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**MINERALS PROJECT • TASMANIA AUSTRALIA**

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**TERRA MARINE PACIFIC INC.**

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MINERALS PROJECT . TASMANIA AUSTRALIA  
SUMMARY

Deposit

Fully leased. Located at river mouth in protected bay, W Tasmania. Accessible by road, sea or air. Partly submerged; water depths to 37 m. Consists of unconsolidated sand and silt; density, approx. 1 mt solids/m<sup>3</sup> in place. Proved reserve, 100,000,000 mt of which one-seventh is heavy mineral. Heavy mineral fraction runs about 45% sulphides, 7% miscellaneous. Sulphide component, mainly pyrite, carries recoverable cobalt, copper, silver and sulphur plus byproduct quantities of gold and other metals. Miscellaneous component yields, barite, beach minerals, tin.

Investigations

Deposit thoroughly drilled and sampled. Several thousand chemical analyses made. High proportion of sulphide in deposit proves recoverable. Flotation separates over 90% of total sulphur. Gravity processes retain 80% of sulphide, rejecting more than 80% of sediment; fair recoveries of cassiterite, and associated minerals also appear likely. Electron probe studies indicate cobalt confined to small percentage of sulphides averaging 1.9% Co. Process investigations and assaying by Tasmanian Mines Dept, Australian Mineral Development Labs, Mineral Deposits Ltd, Lakefield Research, Robertson Research and others. Expenditure to date, US \$627,000.

Potential

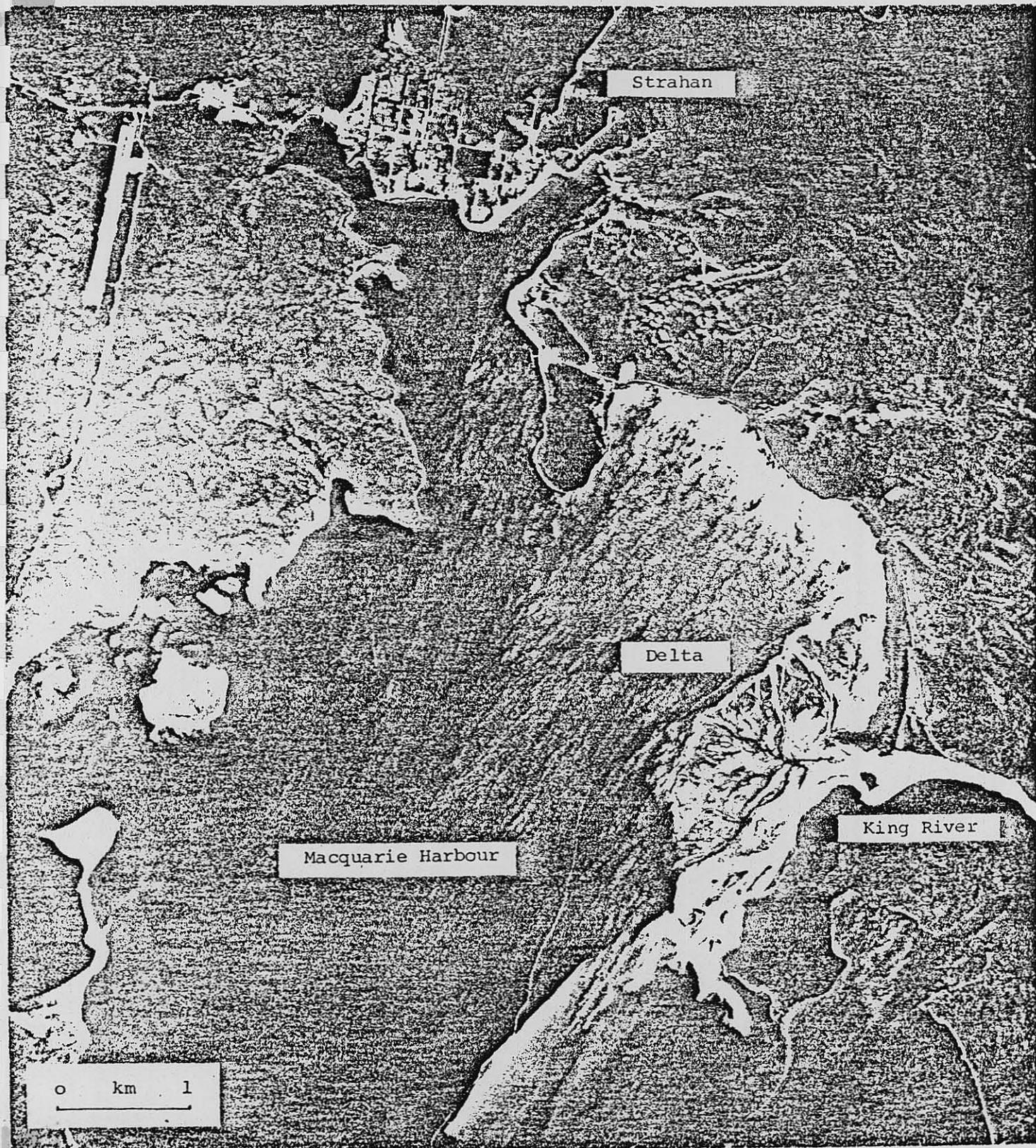
Deposit considered capable of sustaining profitable mining operation yielding concentrate for sale, toll processing at other Tasmanian plants, or treatment on site. Current recoverable values of main target materials in delta are: cobalt, \$325,000; barite, beach minerals and tin, \$100,000,000; sulphur (as acid), \$100,000,000; copper and silver, \$75,000,000. Based on these figures unit value of delta sediment is approximately \$6/mt and value of concentrate representing 7% of sediment, \$84/mt. Projected costs: dredging, concentrating and (optional) limited grinding, \$0.34/mt sediment extracted, that is, unit cost of \$4.86/mt concentrate produced. Additional costs for flotation, for gravity, magnetic, electrostatic separation, for smelting and refining (all optional), \$1.61/mt sediment dredged. Taxes: comparable to US taxes. Technology: cobalt, copper, other metals, acid being produced from W Tasmanian sulphide ore elsewhere in state; also from pyritic concentrate recovered from tailings resembling our delta sediment in OFS, South Africa. Environmental considerations: bay naturally toxic, essentially lifeless, thus no grounds for conservationist barriers to mining.

