PR-Pine Pass 80(1)B

93O/9 00589

Report on Pine Pass Project

Shell Canada Resources Inc.

G.S. Singhai

CL.#

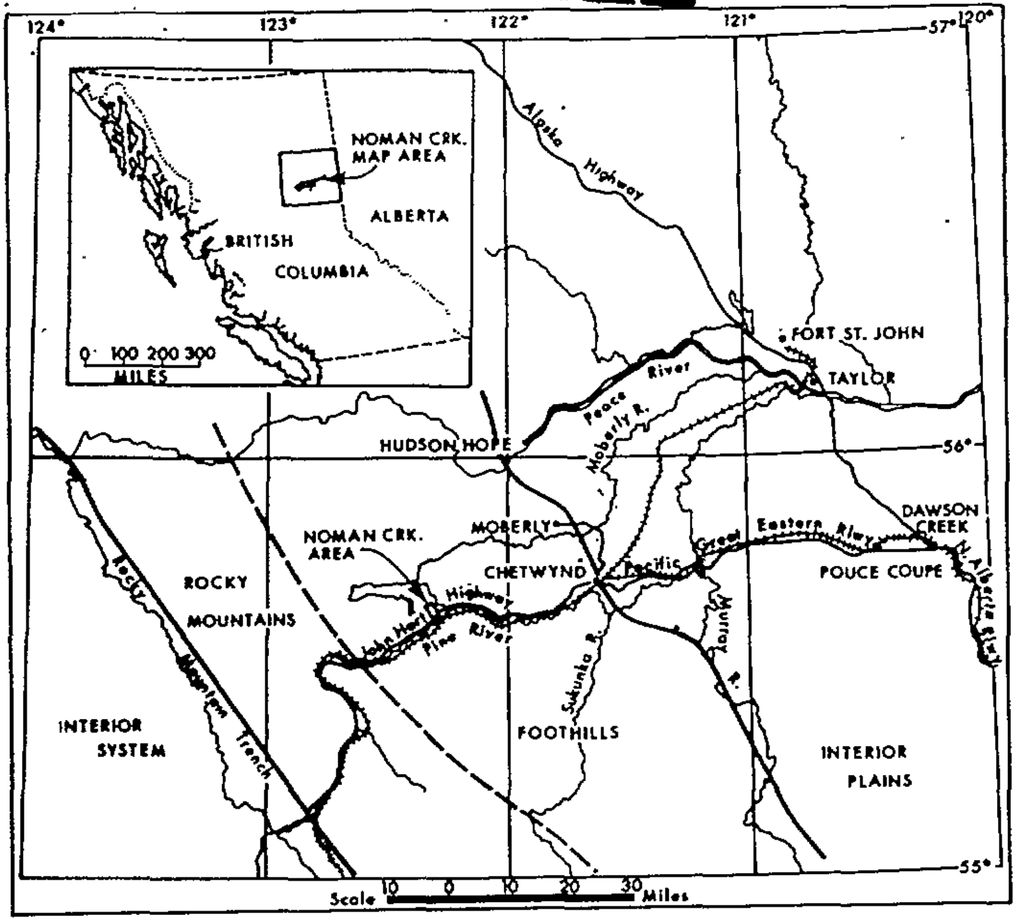
6243-6276

July 1981

589

CONFIDENTIAL

OPEN FILE



LOCATION MAP

REPORT ON COAL LICENCES 6243 TO 6276 INCLUSIVE.
PEACE RIVER LAND DISTRICT, BRITISH COLUMBIA JULY 31, 1981

ON FIELD WORK DONE IN PERIOD OF JUNE 9, 1980 TO AUGUST 29, 1980

HELD BY: SHELL CANADA RESOURCES LIMITED
OPERATED BY: CROWS NEST RESOURCES LIMITED

LAT. 55° 32' TO 55° 40' LONG. 122° 07' TO 122° 22'
NTS, B.C. GOV'T. COAL DISPOSITION MAP: 93-O/9
CNRL COAL LAND DISPOSITION MAP: HF-18B

AUTHOR: G.S. SINGHAI, P. ENGINEER
SINGHAI ENGINEERING INTERNATIONAL
901, 675 WEST HASTINGS STREET
VANCOUVER, B.C., V6B 1N2

DATE: JULY 31, 1981

Crows Nest Resources Limited
EXPLORATION

PINE PASS
NE BRITISH COLUMBIA

PINE PASS COAL PROPERTY

AUTHOR SINGHAI	SCALE	ENCLOSURE No. 1
DATE MAY 1981	REVISED	DRAWING No. AA-634

PINE PASS

COAL EXPLORATION

- 1980 -

Coal Licences 6243-6276 Inclusive

Peace River Land District, Northeast British Columbia

National Topographic Sheet #930/9

Latitude: 55° 37' 00" North

Longitude: 122° 20' 00" West

Owner: Shell Canada Resources Limited

Operator: Crows Nest Resources Limited

Consultant and Author: G.C. Singhai, M.Tech., P.Eng.
Singhai Engineering International Ltd.
#901, 675 West Hastings Street
Vancouver, B.C., V6B 1N2

Field Work: June 9th through August 29, 1980

Submission Date: June 2, 1981

CNRL Coal Land Disposition Map HF-73B

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Willow, Falling, Beaudette Creek Areas				
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A3/AQb.51

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A3/AQb.54

1.0 SUMMARY

The Pine Pass Coal Property consists of 34 coal licences covering 9962 hectares of land held by Shell Canada Resources Limited. The licences are located about 45 air kilometers west of Chetwynd, north and south of the Pine River, in the Peace River Land District, Liard Mining Division of Northeast British Columbia. The history of the property dates back to 1948-51 when N.D. McKechnie, Geologist with the Coal Division of the British Columbia Department of Lands and Forest initiated an exploration program of geological mapping and diamond drilling 24 holes totalling 15,835 feet. Later in 1969, Brameda Resources Ltd. completed 23 diamond drill holes totalling 4,787 meters, and estimated about 11,618,600 short tons of coal.

The property is underlain by the Cadomin and Gething formations of the Bullhead Group and Moosebar Formation of the Fort St. John Group, both of the Lower Cretaceous age. The Gething formation coal measures are the prime prospect for coal. The geology of the Noman Creek area is complicated by tight folding and faulting.

The Noman Creek syncline is a tight southerly plunging fold preserving 300 - 400 meters of Gething formation. This syncline strikes at N 40° W. The south end of the fold is cut off by alluvial deposits in the Pine River Valley, while the northern end extends for about 7 kilometers.

The middle zone of Gething covers two main coal seams which occur about 250 meters below the contacts of Gething and Moosebar. The coal seams are about 30 meters apart with an aggregate thickness of about 10 meters. The preliminary coal reserves estimates indicate about 24.6 metric million tonnes in place with the overburden ratio of 4.6 bank cubic meters per tonne. This coal can be mined by open pit.

The total cost of the 1980 exploration program was $301,806.69. Further exploration work of 3751 meters of rotary drilling, 3,800 meters of backhoe trenching, and 4.5 kilometers of road building is recommended for 1981.

A3/AQb.2

2.0 INTRODUCTION

This report describes the work carried out by Mr. G.C. Singhai, P. Eng., Consulting Geologist of Singhai Engineering International Ltd., #901, 675 West Hastings Street, Vancouver, B.C. on behalf of Crows Nest Resources Limited of Calgary, Alberta, the operator of the property, during the period of June 9, 1980 to August 30, 1980, in an attempt to evaluate an economically viable coal deposit of metallurgical grade coking or Steam Coal on coal licences held by Shell Canada Resources Limited in the Pine Pass area of Northeast British Columbia. This exploration program was initiated as an encouraging result of the work carried out by Mr. Eric Pancy, Geologist of Crows Nest Resources Limited during the summer of 1979.

2.1 Coal Land Tenure

Shell Canada Resources Limited holds 34 coal licences (No's 6243 to 6276 Inclusive) covering 9962 hectares of land in the Land District of Peace River, Northeast British Columbia. The property is operated by Crows Nest Resources Limited, a wholly owned subsidiary of Shell Canada Resources Limited.

The following table, entitled "B.C. Coal Licences Tenure Standing" gives details of tenure.

