K-FERNIE COAL AREA 67(8)C

FEASIBILITY REPORT

FERNIE COAL MINE PROJECT
B.C., CANADA

K. SHIOKAWA of.
NITTETSU MINING CO., LTD.

MAY 1968

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K-FERNIE

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B.C., CANADA

24

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CONFIDENTIAL

NITTETSU MINING CO., LTD.

Nittetsu Mining Company. Ltd.

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Date June 29, 1968

Pacific Coal Limited
Vancouver,
B.C., Canada

To: Board of Directors

Re: Feasibility Report on Fernie Coal Mine Project

Gentlemen:

We are pleased to submit our report covering feasibility studies conducted in Canada and in Japan by our staff on Fernie Coal Mine Project.

This report was made by staff of Nittetsu Mining Co., Ltd. and is as complete and accurate as present sources of information and normal engineering practice will allow.

We wish you will kindly give your best attention to this report and we believe this project will turn out sound and lasting.

Yours very truly,
Nittetsu Mining Co., Ltd.

K. Shiokawa
Managing Director

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INTRODUCTION

The geological survey of the coal properties near Morrisey Creek, Fernie, B.C., Canada, the licence of which is held by Pacific Coal Limited, was made for the first time in 1964 by Consulting Engineer, Douglas D. Campbell, Ph. D., P. Eng. Then in 1965, at the request of Toyo Menka Kaisha, Ltd., Nittetsu Mining Consultants Co., Ltd. conducted an exploratory work, which was followed by the one in 1966, carried out jointly by Toyo Menka Kaisha, Ltd. and Nittetsu Mining Co., Ltd. (Reports have been submitted on the results of these two surveys.)

Further, in 1967, the final exploratory work was conducted jointly by NITTETSU MINING and TOYO MENKA, to make certain of coal quality, coal reserves and conditions of existence of coal seams.

Those geological surveys and the findings of tests carried out at Steel Mills in Japan on the quality of coal sampled in the course of the surveys, have proved that the coal from the area is marketable as coking coal to be used for the making of iron, and that the coal reserves exist in such tonnage as making it possible to develop them economically.

A report will be submitted on the results of the 1967 exploratory work and the findings of tests on the quality of coal. Along with those activities, investigations were started in October,1967 of the possibilities of the mining properties for development on a commercial basis by Fernie Feasibility Studies Committee. It was composed of 17 members and seated in NITTETSU MINING. It devoted about three months time to all-inclusive researches, and finally, to consummate its work, it despatched in March,1968 a group of specialists in coal mining engineering, coal preparation, mechanical, electrical and civil engineering, labor, etc., to Canada to acquire the real and firsthand knowledge. Work spent by our members from October,1967 amounts to 575 man days up to the completion of this report which conveys the essence of the results of its activities.

On presenting this report, we express our deep gratitude to co-operation, assistance and advices which officers concerned of the Governments of the Dominion and the Province of British Columbia, managers and engineers of coal mines, consulting engineers

and other interested parties gave us unsparingly.

June, 1968

NITTETSU MINING COMPANY LIMITED

FERNIE FEASIBILITY STUDIES COMMITTEE

K. SHIOKAWA, CHAIRMAN

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1. QUALITY OF COAL

A separate report will be submitted on the quality of coal, inclusive of the results of the tests conducted by Japanese Steel Mills. As a result of overall investigation of Seam B which will be the object of Mining in the beginning, the guaranteed quality is given as follows:

Total moisture	6%
Ash Content	7%, tolerance 0.5%
Sulphur	0.5% tolerance 0.05%
Volatile Matter	19 - 22 %
FSI	7 - 9 %

Fernie Coal is not only marketable as coking coal for making iron, but it is not inferior in its quality to the other brands of Canadian coal that are under contract for shipment to Japan (Balmar, Vicarry Creek, Michel).

It has to be pointed out that the statement above is based on the results of the tests carried out by the Japanese Steel Mills who we wish to be the purchasers of Fernie Coal.

2. COAL RESERVES (NET)

Apart from a separate report setting forth the details of coal reserves along with the quality of coal, the reserves which have been confirmed so far are given as follows:

Seam		Theoretical Reserves	Theoretically Mineable Reserves
		M.T.	M.T.
Seam A	Morrissey Area	41,000,000	0
	Pipeline Area	21,200,000	17,500,000
	Sub Total	62,200,000	17,500,000
Seam A-1		12,400,000	0
Seam A-2		11,200,000	8,800,000
Seam B		68,000,000	44,000,000
Total		153,800,000	70,300,000

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3. DEVELOPMENT PLAN

(1) Plan of Development Underground

As will be seen from attached Map, the tunnel mouth will be set at a point 1,160 m. above sea-level on the eastern side of Morrissey Creek, and main level and by-level will be driven about 30 meter's apart from each other in the direction of the strike of the seams. Starting at a point 1,360 m.from the tunnel mouth slope No. 1 and by-slope No. 1 will be driven upward and on both right and left sides of these slopes two working faces, 70 meter's long and having 800 meters long minor level, are made to start operations with these two faces which form one panel. The initial two faces will be 70 m.long, but from the next working faces onward, they will be 80 m.long. The extension of drifting required for the establishment of the first one panel with two faces will be as follows:

Main levels:	Principal one	2,250 m.(of which 500m through rock)
	By-level	2,000 m.(of which 500m through rock)
Slopes No. 1:	Principal one	580 m.
	By-slope	410 m.
Airway No. 1		330 m.
Face No. 1, Minor level		1,840 m.
Face No. 2, Minor level		1,660 m.
Airway No. 2		330 m.
Other drifts, such as connecting tunnels, pocket, etc.		640 m.(of which 420 m through rock)
Total		10,030 m.(of which 1,420 m through rock)

A thorough conveyor system will be employed for the haulage of raw coal in the mine:

Up to the pocket at the main level,

Haulage along minor level: by Panzer conveyor and belt conveyor

Haulage along slope: by belt conveyor

From the pocket to the tippler,

Haulage along principal level: by belt conveyor

The carrying of supplies into the mine will be made by locomotive and hoist which will be independent from the haulage system of raw coal.

(2) Surface Facilities

Coal preparation plant, the most important of surface facilities, and other ancil-

'lary equipments which are necessary for mine operation, such as repair shop, office, etc. will all be constructed on the gentle slope neighboring the tunnel mouth.

The transport of clean coal produced by the coal preparation plant from the plant to the clean coal pocket at the loading point will be undertaken by a subsidiary which will use for that purpose trucks of about 40 ton capacity.

