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A REPORT ON

THE GRUM DEPOSIT

WITH A

REVIEW OF ITS ECONOMIC POTENTIAL

G. M. Hogg, P. Eng.
G. M. Hogg & Associates Ltd.
Toronto, Ontario
April 6, 1976

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CERTIFICATE OF QUALIFICATION

I, Glen M. Hogg, of the City of Toronto, in the Province of Ontario, Canada, do hereby certify that:

1. I am a Consulting Geologist with an office situated at 28 Thompson Avenue, Toronto, Ontario.

2. I am a graduate of Queen's University, Kingston, Ontario, having received the degree of Master of Science in Geological Science from the Faculty of Applied Science in 1952. I have since that time practised professionally in the field of mineral exploration and development.

3. I have an intimate knowledge of the Grum deposit and the general district through continued association with the Faro area of the Yukon Territory since 1969 and have been closely associated with the exploration and development of the Grum deposit since its discovery in 1973. I last examined the property on July 19, 1975 and, until the end of February, 1976, I was involved in the administration of continued exploration of the deposit.

4. In addition to my personal knowledge of this deposit I have made use of data supplied by Kerr Addison Mines Limited, and reports by Dr. C. E. Michener, P. Eng., of Derry, Michener & Booth; Mr. J. S. Redpath, P. Eng., of J. S. Redpath Limited; and Mr. R. P. Ehrlich, P. Eng., of Canadian Bechtel Limited.

5. I have no interest, direct or indirect, in the property on which this report is written, nor do I expect to receive any. I have no interest, direct or indirect, in Canadian Natural Resources Limited, as successor to AEX Minerals Corporation, nor do I expect to receive any.

DATED this 6TH day of APRIL, 1976.

REGISTERED PROFESSIONAL ENGINEER
G. M. HOGG
PROVINCE OF ONTARIO

G. M. Hogg, P. Eng.

SUMMARY

In surface drilling to date on the Grum property in the Yukon Territory a mineral reserve of 21,390,500 tons, grading 3.98% lead, 6.51% zinc and 1.77 oz. silver per ton, has been indicated above the 3400 ft. level for a length of 2000 ft. and a width of 1200 ft. Recent detail drilling from underground has indicated a general increase in grade is probable, has confirmed continuity of sulphide zones and has further indicated that selective ? mining of very high grade areas is possible. The drill-indicated reserve is based on surface holes drilled at 200 ft. centres, and widely spaced exploratory holes to the north and south confirm that substantial tonnages of similar grade can be developed by additional drilling.

The estimated capital cost for development of the Grum deposit, based on 1976 prices, is $91,251,295. Of this total $73,518,195 is required for a 5000 ton per day concentrator and surface facilities and $17,733,100 for underground development and equipment.

Operating costs, based on 1976 prices, are estimated at $9.22 per ton for mining, $6.00 per ton for milling and surface facilities, and $2.75 per ton for transportation, treatment and marketing costs based on shipment of concentrates

to Skagway. The total estimated operating cost is therefore $17.97 per ton.

A cut and fill mining method is proposed with stoping by horizontal undercut and sand-cement fill. Dilution has been estimated at 10% with variable grade depending on the material being mined. In early production an estimated mill feed grade is 4.99% lead, 8.07% zinc and 2.16 oz. silver per ton, with later production at 3.71% lead, 6.10% zinc and 1.63 oz. silver per ton.

Preliminary metallurgical test work only has been done to this time, and as previous operating experience in the area has shown, the Grum sulphide material is metallurgically difficult. Recoveries of 78% for lead, 87% for zinc and 80% for silver have been estimated and used for the purpose of this study.

Based on present prices of $0.20 per lb. for lead, $0.37 per lb. for zinc and $4.05 per oz. for silver the net smelter return for higher grade production is estimated at $37.19 per ton. For lower grade material the estimated net smelter return is $28.53 per ton. The operating profit is therefore $19.22 per ton for higher grade material and $10.56

per ton for the lower grade material, or $33,635,000 per year and $18,480,000 per year respectively at a 5000 ton per day production rate.

In a rate of return estimate at a production rate of 5000 tons per day or 1,750,000 tons per year, assuming a three year preproduction phase, the capital requirement of $91,251,295 is increased to $102,184,000 through interest charges. This debt would be retired in five years and the on going indicated cash flow available for distribution would vary from $18 million to $8.5 million per year after payment of Yukon royalties and income taxes and at present metal prices.

A sensitivity study shows that variations in zinc price and mill recovery are most critical. Operating costs are moderately significant and changes in capital costs are secondary. A change of 10% in the price of zinc creates a difference of $4,182,500 or 12.4% in the annual operating profit in the early years of operation. A price change of 10% in all metals creates a change of $6,510,000 or 19.4% in the annual operating profit. A change of 5% in the recovery of zinc creates a difference of $2,100,000 or 6.2% in the annual operating profit in the initial period.

It is apparent that the price of metals is the most sensitive factor in the operation and, insofar as current metal prices are depressed below historical levels in relation to labour and other costs, a favourable effect on the estimated earnings may be reasonably anticipated.

REGISTERED PROFESSIONAL ENGINEER
G. M. HOGG
PROVINCE OF ONTARIO

G. M. Hogg, P. Eng.

Toronto, Ontario
April 6, 1976

INTRODUCTION

This report is prepared at the request of Canadian Natural Resources Limited in order to present a factual assessment of the economic potential of the Grum lead-zinc-silver deposit and other properties in the Faro area of the Yukon Territory in which this Company holds an interest. At this time Canadian Natural Resources Limited holds a 40% participating interest in the Grum deposit.

On the Grum deposit approximately 120,000 ft. of surface drilling has been completed, a decline driven into the mineralized zones, and at present exploration drifts are being extended to the northwest and southeast with exploratory underground drilling in progress. Underground headings are being driven in such configuration and size as will be required for production purposes, and the closely spaced underground drilling on 200 ft. sections is of a development nature as well as for exploratory purposes. Management of the project is by Kerr Addison Mines Limited with overall direction provided by a Management Committee comprised of representatives of Canadian Natural Resources Limited and Kerr Addison Mines Limited.

Metallurgical research and testing is presently in progress and is being carried on by Lakefield Research and the Noranda Mines group. The environmental aspects of the project and power supply are under study by Montreal Engineering Limited. Considerable research into methods and costs of production and marketing has been completed by Kerr Addison Mines Limited, but this is necessarily of a highly preliminary nature at this time.

During 1975 a drilling and underground test programme on the Grum deposit was approved by the principals in the amount of $6.25 million. This programme has since been enlarged to the $9.2 million level and is scheduled for completion by June 30, 1976. Until completion of this programme no precise estimates can be made as to production schedules, methods, or costs. However, enough information is available at this time on which to base an opinion as to economic viability.

A previous study (July 31, 1975) of the deposit was completed by Dr. C. E. Michener, P. Eng., of Derry, Michener & Booth of Toronto. In that report a mineral reserve for the Grum deposit was prepared by Mr. I. S. Thompson, P. Eng., of that same firm and also included were a review of estimated capital and operating costs by Mr. J. S. Redpath, P. Eng., of

J. S. Redpath Limited, and a review of metallurgical and marketing data available by Mr. R. P. Ehrlich, P. Eng., of Canadian Bechtel Limited. This material has been reviewed and updated by the writer, and insofar as comments by Messrs. Redpath and Ehrlich are in essence still valid have been included with this report as Appendices D and E respectively. A recalculation of Mineral Reserves by the writer is included as Appendix C.

A forecast of profitability is included based on estimated capital and operating costs in 1976 dollars. No attempt has been made to escalate costs to start-up date nor to forecast changes in metal prices in the exercise, and its inclusion is simply as an indicator of potential profitability. A production rate of 5000 tons per day for a 10 year period is assumed at present drill-indicated grades. Federal income taxes and Yukon royalty have been applied to the cash flow for calculation of net profit and present value at a discount factor of 10%.

DESCRIPTION OF PROPERTIES

Canadian Natural Resources Limited, as successor to AEX Minerals Corporation, retains a 40% interest in 87 claims comprising approximately 3295 acres held by Kerr Addison Mines Limited in the Faro area of the Yukon Territory. These claims are located in 3 non-contiguous groups as indicated in Appendix A to this report.

The Grum group, which includes the Grum deposit, is comprised of 17 claims which have been brought to lease. The Swim claims, located approximately 6 miles south of the Grum deposit, include 63 unsurveyed claims which surround but do not include the Kerr Addison Swim Lake deposit. A third group of 7 unsurveyed claims is located on the southeast boundary of and contiguous with the Vangorda Mines Ltd. property.

Canadian Natural Resources, as successor to AEX Minerals Corporation, also holds an option on 13 surveyed and 30 unsurveyed claims in the Faro area of the Yukon Territory from Vangorda Mines Ltd. These claims are contiguous with the Grum group to the southeast and surround but do not include the Vangorda deposit. It is notable that a portion of the Grum mineralized zone does extend onto the northwest portion of this group.

These claims are held in good standing under the laws relevant to claim tenure in the Yukon Territory, and the terms and conditions specified in the Canadian Natural Resources-Vangorda Mines option to this stage have been fully met by Canadian Natural Resources Limited.

ACCESSIBILITY AND TOPOGRAPHY

The Faro area is located 120 miles northeast of Whitehorse, lying just east of the Pelly River. The area is mountainous, forming part of the Anvil Range. In the immediate area of the Grum deposit Mount Nye is the highest peak with an elevation of 6763 ft., rising from the Pelly River elevation of approximately 2500 ft. Local relief in the deposit areas is about 1000 ft. and the area is well wooded to an elevation of about 4000 ft.

The area is presently accessible by road from Whitehorse via Carmacks and via Ross River. The all-weather road via Carmacks is used to haul concentrates from the Anvil Mine at Faro to the White Pass Railway at Whitehorse, a distance of about 240 miles.

The Town of Faro, built to house employees at the Anvil Mine, has a population of 1500. The Anvil Mine lies about 6 miles north of the town, and the Grum deposit about 4 miles east. The Grum deposit and the Swim Lakes area to the southeast are accessible by road. There is a gravel airstrip suitable for small aircraft a mile west of the Town of Faro.

HISTORY

In 1953 the Vangorda deposit was discovered in the area and acquired by Prospectors Airways Ltd. It was drilled in following years and an estimated 9.4 million tons of sulphide material, grading 3.16% Pb, 4.69% Zn, 0.27% Cu, 1.76 oz./ton Ag, and 0.02 oz./ton Au, was indicated. In 1962 Kerr Addison Mines Limited acquired control of this deposit, now held by Vangorda Mines Ltd., and carried on additional exploration in the area. In 1964 the Swim Lake deposit was located and tested with an indicated 6 million tons of sulphide material, grading 9.5% combined lead-zinc and 1.5 oz./ton Ag. In 1965 the Anvil deposit was located and subsequent drilling proved 67.4 million tons of sulphide material, grading 3.4% Pb, 5.7% Zn, and 1.20 oz./ton Ag. Development and construction of the Town of Faro was started shortly thereafter, and production from the Anvil Mine commenced in 1969 on an open pit basis. Present production from the Anvil Mine is approximately 10,000 tons per day.

In 1973 the AEX Syndicate optioned certain claims from Kerr Addison Mines Limited and Vangorda Mines Ltd. in the Vangorda-Swim Lakes area. Drilling on the Grum group in that year yielded a 19 ft. intersection of good grade lead-zinc mineralization at a depth of 656 ft., and subsequent drilling proved the existence of an extensive zone of sulphide mineralization on the claim group. Since 1974 Kerr Addison Mines Limited and the AEX Syndicate and its successors have participated in exploration and development of this sulphide zone on a 60-40% basis respectively.

In early 1976 Canadian Natural Resources Limited was incorporated and acquired the 40% position of the original AEX Syndicate.

GEOLOGY

The oldest rocks in the vicinity of Faro are identified as Cambrian to early Ordovician in age. They include calcareous phyllites, sericitic phyllites, chloritic phyllites, carbonaceous phyllites, and all combinations thereof. They strike northeasterly and dip to the southwest in the general sense, but have been highly folded and contorted by thrusting from the northeast and by lateral movement related to northwesterly faulting of considerable magnitude. These rocks are host to the Anvil-Vangorda lead-zinc-silver deposits.

Overlying these rocks to the southwest, and probably in fault contact with them, are argillaceous and tuffaceous cherts and basalts of Pennsylvanian age.

Intrusive into the Cambrian rocks on the northeast is the Anvil batholith. This is a Cretaceous intrusive mass ranging in composition from a granodiorite to a quartz monzonite. It is sometimes porphyritic in character.

Structurally the Anvil batholith occupies the Anvil arch or dome to the northeast of Faro. The Grum deposit area is thus bounded by this intrusive mass on the northeast and the Tintina Trench on the southwest. This "trench", occupying the bed of the Pelly River, is a large and complex fault system which can be traced in a northwesterly direction for over 600 miles. 250 miles of right lateral displacement has been postulated, and movement has taken place from Cretaceous to Tertiary times. Subsidiary faulting parallel to and at right angles to the Tintina system is common in the region.

Mineralization in the Anvil-Vangorda area consists of stratiform zones of pyrite, sphalerite, galena and minor chalcopyrite generally situated in the broad contact zone between major units of sericitic phyllite and graphitic phyllite. In the case of the Grum deposit this interface area between underlying sericite phyllite and overlying graphitic phyllite includes chloritic members, and it is of course characterized by alternating or interfingering bands of graphite-rich and sericite-rich material. Overlying this sequence, and in evidence in the northernmost portion of the known deposit area, is a calcareous-chlorite-sericite phyllite.

The sulphide bearing structure of the Grum deposit is a northwesterly striking overturned fold system (overturned or recumbent to the southwest) along which pyrite, sphalerite, and galena occur in folds as zones with a roughly cigar-shaped configuration. Tabular sulphide zones on fold limbs and possibly along fault planes are present. Generally strong silicification is present with the major sulphide mineralization along with barite, minor pyrrhotite, chalcopyrite, magnetite, and rarely, arsenopyrite. The sulphide zones and the controlling fold structures plunge at about 10° to the northwest. The mineralized zones are of complex configuration.

Strike faulting is present both parallel to the plane of folding and with a steep dip to the southwest. Cross-faulting is also present, but there does not seem to be any major offsetting involved in the areas explored thus far at least.

Broad open cross-folding with axes trending southwesterly is present but this feature is not well documented in the Grum deposit area as yet.

To the northeast of the known Grum deposit area, in the vicinity of the Firth prospect, the Anvil granodiorite occurs. The south contact of the intrusive appears to dip to the southeast and underlies the formations which host the sulphide mineralization. The development of biotite, staurolite, and garnet is noted in the phyllitic rocks in proximity to the intrusive. Notably these metamorphic derivatives occur below the central part of the Grum zones at a depth of about 1000 ft.

