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Amdel Report

No. 1277

CASSITERITE RECOVERY PLANT

Bureau of Mineral Resources
Record 1982/33

by

D.W. Allen - Senior Consultant
G.A. Dunlop - Consultant
B.P. Watson - Plant Engineer

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Preface

This Record consists of a report commissioned by BMR from a consultant as part of BMR's mineral resource studies.

This report, or parts thereof, may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director.

BMR does not accept responsibility for any statement of fact or expression of opinion contained in the report.

BMR would welcome discussion with anyone using information from this report in carrying out their own feasibility studies.

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SUMMARY

Background

As a follow on from earlier work on estimating costs of copper concentrators and smelters, the Bureau of Mineral Resources requested Amdel to supply capital and operating cost estimates for tin concentrators treating 500, 1500 and 3000 tonnes per day of ore from an underground mining operation as distinct from open-cut or dredging operations.

Approval for this work was given witn O/N J70188 dated 7 April 1978.

Summary of Work Done

A metallurgical balance and treatment requirements for the 1500 tonne per day plant were determined. With this information as a base, flowsheets, material balances, a capital cost estimate, manpower and production costs were determined. Balances and equipment are listed in flowsheet order for the various plant sections, namely:

(a) Washing and crushing plant
(b) Heavy media separation plant
(c) Grinding and sulphide flotation plant
(d) Gravity tin plant
(e) Tin flotation plant
(f) Final product handling and miscellaneous.

Support facilities are listed.

Summaries of all major plant items along with weights, power consumption and a brief description based on size or capacity were prepared.

With the 1500 t/d plant as a basis, capital and operating cost estimates for the 500 and 3000 t/d concentrators were then prepared.

Conclusions

The capital and operating costs for the three plant sizes are given below:

Plant Capacity, t/d	500	1500	3000
Installed Capital Cost, $A10^6		27.398	
Nominal Operating Cost, $/t feed		18.24	

1. INTRODUCTION

The initial enquiry for this mining cost study came in a letter dated 9 November 1977. Illness and heavy overseas commitments delayed action until an Amdel quotation was submitted in a letter 'Mining Cost Studies' dated 20 February 1978. This was accepted by telex on 15 March 1978. Further action by Amdel was again delayed by an overseas commitment to a plant commissioning. Further delays and the resignation of Mr D.W. Allen, Senior Consultant, meant that the work had to be rescheduled completely in amongst other Clients' heavy commitments with other Amdel personnel.

The terms of reference were such as to allow a large degree of freedom with selection of ore type, mill location and flowsheet detail, the principal stipulations being for estimates for 500, 1500 and 3000 t/d concentrators processing a hard rock tin ore.

2. BASIS

Major consideration was given to making sure that the plant would be an 'average' type to suit conditions anywhere in Australia while taking into account many recent developments in processing hard rock tin ores. The plant is versatile and various sections could be deleted if simpler ores than that described are encountered.

The generalised flowsheet, plant and equipment allocations were prepared in detail for the 1500 t/d plant. Plants for the lower tonnage (500 t/d) and higher tonnage (3000 t/d) were then sized and costed using this plant as a basis.

Flowsheets, material balances, manpower requirements, equipment, manpower requirements and costs were derived by the authors after studying various company reports and articles and consulting with colleagues at Amdel and with equipment suppliers.

It has to be stressed that basic assumptions have had to be made in the flowsheets used. Variations are possible on different ores or in different localities in Australia. These assumptions include:

(a) The rock type is folded and contains faulted slates and quartzites.

(b) Mineralisation is principally cassiterite of liberation size at 150 micrometres (μm) closely associated with iron sulphides in veins plus minor massive occurrences in pipes. Both magnetic and non-magnetic sulphides are present.

(c) Concentrator head grade averages 0.8% Sn with iron sulphides content of 15%. The ore has a specific gravity of 3.0 t/m^3.

(d) Economic recovery is obtained by gravity and flotation methods together with flotation for removal of sulphides.

(e) Climate is essentially warm and dry:
- rainfall 500 mm p.a. well distributed
- temperature 0°C min., 40°C max., 20°C ave.
- open air type building construction is possible.

(f) Location is a site away from a major city, say 500 km.

(g) Topography relevant to plant construction is low hills and gently undulating plains.

(h) Adequate water for the processing plant is available by a combination of pumping from the mine plus a dam within 30 km and pumping to storage at the mill.

(i) Grid power at 11 kV is available.

(j) Planned maintenance is all carried out by a central workshop but workshop personnel are allotted to the plant to cope with day to day maintenance.

(k) Planned maintenance shut-downs are in use for plant overhauls.

(l) Analytical and research of a plant nature, are associated with the concentrator.

(m) Tailings disposal is to an essentially level site within 1000 metres from the concentrator and tailings use in mine backfill is not considered.

(n) There is always an ore stockpile between underground mine and concentrator and blending of head grades and ore types is possible. Concentrator design limit commences with this coarse ore stockpile and ends with a finished concentrate for marketing.

(o) The concentrator will operate on a continuous shift roster.

(p) Market concentrate grade is a minimum of 55% Sn.

Further assumptions peculiar to each section of the concentrator are given in the relevant sections. Costs have been derived for the concentrator only up to the point of producing final concentrates and tailings and do not include provision of backfill material for the mine.

The costs of providing a township, road or railway, power and water supplies etc., have not been included.

3. PROCESS PLANT

The concentrator contains the following major processing sections:

3.1 Washing and Crushing Plant

Run-of-mine ore is received at 100% minus 150 mm size from a 1070 mm × 760 mm underground jaw crusher for a 1500 t/d design. Coarse ore is stockpiled in the open air and processed through a washing and crushing plant to produce crushed ore passing 12 mm for further processing.

Constraints applied to the plant design are:

(a) Haulage from the mine is on the basis of 2 shifts per day by a 6 day week. Allowance is made for tramp oversize.

(b) Washing, secondary and tertiary crushing is on the basis of 2 shifts per day by a 6 day week.

(c) Subsequent processing sections have a maximum daily throughput based on 90% time efficiency for all reasons i.e. 1667 tonnes maximum throughput for a 1500 t/d operation overall.

(d) Periodic use of a washing plant is required due to pockets of 'gouge' in the orebody.

(e) Oxidation of iron sulphides is not a problem in coarse ore stockpiles over periods of not more than one week of storage.

A schematic flowsheet is given in Fig. 1 for the 1500 t/d concentrator illustrating the treatment involved and showing all major equipment items and tonnages handled. Flowsheets for the 500 and 3000 t/d concentrators are similar but with equipment sized to suit these operations.

3.2 Heavy Media Separation Plant

Fine ore at 100% minus 12 mm size is treated and light gangue is removed to waste thus upgrading the feed to subsequent processing sections and reducing the total weight of material to be handled.

Constraints applied to the plant design are:

(a) Maximum daily throughput is based on 90% time efficiency for all reasons allowing for planned maintenance shut-downs and holidays.

(b) Magnetic iron sulphides being present, the dense medium in use has to be cleaned of this contaminant in the medium cleaning circuit.

(c) Dense medium losses are 1.0 kg per tonne of ore treated.

(d) A H.M. cyclone is used but the Dynawhirlpool unit is equally applicable to suitable ores.

A schematic flowsheet is given in Fig. 2 for the 1500 t/d concentrator illustrating the treatment involved and showing all major equipment items and tonnages handled. Flowsheets for the 500 and 3000 t/d concentrators are similar but with equipment sized to suit these operations.

3.3 Grinding and Sulphide Flotation Plant

Upgraded fine ore from the H.M. Separation Plant is ground to 80% passing 115 μm and nominally 90% of the sulphides removed by flotation into a sulphide concentrate which becomes final tailing. Flotation tailing is feed to the tin recovery sections of the plant.

Constraints applied to the plant design are:

(a) Overgrinding is to be avoided at all costs thus reducing possible cassiterite losses.

(b) In line with current Australian operations, single stage grinding is employed.

(c) Ore/water pulp mixture is acidic at pH = 5.0.

(d) Water circuitry and spillage requirements are strictly contained within the section.

(e) Tin recovery section middlings are returned for regrinding and stripping of sulphides further released in this regrind.

A schematic flowsheet is given in Fig. 3 for the 1500 t/d concentrator illustrating the treatment involved and showing all major equipment items and tonnages handled. Flowsheets for the 500 and 3000 t/d concentrators are similar but with equipment sized to suit these operations.

3.4 Gravity Tin Plant

The plant is divided into three treatment circuits recovering tin by gravity concentration methods from three carefully prepared pulp streams each containing material in specific size ranges as follows:

(a) Coarse gravity circuit - 100% <200 μm, 0 <100 μm.

(b) Medium gravity circuit - 100% <100 μm, minimum <40 μm.

(c) Fine gravity circuit - 100% <40 μm, minimum <25 μm.

Feed to the plant is tailings from sulphide flotation and coarse material is returned for regrind and gravity tailings are feed to the tin flotation plant.

Constraints applied to the plant design are:

(a) At least 50% of the tin is recovered.

(b) Minimum equipment is involved.

(c) A middlings regrind is required.

A schematic flowsheet is given in Fig. 4 for the 1500 t/d concentrator illustrating the treatment involved and showing all major equipment items and tonnages handled. Flowsheets for the 500 and 3000 t/d concentrators are similar but with equipment sized to suit these operations.

3.5 Tin Flotation Plant

Tailings from the gravity tin plant are deslimed at 5 μm and tin recovered by flotation from the plus 5 μm fraction.

Constraints applied to the plant design are:

(a) Desliming of feed to this plant is by cyclones.

(b) Remaining sulphides in feed to this plant are stripped out by flotation, the sulphide concentrate cleaned once. In practice this sulphide concentrate is recycled to the head of the grinding and sulphide flotation plant for additional tin recovery but in this design it is part of final tailings to simplify calculations.

(c) Tin concentrate produced is not final grade.

(d) Water circuitry and spillage requirements are strictly contained within the section.

A schematic flowsheet is given in Fig. 5 for the 1500 t/d concentrator illustrating the treatment involved and showing all major equipment items and tonnages handled. Flowsheets for the 500 and 3000 t/d concentrators are similar but with equipment sized to suit these operations.

3.6 Final Product Handling

Final products from the concentrator include:

(a) Floats from H.M. separation plant.

(b) Sulphide flotation concentrates from plant Sections 3.3 and 3.5.

(c) Desliming cyclone overflow (<5 μm) from Section 3.5.

(d) Flotation tailings from Section 3.5.

(e) Gravity tin concentrate from Section 3.4.

(f) Tin flotation concentrate from Section 3.5.

These products are handled as follows:

(i) (a) is trucked to waste or used as mine backfill.

(ii) (b), (c) and (d) are combined and dewatered by thickening with thickener underflow going to the final tailings dam. Part of this final tailing may be used as mine backfill. Water recovered is recycled for plant use.

(iii) (e) and (f) are handled separately and cleaned up to final concentrate grade specification by batch processing using magnetic separators, flotation, washing and/or chemical treatment before being packed for shipment to market.

It should be noted that provision has been made in this design to pump sulphide concentrates straight to tailings but the alternative route through the tailings thickener has been incorporated to size this thickener to handle all ground plant tailings for maximum process water recovery.

These steps in the overall plant are shown schematically in Fig. 5 for the 1500 t/d concentrator. The treatment steps are not detailed for the concentrates because of the need to develop special methods of upgrading for each concentrate produced. Similar methods apply for concentrates from the 500 and 3000 t/d concentrators.

4. DESIGN CALCULATIONS

Mass balance calculations for the 1500 t/d concentrator are set out in Table 1.

Figures given include per cent weight of solids and tin and sulphide contents within each plant section as well as overall metal recoveries. These figures are the same for the 500 and 3000 t/d concentrators thus allowing solids, pulp and water balances to be calculated for these sizes of concentrators.

Nominal sizings of feed into and products from various plant sections are shown in Figs 6 to 8.

5. CAPITAL EQUIPMENT - 1500 t/d CONCENTRATOR

The figures contained in Table 1 were used for sizing the major items of equipment and determining operating requirements for the 1500 t/d concentrator.

Cost of purchase, shipping weight and energy requirements were then determined from equipment suppliers or from information at Amdel.

Capital equipment required is as follows:

5.1 Washing and Crushing Plant

A list of all major items required in this plant section is given in Table 2. This list includes all material handling equipment such as scrubbers, crushers, conveyors, screens, feeders etc. plus ancillary items such as spillage recovery systems, cranes and tramp iron collectors.

Purchase cost and energy requirements are summed to give the total for this section of the plant.

Several important points should be noted:

(a) The coarse ore stockpile is uncovered and serviced by a front end loader.

(b) The scrubbing section can be bypassed when washing of the ore for removal of 'gouge' is not required.

(c) The plant is operated with the ore wet for most of the time. Therefore dust collection is not the problem associated with conventional dry crushing and screening plants and water sprays are used to maximum benefit. A separate dust collection system is not required.

(d) Every attempt is made to avoid overbreakage whereby overgrinding of cassiterite could occur and losses in subsequent treatment stages increase. Once to size, material is removed from the plant by the shortest practical route.

(e) Spillage is contained within the section of the plant, the fines being handled by sump pump and the coarse by the front end loader back to the start at the road hopper.

(f) Heavy maintenance is done by mobile crane. What building coverage is provided allows full access by this crane to all parts of the plant.

(g) Control of this section of the concentrator is from the control room in the heavy media plant.

5.2 Heavy Media Separation Plant

This section is essentially as supplied by Mitchell Cotts Projects (Australia) Pty Ltd and because of this has a different format from the rest of the equipment selections. The equipment items have been checked as far as possible from the information supplied. Reasonable confirmation was obtained using general design principles and normal operating practices. Published plant details were also compared with the Mitchell Cotts design.

Information not supplied to Mitchell Cotts was the presence in the ore of friable, magnetic iron sulphides which would contaminate the dense medium. Hence items added by Amdel are a demagnetising coil, sieve bend and flotation cells to remove coarse and fine magnetic sulphides.

Also added are bins for sinks and floats, plus a truck for floats removal to dump.

The feed conveyor supplied by Mitchell Cotts has been deleted as it appears as part of the previous washing and crushing plant. This deletion has been offset by the inclusion of a floats conveyor of essentially the same size.

