

**TERMS AND BACKGROUND**

**OF LONG-TERM CONTRACTS**

**(1) 15-Year Contract for Balmer Coal (Signed March 22, 1968)**

(With interim contract for 1967-1969 shipment appended)

- (a) Period of Shipment: 15 years on and after April 1, 1970
- (b) Price and Volume:

Contract Year	(Price - US\$. Volume - in 1,000 L/T)						
	1970	1971	1972	1973	1974	1975-1984	Total
Volume	5,150	5,150	5,150	5,150	5,150	5,000 annually	75,750
Price FOB T	\$12.85	\$12.85	\$12.85	\$12.85	\$12.85	To be negoti- ated later	

- (c) **Optional Change in Shipment Volume:**  
 An annual shipment volume may be increased or decreased within 10% of the contracted volume at the buyers' option.  
 The exercise of this option for the first contract year requires the agreement of the seller.
- (d) **Reviews of Price Terms:**  
 At the ends of the 4th and 9th contract years the contracting parties will reexamine the price terms and the price escalator terms applicable to the following five years.  
 In case the parties fail to reach an agreement on these terms, the buyers side may cancel the contract.
- (e) **Escalator Clause:**
  - 1) Price hike in line with rise in railway transport cost.  
 The FOB price of the coal may be increased according to the following table in case of a rise in the labor cost (wages and fringe benefits) of Canadian Pacific Railway Co. (CPR), which hauls Balmer coal to the shiploading port. (Remarks: The railway freight for the coal as of Jan. 1, 1968 was Can. \$3.50 per S/T or US\$3.626 per L/T.)

Rise in CPR's labor cost in the Period			Resultant hike in FOB price of Balmer coal to be effected	
from:	to:	as from:	by up to:	
Jan. 1, '68	Mar. 31, '71	Apr. 1, '71	Can.\$0.17 per S/T	(US\$0.1712 per L/T)
Apr. 1, '71	Mar. 31, '72	Apr. 1, '72	Can.\$0.07 per S/T	(US\$0.07252 per L/T)
Apr. 1, '72	Mar. 31, '73	Apr. 1, '73	Can.\$0.07 per S/T	(US\$0.07252 per L/T)
Apr. 1, '73	Mar. 31, '74	Apr. 1, '74	Can.\$0.08 per S/T	(US\$0.08288 per L/T)
Apr. 1, '74	Mar. 31, '75	Apr. 1, '75	"	"
Apr. 1, '75	Mar. 31, '76	Apr. 1, '76	"	"
Apr. 1, '76	Mar. 31, '77	Apr. 1, '77	"	"
Apr. 1, '77	Mar. 31, '78	Apr. 1, '78	Can.\$0.09 per S/T	(US\$0.09524 per L/T)
Apr. 1, '78	Mar. 31, '79	Apr. 1, '79	"	"
Apr. 1, '79	Mar. 31, '80	Apr. 1, '80	"	"
Apr. 1, '80	Mar. 31, '81	Apr. 1, '81	Can.\$0.10 per S/T	(US\$0.1036 per L/T)
Apr. 1, '81	Mar. 31, '82	Apr. 1, '82	"	"
Apr. 1, '82	Mar. 31, '83	Apr. 1, '83	"	"
Apr. 1, '83	Mar. 31, '84	Apr. 1, '84	"	"

Remarks: Rise in shiploading charge is not applicable to the above table.

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2) Price hike in line with mining cost.

In case of a rise in miners' wages, fringe benefits, power cost supplies expenses and taxes excepting income tax, the coal price may be hiked by up to US\$0.30 per L/T per two years on and after April 1, 1970. The seller may apply to the two years from the time of contract conclusion (March 22, 1968) to the day before starting date of shipment (April 1, 1970) 20 cents out of the 30 cents that is the range of price raise allowed under the aforementioned provision for the period from April 1, 1970 to March 31, 1972. This means a price hike range of 30 cents is applicable to about four years from March 22, 1968 to March 31, 1972.

In case of rise in supplies cost ..... The whole sum of rise in cost per ton of the coal as certified by an auditor.

In case of rise in labor cost .....

1st contract year:- The sum of rise in labor cost x 15%

Later contract years:- The sum of price hike are to be fixed through consultation between the contracting parties.

In case of rise in tax cost ..... The sum of price hike is to be set within a range of 30 cents for 2 years.

(f) Guaranteed Analysis: (on an air dried basis unless otherwise specified)

Inherent moisture .....	1.5%
Total moisture .....	6.0% max. on a natural basis
Ash .....	8.75% (Tolerance - 0.5%)
Volatile matter .....	19 - 22%
Sulphur .....	0.4% max.
Coke button index .....	6 - 8
British thermal index .....	14,000
Sizing .....	$\frac{1}{2}$ " minus 90% min. 1 $\frac{1}{2}$ " max.

(g) Coal seam worked ..... No. 10 seam

(h) Effectuation of Contract:

The contract takes effect when the seller Kaiser Steel Corp. secures the approval of the competent Government agencies on the funds arrangements for development of Balmer coal mine and the construction of the loading port Roberts Bank.

Roberts Bank port must be completed by January 1, 1970. If the port is not completed by that date, Kaiser Steel will have to ship the coal from Port Moody under the same conditions as provided in the case of shipment from Roberts Bank port.

(i) Loading Guarantee and Despatch Money/Demurrage:  
(At Roberts Bank port)

Size of Carrier	Loading Guarantee (per day)	Despatch Money/Demurrage
Below 15,000 DWT	5,000 tons	\$400/\$800
15,000-30,000 DWT	10,000 tons	\$1,000-\$1,250/\$2,000-\$2,500
30,000-45,000 DWT	15,000 tons	\$1,500-\$1,750/\$3,000-\$3,500
45,000-60,000 DWT	20,000 tons	\$2,000-\$2,250/\$4,000-\$4,500
60,000-75,000 DWT	25,000 tons	\$2,500-\$2,750/\$5,000-\$5,500
Above 75,000 DWT	To be fixed later	To be fixed later

### Background of Contract

Balmer coal mine is operated by Balmer Coal Limited, a subsidiary of Kaiser Steel Corp. U.S.A., which took over the property from Crows Nest Industries Ltd. of Canada February 29, 1968.

Until then the mine was run by Balmer Mines Ltd., 100 per cent subsidiary of Crows Nest Industries.

A basic agreement on the sale of the whole asset of the mine was reached between Kaiser Steel and Crows Nest May 1, 1967.

After that, Kaiser Steel set up afore-mentioned Balmer Coal Ltd., which took over all the assets and liabilities of Balmer Mines Ltd. February 29, 1968, effectuating the contract for purchase of the mine.

Before the sale to the Kaiser interest, Balmer mine was in considerable trouble because of failure to improve its financial status through working a new pit in and after March 1966, followed by a blast accident in early April of 1967 which claimed 14 lives.

In the meantime, Kaiser Steel considered the mine commercially workable through a large-scale strip operation, and investigated the mine with this regard for about one year before the conclusion of the basic agreement on the purchase of the mine.

On May 29, 1967, 20 days after the conclusion of the said agreement, Kaiser sent to Japan Mr. W.J. Gleason, Export Manager, and Mr. S.C. Knight, Transport Manager, to talk with Japanese steel mills on export sale of Balmer coal.

The Kaiser representatives outlined the Balmer coal marketing plan as follows:

Annual production .... 4 million tons in and after 1970.

Home consumption ..... 400,000 tons

Marketing in Canada .. 400,000 tons

Stockpiling ..... 200,000 tons

Export to Japan ..... 3 million tons

(Under a 15-year contract. To be transported by Great Northern Railways of the U.S. to Roberts Bank port for shipment to Japan.)

Kaiser Steel officially proposed to Japanese steel mills a long-term contract for Balmer coal October 20, 1967, about five months after its conclusion of the said basic agreement with Crows Nest on the takeover of the mine.

The contract terms offered were somewhat more advantageous to the Japanese side than those earlier hinted at by Kaiser representatives.

But the price proposed by Kaiser was US\$13.35 FOBT uniformly for each year, a very high price compared with those of U.S. low volatile coals at the time (\$12.43 FOB in the case of Itmann coal).

Two weeks before this, steel mills had an offer of a long-term contract for Smoky River coal also at a very high price. The coal producer McIntyre Porcupine Mines Ltd. proposed an average price of \$14.50 FOB for shipment over 15 years starting in 1970.

Steel mills felt the need to hold a firm position in negotiating the two coal deals. For the following one month they studied the prices they should counterpropose, taking into consideration the contents of the report submitted by the steel mill mission which had surveyed Canadian coking coals and returned to Japan immediately before steel mills received the offers of the two coal deals.

On November 20 of the same year steel mills decided to counterpropose a price of \$12.00 FOBT for Balmer coal or \$1.35 lower than the offered price, and \$12.80 FOBT for Smoky River coal or \$1.70 below the offered price. They notified the coal producers to this effect.

In the course of negotiations until December that year Kaiser Steel

lowered its price terms to \$13.05 and then to \$12.95, while the Japanese steel mills conceded to \$12.50. But the two sides were unable to resolve the remaining difference of 45 cents until they broke off the talks for the year.

In the talks resumed in mid-January next year the two sides first negotiated on the escalator clause shelving the issue of FOB prices for later discussion.

The negotiations on the escalator clause were deadlocked also with the Japanese side insisting on a price hike range of 30 cents for 2 years and Kaiser Steel calling for 60 cents for 2 years.

The contract talks made a rapid headway, however, after Kaiser representatives visited Japan January 25 and began negotiating directly with Japanese steel mills. The two sides reached a basic agreement finally January 31, four months after the presentation of the contract offer by Kaiser Steel.

The basic agreement did not include the provision for the escalator clause, and the two sides proceeded to negotiate on this provision.

As a result the two sides reached the following agreement:

- a) In case of a rise in taxes or imposition of a new tax, the coal price will be hiked by a sum of rise in tax payment minus 10 cents per ton of the coal.
- b) In case of a rise in equipment and supplies cost, the coal price will be hiked by a sum of rise in this cost as certified by an auditor.

As for the price hike owing to a rise in labor cost, the producer and steel mills differed much calling for the price hike margins of 25% and 15%, respectively, of the labor cost increase.

In the end both sides agreed to adopt 15% tentatively for the 1st contract year and to negotiate later the rate for the rest of the contract period. Thus the 15-year contract for Balmer coal was concluded March 22, 1968.

Then, in early December of the same year Kaiser Steel came out with an offer of an additional contract for annual shipment of 2 million tons or a total of 6 million tons over the period from the first to the third year of the principal contract.

The talks for the additional contract did not make an easy start because the producer initially called for a C & F contract and quoted the coal price at a fairly high level of \$15.70.

But Kaiser later switched to a proposal of an FOB contract quoting the coal price at \$13.00 and then reduced the price to \$12.65, the same level as that of the principal contract.

This led to the settlement of the negotiations for the additional contract December 19, 1968. The official signing of the contract took place February 17 next year (1969).

To Japanese steel mills the additional contract was rather an unexpected but welcome thing as it was offered when they were not entirely sure of the shipment of the coal according to the terms of the principal contract.

On the other hand, there were a number of speculations in the steel mill circles at the time about Kaiser's intentions behind the proposal of the additional contract. They were:

- (a) Kaiser wanted to amortize the capital funds invested in the development of the mine in 5 years from 1970.
- (b) After the completion of the amortization Kaiser planned to direct annually 2 million tons of the coal to its own use.
- (c) Kaiser wanted to conclude the additional contract providing against the possible cancellation of the 15-year contract after 5 years of shipment.
- (d) Kaiser wanted to boost the contract volume of Balmer coal to such a massive level that the Japanese side could not cancel the contracts later, if it wished, because of their weight in the supply of coking

coals for the Japanese steel industry.

At the same time, Kaiser wanted the additional contract to be of comparatively short duration as it anticipated a future rise in market prices of coking coals.

Japanese steel mills, therefore, had the additional contract provide for their preferential right to take the shipment of the coal if the producer has a capacity to make it after the termination of the stipulated contract shipment.

Remarks: Kaiser Steel initially planned to use Great Northern Railways of the United States for inland transportation of the coal, but later switched to Canadian Pacific Railways.

This was because the Canadian Government demanded the use of a Canadian railway line for transport of a Canadian product and Canadian Pacific Railways offered the same freight rate for the coal with that proposed by Great Northern Railways.

#### Interim 2-Year Contract for Balmer Coal

(Pending Start of Shipment under 15-Year Contract)

The contract was concluded in December 1966 with the then operator of Balmer Mines Ltd.

Balmer Mines offered the contract in October as a tentative one as the Japanese side had not responded to its earlier offer of a 10-year contract for shipment of 14,710,000 tons in total.

The producer proposed the 10-year contract in June 1966 calling for the start of shipment 18-24 months after the conclusion of the contract.

But the Japanese side declined to consider the offer because of its high price terms as compared with those for U.S. low volatile coals at the time (in the case of Itmann coal \$12.35 FOB)

For the 10-year contract Balmer Mines quoted a price of \$13.00 FOB for half of the total contract volume to be shipped earlier and \$12.75 FOB for the remaining half.

Following are the highlights of the interim 2-year contract:

- (a) Volume: Annually 400,000 tons
- (b) Period of Shipment: 2 years from April 1, 1967 to March 31, 1969.
- (c) Guaranteed Analysis:

Total moisture	..... 5.0%	Sulphur	..... 0.3%
Ash (tolerance 0.5%)	... 9.0%	Coke button index	.... 8 - 9
Volatile matter	..... 19-20%	Sizing	..... 2" max.
- (d) Price: USS12.00 FOBT per L/T.
- (e) Price Increase under Escalator Clause:  
Up to 30 cents a year in case of a rise in miners' wages.

Remarks: The prices as of the ends of 1967 and 1968 contract years were \$12.30 and \$12.60, respectively.

Besides this contract, Japanese steel mills closed another interim deal for Balmer coal with Balmer Coal Ltd. (the Kaiser affiliate) for fiscal 1959 shipment.

The coal price under the new contract was \$13.15 FOB or 55 cents up from the purchase price for 1968 shipment. The price increase was due to a rise of 25 cents in port charges effected during fiscal 1968 and a hike of 30 cents in miners' wages for 1969, both per ton of the coal.

The volume of annual shipment and the quality specification are the same as those for contract with Balmer Mines Ltd.

# PRESENT STATUS OF COAL MINES AND PROSPECTS

## (1) Balmer Coal (Hard Coking Coal)

**OPERATOR:** Balmer Coal Ltd. (A Canadian subsidiary of Kaiser Steel Corp., U.S.A.)

**SHIPPER:** Balmer Coal Ltd.

**MINE LOCATION:** 680 railway miles east of Vancouver.

**COAL SEAM WORKED:** No. 10 seam, with a thickness of 45'. Besides, there are 13 coal seams in the area, designated D,B,A, No. 1,2,3,4,5,6,7,8 and 9 seam. Of them, No. 7 seam (20' thick) and 8(10') along with No.10 seam are said commercially workable so far as seam thickness is concerned. In 1969 the operator took some volume of sample coal from No. 7 seam, but suspended operation on account of considerable unevenness in the coal quality.

**RESERVES MINABLE THROUGH STRIPPING (No.10 seam)**

A total of 81,000,000 tons on a clean coal basis.

- a) Harmer Ridge area ..... 35,000,000 tons
- b) Dry Creek area ..... 2,000,000 tons
- c) Adit No.29 area ..... 14,000,000 tons
- d) Camp 8 area ..... 30,000,000 tons

This mining area further includes East Ridge, Camp 8 East, Harmer Knob and Harmer Knob East areas besides those listed above. Fairly good survey work seems to have already been done in all of these areas except for Camp 8 East area. It is being conducted with a view to an increase in the contract volume of shipment to Japan. That is, there exists a contract of Balmer coal sale to Japanese steel mills in a total volume of 45,750,000 tons for delivery over 15 years 1970 through 1984 (this will be stated in fuller details later.)

The said 4 areas under survey are eyed as dependable supply sources in making an additional yearly sale of 2,000,000 tons to 3,000,000 tons on the current contract terms. Such an increase in the coal shipment is being envisaged in and after 1975 contract year.

Of the 4 areas East Ridge and Camp 8 East are considered each to have a fairly large reserve, while not too much is expected from either Harmer Knob or Harmer Knob East areas.

Coal for the 15-year export shipment as from April of 1970 will come from the aforementioned 8 areas. Extraction of coal for shipment up to 1969 was carried on through underground mining exclusively in Balmer South and Balmer North mines. These mines, combined, have a measured reserve of 59,000,000 tons or an indicated reserve of 26,000,000 tons.

(Note) As sketched here, the 8 areas exist on No.10 seam in two groups on the east and the west sides on the top of a mountain. The severance in the seam was supposedly caused by dislocation of strata. The west side seam is identical with that constituting Balmer North mine at the foot of the mountain.

**EXTRACTION RATIO BY AREA:** Extraction of annually 5,150,000 tons of coal for 3 years beginning in 1970 will basically be achieved in the ratio of Harmer Ridge, 75%, Adit No.29, 15%, and Camp 8, 10%. In addition, some volume is to be worked from Dry Creek area.

**MINING METHOD:** Truck & shovel system. To first explode overburden and remove it by means of a dragline. To again crush the exposed coal seam by use of explosives, and then load it on a 200-ton capacity truck by power shovels to convey it to the preparation plant.

**MINING MACHINES:** One 54 yd<sup>3</sup> capacity dragline and 4.25<sup>3</sup> capacity power shovels

are the main machines. Besides these, 4 continuous miners including a spare one are employed in the underground mining at Balmer South and Balmer North mines. Two are in operation at the former mine and one at the latter. (Note) These two mines produce a combined total of 1,800 tons per day on a clean coal basis (Balmer North - 1,200 tons; Balmer South - 600 tons)

**PREPARATION PLANT:** Treats 1,400 tons of raw coal per hour. Main systems are a froth flotation and a heavy media cyclone.

Work to expand the plant is in progress for completion in mid-January, 1970. When completed, the plant will treat coal to be produced through underground mining under the 15-year contract for shipment to Japan starting April 1, 1970.

Also it aims to produce yearly 5,000,000 tons of clean coal of 8.75% ash content. The operator plans to keep it going 365 days a year on the basis of 2 shifts a day. Workers will take recess in turn.

As for coal workable from Balmer South and North mines where underground mining is presently employed in operation, that of more than 8.75% of ash content after treatment will be shipped for domestic consumption.

The plant's production capacity is put at 4,500 tons per day on a clean coal basis. On account of decrepitude, however, its actual working capacity is pegged at the maximum 900,000 tons per annum.

**WASHING YIELD:** 77-78%. Second-rate coal is rejected together with bass.

**NUMBER OF STAFF:** 48.5, excluding those at Balmer North and South mines.

This is for the first 3 years of the long-term export shipment to Japan to commence in 1970, and will be reinforced from 1973 and onward.

#### Outline of Balmer Coal

Balmer coal mines are owned by U.S. Kaiser Steel Corp. and operated by its subsidiary Balmer Coal Ltd. The mines were taken over officially from Canadian Crows Nest Industries Ltd., the parent company of the former operator Balmer Mines Ltd., as of March 29, 1968.

The transfer of the proprietorship followed conclusion of a basic agreement with Japanese steel mills as of January 31, 1968, for export of a total of 45,750,000 tons over 15 years starting in April of 1970. Shipment volume was contracted for annually 3,150,000 tons for the first 5 contract years, and 3,000,000 tons after that. (In April of 1969 a contract was signed for addition of 2,000,000 tons to the yearly shipment volume for the first 3 years of the original contract.)

The present proprietor of Balmer coal mines Kaiser Steel Corp. had agreed on the purchase of the entire assets of Balmer Mines Ltd. on condition that such agreement would take effect upon materialization of a long-term contract for export of Balmer coal to Japan.

Negotiations for the export contract was opened in mid-November of 1967, about 3 months before the agreement was reached.

The former owner Crows Nest was working Balmer South mine through underground mining until February, 1966 but because of a steep seam angle of 35 degrees and an unfavorable roof condition there switched over to Balmer North mine for operation as from March the same year.

Coal seam at Balmer North mine is angled 12 to 16 degrees. There it began extracting coal from the upper 14' of the fully 45' thick coal seam.

The mine, however, was found to provide a number of unfavorable conditions, including a weak roof just like Balmer South mine, large water flow into the pit slowing down shuttle car operation, and poor washing yield of the coal itself. A lock tunnel was excavated to the seam at a cost of \$2,000,000 but rate of operation remained low. Production at this Balmer North mine consequently proved short of performing annually 400,000 tons as contracted for shipment to Japan. The former operator, therefore, had resumed operation at Balmer South mine as from May, 1967.

Crows Nest kept on working these two mines (both on No.10 seam) till

they were officially sold out to Kaiser Steel on March 29, 1968.

Kaiser Steel as of the end of August, 1969, continues to operate on the same scale as before, i.e. producing 1,200 tons from Balmer North mine and 600 tons from South, both per day and on a clean coal basis.

It seems that Balmer Coal Ltd. will go on working the both mines but that it will cease exporting the coal and sell it inside Canada on and after April 1, 1970, when shipment of the coal produced through stripping is scheduled to begin.