Plan

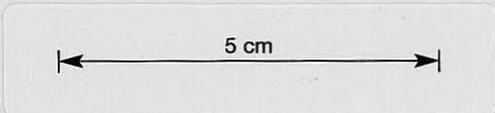
Investigations and proposed development proceeding on phased basis. Phases I and II completed, Phase III in progress; requires final process tests. Phase IV calls for extra pilot plant studies at research establishments. If mining warranted, project to be purchased and company responsible for mine construction and operation acquired or formed. Phase V to cover mine design and construction. Schedule: Phase III, 3 more months; Phase IV, 6 months; Phase V, 12 months. Budget: Phase III balance, \$25,000; Phase IV, \$72,000; Phase V, basic capital cost, dredge and concentrating plant, \$8,000,000. Mining rate proposed, 5,000,000 mt sediment per year; annual yield, 350,000 mt concentrate. Deposit life, 20 years.

Participation

Initial forty-five percent holding in enterprise open to qualified partner. Holdings subject to adjustment later to provide for minimum 50% domestic ownership required by Australian Government. Partner shall meet remaining Phase III costs to offset initial contributions already made to project by TMP. Costs of Phase IV to be met equally by TMI and partner. If TMI and partner elect to proceed to Phase V, partner shall contribute \$185,000 cash or stock toward cost of purchasing project from present owners. All subsequent costs to be borne by private or public company established by TMI and partners to develop and exploit deposit.



KING DELTA: WEST TASMANIA



## DEPOSIT

Deposit comprises delta of King River lying at NE corner of landlocked bay, Macquarie Harbour. Road distances, 5 km to village of Strahan at N end of harbour, 40 km to Queenstown, 230 km to port of Burnie on Bass Strait, 300 km to state capital, Hobart. Approximately 500 km by air from Melbourne on Australian mainland.

Scheduled air service from Strahan and Queenstown to Hobart and N coast. Wharf at Strahan.

King Delta consists of tailings from Mt Lyell mine at Queenstown, plus approximately 10% river sediment plus material of secondary origin. Massive sulphide deposits at Mt Lyell have yielded one-third of Australia's total production of primary copper with some 40% of Tasmania's pyrite and a quarter of both its silver and gold. Lyell reserves sufficient for 20 years' further production at current rate.

