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1974 WOLVERINE EXPLORATION REPORT

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December 16, 1974

GEOLOGICAL BRANCH  
ASSESSMENT REPORT

00 606

Appendix I of this report contains coal quality data, and remains confidential under the terms of the *Coal Act Regulation*, Section 2(1). It has been removed from the public version.

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1) PREFACE

On November 24, 1971 Quintette Coal Limited was granted coal licences 2645 to 2669 at which time an exploration bond was posted to ensure to the government that exploration work totalling \$150,000 was completed on these licences within the first 3 years from their issuance. This report documents exploration work totalling \$150,947 which was carried out under the direction of Denison Mines Limited and later Denison Mines (B.C.) Limited on behalf of Quintette Coal Limited on the above mentioned coal licences prior to November 24, 1974. The exploration work was undertaken in two phases, the costs and results of the first phase carried out between August 1971 and February 1972 have been previously filed. The second phase of exploration concentrated on the newly acquired licences between September 23 and November 9, 1974 and all data and costs from this phase have been documented.

NORTHWEST TERRITORIES

C A N A D A  
BRITISH COLUMBIA ALBERTA SASK.



PR-QUINTETTE 74(2)C

DENISON MINES LIMITED  
(COAL DIVISION)  
CALGARY ALBERTA



LOCATION MAP

DRAWN BY E. Toft	DATE Dec. '71	SCALE 1" = 130mi ±
APPROVED BY <i>Hokey</i>	DRAWING NO MISC 71 - 0262-R02	

2) SUMMARY

The 1974 exploration programme in the Wolverine area of the Quintette coal licences was designed to investigate the structure and coal bearing horizons of the Lower Cretaceous Gething Formation and Gates Member of the Compton Formation. The work was carried out on specific coal licences which have been designated in the preface. The previous geological interpretation of the licence areas was updated from a study of recently acquired air photos at 1" to 2000' and 1" to 4600' scales followed by helicopter supported geological mapping teams using 1" to 400' topographic maps as a base. On completion of the mapping, a 3 hole diamond drill programme totalling 2005 feet tested the stratigraphy in steeply dipping structures to the northeast and southwest of the 1971-72 project area<sup>(1)</sup>, in which 104 million short tons of coal amenable to conventional mining were indicated in place from the Gates and Gething. Drilling results from the upper 550 feet of the Gates to the northeast of the reserve area were somewhat discouraging in that no seams of mineable thicknesses were intersected although tentative coal zone correlations with previous drill results were possible. Drilling and trenching on the northeast limb of the Fortress syncline immediately southwest of the conventional reserve area indicated that Gates #1 and Gates #2 seam were present and had coalesced to form one coal horizon with an aggregate true thickness of 23.4 feet.

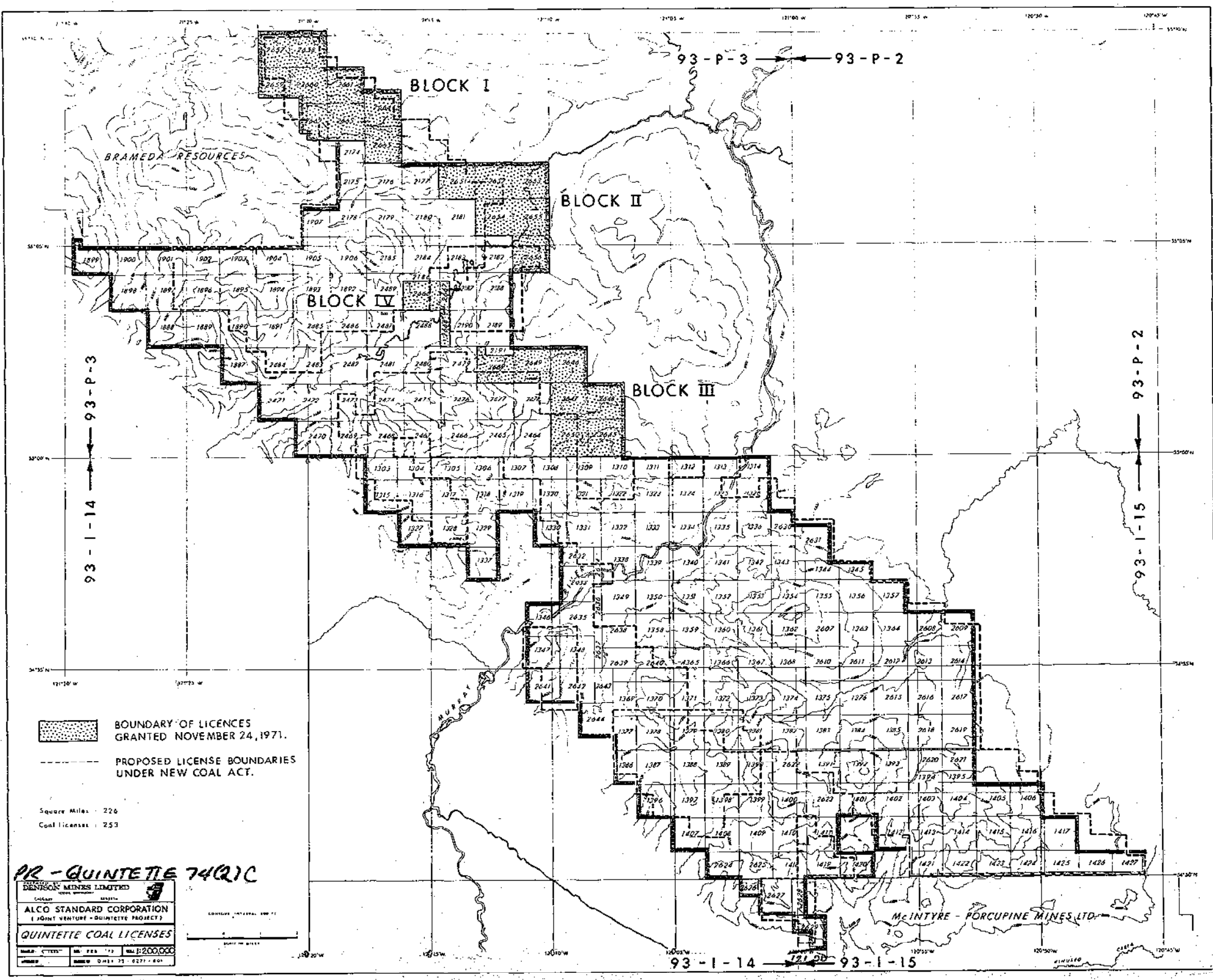
(1) Wolverine Area, Report on Exploration Work North of the Wolverine River between August 1971 and February 1972

The third drill hole, also located on the northeast limb of the Fortress syncline, confirmed the presence of a coal seam in the middle Gething having a true thickness of 8 feet. Analyses from coal seams intersected during the previous and present programmes indicate that Gates coal from the Gates #1 and #2 horizon separated at 1.5 specific gravity will yield between 71 to 93% (by weight) product with ash content ranging from 5.9 to 9.3% and Free Swelling Index between 5 and 8. Coal from the Gething, Skeeter/Chamberlain and middle coal horizons separated at 1.8 specific gravity will yield between 72 and 95% product with ash content from 5 to 7% and Free Swelling Index between 3 and 5. Preliminary reserve estimates indicate that 20 million short tons of coal ammenable to hydraulic mining from the Gates #1 and #2 horizon are in place on the northeast limb of the Fortress Syncline between the Wolverine River and Perry Creek. Further hydraulic reserves of this order of magnitude can be expected on the southwest limb of this syncline and the southwest limb of the Wolf Creek anticline. Gething coal reserves are possible on both limbs of these structures but will require extensive drill data as depth of cover will be the controlling factor in their delineation. Geological data obtained from the coal licences south of the Wolverine River and those forming the north and northeastern boundaries of the Quintette property indicate further detailed mapping followed by drilling will be required to ascertain the reserve potential of those areas.