Kaiser Steel's purchase of Balmer Mines Ltd. is said to have been based on its judgment for a possibility to re-develop Balmer coal mines into a large-scale coal production source. This is to be realized through a wholesale stripping operation on top of the mountain where No.10 seam is bare, instead of the present underground mining. The present owner in fact was pushing investigation along that line from around the spring of 1966, almost a year before it took over the mines.

At the time of closing the 15-year export contract with Japanese steel mills, Kaiser Steel had in mind extraction of coal from the 3 mining areas of Harmer Ridge, Camp 8 and Adit No.29. They have a combined total of 79,000,000 tons in reserve. As investigation proceeded, it was known that a massive coal seam occurred to the east of these 3 mining areas, however.

In April of 1969 the coal mines proprietor contracted with the Japanese purchasers for an additional sale of 2,000,000 tons per year for the first 3 contract years. The addition in the contract volume is to be covered with coal extractable from the said 3 areas. Such coal had in March of 1969 been augmented from the original plan in quantity produced. It also counts on Dry Creek area with a reserve of 2,000,000 tons.

Further, the same mining interest contemplates to beef up the export contract volume to also 5,000,000 tons per year for the 4th contract year (1973) and on, with regard to production from new mining areas including East Ridge area.

Japanese steelmakers and interests concerned sent a survey mission to Balmer coal mines in September 1969. They saw little problem in the production setup there, but had greater apprehensions as to smooth flow of coal as Japan depends on efficient railway haulage, loading work at ports and such.

It appears to be a unanimous view of the Japanese side that they should first observe performance of the present contract before opening any new negotiation for additional purchases. This could be said of not only Balmer coal but of the whole Canadian coals.

### ... South Balmer Mine Re-development Plan And Hydraulic Mining ...

Mitsui Mining Co., Ltd. of Japan set about surveys and studies for re-developing South Balmer mine through hydraulic mining. This was immediately after Crows Nest Industries Ltd. started coal extraction from North Balmer mine. The former owner of Balmer coal mines had given up operation at South Balmer mine because of an extreme 30 degrees seam angle and a bad roof condition there.

Kaiser Steel Corp. of the U.S., taking over Balmer coal mines, turned its attention to hydraulic mining techniques of the Japanese mining company who was actually in operation in Hokkaido by such mining formula. In the spring of 1969 it drew up a plan for resumption of Balmer South mine development work jointly with Mitsui Mining Co. and at the same time proposed a long-term export deal to Japanese steelmakers.

The coal supplier wanted to sign a contract for this coal as early as in 1969, and on terms as separate from those of the Balmer coal already contracted for.

Japanese steelmakers, however, were of the view that this joint venture



coal should be treated as supplemental to the Balmer coal covered by the existing contract. They also expressed their uncertainty about railway and loading port capacities for coal handling. They maintained that they must first see how the existing contract shipment of yearly 5,150,000 tons would be performed before studying any additional deals.

In consequence the plan was shelved in the fall of the same year. It will therefore not be actualized for some time to come.

Kaiser Steel Corp.'s concepts of the said undertaking are as follows: to start test mining through the hydraulic method from November, 1969 and finish in 6 months; to launch trial shipments of a total of 400,000 to 500,000 tons during 1970, and initiate a long-term export to Japan in the minimum volume of 2,000,000 tons per annum from 1971. Of a total investment in the venture of \$46,000,000 to have financial enlistment by Mitsui Mining Co. and other Japanese interests of about 30%, i.e. \$13,800,000. To employ a hydraulic miner with a water pressure of 50-60 kg per centimeter.

(Note) Refer to the preceding chapter as to reserves and other details of this coal. This coal is of the same quality as the Balmer coal for shipment up to 1969, i.e. total moisture - 5%, ash - 9%, volatile content - 18 to 20%, sulfur - 0.3%, Coke Button Index - 8 to 9.

By D. R. Morgan

**Crows Nest Industries Limited** W. R. Prentice, president, Fernie; J. E. Morris, vice-president, Mines, Fernie; N. B. Pepper, secretary-treasurer, Fernie. This company, formerly known as The Crow's Nest Pass Coal Company Limited, has conducted large-scale coal-mining operations in the East Kootenay District since 1897, and its present activities are confined to the Michel Colliery and the surrounding area. The coal is sold on the industrial market, and a large quantity is exported to Japan. A large amount of the fines is also utilized in the making of coke, and the coke is sold in various parts of Western Canada and the United States. The operations are directed from a head office in Fernie.

**MICHEL COLLIERY.**—(49° 114° N.W.) J. E. Morris, manager; James Anderson, general mine overman.

The colliery is at Michel, 24 miles northeast of Fernie, on the Crowsnest branch of the Canadian Pacific Railway. It is a large colliery, and has been in operation since 1899. The present operations include three underground mines, four stripping operations, and a modern by-product plant which is located on the colliery-site. Other activities also include an extensive exploration programme which is being carried out in conjunction with the Kaiser Steel Corporation, pending a large contract for exporting coal to Japan. The mines are on each side of the valley and, with exception of those in the No. 10 seam, are named according to the seam that is worked and the direction of development. Those in the No. 10 seam are known as the Balmer mines. Most of the mines are developed from the outcrop. They are worked by the room-and-pillar system, and the pillars are generally extracted on the retreat. The mines are highly mechanized, and most of the coal is mined by continuous miners, of which there were seven in operation in 1967. The equipment is chiefly operated by electricity. It is of the flame-proof type and has been approved for use in coal mines. The transportation of the coal at most of the mines is via shuttle cars and fast-moving belts, which carry it to the surface, from where it is trucked to the preparation plant for cleaning and treatment. Diesel and battery locomotives are used at one of the mines.

The colliery employs an average 446 men, of whom 258 are employed underground. The underground operations are under the direct supervision of 4 overmen and 21 firebosses. A brief description of the underground operations follows.

**Balmer North Mine.**—William Davey, overman. This mine, in No. 10 seam, is being worked to develop a large area of virgin coal on the north side of Michel Valley. It is entered by two rock tunnels, each 1,150 feet long, which were started in September, 1965, and reached the seam in February, 1966. The portals are at an elevation of 3,850 feet. They are approximately 1 mile west of the preparation plant, and can be reached by the private road leading to the Baldy strip mine. The seam is 40 feet thick, dips at an angle of 15 to 20 degrees in a southwesterly direction, and is overlain by a fairly strong shale roof. The coal is mined by continuous miners. It is loaded onto shuttle cars and transported from the mine by fast-moving belt conveyors. The workings are described in the 1966 Annual Report, page 387.

The operation was seriously disrupted in 1967 by the disastrous explosion that occurred on April 3rd, resulting in the death of 15 workmen and injury to 10 others, the details of which are given in the Inspection section of this report on pages 420 to 430. The explosion wrecked the ventilation system of the whole mine, including the fan drift, but the surface fan was not damaged. Extensive damage was also done to the belt conveyors and electrical equipment. There were a number of large roof falls on the roadways that were relatively light in comparison with the intensity of the explosion. This is attributed mainly to the fact that most of the roadways were in contact with the hangingwall of the seam and the rock roof is supported by rock bolts. Comparatively little damage was done to the continuous mining machines, which were at the faces of the working-places in various parts of the mine. The electric motors and controls on one machine were extensively damaged by water owing to the machine being trapped and flooded by water while recovery operations were in progress.

The gob area of the pillar extraction at the faces of the Nos. 1, 2, and 3 Entries, where the explosion is believed to have initiated, was immediately sealed following the restoration of the ventilation at the mine, and rehabilitation of the remainder of the workings was carried out on a large scale. Most of the electrical equipment was sent from the mine for examination and repairs, and the conveyors were rebuilt and replaced. One of the continuous miners was placed back in operation in June, approximately six weeks after the explosion, and it was used for driving two additional slopes entering the dip workings to increase the ventilation in that area and to provide a means of dividing the mine workings into three separate ventilation districts. Another continuous miner was placed back into operation a month later and was used to develop a small area of workings in the vicinity of the McKay fault in the upper part of the mine. The operations were confined to the working of the two machines for the remainder of 1967, and at the end of December the mine was averaging a daily production of 1,150 tons with a crew of 66 men. Total development during 1967 was 21,000 feet.

The mine is ventilated by two 100-horsepower electrically driven axivane fans which deliver 157,000 cubic feet of air per minute to the mine workings. One of the fans was installed during the latter part of 1967. It was installed at the same portal and placed in series with the original fan. A direct-fired propane heating unit was also placed at the inlet to the fans to increase the temperature of the air entering the mine during the winter, mainly to prevent the water sprinklers at the transfer points on the conveyors from freezing. The conditions in general were fairly good during the course of inspections. Considerable difficulty was experienced with the ventilation of the slope workings during the latter part of 1967 owing to an increase in the emission of gas from the coal in the slope area. Because of this the rate of development by the continuous miner had to be restricted on several occasions. Methanometers were used in conjunction with flame safety lamps for testing for gas during the operation of the machine, and a recording methanometer was installed for checking the ventilation in the main rock tunnel return airway. Consideration is being given to the sinking of an air shaft to improve the ventilation.

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KAISER RESOURCES LTD.  
(FREEHOLD)

KAISER 1967.

**Balmer No. 1 (South) Mine.**—Arnold Webster, overman. This mine, operating in No. 10 seam, was opened in 1960 to develop a large area of coal on the south side of Michel Valley. The portals are approximately 1 mile west of the preparation plant, and the workings are entered by three levels which have been driven from various elevations on the outcrop, near creek level. The seam is 40 feet thick, dips at an angle of 30 degrees in an easterly direction, and is overlain by a moderately hard shale roof. A description of the workings has been given in past Annual Reports.

The mine averaged a daily production of 535 tons during 1967 with a crew of 39 men. There were two continuous miners in operation, and most of the activities were directed to the extraction of pillars in the No. 1 Incline district and the development of a new panel of workings above the main haulage level. The pillars in the No. 1 Incline district were extracted by the caving system, the extraction roadways being driven on the footwall of the seam, and the top coal allowed to cave while on the retreat. The whole operation at both districts was carried out by continuous miners, the coal being loaded onto shuttle cars and fast-moving belts and transferred to various loading points on the main level, where it was loaded into 10-ton capacity bottom-dumping cars and taken from the mine by diesel and battery locomotives. At the surface, the coal is dumped into a large storage bin and later trucked to the preparation plant. The total development at the mine during 1967 was 6,200 feet.

The mine is ventilated by a 100-horsepower electrically driven fan which delivers 51,840 cubic feet of air per minute to the mine workings with a 3.25-inch water gauge. Small auxiliary fans and synthetic tubing are used with each of the continuous miners during development work. The conditions in general were found to be satisfactory during the course of inspections, with the exception of indications of gob heating in the No. 1 slope district, that was abandoned in 1966. Details of the heating are given in more detail under "Dangerous Occurrences." One workman was also fatally injured in the No. 1 Incline district, and is reported in more detail under "Fatal Accidents."

**No. 1 South Mine.**—Henry Eberts, overman. This mine, which was opened in September, 1966, to develop a small area of No. 1 seam coal between the old No. 1 seam mine and the outcrop, was abandoned in November, 1967, owing to geological disturbances and depletion of coal reserves. The continuous miner and other equipment were withdrawn from the mine, and the workmen transferred to the other mines. During its operation the mine averaged a daily production of 550 tons with a crew of 26 men. Total development was 3,750 feet. A description of the workings is given in the 1966 Annual Report, page 388.

**"A" North Mine.**—John Whittaker, overman. This mine, which was opened in 1951 to develop a large area of workings in the "A" seam on the north side of the Michel Valley, was abandoned in October, 1967, owing to geological disturbances and economic reasons.

**"C" North Mine.**—Henry Eberts, overman. This mine, which was opened in November, 1966, is being worked to develop an area of workings in the top section of the "C" seam on the north side of the Michel Valley. The portals are at an elevation of 5,200 feet and are accessible from a private road leading from the preparation plant. The mine is entered by three levels which have been driven from the outcrop by a continuous miner, and follow the strike of the seam. Two other

roadways have also been connected to the surface from the inner workings. The coal is 7 feet thick, dips at an angle of 12 degrees in a southwesterly direction, and is overlain by a strong shale roof.

The mine averaged a daily production of 645 tons during 1967 with a crew of 31 men. Most of the activities were directed to the development of the levels, and the extraction of pillars in a panel of workings below the main level. Some difficulty was experienced with geological disturbances on the levels, and at the end of 1967 three roadways were in process of developing a large area of workings on the upper or north side of the levels. The coal was mined by a continuous miner, and taken from the mine by shuttle car and fast-moving belts, and later trucked to the preparation plant. All the roadways are supported by rock bolts. Total development during 1967 was 13,300 feet.

The small fan that was used for ventilating the mine in its initial stage was replaced in August, 1967, and the mine at present is ventilated by a 100-horsepower electrically driven axivane fan which delivers 112,500 cubic feet of air per minute to the mine workings at 0.9-inch water gauge. No indications of methane have been reported in the mine workings to date. The general conditions were found to be satisfactory during the course of inspections.

**Prospect Tunnels and Exploration.**—Louis Sclipa, fireboss. This work is part of an extensive exploration programme that is being conducted by the company in conjunction with the Kaiser Steel Corporation to prospect and develop a large area of coal lands owned by the company in the vicinity of Michel pending the signing of a contract agreement for the export of large annual amounts of coking-coal to Japan. The 1967 programme was carried out on a large scale and covered a wide area. It included the opening of 12 adit tunnels from the outcrops of three seams for a distance of 2,437 feet (drifting and raising) and drilling 85 rotary and rotary-percussion non-core holes, totalling 26,110 feet, from widely separated points on the mountain-side on Natal Ridge and Baldy Mountain. There were nine large bulldozers in operation, and more than 34 miles of access roads was built to the various adits, drill-sites, and outcrop exposures. Five large test-pits were opened along the outcrop of the No. 10 or Balmer seam, and large bulk samples were sent for coking tests, washability studies, petrographic and proximate analyses, etc. There were 62 men employed, and the work was under the direction of J. J. Crabb, exploration manager. The exploration work continued during the winter months.

During 1967, 12,092 pounds of Monobel No. 4, 10,282 pounds of CXL-ite, and 12,341 electric detonators were used at the colliery for coal and rock blasting. No misfired shots were reported.

A total of 1,825 tons of limestone dust was used for the application of inert dust over the roadways at the various mines to minimize the coal-dust hazard, sealing workings, and tamping shots. Monthly dust samples were taken at all the mines and analysed. The samples were found to be above the minimum requirements needed for incombustible content.

Monthly examinations of workings were made at all the mines by the miners' inspection committees, and regular safety meetings were held each month at the colliery office. The various reports kept at the mines in compliance with the *Coal Mines Regulation Act* were examined periodically and found to be in order.

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**Baldy Strip Mine.**—George Lancaster, foreman. This mine is on Baldy Mountain, 4 miles northwest of Michel. It is at an elevation of 5,000 feet and can be reached by means of a private road leading from the preparation plant. The coal is 40 to 60 feet thick and dips at an angle of 25 to 30 degrees in an easterly direction. The seam is believed to be the No. 10 seam. It can be traced for miles, and the company has operated several open pits along the outcrop since 1948. The present pit is known as the No. 4B pit. It was opened in 1960 and is worked on a contract basis. Removal of overburden was completed in 1961.

The mine was idle for most of 1967 and was only operated for one very short period, during which time a total of 2,620 tons of coal was produced with a crew of four men.

**No. 7 Seam Strip Mine.**—J. Whittaker, foreman. This mine is on Natal Ridge, approximately 2 miles southwest of Michel, and was opened in September, 1966, to develop an area of No. 7 seam coal outcropping on the mountainside. The mine is at an elevation of 4,800 feet and can be reached by means of a private road leading from the preparation plant. The seam is 31 feet thick but contains a 6-foot rock parting approximately 6 feet above the footwall. It dips at an angle of 15 to 20 degrees in a southwesterly direction. The coal is mined by bulldozers, and blasting is restricted to rock work. A large area of the overburden is removed, then the top coal is pushed into the bottom of the pit prior to the removal of the rock parting between the two seams. The coal is then loaded by a front-end loader and power-shovel and trucked to the preparation plant. The work was carried out on a contract basis. The total production during 1967 was 348,192 tons with a crew of 15 men.

**"C" Seam Strip Mine.**—This mine, which was opened in November, 1965, to operate an area of Upper and Lower "C" seam coal on Natal Ridge, 2 miles northeast of Michel, was inactive during 1967 owing to the high moisture content in the coal.

**No. 3 Seam Strip Mine.**—J. Whittaker, foreman. This mine was opened in the spring of 1967, and is being operated to develop an area of No. 3 seam coal outcropping on Natal Ridge, approximately 2½ miles northwest of Michel. The mine is at an elevation of 5,000 feet, and can be reached by a 3½-mile private road leading from the preparation plant. The seam is approximately 30 feet thick but contains two rock partings totalling 12 to 15 feet. It is mined in a similar manner to the No. 7 seam strip mine. Total production during 1967 was 67,903 tons with a crew of nine men.

**Balmer South Strip Mine.**—George Lancaster, foreman. This mine was opened in October, 1967, to develop an area of No. 10 seam coal outcropping on Sparwood Ridge, approximately 2½ miles southwest of Michel. It is at an elevation of 5,000 feet and can be reached by a 3½-mile private road leading from the preparation plant. The coal is 40 to 50 feet thick and dips 30 degrees in an easterly direction. Most of the activities were directed to removal of overburden, and 14,376 tons of coal was produced in December. There were 14 men employed.

**Preparation Plant.**—George Lancaster, superintendent. The preparation plant is on the colliery-site near the entrances to the old rock tunnels on the south side of the valley. It was built in 1936 but has been considerably modernized since then.

**By-product Plant.**—Ian Dufour, superintendent. The by-product plant adjoins the preparation plant. Present operations are confined to the Curran-Knowles ovens. Sixty men were employed. The plant produced 144,147 tons of coke, 15,060 tons of breeze (coke fines), and 915,451 gallons of tar during 1967.

1968.

**Kaiser Coal Ltd.**

J. E. Morris, manager of underground mines and coal-stripping operations; P. J. Urso, open-pit manager. This company on February 29, 1968, took over ownership of the coal-mining operations of Crows Nest Industries Limited. The latter company, formerly known as The Crow's Nest Pass Coal Company Limited, had conducted coal-mining operations in the Crowsnest Pass area since 1897. Present activities are confined to the Michel Colliery. The coal is sold on the industrial market and a large proportion exported to Japan. A large amount of fines is also utilized in the making of coke, and the coke is sold in various parts of Canada and the United States. The operations are directed from a central office situated on the Elk Valley road 2 miles from Natal.

**MICHEL COLLIERY.**—(49° 114° N.W.) J. E. Morris, mine manager; James Anderson, general mine overman; Paul Kusnir, safety supervisor, Harry Corrigan, afternoon-shift overman.

The colliery is at Michel, 24 miles northeast of Fernie, and is on the Crowsnest Pass branch of the Canadian Pacific Railway. It is a large colliery, and has been in operation since 1899. Present workings include three underground mines, five stripping operations, and a coal-preparation plant and by-product plant that are located on the colliery-site. The mines are at various elevations on both sides of the Michel Valley and, with the exception of the Balmer North mine, have been opened from the outcrop of the seams. The underground mines are operated in the No. 10 seam and the "C" seam, and are worked by the room-and-pillar

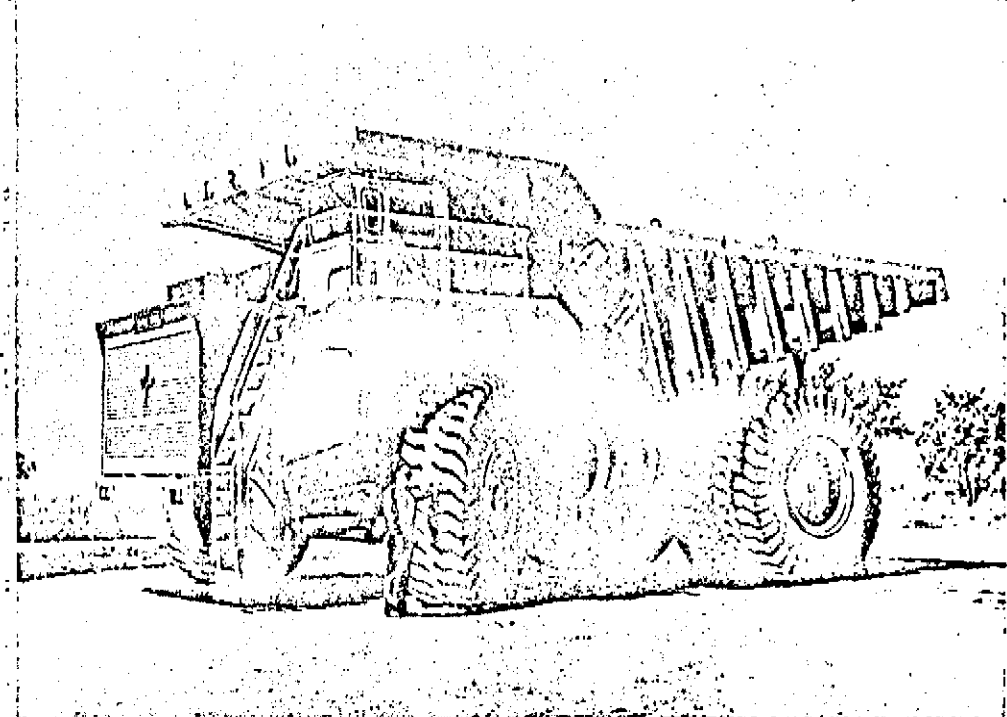


Plate VIIIa. Lectra Haul dump truck of 200 tons capacity used by Kaiser Coal Ltd. at its Harmer Ridge strip mine. This is currently the world's largest two-axle truck.

method. The underground mines are highly mechanized, and the entire output is obtained by the use of continuous miners. The underground equipment is chiefly operated by electricity; it is of the flame-proof type that has been approved for use in coal mines. The present transportation of coal at the underground mines is by shuttle cars and fast-moving belt conveyors which convey the coal to the surface, whence it is hauled by road to the coal-preparation plant for cleaning and treatment. Battery and diesel locomotives are used for transportation in one mine only.

