QUINTETTE COAL LIMITED

MARCH 1976

SUMMARY REPORT

GEOLOGY and RESERVES

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PREFACE

This report has been prepared as a summary of the results of the geological exploration that has been completed on the coal licenses held by Quintette Coal Limited since their acquisition in 1969 and 1970 through to the end of 1975. The preparation of this report has been a joint effort of the staff of Denison Mines (B.C.) Limited, the project manager, and Mitsui Mining Company. Denison staff have had primary responsibility for presenting the 1975 data on surface mineable reserves, the reserve summaries, and the text, while Mitsui's effort has been directed towards the documentation of the underground reserves.

Much of the data on which this report is based has been presented in earlier reports for 1971, 1972, and 1973, while detailed reports for 1974 and 1975 are presented here as appendices.

The following is a list of the more significant preceding reports:

Quintette Project March 15, 1972	Interim Regional Report
Quintette Joint Venture August 1971 to February 1972	Wolverine Area
Quintette Joint Venture March 1972 to April 1972	Five Cabin Area
Quintette Joint Venture May 1973	Second Interim Report Babcock Area

Report on the Geological Exploration of the Babcock Property
August to November 1973

Report on the Geological Exploration of the Babcock Property
June to September 1974 (See also Appendix B)

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Babcock Geology	1"=1000'	1	QNTT 76-9001-R01	" "
Babcock Cross Sections	1"=1000'	3	QNTT 76-9002-R01	" "
Structure and Reserves -Babcock Area	1"-1000'	1	QNTT 76-9003-R01	" "
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SUMMARY

The Quintette project coal licenses are located approximately 80km (50 miles) south of Chetwynd, British Columbia and 105km (65 miles) southwest of Dawson Creek, British Columbia. The licence areas are divided into four major blocks in which various amounts of exploration and development work have been completed. These blocks constitute the Babcock, Murray, Wolverine and Five Cabin areas.

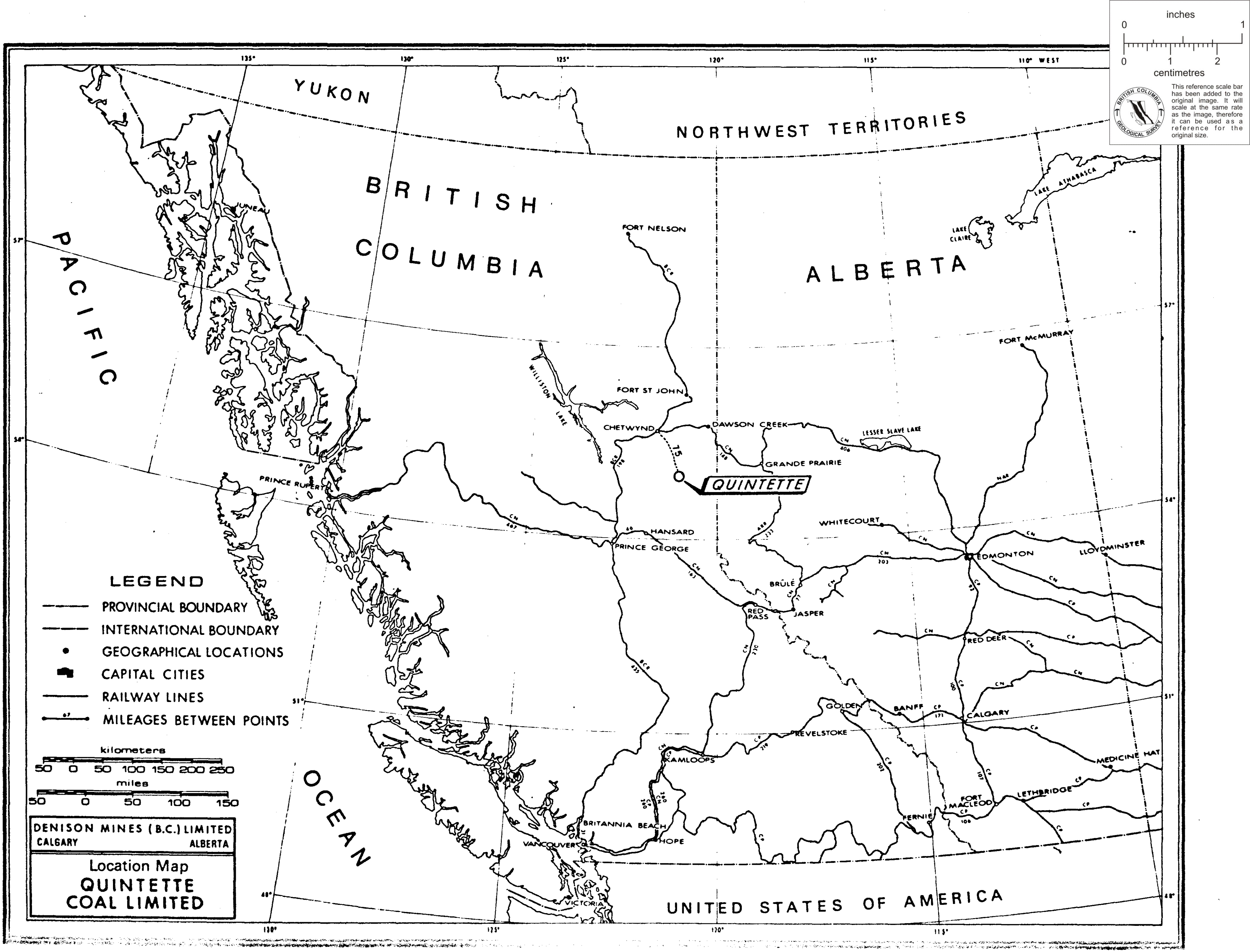
Over 2,500 million metric tons of theoretical coal reserve are estimated to be available within the entire Quintette property. At present, mining plans are being developed for the Babcock and Murray areas only. In the first stage, these mine plans will access 186 million tons of the theoretical coal reserve, to provide 105 million tons of clean coal.

It is important to note that 61 million tons of clean coal will come from the open pits: two of which, Windy and Roman Mountain, are at Babcock; and the other two of which, Sheriff and Frame, are in the Murray area. Preliminary indications are that this coal is available at acceptable strip ratios.

The coal in the present mine plans will all come from seams in the Gates Member of the Commotion Formation. Analytical data from widely separated areas indicates that the mine product will be a medium volatile coal with consistently good to excellent coking characteristics and that the volatile content can be maintained within a narrow range. Low volatile coking coals may also be available from the Gething Formation coal seams. There are presently no plans to mine these seams, which constitute about 25 percent of the total theoretical coal reserve, as they have not yet been analyzed in sufficient detail, but there are indications that some seams may contain

low volatile coals with Free Swelling indices of 5 or 6.

The proposed mine sites are located within relatively simple geological structures which have been mapped in some detail, allowing seam correlations within each proposed pit area to be accomplished with a high degree of reliability.



YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
PACIFIC
OCEAN
UNITED STATES OF AMERICA
JUNEAU
FORT NELSON
LAKE ATHABASCA
LAKE CLAIRE
FORT McMURRAY
WILLISTON LAKE
FORT ST JOHN
CHETWYND
DAWSON CREEK
LESSER SLAVE LAKE
GRANDE PRAIRIE
QUINTETTE
PRINCE RUPERT
WHITECOURT
HANSARD
PRINCE GEORGE
EDMONTON
LLOYDMINSTER
BRÛLÉ
RED PASS
JASPER
RED DEER
GOLDEN
BANFF
CALGARY
REVELSTOKE
KAMLOOPS
MEDICINE HAT
FORT MACLEOD
LETHBRIDGE
FERNIE
BRITANNIA BEACH
HOPE
VANCOUVER
VICTORIA
LEGEND
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
GEOGRAPHICAL LOCATIONS
CAPITAL CITIES
RAILWAY LINES
MILEAGES BETWEEN POINTS
kilometers
50 0 50 100 150 200 250
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DENISON MINES (B.C.) LIMITED
CALGARY ALBERTA
Location Map
QUINTETTE COAL LIMITED
inches
centimetres
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BRITISH COLUMBIA GEOLOGICAL SURVEY

LOCATION AND ACCESS

PROPERTY LOCATION AND ACCESS

The Quintette property is located, in a direct line, about 105km (65 miles) southwest of Dawson Creek, British Columbia and about 80km (50 miles) directly south-southeast of Chetwynd, British Columbia. The present road distance to Chetwynd from the northern part of the property (Wolverine) is about 105km (65 miles) and the government of British Columbia is now constructing the road from Dawson Creek to within about 5 miles of the property boundary in the south (Babcock area). This new road passes through the proposed townsite at the confluence of the Murray River and Flatbed Creek. The proposed townsite itself is located about 16km (10 miles) northeast of the property boundary and would be about 34km (21 miles) from the proposed Babcock mine and plant site, 16km (10 miles) east of the proposed Wolverine plant site, and about 24km (15 miles) from the Sheriff and Frame pits. (Map 93I and 93P, Back Pocket)

The most probable rail access to the property is along a route south from Chetwynd, up Martin Creek, past Gwillim Lake, and down Bullmoose Creek to the proposed townsite, a distance of about 97km (60 miles). From this point a 16km (10 miles) rail spur would be required to reach the Wolverine plant and an additional 34km (21 miles) spur for the Babcock plant site. (See also Map 93I and 93P in Back Pocket.)

Various small airstrips already exist in the Wolverine and Murray river valleys and in the area between the townsite and Babcock. It is anticipated that a larger airstrip will be required during the mine construction period and the favourable topography between the townsite and the Babcock mine site should enable it to be easily constructed there.

PROPOSED MINE AND PLANT SITE LOCATION AND ACCESS

I. Plant Sites (Reference Maps QNTT-71-100-R11 and 93I/93P)

Although consideration is still being given to a single preparation plant in the Murray River valley, the present concept of mine development on the Quintette property centres around two plant sites, one for 2,000,000 metric tons of annual production in the Wolverine valley and one for 3,000,000 metric tons of annual production in the Babcock area.

The Wolverine plant site would require access and transportation systems to be developed to the Sheriff and Frame pit areas. While this might require approximately 14km of road at 6% grade, other options such as conveyors or alternate plant sites may be considered.

The proposed Babcock plant site is located about 7 or 8km from the Roman Mountain pit and adjacent to the proposed No. 1 mine entries at the southeast end of Babcock Mountain, a few hundred metres northwest of Babcock Creek.

II. Mine Sites (Reference Map QNTT-71-100-R11)

In the Babcock area there are three main mine site proposals: two open pits and one underground mine. The Windy pit and the No. 1 underground mine are contiguous and are located at Babcock Mountain which is south of the Murray River, northeast of Waterfall Creek and northwest of Babcock Creek. The Windy pit is on the northwest face of the mountain where the coal seams are exposed and have open pit mining potential. The initial mining in the No. 1 mine will begin with entries just above Babcock Creek and will extend up-dip until it terminates close to the Windy pit.

The other pit in the Babcock area is at Roman Mountain which is located upstream from the Babcock No. 1 mine and southeast of Babcock Creek. The top of Roman Mountain is at an elevation of 2,000 metres and the plant site is at 1,340 metres. On this basis, a maximum haul road for raw coal of 11km can be expected, although the average haul will be only about 7km from an elevation of about 1,750 metres.

In the Wolverine area at the present time, two pits are contemplated and both are located along a ridge which is formed partly as the divide between the Murray River and Wolverine river drainages and partly as the divide between Mast and Mesa creeks. The Sheriff pit is located on Sheriff Mountain which divides these two creeks and the Frame pit is located about 3km south of it. Both the Frame and Sheriff pits attain altitudes of about 1,700 metres elevation, while the Wolverine River valley is at about 800 metres.

