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B.M.I. MINING

AN APPRAISAL OF MINING THE GLADSTONE TIN DEPOSITS BY CUTTER SUCTION DREDGING

AMG REFERENCE POINTS ADDED

D. J. Hughes

A. Mearing

17.10.74

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1. Introduction

A feasibility study of the possibility of economically dredging the tin ore reserves known as Monarch, Hasties, Endurance and Scotia has been completed.

This report contains comments on the preliminary proposals put forward by the retained consultants, Watson Dredging, and also a complete appraisal of the Project based on a dredge design by Watson Dredging in conjunction with B.M.I. staff.

The appraisal is based on exploration carried out to date and a 1974 tin price of M$1100 per picul. The following additional parameters have been used.

1. Tin price increasing simply at 5% p.a.
2. Capital costs increasing at 15% p.a.
3. Operating costs increasing at 10% p.a.

2. Summary & Conclusions

1. The project shows a DCF of 28.5% over a 9 year. period, and a pay back period of 5.2 years.

2 The reserves used in this study are in general indicated only and additional testing is required to confirm these indications.

3 It is considered probable that the reserves could be confirmed.

4. A number of imponderables exist relating to the use of cutter suction dredges which must be answered prior to committal.

5. It is recommended that the minimum of drilling only initially be carried out to confirm the grades and volumes so far indicated. Satisfactory results from the preliminary drilling should lead to a more detailed testing program.

I reckon that any profit which might ever have been made at Monarch's Endeavour has already been eroded away by our extravagant drilling!

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3. Comments on Watson Dredging Proposals

Watson's original proposal covered a single dredge operation and offered costing on throughputs of 250, 350, and 450 cu. yds/hour.

Examination of the drilling carried out at both the Endurance and Scotia indicate a minimum overburden to wash ratio of 1:1. It was therefore a logical step to ask Watson's:

(a) to submit a further proposal using two dredges, one of which would be stripping; and

(b) for reasons as outlined below under "The Original Proposal" to modify the dredge to dig to a much greater depth.

The final proposal by Watson's was made following discussions with B.M.I. staff. All proposals have been examined and the following comments and criticisms offered.

3.1. The Original Proposal

The original proposal under cover of their report dated 26.7.74 called for a 450 t.p.h. plant fed by an equivalent sized dredge with a 36 ft. ladder with which it was proposed to dredge the Monarch area.

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On exhausting the Monarch reserves, Watson proposed modifying the dredge pontoon to accomodate a 46 ft. extension to the ladder enabling the dredge to excavate the Endurance reserves at a depth of 58 ft. below water level.

The average depths of the Endurance are in the order of 140 ft. and 110 ft. to the West and East of the fault respectively with frequent depths to 150 ft. and occasionally to 175 ft., and the whole reserve area has an average overburden/wash ratio in excess of 2:1.

safe?!

If the original Watson proposal is adopted it would be necessary for the dredge to carry a face above water level in excess of 100 ft. Further, the stacking of all trailings by high pressure jetting would be mandatory and as admitted by Jack Watson "tailing stacking accounts for about 25% of the total horsepower in use". He was referring to dredge and treatment plant. In the case of a 450 cu. yd./hr. plant this would represent about 500 h.p.

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Additionally there appears to be some doubt regarding the stability of the Scotia and carrying a + 100 ft. face would likely be dangerous and unacceptable to the Mines Department. (Monitering the face down together with high pressure tailing stacking would make the operating costs prohibitive).

Further the use of reduced water levels would make slimes in the dredge pond a serious handicap, possibly calling for slimes pumping with consequent dam building.

Examinations of surface conditions at the Endurance and Scotia by B.M.I. staff in August, 1974, indicate a high water table, thus the difficulty in maintaining a reduced water level is also a possibility.

It is suggested that Watson's association with the beach sand mining industry prompted their original proposal. The beach sand operator works on reduced water levels due to:

(a) The difficulty in maintaining a high water level in previous sands.

(b) The undulating nature of the dunes to be excavated.

In the case of our Tasmanian reserves these characteristics are not applicable.

For the above reasons Watson's were asked to modify their proposal to a twin dredge operation using deep diggers.

This proposal would eliminate the disadvantages mentioned above and also increase the stability of the ground with water support and thus hopefully reduce the batter angle necessary.

3.2. Interim Proposal

An interim proposal was submitted by Watson's calling for the use of two identical dredging units operating on parallel planes one behind the other, each alternatively stripping and digging wash. This proposal still retained the earlier tailing stacking arrangement. The disadvantages of this arrangement was pointed out to Watson's as:

1. Dropping back the dredges to pick up wash was time consuming and unproductive.
2. Some of our reserves (Scotia) are extremely narrow and operating the dredge side by side would necessitate the excavation of large volumes of barren ground.
3. Operating a fixed ladder length at two widely varying depths (at stripping and treating depths) may cause throughput problems - see as discussed under "Major Critical Factors Influencing the Economics of this Project".

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3.2. Interim Proposal (Cont'd)

4. A layout by BMI Drawing Office demonstrated that with very low jig tailing launders, and, while making adequate provision for angle of repose and, dredge/tailing clearance a maximum of 12% of all tailings would need to be stacked. This situation was demonstrated with the dredge pond at ground surface level.

3.3. The Final Proposal

Two final proposals from Watson's based on discussions with B.M.I. staff have been submitted. In essence, the two proposals are identical except for their capacities, viz. 1000 cu. yds./hour and 600 cu. yds./hour.

Detailed operating costs have only been submitted by Watsons and estimated by BMI staff for the larger capacity units as the smaller unit has a relatively high capital cost/capacity ratio.

Other than for possible problems as discussed under "Major Critical Factors influencing the Economics of this Project" which are applicable to any of the proposals this final proposal would appear to offer the best method for exploiting our reserves.

Comments on this final proposal are sub-headed below.

3.3.1. Dredging Method

Operating one dredge behind the other is likely to present some operating problems but it does enable narrow channels to be worked. These problems are detailed below.

stern dredge

The stern dredge will generally need to operate without a headline and effect a forward pull by crossing the stern lines over the bow lines. When working narrow channels it is probable that a headline could be used.

When exploiting reserves in excess of 120 ft. deep (130 ft. with ladder at 50°) it will be necessary to batter the sides of the dredge pond (unless the ground is soft) to minimise the vertical lift component of the side lines on the dredge when it is operating in the corner of the face.

not to mention a cave-in!

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3.3.1. Dredging Method (Cont'd)

Some care will need to be exercised by the stern dredge in avoiding the floating pipeline of the forward dredge. This is particularly so in view of the ladder support pontoons. It will be necessary that the forward dredge operates with particular attention to the position of the stern dredge, but this should not present too great a problem as the forward unit should be capable of moving a greater volume of material per unit time than the tin winning dredge and as the overburden/wash ratio invariably exceeds 1:1, the stripping unit should be able to vary its pattern to suit the other.