The colliery employs an average of 454 men, of whom 152 are employed underground and 302 on surface. The underground operations are under the direct supervision of four overmen and 22 firebosses. A description of the underground operations follows.

Balmer North Mine.—William Davey, overman. This mine, in the No. 10 seam, is on the north side of the Michel Valley. It is entered by two rock tunnels, each 1,150 feet long, which were started in September, 1965, and reached the seam in February, 1966. The mine portals are at an elevation of 3,850 feet. They are approximately 1 mile west of the coal-preparation plant and can be reached by private road access. The seam is 40 to 60 feet in thickness, dips at an angle of 15 to 20 degrees in a southwesterly direction, and is overlain by a fairly strong shale roof. The coal is mined by continuous miners; it is then loaded on to shuttle cars and transported from the mine by a trunk belt conveying system.

An explosion occurred on April 3, 1967, in this mine with disastrous results, a full account of which was contained in the Annual Report for 1967, page 427. Whilst the mine as a whole cannot be classed as very gassy, certain sections have been known to yield as much as 1,500 to 2,000 cubic feet of methane per ton of coal produced. This together with the volatile-matter content of the coal and its explosibility make it necessary to have an efficient ventilating system, and efficient means of limestone-rock dust application, and a systematic means throughout the mine of cleaning coal-dust deposits.

A significant improvement in the mine ventilation was achieved during 1968 as a result of the sinking of a 400- by 16-foot-diameter ventilating-shaft, situated approximately 1,200 feet from the portals. Following completion of the shaft, the ventilation system of the mine was changed. Both the No. 1 and No. 2 Rock Tunnels became intake airways, and the new shaft became the main return for the whole mine. This together with the provision of one extra forcing fan at the entrance to the No. 1 Rock Tunnel provided an additional 40,000 cubic feet of air per minute for ventilating the mine workings. Kaiser Coal Ltd. is awaiting delivery of a new exhaust fan, which will be installed in the very near future, and will be capable of providing the mine with an additional 100,000 cubic feet of air per minute. During December, work was commenced on the drilling from the surface of a 6-foot-diameter air-shaft. The nature of the strata and the thickness of cover from the hangingwall of the coal seam to the surface leads itself to this particular application. This means of providing additional intake air-shafts will prove to be of immense value when used in conjunction with the new bigger-capacity exhausting-type fan at the top of the main return shaft.

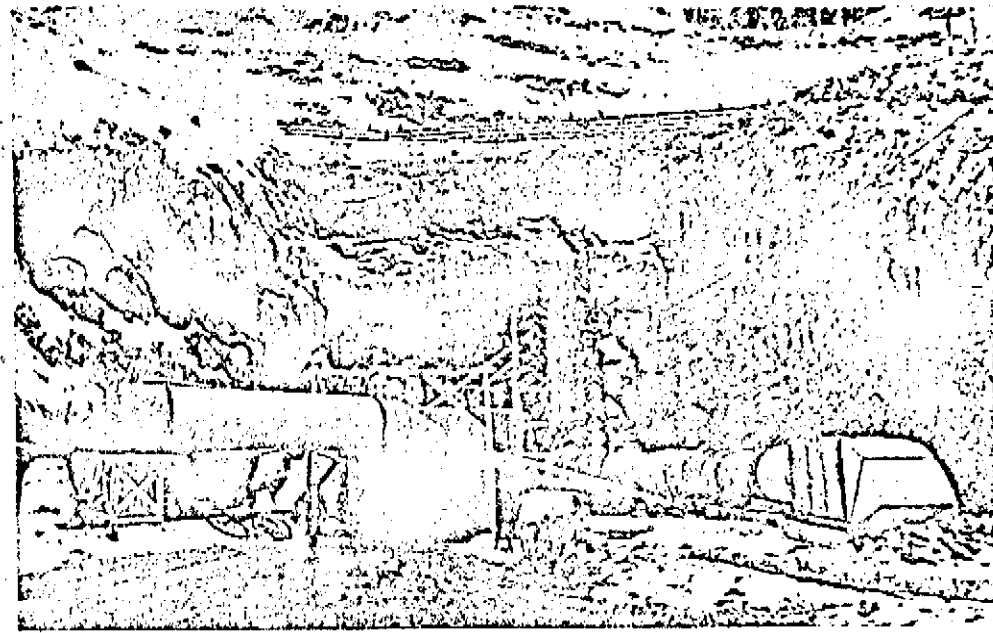


Plate VIIIa. Kaiser Coal Ltd., portal of the tunnel to be used for moving coal from the breaker station to the coal-preparation plant at Sparwood.

Following the construction of a number of air-crossings and the forming of a number of additional airways, a situation was reached during 1968 whereby each of the three continuous miners was ventilated by a separate split. Two continuous miners worked three shifts each up until September, when the third machine came into production following the above-mentioned ventilation improvements.

The mode of application of limestone-rock dust was greatly improved in the mine by the introduction of "sprinkle-dusters." By the end of the year about eight of these machines were in operation, and the results to date have been very encouraging. The proper use and positioning of these "sprinkle-dusters" gives a far better degree of control in achieving uniform dilution of coal dust as it becomes deposited on the floor, roof, and sides of the underground roadways.

Further water sprays were installed at the conveyor transfer points to reduce the coal-dust hazard on the conveyor roadways. The three continuous miners are equipped with water sprays, but further improvements could be obtained by introducing wetting agents into the water supply.

During the latter part of the year, three sets of water barriers were erected at the entrance to the panel being mined at the bottom of the slopes. The practical difficulties involved in the use of barriers in the room-and-pillar method of working are well known, but with careful selection of sites there is still room for further development in the use of both water and stone-dust barriers in the mine.

The mine averaged a daily production of 1,000 tons of saleable coal during 1968. Two continuous-miner machines were employed from the beginning of the year until September, when a third machine was then put on production.

The mine ventilation was improved considerably during the year, and the situation at the end of the year was that the mine was ventilated by three electrically driven fans. These were two 100-horsepower axivane fans at the entrance to the No. 2 Rock Tunnel intake operating at a 3.3-inch water gauge, and a 100-horsepower aerodyne fan at the entrance to the No. 1 Rock Tunnel intake airway operating at a 3-inch water gauge. The combined effect of the three fans delivered 190,000 cubic feet of air per minute to the mine workings. Smaller 30- and 15-horsepower auxiliary fans, in conjunction with 36- and 24-inch-diameter flexible ducting, were used for the ventilation of the face of the rapidly advancing rooms. The conditions in general were found to be satisfactory during the course of inspections, with the exception of two instances, which are reported more fully in another part of this report under the heading of "Dangerous Occurrences."

**Balmer No. 1 (South) Mine.**—Arnold Webster, overman. This mine, operating in the No. 10 seam, was opened in 1960 to develop a large area of virgin coal on the south side of the Michel Valley. The portals are 1 mile west of the coal-preparation plant, and the workings are entered by three levels, which have been driven from the outcrop of the seam, near creek-level. The seam is 40 feet thick, dips at an angle of 30 degrees in an easterly direction, and is overlain by a moderately hard shale roof. The mine was one of the major operations at the colliery, but in recent months has been run down considerably.

The mine averaged a daily production of 600 tons of saleable coal during 1968. There were two continuous miners in operation from January to August and one only for the remainder of the year. Descriptions of the method of work and means of transportation have been given in past Annual Reports.

The mine is ventilated by a 100-horsepower electrically driven axivane fan which delivers 94,000 cubic feet of air per minute to the mine workings at a 3.7-inch water gauge. Auxiliary fans and flexible tubing were used with each continuous miner to provide adequate ventilation at the face. Conditions in general were found to be satisfactory during the course of inspections, with the exception to the occurrence of spontaneous combustion in one old panel. This is more fully reported on in another part of the report under the heading of "Dangerous Occurrences."

**"C" North Mine.**—Henry Eberts, overman. This mine, which was opened in November, 1966, is being worked to develop an area of workings in the top section of the "C" seam on the north side of the Michel Valley. The portals are at an elevation of 5,200 feet and are accessible from a private road leading from the coal-preparation plant. The mine entries were made on the seam outcrop by using continuous miners. The coal is 7 feet thick, dips at an angle of 12 degrees in a southwesterly direction, and is overlain by a strong shale roof.

The mine averaged a daily production of 400 tons of saleable coal during 1968. The room-and-pillar method of work was used, and the coal was mined by a continuous miner. Transportation of coal was by shuttle car and fast-moving belt conveyors and later trucked by road to the preparation plant. Underground roadways are invariably supported by the use of rock-bolts.

In September, following some difficulty experienced with geological disturbances and thickening of the seam, work was commenced on the extension to the

mine. Three new portals were established at an elevation of 5,200 feet, about 3,000 feet in a southeasterly direction from the main portals.

The mine is ventilated by a 100-horsepower electrically driven fan capable of providing the mine workings with 80,000 cubic feet of air per minute at a 1.2-inch water gauge. At the end of the year, the extension to the mine was ventilated by a 30-horsepower electrically driven fan. Ventilation is provided at the face by smaller auxiliary fans in conjunction with flexible tubing.

General conditions were found to be satisfactory during the course of inspections. No indications of methane have been reported from the mine to date, and in most parts of the mine underground workings naturally damp conditions prevail.

**Prospecting and Exploration.**—Brian Murphy, geologist. The principal objective of the 1968 exploration programme was to explore more fully the 10,000-acre Michel area. About 45 persons were directly involved throughout the year. As many as five drills were used to complete 176 drill-holes, totalling some 61,000 feet of drilling. Bulldozers were used to construct access roads, expose coal measures, and to prepare eight adit-sites. A total of 1,265 feet of underground workings was completed for bulk sampling purposes. This work was under the direction of Brian Murphy, geologist for Kaiser Coal Ltd.

During 1968, 20,000 pounds of Monobel No. 4, 2,000 pounds of CXL-ite, and 2,350 electric detonators were used at the colliery for coal and rock blasting. No misfired shots were reported.

A total of 2,744 tons of limestone dust was used for the application of inert dust over the roadways at the various mines to minimize the coal-dust explosion hazard, sealing old workings, and tamping shots. Monthly dust samples were taken at all the mines and analyzed. The samples were found to be above the minimum requirements needed for incombustible content.

Monthly examinations of workings were made at all the mines by the miners' inspection committees, and safety meetings were held each month at the colliery office. Reports kept at the mines in compliance with the *Coal Mines Regulation Act* were checked periodically and found to be in order.

**No. 3 Seam Strip Mine.**—James Anderson, foreman. This mine was opened in the spring of 1967 and has produced coal from the No. 3 seam situated on Natal Ridge, approximately 2½ miles northwest of Michel. The mine is at an elevation of 5,000 feet and can be reached by a 3½-mile private road leading from the preparation plant. The coal is 30 feet thick but contains two dirt bands totalling 12 to 15 feet. The total production of saleable coal during 1968 was 86,522 tons.

**No. 7 Seam Strip Mine.**—James Anderson, foreman. This mine is on the Natal Ridge, approximately 2 miles southwest of Michel, and was opened in September, 1966. The mine is at an elevation of 4,800 feet and is reached by a private road leading from the coal-preparation plant. The seam is 31 feet thick, contains a 6-foot dirt parting about 6 feet above the footwall, and dips in a southwesterly direction at about 15 to 20 degrees. The total production of saleable coal during 1968 was 63,481 tons.

**Balmer South, No. 10 Seam, 4 Pit.**—James Anderson, foreman. This mine was opened in October, 1967, to work an area of No. 10 seam outcropping on the Sparwood Ridge, at a distance of about 2½ miles southwest of Michel. It is at an elevation of 5,000 feet and is reached by a private road leading from the coal-preparation plant. The coal is 40 to 50 feet thick and dips in an easterly direction at about 30 degrees. During 1968 most of the activities were directed to the removal of overburden, but a total production of saleable coal of 104,050 tons was obtained. On November 24th, a slide from the spoil dump of this mine covered part of the main highway, and caused the death of the two occupants of a car that was enveloped by the debris. Reference is made to this in the section of the report under the heading of "Dangerous Occurrences."

**Balmer South, No. 10 Seam, 5 Pit Strip Mine.**—James Anderson, foreman. This mine was opened at the end of 1967 on Harmer Ridge at an elevation of 5,000 feet. During 1968 a total saleable production of 32,340 tons of coal was obtained from the mine.

**Balmer South, No. 10 Seam, 6 Pit Strip Mine.**—James Anderson, foreman. This mine was opened during the spring of 1968 for the mining of an area of the No. 10 seam on the south side of the Michel Valley. The operations at this mine were spasmodic and the production of saleable coal during 1968 was 1,382 tons.

**Coal-preparation Plant.**—George Lancaster, superintendent. This plant is on the colliery-site and is located near the entrance to the old rock tunnels on the south side of the Michel Valley. It was built in 1936, but has been modernized since that date. A description of this preparation plant has been given in past Annual Reports.

**By-product Plant.**—Ian Dufour, superintendent. This plant is situated adjacent to the coal-preparation plant and employed 58 men in 1968. Present operations are confined to the Curran-Knowles ovens, a detailed description of which has been given in past Annual Reports. The plant produced a total of 150,156 tons of coke and coke breeze during 1968.

**Construction Division.**—E. T. Ryan, engineer. To facilitate the proposed expansion of the coal industry in the Michel area, Kaiser Coal Ltd. commenced its development and construction programme on May 15, 1968. This work was performed under the direction of E. T. Ryan, construction engineer for Kaiser Coal Ltd. The work is phased so that the company will be able to meet its market commitments by February, 1970. The following is a brief account of the work performed from the date of commencement to the end of the year.

An area of 670 acres was cleared, and a total length of 16 miles of roadway was constructed. The site of the new coal silos and coal-preparation plant was cleared, and the necessary benching was completed in readiness for the erection of the plant.

Work was commenced on a conveyor tunnel, which when completed will be a mile long and will serve to transport the coal from the open-pit site, through the mountain, to the coal-preparation plant. The contract for driving the tunnel was awarded to Northern Construction and J. W. Stewart Ltd. By the end of the year the tunnel had advanced approximately 1,600 feet, and preparations were being made to commence tunnelling from the opposite end.

The necessary work of clearing and grading for the construction of a railroad spur to the plant-site was completed. Two camps were constructed—one in Elk Valley and the other on Harmer Ridge. A temporary central office was established in Elk Valley approximately 2 miles from Natal. The foregoing construction work provided employment for some 650 persons.

1969.

**KAISER RESOURCES LTD.**

By R. W. Lewis and L. Wardman

G. E. Balsley, vice-president and general manager; P. J. Urso, open-pit manager; K. G. Donald, superintendent, Michel operations; J. Lawrie, manager of underground mines.

In 1969, coal production was confined to the Michel Colliery operation with run-of-mine coal being hauled by truck from the various underground mines and surface open pits to the coal-preparation plant at Michel. The other main activity of the company was the development of the new open-pit operation on Harmer Ridge, and the construction of the coal cleaning and loading facilities at Sparwood. This construction and development is scheduled to be completed by March, 1970, by which time Kaiser Resources Ltd. will be ready to meet its market commitments to the steel industries of Japan.

Throughout 1969 the company directed special attention to the improving of the appearance of the Natal Valley and the Michel Colliery precincts as a whole. Many old buildings and dwellings were dismantled and removed as they were vacated. A reclamation department was set up, means of restoring despoiled locations were being closely studied, and reclamation experimental work was in progress.

**MICHEL COLLIERY.**—(49° 114° N.W.) K. G. Donald, superintendent, Michel operations; J. Lawrie, manager of underground mines; J. Anderson, mine superintendent; R. Sieling, mine superintendent; C. Chakravatti, ventilation engineer; R. Taylor, safety officer.

The colliery is at Michel, 24 miles northeast of Fernie, and is on the Crowsnest Pass branch of the Canadian Pacific Railway. It is a large colliery which has been in operation since 1899. Production from the Michel Colliery during 1969 was obtained from five underground mines and six open pits. The coal-preparation plant and the by-product plant are on the colliery site at Michel. The mines are on both sides of the Michel Valley and at various elevations, having been opened mainly from the outcrop of the seams. Mechanized room-and-pillar methods of mining were used in the underground mines, with the entire output being obtained by Joy continuous miners and Lee Norse miners. Pillar extraction in the thick Balmer seam was small, and an extraction of only 15 to 20 per cent of the total seam thickness was obtained in the areas worked. The underground equipment was operated mainly by electricity and was of the flame-proof type approved for use in coal mines. Underground transportation of coal was by shuttle cars and fast-moving belt conveyors, which conveyed the coal to the surface. The method of mining was trackless, with supplies and materials being transported on rubber-tired battery-operated vehicles. Two diesel-operated Hunslet M.T. 60 vehicles were recently purchased for materials transport in the mines.

In an endeavour to obtain a much higher percentage extraction of the thick Balmer seam, Kaiser Resources Ltd. decided to use a hydraulic method of coal-mining. During the year the Balmer Hydraulic test mine was developed and is scheduled to be in production by April, 1970.

During 1969 at Michel Colliery and on the exploration programme, a total of 1,850 pounds of Monobel and 100 pounds of CXL-ite explosive was used. In addition, 3,120 electric detonators were used with no report of any misfired shot. A total of 3,020 tons of limestone rock dust was used in the underground roadways of all the mines in order to minimize the explosion hazard. Regular monthly dust samples were taken at all the mines in accordance with the requirements of the *Coal Mines Regulation Act*. These samples were analysed and found to be above the minimum requirements needed for incombustible content.

Monthly examinations of workings were made at the mines by the miners' inspection committees, and regular safety meetings were held each month at the mine office. Reports kept at the mine in compliance with the *Coal Mines Regulation Act* were checked periodically and found to be in order.

Manpower on books at Michel Colliery at the end of the year amounted to 446—236 being employed on the surface and 210 being employed underground.

#### UNDERGROUND MINING OPERATIONS

**Balmer North Mine.**—William Davey, overman. This mine in the No. 10 seam is on the north side of the Michel Valley and is entered by two rock tunnels, each 1,150 feet long. The mine portals are at an elevation of 3,850 feet and are approximately 1 mile west of the coal-preparation plant. The seam is 40 to 60 feet thick, dips at an angle of 15 to 20 degrees to the southwest, and is overlain by a fairly strong shale roof. The coal is mined by continuous miners, loaded onto shuttle cars, and transported from the mine by a trunk belt conveying system.

A daily production of approximately 1,400 tons of saleable coal was made during 1969. Three continuous-miner machines produced coal in different sections of the mine, each section being ventilated with a separate split of ventilation. The greater portion of the mine's production was obtained from driving rooms immediately beneath the hangingwall of the seam and along the direction of the line of strike. A lesser portion of the mine's production was obtained from a method of partial pillar extraction. In this method, connections driven to the rise between the main entries on the strike were additionally excavated by doubling the width and depth. A ventilation quantity of approximately 150,000 cubic feet per minute was constantly required in this section of the mine to ventilate the worked-out areas adequately until such time as the panel was sealed off.

At the beginning of May, 1969, a new Joy 400-horsepower mine fan was installed at the Balmer North mine. This exhaust fan was installed at the top of the 16-foot diameter shaft and had the immediate effect of doubling the quantity of air ventilating the mine. The fan operates on a 6-inch water-gauge and provides 360,000 to 380,000 cubic feet per minute to the mine ventilation. The main return air in the upcast shaft has contained in the order of 0.5 per cent methane since the installation of the new mine fan. Prior to the installation of the new fan, the methane content of the main return air was approximately 0.9 per cent.

Ventilation at the working faces was provided by a combination of 30-horsepower electrically driven auxiliary fans and ducting, together with line brattice. By this means, 30,000 to 40,000 cubic feet per minute of air was made available at the face of the workings. During the year, the company equipped each continuous-miner machine with a constant-reading methanometer. These instruments are pre-set to give the machine operator adequate warning when the methane content at the working face reaches a level of 1 per cent.

To obtain reasonable working temperatures underground in this mine during winter conditions, two "Flamemaster" mine air-heating units were installed. The units operating on natural gas were installed at the portals of the two intake rock tunnels. The use of the rock-dust sprinkling-machines throughout the workings of the Balmer North mine continued to improve the efficiency of rock-dust application. The use of sprinkle dusting machines represented a major improvement in the means of combatting the hazards associated with fine coal dust in coal mines. The use of water barriers for the arresting of explosions was extended throughout the mine during the year. Each of the separate entries to the workings in the three sections of the mine was equipped with water barriers.