PREVIOUS WORK

Exploration and development work has proceeded on a regular basis on the Quintette property since 1969, shortly after the original licences were acquired. This work first involved diamond drilling at locations many miles apart to test the presence of coal in prospective strata; then regional geological mapping to identify structures suitable for mining; and afterwards more detailed drilling and mapping programs to outline reserves. This work was often accompanied by selective trenching programs and adit driveages that were used to substantiate the continuity and quality of the coal seams.

The following is a very brief summary of the amounts and types of work that have been completed to date.

Babcock Area (including Roman Mountain and Windy pits)

		Feet
Diamond drilling	1971, 1972	17,896
	1973	9,556
	1974	2,733
	1975	4,846
Rotary drilling	1971	6,138
	1975	6,101
Adits (13)	1971, 1972	1,307
Trenching	1971, 1972	1.5 miles
	1973	1.0 miles
	1974	0.5 miles
	1975	1.5 miles

Wolverine Area

		Feet
Diamond drilling	1969, 1970	1,333
	1971, 1972	6,520
	1974	2,005
Trenching	1969, 1970	0.5 miles
	1974	0.2 miles

Murray Area (includes Sheriff and Frame pits)

		Feet
Rotary drilling	1975	1,205
Trenching	1975	2.0 miles

Five Cabin Area

		Feet
Diamond drilling	1969, 1970	1,174
	1971, 1972	1,873
Trenching	1969, 1970	0.3 miles
	1971, 1972	0.2 miles
Adits (1) (Oxidized)	1969, 1970	81 feet

In all, 48,036 feet of diamond core have been drilled, 13,444 feet of rotary drilling completed, 14 adits driven and approximately 6 miles of trenching has been done.

GEOLOGY

REGIONAL GEOLOGY AND COAL ZONE DEVELOPMENT

The regional geology in the area of the Quintette property is shown on Map QNTT-71-100-R11 accompanying this report. This regional geology has been compiled from the detailed and reconnaissance mapping that has been done on the property and, while it is not complete in some areas, it does accurately reflect the style and distribution of the coal bearing formations.

The Quintette property is located within the Rocky Mountain Foothills region and covers most of the land containing coal bearing formations in an area approximately 25 miles long and 10 miles wide in the Peace River district of northern British Columbia.

The Quintette Coal Field is bounded, for the most part, to both the northeast and southwest by large thrust faults which also splay and transect the belt longitudinally, repeating the coal bearing sections a number of times in the 10 mile width.

The Commotion and Gething Formations are the economically important stratigraphic units in the field which extends from Chetwynd, B.C. southeast to the Alberta-British Columbia border. Within this area, coal development is best in the Gates Member of the Commotion Formation, particularly starting around Bullmoose Creek near the northern boundary of the Quintette property and extending southward through the property. Although good coal seams may be present near the northern boundary of the property, aggregate thicknesses of coal 15 metres thick are not attained until the Wolverine River valley on the Quintette property is reached. In the Murray area of the property, along the ridge dividing the Wolverine and Murray River watersheds, the total coal thickness reaches 20 metres or more. It is in this area that the Sheriff and Frame pits developments are proposed.

Further south, on the other side of the Murray River, coal seams in the Babcock and Roman Mountain areas are very consistently developed and an aggregate coal thickness of 15 metres in the Gates Member is also quite common. In the Five Cabin area, west of Babcock and still south of the Murray River, the Gates seams are not as well developed and attain a combined thickness of 7 or 8 metres.

Development of coal seams in the Gething Formation is also consistent throughout most of the Quintette Coal Field. On the Quintette property itself, three or four coal zones have been distinguished, although they are not always all present or particularly well developed in some localities.

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 this zone must be subdivided into a Bird zone and a Skeeter-Chamberlain zone. The Skeeter-Chamberlain zone seldom exceeds 4 metres in combined coal thickness and the Bird seam or zone may contain up to 6 or 7 metres of coal although this has only been observed in the Roman Mountain and Quintette trend parts of the Babcock area.

The middle coal zone of the Gething Formation appears to be the least persistent. It is best known in the Wolverine area where the zone is composed of one 2.5 metre seam, one 1 metre seam, and another seam or split 0.6 metres in thickness. In the Murray (Sheriff/Frame) area these seams are also present but they are thinner. Only one 1 metre seam is present in the middle coal zone in the Five Cabin area and the zone has not yet been tested in the other parts of the property.

The basal coal zone of the Gething Formation appears to be more erratically developed than the other zones. However, it may be economically significant locally where the total coal thickness attains 6 metres. This zone is apparently present only in the northern part of the property. It is most consistently developed in the west Wolverine area where it is about 3 metres thick. The basal coal zone is located just above or in close proximity to the Cadomin conglomerates.

Since it is so close to this zone of high energy sedimentation, it is reasonable to assume that it may not be laterally consistent and that, in those areas where coal is absent, it has been replaced by stratigraphically equivalent conglomerates and sandstones.

REGIONAL STRATIGRAPHY

The stratigraphic succession exposed on the Quintette property ranges from Upper Jurassic to Lower Cretaceous in age and consists of inter-tonguing shales and sands of both marine and continental origin, with most of the coal-bearing strata being from a deltaic environment. The table of formations for the area is outlined on the following page, with formation thickness ranges and general coal zones as outlined by exploration to date. As has been mentioned, coal seams of economic thickness and quality are found in the Gates Member of the Commotion Formation and the Gething Formation.

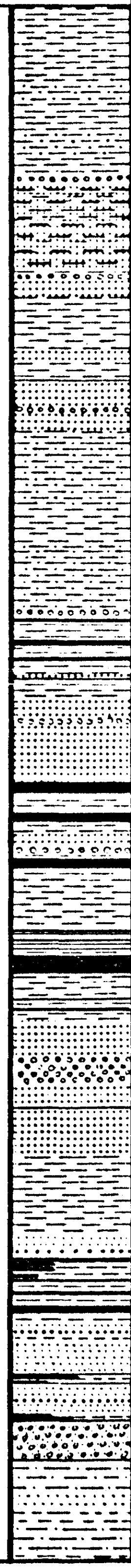
A brief description of the formations encountered at Quintette, from the oldest to youngest, is as follows:

1. Nikanassin Formation

The Nikanassin Formation of the Minnes Group is generally accepted as being Upper Jurassic in age. The formation consists of cyclic beds of argillaceous fine-grained sand, siltstone, carbonaceous shale, and coal. The coal is poorly developed (usually less than 15cm (6") in thickness) and discontinuous. The formation generally occurs under low angle slopes which are tree and bush covered below 1525m (5000') and form grey-grown pebbly talus above 1525m (5000'). Gradation from the Nikanassin Formation to the Cadomin Formation is abrupt, with gradation from fine sand to coarse sand to the sharp contact of cobble conglomerate usually taking place within 6 metres (20 feet). Only the upper portion of this formation is present at Quintette; however, it is reported to range from 150m (500 ft) to 45m (1,500 ft) in thickness.

GENERAL STRATIGRAPHIC SECTION SHOWING GEOLOGICAL FORMATIONS PRESENT ON THE BABCOCK PROPERTY

Series	Group	Formation (Thickness)		Seam	Columnar Section	Description	
LOWER CRETACEOUS	FORT ST. JOHN GROUP	Shaftesbury F. (270 ft +)				Alternation of interbedded dirty gray shale and mudstone with a few thin sandy shale.	
		COMMOTION Formation	Boulder Creek M. (400~460 ft.)			Coarse fine grained, well sorted sandstone, massive conglomerate, and non-marine gray shale with thin layers of carbonaceous materials.	
			Halcross M. (300 ft.)			Dark-gray marine shale and sandy shale with a few sideritic concretions and kaolinitic mudstones.	
			GATES Member (860~900 ft.)	A B C		Upper Gates Interval	Cyclic alternation of interbedded gray shale and coarse-fine grain sandstone, conglomerate and coal. About three coal seams are workable and other six coal seams are unworkable.
						Babcock Member	
				D E F		D.E.F. Zone	
				I J K		Middle Gates Interval	
						Quintette Member	
		Moosebar F (400 ft.)				Dark gray marine shale with sideritic concretions; glauconitic sandstone and pebbles at base	
	BULL HEAD GROUP	Gething F.		X Y Z		Upper Coal Zone includes Bird, Skeeter-Chamberlain Subzones. Alternating sandstone and shale. Middle Coal Zone - Sandstone, shale below glauconitic sandstone.	
		Cadomin F.				Basal Coal Zone. Conglomerates, Sandstones. Shale in coal zone. Conglomerate, massive-chert and quartzite pebbles and cobbles.	
		Nikanassin F				Alternating shiltstone, shales, some sandstone and coaly shale.	



2. <u>Cadomin Formation</u>

The Cadomin Formation and Gething Formation comprise the Bullhead Group of the Lower Cretaceous Series. The Cadomin 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 silicious cement. It is generally believed that this formation was deposited over an extensive area and thus 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. Thcknesses range from 15m (50 feet) to 45m (150 feet).

3. <u>Gething Formation</u>

The Gething Formation 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 conglomeritic beds increasing towards the base of the formation. Four coal zones have been encountered during the course of exploration. The Gething is poorly exposed on the property, with the basal conglomerates forming the only distinctive marker. The formation varies in thickness from 120m (400 feet) to 200m (680 feet). 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 of the Plains area.

4. <u>Moosebar Formation</u>

The Moosebar and Commotion Formations comprise the Ft. St. John Group of Lower Cretaceous age. The basal sequence of the Moosebar Formation consists of homogenous dark grey to black shale, with thin beds of sideritic concretions up to 1 foot 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 from 120m (400 feet) to 215m (700 feet) in thickness. 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.

5. Commotion Formation

Gates Member

The Gates Member (or Formation), which ranges in thickness from 260m (860 feet) to 290m (950 feet), lies conformably over the Moosebar Formation and contains the bulk of the coal reserves explored to date on the Quintette property. The lower portion of the formation consists of massive, light-grey, medium grained sandstone, with minor carbonaceous and conglomeritic horizons, and is tentatively referred to as the Quintette Member. Four, and perhaps five, cyclic sequences of coal deposition occur above the Quintette Member within about 90m (300 feet) of section. Cycles 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 to medium orange rubble where exposed above the treeline. In general, coal seams developed in the upper 3 or 4 zones reach a maximum thickness of about 3m (10 feet), whereas coal seams developed in the lower zone are usually those which show the greatest thickness (up to 3.5 to 12 metres or 12 to 40 feet) and continuity. Excellent correlation of coal seams has been possible over distances up to 8 miles and with continued exploration it is felt such correlation for the entire property will be possible, whereas at present some regional correlations must be considered tentative.

A massive medium to coarse conglomeritic sandstone or pebble conglomerate sequence with an average thickness of about 18 metres (60 feet) overlies the first coal horizon (D seam) in the Middle Gates. The unit, which is known as the Babcock Member, is very resistent as the conglomerates contain a high degree of chert and silicious cement and thus the Member forms a useful marker in locating the Middle Gates coal bearing horizon. A predominantly shale sequence referred to as the Upper Gates Member overlies the Babcock Member. It contains intercalating sandy shale or very fine sandstone and poorly developed coal. Three coal zones (A, B and C) have been located 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 feruginous cement marks the contact of the overlying marine sediments of the Hulcross Formation.

Hulcross Member

The Hulcross Member consists of between 75m (250 feet) and 105m (350 feet) 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 homogenous near the base and contains sideritic concretions.

Boulder Creek Member

The Hulcross marine shale grades conformably into shale, graywacke 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 conglomerate and conglomeritic sandstone. The Upper Boulder Creek lithology closely resembles that of the Babcock Member in the Gates. An average thickness of 165 metres (550 feet) has been measured in this member.

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 major synclines at high elevations and to the northeastern border of the licence area.

REGIONAL GEOLOGICAL STRUCTURE

The regional structure within the Quintette property is best illustrated on the map QNTT-71-100-R11 accompanying this report. This map shows that the primary structural controls are the large thrust faults which define the coal field. Within the Quintette property, in areas which contain the coal-bearing formations, the main geological structures are broad synclines and sharper anticlines which are separated by medium to high angle thrust faults and zones of more highly deformed Nikanassin Formation. The faults dip to the southwest and have vertical displacement in the order of 100 metres. This probably indicates that they are splavs from the major faults system which defines the northeastern boundary of the coal field and may underlie it.