The belt conveyor for hauling clean coal was considered, but truck transport was chosen for the reasons that the former involves higher initial cost of equipment and the problem of how much P.C.L. should bear construction cost of the lead-in line in relation to the contract of transportation with C.P.R.

When the project comes into pre-construction, it would be advisable, depending upon the outcome of negotiations with C.P.R., to locate the loading point as near the tunnel mouth as possible, so that room may be left to make a switchover from truck transportation to belt conveyor system as the scale of production is enlarged in the future.

Transportation from Morrissey Station to Vancouver will be done by C.P.R., following the way of the transport of coal from the Coleman Coal Mine, but when the scale of production is enlarged in the future, further investigation and negotiation will be required as to how to reduce the unit cost of transportation by means of possible adoption of unit train system in co-operation with the Coleman Coal Mine.

The main electrical equipment to supply power required for the running of the Mine will be transmission line from the nearby substation of B.C. Hydro and Power Authority, a 5,000 KVA substation adjacent to the preparation plant and a power center underground.

(3) Land Necessary and their Rights

The important part of the surface facilities described under (2) above will be found in the Dominion Coal Block (owned by the Dominion Government). Transportation to the existent C.P.R. railroad, (together with land required for loading operation) and power transmission line have to pass the land owned by the Crows Nest Industries.

A visit was paid to the Land Registry Office to find the situation of the rights to those lands.

It seems that the coverage by the easement granted to the extinct mines on the right side of Morrisay Creek is not sufficient to meet our requirements. Fortunately in the Province of B.C. an act exists to grant right-of-way to mines.

(4) Time for Development Works

On developing the Fernie Coal Mine, the work that involves the greatest number of days is the construction of coal preparation plant and the development underground. We worked a time schedule to study the development period to be required by the present project, and found that, on condition that everything goes on smoothly, the former requires 18 months as the period of actual construction and the latter 15 months. As a result of consideration in details, it has been found that, combining the construction period for other various equipments, and inclusive of various preparatory operations and trial run, the operating stage would be arrived at 2 years and a half after the development policy is decided, unless an unexpected snag was hit.

(5) Machinery and Equipment necessary for Development and their Estimated Costs

Machinery and equipments necessary for development of the Fernie Coal Mine are tabulated item by item in Appendix 1.

The estimated values are the results of researches made of purchasing prices in Canada under the prevailing market conditions, and, for importation from Japan, calculation was made by adding to the purchasing prices in Japan its 50% as ocean freight, customs duties, inland freight and other charges. It is deemed that procurement will be possible within the limits of that estimation. However, since it is based on the researches at this time of our survey, in view of such factors as future fluctuation of prices, it would be appropriate and more practical to allow a margin of variations, say, from 5% to 10%.

4. OPERATION PLAN

(1) Mining Method

In choosing the mining method, sway will be held in principle by the natural conditions of a given coal field, such as, thickness of coal seam, dip of seam, conditions of the roof and floor and of methane.

With regard to the mining method it is not inconceivable to adopt room and pillar system which has been widely employed in North America. But we are of the opinion that long wall system should be adopted for the following reasons:

(a) In the case of Fernie, the dip of the coal seam is expected to be 10 to 20 degrees. Whereas room and pillar system suffers considerable restriction from dip, long wall system is little affected by a dip of such degree.

(b) In room and pillar system, the output of coal is restricted by the hauling capacity

of shuttle cars, with a consequence that the output of the mine is not free from fluctuations. In this connection, merit will be great to be enjoyed by long wall system which can rely upon operations with concentrated faces and a stable amount of output.

(c) In the case of Fernie, it is essential in mining to take into consideration the factor of existence of methane, and it follows that the security of ventilation will be indispensable to production.

Air leaks much in room and pillar system due to the nature of its mode of haulage, and it is difficult to ensure ventilation to the end of the underground complex, whilst long wall system will enable to concentrate coal faces and thereby to secure steady ventilation.

Moreover, employment of self-advancing prop will have better effects to the support of roof and result in better safety than room and pillar system which relies on roof bolt alone.

(d) As is generally known, long wall system gives effective recovery rate compared with room and pillar system.

(e) In latest long wall mining, the appearance of superior self-advancing prop, coupled with the greater power of coal cutting machinery, promises rapid increase in efficiency. This is demonstrated in the U.S.A., and in Japan also it will not be in a remote future that the long wall system using self-advancing prop becomes general practice.

In Canada also, it is reported that long wall system is contemplated in the development of Smoky River Coal Properties. Bearing in mind progress in coal mining techniques which will take place henceforth up to the commencement of the operation, the adoption of long wall system will be the most suitable to our case.

In Canada some people have the notion that room and pillar system is for thick seams and long wall system for thin ones, but in the case of the present project such a stereotyped thought can hardly be justified.

(2) Drifting Method

In developing underground slopes and levels mechanized method should be employed in order to satisfy the requirement that they must be developed speedily to keep pace with the advance of working faces, although blasting will be used in some parts. In this project

a drifting machine of similar type to PK7 made in the Soviet Union is envisaged, but if complications ensue in respect to the standard of safety as required by the Canadian safety regulations, it may be replaced by continuous miner of U.S. make or a Roadway cutter-loader manufactured by DOSCO.

(3) Coal Preparation

Needless to say, the objective of coal preparation lies in recovering as efficiently as possible our brand of clean coal from its raw material. In appendix 6, the flowsheet of coal preparation is shown. Nittetsu Mining Company has a subsidiary who manufactures coal preparation equipment under licence from the Stami-Carbon Co., Ltd., Netherlands, and the said flowsheet has been drawn up by combining our own coal preparation techniques with the knowhow of our subsidiary. Main items of the coal preparation are as follows:

(a) Main separating machine and size distribution

Heavy media cyclone	30mm - 0.5mm	70%
Classifying cyclone	0.5mm - 0.3mm	5%
Flotation	-0.3mm	25%

(b) Treating capacity

Production per annum	1,000,000 tons
Yield ratio (clean to raw coal)	70%
Operating days per annum	240 days
Operating hours per diem	20 hours
Capacity of treating raw coal	300 t/h

(c) The preparation plant will incorporate the following features:

i) Drying device in order to keep the moisture content of clean coal under 6% in total moisture.

ii) Complete circulating system in order to protect rivers and streams from pollution by waste water produced from washing process.

iii) Automation system in order to keep the operating cost of the plant to a minimum.

It is possible to install a preparation equipment imported from Japan. On the other hand, as a result of discussion with the Roberts & Schaefer Co., Ltd., U.S.A., maker of coal preparation plant, it has been found that, if the plant is designed, manufactured and assembled in Canada or the U.S.A., the advantages therefrom will be comparatively low cost (as viewed by the Roberts & Schaefer Co., Ltd.)

and easier maintenance and repairs.

