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AMDEL REPORT NO. 06860(26)/90

BILLITON AUSTRALIA GOLD PTY LTD

COMMINUTION TESTS

OD 3/114/0-06860 OCTOBER 1989

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amdel
technology and enterprise

Amdel Limited
(Incorporated in S.A.)
International Operations Group
Osman Place,
Thebarton, S.A. 5031

Telephone: (08) 43 5733
International: +618 43 5733

Address all correspondence to:
P.O. Box 114,
Eastwood, S.A. 5063,
Australia

Telex: AA82725
Facsimile: (08) 352 8243

31 October 1989

OD 3/114/0-06860

Mr. Mike Battersby
Senior Metallurgist
Billiton Australia Gold Pty Ltd
P.O. Box 872K
MELBOURNE Vic 3001

AMDEL REPORT NO. 06860(26)/90

YOUR REFERENCE:	ITC No. 017159/BOD
MATERIAL:	Mt. Todd Primary Ore
IDENTIFICATION:	Ore samples 1 to 6
DATE RECEIVED:	19 October 1989
WORK REQUIRED:	Ball Mill Work Index and Abrasion Index determinations.

Investigation and Report by: Ian W. McPheat IWMcP

General Manager, Mineral Process Division: Ray F. Dougherty

COMMINUTION TESTING OF GOLD ORE SAMPLES

Six ore samples, identified as Samples 1 through to Sample 6, were received for determination of Ball Mill Work Indices and Abrasion Indices as follows.

Sample No.	Determinations	
	Ball Mill Work Index	Abrasion Index
1	Yes	Yes
2	Yes	Yes
3	–	Yes
4	Yes	Yes
5	Yes	Yes
6	–	Yes

All samples required stage crushing to provide feed materials of appropriate size for the tests required. These feed sizings are specified in Appendices attached to this report.

1. BALL MILL WORK INDEX DETERMINATIONS

Ball Mill Work Index determinations were made for Ore Samples 1, 2, 4 and 5 using the Bond Ball Mill Grindability procedure described in Appendix A. A product size of 80% passing 75 μm was nominated for these tests and this was sought using a mill product screen of 106 μm aperture.

Feed and product size distributions for the tests are given in Tables 1 to 4 for Samples 1, 2, 4 and 5 respectively. Corresponding grindability and Work Index data are present in Tables 5 to 8. The results are summarised below:

	Ore Sample No.			
	1	2	4	5
Work Index, kWh/tonne	27.0	25.3	23.3	23.3
Feed size (F_{80}), μm	2380	2380	2320	2320
Product size (P_{80}), μm	78	74	73	74

Ball Mill Work Indices for various materials are included in Appendix A.

2. ABRASION INDEX DETERMINATIONS

An Abrasion Index was determined for each of the six ore samples using the test procedure described in Appendix B.

The following results were obtained.

Ore Sample No.	Abrasion Index
1	0.152
2	0.080
3	0.253
4	0.072
5	0.117
6	0.164

Abrasion Indices for various materials are listed in Appendix B together with data correlating Abrasion Index with metal wear in comminution.

APPENDIX A

Bond Ball Mill Grindability Test for Work Index Determinations

This test is used to determine the Work Index of an ore for calculating ball mill size and power requirements.

Feed is prepared by stage crushing to minus 3.35 mm and the size distribution determined by wet and dry sieving.

A tightly packed 700 ml feed sample is weighed and then dry ground in a 305 x 305 mm batch ball mill rotating at 70 rpm.

The ground charge is screened at the selected mill screen size and the undersize product is replaced with an equal weight of minus 3.35 mm feed. The charge is again ground for a number of revolutions calculated to yield a 250% circulating load.

Testing is continued until the net weight of product generated per mill revolution (Gbp) becomes constant.

The Work Index is calculated from the following factors:

P	–	mill product screen aperture
Gbp	–	grindability
F80	–	80% passing size of feed
P80	–	80% passing size of product

Sample Requirement

Ore sample of 15 kg, stage crushed to minus 3.35 mm.

Test Result

The Work Index (kWh/tonne) determined from this test is for material ground in a closed circuit wet ball mill of 2.44 m diameter.

Reference

BOND, F.C. (1961) "Crushing and Grinding Calculations," Brit. Chem. Engng Vol 67, Nos 6, 8.

Table 25. Average Rod and Ball Mill Work Indices *

Material	Rod mill			Ball mill		
	No. tests	Avg.	Range	No. tests	Avg.	Range
Alumina	3	12.2	9–17	6	17.9	7–34
Barite	6	5.7	2–12	7	5.8	4– 9
Bauxite	33	10.8	2–20	23	14.5	1–31
Cement clinker	29	12.1	8–15	180	13.6	7–77
Cement raw material	115	12.3	4–18	284	10.0	3–27
Chrome ore	2	7.9	7– 9	5	13.4	7–17
Clay	6	12.5	6–18	11	10.8	4–23
Clay, calcined	4	7.0	3–13	7	19.6	15–26
Coal	4	9.8	8–12	6	15.4	13–18
Coke	7	16.9	12–24	4	33.5	29–40
Copper-nickel ore	4	19.2	16–24	6	15.5	12–18
Copper ore	396	14.3	4–34	769	12.8	4–30
Copper-zinc ore	4	11.0	6–16	9	9.8	5–14
Diorite	7	17.5	10–30	2	11.6	10–13
Dolomite	11	14.2	3–24	5	13.9	6–25
Feldspar	7	11.0	8–16	7	11.7	9–14
Ferrochrome	1	8.4	-	6	20.4	2–77
Ferromagnesium				5	7.2	6– 9
Ferromanganese	2	7.6	7– 8	5	7.9	5–14
Ferrosilicon	3	7.1	4–11	8	17.9	6–51
Flint	1	16.1	-	5	27.4	22–31
Fluospar	4	11.0	9–13	9	12.7	6–25
Gold ore	42	15.2	8–29	183	14.6	3–42
Granite	10	16.3	8–36	8	9.9	10–11
Gravel	21	15.9	8–24	6	18.0	11–27
Iron ore, unidentified	54	11.3	3–20	118	12.4	4–31
Hematite	64	12.5	5–22	116	11.1	2–31
Conc.				5	18.5	7–23
Limonite	12	9.3	4–16	20	9.0	5–19
Magnetite	43	11.4	5–25	73	13.2	6–29
Conc.				23	19.2	7–27
Tailings				5	14.0	12–16
Siderite				5	10.4	9–14
Taconite	35	9.3	7–37	20	12.0	8–19
Conc.	12	11.6	10–13			
Lead ore	14	12.6	10–15	12	10.3	8–13
Lead-zinc ore	31	12.4	7–19	58	12.5	7–26
Limestone	84	12.7	7–50	177	9.9	4–26
Limestone, burnt				5	11.0	6–18
Magnesite	3	15.9	10–22	18	14.6	5–25
Manganese ore	3	10.9	7–14	19	13.9	6–23
Marl	2	10.6	10–11	8	10.2	4–18
Molybdenum ore	25	11.8	8–18	43	11.6	10–16
Nickel matte	2	9.8	9–11	6	28.4	12–37
Nickel ore	19	14.9	8–22	39	12.5	2–24
Oil shale	1	27.0	-	5	38.2	16–78
Oyster shells	5	17.6	2–28	5	15.1	13–19
Phosphate fertilizer				6	16.5	12–30
Phosphate rock	22	12.8	5–28	36	13.6	3–25
Pyrite	3	8.7	8–10	6	10.1	7–13
Quartz	1	14.4	-	13	14.4	11–21
Quartzite	8	12.3	8–19	13	11.2	7–16
Sand, silica	14	13.0	3–33	45	23.8	9–50
Sandstone	6	11.4	1–20	8	27.4	16–38
Shale	4	13.4	6–24	12	10.1	3–21
Silica rock	6	8.9	7–12	11	14.3	8–23
Silver ore	6	17.5	15–19	19	17.0	13–22
Slag	10	16.0	10–27	26	17.2	10–27
Slag, blast furnace	4	10.1	5–13	8	18.3	12–26
Steel mill scrap				16	22.1	6–89
Talc	4	14.1	11–16	10	15.3	8–22
Tin ore	3	10.9	10–12	12	11.8	10–14
Titanium ore	5	12.8	9–17	9	11.4	7–17
Tungsten ore	13	13.3	3–18	4	11.0	7–17
Uranium ore	6	12.9	7–22	18	14.6	10–20
Zinc ore				9	10.9	6–16
Totals	1244			2633		

From SME Mineral Processing Handbook (1985), Edited by N.L. Weiss, Society of Mining Engineers, N.Y.

* Work Index Values are given in kWh/short ton.

APPENDIX B

BOND ABRASION INDEX

This test is used to determine the abrasiveness of a material in relation to metal wear in crushing and grinding.

The test material, in the size range minus 19.0 plus 12.7 mm, is tumbled in a drum and cascades over a hardened steel paddle which rotates concentrically with the drum.

The test material is replaced with a fresh charge after each 15 minutes and the test continues for a total period of one hour.

The weight (g) lost by the paddle for the full test period is the Abrasion Index.

Sample Requirement

Minimum of 3 kg of minus 19.0 plus 12.7 mm material.

Reference

BOND, F.C. (1963) "Metal Wear in Crushing and Grinding", 54th Ann. Mtg of AIME, Inst. Chem. Engrs. Houston, Texas, p.3.

Table 26. Average Abrasion Indices

Material	No. tests	Average	Range
Aluminum oxide	2	0.86	0.58–1.14
Basalt	5	0.45	0.19–0.83
Bauxite	11	0.02	0.003–0.12
Beryllium ore	2	0.45	0.45–0.45
Cement clinker	15	0.08	0.009–0.17
Cement raw mix	37	0.05	0.001–0.83
Clay, calcined	2	0.04	0.004–0.07
Copper-nickel matte	2	0.002	0.001–0.003
Copper-nickel ore	2	0.46	0.43–0.49
Copper ore	112	0.26	0.002–0.91
Copper-silver ore	2	0.62	0.58–0.65
Dolomite	8	0.03	0.01–0.07
Feldspar	2	0.19	0.07–0.30
Ferrochrome alloy	3	0.35	0.27–0.52
Ferromanganese	2	0.25	0.18–0.32
Fullers earth	2	0.001	0.00–0.001
Gold ore	4	0.48	0.30–0.71
Granite	18	0.40	0.10–0.78
Gravel	6	0.29	0.11–0.43
Iron ore, unidentified	33	0.25	0.01–0.98
Hematite	38	0.37	0.00–1.79
Limonite	6	0.13	0.01–0.23
Magnetite	18	0.48	0.11–0.83
Taconite	15	0.60	0.32–0.85
Lead zinc ore	9	0.21	0.03–0.41
Limestone	52	0.05	0.00–0.65
Magnesite	3	0.08	0.04–0.10
Marble	3	0.01	0.002–0.04
Molybdenum ore	8	0.41	0.13–0.68
Nickel ore	5	0.03	0.01–0.06
Oil shale	3	0.02	0.01–0.02
Phosphate rock	2	0.02	0.01–0.02
Quartzite	7	0.69	0.19–0.99
Schist	2	0.12	0.11–0.13
Shale	2	0.004	0.003–0.005
Silica rock	4	0.29	0.06–0.83
Silver ore	2	0.74	0.72–0.76
Slag	9	0.28	0.01–0.52
Slate	2	0.003	0.003–0.003
Stone	5	0.22	0.07–0.32
Tin ore	4	0.24	0.03–0.35
Trap rock	18	0.35	0.02–0.70
Total	487		

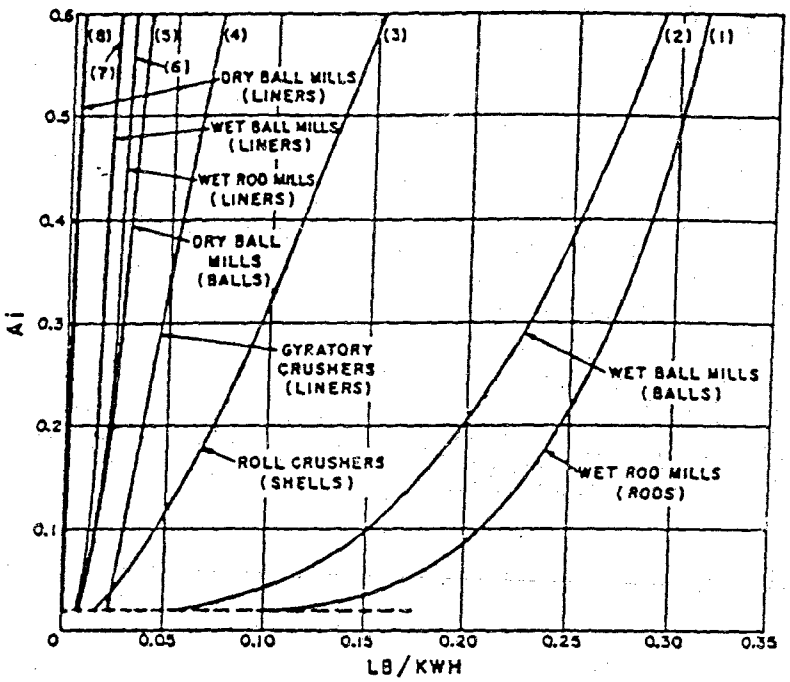

Fig. 1 – Abrasion Index plotted against metal wear in lb/kwn. *

* BOND, F.C., (1963) "Metal Wear in Crushing and Grinding", 54th Ann. Mtg., American Inst. Chem. Engrs., Houston, Texas.

TABLE 1: SIZINGS OF BALL MILL FEED AND PRODUCT
Sample 1

Screen Aperture µm	Weight Passing, cum. %	
	Feed	Product
2800	92.1	
2360	79.6	
2000	68.7	
1700	59.6	
1400	48.3	
1000	35.7	
710	26.7	
500	20.3	
355	15.7	
180	9.4	
125	7.3	
106	6.5	
90	5.8	88.1
75	-	78.2
63	-	66.7
53	-	62.6
45	-	57.9
38	-	49.4

B1.SIZ

TABLE 2: SIZINGS OF BALL MILL FEED AND PRODUCT
Sample 2

Screen Aperture µm	Weight Passing, cum. %	
	Feed	Product
2800	91.2	
2360	79.4	
2000	69.4	
1700	61.5	
1400	50.4	
1000	37.3	
710	28.3	
500	21.8	
355	17.1	
180	10.5	
125	8.2	
106	7.4	
90	6.7	89.5
75	-	80.6
63	-	69.9
53	-	66.1
45	-	61.6
38	-	53.1

B2.SIZ

TABLE 3: SIZINGS OF BALL MILL FEED AND PRODUCT
Sample 4

Screen Aperture µm	Weight Passing, cum. %	
	Feed	Product
2800	90.8	
2360	80.6	
2000	70.7	
1700	61.4	
1400	51.7	
1000	38.8	
710	29.6	
500	23.0	
355	17.5	
180	10.9	
125	8.7	
106	8.0	
90	7.2	90.2
75	-	80.5
63	-	69.2
53	-	65.5
45	-	61.7
38	-	53.0

B4.SIZ

TABLE 4: SIZINGS OF BALL MILL FEED AND PRODUCT
Sample 5

Screen Aperture µm	Weight Passing, cum. %	
	Feed	Product
2800	91.0	
2360	81.0	
2000	71.8	
1700	62.9	
1400	53.3	
1000	40.1	
710	30.6	
500	23.8	
355	18.2	
180	11.4	
125	9.2	
106	8.3	
90	7.5	90.3
75	-	80.4
63	-	69.1
53	-	65.4
45	-	60.4
38	-	52.0

B5.SIZ

TABLE 5 : BALL MILL GRINDABILITY
Sample 1

Grinding Stage	Mill Revolutions	Gross Product Weight g	Net Product Weight g	Grindability g/rev	Circulating Load %
1	260	219	147	0.57	408
2	580	329	316	0.54	238
3	538	337	316	0.59	230
4	493	321	300	0.61	247
5	488	320	299	0.61	248
6	485	318	298	0.61	250

Volume of Feed in Mill = 700 ml
Weight of Feed in Mill = 1115 g

Average for Last 2 Stages:
Grindability = 0.61 g/rev.
Circulating Load = 249 %

80% Passing Size for Feed = 2380. micrometres
80% Passing Size for Product = 78. micrometres

Work Index = 24.5 kWh/s.ton
= 27.0 kWh/tonne

B1.F

TABLE 6 : BALL MILL GRINDABILITY
Sample 2

Grinding Stage	Mill Revolutions	Gross Product Weight g	Net Product Weight g	Grindability g/rev	Circulating Load %
1	250	242	158	0.63	371
2	520	325	307	0.59	251
3	511	339	316	0.62	236
4	478	332	308	0.64	243
5	463	319	295	0.64	257

Volume of Feed in Mill = 700 ml
Weight of Feed in Mill = 1140 g

Average for Last 2 Stages:
Grindability = 0.64 g/rev.
Circulating Load = 250 %

80% Passing Size for Feed = 2380. micrometres
80% Passing Size for Product = 74. micrometres

Work Index = 22.9 kWh/s.ton
= 25.3 kWh/tonne

B2.F

TABLE 7 : BALL MILL GRINDABILITY
Sample 4

Grinding Stage	Mill Revolutions	Gross Product Weight g	Net Product Weight g	Grindability g/rev	Circulating Load %
1	310	293	199	0.64	301
2	513	364	341	0.67	222
3	444	338	309	0.70	248
4	443	346	320	0.72	239
5	421	324	296	0.70	263
6	447	337	312	0.70	248

Volume of Feed in Mill = 700 ml
Weight of Feed in Mill = 1176 g

Average for Last 2 Stages:
Grindability = 0.70 g/rev.
Circulating Load = 255 %

80% Passing Size for Feed = 2320. micrometres
80% Passing Size for Product = 73. micrometres

Work Index = 21.2 kWh/s.ton
= 23.3 kWh/tonne

B4.F

TABLE 8 : BALL MILL GRINDABILITY
Sample 5

Grinding Stage	Mill Revolutions	Gross Product Weight g	Net Product Weight g	Grindability g/rev	Circulating Load %
1	320	296	199	0.62	296
2	525	364	340	0.65	222
3	453	345	315	0.69	240
4	435	336	308	0.71	249
5	434	336	309	0.71	249

Volume of Feed in Mill = 700 ml
Weight of Feed in Mill = 1173 g

Average for Last 2 Stages:
Grindability = 0.71 g/rev.
Circulating Load = 249 %

80% Passing Size for Feed = 2320. micrometres
80% Passing Size for Product = 74. micrometres

Work Index = 21.1 kWh/s.ton
= 23.3 kWh/tonne

B5.F

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LAURIE SMITH & ASSOCIATES PTY. LTD.
Incorporated in Western Australia
CONSULTING METALLURGISTS
Managing Director L.I. Smith, A.W.A.S.M. (Metallurgy), M.Aus.I.M.M.

16 BRODRICK STREET
KARRINYUP 6018
WESTERN AUSTRALIA
PHONE: (09) 447 5879
LAB: (09) 244 1423
FAX: (09) 447 8412

METALLURGICAL INVESTIGATIONS
FOR
BILLITON AUSTRALIA GOLD PTY LTD
CYANIDE LEACH TESTS
ON
MT TODD WEATHERED ORE
8 December, 1989

08-4956

L. I. Smith

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LAURIE SMITH & ASSOCIATES PTY LTD
Consulting Metallurgists,Perth WA

METALLURGICAL INVESTIGATIONS FOR BILLITON AUSTRALIA GOLD PTY LTD CYANIDE LEACH TESTS ON MT TODD WEATHERED ORE 8 December, 1989

1. Introduction

A program of testwork on four separate weathered ore composite samples at gold grades of 0.6, 0.8, 1.0 and 1.2ppm was drawn up by W.R. Lethlean & Associates Pty Ltd to determine the recovery and reagent consumption at:

(a) various grind times
(b) various leach times

A log of 512 samples was provided together with specific instructions regarding sample preparation, sample compositing and sample splitting. Instructions were also received regarding assays and tests to be conducted on specific riffle splits and the conditions for the tests.

2. Percussion Drill Samples Received

A total of 506 samples, representing one-metre intervals, were received on the 7th September, 1989. The samples were in labelled plastic bags, stacked on open pallets. The majority of the bags were damaged, allowing a quantity of material to be spilled and also allowing water to enter the bags. Consequently most of the samples contained moisture, and ranged from "slightly damp" to "mud".

Samples not received:

Comp. BMT 0.6	BP137		5-6m
			13-14m
Comp. BMT 1.0	BP149	8 samples	1-9m
	BP133	7 samples	7-14m

Additional samples received:

Comp. BMT 0.6	BP111	3-4m
	BP172	7-8m
Comp. BMT 0.8	BP115	15-16m
Comp. BMT 1.0	BP124	2-3m
	BP120	19-20m
		20-21m
	BP159	4-5m

Comp. BMT 1.2	BP143	2-3m
	BP145	5-6m
	BP152	5-6m
	BP171	1-2m

3. **Water for Testwork**
Three additional 200 litre plastic drums of Billiton sitewater were received on 14 September, 1989.

4. **Qualifications**
(i) No responsibility will be accepted for the data provided in this report except insofar as they apply to the samples tested.

(ii) Billiton sitewater was used in all testwork except the time versus grind studies.

(iii) All gold assays on liquor were determined by solvent extraction followed by AAS. Results are reported on a w/w basis. All copper and zinc assays on liquor were determined by AAS and reported on a w/v basis. Total sulphur was determined on composite leach liquors by classical gravimetric analysis.

(iv) All solids samples were assayed by the fire method followed by gravimetric finish except where grades were very low, e.g. - residues. In this instance the prill from cupellation was dissolved in aqua regia and the gold determined by AAS after solvent extraction. Duplicate determinations were conducted on all samples except leach residue size fractions of mass generally less than 60g, where the total mass available was assayed and on duplicate hole composite samples.

All head samples were pulverised prior to assay an all residue fractions coarser than 75um were pulverised except where the total sample available was taken for assay. Head samples were assayed for sulphur by a classical gravimetric method. Head samples were assayed for Fe, Cu, Zn, As, Pb and Ag by acid digestion followed by AAS.

5. **Sample Preparation**
Individual drill hole intersections nominated for inclusion in each composite had been selected on the basis of the initial assays conducted on the one-metre samples. Confirmation that the drill hole intersections selected were of the indicated grade was required. "Hole composites" were therefore prepared and splits submitted for assay.

Each individual one-metre sample was weighed and the weight recorded on sheets 1-8, Appendix 1. Where necessary, the sample was dried in the oven before weighing.

Visual inspection of the samples showed that, although the bulk of each sample was very fine, most samples contained some very coarse particles, too big to be taken directly to the roll crusher. The requested crushing procedure was therefore modified, and each sample was passed through the jaw crusher at a nominal closed side setting of 2mm. After this treatment the material was fine enough to split out the required quantity for each "hole composite".

The quantity of each intersection sample taken to make the hole composites is also recorded on sheets 1-8, Appendix 1.

Each hole composite was screened through a 2mm screen and the weights of the oversize and undersize fractions recorded before roll-crushing the oversize to all pass 2mm (Table 1).

Each "hole composite" was then mixed in a urethane lined mixer, and riffle-split to produce two assay samples of approximately 100g, each of which was assayed for Au.

The assayed head grades of a number of hole composites varied significantly from those calculated on the basis of individual one-metre intervals, and the allocation of hole composites to the different grade composites was revised. The original and revised sample distribution are shown in Tables 2 and 3 respectively. Some of the hole composite grades were outside the expected range and they were not therefore included in any of the four grade composites. Consequently some of the individual test composite masses were significantly less than planned. The masses available and the grades calculated from the hole assays are also shown in Table 3.

Each grade composite sample was mixed in a urethane-lined mixer and riffle-split into 32 portions, regardless of the quantity available.

Riffle-splitting presented some difficulty, as the material was not free-flowing, although it appeared completely dry to the touch. As a result the weight of individual splits in each grade composite shows a significant degree of variation. LS&A general practice is to avoid high temperature drying of ore samples prior to certain types of testwork because it has been found that organic materials which may be present can be destroyed or modified resulting in misleading results - particularly oxygen demand. Practice is generally to air-dry to a workable moisture. The moisture content of such samples is then determined and the dry mass taken to test is calculated.

One split from each composite was used for the moisture determination. The moisture content of the four composites varied from 0.34% to 0.92% (Table 3).

The riffle splitting procedure adopted for all four composites was as outlined for the BMT 0.6 as shown in Appendix 2. As previously discussed the average mass of the splits for each composite varied.

6. **Head Assays and Analyses**

Throughout this report assays on solids and liquors are stated as ppm or % on a w/w basis except for Cu, Zn and S assays on liquors which are on a w/v basis. Extractions are stated as g/t (grams per tonne).

Four working samples from each of the composites 0.6, 0.8, 1.0 and 1.2 were submitted for gold assay and the total of each sample was pulverised prior to taking duplicate assay portion. Two of each of the four samples were analysed for further elements.

Sample	Au ppm	Au ppm	Au Ave ppm	Cu ppm	Zn ppm	Ag ppm	Pb ppm	As ppm	F %	S %
BMT 0.6										
2A	0.60	0.62	0.61	290	360	2.7	165	115	6.00	<0.01
4C	0.61	0.62	0.62	295	365	15.8	180	115	6.02	<0.01
6B	0.60	0.60	0.60							
8D	0.62	0.65	0.64							
Ave			0.62	292	362					
BMT 0.8										
2A	0.77	0.78	0.78	305	205	<0.2	55	95	6.13	<0.02
4C	0.73	0.73	0.73	315	210	<0.2	55	115	6.25	<0.02
6B	0.88	0.87	0.88							
8D	0.78	0.78	0.78							
Ave			0.79	310	208					
BMT 1.0										
2A	1.08	1.07	1.08	355	320	0.5	370	285	6.1	0.08
4C	1.20	1.19	1.20	365	310	0.5	355	290	6.2	0.08
6B	1.12	1.13	1.12							
8D	1.11	1.11	1.11							
Ave			1.13	360	315					
BMT 1.2										
2A	1.14	1.13	1.14	280	200	<0.2	125	345	6.34	<0.02
4C	1.02	1.09	1.06	280	195	<0.2	125	350	6.33	<0.02
6B	1.08	1.10	1.09							
8D	1.20	1.18	1.19							
Ave			1.12	280	198					

The analysis of the previously supplied sitewater was as follows:-

TDS	<10ppm
Na	1.5ppm
Ca	0.8ppm
Mg	0.4ppm
Cl	<1 ppm
SO_4	<1 ppm
pH	6.8

An analysis of the supplied 3 x 200 litres of sitewater was not conducted.

7. **Grinding of the Composite Samples**
The fine nature of the weathered ore samples indicated that the standard rod load used for grinding would result in very short grind times with consequent possibility for error. Three trial grinds using different rod loads were conducted on a composite of portions of six one-metre intersections. The sizings are shown in Figure 1.

The standard and selected reduced rod charge was:

	Standard Charge	Reduced Charge
19mm x 302mm	22	13
12mm x 302mm	6	6
Rod Mass (kg)	16.3	10.3

When the tests on BMT 0.6 and BMT 1.0 were completed work was commenced on a Billiton Primary Low Grade sample BMT P0.8. During testing of this low grade sample 110kg of primary ore and 20kg of Pine Creek ore grinding was conducted to provide samples for physical tests and establish rod wear. During this grinding exercise wear on the mill drive occurred and slippage resulted in a lower mill speed. The BMT 0.6 and BMT 1.0 samples were ground at 72 rpm and the BMT 0.8 and BMT 1.2 samples were ground at about 67 rpm. The details of the mill are:

Urethane lined with eight 5mm high x 5mm wide lifters
Inside diameter (between plates) 195mm
Inside length 315mm

Grinding times to achieve P80 values of 150, 106 and 75 micron with this reduced rod charge were established by conducting three grinds of different times on each composite. The grind data are shown graphed in Figures 2 to 9. The actual grind times were established as:-

4 min 40 sec, 7 min 55 sec, 14 min - composite BMT 0.6
3 min 30 sec, 5 min 30 sec, 10.67 min - composite BMT 0.8
5 min 30 sec, 9 min 10 sec, 15 min - composite BMT 1.0
5 min 15 sec, 8 min 20 sec, 15 min - composite BMT 1.2

Grinding for leach tests was conducted in Billiton site water at 50% solids. The rod charge was accurately weighed before and after grinding each composite the rod wear was determined. The wear, together with that determined on other BMT samples and on a Pine Creek sample is shown in Table 4.

8. **Sampling of Ground Product**

Before transferring the ground pulp to the leach vessels, it was passed through a pulp splitter to take out a one-eighth split for duplicate gold assay. The pulp splitter used in the test program on the primary ore had been modified, which resulted in improved reproducibility of sample weight taken. The sample was filtered, dried, weighed and pulverized before assaying in duplicate. These assays are recorded in the test result summary sheets (sheet 2).

The remaining pulp would not settle overnight to higher than 40% solids, and leaching was required at 40% solids. In addition, the supernatant liquor was turbid and the surplus liquor could not be removed without taking some solids. To overcome this problem, a weighed quantity (1.20g) of technical grade calcium hydroxide was

added to the ground pulp after sampling, which resulted in a pulp approaching 50% solids after overnight settling.

9. Leaching Tests

After allowing the pulp to settle, the % solids was adjusted to 40 by syphoning off the surplus liquor. The leach vessels were wide-neck polythene jars of nominal 5 litre capacity, 170mm diameter x 170mm parallel shell length. The decanted liquor from each sample was weighed and the CaO removed in the decant was determined by titration. The quantity of CaO added to each leach test was then determined as the difference between that added for settling and the quantity removed in the decant. The quantity of CaO added for settling was determined from the preliminary grinding tests.

The standard procedure is to cap the leach vessels with a screw cap with a 26mm diameter hole in the centre. With the Billiton primary ore pulp samples, the cap was necessary to retain the pulp in the vessel and, in the preliminary CaO requirement tests, it was found that pulp would film onto the cap, be taken overhead of the hole and flow out of the hole. This problem was overcome by fitting a tube through the hole to act as a deflector. The hole was still retained at 26mm diameter. Although the weathered ore pulp volumes were lower than for the primary ore this same type of cap was used on all leach vessels.

The test conditions laid out for each composite is shown as Appendices 3-6. Also shown in these appendices is the samples used for grinding definition tests and for an environmental study leach.

NaCN concentration	0.05%
CaO concentration	0.01%
Pulp (% solids)	40
Temperature	ambient

The initial NaCN addition was made to ensure that there was no deficiency in NaCN concentration within the first three hours. For that purpose a preliminary leach test was run for 3 hours, with excess cyanide (1.5kg NaCN/tonne). At the end of this test it was found, by titration a liquor sample, that cyanide had been consumed at the rate of 0.06kg NaCN/tonne of ore.

Taking this figure as the basis for the initial NaCN addition, it was possible to maintain the NaCN concentration near the required level of 0.05% throughout all leach tests, by making up the losses at each sampling stage.

The same starting addition, in terms of kg NaCN/tonne, was maintained for all tests. The mass of solids taken to the leach tests was calculated as the difference between the mass taken to grinding and the mass of ground sample split out for assay.

The leach vessels were roll-agitated at a speed of 42 rpm and the liquor sampled at 3, 6, 8 or 12 and 18 hours as called upon by the test program. All tests were run in batches of 10 and each composite program consisted of:-

Batch 1	2 off	P80 75um	8 hours
	3 off	P80 75um	12 hours
	2 off	P80 75um	18 hours
	2 off	P80 150um	8 hours
	1 off	P80 150um	18 hours
Batch 2	2 off	P80 106um	8 hours
	3 off	P80 106um	12 hours
	2 off	P80 106um	18 hours
	2 off	P80 150um	12 hours
	1 off	P80 150um	18 hours

The gross mass of the vessel and pulp was recorded prior to placing on the rolls and the gross mass again recorded when the vessel was removed from the rolls for liquor sampling. The pH of each pulp was recorded and the temperature of the pulp in one vessel only was determined at each time of sampling.

Settling of the pulp was quick and the liquor sample was removed with a pipette and filtered. The vessels were again weighed and Billiton sitewater added to return the gross mass to that recorded when the vessels were removed from the rolls. This procedure maintained the leach pulp at 40% solids throughout the test and also provided the mass of liquor sample removed for assay and test.

The cyanide concentration was determined by silver nitrate titration of a 10ml portion of the liquor using approximately 0.5g potassium iodide as indicator. After adding about 1ml excess of silver nitrate, the available CaO was determined by titration with oxalic acid using phenolphthalein indicator. The remainder of the liquor sample was assayed for gold, copper and zinc.

At the termination of each test, the pulp was filtered to recover about 250g of liquor to permit determination of total soluble sulphur in addition to gold, copper, zinc, NaCN and CaO. (Pulps were very slow filtering.) The filter cake was repulped with Perth tapwater and wet-screened on a 53 screen. The undersize was flocculated, washed twice by decantation and finally filtered, dried and weighed. The oversize was transferred to a tray, dried and weighed.

All test details are shown on sheet 2 of the accompanying tables.

10. **Preparation of Residue Samples**

The plus 53um material from the wet screening described above was dry-screened on a nest of screens and the size fractions weighed and bagged for assay. The minus 53 material recovered from dry screening was combined with the minus 53 from wet screening and the material passed through a 800um screen, mixed by rolling and bagged for assay.

All residue fractions coarser than 75um were pulverised prior to assay except for some minus 106um plus 75um fractions where the total sample available was taken for assay.

The sizings assays and gold distribution for the residue of each composite are shown on sheets 3, 4, 5 and 6 of the accompanying tables.

11. Calculations and Results

The leach extractions were calculated based on the mass of liquor in the leach vessel at the time of testing and this mass was determined by subtracting the mass of the vessel and the mass of the sample taken to leach from the gross mass at the time of testing. Allowance was made for the gold, copper and zinc contained in samples that were removed. The same procedure was used to calculate the reagent consumptions. The calculations for all four composite samples are included in the accompanying tables.

The total of 20 tests conducted on each of the grade composites is shown in one set of 14 sheets as follows:

Sheet 1	Summary of calculated and assay data
Sheet 2	Actual bench test data
Sheet 3	Size and gold distribution of five residues
Sheet 4	" " " " " " "
Sheet 5	" " " " " " "
Sheet 6	" " " " " " "
Sheet 7	Analysis of calculated and assay data for each grind level
Sheet 8	Summary of individual test residue size fraction assays by leach hours
Sheet 9	Summary of averages of residue size fraction assays
Sheet 10	Summary of individual test residue size fraction gold distributions by leach hours
Sheet 11	Summary of averages of residue size faction gold distributions
Sheet 12	Summary of individual test calculated data by leach hours
Sheet 13	Summary of averages of test calculated data
Calc	The calculations of contents of leach liquors and samples

Each sheet is identified with the BMT composite name and sheet No.

The sets of data are presented in the following order.

BMT 0.6
BMT 0.8
BMT 1.0
BMT 1.2

12. Discussion

Discussion is generally confined to those matters only relating to the reproducibility of the testwork and to those matters which were observed at bench scale and may be of some value in design considerations.

P80 achieved by Grinding

The following average percentage passing the nominated screen size was achieved.

P80 objective	75	106	150
BMT 0.6	80.5	81.3	78.3
BMT 0.8	82.7	78.8	81.0
BMT 1.0	79.4	80.8	80.5
BMT 1.2	79.4	78.4	78.6

Repeat Assays on BMT 1.0 Residue Size Fractions

The calculated heads for some of the tests on the BMT 1.0 composite were significantly higher than the ground head and in particular the residue calculated assay was in some cases significantly higher than those of the BMT 0.6 residue assays.

Repeat duplicate assays were conducted initially on three of the minus 53um residue fractions and then finally on all remaining minus 53um fractions.

From the twenty tests there were only five coarse size (plus 150um) fractions with reserve material and a single assay was also conducted on these fractions.

The original and repeat assays are shown in Table 5.

Substitution of repeat assays in the residue accounts resulted in a slight overall <u>average</u> decrease in residue grade.

		P80=75um	P80=106um	P80=150um	Total
Original Assays	ppm Au	0.21	0.25	0.28	0.25
Repeat Assays	ppm Au	0.21	0.24	0.29	0.24

The <u>average</u> calculated head for this sample remained unchanged at 1.15ppm Au when rounded to the second decimal place.

Sheets 1 and 7 from the repeat assay calculations are shown as Tables 6 and 7.

Comparison of Head Assays and Calculated Heads

The values for ground test head and calculated test head are shown for each test on sheet 1 of each set. The calculated head from the hole assays are shown in Table 3 and the values for the splits are shown in 6 above. The following are averages.

	Split Head	Calculated Assay Head(1)	Ground Head	Calculated Test Head
BMT 0.6	0.62	0.67	0.63	0.68
BMT 0.8	0.79	0.76	0.85	0.90
BMT 1.0	1.13	0.98	1.15	1.25
BMT 1.0 (2)			1.15	1.25
BMT 1.2	1.12	1.19	1.17	1.20

(1) calculated from assays on Hole Composites
(2) calculated from repeat assays on twenty minus 53um residue fractions and five plus 150um residue fractions

Soluble Copper in Grind Liquor
After grinding one split of BMT 0.6 at 50% solids the liquor was sampled and assayed for copper.

pH 6.4 ppm Cu 0.15

Total Sulphur Assays on Leach Liquors
Total sulphur was determined on composites of terminal leach liquors from three of the composites and sulphate sulphur from one composite single test. All liquors were from 40% solids pulps.

Sample Composite	Liquor Composite	ppm Total S
BMT 0.6	P80=150um, 1 x 12hr	6 (1)
BMT 0.8	P80= 75um, 3 x 18hr	2
BMT 1.0	all 20 tests	18
BMT 1.2	P80= 75um, 3 x 18hr	12
BMT 1.2	P80= 53,75 & 150um, 6 x 18 hr	11

(1) Sulphate S only

Unaccounted Mass of Test Samples
The mass of the recovered residue size fractions was added to the mass of the ground sample split out for duplicate assay and compared with the mass of the sample split taken into the grind.

Generally there is an unavoidable loss of material in the many handling operations. With the weathered ore samples the data shows a gain for some samples indicated on sheets 2 as a negative "Unaccounted Loss". This was probably due to the hygroscopic nature of the weathered ore. A check on one sample showed that after overnight oven-drying the sample mass increased by 0.6% over a period of seven hours standing at ambient temperature. All residues were dried at 110 deg. C overnight and then reheated at about 80 deg. C immediately prior to dry screening. The negative accounts are no doubt due to a small uptake of moisture during the screening operation.

The average maximum and minimum losses of mass in the tests were:

	Ave	Max	Min
BMT 0.6	0.53	3.93	-2.35
BMT 0.8	0.50	0.95	-0.36
BMT 1.0	0.28	0.84	-0.20
BMT 1.2	0.39	0.93	0.10

Comparison of Copper Extractions and Cyanide Consumption
The average copper extractions for the four composites at P80 = 75um and 18 hours leach time are compared with the cyanide consumptions and assay heads.

	BMT 0.6	BMT 0.8	BMT 1.0	BMT 1.2
Assay Head ppm Cu	292	310	360	280
Copper Extraction g/t	5.4	9.7	41	27
NaCN Consumption kg/t	0.13	0.13	0.20	0.16

Because of the significant difference between copper extraction, one liquor sample, chosen at random from each composite test series was reassayed as a batch and the assay results confirmed the above extractions to be correct. The variations in cyanide consumptions are also consistent with the copper extractions.

Comparison of Composite Leach Response
The Analysis Sheet (7) for each composite sample have been brought together in Table 8 in order that a comparison of significant test data can be made.

Anomalous Results
BMT 0.8
All P80 = 106um leaches show low cyanide consumption compared with the other grind levels. The copper extraction in these tests is marginally lower than for other tests but does not account for the reduced cyanide consumption.

There may have been a small error in the initial NaCN addition.

BMT 1.0
Samples 1A and 7D show anomalous reagent consumptions. When samples were tested at three hours the pulp pH was 11.0 - 11.2. The pH of the liquor sample was not taken but the available CaO was zero.

It appears probable that a trace of acid was retained in the sample bottles after cleaning.

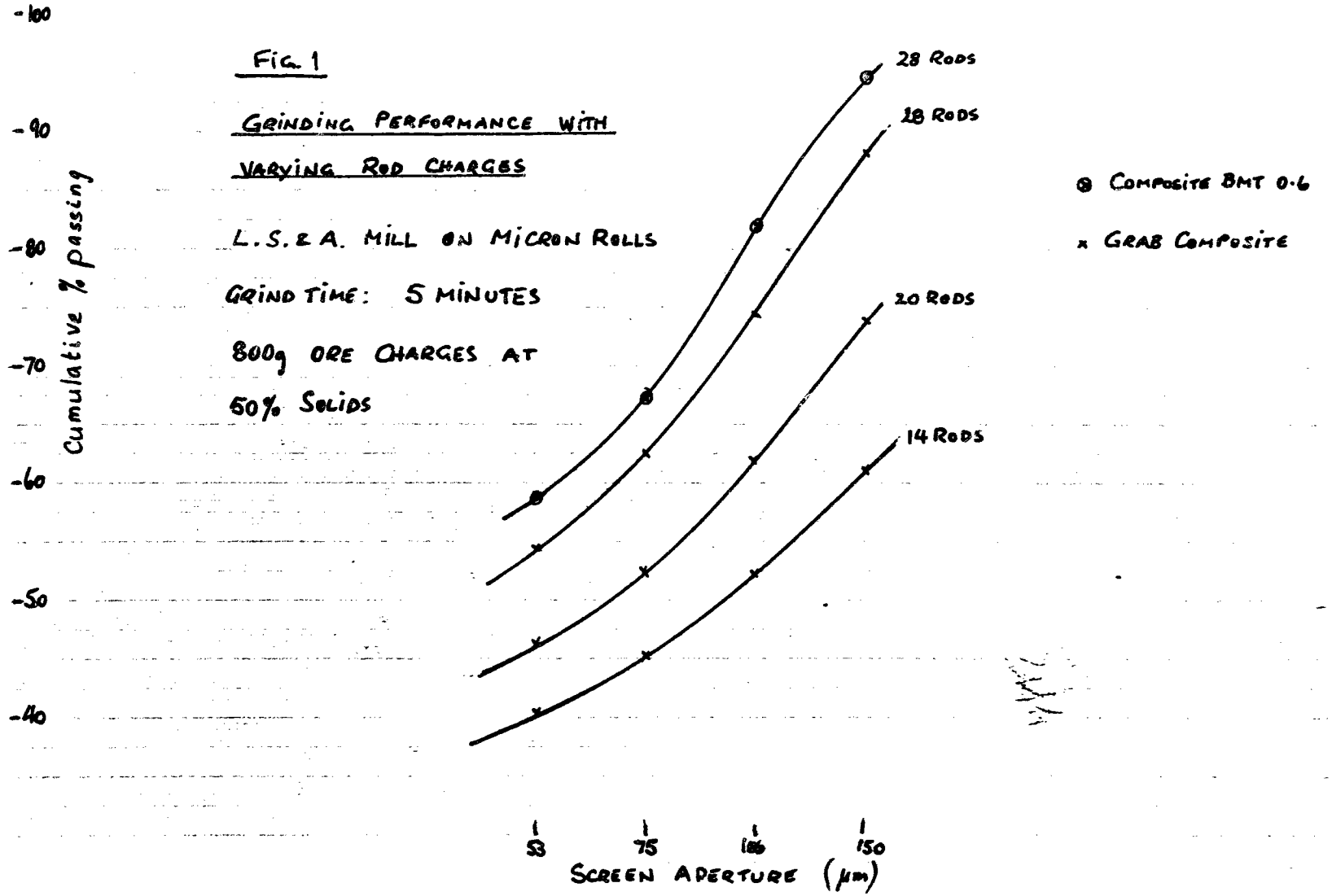
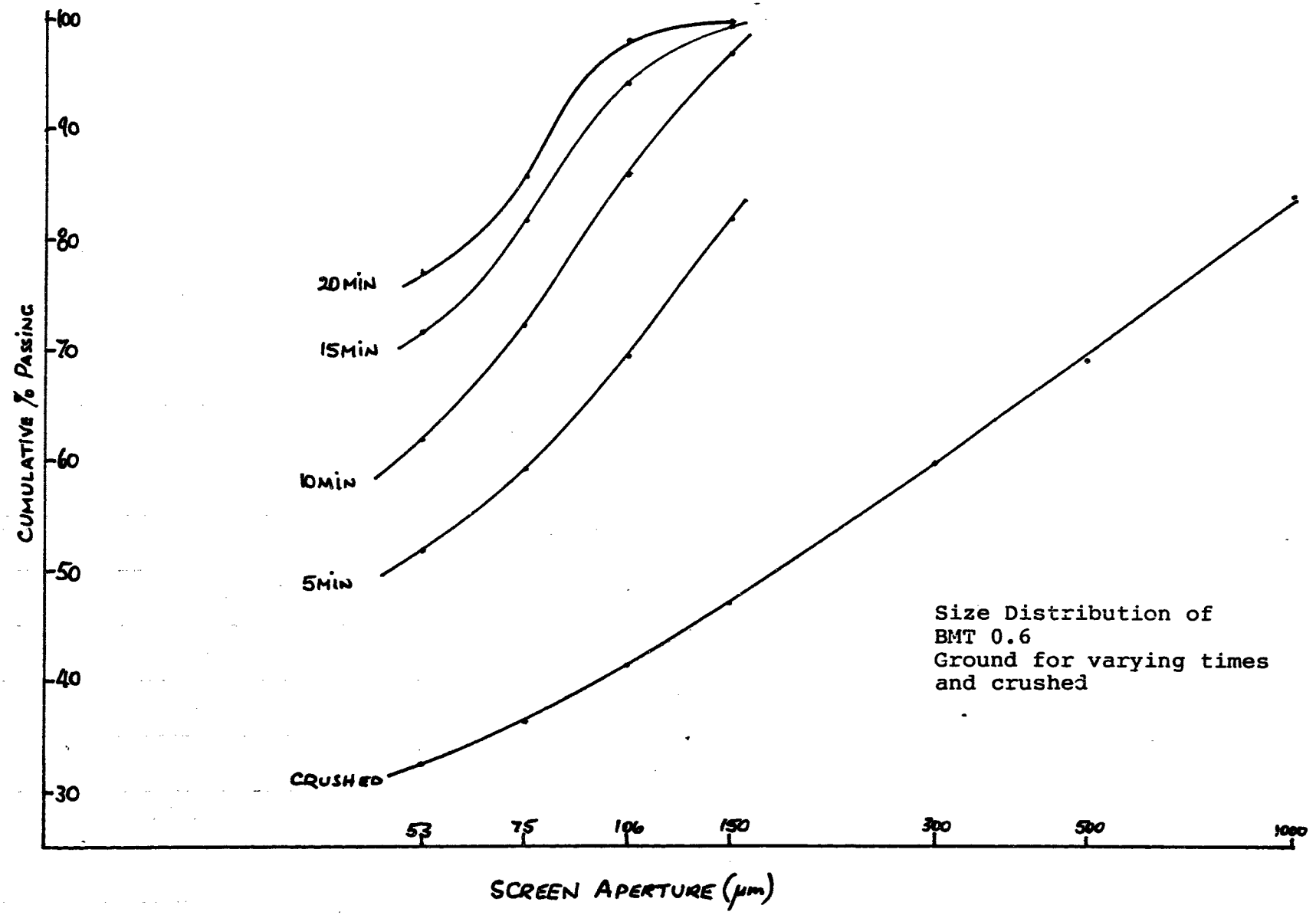


Fig. 1
GRINDING PERFORMANCE WITH VARYING ROD CHARGES
L.S.&A. MILL ON MICRON ROLLS
GRIND TIME: 5 MINUTES
800g ORE CHARGES AT 50% SOLIDS
28 RODS
18 RODS
20 RODS
14 RODS
⊛ COMPOSITE BMT 0·6
× GRAB COMPOSITE
Cumulative % passing
100
90
80
70
60
50
40
53
75
106
150
SCREEN APERTURE (μm)

FIGURE 1



Size Distribution of
BMT 0.6
Ground for varying times
and crushed

FIGURE 2

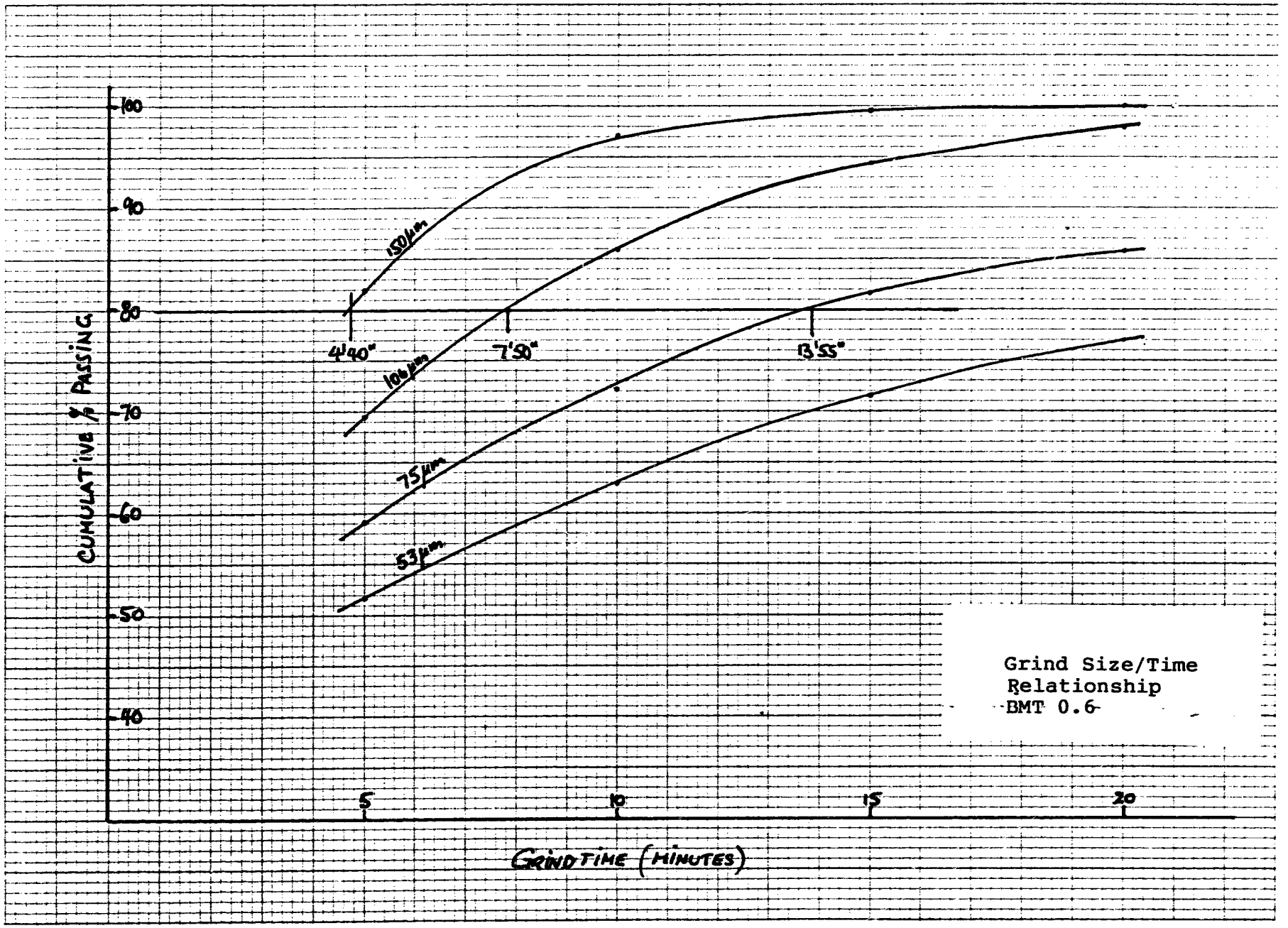
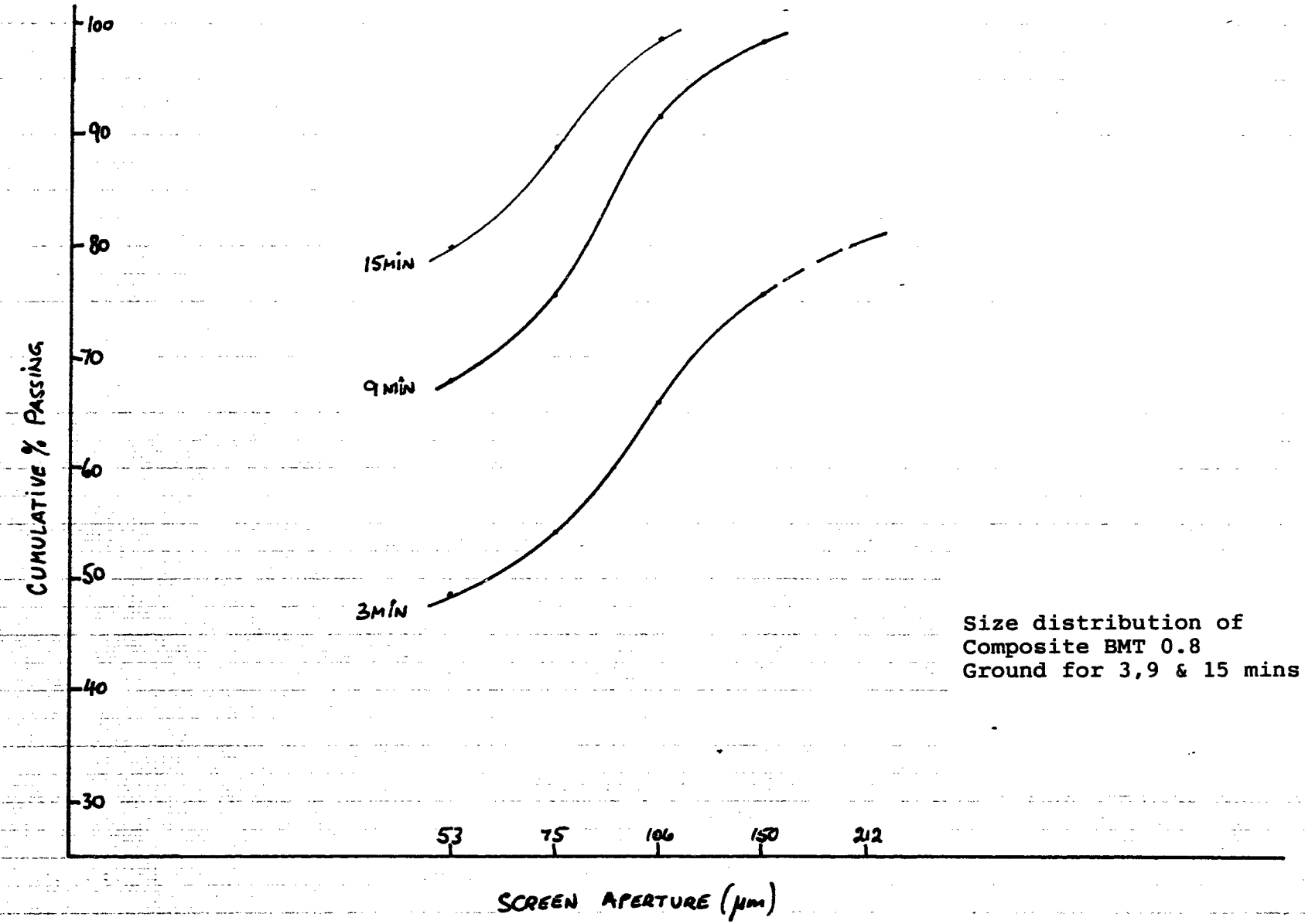

100
90
80
70
60
50
40
CUMULATIVE % PASSING
150 µm
106 µm
75 µm
53 µm
4'40"
7'50"
13'55"
5
10
15
20
GRIND TIME (MINUTES)
Grind Size/Time
Relationship
BMT 0.6

FIGURE 3



Size distribution of
Composite BMT 0.8
Ground for 3,9 & 15 mins

FIGURE 4

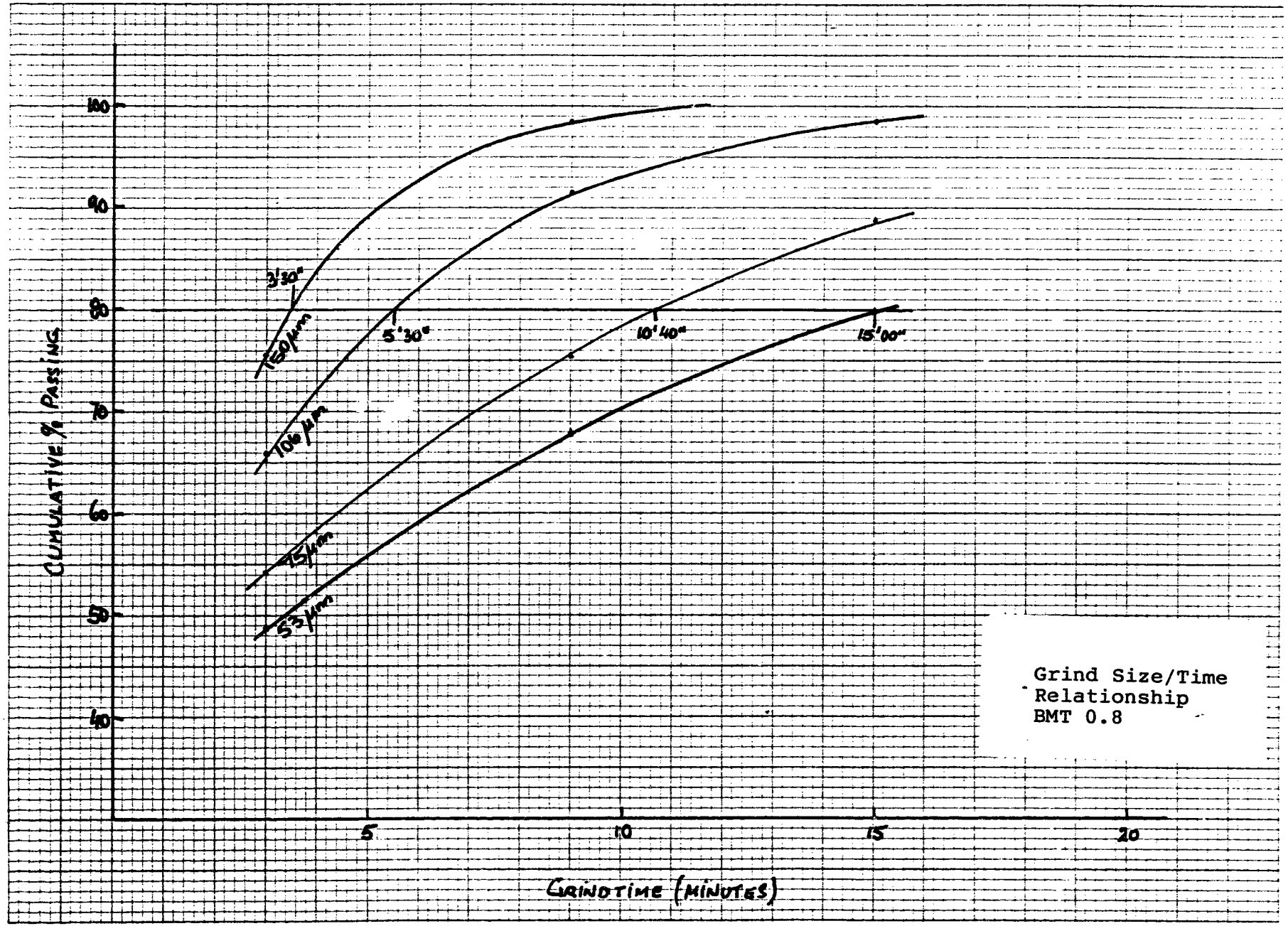

100
90
80
70
60
50
40
CUMULATIVE % PASSING
3'30"
5'30"
10'40"
15'00"
150 µm
106 µm
75 µm
53 µm
5
10
15
20
GRINDTIME (MINUTES)
Grind Size/Time
Relationship
BMT 0.8

FIGURE 5

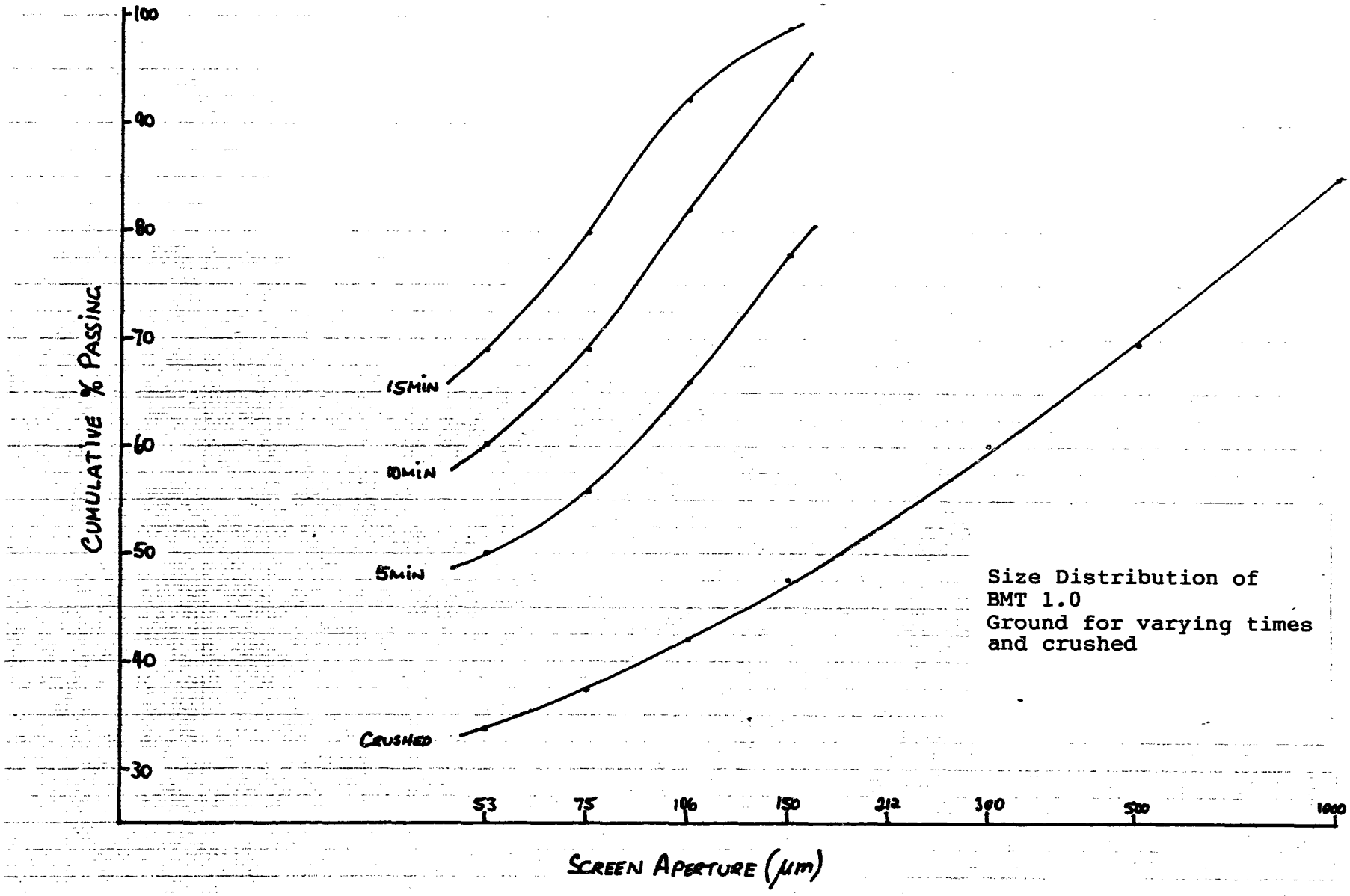

100
90
80
70
60
50
40
30
CUMULATIVE % PASSING
15MIN
10MIN
5MIN
CRUSHED
53
75
106
150
212
300
500
1000
SCREEN APERTURE (μm)
Size Distribution of
BMT 1.0
Ground for varying times
and crushed

FIGURE 6

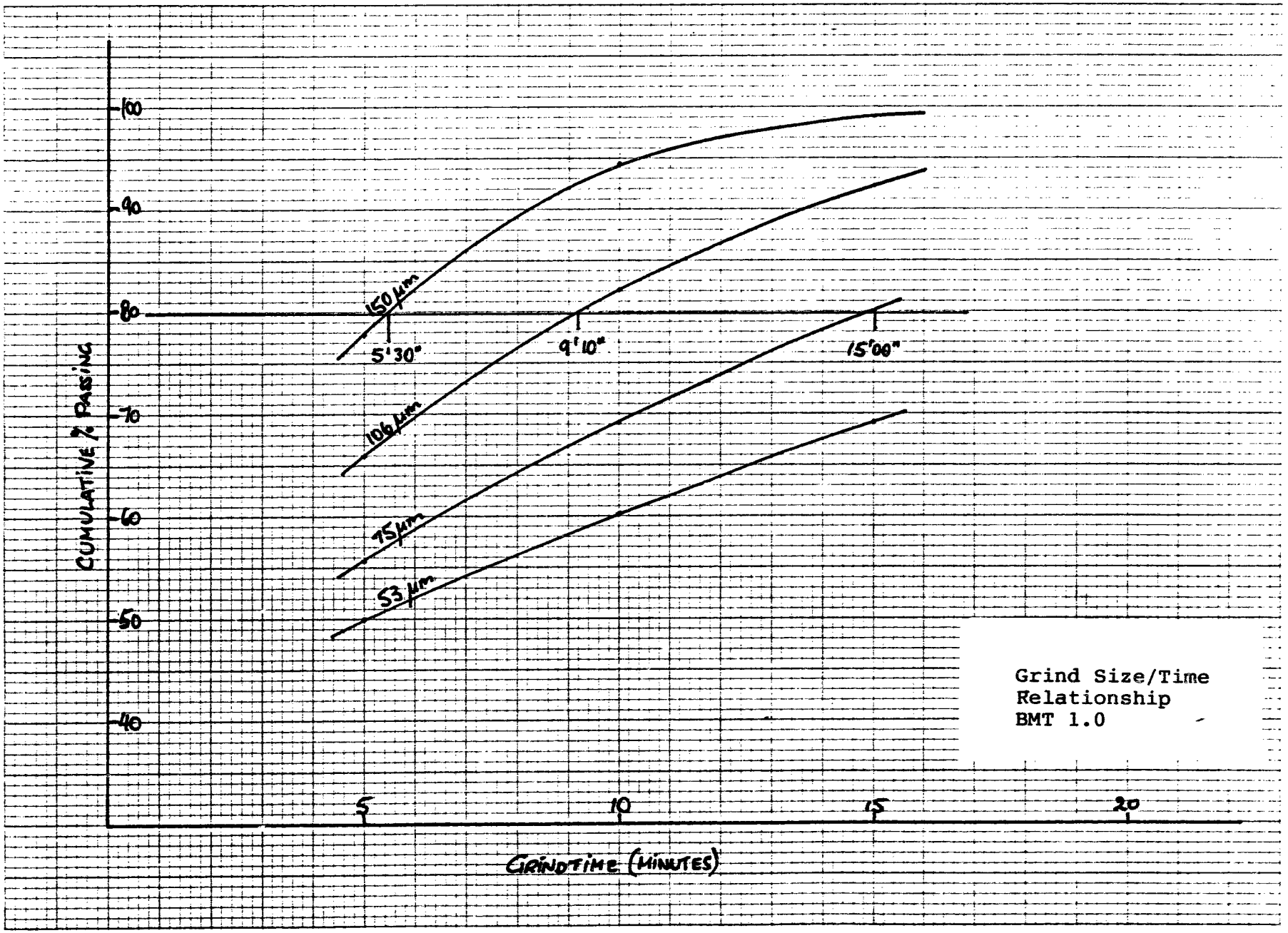
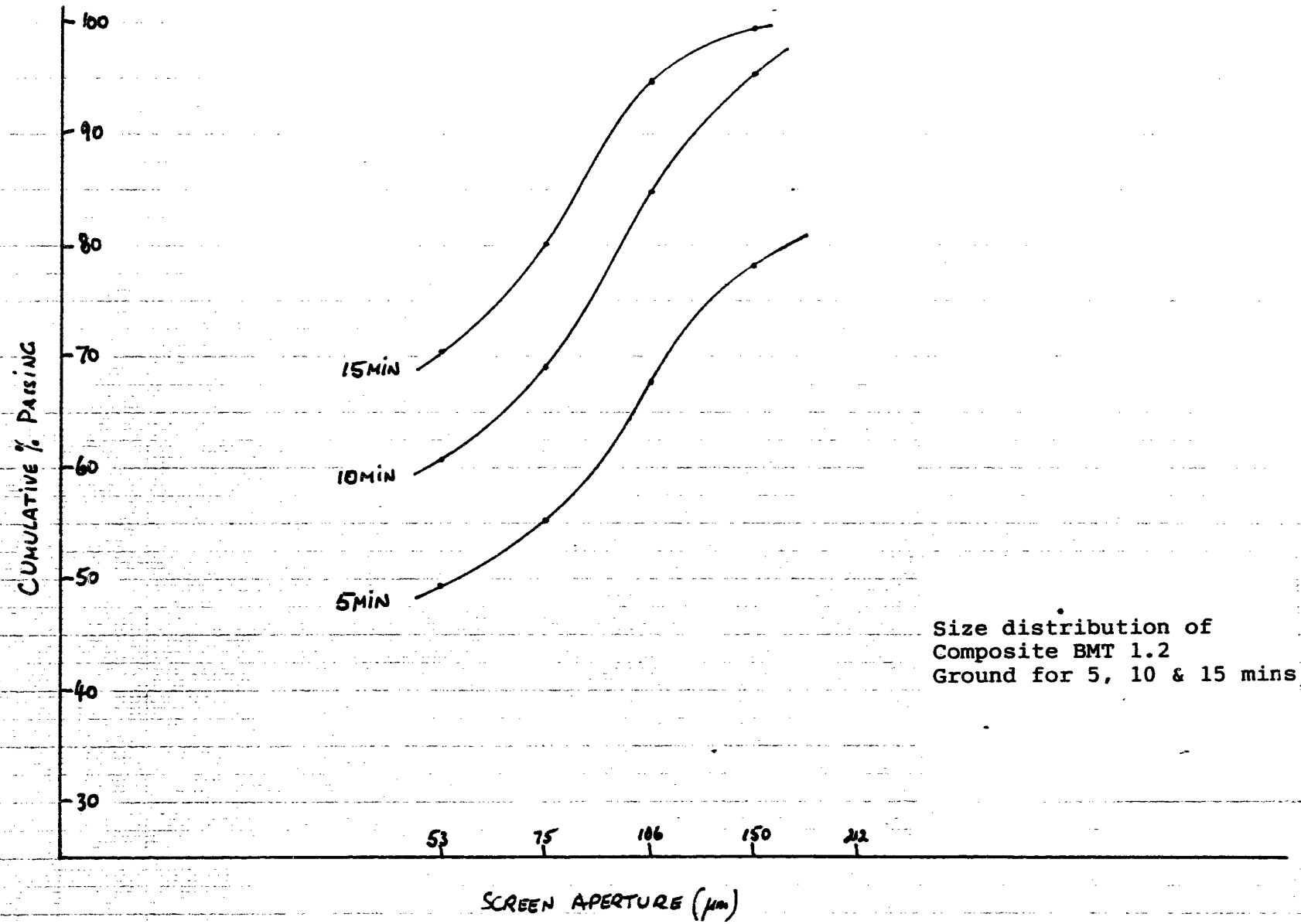

100
90
80
70
60
50
40
CUMULATIVE % PASSING
150 µm
106 µm
75 µm
53 µm
5'30"
9'10"
15'00"
5
10
15
20
GRINDTIME (MINUTES)
Grind Size/Time
Relationship
BMT 1.0

FIGURE 7



Size distribution of
Composite BMT 1.2
Ground for 5, 10 & 15 mins

FIGURE 8

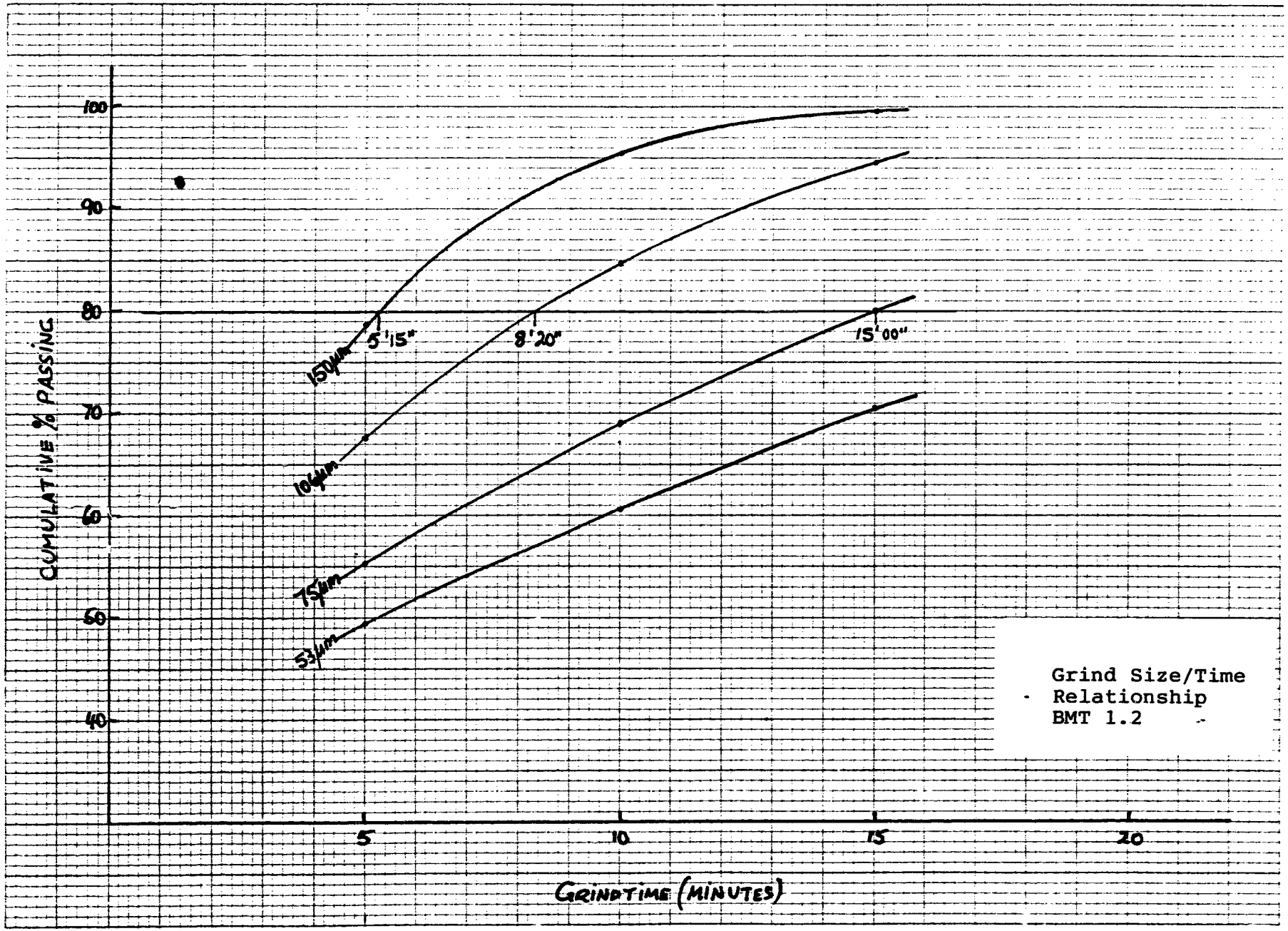

100
90
80
70
60
50
40
CUMULATIVE % PASSING
150μm
106μm
75μm
53μm
5'15"
8'20"
15'00"
5
10
15
20
GRINDTIME (MINUTES)
Grind Size/Time
Relationship
BMT 1.2

FIGURE 9

TABLE 1

BMT5747 8-Dec-89
BILLITON MT TODD WEATHERED ORE HOLE COMPOSITES.

