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MOUNT BISCHOFF PROJECT

FEASIBILITY STUDY

FOR A MINING OPERATION AT A PRODUCTION RATE
GREATER THAN 100 TONS PER ANNUM CONTAINED TIN

Prepared February 1983 by CRAS
for the Mount Bischoff Joint Venture

83-1956

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1. INTRODUCTION

1.1 Background

Geological interpretation of surface exposures and exploration drilling results has established a tin ore reserve at Mount Bischoff. Extensive metallurgical testwork by the project team at the Tasmanian Department of Mines facility in Launceston, supported by further work at AMDEL, Aberfoyle and Mineral Deposits has established that treatment of Mount Bischoff ore is technically viable.

Previous preliminary feasibility studies have evaluated the Mount Bischoff tin deposit at production rates commensurate with:

- (a) economies of scale;
- (b) inferred capacity of offsite custom treatment plant.

Such studies highlighted the need for improvement in world tin economics before any large scale operation at Mount Bischoff can be economically justified.

In view of the current state of the industry it has been proposed that initial operations at Mount Bischoff should be developed on a minimum cost basis. The objective will be to produce run of mine ore for sale to an offsite treatment plant.

This study examines the feasibility of an initial minimum scale operation only.

1.2 Scope

This study is a feasibility study of the Mount Bischoff tin deposit based on a small scale open pit mining operation that:

- (i) is intended to be continuous;
- (ii) achieves an annual mining production rate greater than 100 tons (101.6 tonnes) contained tin (in situ);
- (iii) involves the production of run of mine tin ore for sale to an offsite treatment plant.

It assesses within the limits of present knowledge:

- (a) the establishment of a small open pit at Mount Bischoff;
- (b) indicative sale price for run of mine tin ore;
- (c) financial evaluation of the project.

1.3 Location

The Mount Bischoff tin deposit is located near the township of Waratah in the North West of Tasmania at an altitude of 620 metres. It is 85 kilometres by road from the north coast town of Burnie.

1.4 Ownership

As at 31 December, 1982, ownership status of Exploration Licence 13/79, Authority to Prospect 5/80 and Mining Lease 43M/77 was:

CRA Exploration Pty. Ltd.	54%*
Metals Exploration Ltd.	31%*
Comstaff Pty. Ltd. and Preussag Australia Pty. Ltd.	15%
	100%

(*Approximate only, pending confirmation.)

2. SUMMARY

2.1 Capital Cost

Capital expenditure for the proposed operation is \$191,000.

2.2 Operating Costs

The estimated operating expenditure to sustain the operation at Mount Bischoff is:

	Cost per Tonne all Material Mined \$A	Cost per Tonne Ore Mined \$A	Annual Expenditure \$A
Year 1	6.11	16.03	165,100
Year 2	5.82	17.58	156,500
Year 3	7.75	22.75	170,600
Year 4	10.71	22.42	143,500
Year 5	13.61	15.99	137,500

The operating cost estimate is based on costs directly associated with the mining operation, costs associated with maintenance of the Joint Venture and indirect head office corporate costs.

2.3 Operations

The following production rates of run of mine dolomite sulphide lode (DSL) tin ore are scheduled:

Year 1	10,300 tonnes @ 1.0% Sn (103 tonnes of tin)
Year 2	8,900 tonnes @ 1.2% Sn (102 tonnes of tin)
Year 3	7,500 tonnes @ 1.4% Sn (103 tonnes of tin)
Year 4	6,400 tonnes @ 1.6% Sn (103 tonnes of tin)
Year 5	8,600 tonnes @ 1.8% Sn (152 tonnes of tin)
Total	41,700 tonnes @ 1.4% Sn (563 tonnes of tin)

Mining the 41,700 tonnes of ore will involve 57,700 tonnes of waste, reporting an overall waste to ore ratio of 1.4:1.

The mining operation will be undertaken by two permanent Joint Venture employees stationed at Waratah. All equipment necessary for mining will be hired on an "as required" basis.

