

REPORT on
CERNA COPPER MINES LIMITED
JORDAN RIVER - VANCOUVER ISLAND, B.C.
for
Largo Mines Ltd. (N.P.L.)

by:

Bacon & Crowhurst Ltd. April 18, 1969.

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REPORT
on
CERNA COPPER MINES LIMITED
(COWICHAN COPPER - JORDAN RIVER - VANCOUVER ISLAND, B.C.)

for
LARGO MINES LTD. (N.P.L.)

by
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G.D. DELANE, B.Sc.

Vancouver, B.C.

April 18th, 1969.

BACON AND CROWHURST
CONSULTING ENGINEERS

April 18th, 1969.

Largo Mines Ltd. (N.P.L.),
505 Burrard St.,
Vancouver, 1, B.C.

Attention: Mr. B.I. Nesbitt, President

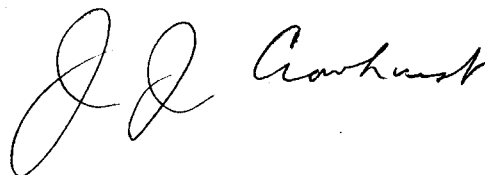
Dear Sir:

As authorized by you, we are pleased to submit herewith our preliminary report on the Cowichan Copper Mine (Cerna Copper Mines Limited), Jordan River, Vancouver Island, British Columbia.

It will be noted in the text of the report that certain assumptions have been made, such as expected metallurgical results.

Yours truly,

BACON & CROWHURST LTD.

A handwritten signature in cursive script, appearing to read "J.J. Crowhurst".

J.J. Crowhurst, P.Eng.

JJC/ic

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TERMS OF REFERENCE

At a meeting attended by Mr. B.I. Nesbitt, President, Largo Mines Ltd., Mr. B.F. Bartholomew, Director, Dr. H.A. Quinn, Consulting Geologist (all of Largo Mines Ltd.), and Mr. J.J. Crowhurst of Bacon & Crowhurst Ltd., held in Vancouver on April 4th, 1969, the scope and terms of reference of this report were discussed.

It was understood the report would cover the following:

(A) Study of a report, dated November 20th, 1968, entitled "General Analysis & Economic Study of Cowichan Mine, Jordan River", and written by Mr. D.W. Pringle, P.Eng., of Richmond, B.C., for Cerna Copper Mines Limited.

Particular attention was to be directed toward the suggested capital requirements, operating costs, estimated time to recommence production and rate of return of invested capital.

(B) Check that part of Ore Reserves in Mr. Pringle's report designated "Positive Tons" as to tons, grade and mineability.

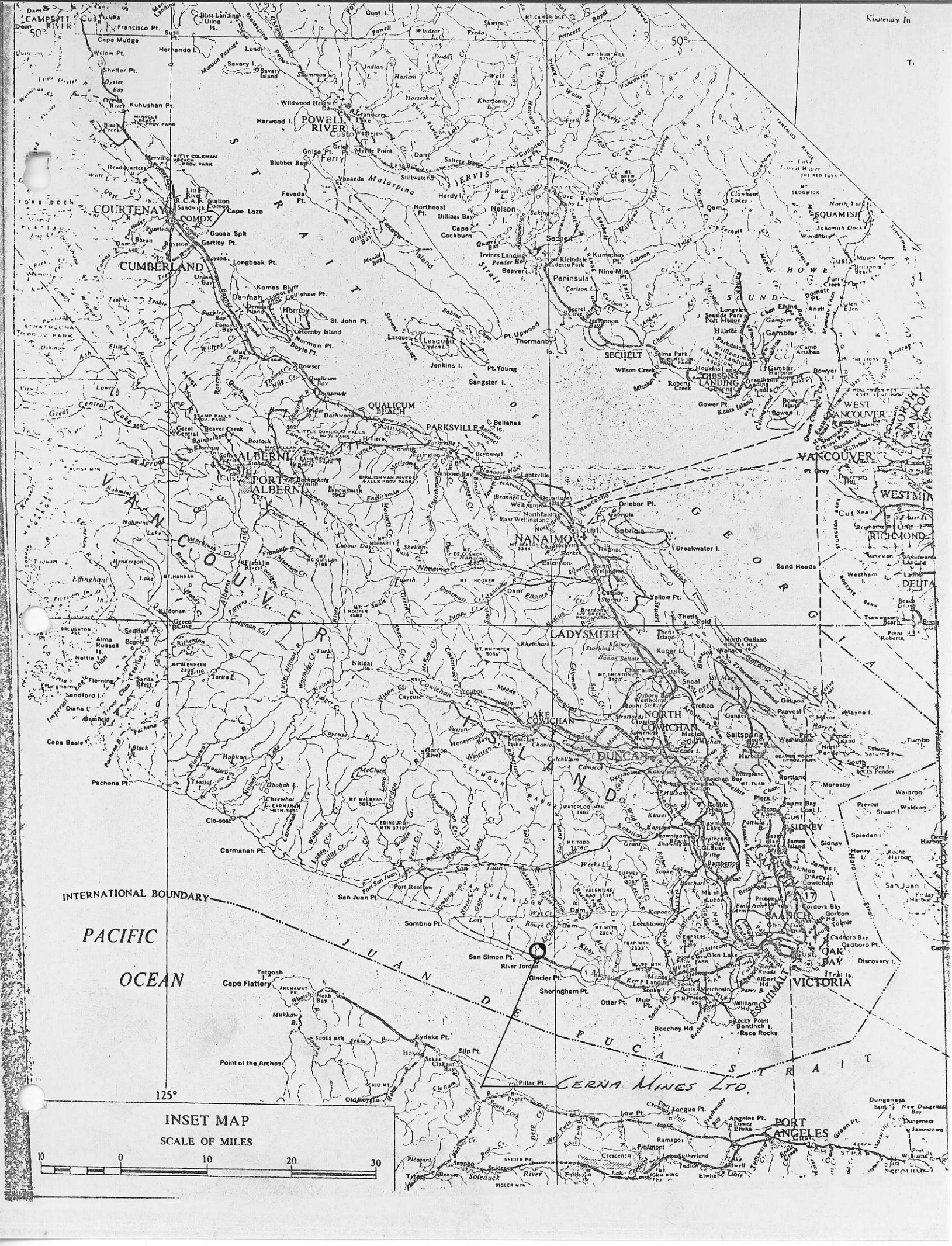
(C) Check problems associated with re-initiating underground mining close to zone of caving under the Jordan River, reputedly now sealed to prevent further flooding.

(D) Analysis of proposal submitted by Haste Mine Development Ltd. (Cameron-McCutcheon) of Vancouver, B.C., re extraction of ore from the "Cave" orebody and delivery to the concentrator.

(E) Check Mr. Pringle's proposed rate of milling ore after suggested alterations have been completed, together with expected metallurgical results.

- (F) Comment on future exploration possibilities at the Jordan River property.
- (G) Review and comment on the general concept of Mr. D.W. Pringle's proposal.
- (H) Discuss any other factors, other than those enumerated above, related to the estimate of cash flow.

It should be noted that the ownership of the mineral claims has not been investigated by Bacon & Crowhurst Ltd., neither has the present financial position of Cerna Copper Mines Limited. Information concerning the royalty arrangement with Cominco (Sunro Mines) was received verbally and not confirmed in detail. No attempt has been made toward ascertaining the tax position, either Provincial or Federal.



COURTENAY
COMOX
CUMBERLAND
ALBERNI
PORT ALBERNI
NANAIMO
LADYSMITH
DUNCAN
SIDNEY
VICTORIA
PORT ANGELES

PACIFIC OCEAN
JUAN DE FUCA STRAIT
CERIA MINES LTD.

50°
125°

INSET MAP
SCALE OF MILES
0 10 20 30

CHAPTER I
SUMMARY, CONCLUSIONS & FINANCING

CHAPTER I
SUMMARY, CONCLUSIONS & FINANCING

SUMMARY

ORE RESERVES

Ore reserves classed as drill indicated, probable and possible are estimated to be 1,092,720 tons, assaying 1.226% copper before any allowance for mining dilution. After dilution, the reserves are estimated to be 1,365,900 tons, assaying 1.021% copper. Some of the calculations have not been checked by Bacon & Crowhurst.

Reference is made to the attached calculation showing previous production amounting to a total of 823,275 tons containing an average of 1.37% copper

Exploration possibilities regarding establishing new ore zones of the same size and grade appear good.

ECONOMICS

Under a carefully planned program and good supervision, the present ore reserves should suffice to carry on economic operation of the mine for 3-1/3 years and beyond. Calculations have been made for the period during which the first 796,000 tons, assaying 1.10% copper, would be treated.

During this period the preproduction initial investment of \$568,000 plus interest thereon, could be repaid, and working capital amounting to approximately \$500,000 established, providing that certain assumptions inherent in this report can be established more firmly.

These assumptions are as follows:

(1) Ore Reserves - Calculations regarding "Group #1" ore zones, as designated later in this report, should be checked. Bacon & Crowhurst have assumed the Cerna figures to be correct.

(2) Mining - After "Group #1" ore reserves have been established, mining methods and costs should be reviewed. The cost of additional mine machinery appears adequate but should be examined subsequently.

(3) Milling & Metallurgy -

(a) The cost of repairing mill machinery and installing new machinery has been estimated quickly and should be reviewed.

(b) Metallurgy regarding treating "Cave" ore should be established by preliminary inexpensive test work.

(4) Marketing - It has been assumed that a "normal" smelter copper purchase contract can be negotiated and that prior commitments will not detract from the estimated net returns.

(5) A detailed examination should be made regarding the "caved stope" area. It has been assumed a minimum amount of work will suffice.

(6) Cost estimates have been based on prices for labour and supplies expected to prevail over the next two to three years.

All of the above assumptions are considered to be of the nature of "business risks" and the interpretation in this report is considered to be correct until proved otherwise. Nevertheless some doubt exists because adequate checking has not been possible.

ESTIMATED OPERATING PROFIT (000's \$)

CERNA COPPER MINES LTD.
JORDAN RIVER, B.C.

<u>Year #1</u> <u>Months</u>	<u>Mining</u>	<u>Milling</u> <u>@ 1.75/ton</u>	<u>Concentrate</u> <u>Handling</u>	<u>Administrative</u> <u>and General</u>	<u>Royalty</u> <u>Price Cu</u> <u>45¢ U.S.</u>	<u>Total</u> <u>Operating</u> <u>Cost</u>	<u>Revenue</u> <u>Price Cu</u> <u>45¢ U.S.</u>	<u>Operating</u> <u>Profit</u>	<u>Revenue</u> <u>Price Cu</u> <u>50¢ U.S.</u>	<u>Operating</u> <u>Profit</u>
1	13	2	-	7	-	22	-	(22)	-	(22)
2	55	3	-	7	-	65	-	(65)	-	(65)
3	76	5	-	10	-	91	-	(91)	-	(91)
4	116	5	-	12	-	133	-	(133)	-	(133)
5	149	42	8	15	9	223	214	(9)	242	19
6	139	42	8	15	9	213	214	1	242	29
7	184	60	11	15	12	282	294	12	332	50
8	131	59	11	15	12	228	294	66	333	105
9	78	60	11	15	12	176	294	118	332	156
10	78	59	11	15	12	175	294	119	333	158
11	91	60	9	15	9	184	228	44	257	73
<u>12</u>	<u>92</u>	<u>59</u>	<u>9</u>	<u>15</u>	<u>9</u>	<u>184</u>	<u>228</u>	<u>44</u>	<u>257</u>	<u>73</u>
Sub-Total	1,202	456	78	156	84	1,976	2,060	84	2,328	352
<u>Year #2</u>										
First Half	545	357	53	90	57	1,102	1,364	262	1,542	440
2nd Half	<u>545</u>	<u>357</u>	<u>69</u>	<u>90</u>	<u>43</u>	<u>1,104</u>	<u>1,763</u>	<u>659</u>	<u>1,993</u>	<u>889</u>
Sub-Total	1,090	714	122	180	100	2,206	3,127	921	3,535	1,329
<u>Year #3</u>										
Months 1-4	363	238	44	60	47	752	1,133	381	1,280	528

PRODUCTION - COWICHAN COPPER MINES LTD.

