (MANALTA COAL LTD.)
4. SUKUNKA – 87.5 % BP
5. CHAMBERLAIN – 100 % BP
6. BULLMOOSE – 100 % BP
7. BRAMEDA – TECK
8. BRAMEDA RESOURCES LTD. (OPTIONED TO NICHIMEN CANADA LTD.)
9. DENWORLD MINING LTD. (DENISON MINES LTD.)
10. QUINTETTE COAL LTD. (DENISON MINES LTD.)
11. McINTYRE MINES LTD. (OPTIONED TO PACIFIC PETROLEUM)
12. BELCOURT (DENISON MINES LTD.)
13. SAXON COAL LTD. (DENISON MINES LTD.)

Map information obtained from Geographic Division, Surveys and Mapping Branch, Department of Lands, Forests, and Water Resources, Victoria, B.C. 1968-70.

Planimetry compiled from B.C. Prov. Govt. air surveys interim mapping, 1951, and 1956-57. B.C. air photos 1948, 1954-56 and 1960-65.

1. Contours compiled from B.C. Prov. Govt. topographical surveys mapping, 1956-57.
2. Contours compiled from mapping by Dept. of Mines and Technical Surveys, Ottawa, 1950-54, 1960.
3. Contours compiled from mapping by Dept. of Energy, Mines and Resources, Ottawa, 1943. Culture revised from B.C. Prov. Govt. air photos 1964, and 1968-69.

REFERENCE

Land alienated or covered by application under the Land Act
Surveyed Timber Lease, Licence, or Berth
Indian Reserve
Government Reserve
Land District Boundary
Municipality
Park
Campsite or Picnic Site
Forest Service Lookout
Settlement or Locality
Post Office
School
Hospital
Mine
Dyke
Historic Monument
Mile Post
Interprovincial Boundary and Monument
Coal Bearing Areas

BP EXPLORATION CANADA LIMITED — COAL DIVISION

BRITISH COLUMBIA
SHEET 93I & 93P
Scale 1:250,000 or approximately 1 Inch to 4 Miles

Miles 5 0 5 10 15 20 Miles
Scale of Kilometres 5 0 5 10 15 20 25 30

Magnetic Declination approximately 26°09' East at centre of sheet, 1970. Decreasing approximately 8'15" annually.

FIRST PRINTING APRIL, 1975
FOURTH PRINTING MARCH, 1978

REVISED MAY 1977
REVISED DEC 1978

Universal Transverse Mercator Projection

REFERENCE

Road, Hard Surface, All Weather
Road, Loose Surface, All Weather
Road, Loose Surface,
Road Four Wheel Drive
Trail
Railway Existing
Main Telephone Line
Main Electric Power Line
Horizontal Control Station
Contours (Interval 500 feet)
Elevation in feet above mean sea-level
Intermittent Stream
Intermittent Lake or Seasonal Inundation
Swamp or Marsh
Glacier or Icefield
Spring
Dam
Airport or Airstrip
Airharbour or Seaplane Anchorage
Gas Wells
Existing Mine Site
Proposed Mine Site

LOCATION MAP

MAP #1

666

SHEET 93I & 93P.

Re- SUKUNKA 79 (2*)A.
*(1)

UNDERGROUND DEVELOPMENT
IN 1979 FROM LICENSE
No. 3103

'D' HEADING Drive to Upper Chamb.

'C' HEADING

'B' HEADING

'A' HEADING

B/H TO UPPER CHAMB WORKINGS

B/H TO SURFACE FOR WATER PIPE

D.D.C.M.3 D.D.C.4.6 D.D.C.5.5 D.D.C.M.2 D.D.C.5.4 GD572 D.D.C.5.3 D.D.C.M.1 D.D 547 D.D.C.11 D.D.C.5.2 D.D.C.5.1

REFERENCE DRAWINGS
N.B. COALITION GRID

FEET 0 100 200 300 400 500
METRES 0 50 100 150

REV Nº	DESCRIPTION	DATE
	Plan made up to	80/02/15

Sukunka Mines Limited

SUBJECT:
UNDERGROUND DEVELOPMENT
IN 1979

TITLE:
Lower Chamberlain Seam
No 1 Mine Workings

ISSUED FOR BID		THIS DRAWING IS THE PROPERTY OF B.P. EXPLORATION CANADA LIMITED IS CONFIDENTIAL AND NOT TO BE COPIED
DESIGNED		
DRAWN	RS Mar 79	
CHECKED		DRAWING NUMBER A 30138 REV
APPROVED		
SCALE	DATE	

SHEET Nº OF SHEETS

666

6,118,250m N.

589,750m E.

590,000m E.

6,118,500m N.

590,250m E.

6,118,750m N.

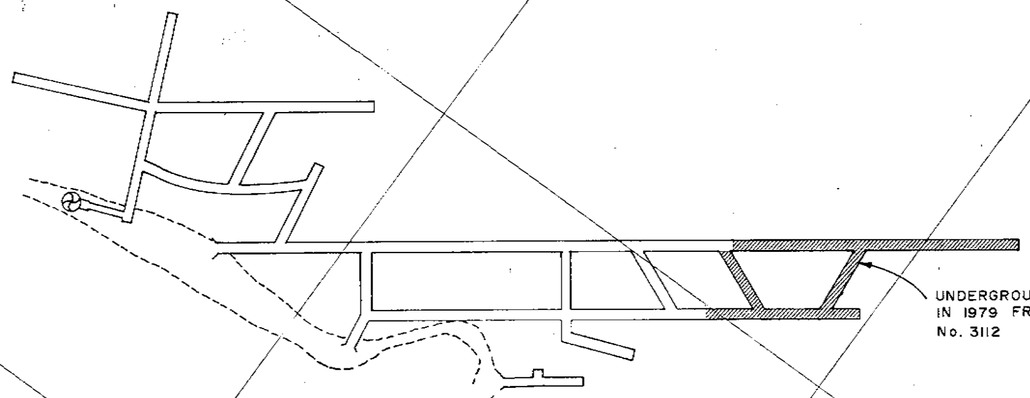
590,500m E.

N

6,118,000m N.

590,750m E.

6,117,750m N



UNDERGROUND DEVELOPMENT
IN 1979 FROM LICENSE
No. 3112

6,117,500m N

METRES
0 25 50 100
SCALE

REV No	DESCRIPTION	DATE

Sukunka Mines Limited

SUBJECT:

SUKUNKA COAL MINING PROJECT

TITLE:

SUKUNKA MAIN COLLIERY
LOWER CHAMBERLAIN SEAM
UNDERGROUND DEVELOPMENT IN 1979

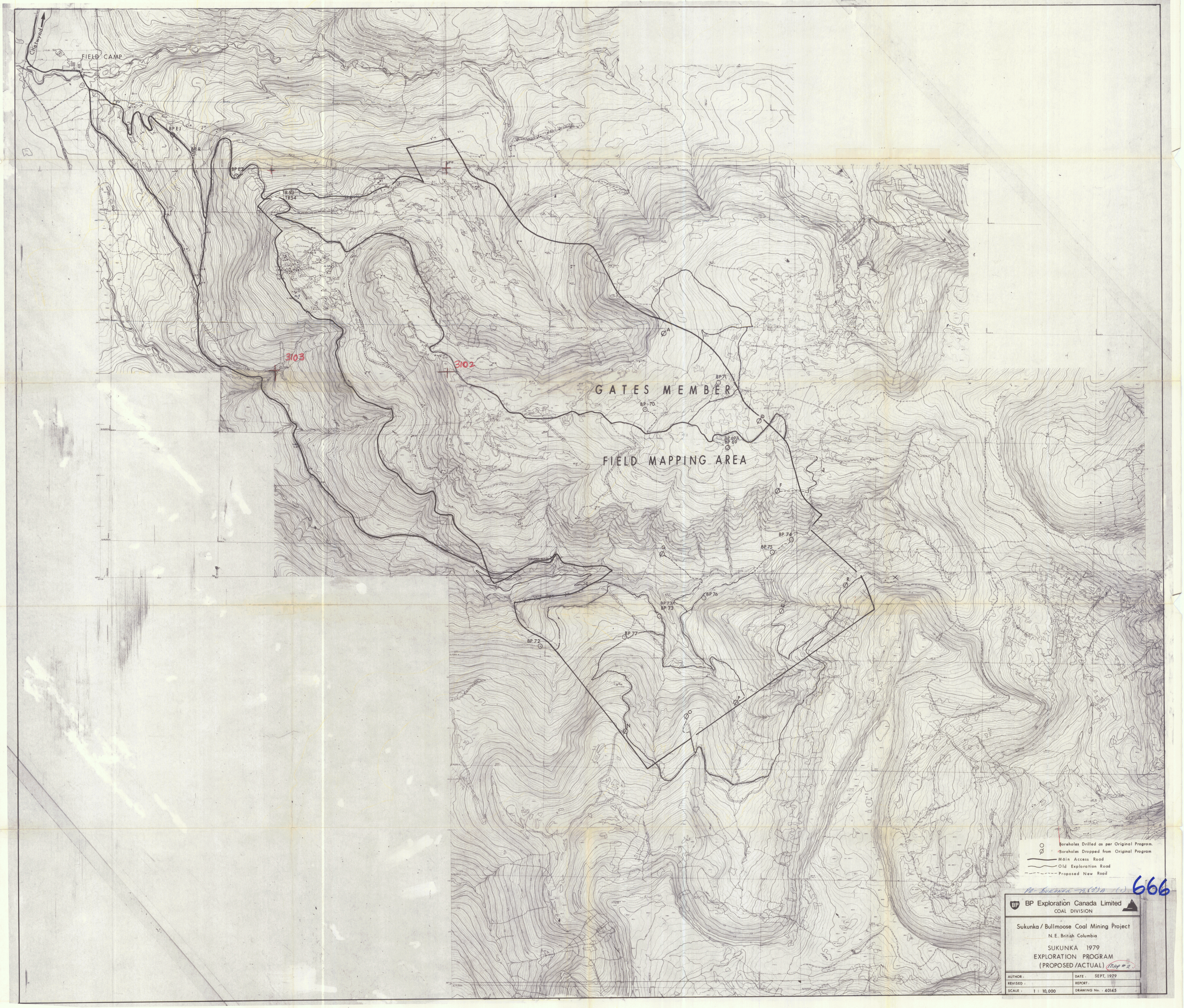
ISSUED FOR BID		THIS DRAWING IS THE PROPERTY OF B.P. EXPLORATION CANADA LIMITED IS CONFIDENTIAL AND NOT TO BE COPIED.
DESIGNED:		
DRAWN: RALLY	MAR./80	
CHECKED:		DRAWING NUMBER / REV
APPROVED:		B 30137
SCALE: 1:2500	DATE	

REFERENCE DRAWINGS

SHEET Nº OF SHEETS

CAL 903 Z

666


FIELD CAMP
GATES MEMBER
FIELD MAPPING AREA
3103
3102
Boreholes Drilled as per Original Program.
Boreholes Dropped from Original Program
Main Access Road
Old Exploration Road
Proposed New Road
666
BP Exploration Canada Limited
COAL DIVISION
Sukunka / Bullmoose Coal Mining Project
N. E. British Columbia
SUKUNKA 1979
EXPLORATION PROGRAM
(PROPOSED / ACTUAL) Map #2.
AUTHOR :
DATE : SEPT, 1979
REVISED :
REPORT :
SCALE : 1 : 10,000
DRAWING No. : 40145

SHEET 3 — BULLMOOSE CR. — HASLER CR.

• BORE HOLE - 1979
Y ADIT
Tr. TRENCH
° BORE HOLE
ROADWAY (Used by BP)

Scale 1: 50,000

POSITION OF M. of M. & P.R. ROADWAY INACCURATE THROUGH PROSPECT

BP SUKUNKA '77-'79 EXPLORATION PROGRAMS (MAP #3.)

MINISTRY OF MINES & PETROLEUM RESOURCES, 1977.

666

PR-SUKUNKA 79 (2*) A.
*(1)

RECLAMATION REPORT

SUKUNKA 1979

DRILLING PROGRAM

OCTOBER 1979

AUTHOR:

W. NYLAND,

EXPLORATION
TECHNOLOGIST

TABLE OF CONTENTS

INTRODUCTION

The Sukunka Exploration Program was designed to upgrade stratigraphic and structural data as well as upgrading analytical data to a minor extent.

A total of eighteen core and open holes were planned initially with only twelve holes drilled at the end of the program, the reason for this being access and budget considerations. The coring was done by a unitized Longyear thirty-eight rig supplied by Tonto Drilling and the open hole drilling was done by a Sanderson Cyclone drill supplied by Hi-Rate Drilling Company Ltd.

The areas drilled on the Sukunka-Bullmoose property were on the northern flank of Bullmoose Mountain and on the south side of Chamberlain Creek. (See attached Reclamation Plan.)

The heavy reclamation ie. recontouring, erosion barring, bridge removal, etc., was accomplished concurrently throughout the program while all the seeding, fertilizing, and scarifying was done in the first two weeks of September 1979.

LOCATION

The Sukunka-Bullmoose coal property is situated in the Rocky Mountain foothills of northeastern British Columbia and occupies an area of approximately 165 km^2. The property is located approximately 60 km south of the village of Chetwynd. (See figure 1.)

The geographical coordinates which would describe a central point within the property are:

Latitude 55° 11', N

Longitude 121° 36', E

Access

Access to the property is via the Northeast Development Road, which is a B.C. provincially maintained gravel road (23km), and the Sukunka Forestry road (32km). Alternate access to the southern part of the property (Bullmoose Area) is via the Northeast Development and Bullmoose Valley Roads, a distance of 95 km.

Biophysical Description

A description of the biophysical features of the region and Sukunka area can be found in a number of sources, including BP (1977)(1979), E.L.U.C. (1977). Therefore, only a brief overview will be presented.

The Sukunka area is mountainous with deeply cut valleys, and ranges in elevation from 701 meters in the Sukunka Valley to 2038 meters atop Bullmoose Mountain. The major drainages of the area development are Skeeter and Chamberlain Creeks, which flow west to meet the Sukunka

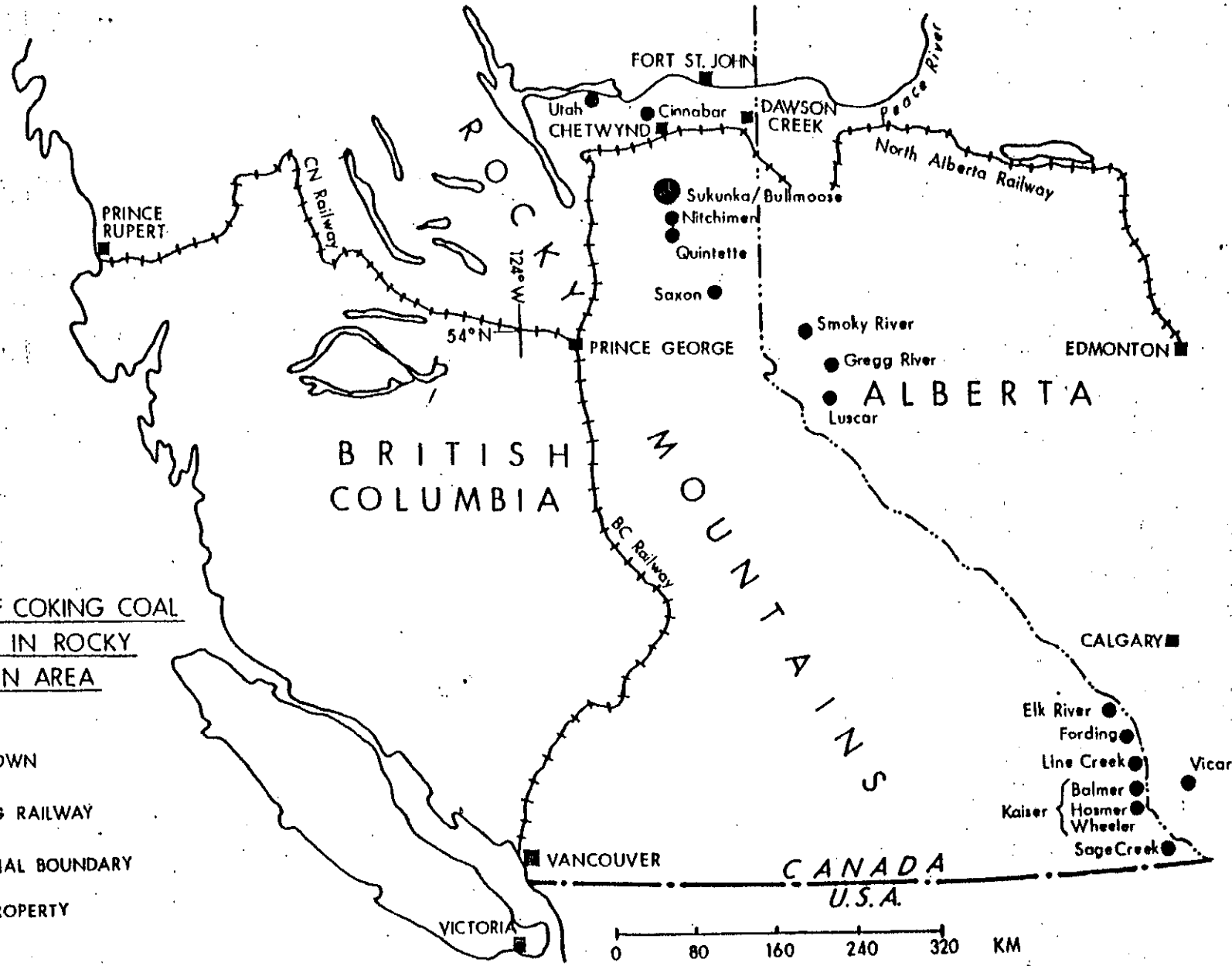


FIGURE 1
LOCATION OF COKING COAL PROPERTIES IN ROCKY MOUNTAIN AREA

River. Three vegetation zones are present in the area: the Suboreal White Spruce - Alpine Fir Zone; the Subalpine Engelman Spruce - Alpine Fir Zone; and the Alpine Tundra Zone. A diversity of wildlife is evident on the property, including up to 46 species of mammals and 160 species of birds. The climate of the region is Humid Continental, short summer with a mean annual temperature of 0° C and a total annual precipitation of approximately 69 cm.

ENVIRONMENTAL PROTECTION PLANNING

The single most important aspect of environmental protection was in the planning stages - both office studies and the planning undertaken concurrent with the implementation of construction. Office studies undertaken included studies of airphotos, topographic plans and soil association/terrain plans (from the Resource Analysis Branch of the B.C. government). These studies gave a good indication of areas suitable for road construction in regard to relief, soil type and sensitivity and vegetative cover. In addition to the above, areas of natural range for mountain goat Oreamnos americanus and mountain caribou Rangifer tarandus basically southern facing slopes above the tree line and flat alpine regions, were regarded as areas where construction would take place only if no other suitable alternative route could be located.

After the work proposal was submitted, planning was taken to the field where each proposed road was ground-truthed to ensure that adverse construction conditions would be avoided.

In all stages of planning liaison was maintained with the Ministry of Energy, Mines and Petroleum Resources, Minerals Resources Branch of the Government of British Columbia up to and including the actual construciton.

Erosion Control Planning

During construction several steps were taken to ensure

that excessive erosion would be controlled. This included ditching on the upslope side of roadways so that any near surface ground water seepage would not be allowed to collect; and installation of culverts in suitable intervals so that water velocities did not become excessive. In most cases the water channeled through the culverts was directed in to the bush covered areas and/or areas of low relief so that any sediments carried by the water would be dropped when the water velocity was reduced.

Another aspect of erosion control was the instruction and close supervision of the machine operators so that excessive material side casting could be avoided where possible.

Habitat Protection

Even though the exploration program was not extensive over larger tracts of land, key areas of habitat sensitivity were identified by the BP Environmental group so that these areas could be avoided or protected. Two main areas of concern, namely Chamerlain Creek and the south facing subalpine slope above Chamberlain Creek were identified as sensitive areas. In the latter a proposed road to drill site "G" was not constructed mainly due to the high cost of construction but also with consideration given to the suitability of this area as a natural range for certain ungulate species as mentioned earlier. In the former case a crossing was proposed in an area upstream of productive

fish habitat, specifically mountain white fish Prosopium williamsoni and Dolly Varden char Salvelinus malma, coupled with the fact that a high volume of traffic would be using this crossing as it was the main access route. A decision was made to construct a bridge. This bridge ensured that continuous sedimentation would not disrupt any fish activity downstream from this area. See photo 1.

PHOTO 1

SURFACE DISTURBANCE

General

The 1979 Sukunka Exploration program was generally confined to existing trails and roadways with a small portion of new construction (under 1kilometer). The maximum size of any given drill site would be no more than 500 square meters which was normally constructed adjacent to or at the end of any roadway.

In the process of clearing old roadways for traffic, problems were encountered in the form of mud slides and slumping particularly along the lower Chamberlain Creek road where it runs adjacent to the south fork of Chamberlain Creek. The overburden in this area consisted of unconsolidated glacial moraine material made up of rounded to angular sands, gravels, and boulders in a matrix of clay. This ground is particularly sensitive to solifluction due to the saturation of the clays by meteoric and phreatic water, in addition to the ground frost melting which was accelerated by exposing the frozen ground to the air early in the spring. Even though steps were taken to minimize the effect of this slumping, by the use of wide ditches and water diversion some slides did reach the creek channel. See photos 2 & 3. After the initial slide took place the toe of the slide which encroached upon the stream channel, seemed to "set-up" or solidify causing no further turbidity. Some extra siltation and turbidity can be expected during subsequent spring run-off periods.

PHOTO 2

NOTE THE LACK OF SILTATION
ON THE DOWN STREAM SIDE
OF THE SLIDE

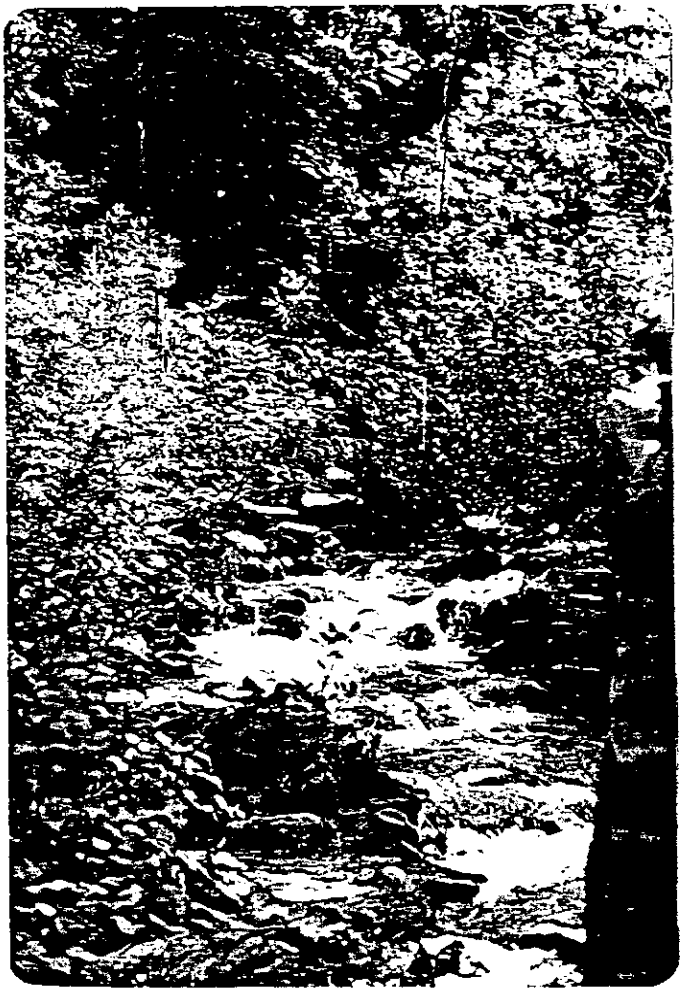


PHOTO 3

The drill lease sites were normally constructed on high or relatively dry ground wherever possible. In the case of redrill locations the old site had to be used as it was. Again, as in the case of roads, the drill leases were ditched on the high side and sloped so that water would, as much as possible, not be allowed to collect on the pad. In all cases the drilling fluids that were produced during the drilling operation (such as muds, soaps, and other materials) were contained to prevent contamination of water courses. This involved ditching and sumping to allow the above mentioned materials to settle out or disperse before they could reach water courses.

New roads constructed were placed in areas where the least amount of disturbance would be created, normally along ridges if possible. Swamps, creeks and large stands of timber were avoided. When a creek had to be crossed during new construction it was culverted in its natural channel so that no large quantities of water would build up on the upstream side.

RECLAMATION

Site Preparation

The majority of the drill sites and roadways were prepared in the following way:

1) Culverts were either removed or incorporated into the erosion bar.

2) Erosion bars were established on slopes where erosion could be foreseen, utilizing established waterways where possible.

3) Sumps*, ditches, and deep ruts were backfilled.

4) Disturbed areas were re-sloped so that any surface meteoric water would be confined to sheet wash rather than going through further stages of rill and gully erosion.

5) Immediately prior to seeding the heavy equipment had already provided suitable microenvironments.

6) The bridge was removed (See photos 12 & 13) and road blocks were placed on the main access.

In some cases an attempt was made to restore disturbed land to the original contours, specifically the following drillsites and associated roads:

BP 70 and R19 (See photos 4,5,6,7,8 & 9)

BP 71 and R20 (See photo 10)

BP 69 - 69A and R21 (See photo 11)

including a portion of R23 which was on a steep gradient. After the recontouring no further work took place except for seeding and fertilizing. (See TABLE A.)

* On drill leases only.

TABLE A

DISTURBANCE	RECLAMATION PROCEDURE						COMMENTS
	Recontouring	Seeded	Fertilized	Erosion Bar	Scarified	Road Block	
R23	X	X			X		
R19	X	X	X				
R21	X	X	X				
R20	X	X	X		X		
Lower Chamberlain Creek Road		X		X	X	X	Road blocks set a main access.
Upper Chamberlain Road		X	X	X	X		Fertilizer applied in the sub-alpine areas approximately 2.14 km.
Skeeter Creek Road		X		X	X	X	
Bullmoose Highway				X		X	Erosion barred to maintain road grade.
T53	X	X	X				After reclamation trenches were
T54	X	X	X				reopened for further study.
South Chamberlain outcrop strip		X	X	X	X		
Gravel Pit A & B	X	X			X		
BP 69,69A,70,71	X	X	X		X		
BP 74	X	X			X	X	
BP 72,73,75,76,77 E2,R		X			X		

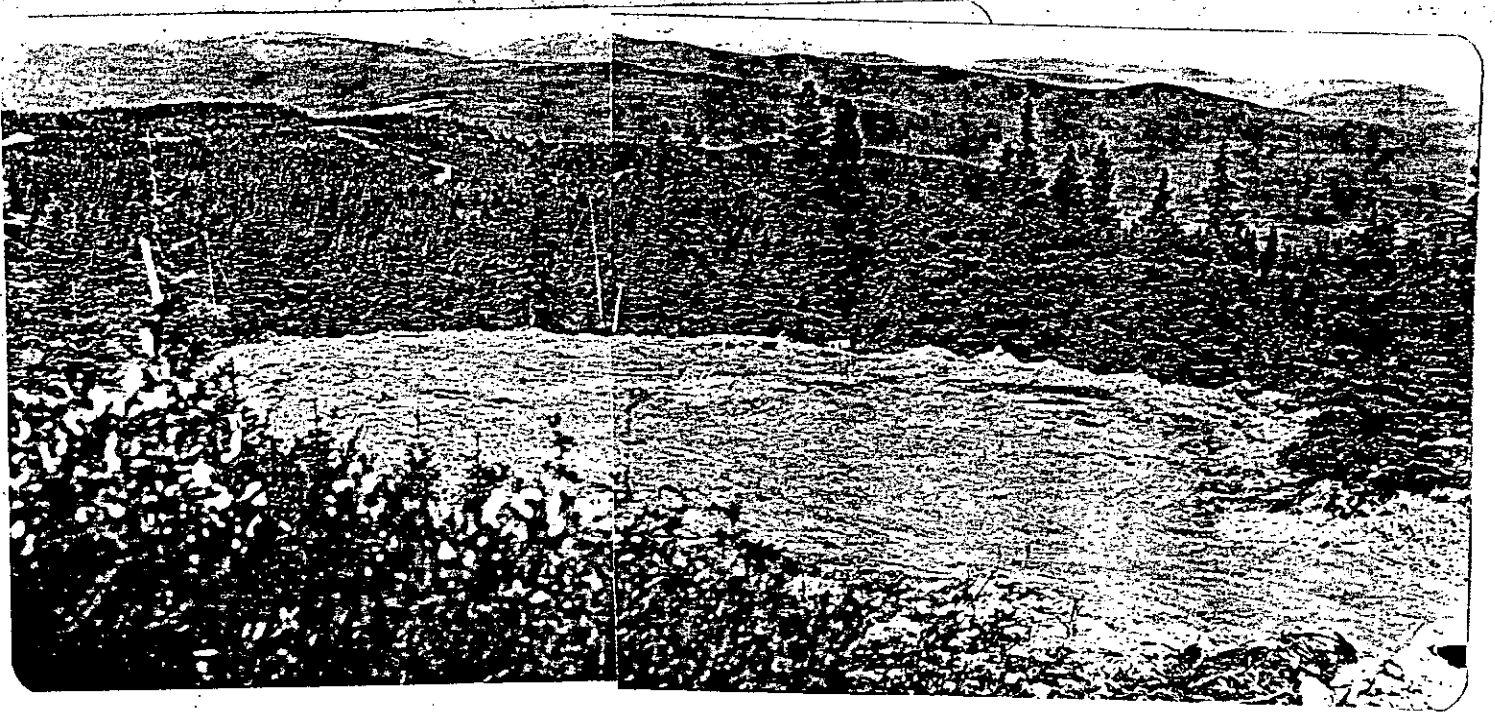


PHOTO 4

BEFORE RECLAMATION

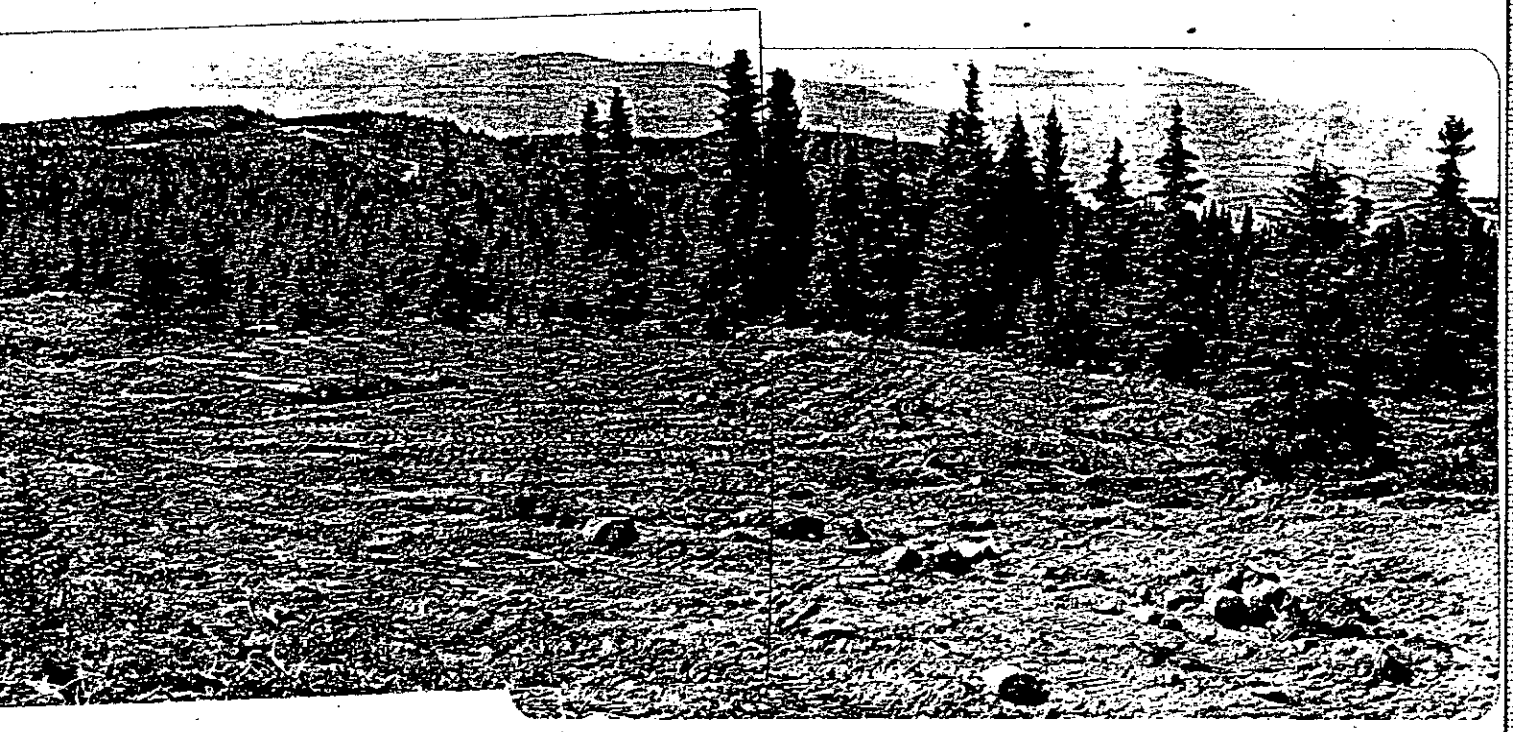


PHOTO 5

AFTER RECLAMATION

PHOTO 6

PHOTO 7

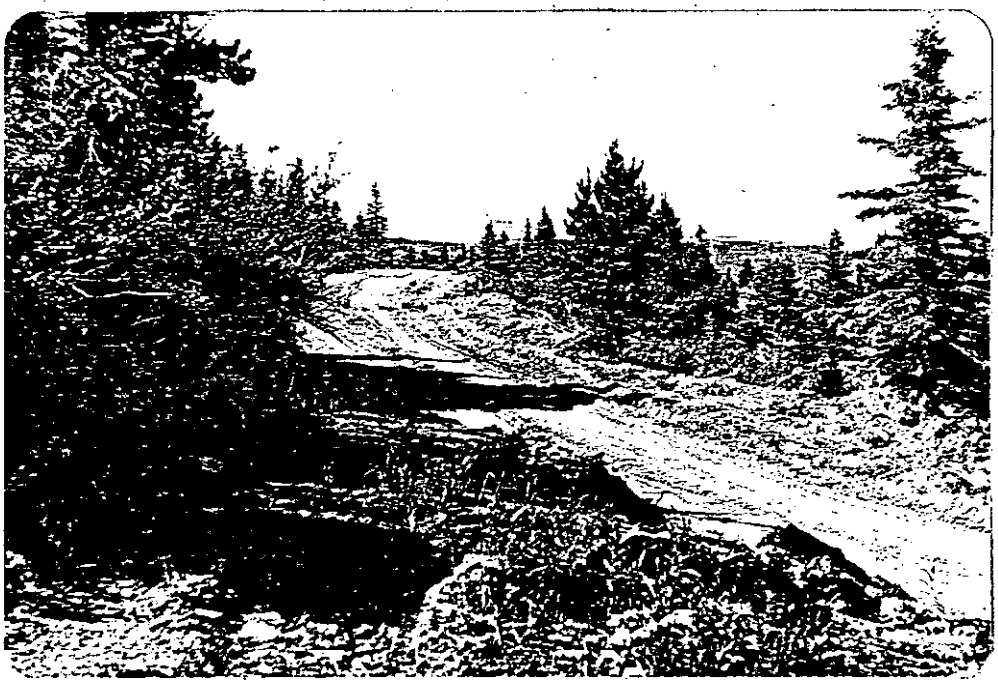


PHOTO 8

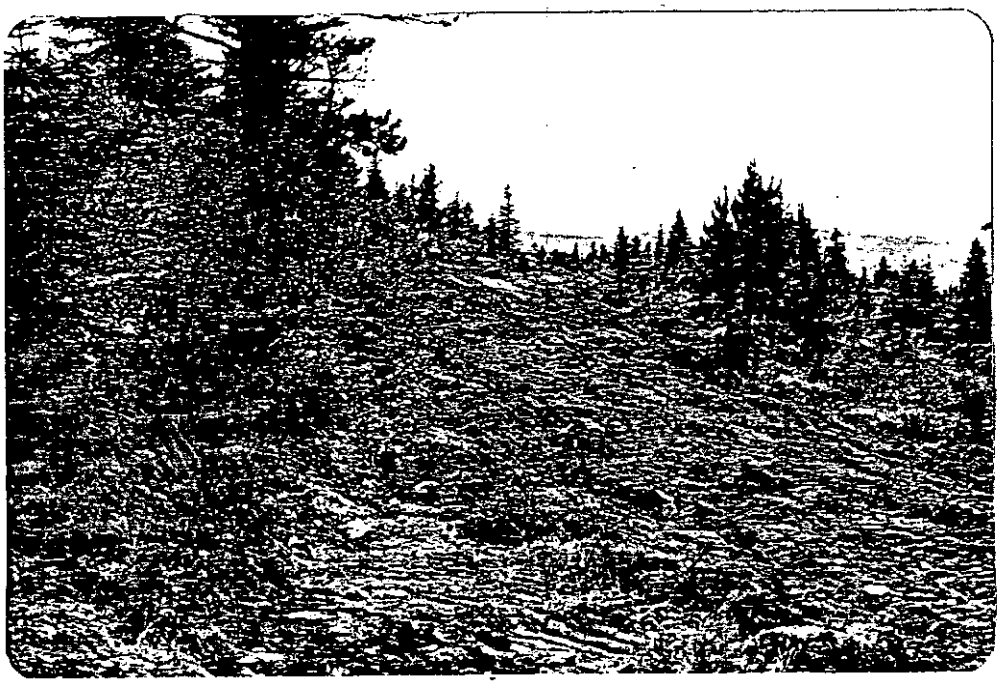


PHOTO 9

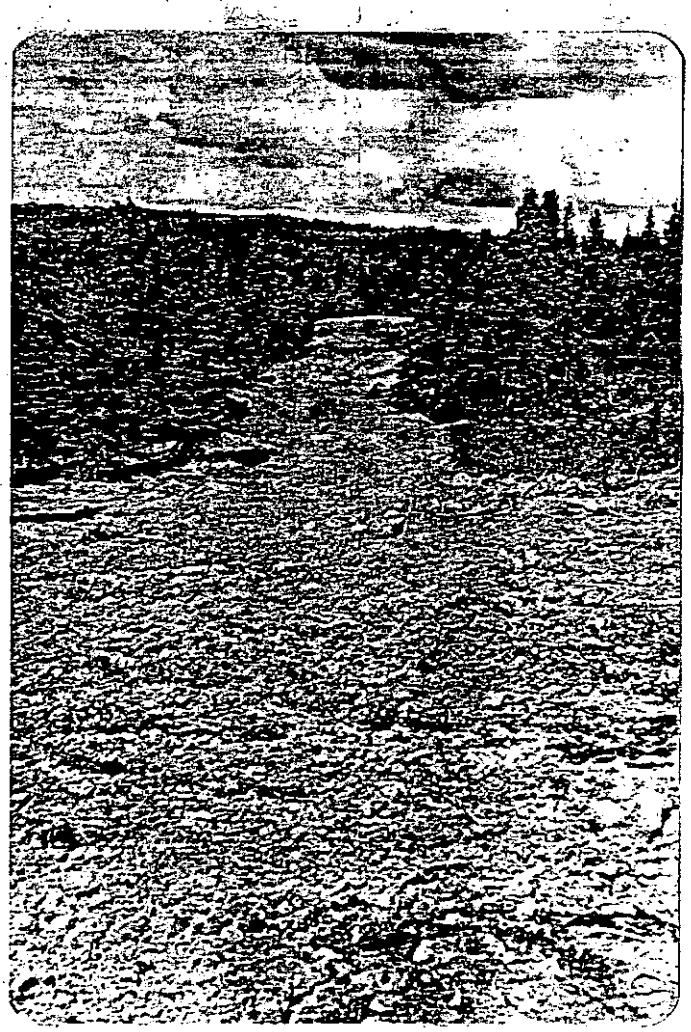


PHOTO 10

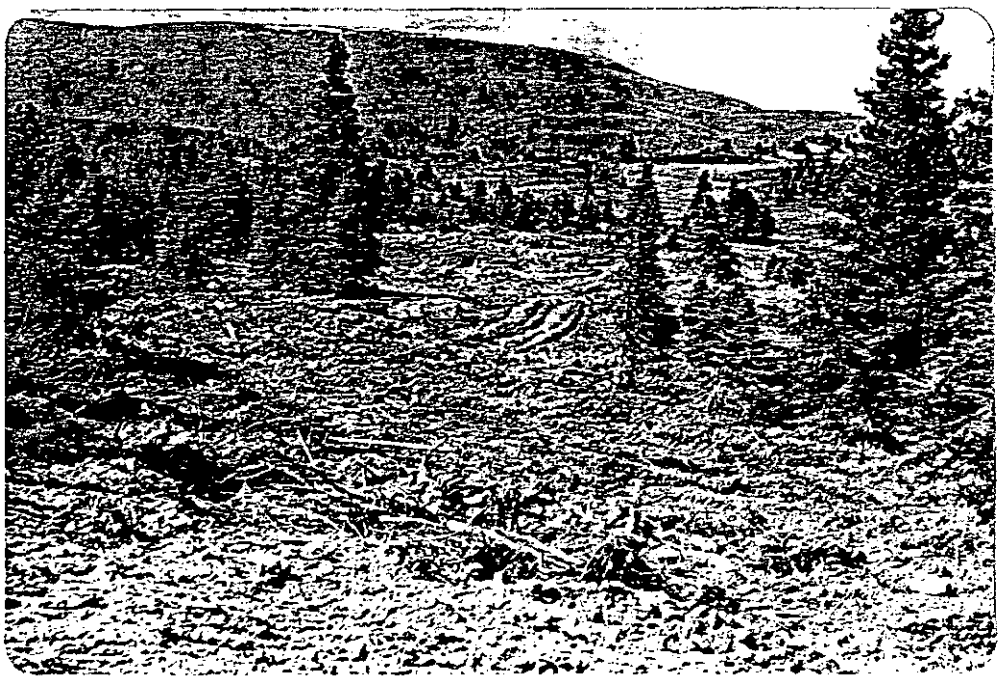


PHOTO 11

PHOTO 12

PHOTO 13

Seeding

Seeding took place on all road and drill sites with the exception of the Bullmoose "highway" and Trenches 53 and 54. The method of seeding was by the use of a electric motor driven broadcaster mounted on a 350 John Deere Tractor. The seed mixture was as follows for forested areas:

Boreal creeping red fescue	40%	
Climax Timothy	20%	By Weight
Red Tops	15%	
Alsike Clover	25%	

applied at a rate of approximately 44Kg/hectare. The seed mixture for the sub-alpine areas was as follows:

Boreal Creeping red fescue	25%	
Meadow foxtail	25%	
Climax Timothy	20%	By Weight
Canada Bluegrass	5%	
Carlton bromgrass	10%	
Alsike clover (inoculated)	15%	

applied at a rate of approximately 55kg/hectare.