Geological structures and topography, to a large extent, define the coal reserve areas within the Quintette property. This is most obvious in some of the proposed open pits where the coal reserves are entirely contained within synclines which form topographic highs. The Roman Mountain, Sheriff and Frame Pits are good examples of this. The underground reserves are located in large, structurally continuous blocks on the limbs of anticlines and synclines. It is important to note that 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 metres. In any case, the faulting that is present is not expected to have a significant effect on the mineability of the various reserves.

REGIONAL 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. Once they have been identified the two main coal bearing units, the Gates Member and the Gething Formation, are easily distinguished.

The regional correlation of the important formations and coal zones on the Quintette property is presented in drawing QNTT 76-0647-R01 of this report. This drawing, which is composed of composite type sections from each of the major reserve areas, demonstrates the regularity of the development of the strata in this area. It is also evident from this illustration that all of the important coal development within the Gates Member occurs between the persistent and readily defined Babcock and Quintette sandstones.

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

Between these two widespread coal zones there is considerable variation in the E and F seam developments which may effectively constitute a separate coal zone. In the Sheriff area these seams appear to coalesce to form a significant coal zone containing approximately 7 metres of coal.

Seam G is developed below seams E and F, but only in the area from Babcock Mountain north to the Wolverine area. It attains a thickness of about 1 to 2 metres and is only locally significant.

It is now apparent that seam I is essentially a split from seam J as the two seams merge in a number of places, forming very significant widths of mineable coal (Roman Mountain, Quintette trend, Sheriff Pit, and Perry Creek anticline). Seam K is also apparently a split from seam J as the two seams nearly merge in the Little Windy portion of the Windy pit at Babcock.

In the Gething Formation, the major coal zones have not been 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 metres of strata but they 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 metres thick).

The middle coal zone of the Gething Formation has only been documented in a few places and so far it is only known to attain economic thickness in the Wolverine area where one split is about 2.5 metres thick. More exploration is required before the full significance of this zone can be determined, particularly in the Meadow prospect in the Murray area where apparently significant subcrops of coal have been found at this stratigraphic level.

The Lower or basal coal zone of the Gething Formation has only been observed persistently in the Wolverine west and Meadow prospect areas. This seam appears to have a thickness of from 3 to 6 metres 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.

REGIONAL RESERVES

The Quintette property is comprised of a number of areas within which varying degrees of exploration and development work have been done. As a consequence, large reserves of medium volatile coking coal and of some low volatile coal have been identified in a variety of potential mining conditions. These reserves now amount to over 2.5 billion metric tons of theoretical coal in place.

Map numbers QNTT-76-0656-R01 and QNTT-76-0657-R01 outline the areas for which reserves have been recently recalculated on the basis of the 1975 mapping and drilling program and earlier drilling and trenching programs. These maps and this reserve calculation combine all the known reserves regardless of the degree to which they have been explored. As a consequence, the reserves associated with the various mining proposals are included in this total resource figure and are not in addition to it.

The total theoretical coal in place reserve for the Quintette property is summarized in the tables on the following pages and the details of the calculations or sources of reserve data are presented in Appendix I. It should, of course, be understood that these reserve estimates are only approximate except in those areas where detailed reserve estimates have been made (i.e. for Babcock, Sheriff, Frame, part of Wolverine, etc.). The basic method of calculation has been to assign a thickness of coal to each area based on a few known measurements in the area or adjacent to it and to apply this coal thickness to the entire area, corrected for a conservatively selected average dip in that area. Areas which are structurally complex have been omitted from the estimates at the present time, even though it is reasonably certain coal seams exist there and may have open pit mining potential.

REGIONAL RESERVES

QUINTETTE COAL LICENCES

TOTAL THEORETICAL COAL IN PLACE *

AREA	GETHING FORMATION (KGt)	GATES MEMBER (KCm(g))	THEORETICAL COAL IN PLACE METRIC TONS x 10^6
Babcock	117	1464	1581
Five Cabin	100	39	139
Murray	166	61	227
Wolverine	239	325	564
Total	622	1889	2511 *

* Theoretical Coal in place represents the basic geological resource of the Quintette licence areas and includes those areas for which detailed reserve calculations have been prepared. Clean coal product availability is not implied as such estimates are provided only in the detailed calculations for specific mine plans.

Specific gravity used = 1.4

QUINTETTE COAL LICENSES

BABCOCK AREA

TOTAL THEORETICAL COAL IN PLACE

AREA	FORMATION	ESTIMATED AGGREGATE COAL THICKNESS	THEORETICAL COAL IN PLACE METRIC TONS x 10^6
Mitsui 1974 Reserve Area	KCm(g)	See detailed calculation 1974 Report	699
	KGt Bird seam		52
Denison 1972 Reserve Area	KCm(g)	See detailed calculation 1972 Report	247
South Roman Mountain Trend	KGt Bird seam	4.6 m	9
Quintette Mountain South	KGt Bird seam	4.6 m	56
	KCm(g)	14.0 m	518
		Babcock area sub-total	1581

QUINTETTE COAL LICENSES

MURRAY AREA

TOTAL THEORETICAL COAL IN PLACE

AREA	FORMATION	ESTIMATED AGGREGATE COAL THICKNESS	THEORETICAL COAL IN PLACE METRIC TONS x 10^6
Murray West	KGt Bird, and Skeeter/Chamberlain and basal coal	5.5 m.	40
Meadow	KGt Bird, and Skeeter/Chamberlain seams and basal coal	12.6 m.	126
Sheriff	KCm(g)	12.5 m. See Appendix A	36
Frame	KCm(g)	20.0 m. See Appendix A	25
		Murray area sub-total	227

QUINTETTE COAL LICENSES

WOLVERINE AREA

TOTAL THEORETICAL COAL IN PLACE

AREA	FORMATION	ESTIMATED AGGREGATE COAL THICKNESS	THEORETICAL COAL IN PLACE METRIC TONS x 10^6
Wolverine West	KCm(g)	10 m.	101
	KGt basal + middle coals	5 m.	56
Fortress Mountain	KCm(g)	6.7 m.	224
	KGt Skeeter and Chamberlain seams	4.7 m.	183
		Wolverine area sub-total	564

QUINTETTE COAL LICENSES

FIVE CABIN AREA

TOTAL THEORETICAL COAL IN PLACE

AREA	FORMATION	ESTIMATED AGGREGATE COAL THICKNESS	THEORETICAL COAL IN PLACE METRIC TONS x 10^6
Five Cabin North	KCm (g)	7.5 m.	21
	KGt Skeeter/Chamberlain Seam	3.3 m.	57
Five Cabin South	KCm (g)	7.0 m.	18
	KGt Skeeter/Chamberlain Seam	3.3 m.	27
Turning Mountain	KGt Skeeter/Chamberlain Seam	3.3 m.	16
		Five Cabin area sub-total	139

REGIONAL COAL QUALITY

Gates Member Coal

I. Volatile Content

Within the Gates Member of the Commotion Formation, coal quality is usually consistent. This consistency is best exemplified by the d.a.f. volatile content. From seam J at the base to seam D at the top, there is a small but regular increase in the volatile content. The range of variation apparently varies, on the average, from as little as 3% at Sheriff and Frame to as much as 6 1/2% at Roman Mountain. Individual seams are usually quite consistent within a pit but they also vary somewhat from one pit to another. The dry basis volatile content of seam J, which constitutes over half the mineable reserves outlined to date at Quintette, ranges from about 22.1% in the Number 1 underground mine and at the Windy pit to 23.2% at Roman Mountain and 24.0% at the Sheriff and Frame pit areas. This narrow 2% range in the average variation of the volatile content of the seam is generally characteristic of the Gates seams, although slightly higher variations may be present in some of the less important upper seams.

The following list summarizes the expected weighted average ash and volatile content of the clean coal from each of the proposed mine areas and has been calculated using the numerical averages of coal quality for each seam as presented in the coal quality tables following this section, then weighting them on the basis of the total clean coal product expected from each seam. (see reserve tables)

Area	Seam to be mined	Weighted average ash (d.b.)	Weighted average volatiles
No. 1 Mine	D, F, J	7.18	23.11
Windy Pit	D, E, F, G, J, K	7.45	22.82
Roman Mtn.	D, E, F, I/J	7.02	23.82
Sheriff/Frame	D, E, F, G, J	7.20	24.50 -insufficient data estimated only.

II. Ash

All of the data received to date indicates that a clean coal ash content of about 7 to 8% can be achieved for the coals on the Quintette property while maintaining a recovery of about 70% or better. This subject is treated in more detail in the section on coal preparation.

III. Sulphur

The average sulphur content of the Gates Member seams is below 0.5% for each proposed mining area. Seam J which is the predominant contributor to reserves is usually between 0.3 and 0.4% or less and therefore it is reasonable to assume that the sulphur content of the clean coal product will not exceed 0.5%.

IV. Phosphorous

The reported phosphorous analyses (second Interim Report, May 1973) from the No. 1 Mine and Windy pit areas at Babcock indicated that some seams would have moderately high phosphorous content. Seam E had an average of 0.10% and seam F 0.08%. On the other hand, seams D and J had phosphorous contents of 0.04% and 0.03%. Subsequently, analyses have been received from the Roman Mountain and the Sheriff/Frame areas which indicate that phosphorous contents of the coals will be even lower from these areas, particularly from the Sheriff and Frame pits where this preliminary date indicates that the phosphorous content may be as low as 0.01 or 0.02%. At Roman Mountain it averages 0.032 and reaches a maximum of 0.04 in seam F.

V. Free Swelling Index (F.S.I.)

The Free Swelling Indices of the Gates Member coal seams do not seem to vary significantly, although there is some indication that they become higher with higher volatile content. In all of the areas tested, F.S.I.'s on clean coal range from 5 or 5 1/2 to 8 or 8 1/2 and they are generally in the 6 to 7 range.

Note: Various maps showing the distribution and variation of dmmf volatiles, sulphur, and F.S.I. in the Windy and Roman pits are presented in Appendix A of this report. Similar maps have been presented for the No. 1 Mine area in the May, 1973 Second Interim Report. Summary tables of coal quality are also presented on the pages following this section, including tables of estimated Gates Member coal quality for the Wolverine and Five Cabin areas.