(from B.C. Minister of Mines Annual Reports 1962 - 1967)

<u>Year</u>	<u>Tons Shipped or treated</u>	<u>Gross Metal Content</u>			<u>Average Grade of Metals Produced or Recovered</u>			<u>Head Assay Assum- ing 93% Recovery Copper %</u>
		<u>Gold (oz.)</u>	<u>Silver (oz.)</u>	<u>Copper (lbs.)</u>	<u>Gold (oz./ton)</u>	<u>Silver %</u>	<u>Copper %</u>	
1962	144,009	1218	14,207	5,067,323	0.008	0.099	1.76	1.89
1963	267,675	1816	19,124	8,255,898	0.0068	0.071	1.54	1.66
1966	107,680	400	4,000	1,858,000	0.0037	0.037	0.86	0.93
1967	151,978	460	3,290	3,000,000	0.0031	0.022	0.99	1.06
1968	151,933*			2,828,471*			0.93	1.00*

* Actual

CONCLUSIONS

Without any consideration being given (as in this report) to pre-existing debts, it would appear that with a carefully planned and controlled program, the Jordan River property of Cerna Copper Mines Ltd. could become a profitable producer.

The exploration possibilities indicate that more ore beyond the presently estimated reserves will be found by intelligent work at a reasonable cost.

An extensive exploration program costing from \$500,000 to \$1,000,000 could well disclose enough ore to warrant the construction of a new and efficient concentrator at the portal of the main adit but the possibilities of milling the presently known reserves, at a substantial profit, using the equipment now installed is tempting and cannot be discarded.

Subject to more definite confirmation of the assumptions mentioned previously, and presupposing that all other considerations (such as title and debt structure - beyond the scope of this report) are favourable, it is our recommendation that Mr. D.W. Pringle's proposal be followed in principle.

The property faces a difficult financial and operating period and must be provided with excellent on-the-job management. If adequately financed, however, the chances appear fair that the property could become a long term profitable enterprise.

PREPRODUCTION EXPENSE

EQUIPMENT

The capital requirements for equipment recommended in Mr. Pringle's report have been scrutinized and are recommended. No detailed check has been made by Bacon & Crowhurst concerning the number of pieces or cost of the equipment but, generally, the suggested program is warranted and necessary.

As explained in the section of this report entitled "Milling & Metallurgy", it is mentioned that an additional \$100,000 must be available for concentrator rehabilitation if continuous operation is to be achieved.

FILLING CAVED STOPE

The Mines Inspection Branch of the Provincial Government has directed the company to fill and seal the caved stope lying beneath the Jordan River. This has been partially completed (see sketch attached). To comply with this directive and to prevent additional caving without question, this work should be finished by filling the rest of the open hole with rock and sealing the top surface so that the river, during high water, cannot possibly enter.

As shown on the sketch, enough bulkheads and fill have been placed to render underground operation quite safe but it is recommended that without question the danger should be removed permanently.

No inspection has been made by Bacon & Crowhurst of the situation, other than to look down on the hole from the top. The bulkheads

JORDAN RIVER

CROWN PILLAR
CEMENTATION

BULKHEADS

EL. 5500

① ②

③ ④ ⑤

⑥ ⑦

⑧

FILLED

SERVICE RISE

59-1640

59-1680

59-1690

59-1703

59-1700

C.O.B.

CRUSH

MILL

F.O.B.

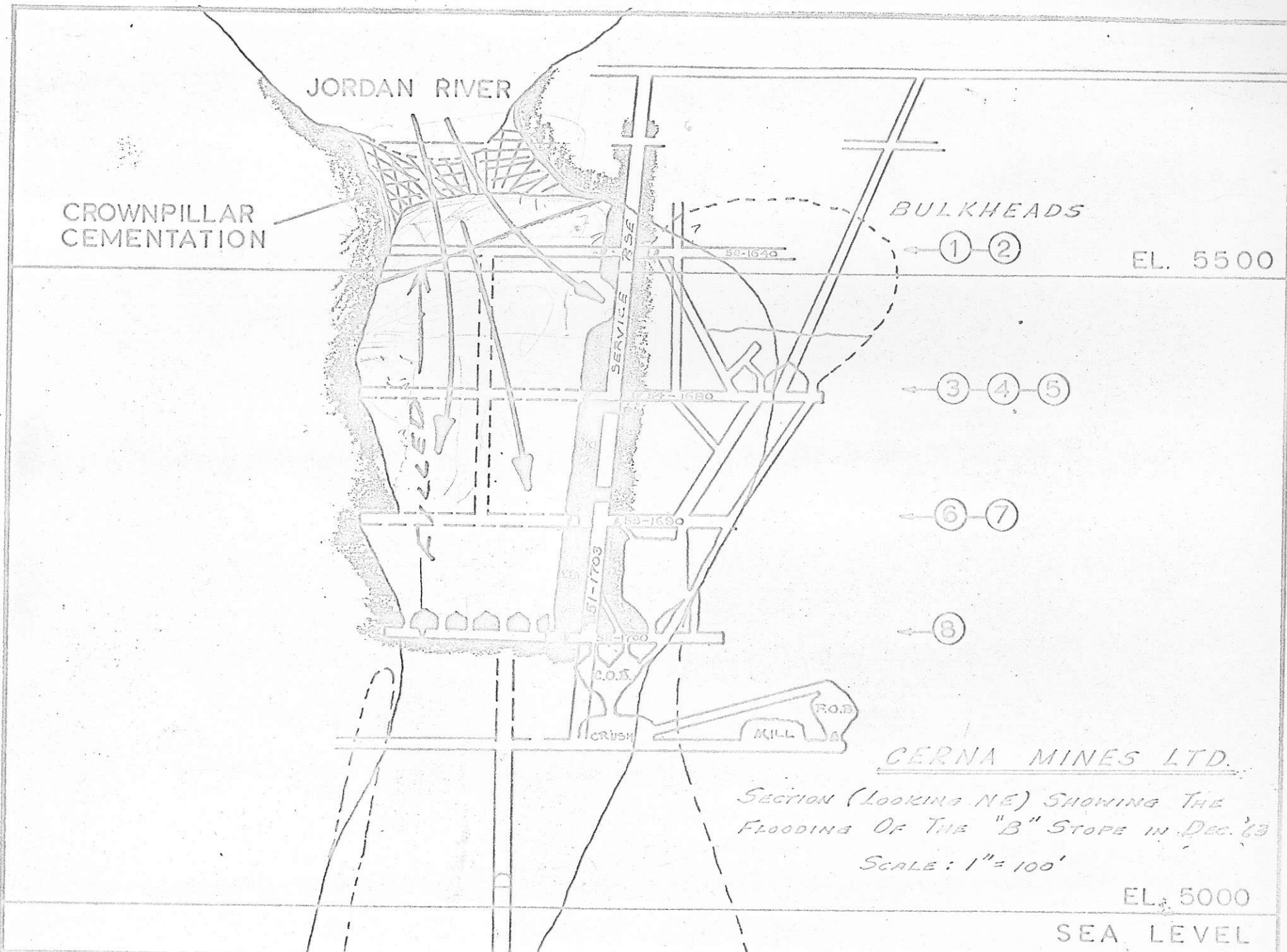
CERNA MINES LTD.

SECTION (LOOKING NE) SHOWING THE
FLOODING OF THE "B" STOPE IN DEC. '63

SCALE: 1" = 100'

EL. 5000

SEA LEVEL



and the dam constructed along the edge of the caved area should be examined and a program started to achieve the results mentioned above before any mining is initiated.

No estimate has been prepared for this work. The sum of \$25,000 should be provided. Waste rock from exploration or development of the "Cominco Adit" zone, situated immediately above the caved area, could be used so as to use the funds to the best advantage.

EXPLORATION

In order to determine the proper stoping outlines, and hence prepare accurate mining and stoping plans, a minimum of \$30,000 should be expended prior to production. A closer study of the present level plans and diamond drill hole information should be made for this purpose. Subsequent diamond drilling and drifting is recommended.

ESTIMATED PREPRODUCTION COST

<u>(A) Equipment</u>	<u>Amount</u>	
Surface (D.W. Pringle)	\$104,000	
Mine (D.W. Pringle)	122,000	
Concentrator (D.W. Pringle plus Bacon & Crowhurst)	<u>240,000</u>	
	\$466,000	
Spares & contingencies @ 10%	<u>47,000</u>	
Total		\$513,000
<u>(B) Filling Caved Stope</u>		
Work as suggested		25,000

(C) <u>Exploration</u>	<u>Amount</u>	
Diamond drilling	\$10,000	
Drifting & crosscutting	10,000	
Administration	<u>10,000</u>	<u>30,000</u>
TOTAL		\$568,000

WORKING CAPITAL

Required from Month 5 onwards -
approximately 2 months operating cost \$500,000

ESTIMATED FEED TO CONCENTRATOR

CERNA COPPER MINES LTD.
JORDAN RIVER, E.C.

	<u>GROUP #2 - DAVE "A" & "B"</u>			<u>GROUP #1 - OTHER</u> <u>("LOWER B" , etc.)</u>		<u>TOTAL</u> <u>(FEED TO CONCENTRATOR)</u>	
	<u>Approx. Elevation</u> <u>Location of Cave ore</u>	<u>Tons</u>	<u>Grade</u> <u>% Cu</u>	<u>Tons</u>	<u>Grade</u> <u>% Cu</u>	<u>Tons</u>	<u>Grade</u> <u>% Cu</u>
<u>Year #1</u>							
<u>Month</u>							
5	5220 - 5310	15,000	1.11	9,000	1.455	24,000	1.239
6	5220 - 5310	15,000	1.11	9,000	1.455	24,000	1.239
7	5220 - 5310	25,000	1.11	9,000	1.455	34,000	1.201
8-9-10	5220 - 5310	75,000	1.11	27,000	1.455	102,000	1.201
11 & 12	5310 - 5460	<u>50,000</u>	<u>0.74</u>	<u>18,000</u>	<u>1.455</u>	<u>68,000</u>	<u>0.929</u>
Sub-Total		180,000	1.01	72,000	1.455	252,000	1.135
<u>Year #2</u>							
First Half	5310 - 5460	150,000	0.74	54,000	1.455	204,000	0.929
Second Half	5220 - 5310	<u>150,000</u>	<u>1.11</u>	<u>54,000</u>	<u>1.455</u>	<u>204,000</u>	<u>1.201</u>
Sub-Total		300,000	0.925	108,000	1.455	408,000	1.065
<u>Year #3</u>							
Months 1 - 4	5220-5310	<u>100,000</u>	<u>1.05</u>	<u>36,000</u>	<u>1.455</u>	<u>136,000</u>	<u>1.157</u>
TOTAL TO DATE (all above 5220 mined)		580,000	0.972	216,000	1.455	796,000	1.103

ESTIMATED DIRECT MINING COST (000's\$)

CERNA COPPER MINES LTD.
JORDAN RIVER, B.C.