When the seeding took place the scarifier was continually dragged behind the machine allowing the seeds to be covered to some extent.

Fertilizing

Fertilizing was carried out only in selected areas; the sub-alpine areas and certain coal outcrop strip areas. A complete fertilizer was used with equal portions of nitrogen,

potassium and phosphorus in a ratio of 16-16-16 (lbs./100). The application rate was approximately 200 kg/hectare and was applied as a mixture with the seed. Even though the application rate was somewhat under the suggested for the alpine areas, it must be remembered that along roadways the machine makes two passes, one on one side and the other on the return trip giving an effective doubling of the application rate.

Slash Disposal

As the roadways used had merely to be re-opened there was very small amounts of slash to be disposed of. The slash in the subalpine areas was incorporated into the road grade and care was taken during the recontouring to keep the slash buried. Along existing roadways any trees damaged or felled by heavy equipment activity were felled and/or cut into lengths so that ground contact was made. On the new drill sites all slash was buried in the drill pad.

ACKNOWLEDGEMENTS

TOR TOR TRUCKING

(HEAVY RECLAMATION) - Recognized for the cooperation and initiative shown throughout the program.

NORTHSTAR FABRICATING LTD.

(LIGHT RECLAMATION)

MR. TED HALL

INSPECTOR/TECHNICIAN (RECLAMATION)

INSPECTION AND ENGINEERING DIVISION

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES.

B.P ENVIRONMENTAL GROUP

- For all technical assistance and advice given freely throughout both planning and operational phases of the 1979 Sukunka program.

SUMMARY OF EXPLORATION AREAS DISTURBED AND REVEGETATED

TO DECEMBER 31, 1979

Type of Disturbance	Length (km)	Disturbed Area (ha)	REVEGETATION				Total Not Seeded
			Area Recontoured (ha)	Area Seeded (ha)	Area Fertilized (ha)	Total Area Receiving Work (ha)	
ROADS:							
R19	0.268	0.121	0.121	0.121	0.121	0.121	
R20	0.4245	0.191	0.191	0.191	0.191	0.191	
R21	0.1238	0.056	0.056	0.056	0.056	0.056	
R23	1.2670	0.570	0.570	0.570	0.570	0.570	
Lower Chamberlain	5.418	2.438		2.438		2.438	
Upper Chamberlain	5.041	2.268		2.269	0.963	2.269	
Skeeter Creek	1.534	0.690		0.690		0.690	
Bullmoose Hwy.	5.291	2.381				2.381	2.381
TRENCHES:							
T53	0.150	0.150				0.150	0.150
T54	0.150	0.150				0.150	0.150
South Chamberlain Creek	0.925	1.850		1.850	1.850	1.850	
Gravel Pit	0.02236	0.050	0.050	0.050		0.050	
Gravel Pit	0.02236	0.050	0.050	0.050		0.050	
DRILLHOLES:							
12		0.600	0.015	0.600	0.015	0.600	
TOTALS		11.566	1.053	8.885	3.766	11.566	2.681

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

MINERAL RESOURCES BRANCH

INSPECTION AND ENGINEERING DIVISION

RECLAMATION REPORT — COAL EXPLORATION

To be submitted in duplicate to Senior Reclamation Inspector, Victoria. *See* note at bottom of page.

1. FOR CALENDAR YEAR 19 79 — PERMIT NO. C117

2. COMPANY BP Exploration Canada Ltd. — NAME OF OFFICIAL D. J. MITCHELL

ADDRESS 333-5 Ave. S.W. Calgary, T2P 3B6 — SIGNATURE D. J. Mitchell

DATE SUBMITTED 1 Nov. 1979

3. DETAILS OF WORK DONE AND DESCRIPTION OF RECLAMATION

Use metric measure (1 metre = 3.3 feet). Show method of reclamation, for example, backfill of excavated earth and replacement of topsoil, seed type, fertilizer used and application, etc. Use back of sheet if required. Reference locations on 1:50,000 map (Coal Titles Reference Maps).

	Area Disturbed	Area Reclaimed
ROADS: Indicate lengths of individual roadways built and approximate width both cut and fill.		
new road	3,673.35 m²	3,673.35 m²
reopened road	59,670 m²	59,670 m²
main access (Bullmoose Highway)	23,809.5 m²	5,098.5 m²
NOTE: See attached listing for individual road ways and reclamation procedures.	m²	m²
TEST PITS:		
	m²	m²
	m²	m²
	m²	m²
	m²	m²
TRENCHES: Indicate lengths, widths, and ground slope.		
* 300 x 10m 0 %	3000 m²	Ø m²
925 x 20m (old pre BP outcrop strip area re-erosion barred, fertilized, scarified and seeded) 0% to 9%	18,500 m²	18,500 m²
	m²	m²
	m²	m²
ADITS:		
Total No. Ø	m²	m²
DRILL SITES:		
Total No. Twelve	6,000.0 m² **	5,500.0 m²
OTHER:		
2 gravel pits	1,000 m²	1,000 m²
	m²	m²
Total Disturbed and Reclaimed Area (square metres)	m²	m²
Total Disturbed and Reclaimed Area (hectares) (1 hectare = 10 000 square metres)	11.57 ha	9.34 ha

4. GENERAL COMMENTS:

** Drill Site BPEI Drilled in center of roadway

* The outcrop strips were recontoured, seeded and fertilized, but shortly thereafter were reopened for further study.

NOTE: Refer to original 'Application for a Reclamation Permit' and note work done on two copies of the 1:50,000 map. Specify where work done has varied from that which was proposed. Attach to this report. Refer to booklet entitled, *Guidelines for Coal and Mineral Exploration*, available at the office of the District Inspector of Mines, for reclamation advice. Attach photographs or other support data if desired to supplement this format.

IRON MAIDEN SYSTEMS CALGARY, ALBERTA, CANADA

1004

IRON MAIDEN

Chetwynd

FIELD CAMP

BP EJ

BP R

BP E2

TR 53
TR 54

SKEETER CR. ROAD

BULLMOOSE HWY

GATES MEMBER

BP 71

BP 70

R.A

R 20

BP 69A
BP 69

FIELD MAPPING AREA

BP 74

BP 75

SOUTH CHAM. CR. OUTCROP STRIP

R 23

LOWER CHAMBERLAIN CR. RD.

BP 73A
BP 73

BP 76

BP 77

BP 72

UPPER CHAMBERLAIN CR. RD.

LEGEND

- Recontoured & Seeded
- Erosion Barred Scarified Fertilized & Seeded
- Erosion Barred Scarified & seeded
- Scarified & Seeded
- Recontoured & Seeded
- Intermitant erosion bars as needed (Normally on steep road sections)

NOTE:- ALL ROADS WITH NO COLOR CODE WERE NOT USED BY THE EXPLORATION PROGRAM.

- Boreholes Drilled as per Original Program.
- Boreholes Dropped from Original Program
- Main Access Road
- Old Exploration Road
- Proposed New Road
- Trench

RE- SUKUNKA 79-(2)A *(1)

666

BP Exploration Canada Limited
COAL DIVISION

Sukunka / Bullmoose Coal Mining Project
N. E. British Columbia
SUKUNKA 1979
EXPLORATION PROGRAM
(PROPOSED /ACTUAL)
RECLAMATION PLAN APPENDIX 'E'

AUTHOR : W. Nyland	DATE : SEPT, 1979
REVISED : OCT., 79	REPORT :
SCALE : 1 : 10,000	DRAWING No. : 40145

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A R Bowler (Name) agent for BP Exploration Canada Limited (Name)

340 Rundlefield Rd. N.E. (Address)
Calgary, Alberta

333 Fifth Avenue S.W. (Address)
Calgary, Alberta T2P 3B6

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3014-3023, 3025, 3026 3028, 3033, 3038, 3089-3129, 3554-3557, 3559 for a further period of one year.

2. I have performed, or caused to be performed, during the period May to December, 1979, work to the value of at least $531,861.23 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical	Not applicable	
Other		
Road construction		
Surface work	see 6 separate applications submitted	
Underground work	with this report.	
Drilling		
Logging, sampling, and testing		
Reclamation		
Other work (specify)		

3. I wish to apply $_____ of this value of work on Coal Licence(s)* _____

4. I wish to pay cash in lieu of work in the amount of $_____ on Coal Licence(s) No(s). _____

5. I wish to apply $_____ of this value of work to claim a refund of cash in lieu of work in the amount of $_____ which was paid to extend the term of Coal Licence(s) No(s). _____ from _____ to _____, 19____. Mining Receipt No. _____ for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled

Sukunka 1979 Exploration Program.

4th December, 1979 (Date)

A R Bowler Project Geologist (Signature and position)

*Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $_____ Value of work applied on licences $_____

Value of work approved $_____ Value of credit remaining $_____

Work performed. Yes [X] No [ ]

The program of operations detailed hereunder was carried out during the period from May to December, 1979. Total costs are $531,861.23, an average of $13.00 per acre.
32.15 per ha

GEOLOGICAL MAPPING Yes [X] No [ ] Cost $10,487.8

	Area (Acres)	Scale	Time
Reconnaissance			
Detail: Surface		1:5000	1 month
Underground			
Other (specify)			

GEOPHYSICAL OR GEOCHEMICAL SURVEYS Yes [ ] No [X] Cost $

Method Line miles

OTHER SURVEYS Yes [X] No [ ] Cost $3389.85

Grid Topographic x Other

ROAD CONSTRUCTION Yes [X] No [ ] Cost $ this item has not been differentiated from surface work (see below)

Length: On Licences 0.62 km new, 13.7 km old Access (off licences)

SURFACE WORK Yes [X] No [ ] Cost $133,776.5

	Length	Licence Number(s)
Trenching		
Seam tracing		
Crosscutting		
Other	rig moving, slashing, road maintenance	

UNDERGROUND WORK Yes [ ] No [X] Cost $-

Test adits: Number Average length Total footage

Other workings: Area Total footage

DRILLING Yes [X] No [ ] Cost $249,681.31

	Hole Size	Number of Holes	Total ~~Footage~~ meterage
Core: Diamond [X] Wireline [X]	HQ	5	1050
Rotary: Conventional [X]	4 7/8"-8"	7	1654
Reverse circulation [ ]			
Other			

Contractor Where core stored Charlie Lake Core Store

LOGGING, SAMPLING, AND TESTING (check) Yes [X] No [ ] Cost $35,615.26

Lithology: Drill samples [ ] Core samples [ ] Bulk samples [ ]

Logs: Gamma-Neutron [X] Density [X] Other [X]

Testing: Prox. analysis [ ] FSI [ ] Washability [ ]

Carbonization [ ] Petrographic [ ] Plasticity [ ] Other [X]

OTHER WORK (specify details) Trench, Camp Costs, fuel truck rental and communications supplies. Cost $89,649.76

REPORTS:

Reclamation work (Permit No. C-117) Detail of work* Reclamation Report dated October 1979

Cost $9,260.75

OPERATIONS:

Work was supervised by Mr. A. R. Bowler (P. Geol., Alberta) Position Project Geologist

Is this person a registered or licensed Professional Engineer in British Columbia? Yes [ ] No [X]

NOTE—Where the licensee intends to perform, during the extended term of his licence, work not set out in the plan of operations filed under section 15 (2) (*c*), a supplemental plan of operations is to be attached.

* If reclamation work reported in separate report give details of report identification.

VALUATION OF WORK: COST STATEMENT
(Sec. 27, B.C. Reg. 436/75)

ON-PROPERTY COSTS: For period from May to September, 1979

1. OPERATOR'S FEES, SALARIES, AND WAGES:

	Average Number of Employees	Average Rate	Average Number of Days	Amount
Professional and technical	7	-	75	10,487.80 (3 contrac employees)
Machine operators and support				
Miners				
Other				

Total operator's costs $ 10,487.80

2. CONTRACTORS AND CONSULTANTS:

Name	Service	Contract Amount
Hi-Rate Drilling Co. Ltd.	Rotary Drilling	$127,943.60
Tonto Drilling Co.	Wireline Drilling	$121,737.71
Tor-Tor Trucking	Cat Work	$128,816.50
North Star Fabricating & Constractors	Slashing	$4,960.00
C. N. Stables & Assoc.	Surveying	3,389.85

Total contractor and consultant costs $ 386,847.66

3. EQUIPMENT AND INSTRUMENTS USED: Owned ____ Rented X

Type	Rented From	Amount
Trailers	Territorial Leasing	$2,368.40
Mobile Phones	AGT and Norcen	$5,311.62

Total equipment and instrument rentals $7,680.02

4. FIELD CAMP COSTS:

		Amount
Food	Cal Van Canus	$12,877.14
Accommodation		
Fuel	Sukunka Mines	11,341.49
Other	First Aid Attendant (Molder & Assoc.)	10,842.95

Total field camp costs $ 35,061.58

5. SAMPLING, ANALYSIS, AND TESTING:

Service	Performed by	Amount
Geophysical Logging	BPB Instruments Canada Ltd.	35,615.26

Totals, samplings, analysis, and testing $35,615.26

6. SUPPLIES AND MATERIALS COSTS:

	Amount
Process supplies	
Operating and maintenance supplies	$14,012.33
Office and technical supplies	6,776.30
Other supplies and materials Culverts & Cement	6,008.42

Total, supplies and materials $ 26,797.05

7. TRANSPORTATION COSTS (Ground transportation details):

Vehicles	Owner	Rental Rate	Amount
4	Aspol Motors	-	$11,253.72

Air support details:

Aircraft Type	Owner	Charter

Total transportation costs $ 11,253.72

8. RECLAMATION WORK:

North Star Fabricators & Contractors and supplies $ 9,260.75

9. TRAVEL EXPENDITURES (operator's costs only):

Number of Personnel	Number of Trips	Amount
7	-	8,857.39

Total travel expenditures $ 8,857.39

Total costs $ 531,861.23

(Secs. 28 and 29, B.C. Reg. 436/75)

OFF-PROPERTY COSTS: Period from ____ to ____, 19____

	Amount
(a) Logistics and field support	$
(b) Technical and feasibility studies	
(c) Preparation of reports	
(d) Supplies and services	
(e) Mobilization and demobilization of equipment	
(f) Travelling expenses (Itemize)	

Total $

Supporting Cost Statements Attached

Amount

Total supporting costs $

SUMMARY

On-property costs	$ 531,861.23
Off-property costs	$ -
Total costs	$ 531,861.23

Statement of costs verified by

DECEMBER 4, 1979
(Date)

Larry B. Peebles
(Signature and position)
ACCOUNTANT, COAL DIVISION

2M-675-8196

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A. R. Bowler (Name) agent for BP Exploration Canada Limited (Name)

340 Rundlefield Rd. N.E. (Address)
Calgary, Alberta

333 Fifth Avenue S.W. (Address)
Calgary, Alberta

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3014, 3107, 3018, 3020, 3021, 3554, 3555, 3556, 3557, 3559, (Group 153)
for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 19 79, work to the value of at least $ 25,429.43 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping	all licences in Group 153	10,487.80
Surveys: Geophysical		
Geochemical		
Other		
Road construction		
Surface work		
Underground work		
Drilling		
Logging, sampling, and testing		
Reclamation		
Other work (specify) Camp & Transportation Costs etc.	all the licences in Group 153	14,941.63

3. I wish to apply $ 25,429.43 of this value of work on Coal Licence(s)* listed above (Group 153)

4. I wish to pay cash in lieu of work in the amount of $ - on Coal Licence(s) No(s).

5. I wish to apply $ - of this value of work to claim a refund of cash in lieu of work in the amount of $ which was paid to extend the term of Coal Licence(s) No(s). from to , 19 . Mining Receipt No. for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Program (1979)

Dec 4th 1979 (Date)

A. R. Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ Value of work applied on licences $

Value of work approved $ Value of credit remaining $

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

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340 Rundlefield Rd. N.E. (Address)
Calgary, Alberta
333 Fifth Avenue S.W. (Address)
Calgary, Alberta

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3100, 3110, 3111, 3112, 3113, 3122, 3123, 3128, 3129, 3016 (Group 154) for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 1979, work to the value of at least $359,705.59 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical		
Other Topographic	3110, 3111, 3122, 3123	2542.39
Road construction	3110, 3111, 3122, 3123	100,332.39
Surface work		
Underground work		
Drilling	3110, 3111, 3122, 3123	210,725.24
Logging, sampling, and testing	3110, 3111, 3122, 3123	24,218.38
Reclamation	3110, 3110	6,945.56
Other work (specify) camp & transportation costs	(all the licences in group 154)	14,941.63

3. I wish to apply $359,705.59 of this value of work on Coal Licence(s)* listed above (Group 154).

4. I wish to pay cash in lieu of work in the amount of $ - on Coal Licence(s) No(s).

5. I wish to apply $ - of this value of work to claim a refund of cash in lieu of work in the amount of $ which was paid to extend the term of Coal Licence(s) No(s). from to , 19 . Mining Receipt No. for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Report (1979).

Dec 4th, 1979 (Date)

A R Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ Value of work applied on licences $

Value of work approved $ Value of credit remaining $

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A. R. Bowler (Name) agent for BP Exploration Canada Limited (Name)
340 Rundlefield Rd. N.E. (Address) 333 Fifth Avenue S.W. (Address)
Calgary, Alberta Calgary, Alberta

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3109, 3120, 3119, 3025 3026, 3019, 3028 (Group 155)
for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 1979, work to the value of at least $21,630.44 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical		
Other		
Road construction	3109, 3120	6,688.82
Surface work		
Underground work		
Drilling		
Logging, sampling, and testing		
Reclamation		
Other work (specify) camp & transportation costs etc.	all the licences in group 155	14,941.62

3. I wish to apply $21,630.44 of this value of work on Coal Licence(s)* listed above (Group 155)

4. I wish to pay cash in lieu of work in the amount of $ on Coal Licence(s) No(s).

5. I wish to apply $ of this value of work to claim a refund of cash in lieu of work in the amount of $ which was paid to extend the term of Coal Licence(s) No(s). from to , 19 . Mining Receipt No. for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Report (1979)

Dec 4th 1979 (Date) A R Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ Value of work applied on licences $

Value of work approved $ Value of credit remaining $

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A. R. Bowler (Name) agent for BP Exploration Canada Limited (Name)

340 Rundlefield Rd. N.E. (Address) — 333 Fifth Avenue S.W. (Address)

Calgary, Alberta — Calgary, Alberta

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3114, 3115, 3116, 3117 3118, 3124, 3125, 3126, 3127, 3015 (Group 156) for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 19 79, work to the value of at least $ 21,630.44 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical		
Other		
Road construction	3124	$6,688.82
Surface work		
Underground work		
Drilling		
Logging, sampling, and testing		
Reclamation	~~group 156.~~	
Other work (specify) Camp & Transportation Costs etc.	all the licences in	$14,941.62

3. I wish to apply $ 21,630.44 of this value of work on Coal Licence(s)* listed above (Group 156)

4. I wish to pay cash in lieu of work in the amount of $ ____ on Coal Licence(s) No(s). ____

5. I wish to apply $ ____ of this value of work to claim a refund of cash in lieu of work in the amount of $ ____ which was paid to extend the term of Coal Licence(s) No(s). ____ from ____ to ____, 19____. Mining Receipt No. ____ for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Program (1979)

Dec 4th 1979 (Date) — A. R. Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ ____ Value of work applied on licences $ ____

Value of work approved $ ____ Value of credit remaining $ ____

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A. R. Bowler (Name) agent for BP Exploration Canada Limited (Name)

340 Rundlefield Road N.E. (Address)
Calgary, Alberta

333 Fifth Avenue S.W. (Address)
Calgary, Alberta

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3089, 3090, 3091, 3092, 3094, 3095, 3096, 3101, 3102, 3103 (Group 157) for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 19 79, work to the value of at least $ 28,319.28 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical		
Other		
Road construction	3102-3103	13,377.65
Surface work		
Underground work		
Drilling		
Logging, sampling, and testing		
Reclamation		
Other work (specify) Camp and Transportation costs etc.	all licences in group 157	14,941.63

3. I wish to apply $ 28,319.28 of this value of work on Coal Licence(s)* listed above (Group 157)

4. I wish to pay cash in lieu of work in the amount of $ - on Coal Licence(s) No(s).

5. I wish to apply $ - of this value of work to claim a refund of cash in lieu of work in the amount of $ which was paid to extend the term of Coal Licence(s) No(s). from to , 19 . Mining Receipt No. for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Program (1979)

Dec. 4th 1979 (Date)

A.R. Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ Value of work applied on licences $

Value of work approved $ Value of credit remaining $

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Coal Act (Sec. 19)

APPLICATION TO EXTEND TERM OF LICENCE

1. I, A. R. Bowler (Name) agent for BP Exploration Canada Limited (Name)
340 Rundlefield Rd. N.E. (Address)
Calgary, Alberta
333 Fifth Avenue S.W. (Address)
Calgary, Alberta T2P 3B6

Valid FMC No. 171977

hereby apply to the Minister to extend the term of Coal Licences No(s). 3093, 3097, 3098, 3099, 3104, 3105, 3106, 3107, 3108, 3121 (Group 158)
for a further period of one year.

2. I have performed, or caused to be performed, during the period May to September, 1979, work to the value of at least $75,146.05 on the location of coal licences as follows:

CATEGORY OF WORK	Licence No(s).	Apportioned Cost
Geological mapping		
Surveys: Geophysical		
Geochemical		
Other - Topographical	3097, 3104	847.46
Road construction	3097, 3104	6688.82
Surface work		
Underground work		
Drilling	3097-3104	38,956.07
Logging, sampling, and testing	3097-3104	11,396.88
Reclamation	3097-3104	2,315.19
Other work (specify) Camp & Transportation Costs	all licences in group 158	14,941.63

3. I wish to apply $75,146.05 of this value of work on Coal Licence(s)* listed above (Group 158)

4. I wish to pay cash in lieu of work in the amount of $ ____ on Coal Licence(s) No(s). ____

5. I wish to apply $ ____ of this value of work to claim a refund of cash in lieu of work in the amount of $ ____ which was paid to extend the term of Coal Licence(s) No(s). ____ from ____ to ____, 19____. Mining Receipt No. ____ for prior payment of cash in lieu of work *is attached* for adjustment.

6. The work performed on the location(s) is detailed in the attached report entitled Sukunka Exploration Report (1979)

Dec 4th 1979 (Date)

A R Bowler Project Geologist (Signature and position)

* Applications to group licences may be filed to apportion costs on a maximum of 10 licences.

(FORMS TO BE SUBMITTED IN DUPLICATE)

FOR DEPARTMENTAL USE ONLY

Value of work reported $ ____ Value of work applied on licences $ ____

Value of work approved $ ____ Value of credit remaining $ ____

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BPE-1

Contractor: Tonto Drilling

Co-ordinates: N 6121704.4
E 586528.8

Commenced: 1/6/79

Surface Elevation: 902.6 m

Completed: 3/6/79

Geophysically logged: yes/~~no~~

Core Size: HQ

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole none m

Logged by:	Geologist	Depth
	D. J. W. Mitchell	0.00-T.D.

Final Depth: 105.6 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Gething (Lower)	105.60	105.60+	797.00

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
B Upper	30.24	2.26	61%	872.36
C Upper	103.84	0.73	53%	798.76

STRUCTURAL FEATURE	DEPTH	REMARKS
F. PO.	8.59 - 9.75	Brecciated. Minor fault
F. PO.	54.84 - 56.69	Brecciated. Minor fault
F. EST.	89.94	13 m throw (?POND)

B Upper Seam highly fractured

BPE-1 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	1.7°	N 39° E
75m	1.5°	N 28° E
104m	2.6°	N 31° E

-oooOooo-

Dip°	Depth m	Thickness m	DESCRIPTION
			CORE COMMENCES AT 1.30 m.
			LOWER GETHING SEQUENCE IMMEDIATELY BELOW 'A' HORIZON
Sedimentary dips up to 45°	16.81	15.51	SANDSTONE-medium-grain, colour laminated, calcareous. Occasional cross-bedding, common in top 3.5 m. Rare cup-shaped pelecypod burrows. Common micaceous planty planes. Occasional thin ferruginous bands. Occasional bedded or unbedded calcite lined fractures 25-45° dip. Highly fractured zone, probably a minor fault of small throw, with abundant shear fractures recemented with calcite up to 0.008 m in thickness, abundant secondary in staining, 0.20 m core loss 8.59-9.75 m. Few small dark mudstone angular clasts 16.15-16-50. Abundant small burrows in basal .03 m. Passage base.
dips 30°-40° throughout	22.46	5.65	MUDSTONE/SILTSTONE/SANDSTONE-fine grained, 50:25 25, sandstone fines toward silt in basal 1.0 m; strongly calcareous. Interlayered thin graded units fining up from weakly erosive sand through silt into dark mudstone, units generally less than 0.05 m in thickness. Abundant fine dark burrows, occasional thin bioturbated layers. Occasional larger light sand filled worm and pelecypod burrows. Rare small slump structures. Sand layers rarely ripple set. Occasional fine carbonaceous debris in mud layers. Few calcite lined fractures dip 50°, rare calcite lines bedded fractures. Passage base.
35° to 40° throughout	27.62	5.16	MUDSTONE-black micaceous, common lighter silt and rare fine sand laminae, lenses and thin layers at top, decreasing in frequency down. Very weakly calcareous. Siltstone layers have undulatory base - ? weakly erosive. Common small pyritised burrows. Occasional rough or semi-polished high angle fractures dip 40°-65°. Few small sub-rounded clasts of coal, siltstone and sandstone up to 0.003 m in basal 0.1 m. Fractured base with ? minor core loss.
	27.76	0.14	CONGLOMERATE-sub-rounded clasts of fine sandstone, siltstone and rarely coal, well cemented by interstitial calcite. Non-graded and moderately well sorted with clasts generally up to .003 m in size, though occasionally increasing up to .01 m. Rough sub-vertical fracture passes centrally down core. Two diagonally opposing fractures (not bedded) cross core, dip a) 45° b) 35°.

BH No. BP E-1

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Uneven parallel bedded base, unattached but partially fitting, dip 45°, locally listric.
	27.90	(0.14)	CORE LOST: MUDSTONE-carbonaceous (from geophysical).
	27.98	(0.08)	CORE LOST: MUDSTONE-(from geophysical)
	27.98	2.26	TOP OF LOWER COALS "B UPPER" SEAM
45°	28.97	0.99	COAL-dull and bright-banded, fractured by abundant semi-polished bedded planes, dip 45°.
	29.63	(0.66)	CORE LOST: COAL
	29.71	0.08	COAL-friable, cut by abundant irregular high angle listric planes.
	29.93	(0.22)	CORE LOST: COAL
	30.24	0.31	COAL-totally pulverised, occasional discrete fragments of highly carbonaceous mudstone. Unattached, non fitting base.
	30.24		BASE OF LOWER COALS "B UPPER" SEAM
45° throughout	31.74	1.50	MUDSTONE-micaceous, dark and poorly laminated in top 0.25 m, occasional lighter silt and rarely fine sand laminae, lenses and thin layers below. Occasional crumpling and rare ?microfaulting. Common fine carbonaceous debris in top 0.25. Common rough fractures, rarely lined by fine calcite, dip 65°. Basal 0.005 m very carbonaceous with fine coal streaks. Fairly sharp base.
	31.79	0.05	MUDSTONE-silty, light-brown, common white speckled grains, few very fine coaly streaks, coarsening down into SANDSTONE-medium-coarse, light brown with common dark sub-rounded grains upto .001 m. Few fine coaly stringers at base. ?ASH BAND. Sharp base dip 40°.
	31.84	0.05	MUDSTONE-very carbonaceous with abundant fine coal streaks. Fragments.
	31.98	(0.14)	CORE LOST in this locality

BH No. BP E-1

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
40° throughout	33.37	1.39	MUDSTONE-poorly laminated, dark with abundant fine coaly plant debris, occasional fine coal laminae. Non-calcareous. Sandy and ferruginous 32.11-32.58 Passage base.
45° dip throughout	45.04	11.67	SILTSTONE-muddy in parts, and SANDSTONE fine, 65:45 to 40.30 m, 70:30 below, interlaminated and thinly interlayered. Highly calcareous in parts. Well cemented. Commonly crumpled, rarely slumped. 0.08 m SANDSTONE-layer, medium-grained, ferruginous, micaceous, with occasional descrete angular mudstone clasts up to 0.015 @ 33.95; well cemented and ferruginous with carbonaceous plant debris 0.10 m below layer. Locally common fine calcite lined fractures, dip 45° (opposed to bedding), 34.07-37.40. Bioturbated and ? root disturbed in parts. Common small plant debris and occasional fine coal streaks in siltstone layers. Sharp base-core loss.
	45.72	(0.68)	CORE LOST-lithology probably as below.
50°	45.78	0.06	MUDSTONE-black and carbonaceous, semi-polished bedding planes at top and bottom. Sharp base, core loss as shown above.
	45.97	0.19	MUDSTONE-poorly laminated, common fine carbonaceous plant debris. Sharp base, dip 55°.
	46.28	0.31	MUDSTONE-black, highly carbonaceous, abundant bright coal streaks. Sharp semi-polished base, 55° dip.
	46.33	0.05	COAL-bright. Minor core loss at base.
	46.43	0.10	MUDSTONE- highly carbonaceous, abundant bright coal streaks. Passage base.
60° 47.30 45° below 47.85 65° 54.84-56.95	58.84	12.41	MUDSTONE-dark and carbonaceous with abundant fine coal laminae, becoming lighter and less carbonaceous to base. Faint colour lamination. Occasional polished bedding planes, locally highly fragmented. 0.11 ferruginous and micaceous fine sandstone band at 50.15 (high gamma on geophysical log)

Dip°	Depth m	Thickness m	DESCRIPTION
60°	56.95-57.50		Rooty appearance in parts. 0.24 m core lost 49.07-50.59 0.59 m core lost 50.59-52.12 Fragmented with a few high angle listric and calcite lined bedded or sub-vertical fractures, 65° bed dip, 1.27 m core loss 54.84-56.69, ? Minor fault. 0.25 m CORE LOST at approximately 57.30. Common very fine calcite stringers below 57.81. 0.04 secondary ferruginous band with minor adjacent fracturing at base 58.84.
55° dip throughout	63.95	5.11	SILTSTONE, sandy in parts, faintly laminated with dark muddy slightly carbonaceous laminae and thin layers, locally common discrete fine sand laminae and layers below 62.00. Micaceous, very well cemented: siliceous. Common roots and root disturbance. Occasional hair-line calcite lined fractures dip 50°. Passage base.
Dips up to 50°	67.95	4.00	SILTSTONE and SANDSTONE-fine 70:30 to 67.05, 55:45 below, interlaminated and interlayered. Occasional sand or silt filled burrows, few roots, highly disturbed and crumpled appearance. Thin sand layers appear to be slightly erosive. 0.15 m sand layer containing angular dark silt clasts up to .03 m with brief passage base at 67.75.
50° dip	68.41	0.46	PASSAGE BED-SILTSTONE and SANDSTONE-fine 50:50, interlaminated and thinly interlayered, locally crumpled. Sand layers occasionally contain small clasts and stringers of siltstone. Rare fine coal laminae.
Dips 40-45°	72.32	3.91	SANDSTONE-medium, light-grey, abundant dark carbonaceous laminae. Erosive. Common ripple sets, common transported sub-angular silt clasts up to 0.03 m. Highly calcareous. Locally common dark mud and silt laminae and thin layers, often crumpled and distorted with erosive sand tops, to 69.68. Occasional, locally common, small carbonaceous mudstone and coal clasts, and irregular transported coal streaks below 69.68.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Sharp, irregular erosive base.
	74.67	2.35	SILTSTONE-and SANDSTONE, 70:30-sand laminae, lenses and thin layers, crumpled, slumped, slurried and root disturbed throughout. Highly calcareous. Occasional high angle rough fractures, dip opposing bedding 45°-60°. Occasional fine coaly plant debris.
			Brief passage.
Dips 30-65°	75.77	1.10	SANDSTONE-medium, darker carbonaceous laminae, highly calcareous. Erosive. Several thin layers containing angular dark siltstone clasts and irregular thin coal laminae, and in basal 0.15 m.
			Occasional calcite lined hairline fractures dip 30°-50°, and .01 calcite infilled cavity of tectonic origin. Rare cross-lamination. ? Few coaly roots. Sharp, irregular erosive base.
	76.85	1.08	SILTSTONE and SANDSTONE, 55:45, interlaminated and thinly interlayerd, crumpled, slumped, and root disturbed. Highly calcareous.
70° dip at base			Sand layers occasionally contain sub-angular silt clasts.
			Vertical thin coal lamination in basal 0.1 m. Fairly sharp base.
dips 50°-70°	77.42	0.57	SANDSTONE-medium grain top becoming coarse down. Erosive. Abundant angular siltstone, dark mudstone clasts up to 0.01 m, coal clasts and irregular thin laminae.
			Sharp, irregular erosive base, 60° dip.
45°	78.11	0.69	PASSAGE BED SILTSTONE-and SANDSTONE-interlaminated and thinly interlayered 60:40. Soft sediment slumping, sand layers contain few angular silt clasts. 45° dip. Common fine plants debris and micaceous planty planes in sand laminae and layers. Sharp slightly erosive base dip 45°.
	83.23	5.12	SILTSTONE-with occasional, locally common thin cluster of sand laminae, and thin layers up to 0.15 m of interlaminated sandstone/siltstone, 70:30. Siltstone fines into mudstone below 81.10. Highly calcareous.
			Sand laminae and layers commonly crumpled, slumped, root disturbed or bioturbated. Occasional worm and pelecypod burrows in sand layers. Occasional carbonaceous roots throughout.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Sand layers occasionally appear to have a sharp slightly erosional base. Occasional slickensided and calcite lined fractures dip 40°.
45° @ 84.32	89.94	6.71	MUDSTONE-dark with ferruginous mottling and staining leading to local colour lamination. Highly calcareous. Local siltstone patches and rare fine sand laminae and fine layers to 85.75.
35° @ 85.80			
45° @ 87.00			Occasional coal streaks and coalified plant debris, ? few roots. Occasional sub rounded to sub angular coal and carbonaceous mudstone clasts below 87.17. CORE LOST: 0.37 m 86.25-86.86 0.85 m 86.86-88.93 0.32 m 88.93-89.91 Occasional calcite lined hairline fractures dip 35° to 85.04. Few slickensided and calcite lined fractures dip 45°-60°. Core heavily fractured by irregular but generally steep angled planes, with core loss and apparently steep dips, below 89.13. Abundant hairline calcite infilled fractures in 0.03 m fragment, from base of unit.
	89.94		FAULT ESTABLISHED -mudstone of above unit thrust over sandstone. Throw estimated from core and geophysical log to be 12.91 m. Core lost at this horizon as described above.
65° dip	90.20	0.26	SANDSTONE-coarse, fining down into medium-grain. Erosive. Common irregular coal laminae and angular chunks, and small siltstone clasts. Few crumpled silt laminae and thin layers. Common fractures lined by up to 0.005 m calcite, and listric planes dip 40°-85°. Sharp, uneven, slightly erosive base, 65° dip.
	99.60	9.40	SILTSTONE and SANDSTONE-fine, interlaminated and interlayered 70:30 to 91.92, 60:40 91.92-94.32, 50:50 94.32-97.77, 70:30 below. Highly calcareous. Siltstone becomes muddy in basal 1.0 m. Slumped, crumpled, root distrubed and bioturbated. Locally common pelecypod and worm burrows. Rare thin layers of angular dark mud or coal clasts.

Dip°	Depth m	Thickness m	DESCRIPTION
50°@ 92.80			Abundant calcite lined hairline and large fractures up to 0.007 m in thickness, 50° dip, top to 91.12, commonly below to base.
30°@ 96.40			Passage base.
40°@ 96.70			
dip 30° @ 100.00 dip 40° @101.60	102.80	3.20	MUDSTONE-dark, non-calcareous, occasional silty laminae to 101.60. Ferruginous staining leading to faint colour lamination to 101.84. Occasional fine carbonaceous plant debris, locally common. Crumpled and root disturbed appearance to 101.60, ?bioturbated. Occasional polished bedding planes, rare calcite lined fractures. Sharp, unattached, non-fitting base.
	102.80	1.04	TOP OF LOWER COALS "C UPPER" SEAM
	103.01	(0.21)	CORE LOST: MUDSTONE carbonaceous/DIRTY COAL (from geophysical).
	103.11	(0.10)	CORE LOST: MUDSTONE (from geophysical).
	103.35	0.24	COAL-dull banded fragments and discs, few small irregular polished planes dip 45°.
	103.52	(0.17)	CORE LOST: COAL
	103.67	0.15	COAL-dull banded fragments and discs, few polished fractures dip 45°.
	103.84	(0.17)	CORE LOST: COAL Sharp, unattached, non-fitting.
	103.84		BASE OF LOWER COALS "C UPPER" SEAM
	103.94	0.10	SANDSTONE-medium grain, grey-brown, very well cemented, common fine carbonaceous plant debris, ? 0.06 m core lost at top. Sharp base.
dip 40° throughout	104.45	0.51	MUDSTONE-highly carbonaceous, abundant fine coaly plant debris, few thick coal streaks dip 40°.
	105.60	1.15	MUDSTONE-passing down into SILTSTONE-poorly laminated, non-calcareous, darkish becoming lighter down.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
30° throughout			Occasional coalified plant debris. Appears rooty. Hard and well cemented, ferruginous appearance locally. Occasional polished bedding planes dip 30°.
			BASE OF BOREHOLE 105.60 m

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP E-2

Contractor: Tonto Drilling

Co-ordinates: N 6121329.5
E 587130.9

Commenced: 4/6/79

Surface Elevation: 1070.8 m

Completed: 7/6/79

Geophysically logged: yes/~~no~~

Core Size: HQ

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Logged by:

Geologist	Depth
D. J. W. Mitchell	0.00 to 37.80
C. L. Bickford	37.80 to 92.57
A. R. Bowler	92.57 to 96.44
C. L. Bickford	96.44 to 162.58

Final Depth: 163.3 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Gething (Lower)	163.30	160.86+	907.50

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
A Zone	67.00-72.87	5.87		997.93
B Upper	96.44	3.87	31.52%	974.36
C Upper	131.78	1.96	24.49%	939.02
C Lower	145.48	2.91	49.14%	925.32

STRUCTURAL FEATURE	DEPTH	REMARKS
F. EST.	99.68-100.69	3.2 m throw (? POND)

BPE-2 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	0.6°	N 9° E
100m	0.9°	N 24° E
125m	1.3°	N 27° E
160m	1.3°	N 47° E

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Dip°	Depth m	Thickness m	DESCRIPTION
	1.22	1.22	DRIFT
	2.44	(1.22)	BEDROCK, not recovered.
			CORE COMMENCES 2.44 m
			MIDDLE GETHING FORMATION
Dips generally up to 5°	7.89	5.45	MUDSTONE-silty/SILTSTONE/SANDSTONE-50:30, thinly interlayered. Highly calcareous. Silt layers fine upwards into muds, sand layers commonly have irregular sharp erosive load casted (and locally ? slightly slumped) bases, and sharp irregular slumped and eroded tops. Occasional pouch and miscellaneous other slump structures. Abundant bioturbation by small dark mud filled burrows, and large mud and sand filled pelecypod burrows. Worm burrows are commonly pyritic. Sand layers occasionally contain small angular mud and silt clasts. Sand layers rarely contain cross lamination. Occasional rough rarely calcite lined fractures, dip up to 15°. Common secondary iron staining.
			PASSAGE BASE
	13.16	5.27	MUDSTONE-silty, micaceous, highly calcareous, occasional siltstone and fine sandstone lenses, otherwise poorly laminated. Strong. Abundant locally pyritic burrows. Common glauconite speckles, fine laminae, lenses and irregular re-worked clasts up to 0.01 m. 12.60-13.10. Occasional rough fractures dip 55°to sub-vertical. Occasional ferruginous secondary staining and small irregular concretions.
			PASSAGE BASE
	18.20	5.04	MUDSTONE-silty/SILTSTONE/SANDSTONE-50:30:20 generally consisting of units grading from sandstone very fine or siltstone up into silty mudstone. Micaceous and highly calcareous throughout. Sand layers up to 0.16 m thick, containing silt laminae,

Dip°	Depth m	Thickness m	DESCRIPTION
			with sharp erosive bases, occasional cross lamination and small dark siltstone sub-rounded clasts, passage or sharp slightly eroded tops. Abundant small dark mud, sand or silt filled medium worm burrows, and common pelecypod burrows, leading to local intense bioturbation. Occasional rough fractures dip 65° up to sub-vertical.
			PASSAGE BASE
	23.85	5.65	SANDSTONE- very fine-grain/SILTSTONE/MUDSTONE/ silty 35:35:30. Thinly interlayered, with several sand/silt 70:30 interlaminated layers up to 0.23 m thick. Highly calcareous. Abundant small and large worm burrows and pelecypod burrows leading to locally intense bioturbation. Few local slump structures. Sand/silt interlaminated layers locally contain sub-angular mudstone clasts, locally show cross-lamination, with erosive bases and passage or sharp irregular tops. Local secondary ferruginous staining. Occasional high angle rough fractures dip 80° up to sub-vertical.
			PASSAGE BASE
	26.45	2.60	MUDSTONE/SILTSTONE-sandy, 65:35, interlayered. Thin sandy siltstone layers with sharp irregular load casted and slightly erosive bases fine upwards into mudstone. Highly calcareous. Abundant small worm burrows, occasional pelecypod burrows. Sub-vertical rough fracture passes down core 24.48-24.81.
			PASSAGE BASE
	35.92	9.47	MUDSTONE-dark, few siltstone laminae, lenses and thin layers to 27.43, rare below. Highly calcareous. Abundant small worm burrows and trails, occasionally pyritic, Entolium sp. at 32.19 m. Occasional sub-vertical rough fractures with dips of 80°-90°. Local faint secondary ferruginous staining. ? Few glauconite grains in basal 0.20 m.

