ALWIN MINING COMPANY LTD.

HIGHLAND VALLEY

BRITISH COLUMBIA

FEASIBILITY REPORT

FOR

500 TON PER DAY

MINING & CONCENTRATING PLANT

WITH

RELATED SERVICES AND FACILITIES

BY

JOINT VENTURE

BACON & CROWHURST LTD.

AND

SANDWELL AND COMPANY LIMITED

CONSULTING ENGINEERS

VANCOUVER, B.C.

MAY, 1970

December 16th, 1970.

Mr. H.E. Jacques, President,
Alwin Mining Company Ltd.,
807 - 409 Granville St.,
Vancouver, 2, B.C.

Dear Sir:

Re: Highland Valley Property

Pursuant to your recent request, please note that the following constitutes a summary of our feasibility study, dated May 1970, which envisaged the construction of a 500 T.P.D. copper mining and concentrating plant. The subsequent agreement between the Alwin Mining Company and Furukawa Mining Co. Ltd. was based on the results and economics contained in this report.

The ore to be extracted will be derived from the OK and IOU Crown Grant mineral claims owned by the Alwin Mining Company in the Highland Valley area of B.C.

GENERAL

The feasibility report included economic studies concerning:

(1) A vertical shaft and horizontal levels.
(2) A decline with trackless haulage.
(3) A horizontal adit driven from a portal area to be selected but situated on the Valley Copper mineral claim properties.

The feasibility study recommended that the decline with trackless haulage method be utilized.

ORE RESERVES

Ore reserves as re-estimated during March 1970 by Mr. W.W. Cummings, P.Eng., Chief Geologist for the Alwin Mining Company, and Mr. T.E. Swanson, P.Eng., Consulting Engineer, acting for Bacon & Crowhurst Ltd., amount to 1,051,949 tons assaying 2.51% copper and

0.375 ounces of silver per ton of material in place, and 1,138,910 tons assaying 2.33% copper and 0.346 ounces of silver per ton after allowance for mining dilution.

It is conservatively estimated that a minimum of 250,000 tons of similar material will be found by future exploration.

CAPITAL & OPERATING COSTS

It is estimated that a total investment of $4,766,586 will be required to prepare the underground workings for production and to construct the 500 ton concentrator with related facilities. This includes an allowance for inventory of supplies and 2 months operating costs for working capital.

During the first 4 years total operating costs are estimated to be $11.829 per ton of ore milled which will increase to $12.451 per ton milled later.

METALLURGICAL PERFORMANCE

The results submitted (a) in April 1969 by the Department of Energy, Mines and Resources, Ottawa, Ontario, (b) those contained in a January 1970 report by Lakefield Research of Canada Limited, Lakefield, Ontario and (c) those given in April 1970 by Allis Chalmers Manufacturing, Process, Test and Research Centre, Oak Creek, Wisconsin, all concerning grinding and copper flotation test work have been studied. Concentrator flow-sheet and design has been based on this information and on a report submitted by Mr. D.A. Livingstone, P.Eng., Metallurgical Consultant.

WATER SUPPLY AND POLLUTION CONTROL

Discussions have been held with various British Columbia government officials, and applications have been formally submitted by the Alwin Mining Company relative to the construction of a five-foot dam at the outlet of Island Lake, the use of the extra water secured thereby, and the use of Little O.K. Lake as a tailings pond and water reclamation area.

The report considers that these applications will be favourably received and that permission will be granted as required.

POWER

It is assumed that the Alwin Mining Company will build a connecting transmission line between the main Highland Valley British Columbia Hydro and Power Authority high voltage line and the Alwin plant site and purchase power from the Authority.

Preliminary discussions with the Authority indicates that this will be possible. It is contemplated that delivery can be effected by the commencement of milling operations; rental diesel-electric units will be used in the interim period.

PRICE OF COPPER

The economic analyses in the report were calculated using metal prices per pound of 50¢, 55¢, 60¢, 65¢ and 70¢ U.S. for copper, and $1.90 U.S. per troy ounce for silver.

MARKETING

It was assumed for the purpose of the report that the concentrates will be sold, loaded, trimmed and stowed, FOB ship at Vancouver, British Columbia, under the terms of typical copper smelter contracts recently negotiated with Japanese companies.

Yours very truly,

BACON & CROWHURST LTD.

J.J. Crowhurst, P.Eng.

JJC/ic

cc: Mr. B.D. Speton

December 14th, 1970.

Mr. H.E. Jacques, President,
Alwin Mining Company Ltd.,
807 - 409 Granville St.,
Vancouver, 2, B.C.

Dear Sir:

Pursuant to your inquiry, this is to advise you that we consider the feasibility report for a 500 ton per day milling and concentrating plant, as submitted on May 15th, 1970, to be complete in all respects.

We recommend therefore that the property be placed in production as outlined and that no further work is anticipated prior to production plans with the exception of a minimal amount of diamond drilling required to investigate the mineralized occurrences situated underneath the proposed plant site. It should be noted that these appear to be small in extent but may prove to be larger than anticipated.

Yours truly,

BACON & CROWHURST LTD.

J.J. Crowhurst, P.Eng.

JJC/ic

cc: Mr. B.D. Speton

Phone 688-5485

1720-1055 West Hastings Street
Vancouver 1, B.C.

BACON & CROWHURST LTD.
CONSULTING ENGINEERS

May 15th, 1970.

Alwin Mining Company Ltd.,
807 - 409 Granville St.,
Vancouver 2, B.C.

Attention: Mr. H.E. Jacques,
President

Dear Sir:

We are pleased to submit herewith a final feasibility report concerning placing your Highland Valley, British Columbia, copper property into production at the rate of 500 tons of ore per day, or 175,000 tons of ore per year.

As a results of this study it is recommended that production be achieved by underground methods using trackless diesel-powered equipment. Access would be by means of a decline roadway system.

As detailed in this report, it will be noted that the property is viable at an average price of 50¢ U.S. per lb. for copper. At the average price of copper effective during the past year, it is considered that the economics are extremely attractive.

Respectfully submitted,

BACON & CROWHURST LTD.

J.J. Crowhurst

J.J. Crowhurst, P. Eng.

TABLE OF CONTENTS

CHAPTER VIII - LIST OF ILLUSTRATIONS

E2572-10 Highland Valley Property
500 Ton per Day Mill
Crushing & Concentrator Plant
General Arrangement Scheme 2

E2572-11 Highland Valley Property
500 Ton per Day Mill
Crushing & Concentrator Plant
General Arrangement Scheme 1

B2572-12 Highland Valley Property
500 Ton per Day Mill
Machine Shop & Compressor House
General Arrangement

B2572-13 Highland Valley Property
500 Ton per Day Mill
Bunkhouse & Guest House
General Arrangement

B2572-14 Highland Valley Property
500 Ton per Day Mill
Changehouse, Office & Warehouse
General Arrangement

A2572-15 Highland Valley Property
500 Ton per Day Mill
Single Line Diagram

TERMS OF REFERENCE

Authority for preparation and the terms of reference for this report were stated in the following letter:

ALWING MINING COMPANY LTD. (N.P.L.)
807 United Kingdom Bldg.
409 Granville Street
Vancouver 115, B.C.

February 23rd, 1970.

Messrs. Bacon & Crowhurst Ltd.,
1720 - 1055 West Hastings Street,
Vancouver 1, B.C.

Attention: Mr. J.J. Crowhurst,
Vice-President and General Manager

As discussed with you, please accept this letter as authorization to proceed immediately with the preparation of a final feasibility report concerning placing the Highland Valley, British Columbia, Alwin Mining Company Ltd. copper property into production at the rate of 500 tons of ore per day or 175,000 tons of ore per year.

This authorization includes the engagement at your discretion of other engineers and technical personnel when deemed necessary for the proper completion of the work.

This feasibility report is to include economic studies concerning the following alternative types of operation:

(1) Shaft and levels as outlined in the preliminary feasibility study as submitted by Bacon and Crowhurst Ltd., dated October, 1969.

(2) Decline with subsequent trackless haulage re ore transportation to the concentrator.

(3) Adit driven from a portal area to be selected and to be situated on the Valley Copper mineral claim properties to the northeast of the Alwin claim group.

In addition to the above, the following assumptions are to be made:

(1) Ore to be extracted will be derived from the O.K. and I.O.U. Crown grant mineral claims in the Highland Valley area, British Columbia, at the average yearly rate quoted above. Provision is to be made for possible future concentrator expansion and/or the possible future installation of facilities required for custom ore treatment. No economic analyses are to be conducted, however, relative to these possibilities.

(2) The design of the concentrator and the selection of related equipment will be based on the metallurgical test work completed to date by the Mines Branch, Department of Energy, Mines and Resources, Ottawa, and by the Lakefield Research Institute at Peterborough, Ontario.

(3) Fresh water supply will be obtained from a source in the central Highland Valley area by arrangement with the Bethlehem Copper Corporation Ltd. or with Valley Copper Mines Ltd., under their existing water licenses or an addendum thereto.

(4) Power will be supplied initially by rental diesel-electric units until delivery of hydro-electric power can be obtained. Discussions are to be held with the British Columbia Hydro Authority and with the property owners over which a transmission line would be erected.

(5) Housing will be supplied by the construction, rental or acquisition of a small number of houses for key employees plus bunkhouse and trailer-type accommodation for the remainder of the required crew.

(6) Copper concentrates will be transported to Vancouver, British Columbia, stored and loaded on deep sea ships, and then sold to prospective purchasers.

(7) Detailed soil investigations of the various prospective concentrator and plant sites will not be completed, but preliminary assessments of the possibilities will be carried out.

(8) Consideration will be given to the purchase of good second-hand equipment, and a preliminary survey of availability will be included in the report.

(9) The final tailing disposal method will be subject to completion of negotiations with the various British Columbia Government Departments. Sufficient information will be obtained, however, to permit fairly accurate estimates of the possibilities.

Yours very truly,

ALWIN MINING COMPANY LTD. (N.P.L.)

Harold E. Jacques,
President.

HEJ/sd

Accordingly, arrangements regarding the completion of this study as a joint venture were made with Sandwell and Company Limited early in March, 1970. This report represents, therefore, the combined effort of both Bacon & Crowhurst Ltd. and Sandwell and Company Limited.

SCOPE OF THE REPORT

This report contemplates the following:

(1) Rate of Production

The concentrator will process 500 tons of ore per day for 350 operating days per year, or 175,000 tons of ore per year. Provision has been made for possible future concentrator expansion and/or the possible future installation of facilities required for custom ore treatment. No economic analyses relative to these possibilities, however, have been included.

(2) Source of Ore

The ore will be extracted from the mineralized zones situated on the O.K. and I.O.U. Crown grant mineral claims owned by Alwin in the Highland Valley area, British Columbia.

(3) General Plan

Three plans have been contemplated but only two have been studied and compared in detail:

(a) Shaft Method

A vertical three compartment shaft, 770 feet in depth with four levels established at 150-foot intervals would be sunk from the surface close to and just northerly from the centre of the ore zone.

Cut-and-fill and shrinkage stoping would be used to extract the ore, which would be hauled by trains to the shaft for hoisting to the surface.

The concentrator and plant services would be situated close to the shaft headframe.

(b) Decline-Trackless Method

A decline ramp system would be driven downwards from the surface close to and between the ore zones to gain access to the stoping areas. Cut-and-fill and shrinkage stoping would again be used to extract the ore, which would, however, be transported by trackless load-haul-dump diesel operated machines to centrally located ore passes.

Diesel dump trucks would then carry the ore from chutes at the bottom of these ore passes through the existing adit to the concentrator coarse ore bin.

The concentrator would be situated on the hillside to the south of Little O.K. Lake, at an approximate distance of 800 feet to 1000 feet from the adit portal.

(e) New Adit Method

The possibility of developing the mine by means of a new adit (or decline) to be driven from a portal area situated to the northeast of the ore zones has also been investigated.

Discussions with Valley Copper Mines officials, on whose mineral claims the proposed portal collar, concentrator and plant services would be located, clearly indicated that the proposal would conflict with their plans for their own plant layout, and that therefore no agreement could be reached between Valley and Alwin relative to the acquisition of a suitable tract of land. As a result, no detailed study of this method of mine development has been made.

(4) Metallurgical Performance

The results submitted (a) in April 1969 by the Department of Energy, Mines and Resources, Ottawa, Ontario, (b) those contained in a January 1970 report by Lakefield Research of Canada Limited, Lakefield, Ontario and (c) those given in April 1970 by Allis Chalmers Manufacturing, Process, Test and Research Centre, Oak Creek, Wisconsin, all concerning grinding and copper flotation test work have been studied. Concentrator flow-sheet and design has been based on this information and on a report submitted by Mr. D.A. Livingstone, P. Eng., Metallurgical Consultant.

(5) Water Supply and Pollution Control

Discussions have been held with various British Columbia government officials, and applications have been formally submitted by the Alwin Mining Company relative to the construction of a five-foot dam at the outlet of Island Lake, the use of the extra water secured thereby, and the use of Little O.K. Lake as a tailings pond and water reclamation area.

This report considers that these applications will be favourably received and that permission will be granted as required.

(6) Power

It is assumed that the Alwin Mining Company will build a connecting transmission line between the main Highland Valley British Columbia Hydro and Power Authority high voltage line and the Alwin plant site and purchase power from the Authority.

Preliminary discussions with the Authority indicates that this will be possible. It is contemplated that delivery can be effected by the commencement of milling operations; rental diesel-electric units will be used in the interim period.

(7) Price of copper

The economic analyses in this report are calculated using metal prices per pound of 50¢, 55¢, 60¢, 65¢ and 70¢ U.S. for copper, and $1.90 U.S. per troy ounce for silver.

(8) Marketing

It is assumed for the purpose of this report that the concentrates will be sold, loaded, trimmed and stowed, FOB ship at Vancouver, British Columbia under the terms of typical copper smelter contracts recently negotiated with Japanese companies.

(9) Economics

An economic analysis has been compiled including preproduction costs, capital expenditures, warehouse inventory, working capital, operating costs, operating profit, Dominion Income and Provincial Mining Taxes, estimated financial charges and net cash flow.

(10) Purchase of Equipment

The detailed cost estimates include prices for both new and available good, used machinery and equipment. The used articles would be carefully examined and perhaps tested before purchase.

Since it is desirable to keep the capital cost of placing the property into production at a minimum, the summary and financial analyses are based on the "new plus used" estimates.

(11) Escalation

Costs have been calculated on the basis of labour and supplies as estimated to cost during 1970-71. No allowances have been included for escalation in these costs, as it has been assumed that this will be offset by improvement in mining technology and general increases in the prices of metals.

ACKNOWLEDGMENTS

Acknowledgments are made to the following, all of whom contributed valuable assistance in the compilation of this report:

(1) Alwin Mining Company Staff

A.E. Wells - Property Superintendent

W.W. Cummings, P. Eng. - Chief Geologist

P.L. Hazell - Executive Assistant

(2) T.E. Swanson, P. Eng.

Ore reserves and mining plans.

(3) The Granby Mining Company Limited

D.A. Livingstone, P. Eng. - Metallurgy and concentrator flow sheet.

(4) R.W. Gould

Metallurgy, concentrator flow sheet and concentrator design.

(5) Sandwell and Company Limited

Senior staff engineers.

CHAPTER I
SUMMARY & FINANCIAL

SUMMARY

Ore reserves as re-estimated during March 1970 by Mr. W.W. Cummings, P. Eng., Chief Geologist for the Alwin Mining Company, and Mr. T.E. Swanson, P. Eng., Consulting Engineer, acting for Bacon & Crowhurst Ltd., amount to 1,051,949 tons assaying 2.51% copper and 0.375 ounces of silver per ton of material in place, and 1,138,910 tons assaying 2.33% copper and 0.346 ounces of silver per ton after allowance for mining dilution.

It is conservatively estimated that a minimum of 250,000 tons of similar material will be found by future exploration.

Capital Costs

Using trackless diesel-powered equipment and a decline system, it is estimated that a total investment of $4,766,586 will be required to prepare the underground workings for production, and to construct a concentrator with related facilities, including townsite requirements, capable of processing 500 tons of ore per day (175,000 tons per year).

The present ore reserves will suffice for 6.51 years operation at this rate, with a further 1.43 years anticipated, for a total of 7.94 years.

The sum of $90,000 representing inventory of supplies, and the sum of $344,992 representing two months' operating costs for working capital are included in the $4,766,586 total.

Similarly, it is estimated that developing the mine by a vertical shaft and horizontal levels will require a total investment of $5,402,226 including costs related to concentrator and plant services.

The sum of $90,000 representing inventory of supplies, and the sum of $363,727 representing two months' operating costs for working capital are included in the $5,402,226 total.

During the first four years, the total operating cost for the trackless method is estimated to be $11.829 per ton of ore milled, and $12.472 per ton of ore milled for the shaft method. It is estimated this will increase to $12.451 per ton milled (trackless) and $13.094 per ton milled (shaft).

The estimated operating profit for each method and the estimated resulting cash flow has been calculated as shown in the tables on the succeeding pages.

It is estimated that nine months time will be required to place the mine in production from the time that suitable finances are provided.

TRACKLESS METHOD

SUMMARY - ESTIMATED CAPITAL COSTS

1.	Mine			
	a. Equipment- including installation	$ 536,730		
	Government Sales Tax	33,950		
	Freight	5,400		
			$ 576,080	
	b. Preproduction Development & Stoping			
	- Direct Cost	$ 744,082		
	- Indirect Cost	345,825		
			$1,089,907	
	Total Mine			$1,665,987
2.	Crushing Plant			
	a. Equipment	$ 246,869		
	b. Building	126,394		373,263
3.	Concentrator			
	a. Equipment	$ 298,606		
	b. Building	184,233		482,839
4.	Plant Services & Administration - Buildings & Equipment			306,459
5.	Water Supply, Fire Protection, & Tailings Disposal			140,000
6.	Power Transmission & Distribution			323,100
7.	Camp Buildings & Housing			256,400
8.	Preproduction Plant Services & Administration Cost			166,836
9.	Vancouver Head Office - 9 months at $4,064			36,576
				$3,751,460
	Contingencies at 10%			375,146
				$4,126,606
	Engineering on Applicable Items			204,988
				$4,331,594
	Inventory of Supplies			90,000
				$4,421,594
	Working Capital - 2 months Operating Costs (i.e. 1/6 x $2,069,955)			344,992
	Total			$4,766,586

SHAFT METHOD

SUMMARY - ESTIMATED CAPITAL COSTS

1.	Mine			
	a. Equipment - including installation	$ 669,515		
	Government Sales Tax	36,374		
	Freight	12,168		
			$ 718,057	
	b. Preproduction Development & Stoping			
	- Direct Cost	$ 996,092		
	- Indirect Cost	437,881		
			$1,433,973	
	Total Mine			$2,152,030
2.	Crushing Plant			
	a. Equipment	$ 241,513		
	b. Building	115,340		356,853
3.	Concentrator			
	a. Equipment	$ 303,494		
	b. Building	144,550		448,044
4.	Plant Services & Administration -Buildings & Equipment			339,449
5.	Water Supply, Fire Protection, & Tailings Disposal			140,000
6.	Power - Including Electrical Distribution			344,400
7.	Camp Buildings & Housing			280,900
8.	Preproduction Plant Services & Administration Cost			183,373
9.	Vancouver Head Office - 9 months at $4,064			36,576
				$4,281,625
	Contingencies at 10%			428,163
				$4,709,788
	Engineering			238,711
				$4,948,499
	Inventory of Supplies			90,000
				$5,038,499
	Working Capital - 2 months Operating Costs (i.e. 1/6 x $2,182,363)			363,727
	Total			$5,402,226

ESTIMATED NET SMELTER RETURNS PER SHORT TON OF CONCENTRATES FOB MINESITE

	Price of Copper - ¢U.S. per lb				
	50.00	55.00	60.00	65.00	70.00
Content & Price Paid For					
a. Lbs of copper contained/ton of concentrate	640	640	640	640	640
b. Lbs of copper paid for/ton of concentrate	620	620	620	620	620
c. Price of copper less deduction of 1.20¢/lb	48.80	53.80	58.80	63.80	68.80
Value of Metals Contained					
d. Value of copper - (item "b") x (item "c") - $U.S.	$ 302.56	$ 333.56	$ 364.56	$ 395.56	$ 426.56
e. Value of silver - 5.40 ozs x $1.90/lb x 90%	9.23	9.23	9.23	9.23	9.23
f. Value of gold - less than 1.0 gr/dry m. ton	-	-	-	-	-
g. Total - item "d" + item "e"	311.79	342.79	373.79	404.79	435.79
Deductions					
h. Treatment Charge = $27.00/dry metric ton i.e.= $\frac{27.00 \times 2000}{2204.6}$ = 24.49/dry short ton	24.49	24.49	24.49	24.49	24.49
Net Value (FOB Ship Vancouver, B.C.)					
i. Item "g" - item "h" - $U.S./short ton concentrate	287.30	318.30	349.30	380.30	411.30
j. Plus Canadian/U.S. exchange @ 7.75%	22.27	24.67	27.07	29.47	31.88
k. Net value - $Canadian/short ton concentrate	$ 309.57	$ 342.97	$ 376.37	$ 409.77	$ 443.18

		Price of Copper - ¢U.S. per lb				
	50.00	55.00	60.00	65.00	70.00
Loading & Freight					
(Mine to Vancouver, B.C. to Ship)	Per Wet Ton of Concentrate				
l. Loading at mine - included in mill operating costs					
m. Trucking (or rail) - mine to Vancouver, B.C.	$ 6.45				
n. Sampling, warehousing & shiploading (Vancouver Wharves - $3.50) + (stevedoring = 17¢)	3.67				
Sub Total	$ 10.12				
	Per Dry Ton of Concentrate				
o. Loading & freight per dry ton of concentrate*	$ 10.88	$ 10.88	$ 10.88	$ 10.88	$ 10.88
Net Smelter Returns					
(FOB Minesite)					
p. Per short dry ton of concentrate (item "k") - (item "o") = $Canadian	298.69	332.09	365.49	398.89	432.30
q. Per lb of copper contained - $\frac{\text{item "p"}}{640}$ = ¢ Canadian	46.67	51.89	57.11	62.33	67.55

Assumptions

Grade of copper concentrate = 32% Cu. + 0.035 ozs Au/ton + 5.40 ozs Ag/ton.

* Moisture content = 7% of wet weight.

Price of silver = $1.90 U.S. per ounce.

TRACKLESS METHOD

ESTIMATED OPERATING COST - 500 TPD OR 175,000 TPY

	First 4 Years		Next 4 Years	
	Amt/yr	Per Ton Milled	Amt/yr	Per Ton Milled
Mining	$1,325,248	$ 7.573	$1,443,125	$ 8.195
Milling	301,175	1.721	301,175	1.721
Power	93,996	.537	93,996	.537
Mine Administration, Plant Services and Townsite	300,768	1.719	300,768	1.719
Vancouver Head Office	48,768	.279	48,768	.279
Totals	$2,069,955	$11.829	$2,187,832	$ 12.451

SHAFT METHOD

ESTIMATED OPERATING COST - 500 TPD OR 175,000 TPY

	First 4 Years		Next 4 Years	
	Amt/yr	Per Ton Milled	Amt/yr	Per Ton Milled
Mining	$1,406,895	$ 8.040	$1,515,850	$ 8.662
Milling	301,175	1.721	301,175	1.721
Power	108,600	0.621	108,600	0.621
Mine Administration, Plant Services and Townsite	316,925	1.811	316,925	1.811
Vancouver Head Office	48,768	0.279	48,768	0.279
Totals	$2,182,363	$12.472	$2,291,318	$13.094

ESTIMATED TONS OF CONCENTRATES PRODUCED AT 500 T.P.D.

Year	Mill Feed Tons	Assay % Cu	Tons of Copper	000's lbs of Copper	Concentrates 000's lbs Cu. Recovered At 94%	Dry Tons At 32% Cu.	Dry Tons Sold at 99% (1% loss in transit)
1	175,000	2.77	4847.5	9695	9113.3	14,240	14,098
2	175,000	2.67	4672.5	9345	8784.3	13,726	13,589
3	175,000	2.30	4025.0	8050	7567	11,823	11,705
4	175,000	2.18	3815.0	7630	7172.2	11,207	11,095
5	175,000	2.18	3815.0	7630	7172.2	11,207	11,095
6	175,000	2.18	3815.0	7630	7172.2	11,207	11,095
7	175,000	2.18	3815.0	7630	7172.2	11,207	11,095
8	175,000	2.18	3815.0	7630	7172.2	11,207	11,095
Totals and Averages	1,400,000	2.33	32620.0	65240	61325.6	95,824	94,867

TRACKLESS METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 50¢ US

Year:	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $298.69/ton of concentrates	4,211	4,059	3,496	3,314	3,314	3,314	3,314	3,314	28,336
Net smelter returns per ton of ore milled	24.063	23.194	19.977	18.937	18.937	18.937	18.937	18.937	20.240
Operating cost per ton of ore milled	11.829	11.829	11.829	11.829	12.451	12.451	12.451	12.451	12.140
Operating Profit per ton of ore milled	12.234	11.365	8.148	7.108	6.486	6.486	6.486	6.486	8.100
Operating Profit - 000's $Can.	2,141	1,989	1,426	1,244	1,135	1,135	1,135	1,135	11,340

TRACKLESS METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 55¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $332.09/ton of concentrates	4,682	4,513	3,887	3,685	3,685	3,685	3,685	3,685	31,504
Net smelter returns per ton of ore milled	26.754	25.789	22.211	21.057	21.057	21.057	21.057	21.057	22.503
Operating cost per ton of ore milled	11.829	11.829	11.829	11.829	12.451	12.451	12.451	12.451	12.140
Operating Profit per ton of ore milled	14.925	13.960	10.382	10.228	8.606	8.606	8.606	8.606	10.363
Operating Profit - 000's $Can.	2,612	2,443	1,617	1,790	1,506	1,506	1,506	1,506	14,508

TRACKLESS METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 60¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $365.49/ton of concentrates	5,153	4,967	4,278	4,055	4,055	4,055	4,055	4,055	34,673
Net smelter returns per ton of ore milled	29.446	28.383	24.446	23.171	23.171	23.171	23.171	23.171	24.766
Operating cost per ton of ore milled	11.829	11.829	11.829	11.829	12.451	12.451	12.451	12.451	12.140
Operating Profit per ton of ore milled	17.617	16.554	12.617	11.342	10.720	10.720	10.720	10.720	12.626
Operating Profit - 000's $Can.	3,083	2,897	2,208	1,985	1,876	1,876	1,872	1,872	17,676

TRACKLESS METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 65¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $398.89/ton of concentrates	5,624	5,421	4,669	4,426	4,426	4,426	4,426	4,426	37,841
Net smelter returns per ton of ore milled	32.137	30.977	26.680	25.291	25.291	25.291	25.291	25.291	27.029
Operating cost per ton of ore milled	11.829	11.829	11.829	11.829	12.451	12.451	12.451	12.451	12.140
Operating Profit per ton of ore milled	20.308	19.148	14.851	13.462	12.840	12.840	12.840	12.840	14.889
Operating Profit - 000's $Can	3,554	3,351	2,599	2,356	2,247	2,247	2,247	2,247	20,845

TRACKLESS METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 70¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $432.30/ton of concentrates	6,095	5,875	5,060	4,796	4,796	4,796	4,796	4,796	41,011
Net smelter returns per ton of ore milled	34.829	33.571	28.914	27.406	27.406	27.406	27.406	27.406	29.294
Operating cost per ton of ore milled	11.829	11.829	11.829	11.829	12.451	12.451	12.451	12.451	12.140
Operating Profit per ton of ore milled	23.000	21.742	17.085	15.577	14.955	14.955	14.955	14.955	17.154
Operating Profit - 000's $Can.	4,025	3,805	2,990	2,726	2,617	2,617	2,617	2,617	24,016

SHAFT METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 50¢ US

Year:	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $298.69/ton of concentrates	4,211	4,059	3,496	3,314	3,314	3,314	3,314	3,314	28,336
Net smelter returns per ton of ore milled	24.063	23.194	19.977	18.937	18.937	18.937	18.937	18.937	20.240
Operating cost per ton of ore milled	12.472	12.472	12.472	12.472	13.094	13.094	13.094	13.094	12.783
Operating Profit per ton of ore milled	11.591	10.722	7.505	6.465	5.843	5.843	5.843	5.843	7.457
Operating Profit - 000's $Can.	2,028	1,876	1,131	1,131	1,023	1,023	1,023	1,023	10,440

SHAFT METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 55¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can. at $332.09/ton of concentrates	4,682	4,513	3,887	3,685	3,685	3,685	3,685	3,685	31,504
Net smelter returns per ton of ore milled	26.754	25.789	22.211	21.057	21.057	21.057	21.057	21.057	22.503
Operating cost per ton of ore milled	12.472	12.472	12.472	12.472	13.094	13.094	13.094	13.094	12.783
Operating profit per ton of ore milled	14.282	13.317	9.739	8.585	7.963	7.963	7.963	7.963	9.720
Operating profit - 000's $Can	2,499	2,330	1,704	1,502	1,394	1,394	1,394	1,394	13,608

SHAFT METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 60¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net Smelter Returns - 000's $Can at $365.49/ton of concentrates	5,153	4,967	4,278	4,055	4,055	4,055	4,055	4,055	34,673
Net Smelter Returns per ton of ore milled	29.446	28.383	24.446	23.171	23.171	23.171	23.171	23.171	24.766
Operating cost per ton of ore milled	12.472	12.472	12.472	12.472	13.094	13.094	13.094	13.094	12.783
Operating Profit per ton of ore milled	16.974	15.911	11.974	10.699	10.077	10.077	10.077	10.077	11.983
Operating Profit - 000's $Can	2,970	2,784	2,095	1,872	1,763	1,763	1,763	1,763	16,776

SHAFT METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS

PRICE OF COPPER - 65¢ U.S.