	<u>#2 GROUP or CAVE ZONE</u>		<u>NO. 1 GROUP</u>	<u>TOTALS</u>
	<u>Contractor Cost</u>	<u>Contractor's Fee @ 12%</u>	<u>Cerna Mines</u>	
<u>Year #1</u>				
<u>Month</u>				
1	7	1	5	13
2	45	5	5	55
3	64	7	5	76
4	95	11	10	116
5	92	11	46	149
6	83	10	46	139
7	122	15	47	184
8	76	9	46	131
9	28	3	47	78
10	28	4	46	78
11	28	3	60	91
12	<u>28</u>	<u>4</u>	<u>60</u>	<u>92</u>
Sub-Total	696	83	423	1,202
<u>Year #2</u>				
First Half	165	20	360	545
Second Half	<u>165</u>	<u>20</u>	<u>360</u>	<u>545</u>
Sub-Total	330	40	720	1,090
<u>Year #3</u>				
Months 1-4	110	13	240	363

ESTIMATED REVENUE

Year #1 - Mill Recovery - 92%

Month	Lbs. Cu. in Heads 000's of lbs.	Lbs. Cu Recovered 000's of lbs.	Net Smelter Returns	
			Net 39.13¢/lb. 000's of \$	Net 44.22¢/lb. 000's of \$
5	595	547	214	242
6	595	547	214	242
7	817	752	294	332
8	817	752	294	332
9	817	752	294	332
10	817	752	294	332
11	632	581	227	257
12	<u>632</u>	<u>581</u>	<u>227</u>	<u>257</u>
Totals	5,722	5,264	2,058	2,326

Year #2

First Half	3,790	3,487	1,364	1,542
2nd half	4,900	4,508	1,764	1,993

<u>Year #3</u>	3,147	2,895	1,133	1,280
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ADMINISTRATIVE & GENERAL EXPENSE

For the purposes of this preliminary report, it is assumed that costs as shown in the table below will apply. Actual costs will vary depending on any particular arrangements made regarding supervision, consultants, inter-company liaison, etc.

<u>JORDAN RIVER COSTS</u>	<u>Per Month</u>	
Management	\$2,000	
Engineering	1,200	
Office (2)	1,500	
Warehouse (1)	700	
Fire protection & safety	500	
Travel & transportation	500	
Vehicles	1,000	
Camp & portal maintenance	2,000	
Telephone, telegraph & postage	600	
Taxes & rentals	2,000	
Insurance	600	
Legal & audit	<u>600</u>	
Total		\$13,200
<u>HEAD OFFICE COSTS</u>		<u>2,000</u>
Total		<u>\$15,200</u>

CHAPTER II
GENERAL INFORMATION

CHAPTER II
GENERAL INFORMATION

LOCATION & ACCESS

The Sunro property is located near the community of River Jordan on the southwest coast of Vancouver Island and about 45 miles by paved highway from Victoria.

The plant buildings of the property and the 5100 level portal lie at an elevation of about 100 ft. above sea level. They are reached by a gravel road, approximately one mile long, which branches off from the coastal highway just east of the River Jordan post office.

PHYSICAL FEATURES

The property is in an area of rugged and precipitous topography. The Jordan River flows through the middle of the claim group in a rocky canyon about 500' deep, in which some mineral zones are exposed. The centre of the present mine workings is below and, in places, very close to this river canyon.

The area was once heavily forested with Douglas fir and hemlock but much of it has been removed by recent logging. The surface is generally covered by a mantle of drift but near the canyon, outcrops are abundant and extensive.

PLANT

A crushing plant and concentrator, intended to handle 1200-1500 T.P.D. were installed in early 1962 underground on the 5130 level about 7500 feet in from the portal.

A mine office, change house, assay office, warehouse, concentrate storage shed and several other small wood frame buildings are situated at the portal of the main adit.

HISTORY

The original properties (Sunloch and Gabbro) were first staked in 1915 by George Winkler of Victoria, B.C., who bonded the Sunloch property to the Sunloch Mining Co. in 1917.

In 1919, The Consolidated Mining & Smelting Co. Ltd. acquired control of the Sunloch Co. and consequently carried out some diamond drilling and underground development on the River, Cave and Centre Zones. In 1920, all operations on the property were suspended.

In 1949, Hedley Mascot Gold Mines Ltd. optioned the Sunloch property from The Consolidated Mining & Smelting Co. Ltd. and the adjoining Gabbro property from Gabbro Mines Ltd. which was controlled by Noranda Mines Ltd. About 13,000 feet of diamond drilling was completed by Hedley Mascot Gold Mines Ltd. in 1949 and 1950.

Shortly thereafter, the Sunloch and Gabbro properties reverted to The Consolidated Mining & Smelting Co. Ltd. and Noranda Mines Ltd., who consolidated the two properties in 1955 under the name of Sunro Mines Ltd.

Late in 1960, the Sunro property was leased from The Consolidated Mining & Smelting Co. Ltd. by Cowichan Copper Ltd. who placed the property into production in April 1962 at an initial rate of 400 T.P.D.

The mine and mill were flooded by the breakthrough of the Jordan River into the upper workings on December 6th, 1963.

Aetna Investment Corporation Ltd. acquired control of the Sunro property in late 1965 and production was resumed in January 1966. The mine was shut down again in September 1966.

Shortly thereafter, the Aetna group relinquished management control of the mine which then reverted to the Cowichan Copper Co. Ltd. Production was resumed in January 1967 but on a curtailed basis.

In October 1968, it is understood control of the property passed on to the Dobell interests (Cerna Copper Mines Limited) who suspended operations immediately.

GENERAL GEOLOGY

The Jordan River-Sooke area is underlain with Tertiary Metchosin volcanics (mainly basalt and diabase) which lie in a belt 5 to 10 miles wide extending west-northwest across the southwestern part of Vancouver Island. Intruding the volcanics are several stock-like masses of Tertiary (Oligocene) gabbro which trend northwesterly. On the Sunro property, the elongated gabbro intrusions may be sills and appear to strike northwesterly in conformity with the basalts.

The Sunro (Cowichan Copper) mineral deposits are considered unique in that they are possibly the only known orebodies of significance occurring in rocks younger in age than Mesozoic. They are in Eocene basalts often in the Oligocene gabbros which intrude them. It is believed that these deposits have a genetic relationship to the gabbros.

MINERAL DEPOSITS - COWICHAN COPPER PROPERTY

Mineralization, consisting mainly of chalcopyrite, pyrite, and pyrrhotite, occurs in shear or shatter zones in the basalt near the contacts of a centrally located band of gabbro. Native copper, molybdenite and small amounts of nickel and cobalt (associated with the pyrrhotite) have been reported from some of the zones.

Near the mineralized zones, the augite in the basalts and the gabbros has been largely altered to hornblende. The sulphides usually appear as irregular veinlets, smears, or blebs in the hornblende rich rocks of the shear zones. In addition to such veinlets and lenses, some chalcopyrite occurs as disseminated grains.

RECOMMENDED EXPLORATION

From our discussions with the staff of Cerna Mines Ltd. about the habit of the ore zones on the property and from study of the available geology, it is felt that the ore reserves could be increased substantially by completing the necessary work.

The following general program is, therefore, submitted for consideration:

(1) Short Term

In order to keep the mine in a satisfactory ore position for the next few years, it is necessary to develop as much, or more, ore than is being mined. To accomplish this, the following short term work would be required:

(a) Carry out closer-spaced diamond drilling in partially-tested mineralized zones with the object of up-grading them to a higher economic classification.

(b) Orient development and diamond drilling towards finding additional reserves near the extensions of known ore zones along strike and also vertically. In this respect, the exploration of the extensions of the Cave zone, presently undefined, may be considered of priority interest.

It will be noted that in our estimate of mining costs, the sum of \$9,000 per month has been included to cover the cost of the above continuing program, which is considered essential.

(2) Long Term

On the Cerna Copper Mines Ltd. property, there are many areas of interest which have been discovered in years past as surface showings, mineral traces in diamond drill holes, geochemical and geophysical anomalies. Some of those which warrant further investigation, preferably by underground development and/or diamond drilling, are listed below with accompanying remarks and recommendations.

(a) Test the area outlined by a geochemical and electromagnetic anomaly found by Noranda Mines Ltd. (See illustration of plan of ore zones). Of interest also is the fact that this anomalous area appears to coincide approximately with the focal point of a "scatter" of important mineral zones which appear to radiate from it.

(b) Seek permission from the British Columbia Hydro and Power Authority to investigate the Turnbull Zone from within the proposed hydro tunnel which is reported will pass close by. It is understood that this has been discussed already with favourable results.

(c) The "Comince" or 5670 level may be extended to explore new areas and to test possible extensions of known mineral zones plus traces which are exposed on surface and in underground workings below the "Cominco" level. For example, the extensions of the "A", New, Centre and "C" zones can be investigated conveniently from the horizon.

(d) Additional exploration and development below the 5130 level is warranted because there is no geological evidence currently available which would suggest that the favourable host rocks, with accompanying copper mineralization, do not extend well below the lowest workings.

(e) Compile up-to-date underground and surface geology maps of the entire claim group with the object of providing sufficient information which may lead to locating other potential ore targets on the property.

GENERAL

Ore reserves have been estimated at various times by various engineers and engineering consultants.

HILL & STARCK ESTIMATE

Two such reports by H. Hill & L. Starck & Associates Ltd., dated November 7th, 1963, and October 13th, 1964, were made available.

In the October 13th, 1964, report the summary states:

"Ore reserves as at October 1964 are summarized below:

	<u>Broken Ore</u>		<u>Proven Ore</u>		<u>Indicated Ore</u>		<u>Total</u>	
	<u>Tons</u>	<u>% Cu</u>	<u>Tons</u>	<u>% Cu</u>	<u>Tons</u>	<u>% Cu</u>	<u>Tons</u>	<u>% Cu</u>
River Zone	8,527	1.32	959,347	1.80	154,000	1.89	1,121,874	1.81
Cave Zone					340,900	1.23	340,900	1.23
Center Zone					38,300	1.37	38,300	1.37
New Zone					54,600	1.20	54,600	1.20
Total	8,527	1.32	959,347	1.80	587,800	1.41	1,555,674	1.65

No allowance for dilution has been made in these figures."

These estimates were up-dated periodically by the Cowichan (Cerna) mine staff and showed 2,012,419 tons in several categories, averaging 1.23% copper as of the 1st of January 1968. From this reserve it should be noted 151,933 tons assaying 1.00% copper were extracted during 1968.

D.W. PRINGLE ESTIMATE

A new estimate was prepared by Fred Chwojka, Mine Engineer, of Cerna Copper Mines for the purposes of a report written by Mr. Pringle,

dated November 20th, 1968. Some "Hill & Starck" calculations were incorporated and some new estimates made.

The total of "Positive", "Probable" and "Possible", outlined in the "Pringle" report, amounted to 4,786,107 tons, assaying 1.02% copper.