3) INTRODUCTION

The 1974 exploration field work in the Wolverine area commenced on September 23, 1974 when three two-man geological parties began 1" to 400' mapping traverses on the various licence blocks which have been outlined in the map on the following page. Air photo interpretations of 1" to 2000' and 1" to 4600' photography which were done prior to the field work were investigated by detailed geological traverses during the course of this work. A five trailer camp was established at mile 46 on the access road into the Wolverine Valley on October 2, 1974 to establish accommodation for all parties associated with the work. A helicopter was necessary to support most of the geological field work and this work was stopped when the predetermined helicopter budget was reached. From geological data obtained a three hole diamond drill programme was planned. It should be pointed out that the cost of access and reclamation had to be considered along with obvious geological requirements in the location of drill sites as this area is heavily forested and of rugged relief. Road construction, drilling, trenching and reclamation progressed rapidly largely due to exceptional weather conditions in the area such that the programme was completed on November 9, 1974.



4) GEOLOGY

(1) Introduction

The data included in this report was obtained during the Autumn 1974 exploration work which consisted of "helicopter assisted" field mapping and 3 diamond drill holes. The area of investigation is located between Bullmoose Creek in the northwest and Murray River on the southeast and is divided into 4 separate coal licence blocks which are illustrated on the map on the preceding page.

The programme was designed to identify the geological formations in the area, especially those which are coal bearing, investigate their structures, and estimate and test the quality of coal, the presence of which had been reported during previous exploration work.

Although this field investigation established the general trend of the structures, it must however be stressed that the stratigraphic identification of various formations is still an open question in some parts of the area. This is partially caused by the petrological similarity between some of the units. This is particularly true of the Commotion Formation, Gates and Boulder Creek members and even the Gething formation, and of the similarity between the marine shale of the Moosebar formation and those of the Commotion, Hulcross member. Another obstacle in defining stratigraphy, especially in the northwestern part of the area, is

the presence of major and local faults which break the continuity of the formations, thus preventing their correlation with the surrounding strata. At the present stage some of the geological boundaries, especially in the northwestern and southeastern part of the area, should be considered tentative.

Also, at present no attempt has been made to correlate structures across the Wolverine Valley which is known to contain alluvium greater than 350 feet in depth. Some transverse faulting is likely present under this alluvium, however this should have little or no effect on mining for the area as initial planning would only involve coal situated above the valley elevation.

(2) General Geology

(a) Stratigraphy:

The detailed stratigraphic description of all formations present in the Wolverine area can be found in previous reports by Denison on the Quintette property.

The following is a summary of that data. As most of the field work this year was concentrated on collecting lithologic and structural data from outcrops, and not on compiling stratigraphic sections, no significant changes have been made in regard to our knowledge of this general stratigraphy.

<u>Series</u>	<u>Group</u>	<u>Formation</u>	<u>Thickness</u>
Lower Cretaceous	Ft. St. John	Shaftesbury (Hasler)	500-1500' (From GSC)
"	Ft. St. John	Commotion: Boulder Ck. Member Hulcross Member Gates Member	500-575' (Regional Map) 250-575' (Interpretation) 900-950' (Drilled)
"	Ft. St. John	Moosebar	355-425' (Drilled)
"	Bullhead	Gething	680' (Drilled)
"	Bullhead	Cadomin	50-100' (Regional Map Interpretation)
"	Minnes	Nikanassin	1500'+ (From GSC)

Selected Stratigraphic Descriptions from Previous and Present Exploration

Gates Member - Commotion Formation

The Gates Member was intersected in six diamond drill holes during the 1972 programme and in two holes in this year's programme. From geological mapping and regional correlation of geophysical logs, it is assumed that the upper 50 to 100 feet of the member is missing in the drill core. No attempt was made to drill this strata as previous work in the Gates at Babcock Mountain, 16 miles to the southeast, and in our field mapping this year, indicates that no economic coal zones would be encountered. Measured Gates sections vary from 850 to 950 feet.

The Hulcross/Gates contact is well marked by an iron rich shale up to one foot in thickness. This zone weathers to a dark red brown and often a thin bed of pebble conglomerate is found at its base. There is a transition from dark grey marine shales of the overlying Hulcross,

through the oxide zone and into 30 to 50 feet of dark carbonaceous mudstones of the Gates. It is felt the iron rich sequence represents a very shallow and gradual marine transgression during which a large amount of pyrite was formed in the sediments. The Gates muds were probably just beginning to grade into marine shales as the Hulcross sea transgressed when a sharp regression occurred leaving iron rich marine sediments in a dormant depositional environment. From three to four coal seams are normally found in the carbonaceous muds below the contact. The seams vary from a few inches to five feet in thickness but all information to date indicates that their development varies greatly on a local scale and, therefore, they have not been considered economic in any portion of the property. These seams were assigned to coal zone V in previous regional reports.

#### Babcock Sandstone

This sequence, located about 200 feet below the Gates/Hulcross contact, consists of 75 feet of light to medium grey, clean, well sorted sandstone. The upper 50 feet of sandstone are massive and medium-grained. The lower 25 feet generally contain thin beds (up to 2 inches) of bioturbated or chaotically bedded dark argillaceous material, poorly preserved worm burrows have been identified in this zone.

#### Sequence of Major Coal Deposition

Approximately 400 feet of mudstone, siltstone, sandstone, conglomerate and coal underlie the Babcock Sandstone. A total of 8 coal seams or carbonaceous zones were documented from the geophysical logs and core

logs in the Wolverine area but, consistency of development is generally poor even over the relatively short lengths between the drill holes and thus only two seams are considered to have potential economic importance. In Hole 7402, these seams (#1 and #2) effectively become one seam.

The upper 260 feet of the sequence generally consists of carbonaceous siltstone and mudstone with local alluvial conglomerate and sandstone beds up to 10 feet thick. The carbonaceous zones were given designations in the lower 80 feet of this sequence, i.e. Gates #6, #7 and #8. Gates #6 and #7 coalesce to form one 10 foot seam in hole #20.

Previous testing has indicated this seam has high ash. Elsewhere, seams #6 and #7 are developed separately with seam #6 ranging from 4.2 to 5.0 feet in thickness. Both thickness and quality preclude these seams from inclusion in mineable reserves at the present time.

Seam #6 is followed by 25 to 45 feet of poorly sorted conglomerate which is in turn followed by 30 feet of generally clean medium-grained, grey sandstone. A vitrain band up to 6 inches thick (Gates #5) occurs at the base of the sandstone and is underlain by 30 to 40 feet of silty carbonaceous mudstone. A seam up to 2 feet thick (Gates #4) is sporadically developed in the lower half of this sequence. Gates #3 is clean and well developed and found at the base of the above mudstone where it attains a thickness of 5 feet.

Following #3 seam, a river channel was tentatively identified. It varied in thickness 45 to 140 feet. The base of this sequence forms the roof of Gates #2 seam which is followed by 5 to 32 feet of carbonaceous siltstone and mudstone forming the roof of Gates Seam #1. The river channel sequence was not found between Seams #3 and #2 in Hole 19 as the interseam lithology consisted of 26 feet of mudstone. In Hole 7402, the mudstone sequence between Seams 1 and 2 has decreased to about 1 foot in thickness and the total seam thickness is 23 feet. This may indicate that the mudstone can be expected to continue thinning to the west, providing a seam with good potential for hydraulic mining. These results are discussed in more detail in the section of this report dealing with Block IV and a more comprehensive review of coal quality follows under the heading Coal Sampling and Analysis.