GATES MEMBER COAL

SUMMARY OF AVERAGE PRODUCT COAL QUALITY
WINDY PIT

Seam	Ash %	Vol %	d.a.f. Vol %	R.M. %	S. %	F.S.I.	Theoretical Yield	Sp. Gr.	% Core Recovery
	Proximate Analysis of Product (Theoretical Clean Coal)								
D (1975)	7.23	25.23	26.86	0.63	0.61	5.0-7.0	73.06	1.62	90.84
D (Pre-1975)	7.24	25.82	27.32	0.74	1.05	5.5-7.0	76.85	1.60	
E (1975)	7.86	24.72	26.36	0.56	0.45	7.0-8.0	52.70	1.53	90.30
E (Pre-1975)	7.56	24.03	25.65	0.87	0.35	6.5-7.5	62.35	1.64	
F (1975)	6.70	24.50	25.85	0.48	0.41	6.5-7.5	78.20	1.77	85.56
F (Pre-1975)	6.12	23.86	25.16	0.84	0.35	7.0-8.5	76.28	1.75	
G (1975)	7.46	23.42	24.79	0.43	0.48	7.0-8.0	62.61	1.44	89.97
G (Pre-1975)	9.70	22.85	24.72	0.84	0.50	5.0-8.0	67.31	1.52	
J (1975)	7.29	21.71	22.97	0.57	0.31	6.0-7.0	68.38	152	94.39
J (Pre-1975)	7.74	22.38	23.88	0.81	0.25	6.0-8.5	66.73	1.51	
K (1975)	7.22	21.38	22.55	0.57	0.48	5.0-8.5	78.69	1.62	90.79
Total Avg.	7.47	23.64	25.10	0.67	0.48	5.0-8.5	69.38	1.59	89.48

GATES MEMBER COAL

SUMMARY OF AVERAGE PRODUCT COAL QUALITY
ROMAN MOUNTAIN PIT

Proximate Analysis of Product (Theoretical Clean Coal)

Seam	Ash %	V.M.%	d.m.m.f. V.M. %	R.M.%	S %	P %	F.S.I.	Theoretical Yield	Sp.Gr.	% Core Recovery
D	7.03	27.35	29.17	0.92	0.40	0.038	5.5	68.40	1.55	94.1
E	6.99	24.51	25.98	0.77	0.48	0.023	7.5	80.76	1.73	80.1
F	7.07	25.25	26.80	0.73	0.48	0.040	8.0	67.07	1.61	75.1
I	7.07	23.25	24.67	0.73	0.29	0.039	7.5	77.57	1.50	58.6
J	6.97	23.10	24.46	0.75	0.38	0.020	6.0	84.93	1.67	74.6
K	5.19	21.71	22.52	0.62	0.63	--	6.0	88.23	2.00	35.0
Total Avg.	6.72	24.12	25.51	0.75	0.44	0.032	5.5 to 8.0	77.83	1.68	69.6

GATES MEMBER COAL

PRELIMINARY ESTIMATE* OF PRODUCT COAL QUALITY
(* Based on 2 Rotary Drill Holes)

SHERIFF AND FRAME PITS

Seam	Location	Proximate Analysis of Product (Theoretical Clean Coal)						
		Ash %	Vol.%	d.m.m.f. Vol. %	R.M.%	S %	P %	F.S.I.
D	Sheriff	7.75	22.26	24.01	1.56	0.40	-	N/A
E	Sheriff	7.24	25.80	27.40	0.54	0.42	0.004	8.0
	Frame	8.04	25.30	27.14	0.81	0.36	0.018	6.5
F	Frame	7.24	25.10	26.68	0.81	0.54	0.010	8.0
G	Sheriff	6.27	24.85	26.03	0.30	0.62	0.005	8.0
	Frame	7.16	24.35	25.85	0.53	0.24	0.024	6.0
J	Sheriff	7.06	24.31	25.79	0.54	0.24	0.005	5.5
	Frame	7.08	23.66	25.15	0.98	0.42	-	1.5
	Average	7.23	24.45	26.01	0.76	0.41	0.011	N.A. to 8.0

GATES MEMBER COAL

SUMMARY OF AVERAGE PRODUCT COAL QUALITY
NO. 1 MINE AREA*

Seam	Ash %	Vol.%	d.a.f. Vol. %	R.M. %	S. %	F.S.I.	Theoretical Yield
D	7.44	25.49	26.70	0.83	0.61	5 1/2	76.9
E	7.40	24.64	26.27	0.84	0.25	7	64.8
F	7.10	23.99	25.87	0.90	0.34	7 1/2	78.4
G	8.08	23.75	24.46	0.78	0.42	7 1/2	59.0
I	7.33	21.99	23.19	0.98	0.27	7 1/2	68.3
J	7.13	22.14	23.45	0.85	0.22	7	74.6
Numerical Average	7.41	23.67	24.99	0.86	0.35	7	70.3

* re-formated from Second Interim Report, May 1973

GATES MEMBER COAL

PRELIMINARY ESTIMATES OF POSSIBLE PRODUCT COAL QUALITY
WOLVERINE AND FIVE CABIN AREAS

	Ash	Volatile	Sulphur	Phos.	F.S.I.	Yield
Wolverine						
Upper Gates (DEF)	7.25	25.64	0.51	--	8	55
Lower Gates (IJK)(D.7401)	7.22	23.14	0.36	0.003	8	65
Lower Gates (IJK) (Avg. 1972)	6.83	22.79	0.30	--	6	79
Five Cabin						
Upper Gates (DEF) (Seam F.C. #5)	7.30	27.24	0.27	--	6 1/2	77
Lower Gates (IJK) (Seam F.C. #1)	7.58	29.10	0.52	0.009	8	58

REGIONAL COAL QUALITY

Gething Formation Coal

1. General Statement

Since exploration on the Quintette property has been concentrated on the coals in the Gates Member of the Commotion Formation, only a limited amount of data is available on the quality of the Gething Formation coal seams. These seams have been tested with occasional drill holes in the Five Cabin, Babcock (Quintette trend) and Wolverine areas. The following table is a representative selection of the analytical results from seam intersections in these areas.

Gething Coals - Selected Analyses

Area and Seam	Clean Coal Analysis						
	Ash	Volatile	S.	P.	F.S.I.	Sp.G.	Yield
Babcock-Quintette							
Bird Seam	6.36	20.55	0.77	0.003	5 1/2	1.69	81
Five Cabin							
Skt.-Chamb.	6.64	20.06	0.15	0.008	3 1/2	--	93
Wolverine	6.49	17.01	0.26	--	5	1.91	70
Skeeter	6.06	18.00	0.46	--	6	1.96	78
	6.68	17.45	0.70	--	5	2.05	97
Wolverine	6.50	18.45	0.49	--	4	1.95	95
Chamberlain	6.44	17.07	0.28	--	5	1.92	89
	5.44	17.10	0.48	--	4 1/2	2.04	98
Wolverine							
Middle zone(U)	6.56	16.58	0.31	0.022	2	1.70	94
Middle zone(L)	9.96	16.11	0.48	0.020	3 1/2	--	60

II. Volatile Content

As can be seen from the foregoing tabulation, the dry basis volatile content of the Gething seams can be expected to be consistently less than 20%, and as low as 16% in the middle coal zone.

No analyses are available from the basal coal zone, but the volatile content there is expected to be about 15%, considering the stratigraphic level of that zone. This may not, however, be the case in the Meadow prospect as there may also be a tendency for the volatiles to increase to the west. If this is the case, the volatile content of the basal coal zone may be higher there.

III. Ash

One of the welcome characteristics of the coal zones is that they apparently can be cleaned easily to 7% ash with relatively high recoveries.

IV. Sulphur

Although there are indications that the sulphur content of the Bird seam may be locally high, detailed analyses of the constituent types of sulphur indicate that it is mostly pyritic in form. Clean coal from this seam, in the Babcock (Quintette trend) area may have about 0.8% sulphur. Other seams in the Gething Formation appear to have average sulphur contents of 0.5% or less.

V. Phosphorous

Only a few tests for phosphorous have been made on Gething seams. The phosphorous content appears to be acceptable as the highest analysis was 0.022%. The Bird seam at Babcock and the Skeeter-Chamberlain seam at Five Cabin had particularly low phosphorous contents (0.003% and 0.008% respectively).

VI. Free Swelling Index

The Free Swelling indices of the Gething coals are generally below 6. While a diminishing F.S.I. might be expected with decreasing volatiles, this concept is not supported by the data received to date. In the Wolverine area, the Skeeter seam has an F.S.I. of from 5 to 6 and volatiles of 17-18%. In the Five Cabin area, the same coal zone has 20% volatiles and an F.S.I. of 3 1/2. Considerably more work will be required to ascertain the swelling and coking characteristics of the Gething coals.

RESERVES

REGIONAL COKING CHARACTERISTICS

Coking Quality

All of the data on the extensive coking tests from coals in the Babcock area was presented in the Second Interim Report of May, 1973. Since that time no additional measurements of coking characteristics have been made except for the Petrographic tests referred to in the previous section and the fluidity measurements that are presented in the Mitsui report for 1974 (Appendix B of this report).

There is every indication that the coking quality of the Gates coals from the Quintette property will not vary much from those shown in the following summary table:

	Range of Maximum Fluidity dd/m	Range and Average J.I.S. Tumbler Test (From Japan) (15mm)		Range of Stability Factors (From Ottawa, 1974)
D Seam	14-275	91.4-94.4	92.8	35.3* -44.0
E Seam	25-303			54.8* -60.9
F Seam	7-435	91.3-94.4	93.5	52.1 -59.5
J Seam	5-328	91.6-94.9	93.5 (upper)	56.4 -57.8
		91.1-94.8	93.4 (lower)	

* oxidized sample.

Petrographic Data

Various seam samples have been selected from the major reserve areas for petrographic analysis and the data from these tests is summarized in two sets of tables on the following pages. These tables combine the essential data from Mitsui Mining's laboratory (1972 and 1976) and the data from the Department of Energy, Mines and Resources in Ottawa. The data from the two laboratories is not combined because of apparent differences that may be due to procedural variations or to peculiarities of clean coal product from some rotary drill hole samples.

Throughout both sets of data a consistent improvement in the mean reflectance is evident with decreasing stratigraphic level. In the Mitsui data, for example, the average mean reflectance varies from 1.20 in Seam D to 1.31 in Seam J. The variation in total reactive content appears to be less regular. Again, in the Mitsui data, Seam D reactives are low (average 55.0) while Seam J reactives are good (average 62.8), but they are better in Seam E (65.0) and exceptionally good in Seam F (70.4). Similar relationships are evident in the data from Ottawa. As noted in the section on correlation, Seam E in the Sheriff pit may actually be Seam F. Such a correlation would be supported by the petrographic data and suggests that this seam, which forms a major portion of the Sheriff reserves, will be an excellent coking coal.

The similarity of the petrographic data for a given seam or stratigraphic level in such widely separated areas as Roman Mountain, Babcock, Sheriff, and Frame pits is a very good indication that the coking quality of the Gates coals from the Quintette property will be consistently good to excellent.

TABLE OF PETROGRAPHIC ANALYSES

(From Mitsui Mining, 1972, 1976)

	Total Reactives	Mean Reflectance	Balance Index	Strength Index	Calculated Strength
Seam D					
Roman Mtn.	55.5	1.19	2.45	4.38	42.5
Sheriff	54.6	1.20	2.77	4.78	44.0
Babcock	54.9	1.22	2.87	4.86	45.0
Average	55.0	1.20	2.70	4.67	43.8
Seam E					
Roman Mtn.	62.9	1.24	2.00	4.93	52.5
Sheriff (F?)	70.3	1.26	1.46	5.22	61.0
Frame	61.7	1.23	2.08	4.94	52.0
Average	65.0	1.24	1.84	5.03	55.2
Seam F					
Roman Mtn.	72.3	1.30	1.47	5.63	62.0
Frame	71.7	1.24	1.31	5.05	61.5
Babcock	71.2	1.26	1.36	5.11	58.0
Sheriff (G?)	66.3	1.33	2.10	5.82	57.5
Average	70.4	1.28	1.56	5.40	59.8
Seam I					
Roman Mtn.	59.3	1.32	2.84	5.60	51.5
Seam J					
Roman Mtn.	65.3	1.34	2.25	5.89	57.5
Sheriff	59.8	1.33	2.94	5.71	51.5
Frame	61.2	1.24	2.16	4.94	51.5
Babcock (U)	62.0	1.31	2.44	5.54	55.0
Babcock (L)	65.5	1.33	2.15	5.75	57.0
Average	62.8	1.31	2.39	5.57	54.5

TABLE OF PETROGRAPHIC ANALYSIS

FROM THE BABCOCK MOUNTAIN AREA

(from Dept. Energy Mines and Resources, Ottawa)