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - 000's $Can at $398.89/ton of concentrates	5,624	5,421	4,669	4,426	4,426	4,426	4,426	4,426	37,841
Net smelter returns per ton of ore milled	32.137	30.977	26.680	25.291	25.291	25.291	25.291	25.291	27.029
Operating cost per ton of ore milled	12.472	12.472	12.472	12.472	13.094	13.094	13.094	13.094	12.783
Operating Profit per ton of ore milled	19.665	18.505	14.208	12.819	12.197	12.197	12.197	12.197	14.246
Operating Profit - 000's $Can	3,441	3,238	2,486	2,243	2,134	2,134	2,134	2,134	19,944

SHAFT METHOD

ESTIMATED OPERATING PROFIT - CANADIAN FUNDS
PRICE OF COPPER - 70¢ US

Years	1	2	3	4	5	6	7	8	Total & Average
Tons milled - 000's	175	175	175	175	175	175	175	175	1,400
Tons concentrates sold	14,098	13,589	11,705	11,095	11,095	11,095	11,095	11,095	94,867
Net smelter returns - ooo's $Can. at $432.30/ton of concentrates	6,095	5,875	5,060	4,796	4,796	4,796	4,796	4,796	41,011
N.S.R. per ton of ore milled	34.829	33.571	28.914	27.406	27.406	27.406	27.406	27.406	29.294
Operating cost per ton of ore milled	12.472	12.472	12.472	12.472	13.094	13.094	13.094	13.094	12.783
Operating profit per ton of ore milled	22.357	21.099	16.442	14.934	14.312	14.312	14.312	14.312	16.511
Operating profit - 000's $Can.	3,912	3,692	2,877	2,613	2,505	2,505	2,505	2,505	23,115

TRACKLESS METHOD

ESTIMATED CASH FLOW
PRICE OF COPPER - 50¢ US

ALL FIGURES ARE 000'S $ CANADIAN

	1/2	1	1-1/2	2	2-1/2	3	4	5	6	7	8
Operating Profit	1,070	1,071	994	995	713	713	1,244	1,135	1,135	1,135	1,135
Investment Income	-	-	-	-	-	-	14	39	39	39	39
Total Income	1,070	1,071	994	995	713	713	1,258	1,174	1,174	1,174	1,174
Replacement of Assets (Non-Capital)	-	50	-	50	-	50	50	50	50	50	50
Interest	396	205	164	122	81	53	14	-	-	-	-
Total Other Deductions	396	255	164	172	81	103	64	50	50	50	50
Operating Profit Prior to Dep'n. & Taxes	674	816	834	823	632	610	1,194	1,124	1,124	1,124	1,124
Depreciation	-	-	-	-	-	-	873	612	428	300	210
Write-off Pre-Production Expenses	674	816	834	823	108	-	-	-	-	-	-
Total Other Write-offs	674	816	834	823	108	-	873	612	428	300	210
Taxable Income for B.C. Min. Tax	-	-	-	-	605	610	307	473	657	785	875
Processing Allowance + $10,000 Allowance	-	-	-	-	101	92	59	81	109	128	141
Taxable Income Sub. to B.C. Min. Tax	-	-	-	-	504	518	248	392	548	657	734
B.C. Mining Tax Payable at 15%	-	-	-	-	76	78	37	60	82	98	110
Taxable Income for Federal Tax Base	-	-	-	-	-	-	284	452	614	726	804
Depletion	-	-	-	-	-	-	95	151	205	242	268
Federal Income Tax at 50%	-	-	-	-	-	-	95	151	205	242	268
Cash Repayment											
- Debt	4,766	4,092	3,276	2,442	1,619	1,063	531	913	837	784	746
- Cash Available for Repayment	674	816	834	823	556	532	1,062	-	-	-	-
- Balance	4,092	3,276	2,442	1,619	1,063	531	-	-	-	-	-
- Cash Available for Shareholders	-	-	-	-	-	-	531	913	837	784	746

TRACKLESS METHOD

ESTIMATED CASH FLOW
PRICE OF COPPER - 60¢ US

ALL FIGURES ARE 000'S $ CANADIAN

	1/2	1	1-1/2	2	3	4	5	6	7	8
Operating Profit	1,541	1,542	1,448	1,449	2,208	1,985	1,876	1,876	1,872	1,872
Investment Income	-	-	-	-	77	69	66	66	66	66
Total Income	1,541	1,542	1,448	1,449	2,285	2,054	1,942	1,942	1,938	1,938
Replacement of Assets (Non-Capital)	-	50	-	50	50	50	50	50	50	50
Interest	396	181	116	52	-	-	-	-	-	-
Total Other Deductions	396	231	116	104	50	50	50	50	50	50
Operating Profit Prior to Dep'n. & Taxes	1,145	1,311	1,332	1,345	2,235	2,004	1,892	1,892	1,888	1,888
Depreciation	-	-	-	-	-	873	612	428	300	210
Write-off Pre-Production Expenses	1,145	1,311	799	-	-	-	-	-	-	-
Total Other Write-offs	1,145	1,311	799	-	-	873	612	428	300	210
Taxable Income for B.C. Min. Tax	-	-	533	1,345	2,158	1,062	1,214	1,398	1,522	1,612
Processing Allowance + $10,000 Allowance	-	-	200	212	345	170	192	220	238	251
Taxable Income Sub. to B.C. Min. Tax	-	-	333	1,133	1,813	892	1,022	1,178	1,284	1,361
B.C. Mining Tax Payable at 15%	-	-	50	170	272	134	153	177	193	204
Taxable Income for Federal Tax Base	-	-	-	-	-	997	1,127	1,287	1,395	1,474
Depletion	-	-	-	-	-	332	372	428	465	490
Federal Income Tax at 50%	-	-	-	-	-	332	372	428	465	490
Cash Repayment										
- Debt	4,766	3,621	2,310	1,028	-	-	-	-	-	-
- Cash Available for Repayment	1,145	1,311	1,282	1,175	1,963	1,538	1,367	1,287	1,230	1,194
- Balance	3,621	2,310	1,028	-	-	-	-	-	-	-
- Cash Available for Shareholders	-	-	-	147	1,963	1,538	1,367	1,287	1,230	1,194

FUNDS REQUIRED - BY MONTHS

Months	Trackless Method	Shaft Method
1	$ 448,226	$ 659,994
2	448,226	427,523
3	493,312	523,387
4	424,233	465,774
5	424,728	509,721
6	459,902	631,177
7	614,204	627,385
8	625,533	690,842
9	828,222	866,423
Totals	$ 4,766,586	$ 5,402,226

CHAPTER II
PROPERTY, HISTORY, GEOLOGY & ORE RESERVES

PROPERTY AND LOCATION

The Alwin Mining Company Ltd. hold a group consisting of three Crown-granted claims and twenty-one recorded claims in the Highland Valley Area. This group is situated about 4½ to 5 miles west of the Bethlehem Copper Corporation Ltd. concentrator, and is connected to the Ashcroft-Bethlehem hard surface highway by 5 miles of good gravel road.

HISTORY

The property was located originally in the early 1900's. 11,000 tons of ore with an average grade of 3.25% copper, 0.30 ounces of silver and a trace of gold per ton were mined by the Ashcroft Copper Company Ltd. in the period 1916, 1917 and 1918.

It appears that the mine was shut down in 1918 because the price of copper declined, since reported estimates of material remaining amounted to 10,000 tons averaging 4.85% copper and 0.28 ounces of silver per ton.

The Alwin Mining Company Ltd. acquired title shortly after incorporation in 1964. Induced polarization, magnetic and geochemical surveys led to extensive surface diamond drilling with successful results.

During 1968 and 1969, further surface diamond drilling was completed. An adit at the 5130 elevation has been driven easterly on line for 2700' and a 700' northerly crosscut through at least seven mineralized zones completed from a point about 1700' from the portal.

Drifting and raising has partially explored four of the zones at and above this 5130 elevation and numerous underground diamond drill holes have probed the various zones at 100' intervals, from the surface, (approximate elevation 5,430) down to about the 4550 elevation.

BUILDINGS AND PLANT

Present buildings are temporary in nature, consisting of a number of trailers and plywood buildings suitable to accommodate an exploration crew of about thirty men.

Similarly, a plywood building houses a compressed air and generating plant consisting of three 600 cfm diesel operated portable compressors. Electricity is supplied by means of two diesel generators, one 25 kW and one 75 kW in size.

GEOLOGY AND MINERALIZATION

The adit area is in the eastern part of the Alwin property, in Bethsaida granodiorite. This rock is fractured along steeply dipping, N60°E and N70°W, planes.

At least seven (and possibly more) mineralized zones of economic significance have been discovered, which occupy such fractures and vary from one foot to over thirty feet in width.

Chalcopyrite and lesser amounts of bornite are present with generally abundant sericite in the fracture fillings. Pyrite occurrence is quite minor.

A north-south dyke of feldspar porphyry, twenty feet wide, traverses the various mineralized zones. It dips 45° easterly and has the effect of segmenting the ore. Another lesser dyke of similar rock is known in the underground workings.

ORE RESERVES

(1) SUMMARY

As of March 1970, the ore reserves are estimated to be 1,051,949 tons in place, containing 2.51% copper and 0.375 ounces of silver per ton. Including an allowance of 86,961 tons assaying 0.10% copper (8.27% average) for mining dilution, these reserves are estimated at 1,138,910 tons assaying 2.33% copper. This represents 1539 tons per vertical foot of depth. All of the ore will have to be mined by underground methods.

Drifting and raising conducted along and upwards from the 5130 level has confirmed much of the results indicated by previous diamond drilling and has demonstrated that the mineralization possesses good continuity.

It is conservatively estimated therefore that an additional 250,000 tons of similar material will be found by further exploration.

(2) GENERAL

The zones vary from about one foot to thirty-two feet and average about 10.5 feet in true width. They are spread along a total strike length of about 1,700 feet, and although some appear to have weakened or have been delimited by the exploration work completed to date, several are still open in strike and in depth.

From the present underground openings it has been possible to probe the structure of long diamond drill holes to about 800 feet below the surface. No change in the favourable geological environment has been observed at this depth and some zones are still open.

The lower limit of this deep diamond drilling represents an approximate economic limit for further exploration by this means.

Along the strike of the favourable structure possibilities still exist relative to the discovery of additional zones of the extension of the present ones.

Four surface diamond drill holes situated about 400' easterly from the underground work cut interesting copper values worthy of further investigation.

Similarly, several diamond drill holes directed across the structure about 500' westerly from the main mineralized zones cut narrow widths of good grade mineralization with extensions as yet not fully determined.

Summarizing, additional ore as stated will undoubtedly be found therefore both easterly and westerly of the presently explored zones with depth extensions possible.

Extensive work was carried on in the 1969 in an effort to prove or disprove the presence of disseminated or "porphyry" type copper deposits on other parts of Alwin's claim group.

Tractor trenching at regular intervals followed by surface diamond drilling, designed to explore several areas showing copper geochemical anomalous values, failed, however, to disclose anything of any economic significance.

(3) CALCULATIONS

The principles used in the ore reserve calculation were as follows:

1. Length of intersections and assay values determined from a total of close to 200 diamond drill holes, both surface and underground, were combined with lengths and assay values obtained from chip and channel sampling of mineralization exposed by underground work. It should be noted that diamond drilling was directed so as to cut the zones at 100' intervals.

2. Areas of influence for any one intersection have been extended halfway to adjacent holes and up to a maximum of 100' (chiefly in depth) where no other drilling exists.

3. True widths of mineralization have been obtained by multiplying the drill hole intersection lengths by factors related to the angle of the drill hole and the angle of the mineralization.

4. If the true width amounted to less than 4.0', which is considered to be a minimum mining width, the grade of copper has been reduced proportionately.

5. If the grade of copper so calculated amounted to less than 0.90%, the intersection was disregarded except as noted below.

6. Material containing 0.70% copper has been included if adjacent to an acceptable block.

7. A factor of 11.2 cu. ft. per ton has been used, as per specific gravity determinations reported by the Department of Energy, Mines and Resources, Ottawa.

8. Mining dilution has been calculated by considering the relative dimensions of the ore zones in relation to the proposed method of mining, and the physical characteristics of the mineralization together with that of the wall rocks. It is considered that both the ore and the wall rocks are competent and will stand well if mined as proposed.

Dilution was therefore calculated as follows: -

(a) Blocks 200' and less in length, with widths less than 9', limited tonnage and no pronounced bends along the strike - shrinkage stoping to be used and dilution factor of 12%.

(b) Blocks over 9' in width, all blocks over 200' in length, blocks too close to other blocks to permit shrinkage stoping - cut and fill stoping to be used and dilution factor of 7%.

(c) Blocks up to 9' in width, but not in category (a) - cut and fill stoping to be used and dilution factor of 10%.

SUMMARY - ORE RESERVE ESTIMATE

Block	Section	Tons	Grade % Copper	Width Feet	% Dilution	Tons Including Dilution	Grade % Copper
1	46	5,625	4.48	6.0	12	6,300	4.01
2	46	3,107	1.61	4.0	12	3,480	1.45
3	46	1,787	1.61	4.0	12	2,001	1.45
4	46	7,303	5.10	5.8	12	8,179	4.56
5	46	2,232	1.66	5.0	12	2,500	1.49
6	46	2,232	1.66	5.0	12	2,500	1.49
7	47	7,152	2.58	7.7	12	8,010	2.31
8	47	4,107	2.51	4.0	12	4,600	2.25
9	47	3,285	0.73	4.0	12	3,679	0.66
10	47	3,125	1.36	7.0	10	3,438	1.24
11	47	3,125	1.36	7.0	10	3,438	1.24
12	47	2,678	0.93	6.0	10	2,946	0.85
13	47	2,678	0.93	6.0	10	2,946	0.85
14	47	3,571	1.01	4.0	10	3,928	0.93
15	48	4,500	3.00	7.0	12	5,040	2.69
16	48	4,464	1.22	5.0	12	5,000	1.10
17	48	2,625	1.09	4.9	12	2,940	0.98
18	48	2,411	1.09	4.9	12	2,700	0.98
19	48	20,464	1.65	19.1	12	22,920	1.48
20	48	3,821	0.77	4.0	12	4,280	0.70
21	48	1,786	2.55	4.0	12	2,000	2.29
22	48	1,786	2.55	4.0	12	2,000	2.29
23	48	8,571	1.76	6.0	12	9,600	1.58
24	48	11,910	2.35	12.7	7	12,744	2.20
25	49	9,036	1.84	9.2	12	10,120	1.65
26	49	1,008	7.18	4.5	12	1,129	6.42
27	49	1,008	7.18	4.5	12	1,129	6.42
28	49	20,035	2.85	18.7	7	21,437	2.67
29	49	23,000	2.63	28.0	7	24,610	2.46
30	50	4,464	4.38	5.0	12	5,000	3.92
31	50	5,893	2.85	4.4	12	6,600	2.55
32	50	12,286	2.24	17.2	7	13,146	2.10
33	50	11,054	4.82	27.5	7	11,828	4.51
34	50	5,357	1.82	20.0	12	6,000	1.63
35	50	24,107	2.62	20.0	7	25,794	2.45
36	50	23,571	4.09	16.0	7	25,221	3.82
37	50	13,500	2.04	14.4	7	14,445	1.91
38	50	3,348	2.15	10.7	7	3,582	2.01
39	50	5,312	2.15	7.0	7	5,684	2.01
40	50	3,214	0.95	4.0	12	3,600	0.89
41	50	30,357	1.06	13.6	7	32,482	0.99
41A	50	17,678	6.27	9.0	7	18,915	5.87
42	50	7,036	1.08	7.5	12	7,880	0.98
43	50	3,571	0.88	4.0	12	4,000	0.80
43A	50	3,482	2.07	3.9	10	3,830	1.89
44	51	9,107	2.89	10.2	7	9,744	2.70
45	51	3,839	0.76	4.3	12	4,300	0.69

Block	Section	Tons	Grade % Copper	Width Feet	% Dilution	Tons Including Dilution	Grade % Copper
46	51	5,455	3.43	4.7	12	6,110	3.07
47	51	4,875	1.52	4.2	12	5,460	1.36
48	51	24,339	1.17	23.7	7	26,043	1.09
49	51	5,089	5.15	7.6	7	5,445	4.81
50	51	4,071	2.42	7.6	7	4,356	2.26
51	51	8,250	2.94	7.7	7	8,827	2.75
52	51	2,678	2.14	5.0	12	3,000	1.92
53	51	2,455	2.14	5.0	12	2,750	1.92
54	51	5,545	1.24	4.6	10	6,100	1.11
55	51	23,661	2.21	17.7	7	25,317	2.07
55A	51	15,267	0.66	11.4	7	16,336	0.62
56	52	3,821	3.14	4.5	7	4,088	2.94
57	52	6,750	2.30	6.3	7	7,223	2.15
58	52	21,152	4.28	20.6	7	22,633	4.00
59	52	13,392	4.28	30.0	7	14,329	4.00
60	52	5,000	1.90	7.0	10		
		2,143	2.80	4.0	10	7,857	1.98
61	52	16,071	3.29	20.0	7	17,196	3.08
62	52	2,321	1.29	5.2	7	2,483	1.21
63	52	4,821	0.94	4.0	12	5,400	0.85
64	52	3,143	5.88	4.4	12	3,520	5.26
65	52	6,696	4.96	7.5	10	7,366	4.52
66	52	4,750	1.92	5.6	10	5,225	1.75
67	52	5,946	2.71	7.4	10	6,541	2.47
68	52	7,553	1.36	8.9	10	8,308	1.24
69	52	5,830	2.78	8.7	12	6,530	2.49
70	52	6,670	1.67	8.3	12	7,470	1.50
71	52	6,223	1.90	8.2	12	6,970	1.71
72	52	3,455	1.13	8.6	12	3,870	1.02
73	52	7,678	1.13	8.6	12	8,600	1.02
74	52	2,857	1.96	4.0	12	3,200	1.76
75	53	1,785	1.30	4.0	12	2,000	1.17
76	53	1,785	1.90	4.0	12	2,000	1.71
77	53	12,223	4.89	8.4	10	13,445	4.45
78	53	8,500	0.90	8.9	10	9,350	0.83
79	53	7,473	0.77	4.7	10	8,220	0.71
80	53	3,786	1.40	4.0	10	4,165	1.28
81	53	3,571	3.27	4.0	12	4,000	2.93
82	53	1,357	1.30	4.0	12	1,520	1.17
83	53	2,571	1.19	4.0	12	2,880	1.07
84	53	32,848	2.83	28.3	7	35,147	2.65
85	53	9,643	2.38	5.4	12	10,800	2.12
86	54	6,071	4.47	4.0	10	6,678	4.07
87	54	5,098	3.52	5.1	12	5,710	3.15
88	54	8,062	2.16	7.4	12	9,030	1.94
89	54	5,714	1.34	8.0	12	6,400	1.20

Block	Section	Tons	Grade % Copper	Width Feet	% Dilution	Tons Including Dilution	Grade % Copper
90	54	6,428	2.60	4.0	12	7,200	2.33
91	54	3,098	1.04	5.1	12	3,470	0.94
92	55	6,955	1.78	4.4	10	7,650	1.63
93	55	2,750	1.51	4.0	10	3,025	1.38
94	55	3,214	1.51	4.0	10	3,535	1.38
95	55	6,071	1.43	4.0	12	6,800	1.29
96	55	5,223	4.03	4.3	12	5,850	3.61
97	55	13,286	1.18	8.7	7	14,216	1.10
98	56	10,178	2.95	19.0	12	11,400	2.64
99	56	7,696	1.61	8.8	12	8,620	1.45
100	56	10,348	4.59	9.5	12	11,590	4.10
101	56	2,901	5.30	5.0	12	3,250	4.74
102	56	2,901	1.20	5.0	12	3,250	1.08
103	56	6,152	2.52	5.1	12	6,890	2.26
104	56	6,071	0.75	4.0	12	6,800	0.68
105	56	5,714	1.47	4.0	12	6,400	1.32
106	56	14,571	8.95	10.2	7	15,591	8.37
107	56	5,714	0.92	4.0	12	6,400	0.83
108	57	3,286	1.10	4.0	12	3,680	0.99
109	57	12,143	2.65	8.5	12	13,600	2.38
110	57	3,571	3.14	4.0	12	4,000	2.81
111	57	2,857	3.14	4.0	12	3,200	2.81
112	57	5,714	3.70	4.0	12	6,400	3.31
113	58	19,973	2.41	23.3	12	22,370	2.16
114	58	4,393	2.02	4.0	12	4,920	1.81
115	58	4,714	0.94	4.0	12	5,280	0.85
116	59	7,607	0.87	7.1	12	8,520	0.79
117	42	3,571	1.47	4.0	12	4,000	1.32
118	42	4,732	1.08	5.3	12	5,300	0.97
119	44	2,857	1.75	4.0	12	3,200	1.57
120	44	1,428	1.75	4.0	12	1,600	1.57
Reasonably Assured		900,169	2.57			985,540	2.36
Probable		151,780	2.17			153,370	2.15
Total:		1,051,949	2.51			1,138,910	2.33

CHAPTER III
MINE

MINING

GENERAL

Two methods of developing the mine have been studied. The first involves the sinking of a three-compartment shaft at the approximate coordinates 96,530 ft north and 97,420 ft east. Two levels will be cut from the shaft, No. 3 at the 4,980 elevation and No. 4 at the 4,830 elevation, in addition to the present adit at 5,130 elevation. A new adit at the 5,280 elevation would be driven from the surface and connect with the shaft.

The section of the shaft from the surface down to the present adit will be constructed by boring a pilot hole about 10 inches in diameter, followed by reaming to 72 inches or 84 inches in diameter. This will subsequently be enlarged to the full shaft size after the installation of the shaft hoist and head frame, by normal progress downwards using the 10 inch diameter hole as a "cut" and removing the broken rock out from the present adit. The section of the shaft below the second level will then be sunk in the ordinary fashion and a minimum amount of work completed on the two lower levels at the 4,980 elevation and the 4,830 elevation prior to production.

The second method would be by means of a decline ramp system, driven downwards through and adjacent to the mineralized zones. A main decline (8 ft x 9 ft in cross section) would be started (at minus 15°) from a portal at the 5,342 elevation and would connect with the present adit as shown on the drawings accompanying this report. Prior to production the decline would also be sunk below the present 5,130 adit, an additional distance of 1,200 ft to permit stope preparation during the first year of production. The decline would be positioned so as to provide access to the bottom of the various ore blocks by means of short connecting cross-cuts. The broken ore would be moved to short ore pass raises for transfer to the adit level by means of diesel-powered trackless load-haul-dump equipment; from thence it would be carried to the concentrator through the present adit using diesel trucks. The section of the adit used for truck haulage would be increased to 11 ft wide and 9 ft high.

In either case it is planned that the ore will be extracted by shrinkage stoping and cut and fill stoping. The ore mined during the pre-production period would be stockpiled on the surface at a point close to the concentrator in order that it can be later reclaimed to serve as feed to the mill during the first year of production.

COMPARISON OF SHAFT METHOD AND TRACKLESS METHOD

The tops and bottoms of the potential ore blocks at Alwin are at many different elevations. With the shaft method, some blocks would have sill elevations above and some below the horizontal levels. Additional preparation work is therefore required for these blocks as compared to those with sill elevations on the level.

With the trackless method, however, openings can be driven off the main declines at any angle and distance required to adjust to the bottom of the ore blocks. Costs are therefore reduced relative to the shaft method and greatly increased flexibility is attained.

Less men are required for the trackless method with corresponding reductions in operating costs, accommodation required, etc.

SELECTION OF STOPING METHODS

The wall rocks at Alwin are quite competent and much of the ore can be mined by shrinkage stoping. A number of the blocks, however, are parallel and are separated by only a few feet of intervening rock. A closely controlled mining sequence must therefore be established in order that one stope underlying another stope would not produce caving before proper mining can be completed.

It would appear that some of the ore blocks will join each other along the strike, but in places insufficient diamond drilling has been completed to determine whether this is so or not. It is proposed therefore to further explore the ore zones by means of closely spaced drilling from the new openings prior to establishing stope layouts.

It is proposed that approximately one-half of the ore will be mined by cut and fill methods, which will avoid, at least partly, the dilution that would be encountered by shrinkage stoping due to possible gaps in the ore shoots along the strike. In addition, cut and fill stoping will provide an immediate source of ore for the mill and does not require time to build up a sufficient broken reserve to supply daily requirements as in shrinkage stoping.

Thirty-nine and two part blocks situated above the 5,130 level have been selected for initial mining, and will provide sufficient ore for the first two years of production.

A total of 14 stopes made up of combinations of these blocks will be prepared during the pre-production period. Of these, 4 cut and fill stopes and 5 shrinkage stopes will supply the necessary initial ore for the concentrator. The extra stopes provide insurance to prevent interruptions in production caused by either the irregular nature of the ore blocks or by mechanical problems. After the first year of mining, sufficient ore will be broken and available in the shrinkage stopes to use as an additional reserve. The ore blocks have been chosen so as to constitute a total of about 16,000 tons/shrinkage stope, and a continuous program to develop and prepare new stopes will replace those exhausted as mining progresses. It is anticipated that 20 such new stopes will be required during the first three years.

STOPE PREPARATION

In this report, preparation work is considered to be composed of the drifts in the footwall parallel to the ore, cross-cuts to the ore zones, the sill drifts, slashing and taking down the first lift in the stope, and the necessary timbering for starting the cut and fill stopes.

SHRINKAGE STOPING

Cross-cuts will be driven to the bottom of the shrinkage stopes from drifts which will be driven in the footwall of the ore zones in a parallel direction but about 25 ft away. These cross-cuts, as it can be seen from the accompanying drawings in this report, will be at an angle of about 30° to the general strike of the ore zones. A sill drift will be driven from the ends of the cross-cuts at the same elevation and the resulting broken ore removed.

It is not planned to drive manway raises for many of the stopes. There will therefore be no point of exit at the top of the stope. Instead it is planned to carry timbered manways up each end of a shrinkage stope to provide access where the stope is 200 ft or more in length. If the stope is only 100 ft long, one manway will be carried at one end.

Two men per shift on each of 2 shifts will carry out the necessary drilling and blasting, and a special timber crew will extend manways as and when necessary. Broken ore will be picked up in the cross-cuts by diesel-operated loaders and moved to ore passes situated close to the stoping areas. Under the trackless method proposed, a 10-ton truck (or two 10-ton trucks) will draw the ore through chutes at the bottom of the ore passes and haul it to the concentrator. In the shaft method, diesel locomotives and trains of ten-45 cu ft cars each will transport the ore to an ore pass system which will be connected at its lower end to a shaft loading pocket, situated below the 4,830 level. It is planned that hoisting will be carried out on a one shift basis, using 3 ton skips operating in balance.

CUT AND FILL STOPING

The cut and fill stopes will be prepared by cross-cuts in the same manner as that suggested for shrinkage stoping. Each cut and fill stope, however, will have two mill holes and 3 manways for the short to medium length stopes and 3 mill holes and 4 manways for the longer stopes. Two of these manways will always be kept open.

One cu yd capacity diesel-operated loaders will be used in the stopes to move the ore to the mill holes. The mill holes will be carried upwards and parallel to the stope but about 20 ft away in the footwall side. This will permit easy turning for the loaders. The mill holes will be timbered on one side and the waste extracted will form part of the fill in the stope. The ore, after being dumped in the mill holes, will be extracted by diesel operated loaders at the bottom of the mill holes and transported to ore passes situated not more than 200 ft away, in the same manner as in the shrinkage stopes.

A stope crew will consist of two machine men and a leader on each of 2 shifts and will carry out the drilling, blasting and transporting of broken ore. Timber crews, who will alternate between the shrinkage stopes and the cut and fill stopes, will construct the manways, build cat-walks, install drains and be responsible for the placing of the fill. Ore will be broken in one section of the stope at the same time as fill is being placed in the other end, so that continuous production can be maintained.

STOPE FILL PLANT

It is planned that the mill tailings will be cycloned at the concentrator to remove slimes, prior to pumping to the fill plant. This will be located on the surface at a point on the top of the hill over the approximate centre of the ore area. Three storage tanks will be provided, with conical bottoms. A cement storage tank and two mixing tanks will also be constructed. One of these mixing tanks will be used for mixing cement and water and the second one for mixing slurry. The resulting sand-cement mix will be passed downwards by gravity to the various stoping areas through holes drilled for this purpose.

From the processing of 175,000 tons of ore approximately 14,000 tons will be removed as concentrates, the remaining 161,000 tons will be available to replace the proposed 95,000 tons of cut and fill ore to be mined yearly. No test work has been done on the ore to ascertain what recovery of suitable sand can be expected but it is felt that enough fill will be thus easily provided.

MINE SERVICING

For the "trackless" method, it is proposed that second hand four wheel drive "Jeeps" will be provided to transport the working crews and the necessary supplies. Five vehicles have been included in the cost estimates of which 2 will be equipped with special bodies so that 14 men can be transported per vehicle.

For the "shaft" method, servicing would take place by means of the 5,130 adit level, the 5,280 adit level and the shaft itself.

VENTILATION

It is planned, for the trackless method, to blow fresh air down the new decline (5,342 elevation) using two 30,000 cfm fans in series, and to blow additional fresh air down the existing raise which has been connected via the old workings to the surface, by means of a 15,000 cfm fan. Foul air will be exhausted through the 5,130 adit portal.

For the shaft method, it is planned to blow fresh air in through the 5,130 adit level, pass it upwards through ventilation raises connected with the stoping areas, and exhaust it as foul air along the levels and up the shaft.

SOURCE OF ORE AND GRADE OF COPPER

The tables following itemise the proposed stope locations, the statistics concerning the preproduction stockpile, the tons developed, mined and drawn during the first three years of production and the estimated grade of ore milled during this period.

Similar calculations have been compiled for the fourth year and partially estimated for the fifth year, but these have not been included in this report; because it is felt insufficient information is now available to project such figures with any degree of accuracy.

TABLE 1.