MINERAL RESERVES

General

The Grum deposit consists of several zones of lead-zinc sulphide mineralization with accompanying silver and low gold values. The mineralization occurs in phyllites with an apparent dip of about 25° SW. The mineralized zones appear to plunge at approximately 10° to the northwest and vary from a few feet to over 100 ft. in thickness.

During 1974 and 1975 approximately 125 surface holes were drilled at roughly 200 ft. centres over an area 3000 ft. in length and 1800 ft. in width. A decline has been driven into the central portion of the deposit area and is presently being extended on four headings to the northwest and southeast with underground drilling on a closely spaced pattern being carried on concurrently. Very widely spaced exploratory drilling has been done up to 2000 ft. northwest of the main deposit area and significant mineralization is present. The deposit also extends southeasterly onto the Vangorda Mines property and its extent at this time is unknown.

Because the mineralization occurs in multiple strata-bound zones folded in a complex manner, it is difficult to estimate tonnage and grade or formulate mining plans with any degree of certainty even with surface drill data on 200 ft. centres. For this reason the developers have been justifiably reticent to quote tonnage and grade figures in anything but gross terms, and only with detailed underground drilling in progress is a clear picture of sulphide zone configuration beginning to emerge.

For purposes of this report all reserves are drill-indicated. It may be noted also that all assay work was done by Whitehorse Assay Laboratories with periodic check work by Loring Laboratories of Vancouver. The writer is satisfied with the accuracy of the analytical data.

Estimates, Surface Drill Data

Included in this report is a tonnage and grade estimate prepared by the writer. It is done on an empirical basis with no effort being made to incorporate any interpretive data. The estimate is made extending drill intersections in regular blocks 1/2 the distance to the next drill hole on longitudinal sections on a 10°N plunge (see Appendix C), and 100 ft. in each direction from the intersection on cross-section. The calculation includes the area from sections 62W to 82W (2000 ft. length), from 1S to 11N (1200 ft. width), and from surface to the 3400 ft. level (vertical range of 800 ft.). The area is shown in drawing no. 2 included in Appendix C and is referred to as the primary mining area. At a 4% combined lead-zinc cut-off and a minimum 10 ft. sulphide zone thickness, the estimated drill-indicated tonnage and grade in this area is:-

<u>21,390,500 tons at 6.51% Zn, 3.98% Pb, 1.77 oz./ton Ag</u>.

During 1975, without the benefit of later drill data, I. S. Thompson of Derry, Michener & Booth completed a tonnage and grade estimate on the Grum sulphide zone between sections 63W and 81W (1800 ft. length), between 1S and 7N (800 ft. width), and from surface to the 3400 ft. level. Longitudinal sections were used and the various sulphide blocks were outlined by joining intersections in the various drill holes. At a 4% combined lead-zinc cut-off and a 10 ft. minimum sulphide zone thickness, this calculation yielded the following results:-

<u>14,808,575 tons at 6.80% Zn, 4.14% Pb, 1.93 oz./ton Ag</u>.

Limiting the width of the estimation area from 1S to 7N (800 ft. width) in the writer's calculation for comparative purposes, the result is as follows:-

16,418,250 tons at 6.73% Zn, 4.10% Pb, 1.83 oz./ton Ag.

This is an excellent correlation considering the fact that the methods used are somewhat different and that additional data is incorporated into the writer's estimate.

Estimates, Underground Data

During early 1976 as underground access became available, underground drilling from the decline commenced. Twenty-five holes were completed on the 72W sections and drilling is presently in progress on the 74W section. Results are available from the 72W area and are shown on the 72W section (1" to 100') included with this report. Preliminary data on the 74W section drilling confirms the sulphide zone configuration and grade indicated on the 72W section and most importantly indicates longitudinal continuity of excellent grade mineralization.

The included 72W section itself illustrates clearly the limitations of the surface drilling data in the estimation of tonnage and grade of the Grum deposit. In detail the mineralized zones are essentially fold controlled and variable in attitude. Further, there is a considerable increase in grade in evidence. This is a most important feature since at this time it appears that initial mining of very high grade material (+14% Pb-Zn combined) may be possible if desired.

A preliminary tonnage and grade estimate has been prepared for the 72W section as indicated on the included 72W cross-section and in Appendix C. Variable grade cut-off levels can be used producing areas of mineable dimensions at varying grades. Extending the zones 100 ft. to each side of the 72W sections and using the 10% combined lead-zinc cut-off, the drill-indicated tonnage and grade developed is as follows:-

1,321,000 tons at 8.58% Zn, 5.29% Pb, 2.33 oz./ton Ag.

For comparative purposes the 4% combined lead-zinc cut-off tonnage and grade figure for the same area calculated on surface drill data alone is as follows:-

2,975,500 tons at 6.26% Zn, 3.82% Pb, 1.73 oz./ton Ag.

Mineable Reserve Estimates

For purposes of an economic forecast of a preliminary nature it is felt that the writer's tonnage and grade estimate is satisfactory for use as an indicator as to the viability of the deposit (21,390,500 tons at 6.51% Zn, 3.98% Pb, 1.77 oz./ton Ag).

The Canadian Mine Services 1974 mining plan suggests that a 10% dilution factor be applied at 84% recovery. The writer has accordingly modified the tonnage and grade estimate for the primary mining area with a 10% dilution factor of 2% Zn, 1% Pb and 0.2 oz./ton Ag to an 84% recovery. The adjusted tonnage and grade on a mineable reserve basis is then as follows:-

19,764,822 tons at 6.10% Zn, 3.71% Pb, 1.63 oz./ton Ag.

Also for purposes of a rate of return calculation, it appears that selective mining of higher grade material would be possible for the initial production period. Using the 10% cut-off grade figures for the 72W section and applying a 10% dilution factor of 3% Zn, 2% Pb and 0.5 oz./ton Ag, the adjusted reserve figure applied to the section 68W to 82W area on a straight projection basis from section 72W would be as follows:-

10,171,700 tons at 8.07% Zn, 4.99% Pb, 2.16 oz./ton Ag.

It will be noted that a portion of the sulphide material included in the primary mining area lies close to surface and from an underground mining point of view should be left as a crown pillar. This material could possibly be recovered by open pit methods however, but a detailed study of this approach remains to be done. Accordingly no adjustment has been applied to the mineable reserve estimate figures as developed herein.

GRADE CONTROL

Recent underground work has indicated the Grum mineralized zones to be possibly more regular from a mining point of view than previously expected. However, close and accurate mining with tight fill will be required particularly near the boundaries of sulphide zones. The enclosing rocks are of a relatively incompetent nature and if adequate care is not taken could certainly produce excessive dilution conditions.

It has been noted in the section on Mineral Reserves that to develop a mining reserve a 10% dilution factor of material grading 2.0% Zn, 1.0% Pb and 0.2 oz./ton Ag has been applied to the general reserve figure. Further, a high grade reserve has been developed for the initial mining period, and a 10% dilution factor of material, grading 3.0% Zn, 2.0% Pb, and 0.5 oz./ton Ag, has been applied to this.

METALLURGICAL RECOVERY

Bench tests in 1974 by Noranda's Ore Dressing Laboratory on Grum drill core, assaying 3.55% Pb and 4.14% Zn, showed that separate lead and zinc concentrates could be achieved. The final lead concentrate assayed 53% Pb and 7.4% Zn with a recovery of 77.9% for lead. The final zinc concentrate assayed 51.8% Zn and 3.5% Pb with a recovery of 77.3% of the zinc. The heads were not assayed for silver; however, 23.84 oz./ton Ag reported in the lead concentrate.

Bechtel feel that the above recoveries are conservative and that recoveries will improve with (1) commercial operations; and (2) treatment of higher grade material approaching diluted mine grade of 10.5% Pb+Zn. In addition, Dowa, a Japanese smelter company, has reported to Kerr recently that recoveries of 90%+ for both lead and zinc were achieved on Vangorda ore, which is reported to be similar to Grum ore.

A chemical analysis of the lead and zinc concentrates by the Noranda Ore Dressing Laboratory, dated January, 1975, follows:-

	Pb Conc.	Zn Conc.
Ag	23.840 oz./ton	3.360 oz./ton
Pb	53.600%	3.520%
Zn	7.400%	51.600%
Cu	0.300%	0.220%
As	0.600%	0.050%
Cd	0.017%	0.051%
Fe	7.700%	7.400%
S	19.400%	30.800%
SiO_2	4.600%	1.600%
Bi	0.009%	0.008%
Sb	0.198%	0.022%
CaO	0.400%	0.420%
Al_2O_3	0.510%	0.230%
Au	0.170 oz./ton	0.002 oz./ton
MgO	0.170%	0.150%
Pyrite	13.920%	3.440%
Pyrrhotite	1.850%	8.850%
Pb as oxides	0.980%	0.430%
Zn as oxides	0.130%	0.340%
Hg	46.400 ppm	416.000 ppm

Bechtel report that provision should be made for more accurate determinations of mercury content in the zinc concentrate since for some smelters this proportion is beyond the allowable limit and penalties may be assessed. Since the tests are preliminary, however, we have not applied any discount factor for mercury.

At the present time metallurgical test work is being emphasized by Kerr Addison Mines using drill core samples from underground holes for the most part. There is no doubt that the Grum sulphide material is metallurgically difficult essentially because of a fine intergrowth of the sphalerite, galena, and pyrite which are the major sulphide minerals present. The Anvil ores and material from the Vangorda Mines sulphide deposit exhibit similar characteristics.

For the purpose of this study we have used recoveries and concentrate grades approximating the better metallurgical test results on samples from the Vangorda deposit. This seems a reasonable approach but it must be appreciated that there is little documentation to support their application. The figures used are as follows:-

	Concentrate Grade	Recovery
Pb	52%	78%
Zn	55%	87%
Ag	18.5 oz./ton	80%

MINING CONCEPT AND ESTIMATED COSTS

The mining plan proposed by Canadian Mine Services Ltd. is schematic at present and may be modified as more information becomes available on the configuration of mineralization and rock competence. It is basically a room and pillar concept using cut and fill methods to avoid excessive dilution. Hoisting will be through a six compartment vertical shaft which will be sunk to a 1500 ft. depth and linked to a service access ramp on the 3400 ft. level (levels are related to elevation above sea level with ground surface approximately 4200 ft. a.s.l.). The shaft would be located on section 84W and the service access ramp driven down the plunge of the mineralized zone to intercept at the 3400 ft. level. Primary crushing facilities would be located at the shaft location below the 3400 ft. level and this level would of course initially serve as the main haulage level.

The stoping method proposed is a horizontal undercut and cement-sand fill with pillars 20 ft. by 20 ft. on a regular pattern. Stope width is estimated at 40 ft. with extraction at 84% and dilution assessed at 10% by Canadian Mines Services Ltd. (see Grade Control section). Assuming a representative block of ore 45 ft. thick, it would be mined by means of a horizontal undercut 15 ft. in height, sand fill, and two subsequent horizontal slices and fill of the same thickness.

Stoping operations would be completely mechanized. A typical operating unit could consist of two twin boom jumbo drills (probably electric powered), an 8 yard load-haul dump unit, a rock bolt jumbo equipped with a drill boom and an operator's basket, and a blaster's service truck. Auxilliary equipment would include personnel vehicles, a road maintenance grader, and a mobile shot-crete unit.

Estimated mining operating costs as prepared by Canadian Mine Services Ltd. and J. S. Redpath Ltd. are shown in Table I as follows (estimates in 1975 dollars):-

Table 1

MINING COSTS AT 5000 T.P.D.

	Cost/ton CMS Report (1974)	Cost/ton Redpath Revision (1975)
Production Drilling	$ 0.59	$ 0.95*
Production Blasting	0.36	0.36
Production Explosives	0.55	0.55
Mucking	0.48	0.96*
Rockbolting	0.68	1.09*
Screening or Shot-Crete	0.10	0.10
Waste Handling	0.75	0.75
Backfill	0.50	0.50
Haulage	0.16	0.20
Primary Crushing	0.25	0.25
Hoisting	0.20	0.20
Power	0.50	0.83*
Ventilation & Mine Heat	0.23	0.23
Pumping	0.05	0.05
Surface Labour	0.26	0.28
General Administration	1.50	1.08
Cost/ton hoisted	$ 7.16	$ 8.38

* - The higher Redpath estimate assumes a lower productivity with consequent increased manpower, increase in number of stoping areas, and a resulting increase in power consumption.

For the purpose of this report the mining operating cost developed by J. S. Redpath Ltd. is used ($8.38/ton). In terms of 1976 dollars a 10% inflationary factor has been added for a total estimated cost of ($8.38 + $0.84) $9.22/ton.

MILLING AND SURFACE OPERATING COST ESTIMATES

Kilborn Engineering Ltd. have estimated the capital and operating costs of the surface plant including an allowance for townsite maintenance. J. S. Redpath revised these estimates on review paying particular attention to the possibility of duplication or omission of certain costs between the earlier estimates of surface and underground operating costs. The comparison is shown in Table 2 as follows:-

Table 2

OPERATING COST - MILL AND SURFACE PLANT AT 5000 T.P.D.

	Kilborn (Cost/Ton)	Redpath Revised (Cost/Ton)
Administration Labour	$ 0.064	$ 0.101
Surface Maintenance Labour	0.250	0.308
Concentrator & Assay Lab. Labour	0.444	0.502
Engineering and Geology Labour	0.144	0.230
Surface Maintenance Supplies	0.286	0.286
Concentrator & Assay Lab. Supplies	2.253	2.253
Engineering & Geology Supplies	0.023	0.023
Electrical	1.248	1.248
General Expense	-	0.506*
Total cost/ton milled	$ 4.712	$ 5.457

* - Redpath allowance of $0.506/ton in general costs include a cafeteria subsidy of $0.40/ton which is regarded as a contingency factor and difficult to assess at this stage.

In spite of the fact that costs are difficult to estimate at this time, it seems justifiable to accept the higher figure for Mill and Surface Plant operating costs. In terms of 1976 dollars the J. S. Redpath figure of $5.457/ton becomes ($5.457 + 0.546) $6.003/ton.

Canadian Bechtel, in a review of the Kilborn cost estimates, have indicated that an allowance should be made for head office management fees and for possibly higher labour and fuel costs. This substantiates the acceptance of the higher estimate indicated by the more detailed Redpath study.

The difficulty in providing cost estimates at this stage is well illustrated by the very recent advice to Cyprus-Anvil by the Northern Canada Power Commission that the power rates to the Anvil Mine are to be increased by 60%. This has prompted action on the part of Cyprus-Anvil to investigate the possibility of constructing a coal-fired generating plant (coal supplied from the Carmacks area) for power in which the Grum deposit developers could likely participate. A very general assessment of this possibility indicates it to be a distinctly viable alternative to purchasing power from the Commission. At this time, however, there are no realistic figures available on which to modify the estimates as given.

It may also be noted that metallurgical studies may suggest downward modification of the Concentrator and Assay Laboratory Supplies figure of $2.253 as shown in Table 2.

