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1981 QUINTETTE GEOLOGICAL REPORT

APRIL 1982

TEXT

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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D. Johnson
Chief Mine Geologist
Quintette Coal Limited

280 pages of this report contain coal quality data, and remain confidential under the terms of the *Coal Act Regulation*, Section 2(1). They have been removed from the public version.

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QUINTETTE COAL LIMITED

This report documents 1981 geological investigations to cover licences 3279-3406, 3592-3606, 3618-3633, 3656-3662, 4530-4544, 4755-4757, and 6039, 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'Nand between Longitudes 120°50'W and 121°17'W. The licences are owned by Quintette Coal Ltd., a company with the following shareholders:

Denison Mines Ltd.	45.95%
Mitsui Mining Co.	21.02%
Tokyo Boeki	21.02%
Charbonnages de France and Minersa	12.01%

This report was prepared by Quintette Coal Ltd. staff, in particular, David G.S. Johnson, Chief Mine Geologist.

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

This report is submitted April 15, 1982 to support expenditures applied to the licences as a result of the geologic work. A ninety day extension was granted by Paul Hagen, Coal Administrator.

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 four 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 1981 on Quintette Coal Limited's coal licences. The work was completed by Quintette Coal staff, Denison Mines (Coal Division) staff, contractors and consultants.

The text provides a regional assessment of the geology and detail geology in areas of concentrated investigations (Sheriff, Frame and Babcock). Quality assessment of 1981 data is at a preliminary stage; therefore the discussion is brief, although all quality data received to date is included.

This report references all previous geologic assessment reports and feasibility studies written over the past eleven years on the Quintette Coal Limited's licences.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF APPENDICES (Cont)

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

(* - 1979 Census)

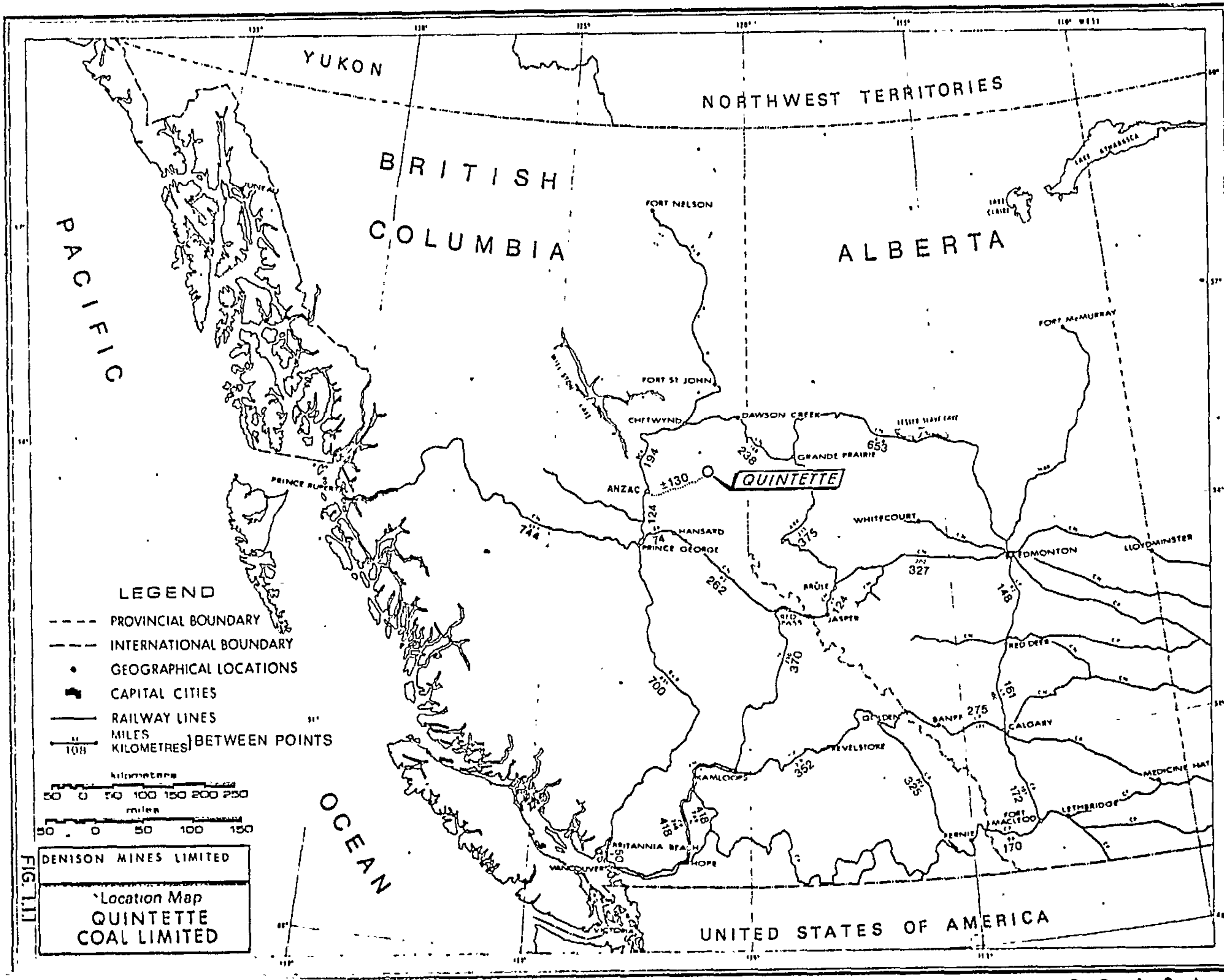
Access to the northern half of the property is provided by 106 km of good-grade gravel road which links the Village of Chetwynd with the Sheriff Camp. From this camp, approximately 15 kilometres of limited access road have been constructed to gain access to the Sheriff and Frame deposits.

In the southern half of the property three access routes link the Babcock Camp, the main exploration camp, with the city of Dawson Creek, B.C., or the city of Grande Prairie, Alberta.

Distances for these routes are listed as follows:

Babcock Camp to Dawson Creek, B.C. via proposed townsite (Fellers Hts. Route)	241 km
Babcock Camp to Dawson Creek, B.C. via Tupper, B. C. (Boundary Route)	207 km
Babcock Camp to Grand Prairie, Alberta via Beaverlodge, Alberta (Monkman Pass Route)	215 km

Numerous roads and trails have been constructed from the Babcock Camp to gain access to the Babcock area.


YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
PACIFIC OCEAN
UNITED STATES OF AMERICA
FORT NELSON
FORT ST JOHN
CHETWYND
DAWSON CREEK
GRANDE PRAIRIE
ANZAC
±130
QUINTETTE
PRINCE RUPERT
HANSARD
PRINCE GEORGE
WHITECOURT
EDMONTON
LLOYDMINSTER
FORT McMURRAY
BRÛLE
JASPER
RED DEER
CALGARY
BANFF
GOLDEN
REVELSTOKE
KAMLOOPS
MEDICINE HAT
LETHBRIDGE
FORT MACLEOD
FERNIE
BRITANNIA BEACH
HOPE
VANCOUVER
VICTORIA
194
124
74
744
262
238
653
375
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LEGEND
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
GEOGRAPHICAL LOCATIONS
CAPITAL CITIES
RAILWAY LINES
MILES
KILOMETRES} BETWEEN POINTS
kilometres
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miles
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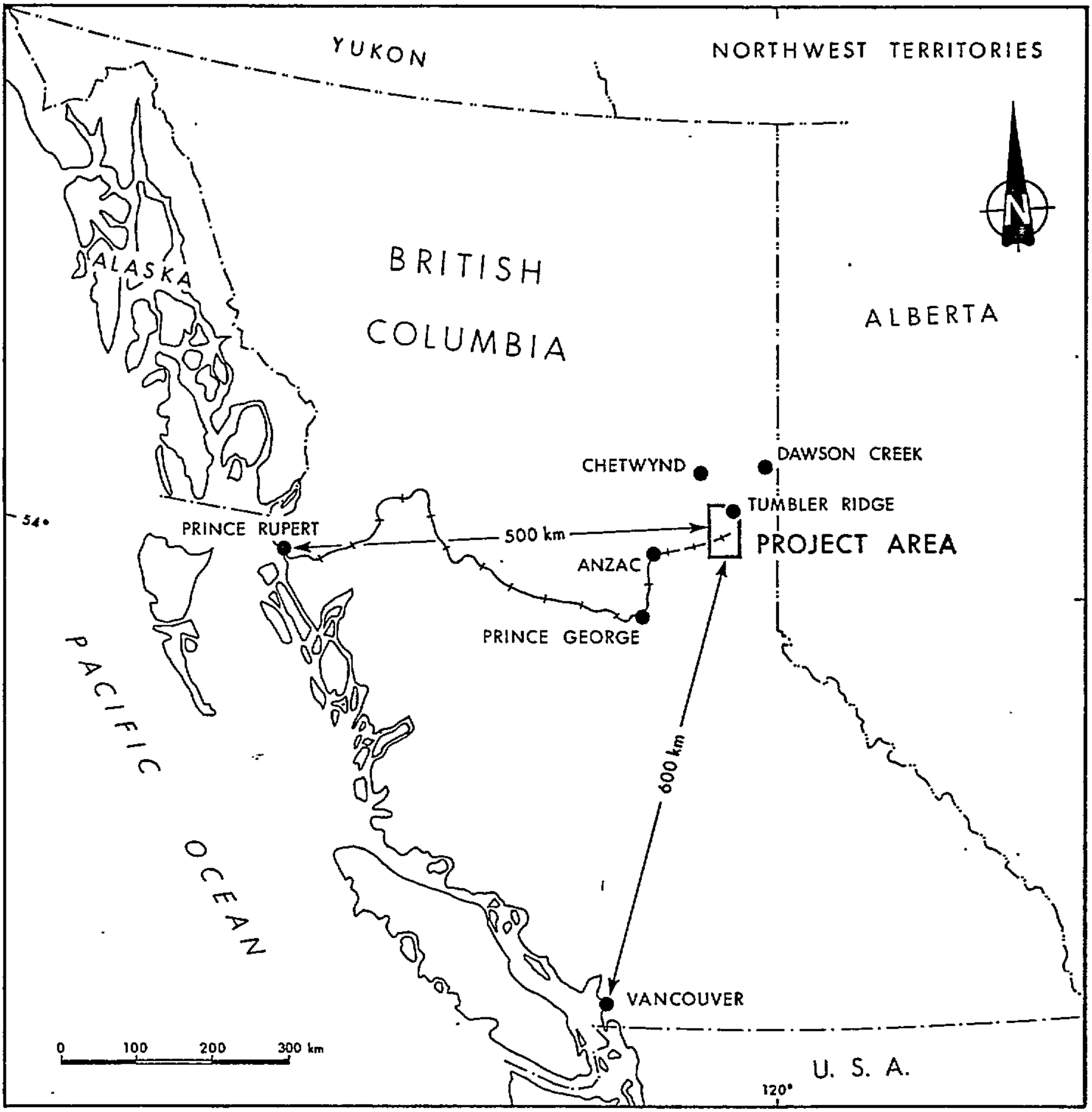
DENISON MINES LIMITED
Location Map
QUINTETTE
COAL LIMITED
FIG. 1.1

FIG 1 3.1



QUINTETTE COAL LIMITED

QUINTETTE PROJECT LOCATION MAP

FIG. 1.1.2

1.2 PROPERTY DESCRIPTION

The Quintette property consists of 202 coal licences covering an area of 49,501 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.

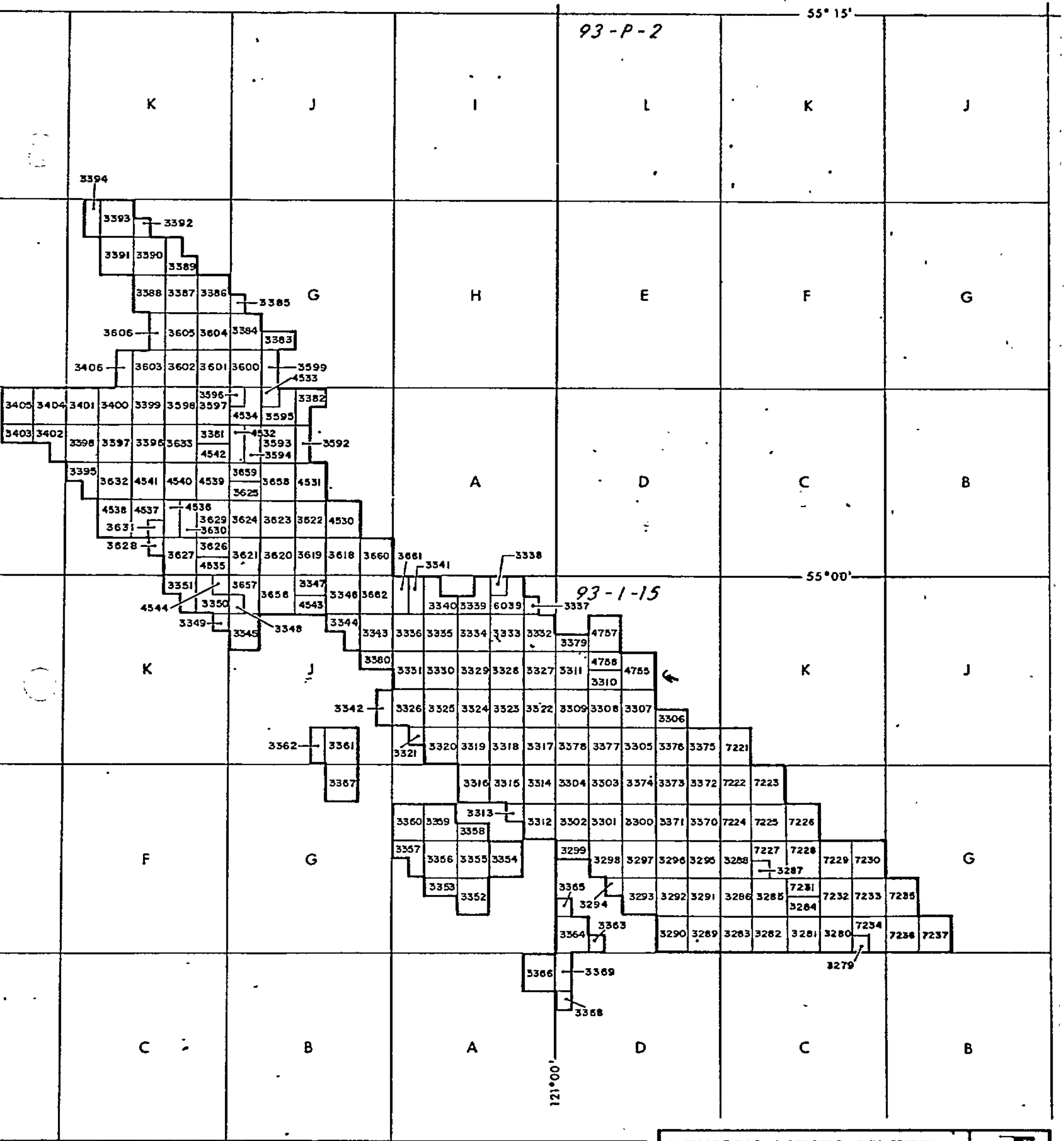
For the purpose of developing the coal licences, Quintette Coal Limited was incorporated under the laws of British Columbia in December 1971.

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.

Quintette Coal Limited (Quintette) is the corporate body which has been formed to carry out the development of the Quintette property.



DENISON MINES LIMITED
(COAL DIVISION)
VANCOUVER BRITISH COLUMBIA

QUINTETTE COAL LICENSES

FIG. 1.2.1

DRAWN BY: E.T.	DATE.	SCALE.
PREPARED BY:	DATE.	DRAWING NUMBER
APPROVED BY:	DATE.	QNTT 75-0563-R07

The shareholders of Quintette are as follows:

Denison Mines Limited	45.95
Mitsui Mining Co. Ltd.	21.02
Tokyo Boeki Ltd.	21.02
Charbonnage de France and Minersa	12.01

By agreement among the shareholders of Quintette, Denison Mines Limited has been appointed to manage the exploration, feasibility, construction and initial operating phases of the project.