Plant Capacity

Feed to plant	68.3 tonnes per h of minus 12 mm ore
Feed to cyclone	51.7 tonnes per h of minus 12 mm plus 1 mm ore
Cyclone product	27% of cyclone feed = 14 tph sink product
Fines	16.6 tonnes per h of minus 1 mm ore in underflow from feed preparation screen

Major Equipment Sizes

Item No.	Equipment
1	Head chute and mixing box - steel, rubber lined
2	1 only feed preparation sieve bend (a DSM screen) - 45° bend, 1 metre radius, 0.6 metres wide, aperture 1.5 mm
3	1 only feed preparation screen. Horizontal, low head, single deck, vibrating screen, with deck aperture of 1.0 mm. Screen size - 1.5 metres wide × 4.8 metres long

Item No.	Equipment
4	1 only DSM cyclone. Size - 400 mm diameter
	Note: The cyclone is gravity fed. A gravity head of approx. 6 metres is required
5	1 only floats sieve bend. 45° bend, 1.0 metre radius, 0.5 metres wide, aperture 1.5 mm
6	1 only sinks sieve bend. 45° bend, 1.0 metre radius, 0.3 metres wide, aperture 1.5 mm
7	1 only medium recovery screen (Drainage and rinsing screen). Horizontal, low head, single deck, vibrating screen with deck aperture of 1.0 mm. Screen size - 2.4 metres wide by 4.8 metres long
	Note: Both sinks and floats are fed onto this single screen with a plate divider. The sinks side of the screen is 0.5 metres wide and the floats side of the screen is 1.9 metres wide. Alternatively, the sinks and floats streams could be fed to two different sized vibrating screens.
8	Product conveyors - 2 off 600 mm wide by 20 metres long
9	1 only Centrifugal densifier feed sump and pump. Pump size - Warman 8 × 6 FAH
10	3 only Centrifugal densifiers. Size - 100 mm diameter
	Note: These are a Mitchell Cotts development - a cylindrical vessel fed tangentially, under pressure, to remove water from the medium via the vortex
11	1 only circulating medium sump
12	1 only circulating medium pump. Pump - Warman 8 × 6 FAH. (Pumps to mixing box at discharge end of feed preparation screen)
13	Medium density control instrumentation to supplier's design
14	1 only dilute medium sump and pump. Pump size - Warman 6 × 4 EAH
15	1 only wet drum primary magnetic separator. Size - 900 mm diameter × 2400 wide
16	1 only primary magnetic separator tailings sump and pump. Pump size - Warman 6 × 4 EAH
	Note: This pump feeds cyclones for desliming, and the cyclone overflow is recycled within the plant as spray water
17	3 only desliming cyclones. Size - 200 mm diameter
18	Clarified water storage tank - steel, lined
19	1 only wet drum secondary magnetic separator. Size - 900 mm diameter × 1200 mm wide

Item No.	Equipment
20	1 only floor drainage sump pump - Sala VASAG - 75
21	1 only sump and pump transferring H.M.S. fines to grinding plant. Pump size - Warman 8 × 6 FAH
22	1 only plant water supply pump - pressure required at screen sprays 200 kPa. Pump size - Warman 6 × 4 D-S
23	1 only bin of steel construction 8 metres diameter by 7 metres overall height and 2.5 metres ground clearance, fitted with suitable pneumatically operated discharge gates. Bin shape is cylinder on truncated cone with allowance for truck to drive through beneath structure
24	Truck - 10 tonne capacity (6.5 m^3) minimum size
25	Sinks Surge Bin - 1 only bin of steel construction 8 metres diameter by 7 metres overall height and 2.5 metres ground clearance, fitted with vibrating feeders on bottom discharge. Bin shape is cylinder on truncated cone
26	Demagnetising Coil - 1 only length 0.2 m, diameter 100 mm
27	Coarse Pyrrhotite Sieve - 2 only DSM screens. 45° bend, 1.0 metre radius, 1.0 metre wide, aperture 0.25 mm
28	6 only No. 60 Agitair flotation cells for medium cleaning Note: By tolerating a higher sulphides level the flotation could be performed on a by-pass stream thus allowing smaller equipment
29	Ferrosilicon Feeder - drum tipping and emptying system
30	5 t O/head Crane.

This list is summarised in Table 3 with accompanying equipment purchase costs, shipping weights and power consumptions.

5.3 Grinding and Sulphide Flotation Plant

This is a completely conventional plant aimed at minimising overgrinding of cassiterite. A list of all major items required in this plant section is given in Table 4.

Purchase cost and energy requirements are summed to give the total for this section of the plant.

One important point should be noted in that all spillage within this section of the plant is returned to the clean-up thickener where overflow provides process water for plant use.

5.4 Gravity Tin Plant

Recent innovations in operating plants have been included thus reducing overall equipment requirements to a minimum. A list of all major items required in this plant section is given in Table 5.

Purchase cost and energy requirements are summed to give the total for this section of the plant.

Again spillage is contained within this section of the plant.

5.5 Tin Flotation Plant

This is a completely conventional plant. A list of all major items required in this plant section is given in Table 6.

Purchase cost and energy requirements are summed to give the total for this section of the plant.

Spillage is once again contained within the section.

Control of this section of the concentrator is from the control room in the grinding and sulphide flotation plant.

5.6 Final Product Handling and Miscellaneous

This section of the concentrator deals with concentrate handling, upgrading of concentrate to saleable grade, filtering, drying and stock-piling of concentrate for shipment; tailings disposal by thickening and pumping to a dam; reagent handling involving storage, mixing and distribution and distribution and recovery of process water to the plant.

It is not practical to layout in full the equipment requirements for this section because:

(a) Individual ores will produce concentrates with specific characteristics to which final upgrading methods will be tailored. Examples of such methods are:

  (i) removal of specific size fraction usually the slimes below 3 to 5 μm

  (ii) magnetic separation for removal of any remaining magnetic iron sulphides

  (iii) chemical treatment ranging from acid leaching in the simplist case to autoclave leaching at temperature and pressure

(iv) further flotation stages

(v) further gravity treatment stages

A number of these methods are currently practised in operating plants. Processing lines are batch or continuous depending on the amount of concentrate to be handled.

(b) Individual sales contracts dictate penalty element payments and the final upgrading plant may be slanted towards the elimination of a specific element or elements.
Since the general case has been assumed and no limits placed on the presence of penalty elements in the original feed, it is not practical to detail equipment requirements to cope with this problem.

An allowance has been made in capital costs to cover both these areas. Major items of equipment which can readily be sized are given in Table 7. The probable cost of other items of equipment which cannot be adequately sized is also indicated in this table and allowance made for energy requirements in the overall total.

5.7 Support Facilities

Support facilities required as back-up to the concentrator include: offices, laboratories, workshops, stores, electrical sub-stations and motor control stations, control rooms and instrumentation.

Details of individual facilities are given in Table 7 but detailed capital costs are not given as they are covered by the appropriate allowance in Table 8.

6. CAPITAL COST ESTIMATE - 1500 t/d CONCENTRATOR

The capital cost was estimated from the cost of purchased equipment (Tables 2 to 7) and then applying appropriate factors to determine the total capital investment given in Table 8. An explanation of the relevant factors is given in Appendix A.

7. MANPOWER, STORES AND OPERATING COSTS - 1500 t/d CONCENTRATOR

Manpower requirements are shown in Table 9. Personnel required are listed along with working hours, job titles, number required and nominal annual salaries for a 1500 t/d concentrator.

Operating costs including stores are shown in Table 10 for a 1500 t/d concentrator on the basis of Australian dollars per tonne of ore milled.

Marketing requirements and shipping costs for concentrates from the plant are not considered.

The factors used in estimating these costs are given in Appendix B.

8. INFORMATION ON 500 AND 3000 t/d CONCENTRATORS

Basic information calculated for the 1500 t/d concentrator was used to establish the requirements for the 500 and 3000 t/d concentrators. Relevant data is given in Appendix C.

9. CONCLUSIONS

The capital and operating costs for the concentrator treating hard rock tin ores are given below:

Plant Capacity, t/d	1500
Total Capital Cost, $A	27.398
Total Operating Cost, $A/t feed	18.24

APPENDIX A

FACTORS USED IN THE CAPITAL COST ESTIMATE

Installation. This assumes installation of the plant on prepared foundations, and includes the costs of erection and painting.

Instrumentation. Includes the purchase and installation of all process instruments, transmitters, receivers and electrical and pneumatic connections. It excludes control valves and the control room building.

Piping. Includes the purchase and installation of all process pipework, fittings, traps, strainers, flanges, control valves, pressure gauges, and all supporting structures.

Electrical. Includes the cost of all wiring between the supply substation and the process equipment. It includes purchase and installation of all power and light feeders, cable pits and ducts, motor starters, switchboards and wiring supports. It excludes motors, building lighting, instrument wiring and the electrical substation.

Buildings. Includes the cost of all necessary buildings and their foundations, i.e. process buildings, raw material and product stores, control rooms, offices, laboratories, canteen, first aid and fire fighting facilities and workshops. It includes all internal building services such as lighting, plumbing and air-conditioning.

Foundations and Scructures. Includes the cost of all foundations for process equipment including piling where necessary, and all structural supports for process equipment, together with associated catwalks, ladders, stairs and working platforms.

Land. This cost includes an allowance for the purchase of the land on which the plant will be sited.

Yard Improvements. Includes the costs of site clearing and the provision of roads, footpaths, fences, vehicle parks and landscaping.

Utilities. Includes the costs of supplying necessary services to the plant, and may include electricity supply substation, transformers and rectifiers, water supply pumps and pipeline, water treatment plant, water distribution system, air compression and distribution, process waste disposal, communications systems and fire-protection systems.

Engineering, Constructors and Contractors Fees. Included here are costs of construction design and engineering, draughting, purchasing, accounting, cost control, travel, communications and home office overheads. It also includes the costs of accommodation of design, construction and commissioning personnel on site, the purchase or hire of construction equipment such as trucks and cranes, special living allowances and the contractor's profit.

Contingency. This factor is included to allow for unforeseen events, such as storm or flood damage, strikes, price changes, design changes, errors, and problems in commissioning.

APPENDIX B

FACTORS USED IN THE OPERATING COST ESTIMATE

Raw Materials. Includes the delivered cost of all materials purchased for consumption in the process.

Utilities. Includes the purchased price of the power and water consumed by the plant and the ancillary services.

Direct Labour. Includes the operators who actually run the plant. It excludes maintenance, process control and supervisory employees and supporting staff.

Supervision. Includes direct supervisory and clerical labour and supporting staff up to the mill superintendent.

Maintenance. Includes the costs of labour and materials necessary to maintain the plant in operating condition in planned maintenance shutdowns and materials used in general maintenance.

Operating Supplies. Includes the costs of miscellaneous supplies necessary to maintain the plant operation, such as protective clothing, charts, paper, lubricants, test chemicals and sanitary supplies.

Payroll Overhead. Includes the costs of providing statutory and other benefits to employees, such as annual leave, sick leave, superannuation, workers compensation, etc.

Plant Overhead. Included here are the costs of non-manufacturing facilities needed to permit the plant to function well. Items included would be staff hospital and medical services, safety training, canteen services, recreation facilities, fire training courses, paymasters office, employment office, drivers and vehicle maintenance, security services, storekeepers, general office staff, etc.

Process Control. Includes the salaries of analysts and sample taking and preparation staff, and normal consumable laboratory supplies.

Depreciation. This is assumed to be straight-line depreciation over 12½ years.

Property Taxes and Insurance. Includes the cost of local government and State taxes on land and property, and the cost of insuring the property.

Administrative Expenses. Includes the costs of salaries paid to personnel required to administer the plant, i.e. directors, accountants, and their secretarial staff.

Distribution and Marketing. Includes the costs of salaries and supplies for staff involved in selling, handling orders, arranging delivery of the plant's product.

Research and Development. Includes the cost of experimental work aimed at improving the efficiency of the process or testing new reagents, or ensuring that the process can accommodate variations in the composition of the plant feed.

TABLES 1 to 10

FIGS 1 to 8

TABLE 1: METALLURGICAL BALANCE - 1500 TPD CONCENTRATOR

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
A	Washing and Crushing																			
1	Course Ore Stockpile			97.5			0.80	15.0			100.0	100.0	100.0			100 <200 mm 89 <150 54 < 75 32 < 37.5 20 < 19 12 < 9.5 9 < 6 d_{80} = 130 d_{50} = 69				Live capacity 5100 t
7	Drum Scrubber	- Feed	146	97.5	52.4	3.74	0.80	15.0	1.168	21.900	100.0	100.0	100.0							
		- Discharge	146	60.0	146.0	97.39														
		- Water	0	0	0	93.59					0									
9	Grizzly	- Feed	146	60.0	146.0	97.33	0.80	15.0	1.168	21.900	100.0	100.0	100.0							
		- Undersize	109	53.6	130.7	94.36					74.7							<100 mm		
		- Oversize	37	92.5	15.3	3.0					25.3								100 <200 mm 5 <100	
10	Wash/Drain Screen	- Feed	109	53.6	130.7	94.36					74.7					<100 mm				
		- Top	59	92.5	24.5	4.78					40.4								100 <100 mm 9 < 40	
		- Bottom	37	92.5	15.3	3.00					25.4								100 < 40 mm 5 < 6	
		- Undersize	13	11.2	107.3	102.93					8.9							<6 mm		
		- Water	0	0	0	16.35					0									
12	Secondary Crusher	- Feed	133	92.5	55.1	10.78					91.1					100 <200 mm 60 <100 27 < 40 5 < 6				

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Nominal Sizing, % Weight <mm or µm Discharge	Nominal Sizing, % Weight <mm or µm Undersize	Nominal Sizing, % Weight <mm or µm Oversize	Notes
		- Discharge	133	92.5	55.1	10.78					91.1						100 <75 mm 91 <37.5 49 <19 26 < 9.5 14 < 4.75 d_{80} = 32 d_{50} = 19				
13	Secondary Screen	- Feed	133	92.5	55.1	10.78					91.1					100 <75 mm 91 <37.5 49 <19 26 < 9.5 14 < 4.75				
		- Oversize	100	95.0	38.6	5.26					68.5								100 <75 mm 5 <12	
		- Undersize	33	85.7	16.5	5.52					22.6							<12 mm		
18	Tertiary Crusher	- Feed	130	95.0	50.2	6.84					-									
		- Discharge	130	95.0	50.2	6.84					-						100 <19 mm 67 < 9.5 37 < 4.75 21 < 2.36 12 < 1.18 d_{80} = 11.7 d_{50} = 6.7			
19	Tertiary Screen	- Feed	130	95.0	50.2	6.84					-					100 <19 mm 67 < 9.5 37 < 4.75 21 < 2.36 12 < 1.18				
		- Oversize	30	95.0	11.6	1.58					-								100 <19 mm 5 <12	
		- Undersize	100	95.0	38.6	5.26					68.5							<12 mm		

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
25	Slimes Pump*		13	11.2	107.3	102.93					8.9									*Ignores spillage via sump pump which is intermittent from floor wash down via spillage pump
26	Desliming Cyclone	- Feed*	13	11.2	107.3	102.93					8.9					d_{50} = 60 µm				
		- Underflow	11	70.0	8.4	4.71					7.5									
		- Overflow	2	2.0	98.9	98.22					1.4							<200 µm		
27	Dewatering Screen*	- Feed	11	70.0	8.4	4.71					7.5									
		- Oversize	10.5	88.0	4.9	1.43					7.2								100 < 6 mm 88 < 4.75 70 < 2.36 55 < 1.18 40 <600 µm 28 <300 20 <150 16 < 75 9 < 38 d_{50} = 3.5 mm d_{50} = 900 µm	
		- Undersize	0.5	13.2	3.5	3.28					0.3							<150 µm		
31	Sump Pump**	- Feed	?	?	?	?					?									**Variable and intermittent, floor wash down
		- Water	?	?	?	?					?									
22	Fine Ore Storage	- Feed	133	95.0	51.3	7.00					91.1					100 <12 mm 78 < 9.5 55 < 4.75 42 < 2.36 32 < 1.18 23 < 0.6 d_{80} = 10 d_{50} = 3.7				

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
Summary Section A																			
23	Fine Ore Storage - Discharge	63.3	97.0	23.1	1.96	0.80	15.0	0.506	9.495	43.4	89.4	89.4	89.4	89.4		Same as 22			
29	Wet Sand Reclaim. - Discharge	5.0	20.0	21.7	20.00	0.80	15.0	0.040	0.750	3.4	7.1	7.1	7.1	7.1		27 oversize			
32	Slimes Exiting Section A*	2.5	2.4	102.4	101.50	0.80	15.0	0.020	0.375	1.7	3.5	3.5	3.5	3.5		<200 µm			
-	Process Water Needed*	0	0	0	109.94	-	-	-	-		-	-	-	-					