Delta has formed since turn of century when large-scale mining at Mt Lyell began. Delta continues to be augmented by addition of approximately 1,500,000 mt tailings per year. Area: 4 km NS, 3 km EW. Thickness, 1 to 32 m, average 7.5 m. Average density, 1.14 mt/m<sup>3</sup> in ground. Tonnages: 100,000,000 mt proved, 25,000,000 probable.

Delta is partly exposed; water depths 0-37 m. Waters fresh to salt; freshwater/saltwater interface off Delta generally at depth of 8 m. Harbour waters and floor below sill depth of 11 m largely stagnant, high in H<sub>2</sub>S, arsenic. No appreciable tide or swell in Harbour; chop only.

Sediment in deposit, sandy near river mouth, silty toward outer edges of Delta. Grain sizes in percent:

$\mu\text{m}$	BSS, mesh	ASS, mesh	delta proper	outer edges
+250	+60	+60	16	
+180	+85	+80	31	
+125	+120	+115	23	25
-125	-120	-115	30	75

Sediment essentially unconsolidated, free of clays, boulders; thin, localised developments of iron pan; occasional pebble bands, tree trunks.

Composition: quartzose sediment running average 14% heavy minerals. HM fraction: 45% sulphides; 35% common silicates; 13% iron oxides, hydroxides, carbonate; 7% miscellaneous.

Sulphide component, principally pyrite, marcasite, contains estimated 8,000,000 kg cobalt, 30,000 mt copper, 42,000 kg silver, 3,300,000 mt sulphur, plus minor concentrations of gold, molybdenum, zinc and selenium. Cobalt largely confined to iron sulphides. Copper occurs partly as chalcopyrite.

Silicate component mainly muscovite.

Iron oxides, hydroxides, carbonate chiefly haematite, limonite, goethite, siderite; small amounts of magnetite.

Miscellaneous component contains estimated 600,000 mt barite, 120,000 mt monazite, 40,000 mt zircon, 40,000 mt rutile and 2,000,000 (?) kg tin.

Sediment fairly well sorted and sized with most heavy minerals conspicuously finer in grain size than bulk of quartzose grains. Coarser pyrite angular, beach minerals sub-rounded. Pyrite, zircon and rutile moderately liberated; chalcopryrite largely intergrown with pyrite; haematite typically intergrown with magnetite, chalcopryrite or silicates.

## INVESTIGATIONS

Delta and surrounds have been examined in detail. Some 2,300 metres of sediment cored, 1,500 samples collected and 4,700 assays obtained. Work carried out by Cities Service Company, Aberdare Incorporated and approved contractors; part supervised by A. G. McKee.

Numerous lab studies undertaken. Investigation by electron probe indicates cobalt confined to calculated 8 to 9% of Delta's iron sulphide component assaying 0.75 to 3.4% Co.

Concentrator tests demonstrate over 70% of the iron sulphides separable from bulk of sediment by physical means, without grinding. For example, screening tests by Australian Mineral Development Labs show 77% of total pyrite and 72% of total cobalt occur in material passing 120 mesh BSS, material constituting 30% of sediment mass. Using a Lamflo sluice plus spirals Amdel recovered 79.7% of the sediment's sulphur in 19.1% of sediment mass. Mineral Deposits Ltd recovered 86.5% of total sulphur in 16% of mass employing cones, and 80% of the sulphur in 7% of mass by spiralling cone concentrate. S. G. Frantz Inc using magnetic separators isolated 74% of the sediment's cobalt in 22% of the sediment mass; also 73% of total silver in 38% of the sediment mass and 73% of the zinc in 17% of the mass.

Physical methods concentrate barite, beach minerals and cassiterite, too. By magnetically separating tabled concentrate Tasmanian Mines Dep't labs produced a concentrate assaying 23.9% barite, approximately 1% monazite and 3,400 ppm Sn. In another tabling experiment the same lab produced concentrate running 3.4% zircon, 2.7% rutile and 2.05% cassiterite.

Higher sulphide recoveries obtainable by simple flotation of bulk sediment. Mines Dep't recovered 97.3% of total sulphur in 13.6% of sediment mass; flotation time, 15 minutes. Lakefield Research of Canada recovered 92.3% of total sulphur in 9% of the sediment mass; flotation time, 6 minutes. Robertson Research recovered 92.3% of total sulphur in 11.7% of the sediment mass; flotation time, 5 minutes. All these results refer to rougher flotation of unground Delta sediment.