3.3.2. The Treatment Plant

Little detailed information has been submitted relating to the treatment plant, Watsons are leaving detail until a decision to proceed is made. The following criticisms are levelled at the Watson proposal:

(a) Allowing a 15% swell factor for tailings, the proposed 60 ft. stacker pipe on an incline of 30° will only allow a maximum face depth of 139 ft. to be dredged (this assuming the ladder at 50° i.e., 130 ft. below water level).
It should not be difficult to extend the stacking pipe to improve on this, and some surplus horse power is available at the pump to cope with some extra head but this section of the design must be detailed more thoroughly prior to commital.

(b) No provision is made to recirculate secondary jig tailings. Whether this is required is, at this stage, conjecture; but some fine SnO_2 is reported at Endurance.

(c) Allowing the following water over the jigs:

ex dredge pump	12000 g.p.m.
ex sparge	3000
Total external water	15000 g.p.m.

= 535 g.p.m./jig

plus say 100 g.p.m. hutch water = 635 g.p.m./jig giving a jig water velocity of 5.8 ft/sec/in depth, ideally this figure should be no more than (actual) 2 ft/sec.

Provision should thus be provided for dewatering under the trommel. Alternatively additional primary jigs would be useful. The present capacity is exactly 500 cu. yds./hour after allowing 10% trommel oversize and using a design figure of 16 cu. yds./hour/jig.

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3.3.3. The Dredge

Complete details of the dredging units proposed are not available, but basically the two units quoted have nominal digging depths of 90 ft. and 120 ft. respectively with their ladders at 45°. These proposed depths will probably warrant adjustment prior to final design, pending more detailed examination of the ore deposits.

In essence the units consist of a pontoon with ladder fitted with a submerged hydraulically driven 24/20 gravel pump and a submerged hydraulic motor drivin the cutter head.

The ladder is supported by two out-rigger pontoons thus reducing the size of and stresses on the main pontoon and on the ladder.

The above arrangement appears ideal and checks on the N.P.S.H. available show this to be ample.

Some differences of opinion relating to pump size and required horsepower to give the desired throput have been aired thus:

	Pump Size	h.p. 90ft. at	digging 120 ft.
Watson's	24/20	756	858
Warman	24/20	-	1000
Kelly & Lewis	18/20	500	

It is also of interest to note that I.H.C. would advocate the use of a 500 h.p. drive on the cutter head versus the 300 h.p. quoted by Watson's.

at 120'd x 100'w?

The method of traversing the dredge across the pond quoted by Watson's calls for the reeving of the bow lines through sheaves at the bottom of the ladder. Thus in effect the ladder is pulled across the pond and the pontoon follows. The advantages of this is reduced stresses on both ladder and pontoon with a subsequent reduction in ladder and pontoon size when compared with an alternative and usual method of winching through sheaves on the pontoon. The distinct disadvantage of reeving through the lower and of the ladder can be demonstrated when the dredge operates on a reduced water level and a tendency to pull the cutter out of the cut occurs, particularly when working in the corner of the cut.

The economics and problems of these proposals must be investigated more fully prior to final design.

4. Major Critical Factors influencing the Economics of this Project

There are two major uncalculable factors likely to have a major effect on the profitability of this project. These factors are:

1. The life of the gravel pump.
2. The actual throughput compared with the design throughput.

This section of the report explains the results of investigations made by BMI staff and the reasoning behind the figures relating to these factors used in the budget.

4.1 Gravel Pump Life

Discussions with dredge operators indicate that gravel pump life i.e. the wet end consisting of door, casing and impellor can vary between 6 million cu. yds. when pumping fine grained beach sands. to 600,000 cu. yds. when handling coarse angular gravels.

A dredge pump of the size included in Watson's quote (24/20) costs $58,000 from Warman's. It is estimated that $40,000 would be required to replace the entire wet end. Accordingly provision has been made within the budget to replace those parts five times each year, on both pumps.

4.2. Pump Throughput

The percent solids by weight achieved through the dredge pump of a cutter/ suction unit varies widely depending upon the material being dredged. Figures as high as 40-45% are regularly (but not continuously) obtained by beach sand operators dredging unconsolidated sands. Conversely figures as low as 15% are not unusual when dredging clays, conglomerates or sandstones.

The pump selection is based on throughput, grain size and total head, with the pipe lines (delivery and suction) designed to keep all solids in suspension. This calls for a velocity in the order of 18 ft/sec. for a + 3 in. material.

A critical feature in the overall pump installation is the location and diameter of the suction end. The cutter head creates turbulence and eddies favourable to settling the heavies beyond the sphere of influence of the pump suction - this phenomena would be amplified with increases in s.g. of the material to be recovered. It is obviously of the utmost importance that all material enters the suction pipe. In the case of heavy minerals these would tend to settle out faster than the gangue, therefore sufficient inlet velocity must be generated to create a 'void' of sufficient magnitude to minimise the loss of particles, behind the suction end. Additional 'sweeping' of the horizon being dredged or bottom, would pick up material missed on the first pass but this is inefficient and would reduce throughput.

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4.2. Pump Throughput (Cont'd)

Members of BMI staff visited Mineral deposits No. 3 dredging unit on N. Stradbroke Island where an 18/20 pump was handling an average of 1400 tonnes/hour of beach sand material using a 650 h.p. motor. This quantity of solids in slurry represents 25% by weight, compared with a design figure of 19% proposed by Watsons, for our application.

4.3. The Cutterhead

Obviously the cutter head must be designed for:

1. To suit the material to be excavated.
2. To complement the pump size which has been selected to give the desired capacity.
3. To suit the depth (or angle) at which dredging is required.

4.3.1. The Material

Designing a cutterhead to suit the excavation of a particular type of material is today the result of a number of years of trial and error. In the case of a gravel, sand, clay mixture likely to be encountered in our leases, an open basket type is likely to be recommended and experience has shown that this type should be suitable.

A feature of the type of dredging proposed, is that generally the cutter excavates in one direction only and therefore in theory it should be capable of excavating on the cutting pass sufficient material to satisfy the pump on two passes i.e. to and fro. It is probable that in effect this does not occur and that a higher throughput is achieved on the cutting pass.

Additionally, frequent slips and falls on the face would tend to increase pulp density (and therefore throughput) and reduce the cutting required of the cutter head.

Conversely clay is not excavated so readily and falls of clay would not break up so easily and may be clog the cutter head.

All in all therefore it is guessed that one adverse factor counteracts a beneficial factor and cutters today are capable of excavating most types of materials.

4.3.2. Relationship Cutter head to Pump

Obviously there must be some relationship between cutter head design and pump capacity. Once again this is an inexact science and designers tend to overdesign or 'play safe'. In any event if the winching speed is variable up to the critical sweeping velocity a degree of error in design can be compensated for

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4.3.3. Ladder Angle or Depth

Cutter heads are designed to operate at a particular ladder angle and therefore the cone angle, sweep, and tooth rake are designed for optimum performance at a particular depth.

Opinions are how critical these design parameters are vary widely between the dredge operator who claims that little if any difference is noticeable in performance (throughput) with a ladder angle varying $\pm 7\frac{1}{2}^{\circ}$ from optimum, to the cutter head designers who quote vast increases in performance by altering the rake of some of the cutter teeth by as little as 2°.