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
B	Heavy Media Separation																			
1	Feed	- (a) Fine ore	63.3	97.0	23.1	1.96	0.80	15.0	0.506	9.495	91.1	91.1	91.1	92.7	92.7					
		- (b) Wet sand	5.0	20.0	21.7	20.00	0.80	15.0	0.040	0.750	7.2	7.2	7.2	7.3	7.3					
		- (c) Water	0	0	116.7	116.71	-	-	-	-	-	-	-	-	-					
	Sub Total Section B		68.3	33.0	161.4	138.67	0.80	15.0	0.546	10.245	98.3	98.3	98.3	100.0	100.0	100 <12 mm 24 < 1				Washing plant slimes go to Section C (1.2 t/h)
2	Feed Prep. Sieve	- Feed	68.3	33.0	161.4	138.67	0.80	15.0	0.546	10.245	98.3	98.3	98.3			As 1				
		- Oversize	55.0	70.0	41.9	23.57														
		- Undersize	13.3	10.4	119.5	115.10												<1 mm		
3	Feed Prep. Screen	- Feed	55.0	70.0	41.9	23.57														
		- Oversize	51.7	92.0	21.7	4.50													100 <12 mm 0 < 1	
		- Undersize	3.3	9.9	31.2	30.07												<1 mm		
		- Water	0	0	11.0	11.00														
4	H.M.S. Cyclone Feed	- (a) Ore	51.7	92.0	21.7	4.50	0.8	15.0	0.414	7.755	74.4	74.4	74.4	75.7	75.7	100 <12 mm 0 < 1				S.G. Ore = 3.9 t/m³
		- (b) Ferrosilicon	258.5	100.0	38.6	0														Media: Ore ratio = 5:1 S.G. Ferrosilicon = 6.7 t/m³ Media = ½ Ferrosilicon by volume
		- (c) Water	0	0	71.4	71.39														
		Total	310.2	80.3	131.7	75.89														

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Nominal Sizing, % Weight <mm or µm Discharge	Nominal Sizing, % Weight <mm or µm Undersize	Nominal Sizing, % Weight <mm or µm Oversize	Notes
	Sinks	- (a) Ore	15.1																		
		- (b) Ferrosilicon	65.4																		
		Total	80.5	80.5	33.3	19.50															
	Floats	- (a) Ore	36.6																		
		- (b) Ferrosilicon	193.1																		
		Total	229.7	80.3	98.4	56.39															
5	Floats Sieve	- Feed	229.7	80.3	98.4	56.39															
		- Oversize	45.6	85.0	22.4	8.05															
		- Undersize	184.1	79.2	76.0	48.34												<1 mm			
6	Sinks Sieve	- Feed	80.5	80.5	33.3	19.50															
		- Oversize	17.8	85.0	7.5	3.14															
		- Undersize	62.7	79.3	25.8	16.36												<1 mm			
7	Floats Screen	- Feed	45.6	85.0	22.4	8.05															
		- Oversize	36.4	92.5	16.0	2.95	0.11	1.7	0.040	0.619	52.4	7.2	5.9	7.3	6.0	100 <12 mm 0 < 1					S.G. Floats = 2.8 t/m³
		- Undersize	9.2	16.9	46.4	45.10												<1 mm			
		- Water	0	0	40.0	40.00															
	Sinks Screen	- Feed	17.8	85.0	7.5	3.14															
		- Oversize	14.0	92.5	4.9	1.14	2.41	48.8	0.337	6.832	20.1	60.7	65.5	61.8	66.7	100 <12 mm 0 < 1					S.G. Sinks = 3.7 t/m³
		- Undersize	3.8	14.7	22.6	22.00												<1 mm			
		- Water	0	0	20.0	20.00															
9	Desnifier Pump	- From 5	184.1	79.2	76.0	48.34										<1 mm					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
10 Densifier	- Feed	184.1	79.2	76.0	48.34										<1 mm				
	- Discharge	165.0	85.0	53.7	29.10														
	- Overflow	19.1	49.8	22.3	19.22														
14 Dilute Medium Pump	- Feed																		{Contains 3 t/h non-magnetics circulating
	- (a) From 10 O/F	19.1	49.8	22.3	19.22														
	- (b) From 7 floats	9.2	16.9	46.A	45.10														
	- (c) From 7 sinks	3.8	14.7	22.6	22.00														
	- (d) From 19 mags	3.54	65.0	2.5	1.91														
	Total	35.64	28.8	93.8	88.23														
27 Pyrrhotite Sieve	- Feed	35.64	28.8	93.8	83.23														
	- Oversize	0.10	70.0	0.1	0.04	3.00	70.0	0.003	0.070	0.2	0.5	0.7	0.6	0.7					
	- Undersize	35.54	28.7	93.7	88.19														
28 Media Flotation	- Feed	35.54	28.7	93.7	88.19														
	- Conc	0.16	40.0	0.1	0.24	2.50	50.0	0.004	0.080	0.2	0.7	0.8	0.7	0.8					
	- Tailing	35.38	28.7	93.6	87.95														
15 Prim. Mag. Sep.	- Feed	35.38	28.7	93.6	87.95														
	- Magnetics	30.8	70.0	17.8	13.20														Recovery 95%
	- Non-mags	4.58	5.8	75.8	74.75														
17 Deslime Cyclones	- Feed	4.58	5.8	75.8	74.75														d_{50} = 15 µm
	- Underflow	4.58	50.0	5.6	4.58														
	- Overflow	0	0	(70.2)	(70.17)														{Taken as very minor flow in media circulation

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
19	Sec. Mag. Sep.	- Feed	4.58	50.0	5.6	4.58														
		- Magnetics	3.54	65.0	2.5	1.91														
		- Non-mags	1.04	10.6	9.2	8.78	2.79	14.8	0.029	0.154	1.5	5.3	1.5	5.3	1.5					
		- Water	0	0	6.1	6.11														
12/13	Circulating Medium	- Feed																		
		- (a) From 6	62.7	79.3	25.8	16.36														
		- (b) From 10	165.0	85.0	53.7	29.10														
		- (c) From 15 Mags	30.8	70.0	17.8	13.20														
		- (d) Water	0	0	12.7	12.73														
		Total	258.5	78.4	110.0	71.39														
23	Sump Pump	- Feed	?	?	?	?														Variable and intermittent - floor wash down
		- Water	?	?	?	?														
18	Clarified Water Tank		0	0	70.2	70.17														See Note on 17
Summary - Section B																				
2	Feed Prep. Sieve	- Undersize	13.30	10.4	119.5	115.10														
3	Feed Prep. Screen	- Undersize	3.30	9.9	31.2	30.07														
	M.M.S. Feed Prep. Fines	- Total	16.60	10.3	150.7	145.17	0.80	15.0	0.133	2.490	23.9	23.9	23.9	24.3	24.3		<1 mm			S.G. = 3.0 t/m³
19	Sec. Mag. Sep.	- Non-mags	1.04	10.6	9.2	8.78	2.79	14.8	0.029	0.154	1.5	5.3	1.5	5.3	1.5		< 30 µm			
27	Pyrrhotite Sieve	- Oversize	0.10	70.0	0.1	0.04	3.00	70.0	0.003	0.070	0.2	0.5	0.7	0.6	0.7		100 < 1 mm 0 <150 µm			
28	Media Flotation	- Conc	0.16	40.0	0.1	0.24	2.50	50.0	0.004	0.080	0.2	0.7	0.8	0.7	0.8		<150 µm			
	Total M.M.S. Plant Fines		17.90	10.4	160.1	154.23	0.94	15.6	0.169	2.794	25.8	30.4	26.9	30.9	27.3		<1 mm			S.G. = 3.05 t/m³

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
7	Sinks	14.00	92.5	4.9	1.14	2.41	48.8	0.337	6.832	20.1	60.7	65.5	61.8	66.7		100 <12 mm 0 < 1			S.G. = 3.7 t/m^3
	Total Feed to Section C	31.90	17.6	158.9	149.26	1.59	30.2	0.506	9.626	45.9	91.1	92.4	92.7	94.0		<12 mm			S.G. = 3.3 t/m^3
7	Slimes	36.40	92.5	16.0	2.95	0.11	1.7	0.040	0.619	52.4	7.2	5.9	7.3	6.0		100 <12 mm 0 < 1			S.G. = 2.8 t/m^3
-	Process Ferrosilicon Needed	-	-	-	-	-	-	-	-	-	-	-	-	-					258.5 t at $500/t
-	Process Water Needed	0	0	136.4	136.38	-	-	-	-	-	-	-	-	-					
-	Feed	68.30	75.7	44.8	21.96	0.80	15.0	0.546	10.245	98.3	98.3	98.3	100.0	100.0					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight ≤mm or μm Feed	Discharge	Undersize	Oversize	Notes
C	Grinding, Sulphide Float																		
1	H.M.S. Fines Cyclone - Feed	17.90	10.4	160.1	154.23	0.94	15.6	0.169	2.794	25.8	30.4	26.9	32.7	28.5	<1 mm				S.G. = 3.05 t/m³, d_{50} = 40 μm
	- Underflow	12.90	70.0	9.8	5.53														
	- Overflow	5.00	3.3	150.3	148.70														
2	Clean-up Thickener - Feed																		
	- (a) Spillage	0	0	20.00	20.00														Average rate of clean-up ignored
	- (b) Wash Plant Slimes	1.20	2.4	49.1	48.72	0.80	15.0	0.010	0.188	1.7	1.7	1.7	1.9	1.8	<200 μm				S.G. = 3.0 t/m³
	- (c) From 1 - O/F	5.00	3.3	150.3	148.70														
	Total	6.20	5.7	219.4	217.42														
3	Clean-up Thickener - Underflow	6.20	40.0	11.3	3.30														
	- Overflow	0	0	(208.1)	(208.12)														
4	Prim. Mill Discharge - Feed																		
	- (a) H.M.S. Sinks	14.00	92.5	4.9	1.14	2.41	48.8	0.337	6.832	20.1	60.7	65.5	65.4	69.7	<6 mm				S.G. = 3.7 t/m³
	- (b) From 1 - U/F	12.90	70.0	9.8	5.53										<1 mm				
	- (c) From 3 - U/F	6.20	40.0	11.3	9.30														
	- (d) Mill Discharge	75.00	75.0	47.7	25.00														Allow 150% circ. load on (a) + (b)
	- (e) Water	0	0	20.0	20.00														
	Total	108.10	63.9	93.7	60.97														S.G. = 3.3 t/m³
5	Prim. Mill Sieve - (a) Feed	108.10	63.9	93.7	60.97														
	- (b) Water	0	0	23.5	23.38														
	Total	108.10	56.2	117.2	84.35														

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
	- Oversize	75.00	75.0	47.7	25.00														
	- Undersize	33.10	35.8	69.5	59.35	1.56	29.6	0.515	9.804	47.6	92.8	94.1	100.0	100.0			80 <115 µm		S.G. = 3.22 t/m³
13 Sulphide Roughers	- Feed																		
	- (a) From 5 - U/S	33.10	35.8	69.5	59.35	1.56	29.6	0.515	9.804	47.6	92.8	94.1	100.0	100.0	80 <115 µm				S.G. = 3.32 t/m³
	- (b) Sul. I/C Tail	3.00	14.7	18.3	17.44	2.00	40.0	0.060	1.200	4.3	10.8	11.5	11.6	12.2					1.50 t/h final sulphides + 1.50 t/h gangue content
	- (c) Sul. Scav. Con.	3.14	40.0	5.6	4.71	1.00	24.4	0.031	0.766	4.6	5.6	7.3	6.0	7.8					2.14 t/h final sulphides + 1.00 t/h gangue content
	Total	39.24	32.5	93.4	81.50	1.54	30.0	0.606	11.770	56.5	109.2	112.9	117.6	120.0					
	- Concentrate	13.94	50.0	17.6	13.94	0.67	75.4	0.093	10.511	20.1	16.8	100.8	18.0	107.2					S.G. = 3.60 t/m³
	- Tailings	25.30	27.3	75.8	67.56	2.03	5.0	0.513	1.259	36.4	92.4	12.1	99.6	12.8					S.G. = 3.07 t/m³
14 Gravity Circuit Feed Pump	- Feed																		
	- (a) From 13 Tails	25.30	27.3	75.8	67.56	2.03	5.0	0.513	1.259	36.4	92.4	12.1	99.6	12.8					S.G. = 3.07 t/m³
	- (b) Sul. Scav. Tail	11.00	16.2	60.6	56.78	1.00	2.7	0.110	0.300	15.8	19.8	2.9	21.4	3.1					S.G. = 2.80 t/m³
	Total	36.30	22.6	136.4	124.34	1.72	4.3	0.623	1.559	52.2	112.2	15.0	121.0	15.9					S.G. = 2.93 t/m³
16 Sulphide R/G Discharge	- Feed																		
	- (a) From 13 Cons	13.94	50.0	17.6	13.94	0.67	75.4	0.093	10.511	20.1	16.8	100.8	18.0	107.2					
	- (b) Mill Discharge	34.85	70.0	24.1	14.94														Allow 150% circ. load
	- (c) Water	0	0	18.0	18.00														
	Total	48.79	51.0	59.7	46.88														
18 Sulphide R/G Sieve	- (a) Feed	48.79	51.0	59.7	46.88														
	- (b) Water	0	0	1.9	1.91														
	Total	48.79	50.0	61.6	48.79														
	- Oversize	34.85	70.0	24.1	14.94														
	- Undersize	13.94	29.2	37.5	33.85	0.67	75.4	0.093	10.511	20.1	16.8	100.8	18.0	107.2			80 <75 µm		