The plant will be so constructed as it can be expanded any time, giving due consideration to enlarged scale of production in the future.

(d) Yield (Clean to raw coal)

In determining yield the following process was pursued:

First, a theoretical rate of yield of clean coal with 7% of ash content was calculated from the result of analysis of samples taken from each spot, then a theoretical rate of yield at the part of coal seams that is to be the object of mining (2.5 to 3.0 metres thick) was calculated (Column A of Table below). Further, a practical rate of yield was figured out by reducing, first, 10 percent of yield due to the factors anticipated in the course of actual mining such as, fall of rock from roof, relative rise of floor against advance of working face and conditions affecting selective mining, and, secondly 3% of yield that is attributed to the preparation process; thus actual yield was set, as set forth in Column B below, at 70%.

Sample Name	(metre) Thickness, Working Coal Face	(metre) Thickness, Part of Coal Out of the Left Column	(%) Ash Content of Raw Coal	(Column A) (%) Theoretical Rate of Yield	(Column B) (%) Actual Rate of Yield
TB-2	3.01	2.85	17.8	84	73
TB-3	2.51	2.24	27.4	64	55
TB-4	2.78	2.63	13.8	79	68
TB-5	2.79	2.65	21.1	54	46
TB-6	3.03	3.03	9.0	95	83
J-1	2.97	2.97	6.3	100	87
J-4	2.87	2.87	13.4	80	69

To be specific, the simple average of all the figures of actual rate of yield in Column B is 68.7%; but, as samples TB-5 and TB-6 are from the part mining of which would be take place 10 years afterwards, this part is left to a closer investigation in the stage of operation; and for the present purpose, an average was calculated from the 5 sections of TB-2, TB-3, TB-4, J-1 and J-4, resulting in 70 percent. We must add that the simple average itself is not free from problems.

In the actual operation deeper part (J-1, J-4) will be given more weight than the one near outcrop (TB-2, TB-3, TB-4). If J-1 and J-4 were so given more weight, the actual rate of yield would be more than 70%,but following the policy of taking safer side, the simple average was adopted here.

The washability curve corresponding to the actual rate of yield is shown in Appendix 7.

(4) Transportation

Remarks have been made that clean coal turned out from the coal preparation plant will be carried by trucks to the loading point, and that consideration should be given, in negotiating with C.P.R., to having the loading point as near the tunnel mouth as possible so that the transportation may be advantageously switched over to belt conveyor system in the future.

As the result of preliminary discussions with C.P.R. it has been presumed that their line will be used for transportation to Vancouver from the Morrisey loading point; and the capacity of loading equipment has been determined on the basis of handling being made six days weekly from Monday to Saturday, except Sunday and National holidays.

As has been referred to already, in view of the great influence of the transportation cost from Fernie to Vancouver and the loading charges at Vancouver on profitability of Fernie Coal Mine, it will be necessary to deliberate means to reduce those transportation charges in negotiation with C.P.R.

As the proposed subsidiary for the transportation of clean coal (it will handle also the dumping of refuse turned out from the coal preparation plant) will not be able to procure equipment, funds necessary for that purpose will have to be provided in case the equipment (almost all of which will be trucks) is not available on a rental basis.

(5) Production Plan

(a) Rate of production

	1st operating year	2nd operating year	3rd operating year onward
Production	750,000 tons	900,000 tons	1,000,000 tons

From the viewpoint of profit alone of the project, it is desirable that production be made on a large scale. However, after study being made taking into account various factors, such as smaller risk of capital investment, extent of difficulty

in raising capital, hardship to be met with in recruiting labor, suitable annual tonnage for inland transportation and appropriate annual tonnage for sale, the scale of production in the normal operating year has been set at 1,000,000 tons. It is quite possible to attain that tonnage by output from two working faces under long wall system combined with coal recovered from drifting.

Production will be enhanced step by step during the 1st and 2nd operating years and the normal producing scale will be reached in the third year.

At a stage where coal has reached 1,000,000 tons and production has been placed on the beam, stepping up the scale of production should be contemplated taking into consideration the progress of recovery of the initial capital investment and its bearing on additional investment.

(b) Number of Working Days

The number of working days has been set at 240 days per annum (in monthly average 20 days) based on 40 hours in five days which is a general practice at coal fields in Western Canada.

3-shift system will be adopted, and one half of the 3rd shift will be applied to production and the other half to the works of fixing working face. The last-named half shift can be applied for usual production should trouble in mining happen in any of the other shifts.

(c) Efficiency

The efficiency of long wall working face is in direct proportion to multiplication of thickness of working face, length of the face, advance of the face (viz., the cutting speed of drum cutter), specific gravity of raw coal and rate of recovery, in other words, coal produced from the face, and in inverse proportion to the number of workers employed in mining.

In the present project, individual efficiency at working face has been estimated at 68 t/man/shift at a normal operating rate, on a basis of production of 820 tons of coal from one face where 12 workers are engaged. The basis of calculation is as follows.

i) Producing capacity of working face

The producing capacity of a long wall with latest equipment is determined by

the thickness of coal (metre) and the strength of coal cutting machine (HP). Generally, coal seam 1.8 m to 2.5 m thick is easiest to work.

ii) Calculation formula of output

The output of working face is calculated as follows:

Output t/shift = Thickness of seam (m.) x Length of face (m.) x advance of face (m/shift) x Specific gravity x recovery rate (%)

Thickness of seam: 3m Length of face: 80m Advance of face: 3.5m/shift
Specific gravity: 1.4 Recovery: 70%

Output (t/shift) = 3.0 m x 80 m x 3.5 m/shift x 1.4 x 0.7 = 823.2 t/shift

Coal cutting crew: 12 men/shift

Cutter operator: 1, Operator of self-advancing prop: 1, Pump operator: 1, Attendant at dropping end of trough: 1, Attendants at stable: 3, Maintenance of timbering: 3, Attendant at feeding end to main belt conveyer: 3, Head of crew: 1

Coal cutting efficiency = 823.2 t/shift ÷ 12 men = 68.7 t/man/shift

This efficiency may seem too high compared with the present efficiency of room and pillar system in Canada, but as already mentioned above, we are convinced that it is fully possible to realize it. As for the number of workers, it may rather be too many in view of the length of 80 meters of face planned by us.

Efficiency for all the workers employed during the course of normal operation will be 17.4 t/man/day for labor force on payroll.

For reference, latest statistics on mechanized coal mining in the U.K. and the U.S.A. are cited in the next page:

LATEST STATISTICS ON MECHANIZED COAL MINING IN THE U.K. AND THE U.S.A.

