BRIAN MOUNTFORD AND ASSOCIATES

NORCEN ENERGY RESOURCES LTD

CARMI PROJECT

A PRELIMINARY

VIABILITY ASSESSMENT

BRIAN MOUNTFORD AND ASSOCIATES

904—675 WEST HASTINGS STREET, VANCOUVER, B.C. V6B 1N2
TELEPHONE 688-3584

October 1, 1977

Mineral Exploration Department
Norcen Energy Resources Ltd
715 - 5th Avenue SW
Calgary
Alberta
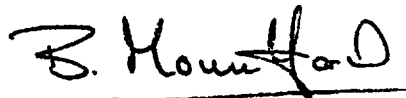
Attention: Mr Glen Garratt

Gentlemen:

We are pleased to submit our report entitled,
Carmi Project - A Preliminary Viability Assessment.

The ore reserves have been developed solely
from the information provided by Norcen. The costs
and economic evaluation are based upon the given data
and past experience with similar operations.

It is considered that the results of the study
will allow you to decide your next step.

We appreciate very much your confidence in
entrusting this study to us and of course would be
pleased to answer any questions that may arise.

Yours truly,
BRIAN MOUNTFORD & ASSOCIATES

B. Mountford P. Eng.

BM:mm

TABLE OF CONTENTS

TERMS OF REFERENCE

The terms of reference for this study were given on Tuesday September 27, 1977 at a meeting between Mr Glen Garrett of Norcen and Mr B Mountford of B Mountford and Associates.

"Norcen Energy Resources, through its exploration arm, Great Plains Development Company wish to evaluate the potential of the Carmi prospect. To that end, B. M. & A. were asked to make a quick preliminary assessment of viability, with particular reference to:

a) Develop and/or confirm the ore reserves
b) Establish reasonable operating and capital costs
c) Make an order of magnitude economic evaluation
d) Have the completed reports in Calgary during the week ending October 8, 1977"

CONCLUSIONS

1) The minable reserves on the Carmi property
are:-

Main Zone

12,364,000 tons of probable and possible ore
with the grade to be verified.

Lake Zone

2,600,000 tons of possible ore at a grade of
0.14% MoS_2. The peripheral areas to these tonnages
contain sub-economic mineralization (at today's prices).

2) A 5000 Tpd mine would have a life of approx-
imately eight and one half years, and would cost $56,000,000.

3) The above mine would operate at a cost of
$5.70 per ton milled; the labour would probably be high
quality and the turnover a minimum.

4) At the rate of 5000 Tpd; at a selling price
of $4 per lb Mo and at a grade of 0.25% MoS_2, the operation
would recuperate the capital expended and have an
approximate rate-of-return of 1½% per annum.

INFORMATION PROVIDED

Data provided, from which the assessment has been completed is as follows:-

a) Letter and pertinent hole data from Vestor Exploration to Norcen on August 10, 1977.

b) A number of plans and sections drafted by Canadian Superior Exploration dated September 25, 1975.

c) A series of geological area-plans compiled by Craigmont Mines and dated August 30, 1976.

d) A Vestor Exploration report including holes V1 through V19 and P1 through P8.

e) A Canex Placer Ltd report specifying ore reserves and grade dated October 30, 1975.

f) A series of borehole logs as follows:-
DDH 1 through 14; P55-57; P60-65; P70-71;
DDH 77-21 through 25; (Some of these logs did not contain assay results).

ORE RESERVES

SUMMARY

Main Zone

        12,364,000 probable tons at 0.25% MoS_2 with a
2.42:1 stripping ratio.

Lake Zone

        2,600,000 possible tons at 0.14% MoS_2 with a
stripping ratio of 0.68:1.

GENERAL

        Initially, an effort was made to correlate the
plans and sections with the full number of holes drilled
on the property. It was not possible to do this and
therefore the ore reserves estimated are based upon a
limited amount of the information apparantly available.

        In view of the difference in calculation of
ore reserve (compared say to Canex Placer) I would
recommend that new plans and sections be compiled. All
of the borehole-log assay intersections should be con-
verted to economical mining intersections and grade
calculated. This data can then be transposed to the
plans and sections and the reserve tonnage and grade
verified.

        The Canadian Superior plans and sections in
conjunction with the Vestor letter and the Canex Placer
report were the main items used in the development of
reserves. The grade of ore used (0.25% MoS_2) is a
deduction rather than a calculation. Its use allows the
viability check to be made, its accuracy will be veri-
fied by the reserve re-calculation recommended above.

MINABLE RESERVES

        In order to estimate a minable reserve a very
preliminary pit was designed. (refer to drawings attached).
The parameters below were applied in a quick visual
procedural method:-

MINABLE RESERVES (Continued)

      a)   Final pit slope $45°$

      b)   Molybdenum price of \$4 per lb of Mo

      c)   A grade of 0.1% MoS_2 would be the approximate break-even figure and therefore minable if no waste had to be removed also.

      d)   For every 0.02% increase in MoS_2 it would be economical to remove one ton of waste in order to mine one ton of ore i.e.:-

Grade	Allowable stripping ratio
0.1% MoS_2	0 waste to 1 ton ore
0.12% "	1 ton waste to 1 ton ore
0.14% "	2 ton waste to 1 ton ore
0.16% "	3 ton waste to 1 ton ore

      etc, etc, etc.

      e)   With the pit designed, ore would consist of material which had a value equal to the cost of processing, plus smelting, plus required profit. (Once the pit is designed the cost of mining does not enter the economics). Therefore 0.08% MoS_2 was the in-pit cut-off for ore reserves.

      f)   No smoothing of the pit was attempted and no allowance for final roads.

      g)   A "density" of 11 cu ft per short ton was used in the reserve calculation for both ore and waste.

Tonnages

Main Zone

Section	Tons of Ore	Tons of Waste	Total tons
1 + 50 N	1,759,000	5,082,000	6,841,000
4 + 20 N (+ East pit)	2,967,000	8,011,000	10,978,000
6 + 10 N	5,282,000	6,500,000	11,782,000
7 + 60 N	2,356,000	4,975,000	7,331,000
9 + 60 N	-	5,345,000	5,345,000
TOTALS	12,364,000	29,913,000	42,277,000

Lake Zone

Possible minable ore	=	2,600,000	tons
Waste	=	1,775,000	"
TOTAL	=	4,375,000	"
Stripping Ratio	=	0.68:1	

GRADE

Main Zone

The lack of a complete tabulation of boreholes and assay results made the calculation of a grade very difficult. If the Canadian Superior plan and section data is used on its own, a grade of 0.14% MoS_2 is indicated. This figure is not supported by the Vestor letter nor the Canex Placer calculations.