MARKETING, TREATMENT AND TRANSPORTATION COSTS

At the present time metal prices are low relative to general costs, and metal inventories remain high. As of the end of March, 1976 the price of zinc was 37¢/lb., the price of lead 20¢/lb., and silver remained at $4.05/oz. These figures are used to determine the present value of metals contained in the Grum sulphide deposit.

Treatment charges are escalating and variable depending on the location of sale concentrate. For purposes of this study the following net smelter return values are used:-

	Market Price	Treatment Charge	Net Smelter Return Value
Lead	$ 0.20/lb.	$ 0.14/lb.	$ 0.06/lb.
Zinc	0.37/lb.	0.20/lb.	0.17/lb.
Silver	4.05/oz.	0.20/oz. (5% value)	3.85/oz.

In addition to the above metals, gold is present in the Grum sulphide material and is recoverable from lead concentrate. Historically the Anvil recovery is $20.00/ton of lead concentrate, and the same value will be applied in this study of the Grum deposit.

Assuming concentrates are sold F.O.B. Skagway and truck haulage from the concentrator to the Whitehorse Rail terminal remains necessary for the forseeable future, transportation and market costs are estimated as follows:-

Truck Transport - Concentrator to Whitehorse	$ 14.00
Rail Transport - Whitehorse to Skagway	8.25
Dockside Handling, Storage	1.75
Product Insurance, Sales	1.00
Estimated Total/S.D.T. Concentrate	$ 25.00*

Since one ton of ore will produce 218.2 lbs. or 0.11 tons of concentrate (see Metallurgical Recovery section) the shipping cost per ton of ore equates to $2.75/ton.

* - This figure does not include any estimate for transportation cost from Skagway to smelter facility.

ESTIMATED OPERATING COST SUMMARY

As noted in the foregoing sections on Mining Concept and Estimated Costs, Milling and Surface Operating Cost Estimates, and Marketing, Treatment and Transportation Costs, it is felt that operating cost figures have been developed in terms of 1976 dollars which give a reasonably accurate picture of operating costs under present conditions. To summarize, these are as follows:-

Mining Cost	$ 9.22/ton
Milling & Surface Operating Cost	6.00/ton
Transportation & Marketing Cost	2.75/ton
Total	$ 17.97/ton

ESTIMATED CAPITAL COSTS

The capital cost estimates for both underground and surface plant have been developed in terms of 1976 dollars on the basis of estimates prepared in 1975. No provision in the subsequent rate of return exercise has been made for escalation to startup date. This is felt to be a reasonable approach since no date has been set for production, and this will, of course, have an important bearing on both capital costs and especially metal prices. Both these items are unknown quantities when viewed in terms of an approximate three year preproduction development and construction period. It is felt that perhaps the most rapid period of capital cost escalation has passed.

Mining Capital Costs

Table 3 overleaf shows a comparison between capital costs for mining at 3000 t.p.d. by Canadian Mine Services Ltd. (1974 estimate), a revision of this 3000 t.p.d. estimate by J. S. Redpath Limited (1975 revision), and an up-graded estimate for a 5000 t.p.d. operation by the same firm (1975). As in the J. S. Redpath figures in the section on mining operating costs, the basic increase in estimated capital costs for the

Table 3

CAPITAL COSTS - MINING

	3,000 tons CMS Estimate	3,000 tons J. S. Redpath	5,000 tons J. S. Redpath
Summary:			
Mining Equipment	$ 1,470,000.00	$ 1,822,000.00 *	$ 2,469,000.00
Track haulage equipment	799,000.00	799,000.00	919,000.00
Primary ventilation & mine heat	100,000.00	250,000.00	300,000.00
	$ 2,369,000.00	$ 2,871,000.00 *	$ 3,688,000.00
Mine Development:			
Track haûlage	$ 1,270,000.00	$ 1,270,000.00	$ 1,620,000.00
Access decline-incline	1,024,000.00	1,458,000.00	1,630,000.00
Cross-cut access to ore	684,000.00	684,000.00	1,026,000.00
Ore pass system	581,000.00	842,000.00	1,263,000.00
Sand fill bore-holes	50,000.00	100,000.00	150,000.00
Ground & water control	300,000.00	300,000.00	300,000.00
	$ 3,909,000.00	$ 4,654,000.00	$ 5,989,000.00
Production Shaft (1300'):			
Mobilization	$ 21,000.00	$ 21,000.00	$ 21,000.00
Sinking & installation materials	1,450,000.00	1,450,000.00	1,450,000.00
Collar construction	30,000.00	100,000.00	100,000.00
Equipment for production	255,000.00	255,000.00	255,000.00
Ground & water control	274,000.00	274,000.00	274,000.00
	$ 2,030,000.00	$ 2,100,000.00	$ 2,100,000.00
Crusher & Ancilliary Equipment:			
Excavation - ore bins	$ 80,000.00	$ 160,000.00	$ 160,000.00
- crusher battery, etc.	266,000.00	266,000.00	266,000.00
Equipment purchase & installation	1,111,000.00	1,111,000.00	1,111,000.00
Shotcrete & rockbolt	120,000.00	120,000.00	120,000.00
	$ 1,577,000.00	$ 1,657,000.00	$ 1,657,000.00
	$ 9,885,000.00	$11,282,000.00 *	$13,434,000.00
Management - 20 %	1,977,000.00	2,256,400.00 *	2,687,000.00
ESTIMATED CAPITAL COST	$11,862,000.00	$13,538,400.00 *	$16,121,000.00

* - Addition error Redpath p. 13

3000 t.p.d. operation in Table 3 reflects an additional allowance for lower productivity per man shift and a resulting increase in underground staff and equipment.

In subsequent calculations we have accepted and used the Redpath estimate for a 5000 t.p.d. underground operation and have applied a 10% escalation factor to bring the total figure from $16,121,000 to $17,733,100.

Surface Plant Capital Costs

The capital cost estimates by Kilborn Engineering, later reviewed by Redpath, are both very preliminary, order-of-magnitude estimates and, therefore, caution should be exercised in extrapolation of such estimates. The Kilborn original estimate for a 3000 t.p.d. operation was "mocked up" from their cost data prepared previously for the Mattagami Lake Mines' plant (3000 t.p.d.). Their estimate for a 5000 t.p.d. operation was "factored up" from this estimate and is $63,238,723.

Redpath have added a further $3,596,000 to this estimate to arrive at a total capital cost of $66,834,723. This increase is mainly related to an allowance for additional housing units; however, it is thought that much of the housing could be arranged by separate financing and should not be included in preliminary estimates.

On the other hand, Redpath note that an allowance should be made for an additional $3,000,000 capital to cover the cost of a transmission line and for more working capital. It is felt that these factors cancel eath other so we have used the $66,834,723 figure escalated by a factor of 10% to a total of $73,518,195 in 1976 dollars.

The total capital cost for underground and surface operations on the Grum deposit is therefore $91,251,295 at a 5000 t.p.d. rate. This data is included in the following summary of the economic parameters.

SUMMARY OF ECONOMIC PARAMETERS

As pointed out in the section on Mineral Reserves there is a definite possibility that for the first several years of operation a much higher grade production may be maintained than the general reserve calculation figures indicate. For this reason two cases are given herein for the net smelter return, and the Case 2 figures are used for the first 5.8 years of operation in the following Rate of Return Calculation (Table 4) at a 1,750,000 t.p.y. production rate.

Case 1

Net Smelter Return

Metal	Head Grade	X	Recovery	X	lb./ton	X	Smelter Return	=	$/ton
Lead	3.71%		0.78		2000		$0.06/lb.		3.47
Zinc	6.10%		0.87		2000		$0.17/lb.		18.04
Silver	1.63 oz./t.		0.80		-		$3.85/oz.		5.02
Gold	($20.00/ton lead concentrate=$2.00/ton of ore)								2.00
									$28.53

Case 2

Net Smelter Return

Metal	Head Grade	X	Recovery	X	lb./ton	X	Smelter Return	=	$/ton
Lead	4.99%		0.78		2000		$0.06/lb.		4.67
Zinc	8.07%		0.87		2000		$0.17/lb.		23.87
Silver	2.16/oz./t.		0.80		-		$3.85/oz.		6.65
Gold	($20.00/ton lead concentrate=$2.00/ton of ore)								2.00
									$37.19

Operating Cost (1976 Dollars)

Mining (including Administration)	$ 9.22/ton
Milling (including Administration)	6.00/ton
Transportation & Marketing (F.O.B.Skagway)	2.75/ton
Total	$17.97/ton

Operating Profit (1976 Dollars)

Case 1 Net Smelter Return	$28.53/ton
Operating Cost	17.97/ton
Profit	$10.56/ton
Case 2 Net Smelter Return	$37.19/ton
Operating Cost	17.97/ton
Profit	$19.22/ton

Capital Costs (1976 Dollars)

Surface Plant	$73,518,195.00
Underground	17,733,100.00
Total	$91,251,295.00

Table 4

GRUM DEPOSIT

ESTIMATED RATE OF RETURN - $000's
(over 10 year operating period at 1,750,000 t.p.y.)

Year	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Operating Profit (before interest and taxes)	-	-	-	33,635	33,635	33,635	33,635	33,635	30,604	18,480	18,480	18,480	18,480	272,699 X
Interest Charges (10%)*	684	3,033	7,215	10,218	8,071	5,769	3,301	647	-	-	-	-	-	38,938
Yukon Royalty**	-	-	-	471	1,076	1,715	2,321	2,893	3,122	2,014	2,088	2,144	2,199	20,043
Income Tax**	-	-	-	-	-	-	-	3,532	7,376	4,546	4,712	6,098	6,117	32,381
Cash Flow From Operations	-	-	-	22,946	24,488	26,151	28,013	26,563	20,106	11,920	11,680	10,238	10,164	192,269
Capital Requirements+	13,688	31,938	45,626	1,470***	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	14,700
Cumulative Debt Received (Repaid)#	14,372	49,343	102,184	(21,476)	(23,018)	(24,681)	(26,543)	(6,466)	-	-	-	-	-	(102,184)#
Cash Flow Available For Distribution After Capital and Debt Requirements****	-	-	-	-	-	-	-	18,627	18,636	10,450	10,210	8,768	8,694	75,385
P.V. (10% discount) of Future Cash Flow Available For Distribution at 3 Years Before Production For Successive Years ****	29,514	32,465	35,712	39,283	43,211	47,532	52,285	57,514	44,637	30,464	23,060	15,156	7,904	

* - Assumed capital borrowed in mid-year.
** - Basic calculation as per existing regulations.
*** - Taken as 2% or surface plant and equipment.
**** - Canadian Natural Resources interest is 40% of cash flow and present value figure.
\+ - Excludes estimated exploration expenditure of $9.2 million to June 30, 1976. Total preproduction cost is $91,252,000: 15% req. Yr.-3; 35% req. Yr.-2; 50% req. Yr.-1.
\# - Includes capitalized preproduction interest.
X - A fifteen year operation would add $92,400,000 to the operating profit.

Metal Prices: Lead - $0.20/lb.; Zinc - $0.37/lb.; Silver $4.05/oz.

ESTIMATED RATE OF RETURN ON CAPITAL INVESTMENT OF $102,184,000 IN 10 YEARS = 34.9%..

SENSITIVITY ANALYSIS

The following tabulation indicates the effect on operating profit of stated changes in variable factors. They are listed in descending order of sensitivity.

Variable	Change of	Change in Value for Ton of Ore Milled (Case 2)	Change in Annual Operating Profit at 1.75 m.t.p.y.
Price of All Metals	±10%	$ 3.72	$ 6,510,000
- Price of Zinc	±10%	2.39	4,182,500
- Price of Silver	±10%	0.66	1,155,000
- Price of Lead	±10%	0.47	822,500
- Price of Gold	±10%	0.20	350,000
Recovery of all Metals	±5%	1.98	3,465,000
- Recovery of Zinc	±5%	1.20	2,100,000
- Recovery of Silver	±5%	0.44	770,000
- Recovery of Lead	±5%	0.24	420,000
- Recovery of Gold	±5%	0.10	175,000
Operating Cost	±10%	1.92	3,360,000
Capital Cost	±10%	-	1,605,600*

* - Assuming increase spread over an 8 year forecast payback period.

OTHER PROPERTIES

As noted, Canadian Natural Resources holds a 40% participating interest in additional claims adjoining the Vangorda Mines property on the south, and in the Swim Lakes area. At present there are no significant indications of the presence of sulphide deposits on these properties, but they warrant careful attention in the future, particularly in regard to sulphide concentrations at depth.

On the Vangorda Mines claims which adjoin the Grum claims on the south some good grade sulphide intersections have been obtained in the Champ Zone area and in the area just south of Doal Lake (see included Property Map). These zones represent the southerly extension of the Grum deposit and they have not been fully delimited. On the projection of the Grum zone into the Vangorda-Doal Lake area the writer has estimated, on the same basis as the included Mineral Reserve Estimate on the Grum deposit, 622,000 tons of sulphide material, grading 5.14% Pb, 5.88% Zn, and 1.95 oz./ton Ag, to occur.

CONCLUSIONS

(1) The Grum deposit is an extensive one carrying excellent values in lead, zinc and silver. The writer's tonnage and grade estimate, based on surface drill data, is accepted as the most representative available at this time since all surface drill data is incorporated into its development. Estimates by I. S. Thompson, P. Eng., and the writer check satisfactorily. The accepted reserve, for purposes of this report, is 21,390,500 tons at 3.98% lead, 6.51% zinc and 1.77 oz./ton silver. This reserve is drill-indicated.

(2) The primary mining area for which reserves are estimated is 2000 ft. in length, 1200 ft. in width and approximately 800 ft. in depth. Significant mineralization, as shown by exploratory drilling, extends over an area 4800 ft. in length, 1200 ft. in width, and to a depth of at least 1600 ft. in the northern portion. This area includes the primary mining area and it may be noted that this primary mining area represents only about one third of the known potential ore bearing zone. It appears certain that in addition to the extension of the mining operation for many years past the 10 year operating period considered in this report, it is likely that the extraction of higher grade material can be maintained for a considerably longer period than estimated in this study.

(3) Recent underground exploration has indicated a general up-grading of metal content, continuity of sulphide zones adequate for underground mining purposes, and that selective mining of higher grade zones (12%-15% combined lead-zinc) will likely be possible. Underground exploration is continuing.

(4) Although the host rocks are phyllitic in character and thus relatively incompetent, experience to date indicates that with care underground mining operations are definitely feasible on this deposit.

(5) Metallurgically the Grum sulphide material is complex and because of the difficulty in obtaining samples to this time, test work has been only of a preliminary nature. Intensive test work is presently in progress.

(6) The present programme of underground exploration, metallurgical testing, cost studies, and environmental studies will be completed by June 30, 1976 at an estimated cost of $9.2 million. At that time more detailed and accurate conclusions as to the means of exploitation of the deposit and the costs involved can be drawn.

(7) At this time updated preliminary operating and capital cost estimates balanced against estimated production indicate a profitable mining operation is possible at a 5000 ton per day rate. Payback of a capital requirement of $91,252,000 is estimated in five years at this production rate.