John Trump of I.H.C. who has extensive experience with dredgers of all sizes reckons that any difference in performance with the ladder varying say between 25° and 45° would be negligible.

Beach sand miners invariably operate on a fixed water level and digging depth with varying heights of face above water. This method enables the cutter head to operate continuously at its designed angle.

The face is allowed to cave as the cutter head undercuts at maximum depth. In the case of our Tasmanian operations this method of operation is not practicable because of reasons as outlined under "Comments on Watson Dredging Proposals" and also not possible due to the widely varying depths to bedrock which would be encountered over short distances.

At this juncture it is not known whether we will be able to operate at a fixed depth for stripping or whether benching will be necessary. (This would need to be experimented with). In any event operating at a fixed depth (ladder angle) whilst digging wash will not be possible.

There are three ways to overcome the possible ladder angle problem. Namely

(a) Overdesign on the cutter head and the pump and 'adjust' throughput by pulling the dredge in or out of the cut. Watson's have certainly done this with the pump.

(b) Change cutter heads to suit varying depths. Operators estimate 30 min for each change but those consulted are only hauling the ladder up from about 35 ft.

(c) Use an articulated cutter head. Such a unit has been designed by a U.S.A. Company but how effective this is is not known.

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5. The Project

5.1. Reserves

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5.1.1. General

Reserves have been estimated from all available drilling data. Only on the Monarch and on sections of Scotia can reserves be classed as 'measured'. A considerable amount of additional drilling is required to confirm the total reserves indicated below. The proposed drilling should also confirm the degree of accuracy of earlier work.

In general a whole of hole grade of 2 oz. SnO_2 / cu. yd. and an horizon grade of 1.5 oz. SnO_2 / cu. /yd. have been used as cut off grade but some variance has taken place to ensure a dredgeable reserve outline.

It should be noted that drilling on these areas has been carries out by a number of parties using both percussion and auger drills.

The only positive example of recovies is available at the Monarch where drilling indicated a grade of 5.37 oz. SnO_2 per cu. yd. versus a recovery of 7.32 oz. SnO_2 per cu. yd.

With insufficient data relating to ground stability and the nature of the ground to be dug, an 85% tin ore recovery has been assumed and the batter angles as indicated below used in the exercise.

It should be noted that isolated patches inaccessible to the proposed dredges do exist within our leases it is recommended that these additional reserves be checked, and, if warranted a mobile treatment plant constructed to effect efficient recovery.

Total reserves of this type are estimated to contain in excess of 100 tonnes tin.

5.1.2. Volumes/Grades

Total	O'burden	Wash	Batter	Grade oz. Sn/cu.yd.	Content Sn tonnes
Monarch					
4792744	-	4792744	0°	4.16	565
Hasties					
3049233	-	3049233	0°	7.64	660
Endurance					
10,781,701	7,536,191	3245520	0°	3.68	1125
11,236,676	7,970,286	3266390	22½°	3.54	1127
Scotia					
21,307,957	16,050,918	5,257,039	30°	3.26	1968

5.2. Programme

Month		
1-4	(thro')	Exploration and Investigation
5-6	"	Reappraisal of Project
7-9	"	Decision to Proceed
10-21	"	Dredge Building & Site Preparation
22-23	"	Half Production in Monarch
24-38	"	Full Production " "
39-40	"	Transfer to Hasties
41-50		Operating in Hasties
51-52		Transfer to Endurance
53-71		Operating in Endurance
72-74		Transfer to Scotia
75-109		Operating in Scotia

5.3 Method of Operations

General

It is proposed that the reserves be exploited in the following sequence:

Monarch

Hasties

Endurance

Scotia

A continuous ore body outline to facilitate dredging has been plotted for each area. This has made it necessary to include a proportion of below grade ground (particularly in the Monarch to ensure continuity of operations).

The Monarch and Hasties areas will be exploited consecutively using one dredge only, with a digging depth of about 30 ft. All excavated material will pass through the treatment plant at a rate of 500 cu.yds./hr.

Operations will take place on a 7 day 24 hours per week basis and a 600 hour month has been used in the study.

Exploitation of the total Monarch and Hasties reserves will take 24 months, shortly after which the dredge and treatment plant will be at the Western end of the Endurance leases where the second dredge will be constructed and ready to commence operations with the existing unit.

It is assumed at this stage that it is possible to dredge, albeit barren ground, between the Monarch and Hasties and between the Hasties and Endurance, thus avoiding a costly rebuilding program.

On exhausting the Endurance reserves the dredges and treatment plant will be dismantled and re-erected on the Scotia lease.

5.3.2. The Dredges

The varying overburden/wash ratio precludes the use of a stripping dredge with a much greater capacity than the treating dredge, and as it is necessar that both dredges operate at a fixed distance apart it was decided to base this exercise on twin dredge units with different maximum digging depths. It is expected however, that the stripping unit will be able to strip more ground than the treating unit.

5.3.3. The Treatment Plant

The treatment plant will be designed to treat 500 cu.yds./hour of feed from the rear most dredge. Feed will be discharged into a trommel with forward discharge of oversize, thus affecting a barrier to hold back tailings

Primary jigs will be gravity fed and all jig tailings will be discharged by gravity via chutes over the stern of the plant.

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5.3.3. The Treatment Plant (Cont'd)

In addition to its treating function this plant will also support the floating discharge column from the stripping dredge and be fitted at the stern with an angled discharge pipe to effectively dispose of stripped overburden beyond the sphere of the operation.

5.4. The Mining Areas

5.4.1. The Monarch Area

It is proposed that dredging will commence at the north west end of this area and finish at the end towards the Hasties area. Water supply will originate from the main dam and be gravity fed to the intermediate dam from where it will be pumped to the lower regulating dam. The existing 10/8 pump will be used.

In the unlikely event that this water supply dries up, provision is made to pump from the Blue Lake via the Endurance to the Monarch.

5.4.2. The Hasties

On exhausting the Monarch reserves the dredge will leave via the southern end and dig a channel (along the trace shown on map No. 1 appended), into the northern end of the Hasties deposit.

Costing of this exercise is based on a visual survey only but provision is made within the budget to carry out stadia survey work and ground probing to confirm the proposed route.

Costs are based on digging a channel 100 ft. x 12 ft x 1.8 miles plus additional 'overburden' removal between Bonser and Little Boobyalla Creeks. The total quantity of ground to be dredged in this exercise is 480,000 cu. yds. and is expected to take 2 months. In addition it will be necessary to build one dam to elevate the dredge from the Monarch to a point from which to gain access to Bonser Creek. This dam can be filled from the existing Monarch water supply. It is expected that (pending results of ground probing) the dredge will be capable of lowering itself into Bonser Creek but this exercise will require careful planning.

For the purpose of this study, ground between the Monarch and Hasties is considered barren of tin. However, the possibility of additional tin bearing ground in Bonser Creek is considered real and provision is made within the budget to test this theory.

Water for operations will be supplied from the Endurance Blue Lake via the existing pump and drainage channel.

Power will be tapped off the existing Monarch supply line running between Bonser and Boobyalla Creeks.

