Various pages, including Appendices 1.1 & 1.2, contain confidential information or data, as described in *Section 2 of the Coal Act Regulation*, and have been excludedfrom this report.

Coal Act Regulation: http://www.qp.gov.bc.ca/statreg/reg/C/251_2004.htm

Quintette
Coal Limited

Canada

Process Plant

West/McConkey Service Complex
242-3211

GEOLOGICAL BRANCH
ASSESSMENT REPORT

00 616

August 14, 1984

Mr. Paul Hagen
Coal Administrator
Ministry of Mines, Energy &
Petroleum Resources
Room 412, 617 Government Street
Victoria, B. C.
V8R 1J6

OPEN FILE

Dear Sir:

Re: Quintette Coal Limited, 1982 Geological Report

In reply to your letter of January 12, 1984 addressed to J.C. Sexton, Project Accountant, I have enclosed the requested data and amendments to the QCL, 1982 Geological Report.

The following is a list of attached materials (two copies of each):

1. Figure 1.2.1 - showing geographic features and with bar scale.
2. Figure 3.1.2.1 - with Figure number
3. Figures 3.1.3.2. and 3.1.3.3. are enclosed as full scale plans to show ✓ the detail as required.
4. Figure 1.2. - no such figure is in the text or reference.
5. Figure 1.1.3 - with latitude and longitude indicated and figure number number.
6. Geology Plans -McConkey Pit Geology Plans 82-105-21-1001, 82-102-21-1001, 82-102-21-1001 showing additional UTM coordinates.
7. Figures 1.1.1 and 1.1.2 - Figure numbers have been added
8. Regional Geology Plan (Appendix 1.2) -number revised to QNTT-71-0100-R15 and "Table of Contents" updated to include this number.
9. Section 4.1 - additional paragraphs describing sample procedure and listing sample intervals for sample tag numbers in holes QMR8201 and 8202. The other drill holes have intervals listed in Appendix III, Section 1.
10. Geophysical logs are included for drill holes QMR 8227, 8251 and QBR8210. Drill holes QMR8239, 8272, QBR8211 and 8212 were not logged and this is indicated on their summary sheets in Appendix 1.3.1.
11. Drill holes QJR8205 and 8206 were mislabelled QBR8206 and QBR8205 when they were plotted. Enclosed is a copy of the current plan with correct indentification (W31 QNTT-75-0624-R02). This plan has also been added to the list in Appendix I. QMR8211 is plotted on Deputy Geology plan 82-101-21-1001. QMR 8262 is plotted and underlined in red on two copies of Frame Geology plan #QNTT 76-0708-R01.

Administration Telecopier: (604) 242-3580 Telex: 047-7199 Process Telex: 047-8848

12. A list of "Errata" to update the Table of Contents and corrections to the text is attached.
13. Drawing 82-300-2[illegible]001 and Figure 3.1.1 are enclosed with bar scale added.
14. Coking reports - Copies of the coke oven tests are attached. They are to be included in Appendix III, Section 4 as Section 4.4 As stated in the text on p. 4-4, these reports were not available at the time of submission of the 1982 Geological Report.

I trust the enclosed information meets your requirments for approval of the Quintette Coal Exploration 1982 Geological Report.

Thank you for your attention.

Yours Truly,
QUINTETTE COAL LIMITED

M. H. Pelley
Manager of
Technical Services

JS/ss

Enclosure:

ERRATA

Add or change sections in quotations (""):

1. P. ii This report documents "1982"....

2. Table of Contents

List of Appendices

Appendix 1.0 (IN TEXT)

1.2 Regional Geology Map; 1:50000 (w. 1982 Geological Exploration); Drawing no QNTT-71-0100-R15"

Appendix I - Geology

Part 2

Quintette Geology Maps: (1:5000)
"W31 QNTT-75-0624-R02"

Appendix III - Testing
Section 4

"4.4 Adit Bulk Sample Coke Test Reports."

3. P.4-4 Section 4.3
add the following to the end fo the second paragraph:
"Cammet coke test reports are presented in Appendix III, Section 4.4"

4. P.4-1 Section 4.1 Rotary Drilling...
add following paragraph, after first paragraph:

"Sampling with the rotary drill was conducted over every metre of intersection. The drillers took a continuous split of the drill cuttings coal or rock as they came out of the collecting cyclone on the side of the drill rig. These cuttings were collected in a bucket and then a representative portion placed in a sample bag marked with the drill hole number and sample interval. For example, a typical sample bag would be labelled QMR8228, 13-14. These sample intervals are the I.D. number as listed in Appendix III Section 1.1. The decision as to what intervals would be analysed was made by the supervising geologist. The drill hole number, sample interval and analysis are recorded in Appendix III, Section 1. Two drill holes (QMR8201 and 8202) had analysis completed by General Testing Laboratories. The intervals were tagged and shipped to General Testing. The following is a listing of the tag numbers and the sample interval:

DRILL HOLE	SAMPLE TAG #	SAMPLE INTERVAL
QMR8201	1948	36-37 D3
	1949	45-46 D4
	1950	47-48
	1951	48-49
	1952	49-50
	1953	50-51
	1954	51-52
	1955	52-53
	1956	53-54
	1957	54-55
	1958	55-56
	1959	56-57
	1960	57-58
	1961	58-59
	1962	59-60
	2002	37-38
	2035	38-39
QMR8202	1919	24-25
	1920	35-36
	1921	36-37
	1922	37-38
	1923	38-39
	1924	39-40
	1925	40-41
	1926	41-42
	1927	42-43
	1928	43-44
	1929	44-45
	1930	45-46

DRILL HOLE	SAMPLE TAG #	SAMPLE INTERVAL
QMR8202	1931	46-47
	1932	47-48
	1933	48-49
	1934	51-52
	1935	52-53
	1936	64-65
	1937	65-66
	1938	82-83
	1939	83-83
	1940	84-85
	1941	85-86
	1942	86-87
	1943	87-88
	1944	88-89
	1945	89-90
	1946	90-91
	1947	92-93
	2036	53-54

CONFIDENTIAL

QUINTETTE COAL LIMITED

This report documents 1981 geological investigations to cover licences 3279-3406, 3592-3606, 3618-3633, 3656-3662, 4530-4544, 4755-4757, 6039, 7221-7237, and 3914-3929 in the Peace River District of Northeast British Columbia. The licences are covered by NTS Map Sheets 93-I-15, 93-I-14 and 93-P-3 between latitudes 54°48'N and 55°10'N and between Longitudes 120°42'W and 121°25'W. The licences are owned by Quintette Coal Ltd., a company with the following shareholders:

Denison Mines Ltd.	50.00%
Mitsui Mining Co.	12.50%
Tokyo Boeki	10.49%
Charbonnages de France and Minersa	12.01%
Sumitomo Corp.	5.00%
Nippon Steel Corp.	3.84%
Nippon Kokan Kabushiki Kaisha	1.62%
Kawasaki Steel Corporation	1.50%
Sumitomo Metal Ind.	1.49%
Kobe Steel Ltd.	0.88%
Nisshin Steel Co. Ltd.	0.29%
Nakayoma Steel Works Ltd.	0.20%
Mitsubishi Chemical Ind. Ltd.	0.11%
Godo Steel Ltd.	0.07%

This report was prepared by Quintette Coal Ltd. Geological staff.

Geological discussions are based on all geologic work to date, over the last twelve years.

This report is submitted April 15, 1983 to support expenditures applied to the licences as a result of the geologic work.

STATEMENT OF QUALIFICATIONS

I, David G.S. Johnson, graduated from Mount Allison University, Sackville, New Brunswick, with a Bachelor of Science in Geology in May 1970. I have worked in Mineral Exploration for six years, managing field exploration programs and writing reports and recommendations on those programs. I have worked in Coal Exploration for the last five years in Northeast British Columbia. I am responsible for budgets, planning, interpretations, supervision and reporting for the Geology Department, Quintette Coal Ltd.

David G.S. Johnson
Chief Mine Geologist
Quintette Coal Limited
Dawson Creek, B.C.

PREFACE

This report documents the exploration and development work completed during 1982 on Quintette Coal Limited's coal licences. The work was completed by Quintette Coal staff, contractors and consultants with technical assistance from Denison Mines (Coal Division) staff and Mitsui Mining Company geologists.

The text provides a regional assessment of the geology and detail geology in areas of concentrated investigations (McConkey, Frame and Shikano). Quality assessment of 1982 data confirms previous investigations; all quality data received to date is included in the report.

This report references all previous geologic assessment reports and feasibility studies written over the past twelve years on Quintette Coal Limited's licences, including those submitted by Dupont Canada Exploration whose licences (3914-3929) were recently acquired by Quintette.

Three areas within the Quintette Property were renamed in late 1982. They are:

OLD NAME	NEW NAME
Sheriff	McConkey
Johnson	Hermann
Syncline Extension	Shikano

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- 1.3.1 Summary Sheets:
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  - Frame Rotary Holes
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  - Shikano Diamond Holes
- 1.3.2 Descriptive Logs: (Core Holes)
  - QBD 8201 through QBD 8218

APPENDIX I - GEOLOGY

PART 1

McConkey: (Scale 1:1250)	Drawing Number
- General Stratigraphic Correlation	82.100.26.1001
- Deputy Geology	82.101.21.1001
- Marmot Geology	82.105.21.1001
- Mesa Geology	82.102.21.1001
- Deputy Section 34900	82.101.22.1001
- Marmot Section 35000	82.105.22.1001
- Mesa Section 36400	82.102.22.1001
- Deputy Structure Contour - Top of J Seam	82.101.34.003
- Marmot Structure Contour - Top of J Seam	82.105.34.1001
- Mesa Early Pit Structure Contour - Top of J Seam	82.102.34.1002
- Mesa Pit (Early/Middle) - Top of J Seam	82.102.34.1001

APPENDIX I - GEOLOGY (CONT.)

Frame: (Scale 1:2500)

- General Stratigraphic Correlation		82-GL-100
- Frame Geology		QNTT76-0708-R01
- Cross Sections:	34400	82.200.22.1001
	35000	82.200.22.1007
	35300	82.200.22.1010
	35700	82.200.22.1014
- Structure Contour - Top of J Seam		82.200.34.1001

Shikano: (Scale 1:5000)

		Drawing Number
- General Stratigraphic Correlation		82.300.26.1005
- Geology Plan		82.300.21.0001
- Cross Sections:	23200	82.300.22.1001
	23600	82.300.22.1005
	24000	82.300.22.1009
- Structure Contour - Top of J Seam		82.300.34.004

PART 2

Adit Drawings

QMA 8102 (Revised 1982) Seam E	82-GL-002
QMA 8104 (Revised 1982) Seam G	82-GL-004
QMA 8201 Seam D	82.200.26.1001
QMA 8202 Seam F-2	82.200.26.1002
QMA 8203 Seam J-3	82.200.26.1003
QBA 8201 Seam J	82.300.26.1003
QBA 8202 Seam F	82.300.26.1002
QBA 8203 Seam D/E	82.300.26.1001
QBA 8204 Seam J	82.300.26.1004

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Quintette Geology Maps: (1:5000)

Map	Drawing Number
U-30	
V-30	QNTT-75-0624-R02
V-31	QNTT-75-0624-R02
W-30	QNTT-75-0624-R02
W-31	
X-30	QNTT-75-0624-R02
X-31	QNTT-75-0624-R02
Y-31	QNTT-75-0624-R02
Y-32	QNTT-75-0624-R02
Y-33	QNTT-75-0624-R02
Z-32	QNTT-75-0624-R02

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Rotary Drill Holes

Diamond Drill Holes

APPENDIX III - TESTING

Section 1 Rotary Cuttings Analysis

1.1 Quintette Analysis (To Date)

1.2 General Testing Laboratories - QMR 8101,02,03

- QBR 8202,03,04,07,08

Section 2 Diamond Drill Core Analysis

2.1 General Testing Laboratories

QBD 8202,04,05,06,07,08,09,10,11,12,13,14,15,16,17,18

2.2 Standard Laboratories - Rheology of Composite Samples

QBD 8202,04,05,06,07,08

LIST OF APPENDICES (Cont.)

PART 2 (CONT.)

APPENDIX III - TESTING (CONT.)

Section 3 Adits - Washabilities

3.1 **Shikano** Metallurgical Coal - Washabilities

3.1.1 D Seam - QBA 8203 - Wash #1; Short Wash, Long Wash
- Wash #2; Short Wash

3.1.2 E Seam - QBA 8203 - Wash #1; Short Wash, Long Wash
- Wash #2; Short Wash
- Rewash Filter Cakes #1 and #2
- Wash #3; Short Wash

3.1.3 F Seam - QBA 8202 - First Sample; Short Wash, Long Wash (No pilot scale wash - oxidized)
- Wash #2; Short Wash, Long Wash
- Wash #3; Short Wash
- Wet Attrition

3.1.4 J Seam - QBA 8201 - Sample J1; Short Wash, Long Wash
- Sample J2; Short Wash (No pilot scale wash - oxidized)

3.1.5 J Seam - QBA 8204 - Wash #1
- Wash #2; Short Wash, Long Wash
- Wash #3

3.2 **Frame** Metallurgical Coal - Washabilities

3.2.1 D Seam - QMA 8201 - Wash #1; Short Wash, Long Wash
- Wash #2
- Wet Attrition

3.2.2 E Seam - QMA 8102 - Wash #1
- Wash #2; Short Wash; Long Wash

3.2.3 F Seam - QMA 8202 - Wash #1
- Wash #2; Short Wash, Long Wash
- Wet Attrition

3.2.4 G Seam - QMA 8104 - Wash #1
- Wash #2; Short Wash, Long Wash

3.2.5 J Seam - QMA 8203 - Wash #1
- Wash #2; Short Wash, Long Wash
- Wet Attrition

LIST OF APPENDICES (Cont.)

APPENDIX III - TESTING (CONT.)

Section 3 Adits - Washabilities (Cont.)

3.3 **Thermal Coal** -Washabilities

3.3.1 Shikano Blend - Seams D,E,F,J1,J2
- Wash; Short Wash
- Wet Attrition

3.3.2 McConkey/Frame Blend
- Wash; Sizing, Short Wash
- Raw Analysis

Section 4 Adits - Analysis

4.1 **Frame:** Summary Tables
- Chemical
- Petrographic
- Rheological
- Coke Analysis
- Carbonization Data

4.2 **Shikano:** Summary Tables
- Chemical
- Petrographic
- Rheological
- Coke Analysis
- Carbonization Data

4.3 **Adit Channel Samples** -Component Analysis
- Frame
- Shikano

1.0 INTRODUCTION

1.1 LOCATION AND ACCESS

The Quintette property is located in the Rocky Mountain foothills belt of northeastern British Columbia (Figure 1.1.1 and 1.1.2.). The coal-bearing trend of this region is commonly referred to as the Peace River Coal Block.

Air distances to communities surrounding the property are as follows:

The City of Prince George, B.C.	(pop. *71,100)	- 160 km southwest
The City of Dawson Creek, B.C.	(pop. *13,800)	- 106 km northeast
The Village of Chetwynd, B.C.	(pop. * 2,200)	- 98 km north
The Town of Tumbler Ridge, B.C.	(pop. growing)	- 20 km east

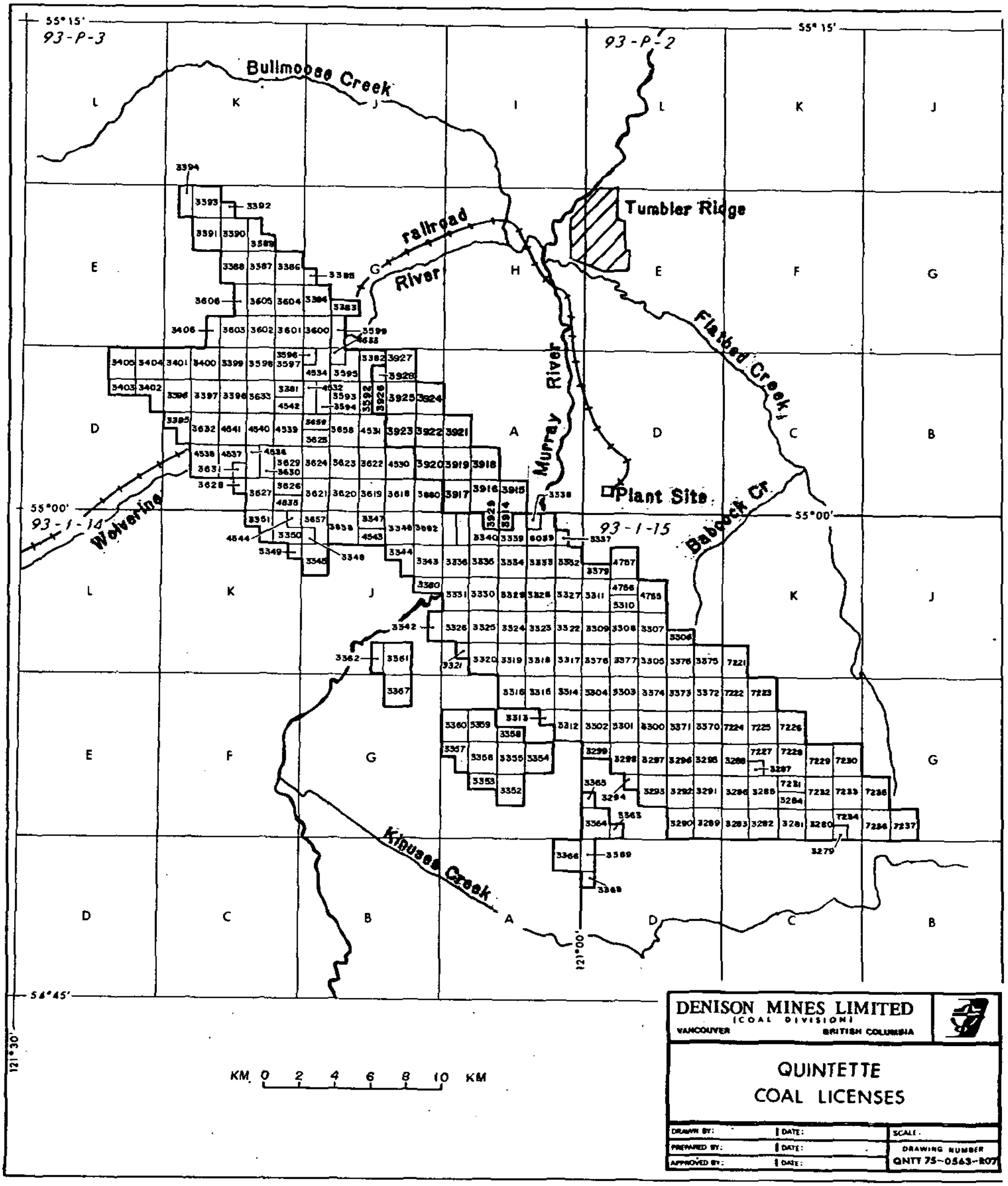
(* - 1979 Census)

Crews conducting exploration work lived in the Sheriff Camp and the Plantsite area camps. The Sheriff camp is 106 km from Chetwynd and 20 km from Tumbler Ridge. The Plantsite is 15 km south of Sheriff Camp along Quintette's access road and Murray River bridge crossing. The Plantsite is 15 km from Tumbler Ridge and 140 km southwest of Dawson Creek.