The "Positive" portion is as follows:

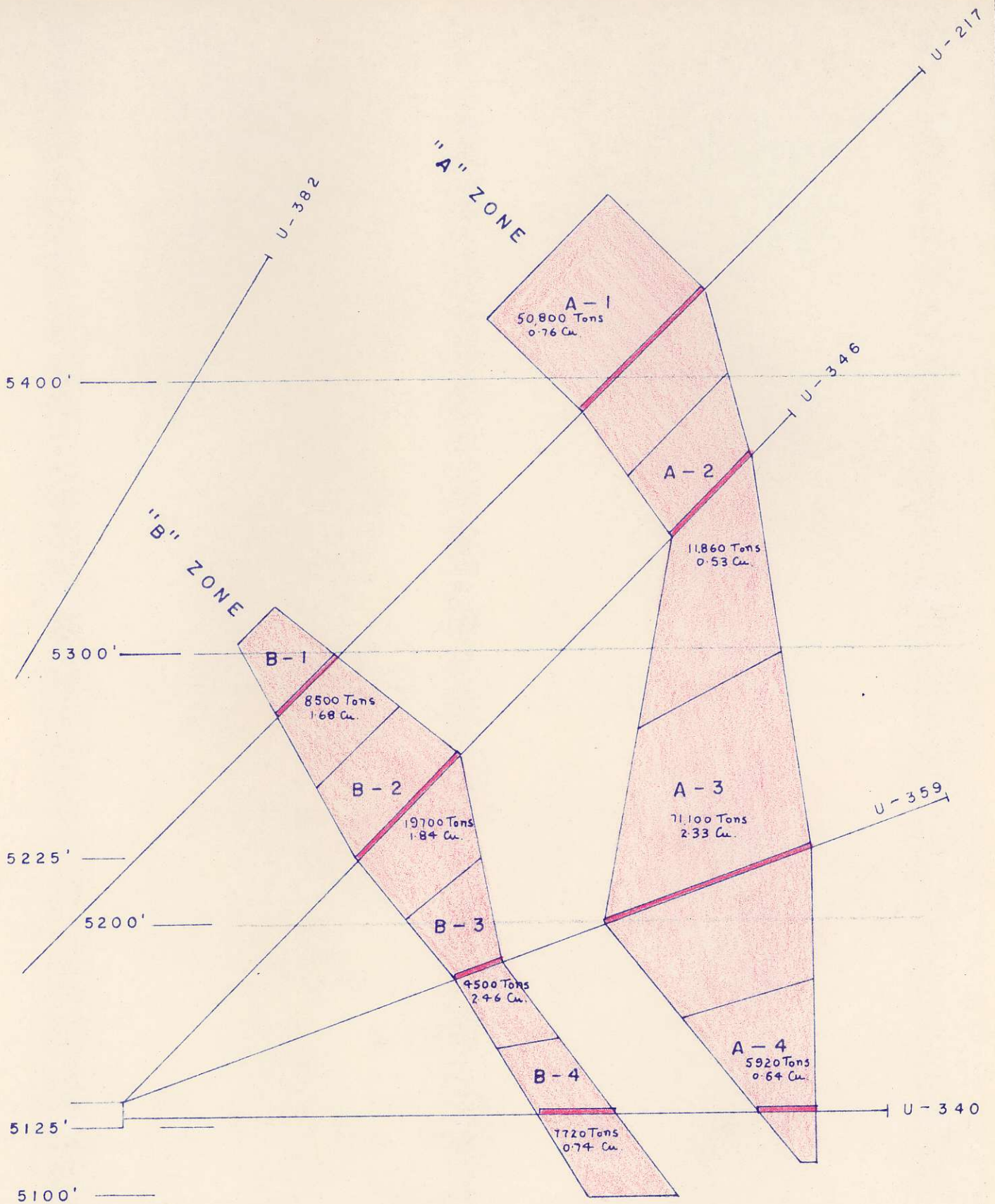
	<u>Tons</u>	<u>Grade - % Cu</u>
<u>Group 1</u>		
A-Zone	87,300	1.04
B-Shrink	5,385	2.87
B-South-South	10,200	2.25
C-Zone	12,725	1.50
X-Fault	48,000	2.28
Lower B	<u>185,000</u>	<u>2.17</u>
Total	348,610	1.891
<u>Group 2</u>		
Cave Ore	<u>974,997</u>	<u>1.01</u>
Total	1,323,607	1.24

BACON & CROWHURST ESTIMATES

Insufficient time has been made available to make proper accurate estimates of the ore reserve situation.

J.J. Crowhurst and G.D. Delane, together with D.W. Pringle visited the property on April 9th and studied maps, estimates and calculations with Mr. Chwojka.

Subsequently, it must be noted that no detailed calculations have been made concerning Group 1 by Bacon & Crowhurst, but enough of the relative information concerning the "Lower B", the "A" and the



CAVE ZONE RESERVE BLOCKS

Section I
(looking NW)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.

5400'

5300'

5225'

5200'

5100'

"A" ZONE

"B" ZONE

A - 5

B - 5

59.020 Tons
0.82 Cu.

24.00 Tons
3.17 Cu.

U-360

U-341

5125'

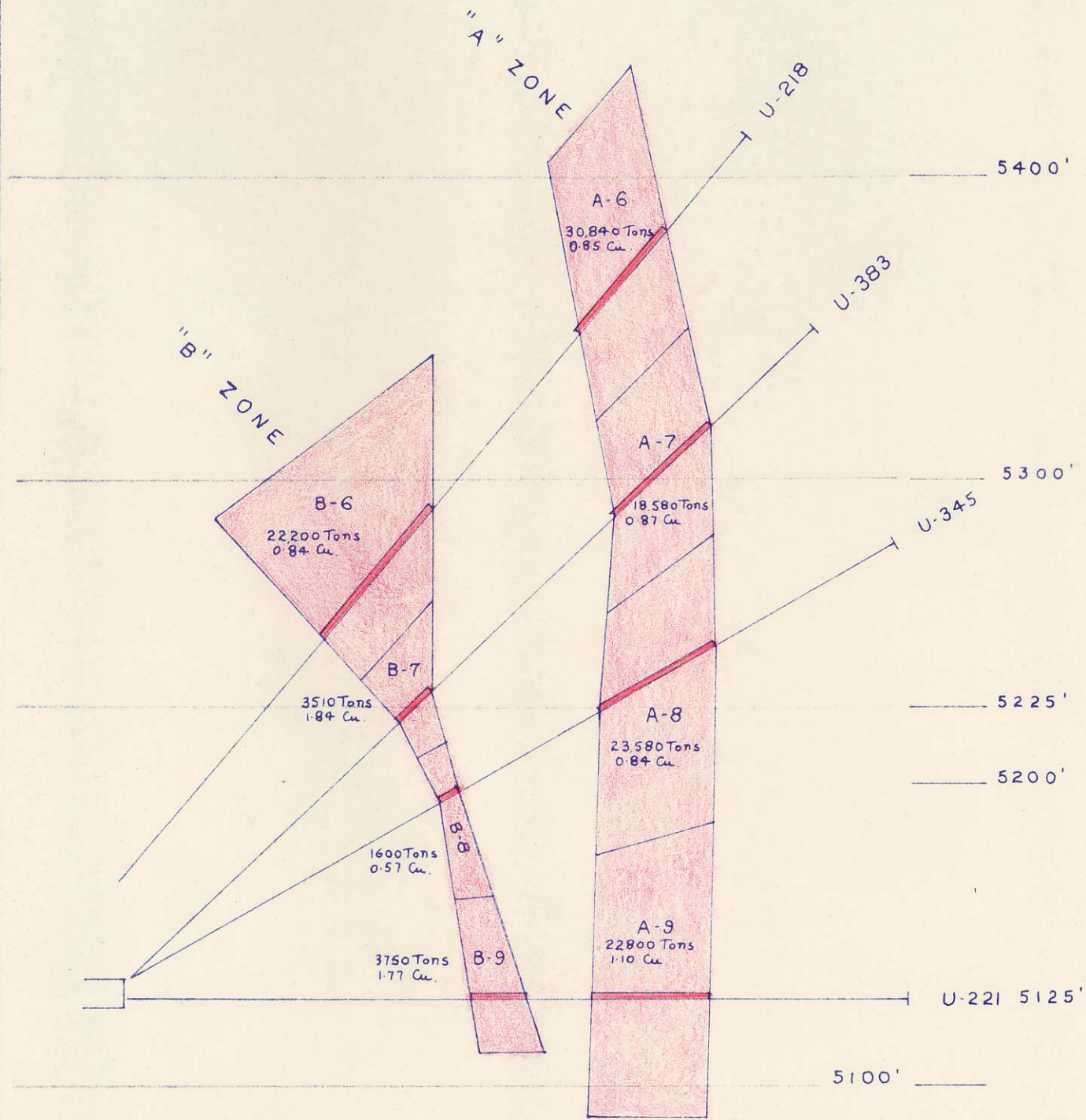
CAVE ZONE RESERVE BLOCKS

Section 2
(looking NW)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



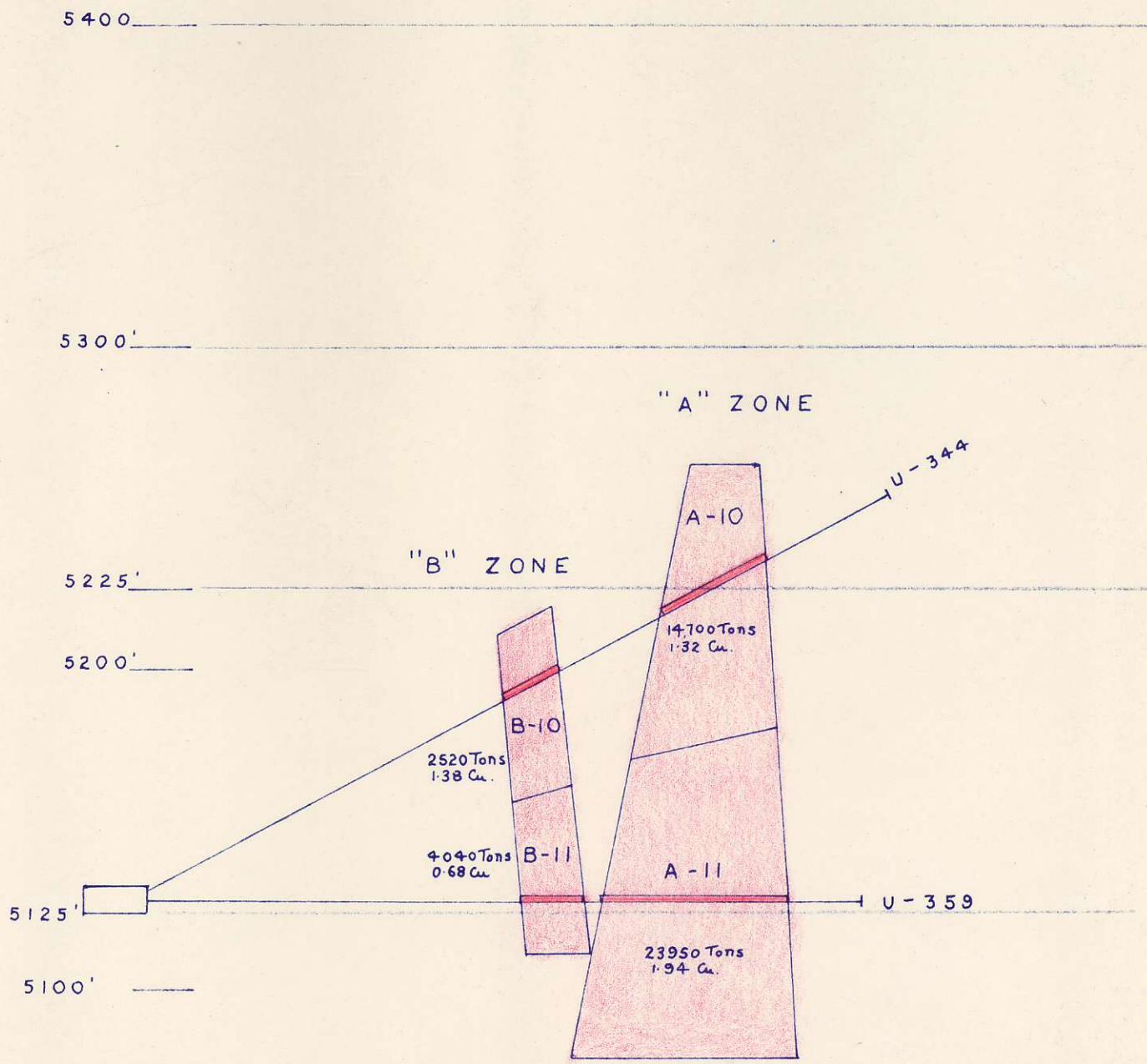
CAVE ZONE RESERVE BLOCKS

Section 3
(looking NW)

Scale: 1" = 50'

April 15, 1969.