2.0 1981 EXPLORATION/DEVELOPMENT PROGRAM

The 1981 program was conducted primarily in the three planned mine areas; Babcock, Sheriff and Frame. Investigations included geological mapping, diamond drilling, rotary drilling and aditing. The work was conducted by Dension Mines staff and contractors. The work period was from July 18 through to November 4, 1982. 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 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 was conducted in all three pit areas primarily directed towards drill hole locating. Other mapping in surrounding areas helped interpret dump geology. Mapping particularly concentrated in the Windy dump area of Babcock Mine and along the northeast perimeter of Babcock.

2.2 DIAMOND DRILLING

Diamond drilling (core holes) was contracted to Longyear Canada Incorporated, New Westminster, B.C. and to Acadia Drilling, Cranbrook, B.C.

Drilling equipment used was the Longyear 44 drill rig with associated auxiliary equipment. Two holes utilized a Longyear 38 skidmounted rig. In the majority of cases, HQ core was recovered, except in two drill holes, when NQ coring was required. A total of thirteen drill holes were completed. Table 2.2.1 summarized them by area, location and total depth. All core recovered is stored in permanent core storage facilities at the Babcock Camp site, on the Quintette property. Detail descriptive core logs are presented in Appendix II, Parts 1 and 2. Geophysical logs of each hole are presented in Appendix III.

TABLE 2.2.1

DIAMOND DRILLING SUMMARY

BABCOCK AREA

DRILL HOLE	NORTHINGS	EASTINGS	TOTAL DEPTH (Metres)
QBD 8101	6,091,172N	627,555E	405
QBD 8102	6,090,740N	628,713E	495
QBD 8103	6,090,624N	630,288E	195
QBD 8104	6,090,624N	630,288E	249
QBD 8105	6,092,777N	627,146E	555
QBD 8106	6,093,412N	626,192E	483
			2,382

FRAME AREA

DRILL HOLE	NORTHINGS	EASTINGS	TOTAL DEPTH (Metres)
QMD 8101	6,097,675N	613,302E	157
QMD 8102	6,097,601N	613,279E	196
QMD 8103	6,097,340N	613,529E	280
QMD 8104	6,097,509N	613,530E	120
QMD 8105	6,097,322N	613,980E	185
QMD 8106	6,096,859N	614,152E	262
QMD 8107	6,096,878N	614,420E	336
			1,536

Total metrage - 3,918

2.3 ROTARY DRILLING

Rotary drilling was contracted to Garritty and Baker Drilling Ltd., Calgary, Alberta.

The drilling equipment used was a Sanderson Cyclone TH300 drill rig equipped with reverse circulation equipment. Reverse circulation drilling ceased after completion of QMR 8104. Therefore, approximately 1,456m of drilling was completed using reverse circulation and 4,294m with conventional drill rods. A down the hole hammer was used whenever possible since it proved to have the best penetration rate. An auxillary compressor with 750psi and 250cfm was also used throughout the program.

A total of 40 rotary holes were completed on the Quintette Property. Table 2.3.1 summarizes them by area, location and total depth. Geophysical logs of each hole are presented in Appendix III.

Table 2.3.1

TABLE 2.3.1

ROTARY DRILLING SUMMARY

BABCOCK AREA

DRILL HOLE	NORTHINGS	EASTINGS	TOTAL DEPTH (Metres)
QBR 8101	6,089,920N	630,728E	214
QBR 8102	6,088,859N	629,307E	98
QBR 8103	6,088,851N	629,303E	244
QBR 8104	6,089,243N	626,850E	163
QBR 8105	6,089,440N	626,334E	103
QBR 8111	6,094,090N	626,075E	30*
QBR 8112	6,093,916N	625,878E	158
QBR 8113	6,093,755N	625,752E	30*
QBR 8114	6,093,731N	625,169E	30*
QBR 8115	6,094,220N	626,015E	158
QBR 8116	6,094,276N	626,252E	202
QBR 8117	6,094,398N	626,535E	172
QBR 8118	6,092,569N	624,349E	109
QBR 8119	6,094,606N	626,893E	134
QBR 8120	6,093,591N	625,026E	30*
QBR 8121**			197
QBR 8122**			190
			2,262m.

FRAME/SHERIFF AREA

QMR 8101	6,096,339N	614,030E	119
QMR 8102	6,096,185N	614,224E	153
QMR 8103	6,096,134N	614,384E	148

TABLE 2.3.1 (Cont.)

ROTARY DRILLING SUMMARY

DRILL HOLE	NORTHINGS	EASTINGS	TOTAL DEPTH (Metres)
QMR 8104	6,096,285N	614,672E	214
QMR 8105	6,096,493N	614,909E	238
QMR 8106	6,096,684N	614,963E	234
QMR 8107	6,098,120N	615,573E	165
QMR 8108	6,096,206N	615,727E	130
QMR 8109	6,098,873N	615,635E	209
QMR 8110	6,099,292N	615,580E	277
QMR 8111	6,098,791N	615,795E	187
QMR 8112	6,099,693N	614,695E	219
QMR 8113	6,099,550N	614,790E	121
QMR 8114	6,099,646N	614,416E	180
QMR 8115	6,096,023N	614,181E	140
QMR 8116	6,096,009N	614,303E	202
QMR 8117	6,099,130N	616,091E	184
QMR 8118	6,099,030N	616,030E	170
QMR 8119	6,099,030N	615,754E	234
QMR 8120	6,098,277N	615,743E	154
QMR 8121	6,098,598N	615,765E	156
QMR 8122	6,097,649N	615,461E	212
QMR 8123	6,097,163N	615,312E	248
			4,294m.
		Grand Total	6,556m.

* Overburden excessive

** Surveyed location not available at printing

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.

Four portals were constructed, three adits driven and two adits successfully sampled for bulk metallurgical coal. 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 sample was washed in a pilot plant and carbonized. This is discussed in the Section 3.0, Quality.

Seams E, F, G were also sampled, in their respective adits for surface oxidized thermal coal. Approximately three tonnes were taken from each seam. Since Seam D is well exosed in the area, a surface oxidized sample was also taken from this seam with a backhoe. The seam section is also presented with the Adit drawings in Appendix I. All four seams were blended and this large bulk sample washed. Combustion tests will be performed on the sample.

TABLE 2.4.1.

ADIT SUMMARY

ADIT	SEAM	TOTAL DEPTH (Metres)	LOCATION (U.T.M.)		DEPTH OF METALLURGICAL SAMPLE	DEPTH OF THERMAL SAMPLE
QMA 8101	G	60	6,095,884N	614,172E	-	18
QMA 8102	E*	109	6,096,290N	613,940E	109	40
QMA 8103	F	6.4	6,095,920N	614,211E	-	3
QMA 8104	G	53	6,095,915N	614,310E	53	-
SURFACE	D*	2	6,095,980N	614,248E	-	2
Total drainage		230.4				

Note: All Adits are located in the Frame Mine Area.

* - not surveyed

2.5 GEOPHYSICAL LOGGING

Geophysical logging was contracted to BPB Instruments Ltd., Calgary, Alberta. The logging was conducted with helicopter portable equipment and tools. The same equipment was used to log all holes, whether they were rotary or diamond, or in open holes or "through the rods".

A full suite of logs were run for most holes, although various constraints such as lack of water or the necessity to log through the rods did not allow some logs to be run. The following is a list of logs run:

Natural Gamma
Density
Resistivity
Dipmeter (directional)
Neuton-Neutron
Sonic

Natural gamma/density was the most common log run. These two logs are displayed together and are used extensively for correlation. Gamma/ neutron- neutron were also displayed together to assist in interseam correlations and fault identifications. Detail density logs provide information for seam thickness determinations.

Although dipmeter surveys (three simultaneous gamma traces) were run on most holes, interpretations were not made for every hole since it was not necessary for geologic interpretation. The directional survey that is associated with the dipmeter only allowed for hole deviations of up to 15° from the perpendicular.

Sonic logs were run on a representation of holes from each mine area. All logs were digitized in the field and are stored at BPB's offices in Calgary.

All geophysical logs are in Appendix III.