Seam	Sample Location & Number	Total Reactive Components	Mean Reflectance	Balance Index	Strength Index	Stability Index
D	Adit D-4	62.6	1.16	1.95	4.27	46.0
	Adit D-9	65.9	1.08	1.47	4.03	50.3
	Hole R 7105	68.7	1.17	1.54	4.47	54.0
	Average	65.7	1.14	1.65	4.26	50.1
E	Adit E-8	68.0	1.25	1.90	4.96	57.0
	Adit E-10	66.7	1.19	1.75	4.59	52.6
	Hole R 7103	73.9	1.21	1.29	4.68	60.2
	Hole R 7106	75.5	1.17	1.08	4.53	60.7
	Hole R 7114	72.1	1.15	1.25	4.44	58.2
	Average	71.2	1.19	1.45	4.64	57.7
F	Adit F-1	71.4	1.19	1.40	4.58	57.3
	Adit F-6	71.4	1.24	1.57	4.95	58.0
	Adit F-11	68.4	1.26	1.95	5.07	54.3
	Hole R 7103	76.8	1.24	1.19	4.87	61.9
	Hole R 7106	68.3	1.26	1.95	4.95	53.2
	Hole R 7107	75.7	1.15	1.04	4.48	60.6
	Average	72.0	1.22	1.52	4.82	57.6

TABLE OF PETROGRAPHIC ANALYSIS

... Continued

Seam	Sample Location & Number	Total Reactive Components	Mean Reflectance	Balance Index	Strength Index	Stability Index
G	Adit G-5	70.7	1.21	1.54	4.72	56.7
	Adit G-12	65.7	1.27	2.25	4.94	50.6
	Average	68.2	1.24	1.90	4.83	53.7
I	Hole R 7110	66.2	1.29	2.30	5.11	51.9
	Hole R 7114	76.6	1.16	1.02	4.52	60.9
	Average	71.4	1.23	1.66	4.82	56.4
J	Adit J-14 Main	67.9	1.25	1.93	4.80	53.0
	Adit J-14	65.0	1.21	1.97	4.40	97.5
	Hole R 7106	67.9	1.30	2.18	5.25	53.3
	Hole R 7107	70.6	1.21	1.54	4.64	55.6
	Hole R 7114	64.9	1.25	2.20	4.71	48.7
	Average	67.3	1.24	1.96	4.76	51.6

RESERVES

REGIONAL WASHABILITY

Theoretical Yield and Washabilities

The sink/float analyses and washability data for the Gates coal in the proposed mining areas indicate that this coal will clean easily to provide a coal product with 7 to 8% ash at a yield of about 70% or better. The theoretical yields and coal quality data are presented in the summary tables of average product coal quality. These tables may be considered to be quite conservative, as they relate to theoretical yields and data from sections with core recovery as low as 75% may be included, and it is likely that the lost core sections contain a disproportionate amount of coal as compared to waste. On this basis, it would not be unduly optimistic to expect clean coal recoveries of about 75% in the Number 1 mine, Roman Mountain pit, and Windy pit. There is not yet sufficient data available to estimate the clean coal yield at the Sheriff and Frame pits, but it is apparent that the in-seam dilution from seam E may reduce the yield somewhat, compared to the other proposed mine sites, although the estimated clean coal recovery for the pit as a whole is 75.1% based on a 0.95 wash plant efficiency factor applied to the coal only portion of the seam sections in the Sheriff pit. The same estimate is 69.8% for the Frame pit.

At the Roman Mountain pit, preliminary washability data is available which indicates that the clean coal yields for the I and J seams, with the intervening rock removed, may be as high as 80%. These results are supported by the independent estimate of 81.4% based on applying the 0.95 estimate of wash plant efficiency to the coal portion of the seam logs.

Additional work is required to confirm the present estimates of theoretical yield, particularly in the Sheriff, Frame, and Roman

Mountain areas. On a regional basis, however, it is reasonably certain that the wash characteristics of the Gates coal seams, as a whole, will not vary significantly.

GEOLOGY AND RESERVES

OF

PROPOSED MINING AREAS

SUMMARY

Detailed reserve calculations have been made for the No. 1 underground mine area at Babcock, and the four proposed open pit mine areas: Windy and Roman Mountain at Babcock, and Sheriff and Frame in the Murray area. These reserve calculations, which are summarized in the table on the following page, indicate that 105.3 million metric tons of clean coal are available from the mine sites that are presently contemplated. Of this amount, 26.8 million tons is available as open pit coal in the Babcock area, 35.0 million tons is present in the Murray area pits (Sheriff and Frame) and 43.5 million tons is available as clean coal product from the first stage of underground mining in seams D, F, and J in the No. 1 underground mine. These reserves are more than sufficient to support coal production at a level of 5 million tons per year over a 20 year period.

The mine sites are all located in relatively simple geological structures. The Sheriff, Frame, and Roman Mountain strata form synclines which are usually only locally faulted, although the Sheriff pit is also terminated to the east by a larger thrust fault. The Windy pit and No. 1 underground mine are contiguous and underlie Babcock Mountain. The structure there is essentially "flat" as dips are usually less than 10 degrees. In the northeast end of the Windy pit the coal seams are repeated by a fairly large fault and smaller associated faults but in the main reserve area only a few small faults with displacements of 10 to 15 metres have been observed.

Although detailed mining plans are not yet available, stripping ratios have been calculated for each pit on the basis of volume of overburden to tons of raw coal mined (including mined dilution) and

QUINTETTE
SUMMARY OF RESERVES
IN
PROPOSED MINE AREAS

OPEN PIT RESERVES

Pit	Theoretical Coal Reserve: Total	Theoretical Coal Reserve: Oxidized	Theoretical Coal Reserve: Unoxidized	Geologically Factored Coal Reserve (m.t. x 10^6) True Coal Thickness - .3m	Estimated Mined Coal Reserve (m.t. x 10^6) -10% Mining Factor	Estimated Clean Coal Reserve (m.t. x 10^6) .95 Wash Plant Efficiency	Mined Raw Coal Strip Ratio m^3/m.t.	Mined Raw Coal Strip Ratio y^3/l.t.	Clean Coal Strip Ratio m^3/m.t.	Clean Coal Strip Ratio y^3/l.t.
Windy	16.255	2.782	13.412	11.613	10.453	9.930	6.14:1	8.16:1	9.18:1	12.20:1
Roman	22.812	1.637	21.175	19.732	17.758	16.870	6.41:1	8.52:1	7.99:1	10.62:1
Sheriff	25.23	9.00	16.23	15.17	13.67	12.99	4.15:1	5.52:1	5.70:1	7.58:1
Frame	36.36	7.27	29.09	25.62	23.06	21.91	10.78:1	14.33:1	15.66:1	18.15:1
TOTALS	100.657	20.689	79.968	72.135	64.941	61.700				

UNDERGROUND RESERVES

	Theoretical Coal Reserve*	Geologically Factored Coal Reserve	Estimated Clean Coal Reserve
D.F.J. 1st Stage	86.169	73.243	42.481
D.F.J. 2nd Stage	70.626	56.500	33.797
TOTALS	156.795	129.743	76.278

TOTAL ESTIMATED CLEAN COAL RESERVE - OPEN PITS PLUS FIRST STAGE UNDERGROUND = 104.181

* Theoretical Coal for the underground reserve is based on actual washability data applied to the raw coal reserve, therefore the 0.95 wash plant efficiency factor is not applied.

also on a clean coal basis, combining the overburden and internal waste, and assuming that the preparation plant is 95% efficient in removing the coal portion of the seam sections. The mined raw coal stripping ratios in the Babcock area at Windy and Roman Mountain are approximately the same (8.2 cubic yards per long ton and 8.5 cubic yards per long ton) but those at the Sheriff and Frame pits are quite different (5.5 cubic yards per long ton and 14.3 cubic yards per long ton).

A table of average coal quality for each proposed mine area is presented on the following page and more detailed tables of coal quality have been presented in the section on regional coal reserves. As has been mentioned, the analyses obtained to date indicate that the coal product will be consistent and of very good quality. Representative geological sections of the coal seams from each proposed mine area are presented on Drawing QNTT-76-0648-R01 (2 sheets) in the box pocket of this report.

Definitions and Methods of Calculation

The open pit reserve calculations were made by drawing structure contour maps of each coal seam and dividing each map into blocks with reasonably consistent dips. The area of these blocks was measured and corrected to true area by multiplying by the secant of the dip.

The volume of coal was calculated by multiplying this corrected area by the true coal thickness. Areas of both oxidized and unoxidized coal were measured separately. A geological factor of 0.30 metres or 0.98 feet was used to reduce the coal portion of each seam and to obtain a geologically factored coal reserve. This reserve was then further reduced by 10% to obtain the estimate of mineable coal for each pit. No geological factor or mining loss factor was applied to the amount of in seam dilution which was included with the unoxidized coal in the strip ratio calculations. The mineable reserves, which are based only on the coal portion of each seam section were reduced by 5% (wash plant efficiency factor) to obtain the estimated clean coal reserve.

QUINTETTE

SUMMARY TABLE

AVERAGE* COAL PRODUCT QUALITY

FROM

PROPOSED MINING AREAS

	Ash	Vol.%	d.a.f. Vol. %	R.M.	S.	F.S.I.	Theoretical Yield	Sp. G.
Windy	7.47	23.63	25.10	0.67	0.48	5.0-8.5	69.38	1.59
Roman Mountain	6.72	24.12	25.51	0.75	0.44	5.5-8.0	77.83	1.68
Sheriff & Frame	7.23	24.45	26.01	0.76	0.41	? -8.0	70+Est.	--
No. 1 Mine	7.41	23.67	24.99	0.86	0.35	5.5-7.5	70.30	--

* Numerical Average

The following definitions apply to the summaries of reserve data that appear in the geology and reserve section for each proposed mine area. More detailed data and specific information regarding the selection of criteria for each reserve calculation are given in the detailed reports for 1975 and 1974 (Appendices A and B of this report).

1. True Coal Thckness: The thickness of the coal only portion of the coal seam, corrected for dip in the case of drill hole intersections.

2. Corrected Area: The plan area of a reserve block, corrected to true or actual area by multiplying by the secant of the average dip in that block.

3. Theoretical Coal: Coal reserves based on the coal only portion of the seam sections (Coal A + Coal B + Coal C in the Mitsui system).

4. Geologically Factored Coal Reserve: Theoretical Coal less 0.30 metres or 0.98 feet from each seam.

5. Estimated Mined Coal Reserve: Geologically Factored Coal Reserve less 10%.

6. Estimated Clean Coal Reserve: Estimated Mined Coal Reserve less 5%.

Strip Ratio Calculations

Ratios of overburden to coal have been calculated in the British and metric systems for raw coal and clean coal. In these calculations, the following definitions and procedures were used:

1. Raw Coal: Estimated Mined Coal Reserve plus calculated dilution associated with the unoxidized portion of the reserve. Dilution was not reduced for geological factors or mining loss.

2. Clean Coal: Estimated Clean Coal Reserve.

3. Dilution: in-seam dilution including rock partings plus coal D within the seam section. Only those portions associated with the unoxidized (mined) coal portion were used.

4. Specific Gravity: of coal = 1.4, of rock = 1.9 (for dilution)

5. Total Pit Volume: The total volume of the proposed pit. Includes all rock, coal, oxidized coal, and dilution to the base of the lowermost seam*.

6. Raw Coal Strip Ratio

$$= \frac{\text{Total pit volume - (vol unox. coal + vol dilution)}}{\text{tons estimated mined coal + tons dilution}}$$

in cubic metres per metric ton or cubic yards per long ton.

7. Clean Coal Strip Ratio

$$= \frac{\text{Total pit volume - volume estimated clean coal}}{\text{tons of estimated clean coal}}$$

in cubic metres per metric ton or cubic yards per long ton.

* For details see Appendix A

GEOLOGY AND RESERVES
OF
PROPOSED MINING AREAS

Windy Pit

Geologically, the Windy pit is located on the northeast limb of the Waterfall Creek anticline and it terminates near a structurally disturbed zone northeast of Babcock Mountain. There are five coal seams, D, E, F, G, and K which are about 2 metres thick on the average and one seam, J, which is 3.8 metres thick. Seams J and K nearly coalesce at the northeast end of the proposed pit (Little Windy area).