If we assume that Canex is accurate for the entire "mineralized" tonnage and further assume that the grade of the ore outside the pit limits is 0.08% MoS_2, then by deduction, the grade of in-the-pit ore could possibly be:-

    a) (30,576,000 @ 0.0157% - Placer)

    b) (12,364,000 @ x % - Mountford)

    c) Difference @ 0.08% - Assumption

$$x\% = \frac{(30,576,000 \times 0.157) - (18,212,000 \times 0.08)}{12,364,000}$$

$$= \frac{3,343,472}{12,364,000} = 0.27\% \; MoS_2$$

It is proposed to use 0.25% MoS_2 as a grade for the minable reserves in the Main Zone. It is logical to assume that the smaller tonnage will be at a higher grade; the Vestor letter also indicates some high value intersections.

Lake Zone

A possible grade for the Lake Zone would be 0.14% MoS_2 .

Comments in Relation to Grade

1) No dilution has been taken into account in the above grade estimates.

<u>Comments in Relation to Grade (Continued)</u>

      2) The bulk of the assay values were obtained from percussive sludge samples. An inspection of some of the diamond drill logs shows that the sludge assays are normally higher grade than the corresponding core assays. (Holes checked were DDH V18; DDH V7 & DDH V8).

CAPITAL COST

The potential reserves are some 15,000,000 tons. A reasonable size of operation would be one that guaranteed at least eight years of life. Therefore it is proposed to assess the viability of Carmi at a production rate of 5000 TPD or 1,800,000 tons per annum.

COST SUMMARY

Item	Cost
Drilling; Pioneer roads;bulk samples; studies,	$ 1,000,000
Pre-production mining and production equipment	9,500,000
Crushing and Screening	6,500,000
Concentrator	16,000,000
Water supply; reclamation and tailing disposal	2,000,000
Power supply and distribution	6,500,000
Access roads including up grading	500,000
Ancillary buildings,shops,offices, warehouse	3,000,000
Sub-Total	$45,000,000
Working Capital and warehouse inventory	2,000,000
Engineering design and construction management	4,000,000
Total	$51,000,000
Add 10% to cover interest charges and contingency	5,000,000
Estimated Capital Cost	$56,000,000

OPERATING COSTS

COST SUMMARY	Cost per ton of ore
Mining @ 73¢ per ton mined	2.50
Milling, crushing, processing & drying	2.40
General & administrative	0.70
Freight & concentrate shipping	0.10
Operating Cost	$5.70

GENERAL COMMENTS

1) A conventional mining and milling system is anticipated. Nominal pre-production stripping being carried out under contract. Rougher and cleaner flotation would produce acceptable concentrates and deleterious elements would not be present. Concentrate would be shipped in 33 U.S. gallon drums. One hundred per cent water reclamation from the tailing area would be practiced.

2) No townsite would be necessary, the labour commuting from Kelowna. This area of British Columbia is a desirable location, hence labour would be high quality and the turnover at a minimum.

3) Power would be supplied by the West Kootenay Power Authority. Presently there is a single phase system at Carmi. Upgrading this to 3-phase would be relatively inexpensive.

The cost of power includes full plant equipment and a three mile transmission line. Power is estimated at 1.5 - 2.0 MW per 1000 tons of daily capacity.

4) Currently the Canadian Pacific Railway is presenting a brief to the government for the abandonment of the Kettle Valley line.

Concentrates would have to be initially transported by road. Possible outlets are Japan via Vancouver; sale to Endako via Kelowna and CNR then truck; or to Climax in Colorado (assumed most likely). The movement to Climax would be truck to Keremeos or Oroville, then Burlington National Railway direct to Climax. The freight costs shown reflect this latter movement.

It is assumed that the majority of the make-up water (some 1000 gpm) would be from the tailing pond. However, a need for approximately 200 - 300 gpm of fresh water would exist. No problems are foreseen in this respect. The capital costs represent potential expenditures in pumps, starter dams and environmental facilities.

ECONOMIC ANALYSIS

GENERAL

It is proposed to take five cases and examine them for relative viability.

Case One   Main Zone @ 0.25% MoS_2 & Mo   @ $4.00 per lb.

Case Two   Main Zone @ 0.20% MoS_2 & Mo   @ $3.50 per lb.

Case Three   Main Zone @ 0.25% MoS_2 & Mo   @ $4.00 per lb.

Case Four   Main Zone @ 0.20% MoS_2 & Mo   @ $3.50 per lb.

Case Five   Placers reserve
of 30,000,000 tons
@ 0.157% MoS_2 & Mo   @ $4.00 per lb.

Note   In every case except Five, the Lake Zone is mined at 0.14% MoS_2 and operating costs of $4.40 immediately following exhaustion of Main Zone ore.

ANALYSIS

Smelter returns are calculated as follows:
Tons per year x grade x 0.6 (Mo in MoS_2) x plant recovery x smelter payment percentage x price x 2000 to convert to lbs.

Case One

Main Zone Smelter return   = $18,468,000 per annum

Lake Zone Smelter return   = $10,342,000 per annum

Operating Costs Main Zone = $10,260,000 per annum

Operating Costs Lake Zone = $ 7,920,000 per annum

As can be seen from the Cash Flow Table (next page) this case is basically the break-even situation. The capital is repaid and in the final year, some $7,000,000 in dividends are available. Expressing this in simple interest per annum, it is equivalent to an approximate 1.5% return on investment.

CARMI PROJECT
CASH FLOW CASE I
(Figures in $'000's)

	Year 1	2	3	4	5	6	7	8	Total
Smelter Returns	18,468	18,468	18,468	18,468	18,468	18,468	17,411	10,342	138,561
Operating Costs	10,260	10,260	10,260	10,260	10,260	10,260	9,954	7,920	81,594
Royalty Payments		I f	A p p l i c a b l e						
Depreciation & Amortisation	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	56,000
Taxable Income	1,208	1,208	1,208	1,208	1,208	1,208	457	(4,578)	3,127
Income Tax 40%	483	483	483	483	483	483	183	--	3,081
Net Profit	725	725	725	725	725	725	274	2,422	7,046
Source and Application									
Source									
Net Profit	725	725	725	725	725	725	274	2,422	7,046
Recover Depreciation	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	56,000
Total Source	7,725	7,725	7,725	7,725	7,725	7,725	7,274	9,422	63,046
Application									
Repay Capital	7,725	7,725	7,725	7,725	7,725	7,725	7,274	2,376	56,000
Available for Dividend								7,046	7,046

Notes: 1. Assumes all equity investment.