(8) The financial analysis is highly sensitive to variations in metal prices in particular. It is felt that metal prices are unrealistically low relative to present general cost levels.

(9) Other properties in the area in which Canadian Natural Resources has earned a 40% interest or are held under option warrant additional exploration.

In view of the foregoing comments and on the basis of present knowledge of the Grum deposit, it is the writer's opinion that the present exploration programme on the deposit is fully justified and that in all probability early development will be warranted.

Respectfully Submitted,

G. M. Hogg, P. Eng.

REGISTERED PROFESSIONAL ENGINEER
G. M. HOGG
PROVINCE OF ONTARIO

Toronto, Ontario
April 6, 1976

APPENDIX A

Appendix A

LISTING OF CLAIMS HELD BY KERR ADDISON MINES LIMITED IN WHICH CANADIAN NATURAL RESOURCES LIMITED HAS EARNED A 40% OWNERSHIP

Grum Claims (Leased)

Grum 1-3 incl., 5	
Chuck 1 and 2, 5-8 incl.	
Firth 6 and 8	
Hank 4-8 incl. (fractions)	Total - 17

South Vangorda Claims (Unsurveyed)

Mac 1 and 2	
Tim 1-3 incl., 6 and 7	Total - 7

Swim Claims (Unsurveyed)

Swim 1-7 incl.	
Swim 9 and 11	
Swim 13-22 incl.	
Swim 29-72 incl.	Total - 63

GRAND TOTAL - 87

APPENDIX B

Appendix B

LISTING OF CLAIMS HELD BY VANGORDA MINES LIMITED WHICH ARE UNDER OPTION TO CANADIAN NATURAL RESOURCES LIMITED

Leased Claims

Rocky 3, 5, 7, 8
Champ 3, 4, 5, 6
Bix 2, 3
Ellemay 3
Hank 2, 3, (fractions) — Total - 13

Unsurveyed Claims

Sally 1-4 incl.
Alice 1-8 incl.
Ellemay 4
Wynne 4, 6, 8
Rocky 1
Jack 1-5 incl.
Champ 1, 2, 7, 8
HIW 1-4 incl. (internal fractions) — Total - 30

GRAND TOTAL - 43

APPENDIX C

Appendix C

TONNAGE AND GRADE ESTIMATE
GRUM DEPOSIT

In this estimate for the Grum deposit the approach adopted was a purely empirical one based on surface drilling results. No interpretive factors are considered and the area of influence of each included drill intersection is simply taken at 100 ft. in each direction at the indicated thickness and grade. Reserves quoted are drill-indicated only.

Because underground drilling is presently in progress and at a preliminary stage, it was felt that an interpretive estimate, although more accurate, would serve no useful purpose at this time. This is particularly true as to grade as on the basis of underground drilling results to this time it is clear that a substantial increase in grade is in prospect (see cross section 72W included with this report). This up-grading is not an unreasonable expectation since surface drilling on 200 ft. centres on a deposit of this size and configuration will statistically cut a number of areas peripheral to strongly mineralized zones and would exercise a depressing effect on grade.

It should be emphasized too that this estimate is limited to the area between sections 62W and 82W (2000 ft.) for comparative purposes with previous estimates, and the reserves on Vangorda Mines Limited claims to the south are shown separately. There is no doubt that substantially more sulphide material of excellent grade exists in extensions of the Grum deposit. This estimate then is useful as a check on previous estimates, and the comparative results are discussed in the section on Mineral Reserves in this report.

The parameters used in this estimate are as follows:-

Tonnage Factor	-	8 cu. ft./ton
Minimum Mining Width	-	9.2 ft.
Area of Estimate*	-	(1) section 62W-82W from 15 to 11N
		(2) section 62W-82W from 15 to 7N
Maximum Depth	-	3400 ft. level (800 ft. approx.)
Cut-off Grade	-	4% Pb-Zn combined

* - Limited by the Grum-Vangorda Mines Limited property boundary on the south.

The development of the various estimates used by the writer are shown in Tables I, II and III, and longitudinal sections L-00 to L-10N showing drill locations and blocks are appended. Underground drill data for section 72W is shown on cross-section 72W accompanying this report.

Table I

Grum Deposit Reserves
(Section 62W to 82W, 1S to 11N)

Longitudinal Section	Tons	% Zn	% Pb	oz./ton Ag
L-00	2,123,000	5.60	4.24	2.03
L-2N	5,547,500	7.46	4.63	2.10
L-4N	3,447,750	6.54	3.77	1.63
L-6N	5,300,000	6.55	3.69	1.60
L-8N	2,285,000	6.12	4.20	1.85
L-10N	2,687,250	5.49	3.06	1.31
Total	21,390,500	6.51	3.98	1.77

Grum Deposit Reserves
(Section 62W to 82W, 1S to 7N)

Longitudinal Section	Tons	% Zn	% Pb	oz./ton Ag
L-00	2,123,000	5.60	4.24	2.03
L-2N	5,547,500	7.46	4.63	2.10
L-4N	3,447,750	6.54	3.77	1.63
L-6N	5,300,000	6.55	3.69	1.60
Total	16,418,250	6.73	4.10	1.83

Table II

GRUM DEPOSIT RESERVES - SECTION 72W AREA
(Surface Drill Estimate, Section 71W to 73W, 1S to 7N, above 3400' Level)

Longitudinal Section	Tons	% Zn	% Pb	oz./ton Ag
L-00	378,500	4.96	4.52	1.90
L-2N	687,500	6.37	4.30	2.12
L-4N	544,500	7.63	4.37	1.97
L-6N	1,365,000	6.01	3.17	1.39
Total	2,975,500	6.26	3.82	1.73

GRUM DEPOSIT RESERVES - SECTION 72W AREA
(Underground and Surface Drill Estimate,
Section 71W to 73W, 1S to 7N, above 3400' Level)

	Tons	% Zn	% Pb	oz./ton Ag
* 10% Cut-off Grade (Avg. thickness 29.3')	1,321,000	8.58	5.29	2.33
12% Cut-off Grade (Avg. thickness 23.0')	973,200	9.04	5.75	2.53
15% Cut-off Grade (Avg. thickness 30.5')	343,200	9.37	6.08	2.70

* - Used in development of high grade tonnage for mining in initial years for Rate of Return Estimate.

Table III

GRUM EXTENSION RESERVES ON
VANGORDA MINES LTD. PROPERTY

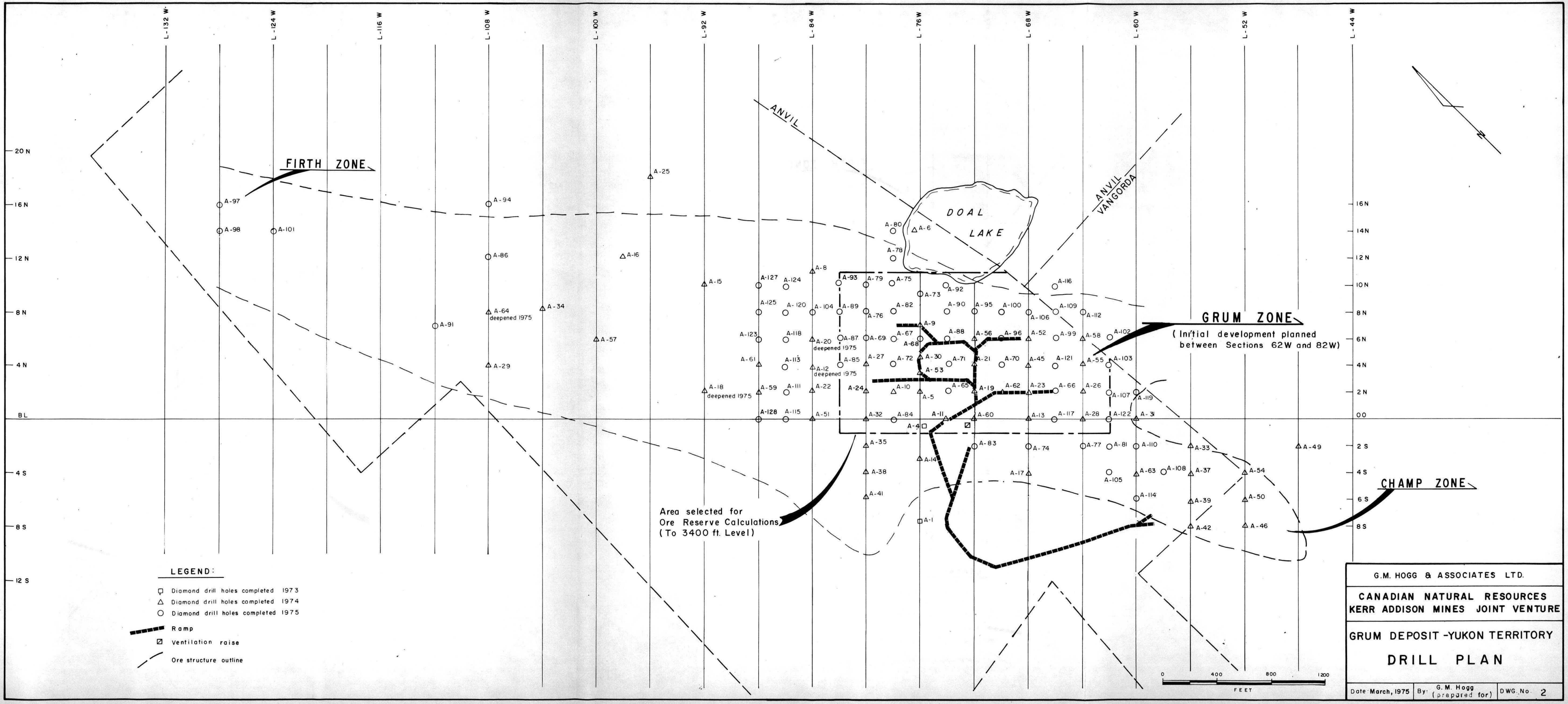
Longitudinal Section	Tons	% Zn	% Pb	oz./ton Ag
L-6N (Blocks V1, V2)	165,500	4.82	4.59	1.62
L-8N (Blocks V1, V2)	456,500	6.36	5.29	2.06
Total	622,000	5.95	5.11	1.95

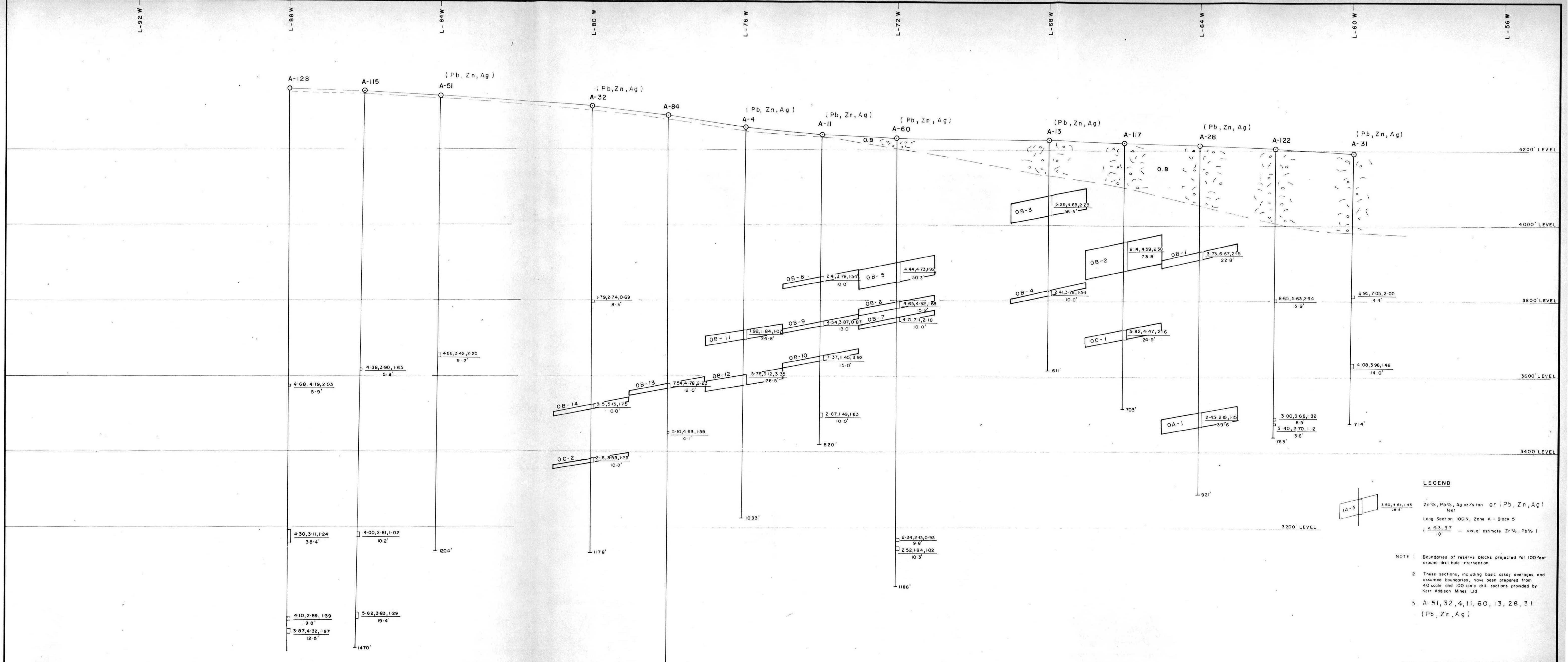
REGISTERED PROFESSIONAL ENGINEER
G. M. HOGG
PROVINCE OF ONTARIO

G. M. Hogg, P. Eng.

Toronto, Ontario
March 31, 1976

Leave extra for binding 1/4





LEGEND

Zn%, Pb%, Ag oz/s ton or (Pb, Zn, Ag)
feet

Long Section 100N, Zone A - Block 5

(V 6.3, 3.7 / 10' — Visual estimate Zn%, Pb%)

NOTE 1 Boundaries of reserve blocks projected for 100 feet around drill hole intersection

2 These sections, including basic assay averages and assumed boundaries, have been prepared from 40 scale and 100 scale drill sections provided by Kerr Addison Mines Ltd

3. A-51, 32, 4, 11, 60, 13, 28, 31 (Pb, Zr, Ag)

0 100 200 300
FEET

G.M. HOGG & ASSOCIATES LTD.