Bacon and Crowhurst Ltd.



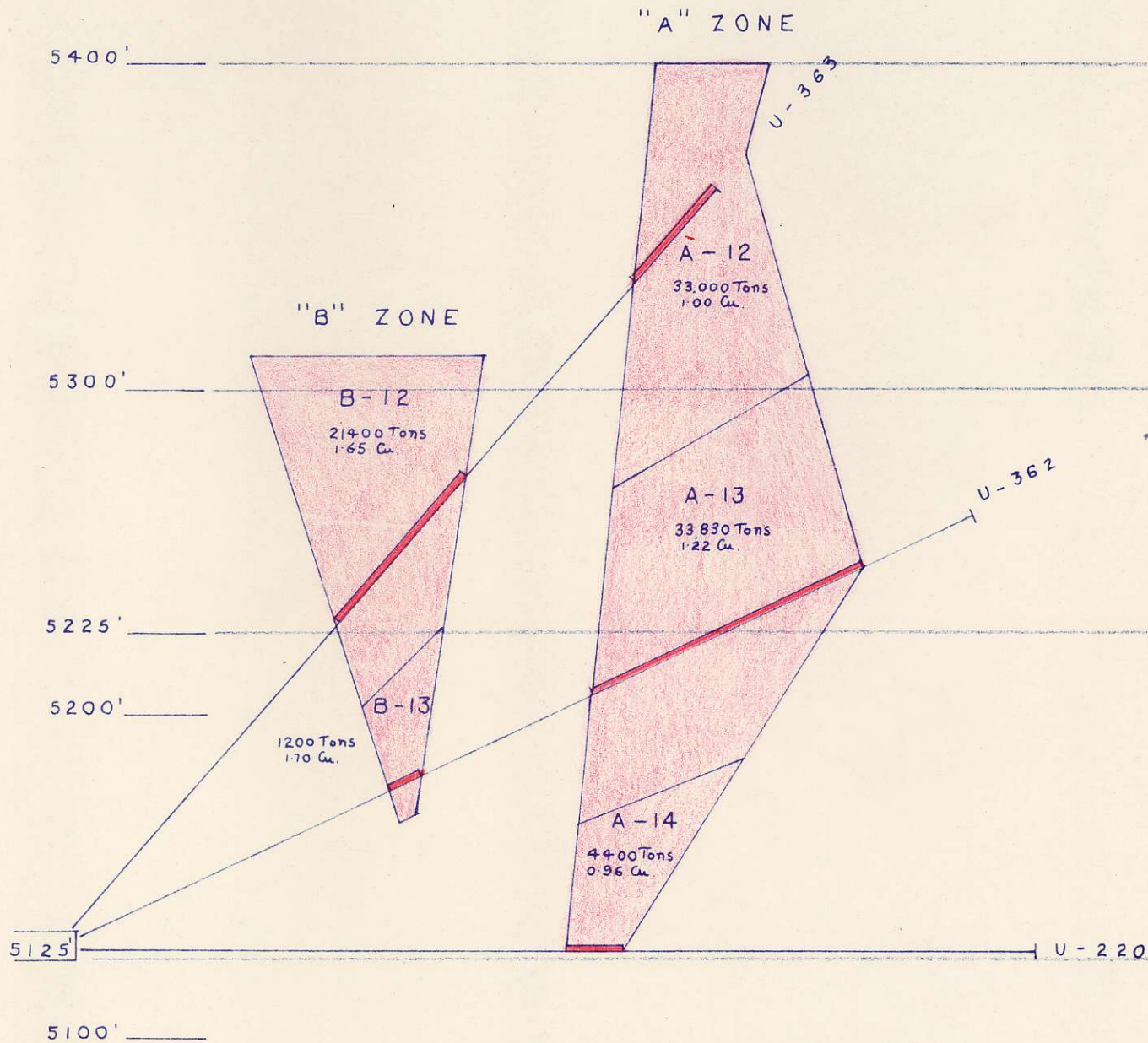
CAVE ZONE RESERVE BLOCKS

Section 4
(looking N)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



CAVE ZONE RESERVE BLOCKS

Section 5
(looking N)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.

5400'

5300'

5225'

5200'

5125'

5100'

"A" ZONE

A-15
16,730 Tons
1.63 Cu.

A-16
44,800 Tons
1.08 Cu.

A-17
55,200 Tons
0.48 Cu.