2. Price of Molybdenum at $4.00 per lb.

3. Grade of Main Zone ore at 0.25% MoS_2.

Case Two

Main Zone Smelter return = $14,774,000

Lake Zone Smelter return = $10,343,000

There is a difference in smelter returns of some $25,378,000 over the live of the project compared to Case One. This is obviously a loss situation; assuming no taxes, only $37,668,000 of initial investment is recovered.

Case Three

A slight improvement on Case Two with a Main Zone smelter return of $16,160,000 and a Lake Zone return of $9,049,000. This situation, too, would not repay the invest- ment.

Case Four

Is obviously a losing situation.

Case Five
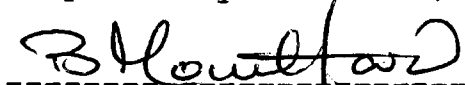
The Main Zone smelter return in Case Five would be:

1,800,000 x 0.00157 x 0.6 x 0.9 x 0.95 x 4 x 2000 = $11,598,000 per annum

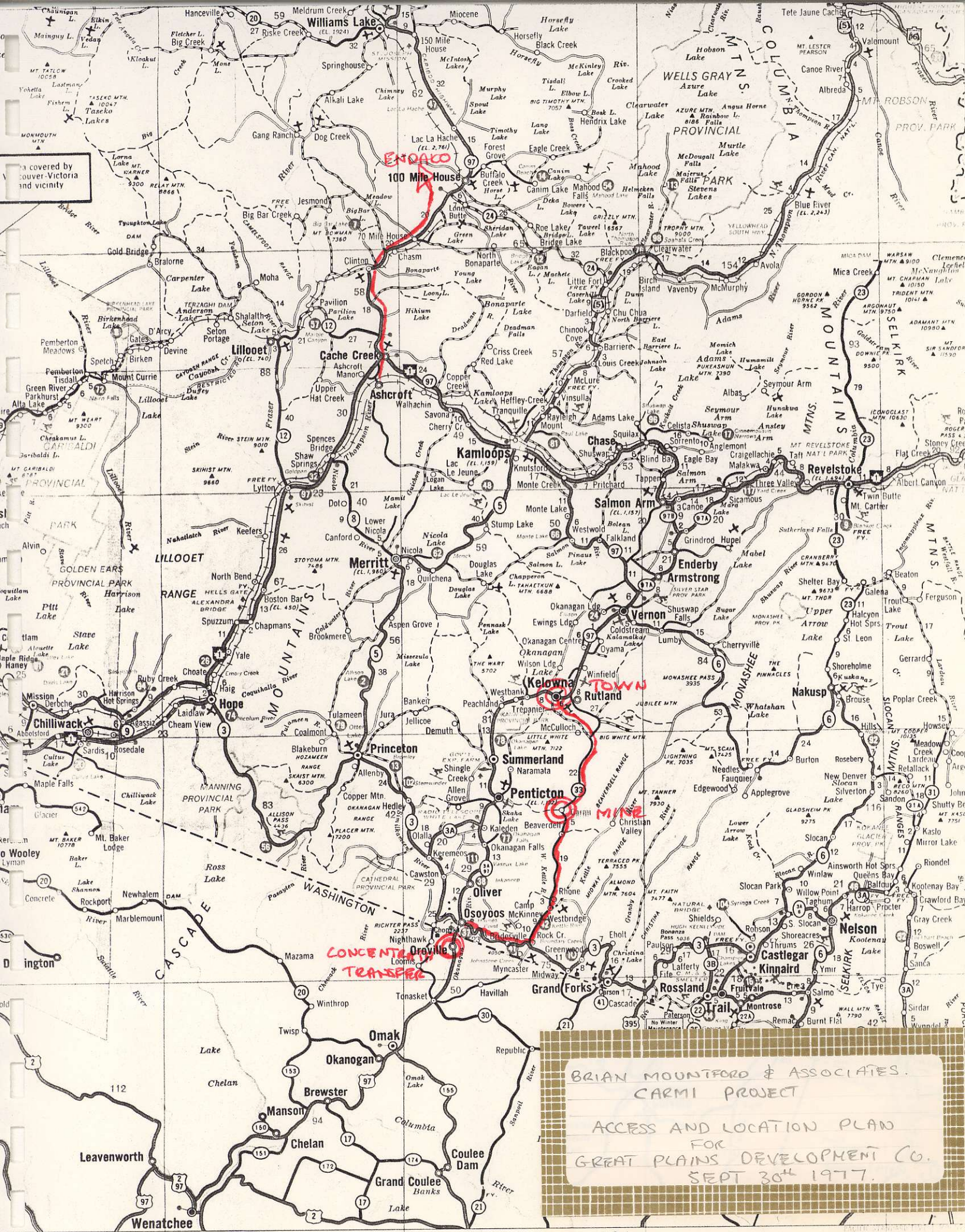Operating Cost at 2.42:1 stripping ratio would be $10,260,000;