(As of 1967)

Country / Coal Mine / Item	U. K.			U. S. A.			
	Measham	Snibston	Rawdon	Sunnyside	Carbon Fuel No.20	Bethlehem	Keystone
Thickness of face	2.0 m	1.7 m	2.1 m	1.5 m - 2.1 m	1.6 m	1.07 m	2.0 m
Length of face	192.0 m	46.0 m	66.0 m	210.0 m	105.0 m	165.0 m	200.0 m
Coal cutting machine	200HP A.B. Ranging Drum Cutter	100HP B.J.D. Reciprocating Drum Cutter	200HP A.B. Ranging Drum Cutter	A.B. Drum Cutter	Hobel	Anderton Reciprocating Drum Cutter	Hobel
Width of drum	0.51 m	0.52 m	0.51 m	-	-	-	-
Supports	Self-advancing Wild Desford Goal Post	Self-advancing Wild Desford Goal Post	Self-advancing Wild Desford Goal Post	2 - 3 Dowty Self-Advancing Prop	Westfalia Self-Advancing Prop	Roof-O-Matic 6-point Support Self-advancing Prop	Westfalia Self-advancing Prop.
Average Output per Shift	916t/shift	300t/shift	607t/shift	967t/shift	712t/shift	900t/shift	1,045t/shift
Miners per Shift	15men/shift	3men/shift	4 men/shift	12men/shift	10men/shift	9men/shift	12men/shift
Efficiency per Man per Shift	61.0t/man	100.3t/man	151.8t/man	80.0t/man	71.2t/man	100.0t/man	73.0t/man
Number of Shifts	2	2	2	-	-	-	-
Max. Advance per Week	18 m	30 m	35 m	-	-	-	-
Advance per Shift	1.8m/shift	3.0m/shift	3.5m/shift	2.5m/shift	3.8 - 4.6m/shift		

(6) Personnel Plan

Staff personnel and labor force necessary for operating the Fernie Coal Mine are shown on Appendices 2 and 3.

One of the most important problems to be faced by the management in the actual operations will be the employment of a mine manager and engineers of rich experience. In this connection, due consideration will have to be paid to qualifications prescribed in Coal Mine Regulations Act. In view of the shortage of mining engineers in Canada, it is deemed that much will be done to the development and operations of the Fernie Coal Mine, if discreet use is made, within the provisions of the Regulations, of Japanese mining techniques, in particular in long wall system, supported by a long history.

As to the problem of recruiting labor to be put to the actual front of mining, our views will be set force hereinafter.

5. CAPITAL COST

Total capital investment required for the Fernie Coal Mine is as shown on Appendix 1, of which the estimates by year are as follows:

1st year (6 months)	Can. $	492,000
2nd year (12 months)		5,454,000
3rd year (12 months)		5,445,000
1st operating year		289,000
Total	Can. $	11,680,000

If the entire amount of these financial requirements is filled by loan, the accumulated amount of interest up to the commencement of operations will be Can. $1,032,000 (at an annual rate of 8%); therefore, the sum total of financial requirements inclusive of the funds for payment of interest will amount to Can. $13,712,000 to be disbursed in about three years.

Ways and means to raise the fund are omitted in this report.

6. OPERATING COST

The Estimate of the cost of production is shown on Appendix 4. The cost may be given by using a mean amount representing a normal operating year. But, since in this

project the production in the first and second operating years comes up progressively and the provision for exemption for 3 years contained in the Income Tax Act of the Dominion of Canada has a considerable effect, production cost has been shown as differential amounts ranging over a period of 10 years.

Though it is also possible to show the cost by department or production stage as is practice in Canadian coal fields, in this report the cost at each stage of production was disregarded and the focus was set on the cost F.O.R. Fernie.

As to the enhancement of wages and some other cost items from the commencement of operation onward, we presupposed that the selling price can be escalated accordingly following the practice. Supplementary explanation is given hereunder.

(1) *Salaries of Staff*

The rates of salaries for the staff personnel as listed on Appendix 2, at the moment of commencement of operations in 1971, are estimated at ranging from Can. $700 to $1,500 monthly per head.

(2) Wages of Workers

Wages for the working force as listed on Appendix 3 are based on manhours for the actual number on job and for the regular working hours. Wage rates, at the moment of commencement of operations in 1971, are estimated making reference to the rates stipulated in the current wage agreements of the Coleman Collieries Ltd. and Crows Nest Industries Ltd. and estimating the rate of annual increase from the present at 8%. From the foregoing, the wage rate of a man per shift at the commencement in 1971 is estimated at ranging from Can. $26.50 to $31.50.

(3) Overtime

In estimating overtime necessary for operations, we made reference to the additional rates stipulated in the above agreements, inclusive of the premium on afternoon shift and night shift.

(4) Welfare Fund

Can. $0.27 per short ton of production

(5) Sundry Labor Costs

a) Workmen's Compensation

The rate applicable in 1968 to a company in coal mining industry in B.C., inclusive of silicosis is 10.25% on wages. The rate of contribution ought to become lower year by year.

b) Unemployment Insurance

Estimated at the highest rate in the relevant Federal Act.

c) Fringe Benefits

Estimated on the basis that the payment by the company for holiday with pay, paid holiday, medical service and group insurance will cover all the employees.

d) Fringe benefits for the staff personnel estimated at 20% on the total amount of salaries.

(6) From the foregoing, the labor cost per ton amounts to about $3.

(7) Costs of supplies, Repairs and Power.

Cost of supplies, maintenance and repairs of machinery are estimated at $0.89 per ton, and cost of electric power for the equipment underground and surface facilities at $0.20 per ton, for a normal year of operations. Wages and other labor costs are not included herein,for they are estimated in the foregoing. However, maintaining replacements for machinery, e.g., the replacement of conveyor belt, are included.

(8) Transport Cost of Clean Coal

This is the cost of transporting coal from the preparation plant to the loading point, payable to the proposed subsidiary. The item covers all the particulars: capital cost, running expenses, such as labor and other costs, profit, etc.

Included are also expenses for dumping refuse turned out from the coal preparation plant.

(9) Taxes and Charges

Royalty and rental for mining leases according to the Coal Act.

(10) Administrative Expenses

Included herein are dues to the Coal Operators' Association, auditing fees, insurance premiums otherwise than in connection with labor, statutory taxes and charges excluding royalty and rental for mining lease, selling and advertising expenses, traveling and communicating expenses, and other office expenses; wages, salaries and other labor costs are excluded. Remunerations to full-time directors are also included.

(11) Interest

Interest rate here has been estimated at 8% p.a. on an assumption that the capital investment will be repaid in uniform annual installments spreading over a period of 10 years.

