TCR 79-1330

BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES

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CENTRAL TASMANIAN TUNGSTEN PTY. LTD.

A RESUME OF THE PROJECT

BY

M. J. LAWRENCE

78/SYD/18
SEPTEMBER, 1978

B.R.G.M. AUSTRALIA

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INTRODUCTION

Central Tasmanian Tungsten Pty. Ltd., a joint venture to exploit the old Mt. Pelion wolframite mine located near Sheffield, Tasmania, is a consortium of French and Australian mining interests, which have considerable expertise and experience. The new mine is called *Oakleigh Creek*.

This resumé outlines who are the partners, the general scope of the proposed development and specific information on the mining method, treatment of the ore and tailings disposal.

When the mine commences operations, probably in the first half of 1979, it will have a production of 100 tonnes per day of ore. The majority of workers will have permanent accommodation at Sheffield or other towns in the area, but there will be portable housing on site for single men. The capital cost of the project is expected to be A$1.5 - A$2 million and on current reserves the mine will have a life of 5 years. Shrinkage stoping will be the mining method and the ore will be treated by conventional gravity methods (jigs and tables), which also incorporate a wet high intensity magnetic separator circuit. Since physical separation techniques will be used, tailings disposal will be fairly simple. A small tailings dam will be located just north of Reid Creek.

Although quite a small enterprise directly employing no more than 25 men, it will provide, nevertheless, new employment opportunities and generate useful export income from the projected production of 250 tonnes per year of wolframite concentrates (currently valued at around A$2 million). The partners are acutely aware of the environmental impact of this development so close to a magnificent National Park and believe that the data presented herein will demonstrate that the impact will be minimal. The mining and metallurgical techniques employed are simple and well known to have little effect on the environment. Tailings disposal is facilitated by the absence of chemical processes in the ore treatment and the uncomplicated ore and relatively unreactive ore mineralogy. Even the country rock, a hard, durable quartzite, will pose no problems as it will not readily breakdown and make erosion and landslips a visual problem. Similarly the mill water discharge will be low in solids and chemical impurities.

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The initial section was prepared by B.R.G.M. *Australia*, an associate company of *Serem (Australia) Pty. Ltd.*, and a subsidiary of the internationally experienced French Government geological consultant agency, *Bureau de Recherches Géologiques et Minières*. It discusses the project's location and access, ownership, relevant agreements and tenement situation, and briefly describes the geological setting, ore reserves and sampling methods, and finally the mining approach to be adopted.

The mill design and explanation of the metallurgical process to be adopted was proposed by *Dravo Pty. Ltd.*, the Australian subsidiary of the well known American engineering and construction consultant group, *Dravo Corporation*. The tailings disposal problem has been studied by *W. L. P.U. Consultants (Australia) Pty. Ltd.*, the local subsidiary of the British consulting engineering and environment specialist firm of *Watermeyer, Legge, Piesold & Uhlmann*. Their assessment of the environmental impact of the tailings disposal form the last part of this resumé.

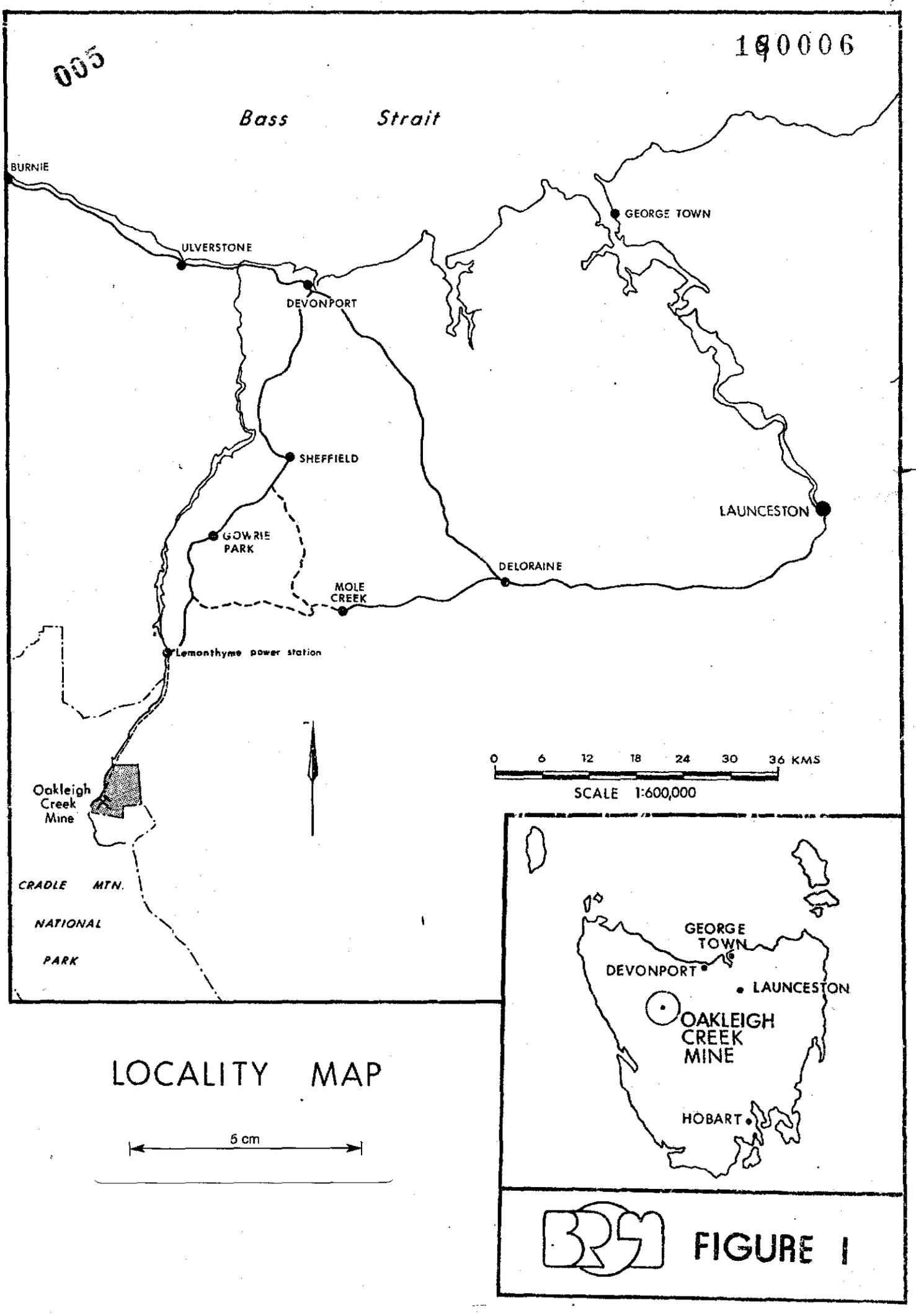
1. LOCATION AND ACCESS (See Figures 1, 2, 3 and Plate 1)

The mine site is situated on the eastern side of the upper Forth River Valley, in rugged, mountainous, isolated terrain, where the rain fall averages 2.54m (100") per year. (See Figure 1) To the west, on the opposite side of the Forth River, is located the Cradle Mountain - Lake St. Clair National Park, having the river as its eastern boundary. The Forth River flows north, discharging into the Bass Strait near Devonport.

At present the mine can be reached from Launceston or Devonport by sealed road as far as the Lemonthyme Power Station, which is 26 km from the mine via a gravel road of variable quality. The section from Lemonthyme Power Station to the mine will take up to 1 hour to travel. It takes about 2 hours from Launceston to Lemonthyme and 1 hour from Devonport (see Figure 2).

The distances from the mine site to significant towns in the area are shown below:

Launceston	150 km	(93 miles)
Devonport	99 km	(62 miles)
Burnie	151 km	(94 miles)
Sheffield	66 km	(41 miles)
Mole Creek	63 km	(39 miles)
Gowrie Park	52 km	(33 miles)



LOCALITY MAP

5 cm

BRS

FIGURE 1

The *J. T. Gunn Lumber Company* maintains the first 13km of the gravel road and will continue to do so for some years to come.

Launceston and Devonport airports provide daily flights to Melbourne and Hobart. Burnie and Devonport are marine ports, as well as providing contractors and repair shops. Explosive supplies would come from Burnie. Food supplies would come from Sheffield. Mole Creek is the nearest railhead, but Railton is more convenient. A sawmill also operates at Mole Creek.

2. PROJECT OWNERSHIP

Participants in the joint venture, which will be operated through a trustee company, *CENTRAL TASMANIAN TUNGSTEN PTY. LTD.*, are as follows :-

TRIAKO MINES N.L.	33 1/3%
BUKA MINERALS N.L.	33 1/3%
SEREM (AUSTRALIA) PTY. LTD.	33 1/3%

SEREM (AUSTRALIA) PTY. LTD. is a wholly owned subsidiary of *Société d'Etudes, de Recherches et d'Exploitations Minières* (S.E.R.E.M.) which is itself a wholly owned subsidiary of *Bureau de Recherches Géologiques et Minières* (B.R.G.M.), a mining and geological agency of the French Government.

BUKA MINERALS N.L. and *TRIAKO MINES N.L.* are both listed on the Australian Stock Exchange, but *Triako* owns 58% of *Buka*.