The property is accessible by three routes: the Boundary Road (Heritage Highway) from Tupper B.C.; the Fellers Heights Road (Heritage Highway) from Dawson Creek/Feller Heights; and the road from Chetwynd to the Wolverine River Valley and Tumbler Ridge. The distances for these routes are as follows.

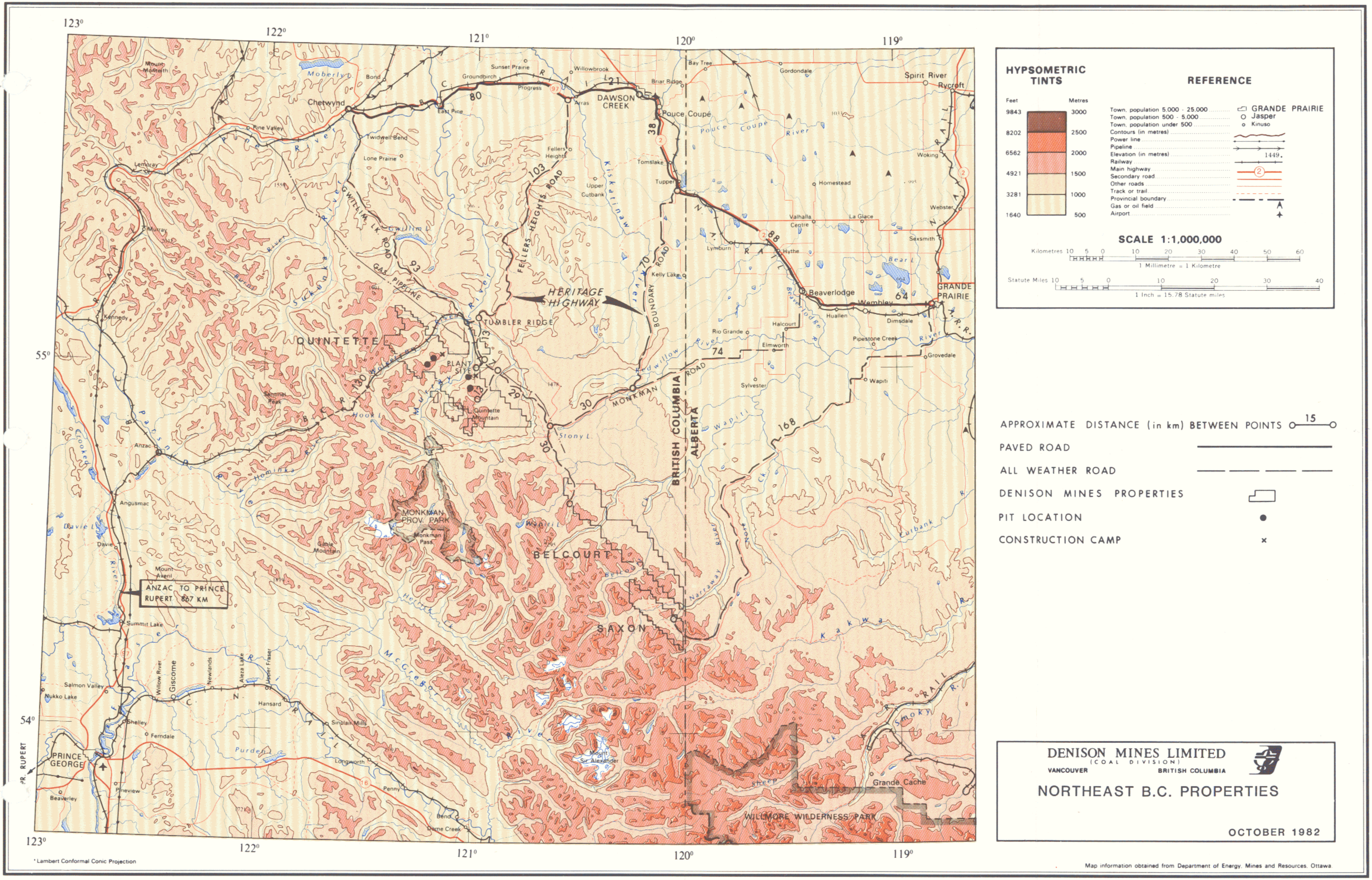
Boundary Rd - Dawson Creek to Plantsite	210 km
Fellers Heights Road - Dawson Creek to Sheriff	150 km
Chetwynd to Sheriff	106 km

Access within the property is gained by several existing roads and trails as well as access recently developed for the mine. Figure 1.1.3 shows the main access routes in the construction areas.



55° 15'
93-P-3
93-P-2
Bullmoose Creek
Tumbler Ridge
railroad
River
Flatbed Creek
Murray River
Plant Site
Babcock Cr.
55°00'
93-I-14
93-I-15
Wolverine
Kiskatinaw Creek
121°00'
54°45'
121°30'
KM 0 2 4 6 8 10 KM
DENISON MINES LIMITED
(COAL DIVISION)
VANCOUVER
BRITISH COLUMBIA
QUINTETTE
COAL LICENSES
DRAWN BY:
DATE:
SCALE:
PREPARED BY:
DATE:
DRAWING NUMBER
APPROVED BY:
DATE:
QNTT 75-0563-R07

FIGURE 1.2.1



HYPSOMETRIC TINTS
Feet 9843 8202 6562 4921 3281 1640
Metres 3000 2500 2000 1500 1000 500
REFERENCE
Town, population 5,000 - 25,000 GRANDE PRAIRIE
Town, population 500 - 5,000 Jasper
Town, population under 500 Kinuso
Contours (in metres)
Power line
Pipeline
Elevation (in metres) 1449
Railway
Main highway
Secondary road
Other roads
Track or trail
Provincial boundary
Gas or oil field
Airport
SCALE 1:1,000,000
Kilometres 10 5 0 10 20 30 40 50 60
1 Millimetre = 1 Kilometre
Statute Miles 10 5 0 10 20 30 40
1 Inch = 15.78 Statute miles
APPROXIMATE DISTANCE (in km) BETWEEN POINTS 15
PAVED ROAD
ALL WEATHER ROAD
DENISON MINES PROPERTIES
PIT LOCATION
CONSTRUCTION CAMP
DENISON MINES LIMITED
(COAL DIVISION)
VANCOUVER BRITISH COLUMBIA
NORTHEAST B.C. PROPERTIES
OCTOBER 1982
HERITAGE HIGHWAY
QUINTETTE
BELCOURT
SAXON
TUMBLER RIDGE
PLANT SITE
MONKMAN PROV. PARK
WILLMORE WILDERNESS PARK
BRITISH COLUMBIA
ALBERTA
ANZAC TO PRINCE RUPERT 867 KM
DAWSON CREEK
Chetwynd
Pouce Coupé
GRANDE PRAIRIE
PRINCE GEORGE
Beaverlodge
Grande Cache
FELLERS HEIGHTS ROAD
BOUNDARY ROAD
MONKMAN ROAD
GAS PIPELINE
GWILLIM LK ROAD
123° 122° 121° 120° 119°
55° 54°
Lambert Conformal Conic Projection
Map information obtained from Department of Energy, Mines and Resources, Ottawa

FIGURE 1.1.2.

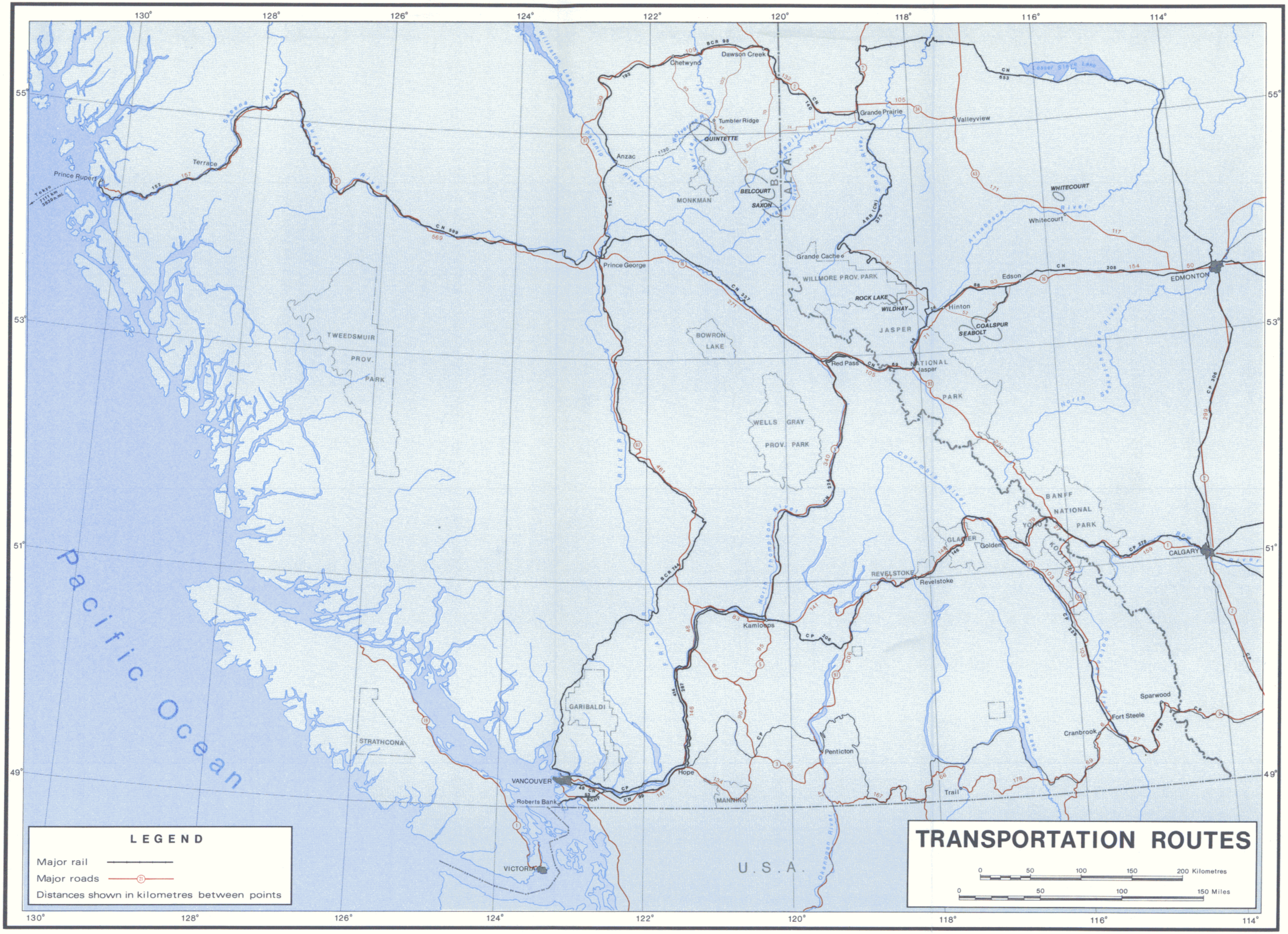
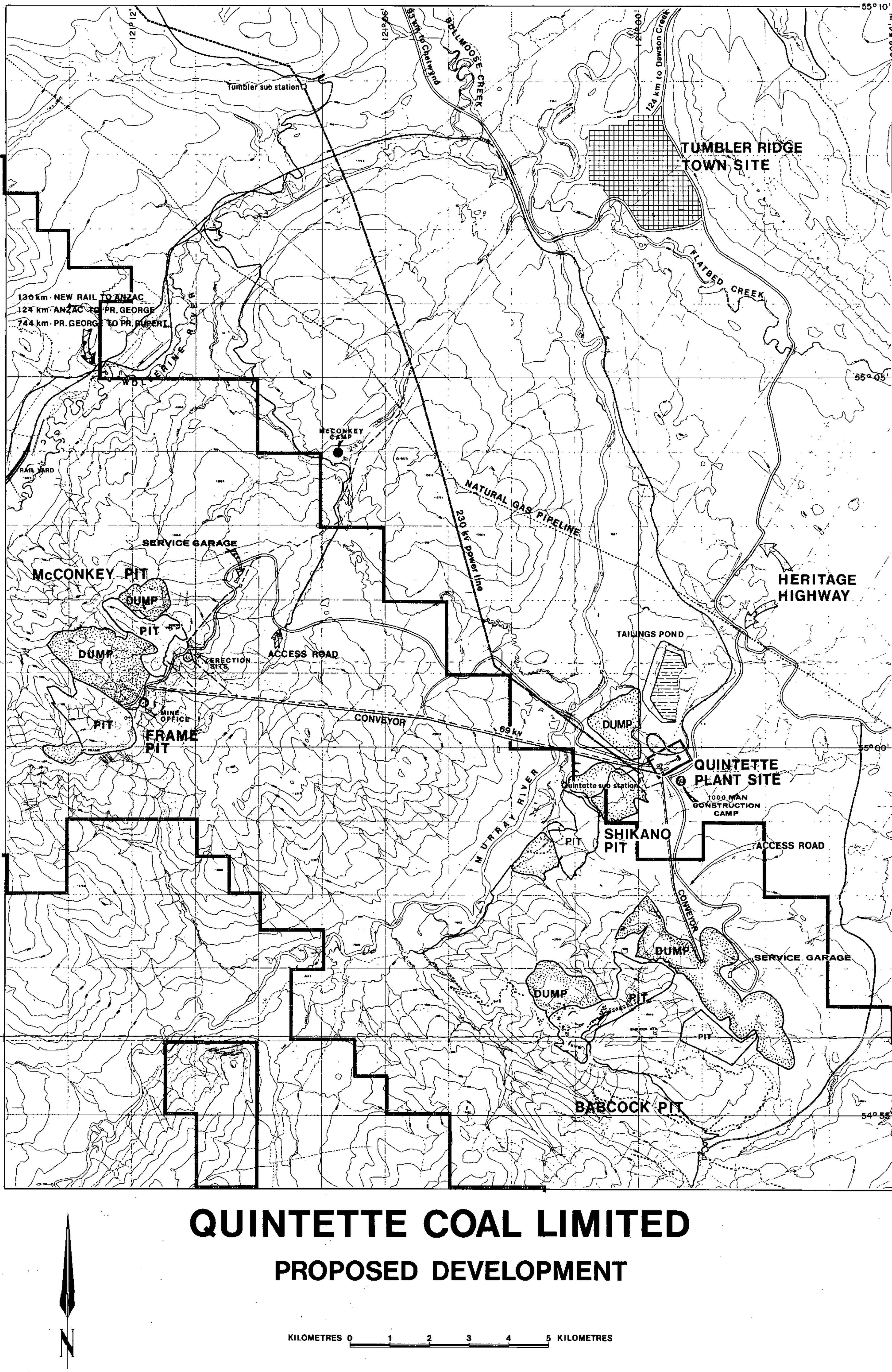

TRANSPORTATION ROUTES
LEGEND
Major rail
Major roads
Distances shown in kilometres between points
0 50 100 150 200 Kilometres
0 50 100 150 Miles
Pacific Ocean
U.S.A.
B.C.
ALTA.
Prince Rupert
Terrace
Prince George
Anzac
Chetwynd
Dawson Creek
Tumbler Ridge
QUINTETTE
MONKMAN
BELCOURT
SAXON
Grande Prairie
Valleyview
WHITECOURT
Whitecourt
Grande Cache
WILLMORE PROV. PARK
ROCK LAKE
WILDHAY
Hinton
COALSPUR
SEABOLT
Edson
EDMONTON
JASPER
NATIONAL
PARK
Jasper
Red Pass
TWEEDSMUIR
PROV.
PARK
BOWRON
LAKE
WELLS GRAY
PROV. PARK
BANFF
NATIONAL
PARK
YOHO
KOOTENAY
GLACIER
Golden
CALGARY
REVELSTOKE
Revelstoke
Kamloops
GARIBALDI
STRATHCONA
VANCOUVER
Roberts Bank
VICTORIA
Hope
MANNING
Penticton
Trail
Cranbrook
Fort Steele
Sparwood
130°
128°
126°
124°
122°
120°
118°
116°
114°
55°
53°
51°
49°

FIGURE 1.1.1.