Dip°	Depth m	Thickness m	DESCRIPTION
	37.80	1.88	MUDSTONE-glauconitic, coarsening rapidly through SILTSTONE in to SANDSTONE fine to medium-grained and glauconitic. Micaceous, non-calcareous. Entolium sp. at 0.48 m above base.
2° to 5°	39.58	1.78	SANDSTONE-very fine to fine-grained/SILTSTONE/MUDSTONE- interbedded medium grey low-angle and ripple-laminated argillaceous sandstone, dark grey siltstone and silty mudstone. Locally abundant very small dark burrows in silty/muddy phases, common microerosional contacts and load casting. Pyrite blebs and burrow fillings in top 0.34 m. Unit strongly calcareous throughout. Abrupt. Slickensides and calcite at: 37.84 — 90° CA 38.11 — 90° CA 38.64 — 80° to 85° CA 38.86 — 50° to 60° CA One glauconite-filled worm burrow at 39.69.
	41.01	1.43	SILTSTONE-dark grey, very argillaceous, devoid of lamination except for occasional sandy wisps. Some slumping near top. Strongly calcareous. Abrupt.
7° at 5° at 5° at	55.00 48.48 52.93 53.53	13.99	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (50:25:25)-interbedded, medium grey, argillaceous sandstone (as lenses and as beds up to 0.15 m thick) and dark grey siltstone and silty mudstone. Common fining-upward units with scoured bases, 0.01 to 0.05 m thick. Abundant small dark worm burrows, and pelecypod burrows. Where not intensely burrowed, sandy and silty phases are small-scale low-angle cross-laminated. Some load casts. Strongly to very strongly calcareous throughout. Pyrite blebs locally abundant in muddy phases. Abrupt. Pyrite band from 50.40 to 50.42. Slickensides and calcite: 41.03 — 85° CA } between these points 41.06 — 90° CA } some minor brecciation 43.66 — 45° CA 43.97 — 74° CA 45.13 — 56° CA 45.31 — 79° CA 45.50 — 82° CA 46.86-47.06 — rough, rusty joint 0° to 20° CA 47.41-47.66 — rough, rusty joint 20° CA

Dip°	Depth m	Thickness m	DESCRIPTION
			48.62 75° CA 48.69-49.06 rough, rusty joint with calcite at 0° to 30° CA 49.99 76° CA 50.36 58° CA 50.41 rough, rusty joint at 0° to 30° CA 50.80-50.81 81° CA 51.63 88° CA 52.11-52.43 rough, rusty joints at 0° to 45° CA 52.43-52.54 brecciation and rough, rusty joints with calcite veinlets 52.54-52.69 rough, rusty joint at 0° to 20° CA 53.06 78° CA 53.99-54.23 rough, rusty joint at 0° to 30° CA 54.23 56° CA 54.97 78° CA
	66.77	11.77	MUDSTONE/SILTSTONE-(50:50 at top, grading to 95:5 from 57.00 to base)-interbedded dark grey silty mudstone and argillaceous siltstone; intensely bioturbated with abundant small dark worm burrows and pelecypod burrows. Scouring and load casts at base of silty beds. Core locally badly broken from 65.73 to base. Possible core loss. Rough rusty joints at 5° CA, from 65.90 to base. Unit moderately to strongly calcareous throughout. Slickensided basal contact (74° CA).
	67.00	0.23	CONGLOMERATE-well rounded pebbles of light and dark grey chert, in a sand/mud matrix. Joints with rusty calcite at 10° and 28° CA, and calcite veinlet at 43° CA. Matrix rusty weathering, strongly calcareous. ("A" Horizon roof marker). Abrupt at base, contact at 72° CA (±18° dip).
			LOWER GETHING FORMATION
			TOP OF A HORIZON
	67.64	0.64	SANDSTONE-fine-grained/MUDSTONE (60:40)-interbedded, medium grey, argillaceous, strongly calcareous sandstone and dark grey, slightly carbonaceous mudstone with carbonised plant fragments. Slumped at top; medium scale low-angle and ripple cross-lamination basal 0.20 m. Plant fossils, well preserved, at 0.03 m above base. Gradational.

Dip°	Depth m	Thickness m	DESCRIPTION
	68.59	0.95	MUDSTONE/SILTSTONE (50:50)-dark grey very silty mudstone and argillaceous siltstone, locally carbonaceous. Slightly sandy in middle of unit. Moderately to strongly calcareous, except top 0.21: non-calcareous, carbonaceous mudstone with coaly plant fragments. Possible rootlets in sandy siltstone, from 67.85 to 67.91. Minor shearing and calcite from 75° to 80° CA, in top 0.40 m. Gradational.
	70.89	2.30	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (30:60:10)-interbedded, churned and slumped medium grey argillaceous sandstone and dark grey siltstone and mudstone. Occasional phases of dark grey carbonaceous mudstone. Scattered ? pelecypod burrows, especially in more sandy phases. Original lamination observed, probably low-angle. Locally abundant plant fragments. Mudstones generally slightly listricated. Strongly calcareous. Gradational. Slickensides and calcite (70° to 80° CA) at 69.30.
	72.21	1.32	SANDSTONE-very fine to fine-grained/SILTSTONE-(80:20 at top, grading down to 40:60)-poorly sorted, churned, intensely bioturbated interbeds of medium grey argillaceous sandstone and dark grey argillaceous siltstone. Rootlets in top 0.35 m. Strongly calcareous at top, moderately at base. Plant fragments in basal 0.28 m; carbonaceous in basal 0.18 m. Gradational.
	72.87	0.66	MUDSTONE-silty, black, carbonaceous, with abundant thin (0.001 m) bright coal bands in top 0.25 m. Abundant plant fragments thin sand and silt lenses in basal 0.05 m. Gradational.
2° at	72.87		
			BASE OF A HORIZON
	82.09	9.22	SANDSTONE-fine-grained, clean, well-sorted, medium to dark grey. Small-scale low-angle cross-lamination in top 3.49 m; medium to large-scale to base. Abundant medium (0.002 to 0.003) faint dark-rimmed worm burrows. Abrupt. Rough, rusty joint (20° CA) from 74.27 to 74.52. Calcite (30° CA) at 78.97. Rough, rusty joint (8° CA) from 79.09 to 79.50. Calcite (76° CA) at 80.72, at 80.90 (87° CA), and at 81.71 (75° CA).

Dip°	Depth m	Thickness m	DESCRIPTION
	85.33	3.24	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (50:30:20)-interbedded, fining-upward cycles of argillaceous, medium grey sandstone and siltstone and dark grey silty, mudstone. Abundant scouring, minor load casts. Beds of small-scale low-angle cross-laminated clean sandstone, up to 0.30 m thick. Abundant very small dark worm burrows in muddy phases, occasional larger sand-filled burrows. Common rusty joints at 0° to 30° CA; calcite (70° to 80° CA) at 82.53, slickensides and calcite (45° to 70° CA) from 83.45 to 83.61, and at 84.21 (85° CA). Unit strongly calcareous throughout. Abrupt.
	87.93	2.60	MUDSTONE/SILTSTONE/SANDSTONE-very fine-grained (70:25:5)-interbedded dark grey siltstone and silty mudstone with occasional wisps and laminae of medium grey, argillaceous sandstone. Common fining-upward cycles from thin sandstone to mud-
3° at	87.39		stone scoured at top. Abundant very small dark worm burrows; some slumping notably at top and base of unit. Core badly ground at top. Probable core loss. Slickensides and calcite: 85.45 to 85.47: 75° to 85° CA 86.48: 78° CA Strongly calcareous throughout. Gradational.
	92.57	4.64	MUDSTONE/SILTSTONE (95:5 at top grading to 100:0 at base)-dark grey silty mudstone with lenticles, medium to dark grey, argillaceous siltstone, and rare sandy laminae. Abundant pyritised worm burrows in basal 0.32 m. Scattered chert granules (well-rounded), marker in basal 0.08 m. Silty phases calcareous; otherwise non-calcareous. Abrupt.
	92.57	3.87	TOP OF "B UPPER" SEAM
	92.65	0.08	COAL-dull lustrous with occasional thin bright bands. Strong smell of H_2S. Stick.
	92.94	(0.29)	CORE LOST: COAL Position assumed.
	92.96	0.02	MUDSTONE-black, slightly silty, occasional thin bright coal streaks, occasional dull lustrous slickensided surfaces. Fragmented.
	93.02	(0.06)	CORE LOST: MUDSTONE, carbonaceous, position assumed

Dip°	Depth m	Thickness m	DESCRIPTION
	93.16	0.14	COAL-dull lustrous with bright coal bands, sheared. Fragmented.
	93.90	(0.74)	CORE LOST: COAL.
	93.99	(0.09)	CORE LOST: MUDSTONE carbonaceous.
	94.34	0.35	COAL-dull fragmented, containing misplaced fragments of mudstone, black, (silty with bright coal streaks), slightly concentration of mudstone fragments 0.10 from base of recovered unit (approximately 0.02 m thick).
	94.50	0.16	MUDSTONE-carbonaceous.
	94.80	0.30	COAL-dull occasional bright bands, sheared. Fragmented.
	95.13	0.33	COAL-sheared pulverized, coal type indistinct.
	96.44	(1.31)	CORE LOST: COAL.
	96.44		BASE OF "B UPPER" SEAM
	97.11	0.67	MUDSTONE-black, canneloid, locally splits readily parallel to core axis. Occasional very thin coaly laminae. Sheared and pulverized in top 0.05 m, at 96.81. General fracturing and listrication at 85° CA throughout. Core badly broken. Gradational.
	98.04	0.93	SILTSTONE-dark grey, argillaceous, with very fine-grained ripple-laminated sandstone from 97.20 to 97.23 and 97.34 to 97.35. Slickensides at 82° CA, at 98.74, and at 88° CA at 98.00. Basal contact abrupt, marked by 0.02 m of slumped, bentonitic very fine-grained sandstone. Non-calcareous.
	99.20	1.16	MUDSTONE-black, carbonaceous. Scattered finely broken plant debris, occasional coaly streaks. Abundant slumped and disseminated fine sand grains from 98.54 to 98.64. Generally listricated, dominantly at 45° CA. Gradational.
25° at 99.54 17° at 99.64 118° at 99.70	100.17	0.97 (over-turned)	SILTSTONE/SANDSTONE-very fine-grained (90:10 at top, grading to 50:50 at base)-interbedded, medium grey sandstone and dark grey siltstone. 0.005 m bright coal lens at 99.21.

Dip°	Depth m	Thickness m	DESCRIPTION
90° at	99.72		Slickensides 66° CA at 99.58 with calcite veinlets at 60° to this plane, for next 0.05 m.
62° at	99.80		Minor fault plane with slickensides and 0.01 m breccia band (77° CA) at 99.68 to 99.69.
70° at	99.90		Abundant calcite veinlets sub-parallel to bedding
70° at	99.95		from 99.69 to 99.80, and slickensides at 65° to
70° at	100.10		75° CA, from 99.80 to 100.04, with associated fractures. Polished fault plane at base, 48° CA.
	100.69	0.52	SILTSTONE/MUDSTONE (20:80)-interlaminated medium grey siltstone and dark grey mudstone. Listricated, abundant calcite veinlets. Dips 60° to 120° (overturned). Ground at base; core loss 0.36, faulted at base.
	101.19	0.50	MUDSTONE-black, carbonaceous to canneloid, very thin bright coal streaks. From 100.81 to 100.92, 30% brown siltstone with disseminated sand grains, as slumped laminae. Core badly ground and broken below this point.
	102.23	1.04	SILTSTONE-argillaceous, almost a silty mudstone. Dark grey, carbonaceous in top 0.10 m, with 0.03 m
8° at	102.04		of carbonaceous mudstone at base, underlain by 0.01 m of very fine, slumped bentonitic sand (marker). Ripples of very fine sand from 101.31 to 101.36 and thin sandy laminae from 102.01 to 102.05, and 101.92 to 101.97.
			Minor fault at 101.97 (55° CA) with slickensides and calcite, but throw only 0.09 m. Slickensides at 101.76 m (87° CA), and at 102.08 m (82° CA). Unit non-calcareous; abrupt.
	103.50	1.27	MUDSTONE-black, carbonaceous. Locally abundant finely broken plant debris; common listric surfaces, dominantly at 45° CA. Slumped brown siltstone and fine sandstone band from 103.03 to 103.04. Abrupt.
	103.66	0.16	SILTSTONE-dark brown to black, argillaceous with scattered very fine sand grains and carbonized plant fragments. Possible paleosol horizon. Internally sheared and listricated. Gradational.
	103.92	0.26	SILTSTONE/SANDSTONE-very fine-grained (50:50)-interbedded medium grey argillaceous sandstone and dark grey, argillaceous siltstone with rootlets. Non-calcareous; abrupt.

Dip°	Depth m	Thickness m	DESCRIPTION
0° at 3°	104.63	0.71	SANDSTONE-very fine to fine-grained/SILTSTONE (50:50 grading down to 70:30)-interbedded medium grey sandstone and argillaceous, dark grey siltstone, with abundant carbonaceous laminae. Medium-scale low-angle cross-laminated. Non-calcareous, gradational. Some slumping, near top.
	105.68	1.05	SANDSTONE-medium to very coarse-grained, siliceous, dirty abundant muddy and coaly intraclasts. Weakly calcareous, with rough calcareous joint coatings. Fractured at 30° CA. Erosional.
	105.70	0.02	MUDSTONE-dark grey, silty, pyritic. Abrupt.
13° at	105.77 base	0.07	CLAYSTONE-light grey, micaceous, greasy lustre, with large carbonized plant fragments. Probable ash band. Non-calcareous. Abrupt.
	105.79	0.02	MUDSTONE-black, carbonaceous, with thin bright coal bands. Core ground, possible core loss. Gradational.
	106.63	0.84	SILTSTONE-argillaceous/SANDSTONE-very fine-grained, silty (100:0 grading down to 0:100)-interlaminated, coarsening-downwards by increase of sand component. Some large ripple-sets. Rare sheared carbonaceous laminae. Slickensides and quartz at 106.43 m (73° CA) and 105.99 m (83° CA). Abrupt.
	107.78	1.15	SANDSTONE-medium to coarse-grained, with minor very coarse-grained phases. Dirty, weakly calcareous, abundant muddy and coaly intraclasts. Cross bedded (sedimentary dip to 40°). Dark grey, very fine sandstone and siltstone from 107.60 to 107.64 m. Slickensides and calcite (50° CA) at 107.70. Erosional.
	107.79	0.01	MUDSTONE-black, carbonaceous. listricated, with thin bright coal bands. Stick.
	107.80	0.01	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands. Stick.
	107.82	0.02	MUDSTONE-black, carbonaceous, with thin bright coal bands. Stick.
	107.89	0.07	MUDSTONE-black, carbonaceous, listricated with thin bright coal bands. Broken and broken stick. Core ground.

Dip°	Depth m	Thickness m	DESCRIPTION
20°	107.92	0.03	MUDSTONE-black, carbonaceous, listricated, with thin bright coal bands. Stick.
	107.98	0.06	MUDSTONE-black, carbonaceous, with thick (to 0.003 m) bright coal bands. Abundant thin bright coal bands. Listricated. Stick. Core ground at top.
	108.03	0.05	MUDSTONE-black, carbonaceous, listricated in top 0.01 m, with 30% bright coal bands.
	108.05	0.02	COAL/MUDSTONE-(50:50)-coal, dull and bright with bands of black, carbonaceous mudstone. Stick.
	108.13	0.08	COAL-dull banded, lustrous, stick. Ground at top.
	108.20	0.07	MUDSTONE-black, carbonaceous, listricated, with thin bright coal bands. Stick.
	108.24	0.04	MUDSTONE-black, carbonaceous, with thin bright coal bands. Broken.
	108.28	0.04	MUDSTONE-black, carbonaceous, with a few thin bright coal bands. Listricated. Stick.
	108.31	0.03	MUDSTONE-black, carbonaceous, with thin bright coal bands. Listricated. Stick.
	108.37	0.06	MUDSTONE-black, carbonaceous, with abundant tiny coal specks. Listricated. Stick.
25° @ 108.62 8° @ 108.95 26° @ 109.18	109.21	0.84	MUDSTONE-black, carbonaceous, with thin bright coal bands, abundant plant fragments. Listricated. Some sheared thick, bright coal bands (0.002 to 0.003 m), defining bedding. Stick. Abrupt.
15° to 30°	109.50	0.29	MUDSTONE-dark grey, listricated, slightly ferruginous. Abundant plant fragments, calcite veinlets parallel to bedding (60° to 75° CA). Few tiny rootlets. Possible seatearth. Gradational. Weakly calcareous.
	110.26	0.76	MUDSTONE-dark grey to black, carbonaceous, approximately 30% ferruginous phases. Occasional coaly bands; abundant carbonized plant fragments. Moderately to strongly calcareous.
	110.84	0.58	MUDSTONE-dark grey, ferruginous, strongly calcareous. Abundant rootlets. Probable seatearth. Abundant carbonized plant debris at top. Gradational.

Dip°	Depth m	Thickness m	DESCRIPTION
	111.97	1.13	MUDSTONE-dark grey to black, carbonaceous, approximately 50% ferruginous phases. Moderately to strongly calcareous; abundant carbonized plant fragments, locally listricated. Gradational.
	112.26	0.29	MUDSTONE-black, carbonaceous, becoming canneloid in basal 0.16 m. Core ground at base.
	112.28	0.02	COAL-dull banded, sheared, stick. Ground at top.
	112.30	0.02	MUDSTONE-carbonaceous, black, abundant coaly flecks. Stick.
	112.36	0.06	MUDSTONE-black, carbonaceous, with thin bright coal bands. Listricated. Broken.
	112.40	0.04	MUDSTONE-black, carbonaceous, with a few thin bright coal bands. Listricated at top and base. Stick.
	112.42	0.02	MUDSTONE/COAL-(50:50)-black, carbonaceous, mudstone with bright coal bands. Abrupt.
14° @ top 12° @ base	112.48	0.06	SILTSTONE-medium grey, argillaceous, with large carbonized plant fragments. Non-calcareous. Abrupt.
	114.93	2.45	MUDSTONE-black, carbonaceous. Abundant bright coal bands in top 0.12 m, and scattered throughout unit. Becomes slightly ferruginous in basal 0.22 m, and silty. Core Loss: 1.15 m. Gradational.
	115.90	0.97	SILTSTONE-dark grey, argillaceous. Vague rootlets and slightly ferruginous in top 0.09 m. Non-calcareous. Gradational.
	116.92	1.02	MUDSTONE-dark grey, locally listricated, with silty carbonaceous and ferruginous phases.
	117.60	0.68	SILTSTONE-dark grey, alternating sandy and argillaceous carbonaceous phases. Moderately calcareous; gradational.
	118.80	1.20	MUDSTONE-black, carbonaceous, scattered plant fragments towards top; occasional bright coal bands, listricated. Abrupt.
2° to 10°	121.88	3.08	MUDSTONE-black, carbonaceous, becoming silty towards base. Locally very silty and strongly

Dip°	Depth m	Thickness m	DESCRIPTION
			calcareous with occasional rootlets and scattered bright coal bands. Listricated abundant calcite veinlets parallel to bedding. Gradational.
	126.40	4.52	SILTSTONE-dark grey sandy at top, becoming argillaceous towards base, calcareous throughout. Top 1.60 m slumped with calcite veinlets parallel to bedding and occasional coaly bands. Lamination becomes vague toward base of unit as sandy laminae become scarcer. Abrupt.
	126.77	0.37	MUDSTONE-dark grey, silty, rare finely broken plant debris 0.01 m at top with sheared coal bands. Gradational. Non-calcareous.
	127.58	0.81	MUDSTONE-medium grey at top, grading down to dark grey. Listricated throughout, with sphaerosiderite nodules and rootlets in top 0.36 m. Gradational. Non-calcareous.
	128.87	1.29	MUDSTONE/SILTSTONE-interbedded (30 cm) brownish-grey argillaceous siltstone and dark grey silty mudstone. Siltstone contains rootlets; both siltstone and mudstone are locally listricted. Thin calcareous films on listric surfaces in siltstone, unit otherwise non-calcareous. Gradational.
	129.82	0.95	MUDSTONE-dark grey to black, slightly calcareous at top, increasing towards base. Non-calcareous. Slightly listricated at top. Basal contact with coal ground out, core loss 0.50 m.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	129.82	1.96	TOP OF "C UPPER"SEAM
	129.84	0.02	COAL-dull, lustrous, broken
	129.93	0.09	COAL-dull banded, broken stick
	130.03	0.10	COAL-dull lustrous, stick
	130.05	0.02	COAL-dull lustrous, stick
	130.25	(0.20)	CORE LOST: COAL-position assumed
	130.28	0.03	MUDSTONE-medium to dark grey with weakly calcareous silty laminae. Stick.
	130.31	0.03	MUDSTONE-dark grey, rooty, with bright coal bands and sphaerosiderite nodules. Non-calcareous.
	130.35	(0.04)	CORE LOST: MUDSTONE. Position assumed.
	130.36	0.01	MUDSTONE-dark grey, rooty, non-calcareous. Stick.
	130.52	(0.16)	CORE LOST: COAL
	130.55	0.03	COAL-dull banded, sheared, stick.
	130.58	0.03	COAL-bright banded, broken.
	130.59	0.01	MUDSTONE-dark grey with bright coal bands and sphaerosiderite nodules. Broken.
	130.69	(0.10)	CORE LOST: MUDSTONE Position assumed.
	130.73	0.04	COAL-dull and bright, sheared, ground. Broken stick.
	130.80	0.07	COAL-dull and bright, bright bands up to 0.01 m Stick.
	131.78	(0.98)	CORE LOST: COAL. Position assumed.
	131.78		FLOOR OF "C UPPER" SEAM
	131.97	0.19	MUDSTONE-medium grey listricated, abundant plant fragments, rooty. Non-calcareous; gradational.
	132.42	0.45	MUDSTONE-dark grey to black, ferruginous at top, carbonaceous at base. Listricated, non-calcareous. Abundant bright coal bands. Core ground, loss 0.15 m.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Ground at base.
	132.93	0.51	MUDSTONE-medium grey listricated, sheared, crumbly. Occasional rootlets. Non-calcareous, basal contact ground out.
10° to 90° average 30° (slumping)	136.80	3.87	MUDSTONE-dark grey, carbonaceous, with ferruginous moderately calcareous phases. Abundant plant fragments locally sheared and listricated. Abundant bright coal bands in top 0.70 m. Slumped with dips up to vertical. Ferruginous band, moderately calcareous, with rootlets, from 135.92 to 136.06 below top.
	137.17	0.37	SILTSTONE/MUDSTONE(80:20)-interbedded slumped dark grey siltstone and carbonaceous mudstone. Siltstone strongly calcareous, mudstone non-calcareous. Gradational.
10° @	138.87 138.23	1.70	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (40:20:40)-interbedded, slumped, argillaceous sandstone, siltstone, and silty mudstone. Some worm and pelecypod burrows. Sandstones show disrupted small-scale low-angle cross-lamination. Strongly calcareous throughout. Overall "churned" appearance. Occasional bright coal bands in top 0.80 m.
12° to 30°	141.27	2.40	SANDSTONE-very fine-grained/SILTSTONE(60:40)-interbedded, slumped silty sandstone and siltstone. Lamination is vague, ripples, low-angle cross-lamination and scouring. Strongly calcareous throughout. Abrupt, slumped at base.
	142.30	1.03	SILTSTONE-argillaceous, grading down to MUDSTONE, silty-dark grey, strongly calcareous. Small-scale low-angle cross-lamination, defined by stringers of very fine sand in middle third of unit. Some well-preserved plant fossils. Ferruginous band, with coarse calcite veining, from 0.22 to 0.30 m above base. Basal 0.10 m slightly carbonaceous. Gradational.
	142.57	0.27	MUDSTONE-black, carbonaceous with abundant bright coal bands. Locally listricated. Core ground.
	142.57	2.91	TOP OF "C LOWER" ZONE
	143.00	(0.43)	CORE LOST: COAL, poor quality.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
13°	143.38	0.38	MUDSTONE-black, carbonaceous, abundant bright coal bands, locally listricated, ground.
	143.41	0.03	MUDSTONE-black, lustrous, very carbonaceous, "bone", well developed cleat at 70° to bedding. Abrupt, stick
	143.43	0.02	MUDSTONE-black, carbonaceous, with thin bright coal bands. Stick.
	143.52	0.09	MUDSTONE-black, carbonaceous, with thin bright coal bands. Broken.
	143.66	0.14	MUDSTONE-black, carbonaceous, with abundant bright coal bands, increasing toward base. Stick.
	143.72	0.06	MUDSTONE-black, carbonaceous, abundant thin bright coal bands, lustrous ("bony"). Broken.
	143.87	(0.15)	CORE LOST: MUDSTONE
	143.90	(0.03)	CORE LOST: COAL
	143.94	0.04	COAL-dull banded, friable, ground at top. Stick.
	144.01	0.07	COAL-dull, lustrous, friable, stick.
	144.10	0.09	COAL-dull, lustrous, friable, broken.
	144.12	0.02	MUDSTONE-black, carbonaceous, badly broken.
	144.82	(0.70)	CORE LOST:COAL
	144.89	0.07	COAL-bright banded, strongly cleated; broken stick.
	145.09	0.20	MUDSTONE-dark grey, listricated,black, carby at top and base. Stick.
	145.29	(0.20)	CORE LOST:COAL
	145.35	0.06	COAL-dull, lustrous, stick.
	145.40	0.05	COAL-dull, lustrous, stick
	145.42	0.02	COAL-bright banded, stick.
	145.48	0.06	COAL-dull lustrous, sheared, stick.
	145.48		FLOOR OF "C LOWER" ZONE

BH NO. BPE-2

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	146.95	1.47	SILTSTONE-medium grey, argillaceous, ferruginous phases, occasional rootlets. Non-calcareous, gradational.
10° at 149.07	149.32	2.37	SANDSTONE-very fine-grained/SILTSTONE-(50:50)-medium-grey, interlaminated, lamination obliterated by root disturbance in top 1.53 m; rootlets throughout. Non-calcareous; abrupt.
	150.17	0.85	SANDSTONE-fine to medium-grained, grading down to coarse-grained/SILTSTONE(70:30 grading down to 90:10) interlaminated, "dirty" sandstone and siltstone with argillaceous and coaly laminae. Generally slumped. Siliceous, non-calcareous, abrupt.
3° at 150.71	150.71	0.54	SILTSTONE-dark, grey, argillaceous, occasional bright coal bands. Basal 0.10 m contains 50% laminae of very fine sandstone. Non-calcareous; gradational.
	151.43	0.72	SANDSTONE-coarse-grained, well-sorted grains interlock. Abundant coaly laminae, some small-scale cross-lamination. Locally with abundant muddy matrix. Siliceous, non-calcareous, erosional.
	155.25	3.82	SILTSTONE-dark grey, argillaceous. Very fine, silty sandstone phases from 151.47 to 151.67, 152.57 to 153.80, and 153.52 to 153.74. Ferruginous band from 153.74 to 154.14, 154.46 to 154.60 and 154.72 to 154.83. Dark grey silty carbonaceous mudstone from 154.33 to 154.46. Basal contact ground out; probably gradational.
21° at base	155.79	0.54	MUDSTONE-dark grey, silty in top 0.12 m, remainder of unit dark grey to black, carbonaceous with thin bright coal bands. Core ground. Probable core loss. Basal 0.02 m contains 50% bright coal bands. Abrupt.
	156.52	0.73	SILTSTONE-dark grey, argillaceous, "churned" appearance (possibly root disturbance); rooty. Rare coal bands Non-calcareous; gradational.
	157.54	1.02	SILTSTONE/SANDSTONE-very fine-grained (80:20)-interlaminated, locally slumped medium-grey sandstone and dark grey, argillaceous siltstone. Non-calcareous gradational.
	162.58	5.04	SANDSTONE/SILTSTONE-fine to very-fine sand/silt (50:50) from top to 159.18, fine silty sand from 159.18 to 160.79, medium to coarse sand from 160.79 to 162.13, coarse to very-coarse sand from 162.13 to base. Except for interval 159.18 to 160.79 which is patchily calcareous, overall the units is non-calcareous, and

Dip°	Depth m	Thickness m	DESCRIPTION
10° at	159.23		is siliceous throughout. Occasional granule bands in basal 0.45 m. Common carbonaceous and argillaceous laminae and intraclasts. Abundant scouring and medium-scale cross-lamination. Overall "cooked" and dirty appearance. Stylolitic seams in basal 0.45 m.
	163.30	(0.72)	CORE LOST: ROCK
			BASE OF BOREHOLE 163.30 m.

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-R (cleanout)

Contractor: Tonto Drilling

Co-ordinates: N 6121533.0
E 586723.0

Commenced: 8/6/79

Surface Elevation: 921.7 m

Completed: 9/6/79

Geophysically logged: yes/~~no~~ (through casing)

Core Size: ____

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole See below m

	Geologist	Depth
Logged by:	-	-

Final Depth: 67 m ±

Triconed from 61.57 m to 67 m.
Tricone, sub and 1 x 3 m rod, left down hole 62.5 to 67 m.

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Gething (Lower)	67.00	67.00+	854.70

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
A Zone	14.00	-	-	907.70
B Upper	33.19	2.94	-	888.51

STRUCTURAL FEATURE	DEPTH	REMARKS
F. PR.	46.00	Probable repeat section of B to C Seam interval. Throw 8 to 9 m.

BP-R SPOT VERTICALITY SURVEY

DEPTH	INCLINATION
25 m	3.6^{o}
50 m	4.4^{o}
65 m	5.6^{o}

(Azimuth unavailable due to rods in hole)

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 69

Contractor: Tonto Drilling

Co-ordinates: N 6118919.3
E 591643.0

Commenced: 10/6/79

Surface Elevation: 1624.1 m

Completed: Redrilled from surface as BP 69A

Geophysically logged: /yes/no

Core Size: HQ

Hole cemented: /yes/no

Hole Angle & Azimuth: ~~see details~~ vertical

Casing Left in Hole 3 m* (see below)

Details not available

Geologist	Depth
Logged by: C. Bickford	0.00-T.D.

Final Depth: 117.41 (Drillers depth)

*97.5 m drill pipe left in hole 19.91-117.41 m.

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Hullcross	5.00	0.80+	1619.1
Gates	117.41	112.41+	1506.69

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION

See summary sheet BP69A

STRUCTURAL FEATURE	DEPTH	REMARKS
F. PR.	64.03-66.47	3.96 m throw; steep dips, slickensides, calcite

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			HULCROSS MEMBER
5°	5.00	0.80	SANDSTONE-very fine to fine grained, argillaceous medium scale low-angle cross-laminated. Locally slumped with muddy intraclasts. Non-calcareous. Core broken and jumbled, ground at top. Basal contact ground out. Rough rusty joints parallel to core axis. Core loss 0.21.
			GATES MEMBER
	5.21	0.21	SANDSTONE-coarse-grained, grading to conglomerate in basal 0.03 m. Well-sorted but with argillaceous laminae; small-scale low-angle cross-lamination and scouring. Rough rusty joints parallel to core axis, rusty slickensides at 30° CA. Non-calcareous Erosional.
5°	5.46	0.25	SILTSTONE-dark grey, sandy at top, argillaceous at base. Abundant rusty joints parallel and perpendicular to bedding. Scattered plant fragments. Weakly to moderately calcareous. Core badly broken; sheared at base.
	5.49	0.03	MUDSTONE-dark grey, sheared, non-calcareous, abundant sheared coaly bands.
	5.77	(0.28)	CORE LOSS-ROCK
	5.87	(0.10)	CORE LOSS-COAL
	5.97	0.10	COAL-dull lustrous. Broken and ground. BP 69/?G/1
	6.69	0.72	MUDSTONE-grading down to SILTSTONE-mudstone, dark grey, listricated, grading down through silty mudstone to dark grey, argillaceous, siltstone, with carbonized and pyritized plant fragments. Non-calcareous; gradational. Core broken. Core loss 0.44 m.
	7.17	0.48	SANDSTONE-very fine-grained, silty, dark grey, weakly calcareous, with carbonised (pyritised at top) plant fragments, and occasional rootlets. Core badly broken; basal contact ground out.
	7.19	0.02	COAL-dull lustrous. Broken and ground
	7.21	0.02	MUDSTONE-dark grey to black, carbonaceous, pyritic, thin bright coal bands. Broken and ground
	7.57	0.36	SANDSTONE-very fine-grained, medium grey, silty, ferruginous, calcareous, with pyrite-filled worm burrows. Gradational. Rootlets. Core badly broken.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	8.84	1.27	SILTSTONE-dark grey, argillaceous, sandy in top 0.07 and basal 0.04. Ferruginous band at 0.59 to 0.64 m above base. Calcareous. Abundant pyritised worm burrows. Core badly ground from 0.15 to 0.37 below top. Probable core loss. Top 0.04 slumped, listricated. Gradational.
	9.22	0.38	SANDSTONE-medium grey, silty, fine to very fine-grained. Abundant carbonaceous laminae and slumping at top. Moderately to strongly calcareous. Broken and ground at base.
	9.75	(0.53)	CORE LOSS-ROCK
	9.76	0.01	MUDSTONE-dark brown, intensely listricated, ground.
	10.42	0.66	SILTSTONE-dark grey, sandy, non-calcareous, rooty at top; devoid of lamination: possible root-disturbance. Gradational. Listricated top contact with sheared bright coal bands. Contact dip: 29°.
	11.29	0.87	SANDSTONE-fine-grained (very fine in basal 0.16 m). light grey, well-sorted but with abundant argillaceous laminae and occasional plant-fragments. Low-angle and ripple-drift cross-lamination occasional rootlets. Silty, weakly calcareous in top 0.13 m, otherwise strongly calcareous. Core broken, rough rusty joints at 0° to 20° CA. Abrupt.
	12.06	0.77	SILTSTONE-dark grey, argillaceous, locally grading to very silty mudstone. Strongly calcareous at top. decreasing to weakly at base. Occasional carbonaceous laminae and plant fragments. Rough, rusty joint at 0° to 10° CA. Abrupt.
	12.71	0.65	MUDSTONE/SILTSTONE-(100:0 to 50:50 at base)- thinly interlaminated, slightly slumped, non-calcareous dark grey argillaceous siltstone and carbonaceous mudstone. Large coaly fragments in top 0.13 m. Some rootlets. Possible lake-beds? Gradational.
	13.71	1.00	SILTSTONE/MUDSTONE(50:50)- interlaminated medium grey siltstone and dark grey silty mudstone. Intensely bioturbated in top 0.73 m, with abundant small dark worm burrows. Followed by less intensely burrowed sequence in which ripples of silt are still discernable. A few coal streaks in this basal sequence, which is moderately calcareous, while remainder of unit is non-calcareous. Gradational, ground towards base.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	13.89	0.18	MUDSTONE-dark grey, silty, slightly carbonaceous, with abundant plant fragments. Abrupt.
	14.40	0.51	MUDSTONE/SILTSTONE(50:50)-dark grey, churned (root-disturbed), listricated, rooty argillaceous siltstone and silty mudstone. Carbonaceous phase from 0.06 to 0.17 m; sandy phase from 0.17 to 0.36 m below top. Non-calcareous throughout. Core locally ground; gradational.
0° to 6°	15.52	1.12	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (70:0:30 grading down to 60:30:10 at base)-interlaminated silty sandstone, siltstone and silty mudstone. Abundant slumping, worm and pelecypod burrows. Muddy phases slightly listricated. Weakly calcareous; gradational.
	16.24	0.72	SANDSTONE-very fine-grained, silty, medium grey, low-angle cross-laminated with some scours and slumps. Occasional small dark burrows in basal 0.10 m. Occasional muddy laminae. Weakly to moderately calcareous; very gradational.
	16.51	0.27	SILTSTONE-argillaceous, dark grey, abundant small dark burrows. Gradational at both top and base, weakly calcareous.
0° to 5°	17.65	1.14	MUDSTONE/SILTSTONE(40:60)-dark grey silty mudstone and siltstone-occasional sandy phases. Lamination obscured at top by abundant small dark burrows; remainder of unit consists of many fining upward cycles, reminscent of the Sukunka Member (this is not the Sukunkoid Marker) Locally slumped. Gradational Non-calcareous except for strongly calcareous sandy phases.
	18.59	0.94	SILTSTONE-dark grey, very argillaceous, non-calcareous Core badly broken at base, 0.44 m lost.
	18.86	0.27	MUDSTONE-black, carbonaceous. Core badly broken Occasional pyritized worm burrows. Abundant whole and fragmented pelecypods; some still articulated BP 69/F/1 at 0.10 m below top BP 69/F/2, 3, 4, at 0.15 to 0.20 m

BH No. | BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	19.55	0.69	MUDSTONE-dark grey, with carbonaceous phases - listricated, increasing in intensity towards base. Non-calcareous. Plant fragments. Sheared at base; broken throughout-possible core loss.
	19.56	0.01	COAL-dull, lustrous, broken.
	19.72	0.16	MUDSTONE-black, carbonaceous, intensely sheared and listricated.
	20.74	(1.02)	CORE LOSS-ROCK
	22.26	1.52	SILTSTONE-dark grey, argillaceous, with occasional phases of silty mudstone. Top 0.08 m grades into listricated, slightly carbonaceous mudstone. Scattered finely broken plant fragments throughout Moderately to strongly calcareous. Gradational.
	23.37	1.11	SANDSTONE-fine grained/MUDSTONE (80:20)- medium grey strongly calcareous sandstone with laminae and interbeds of dark grey, silty mudstone. Abundant finely broken plant fragments; some slumping. Abrupt.
	23.61	0.24	MUDSTONE-dark grey, slightly carbonaceous, listricated plant fragments, pyrite flecks. abundant thin bright coal bands towards top. Abrupt.
	27.63	4.02	SILTSTONE/SANDSTONE,very fine-grained (70:30 grading down to 90:10)-dark grey argillaceous siltstone and medium grey, silty sandstone, interlaminated. Sandy phases are moderately to strongly calcareous, otherwise non-calcareous. Locally slumped. Rooty at top. Gradational.
	30.16	2.53	SILTSTONE-dark grey, argillaceous, rare sandy phases Weakly calcareous. Gradational.
	31.55	1.39	MUDSTONE-silty, slightly carbonaceous in top 0.62 m and in basal 0.36 (with sandy lenses). Remainder of unit is carbonaceous, listricated at top. Non-calcareous, gradational.
0° to	3°32.29	0.74	SANDSTONE-very fine to fine grained/MUDSTONE(90:10) interlaminated medium grey , silty sandstone and dark grey silty mudstone. Some ripple-lamination, Scattered small worm burrows and finely broken plant debris: Strongly calcareous-40% muddy laminae in basal 0.28 m. Abrupt.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	34.33	2.04	MUDSTONE/SANDSTONE-very fine-grained (80:20)-dark grey silty mudstone with ripples and laminae of medium grey, silty sandstone. Occasional pelecypod burrows. Gradational.
	40.65	6.32	SANDSTONE-medium-grained, light grey, clean, well-sorted. Alternately weakly and strongly calcareous phases. Abundant churned muddy laminae in top 0.12 m. Carbonaceous mudstone laminae in basal 2.46 m. Occasional large burrows. Abrupt.
	41.80	1.15	SILTSTONE-argillaceous, with sandy laminae towards base. Top 0.16 m grades up from silty mudstone to carbonaceous mudstone with a few bright coal bands. Below this mudstone, scattered plant fragments in top 0.38 m of the siltstone. Non-calcareous. Gradational.
	49.68	7.88	SANDSTONE-fine to medium-grained. Medium gray. Alternating phases of clean sandstone and sandstone with up to 30% laminae of silty mudstone and siltstone. Mudstone laminae tending to be carbonaceous with mica flecks. Generally weakly to moderately calcareous; occasional phases of light grey, clean, very strongly calcareous sandstone (almost calcarenite). Occasional large worm burrows. Abrupt.
	53.03	3.35	SANDSTONE-fine-grained, some medium and very fine-grained phases. Alternating clean and laminated phases as above. Generally weakly calcareous; locally moderately calcareous. Abrupt.
	54.39	1.36	SANDSTONE-fine to medium-grained at top grading down to very fine-grained at base. Abundant laminae of mudstone (locally carbonaceous). weakly to moderately calcareous. Slumped: locally overturned bedding. Gradational.
	58.02	3.63	SILTSTONE/SANDSTONE, very fine-grained (80:20) interbedded, dark grey argillaceous siltstone and medium grey silty sandstone, locally intensely bioturbated. Weakly calcareous scattered large worm burrows; pelecypod burrows. Gradational.
	59.91	1.89	SANDSTONE-very fine-grained, dark grey, silty; one slumped block of laminated fine sandstone (strongly calcareous) and siltstone, from 0.69 to 0.86 m above base. Unit weakly calcareous. Abrupt.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	67.87	7.96	SILTSTONE/SANDSTONE, very fine-grained/MUDSTONE (50:10:40)-interbedded and interlaminated dark grey silty mudstone and argillaceous siltstone with laminae of medium grey silty sandstone. Many fining-upward cycles, scoured at base, with locally abundant small dark worm burrows and pelecypod burrows. Weakly calcareous. Very strongly calcareous, light grey, very fine sandstone from 3.42 to 3.50 m below top. Core badly ground from 3.50 to 3.80 m. Probable fault in interval from 4.12 m below top to 1.40 m above base. (Recovery in this zone 0.78 m; core loss 1.66 m.)
6° at	61.93		Slickensides and calcite at top of fault zone.
12° at	63.38		62° CA.
6° at	66.49		in middle of zone 56° CA-with clayey gouge.
4° at	63.87		at base of zone 73° CA
6° at	67.75		Dips in fault zone 15°, 25°, 32°
			Basal 0.58 m of unit consists of strongly to very strongly calcareous light grey very fine sandstone with minor mudstone laminae. Probably equivalent to unit from 3.42 to 3.50 m below top; throw on fault = 3.96 m.
	71.39	3.52	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained to medium-grained (30:30:40, grading down to 40:40:20) interlaminated, bioturbated dark grey siltstone and silty mudstone with lenses and thin beds of sandstone, locally churned by burrowing. Abundant large and small worm burrows, Common fining-upward cycles with scoured bases. Patchily weakly calcareous. Abrupt.
	71.60	0.21	SILTSTONE-dark grey, sandy, with abundant very small dark worm burrows. Strongly calcareous. Abrupt. Very homogeneous unit.
	72.15	0.55	SILTSTONE-dark grey, with a few thin sandy laminae Non-calcareous. Abundant small dark worm burrows. Gradational.
	43.59	1.44	SILTSTONE-dark grey, very argillaceous, homogeneous pyritic, non-calcareous. Slickensides and calcite (60° CA) at 0.95 m below top. Core broken and sheared; some calcite from 1.15 to 1.20 m. Gradational.
	74.75	1.16	MUDSTONE/SILTSTONE(50:50)-interbedded dark grey silty mudstone and siltstone, with lighter silty laminae. Non-calcareous, gradational. Slickensides and calcite (55° CA) adjacent to basal contact.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	78.25	3.50	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained (50:25:25)-interlaminated, intensely bioturbated, Sukunkoid Marker; non-calcareous with very abundant small worm burrows. Lamination generally obscure. Basal 0.88 m is SANDSTONE/SILTSTONE (70:30), otherwise as above. Abrupt.
5°	78.53	0.28	MUDSTONE/SANDSTONE-very fine to fine-grained (50:50) interlaminated silty sandstone and mudstone, with occasional laminae of carbonaceous mudstone. Abundant small worm burrows.
	82.60	4.07	SANDSTONE-very fine to fine-grained, argillaceous, abundant burrows, locally pyritic. Some scouring and medium scale low-angle cross-lamination. Some shearing, listrication from 0.37 to 0.65 m below top. Breccia in calcite with slickensides (70° CA) at 2.58 m below top. 60% laminae of dark grey, pyritic mudstone from 1.91 to 2.24 m below top. Unit non-calcareous; ground at base.
	82.73	0.13	CONGLOMERATE-marker, well-rounded pebbles and graules of chert in a silty, muddy matrix. Sheared with slickensides and calcite. Abrupt, listricated at base.
			TOP OF E_3 ZONE
	83.08	(0.35)	CORE LOSS-COAL
	83.15	0.07	MUDSTONE/COAL-mixed fragments of listricated dark grey carbonaceous mudstone, black canneloid mudstone and sheared dull lustrous coal. Many fragments ground. Probable core loss. BP 69/E3/1
	83.21	0.06	COAL-dull, slightly sheared, with three bands, 0.001 m thick, of carbonaceous mudstone. Stick. BP 69/E3/2
	83.22	0.01	MUDSTONE-dark grey, carbonaceous, listricated, broken.
	83.56	0.34	MUDSTONE-dark grey, listricated, stick. Top 0.06 m carbonaceous, remainder of unit with sheared coaly inclusions (rootlets?). Basal 0.02 m carbonaceous.
	83.58	0.02	MUDSTONE-dark grey, listricated, slightly carbonaceous stick.
	83.59	0.01	MUDSTONE-dark grey, carbonaceous, listricated, sheared broken
	83.61	0.02	COAL-dull lustrous, sheared, broken stick BP 69/E3/3
	83.64	0.03	MUDSTONE-black, carbonaceous, with coal bands up

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			to 0.002 m thick. Broken stick.
	83.69	0.05	MUDSTONE-dark grey to black, carbonaceous, with thin bright coal bands. Listricated. Broken stick.
	83.73	0.04	MUDSTONE-black, as above, stick
	83.75	0.02	MUDSTONE-black, carbonaceous, listricated, broken.
	83.80	0.05	MUDSTONE-black, carbonaceous, one 0.002 m coal band. Listricated top & base. Stick.
	83.83	0.03	MUDSTONE-black, carbonaceous, stick, sheared.
	83.94	0.11	MUDSTONE-black, canneloid, lustrous. Broken stick BP 69/E3/4
	83.98	0.04	MUDSTONE-black, carbonaceous, broken stick
	84.23	0.25	MUDSTONE-black, canneloid, lustrous, broken stick BP 69/E3/5
	84.29	0.06	COAL-sheared and pulverised, indistinguishable. BP 69/E3/6
	84.74	(0.45)	CORE LOSS- COAL AND ROCK
			BASE OF E_3 ZONE
	85.04	0.30	MUDSTONE-dark grey, rooty. Non-calcareous. Abrupt
	85.07	0.03	SANDSTONE-fine-grained, argillaceous, with carbonaceous laminae. Abrupt. Non-calcareous.
	86.15	1.08	MUDSTONE-dark grey, silty, occasional sandy laminae Non-calcareous. Carbonaceous phases from 0.61 to 0.82 m below top, and in basal 0.15. Listricated at base.
	86.60	0.45	SILTSTONE/SANDSTONE-very fine-grained (50:50)-interlaminated dark grey argillaceous siltstone and medium grey, argillaceous sandstone. Abundant carbonised plant fragments; rooty towards top. Non-calcareous. Abrupt.
			TOP OF E_2 UPPER ZONE
	86.77	0.17	MUDSTONE-black, carbonaceous, listricated, with large coaly plant fragments. Abrupt
	86.94	0.17	MUDSTONE-dark grey, carbonaceous. Ground at base.
	87.14	0.20	MUDSTONE-black, carbonaceous abundant thin bright coal bands. Abrupt.
	87.17	0.03	COAL-bright, contorted structure. Hard, stick. Not sampled. Abrupt.