i.e. an annual gross income of $1,338,000 which would not repay the capital over the 30,000,000 tons. At an estimated 1:1 stripping ratio, the total gross income would be $52,300,000 still insufficient to pay back the investment.
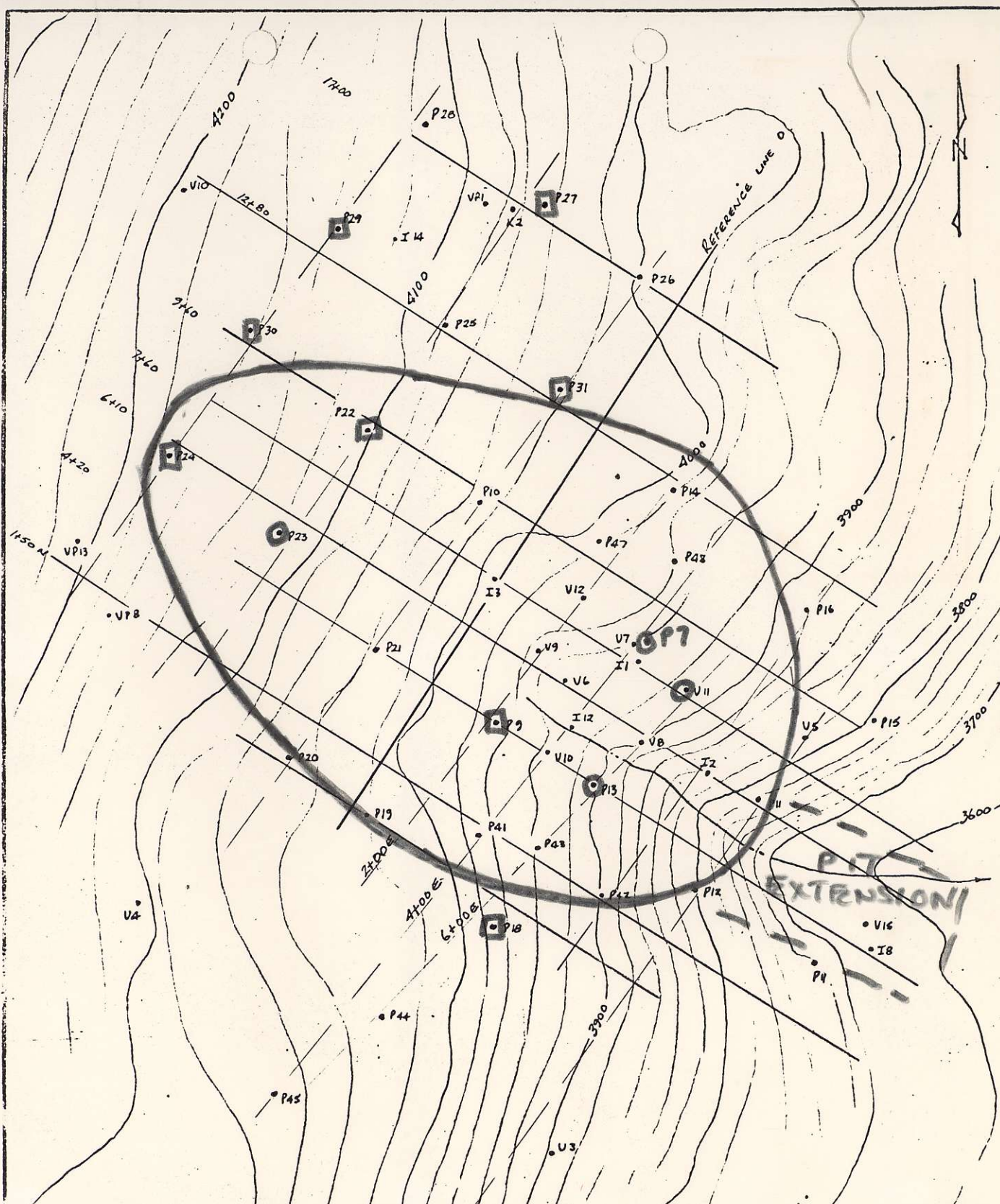
Respectfully submitted,

B. Mountford, P.Eng.

APPENDIX ONE

Handwritten annotations:

- ENDAKO
- TOWN
- MINE
- CONCENTRATE TRANSFER

NOTES.

☐ GRADE BELOW CUT-OFF

◎ GRADE ABOVE CUT-OFF

BRIAN MOUNTFORD & ASSOCIATES

PRELIMINARY OPEN PIT PLAN
ON CARMI MAIN ZONE
FOR
GREAT PLAINS DEVELOPMENT Co.

SCALE 1" = 400'   SEPT 30/1977.

N

REFERENCE LINE O

PIT EXTENSION

4200
1400
4100
5+60
6+10
4+20
1+50 N
2+00 E
4+00 E
6+00 E
12+80
4000
3900
3800
3700
3600
3900

P28
V10
VP1
I1
P27
P29
I14
P26
P30
P25
P31
P22
P24
P23
P10
P14
4000
P47
P43
VP13
I3
V12
P16
VP8
V7
P7
P21
V9
I1
V11
V6
U5
P15
I12
P29
V8
I2
V10
P20
P13
I1
P19
P41
P43
VP7
P12
U4
P18
V16
I8
P11
P44
3900
U3
P45
V14
VP5

REF.

ELEV.

4400

VP13 VP8

VP61 VP43 VP42

4000

3600
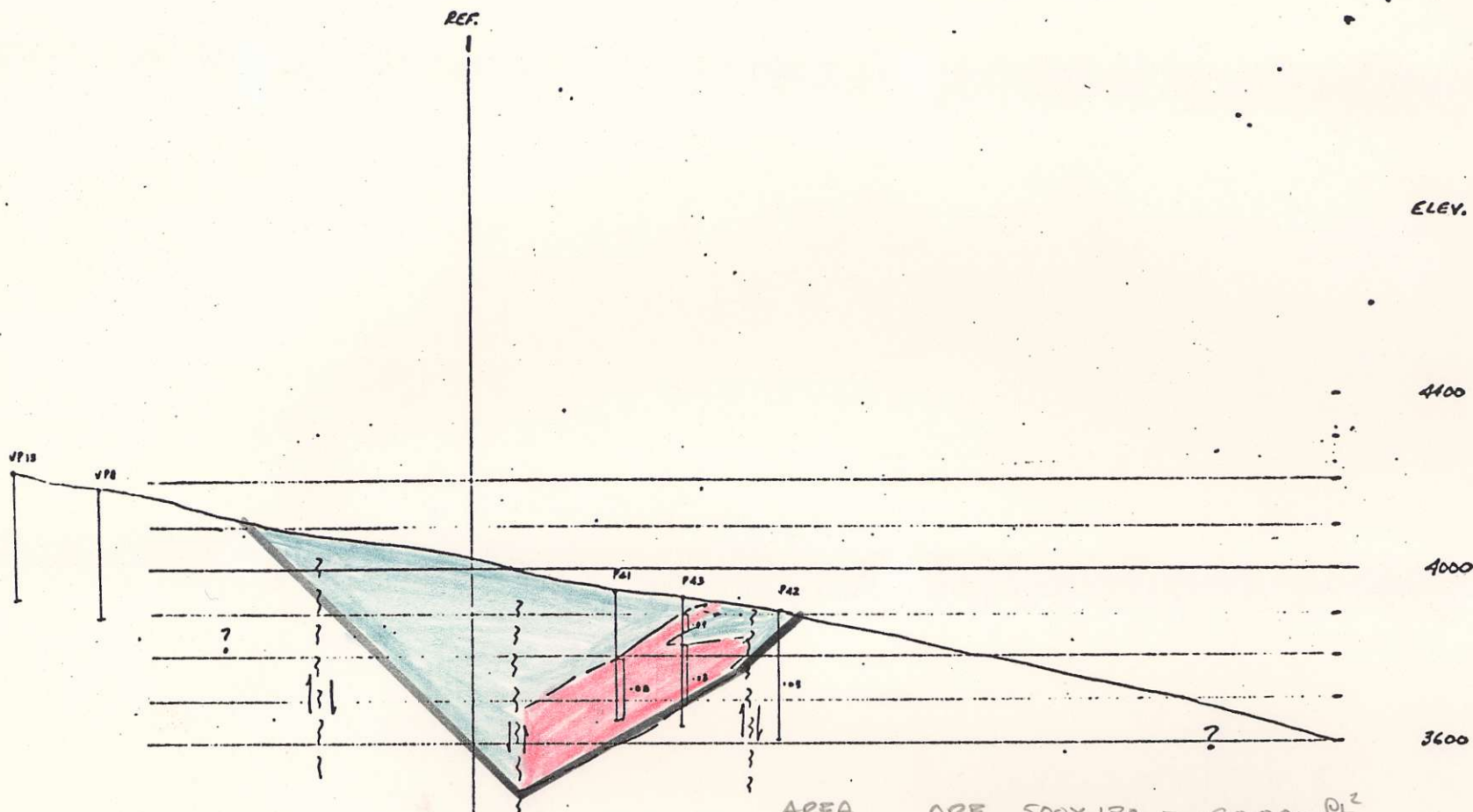
AREA.   ORE 500 × 180 = 90,000 ft^2