Improvements remain to be made in dust suppression at the working-places in the mine. Results of airborne-dust surveys, conducted by the Environmental Control Branch of the Department of Mines and Petroleum Resources in 1969, more than confirmed this need. The company purchased a sampling instrument which will enable them to conduct airborne-dust surveys themselves. The availability of water at pressure to each of the continuous-miner machines was greatly increased and modifications to the cutting heads of the Joy continuous miners are planned in order to improve dust suppression.

Three 150-kva., 6,600–550-volt transformers were installed to supply the Joy exhaust fan driven by a 400-horsepower motor. This fan is provided with an emergency standby diesel. The diesel starts immediately on loss of electric power and picks up the fan load by means of an automatic clutch. When electric power is restored, the diesel idles for 5 minutes and then shuts down automatically.

At the No. 2 tunnel portal a mine air-heating system and a 100-horsepower fan were installed.

The Balmer North mine was regularly inspected throughout the year, and in general conditions were found to be fairly satisfactory.

**Balmer No. 1 (South) Mine.**—Arnold Webster, overman. This mine operating in the Balmer seam has been in production since 1960. It is on the south side of the Michel Valley, the mine portals being 1 mile west of the coal-preparation plant. The operation has been adequately described in previous Annual Reports. One continuous-miner machine was engaged in coal production from January to June of 1969, during which period the daily saleable tonnage of coal produced was approximately 400 tons.

On June 19, 1969, a month before the mine was scheduled to be closed, a tragic accident occurred in the Balmer No. 1 mine, accompanied by the loss of three lives. An inrush of water took place, accompanied by extensive roof caving. A special investigation was conducted and reported on by the Department of Mines and Petroleum Resources. The mine was closed for production immediately after this incident.



**Balmer Hydraulic Mine.**—R. E. Sieling, superintendent. This mine operating in the No. 10 seam was opened in 1969 for the purpose of testing the application of hydraulic methods of mining to this particular seam. The mine is approximately 1 mile west of the coal-preparation plant at Michel, and on the south side of the valley. Two main entries were driven to the rise in the coal seam, one at the hangingwall and one at the footwall of the outcrop of the seam on the mountainside. The coal seam averages 50 feet in thickness and is overlain with a hard shale roof. During the year the mine was developed by a continuous miner which was used to drive the main entries, airways, and the first two sub-levels. The mine produced solely from development work an average daily production of 300 tons saleable coal during 1969.

Ventilation to the mine was provided by a 100-horsepower electrically driven axivane fan delivering approximately 100,000 cubic feet of air per minute at a 3-inch water-gauge. To provide adequate ventilation at the working face, a 30-horsepower auxiliary fan was used with flexible ducting. During the course of inspection, general conditions were found to be satisfactory and at no time could methane gas be detected by either flame safety lamp or methanometer.

The size of the power-line to this mine was increased to 3/0 A.W.G. and a 100-horsepower Jeffrey fan was installed on the surface.

The development of the main entries and sub-levels was completed by November, 1969, and the company has since been engaged upon surface and underground plant assembly. Pumping equipment capable of providing 1,060 gallons of water per minute at pressures varying between 1,800 to 2,300 pounds per square inch was being installed. The mine is scheduled to commence production, using the hydraulic method, early in 1970.

The intended underground method of work will be to drive sub-levels at a uniform rising gradient of 10 degrees in the footwall horizon of the thick seam, from the side of the main entry to an agreed boundary-line. The 35-foot strip of coal immediately adjacent to and on the rise side of the sub-level will then be excavated as a retreating pillar. The coal will be cut off the solid by a high-pressure jet of water directed at the face by a hydraulic monitor, and will then be transported by the same water in semi-circular steel troughs, outby along the mine roadways and to the dewatering plant on the mine surface. This method of coal-mining has many advantages over other mechanized methods at present being used, and progress made by the company will be observed with close interest and care.

**"C" North Mine.**—Henry Eberts, overman. This mine was opened in November, 1966, and produced coal continuously from that date until it was closed in September, 1969. The workings of the mine and the geology of the coal measures have been adequately described in previous reports. From the beginning of the year until September, 1969, the daily production averaged 400 tons of saleable coal. The room-and-pillar method of work was used, the coal being mined by one Joy continuous-miner machine. The extension to the "C" North mine, with workings in the lower "C" seam, was taken off production at the same time.

Approximately three-quarters of a mile of No. 3/0 A.W.G. 6,900-volt power-line was built from upper "C" mine to lower "C" mine and a 100-horsepower fan was installed on the surface.

General conditions were found to be satisfactory during the course of inspections, with no indications of methane being observed or reported from the "C" North mine.

**"D" North Mine.**—Henry Eberts, overman. This mine was opened in October, 1969, to develop an area of workings in the "D" seam, on the north side of the Michel Valley. The portals at an elevation of 5,300 feet are accessible from a private road leading from the coal-preparation plant. The mine entries were made on the seam outcrop with a continuous-miner machine. The coal seam is about 8 feet thick, dips at an angle of 12 degrees to the southwest, and is at an average depth of 90 feet below the surface. The mine was ventilated by a 100-horsepower electrically driven fan, capable of producing 80,000 cubic feet of air per minute at a 1.2-inch water-gauge.

A 6,900-volt No. 3/0 A.W.G. power-line 900 feet long was built from "C" North mine to "D" North mine.

The mine averaged a daily production of 200 tons of saleable coal from October to the end of the year. Rooms were driven by a continuous-miner machine, but no pillar extraction took place. Coal was transported by shuttle car and belt conveyor to the loading point outside the mine. The immediate roof beds of the coal seams, being of a friable nature, were supported throughout the mine by close-set timber posts.

General conditions were found to be satisfactory during the course of inspections. No indications of methane were detected or reported from the mine and damp conditions prevailed through most of the workings.

#### OPEN PIT MINING OPERATIONS

J. Anderson, superintendent. During 1969, Kaiser Resources Ltd. produced almost 60 per cent of the total output of coal from a number of open pits. These are at fairly high elevations on both sides of the Michel Valley and have workings in three separate coal seams. A brief description of each open pit follows:—

**No. 3 Seam Open Pit.**—This open-pit operation commenced in the spring of 1967, and has since continuously produced coal from the No. 3 seam. The open pit is at an elevation of 5,000 feet on the Natal Ridge, approximately 2½ miles north and west of Michel. The total thickness of the coal seam is about 45 feet, but contains two thick bands of dirt with a combined thickness of 15 feet. The pit wall is benched, and slopes at an angle of 55 degrees to the horizontal. Coal produced at the open pit was hauled 4 miles by truck over a company road to the coal-preparation plant at Michel.

**No. 7 Seam Open Pit.**—This open pit is on the Natal Ridge at an elevation of 4,800 feet, approximately 2 miles southwest of Michel. The seam is 31 feet thick and contains a 6-foot dirt band about 8 feet above the footwall. It dips southwesterly 15 to 20 degrees. Operations were spasmodic in 1969 and coal production was low.



Plate XIa.—Kaiser Resources Ltd.'s Harmer No. 1 open pit with several 200-ton capacity Lectra Haul dump trucks. (Courtesy Kaiser Resources Ltd.)



Plate XIIa.—Coal conveyor running down the slope from the tunnel toward the preparation plant in the middle distance. (Courtesy Kaiser Resources Ltd.)



Plate XIb.—View inside the mile-long coal-conveyor tunnel through which coal is moved

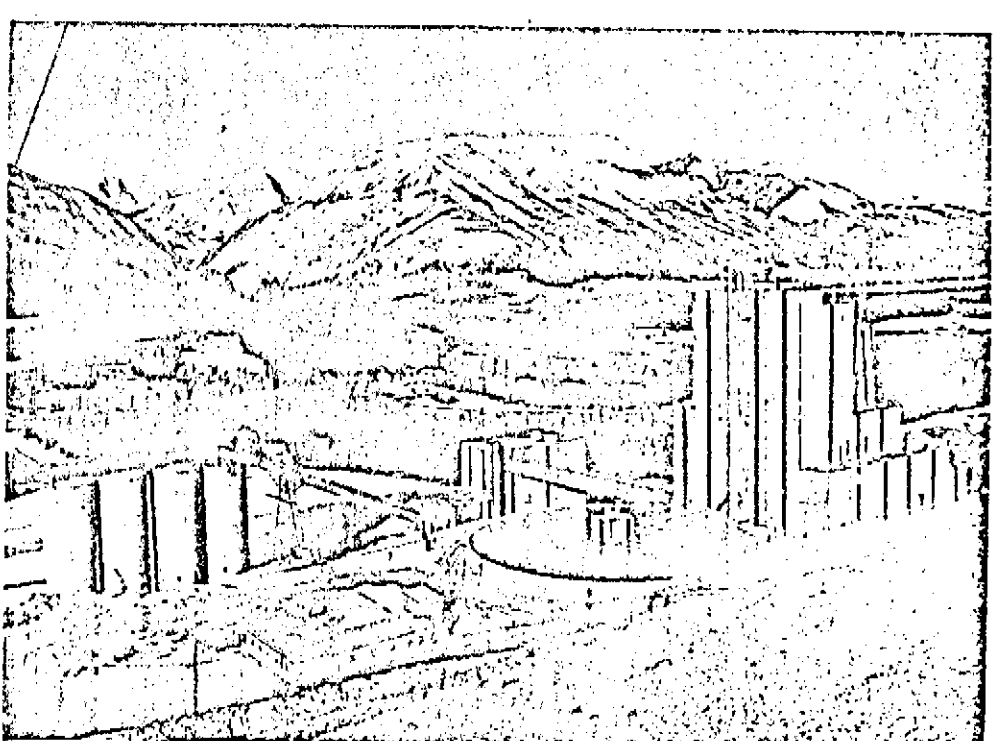


Plate XIIb.—Kaiser Resources Ltd.'s coal-preparation plant at Natal. (Courtesy Kaiser Resources Ltd.)

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**No. 10 Seam, 4 Open Pit.**—This open-pit operation commenced in October, 1967, and finished in September, 1969. It was on the Sparwood Ridge at an elevation of 5,000 feet and a distance of 2½ miles southwest of Michel. All operations at the open pit were carried out by Emil Anderson Ltd., under contract to Kaiser Resources Ltd. The coal seam is 40 to 50 feet thick and dips easterly at about 30 degrees. The face of the open pit was benched, and the pit wall was sloped at an inclination of 57 degrees to the horizontal.

**No. 10 Seam, 4A Open Pit.**—This open pit is at an elevation of 5,000 feet on the Harmer Ridge and has access to the coal-preparation plant by 5 miles of private road. The coal seam is about 40 feet thick and is overlain by about 70 feet of strata. Operations during 1969 were spasmodic and were carried out by Emil Anderson Ltd. under contract to Kaiser Resources Ltd.

**No. 10 Seam, 6 Open Pit.**—This open pit was brought into operation in the spring of 1968, for the mining of an area of No. 10 seam at McGillivray, off the south side of the Michel Valley. Because of the high ash content in the coal, operations in 1969 were spasmodic. Access to the mine from the preparation plant is by 4 miles of public road and 3 miles of private road.

**No. 10 Seam, 7 Open Pit.**—This open-pit operation commenced in January, 1969, to work coal outcropping on the east side of the Elk Valley. The open pit is at an elevation of 4,900 feet and is approximately 3 miles southeast of Sparwood. All the operations at this open pit are carried out by Emil Anderson Ltd. under contract to Kaiser Resources Ltd.

**Harmer Ridge, Open Pit.**—P. G. Urso, open-pit manager; J. Korski, open-pit superintendent; T. Stokay, plant superintendent; H. Henderson, maintenance superintendent.

Throughout 1969, as soon as the facilities were made available to them, the open-pit operations staff commenced on various pre-production operations—6.9 million cubic yards of overburden was drilled, 6.5 million cubic yards was blasted, and 6 million cubic yards was transported from the pit to the dump. Most of this work was performed in the Harmer No. 1 and Dry Creek pit areas.

In addition to extensive road construction, a raw-coal stockpile base was made adjacent to the breaker station. In the Harmer No. 1 pit, the 6460 and 6520 benches were stripped to uncover the coal and stripping commenced on the 6340 and 6400 benches. In the Dry Creek pit, stripping was finished on the 5380 and 5440 east side benches. In the No. 8 pit area, the surface was cleared and work commenced on the first shovel bench. A continuously operating programme employed 360 men on the pre-production development.

Power-lines were run throughout the pit to supply three 25-cubic-yard shovels, one 16-cubic-yard shovel, and four 12-inch rotary drills. The shovel load is 1,600 horsepower. An air compressor driven by a 50-horsepower motor was also installed. A maintenance complex which adds 1,300 horsepower to the total was also built.

#### PROSPECTING AND EXPLORATION

J. B. Murphy, geologist. During 1969, the company continued its exploration programme under the direction of J. B. Murphy, exploration geologist. In the vicinity of Michel, emphasis was placed upon proving-up additional reserves of high-quality coking-coal. General access roads were constructed to more remote portions of the property within a 10-mile radius of the Michel area. Reconnaissance mapping was conducted in the vicinity of Tent Mountain, Sparwood Ridge, and Mount Hosmer.

During the year, 18 miles of access road, 5 miles of trenching, and the driving of 15 adits with a total length including crosscuts of 3,809 feet, and 45,000 feet of drilling were completed. On the company's Elk River coal lands, a geological reconnaissance of the entire area was carried out. Access roads were built to the Greenhills area east of the Elk River, and to the Burnt Hill Ridge east of the Fording River. During the year 12 miles of access road and 3 miles of trenching were completed.

**Kaiser Construction Division.**—Considerable progress was made during 1969 in preparing for the new surface-mining operation. L. Cherene and E. Ryan, project engineers for Kaiser, supervised and co-ordinated the activities of all the contractors on the site.

During the year the mile-long conveyor tunnel was completed and lined, and the conveyor equipment between the coal-breaking station and the coal-preparation plant was installed. Two 1,000-horsepower motors located outside the upper portal will control the conveyor. Their duty will be braking rather than driving when the conveyor is loaded. By the end of the year the coal-preparation plant and unit train-loading facilities were almost completed. It is expected that the plant will be ready to receive coal from the new open pit by February, 1970. On the Harmer Ridge, the maintenance shop, warehouse, changehouse, and mine office were all constructed and commissioned during the year. The first electrical power substation was erected and brought into use. A second substation should be completed by February, 1970. By the end of the year most of the construction of the haulage roads necessary to serve the operation had been completed. The following list of machinery and equipment was assembled during 1969, and made available for use by the operations staff:—

- Three Model 2800 P and H 25-cubic-yard shovels.
  - One Model 181M Marion 8-cubic-yard shovel.
  - One Model 183M Marion 10-cubic-yard shovel.
  - Nine M200 unit rig 200-ton trucks (rock).
  - Three M100 unit rig 100-ton trucks (rock).
  - Three M100 unit rig 100-ton trucks (coal).
  - Four Model 60R Bucyrus Erie rotary blast-hole drills, 12- to 14-inch diameter.
  - One Model 45R Bucyrus Erie rotary blast-hole drill, 9-inch diameter.
  - One Model 988 Caterpillar front-end loader, 6½-yard bucket.
  - Nine D9G Caterpillar tractors.
  - Two Model 633 Caterpillar scrapers, 30 cubic yards.
  - Two Model 824 Caterpillar rubber-tired bulldozers.
  - Three Model 16C Caterpillar road graders.
  - One Model D600 KW Dart front-end loaders, 12 cubic yards (rock).
- In addition, the following equipment has arrived and is being erected:—
- One Page dragline, 54 cubic yards.
  - One Model 2800 P and H 25-cubic-yard shovel.
  - One Model 2100 P and H 15-cubic-yard shovel.
  - One M200 unit rig 200-ton truck.

**Old Coal-preparation Plant.**—G. Lancaster, superintendent. This plant is on

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side of the Michel Colliery. This plant was built in 1936, and a description of the mode of operation has been given in past Annual Reports.

A pump driven by a 50-horsepower 550-volt motor was installed in the powerhouse.

*New Coal-preparation Plant.*—A new plant for coal processing was built and the installation of machinery was nearly completed by the end of the year. In this plant there will be the following equipment:—

Equipment	Horsepower
Air compressors .....	70
Conveyors .....	710
Hoists .....	80
Coal washer .....	652
Coal screens .....	2,573
Pumps .....	6,200
Miscellaneous .....	4,650
<b>Total .....</b>	<b>14,935</b>

*By-product Plant.*—I. Dufour, superintendent. This plant is situated adjacent to the coal-preparation plant. It employed 58 men in 1969. Present operations are confined to the horizontal-fired Curran-Knowles ovens, a detailed description of which has been given in past Annual Reports. The plant produced a total of 161,303 tons of coke and 15,877 tons of breeze in 1969.

1970.

#### KAISER RESOURCES LTD.

H. M. Conger, general manager; J. E. Korski, open-pit manager; R. E. Sieling, manager of underground mines; J. Lawrie, senior mining engineer.

The open-pit operation on Harmer Ridge and the new coal-preparation plant in the Elk Valley came into operation during the early part of the year, considerably increasing the total coal production from the East Kootenay District. Michel Colliery operated throughout 1970 at a production level comparable with former years. One significant change in the method of coal production at the colliery took place toward the end of the year, this being the introduction of the hydraulic method of coal mining.

Throughout the year the company continued to devote special attention to its reclamation programme. The company purchased a 1,500-gallon hydroseeding machine capable of jetting mixtures of water, peat, grass seed, and fertilizers a distance of 150 feet in any direction. They also established a small tree farm and built and equipped a large, heated greenhouse. By the end of 1970, a total of 880 acres of the property had been hydroseeded, and some 40 acres of tree planting completed, with fairly encouraging results to date.

**HARMER RIDGE OPEN PITS AND COAL-PREPARATION PLANT**—J. E. Korski, open-pit superintendent; W. L. McMorris, coal-preparation plant superintendent; G. H. Henderson, maintenance superintendent.

In the general area known as Harmer Ridge, the company conducted mining operations in the Harmer Knob, Harmer No. 1, Dry Creek, and Camp Eight open pits.

During April, a Page dragline was put into service in the Harmer No. 1 open pit, which was then worked by a combination of dragline, shovel, and truck, whereas the other three open pits were worked by shovel and truck only.

A total of about 9,000 tons of explosives was used during the year, to prepare some 23 million cubic yards of overburden. This uncovered approximately 3¼ million tons of run-of-mine coal that was loaded and conveyed through the mountain to the Elkview coal-preparation plant near Sparwood.

The following list of additional equipment was assembled and put into operation in the open pits during the year:

- One M200 Unit-Rig 200-ton truck.
- Ten M100 Unit-Rig 100-ton trucks.
- Four D9 Caterpillar tractor dozers.
- Two Model 16C road graders.
- One Model D600 KW Dart front-end loader.

Raw coal from the open pits was delivered by trucks to the breaker station, where it was reduced to a 4 to 0-inch size range. The coal was then conveyed through a mile-long tunnel to the four raw-coal silos having a capacity of 8,000 tons. The coal was then conveyed into the coal-preparation plant where it was separated for treatment into four different size ranges. The 4 to ¾-inch coal was treated in a heavy medium magnetite washer, the ¾-inch 28-mesh coal was treated in heavy media cyclones, the 28 to 100-mesh size range was treated in hydro-cyclones, and finally the minus 100-mesh coal was treated in the flotation plant.

The clean coal in the size range ¾ to 0-inch was dried in a fluid-bed thermal coal-drier and added to the clean, coarse coal for storage in the clean-coal silos. The unit trains were automatically loaded as they were hauled through the loading station at the base of the clean-coal silos.

Coarse refuse from the plant was hauled by scrapers to the spoil area, where it was layered and compacted. The minus 28-mesh tailings were fed into tailings impoundments.

The first coal was put through the preparation plant in March 1970, the first shipment by unit train from the plant was on April 28, 1970, and by the end of the year the average hourly input to the plant had reached 1,000 tons.

The total manpower at the end of the year at the new open-pit mining operation, including the coal-preparation plant and maintenance complex, was 759.

**MICHEL COLLIERY**—R. E. Sieling, mine manager; J. Anderson, senior mine overman; D. Anderson, mechanical superintendent; F. Fairclough, electrical superintendent; C. Chakravatti, ventilation engineer.

This colliery, which has been in operation since 1899, is at Michel, some 24 miles northeast of Fernie. Production from the Michel Colliery during 1970 was obtained from four underground mines and five open pits. The coal-preparation plant and the by-product plant are on the colliery site at Michel. The mines are on both sides of the Michel Valley at various elevations, having been opened mainly from the seam outcrops. For the past decade the underground mines have been

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The stand of limestone rock-dust application in the underground roadways of the mine was good throughout the year, resulting from the regular and sometimes continuous use of several rock dust sprinkle-dusting machines. In accordance with the provisions of Rule 90 of the *Coal Mines Regulation Act*, 12 separate sets of water barriers were used at various locations in the mine. These are used in coal mines to stop the propagation of underground methane-air or coal-dust explosions.

The results of airborne dust surveys conducted by the Environmental Control Branch of the Department of Mines and Petroleum Resources in 1970, while being better than in previous years, still indicate that there is much progress to be made in the future in the field of airborne dust control. The company now conducts its own airborne dust surveys using the gravimetric sampler, and the results of the surveys are submitted to the Department of Mines and Petroleum Resources.