BP No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	87.58	0.41	MUDSTONE-dark grey to black, carbonaceous, with thin bright coal bands. Coal from 0.21 to 0.22 and 0.26 to 0.29 m below top. Not sampled. Abundant listric bedding surfaces. Abrupt.
	87.69	0.11	COAL-sheared, possibly dull & bright, stick. Abrupt attached BP 69/E?/1
	88.29	0.60	MUDSTONE-dark grey, listricated, slightly carbonaceous; black, carbonaceous at top and base. Stick. Abrupt, attached
	88.38	0.09	COAL-dull, lustrous, stick.
	88.40	0.02	MUDSTONE-black, carbonaceous, thin bright coal bands Stick.
	88.53	0.13	MUDSTONE-black, canneloid, ground at top, stick.
	88.60	0.07	MUDSTONE-black, canneloid, mixed with mudstone black, carbonaceous, broken. BP 69/E?/2
	88.91	0.31	MUDSTONE-black, carbonaceous, with thin bright coal bands. Slickensides and calcite (62° CA) at 0.14 m above base. Abrupt, listricated.
	89.03	0.12	COAL-dull, lustrous, sheared, stick, broken at base.
	89.09	0.06	MUDSTONE-black, canneloid, lustrous, with thin bright coal bands. BP 69/E?/3
	89.15	0.06	MUDSTONE-dark grey, carbonaceous, listricated, rooty, bright coal particles adhering to top. Stick.
	89.27	0.12	MUDSTONE-black, carbonaceous, listricated abundant bright coal bands. Stick. Ground. Core loss 0.08 m.
	89.30	0.03	MUDSTONE-black, carbonaceous, abundant thin bright coal bands. Stick.
	89.31	0.01	MUDSTONE-dark grey, carbonaceous, silty with attached thick coaly plant debris with pyrite flecks, at top Gradational.
			BASE OF E_2 UPPER ZONE
	89.86	0.55	SILTSTONE-dark grey, with sandy phases. Non-calcareous rooty at top. Gradational. Stick.
	89.91	0.05	MUDSTONE-black, carbonaceous, listricated, with abundant thin bright coal bands. Stick.

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	89.93	0.02	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands. Pyrite flecks on bedding. Stick.
	90.03	0.10	MUDSTONE-dark grey, abundant carbonised plant fragments, some pyrite flecks. Stick.
	90.22	0.19	MUDSTONE-medium grey, silty, slightly ferrugious. Badly ground, broken.
	90.70	(0.48)	CORE LOSS-ROCK
	90.78	0.08	MUDSTONE-black, carbonaceous, with thin bright coal bands. Stick.
	91.28	0.50	SANDSTONE-very fine-grained, silty, finer at top, burrowed at top; low angle cross-lamination and scouring towards base; non-calcareous, abrupt.
	91.72	0.44	MUDSTONE-dark grey, carbonaceous, abundant carbonized plant fragments. Silty towards base, gradational.
	92.76	1.04	SANDSTONE-very fine to fine-grained, occasionally grading up to siltstone. Some scouring and ripple sets. Occasional argillaceous laminae. Non-calcareous, erosional.
	100.72	7.96	SILTSTONE/SANDSTONE-very fine to fine-grained (70:30)-interbedded, locally slumped argillaceous siltstone and sandstone. Top 2.30 m non-calcareous; remainder of unit strongly calcareous. Gradational.
	105.46	4.74	SILTSTONE/MUDSTONE-(80:20 grading down to 50:50)-dark grey, argillaceous siltstone and silty mudstone, thinly bedded; occasional bright coal chips. Locally slumped; strongly calcareous, gradational, Some well preserved leaves. Occasional rootlets.
			TOP OF E_1 ZONE
	105.80	0.34	MUDSTONE-dark grey, carbonaceous, with finely broken plant debris. Thin, silty laminae. Abrupt
	105.81	0.01	COAL-dull lustrous, stick
	105.86	0.05	COAL-dull banded, slightly sheared, broken stick
	105.88	0.02	COAL-dull banded, slightly sheared, broken.
	105.91	0.03	COAL-dull banded, slightly sheared, stick
	105.95	0.04	COAL-dull lustrous, stick

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	105.97	0.02	COAL-bright banded, stick
	106.01	0.04	COAL-bright banded, sheared, stick
	106.03	0.02	COAL-bright banded, stick
	106.04	0.01	COAL-dull lustrous, stick
	106.10	0.06	COAL-bright banded, sheared, stick
	106.11	0.01	COAL-bright, with very thin mudstone laminae. Abrupt, attached. BP 69/E1/1
	106.12	0.01	MUDSTONE-black, with bright coal bands at top and base. Stick.
	106.14	0.02	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands, stick, ground. Listricated.
	106.88	0.74	MUDSTONE-medium grey, slightly carbonaceous, listricated, abundant plant fragments. Ferruginous, rooty, from 0.15 to 0.30 m below top. Stick.
	106.93	0.05	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands. Broken.
	107.27	0.34	MUDSTONE-dark grey, carbonaceous, listricated with abundant sheared coaly inclusions (large plant fragments or rootlets?). Bright coal powder in box. Broken stick.
	107.35	0.08	MUDSTONE-dark grey, carbonaceous, slightly listricated, occasional thin bright coal bands, H_2S odor. Stick, ground.
	107.55	0.20	MUDSTONE-black, carbonaceous, listricated thin sheared coal bands. Ground at top. Abrupt, attached.
	107.58	0.03	COAL-bright banded, with 25% mudstone bands. Stick gradational. BP 69/E1/2
	107.64	0.06	MUDSTONE-black, carbonaceous, with thick bands and inclusions of bright coal. Stick, abrupt; attached. BP 69/E1/3
	107.67	0.03	COAL-bright banded, stick.
	107.70	0.03	COAL-dull banded, stick BP 69/E1/4

BH No. | BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	107.83	0.13	MUDSTONE-dark grey, carbonaceous, listricated, with scattered plant fragments. Gradational. Stick
	107.85	0.02	MUDSTONE-black, carbonaceous, with thin bright coal bands. Gradational. Stick.
	107.92	0.07	MUDSTONE-black, carbonaceous to canneloid, lustrous with abundant thin bright coal bands. Stick. Gradational. BP 69/E1/5
	107.97	0.05	MUDSTONE-dark grey to black, carbonaceous, with thin bright coal bands. Stick. Abrupt.
	108.07	0.10	SILTSTONE-dark grey, argillaceous, carbonaceous, rooty, stick. Abrupt.
	108.13	0.06	MUDSTONE-black, carbonaceous, with thin and thick bright coal bands. Abrupt.
	108.15	0.02	COAL-dull, stick
	108.16	0.01	COAL-bright, stick.
	108.17	0.01	COAL-dull banded, stick
	108.22	0.05	COAL-dull, lustrous, stick. BP 69/E1/6
	108.24	0.02	MUDSTONE-black, carbonaceous, broken, with abundant thin bright coal bands. BP 69/E1/7
	108.27	0.03	COAL-dull banded, lustrous. Stick.
	108.29	0.02	COAL-dull lustrous with 50% laminae of carbonaceous mudstone. Stick.
	108.31	0.02	COAL-dull banded, lustrous. Stick.
	108.34	0.03	COAL-dull and bright, stick. BP 69/E1/8
	108.44	0.10	MUDSTONE-black, carbonaceous, with thin bright coal bands, stick. BP 69/E1/9
	108.51	0.07	COAL-dull, lustrous, stick.
	108.58	0.07	COAL-dull banded, stick
	108.64	0.06	COAL-dull, stick
	108.65	0.01	COAL-bright, stick
	108.67	0.02	COAL-dull, stick
	108.68	0.01	COAL-bright, stick

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION	
	108.71	0.03	COAL-dull, stick	BP 69/E1/10
	108.78	0.07	COAL-dull, stick	
	108.87	0.09	COAL-dull banded, stick	BP 69/E1/11
	108.88	0.01	MUDSTONE-black carbonaceous, with abundant bright coal bands. Listricated.	BP 69/E1/12
			BASE OF E_1 ZONE	
	110.82	1.94	CONGLOMERATE-granule at top, coarsening down to pebbles. Framework supported, with coarse sand matrix. Overall clean appearance. Non-calcareous Occasional coarse to very coarse sandstone phases. Abrupt. Carbonaceous in top 0.09 m.	
5°	112.75	1.93	SANDSTONE-fine to coarse-grained; overall good sorting, clean. Non-calcareous. Grainsize consistent in individual beds of 0.05 to 0.40 m. A few thin silty-muddy phases, totalling 0.15 m Large scale low-angle cross-laminated. Gradational.	
	113.51	0.76	SANDSTONE-coarse to very coarse-grained, with pebbly phases. Clean, well-sorted. Non-calcareous abrupt.	
	113.68	0.17	SANDSTONE-very fine to coarse-grained/SILTSTONE (50:50)-fining-upwards cycles, with conglomeratic band at 0.12 m below top. Non-calcareous. Gradational.	
	114.14	0.46	SANDSTONE-medium-grained, with pebble and granule phases. Clean, weakly calcareous, abrupt.	
0° to 12°	114.39	0.25	SILTSTONE/MUDSTONE(50:50)-fining upward cycles of siltstone and silty mudstone, scoured at base, with thin sandy basal laminae. Weakly calcareous Erosional.	
			TOP OF D_1 ZONE	
	114.62	0.23	MUDSTONE-black, carbonaceous, with 20% bright coal bands, up to 0.01 m thick.	
	114.68	0.06	MUDSTONE-black, carbonaceous, abundant (up to 50%) thin bright coal bands. Stick.	
	115.21	0.53	COAL AND MUDSTONE-fragments mixed in core box. coal is sheared and ground, type indistinguishable; mudstone is dark grey to black, listricated, with some thin bright coal bands. Core loss 0.32 m.	

BH No. BP 69

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	115.43	0.22	MUDSTONE AND SILTSTONE-rounded fragments and pebbles (?cavings) mixed in core box. Mudstone is dark grey, carbonaceous; siltstone is medium grey, non-calcareous.
	115.45	0.02	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands. Broken and ground.
	115.50	0.05	MUDSTONE-dark grey, carbonaceous, listricated with abundant carbonised plant fragments.
	116.12	0.62	MUDSTONE-silty, dark grey, slightly carbonaceous; listricated at top; plant fragments. Gradational.
			BASE OF D_1 ZONE
	116.89	0.77	SILTSTONE-dark grey with sandy wisps. Scattered tiny rootlets and plant fragments. Occasional pyrite specks and ferruginous laminae. Gradational.
15° at top 20° at bottom	117.41	0.52	SANDSTONE-very fine-grained, ripple-laminated, with occasional silty and carbonaceous laminae in top 0.22 m. Non-calcareous. Calcite: one band parallel to bedding and thin veinlet at 10° to 30° CA.
			BASE OF RECOVERED CORE HOLE JUNKED AND ABANDONED-SEE BP 69A

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-69A

Contractor: Tonto Drilling

Co-ordinates: N 6118931.6
E 591655.7

Commenced: 21/6/79

Surface Elevation: 1625.4 m

Completed: 8/7/79

Geophysically logged: yes/~~no~~

Core Size: HQ

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Logged by:	Geologist	Depth
	C. Bickford	0.00-360.90
	D. Mitchell	360.90-T.D.

Final Depth: 495.20 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Hulcross	5.13	2.13 +	1620.27
Gates	229.80	224.67	1395.60
Sukunka	360.90	131.1	1264.50
Moosebar	437.18	76.28	1188.22
Gething (Upper)	489.56	52.38	1135.84
(Lower)	495.20	5.64 +	1130.20

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	439.20	2.02 (d0.29)	58%	1186.20
U. Chamberlain (U.L.)	476.77	1.13 (d/dc1.13)	43%	1148.63
U. Chamberlain (L.L.)	481.77	0.28	21%	1143.63
L. Chamberlain	489.56	3.10 (d/dc/bone 0.44)	82%	1135.84

STRUCTURAL FEATURE	DEPTH	REMARKS
F. EST	114.65	Steep dips/shearing, repeat of E_1 floor, throw 5.45 m.
F. PR	196.00	Steep dips/shearing, minor fault.
F. PR	387.70-388.81	Brecciation, minor fault (?RIM Fault).

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-69A SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	0.6°	N 22° E
100m	0.8°	N 20° E
150m	0.8°	N 21° E
200m	0.9°	N 15° E
250m	1.0°	N 19° E
300m	1.3°	N 20° E
350m	1.5°	N 18° E
400m	1.7°	N 19° E
450m	2.0°	N 14° E
494m	2.4°	N 12° E

-0000000-

BH NO. BP-69 A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	70.18		Start Log of core. For interval 0.0 to 70.18, refer to log of BP-69.
			GATES MEMBER
	70.46	0.28	SILTSTONE-medium grey, abundant small dark worm burrows. Vaguely laminated. Weakly calcareous at top. Increasing to very strongly calcareous at base. Abrupt.
	71.18	0.72	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained (40:40:20)-interlaminated dark grey, non-calcareous siltstone and silty mudstone with interbeds of medium grey, strongly calcareous sandstone. Abundant small dark worm burrows. Basal contact ground out.
	72.92	1.74	SILTSTONE-dark grey, with occasional sandy and argillaceous phases. Vague lamination; weakly calcareous. Gradational.
	73.51	0.59	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained (40:40:20)-interlaminated, fining-upward cycles of dark grey non-calcareous siltstone and silty mudstone, with thin stringers of strongly calcareous, medium grey, sandstone. Gradational.
	77.42	3.91	SILTSTONE/MUDSTONE/SANDSTONE-very fine to fine-grained (40:30:30)-similar to overlying unit but intensely bioturbated, with abundant small dark worm burrows. Locally relict low-angle cross-lamination in sandy phases. Sukunkoid Marker. Long vertical worm burrows towards base. Basal 0.85 m consists of sandstone/siltstone/mudstone (80:10:10), with abundant glauconite grains. Abrupt; load-casted at base. Unit is non-calcareous.
	78.22	0.80	SANDSTONE-very fine-grained, silty, intensely bioturbated, with occasional relict lamination. Abundant burrowing. Non-calcareous. Dark grey pyritic mudstone phases at top and base. Gradational.
	78.78	0.56	MUDSTONE-dark grey, with thin sandy laminae at top. Silty. Carbonaceous. Non-calcareous. Basal 0.29 m contains 50% interbeds of very fine-grained sandstone.
0° to 10°	81.96	3.18	SANDSTONE-very fine-grained/MUDSTONE(90:10)-medium grey, low-angle and parallel-laminated silty sandstone with thin interbeds and laminae of dark grey very silty mudstone. Non-calcareous. 80% mudstone with 20% sand laminae and lenses, from 80.48 to 80.74. Coarse grained sandstone with abundant mud matrix from 80.74 to 80.81 (Erosional at base).

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Locally intense burrowing, characteristically small dark burrows. The 80% mudstone phase is notably unburrowed. Unit abrupt, slightly sheared at base.
	82.15	0.19	CONGLOMERATE-granules at top, grading down to granules and small pebbles (50:50) at base. Overall good sorting. Silty, non-calcareous matrix. Listricated basal contact, with flakes of sheared coal adhering. Contact dip 15°.
			——— TOP OF E_3 SEAM ———
	82.18	0.03	COAL-sheared and broken. Coal type indistinguishable.
			——— FAULT, ESTABLISHED, Throw 1 m
	82.34	(0.16)	CORE LOST- rock
	82.92	0.58	SANDSTONE-very fine-grained/MUDSTONE (90:10) medium grey silty sandstone with laminae of dark grey silty mudstone. Locally bioturbated with scattered small dark worm burrows. Non-calcareous. Top 0.25 m with abundant fractures and ? dolomite veinlets, and shearing at 45° CA. Dips increase abruptly upward from 15° to 20° at base of sheared zone, to 80° at top. Basal contact of unit with conglomerate interfingering over 0.01 m (erosional?) and listric?
	83.15	0.23	CONGLOMERATE-granule, but with clasts up to 80 mm in basal 0.16 m. Granule phase itself is moderately well-sorted, with occasional small pebbles and silty non-calcareous matrix. 0.01 to 0.03 m sheared coal from 0.15 to 0.18 m below top, possibly faulted (base of coal band is polished and grooved, dipping 45°). Basal contact very irregular, with load structures. (coal squeezed up between pebbles) Sheared coal adheres to base.
			——— TOP OF E_3 SEAM ———
	83.17	0.02	COAL-dull and bright, sheared, broken
	83.38	0.21	COAL-dull lustrous, pyrite in basal 0.02 m, slightly sheared, stick.
	83.42	0.04	COAL-dull lustrous, sheared, broken and pulverised
	83.48	0.06	COAL-dull lustrous, sheared, broken stick. Includes 0.005 m fusain band.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	83.69	0.21	COAL-sheared, broken and pulverised. Some broken pieces of recognizable dull and bright, and dull lustrous coal, but mainly indistinguishable. Pyrite flecks noted on one piece.
	83.73	0.04	COAL-dull, lustrous, hard, sheared at 35° CA. Broken stick. BP 69A/E3/1
	83.74	0.01	COAL-dull, lustrous, listricated, stick
	83.78	0.04	MUDSTONE-black, carbonaceous, abundant thin bright coal bands. Sheared and listricated. Broken stick.
	83.81	0.03	COAL-bright, sheared, broken stick, listricated
	83.84	0.03	COAL AND MUDSTONE-sheared and listricated, fragments mixed in core box. BP 69A/E3/2
	84.22	0.38	MUDSTONE-dark grey, silty, abundant plant fragments, rootlets, locally listricated and ferruginous. Carbonaceous in top 0.04 m. Gradational. Stick.
	84.27	0.05	MUDSTONE-black, carbonaceous, listric surfaces and a few rootlets. Stick.
	84.29	0.02	COAL-dull, lustrous, sheared, stick. BP 69A/E3/3
	84.31	0.02	MUDSTONE AND COAL-fragments of sheared dull lustrous coal and black, listricated carbonaceous mudstone, mixed in core box.
	84.34	0.03	MUDSTONE-dark grey, carbonaceous, pyritic. Broken stick.
	84.42	0.08	COAL-intensely sheared, appears to be dull, lustrous Broken stick. Breaks into "cornflakes"
	84.58	0.16	COAL AND MUDSTONE-mixed, sheared fragments and "cornflakes" of black, canneloid mudstone and dull, lustrous coal. Proportion of coal increases towards top-(possibly upward gradation from conneloid mudstone to coal?) BP 69A/E3/3
	84.92	0.34	MUDSTONE-black, carbonaceous, grading towards canneloi mudstone in top 0.07 m. Listricated throughout with abundant thin bands of sheared bright coal. Rootlets, a few plant stems. 50% bright coal bands in basal 0.04m.
	85.16	0.24	MUDSTONE-black, canneloid, lustrous, gradational at base.
			BASE OF E_3 ZONE

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	85.53	0.37	MUDSTONE-dark grey, silty, slightly carbonaceous, rooty, gradational.
	86.23	0.70	SILTSTONE-grading down to SANDSTONE, very fine-grained medium grey, argillaceous, siliceous, non-calcareous, slumped, rooty, (especially at top), listricated at base.
	86.30	0.07	MUDSTONE-black, carbonaceous, sheared, abundant thin bright coal bands, broken at base.
	86.48	0.18	MUDSTONE-dark brownish grey, ferruginous, silty, listricated, tough.
	87.23	0.75	MUDSTONE-dark grey, silty, slightly carbonaceous, abundant plant fragments and rootlets at top, thin listricated bright coal bands at base. Very fine-grained rippled sandstone laminae from 0.20 to 0.28 m below top. Abrupt.
			TOP OF E_2 UPPER ZONE
	88.20	0.97	MUDSTONE-black, carbonaceous, with locally abundant thin bright coal bands and occassional thicker (to 0.03 m) bands of sheared, dull lustrous coal. Abrupt.
	88.31	0.11	COAL-dull and bright, sheared, broken stick.
	88.32	0.01	MUDSTONE-black, carbonaceous, with abundant thin bright coal bands. Broken.
	88.94	0.62	MUDSTONE-medium grey, rooty, occasionally crumbly, locally carbonaceous.
	88.99	0.05	COAL-dull
	89.09	0.10	COAL-dull banded, slightly sheared, lustrous
	89.17	0.08	COAL-dull and bright, sheared, friable.
	89.24	0.07	COAL-dull, lustrous hard, close to cannelpid mudstone. Stick
	89.46	0.22	MUDSTONE-black, carbonaceous, abundant plant fragments, ferruginous at base. Abrupt.
	89.58	0.12	MUDSTONE-black, canneloid, lustrous, abundant very thin bright coal streaks; plant impressions. Abrupt.
	89.65	0.07	MUDSTONE-dark grey, ferruginous rooty Carbonaceous at top. Abrupt.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	89.67	0.02	MUDSTONE-black, canneloid, lustrous, abundant very thin bright coal streaks. Stick.
	89.74	0.07	COAL-dull banded
	89.84	0.10	COAL-dull lustrous
	89.86	0.02	COAL-dull banded, stick.
	89.97	0.11	MUDSTONE-dark grey, ferruginous, carbonaceous, listricated, rooty. Pyrite flecks on top surface. Gradational. Stick.
	90.11	0.14	MUDSTONE-black, carbonaceous, abundant bright coal bands up to 0.002 m thick. Broken stick. Abrupt.
			BASE OF E_2 UPPER ZONE
	90.43	0.32	MUDSTONE-dark grey, very silty, rooty, slightly ferruginous in centre, non-calcareous. Abrupt.
	90.67	0.24	SILTSTONE-dark grey, grading down to very fine-grained silty sandstone at base. Non-calcareous, with tiny rootlets at top. Abrupt.
	91.89	1.22	SILTSTONE/MUDSTONE(70:30)-interbedded dark grey argillaceous siltstone and silty mudstone. Vague lamination. Occasional roolets and well-preserved plant fragments (? levee deposit). Non-calcareous. 20% very fine sand as thin interbeds in basal 0.20 m. Gradational.
	92.38	0.49	SANDSTONE-very fine-grained, silty, with dark carbonaceous laminae. Ripple sets at base, slumping and large scale cross-lamination at top. Carbonised plant stem and rootlet 0.04 m below top. Weakly calcareous; gradational.
	93.62	1.24	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (50:50:0 grading down to 0:30:70)-interbedded medium grey silty sandstone, dark grey siltstone and silty mudstone. Overall fining-downward, non-calcareous. Occasional ripple sets in sandstones. Mudstone tends to be rubbly. Abrupt.
	95.00	1.38	SILTSTONE-sandy, occasional argillaceous phases with abundant plant fragments. Scattered rootlets. Vague long dark worm burrows in top 0.08 m. Non-calcareous. Abrupt.
	98.56	3.56	SANDSTONE-very fine-grained/SILTSTONE(80:20 grading down to 20:80)-interbedded and interlaminated, locally slumped silty sandstone and siltstone, with occasional argillaceous phases. Strongly calcareous

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			throughout except in top 0.17 m. Abundant carbonaceous laminae in top 0.40 m, with some rootlets. Occasional large ripple-sets. Abrupt.
2° to 4° (locally higher in slumps)	103.62	5.06	SILTSTONE/MUDSTONE-(80:20 grading down to 30:70)-interlaminated medium grey siltstone (sandy at top of unit, fining downwards) and dark grey silty mudstone. Common ferruginous bands. Generally parallel-laminated, fining-upwards beds; occasional delicate ripples and abundant slumping. Very strongly calacreous throughout. Interval marked by well-preserved plant fossils. Abrupt.
	104.15	0.53	MUDSTONE-dark grey, silty, vague ferruginous mottles, scattered small plant fragments, strongly calcareous, abrupt.
	105.70	1.55	SILTSTONE/MUDSTONE(50:50 grading down to 0:100)-interlaminated, locally slumped, medium grey sandy siltstone and dark grey silty mudstone. Ferruginous bands. Silt component calcareous; mud non-calcareous. Intense bioturbation and tiny burrows at top. Abrupt.
			TOP OF E_1 ZONE
	105.75	0.05	COAL-sheared. Coal type indistinguishable. Stick.
	105.78	0.03	COAL-dull and bright, sheared. Thin fusain bands.
	105.81	0.03	COAL-dull lustrous. Sheared. Stick.
	105.83	0.02	COAL-dull and bright, sheared.
	105.84	0.01	COAL-dull lustrous, sheared
	105.86	0.02	COAL-bright banded, sheared, stick.
	105.91	0.05	COAL-dull banded, sheared, stick. BP 69A/E1/1
	106.10	(0.19)	CORE LOSS-COAL
	106.15	0.05	MUDSTONE-black carbonaceous to canneloid. Abundant thin bright coal bands. Slightly sheared.
	106.85	0.70	MUDSTONE-dark grey slightly carbonaceous, abundant carbonised plant fragments. Ferruginous mottling. Rootlets (?) at top. Gradational.
	107.61	0.76	MUDSTONE-dark grey, slightly carbonaceous at top, grading down to black, carbonaceous at base. Ferruginous bands. Locally abundant plant fragments. Slightly listricated at base.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	107.65	0.04	MUDSTONE-black, carbonaceous, listricated, one thin bright coal band. Stick.
	107.66	0.01	MUDSTONE-black, carbonaceous, thin bright coal bands. Core badly broken and ground.
	107.95	(0.29)	CORE LOSS-COAL AND ROCK
	108.00	0.05	COAL-sheared, mostly indistinguishable. A few recognisable fragments of coal, dull banded, sheared. Broken. BP 69A/E1/2
	108.05	0.05	MUDSTONE-dark grey, carbonaceous, slightly ferruginous Listricated. Stick. BP 69A/E1/3
	108.17	0.12	MUDSTONE-black, lustrous, canneloid, sheared, listricated. Broken. BP 69A/E1/4
	108.28	0.11	MUDSTONE-dark grey to black, carbonaceous, slightly ferruginous. plant fragments. Gradational.
	108.35	0.07	MUDSTONE-black, carbonaceous. large plant fragments, slightly listricated. Gradational.
	108.38	0.03	MUDSTONE-black, carbonaceous to canneloid, abundant thick bright coal bands. Stick.
	108.41	0.03	MUDSTONE-black, carbonaceous to canneloid, abundant thin bright coal bands. Stick. BP 69A/E1/5
	108.46	0.05	COAL-bright banded, sheared BP 69A/E1/6
	108.51	0.05	MUDSTONE-black, carbonaceous to canneloid, abundant thin bright coal bands. Sheared. Stick.
	108.58	0.07	MUDSTONE-black, carbonaceous, to canneloid, abundant thin bright coal bands. Broken stick BP 69A/E1/7
	108.64	0.06	MUDSTONE-dark grey, ferruginous, abundant plant fragments. Abrupt, attached. Stick. BP 69A/E1/8
	108.67	0.03	MUDSTONE-black, carbonaceous to canneloid. Gradational.
	108.73	0.06	COAL-dull lustrous, few thin bright bands.
	108.79	0.06	COAL-bright banded, slightly sheared. One 0.005 mudstone lens at top.
	108.88	0.09	COAL-dull lustrous. Few thin bright bands.
	108.92	0.04	COAL-dull banded
	108.94	0.02	COAL-sheared, type indistinguishable

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	109.00	0.06	COAL-dull and bright. Stick.
	109.10	(0.10)	CORE LOSS- COAL
	109.11	0.01	MUDSTONE-black, carbonaceous, abundant thin bright coal bands. Stick.
	109.15	0.04	COAL-sheared and broken. Type indistinguishable. BP 69A/E1/9
			BASE OF E_1 ZONE
	109.20	0.05	MUDSTONE-black, carbonaceous with occasional bright coal lenses and rootlets. Abundant granules and small, well rounded pebbles of chert. Sheared and listricated at top and base. Gradational.
	109.28	0.08	CONGLOMERATE-granules and pebbles of chert in abundant matrix of carbonaceous mud and silt. Occasional lenses of bright coal. Listricated. Abrupt. Slightly ferruginous.
	110.96	1.68	CONGLOMERATE-granule to pebble (max. 27 mm; mode 5 mm to 10 mm), overall coarsening-downward, with occasional coarse to very coarse sandstone phases. Moderately to well-sorted; medium to coarse-grained sand matrix; non-calcareous. Rootlets in top 0.04 m. Occasional joints (28° to 32° CA) with slickensides (80° CA); sheared and listricated coaly laminae in top 0.50 m. Abrupt.
6° at 12° at	113.23 113.13 112.96	2.27	SANDSTONE-medium to coarse-grained, very fine-grained and silty from 111.36 to 111.67, granular and pebbly phases from 112.78 to 113.01 and in top 0.40 m. Overall fining-upward unit. Clean, well-sorted, non-calcareous, large-scale low-angle cross-laminated. Basal 0.75 m of unit is sheared, with slickensides at 70° CA, with increasing intensity downwards. Dips from 60° to 90° in basal 0.28 m.
	113.81	(0.58)	CORE LOSS-ROCK
38° at top 130° at base	114.65	0.84	CONGLOMERATE-granule to pebble, with occasional coarse-grained sandstone phases and medium-grained sand matrix. Non-calcareous. Abundant tension fractures, some filled with calcite and a chalky white mineral; occasional pyrite. Unit sheared and folded. (overturned)
			FAULT ESTABLISHED, Throw 5.6 m

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
30° at base	114.80	0.15	MUDSTONE-black, carbonaceous, pebbly, with coaly lenses and rootlets. Similar to floor of E_1 seam. Listricated. Abrupt, listricated basal contact.
	117.60	2.80	CONGLOMERATE-granule to pebble (max. 20 mm, mode 5 to 8 mm), overall coarsening-downward sequence, but with occasional phases of medium to coarse-grained sandstone. Matrix of conglomerate also medium to coarse sand. Non-calcareous. A few rootlets and carbonaceous laminae at top. Unit overall well-sorted. Occasional joints, some open, at 0° to 20° CA. Abrupt.
	119.57	1.97	SANDSTONE-medium to very coarse-grained, with occasional pebbly and granular phases in top 1.22 m Clean, well-sorted, non-calcareous throughout. Occasional polished slip planes from 70° to 80° CA; fractures at 40° CA; concentrated in top 0.80 m of unit. Abrupt. listricated at base.
11° at 119.82	123.46	3.89	SANDSTONE-medium to coarse-grained/CONGLOMERATE granule and pebble/MUDSTONE(45:25:20)-interbedded, clean, weakly to moderately calcareous sandstone (dominantly medium to coarse-grained with occasional fine-grained phases) with dark grey, silty mudstone and conglomerate (max. 25 mm pebbles; mode 5 to 10 mm) Sandstones and conglomerate large-scale low-angle cross-laminated with occasional ripples; mudstones with occasional scoured sandy laminae. Mudstone phases locally listricated and sheared at 80° to 85° CA, also occasional slickensides at 50° to 60° CA. Occasional quartz veinlets at 0° to 30° CA, also occasional carbonaceous to coaly mudstone laminae. Abrupt.
			TOP OF D ZONE
	124.40	0.94	MUDSTONE-dark grey to black, carbonaceous, with locally abundant thin bright coal bands, and 0.01 m bright coal from 0.05 to 0.06 below top. Unit sheared and broken, locally pulverised. Gradational. Core loss 0.39 (coal and rock).
			BASE OF D ZONE
	125.13	0.73	MUDSTONE-dark grey with abundant plant fragments at top, grading down to very silty mudstone at base. Non-calcareous, gradational.
7° to 10°	126.23	1.10	SANDSTONE-very fine to fine-grained/SILTSTONE(60:40)-interlaminated, with small-scale low-angle and ripple cross-lamination and some slumping. Weakly

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			calcareous. Occasional finely broken plant debris and listricated carbonaceous laminae. Gradational.
	130.80	4.57	MUDSTONE-dark grey. Silty in top 0.25 m; slightly carbonaceous with ferruginous bands to 2.70 m below top; dark grey to black, carbonaceous to base. Ferruginous bands are weakly calcareous, otherwise non-calcareous. Abrupt.
			TOP OF C SEAM
	131.37	(0.57)	CORE LOSS-COAL, may include some ROCK
	131.43	0.06	COAL-dull banded, slightly sheared, stick.
	131.54	0.11	COAL-dull banded, lustrous hard, stick.
	131.58	0.04	COAL-dull banded, slightly sheared, stick. BP 69A/C/1
	131.63	0.05	MUDSTONE-dark grey, carbonaceous, with finely broken carbonised plant debris. Stick BP 69A/C/2
	131.66	0.03	COAL-bright banded, stick. BP 69A/C/3
	131.86	0.20	MUDSTONE-dark grey, carbonaceous, listricated/COAL dull and bright, sheared (50:50)-fragments mixed in core box. Badly broken and pulverised. Ground out at base. BP 69A/C/4
			BASE OF C SEAM
	132.80	0.94	MUDSTONE-dark grey, with carbonaceous phases. Rooty and slightly listricated at top; Locally sheared and listricated in basal 0.50 m. Abrupt, listricated.
1° at 140.97 6° at base	154.75	21.95	SANDSTONE-medium to coarse-grained from top to 140.94; fine-grained to base. Scattered pebbles & granules from 140.85 to 140.94. Clean, well-sorted throughout, with large-scale low-angle cross-lamination with scours, from 140.94 to 142.13 Abundant large (0.006 m) dark-rimmed "Gates type" worm burrows from 141.74 to 143.80. Occasionally muddy intraclasts from 150.56 to base. Moderately to strongly calcareous, except top 0.58 m which is weakly to non-calcareous, with rootlets in top 0.35 m. Abrupt. From 138.30 to 140.70, abundant calcite veinlets (20° to 40° CA), some rusty staining, and open fractures. Core ground in part of this interval.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	164.01	9.26	SANDSTONE-very fine to fine-grained/MUDSTONE (50:50) interbedded, medium grey, small-scale cross-laminated argillaceous sandstone and dark grey silty mudstone. Locally large worm burrows in Sandstones both as thick, relatively clean beds, and as lenses in mudstone (commonly with scoured bases, fining-upwards). Occasional pyrite nodules and coaly laminae (up to 15 mm thick at 158.30). Abundant pebbles from 158.33 to 158.38, with coaly laminae between. Abundant coaly laminae in basal 0.15 m. Occasional polished or slickensided surfaces sub-parallel to lamination in muddy phases; also occasional rough, rusty joints at 0° to 20° CA, in top 3.15 m. Unit moderately to very strongly calcareous thoughout. Gradational.
2° at	161.75	mudstone.	
	164.10	0.09	CONGLOMERATE-pebbles and granules of chert in a very fine sand matrix, with abundant small coaly fragments, some replaced by pyrite. Erosional at base. "B" roof marker.
			B HORIZON
	165.00	0.90	SANDSTONE-fine-grained, dark grey argillaceous, top 0.10 m carbonaceous. Rooty, with a few coal lenses towards top. Occasional mica flecks. Non-calcareous; ground at base. Core loss, 0.26 m.
	170.23	5.23	SILTSTONE/SANDSTONE-very fine to fine-grained/MUDSTONE(50:30:20)-interbedded, generally poorly sorted argillaceous sandstone, siltstone and silty (locally carbonaceous) mudstone. Weakly to moderately calcareous. Common ripple-lamination. Gradational.
	171.06	0.83	SILTSTONE-dark grey, occasional sandy phases. Vaguely laminated. Non-calcareous. Gradational.
	171.68	0.62	MUDSTONE-dark grey, slightly carbonaceous, with ferruginous bands. Silty towards top. Gradational.
			TOP OF A ZONE
	172.40	0.72	MUDSTONE-black, carbonaceous, locally pulverised. Listricated, with finely broken plant fragments. Abrupt, listricated.
			BASE OF A ZONE
0° to 6°	183.64	11.24	SANDSTONE-medium to coarse-grained from top to 176.04, fine to medium-grained to base. Clean, well-sorted throughout. Large-scale low-angle cross-

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			laminated throughout. Abundant large dark-rimmed "Gates-Type" worm burrows from 183.30 to 183.43 m. Top 0.02 m of unit black, carbonaceous. Top 1.0 m moderately, remainder strongly calcareous.
	184.68	(1.04)	CORE LOSS-ROCK
	189.50	4.82	SANDSTONE-fine to medium-grained from top to 185.81 very fine to medium-grained with 30% silty interbeds to 186.49; fine-grained to base. Overall clean unit, low-angle cross-laminated. Sporadic muddy intraclasts in basal 2.3 m; locally abundant large dark-rimmed worm burrows in top 1.05 m. Strongly calcareous throughout. Abrupt.
6° at	191.68 190.68	2.18	SILTSTONE/MUDSTONE/SANDSTONE-very fine to fine-grained (50:30:20)-interbedded and interlaminated, fining-upward cycles of medium grey sandstone and dark grey siltstone and mudstone. Strongly calcareous throughout. Occasional slump structures and small dark grey muddy intraclasts. Occasional ripples in sandstones. Abrupt.
	194.07	2.39	SANDSTONE-very fine to fine-grained/MUDSTONE/SILTSTONE(70:15:15)-clean, medium grey low-angle cross-laminated sandstone with interbeds (30% of unit) of interlaminated argillaceous sandstone, siltstone and mudstone. Interlaminated phases are generally slumped; locally bioturbated. Occasional silty laminae in the sandstone beds. Unit as a whole is moderately to strongly calcareous. Gradational
	196.11	2.04	SANDSTONE-very fine to fine-grained, with silty laminae toward top of unit. Medium-scale low-angle cross-laminated. Unit becomes argillaceous towards base. Weakly to moderately calcareous at top, becoming strongly calcareous twoards base. Abundant slickensides, calcite and polished slip planes (40° to 75° CA) in basal 1.0 m. Gradational.
3° to	14°		
0° to 90° to 120° (overturned)	197.74	1.63	SANDSTONE-very fine-grained/SILTSTONE(70:30)-thinly interbedded medium grey strongly calcareous small-scale low-angle and ripple-laminated sandstone and dark grey weakly calcareous siltstone, with occasional phases of dark grey, pyritic mudstone. Bedding crumpled and tightly folded with abundant listric surfaces, slickensides and calcite. Dips 0° to 90° to 120° (overturned)
			POSSIBLE FAULT ZONE, 196.11 to 197.74