Flexibility of operations will allow for expansion of the operation at minimum expenditure.

2.4 Financial Evaluation

The forecast cash flow reflected in Table 4 is based on successful negotiation of a sales agreement similar in terms to those assumed in this study.

MOUNT BISCHOFF PROJECT

PRODUCTION AND EXPENDITURE SUMMARY
(Constant 1st Quarter 1982 \$A Terms)

	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Total		
1. Production									
DSL ore tonnes	-	10 300	8 900	7 500	6 400	8 600	41 700		
Grade % Sn	-	1.0	1.15	1.37	1.61	1.77	1.35		
Contained tin tonnes	-	103	102	103	103	152	563		
Waste tonnes	-	16 700	18 000	14 500	7 000	1 500	57 700		
Total material tonnes	-	27 000	26 900	22 000	13 400	10 100	99 400		
Waste:ore ratio	-	1.6:1	2.0:1	1.9:1	1.1:1	0.2:1	1.4:1		
		Cost per Tonne all Material Mined						Cost per Tonne Ore Mined	
2. Operating Costs									
		\$	\$	\$	\$	\$	\$	\$	
2.1 Labour	1.93	-	38 400	38 400	38 400	38 400	38 400	192 000	4.60
2.2 Drill hire	0.24	-	6 300	6 300	5 200	3 200	2 400	23 400	0.56
2.3 Drilling consumables & fuel	0.05	-	1 300	1 300	1 100	700	600	5 000	0.12
2.4 Loader hire and fuel	0.25	-	6 700	6 700	5 400	3 300	2 500	24 600	0.59
2.5 Truck hire and fuel	0.25	-	6 700	6 700	5 400	3 300	2 500	24 600	0.59
2.6 Explosives	0.77	-	20 800	20 700	16 900	10 300	7 800	76 500	1.83
2.7 Road up-grade	0.04	-	800	800	800	800	400	3 600	0.09
2.8 Dewatering	0.01	-	-	-	500	500	400	1 400	0.03
2.9 Services	0.08	-	1 500	1 500	1 500	1 500	1 500	7 500	0.18
2.10 Vehicle	0.17	-	3 500	3 500	3 500	3 000	3 000	16 500	0.40
2.11 Stockpile const. and maint.	0.30	-	10 000	5 000	5 000	5 000	5 000	30 000	0.72
2.12 Routine rehabilitation	0.60	-	-	-	20 000	20 000	20 000	60 000	1.44
2.13 Supervision and survey	1.11	-	26 400	26 400	26 400	15 500	15 500	110 200	2.64
2.14 Joint Venture Management	1.26	-	25 000	25 000	25 000	25 000	25 000	125 000	3.00
SUB-TOTAL	7.05	-	147 400	142 300	155 100	130 500	125 000	700 300	16.79
10% Contingency	-	-	14 700	14 200	15 500	13 000	12 500	69 900	
2.15 Environmental Requirements	-	-	3 000	-	-	-	-	3 000	
TOTAL	7.78	-	165 100	156 500	170 600	143 500	137 500	773 200	18.54
3. Capital Costs									
3.1 Pre-production Joint Venture Management	50 000	-	-	-	-	-	-	50 000	
3.2 Environmental Impact Statements & Approval	15 000	-	-	-	-	-	-	15 000	
3.3 Pre-production Access Works	25 000	-	-	-	-	-	-	25 000	
3.4 Site Preparation, Waste & Ore Piles	20 000	-	-	-	-	-	-	20 000	
3.5 General Infrastructure	20 000	-	-	-	-	-	-	20 000	
Contingency @ 15%	20 000	-	-	-	-	-	-	20 000	
3.6 Working Capital	-	41 000	-	-	-	-	-	-	
TOTAL	150 000	41 000	-	-	-	-	-	191 000	

3. OPERATION DESCRIPTION

3.1 General

Mining will be by open pit mining techniques. An initial mine life of 5 years is considered. Provision is made for extension of mine life in that the proposed pit can be extended and/or other similar near surface high grade ore occurrences can be exploited.