#### Quintette Member

From 265 to 315 feet of predominantly medium to fine-grained marine sandstone extends from the floor of Gates Seam #1 to the silty muds of the Moosebar transition zone. Although variations such as the development of fluctuating, minor, coal horizons and beds of fine-grained carbonaceous material occur in the central portion of this member throughout the property, it has been found that the massive sandstones predominate.



### Moosebar Formation

In the Wolverine area the Moosebar Formation was cored in a number of drill holes and logged thicknesses of 355, 396 and 425 feet have been recorded. The formation can be divided into an upper Transition Zone ranging from 100 to 140 feet in thickness and a lower sequence of homogeneous marine mudstone ranging from 255 to 294 feet in thickness. This division has been noted in other areas of the Quintette property but it is more pronounced north of the Wolverine River.

### Gething Formation

The Gething Formation has been cored in a number of diamond drill holes and found to be about 680 feet thick. Total thickness was inferred from correlating drill holes QWD 71-15 and 17 which encountered the Upper Gething with drill hole Wolverine #1 which bottomed in the Cadomin Formation. This has been confirmed from the data obtained from Hole #7403. Regional correlations from drilling in the Sukunka Valley, Babcock Mountain and Five Cabin Creek area have indicated that a major coal zone is developed throughout the entire region about 150 feet below the Moosebar-Gething contact and thus the floor of the lower seam (Chamberlain) has been used to divide the formation into an upper and lower sequence.

#### Upper Sequence

Following the erosional Moosebar contact, 55 to 75 feet of carbonaceous mudstone were deposited in a turbid environment. Coal seams up to two feet in

thickness were developed in the upper 30 feet of these sediments and are thought to be equivalent to the Bird zone encountered in the Sukunka area to the north. A glauconitic sandstone from 5 to 10 feet in thickness is found above the first coal seam encountered in this interval.

A massive medium to coarse-grained sandstone with carbonaceous partings follows the turbid muds. This sequence is a consistent 28 feet in thickness. From 15 to 35 feet of bioturbid mudstone follows and forms the roof of the Skeeter seam. These muds are carbonaceous with localized accumulation of coal up to 6 inches. Pyrite is common as replacement of fucoidal markings and the sequences grade downward to siltstone and sandstone up to 8 feet thick. The interval between the Skeeter and Chamberlain seams consists of 7 to 20 feet of mudstone gradational to siltstone. Ten feet of carbonaceous sandstone may be encountered at the bottom of this interval. The environment of the upper sequence is considered to be near shore marine with local embayments and minor low velocity alluvial deposition being responsible for the coarse-grained sediments interbedded with turbidic marine muds.

#### Lower Sequence

Sediments of the lower Gething sequence were cored in WDH #1, QWD 71-12 and 7403.

Approximately 75 feet of clean grey gradational mudstone with clean fine to medium-grained sandstone interbeds up to 3 feet thick underlie the Chamberlain seam in Hole #1. Both sand and mud have parallel laminations and are structureless. The diagnostic features of this sequence is its

lack of turbid bedding and carbonaceous material suggesting a possible transgression of the shoreline.

One hundred and sixty-two feet of near shore mudstone and siltstone follow; contacts are turbid and bioturbid. Pyrite is ubiquitous and glauconite has been found in coarse-grained zones, just above the middle coal zone which is located 90 to 120 feet from the Moosebar-Gething contact.

A sequence of 120 feet of sand, silt and mud follow a thin zone containing pebble conglomerate. The conglomerate is composed of quartzitic and phyllitic pebbles in a dark sandy matrix. Although this zone is thin (less than 7 feet) it may be a potential marker as no conglomerate has been found for 240 feet above or 100 feet below this horizon. Six fine to medium grained sandstones were encountered in the sequence, these sandstones increased downward in thickness from one-half inch to seven feet. They were well sorted with carbonaceous material, bioturbated zones, burrow markings and isolated angular mudstone clasts. The mudstones were carbonaceous and banded in appearance due to the high percentage of silts in a light argillaceous matrix which were cross bedded throughout.

The middle coal zone, a 33 foot zone, follows with 17 feet of relatively clean coal being found in four separate seams separated by black carbonaceous mudstone. The thickest seam was 5½ feet. In Hole #7403 the first two seams merge to one 8' seam. The remaining 240 feet of the formation consists of 80% mudstone with interbeds of siltstone and fine-grained sandstone. The depositional environment is believed to be very similar to that of

the upper strata. Five coal seams are located in this sequence but they are poorly developed (less than 2 feet thick) and well spaced which precludes the possibility of convergence to a mineable thickness within the reserve area. Specific coal qualities obtained for various Gething coal intersections are discussed under the heading of Coal Sampling and Analysis.

The lower contact of this formation is generally gradational from an increase in fine-grained sandstone to pebble and boulder conglomerate of the Cadomin. In this area, the top of the first conglomerate over two feet thick was considered the contact. In Hole #7403 the contact is sharp from siltstone to 5.4 feet of conglomerate. Seven feet of mudstone which gradually changes to siltstone follows and 9 feet of fine-grained sandstone overlies the massive conglomerate. 33.7 feet of Cadomin were found in Hole 7403 but the base of the formation was not reached.

(b) Tectonics:

As illustrated in the geology map, all structural axes follow the northwest-southeast trend which is typical for the Rocky Mountain Foothills. Structures are generally slightly sinuous. One major thrust fault has been investigated in the northwestern part of the area (Spartan Thrust) which, toward the Wolverine River, grades into steep anticline with minor fault breaks on its hinge line. Further southeast from the river it is probably completely transformed into the anticline.

Also in the northwestern part of the area, a very steep or vertical fault (Alpha Fault Zone) is present. It strikes parallel to the general trend of the structures and can be followed, with some intermissions, to Perry Creek. Minor, secondary, transverse faults have also been encountered, but most often they are restricted in space and have very small, local displacement of no more than one hundred feet.

In less competent strata (i.e. the Moosebar formation and the Hulcross member) drag folds are present in some places, but they do not affect the more resistant strata. Restricted drag folds have also possibly developed in shaly intervals of the Gething formation and the Gates member of the Commotion.

### (3) Description of Geology in Particular Blocks

#### (a) Block I (refer to North Wolverine Geology Map):

The area covered by this block is divided into two parts by the Spartan Thrust Fault mentioned above. This fault is well defined on the airphotos and has been observed in the unnamed creek in the northwestern corner of the property. The thrust dips southwesterly and has a morphological expression in the form of steep slopes which are formed by the sandstone and conglomerate of the Gates member. Toward the southeast it is transformed gradually into an anticline.

The area southwest from the fault consists of an elongated fold zone pushed northeasterly upon Hulcross shales and possibly upon the Gates member in the southeastern part. It is entirely covered by

the Gates member although possible, very restricted Moosebar outcrop may be present in the upper part of the unnamed Two Creek tributary adjacent to the northwestern corner of the block.

Two anticlines and two synclines have been investigated in this area. In describing them from west to east, the first anticline is restricted to the northwestern corner of the block. On its southwestern limb secondary folding has been observed in the upper part of Two Creek.

The southwest limb of the syncline to the east of this anticline is cut longitudinally by nearly vertical, local faulting. The northeast limb has dips ranging from  $35^{\circ}$  to  $50^{\circ}$  with some contorted microfolds close to the thrust bordering this area.