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	203.60	5.86	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (60:30:10)-interbedded clean medium grey low-angle cross-laminated sandstone (with silty laminae) and interlaminated siltstone and silty mudstone (as discrete intervals between beds of sandstone). Occasional slumps, ripples, and small burrows in silty/muddy phases. Sandstone beds 5 to 20 cm thick. Strongly calcareous throughout. 2 cm of blocky calcite filing fracture (80° CA) at 2.83 to 2.85 m below top. Gradational.
5° at	200.84		
	205.68	2.08	SANDSTONE-very fine-grained, medium grey, slightly argillaceous, large-scale low-angle cross-laminated. Occasional small muddy intraclasts. Weakly calcareous Abrupt.
4° at	base.		
	209.03	3.35	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (70:20:10)-medium grey, large-scale low-angle cross-laminated sandstone with interbeds of interlaminated, locally bioturbated, dark grey siltstone and mudstone. Occasional very small dark, near vertical worm burrows, and stringers of small muddy intraclasts in sandstone beds (which are up to 0.70 m thick). Occasional load casts and bedding plane slip in silty/muddy phases. Weakly to moderately calcareous throughout. Abrupt.
	212.02	2.99	SANDSTONE-very fine-grained/MUDSTONE (50:50)-interbedded locally intensely bioturbated medium grey, patchily calcareous sandstone and dark grey to black, pyritic mudstone. Abundant burrows. Some relict low-angle cross-lamination and occasional muddy intraclasts in sandstones; occasional sandy ripples in mudstones. Abrupt. Core loss 0.24 m.
	213.20	1.18	SANDSTONE-very fine-grained/MUDSTONE(90:10)-clean, large scale low-angle cross-laminated, strongly calcareous sandstone with laminae and thin interbeds of dark grey silty mudstone. Locally sandstone is intensely bioturbated, destroying lamination. Abrupt
5° at	212.35		
	217.53	4.33	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (40:30:30)-interbedded medium grey sandstone (with occasional relict low-angle cross-lamination) and interlaminated dark grey siltstone and mudstone. Occasional pyrite nodules. Sandstone beds up to 0.30 m thick with occasional concentrations of muddy intraclasts. Bioturbation locally intense, destroying lamination. Occasional long vertical worm burrows. Some small pyritised worm burrows in muddy phases.
0° to	10°		

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Unit strongly calcareous throughout; gradational.
	229.80	12.27	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (40:40:20)-interlaminated dark grey siltstone and mudstone with thin interbeds and ripples of medium grey, silty sandstone. Locally intense bioturbation Abundant small dark worm burrows. Occasional pelecypod burrows and muddy intraclasts. Slickensides and coarsely crystalline calcite (60° CA) at 4.15 m below top. Weakly to moderately calcareous. Gradational. Core loss 0.62 m.
			SUKUNKA MEMBER
	237.20	7.40	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (75:15:10)-dark grey argillaceous, intensely bioturbated siltstone with occasional phases of silty mudstone; interbedded and interlaminated with medium grey, silty rippled sandstone. Abundant small worm burrows; siltstone and mudstone generally more intensely bioturbated, but occasional sandstone beds may be intensely burrowed and churned. Patchily weakly calcareous; sheared bright coal band at 1.26 m below top. Pelecypod: BP/F/1:at 1.90 m below top.
1° to 4°			
	237.63	0.43	SANDSTONE-very fine-grained, silty, low-angle and ripple laminated, with 0.13 m of bioturbated, argillaceous siltstone with sandy lenticles, from 0.20 to 0.33 m below top. Unit intensely bioturbated in top 0.09 m. Patchily calcareous. Abrupt.
	245.91	8.28	SILTSTONE/SANDSTONE-very fine grained (75:25 grading down to 85:15 at base)-dark grey siltstone with abundant burrows, with thin (0.02 m to 0.10 m) interbeds of medium grey silty sandstone. Sandstone generally small-scale low-angle cross-laminated; occasional ripples. Occasional sandstone beds disrupted and churned (bioturbated). Siltstone becomes finer and more argillaceous downward. Unit generally non-calcareous. Some sandstone beds weakly calcareous. Gradational. Listric surface and slickensides (45° CA) at 1.61 to 1.69 m below top.
	254.92	9.01	MUDSTONE/SILTSTONE (95:5)-interbedded, dark grey silty mudstone and sandy siltstone. Abundant very small dark worm burrows in mudstone. Locally abundant pyritised burrows. Non-calcareous, except for slightly calcareous ferruginous band from 1.10 m to 1.16 m below top. Large flat plant fragment at

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			2.65 m below top. Bentonite from 6.06 to 6.10 and 6.19 to 6.32 m below top. Upper band is sheared, with abundant biotite. (Basal 0.01 m of this band sampled for geochronology: BP 69A/X/1). Broken at base.
	258.08	3.16	SILTSTONE/SANDSTONE-very fine-grained (70:30)-interbedded, intensely bioturbated medium grey silty sandstone and dark grey siltstone. Ubiquitous small dark burrows. Sandstone beds patchily weakly calcareous; rest non-calcareous. Gradational. From 0.56 to 0.86 m below top unit badly broken (no sign of shearing or calcite-probably hammering DD 256.52 at base of this interval.)
	260.32	2.24	SANDSTONE-very fine-grained/SILTSTONE(60:40)-interbedded, intensely bioturbated medium grey silty sandstone and darker siltstone. Ubiquitous small dark worm burrows, and long vertical burrows (up to 0.33 m long). Rare relict lamination of siltstone and sandstone; medium-scale low-angle cross- and parallel-lamination. Patchily weakly calcareous; gradational.
	267.81	7.49	SILTSTONE/SANDSTONE-very fine-grained(80:20)-intensely bioturbated, with only rare relict lamination. Ubiquitous small dark burrows. Patchily calcareous. Gradational.
	277.94	10.13	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (70:20:10, grading down to 85:10:5 at base)-thinly interbedded, intensely bioturbated. Occasional sandstone beds from 0.03 to 0.15 m thick, showing sharp basal contacts, and fining-upward to siltstone. Low-angle cross-lamination (some serrated as is typical of the Sukunka). Some larger vertical burrows. Burrows pyritised in mudstone phases. Occasional strongly calcareous pyrite-rich bands; remainder of unit patchily calcareous. Scattered pyritised plant fragments, coaly in centres. Abrupt.
	281.09	3.15	SILTSTONE/SANDSTONE-very fine-grained (50:50) grading down to 70:30 at base) - intensely bioturbated, with occasional relict lamination in sandstone phases, which are abrupt at base and fine upwards to siltstone. Abundant small dark worm burrows (many serrated). One large vertical burrow towards base of unit. Patchily calcareous. Gradational.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
0° to 5°	281.85	0.76	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (50:40:10)-interbedded, less intense bioturbation than above. Scattered small dark burrows. Parallel and ripple-lamination. Weakly to moderately calcareous. Occasional calcite (90° CA).Slightly slumped at base. Abrupt.
	286.21	4.36	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (70:25:5 grading down to 50:5:45 at base)-intensely bioturbated dark grey siltstone and mudstone with thin interbeds of medium grey silty sandstone (with occasionally recognisable parallel lamination and ripples). Abundant small dark worm burrows. Occasional larger vertical burrows. Patchily calcareous. Gradational.
	288.41	2.20	MUDSTONE/SILTSTONE(50:50)-dark grey, intensely bioturbated with locally abundant pyritised worm burrows. Basal 0.79 m contains increasing abundant (downwards) very fine and fine sand grains, generally disseminated throughout rock but some as laminae, suggesting disruption of laminae by intense bioturbation. Non-calcareous; abrupt.
	289.40	0.99	SANDSTONE-fine-grained, argillaceous, bioturbated in top 0.61 m; remainder of unit is very fine-grained, cleaner, with abundant burrows but traces of lamination. Top 0.61 m weakly calcareous; remainder very strongly calcareous. Gradational.
	292.80	3.40	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (30:50:20)-interbedded medium grey, low-angle and rarely ripple-laminated silty sandstone, and dark grey, locally rippled siltstone and very silty mudstone. Locally intensely bioturbated, expecially towards base. Strongly calcareous throughout. Abundant burrows, including some large, dark-rimmed burrows in sandy phases. Abrupt.
4° at 292.85	294.13	1.33	SANDSTONE-very fine-grained/MUDSTONE(80:20)-interbedded medium grey, silty, low-angle and occasionally ripple-laminated sandstone, and intensely bioturbated dark grey silty mudstone with abundant sandy wisps. Sandstone very strongly calcareous, mudstone strongly calcareous. Gradational by interbedding at base.
	296.98	2.85	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (40:40:20, grading down to 20:50:30 at base). interbedded, medium grey silty low-angle and rarely

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			ripple-laminated sandstone and dark grey siltstone and silty mudstone. Bioturbated, locally intensely Strongly calcareous throughout. One band of pyrite 0.02 m thick. (0.36 m above base). Gradational.
	334.29	37.41	MUDSTONE/SILTSTONE/SANDSTONE-very fine-grained (40:40:20 grading down to 50:45:5 at base)-intensely bioturbated dark grey siltstone and silty mudstone with laminae and occasional beds (up to 0.23 m) of medium grey, silty, locally rippled sandstone. Abundant small dark worm burrows. Strongly calcareous throughout. Bioturbation decreases towards base. Pyrite blebs at 328.80. and occasionaly, below this point. Base of unit taken at base of last significant sandy bed (0.05 m thick), and is arbitrary as sand beds grade downward to coarse silts below this point. Siltstone component of this unit fines down to almost silty mudstone, at base. Slickensides and calcite:
			80° CA at 324.41 88° CA at 325.06 85° CA at 329.47 80° CA at 331.61 88° CA at 332.34
	Calcite-lined joint Slicks and calcite:		(12° CA) from 323.34 to 332.55 68° CA at 332.86 82° CA at 333.26 75° CA at 333.57 88° CA at 333.67
	360.90	26.61	MUDSTONE/SILTSTONE-(50:50 grading down to 100:0 at base)-interbedded and interlaminated dark grey silty mudstone and argillaceous siltstone, with scattered thin beds of coarse siltstone (5% of unit). Burrowing generally obscure, but evident in disruption of lamination. Coarse silt bands are delicately laminated, with occasional thin sandy laminae. Unit strongly calcareous at top, becoming patchily calcareous downward. Mudstone component
4°@	337.10		is non-calcareous towards base; base of unit defined by last calcareous band.
			Core ground; possible loss at 349.34. Slickensides and calcite: 55° CA at 336.81, 80° CA at 336.89, 86° CA at 337.10; 80° to 88° CA at 338.28 to 338.30; 88° CA at 346.02 Irregular calcite veins 353.22 to 353.48 (0° at 30° CA)
			Possible shell fragments (calcareous, with a cross-columnar structure, reminiscent of Inoceramus.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Specimen BP 69A/F/2, from 344.88.
			Extended passage base
			MOOSEBAR FORMATION
5° at 363.68 10° at 369.99 10° at 375.58	435.70	74.80	MUDSTONE-dark grey, slightly silty in parts, feintly micaceous, non-calcareous. Lacks lamination, but appears to expand and fracture along closely spaced bedding planes. Common lighter ferruginous bands and patches. Occasional pyrite lenses, small nodules and disseminated pyrite. Small burrows throughout. Occasional, locally common small, few medium pyritic burrows and trails througout. STRUCTURE-occasional high angle polished and slickensided planes 20° to 30° CA. Sub-vertical rough fracture plane passes in and out of core throughout unit (jointing). Few ?bedded polished slickensides and calcite lined planed 70° CA at 386.74. Brecciated with common polished slickensided and calcite lined planes 20° - 45° CA at 387.70 to 388.05, 388.66 - 388.81, and locally common polished slickensided and calcite lined planes 70°-75° CA (?bedding planes) and fractures 15°, 45° and 55° CA below to 392.44. Minor core loss, ?Minor Fault. Brecciated with common polished slickensided and calcite lined fractures 40° CA, and abundant small irregular hairline calcite infilled fractures 402.45 - 402.93. Thin layers containing calcite lined and slickensided hairline fractures 40°-70° CA, and highly irregular fractures infilled with up to 3 mm. calcite, commonly with secondary iron cementation: 406.70-406.78 407.76-407.92 409.32-409.35 413.45-413.59 414.82-414.97 415.29-415.39 418.17-418.22 419.69-420.00 422.14-422.18 424.97-425.04

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			BENTONITE BANDS 0.15 reworked layer with common small and large elliptical mud filled burrows, brecciated with few polished slickensided and calcite lined planes 0.03 ?ironstone band at base, 416.79. 0.06 layer with common mud filled ellipticalburrows up to 3 mm in top 0.02 m, sharp ground top, sharp base dip 12° at 422.56. 0.03 layer with irregular reworked top, common elliptical mud filled burrows up to 4 mm in top 0.02, slightly irregular and uneven base at 429.18. Few highly irregular reworked bentonite lenses up to 6 mm in thickness with vague elliptical mud filled burrows 434.36 - 434.43. Few irregular reworked and burrowed bentonite lenses and thin layers 433.90-433.95, 435.11-435.13.
10° at 435.39			Common irregular reworked lenses and thin layers up to .025 m with dark mud elliptical burrows, siliceous with ? few local glauconite grains, 435.30-435.41. 0.02 m mud infilled? pelecypod burrows in basal 0.02 m. Several bentonite infilled burrows up to 8 mm in width and 0.04 m in length, with small mud filled burrows up to 1 mm and small irregular reworked lenses 435.41 - 435.54. 0.07 bentonite layer with few small mud filled burrows, slightly irregular reworked top, and few thin mud lenses up to 0.02 m in width, 0.004 m sheared bentonite gouge at base 436.13. Sharp, non-fitting base.
	437.18	1.48	SANDSTONE-glauconitic, fine-grain with argillaceous matrix to 437.06, medium-grain below. No apparent lamination or bedding, non-calcareous. Few; locally common poorly sorted sub-rounded to sub-angular clasts up to 0.015 m of light and dark chert, few dark mud and silt clasts becoming more common below 437.06. Few irregular pyrite lined coal streaks at top and in top 0.07 m. Few pyrite lenses. Irregular erosive base, non-fitting.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			UPPER GETHING FORMATION
	437.18	2.02	TOP OF BIRD SEAM
	437.20	0.02	COAL -bright banded. Disc.
	437.22	0.02	COAL -bright banded. Disc
	437.24	0.02	COAL -dull hard. Fragment. Few semi-polished bedding planes dip 20°.
	438.12	(0.88)	CORE LOSS: COAL
	438.19	0.07	COAL-bright banded. Cylinder. Few polished bedding planes dip 20°, and fractures dip 50°-60°.
	438.24	0.05	COAL-dull banded. Cylinder. Few semi-polished beddin planes dip 20°, and polished fracture planes dip 45°.
	438.31	0.07	COAL-dull and bright. Fitting discs. Polished planes at top and bottom dip 40°.
	438.41	0.10	COAL-dull and bright. Fitting cylinders. Common low angle polished planes dip 40°.
30°	438.57	0.16	MUDSTONE-slightly carbonaceous. Partially fitting discs and cylinders. Common plant debris. Common slickensided and polished planes dip 40°. Calcite lined irregular fractures and microfaults in basal 0.07.
	438.68	0.11	MUDSTONE-carbonaceous. Cylinder. Microfaulted, calcite and microfaults in basal 0.03, listric bedding plane dip 10° at top, few listric fracture planes dip 45°-50°.
	438.70	(0.02)	CORE LOSS: MUDSTONE
	438.82	0.12	COAL-highly sheared: cornflakes.
	439.20	(0.38)	CORE LOSS: COAL Sharp, non-fitting base, polished, dip 22°.
	439.20		BASE OF BIRD SEAM
7° at 442.41	456.26	17.06	SANDSTONE-medium-grain to 445.23, fine-grain below. Very weakly calcareous to 442.00, highly calcareous below. Massively bedded, poorly laminated to 441.84 well laminated below. Dark grey and slightly carbonaceous with few coal streaks (? roots) and small coal clasts up to 4 mm, in top 0.47 m. Occasionally

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			below to 440.07 m. Occasional coaly roots below. Variably light to medium-grey below 440.07. 7mm thick pyrite lense at top of unit.
			Slightly churned up with few pin burrows 440.17-.37; small to medium burrows, abundant 440.37-441.38 Medium and large burrows 448.99-449.10.
			Cross-bedding and ripple sets 441.84 to sharp highly irregular erosive surface at 444.80.
5° at 447.12			Few thin pyrite laminae below 441.38.
			Few mud laminae lenses and thin layers 443.77-444.10
			Generally parallel bedded but with occasional small scale cross-bedding 443.35-453.53.
8° at 455.64			Intensely bioturbated and root distrubed 453.53-454.05 with few irregular dark mud lenses and laminae (?infilled roots). Common small sub-angular dark tabular mud clasts, calcite lined coaly laminae and few mud or rarely sand infilled roots, rare pyrite lenses, 454.05-454.66.
			STRUCTURE-sub-vertical rough joint occasionally passes in and out of core throughout.
			Rough fracture calcite lined 25° CA at 445.14.
			Sharp base-irregular, erosive.
			BIRD MARINE BAND 456.26-465.00
	459.62	3.36	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE-40:30:30 Highly calcareous throughout.
			Generally thinly bedded graded units fining upwards from medium-grey sand to dark mud. Base to sand commonly erosive or load casted, rarely granular with rounded granules of silt and white ?chert.
Sedimentary dips up to 20°			Common small dark mud filled burrows, medium sand filled burrows, few sand filled pelecypod burrows up to 0.01 m.
			Few calcite lined coal streaks at 456.40.
			Occasional ripple drift, small scale cross-lamination and slumping in sand units.
			Occasional disseminated pyrite throughout.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			STRUCTURE- sub-vertical joints pass down core.
Sedimentary dips up to 15°	461.45	1.83	SANDSTONE-fine-grained/MUDSTONE 75:25 interbedded. Sand layers medium-grey, very poorly laminated, highly calcareous, sharp erosive bases, sharp or gradational tops, occasional irregular dark mud lenses and stringers. Rare pelecypod burrows and medium worm burrows. Mud layers dark-grey, poorly laminated weakly calcareous, containing sand wisps, rare thin erosive sand layers and slumped sand. Micaceous, occasional disseminated pyrite. Locally silty. Common small burrows. STRUCTURE-sub-vertical calcite lined joint passes in and out of core. Rare rough fractures 30° CA.
Sedimentary dips up to 30°	463.75	2.30	SANDSTONE/MUDSTONE -50:50, interlayered. Sand layers fine to very fine but rarely medium-grain, medium-grey, highly calcareous, burrowed and root disturbed, passage top, erosive or passage base, commonly argillaceous. Few ripple sets, silt and mud angular lensoid or tabular clasts. Few roots, occasionally pyritic. Common disseminated pyrite. Mud layers, dark highly calcareous, containing common slumped and root distrubed sand stringers and lenses. Few roots occasionally pyritic. Common disseminated pyrite.
3° at 464.00	465.00	1.25	MUDSTONE-dark ferruginous mottling, highly calcareous, common fine burrows, sand lenses and stringers. Well cemented. Dark, canneloid and carbonaceous with common fine coaly plant debris in basal 0.22 m. Abundant small commonly sand filled burrows. STRUCTURE-sub-vertical rough joint passes in and out of core.
			Brief passage base
5° dip throughout	468.45	3.45	SANDSTONE-fine to medium-grain, rarely coarse-grain, highly calcareous. Abundant dark carbonaceous mud laminae and thin layers and calcite lined coal laminae (70 sand: 30 mud), crumpled and bioturbated by sand and mud filled medium and small burrows and few roots; occasional low angle cross lamination in top 0.59 m, and below 467.59 to base. 50% mud in basal 0.23 m. Rare mud laminae below 465.59, increasing in frequency to 467.59. Large globose to ellipsoidal sand filled burrows 465.69 - 465.98, and at 466.63.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Steep sedimentary dips 465.98-466.09, ? slumped and or burrowed. Ripple sets common below 466.14, decreasing in frequency to 467.59.
	468.48	0.03	COAL-dull and bright, cleated. Sharp non fitting top and base. (Does not pick out on geophysical.)
5° at 468.53	468.68	0.20	MUDSTONE-dark non-calcareous, slightly carbonaceous and canneloid. Abundant crumpled and cross-laminated, very fine calcareous sand lenses. Common fine carbonaceous plant debris. Several bedded calcite lined polished planes. STRUCTURE-several sub-vertical joint surfaces, 0.01 m spacing. Sharp, irregular eroded base.
	470.23	1.55	SANDSTONE-fine to medium-grain, highly calcareous, massively bedded and unlaminated, abundant coaly roots Few calcite replaced pelecypod shells up to 0.015 m. Brief passage base.
	470.76	0.53	MUDSTONE-dark, weakly calcareous, slightly carbonaceous. Few, locally common disturbed and bioturbated very fine-grain sand lenses. Few roots in top 0.11 m. Occasional calcite lined fine coal laminae, common micaceous planty planes. Very brief passage base.
			?SHELL COAL EQUIVALENT
	471.05	0.29	MUDSTONE-dark and slightly canneloid. Common disseminated pyrite and pyrite lenses. Common large pyritic and calcite replaced pelecypod shells up to .02m, and small shells up to 3 mm. ?Pyritic burrows. Closely spaced joints 20° CA pass down core (0.01-0.02 spacing). Occasional coalified plant debris. 6 mm bright coal with calcite laminae at top, dip 4° at base 471.14.
4° @ 471.14			
	471.63	0.58	SILTSTONE-sandy, few root disturbed sand lenses. Common roots. Highly calcareous, well cemented and massive. Passage base.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
Sedimentary dips up to 10° 2° at base	473.03	1.40	SANDSTONE-very fine grain/SILTSTONE/MUDSTONE, 40:35:20, interlaminated and thinly interlayered. Highly calcareous throughout. Occasional root disturbance to 472.10. Occasional small burrows. Occasional ripple sets. Local crumpling and small scale slumping. Passage base.
1° at 474.00	474.55	1.52	MUDSTONE-silty in top 0.3 m, colour laminated, well cemented, highly calcareous; abundant small ripple cross-laminated sand lenses at top, decreasing infrequency to base, few only below. Occasional sand filled medium burrows. Large slump structures 473.89-474.02
	475.54	2.22	MUDSTONE-dark, locally colour laminated to 475.51. Black, micaceous and commonly canneloid below 475.51 with common fine coalified plant debris and rare small pelecypod shells. Few vague small burrows to 475.51. STRUCTURE-joint 12° CA in basal 0.13 m Unattached, non-fitting base.
	475.64		TOP OF UPPER CHAMBERLAIN SEAM UPPER LEAF
	475.88	(0.24)	CORE LOST- MUDSTONE
	475.93	0.05	COAL-dull and bright. Fragments
	476.10	(0.17)	CORE LOST- COAL
	476.13	0.03	MUDSTONE-carbonaceous, few polished and calcite lined planes. Fragments.
	476.18	(0.05)	CORE LOST -MUDSTONE
laminations dip up to 10°	476.19	0.01	MUDSTONE-carbonaceous. Disc, attached to cylinder below.
	476.24	0.05	COAL-dull banded. Cylinder.
	476.30	0.06	COAL-dull and bright, dirty appearance. Fragments and part disc.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	476.33	(0.03)	CORE LOST-MUDSTONE
	476.62	0.29	MUDSTONE-very carbonaceous (approaching dirty coal basal .06). Locally cleated, low S.G. Fitting and non-fitting discs and cylinders.
	476.77	0.15	CORE LOST-MUDSTONE
	476.77		BASE OF UPPER CHAMBERLAIN SEAM UPPER LEAF
	476.98	0.21	MUDSTONE-dark and carbonaceous with abundant small and large coaly plant debris. Non-calcareous. Common irregular listric surfaces in top 0.07 m. Passage base.
	479.12	2.14	SILTSTONE-light grey with common dark thin mud laminae and interbeds to 478.24; SILTSTONE-light grey/MUDSTONE-medium grey silty 70:30 thinly interbedded with few dark mud laminae and thin interbeds below to base. Highly calcareous abundant roots with root disturbance to 477.50, occasionally below. Vaguely burrowed appearance below 477.83. STRUCTURE-core locally fractures along rough planes 25°-45° CA. Occasionally sub-vertical rough joints.
Dips up to 5° throughout	480.93	1.81	MUDSTONE-silty light-grey/MUDSTONE-dark grey, generally thinly interlayered, locally interlaminated. 70:30 top to 480.12, 60:40 480.12-480.42, 10:90 480.42 480.65, 50:50 480.65 base. Highly calcareous throughout. Commonly crumpled with small to medium commonly flattened burrows. STRUCTURE-core locally fractures along rough planes 25° - 45° CA. Occasional rough sub-vertical joints.
0° at 480.60 ?5° at 481.42	481.49	0.56	MUDSTONE-dark, few lighter silty laminae towards top, poorly laminated below; dark with common fine carbonaceous plant debris 481.01-481.10. Weakly calcareous throughout. Locally abundant small burrows 481.10 to base. Calcite lined and slickensided probable bedding plane (sub horizontal) at 480.60, probable bedding plane dip 5° at 481.42.

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Dip°	DEPTH m	THICKNESS m	DESCRIPTION
5° at base			Sharp unattached base, polished ? bedding plane with few calcite laminae up to 2 mm thickness, 5° dip.
			TOP OF UPPER CHAMBERLIAN SEAM, LOWER LEAF
	481.77	0.28	COAL-highly sheared dull and bright fragments. 0.22 m core lost.
			Sharp base, 5 mm of sheared coal attached.
			BASE OF UPPER CHAMBERLAIN SEAM, LOWER LEAF
	482.17	0.40	MUDSTONE-dark and carbonaceous with abundant coaly plant material and roots. Becoming silty below top 0.05 m, and rapidly sandy at base. Sheared in top 0.05 m with abundant listric, few calcite lined planes.
	483.34	1.17	SILTSTONE-medium-grey/SANDSTONE-very fine grain, light-grey, 65:35, thinly interbedded, becoming 70:30 to base. Siltstone becomes muddy with dark mud laminae and thin layers below 482.70. Highly calcareous throughout. Common small to medium burrows with bioturbation and crumpling.
			Dark in top 0.12 m with common roots. Occasional root disturbance below.
			Occasional low angle cross-lamination.
			Occasional micaceous planty planes.
Dips up to 4° throughout	486.46	3.12	MUDSTONE/MUDSTONE silty/SANDSTONE 30:45:20 top to 485.20. Mudstone and silty mudstone interbedded with common sand laminae and thin layers. Crumpled and locally slumped with small to medium burrows and few roots.
			Sand content rapidly decreases down, mud content increases. 55:35:10 485.20-485.95, 70:30 below, to 80:20 at base, with few low angle cross-laminated and burrowed sand laminae and lenses. Sand is moderately calc, silt and mud weakly calcareous.
			Rare semi-polished bedding planes.
			Unattached, non-fitting. Several semi-polished slickensided and calcite lined planes in basal .02m.
	486.46		TOP OF LOWER CHAMBERLAIN SEAM
	486.48	0.02	MUDSTONE-very carbonaceous and canneloid, low S.G. Part cylinder. Attached.

BH NO. BP-69A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	486.50	0.02	COAL-dull and bright. Part cylinder.
	486.53	0.03	COAL-dull and bright, few semi-polished planes dip 25°. Part disc.
	486.58	0.05	COAL-dull and bright, bounded by semi-polished planes, dip 25°. Fitting Discs.
	486.61	0.03	COAL-dull banded. Fragments.
	486.64	0.03	COAL-bright. Disc.
	486.83	0.19	COAL-dull banded, locally dull and bright. Fitting cylinders and discs.
	486.85	0.02	COAL-dull banded. Fragments.
	486.92	0.07	COAL-dull and bright. Fitting disc and cylinder.
	487.01	0.09	COAL-dull and bright, few semi-polished planes dip 25°. Fitting cylinder and disc.
	489.03	0.02	COAL-bright banded. Fragment.
	487.16	0.13	COAL-dull and bright, few semi-polished planes, dip 25°. Fitting cylinders.
	487.20	0.04	COAL-dull and bright, few semi-polished planes dip 25°. Cylinder.
	487.26	0.06	COAL-dull and bright, few semi-polished planes, dip 25° Cylinder.
	487.45	0.19	COAL-dull and bright, few semi-polished planes, dip 25°. Cylinder.
	487.54	0.09	COAL-dull and bright, few semi-polished planes, dip 25°. Cylinder.
	487.56	0.02	COAL-dull banded, few semi-polished planes, dip 25°. Cylinder.
	487.65	0.09	COAL-dull and bright, few semi-polished planes, dip 25°. Cylinder.
	487.78	0.13	COAL-dull and bright few semi-polished planes, dip 25°. Cylinder.
	488.26	0.48	COAL-dull and bright, few semi-polished planes, dip 25°. Fitting cylinders.
	488.43	0.17	COAL-bright banded top .08 dull banded central .04

BH NO. BP-69A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			dull and bright basal .05, few semi-polished planes dip 25°. Cylinder fitting to cylinder below.
	488.66	0.23	COAL-dull banded top .10, bright banded below, few semi-polished planes dip 25°. Cylinder.
	488.90	0.24	COAL-dull and bright, bright in basal .04, few semi-polished planes dip 25°. Fitting cylinders.
	488.92	0.02	COAL-dull and bright. Disc.
	488.95	(0.03)	CORE LOST: COAL
	489.14	0.19	COAL-dull and bright. Fragments.
	489.21	(0.07)	CORE LOST-MUDSTONE, carbonaceous.
	489.22	0.01	MUDSTONE-carbonaceous, common polished bedding planes.
	489.25	0.03	MUDSTONE, very carbonaceous. Part disc.
	489.56	(0.31)	CORE LOST: DIRTY COAL
	489.56		BASE OF LOWER CHAMBERLAIN SEAM
	495.20	5.64	SANDSTONE-medium-grain, locally fine, fine-grain below 493.64, medium-grey, very weakly calcareous. Very poorly laminated and massively bedded. Dark and carbonaceous with abundant disseminated coal grains and few coal streaks and coaly roots in top 0.3 m. Occasional micaceous planty or coaly planes, and coaly roots throughout. 0.2 dark siltstone layer at 493.26, sharp top 5° dip, sharp base polished by drillers, abundant mica flecks and carbonaceous plant debris, .01 fine sand lense centrally. 0.01 dark carbonaceous siltstone layer, sharp uneven eroded top and base, base at 493.41 0.02 layer with angular dark carbonaceous siltstone clasts, 5° dip at 493.46. Occasional drifting lamination with dips up to 25°. STRUCTURE-occasional calcite lined locally slickensided rough fractures 15° CA, Occasional calcite lined ? bedding planes dip 5°-10°.
Sedimentary dips up to 25°			
			BASE OF BOREHOLE 495.20 m

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 70

Contractor: Hi-Rate Drilling

Co-ordinates: N 6119262.4
E 590884.0

Commenced: 11/6/79

Surface Elevation: 1551.2 m

Completed: 10/7/79

Geophysically logged: yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Geologist — Depth —

Logged by:

Final Depth: 490.00 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Gates	148.80	143.80+	1402.40
Sukunka	280.00	131.20	1271.20
Moosebar	346.38	UP 66.38	1204.82
Gething (Upper)	UP 404.09 LP 488.52	LP 57.71 50.52	1147.11 1062.68
(Lower)	UP 438.00 LP 490.00	UP 33.91 LP 1.48+	1061.20

SEAMS		DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird		348.10	1.72 (d/dc 0.73)	-	1203.10
U. Chamberlain	UP	393.90	2.37 (d 0.97)	-	1157.30
	LP	477.76	6.44 (d/dc 3.36)	-	1073.44
L. Chamberlain	UP	404.09	3.97*(bone 0.16)	-	1147.11
	LP	488.52	4.04*(bone 0.12)	-	1062.68

* ? overthickened by dip element.

STRUCTURAL FEATURE	DEPTH	REMARKS
F. EST.	438.00 m	RIM Fault, throw 84.43 m.

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-70 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	0.7°	N 33° W
100m	1.6°	N 32° W
150m	1.6°	N 49° W
200m	2.7°	N 41° W
250m	3.2°	N 14° W
300m	5.4°	N 10° E
350m	9.2°	N 29° E
400m	10.0°	N 30° E
450m	9.0°	N 24° E
488m	9.0°	N 17° E

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 71

Contractor: Hi-Rate Drilling

Co-ordinates: N 6119514.3
E 591555.3

Commenced: 28/6/79

Surface Elevation: 1605.7 m

Completed: 8/7/79

Geophysically logged: yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Geologist Depth

Logged by: - -

Final Depth: 441.20 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Gates	182.40	179.40+	1423.30
Sukunka	311.60	129.20	1294.10
Moosebar	377.22	65.62	1228.48
Gething (Upper)	427.84	50.62	1177.86
(Lower)	441.20	13.36+	1164.50

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	379.25	2.03 (d/dc 0.97)	-	1226.45
U. Chamberlain (UL)	416.38	0.92 (d/dc 0.92)	-	1189.32
U. Chamberlain (LL)	420.22	0.41	-	1185.48
L. Chamberlain	427.84	2.74		1177.86

STRUCTURAL FEATURE DEPTH REMARKS

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-71 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	1.1°	N 29° W
100m	2.7°	N 15° W
150m	2.1°	N 12° W
200m	3.2°	N 6° E
250m	3.8°	N 12° E
300m	4.2°	N 14° E
350m	5.3°	N 32° E
400m	6.2°	N 34° E
440m	7.8°	N 31° E

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BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 72 & BP 72A

Contractor: Tonto Drilling

Co-ordinates: N 6117087.3
E 589955.8

Commenced: 11/7/79

Surface Elevation: 1187.7 m

Completed: 22/7/79

Geophysically logged: yes/~~no~~/*
(through rods)

Core Size: HQ

Hole cemented: yes/~~no~~/

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m
- base of divertion wedge 98.70

	Geologist	Depth
Logged by:	D. J. W. Mitchell	0.00-T.D.

Final Depth: 109.7 m

N.B. BP72A diverted off BP72, to recover Lower Chamberlain Seam

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Moosebar	21.80	3.3 +	1165.90
Gething (Upper)	UP 18.50	4.19+	1169.18
	MP 52.80	34.28	1134.90
	LP 102.33	49.53	1085.37
(Lower)	109.70	7.37+	1078.00

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	23.20	1.4 (d 0.41)	1%	1164.5
U. Chamberlain	92.01	1.96 (d/dc 1.18)	9.4%	1095.69
L. Chamberlain	102.33	3.17 (bone 0.14)	54.31%	1085.37

STRUCTURAL FEATURE	DEPTH	REMARKS
F. EST	18.50	Brecciation, major core loss; major fault, throw indeterminable (4.19 m+).
F. EST	52.80	Brecciation, calcite, micro-faults; throw 23.9 m.

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-72 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION
50m	1.0°
109m	0.7°

Hole logged through drill-rods, so azimuth figures unavailable.

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BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	14.31	14.31	DRIFT, contains large blocks up to 0.15 m of sandstone medium-grain, salt and pepper texture, vaguely laminated, highly calcareous. Major core loss.
	19.40	5.09	UPPER GETHING FORMATION SANDSTONE, fine to medium-grain, laminated, highly calcareous.
50° @	14.77		
50° @	17.37		Few rough bedding plane fractures, few calcite lined fractures 45°-60° CA.
60° @	18.08		Occasional discrete ferruginous weathering. Fault disturbed with major core loss.
			FAULT ESTABLISHED, major displacement, fault zone 19.40 -23.16.
	20.80	1.40	FRAGMENTS: MUDSTONE, light-grey, poorly laminated, thinly bedded, soapy texture. One disc with 20° dip and 2 sets fine calcite lined joints conjugate angles 49° and 54°, sub-vertical to bedding. Wormy appearance. Highly calcareous. Major core loss. Sharp base: core loss.
	21.80	1.00	FRAGMENTS AND DISCS: SANDSTONE, fine to medium-grain, poorly laminated, salt and pepper texture. Highly calcareous. 0.1 m ferriginous weathered cylinder with abundant irregular calcite infilled fractures @ 23.06.
	23.20	1.40	CORE LOST BIRD SEAM: Recovery of few Coal fragments only; from geophysical log - Coal 0.47 Mudstone Carbonaceous 0.41 Coal 0.52
	24.21	1.01	MUDSTONE, micaceous, slightly silty passing into a muddy siltstone down, poorly laminated. Abundant roots. Few very small carbonaceous mudstone and coal laminae at top. Non-calcareous. Common ochre stained weathered fracture surfaces. Sharp base: core loss

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	44.41	20.20	SANDSTONE, medium-grain, fine-grain below 40.80; salt and pepper texture to 40.80. Poorly laminated to 26.00, laminated with locally common dark muddy carbonaceous and coaly laminae to 30.80, disturbed 30.80-40.80 (see below), poorly laminated and massively bedded below 40.80. Non-calcareous to 29.50 becoming high calcareous below. Dark and carbonaceous with coaly roots in top 0.17, few roots below to 36.25.
Sedimentary dips 18° to 30° throughout			Occasional large scale cross-lamination top to 30.80.
			Common small light burrows 26.72-26.82. Common large globose burrows 29.45-40.80.
			Thoroughly bioturbated and disturbed with large globose burrows, few pelecypod burrows, rare root disturbance to 36.25, few slump structures, and few thin laminated layers 30.80-40.80.
			Few small light burrows 38.28-41.15. Common globose, few small burrows 42.67-42.93.
			Occasional rough and calcite lined rough fractures 55° - 60° CA.
			Thick calcite up to 0.01 m with common fine calcite lined hairline fractures immediately adjacent at 30.25. Sharp base: minor core loss.
	46.00	1.59	MUDSTONE/SILTSTONE/SANDSTONE, very fine-grain 35:30:35, with 0.5 m fine parallel bedded sand layer-passage top, slightly erosive base at 45.20. Generally thin graded units with sharp slightly erosive and load casted bases, usually fining up from sand through silt to dark mud.
			Sand-highly calcareous, mud-very weakly calcareous.
20°@	44.82		Occasional crumpling; occasional cross-lamination; occasional bioturbation below 45.31.
20°@	45.00		
15°@	45.25		
20°@	45.64		Common calcite lined and listric bedding planes and few irregular calcite infilled hairline fractures in top 0.15 m, occasionally below, and in basal 0.03 m.

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Few small light burrows, common small light and dark burrows; few medium and large burrows below 45.31. Sharp even base, dip 17°.
	51.20	5.20	SANDSTONE, fine to medium-grain, medium to coarse-grain below 49.87. Thin graded units in top 0.35 m fining up from medium to very fine-grain. Generally poorly laminated throughout. Moderate to highly calcareous. Salt and pepper texture in top 0.42
30° @	49.70		and below 49.87. Dark and slightly carbonaceous with disseminated coal grains and coaly pyritic plant debris 49.38 to 49.69; irregular pyritic and dirty coal laminae up to 0.01 thick at 49.70, muddy with common coal streaks to 0.04 m below; occasional coal streaks and roots below to 50.00.
25° @	base		
			FAULT, ESTABLISHED-major displacement, fault zone-51.20-53.20
	53.20	2.00	SANDSTONE, fine to medium-grain, vaguely laminated, abundant highly irregular polished and calcite lined fractures and microfaults. Weakly to moderately calcareous.
53°@	51.32		Few dark carbonaceous mudstone and dirly coal streaks.
	67.82	14.62	SANDSTONE, fine to medium grain, highly calcareous throughout. Common dark and carbonaceous laminations with occasional roots, top to 54.88; vaguely laminated in parts below, with roots to 64.90.
Sedimentary dip 2°-15°, top to 54.80			Locally common large globose burrows to 64.90.
			Locally disturbed with abundant globose burrows, few ?pelecypod burrows, bioturbation, local crumpling and slumping 59.10-64.90.
			Occasional large scale cross-lamination top to 54.80
5° @	60.69		Occasional rough or calcite lined fractures 55°-65° CA.
3° @	66.80		Dark grey and slightly carbonaceous with few dark micaceous and carbonaceous laminations, coaly roots and plant debris, and common large globose burrows 66.75-66.94. Slightly carbonaceous and unlaminated below to 67.53.
			Sharp, slightly irregular and erosive base dip 15°.

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	69.80	1.98	MUDSTONE/SILTSTONE/SANDSTONE, fine to very fine grain, 40:20:40, thin graded units, interbedded with thin SANDSTONE fine beds. Mud/silt/sand units generally consist of thin graded units with sharp slightly erosive bases, fining from sand up to mud. Sand are occasionally ripple set. Common small light and dark burrows. Occasional, locally common, medium and large burrows with associated bioturbation. Sandstone fine units or medium/coarse units are up to 0.21 m in thickness, are laminated with micaceous planty planes and contain occasional large scale cross-lamination with sharp slightly erosive bases and sharp tops. Sub-vertical step jointing 68.35-68.63
	73.08	3.28	SANDSTONE, fine, locally medium-grain, generally massive but locally faintly laminated, highly calcareous.
15°@	71.41		Fine to very fine grain with two thin dark mud layers in top 0.25 m. Weakly micaceous. Local disseminated coal grains and small fragments. Rare disseminated pyrite throughout. Few calcite lined fractures 20° CA. Sharp, slightly uneven and erosive base, 40° dip. Polished, slickensided and calcite lined.
	73.29	0.21	SILTSTONE, slightly carbonaceous mud laminae, disturbed appearance-burrowed and root distrubed. Common carbonaceous roots. Few pyrite infilled ?roots. Weakly calcareous. Brief passage base.
	74.95	1.66	SANDSTONE fine to very fine-grain/SILTSTONE/MUDSTONE 55:30:15, interlaminated and thinly interlayered. Few thin ripple set medium-grain sand layers up to 0.22 m. Highly calcareous. Common ripple sets and cross-lamination. Few roots - occasionally pyritic. Small commonly pyritic burrows 73.90-74.16. Occasional micaceous planty and coaly planes. Rare hairline calcite lined bedding planes. Sharp, slightly uneven and erosive base 3° dip.