Plus & minus 2mm size distribution in hole composite before roll crushing.

Grade Composite	Hole Composite	% +2mm	% -2mm
BMT 0.6	BP116	nd	nd
	BP130	22.6	77.4
	BP172	20.8	79.3
	BP163	25.2	74.8
	BP111	31.6	68.4
	BP121	28.5	71.5
	BP137	20.4	79.6
BMT 0.8	BP115	30.4	69.6
	BP152	21.7	78.3
	BP120	25.5	74.5
	BP118	27.9	72.1
	BP125	28.5	71.5
	BP171	16.7	83.3
	BP129	32.1	67.9
BMT 1.0	BP136	31.6	68.4
	BP124	27.0	73.0
	BP122	30.3	69.7
	BP120	26.3	73.7
	BP159	19.3	80.7
BMT 1.2	BP143	18.9	81.1
	BP123	28.8	71.2
	BP128	26.7	73.2
	BP145	12.8	87.2
	BP119	20.4	79.6
	BP169	23.5	76.5

nd = not determined

TABLE 2

BMT5739 Sheet 1 29-Nov-89
BILLITON MT TODD WEATHERED ORE PERCUSSION DRILL 'HOLE COMPOSITE' ASSAYS.

Original Composite Nominated	North	Drill Hole No.	From metres	To metres	metres	Ave. Drill Grade ppm Au	Composite Assays (1) ppm Au	(2) ppm Au	(Ave.) ppm Au	Mass of Composite dry g	Actual Composite Nominated
BMT 0.6	10000	BP116	7	12	5.0	0.62	0.88	0.84	0.86	2298	BMT 0.6
BMT 0.6	10040	BP137	8	17	9.0	0.64	0.73	0.89	0.81	4378	BMT 0.6
BMT 0.6	10050	BP130	2	12	10.0	0.65	0.54	0.60	0.57	4854	BMT 0.6
BMT 0.6	10070	BP121	2	11	9.0	0.52	0.51	0.51	0.51	4243	BMT 0.6
BMT 0.6	10100	BP111	4	15	11.0	0.66	1.24	1.30	1.27	5369	BMT 1.2
BMT 0.6	10135	BP163	9	19	10.0	0.61	0.60	0.62	0.61	4909	BMT 0.6
BMT 0.6	10170	BP172	8	18	10.0	0.69	0.73	0.75	0.74	4929	BMT 0.6
BMT 0.8	10000	BP115	16	21	5.0	0.88	0.81	0.80	0.81	2303	BMT 0.8
BMT 0.8	10025	BP152	6	15	9.0	0.84	0.61	0.57	0.59	4437	
BMT 0.8	10040	BP125	4	11	7.0	0.78	1.94	1.67	1.81	3353	
BMT 0.8	10050	BP118	17	26	9.0	0.84	1.31	1.10	1.21	4370	BMT 1.2
BMT 0.8	10070	BP129	7	20	13.0	0.76	0.60	0.66	0.63	6479	
BMT 0.8	10100	BP120	4	19	15.0	0.81	1.01	0.91	0.96	7677	BMT 1.0
BMT 0.8	10170	BP171	2	12	10.0	0.92	0.90	0.90	0.90	4870	BMT 1.0
BMT 1.0	10000	BP124	3	8	5.0	1.02	0.63	0.69	0.66	3677	
BMT 1.0	10040	BP136	5	14	9.0	1.06	0.96	0.90	0.93	6881	BMT 1.0
BMT 1.0	10050	BP122	4	15	11.0	1.03	0.80	0.79	0.80	8393	BMT 0.8
BMT 1.0	10070	BP149	1	9	8.0	1.11	(1)				
BMT 1.0	10100	BP120	21	29	8.0	1.04	1.86	1.59	1.73	6066	
BMT 1.0	10135	BP159	5	16	11.0	1.02	0.70	0.73	0.72	8413	BMT 0.8
BMT 1.0	10170	BP133	7	14	7.0	1.00	(1)				
BMT 1.2	10000	BP143	3	13	10.0	1.24	1.52	0.97	1.25	5851	
BMT 1.2	10040	BP123	5	11	6.0	1.24	1.12	1.11	1.12	3447	BMT 1.0
BMT 1.2	10050	BP145	6	17	11.0	1.21	1.05	1.05	1.05	6557	BMT 1.0
BMT 1.2	10070	BP119	23	35	12.0	1.16	1.13	1.18	1.16	7120	BMT 1.2
BMT 1.2	10100	BP128	2	12	10.0	1.29	2.54	2.34	2.44	5915	
BMT 1.2	10170	BP169	5	20	15.0	1.22	1.19	1.15	1.17	9139	BMT 1.2

TABLE 3

BMT5739 Sheet 2 8-Dec-89
BILLITON MT TODD WEATHERED ORE PERCUSSION DRILL 'HOLE COMPOSITE' ASSAYS.
SORTED INTO ALLOCATED COMPOSITES.

Original Composite Nominated	North	Drill Hole No.	From metres	To metres	metres	Ave. Drill Grade ppm Au	Composite Assays (1) ppm Au	(2) ppm Au	(Ave.) ppm Au	Mass of Composite dry g	Actual Composite Nominated	
BMT 0.6	10000	BP116	7	12	5.0	0.62	0.88	0.84	0.86	2298	BMT 0.6	
BMT 0.6	10040	BP137	8	17	9.0	0.64	0.73	0.89	0.81	4378	BMT 0.6	
BMT 0.6	10050	BP130	2	12	10.0	0.65	0.54	0.60	0.57	4854	BMT 0.6	
BMT 0.6	10070	BP121	2	11	9.0	0.52	0.51	0.51	0.51	4243	BMT 0.6	
BMT 0.6	10135	BP163	9	19	10.0	0.61	0.60	0.62	0.61	4909	BMT 0.6	
BMT 0.6	10170	BP172	8	18	10.0	0.69	0.73	0.75	0.74	4929	BMT 0.6	
COMPOSITE BMT 0.6						Calculated dry mass (g)				25611		800 (Ave. split dry g)
						Calculated weighted grade of composite			0.67			
						Moisture (%)				0.92		
BMT 0.8	10000	BP115	16	21	5.0	0.88	0.81	0.80	0.81	2303	BMT 0.8	
BMT 1.0	10050	BP122	4	15	11.0	1.03	0.80	0.79	0.80	8393	BMT 0.8	
BMT 1.0	10135	BP159	5	16	11.0	1.02	0.70	0.73	0.72	8413	BMT 0.8	
COMPOSITE BMT 0.8						Calculated dry mass (g)				19109		597 (Ave. split dry g)
						Calculated weighted grade of composite			0.76			
						Moisture (%)				0.84		
BMT 0.8	10100	BP120	4	19	15.0	0.81	1.01	0.91	0.96	7677	BMT 1.0	
BMT 0.8	10170	BP171	2	12	10.0	0.92	0.90	0.90	0.90	4870	BMT 1.0	
BMT 1.0	10040	BP136	5	14	9.0	1.06	0.96	0.90	0.93	6881	BMT 1.0	
BMT 1.2	10040	BP123	5	11	6.0	1.24	1.12	1.11	1.12	3447	BMT 1.0	
BMT 1.2	10050	BP145	6	17	11.0	1.21	1.05	1.05	1.05	6557	BMT 1.0	
COMPOSITE BMT 1.0						Calculated dry mass (g)				29432		920 (Ave. split dry g)
						Calculated weighted grade of composite			0.98			
						Moisture (%)				0.77		
BMT 0.6	10100	BP111	4	15	11.0	0.66	1.24	1.30	1.27	5369	BMT 1.2	
BMT 0.8	10050	BP118	17	26	9.0	0.84	1.31	1.10	1.21	4370	BMT 1.2	
BMT 1.2	10070	BP119	23	35	12.0	1.16	1.13	1.18	1.16	7120	BMT 1.2	
BMT 1.2	10170	BP169	5	20	15.0	1.22	1.19	1.15	1.17	9139	BMT 1.2	
COMPOSITE BMT 1.2						Calculated dry mass (g)				25998		812 (Ave. split dry g)
						Calculated weighted grade of composite			1.19			
						Moisture (%)				0.34		

The following hole composites were not taken into test composites.

BMT 0.8	10025	BP152	6	15	9.0	0.84	0.61	0.57	0.59	4437
BMT 0.8	10040	BP125	4	11	7.0	0.78	1.94	1.67	1.81	3353
BMT 0.8	10070	BP129	7	20	13.0	0.76	0.60	0.66	0.63	6479
BMT 1.0	10000	BP124	3	8	5.0	1.02	0.63	0.69	0.66	3677
BMT 1.0	10070	BP149	1	9	8.0	1.11	(1)			
BMT 1.0	10100	BP120	21	29	8.0	1.04	1.86	1.59	1.73	6066
BMT 1.0	10170	BP133	7	14	7.0	1.00	(1)			
BMT 1.2	10000	BP143	3	13	10.0	1.24	1.52	0.97	1.25	5851
BMT 1.2	10100	BP128	2	12	10.0	1.29	2.54	2.34	2.44	5915

TABLE 4

BMT5736 5-Dec-89
BILLITON MT TODD
COMPARISON OF GRINDING ROD WEAR

Composite Sample	Ore Type	Mass Ground g	Grind Time hours	Feed F80 um	Product actual pass. nom. um %	Product actual P80 um	Product P80 nom. um	1/(P80)^.5 - 1/(F80)^.5 (E) (4)	Rod Charge Start g	Rod Charge Finish g	Rod Wear g	Rod Wear g/kg	Factor g/(E*kg)	Rod Wear g/hour
BMT 1	Primary	35.662	17.63	1630	101 (1)		101	0.0747	16271.0	16214.0	57.0	1.60	21	3.23
BMT 2	Primary	19.898	11.00	1630			75	0.0907	16183.5	16139.1	44.4	2.23	25	4.04
BMT 2	Primary	9.610	5.50	1630			75	0.0907	16139.1	16121.3	17.8	1.85	20	3.24
BMT 2	Primary	9.872	5.50	1630			75	0.0907	16121.3	16098.9	22.4	2.27	25	4.07
BMT 2	Primary	9.555	5.50	1630			75	0.0907	16098.9	16074.9	24.0	2.51	28	4.36
BMT 2	Primary								16074.9	16041.9	33.0			
									16021.8	15987.8	34.0			
	total	29.568	16.50	1630			75	0.0907			67.0	2.27	25	4.06
BMT 2	Primary	29.504	16.50	1630			75	0.0907	15984.8	15928.7	56.1	1.90	21	3.40
Pine Creek		10.000	5.24	1550		70	75	0.0901	15920.5	15895.1	25.4	2.54	28	4.85
Pine Creek		10.000	5.24	1550	83.9 (2)	70	75	0.0901	15895.1	15866.7	28.4	2.84	32	5.42
BMT P 0.8	Primary L	10.073	6.21	1600	75.2 (3)		75	0.0905	16041.9	16021.8	20.1	2.00	22	3.24
BMT P 0.8	Primary L	10.129	6.58	1600	78.4 (3)		53	0.1124	15866.7	15845.5	21.2	2.09	19	3.22
BMT P 0.8	Primary L	4.039	3.13	1600	(3)		38	0.1372						
		10.090	3.75	1600	76.6 (3)		106	0.0721						
	total	14.129	6.88					0.0907	15845.5	15820.5	25.0	1.77	20	3.63
BMT P 0.8	Primary L	10.126	2.58	1600	66.3 (3)		150	0.0566	15820.5	15811.3	9.2	0.91	16	3.57
BMT 0.6	Weathered	5.476	1.62	820	80.8 (3)		75	0.0805						
		5.535	0.92	820	81.3 (3)		106	0.0622						
		4.773	0.47	820	78.3 (3)		150	0.0467						
	total	15.784	3.01					0.0639	10287.2	10274.1	13.1	0.83	13	4.35
BMT 0.8	Weathered	4.113	1.25	820	82.7 (3)		75	0.0805						
		4.088	0.64	820	78.8 (3)		106	0.0622	10024.5	10020.6	3.9			
		3.516	0.35	820	81.0 (3)		150	0.0467	10020.4	10017.3	3.1			
	total	11.717	2.24					0.0640			7.0	0.60	9	3.13
BMT 1.0 includes three definition grinds	Weathered	6.833	2.00	820	79.4 (3)		75	0.0805						
		6.816	1.24	820	80.8 (3)		106	0.0622						
		5.937	0.63	820	80.5 (3)		150	0.0467						
	total	19.586	3.87					0.0639	10273.6	10263.7	9.9	0.51	8	2.56
BMT 1.2	Weathered	5.580	1.75	820	79.4 (3)		75	0.0805						
		5.593	0.92	820	78.4 (3)		106	0.0622						
		4.895	0.53	820	78.6 (3)		150	0.0467						
	total	16.068	3.20					0.0639	10017.3	10006.8	10.5	0.65	10	3.28

(1) weighted nominated of 43 tests.

(2) sizing on last two kg of Pine Creek.
(3) average from test residues.
(4) calculated from the nominal P80 and F80

TABLE 5

BMT5746 8-Dec-89
BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.
REPEAT ASSAYS ON AVAILABLE RESERVES OF LEACH RESIDUES.

COMPOSITE BMT 1.0

	-53um				+150um				
Test	Assay		Repeat Assay		Assay		Repeat	Leach	
No.	ppm Au	ppm Au	ppm Au	ppm Au	ppm Au	ppm Au	ppm Au	Hours	
3C	0.11	0.10	0.12	0.12)				8	
6D	0.14	0.12	0.12	0.13)				8	
3B	0.12	0.14	0.12	0.11)				12	Batch 2
6C	0.18	0.23	0.19	0.20)-- no fraction for assay				12	Request
3D	0.14	0.13	0.12	0.12)				12	B136
8A	0.15	0.14	0.12	0.15)				18	
4B	0.10	0.09	0.12	0.10)				18	
Average	0.13	0.14	0.13	0.13					
1B	0.18	0.13	0.11	0.11	0.58			8	
5C	0.09	0.07	0.11	0.11	0.61			8	
7A	0.09	0.09	0.10	0.10	0.51			12	
8B	0.17	0.22	0.10	0.10	0.49			12	
2C	0.17	0.11	0.10	0.10	0.53			12	
6A	0.18	0.15	0.10	0.10	0.55			18	Batch 1
4D	0.06	0.07	0.10	0.10	0.34			18	Request
4A	0.09	0.08	0.12	0.11	0.59		0.60	8	B135
5B	0.08	0.08	0.10	0.11	0.62		0.68	8	
1A	0.13	0.17	0.08	0.09	0.61		0.64	12	
7D	0.09	0.10	0.09	0.09	0.65		0.63	12	
7C	0.07	0.06	0.09	0.09	0.60			18	insufficient for repeat
1D	0.06	0.06	0.08	0.09	0.59		0.62	18	
Average	0.11	0.11	0.10	0.10					

TABLE 6

BMT5754 Sheet 7 8-Dec-89 **** REPEAT RESIDUE ASSAYS SUBSTITUTED.****

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 1.0		P80=75um			P80=106um			P80=150um		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18.0	8.0	12.6	18.0	8.0	12.7	18.0	8.0
Extraction Au										
at 3 hours	g/t	0.85	0.88	0.82	0.78	0.84	0.74	0.72	0.75	0.67
at 6 hours	g/t	1.00	1.07	0.97	0.92	0.97	0.90	0.87	0.89	0.86
at 8 hours	g/t	1.04	1.06	1.03	0.95	0.96	0.93	0.93	0.93	0.93
at 12 hours	g/t	1.06	1.09	1.04	1.00	1.03	0.96	0.95	0.97	0.93
at 18 hours	g/t	1.08	1.09	1.06	1.03	1.06	1.01	0.97	0.98	0.96
at 3 hours	%	66.4	69.7	62.6	63.3	66.7	60.7	58.2	61.4	53.3
at 6 hours	%	78.4	83.7	75.7	75.2	77.3	73.5	70.3	73.0	68.7
at 8 hours	%	83.7	83.8	83.6	79.5	79.6	79.5	75.7	76.4	75.0
at 12 hours	%	82.6	85.1	80.7	80.3	81.8	78.2	76.1	76.7	75.0
at 18 hours	%	84.1	85.1	83.0	82.2	84.0	80.5	77.7	78.3	77.1
Calculated Head	ppm Au	1.28	1.31	1.23	1.23	1.32	1.17	1.24	1.27	1.22
Ground Head Assay 1	ppm Au	1.16	1.39	1.05	1.14	1.20	1.07	1.10	1.19	0.98
Ground Head Assay 2	ppm Au	1.19	1.57	1.09	1.13	1.19	1.08	1.16	1.22	1.02
Average Ground Head Assay	ppm Au	1.17	1.48	1.07	1.13	1.17	1.10	1.13	1.20	1.00
Calculated residue grade	ppm Au	0.21	0.25	0.19	0.24	0.26	0.19	0.29	0.31	0.27
Extraction Cu										
at 3 hours	g/t	29	30	27	27	27	25	25	25	24
at 6 hours	g/t	34	36	31	33	34	31	31	33	31
at 8 hours	g/t	37	39	36	35	36	34	34	34	34
at 12 hours	g/t	37	39	36	37	37	36	36	37	36
at 18 hours	g/t	41	42	40	38	39	37	37	39	36
Assay Head	ppm Cu									
Extraction Zn										
at 3 hours	g/t	4.6	5.1	4.2	4.5	5.0	3.9	4.4	4.8	3.9
at 6 hours	g/t	5.7	6.1	5.3	5.3	5.6	5.2	5.3	5.6	5.1
at 8 hours	g/t	8.1	8.6	7.6	7.0	7.1	6.9	6.8	7.0	6.5
at 12 hours	g/t	6.5	7.1	6.1	6.4	6.9	6.1	6.5	6.6	6.3
at 18 hours	g/t	7.0	7.0	6.9	7.3	7.3	7.3	7.7	8.0	7.4
Assay Head	ppm Zn									
NaCN consumption										
at 3 hours	kg/t	0.15	0.18	0.08	0.15	0.21	0.10	0.23	0.47	0.10
at 6 hours	kg/t	0.19	0.22	0.14	0.17	0.21	0.13	0.07	0.14	-0.04
at 8 hours	kg/t	0.22	0.22	0.21	0.21	0.22	0.20	0.18	0.19	0.17
at 12 hours	kg/t	0.23	0.25	0.18	0.24	0.28	0.20	0.12	0.22	0.03
at 18 hours	kg/t	0.20	0.23	0.17	0.19	0.20	0.19	0.18	0.19	0.17
CaO consumption										
at 3 hours	kg/t	1.89	2.10	1.57	1.83	1.96	1.60	1.83	2.00	1.57
at 6 hours	kg/t	1.91	2.12	1.59	1.84	1.98	1.62	1.95	2.29	1.58
at 8 hours	kg/t	1.97	2.01	1.93	2.00	2.01	1.98	1.97	2.03	1.92
at 12 hours	kg/t	1.89	2.13	1.59	1.79	1.91	1.62	1.95	2.30	1.58
at 18 hours	kg/t	1.64	1.69	1.59	1.64	1.65	1.62	1.60	1.63	1.57
Actual grind passing nominated um (%)		79.4	80.1	79.0	80.8	81.7	79.6	80.5	81.9	78.9

BMT5754 Sheet 1 8-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0 |

**** REPEAT RESIDUE ASSAYS SUBSTITUTED.**** 40

SUMMARY

Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A	4D	4A	5B	1A	7D	7C	1D
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106	106	150	150	150	150	150	150
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18	18	8	8	12	12	18	18
Extraction Au																					
at 3 hours	g/t	0.86	0.84	0.82	0.82	0.83	0.88	0.88	0.78	0.76	0.75	0.77	0.74	0.84	0.78	0.75	0.73	0.67	0.68	0.75	0.75
at 6 hours	g/t	0.98	0.99	1.07	0.99	1.01	0.97	0.99	0.91	0.90	0.92	0.94	0.90	0.97	0.92	0.89	0.87	0.86	0.87	0.88	0.88
at 8 hours	g/t	1.03	1.06						0.96	0.93						0.93	0.93				
at 12 hours	g/t			1.09	1.05	1.09	1.04	1.05			1.01	1.01	0.96	1.03	0.98			0.96	0.97	0.93	0.95
at 18 hours	g/t						1.06	1.09						1.06	1.01					0.96	0.98
at 3 hours	%	69.7	66.4	63.8	62.6	64.3	69.0	68.9	64.5	66.7	60.7	61.0	61.3	63.7	65.0	61.4	59.5	54.2	53.3	60.5	60.1
at 6 hours	%	80.2	78.0	83.7	76.2	78.4	75.7	76.9	75.0	77.3	74.3	74.4	75.1	73.5	76.8	73.0	70.7	68.7	68.7	70.6	70.2
at 8 hours	%	83.6	83.8						79.6	79.5						76.4	75.0				
at 12 hours	%			85.1	80.7	84.3	81.7	81.4			81.4	80.3	79.8	78.2	81.8			76.7	76.6	75.0	75.9
at 18 hours	%						83.0	85.1						80.5	84.0					77.1	78.3
Calculated Head	ppm Au	1.23	1.27	1.28	1.31	1.29	1.28	1.28	1.21	1.17	1.24	1.26	1.20	1.32	1.20	1.22	1.23	1.25	1.27	1.24	1.25
Ground Head Assay 1	ppm Au	1.39	1.11	1.13	1.12	1.21	1.12	1.05	1.20	1.12	1.15	1.16	1.15	1.11	1.07	1.10	1.09	1.07	1.19	0.98	1.15
Ground Head Assay 2	ppm Au	1.57	1.14	1.13	1.11	1.17	1.10	1.09	1.14	1.08	1.13	1.14	1.19	1.10	1.12	1.14	1.22	1.18	1.20	1.02	1.21
Average Ground Head Assay	ppm Au	1.48	1.13	1.13	1.12	1.19	1.11	1.07	1.17	1.10	1.14	1.15	1.17	1.11	1.10	1.12	1.16	1.13	1.20	1.00	1.18
Calculated residue grade	ppm Au	0.20	0.21	0.19	0.25	0.20	0.22	0.19	0.25	0.24	0.23	0.25	0.24	0.26	0.19	0.29	0.31	0.29	0.30	0.28	0.27
Extraction Cu																					
at 3 hours	g/t	27	28	30	30	27	28	28	27	25	27	27	26	27	27	24	24	25	24	25	25
at 6 hours	g/t	34	36	34	36	34	34	31	33	33	34	34	33	31	31	31	31	33	31	31	31
at 8 hours	g/t	36	39						36	34						34	34				
at 12 hours	g/t			39	39	37	36	36			37	37	37	37	36			37	37	36	36
at 18 hours	g/t						42	40						39	37					39	36
Assay Head	ppm Cu	360 (ave. of two head splits)																			
Extraction Zn																					
at 3 hours	g/t	5.1	4.9	4.4	4.8	4.2	4.6	4.3	5.0	4.9	4.2	3.9	4.4	4.5	4.3	4.8	4.6	3.9	3.9	4.8	4.5
at 6 hours	g/t	6.1	5.9	5.6	5.9	5.4	5.5	5.3	5.6	5.6	5.3	5.3	5.3	5.2	5.2	5.6	5.3	5.1	5.1	5.3	5.5
at 8 hours	g/t	8.6	7.6						7.1	6.9						6.5	7.0				
at 12 hours	g/t			6.9	7.1	6.3	6.2	6.1			6.4	6.3	6.9	6.4	6.1			6.4	6.6	6.6	6.3
at 18 hours	g/t						7.0	6.9						7.3	7.3					7.4	8.0
Assay Head	ppm Zn	315 (ave. of two head splits)																			
NaCN consumption																					
at 3 hours	kg/t	0.18	0.17	0.16	0.16	0.16	0.08	0.10	0.13	0.13	0.21	0.21	0.19	0.12	0.10	0.12	0.11	0.45	0.47	0.11	0.10
at 6 hours	kg/t	0.19	0.17	0.22	0.22	0.20	0.14	0.19	0.15	0.15	0.21	0.21	0.21	0.14	0.13	0.13	0.12	-0.03	-0.04	0.12	0.14
at 8 hours	kg/t	0.22	0.21						0.22	0.20						0.19	0.17				
at 12 hours	kg/t			0.25	0.24	0.23	0.18	0.24			0.25	0.28	0.25	0.21	0.20			0.04	0.03	0.20	0.22
at 18 hours	kg/t						0.17	0.23						0.20	0.19					0.17	0.19
CaO consumption																					
at 3 hours	kg/t	1.91	1.98	1.92	2.10	2.10	1.57	1.64	1.96	1.96	1.87	1.90	1.88	1.63	1.60	2.00	1.91	1.97	1.94	1.57	1.61
at 6 hours	kg/t	1.92	2.01	1.93	2.11	2.12	1.59	1.68	1.98	1.97	1.87	1.90	1.88	1.64	1.62	2.00	1.91	2.28	2.29	1.58	1.62
at 8 hours	kg/t	1.93	2.01						2.01	1.98						2.03	1.92				
at 12 hours	kg/t			1.94	2.12	2.13	1.59	1.68			1.88	1.91	1.89	1.65	1.62			2.29	2.30	1.58	1.63
at 18 hours	kg/t						1.59	1.69						1.65	1.62					1.57	1.63
Actual grind passing nominated um (%)		79.0	80.1	79.8	79.2	79.1	79.1	79.0	81.7	81.5	80.5	79.6	80.6	80.9	81.1	81.9	81.0	80.4	80.5	78.9	80.1

TABLE 7

8MT5755 Composite of sheets 7
BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.
PRESENTATION OF ANALYSIS SHEETS
8-Dec-89

		COMPOSITE 8MT 0.6									COMPOSITE 8MT 0.6								
		P80=75um			P80=106um			P80=150um			P80=75um			P80=106um			P80=150um		
ANALYSIS																			
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18	8	12.6	18	8	12.7	18	8	12.6	18	8	12.6	18	8	12.7	18	8
Extraction Au																			
at 3 hours	g/t	0.51	0.57	0.47	0.48	0.51	0.44	0.48	0.50	0.45	0.76	0.81	0.72	0.66	0.70	0.63	0.64	0.67	0.60
at 6 hours	g/t	0.57	0.64	0.53	0.53	0.55	0.49	0.51	0.54	0.49	0.79	0.84	0.76	0.69	0.74	0.67	0.69	0.71	0.67
at 8 hours	g/t	0.55	0.55	0.55	0.52	0.53	0.51	0.54	0.55	0.53	0.83	0.85	0.80	0.74	0.76	0.71	0.71	0.72	0.70
at 12 hours	g/t	0.61	0.66	0.55	0.56	0.58	0.56	0.53	0.56	0.51	0.80	0.86	0.76	0.70	0.72	0.69	0.70	0.72	0.69
at 18 hours	g/t	0.57	0.60	0.55	0.55	0.56	0.54	0.54	0.55	0.52	0.79	0.80	0.79	0.72	0.72	0.72	0.72	0.72	0.72
at 3 hours	%	74.4	79.5	68.3	71.5	73.5	68.4	70.4	78.5	65.4	81.7	84.7	79.0	76.1	80.3	73.7	71.3	73.5	67.4
at 6 hours	%	83.5	87.7	76.0	79.2	82.2	77.1	75.8	78.1	71.6	85.4	88.0	83.4	79.3	80.8	76.9	76.7	78.5	74.7
at 8 hours	%	85.0	85.3	84.7	82.5	84.1	81.0	79.0	79.1	78.9	86.4	87.0	85.8	81.1	81.3	80.8	77.5	78.5	76.5
at 12 hours	%	86.2	87.5	84.7	82.2	83.2	79.6	78.0	80.8	75.2	87.2	87.7	86.7	81.9	82.4	80.3	79.6	80.7	78.8
at 18 hours	%	86.9	87.5	86.2	80.6	80.6	80.5	79.3	81.4	77.2	87.7	88.5	87.0	82.1	82.4	81.9	80.0	80.7	79.2
Calculated Head	ppm Au	0.69	0.76	0.63	0.67	0.70	0.63	0.68	0.73	0.63	0.93	0.99	0.88	0.87	0.94	0.84	0.90	0.95	0.86
Ground Head Assay 1	ppm Au	0.65	0.76	0.60	0.62	0.67	0.58	0.62	0.64	0.56	0.84	0.90	0.77	0.82	0.87	0.76	0.88	1.01	0.77
Ground Head Assay 2	ppm Au	0.64	0.69	0.59	0.63	0.70	0.58	0.63	0.68	0.55	0.87	0.92	0.82	0.81	0.86	0.77	0.88	1.03	0.75
Average Ground Head Assay	ppm Au	0.65	0.72	0.60	0.63	0.69	0.58	0.62	0.66	0.56	0.85	0.89	0.80	0.81	0.85	0.77	0.88	1.02	0.76
Calculated residue grade	ppm Au	0.10	0.11	0.09	0.13	0.14	0.10	0.14	0.17	0.12	0.12	0.14	0.10	0.16	0.18	0.15	0.19	0.22	0.17
Extraction Cu																			
at 3 hours	g/t	3.3	7.1	2.3	2.4	2.7	1.8	2.2	2.4	2.0	4.8	5.1	4.5	3.3	3.6	2.9	4.0	4.9	3.2
at 6 hours	g/t	4.2	7.6	3.1	3.3	3.9	2.8	3.0	3.4	2.5	6.7	7.1	6.5	4.9	5.4	4.4	5.8	7.1	4.6
at 8 hours	g/t	3.6	3.6	3.6	3.4	3.6	3.2	3.2	3.3	3.1	7.7	8.1	7.2	6.6	6.7	6.5	7.8	7.8	7.7
at 12 hours	g/t	5.6	8.9	4.6	4.7	5.1	4.3	4.4	4.8	4.1	8.6	9.2	8.0	6.8	8.0	6.2	7.3	8.6	6.4
at 18 hours	g/t	5.4	5.4	5.4	5.5	5.7	5.4	5.1	5.2	5.1	9.7	10.1	9.2	7.5	7.7	7.2	9.0	9.5	8.5
Assay Head	ppm Cu	292 (average of two splits)									310 (average of two splits)								
Extraction Zn																			
at 3 hours	g/t	4.9	5.7	4.2	5.0	5.9	3.9	5.2	5.9	4.5	3.0	3.0	3.0	2.6	2.7	2.4	3.0	3.3	2.9
at 6 hours	g/t	6.0	6.5	5.2	6.0	7.0	4.9	6.2	7.7	5.2	3.6	4.3	3.4	3.8	7.2	3.0	4.6	10.1	3.3
at 8 hours	g/t	5.9	6.0	5.7	5.7	5.7	5.6	5.9	5.9	5.9	3.8	3.9	3.8	3.7	3.7	3.7	4.3	4.6	3.9
at 12 hours	g/t	7.5	8.0	6.9	7.8	8.6	7.1	8.1	8.6	7.4	4.4	4.5	4.3	4.0	4.4	3.7	4.3	4.6	4.0
at 18 hours	g/t	8.5	8.5	8.5	9.0	9.1	8.9	9.2	9.3	9.0	4.9	5.1	4.8	4.2	4.2	4.2	5.0	5.2	4.8
Assay Head	ppm Zn	362 (average of two splits)									208 (average of two splits)								
NaCN consumption																			
at 3 hours	kg/t	0.08	0.11	0.07	0.06	0.10	0.04	0.05	0.08	0.01	0.07	0.09	0.05	0.02	0.03	0.02	0.05	0.07	0.04
at 6 hours	kg/t	0.10	0.15	0.07	0.08	0.15	0.03	0.08	0.12	0.05	0.07	0.09	0.06	0.03	0.06	0.01	0.04	0.06	0.02
at 8 hours	kg/t	0.13	0.13	0.13	0.09	0.11	0.08	0.10	0.10	0.10	0.11	0.11	0.10	0.08	0.09	0.06	0.10	0.11	0.09
at 12 hours	kg/t	0.12	0.17	0.09	0.12	0.16	0.03	0.11	0.14	0.06	0.14	0.17	0.10	0.07	0.09	0.06	0.08	0.10	0.07
at 18 hours	kg/t	0.13	0.14	0.13	0.12	0.12	0.12	0.10	0.10	0.10	0.13	0.13	0.13	0.05	0.06	0.04	0.10	0.11	0.08
CaO consumption																			
at 3 hours	kg/t	1.72	2.12	1.55	1.69	1.97	1.50	1.68	1.96	1.53	1.99	2.10	1.91	1.88	1.97	1.77	1.83	1.91	1.73
at 6 hours	kg/t	1.81	2.10	1.55	1.79	1.99	1.50	1.76	1.98	1.53	1.99	2.10	1.92	1.88	1.98	1.76	1.84	1.93	1.75
at 8 hours	kg/t	2.04	2.10	1.98	1.98	1.99	1.97	1.97	1.99	1.95	2.07	2.12	2.03	1.95	1.99	1.91	1.86	1.92	1.80
at 12 hours	kg/t	1.73	1.87	1.57	1.73	1.91	1.54	1.67	1.81	1.55	1.97	2.07	1.92	1.86	1.95	1.78	1.83	1.92	1.76
at 18 hours	kg/t	1.58	1.59	1.57	1.56	1.58	1.55	1.57	1.57	1.57	1.96	1.99	1.92	1.83	1.90	1.76	1.87	1.92	1.83
Actual grind passing nominated um (%)		80.8	81.8	80.0	81.3	82.1	80.5	78.3	81.7	77.3	82.7	87.3	81.2	79.8	80.8	78.3	81.6	81.5	78.8

		COMPOSITE 8MT 1.0									COMPOSITE 8MT 1.2								
		P80=75um			P80=106um			P80=150um			P80=75um			P80=106um			P80=150um		
ANALYSIS																			
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18	8	12.6	18	8	12.7	18	8	12.6	18	8	12.6	18	8	12.7	18	8
Extraction Au																			
at 3 hours	g/t	0.85	0.88	0.82	0.78	0.84	0.74	0.72	0.75	0.67	0.81	0.87	0.75	0.70	0.76	0.53	0.68	0.73	0.61
at 6 hours	g/t	1.00	1.07	0.97	0.92	0.97	0.90	0.87	0.89	0.86	1.04	1.11	0.98	0.91	1.03	0.66	0.90	0.93	0.86
at 8 hours	g/t	1.04	1.06	1.03	0.95	0.96	0.93	0.93	0.93	0.93	1.06	1.10	1.02	0.79	0.89	0.70	0.97	0.98	0.95
at 12 hours	g/t	1.06	1.09	1.04	1.00	1.03	0.96	0.95	0.97	0.93	1.08	1.14	1.03	1.03	1.10	0.98	0.95	1.00	0.89
at 18 hours	g/t	1.08	1.09	1.06	1.03	1.06	1.01	0.97	0.98	0.96	1.10	1.14	1.06	1.07	1.07	1.06	1.02	1.03	1.01
at 3 hours	%	66.3	70.3	62.2	62.6	67.8	58.4	58.5	62.3	53.0	66.4	70.2	63.9	59.4	62.0	56.8	56.0	60.7	49.5
at 6 hours	%	78.3	83.0	75.3	74.4	78.5	71.2	70.7	74.1	67.2	84.8	87.4	83.4	77.6	80.1	74.2	73.8	76.4	69.5
at 8 hours	%	83.9	84.3	83.5	79.3	80.7	77.9	77.0	77.6	76.5	86.4	86.7	86.2	78.6	78.9	78.3	78.3	78.8	77.8
at 12 hours	%	82.3	84.5	80.2	79.2	83.2	76.0	76.0	77.0	75.1	88.1	89.2	87.1	83.5	85.4	80.1	78.8	79.8	77.8
at 18 hours	%	84.2	85.8	82.6	81.8	85.4	73.2	78.7	79.4	77.9	89.0	89.2	88.9	85.7	86.2	85.2	80.8	81.1	80.4
Calculated Head	ppm Au	1.28	1.31	1.22	1.24	1.36	1.15	1.24	1.28	1.20	1.22	1.28	1.17	1.17	1.39	0.88	1.22	1.28	1.13
Ground Head Assay 1	ppm Au	1.16	1.39	1.05	1.14	1.20	1.07	1.10	1.19	0.98	1.18	1.28	1.13	1.16	1.28	1.05	1.14	1.20	1.05
Ground Head Assay 2	ppm Au	1.19	1.57	1.09	1.13	1.19	1.08	1.16	1.22	1.02	1.18	1.29	1.05	1.15	1.28	1.04	1.19	1.30	1.11
Average Ground Head Assay	ppm Au	1.17	1.48	1.07	1.13	1.17	1.10	1.13	1.20	1.00	1.18	1.26	1.12	1.16	1.27	1.08	1.16	1.21	1.10
Calculated residue grade	ppm Au	0.21	0.26	0.18	0.25	0.30	0.17	0.28	0.32	0.25	0.15	0.18	0.13	0.20	0.25	0.17	0.25	0.28	0.24
Extraction Cu																			
at 3 hours	g/t	29	30	27	27	27	25	25	25	24	20	21	19	19	21	14	18	21	16
at 6 hours	g/t	34	36	31	33	34	31	31	33	31	22	24	19	23	25	17	23	24	23
at 8 hours	g/t	37	39	36	35	36	34	34	34	34	23	23	23	23	26	19	25	26	25
at 12 hours	g/t	37	39	36	37	37	36	36	37	36	26	26	25	26	26	26	26	27	26
at 18 hours	g/t	41	42	40	38	39	37	37	39	36	27	27	27	27	28	27	27	27	27
Assay Head	ppm Cu	360 (average of two splits)									280 (average of two splits)								
Extraction Zn																			
at 3 hours	g/t	4.6	5.1	4.2	4.5	5.0	3.9	4.4	4.8	3.9	2.3	2.4	2.2	2.1	2.3	1.6	2.3	2.4	2.2
at 6 hours	g/t	5.7	6.1	5.3	5.3	5.6	5.2	5.3	5.6	5.1	2.7	2.8	2.5	2.7	2.8	2.0	3.0	3.4	2.3
at 8 hours	g/t	8.1	8.6	7.6	7.0	7.1	6.9	6.8	7.0	6.5	2.9	2.9	2.8	2.6	3.1	2.2	3.0	3.0	3.0
at 12 hours	g/t	6.5	7.1	6.1	6.4	6.9	6.1	6.5	6.6	6.3	3.3	3.4	3.3	3.4	3.6	3.2	3.5	3.6	3.4
at 18 hours	g/t	7.0	7.0	6.9	7.3	7.3	7.3	7.7	8.0	7.4	3.8	3.9	3.7	3.9	3.9	3.9	4.0	4.0	4.0
Assay Head	ppm Zn	315 (average of two splits)									198 (average of two splits)								
NaCN consumption																			
at 3 hours	kg/t	0.15	0.18	0.08	0.15	0.21	0.10	0.23	0.47	0.10	0.10	0.17	0.03	0.10	0.15	0.08	0.10	0.19	0.07
at 6 hours	kg/t	0.19	0.22	0.14	0.17	0.21	0.13	0.07	0.14	-0.04	0.13	0.18	0.08	0.12	0.16	0.10	0.11	0.14	0.07
at 8 hours	kg/t	0.22	0.22	0.21	0.21	0.22	0.20	0.18	0.19	0.17	0.15	0.19	0.11	0.16	0.18	0.13	0.11	0.11	0.11
at 12 hours	kg/t	0.23	0.25	0.18	0.24	0.28	0.20	0.12	0.22	0.03	0.17	0.18	0.15	0.14	0.18	0.10	0.15	0.16	0.13
at 18 hours	kg/t	0.20	0.23	0.17	0.19	0.20	0.19	0.18	0.19	0.17	0.16	0.16	0.16	0.15	0.17	0.14	0.16	0.17	0.15
CaO consumption																			
at 3 hours	kg/t	1.89	2.10	1.57	1.83	1.96	1.60	1.83	2.00	1.57	1.56	1.61	1.46	1.48	1.55	1.32	1.50	1.54	1.48
at 6 hours	kg/t	1.91	2.12	1.59	1.84	1.98	1.62	1.95	2.29	1.58	1.55	1.60	1.47	1.48	1.54	1.31	1.50	1.54	1.47
at 8 hours	kg/t	1.97	2.01	1.93	2.00	2.01	1.98	1.97	2.03	1.92	1.57	1.60	1.54	1.40	1.48	1.31	1.51	1.54	1.49
at 12 hours	kg/t	1.89	2.13	1.59	1.79	1.91	1.62	1.95	2.30	1.58	1.56	1.59	1.47	1.52	1.54	1.49	1.50	1.52	1.46
at 18 hours	kg/t	1.64	1.69	1.59	1.64	1.65	1.62	1.60	1.63	1.57	1.58	1.58	1.58	1.53	1.56	1.50	1.51	1.53	1.48
Actual grind passing nominated um (%)		79.4	80.1	79.0	80.8	81.7	79.6	80.5	81.9	78.9	79.4	80.3	77.2	78.4	79.6	76.5	78.6	79.3	78.3

BMT 0.6
Sheets 1 - 13
Calc.

BMTS721 Sheet 1 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. 40

COMPOSITE BM7 0.6

SUMMARY

Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18
Extraction Au														
at 3 hours	g/t	0.48	0.47	0.57	0.50	0.53	0.50	0.54	0.47	0.44	0.48	0.48	0.51	0.51
at 6 hours	g/t	0.53	0.53	0.61	0.64	0.58	0.54	0.58	0.52	0.49	0.55	0.53	0.55	0.55
at 8 hours	g/t	0.55	0.55						0.53	0.51				
at 12 hours	g/t			0.61	0.62	0.66	0.55	0.60			0.56	0.56	0.57	0.58
at 18 hours	g/t						0.55	0.60						0.56
at 3 hours	%	74.2	72.4	79.5	68.3	69.2	78.2	79.3	73.5	68.7	68.4	71.6	73.5	73.5
at 6 hours	%	82.6	83.0	85.1	87.7	76.0	84.7	85.5	82.2	77.1	78.2	79.7	79.0	79.2
at 8 hours	%	84.7	85.3						84.1	81.0				
at 12 hours	%			84.7	85.2	87.1	86.5	87.5			79.6	83.2	82.2	83.0
at 18 hours	%						86.2	87.5						80.5
Calculated Head	ppm Au	0.65	0.64	0.72	0.72	0.76	0.63	0.68	0.63	0.63	0.70	0.67	0.69	0.69
Ground Head Assay 1	ppm Au	0.63	0.76	0.62	0.65	0.60	0.65	0.65	0.67	0.67	0.60	0.58	0.58	0.65
Ground Head Assay 2	ppm Au	0.64	0.67	0.63	0.60	0.59	0.67	0.69	0.70	0.60	0.62	0.59	0.58	0.65
Average Ground Head Assay	ppm Au	0.64	0.72	0.63	0.63	0.60	0.66	0.67	0.69	0.64	0.61	0.59	0.58	0.65
Calculated residue grade	ppm Au	0.10	0.10	0.11	0.10	0.10	0.09	0.09	0.10	0.13	0.14	0.11	0.12	0.14
Extraction Cu														
at 3 hours	g/t	2.4	2.3	2.9	7.1	2.7	3.0	2.5	2.0	1.8	2.7	2.7	2.3	2.7
at 6 hours	g/t	3.1	3.1	3.9	7.6	3.4	4.2	3.7	2.8	2.8	3.9	3.3	3.0	3.9
at 8 hours	g/t	3.6	3.6						3.6	3.2				
at 12 hours	g/t			4.7	8.9	4.6	5.0	4.7			4.8	4.3	4.3	5.1
at 18 hours	g/t						5.4	5.4						5.7
Assay Head	ppm Cu	292 (ave. of two head splits)												
Extraction Zn														
at 3 hours	g/t	4.2	4.2	4.7	5.7	5.0	5.4	5.4	4.2	3.9	5.1	5.3	4.8	5.9
at 6 hours	g/t	5.2	5.2	6.2	6.5	5.8	6.4	6.4	5.2	4.9	5.9	6.1	5.6	7.0
at 8 hours	g/t	5.7	6.0						5.7	5.6				
at 12 hours	g/t			6.9	8.0	7.2	7.6	7.6			7.7	7.4	7.1	8.6
at 18 hours	g/t						8.5	8.5						9.1
Assay Head	ppm Zn	362 (ave. of two head splits)												
NaCN consumption														
at 3 hours	kg/t	0.10	0.11	0.08	0.07	0.07	0.07	0.08	0.10	0.08	0.04	0.04	0.05	0.07
at 6 hours	kg/t	0.14	0.15	0.10	0.07	0.08	0.09	0.10	0.10	0.15	0.07	0.03	0.05	0.09
at 8 hours	kg/t	0.13	0.13						0.08	0.11				
at 12 hours	kg/t			0.09	0.09	0.10	0.17	0.17			0.13	0.03	0.11	0.16
at 18 hours	kg/t						0.14	0.13					-	0.12
CaO consumption														
at 3 hours	kg/t	1.99	2.12	1.58	1.63	1.58	1.57	1.55	1.97	1.95	1.62	1.61	1.67	1.50
at 6 hours	kg/t	1.99	2.10	1.81	1.87	1.82	1.56	1.55	1.99	1.97	1.82	1.81	1.91	1.50
at 8 hours	kg/t	1.98	2.10						1.99	1.97				
at 12 hours	kg/t			1.80	1.87	1.82	1.59	1.57			1.81	1.83	1.91	1.54
at 18 hours	kg/t						1.59	1.57						1.55
Actual grind passing nominated um (%)		80.0	81.8	80.3	80.7	81.2	80.9	81.0	81.3	82.1	80.9	80.5	82.0	80.9

BMT5721 Sheet 2 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

tests conducted (date)		2/10	2/10	27/9	27/9	27/9	28/9	28/9	2/10	2/10	27/9	27/9	27/9	28/9	28/9	2/10	2/10	27/9	27/9	28/9	28/9
Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A	4D	4A	5B	1A	7D	7C	1D
Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106	106	150	150	150	150	150	150
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18	18	8	8	12	12	18	18
Vessel	g	407.5	407.8	407.0	408.3	405.0	407.5	407.8	408.4	406.6	407.9	407.6	407.0	408.4	406.6	406.3	406.8	408.3	407.5	406.3	406.8
Sample mass	g	693.7	652.4	695.3	667.4	695.3	672.6	678.6	695.9	697.5	686.2	683.4	653.9	698.2	672.3	708.0	696.2	667.4	690.6	657.3	677.6
Sitewater added	g	1041	979	1043	1001	1043	1009	1018	1044	1046	1029	1025	981	1047	1008	1062	1044	1001	1034	986	1016
Natural pH		6.4	6.4	6.6	6.6	6.6			6.4	6.4	6.6	6.6	6.6			6.4	6.4	6.6	6.6		
CaO added	g	1.41	1.41	1.15	1.15	1.15	1.11	1.10	1.42	1.41	1.15	1.15	1.15	1.11	1.10	1.42	1.42	1.11	1.11	1.08	1.10
NaCN added	g	0.56	0.53	0.56	0.54	0.56	0.54	0.55	0.56	0.56	0.55	0.55	0.53	0.56	0.54	0.57	0.56	0.54	0.56	0.54	0.55
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2141.3	2039.0	2147.0	2077.1	2144.6	2089.2	2103.9	2149.2	2150.6	2122.9	2116.9	2042.2	2154.6	2066.6	2174.9	2150.3	2076.6	2133.0	2051.3	2100.1
Pulp temperature	deg C	16	16	18	18	18	18	18	16	16	18	18	18	18	18	16	16	18	18	18	18
Liquor sample A	pH	11.0	11.2	10.7	10.7	10.8	11.0	11.1	11.1	11.1	10.7	10.8	11.1	11.0	11.1	11.2	11.2	10.8	10.8	11.1	11.1
	ppm Au	0.32	0.31	0.38	0.33	0.35	0.33	0.36	0.31	0.29	0.32	0.32	0.34	0.34	0.32	0.30	0.32	0.32	0.33	0.33	0.31
	ppm Cu	1.6	1.5	1.9	4.7	1.8	2.0	1.7	1.3	1.2	1.8	1.8	1.5	1.8	1.7	1.4	1.3	1.4	1.5	1.6	1.6
	ppm Zn	2.8	2.8	3.1	3.8	3.3	3.6	3.6	2.8	2.6	3.4	3.5	3.2	3.9	3.8	3.0	3.0	3.4	3.5	3.9	3.8
	% NaCN	0.047	0.047	0.048	0.049	0.049	0.049	0.049	0.047	0.048	0.051	0.051	0.051	0.049	0.049	0.049	0.048	0.053	0.053	0.051	0.051
	% CaO	0.003	0.003	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.005	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.006	0.006
Gross after sample	g	2087.5	1981.7	2099.4	2034.4	2101.3	2036.6	2051.4	2091.6	2093.8	2071.5	2065.2	1996.3	2103.0	2033.5	2118.8	2094.1	2023.5	2082.1	1998.1	2048.2
CaO added	g			0.15	0.15	0.15					0.15	0.15	0.15					0.15	0.15		
NaCN added	g	0.03	0.03						0.03	0.02						0.01	0.02				
Leach time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2141.2	2030.3	2146.2	2076.7	2144.2	2088.7	2103.2	2147.8	2150.3	2122.5	2116.3	2041.4	2153.9	2086.2	2175.3	2146.7	2076.1	2131.7	2051.0	2099.4
Pulp temperature	deg C	17	17	20	20	20	19	19	17	17	20	20	20	19	19	17	17	20	20	19	19
Liquor sample B	pH	10.9	11.1	11.1	11.0	11.1	11.0	11.0	10.9	10.9	11.1	11.1	11.2	10.9	11.0	11.0	11.0	11.2	11.2	11.0	11.0
	ppm Au	0.34	0.34	0.39	0.41	0.37	0.34	0.37	0.33	0.31	0.35	0.34	0.35	0.35	0.34	0.33	0.34	0.34	0.31	0.32	0.32
	ppm Cu	2.0	2.0	2.5	4.9	2.2	2.7	2.4	1.8	1.8	2.5	2.1	1.9	2.5	2.3	1.8	1.6	1.9	1.9	2.2	2.2
	ppm Zn	3.3	3.3	4.0	4.2	3.7	4.1	4.1	3.3	3.1	3.8	3.9	3.6	4.5	4.4	3.3	3.3	3.8	4.0	4.9	4.3
	% NaCN	0.045	0.045	0.045	0.047	0.046	0.045	0.045	0.047	0.043	0.046	0.049	0.048	0.045	0.045	0.044	0.045	0.048	0.047	0.047	0.047
	% CaO	0.003	0.004	0.004	0.005	0.003	0.005	0.005	0.003	0.003	0.005	0.006	0.005	0.006	0.006	0.003	0.004	0.005	0.005	0.006	0.006
Gross after sample	g	2083.4	1974.0	2097.2	2032.6	2097.6	2035.3	2049.7	2091.1	2095.2	2072.8	2067.5	1998.6	2100.0	2033.1	2119.0	2090.5	2027.4	2084.1	1997.0	2045.7
CaO added	g																				
NaCN added	g	0.05	0.05	0.05	0.03	0.04	0.05	0.05	0.03	0.07	0.04	0.01	0.02	0.05	0.05	0.06	0.05	0.02	0.03	0.03	0.03
Leach time	hrs	2	2	6	6	6	6	6	2	2	6	6	6	6	6	2	2	6	6	6	6
Gross off rolls	g	2141.2	2030.4	2145.4	2076.1	2143.4	2087.6	2102.0	2147.5	2149.9	2120.8	2115.5	2040.3	2152.9	2085.1	2175.4	2145.8	2075.3	2130.1	2050.2	2098.1
Pulp temperature	deg C	18	18	19	19	19	18	18	18	18	19	19	19	18	18	18	18	19	19	18	18
Liquor sample C	pH	10.8	11.0	11.0	11.0	11.1	10.8	10.9	10.9	10.9	11.1	11.1	11.2	10.8	10.9	10.9	11.0	11.1	11.1	10.9	10.9
	ppm Au	0.33	0.33	0.37	0.38	0.41	0.33	0.36	0.32	0.31	0.34	0.34	0.35	0.35	0.34	0.32	0.33	0.34	0.31	0.32	0.31
	ppm Cu	2.2	2.2	2.9	5.5	2.9	3.1	2.9	2.2	2.0	3.0	2.7	2.7	3.2	3.1	2.0	1.9	2.6	2.7	2.8	3.0
	ppm Zn	3.5	3.7	4.3	5.0	4.5	4.7	4.7	3.5	3.4	4.8	4.6	4.4	5.3	5.1	3.6	3.6	4.6	4.8	5.2	5.3
	% NaCN	0.048	0.049	0.048	0.047	0.047	0.042	0.043	0.049	0.050	0.044	0.048	0.044	0.043	0.043	0.049	0.049	0.047	0.046	0.043	0.043
	% CaO	0.003	0.004	0.004	0.005	0.003	0.003	0.003	0.003	0.003	0.005	0.004	0.005	0.003	0.003	0.003	0.003	0.005	0.005	0.004	0.004
Gross after sample	g						2029.8	2043.8						2096.9	2027.5					1991.2	2038.6
CaO added	g																				
NaCN added	g						0.08	0.07						0.07	0.07					0.07	0.07
Leach time	hrs						6	6						6	6					6	6
Gross off rolls	g						2088.0	2100.4						2152.4	2084.3					2050.0	2096.8
Pulp temperature	deg C						16	16						16	16					16	16
Liquor sample D	pH						10.8	10.9						10.8	10.8					10.9	10.9
	ppm Au						0.31	0.34						0.32	0.31					0.31	0.30
	ppm Cu						3.2	3.2						3.4	3.2					3.0	3.1
	ppm Zn						5.0	5.0						5.4	5.2					5.4	5.3
	% NaCN						0.050	0.050						0.050	0.050					0.050	0.050
	% CaO						0.003	0.003						0.002	0.003					0.004	0.003
Sample mass account																					
Residue recovered (screened)	g	690.1	630.1	674.9	685.6	691.0	669.9	678.3	687.1	665.9	677.8	682.9	654.3	696.8	670.9	706.8	695.2	669.1	697.1	655.7	677.0
Ground head to assay	g	110.5	96.3	104.8	107.0	104.5	97.9	99.5	110.5	106.5	111.1	111.1	100.1	109.2	99.1	114.0	113.4	107.5	122.0	104.2	114.5
Calculated head to grind	g	800.6	726.4	779.7	792.6	795.5	767.8	777.8	797.6	772.4	788.9	794.0	754.4	806.0	770.0	820.8	808.6	776.6	819.1	759.9	791.5
Actual head to grind	g	804.2	748.7	800.1	774.4	800.4	770.5	778.1	806.4	804.0	797.3	794.5	754.0	807.4	771.4	822.0	809.6	774.9	812.6	761.5	792.1
Unaccounted mass	%	0.45	2.98	2.55	-2.35	0.61	0.35	0.04	1.09	3.93	1.05	0.06	-0.05	0.17	0.18	0.15	0.12	-0.22	-0.80	0.21	0.08

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 3C		**Nom. P80um 75**		**Leach hrs 8**				
+ 150		0.0	100.0					0.0
- 150 + 106	46.3	6.7	93.3	0.26		0.26	12.04	17.5
- 106 + 75	92.0	13.3	80.0	0.17	0.17	0.17	15.64	22.8
- 75 + 53	68.5	9.9	70.0	0.21		0.21	14.39	21.0
- 53	483.3	70.0		0.06	0.05	0.06	26.58	38.7
Calculated	690.1	100.0				0.10	68.6	100.0
Test No. 6D		**Nom. P80um 75**		**Leach hrs 8**				
+ 150		0.0	100.0					0.0
- 150 + 106	37.2	5.9	94.1	0.24		0.24	8.93	14.5
- 106 + 75	77.5	12.3	81.8	0.24	0.19	0.22	16.66	27.0
- 75 + 53	65.5	10.4	71.4	0.14		0.14	9.17	14.8
- 53	449.9	71.4		0.06	0.06	0.06	26.99	43.7
Calculated	630.1	100.0				0.10	61.8	100.0
Test No. 3B		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					0.0
- 150 + 106	46.5	6.9	93.1	0.24		0.24	11.16	14.6
- 106 + 75	86.2	12.8	80.3	0.26	0.22	0.24	20.69	27.1
- 75 + 53	66.7	9.9	70.5	0.17		0.17	11.34	14.8
- 53	475.5	70.5		0.06	0.08	0.07	33.29	43.5
Calculated	674.9	100.0				0.11	76.5	100.0
Test No. 6C		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					0.0
- 150 + 106	44.3	6.5	93.5	0.39		0.39	17.28	24.2
- 106 + 75	88.0	12.8	80.7	0.20	0.17	0.19	16.28	22.8
- 75 + 53	72.1	10.5	70.2	0.12	0.13	0.13	9.01	12.6
- 53	481.2	70.2		0.06	0.06	0.06	28.87	40.4
Calculated	685.6	100.0				0.10	71.4	100.0
Test No. 3D		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					0.0
- 150 + 106	43.1	6.2	93.8	0.23		0.23	9.91	14.6
- 106 + 75	87.1	12.6	81.2	0.20	0.20	0.20	17.42	25.6
- 75 + 53	75.2	10.9	70.3	0.15	0.16	0.16	11.66	17.1
- 53	485.6	70.3		0.06	0.06	0.06	29.14	42.8
Calculated	691.0	100.0				0.10	68.1	100.0

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.6 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8A	Nom. P80um 75	Leach hrs 18						
+ 150		0.0	100.0					0.0
- 150 + 106	39.9	6.0	94.0	0.23		0.23	9.18	15.7
- 106 + 75	87.8	13.1	80.9	0.17	0.17	0.17	14.93	25.5
- 75 + 53	71.2	10.6	70.3	0.13	0.11	0.12	8.54	14.6
- 53	471.0	70.3		0.05	0.06	0.06	25.91	44.2
Calculated	669.9	100.0				0.09	58.6	100.0
Test No. 4B	Nom. P80um 75	Leach hrs 18						
+ 150		0.0	100.0					0.0
- 150 + 106	39.4	5.8	94.2	0.23		0.23	9.06	15.7
- 106 + 75	89.5	13.2	81.0	0.17	0.17	0.17	15.22	26.4
- 75 + 53	74.5	11.0	70.0	0.13	0.13	0.13	9.69	16.8
- 53	474.9	70.0		0.06	0.04	0.05	23.75	41.1
Calculated	678.3	100.0				0.09	57.7	100.0
Test No. 1B	Nom. P80um 106	Leach hrs 8						
+ 150	45.3	6.6	93.4	0.22		0.22	9.97	14.2
- 150 + 106	83.5	12.2	81.3	0.21	0.22	0.22	17.95	25.6
- 106 + 75	92.9	13.5	67.7	0.20	0.15	0.18	16.26	23.2
- 75 + 53	58.6	8.5	59.2	0.13		0.13	7.62	10.9
- 53	406.8	59.2		0.04	0.05	0.05	18.31	26.1
Calculated	687.1	100.0				0.10	70.1	100.0
Test No. 5C	Nom. P80um 106	Leach hrs 8						
+ 150	40.1	6.0	94.0	0.26		0.26	10.43	12.4
- 150 + 106	79.4	11.9	82.1	0.45	0.25	0.35	27.79	33.1
- 106 + 75	91.8	13.8	68.3	0.17	0.16	0.17	15.15	18.0
- 75 + 53	59.8	9.0	59.3	0.15		0.15	8.97	10.7
- 53	394.8	59.3		0.06	0.05	0.06	21.71	25.8
Calculated	665.9	100.0				0.13	84.0	100.0
Test No. 7A	Nom. P80um 106	Leach hrs 12						
+ 150	46.7	6.9	93.1	0.44		0.44	20.55	20.9
- 150 + 106	82.7	12.2	80.9	0.25	0.30	0.28	22.74	23.2
- 106 + 75	86.9	12.8	68.1	0.17	0.21	0.19	16.51	16.8
- 75 + 53	59.8	8.8	59.3	0.17		0.17	10.17	10.4
- 53	401.7	59.3		0.08	0.06	0.07	28.12	28.7
Calculated	677.8	100.0				0.14	98.1	100.0

BMT5721 Sheet 5 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.6 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8B	Nom. P80um 106	Leach hrs 12						
+ 150	50.0	7.3	92.7	0.26		0.26	13.00	16.9
- 150 + 106	83.5	12.2	80.5	0.23	0.25	0.24	20.04	26.0
- 106 + 75	89.7	13.1	67.3	0.18	0.18	0.18	16.15	21.0
- 75 + 53	56.6	8.3	59.0	0.17		0.17	9.62	12.5
- 53	403.1	59.0		0.04	0.05	0.05	18.14	23.6
Calculated	682.9	100.0				0.11	76.9	100.0
Test No. 2C	Nom. P80um 106	Leach hrs 12						
+ 150	40.3	6.2	93.8	0.27		0.27	10.88	13.5
- 150 + 106	77.2	11.8	82.0	0.24	0.26	0.25	19.30	23.9
- 106 + 75	83.6	12.8	69.3	0.27	0.22	0.25	20.48	25.4
- 75 + 53	57.4	8.8	60.5	0.18		0.18	10.33	12.8
- 53	395.8	60.5		0.05	0.05	0.05	19.79	24.5
Calculated	654.3	100.0				0.12	80.8	100.0
Test No. 6A	Nom. P80um 106	Leach hrs 18						
+ 150	49.8	7.1	92.9	0.27		0.27	13.45	14.2
- 150 + 106	83.3	12.0	80.9	0.29	0.26	0.28	22.91	24.3
- 106 + 75	94.8	13.6	67.3	0.19	0.18	0.19	17.54	18.6
- 75 + 53	61.6	8.8	58.5	0.21	0.18	0.20	12.01	12.7
- 53	407.3	58.5		0.07	0.07	0.07	28.51	30.2
Calculated	696.8	100.0				0.14	94.4	100.0
Test No. 4D	Nom. P80um 106	Leach hrs 18						
+ 150	46.8	7.0	93.0	0.24		0.24	11.23	12.7
- 150 + 106	79.7	11.9	81.1	0.25	0.27	0.27	21.12	24.0
- 106 + 75	87.1	13.0	68.2	0.21	0.18	0.20	16.98	19.3
- 75 + 53	60.0	8.9	59.2	0.15		0.15	9.00	10.2
- 53	397.3	59.2		0.08	0.07	0.08	29.80	33.8
Calculated	670.9	100.0				0.13	88.1	100.0
Test No. 4A	Nom. P80um 150	Leach hrs 8						
+ 150	144.5	20.4	79.6	0.26	0.26	0.26	37.57	37.5
- 150 + 106	84.2	11.9	67.6	0.22	0.21	0.22	18.19	18.1
- 106 + 75	76.7	10.9	56.8	0.19	0.26	0.23	17.26	17.2
- 75 + 53	44.7	6.3	50.5	0.13		0.13	5.81	5.8
- 53	356.7	50.5		0.06	0.06	0.06	21.40	21.4
Calculated	706.8	100.0				0.14	100.1	100.0

BMT5721 Sheet 6 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.6 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 5B	Nom. P80um 150	Leach hrs 8						
+ 150	139.2	20.0	80.0	0.30	0.30	0.30	41.76	41.5
- 150 + 106	83.4	12.0	68.0	0.22	0.23	0.23	18.77	18.7
- 106 + 75	73.7	10.6	57.4	0.20	0.18	0.19	14.00	13.9
- 75 + 53	47.8	6.9	50.5	0.14		0.14	6.69	6.7
- 53	351.1	50.5		0.06	0.05	0.06	19.31	19.2
Calculated	695.2	100.0				0.14	100.5	100.0
Test No. 1A	Nom. P80um 150	Leach hrs 12						
+ 150	163.8	24.5	75.5	0.28	0.33	0.31	49.96	43.1
- 150 + 106	75.7	11.3	64.2	0.25	0.25	0.25	18.93	16.3
- 106 + 75	61.2	9.1	55.1	0.18		0.18	11.02	9.5
- 75 + 53	42.5	6.4	48.7	0.16		0.16	6.80	5.9
- 53	325.9	48.7		0.09	0.09	0.09	29.33	25.3
Calculated	669.1	100.0				0.17	116.0	100.0
Test No. 7D	Nom. P80um 150	Leach hrs 12						
+ 150	189.5	27.2	72.8	0.22	0.22	0.22	41.69	50.0
- 150 + 106	71.7	10.3	62.5	0.24	0.21	0.23	16.13	19.3
- 106 + 75	62.4	9.0	53.6	0.15		0.15	9.36	11.2
- 75 + 53	42.1	6.0	47.5	0.15		0.15	6.32	7.6
- 53	331.4	47.5		0.02	0.04	0.03	9.94	11.9
Calculated	697.1	100.0				0.12	83.4	100.0
Test No. 7C	Nom. P80um 150	Leach hrs 18						
+ 150	119.8	18.3	81.7	0.28	0.28	0.28	33.54	31.5
- 150 + 106	80.8	12.3	69.4	0.29	0.29	0.29	23.43	22.0
- 106 + 75	65.7	10.0	59.4	0.24	0.24	0.24	15.77	14.8
- 75 + 53	46.5	7.1	52.3	0.17		0.17	7.91	7.4
- 53	342.9	52.3		0.08	0.07	0.08	25.72	24.2
Calculated	655.7	100.0				0.16	106.4	100.0
Test No. 1D	Nom. P80um 150	Leach hrs 18						
+ 150	134.5	19.9	80.1	0.23	0.24	0.24	31.61	38.9
- 150 + 106	77.5	11.4	68.7	0.27	0.24	0.26	19.76	24.3
- 106 + 75	68.5	10.1	58.6	0.13	0.12	0.13	8.56	10.5
- 75 + 53	47.6	7.0	51.5	0.08		0.08	3.81	4.7
- 53	348.9	51.5		0.05	0.05	0.05	17.45	21.5
Calculated	677.0	100.0				0.12	81.2	100.0

BMT5720 Sheet 7 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 0.6		P80=75um			P80=106um			P80=150um		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18.0	8.0	12.6	18.0	8.0	12.7	18.0	8.0
Extraction Au										
at 3 hours	g/t	0.51	0.57	0.47	0.48	0.51	0.44	0.48	0.50	0.45
at 6 hours	g/t	0.57	0.64	0.53	0.53	0.55	0.49	0.51	0.54	0.49
at 8 hours	g/t	0.55	0.55	0.55	0.52	0.53	0.51	0.54	0.55	0.53
at 12 hours	g/t	0.61	0.66	0.55	0.56	0.58	0.56	0.53	0.56	0.51
at 18 hours	g/t	0.57	0.60	0.55	0.55	0.56	0.54	0.54	0.55	0.52
at 3 hours	%	74.4	79.5	68.3	71.5	73.5	68.4	70.4	78.5	65.4
at 6 hours	%	83.5	87.7	76.0	79.2	82.2	77.1	75.8	78.1	71.6
at 8 hours	%	85.0	85.3	84.7	82.5	84.1	81.0	79.0	79.1	78.9
at 12 hours	%	86.2	87.5	84.7	82.2	83.2	79.6	78.0	80.8	75.2
at 18 hours	%	86.9	87.5	86.2	80.6	80.6	80.5	79.3	81.4	77.2
Calculated Head	ppm Au	0.69	0.76	0.63	0.67	0.70	0.63	0.68	0.73	0.63
Ground Head Assay 1	ppm Au	0.65	0.76	0.60	0.62	0.67	0.58	0.62	0.64	0.56
Ground Head Assay 2	ppm Au	0.64	0.69	0.59	0.63	0.70	0.58	0.63	0.68	0.55
Average Ground Head Assay	ppm Au	0.65	0.72	0.60	0.63	0.69	0.58	0.62	0.66	0.56
Calculated residue grade	ppm Au	0.10	0.11	0.09	0.13	0.14	0.10	0.14	0.17	0.12
Extraction Cu										
at 3 hours	g/t	3.3	7.1	2.3	2.4	2.7	1.8	2.2	2.4	2.0
at 6 hours	g/t	4.2	7.6	3.1	3.3	3.9	2.8	3.0	3.4	2.5
at 8 hours	g/t	3.6	3.6	3.6	3.4	3.6	3.2	3.2	3.3	3.1
at 12 hours	g/t	5.6	8.9	4.6	4.7	5.1	4.3	4.4	4.8	4.1
at 18 hours	g/t	5.4	5.4	5.4	5.5	5.7	5.4	5.1	5.2	5.1
Assay Head	ppm Cu									
Extraction Zn										
at 3 hours	g/t	4.9	5.7	4.2	5.0	5.9	3.9	5.2	5.9	4.5
at 6 hours	g/t	6.0	6.5	5.2	6.0	7.0	4.9	6.2	7.7	5.2
at 8 hours	g/t	5.9	6.0	5.7	5.7	5.7	5.6	5.9	5.9	5.9
at 12 hours	g/t	7.5	8.0	6.9	7.8	8.6	7.1	8.1	8.6	7.4
at 18 hours	g/t	8.5	8.5	8.5	9.0	9.1	8.9	9.2	9.3	9.0
Assay Head	ppm Zn									
NaCN consumption										
at 3 hours	kg/t	0.08	0.11	0.07	0.06	0.10	0.04	0.05	0.08	0.01
at 6 hours	kg/t	0.10	0.15	0.07	0.08	0.15	0.03	0.08	0.12	0.05
at 8 hours	kg/t	0.13	0.13	0.13	0.09	0.11	0.08	0.10	0.10	0.10
at 12 hours	kg/t	0.12	0.17	0.09	0.12	0.16	0.03	0.11	0.14	0.06
at 18 hours	kg/t	0.13	0.14	0.13	0.12	0.12	0.12	0.10	0.10	0.10
CaO consumption										
at 3 hours	kg/t	1.72	2.12	1.55	1.69	1.97	1.50	1.68	1.96	1.53
at 6 hours	kg/t	1.81	2.10	1.55	1.79	1.99	1.50	1.76	1.98	1.53
at 8 hours	kg/t	2.04	2.10	1.98	1.98	1.99	1.97	1.97	1.99	1.95
at 12 hours	kg/t	1.73	1.87	1.57	1.73	1.91	1.54	1.67	1.81	1.55
at 18 hours	kg/t	1.58	1.59	1.57	1.56	1.58	1.55	1.57	1.57	1.57
Actual grind passing nominated um (%)		80.8	81.8	80.0	81.3	82.1	80.5	76.3	81.7	72.8