The second anticline is not well defined but does have a morphological expression in the form of a prominent cliff above the upper part of Two Creek and is diagonally truncated by the major thrust.

In the southeastern corner a second syncline, which possibly dies out to the west, has been mapped in the Shaftesbury Formation.

The area northeast of the fault consists of a relatively gentle folded zone of upper Commotion formation (Hulcross and Boulder Creek members) and Shaftesbury formation. Only one syncline and anticline in the last formation has been mapped. Microfolding is observed in the Hulcross shales and siltstones directly below the

thrust, but it probably does not reflect the nature of folding in the Gates member below. A large northeastern part of this area is unmapped but it seems that it is underlain by the Shaftesbury formation. Goodrich sandstone has been recognized in the homoclinal structure on the ridge in the northern part of this block.

#### Potential Coal Bearing Areas:

So far no single coal outcrop has been identified in the field that would indicate the presence of known seams of mineable thickness. Based on the known stratigraphy and coal deposition in the Gates formation and Gething member in adjoining areas, the area may contain some potential reserves. In the southwestern part, relatively regularly folded Gates may create an area of interest. Previous drilling in the reserve area to the southeast however, seems to indicate diminishing amounts of coal in the strata toward this block.

As for the Gething formation, its structure is probably highly complicated by the thrust fold and local dislocation.

The area to the northeast from the above thrust has tectonics more suitable for coal exploitation. Its reserves, if considered to 1500' depth, would be mainly restricted to the Gates member, however, a possible narrow strip of Gething formation reserves may be present along and under the thrust fold.

Outstanding Investigation:

As the geological mapping in this area has not been completed, it is worth noting that the following problems are outstanding.

The final identification of the strata on the southwestern side of the thrust fold has not been made. The Boulder Creek member is not excluded here, at least in the northwestern part of the area. A traverse on the right bank of the unnamed tributary to the south of where Two Creek presumably crosses the thrust may solve this problem. The crucial factor would be the presence or absence of the Hulcross member in the position stratigraphically above the cliff forming conglomerate. Another important field traverse should be done on the large outcrop in the northeastern end of the syncline for both identification purposes and to investigate possible coal zones.

Further investigation of the partially unmapped area in the northeastern part of the block would make possible a rough estimate of the width available for underground reserves in Gething formation.

(b) Block II (Refer to North Wolverine Geology Map):

Most of the area in this block is covered by Shaftesbury formation. Coal bearing strata (Gates member) crops out only in the northwestern part of the block and is situated on the northeastern



limb of a prominent anticline. Further to the northeast the axial trace of this anticline is transformed to the Spartan Thrust. Average dips of  $45^{\circ}$  in this structure increases very quickly to the south and in Perry Creek the strata is overturned ( $85^{\circ}/W$ ). Eastward two irregular synclines and one anticline have been mapped in the Shaftesbury formation. Only the first syncline is relatively well documented from attitudes taken in Perry Creek.

#### Potential Coal Bearing Areas:

Taking into account the tectonic conditions of the area and the results obtained from diamond drilling Hole #7401, this block does not represent any considerable amount of reserves of mineable coal.

#### (c) Block III (Refer to South Wolverine Geology Map):

An elongated and intensively folded zone of mainly Commotion formation occupies the southwestern half of this block. The remaining northeastern half is covered by gently folded Shaftesbury formation. Detailed field investigation has been done only in the northwestern part of the block and mainly above the timberline. The southeastern extensions of the mapped structures have not yet been defined. Gates member covers most of the area. Tectonic structures are more "squared", their axes are more sinuous and a large degree of secondary local folding is present. Local faults with very little displacement cut the secondary folds in the northwestern part of the block.

Progressing from the southwest in the northern end of this block, the axis of the first anticline has been located on the top of a prominent conglomerate ridge. Further to the northwest, Gething and Moosebar formations appear in its core (air photo interpretation).

Adjacent to this structure, an asymmetrical syncline has been mapped with a gentle northeast limb (dips  $0-15^{\circ}$ ) and steep southwest limb (dips  $30-40^{\circ}$ ). Massive conglomerate of the Gates member forms steep cliffs in places up to 30' high in this region. A similar morphological expression is visible to the southeast beyond the local fault. This fault makes the axis of syncline more sinuous or possibly creates a small displacement.

The adjacent anticline has a shaly section of the Gates member in its core; it is also asymmetrical with a steep ( $55-75^{\circ}$ ) northeastern limb. The southeastern extension of the axis of this structure is not definitely known, however a tentative correlation to the major anticline in the southern portion of the block may be made.

The most easterly syncline mapped in this block is generally expressed by Gates conglomerates and sandstones with dips from  $60-70^{\circ}$  on the southwest and  $40^{\circ}$  on the northeast; Hulcross and possibly Boulder Creek outcrops have been mapped in its axis to the north near the Wolverine Valley.

The remaining part of the block has not been mapped and only a few helicopter landings for strata recognition and geologic attitudes have been completed. Air photo interpretation reveals the same type of tectonic style. Although little doubt remains as far as general trend of structures, geological boundaries should, however, be considered as tentative.

#### Potential Coal Bearing Areas:

Several coal outcrops have been located in this area. They are all within the upper part of the Gates member. During the previous regional exploration, coal seams at least up to 10 feet thick have been found on the southwestern limb of the first anticline described above. Close to the axis of the adjacent syncline another coal seam, 5.5' thick, is found beneath 30 feet of conglomerate (see the enclosed detail 20c - 20e on the following page.) Towards the southeast, this seam thins to only 3 feet under the same conglomerate (see detail A-A<sub>3</sub> on the following page).

Other coal "subcrops" have been found in the vicinity of the unnamed 5932' high peak but further work in the form of hand trenching will be required to possibly establish actual thicknesses.

#### Outstanding Investigation:

Detailed mapping on the southwestern portions of this block are yet to be completed. Detailed mapping in the southern regions should concentrate on the Gates with particular attention