Structurally, the coal seams in the Windy pit area are essentially flat, with dips of less than 10 degrees. The pit area is composed of two topographic lobes which are relatively flat. These two areas are known as Big Windy (to the southwest) and Little Windy (to the northeast). At Big Windy there are only a few known faults which have small displacements (10 - 15 metres) but the Little Windy area is transected by a fairly major fault that contributes to a significant increase in reserves by repeating some seams. There are also a number of smaller faults that are splays from this main fault. The main fault has a vertical displacement of about 60 metres.

The coal seams in the Windy area have been correlated with a high degree of certainty, although one or two tentative correlations have been made in the faulted zone at Little Windy and will require future clarification.

The oxidation zones in the Windy area have been based on about 40 drill hole and adit sites. Generally, the coal is most oxidized under the flat areas at Big and Little Windy and a large portion of the Big Windy area has been excluded from the proposed pit.

The proposed pit that has been selected for the calculation of reserves at this time is not an optimum pit in regard to total reserves or strip ratios. The backwall of the pit was located arbitrarily on the basis of some rough estimates of coal rock ratios which were made from preliminary cross sections. It is quite likely that this pit can be optimized to either increase reserves or slightly decrease the strip ratio. In the present calculation 9.9 million tons of clean coal are estimated to be available at a raw coal strip ratio of 8.16 cubic yards/long ton (6.14 cubic metres/metric ton) or at a clean coal ratio of 12.20 cubic yards per long ton (9.18 cubic metres per metric ton).

For the Windy area, sufficient data was available to allow coal seam thicknesses to be contoured. These thickness isopachs were therefore used to assign average seam thicknesses to each block.

Illustrations accompanying Windy Pit reserve calculations

Reserve tables	
Windy Geology BBCK-76-0642-R01	- following pages
Windy Area Structure Contours QNTT-76-0641-R01	- Box Pocket
Cross Sections A to E inclusive BBCK-76-0645-R02	- Box Pocket
Windy Thickness isopachs BBCK-76-0653-R01	- Box Pocket

See also Windy pit section - appendix A.

OPEN PIT RESERVES SUMMARY - WINDY PIT

Seam	True Coal Thickness Range (m.)	Weighted Average True Coal Thickness (m.)	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. $x 10^6$			Geologically Factored Coal Reserve m.t. $x 10^6$	Estimated Mines Coal Reserve m.t. $x 10^6$	Estimated Clean Coal Reserve m.t. $x 10^6$
				Total	Oxidized	Unoxidized			
D	2.00 to 3.10	2.40	0.4571	1.534	.346	1.188	1.017	.916	.870
E	1.80 to 2.80	2.14	0.6289	1.885	.380	1.505	1.292	1.163	1.105
F	1.95 to 2.55	2.25	0.6507	2.051	.614	1.437	1.242	1.118	1.062
G	1.20 to 2.55	2.08	0.7676	2.242	.483	1.759	1.160	1.044	.992
J	3.40 to 4.30	3.85	1.0403	5.601	.624	4.977	4.622	4.160	3.952
K	1.85 to 2.65	2.04	1.0315	2.942	.335	2.607	2.280	2.052	1.949
TOTAL			4.5761	16.255	2.782	13.473	11.613	10.453	9.930

OPEN PIT RESERVES - WINDY PIT

SEAM 'D'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area ($x\ 10^6\ m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
A	2.00 to 2.70	7.0	0.1872	.662	.127	.535	.465	.419
B	2.00 to 2.70	9.2	0.1694	.505	.127	.378	.307	.276
C	2.00 to 3.10	7.4	0.1005	.367	.092	.275	.245	.221
TOTAL			0.4571	1.534	.346	1.188	1.017	.916

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

OPEN PIT RESERVES - WINDY PIT

SEAM 'E'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area (x 10^6 m^2	Theoretical Coal m.t. x 10^6 Total	Oxidized	Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
A	1.80 to 2.20	6.2	0.2915	.803	.111	.692	.587	.528
B	2.00 to 2.80	11.6	0.1817	.600	.231	.369	.322	.290
C	2.00 to 2.55	11.0	0.0897	.294	-	.294	.255	.230
D	2.00 to 2.15	11.7	0.0660	.188	.038	.150	.128	.115
TOTAL			0.6289	1.885	.380	1.505	1.292	1.163

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.105

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

OPEN PIT RESERVES - WINDY PIT

SEAM 'F'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area (x 10^6 m^2)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
A	2.00 to 2.55	5.8	0.1886	.620	.148	.472	.408	.367
B	2.00 to 2.55	8.4	0.2959	.941	.290	.651	.565	.509
C	1.95 to 2.40	8.7	0.1578	.461	.160	.301	.258	.232
D	2.40	11.3	0.0084	.029	.016	.013	.011	.010
TOTAL			0.6507	2.051	.614	1.437	1.242	1.118

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.062

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

OPEN PIT RESERVES - WINDY PIT

SEAM 'G'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6			Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
				Total	Oxidized	Unoxidized		
A	1.35 to 1.90	7.8	0.1968	.451	.131	.320	.263	.237
B	1.70 to 2.25	9.4	0.3454	.951	.216	.735	.623	.561
C	1.20 to 2.55	11.4	0.2012	.796	.122	.674	.251	.226
D	1.30	14.0	0.0242	.044	.014	.030	.023	.020
TOTAL			0.7676	2.242	.483	1.759	1.160	1.044

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = .992

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

OPEN PIT RESERVES - WINDY PIT

SEAM 'J'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area (x 10^6 m^2	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
A	3.40 to 4.15	8.6	0.4804	2.500	.392	2.108	1.953	1.758
B	3.85 to 4.3	9.9	0.2509	1.400	.161	1.239	1.153	1.038
C	3.9 to 4.3	3.6	0.2079	1.152	-	1.152	1.072	.964
D	3.9	12.0	0.1011	.549	.071	.478	.444	.400
TOTAL			1.0403	5.601	.624	4.977	4.622	4.160

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 3.952

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

OPEN PIT RESERVES - WINDY PIT

SEAM 'K'

Block	True Coal* Thickness Range (m.)	Dip°	Total Corrected Area (x 10^6 m^2)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
A	1.9 to 2.05	4.6	0.1023	.268	.091	.177	.154	.139
B	1.9 to 2.95	7.7	0.4206	1.278	.075	1.203	1.059	.953
C	2.15 to 2.65	8.7	0.1965	.556	.100	.456	.398	.358
D	2.15 to 2.35	4.3	0.2071	.563	-	.563	.489	.440
E	2.15 to 2.30	12.3	0.1050	.277	.069	.208	.180	.162
TOTAL			1.0315	2.942	.335	2.607	2.280	2.052

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.949

* - For details of actual thickness used in each block, refer to isopach sub-blocks.

GEOLOGY AND RESERVES
OF
PROPOSED MINING AREA

ROMAN MOUNTAIN PIT

The proposed Roman Mountain pit is essentially an extension of the Murray syncline into Roman Mountain. In this area the syncline plunges to the northwest. The coal zone of the Gates Member is fairly well exposed in outcrop and subcrop on the southeast side of Roman Mountain but, as the structure plunges northwest, the basal coal zone does not outcrop there but passes beneath Babcock Creek. On the southwest limb of the syncline small faults and one small drag fold are apparent from the drilling and trenching. Geological mapping on the northeast limb has also outlined a somewhat larger fault but the structural discontinuities observed to date do not have a significant effect on coal reserves.

The coal seams at Roman Mountain are essentially the same as those in the remainder of the Babcock area and therefore seam correlations are very reliable. Seams, D, E, F, I, J, and K are all present to some degree, although the bulk of the reserves (76%) will come from the I/J zone. In the I/J zone the two seams may be close enough to be considered as one seam for mining and in the present calculation the area of the base of seam J has been used to calculate the theoretical coal volume of the aggregate thickness of both seams. However, the parting between Seam I and Seam J has been considered as a separate unit of mined waste.

For the present calculation the proposed pit which has been chosen for estimating reserves at Roman Mountain takes in all of the rock volume above the floor of seam J, plus the rock that must be removed below seam J to form a 15 metre berm where the height of the pit wall exceeds 150 metres. On this basis, the calculated raw coal strip ratio for the entire pit is 8.52 cubic yards per long ton or 6.41 cubic metres per metric ton. The clean coal ratio is 10.62 cubic yards per long ton or 7.99 cubic metres per metric ton.

For the Roman Mountain reserve calculation average coal seam thicknesses were used as there were not sufficient data points to allow isopachs of seam thickness to be prepared.

Illustrations accompanying Roman Mountain reserve calculations.

Reserve tables		- following pages
Roman Mtn. Geology	QNTT-76-0644-R01	- Box Pocket
Roman Mtn. Cross Sections	QNTT-75-0594-R01	- Box Pocket
Roman Mtn. Structure Contours	QNTT-76-0640-R01	- Box Pocket
Roman Mtn. Pit Contours	QNTT-76-0649-R01	- Box Pocket

See also Roman Mountain Section - appendix A.

OPEN PIT RESERVES SUMMARY - ROMAN MOUNTAIN

Block	Average True Coal Thickness (m.)	Dip° Range	Total Corrected Area (x 10^6 m^2)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6	Estimated Clean Coal Reserve m.t. x 10^6
D	2.86	26 to 58	0.5356	2.147	.216	1.931	1.729	1.556	1.478
E	1.50	37 to 56	0.7487	1.572	.147	1.425	1.190	1.071	1.017
F	1.76	41 to 60	1.0191	2.516	.318	2.198	1.827	1.644	1.562
I/J	7.70	30 to 60	1.5380	16.577	.956	15.621	14.986	13.487	12.813
TOTALS			3.8414	22.812	1.637	21.175	19.732	17.758	16.870

OPEN PIT RESERVES - ROMAN MOUNTAIN

SEAM 'D' (AVERAGE TRUE THICKNESS 2.86 M.)

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area (x 10^6 m^2	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
1	2.86	48.5	0.0122	.049	.017	.032	.028	.025
2	"	42.0	0.0298	.120	.012	.108	.096	.086
3	"	49.1	0.0311	.125	.012	.113	.101	.091
4	"	48.0	0.0154	.062	.004	.058	.052	.047
5	"	57.7	0.0910	.364	.022	.342	.307	.276
6	"	26.6	0.0192	.077	-	.077	.069	.062
7	"	35.5	0.0284	.114	-	.114	.102	.092
8	"	50.2	0.0779	.312	.013	.299	.268	.241
9	"	47.2	0.0909	.364	.027	.337	.302	.272
10	"	58.2	0.0635	.255	.027	.228	.204	.184
11	"	38.7	0.0463	.185	.013	.172	.154	.139
12	"	51.3	0.0299	.120	.069	.051	.046	.041
TOTAL			0.5356	2.147	.216	1.931	1.729	1.556

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.478

OPEN PIT RESERVES - ROMAN MOUNTAIN

SEAM 'E' (AVERAGE TRUE THICKNESS 1.50 M.)

Block	Average True Coal Thickness (m.)	Dip^o	Total Corrected Area (x 10^6 m^2	Theoretical Coal m.t. x 10^6 Total	Oxidized	Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
1	1.50	50.0	0.0302	.064	.006	.058	.046	.041
2	"	37.3	0.0294	.061	.005	.056	.045	.041
3	"	46.5	0.0244	.051	.003	.048	.039	.035
4	"	49.6	0.0483	.102	.007	.095	.076	.068
5	"	55.9	0.0922	.194	.013	.181	.145	.131
6	"	49.6	0.0352	.074	-	.074	.059	.053
7	"	40.6	0.0243	.051	-	.051	.041	.037
8	"	52.0	0.1081	.227	.031	.196	.157	.141
9	"	50.0	0.1177	.247	.011	.236	.226	.203
10	"	50.2	0.0746	.157	.011	.146	.128	.115
11	"	38.7	0.1075	.225	.040	.185	.148	.133
12	"	56.3	0.0568	.119	.020	.099	.080	.072
TOTAL			0.7487	1.572	0.147	1.425	1.190	1.071

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.017

OPEN PIT RESERVES - ROMAN MOUNTAIN

SEAM 'F' (AVERAGE TRUE THICKNESS 1.76 M.)