Recently, *AQUITAINE (AUSTRALIA AND NEW ZEALAND) LIMITED* acquired 42% of the shares in *Triako*, and has an option to increase this to 60%. The parent company of *Australian Aquitaine* is *Société Nationale Elf Aquitaine* (SNEA), 92%, with the remainder held by Australian institutions and investors. SNEA is itself owned by *Enterprise de Recherches et d'Activités Pétrolières* (ERAP) 70%, and *Société Nationale des Pétroles d'Aquitaine* (SNPA). ERAP is also a French Government agency.

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3. AGREEMENTS AND TENEMENT SITUATION (See Plate 1)

SCAMANDER MINING CORPORATION N. L. and *LOUISA MINING CORPORATION N.L.*, by virtue of an Agreement between them dated June 30,1976, hold three Tasmanian Mining Leases covering 80 ha. (210 acres), which are valid for 21 years, over the old Mt. Pelion lodes : No 60M/69 (granted 1.4.69), 60M/71 and 59M/71 (granted 1.10.71). These leases were the subject of an Option Agreement between these companies and *KIBUKA MINES PTY. LTD.* (acting on behalf of *Triako* and *Buka*, and being a wholly owned subsidiary of the latter) dated June 2, 1977.

The Option period originally expired on July 2, 1977,but was extended to February 15, 1978, when it was exercised. On exercise of the Option, *Kibuka Mines* agreed to pay the vendors $100,000 over a period of five years as specified below :-

$10,000	ten calendar months after the effective date 15/4/78 (2 months after the Option date)
$20,000	before the second anniversary of the effective date
$23,333	on each of the next successive anniversaries of the effective date until the $100,000 is paid.

In addition, $2,000 was paid to the vendors to obtain the extension of the Option period.

These leases were then offered to *Serem (Australia) Pty. Ltd.*, as part of an option package, which also included the Tasmanian Exploration Licence 5/77 "River Forth" (which expires on 4/11/78). An area of common exploration interest was also defined as "all that area extending in any direction for a radius of 20 km from the 240m (780ft) adit level portal of the old workings." This option agreement between *Serem-Triako-Buka* was signed on July 26, 1977, with an exercise date of 31/1/78. The location of the leases and Exploration Licence are shown on Figure 2.

In the option period, *Serem* was required to carry out a geological examination of the area and a reassessment of the feasibility of establishing a wolfram mining project there. In addition, *Serem* provided $35,000 towards the upgrading of the access road to the mine site.

Serem carried out this programme, exercised on the due date,and thereupon was entitled to purchase a 33 1/3% interest in the project on the following terms :-

> Payment of $330,000 in three installments, $110,000 on effective date (31/1/78), $110,000 one month after the effective date, and $110,000 two months after the effective date.

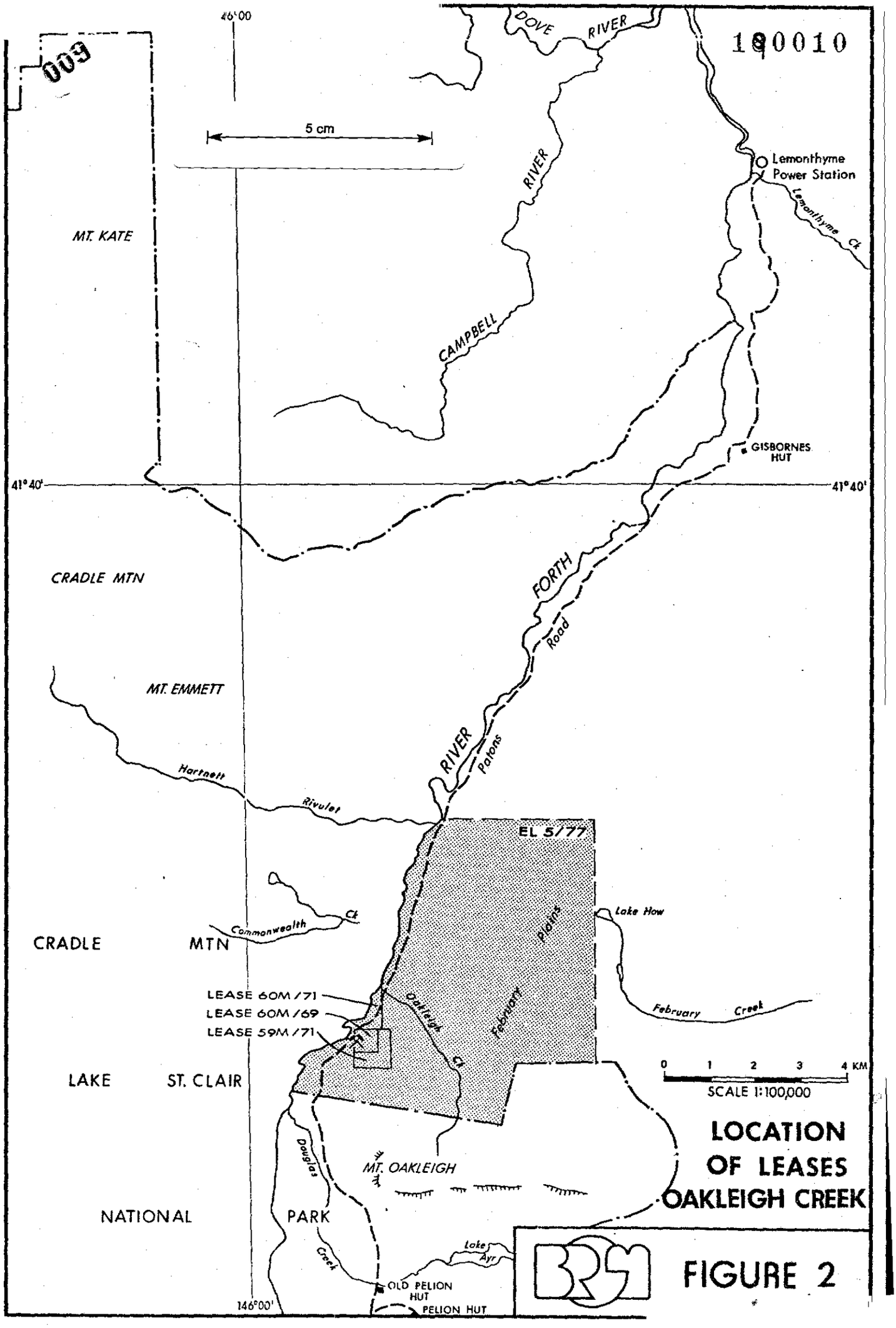
This money was to be used for the mine development programme and was duly paid. Shares in the venture are now held as follows :-

Triako 33 1/3%; *Buka* 33 1/3%; *Serem* 33 1/3%

Any funds required for the purposes of the joint venture in excess of the $330,000 provided by *Serem* will be contributed by the parties in proportion to their interest.

Serem is the mining and exploration operator responsible to a Management Committee, which comprises representatives of *Serem*, *Triako* and *Buka*, voting in accordance with the percentage share of each party.

Kibuka have entered into an option agreement dated 26/6/78 with L. M. Graue and W. P. Kidd over Mineral Lease 24M/60 which covers the All Nations Mine, Moina. This is a free option with an exercise date of 26/6/79 and a purchase price of $26,000. As it lies within the area of common exploration interest referred to previously, *Serem* has been given the right to earn 33 1/3% interest in the property by carrying out all necessary exploration and appraisal in the option period. If it is agreed to exercise, *Serem* would contribute one-third of the purchase price of $26,000 and one third of monies spent on exploration would be refunded to *Serem* by *Triako* and *Buka* out of profits from the operation of the Oakleigh Creek mine.


009
46°00
5 cm
DOVE RIVER
190010
RIVER
Lemonthyme Power Station
Lemonthyme Ck
MT. KATE
CAMPBELL
GISBORNES HUT
41°40'
41°40'
CRADLE MTN
FORTH
Road
MT. EMMETT
RIVER
Patons
Hartnett
Rivulet
EL 5/77
Commonwealth
Ck
Lake How
Plains
CRADLE
MTN
LEASE 60M/71
LEASE 60M/69
LEASE 59M/71
Oakleigh
February
February Creek
0 1 2 3 4 KM
SCALE 1:100,000
LAKE
ST. CLAIR
Douglas
MT. OAKLEIGH
LOCATION OF LEASES OAKLEIGH CREEK
NATIONAL
PARK
Creek
Lake Ayr
OLD PELION HUT
PELION HUT
146°00'
BRGM
FIGURE 2

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4. GEOLOGICAL SETTING (See Figure 3)

In the Forth Valley the rock types include quartzite, mica schist and quartz mica schist of the Fisher Group with a general strike slightly east of north and dips of between 15° and 30° to the south-east. At the Oakleigh Creek mine the strike varies from 082° to 109° magnetic and dips from 15° to 27° in a northerly direction. The metasediments are abundantly veined by white quartz and locally sheared along planes trending north-north-west. These shear planes served as structural controls in the localization of copper and wolfram mineralisation in the Forth Valley. Most of the rocks have been derived from orthoquartzite and siltstone and metamorphosed to greenschist facies.

Two small granitic intrusions (adamellite of mid-Devonian age) occur within the EL, the Birthday and Lone Pine Granites. They are the source of the wolfram, tin and copper mineralisation in this district. The granite is discordantly intrusive into the Precambrian quartzite and quartz-mica schist of the Fisher Group. The granite contains biotite and muscovite (with the latter predominating in some exposures), pinkish white feldspar and coarse quartz. Tourmaline, molybdenite and arsenopyrite have been noted. Near its contact the granite commonly develops large phenocrysts of feldspar and abundant biotite. The granite is associated with several small quartz veins which in the past were prospected for tin and wolfram (nearby Lone Pine and Birthday prospects).