CROWS NEST RESOURCES LIMITED
EXPLORATION

B. C. COAL LICENCES
TENURE STANDING

BLOCK: PINE PASS
GROUP: UNGROUPED

PROJECT: PINE PASS
PEACE RIVER LAND DISTRICT

YEAR:
DATE:

PROJECT			BLOCK			GROUP				LICENCE			ACQ/ADM		RENTALS		REQUIREMENT WORK						BUDGET		EXP	POTL	COMMITMENTS, J. V.	REMA
NAME	LICS. TOTAL NO.	AREA TOTAL AC/HA	NAME	LIC. TOTAL NO.	AREA TOTAL AC/HA	NO.	LICS. TOTAL NO.	AREA TOTAL AC/HA	YEAR	NO.	LEGAL DESCRIPTION	AREA TOTAL AC/HA	FEES YEAR	FEES $	ANNUAL $	TOTAL TO NEXT ANN. $10^3	EXPIRED $10^3	CURRENT LIC. YEAR	YEAR $	PRE-FULFILMENT YEAR	FULFILMENT $	ANNIVERSARY DATE	CURRENT YEAR AFE	CURRENT YEAR $10^3	TOTAL $10^3	SHELL CLASS.	OTHER THAN B.C. GOV'T DESCRIPTION	
PINE PASS	34	9962	PINE PASS	34	9962	-						9962	80	340	49,810	99.6	74.7	2	124,525	1-3/4	227.5	MAY 21			402.2	Y		
											NTS 93-0-9 BLOCK B UNITS																	
										6243	43, 44, 53, 59	293																
										6244	45, 46, 55, 56	293																
										6245	47, 48, 57, 58	293																
										6246	49, 50, 59, 60	293																
										6247	65, 66, 75, 76	293																
										6248	67, 68, 77, 78	293																
										6249	69, 70, 79, 80	293																
										6250	81, 82, 91, 92	293																
										6251	87, 88, 97, 98	293																
										6252	89, 90, 99, 100	293																
											BLOCK C UNITS																	
										6253	41, 42, 51, 52	293																
										6254	61, 62, 71, 72	293																
										6255	63, 64, 73, 74	293																
										6256	83, 84, 93, 94	293																
										6257	85, 86, 95, 96	293																
											BLOCK F UNITS																	
										6258	3, 4, 13, 14	293																
										6259	5, 6, 15, 16	293																
										6260	7, 8, 17, 18	293																
										6261	25, 26, 35, 36	293																
										6262	27, 28, 37, 38	293																
										6263	29, 30, 39, 40	293																
										6264	45, 46, 55, 56	293																
										6265	47, 48, 57, 58	293																
										6266	49, 50, 59, 60	293																
										6267	67, 68, 77, 78	293																
										6268	89, 90, 99, 100	293																
											BLOCK G UNITS																	
										6269	3, 4, 13, 14	293																
											BLOCK B UNITS																	
										6270	61, 62, 71, 72	293																
										6271	63, 64, 73, 74	293																
										6272	83, 84, 93, 94	293																
										6273	85, 86, 95, 96	293																
											BLOCK G UNITS																	
										6274	7, 8, 17, 18	293																
											BLOCK F UNITS																	
										6275	23, 24, 33, 34	293																
										6276	69, 70, 79, 80	293																
														WORK DONE	1980													
														$	302,290													

GENERAL REMARKS: FILL NECESSARY LINES AND COLUMNS ONLY, COAL DEVELOPMENT POTENTIAL IS "Y" (PRIME) UNLESS OTHERWISE STATED. LICENCES HELD BY SHELL CANADA RESOURCES LTD.- C
IS THE OPERATOR.

Table I

2.2 Location, Geography and Physiography

The Pine Pass property is located contiguously north and south of the Pine River, about 45 air kilometers west of Chetwynd and 55 air kilometers southwest of Hudson Hope in the Peace River Land District and Liard Mining Division of Northeast British Columbia (see Encl. #3). The property is centered approximately 55° 37' North Latitude and 122° 20' West Longitude on Topo Sheet N.T.S. 93-0-9.

These coal licenses are situated on the eastern slope of Mount Bickford and Pyramis Peak on the north and south of Pine River respectively, in the foothills of the Rocky Mountains. Elevations throughout the licences range from 655 meters in the Pine River Valley to 1220 meters in the northwest part of the Noman Creek area and to 1372 meters on the peak east of Willow Creek in the southern part of the area. The area is characterized by relatively low, rounded, northwest-southeast trending ridges and valleys dissected by the northeast-southwest trending 1.5 kilometer wide Pine River Valley. Physiographically, this valley divides the licence area into two main blocks: north (Noman Creek area) and south (Falling Creek and Willow Creek areas). The ridges are separated by valleys of creeks (Cleveland Creek, Fisher Creek, Noman Creek - in the north; and Willow Creek, Falling Creek, and

Beaudette Creek - in the south of Pine River) which are tributaries of the Pine River.

The area is well forested by poplar and some birch in low elevations as in the Pine River Valley, and fir or spruce at higher elevations. In wet areas willows and devils club are common. The timberline is at an elevation of about 1300 meters above sea level.

2.3 Access

The property is accessible by highway #97 (John Hart Highway) which runs through the middle of the property north of the Pine River. It is an all-weather road connecting Prince George to Dawson Creek via Chetwynd. The town of Chetwynd is about 70 kilometers east of the property by this highway and the deep sea ports of Vancouver and Prince Rupert are about 1200 kilometers west of the area.

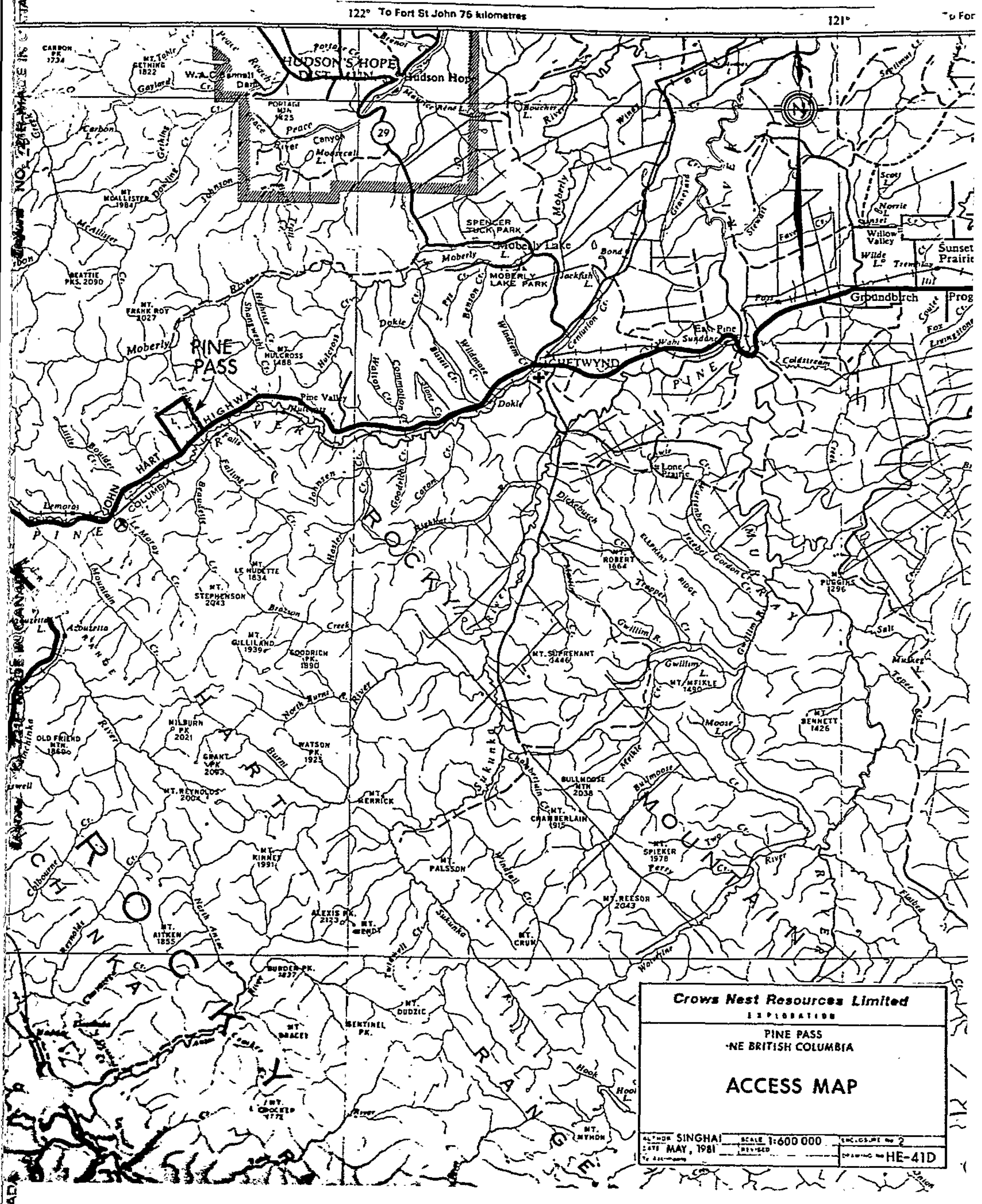
The British Columbia Railway line runs south of the Pine River which connects the area with the Vancouver and Prince Rupert sea ports. This is the only property in the northwestern coal field which has road and railway access to the deep sea ports at present.

Dawson Creek and Fort St. John, about 100 km and 160 km north of Chetwynd respectively, are serviced by daily flights of commercial airlines. Numerous helicopters are available at Chetwynd.

The Noman area is immediately north of the main highway and railway and is accessible on good dirt roads as a result of previous exploration and high voltage power line construction by B.C. Hydro.

There is a reasonably good dirt road on the east edge of the licences along Willow Creek, but most of the property on the south side of the Pine River is accessible by helicopter only. Landing sites are very few due to relatively thick forest cover. These dirt roads are accessible by four-wheel drive vehicles.

Two high voltage power lines run through the Noman Creek area which could supply all power requirements. Water is available from the Pine River and its tributaries. Mining and exploration can be carried out throughout the year (see Encl. #2).