Most favourable separation procedure appears to be one combining coning with flotation. Grinding coarse fractions of sediment and concentrate and recirculating ground products through cone plant should raise high recoveries reported yet further.

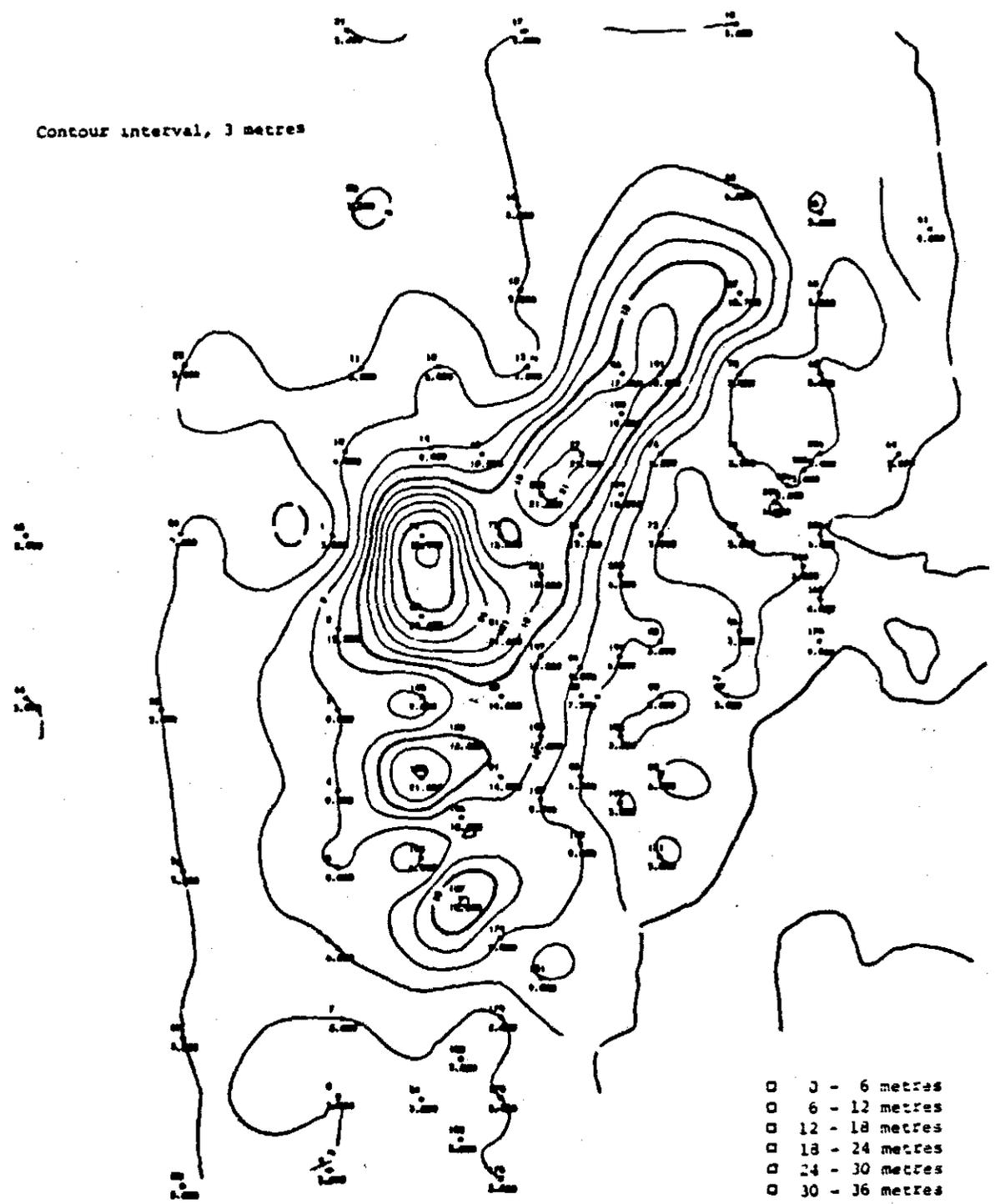
Calculations demonstrate three-stage procedure above will yield sulphide fraction totalling 5% of sediment mass. This fraction assays approximately

0.16% Co	8.5 ppm Ag
50 % S	1.3 ppm Au
0.63% Cu	70 ppm Se
45 % Fe	plus some Mo, Zn

(Amount of copper recoverable can be increased three to four times by dispensing with coning step and running all sediment dredged through fairly complex flotation plant, but economics less attractive than those of three-stage procedure.)