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

Summary of 8 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3C	75	0.10	0.00	0.26	0.17	0.21	0.06
6D	75	0.10	0.00	0.24	0.22	0.14	0.06
Average		0.10	0.00	0.25	0.19	0.18	0.06
1B	106	0.10	0.22	0.22	0.18	0.13	0.05
5C	106	0.13	0.26	0.35	0.17	0.15	0.06
Average		0.11	0.24	0.28	0.17	0.14	0.05
4A	150	0.14	0.26	0.22	0.23	0.13	0.06
5B	150	0.14	0.30	0.23	0.19	0.14	0.06
Average		0.14	0.28	0.22	0.21	0.14	0.06

Summary of 12 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3B	75	0.11	0.00	0.24	0.24	0.17	0.07
6C	75	0.10	0.00	0.39	0.19	0.13	0.06
3D	75	0.10	0.00	0.23	0.20	0.16	0.06
Average		0.11	0.00	0.29	0.21	0.15	0.06
7A	106	0.14	0.44	0.28	0.19	0.17	0.07
8B	106	0.11	0.26	0.24	0.18	0.17	0.05
2C	106	0.12	0.27	0.25	0.25	0.18	0.05
Average		0.13	0.32	0.26	0.21	0.17	0.06
1A	150	0.17	0.31	0.25	0.18	0.16	0.09
7D	150	0.12	0.22	0.23	0.15	0.15	0.03
Average		0.15	0.26	0.24	0.17	0.16	0.06

Summary of 18 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
8A	75	0.09	0.00	0.23	0.17	0.12	0.06
4B	75	0.09	0.00	0.23	0.17	0.13	0.05
Average		0.09	0.00	0.23	0.17	0.13	0.05
6A	106	0.14	0.27	0.28	0.19	0.20	0.07
4D	106	0.13	0.24	0.27	0.20	0.15	0.08
Average		0.13	0.26	0.27	0.19	0.17	0.07
7C	150	0.16	0.28	0.29	0.24	0.17	0.08
1D	150	0.12	0.24	0.26	0.13	0.08	0.05
Average		0.14	0.26	0.27	0.18	0.13	0.06

BMT5721 Sheet 9 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.6 |

Summary of Residue Size Fraction Assays

Leach Time	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
18 Hour (2 tests)	150	0.14	0.26	0.27	0.18	0.13	0.06
12 Hour (2 tests)	150	0.15	0.26	0.24	0.17	0.16	0.06
8 Hour (2 tests)	150	0.14	0.28	0.22	0.21	0.14	0.06
Weighted Ave.		0.14	0.27	0.24	0.19	0.14	0.06
18 Hour (2 tests)	106	0.13	0.26	0.27	0.19	0.17	0.07
12 Hour (3 tests)	106	0.13	0.32	0.26	0.21	0.17	0.06
8 Hour (2 tests)	106	0.11	0.24	0.28	0.17	0.14	0.05
Weighted Ave.		0.13	0.28	0.27	0.19	0.16	0.06
18 Hour (2 tests)	75	0.09	0.00	0.23	0.17	0.13	0.05
12 Hour (3 tests)	75	0.11	0.00	0.29	0.21	0.15	0.06
8 Hour (2 tests)	75	0.10	0.00	0.25	0.19	0.18	0.06
Weighted Ave.		0.10	0.00	0.26	0.19	0.15	0.06

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

Summary of 8 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3C	75	0.10	0.0	17.5	22.8	21.0	38.7
6D	75	0.10	0.0	14.5	27.0	14.8	43.7
Average		0.10	0.0	16.0	24.9	17.9	41.2
1B	106	0.10	14.2	25.6	23.2	10.9	26.1
5C	106	0.13	12.4	33.1	18.0	10.7	25.8
Average		0.11	13.3	29.3	20.6	10.8	26.0
4A	150	0.14	37.5	18.1	17.2	5.8	21.4
5B	150	0.14	41.5	18.7	13.9	6.7	19.2
Average		0.14	39.5	18.4	15.6	6.2	20.3

Summary of 12 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3B	75	0.11	0.0	14.6	27.1	14.8	43.5
6C	75	0.10	0.0	24.2	22.8	12.6	40.4
3D	75	0.10	0.0	14.6	25.6	17.1	42.8
Average		0.11	0.0	17.8	25.1	14.9	42.2
7A	106	0.14	20.9	23.2	16.8	10.4	28.7
8B	106	0.11	16.9	26.0	21.0	12.5	23.6
2C	106	0.12	13.5	23.9	25.4	12.8	24.5
Average		0.13	17.1	24.4	21.1	11.9	25.6
1A	150	0.17	43.1	16.3	9.5	5.9	25.3
7D	150	0.12	50.0	19.3	11.2	7.6	11.9
Average		0.15	46.5	17.8	10.4	6.7	18.6

Summary of 18 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
8A	75	0.09	0.0	15.7	25.5	14.6	44.2
4B	75	0.09	0.0	15.7	26.4	16.8	41.1
Average		0.09	0.0	15.7	25.9	15.7	42.7
6A	106	0.14	14.2	24.3	18.6	12.7	30.2
4D	106	0.13	12.7	24.0	19.3	10.2	33.8
Average		0.13	13.5	24.1	18.9	11.5	32.0
7C	150	0.16	31.5	22.0	14.8	7.4	24.2
1D	150	0.12	38.9	24.3	10.5	4.7	21.5
Average		0.14	35.2	23.2	12.7	6.1	22.8

BMT5721 Sheet 11 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.6 |

Summary of Residue Size Fraction Gold Distribution

Leach Time	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
18 Hour (2 tests)	150	0.14	35.2	23.2	12.7	6.1	22.8
12 Hour (2 tests)	150	0.15	46.5	17.8	10.4	6.7	18.6
8 Hour (2 tests)	150	0.14	39.5	18.4	15.6	6.2	20.3
Weighted Ave.		0.14	40.4	19.8	12.9	6.3	20.6
18 Hour (2 tests)	106	0.13	13.5	24.1	18.9	11.5	32.0
12 Hour (3 tests)	106	0.13	17.1	24.4	21.1	11.9	25.6
8 Hour (2 tests)	106	0.11	13.3	29.3	20.6	10.8	26.0
Weighted Ave.		0.13	15.0	25.7	20.3	11.4	27.5
18 Hour (2 tests)	75	0.09	0.0	15.7	25.9	15.7	42.7
12 Hour (3 tests)	75	0.11	0.0	17.8	25.1	14.9	42.2
8 Hour (2 tests)	75	0.10	0.0	16.0	24.9	17.9	41.2
Weighted Ave.		0.10	0.0	16.7	25.3	16.0	42.1

BMT5721 Sheet 12 16-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

Summary of L.S.& A. 8 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3C	75	0.62	0.64	0.65	0.10	84.7	8	40	0.048	10.8	0.13	1.98	292	3.6	1.2	362	5.7	1.6
6D	75	0.62	0.72	0.64	0.10	85.3	8	40	0.049	11.0	0.13	2.10	292	3.6	1.2	362	6.0	1.7
Average		0.62	0.68	0.64	0.10	85.0	8	40	0.049	10.9	0.13	2.04	292	3.6	1.2	362	5.9	1.6
1B	106	0.62	0.69	0.63	0.10	84.1	8	40	0.049	10.9	0.08	1.99	292	3.6	1.2	362	5.7	1.6
5C	106	0.62	0.64	0.63	0.13	81.0	8	40	0.050	10.9	0.11	1.97	292	3.2	1.1	362	5.6	1.5
Average		0.62	0.66	0.63	0.11	82.5	8	40	0.050	10.9	0.09	1.98	292	3.4	1.2	362	5.7	1.6
4A	150	0.62	0.65	0.67	0.14	78.9	8	40	0.049	10.9	0.10	1.95	292	3.3	1.1	362	5.9	1.6
5B	150	0.62	0.66	0.69	0.14	79.1	8	40	0.049	11.0	0.10	1.99	292	3.1	1.1	362	5.9	1.6
Average		0.62	0.65	0.68	0.14	79.0	8	40	0.049	11.0	0.10	1.97	292	3.2	1.1	362	5.9	[illegible]

Summary of L.S.& A. 12 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3B	75	0.62	0.63	0.72	0.11	84.7	12	40	0.048	11.0	0.09	1.80	292	4.7	1.6	362	6.9	1.9
6C	75	0.62	0.63	0.72	0.10	85.2	12	40	0.047	11.0	0.09	1.87	292	8.9	3.0	362	8.0	2.2
3D	75	0.62	0.60	0.76	0.10	87.1	12	40	0.047	11.1	0.10	1.82	292	4.6	1.6	362	7.2	2.0
Average		0.62	0.62	0.73	0.11	85.7	12	40	0.047	11.0	0.09	1.83	292	6.0	2.1	362	7.4	2.0
7A	106	0.62	0.61	0.70	0.14	79.6	12	40	0.044	11.1	0.13	1.81	292	4.8	1.6	362	7.7	2.1
8B	106	0.62	0.59	0.67	0.11	83.2	12	40	0.048	11.1	0.03	1.83	292	4.3	1.5	362	7.4	2.1
2C	106	0.62	0.58	0.69	0.12	82.2	12	40	0.044	11.2	0.11	1.91	292	4.3	1.5	362	7.1	1.9
Average		0.62	0.59	0.69	0.13	81.7	12	40	0.045	11.1	0.09	1.85	292	4.5	1.5	362	7.4	2.0
1A	150	0.62	0.60	0.73	0.17	76.3	12	40	0.047	11.1	0.06	1.81	292	4.1	1.4	362	7.4	2.1
7D	150	0.62	0.56	0.63	0.12	80.8	12	40	0.046	11.1	0.10	1.74	292	4.3	1.5	362	7.7	2.1
Average		0.62	0.58	0.68	0.15	78.6	12	40	0.047	11.1	0.08	1.77	292	4.2	1.4	362	7.6	2.1

Summary of L.S.& A. 18 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
8A	75	0.62	0.66	0.63	0.09	86.2	18	40	0.050	10.8	0.14	1.59	292	5.4	1.9	362	8.5	2.3
4B	75	0.62	0.67	0.68	0.09	87.5	18	40	0.050	10.9	0.13	1.57	292	5.4	1.8	362	8.5	2.3
Average		0.62	0.67	0.66	0.09	86.9	18	40	0.050	10.9	0.13	1.58	292	5.4	1.8	362	8.5	2.3
6A	106	0.62	0.65	0.69	0.14	80.5	18	40	0.050	10.8	0.12	1.55	292	5.7	1.9	362	9.1	2.5
4D	106	0.62	0.64	0.68	0.13	80.6	18	40	0.050	10.8	0.12	1.58	292	5.4	1.8	362	8.9	2.4
Average		0.62	0.64	0.69	0.13	80.6	18	40	0.050	10.8	0.12	1.56	292	5.5	1.9	362	9.0	[illegible]
7C	150	0.62	0.64	0.71	0.16	77.2	18	40	0.050	10.9	0.10	1.57	292	5.1	1.7	362	9.3	2.6
1D	150	0.62	0.63	0.64	0.12	81.4	18	40	0.050	10.9	0.10	1.57	292	5.2	1.8	362	9.0	2.5
Average		0.62	0.64	0.68	0.14	79.3	18	40	0.050	10.9	0.10	1.57	292	5.1	1.8	362	9.2	2.5

BMT5721 Sheet 13 16-Oct-89

BILLITON BT 7390 WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.6 |

Summary of L.S.& G. Bottle Roll Leach Test Results

Leach Time	Grind P80 um	Head Grade Assay Comp. ppm Au	Head Grade Ground Head ppm Au	Au Leach Results Calc'd Head ppm Au	Au Leach Results Residue Solids ppm Au	Au Leach Results Extr'n %	Leach Parameters Time Hours	Leach Parameters Pulp % Solids	Leach Parameters % NaCN	Leach Parameters pH	Reagent Consumption NaCN kg/t	Reagent Consumption CaO kg/t	Cu Leach Results Assay Head ppm	Cu Leach Results Extraction g/t	Cu Leach Results Extraction %	Zn Leach Results Assay Head ppm	Zn Leach Results Extraction g/t	Zn Leach Results Extraction %
18 Hour (2 tests)	150	0.62	0.64	0.68	0.14	79.3	18	40	0.050	10.9	0.10	1.57	292	5.1	1.8	362	9.2	2.5
12 Hour (2 tests)	150	0.62	0.58	0.68	0.15	78.6	12	40	0.047	11.1	0.08	1.77	292	4.2	1.4	362	7.6	2.1
8 Hour (2 tests)	150	0.62	0.65	0.68	0.14	79.0	8	40	0.049	11.0	0.10	1.97	292	3.2	1.1	362	5.9	1.6
Weighted Ave.		0.62	0.62	0.68	0.14	79.0	13	40	0.049	11.0	0.09	1.77	292	4.2	1.4	362	7.5	2.1
18 Hour (2 tests)	106	0.62	0.64	0.69	0.13	80.6	18	40	0.050	10.8	0.12	1.56	292	5.5	1.9	362	9.0	2.5
12 Hour (3 tests)	106	0.62	0.59	0.69	0.13	81.7	12	40	0.045	11.1	0.09	1.85	292	4.5	1.5	362	7.4	2.0
8 Hour (2 tests)	106	0.62	0.66	0.63	0.11	82.5	8	40	0.050	10.9	0.09	1.98	292	3.4	1.2	362	5.7	1.6
Weighted Ave.		0.62	0.63	0.67	0.13	81.6	13	40	0.048	11.0	0.10	1.81	292	4.5	1.5	362	7.4	2.0
18 Hour (2 tests)	75	0.62	0.67	0.66	0.09	86.9	18	40	0.050	10.9	0.13	1.58	292	5.4	1.8	362	8.5	2.3
12 Hour (3 tests)	75	0.62	0.62	0.73	0.11	85.7	12	40	0.047	11.0	0.09	1.83	292	6.0	2.1	362	7.4	2.0
8 Hour (2 tests)	75	0.62	0.68	0.64	0.10	85.0	8	40	0.049	10.9	0.13	2.04	292	3.6	1.2	362	5.9	1.6
Weighted Ave.		0.62	0.65	0.69	0.10	85.8	13	40	0.048	10.9	0.11	1.82	292	5.2	1.8	362	7.3	2.0

BMT 0.6
Sheet 13

BHT5721 Sheet Calc

Calculation sheet only

COMPOSITE BHT 0.6

Sample mass	g	693.7	652.4	695.3	667.4	695.3	672.6	678.6	695.9	697.5	686.2	683.4	653.9	698.2	672.3	708	696.2	667.4	690.6	657.3	677.6
Vessel + sample	g	1101.2	1060.2	1102.3	1075.7	1100.3	1080.1	1086.4	1104.3	1104.1	1094.1	1091	1060.9	1106.6	1078.9	1114.3	1103	1075.7	1098.1	1063.6	1084 4
In vessel at A	g	1040.1	978.8	1044.7	1001.4	1044.3	1009.1	1017.5	1044.9	1046.5	1028.8	1025.9	981.3	1048	1007.7	1060.6	1047.3	1000.9	1034.9	987.7	1015.7
	ug Au	332.832	303.428	396.986	330.462	365.505	333.003	366.3	323.919	303.485	329.216	328.288	333.642	356.32	322.464	318.18	335.136	320.288	341.517	325.941	314.867
	mg Cu	1.66416	1.4682	1.98493	4.70658	1.87974	2.0182	1.72975	1.35837	1.2558	1.85184	1.84662	1.47195	1.8864	1.71309	1.48484	1.36149	1.40126	1.55235	1.58032	1.62512
	ug Zn	2912.28	2740.64	3238.57	3805.32	3446.19	3632.76	3663	2925.72	2720.9	3497.92	3590.65	3140.16	4087.2	3829.26	3181.8	3141.9	3403.06	3622.15	3852.03	3859.66
	g NaCN	0.488847	0.460036	0.501456	0.490686	0.511707	0.494459	0.498575	0.491103	0.50232	0.524688	0.523209	0.500463	0.51352	0.493773	0.519694	0.502704	0.530477	0.548497	0.503727	0.518007
	g CaO	0.031203	0.029364	0.052235	0.060084	0.052215	0.050455	0.050875	0.052245	0.052325	0.041152	0.051295	0.058878	0.06288	0.060462	0.05303	0.052365	0.050045	0.051745	0.059262	0.060942
Removed in A	g	53.8	57.3	47.6	42.7	43.3	52.6	52.5	57.6	56.8	51.4	51.7	45.9	51.6	53.1	56.1	56.2	53.1	50.9	53.2	51.9
	ug Au	17.216	17.763	18.088	14.091	15.155	17.[illegible]	18.9	17.856	16.472	16.448	16.544	15.606	17.544	16.992	16.83	17.984	16.992	16.797	17.556	16.089
	mg Cu	0.08608	0.08595	0.09044	0.20069	0.07794	0.1052	0.08925	0.07488	0.06816	0.09252	0.09306	0.06885	0.09288	0.09027	0.07854	0.07306	0.07434	0.07635	0.08512	0.08304
	ug Zn	150.64	160.44	147.56	162.26	142.89	189.36	189	161.28	147.68	174.76	180.95	146.88	201.24	201.78	168.3	168.6	180.54	178.15	207.48	197.22
	g NaCN	0.025286	0.026931	0.022848	0.020923	0.021217	0.025774	0.025725	0.027072	0.027264	0.026214	0.026367	0.023409	0.025284	0.026019	0.027489	0.026976	0.028143	0.026977	0.027132	0.026469
	g CaO	0.001614	0.001719	0.00238	0.002562	0.002165	0.00263	0.002625	0.00288	0.00284	0.002056	0.002585	0.002754	0.003096	0.003186	0.002805	0.00281	0.002655	0.002545	0.003192	0.003114
In vessel at B	g	1040	970.1	1043.9	1001	1043.9	1008.6	1016.8	1043.5	1046.2	1028.4	1025.3	980.5	1047.3	1007.3	1061	1043.7	1000.4	1033.6	987.4	1015
	ug Au	353.6	329.834	407.121	410.41	386.243	342.924	376.216	344.355	324.322	359.94	348.602	343.175	366.555	342.482	350.13	354.858	340.136	320.416	315.968	324.8
	mg Cu	2.08	1.9402	2.60975	4.9049	2.2965	2.72322	2.44032	1.8783	1.88316	2.571	2.15313	1.86295	2.61825	2.31679	1.9098	1.66992	1.90076	1.96384	2.17228	2.233
	ug Zn	3432	3201.33	4175.6	4204.2	3862.43	4135.26	4168.88	3443.55	3243.22	3907.92	3998.67	3529.8	4712.85	4432.12	3501.3	3444.21	3801.52	4134.4	4838.26	4364.5
	g NaCN	0.468	0.436545	0.469755	0.47047	0.480194	0.45387	0.45756	0.490445	0.449866	0.473064	0.502397	0.47064	0.471285	0.453285	0.46684	0.469665	0.480192	0.485792	0.464078	0.47705
	g CaO	0.0312	0.038804	0.041756	0.05005	0.031317	0.05043	0.05084	0.031305	0.031386	0.05142	0.061518	0.049025	0.062838	0.060438	0.03183	0.041748	0.05002	0.05168	0.059244	0.0609
Removed in B	g	57.8	56.3	49	44.1	46.6	53.4	53.5	56.7	55.1	49.7	48.8	42.8	53.9	53.1	56.3	56.2	48.7	47.6	54	53.7
	ug Au	19.652	19.142	19.11	18.081	17.242	18.156	19.795	18.711	17.081	17.395	16.592	14.98	18.865	18.054	18.579	19.108	16.558	14.756	17.28	17.184
	mg Cu	0.1156	0.1126	0.1225	0.21609	0.10252	0.14418	0.1284	0.10206	0.09918	0.12425	0.10248	0.08132	0.13475	0.12213	0.10134	0.08992	0.09253	0.09044	0.1188	0.11814
	ug Zn	190.74	185.79	196	185.22	172.42	218.94	219.35	187.11	170.81	188.86	190.32	154.08	242.55	233.64	185.79	185.46	185.06	190.4	264.6	239.91
	g NaCN	0.02601	0.025335	0.02205	0.020727	0.021436	0.02403	0.024075	0.026649	0.023693	0.022862	0.023912	0.020544	0.024255	0.023895	0.024772	0.02529	0.023376	0.022372	0.02538	0.025239
	g CaO	0.001734	0.002252	0.00196	0.002205	0.001398	0.00267	0.002675	0.001701	0.001653	0.002485	0.002928	0.00214	0.003234	0.003186	0.001689	0.002248	0.002435	0.00238	0.00324	0.003222
In vessel at C	g	1040	970.2	1043.1	1000.4	1043.1	1007.5	1015.6	1043.2	1045.8	1026.7	1024.5	979.4	1046.3	1006.2	1061.1	1042.8	999.6	1032	986.6	1013.7
	ug Au	343.2	320.166	385.947	380.152	427.671	332.475	365.616	333.824	324.198	349.078	348.33	342.79	366.205	342.108	339.552	344.124	339.864	319.92	315.712	314.247
	mg Cu	2.288	2.13444	3.02499	5.5022	3.02499	3.12325	2.94524	2.29504	2.0916	3.0801	2.76615	2.64438	3.34816	3.11922	2.1222	1.98132	2.59896	2.7864	2.76248	3.0411
	ug Zn	3640	3589.74	4485.33	5092	4693.95	4735.25	4773.32	3651.2	3555.72	4928.16	4712.7	4309.36	5545.39	5131.62	3819.96	3754.08	4598.16	4953.6	5130.32	5372.61
	g NaCN	0.4992	0.475398	0.500688	0.470188	0.490257	0.42315	0.436708	0.511168	0.5229	0.451748	0.49176	0.430936	0.449909	0.432666	0.519939	0.510972	0.469812	0.47472	0.424238	0.435891
	g CaO	0.0312	0.038808	0.041724	0.05002	0.031293	0.030225	0.030468	0.031296	0.031374	0.051335	0.04098	0.04897	0.031389	0.030186	0.031833	0.031284	0.04998	0.0516	0.039464	0.040548
Removed in C	g						57.8	58.2						56	57.6					59	59.5
	ug Au						19.074	20.952						19.6	19.584					18.88	18.445
	mg Cu						0.17918	0.16878						0.1792	0.17856					0.1652	0.1785
	ug Zn						271.66	273.54						296.8	293.76					306.8	315.35
	g NaCN						0.024276	0.025026						0.02408	0.024768					0.02537	0.025585
	g CaO						0.001734	0.001746						0.00168	0.001728					0.00236	0.00238
In vessel at D	g						1007.9	1014						1045.8	1005.4					986.4	1012.4
	ug Au						312.449	344.76						334.656	311.674					305.784	303.72
	mg Cu						3.22528	3.2448						3.55572	3.21728					2.9592	3.13844
	ug Zn						5039.5	5070						5647.32	5228.08					5326.56	5365.72
	g NaCN						0.50395	0.507						0.5229	0.5027					0.4932	0.5062
	g CaO						0.030237	0.03042						0.020916	0.030162					0.039456	0.030372
Residue	ug Au	68.6	61.7545	76.5	71.4415	68.125	58.6	57.707	70.1	84.047	98.0865	76.9475	80.785	94.4145	88.1345	100.1435	100.5305	116.031	83.4395	106.3665	81.1855
Calculated Head	ug Au	448.71	418.83	499.62	483.77	528.19	425.59	462.11	440.49	441.80	481.01	458.41	454.16	485.08	454.44	475.10	481.75	489.45	434.91	465.87	436.62
Sample leached	g	693.7	652.4	695.3	667.4	695.3	672.6	678.6	695.9	697.5	686.2	683.4	653.9	698.2	672.3	708.0	696.2	667.4	690.6	657.3	677.6

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BMT 0.8
Sheets 1-13
Calc.

BMT5726 Sheet 1 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. 40

COMPOSITE BMT 0.8

SUMMARY

Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	1
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	
Extraction Au														
at 3 hours	g/t	0.78	0.81	0.79	0.72	0.72	0.75	0.73	0.69	0.70	0.64	0.63	0.64	0.
at 6 hours	g/t	0.81	0.84	0.84	0.76	0.76	0.77	0.77	0.74	0.70	0.68	0.67	0.68	0.
at 8 hours	g/t	0.80	0.85						0.76	0.71				
at 12 hours	g/t			0.86	0.80	0.76	0.79	0.79			0.69	0.69	0.69	0.
at 18 hours	g/t						0.80	0.79						0.
at 3 hours	%	84.7	81.5	80.6	79.0	82.1	83.2	80.9	73.7	80.3	76.9	75.2	76.5	75.
at 6 hours	%	88.0	84.7	84.8	83.4	86.4	85.8	84.7	78.8	79.3	80.8	80.4	80.3	79.
at 8 hours	%	87.0	85.8						80.8	81.3				
at 12 hours	%			87.0	87.3	87.1	87.7	86.7			82.4	82.1	82.2	82.
at 18 hours	%						88.5	87.0						82.
Calculated Head	ppm Au	0.92	0.99	0.99	0.91	0.88	0.90	0.91	0.94	0.88	0.84	0.84	0.84	0.
Ground Head Assay 1	ppm Au	0.84	0.90	0.81	0.86	0.77	0.83	0.84	0.80	0.84	0.86	0.87	0.80	0.
Ground Head Assay 2	ppm Au	0.86	0.88	0.91	0.88	0.82	0.92	0.82	0.85	0.78	0.83	0.77	0.86	0.
Average Ground Head Assay	ppm Au	0.85	0.89	0.86	0.87	0.80	0.88	0.83	0.83	0.81	0.85	0.82	0.83	0.
Calculated residue grade	ppm Au	0.12	0.14	0.13	0.12	0.11	0.10	0.12	0.18	0.16	0.15	0.15	0.15	0.
Extraction Cu														
at 3 hours	g/t	4.6	5.1	4.6	4.9	4.5	4.8	4.6	3.4	3.6	3.3	3.6	3.0	3.
at 6 hours	g/t	6.7	7.1	6.5	6.7	6.5	6.8	6.5	5.2	5.1	5.0	5.4	4.4	4.
at 8 hours	g/t	7.2	8.1						6.7	6.5				
at 12 hours	g/t			8.4	8.9	8.0	9.2	8.7			7.2	8.0	6.2	6.
at 18 hours	g/t						10.1	9.2						7.
Assay Head	ppm Cu	310	(ave. of two head splits)											
Extraction Zn														
at 3 hours	g/t	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.7	2.7	2.7	2.7	2.5	2.
at 6 hours	g/t	3.5	3.4	3.7	3.5	4.3	3.5	3.6	3.5	3.2	3.2	7.2	3.0	3.
at 8 hours	g/t	3.8	3.9						3.7	3.7				
at 12 hours	g/t			4.5	4.4	4.3	4.3	4.3			4.3	4.4	3.8	3.
at 18 hours	g/t						5.1	4.8						4.
Assay Head	ppm Zn	208	(ave. of two head splits)											
NaCN consumption														
at 3 hours	kg/t	0.08	0.09	0.08	0.06	0.06	0.05	0.05	0.02	0.03	0.02	0.02	0.03	0.
at 6 hours	kg/t	0.07	0.06	0.06	0.08	0.08	0.09	0.06	0.04	0.06	0.01	0.02	0.06	0.
at 8 hours	kg/t	0.11	0.10						0.06	0.09				
at 12 hours	kg/t			0.13	0.16	0.10	0.17	0.13			0.08	0.08	0.09	0.
at 18 hours	kg/t						0.13	0.13						0.
CaO consumption														
at 3 hours	kg/t	2.10	2.04	1.93	1.96	2.07	1.96	1.91	1.91	1.97	1.84	1.85	1.96	1.
at 6 hours	kg/t	2.10	2.03	1.92	1.96	2.06	1.97	1.92	1.90	1.98	1.83	1.85	1.95	1.
at 8 hours	kg/t	2.12	2.03						1.91	1.99				
at 12 hours	kg/t			1.92	1.96	2.07	1.98	1.93			1.84	1.84	1.95	1.
at 18 hours	kg/t						1.99	1.92						1.
Actual grind passing nominated um (%)		87.3	83.3	81.2	81.7	82.1	82.1	81.5	79.4	80.7	78.3	78.8	80.6	79.

BMT5726 Sheet 2 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8 |

tests conducted (date)		9/11	9/11	9/11	9/11	9/11	9/11	9/11	13/11	13/11	13/11	13/11	13/11	13/11	13/11
Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A	4D
Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106	106
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18	18
Vessel	g	407.6	407.7	407.0	408.6	408.5	406.5	408.0	405.3	407.0	408.6	407.0	407.2	408.0	408.1
Sample mass	g	479.0	496.9	524.8	503.4	486.9	502.6	525.6	506.1	486.7	514.0	503.3	474.2	507.0	487.4
Sitewater added	g	718	745	787	755	730	754	788	759	730	771	755	711	760	731
Natural pH															
CaO added	g	1.05	1.05	1.05	1.03	1.05	1.04	1.06	1.01	1.01	1.00	0.97	0.98	0.95	0.98
NaCN added	g	0.39	0.40	0.42	0.41	0.40	0.41	0.42	0.41	0.40	0.42	0.41	0.39	0.41	0.40
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	1604.8	1649.8	1718.8	1666.8	1625.6	1662.6	1721.4	1670.4	1623.7	1693.5	1665.5	1592.5	1675.5	1626.6
Pulp temperature	deg C	26	26	26	26	26	26	26	22	22	22	22	22	22	22
Liquor sample A	pH	11.3	11.3	11.3	11.3	11.4	11.4	11.2	11.5	11.5	11.5	11.5	11.6	11.6	11.6
	ppm Au	0.52	0.54	0.53	0.48	0.48	0.50	0.49	0.46	0.47	0.43	0.42	0.43	0.44	0.44
	ppm Cu	3.1	3.4	3.1	3.3	3.0	3.2	3.1	2.3	2.4	2.2	2.4	2.0	2.0	1.9
	ppm Zn	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.8	1.8	1.8	1.8	1.7	1.6	1.7
	% NaCN	0.049	0.048	0.048	0.050	0.051	0.051	0.050	0.053	0.053	0.053	0.053	0.053	0.052	0.053
	% CaO	0.006	0.005	0.005	0.006	0.006	0.007	0.007	0.006	0.007	0.007	0.005	0.007	0.007	0.009
Gross after sample	g	1549.5	1592.5	1662.8	1608.4	1572.3	1608.9	1668.1	1617.8	1570.2	1636.0	1612.9	1540.2	1623.4	1574.3
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	1605.0	1649.7	1718.6	1666.6	1625.4	1662.5	1721.2	1670.4	1623.5	1693.3	1665.3	1592.3	1675.3	1626.5
Pulp temperature	deg C	26	26	26	26	26	26	26	24	24	24	24	24	24	24
Liquor sample B	pH	11.3	11.3	11.3	11.3	11.4	11.4	11.2	11.3	11.3	11.3	11.3	11.4	11.4	11.5
	ppm Au	0.50	0.52	0.52	0.47	0.47	0.48	0.48	0.46	0.43	0.42	0.42	0.42	0.43	0.42
	ppm Cu	4.2	4.5	4.1	4.2	4.1	4.3	4.1	3.3	3.2	3.2	3.4	2.8	2.8	2.9
	ppm Zn	2.2	2.1	2.3	2.2	2.7	2.2	2.3	2.2	2.0	2.0	4.7	1.9	1.9	2.0
	% NaCN	0.046	0.046	0.046	0.045	0.046	0.045	0.046	0.048	0.047	0.050	0.049	0.047	0.050	0.049
	% CaO	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.005	0.007	0.007	0.007
Gross after sample	g	1555.9	1596.2	1665.3	1613.1	1572.4	1612.2	1667.8	1616.4	1570.0	1640.4	1612.0	1540.0	1623.1	1574.5
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.02	0.02	0.00	0.01	0.02	0.00	0.01
Leach time	hrs	2	2	6	6	6	6	6	2	2	6	6	6	6	6
Gross off rolls	g	1604.7	1649.7	1718.4	1666.5	1625.3	1662.3	1721.0	1670.4	1623.9	1693.1	1665.3	1592.3	1675.2	1626.4
Pulp temperature	deg C	26	26	25	25	25	25	25	24	24	23	23	23	23	23
Liquor sample C	pH	11.3	11.3	11.2	11.2	11.4	11.3	11.3	11.3	11.3	11.3	11.3	11.4	11.4	11.5
	ppm Au	0.46	0.49	0.50	0.46	0.44	0.46	0.46	0.44	0.41	0.40	0.40	0.40	0.42	0.41
	ppm Cu	4.3	4.8	5.1	5.4	4.8	5.6	5.3	4.1	3.9	4.4	4.9	3.8	3.8	4.1
	ppm Zn	2.2	2.3	2.7	2.6	2.5	2.6	2.6	2.2	2.2	2.6	2.5	2.3	2.2	2.3
	% NaCN	0.044	0.044	0.042	0.042	0.045	0.042	0.042	0.045	0.044	0.042	0.043	0.044	0.043	0.045
	% CaO	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.007	0.005	0.006
Gross after sample	g						1609.4	1669.1						1636.7	1574.1
CaO added	g						0.00	0.00						0.00	0.00
NaCN added	g						0.06	0.06						0.00	0.00
Leach time	hrs						6	6						6	6
Gross off rolls	g						1665.8	1723.4						1692.8	1626.2
Pulp temperature	deg C						22	22						21	21
Liquor sample D	pH						11.3	11.3						11.3	11.4
	ppm Au						0.43	0.43						0.39	0.39
	ppm Cu						5.8	5.3						4.5	4.2
	ppm Zn						2.9	2.7						2.4	2.4
	% NaCN						0.049	0.047						0.040	0.043
	% CaO						0.004	0.005						0.006	0.006
Sample mass account															
Residue recovered (screened)	g	475.3	493.4	521.5	500.3	484.5	500.1	521.3	507.3	485.0	511.0	500.7	476.2	503.1	482.0
Ground head to assay	g	76.7	85.0	88.9	88.8	83.1	88.3	83.1	99.8	82.1	83.5	93.7	85.8	85.5	79.1
Calculated head to grind	g	552.0	578.4	610.4	589.1	567.6	588.4	604.4	607.1	567.1	594.5	594.4	562.0	588.6	561.1
Actual head to grind	g	555.7	581.9	613.7	592.2	570.0	590.9	608.7	605.9	568.8	597.5	597.0	560.0	592.5	566.5
Unaccounted mass	%	0.67	0.60	0.54	0.52	0.42	0.42	0.71	-0.20	0.30	0.50	0.44	-0.36	0.66	0.95

BMT5726 Sheet 3 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 3C		**Nom. P80um 75**		**Leach hrs 8**				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	60.5	12.7	87.3	0.28		0.28	16.94	29.5
- 75 + 53	55.8	11.7	75.5	0.21		0.21	11.72	20.4
- 53	359.0	75.5		0.08	0.08	0.08	28.72	50.1
Calculated	475.3	100.0				0.12	57.4	100.0
Test No. 6D		**Nom. P80um 75**		**Leach hrs 8**				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	82.4	16.7	83.3	0.36	0.35	0.36	29.25	41.8
- 75 + 53	51.0	10.3	73.0	0.20		0.20	10.20	14.6
- 53	360.0	73.0		0.09	0.08	0.09	30.60	43.7
Calculated	493.4	100.0				0.14	70.1	100.0
Test No. 3B		**Nom. P80um 75**		**Leach hrs 12**				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	97.8	18.8	81.2	0.30	0.33	0.32	30.81	45.9
- 75 + 53	47.1	9.0	72.2	0.21		0.21	9.89	14.7
- 53	376.6	72.2		0.07	0.07	0.07	26.36	39.3
Calculated	521.5	100.0				0.13	67.1	100.0
Test No. 6C		**Nom. P80um 75**		**Leach hrs 12**				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	91.8	18.3	81.7	0.26	0.29	0.28	25.25	43.3
- 75 + 53	48.6	9.7	71.9	0.20		0.20	9.72	16.7
- 53	359.9	71.9		0.06	0.07	0.07	23.39	40.1
Calculated	500.3	100.0				0.12	58.4	100.0
Test No. 3D		**Nom. P80um 75**		**Leach hrs 12**				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	86.8	17.9	82.1	0.28	0.26	0.27	23.44	42.4
- 75 + 53	47.4	9.8	72.3	0.19		0.19	9.01	16.3
- 53	350.3	72.3		0.06	0.07	0.07	22.77	41.2
Calculated	484.5	100.0				0.11	55.2	100.0

BMT5726 Sheet 4 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.8 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8A		Nom. P80um 75		Leach hrs 18				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	89.6	17.9	82.1	0.24	0.23	0.24	21.06	40.3
- 75 + 53	50.8	10.2	71.9	0.19		0.19	9.65	18.5
- 53	359.7	71.9		0.06	0.06	0.06	21.58	41.3
Calculated	500.1	100.0				0.10	52.3	100.0
Test No. 4B		Nom. P80um 75		Leach hrs 18				
+ 150								
- 150 + 106		0.0	100.0					
- 106 + 75	96.5	18.5	81.5	0.30	0.26	0.28	27.02	43.5
- 75 + 53	53.3	10.2	71.3	0.17		0.17	9.06	14.6
- 53	371.5	71.3		0.07	0.07	0.07	26.01	41.9
Calculated	521.3	100.0				0.12	62.1	100.0
Test No. 1B		Nom. P80um 106		Leach hrs 8				
+ 150	40.1	7.9	92.1	0.50		0.50	20.05	22.0
- 150 + 106	64.5	12.7	79.4	0.32		0.32	20.64	22.7
- 106 + 75	63.9	12.6	66.8	0.26		0.26	16.61	18.3
- 75 + 53	43.1	8.5	58.3	0.30		0.30	12.93	14.2
- 53	295.7	58.3		0.06	0.08	0.07	20.70	22.8
Calculated	507.3	100.0				0.18	90.9	100.0
Test No. 5C		Nom. P80um 106		Leach hrs 8				
+ 150	31.5	6.5	93.5	0.51		0.51	16.07	20.1
- 150 + 106	62.0	12.8	80.7	0.30		0.30	18.60	23.3
- 106 + 75	62.5	12.9	67.8	0.26		0.26	16.25	20.3
- 75 + 53	44.5	9.2	58.7	0.27		0.27	12.02	15.0
- 53	284.5	58.7		0.06	0.06	0.06	17.07	21.3
Calculated	485.0	100.0				0.16	80.0	100.0
Test No. 7A		Nom. P80um 106		Leach hrs 12				
+ 150	45.5	8.9	91.1	0.37		0.37	16.84	22.2
- 150 + 106	65.3	12.8	78.3	0.30		0.30	19.59	25.8
- 106 + 75	63.1	12.3	66.0	0.25		0.25	15.78	20.8
- 75 + 53	40.7	8.0	58.0	0.22		0.22	8.95	11.8
- 53	296.4	58.0		0.06	0.04	0.05	14.82	19.5
Calculated	511.0	100.0				0.15	76.0	100.0

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BMT5726 Sheet 5 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.8 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8B		Nom. P80um	106	Leach hrs	12			
+ 150	42.0	8.4	91.6	0.47		0.47	19.74	26.2
- 150 + 106	64.3	12.8	78.8	0.27		0.27	17.36	23.0
- 106 + 75	62.7	12.5	66.2	0.21		0.21	13.17	17.5
- 75 + 53	41.7	8.3	57.9	0.22		0.22	9.17	12.2
- 53	290.0	57.9		0.06	0.05	0.06	15.95	21.2
Calculated	500.7	100.0				0.15	75.4	100.0
Test No. 2C		Nom. P80um	106	Leach hrs	12			
+ 150	33.3	7.0	93.0	0.44		0.44	14.65	20.6
- 150 + 106	59.2	12.4	80.6	0.28		0.28	16.58	23.3
- 106 + 75	59.4	12.5	[illegible]	0.24		0.24	14.26	20.1
- 75 + 53	40.7	8.5	59.6	0.21		0.21	8.55	12.0
- 53	283.6	59.6		0.06	0.06	0.06	17.02	24.0
Calculated	476.2	100.0				0.15	71.0	100.0
Test No. 6A		Nom. P80um	106	Leach hrs	18			
+ 150	37.0	7.4	92.6	0.45		0.45	16.65	21.3
- 150 + 106	64.4	12.8	79.8	0.31		0.31	19.96	25.5
- 106 + 75	63.0	12.5	67.3	0.21		0.21	13.23	16.9
- 75 + 53	43.3	8.6	58.7	0.21		0.21	9.09	11.6
- 53	295.4	58.7		0.07	0.06	0.07	19.20	24.6
Calculated	503.1	100.0				0.16	78.1	100.0
Test No. 4D		Nom. P80um	106	Leach hrs	18			
+ 150	32.1	6.7	93.3	0.41		0.41	13.16	16.9
- 150 + 106	60.6	12.6	80.8	0.22		0.22	13.33	17.1
- 106 + 75	59.4	12.3	68.4	0.23		0.23	13.66	17.5
- 75 + 53	42.9	8.9	59.5	0.21		0.21	9.01	11.6
- 53	287.0	59.5		0.10	0.10	0.10	28.70	36.9
Calculated	482.0	100.0				0.16	77.9	100.0
Test No. 4A		Nom. P80um	150	Leach hrs	8			
+ 150	102.9	18.6	81.4	0.41	0.36	0.39	39.62	36.9
- 150 + 106	72.8	13.1	68.3	0.36	0.39	0.38	27.30	25.4
- 106 + 75	58.6	10.6	57.7	0.23		0.23	13.48	12.5
- 75 + 53	35.9	6.5	51.2	0.28		0.28	10.05	9.4
- 53	283.9	51.2		0.06	0.06	0.06	17.03	15.8
Calculated	554.1	100.0				0.19	107.5	100.0

BMT5726 Sheet 6 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.8 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 5B	Nom. P80um 150	Leach hrs 8						
+ 150	91.9	18.6	81.4	0.57	0.56	0.57	51.92	46.9
- 150 + 106	63.6	12.8	68.6	0.28		0.28	17.81	16.1
- 106 + 75	52.4	10.6	58.0	0.38		0.38	19.91	18.0
- 75 + 53	34.1	6.9	51.1	0.21		0.21	7.16	6.5
- 53	253.1	51.1		0.[illegible]	0.05	0.06	13.92	12.6
Calculated	495.1	100.0				0.22	110.7	100.0
Test No. 1A	Nom. P80um 150	Leach hrs 12						
+ 150	102.6	20.2	79.8	0.41	0.46	0.44	44.63	50.6
- 150 + 106	64.1	12.6	67.2	0.23		0.23	14.74	16.7
- 106 + 75	52.3	10.3	56.9	0.23		0.23	12.03	13.6
- 75 + 53	32.9	6.5	50.5	0.20		0.20	6.58	7.5
- 53	256.6	50.5		0.04	0.04	0.04	10.26	11.6
Calculated	508.5	100.0				0.17	88.2	100.0
Test No. 7D	Nom. P80um 150	Leach hrs 12						
+ 150	99.8	19.6	80.4	0.45	0.48	0.47	46.41	52.6
- 150 + 106	65.2	12.8	67.7	0.22		0.22	14.34	16.3
- 106 + 75	53.9	10.6	57.1	0.20		0.20	10.78	12.2
- 75 + 53	33.1	6.5	50.6	0.19		0.19	6.29	7.1
- 53	258.4	50.6		0.04	0.04	0.04	10.34	11.7
Calculated	510.4	100.0				0.17	88.2	100.0
Test No. 7C	Nom. P80um 150	Leach hrs 18						
+ 150	89.5	18.5	81.5	0.49		0.49	43.86	47.8
- 150 + 106	60.4	12.5	69.1	0.26		0.26	15.70	17.1
- 106 + 75	51.3	10.6	58.5	0.25		0.25	12.83	14.0
- 75 + 53	32.1	6.6	51.9	0.17		0.17	5.46	6.0
- 53	251.6	51.9		0.06	0.05	0.06	13.84	15.1
Calculated	484.9	100.0				0.19	91.7	100.0
Test No. 1D	Nom. P80um 150	Leach hrs 18						
+ 150	90.6	18.6	81.4	0.42	0.42	0.42	38.05	45.2
- 150 + 106	61.5	12.6	68.8	0.24		0.24	14.76	17.5
- 106 + 75	50.2	10.3	58.4	0.21		0.21	10.54	12.5
- 75 + 53	33.3	6.8	51.6	0.21		0.21	6.99	8.3
- 53	251.2	51.6		0.05	0.06	0.06	13.82	16.4
Calculated	486.8	100.0				0.17	84.2	100.0

BMT5726 Sheet 7 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 0.8		P80=75um			P80=106um			P80=150um		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18.0	8.0	12.6	18.0	8.0	12.7	18.0	8.0
Extraction Au										
at 3 hours	g/t	0.76	0.81	0.72	0.66	0.70	0.63	0.64	0.67	0.60
at 6 hours	g/t	0.79	0.84	0.76	0.69	0.74	0.67	0.69	0.71	0.67
at 8 hours	g/t	0.83	0.85	0.80	0.74	0.76	0.71	0.71	0.72	0.70
at 12 hours	g/t	0.80	0.86	0.76	0.70	0.72	0.69	0.70	0.72	0.69
at 18 hours	g/t	0.79	0.80	0.79	0.72	0.72	0.72	0.72	0.72	0.72
at 3 hours	%	81.7	84.7	79.0	76.1	80.3	73.7	71.3	73.5	67.4
at 6 hours	%	85.4	88.0	83.4	79.3	80.8	76.9	76.7	78.5	74.7
at 8 hours	%	86.4	87.0	85.8	81.1	81.3	80.8	77.5	78.5	76.5
at 12 hours	%	87.2	87.7	86.7	81.9	82.4	80.3	79.6	80.7	78.8
at 18 hours	%	87.7	88.5	87.0	82.1	82.4	81.9	80.0	80.7	79.2
Calculated Head	ppm Au	0.93	0.99	0.88	0.87	0.94	0.84	0.90	0.95	0.86
Ground Head Assay 1	ppm Au	0.84	0.90	0.77	0.82	0.87	0.76	0.88	1.01	0.77
Ground Head Assay 2	ppm Au	0.87	0.92	0.82	0.81	0.86	0.77	0.88	1.03	0.75
Average Ground Head Assay	ppm Au	0.85	0.89	0.80	0.81	0.85	0.77	0.88	1.02	0.76
Calculated residue grade	ppm Au	0.12	0.14	0.10	0.16	0.18	0.15	0.19	0.22	0.17
Extraction Cu										
at 3 hours	g/t	4.8	5.1	4.5	3.3	3.6	2.9	4.0	4.9	3.2
at 6 hours	g/t	6.7	7.1	6.5	4.9	5.4	4.4	5.8	7.1	4.6
at 8 hours	g/t	7.7	8.1	7.2	6.6	6.7	6.5	7.8	7.8	7.7
at 12 hours	g/t	8.6	9.2	8.0	6.8	8.0	6.2	7.3	8.6	6.4
at 18 hours	g/t	9.7	10.1	9.2	7.5	7.7	7.2	9.0	9.5	8.5
Assay Head	ppm Cu									
Extraction Zn										
at 3 hours	g/t	3.0	3.0	3.0	2.6	2.7	2.4	3.0	3.3	2.9
at 6 hours	g/t	3.6	4.3	3.4	3.8	7.2	3.0	4.6	10.1	3.3
at 8 hours	g/t	3.8	3.9	3.8	3.7	3.7	3.7	4.3	4.6	3.9
at 12 hours	g/t	4.4	4.5	4.3	4.0	4.4	3.7	4.3	4.6	4.0
at 18 hours	g/t	4.9	5.1	4.8	4.2	4.2	4.2	5.0	5.2	4.8
Assay Head	ppm Zn									
NaCN consumption										
at 3 hours	kg/t	0.07	0.09	0.05	0.02	0.03	0.02	0.05	0.07	0.04
at 6 hours	kg/t	0.07	0.09	0.06	0.03	0.06	0.01	0.04	0.06	0.02
at 8 hours	kg/t	0.11	0.11	0.10	0.08	0.09	0.06	0.10	0.11	0.09
at 12 hours	kg/t	0.14	0.17	0.10	0.07	0.09	0.06	0.08	0.10	0.07
at 18 hours	kg/t	0.13	0.13	0.13	0.05	0.06	0.04	0.10	0.11	0.08
CaO consumption										
at 3 hours	kg/t	1.99	2.10	1.91	1.88	1.97	1.77	1.83	1.91	1.73
at 6 hours	kg/t	1.99	2.10	1.92	1.88	1.98	1.76	1.84	1.93	1.75
at 8 hours	kg/t	2.07	2.12	2.03	1.95	1.99	1.91	1.86	1.92	1.80
at 12 hours	kg/t	1.97	2.07	1.92	1.86	1.95	1.78	1.83	1.92	1.76
at 18 hours	kg/t	1.96	1.99	1.92	1.83	1.90	1.76	1.87	1.92	1.83
Actual grind passing nominated um (%)		82.7	87.3	81.2	79.8	80.8	78.3	81.0	81.5	79.8

BMT5726 Sheet 8 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0,8 |

Summary of 8 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3C	75	0.12	0.00	0.00	0.28	0.21	0.08
6D	75	0.14	0.00	0.00	0.36	0.20	0.09
Average		0.13	0.00	0.00	0.32	0.21	0.08
1B	106	0.18	0.50	0.32	0.26	0.30	0.07
5C	106	0.16	0.51	0.30	0.26	0.27	0.06
Average		0.17	0.51	0.31	0.26	0.29	0.07
4A	150	0.19	0.39	0.38	0.23	0.28	0.06
5B	150	0.22	0.57	0.28	0.38	0.21	0.06
Average		0.21	0.48	0.33	0.31	0.25	0.06

Summary of 12 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3B	75	0.13	0.00	0.00	0.32	0.21	0.07
6C	75	0.12	0.00	0.00	0.28	0.20	0.07
3D	75	0.11	0.00	0.00	0.27	0.19	0.07
Average		0.12	0.00	0.00	0.29	0.20	0.07
7A	106	0.15	0.37	0.30	0.25	0.22	0.05
8B	106	0.15	0.47	0.27	0.21	0.22	0.06
2C	106	0.15	0.44	0.28	0.24	0.21	0.06
Average		0.15	0.43	0.28	0.23	0.22	0.06
1A	150	0.17	0.44	0.23	0.23	0.20	0.04
7D	150	0.17	0.47	0.22	0.20	0.19	0.04
Average		0.17	0.45	0.23	0.22	0.20	0.04

Summary of 18 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
8A	75	0.10	0.00	0.00	0.24	0.19	0.06
4B	75	0.12	0.00	0.00	0.28	0.17	0.07
Average		0.11	0.00	0.00	0.26	0.18	0.07
6A	106	0.16	0.45	0.31	0.21	0.21	0.07
4D	106	0.16	0.41	0.22	0.23	0.21	0.10
Average		0.16	0.43	0.27	0.22	0.21	0.08
7C	150	0.19	0.49	0.26	0.25	0.17	0.06
1D	150	0.17	0.42	0.24	0.21	0.21	0.06
Average		0.18	0.46	0.25	0.23	0.19	0.06

BMT5726 Sheet 9 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 0.3 |

Summary of Residue Size Fraction Assays

Leach Time	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
18 Hour (2 tests)	150	0.18	0.46	0.25	0.23	0.19	0.06
12 Hour (2 tests)	150	0.17	0.45	0.23	0.22	0.20	0.04
8 Hour (2 tests)	150	0.21	0.48	0.33	0.31	0.25	0.06
Weighted Ave.		0.19	0.46	0.27	0.25	0.21	0.05
18 Hour (2 tests)	106	0.16	0.43	0.27	0.22	0.21	0.08
12 Hour (3 tests)	106	0.15	0.43	0.28	0.23	0.22	0.06
8 Hour (2 tests)	106	0.17	0.51	0.31	0.26	0.29	0.07
Weighted Ave.		0.16	0.45	0.29	0.24	0.23	0.07
18 Hour (2 tests)	75	0.11	0.00	0.00	0.26	0.18	0.07
12 Hour (3 tests)	75	0.12	0.00	0.00	0.29	0.20	0.07
8 Hour (2 tests)	75	0.13	0.00	0.00	0.32	0.21	0.08
Weighted Ave.		0.12	0.00	0.00	0.29	0.20	0.07

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8 |

Summary of 8 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3C	75	0.12	0.0	0.0	29.5	20.4	50.1
6D	75	0.14	0.0	0.0	41.8	14.6	43.7
Average		0.13	0.0	0.0	35.6	17.5	46.9
1B	106	0.18	22.0	22.7	18.3	14.2	22.8
5C	106	0.16	20.1	23.3	20.3	15.0	21.3
Average		0.17	21.1	23.0	19.3	14.6	22.1
4A	150	0.19	36.9	25.4	12.5	9.4	15.8
5B	150	0.22	46.9	16.1	18.0	6.5	12.6
Average		0.21	41.9	20.7	15.3	7.9	14.2

Summary of 12 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3B	75	0.13	0.0	0.0	45.9	14.7	39.3
6C	75	0.12	0.0	0.0	43.3	16.7	40.1
3D	75	0.11	0.0	0.0	42.4	16.3	41.2
Average		0.12	0.0	0.0	43.9	15.9	40.2
7A	106	0.15	22.2	25.8	20.8	11.8	19.5
6B	106	0.15	26.2	23.0	17.5	12.2	21.2
2C	106	0.15	20.6	23.3	20.1	12.0	24.0
Average		0.15	23.0	24.0	19.4	12.0	21.5
1A	150	0.17	50.6	16.7	13.6	7.5	11.6
7D	150	0.17	52.6	16.3	12.2	7.1	11.7
Average		0.17	51.6	16.5	12.9	7.3	11.7

Summary of 18 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
8A	75	0.10	0.0	0.0	40.3	18.5	41.3
4B	75	0.12	0.0	0.0	43.5	14.6	41.9
Average		0.11	0.0	0.0	41.9	16.5	41.6
6A	106	0.16	21.3	25.5	16.9	11.6	24.6
4D	106	0.16	16.9	17.1	17.5	11.6	36.9
Average		0.16	19.1	21.3	17.2	11.6	30.7
7C	150	0.19	47.8	17.1	14.0	6.0	15.1
1D	150	0.1[illegible]	45.2	17.5	12.5	8.3	16.4
Average		0.18	46.5	17.3	13.3	7.1	15.8

BMT5726 Sheet 11 6-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8

Summary of Residue Size Fraction Gold Distribution

Leach Time	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
18 Hour (2 tests)	150	0.18	46.5	17.3	13.3	7.1	15.8
12 Hour (2 tests)	150	0.17	51.6	16.5	12.9	7.3	11.7
8 Hour (2 tests)	150	0.21	41.9	20.7	15.3	7.9	14.2
Weighted Ave.		0.19	46.7	18.2	13.8	7.4	13.9
18 Hour (2 tests)	106	0.16	19.1	21.3	17.2	11.6	30.7
12 Hour (3 tests)	106	0.15	23.0	24.0	19.4	12.0	21.5
8 Hour (2 tests)	106	0.17	21.1	23.0	19.3	14.6	22.1
Weighted Ave.		0.16	21.3	23.0	18.8	12.6	24.3
18 Hour (2 tests)	75	0.11	0.0	0.0	41.9	16.5	41.6
12 Hour (3 tests)	75	0.12	0.0	0.0	43.9	15.9	40.2
8 Hour (2 tests)	75	0.13	0.0	0.0	35.6	17.5	46.9
Weighted Ave.		0.12	0.0	0.0	41.0	16.5	42.5

BMT5726 Sheet 12 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8 |

Summary of L.S.& A. 8 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3C	75	0.79	0.85	0.92	0.12	87.0	8	40	0.044	11.3	0.11	2.12	310	7.2	2.3	208	3.8	1.8
6D	75	0.79	0.89	0.99	0.14	85.8	8	40	0.044	11.3	0.10	2.03	310	8.1	2.6	208	3.9	1.9
Average		0.79	0.87	0.96	0.13	86.4	8	40	0.044	11.3	0.11	2.07	310	7.7	2.5	208	3.8	1.8
1B	106	0.79	0.83	0.94	0.18	80.8	8	40	0.045	11.3	0.06	1.91	310	6.7	2.2	208	3.7	1.8
5C	106	0.79	0.81	0.88	0.16	81.3	8	40	0.044	11.3	0.09	1.99	310	6.5	2.1	208	3.7	1.8
Average		0.79	0.82	0.91	0.17	81.1	8	40	0.045	11.3	0.08	1.95	310	6.6	2.1	208	3.7	1.8
4A	150	0.79	1.02	0.89	0.19	78.5	8	40	0.045	11.2	0.09	1.80	310	7.8	2.5	208	4.6	2.2
5B	150	0.79	0.93	0.95	0.22	76.5	8	40	0.042	11.2	0.11	1.92	310	7.7	2.5	208	3.9	1.9
Average		0.79	0.97	0.92	0.21	77.5	8	40	0.044	11.2	0.10	1.86	310	7.8	2.5	208	4.3	2.1

Summary of L.S.& A. 12 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3B	75	0.79	0.86	0.99	0.13	87.0	12	40	0.042	11.2	0.13	1.92	310	8.4	2.7	208	4.5	2.2
6C	75	0.79	0.87	0.91	0.12	87.3	12	40	0.042	11.2	0.16	1.96	310	8.9	2.9	208	4.4	2.1
3D	75	0.79	0.80	0.88	0.11	87.1	12	40	0.045	11.4	0.10	2.07	310	8.0	2.6	208	4.3	2.0
Average		0.79	0.84	0.92	0.12	87.1	12	40	0.043	11.3	0.13	1.98	310	8.4	2.7	208	4.4	2.1
7A	106	0.79	0.85	0.84	0.15	82.4	12	40	0.042	11.3	0.08	1.84	310	7.2	2.3	208	4.3	2.1
8B	106	0.79	0.82	0.84	0.15	82.1	12	40	0.043	11.3	0.08	1.84	310	8.0	2.6	208	4.4	2.1
2C	106	0.79	0.83	0.84	0.15	82.2	12	40	0.044	11.4	0.09	1.95	310	6.2	2.0	208	3.8	1.8
Average		0.79	0.83	0.84	0.15	82.2	12	40	0.043	11.3	0.08	1.88	310	7.1	2.3	208	4.2	2.0
1A	150	0.79	0.82	0.86	0.17	80.0	12	40	0.045	11.4	0.07	1.82	310	6.7	2.2	208	4.2	2.0
7D	150	0.79	0.83	0.89	0.17	80.7	12	40	0.043	11.4	0.09	1.76	310	6.4	2.1	208	4.0	1.9
Average		0.79	0.82	0.87	0.17	80.3	12	40	0.044	11.4	0.08	1.79	310	6.5	2.1	208	4.1	2.0

Summary of L.S.& A. 18 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
8A	75	0.79	0.88	0.90	0.10	88.5	18	40	0.049	11.3	0.13	1.99	310	10.1	3.3	208	5.1	2.4
4B	75	0.79	0.83	0.91	0.12	87.0	18	40	0.047	11.3	0.13	1.92	310	9.2	3.0	208	4.8	2.3
Average		0.79	0.85	0.90	0.11	87.7	18	40	0.048	11.3	0.13	1.96	310	9.7	3.1	208	4.9	2.4
6A	106	0.79	0.80	0.87	0.16	82.4	18	40	0.040	11.3	0.06	1.76	310	7.7	2.5	208	4.2	2.0
4D	106	0.79	0.77	0.88	0.16	81.9	18	40	0.043	11.4	0.04	1.90	310	7.2	2.3	208	4.2	2.0
Average		0.79	0.78	0.88	0.16	82.1	18	40	0.042	11.4	0.05	1.83	310	7.5	2.4	208	4.2	2.0
7C	150	0.79	0.93	0.91	0.19	79.2	18	40	0.046	11.3	0.11	1.92	310	9.5	3.1	208	5.2	2.5
1D	150	0.79	0.76	0.89	0.17	80.7	18	40	0.041	11.3	0.08	1.83	310	8.5	2.8	208	4.8	2.3
Average		0.79	0.85	0.90	0.18	80.0	18	40	0.044	11.3	0.10	1.87	310	9.0	2.9	208	5.0	2.4

BMT5726 Sheet 13 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 0.8 |

Summary of L.S.& A. Bottle Roll Leach Test Results

Leach Time	Grind P80 um	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp. ppm Au	Ground Head ppm Au	Calc'd Head ppm Au	Residue Solids ppm Au	Extr'n %	Time Hours	Pulp % Solids	% NaCN	pH	NaCN kg/t	CaO kg/t	Assay Head ppm	Extraction g/t	Extraction %	Assay Head ppm	Extraction g/t	Extraction %
18 Hour (2 tests)	150	0.79	0.85	0.90	0.18	80.0	18	40	0.044	11.3	0.10	1.87	310	9.0	2.9	208	5.0	2.4
12 Hour (2 tests)	150	0.79	0.82	0.87	0.17	80.3	12	40	0.044	11.4	0.08	1.79	310	6.5	2.1	208	4.1	2.0
8 Hour (2 tests)	150	0.79	0.97	0.92	0.21	77.5	8	40	0.044	11.2	0.10	1.86	310	7.8	2.5	208	4.3	2.1
Weighted Ave.		0.79	0.88	0.90	0.19	79.3	13	40	0.044	11.3	0.09	1.84	310	7.8	2.5	208	4.4	2.1
18 Hour (2 tests)	106	0.79	0.78	0.88	0.16	82.1	18	40	0.042	11.4	0.05	1.83	310	7.5	2.4	208	4.2	2.0
12 Hour (3 tests)	106	0.79	0.83	0.84	0.15	82.2	12	40	0.043	11.3	0.08	1.88	310	7.1	2.3	208	4.2	2.0
8 Hour (2 tests)	106	0.79	0.82	0.91	0.17	81.1	8	40	0.045	11.3	0.08	1.95	310	6.6	2.1	208	3.7	1.8
Weighted Ave.		0.79	0.81	0.87	0.16	81.9	13	40	0.043	11.3	0.07	1.88	310	7.1	2.3	208	4.1	2.0
18 Hour (2 tests)	75	0.79	0.85	0.90	0.11	87.7	18	40	0.048	11.3	0.13	1.96	310	9.7	3.1	208	4.9	2.4
12 Hour (3 tests)	75	0.79	0.84	0.92	0.12	87.1	12	40	0.043	11.3	0.13	1.98	310	8.4	2.7	208	4.4	2.1
8 Hour (2 tests)	75	0.79	0.87	0.96	0.13	86.4	8	40	0.044	11.3	0.11	2.07	310	7.7	2.5	208	3.8	1.8
Weighted Ave.		0.79	0.85	0.93	0.12	87.1	13	40	0.045	11.3	0.12	2.00	310	8.6	2.8	208	4.4	2.1

BMT 0.8
Sheet 13

Calculation sheet only

COMPOSITE BMT 0.8

Sample mass	g	479	496.9	524.8	503.4	486.9	502.6	525.6	506.1	486.7	514	503.3	474.2	507	487.4	558.2	497.7	514.1	513.8	487.8	490
Vessel + sample	g	886.6	904.6	931.8	912	895.4	909.1	933.6	911.4	893.7	922.6	910.3	881.4	915	895.5	966	903.5	92	921.5	894.7	898
In vessel at A	g	718.2	745.2	787	754.8	730.2	753.5	787.8	759	730	770.9	755.2	711.1	760.5	731.1	836.8	746.2	771.2	770.7	731.7	735
	ug Au	373.464	402.408	417.11	362.304	350.496	376.75	386.022	349.14	343.1	331.487	317.184	305.773	334.62	321.684	359.824	335.79	323.904	323.694	321.948	294.
	mg Cu	2.22642	2.53368	2.4397	2.49084	2.1906	2.4112	2.44218	1.7457	1.752	1.69598	1.81248	1.4222	1.521	1.38909	2.76144	2.38784	1.61952	1.61847	2.1951	1.83
	ug Zn	1436.4	1490.4	1574	1509.6	1460.4	1507	1575.6	1366.2	1314	1387.62	1359.36	1208.87	1216.8	1242.87	1840.96	1567.02	1465.28	1464.33	1536.57	1471
	g NaCN	0.351918	0.357696	0.37776	0.3774	0.372402	0.384285	0.3939	0.40227	0.3869	0.408577	0.400256	0.376883	0.39546	0.387483	0.410032	0.380562	0.393312	0.393057	0.380484	0.3826
	g CaO	0.043092	0.03726	0.03935	0.045288	0.043812	0.052745	0.055146	0.04554	0.0511	0.053963	0.03776	0.049777	0.053235	0.065799	0.04184	0.059696	0.053984	0.069363	0.058536	0.0588
Removed in A	g	55.3	57.3	56	58.4	53.3	53.7	53.3	52.6	53.5	57.5	52.6	52.3	52.1	52.3	59.3	52.3	52.5	52.5	56.7	52
	ug Au	28.756	30.942	29.68	28.032	25.584	26.85	26.117	24.196	25.145	24.725	22.092	22.489	22.924	23.012	25.499	23.535	22.05	22.05	24.948	20.
	mg Cu	0.17143	0.19482	0.1736	0.19272	0.1599	0.17184	0.16523	0.12098	0.1284	0.1265	0.12624	0.1046	0.1042	0.09937	0.19569	0.16736	0.11025	0.11025	0.1701	0.130
	ug Zn	110.6	114.6	112	116.8	106.6	107.4	106.6	94.68	96.3	103.5	94.68	88.91	83.36	88.91	130.46	109.83	99.75	99.75	119.07	104
	g NaCN	0.027097	0.027504	0.02688	0.0292	0.027183	0.027387	0.02665	0.027878	0.028355	0.030475	0.027878	0.027719	0.027092	0.027719	0.029057	0.026673	0.026775	0.026775	0.029484	0.0270
	g CaO	0.003318	0.002865	0.0028	0.003504	0.003198	0.003759	0.003731	0.003156	0.003745	0.004025	0.00263	0.003661	0.003647	0.004707	0.002965	0.004184	0.003675	0.004725	0.004536	0.0041
In vessel at B	g	718.4	745.1	786.8	754.6	730	753.4	787.6	759	729.8	770.7	755	710.9	760.3	731	836.6	746	771.2	770.6	731.6	735
	ug Au	359.2	387.452	409.136	354.662	343.1	361.632	378.048	349.14	313.814	323.694	317.1	298.578	326.929	307.02	359.738	328.24	323.904	331.358	314.588	308.9
	mg Cu	3.01728	3.35295	3.22588	3.16932	2.993	3.23962	3.22916	2.5047	2.33536	2.46624	2.567	1.99052	2.12884	2.1199	3.7647	3.0586	2.39072	2.23474	2.99956	2.57
	ug Zn	1580.48	1564.71	1809.64	1660.12	1971	1657.48	1811.48	1669.8	1459.6	1541.4	3548.5	1350.71	1444.57	1462	5521.56	1715.8	1619.52	1618.26	1755.84	1618.
	g NaCN	0.330464	0.342746	0.361928	0.33957	0.3358	0.33903	0.362296	0.36432	0.343006	0.38535	0.36995	0.334123	0.38015	0.35819	0.384836	0.35062	0.370176	0.377594	0.358484	0.3457
	g CaO	0.043104	0.037255	0.03934	0.03773	0.0438	0.045204	0.047256	0.04554	0.043788	0.053949	0.03775	0.049763	0.053221	0.05117	0.04183	0.05222	0.053984	0.053942	0.043896	0.0441
Removed in B	g	49.1	53.5	53.3	53.5	53	50.3	53.4	54	53.5	52.9	53.3	52.3	52.2	52	54.7	53.3	52.8	52.6	53.8	52
	ug Au	24.55	27.82	27.716	25.145	24.91	24.144	25.632	24.84	23.005	22.218	22.386	21.966	22.446	21.84	23.521	23.452	22.176	22.618	23.134	21.9
	mg Cu	0.20622	0.24075	0.21853	0.2247	0.2173	0.21629	0.21894	0.1782	0.1712	0.16928	0.18122	0.14644	0.14616	0.1508	0.24615	0.21853	0.16368	0.15254	0.22058	0.18
	ug Zn	108.02	112.35	122.59	117.7	143.1	110.66	122.82	118.8	107	105.8	250.51	99.37	99.18	104	361.02	122.59	110.88	110.46	129.12	114.1
	g NaCN	0.022586	0.02461	0.024518	0.024075	0.02438	0.022635	0.024564	0.02592	0.025145	0.02645	0.026117	0.024581	0.0261	0.02548	0.025162	0.025051	0.025344	0.025774	0.026362	0.0245
	g CaO	0.002946	0.002675	0.002665	0.002675	0.00318	0.003018	0.003204	0.00324	0.00321	0.003703	0.002665	0.003661	0.003654	0.00364	0.002735	0.003731	0.003696	0.003682	0.003228	0.0031
In vessel at C	g	718.1	745.1	786.6	754.5	729.9	753.2	787.4	759	730.2	770.5	755	710.9	760.2	730.9	836.6	746.1	770.8	770.3	731.4	735.
	ug Au	330.326	365.099	393.3	347.07	321.156	346.472	362.204	333.96	299.382	308.2	302	284.36	319.284	299.669	343.006	313.362	308.32	323.526	299.874	301.5
	mg Cu	3.08783	3.57648	4.01166	4.0743	3.50352	4.21792	4.17322	3.1119	2.84778	3.3902	3.6995	2.70142	2.88876	2.99669	3.93202	3.43206	3.16028	3.00417	3.80328	3.456
	ug Zn	1579.82	1713.73	2123.82	1961.7	1824.75	1958.32	2047.24	1669.8	1606.44	2003.3	1887.5	1635.07	1672.44	1681.07	2091.5	1716.03	1927	1848.72	1901.64	2059.1
	g NaCN	0.315964	0.327844	0.330372	0.31689	0.328455	0.316344	0.330708	0.34155	0.321288	0.32361	0.32465	0.312796	0.326886	0.328905	0.37647	0.313362	0.34686	0.331229	0.307188	0.3309
	g CaO	0.028724	0.037255	0.03933	0.037725	0.036495	0.03766	0.03937	0.03795	0.03651	0.04623	0.03775	0.049763	0.03801	0.043854	0.04183	0.044766	0.046248	0.046218	0.043884	0.0441
Removed in C	g						52.9	51.9						38.5	52.3					59.1	55.
	ug Au						24.334	23.874						16.17	21.443					24.231	22.63
	mg Cu						0.29624	0.27507						0.1463	0.21443					0.30732	0.259
	ug Zn						137.54	134.94						84.7	120.29					153.66	154.9
	g NaCN						0.022218	0.021798						0.016555	0.023535					0.024822	0.024
	g CaO						0.002645	0.002595						0.001925	0.003138					0.003546	0.00331
In vessel at D	g						756.7	789.8						777.8	730.7					731.1	736.
	ug Au						325.381	339.614						303.342	284.973					277.818	287.31
	mg Cu						4.38886	4.18594						3.5001	3.06894					3.94794	3.609
	ug Zn						2194.43	2132.46						1866.72	1753.68					2120.19	1989.0
	g NaCN						0.370783	0.371206						0.31112	0.314201					0.336306	0.3020
	g CaO						0.030268	0.03949						0.046668	0.043842					0.043866	0.0442
Residue	ug Au	57.4	70.052	67.1	58.3585	55.2115	52.3	62.086	90.933	80	75.974	75.392	71.047	78.138	77.864	107.4805	110.725	88.247	88.156	91.679	84.16
Calculated Head	ug Au	441.01	493.91	517.76	458.61	426.86	453.00	477.32	473.93	427.53	431.12	421.87	399.86	443.02	429.13	499.51	471.07	440.79	456.35	441.81	436.9

1900

BMT 1.0
Sheets 1-13
Calc.