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5.4.3. The Endurance

On exhausting the Hasties reserves the dredge will dig itself a channel into the Endurance deposit. Two routes are available:

(a) By returning through the Hasties tailings and turning east along the base of south Mount Cameron.

(b) Dredging directly from the southern end of the Hasties and entering the Endurance via the high ground between the two valleys.

For this exercise case (a) is taken as being the more probable.

Costs of transferring between the Hasties and Endurance are based on digging a channel 100 ft x 12 ft x 1.8 miles giving a total excavation of 442,000 cu. yds. In addition it will be necessary to build three dams to elevate the dredge from the Little Boobyalla River to the Endurance reserve. These dams can be filled from the Blue Lake. Transferring from the Hasties to the Endurance is expected to take six weeks.

It is proposed that the second dredge be constructed at the Western end of the Endurance and its launching be timed to coincide with the arrival of the first dredge. At this point it will be necessary to extend the ladder on the first dredge to enable it to dig to 90 ft. The second dredge will be constructed capable of digging to 120 ft. (45° ladder angle).

Dredging the Western end of the Endurance will necessitate operating on reduced water levels, possibly to - 40 ft.

At this point a temporary stacker will be installed in the jig tailing system to ensure adequate tailing clearance for the treatment plant.

Water supply for operating the Western end of the Endurance will be pumped from the Blue Lake into the existing channel.

Rainfall charts and local knowledge indicate that sufficient local run-off should be obtained to maintain adequate water levels in the Blue Lake. In the event that water levels cannot be maintained on existing 12/10 pump can be installed on the Ringarooma River.

To the east of the fault the depth to bedrock becomes shallower and if desirable the dredge ladder (s) can be shortened at this point. For this section of the operation water can be fed by gravity from the Blue Lake as long as levels are maintained.

Reference has been made in a number of Endurance Mining Company reports (ref. annual report of 30.6.67) to "boulders and hard granite bottom". As such conditions are likely to have adverse effects on recovery these reports must be checked.

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5.4.4. The Scotia

On exhausting the Endurance reserves the dredges and treatment plant are to be dismantled and with site offices etc. relocated at the Scotia. A sum of $250,000 is allowed for this and relocating is expected to be completed within three months.

It is proposed that this deposit is worked in a direction from north to south. This will take advantage of the natural surface slope and allow water from the Mines Department water race to be channelled directly into the dredge pond via the face.

If available when firm application made !!

Discussions with the Mines Department (Mr. Johnson) in Hobart indicate that 6000 g.p.m. of make up water can be made available to us from the existing races between the Scotia and the Ringarooma River.

Most of the bores in the Scotia bottomed on slate and a number on hard slate. It is of the utmost importance that the 'dredgability' of this bottom be determined during the exploration/investigation period proposed.

5.5. Infrastructure

5.5.1. Office/Store Complex

It is proposed that the offices etc. consisting of Mine Office, ablutions, workshop, tin shed and store be relocated with the dredges. This proposal would entail only one move as initially this complex would be sited at the Endurance during mining of the Monarch, Hasties and Endurance reserves. The complex would be relocated at the Scotia when the Endurance reserves are exhausted.

5.5.2. Store

It is proposed that the c.g.i. shed currently on the Ringarooma river be used as the mine store. Provision is made within the budget for the purchase of additional racking.

5.5.3. Workshop

It is considered that a workshop with sufficient facilities to ensure continuity of operations should be provided.

Existing workshop equipment has been extended to provide such a facility.

5.5.4. Transport

Provision is made within the budget for the purchase of a tractor/trailer to transport ore from the mine (pump-off facility on the plant), in secure drums to the tin shed, and also to transport bagged concentrate from the tin shed to the rail siding at Herrick.

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5.5.4. Transport (Cont'd)

An additional provision of $50,000 is made for the purchase of a B.E. Dynahoe suitable for digging channels, moving anchors and assisting in change of cutter heads and dredge pump parts.

Ore transport is effected from Herrick to Launceston by rail.

5.5.5. Power Supply

22 k.v. power is available at all sites. It is necessary that we provide a 22/3.3 kv transformer and suitable circuit breaker and a provision of $60,000 for this has been allowed.

Two tariffs are available from the H.E.C. and initial calculations show that tariff 87 based on maximum demand only is the more favourable. This is particularly so with a continuous operation. Using this tariff however, it will be necessary to provide adequate protection against overload.

5.5.6. Tin Shed

In the absence of sufficient information relating to SnO_2 and associated heavies it has been assumed that classifying and tabling will produce a marketable head product.

Provision is made in the budget for a building measuring 60 ft x 40 ft containing; wet area, dry area, secure store and a laboratory.

A flow sheet appears below.

It is expected that the tin shed together with other site offices will be located convenient to the mine water supply race in which a sump will be constructed.

Flow Sheet follows:

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TIN SHED DESIGN

Assume average grade of treated ground as 5oz SnO_2/cu/yd.