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
Core fractures along bedding at 3° dip	76.10	1.15	MUDSTONE, abundant lighter silty bands. Highly calcareous. Very silty in top 0.04. Abundant small burrows, few large burrows. Rare sand filled roots. Few rough and calcite lined fractures, sub-vertical to 12° CA. Brief passage base
	76.18	0.08	MUDSTONE, dark, canneloid and slightly carbonaceous. Slightly silty, micaceous. Abundant carbonaceous plant debris. Very brief passage base.
Sedimentary dips up to 25°	79.40	3.22	SANDSTONE, medium-grain, few, locally abundant micaceous and carbonaceous or coaly laminae. Highly calcareous. Dark and carbonaceous in top 0.05. Abundant ripple sets. Few light small to medium burrows 76.23-76.26. Few roots, becoming common below 78.51. Few, locally common small light burrows 78.69-78.86, 79.11 to base. Common crumpled dark carbonaceous mud laminae 76.96-77.26, 78.69-78.86, abundant below 79.11 increasing in frequency to base. Extended passage base.
Sedimentary dips up to 10°	80.48	1.08	SILTSTONE, dark mud phases locally canneloid and slightly carbonaceous, abundant sand laminae, and crumpled bioturbated, low angle ripple cross-laminated and rarely slumped calcareous sand lenses. Micaceous. Abundant pelecypod shells up to 0.01 m in width. Occasional disseminated pyrite. Common small and medium sand filled burrows. Sharp base: core loss
	83.32	2.84	MUDSTONE, dark, very carbonaceous in top 0.4 m recovered, becoming slightly silty and slightly carbonaceous below. Abundant carbonaceous and coaly roots and plant debris, occasionally listric. Few small irregular listric surfaces, few listric fractures 45°-55° CA. Non-calcareous 0.32 m core lost: 80.48-83.32

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
Cont'd		0.60m+ SANDSTONE - very fine-grained, silty laminae, medium-bedded, laminated, rippled, blocky, orange-weathering, one red-weathering band, strongly calcareous. Occasional tiny plant fragments. Attitude: 170/3E
		0.15m+ SILTSTONE - thinly-bedded, brown, light brown-weathering, rubbly, with ironstone band at base. Weakly calcareous. Abundant plant fragments on bedding planes. Some tiny ripples.
		0.93m+ MUDSTONE - dark grey, purplish-grey-weathering, rubbly, silty, with ironstone band near top. Non-calcareous.
		BASE OF SECTION. This section is the upward continuation of that exposed at △MR62. (Probably just below floor of DE$_1$ SEAM).
C136	Cog	SILTSTONE - dark grey, very sandy, devoid of lamination, abundant dark burrows. Non-calcareous. Sukunkoid Marker
C137	Cog	SILTSTONE - dark grey, very sandy, traces of lamination, abundant dark burrows. Sukunkoid Marker. Non-calcareous, rubbly, dark grey-weathering, thinly-bedded to massive. Attitude: 147/9SW.
C138	Cog	SILTSTONE - brown, laminated, rippled, some sandy laminae, non-calcareous, thinly-bedded, rubbly, dark argillaceous laminae, scattered small dark worm burrows. Attitude: 051/6SE.
C139		ATP DDH S-25. Rods in hole (NQ?). Water level about 10m. Open to at least 68m.
C140	Cog	MUDSTONE - brown, blocky to rubbly, slightly silty, scattered tiny flat plant debris, possible rootlets? Non-calcareous.
C140A =K627	Cog	Section in roadcut: Top: 0.6m+ SILTSTONE/SANDSTONE - very fine-grained, interbedded, with scattered small worm burrows, non-calcareous, grey-brown, platy, thin-bedded, well-laminated and rippled.

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	92.01	0.74	COAL, dull and dull lustrous. Well cleated, common irregular polished planes; fragments and discs. MAJOR CORE LOSS: 0.63 m Coal lost. Sharp unattached base.
	92.01		BASE OF UPPER CHAMBERLAIN SEAM
	92.44	0.43	MUDSTONE, dark, slightly silty, passing down to SILTSTONE dark. Massive and strong. Abundant carbonaceous and coaly roots. Very weakly calcareous towards base.
			Passage base.
	94.64	2.20	SANDSTONE fine and SILTSTONE, interlaminated and thinly interlayered. 60:40 to 94.14, fining below to 20:80. Very fine sand and siltstone at base. Few dark mud laminae and thin layers. Highly calcareous throughout. Slumped and slurred with common root disturbance to 92.55, occasional crumpling and root distrubance below.
			Locally common ripple sets 92.55 to 94.02, occasional low angle cross-lamination below. Few small to medium burrows locally. Bioturbated with common small burrows below 94.02.
			Common micaceous planty planes. Common calcite lined sub-vertical fractures stemming from master calcite lined fracture 28° CA at 92.32. 0.01 sub-horizontal calcite with common calcite lined irregular fractures adjacent at 93.32.
			Extended passage base.
	97.45	2.81	MUDSTONE, silty, locally SILTSTONE, common thin darker mud layers. Thinly interlayered. Common crumpled
5° @	95.15		and bioturbated sand laminae and lenses.
10°@	95.93		
			Common small burrows throughout. Few rough or calcite lined fractures 20° CA.
	98.93	1.48	MUDSTONE dark/MUDSTONE silty, 40:60 top to 98.51, fining to 50:50 at base. Very weakly calcareous. Few crumpled sand lenses. Common small burrows throughout.
			Brief passage.

BH No. BP-72

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	99.16	0.23	MUDSTONE-dark, abundant thin micaceous silty bands. Occasional very fine carbonaceous plant debris. Unattached, non-fitting base
	99.16	+	TOP OF LOWER CHAMBERLAIN SEAM COAL-not logged in detail: Major core loss, borehole appears to have bottomed within seam. Re-drilled as BP72A. BASE OF HOLE (drillers depth) 102.71 m.

BH No. BP-72A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			Core Commences 98.70m. (Diversion by wedge off BP-72, to redrill Lower Chamberlain Seam.)
	98.93	0.23	MUDSTONE dark/MUDSTONE silty, 40:60 top, fining to 50:50 at base. Very weakly calcareous. Few crumpled sand lenses. Common small burrows throughout
			Brief Passage
	99.16	0.23	MUDSTONE dark, abundant thin micaceous silty bands. Occasional very fine carbonaceous plant debris.
	99.16	3.17	TOP OF LOWER CHAMBERLAIN SEAM
	99.30	(0.14)	CORE LOST: ? BONE or MUDSTONE carbonaceous.
	99.36	0.06	COAL. Slurry.
	99.77	(0.41)	CORE LOST: COAL, 99.16-99.77
	99.85	0.08	COAL, dull and bright, highly sheared. Fragments.
	99.89	0.04	COAL, dull and bright. Cylinder.
	99.92	0.03	COAL, dull banded. Disc.
	100.03	0.11	COAL, bright and dull. Fragments. Few irregular shear planes.
	100.14	0.11	COAL, highly sheared and pulverized. Fragments.
	100.17	0.03	COAL, dull banded. Fragments.
	100.23	0.06	COAL, bright and dull. Cylinder.
	100.26	0.03	COAL, dull banded. Disc.
	100.68	(0.42)	CORE LOST: COAL, 99.77-100.68
	100.72	0.04	COAL, dull and bright. Cylinder.
	100.78	0.06	COAL, dull and bright. Fragments. Few irregular shear planes.
	100.84	0.06	COAL, dull and bright. Fragments. Few irregular shear planes
	100.88	0.04	COAL, dull and bright. Fragments.
	100.92	0.04	COAL, dull and bright. Cylinder.

BH No. BP-72A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	100.95	0.03	COAL, bright, highly sheared. Cylinder
	100.99	0.04	COAL, bright and dull, highly sheared. Cylinder
	101.03	0.04	COAL, dull and bright, highly sheared. Cylinder
	101.07	0.04	COAL, dull and bright, highly sheared. Cylinder
	101.08	0.01	COAL, dull and bright, highly sheared. Disc
	101.11	0.03	COAL, dull and bright, highly sheared. Disc
	101.14	0.03	COAL, dull highly sheared. Disc
	101.16	0.02	COAL, dull highly sheared. Disc
	101.18	0.02	COAL, dull highly sheared. Disc
	101.20	0.02	COAL, dull highly sheared. Disc
	101.24	0.04	COAL, dull highly sheared. Disc
	101.27	0.03	COAL, dull and bright highly sheared. Disc
	101.35	0.08	COAL, dull highly sheared. Cylinder
	101.37	0.02	COAL, sheared. Fragments
	101.41	0.04	COAL, dull. Disc
	101.43	0.02	COAL, dull. Disc
	101.45	0.02	COAL. Disc.
	101.49	0.04	COAL, sheared. Fragments
	101.58	0.09	COAL, pulverized and sheared. Fragments
	102.33	(0.75)	CORE LOST: COAL, 100.68-102.33
	102.33		——————— BASE OF LOWER CHAMBERLAIN SEAM ———
	103.65	1.32	MUDSTONE, dark, carbonaceous with coal laminae in top 0.10 m recovered, (0.33 m core lost top to 102.79), slightly silty and micaceous below. Abundan roots. Hard and competent. Occasional irregular polished surfaces.
	104.67	1.02	SILTSTONE, dark unlaminated. Occasional vague disturbed sand lenses, common below 104.31, becoming abundant to base.

BH No. BP-72A

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
Core Fractures at 14°? bedding			Abundant coaly roots Brief passage base.
	107.82	3.15	SANDSTONE, fine-grained becoming medium down, mostly dark and carbonaceous with disseminated coal grains and small fragments. Few thick coal streaks. Few irregular calcite lined bedding planes of low angle dip. Few rough fractures, sub-vertical or 25° CA. Fairly sharp base.
	109.70	1.88+	SANDSTONE, fine to medium-grain, vaguely laminated.
10° @ 109.11			Sub-vertical rough calcite lined fracture passes down core throughout.
			BASE OF BOREHOLE 109.70

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 73

Contractor: Hi-Rate Drilling

Co-ordinates: Not surveyed
N location adjacent
E to BP 73A

Commenced: 16/7/79

Surface Elevation: m

Completed: 18/7/79

Geophysically logged: *yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m
(?4 7/8 "tricone cemented in top of hole)

Logged by:

Geologist	Depth
-	-

Final Depth: 143.60

* Redrilled on adjacent location as BP-73A.

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION

See summary sheet BP-73A

STRUCTURAL FEATURE	DEPTH	REMARKS

BP 73 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
10 m	0.6^{o}	-
50 m	1.6^{o}	-
100 m	1.7^{o}	-
144 m	1.4^{o}	-

(Azimuth not available due to rods in hole)

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 73A

Contractor: Hi-Rate Drilling

Co-ordinates: N 6117370.6
E 591050.4

Commenced: 28/7/79

Surface Elevation: 1204.2 m

Completed: 29/7/79

Geophysically logged: yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole 13 m

Geologist — Depth —

Logged by:

Final Depth: 105.00 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Moosebar	41.63	41.63+	1162.57
Gething (Upper)	102.43	60.80	1101.77
(Lower)	105.00	2.57+	1099.20

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	41.92	0.29(d/dc 0.29)	-	1162.28
U. Chamberlain (UL)	87.83	0.62(d 0.62)	-	1116.37
(LL)	93.64	0.40(d 0.40)	-	1110.56
L. Chamberlain	102.43	2.77	-	1101.77

STRUCTURAL FEATURE	DEPTH	REMARKS

BP 73A SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50 m	1.5°	N 62° E
82 m	2.9°	N 72° E

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 74

Contractor: Hi-Rate Drilling

Co-ordinates: N 6118097.7
E 592243.5

Commenced: 18/7/79

Surface Elevation: 1273.8 m

Completed: 20/7/79

Geophysically logged: yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Geologist

Depth

Logged by:

Final Depth: 165.80 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Moosebar	81.08	76.08+	1192.72
Gething (Upper)	134.06	52.98	1139.74
(Lower)	165.80	31.74+	1108.00

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	83.05	1.97 (d 0.79)	-	1190.75
U. Chamberlain	124.24	3.79 (d/dc 3.79)	-	1149.56
L. Chamberlain	134.06	2.98	-	1139.74

STRUCTURAL FEATURE	DEPTH	REMARKS

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 75

Contractor: Hi-Rate Drilling

Co-ordinates: N 6117982.4
E 592063.2

Commenced: 21/7/79

Surface Elevation: 1252.4 m

Completed: 22/7/79

Geophysically logged: yes/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole None m

Logged by:

Geologist	Depth
-	-

Final Depth: 141.30 m

FORMATION/MEMBER		DEPTH	THICKNESS	ELEVATION
Moosebar		UP 62.20		1190.20
		MP 68.26	6.06	1184.14
		LP 73.11	4.85	1179.29
Gething	Upper	133.58	60.47	1118.82
	Lower	141.30	7.72+	1111.10

SEAMS		DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	UP	64.33	2.13 (d/dc 0.88)	-	1188.07
	MP	72.24	3.98	-	1180.16
	LP	77.48	4.37 (d/dc 1.42)	-	1174.92
Upper Chamberlain		119.73	0.50	-	1132.67
Lower Chamberlain		133.58	3.80 (bone 0.27)		1118.82

STRUCTURAL FEATURE	DEPTH	REMARKS
F. EST	67.20-76.00	Bird Seam overthickened and repeated; RIM Fault, throw ± 13 m.

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-75 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION	AZIMUTH
50m	9.1°	N 33° E
100m	10.8°	N 29° E
139m	11.6°	N 33° E

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 76

Contractor: Hi-Rate Drilling

Co-ordinates: N 6117555.6
E 591443.9

Commenced: 23/7/79

Surface Elevation: 1229.3 m

Completed: 28/7/79

Geophysically logged: yes*/~~no~~

Core Size: (Rotary)

Hole cemented: yes/~~no~~

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole 16 m

Logged by:	Geologist	Depth
	-	-

Final Depth: 177.7 m

* Section 130-177.7 m logged through rods

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Moosebar	77.47	68.47+	1151.83
Gething (Upper)	174.91	97.44	1054.39
(Lower)	177.7	2.79+	1051.60

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	79.88	2.41 (d/dc 1.4)	-	1149.42
Upper Chamberlain	166.69	0.39	-	1062.61
Lower Chamberlain	174.91	1.63 (bone 0.14)	-	1054.39

STRUCTURAL FEATURE	DEPTH	REMARKS
FAULT	120.90	Fractured to 6m above; COAL Fault, throw ± 41 m.

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP 77

Contractor: Hi-Rate Drilling

Commenced: 30/7/79

Completed: 2/8/79

Core Size: (Rotary)

Hole Angle & Azimuth: see details overleaf

Co-ordinates: N 6117186.8
E 590725.2

Surface Elevation: 1249.1 m *

Geophysically logged: yes/~~no~~ (through rods)

Hole cemented: yes/~~no~~

Casing Left in Hole 36.6 m

Logged by:	Geologist	Depth
	-	-

Final Depth: 132.60 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Moosebar	47.60	43.10+	1201.50
Gething: (Upper)	113.16	65.56	1135.94
(Lower)	132.60	19.44+	1116.50

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Bird	48.74	1.14 (d/dc 0.59)	-	1200.36
Upper Chamberlain (UL)	99.44	0.90 (d 0.90)	-	1149.66
Upper Chamberlain (LL)	103.48	0.48 (d/dc 0.48)	-	1145.62
Lower Chamberlain	113.16	2.64 (bone 0.08)	-	1135.94

STRUCTURAL FEATURE	DEPTH	REMARKS

BPB INSTRUMENTS (CANADA) LTD

P.O. BOX 5638, POSTAL STATION "A", CALGARY, ALBERTA

BP-77 SPOT VERTICALITY SURVEY

DEPTH	INCLINATION
25m	3.1°
50m	2.7°
75m	2.1°
100m	1.9°
132m	5.9°

-oooOooo-

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-W12

Contractor: TECK CORPORATION

Co-ordinates: N 23520 ±100 m
E 89797

Commenced: 1974

Surface Elevation: 1181 m

Completed:

Geophysically logged: yes/no

Core Size: EX

Hole cemented: unknown yes/no

Hole Angle & Azimuth: see details overleaf

Casing Left in Hole unknown

No details available

Geologist	Depth
Logged by: C. Bickford	

Final Depth: 38.4 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Upper Gething		36.61+	

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Upper Chamberlain	28.50	0.36	33.3%	1152.50
Lower Chamberlain	32.78	2.50	1.2%	1148.22

STRUCTURAL FEATURE	DEPTH	REMARKS
Dips throughout 5^{o} to 18^{o}		

BH NO. BP-W12

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	1.79	1.79	OVERBURDEN-probably weathered sandstone
			——— UPPER GETHING BELOW BIRD HORIZON ———
	3.66	1.87	SANDSTONE-fine to very fine-grained, medium grey, clean well-sorted, medium to large-scale low-angle
14° @	2.35		cross-laminated; locally rusty-weathered; rough joints (45° CA). Strongly calcareous, very strongly in weathered bands. Base not seen.
	8.58	4.92	CORE MISSING
	12.90	4.34	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (20:60:20, grading down to 5:65:30)-interbedded medium grey, argillaceous, small-scale low-angle cross-laminated sandstone and dark grey siltstone and silty mudstone, with abundant small and very
8° @	8.64		small dark worm burrows and scattered pelecypod
15° @	9.80		burrows. Bioturbation locally intense, destroying
9° @	10.85		stratification, but general fining-upward beds
11° @	11.80		with scoured bases. Strongly calcareous throughout,
15° @	12.75		with pyrite blebs and burrow fillings in top 0.90 m. Erosional.
	19.64	6.72	SANDSTONE-fine to medium-grained, clean, well-sorted medium to large-scale low-angle cross-laminated.
15° @	16.28		Medium grey except top 0.64 m (dark grey to black,
16° @	17.65		carbonaceous, rootlets). Non-calcareous from top
18° @	18.60		to 15.91 m; weakly to moderately calcareous to base.
12° @	19.56		From 14.22 to 14.56 m, medium (0.002 m) worm burrows similar to those forming the marker horizon below the Bird Seam. Occasional silty, carbonaceous laminae from 18.14 m to base. Abrupt.
	19.78	0.14	MUDSTONE-dark grey, carbonaceous, silty, crumbly light grey-weathering. Abrupt.
	28.14	8.36	SANDSTONE-fine to medium-grained, occasional coarse-
5° @	21.90		grained phases. Clean, well-sorted throughout.
15° @	24.75		Medium to large-scale low-angle cross-laminated.
10° @	26.55		Occasional trough cross-lamination and concentrations
15° @	27.50		of carbonaceous and coaly laminae. Medium to dark grey throughout. Strongly calcareous from top to 23.89 m; moderately calcareous to base. CORE MISSING from 24.38 to 24.69 m, and 26.03 to 26.72 m. Coarse pyrite crystals in basal 0.005 m. Abrupt.
	28.50	0.36	COAL-hard, broken. Dominantly dull banded. Recovered 0.12 m. Dirty in top 0.03 m. Sample: W12/-/1. Top and base ground out.
	28.52	0.02	MUDSTONE-dark grey, listricated. Carbonised plant fragments. Abrupt. Non-calcareous.

BH NO. BP-W12

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	28.59	0.07	SILTSTONE-dark grey, argillaceous, listricated, with abundant carbonized plant fragments. Non-calcareous; gradational.
	28.79	0.20	SANDSTONE-very fine to medium grained/SILTSTONE (80:20) two graded, fining-upwards beds. Sorting good. Weakly calcareous; erosional.
	29.53	0.74	SILTSTONE-dark grey, argillaceous, grading down to SANDSTONE-very fine-grained ripple cross-laminated non-calcareous. Scattered radiating-textured pyrite crystals, 0.003 to 0.004 m in diameter. Abundant
17° @	28.92		mica flecks on bedding planes. Abrupt.
	29.58	0.05	SILTSTONE/MUDSTONE (80:20)-interlaminated, rippled Midium to dark grey; non-calcareous. Abrupt.
	30.16	0.58	MUDSTONE-silty, dark grey, thinly laminated, flaky. Recovered 0.12 m.
	30.28	0.22	MUDSTONE/SILTSTONE(80:20)-interlaminated, dark grey silty mudstone and medium grey, argillaceous silt-
15°			stone. Core broken. Non-calcareous.
	32.78	2.50	COAL-Chamberlain Seam. Recovered 0.03 m of hard, dull and bright coal. Core apparently ground away.
	33.54	0.76	SANDSTONE-medium to coarse-grained, well-sorted, rooty at top, dark grey to black, carbonaceous. Coaly bands in top 0.02 m. Non-calcareous. Massive; gradational.
	38.40	4.86	SANDSTONE-medium to coarse-grained from top to 35.07 m fine to medium-grained to 36.34 m; fine-grained to
8° @	36.57		36.46 m; coarse grained to 36.55 m; fine to medium-grained to 36.88 m; fine to very-fine-grained to base. Clean, well-sorted throughout. Large-scale low-angle cross-laminated except from top to 35.27 m, where lamination has been destroyed by intense burrowing; scattered 0.002 to 0.003 m burrows are faintly visible. Locally abundant large (0.003 to 0.004 m) dark-rimmed worm burrows in basal 1.0 m. Non-calcareous from top to 35.23 m; weakly to moderately calcareous to 35.97 m strongly calcareous to base.
			TD 38.40 m. Core diameter 34 mm.

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-W15

Contractor: TECK CORPORATION
(drilled by J. Schilling)

Co-ordinates: N 16600 m ±5m
E 89095 m

Commenced: 1974

Surface Elevation: 1392± m

Completed:

Geophysically logged: ~~yes~~/no

Core Size: EX to 44.81; AX to TD

Hole cemented: ~~yes~~/no

Hole Angle & Azimuth:

Casing Left in Hole 0 m

No details available

Logged by:

Geologist: C. Bickford

Depth

Final Depth: 53.04 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Upper Gething	15.57	15.11+	1376.43
Middle Gething		37.47+	

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION

None encountered
Hole collared below Chamberlain "Marine" Band, in basal sandstone of Upper Gething

STRUCTURAL FEATURE	DEPTH	REMARKS

Dips 18° to 33° throughout

BH NO. BP-W15

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	0.46	0.46	OVERBURDEN. NO CORE
			UPPER GETHING
	12.33	11.87	SANDSTONE-fine to medium-grained to 11.87 m; fine to very fine-grained to base. From 7.65 m to 8.10 m, occasional (10%) coarse sand and grit stringers. Unit medium grey, clean, well sorted throughout. Occasional mica flecks and orange-weathering specks. Rusty-weathering near joints, with occasional calcite crusts on joints. Strongly calcareous throughout. Vague mottling in top 0.51 m; large dark-rimmed "Gates-types" worm burrows from 8.25 m to 10.59 m Medium to large-scale low-angle cross-lamination throughout unit. Small floating coal fragment at 4.53 m. Occasional concentrations of mudddy intra-clasts from 10.03 m to base. Mudstone, dark brown, and sandstone swirled together from 11.31 m to 11.52 m, with slickensides and calcite (72° CA), at 11.38 m. Erosional at base.
21° @	3.25		
18° @	5.59		
18° @	8.45		
20° @	11.94		
	13.07	0.74	SANDSTONE-fine-very fine-grained/MUDSTONE(50:50)-Strongly calcareous throughout; fining upward units from 0.005 to 0.05 m thick, scoured at base, with medium-grey sandstone grading up to dark olive-grey mudstone. Sandstone clean, small-scale cross-laminated, scattered load casts. Basal contact ground out.
	15.57	2.50	SANDSTONE-fine-grained, clean, large-scale low-angle cross-lamination, medium grey, rusty-weathering on joints. Scattered intraclasts. Strongly calcareous throughout. Abrupt.
25° @	14.32		
			MIDDLE GETHING
	17.36	1.79	SILTSTONE/SANDSTONE-fine to very fine-grained (70:30)-siltstone dark grey, argillaceous, with occasional thin sandy laminae. Sandstone medium-grey, argillaceou silty, in beds up to 0.20 m thick; laminated; small scale cross-laminated. Occasional rough rusty joints with calcite crusts (40° to 60° CA). Unit strongly calcareous throughout. Occasional pelecypod burrows. Gradational.
29° @	16.29		
	18.54	1.14	SANDSTONE-very fine-grained, argillaceous. Medium grey. Medium to large-scale low-a le cross-lamination, Strongly calcareous throughout. Basal 0.05 m includes abundant muddy intraclasts. Abrupt.

BH NO. BP-W15

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	30.64	12.10	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (30:60:10 grading down to 60:10:30)-interbedded and interlaminated. Common fining-upward beds, scoured at base. Ubiquitous small and very small dark worm burrows. Occasional pelecypod burrows, small-scale slumps, and load casts. Sandstone medium grey, argillaceous; siltstone and mudstone (silty) dark grey. Unit strongly calcareous throughout. Bioturbation increases downwards; locally intense below 27.69 m. Sandstones show medium to small-scale low-angle cross lamination, and occasional intraclasts. Pyritic band from 21.92 m to 21.97 m, with abundant shell fragments. Gradational
24° @	23.54		
	38.94	8.30	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained (50:45:5)-interbedded, but bedding generally obscured by intense bioturbation. Sandstone is medium grey, argillaceous; remainder of unit is dark grey. Sandstone appears as wisps and streaks. Mudstone is silty. Unit is strongly calcareous throughout. Occasional fining-upward beds from sandstone through to mudstone; sandstones scoured at base. Abundant small and very small dark worm burrows, pyritic towards base of unit. Base of unit abrupt, marked by highly glauconitic mudstone (0.08 m thick). Glauconite also found in burrow-fillings in top underlying unit. Possible Inoceramus fragments at 37.52 m. Occasional slickensides and calcite and rusty curved joints, at 35° to 60° CA. Abrupt.
26° @	base		
	40.44	1.50	SANDSTONE-very fine-grained/SILTSTONE (50:50)-interbedded (0.01 to 0.03 m beds), locally intensely bioturbated medium grey argillaceous sandstone and dark grey siltstone. Abundant small and very saml dark worm burrows. Occasional slumping and load ~~cashing~~ casting in sandstone. Strongly calcareous throughout. Slickensides and calcite (49° CA) at 39.89 m. Abrupt.
22° @	39.04		
33° @	40.42		
	42.14	1.70	SILTSTONE/MUDSTONE/SANDSTONE-very fine-grained (60:30:10)-intensely bioturbated dark grey siltstone and silty mudstone with occasional thin beds (0.01 m) of cross-laminated, medium grey argillaceous sandstone. Abundant small and very small dark worm burrows. Strongly calcareous. Scattered pyrite in top 0.60 m. Gradational.
	44.19	2.05	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (40:40:20)-moderately bioturbated interbedded dark grey siltstone and silty mudstone and medium grey argillaceous laminated sandstone. Abundant very
31° @	42.34		

BH NO. BP-W15

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
			small and small dark worm burrows; scattered dark, serrated worm burrows (considered diagnostic of Sukunka Member). Burrows occasionally pyritised. Some load casts. Unit strongly calcareous throughout. Overall fining-downwards. Gradational.
	45.51	1.32	MUDSTONE/SILTSTONE(50:50 grading dowm to 80:20 at base)-intensely bioturbated dark grey silty mudstone and siltstone, fining-downwards. Abundant very small dark worm burrows. Scattered wisps of argillaceous very fine sandstone near top. Basal 0.20 m consists of dark olive-grey mudstone with 10% glauconite as medium-sand-sized grains in a highly pyritic, muddy matrix. Strongly calcareous-throughout.
32° @	48.64 46.38	3.13	SANDSTINE-fine to very fine-grained/SILTSTONE (70:30) interbedded clean to slightly argillaceous medium grey sandstone and dark grey intensely bioturbated siltstone. Sandstone in beds of 0.20 m, medium-scale low-angle cross-laminated strongly calcareous, with abrupt tops and bases. Siltstone in beds of 0.02 to 0.15 m, with small dark worm burrows; moderately calcareous. Gradational.
25° @	51.99 49.48	3.35	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE-(50:50:0)grading down to 5:35:60 at base)-interbedded dark grey siltstone and silty mudstone with medium grey low-angle cross-laminated argillaceous sandstone. Occasional small dark burrows in mudstone; locally intense bioturbation in basal 1.0 m. Unit strongly calcareous throughout. Gradational.
	53.04	1.05	MUDSTONE/SILTSTONE-(85:15)-dark grey moderately calcareous silty mudstone with lenses of dark grey argillaceous siltstone and traces of very fine sandstone. Scattered very small dark worm burrows. TD 53.04 m NOTE: 34 mm core to 44.81 m 24 mm core from 44.81 m to TD DRILLED BY J. SCHILLING FOR TECK

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-W16

Contractor: TECK CORPORATION

Co-ordinates: N 22077 m ±100 m
E 90911 m

Commenced: 1976

Surface Elevation: 1097 m

Completed:

Geophysically logged: ~~yes~~/no

Core Size: AX

Hole cemented: unknown ~~yes~~/no

Hole Angle & Azimuth: ~~see above~~
No details

Casing Left in Hole no m

Geologist Depth

Logged by: C. Bickford

Final Depth: 44.50 m

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Upper Gething	42.94		

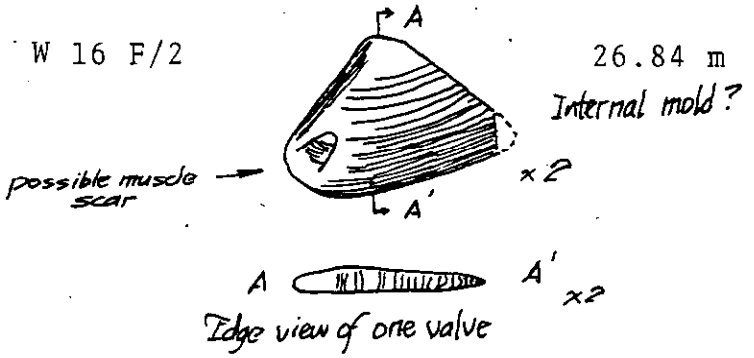
SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Lower Chamberlain	42.94	3.50 (incl. 0.24 parting)	unknown (mostly sampled)	1054.06

STRUCTURAL FEATURE	DEPTH	REMARKS
Dips throughout 5° to 10°		

BH NO. BP-W16

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	1.83	1.83	Overburden-weathered sandstone
			——————— UPPER GETHING below Bird floor ———
	17.56	15.73	SANDSTONE-medium to coarse-grained from top to 3.90 m CORE MISSING to 6.04 m; fine to medium-grained with minor stringers of coarse sand to 8.53 m; fine to very fine-grained to base. Band of small, rounded pebbles with erosional base, from 7.05 to 7.06 m. Hard weakly calcareous, olive-grey argillaceous
9° @	13.57		siltstone with wisps of very fine sand, from 7.67 to
10°@	15.83		7.94 m. Remainder of unit weakly calcareous from top to 3.90 m; strongly calcareous from 6.04 m to base. Abundant small (0.002 m) worm burrows from 2.11 to 2.51 m, (this is the Bird Floor marker). Scattered faint dark-rimmed medium (0.003 m) worm burrows throughout unit. Ubiquitous large-scale low-angle cross-lamination except where worm burrows obscure it (chiefly above 2.51 m). NOTE: CORE ALSO MISSING: 10.42 m to 12.49 m. Occasional ripple-drift below 12.49 m. Rare floating pebbles above 10.42 m. Abundant large carbonised plant fragments from 14.87 to 14.99 m (wood chips). Abrupt.
	19.45	1.89	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (10:50:40)-interbedded medium grey, argillaceous,
8° @	18.65		ripple-laminated sandstone and dark grey siltstone and silty mudstone, with abundant small dark burrows with pyrite flecks and blebs. Strongly calcareous throughout. Occasional load casts and pyritised pelecypod burrows. Base not seen.
	21.97	2.54	MISSING CORE-probably sandstone/siltstone/mudstone as above.
	22.95	0.98	SANDSTONE-very fine-grained/SILTSTONE/MUDSTONE (20:60:20)-as above, but coarser overall. Occasional relict lamination, but bioturbation is general. A few medium burrows filled with coarse sand, in basal 0.03 m. Abrupt.
	23.07	0.12	SANDSTONE-coarse-grained, clean and well-sorted at top but with occasional lenses of very fine sand and silt towards top and base. Weakly calcareous. Abrupt.
	23.17	0.10	MUDSTONE-silty dark grey, core badly weathered and fragmented, grading down to dark grey siltstone with lenses of coarse sand. Weakly calcareous, Gradational.

BH No. BPW-16

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	26.65	3.48	SANDSTONE-medium to coarse-grained/fine-grained (50:50)-clean, well-sorted, medium grey, with large-scale low-angle cross-lamination. Abundant coaly wisps and laminae of carbonaceous mudstone with mica flecks, from 24.90 to 26.39 m. Sandy carbonaceous mudstone with mica flecks from 26.18 to 26.21 m. Non-calcareous from top to 25.54 m; weakly calcareous below 25.54, increasing to moderately calcareous at base. Erosional.
	26.76	0.11	MUDSTONE/SANDSTONE-dark grey, very silty mudstone and very fine-grained sandstone, intensely bioturbated and churned. Sandstone moderately calcareous, mudstone non-calcareous. Abrupt.
	26.94	0.18	MUDSTONE-black, carbonaceous, silty, with sandy lenticles. Abundant pelecypod fossils: W 16 F/1 26.67 m  W 16 F/2 26.84 m  The remainder are fragmented or too poorly preserved to identify. Unit non-calcareous; abrupt.
	29.36	2.42	SANDSTONE-fine to medium-grained, dominantly medium grained in top 0.80 m. Locally abundant laminae of dark grey to black, carbonaceous siltstone and silty mudstone, with occasional coaly wisps. Small-scale low-angle cross-lamination. Strongly calcareous throughout.
10° @	28.45		
	29.67	0.31	MUDSTONE-dark grey, carbonaceous, with scattered bands of fine sand grading from 0% at top to 50% at base. Base of unit marked by 0.03 m of low-angle cross-laminated, argillaceous sandstone. Very weakly calcareous. Scattered mica flecks. Abrupt.

BH No. BPW-16

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	32.95	3.28	MUDSTONE-dark grey, carbonaceous from top to 31.09 m; silty from 32.81 to base. Abundant carbonised plant debris and local listrication, from top to 31.09 m; (possible seatearth lithology). Non-calcareous to 31.64 m; calcareous from 31.64 to base. Gradational.
	33.18	0.23	SANDSTONE-medium-grained, clean with one interbed of dark grey silty mudstone and siltstone from 33.00 to 33.08 m. Sandstone strongly calcareous; mudstone weakly calcareous. Abrupt.
	35.58	2.40	SANDSTONE-very fine-grained/SILTSTONE (90:10, grading down to 30:70 at base)-interlaminated, medium grey argillaceous sandstone and dark grey siltstone. Medium-scale low-angle cross-laminated at top; small-scale low-angle and ripple cross-laminated towards base. Medium to coarse sandstone phase from 33.35 to 33.38 m. Sandstone breccia with coarse calcite cement at 33.32. (No evidence of significant movement). Strongly calcareous throughout. Gradational.
9° @	35.06		
5° @	35.51	2.93	MUDSTONE/SILTSTONE/SANDSTONE-very fine-grained (20:60:20 at top, grading to 20:80:0 at 36.28 m, 50:50 at 36.42 m, 95:5 at base)-interlaminated; mudstone dark grey, non-calcareous, siltstone medium-grey; moderately to strongly calcareous. Lamination mainly parallel. (Resembles typical Chamberlain Roof) Gradational.
5° @	36.45		
	39.44	0.93	MUDSTONE-dark brown, very minor silt fraction Readily broken at 80° to CA. Core badly broken and ground up towards base. Unit non-calcareous. Basal contact ground out; probable coreloss. Some listrication in basal 0.05 m.
	39.99	0.55	COAL-sheared, dominantly dull and bright. Recovered 0.18 m.. SAMPLED: W16/CH/1. Listricated, abrupt.
	40.00	0.01	MUDSTONE-carbonaceous, dark grey. Very irregular basal contact; thickness ranges from 0 to 1 cm across core. Abundant very thin coaly laminae. Abrupt.
	40.13	0.13	SILTSTONE-dark grey, very argillaceous. Listricated at 40° CA at 40.00 to 40.03 m, and at 75° CA at 40.08 m. Non-calcareous. Scattered carbonised plant debris (rootlet bed). Gradational.
	40.23	0.10	MUDSTONE-dark grey, very silty. Intensely listricated Non-calcareous. Core broken and ground.

BH No. BP-W16

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	49.94	2.71	CORE MISSING-coal dust in box. Probably Chamberlain seam, sampled. Drillers blocks for 40.23, 40.69, 41.76 m. Floor dip 10°.
6° @	44.50 44.30	1.56	SANDSTONE-medium-grained, medium to dark grey, clean, well-sorted, hard and strong. Faint low-angle cross-lamination. Occasional concentrations of faint, dark rimmed medium (0.002 to 0.003 m) worm burrows. Fine-grained, very carbonaceous, black sandstone in top 0.11 m (typical of Lower Chamberlain floor), underlain by 0.01 m of black, sandy, coaly mudstone with occasional mica flecks. Rootlets in top 0.11 m. Unit non-calcareous throughout.
			TD 44.50 m Core diameter 34 mm

BP CANADA COAL DIVISION

PROJECT: SUKUNKA

B.H. BP-W17

Contractor: TECK CORPORATION LTD.

Co-ordinates: N 25060 m ±100 m
E 89364 m

Commenced: 1976

Surface Elevation: 1229 m

Completed:

Geophysically logged: ~~yes~~/no

Core Size: AX

Hole cemented: unknown/~~yes~~/no

Hole Angle & Azimuth: ~~see details available~~

Casing Left in Hole unknown m

no details available

Geologist	Depth
C. Bickford	

Logged by:

Final Depth: 45.20

FORMATION/MEMBER	DEPTH	THICKNESS	ELEVATION
Upper Gething		39.85+	

SEAMS	DEPTH	THICKNESS	%RECOVERY	ELEVATION
Sub-Bird	30.03	0.07	100%	1198.97

STRUCTURAL FEATURE	DEPTH	REMARKS
Fault, possible, immediately above collar (high dips at top of hole)		

BH NO. BR-W17

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	2.5	2.5	OVERBURDEN-probably weathered sandstone.
	5.35	2.85	SANDSTONE-very poor recovery, probable cores from sandstone rubble overlying bedrock. Not logged in detail; individual cores range from very fine-grained, and fresh to badly weathered.
			——— UPPER GETHING BELOW BIRD FLOOR ———
	11.55	6.20	SANDSTONE-medium to coarse-grained from top to 9.29 m fine to medium-grained to 10.84 m; coarse-grained with scattered pebbles to 10.94 m; fine to medium-grained to 11.22 m; fine-grained to base. Clean and well-sorted throughout. Strongly calcareous to 6.82 m; CORE MISSING from 6.82 m to 6.96 m; weakly to moderately calcareous to 7.50 m; moderately calcareous to 9.50 m; strongly calcareous to base. Medium to dark grey at top becoming lighter, to medium grey at base. Large scale low-angle cross-laminated throughout, except where obscured by burrowing. Locally abundant medium (0.002 m) burrows (marker) from 6.96 m to 8.80. Scattered medium burrows with faint dark rims throughout unit. High dips at top of unit, suggest fault overlying this unit (but above present bedrock surface.) Marker burrows and general lithology suggest that the bedrock surface is slightly below the Bird Seam floor horizon.
45° @	5.40		
35° @	5.70		
62° @	6.00		
62° @	6.10		
28° @	8.36		
9° @	8.87		
18° @	9.50		
18° @	10.05		
15° @	11.38		
	18.21	6.66	CORE MISSING-probably sandstone, similar to that above and below.
	20.48	2.27	SANDSTONE-fine to very fine-grained, clean, well-sorted, large-scale low-angle cross-laminated, strongly calcareous throughout. Scattered medium, faintly dark-rimmed burrows throughout; large (0.004 m) dark-rimmed burrows from 18.52 to 18.83 m. Base of unit not seen.
13° @	18.26		
10° @	20.15		
	25.15	4.67	CORE MISSING-probably sandstone as above, to approximately 24 m, then interbeds as below.
	29.96	4.81	SILTSTONE/SANDSTONE-very fine-grained/MUDSTONE (70:15:15)-interbedded medium grey, argillaceous sandstone and dark grey siltstone and silty mudstone. Common erosional contacts at base of fining-upward units. Abundant small and very small dark worm burrows; occasional load casts and small pelecypod burrows. Burrows pyritised in top 0.50 m of unit. Strongly calcareous throughout. Erosional at base.
16° @	26.88		
18° @	29.86		
21° @	base		

BH NO. BP-W17

Dip°	DEPTH m	THICKNESS m	DESCRIPTION
	30.03	0.07	COAL-sheared, intensely listricated, core ground Coal type indistinguishable. Recovery: 0.07 m.
	36.58	6.55	SANDSTONE-fine to medium-grained to 30.86 m; medium to coarse-grained to 31.42 m fine to medium-grained to 32.20 m fine-grained to 33.0 m; medium-grained to 33.37 m; fine-grained to 33.55 m; very fine-grained to 34.88 m (CORE MISSING, 33.78 m to 34.29 m) fine-grained to 35.77; medium-grained to 36.03 m; fine to medium-grained to 36.26 m; fine to very fine-grained to base. Clean, well-sorted throughout; medium to dark grey at top, grading to medium grey
15° @	34.35		at base. Dark grey to black, carbonaceous with rootlets, in top 0.15 m. Top 1.22 m intensely burrowed and devoid of lamination. Individual burrows very vague; possible "Pin Prick" horizon. From 31.24 to 31.87 m, abundant medium (0.002 m) burrows. Remainder of unit shows large-scale, low-angle cross-lamination. Non-calcareous to 32.46 m; weakly to moderately calcareous to 33.78 m moderately calcareous to base.
	41.15	4.57	CORE MISSING-probably sandstone as above and below.
	43.59	1.44	SANDSTONE-fine to very fine-grained to 41.73 m, fine to medium-grained to 41.85 m; medium to coarse-grained
14° @	42.30		to 42.27 m; very fine-grained to base. Medium grey,
19° @	43.50		clean, well-sorted, medium to large-scale low-angle cross-laminated. Listricated coaly laminae from 41.85 to 42.27 m. Strongly calcareous throughout.
	45.2	1.61	CORE MISSING-probably sandstone as above.
			TD 45.2 m CORE DIAMETER 34 mm

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: MR1 to MR64.
PROJECT: Sukunka 1979. DATE: June, July 1979.
LOCATION: . ELEVATION: .
GEOLOGIST: D. Mitchell.