Crows Nest Resources Limited
EXPLORATION
PINE PASS
NE BRITISH COLUMBIA
ACCESS MAP
AUTHOR SINGHAI
DATE MAY, 1981
SCALE 1:600 000
ENCLOSURE No 2
DRAWING No HE-41D
122° To Fort St John 76 kilometres
121°
HUDSON'S HOPE
Hudson Hope
W.A.C. Bennett Dam
29
SPENCER TUCK PARK
Moberly Lake
MOBERLY LAKE PARK
PINE PASS
JOHN HART HIGHWAY
Pine Valley
CHETWYND
East Pine
Groundbirch
Willow Valley
Sunset Prairie
Lone Prairie
ROCKY
MURRAY
PINE
HART
ROCKY MOUNTAINS
MOUNTAIN
RANGE
MT. ROBERT 1664
MT. PUGGINS 1296
MT. SUPRENANT 1446
MT. MFIKLE 1490
MT. BENNETT 1426
BULLMOOSE MTN 2038
MT. CHAMBERLAIN 1915
MT. SPIEKER 1978
MT. REESOR 2043
MT. PALSSON
MT. KERRICK
MT. KINNEY 1991
ALEXIS PK. 2123
MT. CRUK
MT. AITKEN 1855
MT. REYNOLDS 2004
GRANT PK 2093
MILBURN PK 2021
WATSON PK. 1925
GOODRICH PK. 1990
MT. GILLILAND 1939
MT. STEPHENSON 2043
MT. LE HUDETTE 1834
MT. HULCROSS 1488
MT. FRANK ROY 2027
BEATTIE PKS. 2090
MT. MCALLISTER 1984
MT. GETHING 1822
CARBON PK 1734
PORTAGE MTN. 1425
OLD FRIEND MTN. 1860
BURDEN PK. 1837
MT. DUDZIC
SENTINEL PK.
MT. MYHON
ELEPHANT RIDGE

3.0 WORK DONE

3.1 Summary of Previous Work

The history of the area goes back to as late as 1946 and 1951 when the British Columbia Department of Mines carried out an exploration program of geological mapping, trenching and diamond drilling of coal deposits in the Peace River District, about 100 kilometers west of Dawson Creek. The coal field extended from about 1.6 kilometers north of the Pine River to some 29 kilometers southeast. The objective of the work was to estimate the tonnage of mineable coal that might be available contiguous to a proposed route of the Pacific Great Eastern Railroad into the Peace River District. Since then the area has been fairly active. The principle sources of data are the following published reports (see Bibliography):

a) McKechnie, N.D., 1955

The Coal Division of the Department of Lands and Forests of British Columbia carried out geological mapping and diamond drilling, 1948 to 1951, under the supervision of Mr. N.D. McKechnie, Geologist with the B.C. Government. During this period he drilled 24 holes to a total of 15,835 feet in and

39 holes to a total of 25,447 feet in Noman Creek and Willow Creek areas respectively. The proximate analysis of coal intersections were performed by the department laboratory (B.C. Dept. of Mines, Bulletin No. 36).

b) Muller, J.E., 1961

The geological map 11-1961 published by the Geological Survey of Canada at a scale of 1:250,000, completed by Mr. J.E. Muller, is of little significance as mapping is too generalized and of doubtful quality.

c) Hughes, J.E., 1964

Reconnaissance geological mapping at a scale of 2 inches to 1 mile, of the Pine Pass area, carried out by Mr. J. Hughes during 1954-1958 in order to describe the succession of Jurassic and Cretaceous strata in detail (B.C. Dept. of Mines and Petroleum Resources Bulletin #51).

d) Hughes, J.E., 1967

Regional geological mapping at a scale of 1 inch to 1 mile was carried out during 1954-1960. The geological map accompanies B.C. Mines Bulletin #52 which describes the geology along the John Hart Highway in the area under study. This is probably the most detailed geological map published at this scale.

e) Pine Pass Coal Company, 1968

As a result of the N.D. McKechnie report of 1955, Pine Pass Coal Company drove an adit into a thick coal seam along strike for a distance of 120 feet, and at this point a crosscut of uniform length. A bulk sample was collected from the adit and submitted for proximate and ultimate analysis to Warnock Hersey (see Table V).

f) Brameda Resources Ltd.

Brameda Resources Ltd. conducted a coal exploration program in the Noman Creek area during 1968-69 under the supervision of Mr. Harold M. Jones, P. Eng., of Vancouver, B.C. This program consisted of geological mapping at a scale of 1:4800, bulldozer trenching, diamond drilling and sampling. They drilling 23 diamond drill holes totalling 4,787 meters. Trenching was carried out in association with road construction. Trench descriptions are missing but core descriptions are available. They estimated about 11,618,600 short tonnes in place. Most of the reserves are estimated from coal seams #76 and 78 with average thickness of 5 feet to 18.5 feet over a strike length of 9,600 feet and dip length of 1380 feet.

g) Crows Nest Resources Limited, 1979

Crows Nest Resources Limited carried out a program of geological mapping at a scale of 1:5000, limited hand trenching and sampling of exposed coal in these trenches. The samples were shipped for analysis to Crows Nest Resources' Laboratory in Fernie, B.C.

Preliminary coal reserves were estimated at 5 to 10 million tonnes open pit mineable at 5:1 to 10:1 overburden ratio. The two main seams 78 and 76 were taken into consideration mainly due to their thickness and continuity in the area.

3.2 Scope and Objective of 1980 Exploration

The previous extensive exploration drilling and geological mapping program by the B.C. Government and Brameda Resources Limited during the periods 1948-1951 and 1968-1969 respectively, did not resolve the problems of structure or seam correlation. Thus reserve estimations could not be made properly. Early reserve estimates of about 10 million tonnes with a stripping ratio of 10:1 was not economically feasible.

The exploration program of 1980 was oriented towards structural setting, correlation of coal seams, and to increase coal reserves if possible. The most economical way of achieving this objective was by detailed geological mapping on a scale of 1:2000, backhoe trenching and sampling exposed coal seams. This would allow the preparation of detailed structural cross-sections on a scale of 1:1000. The cross-sections could then be used for estimation of coal reserves, geological interpretation of the area, and for planning of 1981 exploration program if warranted.

3.3 Work Done in 1980

The majority of the exploration work was carried out on Noman Creek area, north of the Pine River, east of Cleveland Creek and west of Fisher Creek, for a length of about 7 km. This area was given importance because of the availability of detailed information of previous extensive exploration work, potential for increasing reserves, and easy access to the area. During the period of June 9th to August 30, 1980, the following program was carried out.

a) Detailed geological mapping of the Noman Creek area on a scale of 1:2000 using topographic sheets as the base, prepared by Crows Nest Resources Limited. Details are shown on the geological maps contained in the enclosures (see Encl. 7-1, 7-2).

b) Trenching was carried out by a John Deere 450C crawler type combination front end loader-backhoe. These trenches were laid out in the areas of interest by running a flagged compass line down the proposed centerline of the trench along existing roads, bulldoze trails and old trenched areas. Depth of overburden was variable from 0.2 meters to greater than 3.5 meters. Most trenches averaged 0.5 meters in width and 1.0 - 1.2 meters in depth, except in significant coal seams which were deepened to at least 2.5 meters in search of fresher coal. When bedrock was lost due to deep burial several pits were dug to approximately 4 meters, the limit of the equipment. When no bedrock was encountered trenching was terminated. The geology and intersections of coal seams were mapped in detail, on a scale of 1:200 and measured (see Encl. 10 and 11). A total of 30 trenches with a total length of 3434 meters were completed and surveyed (Appendix B).

In addition to the above backhoe trenches, one hand trench was dug near the intersection of the southernmost powerline right-of-way and Noman Creek to protect environmental conditions.

c) About 2.30 km of 5-meter wide roads were built by bulldozer as an access to the proposed drill holes as a result of 1979 field work. Drill sites were prepared, however, the holes were not started. These roads were laid out in such a way that the road cut perpendicular to the strike of the beds so that trenches and exposed bedrock information could be gathered.

d) All exposed intersections of coal were systematically sampled, marked by paint and photographed. Samples were sent to Crows Nest Resources Lab, Fernie, B.C., for proximate analysis.

e) A section from Cadomin Conglomerate, which is exposed at about 500 meters west of Cleveland Creek to the base of Moosebar Formation, was measured and a section was prepared.

f) All these trenches, diamond drill hole locations, and roads were surveyed and survey stations marked by iron pins were established. The survey work was started from the known bench marks and traverses were closed. Surveying was carried out by Tronnes Surveys Limited of Calgary, Alberta (Appendix B).

g) All these trenches were filled after collecting available information. Road and recovered trenched areas were seeded and fertilized as per Ministry of Environment of British Columbia requirements.

h) In addition to the above work in Noman Creek area some geological mapping was initiated in Willow Creek and Falling Creek areas. Due to heavy overburden and thick undergrowth, most of the area was not accessible. Apart from this, few exposures of bedding or coal were found except along some creeks or roads.

A successful and on-schedule completion of the 1980 program is due to average weather conditions and a good effort from the support staff.

3.4 Cost of Work Done in 1980

The detailed costs of the 1980 exploration program are contained in the Application to Extend Term of Licence on the following pages. The figures have been apportioned to all the licences, reflecting those parts of the total area in which Crows Nest Resources Limited has interests.

The 1980 exploration program was completed at a cost of $301,806.89.

A3/AQb.15

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

APPLICATION TO EXTEND TERM OF LICENCE

1. I, Bolton Agnew (Name) agent for Shell Canada Resources Limited (Name)
P.O. Box 100 (Address) 400 - 4 Avenue, S.W. (Address)
Calgary, Alberta Calgary, Alberta, T2P 2H5
Valid FMC No. 207568

hereby apply to the Minister to extend the term of Coal Licence(s) No(s). 6243 - 6276 Inclusive, Thirty-four B.C. Crown Coal Licences, 9962 Hectares

for a further period of one year.