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
19	Sulphide Cleaners	- Feed	13.94	29.2	37.5	33.85	0.67	75.4	0.093	10.511	20.1	16.8	100.8	18.0	107.2	80 <75 µm				
		- Concentrate	10.94	40.0	19.2	16.41	0.30	85.1	0.033	9.311	15.7	6.0	89.3	6.4	95.0					S.G. = 3.9 t/m³
		- Tailings	3.00	14.7	18.3	17.44	2.00	40.0	0.060	1.200	4.4	10.8	11.5	11.6	12.2					
21	Table R/G Discharge	- Feed																		
		- (a) C+M Grav. Tail	14.14	19.2	64.0	59.34	1.00	7.5	0.141	1.066	20.3	25.4	10.2	27.4	10.9					S.G. = 3.0 t/m³
		- (b) Mill Discharge	37.59	70.0	28.6	16.11														Allow 250% circ. load
		- (c) Water	0	0	2.2	2.15	-	-	-	-	-	-	-	-	-					
		Total	51.73	40.0	94.8	77.60														
22	Table R/G Sieve	- Feed	51.73	40.0	94.8	77.60														
		- Oversize	37.59	70.0	28.6	16.11														
		- Undersize	14.14	18.7	66.2	61.49	1.00	7.5	0.141	1.066	20.3	25.4	10.2	27.4	10.9			80 <60 µm		
24	Sulphide Scavenger	- Feed	14.14	19.7	65.2	61.49	1.00	7.5	0.141	1.066	20.3	25.4	10.2	27.4	10.9	80 <60 µm				
		- Concentrate	3.14	40.0	5.6	4.71	1.00	24.4	0.031	0.766	4.5	5.6	7.3	6.0	7.8					
		- Tailings	11.00	16.2	60.6	56.78	1.00	2.7	0.110	0.300	15.8	19.8	2.9	21.4	3.1					S.G. = 2.80 t/m³
Summary - Section C																				
19	Sulphide Concentrate		10.94	40.0	19.2	16.41	0.30	85.1	0.033	9.311	15.7	6.0	89.3	6.4	95.0					S.G. = 3.9 t/m³
14	Gravity Circuit Feed		36.30	22.6	136.4	124.34	1.72	4.3	0.623	1.559	52.2	112.2	15.0	121.0	15.9					S.G. = 2.99 t/m³
21	C+M Gravity Tail Circulating		14.14	19.2	64.0	59.34	1.00	7.5	0.141	1.066	20.3	25.4	10.2	27.4	10.9					
	Process Water (recovered)		0	0	(122.68)	(122.68)	-	-	-	-	-	-	-	-	-					
	Feed to Section C		33.10	*	214.1	204.09	1.56	29.6	0.515	9.804	47.6	92.8	94.1	100.0	100.0					*Meaningless
	Feed to Flotation		33.10	28.9	91.4	81.41	1.56	29.6	0.515	9.804	47.6	92.8	94.1	100.0	100.0					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
5	Gravity Sn Section																		
1	No. 1 Cyclone - Feed	36.30	22.6	136.4	124.34	1.72	4.3	0.623	1.559	52.2	112.2	15.0	100.0	100.0	*				S.G. = 2.99 t/m^3
	- Underflow	9.31	55.0	10.72	7.62	1.72	4.3	0.160	0.403	13.4	28.8	3.9	25.7	25.9			*		S.G. = 3.00 t/m^3
	- Overflow	26.99	18.8	125.68	116.72	1.72	4.3	0.463	1.156	38.8	83.4	11.1	74.3	74.1			<80 µm		*For convenience sizing products are all assumed to have the same Sn assay. This is not strictly correct but does not affect overall circuit performance or equipment selection
2	Hydrosizer - Feed	9.31	55.0	10.72	7.62	1.72	4.3	0.160	0.403	13.4	28.8	3.9	25.7	25.9					
	- Water	0	0	5.28	5.28	-	-	-	-	-	-	-	-	-					
	- Underflow	6.62	50.0	8.83	6.62	1.72	4.3	0.114	0.284	9.5	20.5	2.7	18.3	18.2				0 <100 µm	
	- Overflow	2.69	30.0	7.17	6.28	1.71	4.3	0.046	0.119	3.9	8.3	1.2	7.4	7.7			<100 µm		
3/4	Surge Bin-Pump - Feed	6.62	50.0	8.83	6.62	1.72	4.3	0.114	0.284	9.5	20.5	2.7	18.3	18.2					
	- Discharge	6.50	55.3	7.43	5.26	1.72	4.3	0.112	0.278	9.3	20.1	2.7	18.0	17.8					
	- Overflow	0.12	8.1	1.40	1.36	1.67	4.3	0.002	0.006	0.2	0.4	<0.1	0.3	0.4					
5	No. 1 Sieve - Feed	6.50	55.3	7.43	5.26	1.72	4.3	0.112	0.278	9.3	20.1	2.7	18.0	17.8					
	- Oversize	1.65	80.0	0.96	0.41	1.72	4.3	0.029	0.071	2.3	5.2	0.7	4.7	4.5					
	- Undersize	4.85	50.0	6.47	4.85	1.72	4.3	0.083	0.207	7.0	14.9	2.0	13.3	13.3			<200 µm		
6	G. Sluice - Cut 1 - Feed	4.85	50.0	6.47	4.85	1.72	4.3	0.083	0.207	7.0	14.9	2.0	13.3	13.3					
	- Concentrate	1.00				1.72	4.3	0.017	0.043	1.4	3.0	0.4	2.7	2.8					
	- Tailing	3.85				1.72	4.3	0.066	0.164	5.6	11.9	1.6	10.6	10.5					
	- Cut 2 - Feed	3.85				1.72	4.3	0.066	0.164	5.6	11.9	1.6	10.6	10.5					
	- Concentrate	1.00				1.72	4.3	0.017	0.043	1.4	3.1	0.4	2.7	2.8					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
	- Tailing	2.85				1.72	4.3	0.049	0.121	4.2	8.8	1.2	7.9	7.7					
	- Cut 3 - Feed	2.85				1.72	4.3	0.049	0.121	4.2	8.8	1.2	7.9	7.7					
	- Concentrate	1.40				1.72	4.3	0.024	0.060	2.1	4.3	0.6	3.9	3.8					
	- Tailing	1.45				1.72	4.2	0.025	0.061	2.1	4.5	0.6	4.0	3.9					
7 C. Spirals	- No. 1 - Feed	1.00	50.0	1.33	1.00	1.72	4.3	0.017	0.043	1.4	3.0	0.4	2.7	2.8					
	- Concentrate	0.30	30.0	0.80	0.70	4.00	6.0	0.012	0.018	0.4	2.1	0.2	1.9	1.2					
	- Tailing	0.70	12.7	5.03	4.80	0.71	3.6	0.005	0.025	1.0	0.9	0.2	0.8	1.6					
	- No. 2 - Feed	1.00	50.0	1.33	1.00	1.72	4.3	0.017	0.043	1.4	3.1	0.4	2.7	2.8					
	- Concentrate	0.30	30.0	0.80	0.70	4.00	6.0	0.012	0.018	0.4	2.2	0.2	1.9	1.2					
	- Tailing	0.70	12.7	5.03	4.80	0.71	3.6	0.005	0.025	1.0	0.9	0.2	0.8	1.6					
	- No. 3 - Feed	1.40	50.0	1.87	1.40	1.72	4.3	0.024	0.060	2.1	4.3	0.6	3.9	3.8					
	- Concentrate	0.40	30.0	1.06	0.93	4.75	6.3	0.019	0.025	0.6	3.4	0.2	3.1	1.6					
	- Tailing	1.00	16.8	5.39	4.97	0.50	3.5	0.005	0.035	1.5	0.9	0.4	0.8	2.2					
	- No. 4 - Feed	1.45	50.0	1.93	1.45	1.72	4.2	0.025	0.061	2.1	4.5	0.6	4.0	3.9					
	- Concentrate	0.40	30.0	1.06	0.93	5.00	6.8	0.020	0.027	0.6	3.6	0.3	3.2	1.7					
	- Tailing	1.05	17.3	5.37	5.02	0.48	3.2	0.005	0.034	1.5	0.9	0.3	0.8	2.2					
Total Water to Spirals		0	0	18.09	18.00	-	-	-	-	-	-	-	-	-					Wash water
2 C. Tables	- No. 1 - Feed	0.30	30.0	0.80	0.70	4.00	6.0	0.012	0.018	0.4	2.1	0.2	1.9	1.2					
	- Concentrate	0.03	35.0	0.07	0.06	30.00	3.3	0.009	0.001	<0.1	1.6	<0.1	1.4	<0.1					
	- Tailing	0.27	13.2	1.97	1.78	1.11	6.3	0.003	0.017	0.4	0.5	0.2	0.5	1.1					
	- No. 2 - Feed	0.30	30.0	0.80	0.70	4.00	6.0	0.012	0.018	0.4	2.2	0.2	1.9	1.2					
	- Concentrate	0.03	35.0	0.07	0.06	30.00	3.3	0.007	0.001	<0.1	1.6	<0.1	1.4	<0.1					

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
		- Tailing	0.27	13.2	1.87	1.78	1.11	6.3	0.003	0.017	0.4	0.6	0.2	0.5	1.1					
	- No. 3	- Feed	0.40	39.0	1.06	0.93	4.75	6.3	0.019	0.025	0.6	3.4	0.2	3.1	1.6					
		- Concentrate	0.02	35.0	0.05	0.04	50.00	5.0	0.010	0.001	<0.1	1.8	<0.1	1.6	<0.1					
		- Tailing	0.38	15.8	2.15	2.03	2.37	6.3	0.009	0.024	0.6	1.6	0.2	1.5	1.5					
	- No. 4	- Feed	0.40	30.0	1.06	0.93	5.00	6.8	0.020	0.027	0.6	3.6	0.3	3.2	1.7					
		- Concentrate	0.02	35.0	0.05	0.04	50.00	5.0	0.010	0.001	<0.1	1.8	<0.1	1.6	<0.1					
		- Tailing	0.38	15.3	2.15	2.03	2.63	6.8	0.010	0.026	0.6	1.8	0.3	1.6	1.6					
	Total Water to Tables		0	0	4.54	4.54	-	-	-	-	-	-	-	-	-					Wash water
9A	Coarse Gravity Cons Pump	- From 7	0.10	35.0	0.24	0.20	38.0	4.0	0.038	0.004	0.1	6.8	<0.1	6.1	0.3					
10	Coarse Gravity Tails Box	- Feed																		
		- (a) From 7 - Tails	1.30	14.6	8.02	7.62	1.92	6.5	0.025	0.084	1.9	4.5	0.8	4.0	5.4					
		- (b) From 6 - Tails	5.45	15.0	20.73	19.59	0.58	3.5	0.020	0.119	5.0	3.6	1.1	3.0	7.6					
		- (c) From 4 - C/S	1.65	80.0	0.96	0.41	1.72	4.3	0.029	0.071	2.3	5.2	0.7	4.7	4.6					
		Total	6.40	18.8	29.71	27.62	1.14	4.3	0.073	0.274	9.2	13.3	2.6	11.7	17.6					
11	Coarse Gravity Slimes Pump	- (a) From 1 - O/F	26.99	18.8	125.68	116.72	1.72	4.3	0.463	1.156	38.8	83.3	11.1	74.3	74.1	<80 µm				
		- (b) From 2 - O/F	2.69	30.0	7.17	6.28	1.71	4.3	0.046	0.119	3.9	8.3	1.2	7.4	7.7	<100 µm				
		- (c) From 3 - O/F	0.12	8.1	1.40	1.36	1.67	4.3	0.002	0.006	0.2	0.4	<0.1	0.3	0.4					
		Total	29.80	19.3	134.25	124.36	1.71	4.3	0.511	1.281	42.9	92.0	12.3	82.0	82.2					S.G. = 3.0 t/m³
12	No. 8 Cyclone	- Feed	29.80	19.3	134.25	124.36	1.71	4.3	0.511	1.281	42.9	92.0	12.3	82.0	82.2					
		- Underflow	7.83	60.0	7.60	5.25	1.73	19.2	0.136	0.802	11.3	24.5	7.7	21.8	51.4					S.G. = 3.0 t/m³
		- Overflow	21.92	15.5	126.45	119.11	1.71	2.2	0.375	0.479	31.6	67.5	4.6	60.2	30.7			<40 µm		S.G. = 2.96 t/m³ To fine gravity circuit

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight mm or µm Feed	Discharge	Undersize	Oversize	Notes
14 M. Spirals	- Feed	7.38	60.0	7.80	5.25	1.73	10.2	0.136	0.802	11.3	24.5	7.7	21.8	51.4					
	- Concentrate	6.00	35.0	13.06	11.14	1.67	4.7	0.100	0.282	8.6	18.0	2.7	16.0	18.1					
	- Tailings	1.88	15.4	14.74	14.11	1.91	27.7	0.036	0.520	2.7	6.5	5.0	5.8	33.3					
	- Water	0	0	20.00	20.00	-	-	-	-	-	-	-	-	-					Wash water
16 M. Rougher Tables	- Feed	6.00	35.0	13.06	11.14	1.67	4.7	0.100	0.282	8.6	18.0	2.7	16.0	18.1					
	- Concentrate	0.40	35.0	0.86	0.74	20.00	10.0	0.080	0.040	0.6	14.4	0.4	12.8	2.6					
	- Tailings	5.60	31.1	14.20	12.40	0.36	4.3	0.020	0.242	8.0	3.6	2.3	3.2	15.5					
	- Water	0	0	2.00	2.00	-	-	-	-	-	-	-	-	-					Wash water
15 M. Scavenger Tables	- Feed	1.88	15.4	14.74	14.11	1.91	27.7	0.036	0.520	2.7	6.5	5.0	5.8	33.3					Ignored dewatering system ahead of this
	- Concentrate	0.10	30.0	0.26	0.23	20.00	20.0	0.030	0.020	0.1	3.6	0.2	3.2	1.3					
	- Tailings	1.78	10.7	15.48	14.88	0.90	28.1	0.016	0.500	2.6	2.9	4.8	2.6	32.0					
	- Water	0	0	1.00	1.00	-	-	-	-	-	-	-	-	-					Wash water
21 M. Cleaner Tables	- Feed	0.40	35.0	0.86	0.74	20.00	10.0	0.080	0.040	0.6	14.4	0.4	12.8	2.6					
	- Concentrate	0.08	35.0	0.17	0.15	60.00	6.0	0.048	0.005	0.1	8.6	<0.1	7.7	0.3					
	- Tailings	0.32	14.8	1.94	1.84	10.00	10.9	0.032	0.035	0.5	5.8	>0.3	5.1	2.3					
	- Water	0	0	1.25	1.25	-	-	-	-	-	-	-	-	-					Wash water
23 M. Scav. Cleaner Table	- Feed	0.10	30.0	0.26	0.23	20.00	20.0	0.020	0.020	0.1	3.6	0.2	3.2	1.3					
	- Concentrate	0.02	35.0	0.05	0.04	60.00	10.0	0.012	0.002	<0.1	2.2	<0.1	1.9	0.1					
	- Tailing	0.08	4.5	1.71	1.69	10.00	22.5	0.008	0.018	0.1	1.4	0.2	1.3	1.2					
	- Water	0	0	1.50	1.50	-	-	-	-	-	-	-	-	-					Wash water

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
25	M. Cleaner Tail Scav. Table	- Feed	0.40	10.2	3.65	3.53	10.00	13.3	0.040	0.053	0.6	7.1	0.5	6.4	3.4					
		- Concentrate	0.04	30.0	0.10	0.09	17.50	7.5	0.008	0.003	0.1	1.4	<0.1	1.3	0.2					
		- Tailing	0.36	7.5	4.55	4.44	8.89	13.9	0.032	0.050	0.5	5.7	0.5	5.1	3.2					
		- Water	0	0	1.00	1.00	-	-	-	-	-	-	-	-	-					Wash water
98	Medium Gravity Cons Pump	- Feed																		
		- (a) From 15 - Cons	0.08	35.0	0.17	0.15	60.00	6.0	0.048	0.005	0.1	8.7	<0.1	7.7	0.3					
		- (b) From 16 - Conc	0.02	35.0	0.05	0.04	60.00	10.0	0.012	0.002	<0.1	2.2	<0.1	1.9	0.1					
		- (c) From 17 - Conc	0.04	30.0	0.10	0.09	17.50	7.5	0.008	0.003	0.1	1.4	<0.1	1.3	0.2					
		Total	0.14	33.3	0.32	0.28	48.57	7.1	0.068	0.010	0.2	12.3	0.1	10.9	0.6					
26	Medium Gravity Tails Box	- Feed																		
		- (a) From 13 - Tails	5.60	31.1	14.20	12.40	0.36	4.3	0.020	0.242	8.9	3.6	2.3	3.2	15.5					
		- (b) From 14 - Tails	1.78	10.7	15.48	14.88	0.90	28.1	0.016	0.500	2.6	2.9	4.8	2.6	32.1					
		- (c) From 17 - Tails	0.36	7.5	4.55	4.44	8.89	13.9	0.032	0.050	0.5	5.7	0.5	5.1	3.2					
		Total	7.74	19.6	34.23	31.72	0.88	10.2	0.068	0.792	11.1	12.2	7.6	10.9	50.8					
-	Summary C & M Gravity Tails Return																			Back to Section C Table
		- (a) From 9	6.40	18.8	29.71	27.62	1.14	4.3	0.073	0.274	9.2	13.2	2.6	11.7	17.6					Regrind Mill Discharge
		- (b) From 19	7.74	19.6	34.23	31.72	0.88	10.2	0.068	0.792	11.1	12.2	7.6	10.9	50.8					
		Total	14.14	19.2	63.94	59.94	1.00	7.5	0.141	1.066	20.3	25.4	10.2	22.6	68.4					
28	No. 3 Cyclone	- Feed	21.92	15.5	126.45	119.11	1.71	2.2	0.375	0.479	31.6	67.5	4.6	60.2	30.7					S.G. = 2.96 t/m³
		- Underflow	5.97	45.0	9.29	7.30	2.14	1.3	0.128	0.080	8.6	23.0	0.8	20.6	5.1					
		- Overflow	15.95	12.5	117.16	111.81	1.55	2.5	0.247	0.399	23.0	44.5	3.8	39.6	25.6					To Tin Flotation Section