QUINTETTE COAL LIMITED

PROPOSED DEVELOPMENT

QCL 1-3 January 31, 1983

FIGURE 1.1.3

1.2 PROPERTY DESCRIPTION

The Quintette property consists of 172 coal licences covering an area of 41,856 paying hectares and Coal Lease #6 consisting of 11,693 paying hectares. The location of the coal licences are illustrated on the following page (Figure 1.2.1), and legal descriptions of the licences are provided in Appendix 1.1.

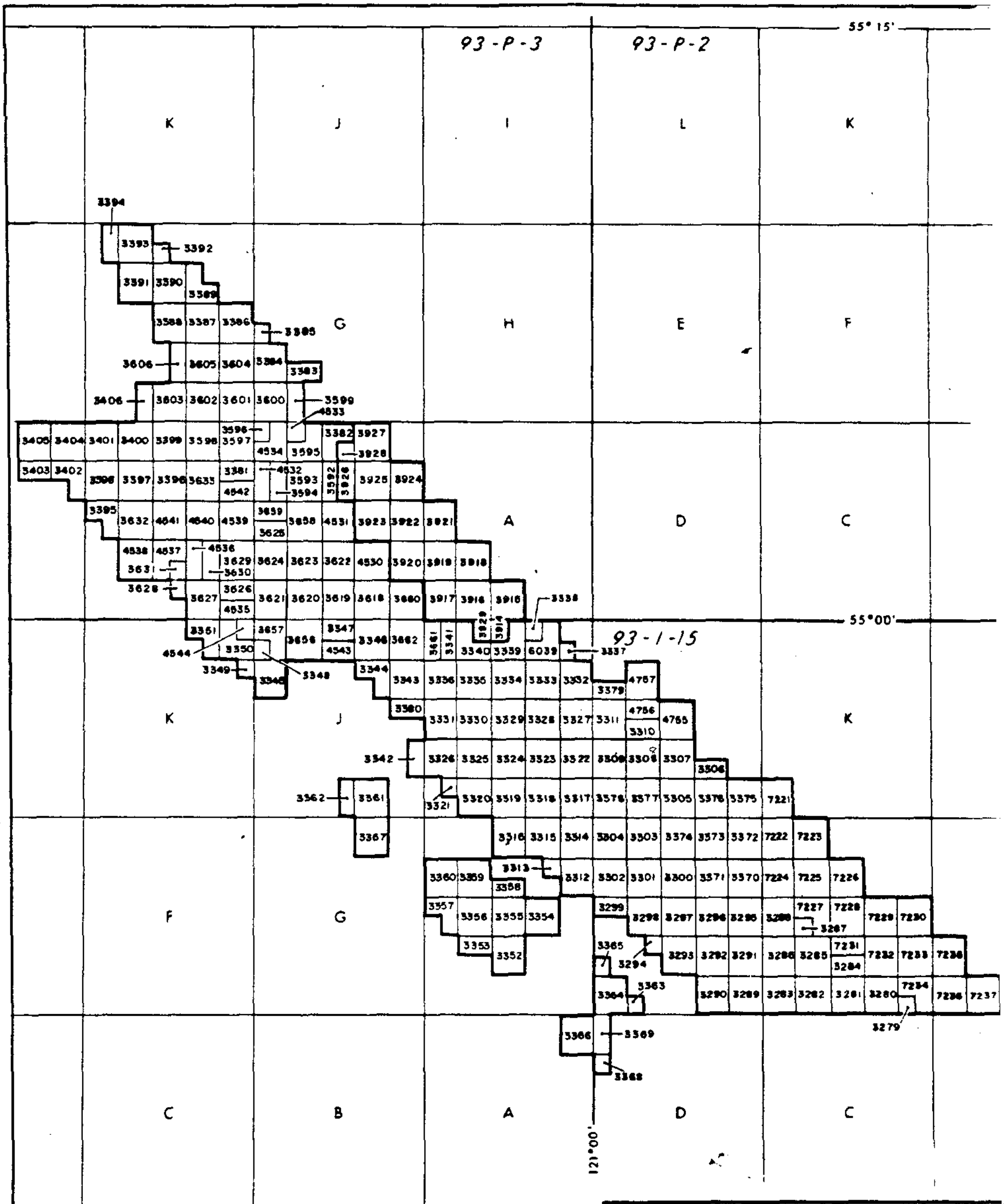
The original Quintette coal licences were acquired by Denison Mines Limited in 1969 and 1970. The first coal exploration on the property was undertaken by Denison in 1971. A significant exploration program was completed each of the following years to 1977. Smaller programs were conducted in 1979 and 1980. In 1981, large scale exploration was again undertaken. Additional licences (7221-7237) were acquired in 1981. In 1982, Dupont Canada Exploration licences (3914-3929) were acquired.

For the purpose of developing the coal licences, Quintette Coal Limited was incorporated under the laws of British Columbia December 20, 1971.

Denison Mines Limited was appointed by Quintette Coal Limited to manage the Quintette project through the feasibility and construction development stages of the project and to assume the ongoing management of the operations during the initial years of operation.

Extensive sampling and testing programs have confirmed that the Quintette coal is a good quality medium volatile coking coal. It is a strong coking coal in its own right, and is capable of replacing most of the world's best medium and low volatile coking coals in blends.

Potential mineable reserves on the Quintette property are estimated at 2.8 billion tonnes of coal in place, to a maximum depth below surface of 500 m.



DENISON MINES LIMITED
(COAL DIVISION)
VANCOUVER BRITISH COLUMBIA

QUINTETTE COAL PROJECT

COAL LICENSES
FIG. 1.2.1

PREPARED BY:	DATE:	DRAWING NUMBER
APPROVED BY:	DATE:	QNTT 75-0363-R07

2.0 1982 EXPLORATION/DEVELOPMENT PROGRAM

The 1982 program concerned three main areas: McConkey, Frame and Shikano. These areas were investigated by geological mapping, diamond drilling, rotary drilling and aditing. Qualitative investigations also were carried out for the three mentioned areas. All investigations except some of the quality analysis were conducted by Quintette Coal Limited's on site staff and the required contractors. The work period began January 20, 1982 and was completed on October 17, 1982.

With all areas considered, 92 rotary holes and 18 diamond drill holes were drilled for both geological and engineering purposes. The respective areas had the following holes drilled: McConkey, 62 rotary; Frame, 9 rotary; Shikano, 15 rotary, 18 diamond drill; Hermann, 6 rotary holes.

Four adits were driven in the Shikano Mine for seam bulk sampling. The Frame Mine had three new adits driven and also two of the 1981 adits were resampled. Both thermal and metallurgical coal samples were taken.

Geological mapping was conducted in Shikano, Hermann and McConkey areas. Some of this work was helicopter assisted. The areas of work are highlighted on the 1:50,000 scale geologic map, Appendix 1.2.

2.1 GEOLOGIC MAPPING

Geologic mapping was conducted in the field on map cards prepared from 1:5000 scale maps. Mapping started from a known point recognizable on an air photograph and the map card. The traverse then proceeded by chain and compass or by following a distinguishable topographic feature such as a stream. This allowed the geologist to maintain his location on the map card within the accuracy of the map. Locations of outcrops were shown on the cards by lithologic symbols; other geologic features were noted by symbol. This information was plotted in the office on full size 1:5000 scale maps. The information was plotted on the original mylars in the main office. Copies of the maps where new geologic information was collected are in Appendix I.

Mapping in 1982 concentrated on two main areas: Hermann (Johnson) and McConkey (Sheriff). Mapping was conducted in the Hermann area to delineate potential thermal coal reserves between McConkey and Shikano Mines. This area comprised most of the summer's work. Mapping scale was 1:5000. The mapping also insured that coal would not be sterilized by the planned infrastructure for the mine.

Geologic mapping in the McConkey area concentrated on the following:

a) to define the outcrop trace of the lowest seam (J seam) in the valley where the Deputy Syncline extends;
b) to investigate both the Gething Formation anticline which exists between Deputy and Frame;
c) to investigate Gates Member extension towards the Wolverine River.

In the area between McConkey and the Wolverine River mapping was used to interpret potential thermal and metallurgical coal reserves and to plan future exploration. Mapping scale was 1:5000.

Some minor mapping was done in Shikano Mine for adit location.

2.2 DIAMOND DRILLING

Diamond drilling (core holes) was contracted to Longyear Canada Incorporated, New Westminster, B.C., (QBD 8201 to 08) and to Northern Wireline Coring and Grouting, (QBD 8209 to 18) Winterburn, Alberta.

Drilling equipment used for drill holes QBD 8201 through 8208 was the Longyear 44 drill rig with associated auxiliary equipment. For drill holes QBD 8209 through 8218, a Cyclone TH-60 truck mounted rotary rig was used to core coal sections only, using rented wireline drill equipment. In all cases, HQ core was recovered. All core recovered (except sampled coal sections) is stored in permanent core storage facilities at the old Babcock Camp site, on the Quintette property. Detail descriptive core logs are presented in Appendix 1.3.2. Geophysical logs of each hole are presented in Appendix II.

Diamond drill core analysis was conducted by General Testing Laboratories and results are presented in Appendix III.

A summary of hole locations and depths is presented in Table 2.2.1.

TABLE 2.2.1

DIAMOND DRILLING SUMMARY

SHIKANO MINE

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (m) DRILLED
QBD 8201	6,092,358N	626,874E	249
QBD 8202	6,091,876N	626,554E	158
QBD 8203	6,092,434N	625,996E	72
QBD 8204	6,092,011N	627,462E	134
QBD 8205	6,093,636N	626,548E	298
QBD 8206	6,093,021N	626,483E	97
QBD 8207	6,094,023N	626,833E	206
QBD 8208	6,094,898N	626,531E	164
QBD 8209	6,093,577N	626,065E	45
QBD 8210	6,093,713N	626,266E	47
QBD 8211	6,093,917N	625,891E	33
QBD 8212	6,094,200N	625,935E	57
QBD 8213	6,094,044N	626,454E	99
QBD 8214	6,093,670N	626,141E	54
QBD 8215	6,094,514N	626,622E	77
QBD 8216	6,094,542N	626,707E	27
QBD 8217	6,093,916N	625,889E	32
QBD 8218	6,093,915N	625,887E	31
		TOTAL	1,880

2.3 ROTARY DRILLING SUMMARY

Rotary drilling was contracted to Northern Wireline Coring and Grouting, Ltd. Winterburn, Alberta. The eight hole program in Shikano Mine was contracted to SDS Drilling, Vancouver, B.C.

Drilling equipment used by Northern Wireline was a Model TH-60 Cyclone Drill equipped with Drill Systems dual-wall reverse circulation drill stem and using a down the hole hammer bit. SDS Drilling used a Drill Systems CSR 1000 AV drill rig, also equipped with reverse circulation equipment.

A total of 92 rotary holes were completed for a total of 8,703 metres. Tables 2.3.1. through 2.3.6. summarize the drilling by area, location and depth drilled.

The reverse circulation equipment allows for continuous uncontaminated sampling over any interval in the hole. The drill program took continuous samples at one metre intervals. Analysis of the coal cuttings from each hole is ongoing, at the Mine site laboratory. Results to date are presented in Appendix III, Section 1, and include raw and clean ash, moisture, FSI. Some samples for drill holes QMR 8101 to 8103 were analysed by General Testing Laboratories for comparison purposes. These results are also included in Appendix III.

TABLE 2.3.1

ROTARY DRILLING SUMMARY

McCONKEY MINE

DEPUTY

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M) DRILLED
QMR 8201	6098108.5	615698.2	150
QMR 8202	6098125.7	615742.4	150
QMR 8203	6098159.6	615674.1	108
QMR 8204	6098240.8	615634.3	100
QMR 8205	6098174.7	615587.7	150
QMR 8206	6098009.1	615612.5	150
QMR 8207	6098006.4	615678.7	120
QMR 8208	6098433.9	615614.8	46
QMR 8209	6098347.9	615588.2	60
QMR 8210	6098255.4	615531.6	100
QMR 8211	6098122.9	615477.4	110
QMR 8212	6098361.6	615530.3	40
QMR 8213	6098277.8	615477.8	80
QMR 8214	6098198.6	615420.6	50
QMR 8216	6098341.8	615704.1	60
QMR 8217	6098418.8	615710.9	98
QMR 8218	6098498.3	615646.9	60
QMR 8219	6098352.5	615793.8	67
QMR 8220	6098431.3	615809.6	70
QMR 8221	6098507.8	615789.4	50
QMR 8228	6097887.4	615606.2	55
QMR 8229	6097882.8	615650.1	55
QMR 8230	6097932.0	615702.0	178
QMR 8231	6098082.9	615860.5	70
QMR 8232	6098259.5	615872.5	70
QMR 8233	6098170.1	615870.3	70
QMR 8234	6097928.8	615547.7	86
QMR 8235	6097987.0	615507.3	82
QMR 8236	6098045.5	615483.2	54
QMR 8237	6098073.5	615564.8	120
QMR 8261	6097944.0	615620.3	160
31		TOTAL	2,819

TABLE 2.3.2.

ROTARY DRILLING SUMMARY

McCONKEY MINE

MARMOT

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M) DRILLED
QMR 8222	6098732.1	616059.2	70
QMR 8223	6098602.9	615856.9	70
QMR 8224	6098650.9	615916.1	55
QMR 8225	6098710.5	615716.0	97
QMR 8227	6098844.1	615846.9	225
QMR 8240	6098695.6	615998.0	70
QMR 8241	6098917.3	616315.9	120
QMR 8244	6099073.3	616057.5	140
QMR 8248	6098805.5	615583.0	95
QMR 8251	6098932.1	615721.1	121
QMR 8253	6099105.1	615782.3	232
QMR 8256	6099244.7	615840.7	180
12		TOTAL	1,475

TABLE 2.3.3.

ROTARY DRILLING SUMMARY

McCONKEY MINE

MESA

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M) DRILLED
QMR 8215	6099394.4	614525.9	50
QMR 8226	6099386.6	614600.9	80
QMR 8238	6099249.7	614862.0	55
QMR 8239	6099276.8	614618.6	55 Not Logged
QMR 8242	6099305.0	614749.1	83
QMR 8243	6099355.7	614668.5	70
QMR 8245	6099169.2	614962.8	50
QMR 8246	6099067.0	615059.6	50
QMR 8247	6099013.0	615131.0	50
QMR 8249	6098978.0	615186.0	60
QMR 8264	6099079.4	614812.1	65
QMR 8265	6098978.7	615017.4	48
QMR 8266	6099528.0	614358.1	100
QMR 8268	6099154.8	614738.7	66
QMR 8269	6099008.3	614970.8	50
QMR 8270	6099051.1	614856.4	50
QMR 8271	6099111.4	614764.5	50
QMR 8272	6099191.5	614647.3	38
QMR 8273	6099198.0	614538.1	40
19		TOTAL	1,110

TABLE 2.3.4.

ROTARY DRILLING SUMMARY

FRAME AREA

EAST LIMB

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M)
QMR 8250	6096795.6	6149004.4	232
QMR 8252	6096948.9	614691.6	225
QMR 8254	6097077.1	614574.4	200
QMR 8255	6097175.1	614398.0	190
QMR 8257	6097339.3	614195.1	159
QMR 8258	6097488.1	614012.3	128
QMR 8259	6096849.4	614598.1	235
QMR 8260	6096386.6	614818.2	155
QMR 8262	6097268.4	615339.1	189
9		TOTAL	1,713

TABLE 2.3.5

ROTARY DRILLING SUMMARY

SHIKANO MINE

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M)
QBR 8201	6093873.3	625827.7	50
QBR 8202	6093994.2	625972.8	80
QBR 8203	6094046.7	626030.8	104
QBR 8204	6094097.9	626092.1	103
QBR 8205	6094375.9	625990.7	51
QBR 8206	6094306.2	626447.6	51
QBR 8207	6094516.3	626621.6	92
QBR 8208	6094540.9	626715.6	92
QBR 8209	6093577.1	626061.5	58
QBR 8210	6093713.6	626260.5	69
QBR 8211	6093690.4	626195.4	90
QBR 8212	6094194.9	625930.5	105
QBR 8213	6094297.3	625845.5	48
QBR 8214	6094090.1	626428.2	90
QBR 8215	6094043.8	626451.4	113
15		TOTAL	1,196

TABLE 2.3.6

ROTARY DRILLING SUMMARY

HERMANN AREA

DRILL HOLE	NORTHING	EASTING	TOTAL DEPTH (M)
QJR 8201	6095165.2	618195.0	70
QJR 8202	6094912.4	618062.9	70
QJR 8203	6095442.0	617955.5	70
QJR 8204	6095310.9	617890.1	49
QJR 8205	6096634.9	618431.9	70
QJR 8206	6096804.1	618532.2	61
6		TOTAL	390

GRAND TOTAL **8,703 metres**

2.4 ADITS

Adit construction was contracted to Target Tunnelling Limited, Strathmore, Alberta.