Permanent Joint Venture employees will undertake all aspects of mining using hired equipment. Equipment maintenance is the responsibility of the equipment supplier.

Waste material will be dumped into "Happy Valley" locality and ore will be stockpiled in the "Alan's Workings" area.

Compliance with the condition that in excess of 101.6 tonnes of contained tin per annum must be mined requires the mining of a minimum of 27,000 tonnes of material in Years 1 and 2 reducing to 10,100 tonnes in Year 5.

Management of the operation will be from Melbourne and involve (Registered Manager) monthly visits to site by a MBJV representative.

3.2 Mined Ore Reserves

The mined ore reserve calculations are based on the Stage IV geological ore reserve estimate.

A 90% recovery of geological ore reserves and a 20% dilution of geological ore reserves by barren waste has been applied.

It is estimated that 41,700 tonnes of DSL type ore at an average grade of 1.4% Sn will be produced over the 5 years of mine life, ie. 563 tonnes of contained tin.

3.3 Material Movement Schedule

The annual material movement schedule is set out in Table 1.

Incremental material movement details are given in Table 2.

The total material distribution of the open pit is given in Table 3.

3.4 Pit Design and Stockpile Locations

The general location of the open pit waste dump and ore stockpile is given in Figure 1. Allowance has been made for stockpile site preparation and run-off drainage control if required.

3.5 Environment

An Environmental Impact Statement will be prepared for presentation to the Tasmanian Government prior to proceeding with the operation. Routine rehabilitation activities on the mine site are scheduled during the latter years of the mine life.

3.6 Sales

Negotiation of a sales agreement with an off-site treatment plant will take into account the following factors:

3.6.1 Reclaim and Haulage Costs

The ore stockpiled at Mount Bischoff will be reclaimed and transported by road to the designated treatment plant. Reclaim and haulage costs are estimated at \$0.25 per tonne per kilometer.

3.6.2 Metallurgical Performance

Detailed metallurgical testwork has shown that Mount Bischoff DSL ore can be treated by hard rock tin processing plants located in Tasmania to produce concentrates of marketable grade at acceptable recoveries.