BMT5725 Sheet 1 31-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. 40

COMPOSITE BMT 1.0

SUMMARY

Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18
Extraction Au														
at 3 hours	g/t	0.86	0.84	0.82	0.82	0.83	0.88	0.88	0.78	0.78	0.75	0.77	0.74	0.84
at 6 hours	g/t	0.98	0.99	1.07	0.99	1.01	0.97	0.99	0.91	0.90	0.92	0.94	0.90	0.97
at 8 hours	g/t	1.03	1.06						0.96	0.93				
at 12 hours	g/t			1.09	1.05	1.09	1.04	1.05			1.01	1.01	0.96	1.03
at 18 hours	g/t						1.06	1.09						1.06
at 3 hours	%	70.3	66.2	63.2	62.2	63.8	68.7	69.5	63.1	67.8	61.0	58.4	60.2	61.9
at 6 hours	%	80.8	77.8	83.0	75.8	77.8	75.3	77.6	73.3	78.5	74.7	71.2	73.7	71.4
at 8 hours	%	84.3	83.5						77.9	80.7				
at 12 hours	%			84.5	80.2	83.6	81.2	82.1			81.8	76.9	78.2	76.0
at 18 hours	%						82.6	85.8						78.2
Calculated Head	ppm Au	1.22	1.27	1.29	1.31	1.30	1.29	1.27	1.24	1.15	1.23	1.31	1.23	1.36
Ground Head Assay 1	ppm Au	1.39	1.11	1.13	1.12	1.21	1.12	1.05	1.20	1.12	1.15	1.16	1.15	1.11
Ground Head Assay 2	ppm Au	1.57	1.14	1.13	1.11	1.17	1.10	1.09	1.14	1.08	1.13	1.14	1.19	1.10
Average Ground Head Assay	ppm Au	1.48	1.13	1.13	1.12	1.19	1.11	1.07	1.17	1.10	1.14	1.15	1.17	1.11
Calculated residue grade	ppm Au	0.19	0.21	0.20	0.26	0.22	0.22	0.18	0.27	0.22	0.23	0.30	0.27	0.30
Extraction Cu														
at 3 hours	g/t	27	28	30	30	27	28	28	27	25	27	27	26	27
at 6 hours	g/t	34	36	34	36	34	34	31	33	33	34	34	33	31
at 8 hours	g/t	36	39						36	34				
at 12 hours	g/t			39	39	37	36	36			37	37	37	37
at 18 hours	g/t						42	40						39
Assay Head	ppm Cu	360	(ave. of two head splits)											
Extraction Zn														
at 3 hours	g/t	5.1	4.9	4.4	4.8	4.2	4.6	4.3	5.0	4.9	4.2	3.9	4.4	4.5
at 6 hours	g/t	6.1	5.9	5.6	5.9	5.4	5.5	5.3	5.6	5.6	5.3	5.3	5.3	5.2
at 8 hours	g/t	6.6	7.6						7.1	6.9				
at 12 hours	g/t			6.9	7.1	6.3	6.2	6.1			6.4	6.3	6.9	6.4
at 18 hours	g/t						7.0	6.9						7.3
Assay Head	ppm Zn	315	(ave. of two head splits)											
NaCN consumption														
at 3 hours	kg/t	0.18	0.17	0.16	0.16	0.16	0.08	0.10	0.13	0.13	0.21	0.21	0.19	0.12
at 6 hours	kg/t	0.19	0.17	0.22	0.22	0.20	0.14	0.19	0.15	0.15	0.21	0.21	0.21	0.14
at 8 hours	kg/t	0.22	0.21						0.22	0.20				
at 12 hours	kg/t			0.25	0.24	0.23	0.18	0.24			0.25	0.28	0.25	0.21
at 18 hours	kg/t						0.17	0.23						0.20
CaO consumption														
at 3 hours	kg/t	1.91	1.98	1.92	2.10	2.10	1.57	1.64	1.96	1.96	1.87	1.90	1.88	1.63
at 6 hours	kg/t	1.92	2.01	1.93	2.11	2.12	1.59	1.68	1.98	1.97	1.87	1.90	1.88	1.64
at 8 hours	kg/t	1.93	2.01						2.01	1.98				
at 12 hours	kg/t			1.94	2.12	2.13	1.59	1.68			1.88	1.91	1.89	1.65
at 18 hours	kg/t						1.59	1.69						1.65
Actual grind passing nominated um (%)		79.0	80.1	79.8	79.2	79.1	79.1	79.0	81.7	81.5	80.5	79.6	80.6	80.9

BMT5725 Sheet 2 4-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0 |

tests conducted (date)		11/10	11/10	9/10	9/10	9/10	11/10	11/10	11/10	11/10	9/10	9/10	9/10	11/10	1
Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A	
Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106	
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18	
Vessel	g	409.0	407.8	407.0	406.8	406.6	406.9	406.9	408.0	407.6	406.3	408.3	408.4	407.2	4
Sample mass	g	750.7	724.6	712.9	750.7	743.4	748.7	717.7	723.7	727.7	730.4	717.9	731.8	739.7	7
Sitewater added	g	1126	1087	1069	1126	1115	1123	1077	1086	1092	1096	1077	1098	1110	
Natural pH		6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	
CaO added	g	1.49	1.49	1.42	1.63	1.62	1.23	1.24	1.48	1.48	1.41	1.41	1.42	1.25	
NaCN added	g	0.61	0.59	0.57	0.61	0.60	0.60	0.58	0.59	0.60	0.59	0.58	0.59	0.60	
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	
Gross off rolls	g	2286.1	2218.7	2197.9	2293.3	2272.2	2276.2	2201.1	2217.5	2226.5	2232.1	2206.0	2241.7	2254.8	22
Pulp temperature	deg C	20	20	19	19	19	19	19	20	20	19	19	19	19	
Liquor sample A	pH	11.3	11.4	11.1	11.2	11.3	11.4	11.4	11.4	11.5	11.1	11.1	11.0	11.3	
	ppm Au	0.57	0.56	0.54	0.54	0.55	0.59	0.59	0.52	0.52	0.50	0.51	0.49	0.56	
	ppm Cu	18	19	20	20	18	19	19	18	17	18	18	17	18	
	ppm Zn	3.4	3.3	2.9	3.2	2.8	3.1	2.9	3.3	3.3	2.8	2.6	2.9	3.0	
	% NaCN	0.042	0.043	0.042	0.043	0.043	0.048	0.047	0.046	0.046	0.040	0.040	0.041	0.046	0
	% CaO	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.004	0.004	0.004	0.004	0
Gross after sample	g	2234.6	2161.8	2148.1	2243.0	2221.2	2223.5	2147.4	2164.7	2178.5	2181.9	2155.4	2191.8	2201.6	21
CaO added	g														
NaCN added	g	0.08	0.07	0.09	0.08	0.08	0.02	0.03	0.04	0.04	0.11	0.11	0.10	0.04	
Leach time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	
Gross off rolls	g	2285.2	2217.5	2188.3	2281.7	2263.8	2275.3	2200.0	2216.7	2225.4	2231.6	2202.8	2237.6	2254.1	22
Pulp temperature	deg C	22	22	21.5	21.5	21.5	21.5	21.5	22	22	21.5	21.5	21.5	21.5	
Liquor sample B	pH	11.1	11.2	10.9	11.0	11.1	11.3	11.2	11.2	11.3	11.0	10.9	10.9	11.2	
	ppm Au	0.63	0.63	0.69	0.64	0.65	0.62	0.63	0.58	0.58	0.59	0.60	0.58	0.62	
	ppm Cu	22	23	22	23	22	22	20	21	21	22	22	21	20	
	ppm Zn	3.9	3.8	3.6	3.8	3.5	3.5	3.4	3.6	3.6	3.4	3.4	3.4	3.3	
	% NaCN	0.047	0.047	0.045	0.045	0.046	0.044	0.042	0.046	0.047	0.048	0.048	0.047	0.046	0
	% CaO	0.004	0.003	0.004	0.004	0.004	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.003	0
Gross after sample	g	2234.0	2168.5	2136.7	2228.2	2209.9	2217.7	2149.7	2164.9	2173.6	2177.8	2148.7	2184.4	2197.2	21
CaO added	g														
NaCN added	g	0.03	0.03	0.05	0.06	0.06	0.06	0.08	0.04	0.03	0.02	0.02	0.03	0.04	
Leach time	hrs	2	2	6	6	6	6	6	2	2	6	6	6	6	
Gross off rolls	g	2283.9	2217.1	2187.0	2279.4	2262.5	2273.7	2197.8	2216.0	2224.7	2230.0	2201.8	2236.3	2252.7	22
Pulp temperature	deg C	22	22	20	20	20	20.5	20.5	22	22	20	20	20	20.5	
Liquor sample C	pH	11.1	11.2	10.9	11.0	11.1	11.3	11.2	11.2	11.3	11.0	11.0	10.9	11.2	
	ppm Au	0.63	0.65	0.67	0.65	0.67	0.64	0.64	0.59	0.57	0.62	0.62	0.59	0.63	
	ppm Cu	22	24	24	24	23	22	22	22	21	23	23	23	23	
	ppm Zn	5.4	4.7	4.3	4.4	3.9	3.8	3.8	4.4	4.3	4.0	3.9	4.3	4.0	
	% NaCN	0.045	0.045	0.046	0.047	0.047	0.044	0.044	0.043	0.044	0.045	0.043	0.045	0.043	
	% CaO	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.002	
Gross after sample	g						2217.8	2142.9						2197.7	2
CaO added	g														
NaCN added	g						0.06	0.06						0.07	
Leach time	hrs						6	6						6	
Gross off rolls	g						2272.8	2196.8						2250.9	2
Pulp temperature	deg C						19	19						19	
Liquor sample D	pH						11.3	11.2						11.2	
	ppm Au						0.62	0.64						0.62	
	ppm Cu						25	24						23	
	ppm Zn						4.2	4.1						4.4	
	% NaCN						0.048	0.048						0.048	
	% CaO						0.003	0.002						0.002	
Sample mass account															
Residue recovered (screened)	g	748.9	726.3	705.8	748.2	736.7	747.8	717.5	722.3	726.1	725.3	717.4	728.7	739.0	
Ground head to assay	g	112.6	117.2	129.9	100.4	119.6	103.8	143.7	128.0	114.5	113.5	148.6	117.7	116.9	
Calculated head to grind	g	861.5	843.5	835.7	848.6	856.3	851.6	861.2	850.3	840.6	838.8	866.0	846.4	855.9	
Actual head to grind	g	863.3	841.8	842.8	851.1	863.0	852.5	861.4	851.7	842.2	843.9	866.5	849.5	856.6	
Unaccounted mass	%	0.21	-0.20	0.84	0.29	0.78	0.11	0.02	0.16	0.19	0.60	0.06	0.36	0.08	

BMT5725 Sheet 3 31-Oct-89

BILLITON MT TODD WEATHERED OXE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.0 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 3C	Nom. P80um 75	Leach hrs 8						
+ 150		0.0	100.0					0.0
- 150 + 106	56.6	7.6	92.4	0.50		0.50	28.30	19.7
- 106 + 75	100.7	13.4	79.0	0.37	0.42	0.40	39.78	27.7
- 75 + 53	68.5	9.1	69.8	0.30		0.30	20.55	14.3
- 53	523.1	69.8		0.11	0.10	0.11	54.93	38.3
Calculated	748.9	100.0				0.19	143.6	100.0
Test No. 6D	Nom. P80um 75	Leach hrs 8						
+ 150		0.0	100.0					0.0
- 150 + 106	49.3	6.8	93.2	0.56		0.56	27.61	18.2
- 106 + 75	94.9	13.1	80.1	0.37	0.38	0.38	35.59	23.5
- 75 + 53	66.5	9.2	71.0	0.32		0.32	21.28	14.0
- 53	515.6	71.0		0.14	0.12	0.13	67.03	44.2
Calculated	726.3	100.0				0.21	151.5	100.0
Test No. 3B	Nom. P80um 75	Leach hrs 12						
+ 150		0.0	100.0					0.0
- 150 + 106	51.0	7.2	92.8	0.47		0.47	23.97	16.7
- 106 + 75	91.3	12.9	79.8	0.37	0.43	0.40	36.52	25.5
- 75 + 53	62.7	8.9	71.0	0.28		0.28	17.56	12.3
- 53	500.8	71.0		0.12	0.14	0.13	65.10	45.5
Calculated	705.8	100.0				0.20	143.2	100.0
Test No. 6C	Nom. P80um 75	Leach hrs 12						
+ 150		0.0	100.0					0.0
- 150 + 106	57.8	7.7	92.3	0.48		0.48	27.74	14.2
- 106 + 75	97.7	13.1	79.2	0.39	0.39	0.39	38.10	19.6
- 75 + 53	64.9	8.7	70.5	0.32		0.32	20.77	10.7
- 53	527.8	70.5		0.18	0.23	0.21	108.20	55.5
Calculated	748.2	100.0				0.26	194.8	100.0
Test No. 3D	Nom. P80um 75	Leach hrs 12						
+ 150		0.0	100.0					0.0
- 150 + 106	54.9	7.5	92.5	0.48		0.48	26.35	16.6
- 106 + 75	99.1	13.5	79.1	0.40	0.41	0.41	40.14	25.3
- 75 + 53	65.4	8.9	70.2	0.34		0.34	22.24	14.0
- 53	517.3	70.2		0.14	0.13	0.14	69.84	44.0
Calculated	736.7	100.0				0.22	158.6	100.0

BILLITON MT TODD WEATHERED OXE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8A		Nom. P80um 75		Leach hrs 18				
+ 150		0.0	100.0					0.0
- 150 + 106	54.7	7.3	92.7	0.45		0.45	24.62	14.7
- 106 + 75	101.4	13.6	79.1	0.46	0.40	0.43	43.60	26.0
- 75 + 53	67.1	9.0	70.2	0.35		0.35	23.48	14.0
- 53	524.6	70.2		0.15	0.14	0.15	76.07	45.3
Calculated	747.8	100.0				0.22	167.8	100.0
Test No. 4B		Nom. P80um 75		Leach hrs 18				
+ 150		0.0	100.0					0.0
- 150 + 106	54.9	7.7	92.3	0.49		0.49	26.90	20.8
- 106 + 75	95.5	13.3	79.0	0.38	0.38	0.38	36.29	28.0
- 75 + 53	66.7	9.3	69.7	0.28		0.28	18.68	14.4
- 53	500.4	69.7		0.10	0.09	0.10	47.54	36.7
Calculated	717.5	100.0				0.18	129.4	100.0
Test No. 1B		Nom. P80um 106		Leach hrs 8				
+ 150	47.2	6.5	93.5	0.58		0.58	27.38	13.8
- 150 + 106	84.9	11.8	81.7	0.53	0.55	0.54	45.85	23.1
- 106 + 75	97.2	13.5	68.3	0.36	0.39	0.38	36.45	18.4
- 75 + 53	56.6	7.8	60.4	0.37		0.37	20.94	10.6
- 53	436.4	60.4		0.13	0.18	0.16	67.64	34.1
Calculated	722.3	100.0				0.27	198.3	100.0
Test No. 5C		Nom. P80um 106		Leach hrs 8				
+ 150	51.4	7.1	92.9	0.61		0.61	31.35	19.4
- 150 + 106	83.1	11.4	81.5	0.49	0.54	0.52	42.80	26.5
- 106 + 75	95.6	13.2	68.3	0.36	0.39	0.38	35.85	22.2
- 75 + 53	55.1	7.6	60.7	0.29		0.29	15.98	9.9
- 53	440.9	60.7		0.07	0.09	0.08	35.27	21.9
Calculated	726.1	100.0				0.22	161.3	100.0
Test No. 7A		Nom. P80um 106		Leach hrs 12				
+ 150	57.1	7.9	92.1	0.51		0.51	29.12	17.8
- 150 + 106	84.6	11.7	80.5	0.51	0.51	0.51	43.15	26.3
- 106 + 75	97.4	13.4	67.0	0.38	0.38	0.38	37.01	22.6
- 75 + 53	51.5	7.1	59.9	0.30		0.30	15.45	9.4
- 53	434.7	59.9		0.09	0.09	0.09	39.12	23.9
Calculated	725.3	100.0				0.23	163.9	100.0

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.0 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8B	Nom. P80um	106	Leach hrs	12				
+ 150	60.5	8.4	91.6	0.49		0.49	29.65	13.6
- 150 + 106	85.5	11.9	79.6	0.54	0.53	0.54	45.74	21.0
- 106 + 75	93.8	13.1	66.6	0.45	0.41	0.43	40.33	18.5
- 75 + 53	53.6	7.5	59.1	0.36		0.36	19.30	8.9
- 53	424.0	59.1		0.22	0.17	0.20	82.68	38.0
Calculated	717.4	100.0				0.30	217.7	100.0
Test No. 2C	Nom. P80um	106	Leach hrs	12				
+ 150	52.2	7.2	92.8	0.53		0.53	27.67	14.2
- 150 + 106	89.2	12.2	80.6	0.55	0.57	0.56	49.95	25.6
- 106 + 75	102.0	14.0	66.6	0.37	0.39	0.38	38.76	19.9
- 75 + 53	51.6	7.1	59.5	0.35		0.35	18.06	9.3
- 53	433.7	59.5		0.11	0.17	0.14	60.72	31.1
Calculated	728.7	100.0				0.27	195.2	100.0
Test No. 6A	Nom. P80um	106	Leach hrs	18				
+ 150	54.0	7.3	92.7	0.55		0.55	29.70	13.6
- 150 + 106	86.8	11.7	80.9	0.62	0.73	0.68	58.59	26.8
- 106 + 75	99.9	13.5	67.4	0.36	0.36	0.36	35.96	16.5
- 75 + 53	57.6	7.8	59.6	0.37		0.37	21.31	9.8
- 53	440.7	59.6		0.15	0.18	0.17	72.72	33.3
Calculated	739.0	100.0				0.30	218.3	100.0
Test No. 4D	Nom. P80um	106	Leach hrs	18				
+ 150	51.9	7.1	92.9	0.34		0.34	17.65	14.0
- 150 + 106	86.9	11.9	81.1	0.39	0.39	0.39	33.89	26.9
- 106 + 75	98.0	13.4	67.7	0.34	0.30	0.32	31.36	24.9
- 75 + 53	56.8	7.8	59.9	0.26		0.26	14.77	11.7
- 53	438.9	59.9		0.07	0.06	0.07	28.53	22.6
Calculated	732.5	100.0				0.17	126.2	100.0
Test No. 4A	Nom. P80um	150	Leach hrs	8				
+ 150	128.8	18.1	81.9	0.59	0.59	0.59	75.99	39.5
- 150 + 106	85.6	12.0	69.8	0.47	0.47	0.47	40.23	20.9
- 106 + 75	73.1	10.3	59.6	0.39		0.39	28.51	14.8
- 75 + 53	46.8	6.6	53.0	0.33		0.33	15.44	8.0
- 53	376.8	53.0		0.08	0.09	0.09	32.03	16.7
Calculated	711.1	100.0				0.27	192.2	100.0

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.0 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 5B	Nom. P80um 150	Leach hrs 8						
+ 150	140.9	19.0	81.0	0.62	0.62	0.62	87.36	41.3
- 150 + 106	88.9	12.0	69.0	0.51	0.52	0.52	45.78	21.6
- 106 + 75	76.4	10.3	58.7	0.37		0.37	28.27	13.3
- 75 + 53	47.1	6.4	52.4	0.41		0.41	19.31	9.1
- 53	388.2	52.4		0.08	0.08	0.08	31.06	14.7
Calculated	741.5	100.0				0.29	211.8	100.0
Test No. 1A	Nom. P80um 150	Leach hrs 12						
+ 150	139.5	19.6	80.4	0.62	0.60	0.61	85.10	37.4
- 150 + 106	86.7	12.2	68.3	0.47	0.49	0.48	41.62	18.3
- 106 + 75	73.7	10.3	58.0	0.39		0.39	28.74	12.6
- 75 + 53	44.5	6.2	51.7	0.38		0.38	16.91	7.4
- 53	369.1	51.7		0.17	0.13	0.15	55.37	24.3
Calculated	713.5	100.0				0.32	227.7	100.0
Test No. 7D	Nom. P80um 150	Leach hrs 12						
+ 150	143.0	19.5	80.5	0.65	0.65	0.65	92.95	41.8
- 150 + 106	88.4	12.1	68.4	0.56	0.56	0.56	49.50	22.3
- 106 + 75	76.3	10.4	57.9	0.39		0.39	29.76	13.4
- 75 + 53	43.7	6.0	52.0	0.32		0.32	13.98	6.3
- 53	380.2	52.0		0.10	0.09	0.10	36.12	16.2
Calculated	731.6	100.0				0.30	222.3	100.0
Test No. 7C	Nom. P80um 150	Leach hrs 18						
+ 150	155.6	21.1	78.9	0.60	0.59	0.60	92.58	46.3
- 150 + 106	90.4	12.3	66.6	0.50	0.46	0.48	43.39	21.7
- 106 + 75	79.6	10.8	55.8	0.34		0.34	27.06	13.5
- 75 + 53	44.8	6.1	49.7	0.29		0.29	12.99	6.5
- 53	366.2	49.7		0.06	0.07	0.07	23.80	11.9
Calculated	736.6	100.0				0.27	199.8	100.0
Test No. 1D	Nom. P80um 150	Leach hrs 18						
+ 150	142.2	19.9	80.1	0.57	0.60	0.59	83.19	45.7
- 150 + 106	85.3	11.9	68.2	0.41	0.48	0.45	37.96	20.9
- 106 + 75	75.8	10.6	57.7	0.35		0.35	26.53	14.6
- 75 + 53	41.5	5.8	51.9	0.29		0.29	12.04	6.6
- 53	371.4	51.9		0.06	0.06	0.06	22.28	12.2
Calculated	716.2	100.0				0.25	182.0	100.0

BMT5725 Sheet 7 31-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 1.0		P80=75um			P80=106um			P80=150um		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18.0	8.0	12.6	18.0	8.0	12.7	18.0	8.0
Extraction Au										
at 3 hours	g/t	0.85	0.88	0.82	0.78	0.84	0.74	0.72	0.75	0.67
at 6 hours	g/t	1.00	1.07	0.97	0.92	0.97	0.90	0.87	0.89	0.86
at 8 hours	g/t	1.04	1.06	1.03	0.95	0.96	0.93	0.93	0.93	0.93
at 12 hours	g/t	1.06	1.09	1.04	1.00	1.03	0.96	0.95	0.97	0.93
at 18 hours	g/t	1.08	1.09	1.06	1.03	1.06	1.01	0.97	0.98	0.96
at 3 hours	%	66.3	70.3	62.2	62.6	67.8	58.4	58.5	62.3	53.0
at 6 hours	%	78.3	83.0	75.3	74.4	78.5	71.2	70.7	74.1	67.2
at 8 hours	%	83.9	84.3	83.5	79.3	80.7	77.9	77.0	77.6	76.5
at 12 hours	%	82.3	84.5	80.2	79.2	83.2	76.0	76.0	77.0	75.1
at 18 hours	%	84.2	85.8	82.6	81.8	85.4	78.2	78.7	79.4	77.9
Calculated Head	ppm Au	1.28	1.31	1.22	1.24	1.36	1.15	1.24	1.28	1.20
Ground Head Assay 1	ppm Au	1.16	1.39	1.05	1.14	1.20	1.07	1.10	1.19	0.98
Ground Head Assay 2	ppm Au	1.19	1.57	1.09	1.13	1.19	1.08	1.16	1.22	1.02
Average Ground Head Assay	ppm Au	1.17	1.48	1.07	1.13	1.17	1.10	1.13	1.20	1.00
Calculated residue grade	ppm Au	0.21	0.26	0.18	0.25	0.30	0.17	0.28	0.32	0.25
Extraction Cu										
at 3 hours	g/t	29	30	27	27	27	25	25	25	24
at 6 hours	g/t	34	36	31	33	34	31	31	33	31
at 8 hours	g/t	37	39	36	35	36	34	34	34	34
at 12 hours	g/t	37	39	36	37	37	36	36	37	36
at 18 hours	g/t	41	42	40	38	39	37	37	39	36
Assay Head	ppm Cu									
Extraction Zn										
at 3 hours	g/t	4.6	5.1	4.2	4.5	5.0	3.9	4.4	4.8	3.9
at 6 hours	g/t	5.7	6.1	5.3	5.3	5.6	5.2	5.3	5.6	5.1
at 8 hours	g/t	8.1	8.6	7.6	7.0	7.1	6.9	6.8	7.0	6.5
at 12 hours	g/t	6.5	7.1	6.1	6.4	6.9	6.1	6.5	6.6	6.3
at 18 hours	g/t	7.0	7.0	6.9	7.3	7.3	7.3	7.7	8.0	7.4
Assay Head	ppm Zn									
NaCN consumption										
at 3 hours	kg/t	0.15	0.18	0.08	0.15	0.21	0.10	0.23	0.47	0.10
at 6 hours	kg/t	0.19	0.22	0.14	0.17	0.21	0.13	0.07	0.14	-0.04
at 8 hours	kg/t	0.22	0.22	0.21	0.21	0.22	0.20	0.18	0.19	0.17
at 12 hours	kg/t	0.23	0.25	0.18	0.24	0.28	0.20	0.12	0.22	0.03
at 18 hours	kg/t	0.20	0.23	0.17	0.19	0.20	0.19	0.18	0.19	0.17
CaO consumption										
at 3 hours	kg/t	1.89	2.10	1.57	1.83	1.96	1.60	1.83	2.00	1.57
at 6 hours	kg/t	1.91	2.12	1.59	1.84	1.98	1.62	1.95	2.29	1.58
at 8 hours	kg/t	1.97	2.01	1.93	2.00	2.01	1.98	1.97	2.03	1.92
at 12 hours	kg/t	1.89	2.13	1.59	1.79	1.91	1.62	1.95	2.30	1.58
at 18 hours	kg/t	1.64	1.69	1.59	1.64	1.65	1.62	1.60	1.63	1.57
Actual grind passing nominated um (%)		79.4	80.1	79.0	80.8	81.7	79.6	80.5	81.9	78.9

BMT5725 Sheet 8 31-Oct-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0

Summary of 8 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3C	75	0.19	0.00	0.50	0.40	0.30	0.11
6D	75	0.21	0.00	0.56	0.38	0.32	0.13
Average		0.20	0.00	0.53	0.39	0.31	0.12
1B	106	0.27	0.58	0.54	0.38	0.37	0.16
5C	106	0.22	0.61	0.52	0.38	0.29	0.08
Average		0.25	0.60	0.53	0.38	0.33	0.12
4A	150	0.27	0.59	0.47	0.39	0.33	0.09
5B	150	0.29	0.62	0.52	0.37	0.41	0.08
Average		0.28	0.61	0.49	0.38	0.37	0.08

Summary of 12 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3B	75	0.20	0.00	0.47	0.40	0.28	0.13
6C	75	0.26	0.00	0.48	0.39	0.32	0.21
3D	75	0.22	0.00	0.48	0.41	0.34	0.14
Average		0.23	0.00	0.48	0.40	0.31	0.16
7A	106	0.23	0.51	0.51	0.38	0.30	0.09
8B	106	0.30	0.49	0.54	0.43	0.36	0.20
2C	106	0.27	0.53	0.56	0.38	0.35	0.14
Average		0.27	0.51	0.54	0.40	0.34	0.14
1A	150	0.32	0.61	0.48	0.39	0.38	0.15
7D	150	0.30	0.65	0.56	0.39	0.32	0.10
Average		0.31	0.63	0.52	0.39	0.35	0.12

Summary of 18 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
8A	75	0.22	0.00	0.45	0.43	0.35	0.15
4B	75	0.18	0.00	0.49	0.38	0.28	0.10
Average		0.20	0.00	0.47	0.41	0.32	0.12
6A	106	0.30	0.55	0.68	0.36	0.37	0.17
4D	106	0.17	0.34	0.39	0.32	0.26	0.07
Average		0.23	0.45	0.53	0.34	0.32	0.12
7C	150	0.27	0.60	0.48	0.34	0.29	0.07
1D	150	0.25	0.59	0.45	0.35	0.29	0.06
Average		0.26	0.59	0.46	0.35	0.29	0.06

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 1.0

Summary of Residue Size Fraction Assays

Leach Time	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
18 Hour (2 tests)	150	0.26	0.59	0.46	0.35	0.29	0.06
12 Hour (2 tests)	150	0.31	0.63	0.52	0.39	0.35	0.12
8 Hour (2 tests)	150	0.28	0.61	0.49	0.38	0.37	0.08
Weighted Ave.		0.28	0.61	0.49	0.37	0.34	0.09
18 Hour (2 tests)	106	0.23	0.45	0.53	0.34	0.32	0.12
12 Hour (3 tests)	106	0.27	0.51	0.54	0.40	0.34	0.14
8 Hour (2 tests)	106	0.25	0.60	0.53	0.38	0.33	0.12
Weighted Ave.		0.25	0.52	0.53	0.37	0.33	0.13
18 Hour (2 tests)	75	0.20	0.00	0.47	0.41	0.32	0.12
12 Hour (3 tests)	75	0.23	0.00	0.48	0.40	0.31	0.16
8 Hour (2 tests)	75	0.20	0.00	0.53	0.39	0.31	0.12
Weighted Ave.		0.21	0.00	0.49	0.40	0.31	0.14

Summary of 8 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3C	75	0.19	0.0	19.7	27.7	14.3	38.3
6D	75	0.21	0.0	18.2	23.5	14.0	44.2
Average		0.20	0.0	19.0	25.6	14.2	41.3
1B	106	0.27	13.8	23.1	18.4	10.6	34.1
5C	106	0.22	19.4	26.5	22.2	9.9	21.9
Average		0.25	16.6	24.8	20.3	10.2	28.0
4A	150	0.27	39.5	20.9	14.8	8.0	16.7
5B	150	0.29	41.3	21.6	13.3	9.1	14.7
Average		0.28	40.4	21.3	14.1	8.6	15.7

Summary of 12 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3B	75	0.20	0.0	16.7	25.5	12.3	45.5
6C	75	0.26	0.0	14.2	19.6	10.7	55.5
3D	75	0.22	0.0	16.6	25.3	14.0	44.0
Average		0.23	0.0	15.9	23.5	12.3	48.4
7A	106	0.23	17.8	26.3	22.6	9.4	23.9
8B	106	0.30	13.6	21.0	18.5	8.9	38.0
2C	106	0.27	14.2	25.6	19.9	9.3	31.1
Average		0.27	15.2	24.3	20.3	9.2	31.0
1A	150	0.32	37.4	18.3	12.6	7.4	24.3
7D	150	0.30	41.8	22.3	13.4	6.3	16.2
Average		0.31	39.6	20.3	13.0	6.9	20.3

Summary of 18 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
8A	75	0.22	0.0	14.7	26.0	14.0	45.3
4B	75	0.18	0.0	20.8	28.0	14.4	36.7
Average		0.20	0.0	17.7	27.0	14.2	41.0
6A	106	0.30	13.6	26.8	16.5	9.8	33.3
4D	106	0.17	14.0	26.9	24.9	11.7	22.6
Average		0.23	13.8	26.8	20.7	10.7	28.0
7C	150	0.27	46.3	21.7	13.5	6.5	11.9
1D	150	0.25	45.7	20.9	14.6	6.6	12.2
Average		0.26	46.0	21.3	14.1	6.6	12.1

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0

Summary of Residue Size Fraction Gold Distribution

Leach Time	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
18 Hour (2 tests)	150	0.26	46.0	21.3	14.1	6.6	12.1
12 Hour (2 tests)	150	0.31	39.6	20.3	13.0	6.9	20.3
8 Hour (2 tests)	150	0.28	40.4	21.3	14.1	8.6	15.7
Weighted Ave.		0.28	42.0	20.9	13.7	7.3	16.0
18 Hour (2 tests)	106	0.23	13.8	26.8	20.7	10.7	28.0
12 Hour (3 tests)	106	0.27	15.2	24.3	20.3	9.2	31.0
8 Hour (2 tests)	106	0.25	16.6	24.8	20.3	10.2	28.0
Weighted Ave.		0.25	15.2	25.2	20.4	9.9	29.3
18 Hour (2 tests)	75	0.20	0.0	17.7	27.0	14.2	41.0
12 Hour (3 tests)	75	0.23	0.0	15.9	23.5	12.3	48.4
8 Hour (2 tests)	75	0.20	0.0	19.0	25.6	14.2	41.3
Weighted Ave.		0.21	0.0	17.3	25.1	13.4	44.2

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.0 |

Summary of L.S.& A. 8 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3C	75	1.13	1.48	1.22	0.19	84.3	8	40	0.045	11.1	0.22	1.93	360	35.7	9.9	315	8.6	2.7
6D	75	1.13	1.13	1.27	0.21	83.5	8	40	0.045	11.2	0.21	2.01	360	39.0	10.8	315	7.6	2.4
Average		1.13	1.30	1.24	0.20	83.9	8	40	0.045	11.2	0.22	1.97	360	37.3	10.4	315	8.1	2.6
1B	106	1.13	1.17	1.24	0.27	77.9	8	40	0.043	11.2	0.22	2.01	360	35.8	9.9	315	7.1	2.3
5C	106	1.13	1.10	1.15	0.22	80.7	8	40	0.044	11.3	0.20	1.98	360	34.1	9.5	315	6.9	2.2
Average		1.13	1.14	1.19	0.25	79.3	8	40	0.044	11.3	0.21	2.00	360	34.9	9.7	315	7.0	2.2
4A	150	1.13	1.12	1.20	0.27	77.6	8	40	0.044	11.3	0.19	2.03	360	34.1	9.5	315	6.5	2.1
5B	150	1.13	1.16	1.21	0.29	76.5	8	40	0.044	11.3	0.17	1.92	360	33.9	9.4	315	7.0	2.2
Average		1.13	1.14	1.21	0.28	77.0	8	40	0.044	11.3	0.18	1.97	360	34.0	9.5	315	6.8	2.1

Summary of L.S.& A. 12 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3B	75	1.13	1.13	1.29	0.20	84.5	12	40	0.046	10.9	0.25	1.94	360	38.9	10.8	315	6.9	2.2
6C	75	1.13	1.12	1.31	0.26	80.2	12	40	0.047	11.0	0.24	2.12	360	38.8	10.8	315	7.1	2.2
3D	75	1.13	1.19	1.30	0.22	83.6	12	40	0.047	11.1	0.23	2.13	360	37.2	10.3	315	6.3	2.0
Average		1.13	1.15	1.30	0.23	82.8	12	40	0.047	11.0	0.24	2.06	360	38.3	10.6	315	6.7	2.1
7A	106	1.13	1.14	1.23	0.23	81.8	12	40	0.045	11.0	0.25	1.88	360	37.3	10.4	315	6.4	2.0
8B	106	1.13	1.15	1.31	0.30	76.9	12	40	0.043	11.0	0.28	1.91	360	37.4	10.4	315	6.3	2.0
2C	106	1.13	1.17	1.23	0.27	78.2	12	40	0.045	10.9	0.25	1.89	360	37.1	10.3	315	6.9	2.2
Average		1.13	1.15	1.26	0.27	79.0	12	40	0.044	11.0	0.26	1.89	360	37.3	10.4	315	6.5	2.1
1A	150	1.13	1.13	1.27	0.32	75.1	12	40	0.061	11.3	0.04	2.29	360	37.2	10.3	315	6.4	2.0
1D	150	1.13	1.20	1.28	0.30	76.2	12	40	0.061	11.3	0.03	2.30	360	37.1	10.3	315	6.6	2.1
Average		1.13	1.16	1.27	0.31	75.6	12	40	0.061	11.3	0.03	2.30	360	37.1	10.3	315	6.5	2.1

Summary of L.S.& A. 18 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
8A	75	1.13	1.11	1.29	0.22	82.6	18	40	0.048	11.3	0.17	1.59	360	42.0	11.7	315	7.0	2.2
4B	75	1.13	1.07	1.27	0.18	85.8	18	40	0.048	11.2	0.23	1.69	360	40.4	11.2	315	6.9	2.2
Average		1.13	1.09	1.28	0.20	84.2	18	40	0.048	11.3	0.20	1.64	360	41.2	11.4	315	7.0	2.2
6A	106	1.13	1.11	1.36	0.30	78.2	18	40	0.048	11.2	0.20	1.65	360	38.9	10.8	315	7.3	2.3
4D	106	1.13	1.10	1.18	0.17	85.4	18	40	0.048	11.2	0.19	1.62	360	37.3	10.3	315	7.3	2.3
Average		1.13	1.10	1.27	0.23	81.8	18	40	0.048	11.2	0.19	1.64	360	38.1	10.6	315	7.3	2.3
7C	150	1.13	1.00	1.23	0.27	77.9	18	40	0.049	11.2	0.17	1.57	360	38.7	10.7	315	7.4	2.3
1D	150	1.13	1.18	1.23	0.25	79.4	18	40	0.049	11.2	0.19	1.63	360	35.9	10.0	315	8.0	2.5
Average		1.13	1.09	1.23	0.26	78.7	18	40	0.049	11.2	0.18	1.60	360	37.3	10.4	315	7.7	2.4

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.0 |

Summary of L.S.& A. Bottle Roll Leach Test Results

Leach Time	Grind P80 um	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp. ppm Au	Ground Head ppm Au	Calc'd Head ppm Au	Residue Solids ppm Au	Extr'n %	Time Hours	Pulp % Solids	% NaCN	pH	NaCN kg/t	CaO kg/t	Assay Head ppm	Extraction g/t	Extraction %	Assay Head ppm	Extraction g/t	Extraction %
18 Hour (2 tests)	150	1.13	1.09	1.23	0.26	78.7	18	40	0.049	11.2	0.18	1.60	360	37.3	[illegible]	315	7.7	2.4
12 Hour (2 tests)	150	1.13	1.16	1.27	0.31	75.6	12	40	0.061	11.3	0.03	2.30	360	37.1	10.3	315	6.5	2.1
8 Hour (2 tests)	150	1.13	1.14	1.21	0.28	77.0	8	40	0.044	11.3	0.18	1.97	360	34.0	9.5	315	6.8	2.1
Weighted Ave.		1.13	1.13	1.24	0.28	77.1	13	40	0.051	11.3	0.13	1.96	360	36.1	10.0	315	7.0	2.2
18 Hour (2 tests)	106	1.13	1.10	1.27	0.23	81.8	18	40	0.048	11.2	0.19	1.64	360	38.1	10.6	315	7.3	2.3
12 Hour (3 tests)	106	1.13	1.15	1.26	0.27	79.0	12	40	0.044	11.0	0.26	1.89	360	37.3	10.4	315	6.5	2.1
8 Hour (2 tests)	106	1.13	1.14	1.19	0.25	79.3	8	40	0.044	11.3	0.[illegible]	2.00	360	34.9	9.7	315	7.0	2.2
Weighted Ave.		1.13	1.13	1.24	0.25	79.9	13	40	0.045	11.1	0.23	1.85	360	36.8	10.2	315	6.9	2.2
18 Hour (2 tests)	75	1.13	1.09	1.28	0.20	84.2	18	40	0.048	11.3	0.20	1.64	360	41.2	11.4	315	7.0	2.2
12 Hour (3 tests)	75	1.13	1.15	1.30	0.23	82.8	12	40	0.047	11.0	0.24	2.06	360	38.3	10.6	315	6.7	2.1
8 Hour (2 tests)	75	1.13	1.30	1.24	0.20	83.9	8	40	0.045	11.2	0.22	1.97	360	37.3	10.4	315	8.1	2.6
Weighted Ave.		1.13	1.17	1.28	0.21	83.5	13	40	0.047	11.1	0.22	1.92	360	38.9	10.8	315	7.2	2.3

BMT 1.0
Sheet 13

BMT5725 Sheet Calc
Calculation sheet only

COMPOSITE BMT 1.0

Sample mass	g	750.7	724.6	712.9	750.7	743.4	748.7	717.7	723.7	727.7	730.4	717.9	731.8	739.7	735.9	712.1	745.4	717	732.4	737.7	719.4
Vessel + sample	g	1159.7	1132.4	1119.9	1157.5	1150	1155.6	1124.6	1131.7	1135.3	1136.7	1126.2	1140.2	1146.9	1142.4	1120.4	1150.7	1124.8	1139.9	1146.3	1127.9
In vessel at A	g	1126.4	1086.3	1078	1135.8	1122.2	1120.6	1076.5	1085.8	1091.2	1095.4	1079.8	1101.5	1107.9	1103.3	1067.4	1118	1075.3	1101.6	1105.8	1078.5
	ug Au	642.048	608.328	582.12	613.332	617.21	661.154	635.135	564.616	567.424	547.7	550.698	539.735	620.424	573.716	533.7	547.82	483.885	495.72	552.9	539.25
	mg Cu	20.2752	20.6397	21.56	22.716	20.1996	21.2914	20.4535	19.5444	18.5504	19.7172	19.4364	18.7255	19.9422	19.8594	17.0784	17.888	18.2801	17.6256	18.7986	18.3345
	ug Zn	3829.76	3584.79	3126.2	3634.56	3142.16	3473.86	3121.85	3583.14	3600.96	3067.12	2807.48	3194.35	3323.7	3199.57	3415.68	3465.8	2795.78	2864.16	3538.56	3235.5
	g NaCN	0.473088	0.467109	0.45276	0.488394	0.482546	0.537888	0.505955	0.499468	0.501952	0.43816	0.43192	0.451615	0.509634	0.518551	0.491004	0.52546	0.258072	0.242352	0.508668	0.506895
	g CaO	0.05632	0.054315	0.0539	0.05679	0.05611	0.05603	0.06459	0.065148	0.05456	0.043816	0.043192	0.04406	0.044316	0.055165	0.05337	0.0539	0	0	0.044232	0.053925
Removed in A	g	51.5	56.9	49.8	50.3	51	52.7	53.7	52.8	48	50.2	50.6	49.9	53.2	52.9	52.5	50.6	51.1	50	53.3	52.9
	ug Au	29.355	31.864	26.892	27.162	28.05	31.093	31.683	27.456	24.96	25.1	25.806	24.451	29.792	27.508	26.25	24.794	22.995	22.5	26.65	26.45
	mg Cu	0.927	1.0811	0.996	1.006	0.918	1.0013	1.0203	0.9504	0.816	0.9036	0.9108	0.8483	0.9576	0.9522	0.84	0.8096	0.8687	0.8	0.9061	0.8993
	ug Zn	175.1	187.77	144.42	160.96	142.8	163.37	155.73	174.24	158.4	140.56	131.56	144.71	159.6	153.41	168	156.86	132.86	130	170.56	158.7
	g NaCN	0.02163	0.024467	0.020916	0.021629	0.02193	0.025296	0.025239	0.024288	0.02208	0.02008	0.02024	0.020459	0.024472	0.024863	0.02415	0.023782	0.012264	0.011	0.024518	0.024863
	g CaO	0.002575	0.002845	0.00249	0.002515	0.00255	0.002635	0.003222	0.003168	0.0024	0.002008	0.002024	0.001996	0.002128	0.002645	0.002625	0.00253	0	0	0.002132	0.002645
In vessel at B	g	1125.5	1085.1	1068.4	1124.2	1113.8	1119.7	1075.4	1085	1090.1	1094.9	1076.6	1097.4	1107.2	1102.5	1066.5	1117.2	1074.3	1100.8	1105.3	1078.1
	ug Au	709.065	683.613	737.196	719.488	723.97	694.214	677.502	629.3	632.258	645.991	645.96	636.492	686.464	650.475	607.905	625.632	590.865	616.448	618.968	603.736
	mg Cu	24.761	24.9573	23.5048	25.8566	24.5036	24.6334	21.508	22.785	22.8921	24.0878	23.6852	23.0454	22.144	22.05	21.33	22.344	22.5603	22.016	22.106	21.562
	ug Zn	4389.45	4123.38	3846.24	4271.96	3898.3	3918.95	3656.36	3906	3924.36	3722.66	3660.44	3731.16	3653.76	3638.25	3839.4	3798.48	3545.19	3632.64	3758.02	3773.35
	g NaCN	0.528985	0.509997	0.40078	0.50589	0.512348	0.492668	0.451668	0.4991	0.512347	0.525552	0.516768	0.515778	0.509312	0.496125	0.501255	0.525084	0.741267	0.759552	0.519491	0.485145
	g CaO	0.04502	0.032553	0.042736	0.044968	0.044552	0.033591	0.032262	0.0434	0.043604	0.043796	0.043064	0.043896	0.033216	0.033075	0.053325	0.05586	0.053715	0.05504	0.033159	0.043124
Removed in B	g	51.2	49	51.6	53.5	53.9	57.6	50.3	51.8	51.8	53.8	54.1	53.2	56.9	56.2	53.1	52.6	53.3	53.6	52.3	55
	ug Au	32.256	30.87	35.604	34.24	35.035	35.712	31.689	30.044	30.044	31.742	32.46	30.856	35.278	33.158	30.267	29.456	29.315	30.016	29.288	30.8
	mg Cu	1.1264	1.127	1.1352	1.2305	1.1858	1.2672	1.006	1.0878	1.0878	1.1836	1.1902	1.1172	1.138	1.124	1.062	1.052	1.1193	1.072	1.046	1.1
	ug Zn	199.68	186.2	185.76	203.3	188.65	201.6	171.02	186.48	186.48	182.92	183.94	180.88	187.77	185.46	191.16	178.84	175.89	176.88	177.82	192.5
	g NaCN	0.024064	0.02303	0.02322	0.024075	0.024794	0.025344	0.021126	0.023828	0.024346	0.025824	0.025968	0.025004	0.026174	0.02529	0.024957	0.024722	0.036777	0.036984	0.024581	0.02475
	g CaO	0.002048	0.00147	0.002064	0.00214	0.002156	0.001728	0.001509	0.002072	0.002072	0.002152	0.002164	0.002128	0.001707	0.001686	0.002655	0.00263	0.002665	0.00268	0.001569	0.0022
In vessel at C	g	1124.2	1084.7	1067.1	1121.9	1112.5	1118.1	1073.2	1084.3	1089.4	1093.3	1075.6	1096.1	1105.8	1101.3	1065.9	1116.2	1072.8	1099.1	1104.1	1076.6
	ug Au	708.246	705.055	714.957	729.235	745.375	715.584	686.848	639.737	620.958	677.846	666.872	646.699	696.654	660.78	607.563	636.234	632.952	659.46	629.337	624.428
	mg Cu	24.7324	26.0328	25.6104	26.9256	25.5875	24.5982	23.6104	23.8546	22.8774	25.1459	24.7388	25.2103	25.4334	24.2286	22.3839	23.4402	24.6744	25.2793	24.2902	23.6852
	ug Zn	6070.68	5098.09	4588.53	4936.36	4338.75	4248.78	4078.16	4770.92	4684.42	4373.2	4194.84	4713.23	4423.2	4184.94	4263.6	4911.28	4291.2	4506.31	4526.81	4198.74
	g NaCN	0.50589	0.488115	0.490866	0.527293	0.522875	0.491964	0.472208	0.466249	0.479336	0.491985	0.462508	0.493245	0.475494	0.473559	0.468996	0.491128	0.654408	0.670451	0.463722	0.452172
	g CaO	0.033726	0.032541	0.032013	0.033657	0.033375	0.033543	0.032196	0.021686	0.032682	0.032799	0.032268	0.032883	0.022116	0.033039	0.031977	0.044648	0.042912	0.043964	0.033123	0.032298
Removed in C	g						55.9	54.9						55	52.2					54.2	55.8
	ug Au						35.776	35.136						34.65	31.32					30.894	32.364
	mg Cu						1.2298	1.2078						1.265	1.1484					1.1924	1.2276
	ug Zn						212.42	208.62						220	198.36					222.22	217.62
	g NaCN						0.024596	0.024156						0.02365	0.022446					0.022764	0.023436
	g CaO						0.001677	0.001647						0.0011	0.001566					0.001626	0.001674
In vessel at D	g						1117.2	1072.2						1104	1099.7					1103.7	1075.8
	ug Au						692.664	686.208						684.48	648.823					618.072	613.206
	mg Cu						27.93	25.7328						25.392	24.1934					25.3851	22.5918
	ug Zn						4692.24	4396.02						4857.6	4838.68					4854.28	5163.84
	g NaCN						0.536256	0.514656						0.52992	0.527856					0.540813	0.527142
	g CaO						0.033516	0.021444						0.02208	0.032991					0.033111	0.032274
Residue	ug Au	143.6	151.5035	143.2	194.814	158.559	167.8	129.405	198.256	161.2515	163.852	217.6975	195.156	218.2815	126.1935	192.205	211.7765	227.729	222.314	199.833	181.9945
Calculated Head	ug Au	913.41	919.29	920.60	985.45	967.02	963.01	914.12	895.49	857.21	898.54	942.84	897.16	1002.48	867.00	856.28	902.26	912.99	934.29	904.74	884.81
Sample leached	g	750.7	724.6	712.9	750.7	743.4	748.7	717.7	723.7	727.7	730.4	717.9	731.8	739.7	735.9	712.1	745.4	717.0	732.4	737.7	719.4

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BMT 1.2
Sheets 1-13
Calc.

BMT5727 Sheet 1 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

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COMPOSITE BMT 1.2

SUMMARY

Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12
Extraction Au													
at 3 hours	g/t	0.75	0.82	0.79	0.87	0.81	0.86	0.78	0.53	0.70	0.71	0.76	0.70
at 6 hours	g/t	0.98	1.06	1.03	1.04	1.03	1.11	1.00	0.66	0.91	0.92	1.03	0.91
at 8 hours	g/t	1.02	1.10						0.70	0.89			
at 12 hours	g/t			1.07	1.09	1.05	1.14	1.03			1.03	1.10	0.98
at 18 hours	g/t						1.14	1.06					
at 3 hours	%	63.9	64.8	65.0	70.2	68.5	66.6	65.7	60.5	62.0	56.8	58.9	60.7
at 6 hours	%	83.7	83.4	84.4	83.9	87.4	86.5	84.3	74.5	79.6	74.2	79.4	78.2
at 8 hours	%	86.7	86.2						78.9	78.3			
at 12 hours	%			87.5	88.2	89.2	88.5	87.1			82.6	84.7	84.7
at 18 hours	%						89.2	88.9					
Calculated Head	ppm Au	1.17	1.27	1.22	1.24	1.18	1.28	1.19	0.88	1.14	1.24	1.30	1.16
Ground Head Assay 1	ppm Au	1.18	1.15	1.17	1.14	1.19	1.28	1.13	1.16	1.11	1.28	1.26	1.05
Ground Head Assay 2	ppm Au	1.05	1.16	1.19	1.12	1.18	1.24	1.29	1.12	1.04	1.14	1.28	1.11
Average Ground Head Assay	ppm Au	1.12	1.16	1.18	1.13	1.19	1.26	1.21	1.14	1.08	1.21	1.27	1.08
Calculated residue grade	ppm Au	0.16	0.18	0.15	0.15	0.13	0.14	0.13	0.22	0.25	0.22	0.20	0.18
Extraction Cu													
at 3 hours	g/t	19	19	21	20	21	20	21	14	21	20	19	19
at 6 hours	g/t	22	22	24	23	24	22	19	17	25	24	24	24
at 8 hours	g/t	23	23						19	26			
at 12 hours	g/t			26	25	26	26	26			26	26	26
at 18 hours	g/t						27	27					
Assay Head	ppm Cu	280	(ave. of two head splits)										
Extraction Zn													
at 3 hours	g/t	2.2	2.2	2.2	2.3	2.2	2.3	2.4	1.6	2.2	2.3	2.1	2.1
at 6 hours	g/t	2.5	2.7	2.7	2.8	2.7	2.7	2.8	2.0	2.8	2.8	2.7	2.8
at 8 hours	g/t	2.8	2.9						2.2	3.1			
at 12 hours	g/t			3.3	3.3	3.4	3.3	3.4			3.4	3.2	3.6
at 18 hours	g/t						3.7	3.9					
Assay Head	ppm Zn	198	(ave. of two head splits)										
NaCN consumption													
at 3 hours	kg/t	0.08	0.17	0.03	0.13	0.09	0.11	0.07	0.15	0.09	0.08	0.09	0.09
at 6 hours	kg/t	0.08	0.18	0.13	0.14	0.10	0.13	0.12	0.16	0.11	0.10	0.12	0.13
at 8 hours	kg/t	0.11	0.19						0.18	0.13			
at 12 hours	kg/t			0.18	0.18	0.15	0.18	0.17			0.14	0.16	0.18
at 18 hours	kg/t						0.16	0.16					
CaO consumption													
at 3 hours	kg/t	1.61	1.54	1.59	1.46	1.57	1.58	1.57	1.32	1.48	1.49	1.53	1.49
at 6 hours	kg/t	1.60	1.54	1.59	1.47	1.55	1.56	1.57	1.31	1.47	1.48	1.53	1.49
at 8 hours	kg/t	1.60	1.54						1.31	1.48			
at 12 hours	kg/t			1.59	1.47	1.56	1.59	1.58			1.49	1.54	1.50
at 18 hours	kg/t						1.58	1.58					
Actual grind passing nominated um (%)		78.9	80.3	79.5	77.2	79.6	80.0	80.3	78.3	76.5	77.5	79.6	79.1

BMT5727 Sheet 2 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

tests conducted (date)		15/11	15/11	15/11	15/11	15/11	15/11	15/11	17/11	17/11	17/11	17/11	17/11	17/11	17/11	15/11	15/11	17/11	17/11	15/11	17/11
Test No. (% solids)	Units	3C	6D	3B	6C	3D	8A	4B	1B	5C	7A	8B	2C	6A	4D	4A	5B	1A	7D	7C	1D
Grind 80% passing	um	75	75	75	75	75	75	75	106	106	106	106	106	106	106	150	150	150	150	150	150
Total leach time	hours	8	8	12	12	12	18	18	8	8	12	12	12	18	18	8	8	12	12	18	18
Vessel	g	409.2	406.5	408.2	407.5	408.5	408.6	407.0	407.5	407.7	407.9	406.8	406.6	408.2	408.8	406.9	407.8	407.7	406.7	405.2	404.9
Sample mass	g	672.4	686.8	677.5	720.0	675.5	677.1	668.2	793.1	702.6	697.8	670.9	675.4	692.3	678.9	720.3	686.3	704.0	679.9	709.4	679.5
Sitewater added	g	1009	1030	1016	1080	1013	1016	1002	1017	1054	1047	1006	1013	1038	1018	1080	1029	1056	1020	1064	1019
Natural pH																					
CaO added	g	1.12	1.10	1.12	1.10	1.10	1.11	1.10	1.09	1.09	1.09	1.09	1.07	1.09	1.10	1.11	1.10	1.10	1.09	1.10	1.08
NaCN added	g	0.54	0.56	0.55	0.58	0.55	0.55	0.54	0.55	0.57	0.56	0.54	0.55	0.56	0.55	0.58	0.55	0.57	0.55	0.57	0.55
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2089.7	2122.4	2101.2	2107.2	2096.6	2101.5	2077.3	2102.6	2163.9	2152.8	2083.4	2094.8	2137.9	2105.4	2207.1	2122.7	2167.3	2106.1	2178.3	2103.1
Pulp temperature	deg C	22	22	22	22	22	22	22	24	24	24	24	24	24	24	22	22	23	24	22	24
Liquor sample A	pH	11.0	11.1	11.1	11.0	11.1	11.1	11.1	11.1	11.1	11.1	11.2	11.1	11.2	11.2	10.9	10.9	11.1	11.2	11.0	11.2
	ppm Au	0.50	0.55	0.53	0.64	0.54	0.57	0.52	0.47	0.47	0.47	0.51	0.47	0.49	0.48	0.48	0.49	0.43	0.45	0.41	0.46
	ppm Cu	13.0	13.0	14.0	15.0	14.0	13.0	14.0	12.0	14.0	13.0	13.0	13.0	12.0	13.0	14.0	13.0	12.0	12.0	11.0	12.0
	ppm Zn	1.5	1.5	1.5	1.7	1.5	1.5	1.6	1.4	1.5	1.5	1.4	1.4	1.4	1.5	1.6	1.6	1.5	1.5	1.6	1.6
	% NaCN	0.048	0.043	0.052	0.050	0.048	0.047	0.049	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.047	0.049	0.048	0.048	0.041	0.048
	% CaO	0.004	0.004	0.004	0.005	0.004	0.004	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.005	0.004	0.004	0.005	0.006	0.004	0.005
Gross after sample	g	2038.9	2070.6	2046.7	2052.8	2042.3	2047.7	2023.5	2046.7	2109.4	2098.5	2029.0	2040.5	2083.7	2051.2	2151.7	2067.7	2112.6	2051.9	2128.5	2049.0
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.02	0.07	0.00	0.00	0.02	0.03	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.09	0.02
Leach time	hrs	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2089.4	2122.8	2100.7	2106.7	2096.1	2101.0	2076.6	2102.3	2163.5	2152.4	2083.0	2094.5	2137.4	2105.0	2206.9	2122.3	2166.5	2105.7	2177.9	2102.7
Pulp temperature	deg C	26	25	25	25	25	25	25	27	27	27	27	27	27	27	26	26	27	27	26	27
Liquor sample B	pH	11.0	11.0	11.1	11.0	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.2	10.8	10.9	11.1	11.2	11.0	11.1
	ppm Au	0.63	0.68	0.66	0.73	0.66	0.71	0.64	0.55	0.58	0.59	0.66	0.58	0.62	0.64	0.59	0.59	0.55	0.55	0.60	0.57
	ppm Cu	14	14	15	16	15	14	12	14	16	15	15	15	15	15	15	15	15	15	15	15
	ppm Zn	1.6	1.7	1.7	2.0	1.7	1.7	1.8	1.7	1.8	1.8	1.7	1.8	1.8	1.8	2.2	1.8	1.8	1.9	1.9	1.8
	% NaCN	0.048	0.047	0.043	0.046	0.047	0.046	0.044	0.046	0.046	0.046	0.045	0.045	0.045	0.047	0.047	0.047	0.045	0.046	0.052	0.044
	% CaO	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.005	0.005	0.004	0.004	0.005	0.006	0.005	0.005
Gross after sample	g	2036.9	2070.2	2046.6	2054.0	2043.1	2047.0	2026.3	2046.7	2108.8	2098.0	2028.3	2039.9	2082.9	2050.6	2151.8	2070.3	2111.7	2051.2	2123.6	2048.4
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.02	0.03	0.07	0.04	0.03	0.04	0.06	0.04	0.04	0.04	0.05	0.05	0.05	0.03	0.03	0.03	0.05	0.04	0.00	0.06
Leach time	hrs	2	2	6	6	6	6	6	2	2	6	6	6	6	6	2	2	6	6	6	6
Gross off rolls	g	2089.5	2122.1	2100.5	2106.3	2095.9	2100.9	2076.9	2102.2	2163.2	2150.9	2082.8	2094.0	2137.2	2104.6	2206.9	2122.4	2166.5	2105.3	2176.9	2102.5
Pulp temperature	deg C	26	26	26	26	26	26	26	28	28	26	26	26	26	26	26	26	26	26	26	26
Liquor sample C	pH	11.0	11.0	11.1	10.9	11.1	11.0	11.1	11.0	10.9	11.1	11.1	11.1	11.1	11.2	10.8	10.9	11.0	11.0	11.0	11.1
	ppm Au	0.62	0.67	0.65	0.73	0.64	0.69	0.63	0.55	0.54	0.63	0.67	0.60	0.61	0.65	0.60	0.58	0.54	0.57	0.61	0.61
	ppm Cu	14.0	14.0	16.0	17.0	16.0	16.0	16.0	15.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	15.0	16.0	16.0	17.0	16.0
	ppm Zn	1.7	1.8	2.0	2.2	2.1	2.0	2.1	1.7	1.9	2.1	2.0	2.2	2.0	2.1	1.8	1.8	2.1	2.2	2.2	2.2
	% NaCN	0.045	0.047	0.044	0.045	0.044	0.044	0.045	0.046	0.046	0.045	0.045	0.044	0.047	0.047	0.047	0.045	0.045	0.046	0.048	0.047
	% CaO	0.004	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.004	0.004	0.005	0.005	0.004	0.005	0.003	0.004	0.004	0.005	0.004	0.004
Gross after sample	g						2046.6	2021.0						2081.4	2046.2					2119.4	2046.3
CaO added	g						0.00	0.00						0.00	0.00					0.00	0.00
NaCN added	g						0.06	0.05						0.03	0.03					0.02	0.03
Leach time	hrs						6	6						6	6					6	6
Gross off rolls	g						2098.9	2075.1						2136.7	2103.5					2175.6	2101.2
Pulp temperature	deg C						22	22						23	23					22	23
Liquor sample D	pH						11.0	11.0						11.1	11.1					11.0	11.0
	ppm Au						0.66	0.61						0.62	0.62					0.59	0.60
	ppm Cu						16.0	16.0						16.0	16.0					16.0	16.0
	ppm Zn						2.2	2.3						2.3	2.3					2.4	2.4
	% NaCN						0.049	0.048						0.045	0.045					0.047	0.046
	% CaO						0.003	0.004						0.004	0.003					0.004	0.003
Sample mass account																					
Residue recovered (screened)	g	668.9	682.6	676.7	717.7	673.1	669.8	665.7	675.3	700.2	696.4	666.2	672.0	687.4	674.6	716.8	683.3	700.9	678.5	706.8	677.2
Ground head to assay	g	133.9	98.1	110.2	118.6	114.1	112.0	115.9	115.0	123.4	104.3	104.5	106.0	117.1	126.9	113.3	123.8	117.7	121.4	127.5	111.9
Calculated head to grind	g	802.8	780.7	786.9	836.3	787.2	781.8	781.6	790.3	823.6	800.7	770.7	778.0	804.5	801.5	830.1	807.1	818.6	799.9	834.3	789.1
Actual head to grind	g	806.3	784.9	787.7	838.6	789.6	789.1	784.1	793.1	826.0	802.1	775.4	781.4	809.4	805.8	833.6	810.1	821.7	801.3	836.9	791.4
Unaccounted mass	%	0.43	0.54	0.10	0.27	0.30	0.93	0.32	0.35	0.29	0.17	0.61	0.44	0.61	0.53	0.42	0.37	0.38	0.17	0.31	0.29

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 3C		**Nom. P80um 75**		**Leach hrs 8**				
+ 150		0.0	100.0					
- 150 + 106	50.5	7.5	92.5	0.47		0.47	23.74	22.6
- 106 + 75	90.5	13.5	78.9	0.41	0.30	0.36	32.13	30.5
- 75 + 53	73.3	11.0	68.0	0.27		0.27	19.79	18.8
- 53	454.6	68.0		0.07	0.06	0.07	29.55	28.1
Calculated	668.9	100.0				0.16	105.2	100.0
Test No. 6D		**Nom. P80um 75**		**Leach hrs 8**				
+ 150		0.0	100.0					
- 150 + 106	42.9	6.3	93.7	0.49		0.49	21.02	17.5
- 106 + 75	91.5	13.4	80.3	0.38	0.41	0.40	36.14	30.0
- 75 + 53	73.6	10.8	69.5	0.31		0.31	22.82	19.0
- 53	474.6	69.5		0.09	0.08	0.09	40.34	33.5
Calculated	682.6	100.0				0.18	120.3	100.0
Test No. 3B		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					
- 150 + 106	47.3	7.0	93.0	0.52		0.52	24.60	23.8
- 106 + 75	91.2	13.5	79.5	0.32	0.29	0.31	27.82	26.9
- 75 + 53	74.5	11.0	68.5	0.25		0.25	18.63	18.0
- 53	463.7	68.5		0.08	0.06	0.07	32.46	31.4
Calculated	676.7	100.0				0.15	103.5	100.0
Test No. 6C		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					
- 150 + 106	60.8	8.5	91.5	0.38		0.38	23.10	21.9
- 106 + 75	102.7	14.3	77.2	0.29	0.28	0.29	29.27	27.8
- 75 + 53	74.9	10.4	66.8	0.26		0.26	19.47	18.5
- 53	479.3	66.8		0.07	0.07	0.07	33.55	31.8
Calculated	717.7	100.0				0.15	105.4	100.0
Test No. 3D		**Nom. P80um 75**		**Leach hrs 12**				
+ 150		0.0	100.0					
- 150 + 106	44.9	6.7	93.3	0.44		0.44	19.76	23.0
- 106 + 75	92.7	13.8	79.6	0.27	0.37	0.32	29.66	34.5
- 75 + 53	70.4	10.5	69.1	0.19		0.19	13.38	15.5
- 53	465.1	69.1		0.04	0.06	0.05	23.26	27.0
Calculated	673.1	100.0				0.13	86.1	100.0

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8A		Nom. P80um 75		Leach hrs 18				
+ 150		0.0	100.0					
- 150 + 106	48.7	7.3	92.7	0.39		0.39	18.99	20.2
- 106 + 75	85.0	12.7	80.0	0.34	0.24	0.29	24.65	26.2
- 75 + 53	71.2	10.6	69.4	0.25		0.25	17.80	18.9
- 53	464.9	69.4		0.07	0.07	0.07	32.54	34.6
Calculated	669.8	100.0				0.14	94.0	100.0
Test No. 4B		Nom. P80um 75		Leach hrs 18				
+ 150		0.0	100.0					
- 150 + 106	43.6	6.5	93.5	0.28		0.28	12.21	13.8
- 106 + 75	87.7	13.2	80.3	0.30	0.20	0.25	21.93	24.8
- 75 + 53	71.0	10.7	69.6	0.24		0.24	17.04	19.3
- 53	463.4	69.6		0.08	0.08	0.08	37.07	42.0
Calculated	665.7	100.0				0.13	88.2	100.0
Test No. 1B		Nom. P80um 106		Leach hrs 8				
+ 150	62.0	9.2	90.8	0.42		0.42	26.04	17.6
- 150 + 106	84.8	12.6	78.3	0.42	0.44	0.43	36.46	24.7
- 106 + 75	89.2	13.2	65.1	0.36	0.30	0.33	29.44	19.9
- 75 + 53	58.3	8.6	56.4	0.24		0.24	13.99	9.5
- 53	381.0	56.4		0.10	0.12	0.11	41.91	28.3
Calculated	675.3	100.0				0.22	147.8	100.0
Test No. 5C		Nom. P80um 106		Leach hrs 8				
+ 150	73.0	10.4	89.6	0.61		0.61	44.53	25.7
- 150 + 106	91.8	13.1	76.5	0.39	0.39	0.39	35.80	20.7
- 106 + 75	86.9	12.4	64.1	0.30	0.31	0.31	26.50	15.3
- 75 + 53	59.8	8.5	55.5	0.46		0.46	27.51	15.9
- 53	388.7	55.5		0.10	0.10	0.10	38.87	22.4
Calculated	700.2	100.0				0.25	173.2	100.0
Test No. 7A		Nom. P80um 106		Leach hrs 12				
+ 150	72.3	10.4	89.6	0.61		0.61	44.10	29.3
- 150 + 106	84.5	12.1	77.5	0.41	0.44	0.43	35.91	23.9
- 106 + 75	92.1	13.2	64.3	0.29	0.28	0.29	26.25	17.4
- 75 + 53	57.3	8.2	56.0	0.26		0.26	14.90	9.9
- 53	390.2	56.0		0.07	0.08	0.08	29.27	19.5
Calculated	696.4	100.0				0.22	150.4	100.0

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8B	Nom. P80um 106	Leach hrs 12						
+ 150	54.5	8.2	91.8	0.42		0.42	22.89	17.2
- 150 + 106	81.3	12.2	79.6	0.44	0.43	0.44	35.37	26.6
- 106 + 75	94.8	14.2	65.4	0.31	0.31	0.31	29.39	22.1
- 75 + 53	58.6	8.8	56.6	0.23		0.23	13.48	10.1
- 53	377.0	56.6		0.09	0.08	0.09	32.05	24.1
Calculated	666.2	100.0				0.20	133.2	100.0
Test No. 2C	Nom. P80um 106	Leach hrs 12						
+ 150	61.0	9.1	90.9	0.38		0.38	23.18	19.4
- 150 + 106	79.5	11.8	79.1	0.41	0.37	0.39	31.01	25.9
- 106 + 75	90.8	13.5	65.6	0.28	0.29	0.29	25.88	21.6
- 75 + 53	57.8	8.6	57.0	0.22		0.22	12.72	10.6
- 53	382.9	57.0		0.07	0.07	0.07	26.80	22.4
Calculated	672.0	100.0				0.18	119.6	100.0
Test No. 6A	Nom. P80um 106	Leach hrs 18						
+ 150	58.3	8.5	91.5	0.38		0.38	22.15	17.4
- 150 + 106	87.9	12.8	78.7	0.40	0.39	0.40	34.72	27.2
- 106 + 75	94.8	13.8	64.9	0.27	0.29	0.28	26.54	20.8
- 75 + 53	60.0	8.7	56.2	0.22		0.22	13.20	10.4
- 53	386.4	56.2		0.08	0.08	0.08	30.91	24.2
Calculated	687.4	100.0				0.19	127.5	100.0
Test No. 4D	Nom. P80um 106	Leach hrs 18						
+ 150	57.1	8.5	91.5	0.34		0.34	19.41	16.6
- 150 + 106	82.5	12.2	79.3	0.39	0.38	0.39	31.76	27.1
- 106 + 75	91.9	13.6	65.7	0.30	0.29	0.30	27.11	23.2
- 75 + 53	59.8	8.9	56.8	0.20		0.20	11.96	10.2
- 53	383.3	56.8		0.07	0.07	0.07	26.83	22.9
Calculated	674.6	100.0				0.17	117.1	100.0
Test No. 4A	Nom. P80um 150	Leach hrs 8						
+ 150	154.8	21.6	78.4	0.53	0.54	0.54	82.82	41.1
- 150 + 106	93.6	13.1	65.3	0.42	0.48	0.45	42.12	20.9
- 106 + 75	73.7	10.3	55.1	0.37		0.37	27.27	13.5
- 75 + 53	48.9	6.8	48.2	0.37		0.37	18.09	9.0
- 53	345.8	48.2		0.10	0.08	0.09	31.12	15.5
Calculated	716.8	100.0				0.28	201.4	100.0

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.2 |

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 5B	Nom. P80um	150	Leach hrs	8				
+ 150	141.7	20.7	79.3	0.60	0.54	0.57	80.77	45.9
- 150 + 106	91.3	13.4	65.9	0.47	0.46	0.47	42.45	24.2
- 106 + 75	70.1	10.3	55.6	0.26		0.26	18.23	10.4
- 75 + 53	48.3	7.1	48.6	0.23		0.23	11.11	6.3
- 53	331.9	48.6		0.07	0.07	0.07	23.23	13.2
Calculated	683.3	100.0				0.26	175.8	100.0
Test No. 1A	Nom. P80um	150	Leach hrs	12				
+ 150	150.9	21.5	78.5	0.55	0.53	0.54	81.49	46.9
- 150 + 106	89.9	12.8	65.6	0.40	0.38	0.39	35.06	20.2
- 106 + 75	70.2	10.0	55.6	0.29		0.29	20.36	11.7
- 75 + 53	46.8	6.7	49.0	0.24		0.24	11.23	6.5
- 53	343.1	49.0		0.08	0.07	0.08	25.73	14.8
Calculated	700.9	100.0				0.25	173.9	100.0
Test No. 7D	Nom. P80um	150	Leach hrs	12				
+ 150	146.9	21.7	78.3	0.53	0.56	0.55	80.06	49.7
- 150 + 106	85.8	12.6	65.7	0.41	0.41	0.41	35.18	21.8
- 106 + 75	68.4	10.1	55.6	0.27	0.07	0.17	11.63	7.2
- 75 + 53	46.7	6.9	48.7	0.24		0.24	11.21	7.0
- 53	330.7	48.7		0.07		0.07	23.15	14.4
Calculated	678.5	100.0				0.24	161.2	100.0
Test No. 7C	Nom. P80um	150	Leach hrs	18				
+ 150	153.4	21.7	78.3	0.50	0.52	0.51	78.23	46.9
- 150 + 106	95.0	13.4	64.9	0.42	0.39	0.41	38.48	23.1
- 106 + 75	69.4	9.8	55.0	0.28		0.28	19.43	11.6
- 75 + 53	45.8	6.5	48.6	0.22		0.22	10.08	6.0
- 53	343.2	48.6		0.06	0.06	0.06	20.59	12.3
Calculated	706.8	100.0				0.24	166.8	100.0
Test No. 1D	Nom. P80um	150	Leach hrs	18				
+ 150	143.5	21.2	78.8	0.50	0.48	0.49	70.32	41.3
- 150 + 106	86.2	12.7	66.1	0.36	0.36	0.36	31.03	18.2
- 106 + 75	66.2	9.8	56.3	0.49		0.49	32.44	19.0
- 75 + 53	46.7	6.9	49.4	0.28		0.28	13.08	7.7
- 53	334.6	49.4		0.07	0.07	0.07	23.42	13.8
Calculated	677.2	100.0				0.25	170.3	100.0