To drive the adits, Target Tunnelling used a technique of blasting and mucking with assistance of an underground miner, front end loader and dump truck for coal removal from the hillside.

Seven adits were driven in Shikano and Frame Mines. One adit was abandoned due to oxidized coal (QBA 8201). The remaining adits were successfully sampled for bulk metallurgical coal and thermal coal. Two adits in Frame were resampled (QMA 8102, 8104). Table 2.4.1 summarizes the area, location, depth, seam, sample type and sample depth in each adit. Details of each adit can be seen on their respective adit drawings in Appendix I.

Bulk metallurgical samples were taken in seams E and G and were approximately 10 tonnes each. Each bulk metallurgical sample was washed in a pilot plant and carbonized. This is discussed in Section 4.0, Quality. The thermal samples were blended from each mine and then washed.

Wash tests, carbonization tests and coal analysis results are all presented in Appendix III.

TABLE 2.4.1

ADIT SUMMARY

ADIT	SEAM	TOTAL DEPTH	LOCATION U.T.M.		ELEVATION	DEPTH OF MET. SAMPLE	DEPTH OF OXIDIZED SAMPLE
SHIKANO							
QBA 8201	J	30.5	6,094,168.8N	626,552.1E	920.8	28.5	7.0
QBA 8202	F	49.0	6,094,082.3N	626,449.6E	882.4	47.3	11.1
QBA 8203	E/D	56.9	6,094,031.9N	626,562.6E	898.0	53.9	11.6
QBA 8204	J	78.3	6,094,521.8N	626,478.7E	866.1	76.1	26.9
FRAME							
QMA 8201	D	77.8	6,096,026.6N	614,533.4E	1,770.4	73.8	50.0
QMA 8202	F	52.2	6,095,974.5N	614,461.5E	1,769.6	49.7	13.4
QMA 8203	J	48.4	6,095,847.7N	614,280.5E	1,777.1	46.5	17.3
QMA 8102*	E	111.5	6,096,290 N	613,940 E	1,763.	109.	92.7
QMA 8104*	G	55.	6,095,915.10N	614,309.95E	1,792.97	53.	16.

*Adits Driven 1981
Resampled 1982

2.5 GEOPHYSICAL LOGGING

Geophysical logging of rotary holes drilled during the summer (May - September, 1982) was conducted by Quintette personnel using a rented logging unit from SIE/Geosource, Calgary, Alberta. The unit has since been purchased by Quintette Coal Ltd. Two tools were used producing three logs; the T-31 Gamma tool and the T-59 Density/Caliper tool.

The Density/Caliper logs are displayed together. All three logs for each hole (when available) are presented with a title block in Appendix II.

Directional surveys of the rotary holes were conducted using a rented pjari instrument rented from Longyear Canada, New Westminister, B.C. This study indicated that deviations with the dual wall pipe (reverse circulation) was not significant and that holes can be considered vertical.

The holes from the winter diamond drilling and rotary drilling programs were geophysically logged by Roke Oil Enterprises, Calgary, Alberta. The suite of logs usually produced were gamma, density, neutron-neutron and caliper. Directioanl surveys were also conducted when required (angle holes). These geophysical logs are also presented in Appendix II.

2.6 ROAD CONSTRUCTION

Trails to adit sites and rotary drill sites were primarily existing trails from previous exploration activities. Two D-7's were contracted from Lee's Ventures Ltd., Fort St. John, B.C. They were used to reopen trails, for snow removal, to construct new trails, to clear drill and adit sites, and to assist moving the drill rig from site to site. One D-7 was used extensively for reclamation.

2.7 GEOTECHNICAL INVESTIGATIONS

Geotechnical work consisted of hydrological studies in Shikano, Frame and McConkey Mine areas. New piezometers were installed in the Shikano area and all pre-existing piezometers were monitored.

Golder Associates and Piteau Associates performed rock stability studies in the crusher loadout area, near the McConkey Mine entrance.

2.8 FIELD CAMP

The Babcock Camp located on the southwest corner of Babcock Mountain was dismantled and moved to various locations near McConkey Mine Site to serve as office trailers.

All geological operations were based mainly from the 30 man camp located near McConkey Mine. Some temporary operations were based at the 126 man camp (now dismantled) located at the Plantsite (winter diamond drilling, rotary drilling and summer adit driveage). Geology staff stayed mainly at the 30 man camp but during the year staff also stayed at the 126 (Plantsite), 350 and 102 man camps (McConkey).

Catering was provided by West Camp Construction caterers and Northmount Catering.

2.9 PROJECT MANAGEMENT AND PRIMARY CONTRACTORS

The following permanent Quintette Coal Ltd. staff assisted in the 1982 exploration Program:

D. Johnson	Chief Geologist - Quintette Coal Ltd.
R. Ogilvie	Senior Geologist
D. Lortie	Geologist
K. Tymofichuk	Geologist
G. Homlund	Technician
R. Bray	Technician

CONTRACTORS:

Target Tunnelling Ltd.	Adits
Northern Wireline Coring and Grouting Ltd.	Rotary Drilling
Longyear Canada	Diamond Drilling
S.D.S. Ltd.	Rotary Drilling
Roke Enterprises Ltd.	Geophysical Logging
Birtley Coal and Minerals Testing	Pilot Scale Washing
General Testing Laboratories	Coal Analysis
Knutson Ambulance	First Aid
Westcamp Caterers	Catering
Lee's Ventures Ltd.	Road Construction/Adit, drill site preparation
Piteau and Associates	Geotechnical
Golder Associates	Geotechnical/Geological
Rotortech	Helicopter
Northmount Catering	Catering
Canmet, Western Research Labs.	Carbonization/petrography

Denison Mines, Coal Division, staff provided assistance, particulary in the area of analysis and quality interpretation:

Raju Sagi — Chief Geologist, Coal Division

Ross Leeder

Camille Dionne

I. Kakizaki and H. Wada, Mitsui Mining Company, assisted in the geologic interpretations of Shikano and McConkey Pits.

3.0 GEOLOGY

3.1 REGIONAL GEOLOGY

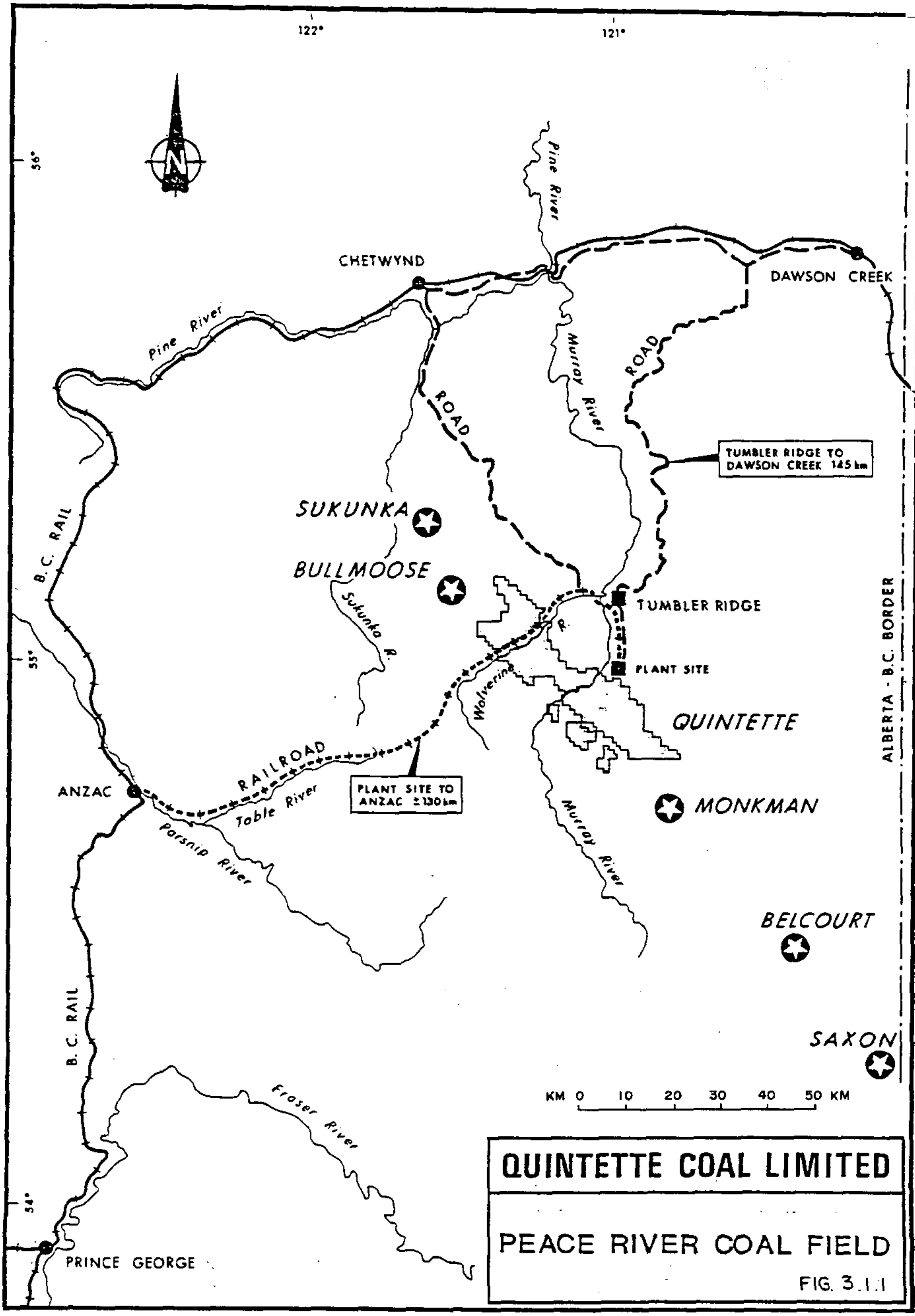
The Quintette Coal property lies within the Peace River Coal Field of northeastern British Columbia. The field extends along the inner foothills of the Rocky Mountains from the Prophet River in the north to the Alberta Boundary in the south. Other major coal properties in the field include Sukunka, Bullmoose, Monkman, Belcourt, and Saxon (Figure 3.1.1).

The coal field is characterized by structural disturbances that resulted from its proximity to the Rocky Mountain structural zone. Major thrusting is common, as is a varying degree of folding. All major features follow a general northwest-southeast trend, reflecting the Rocky Mountain fold structure.

The Commotion and Gething Formations are the economically important stratigraphic units in the coal field. Regionally, coal development is most continuous in the Gates Member of the Commotion Formation, particularly in those areas where mineable reserves have been defined.

In the Quintette property, the folding and faulting has divided the coal-bearing sequence into blocks of varying degrees of mineable potential. The deposits of current economic potential all fall within the Gates Member and occur as isolated deposits on the tops of mountains.

The geology of the Quintette property is known in detail from photogeological interpretation, extensive field mapping, trenching and drilling. The deposits of current economic interest have been mapped in detail with the major concentration of drilling in those areas.



QUINTETTE COAL LIMITED

PEACE RIVER COAL FIELD

FIG. 3.1.1

To the end of 1982, in excess of 290 holes (both rotary and core), totalling approximately 43 000 m, have been drilled on the Quintette coal licences for geological and reserve evaluation purposes.

3.1.1 **Regional Stratigraphy**

The stratigraphic succession (Figure 3.1.1.1) exposed on the Quintette property ranges from Upper Jurassic to Lower Cretaceous in age, and consists of interbedded shales and sands of both marine and continental origin, with most of the coal-bearing strata being from a deltaic environment. The groups of sediments found on the property are from the Minnes Group, the Bullhead Group and the Fort St. John Group from oldest to youngest.

3.1.1.1 **Minnes Group**

The Minnes Group is Upper Jurassic/Lower Cretaceous in age. The part of the group mapped consists of cyclic beds of argillaceous fine grained sand, siltstone, carbonaceous shale, and coal. The coal is poorly developed (usually less than 150 mm in thickness) and discontinuous. Below 1525 m elevation*, the group generally occurs under low angle slopes which are tree and brush covered; above 1525 m, it generally forms grey-brown pebbly talus. The change from the Minnes to the Bullhead Group is abrupt, with gradation from fine sand to coarse sand to the sharp contrast of cobble conglomerate usually taking place within 6 m. Only the upper portion of the Minnes Group is present at Quintette; however, it is reported to reach 2100 m in thickness (Stott, 1981).

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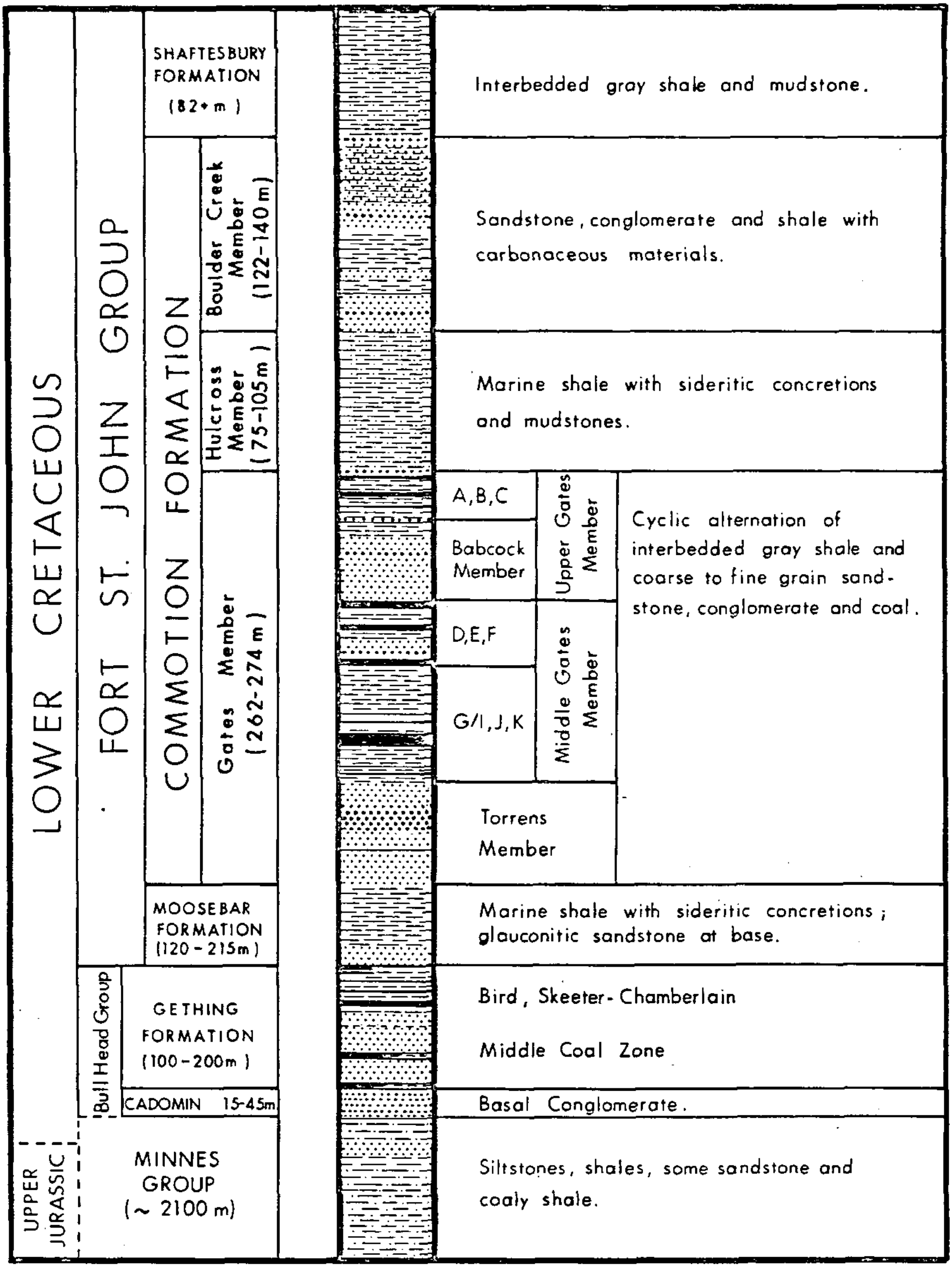
* All elevations given in the report are above sea level (ASL).



QUINTETTE COAL LIMITED

GENERAL STRATIGRAPHIC SECTION

FIG. 3.1.1.1

3.1.1.2 **Cadomin Formation**

The Cadomin Formation, the lowest member of the Bullhead Group, consists of well-rounded cobbles and boulders of black, white and green chert, white and grey quartzite and quartz with minor flattened and rounded pebbles of the same material, all of which are bound by siliceous cement. This formation was deposited over an extensive area, ranging in thickness from 15 to 45 m.

The upper contact is defined at the first stratigraphic break in the massive conglomerate. Due to its resistant nature, the formation is usually well exposed. It weathers to a rusty gravel and forms one of the better stratigraphic markers on the property.