           TOTAL 700 × 500 = 350,000 ft^2

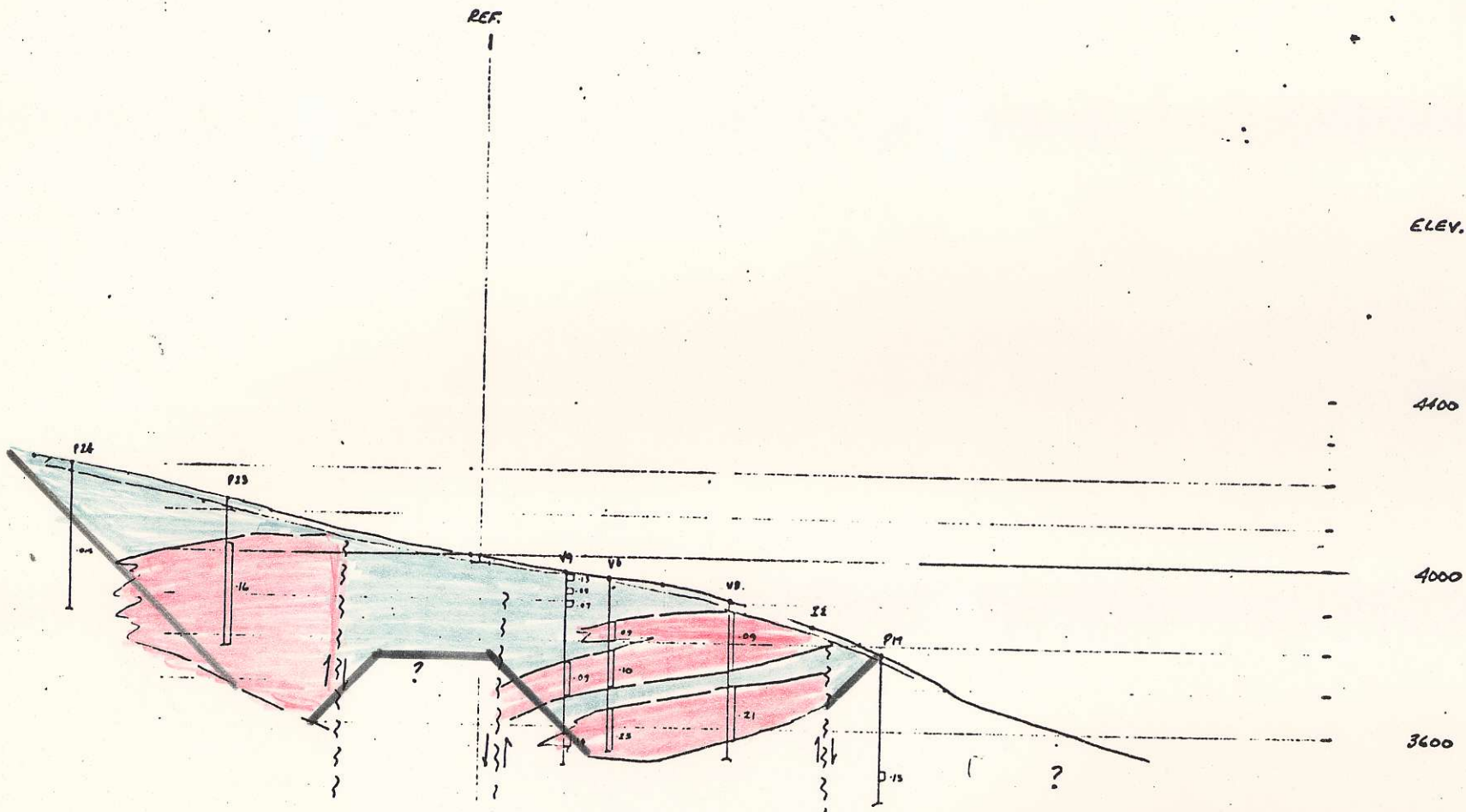   WASTE   260,000

FOR VOLUME X by 215' AND USE 11 cuft/TON

ORE 1,759,000 TONS WASTE 5,082,000 TONS.