The Balmer North mine was inspected regularly throughout the year, and general conditions were found to be fairly satisfactory.

**Balmer Hydraulic Mine**—Arnold Webster, overman; Arthur Grimley, overman. This mine, operating in the No. 10 seam, is on the south side of the valley, approximately 1 mile west of the coal-preparation plant at Michel. The mine was opened in 1969, with two main entries driven from the outcrop of the No. 10 seam on the mountainside. The development of this mine was primarily to explore the possibilities of working by hydraulic methods this thick, inclined seam of coal. The main entries airways and the first sublevels had been driven by the beginning of 1970. The installation of the underground plant was completed during the early part of the year, but as a result of considerable delay in the construction of the surface dewatering and coal-handling plant, mining by the hydraulic method was not commenced until November.

A team of mining engineers and machine operators from the Mitsui Mining Company of Japan arrived in Michel in November 1970. These persons were engaged by Kaiser Resources Ltd. in order to teach and train the coal personnel in this new method of coal mining. The Mitsui Mining Company has had considerable experience in this method of coal mining in a number of their coal mines in northern Japan.

In this type of mining the coal is cut off the solid by a high-pressure jet of water directed at the coal face by a hydraulic monitor. The same water is then used to transport the broken coal in semicircular steel troughs, outbye along the mine roadways to the surface dewatering plant. The surface plant is designed to work on a closed-circuit principle, using a thickener and a filtration plant for recovery of fine coal and thus permitting the reuse of the same water in the mine. This method of coal mining has considerable merit, and the results obtained during the last two months of 1970 were fairly encouraging.

Ventilation for the mine was provided by a 100-horsepower electrically driven axivane mine fan, which delivered approximately 100,000 cubic feet of air per minute at a water gauge of 3 inches. Through ventilation was provided in the hydraulic sublevels, with fresh air passing over the operating team, through the worked out areas, and to the main return airway via bleeder levels. The mine remained free of methane gas, and at no time during the year could methane be detected on either the flame safety lamp or methanometer.

**"D" Seam, North Mine**—Henry Eberts, overman. This mine was opened in October 1969 to work an area of the "D" seam on the north side of the Michel Valley. The mine entries were formed at the coal-seam outcrop at an elevation of 5,300 feet. At this location the "D" seam is about 8 feet thick, dips 12 degrees southwesterly, and is overlain by approximately 100 feet of cover to the surface.

ked by mechanized room-and-pillar methods; however, in the latter part of 1970 a start was made on hydraulic coal mining in one of the mines.

Underground equipment was operated mainly by electricity, and all the equipment was of the flame-proof type approved for use in coal mines. Underground transportation of coal was by shuttle cars and fast-moving belt conveyors. Underground transportation of supplies and materials was by means of rubber-tired vehicles operated by diesel or battery units.

During 1970, at Michel Colliery and the exploration sites, a total of 28,525 pounds of Monobel and 375 pounds of CXL-ite explosive was used. In conjunction with this, 45,600 electric detonators were used, with no reported misfired shots. A total of 3,069 tons of limestone rock dust was spread in the underground mines to minimize the coal-dust explosion hazard. Regular monthly dust samples were taken in all the mines in accordance with the requirements of the *Coal Mines Regulation Act*. These samples were analysed and the results made available for scrutiny.

Monthly examinations of workings at the mines were made by the miners' inspection committee, and regular safety meetings were held each month in the mine office. Reports kept at the mine in compliance with the *Coal Mines Regulation Act* were checked periodically and found to be in order.

At the end of the year 441 men were employed at Michel Colliery, 233 on the surface and 208 underground. Sufficient overmen and firebosses were employed to ensure that safety inspections and work supervision were conducted in accordance with the requirements of the *Coal Mines Regulation Act*. A description of the underground mining operations follows.

#### UNDERGROUND MINING OPERATIONS

**Balmer North Mine**—William Davcy, overman. This mine, in the No. 10 seam, is on the north side of Michel Valley. It is entered by two rock tunnels, each 1,150 feet long, which were driven by February 1966. The mine portals are at an elevation of 3,850 feet, 1 mile west of the coal-preparation plant, and can be reached by private access road. The coal seam is about 50 feet thick, dips at an angle of 15 to 20 degrees to the southwest, and is overlain by a fairly strong shale roof. The coal was mined by continuous-miner machines, then loaded onto shuttle cars and transported from the mine by a trunk belt-conveyor system.

The mine had a daily production of approximately 1,300 tons of saleable coal during 1970. Three continuous miners produced coal from different sections of the mine. Each section is ventilated by a separate split of ventilation. Most of the mine output was obtained from driving rooms immediately underneath the hanging-wall of the seam along the strike direction. The rest of the mine output was obtained from a method of partial pillar extraction, by widening rooms, and further shrinking into the thick seam of coal.

The ventilation of the mine was provided by a Joy 400-horsepower mine fan operating at a water gauge of 6 inches installed on and exhausting from the top of the 16-foot diameter vertical air shaft. The mine fan provided about 360,000 cubic feet per minute of air. The main return airway, at the bottom of the air shaft, contained on average about 0.6 per cent methane during normal working conditions. Cold-weather problems during the winter months were overcome by the use of two Flamemaster mine air-heating units at the portals of the two rock tunnels.

Ventilation of the working faces was mostly by auxiliary fans and flexible ducting, and sometimes by a combination of fan and ducting with line brattice. During the year, each working face was equipped with a constant running methanometer, preset to give the continuous-miner operator warning when the methane content at the face reached a level of 1 per cent.

Mining has indicated unfavourable working conditions in "D" seam, with constant variations in seam section and a very weak and friable hangingwall. The company continued to operate the mine, hoping for improved mining conditions, but eventually closed it in March 1970.

"A" Seam North, No. 2 Mine—Henry Eberts, overman. This mine was opened in March 1970 to work an area of the "A" coal seam on the north side of the Michel Valley. The portals are at an elevation of approximately 5,000 feet and are accessible from a private road leading from the coal-preparation plant at Michel. The mine entries were formed at the seam outcrop by using a continuous-miner machine. The coal seam averages about 12 feet thick, and dips 15 degrees southwesterly.

The mine was ventilated by a 100-horsepower axivane electrically driven fan, capable of providing 90,000 cubic feet of air per minute at a working water gauge of 1.5 inches. Ventilation of the advancing rooms was provided by a 15-horsepower auxiliary fan in conjunction with flexible ducting.

The mine had a daily production of 400 tons of saleable coal from April to the end of the year. Rooms were driven by continuous miners, but no pillars were extracted. The coal was transported by shuttle cars and fast-moving belt conveyors to the loading point outside the mine. This mine was closed at the end of the year, when the main development headings encountered a complete wash-out of the coal seam, which persisted over a very extensive area.

#### OPEN-PIT MINING OPERATIONS

J. Lawrie, mining engineer; J. Anderson, superintendent. These open pits are quite separate from the new operation in the vicinity of the Harmer Ridge, and the mined coal is treated at the Michel coal-preparation plant. Open pits which produced during 1970 were No. 10 seam, 7 pit; No. 10 seam, 6 pit; No. 10 seam, 4A pit; No. 3 seam pit; and No. 7 seam pit. These open pits are at fairly high elevations on both sides of the Michel Valley, and are served by private mining-roads leading from the coal-preparation plant at Michel. A brief description of each open pit follows:

*No. 10 seam, 6 open pit*—This open pit was brought into operation in the spring of 1968 for the mining of an area of the No. 10 seam at McGillivray, off the south side of the Michel Valley. Access to the pit from the coal-preparation plant is by 4 miles of public road and a further 3 miles of private road. Operations at the open pit were spasmodic during 1970 and coal production was low. All operations at this open pit were conducted by a contractor.

*No. 10 seam, 7 open pit*—This open pit, at an elevation of 4,900 feet, is approximately 3 miles south of Sparwood on the east side of the Elk Valley. Coal mined at the open pit was hauled by contractor over 5 miles of private road to the coal-preparation plant at Michel. Operations in the open pit were carried out by Emil Anderson Ltd. under contract to Kaiser Resources Ltd.

*No. 10 seam, 4A open pit*—This open pit, at an elevation of 5,000 feet near Camp Eight open pit on Harmer Ridge, had access to the preparation plant at Michel by 5 miles of private road. Operations in this open pit were stopped very early in 1970 because of its close proximity to the new open pit mentioned above. Work in the pit was carried out by Emil Anderson Ltd. under contract to Kaiser Resources Ltd.

*No. 3 seam open pit*—This open pit, situated on Natal Ridge at an elevation of 5,000 feet, is approximately 2½ miles north and west of Michel. Operations

pit was closed in the spring of 1970. During March 1970, a failure of the main pit wall occurred and all activities other than certain protective measures ceased. Kaiser Resources Ltd. rock mechanics engineers and an independent firm of geotechnical engineers made a close investigation of the failure. Energy dissipation berms were constructed over continuous areas at 350 and 850 feet from the toe of the pit wall. Observations of movement were maintained, and showed a rapid slowing down of movement during April and May 1970. The examination by the firm of geotechnical engineers carried out in November 1970 indicated that sudden stress release would be unlikely. It was also noted that any rock falls would be absorbed by the relatively flat footwall and by the energy-dissipation berms.

*No. 7 seam open pit*—This open pit, on the Natal Ridge, at an elevation of 4,800 feet, is approximately 2 miles southwest of Michel. The coal seam is 31 feet thick and contains a 6-foot dirtband about 8 feet above the footwall. Operations were spasmodic during 1970 and production low.

#### PROSPECTING AND EXPLORATION

J. B. Murphy, geologist. During 1970, the company embarked upon a much-expanded exploration programme, under the direction of J. B. Murphy, exploration geologist. For most of 1970 approximately 50 men, including supervisory staff, were engaged in this programme. The work was carried out in the Elk Valley coal lands, the Crows Nest coalfield, and the immediate mining areas around Michel. Work done included both rotary and core drilling, the driving of prospect adits, construction of access roads, and the tracing and mapping of coal-seam outcrops. The following is a summary of physical work completed on the Crows Nest property and on coal licence lands:

- (a) 39 miles of access roads constructed;
- (b) 29,364 feet of exploratory drilling (Michel area);
- (c) 7,806 feet of drilling (Hosmer area);
- (d) 31 prospect adits, including 6,150 feet of drifting and crosscuts;
- (e) 15 miles of coal outcrop exposed.

#### MICHEL COAL-PREPARATION PLANT

G. Lancaster, superintendent. This plant is on the colliery site near the entrance to the old rock tunnels on the south side of the Michel Colliery. It was built in 1936, and a description of the mode of operation has been given in past Minister of Mines and Petroleum Resources Annual Reports. During the year, natural gas was introduced for the firing and operation of the thermal coal-dryer. This displaced the old method using pulverized fuel, and has contributed to the reduction in airborne dust problems.

#### BY-PRODUCT PLANT

G. Lancaster, superintendent. This plant is situated near the coal-preparation plant. During the year the plant employed approximately 56 men. Present operations are confined to the horizontal-fired Curran-Knowles ovens, a detailed description of which has been given in previous Annual Reports. The plant produced a total of 170,686 tons of coke and 20,290 tons of breeze in 1970.

CROWS NEST COAL FIELD - PROPERTY MAP RESERVE ESTIMATES 1969

	Q - 2,500' COVER (N.T. RAW)	ESTIMATED TOTAL COAL IN PLACE		TOTAL RESERVE N.T. RAW	REMARKS
		SECT	OVER 2,500' COVER (N.T. RAW)		
K-1	1,302,426,000 )	Michel	-	1,302,426	Reserve estimates within K-1 & K-2 area based on specific Michel data available.
K-2	339,807,000 )	information	-	339,807	
K-3	286,000,000 )	4-4'	-	286,000	
K-4	4,563,504,000	Loop report	-	23,963,240	Estimate based on reserve estimates of the McGillivray (loop area) report.
		F-F'	19,399,740,000		
		G-G'			
		M-M'			
K-5	811,582,000		918,418,000	1,730,000	Estimates of areas K-5 to K-9 as well as G-1, G-2 based on studies by KRL as well as other groups. An average of 173 feet of coal was derived from the numerous stratigraphic columns compiled for the above areas.
K-6	190,668,000		105,200,000	295,868	
K-7	287,649,000		-	287,649	
K-8	173,617,000		-	173,617	
K-9	193,136,000		-	193,136	
G-1	1,801,818,000	Q-Q1	18,065,772,000	11,867,591	
G-2	528,281,000	T-T1	5,871,917,000	6,400,198	
Sub				46,839,520	
Total	10,478,488,000		36,361,047,000		

NORTH END OF PROPERTY  
ELK VALLEY

1-1')	1,694,681,000		250,000,000	1,944,681	Estimates based on geological mapping done by Kaiser Resources staff 1969.
2-2')					
3-3')					
Total	12,173,169,000		36,611,047,000	48,784,216	

Note: The above mentioned reserves take no account of economic considerations or coal quality.

It is the understanding of KAISER RESOURCES LTD. that the above reserve data submitted to the Canadian Government Dept. of Energy, Mines and Resources, Calgary, Alberta as per the request of the Deputy Minister of Mines C. M. Isbister, Mr. W. C. Whittaker of the Western Coal Operators Assoc. that Kaiser Resources Ltd. has the complete assurance of Mr. Latour, staff geologist of the Geological Survey of Canada that the reserve information to be confidential and that any published figures will not be identified with our property.

JANUARY 1970

S. LAPOUR NOTES

Kaiser Resources Ltd (Cowmont area, B.C.) 5 Feb/70

Revenue figures provided by this company includes much coal that is in the Indicated and Inferred class. According to Brian Murphy much of the revenue (he could not be specific as to exact areas) are based on joints of information that are up to 2 miles apart. Murphy explained that it was his company's policy to withhold more exact information and this was the best he could do.

In order to bring these figures into line with our "measured" revenues we made the following decisions:



(2)

1. From information obtained in the past from J. Crabbs we know that most of the exploration was done in blocks K1, K2 and K4

2. We can accept the tonnages given by Murphy as occurring in within 2,500' of surface in Blocks K1, K2, K3 as being measured reserves. These tonnages are:

K1	1,302,426,000
K2	339,807,000
K4	4,563,504,000
	<hr/>
	6,205,737,000

3. The tonnages in within 2,500' of surface in the remaining blocks are accepted as Indicated. These tonnages are:

K3	286,000,000
K5	811,582,000
K6	190,668,000
K7	287,649,000
K8	173,617,000
K9	193,136,000
G1	1,801,818,000
G2	528,281,000
	<hr/>
	4,272,751,000

1-1' + 2-2' + 3-3'	1,694,681,000
	<hr/>
	5,967,432,000

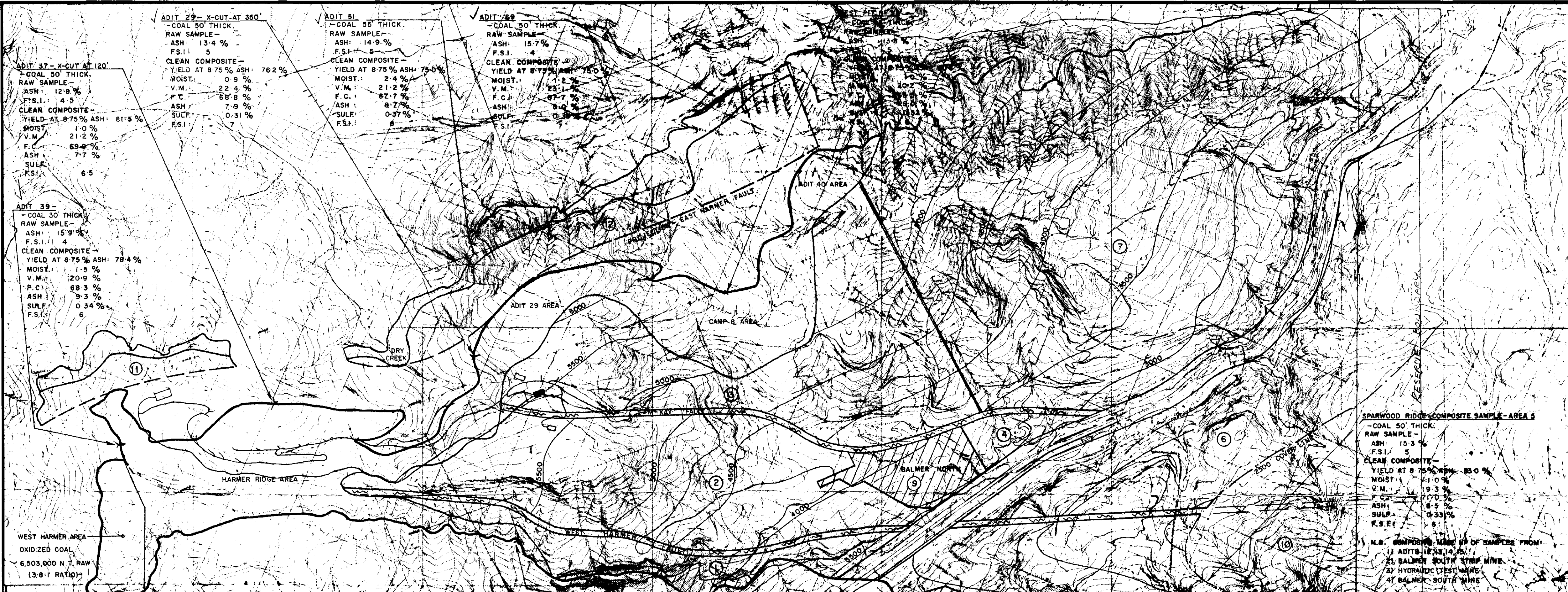
Mackay's Probable (Indicated) was 10,334,338

4. We will accept his tonnages over 2,500' from surface as Inferred. These tonnages are 36,611,047,000

SUMMARY to report to Christmas

1. Kaiaua Measured Reserves = 6,205,737,000

2. ~~Kaiaua Indicated Reserves = 10,334,338~~



<b>ADIT 29 - X-CUT AT 350'</b> - COAL 50' THICK RAW SAMPLE - ASH: 13.4 % F.S.I.: 5 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 76.2 % MOIST.: 0.9 % V.M.: 22.9 % F.C.: 68.8 % ASH: 7.8 % SULF.: 0.31 % F.S.I.: 7	<b>ADIT 51</b> - COAL 55' THICK RAW SAMPLE - ASH: 14.9 % F.S.I.: 5 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 75.0 % MOIST.: 2.4 % V.M.: 21.2 % F.C.: 67.7 % ASH: 8.7 % SULF.: 0.37 % F.S.I.: 6	<b>ADIT 69</b> - COAL 50' THICK RAW SAMPLE - ASH: 15.7 % F.S.I.: 4 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 75.0 % MOIST.: 1.2 % V.M.: 23.1 % F.C.: 67.7 % ASH: 8.0 % SULF.: 0.38 % F.S.I.: 6
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<b>ADIT 39 -</b> - COAL 30' THICK RAW SAMPLE - ASH: 15.9 % F.S.I.: 4 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 78.4 % MOIST.: 1.5 % V.M.: 20.9 % F.C.: 68.3 % ASH: 9.3 % SULF.: 0.34 % F.S.I.: 6
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<b>SPARWOOD RIDGE COMPOSITE SAMPLE - AREA 5</b> - COAL 50' THICK RAW SAMPLE - ASH: 15.3 % F.S.I.: 5 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 83.0 % MOIST.: 1.0 % V.M.: 19.3 % F.C.: 77.0 % ASH: 6.5 % SULF.: 0.33 % F.S.I.: 6
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WEST HARMER AREA  
 OXIDIZED COAL  
 6,503,000 N.T. RAW  
 (3.8:1 RATIO)