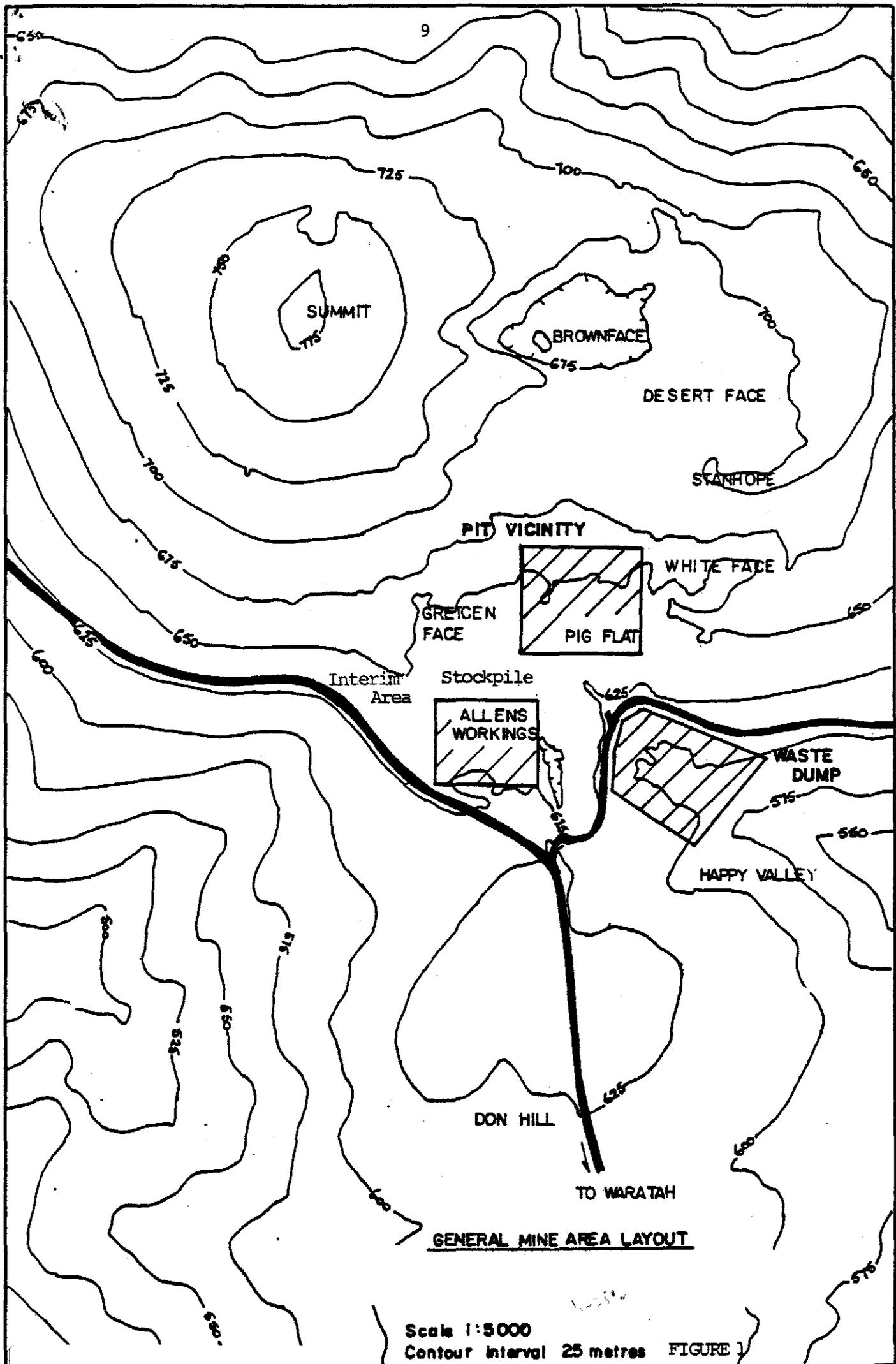
3.6.3 Sale Price for Ore

Determination of the indicative net treatment plant realization per tonne of ore treated will influence sales price for ore. Terms for sale of the ore cannot be specified until a sales agreement with an offsite treatment plant has been finalised.