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight cm or µm Feed	Discharge	Undersize	Oversize	Notes
30	F. Rougher Vanners - Feed																		
	- (a) From 21 - U/F	5.97	45.0	9.29	7.30	2.14	1.3	0.128	0.080	8.6	23.0	0.8	20.6	5.1					
	- (b) From 24 - Tail	1.17	18.0	5.68	5.33					1.7									
	Total	7.14	36.1	14.97	12.63					10.3									
	- Concentrate	1.56	10.0	14.51	14.04					2.3									
	- Tailing	5.58	20.0	24.18	22.32	0.45	1.3	0.025	0.074	8.0	4.5	0.8	4.1	4.7					
	- Water	0	0	23.73	23.73	-	-	-	-	-	-	-	-	-					* Wash water
31	F. Van. Rougher Con - Feed Thickener																		
	- (a) From 22 - Conc	1.56	10.0	14.51	14.04					2.3									
	- (b) From 26 - Tail	0.61	18.0	2.97	2.78					0.9									
	Total	2.17	11.4	17.48	16.82					3.2									
	- Underflow	2.17	25.0	7.16	6.51					3.2									
	- Overflow	0	0	(10.31)	(10.31)	-	-	-	-	-	-	-	-	-					
34	F. Cleaner Vanner - Feed	2.17	25.0	7.16	6.51					3.2									
	- Concentrate	1.00	10.0	9.30	9.00					1.4									
	- Tailing	1.17	18.0	5.68	5.33					1.8									
	- Water	0	0	7.82	7.82	-	-	-	-	-	-	-	-	-					Wash water
36	Vanner Cleaner Conc - Feed Thickener	1.00	10.0	9.30	9.00					1.4									
	- Underflow	1.00	25.0	3.30	3.00					1.4									
	- Overflow	0	0	(6.00)	(6.00)	-	-	-	-	-	-	-	-	-					
39	F. Recleaner Vanner - Feed	1.00	25.0	3.30	3.00					1.4									
	- Concentrate	0.39	10.0	3.62	3.51	26.40	1.5	0.103	0.006	0.6	18.6	<0.1	16.5	0.4					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <sm or µm Feed	Discharge	Undersize	Oversize	Notes
	- Tailing	0.61	15.0	2.97	2.78					0.8									
	- Water	0	0	3.29	3.29	-	-	-	-	-	-	-	-	-					Wash water
40 Sn Float Section	- Feed																		
	- (a) From 21 - O/F	15.95	12.5	117.16	111.81	1.55	2.5	0.247	0.399	23.0	44.5	3.8	39.6	25.6					
	- (b) From 22 - Tail	5.58	20.0	24.18	22.32	0.45	1.3	0.025	0.074	8.0	4.5	0.8	4.1	4.7					
	Total	21.53	13.8	141.34	134.13	1.26	2.2	0.272	0.473	31.0	49.0	4.6	43.7	30.3					
Summary - Section D																			
9A Coarse Gravity Concentrate		0.10	35.0	0.24	0.20	38.0	4.0	0.038	0.004	0.1	6.8	<0.1	6.1	0.3					
9B Medium Gravity Concentrate		0.14	33.3	0.32	0.28	48.57	7.1	0.068	0.010	0.2	12.3	0.1	10.9	0.6					
39 Fine Gravity Concentrate		0.39	10.0	3.62	3.51	26.40	1.5	0.103	0.006	0.6	18.6	<0.1	16.5	0.4					
Total Gravity Concentrate		0.63	13.6	4.18	3.99	33.18	3.2	0.209	0.020	0.9	37.7	0.2	33.5	1.3					
C & M Gravity Tail Circulating		14.14	19.2	63.94	59.34	1.00	7.5	0.142	1.066	20.3	25.4	10.2	22.8	68.4					
40 Sn Float Section Feed		21.53	13.8	141.34	134.13	1.26	2.2	0.272	0.473	31.0	49.0	4.6	43.7	30.3					
Process Water Needed		0	0	73.10	73.10	-	-	-	-	-	-	-	-	-					
Feed to Section D		36.30	22.6	136.4	124.34	1.72	4.3	0.623	1.559	52.2	112.2	15.0	100.0	100.0					

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TABLE 1: (Continued)

Item	Detail		Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
E	Sn Plant Section																			
1	Dorline Cyclones	- Feed	21.53	13.8	141.34	134.13	1.26	2.2	0.272	0.473	31.0	49.0	4.6	100.0	100.0					
		- Underflow A	5.81	40.0	10.59	8.72														
		- Overflow A	15.72	11.1	130.75	125.41														
		- Underflow B	4.17	30.0	11.08	9.73														
		- Overflow B	11.55	9.1	119.67	115.68	0.36	2.6	0.042	0.294	16.6	7.6	2.9	15.4	62.2					
3	Sulphide Scavengers	- Feed																		
		- (a) From 1 - U/F, A	5.81	40.0	10.59	8.72														
		- (b) From 1 - U/F, B	4.17	30.0	11.08	9.73														
		- (c) From 5 - Tailing	0.16	40.0	0.31	0.24														
		Total	10.14	35.2	21.98	18.69														
		- Concentrate	0.51	40.0	0.92	0.77														
		- Tailing	9.63	35.0	21.06	17.92														
5	Sulphide Scav. Cleaner	- Feed	0.51	40.0	0.92	0.77														
		- Concentrate	0.35	40.0	0.61	0.53	0.57	20.3	0.002	0.071	0.5	0.4	0.7	0.7	15.0					Normally recycled to clean-up thickener in Section C but omitted to simplify calculation
		- Tailing	0.16	40.0	0.31	0.24														
6	Sn Roughers	- Feed																		
		- (a) From 9 - Tailing	9.63	35.0	21.06	17.92														
		- (b) From 8 Conc	0.87	25.0	2.87	2.61														
		- (c) From 10 - Tailing	2.52	28.7	7.00	6.25														
		Total	13.02	32.7	30.93	26.78														

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
	- Concentrate	3.36	23.4	12.00	11.01														
	- Tailing	9.66	38.0	18.93	15.77														
9 Sn Scavengers	- Feed	9.66	38.0	18.93	15.77														
	- Concentrate	0.87	25.0	2.87	2.61														
	- Tailing	8.79	40.1	16.06	13.16	0.20	0.75	0.018	0.066	12.7	3.2	0.6	6.6	14.0					
10 Sn Cleaners																			
	- (a) From 6 - Conc	3.36	23.4	12.00	11.01														
	- (b) From 12 - Tail	1.85	28.6	5.16	4.62														
	Total	5.21	25.0	17.16	15.63														
	- Concentrate	2.69	22.3	10.16	9.38														
	- Tailing	2.52	28.7	7.00	6.25														
12 Sn Recleaners	- Feed																		
	- (a) From 10 - Conc	2.69	22.3	10.16	9.38														
	- (b) From 14 - Tailing	1.26	33.8	2.85	2.47														
	Total	3.95	25.0	13.01	11.85														
	- Concentrate	2.10	22.5	7.85	7.23														
	- Tailing	1.85	28.6	5.16	4.62														
14 Sn Third Cleaners	- Feed	2.10	22.5	7.85	7.23														
	- Concentrate	0.84	15.0	5.00	4.76	25.0	5.0	0.210	0.042	1.2	37.8	0.4	77.2	8.8					
	- Tailing	1.26	33.3	2.85	2.47														
15 Section Tailing	- (a) From 1 - D/F B	11.55	9.1	119.67	115.68	0.36	2.6	0.042	0.294	16.6	7.6	2.9	15.4	62.2					
	- (b) From 5 - Concentrate	0.35	40.0	0.61	0.53	0.57	20.3	0.002	0.071	0.5	0.4	0.7	0.7	15.0					
	- (c) From 8 - Tailing	8.79	40.1	16.06	13.16	0.20	0.75	0.018	0.066	12.7	3.2	0.6	6.6	14.0					
	Total	20.69	13.8	136.34	129.37	0.30	2.08	0.062	0.431	29.8	11.2	4.2	22.8	91.2					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or um Feed	Discharge	Undersize	Oversize	Notes
Summary - Section E																			
1	Deslime Cyclone O/F	11.55	9.1	119.67	115.68	0.36	2.6	0.042	0.294	16.6	7.6	2.9	15.4	62.2					
5	Sulphide Scav. Concentrate	0.35	40.0	0.61	0.53	0.57	20.3	0.002	0.071	0.5	0.4	0.7	0.7	15.0					
9	Sn Scav. Tailing	8.79	40.1	16.96	13.16	0.20	0.75	0.018	0.066	12.7	3.2	0.6	6.6	14.0					
15	Section Tailing	20.69	13.8	136.34	129.37	0.30	2.08	0.062	0.431	29.8	11.2	4.2	22.8	91.2					
14	Sn Float Concentrate	0.84	15.0	5.00	4.76	25.0	5.0	0.210	0.042	1.2	37.8	0.4	77.2	8.8					
	Feed to Section E	21.53	13.8	141.34	134.13	1.26	2.2	0.272	0.473	31.0	49.0	4.6	100.0	100.0					

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m³/h	Water m³/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight fm or on: Feed	Discharge	Undersize	Oversize	Notes
3	Final Products Sections																		
1	Floats ex Section E	36.40	92.5	16.0	2.95	0.11	1.7	0.040	0.619	52.4	7.2	5.9	-	-					To disposal
2	Tailings Thickener - Feed																		
	- (a) Sect C - Sulphide Conc	10.94	40.0	19.2	16.41	0.30	85.1	0.033	9.311	15.7	6.0	89.3	-	-					
	- (b) Sect E - Sect. Tail	20.69	13.8	136.34	129.37	0.30	2.08	0.062	0.431	29.3	11.2	4.2	-	-					
	Total	31.63	17.8	155.54	145.78	0.30	30.8	0.095	9.742	45.5	17.2	93.5	-	-					
	- Underflow	31.63	50.0	41.39	31.63	0.30	30.8	0.095	9.742	45.5	17.2	93.5	-	-					S.G. = 3.24 t/m³
	- Overflow	0	0	(114.15)	(114.15)	-	-	-	-	-	-	-	-	-					
4	Gravity Concentrate Clean-up																		
	- Feed	0.63	13.6	4.18	3.99	33.18	3.2	0.209	0.020	0.9	37.7	0.2	-	-					
	- Concentrate	0.36	92.0	0.10	0.03	55.00	0.5	0.197	0.002	0.5	35.5	<0.1	-	-					
	- Tailing	0.27	9.0	4.08	3.96	4.44	6.7	0.012	0.018	0.4	2.2	0.2	-	-					Normally recycled to gravity Section D but omitted to simplify calculations
5	Sn Float Concentrate Clean-up																		
	- Feed	0.84	15.0	5.00	4.76	25.0	5.0	0.210	0.042	1.2	37.8	0.4	-	-					
	- Concentrate	0.42	92.0	0.12	0.04	50.0	1.0	0.208	0.004	0.6	37.5	<0.1	-	-					
	- Tailing	0.42	60.0	0.44	0.28	4.76	9.0	0.002	0.038	0.6	0.3	0.4	-	-					As for concentrate in 3 but returned to Sn float feed
	- Water loss	0	0	4.44	4.44	-	-	-	-	-	-	-	-	-					Dryer - loss
7	Water Circuit Components																		
	- (a) Sect A requires				109.94														
	- (b) Sect B requires				136.38														

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TABLE 1: (Continued)

Item	Detail	Solids t/h	Solids Dry %	Pulp Vol. m^3/h	Water m^3/h	Assay, % Sn	Assay, % Sulphides	Metal Content, t/h Sn	Metal Content, t/h Sulphides	Distribution, % Solids	Distribution, % Sn	Distribution, % Sulphides	Stage Distribution, % Sn	Stage Distribution, % Sulphides	Nominal Sizing, % Weight <mm or µm Feed	Discharge	Undersize	Oversize	Notes
	- (c) Sect D requires				73.10														
	- (d) Sect E requires				0														
	Sub-Total required				319.42														
	- (e) Sect C recovers				122.68														
	- (f) Sect F recovers				114.15														
	Sub-Total recovered				236.83														
	- (g) Spillage circulating				40.00														
	Process Water Needed				42.59														Required - recovered - circulating = make-up
	Feed to Plant	69.50		24.95	1.78	0.80	15.0	0.554	10.423	100.0	100.0	100.0	-	-					Error on Water balance +3% which is acceptable

TABLE 2: CRUSHING, WASHING, SCREENING AND ORE STORAGE

Item	Detail	Cost Purchase $A	Shipping Weight Tonnes	Consumed Power kW	Materials Handling t/h (Ave.)
1	Coarse ore stockpile 5500 t cap.	-	-	-	-
2	End loader, 2.5 m^3 bucket	100,000	30	-	146
3	Road hopper, 41 m^3 capacity	22,000	3	-	-
4	Apron feeder, 1.3 m wide × 7 m long	21,000	4	23.5	146
5	Magnet	4,000	0.75	1	-
6	Elevating conveyor 750 mm × 38.6 m long × 10 m lift	40,000	4.5	8	146
7	Drum scrubber 2.5 m dia. × 3.0 m long	120,000	35	44	146
8	By-pass conveyor 750 mm wide × 6 m long × zero lift	8,000	1.1	2	146
9	Grizzly, static type, 100 mm bar spacing	4,000	0.75	-	146
10	Vibrating screen, washing and draining decks with 40 mm and 6 mm apertures	17,500	2.0	5.6	109
11	Elevating conveyor 750 mm wide × 38.6 m long × 10 m lift	35,000	4.5	8	133
12	Secondary crusher set at 25 mm, 1295 mm standard	120,000	21.4	150	133
13	Secondary vibrating screen 13.2 mm aperture (square mesh equivalent)	20,800	2.0	5.6	133
14	Elevating conveyor 600 mm wide × 36 m long × 8 m lift	27,600	4.0	5	130
15	Elevating conveyor 600 mm wide × 26 m long × 8 m lift	22,600	3.0	5	130
16	Surge bin 260 t cap	48,000	10	-	-
17	Belt feeder 600 mm wide × 7 m long	22,000	0.75	10	130
18	Tertiary crusher set at 9 mm, 1295 mm shorthead	120,000	21.5	150	130
19	Tertiary vibrating screen 13.2 mm aperture	20,800	2.0	5.6	130
20	Elevating conveyor 600 mm wide × 77 m long × 10 m lift	43,000	9.6	12	133
21	Tripper 600 mm wide	15,500	2.0	2	133
22	Fine ore storage bin 3000 t cap	340,000	60	-	-
23	Vibrating feeders 10 off 4 operating	17,000	2.0	2	70
24	Belt conveyor 600 mm wide × 67 mm long × 10 m lift	37,000	7.5	4	70
25	Pump for wet fines - 6/4 or equivalent	6,500	0.75	17	13
26	Desliming cyclone - 380 mm dia.	2,400	0.15	-	13
27	DSM screen for sand drainage - static wedge wire 0.5 m wide, 1.0 m long with 0.2 mm aperture	6,000	0.75	-	10
28	Surge bin for wet sand 100 ton cap	40,000	10	-	-
29	Ejector and pump for sand reclaim - Warman 4/3	4,350	1.0	19 V.S.	5
30	10 t O/Head crane	20,000	1.2	8	-
31	Floor drainage sump pump - Sala VASAG-75	5,500	0.75	8	variable
	Nominal Totals	1,310,550	-	496	-

TABLE 3: HEAVY MEDIA SEPARATION PLANT

Item	Detail	Cost Purchase $A (1)	Shipping Weight Tonnes	Consumed Power kW	Materials Handling t/h (Ave.)
1	Head chute and mixing box steel rubber lined	3,000	1	-	68
2	Feed preparation sieve bend	9,000	0.8	-	68
3	Feed preparation vibrating screen	18,000	4	5	55
4	H.M.S. DSM cyclone	3,000	1	-	310
5	Floats sieve bend	8,000	0.8	-	230
6	Sinks sieve bend	8,000	0.8	-	80
7	Floats and sinks vibrating screen	25,000	5	5	45/18
8	Floats and sinks product conveyors - 2 off	40,000	3	2.5	37/14
9	Centrifugal densifier sump and pump	28,000	3	150 V.S.	185
10	Centrifugal densifier - 3 off	6,000	1	-	185
11	Circulating medium sump	5,000	0.5	-	260
12	Circulating medium pump	28,000	3	150 V.S.	260
13	Medium density control instrumentation (2)	-	-	-	-
14	Dilute medium sump and pump	13,000	2	20 V.S.	35
15	Wet drum primary magnetic separator	35,000	5	5	35
16	Primary magnetic separator non-magnetics sump and pump	6,500	1.5	23.5	5
17	Desliming cyclones - 3 off	6,000	0.5	-	5
18	Clarified water storage tank	6,000	2	-	-
19	Wet drum secondary magnetic separator	35,000	5	5	5
20	Floor drainage sump pump	5,500	0.5	8	Variable
21	Transfer pump for H.M.S. fines	17,500	2	38 V.S.	18
22	Plant water supply pump	4,000	1	30	-
23	Floats surge bin	75,000	60	-	150
24	Truck	60,000	-	-	10
25	Sinks surge bin	75,000	60	-	170
26	Demagnetising coil	4,000	0.5	2	36
27	Coarse pyrrhotite sieves - 2 off	16,000	2	-	36
28	No. 60 Agitair cells - 6 off	60,000	15	118.5	36
29	Ferrosilicon feeder	1,000	0.5	-	-
30	5 t o/head crane	5,500	8	8.25	-
	Nominal Totals	606,000	-	571	-
	Add 15% on cost for equipment duplication (3)	696,800			

Notes (1) Mitchell Cotts advise Items 1 to 20 installed including supply, steelwork, foundations, piping, erection, etc. included totals $A1,250,000.