Wolframite (with very minor cassiterite) mineralisation at the Mt. Pelion mine occurs in a quartz vein which cuts Precambrian quartzite. The ore grade for the vein averages 3 to 4% WO_3. Table 1 shows the chemical and mineralogical composition of a typical ore concentrate. The strike of the quartz vein varies somewhat, but is generally 170° to 175° with a dip of 75° to the east. The wallrock dips to the north at 25° and strikes 095°. As exposed in the adit, the vein splits and rejoins several times so that the mineralisation actually occurs in a zone rather than a single vein, but it is not a particularly complex system with no significant faulting being observed. Average thickness of the vein fissure is 39cm. The ore veins resemble those at Storey's Creek and Rossarden, except that they have less cassiterite and fluorite and lack muscovite and pyrite selvedges along the vein. Overall, the sulphide content appears low.

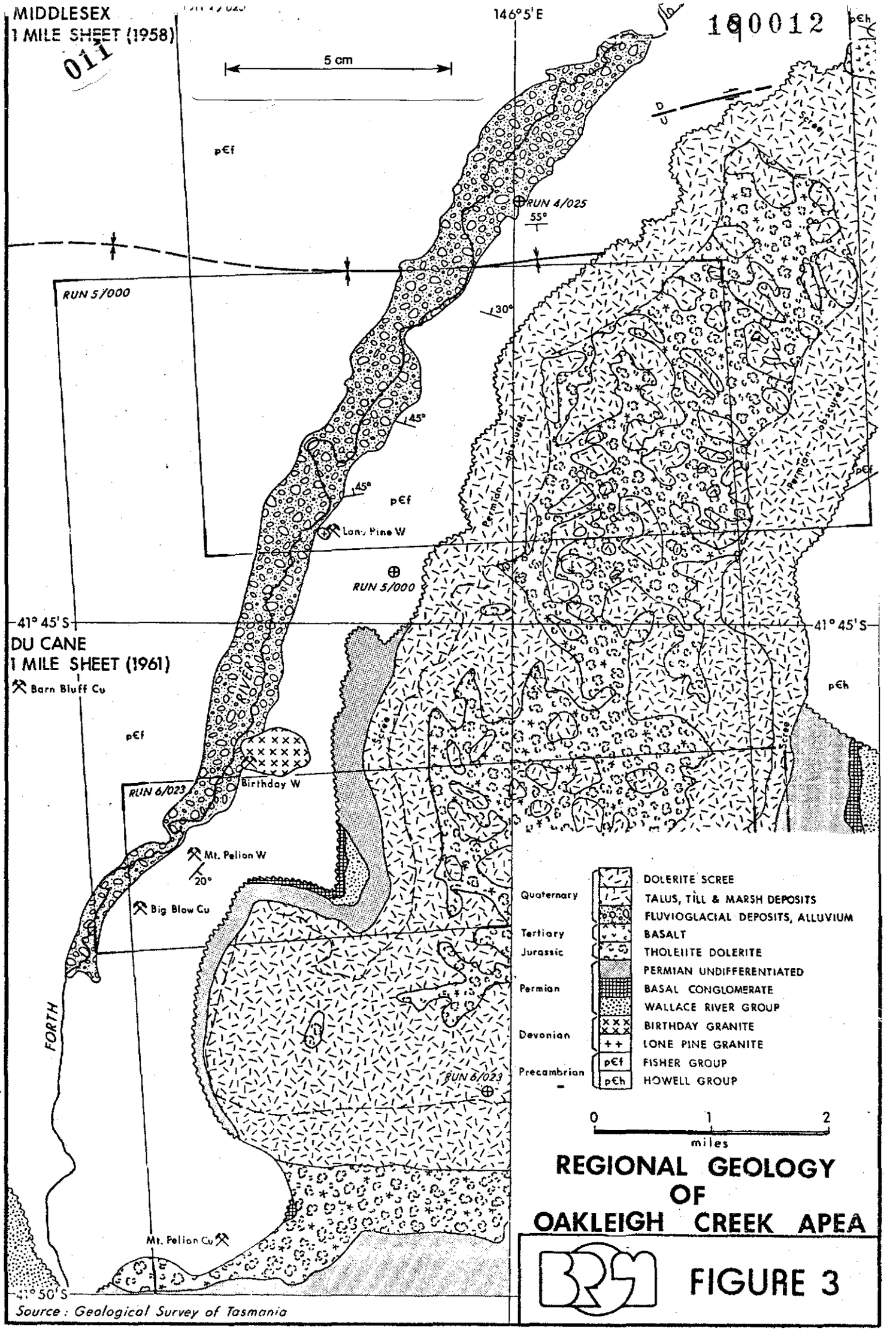

MIDDLESEX
1 MILE SHEET (1958)
011
146°5'E
190012
5 cm
pEf
RUN 4/025
55°
RUN 5/000
30°
45°
45°
pEf
Lone Pine W
RUN 5/000
41° 45'S
41° 45'S
DU CANE
1 MILE SHEET (1961)
Barn Bluff Cu
pEf
RIVER
RUN 6/023
Birthday W
Mt. Pelion W
20°
Big Blow Cu
FORTH
RUN 6/023
Mt. Pelion Cu
41° 50'S
pEh
Quaternary
Tertiary
Jurassic
Permian
Devonian
Precambrian
DOLERITE SCREE
TALUS, TILL & MARSH DEPOSITS
FLUVIOGLACIAL DEPOSITS, ALLUVIUM
BASALT
THOLEIITE DOLERITE
PERMIAN UNDIFFERENTIATED
BASAL CONGLOMERATE
WALLACE RIVER GROUP
BIRTHDAY GRANITE
LONE PINE GRANITE
pEf FISHER GROUP
pEh HOWELL GROUP
0 1 2
miles
REGIONAL GEOLOGY
OF
OAKLEIGH CREEK APEA
FIGURE 3
Source : Geological Survey of Tasmania

TABLE 1

CHEMICAL & MINERAL COMPOSITION OF TYPICAL ORE CONCENTRATE

CHEMICAL ANALYSIS		MINERALOGY		
Element	%	Mineral	%	Element
WO_3	68.0	Wolframite	45	W,Fe,Mn
Sn	0.108	Tourmaline	30	Fe
As	0.244	Arsenopyrite	1	As, S
Sb	0.010	Quartz	5	-
Bi	0.29	-	-	-
S	3.44	Muscovite	3	
P	0.14	Siderite	3	Fe
Pb	0.02	Goethite	4	Fe
Zn	0.74	Sphalerite	1	Zn,S
Cn	0.53	Chalcopyrite	1	Cn,S
Mo	0.014	Pyrite	2	Fe, S
Mn	2.38	Pyrrhotite	1	Fe, S
Fe	40.5	Ferrosilicon$^{\phi}$	6	Fe

* Source : AMDEL REPORT GS 48/79 (14.6.78) by K. Henley with concentrate assays recalculated to 68% WO_3 grade based on bulk sample from 240m adit.

ϕ Contaminated from heavy media cyclone.

5. ORE RESERVES AND SAMPLING METHODS EMPLOYED (See Figure 4)

In 1951, J. Elliston, a Tasmanian Government geologist, reported that there were 68 tons extracted from the drive prior to 1919, and possibly not included in the production statistics 1944-1948 (27.5 tons from the underhand stope; and at least 200 tons from the surface trench workings) for 5.145 tons of concentrates. At the time of his visit, the vein has been opened at the 240m level by an adit some 40m long, and by 15m of shallow trenching on the surface up the hillside. Also, about 12m of underhand stoping had taken place in the drive. He further stated that if the material from the drive is included, "*the grade is about 1.1% WO_3, whereas if this material had been previously treated the grade worked out on 227½ tons (say 250 for margin) is 1.3% WO_3. Because of the very inefficient method used for refining the ore, which was broken by hand, sluiced and jigged in a primitive home made jig, the recovery was probably as low as 50%. Thomson's estimated grade of 1.5 % WO_3 is then almost certainly an underestimate and a more probable grade would be 1.7 - 1.8% WO_3.*" His impression on inspection was about 1 - 2% WO_3, so he took 1.7% WO_3 as the grade,

Mineralization in the main vein system (Tunnel Lode) exposed by the 240m adit consists of blades, plugs, splashes and blebs of wolframite in a milky white quartz vein. Thin needles of tourmaline are common in the country rock and margins of the veins, but are readily distinguished from wolframite. Because of the nature of the mineralization, which occurs randomly within but not outside the quartz vein, point counting was considered a reasonable sampling method.

Also, the average grades obtained from a bulk sampling programme agreed fairly well with the point counting results over the same section (See Table 2).

TABLE 2

COMPARISONS OF ORE GRADE MEASUREMENTS METHODS

Survey	Method	Grade (%WO_3)	Vein Width(cm)
Casey 1977	Bulk Sampling - 154m	3.17	N/A
Casey 1977	Point Counting 154m	2.96	35.3
Ayling 1978*	Point Cointing 154m	3.76	37.8
Ayling 1978	Point Counting 168m	4.11	40.0
Casey 1978	Point Counting 168m	3.75	39.5

* In 1978, all veins regardless of size, were counted and the points measured were not the same, although the distance was still 154m.