The actual interest will be influenced by the method of financing investment and the rate of 8% p.a. may appear rather low in the light of the present trend of high interest in Canada and the U.S.A. A further realistic review ought to be needed in this connection.

(12) Putting together the above, the operations cost per ton, exclusive of cost of development and depreciation, amounts to $6.11.

(13) Depreciation of Development Costs

Estimation has been made on a basis of uniform annual amount of depreciation spreading over a period of 7 years starting from the 4th year after the commencement of operations, giving consideration to the provision of exemption for 3 years contained in the Dominion Income Tax Act. As the Act sets no limitation to the depreciation of development costs, it is free where to fix the amount of depreciation. We believe it is wise to complete the depreciation at least within the said period.

(14) Depreciation (except the above)

Apart from the development costs, the investment subject to depreciation amounts to $9,877,000.

Estimation here has been made in the same way as the case of development cost, viz., depreciation to start from the 4th year in consideration of the said exemption for 3 years. As for method of depreciation we took the maximum rate in the Dominion Income Tax Act (most of mining industry falls under the maximum rate of 30%), so that depreciation may be effected to the fullest extent permissible.

In this way the depreciation amounts to $7,710,000, which means 78% of depreciation progress. Needless to say, depreciation does not require the maximum rate of the tax law, and it is free to use any rate within the limit of the maximum, and fixed installment method instead of fixed percentage method can be employed for company's judgement. The abovementioned way has only been used for seeing what the maximum effects on the cost would be by applying the maximum rate.

(15) Depletion

Depletion has been set here at $0.10 per ton of coal following the provisions in the Income Tax Act, although it may be disputed whether allowance for depletion should be included in the cost.

(16) The cost F.O.R. Fernie of $7.31 has thus been arrived at.

If the production of 1,000,000 tons of coal can be assured, the cost of production will, in our opinion, not run beyond that value.

7. SOME PROBLEMS INVOLVED IN DEVELOPMENT AND OPERATION OF FERNIE COAL MINE

(1) Manpower

Generally speaking, manpower shortage in Canada is one of the most serious problems of national economy, and stress is placed in that respect for mining industry in particular. From our limited experience we have had in Canada we realize this problem.

On conducting the present survey, it was presupposed that manpower could be secured, and then the problem was boiled down to how to secure manpower, and, if it was possible, whether or not it was difficult.

As no actual recruiting activity has been made, the following remarks are no better than deduction, nevertheless the situation may be explained as under:

a. As the Fernie area finds itself in a coal area inhabited by a considerable coal mining population, it will be possible to recruit a certain labor force within the area.

b. The fact that this is a coal area is accompanied by favourable conditions in respect to the stable employment of miners.

c. The Fernie Mine is near the city of Fernie which has a good social environment.

Those factors suggest that the location has a great advantage over other regions in securing manpower. In actually recruiting manpower, the following points should be given full consideration.

a. With regard to the requisites for the mine manager, to select the one who realizes the importance of relations with the local community of Fernie area and have rich experience in labour.

b. To make full use of agencies of the Canada Manpower Division (Department of Manpower and Immigration). This has, in particular, an important bearing upon promoting immigration.

c. Of the total 240 of labor requirement except staff members, those who are particularly difficult to recruit will be more or less 100 to be engaged in working faces and some skilled workers who will make the core of the labor force, and those categories of workers should form the key point of recruiting activity.

d. To further look into working conditions, or to consider in a realistic manner what kind and extent of attractiveness to add to working conditions in contrast with other branches of industry or other coal mines in order to facilitate recruiting.

e. If there is a trend that Canadian workers do not like to work underground and this is detrimental to the project, then consideration should be lent to the acceptance of workers immigrated from other countries inclusive of Japan.

It is admittedly not easy at all to secure manpower. But, if measures suggested above are advanced step by step in a course of time at least no negative statement can be made of securing manpower at the Fernie Coal Mine.

This sort of problem of labor is of course a ticklish one, particularly in such a line of industry where labor is comparatively concentrated, and it is dangerous to form easygoing prospects against the problem of manpower.

(2) Townsite

It is reported that in vast Canada the development of a mine is often accompanied by the founding of a town comprising school, hospital, church, water supply and sewage systems, etc., in addition to dwelling houses. Our survey indicates that the Fernie Mine seems fortunately to be free from any particular problems except housing.

Therefore, the only problem will after all be that of housing, and, in that respect, it may be concluded that no serious problems will be encountered in securing living houses. Attention will rather be directed to the study of concrete measures beneficial to workers, such as effective use of loan under the National Housing Act, minimizing the unit building cost, etc.

(3) "Investment climate" in respect to Income Tax and Mining Tax

The revision of the B.C. Mining Tax Act passed in April 1968 by the Provincial Legislature was shocking to us.

The financial effects of the revised Mining Tax Act may not be great compared with the old version. However, the recommendations of the Crown Tax Commission -- although they may not be put into effect immediately --- to abolish the tax free period and the allowance for depletion that have hitherto been applied to mining in the Canadian Income Tax Act cause us misgivings that Canada is contemplating to flatly abolish the favorable measures she has been granting to mining in regard to taxation. At least, it can be said that there is a possibility of less favorable investment climate with regard to tax.

Furthermore, attention should be aroused of the fact that royalty of 25 cents is imposed on each ton of produced coal.

8. CONCLUSION

In pursuing the present feasibility studies, an earnest attempt has been made to bring ourselves, as near as possible, to the realities to be formed in the future, and efforts have been made as far as possible not to be optimistic.

The profitability of the project depends a great deal upon the selling price of clean coal, rail freight up to Vancouver and loading charges; but at least we can say, inferring from the known amount of such price and charges about other coal brands, and in view of stability of the selling price, this project will grow into a coal mine with steady profitability. Also in comparison with other coal projects of which development is contemplated, this project seems to enjoy a superior competitive status when we deliberate over the factors determinant to such projects.