(2) Allowed in instrumentation costs - Table 8.

(3) Components such as pumps in critical plant areas are duplicated.

TABLE 4: GRINDING AND SULPHIDE FLOTATION PLANT

Item	Detail	Cost Purchase $A	Shipping Weight Tonnes	Power Consumed kW	Materials Handling t/h (Ave.)
1	H.M.S. fines desliming cyclone - 3 by D10B	6,000	0.5	-	18
2	Clean-up thickener - 23 m dia.	140,000	55	5	10
3	Thickener underflow pump - Warman 3/2	2,300	0.5	3.5 V.S.	10
4	Primary mill discharge pump - Warman 6/4	9,500	1	17 V.S.	108
5	Primary mill feed sieve - 4 screens, 1 m wide, 3 operating	30,000	8	-	108
6	Primary mill - 2135 mm dia. × 4270 mm long grate discharge	277,000	43 + 29 t ball load	253 V.S	75
7	Circuit water pump, Warman 8/6	6,400	3	40	-
8	Sinks bin discharge feeder - 600 mm wide belt feeder × 5 m long	16,000	2	2	14
9	Sinks elevating conveyor - 600 mm wide × 27 m long × 7 m lift	23,000	20	2	14
10	Sinks vibrating screen - 6 mm aperture	10,000	5	1	14
11	H.M.S. sinks crusher - shorthead set at 4 mm	100,000	4.6	22	14
12	Elevating conveyor to primary grind - 600 mm wide × 15 m long × 4 m lift	16,000	10	2	14
13	Sulphide rougher flotation - 4 by Agitair No. 96 cells, rubber lined	57,600	12	98.5	39
14	Gravity circuit feed pump - Warman 6/4	6,400	1.5	32.5	37
15	Sulphide concentrate transfer pump - Sala SPV - 75 mm	6,000	0.5	5	14
16	Sulphide regrind mill discharge pump - Warman 6/4	9,900	2	25 V.S.	49
17	Sulphide regrind mill - 1525 mm dia. × 2135 mm long grate discharge	105,000	11 + 7 t ball load	60 V.S.	35
18	Sulphide regrind mill sieve - 3 screens, 1 m wide, 2 operating	20,000	6	-	49
19	Sulphide cleaner flotation - 2 by Agitair No. 96 cells, rubber lined	28,800	8	49.5	14
20	Sulphide final concentrate pump - 2 Sala pumps (SPV - 100, VSA - 100) in series	11,000	1.5	15	11
21	Table tailings regrind mill pump - Warman 6/4	6,400	1	14.5	14
22	Table tailings regrind mill sieve - screen 1 m wide	8,000	2	-	52
23	Table tailings regrind mill - 1830 mm dia. × 3660 mm long grate discharge	198,000	23.6 + 17.8 t ball load	150 V.S.	38
24	Sulphide scavenger flotation cells - 8 by Agitair No. 60 cells, rubber lined	86,400	20	158	15
25	Floor drainage pump - Sala VASAG - 75	5,500	0.5	8	Variable
26	O/head cranes - grinding bay 40/10 t	150,000	80	20	-
	- flotation section 10 t monorail	20,000	12	8	-
	Nominal Totals	1,355,200	398	992	-
	Add 5% on cost for equipment duplication(1)	1,423,000			

Note (1) Components such as pumps in critical plant areas are duplicated.

TABLE 5: GRAVITY TIN PLANT

Item		Cost Purchase $A	Shipping Weight Tonnes	Consumed Power kW	Materials Handling t/h (Ave.)
1	No. 1 cyclones - 5 by D10B (one standby)	10,000	1	-	37
2	Hydrosizer - 2 compartment Stokes unit, 2 off	26,500	10	-	9.5
3	Hydrosizer spigot surge bin - steel, rubber lined	3,000	1.5	-	7
4	Surge bin pump - Warman 2/1½	2,900	0.5	3 V.S.	7
5	Degritting sieve bend - DSM, 45° bend, 1 metre radius, 0.3 m wide with 300 µm aperture	6,000	2	-	7
6	Sluice concentrator - standard unit	5,000	2.5	-	5
7	Coarse spirals - 4 by twin start spirals	5,500	1	-	5
8	Coarse gravity tables - 4 by full size sand tables	45,000	9	6	1.5
9	MHC gravity concentrate sump and pump - Sala SPV260	4,000	0.5	1	0.25
10	Coarse gravity tails box - steel, rubber lined	3,000	1	-	6.5
11	No. 2 cyclone feed sump and pump - Warman 8/6	21,500	3	35 V.S.	30
12	No. 2 cyclones - 6 by Linatex 230 mm (one standby)	6,500	2	-	30
13	Medium gravity feed distributor - 36 way, rubber lined	13,000	5	1	8
14	Fine spirals - 16 by twin start spirals	16,500	2	-	8
15	Medium gravity table feed distributors - 4 by 8 way and 1 by 12 way	23,500	8.5	5	6
16	Medium gravity rougher tables - 24 by full size units	268,800	52	30	6
17	Spiral tailings thickener - 8 m dia.	68,000	30	3	2
18	Thickener U/F pump - Warman 2/1½	1,900	0.5	1.5	2
19	Medium gravity scavenger tables - 9 by full size units	100,800	19.5	11.5	2
20,22,24	Table concentrate sumps and pumps - 6 by Sala SPV180	4,800	1	5	0.2
21,23,25	Tables for cleaning duty - 7 by full size units	78,400	15.5	9	1
26	Medium gravity tails box - steel, rubber lined	3,000	1	-	8
27	No. 3 cyclone feed sump and pump - Warman 6/4	13,500	3	29 V.S	22
28	No. 3 cyclones - 12 by Linatex 150 mm (one standby)	10,500	3	-	22
29	Fine gravity feed distributor - 36 way, rubber lined	13,000	5	1	6
30	Rougher Vanners - 36 by Fieldhouse units	360,000	108	27.5	6
31	Vanner concentrate thickener No. 1 - 6 m	50,500	25	1.5	2.5
32	No. 1 thickener U/F pump - Warman 2/1½	2,900	0.5	1.5 V.S.	2.5
33	Cleaner Vanners feed distributor - 8 way, rubber lined	4,000	1.5	1	2.5
34	Cleaner Vanners - 8 by Fieldhouse units	80,000	25	6	2.5
35	Vanner cleaner tail sump and pump - Warman 2/1½	1,900	0.5	1.5	1.5
36	Vanner concentrate thickener No. 2 - 6 m	50,500	25	1.5	1
37	No. 2 thickener U/F pump - Warman 2/1½	2,900	0.5	1.5 V.S.	1
38	Recleaner Vanners feed distributor - 8 way, rubber lined	4,000	1.5	1	1
39	Recleaner Vanners - 8 by Fieldhouse units	80,000	25	6	1
40	Floor drainage sump - Sala VASAG, 75	5,500	0.5	8	Variable
41	O/head cranes - 10 t monorail	20,000	12	8	-
42	Gravity circuit tails sump and pump - Warman 6/4	17,500	2.5	65 V.S.	22
	Nominal Totals	1,434,300	-	268	-
	Add 5% on cost for equipment duplication(1)	1,506,100			

Note (1) Components such as pumps in critical plant areas are duplicated.

TABLE 6: TIN FLOTATION PLANT

Item	Detail	Cost Purchase $A	Shipping Weight Tonnes	Consumed Power kW	Materials Handling t/h (Ave.)
1	Deslime Cyclones A - 14 by 120 mm Linatex units, 12 operating, 2 on standby	4,200	3.5	-	22
	Deslime Cyclones B - 36 by 80 mm Linatex units, 30 operating, 6 on standby	10,800	9	-	16
2	No. 2 deslime cyclone sump and pump - Warman 6/4	14,000	3	45 V.S.	16
3	Sulphide scavenger flotation cells - 4 by No. 60 Agitair cells, rubber lined	40,000	10	79.5	10
4	Sulphide scavenger concentrate pump - Sala SPVF260	2,500	0.5	1.5	0.5
5	Sulphide scavenger cleaner flotation cells - 2 by No. 60 Agitair cells, rubber lined	20,000	5	39.5	0.5
6	Tin rougher flotation cells - 8 by No. 60 Agitair cells, rubber lined	80,000	20	157.5	13
7	Tin rougher concentrate sump and pump - Sala SPVF260	2,500	0.5	1.5	3.5
8	Tin scavenger flotation cells - 4 by No. 60 Agitair cells, rubber lined	40,000	10	79.5	10
9	Tin scavenger concentrate sump and pump - Sala SPVF260	2,500	0.5	1.5	1
10	Tin cleaner flotation cells - 4 by No. 60 Agitair cells, rubber lined	40,000	10	79.5	5.5
11	Tin cleaner concentrate sump and pump - Sala SPVF260	2,500	0.5	1.5	2.5
12	Tin recleaner flotation cells - 2 by No. 60 Agitair cells, rubber lined	20,000	5	39.5	4
13	Tin recleaner concentrate sump and pump - Sala SPVF260	2,500	0.5	1.5	2
14	Tin third cleaner flotation cells - 2 by No. 60 Agitair cells, rubber lined	20,000	5	39.5	2
15	Flotation tailings pump - Warman 6/4	6,400	2	25	21
16	Floor drainage pump - Sala VASAG - 75	5,500	0.5	8	Variable
17	O/head crane(1)	N/A	N/A	N/A	N/A
18	Air blower for flotation cell air supply(2) - Roots Blower or Richardson Fan	23,500	1.5	-	-
	Nominal Totals	336,900	-	600	-
	Add 10% on cost for equipment duplication(3)	370,600			

Notes: (1) Correct plant layout allows use of unit installed in grinding and sulphide flotation area of concentrator.

(2) Power requirements are included in power consumptions for individual cell groups. Total power is nominally 55 kW for air.

(3) Components such as pumps in critical plant areas are duplicated.

TABLE 7: FINAL PRODUCT HANDLING AND MISCELLANEOUS

Item	Detail	Cost Purchase $A	Shipping Weight Tonnes	Consumed Power kW	Materials Handling t/h (Ave.)
1	Floats stockpile	-	-	-	-
2	Tailings thickener - 23 m dia.	140,000	65	5	32
3	Tailings thickener U/F pump - Warman 8/6	21,500	3	75 V.S.	32
4	Gravity concentrate clean-up section - 5% capital cost for Section D(1)	75,300	20	10	0.6
5	Tin flotation concentrate clean-up section - 35% capital cost for Section E(1)	129,700	30	45	0.9
6	Concentrate drying and bagging - 5% capital cost for Sections D and E	93,800	20	15	0.8
7	Water storage - 2 by corrosion proofed tanks 9 m dia. × 7 m high	85,000	50	-	-
8	Reagent supply - 20% capital cost for Section E	74,200	20	15	-
9	Operations office 30 m × 10 m × 3 m high, complete with all facilities including furniture, lighting and airconditioning	Covered in Table 8 by Items 7 and 10			
10	Sample preparation and analytical/ metallurgical laboratory 40 m × 15 m × 3 m high, complete with all facilities including bench space, offices, lighting and airconditioning				
11	Workshop 60 m × 15 m × 6 m high complete with all equipment and office space				
12	Warehouse/stores 15 m × 35 m × 8 m high complete with all storage racks and office space				
13	Changehouse 10 m × 15 m × 4 m high complete with ventilation				
14	Motor control centre 5 m × 15 m × 4 m high complete with airconditioning and CO_2 fire control				
15	Sub-station 15 m × 10 m × 5 m high excluding equipment which is outside scope of this study				
16	Compressor house 5 m × 10 m × 4 m soundproofed and complete excl. equipment				
	Nominal Totals	619,500	-	165	-
	Add 2.5% on cost for equipment duplication(2)	635,000			

Notes: (1) Assumes some chemical treatment is necessary.

(2) Components such as pumps in critical plant areas are duplicated.

TABLE 8: CAPITAL COST ESTIMATE ($A × 10^6) - 1500 t/d

	Items	
(1)	Purchased Equipment	
	(a) Washing and Crushing Plant	1,310,600
	(b) Heavy Media Separation Plant	695,800
	(c) Grinding and Sulphide Flotation Plant	1,423,000
	(d) Gravity Tin Plant	1,506,100
	(e) Tin Flotation Plant	370,600
	(f) Final Product Handling and Miscellaneous	635,000
(A)	TOTAL	5,942,100
(2)	Delivered Equipment Cost - 4% of (A)	237,700
(3)	Installation - 20% of (A)	1,188,400
(4)	Instrumentation - 5% of (A)	297,100
(5)	Piping - 50% of (A)	2,971,000
(6)	Electrical Installation - 15% of (A)	891,300
(7)	Buildings - 25% of (A)(1)	1,485,500
(8)	Foundations and Structures - 20% of (A)	1,188,400
(9)	Land and Improvements, environmental requirements - 5% of (A)	297,100
(10)	Utilities - 25% of (A)	1,485,500
(B)	TOTAL DIRECT EQUIPMENT COST (1 to 10)	15,984,200
(11)	Engineering, Constructors and Contractors Fees - 20% of (B)	3,196,800
(C)	TOTAL EQUIPMENT COST (1 to 11)	19,181,000
(12)	Contingency - 30% of (C)	5,754,300
(D)	FIXED CAPITAL INVESTMENT (1 to 12)	24,935,300
(13)	Working Capital - 90 days operating cost - Table 10	2,462,400
(E)	TOTAL CAPITAL INVESTMENT (1 to 13)	27,397,700

Notes: (1) Reduced from normal 40% to 25% to account for fact layout based on open air layout of majority of operating plant.

TABLE 9: MANPOWER REQUIREMENTS - 1500 t/d

Classification	Working Times[1]	Job Title	No. at Salary/Annum
1. Workforce	16 week/4 shift roster	Operators:	
		H.M. Separation	4 - $ 12,000
		Grinding/Flotation	4 - $ 12,000
		Gravity Tin	4 - $ 12,000
		Tails/Conc/General	4 - $ 10,000
		Shift Assayer	4 - $ 11,000
	6 day week, day/afternoon shift	Operators:	
		Washing/Crushing	2 - $ 11,000
		Drivers/F.E. Loader/General	4 - $ 10,000
		General	2 - $ 8,500
Sub Total			28 - $307,000
+40% on Costs[2]			$122,800
Total direct salaries and wages for 28 employees			$429,800
2. Staff	5 day per week, 8 h per day, On call roster	Mill Superintendent	1 - $ 22,500
		Metallurgist	1 - $ 18,000
		Assayer	1 - $ 15,000
		Mill Engineer	1 - $ 18,500
		Day Foreman	1 - $ 16,000
	16 week/4 shift roster	Shift Bosses	4 - $ 14,000
Sub Total			9 - $146,000
+30% on Costs[2]			$ 43,800
Total staff salaries for 9 personnel			$189,800
3. Supporting	5 day per week, 8 h per day, On call roster	Operators:	
		Training	1 - $ 8,500
		Workshop:[3]	
		Fitters	2 - $ 15,000
		Instruments/Electrician	2 - $ 15,000
		Welders	2 - $ 15,000
		Mechanical	2 - $ 12,000
		Other:	
		Clerk/Typing	1 - $ 9,000
		Cleaner	1 - $ 8,000
		Labourer[4],[5]	1 - $ 8,000
		Lab. Assistant	1 - $ 9,500
Sub Total			11 - $157,000
+35% on Costs[2]			$ 54,950
Total supporting salary for 11 personnel			$211,950

Total salary and wages for 48 personnel is $831,550 or $1.53/tonne of ore treated.