2. Property name Pine Pass Coal Project, Peace River Land District

3. I am allowing the following Coal Licence(s) No(s). to forfeit

4. I have performed, or caused to be performed, during the period May 21, 1980 to May 20, 1981, work to the value of at least $ 302,290.54 on the location of coal licence(s) as follows:

CATEGORY OF WORK

	Licence(s) No(s).	Apportioned Cost
Geological mapping	6243-6276 Incl.	100,750.83
Surveys: Geophysical	-	
Geochemical	-	
Other	6259-6276 Incl.	42,613.79
Road construction	6260,6262,6263,6266	53,678.99
Surface work	6260,6262,6263,6266	50,411.92
Underground work	-	
Drilling	-	
Logging, sampling, and testing	6260,6262,6263,6266	2,350.00
Reclamation	6260,6262,6263,6266	4,882.00
Other work (specify)		
Off-property costs		47,603.01

5. I wish to apply $ 302,290.54 of this value of work on Coal Licence(s) No(s). 6243 - 6276 Incl.

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

7. The work performed on the location(s) is detailed in the attached report entitled Pine Pass Geological Report 1980, will be submitted in ninety days

May 20, 1981 (Date)

ORIGINAL SIGNED BY BOLTON AGNEW (Signature)

Land Supervisor (Position)

(FORMS AND REPORT TO BE SUBMITTED IN DUPLICATE)

Appendix A

CATEGORY OF WORK

GEOLOGICAL MAPPING — Yes ☒ No ☐

	Area (Hectares)	Scale	Duration
Reconnaissance	1000 / 9000	1:2,000 / 1:10,000	304 Mandays
Detail: Surface			
Underground			

*Other (specify) ....

Total Cost $100,750.83

GEOPHYSICAL/GEOCHEMICAL SURVEYS — Yes ☒ No ☐

Method ....
Grid ....
Topographic ... Photogrammetric mapping and location surveys
*Other (specify) ....

Total Cost $ 42,613.79

ROAD CONSTRUCTION — Yes ☒ No ☐

Length ... 2.3 km ... Width ... 5m
On Licence(s) No(s). 6260, 6262, 6263, 6266
Access to ....
Upgrading old roads: 2.5 km

Total Cost $ 53,678.99

SURFACE WORK — Yes ☒ No ☐

	Length	Width	Depth	Cost
Trenching	3434 m	0.5 m	1.2 m	50,411.92
Seam Tracing				
Crosscutting				
*Other (specify)				

Total Cost $ 50,411.92

UNDERGROUND WORK — Yes ☐ No ☒

	No. of Adits	Maximum Length	No. of Holes	Total Metres	Cost
Test Adits					
*Other workings					

Total Cost $ -

DRILLING — Yes ☐ No ☒

		Hole Size	No. of Holes	Total Metres	Cost
Core:	Diamond				
	Wireline				
Rotary:	Conventional				
	Reverse circulation				
*Other (specify)					

Contractor ....
Where is the core stored? ....

Total Cost $ -

LOGGING, SAMPLING AND TESTING — Yes ☒ No ☐

Lithology: Drill samples ☐ Core samples ☐ Bulk samples ☐
Logs: Gamma-neutron ☐ Density ☐
*Other (specify) 47 Backhoe trench samples, analysed both raw and washed at 1.6 SG
Testing: Proximate analysis ☒ FSI ☐ Washability ☐
Carbonization ☐ Petrographic ☐ Plasticity ☐
*Other (specify) ....

Total Cost $ 2,350.00

OTHER WORK (specify details)

	Cost
Reclamation	4,882.00

Total Cost $ 4,882.00
On-property costs 254,687.53
Off-property costs 47,603.01
Total Expenditures $302,290.54

May 20, 1981
(Date)

[signature]
(Signature)

Manager - Accounting, CNRL
(Position)

*A full explanation of other work is to be included.

4.0 GEOLOGY

4.1 Regional Geology

The area under consideration lies within the Rocky Mountain Foothills and trends northwesterly along the front of the Rocky Mountains between the Sukunka and north of the Pine Rivers in northeastern British Columbia. The strata outcropping in the Pine River Valley are of Mesozoic age, from middle Triassic to upper Cretaceous, which were deposited on the shelf of a miogeosyncline. These formations thin eastwards across the Foothills and onto the plains. The sedimentary environment in the Foothills and Plains were continuous and similar.

Triassic strata is marine in origin, consisting of limestone, calcareous shales, siltstone and sandstone. Jurassic sediments are also mainly marine shales. The lower Cretaceous sediments of sandstone, shales and coal measures of deltaic deposition marked the end of marine sedimentation. The coal bearing beds of lower Cretaceous age outcrop extensively along the Foothills of Alberta and Northeast British Columbia. These sediments have been assigned to the Blairmore, Bullhead and Fort St. John groups (see Encl. 5).

These sediments were folded, thrust faulted and uplifted during the Columbian orogeny and being deformed into elongate plunging anticlines and synclines with associated faulting. These rocks are exposed in a series of en echelon folds and thrust belts trending northwest-southeast (see Encl. 6).

Regional Stratigraphic studies have been made by the Geological Survey of Canada and published as Stott (1968a) and Stott (1971) (see Table of Formation #11).

Several local stratigraphic and mapping projects have been completed within the area - both by Geological Survey of Canada and by the British Columbia Department of Mines. These are documented by Hughes (1964), Hughes (1967), McLean and Kindle (1950), McKechnie (1955) and Spivate (1944).

A. Geology of Area

The geology of the area has been mapped at a scale of 1" = 4 miles by Muller (1961) and Stott (1961), of Geological Survey of Canada. These two maps are of a reconnaissance nature only.

TABLE II

TABLE OF FORMATIONS

		Formation or Group	Thickness (feet)	Lithology
Lower Cretaceous		Fort St. John Group (includes Moosebar fm.)	3,000 - 5,000	Dark grey, marine shale with fine grained sandstone.
Lower Cretaceous	Bullhead Group 0-2,500	Gething Formation	1,000 - 3,000 (?)	Fine-grained, cherty to quartzose sandstone; rusty weathering shales; carbonaceous mudstone and coal seams; minor conglomerate.
Lower Cretaceous	Bullhead Group 0-2,500	Cadomin Formation	100 - 500	Massive chert conglomerate and coarse-grained sandstone; carbonaceous shale, minor coal.
		Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward.		
Jurassic		Minnes Group	0 - 6,000	Massive quartzose sandstone; alternating units of fine-grained sandstone and mudstone; minor carbonaceous sediments.
Jurassic		Fernie Formation	500 - 1,000	Calcareous and phosphatic shales; rusty weathering shales; glauconitic siltstone; sideritic shales; thinly interbedded sandstone, shale, and siltstone.

Mapping was also done by McKechnie, N.D. (1955) and Hughes, J.E. (1967), Department of Mines and Petroleum Resources, British Columbia. Mr. Hughes published a map at a scale of 1" = 1 mile to accompany Bulletin No. 52. Detailed mapping was completed for the Noman Creek area by Brameda Resources on a scale of 1:4800 during the period 1968-1969.

The Noman Creek area, on which most of the exploration and geological mapping at a scale of 1:2000 was carried out during 1980, is underlain by the Cadomin and Gething formations of Bullhead Group and Moosebar formations of Fort St. John Group of Lower Cretaceous age (see Table III).

A3/AQb.18

HUGHES 1964 (Group)	HUGHES 1964	SCOTT 1968	SCOTT 1968 (Group)
FORT ST. JOHN GROUP	MOOSEBAR FM	MOOSEBAR FM	FORT ST. JOHN GROUP
CRASSIER GROUP	GETHING FM	GETHING FM	BULLHEAD GROUP
CRASSIER GROUP	DRESSER FM	CADOMIN FM	BULLHEAD GROUP
CRASSIER GROUP	BRENOT FM	UNCONFORMITY	
CRASSIER GROUP	BRENOT FM	UNNAMED	MINNES GROUP
DISCONFORMITY		UNNAMED	MINNES GROUP
BEAUDETTE GROUP	MONACH FM	MONACH FM	MINNES GROUP
BEAUDETTE GROUP	BEATTIE PEAKS FM	BEATTIE PEAKS FM	MINNES GROUP
BEAUDETTE GROUP	MONTEITH FM	MONTEITH FM	MINNES GROUP

Crows Nest Resources Limited
EXPLORATION

PINE PASS
NE BRITISH COLUMBIA

TABLE OF FORMATIONS
PINE PASS REGION

AUTHOR [illegible] | SCALE
DATE DEC 1979 | REVISED
TABLE [illegible]
DRAWING No HE-41C

4.2 Stratigraphy

The rocks exposed in the area of the Crows Nest Coal Licences and in particular in the Noman Creek area are the main coal bearing horizon, the Gething formation. The Minnes group of Jurassic age is exposed about 600 meters west of Cleveland Creek out of the licence area. It is not discussed in this report other than to record its presence underlying the Cadomin formation which marks the base of the Bullhead group of Lower Cretaceous age.

A. Bullhead Group

The Bullhead group contains two formations: the coal bearing Gething formation and its basal conglomerate unit - the Cadomin formation.

i) Cadomin Formation

The coarser sediments consist of conglomerates and gritty sands which grade laterally into siltstones and mudstones and seem to be flood plain sediments. Outcrops of Cadomin formation stand in relief against those of the Gething, though they are not distinctive everywhere. On hilly ground or above treeline, the steeply dipping beds of coarse clastics form ridges, such as those above 500 m west of Cleveland Creek. The conglomerates form thick beds and lenses but at places it is missing or replaced by grit and/or very coarse-grained sandstone. The thickness of Cadomin formation about 600 meters west of Cleveland Creek is approximately 10 meters.

ii) Gething Formation

The term Gething was given first by McLean when he was working in the Peace River Foothills (1918, 1923). It indicates a productive coal measures in the upper part of the Bullhead succession, and separates them from underlying non-marine sandstones, lean coal measures and its basal conglomeratic unit - the Cadomin formation.