**N# 10 SEAM**

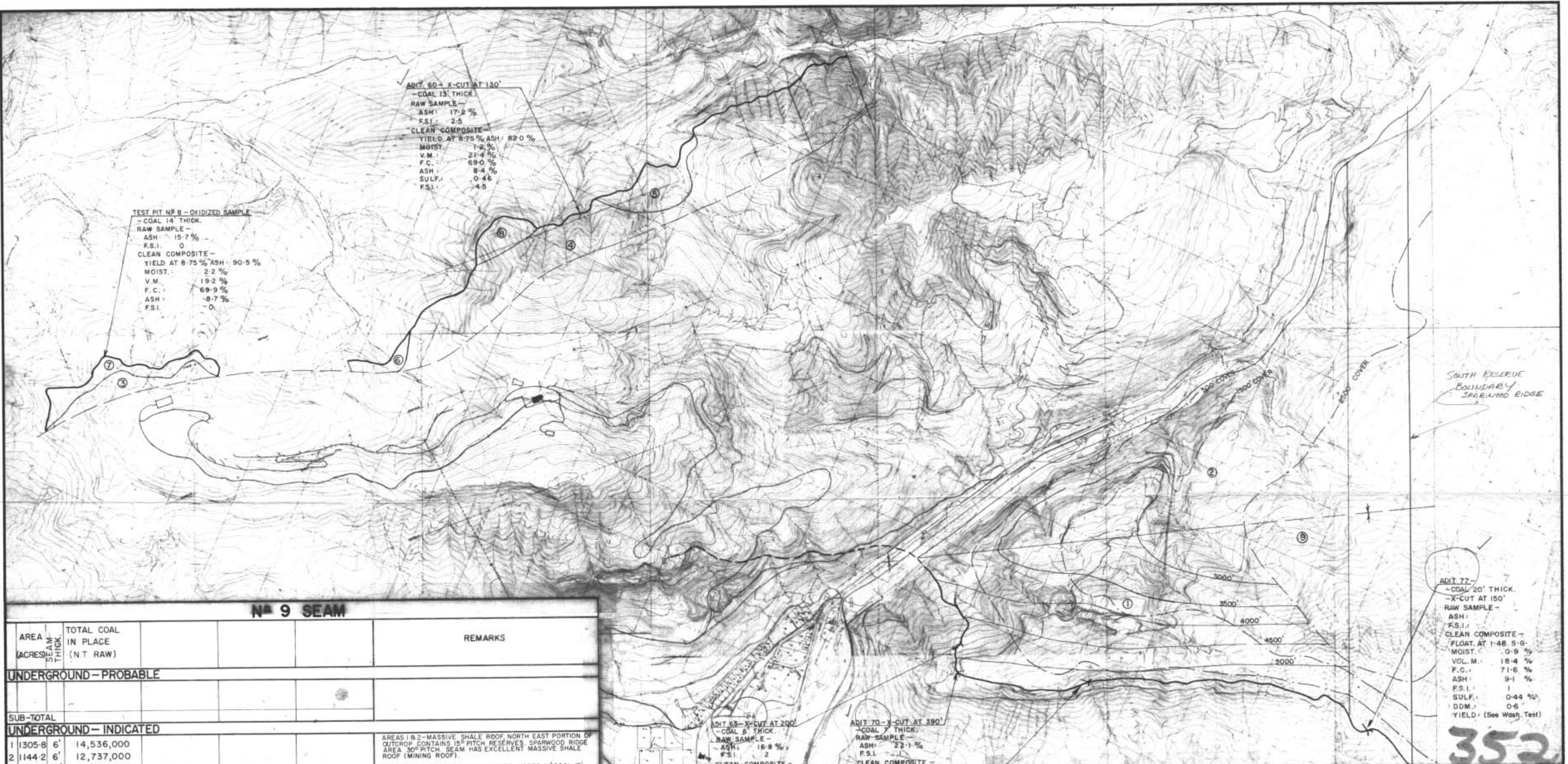
AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS CU YDS./TON OF RAW MET. COAL TO BREAKER
<b>UNDERGROUND - PROBABLE</b>			
1	266.3	24,704,000	
2	1215.9	112,785,000	
3	1237.8	114,830,000	
4	735	6,815,000	
5	1333.3	123,689,000	
6	956.8	88,763,000	
7	3496.8	324,385,000	
8	183.6	14,481,000	
9	177.2	13,975,000	
<b>SUB-TOTAL</b>		<b>824,427,000</b>	
<b>UNDERGROUND - INDICATED</b>			
10	674.9	62,611,000	
11	121.2	11,244,000	
12	525.3	48,726,000	
<b>SUB-TOTAL</b>		<b>122,581,000</b>	
<b>STRIP - PROVEN</b>			
		56,700,000	HARMER RIDGE 4.45:1
		30,800,000	ADIT 29 6.36:1
		28,400,000	CAMP 8 6.36:1
		9,400,000	BALMER EAST 6.0:1 SOUTH TO DRY CREEK.
<b>SUB-TOTAL</b>		<b>125,300,000</b>	<b>AVERAGE 5.46:1</b>
<b>ADDITIONAL RESERVES PROPOSED FOR SUPPORT OF EXTENDED CONTRACT</b>			
		14,800,000	BALMER EAST 6.0:1 SOUTH OF DRY CREEK.
		14,200,000	ADIT 40 5.99:1
<b>SUB-TOTAL</b>		<b>29,000,000</b>	<b>AVERAGE 6.0:1</b>
<b>TOTAL</b>		<b>1,101,308,000</b>	<b>(TOTAL AVERAGE 5.55:1)</b>

<b>ADIT 12</b> - COAL 50' THICK RAW SAMPLE - ASH: 15.8 % F.S.I.: 4.8 CLEAN COMPOSITE - YIELD AT 8.75% ASH: 83.0 % MOIST.: 1.2 % V.M.: 20.4 % F.C.: 69.6 % ASH: 8.7 % SULF.: 0.33 % F.S.I.: 6.5
--

LEGEND	
UNDERGROUND RESERVES - PROBABLE	[Symbol]
UNDERGROUND RESERVES - INDICATED	[Symbol]
UNDERGROUND RESERVES - INDICATED + 2500' COVER	[Symbol]
STRIP RESERVES - PROVEN (6:1 RATIO)	[Symbol]
STRIP RESERVES - INDICATED	[Symbol]
OXIDIZED COAL RESERVES	[Symbol]
COVER ISOPACHS	[Symbol]
STRUCTURAL CONTOURS	[Symbol]
PREVIOUSLY MINED AREA	[Symbol]

REV	DATE	REVISION	DR	CH	APP
<b>KAISER RESOURCES</b> NATAL, B.C.					
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)					
<b>MICHEL MINING AREA ①</b>					
DESIGNED	SCALES				
DRAWN W.P.	HOR. 1" = 2000'				
CHECKED	VERT.				
APPROVED	DWG. NO.				REV.
DATE APRIL 1970	145-13-2				

10 SEAM



ADIT 60 - X-CUT AT 130'  
 - COAL 13' THICK  
 RAW SAMPLE -  
 ASH: 17.2 %  
 F.S.I.: 2.5  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 82.0 %  
 MOIST.: 1.2 %  
 V.M.: 21.4 %  
 F.C.: 69.0 %  
 ASH: 8.4 %  
 SULF.: 0.46 %  
 F.S.I.: 4.5

TEST PIT NO 8 - OXIDIZED SAMPLE  
 - COAL 14' THICK  
 RAW SAMPLE -  
 ASH: 15.7 %  
 F.S.I.: 0  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 90.5 %  
 MOIST.: 2.2 %  
 V.M.: 19.2 %  
 F.C.: 69.9 %  
 ASH: 8.7 %  
 F.S.I.: 0

SOUTH RESERVE  
 BOUNDARY  
 SPARWOOD RIDGE

ADIT 77 -  
 - COAL 20' THICK  
 - X-CUT AT 150'  
 RAW SAMPLE -  
 ASH: 18.4 %  
 F.S.I.: 1  
 CLEAN COMPOSITE -  
 FLOAT AT 1.48: 5.6 %  
 MOIST.: 0.9 %  
 VOL. M.: 18.4 %  
 F.C.: 71.6 %  
 ASH: 9.1 %  
 F.S.I.: 1  
 SULF.: 0.44 %  
 DDM.: 0.6 %  
 YIELD: (See Wash Test)

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**№ 9 SEAM**

AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS
<b>UNDERGROUND - PROBABLE</b>			
SUB-TOTAL			
<b>UNDERGROUND - INDICATED</b>			
1	1305-8 6'	14,536,000	AREAS 1 & 2 - MASSIVE SHALE ROOF NORTH EAST PORTION OF OUTCROP CONTAINS 15° PITCH RESERVE SPARWOOD RIDGE AREA 30° PITCH SEAM HAS EXCELLENT MASSIVE SHALE ROOF (MINING ROOF)  AREA 3 - SEAM SPLIT INTO 2 ZONES, UPPER 14' COAL, 17' SHALE, 12' COAL - UPPER ZONE CONSIDERED MINEABLE ONLY. AREA 4 - SEAM THICKNESS VARIABLE 7-12' COAL
2	1144-2 6'	12,737,000	
3	63-4 14'	1,646,000	
4	672-2 12'	14,965,000	
9	390-3 6'	4,344,000	
SUB-TOTAL		48,228,000	
<b>STRIP - PROVEN</b>			
5	142-5 12'	3,176,000	AREAS 5 & 6 - COAL ZONE AVERAGES 12' THICKNESS SAME ZONE AS IN AREA 4, ROOF (SHALE) HAS SEVERAL COAL SPLITS ABOUT 5' ABOVE ROOF CONTACT.
6	45-4 12'	800,000	
SUB-TOTAL		3,976,000	
<b>STRIP - INDICATED</b>			
7	94-5 15'	2,619,000	AREA 7 COAL ZONE CONSISTS OF 14' COAL ZONE, 17' SHALE SPLIT AND 10' COAL ZONE 14' ZONE APPEARS THE CLEANEST UNDER GEOLOGIC STUDY. AREA 8 COAL ZONE 12' SAME AS IN AREAS 5 & 6.
8	42-2 12'	1,621,000	
SUB-TOTAL		4,240,000	
<b>TOTAL</b>		<b>56,444,000</b>	

ADIT 68 - X-CUT AT 200'  
 - COAL 6' THICK  
 RAW SAMPLE -  
 ASH: 16.8 %  
 F.S.I.: 2  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 77.0 %  
 MOIST.: 1.2 %  
 V.M.: 18.3 %  
 F.C.: 70.5 %  
 ASH: 9.0 %  
 SULF.: 0.60 %  
 F.S.I.: 2.5

ADIT 70 - X-CUT AT 390'  
 - COAL 7' THICK  
 RAW SAMPLE -  
 ASH: 22.1 %  
 F.S.I.: 1  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 55.4 %  
 MOIST.: 0.8 %  
 V.M.: 18.4 %  
 F.C.: 72.3 %  
 ASH: 8.5 %  
 SULF.: 0.54 %  
 F.S.I.: 1

ADIT 74 -  
 - COAL 7' THICK  
 - X-CUT AT 80'  
 RAW SAMPLE -  
 ASH: 16.3 %  
 F.S.I.: N.C.  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 72.0 %  
 MOIST.: 2.1 %  
 VOL. M.: 17.8 %  
 F.C.: 72.5 %  
 ASH: 7.6 %  
 SULF.: -  
 F.S.I.: N.C.  
 DDM.: -

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- UNDERGROUND RESERVES - INDICATED +2500' COVER
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV. DATE	REVISION	DR. CH. APP.
<b>KAISER RESOURCES</b> NATAL, B.C.		
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)		
<b>MICHEL MINING AREA</b> (2)		
DESIGNED	SCALES	
DRAWN W.P.	HOR. 1" = 2000'	
CHECKED	VERT.	
APPROVED	DWG. NO.	REV.
DATE APRIL 1970	145-13-3	

95 SEAM



ADIT 59  
COAL THICK. 25' 13'  
X-CUT AT 130'  
RAW SAMPLE -  
ASH: 15.5% 25.0%  
F.S.I.: 4-3 6  
CLEAN COMPOSITE -  
YIELD AT 8.75% ASH: 88.0% 62.0%  
MOIST.: 1.0% 1.2%  
V.M.: 23.4% 22.0%  
F.C.: 66.6% 67.8%  
ASH: 8.75% 8.75%  
SULF.: 0.24% 0.30%  
F.S.I.: 5 7.5

ADIT 31 - X-CUT AT 80'  
COAL 10' THICK  
(DATA TO BE COMPLETED 1970)

ADIT 36 - X-CUT AT 90'  
COAL 11' THICK  
RAW SAMPLE -  
ASH: 16.0%  
F.S.I.: 3  
CLEAN COMPOSITE -  
YIELD AT 11.45 S.G.: 62.2%  
MOIST.: 0.8%  
V.M.: 20.9%  
F.C.: 69.9%  
ASH: 8.4%  
SULF.: 0.57%  
F.S.I.: 4/5

ADIT 17 - X-CUT AT 90'  
COAL 11' THICK  
RAW SAMPLE -  
ASH: 16.0%  
F.S.I.: 3  
CLEAN COMPOSITE -  
YIELD AT 11.45 S.G.: 62.2%  
MOIST.: 0.8%  
V.M.: 20.9%  
F.C.: 69.9%  
ASH: 8.4%  
SULF.: 0.57%  
F.S.I.: 4/5

ADIT 28 -  
COAL 20'-0" THICK  
X-CUT AT 150'  
RAW SAMPLE -  
ASH: 24.7%  
F.S.I.: 2  
CLEAN COMPOSITE -  
FLOAT AT 1.50 S.G.:  
MOIST.: 1.0%  
VOL. M.: 19.6%  
F.C.: 70.7%  
ASH: 8.7%  
F.S.I.: 6  
SULF.: 0.56%  
DDM.: 4-2  
YIELD: (See Wash. Graph.)

SPARWOOD RIDGE  
SOUTH RESERVE  
BOUNDARY

N° 5 MINE WORKINGS -  
MAIN TUNNEL  
650' FROM FORTAL  
COAL 13'-5" THICK  
RAW SAMPLE -  
ASH: 17.5%  
F.S.I.: 4  
CLEAN COMPOSITE -  
YIELD AT 8.75% ASH: 80.0%  
MOIST.: 1.5%  
VOL. M.: 22.7%  
F.C.: 67.5%  
ASH: 8.3%  
SULF.: 0.69%  
F.S.I.: 5.5

N° 8 SEAM			REMARKS
AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	
<b>UNDERGROUND - PROBABLE</b>			SEAM HAS MASSIVE SHALE ROOF, A 1' CARBONACEOUS PARTING APPEARS BETWEEN SHALE ROOF AND COAL ZONE. PREVIOUS TESTS ON THIS COAL BED DONE BY C.N.I. - SEE WASHABILITY DATA.
1	1277.5	11' 26,200,000	
2	247.6	11' 5,079,000	
SUB-TOTAL			
			AREAS 3,4,5,8,6 - SEAM HAS MASSIVE SHALE ROOF. A 1' SHALE SPLIT IS PRESENT IN UPPER PORTION OF SEAM. RESERVE AREA WEST SIDE OF MICHEL CREEK - 15° PITCH ON SPARWOOD SIDE - 30° PITCH.
<b>UNDERGROUND - INDICATED</b>			
3	1196.2	6' 13,381,000	
4	809.6	6' 9,057,000	
5	269.0	6' 2,995,000	
6	152.6	6' 1,707,000	
7	3229.6	11' 65,911,000	
8	461.0	30' 25,658,000	
SUB-TOTAL			
			AREA 9 - SEAM CONSISTS OF 20' COAL, 3' SHALE, 12' COAL. WASHABILITY DATA COMPILED IS A COMPOSITE OF BOTH ZONES, EXCLUDING THE 3' SHALE PARTING.
<b>STRIP - PROVEN</b>			
9	78.4	30' 4,353,000	
SUB-TOTAL			
			AREA 10 - SEAM DESCRIPTION SAME AS THAT OF AREA 9 - SEE WASHABILITY DATA.
<b>STRIP - INDICATED</b>			
10	42.2	30' 1,765,000	
SUB-TOTAL			
SUB-TOTAL			
TOTAL			

ADIT 36 - X-CUT AT 90'  
COAL 11' THICK  
RAW SAMPLE -  
ASH: 16.0%  
F.S.I.: 3  
CLEAN COMPOSITE -  
YIELD AT 11.45 S.G.: 62.2%  
MOIST.: 0.8%  
V.M.: 20.9%  
F.C.: 69.9%  
ASH: 8.4%  
SULF.: 0.57%  
F.S.I.: 4/5

ADIT 17 - X-CUT AT 90'  
COAL 11' THICK  
RAW SAMPLE -  
ASH: 16.0%  
F.S.I.: 3  
CLEAN COMPOSITE -  
YIELD AT 11.45 S.G.: 62.2%  
MOIST.: 0.8%  
V.M.: 20.9%  
F.C.: 69.9%  
ASH: 8.4%  
SULF.: 0.57%  
F.S.I.: 4/5

(DATA TO BE COMPLETED 1970)

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- UNDERGROUND RESERVES - INDICATED +2500 COVER
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV. DATE REVISION DR. CR. APP.

**KAISER RESOURCES** NATAL, B.C.

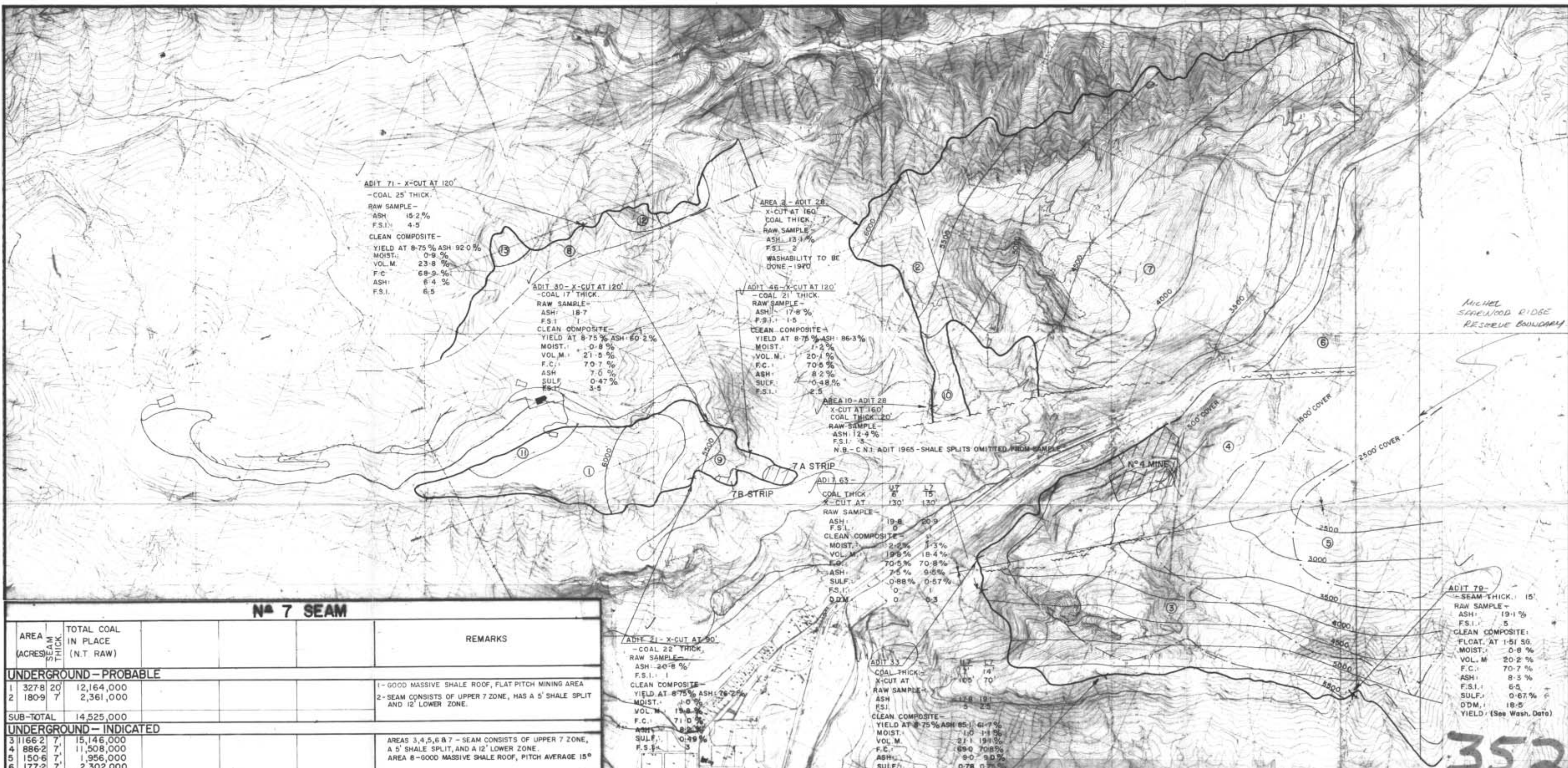
**COAL RESERVES**  
(ESTIMATED NET TONS RAW TO PLANT)

**MICHEL MINING AREA** ③

DESIGNED \_\_\_\_\_ SCALES  
DRAWN W.P. HOR. 1" = 2000'  
CHECKED \_\_\_\_\_ VERT.  
APPROVED \_\_\_\_\_ DWG. NO.  
DATE APRIL 1970 145-13-4 REV.