2.6 ROAD CONSTRUCTION

Trails to access adit sites and rotary drill sites were primarily existing trails from previous exploration activities. A D-6 Caterpillar contracted from Tompkins Construction, Fort St. John, B.C., was used to reopen these trails and to assist equipment when moving from site to site.

The tractor worked with the drilling and adit crews for the duration of the program, although the cat was not utilized continuously. The cat was also used in reclaiming some of the roads that were of no further use to the program.

2.7 GEOTECHNICAL INVESTIGATIONS

Geotechnical studies, conducted by Golder Associates, Vancouver, B.C., were undertaken in all three Mine areas. The studies included hydrology (surface and ground) and fracture populations. The work was primarily to support the mining feasibility presented in the Stage II report. Therefore, the Golder report is referenced in that report.

2.8 FIELD CAMP

The Babcock Camp located on the southwest corner of Babcock Mountain was reopened in July and utilized until early November as the main centre for exploration activities.

The camp had 49 single rooms. Occupancy averaged at approximately 40 persons. The trailers are rented from Atco Pacific, although some older units are owned by Quintette Coal. Other structures such as the pump house, core storage sheds, and generator sheds are also owned by Quintette and are semipermanent in nature.

Catering was provided by Westcamp Construction Caterers, Edmonton, Alberta. First Aid Attendant and ambulance were provided by Park Ambulance, Fort St. John, B.C.

2.9 PROJECT MANAGEMENT AND PRIMARY CONTRACTORS

The following permanent Denison Mines, Coal Division staff assisted in the 1981 Exploration Program:

R. Sagi	Chief Geologist - Coal Division
D. Johnson	Chief Geologist - Quintette Coal Ltd.
D. Lortie	Geologist - Quintette Coal Ltd.
R. Nellis	Geologist - Coal Division
R. Gunter	Geologist - Coal Division

D.R. Lucas, consulting Geologist, assisted greatly with core logging and coal sampling.

The following is an alphabetical list of the major contractors involved in the program:

Acadia Drilling	Diamond Drilling
BPB Instruments	Geophysical Logging
Birtley Coal & Minerals Testing	Pilot Scale Washing
Garritty & Baker	Rotary Drilling
General Testing Laboratories	Coal Analysis
Golder Associates	Geotechnical
Longyear Canada	Diamond Drilling
Lucas, D.R.	Geological
Northern Mountain Helicopters	Helicopter Support
Pacific Helicopters	Helicopter Support
Park Ambulance	First Aid
Pearson, David	Petography
Target Tunnelling	Adits
Tompkins Construction	Roads
Westcamp Caterers	Catering

3.0 GEOLOGY

3.1 REGIONAL GEOLOGY

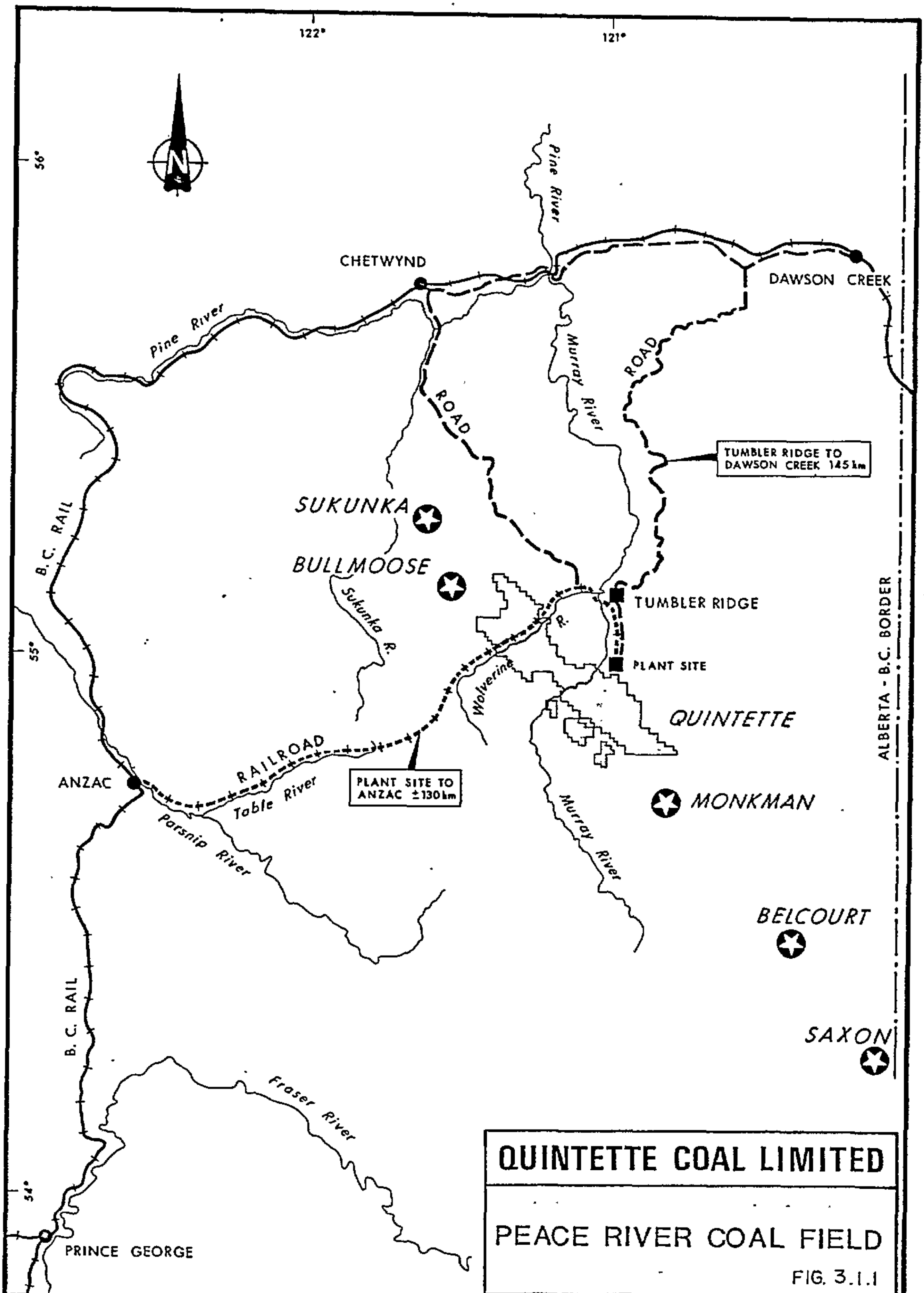
The Quintette coal property lies within the Peace River Coal Field of northeastern British Columbia. The field extends along the inner foothills of the Rocky Mountains from the Prophet River in the north to the Alberta Boundary in the south. Other major coal properties in the field include Sukunka, Bullmoose, 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 1981, in excess of 200 holes (both rotary and core), totalling approximately 35 000 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 (Scott, 1981).