The Gething formation is predominantly a sequence of shales, siltstones, sandstone and coal seams. In the Noman Creek area approximately 300 meters of Gething strata could be measured. Both the lower and upper contacts exist. However, wide covered intervals, complicated structural setting, difficulties in correlating strata above and below coal seams 78 and 76, made it impossible at this time to establish a type section.

4.2 B. Moosebar Formation

The Gething Formation is overlain by Moosebar formation. A thin chert pebble bed of 0.25-1.00 meters thickness marks the contact usually in this area. This conglomeratic bed is known as the Blue Sky conglomerate.

The Moosebar formation is lithologically distinct from the Gething formation and consists mostly of dark gray, rubbly and partly calcareous mudstones and shales with minor beds of argillaceous sandstones and ironstone bands. Thin layers of bentonite are also noticed occasionally. Clasts in the basal Moosebar conglomerate are well rounded and 0.2 to 2.5 cm in diameter, mostly vari-colored chert pebbles with a matrix of sandstone and mudstone. The contact is regarded as disconformable, and indicating an overall marine transgression. The Moosebar formation is probably about 360 meters thick. It is soft and easily weathered. Their outcrops are generally in the valleys of Fisher, Falling and Beaudette Creeks and cliff faces.

5.0 NOMAN CREEK AREA

5.1 Geological Structure

The available geological and structural data suggests that the structure of the Noman Creek area is complex consisting of small scale folds and faults. The problem is compounded by poor outcrop. An attempt was made to interpret the structure of the area by twelve structural cross-sections (Encl. 9, Section 1-12) and a structural contour map at the base of coal seam #76 (Encl. 12).

The Noman Creek syncline, Noman Creek anticline, and Fisher Creek syncline are three main folds in the area. The folding of Lower Cretaceous strata is complicated by several shear zones and three reverse faults in this area.

The Noman Creek syncline is assymetrical in shape with variable dips of 42°-80° on the west limb and 35°-70° on the east limb. The axis of the syncline strikes about North 30° West (330°) and plunges approximately 12° to the southeast in the southern part of the area or close to the John Hart Highway. But the plunge of the syncline decreases towards the northwest and at about 900 meters (between Section 6 and 7; Encl.9) north of the highway, the plunge almost disappears.

The east limb of the syncline or west limb of the Noman Creek anticline is cut by the Noman Creek reserve fault. This fault strikes North 33° West and dips 60° southwest. About 700 meters north of the highway the strike of fault changes to 320°, possibly deflected by a thick sandstone bed on the crest of the Noman Creek anticline. This fault can be traced up to about 1.5 km north of the highway and most probably terminated by a 246° striking fault which runs along the termination point of Noman Creek towards the west.

The Noman Creek fault is also displaced about 80 meters to the west by a normal fault which strikes about northeast-southwest and occurs about 300 meters north of the highway. About 170 meters of displacement on the Noman Creek fault is indicated by McKechnie (1955).

About 400 meters east of Noman Creek fault, the Eastern Reverse fault occurs which strikes N 50° W, and dips 60° N.E. and displaces the northeast limb of the Noman Creek anticline up dip by 135 meters. As a result of the fault, the contact of Moosebar and Gething is repeated. As a result of the Noman Creek and Eastern Reverse faults of opposite dips, a down-dropped block was formed causing a rift valley at the central part of the anticline. It indicates that in between these two faults seams #76 and 78 are preserved which are intersected by diamond drill holes nos. PR-12 and PR-16 (see Section 8-7 Encl. 9). From the present interpretation these seams should be intersected in proposed rotary drill hole #29 at a depth of 75 and 95 meters.

There is another reverse fault called the Far Eastern Fault, which strikes N 55° W and dips 75° NE at 280 meters east of Eastern Fault or about 600 meters west of Fisher Creek. This fault gives the effect of a step fault and Gething-Moosebar contact repeats again.

East of the Noman Creek anticline is the Fisher Creek syncline. Its axis runs east of Fisher Creek and strikes N 35° W. Its west limb dips 30° while the east limb dips 50°. This syncline is entirely of Moosebar formation. About 7 kilometers north of the John Hart highway, the Gething formation outcrops on the west limb.

East of the Fisher Creek syncline and Fisher Creek, the Cadomin formation including some coal up to one meter thick, is exposed with steep dip towards the west.

In the area of trench #W.17 the strike and dip of the formation suddenly changes to N 59° E and dipping 50° to 58° N.W. (see Encl. #7-2 and 10 - Trench #W-17). The abrupt change in the attitudes of the strikes may be due to faulting or some structural change which is not known at the present time.

5.2 Coal Geology

In the area under consideration only the Gething formation is prospective for coal. Coal seams have been reported in the Cadomin formation but these are not thought to be economically feasible.

The coal bearing Gething formation can be divided into three zones. The upper, middle, and lower Gething. A small marine fauna collected in-situ, about 46 meters below the top of the Gething formation at Fisher Creek area indicates marine conditions of its deposition. However, in the north (Peace River) and south (Sukunka River) areas, and Pine River, prime coal zones - Superior-Trojan Zone and Chamberlain-Skeeter Zone - lie within the upper 60 meters of the Gething formation.

There are four coal seams exposed in trench #E-7 (Encl. 7-1 and 11-7) just east of the Gething and Moosebar contact varying in nhickness from 2.8 - 5.2 meters. These seams could be equivalent to the Chamberlain or Trojan seams but neither the continuity nor the stratigraphic position has been established at the present time.

The second and main coal bearing horizon is approximately 150 meters below the first zone and finally, the third zone is about 100 meters below the second zone.

In Noman Creek area two major coal seams #76 and 78 were recognized by previous drilling and exploration (McKechnie 1948-51 and Brameda 1964). Their stratigraphic depth below the top of the Gething averages about 168 meters for seam #78 and 200 meters for seam #76. Stratigraphic separation betwen 78 and 76 is maintained at approximately 30 meters. There are some other minor seams which have a tendency to thicken towards the northwest. The main seams in the area are:

Seam	Depth Below Moosebar-Gething Contact	Interval (Meters)	Thickness (Meters)
60	50 - 75 m		0-1.6
78	165 - 175 m	115-125	1-4
76	200 m	25-35	4-6
40	246 m	40	0-1
39	275 m	35	0-1.5

The intervals and thicknesses of seams depend on the correlation. At present the correlation of these seams is a problem due to complicated structure, thick overburden, lack of outcrops and no down hole electric logs from previous diamond drill holes.

Seam 60 varied considerably in its thickness and continuity in the area. The seam is mostly dirty and dull coal.

Seams 78 and 76 are estimated to be within the second zone (Encl. 5). Seam 78 has a tendency to vary in thickness from 1-4.2 meters and has breaks in continuity. This could be due to miscorrelation. This is a fairly clean coal with an average ash content of 7% and volatiles of 25.8% (McKechnie, 1951) and on an air-dried basis (Table IV).

Seam 76, the most important seam, has a maximum known thickness of 7 meters and an average thickness in its main bench of 4.7 meters. It has the greatest continuity in the area (Encl. #4, and Encl. 9-1 to 9-12). The Pine Pass Coal Company drove an adit into this seam and the results on an air-dried basis are, on a 76% yield: an average ash of 5%; volatile of 23% and an F.S.I. of 8 (Table V). The quality results look very encouraging.

TABLE IV

ANALYSES OF DRILL CORE COAL SAMPLES
BY McKECHNIE (1955) OF NOMAN CREEK AREA

HOLE NO.	THICKNESS	RECOV.	ASH	V.M.	F.C.	S	HEAT VALUE
"Seam 78"	Feet	%	%	%	%	%	BTU/lb.
P.R. 7	1	58	3.8	26.5	69.7	0.9	15,030
P.R. 8	2	37	15.5	22.3	62.2	1.0	13,110
P.R. 14	2	55	1.5	22.2	76.0	0.7	15,200
P.R. 19	3	33	7.2	29.9	62.9	0.8	14,270
P.R. 21	4	32	6.8	27.5	65.7	0.7	14,230
P.R. 22	10	43	7.6	26.9	65.5	0.5	14,010
"Seam 76"							
P.R. 14	5	26	6.3	20.9	72.8	0.7	14,420
P.R. 16	10	44	2.5	23.1	74.4	0.4	15,070
P.R. 17	15	41	2.4	25.2	75.1	0.4	15,080
P.R. 18	22	22	5.0	20.5	74.5	0.7	14,810
P.R. 19	6	100	9.8	26.9	63.5	0.4	13,590
P.R. 20	21	31	11.9	20.8	60.1	0.5	13,070
P.R. 22	10	35	3.3	22.4	74.3	0.4	14,930
P.R. 23	2	33	13.3	28.0	58.7	0.6	12,720

* taken from B.C. Dept. of Mines, Bulletin No. 36 - p. 28

TABLE V

PINE PASS COAL CO. - BULK SAMPLE - SEAM 76

	TOP 8 FEET		BOTTOM 8 FEET		COMPOSIT
	As Rec'd	Air Dried	As Rec'd	Air Dried	AIR DRIED
	%	%	%	%	%
Moisture					
Total	5.4		4.7		
Inherent	0.71	0.74	0.64	0.67	0.70
Surface	4.70		4.10		
Ash	15.34	16.10	19.27	20.09	18.07
Volatile	19.73	20.70	17.37	18.11	19.30
Fixed Carbon	59.52	62.46	58.62	61.13	61.93
Sulpher	0.63	0.66	0.57	0.59	0.63
BTU/LB	12,721	13,348	12,202	12,724	13,024
F.S.I.	-	6 1/2	-	7	7

SINK FLOAT TEST AT 1.50 S.G.