Non sulphide fraction from flotation, comprising another 2% of sediment mass and representing balance of initial 7% cone concentrate, runs estimated 21% barite, 2% monazite, 1.5% rutile, 1.5% zircon, 0.1% cassiterite, and carries considerable percentage of iron oxides, hydroxides, carbonate. Higher concentrations of most of these components expected when limited grinding added and standard separation methods fully adapted.

Contour interval, 3 metres



- 3 - 6 metres
- 6 - 12 metres
- 12 - 18 metres
- 18 - 24 metres
- 24 - 30 metres
- 30 - 36 metres

King Delta: sediment thickness

5 cm

Economic analysis indicates King Delta deposit will support profitable mining enterprise.

Valuable concentrate may be produced at low cost by dredging bulk sediment and separating heavy mineral fraction in barge-mounted cone plant. Concentrate may be sold as is, processed on toll basis at existing facilities elsewhere in Tasmania or treated at plant to be erected for this purpose near Delta.

No technical difficulties expected in treating concentrate. Metals and sulphur in pyritic fraction recoverable by well-established methods involving roasting, acid manufacture, leaching, liquid ion exchange, electrowinning/chemicals production. Plant also yields iron cinder. Useful components of non sulphide fraction may be isolated by conventional techniques employing gravity, magnetic and electrostatic separators.

Acid, copper, cobalt, silver, gold, zinc already being produced from west coast sulphides in Tasmania, should it be decided to have Delta concentrate treated elsewhere in the State either under toll arrangement or after sale.

South Africa's Joint Metallurgical Scheme successfully treating pyritic tailings and slimes similar to King Delta sediment. JMS concentrate reputedly runs about 2,000 ppm Cu, 1,000 ppm Co, 9 ppm Au. Concentrate said to represent 2.5% of tailings mass. Tailings brought to processing plant from five other gold/uranium mines. About 1,000,000 tonnes concentrate said to be processed each year.

Proved reserve of King Delta sediment worked at rate of 5,000,000 mtpa sufficient for twenty-year operation. Annual production would be 350,000 mt concentrate. Approximate yield per year expressed non metrically would be 825,000 lb cobalt oxide, 2,500,000 lb copper, 50,000 troy oz. silver, 100,000 st sulphur or roughly 250,000 st sulfuric acid, and 16500 lb barite.

Cobalt figures, representing 15-fold increase over present Tasmanian production, would meet 3 to 4% of US needs or higher proportion of those of Japan or West Germany. Though major consumers, none of the three countries has significant mine production of cobalt.

King Delta projected sulphur production equals one-third of total produced in Australia in 1977 or one-quarter of sulphur imported by Commonwealth that year. Country lacks deposits of elemental sulphur. Recovered at projected rate in form of acid delta sulphur would augment Tasmania's acid production by 75%.

Projected barite production equals 125% of total produced in Australia in 1977; equals one-twelfth West Germany's barite imports that year and, it appears, greater fraction of Japan's.

Each production estimate above may be increased two-thirds if proved reserve exploited in 12 rather than 20 years. Probable reserves likely to provide minimum three years' further working life. Probable reserves in lower parts of Delta, in Delta margin, and in material of primary and secondary origin being added to delta. For example, proved cobalt reserve growing by estimated 1.78% per year, that is, by 340,000 lb Co annually; 42.5% of this amount is secondary. In case of copper reserve, 55 to 75% is secondary.

Current value of cobalt, copper, silver and acid recoverable from sulphide fraction of King Delta concentrate approximately \$70/mt. Value of barite, beach minerals and tin recoverable from non sulphide fraction approximately \$14/mt. Value of all these components in unseparated concentrate about \$84/mt or some \$6 mt Delta sediment. Figures are conservative and likely to be augmented during exploitation of deposit by additional values from byproduct recovery of some of following: Au, Mo, Zn, Se; iron cinder, oxides, hydroxides and carbonate ; fine grained muscovite.

Anticipated capital and operating costs per metric tonne sediment dredged are: extraction, \$0.07; limited grinding (optional), \$0.11; coning, \$0.16; total, \$0.34.