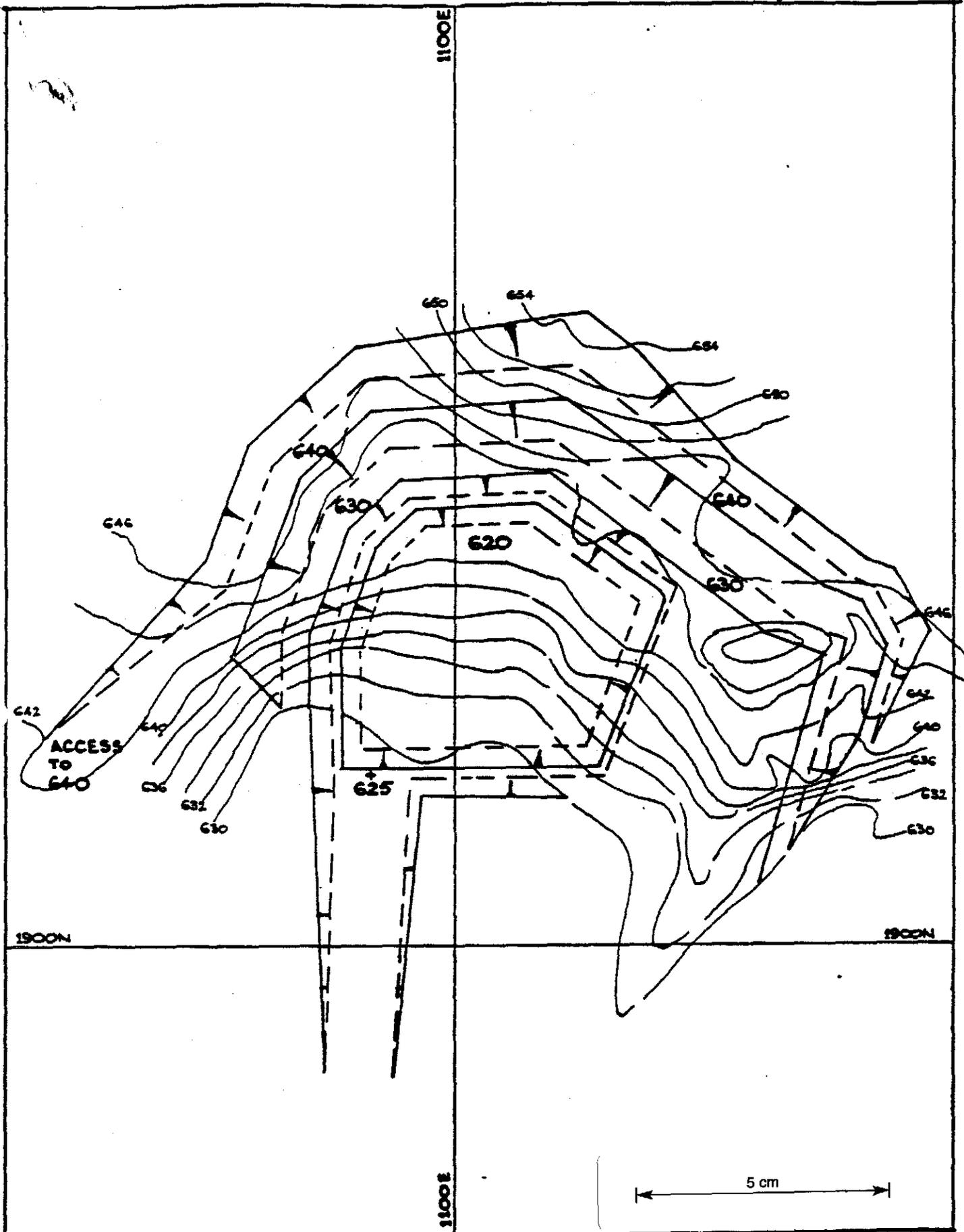
The sale price for the ore has been estimated by deducting from the value of the tin contained a percentage to allow for metallurgical losses in the treatment process, smelter charges, costs of treatment, haulage and reclaim, and an appropriate profit margin for the treatment plant operator.

The resulting mine site sale prices based on a tin price of \$M29.39 per kg are as follows:

Head Grade	Proportion of Gross Value Realised	Ore Sale Price
% Sn	%	\$A per tonne
1.0	15.9	21.20
1.2	19.4	31.10
1.4	22.5	42.00
1.6	24.7	52.80
1.8	26.5	63.60



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FINAL PIT PROFILE

SCALE 1:500

DATE 10/12/82

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Table 2

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INCREMENTAL MATERIAL MOVEMENT SCHEDULE

Year	Bench	DSL		Contained Tin Tonnes	Waste Tonnes	Total Tonnes
		Tonnes	% Sn			
1	640	3,500	0.71	24.8	6,700	10,200
	630	6,800	1.15	78.2	10,000	16,800
	Total	10,300	1.00	103.0	16,700	27,000
2	640	-	-	-	13,000	13,000
	630	8,900	1.15	102	5,000	13,900
	Total	8,900	1.15	102	18,000	26,900
3	630	3,700	1.15	42.6	7,500	11,200
	625	3,800	1.59	60.4	7,000	10,800
	Total	7,500	1.37	103	14,500	22,000
4	625	5,600	1.59	89.0	6,500	12,100
	620	800	1.77	14.2	500	1,300
	Total	6,400	1.61	103.2	7,000	13,400
5	620	8,600	1.77	152	1,500	10,100
	Total	8,600	1.77	152	1,500	10,100
GRAND TOTAL		41,700	1.35	563.2	57,700	99,400