This method consists of taking measurements of the linear amount of wolframite present along lines normal to the strike of the vein at one metre intervals. Where more than one vein occurred, all veins were counted. Since the 1977 work, the 240 level adit has been stripped to 2.1m x 2.1m and extended, exposing fresh surfaces in the backs of the adit. During the 1978 work, 168m of adit was re-mapped and point counted. The adit will be initially lengthened to 254m.

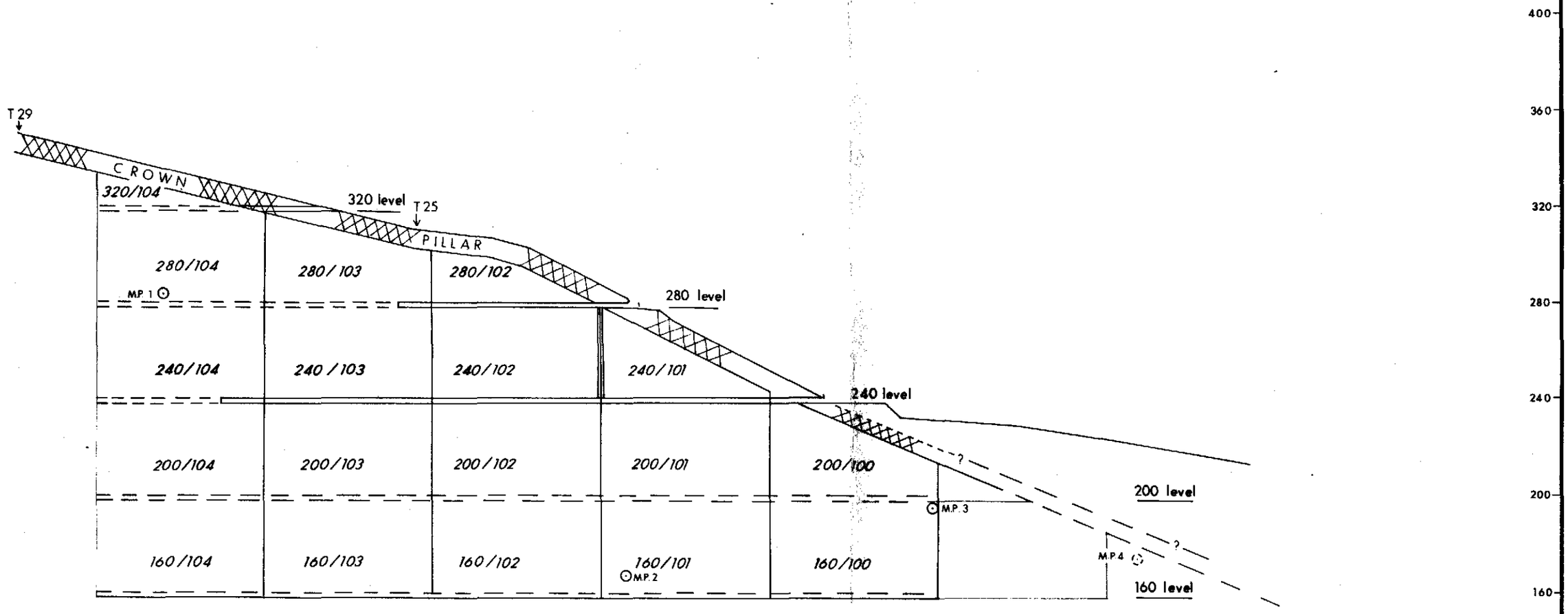
The width of wolframite along each of these lines was measured as well as the width of the vein or veins. The percentage of wolframite was calculated according to the following formula :-

$$\% \text{ Wolframite} = \frac{\text{width w} \times \text{S.G.w}}{(\text{width w} \times \text{S.G.w}) + \text{width q} \times \text{S.G.q}}$$

S.G. quartz 2.65, S.G. wolframite 7.25

$$\% WO_3 = \text{Wolframite} \times 0.76$$

An average grade for the length of the adit was obtained by weighting the WO_3 value obtained by the relevant vein width factor. Four holes were drilled (381m) in late 1977 to test the lateral and vertical extent of the vein. No assays were taken of vein material because of the inaccuracy inherent is using such a small sample. Ore reserves have been recently calculated using a mining width of 1.4m, S.G. of ore of 2.65, the vein extent determined by drilling and adit development, and grade by point counting. It is estimated that there are 163,000 tonnes of run of mine ore having a head grade to the mill around 1% WO_3. (See Figure 4 and Table 2) Two methods of calculating grade have been used at the mine: point counting and bulk sampling.



Block	Volume	Tonnage	Block	Volume	Tonnage	Block	Volume	Tonnage	Block	Volume	Tonnage	Block	Volume	Tonnage
160/104	3,920	10,400	160/103	3,920	10,400	160/102	3,920	10,400	160/101	3,920	10,400	160/100	3,920	10,400
200/104	3 920	10,400	200/103	3,920	10,400	200/102	3,920	10,400	200/101	3,920	10,400	200/100	3,000	8,000
240/104	3,920	10,400	240/103	3,920	10,400	240/102	3,920	10,400	240/101	2,300	6,100			
280/104	3 920	10 400	280/103	3,100	8,200	280/102	1,500	4,000						
320/104	720	1,900												
		43,500			39,400			35,200			26,500			18,400

TOTAL = 163,000 tonnes

Longitudinal Section (looking west) Showing Geological Ore Blocks
scale = 1:2,000

N.B. Average mining with of 1·4m used and S.G. 2·65

240/102 *block identification number*

⊙M.P.2 *Diamond Drill Hole*

T25 *ground survey mark*

5 cm

SCALE 1:2000

OAKLEIGH CREEK AREA GEOLOGICAL ORE RESERVE BLOCKS

BRM

FIGURE 4

PART II

MINING APPROACH

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MINING APPROACH PROPOSED

Although copper had been found in the area in 1892, the discovery of wolfram deposits in the Upper Forth Valley did not take place until 1916 (by P. Hartnett during the construction of the Pelion Road). Most development was undertaken shortly afterwards by the *MT. PELION MINING COMPANY* and other independent operators, on deposits located on the eastern side below Mt. Oakleigh. The main lode was discovered by F. Duncan of the Company and other wolfram and cassiterite veins were discovered in the locality by Hartnett of the 1916-1919 period. By 1919, the adit had been driven 36m into the main vein, and numerous trenches had been excavated in the area.

In 1944 the W. Bloomfield R. Knight J. Martin syndicate worked the deposit by shallow open cutting and a little underhand stoping until 1948, producing 5.145 tons of concentrates (64% WO_3) from some 250 tons of ore (according to J. Elliston, Tasmanian Government geologist, who visited the area in 1951.) The adit had been extended to 40m into the hillside on the main vein and it had been exposed at the surface with a 15m long shallow trench.

Very little was written on the area until the exploration work of *THE BROKEN HILL PROPRIETARY CO. LTD., INTERNATIONAL MINING CORPORATION N.L., SCAMANDER MINING CORPORATIO N.L., LOUISA MINING CORPORATION N.L.* and finally the present *Buka-Serem-Triako* joint venture.

When *Scamander* took over in 1970, the 1.8m x 1.2m adit had been driven to 41m along the main quartz vein and the surface trench had been excavated to an average depth of 1.5m (maximum 4.5m) and extended it to a length of 137m. It extended the 240m level adit to the present length of 154m, but enlarged it to 2.1m x 2.1m by the close of driving operations in September, 1971. A 1.8m x 1.2m winze was also sunk in the vein about 40m from the portal. It was sunk in late 1970 at 76° east to a depth of 11.4m partly in the clear.

When the joint venture commenced activities in the area in 1977, much of the previous work was obscured by overgrowth of vegetation and the surface trench was difficult to trace. The adit, of course, remained in good condition and the small amount of underhand stoping (believed to be about 400 tonnes) had been backfilled. The small mine dump remained at the entrance as it has done for the last 60 years. *Serem* had 381m diamond drilling performed in 4 drill holes to precise the length and depth extension of the vein and extracted a 27 tonnes bulk sample from the 240m level adit. All of this was achieved with negligible impact on the surface.

In April 1978, mining contractors were engaged to perform a programe of limited mine development to provide additional exposure of the vein to assist in the assessment of ore reserves :

* The 240m level adit had been enlarged to 2.44m high x 2.7m wide for its entire original length (154m). It is now being extended another 100m.

* A new drive (280m level adit) is being made 40m above the original drive. This drive will continue for 100m with a section 2.44m x 2.13m.

* A 40m rise to connect these levels is being advanced, about 90m from the portal and has a section 1.52m x 1.52m. This total work programme will be completed in early October 1978.

Support facilities at the mine site include two small sheds (workshop and generator shed) and there has been reconstruction of a surface track on the hillside to gain access to the 280m level.

The major visual impact has been the enlargement of the surface ore stockpile in front of the original adit with the rock removed from underground. All of this dump will be subsequently removed as it consists of ore which will be the initial supply for the mill.

Future mining activity will consist of mining above and below the 240m level adit. With the exception of the creation of a maximum of two more portals, all of the mining work will be confined to below ground. This means that noise and disturbance from machinery and blasting, apparent on the surface, will be negligible.

The only physical and visual impact of the mine will be the underground entrances.