BRIAN MOUNTFORD & ASSOCIATES
CARMI MAIN ZONE
SECTION 1+50 N.
FOR
GREAT PLAINS DEVELOPMENT Co.
SCALE 1" = 400 SEPT 30/77.
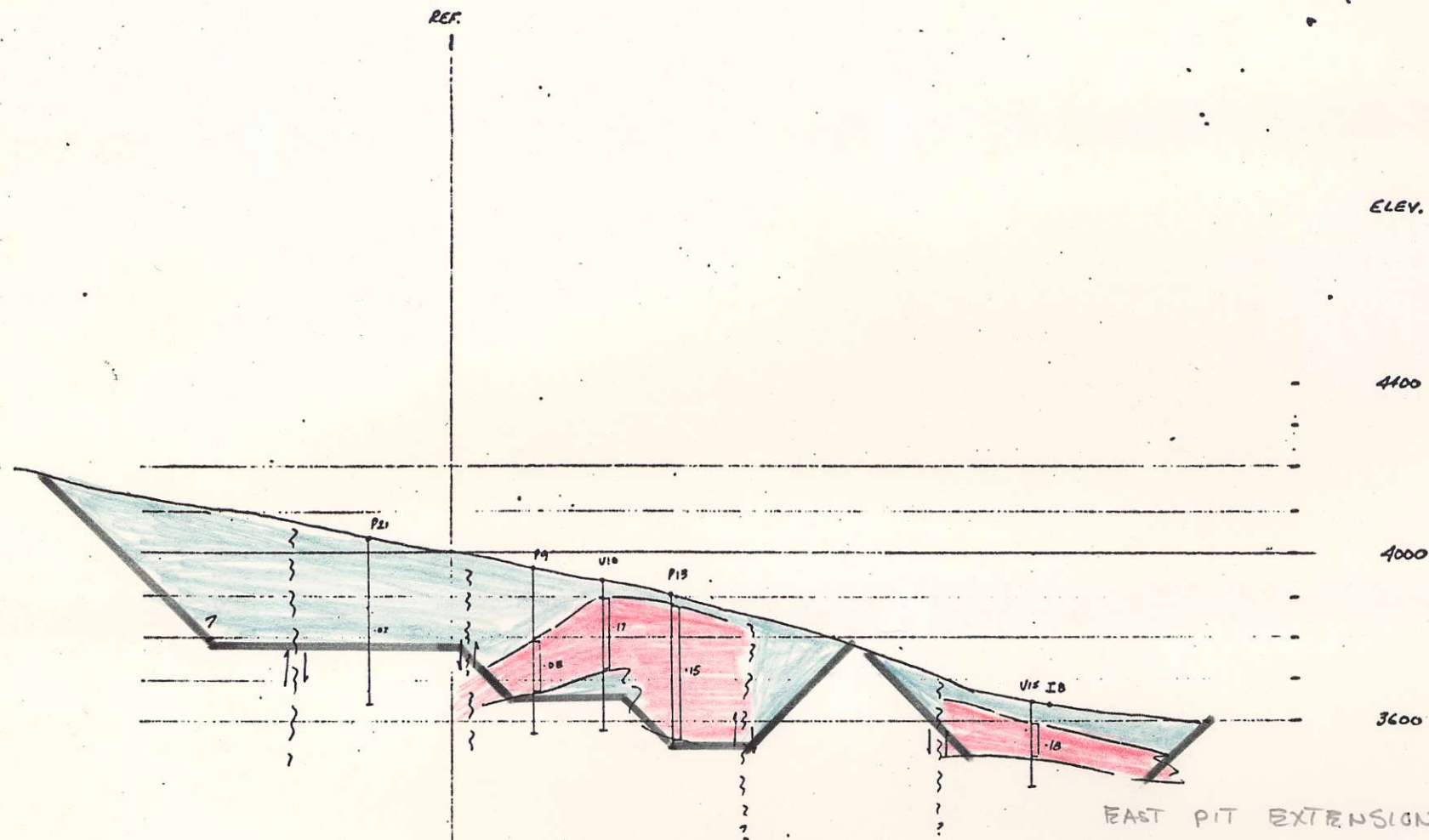
AREA MAIN PIT

ORE $500 \times 200 = 100,000 \, ft^2$

TOTAL $1700 \times 250 = 425,000$

WASTE $\qquad 325,000$

VOLUME $\times 240 \div 11$

ORE $\quad 2,182,000$ TONS

WASTE $7,091,000$ TONS

EAST PIT EXTENSION

ORE $\quad 785,000$ TONS

WASTE $\quad 920,000$ TONS.

BRIAN MOUNTFORD & ASSOCIATES

CARMI MAIN ZONE

SECTION 4+20N

FOR

GREAT PLAINS DEVELOPMENT Co.

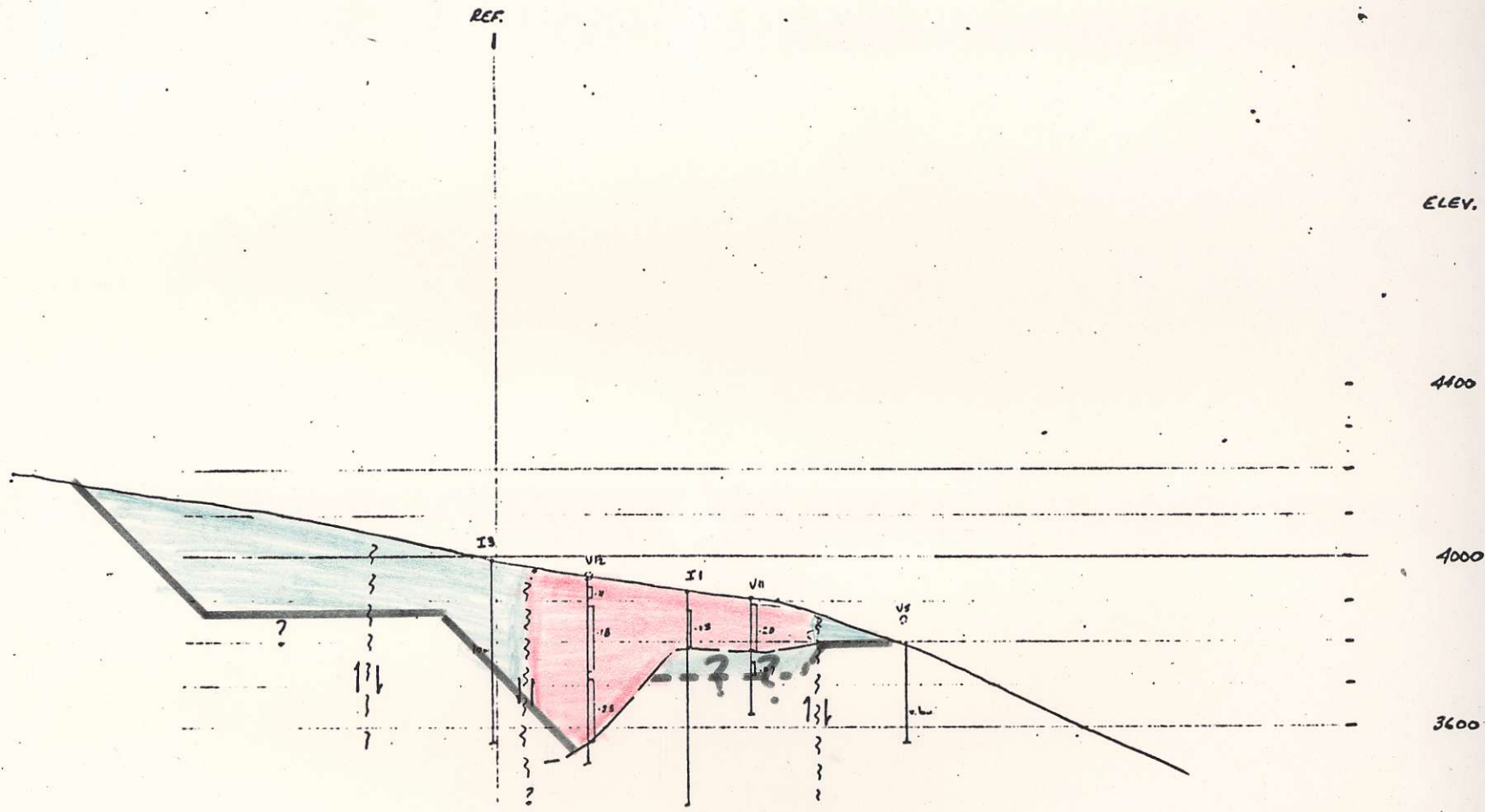$1" = 100'$ SEPT 30/77

REF.