Extra costs (all optional): gravity, magnetic and electrostatic separation, \$0.24; flotation, \$0.62; smelting and refining, \$0.75; total \$1.61.

Figures above for dredging and coning plus limited grinding convert to a cost of \$4.86/mt concentrate produced. Optional separation and processing of both sulphidic and non sulphide fractions convert to a cost of \$23/mt concentrate handled.

Margin between value of concentrate, approximately \$84, and estimated cost of producing and processing it, approximately \$28, attractive enough to support profitable operation even if gains reduced through fall in cobalt price, sale of acid at cost, recovery of fewer components or other factors.

Corporate taxes in Australia similar to those of US. Tasmanian state tax amounts to 5% of profits or 2% royalty, whichever lower; profits from pyrite sales are tax free. Additional 2% royalty to present owners if TMI or others purchase project and exploit deposit.

Macquarie Harbour anoxic; sediment studies show it has been for several thousand years at least. No hatcheries, shell beds or fish population to be disturbed by dredging. To contrary, moving sediment from Delta to bay floor ultimately will lead to natural flushing of Lyell mine wastes from King River valley, bed and mouth, restoring form close to original.

Land abutting Delta and most of Macquarie Harbour forested, uninhabited, undeveloped. Plant sites, water, available. Cheap power from Pedder/Gordon hydroelectric scheme. Supplies, skilled labour at Queenstown and other west coast mining centres. Equipment, technical services from Hobart, Melbourne.

## PLAN

First two phases of project completed. Latter defined, assessed delta deposit.  
Third phase embodying process studies 80% finished.

Plan calls for Phase III to be completed, then 1 to 2 more phases run; Phase IV, pilot plant studies at Tasmanian Mines Department, Amdel and Lakefield Research; Phase V, if warranted, design and construct dredge and plant.

Sample available for Phase IV and rest of Phase III tests: Adelaide, 1.6 tonnes; Southport, 2.5 tonnes; Launceston, 0.3 tonnes. Additional quantities obtainable from deposit.

Bulk tests of Phase III showed rapid production of valuable concentrate by inexpensive gravity methods feasible. Balance of Phase III tests to establish best ways of upgrading concentrate.

In Phase IV nature of cobaltiferous sulphide and possibility of separating it from barren sulphide will be investigated and extensive smelting, leaching and extraction tests will be run.

If mining warranted, project to be purchased and a company obtained or formed; company will be responsible for mine design, construction, and will operate mine.

Schedule: Final phase III tests, approximately 3 months; Phase IV about 6 months; Phase V, estimated 12 months.

Budget:		Phase III balance	Phase IV
Leasing and administration		\$7,000	\$10,000
Testing		10,000"	40,000 <sup>+</sup>
Travel		5,000	15,000
Contingencies		3,000	7,000
"Assaying	\$1,000	+Sample storage, collection, shipment	\$5,000
Mineralogy	2,000	Preparation, grinding, coning	5,000
Roast tests	3,000	Flotation, smelting, extraction	20,000
Phy. procedures	4,000	Tabling, elec/magnetic separation	10,000