The likely method of mining will be shrink stoping, which entails breaking the ore with explosives and thence removing it by allowing it to "flow" within the stope to rail trucks beneath. Some small blocks of ore will be left (pillars) to provide support throughout mining and afterwards. However, these will be few as ground conditions are exceptionally good with there being no evidence of high stresses present. A very important consideration is that the vein width does not exceed 0.5m and hence a stoping width of less than 1.4m can be used. Blocks of ore will be left, (crown pillars), such that underground openings do not break through to the surface. It may be decided to place some of the waste material from the concentrator in the worked out openings. However, this would only be for the convenience of disposing of such materials as it would not be required for support.

There will be almost no waste rock from development and mining above the 240m adit level. All material removed from underground will be ore and will be taken directly to the concentrator. Development below the 240m adit level will produce some barren rock which will require disposal, but the quantity is unlikely to be large. The daily production of ore is unlikely to be larger than 100 tonnes and it is envisaged that the total underground workforce will not exceed 12 men. Figure 4 gives a section through the proposed mine and shows the basic mine development. Plate 1 shows the location of the adit and leases in relation to the Forth River.

PART III

ORE TREATMENT AND MILL DESIGN

021 Dravo PTY. LTD.

190022

30 ATCHISON STREET, ST. LEONARDS, N.S.W.

19th September, 1978

The Manager,
Serem (Australia) Pty. Ltd.,
55 Clarence Street,
SYDNEY. N.S.W. 2000.

Attention: Mr. M. Lawrence - Technical Director

Dear Sir,

Re: Mt. Pelion Wolframite Concentrator
Environmental Considerations

As per your request of Thursday, 14th September, 1978 please find enclosed a brief environmental description of the Mt. Pelion Wolframite Concentrator.

Please note that this description applies generally to the three plants proposed and Alternate 1A.

Yours faithfully,
DRAVO PTY. LTD.,

Ian Bare

fr. MARTIN ACKLAND
Manager Marketing - Minerals Processing

MA:JP

P.O. BOX 583, CROWS NEST, N.S.W. 2065. TELEPHONE 439-4666 - TELEX AA21797

MT. PELION WOLFRAMITE CONCENTRATOR

ENVIRONMENTAL CONSIDERATIONS

1. GENERAL

The Mt. Pelion Wolframite Concentrator* design has been based on three possible process routes, as described in the Dravo report to Serem (Australia) Ltd. "Mt. Pelion Wolframite Concentrator-Conceptual Engineering and Capital Estimate" September, 1978.

The rates below have been extracted from this report.

Table 1 shows A.M.D.E.L. analyses of a typical ore concentrate.

* Mine to be operated by joint venture is called Oakleigh Creek.

2. FUNCTIONAL DESCRIPTION

2.1 General

The plant is broadly divided into the following areas.

Crushing Circuit
Jig Circuit
Grinding Circuit
Table Circuit
Concentrate Dressing Circuit

The alternate cicuits proposed are described in the latter paragraphs of this section. It should be noted that of these alternates, alternate (1) differs only in that the table circuit is replaced with a primary WHIMS circuit in lieu of the rougher tables, whereas alternate 2 uses a longer grinding circuit and WHIMS to replace the jigs and the rougher tables.

2.1.1 Crushing Circuit

Ore at approximately -250 mm is received into the ROM ore bin from either side tipper mine cars or diesel powered front end loader or dump truck.

Primary crushing is effected in a jaw breaker at a rate of 20 TPH. Crushed ore is stored in a 120 tonne storage bin. Ore from the crushed ore storage bin is fed to the fine crushing circuit, where it is reduced to -6 mm prior to screening into the following size fractions.

- 6 mm + 3 mm
- 3 mm + 0.5 mm
- 0.5 mm

The coarse fraction - 6 mm + 3 mm is fed to the coarse jig; the - 3 mm + 0.5 mm fraction is fed to fine jig and the - 0.5 mm fraction is fed to the table circuit or WHIMS circuit.

2. FUNCTIONAL DESCRIPTION (continued)

2.1 General (continued)

2.1.2 Jig Circuit

Ore is concentrated in both the coarse and the fine jigs, with concentrates from both jigs being combined to feed an .5m x .5m cleaner jig. Middlings from the jig circuit, are combined with the tailing from the cleaner jig and pumped to the grinding circuit.

Jig tailings from both coarse and fine jigs are pumped to a dewatering cyclone for discharge to either the road bin or the coarse tailings stockpile.

2.1.3 Grinding Circuit

Middlings and cleaner jig tails from the jig circuit are combined and fed to the 1.22 m x 2.13 m (4' x 7') peripheral discharge rod mill for grinding to -0.5 mm. The mill is in close circuit with a 0.5 mm wedgewire screen.

2.1.4 Table Circuit

Ground material is fed to the hydraulic classifier via the rougher cleaner spiral circuit. Classification in the hydrosizer is to three size fractions for table feed.

The table circuit consists of six tables treating three size fractions. Four of the tables are on roughing duties, and two on cleaning duties.

Middlings from the roughing tables are returned to the classification circuit, and tailings are scavenged in the scavenger spirals prior to pumping to the tailings dam.

2. FUNCTIONAL DESCRIPTION (continued)

2.1 General (continued)

2.1.5 Concentrate Dressing Circuit

Concentrates from the table circuit are dressed to grade and market specification by magnetic separator, followed by flotation to effect final sulphide mineral removal.

Dressed concentrates are dewatered in a settling tank and kieved, for a final dressing and dewatering prior to bagging and despatch.

Kieve toppings are returned to the table circuit when required for final upgrading. Concentrates from the keive are discharged to the concentrate feed hopper, and subsequently removed by screw conveyor to the weighing and packing system.

Consumables, such as grinding media, jig ragging, and flotation reagents are received into the plant from water transport via the mill gantry.

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2. FUNCTIONAL DESCRIPTION (continued)

2.2 Alternate 1

In this plant, the primary tables have been replaced with a Wet High Intensity Magnetic Separator. Concentrates from the WHIMS are further upgraded on cleaner tables as for the gravity plant, (with the difference that no further magnetic separator is required).

This flowsheet offers a higher recovery than the coventional gravity plant.

2.3 Alternate 2

In this plant, the jigs and primary tables have been replaced by a larger grinding mill and a 16 Pole WHIMS unit. All ore is crushed and ground to - 0.5mm before being fed to the WHIMS. Concentrates from the WHIMS are cleaned up on tables and dressed in a similar manner to that used in Alternate 1.

3.0 ENVIRONMENTAL CONSIDERATIONS

In order that the environment in the area of the Mt. Pelion wolframite concentrator be disturbed as little as possible, the plants proposed have been designed with the following considerations in mind.

3.1 Plant Size

The overall size of the plant has been kept to a minimum to both reduce capital cost and reduce the visual impact of the plant on the natural surroundings. Also the plant will fit into the area already cleared of major timber and will involve no further clearing of forest.

3.2 Effluent Emission

The waste products from the plants consist mainly of ground quartz with tourmaline and minor amounts of sulphides. With the exception of Alternate 2, the plants proposed will produce both a coarse and a fine tailings product as previously described earlier in this section.

Tailings disposal is to the coarse tailings stockpile and to the tailings dam. Run off from both dam and stockpile will be of a quality that will not cause any hazard to water quality in the surrounding creeks and rivers.

If the flotation plant is used for the cleaning of concentrates, the total xanthate or aerofloat usage will be about .5 kgs per day. Even if a portion of this material did report to the fine tailings dam, it is not likely that any xanthate could be detected in the effluent by any existing analytical techniques.

Should market conditions be such that the flotation section is not required, then no xanthate additions would be made in the course of normal operations.

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3.0 ENVIRONMENTAL CONSIDERATIONS (continued)

3.3 Noise Pollution and Dust Emissions

As the crushing plant and equipment is contained totally within the mill building, noise and dust emissions will be kept to a minimum.

The only items not contained in the concentrator building are the ROM bin, the ore storage bin and the conveyors.

As the ore is expected to be low in sulphides (see AMDEL minerological report) it is not expected that sulphides in the tailings will represent any environmental hazard. However, should it be desired to ensure that sulphides are removed from the tailings, the sulphides removed as kieve toppings (on flotation concentrates) can be disposed of separately.

This action would ensure that the sulphides sent to the fine tailings dam would be minimized.