U-361

U-343

U-342

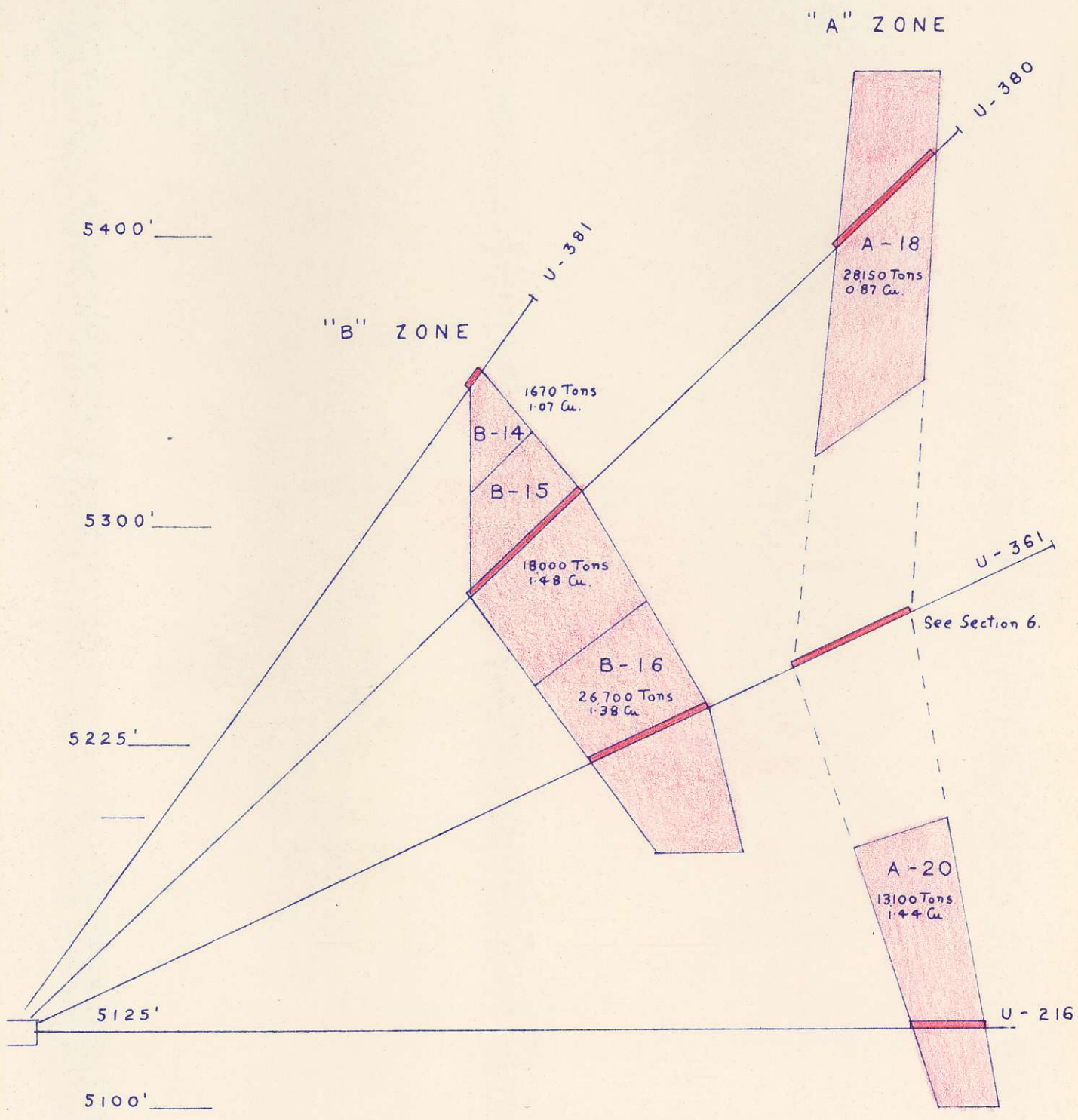
CAVE ZONE RESERVE BLOCKS

Section 6
(looking N)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



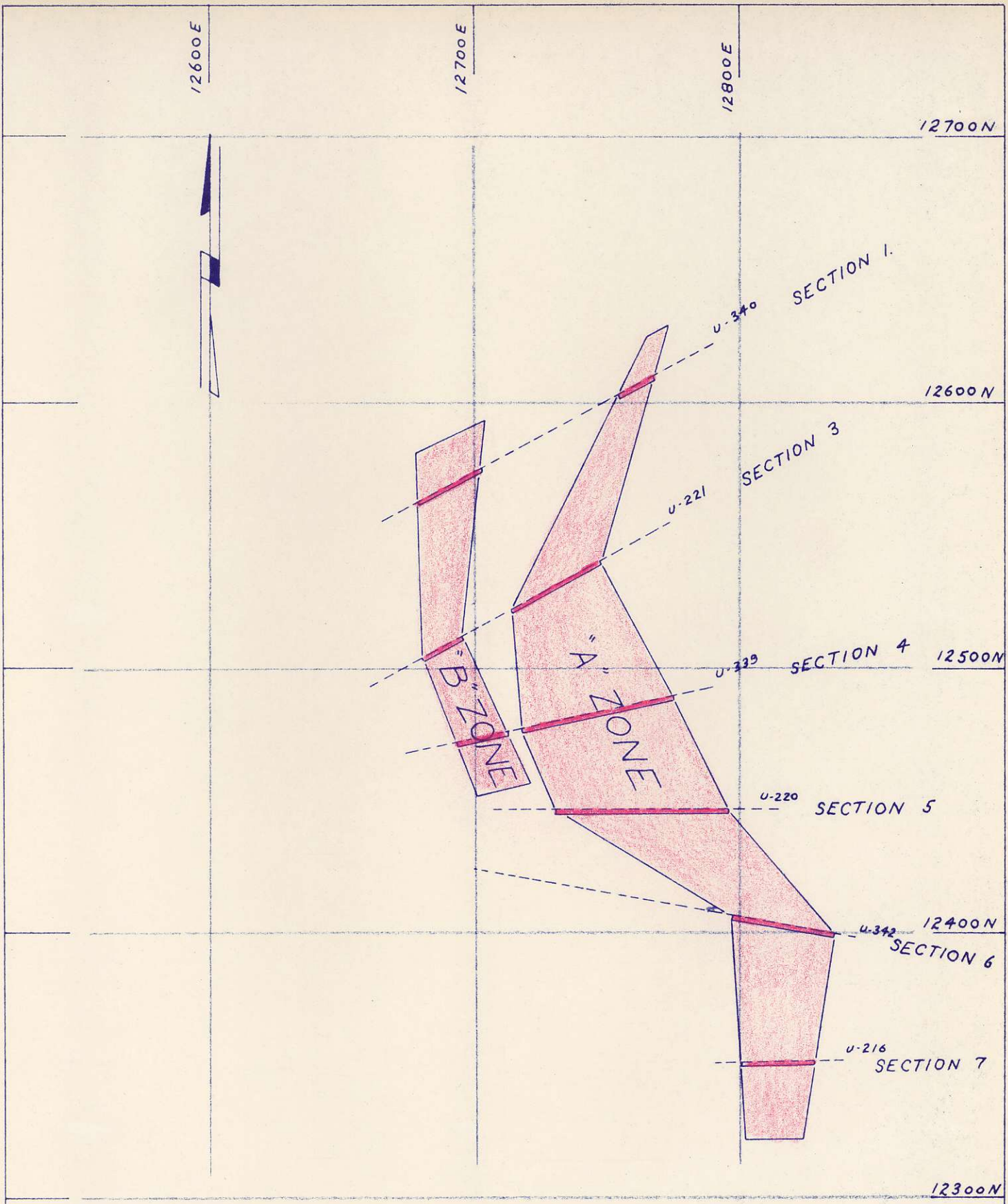
CAVE ZONE RESERVE BLOCKS

Section 7
(looking N)