BMTS727 Sheet 7 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT 1.2		P80=75um			P80=106um			P80=150um		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	106	106	106	150	150	150
Total leach time	hours	12.6	18.0	8.0	12.6	18.0	8.0	12.7	18.0	8.0
Extraction Au										
at 3 hours	g/t	0.81	0.87	0.75	0.70	0.76	0.53	0.68	0.73	0.61
at 6 hours	g/t	1.04	1.11	0.98	0.91	1.03	0.66	0.90	0.93	0.86
at 8 hours	g/t	1.06	1.10	1.02	0.79	0.89	0.70	0.97	0.98	0.95
at 12 hours	g/t	1.08	1.14	1.03	1.03	1.10	0.98	0.95	1.00	0.89
at 18 hours	g/t	1.10	1.14	1.06	1.07	1.07	1.06	1.02	1.03	1.01
at 3 hours	%	66.4	70.2	63.9	59.4	62.0	56.8	56.0	60.7	49.5
at 6 hours	%	84.8	87.4	83.4	77.6	80.1	74.2	73.8	76.4	69.5
at 8 hours	%	86.4	86.7	86.2	78.6	78.9	78.3	78.3	78.8	77.8
at 12 hours	%	88.1	89.2	87.1	83.5	85.4	80.1	78.8	79.8	77.8
at 18 hours	%	89.0	89.2	88.9	85.7	86.2	85.2	80.8	81.1	80.4
Calculated Head	ppm Au	1.22	1.28	1.17	.17	1.30	0.88	1.22	1.28	1.13
Ground Head Assay 1	ppm Au	1.18	1.28	1.13	1.16	1.28	1.05	1.14	1.20	1.05
Ground Head Assay 2	ppm Au	1.18	1.29	1.05	1.15	1.28	1.04	1.19	1.30	1.11
Average Ground Head Assay	ppm Au	1.18	1.26	1.12	1.16	1.27	1.08	1.16	1.21	1.10
Calculated residue grade	ppm Au	0.15	0.18	0.13	0.20	0.25	0.17	0.25	0.28	0.24
Extraction Cu										
at 3 hours	g/t	20	21	19	19	21	14	18	21	16
at 6 hours	g/t	22	24	19	23	25	17	23	24	23
at 8 hours	g/t	23	23	23	23	26	19	25	26	25
at 12 hours	g/t	26	26	25	26	26	26	26	27	26
at 18 hours	g/t	27	27	27	27	28	27	27	27	27
Assay Head	ppm Cu									
Extraction Zn										
at 3 hours	g/t	2.3	2.4	2.2	2.1	2.3	1.6	2.3	2.4	2.2
at 6 hours	g/t	2.7	2.8	2.5	2.7	2.8	2.0	3.0	3.4	2.8
at 8 hours	g/t	2.9	2.9	2.8	2.6	3.1	2.2	3.0	3.0	3.0
at 12 hours	g/t	3.3	3.4	3.3	3.4	3.6	3.2	3.5	3.6	3.4
at 18 hours	g/t	3.8	3.9	3.7	3.9	3.9	3.9	4.0	4.0	4.0
Assay Head	ppm Zn									
NaCN consumption										
at 3 hours	kg/t	0.10	0.17	0.03	0.10	0.15	0.08	0.10	0.15	0.07
at 6 hours	kg/t	0.13	0.18	0.08	0.12	0.16	0.10	0.11	0.14	0.07
at 8 hours	kg/t	0.15	0.19	0.11	0.16	0.18	0.13	0.11	0.11	0.11
at 12 hours	kg/t	0.17	0.18	0.15	0.14	0.18	0.10	0.15	0.16	0.13
at 18 hours	kg/t	0.16	0.16	0.16	0.15	0.17	0.14	0.16	0.17	0.15
CaO consumption										
at 3 hours	kg/t	1.56	1.61	1.46	1.48	1.55	1.32	1.50	1.54	1.48
at 6 hours	kg/t	1.55	1.60	1.47	1.48	1.54	1.31	1.50	1.54	1.47
at 8 hours	kg/t	1.57	1.60	1.54	1.40	1.48	1.31	1.51	1.54	1.49
at 12 hours	kg/t	1.56	1.59	1.47	1.52	1.54	1.49	1.50	1.52	1.48
at 18 hours	kg/t	1.58	1.58	1.58	1.53	1.56	1.50	1.51	1.53	1.48
Actual grind passing nominated um (%)		79.4	80.3	77.2	78.4	79.6	76.5	78.6	79.3	78.3

BMTS727 Sheet 8 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Summary of 8 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3C	75	0.16	0.00	0.47	0.36	0.27	0.07
6D	75	0.18	0.00	0.49	0.40	0.31	0.09
Average		0.17	0.00	0.48	0.38	0.29	0.08
1B	106	0.22	0.42	0.43	0.33	0.24	0.11
5C	106	0.25	0.61	0.39	0.31	0.46	0.10
Average		0.23	0.52	0.41	0.32	0.35	0.11
4A	150	0.28	0.54	0.45	0.37	0.37	0.09
5B	150	0.26	0.57	0.47	0.26	0.23	0.07
Average		0.27	0.55	0.46	0.32	0.30	0.08

Summary of 12 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
3B	75	0.15	0.00	0.52	0.31	0.25	0.07
6C	75	0.15	0.00	0.38	0.29	0.26	0.07
3D	75	0.13	0.00	0.44	0.32	0.19	0.05
Average		0.14	0.00	0.45	0.30	0.23	0.06
7A	106	0.22	0.61	0.43	0.29	0.26	0.08
8B	106	0.20	0.42	0.44	0.31	0.23	0.09
2C	106	0.18	0.38	0.39	0.29	0.22	0.07
Average		0.20	0.47	0.42	0.29	0.24	0.08
1A	150	0.25	0.54	0.39	0.29	0.24	0.08
7D	150	0.24	0.55	0.41	0.17	0.24	0.07
Average		0.24	0.54	0.40	0.23	0.24	0.07

Summary of 18 hour Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
8A	75	0.14	0.00	0.39	0.29	0.25	0.07
4B	75	0.13	0.00	0.28	0.25	0.24	0.08
Average		0.14	0.00	0.34	0.27	0.25	0.08
6A	106	0.19	0.38	0.40	0.28	0.22	0.08
4D	106	0.17	0.34	0.39	0.30	0.20	0.07
Average		0.18	0.36	0.39	0.29	0.21	0.08
7C	150	0.24	0.51	0.41	0.28	0.22	0.06
1D	150	0.25	0.49	0.36	0.49	0.28	0.07
Average		0.24	0.50	0.38	0.39	0.25	0.07

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BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Summary of Residue Size Fraction Assays

Leach Time	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	- 53 ppm Au
18 Hour (2 tests)	150	0.24	0.50	0.38	0.39	0.25	0.07
12 Hour (2 tests)	150	0.24	0.54	0.40	0.23	0.24	0.07
8 Hour (2 tests)	150	0.27	0.55	0.46	0.32	0.30	0.08
Weighted Ave.		0.25	0.53	0.41	0.31	0.26	0.07
18 Hour (2 tests)	106	0.18	0.36	0.39	0.29	0.21	0.08
12 Hour (3 tests)	106	0.20	0.47	0.42	0.29	0.24	0.08
8 Hour (2 tests)	106	0.23	0.52	0.41	0.32	0.35	0.11
Weighted Ave.		0.20	0.45	0.41	0.30	0.26	0.08
18 Hour (2 tests)	75	0.14	0.00	0.34	0.27	0.25	0.08
12 Hour (3 tests)	75	0.14	0.00	0.45	0.30	0.23	0.06
8 Hour (2 tests)	75	0.17	0.00	0.48	0.38	0.29	0.08
Weighted Ave.		0.15	0.00	0.42	0.31	0.25	0.07

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Summary of 8 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3C	75	0.16	0.0	22.6	30.5	18.8	28.1
6D	75	0.18	0.0	17.5	30.0	19.0	33.5
Average		0.17	0.0	20.0	30.3	18.9	30.8
1B	106	0.22	17.6	24.7	19.9	9.5	28.3
5C	106	0.25	25.7	20.7	15.3	15.9	22.4
Average		0.23	21.7	22.7	17.6	12.7	25.4
4A	150	0.28	41.1	20.9	13.5	9.0	15.5
5B	150	0.26	45.9	24.2	10.4	6.3	13.2
Average		0.27	43.5	22.5	12.0	7.7	14.3

Summary of 12 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
3B	75	0.15	0.0	23.8	26.9	18.0	31.4
6C	75	0.15	0.0	21.9	27.8	18.5	31.8
3D	75	0.13	0.0	23.0	34.5	15.5	27.0
Average		0.14	0.0	22.9	29.7	17.3	30.1
7A	106	0.22	29.3	23.9	17.4	9.9	19.5
8B	106	0.20	17.2	26.6	22.1	10.1	24.1
2C	106	0.18	19.4	25.9	21.6	10.6	22.4
Average		0.20	22.0	25.5	20.4	10.2	22.0
1A	150	0.25	46.9	20.2	11.7	6.5	14.8
7D	150	0.24	49.7	21.8	7.2	7.0	14.4
Average		0.24	48.3	21.0	9.5	6.7	14.6

Summary of 18 hour Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
8A	75	0.14	0.0	20.2	26.2	18.9	34.6
4B	75	0.13	0.0	13.8	24.8	19.3	42.0
Average		0.14	0.0	17.0	25.5	19.1	38.3
6A	106	0.19	17.4	27.2	20.8	10.4	24.2
4D	106	0.17	16.6	27.1	23.2	10.2	22.9
Average		0.18	17.0	27.2	22.0	10.3	23.6
7C	150	0.24	46.9	23.1	11.6	6.0	12.3
1D	150	0.25	41.3	18.2	19.0	7.7	13.8
Average		0.24	44.1	20.6	15.3	6.9	13.0

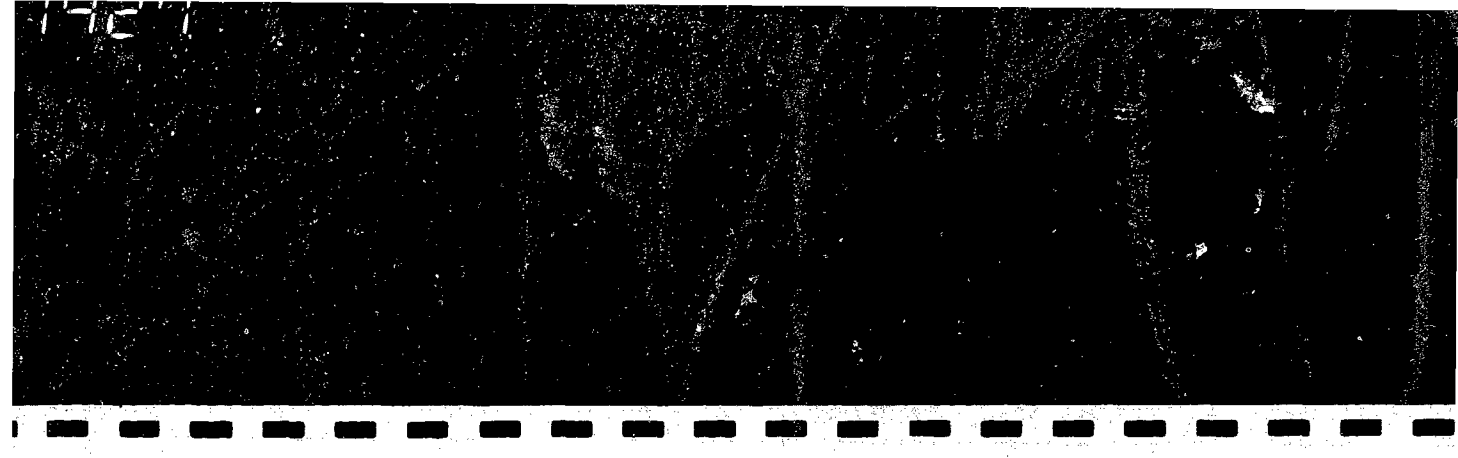
BMT5727 Sheet 11 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.2 |

Summary of Residue Size Fraction Gold Distribution

Leach Time	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	- 53 %
18 Hour (2 tests)	150	0.24	44.1	20.6	15.3	6.9	13.0
12 Hour (2 tests)	150	0.24	48.3	21.0	9.5	6.7	14.6
8 Hour (2 tests)	150	0.27	43.5	22.5	12.0	7.7	14.3
Weighted Ave.		0.25	45.3	21.4	12.3	7.1	14.0
18 Hour (2 tests)	106	0.18	17.0	27.2	22.0	10.3	23.6
12 Hour (3 tests)	106	0.20	22.0	25.5	20.4	10.2	22.0
8 Hour (2 tests)	106	0.23	21.7	22.7	17.6	12.7	25.4
Weighted Ave.		0.20	20.5	25.1	20.0	10.9	23.4
18 Hour (2 tests)	75	0.14	0.0	17.0	25.5	19.1	38.3
12 Hour (3 tests)	75	0.14	0.0	22.9	29.7	17.3	30.1
8 Hour (2 tests)	75	0.17	0.0	20.0	30.3	18.9	30.8
Weighted Ave.		0.15	0.0	20.4	28.7	18.3	32.6



BMTS727 Sheet 12 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS. | COMPOSITE BMT 1.2 |

Summary of L.S.& A. 8 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			In Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3C	75	1.12	1.12	1.17	0.16	86.7	8	40	0.045	11.0	0.11	1.60	280	23.1	8.2	198	2.8	1.4
6D	75	1.12	1.16	1.27	0.18	86.2	8	40	0.047	11.0	0.19	1.54	280	23.0	8.2	198	2.9	1.5
Average		1.12	1.14	1.22	0.17	86.4	8	40	0.046	11.0	0.15	1.57	280	23.0	8.2	198	2.9	1.4
1B	106	1.12	1.14	0.88	0.22	78.9	8	40	0.046	11.0	0.18	1.31	280	18.9	6.7	198	2.2	1.1
5C	106	1.12	1.08	1.14	0.25	78.3	8	40	0.046	10.9	0.13	1.48	280	26.3	9.4	198	3.1	1.6
Average		1.12	1.11	1.01	0.23	78.6	8	40	0.046	11.0	0.16	1.40	280	22.6	8.1	198	2.6	1.3
4A	150	1.12	1.17	1.26	0.28	77.8	8	40	0.047	10.8	0.11	1.49	280	26.2	9.4	198	3.0	1.5
5B	150	1.12	1.20	1.21	0.26	78.8	8	40	0.045	10.9	0.11	1.54	280	24.7	8.8	198	3.0	1.5
Average		1.12	1.18	1.24	0.27	78.3	8	40	0.046	10.9	0.11	1.51	280	25.4	9.1	198	3.0	1.5

Summary of L.S.& A. 12 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			In Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
3B	75	1.12	1.18	1.22	0.15	87.5	12	40	0.044	11.1	0.18	1.59	280	26.3	9.4	198	3.3	1.6
6C	75	1.12	1.13	1.24	0.15	88.2	12	40	0.045	10.9	0.18	1.47	280	25.4	9.1	198	3.3	1.6
3D	75	1.12	1.19	1.18	0.13	89.2	12	40	0.044	11.1	0.15	1.56	280	26.3	9.4	198	3.4	1.7
Average		1.12	1.17	1.21	0.14	88.3	12	40	0.044	11.0	0.17	1.54	280	26.0	9.3	198	3.3	1.7
7A	106	1.12	1.21	1.24	0.22	82.6	12	40	0.045	11.1	0.14	1.49	280	26.1	9.3	198	3.4	1.7
8B	106	1.12	1.27	1.30	0.20	84.7	12	40	0.045	11.1	0.16	1.54	280	26.2	9.4	198	3.2	1.6
2C	106	1.12	1.08	1.16	0.18	84.7	12	40	0.044	11.1	0.18	1.50	280	26.2	9.4	198	3.6	1.8
Average		1.12	1.19	1.23	0.20	84.0	12	40	0.045	11.1	0.16	1.51	280	26.2	9.4	198	3.4	1.7
1A	150	1.12	1.21	1.13	0.25	78.2	12	40	0.045	11.0	0.16	1.49	280	26.1	9.3	198	3.4	1.7
7D	150	1.12	1.10	1.17	0.24	79.8	12	40	0.046	11.0	0.13	1.52	280	26.1	9.3	198	3.6	1.8
Average		1.12	1.15	1.15	0.24	79.0	12	40	0.046	11.0	0.15	1.51	280	26.1	9.3	198	3.5	1.8

Summary of L.S.& A. 18 - Hour Bottle Roll Leach Test Results

Sample Identification	Grind P80	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			In Leach Results		
		Assay Comp.	Ground Head	Calc'd Head	Residue Solids	Extr'n	Time	Pulp	%		NaCN	CaO	Assay Head	Extraction		Assay Head	Extraction	
	um	ppm Au	ppm Au	ppm Au	ppm Au	%	Hours	% Solids	NaCN	pH	kg/t	kg/t	ppm	g/t	%	ppm	g/t	%
8A	75	1.12	1.26	1.28	0.14	89.2	18	40	0.049	11.0	0.16	1.58	280	27.4	9.8	198	3.7	1.9
4B	75	1.12	1.21	1.19	0.13	88.9	18	40	0.048	11.0	0.16	1.58	280	27.3	9.8	198	3.9	2.0
Average		1.12	1.24	1.24	0.14	89.0	18	40	0.049	11.0	0.16	1.58	280	27.3	9.8	198	3.8	1.9
6A	106	1.12	1.19	1.25	0.19	85.2	18	40	0.045	11.1	0.17	1.50	280	27.4	9.8	198	3.9	1.9
4D	106	1.12	1.13	1.25	0.17	86.2	18	40	0.045	11.1	0.14	1.56	280	27.6	9.8	198	3.9	2.0
Average		1.12	1.16	1.25	0.18	85.7	18	40	0.045	11.1	0.15	1.53	280	27.5	9.8	198	3.9	2.0
7C	150	1.12	1.19	1.24	0.24	81.1	18	40	0.047	11.0	0.15	1.48	280	27.2	9.7	198	4.0	2.0
1D	150	1.12	1.12	1.28	0.25	80.4	18	40	0.046	11.0	0.17	1.53	280	27.4	9.8	198	4.0	2.0
Average		1.12	1.15	1.26	0.24	80.8	18	40	0.047	11.0	0.16	1.51	280	27.3	9.8	198	4.0	2.0

BMT5727 Sheet 13 7-Dec-89

BILLITON MT TODD WEATHERED ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

| COMPOSITE BMT 1.2 |

Summary of L.S.& A. Bottle Roll Leach Test Results

Leach Time	Grind P80 um	Head Grade		Au Leach Results			Leach Parameters				Reagent Consumption		Cu Leach Results			Zn Leach Results		
		Assay Comp. ppm Au	Ground Head ppm Au	Calc'd Head ppm Au	Residue Solids ppm Au	Extr'n %	Time Hours	Pulp % Solids	% NaCN	pH	NaCN kg/t	CaO kg/t	Assay Head ppm	Extraction g/t	Extraction %	Assay Head ppm	Extraction g/t	Extraction %
18 Hour (2 tests)	150	1.12	1.15	1.26	0.24	80.8	18	40	0.047	11.0	0.16	1.51	280	27.3	9.8	198	4.0	2.0
12 Hour (2 tests)	150	1.12	1.15	1.15	0.24	79.0	12	40	0.046	11.0	0.15	1.51	280	26.1	9.3	198	3.5	1.8
8 Hour (2 tests)	150	1.12	1.18	1.24	0.27	78.3	8	40	0.046	10.9	0.11	1.51	280	25.4	9.1	198	3.0	1.5
Weighted Ave.		1.12	1.16	1.22	0.25	79.3	13	40	0.046	11.0	0.14	1.51	280	26.3	9.4	198	3.5	1.8
18 Hour (2 tests)	106	1.12	1.16	1.25	0.18	85.7	18	40	0.045	11.1	0.15	1.53	280	27.5	9.8	198	3.9	2.0
12 Hour (3 tests)	106	1.12	1.19	1.23	0.20	84.0	12	40	0.045	11.1	0.16	1.51	280	26.2	9.4	198	3.4	1.7
8 Hour (2 tests)	106	1.12	1.11	1.01	0.23	78.6	8	40	0.046	11.0	0.16	1.40	280	22.6	8.1	198	2.6	1.3
Weighted Ave.		1.12	1.16	1.17	0.20	83.0	13	40	0.045	11.1	0.16	1.48	280	25.5	9.1	198	3.3	1.7
18 Hour (2 tests)	75	1.12	1.24	1.24	0.14	89.0	18	40	0.049	11.0	0.16	1.58	280	27.3	9.8	198	3.8	1.9
12 Hour (3 tests)	75	1.12	1.17	1.21	0.14	88.3	12	40	0.044	11.0	0.17	1.54	280	26.0	9.3	198	3.3	1.7
8 Hour (2 tests)	75	1.12	1.14	1.22	0.17	86.4	8	40	0.046	11.0	0.15	1.57	280	23.0	8.2	198	2.9	1.4
Weighted Ave.		1.12	1.18	1.22	0.15	88.0	13	40	0.046	11.0	0.16	1.56	280	25.5	9.1	198	3.3	1.7

BMT 1.2
Sheet 13

Calculation sheet only

COMPOSITE BMT 1.2

Sample mass	g	672.4	686.8	677.5	720	675.5	677.1	668.2	793.1	702.6	697.8	670.9	675.4	692.3	678.9	720.3	686.3	704	679.9	709.4	679.5
Vessel + sample	g	1081.6	1093.3	1085.7	1127.5	1084	1085.7	1075.2	1200.6	1110.3	1105.7	1077.7	1082	1100.5	1087.7	1127.2	1094.1	1111.7	1086.6	1114.6	1084.4
In vessel at A	g	1008.1	1029.1	1015.5	979.7	1012.6	1015.8	1002.1	902	1053.6	1047.1	1005.7	1012.8	1037.4	1017.7	1079.9	1028.6	1055.6	1019.5	1063.7	1018.7
	ug Au	504.05	566.005	538.215	627.008	546.804	579.006	521.092	423.94	495.192	492.137	512.907	476.016	508.326	488.496	518.352	504.014	453.908	458.775	436.117	468.602
	mg Cu	13.1053	13.3783	14.217	14.6955	14.1764	13.2054	14.0294	10.824	14.7504	13.6123	13.0741	13.1664	12.4488	13.2301	15.1186	13.3718	12.6672	12.234	11.7007	12.2244
	ug Zn	1512.15	1543.65	1523.25	1665.49	1518.9	1523.7	1603.36	1262.8	1580.4	1570.65	1407.98	1417.92	1452.36	1526.55	1727.84	1645.76	1583.4	1529.25	1701.92	1629.92
	g NaCN	0.483888	0.442513	0.52806	0.48985	0.486048	0.477426	0.491029	0.43296	0.505728	0.502608	0.482736	0.486144	0.497952	0.488496	0.507553	0.504014	0.506688	0.48936	0.436117	0.488976
	g CaO	0.040324	0.041164	0.04962	0.048985	0.040504	0.040632	0.050105	0.0451	0.05268	0.052355	0.060342	0.060768	0.05187	0.050885	0.043196	0.041144	0.05278	0.06117	0.042548	0.050935
Removed in A	g	50.8	51.8	54.5	54.4	54.3	53.8	53.8	55.9	54.5	54.3	54.4	54.3	54.2	54.2	55.4	55	54.7	54.2	49.8	54.1
	ug Au	25.4	28.49	28.885	34.816	29.322	30.666	27.976	26.273	25.615	25.521	27.744	25.521	26.558	26.016	26.592	26.95	23.521	24.39	20.418	24.886
	mg Cu	0.6604	0.6734	0.763	0.816	0.7602	0.6994	0.7532	0.6708	0.763	0.7959	0.7072	0.7059	0.6504	0.7046	0.7756	0.715	0.6564	0.6504	0.5478	0.6492
	ug Zn	76.2	77.7	81.75	92.48	81.45	80.7	86.08	78.26	81.75	81.45	76.16	76.02	75.88	81.3	88.64	88	82.05	81.3	79.68	86.56
	g NaCN	0.024384	0.022274	0.02834	0.0272	0.026064	0.025286	0.026362	0.026832	0.02616	0.026064	0.026112	0.026064	0.026016	0.026016	0.026038	0.02695	0.026256	0.026016	0.020418	0.025968
	g CaO	0.002032	0.002072	0.00218	0.00272	0.002172	0.002152	0.00269	0.002795	0.002725	0.002715	0.003264	0.003258	0.00271	0.00271	0.002216	0.0022	0.002735	0.003252	0.001992	0.002705
In vessel at B	g	1007.8	1029.5	1015	979.2	1012.1	1015.3	1001.4	901.7	1053.2	1046.7	1005.3	1012.5	1036.9	1017.3	1079.7	1028.2	1054.8	1019.1	1063.3	1018.3
	ug Au	634.914	700.06	669.9	714.816	667.986	720.863	640.896	495.935	610.856	617.553	663.498	587.25	642.878	651.072	637.023	606.638	580.14	560.505	637.98	580.431
	mg Cu	14.1092	14.413	15.225	15.6672	15.1815	14.2142	12.0168	12.6238	16.8512	15.7005	15.0795	15.1875	15.5535	15.2595	16.1955	15.42	15.822	15.2865	15.9495	15.2745
	ug Zn	1612.48	1750.15	1725.5	1958.4	1720.57	1726.01	1802.52	1532.89	1895.76	1884.06	1709.01	1822.5	1866.42	1831.14	2375.34	1850.76	1898.64	1936.29	2020.27	1832.94
	g NaCN	0.483744	0.483865	0.43645	0.450432	0.475687	0.467038	0.440616	0.414782	0.484472	0.481482	0.452385	0.455625	0.466605	0.478131	0.507459	0.483254	0.47466	0.468786	0.552916	0.448052
	g CaO	0.040312	0.04118	0.0406	0.039168	0.050605	0.050765	0.05007	0.045085	0.05266	0.052335	0.060318	0.06075	0.051845	0.050865	0.043188	0.041128	0.05274	0.061146	0.053165	0.050915
Removed in B	g	52.5	52.6	54.1	52.7	53	54	50.3	55.6	54.7	54.4	54.7	54.6	54.5	54.4	55.1	52	54.8	54.5	54.3	54.3
	ug Au	33.075	35.768	35.706	38.471	34.98	38.34	32.192	30.58	31.726	32.096	36.102	31.668	33.79	34.816	32.509	30.68	30.14	29.975	32.58	30.951
	mg Cu	0.735	0.7364	0.8115	0.8432	0.795	0.756	0.6036	0.7784	0.8752	0.816	0.8205	0.819	0.8175	0.816	0.8265	0.78	0.822	0.8175	0.8145	0.8145
	ug Zn	84	89.42	91.97	105.4	90.1	91.8	90.54	94.52	98.46	97.92	92.99	98.28	98.1	97.92	121.22	93.6	98.64	103.55	103.17	97.74
	g NaCN	0.0252	0.024722	0.023263	0.024242	0.02491	0.02484	0.022132	0.025576	0.025162	0.025024	0.024615	0.02457	0.024525	0.025568	0.025897	0.02444	0.02466	0.02507	0.028236	0.023892
	g CaO	0.0021	0.002104	0.002164	0.002108	0.00265	0.0027	0.002515	0.00278	0.002735	0.00272	0.003282	0.003276	0.002725	0.00272	0.002204	0.00208	0.00274	0.00327	0.002715	0.002715
In vessel at C	g	1007.9	1028.8	1014.8	978.8	1011.9	1015.2	1001.7	901.6	1052.9	1045.2	1005.1	1012	1036.7	1016.9	1079.7	1028.3	1054.8	1018.7	1062.3	1018.1
	ug Au	624.898	689.296	659.62	714.524	647.616	700.488	631.071	495.88	568.566	658.476	673.417	607.2	632.387	660.985	647.82	596.414	569.592	580.659	648.003	621.041
	mg Cu	14.1106	14.4032	16.2368	16.6396	16.1904	16.2432	16.0272	13.524	16.8464	16.7232	16.0816	16.192	16.5872	16.2704	17.2752	15.4245	16.8768	16.2992	18.0591	16.2896
	ug Zn	1713.43	1851.84	2029.6	2153.36	2124.99	2030.4	2103.57	1532.72	2000.51	2194.92	2010.2	2226.4	2073.4	2135.49	1943.46	1850.94	2215.08	2241.14	2337.06	2239.82
	g NaCN	0.453555	0.483536	0.446512	0.44046	0.445236	0.446688	0.450765	0.414736	0.484334	0.47034	0.452295	0.44528	0.487249	0.477943	0.507459	0.462735	0.47466	0.468602	0.509904	0.478507
	g CaO	0.040316	0.041152	0.040592	0.039152	0.040476	0.030456	0.040068	0.04508	0.042116	0.041808	0.050255	0.0506	0.041468	0.050845	0.032391	0.041132	0.042192	0.050935	0.042492	0.040724
Removed in C	g						54.3	55.9						55.8	58.4					57.5	56.2
	ug Au						37.467	35.217						34.038	37.96					35.075	34.282
	mg Cu						0.8688	0.8944						0.8928	0.9344					0.9775	0.8992
	ug Zn						108.6	117.39						111.6	122.64					126.5	123.64
	g NaCN						0.023892	0.025155						0.026226	0.027448					0.0276	0.026414
	g CaO						0.001629	0.002236						0.002232	0.00292					0.0023	0.002248
In vessel at D	g						1013.2	999.9						1036.2	1015.8					1061	1016.8
	ug Au						668.712	609.939						642.444	629.796					625.99	610.08
	mg Cu						16.2112	15.9984						16.5792	16.2528					16.976	16.2688
	ug Zn						2229.04	2299.77						2383.26	2336.34					2546.4	2440.32
	g NaCN						0.496468	0.479952						0.46629	0.45711					0.49867	0.467728
	g CaO						0.030396	0.039996						0.041448	0.030474					0.04244	0.030504
Residue	ug Au	105.2	120.3205	103.5	105.3985	86.051	94.0	88.245	147.842	173.2145	150.427	133.1665	119.582	127.5305	117.078	201.422	173.791	173.8695	161.2235	166.809	170.283
Calculated Head	ug Au	783.58	873.87	827.71	893.21	797.97	869.17	793.57	700.58	799.12	866.52	870.43	783.97	864.36	845.67	908.34	829.84	797.12	796.25	880.87	870.48
Sample leached	g	672.4	686.8	677.5	720.0	675.5	677.1	668.2	793.1	702.6	697.8	670.9	675.4	692.3	678.9	720.3	686.3	704.0	679.9	709.4	679.5

1429

BMT5727 Sheet Calc

Calculation sheet only

COMPOSITE BMT 1.2

Sample mass	g	672.4	686.8	677.5	720	675.5	677.1	668.2	793.1	702.6	697.8	670.9	
Vessel + sample	g	1081.6	1093.3	1085.7	1127.5	1084	1085.7	1075.2	1200.6	1110.3	1105.7	1077.7	
In vessel at A	g	1008.1	1029.1	1015.5	979.7	1012.6	1015.8	1002.1	902	1053.6	1047.1	1005.7	
	ug Au	504.05	566.005	538.215	627.008	546.804	579.006	521.092	423.94	495.192	492.137	512.907	4
	mg Cu	13.1053	13.3783	14.217	14.6955	14.1764	13.2054	14.0294	10.824	14.7504	13.6123	13.0741	1
	ug Zn	1512.15	1543.65	1523.25	1665.49	1518.9	1523.7	1603.36	1262.8	1580.4	1570.65	1407.98	1
	g NaCN	0.483888	0.442513	0.52806	0.48985	0.486048	0.477426	0.491029	0.43296	0.505728	0.502608	0.482736	0.
	g CaO	0.040324	0.041164	0.04962	0.048985	0.040504	0.040632	0.050105	0.0451	0.05268	0.052355	0.060342	0.
Removed in A	g	50.8	51.8	54.5	54.4	54.3	53.8	53.8	55.9	54.5	54.3	54.4	
	ug Au	25.4	28.49	28.885	34.816	29.322	30.666	27.976	26.273	25.615	25.521	27.744	
	mg Cu	0.6604	0.6734	0.763	0.816	0.7602	0.6994	0.7532	0.6708	0.763	0.7059	0.7072	
	ug Zn	76.2	77.7	81.75	92.48	81.45	80.7	86.08	78.26	81.75	81.45	76.16	
	g NaCN	0.024384	0.022274	0.02834	0.0272	0.026064	0.025286	0.026362	0.026832	0.02616	0.026064	0.026112	0.
	g CaO	0.002032	0.002072	0.00218	0.00272	0.002172	0.002152	0.00269	0.002795	0.002725	0.002715	0.003264	0.
In vessel at B	g	1007.8	1029.5	1015	979.2	1012.1	1015.3	1001.4	901.7	1053.2	1046.7	1005.3	
	ug Au	634.914	700.06	669.9	714.816	667.986	720.863	640.896	495.935	610.856	617.553	663.498	
	mg Cu	14.1092	14.413	15.225	15.6672	15.1815	14.2142	12.0168	12.6238	16.8512	15.7005	15.0795	1
	ug Zn	1612.48	1750.15	1725.5	1958.4	1720.57	1726.01	1802.52	1532.89	1895.76	1884.06	1709.01	
	g NaCN	0.483744	0.483865	0.43645	0.450432	0.475687	0.467038	0.440616	0.414782	0.484472	0.481482	0.452385	0.
	g CaO	0.040312	0.04118	0.0406	0.039168	0.050605	0.050765	0.05007	0.045085	0.05266	0.052335	0.060318	0
Removed in B	g	52.5	52.6	54.1	52.7	53	54	50.3	55.6	54.7	54.4	54.7	
	ug Au	33.075	35.768	35.706	38.471	34.98	38.34	32.192	30.58	31.726	32.096	36.102	
	mg Cu	0.735	0.7364	0.8115	0.8432	0.795	0.756	0.6036	0.7784	0.8752	0.816	0.8205	
	ug Zn	84	89.42	91.97	105.4	90.1	91.8	90.54	94.52	98.46	97.92	92.99	
	g NaCN	0.0252	0.024722	0.023263	0.024242	0.02491	0.02484	0.022132	0.025576	0.025162	0.025024	0.024615	0
	g CaO	0.0021	0.002104	0.002164	0.002108	0.00265	0.0027	0.002515	0.00278	0.002735	0.00272	0.003282	0.
In vessel at C	g	1007.9	1026.8	1014.8	978.8	1011.9	1015.2	1001.7	901.6	1052.9	1045.2	1005.1	
	ug Au	624.898	689.296	659.62	714.524	647.616	700.488	631.071	495.88	568.566	658.476	673.417	
	mg Cu	14.1106	14.4032	16.2368	16.6396	16.1904	16.2432	16.0272	13.524	16.8464	16.7232	16.0816	
	ug Zn	1713.43	1851.84	2029.6	2153.36	2124.99	2030.4	2103.57	1532.72	2000.51	2194.92	2010.2	
	g NaCN	0.453555	0.483536	0.446512	0.44046	0.445236	0.446688	0.450765	0.414736	0.484334	0.47034	0.452295	0
	g CaO	0.040316	0.041152	0.040592	0.039152	0.040476	0.030456	0.040068	0.04508	0.042116	0.041808	0.050255	
Removed in C	g						54.3	55.9					
	ug Au						37.467	35.217					
	mg Cu						0.8688	0.8944					
	ug Zn						108.6	117.39					
	g NaCN						0.023892	0.025155					
	g CaO						0.001629	0.002236					
In vessel at D	g						1013.2	999.9					
	ug Au						668.712	609.939					
	mg Cu						16.2112	15.9984					
	ug Zn						2229.04	2299.77					
	g NaCN						0.496468	0.479952					
	g CaO						0.030396	0.039996					
Residue	ug Au	105.2	120.3205	103.5	105.3985	86.051	94.0	88.245	147.842	173.2145	150.427	133.1665	1
Calculated Head	ug Au	788.58	873.87	827.71	893.21	797.97	869.17	793.57	700.58	799.12	866.52	870.43	
Sample leached	g	672.4	686.8	677.5	720.0	675.5	677.1	668.2	793.1	702.6	697.8	670.9	

APPENDIX 1
(8 sheets)

sheet 1
WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 0.6

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10000	BP116	7	8	1.0	0.28		2790	505
		8	9	1.0	0.71		2410	537
		9	10	1.0	0.52		2220	507
		10	11	1.0	1.17		1590	487
		11	12	1.0	0.42	0.62	2450	494
10040	BP137	3	4	1.0	0.69		19290	528
		4	5	1.0	0.75		21200	514
		6	7	1.0	0.57		13020	520
		7	8	1.0	0.70		11580	536
		8	9	1.0	0.90		15440	490
		9	10	1.0	0.66		20320	538
		10	11	1.0	0.51		13910	473
		11	12	1.0	0.28		18690	493
		12	13	1.0	1.07	0.68	14080	509
10050	BP130	2	3	1.0	0.56		20300	502
		3	4	1.0	1.04		1870	489
		4	5	1.0	1.36		9810	483
		5	6	1.0	0.51		12430	513
		6	7	1.0	1.39		10260	541
		7	8	1.0	0.43		13590	503
		8	9	1.0	0.14		1255	534
		9	10	1.0	0.58		11880	496
		10	11	1.0	0.26		13950	520
		11	12	1.0	0.23	0.65	12450	517
10070	BP121	2	3	1.0	0.81		1210	510
		3	4	1.0	0.91		15250	493
		4	5	1.0	0.69		14300	530
		5	6	1.0	0.26		18550	494
		6	7	1.0	0.56		18360	493
		7	8	1.0	0.15		23340	506
		8	9	1.0	0.72		18940	531
		9	10	1.0	0.26		17000	529
		10	11	1.0	0.87	0.52	16730	492

sheet 2
WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 0.6

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10100	BP111	4	5	1.0	0.48		6410	511
		5	6	1.0	1.26		5860	525
		6	7	1.0	0.74		7060	483
		7	8	1.0	0.32		5730	502
		8	9	1.0	0.58		5060	513
		9	10	1.0	0.78		6230	510
		10	11	1.0	1.42		5250	530
		11	12	1.0	0.87		7490	505
		12	13	1.0	0.45		4770	519
		13	14	1.0	0.25		6550	494
		14	15	1.0	0.11	0.66	2310	511
10135	BP163	9	10	1.0	0.26		10290	514
		10	11	1.0	1.78		10400	530
		11	12	1.0	0.13		13900	518
		12	13	1.0	0.31		14010	511
		13	14	1.0	0.72		11000	490
		14	15	1.0	0.40		10750	491
		15	16	1.0	0.82		17040	528
		16	17	1.0	0.13		14170	543
		17	18	1.0	1.43		13550	509
		18	19	1.0	0.16	0.61	16150	525
10170	BP172	8	9	1.0	0.61		10130	536
		9	10	1.0	0.65		7890	508
		10	11	1.0	0.82		9300	521
		11	12	1.0	0.45		14000	507
		12	13	1.0	0.74		5590	509
		13	14	1.0	0.69		4610	539
		14	15	1.0	0.55		5860	488
		15	16	1.0	1.64		3440	519
		16	17	1.0	0.07		6350	538
		17	18	1.0	0.63	0.69	3120	501

sheet 3

WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 0.8

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10000	BP115	16	17	1.0	0.70		7180	503
		17	18	1.0	0.76		8030	510
		18	19	1.0	0.69		9050	492
		19	20	1.0	1.79		8510	496
		20	21	1.0	0.45	0.88	9600	535
10025	BP152	6	7	1.0	0.24		11800	530
		7	8	1.0	0.35		14830	495
		8	9	1.0	2.36		15100	510
		9	10	1.0	0.88		14950	525
		10	11	1.0	0.30		19270	543
		11	12	1.0	0.83		14100	505
		12	13	1.0	0.89		13560	501
		13	14	1.0	1.42		16700	502
		14	15	1.0	0.26	0.84	14130	526
10040	BP125	4	5	1.0	1.40		13600	529
		5	6	1.0	0.49		3850	498
		6	7	1.0	0.11		9450	487
		7	8	1.0	0.81		6650	532
		8	9	1.0	0.99		5150	494
		9	10	1.0	0.66		7550	499
		10	11	1.0	1.01	0.78	8800	534
10050	BP118	17	18	1.0	0.80		5900	528
		18	19	1.0	1.50		3650	503
		19	20	1.0	0.77		7900	507
		20	21	1.0	1.82		6100	534
		21	22	1.0	0.57		4200	584
		22	23	1.0	0.81		1600	524
		23	24	1.0	0.35		6330	536
		24	25	1.0	0.41		9620	538
		25	26	1.0	0.52	0.84	8000	482

sheet 4
WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 0.8

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10070	BP129	7	8	1.0	0.80		8780	477
		8	9	1.0	0.10		7450	472
		9	10	1.0	0.47		1260	509
		10	11	1.0	1.66		7420	497
		11	12	1.0	0.75		7200	541
		12	13	1.0	0.68		11960	522
		13	14	1.0	0.92		9450	521
		14	15	1.0	0.09		9470	524
		15	16	1.0	0.14		15300	493
		16	17	1.0	1.47		9500	531
		17	18	1.0	1.49		10500	517
		18	19	1.0	0.43		9350	533
		19	20	0.0	0.94	0.76	6250	545
10100	BP120	4	5	1.0	0.68		12500	538
		5	6	1.0	1.64		5950	541
		6	7	1.0	0.32		11100	536
		7	8	1.0	0.38		8350	503
		8	9	1.0	1.46		7900	514
		9	10	1.0	0.48		11860	525
		10	11	1.0	0.49		10000	528
		11	12	1.0	0.81		7950	529
		12	13	1.0	0.64		7850	499
		13	14	1.0	0.28		10000	500
		14	15	1.0	2.25		5600	546
		15	16	1.0	0.53		11050	543
		16	17	1.0	0.56		11400	532
		17	18	1.0	0.83		9720	533
		18	19	1.0	0.77	0.81	12120	528
10170	BP171	2	3	1.0	0.84		14800	500
		3	4	1.0	0.27		1100	486
		4	5	1.0	1.30		6100	523
		5	6	0.0	0.81		7530	484
		6	7	1.0	1.49		8000	479
		7	8	1.0	0.86		5620	499
		8	9	1.0	1.00		5460	534
		9	10	1.0	1.95		6030	538
		10	11	1.0	0.26		7780	492
		11	12	1.0	0.38	0.92	5750	508

sheet 5
WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 1.0

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10000	BP124	3	4	1.0	0.95		19930	768
		4	5	1.0	1.79		7650	769
		5	6	1.0	1.05		9300	800
		6	7	1.0	1.01		7620	782
		7	8	1.0	0.30	1.02	5250	793
10040	BP136	5	6	1.0	0.44		20430	769
		6	7	1.0	1.95		15760	799
		7	8	1.0	0.75		18190	774
		8	9	1.0	1.73		23870	794
		9	10	1.0	1.35		24900	796
		10	11	1.0	0.38		24100	783
		11	12	1.0	0.27		25850	784
		12	13	1.0	0.82		17280	793
		13	14	1.0	1.87	1.06	24670	782
10050	BP122	4	5	1.0	1.06		7260	793
		5	6	1.0	2.13		17760	775
		6	7	1.0	3.51		15450	798
		7	8	1.0	0.46		16100	795
		8	9	1.0	0.92		17930	777
		9	10	1.0	0.10		21260	778
		10	11	1.0	0.46		17360	784
		11	12	1.0	0.16		17100	795
		12	13	1.0	1.02		22260	792
		13	14	1.0	0.14		21310	778
		14	15	1.0	1.35	1.03	18790	794
10070	BP149	1	2	1.0	1.18		sample	
		2	3	1.0	1.05		not	
		3	4	1.0	0.96		supplied	
		4	5	1.0	1.44		_____	
		5	6	1.0	3.27		_____	
		6	7	1.0	0.39		_____	
		7	8	1.0	0.26		_____	
		8	9	1.0	0.34	1.11	_____	

sheet 6

WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 1.0

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10100	BP120	21	22	1.0	0.32		13500	793
		22	23	1.0	0.16		12820	789
		23	24	1.0	1.60		6700	788
		24	25	0.0	1.52		10350	766
		25	26	1.0	0.76		11330	781
		26	27	1.0	0.68		11020	788
		27	28	1.0	1.89		6230	763
		28	29	1.0	1.40	1.04	6160	777
10135	BP159	5	6	1.0	1.85		13130	789
		6	7	1.0	2.36		13850	790
		7	8	1.0	3.15		14890	773
		8	9	1.0	0.24		14590	788
		9	10	1.0	0.67		15410	789
		10	11	1.0	0.51		15410	779
		11	12	1.0	0.71		15850	770
		12	13	1.0	0.48		17820	793
		13	14	1.0	0.33		17720	781
		14	15	1.0	.67		18270	797
		15	16	1.0	.24	1.02	21280	787
10170	BP133	7	8	1.0	0.56		sample	
		8	9	1.0	1.64		not	
		9	10	1.0	0.86		supplied	
		10	11	1.0	1.02		_____	
		11	12	1.0	0.15		_____	
		12	13	0.0	1.63		_____	
		13	14	0.0	1.11	1.00	_____	

sheet 7
WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 1.2

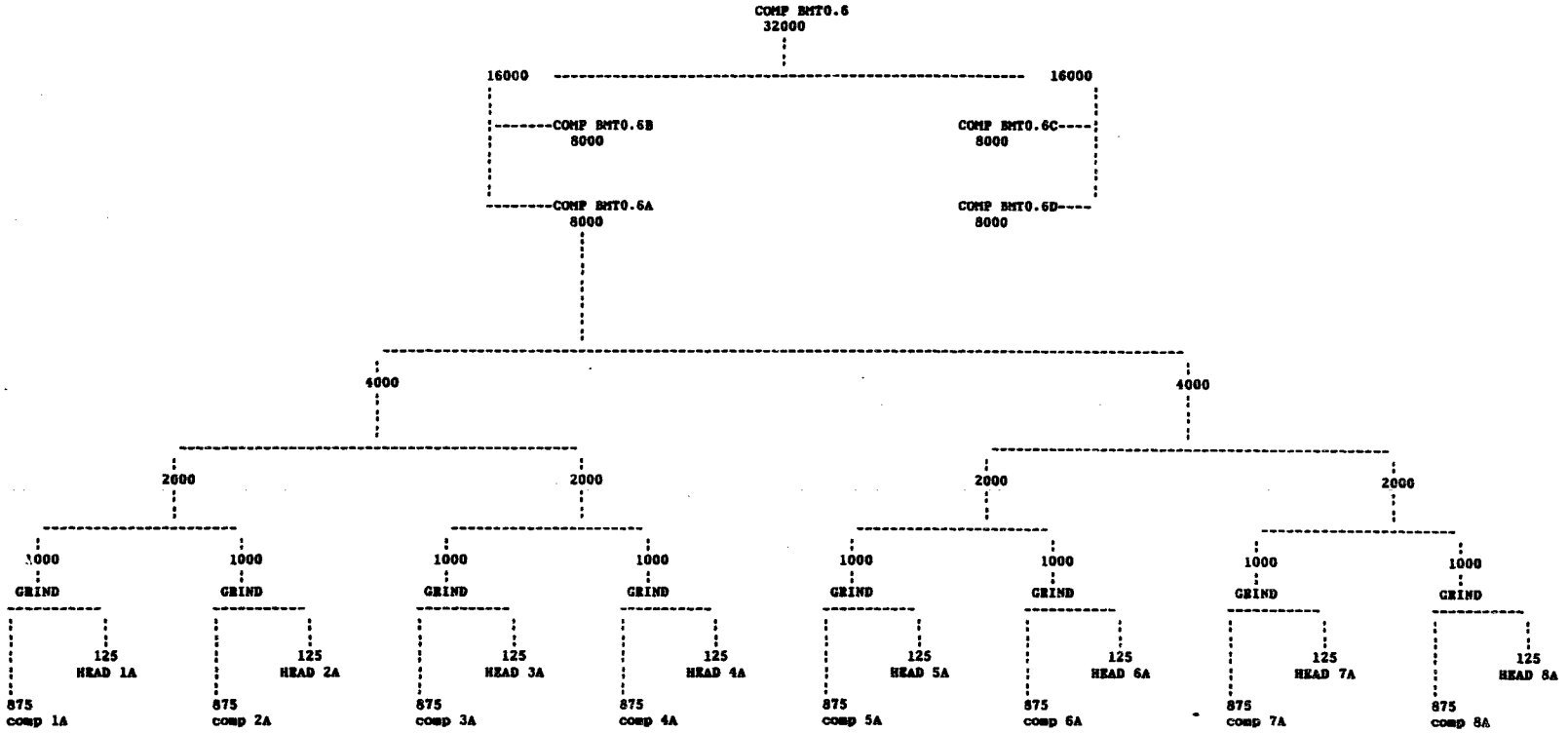
north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10000	BP143	3	4	1.0	0.51		1160	593
		4	5	1.0	0.43		5060	588
		5	6	1.0	0.55		7610	583
		6	7	1.0	1.80		8700	628
		7	8	1.0	1.26		6350	630
		8	9	1.0	0.65		8740	603
		9	10	1.0	2.46		7520	588
		10	11	1.0	0.45		8150	619
		11	12	1.0	3.20		6460	626
		12	13	1.0	1.04	1.24	12510	578
10040	BP123	5	6	1.0	2.10		12500	632
		6	7	1.0	0.55		25600-	589
		7	8	1.0	1.60		15470	583
		8	9	1.0	2.01		14610	610
		9	10	1.0	0.51		18100	636
		10	11	1.0	0.69	1.24	11060	615
10050	BP145	6	7	1.0	1.17		6710	591
		7	8	1.0	1.30		5310	637
		8	9	1.0	0.66		7450	623
		9	10	1.0	1.14		1100	650
		10	11	1.0	0.57		6100	584
		11	12	1.0	1.75		6400	623
		12	13	1.0	1.57		5910	617
		13	14	1.0	2.83		5000	603
		14	15	1.0	0.61		5200	614
		15	16	1.0	0.15		6400	580
		16	17	1.0	1.52	1.21	5520	640

sheet 8

WEATHERED ORE PERCUSSION DRILL SAMPLE FOR COMPOSITE BMT 1.2

north	drill hole number	from	to	m	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10070	BP119	23	24	1.0	1.31		6940	614
		24	25	1.0	1.96		12250	622
		25	26	1.0	0.80		10150	595
		26	27	1.0	0.25		14300	622
		27	28	1.0	0.31		9310	573
		28	29	1.0	2.93		10100	617
		29	30	1.0	1.25		8860	618
		30	31	1.0	1.88		11950	626
		31	32	1.0	0.56		11670	625
		32	33	1.0	0.20		11100	617
		33	34	1.0	1.95		8700	610
		34	35	1.0	0.55	1.16	7400	634
10100	BP128	2	3	1.0	0.89		26400	615
		3	4	1.0	0.95		15500	648
		4	5	1.0	2.32		3840	610
		5	6	1.0	0.74		4060	606
		6	7	1.0	1.44		11160	619
		7	8	1.0	0.62		3950	582
		8	9	1.0	1.47		3420	618
		9	10	1.0	2.27		11200	603
		10	11	1.0	1.38		4250	595
		11	12	1.0	0.77	1.29	4250	610
10170	BP169	5	6	1.0	1.35		3700	640
		6	7	1.0	0.46		5610	623
		7	8	1.0	0.94		4950	616
		8	9	1.0	0.79		5270	638
		9	10	1.0	1.85		5450	649
		10	11	1.0	0.25		11100	607
		11	12	1.0	1.14		11350	625
		12	13	1.0	2.27		11050	639
		13	14	1.0	1.03		7360	639
		14	15	1.0	3.21		10100	636
		15	16	1.0	0.50		10300	642
		16	17	1.0	0.36		10110	605
		17	18	1.0	1.05		5120	588
		18	19	1.0	1.80		11650	628
		19	20	1.0	1.33	1.22	3410	606

sheet 1
FLOW SHEET TO RIFFLE DOWN COMPOSITE BMT 0.6



APPENDIX 2

sheet 5
LEACH TEST PROGRAM

COMPOSITE BMT0.6A TEST PROGRAM					COMPOSITE BMT0.6B TEST PROGRAM					COMPOSITE BMT0.6C TEST PROGRAM					COMPOSITE BMT0.6D TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1A	875	LEACH	150	12	1B	875	LEACH	106	8	1C	875	RESERVE			1D	875	LEACH	150	18
2A	875	ASSAY			2B	875	RESERVE			2C	875	LEACH	106	12	2D	875	RESERVE		
3A	875	RESERVE			3B	875	LEACH	75	12	3C	875	LEACH	75	8	3D	875	LEACH	75	12
4A	875	LEACH	150	8	4B	875	LEACH	75	18	4C	875	ASSAY			4D	875	LEACH	106	18
5A	875	RESERVE			5B	875	LEACH	150	8	5C	875	LEACH	106	8	5D	875	RESERVE		
6A	875	LEACH	106	18	6B	875	ASSAY			6C	875	LEACH	75	12	6D	875	LEACH	75	8
7A	875	LEACH	106	12	7B	875	RESERVE			7C	875	LEACH	150	18	7D	875	LEACH	150	12
8A	875	LEACH	75	18	8B	875	LEACH	106	12	8C	875	RESERVE			8D	875	ASSAY		

SAMPLE GRIND PREPARATION
Each charge ground @ 50% solids.

LEACH CONDITIONS FOR EACH TEST

Cyanide (NaCN) concentration	: 0.05
Lime (CaO) concentration	: 0.01
Pulp density (% solids)	: 40.0
Pulp temperature (degree C)	:ambient

SAMPLING FOR EACH LEACH TEST
Head assays to be pulverized prior to duplicate fire assay.
Head sample 2A & 4C to be assayed for Cu,Pb,Zn,As,Ag,Fe,& s.
Liquor sample to be taken @ 3,6,12,18,24,32 hours.
Each liquor sample to be assayed for NaCN,CaO,pH,Au,Cu,Zn.
Final liquor for each sample to be assayed for soluble S.
Residue solids to be screened on 150,106,75,53 um
and fractions fire assayed for Au.
Duplicate fire assays required on residue sized fractions if sufficient sample.
Record pulp temperature of each test.
Take indivual head sample from ground pulp;duplicate assay for Au only.

Reserve Samples Used:
Grinding Study 3A, 2B, 1C, 2D
Environmental Leach Test 8C

APPENDIX 3

sheet 6
LEACH TEST PROGRAM

COMPOSITE BMT0.8A TEST PROGRAM					COMPOSITE BMT0.8B TEST PROGRAM					COMPOSITE BMT0.8C TEST PROGRAM					COMPOSITE BMT0.8D TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1A	875	LEACH	150	12	1B	875	LEACH	106	8	1C	875	RESERVE			1D	875	LEACH	150	18
2A	875	ASSAY			2B	875	RESERVE			2C	875	LEACH	106	12	2D	875	RESERVE		
3A	875	RESERVE			3B	875	LEACH	75	12	3C	875	LEACH	75	8	3D	875	LEACH	75	12
4A	875	LEACH	150	8	4B	875	LEACH	75	8	4C	875	ASSAY			4D	875	LEACH	106	18
5A	875	RESERVE			5B	875	LEACH	150	8	5C	875	LEACH	106	8	5D	875	RESERVE		
6A	875	LEACH	106	18	6B	875	ASSAY			6C	875	LEACH	75	12	6D	875	LEACH	75	8
7A	875	LEACH	106	12	7B	875	RESERVE			7C	875	LEACH	150	18	7D	875	LEACH	150	12
8A	875	LEACH	75	18	8B	875	LEACH	106	12	8C	875	RESERVE			8D	875	ASSAY		

SAMPLE GRIND PREPARATION
Each charge ground @ 50% solids.

LEACH CONDITIONS FOR EACH TEST

Cyanide (NaCN) concentration	: 0.05
Lime (CaO) concentration	: 0.01
Pulp density (% solids)	: 40.0
Pulp temperature (degree C)	:ambient

SAMPLING FOR EACH LEACH TEST
Head assays to be pulverized prior to duplicate fire assay.
Head sample 2A & 4C to be assayed for Cu,Pb,Zn,As,Ag,Fe,& s.
Liquor sample to be taken @ 3,6,12,18,24,32 hours.
Each liquor sample to be assayed for NaCN,CaO,pH,Au,Cu,Zn.
Final liquor for each sample to be assayed for soluble S.
Residue solids to be screened on 150,106,75,53 um
and fractions fire assayed for Au.
Duplicate fire assays required on residue sized fractions if sufficient sample.
Record pulp temperature of each test.
Take indivual head sample from ground pulp;duplicate assay for Au only.

Reserve Samples Used:
Grinding Study 5A, 7B, 1C
Environmental Leach Test 2B

APPENDIX 4

sheet 7
LEACH TEST PROGRAM

COMPOSITE BMT1.0A TEST PROGRAM					COMPOSITE BMT1.0B TEST PROGRAM					COMPOSITE BMT1.0C TEST PROGRAM					COMPOSITE BMT1.0D TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1A	875	LEACH	150	12	1B	875	LEACH	106	8	1C	875	RESERVE			1D	875	LEACH	150	18
2A	875	ASSAY			2B	875	RESERVE			2C	875	LEACH	106	12	2D	875	RESERVE		
3A	875	RESERVE			3B	875	LEACH	75	12	3C	875	LEACH	75	8	3D	875	LEACH	75	12
4A	875	LEACH	150	8	4B	875	LEACH	75	18	4C	875	ASSAY			4D	875	LEACH	106	18
5A	875	RESERVE			5B	875	LEACH	150	8	5C	875	LEACH	106	8	5D	875	RESERVE		
6A	875	LEACH	106	18	6B	875	ASSAY			6C	875	LEACH	75	12	6D	875	LEACH	75	8
7A	875	LEACH	106	12	7B	875	RESERVE			7C	875	LEACH	150	18	7D	875	LEACH	150	12
8A	875	LEACH	75	18	8B	875	LEACH	106	12	8C	875	RESERVE			8D	875	ASSAY		

SAMPLE GRIND PREPARATION
Each charge ground @ 50% solids.

LEACH CONDITIONS FOR EACH TEST

Cyanide (NaCN) concentration	: 0.05
Lime (CaO) concentration	: 0.01
Pulp density (% solids)	: 40.0
Pulp temperature (degree C)	:ambient

SAMPLING FOR EACH LEACH TEST
Head assays to be pulverized prior to duplicate fire assay.
Head sample 2A & 4C to be assayed for Cu,Pb,Zn,As,Ag,Fe,& s.
Liquor sample to be taken @ 3,6,12,18,24,32 hours.
Each liquor sample to be assayed for NaCN,CaO,pH,Au,Cu,Zn.
Final liquor for each sample to be assayed for soluble S.
Residue solids to be screened on 150,106,75,53 um
and fractions fire assayed for Au.
Duplicate fire assays required on residue sized fractions if sufficient sample.
Record pulp temperature of each test.
Take indivual head sample from ground pulp;duplicate assay for Au only.

Reserve Samples Used:
Grinding Study 3A, 7B, 1C
Environmental Leach Test 5A

APPENDIX 5

sheet 8
LEACH TEST PROGRAM

COMPOSITE BMT1.2A TEST PROGRAM					COMPOSITE BMT1.2B TEST PROGRAM					COMPOSITE BMT1.2C TEST PROGRAM					COMPOSITE BMT1.2D TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs	comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1A	875	LEACH	150	12	1B	875	LEACH	106	8	1C	875	RESERVE			1D	875	LEACH	150	18
2A	875	ASSAY			2B	875	RESERVE			2C	875	LEACH	106	12	2D	875	RESERVE		
3A	875	RESERVE			3B	875	LEACH	75	12	3C	875	LEACH	75	8	3D	875	LEACH	75	12
4A	875	LEACH	150	8	4B	875	LEACH	75	18	4C	875	ASSAY			4D	875	LEACH	106	18
5A	875	RESERVE			5B	875	LEACH	150	8	5C	875	LEACH	106	8	5D	875	RESERVE		
6A	875	LEACH	106	18	6B	875	ASSAY			6C	875	LEACH	75	12	6D	875	LEACH	75	8
7A	875	LEACH	106	12	7B	875	RESERVE			7C	875	LEACH	150	18	7D	875	LEACH	150	12
8A	875	LEACH	75	18	8B	875	LEACH	106	12	8C	875	RESERVE			8D	875	ASSAY		

SAMPLE GRIND PREPARATION
Each charge ground @ 50% solids.

LEACH CONDITIONS FOR EACH TEST

Cyanide (NaCN) concentration	: 0.05
Lime (CaO) concentration	: 0.01
Pulp density (% solids)	: 40.0
Pulp temperature (degree C)	:ambient

SAMPLING FOR EACH LEACH TEST
Head assays to be pulverized prior to duplicate fire assay.
Head sample 2A & 4C to be assayed for Cu,Pb,Zn,As,Ag,Fe,& s.
Liquor sample to be taken @ 3,6,12,18,24,32 hours.
Each liquor sample to be assayed for NaCN,CaO,pH,Au,Cu,Zn.
Final liquor for each sample to be assayed for soluble S.
Residue solids to be screened on 150,106,75,53 um
and fractions fire assayed for Au.
Duplicate fire assays required on residue sized fractions if sufficient sample.
Record pulp temperature of each test.
Take indivual head sample from ground pulp;duplicate assay for Au only.

Reserve Samples Used:
Grinding Study 3A, 7B, 1C
Environmental Leach Test 2B, 2D

APPENDIX 6

LAURIE SMITH & ASSOCIATES PTY. LTD.
Incorporated in Western Australia
CONSULTING METALLURGISTS
Managing Director L.I. Smith, A.W.A S.M. (Metallurgy), M.Aus.I.M.M.

16 BRODRICK STREET
KARRINYUP 6018
WESTERN AUSTRALIA
PHONE: (09) 447 5879
LAB: (09) 244 1423
FAX: (09) 447 8412

METALLURGICAL INVESTIGATIONS
for
BILLITON AUSTRALIA GOLD PTY LTD

"CYANIDE LEACH TESTS
on
MT TODD LOW GRADE PRIMARY ORE"
Composite BMT P0.8
6 December 1989

08.4955

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APPENDIX

BMT5748

Laurie Smith & Associates Pty. Ltd.
Consulting Metallurgists, Perth, WA

METALLURGICAL INVESTIGATIONS
for
BILLITON AUSTRALIA GOLD PTY LTD

"CYANIDE LEACH TESTS
on
MT TODD LOW GRADE PRIMARY ORE"
Composite BMT P0.8
6 December, 1989

1. Introduction

A program of testwork (on a composite sample crushed to all pass 2mm) was drawn up by W.R. Lethlean & Associates to establish:-

(a) the repeatability of gold assays on a number of sub-samples of the composite

(b) the reproducibility of cyanide leach extractions on triplicate and quadruplicate tests

(c) the optimum grind level for cyanide leaching

(d) the optimum cyanide leach time

(e) the cyanide and alkali consumption over a range of grind levels and leaching times.

A log of 74 samples was provided together with specific instructions regarding sample preparation, sample compositing, and sample splitting. Instructions were also received regarding assays and tests to be conducted on specific riffle splits and the conditions for the tests.

2. Diamond Drill Core Samples Received

A total of 73 half-core samples, representing 8 drill holes, was received. The samples were in labelled calico bags inside polyweave bags. The intersection 217-218m of drill hole BD027 was missing.

The mass of each sample received is shown in Appendix 1, sheets 1 and 2.

3. Water for Testwork

Sufficient Billiton sitewater from earlier consignments was available for this test program.

4. Qualifications

(i) No responsibility will be accepted for the data provided in this report except insofar as they apply to the samples tested.

(ii) Billiton sitewater was used in all testwork except the time versus grind studies.

(iii) All gold assays on liquor were determined by solvent extraction followed by AAS. Results are reported on a w/w basis. All copper and zinc assays on liquor were determined by AAS and reported on a w/v basis. Total sulphur was determined on composite leach liquors by classical gravimetric analysis.

(iv) All solids samples were assayed by the fire method followed by gravimetric finish except where grades were very low - e.g., residues. In this instance, the prill from cupellation was dissolved in aqua regia and the gold determined by AAS after solvent extraction. Duplicate determinations were conducted on all samples except leach residues size fractions of mass generally less than 60g, where the total mass available was assayed.

All head samples were pulverised prior to assay and all residue fractions coarser than 75um were pulverised except where the total sample available was taken for assay (a limited number of -106um +75um fractions). Head samples were assayed for sulphur by a gravimetric method. Head samples were assayed for Fe, Cu, Zn, As, Pb and Ag by acid digestion followed by AAS.

5. Sample Preparation

Each sample of core was weighed and jaw-crushed at a nominal 4mm closed side setting. The sample was then roll-crushed to a nominal 2mm and riffle-split to provide a sub-sample of approximately 2000g to make up individual "hole composites". Some samples as received were already at or below this quantity and, in these cases, the total available quantity was used. The same applied to samples which were initially slightly above 2000g, but less than 2000g after crushing due to inevitable minor losses.

The breakage pattern of the core samples was different to that of the previously tested primary ore composite insofar as the particles did not exhibit a slabby character.

The actual sample masses used for compositing are also shown in Appendix 1, sheets 1 and 2.

Each hole composite was mixed in a urethane-lined mixer and assay portions of approximately 500g riffled out for duplicate gold assays.

Assay results were:-

Hole No.	ppm Au	ppm Au	Ave. ppm Au
BD057	0.56	0.60	0.58
BD069	0.71	0.75	0.73
BD001	1.02	1.06	1.04
BD076	0.70	0.75	0.73
BD035	0.92	0.91	0.92
BD009	0.78	0.79	0.79
BD027	1.61	1.62	1.62
BD065	0.77	0.76	0.77

To ensure good agreement between the duplicate assays, all of each hole composite head sample was pulverized prior to sub-sampling. The pulverized reject portions were returned to LS&A for preliminary leach tests to determine reagent needs and CN-soluble Cu. Hole composite BD027 was excluded from the main composite. The approximate mass of the remaining hole composites was:-

Hole Composite	Mass (kg)
BD057	20
BD069	18
BD001	22
BD076	14
BD035	20
BD009	22
BD065	18

Each hole composite was riffle-split into halves, and one half was taken into the main composite. The other half was bagged for future reference.

The composite sample weighing 63.5kg was mixed and riffle-split according to the flow chart shown as Appendix 2 to provide, initially, four sub-samples A, B, C and D. Each of the four sub-samples was then riffle-split to provide 16 working samples for action detailed in Appendix 3. The working samples were labelled A1 to A16, etc.

6. Head Assays and Analyses

Throughout this report assays on solids and liquors are stated as ppm or % on a w/w basis except for Cu and Zn and S assays on liquors which are on a w/v basis. Extractions are stated as g/t (grams per tonne).

Two working samples from each of the sub-composites A, B, C and D were submitted for gold assay and the total of each sample was pulverised prior to taking duplicate assay portion. Two of the eight samples were analysed for further elements.

Sample	Au ppm	Au ppm	Au Ave ppm	Cu ppm	Zn ppm	Ag ppm	Pb ppm	As ppm	Fe %	S %
2A	0.69	0.72	0.70	290	205	<0.5	35	90	5.87	0.98
10A	0.74	0.75	0.74							
2B	0.73	0.81	0.77							
10B	0.75	0.72	0.74							
2C	0.73	0.71	0.72							
10C	0.71	0.75	0.73	300	195	<0.5	35	65	6.54	0.96
2D	0.75	0.81	0.78							
10D	0.76	0.78	0.77							

The analysis of the previously supplied sitewater was as follows:-

TDS	<10ppm
Na	1.5ppm
Ca	0.8ppm
Mg	0.4ppm
Cl	<1 ppm
SO4	<1 ppm
pH	6.8

7. **Grinding of the Composite Sample**

Four working portions of the composite were each rod-mill-ground for 15, 25, 35 and 45 minutes and the mill product wet-screened on 38um square mesh, followed by dry screening of the oversize on a nest of screens. The data were graphed and curves drawn to show the production rate of particular sizes. This information is shown in Figures 1 and 2. From Figure 2, the required grinding time to produce 80% passing the nominated size was determined.

Laboratory Rod Mill
Urethane lined with eight 5mm high x 5mm wide lifters

Inside diameter (between plates)	195 mm
Inside length	315mm
Rods (stainless steel)	22 off 19mm x 302mm 6 off 12mm x 302mm Mass 16.3kg
Mill speed (refer to discussion)	67-72 rpm

Grinding times, determined at a mill speed of 72 rpm, were established at 15.5, 22.5, 31.25, 39.5 and 47 minutes to achieve P80 values of 150, 106, 75, 53 and 38um. Test grinding was conducted in Perth tapwater at 50% solids. Grinding for leach tests was conducted in Billiton site water at 50% solids.

The tests were conducted in batches wherein all the same nominal P80 grinds were within each batch. The rod load was accurately weighed prior to grinding each batch and weighed again at the completion of grinding each batch. The rod wear data, together with that determined on other BMT samples and on a Pine Creek sample, are shown in Table 1.

8. **Sampling of Ground Product**

Prior to leaching, a sample of the ground solids pulp was taken for a duplicate gold assay.

The pulp was passed through a pulp splitter with the object of taking a one-eighth split for duplicate gold assay. The sample was filtered, dried, weighed and pulverised for duplicate gold assay. The assays are shown in Table 2.

The remaining pulp (generally regardless of the grind size) would not settle overnight to higher than 40% solids and leaching was required at 40% solids. In addition, the supernatent liquor was turbid and the surplus liquor could not be removed without taking some solids.

Two courses of action were available:

1. Filter the pulp and then repulp to 50% solids or
2. Add lime after grinding to assist the settling and provide a clear supernatent liquor.

The course of adding a weighed quantity (1.20g) of technical grade calcium hydroxide to the pulp after sampling was adopted and resulted in a settled pulp approaching 55% solids.

9. **Leaching Tests**

After sampling the ground material and the addition of the calcium hydroxide, the pulp was transferred to nominal 5-litre polythene wide-necked jars, 170mm diameter x 170mm parallel shell length, and the pulp adjusted to 40% solids by decant of supernatent liquor. The decanted liquor from each grind was weighed and the CaO determined by titration. The quantity of CaO added to each leach test was then determined as the difference between that added for settling and the quantity removed in the decant. The quantity of CaO added for settling was determined from the preliminary grinding tests.

The standard procedure is to cap the leach vessels with a screw cap with a 26mm diameter hole in the centre. With the Billiton pulp samples, the cap was necessary to retain the pulp in the vessel and, in the preliminary CaO requirement tests, it was found that pulp would film onto the cap, be taken overhead of the hole and flow out of the hole. This problem was overcome by fitting a tube through the hole to act as a deflector. The hole was still retained at 26mm diameter.

The criteria set for the leach tests were:

NaCN concentration	0.050%
CaO concentration	0.010%
Pulp solids by weight	40%
Temperature	ambient

The initial NaCN addition was made to ensure that there was no deficiency in NaCN concentration within the first three hours. It was planned to make additions at any stage of testing to maintain the concentration of 0.050%. The consumption was, however, lower than indicated by the preliminary leach tests on pulverised samples and, without NaCN addition, the leach terminal concentrations were generally of the order of 0.05-0.06% NaCN. The same starting addition, in terms of kg NaCN/tonne, was maintained for all tests. The mass of solids taken to the leach tests was calculated as the difference between the mass taken to grinding and the mass of ground sample split out for assay.

The leach vessels were roll-agitated at a speed of 42 rpm and the liquor sampled at 3, 6, 12, 18, 24 and 32 hours as called upon by the test program. Batch size varied from four to ten tests.

The gross mass of the vessel and pulp was recorded prior to placing on the rolls and the gross mass again recorded when the vessel was removed from the rolls for liquor sampling. The pH of each pulp was recorded and the temperature of the pulp in one vessel only was determined at each time of sampling.

Settling of the pulp was quick and the liquor sample was removed with a pipette and filtered. The vessels were again weighed and Billiton sitewater added to return the gross mass to that recorded when they were removed from the rolls. This procedure maintained the leach pulp at 40% solids throughout the test and also provided the mass of liquor sample removed for assay and test.

The cyanide concentration was determined by silver nitrate titration of a 10ml portion of the liquor using approximately 0.5g potassium iodide as indicator. After adding about 1ml excess of silver nitrate, the available CaO was determined by titration with oxalic acid using phenolphthalein indicator. The remainder of the liquor sample was assayed for gold, copper and zinc.

At the termination of the 32-hour tests for each grindsize (24-hour for P80=38um), the pulp was filtered to recover all the of liquor to permit determination of total soluble sulphur in addition to gold, copper, zinc, NaCN and CaO. The filter cake was repulped with Perth tapwater and wet-screened on a 38um screen. The undersize was flocculated, washed twice by decantation and finally filtered, dried and weighed. The oversize was transferred to a tray, dried and weighed.

All test details are shown on sheet 2 of the accompanying tables.

10. **Preparation of Residue Samples**

The plus 38um material from the wet screening described above was dry-screened on a nest of screens and the size fractions weighed and bagged for assay. The minus 38um material recovered from dry screening was combined with the minus 38um from wet screening and the material passed through an 800um screen, mixed by rolling and bagged for assay.

All residue fractions coarser than 75um were pulverised prior to assay except where the total sample available was taken for assay.

The sizings assays and gold distributions for the residues are shown on sheets 3 and 4 of the accompanying tables for four batches of tests and on sheet 3 only for the batch of P80=38um.

During screening, it was noted that pegging or blinding of the screen cloth was exceptionally high. After a program of test sieving and result evaluation a procedure involving cleaning of the screen cloth was adopted after screening for 10 minutes, and screening then continued for a further 10 minutes.

11. **Calculations and Results**

The leach extractions were calculated based on the mass of liquor in the leach vessel at the time of testing and this mass was determined by subtracting the mass of the vessel and the mass of the sample taken to leach from the gross mass at the time of testing. Allowance was made for the gold, copper and zinc contained in samples that were removed. The same procedure was used to calculate the reagent consumptions. A typical calculation sheet is shown as Table 3.

All significant results are shown for each of the P80 batches on sheet 1 of the attached tables. These tables are not numbered but are identified by nominal P80 and Sheet No.