15, 080 E  
 92, 360 N  
 | 20c

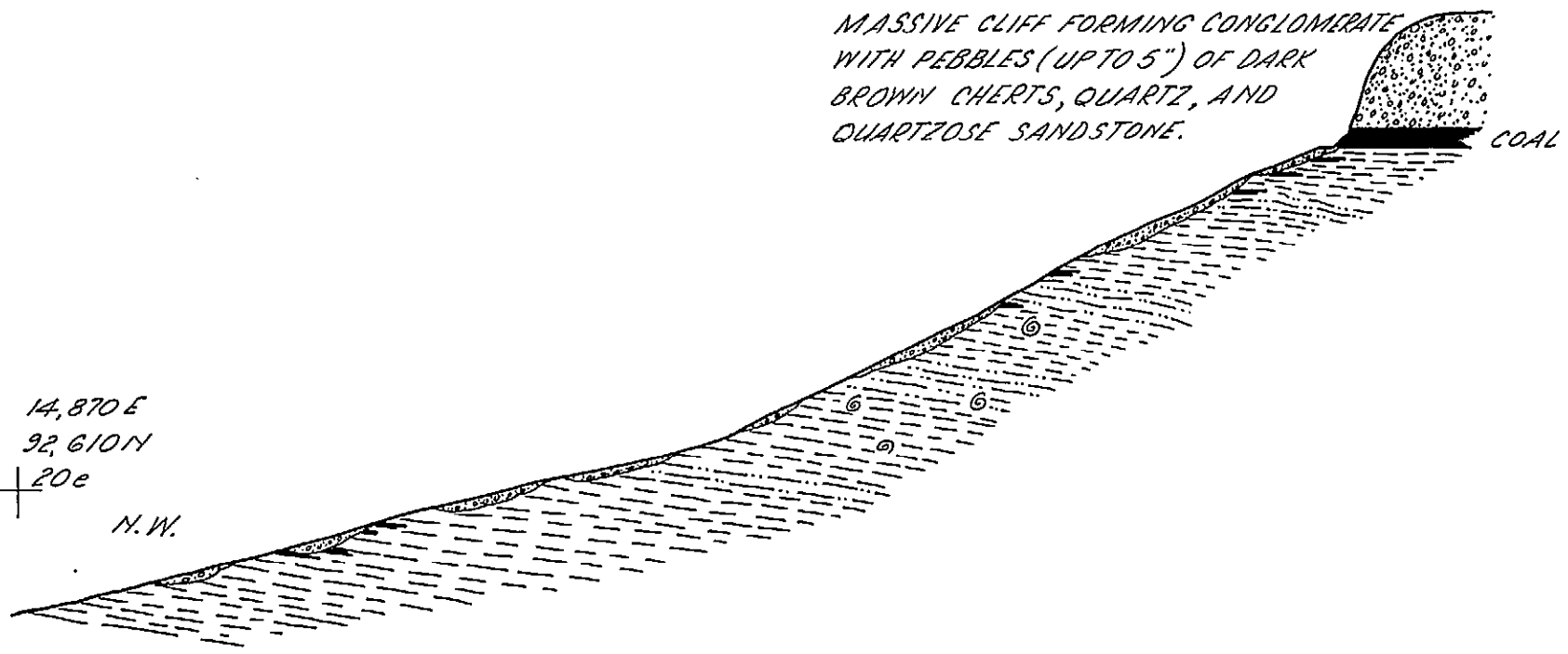
S.E.

MASSIVE CLIFF FORMING CONGLOMERATE  
 WITH PEBBLES (UP TO 5") OF DARK  
 BROWN CHERTS, QUARTZ, AND  
 QUARTZOSE SANDSTONE.

COAL


14, 870 E  
 92, 610 N  
 | 20e

N.W.



NOTE: DARK & BLACK COALY SHALE INTERBEDDED WITH  
 SILTSTONE RICH IN FOSSILS (FERNS & LEAVES)  
 THE WHOLE AREA CONTAINS POSSIBLE COAL ZONES  
 OF UNKNOWN THICKNESS. PARTIAL COVER OF  
 OVERBURDEN & SNOW AT TIME OF INVESTIGATION  
 DID NOT ALLOW PROPER EXAMINATION OF STRATA.  
 TRENCHING HIGHLY RECOMMENDED ON 20c-20d.

PR-QUINETTE 74(2)C

DENISON MINES LIMITED (COAL DIVISION)		
CALGARY	ALBERTA	
<b>CROSS-SECTION 20c-20e</b>		
DRAWN BY:	DATE: DEC. '74	SCALE: 1"=50'
APPROVED BY:	DRAWING NO. QNTT 74-0549-R01	

MASSIVE, CLIFF FORMING CONGLOMERATE, WITH PEBBLES OF QUARTZ, QUARTZOSE SANDSTONE, BROWN & DARK CHERTS, SOME INTERCALATIONS OF COARSE GRAINED & CONGLOMERATIC SANDSTONE.

DARK GREY SILTY SHALE, LAMINATED, CROSS-BEDDED. THICKNESS MAY BE EXAGGERATED BY SECONDARY FOLDING.

DARK BROWN SHALE

SHALE WITH INTERCALATIONS OF THIN BEDDED SANDSTONE

VERY FINE GRAIN, AND FINE GRAIN SANDSTONE, THIN/MEDIUM BEDDED, LAMINATED.

DARK GREY SHALE

FINE GRAINED SANDSTONE, THIN BEDDED WITH SOME INTERCALATIONS OF SHALE.

DARK SHALE

COAL

FINE GRAINED SANDSTONE, BRIGHT GREY, LAMINATED.

FINE GRAINED LAMINATED SANDSTONE.

### STRATIGRAPHIC SECTION

NOTE: MICROFOLDING & SOME SMALL AMPLITUDE FOLDS HAVE BEEN OBSERVED IN THE STRATA BELOW THE CLIFF FORMING CONGLOMERATE. THEY MAY BE PARTIALLY CAUSED BY ITS WEIGHT, OR MAY ALSO BE LINKED TO THE TRANSVERSE DISLOCATION OBSERVED IN THE VALLEY WEST OF THE ABOVE CROSS-SECTION. THESE DEFORMATIONS HAVE PROBABLY ONLY LOCAL EXTENSIONS.

A 18,250 E  
91,240 N

18,050 E  
91,470 N  
A<sub>3</sub>

### FIELD CROSS-SECTION

PA-QUINETTE 74(2)C

DENISON MINES LIMITED  
(COAL DIVISION)  
CALGARY ALBERTA



### STRATIGRAPHIC SECTION & CROSS-SECTION A-A<sub>3</sub>

DRAWN BY: EJA	DATE: DEC. 1974	SCALE: 1" = 50'
APPROVED BY:	DRAWING NO: ONTT 74-0548-R01	

to hand trenching in the middle Gates to enable a more complete inventory of the coal section.

In the northern end of the block, trenching and possible drilling of the Gething Formation on major structural limbs in the south Wolverine Valley will enable evaluation of Gething potential. This type of work could also be undertaken to obtain the Gates coal section.

(d) Block IV (Refer to South Wolverine Geology Map):

Attention was focused on the Commotion; Gates member and Gething formations which were located on the limbs of the Perry Creek anticline, Fortress syncline and Fox anticline respectively progressing from the northeast to the southwest of this block. Previous work<sup>(1)</sup> has outlined reserves in the Gates and Gething on the gently dipping northeast limb of the Perry Creek anticline in which a dip range from 0 to 15° indicates that conventional mining may be feasible and thus an investigation into the nature of coal development on the steeply dipping southwest limb of this structure was undertaken by drilling to indicate the potential for additional adjacent reserves amenable to hydraulic mining methods. This consideration was substantiated by dips of 45° which were measured from a trench (see Trenching) and surface exposures in the Gates on the southwest limb of the anticline and later confirmed by drill results in hole QWD-7402, dips between 30 and 45° were encountered on this limb in the Gething Formation in drill hole QWD-7403.

(1) Wolverine Area, Report on Exploration Work North of the Wolverine River between August 1971 and February 1972

Coal Development - Gates Member:

All 8 seams found previously were intersected in the second drill hole and tentatively correlated to the previously drilled reserve area. (Refer to 1974 Wolverine Correlation chart, back pocket)

Outstanding Investigation:

Further work in the area should concentrate on the detailed mapping of the Fortress syncline and adjacent Fox anticline such that the continuity along strike of these structures can be ascertained and also that accurate cross sections can be extended across the axis of these structures to aid in the reserve potential evaluation and subsequent drilling of hydraulic reserves.

Gates Seam #1 continues to demonstrate the most consistent development in this area and has potential regional correlation with the Babcock area 16 miles to the southeast where the most significant coal seams in the area (Seams I and J) are developed above the Quintette sandstone. Gates Seams #1 and #2 were found to coalesce in hole QWD 7402 with an aggregate true thickness of 23.2 feet comprised of 9.3 feet of Gates #1, .8 feet coaly shale and 13.9 feet of Gates #2. This development has encouraging implications in that the overall stratigraphic trend indicates both increased thickness development of Gates #2 and a decrease in the shaly parting between Seams 1 and 2 toward the northeast and thus a consistent seam of greater than 20 feet in thickness may be expected on the limbs of the Fortress syncline and Fox anticline.