STATION	UNIT	
MR1	COG	SANDSTONE - medium-grained, thinly bedded, flaggy, salt and pepper appearance. Strongly calcareous.
		(Strike/dip not measurable). Not in place?
MR2	COH	SILTSTONE - common sand laminae, non-calcareous, thinly bedded, stripy appearance, shallow ripple undulation on some bedding surfaces. 330/6°SW.
MR3	COH	As above. 330/11°SW.
MR4	COH	C15 borehole standpipe located. Talus, abundant scree of siltstone with sand laminae as above. Probable outcrop below.
MR5	COH	SILTSTONE - common sand laminae as above, 320/6°SW.
MR6	COH	SILTSTONE - common sand laminae as above, 310/6°SW.
MR7	COH	SILTSTONE - sand laminae as above, non-calcareous. +
	COG	CONGLOMERATE - .15 m thickness, large rounded chert pebbles up to .02 m diameter, siliceous matrix, poorly sorted. 0.15m
	COG	SANDSTONE - fine-grained, brown weathering, thinly bedded, strongly calcareous. 335/6°SW. +
MR8	COG	SANDSTONE - fine to medium-grained, light brown weathering, thinly bedded, highly calcareous. 325/11°SW.
MR9	COH	SANDSTONE - very fine-grained, common silt laminae, medium bedded, becoming thin bedded and highly silty up. Non-calcareous. Sharp base. 340/16°SW. +
	COG	CONGLOMERATE - poorly sorted, broadly grading upwards with chert pebbles up to 0.02 m @ base, fining to 0.004 m @ top. Sharp base. 0.27m
		SANDSTONE - fine-grained, thinly bedded, highly calcareous, ferruginous weathering. +
MR10	COG	Float: SANDSTONE - fine-grained, thinly bedded, ferruginous weathering, highly calcareous. Probably drift.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR11	COH	SILTSTONE - non-calcareous, few sand and dark mud laminae, highly weathered outcrop. Quarried for lease road fill. (Strike/dip not measurable).
MR12	COG	SANDSTONE - fine-grained, common silty micaceous planty planes, highly calcareous, medium-bedding with blocky fracturing. 345°/15°W.
MR13	? COG	SILTSTONE - thinly bedded, non-calcareous, very well jointed, ironstone nodules, purple hematitic staining and mottling, local spheroidal weathering. 345°/21°W.
MR14	COG	SANDSTONE - very fine-grained, grey, siliceous: non-calcareous. Thinly bedded in basal 0.14 m, poorly bedded above. 40/11°NW.
		CONGLOMERATE - dark chert pebbles and few milky or red siliceous pebbles up to .006 m in an argillaceous matrix. Siliceous: non-calcareous. Moderately well sorted, non-graded. 0.17 m
	COG	SANDSTONE - very fine-grained, grey, siliceous: non-calcareous, poorly bedded. 0.19 m
	COG	CONGLOMERATE - as above conglomerate unit. 0.57 m
	COG	SANDSTONE - as above sand unit. 0.13 m
	COG	CONGLOMERATE - dark chert pebbles up to 0.06 m in an argillaceous matrix. Siliceous: non-calcareous. Poorly sorted, non-graded. 0.12 m
	COG	Lense out laterally to west: SANDSTONE - very fine-grained, grey, siliceous: non-calcareous. Poorly bedded. Common large carbonaceous plant stems at base. 0.12 m CONGLOMERATE - dark chert pebbles up to 0.1 m in an argillaceous matrix. Siliceous: non-calcareous. Very poorly sorted, non-graded. 0.14 m
		All above units exhibit hematitic staining on weathered surfaces.

(Cont'd over)

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
(Cont'd)	COG	MUDSTONE - friable, highly weathered, few thick coal streaks. +
MR15	COG	SANDSTONE - light brown-grey, fine-grained, orange weathering, flaggy, non-calcareous. 40/11°NW
MR16	COG	SANDSTONE - fine-grained, orange weathering, few coaly inclusions, no visible bedding, non-calcareous. 0.15 m
		SILTSTONE - light brown-grey, thinly bedded with dark mudstone laminae, some cross-bedding visible, traces of carbonaceous mudstone laminae, non-calcareous. 0.46 m
		IRONSTONE - nodules in silty matrix, nodules .15 m diameter and .05 m thick. 0.13 m
		SANDSTONE - light grey-brown, very fine-grained, thin dark silty laminae and traces of coaly plant debris, non-calcareous. 0.03 m
		- outcrop broken up (Strike/dip not measurable).
MR17	COH	SILTSTONE - rubble, dark mudstone laminae, non-calcareous (Hulcross type).
MR18	? COG	SANDSTONE - fine-grained, grey-weathering, thinly bedded with dark silt laminae, non-calcareous. 60/11°NW.
MR19	COG	SANDSTONE - fine to medium-grain, medium bedding, non-calcareous, ferruginous weathering.
MR20	COG	CONGLOMERATE - granular, coarsening to pebbly down, well sorted. Massively bedded, vague trough cross-stratification. Base obscured. +
	COG	SANDSTONE - fine-grain, medium to massive bedding but locally thin, few thin pebble horizons and pebbly layers. Non-calcareous, ferruginous weathering. Occasional cross-bedding. 180/13E. Approximately 10 m thick. Sharp base. 10 m
	COS	SANDSTONE - fine-grain/SILTSTONE - 60:40, thinly interbedded, sand layers commonly cross-bedded, silt layers contain common burrows, mud stringers, soft sediment erosional structures, slumping. Weakly calcareous. 180/16E. 1 m+
MR21		Stations not utilized.
MR22		

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR23	COG	SANDSTONE - fine-grain, thinly bedded, strongly calcareous, ferruginous weathering, occasional cross-bedding. 215/9SE.
MR24	COS	SANDSTONE - very fine-grain/MUDSTONE - silty, thinly interbedded, non-calcareous. Sand layers highly disturbed with mud and coal inclusions. Poor exposure.
MR25	COS	SANDSTONE - fine-grain, thin to medium bedding, non-calcareous. Abundant micaceous planty planes and large plant stems. Ferruginous weathering. Poor exposure. 172/12E.
MR26	COS	SANDSTONE - very fine-grain, common siltstone laminae and thin layers, non-calcareous. Abundant burrows and bioturbation. Ferruginous weathering.
MR27	COS	SANDSTONE - very fine-grain, common siltstone laminae and thin layers. Common bioturbation. Abundant closely spaced parallel fractures, occasionally calcite lined - 160/83W - Minor disturbance.
MR28	COS	SANDSTONE - fine-grain/SILTSTONE - sandy, thinly interbedded. Common micaceous planty planes and large plant debris. Non-calcareous. Common burrows in silt layers. (Strike/dip not measurable.)
MR29	COG	SANDSTONE - fine-grain, medium to thick bedded. Common micaceous planty planes and large plant stems. Bed bases exhibit moderate erosion, common ripples, load casts, few large pelecypod impressions, and large burrows. Occasional cross-lamination, pebble bands and thin layers of angular mudstone stringers. 210/4SE. 2 m+ Sharp base.
	COS	SANDSTONE - very fine-grain/MUDSTONE - silty, micaceous, thinly interbedded. Sand layers appear parallel bedded with a few burrows. Non-calcareous. Common micaceous planty planes in sand layers. 1 m+
MR30	COG	CONGLOMERATE - sub-rounded pebbles, well sorted.
MR31	COG	CONGLOMERATE - sub-rounded pebbles, well sorted.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR32	COG	CONGLOMERATE - sub-rounded pebbles, well sorted. S26 drill site and hole located. Hole blocked at surface by debris.
MR33	COG	CONGLOMERATE - sub-rounded pebbles, well sorted.
MR34	COG	CONGLOMERATE - sub-rounded pebbles, well sorted. Base obscured.
	COG	SANDSTONE - fine-grain, thin to medium-bedding, non-calcareous, ferruginous weathering. 186/8E. Thickness 8 m+ COG/COS boundary thought to be immediately below.
MR35	COG	SANDSTONE - fine-grain, medium locally thin bedding, non-calcareous, ferruginous weathering. Cross-bedded. (Strike/dip not measurable)
MR36	COG	SANDSTONE - fine-grain, common micaceous planty planes, massive, non-calcareous, mildly ferruginous weathered surfaces. Site of C5 borehole, blocked standpipe located. 160/8E.
MR37	COG	SANDSTONE - fine-grain, vaguely colour laminated, massive, weakly calcareous, local cross-bedding; few weakly ferruginous weathered surfaces, 93/6E. Joints 124/74°N 139/71°N
MR38	COG	SANDSTONE - fine-grain, medium to thick bedding, non-calcareous, ferruginous weathering, abundant cross-bedding. (Strike/dip not measurable)
MR39	COG	SANDSTONE - fine-grain, medium to massive bedding, non-calcareous, abundant cross-bedding, faintly colour laminated, ferruginous weathering. (Strike/dip not measurable).
MR40	COG	SANDSTONE - fine-grain, medium to thin bedding, ferruginous weathering. Talus.
MR41	COG	SANDSTONE - fine-grain, thin to medium bedding, ferruginous weathering, local cross-bedding, strongly calcareous. 200/22E.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR42	COG	CONGLOMERATE - pebbles, clean, moderately well-sorted, poorly sorted in parts.
MR43	COG	Station not utilized.
MR44	COG	CONGLOMERATE - sandstone, fine-grain.
MR45	COS	SANDSTONE - fine-grain, common micaceous planty planes, medium bedding, appears locally disturbed and erosive, occasional planes with large plant stems. Occasional pelecypod burrows, few thin mud layers, occasional medium burrows, occasional large and sand filled burrows. Loose rubble, occasionally bounded by slickensides, ferruginous and calcite lined planes of movement at low angle to bedding. 0.3 m+ Appears to overlie MR46.
MR46	COS	SANDSTONE - medium-grain, erosive appearance in parts, few coarse granular laminae and thin layers. Medium bedding, ferruginous weathering, non-calcareous. Thin interbeds of interlaminated silt/fine sand and disburbed interlaminated mud/silt. Common medium burrows throughout. 0.3 m+
MR47	COG	SANDSTONE - fine-grain, thinly bedded, platy, calcareous, hematitic weathering, cross-bedded. 175/20E 155/14E 1.0 m+
MR48	? COS	SANDSTONE - fine-grain, thinly bedded and platy, bedding surfaces slightly irregular and erosive, locally common medium Sukunka type and small, dark burrows. Generally parallel bedded but disturbed in parts. Few thin irregular siltstone interbeds, hematitic weathering. 138/11E.
MR49	COG	SANDSTONE - fine-grain, ferruginous weathering, mildly calcareous, talus rubble.
MR50	COS	SANDSTONE - fine-grain, thinly bedded, minor cross-bedding, calcareous, hematitic weathering, common micaceous planty planes. SANDSTONE - fine-grain with silt/mudstone pods, disturbed appearance, calcareous. 1 medium size Sukunka type burrow. (Strike/dip not measurable)

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR51	? COS	SANDSTONE - fine-grain, ferruginous weathering, with silty laminations, thin interbeds of medium grey silty mudstone, calcareous. Some cross-bedding; mudstone has disturbed appearance, few small burrows. (Strike/dip not measurable.) ?Crop slumped.
MR52	COS	SANDSTONE - fine-grain, silt laminations, ferruginous weathering, disturbed appearance, common Sukunkoid burrows, calcareous. (Strike/dip not measurable.)
MR53	COG	CONGLOMERATE - well sorted, sub-rounded, chert cobbles and pebbles. 10 m thick, forms cliff. 155/15°E.
MR54	COG	SANDSTONE - fine-grain, medium to thick bedding top becoming thinly bedded down. Non-calcareous, ferruginous weathering, common cross-bedding. Occasional small chert pebbles or large mudstone pebbles up to 0.05 m. 90/6S. 10 m+
MR55	COS	SILTSTONE - with sandstone lenses and mud stringers, mud filled burrows, calcareous. Talus.
MR56	COS	SANDSTONE - with silt and mud interbeds, ferruginous weathering, disturbed in parts, non-calcareous. 204/12°S
MR57	COG	SANDSTONE - fine-grain, medium to massive bedding, ferruginous weathering, occasional fine plant debris, moderately calcareous; 1 metre zone of irregular sub-vertical occasionally calcite lined fractures trending 049, minor fault?
MR58	COG	SANDSTONE - fine-grain, ferruginous weathering, medium to massive, bedding, non-calcareous, vague cross-bedding. 138/3°SW.
MR59	COS	SANDSTONE - fine-grain, with silt and mud interbeds, micaceous planty planes, dark mud filled burrows, irregular lamination, non-calcareous, 158/7°SW. 0.3 m+
		SANDSTONE - blocky, fine-grain, thinly bedded, highly disturbed, slickensides! calcite covered planes. Fault established, throw 15-20 m. 0.3 m+

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

STATION	UNIT	
MR60	COG	SANDSTONE - fine-grain, medium to massive bedding,
		common micaceous planty planes, parallel bedding,
		mildly calcareous, 075/10°SE.
MR61	COG	SANDSTONE - fine-grain, medium massive bedding, ferrugin-
		ous weathering, common cross-bedding, non-calcareous.
MR62	COG	MUDSTONE - dark grey/black, micaceous, very thinly
		bedded, platy, non-laminated, non-calcareous, friable;
		few ironstone nodules and thin layers, well jointed,
		few curved irregular fracture planes. 2.25 m+
		Joints 060/sub-vertical spacing·01–05 m 185/9°E.
		2.25 m+
		Stripped outcrop, rare coal fragments in adjacent spoil.
MR63	COG	OLD TRENCH, FLOAT OF COALY MUDSTONE, & SANDSTONE - fine-
		grain, blocky, medium bedding, non-calcareous with few/
		common pebbles.
MR64	COG	OLD TRENCH FLOAT OF WIDE LITHOLOGICAL MAKEUP - also
		containing some fine debris of carbonaceous mudstone.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: C1 to C290.
PROJECT: Sukunka 1979. DATE: June, July 1979.
LOCATION: . ELEVATION: .
GEOLOGIST: C. Rickford.

Station	Unit	Description:
C1	Geu	Winkie hole site (WDH 15) near △525. Casing pulled out but hole open. Probably too small to log. △525=sandstone, fine-grained brown-weathering, thin-bedded, platy, with orange-weathering specks. Strongly calcareous. (Winkie hole shows that this is in Geu, below Chamberlain "Marine" Band). Attitude: 140/14SW
C2	Geu	SANDSTONE - fine-grained, brown-weathering, with orange-weathering specks. Thinly bedded, strongly calcareous, (probably below Lower Chamberlain). Attitude: 126/29SW.
C3	Geu	= △526 and 527. SANDSTONE - fine-grained, medium-grained phases, dark grey, light bluish-grey-weathering, top of outcrop (at centre of roadway) is darker grey and rooty (lower Chamberlain floor). Occasional slightly rusty patches. Low-angle cross-laminated. Non-calcareous. Attitude: 125/16SW (for continuation SE on strike see △C5).
C4	Geu	SANDSTONE - fine to medium-grained, medium grey, grey-weathering, clean, thinly bedded, orange-weathering specks. Non-calcareous (SLP walked S along road, up-section. This unit may be Skeeter sandstone). Attitude: 109/42SW.
C5	Geu	Located 100m @ 100° from △C3. SANDSTONE - as at △C3, continuous outcrop, dip moderate to SW (no good bedding planes). Gully immediately SW of this outcrop may be Lower Chamberlain sub-crop.
C6	Mb	MUDSTONE - chips in road, probably Moosebar sub-crop, along road from this point to DDH C-41. Dark grey, non-calcareous.
		Note: For this and subsequent traverses:
		△ stands for "station"
		DDH stands for "Diamond Drillhole"
		WDH stands for "Winkie Drillhole"
		ATP stands for "at this point"
		SLP stands for "since last point"
C7	Cos	As observed from road to DDH S-12. Cliff exposure, 15 to 40m high of slightly orange-weathering, blocky beds and underlying grey-weathering rubbly beds. Roughly flat-lying.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C8	Cos	SANDSTONE - very fine-grained, argillaceous/SILTSTONE, argillaceous, abundant dark burrows, intensely bioturbated. Weakly calcareous. Attitude: 075/6SE.
C8A	Cos	SILTSTONE - Attitude: 090/10N, possibly some downslope movement.
C9	Cog	CONGLOMERATE - granule, well-sorted, light and dark grey cherts, abundant green cherts. Sparse matrix of coarse chert sand. Rare pebbles up to 15mm. Non-calcareous. Glacially rounded dip-slope.
C10	Cog	CONGLOMERATE - as at ΔC9 but with abundant small pebbles.
C11	Cog	CONGLOMERATE - clean, moderately sorted, small and medium pebbles (4 to 10mm) of light and dark grey chert, also green, rose, turquoise cherts. One pebble of 100mm.
C12,12A	Cog	SANDSTONE - frost-heaved, impossible to measure bedding. Fine-grained, orange-brown-weathering, clean, well-sorted, platy, cross-bedded (1 to 6cm beds), calcareous.
C13	Cog	CONGLOMERATE - granule and pebble, interbedded, tabular cross-beds. Top of snowfield.
C14	Cog	CONGLOMERATE - granule to small pebble. Clean, cross-bedded, occasional pebbles to 20mm.
C15	Cog	CONGLOMERATE - 10m scarp with talus of sandstone (thick, platy beds) and conglomerate for 15m below; conglomerate: small pebbles with abundant granules and fine sand matrix Massive, thick-bedded and better sorting at top of outcrop.
C16	Cog	CONGLOMERATE - granule, clean, well-sorted.
C17	Cog	CONGLOMERATE - granule to small pebble. Moderately to well-sorted. Light and dark grey and green chert. Maximum clast size 50mm. Non-calcareous.
C18	Cog	CONGLOMERATE AND SANDSTONE - 5m scarp. At top, conglomerate, consisting of small pebbles in abundant, non-calcareous fine sand matrix. This conglomerate unit is 3m thick, low angle cross-bedded and is underlain by 3m of sandstone, fine-grained, clean, brown-weathering, non-calcareous, thin to medium-bedded, flaggy.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
(Cont'd)		Probably same sandstone as in talus below △C15.
		Sandstone is cross-bedded, with local concentric "onion-skin" weathering.
C19	Cog	SANDSTONE - as △C18. On continuous outcrop.
		Attitude: 080/2SE.
C20	Cog	CONGLOMERATE - granule to small pebble, clean well-sorted, similar to △C17.
C21	Cog	CONGLOMERATE - as at △C20. Discontinuous, glacially-rounded outcrop. Essentially a bedding-plane surface.
C22	Cog	CONGLOMERATE - granule to pebble, up to 15mm, maximum 30mm. Abundant fine sand matrix.
C23	Cog	SANDSTONE - fine-grained, medium grey, orange-grey-weathering, cross-bedded, low-angle cross-laminated, clean, well-sorted, calcareous, about 6m exposed in scarp. Attitude: 065/3SE.
C24	Cog	CONGLOMERATE - small pebbles, mode 8mm, with fine to medium sand matrix. Overall good sorting. Non-calcareous.
C25	Cog	CONGLOMERATE - small pebbles, as at △C24. Roughly flat-lying.
C26	Cog	SANDSTONE - orange-weathering, clean, well-sorted, fine-grained, thin-bedded, platy, non-calcareous. Abundant float of this unit for 150m to NE. Stratigraphically below △C25. Cross-bedded, roughly flat-lying.
C27	Cog	SANDSTONE - as at △C26.
C28	Cog	SANDSTONE - as at △C23. From this point SW along strike no solid outcrop, only float.
C29	Cog	CONGLOMERATE - granule, clean, well-sorted, abundant light green chert. Discontinuous outcrop.
C30	Cog	CONGLOMERATE - granule to pebble, fine sand matrix, maximum 40mm, with abundant light green chert.
C31	Cog	CONGLOMERATE - granular to small pebbles, moderately well-sorted, light and dark grey, black, green cherts. No visible bedding. Rare joints @294°, 284°, 322°.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: SUKUNKA _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: C. Bickford, D. Mitchell _____.

Station	Unit	Notes:
C32	Cog	SANDSTONE - fine-grained, parallel bedded, low-angle cross-laminated, rusty-weathering, abundant large plant debris, stems, and rusty muddy intraclasts. Non-calcareous, medium worm burrows, occasional interbeds of dark grey silty mudstone. Occasional large ripples. Bedding plane movement is indicated by slickensides and low-amplitude folding. Possible minor fault.
C33	Cog	SANDSTONE - fine-grained, rusty orange-weathering, massive, non-calcareous. Poor exposure. About 3m above horizon at △C32.
C34	Cog	SANDSTONE - fine-grained, clean, rusty orange-weathering, thinbedded, platy. Attitude 078/8S. Forms bluff adjacent to road. Top is dipslope to S. (stratigraphically between △C33 and C32).
C35	Cog	SANDSTONE - fine-grained, rusty brown-weathering clean massive, non-calcareous, well-jointed. Joints: 348° (secondary, widely-spaced), 115°, 116° (primary, spacing 8 to 30cm). Outcrop surface is an irregular bedding plane.
C36	Cog	SANDSTONE - fine-grained, rusty orange-weathering, clean, non-calcareous. Outcrop polished by glacial ice. (Cannot determine attitude). Sandstone is platy, cross-bedded, with a few small chert pebbles. Swamp to NE probably floored by this unit. ATP, DDH C-9 located, hole plugged with wood.
C37	Cog	SANDSTONE - fine-grained, medium-bedded, cross-bedded, rusty orange-weathering, blocky to platy, non-calcareous. Attitude: 110/dip not determinable due to cross-bedding.
C38	Cog	Float of SANDSTONE - fine-grained, clean, rusty-weathering, platy. On seismic line. Small outcrops of this unit to N along bluff. Similar to △C34. Note: Occasional small black chert pebbles.
C39	Cog	ATP DDH S45. SLP walked seismic line, no outcrop. ATP small, glacially rounded outcrop of conglomerate. Granule to small pebble, clean, moderately well-sorted, light and dark grey, white, and green cherts.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Notes:
C40	Cog	ATP: CONGLOMERATE - small pebbles, mode 8 to 10mm, maximum 25mm. Locally abundant sandy matrix, occasional granule phases. Perhaps same horizon as at △C31. 3m thick, underlain by sandstone (see △C41).
C41	Cog	ATP: SANDSTONE - fine-grained, rusty-weathering, clean, non-calcareous, cross-bedded, thinly bedded, platy, rippled, 5m thick. Forms scarp to NW. Attitude: 132/7NE.
C42	Cog	ATP and SLP: SANDSTONE - talus. No outcrop. Probably near Gates-Sukunka contact, but is concealed by talus. Station located approximately 40m below △C41.
C43	Cog	CONGLOMERATE - as at △C40.
C44	Cog	SANDSTONE - float, as at △C41.
C45	Cog	CONGLOMERATE - granule to small pebble, thick-bedded to massive. Located at △Monty.
C46	Cog	SLP - traced conglomerate bed. Here 3m of conglomerate.
C47	Cog	SANDSTONE - fine-grained, massive, brown-weathering, occasional chert-pebble stringers, highly calcareous, 5m thick. Underlies beds of △C46. Dune bedded, blocky, readily exfoliates. Occasional plant fragments and load casts. Rare calcite-lined joints (255° and 217°). Top 2m poorly exposed.
C48	Cog	SLP - followed road down-section with discontinuous sandstone outcrops in road cuts. SANDSTONE - thin to massive-bedded with occasional dune sets. Ripples on bedding planes. Occasional plant fragments. Strongly calcareous. Attitude: 052/3NW (poor).
C49	Cos	SANDSTONE - very fine-grained, parallel-laminated/ SILTSTONE, rubbly (80:20) interbedded, highly calcareous, bioturbated, abundant small dark burrows. One joint at 057°. Beds 5 to 10cm thick, attitude: 046/4½SE.
C50	Cos	ATP:DDH S34, blocked but marked by water pipe. SLP: followed Sukunka outcrop down-section in road cut. Becoming siltier and more intensely bioturbated.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Notes:
C51	Cog	CONGLOMERATE - granule, well-sorted.
C52	Cog	CONGLOMERATE - granule to pebble, massive, large-scale low-angle cross-laminated, 3m thick, underlain by 1m+ SANDSTONE, fine-grained, brown-weathering, platy, cross-bedded.
C53	Cog	CONGLOMERATE - granule, non-calcareous, moderately well-sorted.
C53A	Cog	CONGLOMERATE - as at △C53.
C54	Cog	CONGLOMERATE - granule, well-sorted.
C55	Cog	CONGLOMERATE - granule, well-sorted.
C56	Cog	SANDSTONE - very coarse-grained to granule conglomerate, well-sorted.
C57	Cog	SANDSTONE - very coarse -grained to granule conglomerate, similar to △C55. Well-sorted. ATP DDH CM-5, wood jammed in casing.
C58	Cog	SANDSTONE - fine to very-fine-grained, clean, platy, frost-heaved outcrop.
C59	Cog	"A" Horizon outcrop. SECTION: ROOF: SANDSTONE - very fine to fine-grained, argillaceous, 20% muddy interbeds, load casts. 0.20m+ MUDSTONE - dark grey, few coal streaks. Rusty-weathering. 0.28m MUDSTONE - carbonaceous with coal streaks. ("A" horizon). 0.42m FLOOR: SANDSTONE - fine to medium-grained, dark grey, rooty at top, thin to medium-bedded, low-angle cross-laminated. Abundant polished bedding planes, some slickensides, non-calcareous. Attitude: 092/35S.
C60		ATP DDH S23. Seismic line bearing 054°. No outcrop. Traverse follows line.
C61	Cog	SANDSTONE - fine-grained, ferruginous-weathering, non-calcareous, poorly laminated. 394m on line, 20m left. ATP old water hole for drills.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Notes:
C62	Cog	No outcrop, marked break in slope at 424m online, 40m left.
C63	Cog	SANDSTONE - float, in seismic shot hole. Very fine-grained, brown, platy.
C64	Cog	CONGLOMERATE - small to medium pebbles, massive, outcrop on line at 667m; to SW, large blocks. (may be E_1 floor).
C65	Cog	CONGLOMERATE - granule and pebble, massive, 3m high scarp. At 690m on line.
C66		ATP DDH S-40. Hole blocked. Back bearing to △C65 is 170°.
C67	Cog	20m NW of DDH S-40. Top of cliff: CONGLOMERATE, granule. Cliff extends to NE and SW.
C68	Cog	CONGLOMERATE - granule to pebble, rounded to sub-angular, friable, moderately sorted, little matrix, faint calcite cement. At 998m on line.
C69	Cog	COAL - see log of Hand Trench (HT) - 4. At 1225m on-line 10m left of line. Creek exposure. (E_1 SEAM).
C70	Cog	COAL AND MUDSTONE - spoil in creek bank. At 1250m on-line. (Probably E_1 SEAM).
C71	Cog	SANDSTONE - very fine-grained, argillaceous, platy, brown-weathering, cross-bedded, non-calcareous. Attitude: 160/9NE. At 1274m on-line.
C72	Cog	SANDSTONE - fine-grained, medium bedded, poorly laminated weakly calcareous, ferruginous-weathering, appears cross-bedded. Attitude: horizontal; 1m+. Underlain by: SANDSTONE - very fine-grained, silty, micaceous, common micaceous, planty planes. Moderately calcareous.
C73		Junction of two seismic lines. At this point, line is crossed by a line bearing 142°. Check on line being traversed (backsight) 234°. At 1613m from S-23. No outcrop. (Note: Locations of C73 and C74 corrected to match position of cutlines as established by C91).

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Notes:
C74		Junction of line with road to DDH C-43. At 1740m on line. End of traverse of line. Error in distances +5m. No outcrop.
C75	Cog?	SANDSTONE - very fine-grained, grading to SILTSTONE - laminated, brown-weathering, fine plant debris, thin-bedded, cross-bedded, few low-angle polished surfaces. Dip less than 10°. Non-calcareous.
C76	Cog?	Abundant shattered rock in road - SILTSTONE - common ripple-sets, non-calcareous, abundant micaceous, planty planes, fine plant debris, brown-weathering.
C77	Cog?	Abundant float of SANDSTONE - very fine-grained, sitty, at site of DDH S-29. Hole open but blocked at 10m.
C78		Seismic line BPN40 (bearing 143°) located. No outcrop.
C79	Cog	COAL - seam exposed in Upper Chamberlain Creek Road. See HT (Hand Trench) 5 for details.
C80	Cog	MUDSTONE - dark grey, silty, rubbly, non-calcareous, rusty-weathering. 1m exposed. Attitude: 105/8SW (fair)
C81	Cog	MUDSTONE - dark grey, silty, blocky to rubbly, non-calcareous, rusty-weathering. Rare rootlets and tiny plant fragments. Very small dark worm burrows. Vaguely laminated.
C82	Cog	MUDSTONE - dark grey, silty, grading to argillaceous siltstone. Platy, rubbly, resistant, non-calcareous, thinly-bedded, cross-bedded, hematitic weathering. Attitutde: 084/2S.
C83	Cog	SILTSTONE - dark grey brown, some rootlets, occasional ironstone nodules. Outcrop on road. Thin interbeds of very fine-grained sandstone with carbonaceous laminae, rootlets, and rare burrows. Attitude: 069/5S.
C84	Cog	SANDSTONE - fine to medium-grained, rusty-weathering specks, buff-weathering, hematitic-weathering on joints, medium-bedded, non-calcareous. Attitude: 009/6E (fair). Rough, irregular bedding planes, abundant float on road towards DDH G-7.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____:
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C85	Cog	SANDSTONE - frost-heaved outcrop, fine-grained, orange-weathering, rusty-weathering specks, platy. Abundant muddy intraclasts (some carbonaceous). Non-calcareous.
C86		No Outcrop: ATP DDH G-8; cannot find hole.
C87		No Outcrop SLP, ATP. At end of S-30 road in creek. Creek very boggy. Doubtful if any outcrop along creek.
C88		No Outcrop SLP, ATP. In muskeg.
C89		No Outcrop SLP, ATP. In large clearing (muskeg) on seismic line. Metal plate on stump: Line BPN40'. Commencing Topofil measurement NE on-line.
C90	Cog	COAL - powder in ditch, may have been moved some distance by cats. At intersection of Line 40 and S-30 road.
C91		Re-ocupation of △C73, at 219m on-line. This point is 24m further northeast on-line than anticipated. No outcrop.
C93		ATP Line 40 leaves road (690m on-line). Position of cut line as originally located on field sheet was 15m too far to the right. Bearing checked 142°. No outcrop.
C94	Cog	CONGLOMERATE - granule to pebble, chert & quartz clasts. A few green cherts. Large flat outcrop. At 910m on-line, 34m right of line.
C95	Cog	CONGLOMERATE AND SANDSTONE - at 954m on-line, 4m scarp, trending 80° northeasterly of line: TOP OF SECTION: 1.2 to 1.6m — CONGLOMERATE - granule to pebble, maximum 50mm. Erosional 0.8 to 0.4m — SANDSTONE - fine to medium-grained, thinly bedded, some cross-beds, platy, non-calcareous, buff-weathering. 2.0m — CONGLOMERATE - small pebbles, alternating beds (0.15 to 0.30m) of pebbles and granules. Clasts up to 100mm in basal 0.5m of exposure.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C96	Cog	CONGLOMERATE AND SANDSTONE - at 1066m on-line, 6m scarp. SECTION:
		TOP OF SECTION:
		2.0m CONGLOMERATE - granule, massive
		1.70m CONGLOMERATE - small and medium pebbles
		0.15m SANDSTONE - fine-grained, pebbly
		0.15m CONGLOMERATE - small and medium pebbles
		4.5m SANDSTONE - fine-grained, medium-bedded, non-calcareous, blocky to platy.
C97	Cog	Outcrop observed from △C96; appears to be CONGLOMERATE overlying SANDSTONE, estimated 5m scarp. (Probably below Gates "A" Horizon).
C98	Cog	ATP DDH C-43. Surface outcrop is CONGLOMERATE as at △C96, scarp to north of this point is CONGLOMERATE over SANDSTONE, as at △C96.
C99	Cog	CONGLOMERATE - granule.
C100	Cog	Section measured: Top:
		3m CONGLOMERATE - pebble, thick-bedded
		2m+ SANDSTONE - fine-grained, medium-bedded, orange-weathering, non-calcareous, (probably same unit as at △C96, C97).
C101	Cog	CONGLOMERATE - pebble, with few rounded cobbles to 80mm.
C102	Cog	Section measured: Top:
		CONGLOMERATE - granule to pebble.
		3m+ Fine-grained sandstone interbeds towards base.
		2m+ SANDSTONE - fine-grained, non-calcareous, medium-bedded, marked "salt and pepper" appearance.
		(Section similar to △C100).
C103	Cog	SANDSTONE - fine-grained, thin-bedded, hematitic-weathering, platy, strongly calcareous, becoming thick-bedded at top. Forms scarp near △RIM NORTH. 10m thick.
C104	Cog	Outcrop observed from △C103. 10m high scarp;
		Section: appears to be CONGLOMERATE, 5m, over SANDSTONE, 5m, based on weathering characteristics.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C105	Cog	CONGLOMERATE - granule to pebble, rare cobbles. Outcrop follows contour to south.
C106		ATP DDH C44. Can't find hole (blocked at surface). No outcrop.
C107	Cog	Near north end of continuous, prominent scarp. Section (estimated): 15m CONGLOMERATE - resistant, large-scale cross-bedded. Top of scarp shows granule and small pebble conglomerate with abundant coarse sand matrix. 10m+ SANDSTONE - thick-bedded, slightly less resistant, orange-weathering.
C108	Cog	Outcrop observed from △C107. CONGLOMERATE and SANDSTONE - end of continuous outcrop.
C109		Resistant coutcrops observed from △C107.
C110	Cog	Probably CONGLOMERATE overlying SANDSTONE.
C111		(See △C22).
C112	Cog	SANDSTONE - very coarse-grained to granular conglomerate. Clean, well-sorted.
C113	Cog	CONGLOMERATE - granule.
C114	Cog	SILTSTONE - medium grey, rusty-weathering, non-calcareous, with very fine-grained sand laminae. Abundant finely broken plant debris. Attitude: 179/8E. Bedding irregular.
C115	Cog	CONGLOMERATE - granule to pebble, abundant coarse sand matrix, pebbles maximum 80mm, mode 15mm, with up to 50% interbeds of thickly laminated fine to medium-grained, platy, cross-laminated sandstone. Non-calcareous, with granule stringers. Sandstones pinch out laterally.
C116		
C117	Cog	CONGLOMERATE - granule.
C118	Cog	CONGLOMERATE - small pebbles.
C119	Cog	SILTSTONE - dark grey, sandy, non-calcareous, rubbly, orange-weathering, devoid of lamination, abundant small dark worm burrows. Possibly Sukunkoid Marker.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C120	Cog	SANDSTONE - very fine-grained, silty, buff-weathering, scattered tiny plant fragments and mica-flecks. Thinly bedded, platy to rubbly, non-calcareous, non-resistant bed. Actual outcrop only 10m long in road cut. Attitude: 100/4S (poor).
C121	Cog	SILTSTONE - argillaceous, olive drab, dark-brown-weathering, rubbly, non-calcareous.
C122	Cog	SANDSTONE - abundant float, fine-grained, well-sorted, platy, orange-weathering specks, orange-brown-weathering, medium-bedded, very strongly calcareous. Also abundant small pieces of very fine-grained and medium-grained sandstone.
C123	Cog	SANDSTONE - float, fine to medium-grained, clean, well-sorted, rubbly, orange-weathering, orange-weathering specks, non-calcareous.
C124	Cog	SANDSTONE - fine-grained, clean, well-sorted, platy, thin to medium-bedded, orange-weathering specks, buff-weathering, calcareous, plant impressions on bedding planes. Large ripples at top, thin planar beds at base 5m+ thick. Attitude: Horizontal.
C125	Cog	SANDSTONE - fine-grained, thin-bedded, as at base of △C124. Attitude: 096/12N.
C126		ATP DDH C-1. Hole not found. No outcrop.
C127 } C128 }	Cog	Section measured at this point. Top: 2m+ SANDSTONE - very fine-grained/MUDSTONE - thinly interbedded silty, buff-weathering sandstone and dark grey silty mudstone. Rare elliptical ironstone concretions. Rubbly. Occasional small dark worm burrows in sandstone. Non-calcareous. Locally intense bioturbation. 1m SANDSTONE - very fine grained, silty, thin-bedded, low-angle cross-laminated; 10% thin silty mudstone interbeds. Occasional large dark-rimmed worm burrows. Non-calcareous. Buff-weathering. Attitude: 140/10SW.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
Cont'd.		1.5m+ SANDSTONE - fine and very fine-grained/ SILTSTONE - intensely bioturbated and churned together. Unlaminated, abundant small dark worm burrows. Dark grey, non-calcareous. Sukunkoid Marker.
		BASE OF MEASURED SECTION.
		Top at △C127. Base at △C128.
C129	Cog	SUKUNKOID MARKER - exposed in bed of creek, at road. (As at △C128).
C130	Cog	SANDSTONE - very fine-grained/SILTSTONE - thinly interbedded, medium to dark grey silty sandstone and siltstone. Buff-weathering, non-calcareous, poorly exposed but abundant talus along ridge-line. 3m+
C131	Cog	SANDSTONE - fine-grained, orange-weathering specks, orange-weathering, medium-bedded, laminated, platy to rubbly, large plant fragments. Strongly calcareous, bedding planes rough. Attitude: 093/10S. ATP DDH C-13. Site reclaimed: hole lost.
C132	Cog	SILTSTONE - brown, sandy, thin-bedded, platy to rubbly, rooty, occasional large plant fragments. Non-calcareous Attitude: 090/6N.
C133	Cog	COAL - float, powdery, in road. Possibly dumped into mudhole at this point.
C134	Coh	SANDSTONE - very fine-grained, silty/SILTSTONE - interbedded, medium to dark grey, fine parallel and ripple-lamination, thinly bedded, rubbly, occasional hematitic weathering. Non-calcareous. Occasional finely broken plant fragments and small dark worm burrows. Occasional large flat sand-filled burrows. While locally bioturbated, lamination is remarkably well-preserved. Attitude: 143/5SE.
C135	Cog	Section measured in side of old trench. Top: 0.20m+ SANDSTONE - very fine-grained, dark grey, scattered plant fragments, rubbly, calcareous. Grey-weathering.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
Cont'd		0.60m+ SANDSTONE - very fine-grained, silty laminae, medium-bedded, laminated, rippled, blocky, orange-weathering, one red-weathering band, strongly calcareous. Occasional tiny plant fragments. Attitude: 170/3E
		0.15m+ SILTSTONE - thinly-bedded, brown, light brown-weathering, rubbly, with ironstone band at base. Weakly calcareous. Abundant plant fragments on bedding planes. Some tiny ripples.
		0.93m+ MUDSTONE - dark grey, purplish-grey-weathering, rubbly, silty, with ironstone band near top. Non-calcareous.
		BASE OF SECTION. This section is the upward continuation of that exposed at △MR62. (Probably just below floor of DE_1 SEAM).
C136	Cog	SILTSTONE - dark grey, very sandy, devoid of lamination, abundant dark burrows. Non-calcareous. Sukunkoid Marker
C137	Cog	SILTSTONE - dark grey, very sandy, traces of lamination, abundant dark burrows. Sukunkoid Marker. Non-calcareous, rubbly, dark grey-weathering, thinly-bedded to massive. Attitude: 147/9SW.
C138	Cog	SILTSTONE - brown, laminated, rippled, some sandy laminae, non-calcareous, thinly-bedded, rubbly, dark argillaceous laminae, scattered small dark worm burrows. Attitude: 051/6SE.
C139		ATP DDH S-25. Rods in hole (NQ?). Water level about 10m. Open to at least 68m.
C140	Cog	MUDSTONE - brown, blotky to rubbly, slightly silty, scattered tiny flat plant debris, possible rootlets? Non-calcareous.
C140A =K627	Cog	Section in roadcut: Top: 0.6m+ SILTSTONE/SANDSTONE - very fine-grained, interbedded, with scattered small worm burrows, non-calcareous, grey-brown, platy, thin-bedded, well-laminated and rippled.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
		0.6m+ SILTSTONE/SANDSTONE - as above but devoid of lamination, abundant dark burrows, churned and bioturbated. Non-calcareous. (SUKUNKOID MARKER).
		BASE OF MEASURED SECTION.
C141	Cog	COAL - powder in ditch of road. Dug out to 0.3m with hammer, base not seen but coal slightly firmer. Requires trenching. (E_3 SEAM?)
C142	Cog	SILTSTONE - light grey, rubbly, friable, non-calcareous, tiny rootlets. Well-preserved plant fossils. Passes downward to very fine sandstone.
C143	Cog	SANDSTONE - fine-grained, clean, well-sorted, massive, a few pebble stringers. Non-calcareous, large-scale low-angle cross-lamination.
C144	Cog	COAL - spoil in road cut. Probably E_3 SEAM.
C145	Cog	SANDSTONE - fine to medium-grained, massive, large-scale, low-angle cross-laminated, clean. Non-calcareous orange-grey-weathering.
C146	Cog	SANDSTONE - medium-grained, clean, well-sorted, orange-weathering, massive, low-angle cross-lamination, non-calcareous. ATP DDH S-28. (Can't find hole).
C147	Cog	SANDSTONE - medium-grained, as at △C146.
C148	Cog	Outcrop viewed from △C147. Probably SANDSTONE as at △C147.
C149	Cog	Section measured in bank. Top:
		0.15m+ MUDSTONE - brown, rubbly, non-calcareous,
		0.35m+ CONGLOMERATE - well-rounded, pebbles (10 to 30mm) of dark chert in an abundant, friable matrix of very fine sand.
		0.15m+ SANDSTONE - very fine-grained, very silty, laminated, abundant large and small plant fragments, non-calcareous. (Possibly Gates "B" horizon)

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
		BASE OF MEASURED SECTION
C150	Cog	SANDSTONE - fine-grained, clean, well-sorted, massive, low-angle cross-laminated. Non-calcareous. Attitude: 065/11SE.
C151	Cog	SANDSTONE - medium to coarse-grained, massive, clean, well-sorted, large-scale cross-laminated, weakly calcareous, orange-weathering. ATP DDH BP42. Post in hole.
C152	Cog	Outcrop viewed from △C151 - brown and orange-weathering, medium-bedded, probably SANDSTONE.
C153	Cog	SANDSTONE - fine-grained, massive, thickly laminated, non-calcareous. Attitude: 088/17S.
C154	Cog	MUDSTONE - dark brown, rubbly, slightly carbonaceous, non-calcareous. Abundant ferruginous fragments in float.
C155	Cog	COAL - spoil in road and bank. Powdery.
C156	Cog	SILTSTONE - brown, light brown-weathering, sandy, rubbly, laminated, very strongly calcareous. 0.6m+
C157	Cog	Section measured in bank above drill lease: Top: 0.40m+ MUDSTONE - silty, light brown, light grey-weathering, thin to medium bedded, blocky to platy. Abundant rootlets. Strongly calcareous. 0.50m+ SILTSTONE - dark grey, orange-weathering. Thinly bedded, rubbly, strongly calcareous, abundant large plant fragments. A few rootlets. Attitude: 024/2E.
C158	Cog	Outcrop observed from △C157: orange-weathering; appears thick-bedded, probably sandstone as at △C151.
C159	Cog	Section measured in cliff exposure: Top: 10m+ SANDSTONE - fine to very fine-grained, clean, orange-red-weathering, massive, large-scale cross-bedding, dips 0° to 40°. Strongly calcareous. Channeling within unit. Compactional or compression folding at base with underlying mudstones crumpled into sandstone unit.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
Cont'd		2m MUDSTONE - silty, dark grey, rubbly.
		4m COVERED INTERVAL
		COAL - spoil, mudstone with thin bright coal streaks forms floor.
		Thickness unknown. (DE_1 SEAM ?).
		BASE OF SECTION.
C160	Cog	COAL - section measured. See Hand Trench (HT) 6 for log of roof strata and seam.
C161	Cog	SANDSTONE - silty, very fine-grained, thinly bedded, cross-bedded, ripple sets, non-calcareous, orange-weathering, rubbly, mica flecks and finely broken plant debris, on bedding. In bank of drill lease. Attitude: 160/7W. ATP DDH S-27. Site reclaimed; hole lost.
C162	Cog	SANDSTONE - very fine-grained, silty, light grey, rusty-weathering, large and small burrows and rootlets. Attitude: 169/8W.
C163	Cog	Section measured in roof of reclaimed coal trench; Top:
		1.8m+ SANDSTONE - very fine-grained, silty, medium-bedded to massive, ripple sets, orange-weathering, non-calcareous, micaceous, planty planes. Erosional. Chimney-type compressional structures at base. Dune-bedding. Attitude: 148/7W
		MUDSTONE - silty, thinly bedded laminated few coal streaks, abundant coaly plant debris. Losing silty content downwards. Brown grey-weathering
		0.51 to 0.70m COAL - DE_1 SEAM. Reclaimed. Coal is not involved in chimneys. Sheared with an undulatory roof.
C164	Cog	SILTSTONE - brown, rubbly, purplish-weathering, non-calcareous, abundant plant debris. Attitude: 130/11SW.
C165	Cog	MUDSTONE - silty, non-calcareous, thinly-bedded, blocky, slightly spheroidal weathering. Dark grey. 0.4m+
C166	Cog	SANDSTONE - very fine-grained, thin-bedded, very light buff (fresh and weathered), non-calcareous, friable. Attitude: 043/20NW (unreliable, possible bank movement).