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



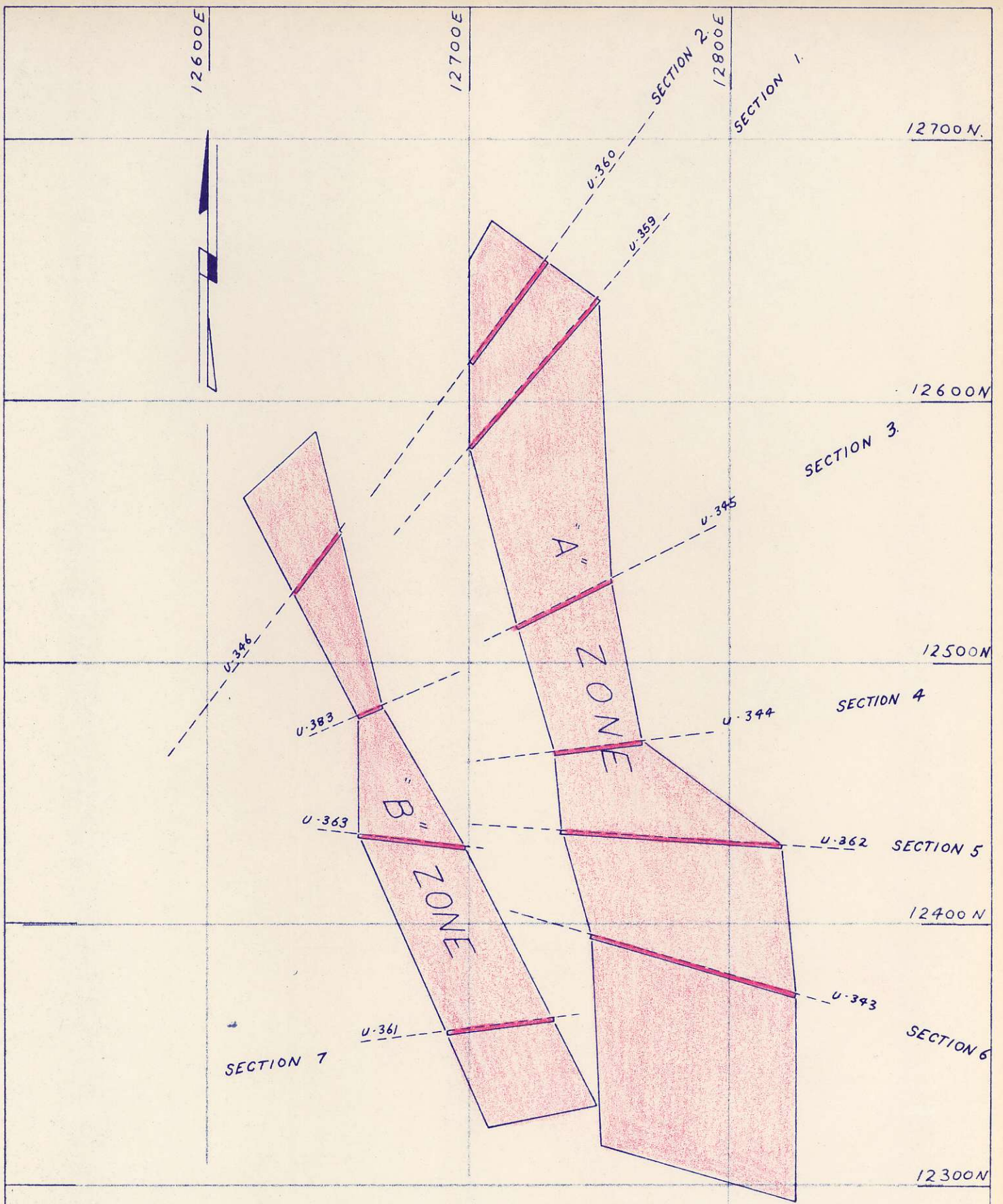
CAVE ZONE

5125' Level Plan

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



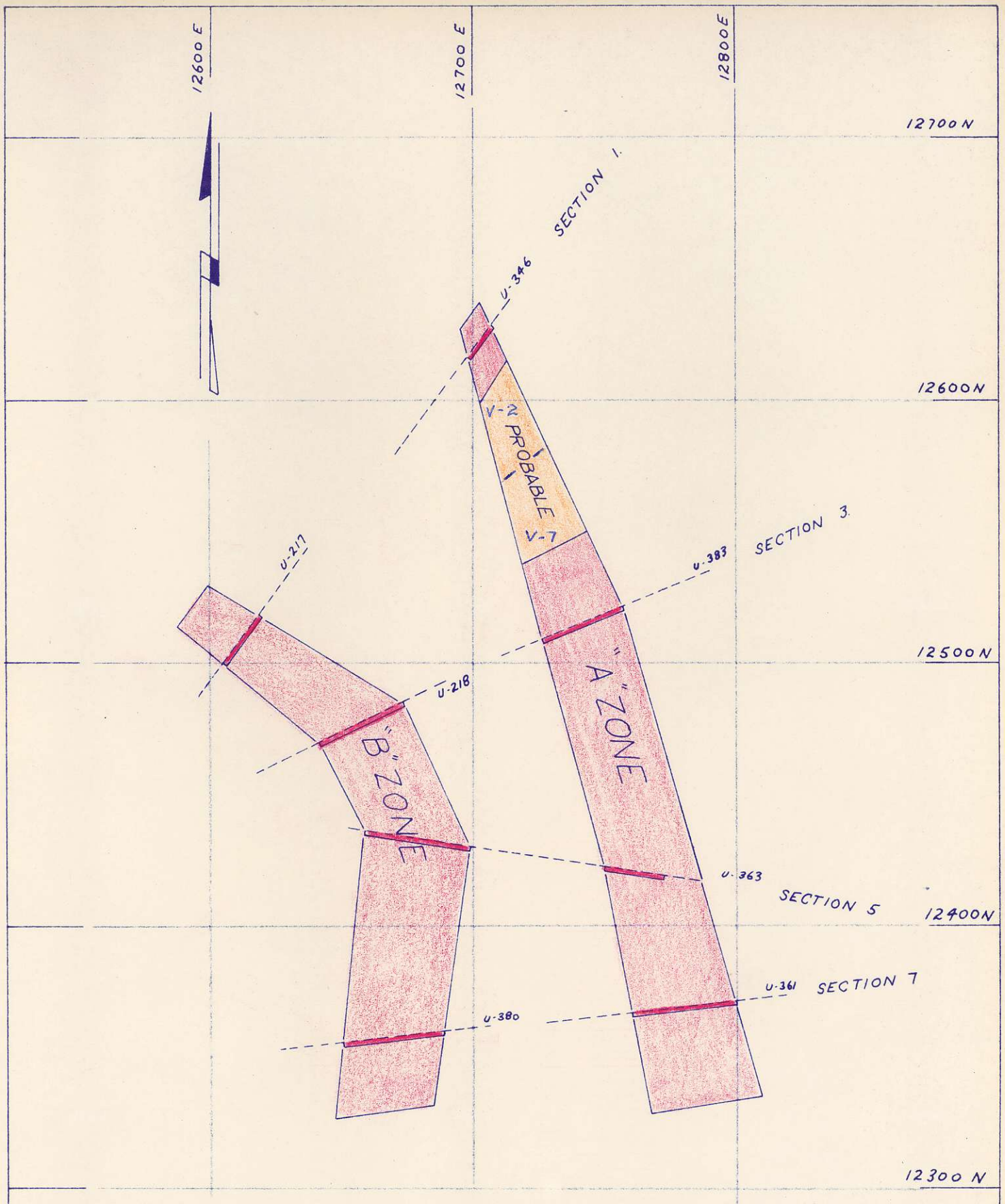
CAVE ZONE

5225' Level Plan

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



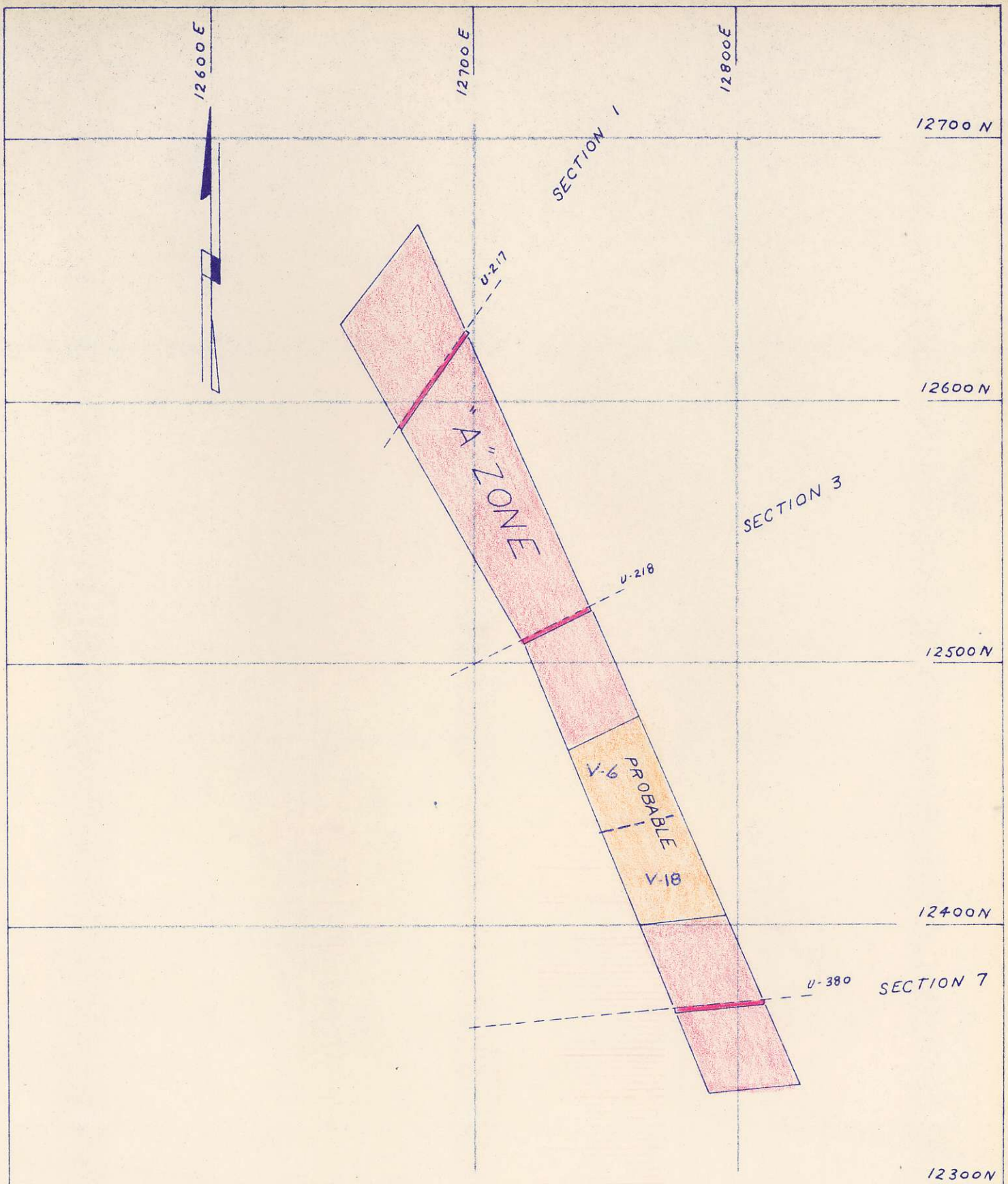
CAVE ZONE

5300' Level Plan

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.



CAVE ZONE

5400' Level Plan

Scale: 1" = 50'

April 15, 1969

Bacon and Crowhurst Ltd.

"X-Fault" zones was examined to be reasonably assured that the figures quoted are accurate and conservative for these three zones. It is assured the figures for the remaining zones in Group 1 are also reasonably correct.

Drill-hole assay grade information supplied by Cerna Copper Mines Ltd. for the "Cave" zone (Group 2) was secured (but not the individual lengths of assays) and a new estimate prepared by averaging these figures arithmetically (to save time). Intersection lengths appeared to be consistently about equal to each other.

The following principles were used by Bacon & Crowhurst during this calculation:

- (a) A tonnage factor of 10.0 cu. ft. per ton was used.
- (b) Material assaying less than 0.50% copper and situated outside the assumed block was discarded. Similarly, any one group of diamond drill hole assays within the block was required to average more than 0.50% copper.
- (c) Seven radiating vertical sections chosen along the plane of the diamond drill holes were prepared and two block outlines determined, as shown in the attached illustrations.
- (d) Three classifications were established; drill indicated (considered as almost equivalent to positive), probable and possible.
- (e) Areas of influence for any one drill hole intersection were extended either half way to adjacent holes or up to a maximum distance equal to the length of the intersection for the "drill indicated" classification.
- (f) Where the distance between drill holes exceeded the length requirements of clause (e), but mineralization appeared continuous, the material was classed as "probable".
- (g) The "possible" ore classification was used for a distance of 100 feet above and below the limits defined on the illustrations.

- (h) Mining dilution has been calculated by adding 25% to the "in place" tonnage calculations, using an assumed grade of 0.20% copper for the material added.

The resulting estimate prepared by Bacon & Crowhurst is shown on the following page. Calculations showing the internal distribution within the blocks at particular critical mining sequence elevations are also incorporated.

ESTIMATED ORE RESERVES
BACON & CROWHURST LTD. CALCULATIONS
SUMMARY OF CAVE ZONES "A" AND "B"

	<u>In Place</u>		<u>Dilution</u>	<u>Total - Fed to Mill</u>	
	<u>Tons</u>	<u>Grade % Cu</u>	<u>25% @ 0.20% Cu Tons</u>	<u>Tons</u>	<u>Grade</u>
"A" Zone (drill indicated & probable)	543,310	1.182	135,827	679,138	0.986
"B" Zone (drill indicated)	<u>149,410</u>	<u>1.448</u>	<u>37,352</u>	<u>186,762</u>	<u>1.199</u>
TOTAL	692,720	1.239	173,179	865,900	1.032
<u>Distribution of Drill Indicated & Probable</u>					
Sill Pillar (5130-5220 elev.)	230,471	1.389	57,618	288,089	1.151
"Mineable" (5220-5460 elev.)	<u>462,249</u>	<u>1.165</u>	<u>115,562</u>	<u>577,811</u>	<u>0.972</u>
TOTAL	692,720	1.239	173,180	865,900	1.032
<u>Possible</u>					
Above 5460 elev.- 100'x2000 tons/vert.ft.	200,000	1.165	50,000	250,000	0.972
Below 5130 " " " " " "	<u>200,000</u>	<u>1.239*</u>	<u>50,000</u>	<u>250,000</u>	<u>1.031</u>
TOTAL	400,000	1.202	100,000	500,000	1.001
GRAND TOTAL - DRILL INDICATED, PROBABLE & POSSIBLE	1,092,720	1.226	273,180	1,365,900	1.021

* Zone averages - not average of lower block.

COMPARISON - "BACON & CROWHURST" vs "PRINGLE"

A comparison of the two estimates for the Cave zone follows:

	<u>Tons</u>	<u>Grade - % Cu</u>
<u>Bacon & Crowhurst</u>		
Drill Indicated & Probable	692,720	1.239
Possible	<u>400,000</u>	<u>1.202</u>
Total	1,092,720	1.226
<u>Pringle</u>		
Positive	974,997	1.01
Possible	<u>1,140,000</u>	<u>0.73</u>
Total	2,114,997	0.85

The difference between the Bacon & Crowhurst "drill indicated & probable" figure of 692,720 tons and the Pringle "positive" figure of 974,997 tons can be attributed directly to the inclusion of surrounding lower grade material not classified as "ore" in the Bacon & Crowhurst estimate.

SUMMARY - BACON & CROWHURST ESTIMATE

The total amount of ore in all zones that appears to be "reasonably assured" at present is estimated as follows:

<u>Group</u>	<u>In Place</u>		<u>Dilution</u>		<u>Total Feed to Mill</u>	
	<u>Tons</u>	<u>Grade % Cu</u>	<u>Assumption</u>	<u>Tons</u>	<u>Tons</u>	<u>Grade % Cu</u>
1.	348,610	1.891	30% @ zero % Cu	104,583	453,193	1.455
2.	<u>692,720</u>	<u>1.239</u>	25% @ 0.20 % Cu	<u>173,180</u>	<u>865,900</u>	<u>1.032</u>
Totals	1,041,330	1.458		277,763	1,319,093	1.177

ORE RESERVE CALCULATIONS

CAVE ZONE "A" - DRILL INDICATED

Tonnage Factor = 10.0

<u>Section</u>	<u>Block</u>	<u>Tons</u>	<u>Grade - % Cu</u>
1	A-1	50,800	0.76
	A-2	11,860	0.53
	A-3	71,100	2.33
	A-4	5,920	0.64
2	A-5	54,020	0.82
3	A-6	30,840	0.85
	A-7	18,580	0.87
	A-8	23,580	0.84
	A-9	22,800	1.10
4	A-10	14,700	1.32
	A-11	23,950	1.94
5	A-12	33,000	1.00
	A-13	33,830	1.22
	A-14	4,400	0.96
6	A-15	16,730	1.63
	A-16	44,800	1.08
	A-17	5,520	0.48
7	A-18	28,150	0.87
	A-20	<u>13,100</u>	<u>1.44</u>
TOTAL - DRILL INDICATED		507,680	1.205%

CAVE ZONE "A" - PROBABLE

Tonnage Factor = 10.0

<u>Block</u>	<u>Tons</u>	<u>Grade % Cu</u>	<u>Remarks</u>
V-18	14,950	0.87	N. of Block A-18
V-6	11,970	0.85	S. of Block A-6
V-7	7,340	0.87	N. of Block A-7
V-2	<u>1,370</u>	<u>0.53</u>	S. of Block A-2
TOTAL - PROBABLE	35,630	0.850%	(drill holes far apart)

SUMMARY OF CAVE ZONE "A"

Drill indicated	507,680	1.205
Probable	<u>35,630</u>	<u>0.850</u>
TOTAL - Cave Zone "A" (drill indicated & probable)	543,310	1.182% Cu

CAVE ZONE "B" - DRILL INDICATED

Tonnage Factor = 10.0

<u>Section</u>	<u>Block</u>	<u>Tons</u>	<u>Grade - % Cu</u>
1	B-1	8,500	1.68
	B-2	19,700	1.84
	B-3	4,500	2.46
	B-4	7,720	0.74
2	B-5	2,400	3.17
3	B-6	22,200	0.84
	B-7	3,510	1.84
	B-8	1,600	0.57
	B-9	3,750	1.77
4	B-10	2,520	1.38
	B-11	4,040	0.68
5	B-12	21,400	1.65
	B-13	1,200	1.70
7	B-14	1,670	1.07
	B-15	18,000	1.48
	B-16	<u>26,700</u>	<u>1.38</u>
TOTAL - "B" ZONE - DRILL INDICATED		149,410	1.448%

CAVE ZONE - DISTRIBUTION

(A) SILL PILLAR - 5130 Elev. to 5220 Elev.

<u>Block</u>	<u>Tons</u>	<u>% Cu</u>
A-4	5,920	0.64
A-3 (50%)	35,550	2.33
B-4	7,720	0.74
B-3	4,500	2.46
B-5	2,400	3.17
A-5 (50%)	27,010	0.82
A-9	22,800	1.10
A-8 (40%)	9,432	0.84
B-9	3,750	1.77
B-8	1,600	0.57
A-11	23,950	1.94
A-10 (50%)	7,350	1.32
B-11	4,040	0.68
B-10	2,520	1.38
A-14	4,400	0.96
A-13 (30%)	10,149	1.22
B-13 (40%)	1,200	1.70
A-17	5,520	0.48
A-16 (60%)	26,880	1.08
A-20	13,100	1.44
B-16	<u>10,680</u>	<u>1.38</u>
	230,471	1.389%

CAVE ZONE - DISTRIBUTION (cont'd.)

(B) "MINEABLE" - above 5220 level to 5460 elev. approx.