3.1.1.3 **Gething Formation**

The Gething Formation also in the Bullhead Group, consists of alternating units of fine to coarse grained sandstone, carbonaceous shale, coal, sandy shale and conglomerate. The sandstones are thickly bedded to massive, with conglomeratic beds increasing toward the base of the formation. The Gething is poorly exposed on the property, with basal conglomerates forming the only distinctive marker. It varies in thickness from 120 to 200 m.

The upper contact of the Gething is defined by a thin bed of pebble conglomerate followed by a bed of glauconitic sandstone, which signifies the start of marine sediments of the overlying Moosebar Formation. This glauconitic sandstone is probably equivalent to the Bluesky Formation on the Plains area to the east.

In the Gething Formation, three or four coal zones have been distinguished in some localities, although they are not always all present or particularly well developed.

The uppermost Gething coal zone contains the Bird, Skeeter, and Chamberlain Seams, or their equivalents. In some places, the Bird Seam itself becomes a distinct zone and then the main zone must be subdivided into a Bird Zone and a Skeeter-Chamberlain Zone. The Skeeter-Chamberlain Zone seldom exceeds 4 m in thickness. In total, the Bird Seam or Zone may be up to 6 or 7 m thick, although this has only been observed at Roman Mountain along the Quintette trend in the Babcock area.

The middle coal zone of the Gething Formation may not be very persistent. It is now best known in the Hermann (Johnson) Area where the zone is 6 to 7 m thick. In the Wolverine River Area, it is composed of one 2.5 m seam and a 1 m seam or split.

3.1.1.4 **Moosebar Formation**

The basal sequence of the Moosebar Formation, the oldest member of the Fort St. John Group, consists of homogeneous dark grey to black shale, with thin beds of sideritic concretions up to 0.3 m in thickness and thin beds of bentonite and siltstone. The upper part of the formation consists of banded or fissile sandy shale, very fine sandstone and sandstone with intercalating shales. This latter sequence forms the transition from marine sediments to massive continental sands at the base of the overlying Gates Member of the Commotion Formation. The variable nature of the transition sequence accounts for the overall variation in the formation which ranges in thickness from 120 to 215 m.

Exposure of Moosebar sediments is normally restricted to areas of high relief where creek channels or gulleys often cut along the strike of the beds.

3.1.1.5 **Commotion Formation**

The Commotion Formation consists of the Gates, Hullcross, and Boulder Creek Members from oldest to youngest.

Gates Member: The Gates Member ranges in thickness from 262 to 274 m, and lies conformably over the Moosebar Formation. It contains approximately 74 % of the regional coal reserves explored to date on the Quintette property. The coal seams have been designated A, B, C, D, E, F, G/I, and K from youngest to oldest.

The lower portion of the formation consists of massive, light-grey, medium-grained sandstones, with minor carbonaceous and conglomeratic horizons, and is tentatively referred to as the Torrens Member. The Middle Gates Member lies above the Torrens Member and contains three, or perhaps four, cyclic sequences of coal deposition within about 90 m of the stratigraphic section, which is terminated by the deposition of the Babcock Member which forms part of the Upper Gates Member.

The cycles of coal deposition in the Middle Gates Member normally begin with laminated medium to fine-grained sandstone and grade to carbonaceous shale and coal. Lenses of conglomerate may also be found in this section which weathers to a light medium orange rubble when exposed above the treeline.

In general, the upper two or three seams reach a maximum thickness of about 3 m (locally 5 m), whereas the lower cycle usually shows the greatest continuity and seam thickness (up to 11 m for seam J). In both the uppermost cycles and the lower cycle, seams may coalesce to form an aggregate thickness up to 12 m, as they do where E and F combine at McConkey (Sheriff), and G/I and J combine in the Roman Mountain area. Excellent correlation of coal seams has been possible over distances up to 13 km in the Babcock area, and additional exploration has provided similarly reliable correlation in the McConkey and Frame areas. It is felt such correlation for the entire property will be possible after more areas have been explored in detail, although at present some regional correlations must be considered tentative.

The Babcock Member, as noted previously, overlies the economic coal zone of the Middle Gates. This unit consists of three distinct units, a discontinuous channel conglomerate, a continuous lag conglomerate and a continuous marine sandstone. The unit is resistant and forms a useful marker for the top of the Middle Gates.

The portion of the Upper Gates Member which overlies the Babcock Member contains a predominantly shale sequence with intercalating sandy shale or very fine sandstone and poorly developed coal. Two or three coal cycles (containing seams A, B, and C) have been recognized in this sequence; however, they have not yet been found to contain sufficient thickness, quality and continuity to be given economic consideration. A very thin bed of chert pebbles with ferruginous cement marks the contact of the overlying marine sediments of the Hulcross Member.

Hulcross Member: The Hulcross Member consists of 75 to 105 m of rubbly or blocky, medium to dark grey shale with thin interbeds of siltstone and very fine sandstone. Sandstone and siltstone interbeds are more prevalent near the top of the formation where a few kaolinite beds have also been observed. The formation is more homogeneous near the base and contains sideritic concretions.

Boulder Creek Member: The Hulcross marine shale grades conformably into shale, sandstones, and conglomerate of the Lower Boulder Creek Member. The middle part of the Member consists of alternating medium-to fine grained sandstone, shale and thin coals, while the upper part consists of massive conglomerates and conglomeratic sandstones. The Upper Boulder Creek lithology closely resembles that of the Babcock Member. A range in thickness of 122 to 140 m has been measured in the Boulder Creek Member.

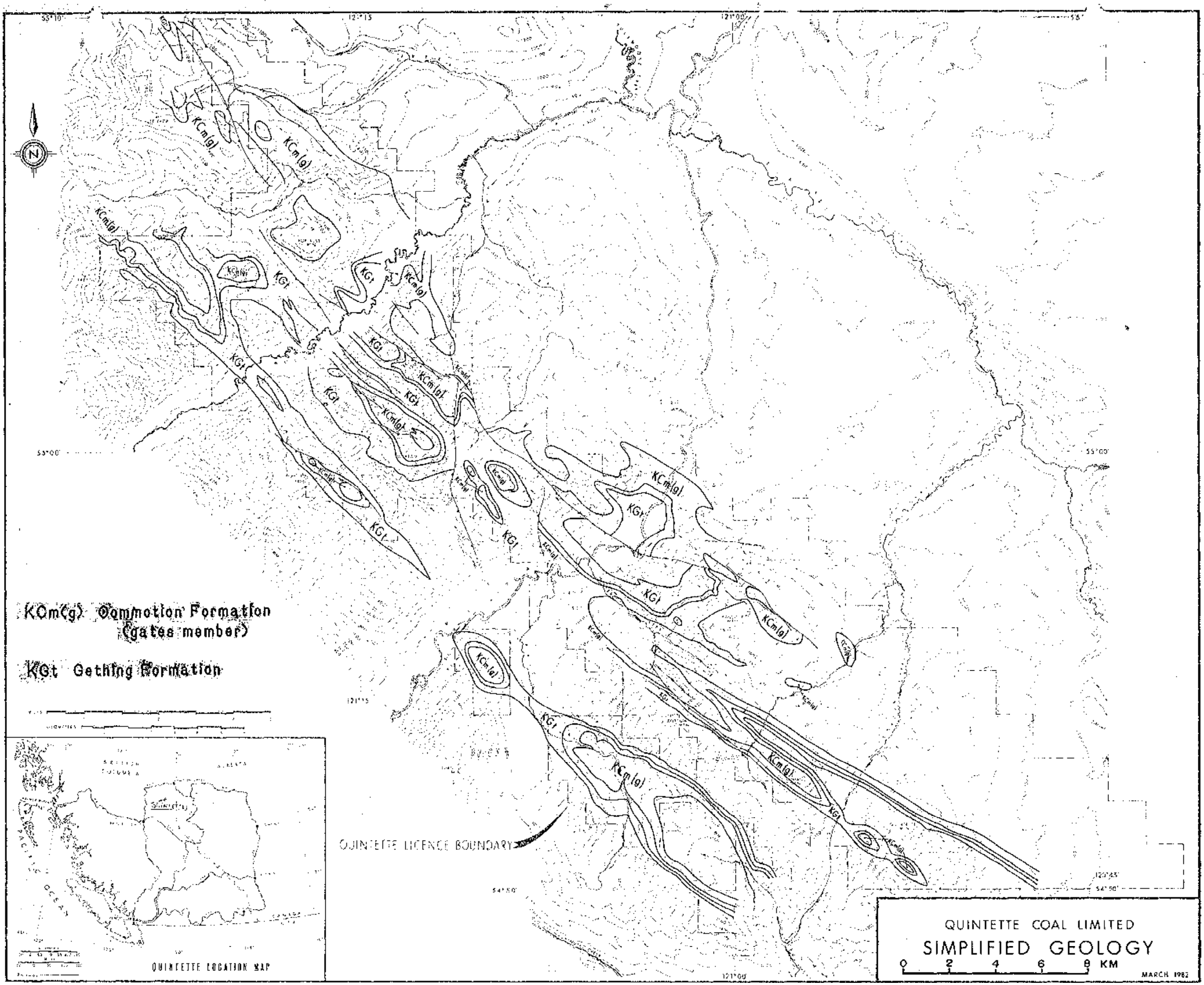
3.1.1.6 **Shaftesbury Formation**

The lower portion of the Shaftesbury Formation, consisting of dark-grey to black marine shale with minor siltstone, overlies the Boulder Creek Member and completes the stratigraphy exposed at Quintette. This formation closely resembles Hulcross shale. Exposures of the Shaftesbury Formation are restricted to the axes of the major synclines at high elevations and to the northeastern border of the licence area.

3.1.2 **Regional Structure**

Primary structural controls in the Peace River Coal Field are the regional thrust faults which have brought the coal-bearing strata to the surface. Within the Quintette property, (see Figure 3.1.2.1) in areas which contain the coal- bearing formations, the main geological structures are broad synclines and sharper anticlines which are separated by low to medium angle thrust faults from the more highly deformed Minnes Group. The faults dip to the southwest and have vertical displacements of up to approximately 100 m. Minor folding on the major fold limbs is uncommon, but minor thrusts frequently parallel or splay from the major faults.

Geological structures and topography define to a large extent, the coal reserve areas within the Quintette property. This is most obvious in some of the potential pit areas where the coal reserves are entirely contained within synclines which form topographic highs. Underground reserves are located in large, structurally continuous blocks on limbs of anticlines and synclines. Faulting is not frequent within these structures, although it does become more frequent as the degree of structural deformation increases. For example, the Roman Mountain reserves, which are located in a tight chevron fold, more often contain small faults than those in the much broader (flat) Babcock Mountain structure, where the few faults that have been observed have displacements in the order of only 5 or 10 m.



KCm(g) Commotion Formation (gates member)
KGt Gething Formation
KCm(g)
KGt
QUINTETTE LICENCE BOUNDARY
QUINTETTE LOCATION MAP
55°10'
121°15'
121°00'
55°00'
54°50'
QUINTETTE COAL LIMITED
SIMPLIFIED GEOLOGY
0 2 4 6 8 KM
MARCH 1982

3.1.3 **Regional Coal Seam Development and Correlation**

Within the Quintette property, three stratigraphic units are particularly valuable for regional correlation. These are the distinctive Cadomin conglomerate, and the Moosebar and Hulcross shales. Although there is some similarity between the Hulcross and Moosebar shales, they can usually be distinguished by their relationships to surrounding strata and the absence of glauconitic sands at the base of the Hulcross. The two main coal-bearing units, the Gates Member and the Gething Formation, are easily distinguished.

A regional correlation of the important formations and coal zones on the Quintette property is presented in Figure 3.1.3.1. Composite sections from each of the major reserve areas demonstrate the regularity of the development of the strata within the property and illustrate that all important coal development within the Gates Member occurs between the persistent and readily defined Babcock and Torrens Members.

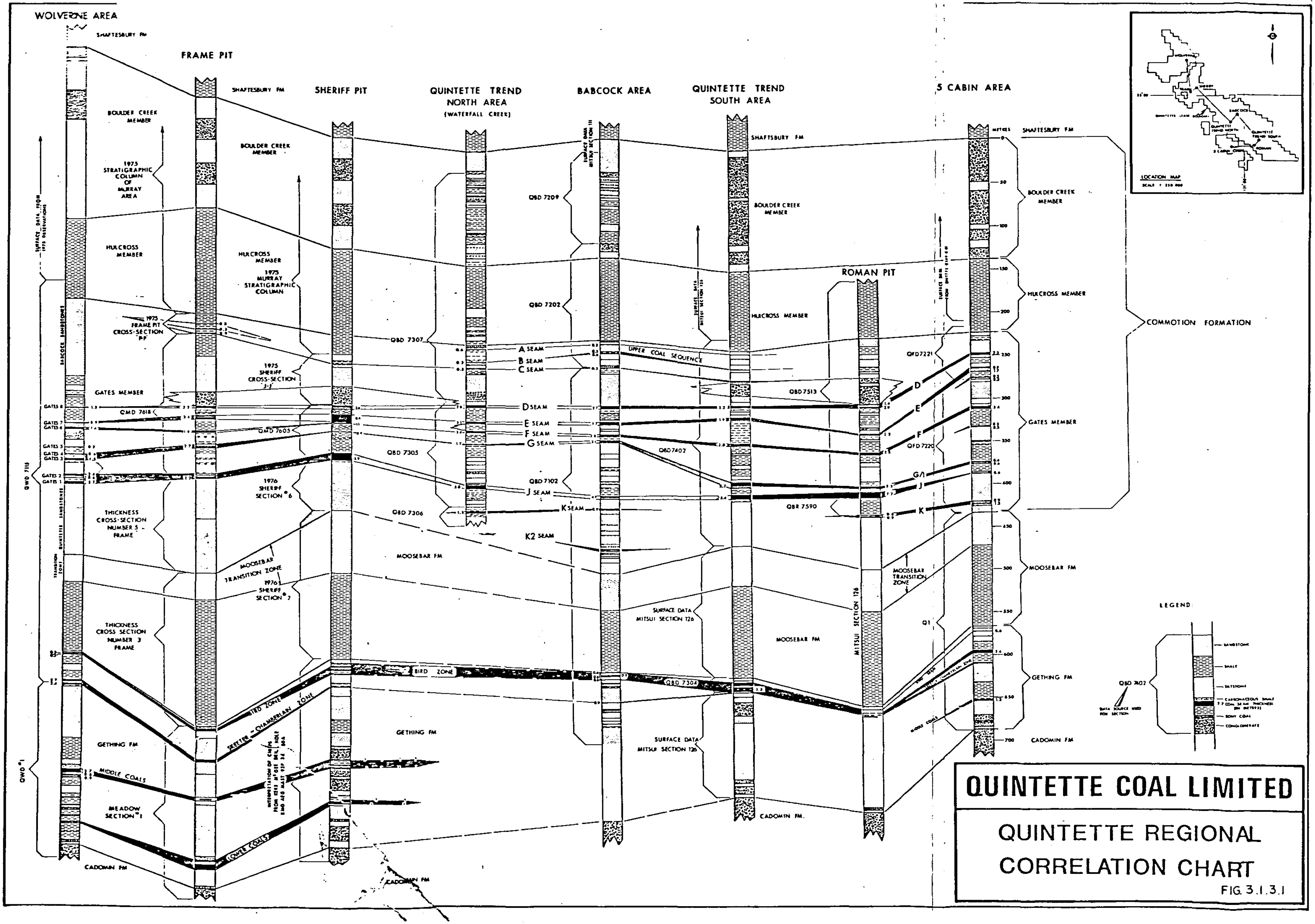
The Babcock Member overlies seam D and this seam has been used as a marker for correlation. Seam J is often located just above the Torrens Member (Quintette sandstone), or occasionally above siltstones and shales that separate it from local development of seam K (for example, in the Babcock and Roman Mountain areas).

Between the D and J coal seams, there is considerable variation in the E and F seam developments which may effectively constitute a separate coal zone. In the McConkey area, these seams appear to coalesce to form a significant coal zone containing approximately 7 m of coal.

Seam G is particularly well developed in the northern regions of the Babcock and Quintette trend deposits, where it attains a thickness ranging from 1.7 to 2.1 m and is developed between 4 and 13 m below seam F. The 1977 drilling program in the northern and central portions of Babcock Mountain indicated a rapid thickening of the F/G interseam sediments such that G seam can be correlated with seam I in the central and southern portions of the deposit. This finding is further illustrated in the discussions of the Babcock deposit stratigraphy, and indicates that seam G may be equivalent to seam I (G/I) throughout the southern portion of the property. It was originally thought that seams F and G had coalesced in this region. The G/I seam is normally developed between 3 and 10 m above the J seam; however, in some locations the seams essentially coalesce to form very significant widths of mineable coal (Roman Mountain, Quintette Trend, McConkey Mine and Perry Creek Anticline). Seam K is apparently a split from seam J as the two seams nearly merge in the Little Windy portion of Babcock (Figure 3.1.3.3).

The major coal zones of the Gething Formation are not as well documented as they are in the Gates Member. However, it is clear that the Bird Zone or Seam is regionally continuous. The relationship of the Skeeter and Chamberlain Seams to this zone is uncertain and they may form a separate zone or be part of the Bird Zone. In the Wolverine and Murray (McConkey and Frame) areas of the property, these seams are well separated by about 30 m of strata, but apparently merge in the southern part of the property (Babcock, Quintette Trend, Roman Mountain). At Five Cabin, just a short distance from Roman Mountain, only a remnant of the Bird Zone is present, but a seam which is very similar in characteristics to the Chamberlain Seam is well developed (3 m thick).