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C167	Cog	SANDSTONE - fine to medium-grained, thin-bedded, orange-weathering, abundant medium (0.002m) lighter-weathering, horizontal worm burrows ("C" horizon floor marker). Strongly calcareous, low-angle cross-laminated. This unit is near the top of an estimated 15m thick cliff-forming sandstone, which is massive in basal part, and thin to medium-bedded at top. Attitude: 162/9E (crossbed?)
C168	Cog	SANDSTONE - very fine-grained, silty, non-calcareous, thin-bedded, laminated, brown-weathering. Attitude: 119/7SW.
C169	Cog	SANDSTONE - medium-grained / MUDSTONE - interlaminated, rubbly, bedding irregular, brown-weathering, non-calcareous. Attitude: 125/3SW.
C170	Cog	SILTSTONE/SANDSTONE - very fine-grained, churned together, intensely bioturbated, abundant small dark burrows, non-calcareous, unlaminated (except for rare relict patches of lamination). Rough blocky fracture, distinctive light grey weathering. Ferruginous bands toward base of outcrop. Sukunkoid Marker.
C171	Cog	COAL with CONGLOMERATE/SANDSTONE roof . See Log of Hand Trench (HT)-7.
C172	Cog	SANDSTONE - section in cliff. Estimated: Top: 15m+ SANDSTONE - fine-grained, thin-bedded, platy, clean, medium grey, poorly exposed dark grey-weathering, non-calcareous, rooty at top, grades to siltstone at top. Abundant finely broken plant debris. Attitude: 130/7SW. 10m+ SANDSTONE - coarse-grained, thin-bedded, platy, weakly calcareous, clean, red-weathering, well-sorted, cross-bedded and cross-laminated. Occasional plant stems and finely broken plant fragments on bedding. Unit becomes medium-bedded at base. BASE
C173	Cog	SANDSTONE - medium to coarse-grained, thin-bedded, cross-bedded, platy, red-weathering, weakly to moderately calcareous. SLP traced small outcrops on strike from △C172

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C174	Cog	SANDSTONE - fine-grained, dark grey, carbonaceous, rooty, medium-bedded, non-calcareous.
C175	Cog	SANDSTONE - medium-grained, thin-bedded, cross-bedded, clean, red-weathering, laminated, very weakly calcareous 3m+
C176	Cog	SANDSTONE - section measured: Top:
		1.0m+ SANDSTONE - very fine-grained, thin to very thin-bedded, clean, platy, low-angle cross-bedded, very weakly calcareous, red-weathering, erosional.
		0.6m+ SANDSTONE - very fine-grained, laminated, massive, clean, strongly calcareous, rare chert granules.
		BASE
C177	Cog	SANDSTONE - very fine-grained, silty, thickly laminated at tops of beds, unlaminated at bases of beds, thickly bedded to massive, orange-red-weathering. Immediately underlies base of △C176. 5m+.
C178	Cog	SANDSTONE - fine-grained, clean, thin to medium-bedded, low-angle cross-bedded, non-calcareous. Abundant dark-rimmed lighter-weathering burrows 0.002 to 0.004m diameter ("medium") ("C" horizon floor marker?). Attitude: 116/1NE.
C179	Cog	SANDSTONE - medium to coarse-grained, medium-bedded, trough cross-bedded, clean, non-calcareous, orange-weathering, irregular bedding. Thickness 0.35m+.
C180	Cog	SANDSTONE - fine to medium-grained, clean, low-angle cross-laminated, non-calcareous, thin to thick-bedded. At top of 8 to 10m scarp.
C181	Cog	SANDSTONE - fine to medium-grained, clean, strongly calcareous, orange-red-weathering, platy, very thinly bedded, low-angle cross-bedded. Attitude: 175/10W.
C182	Cog	SANDSTONE - fine to medium-grained, clean, medium to thick-bedded, orange-weathering, strongly calcareous. Estimated 10m thick. At top of 5 to 7m scarp.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C183	Cog	SANDSTONE - fine-grained, abundant light-weathering horizontal medium worm burrows at top. ("C"horizon floor marker). Strongly calcareous, orange-weathering. Medium-bedded, cross-laminated at top, thinner bedding towards base, discontinuous outcrop. Unit overlies △C182. Attitude: 004/13W.
C184	Cog	SANDSTONE - fine-grained, clean, continuation of ourcrop at △C182. Orange-weathering.
C185	Cog	SANDSTONE - fine-grained, clean, strongly calcareous, thin-bedded, platy, low-angle cross-bedding and cross-lamination at top. Orange brown-weathering. At top of 6m overhanging cliff. Attitude at top: 025/8W.
C186	Cog	SANDSTONE - fine-grained, thin-bedded. Same unit followed from △C185. From this point sketched in outcrops of this unit across creek to west, also outcrops of lower, rubbly, brown-grey-weathering unit which appears to be Sukinka Member.
C187 C188 C189 C190	Cog	Outcrops viewed from △C186. Probably sandstone, continuing from △C186.
C191 C192	Cos	Outcrops viewed from △C186. Probably interbedded sandstone/siltstone. Recognizable as Cos on basis of rubbly nature and ribbed weathering (of more resistant beds).
C193	Cog	Continuation of outcrop from △C167, viewed from △C186.
C194	Cog	SANDSTONE - fine-grained, very thinly-bedded, platy, cross-bedded, strongly calcareous, clean, red-weathering. Attitude: 005/15W.
C195	Cog	SANDSTONE - very fine-grained, silty, weakly to moderately calcareous, thin-bedded at top, thin and thick-bedded at base. 3.5m thick. Attitude: 076/6SE.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C196	Cog	Section measured in cutbank of possible reclaimed trench: Top:
		2.0m+ SANDSTONE - fine to very fine-grained, thick-bedded, blocky, large-scale rough cross-bedding, generally clean, some silty beds. Orange-weathering, strongly calcareous. Occasional plant fragments on bedding. Erosional and load-casted at base, with 0.4m scouring. Attitude: 163/55W.
		1.8 to 2.2m+ MUDSTONE - silty, brown orange-weathering, rubbly, strongly calcareous. Abundant plant fragments and stems, rare bright coal lenses. Occasional bands of very strongly calcareous concretions.
		BASE
		Note: Probable reclaimed trench of E_1 SEAM. Abundant coal spoil including egg-sizes lumps, appears to have been bulldozed over end of road, down bank.
C197	Cog	SANDSTONE - very coarse-grained to CONGLOMERATE, granule and pebble, clean, well-sorted, large-scale cross-beds, thick-bedded to massive, distinctive dark grey-weathering. Forms prominent scarp from here to east. 7m+. Unit appears to die out 10m west of creek, to west of this point. Probable stratigraphic level between D and E_1 horizons.
C198	Cog	Section measured in road cut to DDH S-44: Top:
		0.7m+ SANDSTONE - fine to very fine-grained, silty, abundant carbonized plant debris, thick-bedded, large-scale cross-bedding, abundant prostrate log impressions. Appearance of rapid deposition. Medium to dark grey, with carbonaceous laminae, low-angle cross-laminated, strongly calcareous, red-orange-weathering.
		0.7m+ SILTSTONE - sandy, thin-bedded, brown, rubbly, rooty at top, abundant plant fragments, low-angle cross-bedded, non-calcareous.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
Cont;d.		0.5m+ SANDSTONE - orange-weathering, fine to very fine-grained, silty, medium bedded, low-angle cross-laminated, abundant carbonaceous, laminae, strongly calcareous.
		BASE
		Note: Abundant coal spoil in road. Provenance, unknown. ATP DDH S-44. Rods in hole but plugged with dirt.
C199	Cog	SANDSTONE - very fine-grained, orange-weathering, silty, medium-bedded, thinly laminated, non-calcareous, occasional rooflets, ripple sets, muddy intraclasts, thin laminae of fine-grained sand. Minor interbeds of rubbly brown, iron calcareous, sandy SILTSTONE. Attitude: 307/9W. Abundant weathered dark grey carbonaceous mudstone in road below this unit.
C200	Cog	Section measured: Top:
		0.30m+ MUDSTONE - black carbonaceous, rare thin bright coal streaks, weathered
		0.30m+ SILTSTONE - orange-weathering, rooty, blocky, grading down to SANDSTONE, very fine-grained, silty, thick-bedded, orange weathering, platy, rooty, non-calcareous. Attitude: 019/6W. Base.
C201	Coh	SILTSTONE/MUDSTONE - silty, dark grey, non-calcareous, thinly interlaminated, thinly bedded, platy, lamination well preserved. Tendency to spheroidal weathering. Generally grey-weathering, some hematitic patches. Attitude: 130/7SW.
C202		At 50m SW'ly of △C201 on cutline. ATP line ends. No outcrop.
C203	Coh	SILTSTONE/SANDSTONE - very fine-grained/MUDSTONE - interlaminated, thinly bedded, non-calcareous, dark grey-brown, occasional ripples. Similar to △C201 but blockier. Rare small, near-vertical dark worm burrows, and larger flat burrows. Grey-weathering. Attitude: 020/10W. ATP junction of cutline and Bullmoose Highway. SLP and in creek no outcrop. 293m from △C201 on cutline.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C204	Coh	FLOAT of SILTSTONE/MUDSTONE - silty, interlaminated dark grey siltstone and mudstone, grey-weathering. Occasional hematitic pieces. On bare patch of soil, 10m N of cutline. ATP 390m NE of △C201 on cutline. Near an iron pin, "U&U 6746".
C205		ATP 658m on line. SLP, ATP no OTC. End of line traverse.
C206	Coh	SILTSTONE - medium and dark grey, interlaminated, darker laminae are argillaceous. Lamination well-preserved. A few thin laminae of dark grey mudstone. Grey-weathering, abundant hematitic mottles and patches. Minor anticline/syncline exposed in this outcrop. Non-calcareous, rubbly. Attitudes: 148/1W at uphill end of exposure Syncline 123/4E in middle Anticline 134/44W at bottom end.
C207	Coh	SILTSTONE - as at △C206. Attitude: 130/10W.
C208	Coh	SILTSTONE/MUDSTONE - interlaminated, thinly bedded medium and dark grey siltstone and silty mudstone, grey-weathering, occasional rusty orange-weathering coatings on bedding. Lamination well-preserved. Attitude: 179/1E
C209	Coh	SILTSTONE - laminated, thin-bedded, medium and dark grey, non-calcareous, small-scale low-angle cross-laminated, grey-weathering with some hematitic-weathering bedding planes. Occasional thin laminae of dark grey silty mudstone. Attitude: 040/1SE.
C210	Cog	COAL - section taken in road cut. See Hand Trench (HT) -8.
C211	Cog	SANDSTONE - clean, fine-grained, thin to medium-bedded, buff-weathering, non-calcareous.
C212	Cog	SANDSTONE - very fine to fine-grained/MUDSTONE - interlaminated, thinly-bedded, orange-weathering, occasionally silty sandstone and dark brown mudstone. Rooty, rubbly, non-calcareous. Attitude: 163/6W (fair).

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C213	Cog	SANDSTONE - very fine-grained/SILTSTONE - finely interlaminated, but occasionally churned together so that lamination is only occasionally recognized. Buff-weathering, hackly fracture, blocky, thick-bedded, non-calcareous. Vague dark burrows. Attitude: 116/2 SE. May be sandstone/siltstone unit underlying. Sukunkoid Marker: top of outcrop shows light grey weathering and is unlaminated, intensely bioturbated sandstone/siltstone (possible Sukunkoid Marker).
C214	Cog	COAL - spoil in bank and road. Possibly E_3 coal zone, however, immediate roof appears to be dark grey, rubbly mudstone.
C215		ATP unidentified drill hole. Hole open but full of water to surface. Marked by air target.
C216	Cog	SANDSTONE - very coarse- grained. Abundant granules. Clean, massive. Possible E_1 floor horizon.
C217	Cog	SANDSTONE - as at △C216. Road follows top of this bed.
C218	Cog	SANDSTONE - as at △C217.
C219	Cog	SANDSTONE - medium to coarse-grained, scattered granules, clean, rooty, carbonaceous and darker at top, rest is medium grey. Undulatory surface at top. May be immediate floor of E_1 zone. Attitude: (fair) 041/2 NW.
C220	Cog	Section measured: Top: 2m — CONGLOMERATE AND SANDSTONE - thickly interbedded (70%) conglomerate, pebble and granule with coarse sand matrix and medium to coarse-grained sandstone. Red-weathering, non-calcareous. — Erosional — 1.8m+ — SANDSTONE - fine-grained, clean, thick-bedded, thickly-laminated, large-scale low-angle cross-laminated, occasional platy phases (parting on lamination). Medium grey, buff and orange-weathering, non-calcareous. Rare floating pebbles towards top. Occasional medium to coarse-grained laminae, some small (0.02 to 0.04m) festoons. Occasional concentrations of

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
(Cont'd)		plant stems on bedding. Overhanging at base.
C221		ATP DDH C-14. Hole open. Collared in sandstone boulders. Core of Cos strewn about site. Six boxes of Mb core. No outcrop.
C222	Cog	SANDSTONE - fine-grained, clean, massive at top, thin-bedded, cross-bedded, platy below. Buff-weathering. Strongly calcareous. Marker: medium (0.002m) horizontal light-weathering worm burrows 1.5m below top, making this the "C" roof horizon. ATP 7m scarp. Across creek to west this unit forms a cliff, estimated 20m high.
C223		
C224		
C225	Cos	Outcrops sketched from △C222.
C226		
C227		
C228	Cog	Outcrops sketched from △C222.
C229		
C230	Cog?	Outcrop sketched from △C222.
C231		
C232	Cog	Outcrops sketched from △C222.
C233		
C234		
C235	Cog	Continuation of outcrop of unit at △C220. Top of outcrop is SANDSTONE - very coarse-grained, abundant granules, grading down to CONGLOMERATE - granule in 0.50m. Outcrop forms prominent bench.
C236	Cog	SANDSTONE - fine to medium-grained, clean, orange-weathering, very thin-bedded, platy, dune cross-beds, strongly calcareous.
C231A		
C232A		
C233A		
C234A		
C235A		
C236A		

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TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C237		
C238		
C239		
C240		
C241		
C242	Cog	Outcrops sketched from vicinity of DDH S-39. Three
C243		resistant units can be traced around the valley.
C244		(The topmost is best exposed).
C245		
C246		
C247		
C248		
C249	Cog&Cos	Outcrop sketched from vicinity of DDH S-39. Contact
		located approximately.
C250		
C251		
C252	Cos	Outcrops sketched from vicinity of DDH S-39. Identified
C253		by distinctive interbedded and "ribbed" appearance.
C254	Cog	SANDSTONE - very fine-grained/SILTSTONE (80-20) -
		interbedded dark grey thick bedded, very strongly cal-
		careous well cemented sandstone and brown, rubbly, thin-
		bedded, very strongly calcareous siltstone with plant
		fragments. Sandstones are low-angle cross-laminated,
		rolling at base. Attitude: 153/7W. 2m+
C255	Cog	Section measured: Top:
		1.8m+ MUDSTONE - silty, rubbly, dark grey,
		weakley calcareous, a few rootlets.
		Occasional ferruginous nodules.
		0.27m SILTSTONE - sandy, medium grey, rubbly,
		very strongly calcareous, thin-bedded,
		buff-weathering.
		0.9m MUDSTONE/SILTSTONE - thinly-bedded, inter-
		bedded rubbly, silty, purplish-weathering,
		very strongly calcareous mudstone and
		orange-weathering, occasionally sandy,
		very strongly calcareous siltstone
		0.35m+ SILTSTONE - strongly calcareous, brown
		buff-weathering rootlets, occasionally
		sandy, thin-bedded, rubbly.
		Attitude: 132/13SW.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
		BASE
C256	Cog	Section of cliff-forming unit: Top:
		0.33m+ SANDSTONE - coarse-grained, pebbly, massive, non-calcareous.
		2.0m+ SANDSTONE - fine-grained, thin to thick-bedded, clean, non-calcareous, large vertical burrows at top, orange-weathering. Few thin beds of rubbly siltstone. Large-scale low-angle crossbedding, low-angle cross-lamination. Overhanging. Attitude: 140/12W. Cross-bed 002/7W.
		BASE
C257	Cog	Section measured: Top:
		2.0m+ SANDSTONE - very fine to fine-grained, silty at base, moderately calcareous, orange-weathering, thin wavy bedding. Attitude: 135/21SW
		0.5m+ SILTSTONE - dark grey, scattered finely broken plant debris. Non-calcareous, thin-bedded, rubbly, grades down to dark brown-grey silty mudstone.
		BASE
C258	Cog	SANDSTONE - medium to coarse-grained, occasional fine-grained and rare pebbly phases. Clean, well-sorted, buff-weathering, moderately calcareous. Abundant medium (0.002 to 0.003m) light-weathering horizontal or inclined worm burrows from 1 to 2m below top. Possible "C" horizon floor marker. Large scale low-angle cross-laminated. Thin to thick-bedded at top, becoming massive at base, and fining down to fine to very fine-grained at base. 8m+
C259	Cog	Section exposed in stream: Top:
		EST 14m+ SANDSTONE - as at △C258
		4m+ SANDSTONE/MUDSTONE - interbedded non-calcareous, very fine-grained, low-angle cross-laminated silty sandstone and dark grey, non-calcareous silty mudstone. Attitude: 125/14SW. Probable "B" horizon roof.
		4m+ CONCEALED by talus
		12m+ SANDSTONE - fine-grained, clean, medium grey, non-calcareous, large-scale low-angle

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
(Cont'd)		cross-laminated and cross-bedded. Thick bedded to massive.
		BASE
C260	Cog	SANDSTONE - same unit as at base of △C259. Fine-grained, clean, strongly calcareous at base, laminated, large-scale low-angle cross-bedded, thin to thick-bedded at base, thin to medium-bedded at top. Platy. Forms 10m cliff.
C261	Cog	SANDSTONE/MUDSTONE - interbedded, as at △C259. Abundant large and small horizontal burrows, well exposed on bedding. Attitude: 121/10SW. 4m+
C262	Cog	Section exposed in gully. Upper sandstone forms scarp to west. Top:
		5m+ SANDSTONE - very fine-grained, clean, non-calcareous, massive, blocky, orange-weathering, similar to top unit at △C259.
		5m+ SANDSTONE/MUDSTONE - interbedded, as at △C261.
		BASE
C263	Cog	SANDSTONE - fine-grained, clean, very strongly calcareous at top, thin-bedded, cross-bedded, platy at top, becoming thicker-bedded below. 3m scarp. Probably same unit as at top of △C262. (SLP followed strike).
C264	Cog	SANDSTONE - as at △C263. SLP followed scarp. ATP end of outcrop, up to 8m high. Abundant talus below.
C265	Cog	SANDSTONE - fine-grained, clean, thin-bedded, cross-bedded at top, thicker towards base. Non-calcareous. Orange-weathering.
C266	Cog	SANDSTONE - fine-grained, clean very strongly calcareous, thick-bedded to massive, but thickly-laminated, appears parallel with a few festoons. Platy, red-weathering, individual laminae spall off. Large, hollow-weathering horizontal worm burrows near top. Attitude: 087/1S. 2m+

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
C267	Cog	SANDSTONE - fine to very fine-grained, clean, thin-bedded, platy, low-angle cross-laminated at top, thick-bedded to massive, large-scale spheroidal weathering at base. Non-calcareous. Attitude: 128/5SW. 6m+
C268	Mb	MUDSTONE - dark grey, slightly silty, non-calcareous, bluish-grey-weathering, ferruginous bands. Spheroidal-weathering. Strongly jointed.
C268A	Cog	ATP DDH C-28. Post in hole. No outcrop.
C269	Cog	ATP float boulders of SANDSTONE - very fine-grained, clean, medium-bedded, orange-weathering, non-calcareous.
C269A	Cog	COAL - spoil in road cut. Abundant float of grey-weathering clean, medium-grained sandstone with plant fragments (floor?). Abundant chips of dark grey silty mudstone with rare ferruginous nodules in bank above coal. (Roof?). Coal may be "C" seam.
C270	Cog	ATP dip slope outcrop of SANDSTONE - fine-grained, dark brown, carbonaceous, rooty, non-calcareous; this unit probably forms dip slope all along west side of swamp (but not exposed due to soil cover. "C" floor horizon?).
C270A	Cog	SANDSTONE - fine to medium-grained, clean, medium-bedded, blocky, orange-weathering, weakly calcareous. Attitude: 015/5W. Forms waterfall. 10m+
C271	Cog	SLP followed continuous dip slope outcrop. ATP measured section: Top: 0.5m+ SANDSTONE - fine to medium-grained, clean, non-calcareous, non-carbonaceous. 0.3m+ CONGLOMERATE - granule and small pebble, abundant fine to medium sand matrix. BASE Note: The carbonaceous phase of the sandstone unit appears to be confined to the extreme top of the unit, as at △C270. Strike approximately 065, dip low to E, from outcrop configuration.
C271A	Cog	SANDSTONE - fine-grained, clean, grey-weathering in top 0.30m. Orange-weathering below. Dark grey, carbonaceous

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
(Cont'd)		in top 0.03m. Very strongly calcareous at base, non-
		calcareous at top. Plant fragments and rootlets at top.
		Faint light-weathering medium horizontal burrows, 0.20m
		below top. "C" floor marker. Attitude: 176/9SW. 0.6m+
C272	Cog	SLP followed 0.5 to 1.0m high, scarp of CONGLOMERATE as
		at base of C271. ATP outcrop ends and conglomerate is
		now dominantly composed of small pebbles.
C273	Cog	SANDSTONE - fine-grained, clean, thin-bedded, platy,
		patchily calcareous, buff-weathering. Attitude: 075/6S.
C274	Cog	SANDSTONE - very fine-grained, clean, light grey, thin
		to very thin-bedded, large-scale low-angle cross-bedded,
		buff-weathering, non-calcareous, platy to rubbly,
		scattered carbonaceous laminae, small-scale low-angle
		cross-laminated. Attitude: 103/4S.
C275	Cog	SANDSTONE - very fine-grained, silty, abundant, mudstone,
		laminae, thinly bedded, rippled, rubbly, orange-brown-
		weathering. Abundant finely broken plant debris and thin
		coal streaks. Very weakly calcareous.
		Attitude: 034/7E.
C276		ATP DDH G-4. Hole lost. No outcrop.
C272A		
C273A		
C274A	Cog	Outcrops sketched from △C271A.
C275A		
C276A		
C277	Cog	Float boulders of SANDSTONE - very fine-grained, clean,
		thick-bedded, orange-weathering, non-calcareous.
C278	Cog	CONGLOMERATE - small pebble. Well-sorted. 2m scarp.
C279	Cog	SANDSTONE - fine-grained, clean, non-calcareous, medium-
		bedded, low-angle cross-bedded, orange-weathering.
		Attitude: 042/5SE.
C280	Cog	SANDSTONE - medium-grained, clean, brownish-grey, rooty,
		thick-bedded, blocky at top, medium-bedded, below. Faint
		near-horizontal dark-rimmed medium-sized worm burrows.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: _____.
PROJECT: _____. DATE: _____.
LOCATION: _____. ELEVATION: _____.
GEOLOGIST: _____.

Station	Unit	Description:
(Cont'd)		Non-calcareous. Possible "C" horizon floor. 1m+
C281	Cog	SANDSTONE - fine to medium-grained, clean, brownish-grey, grey-weathering, rootlets. Plant stems on top. Dark grey, carbonaceous in top 0.02m. Thick-bedded, blocky. Faint dark-rimmed, near-horizontal worm burrows. Non-calcareous. Probable "C" horizon floor.
C282	Cog	Float, rubble and blocks of SANDSTONE - very fine-grained, clean, orange-weathering, thin-bedded, platy, non-calcareous.
C283	Cog	(Float?) - SANDSTONE - very fine-grained, silty, grading down to MUDSTONE, silty, non-calcareous, dark grey, rooty, blocky. Poorly exposed in road cut. 0.3m+
C284		ATP DDH S-46. Casing in hole. No outcrop. Boggy.
C285	Cos	SANDSTONE - very fine-grained, silty, thick-bedded, blocky, buff-weathering, non-calcareous. Abundant burrows. Intensely bioturbated. Attitude: 168/9E.
C286	Cos,Mb	Outcrop sketched from Lower Chamberlain Creek Road.
C287		
C288	Mb	MUDSTONE - dark grey, rubbly. Outcrops in vicinity of RDH R15.
C289		
C290	Cos,Mb	Outcrop sketched from vicinity of RDH R15.

B.P. CANADA LTD. COAL GROUP

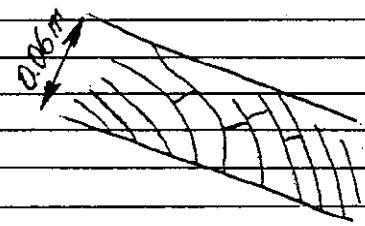
TRAVERSE / TRENCH NUMBER: TR-55

PROJECT: Sukunka 1979 . DATE: June 11, 1979

LOCATION: No. 1 Mine Road . ELEVATION: 965 m ± 5 m (from map)

GEOLOGIST: Bickford, Mitchell . Location from map: 86890 E ± 10 m
21180 N

Unit	Thickness (m)	Description
		Section of Middle Gething
1	1.5±	SANDSTONE-very fine-grained/SILTSTONE, argillaceous/ MUDSTONE, silty (30:30:40)-interbedded; laminated, strongly calcareous. Mostly covered, by scree. Abrupt. 140/30 SW
		REPEAT OF UNIT 4.
2	1.40	SANDSTONE-very fine-grained, dark grey, hard, laminated, thick-bedded, blocky. Strongly calcareous. Poorly exposed from 0.70 to 1.30 m above base. Fault at base. Base: 144/25 SW (irregular)
		REPEAT OF UNIT 5
3.	0.06	MUDSTONE-dark grey, silty, with minor argillaceous siltstone. Strongly calcareous. Sigmoidal-type structures in this unit (see sketch). Movement at top and base (fault zone). 140/40 SW
4.	0.55	SANDSTONE-very fine-grained, silty/SILTSTONE, argillaceous/ MUDSTONE-silty (30:30:40)-interbedded; laminated, blocky, well-jointed, strongly calcareous. Abrupt. 159/25 SW at top (fault plane). Rolling.
5	0.65+	SANDSTONE-very fine-grained, dark grey, hard, overall similar to unit 2. Strongly calcareous.
		Calculated stratigraphic displacement 2.01 m.



Sketch showing "sigmoidal"-type structures in Unit 3.

Approx. 1/4 scale

Location of trench marked by green flags 250 m (by chain) up No. 1 road from the inside corner of its junction with SWITCHBACK road.

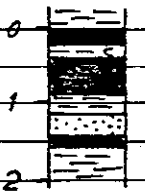
Fault is exposed 2.60 m vertically below top of green flags.

TRENCH 55 is near the center of a continuous cat trench made June 11, 1979, to search for the fault position. The cat trench showed a normal Middle Gething sequence, dipping SW, rising in section downhill along road.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: HT-1
PROJECT: Sukunka 1979 DATE: June 27, 1979
LOCATION: Master "A" Prospect ELEVATION: (from map) 1177
GEOLOGIST: J. Stobernack/C. Bickford 87420 E
23495 N

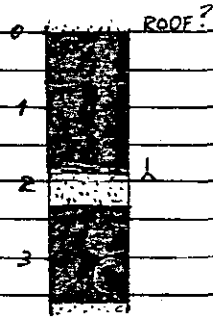
True Thickness	Depth Below roof	Section of Chamberlain Seams
0.35+	----	ROOF-MUDSTONE-ochre-colored, laminated, non-calcareous
0.21	0.21	COAL-weathered
0.17	0.38	MUDSTONE-carbonaceous
0.50	0.88	COAL-weathered
0.27	1.15	MUDSTONE-platy, brown, orange-weathering
0.30	1.45	SANDSTONE-fine to medium-grained
0.12	1.57	COAL-weathered
0.50+		FLOOR-MUDSTONE-non-calcareous, breaking into sharp wedges.
		Outcrop probably slumped
		located at station K-560.
		GRAPHIC SECTION: 1:100 scale:



B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: HT-2 (Hand Trench)
PROJECT: Sukunka 1979 DATE: June 27, 1979
LOCATION: Master "A" Prospect ELEVATION: 1175 m (from map)
GEOLOGIST: J. Stobernack/C. Bickford 87645 E from map
23485 N

True Thickness	Depth Below roof	Section of Chamberlain Seams
0.02+	---	ROOF? - SANDSTONE-medium-grained, dark grey, soil above (lower part of Median Parting?).
1.79	1.79	COAL-weathered
0.05	1.84	MUDSTONE-dark grey, rootlets, dip on top 159/48 NE
0.48	2.32	SANDSTONE-very fine-grained, orange-weathering specks, laminated, grades down to SILTSTONE, laminated, argillaceous
1.27	3.59	COAL-weathered
		SANDSTONE-fine-grained, black, carbonaceous, dip 149/54 NE (floor)
		located at traverse station K512
		NOTE: 48^{o} dip used in calculation of true thickness, since seam floor is generally undulatory.
		Graphic: 1:100 scale:



B.P. CANADA LTD. COAL GROUP

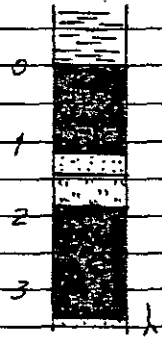
TRAVERSE / TRENCH NUMBER: HT-3

PROJECT: Sukunka 1979 DATE: June 27, 1979

LOCATION: Master "A" Prospect ELEVATION: (from map) 1186 m

GEOLOGIST: J. Stobernack, C. Bickford 87585 E
23605 N

True Thickness	Depth Below Roof	Section of Chamberlain Seams
0.80+	---	ROOF-MUDSTONE-laminated, dark grey-brown, splintery ("laminite" horizon).
1.17	1.17	COAL-weathered
0.31	1.48	SANDSTONE-fine-grained, medium to dark grey, blocky to rubbly, thinly laminated. Attitude on top 145/50 NE.
0.40	1.88	SILTSTONE-dark grey, thinly laminated at top, massive, blocky, at base.
1.54	3.42	COAL-weathered
		FLOOR-SANDSTONE-medium-grained, dark grey, rolling surface, rooty.
		50° dip used for calculation of true thickness.
		Graphic section: 1:100 scale



B.P. CANADA LTD. COAL GROUP

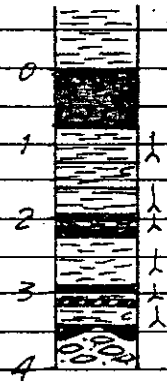
TRAVERSE / TRENCH NUMBER: HT-4 (Hand Trench) (Page 1 of 2)
PROJECT: Sukunka 1979 DATE:
LOCATION: Windy Falls Vicinity ELEVATION: Floor 1513 (from map)
GEOLOGIST: D.J. Mitchell, C. Bickford 91270 E
19930 N

True Thickness	Depth Below Roof	
		Section of Gates E, Zone
0.55+	---	MUDSTONE-dark grey, rubbly, with ferruginous bands.
0.46	---	ROOF-MUDSTONE-dark grey-brown, blocky in top 0.22, rest rubbly. Attitude: 100/15 SW (fair)
0.75	0.75	COAL-weathered, highly sheared in parts. Base irregular.
0.52	1.27	MUDSTONE-dark grey, faintly laminated, common thin coal streaks, abundant roots, ferruginous mottling, thin to medium-bedded, weak. Few irregular polished surfaces.
0.34	1.61	MUDSTONE-carbonaceous, common thick coal streaks. Polished bedding planes. Ferruginous mottling.
0.35	1.96	MUDSTONE-light brown, becoming grey deeper into crop. Poorly laminated, abundant roots, ferruginous mottling.
0.03	1.99	MUDSTONE-carbonaceous, sheared, coal streaks
0.05	2.04	COAL-dull banded
0.06	2.10	MUDSTONE-dark grey, common roots and fine coal streaks. Ferruginous mottling.
0.06	2.16	COAL-dull, highly weathered
0.06	2.22	COAL-dull, highly weathered, sheared
0.69	2.91	MUDSTONE-grey brown, unlaminated, abundant roots, faint lighter mottles, ferruginous mottles, rare coal streaks up to 0.01 m.
0.04	2.95	COAL-dull banded, sheared
0.04	2.99	COAL-dull banded
0.10	3.09	MUDSTONE-common roots, unlaminated, slightly sheared
0.06	3.15	COAL-dirty
0.25	3.40	MUDSTONE-unlaminated, common polished roots, carbonaceous.

B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: HT-4 (Hand Trench)
PROJECT: Sukunka 1979 DATE:
LOCATION: Windy Falls Vicinity ELEVATION:
GEOLOGIST: D. Mitchell, C. Bickford

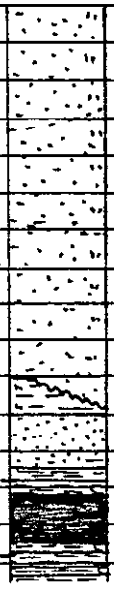
True Thickness	Depth Below Roof	
0.20*	3.60	COAL-cleat in this leaf at 072°, 078°, 081°, 082°. Thickness * ranges from 0.20 to nil, due to rolling floor.
		FLOOR-SANDSTONE-very coarse-grained, to CONGLOMERATE granule. Massive, rolls up to 20 cm on surface; black, carbonaceous at top.
		GRAPHIC SECTION: SCALE 1:100



B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: HT-5
PROJECT: Sukunka 1979 DATE: July 6, 1979
LOCATION: Cow Moo ELEVATION: Seam Top 1685 m
GEOLOGIST: C. Bickford Location scaled from plan: 93510 E, 17685 N

Thickness	Depth	Description:
		Section of Gates below D Zone
5 m+		SANDSTONE-very fine-grained to fine-grained silty, blocky Erosional; channeling within unit.
0 to 0.40		MUDSTONE-dark grey, slity, platy, pinches out laterally.
0.72		SANDSTONE-fine-grained, blocky, trough cross-laminated, clean at top; argillaceous at base. Gradational.
0.15		MUDSTONE-dark brown blocky, few coal streaks. Some listrication. Attitude: 110/24 SW
		TOP OF SEAM
0.17	0.17	MUDSTONE-black, carbonaceous, sheared
0.67	0.84	COAL
0.13	0.97	MUDSTONE-black, carbonaceous
0.17	1.14	MUDSTONE-brown, soft
0.15	1.29	MUDSTONE-black, carbonaceous, sheared, includes minor sheared coal.
0.05+	1.34+	MUDSTONE-brown, hard. Base not reached due to frozen talus of coal and mudstone.
		BASE NOT REACHED
		Graphic:
		SCALE 1:100



B.P. CANADA LTD. COAL GROUP (Page 1 of 2)

TRAVERSE / TRENCH NUMBER: HT-6 (Hand-Trenched).
PROJECT: Sukunka 1979. DATE: July10,11 1979.
LOCATION: S-27 Vicinity. ELEVATION: 1500 m ± .
GEOLOGIST: C. Rickford/D. Mitchell. E 91185 N 18450 from map

Thickness	Depth	Description:
		Section of Gates E3 Zone
0.59		SANDSTONE-very fine-grained, silty, ripple sets, medium-bedded, blocky, rusty-weathering, non-calcareous. Attitude: 091/4W
1.31		SANDSTONE-very fine-grained, rooty, blocky to rubbly, silty carbonaceous laminae, ripple sets, well-cemented, massive. Non-calcareous. Slightly erosive with load casts at base.
0.16		MUDSTONE-dark grey, silty, thinly bedded, ferruginous weathering.
0.94 to 1.19		SANDSTONE-very fine-grained, well-cemented, massive, non-calcareous, ferruginous weathering.
0.26		CONGLOMERATE-small pebbles, granules, poorly sorted but clean. Rare large pebbles to 80 mm.
0.44	0.44	COAL-clean, weathered
0.04	0.48	MUDSTONE-black, carbonaceous, rusty-weathering, abundant very thin bright coal streaks.
0.05	0.53	COAL-clean, weathered
0.13	0.66	MUDSTONE-black, carbonaceous, rusty-weathering, abundant thick bright coal bands. Sheared in basal 0.05 m.
0.73	1.39	MUDSTONE-brown, listricated, few thin coal streaks in top 0.03 m.
0.28	1.67	MUDSTONE-dark brown to black, carbonaceous, sheared, abundant thin bright coal bands.
0.25	1.92	COAL-inferior, with some cleaner bands. Slightly sheared
0.07	1.99	MUDSTONE-brown, listricated
0.08	2.07	COAL-clean, weathered, powdery
0.03	2.10	MUDSTONE-black, carbonaceous, sheared

B.P. CANADA LTD. COAL GROUP

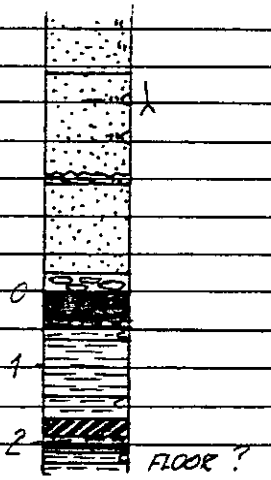
TRAVERSE / TRENCH NUMBER: HT-6

PROJECT: _____ DATE: _____

LOCATION: _____ ELEVATION: _____

GEOLOGIST: _____

Thickness	Depth	Description:
0.04	2.14	COAL-clean, weathered
0.09	2.23	MUDSTONE-black, carbonaceous, may be canneloid, pulverised.
0.03	2.26	MUDSTONE-black, carbonaceous, thin bright coal bands, sheared.
0.18+		FLOOR?-MUDSTONE-brown, listricated, thin bright coal streaks.
		Located at traverse station C160.
		GRAPHIC SECTION: SCALE 1:100



B.P. CANADA LTD. COAL GROUP

TRAVERSE / TRENCH NUMBER: HT-7 (Hand Trench)
PROJECT: Sukunka 1979 . DATE: .
LOCATION: C-1 Vicinity . ELEVATION: 1522 m ± (roof) .
GEOLOGIST: C. Bickford . 91580 E from map
18405 N

True Thickness	Depth below roof	Description:
		Section of Gates E_3 Zone
1.02+		SANDSTONE-very fine-grained, dark grey, massive, well-cemented, blocky, non-calcareous, ferruginous-weathering, abundant small dark burrows, some rootlets. Attitude: 175/5 SW.
0.32		CONGLOMERATE-well-rounded granules and rare small pebbles, silty matrix, ferruginous weathering, massive, blocky, well-cemented, non-calcareous.
0.25		SANDSTONE-very fine-grained, silty, dark grey, massive well-cemented, blocky, rare rootlets, ferruginous-weathering, non-calcareous.
0.24		CONGLOMERATE-granules to small pebbles in a matrix of very fine sand and silt, overall poorly-sorted, with rare elliptical pebbles up to 50 mm, at base. Some coal inclusions in matrix; non-calcareous. Load casts at base.
		TOP OF E_3 SEAM
0.31 to 0.37	0.37	COAL AND MUDSTONE-clean coal with 50% crumpled, thin (0.01 to 0.03 m) bands of rusty-weathering mudstone. Entire unit weathered and crumbly.
0.50	0.87	MUDSTONE-brown, orange-weathering, rooty at top.
0.44	1.31	MUDSTONE-dark grey, carbonaceous. Abundant thin coal streaks. Gradational.
0.10	1.41	COAL-splintery
0.64	2.05	MUDSTONE-dark grey-brown, becoming dark brown to black towards base. Carbonaceous, abundant thin bright coal streaks. Listricated. Occasional bright coal lenses to 0.01 m.
0.33+	2.38+	MUDSTONE-dark grey, brown-weathering. Rubbly, silty towards base. FLOOR?

B.P. CANADA LTD. COAL GROUP (Page 2 of 2)

TRAVERSE / TRENCH NUMBER: HT-8 (Hand Trenched)
PROJECT: Sukunka 1979 DATE: July 15, 1979
LOCATION: ELEVATION: 1655 m ± from map
GEOLOGIST: C. Bickford 92220 E from map
18905 N

True Thickness	Depth Below Roof	Description:
0.17+		SANDSTONE-very fine-grained, silty, thinly bedded, abundant carbonaceous laminae and plant fragments. Gradational. Blocky, non-calcareous.
0.13		SILTSTONE-brown, abundant plant fragments and rootlets. Sandy at top. Thinly bedded, blocky. Non-calcareous Gradational.
0.12		MUDSTONE-dark grey, silty, rubbly. Basal 0.01 m sheared. Possible movement. Non-calcareous.
0.09		COAL-sheared intensely. Attitude at top: 122/27 W
0.71+		COAL-sheared.