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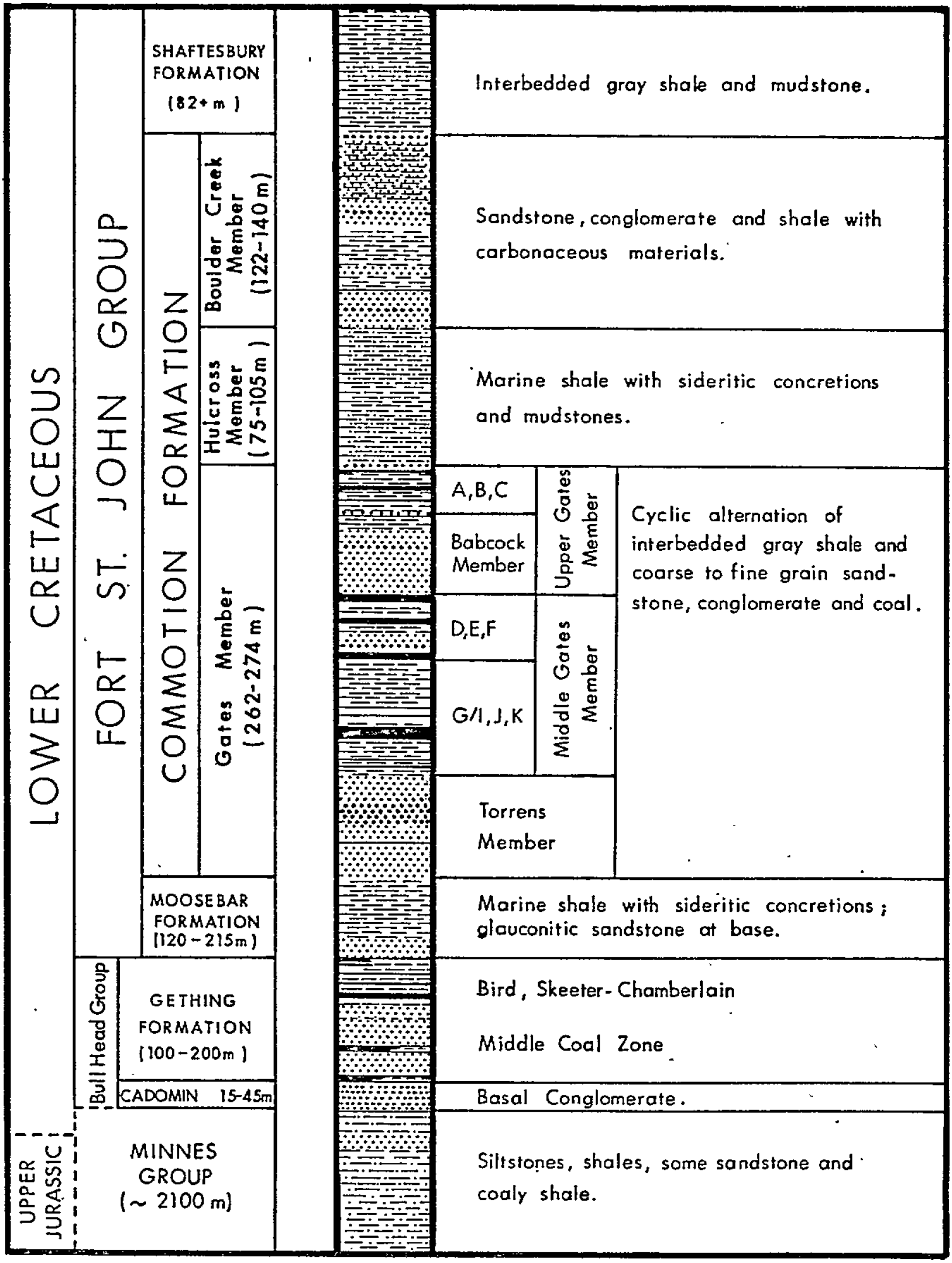
* All elevations given in the report are above sea level (ASL).



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 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 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 Sheriff and Frame areas. It is felt such correlation for the entire property will be possible after more aeras 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 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 and shale, 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.

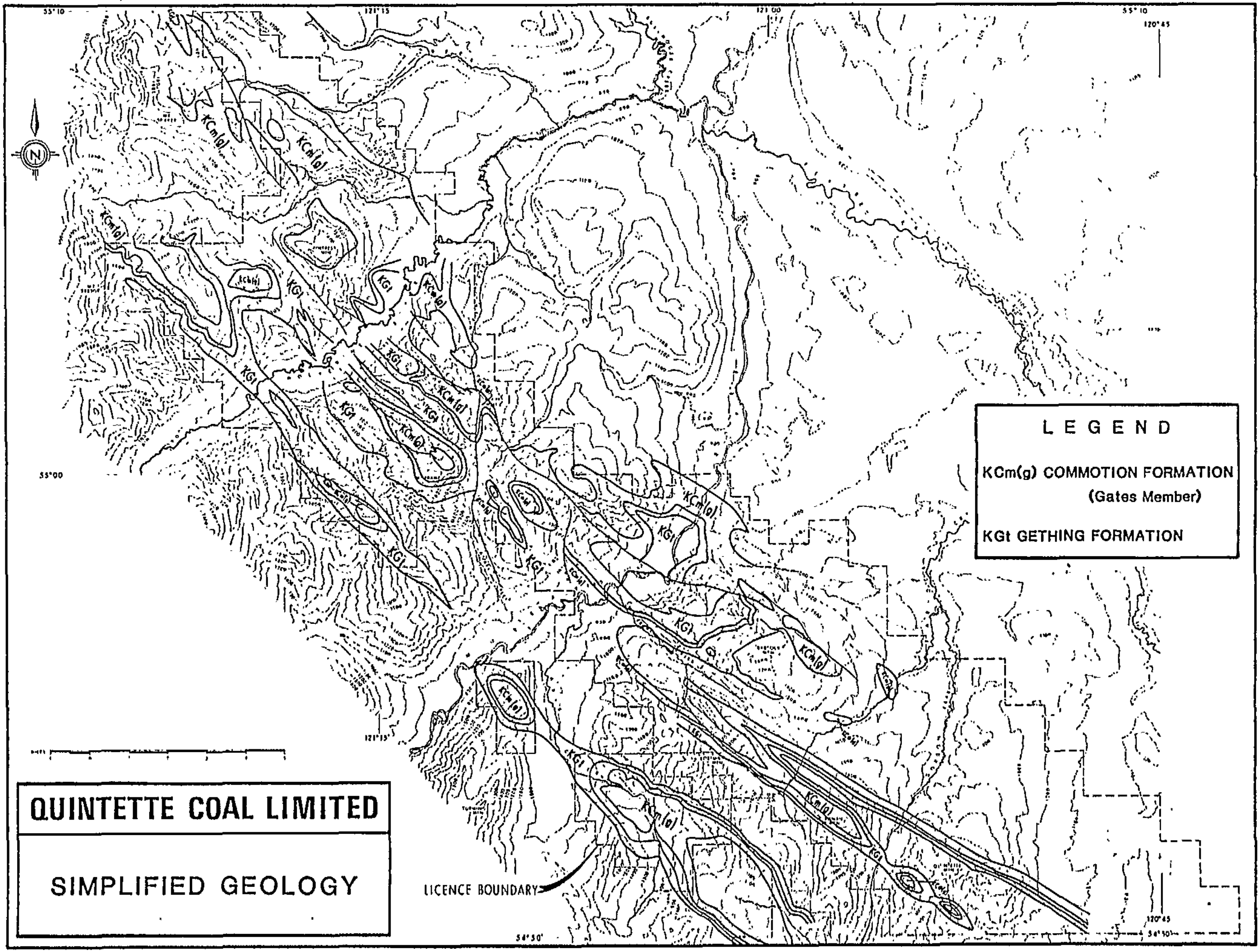
3.1.1.6 Shaftesbury Formation

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.



QUINTETTE COAL LIMITED

SIMPLIFIED GEOLOGY

FIG. 3.1.2.1

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 (Figure 3.1.3.2). In the Sheriff 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, Sheriff Pit, 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 (Sheriff 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 Johnson area where the zone contains 6 m of coal. More exploration is required before the full significance of this zone can be determined.

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 Sheriff Deposit

3.2.1.1 Description

The 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 I). The peaks reach a maximum height of 1775 m and 1740 m, respectively. All mining will be above the 1555 m elevation.

To the end of 1981, 33 rotary and core holes totalling 5357 m have been drilled to define the deposit. In addition, detailed field mapping and trenching has been undertaken. Bulk coal samples have been obtained from adits driven in the deposit.

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

3.2.1.2 Stratigraphy

The stratigraphic sequence exposed in the Sheriff 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 Sheriff. Lithologies of interseam strater 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 Sheriff 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 Sheriff Geology Map, Appendix I).

Each of the predominant 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

SHERIFF

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 30°. The northeastern limb, where exposed at surface, dips in the range of 0° to 20°. 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 a southwesterly direction in the southeast corner of the deposit.

The Mesa Thrust Fault extends along the entire pit in a northwesterly direction and forms the effective northeastern pit limit in the north and central parts of the deposit.

Minor reverse faulting associated with the main thrust system has also been noted on the southwest limb of the Mesa Syncline. These faults parallel the major thrust system, with vertical seam displacements of up to 5 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°.