PROPOSED STOPE LOCATIONS
FOR FIRST 3 YEARS PRODUCTION

Stope No.	Section	Blocks	Width-Ft.	% Dilution	Designation Shrinkage (S) Cut & Fill (CF)
1	46,47	1,7	6.0-7.7	12	S
2	46,47	4,8	4.0-5.8	12	S
3	48	15	7.0	12	S
4	50	31	4.4	12	S
5	49,50	25,30	5.0-9.2	12	S
6	55,56	96,98,99,1/3(100)	4.3-19.0	12	S
7	57,58	108,113	4.0.23.3	12	S
8	47,48	9.19	4.0-19.1	12	S
9	49,50	28,35	18.7-20	7	CF
10	50,51,52	36,48,56,57	4.5-23.7	7	CF
11	52,53,54,55	65,66,77,79,86,½(92)	4.0-8.9	10	CF
12	50,51,52	37,38,49,58	7.6-20.6	7	CF
13	50,51,52,53	43A,54,67,78,80	3.9-8.9	10	CF
14	50,51	32,33,44	17.2-27.5	7	CF
15	48,49	16,26,27	4.5-5.0	12	S
16	50	34	20.0	12	S
17	52	64	4.4	12	S
18	57	112	4.0	12	S
19	54	87,88	5.1-7.4	12	S
20	51	½(68),69	8.7-8.9	10-12	S
21	54	90	4.0	12	S
22	51	52,53	5.0	12	S
23	52,53	½(61),62,63,84	4.0-28.3	7-12	CF
24	52	½(61),59	20.0-30.0	7	CF
25	50,51	39,50,1/3(51)	7.0-7.7	7	CF
26	50,51	2/3(51),½(68)	7.7-8.9	7-10	CF
27	54	89	8.0	12	S

TABLE 2.

ESTIMATED PREPRODUCTION STOCKPILE

FROM STOPE PREPARATION

Stope No.	Tons After Mining Dilution: Reserves	Mined & Stockpiled	Remainder - Tons Developed	Stope Grade % Copper
1	14,310	980	13,330	3.06
2	12,780	700	12,080	3.73
3	5,040	500	4,540	2.69
4	6,600	320	6,280	2.56
5	15,120	1,010	14,110	2.40
6	29,730	930	28,800	2.69
7	26,050	1,950	24,100	2.00
8	26,600	1,640	24,960	1.37
Sub Total & Average	136,230	8,030	128,200	2.25
9	47,220	5,520	41,700	2.55
10	62,570	6,300	56,270	2.44
11	44,765	3,090	41,675	3.16
12	46,105	5,580	40,525	3.29
13	29,970	3,320	26,650	1.45
14	34,710	6,120	28,590	3.09
Sub Total & Average	265,340	29,930	235,410	2.72
Grand Total & Average	401,570	37,960	363,610	2.62

TABLE 3.

ESTIMATED TONS DEVELOPED, MINED & DRAWN
FIRST YEAR PRODUCTION

	Stope No.	Tons Developed at Beginning of Year In Place	Tons Mined	Tons Drawn to Mill	Tons Developed at End of Year Broken	Tons Developed at End of Year In Place
Shrinkage Stopes	1	13,330	13,330	4,660	8,670	-
	2	12,080	12,080	4,230	7,850	-
	3	4,540	4,540	1,590	2,950	-
	4	6,280	-	-	-	6,280
	5	14,110	14,110	4,940	9,170	-
	6	28,800	23,520	8,230	15,290	5,280
	7	24,100	-	-	-	24,100
	8	24,960	-	-	-	24,960
	Sub Total	128,200	67,580	23,650	43,930	60,620
Cut & Fill Stopes	9	41,700	22,000	22,000	-	19,700
	10	56,270	28,795	28,795	-	27,475
	11	41,675	25,000	25,000	-	16,675
	12	40,525	20,000	20,000	-	20,525
	13	26,650	-	-	-	26,650
	14	28,590	-	-	-	28,590
	Sub Total	235,410	95,795	95,795	-	139,615
Shrinkage Stope Preparation	15	7,270	700	700	-	6,570
	16	5,990	1,400	1,400	-	4,590
	17	3,520	310	310	-	3,210
	18	6,410	290	290	-	6,120
	19	14,740	450	450	-	14,290
	20	10,760	625	625	-	10,135
	21	7,200	290	290	-	6,910
	22	5,760	360	360	-	5,400
	27	6,410	580	580	-	5,830
	Sub Total	68,060	5,005	5,005	-	63,055
Cut & Fill Preparation	23	51,390	4,290	4,290	-	47,100
	24	22,930	3,570	3,570	-	19,360
	25	12,980	2,230	2,230	-	10,750
	26	9,930	2,500	2,500	-	7,430
	Sub Total	97,230	12,590	12,590	-	84,640
	Total - Stope Preparation	165,290	17,595	17,595	-	147,695
	Grand Total	528,900	180,970	137,040	43,930	347,930

TABLE 4.

ESTIMATED TONS DEVELOPED, MINED & DRAWN
SECOND YEAR PRODUCTION

	Stope No. (or Sect. & Block No.)	Tons Developed at Beginning of Year		Tons Mined	Tons Drawn to Mill	Tons Developed at End of Year	
		Broken	In Place			Broken	In Place
	1	8,670	-	-	8,670	-	-
	2	7,850	-	-	7,850	-	-
	3	2,950	-	-	2,950	-	-
	4	-	6,280	6,280	1,960	4,320	-
	5	9,170	-	-	9,170	-	-
	6	15,290	5,280	5,280	17,050	3,520	-
	7	-	24,100	24,100	8,000	16,100	-
Shrinkage	8	-	24,960	24,960	8,000	16,960	-
Stopes	15	-	6,570	-	-	-	6,570
	16	-	4,590	-	-	-	4,590
	17	-	3,210	-	-	-	3,210
	18	-	6,120	-	-	-	6,120
	19	-	14,290	-	-	-	14,290
	20	-	10,135	-	-	-	10,135
	21	-	6,910	-	-	-	6,910
	22	-	5,400	-	-	-	5,400
	27	-	5,830	-	-	-	5,830
	Sub Total	43,930	123,675	60,620	63,650	40,900	63,055
	9	-	19,700	19,700	19,700	-	-
	10	-	27,475	27,475	27,475	-	-
	11	-	16,675	16,675	16,675	-	-
	12	-	20,525	20,525	20,525	-	-
Cut & Fill	13	-	26,650	-	-	-	26,650
Stopes	14	-	28,590	7,665	7,665	-	20,925
	23	-	47,100	-	-	-	47,100
	24	-	19,360	-	-		19,360
	25	-	10,750	-	-		10,750
	26	-	7,430	-	-		7,430
	Sub Total	-	224,255	92,040	92,040	-	132,215

continued

	Stope No. (or Sect. & Block No.)	Tons Developed at Beginning of Year		Tons Mined	Tons Drawn to Mill	Tons Developed at End of Year	
		Broken	In Place			Broken	In Place
Shrinkage Stope Preparation	58-114	-	4,920	290	290	-	4,630
	57-109	-	13,600	610	610	-	12,990
	56-105	-	6,400	290	290	-	6,110
	56-103	-	6,890	360	360	-	6,530
	55-95	-	6,800	290	290	-	6,510
	53-85	-	10,800	390	390	-	10,410
	48-23	-	9,600	430	430	-	9,170
	50-42	-	7,880	540	540	-	7,340
	50-43	-	4,000	285	285	-	3,715
	52-72	-	3,870	610	610	-	3,260
	52-63	-	5,400	290	290	-	5,110
	Sub Total	-	80,160	4,385	4,385	-	75,775
Cut & Fill Stope Preparation	56-106	-	15,590	1,460	1,460	-	14,130
	55-97	-	14,215	1,240	1,240	-	12,975
	51-55	-	25,320	2,530	2,530	-	22,790
	49-29	-	24,610	4,000	4,000	-	20,610
	48-24	-	12,740	1,815	1,815	-	10,925
	50-41	-	32,480	3,880	3,880	-	28,600
	Sub Total	-	124,955	14,925	14,925	-	110,030
	Total - Stope Preparation						
	Grand Total	43,930	553,045	171,970	175,000	40,900	381,075

TABLE 5.

ESTIMATED TONS DEVELOPED, MINED & DRAWN
THIRD YEAR PRODUCTION

	Stope No.	Tons developed at Beginning of Year		Tons Mined	Tons Drawn to Mill	Tons Developed at End of Year	
		Broken	In Place			Broken	In Place
	4	4,320	-	-	4,320	-	-
	6	3,520	-	-	3,520	-	-
	7	16,100	-	-	16,100	-	-
	8	16,960	-	-	16,960	-	-
	15	-	6,570	6,570	2,750	3,820	-
Shrinkage	16	-	4,590	4,590	1,530	3,060	-
Stopes	17	-	3,210	3,210	1,070	2,140	-
	18	-	6,120	6,120	2,040	4,080	-
	19	-	14,290	14,290	4,760	9,530	-
	20	-	10,135	10,135	3,375	6,760	-
	21	-	6,910	6,910	2,300	4,610	-
	22	-	5,400	5,400	1,800	3,600	-
	27	-	5,830	-	-	-	5,830
	Stopes prepared during 2nd year	-	75,775	-	-	-	75,775
	Sub Total	40,900	138,830	57,225	60,525	37,600	81,605
	13	-	26,650	26,650	26,650	-	-
	14	-	20,925	20,925	20,925	-	-
Cut & Fill	23	-	47,100	28,000	28,000	-	19,100
Stopes	24	-	19,360	19,360	19,360	-	-
	25	-	10,750	-	-	-	10,750
	26	-	7,430	-	-	-	7,430
	Stopes prepared during 2nd year	-	110,030	-	-	-	110,030
	Sub Total	-	242,245	94,935	94,935	-	147,310
Plus Stope Preparation (estimated but not detailed)		-	195,400	19,540	19,540	-	175,860
	Grand Total	40,900	576,475	171,700	175,000	37,600	404,775

TABLE 6.

ESTIMATED GRADE OF ORE MILLED

		First Year		Second Year		Third Year	
	Stope No.	Tons Drawn to Mill	Grade % Copper	Tons Drawn to Mill	Grade % Copper	Tons Drawn to Mill	Grade % Copper
Shrinkage Stopes	1	4,660	3.06	8,670		-	
	2	4,230	3.73	7,850		-	
	3	1,590	2.69	2,950		-	
	4	-	2.56	1,960		4,320	
	5	4,940	2.40	9,170		-	
	6	8,230	2.69	17,050		3,520	
	7	-	2.00	8,000		16,100	
	8	-	1.37	8,000		16,960	
	15	700	2.72	-		2,750	
	16	1,400	1.64	-		1,530	
	17	310	5.26	-		1,070	
	18	290	3.31	-		2,040	
	19	450	2.41	-		4,760	
	20	625	1.99	-		3,375	
	21	290	2.33	-		2,300	
	22	360	1.92	-		1,800	
	27	580	1.20	-		-	
	Sub Total & Average	28,655	2.77	63,650	2.57	60,525	2.06
Cut & Fill Stopes	9	22,000	2.55	19,700		-	
	10	28,795	2.44	27,475		-	
	11	25,000	3.16	16,675		-	
	12	20,000	3.29	20,525		-	
	13	-	1.45	-		26,650	
	14	-	3.09	7,665		20,925	
	23	4,290	2.48	-		28,000	
	24	3,570	3.66	-		19,360	
	25	2,230	2.26	-		-	
	26	2,500	2.13	-		-	
	Sub Total & Average	108,385	2.82	92,040	2.84	94,935	2.56
Stope Preparation		Included above		19,310	2.24	19,540	1.80
Stockpile		37,960	2.62				
	Grand Total & Average	175,000	2.77	175,000	2.67	175,000	2.30

TABLE 7.

INITIAL 3 YEAR PRODUCTION SUMMARY
TONS MILLED & GRADE

	First Year		Second Year		Third Year		Total	
	Tons Milled	Grade % Copper	Tons Milled	Grade % Copper	Tons Milled	Grade % Copper	Tons Milled	Grade % Copper
Shrinkage Stopes	28,655	2.77	63,650	2.57	60,525	2.06	152,830	2.41
Cut & Fill Stopes	108,385	2.82	92,040	2.84	94,935	2.56	295,360	2.74
Stope Preparation	Included above		19,310	2.24	19,540*	1.80*	38,850	2.02
Stockpile	37,960	2.62	-	-	-	-	37,960	2.62
Total:	175,000	2.77	175,000	2.67	175,000	2.30	525,000	2.58

	Tons	Grade % Copper
Total ore reserves at March, 1970	1,138,910	2.33
Tons milled first 3 years	525,000	2.58
Remaining ore reserves	613,910	2.12
Expected additional reserves	250,000	2.33*
Reserves expected at end of year 3	863,910	2.18

* Estimated

PREPRODUCTION REQUIREMENTS AND ESTIMATED COSTS

A detailed program has been constructed for both the shaft method and the trackless method relative to the preproduction underground work required, and plans, which accompany this report, have been prepared.

Statements and tables follow outlining the requirements and the related estimated costs.

Table 8a

SHAFT METHOD

PREPRODUCTION MINE DEVELOPMENT

Month	Description	Hole & Reaming	Shaft Sinking Conventional	Pilot Shaft Slashing & Timbering	Drifting & Crosscutting	Sub-Drifting & Crosscutting	Raising	Cu.Ft. Sill Drift Slashing
1	(A) Sink 18' shaft & pour concrete collar 2 weeks		18					
	(B) Drill pilot hole for shaft from surface @ 5450 to 5130 elevation (1 week)							
	(C) Drifting on 5130 level to intersect pilot hole & slash station				400			
	(D) Hoist construction & head frame erection 2 weeks							
	(E) Drift from surface @ 5280 elevation				450			
2	(A) Drift (IE) cont'd on 5280 level				450			
	(B) Ream shaft to 7' diameter 5130 level to surface (14 days)							
	(C) Slash & timber shaft 6'/day for 14 days - to elev. 5348			84				
	(D) Drift to west on 5130 to stopes 1 & 2 (230' & 220')				450			
3	(A) Complete slashing & timber shaft (2C) 8'/day to 5130 elev.			218				
	(B) (2A) cont'd & cut station 15 days 5280 level				220			
	(C) Drift to east on 5280 level				230			
	(D) Drift to east on 5130 & crosscuts to stope 13				480			
	(E) Raise ore passes @ 55° from 5140 elevation to stopes 1 & 2 (120' & 125')							

Table 8a (cont'd)

Month	Description	Hole & Reaming	Shaft Sinking Conventional	Pilot Shaft Slashing & Timbering	Drifting & Crosscutting	Sub-Drifting & Crosscutting	Raising	Cu.Ft. Sill Drift Slashing
4	(A) Crosscutting on 5130 level to stope 8				150			
	(B) Begin sinking shaft 25 days 6'/day - below 5130 level		150					
	(C) Continue (3C) to east - drift on 5280				450			
	(D) Raises - ore & waste passes 5130 to 5280 (4 crews - 20'/day)						400	
	(E) Install grizzly on 5280 level & control chute on 5130 level							
	(F) Crosscutting on 5130 level to stopes 14 (115) & 12 (210)				325			
5	(A) Continue sinking shaft 30 days @ 6' (cut 4980 station) (140' shaft)		180					
	(B) Raise (ventilation) 5140 to 5280 elevation east end stope 7						185	
	(C) Drift 120' from (4C) & crosscuts to stopes 6 & 7 (18 x 10) (5280 level)				300			
	(D) Raise ore pass 502 DRE to stope 11 sub dr. 145' @ 57°						145	
	(E) Sub drift stope 11 from 2 raise tops					410		
	(F) Raise ventilation 502 DRE to stope 11 140' @ 57°						140	
	(G) Raise ventilation 502 DRE to stope 10 @ 57°						110	

Table 8a (cont'd)

Month	Description	Hole & Reaming	Shaft Sinking Conventional	Pilot Shaft Slashing & Timbering	Drifting & Crosscutting	Sub-Drifting & Crosscutting	Raising	Cu.Ft. Sill Drift Slashing
6	(A) Continue shaft sinking 30 days @ 6'/day & cut 4830 station (140' shaft)		180					
	(B) Drifting & crosscutting on 5280 to stopes 1,2,3, & 4				500			
	(C) Crosscuts from sub-drift in stope 11				100			
	(D) Manway raise from stope 11 to 5280 elev. @ 45°						15	
	(E) Raises (manway & ore pass) to stope 5 from 5140 elevation						115	
	(F) Sub-drifting & cross-cutting in stope 5					250		
	(G) Raise ore pass from 5140 elev. to stope 10 @ 57°						110	
	(H) Sill drifts in stopes 6 (200), 7 (200), 8 (200), 12 (300), 13 (400), 14 (200)					1500		
7	(A) Complete shaft (20') to 4680 elevation		20					
	(B) Cut out loading & spill pockets							
	(C) Raise 60' to 4830 elevation & install grizzly						60	
	(D) Install lip chute on 4980 level							
	(E) Sub-drift & crosscuts in stope 10					500		
	(F) Ore pass raise to stope 4 (145') & finger to stope 9 (68)						213	
	(G) Sub-drifting for stope 1					260		
	(H) Vent raise to stope 2 from 5140 elevation						140	

Table 8a (cont'd)

Month	Description	Hole & Reaming	Shaft Sinking Conventional	Pilot Shaft Slashing & Timbering	Drifting & Crosscutting	Sub-Drifting & Crosscutting	Raising	Cu.Ft. Sill Drift Slashing
7	(I) Sill drifts in stopes 3 (100), 5 (200), 11 (400)					700		
	(J) Sill drift slashing & taking down backs of stopes 12 (40800), 13 (18560), 11 (17280), 14 (54080)							130,720
8	(A) Install skips & cage, remove dump door, install skip dump mechanism							
	(B) Raises-ore pass & waste pass (2 x 225'-15'/raise/day) 30 days						450	
	(C) Drifting on 4980 level past raise locations (ore & waste)				200			
	(D) Drifting on 4830 level past raise locations (ore & waste)				90			
	(E) Sub-drifting in stope 4 (130), 2 (260), 9 (325)					715		
	(F) Manway raise from stope 10 to 5280 elevation (58') & stope 1 to 5280 (40')						98	
	(G) Vent raise to old workings from 5280 level near stope 1						100	
	(H) Sill drifts in stopes 1 (200), & 10 (300)					500		
	(I) Fill holes, lines & drain holes							
	(J) Sill timbering							

Table 8a (cont'd)

Month	Description	Hole & Reaming	Shaft Sinking Conventional	Pilot Shaft Slashing & Timbering	Drifting & Crosscutting	Sub-Drifting & Crosscutting	Raising	Cu.Ft. Sill Drift Slashing
9	(A) Raises (8B) continued (2 x 165'-15'/raise/day) break through to 5130 level						330	
	(B) Install control chute & grizzly on 4830, 4980; grizzly on 5130 level							
	(C) Raises - manways from stopes 4 (20'), 4 (110') & 2 (30') to 5280 elev.						160	
	(D) Vent raises to stope 9 (66'), 1 (166')						232	
	(E) Sill drifts in stopes 2 (200), 4 (100), 9 (200)					500		
	(F) Sill drift, slashing & taking down backs in stopes 9 (47,520) & 10 (48,960)							96,480
	(G) Sill timbering	—	—	—	—	—	—	—
	TOTAL		548	302	4795	5335	3238	227,200
	GRAND TOTAL							241,418

Table 8b

SHAFT METHOD

ESTIMATED DIRECT COSTS
PREPRODUCTION MINE DEVELOPMENT & STOPE PREPARATION

Description		Footage	Cost/Ft.	Months 1	2	3	4	5	6	7	8	9	Total
Sink 18' of shaft & power collar	1A	18	$341.39	$ 6,145	$	$	$	$	$	$	$	$	$
Move in large hole drill & drill pilot hole	B		16.56	5,000									
Drift - 5,130 level	C	400	35.28	14,112									
Drift - 5,280 level	E	450	45.28	20,376									
Portal preparation (5,280 level)	F			5,000									
Drift - 5,280 level	2A	450	35.28		15,876								
Ream shaft hole	B	302	103.44		31,240								
Slash & timber shaft	C	84	269.56		22,643								
Slash & timber shaft	3A	218	269.56			58,764							
Drift - 5,280 level & station	B	220	35.28			7,762							
Drift - 5,280 level	C	230	35.28			8,114							
Drift - 5,130 level	D	480	35.28			16,934							
Raise - ore passes	E	235	29.94			7,036							
Crosscut - 5,130 level	4A	150	35.28				5,292						
Sink shaft - below 5,130 level	B	150	341.39				51,208						
Drift - 5,280 level	C	450	35.28				15,876						
Raise - ore & waste passes	D	400	29.94				11,976						
Crosscut - 5,130 level	F	325	35.28				11,466						
Sink shaft - below 5,130 level	5A	180	341.39					61,450					
Raise	B	185	29.94					5,539					
Drift - 5,280 level	C	300	35.28					10,584					

Table 8b (cont'd)

Description		Footage	Cost/Ft.	Months 1	2	3	4	5	6	7	8	9	Total
Raise - ore pass	D	145	$ 29.94	$	$	$	$	$ 4,341	$	$	$	$	$
Sub drift	E	410	45.28					20,376					
Raise - ventilation	F	140	29.94					4,192					
Raise - ventilation	G	110	29.94					3,293					
Diamond drilling		2,700	4.50					12,150					
Sink shaft & cut 4,830 station	6A	180	341.39						61,450				
Drift - 5,280 level	B	500	35.28						17,640				
Crosscuts	C	100	45.28						4,528				
Manway raise	D	15	29.94						449				
Raises - ore pass & manway	E	115	29.94						3,443				
Sub drifts & crosscuts	F	250	45.28						11,320				
Raise - ore pass	G	110	29.94						3,293				
Sill drifts	H	1,500	45.28						67,920				
Diamond drilling		2,700	4.50						12,150				
Complete shaft	7A	20	341.39							6,828			
Raise - loading pocket to 4,830 level	C	60	29.94							1,796			
Sub drifts - stope #10	E	500	45.28							22,640			
Ore pass raise	F	213	29.94							6,377			
Sub drift - stope #1	G	260	45.28							11,773			
Vent raise	H	140	29.94							4,192			
Sill drifts - stopes #3, #5 & #11	I	700	45.28							31,696			
Sill drift slash & backs	J	130,720	0.319							41,700			
Hoisting costs										12,603			
Diamond drilling		2,010	4.50							9,045			
Ore pass & waste pass	8B	450	29.94								13,473		
Drift 4,980 level	C	200	35.28								7,056		
Drift 4,830 level	D	90	35.28								3,175		
Sub drifts - stopes #4, #2 & #9	E	715	45.28								32,375		

Table 8b (cont'd)

Description		Footage	Cost/Ft.	Months 1	2	3	4	5	6	7	8	9	Total
Manway raises	F	98	$ 29.94	$	$	$	$	$	$	$	$ 2,934	$	$
Vent raise	G	100	29.94								2,994		
Sill drifts - stopes #1 & #10	H	500	45.28								22,640		
Fill holes, lines & drain holes	I										8,948		
Sill timbering	J										4,598		
Hoisting costs											12,603		
Pump sump on 4,830 level											6,000		
Ore pass & waste pass	9A	330	29.94									9,880	
Manway raises	C	160	29.94									4,790	
Vent raises	D	232	29.94									6,946	
Sill drifts - stopes #2, #4 & #9	E	500	45.28									22,640	
Sill drift slash & backs	F	96,480	0.319									30,777	
Sill timbering	G											8,196	
Hoisting costs												12,603	
Total				$50,633	$85,635	$98,610	$95,818	$121,925	$182,193	$148,650	$116,796	$95,832	$996,092

Table 8c

SHAFT METHOD

ESTIMATED INDIRECT COST

PREPRODUCTION MINE DEVELOPMENT

	Months									
	1	2	3	4	5	6	7	8	9	Total
Supervision	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 51,030
Assaying	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	10,440
Engineering	5,148	5,148	5,148	5,148	5,940	5,940	5,940	7,854	7,854	54,120
First aid-Warehouse	848	848	848	848	848	848	848	848	848	7,632
Change house & lamps	833	833	833	833	833	833	833	833	833	7,497
Compressor & power plant operation	11,055	11,385	12,698	18,322	18,322	18,322	18,322	18,322	18,322	145,070
Truck operation surface	925	925	925	925	925	925	925	925	925	8,325
Tractor operation surface	900	900	1,800	1,800	1,800	1,800	1,800	1,800	1,800	14,400
Mechanical and electrical	7,450	7,450	7,450	7,450	8,750	8,750	8,750	8,750	8,750	73,550
General underground and clean up	698	698	698	1,396	1,396	1,396	2,094	2,094	2,094	12,564
Tramming and Supplies Distribution	5,917	5,917	5,917	5,917	5,917	5,917	5,917	5,917	5,917	53,253
Totals	$40,604	$40,934	$43,147	$49,469	$51,561	$51,561	$52,259	$54,173	$54,173	$437,881

Table 8d

SHAFT METHOD

ESTIMATED CAPITAL COSTS - SUPPLEMENTARY SHEET
PREPRODUCTION MINE DEVELOPMENT

Item	Unit Weight - lbs	Unit Cost (New)	Unit Cost (Used - Where Applicable)	Unit Installation Cost	Amount Required	Total Weight - lbs	Total Cost (New)	Total Cost (Used - Where Applicable)	Installation Cost
900 cfm Stationary Compressor - Electric	7,800	$20,135	$13,425		6	46,800	$120,810	$ 80,550	
Compressor Installation				$2,000	6				$12,000
After Coolers	1,300	1,047	7,000		3	3,900	3,141	2,100	
After Cooler Installation									600
Receivers - 42" x 120"	2,000	702	500		3	6,000	2,106	1,500	
Receiver Installation				100	3				300
Diesel Locomotives (4 ton size)	8,000	6,795	-		3	24,000	20,385	-	
Mine Cars (45 cu ft each)	1,000	1,200	800		35	35,000	42,000	28,000	
Loaders (1 cu yd each)	9,000	26,500	21,300		6	54,000	159,000	127,800	
Air Slusher Hoists (15 hp each)	1,800	3,220	2,576		5	9,000	16,100	12,880	

Table 8d (cont'd)

Item	Unit Weight - lbs	Unit Cost (New)	Unit Cost (Used - Where Applicable)	Unit Installation Cost	Amount Required	Total Weight - lbs	Total Cost (New)	Total Cost (Used - Where Applicable	Installatio Cost
Scraper - 42"	400	$ 800	$ 500		6	2,400	$ 4,800	$ 3,000	
Mucking Machines	6,000	6,500	4,500		4	24,000	26,000	18,000	
Rock Drills	120	1,600	-		24	2,880	38,400	-	
Tugger Hoists	500	2,000	1,500		10	5,000	20,000	15,000	
30,000 cfm Fan (60 hp)	2,000	3,000	2,000		1	2,000	3,000	2,000	
10,000 cfm Fan (20 hp)	1,300	1,200	1,000		1	1,300	1,200	1,000	
5,000 cfm Fans (air 7.5 hp)	400	900	715		7	2,800	6,300	5,000	
Fan Installation									$ 1,000
Pumps - Sub-mersible - Electric - 20 hp	290	1,250	-		2	580	2,500	-	
Station Pumps (150 gpm x 350' head)	250	2,000	-		2	500	4,000	-	
Underground Power Cable						10,000	5,000	-	
Power Cable Installation									700

Table 8d (cont'd)

Item	Unit Weight - lbs	Unit Cost (New)	Unit Cost (Used - Where Applicable	Unit Installation Cost	Amount Required	Total Weight - lbs	Total Cost (New)	Total Cost (Used - Where Applicable	Installation Cost
Prefab Steel Chutes - ore	4,000	$ 2,500	$ -		8	32,000	$ 20,000	$ -	
Grizzlies	4,000	2,000	-		3	12,000	6,000	-	
Shaft Hoist - Double Drum	60,000	85,000							
Hoist Installation and Ream									$15,000
Ropes & Sheaves						6,000	8,000	-	
Skips - 3 Ton	5,000	5,000	4,000		2	10,000	10,000	8,000	
Cage	4,000	5,000	4,000		1	4,000	5,000	4,000	
Shaft Loading Pocket & Installation	30,000	10,000	-	$4,000	1	30,000	10,000	-	4,000
Spill Pocket & Installation	1,000	1,000	-	1,000	1	1,000	1,000	-	1,000
Lip Chute - 4,980 level & Installation	500	1,000	-	500	1	500	1,000	-	500
Head Frame - 125' - 150' - & Bin	450,000	45,000	30,000		1	450,000	45,000	30,000	
Head Frame, Bin, & Dump Door Installation									15,000
Dump Door	1,000	1,000	-		1	1,000	1,000	-	

Table 8d (cont'd)

Item	Unit Weight - lbs	Unit Cost (New)	Unit Cost (Used - Where Applicable	Unit Installation Cost	Amount Required	Total Weight - lbs	Total Cost (New)	Total Cost (Used - Where Applicable	Installatio Cost
Skip Dump Mechanism	1,000	$ 4,000	$ -		1	1,000	$ 4,000	$ -	
14 Ton Bulk Cement Tank	5,000	2,000	-		1	5,000	2,000*	-	
Fill Tanks - 20' x 20'	26,000	5,834	-		4	104,000	23,335*	-	
Fill Tank - 9' x 9' with 15 hp agitator	5,100	2,500	-		1	5,100	2,500*	-	
Fill Tank - 5' x 6' with 5 hp agitator	2,400	1,800	-		1	2,400	1,800*	-	
Fill Pumps 100 gpm (40 hp)	1,000	2,500	-		2	2,000	5,000*	-	
Pipe 3" Standard Fill	7 lbs/ft	$1.05/ft	-		3,000 ft	21,000	3,150*	-	
Pipe - 6" Litewall (6.8)	6.8 lbs/ft	$1.16/ft	-		3,000 ft	20,400	3,475*	-	
Couplings - 6"	10	$5.62	-		155	1,550	870*	-	
Couplings - 3"	4	$6.16	-		155	620	955*	-	
Fill Plant Installation									$10,795
Shop Equipment & Installation						10,000	15,000	12,000	500
Totals						949,730	$643,827	$350,830	$61,395