8 SEAM

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N <sup>o</sup> 7 SEAM			REMARKS
AREA (ACRES)	SEAM THICK (FT)	TOTAL COAL IN PLACE (N.T RAW)	
<b>UNDERGROUND - PROBABLE</b>			
1	327.8 20'	12,164,000	1- GOOD MASSIVE SHALE ROOF, FLAT PITCH MINING AREA 2- SEAM CONSISTS OF UPPER 7 ZONE, HAS A 5' SHALE SPLIT AND 12' LOWER ZONE.
2	180.9 7'	2,361,000	
SUB-TOTAL		14,525,000	
<b>UNDERGROUND - INDICATED</b>			
3	1166.2 7'	15,146,000	AREAS 3,4,5,6 & 7 - SEAM CONSISTS OF UPPER 7 ZONE, A 5' SHALE SPLIT, AND A 12' LOWER ZONE. AREA 8 - GOOD MASSIVE SHALE ROOF, PITCH AVERAGE 15°
4	886.2 7'	11,508,000	
5	150.6 7'	1,956,000	
6	177.2 7'	2,302,000	
7	2640.0 7'	34,287,000	
8	204.8 25'	9,498,000	
SUB-TOTAL		74,697,000	
<b>STRIP - PROVEN</b>			
9	89.6 20'	3,326,000	AREAS 9 & 11 BASED ON 6:1 STRIPPING RATIO, ONE MASSIVE 20' COAL ZONE. AREA 10 - 6:1 STRIP RATIO, SEAM HAS 7' COAL, THEN 5' SHALE, THEN 14' COAL - UPPER COAL. AREA 12, 25' COAL ZONE HAS NO SHALE SPLITS.
10	47.3 20'	1,765,000	
11	42.6 20'	1,581,000	
12	21.5 25'	995,000	
SUB-TOTAL		7,667,000	
<b>STRIP - INDICATED</b>			
13	76.5 25'	1,412,000	AREA 13 - COAL ZONE HAS NO SHALE SPLITS.
SUB-TOTAL		1,412,000	
<b>TOTAL</b>		<b>98,301,000</b>	

**ADIT 21 - X-CUT AT 90'**  
 - COAL 22' THICK  
 RAW SAMPLE -  
 ASH: 20.8%  
 F.S.I.: 1  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 26.2%  
 MOIST.: 1.0%  
 VOL. M.: 19.8%  
 F.C.: 71.0%  
 ASH: 8.2%  
 SULF.: 0.49%  
 F.S.I.: 3

**ADIT 33**  
 COAL THICK: 17' 14'  
 X-CUT AT: 100' 100'  
 RAW SAMPLE -  
 ASH: 17.8 19.1  
 F.S.I.: 5 2.5  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 61.7%  
 MOIST.: 1.0 1.1%  
 VOL. M.: 21.1 19.1%  
 F.C.: 69.0 70.8%  
 ASH: 9.0 9.0%  
 SULF.: 0.78 0.75%  
 F.S.I.: 5.5 2.5

**ADIT 79**  
 SEAM THICK.: 15'  
 RAW SAMPLE -  
 ASH: 19.1%  
 F.S.I.: 5  
 CLEAN COMPOSITE:  
 FLCAT. AT 1.51 SG  
 MOIST.: 0.8%  
 VOL. M.: 20.2%  
 F.C.: 70.7%  
 ASH: 8.3%  
 F.S.I.: 6.5  
 SULF.: 0.67%  
 O.D.M.: 18.5  
 YIELD: (See Wash. Data)

**LEGEND**

UNDERGROUND RESERVES - PROBABLE	<input type="checkbox"/>
UNDERGROUND RESERVES - INDICATED	<input type="checkbox"/>
UNDERGROUND RESERVES - INDICATED COVER	<input type="checkbox"/>
STRIP RESERVES - PROVEN (6:1 RATIO)	<input type="checkbox"/>
STRIP RESERVES - INDICATED	<input type="checkbox"/>
OXIDIZED COAL RESERVES	<input type="checkbox"/>
COVER ISOPACHS	<input type="checkbox"/>
STRUCTURAL CONTOURS	<input type="checkbox"/>
PREVIOUSLY MINED AREA	<input type="checkbox"/>

REVISIONS: [ ]

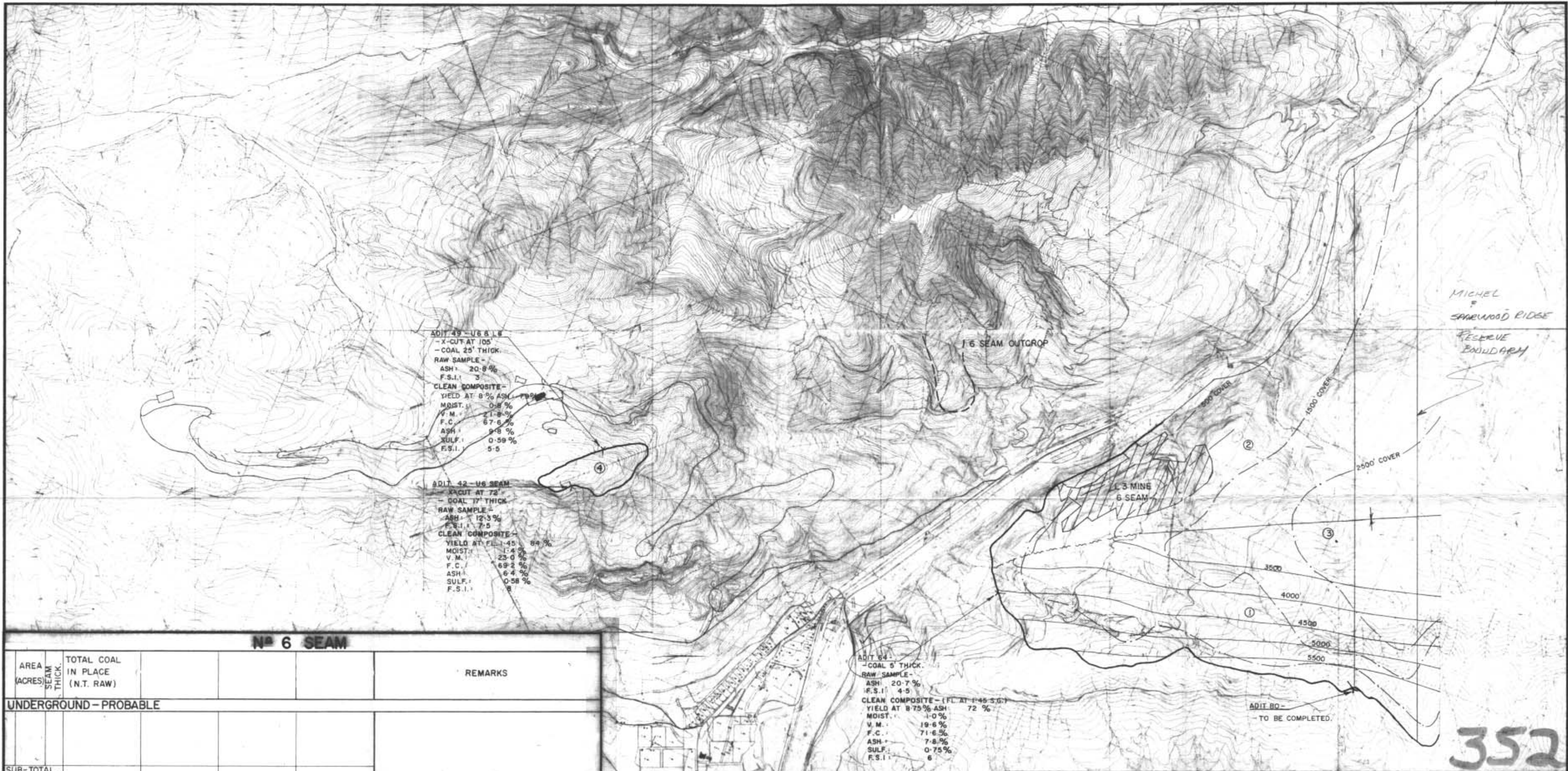
**KAISER RESOURCES** NATAL, B.C.

**COAL RESERVES**  
 (ESTIMATED NET TONS RAW TO PLANT)

**MICHEL MINING AREA** ④

DESIGNED: [ ]  
 DRAWN: W.P.  
 CHECKED: [ ]  
 APPROVED: [ ]  
 DATE: APRIL 1970

SCALE: HOR 1" = 2000'  
 VERT. [ ]  
 DWG. NO. 145-13-5  
 REV. [ ]



ADIT 49 - U6 & L. 8  
 - X-CUT AT 105'  
 - COAL 25' THICK  
 RAW SAMPLE -  
 ASH: 20.8 %  
 F.S.I.: 3  
 CLEAN COMPOSITE -  
 YIELD AT 8% ASH: 78 %  
 MOIST.: 0.8 %  
 V.M.: 21.8 %  
 F.C.: 67.6 %  
 ASH: 9.8 %  
 SULF.: 0.58 %  
 F.S.I.: 5.5

ADIT 42 - U6 SEAM  
 - X-CUT AT 72'  
 - COAL 17' THICK  
 RAW SAMPLE -  
 ASH: 12.3 %  
 F.S.I.: 7.5  
 CLEAN COMPOSITE -  
 YIELD AT 8% ASH: 84 %  
 MOIST.: 1.4 %  
 V.M.: 25.0 %  
 F.C.: 69.2 %  
 ASH: 6.4 %  
 SULF.: 0.58 %  
 F.S.I.: 8

ADIT 54 -  
 - COAL 5' THICK  
 RAW SAMPLE -  
 ASH: 20.7 %  
 F.S.I.: 4.5  
 CLEAN COMPOSITE - (FL. AT 1:45 S.G.)  
 YIELD AT 8.75% ASH: 72 %  
 MOIST.: 1.0 %  
 V.M.: 19.6 %  
 F.C.: 71.6 %  
 ASH: 7.8 %  
 SULF.: 0.75 %  
 F.S.I.: 6

AREA 1 & 2 MASSIVE SANDY SHALE ROOF & SHALE SPLIT OCCURS WITH A VARIATION OF 3' TO 7' OF COAL ABOVE SPLIT AND 6' TO 10' BELOW SPLIT. RESERVE AREA WEST SIDE OF MICHEL CREEK IS 18° PITCH ON SPARWOOD SIDE 30° PITCH.

ENGINEERING DEPT STRIPPING RATIO 4:1, 40 PERPENDICULAR TO OUTCROP COAL ZONE ADDED TO OVERBURDEN, 5% MINING LOSS ADDED TO OVERBURDEN.

N <sup>o</sup> 6 SEAM			REMARKS
AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	
<b>UNDERGROUND - PROBABLE</b>			
SUB-TOTAL			
<b>UNDERGROUND - INDICATED</b>			
1	1065.2 6'	11,858,000	AREA 1 & 2 MASSIVE SANDY SHALE ROOF & SHALE SPLIT OCCURS WITH A VARIATION OF 3' TO 7' OF COAL ABOVE SPLIT AND 6' TO 10' BELOW SPLIT. RESERVE AREA WEST SIDE OF MICHEL CREEK IS 18° PITCH ON SPARWOOD SIDE 30° PITCH.
2	881.6 6'	9,813,000	
3	144.2 6'	1,396,000	
SUB-TOTAL		23,067,000	
<b>STRIP - PROVEN</b>			
4	81.7 25'	3,729,000	ENGINEERING DEPT STRIPPING RATIO 4:1, 40 PERPENDICULAR TO OUTCROP COAL ZONE ADDED TO OVERBURDEN, 5% MINING LOSS ADDED TO OVERBURDEN.
SUB-TOTAL		3,729,000	
<b>TOTAL</b>		<b>26,796,000</b>	

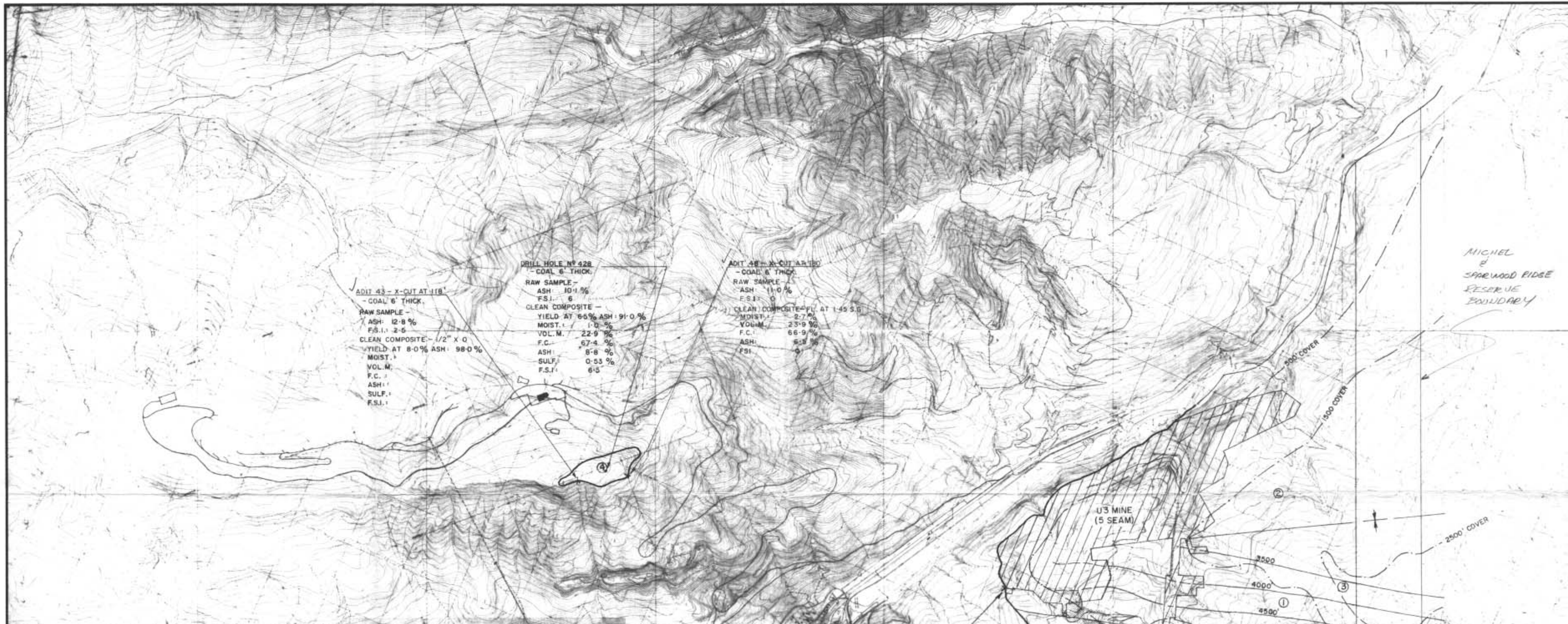
**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- UNDERGROUND RESERVES - INDICATED +2500' COVER
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

6000'

REV. DATE	REVISION	DR. CH. APP.
<b>KAISER RESOURCES</b>		NATAL, B.C.
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)		
<b>MICHEL MINING AREA</b> ⑤		
DESIGNED	SCALES	
DRAWN W.P.	HOR. 1" = 2000'	
CHECKED	VERT.	
APPROVED	DWG. NO.	
DATE APRIL 1970	145-13-6	

MMA 70(5)A



MICHEL  
SPARWOOD RIDGE  
RESERVE  
BOUNDARY

ADIT 43 - X-CUT AT 118'  
- COAL 6" THICK  
RAW SAMPLE -  
ASH: 12.8 %  
F.S.I.: 2.5  
CLEAN COMPOSITE - 1/2" X 0  
YIELD AT 8.0% ASH: 98.0 %  
MOIST.:  
VOL. M.:  
F.C.:  
ASH:  
SULF.:  
F.S.I.:

DRILL HOLE N° 428  
- COAL 6" THICK  
RAW SAMPLE -  
ASH: 10.1 %  
F.S.I.: 6  
CLEAN COMPOSITE -  
YIELD AT 6.6% ASH: 91.0 %  
MOIST.: 1.0 %  
VOL. M.: 22.9 %  
F.C.: 67.4 %  
ASH: 8.8 %  
SULF.: 0.53 %  
F.S.I.: 6.5

ADIT 48 - X-CUT AT 170'  
- COAL 6" THICK  
RAW SAMPLE -  
ASH: 11.0 %  
F.S.I.: 0  
CLEAN COMPOSITE - PL. AT 1.45 S.S.  
MOIST.: 2.7 %  
VOL. M.: 23.9 %  
F.C.: 66.9 %  
ASH: 5.8 %  
F.S.I.: 0

ADIT 62 -  
- PARTIALLY OXIDIZED  
- X-CUT AT 60'  
- COAL 8" THICK  
RAW SAMPLE -  
ASH: 11.1 %  
F.S.I.: 2.5  
CLEAN COMPOSITE -  
YIELD AT 8.75% ASH: 94.2 %  
MOIST.: 1.4 %  
VOL. M.: 21.3 %  
F.C.: 68.7 %  
ASH: 8.6 %  
SULF.: 0.73 %  
F.S.I.: 2.5

**N° 5 SEAM**

AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS
<b>UNDERGROUND - PROBABLE</b>			
SUB-TOTAL			
<b>UNDERGROUND - INDICATED</b>			
1	865.0 8'	12,839,000	- GENERALLY GOOD MINING ROOF. MASSIVE SHALE A & B SHALE SPLIT SEPARATES THE MIDDLE & LOWER SEAMS ONLY THE UPPER 8 FT. COAL ZONE HAS BEEN CONSIDERED AS MINABLE RESERVE AVERAGE PITCH IN RESERVE AREA + 30° WEST SIDE OF MICHEL CREEK MINED EXTENSIVELY.
2	679.5 8'	10,086,000	
3	23.0 8'	341,000	
SUB-TOTAL		23,266,000	
<b>STRIP - PROVEN</b>			
42.2 6'		430,000	NT RECOVERABLE = TOTAL COAL IN PLACE X 90% UNOXIDIZED COAL X 95% MINING RECOVERY. ENGINEERING DATA BASED ON 40° PERPENDICULAR TO SURFACE AS WASTE MATERIAL (SEMI-OXIDIZED) PLACES 5 SEAM RESERVES AT 269,000 TONS - COKE TESTS ON 5 SEAM TO DATE HAVE BEEN INCONCLUSIVE.
SUB-TOTAL		430,000	
<b>TOTAL</b>		<b>23,696,000</b>	

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- UNDERGROUND RESERVES - INDICATED + 2500' COVER
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV. DATE REVISION DB CH APP

**KAISER RESOURCES** NATAL B.C.

**COAL RESERVES**  
(ESTIMATED NET TONS RAW TO PLANT)

**MICHEL MINING AREA** ⑥

DESIGNED \_\_\_\_\_  
DRAWN W.P.  
CHECKED \_\_\_\_\_  
APPROVED \_\_\_\_\_  
DATE APRIL 1970

SCALES  
HOR. 1" = 2000'  
VERT. \_\_\_\_\_  
DWG. NO. 145-13-7  
REV. \_\_\_\_\_

352

5 SEAM



ADIT 30  
 COAL 23' THICK  
 RAW SAMPLE -  
 ASH 21.6 %  
 F.S.I. 7.5  
 CLEAN COMPOSITE -  
 YIELD AT 8% ASH 74 %  
 MOIST 1.4 %  
 V.M. 24.1 %  
 F.C. 65.0 %  
 ASH 8.0 %  
 SULF. 8  
 F.S.I. 8

NORTH MINE  
 COAL 11' THICK  
 RAW SAMPLE -  
 ASH 14.1 %  
 F.S.I. 4.5  
 CLEAN COMPOSITE -  
 YIELD AT 8.9% ASH 76.8 %  
 MOIST 1.4 %  
 V.M. 24.9 %  
 F.C. 64.8 %  
 ASH 8.9 %  
 SULF. 6  
 F.S.I. 6

ADIT 34  
 COAL 10' THICK  
 RAW SAMPLE -  
 ASH 13.8 %  
 F.S.I. 8  
 CLEAN COMPOSITE -  
 YIELD AT 8.7% ASH 96.4 %  
 MOIST 1.0 %  
 V.M. 24.9 %  
 F.C. 67.7 %  
 ASH 6.9 %  
 SULF. 0.8 %  
 F.S.I. 9

**No. 1 SEAM**

AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS
<b>UNDERGROUND - PROBABLE</b>			
1 1827.4	10'	33,904,000	1- MASSIVE SHALE ROOF, FAIR TO GOOD MINING CONDITIONS. TOTAL COAL ZONE CONSISTS OF 10' COAL, 20' SHALE & COAL PARTINGS, 20' COAL (M), 5' SHALE & COAL (L) THE PROXIMITY OF THE MIDDLE & LOWER PORTION OF 1 SEAM TO THE 10' UPPER COAL ZONE HAS RULED OUT INCLUDING ANY RESERVE ESTIMATES FOR M1 & L1
SUB-TOTAL		33,904,000	
<b>UNDERGROUND - INDICATED</b>			
2 959.6	10'	17,804,000	2- FAIR TO GOOD SHALE ROOF, UNMINED RESERVE AREA AT 30° PITCH MINED OUT WEST SIDE OF MICHEL CREEK. 7' SHALE SEPARATION BETWEEN 1 & 2 SEAM, PROBABLY WOULD PRESENT MINING PROBLEM, HENCE NO RESERVE ESTIMATE FOR 2 NO. 2 SEAM, CONSIDERED.
3 962.4	10'	17,855,000	3- SAME AS 2 EXCEPT MINING PITCH PROBABLY +15° PREVIOUS HAND MINING SUITABLE FOR <30° PITCH.
SUB-TOTAL		35,659,000	
<b>STRIP - PROVEN</b>			
SUB-TOTAL			
<b>TOTAL</b>		69,563,000	