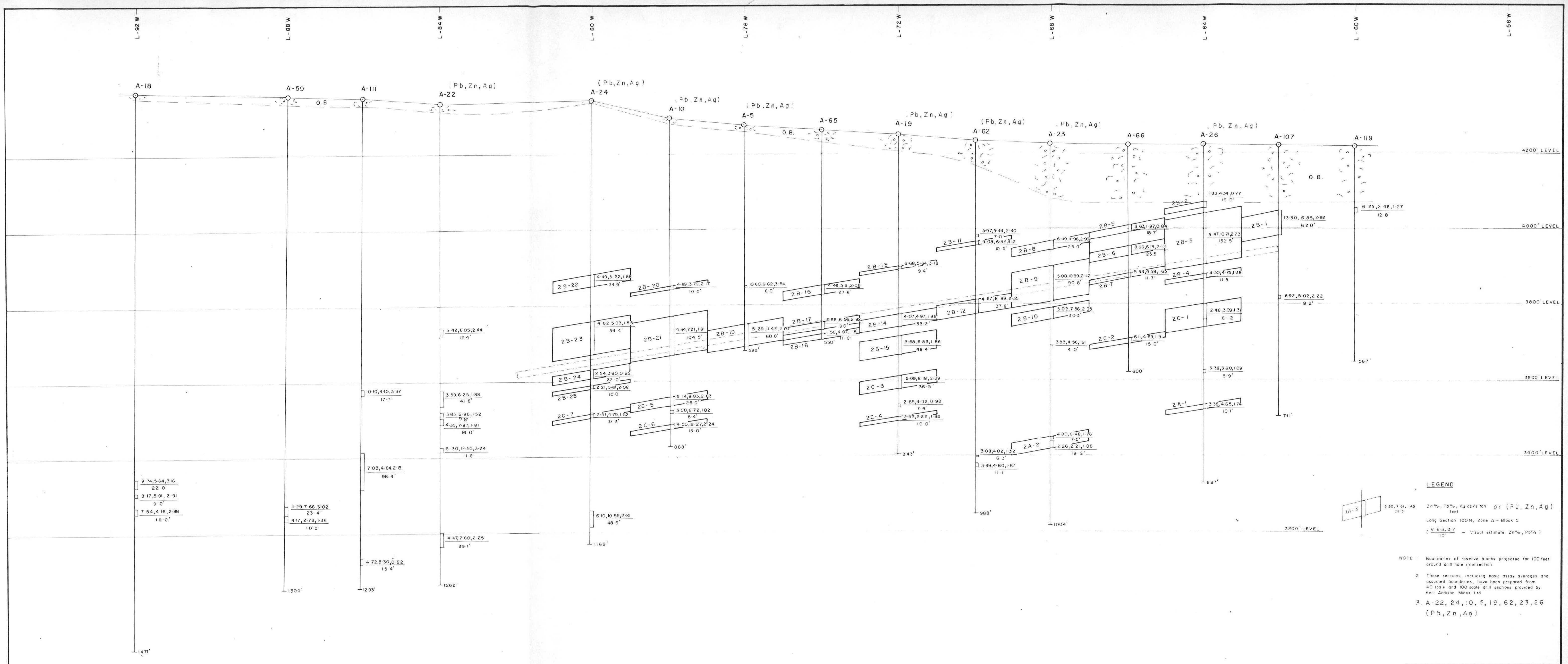
CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE

GRUM DEPOSIT
YUKON TERRITORY

LONGITUDINAL SECTION L-00
LOOKING NORTH

Date March, 1976	By (G. M. Hogg prepared for)	DWG No. 3

Leave extra for Binding 1 1/4"



LEGEND

1A-5 — 3.60, 4.61, 1.43 / 18.5 — Zn%, Pb%, Ag oz/s ton / feet — or (Pb, Zn, Ag)

Long Section 100N, Zone A – Block 5

(V 6.3, 3.7 / 10') – Visual estimate Zn%, Pb%

NOTE 1. Boundaries of reserve blocks projected for 100 feet around drill hole intersection.

2. These sections, including basic assay averages and assumed boundaries, have been prepared from 40 scale and 100 scale drill sections provided by Kerr Addison Mines Ltd.

3. A-22, 24, 10, 5, 19, 62, 23, 26 (Pb, Zn, Ag)

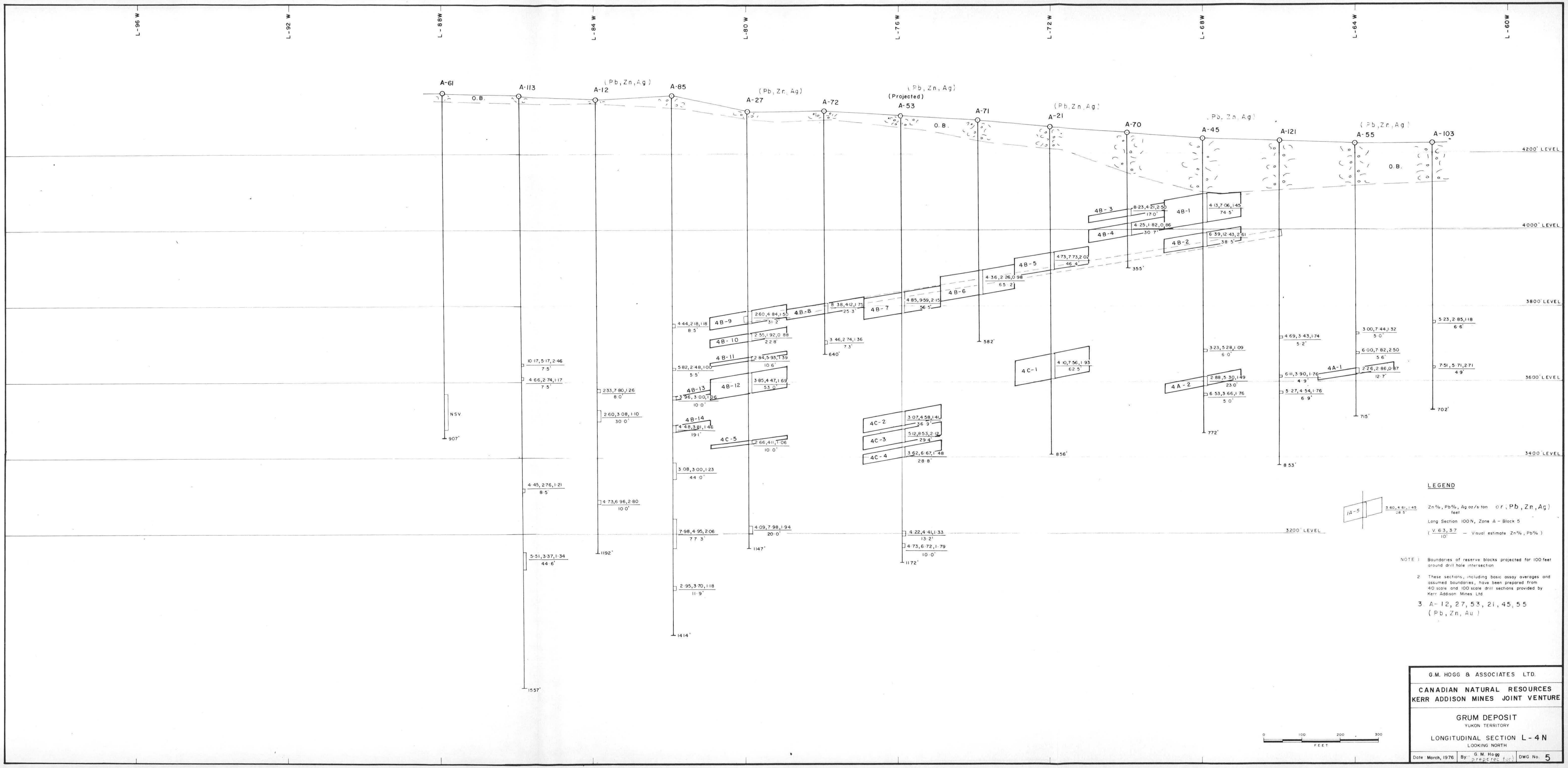
G.M. HOGG & ASSOCIATES LTD.

CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE

GRUM DEPOSIT
YUKON TERRITORY

LONGITUDINAL SECTION L-2N
LOOKING NORTH

Date March, 1976	By (G.M. Hogg / prepared for)	DWG No. 4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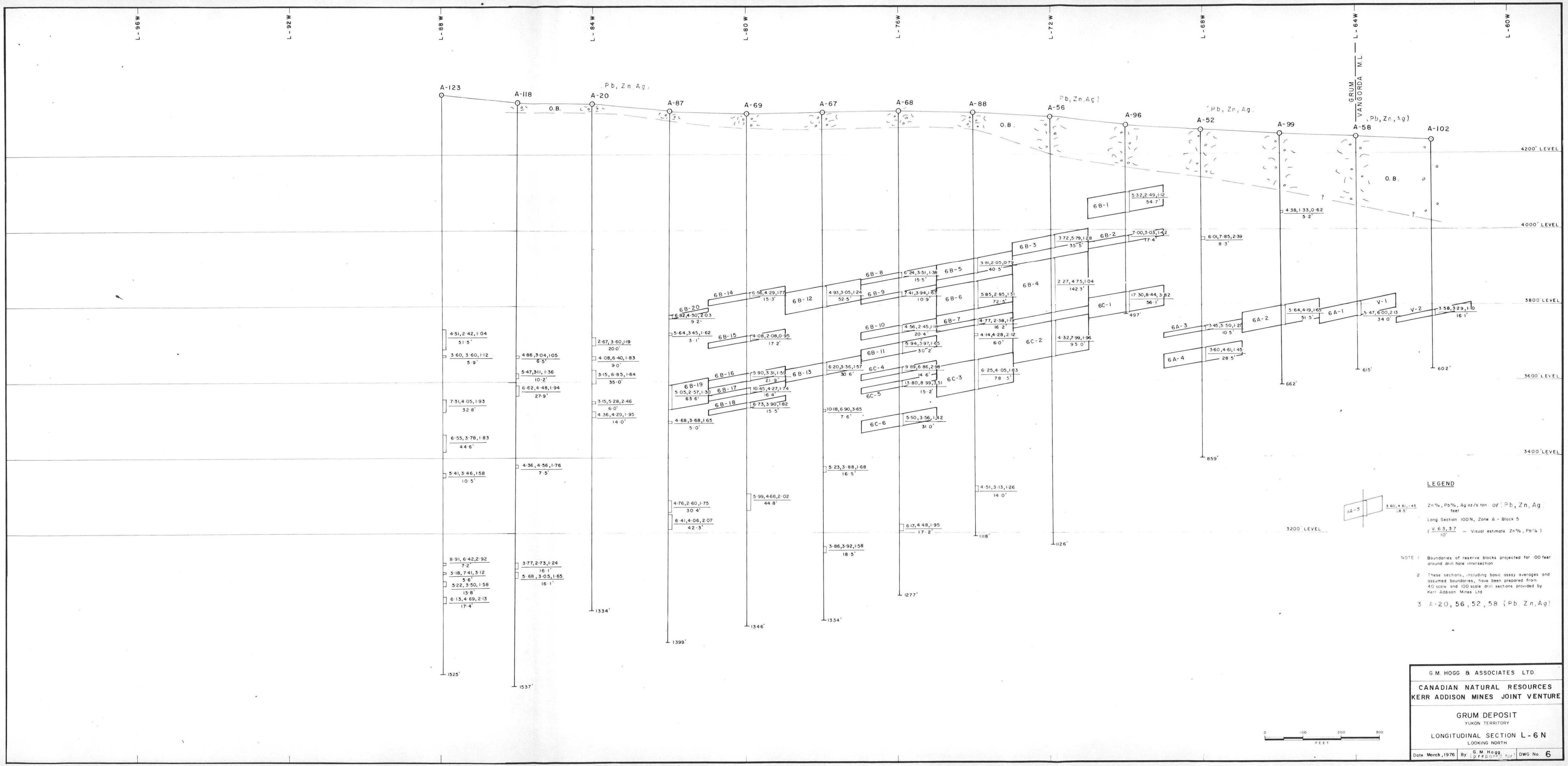
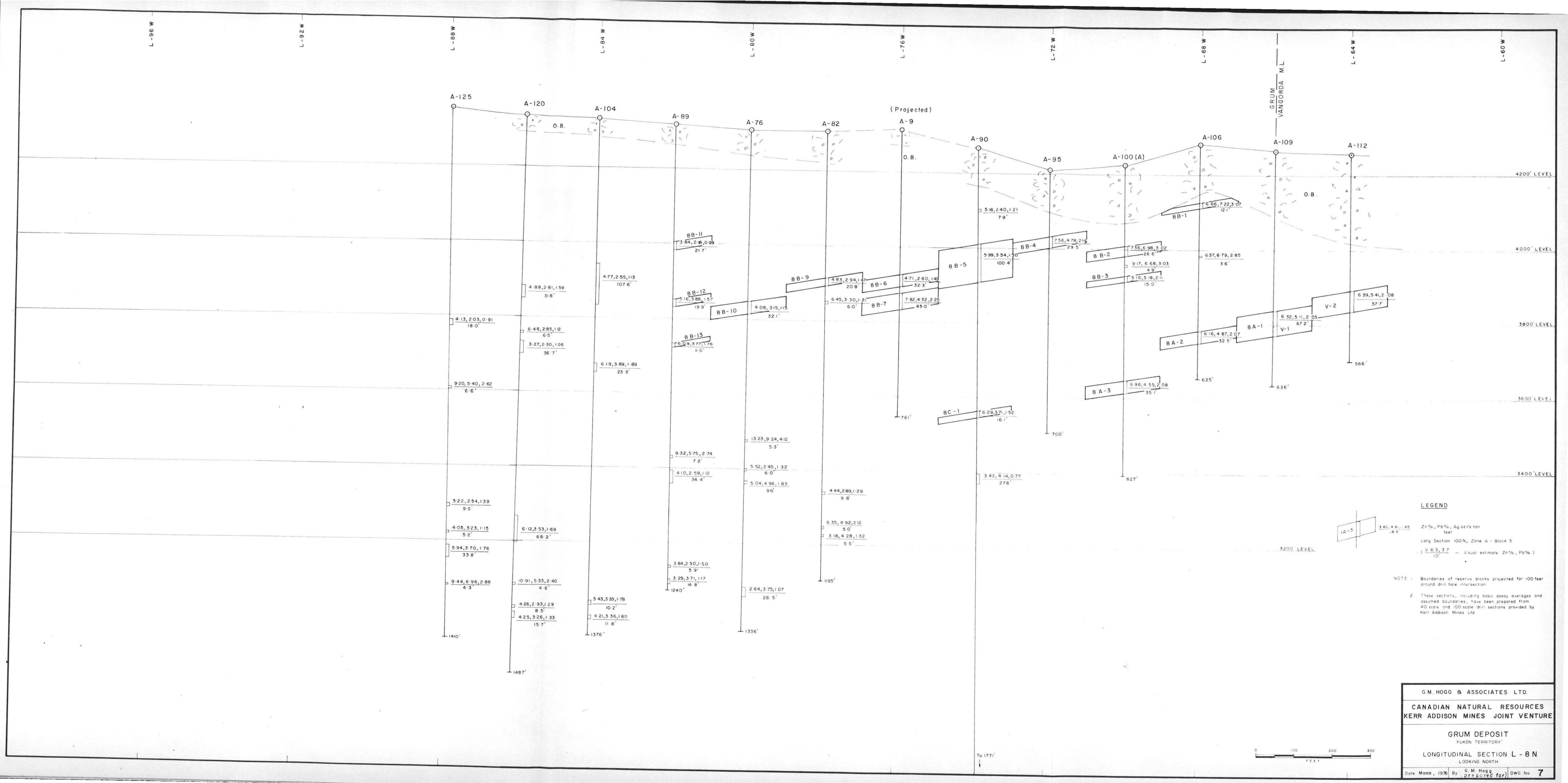
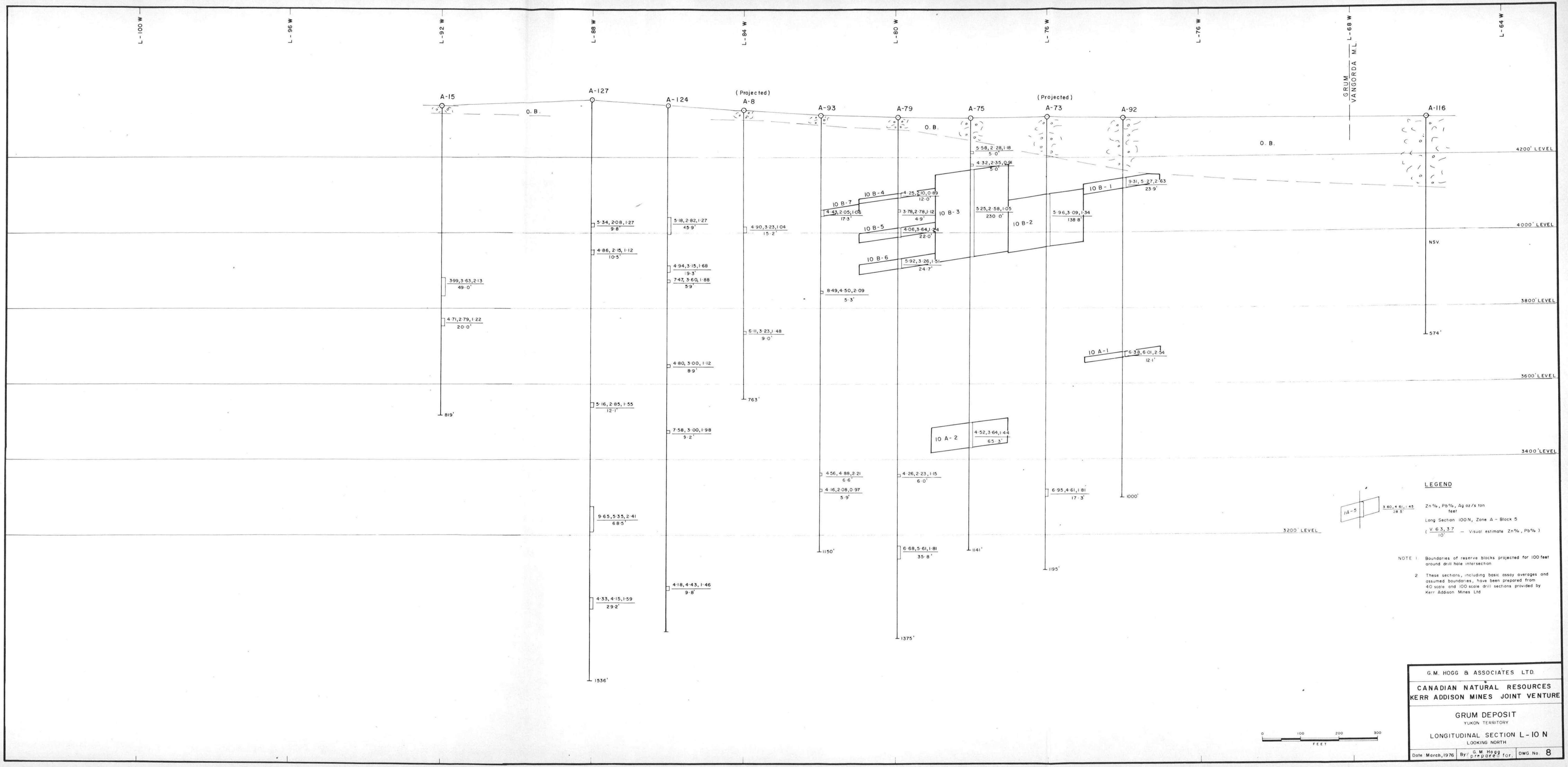
L-92 W
L-88W
L-84 W
L-80 W
L-76 W
L-72 W
L-68W
L-64 W
L-60W
A-61
A-113
(Pb, Zn, Ag)
A-12
A-85
(Pb, Zn, Ag)
A-27
A-72
(Pb, Zn, Ag)
(Projected)
A-53
A-71
(Pb, Zn, Ag)
A-21
A-70
(Pb, Zn, Ag)
A-45
A-121
(Pb, Zn, Ag)
A-55
A-103
O.B.
4200' LEVEL
4000' LEVEL
3800' LEVEL
3600' LEVEL
3400' LEVEL
3200' LEVEL
4B-1
4B-2
4B-3
4B-4
4B-5
4B-6
4B-7
4B-8
4B-9
4B-10
4B-11
4B-12
4B-13
4B-14
4C-1
4C-2
4C-3
4C-4
4C-5
4A-1
4A-2
NSV
907'
1557'
1192'
1414'
1147'
640'
1172'
582'
856'
355'
772'
853'
715'
702'
LEGEND
Zn%, Pb%, Ag oz/s ton or (Pb, Zn, Ag)
feet
Long Section 100N, Zone A - Block 5
(V. 6.3, 3.7 / 10' — Visual estimate Zn%, Pb%)
NOTE 1 Boundaries of reserve blocks projected for 100 feet around drill hole intersection
2 These sections, including basic assay averages and assumed boundaries, have been prepared from 40 scale and 100 scale drill sections provided by Kerr Addison Mines Ltd
3 A-12, 27, 53, 21, 45, 55
(Pb, Zn, Au)
0
100
200
300
FEET
G.M. HOGG & ASSOCIATES LTD.
CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE
GRUM DEPOSIT
YUKON TERRITORY
LONGITUDINAL SECTION L-4N
LOOKING NORTH
Date March, 1976
By: G. M. Hogg
DWG No. 5