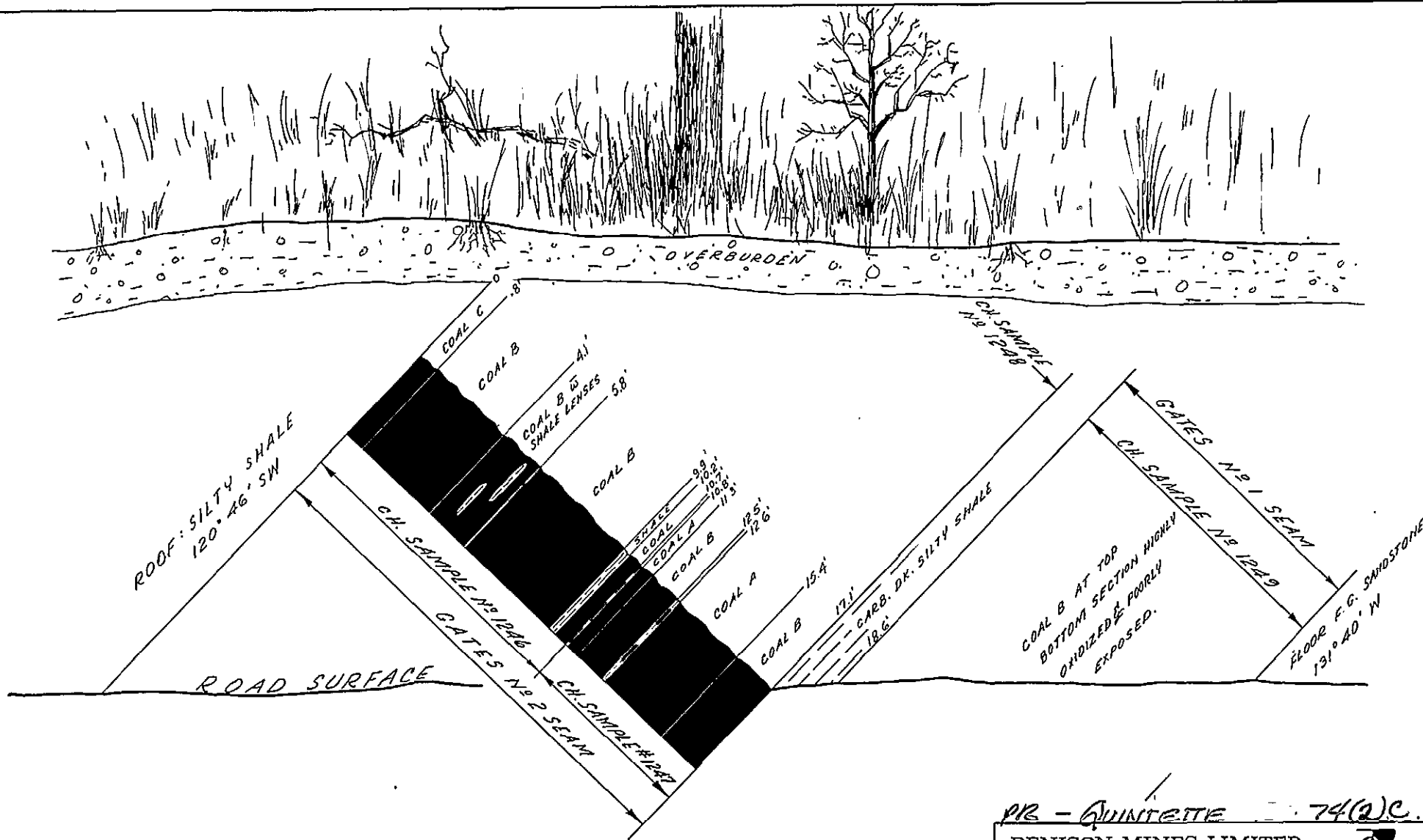
5) ROAD CONSTRUCTION, TRENCHING, DRILLING AND RECLAMATION

All road construction was undertaken with a D-6 and D-8 caterpillar contracted from R. Hanson Construction Ltd. of Chetwynd, B.C. and under the direction of Denison geological staff on the job site. This work consisted of building approximately 5 miles of access road to the 3 holes drilled during the programme. The access routes were flagged by Denison staff prior to construction to minimize surface disturbance and to enable grade control below 12%. These roads were later surveyed (chain and compass) and have been plotted on the geology maps accompanying this report.


The only form of trenching during the 1974 programme was that in which the drill road to hole QWD-7402 was widened in two locations to better expose coal seams intersected during road construction. In total, the road was widened approximately 10 feet over a length of 200 feet. The coal seams exposed in the first area referred to as Trench 1 were accurately measured and sampled (see diagram on the following page). Coal exposed in the second area referred to as Trench 2 was too thin (2 feet) to warrant further consideration. The locations of these sites were surveyed and also plotted on the geology maps enclosed.

Tonto Drilling Ltd. of Vancouver, B.C. were contracted to undertake the diamond drilling in the programme. A skid-mounted Longyear 44 diamond drill equipped with wireline apparatus was employed to drill three drill holes totalling 2005 feet of H.Q. drill core. These three drill holes are summarized as follows.





PR - QUINTEITE 74(2)C.

DENISON MINES LIMITED (COAL DIVISION)		
CALGARY	ALBERTA	
<b>CROSS SECTION SKETCH OF WOLVERINE TRENCH #1 GATES SEAMS NO 1 &amp; 2</b>		
DRAWN BY: E.T.H.	DATE: Dec. '74	SCALE: 1" = 50'
APPROVED BY:	DRAWING NO: WLVR 74-0550-001	

1974 Wolverine Drill Hole Summary

<u>Drill Hole Number</u>	<u>Drill Hole Angle</u>	<u>Drill Hole Direction</u>	<u>Total Footage</u>	<u>Formation Drilled</u>
QWD-7401	90 <sup>0</sup>	-	802	Commotion Fm., Upper & Middle Gates Member
QWD-7402	90 <sup>0</sup>	-	407	Commotion Fm., Middle Gates Member
QWD-7403	60 <sup>0</sup>	N15 <sup>0</sup> E	796	Lower Gething and Upper Cadomin Fm.

All drill core was logged and results can be found in the centre strip of the Gamma Ray-Neutron logs enclosed in the back flap of this text. (1974 Wolverine Correlation Chart)

Reclamation was undertaken on all land disturbed by the 1974 exploration programme including the campsite. The B.C. Forest Service in Chetwynd made trips to the project area prior to and during the programme so that guidelines for reclamation were upheld. Approval from the B.C. Forest for reclamation work including seeding erosion control, slash abatement and total disposal has been obtained for all work undertaken during the programme.

6) GEOPHYSICAL LOGGING AND DRILL HOLE CORRELATION

Roke Oil Enterprises Limited of Calgary were contracted to provide geophysical logs of the three Wolverine diamond drill holes. Gamma Ray, Neutron and High Resolution Density readings were taken at a 1 inch to 20 foot scale, drill hole angle and direction readings were obtained with a Sperry Sun photographic gyro. Copies of all the logs have been included in a separate appendix folder which accompanies this text.

A correlation chart at 1 inch to 50 feet has also been enclosed in the back flap; this chart indicates that there is good correlation between the stratigraphy drilled during the 1971/72 programme and holes QWD 7402 and 7403 and that correlation of hole QWD 7401 is tentative and will require further drilling to establish the nature of stratigraphic correlation and coal seam development northeast of the present reserve area.