* Federal Sales Tax Applicable

Table 8e

SHAFT METHOD

ESTIMATED CAPITAL COSTS

PREPRODUCTION MINE DEVELOPMENT

No.	Description	Months 1 & 2 New	1 & 2 Used	3 New	3 Used	4 & 5 New	4 & 5 Used	6 New	6 Used	7 New	7 Used	8 New	8 Used	9 New	9 Used	Total Estimated Costs New	Total Estimated Costs Used	Purchase Price	Installation
6	Compressors			$60,405	$40,275							$ 60,405	$40,275			$120,810	$ 80,550	$ 80,550	$ -
	Installation			6,000	6,000							6,000	6,000			12,000	12,000	-	12,000
3	Aftercoolers			2,094	1,400							1,047	700			3,141	2,100	2,100	-
	Installation			400	400							200	200			600	600	-	600
3	Receivers			1,404	1,000							702	500			2,106	1,500	1,500	-
	Installation			200	200							100	100			300	300	-	300
3	Diesel Locomotives	$ 13,590	$ -									6,795				20,385	-	20,385	
35	Mine Cars	24,000	16,000									18,000	12,000			42,000	28,000	28,000	
6	Loaders							$79,500	$63,900	$ 79,500	$63,900					159,000	127,800	127,800	
5	Slusher Hoists			9,660	7,728	$ 6,440	$ 5,152									16,100	12,880	12,880	
6	Scrapers - 42"			2,400	1,500	2,400	1,500									4,800	3,000	3,000	
4	Mucking Machines	13,000	9,000	13,000	9,000											26,000	18,000	18,000	
24	Rock Drills	19,200				9,600		9,600								38,400		38,400	
10	Tugger Hoists					10,000	7,500			10,000	7,500					20,000	15,000	15,000	
1	30,000 cfm Fan	3,000	2,000													3,000	2,000	2,000	
1	10,000 cfm Fan	1,200	1,000													1,200	1,000	1,000	
7	5,000 cfm Fans	2,800				3,600	3,000			2,700	2,000					6,300	5,000	5,000	
	Installation	-	500				500										1,000		1,000
2	Pumps - Submersible	2,500														2,500		2,500	
2	Station Pumps											4,000				4,000		4,000	
3	Sump Pumps	1,920														1,920	-	1,920	
	Power Cable					5,000										5,000		5,000	
	Installation					700										700			700
8	Steel Chutes											20,000				20,000	-	20,000	
3	Grizzlies					2,000								$4,000	$ -	6,000		6,000	
1	Shaft Hoist		85,000														85,000	85,000	
	Installation		15,000														15,000	-	15,000
	Ropes & Sheaves	8,000														8,000	-	8,000	
2	Skips							10,000	8,000							10,000	8,000	8,000	
1	Cage							5,000	4,000							5,000	4,000	4,000	
1	Loading Pocket							14,000								14,000		10,000	4,000
1	Lip Chute							1,500								1,500		1,000	500
1	Head Frame	45,000	30,000													45,000	30,000	30,000	
	Installation	15,000	15,000													15,000	15,000		15,000
	Signal System	12,000	6,000													12,000	6,000	6,000	
1	Dump Door	1,000														1,000		1,000	
1	Dump Mechanism	4,000														4,000		4,000	
1	Cement Tank											2,000				2,000	-	2,000*	
1	Spill Pocket							2,000								2,000	-	1,000	1,000

* Federal Sales Tax Applicable

No.	Description	Months 1 & 2 New	1 & 2 Used	3 New	3 Used	4 & 5 New	4 & 5 Used	6 New	6 Used	7 New	7 Used	8 New	8 Used	9 New	9 Used	Total Estimated Costs New	Total Estimated Costs Used	Purchase Price	Installation
4	Fill Tanks 20' x 20'											$ 23,335				$ 23,335		$ 23,335*	
1	Fill Tank 9' x 8'											2,500				2,500		2,500*	
1	Fill Tank 5' x 6'											1,800				1,800		1,800*	
2	Fill Pumps											5,000				5,000		5,000*	
3000'	Pipe - 3"											3,150				3,150		3,150*	
3000'	Pipe - 6"											3,475				3,475		3,475*	
155	Couplings - 6"											870				870		870*	
155	Couplings - 3"											955				955		955*	
	Installation											10,795				10,795		10,795	
	Shop Equipment	$ 15,500	$ 12,500													$ 15,500	$ 12,500	12,000	$ 500
Total		$178,910	$192,000	$95,563	$67,503	$39,740	$17,652	$89,100	$63,900	$124,700	$85,400	$171,129	$59,775	$4,000	$ -	$703,142	$486,230	$618,915	$50,600
Monthly Purchase Price		$242,210		$67,503		$34,952		$73,500		$102,900		$144,450		$4,000				$669,515	

* Federal Sales Tax Applicable

Table 8f

SHAFT METHOD

SUMMARY

ESTIMATED PREPRODUCTION MINE DEVELOPMENT COSTS

	Months									
	1	2	3	4	5	6	7	8	9	Total
Direct Costs	$ 50,633	$ 85,635	$ 98,610	$ 95,818	$121,925	$182,193	$148,650	$116,796	$ 95,832	$ 996,09
Indirect Costs	40,604	40,934	43,147	49,469	51,561	51,561	52,259	54,173	54,173	437,88
Capital Costs	242,210	-	67,503	11,600	23,352	73,500	102,900	144,450	4,000	669,51
Federal Tax @ 12% on 43,085	-	-	-	-	-	-	-	5,170	-	5,17
Provincial Tax @ 5% on 624,085	4,458	-	4,458	4,456	4,458	4,458	4,458	4,458	-	31,20
Freight 507 tons @ $24.00/ton	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	1,352	12,16
Total	$339,257	$127,921	$215,070	$162,695	$202,648	$313,064	$309,619	$326,399	$155,357	$2,152,03

Table 8g

SHAFT METHOD - PRODUCTION

ESTIMATED OPERATING COST

SUMMARY - MINING

Direct Costs	Total/Yr	$ Per Ton Milled
1. Development	$131,216	$ .750
2. Diamond drilling	35,000	.020
3. Stope preparation	83,470	.477
4. Stoping	770,354	4.402
5. Loading	33,114	.189
6. Hauling	43,192	.247
7. Hoisting	67,730	.387
8. Fill plant	20,996	.120
Sub total	$1,185,072	$6.772
Indirect Costs		
1. Mine maintenance	$ 55,431	$ .317
2. Mechanical	50,966	.291
3. Engineering	62,289	.356
4. Supervision	53,137	.304
Sub total	$ 221,823	$1.268
Total	$1,406,895	$8.040

Table 9a

TRACKLESS METHOD

PREPRODUCTION MINE DEVELOPMENT

Month		Description	Decline - Incline footage	Drift & Crosscut footage	Raise footage	Sill drift footage	Sill drift Slashing cu.ft.
1 & 2	(A)	Decline - 9'x8' cross-section from portal (elevation 5340'), past stopes 1,3&4 to turnoff @ elevation 5200' to stope 10 @ -15%	960				
	(B)	Incline - 9'x8' cross-section from 5130 elevation (present adit) @ face of 502 drift west to second crosscut into stope 13 @ +15%	192				
	(C)	Ore pass raise from 5130' to 5280' @ +50°			184		
		Two wings from raise to 5230' & 5195' elevations			85		
3	(A)	Decline - 9'x11' cross-section northerly on Section 45 from main drift @ 5130' elevation to 5080' elevation @ -12%	460				
	(B)	Incline (1B) continued to east to elevation 5195' @ +10%	405				
	(C)	Decline from face (1A) northerly to break-through with (3B) @ -2%	230				
	(D)	Crosscuts to stopes 3(95'), 4(105') @ 0% & 5(35') @ -15%	35	200			

Table 9a (cont'd)

Month		Description	Decline - Incline footage	Drift & Crosscut footage	Raise footage	Sill drift footage	Sill drift Slashing cu.ft.
4	(A)	Decline 9'x11' cross-section from face (3A) to 5045 elevation @ ore & waste pass chutes 123' @ -2%, 217' @ -12%	340				
		Triangular connection to west 80' @ +15%	80				
	(B)	Decline 9'x8' cross-section westerly from main decline @ elevation 5220 to stope 9 & to ore pass, 105' @ -15%, 120' @ 0%, 100' @ -15%	205	120			
	(C)	Crosscuts to stope 9(145') & storage 20' @ 0%		165			
	(D)	Decline 9'x8' cross-section, continuation of (3D) to stope 5 - 80' @ -15%	80				
	(E)	Incline from main decline @ 5200 elevation, to north west to stope 10(200' @ +15%) & flat continuation 270' @ 0%	200	270			
5	(A)	Drift 9'x8' cross-section, - continuation of (4E), to stope 1 @ 0%		315			
	(B)	Drift 9'x8' cross-section, westerly from (4E) to stope 2 @ 0%		300			
	(C)	Crosscuts to stope 10 @ 0%		200			
	(D)	Incline (9'x8') easterly from (4E) @ 5230 elevation to stope 11 @ +10%, & flat	300	70			
	(E)	Incline (9'x11') from face (3A) to stope 8 @ +12½% & + 10%	380				
	(F)	Crosscuts from face (4A) to waste pass & ore pass chutes @ 0% plus sump		140			
	(G)	Raise (under stope 11) from 502 Drift East, @ 5140 elevation to 5260 elevation @ 57°			140		

Table 9a (cont'd)

Month		Description	Decline - Incline footage	Drift & Crosscut footage	Raise footage	Sill drift footage	Sill drift Slashing cu.ft.
6	(A)	Raises 1) ventilation 5130 elevation to 5280 elevation - stope 6 east end @ 50°			185		
		2) ventilation - main decline 5205 elevation to 5280 elevation - stope 6 @ 57°			90		
		3) ore pass from (5F) 5055 elevation to 5130 elevation in 502 DR. @ 46°			103		
		4) waste pass from (5F) 5055 elevation to 5130 elevation in 502 DR. @ 46°			103		
	(B)	Miscellaneous crosscuts on 5130 level to stopes 8 & 12 @ 0% (9'x11') plus sump		705			
	(C)	Crosscuts to stopes 1(215'), 2(200'), 3(20'), 4(15') @ 0%		450			
	(D)	Decline from face (3D) @ -15% (9'x8' cross-section) to stope 5 continued	70				
	(E)	Incline (9'x8') to east @ +10% from face (5D) to stope 6(200'), 5260 elevation to 5280 elevation 380' @ 0%	200	380			
7	(A)	Decline to stope 5(100' @ -15%) to 5190 elevation	100				
	(B)	Drift & crosscuts to stope 5 from (7A)		430			
	(C)	Crosscuts to stope 13 from main decline @ 0%		185			
	(D)	Crosscuts to stope 11 @ 0%		180			
	(E)	Crosscuts to stopes 6 & 7 @ 0%		450			
	(F)	1) ore pass raise to stope 5 from 5140 elevation to 5190 elevation @ 51°			65		

Table 9a (cont'd)

Month		Description	Decline - Incline footage	Drift & Crosscut footage	Raise footage	Sill drift footage	Sill drift Slashing cu.ft.
	(F)	2) ventilation raise stope 1 to main decline 5240 elevation to 5310 elevation @ 57°			85		
		3) ventilation raise stope 2 to main decline 5250 elevation to 5316 elevation @ 46°			90		
	(G)	Sill drifts to shrinkage stopes 1(200'), 2(200'), 3(100'), 4(100'), 5(200')				800	
	(H)	Decline (9'x11') below 5130 level @ -12%	400				
8	(A)	Sill drifts to shrinkage stopes 6(200'), 7(200'), 8(200'), @ 0%				600	
	(B)	Sill drifts to cut & fill stope 9(200')				200	
	(C)	Sill drift slashing (cut & fill) 9(16560 cu.ft.), 10(13680 cu.ft.), 12(9600 cu.ft.), 14(19840 cu.ft.)					59,680
	(D)	Taking down backs (cut & fill), 9(30960 cu.ft.), 10(35280 cu.ft.), 11(17280 cu.ft.), 12(31200 cu.ft.), 13(18560 cu.ft.), & 14(34240 cu.ft.)					167,520
	(E)	Ventilation raise from 5140 elevation to 5195 elevation @ face (4B) @ 50°			73		
	(F)	Ventilation raise from 5120 elevation of (5E) to 5230 elevation of (4E) @ 57°			135		
	(G)	Decline (7H) continued (9' x 11') @ -12%	400				
	(H)	Fill holes, lines & drain holes @ $8,948.00					
	(I)	Sill timbering @ $4,598.00					

Table 9a (cont'd)

Month	Description	Decline - Incline footage	Drift & Crosscut footage	Raise footage	Sill drift footage	Sill drift slashing cu.ft.	
9	(A) Sill drifts to cut & fill stopes 10(300'), 11(400'), 12(300'), 13(400'), 14(200')				1,600		
	(B) Decline (8G) continued (9' x 11') @ -12%	400					
	(C) Sill timbering @ $8,196.00						
	Totals	5,437	4,560	1,338	3,200	227,200	241,665

Table 9b

TRACKLESS METHOD

ESTIMATED DIRECT COSTS
PREPRODUCTION MINE DEVELOPMENT

Description	Footage	Cost/Ft.	Months 1 & 2	3	4	5	6	7	8	9	Total
Decline 1A	960	$43.05	$41,328	$	$	$	$	$	$	$	$
Retimber 180' at 5,130 portal	180	31.17	5,611								
Slashing 5,130 level (1,850'x40)	74,000cu.ft.	.319	23,606								
Incline 1B	192	43.05	8,266								
Raises 1C	269	29.94	8,054								
Decline 3A	460	45.99		21,155							
Incline 3B	405	39.75		16,099							
Decline 3C	230	39.75		9,142							
Diamond drilling	2,700	4.50		12,150							
Chute erection	6	93.26		560							
Cross Cuts 3D flat	200	39.75		7,950							
incline	35	39.75		1,391							
Decline 4A	340	45.99			15,637						
Incline connection	80	39.75			3,180						
Decline 4B	205	39.75			8,149						
Drifting 4B	120	39.75			4,770						
Cross cuts 4C	165	39.75			6,559						
Diamond drilling	2,700	4.50			12,150						
Slash 502 D1-E(330'x40)	13,200cu.ft.	.319			4,211						
Chute erection	6	93.26			560						
Decline 4D	80	39.75			3,180						
Incline 4E	200	39.75			7,950						
Drifting 4E	270	39.75			10,732						
Drifting 5A	315	39.75				12,521					
Drifting 5B	300	39.75				11,925					
Crosscuts 5C	200	39.75				7,950					
Incline 5D	300	39.75				11,925					
Drifting 5D	70	39.75				2,782					
Incline 5E	380	45.99				17,476					

Table 9b (cont'd)

Description	Footage	Cost/Ft.	Months 1 & 2	3	4	5	6	7	8	9	Total
Cross cuts 5F	140	$39.75	$	$	$	$ 5,565	$	$	$	$	$
Raise 5G	140	29.94				4,192					
Diamond drilling month 5	2,010	4.50				9,045					
Raises 6A	481	29.94					4,192				
Cross cuts 6B & 6C	1,155	45.99					53,118				
Chute erection (12)	12	93.26					1,119				
Decline 6D	70	39.75					2,782				
Incline 6E	200	39.75					7,950				
Drifting 6E	380	39.75					15,105				
Decline 7A	100	39.75						3,975			
Drifts & Cross cuts 7B,7C,7D,7E	1,245	39.75						49,489			
Chute erection	6	93.26						560			
Raises 7F	240	29.94						7,186			
Sill drifts 7G	800	39.75						31,800			
Decline 7H	400	45.99						18,396			
Sill drifts 8A & 8B	800	39.75							31,800		
Sill drift slashing 8C	59,680cu.ft.	.319							19,038		
Taking down backs 8D	167,520cu.ft.	.319							53,439		
Raises 8E & 8F	208	29.94							6,228		
Decline 8G	400	45.99							18,396		
Fill holes 8H									8,948		
Sill timbering 8I									4,598		
Sill drift 9A	1,600	39.75								63,600	
Decline 9B	400	45.99								18,396	
Sill timbering 9C										8,196	
			$86,865	$68,447	$77,078	$83,381	$84,266	$111,406	$142,447	$90,192	$744,082

Table 9c

TRACKLESS METHOD

ESTIMATED INDIRECT COSTS
PREPRODUCTION MINE DEVELOPMENT

	Months								
	1 & 2	3	4	5	6	7	8	9	Total
Compressor & Power Plant Operation	$ 9,400	$ 7,547	$ 7,547	$ 7,547	$ 7,547	$ 7,547	$ 7,547	$ 7,547	$ 62,229
Truck Operation - Surface	1,850	925	925	925	925	925	925	925	8,325
Tractor Operation - Surface	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	14,400
Underground Truck & Loader Operation	-	4,349	4,349	4,349	4,349	4,349	4,349	4,349	30,443
Small Service Trucks	2,000	2,331	2,331	2,331	2,331	2,331	3,662	3,662	20,979
Explosive Distribution	-	-	-	698	698	698	698	698	3,490
Mechanical & Electrical	9,994	7,060	7,060	7,060	7,060	7,060	7,060	7,060	59,414
General Underground & Cleanup	1,396	698	698	698	698	2,094	2,094	3,490	11,866
Change House & Lamps	1,666	833	833	833	833	833	833	833	7,497
First Aid - Warehouse	1,696	848	848	848	848	848	848	848	7,632
Engineering	11,088	5,940	5,940	5,940	6,732	6,732	7,854	7,854	58,080
Assaying	2,320	1,160	1,160	1,160	1,160	1,160	1,160	1,160	10,440
Supervision	11,340	5,670	5,670	5,670	5,670	5,670	5,670	5,670	51,030
Totals	$54,550	$39,161	$39,161	$39,859	$40,651	$42,047	$44,500	$45,896	$345,825

TRACKLESS METHOD

ESTIMATED CAPITAL COSTS - SUPPLEMENTARY SHEET

PREPRODUCTION MINE DEVELOPMENT

Item	Unit Wt. -lbs	New Unit Cost	Used Unit Cost (Where Applicable)	Unit Installation Cost	Amt Req'd	Total Wt. -lbs	Total Cost (New)	Total Cost (Used Where Applicable)	Installation Cost
900 cfm Stationary compressor - electric	7,900	$20,135	$13,425		4	31,600	$80,540	$53,700	
Compressor Installation				$2,000	4				$ 8,000
Aftercoolers	1,300	1,047	700		2	2,600	2,094	1,400	
Aftercooler Installation				200	2				400
Air Receivers - 42" x 120"	2,000	702	500		2	4,000	1,404	1,000	
Air Receiver Installation				100	2				200
Diesel Loaders (3 cu yds each)	33,015	37,983	-		3	99,045	113,950	-	
Diesel Trucks (10 tons each)	20,000	40,000	30,000		2	40,000	80,000	60,000	
Loaders (1 cu. yd. each)	9,000	26,500	21,300		5	45,000	132,500	106,500	
Rock Drills	120	1,600	-		24	2,880	38,400	-	
Tugger Hoists - air	500	2,000	1,600		10	5,000	20,000	16,000	
Fans (30,000 cfm) 60 hp	1,000	3,000	-	600	2	2,000	6,000	-	1,200
Fan (15,000 cfm) 30 hp	300	1,200	-	1,240	1	300	1,200	-	240
Fans (7,500 cfm) 30 hp	250	800	-	150	4	1,000	3,200	-	600
Fans - air (4,000 cfm)	80	533	-	120	3	240	1,600	-	360
Pumps - submersible - electric - 20 hp	73	1,250	-		4	290	5,000	-	
Pumps - sump	83	640	-		5	415	3,200	-	
Underground Power Cable & Installation						10,000	5,000	-	700
Prefab Steel Chutes	4,000	4,000	-		5	20,000	20,000	-	
Shop Equipment & Installation						10,000	15,000	1,200	500
Jeeps - rebuilt	3,000	-	4,500		5	15,000	-	22,500*	
14 ton Bulk Cement Tank	5,000	2,000	-		1	5,000	2,000*	-	
Fill tanks 20' x 20'	26,000	5,834	-		4	104,000	23,335*	-	
Fill tank 9' x 8' with 15 hp agitator	5,100	2,500	-		1	5,100	2,500*	-	
Fill Tank 5' x 6' with 5 hp agitator	2,400	1,800	-		1	2,400	1,800*	-	
Fill pumps (100 g.p.m.) 40 hp	1,000	2,500	-		2	2,000	5,000*	-	
Pipe - 3" standard fill	7/ft	$1.05/ft	-		3000 ft	21,000	3,150*	-	
Pipe - 6" litewall (6.8)	6.8/ft	$1.16/ft			3000 ft	20,400	3,475*	-	

Table 9d (cont'd)

Item	Unit Wt. -lbs	New Unit Cost	Used Unit Cost (Where Applicable)	Unit Installation Cost	Amt Req'd	Total Wt. -lbs	Total Cost (New)	Total Cost (Used Where Applicable)	Installation Cost
Couplings - 6"	10	$5.62	-		155	1,550	870*	-	
Couplings - 3"	4	$6.16	-		155	620	955*	-	
Fill plant installation									10,795
Totals						451,440	$572,173	$273,100	$22,995

* Federal Sales Tax Applicable

Table 9e

TRACKLESS METHOD

ESTIMATED CAPITAL COSTS

PREPRODUCTION MINE DEVELOPMENT

No.	Description	Months 1 & 2 New	1 & 2 Used	3 New	3 Used	4 & 5 New	4 & 5 Used	6 New	6 Used	7 New	7 Used	8 New	8 Used	9 New	9 Used	Total Estimated Costs New	Used	Purchase Price	Installation
4	Compressors			$ 40,270	$26,850					$ 40,270	$ 26,850					$ 80,540	$ 53,700	$ 53,700	
	Installation			4,000	4,000					4,000	4,000					8,000	8,000	-	$ 8,000
2	Aftercoolers			1,047	700					1,047	700					2,094	1,400	1,400	
	Installation			200	200					200	200					400	400	-	400
2	Air Receivers			702	500					702	500					1,404	1,000	1,000	
	Installation			100	100					100	100					200	200	-	200
3	Diesel Loaders	$113,950														113,950	-	113,950	
2	Diesel Trucks			40,000	30,000					40,000	30,000					80,000	60,000	60,000	
5	Loaders			26,500	21,300					106,000	85,200					132,500	106,500	106,500	
24	Rock Drills	16,000						$16,000						$6,400		38,400	-	38,400	
10	Tugger Hoists - Air	4,000	$ 3,200					16,000	$12,800							20,000	16,000	16,000	
2	Fans (30,000 cfm)							6,000								6,000	-	6,000	
1	Fan (15,000 cfm)									1,200						1,200	-	1,200	
4	Fans (7,500 cfm)											$ 3,200				3,200	-	3,200	
3	Fans (4,000 cfm)											1,600				1,600	-	1,600	
	Installation							1,200		240		960				2,400	-	-	2,400
4	Pumps - Submersible	2,500				$1,250		1,250								5,000	-	5,000	
5	Pumps - Sump	1,920		1,280												3,200	-	3,200	
	Power Cable					5,700										5,700	-	5,000	700
5	Steel Chutes											20,000				20,000	-	20,000	
	Shop Equipment	15,500	12,500													15,500	12,500	12,000	500
5	Jeeps		9,000				$13,500									-	22,500	22,500*	
1	Cement Tank											2,000				2,000	-	2,000*	
4	Fill Tanks 20' x 20'											23,335				23,335	-	23,335*	
1	Fill Tanks 9' x 8'											2,500				2,500	-	2,500*	
1	Fill Tanks 5' x 6'											1,800				1,800	-	1,800*	
2	Fill Pumps											5,000				5,000	-	5,000*	
3000'	Pipe 3"											3,150				3,150	-	3,150*	
3000'	Pipe 6"											3,475				3,475	-	3,475*	
155	Couplings 6"											870				870	-	870*	
155	Couplings 3"											955				955	-	955*	
	Installation											10,795				10,795	-	-	10,795
Total		$153,870	$24,700	$114,099	$83,650	$6,950	$13,500	$40,450	$12,800	$193,759	$147,550	$79,640	-	$6,400	-	$595,168	$282,220	$513,735	$22,995
Monthly Purchase Price		$159,070		$84,930		$20,450		$37,250		$148,990		$79,640		$6,400				$536,730	

* Federal Sales Tax Applicable.

Table 9f

TRACKLESS METHOD

SUMMARY

ESTIMATED PREPRODUCTION MINE DEVELOPMENT COSTS

	Months								
	1 & 2	3	4	5	6	7	8	9	Total
Direct Costs	$ 86,865	$ 68,447	$ 77,078	$ 83,381	$ 84,266	$111,406	$142,447	$ 90,192	$ 744,082
Indirect Costs	54,550	39,161	39,161	39,859	40,651	42,047	44,500	45,896	345,825
Capital Costs	159,070	84,930	13,500	6,950	37,250	148,990	79,640	6,400	536,730
Sub Total	300,485	192,538	129,739	130,190	162,167	302,443	266,587	142,488	1,626,637
Federal Tax 12% on $ 65,587	2,623						5,247		7,870
Provincial Tax 5% on $521,605	5,800	2,900	2,900	2,900	2,900	2,900	2,900	2,880	26,080
Freight 225 tons at $24.00/ton	1,200	600	600	600	600	600	600	600	5,400
Total	$310,108	$196,038	$133,239	$133,690	$165,667	$305,943	$275,334	$145,968	$1,665,987

Table 9g

TRACKLESS METHOD

ESTIMATED OPERATING COST SUMMARY - MINING

	Total Per Year		$. Per Ton Milled (175,000 TPY)
DIRECT COSTS			
Development	$ 149,867		$ .856
Diamond Drilling	35,000		.200
Stope Preparation	83,470		.477
Stoping	670,707		3.833
Ore Loading	68,275		.39
Ore Hauling	43,057		.246
Fill Plant	20,996		.120
Sub Total		$ 1,071,372	$ 6.122
Indirect Costs			
Mine Maintenance	$ 62,431		
Mechanical Maintenance	76,019		
Engineering	62,289		
Supervision	53,137		
Sub Total		253,876	1.451
Total		$ 1,325,248	$ 7.573

CHAPTER IV
METALLURGY, CRUSHING PLANT & CONCENTRATOR

MILLING

GENERAL

Representative samples obtained by combining diamond drill core and chip samples from underground ore exposures have been submitted to Department of Energy, Mines and Resources, Ottawa, to Lakefield Research of Canada Ltd., Lakefield, Ontario and to Allis Chalmers Metal Processing Research and Test Centre, Oak Creek, Wisoonsin for flotation and grinding tests, and reports have been submitted to Alwin.

Mr. D.A. Livingstone, P. Eng., Group Metallurgist, Grandby Mining Company Limited, Vancouver, British Columbia, has prepared a preliminary report and plant layout, relative to the treatment of ore from the Alwin Mining Company property, at the rate of 500 t.p.d. Mr. Livingstone's report was based upon flotation test work and the mineralogical examinations of ore samples carried out by the Mines Branch at Ottawa.

All of the above report were studied and the various items incorporated in the concentrator flow sheet, plant layout and estimated costs contained in this report.

SUMMARY OF METALLURGICAL TEST WORK RESULTS

(a) Department of Energy Mines and Resources, Ottawa.

Summarizing the results, the following is noted:

The copper in this ore occurs largely as coarse to medium-grained chalcopyrite disseminated in gangue. A smaller amount of copper (about 10%) is present as bornite and chalcocite. The head sample assays 2.50% copper, 0.0025 oz/ton gold, and 0.44 oz/ton silver.

Satisfactory concentrate grades and recoveries were obtained by flotation at a grind of 55% minus 200 mesh. In a seven-stage locked-cycle test, a copper concentrate assaying 33.0% copper, was produced with copper, gold and silver recoveries of 95.1%, 85.4% and 89.7% respectively. Calculated gold and silver assays for this test were 0.0024 and 0.41 oz/ton respectively, which are in close agreement with the assay heads.

The work index determined for the ore was 17.4 kWh/short ton.

(b) Lakefield Research of Canada Ltd.

The complete summary submitted by Lakefield is not quoted in detail but the following paragraphs extracted outline the principal conclusions.

S U M M A R Y

Head Analysis

The chemical analyses of the two composites were as follows:

	% Cu	% Fe	% S
Composite No. 1	2.42	4.83	2.22
Composite No. 2	2.38	4.67	2.38

Work Index

Four grinding tests were performed on Composite No. 1 and one grinding test was performed on Composite No. 2. The work indices were calculated using the relationship established by F.C. Bond in his Third Theory of Comminution. In order to obtain the 80 percent passing size, the screen analyses were plotted and the size moduli K_{80} were determined graphically.

Composite No. 1

Grinding Time minutes/1000 g.	% Passing 200 mesh	Size Modulus K_{80} (Microns)	Power Consumption kwh/ton	Work Index
Feed (nil)	16.6	949	3.1	-
5	54.2	158	3.1	6.6
10	73.5	84.8	6.2	8.2
20	88.3	53.9	12.4	12.0
40	95.9	*	24.8	*

* Not determined because outside range.

Composite No. 2

Grinding Time Minutes/1000 g	% Passing 200 Mesh	Size Modulus K_{80}	Power Consumption kwh/ton	Work Index
Feed (nil)	19.0	833	-	-
5	47.6	175	3.1	7.4

Calculated average work index for 55 percent passing 200 mesh was 7.0.

Flotation - Individual Tests

Flotation tests were conducted on the products from the grinding series on Composite No. 1. One additional test was performed on ore ground to only 50.2% minus 200 mesh. The same procedure was followed in all five tests. This involved a roughing stage and two or three cleaning stages.

Reagent additions to the roughing stage were 0.2 lbs/ton sodium iso-propyl xanthate (Z-11) and 0.1 lbs/ton Dowfroth 250. Addition of 0.5 lbs/ton lime to the ball mill resulted in an initial pH of 9.5 to 10.0 in the cell. The rougher concentrates were cleaned by reflotation using 0.02 lbs/ton Dowfroth 250 when required.

The best results were obtained with the coarsest grinds. After grinding to 54.2 percent minus 200 mesh, a copper concentrate was produced assaying 32.8% Cu at a recovery of 96.7% of the copper. All five tests yielded copper concentrates assaying between 32.0% and 34.0% Cu at recoveries ranging from 95.0% to 96.7%. In one test Cyanamid collector S-3501 was compared with iso-propyl xanthate (Z-11) (tests 4, 9). On a weight for weight basis the iso-propyl xanthate collector was more efficient than reagent S-3501.

Comparison of Z-11 and S-3501

Test	Collector	Cu Cleaner Concentrate	
		Assay % Cu	% Recovery, Cu
4	Z-11	32.8	96.7
9	S-3501	33.8	94.9

Composites No. 1 and 2 had similar flotation characteristics and were combined for subsequent locked cycle, settling and filtering tests. Two tests on each composite were used in the comparison, the results of which are illustrated in Figure 5.