ELEV.

4100

4000

3600

REF.

ELEV.

4400

4000

3600

ORE 5,282,000 TONS
WASTE 6,500,000 TONS.

BRIAN MOUNTFORD & ASSOCIATES
CARMI MAIN ZONE
SECTION 6+10.N
FOR
GREAT PLAINS DEVELOPMENT CO.

1":100'   SEPT 25/77

ORE 2,356,000 TONS
WASTE 4,975,000 "

BRIAN MOUNTFORD & ASSOCIATES
CARMI MAIN ZONE
SECTION 7+60N
FOR
GREAT PLAINS DEVELOPMENT CO.
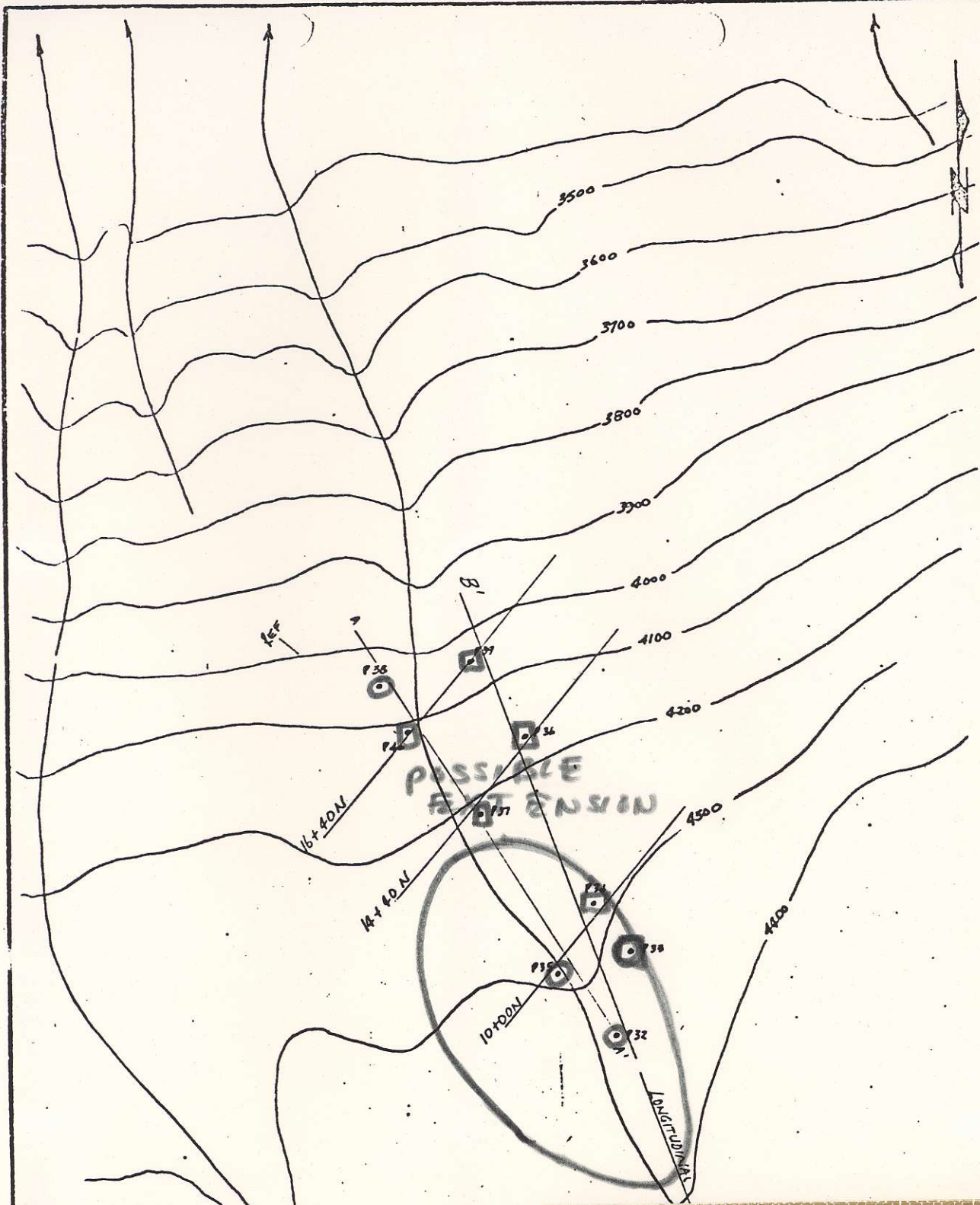SCALE 1" = 400'   SEPT 19/77

REF.

ELEV.

4100

4000

3600

P30

P22

P10

P07

P15

WASTE 5,345,000 TONS

BRIAN MOUNTFORD & ASSOCIATES
CARMI MAIN ZONE
SECTION 9+60 N
FOR
GREAT PLAINS DEVELOPMENT Co

1"=100'   SEPT. 30/77

3500

3600

3700

3800

3900

4000

4100

4200

4300

4400

B'