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 Sheriff and Frame areas. The limbs of the Deputy Syncline dip at an average of approximately 25° and the structural axis plunges gently (5°) to the northwest. Minor faults dipping at 30° to 50° have been inferred on both limbs of Deputy Syncline and in the northwestern portion of the pit. However, due to extensive erosion, the structure is restricted to the Deputy ridge area in the southern part of the deposit.

In the northeastern part of the deposit, east of the Sheriff Fault, the sequence is interpreted to be folded to a vertical attitude in an area known as the Marmot Extension.

Although major structures generally trend northwest, in the northeast corner of the proposed 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 Sheriff deposit are the D, E, G and J seams.

The uppermost seam, D, contains a few sporadically developed thin shale partings and basal coal splits and shows a general thinning trend to 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 Sheriff 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 distinct shale partings 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 in 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 1981, 24 rotary and core holes totalling 4286 m were drilled. Adits were also driven in 1981 to provide bulk metallurgical samples from 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 involves coal seams in 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 Sheriff 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.

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 on the saddle between Frame and Deputy. 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

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 sand-stone with siltstone and minor shale

maximum vertical seam displacements of up to 40 m. Normal dislplacement has been interpreted in one fault due to an interseam thinning identified in drill hole QMR 8106.

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 Coal Seam Development and Correlation

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.

Seam D is overlain by a massive conglomerate and sandstone unit (Babcock Member) and a shale roof which contains 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, E, and E2, have been identified. Seam E1 contains high ash and may not be recoverable; it is separated from E2 by 75 cm of carbonacious claystone.

Seam F is also separated into F1 and F2, however F1 is only a very local development and contains too many partings. Seam F2 is persistent throughout the deposit.

Seam G contains two clearly developed coal splits which could be mined 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, it is not felt that the definition of the mining sections will be difficult.

Seam J is comprised of three main coal splits. Individually, each of these splits is very clean, however, variable thicknesses of shale and minor coal splits separate 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.

Geology map and accompanying geological cross-sections (Appendix I), illustrate the geology of the Babcock deposit.

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. The lithology of interseam strata is summarized in Table 3.2.3.2.1.

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.

TABLE 3.2.3.2.1

SUMMARY OF INTERSEAM STRATA IN THE MIDDLE GATES MEMBER

BABCOCK

Interval	Thickness Range	General Lithology
D Seam Floor to E Seam Roof	9 to 16 m	Generally carbonaceous shale near E seam roof grading upward to siltstone and shales.
E Seam Floor to F Seam Roof	11 to 24 m	Carbonaceous shales near E seam floor and F seam roof, with siltstone and fine sands in the middle.
F Seam Floor to G/I Seam Roof	9 to 57 m	Carbonaceous siltstone and shales with minor sandstones.
G/I Seam Floor to J Seam Roof	5 to 61 m	Conglomerate, sandstone and siltstones in the north grading to siltstones and carbonaceous shale in central and southern areas.
J Seam Floor to K Seam Roof	2 to 11 m	Carbonaceous shale.

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.

4.0 QUALITY

Analysis of coal continued with the 1981 coal recovered in the drilling programs and with the bulk adit samples.

Rotary cuttings and core analysis were conducted by General Testing Laboratories, Vancouver, B.C. Pilot scale washing of thermal and metallurgical adit bulk samples was done by Birtley Coal and Minerals Testing, Calgary, Alberta. Carbonization of clean coal from the adit samples was done by Canmet's Western Research Laboratory, Edmonton, Alberta.

4.1 ROTARY DRILLING, CUTTINGS ANALYSIS

Proximate analysis of the drill cuttings was performed on most coal intersected by the rotary drilling program. The analysis was conducted on the float after a 1.5 S.G. separation. Sulphur analysis was conducted on some samples to verify the consistent low sulphur content of the coals.

The analysis of rotary cuttings is presented in Appendix 1.1 of this text. Table 3.1.1 identifies the area, drill hole, seam, interval and sample tag numbers.

4.2 DIAMOND DRILLING, CORE ANALYSIS

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 low recovery core (-40%) and higher recovery core (+40%) are presented in Figures 4.2.1 and 4.2.2 respectively. The component analysis is the first stage before "Hold for Composite" instructions.

Component and composite analysis results are presented in Appendix 1.3.2 in this text. Table 4.2.1 identifies the drill hole, composite number, tags included in composite, seam and interval. Composite analysis was not performed on some seams due to poor recovery, the seam being too thin (less than 0.50m) or high head ash making the seam uneconomic.

4.3 ADIT BULK SAMPLE ANALYSIS

Adit samples were taken in Frame Mine to test the washability, rheological and chemical properties of coal in this area. Two seams were sampled for metallurgical coal; seams E and G. Four seams were sampled for thermal coal; seams D, E, F and G.

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 and combustion testing results have not been finalized to date and therefore are not included in this report.

The bulk samples (thermal and metallurgical) from Adit QMA 8102, Seam E, were a composite of seams E1 and E2 including the 75m rock split between them. This in part may account for the low yield. The washability of E1 core samples indicates an average yield of less than 40%, which could have depressed the overall E yield.

The bulk samples from the two G seam adits (QMA 8102 and 8104) came from seam G2. Although the seam in each split has a slightly different character, they are readily correlateable.

The D seam thermal sample was taken by backhoe at the surface. The F seam sample was also very near surface, just inside the portal of Adit QMA 8103.

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1981 DRILL CORE ANALYSIS FLOW DIAGRAM FOR POOR CORE RECOVERY SAMPLES

(-40% Core Recovery)

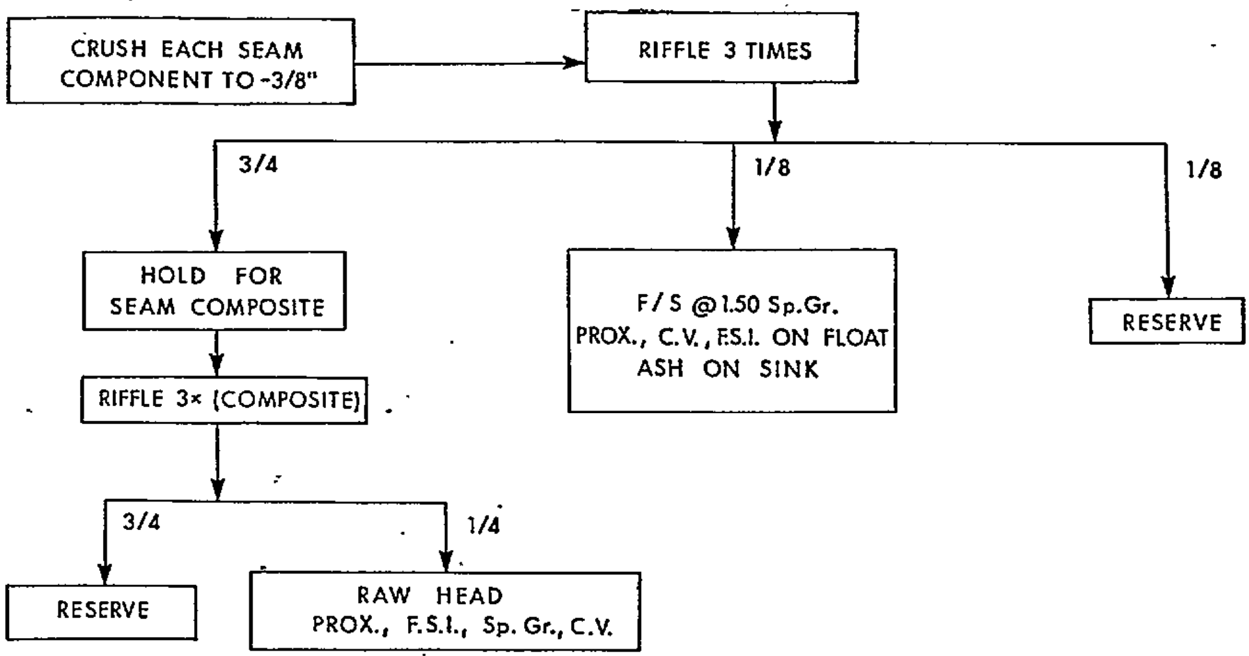

FIGURE 4.2.1

QUINTETTE COAL LIMITED

1981 DRILL CORE ANALYSIS FLOW DIAGRAM

(+40% Core Recovery)