Leave Extra for binding 1¼"




L-96 W
L-92 W
L-88 W
L-84 W
L-80 W
L-76 W
L-72 W
L-68 W
L-64 W
L-60 W
GRUM
VANGORDA M.L.
A-125
A-120
A-104
A-89
A-76
A-82
(Projected)
A-9
A-90
A-95
A-100 (A)
A-106
A-109
A-112
O.B.
4200' LEVEL
4000' LEVEL
3800' LEVEL
3600' LEVEL
3400' LEVEL
3200 LEVEL
8B-1
8B-2
8B-3
8B-4
8B-5
8B-6
8B-7
8B-9
8B-10
8B-11
8B-12
8B-13
8A-1
8A-2
8A-3
8C-1
V-1
V-2
1410'
1487'
1376'
1240'
1336'
1195'
761'
700'
827'
625'
626'
566'
To 1771'
LEGEND
Zn%, Pb%, Ag oz/s ton
feet
Long Section 100N, Zone A - Block 5
(V 6 3, 3 7 / 10' — Visual estimate Zn%, Pb%)
NOTE 1 Boundaries of reserve blocks projected for 100 feet around drill hole intersection
2 These sections, including basic assay averages and assumed boundaries, have been prepared from 40 scale and 100 scale drill sections provided by Kerr Addison Mines Ltd
0 100 200 300
FEET
G.M. HOGG & ASSOCIATES LTD.
CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE
GRUM DEPOSIT
YUKON TERRITORY
LONGITUDINAL SECTION L - 8 N
LOOKING NORTH
Date March, 1976
By G.M. Hogg (prepared for)
DWG No. 7

Leave Extra for Binding 1/4"



APPENDIX D

Bond Street N.
P. O. Box 810, North Bay, Ont.
P1B 8K1
Telephone: 705-474-2461
Telex: 027-76296

J. S. REDPATH LIMITED

MINING CONTRACTORS
CONSULTING ENGINEERS
PROJECT MANAGERS

26 June, 1975.

Mr. Ian Thompson,
Derry Michener & Booth,
401 Bay Street,
TORONTO, Ontario.

Dear Ian,

Attached you will find our report on the Grum Deposit.

Due to the lack of underground knowledge which will only be available when the underground exploration programme is complete, we feel that this estimate must be considered as an order of magnitude estimate at this time.

We sincerely hope the attached information will help you with your own report and should any questions arise in connection with this report, please do not hesitate to get in touch with either myself or Jim Proudfoot at this office.

Yours very truly,

J. S. REDPATH LIMITED.

J. S. Redpath, P.Eng.,
President.

JSR:mo
Att.

TABLE OF CONTENTS

INTRODUCTION:

This report was prepared at the request of Doctor Michener of Derry, Michener and Booth. The details regarding the report and the liaison with that firm was carried out with Mr. Ian Thompson.

The basic object of the report was to review a capital and operating cost estimate prepared by Canadian Mine Services Limited on the Grum Project in the Yukon Territory. Canadian Mine Services' report dealt particularly with a 3,000 ton per calendar day underground operation. This report was prepared in March, 1974.

In addition, we were requested to review a cost estimate prepared by Kilborn Engineering concerning the capital and operating costs for the surface facilities for the above operation. The object in reviewing the Kilborn estimate was basically to try to determine if there was any duplication between the underground and surface estimates or any areas where items might have been left out.

We were also asked to estimate the underground capital and operating costs for a 5,000 ton per calendar day operation.

This report was prepared using the following information provided by Derry Michener and Booth:

1. A report entitled,"A Grum Deposit - Programme for Continued Exploration and Confirmation of Ore Reserve Outlines", prepared by Kerr-Addison Mines Limited, Vancouver Office Staff in January, 1975.

2. A report entitled, "Kerr-Addison Mines Limited Grum Project - Yukon Territory, 3,000 ton per calendar day Underground Operation Cost Estimate", prepared by Canadian Mine Services Limited, March 26, 1975.

3. A report entitled, "Kerr-Addison Mines Limited - Grum Joint Venture, Capital and Operating Costs for 3,000 ton per day Surface Facilities", prepared by Kilborn Engineering Limited, April, 1975.

4. A report entitled, "Kerr-Addison Mines Limited - Grum Joint Venture, Capital and Operating Costs for a 5,000 ton per day Surface Facility", prepared by Kilborn Engineering, April, 1975.

5. A report entitled, "Kerr-Addison Mines Limited - Grum Project, Yukon Territory, 1975 Underground Excavation, 1975 Underground Diamond Drilling, 1975 Surface Diamond Drilling. Programme Plans and Cost Estimates", prepared by Canadian Mine Services, January 31, 1975.

Our report is based entirely on the information provided above and it should be noted that no site visit was made nor was there an opportunity to examine the drill cores or logs. Our opinion as to the anticipated ground conditions is based entirely on comments made in the Kerr-Addison report and on the fact that Canadian Mine Services think that tight cut and fill mining will be required. We have a very high regard for both of the foregoing named companies, and feel that their judgment in this area is good.

Our attached opinion of the cost estimates is our considered opinion of what costs will be at this time. We do not feel that it would be worthwhile carrying out a more detailed estimate at this time as the results of the underground programme being carried out should be obtained first. We endorse the underground programme being carried out for all the reasons put forth by Kerr-Addison Mines Limited.

ESTIMATING METHOD:

Both the Canadian Mine Services and Kilborn estimates have been reviewed to obtain a feel for the capital costs and operating parameters. Where required, items have been added or deleted from both capital and operating costs. The main change is one of labour increase due to reduced productivity. (See Appendix I - Kilborn Engineering).

The underground capital and operating costs have been revalued to reflect the lower productivity, the increased manpower, and the increased number of operating stopes to support both the 3,000 tons per day and the 5,000 tons per day operations (Appendix II - Canadian Mine Services).

COMPARISON WITH EXISTING OPERATIONS:

Please refer to Table I. In this Table, we have compared the Grum project as projected in the Canadian Mine Services report with other existing operations. This has been done to illustrate why we feel that the productivity as predicted in this report is on the high side.

TABLE I

		Nominal Tonnage/ day	Comp.Plant cfm	Installed H.P. Plant	Heating Plant
Strathcona	90% mech.C.&.F.	8,600 5 day 6,140 7 day	23,815	28,596	25,000,000 BTU
Madeleine	Blast hole	2,450	5,200	6,000	
Mattagami	Blast hole	3,800	12,300	17,000	
Geco	Blast hole & Fill Some C.&.F.	5,500	15,200	25,350	
Brunswick #12	90% mech. C.&.F.	6,700	14,900	50,000	
Grum Project (CMS)		"3,000"	"6,000"	"19,000"	

Labour	u/g staff	u/g stoping	u/g dev.	u/g haul & hoist	total u/g	Mill	Total	Total Employees
Strathcona	111	222	44	62	439	117	556	1,650**
Madeleine	20	26	30	19	95	53	148	-
Mattagami	17	89	36	25	167	61	228	449
Geco	46	115	58	39	258	122	380	625
Brunswick #12	87	365	66	47	565	183	748	1,450 *
Grum Project (CMS)	"15"	"46"	-	"14"	"75"	"44"	"119"	"189"

	Tons/man u/g	Tons/man mill	Tons/man Total u/g mill	Tons/man Total employees
Strathcona	13.9	61.5	11.04	5.87 **
Madeleine	25.8	46.2	16.55	N/A
Mattagami	22.8	62.3	16.66	8.46
Geco	19.4	41.0	13.15	8.00
Brunswick #12	11.8	36.6	8.95	6.79 *
Grum Project (CMS)	"40.0"	"68.0"	"25.2"	"16.04"

* 9,850 TPD #6, #12.

** Total West End 1,650 employees 9,700 tons/day

CONCLUSIONS:

The total capital for surface facilities and mine plant, excluding work in the 1975 programme is estimated at 67 million dollars at 3,000 tons per calendar day, excluding any cost for a transmission line and/or generating plant.

Operating and administration costs before depreciation, depletion and interest are estimated at $14.88 per ton at 3,000 tons milled per day.

Total manpower requirements are estimated to be 333 men for a productivity of 9 tons per manshift.

At a plant capacity of 5,000 tons per day, the total capital for surface facilities and underground mine plant, excluding work in the 1975 programme, is estimated to be 83 million dollars, excluding any costs for a transmission line and/or generating plant.

Operating and administration costs before depreciation, depletion and interest are estimated to be $13.84 per ton at 5,000 tons milled per day.

Total manpower at 5,000 tons per day is estimated to be 500 men for an overall productivity of 10 tons per manshift.

Estimated start-up costs appear to be low in the Kilborn report. We would estimate that they could be as high as $1,000,000 but we expect this would be covered in the area "Contingencies" by anyone doing a full feasibility report.

All quoted capital and operating costs are in current (May, 1975) dollars. No provision has been made for escalation to start up date.