Notes: (1) Based on 360 working days/year.

(2) These salary figures have been adjusted to include margins for shiftwork (15% where applicable), overtime (up to 8 hours/week plus 1 5 hours on call-out/week), industry allowance (currently $18/week) and a loading of 17½% on holiday pay.

No allowance has been made for prosperity bonuses or for fringe benefits which appear to range from 15 to 35% of base salary depending on location or company.

(3) These are workshop personnel permanently allocated to the concentrator on general maintenance, pumps and breakdowns. They are part of the total complement of workshop personnel for mine, concentrator etc. whose total services are called upon by the concentrator during planned maintenance shutdowns.

(4) Labourer's wage taken as $3.845/h.

(5) Depending on location an additional number are required 'in training' to cover high labour turn-over. In a very 'bad' area this can add 50% to direct labour requirements in which case it would add another $A1.24 to the total production costs in Table 10. This aspect of high labour turn-over has been ignored in this study.

TABLE 10: OPERATING COSTS ($A per tonne) - 1500 t/d

	Items	$A Per Tonne of Ore Treated		
(1)	Raw Materials and Utilities			
	• Water (make-up and fresh) - 45 m^3/h at 25¢/kilolitre (m^3)	0.18		
	• Power - consumed - 3092 × 90%			
	Total - 2783 at 3.5¢/kWh	1.56		
	• Fuel Oil - dryer - 1.0 t/d at $100/t	0.07		
	Total		1.81	
(2)	Labour - Table 9 (a) Direct labour		0.79	
	(b) Supervisory/labour			
	(i) staff	0.35		
	(ii) supporting	0.39		
	Total		0.74	
(3)	Maintenance - 8% of capital (Table 8 - Item D)		3.64	
(4)	General Supplies - 10% of (2a)		0.08	
(5)	Operating Supplies			
	• Ferrosilicon - 1 kg/t at $550/t	0.55		
	• Reagents - collectors, activators, frothers, depressants, acid etc.	2.55		
	• Grinding media - 0.5 kg/t at $240/t	0.12		
	Total		3.22	
(A)	DIRECT OPERATING COST (1 to 5)			10.28
(6)	Payroll Overhead - 20% of (2a)		0.15	
(7)	Plant Overhead - 125% of (2a)		0.99	
(8)	Process Control - 25% of (2a)		0.20	
(B)	INDIRECT OPERATING COSTS (6 to 8)			1.34
(9)	Depreciation - 8% of capital, (Table 8 - Item D)		3.64	
(10)	Property Taxes and Insurance - 1% of capital, (Table 8 - Item D)		0.46	
(C)	FIXED OPERATING COSTS (9 to 10)			4.10
(D)	TOTAL OPERATING COSTS (A to C)			15.72
(11)	Administrative Expenses - 3% of (D)		0.47	
(12)	Distribution and Marketing - 10% of (D)		1.57	
(13)	Research and Development - 3% of (D)		0.47	
(E)	OVERHEADS (11 to 13)			2.52
(F)	TOTAL PRODUCTION COSTS (D to E)(1)			18.24

Note: (1) Refer Table 9 note (5) for effect of high labour turnover on the total production cost.