Appendix 1

TABLE OF ESTIMATES FOR CAPITAL INVESTMENT

Item		Description	Can. $
I	Costs of preparations for development	Included herein are: Costs of survey and designing; felling trees and clearing ground; temporary construction; vehicles; recruiting workers; personnel expenses during development period except underground development; costs of maintenance and repairs of machinery and equipment; office expenses	1,803,000
II	Costs of preparations for production		
	1. Tunnel drifting	Direct expenses on driving tunnels until a total length of 10,030 meters is attained when two working faces are made available	492,000
	2. Drifting equipment	Including drifting machines, loaders, Panzer conveyor, etc. necessary for developing tunnels underground	666,000
	3. Coal mining equipment	Costs of drum cutters and self-advancing props (3 sets, of which one being spare), conveyors in minor level, power center.	2,037,000
	4. Hauling equipment	Main level belt conveyor, battery loco., mine cars, hoist, rail, etc.	838,000
	5. Coal preparation equipment	All-inclusive costs of a complete plant with 300t/h capacity and its installation cost	3,231,000
	6. Clean coal loading equipment	Cost of improving road from coal preparation plant to loading point, costs of train-loading equipment including clean coal pocket of 7,000t capacity, costs of constructing lead-in and sidings.	1,275,000
	7. Ventilation equipment	Main and local fans, air duct	54,000

Items	Description	Can. $
8. Draining and sprinkling equipment	All works and equipment for draining underground water and sprinkling water for settling coal dust	15,000
9. Power equipment	Erecting power line of 7,000 m. long, substation; portable compressors	279,000
10. Refuse dumping, water supply and sewage facilities, etc.	Bulldozer for refuse dumping, water supply and sewage system, building roadway near the tunnel mouth	156,000
11. Other surface facilities	Costs of office, warehouse, repairing shop, cap-lamp room, shower room, carpentry shop, and heating system	384,000
12. Others	Housing costs and expenses relevant thereto which may be borne partially in order to secure working force; principle, however, is that individuals own houses with financial aid from C.M.H.C., following this practice in Canada	450,000
Total		11,680,000

Appendix 2

STAFF PERSONNEL PLAN

Classification	Number	Remarks
Mine Manager	1	Holder of 1st class certificate
Assistant Manager	2	One being engineer and the other, office manager (non-technical)
Overman	3	Holder of 2nd class certificate, one for each shift
Face Foreman	6	Holder of 3rd class certificate, one for each working face each shift
Drifting Superintendent	3	Holder of 3rd class certificate, one for each shift
Haulage, Ventilation & Track Superintendent	1	Holder of 3rd class certificate, for 1st shift only all the time
Fire Boss	3	Holder of 3rd class certificate, one for each shift
Coal Preparation Superintendent	3	One for each shift, one of them being chief in charge of the sect.
Mechanical Superintendent	3	One for each shift, one of them being chief in charge of the sect.
Electrical Superintendent	3	One for each shift, one of them being chief in charge of the sect.
Surveyor	1	Holder of certificate as qualified surveyor
Assistant in Planning	1	
Others	3	In charge of accounting, labor, purchase and shipping coal
Total	33	

Appendix 3

PLAN OF LABOUR FORCE

Classification	Number on Job				Number on roster
	1st shift	2nd shift	3rd shift	Total	
Coal face	24	24	20	68	76
Drifting, PK7, PK9	6	6	6	18	
Blasting	5	5		10	
Sub-Total	11	11	6	28	31
Maintenance (timbering, bolting)	4	4	4	12	
Maintenance (timbering)	16			16	
Sub-Total	20	4	4	28	31
Haulage: Main-line loco.	1	1	1	3	
Main-line belt conveyor	1	1	1	3	
Ventilation, track	8			8	
Hauling supplies	10			10	
Sub-Total	20	2	2	24	27
Safety (including rock dust spray)	4			4	4
Planning & Surveying	3			3	3
Underground Machinery	6	1	1	8	9
Underground Electrical	4	1	1	6	7
Surface Machinery	13	2	1	16	16
Surface Electrical	3	2	2	7	7
Coal Preparation Plant, Loading	7	5	5	17	17
Warehouse & Miscellaneous	4			4	4
Office	7			7	7
Total	126	52	42	220	239

Note: Number of workers on job underground is reckoned to be 90% out of those on roster.

Appendix 4

ESTIMATED COST OF PRODUCTION

	Year / Production	1971 (750,000t)		1972 (900,000t)		1973 (1,000,000t)		1974 (1,000,000t)		1975 (1,000,000t)		1976 (1,000,000t)		1977 (1,000,000t)		1978 (1,000,000t)		1979 (1,000,000t)		1980 (1,000,000t)		Total (9,650,000t)	
	Item / Amount & per ton	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)	Amount (C$)	per ton (C$)
1	Staff's salaries	405,000	0.54	405,000	0.45	405,000	0.40	405,000	0.40	405,000	0.40	405,000	0.40	405,000	0.40	405,000	0.40	405,000	0.40	405,000	0.40	4,050,000	0.42
2	Miners' wages	1,560,000	2.08	1,560,000	1.74	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	1,560,000	1.56	15,600,000	1.62
3	Overtime (miners)	247,500	0.33	247,500	0.27	247,500	0.25	247,500	0.25	247,500	0.25	247,500	0.25	247,500	0.25	247,500	0.25	247,500	0.25	247,500	0.25	2,475,000	0.25
4	Welfare fund	225,000	0.30	270,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	300,000	0.30	2,895,000	0.30
5	Sundry expenses related to personnel	457,500	0.61	457,500	0.51	457,500	0.46	457,500	0.46	457,500	0.46	457,500	0.46	457,500	0.46	457,500	0.46	457,500	0.46	457,500	0.46	4,575,000	0.47
6	Total personnel cost	2,895,000	3.86	2,940,000	3.27	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	2,970,000	2.97	29,595,000	3.06
7	Costs of supplies, repairing expenses, cost of power	1,027,500	1.37	1,062,000	1.18	1,090,000	1.09															10,809,500	1.12
8	Clean coal transport charges	652,500	0.87	711,000	0.79	740,000	0.74	2,405,000	2.41	2,405,000	2.41	2,405,000	2.41	2,405,000	2.41	2,405,000	2.41	2,405,000	2.41	2,405,000	2.41	7,283,500	0.76
9	Taxes and charges	217,500	0.29	261,000	0.29	290,000	0.29															2,798,500	0.29
10	Administrative expenses	285,000	0.38	285,000	0.32	285,000	0.29															2,850,000	0.30
11	Interest	1,012,600	1.35	909,000	1.01	810,000	0.81	710,000	0.71	610,000	0.61	510,000	0.51	410,000	0.41	300,000	0.30	200,000	0.20	100,000	0.10	5,571,500	0.58
12	Production cost before depreciation	6,090,000	8.12	6,168,000	6.86	6,185,000	6.19	6,085,000	6.09	5,985,000	5.99	5,885,000	5.89	5,785,000	5.79	5,675,000	5.68	5,575,000	5.58	5,475,000	5.48	58,908,000	6.11
13	Depreciation on development cost							462,400	0.46	462,400	0.46	462,400	0.46	462,400	0.46	462,400	0.46	462,400	0.46	462,400	0.46	1,237,000	0.13
14	Depreciation							2,277,000	2.28	1,896,000	1.90	1,218,000	1.22	873,000	1.87	636,000	0.63	465,000	0.47	345,000	0.35	7,710,000	0.80 *
15	Depletion							100,000	0.10	100,000	0.10	100,000	0.10	100,000	0.10	100,000	0.10	100,000	0.10	100,000	0.10	700,000	0.07
16	Total capital cost							2,839,400	2.84	2,458,400	2.46	1,780,400	1.78	1,435,400	1.43	1,198,400	1.19	1,027,400	1.03	907,400	0.91	11,647,000	1.20
17	Total production cost (Item 12 + Item 16)	6,090,000	8.12	6,168,000	6.86	6,185,000	6.19	8,924,400	8.93	8,443,400	8.45	7,665,400	7.67	7,220,400	7.22	6,873,400	6.87	6,602,400	6.61	6,382,600	6.39	70,555,000	7.31