Comparison of Composites No. 1 and 2

Test	Composite No.	Grind Time (min./1000g.)	Collector		Cu Cleaner Conc.	
			Type	Addition (lb/ton)	Assay (%)	Recovery (%)
4	1	5	Z-11	0.2	32.8	96.7
5	2	5	Z-11	0.2	33.2	95.8
7	1	10	Z-11	0.3	33.1	96.3
8	2	10	Z-11	0.3	32.4	97.0

Increasing collector additions from 0.2 lbs/ton to 0.3 lbs/ton Z-11 did not improve the grade-recovery characteristics of the composites.

Comparison of Collector Additions

Test	Composite No.	Collector		Cu Cleaner Conc.	
		Type	Level lbs/ton	Assay %	Recovery %
1	1	Z-11	0.2	33.1	96.1
7	1	Z-11	0.3	33.1	96.3

Mineralogy

The products from the flotation of Composite No. 1 in Test 1 were examined microscopically. The size analysis of the flotation feed was 73.5 percent minus 200 mesh.

The copper cleaner concentrate was a mixture of chalcopyrite and bornite with a ratio greater than 20 to 1. Some chalcocite was tentatively identified. Gangue was present as inclusions in the chalcopyrite.

Chalcopyrite of less than 10 microns size accounted for copper loss in the tailings. In the rougher and first and second cleaner tailings 20%, 30%, and 60% of the chalcopyrite was free.

Flotation Cycle Test

The results from the six-stage cycle test, test 10, showed that the recirculating cleaner tailings approached a steady weight after four cycles. If the recirculating cleaner tailings should be omitted from the calculations of the last two cycles, the metallurgical balance indicated that a copper cleaner concentrate assaying 33.6% Cu at a recovery of 97.7% could be produced. Overall copper cleaner concentrate grade in the six cycles was 33.5% Cu at a recovery of 96.9%.

Thickening Test - Concentrate

Thickening tests were conducted on the copper cleaner concentrate at natural pH (a) without flocculant, (b) with 0.5 pounds per ton lime, (c) with 0.01 pounds per ton Separan AP30 (an anionic polyacrylamide, and (d) with 0.01 pounds per ton Polyhall 402 (an non-toxic polyacrylamide). The results are listed below.

Settling Test Data

Addition Amount	Addition Type	Thickener Area Requirements (ft^2/ton/24 hr)	Thickener Underflow Pulp Density Max Solids	Supernatant Liquid
nil	nil	-	75.0	-
0.5	lime	0.58	72.0	cloudy
0.01	AP30	0.08	72.3	clear
0.01	402	0.09	70.3	almost clear

Note: The area requirements do not include a safety factor.

No solid-liquid demarcation was observable in the sample settled without flocculant. The organic flocculants Separan AP30 and Polyhall 402, notably the latter, produced good results.

Thickening Tests - Rougher Tailing

Thickening tests were conducted on the rougher tailing at natural pH (a) without flocculant, (b) with 1.0 and 2.0 pounds per ton lime, (c) with 0.01 and 0.05 pounds per ton Separan AP30, (d) with 0.05 pounds per ton Polyhall 402, (e) with 0.05 pounds per ton Jaguar MRL 22A (a cationic organic flocculant). The results are listed below.

Settling Test Data

Addition Amount lb/ton	Addition Type	Thickener Area Requirements (ft^2/ton/24 hr)	Thickener Underflow Pulp Density Max. % Solids	Supernatant Liquid
nil	nil	4.9	54.7	very cloudy
1.0	lime	4.1	47.9	slightly cloudy
2.0	lime	2.9	47.1	almost clear
0.01	AP30	2.0	49.0	cloudy
0.05	AP30	0.15	53.5	clear
0.05	402	1.3	52.0	cloudy
0.05	MRL 22A	1.4	52.0	cloudy

Note: The area requirements do not include a safety factor.

Separan AP30 provided the best combination of clarity of overflow and minimum thickener area requirements.

Filtering Tests - Concentrate

A pour-on filter test was performed on the thickened concentrate at a density of 70 percent solids to simulate thickener underflow feed. The filter media was a nylon cloth. Cracking of the cake was not observed, however cake discharge from the cloth was only fair. The percent moisture in the cake was 10 percent. Other filtering tests on the concentrate with laboratory pan filters produced moisture levels of 6.2 to 8.7 percent moisture.

LAKEFIELD RESEARCH OF CANADA LIMITED

A.G. Scobie, P. Eng.,

Manager

(c) Allis Chalmers Metal Processing and Research Test Centre

Allis Chalmers were requested by Alwin to determine a Bond Work Index for closed-circuit ball milling from 5/8 inch to a fineness of 55% - 200 mesh. The rod mill work index indicated by the results amounted to 10.05 and the ball mill work index at 100 mesh amounted to 10.79.

(d) Mr. D.A. Livingstone, P. Eng.,

Mr. Livingstone's report was based on the results of the work submitted by the Department of Mines in Ottawa which involved eight flotation tests including one lock-cycle test. Mr. Livingstone states that subject to a more extensive investigation of a new ore sample, the indications are that the ore can be concentrated very well by conventional flotation methods when ground to a medium fineness of 50-60% minus 200 mesh. Ore the same as that used in the test work may be expected to yield 94% recovery in concentrates grading at least 32% copper on heads containing 2.0% copper.

Chalcopyrite, as coarse to medium grains disseminated in gangue, is the main copper occurrence, but about 10% of the total occurs in the form of bornite and chalcocite. Gold and silver are reported as 0.0024 oz/ton and 0.41 oz/ton, respectively, and therefore inconsequential in so far as mill planning is concerned. The flotation performance and analytical data vailable to date have indicated no deleterious metallic or nonmetallic constituents which would affect adversely either flotation of the ore or marketability of the concentrates.

CRUSHING AND GRINDING

Mr. Livingstone states in part "crushability tests were not performed, so it is assumed that it is similar to other copper ores in the area. A Bond Work Index as a measure of grindability is reported as 17.4, which is medium-hard, and probably similar in this respect to Bethlehem ore.

In ores of this type, copper recovery is almost invariably proportional to the fineness of grind. Since the tests have not proceeded to the point where optimum fineness has been established, a fineness of 60% - 200 mesh is assumed. If coarser grinding proves to be acceptable, operating costs and mill capacity will benefit accordingly."

It will be noted from the Lakefield Research Grinding tests that the calculated work index of 55% passing 200 mesh was 7.0, in comparison to the figure of 17.4 as determined by the Mines Branch in Ottawa.

From the accompanying drawings in this report it will be noted that the ore received from the mine will be reduced in one stage of open circuit jaw crushing and a second stage of closed circuit crushing to minus $\frac{1}{2}$ inch.

It is planned that the coarse ore bin will have a live storage of about 500 tons and the fine ore bin will provide capacity for 1500 live tons, so as to permit a one shift, five day work week for the crusher.

The equipment recommended is a 36 in. x 42 in. jaw crusher and a $5\frac{1}{2}$ ft short head cone crusher.

The grinding circuit will consist of one 8 ft x 10 ft ball mill in closed circuit with one 15 in. cyclone classifier. An extra cyclone has been included to serve as a spare. It is felt that the selection of the above equipment is conservative and will cover the run of Bond Work Indexes indicated satisfactorily, so as to produce the designed performance.

FLOTATION AND DEWATERING OF CONCENTRATES

Ten cells each 50 cu ft in size are provided for roughing in the flotation circuit and 6 cells each 40 cu ft in size will be installed to clean the rougher concentrates. It will be noted that space is provided for an additional 20% in capacity for both the rougher and cleaner circuit to allow for future expansion.

The cleaner concentrates will be partially dewatered in a 25 ft x 10 ft thickener followed by a 6 ft diameter four disc filter and drier. A surge 12 ft x 14 ft in size placed ahead of the filter will permit intermittent operation of the drier to accommodate fluctuating output.

PLANT LAYOUT

Special attention has been made to providing a simplified compact layout in order to obtain maximum efficiency in supervision maintenance and power distribution. It will be noted that the crushing plant has been placed adjacent to the concentrator and that the operating floors in both plants are at the same elevation. An airtight door will be provided to provide passage backwards and forwards between the crushing and concentrating operations.

Processed water will be reclaimed from the tailings pond for the purposes of water conservation and pollution control.

PERSONNEL

Mill Superintendent, foreman - metallurgist, one repairman and two helpers, one crusherman, three grinding operators, three flotation operators, three operators for filtering, drying and concentrate loading, one labourer, for a total of sixteen. In addition, three swing men and two men in the assay office will be required.

OPERATING DATA AND CONSIDERATIONS

1. METAL BALANCE

Quoting from Mr. Livingstone's report "assuming 515 TPD for an average throughput per calendar day of 500.

Product	Tons	% Copper	% Distribution
Mill Heads	515	2.00	100.0
Concentrates	30	32.00	94.0
Tailings	485	0.12	6.0

Owing to the low contents of gold and silver, the test results showed erratic recoveries. Consequently these are not included in the metal balance, but the concentrates may be expected to run about 0.035 oz/ton in gold, and 5.4 oz/ton in silver.

2. ORE BINS

"Broken ore, 18 cu ft/ton. Specific Gravity 2.86.
Coarse ore bin, 60% draw-off through 1 drawpoint.
Fine ore bin, 70% draw-off through 6 drawpoints.

3. COARSE ORE FEEDER

A reciprocating feeder 36 ft x 96 in. will extract the ore from the coarse ore bin and feed it to the jaw crusher.

4. CONVEYOR SLOPES

14° for coarse "run-of-mine" ore
16° for intermediate sizes up to 4"
18° for minus $\frac{1}{2}$ in. ore
20° for concentrates

SHAFT METHOD

CRUSHING PLANT AND ORE STORAGE - 500 TPD

CAPITAL COST ESTIMATE - EQUIPMENT

	Weight - lbs	Cost New	Cost Second-hand (where applicable)
Reciprocating feeder - 34" x 96"	9,500	$10,000	$ 6,750
Jaw crusher 30" x 42" - 140 TPH	108,000	70,000	33,500
Jaw and cone crusher chutes and skirting	1,200	2,000	2,000
#1 Conveyor 36" x 34' @ $105/ft	8,000	3,570	3,570
#1 Transfer chute	900	300	300
#2 Conveyor 36" x 75' @ $105/ft	19,000	7,900	7,900
#2 Transfer chute	900	300	300
#3 Conveyor 36" x 82' @ $105/ft	20,000	8,600	8,600
#3 Feed box to screen	1,000	500	500
Primary screen double-deck 5' x 10' (top deck 2" - lower deck 5/8")	4,600	6,200	6,200
Screen discharge & chute skirting to #4 conveyor	1,000	300	300
#4 Conveyor 24" x 10' @ $70/ft	3,000	700	700
Cone crusher feed chute	2,700	1,000	1,000
Cone crusher - $5\frac{1}{2}$' S.H. - 210 TPH	101,000	84,900	56,600
#5 Conveyor 24" x 80' @ $70/ft	21,000	5,600	5,600
#5 Conveyor-transfer chute	900	300	300
#6 Conveyor 24" x 98' @ $70/ft	25,000	6,900	6,900
Metal detector	500	5,000	3,000
Dust control	12,000	18,000	18,000
5 Ton crane	12,000	7,000	5,000
Sub Total	352,200		$167,020
Equipment installation @ 20%			33,404
Electrical control & distribution	1,000		28,500
Freight @ $24			4,238
Sales Tax @ 5%			8,351
Total	353,200		$241,513

SHAFT METHOD

CRUSHING PLANT & ORE STORAGE

CAPITAL COST ESTIMATE - CONSTRUCTION & INSTALLATION

		Cost
Conveyor Trestles	- 379 ft at $50/ft	$ 19,000
Crusher Foundations (Jaw & Cone)	- 129 cu yds at $120/cu yd	15,480
Building Footings & Floor Slab	- 44 cu yds at $110/cu yd	4,840
Conveyor & Transfer House Footings	- 30 cu yds at $110/cu yd	3,300
Coarse Ore Bin Foundation	- 52 cu yds at $110/cu yd	5,720
Fine Ore Bin Foundation	- 150 cu yds at $110/cu yd	16,500
Coarse Ore Bin	-	12,000
Fine Ore Bin	-	23,000
Crusher Building 26 ft x 52 ft = 1,352 sq ft at $11,426/sq ft (including heating, ventilation & plumbing)		15,500
Total		$ 115,340

Freight and Taxes included in above figures.

SHAFT METHOD

CONCENTRATOR

CAPITAL COST ESTIMATE - EQUIPMENT

	Weight - lbs	Cost New	Cost Second-hand (where applicable)
6 tube feeders	4,000	$ 3,500	$ 3,500
#7A conveyor 24" x 33' @ $70/ft	9,000	2,310	2,310
#7A transfer box	800	300	300
#7B conveyor 24" x 33' @ $70/ft	9,000	2,310	2,310
#7B transfer box	800	300	300
#8A conveyor - 24" x 23' @ $70/ft	7,000	1,610	1,610
#8A transfer box	800	300	300
#8B conveyor - 24" x 69' @ $70/ft	18,000	4,830	4,830
Ball mill feed box	800	700	700
8' x 10' Ball Mill including liners & ball charge	232,500	75,000	43,500
2 - 15" cyclones	1,500	3,500	3,500
3 - 5' x 5' steel reagent tanks	1,500	650	650
10 - 50 cu ft cells	25,700	17,820	12,500
8 - Reagent feeders	700	3,400	2,500
6 - 40 cu ft cells	12,500	9,470	7,800
1 - 25' x 10' thickener with mechanism	29,000	14,000	10,000
1 - 12' x 14' stock tank with mechanism	11,000	5,285	4,000
1 - 6' x 4' leaf filter - with vacuum equipment	11,000	25,000	16,700
1 - 3' x 26' Rotary drier including dust system	51,000	25,000	25,000
#9 conveyor 24" x 9' @ $70/ft	3,000	6,300	6,300
#9 discharge chute & skirting	800	300	300
#10 conveyor 24" x 12' @ $70/ft	4,000	840	840

(Continued)

	Weight - lbs	Cost New	Cost Second-hand (where applicable)
Rod Mill pump box	1,500	$ 800	$ 800
3 pump boxes - flotation	1,000	900	900
1 - 5" x 4" pump	1,150	1,400	1,400
1 - 3" x 3" pump	600	900	900
2 - 2" x 2" pump	400	1,700	1,700
2 - 1½" x 2" pump	400	1,700	1,700
1 - 3" x 3" pump	1,554	1,600	1,600
1 - 2½" x 2" pump	1,400	820	820
Process pipe hoses & launders	10,000	30,000	30,000
Sprinkler system @ $.50/sq ft x 5,200 sq ft	2,000	2,600	2,600
Sub Total	454,404		$192,170
Electrical equipment	4,000	55,900	55,900
Sub Total	458,404		$248,070
Equipment installation @ 20% of $192,170			38,434
Sales Tax @ 5% of $192,170			11,490
Freight @ $24 x 229.2 Tons			5,500
Total			$303,494

SHAFT METHOD

CONCENTRATOR

CAPITAL COST ESTIMATE - CONSTRUCTION & INSTALLATION

	Cost
Clearing & Grubbing Yard & Service Area	$ 2,000
Backfill	5,000
Concrete Foundations (except ball mill) - 236 cu yds at $120/cu yd	28,320
Concrete Foundations (9' x 10' ball mill) - 175 cu yds at $120/cu yd	21,000
Building & Miscellaneous Concrete - 244 cu yds at $110/cu yd	26,840
Concentrator Building (includes heating, plumbing & ventilation)	51,690
Conveyor #2 and 3 Housing and Cover	500
Conveyor #5 and 6 Housing and Cover	500
Conveyor Transfer House & Tower	8,700
Total	$ 144,550

Freight and Taxes included in above figures.

TRACKLESS METHOD

CRUSHING PLANT AND ORE STORAGE - 500 TPD

CAPITAL COST ESTIMATE - EQUIPMENT

	Weight lbs	Cost	
		New	Second-hand (where applicable)
Reciprocating feeder - 34" x 96"	9,500	$ 10,000	$ 6,750
Jaw crusher 30" x 42" - 140 TPH	108,000	70,000	33,500
Jaw & cone crusher chutes & skirting	1,200	2,000	2,000
#1 Conveyor 36" x 15' at $105/ft	4,000	1,580	1,580
#1 Transfer Chute	900	300	300
#2 Conveyor 36" x 100' at $105/ft	25,000	10,500	10,500
#2 Transfer Chute	900	300	300
#3 Conveyor 36" x 82' at $105/ft	20,000	8,610	8,610
#3 Feed box to screen	1,000	500	500
Primary screen double-deck 5' x 10' (top deck 2" - lower deck 5/8")	4,600	6,200	6,200
Screen discharge & chute skirting to #4 conveyor	1,000	300	300
#4 conveyor 24" x 10' at $70/ft	3,000	700	700
Cone crusher feed chute	2,700	1,000	1,000
Cone crusher - 5-1/2' SH - 210 TPH	101,000	84,900	56,600
#5 conveyor 24" x 106' at $70/ft	27,000	7,000	7,000
#5 conveyor - transfer chute	900	300	300
#6 conveyor 24" x 120' at $70/ft	30,000	8,400	8,400
Metal detector	500	5,000	3,000
Dust control	12,000	18,000	18,000
5-ton crane	12,000	7,000	5,000
Sub-Total	365,200		170,540

(Continued)

	Weight lbs	Cost New	Cost Second-hand (where applicable)
Equipment Installation at 20%			$ 34,108
Electrical Control & Distribution	1,000	$ 28,500	28,500
Freight at $24			4,394
Sales Tax at 5%			9,327
Total	366,200		$ 246,869

TRACKLESS METHOD

CRUSHING PLANT & ORE STORAGE

CAPITAL COST ESTIMATE - CONSTRUCTION & INSTALLATION

		Cost
Excavation		$ 5,614
Conveyor Trestles	- 440 ft at $50/ft	22,000
Crusher Foundations (Jaw & Cone)	- 129 cu yds at $120/cu yd	15,480
Building Footings & Floor Slab	- 44 cu yds at $110/cu yd	4,840
Conveyor & Transfer House Footings	- 30 cu yds at $110/cu yd	3,300
Coarse Ore Bin Foundation	- 52 cu yds at $110/cu yd	5,720
Fine Ore Bin Foundation	- 150 cu yds at $110/cu yd	16,500
Coarse Ore Bin		12,000
Fine Ore Bin		23,000
Crusher Building 29 ft x 42 ft = 1,220 sq ft (including heating, ventilation & plumbing)		13,940
Truck Bin Cribbing & Roof		4,000
Total		$ 126,394

Freight and Taxes included in above figures.

TRACKLESS METHOD

CONCENTRATOR

CAPITAL COST ESTIMATE - EQUIPMENT

	Weight - lbs.	Cost New	Cost Second-hand (where applicable)
6 tube feeders	4,000	$ 3,500	$ 3,500
#7A conveyor 24" x 33' @ $70/ft	9,000	2,310	2,310
#7A transfer box	800	300	300
#7B conveyor 24" x 33' @ $70/ft	9,000	2,310	2,310
#7B transfer box	800	300	300
#8 conveyor 24" x 31' @ $70/ft	9,000	2,170	2,170
Ball mill feed box	800	700	700
8' x 10' Ball Mill including liners and ball charge	232,500	75,000	43,500
2 - 15" cyclones	1,500	3,500	3,500
3 - 5' x 5' steel reagent tanks	1,500	650	650
10 - 50 cu. ft. cells	25,700	17,820	12,500
8 - Reagent feeders	700	3,400	2,500
6 - 40 cu. ft. cells	12,500	9,470	7,800
1 - 25' x 10' thickener with mechanism	29,000	14,000	10,000
1 - 12' x 14' stock tank with mechanism	11,000	5,285	4,000
1 - 6' x 4' leaf filter - with vacuum equipment	11,000	25,000	16,700
1 - 3' x 26' Rotary drier including dust system	51,000	25,000	25,000
#9 conveyor 24" x 9' @ $70/ft	3,000	6,300	6,300
#9 discharge chute & skirting	800	300	300

	Weight - lbs.	Cost New	Cost Second-hand (where applicable)
#10 conveyor 24" x 12' @ $70/ft.	4,000	$ 840	$ 840
Rod Mill pump box	1,500	800	800
3 pump boxes - flotation	1,000	900	900
1 - 5" x 4" pump	1,150	1,400	1,400
1 - 3" x 3" pump	600	900	900
2 - 2" x 2" pump	400	1,700	1,700
2 - 1-1/2" x 2" pump	400	1,700	1,700
1 - 3" x 3" pump	1,554	1,600	1,600
1 - 2-1/2" x 2" pump	1,400	820	820
Process pipe, hoses, and launders	10,000	30,000	30,000
Sprinkler system @ $.50 sq. ft. x 6845	2,000	3,442	3,422
Sub total	437,604		$188,422
Electrical equipment	4,000	55,900	55,900
Sub total	441,604		$244,322
Equipment installation at 20%			37,684
Sales tax at 5%			11,300
Freight at $24/Ton			5,300
Total			$ 298,606

TRACKLESS METHOD

CONCENTRATOR

CAPITAL COST ESTIMATE - CONSTRUCTION & INSTALLATION

	Cost
Clearing & grubbing yard & service area	$ 2,000
Excavation & backfill	28,333
Concrete foundations (except ball mill) 236 cu. yds. @ $120/cu. yd.	28,320
Concrete foundation (9' x 10' ball mill) 175 cu. yds @ $120/cu. yd	21,000
Building & miscellaneous concrete - 244 cu. yds. @ $110/cu. yd.	26,840
Concentrator building (includes heating, plumbing & ventilation	68,040
Conveyor #2 & 3 housing & cover	500
Conveyor #5 & 6 housing & cover	500
Conveyor Transfer house & tower	8,700
Total	$184,233

*Freight and taxes included in above figures.

CONCENTRATOR
ESTIMATED OPERATING COST
LABOUR

	Salary/Month	No. of Men	Jobs	Shifts Per Wk.	Rate/hr Per Man	Amt/Day Per Man (Straight Time)	Amt Per* 7 D Wk	Avg. Amt per Calendar D	No. of Men/D	Amt. Per Year (350 days)		Cost/ton Milled 175,000 TPY
Crusher												
Operator		1	1	5	$3.75	$30.00	$180.00	$25.71	1	$ 8,999		
											$ 8,999	$ .052
Concentrator												
Grinding Operator		4	3	21	3.75	30.00	250.50	35.79	3	37,580		
Flotation Operator (Lead Hand)		4	3	21	4.00	32.00	268.80	38.40	3	40,320		
Filter, Drying and Conc. Loading Operator		4	3	21	3.60	28.80	240.48	34.35	3	36,068		
Labourer		1	1	5	3.42	27.36	164.16	23.45	1	8,208		
											122,176	.698
Maintenance												
Mechanic		1	1	6	4.50	36.00	261.00	37.29	1	13,051		
Helper		2	2	10	3.60	28.80	172.80	24.69	2	17,283		
Sub Total		17	14								30,334	.173
Staff												
Superintendent	$1400	1	1	5						20,160		
Mill Foreman - Metallurgist	1200	1	1	5						17,280		
Assayer	800	1	1	5						11,520		
Sample Preparation	600	1	1	5						8,640		
Sub Total		4	4								57,600	.329
Total		21	18								$219,109	$1.252

* Including fringe benefits @ 20% of base wages and weekend overtime where applicable.

CONCENTRATOR
ESTIMATED OPERATING COST
SUPPLIES & OTHER

		Cost/Ton Milled 175,000 TPY
CRUSHER		
Primary-Steel- 0.04#/Ton Milled = 7000# @ 33¢/lb = $2310/yr	$ 0.013	
Secondary-Steel- 0.03#/Ton Milled = 5250# @ 43¢/lb = $2258	0.013	
Screening & Feeders Etc.	0.010	
Conveying	0.010	
Lubrication	0.005	
Subtotal - Crusher		$ 0.051
CONCENTRATOR		
1. Grinding - 1#/Ton = 175,000#/yr @ 13¢/lb = $22,750/yr	0.130	
2. Ball Mill Liners - 0.20#/Ton = 35,000# @ 22¢/lb = $7700/yr	0.044	
3. Pumps, Pipes & Cyclones	0.005	
Subtotal - Grinding & Classifying		0.179

4. Flotation

a. Reagents	#/Ton	Cost/lb	Cost/Ton-¢
Zanthate-Z-11	0.20	34¢	6.80
Dowfroth	0.12	28¢	3.36
Lime	0.50	5¢	2.50
			12.66
b. Cell Repair & Pumps			1.00
			13.66
Subtotal - Flotation			0.137

5. Filtering & Drying	Amt/Yr	
Supplies @ $0.05/ton	$ 875.00	
Fuel - 1½ g/ton of concentrate @30¢/gal 14,000 tons/yr	6,300.00	
	7,175.00	
Subtotal Filtering & Drying		0.041

(Continued)

		Cost/Ton Milled 175,000 TPY
MISCELLANEOUS		
Tailings Disposal	$ 0.010	
Assaying ($250/month)	0.017	
General ($500/month)	0.034	$ 0.061
Total		0.469

CONCENTRATOR
ESTIMATED OPERATING COST
SUMMARY

	Cost/Ton Milled		
	Labour	Supplies & Other	Total
Crushing	$ 0.052	$ 0.051	$ 0.103
Grinding & Classifying	0.215	0.179	0.394
Flotation	0.230	0.137	0.367
Filtering & Drying	0.206	0.041	0.247
Concentrate Disposal	0.047	-	0.047
Maintenance Labour	0.173	-	0.173
Assaying	0.115	0.017	0.132
Tailings Disposal	-	0.010	0.010
Miscellaneous Supplies	-	0.034	0.034
Supervision	0.214	-	0.214
Total	$ 1.252	$ 0.469	$ 1.721

CHAPTER V
FRESH WATER SUPPLY & TAILINGS DISPOSAL

WATER SUPPLY

INTRODUCTION

Water requirements for a 500 TPD mill at Alwin Mines Ltd. property in the Highland Valley have been reviewed. Various schemes have been investigated by Alwin Mines to ensure an adequate water supply for the proposed mill, and the use of additional storage to be constructed at Island Lake together with tailings disposal in Little O.K. Lake has been selected.

Water Requirements

Assuming 25% solids in the tailings and 75% use of reclaims yields the following water quantities:

Total Water Requirement = $\frac{500 \times 3}{6}$ = 250 USGPM

Reclaimed Water Requirement = 0.75 x 250 = 190 USGPM

Fresh Water Required = 60 USGPM

The domestic use of a 100-man camp is expected to range between 25 and 50 US gallons per person per day. Using the maximum figure gives

Domestic Requirement = $\frac{50 \times 100}{24 \times 60}$ = 3.4 USGPM

Applying a safety factor of 1.5 to the above figures gives a fresh water requirement of 100 USGPM.

Water Supply - "Island Lake Scheme"

The "Island Lake Scheme" for water supply will provide a catchment area of 1.7 square miles or approximately 10% of the useable Inkikuh Creek Basin area of 18.7 square miles. Assuming a yield of 25% of the average annual precipitation of 16 in. will give the following runoff from Island Lake.

Annual Yield = 1.7 x 640 x 4/12

= 360 ac ft

This is equivalent to a continuous flow of 225 USGPM or almost sufficient water to supply all of the mill requirement both fresh and reclaim. During the first year of operation there may not be adequate water in the reclaim pond to give adequate settling and the mill may have to operate totally on fresh water. In addition during dry years there may be no runoff except during the freshet.

A five-foot increase in the water level of Island Lake, however, will yield 450 ac ft of storage, sufficient for three years of mill water supply. Normal runoff from the watershed will probably supply the total water required, but the recommended storage will assure a supply even in the driest years when there is virtually no runoff.

During the lifetime of the mill it is estimated that the sands and slimes from the tailings will fill Little O.K. Lake. A five-foot dam on the outlet of the lake will store a minimum of forty days of reclaim water, which will promote adequate settling and reduce the size of the fresh water system.

Fresh water will be pumped from the pumphouses on Island Lake to the fire storage tank above the mill through a six-inch pipeline. Fresh water and domestic use will be circulated through the fire tank to reduce ice build up during the winter, and all pipelines will be buried deep enough to avoid freezing problems. Reclaim water will be pumped at a constant rate to an overflow within the mill. The overflow will provide a constant head, reduce control problems and eliminate some pumps and pump boxes within the mill.

Licenses and Permits

Applications have been made to the Provincial Government for the licenses and permits required for the water supply and tailings disposal systems as outlined. The water license will cover the storage and use of water from Island Lake, and possible diversion of flood water from Inkikuh Creek should this ever be required to fill Island Lake. In addition, an application has been made to divert the runoff around Little O.K. Lake which will control the level of the tailings pond. The application for a Pollution Control Permit covers the disposal of tailings in Little O.K. Lake, construction of a dam to store the supernatant and release of the supernatant at periods of high flow to Inkikuh Creek. Since it appears feasible all effluent will be reused in the mill, diminishing the water requirement, the cost of the Inkikuh Creek diversion and decant line have not been included in the estimate.

The system outlined will provide an adequate water supply and effectively controlled effluent storage scheme at minimum cost. Construction of the storage dams well in advance of the mill will guarantee an assured supply during the expected lifetime of the mine.

Alternative Sources

Assurance has been received from the various governmental representatives and agencies that the required licenses and permits will be issued in due course.

In addition, conversations with the Valley Copper-Lornex-Bethlehem group who are making plans to pump substantial quantities of water on a joint venture basis for their concentrators indicate that Alwin will be able to purchase water from this supply if deemed desirable.