Block	Average True Coal Thickness (m.)	Dip^o	Total Corrected Area (x 10^6 m^2	Theoretical Coal m.t. x 10^6			Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
				Total	Oxidized	Unoxidized		
1	1.76	52.0	0.0453	.116	.012	.104	.086	.077
2	"	44.6	0.0378	.094	.010	.084	.070	.063
3	"	45.0	0.0301	.074	.007	.067	.056	.050
4	"	49.5	0.0650	.160	.009	.151	.126	.113
5	"	60.9	0.1225	.301	.032	.269	.224	.202
6	"	45.0	0.0291	.072	-	.072	.060	.054
7	"	41.0	0.0461	.114	-	.114	.094	.085
8	"	52.6	0.1175	.289	.022	.267	.222	.200
9	"	49.5	0.1457	.359	.028	.331	.275	.248
10	"	52.8	0.1057	.261	.021	.240	.199	.179
11	"	48.0	0.1901	.468	.124	.344	.286	.257
12	"	52.4	0.0842	.208	.053	.155	.129	.116
TOTAL			1.0191	2.516	.318	2.198	1.827	1.644

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 1.562

OPEN PIT RESERVES - ROMAN MOUNTAIN

SEAM 'I/J' (AVERAGE TRUE THICKNESS 7.70 M.)

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mined Coal Reserve m.t. x 10^6
1	7.70	54.4	0.0618	.666	.042	.624	.599	.539
2	"	42.7	0.0745	.803	.044	.759	.728	.655
3	"	45.5	0.0595	.641	.044	.597	.573	.516
4	"	50.5	0.1104	1.190	.043	1.147	1.100	.990
5	"	60.3	0.1507	1.624	.082	1.542	1.479	1.331
6	"	42.3	0.0339	.365	-	.365	.351	.316
7	"	30.8	0.0411	.443	-	.443	.426	.383
8	"	51.0	0.1575	1.698	.047	1.651	1.584	1.426
9	"	51.0	0.1875	2.021	.063	1.958	1.878	1.690
10	"	51.3	0.1636	1.763	.070	1.693	1.624	1.462
11	"	48.4	0.2851	3.073	.281	2.792	2.678	2.410
12	"	56.8	0.2124	2.290	.240	2.050	1.966	1.769
TOTAL			1.5380	16.577	.956	15.621	14.986	13.487

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 12.813

GEOLOGY AND RESERVES
OF
PROPOSED MINING AREAS

SHERIFF AND FRAME PITS

The Sheriff and Frame pits are both located in synclinal structures which contain only small faults but the Sheriff pit terminates against a large fault of unknown displacement. A portion of the Sheriff pit also extends into a smaller structure known as the Deputy Syncline.

The axis of the Sheriff Syncline is quite warped. This is probably due to its proximity to the main fault. At the northwest end of the structure some small faults with a few metres displacement have been observed on the southwest limb of the syncline and, at the southeast end of the pit, a small splay from the main fault has been mapped. In the Sheriff pit none of the faulting is expected to have a deleterious effect on the coal reserves. The Frame Syncline is also a fairly regular structure, although small faults have also been observed on both limbs. The basic form of both the Sheriff and Frame structures is well represented on the accompanying cross sections.

Major thickening in the Gates coal zones occurs in the Sheriff pit area where seams E and J both contain more than 8 metres of coal and, although reasonable correlations have been made within each of the pit areas, the correlation between the Sheriff and Frame pits is not absolutely certain and will have to be confirmed by later work. Correlation of the seams in this area with those at Babcock is not easy, although similarities do exist with the development of coal at various stratigraphic levels, particularly below the Babcock sandstone unit and above the basal Quintette sandstones.

The pits which have been selected for reserve calculations at present constitute the whole of the synclinal forms to the base of seam J in both pit areas. In the Sheriff area, the pit is also terminated on the northeast side by the aforementioned fault. The calculated strip ratios of the Sheriff and Frame pits are tabulated on the following page:

	British ratio		Metric ratio	
	raw coal	clean coal	raw coal	clean coal
Sheriff	5.52	7.85	4.15	5.70
Frame	14.33	18.15	10.78	15.66

Average seam thicknesses, calculated separately for each syncline (including the Deputy syncline), were used to calculate the reserves in both the Sheriff and Frame areas. The depth of oxidation was estimated to be 100 ft.

Illustrations accompanying the Sheriff and Frame reserve calculations.

Reserve tables	- following pages
Sheriff and Frame Geology	QNTT-76-0646-R01- Box Pocket
Sheriff and Frame Cross Section	QNTT-76-0643-R01- Box Pocket
Sheriff Cross Sections	QNTT-75-0584-R01- Box Pocket
Frame Cross Sections	
Sheriff and Frame Structure Contours	QNTT-76-0637-R01- Box Pocket

See also Sheriff and Frame Section, appendix A.

OPEN PIT RESERVES SUMMARY - SHERIFF & FRAME PITS

Block	Average True Coal Thickness (m.)	Total Corrected Area ($\times 10^6$ m^2)	Theoretical Coal m.t. $\times 10^6$ Total	Theoretical Coal m.t. $\times 10^6$ Oxidized	Theoretical Coal m.t. $\times 10^6$ Unoxidized	Geologically Factored Coal Reserve m.t. $\times 10^6$	Estimated Mineable Coal Reserve m.t. $\times 10^6$	Estimated Clean Coal Reserve m.t. $\times 10^6$
SHERIFF PIT								
D	2.01	0.347	0.98	0.57	0.41	0.34	0.31	0.29
E	8.27 to 8.89*	0.826	9.68	3.89	5.79	5.38	4.84	4.60
G	1.32 to 1.67*	1.001	1.96	0.77	1.19	0.94	0.85	0.81
J	8.56 to 8.07*	1.070	12.61	3.77	8.84	8.51	7.67	7.29
TOTALS		3.244	25.23	9.00	16.23	15.17	13.67	12.99
FRAME PIT								
D	2.27	1.498	4.76	1.12	3.64	3.16	2.84	2.70
E	3.08	1.667	7.17	1.38	5.79	5.23	4.71	4.47
F	1.96	2.060	5.65	1.87	3.78	3.21	289	2.75
G	2.90	2.305	9.35	1.86	7.49	6.70	6.04	5.74
J	2.34	2.882	9.43	1.04	8.39	7.32	6.58	6.25
TOTALS		10.412	36.36	7.27	29.09	25.62	23.06	21.91

* - Average True Coal Thickness for Sheriff & Deputy Respectively.

OPEN PIT RESERVES: SEAM 'D'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
SHERIFF PIT								
A	2.01	21	0.168	0.47	0.11	0.36	0.30	0.27
B	2.01	22	0.105	0.30	0.26	0.04	0.03	0.03
C	2.01	5	0.074	0.21	0.20	0.01	0.01	0.01
TOTALS			0.347	0.98	0.57	0.41	0.34	0.31

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = .29

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
FRAME PIT								
A	2.27	23	0.817	2.60	0.74	1.86	1.61	1.45
B	2.27	13	0.196	0.62	0.06	0.56	0.49	0.44
C	2.27	10	0.045	0.15	0.02	0.13	0.11	0.10
D	2.27	24	0.073	0.23	0.03	0.20	0.17	0.15
E	2.27	51	0.137	0.44	0.20	0.24	0.21	0.19
F	2.27	43	0.230	0.72	0.07	0.65	0.57	0.51
TOTALS			1.498	4.76	1.12	3.64	3.16	2.84

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 2.70

OPEN PIT RESERVES: SEAM 'E'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x\ 10^6\ m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
SHERIFF PIT								
A	8.27	28	0.098	1.13	0.34	0.79	0.73	0.66
B	8.27	11	0.039	0.46	0.07	0.39	0.36	0.32
C	8.27	19	0.138	1.60	0.32	1.28	1.19	1.07
D	8.27	25	0.359	4.15	2.02	2.13	1.98	1.78
E	8.27	10	0.063	0.73	0.33	0.40	0.38	0.34
F (Deputy)	8.89	22	0.056	0.69	0.37	0.32	0.30	0.27
G (Deputy)	8.89	7	0.027	0.34	0.11	0.23	0.21	0.19
H (Deputy)	8.89	29	0.046	0.58	0.33	0.25	0.23	0.21
TOTALS			0.826	9.68	3.89	5.79	5.38	4.84

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 4.60

OPEN PIT RESERVES: SEAM 'E'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t.x 10^6
FRAME PIT								
A	3.08	22	0.986	4.24	0.93	3.31	2.99	2.69
B	3.08	16	0.121	0.52	0.09	0.43	0.39	0.36
C	3.08	10	0.060	0.26	0.02	0.24	0.22	0.20
D	3.08	20	0.114	0.49	0.04	0.45	0.40	0.36
E	3.08	46	0.386	1.66	0.30	1.36	1.23	1.11
TOTALS			1.667	7.17	1.38	5.79	5.23	4.71

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 4.47

OPEN PIT RESERVES: SEAM 'G'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. $x 10^6$ Total	Oxidized	Unoxidized	Geologically Factored Coal Reserve m.t. $x 10^6$	Estimated Mineable Coal Reserve m.t. $x 10^6$
SHERIFF PIT								
A (Sheriff)	1.32	28	0.087	0.16	0.05	0.11	0.08	0.07
B (Sheriff)	1.32	17	0.028	0.05	0.01	0.04	0.03	0.03
C (Sheriff)	1.32	17	0.140	0.26	0.06	0.20	0.16	0.14
D (Sheriff)	1.32	21	0.293	0.54	0.09	0.45	0.35	0.31
E (Sheriff)	1.32	0	0.091	0.16	0.13	0.03	0.03	0.03
F (Sheriff)	1.32	29	0.065	0.12	0.12	0.00	0.00	0.00
G (Sheriff)	1.32	10	0.041	0.08	0.02	0.06	0.04	0.04
H (Sheriff)	1.32	10	0.049	0.09	0.04	0.05	0.04	0.04
I (Deputy)	1.67	19	0.099	0.24	0.13	0.11	0.09	0.08
J (Deputy)	1.67	8	0.034	0.08	0.02	0.06	0.05	0.05
K (Deputy)	1.67	18	0.074	0.18	0.10	0.08	0.07	0.06
TOTALS			1.001	1.96	0.77	1.19	0.94	0.85

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. $x 10^6$) = .81

OPEN PIT RESERVES: SEAM 'G'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x\ 10^6\ m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
FRAME PIT								
A	2.90	22	1.457	5.91	1.41	4.50	4.03	3.63
B	2.90	15	0.187	0.76	0.09	0.67	0.60	0.54
C	2.90	10	0.105	0.43	0.05	0.38	0.34	0.31
D	2.90	22	0.058	0.23	0.00	0.23	0.20	0.18
E	2.90	26	0.096	0.39	0.01	0.38	0.34	0.31
F	2.90	44	0.402	1.63	0.30	1.33	1.19	1.07
TOTALS			2.305	9.35	1.86	7.49	6.70	6.04

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) - 5.74

OPEN PIT RESERVES: SEAM 'F'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
FRAME PIT								
A	1.96	23	1.265	3.47	1.56	1.91	1.62	1.46
B	1.96	13	0.131	0.36	0.03	0.33	0.28	0.25
C	1.96	11	0.090	0.25	0.03	0.22	0.18	0.16
D	1.96	24	0.054	0.15	0.00	0.15	0.13	0.12
E	1.96	31	0.135	0.37	0.01	0.36	0.31	0.28
F	1.96	51	0.385	1.05	0.24	0.81	0.69	0.62
TOTALS			2.060	5.65	1.87	3.78	3.21	2.89

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 2.75

OPEN PIT RESERVES: SEAM 'J'