Sheet 1	Summary
Sheet 2	Bench test data
Sheet 3 & 4	Leach residue gold assays and distribution
Sheet 5	Analysis of Summary sheet Ave., Max., Min.
Sheet 6	Summary of residue size fraction assays and gold distribution.

The exception is the nominal P80=38um where:-

Sheet 1	Summary
Sheet 2	Bench test data
Sheet 3	Leach residue gold assays and distribution
Sheet 4	Summary of residue size fraction assays and gold distribution
Sheet 5	Analysis of Summary sheet Ave., Max., Min.

The data are arranged in the following order:

P80 = 38 microns	24-hour leach
P80 = 53 microns	18, 24 and 32-hour leach
P80 = 75 microns	18, 24 and 32-hour leach
P80 = 106 microns	18, 24 and 32-hour leach
P80 = 150 microns	18, 24 and 32-hour leach

12. Discussion

Discussion is confined to those matters only relating to the reproducibility of the testwork and to those matters which were observed at bench scale and may be of value in design considerations.

An overall summary of averages of test conditions and results is shown in Table 4.

P80 achieved by Grinding

The following percentage passing the nominated particle size was achieved:

P80 Objective	um	150	106	75	53	38
24-hour Test Actuals	%	66.3	76.6	73.1	78.8	75.3
		66.0	76.6	79.7	78.8	72.7
		65.9	75.7	72.0	77.8	67.8
		67.2	75.6	73.0	79.8	71.0
32-hour Test Actuals	%	65.3	75.4	76.7	78.3	
		65.1	76.5	75.4	77.7	
		63.1	76.7	75.1	79.0	
18-hour Test Actuals	%	70.4	76.9	77.8	78.3	
		67.0	78.4	73.0	79.0	
		66.5	77.3	76.3	76.0	

The test grinds to establish the grinding times to achieve the nominated P80 were conducted prior to grinding 110kg of Billiton composite BMT P2 for equipment sizing tests and 20kg of Pine Creek ore for rod wear determination. It appears that wear on the mill drive occurred and slippage resulted in a decrease in grinding mill speed from 72 rpm to about 67 rpm. The actual grinding of the various batches of the BMT P0.8 sample was programmed between batches of the BMT P2 grinding. As a result, this BMT P0.8 sample was ground at a lower-than-tested speed resulting in coarser than nominated products.

The finest and coarsest of each test for each nominated P80 has been graphed and shown as Figure 3-7. The tests most heavily influenced by the slower grinding speed were the P80=38um and the P80=150um.

Although it was noticed after the second batch of tests were sized that the grinds were coarser than nominated, it was considered that this was due partially, at least, to a test screen blinding problem which was pronounced with this sample.

Comparison of Head Assays and Calculated Test Heads
These data are presented in Table 1. The averages for the total program are:-

Split Head Assay	0.74ppm Au
Ground Head Assay	0.77ppm Au
Calculated Head	0.83ppm Au

The comparison of the ground head and calculated head for each level of grind is also shown in Table 1.

The test calculated head is derived from a number of assays, the number depending upon the duration of the test and the fineness of the grind. The shortest leach time and finest grind involves the minimum number of product assays and the longest leach time and coarsest grind involves the maximum number of assays.

For example:

	Liquor Assays	Residue Assays
P80=53um, 18-hour leach	4	7
P80=150um, 32-hour leach	6	11

Preparation of the residue - i.e., washing, screening, weighing, etc. - invariably results in some loss of material. This loss has been accounted for and shown at the foot of sheet 2 of the tables. The average loss for 44 tests was 0.75%. The gold content of the residue has been calculated from the residue mass accounted for and the weighted assay of the residue. This content has been added to the total account of gold in liquors and the total divided by the mass of sample taken to the leach to arrive at the calculated head.

If the residue mass had been used as the divisor to calculate the head, the result would have been slightly higher again.

Considering that 70%-80% of the gold accounted for is in liquor, it is most likely that the liquor assay has a small bias. The contract laboratory used for assays periodically checks the AAS determination against the fire assay on evaporated liquors.

Comparison of Liquor Extractions
These data are presented in Table 5 (gold) and Table 6 (copper) showing, for each level of grind, the average, maximum and minimum extraction at each time of testing. The pattern is relatively consistent.

Comparison of Cyanide Consumptions
These data are presented in Table 7 showing for each level of grind the average, maximum and minimum consumption at each time of testing.

The relatively low cyanide consumptions recorded for this primary low grade sample prompted a further test on sub-sample 11D ground to P80=75um using mild steel rods and leached for 24 hours with liquor tests at 3, 6, 12, 18 and 24 hours. The CaO and NaCN consumptions at 12 and 24 hours are compared with one only of the four tests at the same grind using stainless steel rods. The results are shown in Tables 9 and 10 and summarised as:

		SS Rods	MS Rods
CaO Consumption kg/t	12-hr	0.92	1.07
	24-hr	0.93	1.14
NaCN Consumption kg/t	12-hr	0.20	0.49
	24-hr	0.25	0.57

Total Sulphur Assays on Leach Liquor
Total sulphur was determined on composites of terminal leach liquors from three of the test batches. All liquors were from 40% solids pulps.

Liquo. Composite	ppm Total S
P80=150um, 3x32hr	47
P80= 75um, 4x24hr	46
P80= 38um, 4x24hr	63

Cyanide-soluble Copper in Hole Composites
The pulverised reserve from the assay of each Hole Composite made up was leached for 24 hours with an initial addition of NaCN equivalent to 1.08kg NaCN/t. The reagent concentrations were checked at 12 hours and NaCN added to adjust the concentration of 0.05%. Some difficulty was experienced obtaining clear liquor filtrates at a pH of about 10 (not uncommon with some pulverised samples).

The extraction of copper was calculated as a percentage of the assay head. The results are shown in Table 8.

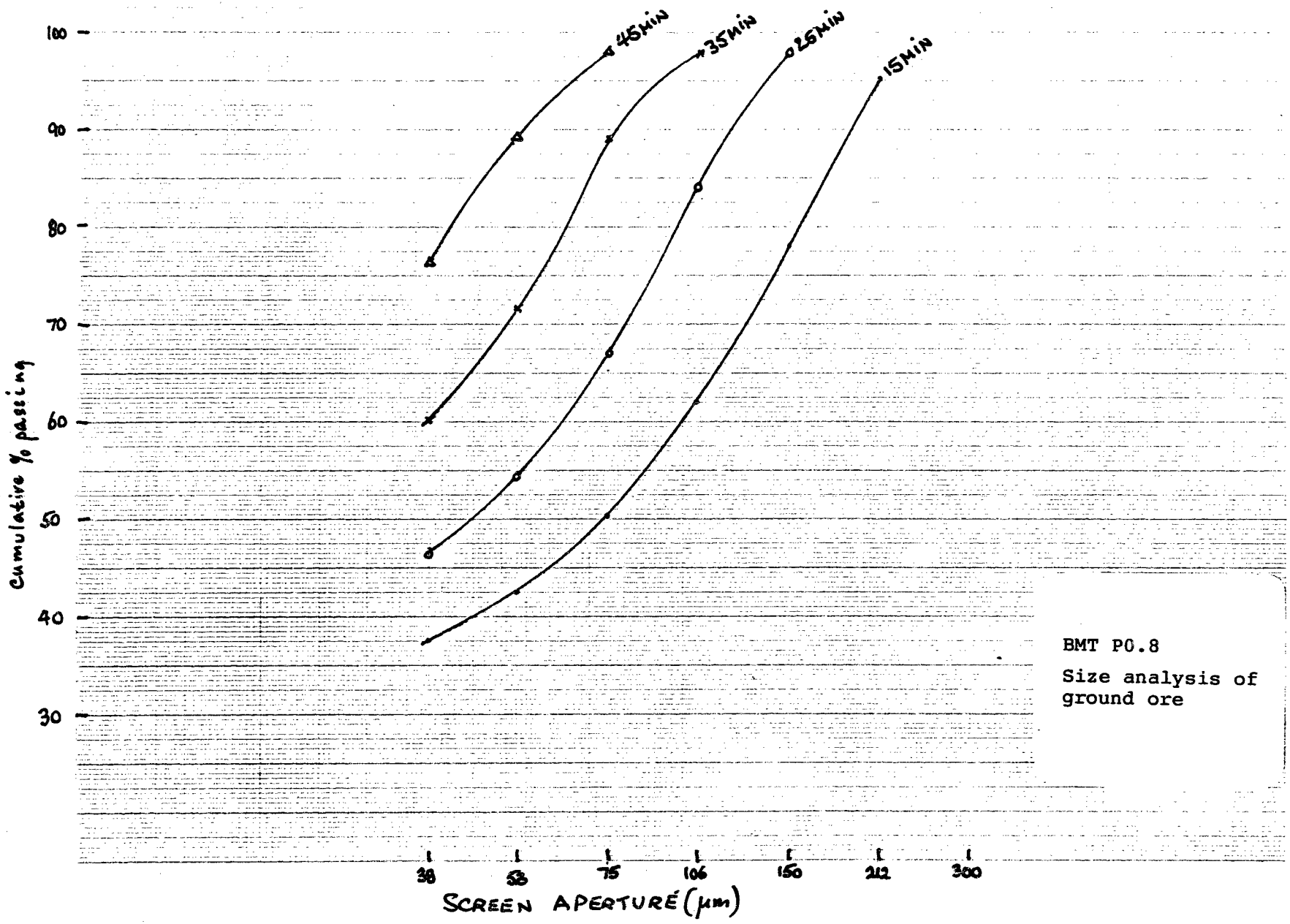
The weighted Cu extraction of the pulverised samples making up composite BMT P0.8 was 101g Cu/t and is to be compared with the 24-hour extraction from the P80=150um, 24-hour leach of 47g/t and the P80=38um, 24-hour leach of 81g/t.

Anomalous Assays
Two minus 38um residue fractions returned very high assays.

Test 7A	P80=106um	24 hour leach
Test 16D	P80=150um	24 hour leach

Repeat assays confirmed the high grade of one of these fractions. It appears that these two fractions must have been contaminated at the wet screening operation.

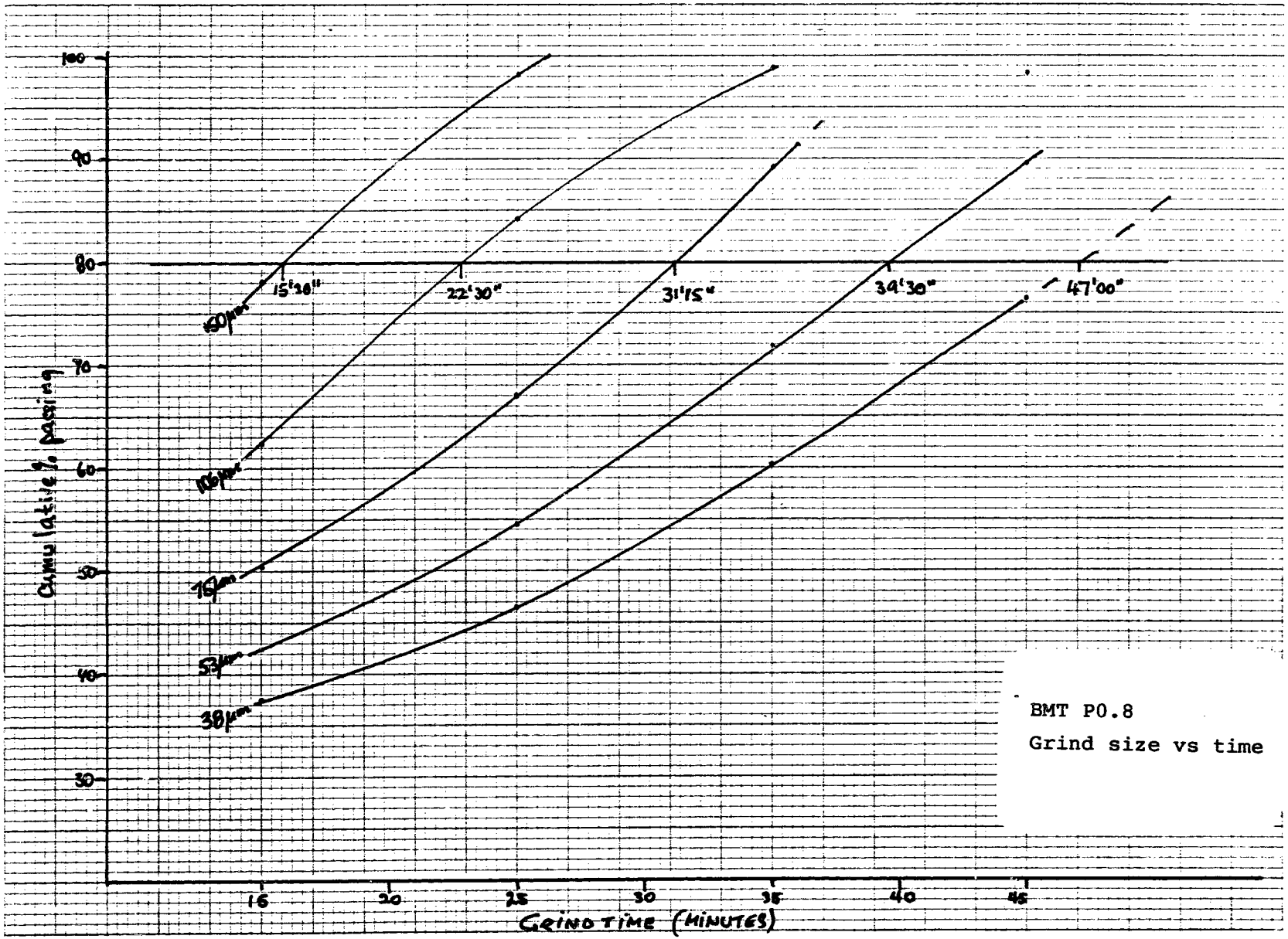
The results of these two tests have been omitted from all averages.



BMT P0.8

Size analysis of ground ore

FIGURE 1



BMT P0.8

Grind size vs time

FIGURE 2

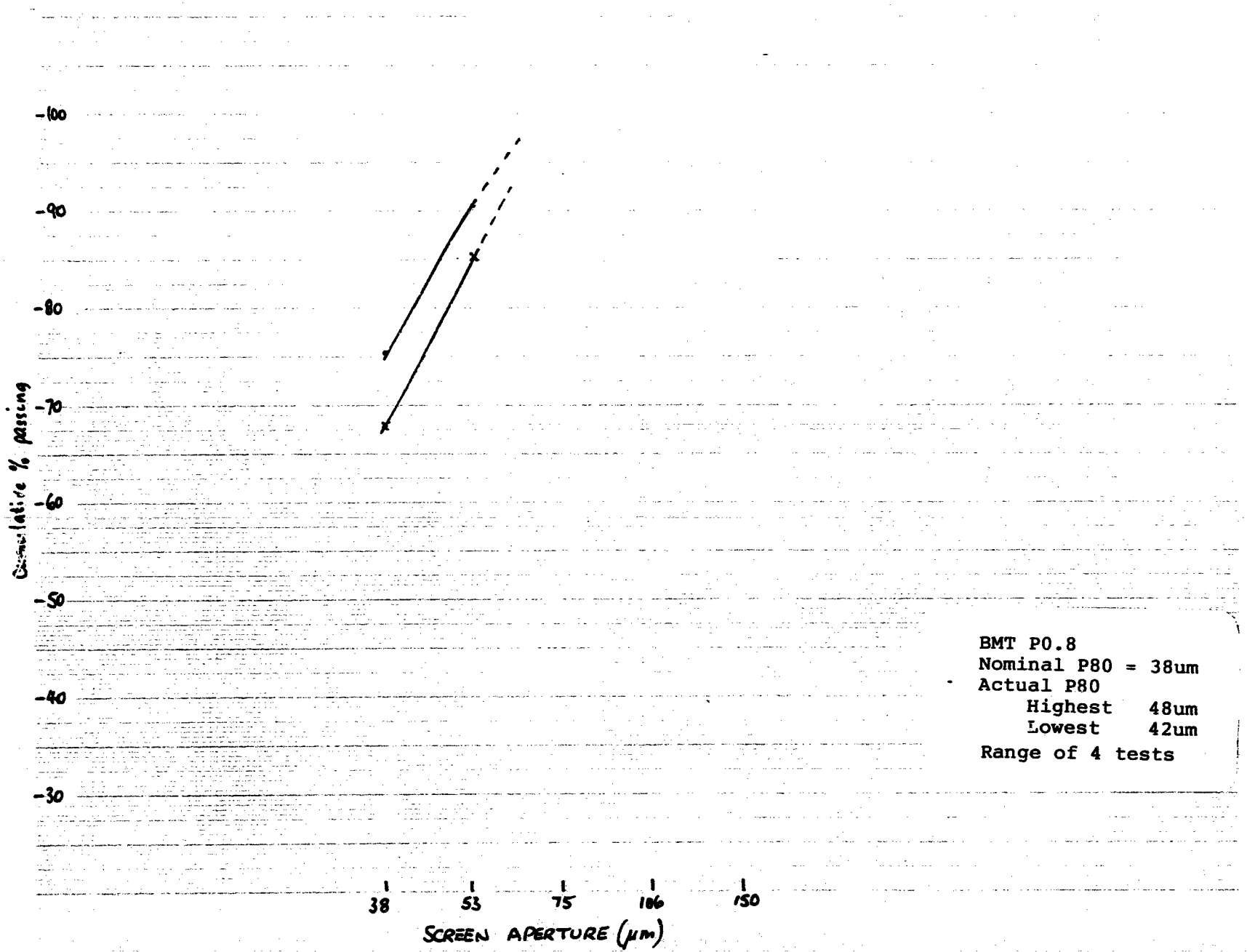

-100
-90
-80
-70
-60
-50
-40
-30
Cumulative % Passing
38
53
75
106
150
SCREEN APERTURE (μm)
BMT P0.8
Nominal P80 = 38um
Actual P80
Highest 48um
Lowest 42um
Range of 4 tests

FIGURE 3

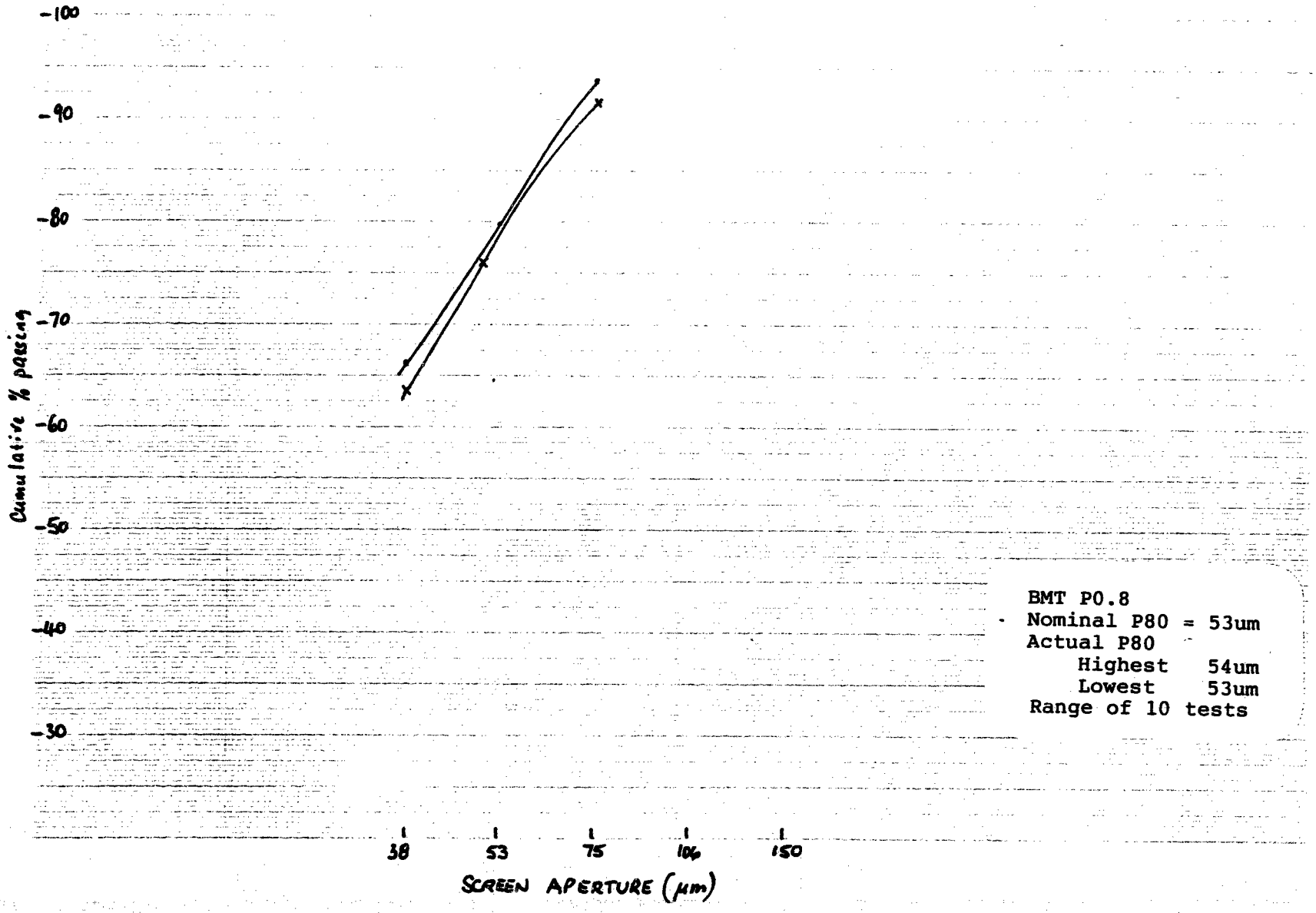
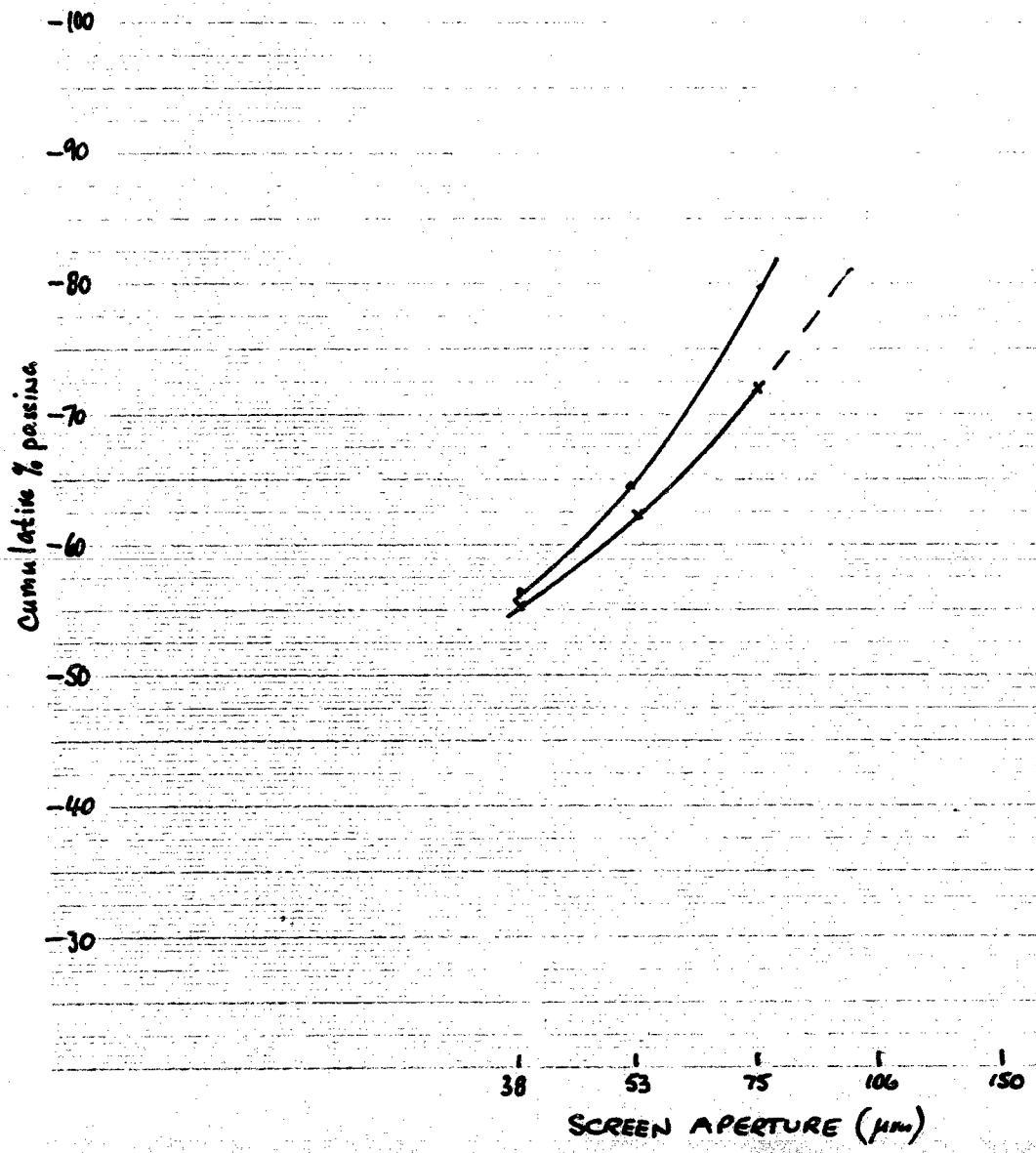

100
90
80
70
60
50
40
30
Cumulative % passing
38
53
75
106
150
SCREEN APERTURE (μm)
BMT P0.8
Nominal P80 = 53um
Actual P80
Highest 54um
Lowest 53um
Range of 10 tests

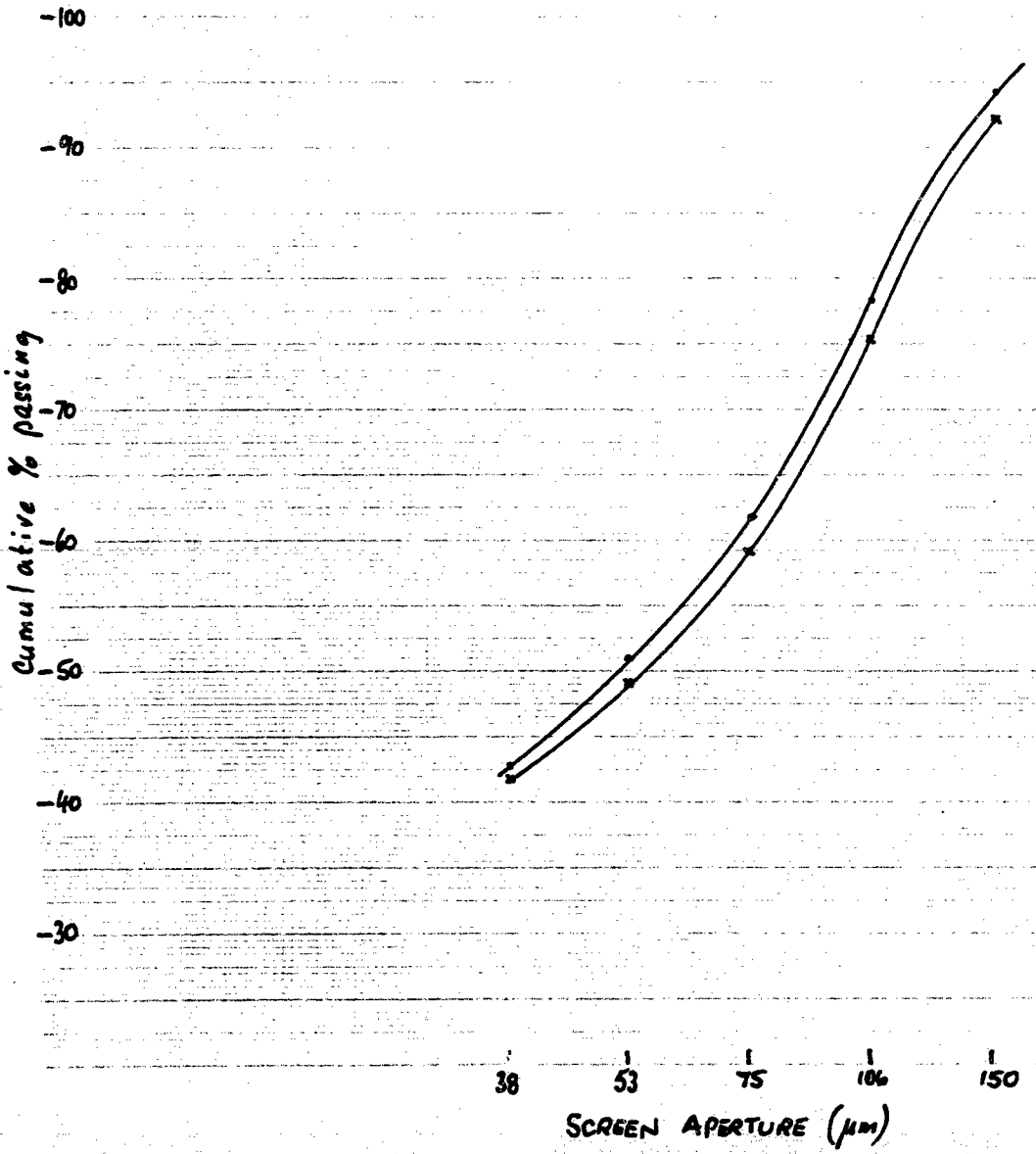
FIGURE 4



BMT P0.8

Nominal P80 = 75um
Actual P80
Highest 94um
Lowest 77um
Range of 10 tests

FIGURE 5



BMT P0.8

Nominal P80 = 106um

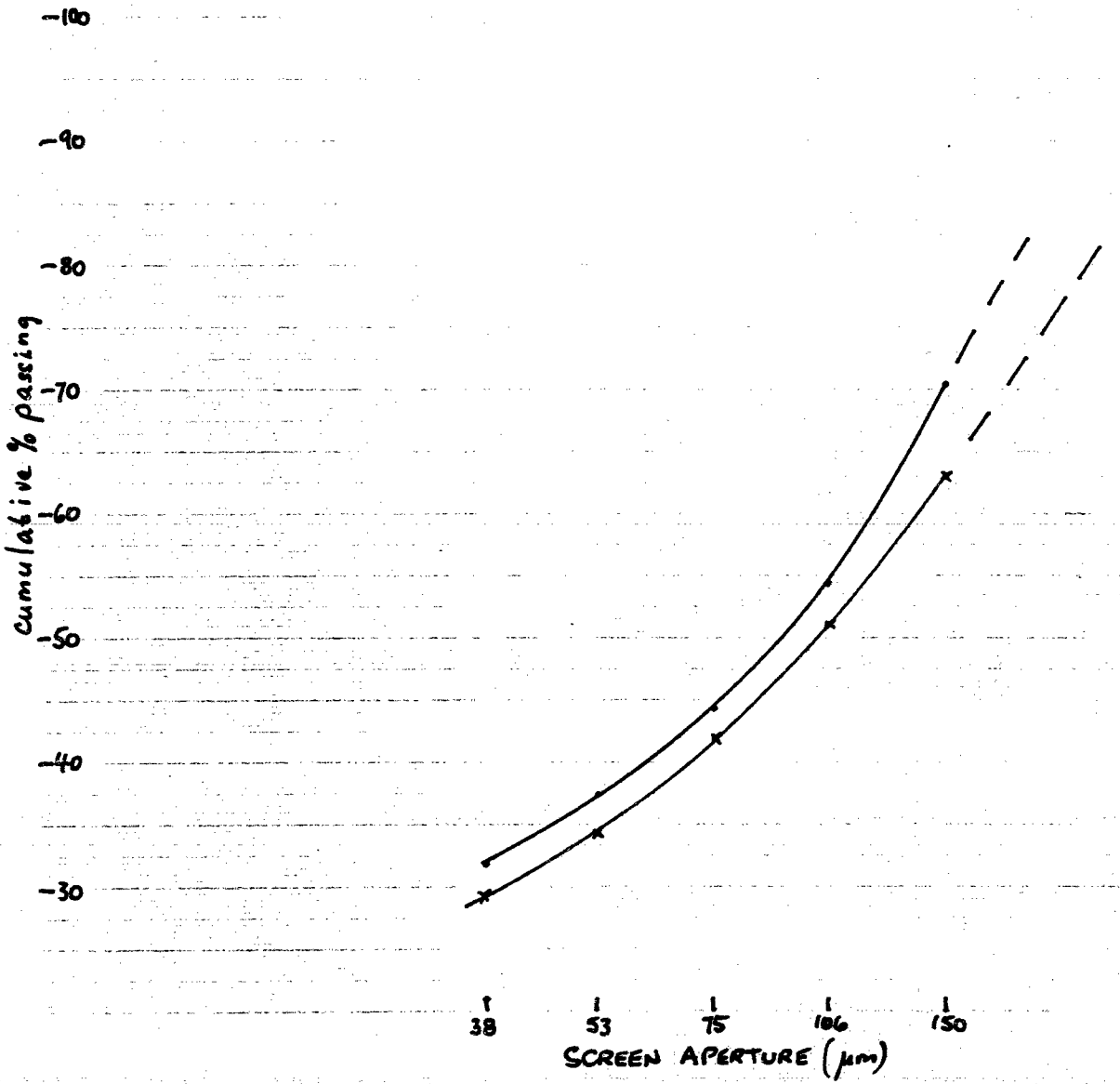
Actual P80

Highest 114um

Lowest 108um

Range of 10 tests

FIGURE 6



BMT P0.8

Nominal P80 = 150um
Actual P80
Highest 230um
Lowest 182um
Range of 10 tests

FIGURE 7

TABLE 1

BMT5736 5-Dec-89
BILLITON MT TODD
COMPARISON OF GRINDING ROD WEAR

Composite Sample	Ore Type	Mass Ground g	Grind Time hours	Feed F80 um	Product actual pass. nom. um %	Product actual P80 um	Product P80 nom. um	1/(P80)^.5 - 1/(F80)^.5 (E) (4)	Rod Charge Start g	Rod Charge Finish g	Rod Wear g	Rod Wear g/kg	Factor g/(E*kg)	Rod Wear g/hour
BMT 1	Primary	35.662	17.63	1630	101 (1)		101	0.0747	16271.0	16214.0	57.0	1.60	21	3.23
BMT 2	Primary	19.898	11.00	1630			75	0.0907	16183.5	16139.1	44.4	2.23	25	4.04
BMT 2	Primary	9.610	5.50	1630			75	0.0907	16139.1	16121.3	17.8	1.85	20	3.24
BMT 2	Primary	9.872	5.50	1630			75	0.0907	16121.3	16098.9	22.4	2.27	25	4.07
BMT 2	Primary	9.555	5.50	1630			75	0.0907	16098.9	16074.9	24.0	2.51	28	4.36
BMT 2	Primary								16074.9	16041.9	33.0			
									16021.8	15987.8	34.0			
	total	29.568	16.50	1630			75	0.0907			67.0	2.27	25	4.06
BMT 2	Primary	29.504	16.50	1630			75	0.0907	15964.8	15928.7	56.1	1.90	21	3.40
Pine Creek		10.000	5.24	1550		70	75	0.0901	15920.5	15895.1	25.4	2.54	28	4.85
Pine Creek		10.000	5.24	1550	83.8 (2)	70	75	0.0901	15895.1	15866.7	28.4	2.84	32	5.42
BMT P 0.8	Primary L	10.073	6.21	1600	75.2 (3)		75	0.0905	16041.9	16021.8	20.1	2.00	22	3.24
BMT P 0.8	Primary L	10.129	6.58	1600	78.4 (3)		53	0.1124	15866.7	15845.5	21.2	2.09	19	3.22
BMT P 0.8	Primary L	4.039	3.13	1600	(3)		38	0.1372						
		10.090	3.75	1600	76.6 (3)		106	0.0721						
	total	14.129	6.88					0.0907	15845.5	15820.5	25.0	1.77	20	3.63
BMT P 0.8	Primary L	10.126	2.58	1600	66.3 (3)		150	0.0566	15820.5	15811.3	9.2	0.91	16	3.57
BMT 0.6	Weathered	5.476	1.62	820	80.8 (3)		75	0.0805						
		5.535	0.92	820	81.3 (3)		106	0.0622						
		4.773	0.47	820	78.3 (3)		150	0.0467						
	total	15.784	3.01					0.0639	10287.2	10274.1	13.1	0.83	13	4.35
BMT 0.8	Weathered	4.113	1.25	820	82.7 (3)		75	0.0805						
		4.088	0.64	820	78.8 (3)		106	0.0622	10024.5	10020.6	3.9			
		3.516	0.35	820	81.0 (3)		150	0.0467	10020.4	10017.3	3.1			
	total	11.717	2.24					0.0640			7.0	0.60	9	3.13
BMT 1.0	Weathered	6.833	2.00	820	79.4 (3)		75	0.0805						
includes three		6.816	1.24	820	80.8 (3)		106	0.0622						
definition grinds		5.937	0.63	820	80.5 (3)		150	0.0467						
	total	19.586	3.87					0.0639	10273.6	10263.7	9.9	0.51	8	2.56
BMT 1.2	Weathered	5.580	1.75	820	79.4 (3)		75	0.0805						
		5.593	0.92	820	78.4 (3)		106	0.0622						
		4.895	0.53	820	78.6 (3)		150	0.0467						
	total	16.068	3.20					0.0639	10017.3	10006.8	10.5	0.65	10	3.28

(1) weighted nominated of 43 tests.

(2) sizing on last two kg of Pine Creek.
(3) average from test residues.
(4) calculated from the nominal P80 and F80

TABLE 2

BMT5749 5-Dec
BILLITON MT TODD LOW GRADE PRIMARY ORE BMT 0.8
COMPARISON OF ASSAY HEAD, GROUND HEAD & TEST CALCULATED HEAD.
All assays are ppm Au

Composite Split	Assay Head No.1	No.2	Ave.	Ground Head No.1	No.2	Ave.	Test Calculated Head
1 AG				0.86	0.77	0.82	0.88
2 AH	0.69	0.72	0.71				
3 A				0.80	0.86	0.83	0.81
4 A				0.76	0.76	0.76	0.84
5 AG							
6 A				0.73	0.74	0.74	0.86
7 A				0.71	0.72	0.72	1.31
8 A				0.69	0.70	0.70	0.79
9 A				0.94	0.73	0.84	0.78
10 AH	0.74	0.75	0.75				
11 A				0.74	0.84	0.79	0.85
12 A				0.80	0.80	0.80	0.86
13 A				0.83	0.95	0.89	0.94
14 A				0.75	0.76	0.76	0.81
15 A				0.75	0.78	0.77	0.81
16 A				0.69	0.76	0.73	0.85
Average	0.72	0.74	0.73	0.77	0.78	0.78	0.84 (1)

Composite Split	Assay Head No.1	No.2	Ave.	Ground Head No.1	No.2	Ave.	Test Calculated Head
1 B				0.81	0.81	0.81	0.82
2 BH	0.73	0.81	0.77				
3 B				0.74	0.71	0.73	0.81
4 B				0.79	0.77	0.78	0.84
5 B				0.76	0.77	0.77	0.83
6 BG							
7 B				0.74	0.74	0.74	0.82
8 B				0.75	0.80	0.78	0.84
9 B				0.74	0.74	0.74	0.79
10 BH	0.75	0.72	0.74				
11 B				0.75	0.70	0.73	0.81
12 B				0.78	0.74	0.76	0.83
13 B				0.69	0.76	0.73	0.83
14 B				0.78	0.75	0.77	0.88
15 B				0.77	0.79	0.78	0.87
16 B				0.77	0.76	0.77	0.84
Average	0.74	0.77	0.75	0.76	0.76	0.76	0.83

Composite Split	Assay Head No.1	No.2	Ave.	Ground Head No.1	No.2	Ave.	Test Calculated Head
1 CR							
2 CH	0.73	0.71	0.72				
3 C				0.78	0.74	0.76	0.82
4 C				0.79	0.79	0.79	0.86
5 CG							
6 C				0.70	0.68	0.69	0.81
7 C				0.86	0.76	0.81	0.85
8 C				0.78	0.73	0.76	0.88
9 C				0.70	0.71	0.71	0.77
10 CH	0.71	0.75	0.73				
11 C				0.79	0.80	0.80	0.85
12 CR							
13 C				0.80	0.75	0.78	0.84
14 C				0.78	0.76	0.77	0.83
15 CR							
16 CR							
Average	0.72	0.73	0.73	0.78	0.75	0.76	0.83

Composite Split	Assay Head No.1	No.2	Ave.	Ground Head No.1	No.2	Ave.	Test Calculated Head
1 D				0.76	0.74	0.75	0.83
2 DH	0.75	0.81	0.78				
3 D				0.72	0.76	0.74	0.79
4 D				0.70	0.74	0.72	0.78
5 D				0.79	0.75	0.77	0.83
6 D				0.76	0.76	0.76	0.79
7 DR							
8 DR							
9 D				1.02	0.73	0.88	0.83
10 DH	0.76	0.78	0.77				
11 DH							
12 D				0.77	0.80	0.79	0.84
13 DR							
14 D				0.77	0.76	0.77	0.86
15 DR							
16 D				0.76	0.74	0.75	1.12
Average	0.76	0.80	0.78	0.78	0.75	0.77	0.82 (1)

Average 'Split' Head Assay 0.74
Average Ground Head Assay 0.77
Average Calculated Head Assay 0.83

For each level of grind

P80	Assay Head No.1	No.2	Ave.	Ground Head No.1	No.2	Ave.	Test Calculated Head
150				0.77	0.77	0.77	0.83
106				0.74	0.74	0.74	0.81
75				0.79	0.77	0.78	0.84
53				0.81	0.78	0.80	0.84
38				0.71	0.74	0.72	0.83
				0.77	0.76	0.77	0.83

G = used for grind studies.
H = split taken for pulverising and duplicate Au assay.
R = reserve split.
M = test using mild steel rods.
Note: 7 Reserves remaining at 5 November, 1989.

(1) high test calculated heads omitted from average.

BMT5734 Sheet Calc

Calculation sheet only

Nominated Grind P80 = 106um

COMPOSITE BMT P 0.8

Sample mass	g	861.1	838.1	844.9	852.4	843.4	859.8	847.6	897.1	843.7	831.8
Vessel + sample	g	1268.0	1245.8	1252.7	1258.2	1251.1	1266.3	1256.1	1304.7	1251.9	1239.8
In vessel at A (3 hours)	g	1289.3	1257.0	1266.4	1278.0	1264.2	1288.7	1269.8	1345.0	1265.5	1246.3
	ug Au	515.72	465.09	455.90	485.64	505.68	489.71	469.83	470.75	518.86	473.59
	mg Cu	25.79	27.65	26.59	26.84	27.81	27.06	26.67	25.55	24.04	26.17
	ug Zn	1418.2	1382.7	1393.0	1533.6	1390.6	1804.2	1396.8	1345.0	1392.1	1246.3
	g NaCN	0.9412	0.9428	0.9118	0.9202	0.9355	0.9408	0.9270	0.9819	0.9365	0.9098
	g CaO	0.0903	0.0880	0.0886	0.0895	0.1011	0.0902	0.0889	0.0942	0.0886	0.0997
Removed in A (3 hours)	g	51.4	51.4	51.8	52.0	51.2	49.4	51.4	51.0	51.3	51.7
	ug Au	20.56	19.02	18.65	19.76	20.48	18.77	19.02	17.85	21.03	19.65
	mg Cu	1.03	1.13	1.09	1.09	1.13	1.04	1.08	0.97	0.97	1.09
	ug Zn	56.5	56.5	57.0	62.4	56.3	69.2	56.5	51.0	56.4	51.7
	g NaCN	0.0375	0.0386	0.0373	0.0374	0.0379	0.0361	0.0375	0.0372	0.0380	0.0377
	g CaO	0.0036	0.0036	0.0036	0.0036	0.0041	0.0035	0.0036	0.0036	0.0036	0.0041
In vessel at B (6 hours)	g	1288.7	1255.9	1265.2	1276.9	1263.0	1287.6	1268.9	1343.8	1264.2	1244.7
	ug Au	541.25	464.68	468.12	472.45	505.20	515.04	469.49	483.77	493.04	472.99
	mg Cu	29.64	31.40	30.36	30.65	31.58	32.19	30.45	29.56	29.08	29.87
	ug Zn	1675.3	1632.7	1771.3	1915.4	1768.2	2188.9	1649.6	1746.9	1643.5	1618.1
	g NaCN	0.8634	0.8540	0.8477	0.8683	0.8588	0.8884	0.8629	0.9003	0.8597	0.7842
	g CaO	0.0644	0.0754	0.0759	0.0894	0.0884	0.1030	0.0761	0.0941	0.0759	0.0871
Removed in B (6 hours)	g	51.9	51.4	51.3	51.2	51.2	51.0	51.2	51.1	50.9	50.8
	ug Au	21.80	19.02	18.98	18.94	20.48	20.40	18.94	18.40	19.85	19.30
	mg Cu	1.19	1.28	1.23	1.23	1.28	1.28	1.23	1.12	1.17	1.22
	ug Zn	67.5	66.8	71.8	76.8	71.7	86.7	66.6	66.4	66.2	66.0
	g NaCN	0.0348	0.0350	0.0344	0.0348	0.0348	0.0352	0.0348	0.0342	0.0346	0.0320
	g CaO	0.0026	0.0031	0.0031	0.0036	0.0036	0.0041	0.0031	0.0036	0.0031	0.0036
In vessel at C (12 hours)	g	1287.4	1254.1	1263.7	1275.7	1260.3	1285.5	1267.8	1342.4	1263.0	1242.6
	ug Au	540.71	464.02	467.57	459.25	491.52	501.35	456.41	483.26	479.94	484.61
	mg Cu	38.62	37.62	37.91	38.27	39.07	38.57	38.03	36.24	35.36	37.28
	ug Zn	1931.1	2006.6	2148.3	2423.8	2520.6	2699.6	2155.3	2147.8	2147.1	1988.2
	g NaCN	0.8111	0.7775	0.7835	0.7782	0.7814	0.7970	0.7860	0.8189	0.7704	0.7331
	g CaO	0.0515	0.0627	0.0632	0.0638	0.0630	0.0771	0.0634	0.0671	0.0632	0.0746
Removed in C (12 hours)	g	59.5	57.2	58.6	60.4	60.9	60.8	57.2	56.6	57.8	57.8
	ug Au	24.99	21.16	21.68	21.74	23.75	23.71	20.59	20.38	21.96	22.54
	mg Cu	1.79	1.72	1.76	1.81	1.89	1.82	1.72	1.53	1.62	1.73
	ug Zn	89.3	91.5	99.6	114.8	121.8	127.7	97.2	90.6	98.3	92.5
	g NaCN	0.0375	0.0355	0.0363	0.0368	0.0378	0.0377	0.0355	0.0345	0.0353	0.0341
	g CaO	0.0024	0.0029	0.0029	0.0030	0.0030	0.0036	0.0029	0.0028	0.0029	0.0035
In vessel at D (18 hours)	g	1286.3	1252.7	1262.9	1275.4	1259.6	1284.6	1269.4	1341.7	1262.0	1241.6
	ug Au	514.52	450.97	442.01	446.39	478.65	500.99	456.98	469.60	454.32	471.81
	mg Cu	41.16	41.34	40.41	40.81	42.83	42.39	40.62	40.25	39.12	39.73
	ug Zn	2186.7	2505.4	2778.4	2550.8	2393.2	2954.6	2284.9	2280.9	2397.8	2110.7
	g NaCN	0.7203	0.7015	0.7072	0.7142	0.6928	0.7065	0.6982	0.7379	0.6815	0.6208
	g CaO	0.0515	0.0591	0.0631	0.0638	0.0504	0.0642	0.0635	0.0537	0.0631	0.0497
Removed in D (18 hours)	g				56.9	57.9	57.5	57.6	57.8	59.2	57.4
	ug Au				19.92	22.00	22.43	20.74	20.23	21.31	21.81
	mg Cu				1.82	1.97	1.90	1.84	1.73	1.84	1.84
	ug Zn				113.8	110.0	132.3	103.7	98.3	112.5	97.6
	g NaCN				0.0319	0.0318	0.0316	0.0317	0.0318	0.0320	0.0287
	g CaO				0.0028	0.0023	0.0029	0.0029	0.0023	0.0030	0.0023
In vessel at E (24 hours)	g				1274.7	1258.6	1283.8	1268.7	1340.1	1260.8	1240.3
	ug Au				433.40	453.10	475.01	431.36	469.04	441.28	458.91
	mg Cu				44.61	45.31	43.65	43.14	41.54	41.61	40.93
	ug Zn				2804.3	2517.2	3209.5	2664.3	2546.2	2395.5	2232.5
	g NaCN				0.6628	0.6419	0.6676	0.6597	0.6969	0.6556	0.5829
	g CaO				0.0382	0.0378	0.0385	0.0254	0.0402	0.0252	0.0372
Removed in E (24 hours)	g								49.3	51.3	55.5
	ug Au								17.26	17.95	20.54
	mg Cu								1.53	1.69	1.83
	ug Zn								93.7	97.5	99.9
	g NaCN								0.0256	0.0267	0.0261
	g CaO								0.0015	0.0010	0.0017
In vessel at F (32 hours)	g								1339.6	1260.1	1239.6
	ug Au								442.07	441.04	421.46
	mg Cu								44.21	42.84	43.39
	ug Zn								2679.2	2646.2	2603.2
	g NaCN								0.6162	0.5796	0.5206
	g CaO								0.0268	0.0252	0.0248
Residue	ug Au	158.6	149.0	156.2	599.6	145.4	160.0	161.4	172.4	160.4	167.7
Calculated Head	ug Au	740.48	659.22	657.53	1113.33	685.25	720.34	672.02	708.62	703.55	695.00
Sample leached	g	861.1	838.1	844.9	852.4	843.4	859.8	847.6	897.1	843.7	831.8

TABLE 4

BMT5738 26-Nov-89
BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.
COMPOSITE P 0.8
SUMMARY OF ALL TESTS

	Natural pH of ground pulp Units													Total or Average
Grind P80	um	53	53	53	53	75	75	75	106	106	106	150	150	150	
Actual grind passing nominated um (%)		77.7	77.8	78.8	78.3	75.7	74.4	75.7	77.5	76.0	76.2	68.0	66.1	64.5	
Number of tests conducted		4	3	4	3	3	4	3	3	4	3	3	4	3	44
Number of tests excluded from averages		0								1			1		2
Leach times	hours	24	18	24	32	18	24	32	18	24	32	18	24	32	
Terminal liquor	pH	11.0	11.3	11.1	11.3	11.2	11.1	11.0	11.2	11.1	10.9	11.0	10.9	10.6	
	% NaCN	0.048	0.057	0.050	0.047	0.055	0.053	0.047	0.056	0.052	0.045	0.056	0.050	0.047	
	% CaO	0.005	0.004	0.005	0.005	0.004	0.004	0.003	0.004	0.003	0.002	0.004	0.004	0.003	
Consumptions	NaCN kg/t	0.34	0.22	0.29	0.30	0.26	0.25	0.31	0.24	0.26	0.34	0.24	0.29	0.32	
	CaO kg/t	0.91	0.93	0.92	1.21 (1)	0.91	0.93	0.92	0.88	0.90	0.89	0.97	0.94	0.97	
Averages															
Assay Head (8 splits)	ppm Au	0.74													0.74
Ground Head		0.72	0.84	0.78	0.78	0.80	0.77	0.78	0.73	0.75	0.74	0.78	0.76	0.78	0.77
Calculated Head		0.83	0.87	0.83	0.83	0.84	0.83	0.84	0.81	0.81	0.82	0.86	0.80	0.84	0.83
Liquor extraction (Au)															
at 3 hours	Au g/t	0.64	0.68	0.62	0.63	0.61	0.59	0.60	0.56	0.57	0.57	0.49	0.47	0.46	
at 6 hours	Au g/t	0.67	0.72	0.66	0.65	0.61	0.62	0.63	0.60	0.61	0.59	0.53	0.51	0.53	
at 12 hours	Au g/t	0.68	0.73	0.69	0.69	0.63	0.64	0.65	0.62	0.61	0.61	0.57	0.54	0.55	
at 18 hours	Au g/t	0.69	0.72	0.70	0.70	0.64	0.64	0.65	0.63	0.64	0.61	0.57	0.54	0.56	
at 24 hours	Au g/t	0.68		0.69	0.70		0.65	0.65		0.63	0.63		0.55	0.56	
at 32 hours	Au g/t				0.70			0.66			0.62			0.58	
Of Calculated Head															
at 3 hours	Au %	77.6	78.1	74.8	75.7	72.5	71.4	71.5	69.8	70.6	69.5	56.9	58.5	54.7	
at 6 hours	Au %	80.3	82.9	79.5	78.1	72.9	74.6	74.8	74.4	74.5	71.6	61.6	63.3	62.2	
at 12 hours	Au %	81.6	84.3	82.5	83.3	75.1	76.6	76.4	77.2	75.4	74.3	66.4	67.1	65.1	
at 18 hours	Au %	83.1	83.9	83.6	84.4	75.8	76.4	76.4	77.4	78.1	74.9	66.3	67.2	66.0	
at 24 hours	Au %	82.4		82.4	84.8		77.7	77.0		77.5	76.7		67.9	66.4	
at 32 hours	Au %				84.1			77.8			76.2			68.2	
Total residue	ppm Au	0.15	0.15	0.15	0.13	0.21	0.19	0.19	0.18	0.18	0.20	0.29	0.26	0.27	
Residue fraction grade															
+ 150um	ppm Au								0.20	0.19	0.25	0.32	0.31	0.33	
+ 106um	ppm Au								0.25	0.25	0.26	0.38	0.38	0.37	
+ 75um	ppm Au		0.22	0.22	0.21	0.26	0.23	0.24	0.26	0.26	0.26	0.34	0.33	0.33	
+ 53um	ppm Au	0.23	0.21	0.21	0.20	0.26	0.24	0.25	0.25	0.24	0.26	0.30	0.28	0.28	
+ 38um	ppm Au	0.20	0.17	0.18	0.17	0.23	0.22	0.22	0.22	0.21	0.22	0.24	0.28	0.23	
- 38um	ppm Au	0.12	0.12	0.12	0.10	0.17	0.15	0.15	0.11	0.11	0.12	0.22	0.12	0.15	
Residue fraction dist'n															
+ 150um	Au %								6.9	7.9	8.9	35.1	41.1	42.9	
+ 106um	Au %								21.4	22.7	22.1	18.4	19.3	17.1	
+ 75um	Au %		11.2	9.9	10.8	30.4	31.5	30.7	23.0	23.0	21.9	11.6	11.9	11.6	
+ 53um	Au %	18.0	20.6	20.0	22.3	15.9	14.9	18.1	14.1	13.4	13.9	7.3	7.6	7.3	
+ 38um	Au %	22.3	15.3	16.5	17.8	8.9	8.4	9.3	9.1	8.9	8.4	4.3	5.6	4.7	
- 38um	Au %	59.7	53.0	53.7	49.0	44.8	45.2	41.9	25.5	24.2	24.9	23.3	14.6	16.3	
Liquor extraction (Cu)															
at 3 hours	Cu g/t	40	32	31	33	31	31	33	31	32	29	29	28	26	
at 6 hours	Cu g/t	51	38	37	40	36	38	39	37	38	36	33	33	31	
at 12 hours	Cu g/t	65	47	46	51	47	48	48	48	48	45	40	40	37	
at 18 hours	Cu g/t	75	53	52	58	53	55	55	53	54	51	46	45	42	
at 24 hours	Cu g/t	80		56	65		60	60		59	55		49	45	
at 32 hours	Cu g/t				70			63			59			51	
Liquor extraction (Zn)															
at 3 hours	Zn g/t	2.8	1.8	1.8	1.8	1.9	1.8	1.8	1.6	1.8	1.5	2.1	1.5	1.6	
at 6 hours	Zn g/t	2.3	2.2	2.2	2.3	2.4	2.2	2.1	2.1	2.3	2.0	3.0	2.0	2.0	
at 12 hours	Zn g/t	3.9	2.6	2.6	2.7	4.8	2.7	2.6	2.5	3.0	2.6	2.5	2.5	2.4	
at 18 hours	Zn g/t	4.1	3.7	2.9	3.0	3.9	3.1	3.0	3.2	3.3	2.9	4.2	2.9	2.6	
at 24 hours	Zn g/t	4.7		3.2	3.2		3.7	3.2		3.7	3.2		5.0	3.2	
at 32 hours	Zn g/t				3.6			3.9			3.6			5.5	

(1) one test had double CaO addition in error.

TABLE 5

BMT5750 5-Dec
BILLITON MT FOOD LOW GRADE PRIMARY ORE BMT PO.8
COMPARISON OF LIQUOR EXTRACTIONS.
All extractions are expressed as g Au/t.

		Grind P80 150						Grind P80 106						Grind P80 75						Grind P80 53						Grind P80 38					
Leach Time		3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32
Split	1 A	0.51	0.56	0.5o	0.61																										
	2 A																														
	3 A	0.48	0.51	0.55	0.56	0.55																									
	4 A	0.49	0.53	0.55	0.56	0.56	0.58																								
	5 A																														
	6 A							0.60	0.65	0.68	0.68																				
	7 A							0.57	0.58	0.58	0.59	0.60																			
	8 A							0.52	0.56	0.58	0.59	0.61	0.60																		
	9 A													0.60	0.58	0.60	0.61														
	10 A																														
	11 A													0.61	0.65	0.66	0.66	0.67													
	12 A													0.61	0.65	0.66	0.66	0.68	0.69												
	13 A																			0.75	0.76	0.79	0.80								
	14 A																			0.60	0.65	0.66	0.68	0.66							
	15 A																			0.61	0.64	0.68	0.69	0.67	0.68						
	16 A																									0.66	0.69	0.70	0.70	0.73	
	1 B																			0.65	0.67	0.70	0.68								
	2 B																														
	3 B																			0.63	0.65	0.68	0.68	0.67							
	4 B																			0.61	0.64	0.69	0.71	0.70	0.71						
	5 B	0.48	0.50	0.58	0.55																										
	6 B																														
	7 B	0.48	0.53	0.55	0.56	0.56																									
	8 B	0.42	0.53	0.55	0.54	0.56	0.56																								
	9 B							0.55	0.58	0.60	0.61																				
	10 B																														
	11 B							0.60	0.62	0.63	0.64	0.64																			
	12 B							0.61	0.61	0.62	0.61	0.62	0.64																		
	13 B																									0.63	0.67	0.67	0.69	0.67	
	14 B													0.61	0.64	0.65	0.66														
	15 B													0.61	0.64	0.65	0.66	0.67													
	16 B													0.60	0.62	0.64	0.64	0.64	0.64												
	1 C																														
	2 C																														
	3 C													0.57	0.61	0.63	0.62	0.63													
	4 C													0.61	0.62	0.64	0.64														
	5 C																														
	6 C																									0.63	0.64	0.66	0.68	0.66	
	7 C																			0.64	0.73	0.71	0.69								
	8 C																			0.64	0.70	0.71	0.74	0.72							
	9 C	0.45	0.48	0.52	0.51	0.52																									
	10 C																														
	11 C	0.47	0.52	0.55	0.58	0.56	0.58																								
	12 C																														
	13 C							0.57	0.62	0.63	0.66	0.65																			
	14 C							0.57	0.59	0.63	0.64	0.65	0.63																		
	15 C																														
	16 C																														
	1 D																									0.66	0.67	0.68	0.69	0.68	
	2 D																														
	3 D							0.55	0.58	0.58	0.61	0.60																			
	4 D							0.54	0.58	0.60	0.59																				
	5 D													0.60	0.62	0.63	0.64	0.63	0.64												
	6 D													0.58	0.59	0.61	0.61	0.62													
	7 D																														
	8 D																														
	9 D																			0.61	0.64	0.69	0.69	0.69							
	10 D																														
	11 D																														
	12 D																			0.66	0.67	0.71	0.71	0.74	0.70						
	13 D																														
	14 D	0.48	0.53	0.55	0.56																										
	15 D																														
	16 D	0.48	0.54	0.57	0.56	0.55																									
Average		0.47	0.52	0.56	0.56	0.55	0.57	0.57	0.60	0.61	0.62	0.62	0.62	0.60	0.62	0.64	0.64	0.65	0.66	0.64	0.68	0.70	0.71	0.69	0.70	0.65	0.67	0.68	0.69	0.69	
Maximum		0.51	0.56	0.58	0.61	0.56	0.58	0.61	0.65	0.68	0.68	0.65	0.64	0.61	0.65	0.66	0.66	0.68	0.69	0.75	0.76	0.79	0.80	0.74	0.71	0.66	0.69	0.70	0.70	0.73	
Minimum		0.42	0.48	0.52	0.51	0.52	0.56	0.52	0.56	0.58	0.59	0.60	0.60	0.57	0.58	0.60	0.61	0.62	0.64	0.60	0.64	0.66	0.68	0.66	0.68	0.63	0.64	0.66	0.68	0.66	

Averages																															
3 Hour	0.47							0.57						0.60						0.64						0.65					
6 Hour		0.52							0.60						0.62						0.68						0.67				
12 Hour			0.56							0.61						0.64						0.70						0.68			
18 Hour				0.56							0.62						0.64						0.71						0.69		
24 Hour					0.55							0.62						0.65						0.69						0.69	
32 hour						0.57							0.62						0.66						0.70						

TABLE 6

BMT5751 5-Dec
BILLITON MT TODD LOW GRADE PRIMARY ORE BMT P0.8
COMPARISON OF COPPER EXTRACTIONS.
All extractions are expressed as g Cu/t.

		Grind P80 150						Grind P80 106						Grind P80 75						Grind P80 53						Grind P80 38					
Leach Time		3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32
Split	1 A	28	33	40	46																										
	2 A																														
	3 A	28	34	41	46	50																									
	4 A	24	29	35	39	43	48																								
	5 A																														
	6 A							30	36	47	52																				
	7 A							31	37	48	53	59																			
	8 A							28	34	43	49	52	57																		
	9 A													31	37	46	53														
	10 A																														
	11 A													31	37	47	54	61													
	12 A													34	40	49	56	61	64												
	13 A																			31	37	46	53								
	14 A																			31	37	46	51	55							
	15 A																			33	39	48	54	59	64						
	16 A																									39	50	63	75	80	
	1 B																			32	39	48	53								
	2 B																														
	3 B																			30	36	44	51	56							
	4 B																			33	40	54	64	71	79						
	5 B	30	34	42	46																										
	6 B																														
	7 B	28	34	41	46	51																									
	8 B	28	33	38	44	48	54																								
	9 B							33	39	48	54																				
	10 B																														
	11 B							33	39	49	56	61																			
	12 B							28	36	44	51	56	59																		
	13 B																									40	51	67	75	81	
	14 B													31	36	46	51														
	15 B													30	39	49	56	60													
	16 B													31	37	46	54	57	61												
	1 C																														
	2 C																														
	3 C													31	37	48	54	57													
	4 C													30	36	47	55														
	5 C																														
	6 C																									40	51	67	75	80	
	7 C																			31	39	48	52								
	8 C																			31	37	46	52	56							
	9 C	27	31	38	43	47																									
	10 C																														
	11 C	26	32	37	43	46	52																								
	12 C																														
	13 C							31	39	48	54	58																			
	14 C							31	37	48	53	56	61																		
	15 C																														
	16 C																														
	1 D																									40	51	65	74	81	
	2 D																														
	3 D							31	37	48	53	58																			
	4 D							31	37	48	53																				
	5 D													33	39	49	56	61	64												
	6 D													33	40	49	56	61													
	7 D																														
	8 D																														
	9 D																			33	39	48	54	59							
	10 D																														
	11 D																														
	12 D																			34	42	51	57	66	68						
	13 D																														
	14 D	28	33	40	45																										
	15 D																														
	16 D	27	31	38	43	46																									
Average		27	32	39	44	47	51	31	37	47	53	57	59	32	38	48	55	60	63	32	39	48	54	60	70	40	51	66	75	81	
Maximum		30	34	42	46	51	54	33	39	49	56	61	61	34	40	49	56	61	64	34	42	54	64	71	79	40	51	67	75	81	
Minimum		24	29	35	39	43	48	28	34	43	49	52	57	30	36	46	51	57	61	30	36	44	51	55	64	39	50	63	74	80	
Averages																															
3 Hour		27						31						32						32						40					
6 Hour			32						37						38						39						51				
12 Hour				39						47						48						48						66			
18 Hour					44						53						55						54						75		
24 Hour						47						57						60						60						81	
32 hour							51						59						63						70						

TABLE 7

BMT5752 5-Dec
BILLITON MT TODD LOW GRADE PRIMARY ORE BMT P0.8
COMPARISON OF CYANIDE CONSUMPTIONS
All consumptions are expressed as kg NaCN/t
(NaCN determined using silver nitrate with KI indicator.

		Grind P80 150						Grind P80 106						Grind P80 75						Grind P80 53						Grind P80 38					
Leach Time		3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32	3	6	12	18	24	32
Split	1 A	0.09	0.14	0.20	0.22																										
	2 A																														
	3 A	0.12	0.17	0.22	0.25	0.30																									
	4 A	0.12	0.17	0.22	0.21	0.25	0.30																								
	5 A																														
	6 A							0.11	0.16	0.18	0.24																				
	7 A							0.12	0.13	0.20	0.23	0.25																			
	8 A							0.10	0.15	0.20	0.25	0.26	0.32																		
	9 A													0.09	0.09	0.19	0.24														
	10 A																														
	11 A													0.08	0.17	0.19	0.26	0.27													
	12 A													0.18	0.22	0.21	0.28	0.26	0.32												
	13 A																			0.10	0.13	0.20	0.21								
	14 A																			0.19	0.25	0.29	0.34	0.35							
	15 A																			0.09	0.10	0.20	0.21	0.27	0.29						
	16 A																									0.14	0.18	0.23	0.31	0.32	
	1 B																			0.09	0.12	0.19	0.22								
	2 B																														
	3 B																			0.11	0.09	0.19	0.22	0.29							
	4 B																			0.09	0.13	0.22	0.27	0.29	0.34						
	5 B	0.11	0.14	0.21	0.25																										
	6 B																														
	7 B	0.12	0.15	0.20	0.24	0.27																									
	8 B	0.12	0.17	0.22	0.26	0.27	0.31																								
	9 B							0.08	0.14	0.19	0.24																				
	10 B																														
	11 B							0.09	0.13	0.18	0.25	0.27																			
	12 B							0.09	0.13	0.20	0.26	0.25	0.31																		
	13 B																									0.14	0.18	0.23	0.32	0.34	
	14 B													0.11	0.19	0.24	0.28														
	15 B													0.08	0.14	0.20	0.22	0.22													
	16 B													0.08	0.15	0.19	0.22	0.25	0.29												
	1 C																														
	2 C																														
	3 C													0.11	0.19	0.19	0.24	0.25													
	4 C													0.13	0.21	0.24	0.26														
	5 C																														
	6 C																									0.13	0.19	0.24	0.30	0.31	
	7 C																			0.10	0.11	0.18	0.23								
	8 C																			0.11	0.10	0.18	0.23	0.27							
	9 C	0.11	0.10	0.23	0.29	0.30																									
	10 C																														
	11 C	0.14	0.18	0.23	0.24	0.27	0.35																								
	12 C																														
	13 C							0.10	0.12	0.19	0.25	0.26																			
	14 C							0.10	0.20	0.22	0.32	0.33	0.37																		
	15 C																														
	16 C																														
	1 D																									0.15	0.19	0.24	0.32	0.36	
	2 D																														
	3 D							0.11	0.14	0.19	0.25	0.26																			
	4 D							0.12	0.15	0.18	0.23																				
	5 D													0.13	0.21	0.20	0.24	0.23	0.31												
	6 D													0.12	0.27	0.23	0.26	0.26													
	7 D																														
	8 D																														
	9 D																			0.09	0.08	0.18	0.22	0.27							
	10 D																														
	11 D																														
	12 D																			0.09	0.12	0.25	0.27	0.25	0.28						
	13 D																														
	14 D	0.12	0.14	0.22	0.25																										
	15 D																														
	16 D	0.12	0.16	0.22	0.23	0.29																									
Average		0.12	0.15	0.22	0.24	0.28	0.32	0.10	0.15	0.19	0.25	0.27	0.33	0.11	0.18	0.21	0.25	0.25	0.31	0.11	0.12	0.21	0.24	0.28	0.30	0.14	0.19	0.24	0.31	0.33	
Maximum		0.14	0.18	0.23	0.29	0.30	0.35	0.12	0.20	0.22	0.32	0.33	0.37	0.18	0.27	0.24	0.28	0.27	0.32	0.19	0.25	0.29	0.34	0.35	0.34	0.15	0.19	0.24	0.32	0.36	
Minimum		0.09	0.10	0.20	0.21	0.25	0.30	0.08	0.12	0.18	0.23	0.25	0.31	0.08	0.09	0.19	0.22	0.22	0.29	0.09	0.08	0.18	0.21	0.25	0.28	0.13	0.18	0.23	0.30	0.31	
Averages																															
3 Hour		0.12						0.10						0.11						0.11						0.14					
6 Hour			0.15						0.15						0.18						0.12						0.19				
12 Hour				0.22						0.19						0.21						0.21						0.24			
18 Hour					0.24						0.25						0.25						0.24						0.31		
24 Hour						0.28						0.27						0.25						0.28						0.33	
32 hour							0.32						0.33						0.31						0.30						

BMT5724 11-Nov-89

BILLITON MT TODD PRIMARY LOW GRADE (BMT P0.8) BOTTLE ROLL CYANIDE LEACH OF PULVERISED HOLE COMPOSITES.

(1) Weighted average of holes making composite BMT P0.8

Hole Composite	Units	BD057	BD069	BD001	BD076	BD035	BD009	BD027	BD065		
Vessel	g	123.0	131.5	132.3	135.1	123.6	124.2	131.2	135.9		
Dry pulverised sample	g	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0		
Distilled water added	g	375	375	375	375	375	375	375	375		
Pulp solids	%	40	40	40	40	40	40	40	40		
Natural pH		8.3	8.6	8.6	8.4	8.0	8.3	8.3	8.3		
CaO added	g	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188		
pH check at 3 hours		8.9	9.6	9.4	9.2	8.7	9.0	9.0	9.0		
CaO added	g	0.075	0.053	0.060	0.075	0.075	0.075	0.075	0.075		
pH check at 5 hours		9.7	10.1	10.0	10.1	9.6	10.2	10.0	10.1		
CaO added	g	0.113	0.075	0.075	0.075	0.113	0.075	0.075	0.075		
NaCN added	g	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27		
Leach time	hrs	12	12	12	12	12	12	12	12		
Gross off rolls	g	741.7	755.7	756.3	756.6	744.0	744.4	754.7	756.8		
Pulp pH		9.8	10.0	9.8	10.0	9.8	9.9	9.8	9.8		
sneak sample taken											
Pulps settled poorly yielding turbid sample filtrates. CaO & flocculant added to samples to obtain clear filtrates. Surplus filtrates and undissolved CaO returned to leach vessel.											
CaO added to sample	g	0.075	0.075	0.075	0.075	0.000	0.000	0.075	0.075		
BD35 & BD9 tested for CaO only											
BD27, BD65, BD57, BD69, BD1 & BD76 % CaO allowed.											
BD57, BD69, BD1 & BD76 only tested for NaCN											
BD35, BD9, BD27, BD65 % NaCN allowed.											
	% NaCN	0.025	0.039	0.031	0.037	0.025	0.025	0.025	0.025		
	% CaO	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		
Gross after sample	g	719.8	728.6	731.0	736.6	722.5	723.0	734.1	737.5		
CaO added to vessel	g	0.188	0.188	0.188	0.188	0.263	0.263	0.188	0.188		
NaCN added	g	0.16	0.11	0.14	0.12	0.16	0.16	0.16	0.16		
Leach time	hrs	12	12	12	12	12	12	12	12		
Gross off rolls	g	719.2	727.2	730.9	735.5	718.9	722.0	733.6	737.0		
Sample		BD57	BD69	BD1	BD76	BD35	BD9	BD27	BD65		
	pH	10.8	10.7	10.8	11.0	10.7	10.6	10.7	10.9		
(liquor samples clear	ppm Au	0.36	0.45	0.65	0.46	0.60	0.49	0.96	0.50		
at higher pH)	ppm Cu	122	37	56	81	46	63	190	91		
	% NaCN	0.055	0.057	0.038	0.050	0.053	0.051	0.026	0.049		
	PpH	10.2	nd	nd	10.5	9.9	nd	10.1	10.3		
	% CaO	0.005	0.004	0.004	0.005	0.004	0.004	0.004	0.006		
Residue recovered (not assayed)	g	247.8	247.7	246.8	247.4	246.8	247.7	246.4	248.4		
Residue colour		l/grey	l/grey	l/grey	d/grey	l/grey	l/grey	d/grey	d/grey		
Grade of sneak sample allowed at 50% of assayed liquor grade											
Extraction at 24 hours	Au g/t	0.51	0.65	0.94	0.66	0.85	0.70	1.39	0.72		
	Cu g/t	174	53	81	117	66	90	276	131	Average (1)	101
(of Assay Head)	Cu %	76	30	32	23	21	26	25	29	Average (1)	34
Consumptions at 24 hours	CaO kg/t	2.48	2.25	2.28	2.33	2.49	2.34	2.34	2.31	Average (1)	2.36
	NaCN kg/t	0.94	0.59	1.08	0.83	0.97	0.99	1.33	1.01	Average (1)	0.94
g NaCN consumed/g Cu dissolved	ratio	5.37	12.97	13.33	7.10	14.75	10.95	4.84	7.71	Average (1)	10.5
One-metre intersections in Hole Composite		10	9	11	7	10	11		9	Total (1)	67
Composites taken to BMT P0.8		yes	yes	yes	yes	yes	yes	no	yes		
Head Assay (ave. of duplicates)	ppm Au	0.58	0.73	1.04	0.72	0.92	0.78	1.61	0.76		
(single assay)	ppm Cu	230	175	250	510	305	345	1120	460	Average (1)	316

BHTS753 Sheet 1 5-Dec-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BHT P 0.8

Nominated Grind P80 = 75um Split 11D ground with mild steel rods.