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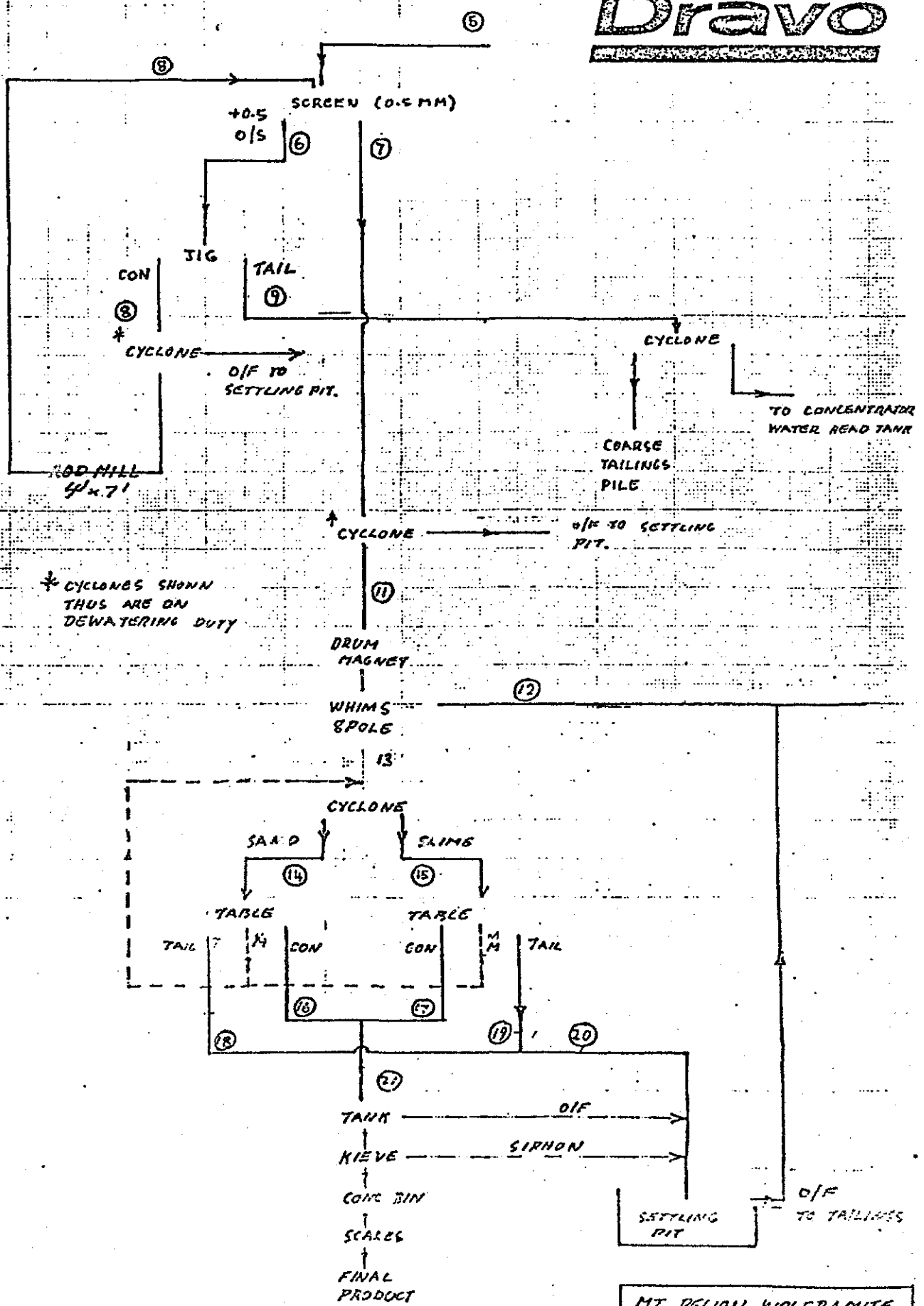
Bravo



	65.0	
	3.57	
	3.57	
	65	
	65	
	35.0	
	35.0	
	35.0	
	0.092	
	2.56	
	0.087	
	0.087	
	5.0	
	2.56	
	0.75	
	0.85	
%	TONS	

NOTE

TIG RECOVERY 90%.

WHIMS 97%.

TABLE 95%.

OVERALL RECOVERY 86%.

(PLUS 2% DUE TO RECIRCULATION OF MATERIAL FROM SETTLING PIT

MT PELION WOLFRAMITE PROJECT - TASMANIA

MASS BALANCE AND OUTLINE FLOW SHEET

ALTERNATE IA

PART IV

TAILINGS DISPOSAL

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(Australia) Pty. Ltd.

CONSULTING ENGINEERS

Associated with
Watermeyer, Legge, Piesold & Uhlmann
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CABLES & TELEGRAMS "ABPASHI" SYDNEY
TELEPHONE: 929 5155
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3005 Northpoint,
100 Miller Street,
North Sydney, N.S.W. 2060
Australia.

YOUR REF:
OUR REF: 703.260.005
NUMBER 8/324

15th September, 1978.

SEREM (Australia) Pty. Ltd.,
55 Clarence Street,
SYDNEY, N.S.W. 2000.

FOR ATTENTION: Mr. M. Lawrence

Dear Sirs,

MT. PELION WOLFRAMITE PROJECT:
TAILINGS DISPOSAL

Further to the discussions held in your Sydney office on 31st August, 1978, we are pleased to provide you with our preliminary comments on the possible environmental effects of tailings disposal at the above mine.

1. THE SITE

The mine is located in the Forth River Valley about 21 km upstream of Lemonthyme Power Station. At this point a gently sloping bench of glacial till extends between 70 m and 150 m from the valley side before dropping steeply to river level. Reid Creek cuts across the bench a short distance east of the mine.

The valley is densely forested, except in the immediate vicinity of the mine, where indications are that clearing has taken place during previous work which has been carried out on the prospect.

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Although we have not examined recorded flow data we believe that both the Forth River and Reid Creek have strong perennial base flows. During the visits we made to site in July and August 1978, we estimate that the flow in Reid Creek was between 100 and 200 litres per second. The results of sampling and analysis carried out by the Department of Mines, Tasmania, as contained in their letter to the Mt. Pelion Joint Venture dated 24th August, 1978, indicate that the water chemistry is similar in both water courses. The pH which is in the range of 5.1 to 5.4 is low, as is the concentration of dissolved solids (T.D.S.) which is in the range of 27 to 33 mg/litre.

2. DISPOSAL OF TAILINGS

The proposed mine will exploit a quartz vein which occurs in the valley for the extraction of wolframite and cassiterite. The planned production rate of 100 tonnes per day is very low in any mining sense and is in the operation's favour as it will significantly reduce potential environmental problems.

On site separation and concentration of minerals from the mined ore will be by gravity and jig process and we understand that at the present the use of chemicals in the process is not planned. The tailings will consist mainly of inert crushed quartz and quartzite. However, present in the ore are small quantities of sulphides, occurring mainly as pyrite, chalcopyrite, arsenopyrite and sphalerite, some of which may be disposed of as tailings.*

The plant process will result in the generation of two separate tailings products which may be described as a sandy gravel and a silty sand. The sandy gravel fraction graded from -6 mm to +0.5 mm will be dewatered at the plant and handled mechanically as described below. The silty fine sand fraction although graded down from -0.5 mm contains less than 15% silt and no clay. This material, which will have

* Refer Table 1 in Part 1.

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rapid settling and drainage characteristics, will be handled hydraulically.

Two tailings disposal areas have been selected and these are shown as Disposal Areas No. 1 and No. 2 * on Drawing No. 703.105 attached to this letter.

Fine tailings will be pumped in slurry form to Disposal Area No. 1 where it will be contained by an embankment of coarse tailings constructed by the upstream method. The excess coarse tailings will be dumped at Disposal Area No. 2. These areas are sufficient for the disposal of about 3.3 years of tailings production.

The water used for the transport of fine tailings in slurry form will drain from the tailings dam at a rate of between 1.6 and 3.6 litres per second depending on the pulp density of the slurry. As even the fine tailings will be very pervious we anticipate that for practical purposes all the water will drain from the material within a very short period.

3. ENVIRONMENTAL IMPACT OF TAILINGS DISPOSAL

At the location of the mine the Forth River marks the boundary of the Cradle Mountain National Park, which extends westwards and northwards from the river. The Forth River flows into Lake Barrington and we are informed that this lake will at some stage in the future be used for water supply to urban areas.

The tailings disposal areas have been selected, as far as possible, to minimise the amount of forest clearing required. The height and density of the forests, which will be allowed to continue to grow up to the edges of the disposal areas, will considerably reduce the visual impact of the tailings both during operation and after decommissioning of the storages.

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The glacial till which forms the bench on which the tailings storages will be constructed is considered to be a competent foundation. The storages have been kept back from the steep banks of Reid Creek and the Forth River to avoid any potential instability of these banks.

The coarse tailings will provide a free draining, stable, erosion resistant outer face to the tailings dam at Disposal Area No. 1 and will be inherently stable as dumped at Disposal Area No. 2. The fine tailings is expected to drain and become stable relatively rapidly and will therefore be suitable for the upstream method of construction. It is considered that these tailings storages will remain stable indefinitely after decommissioning, and that provided freeboard requirements are met during operation there is no risk of physical pollution of the river system by tailings.

Sampling and analysis by the Department of Mines, Tasmania, of water draining from the mine area indicates a lower pH and higher concentration of metals in solution than recorded for samples from the Forth River. The analysis, however, also revealed no significant difference in the nature of the water above and below the mine workings. Although the samples taken can only be considered as "grab samples" there is an indication that a potential problem from the dissolution of metals from the material exists. From the information presently available the extent of the problem is difficult to assess and we favour continued sampling at regular intervals to establish figures for average concentrations.

During operation of the tailings dam at Disposal Area No. 1 the water draining from the dam will be collected in open channels laid along the downstream toes of the embankment and conducted to a sump. The water collected in the sump is expected to be clear and free from suspended solids. As stated it is

/ 5 ...

difficult to estimate on present information what the concentration of metals in solution in this water will be. We believe, however, that it is unlikely that the concentrations would be high enough to affect the ecology of the river system or consumers using water from Lake Barrington when this is developed as a source for urban supply. In view of this it is proposed that the water collected in the sump be discharged into Reid Creek.

On decommissioning of the tailings dam, the only water which is likely to come into contact with the tailings before entering the river system will be infiltration from rainfall which should have a higher pH than the process water supply. The permeability of the tailings is expected to be high and the rate of percolation through the tailings relatively rapid. Therefore, the contact period available for the solution of heavy metals is expected to be short. Further, when the tailings storages have been topsoiled, as discussed below, the quantity of rainfall percolating through the tailings will be reduced.