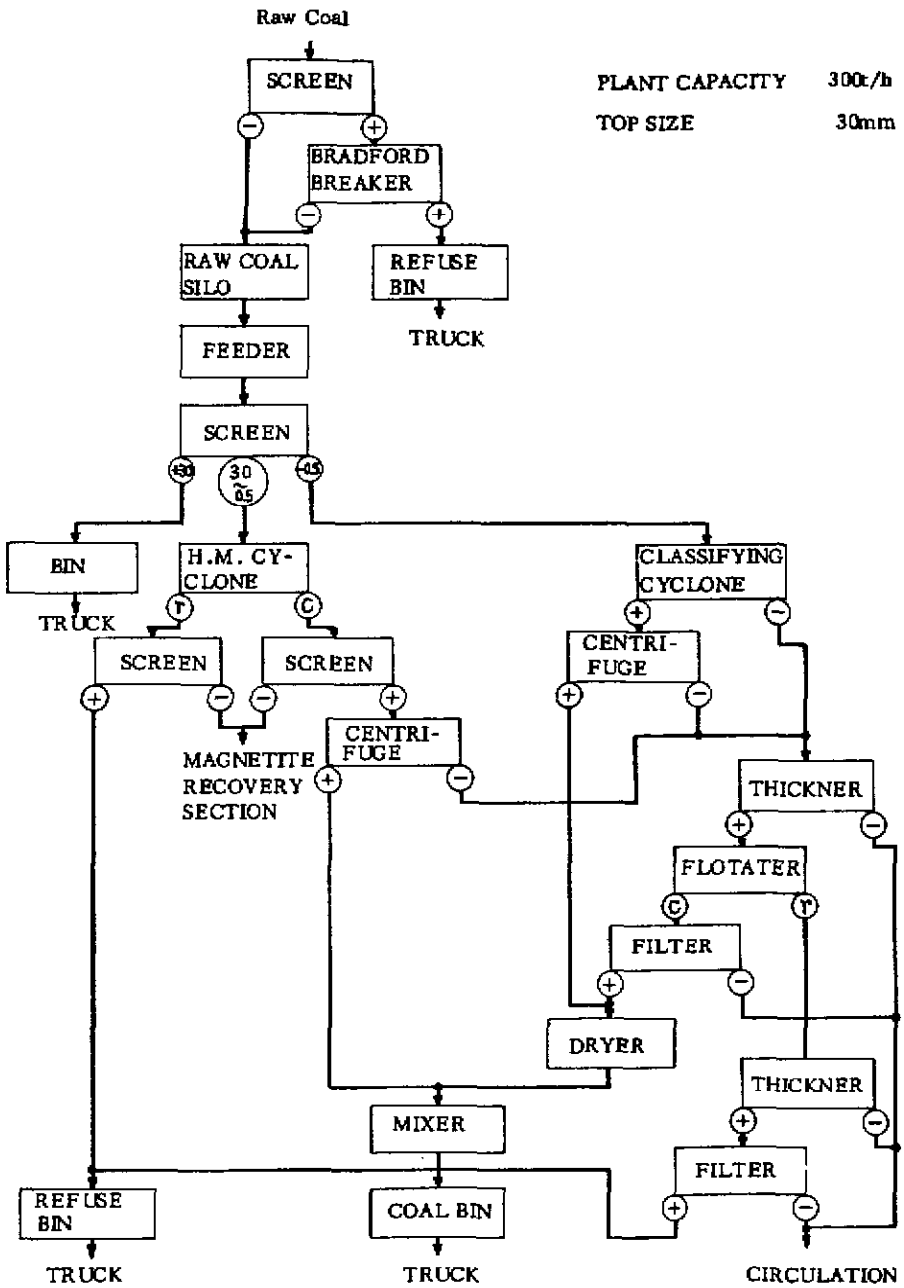
* Amount subject to depreciation 9,877,000 Balance after depreciation 2,167,000