MOUNT BISCHOFF PROJECT

MATERIAL DISTRIBUTION OF OPEN PIT

Level	Area m ³	Volume m ³	Advance	Volume m ³	DSL - GOR		DSL - MOR		Remaining Volume m ³	Waste Tonnes	Total Tonnes	
					Tonnes	% Sn	Tonnes	% Sn				
654	19	19										
652	80	99										
650	124	204										
648	194	318										
646	521	715										
644	862	1,383										
642	1,434	2,296										
640	1,465	2,899	640	7,933	3,350	0.82	3,500	0.71	1,033	6,900	19,700	
638	1,255	2,720										
636	1,248	2,503										
634	1,303	2,551										
632	1,442	2,745										
630	1,661	3,103	630	13,622	18,520	1.34	19,380	1.15	5,715	7,907	22,500	
625 ADV	1,500	7,500	625	7,500	9,000	1.85	9,420	1.59	2,777	4,723	13,500	
620 ADV	607	3,485	620	3,485	8,990	2.06	9,410	1.77	2,774	711	2,000	
TOTAL					39,860	1.57	41,710	1.35			57,700	99,410

Ore Level

Block Name

W:O = 1.4:1

645	6(1)
640	13(1), 12
635	1/4 x 16, 17, 18, 19
630	3/4 x 20, 21, 22
625	.85 x 23, 26
620	29

Table 3

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MOUNT BISCHOFF PROJECT



3. Pig Flat Looking North on 1120E

4. CAPITAL COST

Provision is made for pre-production and working capital expenditure of \$191,000 (refer Table 1).

5. OPERATING COSTS

A summary of the onsite operating cost estimates are given in Table 1.

The basis of the onsite operating cost estimates is given in Appendix 7.1.

Cost estimates are expressed in 1st Quarter 1983 \$A terms.

6. FINANCIAL EVALUATION

A cash flow summary expressed in constant 1st Quarter 1983 \$A terms is reported in Table 4.

A tin price of \$M29.39 per kg was used (18th February, 1983, Penang price).

The following exchange rates (18th February, 1983) were applied:

\$US =	\$M 2.27
\$A =	\$US 0.97

Income tax was calculated at an effective rate of 46%. It was assumed that the operation would be 100% equity financed. A royalty rate of the lesser of 2.5% of sale receipts or 5% net operating profit was applied.

Depreciation was applied over life of mine provision for investment allowance or residual value has been included in cash flow estimates.

MOUNT BISCHOFF PROJECT

INDICATIVE CASH FLOW FORECAST (Constant 1st Quarter 1983 \$A Terms)

	Year	-1	1	2	3	4	5
1. Capital Costs (Establishment) \$A		150 000	41 000	-	-	-	-
2. Saleable Product							
Tonnes	tonnes	-	10 300	8 900	7 500	6 400	8 600
Grade	% Sn	-	1.0	1.2	1.4	1.6	1.8
3. Minesite Realisation from Sale of Run of Mine Ore	\$A	-	218 400	276 800	315 900	338 000	547 300
4. Mine Operating Costs	\$A	-	165 100	156 500	170 600	143 500	137 500
5. Minesite Realisation less Mine Operating Costs less Established Costs	\$A	-	13 200	120 300	144 400	194 500	409 500
6. Royalty Payments	\$A	-	600	6 000	7 200	9 700	20 500
7. Depreciation	\$A	-	30 000	30 000	30 000	30 000	30 000
8. Taxable Income	\$A	-	(18 300)	65 900	107 200	154 800	359 000
9. Income after Taxation	\$A	-	(18 300)	35 600	57 900	83 600	193 900
10. Cash Flow	\$A	(150 000)	11 700	65 600	87 900	113 600	223 900
11. Cumulative Cash Flow	\$A	(150 000)	(138 300)	(72 700)	15 200	128 200	352 700