Taking the various factors and available data into account we consider that the quantity of dissolved solids or metals entering the river system in solution in water draining from the tailings storages both during operation and after decommissioning will be small and should not affect the ecology of the river system.

4. RECOMMENDATIONS

As discussed above, the tailings disposal areas have been selected to minimise the clearing of heavy timber. Topsoil should be stripped from the areas to be covered by tailings, and stockpiled so as to be available on decommissioning of the tailings storages to assist in the establishment of vegetation.

The quantity of topsoil available from these areas will be limited, and no other source of topsoil is available in the area. Therefore we recommend that all of the available topsoil be spread on the horizontal surfaces of the tailings, where maximum

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benefit can be obtained. The slopes of the storages will be stable and are unlikely to be susceptible to erosion. With time we believe that vegetation will re-establish on the slopes, but in the short term these will be effectively screened from view by the surrounding tall forest.

During the operation of the mine the tailings water should be analysed at regular intervals to ensure that concentrations do not approach undesirable levels as weathering of the tailings proceeds. If this is found to occur steps could readily be taken, e.g. chemical treatment, to produce a quality of water suitable for discharge. The sump provided would facilitate this. Even if this situation is reached during the life of the mine for reasons stated above we do not believe it will result in a situation that will persist after decommissioning. As a result ongoing pollution, a problem generally experienced with sulphide ores or considerably finer tailings grinds where permeabilities are lower, is unlikely to be a problem here.

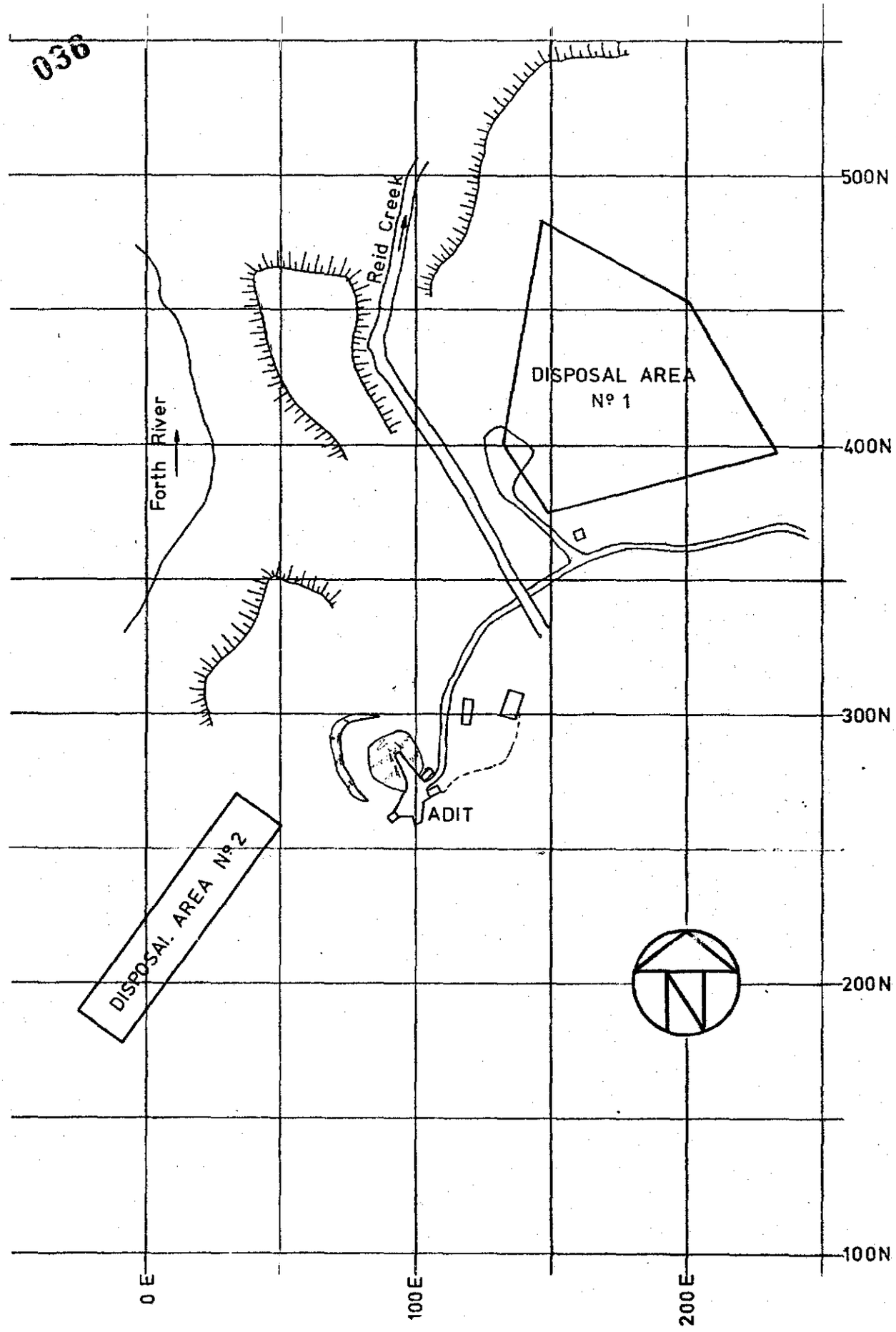
In conclusion we affirm that we are of the opinion that tailings disposal at the proposed Mt. Pelion Mine should not create any serious environmental problems. The most significant local effect is likely to be the visual impact of the tailings storages. However, we believe that if the recommended measures are followed even this should be reduced to a minimum.

Yours faithfully,

WLPU CONSULTANTS (AUSTRALIA) PTY. LTD.

* Enc.

JJB:SGD:PJA



WLPU Consultants (Aust) P/L	Designed			SCALE	SEREM-BUKA-TRIAKO JOINT VENTURE
	Drawn	SD	6/9/78	1 in 2 000	MT. PELION WOLFRAMITE PROJECT
	Traced				TAILINGS DISPOSAL
	Checked				SITE SKETCH
					DRG. Nº 703-105

5 cm

APPENDIX I

BACKGROUND DATA ON B.R.G.M.

TAKEN FROM 1977 ANNUAL REPORT

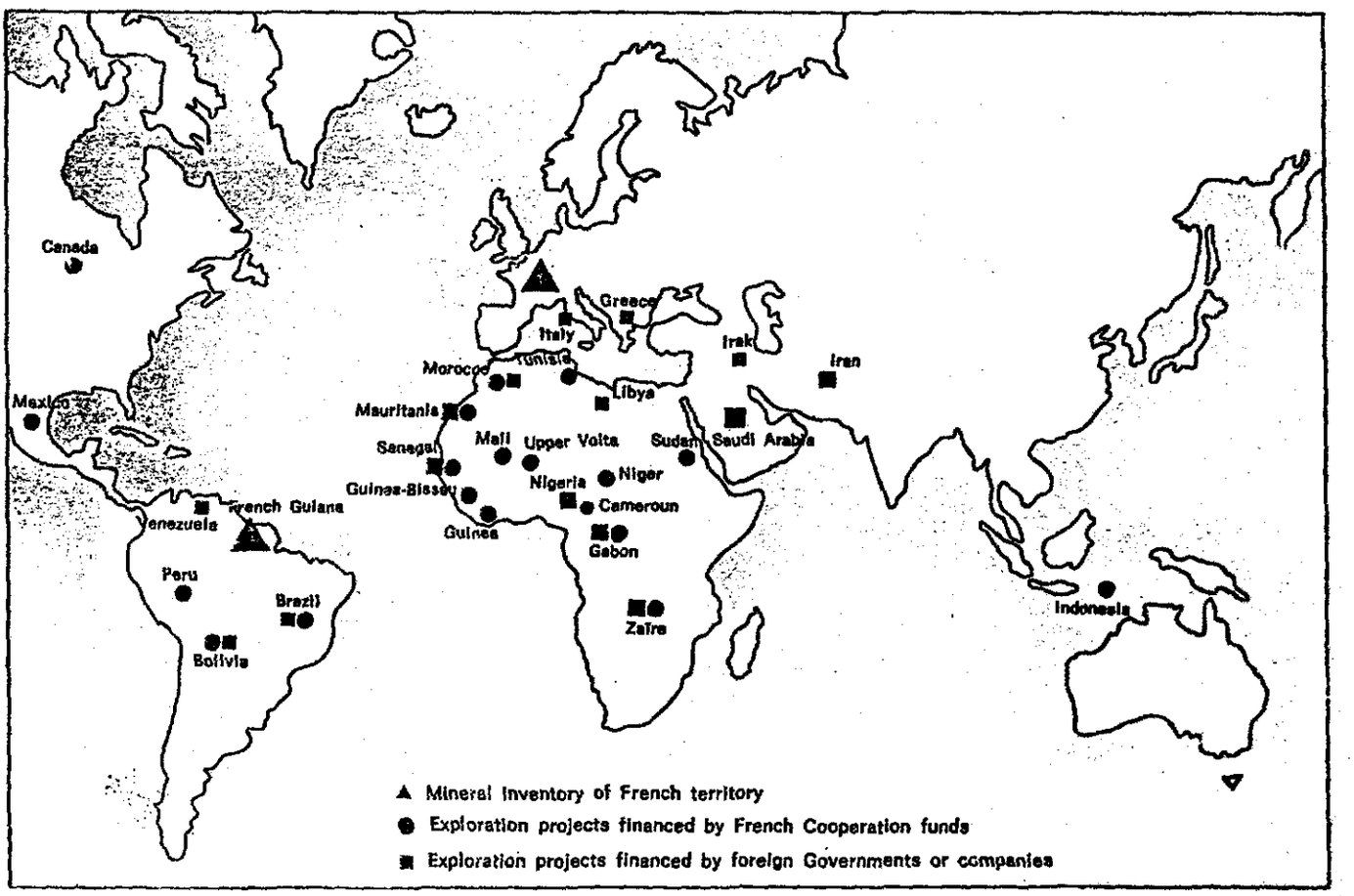
B.R.G.M. 409 M*

89	Basic geology	22	Scientific research		
132	Development of mineral resources	39	Mining Inventory of France	Metropolitan France	30
				French Guiana	9
				French cooperation funds	11
		56	Mineral exploration for foreign companies or governments		
				Input by associates and partners	11
138	Geology applied to town and country planning	65	B.R.G.M. own exploration work	France : 21	
				Abroad : 44	
			Participations in companies and joint ventures not directly managed by the B.R.G.M.		14
			Industrial investments		16

Exploration

* Work done by B.R.G.M. or S.E.R.E.M.