	TOP 8 FEET	BOTTOM 8 FEET
Yield	72.28	79.75
Ash	5.30	4.60
Volatile	22.01	24.18
F.S.I.	8.00	8.00

Seams 39 and 40 are discontinuous and too deep to be of any significance and contribute very little to the coal reserves at the present time. Seams 39 and 40 vary in thickness from 0.5 to 2.5 meters and 0.3 - 2.0 meters respectively, but these thickenings could be due to structure.

Structural thickening of some of the coal seams was also noticed (see about 150 meters west of trench #W2, and Encl. 9-4). A coal seam occurs in the core of an anticline which is thickened by structure. It is also noticed in trench #W15 and W16.

5.3 Coal Reserves

The in-situ coal reserves were estimated by using geological and structural cross-sections (Encl. 9-1 to 9.12). These cross-sections are prepared perpendicular to the average strike of formation using all the information collected from diamond drill holes, trenches and outcrop. The locations of these cross-sections are marked on the geological maps (Encl. 7-1 and 7-2).

To make the reserve calculations, the following factors are taken into consideration:

a) A specific gravity of 1.60 for the coal was used.

b) It is calculated for the total strike length of 3360 meters and the total depth of 50 meters to about 200 meters. At places the bottom of Seam 76 is taken into consideration. The pit area is marked on the sections as Limit of Pit.

c) The middle point of the strike length of two sections is taken as length of influence for each section.

d) Areas occupied by coal seams 76 and 78, and waste material between seams have been scaled by using planimeter. This area is multiplied by the strike length influenced by each section.

The preliminary estimates indicate some 25 million metric tonnes open pit mineable geological in place reserves at 4.6 bank cubic meters per tonne overburden ratio (see Table #VI).

5.4 Mineability

These coal seams are exposed in a quasi-dip slope situation amenable to open pit mining with about 4.6:1 overburden ratio.

One of the main advantages of the area is the proximity of the railway, the paved highway and the town of Chetwynd. The railway and highway run through the middle of the Crows Nest licences as does the power line. This is a distinct advantage for any coal property as one of the major problems common to many is the need of many miles of railway.

Another advantage is the town of Chetwynd, connected to the area by all-weather paved highway. Chetwynd could be used as a townsite for persons working at the mine. These factors make a considerable difference to the economics of operating a coal mine.

TABLE VI

RESERVE CALCULATIONS

WEIGHTED RATIOS

AND

TOTAL RESERVES (ESTIMATED)

SECTIONS 1 TO 12

PINE PASS PROJECT

CROWS NEST RESOURCES LIMITED

Combined East & West Pit Ratios

$$\text{Combined Weighted Ratio} = \frac{(5.29 \overset{\text{West}}{\times} 3722416) + (2.45 \overset{\text{East}}{\times} 1247840)}{3,722,416 + 1,247,840}$$

Combined Weighted Ratio = 4.58:1

SECTIONS 6 - 12

SECTION	TONNAGE (METRIC)	O/B VOLUME (M^3)	STRIPPING RATIO	TONNAGE X RATIO
6	1,856256	11,849,520	6.38:1	11,842,913.0
7 Pit 1	1,354,680	8,671,940	6.40:1	8,669,952.0
Pit 2	2,016,400	11,296,100	5.60:1	11,291,840.0
8	410,400	1,795,500	4.38:1	1,797,552.0
9	2,115,480	9,435,000	4.46:1	9,435,040.8
10 Pit 1	4,008,960	19,336,800	4.82:1	19,323,187.0
Pit 2	635,520	1,440,000	2.27:1	1,442,630.4
11	6,596,000	24,079,765	3.65:1	24,075,400.0
12	694,896	2,271,857	3.27:1	2,272,309.9
	= 19,688,592			= 90,150,823.0

$$\text{Weighted Ratio} = \frac{90,150,823.0}{19,688,592.0}$$

Weighted Ratio = 4.58:1

TOTAL RESERVES WEIGHTED RATIO: SECTION 1 - 12

$$= \frac{(4.58 \times 19,688,592 + 4,48 \times 4,970,256)}{19,688,592 + 4,970,256}$$

$$= \frac{90173751 + 22763772}{24658848} = \frac{112,937,523}{24658848}$$

Total combined weighted average ratio = 4.58.1

TOTAL COAL RESERVES = 24,658,848 metric tonnes @ SPG = 1.60
(ESTIMATED)
Sections 1- 12

TOTAL WASTE VOLUME = 113,178,990 m^3
(ESTIMATED)

AVERAGE STRIPPING RATIO = 4.58:1

WEST OF NOMAN CREEK FAULT: SECTIONS 1 - 5

SECTION	TONNAGE (METRIC)	O/B VOLUME (M^3)	STRIPPING RATIO	TONNAGE X RATIO
1	585,600	2,383,927	4.07:1	2,383,392
2	465,840	2,262,150	4.85:1	2,259,324
3	557,632	3,360,000	6.02:1	3,356,944
4	870,144	4,125,825	4.74:1	4,124,482
5	1,243,200	7,597,765	6.11:1	7,595,952
	Σ = 3,722,416			Σ = 19,720,094

$$\text{Weighted Ratio} = \frac{\Sigma(\text{Tonnage x Ratio})}{\Sigma\ \text{Tonnage}}$$

$$\text{Weighted Ratio} = \frac{19{,}720{,}094\ m^3}{3{,}722{,}416\ \text{tons}} = \underline{5.29:1}$$

EAST OF NOMAN CREEK FAULT: SECTIONS 2 - 5

SECTION	TONNAGE (METRIC)	O/B VOLUME (M^3)	STRIPPING RATIO	TONNAGE X RATIO
2	120,960	512,000	3.02:1	365,299
3	169,600	742,500	6.14:1	1,041,344
4	258,720	922,350	3.57:1	923,630
5	592,000 pit 1	779,641	1.32:1	769,600
	106,560 pit 2	316,350	2.97:1	316,483
	Σ = 1,247,840			Σ = 3,051,057

$$\text{Weighted Ratio} = \frac{3{,}051{,}057\ m^3}{1{,}247{,}840} = \underline{2.45:1}$$

SECTION	SEAM NO.	STRIKE LENGTH (M)	COAL AREA (M²)	COAL VOLUME (M³)	COAL TONNAGE (METRIC)	O/B AREA (M²)	O/B VOLUME (M³)	STRIPPING RATIO	REMARKS *SPG = 1.60*
9	Upper Coals	425	945	401,625	642,600	3700[1]	1,572,500		1. OB Surface to Bottom of Upper Coals
	Middle Coals	425	845	359,125	574,600	2600[2]	1,105,000		2. OB Between 76 and Bottom of Middle Coals
	78	425	300	127,500	204,000	10400[3]	4,420,000		3. OB Surface to top of 78
	76	425	821	348,925	558,280	4050[4]	1,721,250		4. OB Between 78 & 76
	Lower Coals	425	200	85,000	136,000	1450[5]	616,250		5. OB Surrounding Lower Coals
					2,115,480		9,435,000	4.46:1	See Section 9 For Seam Location
10	Upper Coals	600	1820	1,092,000	1,747,200	22500[1]	13,500,000		1. OB Surface to Top 78
Pit 1	78	600	785	471,000	753,600	6800[2]	4,080,000		2. OB Between 78 & 76
	76	600	1571	942,600	1,508,160	2928[3]	1,756,800		3. OB Beneath 76 (to maintain pitwall angle)
					4,008,960		19,336,800	4.82:1	
10 Pit 2	?	600	662	397,200	635,520	2400	1,440,000	2.27:1	Unidentified Coal Seams East of 76 Outcrop
11	?	485	8500	4,122,500	6,596,000	49649	24,079,765	3.65:1	Unidentified Coal Seams (Combin[ed] Areas)
12	?	310	1401	434,310	694,896	7328	2,271,857	3.27:1	Unidentified Coal Seams (Combin[ed] Areas)

SECTION	SEAM NO.	STRIKE LENGTH (M)	COAL AREA (M²)	COAL VOLUME (M³)	COAL TONNAGE (METRIC)	O/B AREA (M²)	O/B VOLUME (M³)	STRIPPING RATIO	REMARKS *SPG = 1.60*
5 (west)	78	185	1500	277,500	444,000	27141	5,021,085		West of Noman Creek Fault only does not include coal above 78 or below 76
	76	185	2700	499,500	799,200	13928*	2,576,680		
					1,243,200		7,597,765	6.11:1	*Area O/B between 78 & 76
5 (east)	76	185	2000	370,000	592,000	4214	779,641	1.32:1	East of Noman Creek Fault only see section 5 for Pit 2 location
	Pit 2 Coal	185	360	66,600	106,560	1710	316,350	2.97:1	Seams numbers are unidentified
6	78	240	1906	457,440	731,904	30535	7,328,400		Includes coal west and east of Noman Creek Fault
	76	240	2928	702,720	1,124,352	18838*	4,521,120		Area of O/B between 78 & 76
					1,856,256		11,849,520	6.38:1	
7 Pit 1	78	355	1071	380,205	608,328	14571	5,172,705		West Limb of Syncline does not include coal other than 78 & 76
	76	355	1314	466,470	746,352	9857*	3,499,235		
					1,354,680		8,671,940	6.40:1	*Area of O/B between 78 & 76
7 Pit 2	78	355	750	266,250	426,000	26000	9,230,000		East Limb of Syncline (both sides of NC Fault)
	76	355	2800	994,000	1,590,400	5820*	2,066,100		Includes split of seam 76
					2,016,400		11,296,100	5.60:1	*Area of O/B between 78 & 76
8	78	285	150	42,750	68,400	2000	570,000		West Limb of Syncline
	76	285	600	171,000	273,600	1420*	404,700		*Area of O/B between 78 & 76
	40	285	150	42,750	68,400	2880**	820,800		**Area of O/B between 40 & 76
					410,400		1,795,500	4.38:1	