TRACKLESS METHOD

WATER SUPPLY AND TAILINGS DISPOSAL ESTIMATED COST
MILL ON DL 3645

Water Supply

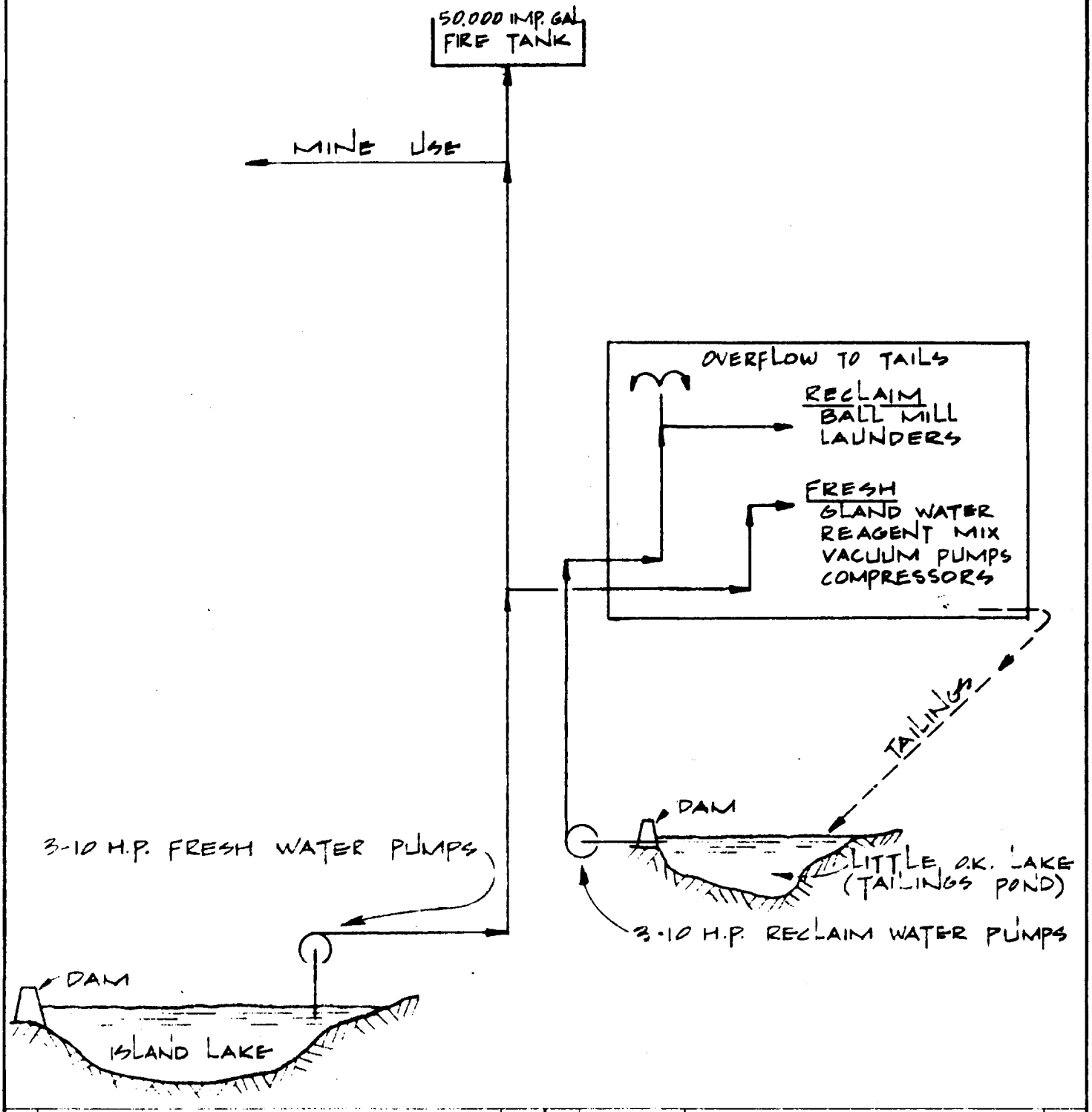
Dam on Island Lake	$10,000	
Clearing trees, Island Lake	10,000	
Water Pumphouse	5,000	
3-10 hp Water Pumps & Motor	3,000	
Valves and Piping	2,000	
5,000 ft 6 in. Supply Main at $10.00/ft	50,000	
50,000 Imp. Gal. Water Tank	12,000	
		$ 92,000

Tailings Disposal

1,000 ft Tailing Line at $10.00/ft	$10,000	
2,000 ft Diversion Ditch at $5.00/ft	10,000	
Storage Dam 5 ft high	5,000	
Reclaim Water Pumphouse	5,000	
3-10 hp Pumps and Motor	3,000	
1,000 ft Reclaim Water Line at $10.00/ft	10,000	
		$ 43.000

Fire Protection

Extinguishers and miscellaneous	5,000
	$140,000



DWG. NO.	REFERENCE	REF. NO.	REV.	BY	DATE	REVISION	APP'D

APPROVED	SCALE	—	DAY	MO.	YR	HIGHLAND VALLEY PROPERTY
DATE	DR'N	D.C.W.	22	5	70	500 TON PER DAY MILL
	CH'K'D					WATER SUPPLY & TAILINGS DISPOSAL
A	APP'D					SCHEMATIC FLOW DIAGRAM
	APP'D.					

SANDWELL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. A 2572 - REV

CHAPTER VI
POWER

REQUIREMENTS AND AVAILABILITY

Mine development and exploration will be started immediately after financing arrangements are completed. Most of the power related to the mine therefore will be required early. For this reason and for construction purposes, rental diesel electric sets will be required until delivery of power from the Hydro Authority can be effected; costs have been included in the estimates.

Power for the concentrator and the trailer camp will probably not be required until immediately prior to production.

A preliminary meeting with a representative from the B.C. Hydro Authority disclosed that an existing 60 kV line comes within 3-3½ miles of the proposed shaft location. It is anticipated that this voltage will be increased to 138 kV. Power therefore will be delivered to Alwin at 60 kV initially and 138 kV later. Assurance has been given that power can be purchased by Alwin as and when desired.

The total estimated cost of power transmission and distribution amounts to $323,100 for the "Trackless Method", and $344,400 for the "Shaft Method" as detailed on the following tables.

TRACKLESS METHOD ESTIMATED COSTS

POWER TRANSMISSION & DISTRIBUTION

Transmission tap. 138 kV	$ 35,000
Transmission substation 138/25 kV	86,000
Primary distribution power line (25 kV - 3½ miles)	52,000
Primary distribution substation	75,000
Secondary distribution substation	26,400
Site power supply - distribution to buildings	21,000
Temporary, construction power distribution	10,000
Transmission lines and controls for fans	12,000
Transmission lines and controls for fill plant	3,850
Transformers and transmission down shaft (in addition to that estimated in mine costs)	-
Lighting - roads and camp general	1,050
Welding and grounding - general	800
	$323,100

SHAFT METHOD ESTIMATED COSTS

POWER TRANSMISSION, & DISTRIBUTION

Transmission tap. 138 kV	$ 35,000
Transmission substation 138/25 kV	86,000
Primary distribution power line (25 kV - 3-1/2 miles)	52,000
Primary distribution substation	75,000
Secondary distribution substation	41,400
Site power supply - distribution to buildings	21,000
Temporary, construction power distribution	10,000
Transmission lines and controls for fans	12,950
Transmission lines and controls for fill plant	3,850
Transformers and transmission down shaft (in addition to that estimated in mine costs)	5,000
Lighting - roads and camp general	1,300
Welding and grounding - general	900
	$344,400

The estimated operating cost when the mine is in production is calculated as follows:

	POWER DEMAND				
	Inst. hp	Max kW	Avg. kW	kWh/mo	Amt - $/mo*
Concentrator	675	463	463	324,000	$3,850
Crushing plant	450	347	215	37,600	450
Mine - "trackless"	1,050	820	574	231,000	2,750
Mine - "shaft"	1,800	1,290	795	335,300	3,970
Water supply	60	26	23	16,300	193
Lighting, heating & power (misc. buildings)	535	270	183	49,500	590
Totals - "trackless"	2,770	1,926	1,454	658,400	$7,833
Totals - "shaft"	3,520	2,396	1,675	762,700	$9,050

* Assuming schedule 1604 i.e. 11.86 mills/kWh.

CHAPTER VII
PLANT SERVICES ADMINISTRATION & MAN POWER

GENERAL

Because the mine is only four to five hours away from mechanical and electrical repair maintenance services in Vancouver, British Columbia, only minimum facilities are required at the mine.

A plan accompanying this report shows the position of the various buildings and services to be constructed if the mine is placed in production by the trackless method. It is assumed that the cost relative to the shaft method will be comparable; no plan has therefore been prepared for this alternative.

CAMP BUILDINGS & HOUSING

In view of the current activity in the mining industry in the Highland Valley area in British Columbia, it would appear that there is a strong possibility that a small to medium size new town (or an addition to one of the surrounding ones) will be undertaken during the next few years in the immediate vicinity.

Alwin's needs, however, will very likely have to be satisfied before such a development takes place, and since present nearby facilities are inadequate, it is suggested that temporary housing must be provided in the interim, in order to secure the necessary personnel for a successful operation.

Construction would be of such a nature that the units could be moved or re-sold in the event that participation in a larger centre of population appears desirable.

The estimated preproduction plant services and administration costs, manpower required during preproduction, capital costs required and the operating costs at the mine and at the head office in Vancouver are shown in the following tables.

SHAFT METHOD

PLANT SERVICES & ADMINISTRATION
ESTIMATED CAPITAL COSTS

		Cost
1)	Assay Office	$ 10,140
2)	Office, Warehouse & Change House	129,228
3)	Machine Shop & Compressor House	93,210
4)	Mobile Equipment	57,000
5)	Access & Plant Roads & General Site Preparation	8,871
6)	Sewage Disposal	21,000
7)	Fuel Oil Storage	10,000
8)	Telephone System	10,000
		$339,449

SHAFT METHOD

CAMP BUILDING & HOUSING

ESTIMATED CAPITAL COST

		Cost
1)	Senior Staff Residences - Ashcroft 6 x 15,000	$ 90,000
2)	Staff House	37,900
3)	Bunkhouse or Trailers	103,000
4)	Trailer Camp	35,000
5)	Present Camp - Alterations and Additions	15,000
		$280,900

SHAFT METHOD

ESTIMATED PREPRODUCTION PLANT SERVICES & ADMINISTRATION COSTS

Months

	1	2	3	4	5	6	7	8	9	Total
Supervision	$ 2420	$ 2420	$ 2420	$ 2420	$ 2420	$ 2420	$ 2420	$ 2420	$ 2420	$ 21780
Mine office	968	968	2331	2331	2331	2331	2331	2331	2331	18253
Mechanical - electrical	1847	1847	1847	1847	1847	1847	1847	1847	1847	16623
Truck & Tractor	2770	2770	2770	2770	2770	2770	2770	2770	2770	24930
First Aid & Safety	100	100	100	100	100	100	100	100	100	900
Cookhouse & single men's quarters	6862	7313	8212	8663	9225	11250	12262	10013	10687	84487
Insurance	200	200	300	300	300	400	400	500	600	3200
Travelling	100	100	100	100	100	100	100	100	100	900
Telephone & telegraph	300	300	300	300	300	300	300	300	300	2700
Taxes, property & school	200	200	500	500	1000	1000	1000	2600	2600	9600
Totals	$15767	$16218	$18880	$19331	$20393	$22518	$23530	$22981	$23755	$183373

SHAFT PREPRODUCTION MINE DEVELOPMENT

MANPOWER REQUIREMENTS

	Months									
Category	1	2	3	4	5	6	7	8	9	Total
Engineers	4	4	4	4	5	5	5	7	7	45
Supervision	4	4	4	4	4	4	4	4	4	36
Assaying	1	1	1	1	1	1	1	1	1	9
1st Aid & Warehouse	1	1	1	1	1	1	1	1	1	9
Changehouse & Lamps	1	1	1	1	1	1	1	1	1	9
Mechanical & Electrical	3	3	3	3	3	3	4	4	4	30
Miners - Drift	12	12	16	16	16	30	30	30	30	192
Miners - Raise	-	-	4	8	8	8	8	8	8	52
Surface Truck & Tractor	1	1	1	1	1	1	1	1	1	9
Explosive Distribution	1	1	1	1	1	1	1	1	1	9
Trainmen & Helpers	-	-	-	-	-	4	4	4	4	16
Labour - Sill Timbering	1	1	1	1	1	1	3	3	9	21
Diamond Drillers	-	-	-	-	4	4	4	-	-	12
Construction - Fill Plant & Lines	-	-	-	-	-	-	4	4	4	12
Shaft Foreman	1	1	1	1	1	1	1	-	-	7
Shaft Miners	12	12	12	12	12	12	12	-	-	84
Hoistman	3	3	3	3	3	3	3	3	3	27
Deckman	3	3	3	3	3	3	3	-	-	21
Shaft Surface Labour	3	3	3	3	3	3	3	3	3	27
Skiptender - Cage Tender	-	-	-	-	-	-	2	2	2	6
Timbermen	-	4	4	4	4	4	4	2	2	28
Totals	51	55	63	67	72	90	99	79	85	661

SHAFT METHOD - PRODUCTION

ESTIMATED OPERATING COST - PLANT SERVICES & ADMINISTRATION

	Per Month				
	Labour	Supplies	Other	Total	Per Ton Milled (14,583 TPM)
As in Trackless Method	$11,131	$ 2,458	$11,475	$25,064	$1.719
Minus "Cookhouse"	-	-	7,425	7,425	
	11,131	2,458	4,050	17,639	
Plus "Actual" Cookhouse	-	-	8,775	8,775	
Total	$11,131	$ 2,458	$12,825	$26,414	$1.811

SHAFT METHOD

VANCOUVER HEAD OFFICE

Salaries	Per Month	
President	$ 1,000	
Secretary-Treasurer	1,000	
Stenographer	400	
Printing, Stationery	100	
Office Rent (partial)	500	
Association Dues & Publicity	100	
Telephone & Telegraph	100	
Audit, Legal & Trust Company	250	
Traveling	100	
Annual Meeting	75	
Stock Exchange	75	
Miscellaneous	100	
		$ 3,800
Fringe Benefits at 11% on $2,400 Salary		264
		$ 4,064

TRACKLESS METHOD

PLANT SERVICES & ADMINISTRATION - BUILDINGS & EQUIPMENT

ESTIMATED CAPITAL COSTS

1.	Assay office	$ 10,140
2.	Office, warehouse & change house	124,228
3.	Machine shop & compressor house	82,020
4.	Mobile equipment	57,000
5.	Access & plant roads & general site preparation	8,871
6.	Sewage disposal	21,000
7.	Fuel oil storage	10,000
8.	Telephone system	10,000
		$306,459

TRACKLESS METHOD

CAMP BUILDINGS & HOUSING

ESTIMATED CAPITAL COST

1.	Senior staff residences - Ashcroft (6 x $15,000)	$ 90,000
2.	Staffhouse	37,900
3.	Bunkhouse or trailers	85,500
4.	Trailer camp	28,000
5.	Present camp-alterations & additions	15,000
	Total	$256,400

TRACKLESS METHOD

ESTIMATED PREPRODUCTION PLANT SERVICES & ADMINISTRATION COSTS

	Months									
	1	2	3	4	5	6	7	8	9	Total
Supervision	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 2,420	$ 21,780
Mine Office	968	968	2,331	2,331	2,331	2,331	2,331	2,331	2,331	18,253
Mechanical - Electrical	1,847	1,847	1,847	1,847	1,847	1,847	1,847	1,847	1,847	16,623
Truck & Tractor	2,770	2,770	2,770	2,770	2,770	2,770	2,770	2,770	2,770	24,930
First Aid & Safety	100	100	100	100	100	100	100	100	100	900
Cookhouse & Single Men's Quarters	4,388	4,950	7,762	7,762	8,100	7,762	8,438	9,000	9,788	67,950
Insurance	200	200	300	300	300	400	400	500	600	3,200
Travelling	100	100	100	100	100	100	100	100	100	900
Telephone & Telegraph	300	300	300	300	300	300	300	300	300	2,700
Taxes, Property & School	200	200	500	500	1,000	1,000	1,000	2,600	2,600	9,600
Totals	$13,293	$13,855	$18,430	$18,430	$19,268	$19,030	$19,706	$21,968	$22,856	$166,836

TRACKLESS PREPRODUCTION MINE DEVELOPMENT MANPOWER REQUIREMENTS

	MONTHS									
Category	1	2	3	4	5	6	7	8	9	Total
Engineers	4	5	5	5	5	6	6	7	7	50
Supervision	4	4	4	4	4	4	4	4	4	36
Assaying	1	1	1	1	1	1	1	1	1	9
1st. Aid & Warehouse	1	1	1	1	1	1	1	1	1	9
Changehouse & Lamps	1	1	1	1	1	1	1	1	1	9
Mechanical & Electrical	5	5	7	7	7	7	7	7	7	59
Material distribution	-	-	-	-	1	1	1	1	1	5
Small service trucks	-	-	1	1	1	1	1	2	2	9
Truck & tractor (surface)	1	1	1	1	1	1	1	1	1	9
Mine development (Miners)	12	12	18	18	18	18	18	18	18	150
Raising 'Miners'	-	4	4	4	6	6	6	6	10	46
Truck & Loader Operators (underground)	-	-	12	12	12	12	12	12	12	84
Labour & Sill timbering	-	-	-	-	-	-	2	5	8	15
Diamond drillers	-	-	4	4	4	-	-	-	-	12
Construction (Fill plant & lines)	-	-	-	-	-	-	4	4	4	12
TOTAL:	29	34	59	59	62	59	65	70	77	514

TRACKLESS METHOD - PRODUCTION

ESTIMATED OPERATING COST
PLANT SERVICES & ADMINISTRATION

	Per Month				Per Ton Milled (14,583 TPM)
	Labour	Supplies	Other	Total	
Supervision	$ 2,220	$ 200	-	$ 2,420	$0.166
Mine Office	2,830	255	-	3,085	0.212
Mechanical - Electrical	3,820	636	-	4,456	0.306
Truck & Tractor	1,484	1,297	-	2,781	0.191
Trailer Camp (Loss)	-	-	200	200	0.014
First Aid & Safety	777	70	-	847	0.058
Cookhouse & Single Men's Quarters	-	-	7,425	7,425	0.508
Insurance	-	-	600	600	0.041
Travelling	-	-	100	100	0.007
Telephone & Telegraph	-	-	300	300	0.021
Taxes - Property & School	-	-	2,600	2,600	0.178
Miscellaneous	-	-	250	250	0.017
Totals	$11,131	$ 2,458	$11,475	$25,064	1.719

TRACKLESS METHOD

VANCOUVER HEAD OFFICE

Salaries	Per Month	
President	$ 1,000	
Secretary-Treasurer	1,000	
Stenographer	400	
Printing, Stationery	100	
Office Rent (partial)	500	
Association Dues & Publicity	100	
Telephone & Telegraph	100	
Audit, Legal & Trust Company	250	
Traveling	100	
Annual Meeting	75	
Stock Exchange	75	
Miscellaneous	100	
		$ 3,800
Fringe Benefits at 11% on $2,400 Salary		264
		$ 4,064

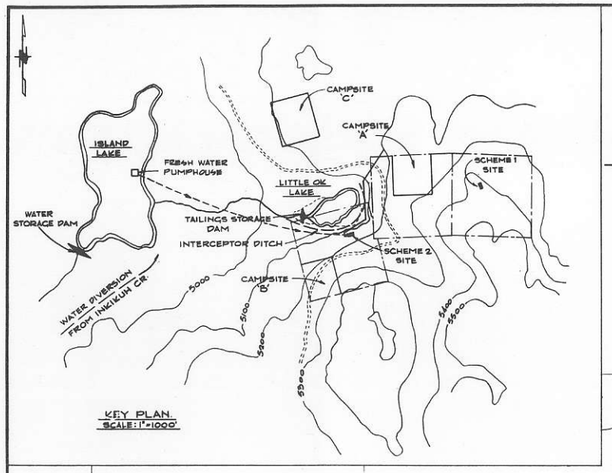
MANPOWER SUMMARY

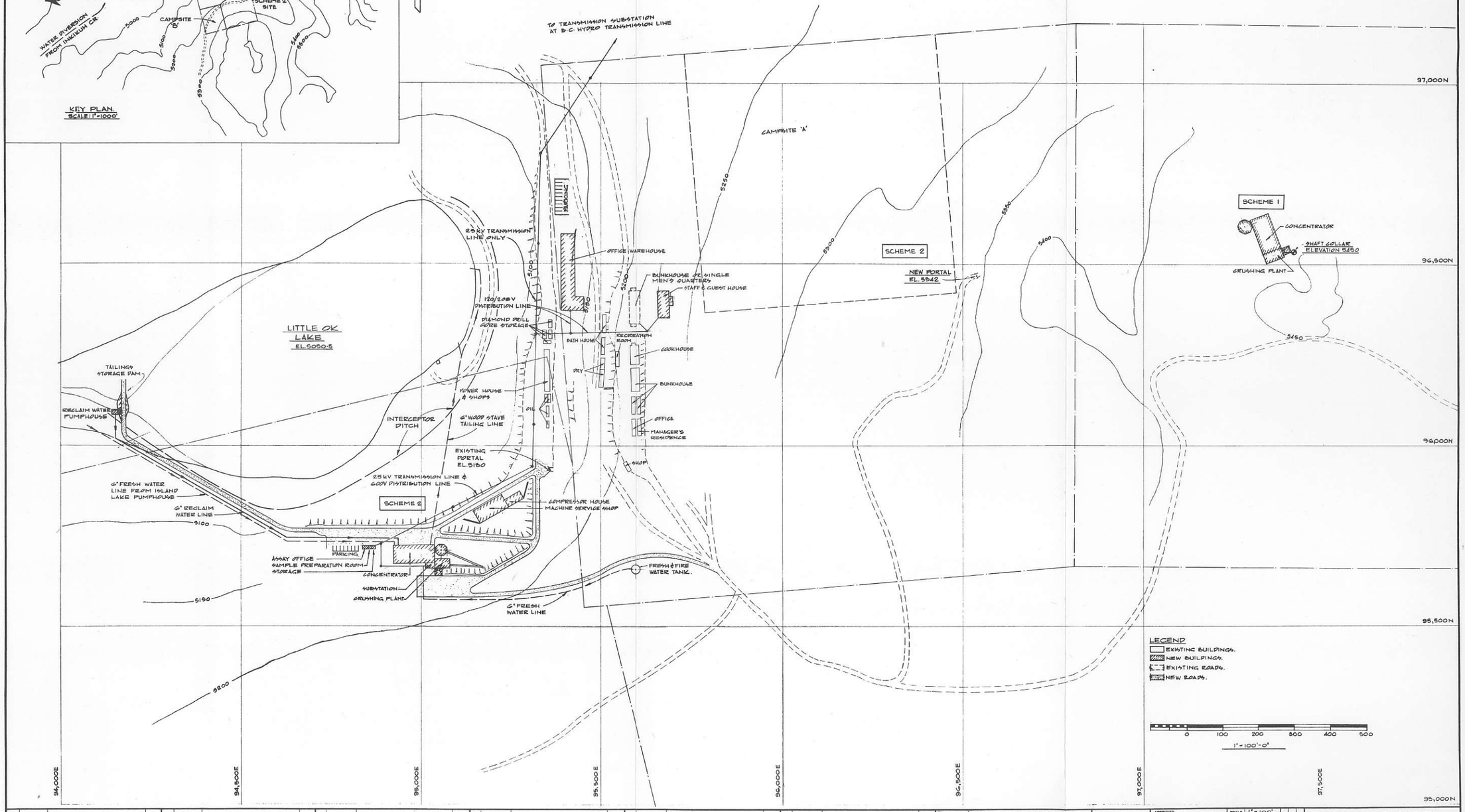
	Trackless	Shaft
Mine	89	100
Mill (incl. swing men)	21	21
Plant Services & Administration	18	19
	128	140

DISTRIBUTION OF EMPLOYEE HOUSING

	Mine Accommodation Required	Mine Accommodation Not Required
Trackless		
Senior staff residences - Ashcroft	-	6
Employee self owned accommodation	-	10
Single men's quarters	52	-
Staff house	10	-
Trailer camp	-	50
	62	66
Shaft		
Additional bunkhouse	12	-
	74	66

CHAPTER VIII
LIST OF ILLUSTRATIONS





DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER. BRITISH COLUMBIA

APPROVED
DATE
E.

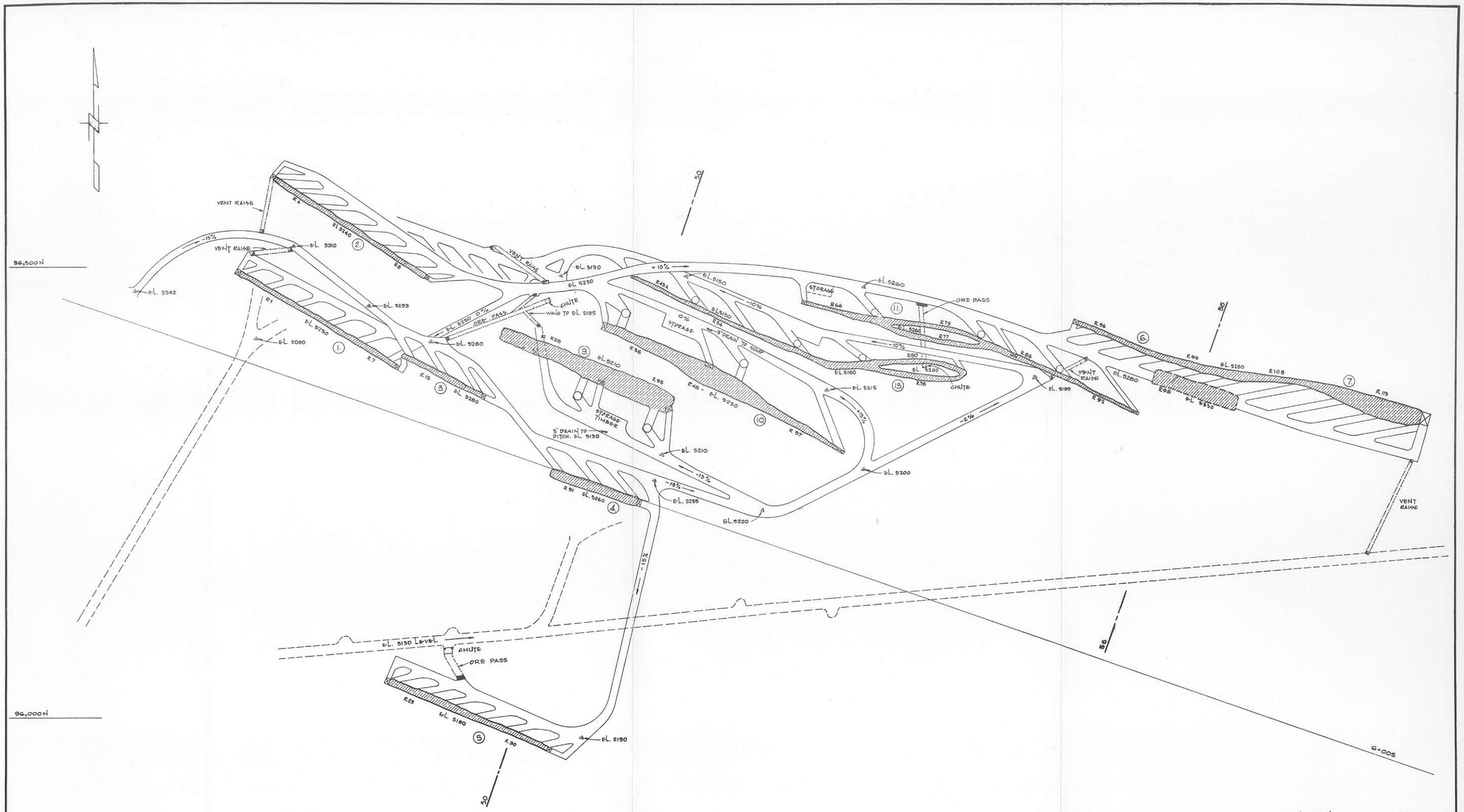
SCALE	1"=100'			
DR'N	IACOBELLI	29	5	70
CH'K'D				
APP'D.	[illegible]	2	6	70
APP'D.	J.J.C	5	6	70

HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
SITE
GENERAL ARRANGEMENT

ALWIN MINING COMPANY LTD.
VANCOUVER, BRITISH COLUMBIA

SANDWELL

DWG. E. 2572-1 REV



BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

DWG. NO.	REFERENCE	REF. NOS.	DWG. NO.	REFERENCE	REF. NOS.