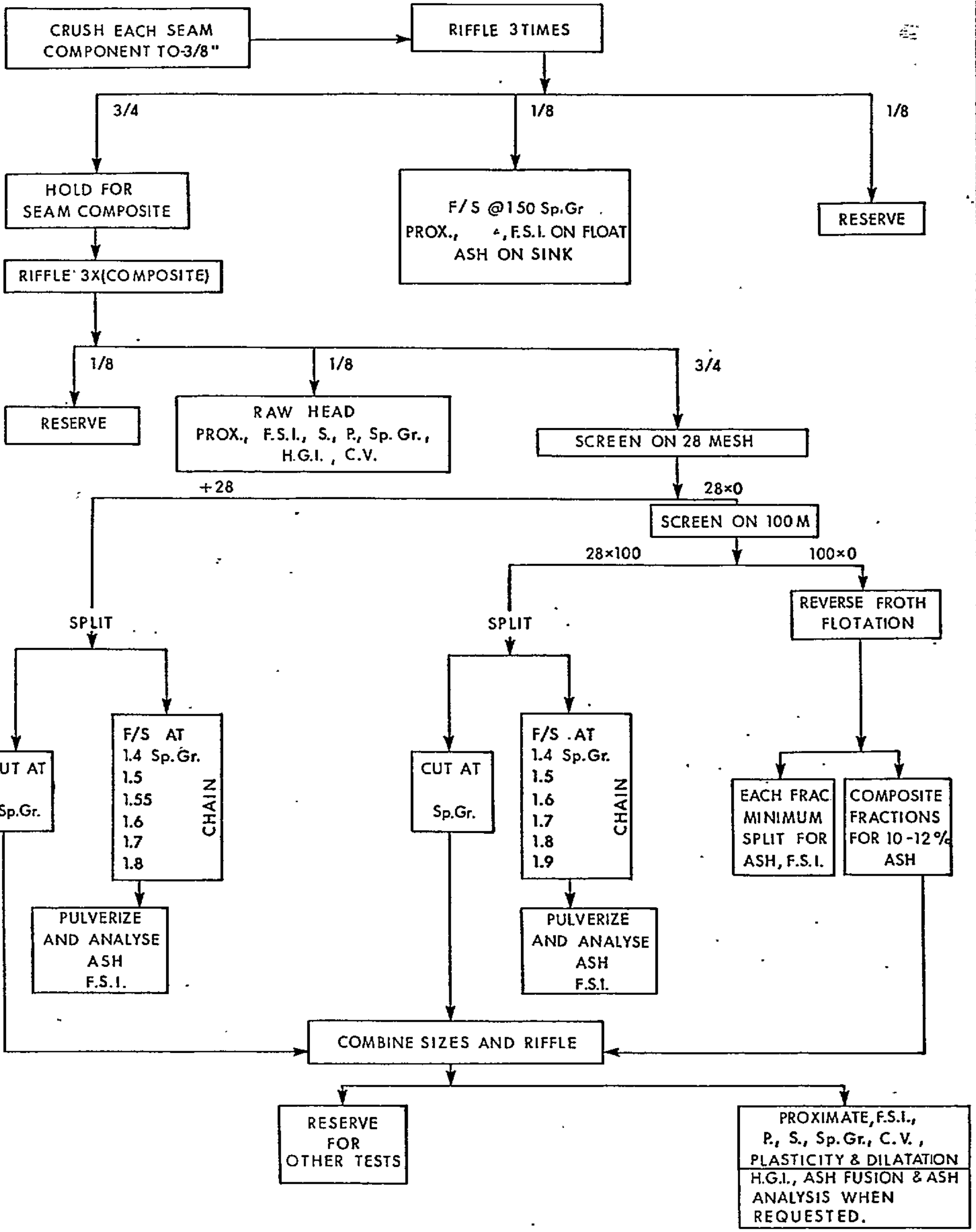

FIGURE 4.2.2

TABLE 4.1.1

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QBR 8101	D?	190.5 - 193.2	1051
QBR 8102	A?	39.2 - 39.7	1052
QBR 8102	A?	40.9 - 41.8	1053
QBR 8102	B?	59.3 - 59.7	1054
QBR 8102	B?	60.4 - 60.8	1055
QBR 8103	D	116.4 - 118.2	1057
QBR 8103	E	132.4 - 135.2	
QBR 8103	F	154.2 - 156.7	1058
QBR 8103	G/I	197.2 - 198.9	1059
QBR 8103	G/I	201.9 - 203.2	1060
QBR 8103	J	205.7 - 202.3	1061
QBR 8103	J	209.2 - 213.4	1062
QBR 8104	D	68.4 - 70.4	1063
QBR 8104	E	87.2 - 90.1	1064
QBR 8104	F	101.2 - 103.9	1065
QBR 8104	G	110.5 - 112.8	1066
QBR 8104		142.0 - 148.0	1067
QBR 8105	J	48.4 - 49.4	1068
QBR 8105	J	50.5 - 51.6	1069
QBR 8105	K1	64.4 - 64.8	1070
QBR 8105	K2	65.7 - 66.5	1070
QBR 8111	No geophysical logs, stopped in overburden		

TABLE 4.1.1. (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QBR 8112	J	20.2 - 21.8	2308
QBR 8112	J	22.6 - 27.2	2309
QBR 8112	K1	29.0 - 29.8	2310
QBR 8112	K2	30.8 - 31.6	2311
QBR 8113	No geophysical logs, stopped in overburden		
QBR 8114	No geophysical logs, stopped in overburden		
QBR 8115	J	23.0 - 29.8	2312
QBR 8115	J Repeat	30.6 - 33.2	2313
QBR 8115	K1	34.8 - 36.0	2314
QBR 8115	K2	39.7 - 40.1	
QBR 8116	Drilled Moosebar, no coal		
QBR 8117	J	12.6 - 14.0	2315
QBR 8117	J	14.8 - 17.0	2316
QBR 8117	K1	19.2 - 20.2	2317
QBR 8118	Gething, no coal		
QBR 8119	B	2.8 - 4.0	2320
QBR 8119	D1	120.4 - 123.0	2321
QBR 8119	D2 (E?)	125.0 - 128.0	2322
QBR 8120	No geophysical logs, stopped in overburden		

TABLE 4.1.1. (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QBR 8121	Gething no major coal		
QBR 8122	Gething no major coal		

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8101	D	17.88 - 20.30	
QMR 8101	E	30.60 - 33.76	
QMR 8101	F	48.37 - 53.16	1056
QMR 8101	G	68.92 - 69.94	1071
QMR 8101	G2	72.00 - 74.65	1072
QMR 8101	J1	106.20 - 106.78	1073
QMR 8101	J2	109.00 - 110.43	1074
QMR 8101	J3	112.80 - 115.28	1075
QMR 8102	D	31.52 - 34.15	1076
QMR 8102	E	42.74 - 48.16	
QMR 8102	F	60.86 - 64.77	
QMR 8102	G1	80.28 - 81.31	1078
QMR 8102	G2	83.32 - 85.97	1079-80
QMR 8102	J1	119.36 - 120.50	1081
QMR 8102	J2	122.21 - 122.87	
QMR 8102	J3	125.44 - 127.53	1082
QMR 8103	D	46.22 - 49.22	1083, 1087
QMR 8103	E	56.30 - 61.16	1089
QMR 8103	F	75.34 - 78.76	1086
QMR 8103	G1	94.46 - 95.45	1088
QMR 8103	G2	97.13 - 99.78	1088
QMR 8103	J1	131.32 - 132.34	
QMR 8103	J2	134.16 - 134.82	
QMR 8103	J3	136.98 - 139.02	1090