RESERVE CA LATIONS

SECTION	SEAM NO.	STRIKE LENGTH (M)	COAL AREA (M^2)	COAL VOLUME (M^3)	COAL TONNAGE (METRIC)	O/B AREA (M^2)	O/B VOLUME (M^3)	STRIPPING RATIO	REMARKS *SPG = 1.60*
1	78	120	1400	168,000	268,800	12850	1,542,091		West of Noman Creek Fault only
	76	120	1650	198,000	316,800	7015*	841,836		does not include coal above 78 or below 76
					585,600		2,383,927	4.07:1	*Area of O/B between 78 and 76
2	78	90	1520	136,800	218,880	17170	1,545,300		West of Noman Creek Fault only
(west)	76	90	1715	154,350	246,960	7965*	716,850		does not include coal above 78 or below 76
					465,840		2,262,150	4.85:1	*Area of O/B between 78 and 76
2	78	90	200	18,000	28,800	6500	585,000		East of Noman Creek Fault only
(east)	76	90	640	57,600	92,160	1750*	157,500		does not include coal above 78 or below 76
					120,960		742,500	6.14:1	*Area of O/B between 78 and 76
3	78	100	1150	115,000	181,632	20500	2,050,000		West of Noman Creek Fault only
(west)	76	100	2350	235,000	376,000	13100*	1,310,000		does not include coal above 78 or below 76
					557,632		3,360,000	6.02:1	*Area of O/B between 78 & 76
3	78	100	210	21,000	336,000	4050	405,000		East of Noman Creek Fault only
(east)	76	100	850	85,000	136,000	1070*	107,000		does not include coal above 78 or below 76
					169,600		512,000	3.02:1	*Area of O/B between 78 & 76
4	78	165	1000	165,000	264,000	15025	2,479,125		West of Noman Creek Fault only
(west)	76	165	2296	378,840	606,144	9980*	1,646,700		does not include coal above 78 or below 76
					870,144		4,125,825	4.74:1	*Area of O/B between 78 & 76
4	78	165	100	16,500	26,400	290	47,850		East of Noman Creek Fault only
(east)	76	165	880	145,200	232,320	5300*	874,500		does not include coal above 78 or below 76
					258,620		922,350	3.57:1	*Area of O/B bewteen 78 & 76

5.5 Coal Quality

McKechnie sampled intersections of drill core from seams 76 and 78 for proximate analysis. The results of these analyses are given in Table #IV.

Based largely on the results of this McKechnie work, Pine Pass Coal Company Ltd. acquired coal licences in the area 1968 and drove an adit into seam 76, adjacent to the highway, for a length of 36.5 meters and then cross-cut to obtain bulk samples. At the sampling point the seam had a true thickness of 4.8 meters. This sample was analyzed by Warnock-Hersey. For results see Table V.

The result of this was most encouraging and suggested that seam 76 may, in fact, be an excellent coking coal.

During the summer of 1980, 30 backhoe trenches were cut and 46 channel samples were collected from exposed seams including 76 and 78 seams. These samples were sent to Crows Nest Laboratory, Fernie, B.C. (for results see Table VII).

This analysis indicated that the percentage of ash and volatile matter is almost constant ranging from ash 6% - 11% and volatile 28% - 32% on an air-dried basis. This percentage of volatiles is

TABLE VII

COAL QUALITY

	SAMPLE NO.	TRENCH NO.	THICKNESS METERS	RAW AS RECEIVED BIAS MOISTURE %	ASH %	CLEAN FLOAT AT SG 1.6 YIELD %	I.M. %	ASH %	V.M. %	F.C. %	AIR DRIED BIAS ASH %	V.M. %	F.C. %	VM DMM
COAL SEAMS BELOW SEAM 76														
704	2	W1	4.2	2.68	35.91	50	2.89	7.47	30.06	59.58	7.69	30.95	61.36	33.5
713	1	W10		1.97	37.64	37	2.83	12.07	27.90	57.70	12.36	28.57	59.07	32.6
722		W15	0.3	0.93	87.05	0								
723	1	W15	1.7	2.13	54.17	20	2.91	12.02	30.31	54.76	12.38	31.22	56.40	35.6
724	2	W15	2.5	2.99	15.71	66	2.33	6.23			6.38			

TABLE VII

COAL QUALITY

	SAMPLE NO.	TRENCH NO.	THICKNESS METERS	RAW AS RECEIVED BIAS MOISTURE %	RAW AS RECEIVED BIAS ASH %	CLEAN FLOAT AT YIELD %	CLEAN SG 1.6 I.M. %	ASH %	V.M. %	F.C. %	AIR DRIED BIAS ASH %	AIR DRIED BIAS V.M. %	F.C. %	VM DMMF
SEAM 78 con't														
730	4D	W15	0.6	1.11	89.07	0								
731	4E	W15	1.1	4.21	34.19	51	3.32	8.62	30.64	57.42	8.92	31.69	59.39	34.8
738	2	TW18	3.2	2.98	48.03	32	3.56	10.78			11.18			
SEAM 76														
698	1	E1	8.4	4.05	26.98	56	2.65	5.62	30.15	61.58	5.78	30.97	63.25	32.9
699	1	E2	4.6	3.30	43.52	41	4.03	10.92			11.38			
700	1	E3	3.1	4.98	16.01	72	3.85	6.85			7.13			
701		E6	8.5	4.21	38.77	34	4.02	11.31	30.50	54.17	11.78	31.78	56.44	36.0
702	1	TE5	3.5	4.39	32.39	49	4.10	8.77			9.15			
703	2	TE5	4.7	4.56	22.00	59	4.00	9.40			9.80			
706	1	W2	4.2	1.09	88.28	0					89.26			
710	2	N7		3.19	15.94	69	3.44	6.97	30.42	59.17	7.22	31.50	61.28	34.0
711	1	W8		2.07	35.92	47	2.91	6.80			7.01			
714	1A	W11	2.3	3.17	31.76	46	2.17	9.36			9.57			
715	1B	W11	1.9	1.51	76.17	9	3.23	10.75			11.11			
716	1C	W11	3.0	3.51	21.28	59	2.80	7.08	29.82	60.30	7.28	30.68	62.04	33.1
725	3A	W15	.7	3.30	41.33	26	4.49	11.45	29.22	54.85	11.99	30.60	57.41	34.8
726	3C	W15		4.57	24.65	52	4.34	9.14			9.56			
737	1	TW18	3.0	4.02	20.53	59	3.61	9.51	29.87	57.01	9.89	30.99	59.14	34.4
741	1	TW20	6.7	3.46	47.95	27	2.30	10.31			10.55			
742	2	TW20	2.8	.42	28.80	51	2.52	9.80			10.05			
7[illegible]		W2	3.5	3.76	12.41	81	3.07	7.35	31.82	57.76	7.58	32.83	59.59	35.5

TABLE VII.

COAL QUALITY

	SAMPLE NO.	TRENCH NO.	THICKNESS METERS	RAW AS RECEIVED BIAS MOISTURE %	ASH %	CLEAN FLOAT AT YIELD %	SG 1.6 I.M. %	ASH %	V.M. %	F.C. %	AIR DRIED BIAS ASH %	V.M. %	F.C. %	VM DMMF
COAL SEAMS ABOVE SEAM 78														
718		W12	2.0	2.52	22.09	64	3.33	7.74			8.01			
719	1A	W14	2.7	1.56	60.85	17	3.15	9.99	28.27	58.59	10.31	29.19	60.50	32.5
720	1B	W14	0.7	4.67	27.53	58	3.95	9.12			9.49			
721	1C	W14	2.3	2.66	32.99	50	2.52	8.85			9.08			
732	5	W15	1.0	4.69	16.07	68	2.46	8.96			9.19			
733	6	W15	4.0	5.17	22.64	59	2.15	7.06			7.22			
734	1	W16	6.7	3.13	22.12	60	2.23	8.61	30.14	59.02	8.81	30.83	60.36	33.8
735	1	W17	3.1	3.79	14.86	72	3.57	7.97			8.27			
736	2	W17	1.5	2.28	50.98	26	3.48	10.87		11.26				
739	3	TW18	3.2	3.99	29.66	53	2.86	8.81			9.07			
740	4	TW18	3.1	4.69	20.29	67	2.89	9.21	28.88	59.02	9.48	29.74	60.78	32.9
744	1	S29	1	1.75	7.68	88	1.84	4.84			4.93			
SEAM 78														
705	2	W2	3.0	2.80	36.32	46	2.59	9.19			9.44			
707	1	W6	3.7	3.98	36.88	43	3.84	10.25	32.25	53.66	10.66	33.54	55.80	37.5
708	2	W6	1.3	2.55	44.41	33	4.04	11.01			11.48			
709	1	W7		1.99	44.62	39	3.25	8.03			8.58			
712	1	W9	2.3	2.03	24.24	59	1.69	5.81			5.91			
717	2	W11	2.5	2.91	22.38	60	1.96	5.50			5.62			
727	4A	W15	1	3.46	20.01	65	3.85	9.35	28.98	57.82	9.73	30.14	60.13	33.4
728	4B	W15	0.8	0.73	85.03	0								
729	4C	W15	3.0	2.34	41.06	41	2.02	8.54			8.72			

expected as these samples are from shallow depths and thus have been oxidized. Therefore, it really does not give a true idea of the quality at the present.