With the foregoing estimated operating costs, we feel that the cut-off grade of 4 per cent combined metals is on the low side. We assume that a revised cut-off grade will be calculated when the information is available from the underground exploration programme. This is a key figure as it has a direct bearing on the risk factor involved in going to a higher tonnage operation as compared to a lower tonnage operation. (We acknowledge here that the cut-off grade is affected directly by the prevailing market prices of the metals concerned).

TABLE II

TOTAL AFTER 1975 PROGRAM

Revised

	MILLING	
	3,000 TPD	5,000 TPD
Capital		
Transmission Line or Generating Plant	Additional ± 2,000,000	Additional ± 2,000,000
Start-Up	Additional ± 1,000,000	Additional ± 1,000,000
Surface	53,951,200	66,834,723
Mine	13,752,000	16,121,000
	$67,703,200	$82,955,723
Operating		
Mine/Ton	$ 7.410	$ 7.300
Mill	4.985	4.596
Administration	2.482	1.940
Total/Ton	14.877	13.836
Manpower	333	500
TPDay/Man	9.0	10.0

KILBORN ESTIMATE

	3,000 TPD	5,000 TPD	
Capital	51,250,200	63,238,723	
Add			±2,000,000
Transmission & Generator	N/A	N/A	
3 Cy. Loader	80,000	80,000	
Cage, Hoist & Conveyance	350,000	350,000	
Additional Compressor Plant	150,000	250,000	
Additional Housing Units	2,310,000	3,155,000	
Less			
Shaft Conveyance included twice	(114,000)	(114,000)	
Start-Up	N/A	N/A	±1,000,000
Revised Capital	54,026,200	66,959,723	
Operating Cost	5.015/ton	4.712	
Revised	5.967/ton	5.457/ton	
Additional	0.952/ton	0.745/ton	

KILBORN

OPERATING COSTS (REVISED)

	3,000 TPD		5,000 TPD	
Administration Labour	141,000	0.134	177,159	0.101
Surface Maintenance Labour	507,638	0.483	539,441	0.308
Concentrator Labour	847,561	0.807	878,083	0.502
Engineering & Geology	240,671	0.229	403,045	0.230
Surface Main Supplies	448,022	0.427	500,000	0.286
Concentrator Supplies	2,331,187	2.220	3,942,310	2.253
Engineering & Geology	30,000	0.029	40,000	0.023
Electrical	1,100,000	1.048	2,183,680	1.248
General Expense (Add)	620,000	0.590	885,000	0.506
		5.967/ton		5.457/ton

	3,000		5,000	
Administration Labour				
	4		7	
Add 4 Security	4		4	
		8		11
Surface Maintenance	19		26	
Add Machinist	1		-	
Welder	1		-	
Helpers	2		2	
Carpenter	2		1	
Electricians	2		3	
		27		32
Concentrater	44		46	
Shifters	4		4	
Crusher Helpers	2		2	
		50		52
Engineering & Geology	9		15	
Grade Control	4		6	
Samplers	2		3	
		15		24
Surface Maintenance Supplies	N/C		N/C	
Concentrater	2,394,187			
Dryer $\frac{400}{700}$	(63,000)		N/C	
	2,331,187			
General Expense	445,000		575,000	
Additional Travel	40,000		40,000	
Insurance ½%/yr.	130,000		145,000	
Cafeteria Subsidy	450,000		700,000	
	1,065,000		1,460,000	

Administration Labour

Calculation (Example)

Revised Labour	8
Kilborn	4
$\frac{8}{4} \times 7050 =$	141,018

CAPITAL COSTS

	3,000 tons CMS estimate	3,000 Revised	5,000 Upgraded
Summary:			
Mining Equipment	1,470,000.00	2,000,000.00	2,469,000.00
Track Haulage equipment	799,000.00	799,000.00	919,000.00
Primary Ventilation & Mine Heat	100,000.00	250,000.00	300,000.00
	2,369,000.00	3,049,000.00	3,688,000.00
Mine Development:			
Track Haulage	1,270,000.00	1,270,000.00	1,620,000.00
Access Decline-Incline	1,024,000.00	1,458,000.00	1,630,000.00
Cross-Cut Access to Ore	684,000.00	684,000.00	1,026,000.00
Ore Pass System	581,000.00	842,000.00	1,263,000.00
Sand Fill Bore-Holes	50,000.00	100,000.00	150,000.00
Ground & Water control	300,000.00	300,000.00	300,000.00
	3,909,000.00	4,654,000.00	5,989,000.00
Production Shaft (1300'):			
Mobilization	21,000.00	21,000.00	21,000.00
Sinking & Installation materials	1,450,000.00	1,450,000.00	1,450,000.00
Collar construction	30,000.00	100,000.00	100,000.00
Equip. for production	255,000.00	255,000.00	255,000.00
Ground & Water control	274,000.00	274,000.00	274,000.00
	2,030,000.00	2,100,000.00	2,100,000.00
Crusher & Ancilliary Equipment:			
Excavation - Ore Bins	80,000.00	160,000.00	160,000.00
- Crusher battery,etc.	266,000.00	266,000.00	266,000.00
Equipment Purchase & Installation	1,111,000.00	1,111,000.00	1,111,000.00
Shotcrete & Rockbolt	120,000.00	120,000.00	120,000.00
	1,577,000.00	1,657,000.00	1,657,000.00
	9,885,000.00	11,460,000.00	13,434,000.00
Management - say 20%	1,977,000.00	2,292,000.00	2,687,000.00
ESTIMATED CAPITAL COST	$11,862,000.00	$13,752,600.00	$16,121,000.00

APPENDIX II

J.S. REDPATH LIMITED

MINING EQUIPMENT

		3,000 tons CMS Estimate		Revised 3,000 tons		Upgraded 5,000 tons
Three (3) only Production Drill Jumbo	2 boom	219,000.00	3 boom (5)	450,000.00	(6)	540,000.00
Two (2) only Rock Bolt Jumbo		166,000.00	(2)	166,000.00	(3)	249,000.00
Three (3) only 8-yd.Loader		399,000.00	(5)	665,000.00	(6)	798,000.00
Two (2) only 5-yd. Loader		182,000.00	(2)	182,000.00	(2)	182,000.00
One (1) only Mine Grader		65,000.00	(1)	64,000.00	(1)	65,000.00
Three (3) only 18 man Carriers		159,000.00	(3)	159,000.00	(4)	212,000.00
Three (3) only 3 man Carriers		42,000.00	(3)	420,000.00	(4)	56,000.00
One (1) only Shotcrete outfit		120,000.00	(1)	120,000.00	(1)	120,000.00
One (1) only Blasters Vehicle		40,000.00	(1)	40,000.00	(2)	80,000.00
Fifteen (15) Secondary Ventilation Fans		45,000.00	(20)	60,000.00	(30)	90,000.00
Twenty (20) Jacklegs & Stopers		18,000.00	(20)	36,000.00	(30)	54,000.00
200 Mine Lamps		15,000.00	(200)	15,000.00	(300)	23,000.00
		1,470,000.00		2,000,000.00		2,469,000.00
TRACK HAULAGE EQUIPMENT						
Haulage locomotive - Trolley		168,000.00		168,000.00		168,000.00
Trolley Electrics		141,000.00		141,000.00		141,000.00
Mine Cars & Dump Facilities		250,000.00		250,000.00		250,000.00
Mine Chutes 8 @ $30,000		240,000.00		240,000.00		360,000.00
		799,000.00		799,000.00		919,000.00
PRIMARY VENTILATION						
Fans & Accessories (150,000 CFM)		50,000.00	(300,000 CFM)	150,000.00	(450,000 CFM)	200,000.00
Mine Air Heater (10,000,000 BTU/HR)		50,000.00		100,000.00		100,000.00
		100,000.00		250,000.00		300,000.00
		2,369,000.00		3,049,000.00		3,688,000.00

MINE DEVELOPMENT

	3,000 tons CMS estimate		3,000 Revised	5,000 Upgraded
Track Haulage 3400 level				
5980' x 10' x 12' @ 206.00	1,230,000.00		1,230,000.00	1,560,000.00
Miscellaneous Slash	40,000.00		40,000.00	60,000.00
	1,270,000.00		1,270,000.00	1,620,000.00
Access Decline-Incline				
4600' x 14' x 14' @ 217.00	1,000.000.00		1,434,000.00	1,600,000.00
Miscellaneous slash	24,000.00		24,000.00	30,000.00
	1,024,000.00		1,458,000.00	1,630,000.00
Cross-cut Access to Ore				
3670' x 14' x 14' @ 181.00	664,000.00		664,000.00	996,000.00
Miscellaneous Slash	20,000.00		20,000.00	30,000.00
	684,000.00		684,000.00	1,026,000.00
Ore Pass System				
2710' x 6' Diameter @ 122.00	331,000.00	@ 200'	542,000.00	813,000.00
2000 Mill-Hole Liner @ 125.00	250,000.00	150'	300,000.00	450,000.00
	581,000.00		842,000.00	1,263,000.00
Sand Fill Drill Holes	50,000.00		100,000.00	150,000.00
Provision for Grount & Water Control	300,000.00		300,000.00	300,000.00
	3,909,000.00		4,654,000.00	5,989,000.00

PRODUCTION SHAFT (1300')

	COST/FT		3,000 tons CMS estimate	3,000 Revised	5,000 Upgraded
Labour	345.00				
Rental-Shaft Sinking Equipment	34.00				
Consumable items	69.00				
Muck Disposal	9.00				
Freight	6.00				
Insurance & Communication	5.00				
Installation Materials	227.00				
Power	200.00				
Amount - 1300' @	895.00	=	1,450,000.00	1,450,000.00	1,450,000.00
Mobilization			21,000.00	21,000.00	21,000.00
Construct Concrete Collar			30,000.00	100.000.00	100,000.00
Equip Shaft:					
2 skips @ 32,000.00 =	64,000.00				
1 cage	35,000.00				
1 counterweight	10,000.00				
1 loading station	75,000.00				
control system	35,000.00				
freight	16,000.00				
installation labour	20,000.00				
			255,000.00	255,000.00	255,000.00
Provision for water & ground control:					
One (1) month labour	71,000.00				
One (1) month rental	7,800.00				
Rock Bolts & Shotcrete	150,000.00				
Power	45,800.00				
			274,600.00	274,600.00	274,600.00
			2,030,600.00	2,100,600.00	2,100,600.00

CRUSHER & ANCILLIARY EQUIPMENT

		3,000 tons CMS estimate	3,000 Revised	5,000 Upgraded
Excavation:				
Ore bins	16,000' @ 5.00	80,000.00	160,000.00	160,000.00
Crusher	165,000 @ 1.60	266,000.00	266,000.00	266,000.00
		346,000.00	426,000.00	426,000.00
Jaw Crusher	48" x 60"	300,000.00		
Concrete for crusher, bins, etc.		431,000.00		
Structure Steel		87,000.00		
Spares for Crusher		10,000.00		
Installations - Mechanical		58,000.00		
Electrical		20,000.00		
Feeders, crane, gates, liners, dust controls, etc.		196,000.00		
		1,111,000.00 *	1,111,000.00	1,111,000.00
Shot Crete & Rock Bolt		120,000.00	120,000.00	120,000.00
			1,657,000.00	1,657,000.00

* Original Error Addition $1,102,000.

Underground performance.

	CMS Report	Revised	Upgraded Tonnage
Mill tonnage/day	3,000	3,000	5,000
Mine tonnage/day	4,200	4,200	7,000
Operating stopes	4	7 + 3 filling	12 + 4 filling
Stope haul	600	600	600
Rockbolts/jumbo shift	40	40	40
/manshift	40	20	20
Feet broken/jumbo shift	577	577	577
/manshift	577	300	300
Tons broken/jumbo shift	750	750	750
/manshift	750	375	375
Tons handled/loader shift	750	375	375
Tons blasted/blaster shift	750	750	750
lbs. explosive/ton	0.67	0.67	0.67
Feet drilled/ton	0.77	0.77	0.77

Equipment

Drill jumbo 2 Boom	3	-	-
3 Boom	-	5	6
Rockbolt Jumbo	2	2	3
Loader 8yd.	3	5	6
Loader 5yd.	2	2	2
Grader	1	1	1
Blaster Vehicle	1	1	2
Shotcrete outfit	1	1	1
Vehicle 18 men	3	3	4
Vehicle 3 men	3	3	5

MINING COSTS

SUMMARY:

	Cost/ton CMS Report	Revised 3,000 TPD mill	Upgraded Revised 5,000 TPD mill
Production drilling	0.59	0.95	0.95
blasting	0.36	0.36	0.36
Explosives	0.55	0.55	0.55
Mucking	0.48	0.96	0.96
Rockbolting	0.68	1.09	1.09
Screening or shot-crete	0.10	0.10	0.10
Handling Waste (Inclusions etc.)	0.75	0.75	0.75
Backfill	0.50	0.50	0.50
Track Haulage	0.16	0.20	0.20
Primary Crushing	0.25	0.25	0.25
Hoisting	0.20	0.20	0.20
Power	0.50	0.83	0.83
Ventilation & Mine Heat	0.23	0.23	0.23
Pumping	0.05	0.05	0.05
Surface labour	0.26	0.39	0.28
General Administration	1.50	1.50	1.08
COST/TON HOISTED	7.16	8.91	8.38

J S REDPATH LIMITED

APPENDIX E

Canadian Bechtel Limited

155 University Avenue
Toronto, Ontario M5H 3B7
Telephone (416) 862-0211

Telex No 06-23256

CANADA

July 17, 1975

Mr. I.S. Thompson, P.Eng.
Derry, Michener and Booth
2302-401 Bay Street
Toronto 1, Ontario

Subject: AEX Minerals Corporation
Grum Deposit
Yukon Territories

Dear Mr. Thompson:

This letter will confirm our recent conversations on the above subject.

Your firm has been retained by AEX Minerals to review technical data supplied them by Kerr Addison Mines Limited pertaining to the "Grum" deposit in the Yukon Territories. You requested that we review this metallurgical, capital cost, operating cost and marketing data. To achieve this, you gave us copies of pertinent reports.

Metallurgy

A report, "Vangorda Project Report No. 2", dated December 19, 1974, prepared by the Noranda Ore Dressing Laboratory was reviewed. Even though it was entitled "Vangorda", you advised that the samples tested came from the "Grum" deposit. Nine single stage flotation tests and one five stage locked cycle test were included. The single stage tests examined grind and reagent combination, whereas the locked cycle test incorporated the best conditions from the single stage tests to simulate plant conditions. It appears that the depression of sphalerite and pyrite during lead flotation is the most difficult aspect of the metallurgy. However, with proper additions of lime, cyanide, and SO_2 gas, good results were obtained.

.... 2

The reported results of the fifth stage of the locked cycle test were:

	Assay		Distribution	
	% Pb	% Zn	% Pb	% Zn
Lead Concentrate	53.6	7.4	77.9	9.2
Zinc Concentrate	3.5	51.8	6.1	77.3

No silver assays were reported in the metallurgical report, but in a memorandum prepared by Noranda Sales Corporation, the following data was included for the above two concentrates.