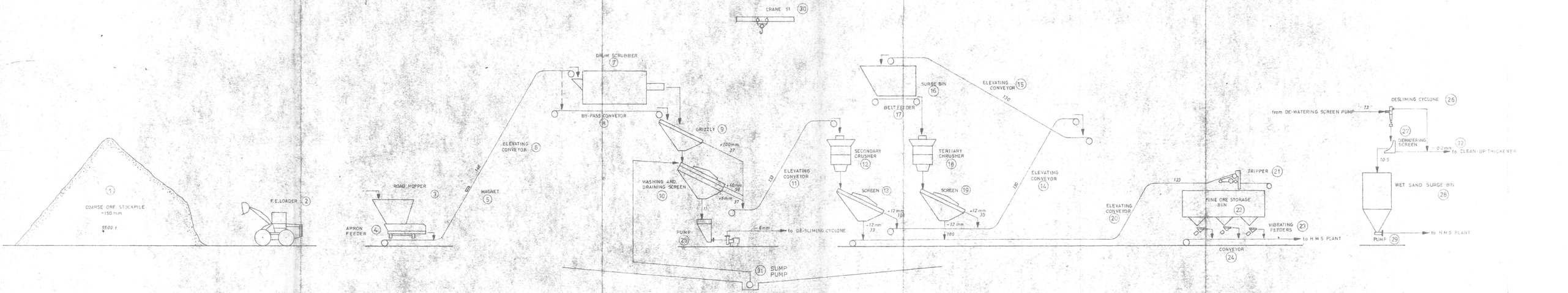

FIG. 1 WASHING AND CRUSHING PLANT

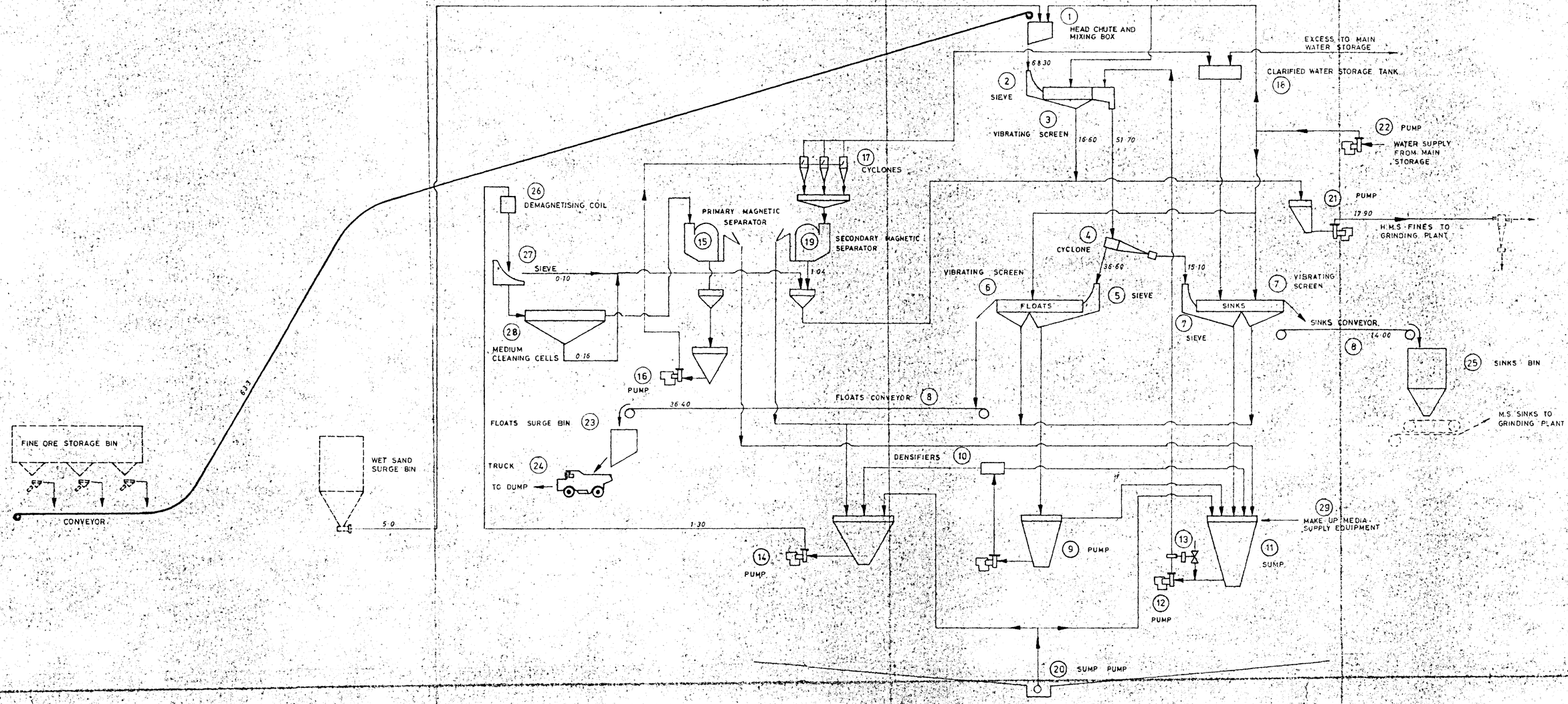

FIG.2: HEAVY MEDIA SEPARATION PLANT

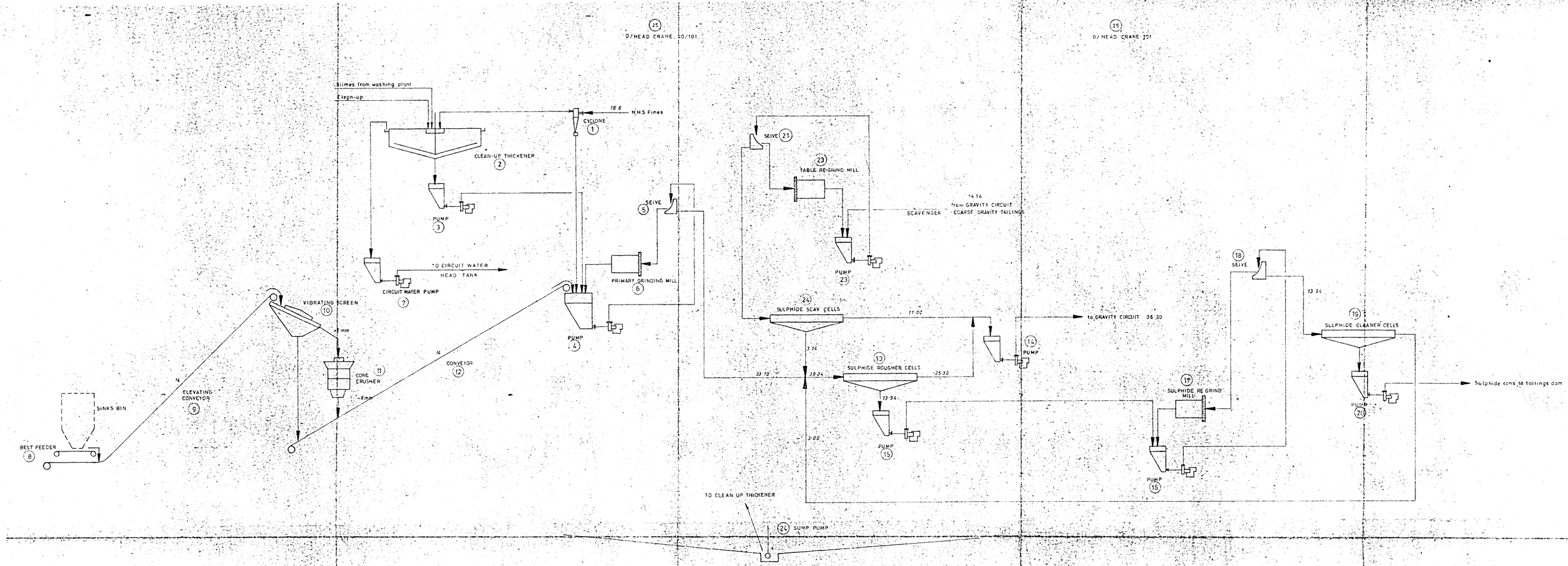

FIG. 3 GRINDING AND SULPHIDE FLOTATION

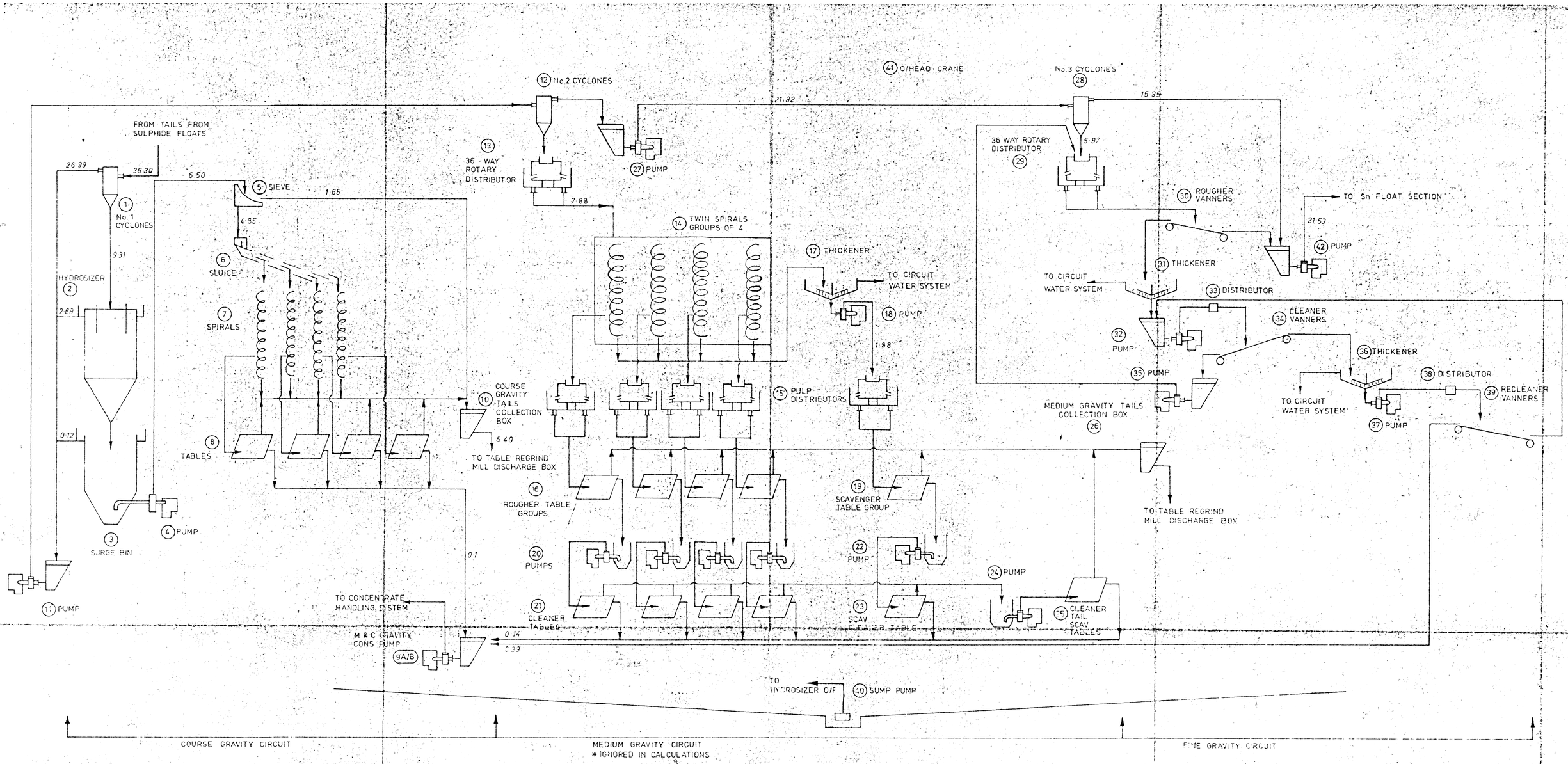

FIG 4 Sn GRAVITY PLANT

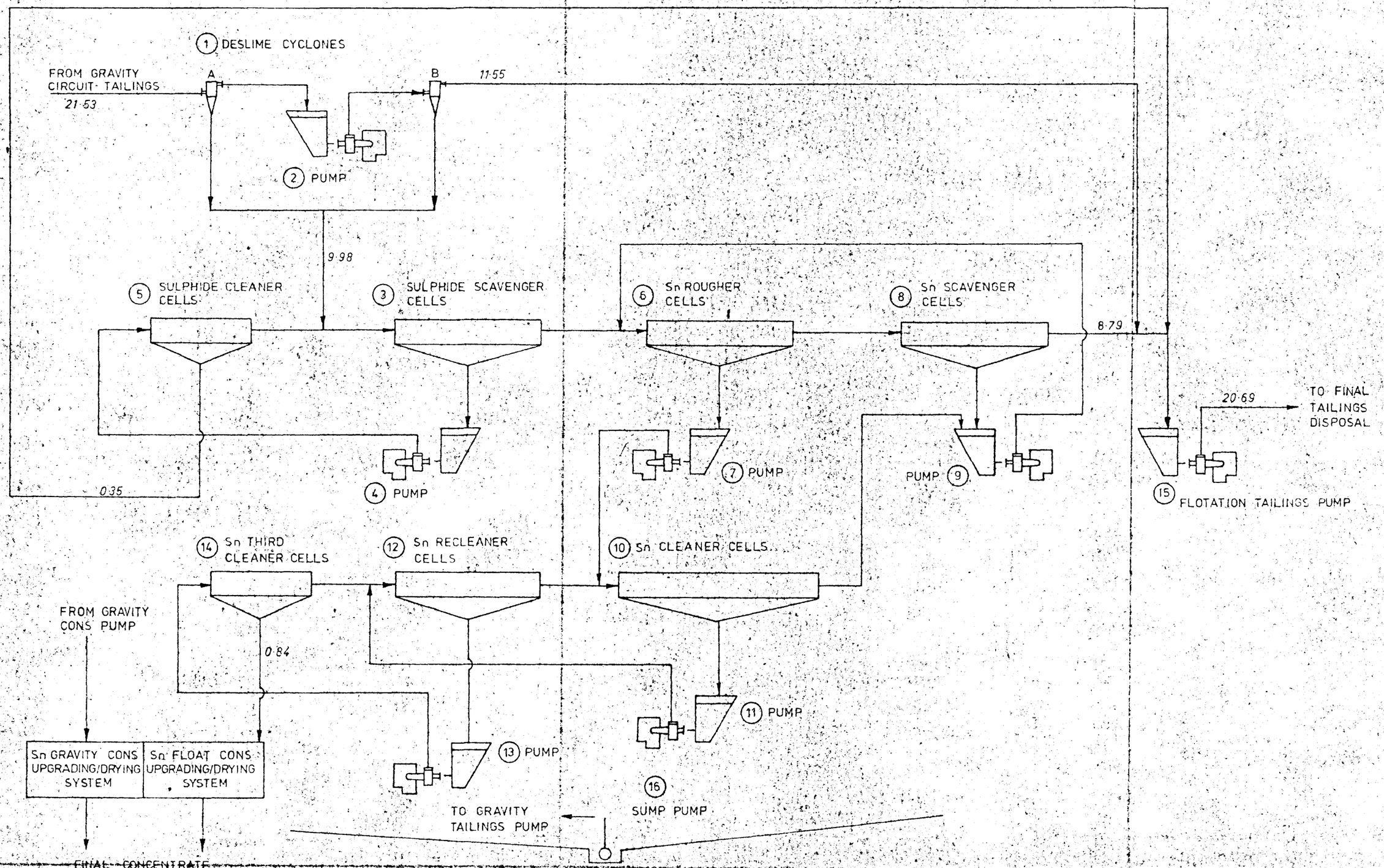

FIG.5 Sn FLOAT SECTION AND FINAL PRODUCT HANDLING

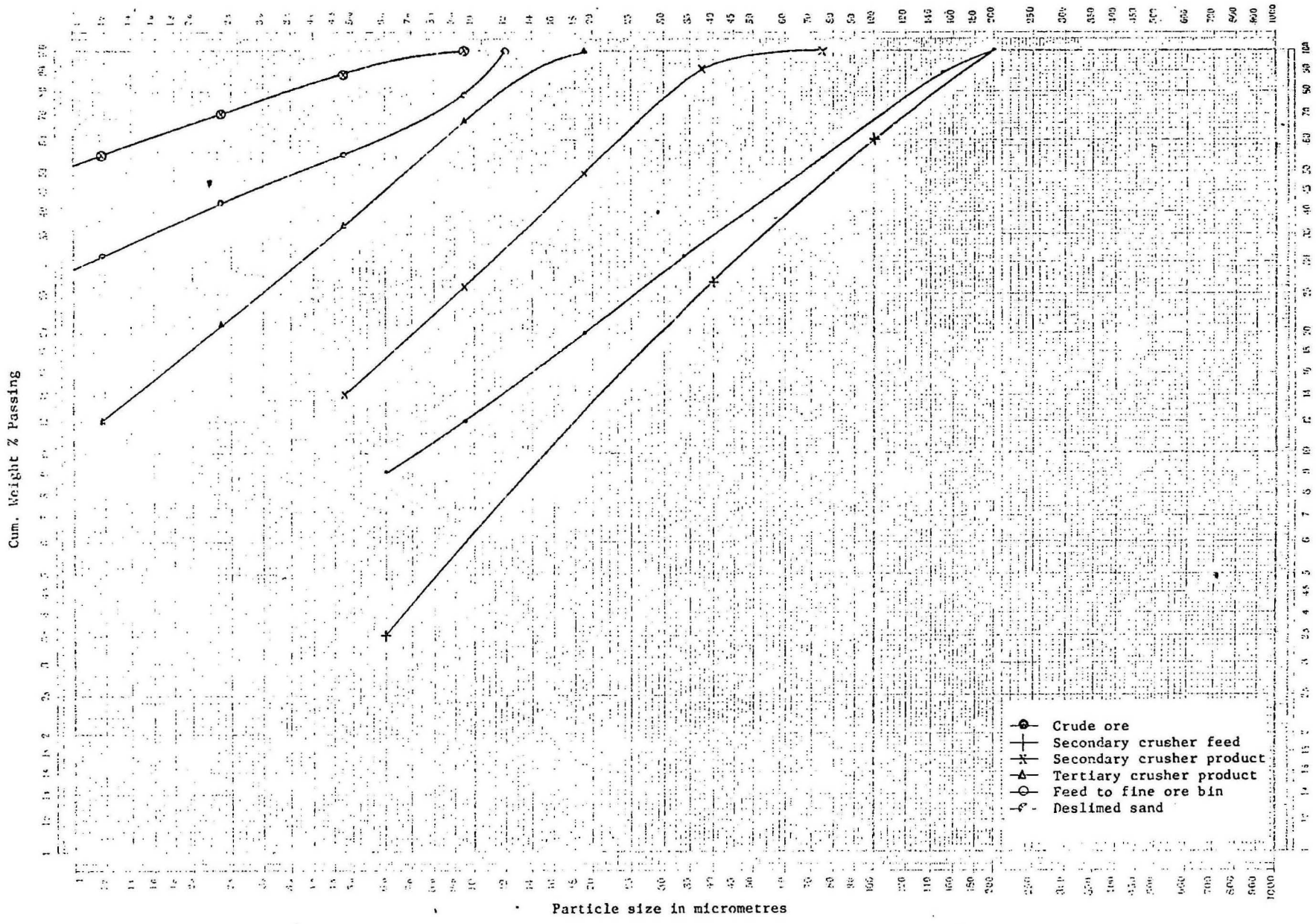

FIG. 6: FEED AND PRODUCT SIZINGS - WASHING AND CRUSHING PLANT

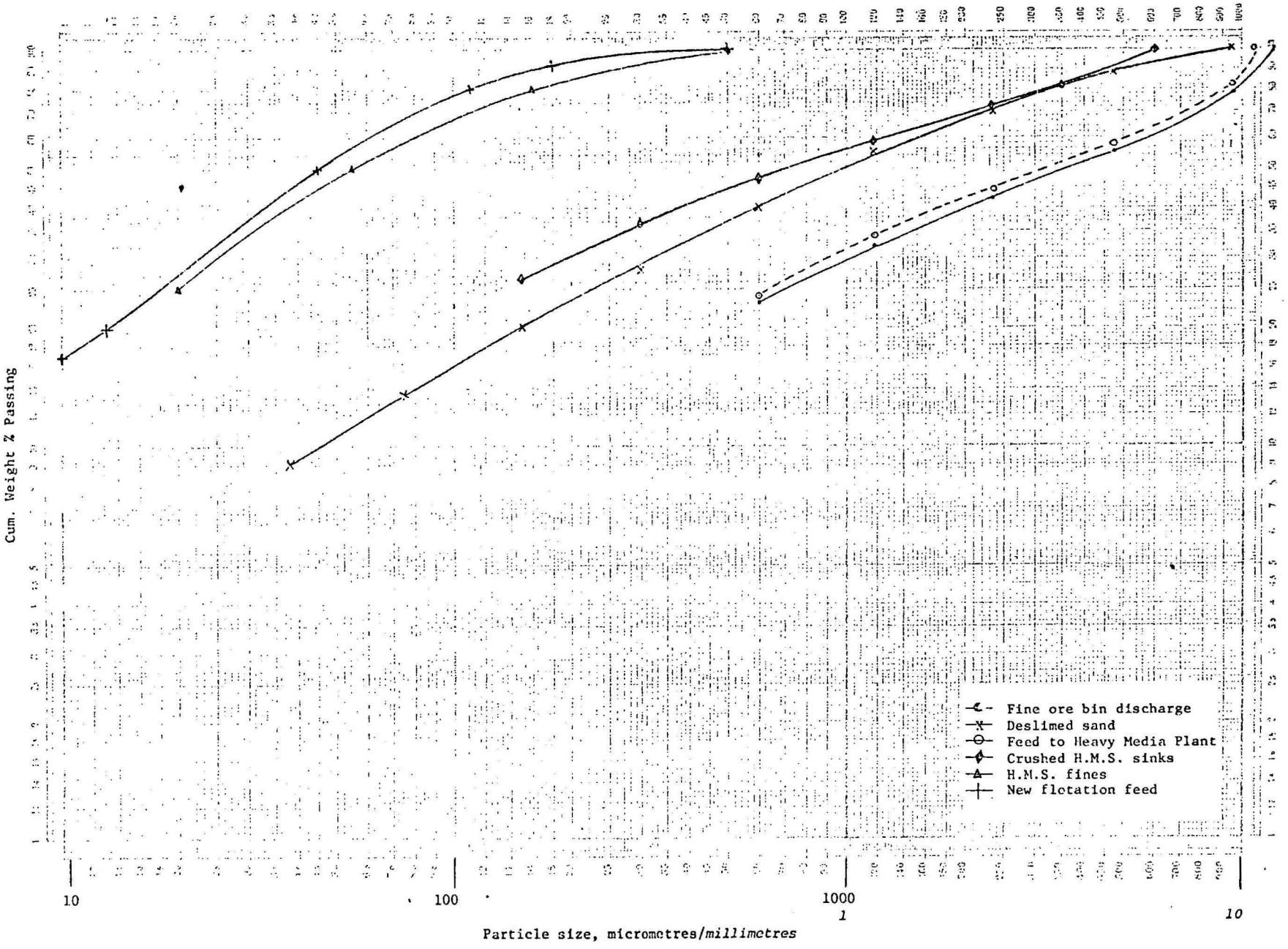

FIG. 7: FEED AND PRODUCT SIZINGS - HEAVY MEDIA

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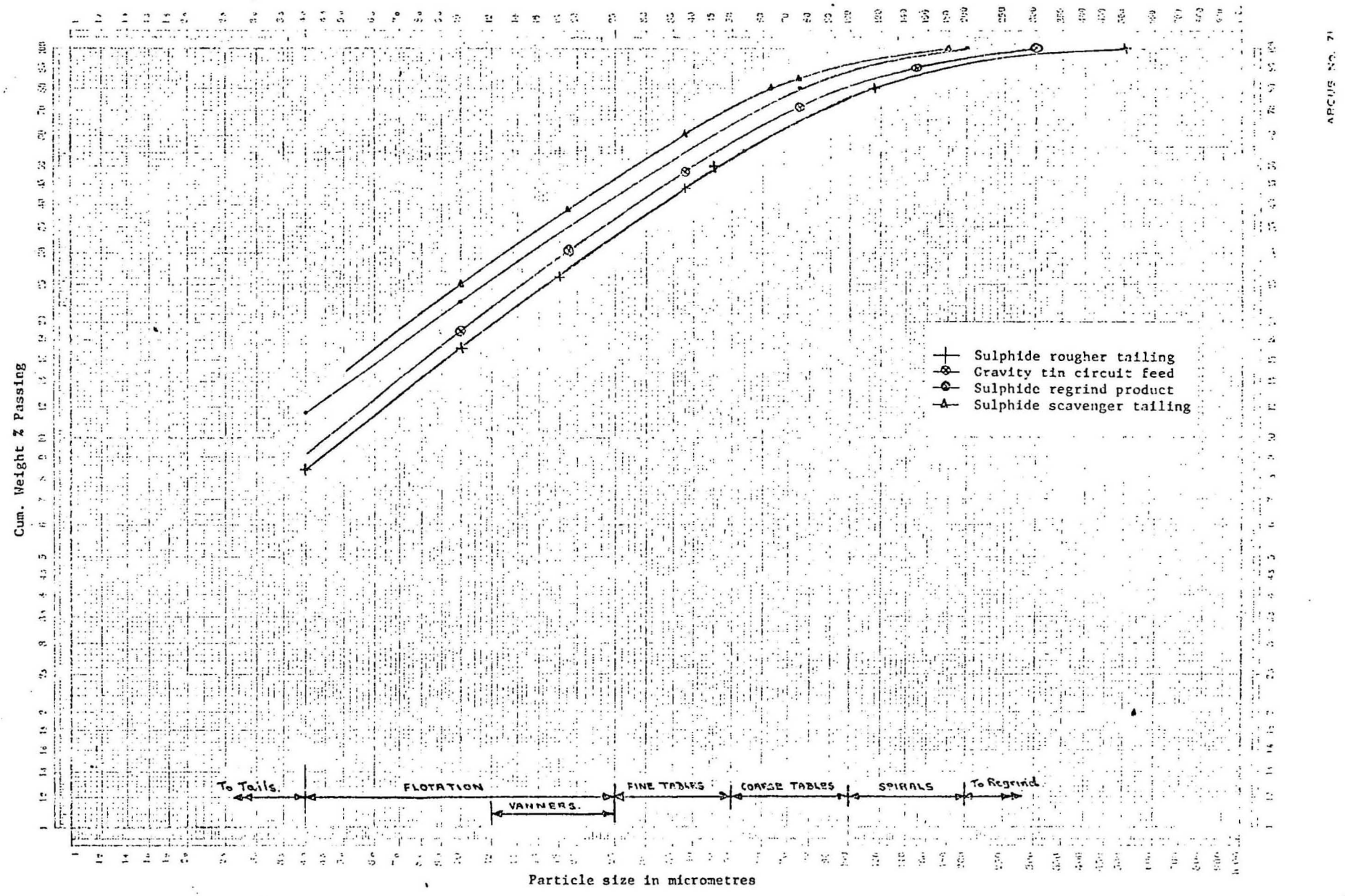

FIG. 8: PRODUCT SIZINGS TO GRAVITY TIN AND TIN FLOTATION PLANTS