Analysis of the 1980 backhoe trench samples (Table VII) did not significantly change the quality picture put forward by previous operators (Tables IV and V).

A3/AQb.32

6.0 WILLOW CREEK AREA

6.1 Location

The Willow Creek area is located immediately northeast of Falls Mountain and bounded to the northwest by the Pine River. Willow Creek flows through the middle of the property along a northwest course.

6.2 Previous Work

The area was mapped in detail at a scale of 1:9600 during the period of 1948 to 1951 by N.D. McKechnie. In addition, he drilled 39 diamond drill holes totalling 25,447 feet in which coal intersections were sampled and analyzed. McKechnie calculated geologic in place coal reserves of 23.8 million short tonnes. However, if all seams averaging thinner than 1.5 meters are excluded from this calculation reserves decline to 21.5 million short tonnes. McKechnie's calculations for coal reserves are affected greatly by problems in resolving seam correlation and continuity of seams. McKechnie (1955) reported nine coal seams of commercial thickness but stated that these seams were lenticular and discontinuous.

6.3 Work Done in 1980

During the summer of 1980 only a reconnaissance geological mapping program at a scale of 1:10000 could be carried out due to lack of time and shortage of crew.

6.4 Stratigraphy and Structure

The Willow Creek area is underlain by the coal bearing Gething Formation of the Bullhead Group. This formation is overlain by the Moosebar and Commotion Formations of the Fort St. John Group. Both of these groups are of Lower Cretaceous age.

The structure of the area is complicated by the southeast shallow plunging 10°, Pine River anticline. Willow Creek more or less follows the axis of this anticline. Numerous faults, both reverse and normal, are known also to cut the anticline at the crest and the limbs. The Willow Fault is a normal fault that apparently cuts the thrust faults, thus it is believed to be of younger age. Displacement on the Willow Fault is thought to be approximately 180 meters of dip slope movement. Strike slip movement has not yet been proven.

Coal bearing Gething strata outcrop on both limbs of this anticline with dips of 25° - 35°. These strata are overlain by Moosebar shales and on the west limb by younger sequences. On the southwest limb (Falls Mountain), there is an outlier of Commotion Formation which is the dominant feature approximately 150 meters thick with less than 10° southwesterly dip. Falls Mountain is a large, almost flat-topped mountain which stands about 460 meters above the surrounding area. Its gently dipping top is about 5 kilometers long and 1.5 kilometers wide. No rocks older than the Gething Formation have been noticed in the axis of the Willow Creek anticlinorium.

The change of dips between the underlying Gething and overlying Moosebar and Commotion may be possibly due to the change of relative competencies of the rocks. The Gething is a more competent sequence overall than the incompetent shales of the Moosebar. Thus, tectonism which folded and faulted the Gething Formation was absorbed by the Moosebar shales. This absorption of tectonic activity left the overlying Commotion relatively flat lying and homogenous.

6.5 Coal Geology

The Gething Formation is the only coal bearing strata which contains economically mineable coal in the area. The Commotion group does contain coal, except in the marine Moosebar member, but no thick seams have been reported north of the Sukunka region.

In the Peace River region, the Trojan zone appears within the upper 60 meters of the Gething. This upper sequence is prospective elsewhere and may hold the same potential in the Willow Creek area. However, the Gething represented in Willow Creek is not yet defined as upper, middle or lower Gething. No comprehensive study into which stratigraphic horizon is represented has been done as of yet.

The nine seams reported by McKechnie are of variable thickness from 1.2 to 3.5 meters. He reports also that these seams may be discontinuous and lenticular. Seams stratigraphically lower than those reported by McKechnie have never been investigated. Thus, the potential of finding more coal reserves lower than those known may exist.

The coal is probably best mined by open pit techniques due to the structural complexity of the ground. Underground mining potential does still exist if a relatively thick continuous seam could be found. However, present seams are thin and show local complexity in structure. The relationship of topography and stratigraphy in the identification of open pit targets has also never been performed in the Willow Creek area. Dip slope or quasi-dip slope mining situation may exist if the structure could be proved.

6.6 Conclusions and Recommendations

To define further coal reserves and the structure of the property further work must be performed.

This can be done by relatively inexpensive exploration methods of mapping, trenching, compilation and evaluation of all available information, old and new. Mechanical exploration such as diamond drilling would follow if and when warranted from future work.

7.0 FALLING CREEK - BEAUDETTE CREEK AREA

7.1 Location

The Falling-Beaudette Creeks area is located to the immediate west of Falls Mountain, on the south side of the Pine River Valley. Falling Creek traverses through the middle of the area and Beaudette Creek runs through the southwest licences.

7.2 Previous Work

Very little in the way of serious exploration has been performed on the Falling Creek-Beaudette Creek area. Pan Ocean did drill three diamond holes south of the Shell licences. Two holes were located immediately south of the licences and one some 1-1/2 miles upstream towards the south. The purpose of these holes was to intersect possible coal sections within the Gething by drilling through the upper Moosebar. One hole failed to intersect the Gething.

7.3 Work Done in 1980

Reconnaissance geological mapping was carried out in the Falling Creek valley and along the west ridge. More detailed work could not be completed due to shortage of time and crew.

7.4 Geology

The area is mainly underlain by the Moosebar formation of the Fort St. John Group along the Falling Creek valley. Towards the west of the valley, a high ridge is underlain princi by steeply dipping Gething formations and possibly older formations of the Bullhead succession of Lower Cretaceous age.

7.5 Structure

The structure of the area is complex as indicated by the highly variable dips in the Moosebar formation along Falling Creek. A traverse of Beaudette Creek reveals many folds and faults in Gething and older Bullhead Group rocks. In many places, beds of these formations are vertical or overturned.

7.6 Coal

The occurrence of economically viable coal seams have not been noticed in the Falling Creek valley due to the extensive outcropping of Moosebar shales. In view of the reported thickness of Moosebar formation and the relative elevation of the Commotion formation on Falls Mountain, it is possible that the Gething formation is covered by a thin layer of Moosebar in Falling

Creek. However, the holes drilled in 1975 by Pan Ocean, to a depth of more than 900 feet failed to intersect the Gething Moosebar contact. The hole was located 1-1/2 miles upstream from the Shell licences bottomed out in Moosebar.

Pan Ocean drilled two other diamond holes on the west side of Falling Creek immediately southwest of the southeast end of Falls Mountain which intersected the Moosebar-Gething contact dipping to the southwest. About 1000 feet of Gething section was tested. These holes intersected two coal seams at 150 feet and 750 feet below the Moosebar-Gething contact with true thicknesses of about 12 and 27 feet respectively. The lower seam has a three-foot mudstone parting.

The analysis on 1/4" x 28 m fraction floated at 1.45 S.G. was as follows:

Seam No.	Yield	Ash	F.S.I.
1	91.3%	3.6%	1-1/2
2	81.4%	2.9%	1-1/2
Lower Part Seam 2	79.9%	2.3%	8-1/2

The F.S.I. of the lower portion of the seam is interesting. The excellent yield-ash characteristics of all coal intersections are noteworthy.

Although the structure of the Gething formation along the west side of Falling Creek is complex, a potential of finding more coal exists. Especially in Beaudette Creek an excellent possibility of discovering workable seams exists in the immediate vicinity.

7.7 Conclusions and Recommendations

Refer to Willow Creek area Conclusions and Recommendations (Section 6.6).

A3/AQb.41

8.0 RECOMMENDATIONS FOR FURTHER WORK

The result of the exploration work carried out during 1980 is very encouraging. This work includes about 25 million metric tonnes of geological in place coal with a ratio of overburden to coal 4.5:1. It is economically feasible to mine open pit.

The structural and correlation problems are still unresolved. There are still unexplored areas left to find more reserves of coal and previous evaluations of coal reserves and coal quality to be confirmed. Therefore, further exploration work is recommended.

1. Additional trenching of 3800 meters to test continuity of coal seams and expose the structure.
2. 38 rotary drill holes by drilling 3750 meters and down hole logging to prove reserves and correlation of seams.
3. Build new roads of 4800 meters as an access to drill sites and also expose the geology if possible.
4. Additional mapping to resolve the structural problems and to find new horizons of coal in the Gething formation.
5. There is a dire need for core samples. Continuous core (diamond) drilling is, however, recommended to be postponed to 1982 when most of the structural problems are resolved. This more expensive drilling would be better utilized then.

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CERTIFICATION

I, Gyan Chand Singhai of 5620 Clearwater Drive, Richmond, B.C., do hereby certify that:

(1) I am a member of the Association of Professional Engineers of British Columbia since 1969, and member of the Canadian Institute of Mining and Metallurgy.

(2) I am a post-graduate in Applied Geology (1959) from the University of Saugor, Sagar, Madhya Pradesh, India, and have been practising my profession since that time.

(3) I was teaching in the University of Saugor, Sagar, and Ravishankar University, Raiput in India, and practised my profession in India, Canada, West Indies, Mexico, Peru, U.S.A., Chile, Australia, Indonesia, and Venezuela.

(4) This report is based on report of working on the property during the period June - August, 1980.

Dated at
901 - 675 West Hastings Street
Vancouver, B.C.
May 20, 1981

G.C. Singhai, M. Tech. P. Eng.

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