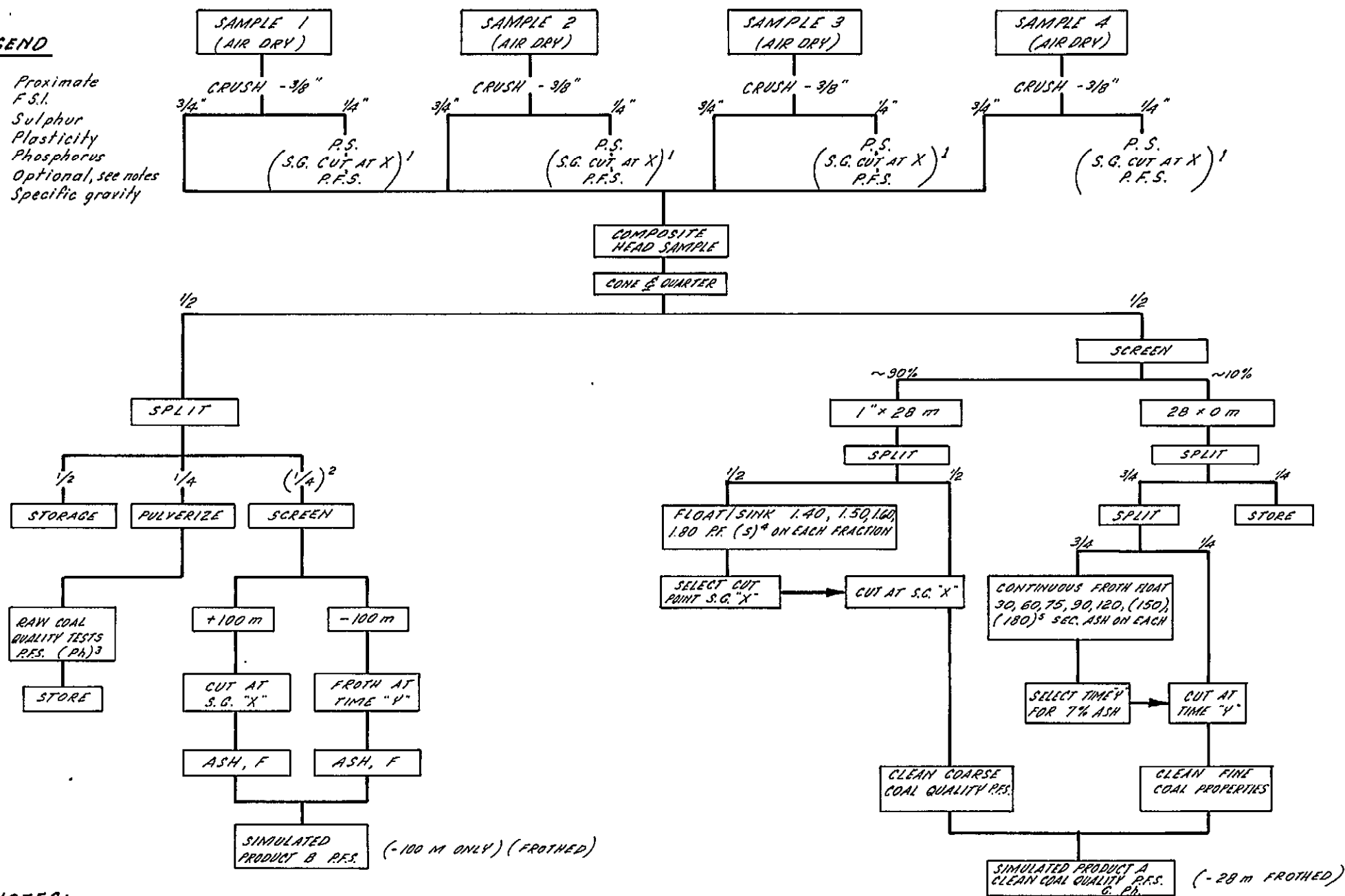
7) COAL SAMPLING AND ANALYSES

All coal seams over 2 feet in thickness were wrapped in plastic at the drill hole, logged and incrementally sampled at the campsite and finally sent for analysis in sealed plastic bags. All sample numbers and their location have been marked on the geophysical logs.

Seams of less than 5 feet in thickness were considered of lesser economic significance however, and the samples from these seams were composited, air dried, crushed to minus 3/8" mesh and separated at 1.55 specific gravity. Proximate analysis, F.S.I., sulphur and phosphorus determinations were then carried out on the float/sink products. Seams greater than 5 feet in thickness were analyzed according to the procedure outlined on the flow sheet on the following page. All analytical results have been included in Appendix I (separate cover), a summary of these results are as follows. *See Confidential Coal Analysis File*

## LEGEND

P	Proximate
F	F.S.I.
S	Sulphur
G	Plasticity
Ph	Phosphorus
( )	Optional, see notes
S.G.	Specific gravity



## NOTES:

1. CONTRIBUTION OF COMPONENT SAMPLES TO COMPOSITE CLEAN COAL TO BE DETERMINED WHEN REQUESTED BY DENISON MINES LIMITED.
2. SIMULATED PRODUCT B TO BE PREPARED ONLY WHEN THERE IS SUFFICIENT SAMPLE FOR A REPRESENTATIVE ANALYSIS.
3. PHOSPHORUS TO BE DONE ON HEAD SAMPLE IF PH. IN CLEAN COAL IS GREATER THAN 0.05.
4. SULPHUR TO BE DONE ON SINK / FLOAT FRACTIONS IF SULPHUR IN THE ANALYSIS IS GREATER THAN 0.70.
5. CONTINUOUS FROTH FLOTATION UP TO 180 SECONDS IS REQUIRED ON INITIAL SAMPLES. THIS MAY BE REVIEWED LATER IF THE FROTH IS RELEASED QUICKLY.

8) POTENTIAL RESERVES

The mapping programme has indicated that the Gates member of the Commotion Formation outcrops on the southwestern halves of Licence Blocks I and III. Drilling and trenching will be necessary to obtain the mineable coal thicknesses in these areas as both tree and talus cover prevented accurate measurement of the coal section and thus no potential reserves estimates will be made. It is expected that further exploration will outline conventional and hydraulic underground reserves plus limited strip reserves in the Gates and possibly limited underground Gething reserves.

Results obtained from Licence Block II indicated that no further attention is warranted as geological mapping outlined one very small area of Gates outcrop on which the results of one drill hole (QWD 7401) indicated that no mineable coal seams were present in the coal section.

Although very little mapping was possible in Block IV as Gates and Gething exposure were limited, the results of drilling on the southeast limb of the Perry Creek anticline were very encouraging in that 23 feet of coal was encountered in hole QWD 7402 (Gates Seams #1 and #2) and 8 feet of coal in the Middle Gething Formation.

The 23 foot Gates seam is of particular interest in that both its thickness, dip ( $45^{\circ}$ ) and proximity to the Wolverine Valley (transportation corridor) indicate excellent potential for hydraulic

mining. Since only one drill hole has so far been completed in this structure no detailed reserve calculations have been made, however based on the following assumptions;

- a) the 23 foot coal seam found in hole QWD 7402 is present from the Wolverine Valley north to Perry Creek on the southeast limb of the Perry Creek anticline,
- b) quality indicated in the analysis from drill hole #2 is consistent,
- c) average dip of the limb remains  $45^{\circ}$ ,

then approximately 20 million short tons of coal would be found in place to a maximum depth of 1500' of vertical cover and which would further be reduced to approximately 10 million short tons of clean coal.

It might also be expected that Gates reserves of this magnitude could be expected from the opposite limbs of the Fox anticline and that limited mining reserves might be outlined in the Gething.

9) CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

Block I:

- (1) The southwestern half of the block contains significant exposures of the Gates member of the Compton Formation.
- (2) Providing a mineable coal section can be located, there is potential for the lineation of conventional and hydraulic underground reserves in the Gates.
- (3) Present mapping indicates limited potential for strip reserves, however more detailed lineation of coal seams is necessary.
- (4) Getting reserves if present will be underground, of small extent and probably structurally complex.

Block II:

- (1) This block contains virtually no prospects for potential coal reserves as coal bearing strata was not found.

Block III:

- (1) The southwestern half of this block consists of Gates member exposure.



(2) Due to the tight nature of the folding in this region within the Gates, especially in the northern section it is felt that a potential for strip coal will have to be established in this area.

(3) More detailed ground investigation must be undertaken to establish thickness of the coal seams within the Gates.

(4) Virtually no potential exists in the Gething.

Block IV:

(1) Present work has indicated that one 23 foot coal seam is present in the Gates and at least one 8 foot seam is present in the Gething.

(2) The potential for proving under ground hydraulic reserves north of this licence block is very good.

Recommendations:

1. Detailed further mapping and hand trenching should be undertaken in the southwestern halves of Blocks I & III.
2. Detailed mapping should be undertaken on the structures north of Block IV (i.e. Perry Creek Anticline, Fortress Syncline and Fox Anticline) and later followed by drilling to establish hydraulic coal reserves.
3. No further work is necessary on Licence Block II.

10) BUDGET

Costs incurred by Denison Mines (B.C.) Limited on exploration work on Coal Licences 2645 to 2669 between September and November 24, 1974 have been tabulated on the following page. These costs were taken directly from the company's accounting files.

## DENISON MINES (B.C.) LIMITED

STATEMENT OF COST INCURRED ON QUINTETTE COAL LICENCES #2645 to 2669 INCLUSIVE  
BETWEEN SEPTEMBER 1 AND NOVEMBER 24, 1974\*

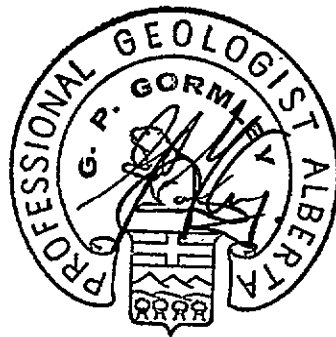
<u>CODE</u>	<u>DESCRIPTION</u>	<u>SEPTEMBER 1974</u>	<u>OCTOBER 1974</u>	<u>NOVEMBER 1974</u>	<u>TOTAL PROJECT</u>
1301	Ground Examination Wages & Salaries	1,282	11,749	7,667	20,698
1304	Ground Examination Supplies & Services	104	1,463	3,794	5,361
1306	Ground Examination Helicopter	-	1,251	16,060	17,311
1309	Ground Examination Lab Assay & Analysis	-	-	1,784	1,784
2008	Diamond Drilling Contractor Charges	-	54,902	(10,351)	44,551
2208	Borehole Logging Contractor Charges	-	-	5,541	5,541
2408	Road Construction & Maint. Contractors Charges	-	-	16,710	16,710
2603	Field Camp Purchase/Rental of Equipment	-	3,465	6,561	10,026
2604	Field Camp Supplies & Services	-	22	867	889
2605	Field Camp Room & Board	-	1,714	6,373	8,087
2608	Field Camp Contractors Charges	-	-	3,082	3,082
2908	Reclamation Contractors Charges	-	-	7,231	7,231
3004	General Field Expenses Supplies & Services	249	71	-	320
3007	General Field Expenses Travel	161	1,739	1,082	2,982
3020	General Field Expenses General	-	41	6,333	6,374
		<u>\$1,796</u>	<u>\$76,417</u>	<u>\$72,734</u>	<u>\$150,947</u>

\* Cost represents all invoices recorded as of November 30, 1974,  
some late invoicing is expected in December

11) QUALIFICATION & ACKNOWLEDGEMENT

All work outlined in this report represents the actual results of field work under my supervision on behalf of Quintette Coal Limited on Coal Licences 2645 to 2669 inclusive. The author wishes to thank the following staff who were involved on the programme:

- A. Johnson - Chief Geologist Coal
- A. Bak - Geologist
- C. McFall - Consultant Geologist
- L. Smith - Geologist
- L. Scorgie - Camp Foreman
- L. Mittlested - Geological Assistant
- B. Blacquiere - Geological Assistant



G. P. Gormley, P. Geol.  
Project Geologist  
Denison Mines Limited

**DENISON MINES LIMITED**  
**COAL DIVISION**

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 TORONTO, ONTARIO M5H 1C2  
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 TELEX 02-2205

D.M.	
ADM (M)	<i>29/1/75</i>
ADM (P)	
C.G.C.	
C.P.R.	
DCGC	
ACPR	
CALGARY, G.C.	January 22, 1975
ACCTS.	
GE. L.	
INS.P.	
M. REV.	
EC. & F	<i>27/1/75</i>
FILE NO.	
FILING CLERK	

DIVISION OFFICE:  
 1500-444 5TH AVENUE S.W.  
 CALGARY, ALBERTA T2P 2T8  
 TEL. 403-269-4327

Dr. James T. Fyles  
 Associate Deputy Minister  
 Mineral Resources  
 Department of Mines and Petroleum Resources  
 Victoria, British Columbia

Dear Dr. Fyles:

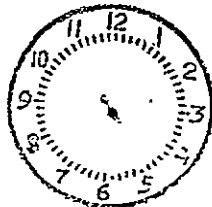
In reference to Mr. A. Johnson's letter of December 16, 1974; I have enclosed the report documenting work undertaken on coal licences 2645 to 2669 (Order in Council 2296). If there are any questions in regard to the report or if additional copies are required please contact me.

Yours truly,

DENISON MINES LIMITED.

*[Signature]*  
 G. P. Gormley, P. Geol.  
 Project Geologist

JAN 24 '75 PM



GPG:gjk

Encl.

DEPT. OF MINES  
 AND PETROLEUM RESOURCES

1097

606

# DENISON MINES LIMITED

COAL DIVISION

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D.M.	
ADM (M)	✓ 2/11/75
ADM (P)	
C.G.C.	
C.P.R.	
DCGC	
ACPR	
G.C.	CALGARY, January 22, 1975
ACCTS.	
GENL.	
INSP.	
M. REV.	
EC. & P	2/11/75
FILE NO.	
FILING CLERK	

**DIVISION OFFICE:**  
1500-444 5TH AVENUE S.W.  
CALGARY, ALBERTA T2P 2T8  
TEL. 403-269-4327

## DEPARTMENT OF MINES AND PETROLEUM RESOURCES

Date: Feb 10/75.

From: *A.R.C. James*  
To: *Mr A.R. Cornell,*  
*Administrator for Coal.*

**INSTRUCTIONS**

- For your approval.
- For your information.
- For necessary action.
- Send me copy of reply.
- For your comments.
- Prepare reply for my signature.
- Prepare draft of reply.
- Return to me.
- Return to file.
- For signature.
- Wish to discuss.

**REMARKS:**

I think that this report and statement of costs incurred is satisfactory, and would recommend that the request by Denison Mines for the return of their \$50,000 performance bond be acceded to.

*Report passed to G. Bell 11/2/75*  
*A.R.C. James*

um Resources

Johnson's letter of December 16, 1974, mentioning work undertaken on coal (Council 2296). If there are any part or if additional copies are required

Yours truly,

DENISON MINES LIMITED

*G.P. Gormley*  
G. P. Gormley, P. Geol.  
Project Geologist

1097

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