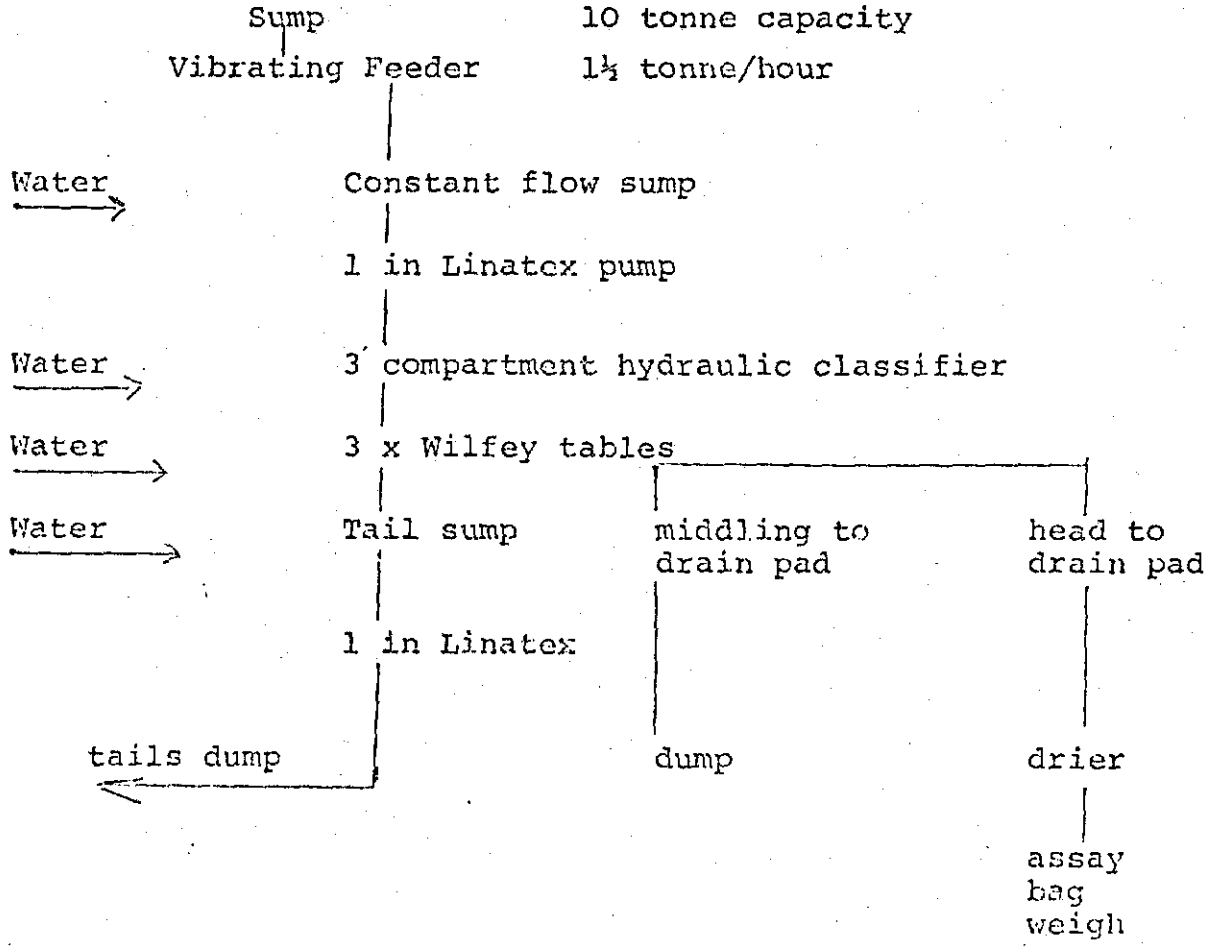
Weight of SnO_2/24 day to tin shed

= 1000 x 24 x 0.85 x 5 - 6376 lbs/day

Assume 30% SnO_2 in concentrate from dredge then conc.
to be treated = $\frac{6376}{0.3}$ = 21,253 lbs.

Say 10 tonnes/day

On 8 hour/day operation = 1½ tonne/hour



5.5.7. Ore Sales

Tin ore sales will be made at Launceston on rail to A.T.S. The nett income figure used in the cash flow reflects losses in revenue due to smelters charges and profit and transport costs incurred by A.T.S. from Launceston to their Sydney smelter. ($70.00 per tonne concentrate).

5.6. Exploration and Investigation

5.6.1. Preamble

A considerable amount of exploration work is required prior to a decision being made to proceed.

A program to adequately cover this work is detailed below and included in the budget at a total cost of $115,000.

It is expected that this program and a reappraisal of the budget would take six months.

5.6.2. Objectives

The program has been designed to:

(a) Confirm as necessary earlier drill results.

(b) Infill drill as required to obtain 'measured' reserves.

(c) Seek extensions to existing ore bodies. This is particularly important between Monarch-Hasties and Hasties-Endurance.

(d) Check on ground stability, wash size analysis and ground tenacity, the nature of bedrock and the presence of boulders.

(e) Determine grain size of SnO_2 and associated heavies.

(f) Selecting a suitable dredge course between the reserves.

5.6.3. Drilling

It is proposed that the drilling be supervised by an 'outsider' i.e. not a local. It is further suggested that one of P.T. Koba Tin's dressers be located on site to dress all drill samples and train one or two locals in the art of tin dressing. Provision is made within the budget for this proposal.

A. Endurance

Minimum additional drilling required to:

(a) confirm existing results

(b) infill

(c) check for western extension

34 holes x 100 ft = 3400 ft.

..... Cont'd

021

5.6.3. Drilling (Cont'd)

B. Hasties

Minimum additional drilling required to confirm existing results.

55 holes x 25 ft. = 1375 ft.

C. Scotia

Minimum additional drilling required

(a) confirm existing results

(b) infill

(c) seek extensions

100 holes x 90 ft. = 9000 ft.

D. Probing

Monarch to Hasties

Hasties to Endurance

Allow for use of auger 100 holes x 20 ft.

deep at 100 ft/day = 10 days

5.6.4. Costeans

It is proposed that three costeans be cut across the Scotia lead and one across the Endurance.

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022

5.7. COSTING

COST SUMMARY

(as at October, 1974)

	Exploration and Investigation	115,000
	Capital (total)	2,542,130
	Establishment at Monarch	16,600
	Operating in Monarch & Hasties (1 dredge)	1,181,660 p.a
*	Transfer & establishment at Hasties	20,700
*	Transfer and establishment at Endurance	73,000
	Operating in Endurance	1,609,624 p.a.
	Transfer and establishment at Scotia	289,600
	Operating in Scotia	1,609,624 p.a.

* Does not include operating costs during the transfer period.

023

5.7.1. Capital Expenditure

Capital expenditure for the whole project and the write-off periods are shown on the following schedules.

Write off of the dredging units takes place over a ten year period as it is expected that these items would have some commercial use beyond mining our reserves.

The treatment plant due to its very limited potential is written off over the life of the reserves.

Except for transport items, it is expected that all other capital expenditure items will have some residual value on exhausting the reserves. These items are then written off over a ten year period.

In the event that sufficient off-shore reserves are proven by P.T. Koba Tin in Indonesia to warrant dredging then the possibility of selling the units to P.T. Koba on completion of the Tasmanian project should not be overlooked.

Designing the dredges and plant suitable for an off-shore operation has been tentatively discussed with Watsons.

It should be noted that it is probable that the dredge builder would be entitled to a shipbuilding subsidy of 25% on the two dredging units. Watson's have stated that this benefit would be passed on to us. Thus reducing the capital outlay by $148,175 in year 2 and: by a further $207,300 in year 4. This probable benefit has not been considered in the Cash Flow.

A. CAPITAL COSTS

Dredge and Treatment Plant	2,066,400
Utility Crane/	50,000
Office and furnishings	7,480
Workshop and equipment	37,490
Tin shed and equipment	47,200
Laboratory and equipment - allow	6,000
Ablution block and crib room	1,600
Store and racking (use existing portable unit)	4,000
Transformer and switchgear (22/3.3 Kva)	60,000
Workboats (2) - sampans	2,000
Replace existing land rover - exploration	6,000 *
Replace Manager's car	3,000 *
Toyota flat-top - workshop	6,200 *
Replace 1 tonne utility - workshop	6,200 *
Replace 1 tonne utility - Production Sup.	2,660 *
Tractor and Trailer	11,000
	$2,311,030
Allow sundries 10%	231,100
	$2,542,130

* Replace every 3 years

B. Capital Expenditure - Write-off Schedule

Item	Period	Annual Charge	Residual Value
Dredge 1 + cable and pipe	10 years	66,770	133,540
Dredge 2 + cable and pipe	10 years	92,930	371,720
Treatment Plant	8 years	95,700	Nil
Utility Crane	10 years	5,000	10,000
Office/Furniture	10 years	748	1,496
Workshop and equipment	10 years	3,749	7,498
Laboratory and equipment	10 years	600	1,200
Store " "	10 years	400	800
Transformer/switchgear	10 years	6,000	12,000
Mobile Transport	3 years	8,023	Nil

C. Transfer & Establishment Costs Amortised As:

Monarch) Hasties)	2 years	@	$18,650 p.a.
Endurance	2 years	@	$36,500 p.a.
Scotia	3 years	@	$83,300 p.a.