REV.	BY	DATE	REVISION	APP'D

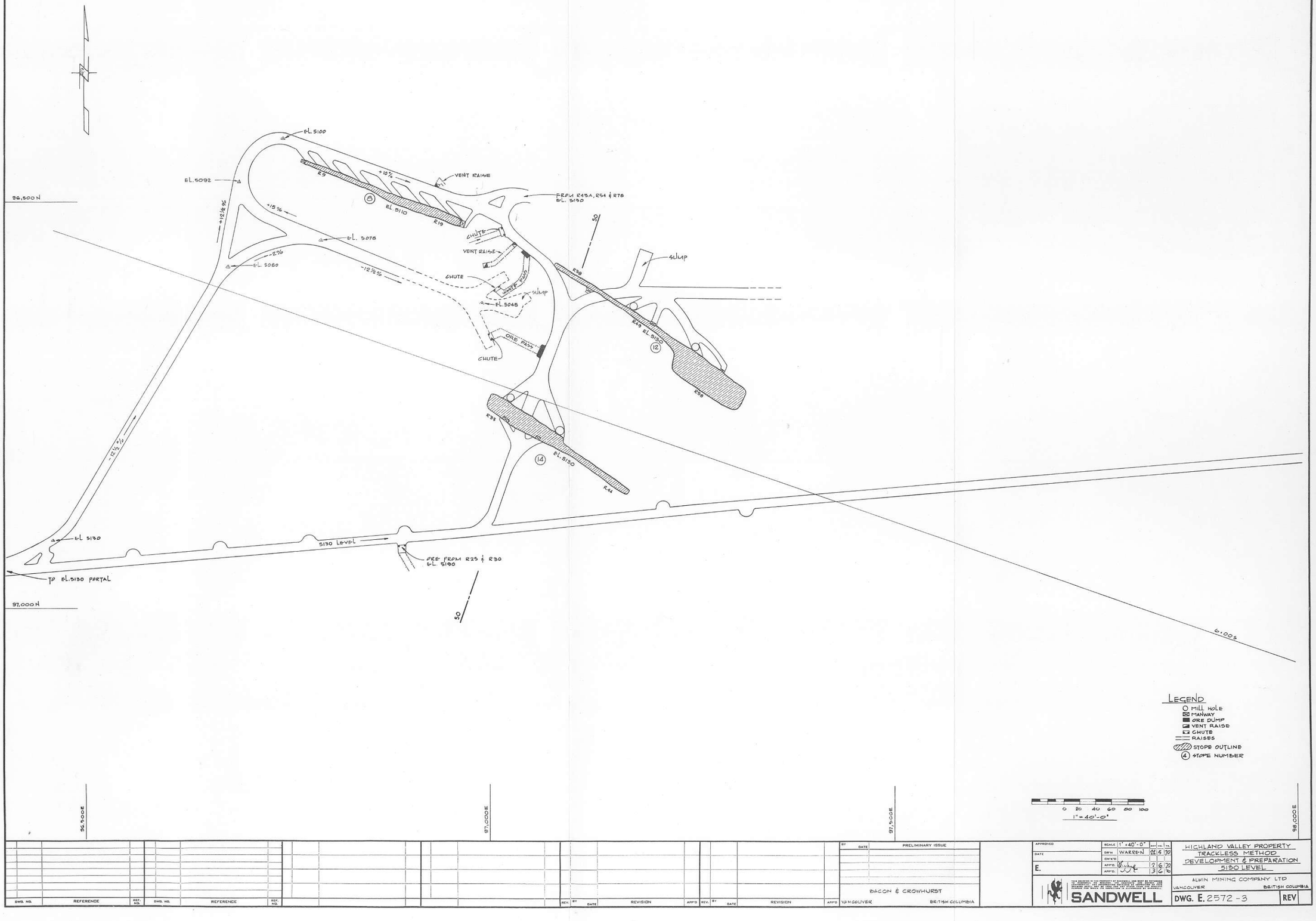
APPROVED		SCALE	1" = 40'-0"			
DATE		DR'N	WARREN	22	5	70
E.		CH'K'D				
		APP'D.		2	6	70
		APP'D.		3	6	76

SANDWELL

HIGHLAND VALLEY PROPERTY
TRACKLESS METHOD
DEVELOPMENT & PREPARATION
5340 LEVEL TO 5190 LEVEL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-2 REV



DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

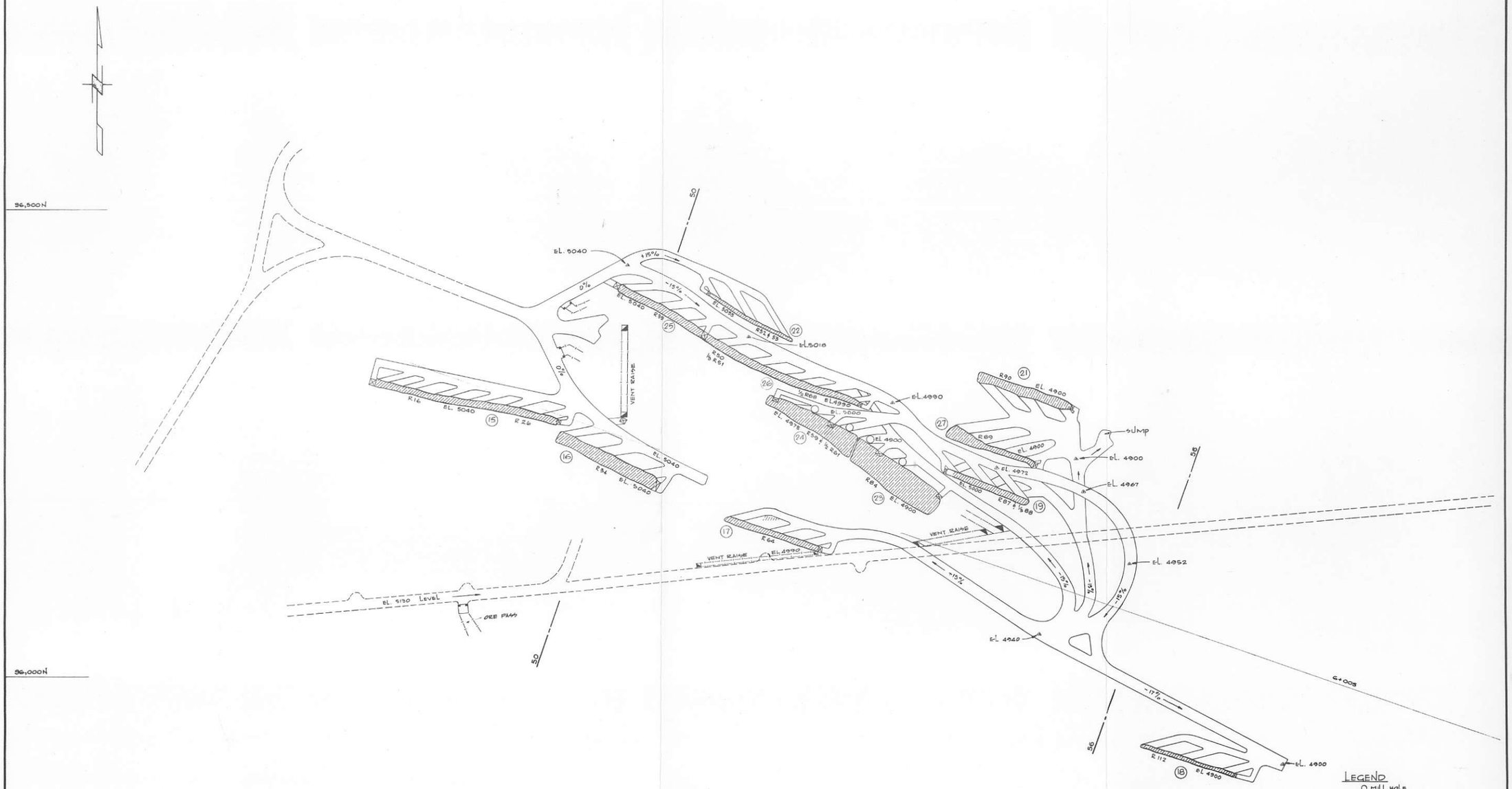
APPROVED	SCALE	1" = 40'-0"		
DATE	DR'N	WARREN	22	5 70
E.	CH'K'D			
	APP'D		2	6 70
	APP'D	JJF	3	6 70

SANDWELL

HIGHLAND VALLEY PROPERTY
TRACKLESS METHOD
DEVELOPMENT & PREPARATION
5130 LEVEL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-3 REV



DWG. NO.	REFERENCE	REF. NOS.	DWG. NO.	REFERENCE	REF. NOS.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

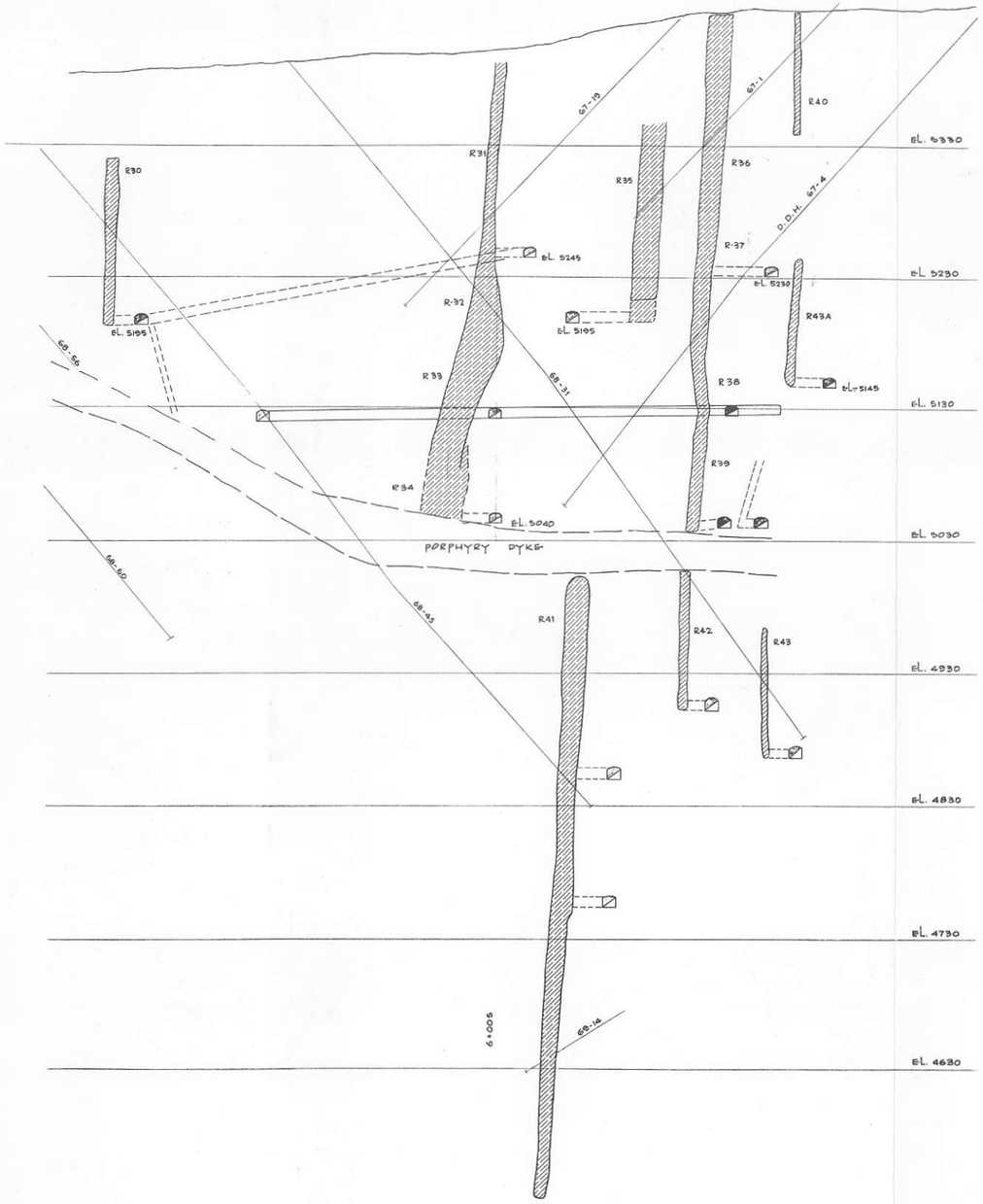
SCALE	1"=40'-0"			
DR'N	WARREN	72	5	10
CH'K'D				
APP'D.		1	6	70
APP'D.		3	6	70

SANDWELL

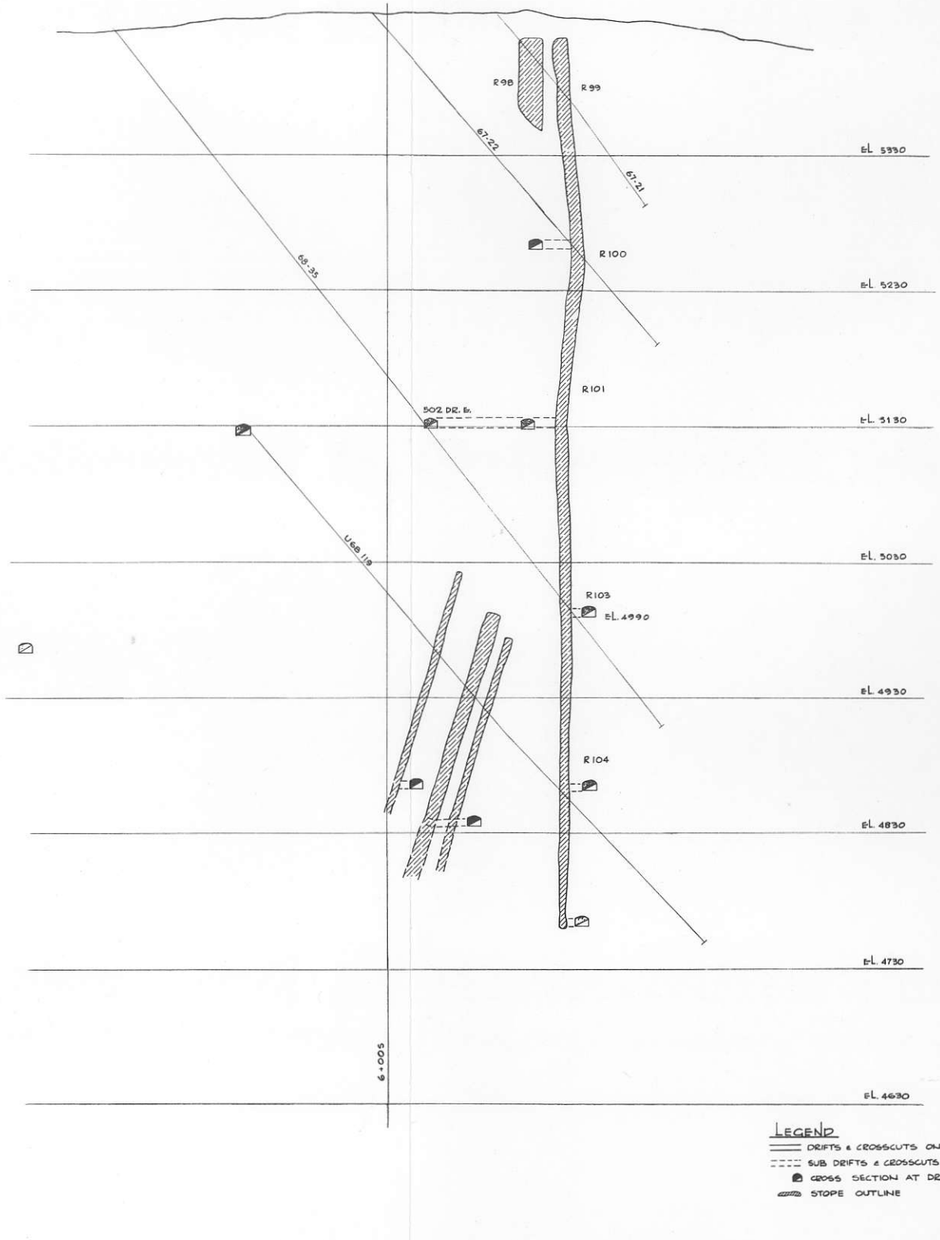
HIGHLAND VALLEY PROPERTY TRACKLESS METHOD DEVELOPMENT & PREPARATION 5130 LEVEL TO 4900 LEVEL

ALWIN MINING COMPANY LTD.
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-4 REV



SECTION AT 50



SECTION AT 56

LEGEND
- DRIFTS & CROSSCUTS ON LEVEL
- SUB DRIFTS & CROSSCUTS AT EL. SHOWN
- CROSS SECTION AT DRIFT
- STOPE OUTLINE

0 20 40 60 80 100
1"=40'-0"

DWG. NO.	REFERENCE	REF. NOS.	DWG. NO.	REFERENCE	REF. NOS.

REV.	BY	DATE	REVISION	APP'D

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

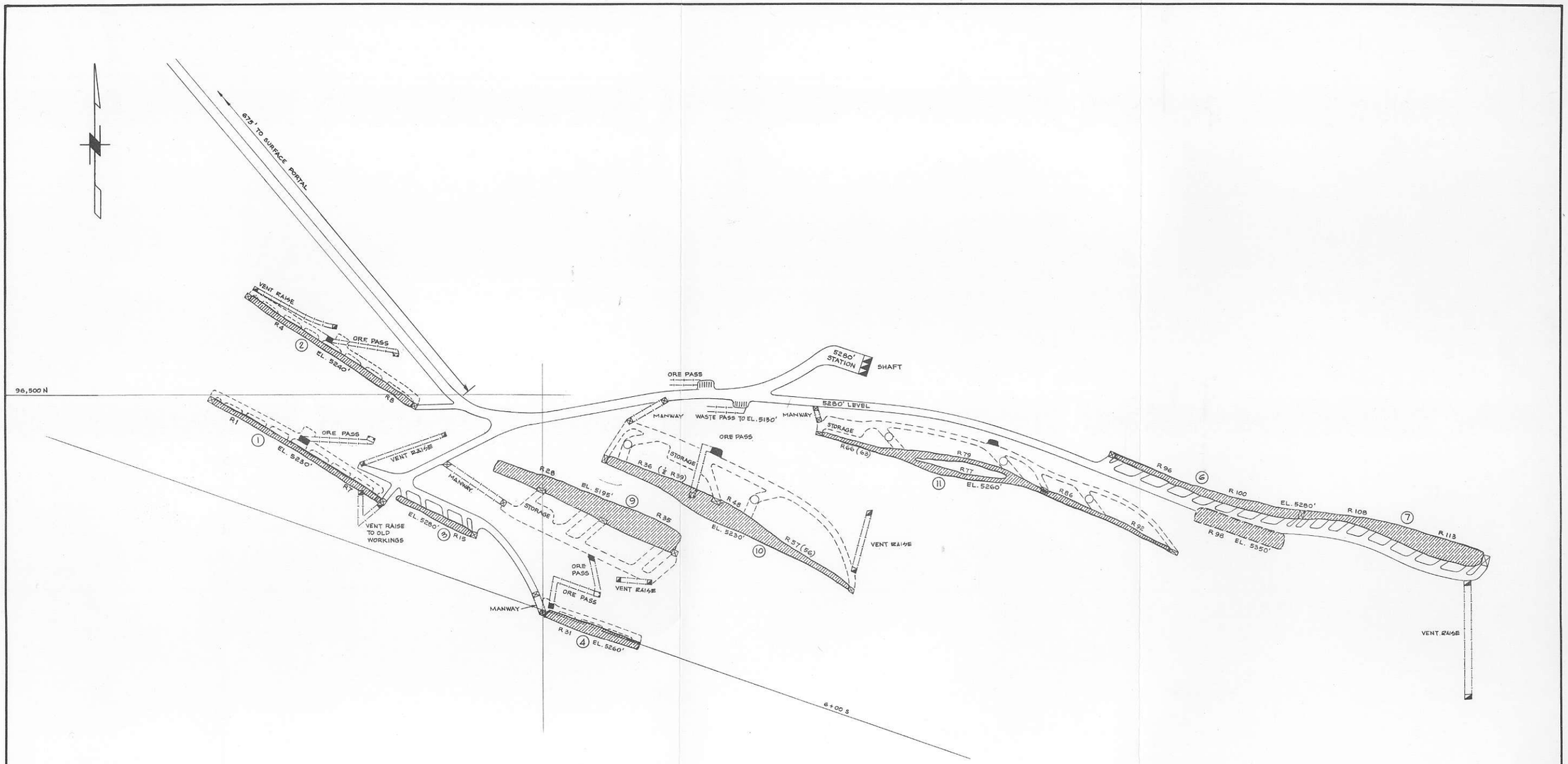
SCALE	1"=40'-0"	MAY	19	70
DR'N	WARREN	29	5	70
CH'K'D				
APP'D		2	6	70
APP'D		3	6	70

SANDWELL

HIGHLAND VALLEY PROPERTY
TRACKLESS METHOD
LOCATION OF DRIFTS
ON SECTION LINES 50 & 56

ALWIN MINING COMPANY LTD.
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-5 REV



LEGEND

- DRIFTS & CROSSCUTS ON LEVEL
- SUB DRIFTS & CROSSCUTS AT ELEVATIONS SHOWN
- RAISE
- (10) STOPE NUMBER
- MILL HOLE
- MANWAY
- ORE DUMP
- VENT RAISE
- CHUTE
- STOPE OUTLINE

0 20 40 60 80 100
1" = 40'-0"

DWG. NO.	REFERENCE	REF. NOS.	DWG. NO.	REFERENCE	REF. NOS.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

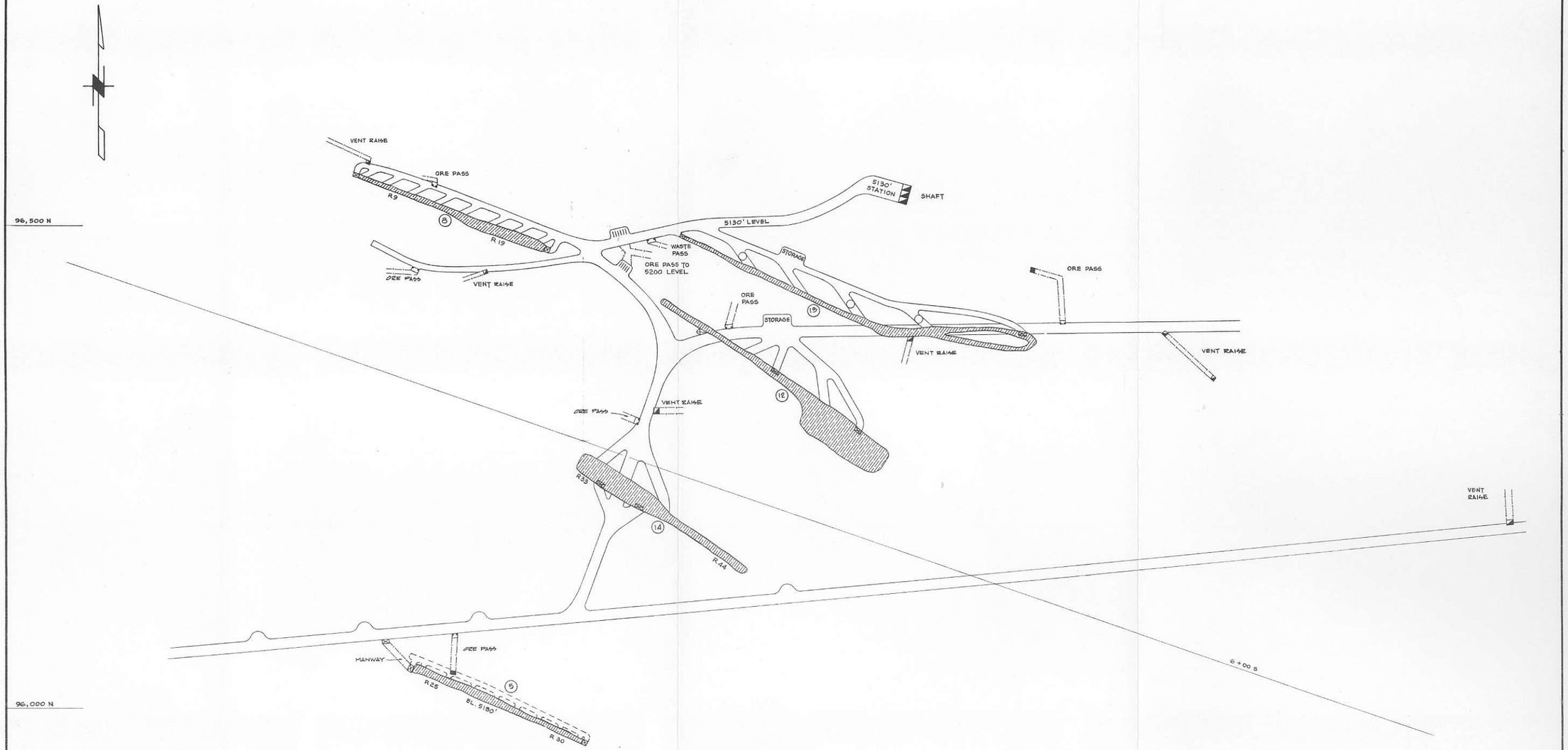
SCALE	1" = 40 FT			
DR'N	JRGL	22	5	70
CH'K'D				
APP'D.		2	6	70
APP'D.		3	6	70

SANDWELL

HIGHLAND VALLEY PROPERTY
SHAFT METHOD
DEVELOPMENT & PREPARATION
5280 LEVEL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-6 REV



LEGEND

- DRIFTS & CROSSCUTS ON LEVEL
- SUB DRIFTS & CROSSCUTS AT ELEVATIONS SHOWN
- RAISE
- (10) STOPE NUMBER
- MILL HOLE
- MANWAY
- ORE DUMP
- VENT RAISE
- CHUTE
- STOPE OUTLINE

DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

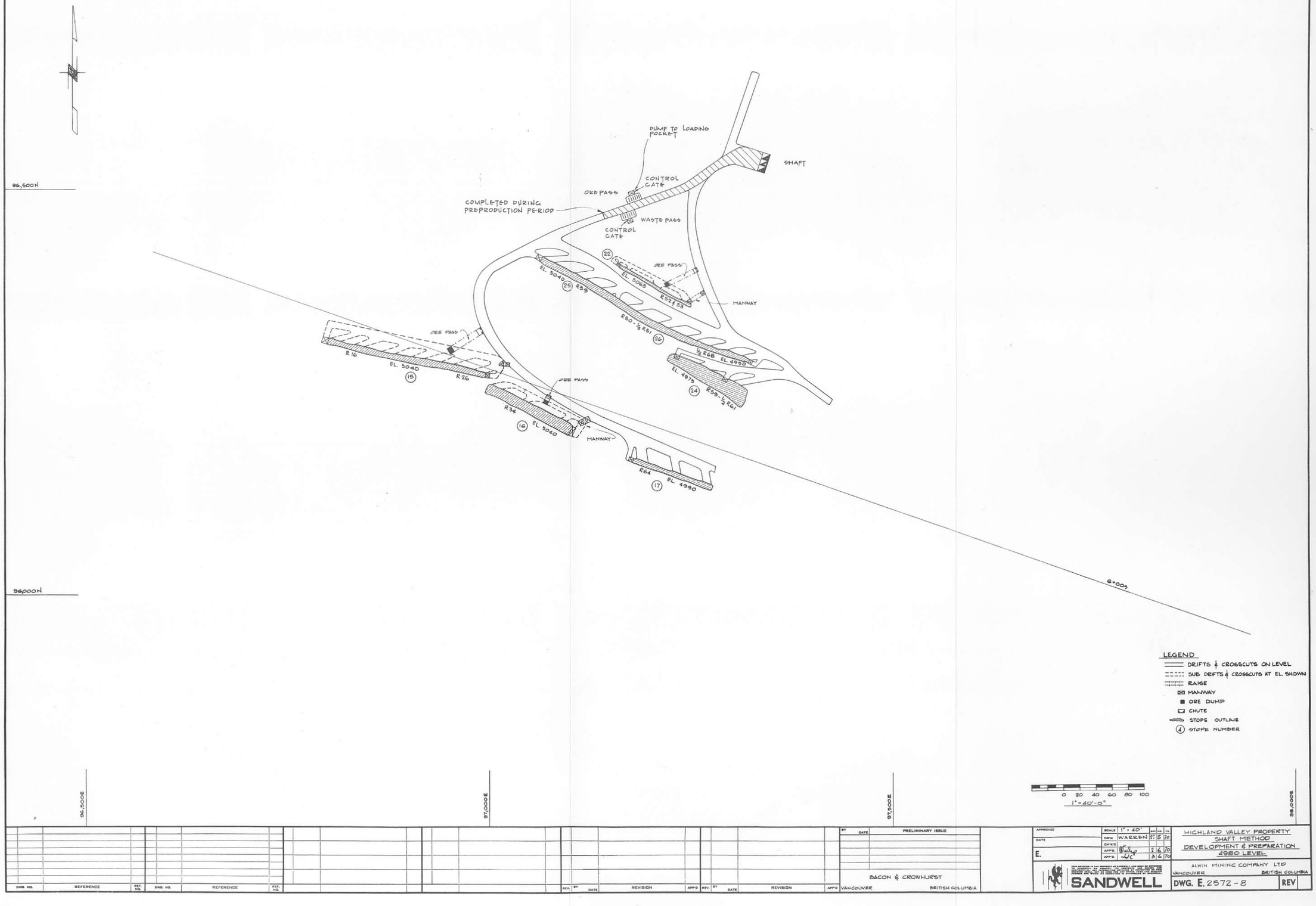
SCALE	1" = 40 FT			
DR'N	JRGL	21	5	70
CH'K'D				
APP'D.		2	6	70
APP'D.		3	6	70

SANDWELL

HIGHLAND VALLEY PROPERTY
SHAFT METHOD
DEVELOPMENT & PREPARATION
5130 LEVEL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-7 REV



DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

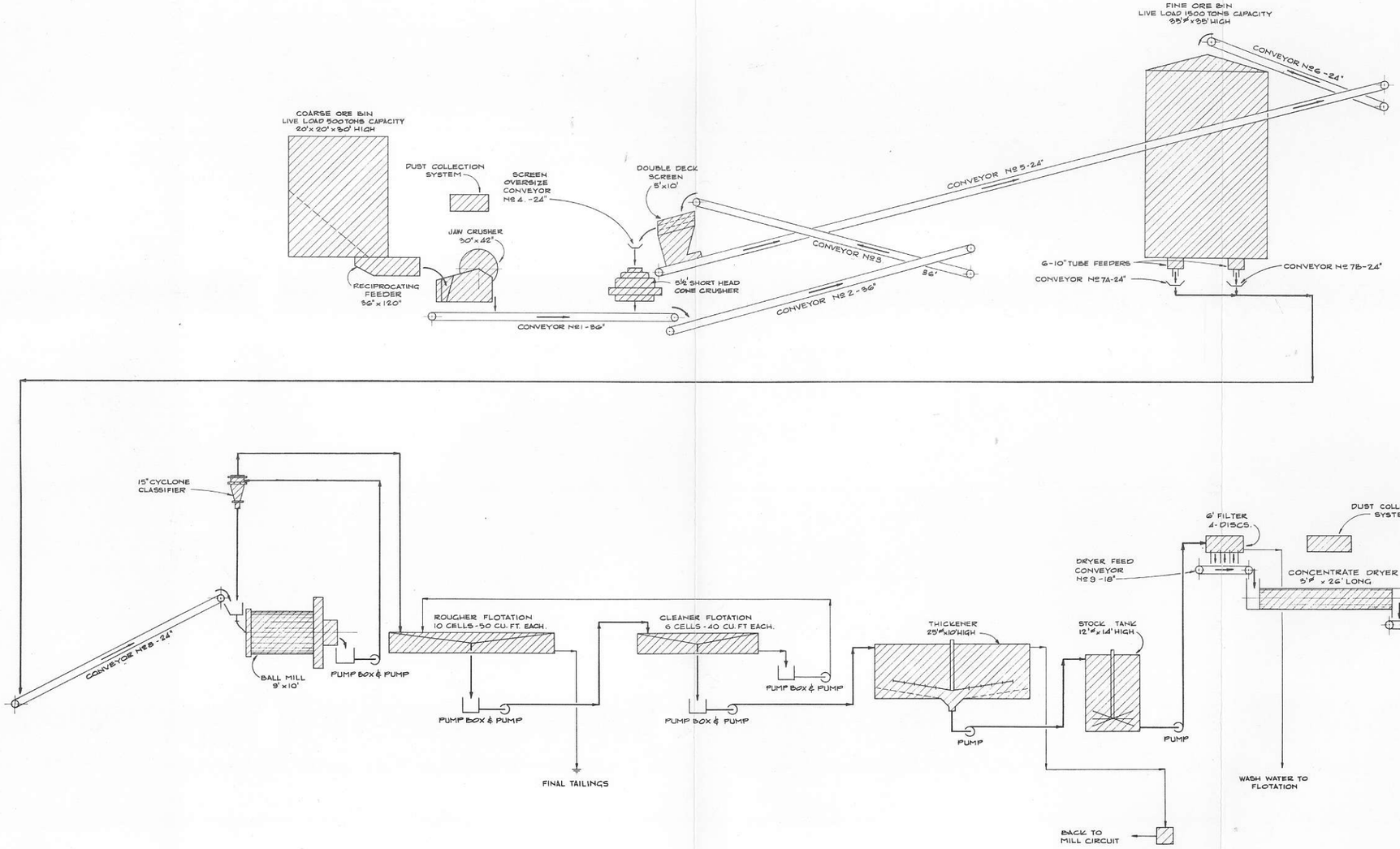
SCALE	1" = 40'			
DR'N	WARREN	2	5	70
CH'K'D				
APP'D		2	6	70
APP'D		3	6	70