Block	Average True Coal Thickness (m.)	Dip^{o}	Total Corrected Area ($x\ 10^6\ m^2$)	Theoretical Coal m.t. x 10^6 Total	Oxidized	Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
SHERIFF PIT								
A (Sheriff)	8.56	24	0.057	0.68	0.23	0.45	0.44	0.40
B (Sheriff)	8.56	18	0.022	0.26	0.04	0.22	0.21	0.19
C (Sheriff)	8.56	18	0.141	1.69	0.42	1.27	1.22	1.10
D (Sheriff)	8.56	21	0.261	3.13	0.43	2.70	2.60	2.34
E (Sheriff)	8.56	10	0.072	0.86	0.33	0.53	0.51	0.46
F (Sheriff)	8.56	0	0.039	0.47	0.23	0.24	0.23	0.21
G (Sheriff)	8.56	0	0.121	1.45	0.39	1.06	1.02	0.92
H (Sheriff)	8.56	29	0.048	0.58	0.58	0.00	0.00	0.00
I (Deputy)	8.07	17	0.174	1.97	0.68	1.29	1.24	1.12
J (Deputy)	8.07	6	0.031	0.35	0.06	0.29	0.28	0.25
K (Deputy)	8.07	19	0.104	1.17	0.38	0.79	0.76	0.68
TOTALS			1.070	12.61	3.77	8.84	8.51	7.67

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 7.29

OPEN PIT RESERVES: SEAM 'J'

Block	Average True Coal Thickness (m.)	Dip°	Total Corrected Area ($x 10^6 m^2$)	Theoretical Coal m.t. x 10^6 Total	Theoretical Coal m.t. x 10^6 Oxidized	Theoretical Coal m.t. x 10^6 Unoxidized	Geologically Factored Coal Reserve m.t. x 10^6	Estimated Mineable Coal Reserve m.t. x 10^6
FRAME PIT								
A	2.34	22	1.743	5.71	0.57	5.14	4.48	4.03
B	2.34	12	0.248	0.81	0.07	0.74	0.65	0.58
C	2.34	11	0.119	0.39	0.03	0.36	0.31	0.28
D	2.34	24	0.065	0.21	0.00	0.21	0.18	0.16
E	2.34	25	0.114	0.37	0.03	0.34	0.30	0.27
F	2.34	48	0.593	1.94	0.34	1.60	1.40	1.26
TOTALS			2.882	9.43	1.04	8.39	7.32	6.58

Based on 0.95 wash plant efficiency, Estimated Clean Coal (m.t. x 10^6) = 6.25

GEOLOGY AND RESERVES

OF

PROPOSED MINING AREAS

BABCOCK

No. 1 Mine (Underground)

The geology of the No. 1 underground mine was fully described in the Second Interim Report of May, 1973. (The "Babcock Flat area"). The coal seams in the Gates Member of the Commotion Formation are very consistently developed in this area and the original correlations that were reported in 1973 have been substantiated by later work in 1973, 1974, and 1975. An up dated correlation chart, which summarizes the correlation of the main formations in the Babcock (No. 1 Mine) area and surrounding areas, is included in the box pocket of this report. A seam correlation drawing is also included.

The reserve table accompanying this section represents essentially the same area that was covered by the reserve calculations in the May, 1973 report. Mitsui Mining's staff have, however recalculated this reserve based on their present concept of the staged development of the underground hydraulic mine. The reserve has also been converted to a theoretical coal base whereas the original reserves were based on raw coal, including seam dilution. It should be noted that the definition of theoretical coal used here is slightly different than that used in the open pit reserve calculations as coal-rock ratios for the seam intervals were not recorded during the early exploratory work. The coal seam thicknesses used were also those which were established in the Second Interim Report.

Illustrations accompanying the calculation of reserves for No. 1 Mine.

Reserve table		- following page
Babcock Geology	QNTT-76-9001-R01	- Box Pocket
Babcock Cross Sections	QNTT-76-9002-R01	- Box Pocket
Babcock Structure and Reserves	QNTT-76-9003-R01	- Box Pocket
Babcock Correlation Chart	QNTT-76-9004-R01	- Box Pocket
Babcock Seam Correlation	QNTT-76-9005-R01	- Box Pocket

See also appendix B.

SUMMARY OF RESERVES

NO. 1 MINE (UNDERGROUND

Seam	Development Stage	Theoretical Coal Reserve m.t. x 10^3	Geological Factor	Estimated Workable Reserve m.t. x 10^3	Mining Factor	Clean Coal Reserve m.t. x 10^3
D	1st stage	14,833	85%	12,608	58%	7,313
	2nd stage	20,004	80%	16,003	58%	9,282
		34,837		28,611		16,595
E	1st stage	13,183	85%	11,206	58%	6,499
	2nd stage	16,337	80%	13,070	58%	7,581
		29,520		24,276		14,080
F	1st stage	18,184	85%	15,456	58%	10,046
	2nd stage	18,330	80%	14,664	58%	9,532
		36,514		30,120		19,578
I	1st stage	24,653	80%	19,722	58%	11,439
	2nd stage	13,697	80%	10,958	58%	6,356
		38,350		30,680		17,795
J	1st stage	53,152	85%	45,179	58%	26,204
	2nd stage	32,292	80%	25,833	58%	14,983
		85,444		71,012		41,187
TOTALS		224,665		184,699		109,235

APPENDIX I

Regional Calculations

Theoretical Coal in Place

QUINTETTE COAL LICENSES

CALCULATION OF THEORETICAL COAL IN PLACE

BABCOCK AREA

Planimeter Factor = 177 = $10^6 m^2$

Specific Gravity = 1.4

Area	Approx. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6$ m^2	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
MITSUI 1974 Calculation Area							
		KCm(g)					699.13
		KGt bird					51.56
DENISON 1972 Calculation Area							
		KCm(g)	(discounted 10% for overlap with above)				247.00
QUINTETTE MOUNTAIN SOUTH	70°/2.9238	KCm(g)	14.0	1136	18.76	262.71	367.79
		KGT bird	4.6	0528	8.72	40.11	56.16
	0°/1.0000	KCm(g)	14.0	1360	7.68	107.57	150.60
ROMAN MOUNTAIN TREND SOUTH	30°/1.1547	KGt bird	4.6	0070	.46	2.12	2.96
	40°/1.3054	KGt bird	4.6	0040	.29	1.33	1.87
	45°/1.4142	KGt bird	4.6	0040	.32	1.47	2.06
	55°/1.7434	KGt bird	4.6	0032	.32	1.47	2.06

Total = 1,581.19

BABCOCK AREA TOTAL 1,581

QUINTETTE COAL LICENSES

CALCULATION OF THEORETICAL COAL IN PLACE

MURRAY AREA

Planimeter Factor = 177 = $10^6 m^2$
Specific Gravity = 1.4

Area	Approx. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6$ m^2	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
MEADOW	35°/1.2208	KGt basal coal	6.0	0615	4.24	25.45	35.62
	25°/1.1034	KGt s-c*	3.6	0629	3.67	14.11	19.76
		KGt bird	3.0	0554	3.45	10.36	14.50
	35°/1.2208	KGT s-c	3.6	0672	4.63	27.81	38.93
		KGt bird	3.0	0575	3.96	11.90	16.66
				MEADOW SUBTOTAL		=	125.47

* s-c = Skeeter-chamberlain zone

Area	Approx. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6$ m^2	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
MURRAY WEST	45°/1.4142	KGt basal coal	3.6	0527	4.21	15.16	21.22
	50°/1.5557	KGt s-c*	3.0	0172	1.51	1.51	2.12
		KGt bird	2.5	0145	1.27	3.19	4.46
	30°/1.1547	KGt s-c	3.0	0273	1.78	5.34	7.48
		KGt bird	2.5	0212	1.38	3.46	4.84
				MURRAY WEST SUBTOTAL		=	40.12

* s-c = Skeeter-chamberlain zone

MT. FRAME, 1976 detailed calculation:	36.40
SHERIFF MTN., 1976 detailed calculation:	25.20
Total =	227.19
MURRAY REGION TOTAL	227

QUINTETTE COAL LICENSES

CALCULATION OF THEORETICAL COAL IN PLACE

THE FIVE CABIN AREA

Planimeter Factor = 177 = $10^6 m^2$
Specific Gravity = 1.4

Area	Approx. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6\ m^2$	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
FIVE CABIN NORTH	15°/1.0352	KCm (g)	7.5	0089	0.52	3.91	5.47
		KGt s-c*	3.3	1328	7.77	17.09	23.92
	40°/1.3054	KCm (g)	7.5	0202	1.49	11.19	15.64
		KGt s-c	3.3	0972	7.17	23.65	33.11
				FIVE CABIN NORTH SUBTOTAL		=	78.14
FIVE CABIN SOUTH	30°/1.1547	KCm (g)	7.0	0135	0.88	6.17	8.63
		KGt s-c	3.3	0442	2.88	9.51	13.32
	45°/1.4142	KCm (g)	7.0	0120	0.96	6.71	9.40
	50°/1.5557	KGt s-c	3.3	0340	2.99	9.86	13.80
				FIVE CABIN SOUTH SUBTOTAL		=	45.15
TURNING MTN.	35°/1.2208	KGt s-c	3.3	0493	3.40	11.22	15.71
					Total =		139.00
				FIVE CABIN AREA TOTAL			139.00

* s-c = Skeeter-chamberlain zone

QUINTETTE COAL LICENSES

CALCULATION OF THEORETICAL COAL IN PLACE

WOLVERINE AREA

Planimeter Factor = 177 = $10^6 m^2$
Specific Gravity = 1.4

Area	Approx. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6$ m^2	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
WOLVERINE WEST							
1	20^o/1.0642	KCm (g)	10	0246	1.48	14.86	20.72
		KGt basal	3	0372	2.24	6.71	9.39
		KGt middle	2	0375	2.25	4.51	6.30
2	30^o/1.1547	KCm (g)	10	0359	2.34	23.42	32.79
		KGt basal	3	0253	1.65	4.95	6.93
		KGt middle	2	0263	1.72	3.43	4.80
3	10^o/1.0154	KGt basal	3	0260	1.49	4.47	6.26
		KGt middle	2	0248	1.42	2.84	3.98
4	30^o/1.1547	KCm (g)	10	0520	3.39	33.92	47.49
		KGt basal	3	0300	1.96	5.87	8.22
		KGt middle	2	0556	3.63	7.25	10.15
				WOLVERINE WEST SUBTOTAL			157.03

QUINTETTE COAL LICENSES

CALCULATION OF THEORETICAL COAL IN PLACE

WOLVERINE AREA

Planimeter Factor = 177 = $10^6 m^2$
Specific Gravity = 1.4

Area	Aprox. Dip used and Secant	Formation and/or Seams	Thickness in Meters	Planimeter Area	Corrected Area $\times 10^6$ m^2	Theoretical Coal $\times 10^6$ cubic meters	Theoretical Coal $\times 10^6$ metric tons
FORTRESS MOUNTAIN							
1	30°/1.1547	KGt s-c*	7.0	0506	3.30	23.11	32.35
		KCm (g)	12.0	0457	2.98	35.78	50.08
2	20°/1.0642	KGt s-c	7.0	0560	3.36	23.57	32.99
		KCm (g)	12.0	0483	2.90	34.85	48.78
3	30°/1.1547	KGt s-c	7.0	0490	3.20	23.38	31.32
		KCm (g)	12.0	0425	2.77	33.27	46.58
4	(See detailed calculation 1972)						
		KCm (g)	5.0				46.82
		KGt s-c	3.5				47.73
5	40°/1.3054	KGt s-c	3.6	0602	4.44	15.98	22.37
		KCm (g)	3.0	0588	4.34	13.00	18.21
6	25°/1.0353	KGt s-c	3.6	0532	3.11	11.20	15.68
		KCm (g)	3.0	0552	3.23	9.69	13.56

FORTRESS MOUNTAIN SUBTOTAL 406.47

Total 563.50

WOLVERINE REGION TOTAL 564

* s-c = Skeeter-chamberlain zone