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026

5.7.2 Establishment Costs

(to be amortised)

A. Monarch

Access Road	1,500
H.T. power line + connection (2 miles)	8,700
Construct initial dredge pond	3,500
Install water supply pump and pipe 10/12 K.L. allow	1,500
Reconstruct water race	400
Connect domestic water (tank and sump)	200
Connect L.T. power	200
Connect telex	300
Connect telephone	300
Locate office, " tin shed, " workshop, " store, " Ablutions — included in capital costs	
Site preparation	500
	$16,600

B. Hasties

Access Road - incl. with Monarch	
H.T. power line connection (2 miles)	8,700

C. Endurance

Access Road - in conjunction with Monarch	
H.T. power line connection (8 Miles)	8,700
Construct initial dredge pond	3,500
Relocate water supply pump & pipe	14,000
Dig water supply race (8500 ft)	800
	$27,000

D. Scotia

Access road and bridge	2,800
H.T. power line connection (4 miles)	17,400
Construct initial dredge pond	3,500
Dig new and reconstruct old water race (19,000 ft)	3,000
Connect domestic water (tank & sump)	200
" telex	300
" telephone	300
Locate office	400
" tin shed	5,500
" workshop	2,400
" Store	3,400
" Ablutions	400
Site preparation	500
Dismantle & Relocate Dredge	250,000
	$290,100

5.7.3. Operating Costs p.a.

(estimated for 1974 costs)

	Monarch/Hasties	Endurance/Scotia
Salaries and Wages	415,685	467,711
Power	120,000	200,000
R & M	492,553	797,753
Lease Renewals	5,000	5,000
Insurance	27,000	41,000
Service Road Construction/ Maintenance	6,000	6,000
Fuel, Oils, Greases	17,622	26,700
Office Supplies/Communications	5,500	5,500
Transport	27,100	27,100
Pre-stripping	43,200	10,800
Dams and Drains	2,000	2,000
Laboratory Costs	3,000	3,000
Sydney Administration	17,000	17,000
	$1,181,660	$1,609,624

Note: Ore freight costs estimated at $9.00/tonne
Herrick - Launceston not included in above.

029

5.7.4 Staffing

A total on site staff of 55 has been provided for at the following rates:

	No.	Per Annum	Per Week
Mine Manager	1	15,000	
Deputy "" /Prod.Sup.	1	11,000	
Accountant	1		175
Typist/Clerk	2	92 x 2	184
Storekeeper/Clerk	1		127
Stores Hand	1		100
Drill Sup./Surveyor	1	8,000	
Drillers	2	105 x 2	210
Sample Washer	1		105
Lab. Technician	1		140
Tin Shed Operators	2	110 x 2	220
Electricians	2	110 x 2	220
Fitter/Turner/Welder	4	115 x 4	460
A asst.	3	91 x 3	273
Carpenter	1		110
Truck/Tractor/Driver	1		105
Field Labour	3	100 x 3	300
Total Day Workers	28		
Dredge Operators	6	6 x 120	720
Dredge Hand	6	6 x 110	660
Leading Hand	3	3 x 118	354
Plant Operators	9	9 x 110	990
Floats	3	3 x 110	330
Total Shift Workers	27		
TOTALS	55	34,000	5,783

Total Salaries/Wages per annum	$334,716
Hol. Pay/Sick Pay etc. at 25%	83,679
overtime at 20% of operatives only	49,316
Total salaries/wages	$467,711

Note: Reduce costs p.a. for Monarch (1 dredge) operation by 3 dredge operators and 3 dredge hands Total p.a. $52,026.

Salaries/Wages one dredge operation $415,685 p.a.

030

559031

5.7.5 Dredge Transfer Costs (to be amortised)

A. Monarch to Hasties	
(480,000 cu.yds. allowing 2 months)	
Dredge operating	196,943
Earthworks	11,250
Water supply	750
	$208,943
B. Hasties to Endurance	
(422,000 cu.yds. allowing 6 weeks)	
Dredge operating	136,345
Earthworks	45,000
Water supply	1,000
	$182,345
C. Endurance to Scotia	
Estimate based on M.D. transfer of similar sized unit to North Stradbroke Island	$250,000

Note: Transfer costs to be charged and amortised over life of respective reserves.

5.7.6 Exploration, Investigation Costs

Drilling:	
(a) Counter Flush 13775 ft. @ $3.75/ft	51,656
mobilisation	5,500
Sample preparation) analysis and assay)	1,500
Air fares tin dresser	650
Wages/allowances tin dresser (3 months)	900
Auger drilling (probing) $2.00/ft	4,000
Survey/Mapping allow	3,000
Geological supervision	5,000
Costeans 4 off at $7,000 each	28,000
Reappraisal of Project	4,600
Fares/Expenses ex Sydney x 2	400
	$105,206
Add contingencies - say	$115,000

PRODUCTION SCHEDULE AND INCOME

032

COMMENT	YEAR	LOCATION	VOLUME MINED 000s	AVERAGE GRADE SN oz/cu.yd.	TONNES SN TOTAL	VALUE $/TONNE	TONNES SN AT 85% Recovery p.a.	TOTAL VALUE $ AT 85% 000s
First 2 months 50% prod.+ 1 month	2	Monarch	600	4.16	71	5721	60	343.3
	3	"	3600	4.16	424	6007	360	2162.5
	4	"	600	4.16	71	6293		
2 months non prod. trans to Hast.	4	Hasties	2400	7.64	519	6293	501	3152.8
	5	"	600	7.64	130	6579		
2 months transfer to End. two dredge operation	5	Endurance	4800	3.54	481	6579	519	3414.5
Trans to Scotia month 12.	6	"		3.54	662	6865	563	3865.0
ten months only.	7	Scotia		3.26	554	7151	471	3368.1
	8	"		3.26	665	7437	565	4201.9
	9	"		3.26	665	7723	565	4363.5
One month operating only	10	"		3.26	55	8009	47	376.4

NOTE:
1. Tin price initially taken as M$1100/picul = A$5721/tonne and escalating at 5% p.a. simply.
2. Actual production calculated at 85% recovery.

559033

DO NOT SCALE PRINTS. WHEN IN DOUBT, ASK.

REFERENCE DRAWINGS

DWG. No.	TITLE

AMG REFERENCE POINTS ADDED

[redacted]

REVISIONS

XL-1051 559034

B.M.I. MINING. PTY. LTD.

AREA LOCATION MAP FOR REPORT

Blue Metal Industries Ltd.