## Estimated capital costs, Phase V:

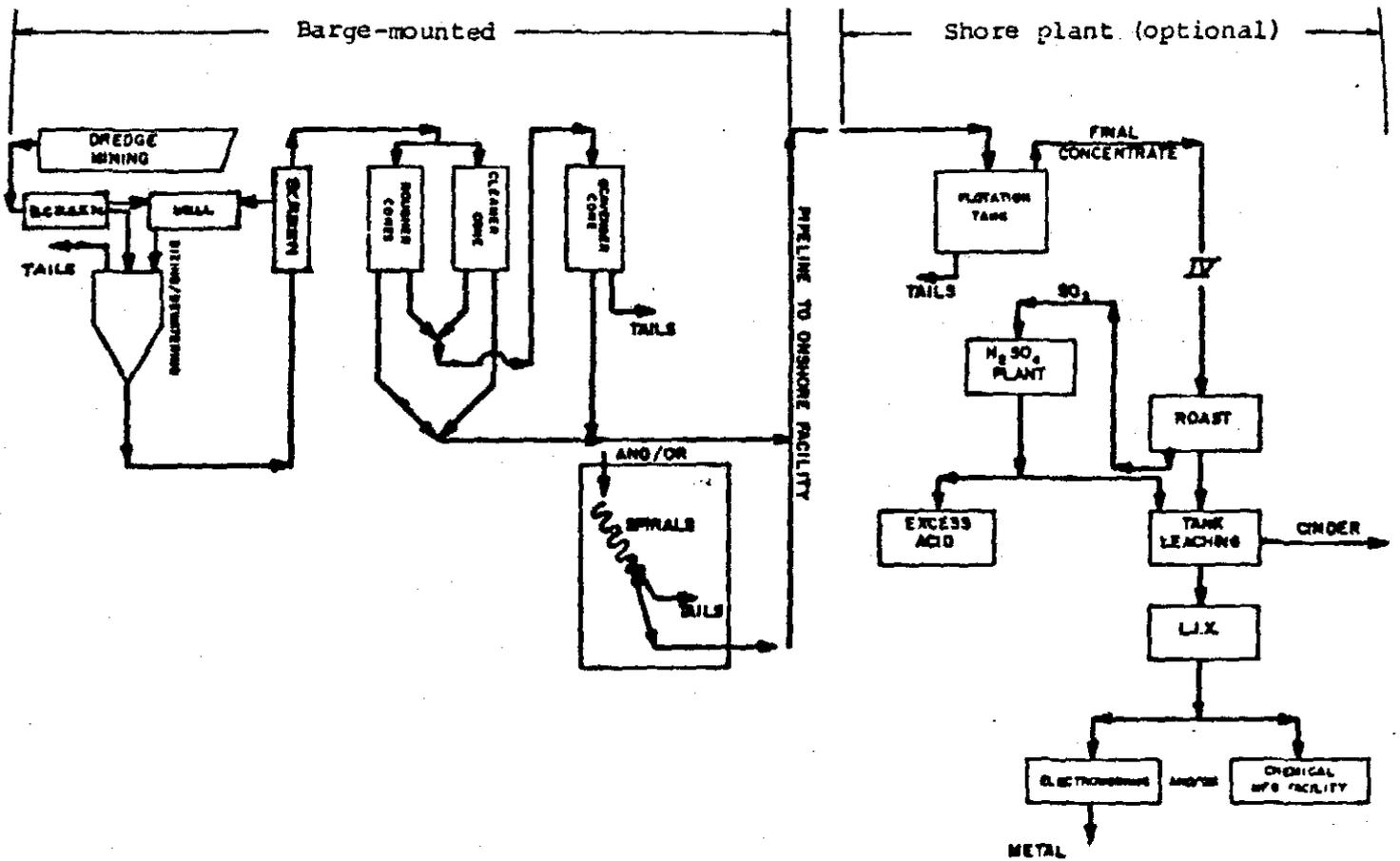
## Concentrate Production

Dredge	\$2,500,000
Gravity separation	5,500,000
Grinding circuit	1,000,000*

## Processing Plant

Flotation	7,000,000*
Smelting and refining	30,000,000*
Acid/sulphur recovery	10,000,000*
Tabling, elec/magnetic separation	4,000,000*

\*optional



Mining and Processing Sequence Proposed:  
King Delta Deposit, Tasmania

## PARTICIPATION

Terra Marine International Inc. wishes to obtain active or inactive partners for King Delta project. Favour company producing or consuming cobalt, copper, sulphur, acid, beach minerals, barite, as active partner.

Forty-five percent share of enterprise available; share possibly subject to adjustment later to provide for 50% Australian ownership required by Commonwealth Government.

Partner to subscribe \$25,000 toward Phase III costs met by TMI. Phase IV costs to be borne equally by TMI and partner. Each to pay sum of \$36,000, half at start of phase, rest in 90 days.

If electing to proceed to Phase V, TMI and partner will buy project from present owners. Partner to contribute \$185,000 in cash or stock toward purchase price.

Costs of Phase V and all subsequent costs to be met by company acquired or incorporated for this purpose by TMI and partner.

Holdings in project assignable, partly or entirely. Should partner or TMI terminate interest, remaining party to have rights of first refusal to purchase holding of party withdrawing. If TMI and partner withdraw jointly before Phase V, both parties to be equally responsible for any liabilities incurred during joint operations: any assets to be split 50:50. In event both parties withdraw without disposing of holdings, or company representing them does, exploration and mining rights plus all technical material to be made over to present owner at no cost.

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