The middle coal zone of the Gething Formation has been documented in only a few places, and to date it is known to attain a potentially economic thickness only in the Wolverine area where one split is about 2.5 m thick and in the Hermann area where the zone contains 6 m of coal. More exploration is required before the full significance of this zone can be determined.



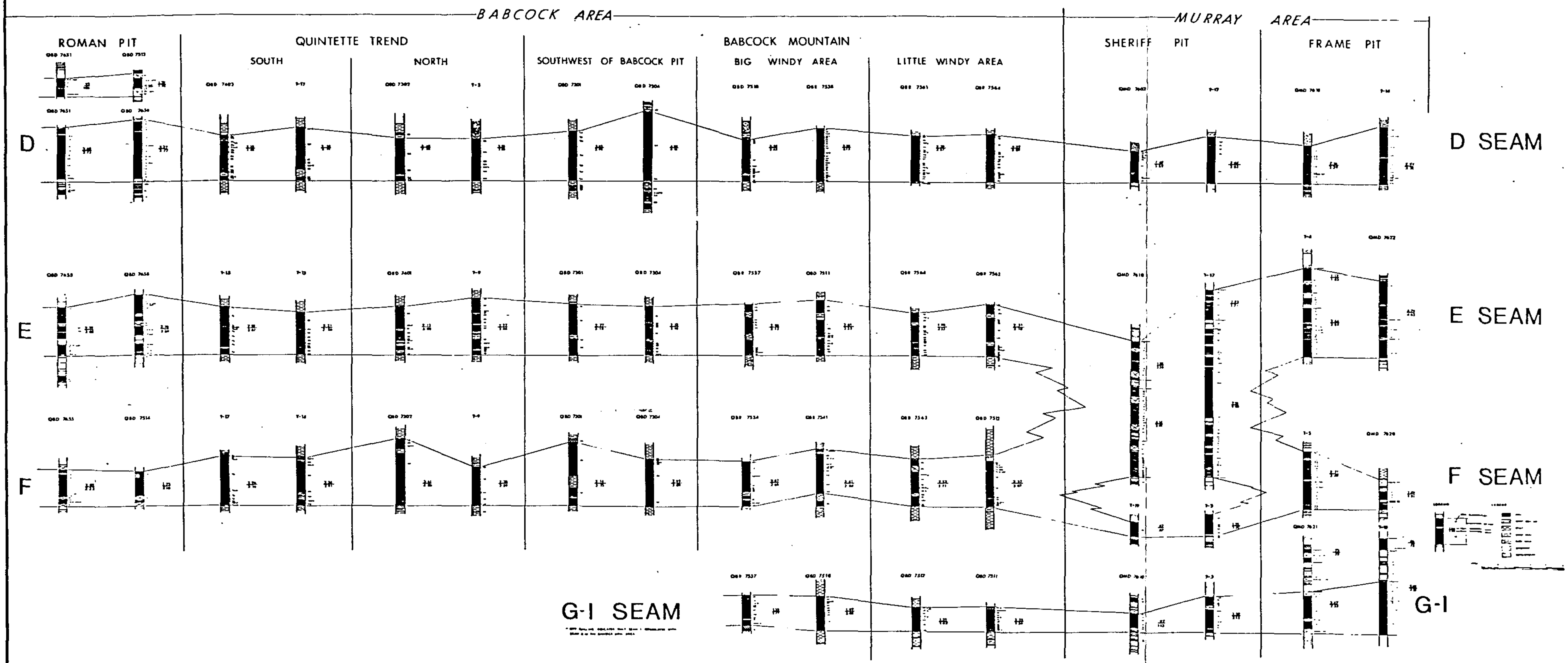
QUINTETTE COAL LIMITED

QUINTETTE REGIONAL CORRELATION CHART

FIG. 3.1.3.1

BABCOCK AREA
MURRAY AREA
ROMAN PIT
QUINTETTE TREND
SOUTH
NORTH
SOUTHWEST OF BABCOCK PIT
BABCOCK MOUNTAIN
BIG WINDY AREA
LITTLE WINDY AREA
SHERIFF PIT
FRAME PIT
D SEAM
E SEAM
F SEAM
G-I SEAM
G-I
* 1977 DRILLING INDICATES THAT SEAM I CORRELATES WITH SEAM G IN THE BABCOCK MTN. AREA
LEGEND:
COAL CLASSIFICATION
MINING SECTION
2.010 COAL THICKNESS - metres
2.160 SEAM THICKNESS - metres
LEGEND:
COAL
BONEY COAL (CD)
SHALE
SANDY SHALE
CARB. SHALE
SANDSTONE
CONGLOMERATE
METRES 1 0 1 2
NO. DESCRIPTION BY DATE
REVISIONS
QUINTETTE COAL LIMITED
PREPARED BY:
DENISON MINES LIMITED
MITSUI MINING CO. LTD.
REPRESENTATIVE SECTIONS
D, E, F & G-I SEAMS
PR-Quintette 82(2)A
DRAWN BY: J.W.K.
DATE: JAN '77
SCALE: 1:50
PREP'D BY:
DATE:
DRAWING NUMBER:
APPR'D BY:
DATE:
QNTT76-0648-R02
616

FIG. 3.1.3.2



QUINTETTE COAL LIMITED

REPRESENTATIVE SECTIONS
D,E,F & G-I SEAMS

FIG. 3.1.3.2


BABCOCK AREA
MURRAY AREA
ROMAN PIT
QUINTETTE TREND
SOUTH
NORTH
QBD 7653
T-12
QBD 7402
QBD 7401
T-5
G-I SEAM
* 1977 DRILLING INDICATES THAT SEAM I CORRELATES WITH SEAM G IN THE BABCOCK MTN. AREA
BABCOCK MOUNTAIN
SOUTHWEST OF BABCOCK PIT
BIG WINDY AREA
LITTLE WINDY AREA
T-7
QBD 7301
QBD 7218
QBD 7507
QBD 7510
QBD 7512
QBD 7511
QBD 7508
QBD 7503
SHERIFF PIT
FRAME PIT
QMD 7608
T-4
T-10
T-12
J SEAM
K SEAM
LEGEND:
COAL
BONEY COAL (CO)
SHALE
SANDY SHALE
CARB. SHALE
SANDSTONE
CONGLOMERATE
METRES 1 0 1 2
NO. DESCRIPTION BY DATE
REVISIONS
QUINTETTE COAL LIMITED
PREPARED BY:
DENISON MINES LIMITED
MITSUI MINING CO. LTD.
REPRESENTATIVE SECTIONS
G-I, J & K SEAMS
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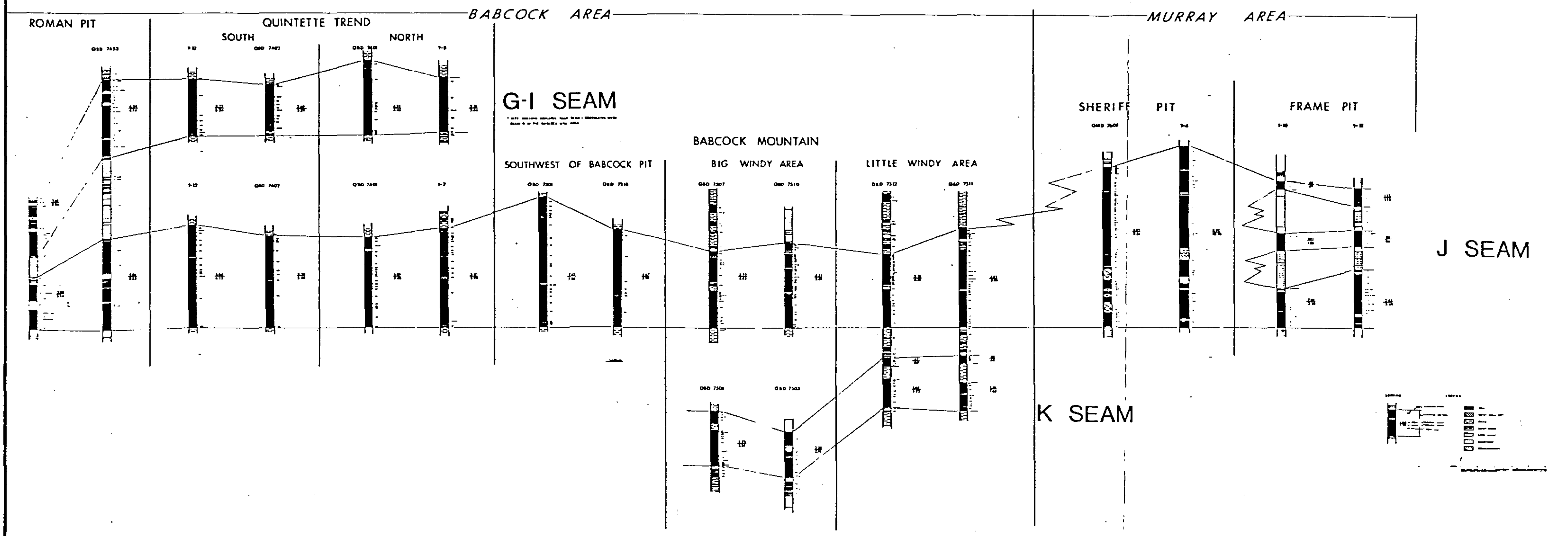
DATE: JAN, 77
SCALE: 1:50
PREP'D BY:
DATE:
DRAWING NUMBER:
QNTT76-0648-R02
APPR'D BY:
DATE:
616

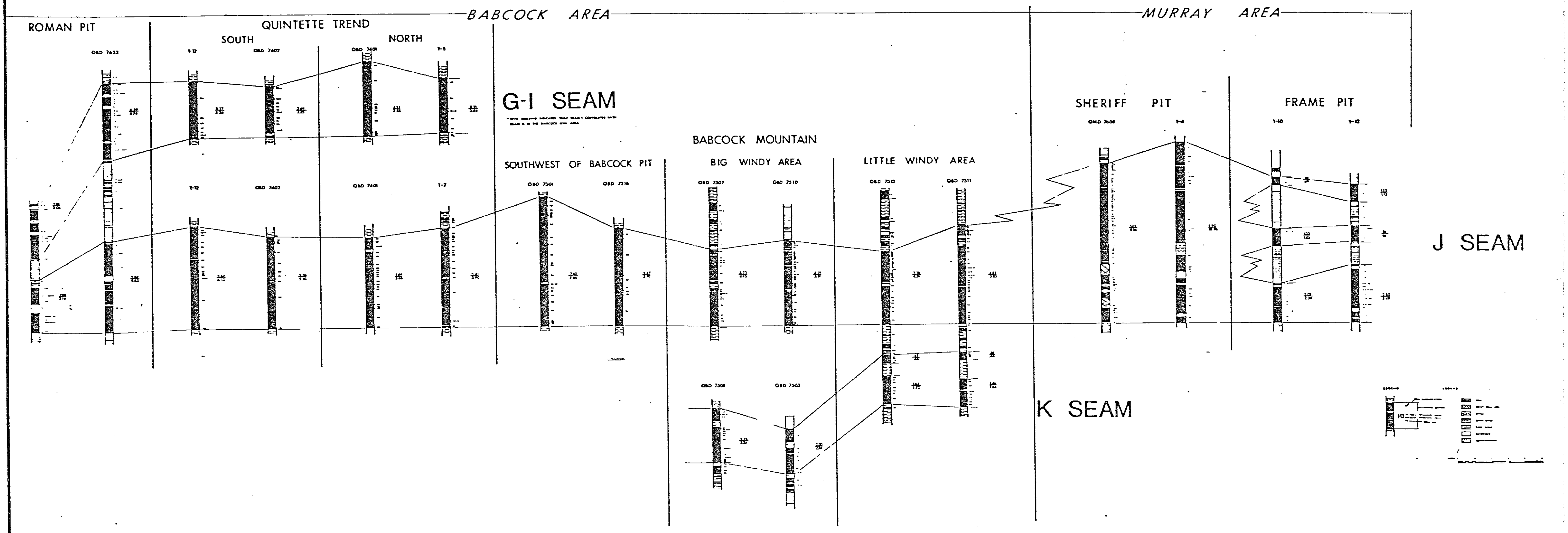
FIG. 3.1.3.3



QUINTETTE COAL LIMITED

REPRESENTATIVE SECTIONS
G-I, J & K SEAMS

FIG. 3.1.3/3



QUINTETTE COAL LIMITED

REPRESENTATIVE SECTIONS
G-I, J & K SEAMS
FIG. 3.1.3.3

The Lower or Basal Coal Zone of the Gething Formation has been observed persistently in the Wolverine West and Meadow Prospect areas only. This seam appears to have a thickness of 3 to 6 m in these areas, and could represent an important source of low volatile coal. In the southern part of the property, this zone appears to be replaced by sandstones and conglomerates.

3.2 DETAILED GEOLOGY OF THE DEPOSITS

3.2.1 McConkey Deposit

3.2.1.1 Description

The McConkey Mine (formerly Sheriff Mine) covers an area of approximately 150 ha on the upper part of Sheriff Mountain and the adjacent Deputy Peak. These are situated between the Murray and Wolverine Rivers in the north-central part of the Quintette property (see 1:50,000 scale map, Appendix 1.2). The peaks reach a maximum height of 1775 m and 1740 m, respectively.

To the end of November 1982, 95 rotary and core holes totalling 10,588m have been drilled to define the deposit. In addition, continued detailed field mapping and trenching has been undertaken. Bulk coal samples have been previously obtained from adits driven in the deposit.

The geology map, geological cross-sections and top of J seam structure contours are presented in Appendix I to illustrate the geology of the McConkey deposit.

3.2.1.2 Stratigraphy

The stratigraphic sequence exposed in the McConkey area is primarily restricted to the coal-bearing Middle Gates and the overlying Babcock Member. The relatively thin sequence covering the D, E, G and J coal seams in the Middle Gates results in the low overall strip ratio for McConkey. Lithologies of interseam strata are summarized in Table 3.2.1.2.1.

Up to 40 m of conglomerate and conglomeratic sandstones of the Babcock Member effectively "cap" the northwestern and south-central portions of the deposit forming prominent vertical escarpments. This sequence, along with the underlying D seam, is eroded in the centre of the deposit. To the southeast, the D seam thins and is to be replaced by siltstones, fine sandstones and shale.

The Upper Gates sequence consists of up to 75 m of primarily fine sandstones, siltstones and claystones; some minor coal may be present. The Middle Gates sequence in the area contains three economic coal seams that are correlated throughout the deposit (E, G, and J seams).

3.2.1.3 Structure

The coal-bearing sedimentary sequence within the McConkey area has been folded into a series of northwest-southeast plunging, open folds and associated low angle thrust faults. Major regional thrusts, termed the Mesa and Sheriff Faults, locally displace the Gates Member over the Hulcross Member, which is exposed on the north side of the mountain (see McConkey Geology Maps, Appendix I).

Each of the major structural features in the pit area has been given a local name. Sequentially, from northeast to southwest at the surface, these features are: Sheriff Fault, Mesa Thrust, Mesa Syncline, Mesa Anticline, and Deputy Syncline. The fold axes are nearly vertical, while the thrusts dip to the southwest at relatively shallow angles. Hence, the Mesa Thrust, in particular, cuts across the fold structures, resulting in thrusting of Gates over Hulcross in the northwest, and Gates over Gates in the southeast. To the north of the Sheriff Fault, the sequence folds over and dips vertically.

TABLE 3.2.1.2.1

SUMMARY OF INTERSEAM STRATA IN THE MIDDLE GATES MEMBER

MC CONKEY

Interval	Thickness Range	General Lithology
D Seam Floor to E Seam Roof	7 to 12 m	Carbonaceous shale, discontinuous coal splits up to 0.5 m thick, siltstone and minor sandstone.
E Seam Floor to G Seam Roof	7 to 15 m	Siltstone grading to shale with minor sandstone.
G Seam Floor to J Seam Roof	10 to 27 m	Predominantly siltstone with minor shale and sandstone.

The Mesa Syncline is the most prominent structure in the pit and contains the bulk of the reserve. Dips on the southwestern limb of the fold range from 15° to 45°. The northeastern limb, where exposed at surface, dips in the range of up to 60°. However, this limb is largely faulted out by the Mesa Thrust which truncates the structure at depth near its axis in the vicinity of J seam. The axis of the Mesa Syncline generally trends in a northwest-southeast direction and is essentially vertical; however, it is warped to an easterly direction in the southeast corner of the deposit.

The Mesa Thrust Fault extends along the entire pit in a northwesterly direction.

Minor reverse faulting associated with the main thrust system has been noted on both limbs of the Mesa Syncline. On the northeast limb, these faults parallel the major thrust system, with vertical seam displacements of up to 20 m; on the southwest limb of the syncline, they are generally conjugate to the major thrust system, with vertical displacements of up to 25 m.

The Mesa Anticline has been mapped to the southwest of the Mesa Syncline along the entire length of the deposit. The fold is a broad, open structure with limbs dipping symmetrically at approximately 20° to 25°. Southwest-dipping faults with vertical seam displacements of up to 20 m occur on the southwest limb of the anticline in the southwest corner of the pit.