Appendix 5

MAP SHOWING PLAN OF UNDERGROUND DEVELOPMENT

Appendix 6

FLOWSHEET OF COAL PREPARATION



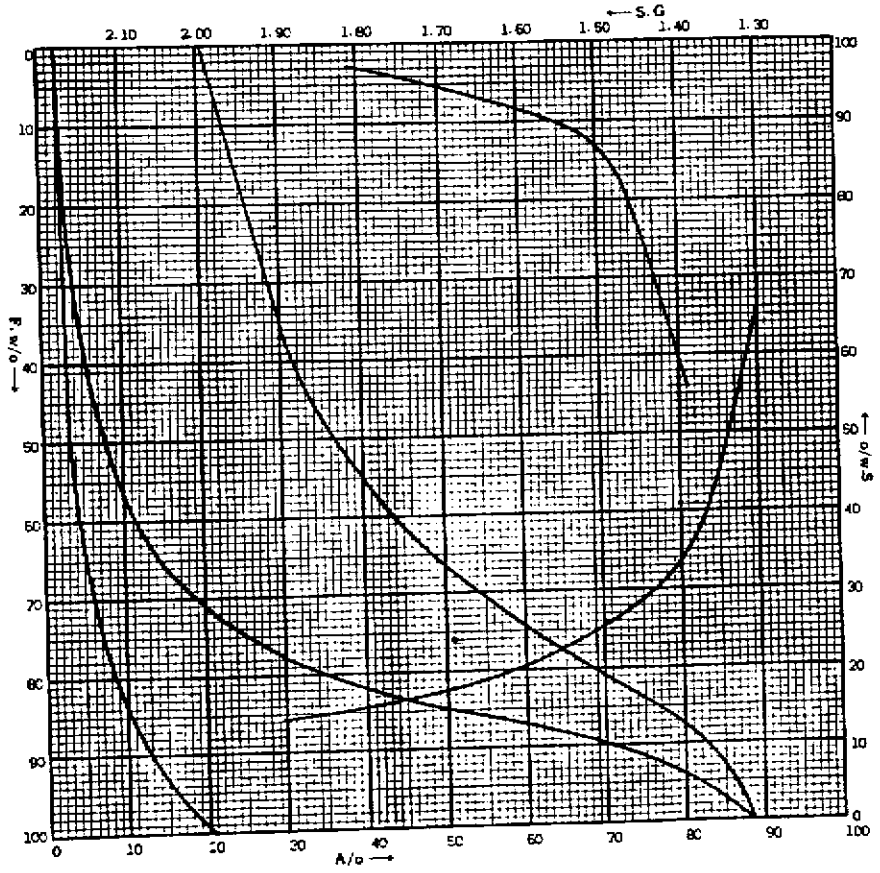
Appendix 7

Coal Seam B

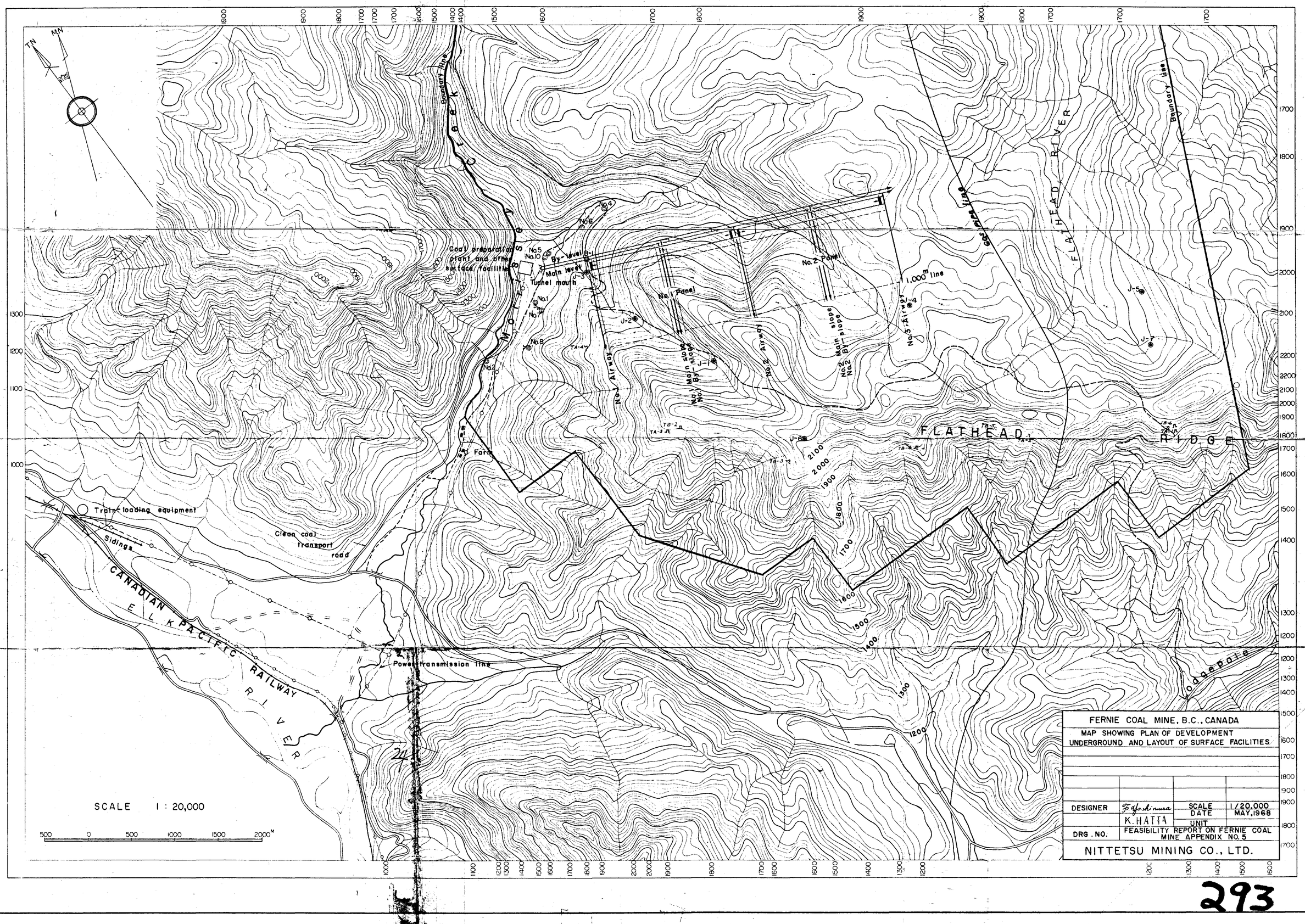
Washability Curve

Size/mm	W%	A%
+0.5	70.0	20.5
−0.5	30.0	14.0
Total	100.0	18.6

S G	w/o	A/o	$\frac{\Sigma Wn-1 - Wn}{2}$	W.A	$\frac{\Sigma WA}{(Af)}$	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100(1-\Sigma A)}{100-\Sigma W}$
−1.30	34.7	2.9	17.4	100.68	100.68	34.7	2.9	29.8
1.30 ~1.35	19.3	6.4	44.4	123.52	224.15	54.0	4.2	39.6
1.35 ~1.40	12.2	11.2	60.1	136.64	360.79	66.2	5.5	49.9
1.40 ~1.50	8.2	18.4	70.8	150.88	511.67	74.4	6.9	59.9
1.50 ~1.60	4.8	29.5	76.8	141.60	653.27	79.2	8.2	67.0
1.60 ~1.70	3.4	37.8	80.9	128.52	781.79	82.6	9.5	72.6
1.70 ~1.80	1.6	44.4	83.4	71.04	852.83	84.3	10.1	75.5
1.80 ~1.90	1.4	50.9	84.9	71.26	924.09	85.6	10.8	77.9
+1.90	14.4	77.9	92.8	1121.76	2045.85	100.0	20.5	



FERNIE COAL MINE (B.C., CANADA)



FERNIE COAL MINE, B.C., CANADA			
MAP SHOWING PLAN OF DEVELOPMENT UNDERGROUND AND LAYOUT OF SURFACE FACILITIES			
DESIGNER	Y. Yoshimura	SCALE	1/20,000
	K. HATTA	DATE	MAY, 1968
		UNIT	
DRG. NO.	FEASIBILITY REPORT ON FERNIE COAL MINE APPENDIX NO. 5		
NITTETSU MINING CO., LTD.			

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