	Ag oz/ton
Lead Concentrate	23.84
Zinc Concentrate	3.36

It is believed that the above results should be achievable in commercial operation. The ore tested in the locked cycle test was of lower grade, containing 3.55% lead and 4.14% zinc, than the ore zone average which, after dilution, is reported assay about 10% combined lead-zinc. Higher grade ore should result in higher percentage recoveries. Only a limited number of tests have been run and we feel that further work could improve the results, as better separation of the lead and zinc can probably be obtained.

We would suggest that the locked cycle test results be used for the financial analysis of the "Grum" ore, without discounting the grade and recovery.

Marketing

Noranda Sales Corporation has analyzed the concentrates and calculated "Net Smelter Return" values (Memo J. J. L. Davies to M. D. Rowswell, dated January 27, 1975). While a detailed analysis of the calculations is not possible (the smelter schedules were not made available), the results appear to be what might be expected. Both concentrates contain mercury, which has created problems at other operations. We do not know the maximum levels acceptable by the smelters in question, hence would suggest that the maximum allowable mercury limits be determined before the project is given a final "go ahead".

Capital Costs

While the time available did not allow us to review the capital costs, we did discuss with you escalation and working capital allowances. We also referred to a recent newspaper report regarding the Tara project in Ireland which, for a 7,500 ton per day operation using underground mining, now has a price tag of $150 million with start-up scheduled for 1977. We also suggested that you check the capital costs of the Greenex mine in Greenland, a 2,000 ton per day lead-zinc operation utilizing second-hand equipment which started production in the second half of 1973. The above data might help you analyze the validity of the capital costs presented.

Operating Costs

We examined the operating costs developed for the 5,000 ton per day case. While we do not have detailed wage rates prevailing in the area available, it is possible that the salaries and hourly wages assumed could be on the low side.

As an allowance for a townsite has been included in the capital costs, some monies should be included in the operating budget for townsite maintenance such as snow removal. No head office costs have been included but concentrate freight was included in the smelter calculations.

The power will be produced using diesel generators, and power costs are difficult to predict in this period of rising fuel oil costs. Ottawa, for example, has just announced a 23% increase in fuel costs which would be reflected in an almost equivalent increase in power costs.

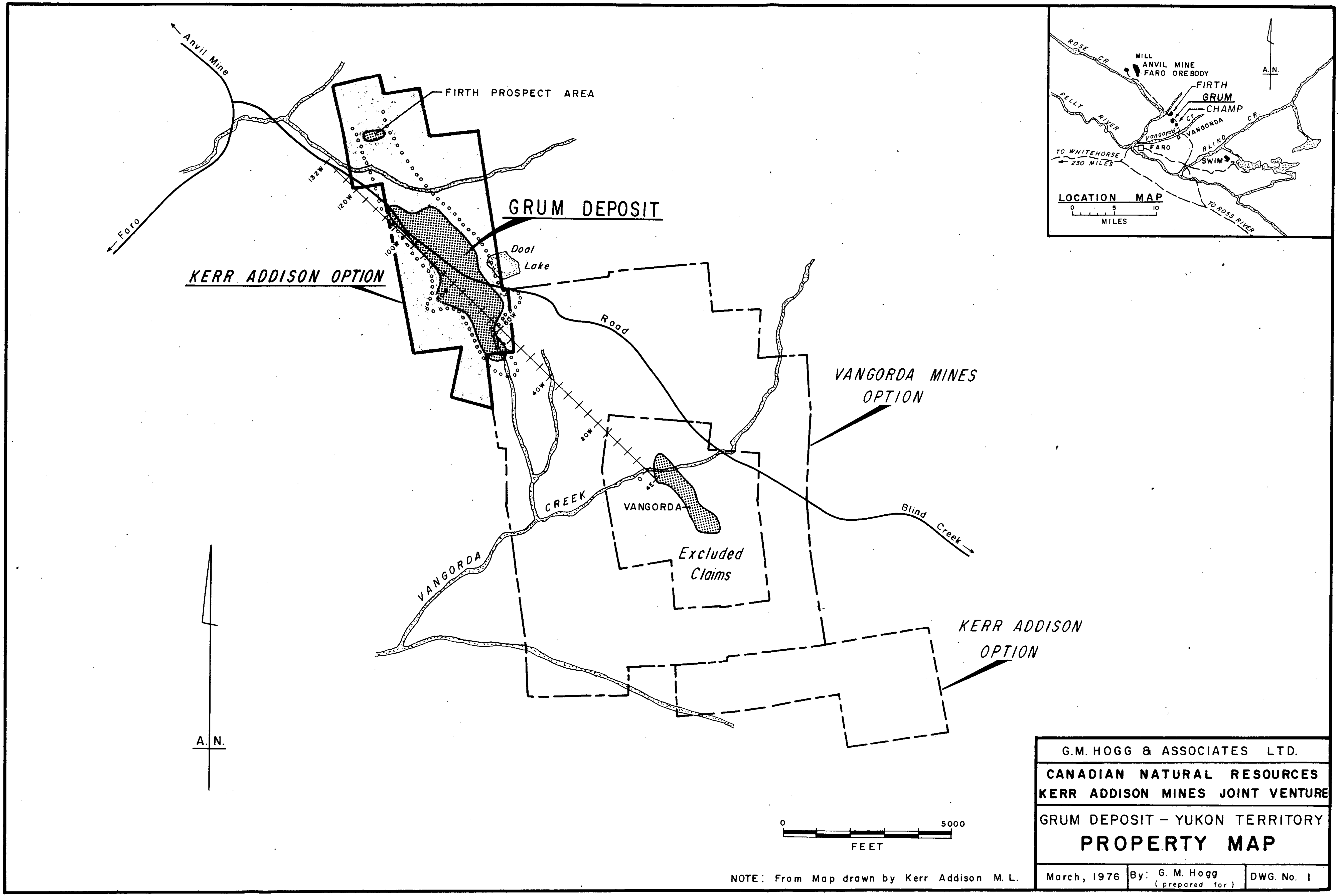
We hope that we have been of help in your review of the "Grum" deposit, and if we can be of further assistance in this study we would appreciate your advising us.

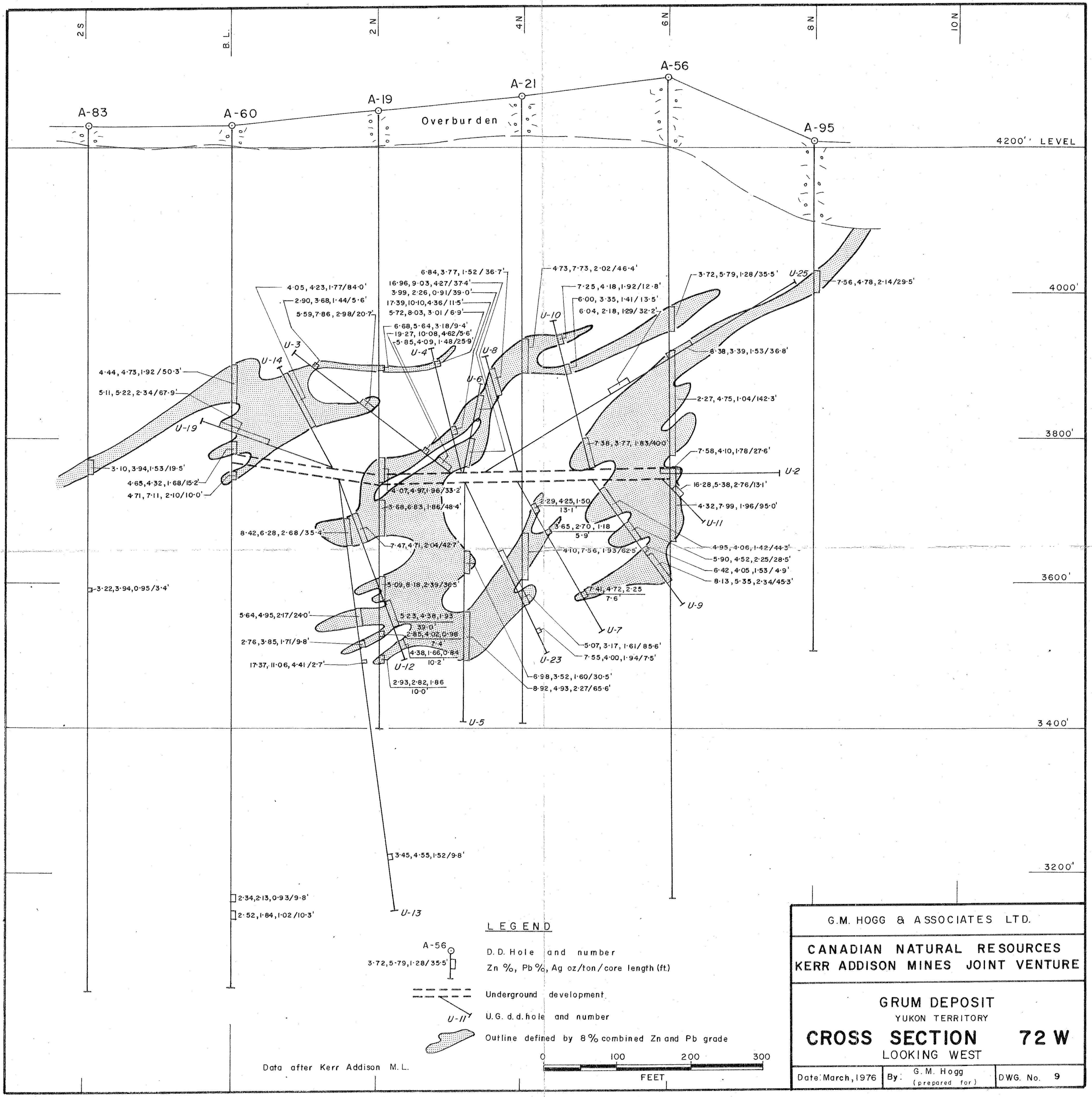
Yours very truly,

R.P. Ehrlich

R.P. EHRLICH, P.Eng.

RPE:jl


Anvil Mine
Faro
FIRTH PROSPECT AREA
GRUM DEPOSIT
KERR ADDISON OPTION
Doal Lake
132W
120W
100W
60W
40W
20W
0
4E
Road
VANGORDA MINES OPTION
VANGORDA
Excluded Claims
CREEK
VANGORDA
Blind Creek
KERR ADDISON OPTION
A. N.
ROSE CR.
MILL
ANVIL MINE
FARO OREBODY
FIRTH
GRUM
CHAMP
VANGORDA
PELLY RIVER
Vangorda Cr.
BLIND CR.
FARO
SWIM
TO WHITEHORSE 230 MILES
TO ROSS RIVER
LOCATION MAP
0 5 10
MILES
0 5000
FEET
NOTE: From Map drawn by Kerr Addison M. L.
G.M. HOGG & ASSOCIATES LTD.
CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE
GRUM DEPOSIT – YUKON TERRITORY
PROPERTY MAP
March, 1976
By: G. M. Hogg (prepared for)
DWG. No. 1


2S
B.L.
2N
4N
6N
8N
10N
A-83
A-60
A-19
A-21
A-56
A-95
Overburden
4200' LEVEL
4000'
3800'
3600'
3400'
3200'
U-2
U-3
U-4
U-5
U-6
U-7
U-8
U-9
U-10
U-11
U-12
U-13
U-14
U-19
U-23
U-25
6·84, 3·77, 1·52 / 36·7'
4·73, 7·73, 2·02 / 46·4'
3·72, 5·79, 1·28 / 35·5'
7·56, 4·78, 2·14 / 29·5'
4·05, 4·23, 1·77 / 84·0'
2·90, 3·68, 1·44 / 5·6'
5·59, 7·86, 2·98 / 20·7'
16·96, 9·03, 4·27 / 37·4'
3·99, 2·26, 0·91 / 39·0'
17·39, 10·10, 4·36 / 11·5'
5·72, 8·03, 3·01 / 6·9'
6·68, 5·64, 3·18 / 9·4'
19·27, 10·08, 4·62 / 5·6'
5·85, 4·09, 1·48 / 25·9'
7·25, 4·18, 1·92 / 12·8'
6·00, 3·35, 1·41 / 13·5'
6·04, 2·18, 1·29 / 32·2'
8·38, 3·39, 1·53 / 36·8'
4·44, 4·73, 1·92 / 50·3'
5·11, 5·22, 2·34 / 67·9'
2·27, 4·75, 1·04 / 142·3'
7·38, 3·77, 1·83 / 40·0'
7·58, 4·10, 1·78 / 27·6'
3·10, 3·94, 1·53 / 19·5'
4·65, 4·32, 1·68 / 15·2'
4·71, 7·11, 2·10 / 10·0'
16·28, 5·38, 2·76 / 13·1'
4·07, 4·97, 1·96 / 33·2'
3·68, 6·83, 1·86 / 48·4'
2·29, 4·25, 1·50 / 13·1'
4·32, 7·99, 1·96 / 95·0'
8·42, 6·28, 2·68 / 35·4'
3·65, 2·70, 1·18 / 5·9'
7·47, 4·71, 2·04 / 42·7'
4·10, 7·56, 1·93 / 62·5'
4·95, 4·06, 1·42 / 44·3'
5·90, 4·52, 2·25 / 28·5'
6·42, 4·05, 1·53 / 4·9'
8·13, 5·35, 2·34 / 45·3'
3·22, 3·94, 0·95 / 3·4'
5·09, 8·18, 2·39 / 36·5'
7·41, 4·72, 2·25 / 7·6'
5·64, 4·95, 2·17 / 24·0'
5·23, 4·38, 1·93 / 39·0'
2·85, 4·02, 0·98 / 7·4
2·76, 3·85, 1·71 / 9·8'
4·38, 1·66, 0·84 / 10·2'
17·37, 11·06, 4·41 / 2·7'
5·07, 3·17, 1·61 / 85·6'
7·55, 4·00, 1·94 / 7·5'
6·98, 3·52, 1·60 / 30·5'
8·92, 4·93, 2·27 / 65·6'
2·93, 2·82, 1·86 / 10·0'
3·45, 4·55, 1·52 / 9·8'
2·34, 2·13, 0·93 / 9·8'
2·52, 1·84, 1·02 / 10·3'
LEGEND
A-56
D. D. Hole and number
3·72, 5·79, 1·28 / 35·5'
Zn %, Pb %, Ag oz/ton / core length (ft.)
Underground development
U-11
U.G. d.d. hole and number
Outline defined by 8% combined Zn and Pb grade
0
100
200
300
FEET
Data after Kerr Addison M.L.
G.M. HOGG & ASSOCIATES LTD.
CANADIAN NATURAL RESOURCES
KERR ADDISON MINES JOINT VENTURE
GRUM DEPOSIT
YUKON TERRITORY
CROSS SECTION 72 W
LOOKING WEST
Date: March, 1976
By: G.M. Hogg (prepared for)
DWG. No. 9