SUMMARY		MS Rods	SS Rods
Test No. (% solids)	Units	11D	11A
Nominal Grind 80% passing	um	75	75
Total leach time	hours	24	24
Extraction Au			
at 3 hours	g/t	0.00	0.00
at 6 hours	g/t	0.00	0.00
at 12 hours	g/t	0.00	0.00
at 18 hours	g/t	0.00	0.00
at 24 hours	g/t	0.00	0.00
at 3 hours	%	#DIV/0!	#DIV/0!
at 6 hours	%	#DIV/0!	#DIV/0!
at 12 hours	%	#DIV/0!	#DIV/0!
at 18 hours	%	#DIV/0!	#DIV/0!
at 24 hours	%	#DIV/0!	#DIV/0!
Calculated Head	ppm Au	0.00	0.00
Ground Head Assay 1	ppm Au		
Ground Head Assay 2	ppm Au		
Average Ground Head Assay	ppm Au		
Calculated residue grade	ppm Au	#DIV/0!	#DIV/0!
Extraction Cu			
at 3 hours	g/t	0	0
at 6 hours	g/t	0	0
at 12 hours	g/t	0	0
at 18 hours	g/t	0	0
at 24 hours	g/t	0	0
Assay Head	ppm Cu	298	(ave. of two head splits)
Extraction Zn			
at 3 hours	g/t	0.0	0.0
at 6 hours	g/t	0.0	0.0
at 12 hours	g/t	0.0	0.0
at 18 hours	g/t	0.0	0.0
at 24 hours	g/t	0.0	0.0
Assay Head	ppm Zn	200	(ave. of two head splits)
NaCN consumption			
at 3 hours	kg/t	0.33	0.08
at 6 hours	kg/t	0.39	0.17
at 12 hours	kg/t	0.49	0.19
at 18 hours	kg/t	0.52	0.26
at 24 hours	kg/t	0.57	0.27
CaO consumption			
at 3 hours	kg/t	1.01	0.89
at 6 hours	kg/t	1.02	0.89
at 12 hours	kg/t	1.07	0.91
at 18 hours	kg/t	1.08	0.94
at 24 hours	kg/t	1.14	0.94

BMT5753 Sheet 2 5-Dec-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 75um Split 11D ground with mild steel rods.

Rod Charge Material		MS Rods	SS Rods
Test No.	Units	11D	11A
Grind 80% passing	um	75	75
Total leach time	hours	24	24
Vessel	g	408.6	405.7
Sample mass	g	1013.4	862.8
Sitewater added	g	1520	1294
Natural pH			
CaO added	g	1.07	0.86
NaCN added	g	1.22	1.01
Leach Time	hrs	3	3
Gross off rolls	g	2941.4	2559.2
Pulp temperature	deg C	28	21
Liquor sample A (3 hours)	pH	11.3	11.4
	ppm Au		
	ppm Cu		
	ppm Zn		
	% NaCN	0.078	0.073
	% CaO	0.003	0.007
Gross after sample	g	2886.7	2508.2
CaO added	g	0.00	0.00
NaCN added	g	0.00	0.00
Leach time	hrs	3	3
Gross off rolls	g	2940.9	2558.4
Pulp temperature	deg C	29	23
Liquor sample B (6 hours)	pH	11.3	11.3
	ppm Au		
	ppm Cu		
	ppm Zn		
	% NaCN	0.052	0.064
	% CaO	0.002	0.007
Gross after sample	g	2885.5	2506.9
CaO added	g	0.08	0.00
NaCN added	g	0.00	0.00
Leach time	hrs	6	6
Gross off rolls	g	2939.3	2556.9
Pulp temperature	deg C	26.0	22.0
Liquor sample C (12 hours)	pH	11.5	11.3
	ppm Au		
	ppm Cu		
	ppm Zn		
	% NaCN	0.044	0.060
	% CaO	0.004	0.005
Gross after sample	g	2881.1	2501.4
CaO added	g	0.00	0.00
NaCN added	g	0.09	0.00
Leach time	hrs	6	6
Gross off rolls	g	2938.1	2555.8
Pulp temperature	deg C	24	20
Liquor sample D (18 hours)	pH	11.2	11.2
	ppm Au		
	ppm Cu		
	ppm Zn		
	% NaCN	0.046	0.053
	% CaO	0.003	0.003
Gross after sample	g	2881.3	2498.7
CaO added	g	0.06	0.00
NaCN added	g	0.06	0.00
Leach time	hrs	6	6
Gross off rolls	g	2957.3	2557.9
Pulp temperature	deg C	22	19
Liquor sample E (24 hours)	pH	11.2	11.1
	ppm Au		
	ppm Cu		
	ppm Zn		
	% NaCN	0.045	0.050
	% CaO	0.003	0.003

1302

BMT P0.8
P80 = 38um
Sheets 1-5

BMT5732 Sheet 1 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0 8

Nominated Grind P80 = 38um

SUMMARY

Test No. (% solids)	Units	16A	13B	6C	1D
Nominal Grind 80% passing	um	38	38	38	33
Total leach time	hours	24	24	24	24
Extraction Au					
at 3 hours	g/t	0.66	0.63	0.63	0.66
at 6 hours	g/t	0.69	0.67	0.64	0.67
at 12 hours	g/t	0.70	0.67	0.66	0.68
at 18 hours	g/t	0.70	0.69	0.68	0.69
at 24 hours	g/t	0.73	0.67	0.66	0.68
at 3 hours	%	77.3	76.0	77.3	79.8
at 6 hours	%	80.5	80.9	78.6	81.2
at 12 hours	%	82.0	80.4	81.7	82.5
at 18 hours	%	81.9	83.3	83.2	84.0
at 24 hours	%	85.2	81.1	81.2	82.2
Calculated Head	ppm Au	0.85	0.83	0.81	0.83
Ground Head Assay 1	ppm Au	0.69	0.69	0.70	0.76
Ground Head Assay 2	ppm Au	0.76	0.76	0.68	0.74
Average Ground Head Assay	ppm Au	0.73	0.73	0.69	0.75
Calculated residue grade	ppm Au	0.16	0.14	0.14	0.15
Extraction Cu					
at 3 hours	g/t	39	40	40	40
at 6 hours	g/t	50	51	51	51
at 12 hours	g/t	63	67	67	65
at 18 hours	g/t	75	75	75	74
at 24 hours	g/t	80	81	80	81
Assay Head	ppm Cu	298	(ave. of two head splits)		
Extraction Zn					
at 3 hours	g/t	1.8	1.5	1.6	6.3
at 6 hours	g/t	2.2	2.0	2.2	2.8
at 12 hours	g/t	2.9	2.7	6.4	3.5
at 18 hours	g/t	3.4	5.6	3.4	3.9
at 24 hours	g/t	3.9	3.6	3.7	7.6
Assay Head	ppm Zn	200	(ave. of two head splits)		
NaCN consumption					
at 3 hours	kg/t	0.14	0.14	0.13	0.15
at 6 hours	kg/t	0.18	0.18	0.19	0.19
at 12 hours	kg/t	0.23	0.23	0.24	0.24
at 18 hours	kg/t	0.31	0.32	0.30	0.32
at 24 hours	kg/t	0.32	0.34	0.31	0.36
CaO consumption					
at 3 hours	kg/t	0.91	0.87	0.88	0.89
at 6 hours	kg/t	0.90	0.86	0.87	0.89
at 12 hours	kg/t	0.92	0.87	0.90	0.90
at 18 hours	kg/t	0.91	0.88	0.91	0.89
at 24 hours	kg/t	0.92	0.89	0.92	0.91
Actual grind passing nominated um (%)		75.3	72.7	67.8	71.0

Note: The 'actual grind passing nominated um' above are from the sizing of the residues. The coarser than nominated grinds were due to mill drive slippage. Refer to report under 'Discussion'.

BMT5732 Sheet 2 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 38um

tests conducted (date)		8/11	8/11	8/11	8/11
Test No.	Units	16A	16B	6C	1D
Grind 80% passing	um	38	38	38	38
Total leach time	hours	24	24	24	24
Vessel	g	408.3	405.2	407.2	408.0
Sample mass	g	857.9	883.0	860.9	873.2
Sitewater added	g	1287	1325	1291	1310
Natural pH					
CaO added	g	0.87	0.87	0.86	0.87
NaCN added	g	1.03	1.06	1.04	1.05
Leach Time	hrs	3	3	3	3
Gross off rolls	g	2550.7	2611.5	2557.3	2589.3
Pulp temperature	deg C	26	26	26	26
Liquor sample A (3 hours)	pH	11.3	11.3	11.3	11.3
	ppm Au	0.44	0.42	0.42	0.44
	ppm Cu	26	27	27	27
	ppm Zn	1.2	1.0	1.1	4.2
	% NaCN	0.071	0.071	0.072	0.070
	% CaO	0.007	0.008	0.008	0.007
Gross after sample	g	2496.1	2556.9	2503.2	2535.1
CaO added	g	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3
Gross off rolls	g	2549.8	2610.2	2556.1	2588.1
Pulp temperature	deg C	30	30	30	30
Liquor sample B (6 hours)	pH	11.1	11.1	11.1	11.1
	ppm Au	0.44	0.43	0.41	0.43
	ppm Cu	32	33	33	33
	ppm Zn	1.4	1.3	1.4	1.7
	% NaCN	0.065	0.065	0.065	0.065
	% CaO	0.007	0.008	0.008	0.007
Gross after sample	g	2495.0	2555.9	2502.0	2534.3
CaO added	g	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6
Gross off rolls	g	2548.3	2608.6	2554.7	2586.9
Pulp temperature	deg C	28.0	28.0	28.0	28.0
Liquor sample C (12 hours)	pH	11.1	11.1	11.1	11.0
	ppm Au	0.43	0.41	0.41	0.42
	ppm Cu	40	42	42	41
	ppm Zn	1.8	1.7	4.2	2.1
	% NaCN	0.059	0.059	0.059	0.059
	% CaO	0.006	0.007	0.006	0.006
Gross after sample	g	2488.4	2554.1	2495.6	2530.1
CaO added	g	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6
Gross off rolls	g	2547.2	2607.2	2553.7	2585.8
Pulp temperature	deg C	24	24	24	24
Liquor sample D (18 hours)	pH	11.1	11.1	11.1	11.0
	ppm Au	0.41	0.41	0.40	0.41
	ppm Cu	46	46	46	45
	ppm Zn	2.1	3.6	2.0	2.3
	% NaCN	0.051	0.051	0.052	0.051
	% CaO	0.006	0.006	0.005	0.006
Gross after sample	g	2488.9	2549.1	2493.0	2528.2
CaO added	g	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6
Gross off rolls	g	2547.1	2606.4	2553.2	2527.4
Pulp temperature	deg C	23	23	23	23
Liquor sample E (24 hours)	pH	11.0	11.0	11.1	11.0
	ppm Au	0.41	0.38	0.37	0.4
	ppm Cu	47	48	47	50
	ppm Zn	2.3	2.1	2.1	4.9
	% NaCN	0.048	0.047	0.049	0.048
	% CaO	0.005	0.005	0.004	0.005
Gross after sample	g				
CaO added	g				
NaCN added	g				
Leach time	hrs				
Gross off rolls	g				
Pulp temperature	deg C				
Liquor sample F (32 hours)	pH				
	ppm Au				
	ppm Cu				
	ppm Zn				
	% NaCN				
	% CaO				
Sample mass account					
Residue recovered (screened)	g	850.3	870.3	856.5	862.4
Ground head to assay	g	139.4	147.5	142.4	134.8
Calculated head to grind	g	989.7	1017.8	998.9	997.2
Actual head to grind	g	997.3	1030.5	1003.3	1008.0
Unaccounted mass	%	0.76	1.23	0.44	1.07

BMT5732 Sheet 3 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 38um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 16A		Nom. P80um 38		Leach hrs 24				
+ 150								
- 150 + 106								
- 106 + 75		0.0	100.0					
- 75 + 53	81.0	9.5	90.5	0.27	0.27	0.27	21.87	16.5
- 53 + 38	129.2	15.2	75.3	0.20	0.22	0.21	27.13	20.5
- 38	640.1	75.3		0.13	0.13	0.13	83.21	62.9
Calculated	850.3	100.0				0.16	132.2	100.0
Test No. 13B		Nom. P80um 38		Leach hrs 24				
+ 150								
- 150 + 106								
- 106 + 75		0.0	100.0					
- 75 + 53	96.3	11.1	88.9	0.24	0.22	0.23	22.15	18.2
- 53 + 38	141.6	16.3	72.7	0.19	0.19	0.19	26.90	22.1
- 38	632.4	72.7		0.11	0.12	0.12	72.73	59.7
Calculated	870.3	100.0				0.14	121.8	100.0
Test No. 6C		Nom. P80um 38		Leach hrs 24				
+ 150								
- 150 + 106								
- 106 + 75		0.0	100.0					
- 75 + 53	127.0	14.8	85.2	0.20	0.20	0.20	25.40	21.6
- 53 + 38	148.5	17.3	67.8	0.19	0.19	0.19	28.22	24.0
- 38	581.0	67.8		0.11	0.11	0.11	63.91	54.4
Calculated	856.5	100.0				0.14	117.5	100.0
Test No. 1D		Nom. P80um 38		Leach hrs 24				
+ 150								
- 150 + 106								
- 106 + 75		0.0	100.0					
- 75 + 53	97.5	11.3	88.7	0.21	0.20	0.21	19.99	15.5
- 53 + 38	152.3	17.7	71.0	0.19	0.19	0.19	28.94	22.5
- 38	612.6	71.0		0.13	0.13	0.13	79.64	61.9
Calculated	862.4	100.0				0.15	128.6	100.0

BMT5732 Sheet 4 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 38um

Summary of Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	+ 38 ppm Au	- 38 ppm Au
24 hour residues								
16A	38	0.16				0.27	0.21	0.13
13B	38	0.14				0.23	0.19	0.12
6C	38	0.14				0.20	0.19	0.11
1D	38	0.15				0.21	0.19	0.13
Average		0.15				0.23	0.20	0.12

Summary of Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	+ 38 %	- 38 %
24 hour residues								
16A	38	0.16				16.5	20.5	62.9
13B	38	0.14				18.2	22.1	59.7
6C	38	0.14				21.6	24.0	54.4
1D	38	0.15				15.5	22.5	61.9
Average		0.15				18.0	22.3	59.7

BMT5732 Sheet 5 5-Dec-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT P 0.8		P80=38um			
ANALYSIS					
Test No. (% solids)	Units	Ave.	Max	Min	
Nominal Grind 80% passing	um	38	38	38	
Total leach time	hours	24	24	24	
Extraction Au					
at 3 hours	g/t	0.64	0.66	0.63	
at 6 hours	g/t	0.67	0.69	0.64	
at 12 hours	g/t	0.68	0.70	0.66	
at 18 hours	g/t	0.69	0.70	0.68	
at 24 hours	g/t	0.68	0.73	0.66	
at 3 hours	%	77.6	79.8	76.0	
at 6 hours	%	80.3	81.2	78.6	
at 12 hours	%	81.6	82.5	80.4	
at 18 hours	%	83.1	84.0	81.9	
at 24 hours	%	82.4	85.2	81.1	
Calculated Head	ppm Au	0.83	0.85	0.81	
Ground Head Assay 1	ppm Au	0.71	0.76	0.69	
Ground Head Assay 2	ppm Au	0.74	0.76	0.68	
Average Ground Head Assay	ppm Au	0.72	0.75	0.69	
Calculated residue grade	ppm Au	0.15	0.16	0.14	
Extraction Cu					
at 3 hours	g/t	40	40	39	
at 6 hours	g/t	51	51	50	
at 12 hours	g/t	65	67	63	
at 18 hours	g/t	75	75	74	
at 24 hours	g/t	80	81	80	
Assay Head	ppm Cu				
Extraction Zn					
at 3 hours	g/t	2.8	6.3	1.5	
at 6 hours	g/t	2.3	2.8	2.0	
at 12 hours	g/t	3.9	6.4	2.7	
at 18 hours	g/t	4.1	5.6	3.4	
at 24 hours	g/t	4.7	7.6	3.6	
Assay Head	ppm Zn				
NaCN consumption					
at 3 hours	kg/t	0.14	0.15	0.13	
at 6 hours	kg/t	0.19	0.19	0.18	
at 12 hours	kg/t	0.24	0.24	0.23	
at 18 hours	kg/t	0.31	0.32	0.30	
at 24 hours	kg/t	0.34	0.36	0.31	
CaO consumption					
at 3 hours	kg/t	0.89	0.91	0.87	
at 6 hours	kg/t	0.88	0.90	0.86	
at 12 hours	kg/t	0.90	0.92	0.87	
at 18 hours	kg/t	0.90	0.91	0.88	
at 24 hours	kg/t	0.91	0.92	0.89	
Actual grind passing nominated um (%)		71.7	75.3	67.8	Refer to report 'Discussion'.

1308

BMT P0.8
P80 = 53um
Sheets 1-6

BMT5733 Sheet 1 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 53um

SUMMARY

Test No. (% solids)	Units	13A	1B	7C	14A	3B	8C	9D	15A	4B	12D
Nominal Grind 80% passing	um	53	53	53	53	53	53	53	53	53	53
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Extraction Au											
at 3 hours	g/t	0.75	0.65	0.64	0.60	0.63	0.64	0.61	0.61	0.61	0.66
at 6 hours	g/t	0.76	0.67	0.73	0.65	0.65	0.70	0.64	0.64	0.64	0.67
at 12 hours	g/t	0.79	0.70	0.71	0.66	0.68	0.71	0.69	0.68	0.69	0.71
at 18 hours	g/t	0.80	0.68	0.69	0.68	0.68	0.74	0.69	0.69	0.71	0.71
at 24 hours	g/t				0.66	0.67	0.72	0.69	0.67	0.70	0.74
at 32 hours	g/t								0.68	0.71	0.70
at 3 hours	%	79.9	78.5	75.9	74.3	77.4	73.6	73.8	75.7	73.2	78.2
at 6 hours	%	81.4	81.5	85.9	81.0	80.5	79.8	76.7	78.7	76.0	79.5
at 12 hours	%	84.4	84.5	83.8	82.2	83.5	81.0	83.2	83.4	82.4	84.2
at 18 hours	%	84.8	82.4	81.8	83.7	83.2	84.3	83.1	85.0	84.2	84.1
at 24 hours	%				81.5	82.8	82.5	82.8	82.9	84.0	87.5
at 32 hours	%								87.9	85.0	83.3
Calculated Head	ppm Au	0.94	0.82	0.85	0.81	0.81	0.88	0.83	0.81	0.84	0.84
Ground Head Assay 1	ppm Au	0.83	0.81	0.86	0.75	0.74	0.78	1.02	0.75	0.79	0.77
Ground Head Assay 2	ppm Au	0.95	0.81	0.76	0.76	0.71	0.73	0.73	0.78	0.77	0.80
Average Ground Head Assay	ppm Au	0.89	0.81	0.81	0.76	0.73	0.76	0.88	0.77	0.78	0.79
Calculated residue grade	ppm Au	0.14	0.15	0.16	0.15	0.14	0.15	0.14	0.13	0.13	0.14
Extraction Cu											
at 3 hours	g/t	31	32	31	31	30	31	33	33	33	34
at 6 hours	g/t	37	39	39	37	36	37	39	39	40	42
at 12 hours	g/t	46	48	48	46	44	46	48	48	54	51
at 18 hours	g/t	53	53	52	51	51	52	54	54	64	57
at 24 hours	g/t				55	56	56	59	59	71	66
at 32 hours	g/t								64	79	68
Assay Head	ppm Cu	298	(ave. of two head splits)								
Extraction Zn											
at 3 hours	g/t	1.8	1.8	1.8	1.6	1.8	1.8	1.8	1.8	1.8	1.9
at 6 hours	g/t	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.6
at 12 hours	g/t	2.7	2.6	2.5	2.5	2.5	2.5	2.7	2.7	2.5	2.9
at 18 hours	g/t	3.1	4.8	3.2	2.8	3.0	3.0	3.0	3.0	2.8	3.1
at 24 hours	g/t				3.1	3.4	3.1	3.4	3.2	2.9	3.4
at 32 hours	g/t								3.6	3.3	3.8
Assay Head	ppm Zn	200	(ave. of two head splits)								
NaCN consumption											
at 3 hours	kg/t	0.10	0.09	0.10	0.19	0.11	0.11	0.09	0.09	0.09	0.09
at 6 hours	kg/t	0.13	0.12	0.11	0.25	0.09	0.10	0.08	0.10	0.13	0.12
at 12 hours	kg/t	0.20	0.19	0.18	0.29	0.19	0.18	0.18	0.20	0.22	0.25
at 18 hours	kg/t	0.21	0.22	0.23	0.34	0.22	0.23	0.22	0.21	0.27	0.27
at 24 hours	kg/t				0.35	0.29	0.27	0.27	0.27	0.29	0.25
at 32 hours	kg/t								0.29	0.34	0.28
CaO consumption										(1)	
at 3 hours	kg/t	0.93	0.91	0.90	0.92	0.92	0.90	0.90	0.90	1.66	0.87
at 6 hours	kg/t	0.93	0.91	0.90	0.91	0.91	0.90	0.91	0.91	1.72	0.87
at 12 hours	kg/t	0.94	0.94	0.91	0.93	0.94	0.91	0.92	0.92	1.74	0.88
at 18 hours	kg/t	0.94	0.94	0.92	0.94	0.94	0.92	0.93	0.92	1.75	0.89
at 24 hours	kg/t				0.92	0.93	0.92	0.91	0.93	1.73	0.90
at 32 hours	kg/t								0.95	1.78	0.92
Actual grind passing nominated um (%)		78.3	79.0	76.0	78.8	78.8	77.8	79.8	78.3	77.7	79.0

Note: The 'actual grind passing nominated um' above are from the sizing of the residues. The courser than nominated grinds were due to mill drive slippage. Refer to report under 'Discussion'.

(1) CaO addition doubled in error.

BHT5733 Sheet 2 26-Nov-89

BILLITON HT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BHT P 0.8 ;

Nominated Grind P80 = 53um

Tests conducted (date)		30/10	30/10	30/10	30/10	30/10	30/10	30/10	30/10	30/10	30/10
Test No.	Units	13A	13	7C	14A	3B	8C	9D	15A	4B	12D
Grind 80% passing	um	53	53	53	53	53	53	53	53	53	53
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Vessel	g	408.1	407.6	407.8	408.5	405.2	407.2	406.8	408.3	409.1	407.8
Sample mass	g	859.7	865.6	879.9	853.0	865.3	878.6	858.7	864.0	872.7	858.6
Sitewater added	g	1290	1298	1320	1280	1298	1318	1288	1296	1309	1288
Natural pH											
CaO added	g	0.88	0.87	0.87	0.86	0.87	0.87	0.86	0.87	1.71	0.84
NaCN added	g	1.04	1.04	1.06	1.03	1.04	1.06	1.03	1.04	1.05	1.03
Leach time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2556.9	2574.9	2606.3	2540.6	2567.4	2603.3	2552.0	2567.6	2589.6	2551.1
Pulp temperature	deg C	18	18	18	18	18	18	18	18	18	18
Liquor sample A (3 hours)	pH	11.4	11.4	11.4	11.4	11.4	11.5	11.4	11.5	12.1	11.7
	ppm Au	0.50	0.43	0.43	0.40	0.42	0.43	0.41	0.41	0.41	0.44
	ppm Cu	21	21	21	21	20	21	22	22	22	23
	ppm Zn	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.3
	% NaCN	0.074	0.074	0.074	0.068	0.073	0.073	0.074	0.074	0.074	0.074
	% CaO	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.020	0.007
Gross after sample	g	2505.2	2523.9	2554.9	2488.9	2515.6	2552.0	2500.0	2516.1	2538.4	2499.7
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2556.0	2573.8	2605.5	2539.7	2566.4	2602.2	2551.3	2566.6	2588.6	2550.2
Pulp temperature	deg C	19	19	19	19	19	19	19	19	19	19
Liquor sample B (6 hours)	pH	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	12.0	11.5
	ppm Au	0.49	0.43	0.47	0.42	0.42	0.45	0.41	0.41	0.41	0.43
	ppm Cu	24	25	25	24	23	24	25	25	26	27
	ppm Zn	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.7
	% NaCN	0.069	0.069	0.070	0.061	0.071	0.071	0.072	0.071	0.069	0.069
	% CaO	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.015	0.007
Gross after sample	g	2504.4	2522.1	2553.9	2488.0	2514.7	2550.7	2499.8	2515.4	2537.2	2498.8
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2554.4	2572.6	2604.2	2538.5	2565.2	2600.0	2549.9	2565.2	2587.2	2548.1
Pulp temperature	deg C	19	19	19	19	19	19	19	19	19	19
Liquor sample C (12 hours)	pH	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	12.0	11.4
	ppm Au	0.49	0.43	0.44	0.41	0.42	0.44	0.43	0.42	0.43	0.44
	ppm Cu	29	30	30	29	28	29	30	30	34	32
	ppm Zn	1.7	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.6	1.8
	% NaCN	0.062	0.062	0.063	0.056	0.062	0.063	0.062	0.061	0.060	0.058
	% CaO	0.005	0.004	0.005	0.005	0.004	0.005	0.005	0.005	0.013	0.006
Gross after sample	g	2496.4	2516.4	2546.5	2480.7	2506.9	2540.7	2491.1	2507.2	2525.9	2490.0
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2554.3	2570.9	2602.9	2536.9	2564.2	2598.9	2549.3	2564.7	2586.4	2547.4
Pulp temperature	deg C	17	17	17	17	17	17	17	17	17	17
Liquor sample D (18 hours)	pH	11.3	11.3	11.3	11.2	11.3	11.2	11.3	11.3	12.0	11.4
	ppm Au	0.47	0.40	0.41	0.40	0.40	0.44	0.41	0.41	0.42	0.42
	ppm Cu	32	32	32	31	31	32	33	33	39	35
	ppm Zn	1.9	3.0	2.0	1.7	1.8	1.8	1.8	1.8	1.7	1.9
	% NaCN	0.058	0.057	0.057	0.050	0.057	0.057	0.057	0.058	0.054	0.054
	% CaO	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.012	0.005
Gross after sample	g				2478.2	2505.8	2541.2	2491.1	2505.8	2526.7	2489.0
CaO added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs				6	6	6	6	6	6	6
Gross off rolls	g				2536.2	2563.9	2598.2	2548.7	2563.8	2585.8	2547.0
Pulp temperature	deg C				16	16	16	16	16	16	16
Liquor sample E (24 hours)	pH				11.1	11.1	11.1	11.1	11.1	11.9	11.2
	ppm Au				0.37	0.38	0.41	0.39	0.38	0.40	0.42
	ppm Cu				32	33	33	35	35	42	39
	ppm Zn				1.8	2.0	1.8	2.0	1.9	1.7	2.0
	% NaCN				0.047	0.050	0.052	0.051	0.051	0.050	0.053
	% CaO				0.005	0.004	0.004	0.005	0.004	0.013	0.004
Gross after sample	g								2512.6	2535.7	2497.2
CaO added	g								0.00	0.00	0.00
NaCN added	g								0.00	0.00	0.00
Leach time	hrs								8	8	8
Gross off rolls	g								2564.1	2586.0	2547.7
Pulp temperature	deg C								22	22	22
Liquor sample F (32 hours)	pH								11.0	11.7	11.1
	ppm Au								0.37	0.39	0.38
	ppm Cu								37	46	39
	ppm Zn								2.1	1.9	2.2
	% NaCN								0.048	0.045	0.049
	% CaO								0.003	0.009	0.003
Sample mass account											
Residue recovered (screened)	g	852.9	859.9	873.5	826.7	861.0	875.6	854.9	856.9	868.6	852.4
Ground head to assay	g	138.8	141.3	155.9	152.0	137.7	152.7	149.3	151.5	144.3	149.0
Calculated head to grind	g	991.7	1001.2	1029.4	978.7	998.7	1028.3	1004.2	1008.4	1012.9	1001.4
Actual head to grind	g	998.5	1006.9	1035.8	1005.0	1003.0	1031.3	1008.0	1015.5	1017.0	1007.6
Unaccounted mass	%	0.68	0.57	0.62	2.62	0.43	0.29	0.38	0.70	0.48	0.62

BMT5733 Sheet 3 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 53um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**13A**	**Nom. P80um**	**53**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	62.9	7.4	92.6	0.22		0.22	13.84	11.3
- 75 + 53	122.0	14.3	78.3	0.20	0.22	0.21	25.62	20.8
- 53 + 38	110.2	12.9	65.4	0.17	0.18	0.18	19.29	15.7
- 38	557.8	65.4		0.12	0.11	0.12	64.15	52.2
Calculated	852.9	100.0				0.14	122.9	100.0
Test No.	**1B**	**Nom. P80um**	**53**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	59.6	6.9	93.1	0.21		0.21	12.52	9.9
- 75 + 53	120.8	14.0	79.0	0.21	0.20	0.21	24.76	19.7
- 53 + 38	117.8	13.7	65.3	0.18	0.18	0.18	21.20	16.8
- 38	561.7	65.3		0.12	0.12	0.12	67.40	53.5
Calculated	859.9	100.0				0.15	125.9	100.0
Test No.	**7C**	**Nom. P80um**	**53**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	72.5	8.3	91.7	0.23		0.23	16.68	12.3
- 75 + 53	137.5	15.7	76.0	0.20	0.22	0.21	28.88	21.3
- 53 + 38	108.6	12.4	63.5	0.17	0.16	0.17	17.92	13.2
- 38	554.9	63.5		0.13	0.13	0.13	72.14	53.2
Calculated	873.5	100.0				0.16	135.6	100.0
Test No.	**14A**	**Nom. P80um**	**53**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	57.8	7.0	93.0	0.21		0.21	12.14	9.6
- 75 + 53	117.6	14.2	78.8	0.21	0.21	0.21	24.70	19.4
- 53 + 38	110.1	13.3	65.5	0.18	0.18	0.18	19.82	15.6
- 38	541.2	65.5		0.13	0.13	0.13	70.36	55.4
Calculated	826.7	100.0				0.15	127.0	100.0
Test No.	**3B**	**Nom. P80um**	**53**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	56.9	6.6	93.4	0.22		0.22	12.52	10.4
- 75 + 53	125.5	14.6	78.8	0.20	0.20	0.20	25.10	20.8
- 53 + 38	112.3	13.0	65.8	0.19	0.18	0.19	20.78	17.2
- 38	566.3	65.8		0.11	0.11	0.11	62.29	51.6
Calculated	861.0	100.0				0.14	120.7	100.0

BMT5733 Sheet 4 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;
Nominated Grind P80 = 53um
Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 8C		**Nom. P80um 53**		**Leach hrs 24**				
+ 150								
- 150 + 106								
- 106 + 75	63.9	7.3	92.7	0.23		0.23	14.70	10.9
- 75 + 53	130.1	14.9	77.8	0.21	0.21	0.21	27.32	20.3
- 53 + 38	115.8	13.2	64.6	0.19	0.19	0.19	22.00	16.3
- 38	565.8	64.6		0.13	0.12	0.13	70.73	52.5
Calculated	875.6	100.0				0.15	134.7	100.0
Test No. 9D		**Nom. P80um 53**		**Leach hrs 24**				
+ 150								
- 150 + 106								
- 106 + 75	52.8	6.2	93.8	0.20		0.20	10.56	8.6
- 75 + 53	120.0	14.0	79.8	0.20	0.20	0.20	24.00	19.5
- 53 + 38	117.4	13.7	66.1	0.17	0.18	0.18	20.55	16.7
- 38	564.7	66.1		0.12	0.12	0.12	67.76	55.2
Calculated	854.9	100.0				0.14	122.9	100.0
Test No. 15A		**Nom. P80um 53**		**Leach hrs 32**				
+ 150								
- 150 + 106								
- 106 + 75	56.7	6.6	93.4	0.20		0.20	11.34	10.0
- 75 + 53	129.2	15.1	78.3	0.20	0.21	0.21	26.49	23.4
- 53 + 38	118.0	13.8	64.5	0.17	0.17	0.17	20.06	17.7
- 38	553.0	64.5		0.10	0.10	0.10	55.30	48.9
Calculated	856.9	100.0				0.13	113.2	100.0
Test No. 4B		**Nom. P80um 53**		**Leach hrs 32**				
+ 150								
- 150 + 106								
- 106 + 75	64.3	7.4	92.6	0.22		0.22	14.15	12.9
- 75 + 53	129.3	14.9	77.7	0.20	0.20	0.20	25.86	23.5
- 53 + 38	116.5	13.4	64.3	0.17	0.17	0.17	19.81	18.0
- 38	558.5	64.3		0.09	0.09	0.09	50.27	45.7
Calculated	868.6	100.0				0.13	110.1	100.0
Test No. 12D		**Nom. P80um 53**		**Leach hrs 32**				
+ 150								
- 150 + 106								
- 106 + 75	57.7	6.8	93.2	0.20		0.20	11.54	9.6
- 75 + 53	121.1	14.2	79.0	0.20	0.20	0.20	24.22	20.1
- 53 + 38	122.1	14.3	64.7	0.17	0.18	0.18	21.37	17.7
- 38	551.5	64.7		0.12	0.11	0.12	63.42	52.6
Calculated	852.4	100.0				0.14	120.5	100.0

BMT5733 Sheet 5 26-Nov-89 Revision 1 Data expanded

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BMT P 0.8		P80 = 53um (18 hours)			P80 = 53um (24 hours)			P80 = 53um (32 hours)			
ANALYSIS											
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min	
Nominal Grind 80% passing	um	53	53	53	53	53	53	53	53	53	
Total leach time	hours	18	18	16	24	24	24	32	32	32	
Extraction Au											
at 3 hours	g/t	0.68	0.75	0.64	0.62	0.64	0.60	0.63	0.66	0.61	
at 6 hours	g/t	0.72	0.76	0.67	0.66	0.70	0.64	0.65	0.67	0.64	
at 12 hours	g/t	0.73	0.79	0.70	0.69	0.71	0.66	0.69	0.71	0.68	
at 18 hours	g/t	0.72	0.80	0.68	0.70	0.74	0.68	0.70	0.71	0.69	
at 24 hours	g/t				0.69	0.72	0.66	0.70	0.74	0.67	
at 32 hours	g/t							0.70	0.71	0.68	
at 3 hours	%	78.1	79.9	75.9	74.8	77.4	73.6	75.7	78.2	73.2	
at 6 hours	%	82.9	85.9	81.4	79.5	81.0	76.7	78.1	79.5	76.0	
at 12 hours	%	84.3	84.5	83.8	82.5	83.5	81.0	83.3	84.2	82.4	
at 18 hours	%	83.0	84.8	81.8	83.6	84.3	83.1	84.4	85.0	84.1	
at 24 hours	%				82.4	82.8	81.5	84.8	87.5	82.9	
at 32 hours	%							84.1	85.0	83.3	
Calculated Head	ppm Au	0.87	0.94	0.82	0.83	0.88	0.81	0.83	0.84	0.81	
Ground Head Assay 1	ppm Au	0.83	0.86	0.81	0.82	1.02	0.74	0.77	0.79	0.75	
Ground Head Assay 2	ppm Au	0.84	0.95	0.76	0.73	0.76	0.71	0.78	0.80	0.77	
Average Ground Head Assay	ppm Au	0.84	0.89	0.81	0.78	0.88	0.73	0.78	0.79	0.77	
Calculated residue grade	ppm Au	0.15	0.16	0.14	0.15	0.15	0.14	0.13	0.14	0.13	
Extraction Cu											
at 3 hours	g/t	32	32	31	31	33	30	33	34	33	
at 6 hours	g/t	38	39	37	37	39	36	40	42	39	
at 12 hours	g/t	47	48	46	46	48	44	51	54	48	
at 18 hours	g/t	53	53	52	52	54	51	58	64	54	
at 24 hours	g/t				56	59	55	65	71	59	
at 32 hours	g/t							70	79	64	
Assay Head	ppm Cu	298			298			298			
Extraction Zn											
at 3 hours	g/t	1.8	1.8	1.8	1.8	1.8	1.6	1.8	1.9	1.8	
at 6 hours	g/t	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.6	2.2	
at 12 hours	g/t	2.6	2.7	2.5	2.6	2.7	2.5	2.7	2.9	2.5	
at 18 hours	g/t	3.7	4.8	3.1	2.9	3.0	2.8	3.0	3.1	2.8	
at 24 hours	g/t				3.2	3.4	3.1	3.2	3.4	2.9	
at 32 hours	g/t							3.6	3.8	3.3	
Assay Head	ppm Zn	200			200			200			
NaCN consumption											
at 3 hours	kg/t	0.09	0.10	0.09	0.12	0.19	0.09	0.09	0.09	0.09	
at 6 hours	kg/t	0.12	0.13	0.11	0.13	0.25	0.08	0.12	0.13	0.10	
at 12 hours	kg/t	0.19	0.20	0.18	0.21	0.29	0.18	0.22	0.25	0.20	
at 18 hours	kg/t	0.22	0.23	0.21	0.25	0.34	0.22	0.25	0.27	0.21	
at 24 hours	kg/t				0.29	0.35	0.27	0.27	0.29	0.25	
at 32 hours	kg/t							0.30	0.34	0.28	
CaO consumption									(1)		
at 3 hours	kg/t	0.92	0.93	0.90	0.91	0.92	0.90	1.15	1.66	0.87	
at 6 hours	kg/t	0.91	0.93	0.90	0.91	0.91	0.90	1.17	1.72	0.87	
at 12 hours	kg/t	0.93	0.94	0.91	0.92	0.94	0.91	1.18	1.74	0.88	
at 18 hours	kg/t	0.93	0.94	0.92	0.93	0.94	0.92	1.19	1.75	0.89	
at 24 hours	kg/t				0.92	0.93	0.91	1.19	1.73	0.90	
at 32 hours	kg/t							1.21	1.78	0.92	
Actual grind passing nominated um (%)		77.8	79.0	76.0	78.8	79.8	77.8	78.3	79.0	77.7	(2)

(1) CaO addition doubled in error.

(2) Refer to report 'Discussion'.

BMT5733 Sheet 6 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 53um

Summary of Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	+ 38 ppm Au	- 38 ppm Au
18 hour residues								
13A	53	0.14			0.22	0.21	0.18	0.12
1B	53	0.15			0.21	0.21	0.18	0.12
7C	53	0.16			0.23	0.21	0.17	0.13
Average		0.15			0.22	0.21	0.17	0.12
24 hour residues								
14A	53	0.15			0.21	0.21	0.18	0.13
3B	53	0.14			0.22	0.20	0.19	0.11
8C	53	0.15			0.23	0.21	0.19	0.13
9D	53	0.14			0.20	0.20	0.18	0.12
Average		0.15			0.22	0.21	0.18	0.12
32 hour residues								
15A	53	0.13			0.20	0.21	0.17	0.10
4B	53	0.13			0.22	0.20	0.17	0.09
12D	53	0.14			0.20	0.20	0.18	0.12
Average		0.13			0.21	0.20	0.17	0.10

Summary of Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	+ 38 %	- 38 %
18 hour residues								
13A	53	0.14			11.3	20.8	15.7	52.2
1B	53	0.15			9.9	19.7	16.8	53.5
7C	53	0.16			12.3	21.3	13.2	53.2
Average		0.15			11.2	20.6	15.3	53.0
24 hour residues								
14A	53	0.15			9.6	19.4	15.6	55.4
3B	53	0.14			10.4	20.8	17.2	51.6
8C	53	0.15			10.9	20.3	16.3	52.5
9D	53	0.14			8.6	19.5	16.7	55.2
Average		0.15			9.9	20.0	16.5	53.7
32 hour residues								
15A	53	0.13			10.0	23.4	17.7	48.9
4B	53	0.13			12.9	23.5	18.0	45.7
12D	53	0.14			9.6	20.1	17.7	52.6
Average		0.13			10.8	22.3	17.8	49.0

BMT P0.8
P80 = 75um
Sheets 1-6

BMT5731 Sheet 1 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 75um

SUMMARY

Test No. (% solids)	Units	9A	14B	4C	11A	15B	3C	6D	12A	16B	5D
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	75	75	75
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Extraction Au											
at 3 hours	g/t	0.60	0.61	0.61	0.61	0.61	0.57	0.58	0.61	0.60	0.60
at 6 hours	g/t	0.58	0.64	0.62	0.65	0.64	0.61	0.59	0.65	0.62	0.62
at 12 hours	g/t	0.60	0.65	0.64	0.66	0.65	0.63	0.61	0.66	0.64	0.63
at 18 hours	g/t	0.61	0.66	0.64	0.66	0.66	0.62	0.61	0.66	0.64	0.64
at 24 hours	g/t				0.67	0.67	0.63	0.62	0.68	0.64	0.63
at 32 hours	g/t								0.69	0.64	0.64
at 3 hours	%	76.6	69.9	71.0	71.8	70.2	69.5	73.9	71.4	71.1	72.0
at 6 hours	%	73.9	72.7	71.9	76.3	73.1	74.0	75.0	75.8	73.9	74.7
at 12 hours	%	77.1	73.7	74.6	77.4	74.5	76.7	77.8	76.9	76.6	75.7
at 18 hours	%	78.4	74.9	74.0	77.0	75.7	76.0	77.0	76.4	76.1	76.8
at 24 hours	%				78.4	77.0	77.1	78.2	79.3	75.5	76.1
at 32 hours	%								80.2	76.2	76.9
Calculated Head	ppm Au	0.78	0.88	0.86	0.85	0.87	0.82	0.79	0.86	0.84	0.83
Ground Head Assay 1	ppm Au	0.94	0.78	0.79	0.74	0.77	0.78	0.76	0.80	0.77	0.79
Ground Head Assay 2	ppm Au	0.73	0.75	0.79	0.84	0.79	0.74	0.76	0.80	0.76	0.75
Average Ground Head Assay	ppm Au	0.84	0.77	0.79	0.79	0.78	0.76	0.76	0.80	0.77	0.77
Calculated residue grade	ppm Au	0.17	0.22	0.23	0.19	0.20	0.19	0.17	0.17	0.20	0.19
Extraction Cu											
at 3 hours	g/t	31	31	30	31	30	31	33	34	31	33
at 6 hours	g/t	37	36	36	37	39	37	40	40	37	39
at 12 hours	g/t	46	46	47	47	49	48	49	49	46	49
at 18 hours	g/t	53	51	55	54	56	54	56	56	54	56
at 24 hours	g/t				61	60	57	61	61	57	61
at 32 hours	g/t								64	61	64
Assay Head	ppm Cu	298 (ave. of two head splits)									
Extraction Zn											
at 3 hours	g/t	2.2	1.8	1.8	1.8	1.9	1.8	1.8	1.9	1.6	1.8
at 6 hours	g/t	2.8	2.2	2.2	2.3	2.3	2.0	2.2	2.2	2.0	2.2
at 12 hours	g/t	3.4	2.5	8.4	2.8	2.9	2.5	2.7	2.7	2.5	2.7
at 18 hours	g/t	3.8	3.8	4.1	3.3	3.3	2.9	2.9	3.1	2.9	2.9
at 24 hours	g/t				4.1	3.3	3.8	3.7	3.4	3.1	3.1
at 32 hours	g/t								4.2	3.5	4.1
Assay Head	ppm Zn	200 (ave. of two head splits)									
NaCN consumption											
at 3 hours	kg/t	0.09	0.11	0.13	0.08	0.08	0.11	0.12	0.18	0.08	0.13
at 6 hours	kg/t	0.09	0.19	0.21	0.17	0.14	0.19	0.27	0.22	0.15	0.21
at 12 hours	kg/t	0.19	0.24	0.24	0.19	0.20	0.19	0.23	0.21	0.19	0.20
at 18 hours	kg/t	0.24	0.28	0.26	0.26	0.22	0.24	0.26	0.28	0.22	0.24
at 24 hours	kg/t				0.27	0.22	0.25	0.26	0.26	0.25	0.23
at 32 hours	kg/t								0.32	0.29	0.31
CaO consumption											
at 3 hours	kg/t	0.91	0.86	0.89	0.89	0.92	0.87	0.89	0.87	0.86	0.89
at 6 hours	kg/t	0.91	0.87	0.88	0.89	0.93	0.88	0.89	0.86	0.86	0.89
at 12 hours	kg/t	0.92	0.88	0.91	0.91	0.94	0.89	0.91	0.89	0.88	0.91
at 18 hours	kg/t	0.93	0.88	0.91	0.94	0.95	0.90	0.93	0.90	0.90	0.93
at 24 hours	kg/t				0.94	0.95	0.90	0.92	0.90	0.89	0.92
at 32 hours	kg/t								0.91	0.91	0.94
Actual grind passing nominated um (%)		77.8	73.0	76.3	73.1	79.7	72.0	73.0	76.7	75.4	75.1

Note: The 'actual grind passing nominated um' above are from the sizing of the residues. The coarser than nominated grinds were due to mill drive slippage. Refer to report under 'Discussion'.

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BHT5731 Sheet 2 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BHT P 0.8 ;

Nominated Grind P80 = 75um

tests conducted (date)		23/10	23/10	23/10	23/10	23/10	23/10	23/10	23/10	23/10	23/10
Test No.	Units	9A	14B	4C	11A	15B	3C	6D	12A	16B	5D
Grind 80% passing	um	75	75	75	75	75	75	75	75	75	75
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Vessel	g	405.2	407.6	407.8	405.7	407.8	409.2	408.3	408.0	406.9	407.6
Sample mass	g	847.6	854.4	869.2	862.8	828.7	863.1	852.3	865.5	860.2	862.3
Sitewater added	g	1271	1282	1304	1294	1243	1295	1278	1298	1302	1293
Natural pH											
CaO added	g	0.85	0.81	0.85	0.86	0.85	0.84	0.85	0.84	0.84	0.86
NaCN added	g	1.03	1.03	1.04	1.01	1.01	1.03	1.03	1.04	1.04	1.03
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2521.4	2540.5	2577.5	2559.2	2477.7	2565.4	2534.0	2568.8	2574.7	2560.8
Pulp temperature	deg C	21	21	21	21	21	21	21	21	21	21
Liquor sample A (3 hours)	pH	11.3	11.3	11.4	11.4	11.4	11.4	11.5	11.4	11.4	11.5
	ppm Au	0.40	0.41	0.41	0.41	0.41	0.38	0.39	0.41	0.40	0.40
	ppm Cu	21	21	20	21	20	21	22	23	21	22
	ppm Zn	1.5	1.2	1.2	1.2	1.3	1.2	1.2	1.3	1.1	1.2
	% NaCN	0.075	0.073	0.071	0.073	0.076	0.072	0.073	0.068	0.075	0.071
	% CaO	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Gross after sample	g	2470.3	2489.6	2527.3	2508.2	2426.4	2514.4	2482.7	2518.6	2523.4	2509.9
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2521.0	2539.8	2576.8	2558.4	2476.6	2564.8	2533.1	2567.3	2573.5	2559.6
Pulp temperature	deg C	23	23	23	23	23	23	23	23	23	23
Liquor sample B (6 hours)	pH	11.2	11.2	11.3	11.3	11.3	11.3	11.4	11.3	11.3	11.4
	ppm Au	0.37	0.41	0.40	0.42	0.41	0.39	0.38	0.42	0.40	0.40
	ppm Cu	24	23	23	24	25	24	26	26	24	25
	ppm Zn	1.8	1.4	1.4	1.5	1.5	1.3	1.4	1.4	1.3	1.4
	% NaCN	0.072	0.065	0.063	0.064	0.069	0.064	0.060	0.063	0.067	0.063
	% CaO	0.006	0.005	0.006	0.007	0.006	0.006	0.007	0.007	0.007	0.007
Gross after sample	g	2468.5	2487.8	2525.6	2506.9	2418.7	2513.5	2482.2	2515.9	2522.9	2509.0
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2525.2	2537.4	2575.7	2556.9	2475.3	2562.2	2531.7	2566.1	2572.1	2557.7
Pulp temperature	deg C	22	22	22	22	22	22	22	22	22	22
Liquor sample C (12 hours)	pH	11.2	11.2	11.3	11.3	11.3	11.2	11.3	11.2	11.2	11.3
	ppm Au	0.37	0.40	0.40	0.41	0.40	0.39	0.38	0.41	0.40	0.39
	ppm Cu	29	29	30	30	31	30	31	31	29	31
	ppm Zn	2.1	1.6	5.5	1.8	1.8	1.6	1.7	1.7	1.6	1.7
	% NaCN	0.062	0.059	0.059	0.060	0.062	0.062	0.060	0.061	0.062	0.061
	% CaO	0.005	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Gross after sample	g	2468.0	2482.8	2520.6	2501.4	2421.5	2507.8	2477.4	2511.7	2515.9	2502.3
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2526.3	2536.1	2574.3	2555.8	2473.7	2561.0	2530.3	2564.8	2571.3	2557.2
Pulp temperature	deg C	20	20	20	20	20	20	20	20	20	20
Liquor sample D (18 hours)	pH	11.2	11.1	11.2	11.2	11.3	11.2	11.3	11.2	11.2	11.3
	ppm Au	0.36	0.39	0.38	0.39	0.39	0.37	0.36	0.39	0.38	0.38
	ppm Cu	32	31	34	33	34	33	34	34	33	34
	ppm Zn	2.3	2.4	2.4	2.0	2.0	1.8	1.8	1.9	1.8	1.8
	% NaCN	0.056	0.054	0.055	0.053	0.058	0.056	0.056	0.054	0.057	0.056
	% CaO	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004
Gross after sample	g				2498.7	2418.6	2505.2	2473.2	2507.7	2512.9	2499.5
CaO added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs				6	6	6	6	6	6	6
Gross off rolls	g				2557.9	2474.4	2559.8	2531.0	2563.2	2570.2	2555.8
Pulp temperature	deg C				19	19	19	19	19	19	19
Liquor sample E (24 hours)	pH				11.1	11.1	11.1	11.2	11.1	11.1	11.2
	ppm Au				0.38	0.38	0.36	0.35	0.39	0.36	0.36
	ppm Cu				36	35	34	36	36	34	36
	ppm Zn				2.5	1.9	2.3	2.2	2.0	1.8	1.8
	% NaCN				0.050	0.055	0.053	0.053	0.053	0.053	0.054
	% CaO				0.003	0.004	0.004	0.004	0.004	0.004	0.004
Gross after sample	g								2512.2	2519.2	2502.1
CaO added	g								0.00	0.00	0.00
NaCN added	g								0.00	0.00	0.00
Leach time	hrs								8	8	8
Gross off rolls	g								2562.9	2569.7	2553.3
Pulp temperature	deg C								22	22	22
Liquor sample F (32 hours)	pH								11.0	11.0	11.1
	ppm Au								0.38	0.35	0.35
	ppm Cu								37	35	37
	ppm Zn								2.5	2.0	2.4
	% NaCN								0.047	0.048	0.047
	% CaO								0.005	0.005	0.005
Sample mass account											
Residue recovered (screened)	g	827.2	848.9	864.8	860.5	823.3	858.8	842.5	856.7	859.4	857.6
Ground head to assay	g	152.5	152.4	146.8	135.8	108.1	153.1	151.4	136.5	141.5	149.3
Calculated head to grind	g	979.7	1001.3	1011.6	996.3	1004.4	1011.9	993.9	993.2	1000.9	1006.9
Actual head to grind	g	1000.1	1006.8	1016.0	998.6	1009.8	1015.2	1005.7	1002.0	1009.7	1011.6
Unaccounted mass	%	2.04	0.55	0.43	0.23	0.53	0.33	0.98	0.88	0.87	0.46

BMT5731 Sheet 3 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 75um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**9A**	**Nom. P80um**	**75**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	183.8	22.2	77.8	0.25	0.22	0.24	43.19	30.2
- 75 + 53	112.8	13.6	64.1	0.21	0.21	0.21	23.69	16.6
- 53 + 38	68.3	8.3	55.9	0.20		0.20	13.66	9.6
- 38	462.3	55.9		0.14	0.13	0.14	62.41	43.7
Calculated	827.2	100.0				0.17	143.0	100.0
Test No.	**14B**	**Nom. P80um**	**75**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	228.9	27.0	73.0	0.29	0.28	0.29	65.24	34.6
- 75 + 53	97.2	11.5	61.6	0.26	0.26	0.26	25.27	13.4
- 53 + 38	61.5	7.2	54.3	0.28		0.28	17.22	9.1
- 38	461.3	54.3		0.18	0.17	0.18	80.73	42.8
Calculated	848.9	100.0				0.22	188.5	100.0
Test No.	**4C**	**Nom. P80um**	**75**	**Leach hrs**	**18**			
+ 150								
- 150 + 106								
- 106 + 75	204.9	23.7	76.3	0.24	0.26	0.25	51.23	26.2
- 75 + 53	117.9	13.6	62.7	0.33	0.26	0.30	34.78	17.8
- 53 + 38	75.0	8.7	54.0	0.21		0.21	15.75	8.1
- 38	467.0	54.0		0.19	0.21	0.20	93.40	47.9
Calculated	864.8	100.0				0.23	195.2	100.0
Test No.	**11A**	**Nom. P80um**	**75**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	231.9	26.9	73.1	0.23	0.22	0.23	52.18	32.7
- 75 + 53	106.7	12.4	60.7	0.22	0.22	0.22	23.47	14.7
- 53 + 38	65.3	7.6	53.1	0.20		0.20	13.06	8.2
- 38	456.6	53.1		0.15	0.16	0.16	70.77	44.4
Calculated	860.5	100.0				0.19	159.5	100.0
Test No.	**15B**	**Nom. P80um**	**75**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	167.4	20.3	79.7	0.25	0.25	0.25	41.85	25.1
- 75 + 53	123.7	15.0	64.6	0.25	0.25	0.25	30.93	18.6
- 53 + 38	67.3	8.2	56.5	0.22		0.22	14.81	8.9
- 38	464.9	56.5		0.18	0.16	0.17	79.03	47.4
Calculated	823.3	100.0				0.20	166.6	100.0

BMT5731 Sheet 4 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 75um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**3C**	**Nom. P80um**	**75**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	240.2	28.0	72.0	0.21	0.21	0.21	50.44	31.1
- 75 + 53	85.1	9.9	62.1	0.22	0.26	0.24	20.42	12.6
- 53 + 38	59.8	7.0	55.2	0.26		0.26	15.55	9.6
- 38	473.7	55.2		0.14	0.18	0.16	75.79	46.7
Calculated	858.8	100.0				0.19	162.2	100.0
Test No.	**6D**	**Nom. P80um**	**75**	**Leach hrs**	**24**			
+ 150								
- 150 + 106								
- 106 + 75	227.2	27.0	73.0	0.23	0.25	0.24	54.53	37.2
- 75 + 53	86.5	10.3	62.8	0.23	0.23	0.23	19.90	13.6
- 53 + 38	54.8	6.5	56.3	0.19		0.19	10.41	7.1
- 38	474.0	56.3		0.13	0.13	0.13	61.62	42.1
Calculated	842.5	100.0				0.17	146.5	100.0
Test No.	**12A**	**Nom. P80um**	**75**	**Leach hrs**	**32**			
+ 150								
- 150 + 106								
- 106 + 75	200.0	23.3	76.7	0.23	0.23	0.23	46.00	31.3
- 75 + 53	111.1	13.0	63.7	0.22	0.22	0.22	24.44	16.6
- 53 + 38	71.2	8.3	55.4	0.21		0.21	14.95	10.2
- 38	474.4	55.4		0.12	0.14	0.13	61.67	41.9
Calculated	856.7	100.0				0.17	147.1	100.0
Test No.	**16B**	**Nom. P80um**	**75**	**Leach hrs**	**32**			
+ 150								
- 150 + 106								
- 106 + 75	211.3	24.6	75.4	0.24	0.23	0.24	49.66	28.6
- 75 + 53	111.3	13.0	62.5	0.26	0.25	0.26	28.38	16.3
- 53 + 38	70.3	8.2	54.3	0.20		0.20	14.06	8.1
- 38	466.5	54.3		0.18	0.17	0.18	81.64	47.0
Calculated	859.4	100.0				0.20	173.7	100.0
Test No.	**5D**	**Nom. P80um**	**75**	**Leach hrs**	**32**			
+ 150								
- 150 + 106								
- 106 + 75	213.2	24.9	75.1	0.26	0.24	0.25	53.30	32.2
- 75 + 53	128.7	15.0	60.1	0.27	0.28	0.28	35.39	21.4
- 53 + 38	63.5	7.4	52.7	0.25		0.25	15.88	9.6
- 38	452.2	52.7		0.12	0.15	0.14	61.05	36.9
Calculated	857.6	100.0				0.19	165.6	100.0

BHT5731 Sheet 5 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BHT P 0.8		P80=75um (18 hours)			P80=75um (24 hours)			P80=75um (32 hours)		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.	Max	Min	Ave.	Max	Min
Nominal Grind 80% passing	um	75	75	75	75	75	75	75	75	75
Total leach time	hours	18	18	18	24	24	24	32	32	32
Extraction Au										
at 3 hours	g/t	0.61	0.61	0.60	0.59	0.61	0.57	0.60	0.61	0.60
at 6 hours	g/t	0.61	0.64	0.58	0.62	0.65	0.59	0.63	0.65	0.62
at 12 hours	g/t	0.63	0.65	0.60	0.64	0.66	0.61	0.65	0.66	0.63
at 18 hours	g/t	0.64	0.66	0.61	0.64	0.66	0.61	0.65	0.66	0.64
at 24 hours	g/t				0.65	0.67	0.62	0.65	0.68	0.63
at 32 hours	g/t							0.66	0.69	0.64
at 3 hours	%	72.5	76.6	69.9	71.4	73.9	69.5	71.5	72.0	71.1
at 6 hours	%	72.9	73.9	71.9	74.6	76.3	73.1	74.8	75.8	73.9
at 12 hours	%	75.1	77.1	73.7	76.6	77.8	74.5	76.4	76.9	75.7
at 18 hours	%	75.8	78.4	74.0	76.4	77.0	75.7	76.4	76.8	76.1
at 24 hours	%				77.7	78.4	77.0	77.0	79.3	75.5
at 32 hours	%							77.8	80.2	76.2
Calculated Head	ppm Au	0.84	0.88	0.78	0.83	0.87	0.79	0.84	0.86	0.83
Ground Head Assay 1	ppm Au	0.84	0.94	0.78	0.76	0.78	0.74	0.79	0.80	0.77
Ground Head Assay 2	ppm Au	0.76	0.79	0.73	0.78	0.84	0.74	0.77	0.80	0.75
Average Ground Head Assay	ppm Au	0.80	0.84	0.77	0.77	0.79	0.76	0.78	0.80	0.77
Calculated residue grade	ppm Au	0.21	0.23	0.17	0.19	0.20	0.17	0.19	0.20	0.17
Extraction Cu										
at 3 hours	g/t	31	31	30	31	33	30	33	34	31
at 6 hours	g/t	36	37	36	38	40	37	39	40	37
at 12 hours	g/t	47	47	46	48	49	47	48	49	46
at 18 hours	g/t	53	55	51	55	56	54	55	56	54
at 24 hours	g/t				60	61	57	60	61	57
at 32 hours	g/t							63	64	61
Assay Head	ppm Cu	298			298			298		
Extraction Zn										
at 3 hours	g/t	1.9	2.2	1.8	1.8	1.9	1.8	1.8	1.9	1.6
at 6 hours	g/t	2.4	2.8	2.2	2.2	2.3	2.0	2.1	2.2	2.0
at 12 hours	g/t	4.8	8.4	2.5	2.7	2.9	2.5	2.6	2.7	2.5
at 18 hours	g/t	3.9	4.1	3.8	3.1	3.3	2.9	3.0	3.1	2.9
at 24 hours	g/t				3.7	4.1	3.3	3.2	3.4	3.1
at 32 hours	g/t							3.9	4.2	3.5
Assay Head	ppm Zn	200			200			200		
NaCN consumption										
at 3 hours	kg/t	0.11	0.13	0.09	0.10	0.12	0.08	0.13	0.18	0.08
at 6 hours	kg/t	0.17	0.21	0.09	0.19	0.27	0.14	0.19	0.22	0.15
at 12 hours	kg/t	0.22	0.24	0.19	0.20	0.23	0.19	0.20	0.21	0.19
at 18 hours	kg/t	0.26	0.28	0.24	0.24	0.26	0.22	0.25	0.28	0.22
at 24 hours	kg/t				0.25	0.27	0.22	0.25	0.26	0.23
at 32 hours	kg/t							0.31	0.32	0.29
CaO consumption										
at 3 hours	kg/t	0.89	0.91	0.86	0.89	0.92	0.87	0.87	0.89	0.86
at 6 hours	kg/t	0.89	0.91	0.87	0.90	0.93	0.88	0.87	0.89	0.86
at 12 hours	kg/t	0.90	0.92	0.88	0.92	0.94	0.89	0.90	0.91	0.88
at 18 hours	kg/t	0.91	0.93	0.88	0.93	0.95	0.90	0.91	0.93	0.90
at 24 hours	kg/t				0.93	0.95	0.90	0.90	0.92	0.89
at 32 hours	kg/t							0.92	0.94	0.91
Actual grind passing nominated um (%)		75.7	77.8	73.0	74.4	79.7	72.0	75.7	76.7	75.1

Refer to report 'Discussion'.

BMT5731 Sheet 6 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 75um

Summary of Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	+ 38 ppm Au	- 38 ppm Au
18 hour residues								
9A	75	0.17			0.24	0.21	0.20	0.14
14B	75	0.22			0.29	0.26	0.28	0.18
4C	75	0.23			0.25	0.30	0.21	0.20
Average		0.21			0.26	0.26	0.23	0.17
24 hour residues								
11A	75	0.19			0.23	0.22	0.20	0.16
15B	75	0.20			0.25	0.25	0.22	0.17
3C	75	0.19			0.21	0.24	0.26	0.16
6D	75	0.17			0.24	0.23	0.19	0.13
Average		0.19			0.23	0.24	0.22	0.15
32 hour residues								
12A	75	0.17			0.23	0.22	0.21	0.13
16B	75	0.20			0.24	0.26	0.20	0.18
5D	75	0.19			0.25	0.28	0.25	0.14
Average		0.19			0.24	0.25	0.22	0.15

Summary of Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	+ 38 %	- 38 %
18 hour residues								
9A	75	0.17			30.2	16.6	9.6	43.7
14B	75	0.22			34.6	13.4	9.1	42.8
4C	75	0.23			26.2	17.8	8.1	47.9
Average		0.21			30.4	15.9	8.9	44.8
24 hour residues								
11A	75	0.19			32.7	14.7	8.2	44.4
15B	75	0.20			25.1	18.6	8.9	47.4
3C	75	0.19			31.1	12.6	9.6	46.7
6D	75	0.17			37.2	13.6	7.1	42.1
Average		0.19			31.5	14.9	8.4	45.2
32 hour residues								
12A	75	0.17			31.3	16.6	10.2	41.9
16B	75	0.20			28.6	16.3	8.1	47.0
5D	75	0.19			32.2	21.4	9.6	36.9
Average		0.19			30.7	18.1	9.3	41.9

1322

BMT P0.8
P80 = 106um
Sheets 1-6

1323

BMT5734 Sheet 1 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 106um

SUMMARY

Test No. (% solids)	Units	6A	9B	4D	7A	11B	13C	3D	8A	12B	14C
Nominal Grind 80% passing	um	106	106	106	106	106	106	106	106	106	106
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Extraction Au											
at 3 hours	g/t	0.60	0.55	0.54	0.57	0.60	0.57	0.55	0.52	0.61	0.57
at 6 hours	g/t	0.65	0.58	0.58	0.58	0.62	0.62	0.58	0.56	0.61	0.59
at 12 hours	g/t	0.68	0.60	0.60	0.58	0.63	0.63	0.58	0.58	0.62	0.63
at 18 hours	g/t	0.68	0.61	0.59	0.59	0.64	0.66	0.61	0.59	0.61	0.64
at 24 hours	g/t				0.60	0.64	0.65	0.60	0.61	0.62	0.65
at 32 hours	g/t								0.60	0.64	0.63
at 3 hours	%	69.6	70.6	69.3	43.6	73.8	68.0	69.9	66.4	73.7	68.3
at 6 hours	%	75.9	73.4	74.0	44.2	76.7	74.1	72.7	70.8	73.1	71.1
at 12 hours	%	78.7	76.2	76.8	44.7	77.7	75.0	73.6	73.3	74.0	75.6
at 18 hours	%	78.6	77.4	76.2	45.5	79.3	78.3	76.7	74.3	73.5	77.0
at 24 hours	%				46.1	78.8	77.8	76.0	77.0	74.7	78.2
at 32 hours	%								75.7	77.2	75.8
Calculated Head	ppm Au	0.86	0.79	0.78	1.31	0.81	0.84	0.79	0.79	0.83	0.83
Ground Head Assay 1	ppm Au	0.73	0.74	0.70	0.71	0.75	0.80	0.72	0.69	0.78	0.78
Ground Head Assay 2	ppm Au	0.74	0.74	0.74	0.72	0.70	0.75	0.76	0.70	0.74	0.76
Average Ground Head Assay	ppm Au	0.74	0.74	0.72	0.72	0.73	0.78	0.74	0.70	0.76	0.77
Calculated residue grade	ppm Au	0.19	0.18	0.19	0.71	0.17	0.19	0.19	0.19	0.19	0.20
Extraction Cu											
at 3 hours	g/t	30	33	31	31	33	31	31	28	28	31
at 6 hours	g/t	36	39	37	37	39	39	37	34	36	37
at 12 hours	g/t	47	48	48	48	49	48	48	43	44	48
at 18 hours	g/t	52	54	53	53	54	54	53	49	51	53
at 24 hours	g/t				59	61	58	58	52	56	56
at 32 hours	g/t								57	59	61
Assay Head	ppm Cu	298	(ave. of two head splits)								
Extraction Zn											
at 3 hours	g/t	1.6	1.6	1.6	1.8	1.6	2.1	1.6	1.5	1.6	1.5
at 6 hours	g/t	2.0	2.0	2.2	2.3	2.2	2.6	2.0	2.0	2.0	2.0
at 12 hours	g/t	2.4	2.5	2.7	3.0	3.1	3.3	2.7	2.5	2.7	2.5
at 18 hours	g/t	2.8	3.2	3.6	3.3	3.1	3.8	3.0	2.8	3.1	2.8
at 24 hours	g/t				3.7	3.4	4.2	3.5	3.2	3.2	3.1
at 32 hours	g/t								3.4	3.6	3.6
Assay Head	ppm Zn	200	(ave. of two head splits)								
NaCN consumption											
at 3 hours	kg/t	0.11	0.08	0.12	0.12	0.09	0.10	0.11	0.10	0.09	0.10
at 6 hours	kg/t	0.16	0.14	0.15	0.13	0.13	0.12	0.14	0.15	0.13	0.20
at 12 hours	kg/t	0.18	0.19	0.18	0.20	0.18	0.19	0.19	0.20	0.20	0.22
at 18 hours	kg/t	0.24	0.24	0.23	0.23	0.25	0.25	0.25	0.25	0.26	0.32
at 24 hours	kg/t				0.25	0.27	0.26	0.26	0.26	0.25	0.33
at 32 hours	kg/t								0.32	0.31	0.37
CaO consumption											
at 3 hours	kg/t	0.86	0.86	0.83	0.85	0.85	0.85	0.84	0.81	0.87	0.81
at 6 hours	kg/t	0.88	0.87	0.84	0.84	0.86	0.83	0.85	0.81	0.88	0.82
at 12 hours	kg/t	0.90	0.88	0.85	0.87	0.89	0.86	0.86	0.83	0.89	0.83
at 18 hours	kg/t	0.89	0.90	0.85	0.86	0.90	0.87	0.86	0.84	0.89	0.85
at 24 hours	kg/t				0.89	0.91	0.89	0.90	0.86	0.93	0.86
at 32 hours	kg/t								0.87	0.93	0.88
Actual grind passing nominated um (%)		76.9	78.4	77.3	76.6	76.6	75.7	75.6	75.4	76.5	76.7

Note: The 'actual grind passing nominated um' above are from the sizing of the residues. The coarser than nominated grinds were due to mill drive slippage. Refer to report under 'Discussion'.