**LEGEND**

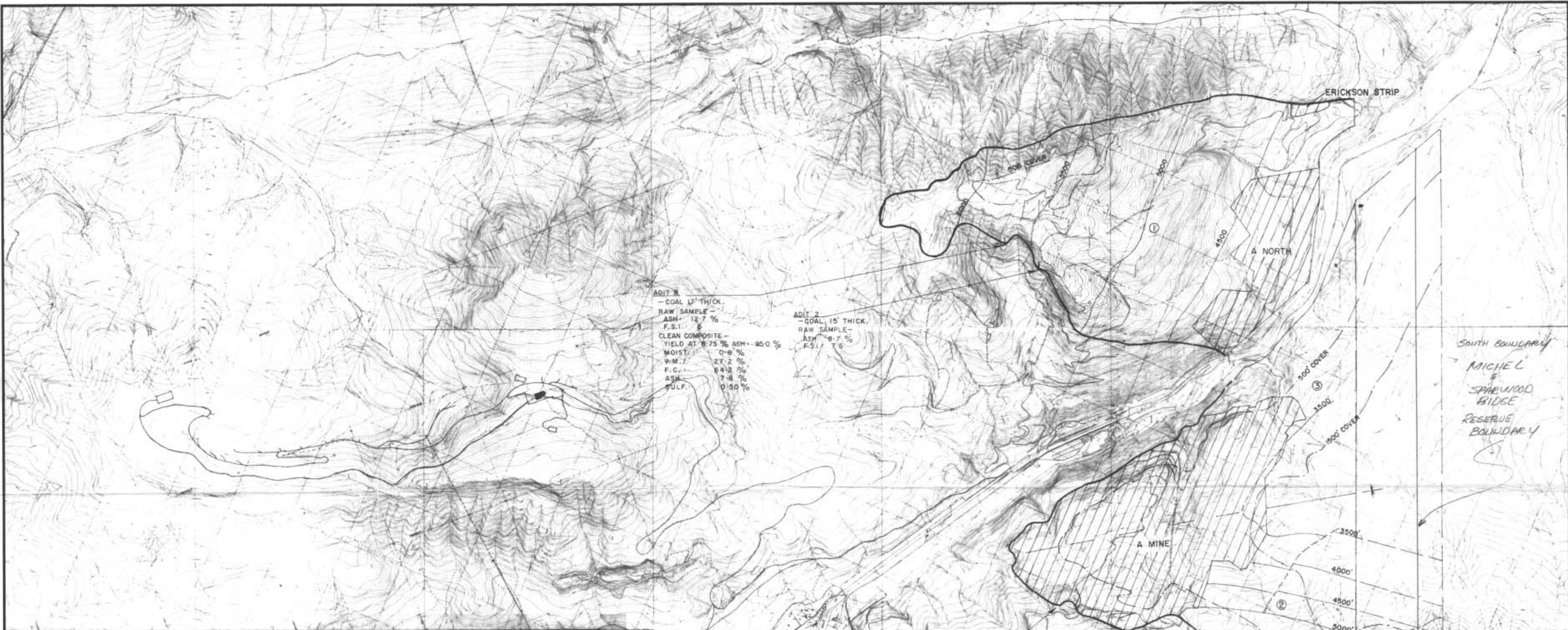
- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV	DATE	REVISION	DR	CH	APP
<b>KAISER RESOURCES</b>		NATAL, B.C.			
<b>COAL RESERVES</b>					
(ESTIMATED NET TONS RAW TO PLANT)					
<b>MICHEL MINING AREA</b> ⑦					
DESIGNED			SCALES		
DRAWN W.P.			HOR. 1" = 2000'		
CHECKED			VERT.		
APPROVED			DWDG. NO.		
DATE APRIL 1970			145-13-8		

352

1 SEAM





ADIT 1  
 - COAL 17' THICK.  
 RAW SAMPLE -  
 ASH: 12.7 %  
 F.S.I.: 8  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 95.0 %  
 MOIST.: 0.9 %  
 V.M.: 27.2 %  
 F.C.: 64.8 %  
 ASH: 7.8 %  
 SULF.: 0.150 %

ADIT 2  
 - COAL 15' THICK.  
 RAW SAMPLE -  
 ASH: 8.7 %  
 F.S.I.: 7.5

ADIT 76 F. 1  
 - COAL 18' THICK  
 RAW SAMPLE -  
 ASH: 14.8 %  
 F.S.I.: 5  
 CLEAN COMPOSITE -  
 FLOAT AT 1.80 SG.  
 MOIST.: 1.5 %  
 V.M.: 22.9 %  
 F.C.: 68.4 %  
 ASH: 7.2 %  
 F.S.I.: 7.5  
 SULF.: 0.55 %  
 D.D.M.: 53.0

A SOUTH STRIP -  
 - COAL 36' THICK  
 RAW SAMPLE -  
 ASH: 8.0 %  
 F.S.I.: 8  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 100 %  
 MOIST.: 1.4 %  
 V.M.: 26.2 %  
 F.C.: 64.4 %  
 ASH: 8.0 %  
 SULF.: 0.45 %  
 F.S.I.: 8

**N<sup>o</sup> A SEAM**

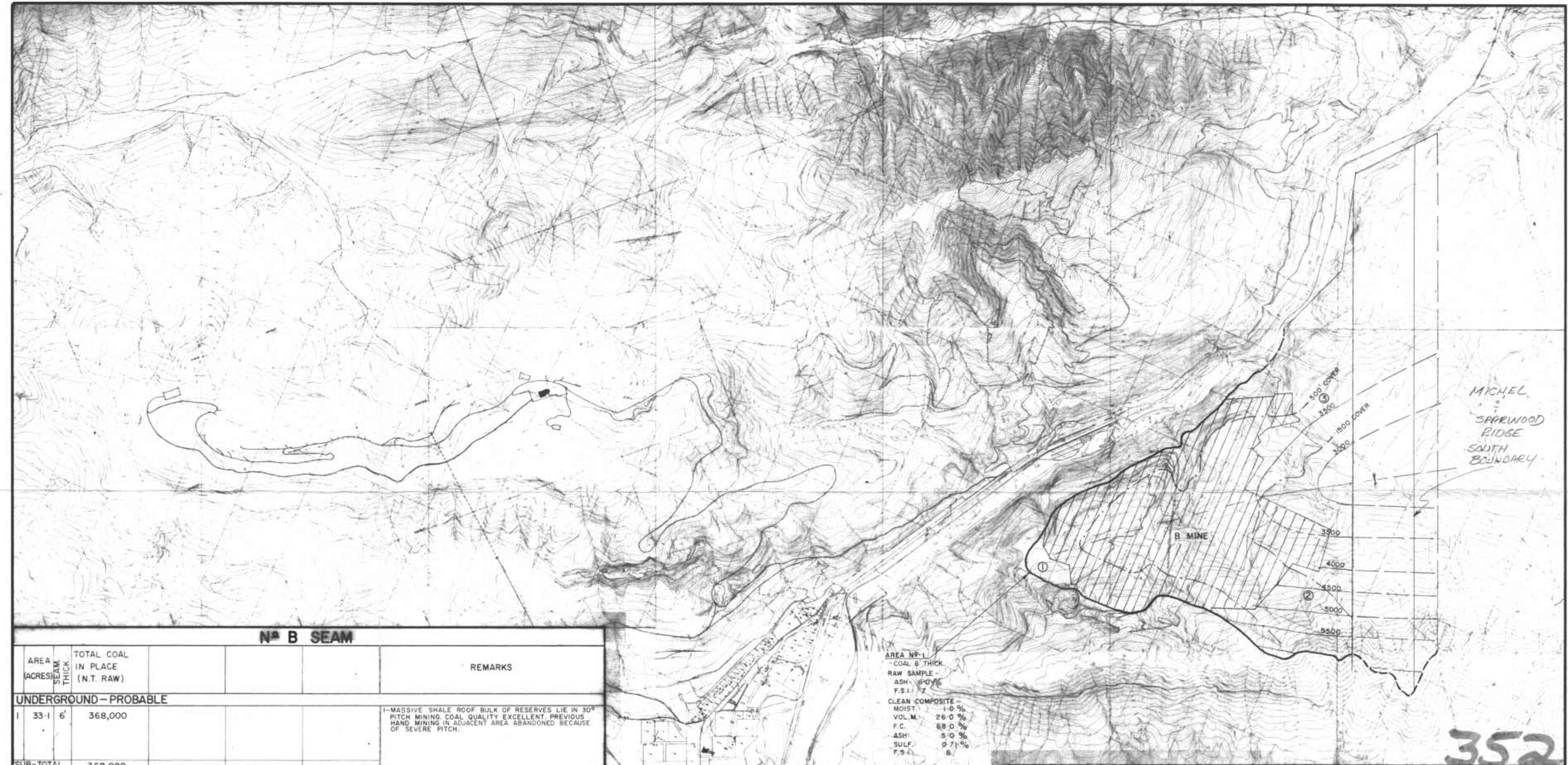
AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS	
<b>UNDERGROUND - PROBABLE</b>				
1	1543.7	15'	42,959,000	1- ROOF CONDITIONS GENERALLY GOOD, MASSIVE SHALE THICKNESS VARIABLE 12 TO 20', GENERALLY AVERAGES 15 FT. QUALITY VARIABLE. RAW ASH RANGES 10-18%. MINING PITCH AVERAGES 15° OR LESS.
SUB-TOTAL		42,959,000		
<b>UNDERGROUND - INDICATED</b>				
2	511.5	15'	14,234,000	2- GOOD SHALE ROOF, UNMINED RESERVES LIE IN 30° PITCH RANGE.
3	4454	15'	12,394,000	3- SAME AS IN 2 EXCEPT SOME RESERVES WOULD BE IN 15° PITCH RANGE. ADJACENT MINED OUT AREAS, HAND MINED, EQUIPMENT USED RESTRICTED TO <30° PITCH.
SUB-TOTAL		26,628,000		
<b>STRIP - PROVEN</b>				
SUB-TOTAL				
<b>TOTAL</b>		<b>69,587,000</b>		

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV	DATE	REVISION	DR.	CH.	APP.
<b>KAISER RESOURCES</b> NATAL, B.C.					
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)					
<b>MICHEL MINING AREA</b> (8)					
DESIGNED			SCALES		
DRAWN W. P.			HOR. 1" = 2000'		
CHECKED			VERT.		
APPROVED			DWG. NO.		
DATE APRIL 1970			145-13-9		

A SEAM



**N<sup>o</sup> B SEAM**

AREA (ACRES)	SEAM THICK (FT)	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS	
<b>UNDERGROUND - PROBABLE</b>				
1	33.1	6'	368,000	1-MASSIVE SHALE ROOF BULK OF RESERVES LIE IN 30° PITCH MINING COAL QUALITY EXCELLENT. PREVIOUS HAND MINING IN ADJACENT AREA ABANDONED BECAUSE OF SEVERE PITCH.
SUB-TOTAL		368,000		
<b>UNDERGROUND - INDICATED</b>				
2	306.7	6'	3,414,000	2-MASSIVE SHALE ROOF MINING SUPPORT GOOD, COAL QUALITY EXCELLENT, RESERVES LIE IN 30° PITCH MINING.
3	347.1	6'	3,864,000	3-SAME AS IN ② EXCEPT PITCH AVERAGE IS 15° ADJACENT MINED OUT AREAS WERE MOSTLY HAND MINED, EQUIPMENT USED LIMITED TO <30° PITCH.
SUB-TOTAL		7,278,000		
<b>STRIP - PROVEN</b>				
SUB-TOTAL				
<b>TOTAL</b>		<b>7,646,000</b>		

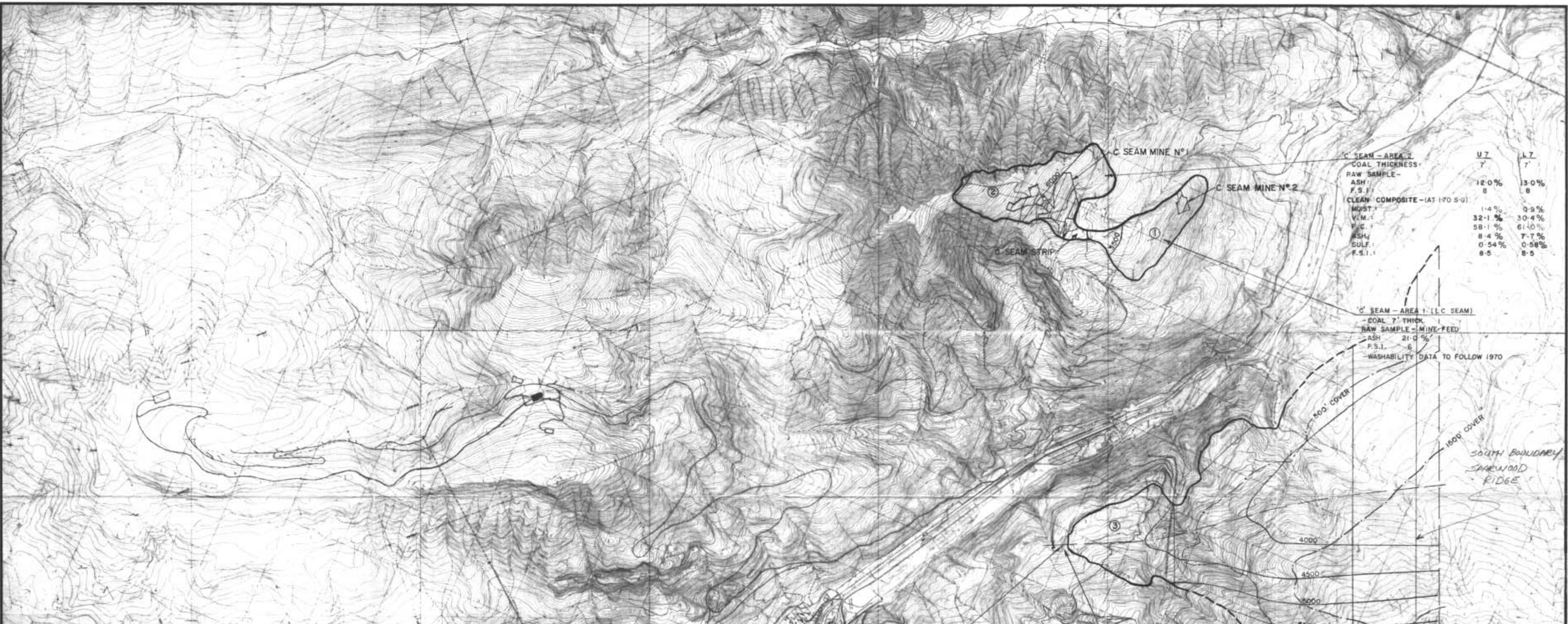
AREA N<sup>o</sup> 1  
 - COAL 6' THICK  
 RAW SAMPLE -  
 ASH: 6.0%  
 F.S.I.: 7  
 CLEAN COMPOSITE -  
 MOIST.: 11.0%  
 VOL. M.: 26.0%  
 F.C.: 68.0%  
 ASH: 5.0%  
 SULF.: 0.71%  
 F.S.I.: 8

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV	DATE	REVISION	DR.	CH.	APP.
<b>KAISER RESOURCES</b> NATAL, B.C.					
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)					
<b>MICHEL MINING AREA ⑨</b>					
DESIGNED			SCALES		
DRAWN W. P.			HOR. 1" = 2000'		
CHECKED			VERT.		
APPROVED			DWG. NO.		
DATE APRIL 1970			145-13-10		

B SEAM



C SEAM - AREA 2 COAL THICKNESS: RAW SAMPLE - ASH: 12.0% F.S.I.: 8 CLEAN COMPOSITE - (AT 170 S-G) MOIST.: 1.4% V.M.: 32.1% F.C.: 58.1% ASH: 8.4% SULF.: 0.54% F.S.I.: 8.5	U7 7' 13.0% 8.8 0.9% 30.4% 61.0% 7.7% 0.58% 8.5	L7 7' 13.0% 8.8 0.9% 30.4% 61.0% 7.7% 0.58% 8.5
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C SEAM - AREA 1 (LC SEAM) COAL 7' THICK RAW SAMPLE - MINE-FEED ASH: 21.0% F.S.I.: 6 WASHABILITY DATA TO FOLLOW 1970
--

UC TEST PIT - COAL 10' THICK RAW SAMPLE - ASH: 13.6% F.S.I.: 7 CLEAN COMPOSITE - YIELD AT 87.5% ASH: 86% MOIST.: 1.2% V.M.: 28.1% F.C.: 63.0% ASH: 7.7% SULF.: 0.45% F.S.I.: 8
--

LC TEST PIT - COAL 8.5' THICK RAW SAMPLE - ASH: 16.4% F.S.I.: 7 CLEAN COMPOSITE - YIELD AT 87.5% ASH: 86% MOIST.: 1.1% V.M.: 24.4% F.C.: 66.7% ASH: 7.8% SULF.: 0.46% F.S.I.: 7.5
---

N° C SEAM		REMARKS
AREA (ACRES)	SEAM THICK (N.T. RAW)	TOTAL COAL IN PLACE (N.T. RAW)
<b>UNDERGROUND - PROBABLE</b>		
1	119.4 7'	1,550,000
1 - LC SEAM - EXCELLENT MASSIVE SHALE ROOF. RESERVE AREA - FLAT PITCH < 10°, GOOD MINING CONDITIONS. UC SEAM LIES ABOUT 25 FT. STRATIGRAPHICALLY ABOVE LC, HOWEVER UC IS LESS THAN 3 FT. THICK. UC SEAM IS NOT CONSIDERED AS A MINEABLE UNIT IN AREA 1		
SUB-TOTAL		
<b>UNDERGROUND - INDICATED</b>		
2	169.9 7'	2,206,000
3	184.6 14'	4,794,000
2 - UC SEAM PREVIOUSLY MINED (7' THICK), THINNED OUT TO LESS THAN 4' IN THE AREA SHOWN IN GREEN. LC SEAM ALSO 7 FEET THICK, HAS A 7 FT. SHALE SPLIT SEPARATING IT FROM UC SEAM. CONVENTIONAL MINING IN LC ATTEMPTED BELOW UC WORKINGS - ABANDONED 1968		
3 - UC AND LC SEAMS BOTH AVERAGE 7' THICK, SEPARATED BY 50' SHALE SPLIT, PITCH VARIES FROM 10° TO 35°		
SUB-TOTAL		
<b>STRIP - PROVEN</b>		
SUB-TOTAL		
<b>TOTAL</b>		<b>8,550,000</b>

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

REV. DATE	REVISION	DR. CR. APP.
<b>KAISER RESOURCES</b> NATAL, B.C.		
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)		
<b>MICHEL MINING AREA</b> ⑩		
DESIGNED	SCALES	
DRAWN W.P.	HOR. 1" = 2000'	
CHECKED	VERT.	
APPROVED	DWG. NO.	REV.
DATE APRIL 1970	145-13-11	

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C SEAM

**D SEAM MINE NO 1**

ADIT NO 6  
 COAL THICKNESS  
 RAW SAMPLE -  
 ASH: 11.0%  
 F.S.I.: 4.5  
 CLEAN COMPOSITE - FL AT 1.60 S.G.  
 YIELD AT 8.75% ASH: 87.5%  
 MOIST: 4.9%  
 VOL. M.: 34.6%  
 F.C.: 59.1%  
 ASH: 4.9%  
 F.S.I.: 7.6  
 SULF.: 0.47%

**SPARWOOD RIDGE (NORTH END OF OUTCROP)**  
 RAW SAMPLE (OXIDIZED) THICKNESS - 3.8  
 ASH: 16.4%  
 F.S.I.: 4.5  
 CLEAN COMPOSITE -  
 YIELD AT 8.75% ASH: 89.0%  
 MOIST: 4.8%  
 VOL. M.: 25.4%  
 F.C.: 60.9%  
 ASH: 8.9%  
 SULF.: 0.67%  
 F.S.I.: 2

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**N<sup>o</sup> D SEAM**

AREA (ACRES)	SEAM THICK.	TOTAL COAL IN PLACE (N.T. RAW)	REMARKS
<b>UNDERGROUND - PROBABLE</b>			
SUB-TOTAL			
<b>UNDERGROUND - INDICATED</b>			
1	47.8 5'	443,000	RESERVE AREA PARTIALLY EXPLORED. MASSIVE SHALE ROOF. SEAM THICKNESS AVERAGES 5', PITCH VARIES FROM 15° TO 35°. UNMINED.
SUB-TOTAL			
<b>STRIP - PROVEN</b>			
2	108.4 7'	1,800,000	STRIPPING RATIO 59:1 BASED ON 59 CU. YDS. ROCK PER N.T. RECOVERABLE COAL. RECOVERABLE COAL = TOTAL COAL IN PLACE X 90% (NON-OXIDIZED) COAL X 95% MINING RECOVERY. LOSSES ADDED TO OVERBURDEN.
SUB-TOTAL			
<b>TOTAL</b>		<b>2,243,000</b>	

**LEGEND**

- UNDERGROUND RESERVES - PROBABLE
- UNDERGROUND RESERVES - INDICATED
- STRIP RESERVES - PROVEN (6:1 RATIO)
- STRIP RESERVES - INDICATED
- OXIDIZED COAL RESERVES
- COVER ISOPACHS
- STRUCTURAL CONTOURS
- PREVIOUSLY MINED AREA

D SEAM  
 D SEAM

REV	DATE	REVISION	BY	CHK	APP
<b>KAISER RESOURCES</b> NATAL, B.C.					
<b>COAL RESERVES</b> (ESTIMATED NET TONS RAW TO PLANT)					
<b>MICHEL MINING AREA (II)</b>					
DESIGNED			SCALES		
DRAWN W.P.			HOR. 1" = 2000'		
CHECKED			VERT.		
APPROVED			DWG. NO.		
DATE APRIL 1970			145-13-12		