HIGHLAND VALLEY PROPERTY
SHAFT METHOD
DEVELOPMENT & PREPARATION
4980 LEVEL

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

SANDWELL

DWG. E. 2572-8 REV



DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED	SCALE		
DATE	DR'N	IACOBELLI	25 5 70
E.	CH'K'D	R Crowhurst	26 5 70
	APP'D	R Crowhurst	26 5 70
	APP'D	W.E.	2 6 70

SANDWELL

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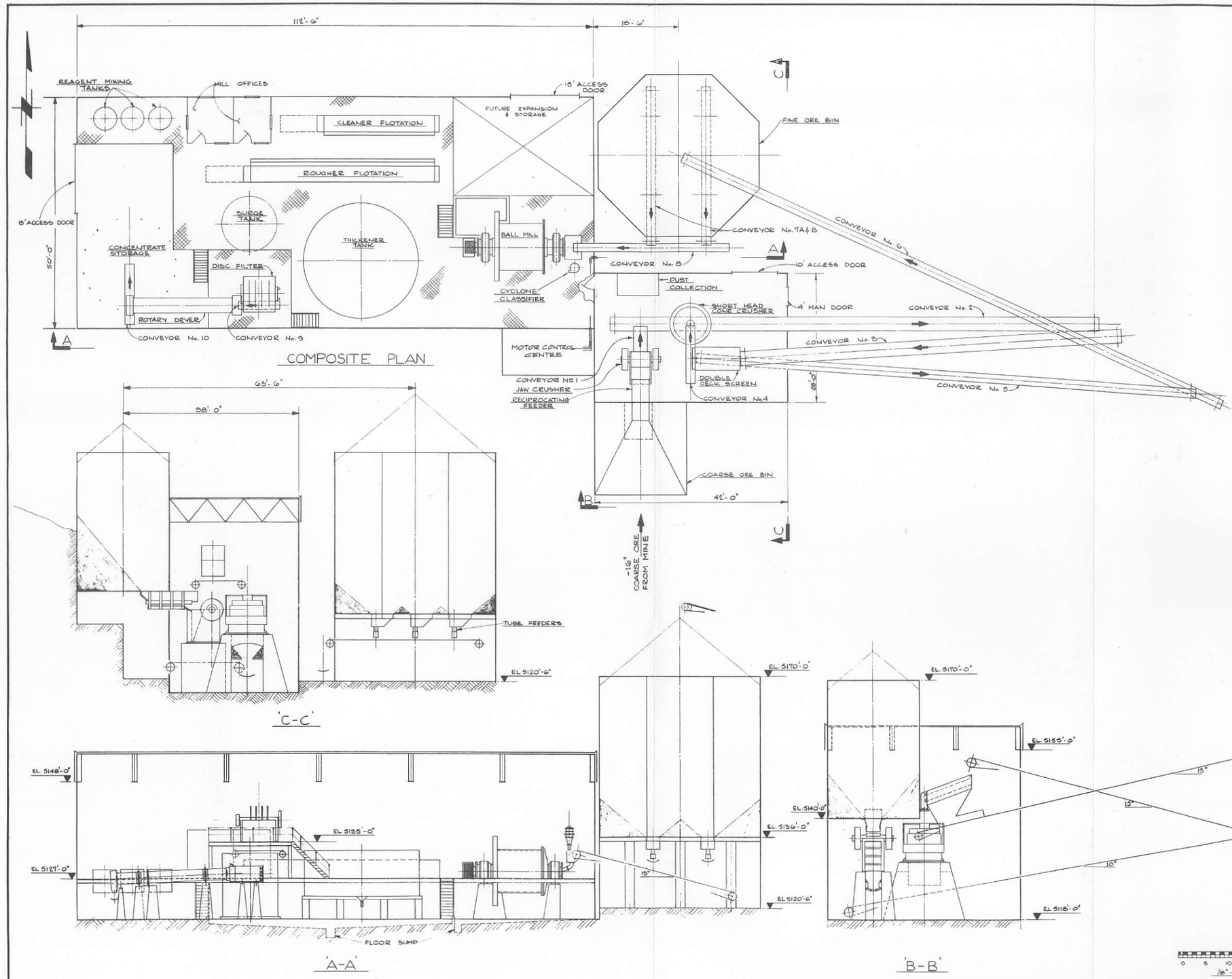
HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
CRUSHING & CONCENTRATOR PLANT
FLOW DIAGRAM

ALWIN MINING COMPANY LTD.
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-9 REV



DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D
			PRELIMINARY ISSUE	

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

APPROVED
DATE
E.

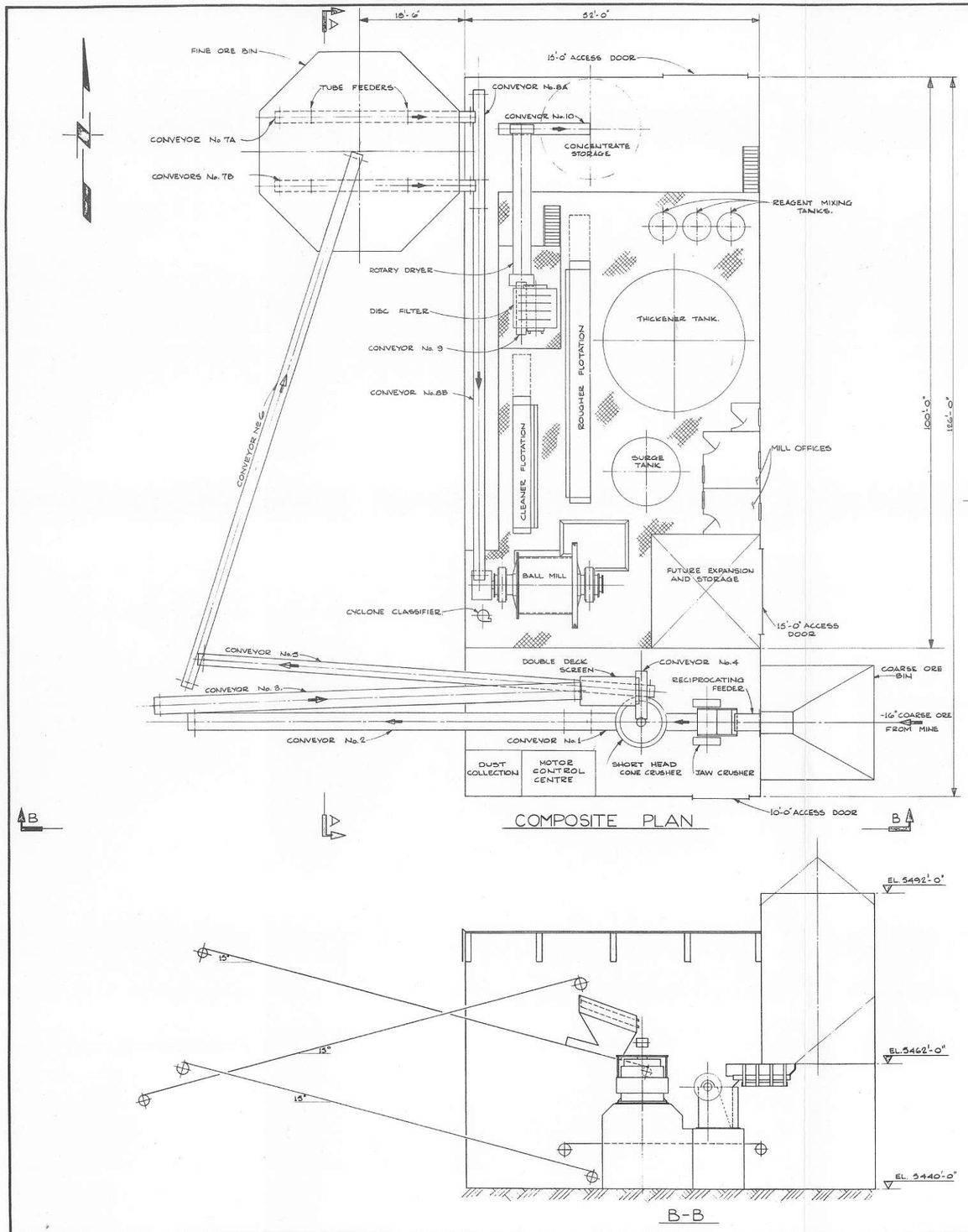
SCALE	1/8"=1'-0"			
DR'N	K.T.VNT	13	5	10
CH'K'D	R. Crowhurst	13	5	10
APP'D	R.G. Crowhurst	13	5	10
APP'D	W.J. Mc	15	6	70

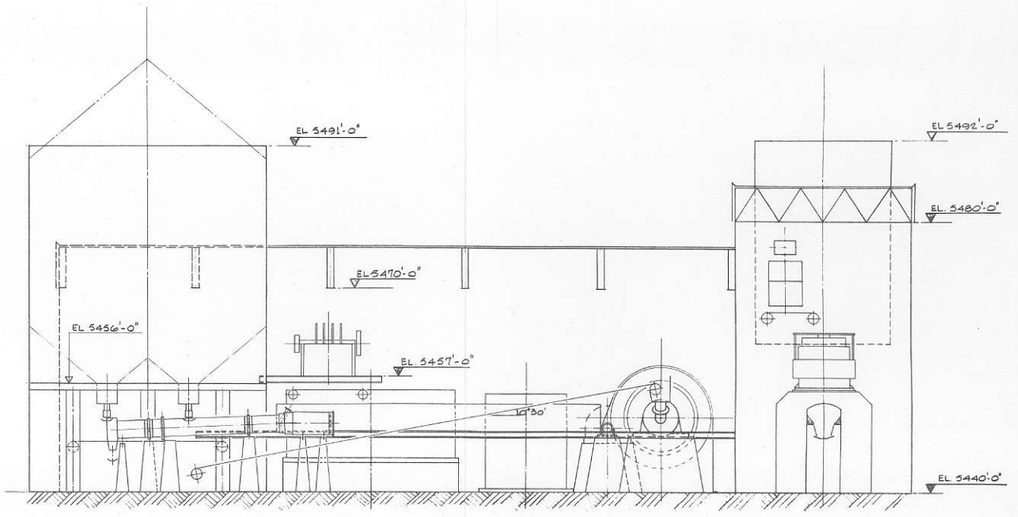
HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
CRUSHING & CONCENTRATOR PLANT
GENERAL ARRANGEMENT SCHEME 2

SANDWELL

ALWIN MINING COMPANY LTD.
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572-10 REV





A-A

B-B

0 5 10 15 20 25

1/8" = 1'-0"

DWG. NO.	REFERENCE	REF. NO.	DWG. NO.	REFERENCE	REF. NO.

REV.	BY	DATE	REVISION	APP'D
			PRELIMINARY ISSUE	

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

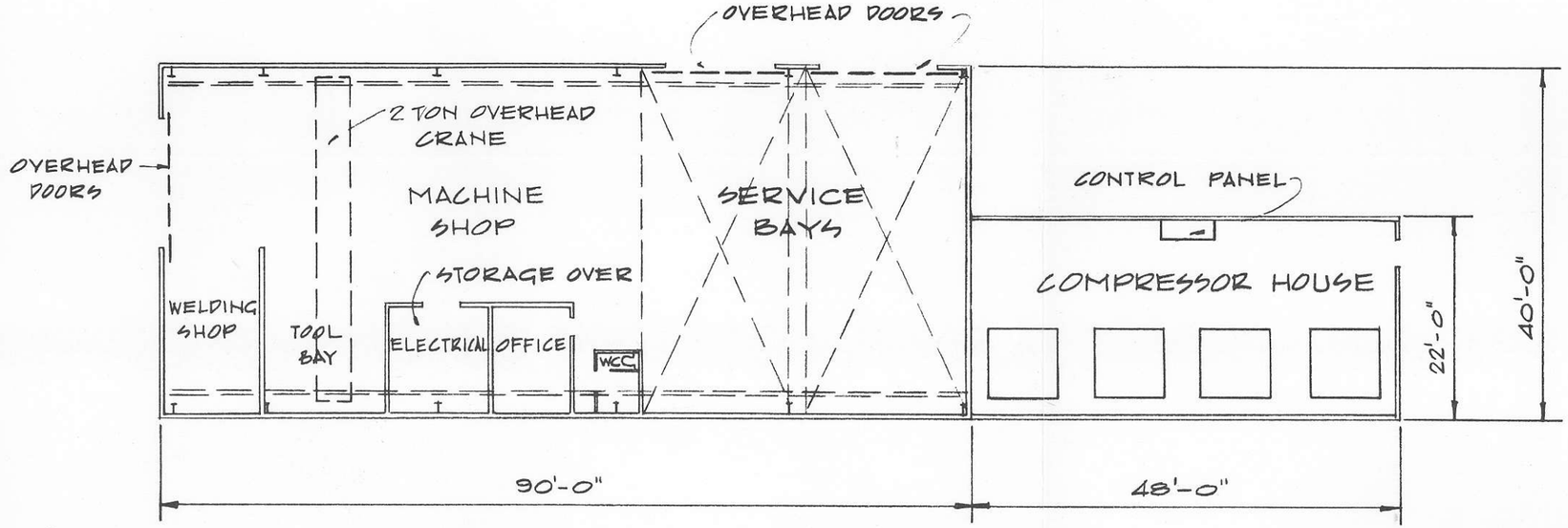
APPROVED	SCALE	1/8" = 1'-0"	13	5 70
DATE	DR'N	E.T. VINT	13	5 70
E.	CH'K'D	R. Crawford	13	5 70
	APP'D	[illegible]	13	5 70
	APP'D	[illegible]	16	6 70

SANDWELL

HIGHLAND VALLEY PROPERTY
3000 TON PER DAY MILL
CRUSHING & CONCENTRATOR PLANT
GENERAL ARRANGEMENT SCHEME I

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. E. 2572 - 11 REV



DWG. No.	REFERENCE	REF. NO.	BY / DATE	PRELIMINARY ISSUE

BACON & CROWHURST

VANCOUVER BRITISH COLUMBIA

REV.	BY / DATE	REVISION	APP'D.

APPROVED

DATE

B

SCALE	——	DAY	MO.	YR.
DR'N.	IACOBELLI	22	5	70
CH'K'D.				
APP'D.		2	6	70
APP'D.		3	6	70

SANDWELL

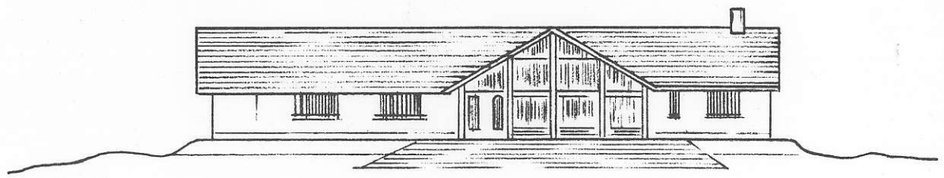
HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
MACHINE SHOP & COMPRESSOR HOUSE
GENERAL ARRANGEMENT

ALWIN MINING COMPANY LTD.

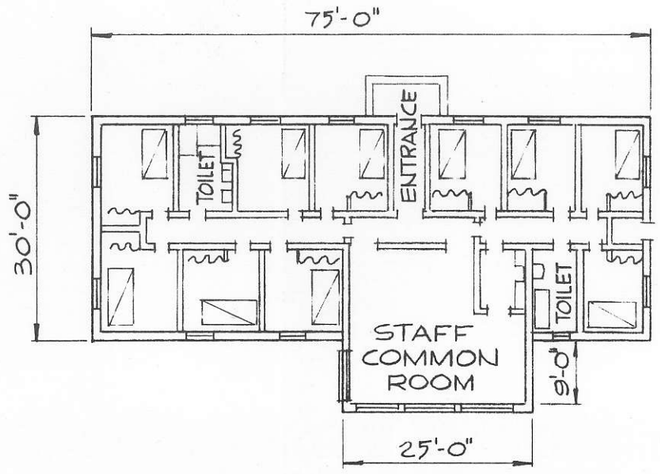
VANCOUVER BRITISH COLUMBIA

DWG. 2572-12 REV

GUEST HOUSE

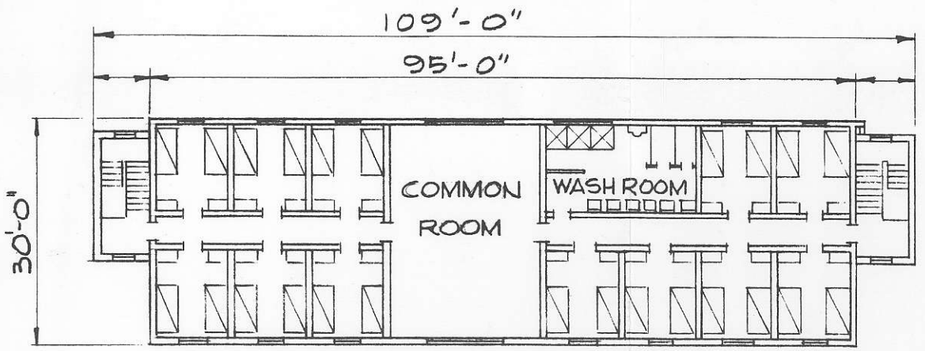


ELEVATION

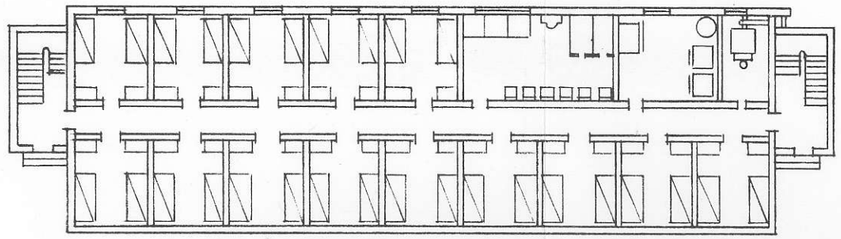


6 STAFF ROOMS 4 GUEST ROOMS
FLOOR PLAN

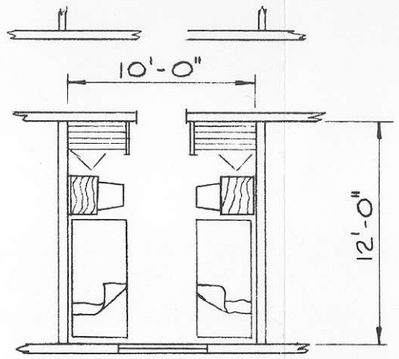
BUNKHOUSE



SECOND FLOOR PLAN



MAIN FLOOR PLAN



TYPICAL ROOM

DWG. No.	REFERENCE	REF. No.	BY DATE	PRELIMINARY ISSUE

BACON & CROWHURST
VANCOUVER BRITISH COLUMBIA

REV.	BY DATE	REVISION	APP'D.

APPROVED
DATE
B

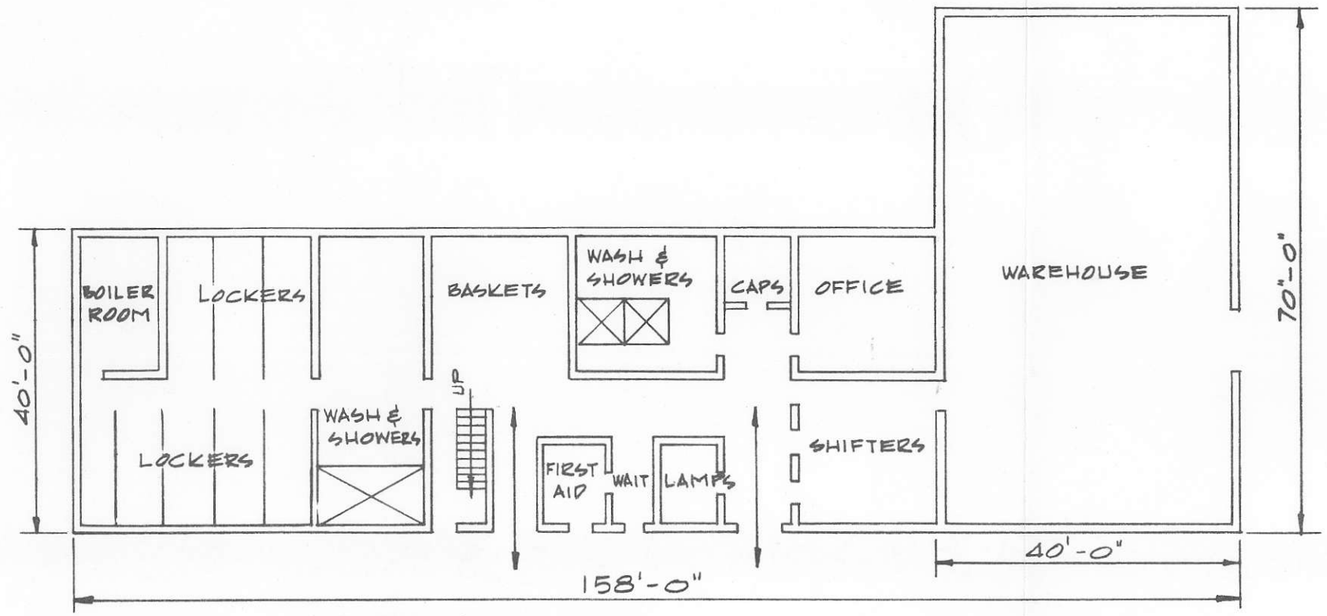
		DAY	MO.	YR.
SCALE	——			
DR'N.	IACOBELLI	22	5	70
CH'K'D.				
APP'D.		2	6	70
APP'D.		3	6	70

SANDWELL

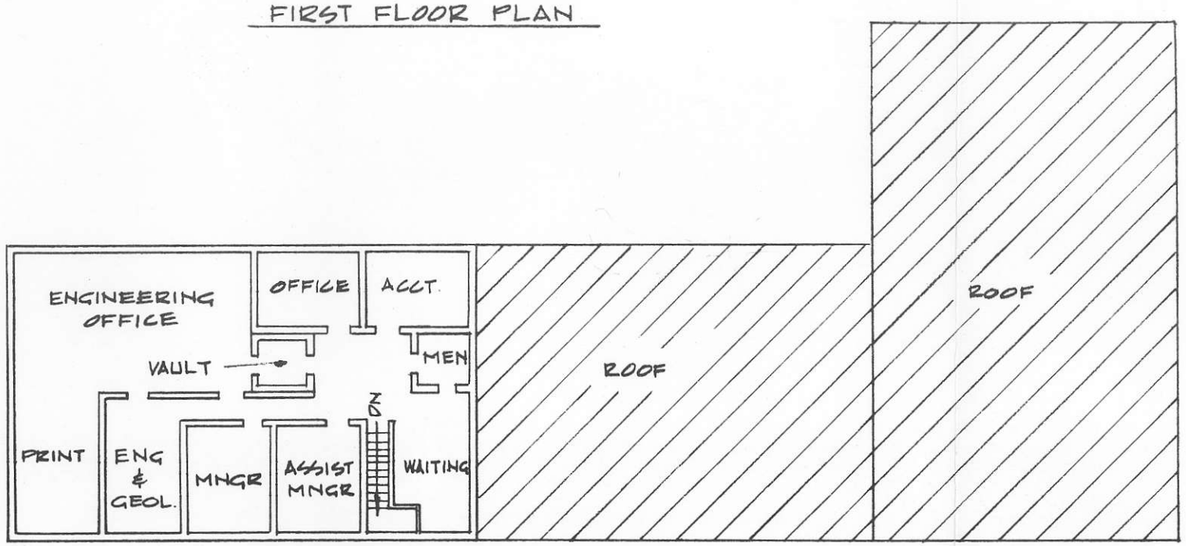
HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
BUNKHOUSE & GUEST HOUSE
GENERAL ARRANGEMENT

ALWIN MINING COMPANY LTD
VANCOUVER BRITISH COLUMBIA

DWG. 2572-13 REV



FIRST FLOOR PLAN



SECOND FLOOR PLAN.

DWG. No.	REFERENCE	REF. No.	BY DATE	PRELIMINARY ISSUE
REV. BY DATE	REVISION	APP'D.		

BACON & CROWHURST

VANCOUVER BRITISH COLUMBIA

APPROVED	SCALE	———	DAY	MO.	YR.
DATE	DR'N.	IACOBELLI	22	5	70
	CH'K'D.				
B	APP'D.		2	6	70
	APP'D.		3	6	70

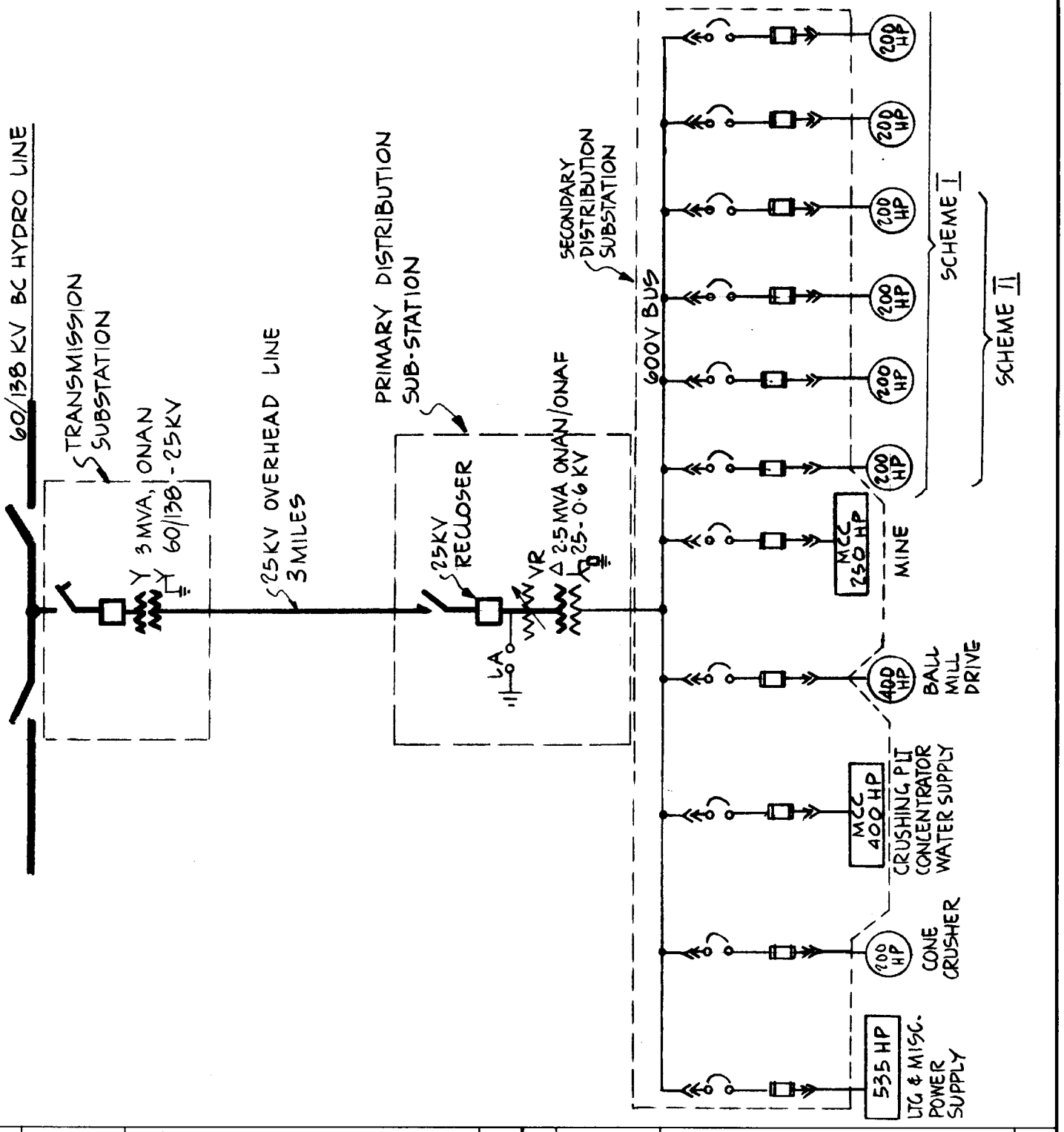
SANDWELL

HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
CHANGE HOUSE, OFFICE & WAREHOUSE
GENERAL ARRANGEMENT

ALWIN MINING COMPANY LTD.

VANCOUVER BRITISH COLUMBIA

DWG. 2572-14 REV



DWG. No.	REFERENCE	REF. No.	REV.	BY	DATE	REVISION	APP'D.

APPROVED

DATE

A

		DAY	MO.	YR.
SCALE	-			
DR'N.	B PARRY	26	5	70
CH'K'D.		26	5	70
APP'D.		2	6	70
APP'D.		27	5	70

HIGHLAND VALLEY PROPERTY
500 TON PER DAY MILL
SINGLE LINE DIAGRAM

SANDWELL

ALWIN MINING COMPANY
VANCOUVER BRITISH COLUMBIA

DWG. 2572-15 REV