7. APPENDICES

MOUNT BISCHOFF PROJECT
OPERATING COST CALCULATION

1. Equipment hire rates, quoted 11/2/83, by Atlas Copco and Jones-Streets Constructions are:

Air track drill and compressor	\$339 per week
Loader (International 60C, 1.5 yd ³)	\$20 per hour
Tipper (10 yd ³)	\$20 per hour

These rates are all inclusive excepting labour and fuel.

Equipment hire rate quoted 6/12/81 by J. Fagan is:

Dozer TD15	\$50 per hour
------------	---------------

This rate is all inclusive.

2. Operating Cost Calculations

- 2.1 Labour

Proposal is for full time employment of two people on site:

Base wage per 40 hour week per man	\$281	
Site allowance per week per man	\$10	
Total weekly wage per man		\$291

Annual cost per man		
48 weeks @ \$291 per week	\$13 968	
4 weeks annual leave		
@ \$291 per week x 1.2	\$1 397	
Total annual wage		\$15 365

Total cost for two employees

Annual direct cost 2x \$16 000 (say)	\$32 000
Overheads cost factor 20%	\$6 400
Total	\$38 400

- 2.2 Drilling

Atlas Copco ROC 301-01	\$175 per week hire
Atlas Copco XAS 350	\$164 per week hire
Total	\$339 per week hire

Assume production of 300 m^3 per 8 hour shift. For W:O ratio of 1.4:1 the weighted average material SC = 3.12. Drill requirements are set out below:

Year	1	2	3	4	5
No. hiring at 5 days per hire	6	6	5	3	2
Hire cost (\$)	3340	3340	2700	1700	1400
Mobilization/demobilization (\$)	3000	3000	2500	1500	1000
Total annual cost (\$)	6340	6340	5200	3200	2400

2.3 Explosives

To achieve good fragmentation (to permit use of small loader) and to minimise dozer requirements, the following assumptions are made:

- . powder factor = 0.25 kg/tonne.
- . 100% of material will be blasted.
- . packaged explosive cost \$2,800 per tonne.
- . accessories cost is 10% of explosives cost.
- . no explosives storage facilities required on site: supply is drawn from existing ICI magazine as required.

Hence direct explosives cost per tonne fired:

$$(0.25 \times \$2,800/1,000) \times 1.1 = \$0.77$$

Explosive magazine

2.4 Loading and Hauling

Assume basis of operation is small scale loader (ie. 1 m^3) and 10 yd^3 tipper, hired on an "as required" basis.

Hire of units without operator and excluding fuel cost is \$20 per unit per hour.

Assume loading/hauling rate is 100 tonnes per hour

$$\begin{aligned} \text{Hence loading cost} &= (\$20 + \text{fuel cost})/100 \text{ per hour} \\ &\text{where fuel cost} = 13 \text{ l/hr} \times \$0.28 \\ &= \$3.64 \\ &= \$0.24 \text{ per tonne} \end{aligned}$$

$$\begin{aligned} \text{Hauling cost} &= (\$20 + \text{fuel cost})/100 \text{ per hour} \\ &\text{where fuel cost} = 13 \text{ l/hr} \times \$0.28 \\ &= \$3.64 \\ &= \$0.24 \text{ per tonne} \end{aligned}$$

Mobilization and demobilization of truck and loader:

Say 2 hour per hire at \$40 per hour
 = \$80 per hire
 Say 5 hirings per year for 27,000 tonnes
 then cost per tonne
 = $(5 \times \$80)/27,000$
 = \$0.015

2.5 Dewatering

Pump hire cost estimate only.