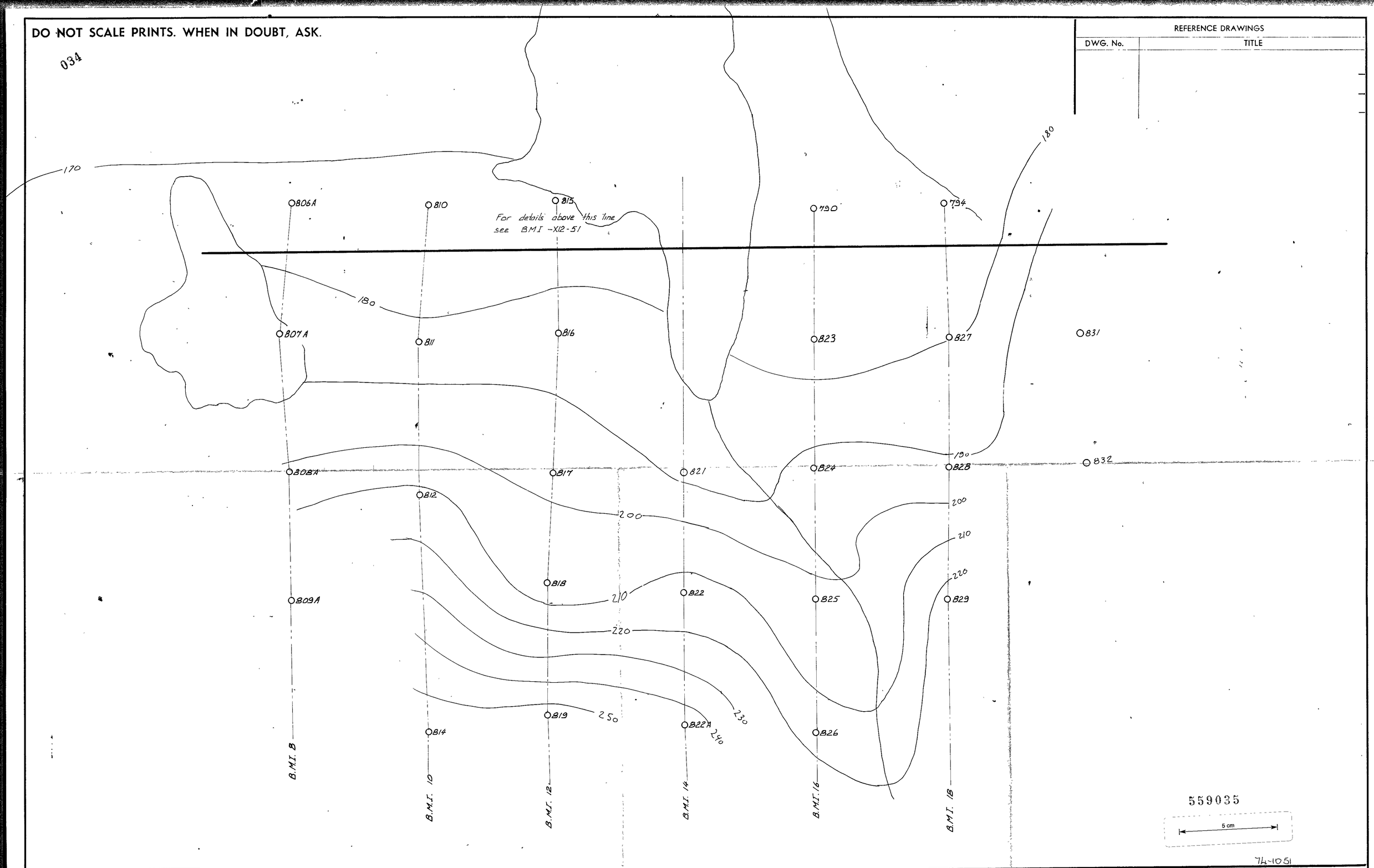
SCALE 40 CH. = 1 INCH		SIZE	DRAWING NUMBER
DRAWN	L.P.F. 23-10-74	B 1	BMI-XG 27
CHECKED			
CHIEF DR.			
APPRD.			REV.

033

DO NOT SCALE PRINTS. WHEN IN DOUBT, ASK.

034

REFERENCE DRAWINGS	
DWG. No.	TITLE



559035

5 cm

74-1051

B.M.I. MINING PTY. LTD.	**Blue Metal Industries Ltd.**
MONARCH MINE	SCALE 1"=100'-00"
PLAN SHOWING DRILL LINES &	DRAWN K.A.L. 26-9-74
CONTOURS SHEET 2 of 2	CHECKED
	CHIEF DR.
	APPRD.
SIZE	B 2
DRAWING NUMBER	B.M.I.-X12 - 58
REV.	

REVISIONS

6652

ADDITIONAL LINES OF BORES

6323 M

6276 M

6277 M

6278 M

6279 M

6285 M

6286 M

6287 M

6320 M

6321 M

6322 M

6348 M

APPROXIMATE CONTOUR TERRACES AT CREEK LEVEL

CREEK LEVEL

No 5 LINE BORES

No 6 LINE BORES

No 7 LINE BORES

No 8 LINE BORES

No 9 LINE BORES

No 10 LINE BORES

No 11 LINE BORES

No 12 LINE BORES

CHECK LINE

LEAD

GRANITE

HUNTER ST

BLUE GRANITE

COURSE

TERRACE APPLIED FOR BY MR T. LYONS

Trace ground from 6 to 9 inch estimated Hydrogen Ions

SECTION A.B.

GENERAL CHARACTER LEAD

HORIZONTAL SCALE 1 INCH TO 120 FEET

VERTICAL SCALE 1 INCH TO 10 FEET

RIVER SILT

COARSE GRAVEL

WASH FINE DRIFT

PUGGY DRIFT

PUG

DRIFT

PUGGY SILT

FINE SAND

GRANITE BOTTOM

PRESENT CREEK

LEGEND

ORIGINAL & ADDITIONAL LEAD

PROPOSED LINE OF BORE HOLES AT 30' INTERVALS.

559036

B.M.I. MINING PTY. LTD.	Blue Metal Industries Ltd.					
CLARENCE TIN ORIGINAL AND ADDITIONAL LEAD	SCALE: 1 INCH = 5 Ch.			SIZE	DRAWING No	
	DRAWN	K.A.C.	19.9.74	A	B.M.I.-X8	22
	CHECKED					
	CHIEF DR.					
	APPRD.					

74-1051

5 cm

DO NOT SCALE PRINTS. WHEN IN DOUBT, ASK.

REFERENCE DRAWINGS	
DWG. No.	TITLE

N

23M 73
18M 65
12M 59
44M 67
50M 65
34M 71
43M 67
89M 67
42M 67
35M 65
47M 72
45M 67
23M 66
43M 72
99M 67
47M 72
91M 67
37M 72
38M 72
39M 72
40M 72
41M 72
24M 72
42M 72
45M 72
100M 67
29M 73
39M 67
90M 67
40M 67
41M 67
30M 69
44M 72
26M 73
38M 67
27M 73
28M 73
31M 73
33M 66

SMITH CK
RUBY CK
B.M.I. POWER LINE

LEGEND
PROPOSED DREDGE AREA & CLEARANCE
RESERVE

559037
5 cm
6653

REVISIONS

B.M.I. MINING PTY. LTD.

ENDURANCE
LOCATION PLAN SHOWING RESERVE AREA, WATERWAYS, ROADS, POWER LINES, & ORE BODY

Blue Metal Industries Ltd.