16F

P38

P39

P40

P36

POSSIBLE
EXTENSION

P37

P34

P35

P33

P32

16+40N

14+40N

10+00N

LONGITUDINAL
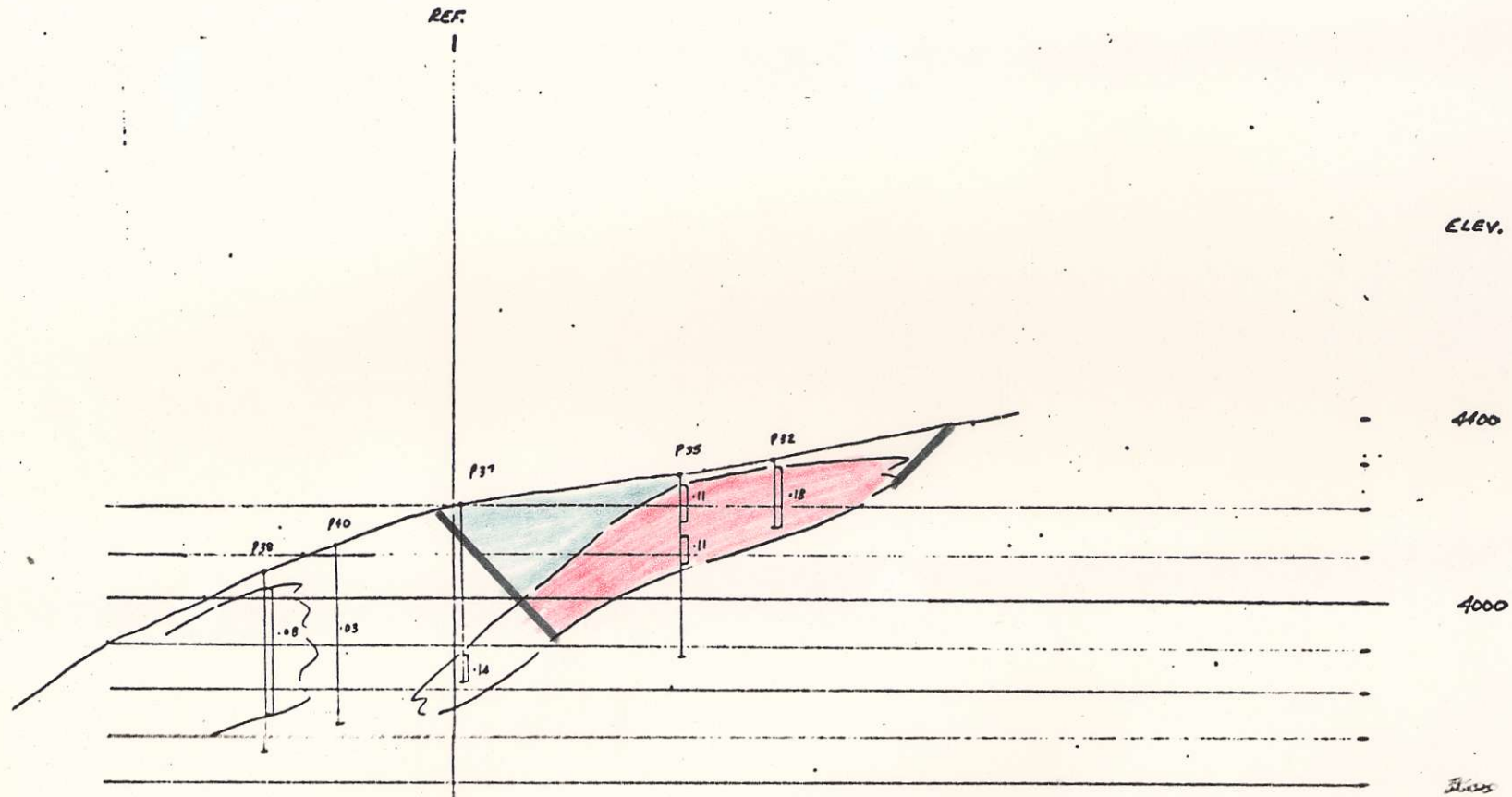
NOTES

☐ GRADE BELOW CUT-OFF

◉ GRADE ABOVE CUT-OFF

BRIAN MOUNTFORD & ASSOCIATES
CARMI LAKE ZONE
PRELIMINARY OPEN PIT PLAN
FOR
GREAT PLAINS DEVELOPMENT Co

SCALE 1" = 400'   SEPT 30/77.

REF.

ELEV.

4100

4000

ORE = 2,600,000 TONS

WASTE = 1,775,000 TONS.

BRIAN MOUNTFORD & ASSOCIATES
CARMI LAKE ZONE
SECTION A-A'
FOR
GREAT PLAINS DEVELOPMENT Co.
SCALE 1" = 400'   SEPT 30/77.

APPENDIX TWO

SOME GENERAL COMMENTS ON
THE FUTURE PROSPECT FOR MOLYBDENUM

INTRODUCTION

Great Plains Development Company Ltd intend to make a preliminary evaluation of the viability of a specific molybdenum prospect. As part of this evaluation it is necessary to take a look at the price of molybdenum and its supply/demand picture for the future.

As a generality it can be stated that the short term prospects (five years) are such that the present market price will be supported. The pressures will tend to elevate the price. In the long term, more new mines will be required. Therefore, any prospect that gives satisfactory corporate returns when evaluated with present day parameters, should be pursued.

GENERAL

The expected rate of growth for molybdenum, estimated by industrial sources, is approximately 7% per annum. Consumption in 1976 was about 90,000 tons (180 million lbs) of Mo. (The peak consumption in 1974 was 10 million lbs higher).

Approximately 80 - 85% of the consumption is taken up by the iron and steel industries. The general apathy in those industries in 1976 resulted in a decrease in consumption. However, more Mo was used in super alloys and the net result was about the same as 1975. A major portion of molybdenum steel is used in pipelines.

SUPPLY

The estimated free world molybdenum production in 1976 was 175,000,000 lbs. Approximately 50% of this figure is mined as subsidiary to copper. The remaining 50% is provided mainly by Amax from its Climax mine in Colorado.

Amax's new Henderson mine will provide 50,000,000 lbs per annum when in full production. However, if new mines are not brought into production by 1981, a supply deficit will occur.

PRICE

Supply and demand for molybdenum appear to be in balance presently. Therefore a price of $4.00 (present figure) would appear to have support.

In the short term a slight over supply may appear to be present. However there are several factors which might tend to restrict this supply.

1) Go-ahead for the Alcan pipeline.
2) Present depressed state of the copper price resulting in cut-backs.
3) Increase in consumption for super alloys.
4) Removal of moly from the U.S. Strategic stock-pile. Thus the General Service Administration will no longer curb the market.
5) "Super" alloys requiring large quantities of molybdenum are utilised in nuclear reactors, the air and allied industries (airplanes, heli-copters, air vehicles, etc.). It would appear that this particular area may create shortages.
6) The Henderson mine is a "technical mine" and utilises much equipment and relatively expensive mining methods. Additionally the capital expendi-ture escalated horrendously (rumoured to be in excess of $500,000,000). Therefore Amax must maintain a corporate philosophy that ensures speedy payback against Henderson's "high" oper-ating cost.
7) The Henderson mine is experiencing start-up problems, rumoured to be:-

a) Low recoveries

b) High lead content

PROGNOSIS

1) A present day price of $4.00 for molybdenum in MoS_2 concentrate (at 85 - 90% MoS_2) would appear reasonable. The short term factors would be such as to maintain this price, with general increases occurring along with the normal escalation of all costs.

2) There are several prospects for new mines to take up the slack. Prominent amongst them would be -

a) U.S. Borax's Quartz Hill property in Alaska.

b) Amax's Glacier Gulch property in B.C.

N.B.

A) Quartz Hill is purported to be very high grade - figures of 0.5% have been mentioned.

B) Glacier Gulch could have 0.3% MoS_2 with 0.06% WO3.