Steeply eroded slopes on the northwest and southeast of the Deputy Syncline restrict seams E, G, and J to an ovoid pod on the ridge of land connecting the McConkey and Frame areas.

The limbs of Deputy Syncline dip at an average of approximately 25° and the structural axis plunges gently at 5° to the northwest. Numerous minor southwest and northeast-dipping faults with vertical seam displacements up to approximately 50 m, and inferred components of strike-slip movement, occur in both limbs of the syncline. A minor anticline/syncline pair separates Deputy Syncline from Mesa anticline at the east limit of the pit; the folds plunge gently (2°-6°) to the southeast, and have shallow dips averaging approximately 20° on their limbs. A dip slope extension of J seam in the northeast limb of Deputy Syncline (southwest limb of Mesa Anticline) is interpreted in the northwest area of McConkey Mine. In this extension of J seam (Deputy Syncline), dips average approximately 45° in the northeast limb of the syncline and 60° in the southwest limb.

In the northeastern part of the deposit, east of the Sheriff Fault, the sequence is interpreted to be folded to a vertical attitude.

Although major structures generally trend northwest, in the northeast corner of the pit, the Mesa Syncline and the faults to the north locally swing to a north-south trend, before reverting to the original strike direction at the southeast wall of the main pit, both laterally and down-dip.

3.2.1.4 Coal Seam Development and Correlation

The four economic coal seams found in the McConkey deposit are the D, E, G and J seams. Their thicknesses are summarized in Table 3.2.1.4.1. The correlation chart presented in Appendix I illustrates the coal seam development.

The uppermost seam, D, contains a few sporadically developed thin shale partings and basal coal splits and shows a general thinning trend to

TABLE 3.2.1.4.1

SEAM THICKNESSES (METRES)

MC CONKEY MINE

Pit Area	Seam	Thickness Range	AVERAGE
South Area (Deputy)	E	7.2 - 10.7	9.0
	E4	0.7 - 1.9	1.2
	G	0.6 - 2.4	1.5
	J	6.8 - 12.6	9.3
Northeast Area of Pit (Marmot/Mesa)	D	0.5 - 3.7	1.3
	E	7.9 - 13.4	11.0
	E4	0.6 - 2.1	1.1
	G	0.7 - 2.3	1.7
	J	4.0 - 8.8	6.6
Northwest Area of Pit (Mesa)	D	1.8 - 2.7	2.2
	E	5.0 - 13.6	8.2
	E4	0.4 - 1.5	1.3
	G	0.6 - 1.5	1.1
	J	2.6 - 9.8	7.0

the southeast of the deposit. As a result of this thinning, D seam is not considered economic throughout the deposit. The roof of D seam generally consists of carbonaceous shale.

Seam E contains numerous sporadically developed shale partings. The abnormal thickness of E seam in McConkey Mine area is probably due to a coalescence with seam F. Below seam E is a consistently developed coal split labelled seam E4. Siltstone and sands ranging in thickness from 1.8 to 4.4 m separate the split from the main seam.

The upper portion of seam G contains a rock parting and a coal split in some areas of the southeast portion of the deposit. Both of these bands are often excluded from the mining section thickness in reserve calculations.

Seam J is well developed and contains two distinct shale partings in its lower section in the southeastern area. A single, continuous mining section is planned for this seam.

3.2.2 Frame Deposit

3.2.2.1 Description

The Frame deposit is located in the central portion of the Murray area, approximately 2.5 km west of the Sheriff deposit. The coal-bearing Gates Member is exposed in a syncline which outcrops on the eastern side of Frame Mountain at an elevation of 1883 m. The peak forms the most prominent topographic feature in the area.

The mountain is joined to the Deputy and Sheriff peaks to the east by saddles, which form the watershed divide between streams flowing east to the Murray River basin, and watercourses draining west to the Wolverine River.

The syncline limbs are exposed on the crest of the northwest trending ridge (west limb) and on the lower east side of the ridge (east limb). The northwesterly plunge of the structure results in the axial area of the syncline outcropping along the upper, south face of the Frame-Deputy saddle to the south. To the north, the steep topographic drop toward the Wolverine River means that the axis of the syncline subcrops on the ridge side, thereby completely defining the extent of the deposit.

Evaluation work on the deposit has involved detailed geological mapping, trenching and drilling. To the end of 1982, 31 rotary and core holes totalling 5999 m were drilled. Adits were also driven in 1982 to obtain bulk metallurgical sampels from seams D, F, and J, along with the resampling of 1981 adits on seams E and G.

The geology map and accompanying geological cross-sections (Appendix I) illustrate the geology of the Frame deposit.

3.2.2.2 **Stratigraphy**

The Frame deposit contains the coal seams of the Gates Member sedimentary sequence, which also contains typical interbedded conglomerates, sandstones, siltstones and mudstones. The general stratigraphic sequence can be equated to that exposed in the McConkey deposit. The lithology of the interseam strata is summarized in Table 3.2.2.2.1.

The major coal seams within the syncline are the D, E, F, G and J seams. A sandstone unit forms the footwall of J seam, which is the lowest economic seam in the deposit.

TABLE 3.2.2.2.1

SUMMARY OF INTERSEAM STRATA IN THE MIDDLE GATES MEMBER

FRAME

Interval	Average Thickness	General Lithology
D Seam Floor to E Seam Roof	7 m	Sandstone, carbonaceous shale and siltstone with minor coal splits
E Seam Floor to F Seam Roof	13 m	Predominantly shale with minor sandstone and coal splits
F Seam Floor to G Seam Roof	14 m	Sandstone grading to siltstone and shale
G Seam Floor to J Seam Roof	31 m	Coarse to fine grained sandstone with siltstone and minor shale

Above D seam, the Babcock Member is represented by the typical sandstone-conglomerate unit which outcrops along the crest of the saddle on the southeast side of the deposit.

The lower portion of the Hulcross Member shale sequence is exposed in the centre of the syncline. This is the highest stratigraphic unit exposed in the deposit.

3.2.2.3 **Structure**

The structure of the deposit is relatively simple, with the Mast Syncline being the only major feature. The fold is asymmetrical with a northerly axial plunge of approximately 14° which flattens in the northern portion of the deposit.

The dip of the northeast limb is generally uniform, being in the range of 40° to 50° over the entire length of the deposit, although local dips in excess of 60° have been mapped in the southeast sector.

In the northeast limb, steeply dipping reverse faults have been interpreted. These have associated local dips of up to 80° and maximum vertical seam displacements of up to 100 m. Normal displacement has been interpreted in one fault due to an interseam thinning identified in drill holes QMR 8106 and QMR 8250.

The southwest limb is generally shallower dipping than the northeast limb. It is homoclinal in its upper section, with dips increasing from approximately 15° in the southeast to about 30° at the northwest end of the deposit. Toward the northwest, the dips in the lower part of the limb, close to the fold axis, increase gradually to as high as 60° to 65°. As the disparity in dip between the upper and lower sections of the limb increases, the flexure area develops an associated thrust fault, which increases in throw up to approximately 50 m in the northwest, with the increasing difference in dips.

3.2.2.4 <u>Coal Seam Development and Correlation</u>

Seams D, E, F, G and J have been correlated within the deposit. These seams are reasonably consistent in their development, however, they comprise a variable number of mining sections based on coal splits and the variable structural dip. The correlation chart presented in Appendix I illustrates the coal seam development. Table 3.2.2.4.1 summarizes the seam true thicknesses.

The massive conglomerate and sandstone of the Babcock Member overlies D seam. The roof contains claystone with sporadically developed coal splits, which are excluded from the mining section. A single mining section, which will contain minor shale partings, has been inferred consistently for this seam throughout the deposit.

The roof transition and middle portion of seam E consists of a series of coal splits and shale partings of variable thickness. The floor is a massive shale or siltstone. Two mining sections, E1 and E2, have been identified. Seam E1 contains high ash and may not be recoverable in all areas; it is separated from E2 by 75 cm of carbonaceous claystone.

Seam F is divided into seams F1 and F2. Seam F1 is a local development with very high ash and is not considered mineable. Seam F2 is persistent throughout the deposit and mineable.

Seam G contains two clearly developed coal splits which will be mined

TABLE 3.2.2.4.1

SEAM THICKNESSES (METRES)

FRAME MINE

SEAM	TRUE THICKNESS RANGE	AVERAGE
D	0.78 - 2.87	1.88
E1	0.41 - 2.26	1.68
E2	0.38 - 2.74	1.50
F1	0 - 2.57	1.58
F2	0.73 - 3.02	1.57
G1	0.46 - 0.99	0.64
G2	1.40 - 5.72	3.65
J1	0.38 - 1.67	0.96
J2	0.52 - 0.86	0.70
J3	1.50 - 3.71	2.50

separately. Only one mining section (G2) is considered for most steeply dipping areas. The upper and lower roof and floor sections of the seam contain minor coal splits as does the parting, however, is not difficult.

Three main coal splits comprise J seam. Individually, each of these splits is very clean with variable thicknesses of silty/carbonaceous claystone splits between them. Three separate mining sections are present throughout the structure, however, in places two of the splits may coalesce, forming a thicker single mining section. The floor of J seam rapidly grades from shale and siltstone to the massive sandstone of the Torrens Member.

3.2.3 Babcock Deposit

3.2.3.1 Description

The Babcock coal deposit covers a surface area of some 1500 ha on the top of Babcock Mountain. To the end of 1981, 82 rotary and core holes totalling 16 126 m have been drilled to define the geology and reserves. In addition, there has been detailed field mapping and trenching and several adits have been driven to provide bulk coal samples. These have shown the Babcock deposit to be the largest known coal reserve on the property.

No geological investigations were conducted in the mine area during 1982.

3.2.3.2 **Stratigraphy**

The geological sequence up to and including the lower portion of the Boulder Creek Member is representative of the stratigraphy on Babcock Mountain. (See Figure 3.1.1.1).

Exposures of the Hulcross and lower Boulder Creek materials occur around the crest and sides of the mountain, while outcrops of the Gates Member are limited to the northwest face and northeast window area of the deposit.

Lower Boulder Creek sediments are found in the central portion of the proposed pit and attain a maximum thickness of approximately 100 m in the north-central region.

The Hulcross Member has a consistent thickness of approximately 90 m. It is moderately well exposed around the periphery of the mountain where, due to its recessive nature and good drainage, it has provided the base for the construction of main access roads.

The Upper Gates Member stratigraphy is defined from the base of the Hulcross Member to the top of seam D, the first coal seam from which production is planned. This section is between 40 and 45 m thick. Three locally developed coal seams (A, B, and C) have been encountered in this sequence. Seam A is commonly found just below the Hulcross contact and is the most consistent.

The Middle Gates Member ranges from approximately 105 to 125 m in thickness, and contains the six coal seams (D, E, G/I, J and K) from which all coal production is planned. The Middle Gates is defined from the roof of D seam to the floor of the lowest coal horizon in the K seam zone.

3.2.3.3 Structure

The primary structure at Babcock Mountain is that of a broad asymmetrical box-like anticline which plunges at approximately 7.5° to the southeast. The bulk of the deposit is contained between the axes of the bounding anticlines of the box fold. The plunge of this fold generally ranges from 5° to 10° to the south, culminating to the southwest in an asymmetric fold which changes the sequence to a near-vertical attitude. The axis of this fold, which represents the approximate limit of the Babcock area, trends in a more easterly direction near the southern end of the deposit, and restricts the development of the southwest limb of the main Babcock structure in that area.

A tight secondary syncline associated with a major fault zone has been mapped and confirmed on the northeast limb of the main Babcock structure adjacent to the Little Windy area at the northern corner of the deposit. This structure plunges at 20° to the northwest and appears to die out to the southeast in the central portion of the northeast side of Babcock Mountain. Bedding dips on the limbs of the syncline reach a maximum of approximately 75° in the northwest, but flatten to less than 30° to the southeast as the fold opens out.

On the northeast side of the planned pit area, a major thrust fault which dips steeply to the southwest effectively forms the limit of the reserves. This fault may gradually die out into an anticlinal axis toward the south. A number of localized thrust faults have been interpreted in the vicinity of the main fault. These have the same general orientation, and it is assumed that they are splays of the main fault.

The Babcock deposit is, therefore, clearly defined by the topography to the northeast, and by the complex structures which increase the depth of burial to the northeast and southwest. To the southeast the overburden depth increases as a result of the plunge to the structure.

3.2.3.4 Coal Seam Development and Correlation

The continuity and development of the coal seams at Babcock have been confirmed by drilling. All of six main coal seams have been found to contain thicknesses amenable to current open pit extraction techniques.

Based on the detailed descriptions of the coal seams intersected during drilling programs, extraction of complete seam sections is planned for seams D, E, F and J. Extraction of seams G/I and K is dependent upon the number of seam splits which are formed with acceptable quality and the total true thickness in excess of approximately 0.5 m.

3.2.4 Shikano Deposit

3.2.4.1 Description

The Shikano deposit is located to the northeast of Babcock Mountain in the Murray River Valley, 2 km southwest of the Coal Preparation Plant. The coal bearing Gates Member is exposed in a syncline - anticline pair which outcrop in the wooded lowlands near the Murray River. A west flowing creek, which drains the northeast slope of Babcock Mountain, cuts through the Shikano deposit along the synclinal axis.

To the end of 1982, 40 rotary and core holes totalling 3,960 m were drilled to evaluate the deposit. Adits were driven to provide metallurgical and thermal bulk samples from seams D, E, F, and J.

The Geology map and accompanying geological cross sections (Appendix I) illustrate the geology of the Shikano deposit.

3.2.4.2 **Stratigraphy**

The Shikano deposit includes coal seams in the Gates Member sequence, which also contains interbedded conglomerates, sandstone, siltstones and claystones. The general stratigraphic section is correlatable with the section in the Babcock deposit. The lithology of the interseam strata is summarized in Table 3.2.4.2.1.

The major coal seams within the deposit are D, E, F, G, J, and K. A hard sandstone forms the floor below K seam. A pebbly conglomerate similar in appearance to the channel conglomerates of the Babcock Member can form the interseam lithology between seams F and G. This conglomerate occurs in the north limb of the anticline. Above D seam, the Babcock Member is represented by the typical sandstone-conglomerate unit which is exposed mainly along the north limb of the anticline and through the anticlinal axis.

Exposures of the Hulcross and lower Boulder Creek Members occur on the north limb of the anticline.

3.2.4.3. **Structure**

The structure of the Shikano deposit is comparatively simple with a syncline -anticline pair forming the major structural feature. The folds are asymmetrical with a southeasterly circular plunge of approximately 15°. Dips in the southern limb of the syncline range from 10° to 30°, with dips in the common limb of the pair range from 30° to 60°, while dips on the northern limb of the anticline range from 25° to 45°.

Three minor reverse faults have been interpreted in the nose of the syncline with maximum displacements of 10 metres.

TABLE 3.2.4.2.1

SUMMARY OF INTERSEAM STRATA IN THE MIDDLE GATES MEMBER

SHIKANO

Interval	Thickness Range	General Lithology
D Seam Floor to E Seam Roof	1.2 to 3.8 m	Very carbonaceous shale
E Seam Floor to F Seam Roof	19 to 23 m	Carbonaceous shales near E seam floor and F seam roof, with siltstone and fine sands in the middle.
F Seam Floor to G Seam Roof	13 to 26 m	Siltstone, shale, minor sandstones and conglomerate.
G Seam Floor to Seam Roof	22 to 38 m	Sandstone, silstone, fining to shale near J seam roof
J Seam Floor to K Seam Roof	3.2 to 6.0 m	Carbonaceous shale.

3.2.4.4. **Coal Seam Development And Correlation**

Seams D, E, F, G, J, and K have been correlated within the deposit. These seams are reasonably consistent in their development, however they comprise a variable number of mining sections based on coal splits and variable structural dip. The correlation chart presented in Appendix I illustrates the seam development. Table 3.2.4.4.1 summarizes the seam true thicknesses.

D seam is overlain by the massive conglomerate and sandstone unit of the Babcock member. A thin claystone unit usually separates the top of the coal seam from the conglomerate. In the adit driven to sample D seam (QBA 8203), the conglomerate was found to have scoured the top of D seam although this occurance has not been noted in drill holes. A single mining section exists throughout the deposit with one claystone parting near the base of the seam. D seam has an average thickness of 3.05 m.

The interseam between seams D and E consists of very carbonaceous claystone with an average thickness of 2.2 m. A thin coal seam with a thickness less than 0.50 m is separated from the top of E mining section by a carbonaceous claystone with a thickness of 0.61 m. The E seam mining section has several small claystone bands which occur near the base of the mining section. The mining section has an average thickness of 2.09 m.

F seam is well developed throughout the area with one mining section occuring in the deposit with an average thickness of 4.09 m. The roof consists of a thin clay band less than 0.30 m thick. The floor is a hard fine grained sandstone. Two small claystone partings occur in the lower third of the coal seam.