SCALE 10 CHAINS = 1"	SIZE	DRAWING NUMBER
DRAWN L Tuckey 17.8.74	B 1	B.M.I.-X8 - 25
CHECKED		REV.
CHIEF DR.		
APPRD.		

DO NOT SCALE PRINTS. WHEN IN DOUBT, ASK.

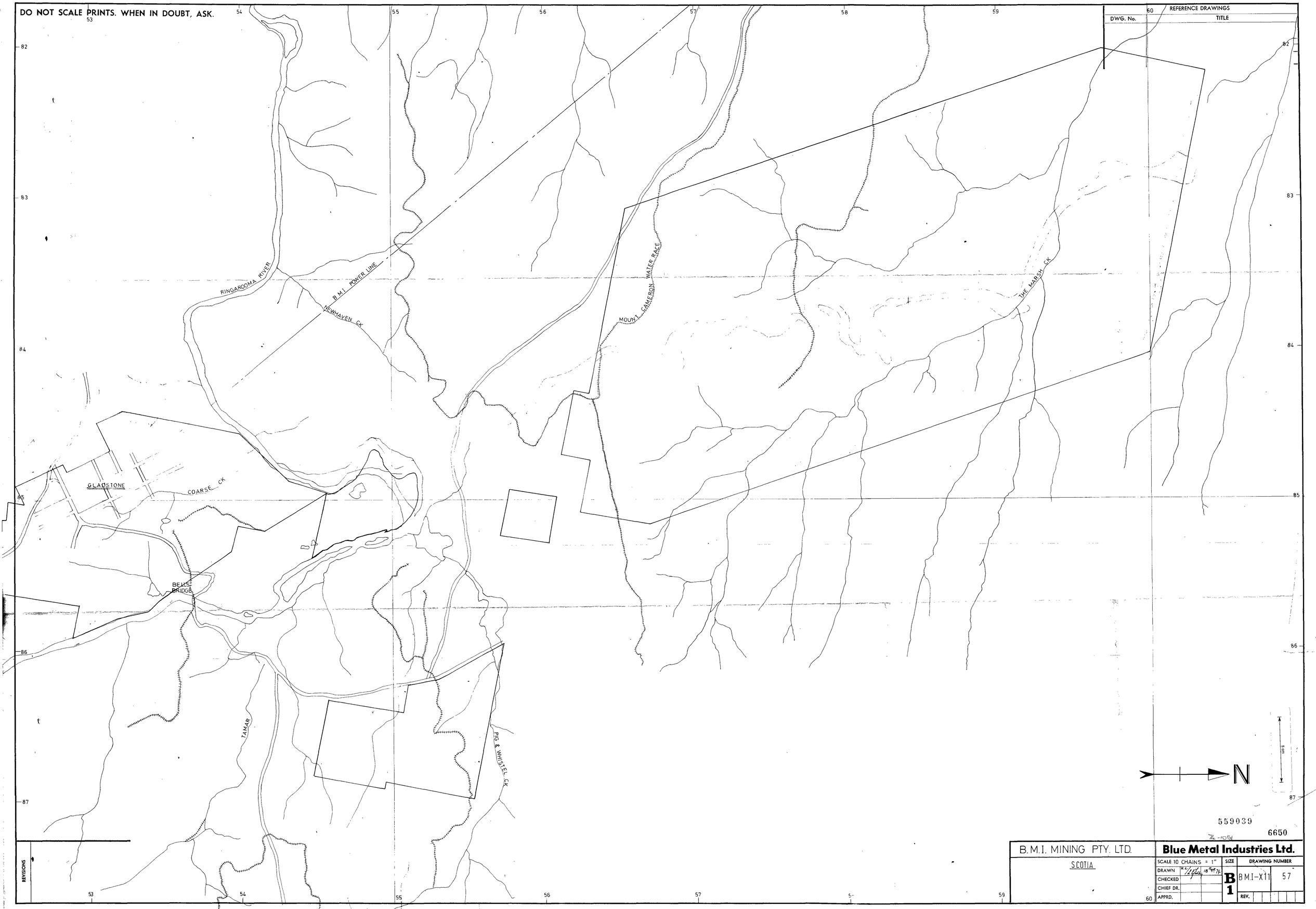
REFERENCE DRAWINGS	
DWG. No.	TITLE

74-1051

B.M.I MINING PTY. LTD.	**Blue Metal Industries Ltd.**		
ENDURANCE MINE WORKING PLAN.	SCALE 200 FT = 1"	SIZE	DRAWING NUMBER
	DRAWN K.A.L.	B 1	BMI-X8 23
	CHECKED		
	CHIEF DR.		
	APPRD.		REV.

REVISIONS

559038


DO NOT SCALE PRINTS. WHEN IN DOUBT, ASK.
REFERENCE DRAWINGS
DWG. No.
TITLE
RINGAROOMA RIVER
B.M.I. POWER LINE
NEWHAVEN CK
MOUNT CAMERON WATER RACE
THE MARSH CK
GLADSTONE
COARSE CK
BELLS BRIDGE
TAMAR
PIG & WHISTEL CK
N
REVISIONS
559039
6650
B.M.I. MINING PTY. LTD.
SCOTIA
Blue Metal Industries Ltd.
SCALE 10 CHAINS = 1"
DRAWN
CHECKED
CHIEF DR.
APPRD.
SIZE
B 1
DRAWING NUMBER
BMI-X11
57
REV.

6651

BM1-X11-6

SCOTIA LEAD
BEDROCK CONTOUR MAP

BM. MINING PTY LTD 6651

74 - 1061

5590.10

Chains 0 5 10 15 20

Feet 0 500 1000 1500

5cm

LEGEND

- Vert. Mag. 5n O2 per cu. yd.
- 4Q3 to 8Q3 " " " "
- 2Q3 to 4Q3 " " " "
- Under 2Q3 " " " "
- Trace
- Barren
- No data available
- BM drilling
- OP ⊙A A = Auger ; P = Percussion
- Utah drilling (1966)

Index to one chain maps.

						03 E1	
					S2	S3 E1	S2 E2
					S1	S1 E1	S1 E2
				00	E1		
			N1	N1 W1			
			N2	N2 W1			
		N3	N3 W2	N3 W1			

S3E2 S3E1 S2E2 S2E1 S2W1 S1E2 S1E1 S1W1 N1E1 N1 N1W1 N1W2 N2E1 N2 N2W1 N2W2 N3E1 N3 N3W1 N3W2 N3W3

1 2 3 4 5 6 7 8 9 10

1A 2A 3A 4A 5A E1 E2 W1

SCOTIA WORKINGS

NEWHAVEN WORKINGS

DOONE WORKINGS

MURRAY & RICHARDS

LOCHABER MINE

M127 L. J. GROVES 20 ac.

DAM

Newhaven Creek

Scotia Trace

Branch Trace

Water Trace

Mount Cameron Water

Mount Cameron

Stinking Creek

MT CAMERON WATER RACE RESERVE

B.M.L. TEST LINE 1

B.M.L. TEST LINE 2

B.M.L. TEST LINE 3

B.M.L. TEST LINE 4

6651

BM1-X11-6