2.6 Road Upgrade

Allow hire of dozer and operator for 16 hours per year at \$50 per hour:

Dozer hire cost = $16 \times \$50$
 = \$800

2.7 Supervision and Survey Costs

Assume supervision/engineering requirement is four days per month.)

Monthly costs:

Salary @ \$450 per day	\$ 1,600	??
Travel @ \$180 + \$180 + \$40/trip	\$ 400	
Food and incidentals/trip	\$ 100	
Total per Month	\$ 2,100	
Annual Total	\$25,200	

Check survey:

Allow two surveys per year of 3 days total per session at \$20 per hour for $(3 \times 8) + 3$ hrs travelling.

Annual cost = $\$20 \times 27 \times 2 =$	\$1,080
Allowance for consumables	\$ 120
Total annual survey cost	\$1,200

Total annual supervision and survey cost
 = $\$25,000 + \$1,200$
 = \$26,400

2.8 Vehicle Cost

Assume retain existing vehicle on site.

Assume annual - maintenance cost	\$2,000
- petrol cost	\$1,000
- insurance and registration	\$ 500
Total annual cost	\$3,500

2.9 Services Costs

Assume power, telephone and sundries, annual cost = \$1,500.

MOUNT BISCHOFF PROJECT
MINED ORE RESERVE CLASSIFICATION

Section	Block N ^o	Tonnes	% Sn	Status
1100	1	11,900	0.89	Possible
	2	33,180	2.06	Probable
	3	4,760	0.84	Possible
	4	3,290	0.61	Probable
	5	3,170	1.57	Probable
	6	1,890	0.45	Possible
1120	1	10,990	2.06	Probable

MOUNT BISCHOFF PROJECT
APPRAISAL OF MINING TARGET ZONES

1. Objectives

- . To mine 102 tonnes contained tin per annum.
- . Duration: several years.
- . Minimum cost, ie. low waste:ore ratio and high ore grade.
- . Maximum "back-up".

2. Target Zones

Four target zones identified:

1. Western end of Greisen Face
 - Adv. Easy access
Good drainage
High grade ie. 1%
Two expl holes
 - Disadv. Maximum 2 years at 100t Sn/yr
2. Upper levels Greisen Face
 - Adv. Easy access initially
 - Disadv. Grades not high ie. 1%
Drainage problems
"Stringer" style mineralisation
Difficult access in medium term
3. Hangwall DSL near Surface
 - Adv. Easy access
High grade ie. 1%
Relatively large tonnage
 - Disadv. Drainage problem
Higher grade ore at depth
4. Footwall DSL near Surface
 - Adv. Easy access
 - Disadv. Difficult mining
"Possible" category
Little "fall back" position potential

3. Assessment Detail

3.1 Western End Greisen Face

Reserves 1% Sn : 17,000 tonnes at 1.2% Sn
Contained Tin : 212 tonnes
Waste : 78,000 tonnes
Total Material : 96,000 tonnes
Waste to Ore Ratio : 4.6:1
Fall-back : Very limited
Life (@ 100t Sn/Yr) : 2 years

3.2 Hanging Wall DSL near Surface

Reserves 1% Sn : 38,000 tonnes at 1.4% Sn
Contained Tin : 532 tonnes
Waste : 55,000 tonnes
Total Material : 93,000 tonnes
Waste to Ore Ratio : 1.5:1
Fall-back : Excellent
Life (@ 100t Sn/Yr) : 5 years

4. Recommended Target

The recommended target is the Hanging Wall DSL near surface.

MOUNT BISCHOFF PROJECT

EQUIPMENT HIRE QUOTATION

(Source - J. Fagan)

Dozers TD 15	\$50 per hour
Loader Hough 65 2.5 Metre Bucket	\$35 per hour
12 Yd Tippers	\$30 per hour
Prime Mover and Float	\$45 per hour
Atlas Copco Air Track	\$60 per hour
Labour apart from Plant Operators	\$15 per hour