Table 3.2.4.4.1

SEAM THICKNESSES (METRES)

SHIKANO MINE

SEAM	TRUE THICKNESS RANGE	AVERAGE
D	2.17 - 3.76	2.80
E	1.53 - 2.34	1.98
F	3.79 - 4.32	4.04
G	2.65 - 3.95	3.49
J1	1.13 - 3.39	1.83
J2	1.90 - 3.57	2.44
J3	0.78 - 1.60	0.99
K	0.54 - 2.25	0.86

G seam contains one mining section which varies in thickness throughout the deposit. Two claystone partings of less than 0.43 m split the mining section into three small seams designated G1, G2, and G3. Since the splits are thin, they will be mined together. The conglomerate which forms the roof of G seam in the northern limb of the antiline scours out G1. The average thickness of G1, G2, G3 are 0.81 m, 1.05 m and 1.23 m respectively.

J seam contains three distinct mining sections which have been designated as J1, J2, and J3. The roof of J1 consists of a carbonaceous claystone. J1 has an average thickness of 1.94 m but thins to less than 0.50 m in the southern portion of the deposit near QBD 8206.

The split between J1 and J2 consists of very carbonaceous claystone and coal with a thickness range of 0.48 m to 0.84 m. The split may be included in the mining section resulting in the combination of J1 and J2 into one mining section. Seam J2 has an average thickness of 2.42 m and remains consistent in thickness throughout the deposit. The split between J2 and J3 is a soft carbonaceous claystone which has an average thickness of 4.39 m. Seam J3 has an average thickness of 0.98 m but varies in thickness throughout the deposit.

K seam consists of up to two distinct coal seams designated as K1 and K2 with average thicknesses of 0.69 m and 0.54 respectively.

The floor below K grades rapidly from siltstone and fine sandstone to the massive hard sandstone of the Torrens Member.

4.0 QUALITY

During 1982, rotary drill cuttings, drill core, channel samples and adit samples were taken in order to satisfy the following coal quality related objectives:

1) complete the evaluation of the seams in Shikano Pit;
2) fill in missing information about the Frame Pit coals;
3) confirm previous information about Frame and McConkey Pit quality;
4) provide a data base to compare rotary cuttings with drill core quality and;
5) provide a preliminary assessment of the variation of quality between drill holes.

4.1 ROTARY DRILLING, CUTTINGS ANALYSIS

A reverse circulation rotary drill was used to determine the location of coal seams in the McConkey, Frame and Shikano pits during 1982. The cuttings from the drill were collected and retained for lab analysis. The samples are currently being analyzed at the QCL trailer-based geology lab located near McConkey Pit.

"Sampling with the rotary drill was conducted over every metre of intersection. The drillers took a continuous split of the drill cuttings coal or rock as they came out of the collecting cyclone on the side of the drill rig. These cuttings were collected in a bucket and then a representative portion placed in a sample bag marked with the drill hole number and sample interval. For example, a typical sample bag would be labelled QMR8228, 13-14. These sample intervals are the I.D. number as listed in Appendix III Section 1.1. The decision as to what intervals would be analysed was made by the supervising geologist. The drill hole number, sample interval and analysis are recorded in Appendix III, Section 1. Two drill holes (QMR8201 and 8202) had analysis completed by General Testing Laboratories. The intervals were tagged and shipped to General Testing. The following is a listing of the tag numbers and the sample interval:

DRILL HOLE	SAMPLE TAG #	SAMPLE INTERVAL
QMR8201	1948	36-37
	1949	45-46
	1950	47-48
	1951	48-49
	1952	49-50
	1953	50-51
	1954	51-52
	1955	52-53
	1956	53-54
	1957	54-55
	1958	55-56
	1959	56-57
	1960	57-58
	1961	58-59
	1962	59-60
	2002	37-38
	2035	38-39
QMR8202	1919	24-25
	1920	35-36
	1921	36-37
	1922	37-38
	1923	38-39
	1924	39-40
	1925	40-41
	1926	41-42
	1927	42-43
	1928	43-44
	1929	44-45
	1930	45-46
	1931	46-47
	1932	47-48
	1933	48-49
	1934	51-52
	1935	52-53
	1936	64-65
	1937	65-66
	1938	82-83
	1939	83-83
	1940	84-85
	1941	85-86
	1942	86-87
	1943	87-88
	1944	88-89
	1945	89-90
	1946	90-91
	1947	92-93
	2036	53-54

The reverse circulation drill cuttings were taken to the geology lab where a sample was split out and dried under infrared lamps. The dry coal was placed in an organic solvent sink-float bath that was adjusted to a density of 1.57. This density was selected after an analysis of the previous QCL data that indicated that rotary cutting floats in a bath of 1.57 density would on average have 9.5% ash. The float material was rinsed with methanol, placed in an oven for half an hour to dry, and then split down and pulverized in a coffee blender, to produce minus 60 mesh coal for FSI, ash, and moisture determination. Similiar analysis was also conducted on the raw portion of the sample. The results of this analysis is recorded in Appendix III, Section 1.

For comparsion purposes, the cuttings from the drill holes in McConkey Pit also analyzed by General Testing Laboratories. These results are also in Appendix III, Section 1.

The rotary cuttings (coal) from the spring drilling program in Shikano Pit were all sent to General Testing Laboratories for Proximate and FSI analysis.

4.2 DIAMOND DRILLING, CORE ANALYSIS

Core drilling of the coal seams was conducted with a wireline drill string used on the rotary drill (a Cyclone TH-60) and during the winter with a Longyear 44 diamond drilling rig. Coring was only conducted in Shikano Pit and surrounding area. Seams cored with the Cyclone TH-60 were initially located with a rotary hole. Once the seams were located, a second hole was drilled beside the first one, coring the coal section only. The objective of conducting this work is to give a data base to compare the results of reverse circulation cuttings analysis to actual drill core analysis, fill in missing or questionable quality information and assess the quality variation expected between drill holes.

At one location three drill hole samples were taken within three metres of each other. The objective was to try to determine the variation that could be expected between drill holes within an area. The three drill holes were QBD 8211, 8217, and 8218. The seams sampled were J1, J2, and J3.

After examining the results (Appendix III, Section 2) the general conclusion is that the variability (±13%) was as high as is expected in core spaced at several hundred metres. The contributing factors for this high variability are probably a combination of:

seam variation
core recovery
sampling
geologist judgment in seam determination
sample preparation
sample analysis

To be more conclusive, further studies with at least 10 pairs are required for statistical confidence. In this small study, large variations were not considered and, therefore, reduced the statistical base.

Drill core underwent two stages of analysis:

1. Component analysis on individual samples within a seam to determine if this portion should be included in a mining section. Analysis includes head ash, 1.5 Float/sink, proximate on the float and F.S.I.

2. Composite analysis on single or combined components was undertaken to determine washability and rheological characteristics of the coal.

Flow sheets for high recovery core (+40%) and low recovery core (-40%) are presented in Figures 4.2.1 and 4.2.2 respectively. The component analysis is the first stage and results are received before compositing instructions are given.

Component and Composite analysis results are presented in Appendix III, Section 2. Summary tables for each drill hole are found in Appendix 1.3.1.. These tables identify the seam, seam interval and sample tag numbers.

The core samples were sent to General Testing Laboratories in Vancouver for analysis.

4.3 ADIT SAMPLING AND TESTING

Adit samples were taken in Frame and Shikano pits to test the washability, rheological and chemical properties of coal in these areas. Four seams were sampled in Shikano pit (D,E,F,J) and five in Frame Pit (D,E,F,G,J). Both metallurgical and thermal coal samples were taken in each seam.

The adit descriptions are presented in plans in Appendix I. The results of analysis of the bulk samples, including washability, and petrographic studies are presented in Appendix III. Carbonization test results are presented in summary form in Section 4 of Appendix III. A formal report from Canmet has not been received. Owing to the natural variability expected within a coal seam, great care was taken to assure that the adit samples taken during 1982 would be representative of the average seam quality for any given seam. Canmet coke test reports are presented in Appendix III, Section 4.4.

Auger samples were taken from the seam, before the adit was driven, to check the FSI's and if necessary produce other tests. Bulk adit samples were taken and shipped in five tonne bins to Birtley Coal and Minerals Testing, Calgary, Alberta.

The bulk samples were homogenized and three barrels of samples split out for analyses. Three barrels were progressively sampled and crushed until a laboratory sample was obtained for the analysis. The characteristics for the raw coal were checked against the expected ash levels from the previous drill core work. Some variation was noted but generally they were well within the variation that could be expected. The three barrels of coal were crushed to -19 mm, the size consist used in the bulk pilot scale wash, and the washability determined for the 19 x 0.5 and 0.5 x 0.25 mm fractions of the sample. The 0.25 x 0 mm sample was tested for flotation characteristics in a laboratory scale cell. FSI and flotation results were checked to assure the coal was not oxidized. In two cases the bulk adit sample was rejected as the FSI and flotation results indicated that the coal had sustained oxidation.

The -19 mm coal washability and flotation results were used as data input to the Denison Mines (Coal Division) wash plant simulator program to predict the theoretical yield and cut points for washing the bulk sample at Birtley. To assure an understanding and knowledge of what occurred during the wash test, an observer was present at all wash tests in Calgary. When problems occurred during the wash test, as far as was practical they were immediately reported and action was taken. Because of a slight difference between the Birtley wash plant flow sheet and the DML wash plant simulator program flow sheet, the Birtley results tended to give clean coal ash levels that were different than predicted. Suitable adjustments were then made including rewashing the coarse coal rejects. Within the limits of the Birtley wash plant, the clean coal samples were as representative of commercial clean coal as could be expected. Analysis of the clean coal was then compared to the average drill core cleaned coal analysis and after checking their consistency, samples were sent for carbonization tests at CANMET, Edmonton.

A number of samples were tested for attrition using the Australian Attrition Test. The test was run with water, for a total time of 7 minutes. These conditions were recommended by Magdy Mikhail, CANMET, Edmonton, who has conducted Australian and Kaiser attrition tests in conjunction with all the western Canadian commercial coal mines. After the coal was attrited in the Australian drum, washability analyses was conducted on the different size ranges. The attrition tests were conducted by Birtley Coal and Minerals Testing in Calgary.

Thermal samples were also taken from the adits in Frame and Shikano Pits. Additional thermal coal was taken from the McConkey Pit and a McConkey-Frame blend was washed to the product specification of 10% ash on an air dry basis.

Results of washplant runs, attrition tests and coal analysis from Birtley are presented in Appendix III.

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1982 DRILL CORE ANALYSIS FLOW DIAGRAM

(+40% Core Recovery)

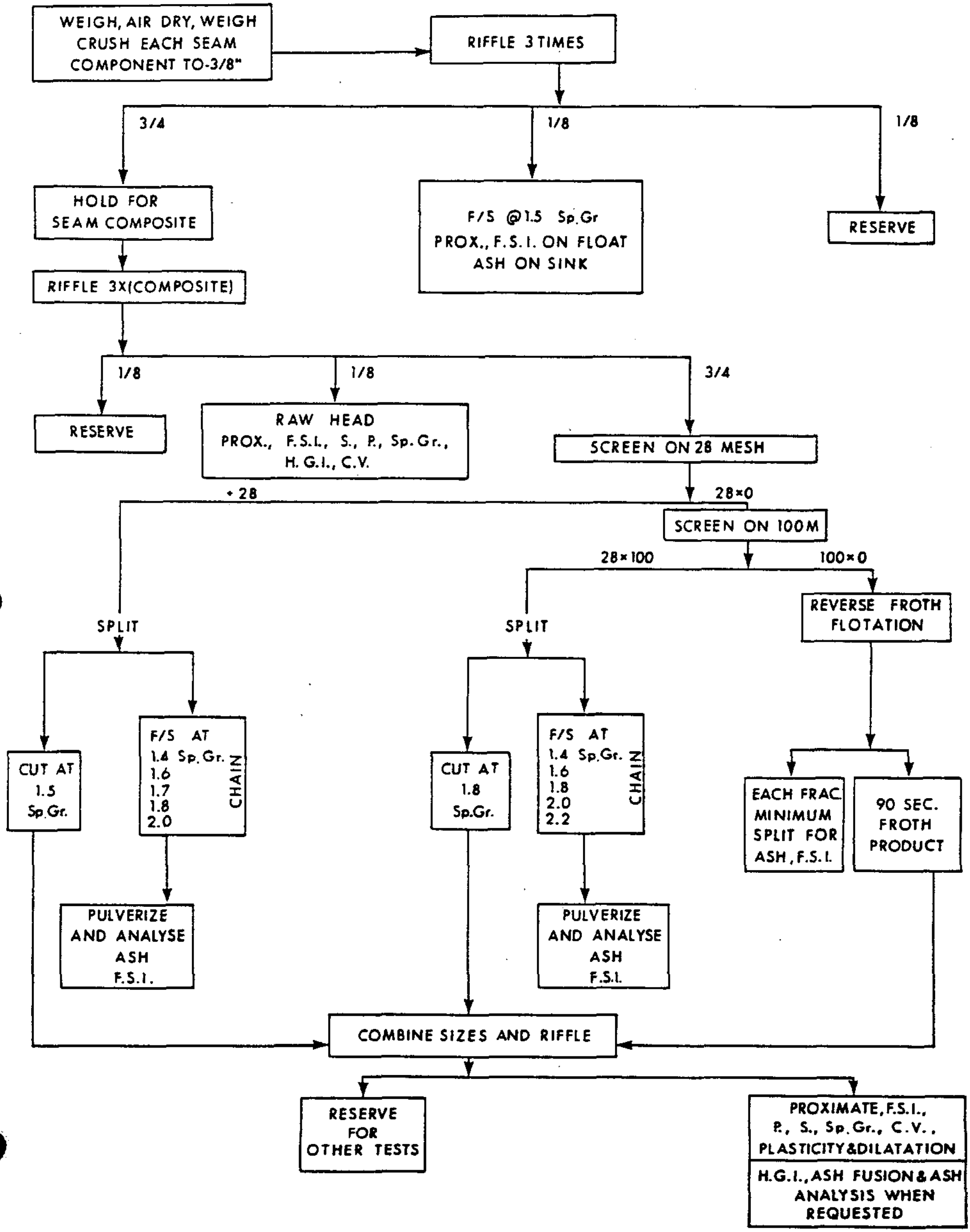

Fig. 4.2.1

QUINTETTE COAL LIMITED

1982 DRILL CORE ANALYSIS FLOW DIAGRAM
FOR POOR CORE RECOVERY SAMPLES
(-40% Core Recovery)

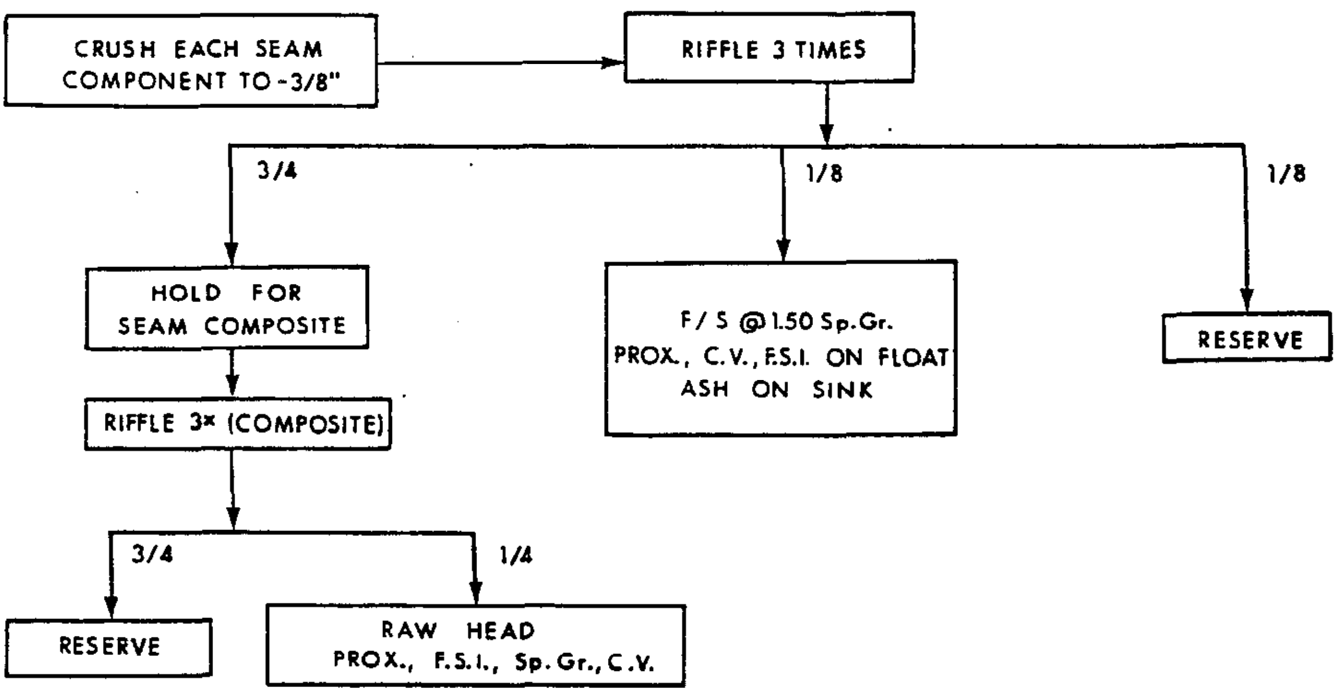

Fig. 4.2.2

Appendices 1.1 and 1.2 contain confidential information or data, as described in Section 2 of the *Coal Act Regulation*, and have been excluded from this report.

Coal Act Regulation: http://www.qp.gov.bc.ca/statreg/reg/C/251_2004.htm