<u>Block</u>	<u>Tons</u>	<u>% Cu</u>
A-3 (50%)	35,550	2.33
A-2	11,860	0.53
A-1	50,800	0.76
B-2	19,700	1.84
B-1	8,500	1.68
A-5 (50%)	27,010	0.82
A-8 (60%)	14,148	0.84
A-7	18,580	0.87
A-6	30,840	0.85
B-7	3,510	1.84
B-6	22,200	0.84
A-10 (50%)	7,350	1.32
A-13 (70%)	23,681	1.22
A-12	33,000	1.00
B-12	21,400	1.65
A-16 (40%)	17,920	1.08
A-15	16,730	1.63
A-18	28,150	0.87
B-16 (60%)	16,020	1.38
B-15	18,000	1.48
B-14	1,670	1.07
V-18	14,950	0.87
V-6	11,970	0.85
V-7	7,340	0.87
V-2	<u>1,370</u>	<u>0.53</u>
	462,249	1.165%
Sill Pillar (5130-5220 elev.)	<u>230,471</u>	<u>1.389</u>
TOTAL	692,720	1.239%

MINING METHODS

"Group 1" Ore Zones

Production to date has resulted from long-hole drill shrinkage stopes (using horizontal and vertical rings), narrow vein shrinkage stopes and cut & fill stopes. Each is applicable, depending on the size and nature of the individual orebody.

It is understood that several stopes, such as in the Lower B zone, using these different methods, have been prepared for production and can be reinitiated fairly easily. This was not investigated in detail because of time considerations and hence cost projections might not be completely accurate for this part of this report. The figures, however, are based on a study of past performance and experience and are considered reasonably accurate.

"Group 2" Cave Ore Zone

It is our opinion that the choice of the method, proposed by Mr. Pringle (supported by Haste Mines Ltd. - A. McCutcheon), for the Cave ore zone, is correct. The ore lenses are steep, extend at least 350' along the strike, and have been explored by widely spaced diamond drill holes for over 300' vertically.

It is contemplated that sub-level shrinkage stoping, using trackless equipment for loading and hauling, will be used. Access to the sub-levels will be by means of a 15% incline 12' x 14' in cross-section designed to intersect the ore lenses at about 60' vertical intervals.

Fairly rapid mining should prevent excessive dilution from wall rocks, which appear to be reasonably competent. Broken rock will be allowed to remain in the stope to support the walls. The excess "swell", which amounts to about 1/3 of the rock drilled and blasted, will be drawn as the stope progresses upwards. When the stope is completed, all of the ore will be drawn through the drawpoints underneath.

The effect of "piping" through the broken rock has been studied broadly and has been anticipated in the compilation of the expected grade of ore at various time intervals.

Initial development costs for this method of mining are high until the top of the ore has been reached by the various openings required. Costs then drop drastically since only drilling and blasting and ore removal are then required.

For the purposes of this report, it has been assumed that the top of the Cave ore zone will be at about the 5460 elevation, although it is felt there are good possibilities for extension upward.

A substantial amount of the zone is situated between the 5130, or adit elevation, and the 5220, or contemplated loading and haulage level. This cannot be removed by the proposed scheme. Consideration should be given to lowering the location of the loading level to permit more complete extraction. This will involve up-hill haulage for the trackless machinery with an attendant additional cost. The relative economics should, however, be studied, particularly if more information, such as the continuity of the ore below the level, can be determined.

Mr. A. McCutcheon and Mr. Ray Smith of Haste Mines Ltd. indicated that the costs last quoted by his company (as used in this

report) would be substantially correct for the 25,000 tons per month contemplated from the Cave zone. This figure has been arbitrarily chosen to conform with the estimated concentrator limitation of 1200 tons of ore per day, or 34,000 tons per month. Perhaps, with more study, a better combination of the amounts suggested to be extracted daily from the Cave zone and from the Group 1 ore zones can be determined, in terms of copper content, metallurgy and resulting operating profit.

Summary of Mining Methods

In summary, it is confirmed that the basic concept of continuing to mine the higher grade, narrower and more erratic orebodies with the methods already started, together with the extraction of the larger lower grade Cave Zone, by a relatively much cheaper trackless method, is considered correct.

Under this system, each stope would generate an operating profit on an individual basis, by taking advantage of the larger daily mill tonnage rate.

It should be noted, it is our impression that considerably more ore could be mined daily, were it not for the mill limitations.

ESTIMATED PRODUCTION "GROUP 1" ORE ZONES

To provide the estimated 9000 tons of ore per month from long-hole drilling stopes, narrow shrinkage stopes, and cut & fill stopes (in the Group 1 ore zones) it is necessary to produce an average of 450 tons per working day on a 5-day week basis. If two shifts are employed, 225 tons per shift must result.

It is estimated this will require seven working places, developed, fully equipped and available for production at all times. This will allow two stoping areas extra, or a 28% margin for breakdowns, unforeseen ground conditions, possible lack of ore continuity, "disappointing" stopes, and other contingencies.

Since no examination of these working places by Bacon & Crowhurst engineers has been made, the estimated number of stopes must be regarded as a guess, subject to confirmation.

MANPOWER AND LABOUR COST

To operate the estimated five working places in the Group 1 areas, to drive one exploration heading continuously (or to complete 2000' of diamond drilling per month) and to provide necessary services to the trackless stoping mining contractor, it is estimated the following manpower and labour cost will be required:

Underground Crew

<u>Classification</u>	<u>No. of Men</u>	<u>Average Cost per mon., incl. 20% fringe benefits</u>	<u>Total Cost Per mon.</u>
Machine men	12	\$700	\$8,400
Slushermen	4	650	2,600
Timber & fill	6	650	3,900
Tramming	2	600	1,200
Pipefitting & track	2	600	1,200
General underground	4	600	2,400
Hoistmen & skiptenders	4	600	2,400
Samplers	<u>1</u>	600	<u>600</u>
Totals	35		22,700

Electrical & Mechanical (also concentrator)

<u>Classification</u>	<u>No. of Men</u>	<u>Average Cost per mon. incl. 20% fringe benefits</u>	<u>Total Cost per mon.</u>
Foreman	1	\$1,000	\$1,000
Rock drill repair & bits	1	650	650
Mechanics & machinist	1	700	700
Electricians	1	700	700
Helpers	<u>1</u>	600	<u>600</u>
Totals	5		\$3,650

Underground Staff

Superintendent	1	1,300	1,300
Shift bosses	2	800	1,600
Geology	1	900	900
Surveyor	1	700	700
Helper	1	500	500
Safety & first aid	<u>1</u>	700	<u>700</u>
Totals	7		5,700

Summary

Underground crew	35		22,700
Electrical & mechanical	5		3,650
Underground staff	<u>7</u>		<u>5,700</u>
	47		\$32,050
Less fringe benefits @ 16.67%			<u>5,342</u>
			\$26,708

ESTIMATED OPERATING COST - CERNA

	<u>Amount (9000 TPM)</u>	<u>Cost/Ton</u>
Labour - 65% of total	\$26,708	\$2.967
Supplies - 35% of total	<u>14,381</u>	<u>1.598</u>
Total	\$41,089	\$4.565
Plus fringe benefits	<u>5,342</u>	<u>0.593</u>
Total	\$46,431	\$5.158

This cost includes about \$1.00 per ton, or \$9,000 per month, to cover development and exploration costs. Several stoping areas are already developed for production, however, at present. It is estimated that an additional \$1.50 per ton of ore or \$13,500 per month would probably be required after about six months production in order to maintain an adequate number of working places for continuing production.

CHAPTER VI
MILLING & METALLURGY

CHAPTER VI
MILLING & METALLURGY

CONCENTRATOR

The underground concentrator was not only very poorly designed and installed but suffered much damage as a result of the flooding of the workings. It is understood, for example, that the electrical power cables under the floor of the concentrator have never been properly dried out or repaired.

Most of the equipment is in exceptionally poor condition and should be thoroughly overhauled prior to any attempt at continuous performance.

Under two or three different mill foremen, all skilled men of some experience, the maximum amount of ore treated per day reached 1000 tons occasionally and that for only brief periods of time.

It is our opinion, that unless almost complete reconstruction is undertaken, the plant should not be expected to handle in excess of 1200 tons per day. In the event re-initiation of production is undertaken, it is recommended that Mr. Pringle's suggested capital expenditures be carried out in full, and provision be made for possibly an extra \$100,000, making a total of \$240,000 in all, as applied to concentrator rehabilitation.

In particular, consideration should be given to substitution of newer rod and/or ball mills. This is a difficult procedure since it appears insufficient head room is present for the proper size of equipment, but the grinding circuit constitutes such a source of breakdowns, with consequent loss of production, that the success of the

whole operation has been and, in all likelihood, will continue to be affected.

The crushing plant and the flotation section should operate properly, if Mr. Pringle's recommendations are completed.

The ore treated to date responds easily to flotation at a moderate grind.

EXPECTED STATISTICS (after repairs & substitutions effected)

Milling rate - 1200 tons per day x 28 days/month or 34,000 tons/month.

Copper recovery - 92%.

Concentrate grade - 25% copper.

Concentrate moisture content - 7%.

Estimated milling cost - \$1.75/ton milled.

It should be noted that little or no ore from the "Cave" zone has been treated to date. Since this zone contains a considerable amount more pyrrhotite than the ore previously milled, test work conducted or representative samples properly taken should precede mill start-up. Lower recoveries and/or lower daily milling rate due to excessive grinding requirements may result if the cave zone type ore is not as amenable to treatment as the No. 1 group type ores.

SMELTER CONCENTRATE PURCHASE SCHEDULE

Payments for copper concentrates along lines currently accepted as standard by B.C. copper producers are approximately as follows:

- (a) Gross value - lbs. of copper contained less one unit (20# copper per ton of concentrate) x E & MJ export refinery price per lb.
- (b) Deduct 1.5¢ per lb. of copper paid for.
- (c) Deduct treatment charge of \$24.00 per dry (sometimes metric) ton of concentrates.
- (d) Deduct penalties for excessive amounts of impurities such as lead, zinc, arsenic, etc.
- (e) Add credit for gold and silver content in excess of base amounts.
- (f) Deduct sales commission - usually 1½% of net value - if applicable.
- (g) Add Canadian-U.S. premium.

For Cerna Copper Mines concentrates, a typical calculation for an E & MJ price of 45¢ U.S. is estimated as follows, assuming no penalties (d) are incurred, and no gold and silver (e) content is present:

<u>1 Ton of concentrate - assaying 25% copper</u>	<u>U.S. - Per dry ton of concentrates</u>
Gross value - 2000# x (25%-1%) x 45¢ =	\$216.00
Less:	
(1) 1.50¢ x 480# = \$7.20	
(2) As in (c) above <u>24.00</u>	
	<u>31.20</u>
	Net \$184.80
Less sales commission @ 1½%	<u>2.77</u>
	\$182.03
Plus Canadian U.S. premium @ 7½%	<u>13.65</u>
Value per ton of concentrates	\$195.68 Can.
Value per lb. of copper contained = $\frac{19568}{500}$ = 39.13¢	

Similarly for an E & MJ export refinery price of 50.0¢ U.S. a net value of \$221.10 per ton of concentrate would be realized, or 44.22¢ per lb. of copper, in Canadian funds.

METAL PRICES

For the purposes of this report, 45¢ U.S. and 50¢ U.S. have been used for the forward price of copper. It is felt this is conservative, but represents a realistic appraisal of possible prices during the next 3 to 4 years.

CONCENTRATE HANDLING

For the purposes of this report, it is assumed that the Hatch Point facilities will be used and hence that the year to date Cerna Copper figures for September 1968, representing 5030 tons of concentrate, will apply as follows:

	<u>Per ton of concentrate</u>
Loading	\$0.54
Trucking	3.32
Warehousing & sampling	0.90
Wharf expense	0.75
Ship loading	<u>1.61</u>
Total	\$7.12

This represents $\frac{712}{500}$ or an additional 1.42¢ per lb. of copper.