MINERAL EXPLORATION WORK FOR FRENCH OF FOREIGN GOVERNMENTS



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B.R.G.M.'s SUBSIDIARIES AND SHAREHOLDINGS

160041

Firms	Countries	B.R.G.M.'s holding	Objectives
MINERAL EXPLORATION AND DEVELOPMENT COMPANIES			
S.E.R.E.M. - Société d'études, de recherches et d'exploitation minières	France	99,9%	Prospecting and holding
SEREMI	Zaire	99,9% *	Mineral exploration
SEREM-Malaysia Sdn. Bhd.	Malaysia	99,9% *	Mineral exploration
SEREM-Australia Ltd.	Australia	99,9% *	Mineral exploration
SEREM Limitée	Canada	99,9% *	Mineral exploration
SEREMIN Inc.	USA	99,9% *	Mineral exploration
SERMINAS	Brazil	99,9% *	Mineral exploration
IMSA - Investigaciones mineras S.A.	Peru	99,9% *	Mineral exploration
COFREMMI - Cie française d'entreprises minières, métallurgiques et d'investissements	France	90%	Opening up nickel deposits in the north of New Caledonia
Compagnie minière de Montredon	France	99,9% *	Reopening the tungsten deposit of Montredon (Tarn)
MIFERSO - Société des mines de fer du Sénégal oriental	Senegal	24% *	Opening up the iron deposits of the Falémé
SOREMI - Société de recherches et d'exploitation minières	Upper Volta	22,9%	Reopening the gold mine of Poura
SOMIFER - Société des mines de fer de Mékambo	Gabon	3%	Opening up the iron deposits of eastern Gabon
SOMIBA - Société minière de Moba	Zaire	44% *	Search for base metals in northeastern Shaba
S.M.D.G. - Société minière de Goma	Zaire	80% *	Search for base metals in Kivu and Shaba
S.M.T.F. - Société minière de Tenké-Fungurumé	Zaire	7%	Opening up copper and cobalt deposits in Shaba
Explo-Zinc Ltd.	Canada	51% *	Opening up a zinc deposit near Joutel (Quebec)
SOPEMI - Pesquisas e exploração de minerios S.A.	Brazil	12,5% *	Search for diamonds
MINING COMPANIES			
COFRAMINES - Compagnie française des mines	France	100%	Mining projects and investments
Société minière d'Anglade	France	7,2% **	Tungsten mine at Salau (Ariège)
Barytine de Chaillac	France	6,3% **	Baryte mine at Chaillac (Indre)
Cie sénégalaise des phosphates de Taïba	Senegal	15,6%	Phosphate mine at Taïba
COMILOG - Cie minière de l'Ogooué	Gabon	19,6%	Manganese mine at Moanda
Compania de minas Buenaventura	Peru	12% *	Silver, lead and zinc mines
CONSULTANCY COMPANIES			
SOCOMINE - Société de coopération industrielle et minière	France	55% *	Assistance to the development and working of mines
SOFREMINES - Société française d'études minières	France	15%	Mining studies and training
C.F.F.M. - Cie française de forages miniers	France	65% *	Drilling
GEOCHALEUR	France	15% *	Promotion of geothermal energy in France
B.R.G.M.-Nigeria Ltd	Nigeria	51% *	Geological, hydrogeological and mineral exploration
GEOMINES Limitée	Canada	30% *	Engineering geology and mining engineering
Phoenix Geophysics Ltd.	Canada	50% to GEOMINES	Geophysical prospecting

* Shares held by SEREM or its local subsidiary.

** Shares held by COFRAMINES.

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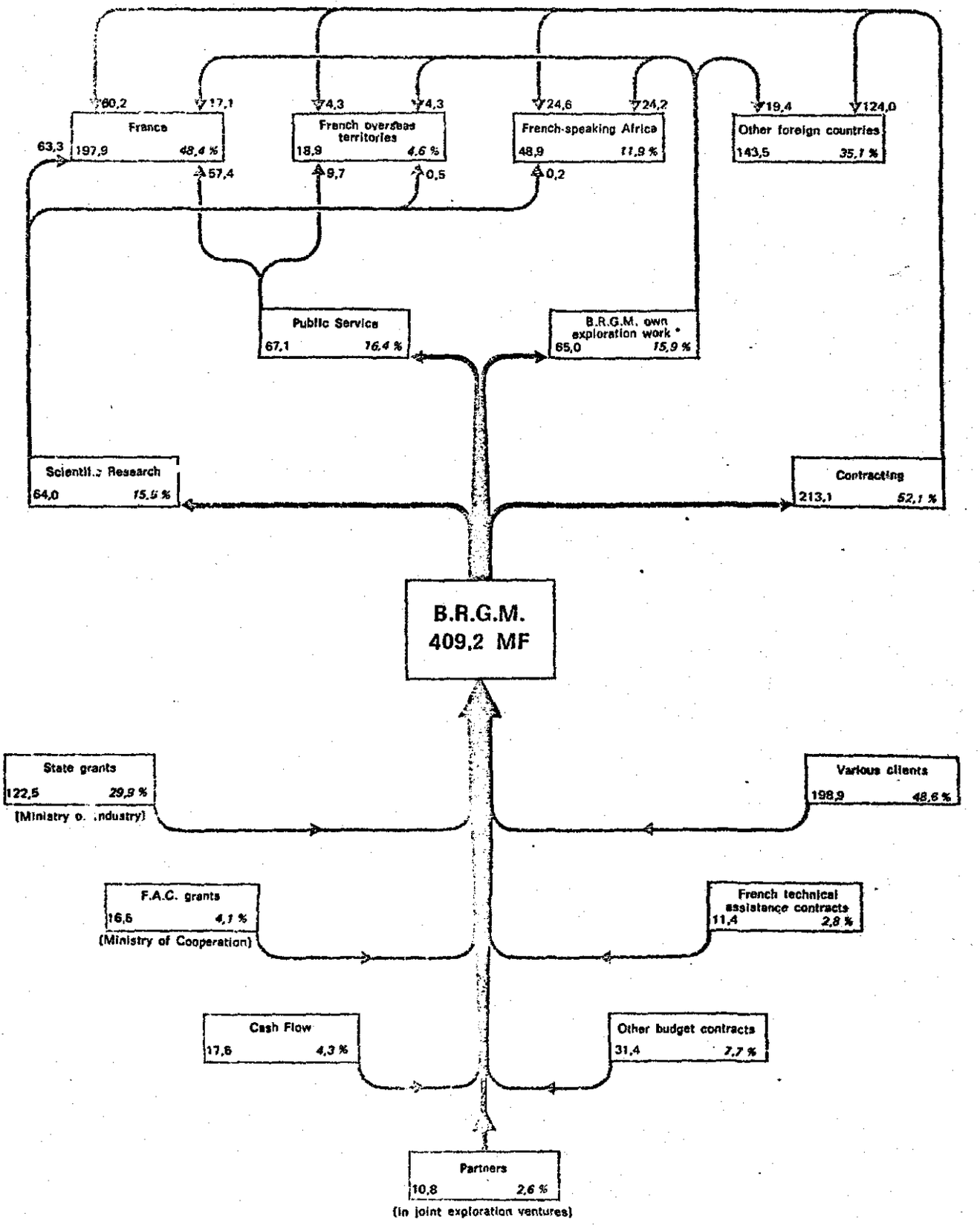
1977 ACTIVITY

Financial investments not included

100042

In millions of francs



* This heading does not include the mineral inventory of France (39 MF — Public service) nor the exploration work on behalf of foreign Governments or companies (56 MF — Contracting).

6707

approx position of river only

Oakleigh Creek

LOCKED GATE

RIVER

FORTH

Top of Bank

Bank

Top of Bank

Reid Creek

Top of Bank

MP4

HUT

WORKSHOP HUT

MP3

240/0 ADIT

240/1

MP2

240/2

240/3

MP1

COSTEAN

60 M/71

60 M/69

59M/71

CRADLE MOUNTAIN — LAKE ST CLAIR NATIONAL PARK

BUKA — SEREM — TRIAKO JOINT VENTURE

LOCATION OF LEASES

OAKLEIGH CREEK AREA

5 cm

0 10 20 30 40 50 100 200 m

SCALE 1 : 2000

100043

PREPARED BY

CENTRAL TASMANIAN TUNGSTEN P/L

BRGM

Plate I

79-1230R