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8104	D	106.11 - 108.65	1094
QMR 8104	E	125.38 - 120.20	1095
QMR 8104	F	132.80 - 137.30	1096-1097
QMR 8104	G1	152.05 - 152.69	1098
QMR 8104	G2	154.23 - 156.68	1098
QMR 8104	J1	188.93 - 189.64	1099
QMR 8104	J2	191.08 - 191.72	1099
QMR 8104	J3	194.13 - 196.57	1100
QMR 8105	D	172.25 - 175.20	1101
QMR 8105	E	180.50 - 186.20	1102
QMR 8105	F1	195.41 - 195.74	
QMR 8105	F2	196.30 - 197.40	
QMR 8105	F3	202.59 - 204.53	1103
QMR 8105	F1R	225.25 - 225.94	1104-1105
QMR 8105	F2R	226.68 - 228.30	
QMR 8105	F3R	233.84 - 235.76	
QMR 8106	D	77.40 - 80.62	
QMR 8106	E	87.18 - 92.10	
QMR 8106	F	109.20 - 111.20	
QMR 8106	G1+G2	130.56 - 136.13	
QMR 8106	?	146.33 - 153.65	1106
QMR 8106	G1R	197.72 - 198.64	1107
QMR 8106	G2R	200.62 - 203.84	1108
QMR 8106	J1	219.08 - 220.02	

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8106	J2	221.16 - 221.68	
QMR 8106	J3	222.17 - 223.89	1109
QMR 8115	D	20.49 - 23.43	1134
QMR 8115	E	30.51 - 35.53	1135
QMR 8115	F	48.21 - 51.91	1136
QMR 8115	G1	69.51 - 70.26	1137
QMR 8115	G2	71.98 - 74.44	1137
QMR 8115	J1	107.46 - 108.53	
QMR 8115	J2	110.65 - 111.25	1138
QMR 8115	J3	114.14 - 116.43	1139
QMR 8116	D	20.20 - 22.90	2301
QMR 8116	E	29.40 - 34.12	2302
QMR 8116	F	47.97 - 50.40	2303
QMR 8116	G1	66.06 - 67.04	
QMR 8116	G2	68.37 - 71.36	2304
QMR 8116	J1	106.49 - 107.34	2305
QMR 8116	J2	108.80 - 109.79	2305
QMR 8116	J3	112.38 - 114.41	2306
QMR 8107	E2 repeat	17.8 - 21.2	
QMR 8107	G repeat	47.0 - 48.2	
QMR 8107	D1	64.0 - 65.8	
QMR 8107	D2	69.2 - 72.0	
QMR 8107	E1	78.8 - 88.2	
QMR 8107	E2	89.2 - 93.2	

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8107	E3	97.2 - 98.4	
QMR 8107	G	113.0 - 113.6	
QMR 8107	J	133.1 - 142.8	
QMR 8108	E1	39.4 - 41.0	1187
QMR 8108	E2	42.0 - 44.2	1188
QMR 8108	E3	45.4 - 47.2	1189
QMR 8108	E4	54.0 - 56.0	1190
QMR 8108	G	68.2 - 69.8	
QMR 8108	J	87.0 - 95.8	1191
QMR 8109	D	64.8 - 66.6	1113
QMR 8109	E1	67.8 - 73.8	1113
QMR 8109	E2	77.4 - 85.6	1113
QMR 8109	E3	89.2 - 91.6	1111
QMR 8109	D repeat	96.2 - 102.6	1112
QMR 8109	E1 repeat	104.2 - 105.6	1112
QMR 8109	E2 repeat	106.6 - 119.0	1112
QMR 8109	E3 repeat	124.8 - 126.1	
QMR 8109	G	150.3 - 152.2	
QMR 8109	J	177.2 - 185.6	1110
QMR 8110	D? repeat	29.6 - 32.1	1115
QMR 8110	?	42.4 - 43.2	1120
QMR 8110	?	80.6 - 84.4	1116
QMR 8110	C ?	164.3 - 166.5	1114
QMR 8110	D	177.9 - 180.1	1117

TABLE 4.1.1. (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8110	E1	191.7 - 193.3	
QMR 8110	E2	195.8 - 202.1	1118
QMR 8110	E3	203.7 - 204.6	
QMR 8110	G	213.0 - 214.6	
QMR 8110	J	235.6 - 242.8	1119
QMR 8111	D	40.8 - 41.4	1123
QMR 8111	E1	53.8 - 54.9	
QMR 8111	E2	59.0 - 65.6	1121
QMR 8111	E3 repeat	66.7 - 75.7	1121
QMR 8111	E	83.4 - 91.0	1122
QMR 8111	E4	93.9 - 95.3	
QMR 8111	G1	105.9 - 107.7	1124
QMR 8111	G2	127.1 - 128.0	1125
QMR 8111	J1	150.1 - 151.7	
QMR 8111	J2	155.1 - 161.0	1126
QMR 8111	J3	164.5 - 168.2	1127
QMR 8111	?	182.8 - 183.8	1128
QMR 8112	D	18.0 - 20.5	1192
QMR 8112	E	22.4 - 26.2	1193
QMR 8112	D	60.9 - 61.8	
QMR 8112	C	141.7 - 142.7	
QMR 8112	D1	148.9 - 154.6	1194
QMR 8112	D2	156.3 - 160.9	1194
QMR 8112	D3	163.6 - 164.7	1194
QMR 8112	E1	169.9 - 172.9	1195

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8112	E2	173.8 - 186.16	1195
QMR 8112	E3	187.7 - 189.3	
QMR 8112	G	195.7 - 197.1	1196
QMR 8113	D	17.2 - 19.9	1197
QMR 8113	E	22.7 - 23.5	1198
QMR 8113	E	27.1 - 42.0	1199,1200,1205
QMR 8113	E	43.1 - 46.2	1206
QMR 8113	E	48.3 - 49.6	
QMR 8113	G	63.7 - 65.3	1207
QMR 8113	J	82.7 - 83.2	
QMR 8113	J	85.2 - 87.1	1208
QMR 8113	J	90.4 - 94.5	1209
QMR 8114	D	19.5 - 22.4	1129
QMR 8114	E	23.9 - 24.7	
QMR 8114	E	26.2 - 31.3	
QMR 8114	E	33.9 - 34.9	1130
QMR 8114	G	43.1 - 44.1	1131
QMR 8114	J?	65.2 - 67.3	1132
QMR 8117	D	5.4 - 6.4	1210
QMR 8117	E1	9.8 - 12.9	
QMR 8117	E2	14.2 - 23.1	1211
QMR 8117	D repeat	91.6 - 93.0	
QMR 8117	?	95.0 - 97.4	1212
QMR 8117	E1 repeat	99.1 - 103.8	1213

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8117	E2 repeat	104.8 - 110.9	1214
QMR 8117	E3	111.9 - 118.8	
QMR 8117	E4 repeat	122.9 - 125.9	
QMR 8117	E4	130.9 - 132.4	
QMR 8117	G	149.5 - 150.8	
QMR 8118	D	41.1 - 42.3	
QMR 8118	E1	45.1 - 58.0	1215
QMR 8118	E2	60.0 - 61.2	
QMR 8118	G	71.5 - 73.8	1216
QMR 8118	J	122.7 - 131.1	1217
QMR 8119	C?	49.7 - 51.1	1218
QMR 8119	D	59.3 - 61.5	1219
QMR 8119	E1	71.8 - 76.3	1220
QMR 8119	E2	78.9 - 80.1	
QMR 8119	E1 repeat	146.9 - 148.2	
QMR 8119	E2 repeat	150.1 - 151.8	
QMR 8119	E3	153.9 - 155.0	
QMR 8119	E4	156.8 - 158.0	
QMR 8119	G	167.8 - 168.9	
QMR 8119	J	188.0 - 192.7	
QMR 8120	E	6.5 - 8.2	
QMR 8120	G	20.4 - 22.2	
QMR 8120	J	45.2 - 55.4	

TABLE 4.1.1 (Cont.)

ROTARY DRILLING - COAL INTERSECTION SUMMARY

DRILL HOLE	SEAM	INTERSECTION	SAMPLE TAG #
QMR 8121	D	8.2 - 9.2	
QMR 8121	E	11.2 - 15.2	1221
QMR 8121	E	15.9 - 23.6	1222
QMR 8121	E	26.5 - 27.8	
QMR 8121	G	38.7 - 40.3	1223
QMR 8121	J	60.1 - 71.4	1224,1225
QMR 8122	Gething coal;	27.4 - 28.6	1226
QMR 8122		56.0 - 57.6	1227
QMR 8122		85.6 - 86.4	1228
QMR 8123	Gething - no major coal		