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8HT5734 Sheet 2 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE 6MT P 0.8 ;

Nominated Grind P80 = 106um

tests conducted (data)		1/11	/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11	1/11
Test No.	Units	6A	9B	4D	7A	11B	13C	3D	8A	12B	14C
Grind 80% passing	um	106	106	106	106	106	106	106	106	106	106
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Vessel	g	406.9	407.7	407.8	405.8	407.7	406.5	408.5	407.6	408.2	408.0
Sample mass	g	861.1	838.1	844.9	852.4	843.4	859.8	847.6	897.1	843.7	831.8
Sitewater added	g	1292	1257	1267	1279	1265	1290	1271	1346	1266	1248
Natural pH											
CaO added	g	0.83	0.81	0.79	0.81	0.82	0.82	0.80	0.82	0.82	0.77
NaCN added	g	1.04	1.01	1.01	1.02	1.01	1.03	1.02	1.07	1.01	0.99
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2557.3	2502.8	2519.1	2536.2	2515.3	2555.0	2525.9	2649.7	2517.4	2486.1
Pulp temperature	deg C	21	21	21	21	21	21	21	21	21	21
Liquor sample A (3 hours)	pH	11.3	11.3	11.3	11.3	11.5	11.4	11.4	11.3	11.4	11.4
	ppm Au	0.40	0.37	0.36	0.38	0.40	0.38	0.37	0.35	0.41	0.38
	ppm Cu	20	22	21	21	22	21	21	19	19	21
	ppm Zn	1.1	1.1	1.1	1.2	1.1	1.4	1.1	1.0	1.1	1.0
	% NaCN	0.073	0.075	0.072	0.072	0.074	0.073	0.073	0.073	0.074	0.073
	% CaO	0.007	0.007	0.007	0.007	0.008	0.007	0.007	0.007	0.007	0.008
Gross after sample	g	2505.9	2451.4	2467.3	2484.2	2464.1	2505.6	2474.5	2598.7	2466.1	2434.4
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2556.7	2501.7	2517.9	2535.1	2514.1	2553.9	2525.0	2648.5	2516.1	2484.5
Pulp temperature	deg C	24	24	24	24	24	24	24	24	24	24
Liquor sample B (6 hours)	pH	11.2	11.2	11.3	11.3	11.4	11.3	11.3	11.2	11.3	11.3
	ppm Au	0.42	0.37	0.37	0.37	0.40	0.40	0.37	0.36	0.39	0.38
	ppm Cu	23	25	24	24	25	25	24	22	23	24
	ppm Zn	1.3	1.3	1.4	1.5	1.4	1.7	1.3	1.3	1.3	1.3
	% NaCN	0.067	0.068	0.067	0.068	0.068	0.069	0.068	0.067	0.068	0.063
	% CaO	0.005	0.004	0.006	0.007	0.007	0.008	0.006	0.007	0.006	0.007
Gross after sample	g	2504.8	2450.3	2466.6	2483.9	2462.9	2502.9	2473.8	2597.4	2465.2	2433.7
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2555.4	2499.9	2516.4	2533.9	2511.4	2551.8	2523.9	2647.1	2514.9	2482.4
Pulp temperature	deg C	24	24	24	24	24	24	24	24	24	24
Liquor sample C (12 hours)	pH	11.2	11.1	11.3	11.2	11.3	11.3	11.3	11.1	11.2	11.2
	ppm Au	0.42	0.37	0.37	0.36	0.39	0.39	0.36	0.36	0.38	0.39
	ppm Cu	30	30	30	30	31	30	30	27	28	30
	ppm Zn	1.5	1.6	1.7	1.9	2.0	2.1	1.7	1.6	1.7	1.6
	% NaCN	0.063	0.062	0.062	0.061	0.062	0.062	0.062	0.061	0.061	0.059
	% CaO	0.004	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.006
Gross after sample	g	2495.9	2442.7	2457.8	2473.5	2450.5	2491.0	2466.7	2590.5	2457.1	2424.6
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2554.3	2498.5	2515.6	2533.6	2510.7	2550.9	2525.5	2646.4	2513.9	2481.4
Pulp temperature	deg C	22	22	22	22	22	22	22	22	22	22
Liquor sample D (18 hours)	pH	11.2	11.1	11.3	11.2	11.3	11.2	11.2	11.1	11.2	11.2
	ppm Au	0.40	0.36	0.35	0.35	0.38	0.39	0.36	0.35	0.36	0.38
	ppm Cu	32	33	32	32	34	33	32	30	31	32
	ppm Zn	1.7	2.0	2.2	2.0	1.9	2.3	1.8	1.7	1.9	1.7
	% NaCN	0.056	0.056	0.056	0.056	0.055	0.055	0.055	0.055	0.054	0.050
	% CaO	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.004	0.005	0.004
Gross after sample	g				2476.7	2452.8	2493.4	2467.9	2588.6	2454.7	2424.0
CaO added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs				6	6	6	6	6	6	6
Gross off rolls	g				2532.9	2509.7	2550.1	2524.8	2644.8	2512.7	2480.1
Pulp temperature	deg C				21	21	21	21	21	21	21
Liquor sample E (24 hours)	pH				11.1	11.1	11.1	11.1	11	11.1	11.1
	ppm Au				0.34	0.36	0.37	0.34	0.35	0.35	0.37
	ppm Cu				35	36	34	34	31	33	33
	ppm Zn				2.2	2.0	2.5	2.1	1.9	1.9	1.8
	% NaCN				0.052	0.051	0.052	0.052	0.052	0.052	0.047
	% CaO				0.003	0.003	0.003	0.002	0.003	0.002	0.003
Gross after sample	g								2595.5	2461.4	2424.6
CaO added	g								0.00	0.00	0.00
NaCN added	g								0.00	0.00	0.00
Leach time	hrs								8	8	8
Gross off rolls	g								2644.3	2512.0	2479.4
Pulp temperature	deg C								26	26	26
Liquor sample F (32 hours)	pH								10.8	10.9	10.9
	ppm Au								0.33	0.35	0.34
	ppm Cu								33	34	35
	ppm Zn								2.0	2.1	2.1
	% NaCN								0.046	0.046	0.042
	% CaO								0.002	0.002	0.002
Sample mass account											
Residue recovered (screened)	g	855.0	824.5	836.6	848.4	838.2	853.0	842.0	889.3	832.3	824.6
Ground head to assay	g	173.5	165.3	157.4	155.7	165.4	155.8	165.9	110.1	156.6	166.5
Calculated head to grind	g	1028.5	989.8	994.0	1004.1	1001.6	1008.8	1007.9	999.4	988.9	991.1
Actual head to grind	g	1034.6	1003.4	1002.3	1008.1	1006.8	1015.6	1013.5	1007.2	1000.3	998.3
Unaccounted mass	%	0.59	1.36	0.83	0.40	0.52	0.67	0.55	0.77	1.14	0.72

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BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 106um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**6A**	**Nom. P80um**	**106**	**Leach hrs**	**18**			
+ 150	60.2	7.0	93.0	0.19		0.19	11.44	7.2
- 150 + 106	137.7	16.1	76.9	0.24	0.26	0.25	34.43	21.7
- 106 + 75	142.1	16.6	60.2	0.26	0.26	0.26	36.95	23.3
- 75 + 53	84.8	9.9	50.3	0.25	0.26	0.26	21.62	13.6
- 53 + 38	62.3	7.3	43.0	0.22		0.22	13.71	8.6
- 38	367.9	43.0		0.11	0.11	0.11	40.47	25.5
Calculated	855.0	100.0				0.19	158.6	100.0
Test No.	**9B**	**Nom. P80um**	**106**	**Leach hrs**	**18**			
+ 150	47.7	5.8	94.2	0.21		0.21	10.02	6.7
- 150 + 106	130.0	15.8	78.4	0.23	0.25	0.24	31.20	20.9
- 106 + 75	139.2	16.9	61.6	0.25	0.22	0.24	32.71	21.9
- 75 + 53	88.9	10.8	50.8	0.24	0.25	0.25	21.78	14.6
- 53 + 38	66.2	8.0	42.8	0.22		0.22	14.56	9.8
- 38	352.5	42.8		0.11	0.11	0.11	38.78	26.0
Calculated	824.5	100.0				0.18	149.0	100.0
Test No.	**4D**	**Nom. P80um**	**106**	**Leach hrs**	**18**			
+ 150	53.0	6.3	93.7	0.20		0.20	10.60	6.8
- 150 + 106	136.6	16.3	77.3	0.25	0.24	0.25	33.47	21.4
- 106 + 75	137.3	16.4	60.9	0.26	0.28	0.27	37.07	23.7
- 75 + 53	87.9	10.5	50.4	0.25	0.25	0.25	21.98	14.1
- 53 + 38	66.9	8.0	42.4	0.21		0.21	14.05	9.0
- 38	354.9	42.4		0.11	0.11	0.11	39.04	25.0
Calculated	836.6	100.0				0.19	156.2	100.0
Test No.	**7A**	**Nom. P80um**	**106**	**Leach hrs**	**24**			
+ 150	61.7	7.3	92.7	0.20		0.20	12.34	2.1
- 150 + 106	137.1	16.2	76.6	0.25	0.27	0.26	35.65	5.9
- 106 + 75	139.4	16.4	60.1	0.25	0.24	0.25	34.15	5.7
- 75 + 53	87.1	10.3	49.9	0.24	0.25	0.25	21.34	3.6
- 53 + 38	65.3	7.7	42.2	0.20		0.20	13.06	2.2
- 38	357.8	42.2		1.29	1.41	1.35	483.03	80.6
Calculated	848.4	100.0				0.71	599.6	100.0
Test No.	**11B**	**Nom. P80um**	**106**	**Leach hrs**	**24**			
+ 150	59.1	7.1	92.9	0.19		0.19	11.23	7.7
- 150 + 106	136.9	16.3	76.6	0.23	0.24	0.24	32.17	22.1
- 106 + 75	139.8	16.7	59.9	0.24	0.25	0.25	34.25	23.5
- 75 + 53	87.3	10.4	49.5	0.23	0.22	0.23	19.64	13.5
- 53 + 38	66.4	7.9	41.6	0.20		0.20	13.28	9.1
- 38	348.7	41.6		0.10	0.10	0.10	34.87	24.0
Calculated	838.2	100.0				0.17	145.4	100.0

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BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 106um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**13C**	**Nom. P80um**	**106**	**Leach hrs**	**24**			
+ 150	65.9	7.7	92.3	0.20		0.20	13.18	8.2
- 150 + 106	141.0	16.5	75.7	0.25	0.26	0.26	35.96	22.5
- 106 + 75	137.8	16.2	59.6	0.26	0.25	0.26	35.14	22.0
- 75 + 53	85.7	10.0	49.5	0.24	0.25	0.25	21.00	13.1
- 53 + 38	64.8	7.6	41.9	0.21		0.21	13.61	8.5
- 38	357.8	41.9		0.11	0.12	0.12	41.15	25.7
Calculated	853.0	100.0				0.19	160.0	100.0
Test No.	**3D**	**Nom. P80um**	**106**	**Leach hrs**	**24**			
+ 150	65.8	7.8	92.2	0.19		0.19	12.50	7.7
- 150 + 106	139.9	16.6	75.6	0.28	0.26	0.27	37.77	23.4
- 106 + 75	135.0	16.0	59.5	0.28	0.28	0.28	37.80	23.4
- 75 + 53	86.8	10.3	49.2	0.26	0.24	0.25	21.70	13.4
- 53 + 38	64.6	7.7	41.6	0.23		0.23	14.86	9.2
- 38	349.9	41.6		0.10	0.11	0.11	36.74	22.8
Calculated	842.0	100.0				0.19	161.4	100.0
Test No.	**8A**	**Nom. P80um**	**106**	**Leach hrs**	**32**			
+ 150	70.3	7.9	92.1	0.18		0.18	12.65	7.3
- 150 + 106	148.8	16.7	75.4	0.26	0.28	0.27	40.18	23.3
- 106 + 75	143.3	16.1	59.2	0.28	0.28	0.28	40.12	23.3
- 75 + 53	91.2	10.3	49.0	0.26	0.25	0.26	23.26	13.5
- 53 + 38	63.9	7.2	41.8	0.24		0.24	15.34	8.9
- 38	371.8	41.8		0.11	0.11	0.11	40.90	23.7
Calculated	889.3	100.0				0.19	172.4	100.0
Test No.	**12B**	**Nom. P80um**	**106**	**Leach hrs**	**32**			
+ 150	58.7	7.1	92.9	0.23		0.23	13.50	8.4
- 150 + 106	137.1	16.5	76.5	0.25	0.26	0.26	34.96	21.8
- 106 + 75	136.2	16.4	60.1	0.25	0.26	0.26	34.73	21.7
- 75 + 53	87.8	10.5	49.6	0.26	0.28	0.27	23.71	14.8
- 53 + 38	63.8	7.7	41.9	0.21		0.21	13.40	8.4
- 38	348.7	41.9		0.12	0.11	0.12	40.10	25.0
Calculated	832.3	100.0				0.19	160.4	100.0
Test No.	**14C**	**Nom. P80um**	**106**	**Leach hrs**	**32**			
+ 150	56.2	6.8	93.2	0.33		0.33	18.55	11.1
- 150 + 106	136.3	16.5	76.7	0.26	0.26	0.26	35.44	21.1
- 106 + 75	139.4	16.9	59.8	0.25	0.25	0.25	34.85	20.8
- 75 + 53	93.0	11.3	48.5	0.24	0.24	0.24	22.32	13.3
- 53 + 38	65.5	7.9	40.5	0.20		0.20	13.10	7.8
- 38	334.2	40.5		0.13	0.13	0.13	43.45	25.9
Calculated	824.6	100.0				0.20	167.7	100.0

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BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BHT P 0.8		P80=106um (18 hours)			P80=106um (24 hours)			P80=106um (32 hours)		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.(1)	Max (1)	Min (1)	Ave.	Max	Min
Nominal Grind 80% passing	um	106	106	106	106	106	106	106	106	106
Total leach time	hours	18	18	18	24	24	24	32	32	32
Extraction Au										
at 3 hours	g/t	0.56	0.60	0.54	0.57	0.60	0.55	0.57	0.61	0.52
at 6 hours	g/t	0.60	0.65	0.58	0.61	0.62	0.58	0.59	0.61	0.56
at 12 hours	g/t	0.62	0.68	0.60	0.61	0.63	0.58	0.61	0.63	0.58
at 18 hours	g/t	0.63	0.68	0.59	0.64	0.66	0.61	0.61	0.64	0.59
at 24 hours	g/t				0.63	0.65	0.60	0.63	0.65	0.61
at 32 hours	g/t							0.62	0.64	0.60
at 3 hours	%	69.8	70.6	69.3	70.6	73.8	68.0	69.5	73.7	66.4
at 6 hours	%	74.4	75.9	73.4	74.5	76.7	72.7	71.6	73.1	70.8
at 12 hours	%	77.2	78.7	76.2	75.4	77.7	73.6	74.3	75.6	73.3
at 18 hours	%	77.4	78.6	76.2	78.1	79.3	76.7	74.9	77.0	73.5
at 24 hours	%				77.5	78.8	76.0	76.7	78.2	74.7
at 32 hours	%							76.2	77.2	75.7
Calculated Head	ppm Au	0.81	0.86	0.78	0.81	0.84	0.79	0.82	0.83	0.79
Ground Head Assay 1	ppm Au	0.72	0.74	0.70	0.76	0.80	0.72	0.75	0.78	0.69
Ground Head Assay 2	ppm Au	0.74	0.74	0.74	0.74	0.76	0.70	0.73	0.76	0.70
Average Ground Head Assay	ppm Au	0.73	0.74	0.72	0.75	0.78	0.73	0.74	0.77	0.70
Calculated residue grade	ppm Au	0.18	0.19	0.18	0.18	0.19	0.17	0.20	0.20	0.19
Extraction Cu										
at 3 hours	g/t	31	33	30	32	33	31	29	31	28
at 6 hours	g/t	37	39	36	38	39	37	36	37	34
at 12 hours	g/t	48	48	47	48	49	48	45	48	43
at 18 hours	g/t	53	54	52	54	56	53	51	53	49
at 24 hours	g/t				59	61	58	55	56	52
at 32 hours	g/t							59	61	57
Assay Head	ppm Cu	298			298			298		
Extraction Zn										
at 3 hours	g/t	1.6	1.6	1.6	1.8	2.1	1.6	1.5	1.6	1.5
at 6 hours	g/t	2.1	2.2	2.0	2.3	2.6	2.0	2.0	2.0	2.0
at 12 hours	g/t	2.5	2.7	2.4	3.0	3.3	2.7	2.6	2.7	2.5
at 18 hours	g/t	3.2	3.6	2.8	3.3	3.8	3.0	2.9	3.1	2.8
at 24 hours	g/t				3.7	4.2	3.4	3.2	3.2	3.1
at 32 hours	g/t							3.6	3.6	3.4
Assay Head	ppm Zn	200			200			200		
NaCN consumption										
at 3 hours	kg/t	0.10	0.12	0.08	0.10	0.11	0.09	0.09	0.10	0.09
at 6 hours	kg/t	0.15	0.16	0.14	0.13	0.14	0.12	0.16	0.20	0.13
at 12 hours	kg/t	0.18	0.19	0.18	0.19	0.19	0.18	0.21	0.22	0.20
at 18 hours	kg/t	0.24	0.24	0.23	0.25	0.25	0.25	0.28	0.32	0.25
at 24 hours	kg/t				0.26	0.27	0.26	0.28	0.33	0.25
at 32 hours	kg/t							0.34	0.37	0.31
CaO consumption										
at 3 hours	kg/t	0.85	0.86	0.83	0.85	0.85	0.84	0.83	0.87	0.81
at 6 hours	kg/t	0.87	0.88	0.84	0.85	0.86	0.83	0.83	0.88	0.81
at 12 hours	kg/t	0.88	0.90	0.85	0.87	0.89	0.86	0.85	0.89	0.83
at 18 hours	kg/t	0.88	0.90	0.85	0.87	0.90	0.86	0.86	0.89	0.84
at 24 hours	kg/t				0.90	0.91	0.89	0.88	0.93	0.86
at 32 hours	kg/t							0.89	0.93	0.87
Actual grind passing nominated um (%)		77.5	78.4	76.9	76.0	76.6	75.6	76.[illegible]	[illegible].7	75.4

(1) Test 7A with anomolously high - 38um residue fraction assays omited.

BMT5734 Sheet 6 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 106um

Summary of Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	+ 38 ppm Au	- 38 ppm Au
18 hour residues								
6A	106	0.19	0.19	0.25	0.26	0.26	0.22	0.11
9B	106	0.18	0.21	0.24	0.24	0.25	0.22	0.11
4D	106	0.19	0.20	0.25	0.27	0.25	0.21	0.11
Average		0.18	0.20	0.25	0.26	0.25	0.22	0.11
24 hour residues								
7A	106							
11B	106	0.17	0.19	0.24	0.25	0.23	0.20	0.10
13C	106	0.19	0.20	0.26	0.26	0.25	0.21	0.12
3D	106	0.19	0.19	0.27	0.28	0.25	0.23	0.11
Average		0.18	0.19	0.25	0.26	0.24	0.21	0.11
32 hour residues								
8A	106	0.19	0.18	0.27	0.28	0.26	0.24	0.11
12B	106	0.19	0.23	0.26	0.26	0.27	0.21	0.12
14C	106	0.20	0.33	0.26	0.25	0.24	0.20	0.13
Average		0.20	0.25	0.26	0.26	0.26	0.22	0.12

Summary of Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	+ 38 %	- 38 %
18 hour residues								
6A	106	0.19	7.2	21.7	23.3	13.6	8.6	25.5
9B	106	0.18	6.7	20.9	21.9	14.6	9.8	26.0
4D	106	0.19	6.8	21.4	23.7	14.1	9.0	25.0
Average		0.18	6.9	21.4	23.0	14.1	9.1	25.5
24 hour residues								
7A	106							
11B	106	0.17	7.7	22.1	23.5	13.5	9.1	24.0
13C	106	0.19	8.2	22.5	22.0	13.1	8.5	25.7
3D	106	0.19	7.7	23.4	23.4	13.4	9.2	22.8
Average		0.18	7.9	22.7	23.0	13.4	8.9	24.2
32 hour residues								
8A	106	0.19	7.3	23.3	23.3	13.5	8.9	23.7
12B	106	0.19	8.4	21.8	21.7	14.8	8.4	25.0
14C	106	0.20	11.1	21.1	20.8	13.3	7.8	25.9
Average		0.20	8.9	22.1	21.9	13.9	8.4	24.9

Test 7A with anomolously high - 38um fraction assays has been omited from this summary of residues.

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BMT P0.8
P80 = 150um
Sheets 1-6

1330

BMT5735 Sheet 1 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;

Nominated Grind P80 = 150um

SUMMARY

Test No. (% solids)	Units	1A	5B	14D	3A	7B	9C	16D	4A	8B	11C
Nominal Grind 80% passing	um	150	150	150	150	150	150	150	150	150	150
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Extraction Au											
at 3 hours	g/t	0.51	0.48	0.48	0.48	0.48	0.45	0.48	0.49	0.42	0.47
at 6 hours	g/t	0.56	0.50	0.53	0.51	0.53	0.48	0.54	0.53	0.53	0.52
at 12 hours	g/t	0.58	0.58	0.55	0.55	0.55	0.52	0.57	0.55	0.55	0.55
at 18 hours	g/t	0.61	0.55	0.56	0.56	0.56	0.51	0.56	0.56	0.54	0.58
at 24 hours	g/t				0.55	0.56	0.52	0.55	0.56	0.56	0.56
at 32 hours	g/t								0.58	0.56	0.58
at 3 hours	%	57.6	57.5	55.7	59.1	58.4	58.1	42.9	58.8	49.8	55.6
at 6 hours	%	63.4	60.0	6 4	63.4	64.3	62.2	48.5	62.9	62.4	61.2
at 12 hours	%	65.9	69.5	63.8	67.7	66.8	66.8	50.6	65.4	64.7	65.2
at 18 hours	%	68.7	65.4	64.7	68.7	67.7	65.4	50.3	66.1	63.9	68.0
at 24 hours	%				67.6	68.5	67.7	49.5	67.0	66.4	65.9
at 32 hours	%								69.2	67.0	68.3
Calculated Head	ppm Au	0.88	0.83	0.86	0.81	0.82	0.77	1.12	0.84	0.84	0.85
Ground Head Assay 1	ppm Au	0.86	0.76	0.76	0.80	0.74	0.70	0.76	0.76	0.75	0.79
Ground Head Assay 2	ppm Au	0.77	0.77	0.77	0.86	0.74	0.71	0.74	0.76	0.80	0.80
Average Ground Head Assay	ppm Au	0.82	0.77	0.77	0.83	0.74	0.71	0.75	0.76	0.78	0.80
Calculated residue grade	ppm Au	0.28	0.29	0.31	0.26	0.26	0.25	0.57	0.26	0.28	0.27
Extraction Cu											
at 3 hours	g/t	28	30	28	28	28	27	27	24	28	26
at 6 hours	g/t	33	34	33	34	34	31	31	29	33	32
at 12 hours	g/t	40	42	40	41	41	38	38	35	38	37
at 18 hours	g/t	46	46	45	46	46	43	43	39	44	43
at 24 hours	g/t				50	51	47	46	43	48	46
at 32 hours	g/t								48	54	52
Assay Head	ppm Cu	298	(ave. of two head splits)								
Extraction Zn											
at 3 hours	g/t	1.5	1.5	3.4	1.5	1.6	1.5	1.6	1.5	1.6	1.7
at 6 hours	g/t	1.9	5.0	2.2	1.9	2.2	1.9	2.0	1.9	2.0	2.2
at 12 hours	g/t	2.4	2.5	2.6	2.5	2.7	2.4	2.4	2.2	2.4	2.5
at 18 hours	g/t	2.5	7.1	2.9	2.8	3.1	2.8	2.7	2.5	2.6	2.8
at 24 hours	g/t				3.0	9.1	2.9	2.9	3.6	2.9	3.2
at 32 hours	g/t								6.4	3.4	6.7
Assay Head	ppm Zn	200	(ave. of two head splits)								
NaCN consumption											
at 3 hours	kg/t	0.09	0.11	0.12	0.12	0.12	0.11	0.12	0.12	0.12	0.14
at 6 hours	kg/t	0.14	0.14	0.14	0.17	0.15	0.10	0.16	0.17	0.17	0.18
at 12 hours	kg/t	0.20	0.21	0.22	0.22	0.20	0.23	0.22	0.22	0.22	0.23
at 18 hours	kg/t	0.22	0.25	0.25	0.25	0.24	0.29	0.23	0.21	0.26	0.24
at 24 hours	kg/t				0.30	0.27	0.30	0.29	0.25	0.27	0.27
at 32 hours	kg/t								0.30	0.31	0.35
CaO consumption											
at 3 hours	kg/t	0.94	0.97	0.95	0.95	0.92	0.91	0.95	0.95	0.94	0.91
at 6 hours	kg/t	0.95	0.98	0.95	0.96	0.93	0.91	0.96	0.96	0.95	0.92
at 12 hours	kg/t	0.95	0.99	0.95	0.96	0.92	0.91	0.96	0.97	0.95	0.93
at 18 hours	kg/t	0.96	0.99	0.96	0.97	0.92	0.92	0.95	0.97	0.95	0.93
at 24 hours	kg/t				0.96	0.93	0.93	0.97	0.97	0.96	0.94
at 32 hours	kg/t								0.99	0.97	0.95
Actual grind passing nominated um (%)		70.4	67.0	66.5	66.3	66.0	65.9	67.2	65.3	65.1	63.1

Note: The 'actual grind passing nominated um' above are from the sizing of the residues. The coarser than nominated grinds were due to mill drive slippage. Refer to report under 'Discussion'.

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BHT5735 Sheet 2 26-Nov-89

BILLITON HT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BHT P 0.8

Nominated Grind P80 = 150

tests conducted (date)

Test No.	Units	1A	5B	14D	3A	7B	9C	16D	4A	8B	11C
Grind 80% passing	um	150	150	150	150	150	150	150	150	150	150
Total leach time	hours	18	18	18	24	24	24	24	32	32	32
Vessel	g	408.7	407.0	407.7	407.0	407.3	407.9	405.9	408.0	407.7	407.6
Sample mass	g	864.6	839.8	866.5	858.2	884.9	899.1	856.0	858.0	863.7	885.3
Sitewater added	g	1297	1260	1300	1287	1327	1349	1284	1287	1296	1329
Natural pH											
CaO added	g	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
NaCN added	g	1.04	1.01	1.04	1.05	1.06	1.07	1.03	1.08	1.04	1.06
Leach Time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2569.5	2505.9	2573.5	2551.5	2618.1	2655.3	2544.8	2551.2	2566.2	2519.1
Pulp temperature	deg C	22	22	22	22	22	22	22	22	22	22
Liquor sample A (3 hours)	pH	11.1	11.1	11.1	11.2	11.1	11.1	11.1	11.1	11.1	11.1
	ppm Au	0.34	0.32	0.32	0.32	0.32	0.30	0.32	0.33	0.28	0.34
	ppm Cu	19	20	19	19	19	18	18	16	19	19
	ppm Zn	1.0	1.0	2.3	1.0	1.1	1.0	1.1	1.0	1.1	1.2
	% NaCN	0.074	0.073	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.076
	% CaO	0.006	0.006	0.005	0.006	0.006	0.005	0.006	0.006	0.006	0.007
Gross after sample	g	2515.9	2452.4	2520.2	2498.4	2565.1	2602.0	2495.2	2499.2	2513.5	2467.3
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	3	3	3	3	3	3	3	3	3	3
Gross off rolls	g	2568.4	2506.0	2573.5	2550.5	2617.1	2654.2	2544.2	2550.1	2565.2	2517.9
Pulp temperature	deg C	25	25	25	25	25	25	25	25	25	25
Liquor sample B (6 hours)	pH	11.0	11.0	11.0	11.1	11.0	11.0	11.0	11.0	11.0	11.0
	ppm Au	0.36	0.32	0.34	0.33	0.34	0.31	0.35	0.34	0.34	0.36
	ppm Cu	21	22	21	22	22	20	20	19	21	22
	ppm Zn	1.2	3.3	1.4	1.2	1.4	1.2	1.3	1.2	1.3	1.5
	% NaCN	0.068	0.068	0.068	0.066	0.067	0.070	0.067	0.066	0.066	0.070
	% CaO	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006
Gross after sample	g	2514.7	2452.3	2520.1	2497.2	2564.2	2594.1	2490.4	2496.0	2513.3	2467.6
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2568.0	2504.3	257[illegible]	2559.0	2617.3	2655.2	2545.7	2549.8	2561.6	2517.2
Pulp temperature	deg C	25	25	25	25	25	25	25	25	25	25
Liquor sample C (12 hours)	pH	11.0	11.0	11.0	11.0	11.0	10.9	11.0	10.9	11.0	11.0
	ppm Au	0.36	0.36	0.34	0.34	0.34	0.32	0.35	0.34	0.34	0.37
	ppm Cu	25	26	25	26	26	24	24	22	24	25
	ppm Zn	1.5	1.5	1.6	1.6	1.7	1.5	1.5	1.4	1.5	1.7
	% NaCN	0.061	0.060	0.060	0.060	0.061	0.058	0.060	0.060	0.060	0.064
	% CaO	0.005	0.004	0.005	0.005	0.005	0.005	0.005	0.004	0.005	0.005
Gross after sample	g	2507.2	2445.1	2513.0	2490.9	2558.5	2590.8	2478.7	2495.5	2500.8	2458.9
CaO added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs	6	6	6	6	6	6	6	6	6	6
Gross off rolls	g	2566.3	2505.4	2570.9	2548.4	2616.1	2651.6	2544.3	2548.1	2560.1	2515.9
Pulp temperature	deg C	22	22	22	22	22	22	22	22	22	22
Liquor sample D (18 hours)	pH	11.0	10.9	11.0	11.0	11.0	10.9	10.9	10.9	11.0	11.0
	ppm Au	0.36	0.32	0.33	0.33	0.33	0.30	0.33	0.33	0.32	0.37
	ppm Cu	28	28	27	28	28	26	26	24	27	28
	ppm Zn	1.5	4.5	1.7	1.7	1.9	1.7	1.6	1.5	1.6	1.8
	% NaCN	0.057	0.055	0.055	0.055	0.056	0.052	0.056	0.058	0.055	0.060
	% CaO	0.004	0.004	0.004	0.004	0.005	0.004	0.005	0.004	0.005	0.005
Gross after sample	g				2491.6	2557.6	2596.1	2487.3	2489.9	2503.2	2458.0
CaO added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
NaCN added	g				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leach time	hrs				6	6	6	6	6	6	6
Gross off rolls	g				2547.5	2615.2	2650.6	2543.5	2548.0	2559.7	2515.2
Pulp temperature	deg C				22	22	22	22	22	22	22
Liquor sample E (24 hours)	pH				10.9	10.8	10.8	10.9	10.8	10.9	10.9
	ppm Au				0.31	0.32	0.30	0.31	0.32	0.32	0.34
	ppm Cu				29	30	28	27	25	28	29
	ppm Zn				1.8	5.8	1.7	1.7	2.2	1.7	2.0
	% NaCN				0.049	0.051	0.049	0.050	0.053	0.052	0.055
	% CaO				0.004	0.004	0.005	0.004	0.004	0.004	0.004
Gross after sample	g								2494.2	2505.8	2460.7
CaO added	g								0.00	0.00	0.00
NaCN added	g								0.00	0.00	0.00
Leach time	hrs								8	8	8
Gross off rolls	g								2543.6	2558.8	2514.4
Pulp temperature	deg C								29	29	29
Liquor sample F (32 hours)	pH								10.6	10.6	10.6
	ppm Au								0.32	0.31	0.34
	ppm Cu								28	31	32
	ppm Zn								4.0	2.0	4.5
	% NaCN								0.047	0.047	0.047
	% CaO								0.002	0.003	0.003
Sample mass account											
Residue recovered (screened)	g	856.2	832.9	857.2	852.7	879.7	893.8	850.2	848.5	857.0	872.8
Ground head to assay	g	144.4	166.6	142.5	144.2	137.5	136.3	144.9	145.6	141.9	145.1
Calculated head to grind	g	1000.6	999.5	999.7	996.9	1017.2	1030.1	995.1	994.1	998.9	1017.9
Actual head to grind	g	1009.0	1006.4	1009.0	1002.4	1022.4	1035.4	1000.9	1003.6	1008.6	1028.4
Unaccounted mass	%	0.83	0.69	0.92	0.55	0.51	0.51	0.58	0.95	0.96	1.02

BMT5735 Sheet 3 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8 ;
Nominated Grind P80 = 150um
Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No.	**1A**	**Nom. P80um**	**150**	**Leach hrs**	**18**			
+ 150	253.5	29.6	70.4	0.35	0.36	0.36	89.99	37.6
- 150 + 106	136.5	15.9	54.4	0.39	0.40	0.40	53.92	22.5
- 106 + 75	86.7	10.1	44.3	0.35		0.35	30.35	12.7
- 75 + 53	59.6	7.0	37.4	0.35		0.35	20.86	8.7
- 53 + 38	46.8	5.5	31.9	0.25		0.25	11.70	4.9
- 38	273.1	31.9		0.12	0.12	0.12	32.77	13.7
Calculated	856.2	100.0				0.28	239.6	100.0
Test No.	**5B**	**Nom. P80um**	**150**	**Leach hrs**	**18**			
+ 150	274.8	33.0	67.0	0.29	0.28	0.29	78.32	32.4
- 150 + 106	106.0	12.7	54.3	0.36	0.37	0.37	38.69	16 0
- 106 + 75	81.0	9.7	[illegible]	[illegible]		0.34	27.54	[illegible]
- 75 + 53	59.8	7.2	37.4	0.29		0.29	17.34	7.2
- 53 + 38	41.8	5.0	32.4	0.24		0.24	10.03	4.1
- 38	269.5	32.4		0.26	0.26	0.26	70.07	29.0
Calculated	832.9	100.0				0.29	242.0	100.0
Test No.	**14D**	**Nom. P80um**	**150**	**Leach hrs**	**18**			
+ 150	287.1	33.5	66.5	0.32	0.33	0.33	93.31	35.4
- 150 + 106	115.5	13.5	53.0	0.37	0.39	0.38	43.89	16.6
- 106 + 75	83.5	9.7	43.3	0.34		0.34	28.39	10.8
- 75 + 53	61.6	7.2	36.1	0.26		0.26	16.02	6.1
- 53 + 38	44.2	5.2	30.9	0.24		0.24	10.61	4.0
- 38	265.3	30.9		0.26	0.28	0.27	71.63	27.1
Calculated	857.2	100.0				0.31	263.8	100.0
Test No.	**3A**	**Nom. P80um**	**150**	**Leach hrs**	**24**			
+ 150	287.2	33.7	66.3	0.32	0.33	0.33	93.34	41.4
- 150 + 106	110.2	12.9	53.4	0.39	0.36	0.38	41.33	18.3
- 106 + 75	82.1	9.6	43.8	0.35		0.35	28.73	12.8
- 75 + 53	61.8	7.2	36.5	0.29		0.29	17.92	8.0
- 53 + 38	44.2	5.2	31.3	0.24		0.24	10.61	4.7
- 38	267.2	31.3		0.13	0.12	0.13	33.40	14.8
Calculated	852.7	100.0				0.26	225.3	100.0
Test No.	**7B**	**Nom. P80um**	**150**	**Leach hrs**	**24**			
+ 150	299.2	34.0	66.0	0.31	0.31	0.31	92.75	40.5
- 150 + 106	113.2	12.9	53.1	0.39	0.41	0.40	45.28	19.8
- 106 + 75	83.0	9.4	43.7	0.33		0.33	27.39	12.0
- 75 + 53	63.6	7.2	36.5	0.28		0.28	17.81	7.8
- 53 + 38	44.7	5.1	31.4	0.31		0.31	13.86	6.1
- 38	276.0	31.4		0.12	0.11	0.12	31.74	13.9
Calculated	879.7	100.0				0.26	228.8	100.0

1333.

BMT5735 Sheet 4 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 150um

Leach Residue Gold Distribution

Particle size um	Mass g	Mass % Retained	Cum. Mass Passing	Assay ppm Au	Assay ppm Au	Ave. assay ppm Au	Contents ug Au	Distrib'n Au %
Test No. 9C	Nom. P80um	150	Leach hrs	24				
+ 150	305.1	34.1	65.9	0.32	0.29	0.31	93.06	41.4
- 150 + 106	124.9	14.0	51.9	0.36	0.35	0.36	44.34	19.7
- 106 + 75	79.1	8.8	43.0	0.31		0.31	24.52	10.9
- 75 + 53	58.7	6.6	36.5	0.27		0.27	15.85	7.0
- 53 + 38	45.0	5.0	31.4	0.30		0.30	13.50	6.0
- 38	281.0	31.4		0.12	0.12	0.12	33.72	15.0
Calculated	893.8	100.0				0.25	225.0	100.0
Test No. 16D	Nom. P80um	150	Leach hrs	24				
+ 150	278.8	32.8	67.2	0.34	0.35	0.35	96.19	19.9
- 150 + 106	110.0	12.9	54.3	0.39	0.38	0.39	42.35	8.8
- 106 + 75	83.0	9.8	44.5	0.33		0.33	27.39	5.7
- 75 + 53	61.8	7.3	37.2	0.29		0.29	17.92	3.7
- 53 + 38	44.8	5.3	32.0	0.25		0.25	11.20	2.3
- 38	271.8	32.0		1.12	1.00	1.06	288.11	59.6
Calculated	850.2	100.0				0.57	483.2	100.0
Test No. 4A	Nom. P80um	150	Leach hrs	32				
+ 150	294.3	34.7	65.3	0.32	0.33	0.33	95.65	43.1
- 150 + 106	108.0	12.7	52.6	0.35	0.39	0.37	39.96	18.0
- 106 + 75	80.3	9.5	43.1	0.33		0.33	26.50	11.9
- 75 + 53	60.8	7.2	36.0	0.28		0.28	17.02	7.7
- 53 + 38	45.8	5.4	30.6	0.23		0.23	10.53	4.7
- 38	259.3	30.6		0.13	0.12	0.13	32.41	14.6
Calculated	848.5	100.0				0.26	222.1	100.0
Test No. 8B	Nom. P80um	150	Leach hrs	32				
+ 150	298.9	34.9	65.1	0.33	0.31	0.32	95.65	39.8
- 150 + 106	107.7	12.6	52.6	0.36	0.36	0.36	38.77	16.1
- 106 + 75	83.1	9.7	42.9	0.35		0.35	29.09	12.1
- 75 + 53	60.4	7.0	35.8	0.29		0.29	17.52	7.3
- 53 + 38	51.2	6.0	29.8	0.24		0.24	12.29	5.1
- 38	255.7	29.8		0.19	0.18	0.19	47.30	19.7
Calculated	857.0	100.0				0.28	240.6	100.0
Test No. 11C	Nom. P80um	150	Leach hrs	32				
+ 150	322.0	36.9	63.1	0.33	0.35	0.34	109.48	46.0
- 150 + 106	105.4	12.1	51.0	0.38	0.40	0.39	41.11	17.3
- 106 + 75	80.9	9.3	41.8	0.32		0.32	25.89	10.9
- 75 + 53	64.7	7.4	34.3	0.26		0.26	16.82	7.1
- 53 + 38	43.6	5.0	29.4	0.23		0.23	10.03	4.2
- 38	256.2	29.4		0.14	0.13	0.14	34.59	14.5
Calculated	872.8	100.0				0.27	237.9	100.0

BHT5735 Sheet 5 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS.

COMPOSITE BHT P 0.8		P80=150um (18 hours)			P80=150um (24 hours)			P80=150um (32 hours)		
ANALYSIS										
Test No. (% solids)	Units	Ave.	Max	Min	Ave.(1)	Max (1)	Min (1)	Ave.	Max	Min
Nominal Grind 80% passing	um	150	150	150	150	150	150	150	150	150
Total leach time	hours	18	18	18	24	24	24	32	32	32
Extraction Au										
at 3 hours	g/t	0.49	0.51	0.48	0.47	0.48	0.45	0.46	0.49	0.42
at 6 hours	g/t	0.53	0.56	0.50	0.51	0.53	0.48	0.53	0.53	0.52
at 12 hours	g/t	0.57	0.58	0.55	0.54	0.55	0.52	0.55	0.55	0.55
at 18 hours	g/t	0.57	0.61	0.55	0.54	0.56	0.51	0.56	0.58	0.54
at 24 hours	g/t				0.55	0.56	0.52	0.56	0.56	0.56
at 32 hours	g/t							0.58	0.58	0.56
at 3 hours	%	56.9	57.6	55.7	58.5	59.1	58.1	54.7	58.8	49.8
at 6 hours	%	61.6	63.4	60.0	63.3	64.3	62.2	62.2	62.9	61.2
at 12 hours	%	66.4	69.5	63.8	67.1	67.7	66.8	65.1	65.4	64.7
at 18 hours	%	66.3	68.7	64.7	67.2	68.7	65.4	66.0	68.0	63.9
at 24 hours	%				67.9	68.5	67.6	66.4	67.0	65.9
at 32 hours	%							68.2	69.2	67.0
Calculated Head	ppm Au	0.86	0.88	0.83	0.80	0.82	0.77	0.84	0.85	0.84
Ground Head Assay 1	ppm Au	0.79	0.86	0.76	0.75	0.80	0.70	0.77	0.79	0.75
Ground Head Assay 2	ppm Au	0.77	0.77	0.77	0.77	0.86	0.71	0.79	0.80	0.76
Average Ground Head Assay	ppm Au	0.78	0.82	0.77	0.76	0.83	0.71	0.78	0.80	0.76
Calculated residue grade	ppm Au	0.29	0.31	0.28	0.26	0.26	0.25	0.27	0.28	0.26
Extraction Cu										
at 3 hours	g/t	29	30	28	28	28	27	26	28	24
at 6 hours	g/t	33	34	33	33	34	31	31	33	29
at 12 hours	g/t	40	42	40	40	41	38	37	38	35
at 18 hours	g/t	46	46	45	45	46	43	42	44	39
at 24 hours	g/t				49	51	47	45	48	43
at 32 hours	g/t							51	54	48
Assay Head	ppm Cu	298			298			298		
Extraction Zn										
at 3 hours	g/t	2.1	3.4	1.5	1.5	1.6	1.5	1.6	1.7	1.5
at 6 hours	g/t	3.0	5.0	1.9	2.0	2.2	1.9	2.0	2.2	1.9
at 12 hours	g/t	2.5	2.6	2.4	2.5	2.7	2.4	2.4	2.5	2.2
at 18 hours	g/t	4.2	7.1	2.5	2.9	3.1	2.8	2.6	2.8	2.5
at 24 hours	g/t				5.0	9.1	2.9	3.2	3.6	2.9
at 32 hours	g/t							5.5	6.7	3.4
Assay Head	ppm Zn	200			200			200		
NaCN consumption										
at 3 hours	kg/t	0.11	0.12	0.09	0.12	0.12	0.11	0.13	0.14	0.12
at 6 hours	kg/t	0.14	0.14	0.14	0.14	0.17	0.10	0.17	0.18	0.17
at 12 hours	kg/t	0.21	0.22	0.20	0.22	0.23	0.20	0.22	0.23	0.22
at 18 hours	kg/t	0.24	0.25	0.22	0.26	0.29	0.24	0.24	0.26	0.21
at 24 hours	kg/t				0.29	0.30	0.27	0.26	0.27	0.25
at 32 hours	kg/t							0.32	0.35	0.30
CaO consumption										
at 3 hours	kg/t	0.95	0.97	0.94	0.93	0.95	0.91	0.93	0.95	0.91
at 6 hours	kg/t	0.96	0.98	0.95	0.93	0.96	0.91	0.94	0.96	0.92
at 12 hours	kg/t	0.96	0.99	0.95	0.93	0.96	0.91	0.95	0.97	0.93
at 18 hours	kg/t	0.97	0.99	0.96	0.94	0.97	0.92	0.95	0.97	0.93
at 24 hours	kg/t				0.94	0.96	0.93	0.95	0.97	0.94
at 32 hours	kg/t							0.97	0.99	0.95
Actual grind passing nominated um (%)		68.0	70.4	66.5	66.1	66.3	65.9	64.5	65.3	63.1

(1) Test 160 with anomolously high - 38um fraction assays omited.

BMT5735 Sheet 6 26-Nov-89

BILLITON MT TODD LOW GRADE PRIMARY ORE BOTTLE ROLL CYANIDE LEACH AT 40% SOLIDS; COMPOSITE BMT P 0.8

Nominated Grind P80 = 150um

Summary of Residue Size Fraction Assays

Sample Identification	Grind P80 um	Head ppm Au	+ 150 ppm Au	+ 106 ppm Au	+ 75 ppm Au	+ 53 ppm Au	+ 38 ppm Au	- 38 ppm Au
18 hour residues								
1A	150	0.28	0.36	0.40	0.35	0.35	0.25	0.12
5B	150	0.29	0.29	0.37	0.34	0.29	0.24	0.26
14D	150	0.31	0.33	0.38	0.34	0.26	0.24	0.27
Average		0.29	0.32	0.38	0.34	0.30	0.24	0.22
24 hour residues								
3A	150	0.26	0.33	0.38	0.35	0.29	0.24	0.13
7B	150	0.26	0.31	0.40	0.33	0.28	0.31	0.12
9C	150	0.25	0.31	0.36	0.31	0.27	0.30	0.12
16D	150							
Average		0.26	0.31	0.38	0.33	0.28	0.28	0.12
32 hour residues								
4A	150	0.26	0.33	0.37	0.33	0.28	0.23	0.13
8B	150	0.28	0.32	0.36	0.35	0.29	0.24	0.19
11C	150	0.27	0.34	0.39	0.32	0.26	0.23	0.14
Average		0.27	0.33	0.37	0.33	0.28	0.23	0.15

Summary of Residue Size Fraction Gold Distribution

Sample Identification	Grind P80 um	Head ppm Au	+ 150 %	+ 106 %	+ 75 %	+ 53 %	+ 38 %	- 38 %
18 hour residues								
1A	150	0.28	37.6	22.5	12.7	8.7	4.9	13.7
5B	150	0.29	32.4	16.0	11.4	7.2	4.1	29.0
14D	150	0.31	35.4	16.6	10.8	6.1	4.0	27.1
Average		0.29	35.1	18.4	11.6	7.3	4.3	23.3
24 hour residues								
3A	150	0.26	41.4	18.3	12.8	8.0	4.7	14.8
7B	150	0.26	40.5	19.8	12.0	7.8	6.1	13.9
9C	150	0.25	41.4	19.7	10.9	7.0	6.0	15.0
16D	150							
Average		0.26	41.1	19.3	11.9	7.6	5.6	14.6
32 hour residues								
4A	150	0.26	43.1	18.0	11.9	7.7	4.7	14.6
8B	150	0.28	39.8	16.1	12.1	7.3	5.1	19.7
11C	150	0.27	46.0	17.3	10.9	7.1	4.2	14.5
Average		0.27	42.9	17.1	11.6	7.3	4.7	16.3

Test 16D with anomolously high - 38um fraction assays omited from this summary of residues.

APPENDIX 1
Sheet 1

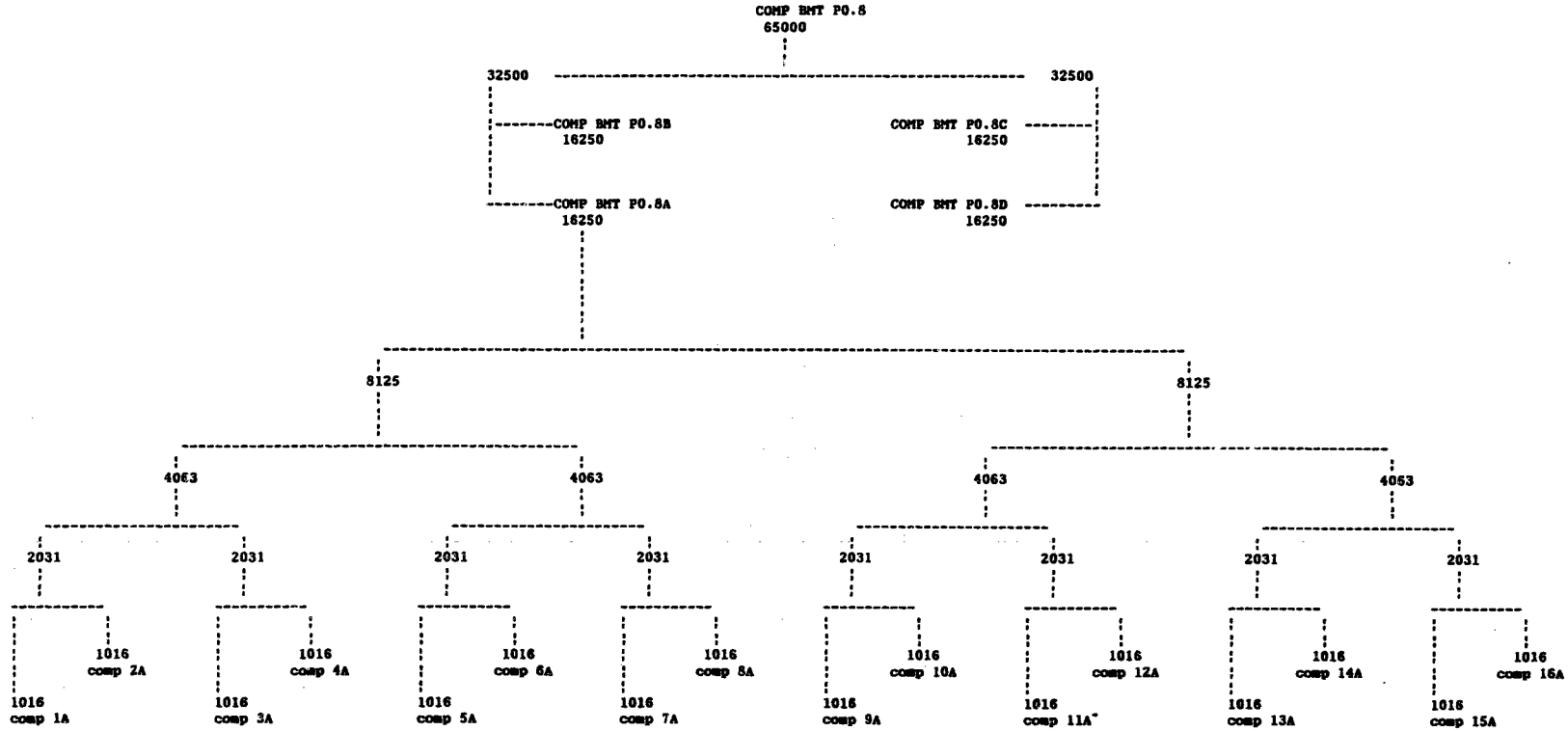
sheet 1
PRIMARY ORE DRILL CORE SAMPLE FOR COMPOSITE BMT P0.8

north	drill hole number	from	to	m	Av. RL	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
9850	BD057	69	70	1.0		0.19		3144	1903
		70	71	1.0		0.09		3114	1971
		71	72	1.0		0.65		3551	2093
		72	73	1.0		0.01		3384	1959
		73	74	1.0		2.22		3817	2083
		74	75	1.0		3.04		3908	1902
		75	76	1.0		0.94		3878	1901
		76	77	1.0		0.51		4027	2094
		77	78	1.0		0.15		3470	2100
		78	79	1.0	108	0.45	0.83	3386	2103
9900	BD069	115	116	1.0		1.30		3836	1904
		116	117	1.0		0.52		4626	1983
		117	118	1.0		0.90		3492	1920
		118	119	1.0		1.34		4211	2062
		119	120	1.0		0.52		3016	2103
		120	121	1.0		0.58		4999	1959
		121	122	1.0		1.09		3266	1976
		122	123	1.0		0.19		3945	1982
		123	124	1.0	57	0.76	0.80	3702	1941
10000	BD001	186	187	1.0		0.41		2218	2025
		187	188	1.0		1.15		2162	2085
		188	189	1.0		0.79		2202	2027
		189	190	1.0		1.61		2256	2089
		190	191	1.0		0.40		2369	2078
		191	192	1.0		0.58		2435	2040
		192	193	1.0		0.96		2246	2045
		193	194	1.0		0.86		2440	2048
		194	195	1.0		0.73		2549	2013
		195	196	1.0		1.19		2379	1995
		196	197	1.0	0	0.70	0.85	2425	1935
10100	BD076	196	197	1.0		1.13		1753	1664
		197	198	1.0		0.32		2039	1941
		198	199	1.0		1.11		2232	2055
		199	200	1.0		0.65		2120	2051
		200	201	1.0		0.69		2513	1981
		201	202	1.0		0.81		2309	1963
		202	203	1.0	-18	0.98	0.81	2491	1940

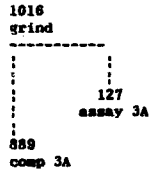
sheet 2
PRIMARY ORE DRILL CORE SAMPLE FOR COMPOSITE BMT P0.8

north	drill hole number	from	to	m	Av. RL	grade g/t	average core grade g/t	wt. of sample received gms	sample wt. to comp. gms
10150	BD035	90	91	1.0		0.75		3254	2010
		91	92	1.0		0.64		4006	1969
		92	93	1.0		0.20		4145	1986
		93	94	1.0		0.28		3376	2035
		94	95	1.0		1.30		3958	1953
		95	96	1.0		1.14		3935	1957
		96	97	1.0		0.23		3787	1969
		97	98	1.0		0.99		4307	2065
		98	99	1.0		1.56		3353	2032
		99	100	1.0	105	0.63	0.77	4318	2095
10200	BD009	109	110	1.0		0.80		4055	1983
		110	111	1.0		0.87		4454	2060
		111	112	1.0		0.88		4141	2021
		112	113	1.0		0.51		5283	1968
		113	114	1.0		0.49		3780	1930
		114	115	1.0		0.82		5082	1917
		115	116	1.0		1.55		4426	2067
		116	117	1.0		0.68		4526	2045
		117	118	1.0		0.57		4403	2056
		118	119	1.0		1.10		4055	2073
		119	120	1.0	90	1.06	0.85	2853	2068
10250	BD065	114	115	1.0		0.61		4252	2025
		115	116	1.0		0.57		4136	2011
		116	117	1.0		0.65		3688	2140
		117	118	1.0		1.24		4026	1950
		118	119	1.0		0.88		4030	2032
		119	120	1.0		0.49		3698	2085
		120	121	1.0		1.26		4254	2086
		121	122	1.0		1.00		3827	2087
		122	123	1.0	77	0.55	0.81	4819	2053
Sample received but not included in Composite BMT P0.8									
10200	BD027	211	212	1.0		1.35		2152	2064
		212	213	1.0		0.51		1955	1868
		213	214	1.0		0.59		1974	1892
		214	215	1.0		1.83		2134	2041
		215	216	1.0		0.28		2192	2087
		216	217	1.0		1.12		2790	2036
		217	218	1.0	-27	0.31	0.86	missing	

sheet 1
FLOW SHEET TO RIFFLE DOWN PRIMARY ORE COMPOSITE BMT P0.8



TYPICAL FOR ALL COMPOSITES



APPENDIX 2

sheet 2
LEACH TEST PROGRAM : PRIMARY ORE COMPOSITE P0.8

COMPOSITE BMT P0.8A TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1A	1016	LEACH	150	18
2A	1016	ASSAY		
3A	1016	LEACH	150	24
4A	1016	LEACH	150	32
5A	1016	RESERVE		
6A	1016	LEACH	106	18
7A	1016	LEACH	106	24
8A	1016	LEACH	106	32
9A	1016	LEACH	75	18
10A	1016	ASSAY		
11A	1016	LEACH	75	24
12A	1016	LEACH	75	32
13A	1016	LEACH	53	18
14A	1016	LEACH	53	24
15A	1016	LEACH	53	32
16A	1016	LEACH	38	24

COMPOSITE BMT P0.8B TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1B	1016	LEACH	53	18
2B	1016	ASSAY		
3B	1016	LEACH	53	24
4B	1016	LEACH	53	32
5B	1016	LEACH	150	18
6B	1016	RESERVE		
7B	1016	LEACH	150	24
8B	1016	LEACH	150	32
9B	1016	LEACH	106	18
10B	1016	ASSAY		
11B	1016	LEACH	106	24
12B	1016	LEACH	106	32
13B	1016	LEACH	38	24
14B	1016	LEACH	75	18
15B	1016	LEACH	75	24
16B	1016	LEACH	75	32

COMPOSITE BMT P0.8C TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1C	1016	RESERVE		
2C	1016	ASSAY		
3C	1016	LEACH	75	24
4C	1016	LEACH	75	18
5C	1016	RESERVE		
6C	1016	LEACH	38	24
7C	1016	LEACH	53	18
8C	1016	LEACH	53	24
9C	1016	LEACH	150	24
10C	1016	ASSAY		
11C	1016	LEACH	150	32
12C	1016	RESERVE		
13C	1016	LEACH	106	24
14C	1016	LEACH	106	32
15C	1016	RESERVE		
16C	1016	RESERVE		

COMPOSITE BMT P0.8D TEST PROGRAM				
comp sub sample	wt.	test	GRIND P80 um	LEACH TIME hrs
1D	1016	LEACH	38	24
2D	1016	ASSAY		
3D	1016	LEACH	106	24
4D	1016	LEACH	106	18
5D	1016	LEACH	75	32
6D	1016	LEACH	75	24
7D	1016	RESERVE		
8D	1016	RESERVE		
9D	1016	LEACH	53	24
10D	1016	ASSAY		
11D	1016	RESERVE		
12D	1016	LEACH	53	32
13D	1016	RESERVE		
14D	1016	LEACH	150	18
15D	1016	RESERVE		
16D	1016	LEACH	150	24

SAMPLE GRIND PREPARATION
Each charge ground @ 50% solids.
Weigh rods before & after grinding.

LEACH CONDITIONS FOR EACH TEST

Cyanide (NaCN) concentration	: 0.05
Lime (CaO) concentration	: 0.01
Pulp pH	: 11.0
Pulp density (% solids)	: 40.0
Pulp temperature (degree C)	:ambient

SAMPLING FOR EACH LEACH TEST
Head assay samples to be pulverized prior to duplicate fire assay.
Duplicate fire assays required on ground head samples
Liquor sample to be taken @ 3,6,12,18,24,32 hours.
Each liquor sample to be assayed for NaCN,CaO,pH,Au,Cu,Zn.
Final liquor for each sample to be assayed for soluble S.
Residue solids to be screened on 150,106,75,53 & 38 um
and fractions fire assayed for Au.
Duplicate fire assays required on residue sized fractions if sufficient sample.
Assay head samples 2A & 10C for Cu,Zn,Ag,Pb,As,Fe,& S.

APPENDIX 3

MOUNT TODD GOLD PROJECT

REPORT ON GOULDIAN FINCH INVESTIGATIONS

IN THE YINBERRIE HILLS, NORTHERN TERRITORY

08.4674

by

Brett A Lane and Denise Goodfellow

Prepared by: Brett A Lane Pty. Ltd.
12/262 Barkly Street,
North Fitzroy, Vic., 3068
Ph (03) 481 6597

Denise Goodfellow
P.O. Box 39373,
Winellie,
N.T., 0821
Ph (089) 81 8492

for: Kinhill Engineers Pty. Ltd.
Billiton Australia Gold Pty. Ltd.

date: March 1989

Billiton Australia Gold Pty. Ltd.
Incorporated in Western Australia

Shell House,
1 Spring Street, Melbourne, 3000
P.O. Box 872K, Melbourne, 3001
Facsimile: (03) 666 5839
Telex: AA 134867 SHELL
Telephone: (03) 666 5444

Date 1 September, 1989

FOREWORD

This report on investigations into the status of the Gouldian Finch and its breeding habitat in the Yinberrie Hills was commissioned by Billiton Australia Gold Pty. Ltd. and Zapopan N.L. as the initial stage in a programme of research whose objective is a management plan for the Mt Todd Gold Project. The Preliminary Environmental Report drew from this report.

Detailed follow up work is in progress on habitat availability in the area coincident with the ore body and will include a statistical analysis of relevant parameters for which data has been collected but not yet reported. Results of this survey will be presented by end-November 1989.

A more intensive study of Gouldian Finch breeding and feeding habits will be carried out in February and March during the bird's main period of residence in the Yinberrie Hills for the breeding season.

The Mt. Todd Gold Project is substantially funding research by World Wildlife Fund Australia into the ecology of the Gouldian Finch. This work is being carried out by the Conservation Commission of the Northern Territory.

The principal objective is to determine the prime cause for the decline in abundance of the Gouldian Finch over recent decades which has been variously attributed to clinical effects of mite infestation and adverse changes in habitat. This will hopefully lead to the discovery of appropriate measures to arrest and perhaps reverse the decline.

The Mt. Todd Gold Project seeks to work closely with the Conservation Commission of the Northern Territory and other interested parties to draw up a sound management plan. With this in place it is believed that the presence of the mine will not be a substantial contributing factor to any further decline of the Gouldian Finch.

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1.0 INTRODUCTION

This report presents the results of an investigation of the status of the Gouldian Finch (**Erythrura gouldiae**) and its habitat on the site of the proposed Billiton Australia Gold Pty. Ltd. gold mine in the Yinberrie Hills area between Pine Creek and Katherine in the Northern Territory. The Gouldian Finch is a highly endangered bird and it has been the subject of intensive research by scientists from the Conservation Commission of the Northern Territory in recent years which has confirmed the precarious state of the species' population.

Billiton Australia Gold Pty. Ltd. propose to develop a gold mine on the eastern edge of the Yinberrie Hills. The Hills are one of only two sites in the Northern Territory where the bird is known to breed. Accordingly, a study was needed to determine the species' status in the area and to develop guidelines for the development and management of the mine which minimise its impact on the species and its habitat. The objectives of this investigation were:

1. to determine the availability of suitable breeding habitat for the Gouldian Finch in the Yinberrie Hills in order to place the mine site in context;

2. to determine the quality of Gouldian Finch breeding habitat (density of hollows and food) in areas where the mine and associated infrastructure could be situated so that a map of breeding habitat quality can be prepared to assist in the siting of components of the mine in the least sensitive areas;

3. to investigate the likelihood of Gouldian Finch feeding areas being affected by the development;

4. to develop management guidelines for the operation of the mine which will minimise or eliminate significant effects on the Gouldian Finch;

5. to develop objectives and guidelines for further research and monitoring work relevant to the design, management and rehabilitation of the mine;

6. to develop objectives and guidelines for research on the ecology of the Gouldian Finch which could be funded by the company through World Wildlife Fund Australia or other avenues.

Because of the lack of detailed data on the distribution of the Gouldian Finch near the mine site, a detailed survey of the availability of breeding and feeding habitat in the area was required. After discussions with Sonia Tidemann of the Conservation Commission of the Northern Territory (John Woinarski was not available), it was decided to survey the area for the quality of breeding and feeding habitat. From this, preliminary recommendations for mine design could be developed.

The next section of this report reviews the status, distribution and habitat of the Gouldian Finch and looks at possible reasons for its decline. This is considered at three scales: nationally, within the Northern Territory and in the Yinberrie Hills area. This is followed by a report on the field investigation conducted between 7th and 12th February and 6th and 13th April 1989 and it includes the methods adopted, summaries of date and analyses and some conclusions. The next section of the report deals with other birds which are of concern. The section following this considers the implications of the findings of the investigation for mine design and management and assesses the impact of the mine on the species and its habitat. The final section comprises a discussion of Gouldian Finch research needs and some research recommendations.

2.0 THE GOULDIAN FINCH

This section of the report describes the distribution, status and habitat of the Gouldian Finch in Australia, in the Northern Territory and in the Yinberrie Hills.

2.1 Distribution

2.1.1 Australia

The Gouldian Finch is the most restricted in distribution of any of the northern Australian finches and its dietary preferences appear to be narrower than other related species (Tidemann, 1987). Immelmann (1982) and Pizzey (1980) give its range as extending west to Derby, W.A. and south-east to Charters Towers in Queensland. Data gathered during the Atlas of Australian Birds (Blakers, Davies & Reilly, 1984) shows a more limited distribution than this. The authors of the Atlas comment that the species' has declined, particularly in the eastern part of its range, in Queensland. Figure 1 shows the species' distribution, both in the past and in more recent times.

2.1.2 Northern Territory

The Gouldian Finch occurs in the northern third of the Northern Territory between the Western Australian border and Boroloola in the east, and from Daly Waters in the south to Greenhill Island (just south of Cobourg Peninsula) in the north (Storr, 1977). Appendix I gives details of the occurrence of the species in the Northern Territory based on a number of published and unpublished sources. This information is summarised below and Figure 2 shows its distribution in the Territory.

The most recent and comprehensive information available on the distribution of the Gouldian Finch in the Territory comes from surveys by Sonia Tidemann and John Woinarski of the Conservation Commission of the Northern Territory. Sonia Tidemann has kindly made available a summary of these records. Twenty-four regions of the Northern Territory, within the species' historical range, were searched for periods ranging from 2 to 35 days. Gouldian Finches were recorded in nine of these regions. Appendix I gives details.

On the face of it, these records suggest a strong parallel between the occurrence of the species in a region and the number of days spent by observers in that region. However, two points are worth noting.

First, Gouldian Finches were generally detected within a day or two of arriving in an area (S. Tidemann, pers. comm.). If the species was found then more time was spent surveying the area. The parallel is thus an artifact of the need to collect detailed information on the behaviour of the finch if detected in a region.

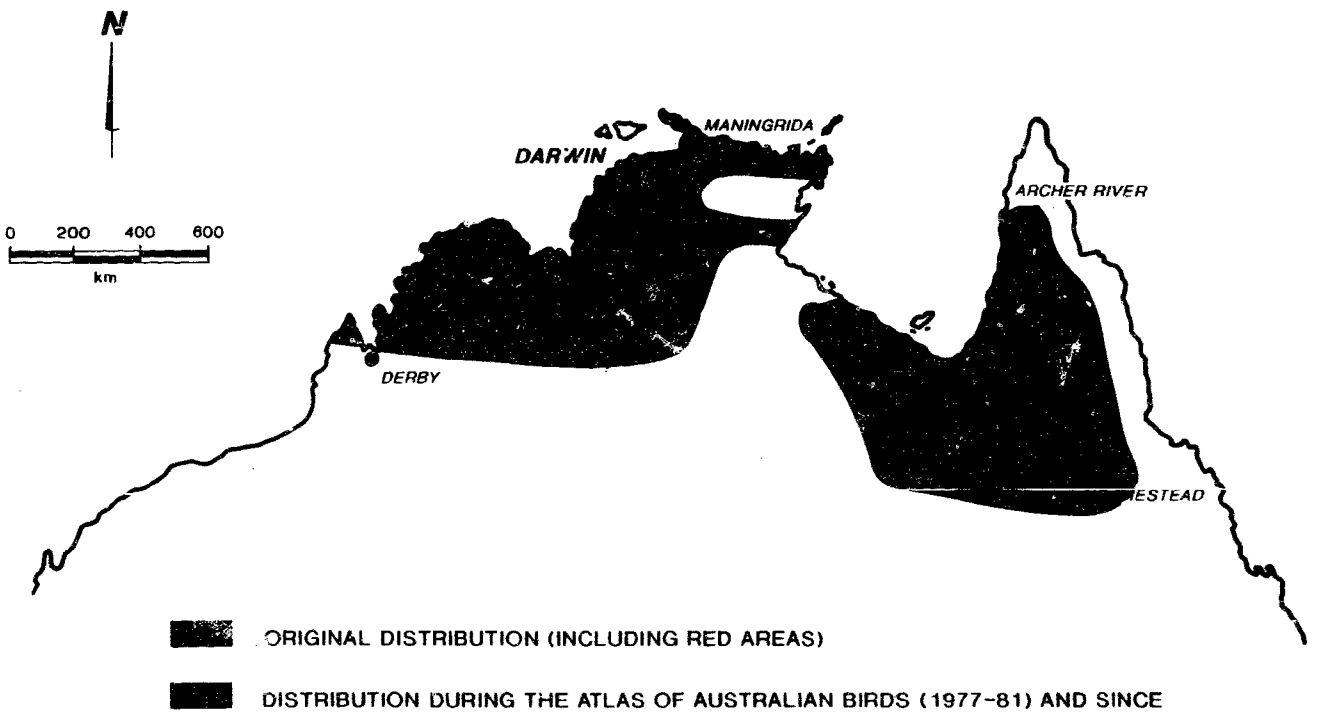

FIGURE 1 : MAP OF NORTHERN AUSTRALIA SHOWING ORIGINAL AND CURRENT KNOWN DISTRIBUTION OF THE GOULDIAN FINCH

(SOURCES : BLAKERS, ET AL., 1984; TIDEMANN, 1987)

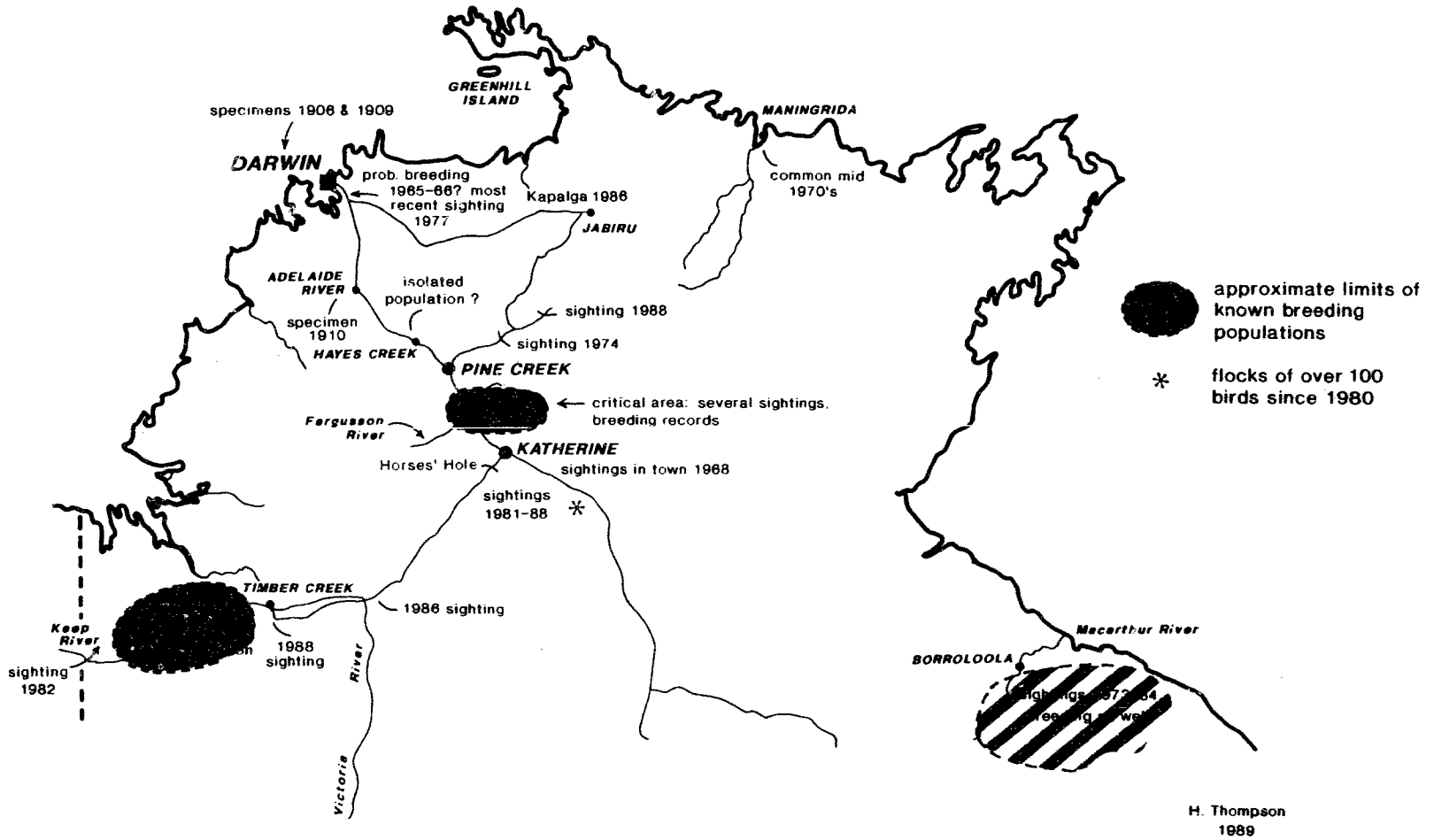

FIGURE 2: RECORDS & BREEDING SITES OF GOULDIAN FINCH SINCE MID–1960'S

The results of the survey are therefore a good indication of the distribution and status (see later) of the Gouldian Finch in the Northern Territory.

Second, the Conservation Commission has found the bird breeding in only two places in the Territory: at Newry Station and in the Yinberrie Hills.

Its occurrence within its range does not appear to be continuous. Blakers et al. (1984) draw attention to a "recent" break in its distribution at the head of the Gulf of Carpentaria. This break appears to be a longer standing phenomenon than these authors believe. Recent historical research by Tidemann (1987) shows that there are no documented records from this part of the species' range (see Figure 2).

No records have been documented away from the coast of Arnhem Land. This could reflect the distribution of observers as the region has been subject to very limited access for many years. Field surveys here could clarify the status and distribution of the Gouldian Finch in this region.

The distribution of the Gouldian Finch in the Northern Territory has contracted in recent years. As evidence for the decline in the species' status, Tidemann (1987) cited the fact that records between 1978 and 1982 from the **Atlas of Australian Birds** (Blakers, et al.,1984) appeared to come from a smaller area than did earlier records (back to 1840). The relevant latitude and longitude limits for the two periods are given in Table 1.

TABLE 1: latitude and longitude limits for the distribution of the Gouldian Finch in the Northern Territory, pre-1978 and post-1978 (source: Tidemann, 1987).

Period	Latitude		Longitude	
	North limit	South limit	West limit	East limit
pre-1978	11°25'S	17°50'S	129°30'E	137°42'E
post-1978	12°20'S	16°00'S	129°10'E	139°10'E
percent change	-14	-29	+4	+18

As can be seen, there has been a 43 percent decline in the north-south range of the species, much of it in the southern part of the species' range. Conversely, there has been a 23 percent increase in its east-west range. The increased east-west range is more than cancelled out by the dramatic decline in north-south range, showing that the Gouldian Finch has indeed contracted in distribution in the Northern Territory. The reasons for the expansion in its east-west range are not

known, but it could be related to the increased accessibility to observers of areas in the east with the construction over the last twenty years of "developmental roads" in north-western Queensland.

2.1.3 Yinberrie Hills

The Yinberrie Hills area, 40 kilometres north of Katherine has been known to local bird-watchers and trappers for at least twenty years, and it is considered by them to be the traditional area in which to see Gouldian Finches.

Figure 3 shows the distribution of the species in the Yinberrie Hills area. This is based on discussions with Sonia Tidemann, and Rob and Jenny Elvish of the Conservation Commission of the Northern Territory, on information supplied to Billiton Australia Gold Pty. Ltd. by World Wildlife Fund Australia and on information gathered during the two field trips. Information provided on this map includes data gathered up to mid-1988. Details are provided in Appendix II.

2.1.4 Movements

Both Immelmann (1982), and Evans and Fidler (1986) mention a migration of the Gouldian Finch out of the northern part of its range in the wet season, its breeding season (December to April). Blakers, et al. (1984) comment that there were too few records of the species in the **Atlas of Australian Birds** to determine the extent of the movement, or if, as Immelmann suggests, they breed only in the southern part of their range. This, together with records summarised in Appendices I and II, show that there is <u>little evidence to indicate a seasonal movement.</u> Indeed, there are records of Gouldian Finches breeding in the Darwin area in the late 1960's (see Appendices). Research by Tidemann (pers. comm.) in the Yinberrie Hills shows that numbers there vary through the year, suggesting a degree of nomadism, as distinct from regular seasonal migration. More research is needed to determine the nature, extent and factors influencing movements of the Gouldian Finch.

In the Yinberrie Hills, the species is present all year round, albeit in varying numbers, both as a breeder and in non-breeding flocks. <u>Banded individuals have moved up to 4 kilometres</u> within the area. This suggests that the year-round requirements of the species are met in this area. This includes food, water, shelter for roosting at night and breeding sites. Birds recorded in other regions of the Territory may be more mobile if these requirements are not met at some times of year. Tidemann (pers. comm.) has suggested that the breeding population in the Yinberrie Hills may be a source of some of the birds sighted elsewhere, although there is not direct evidence to support this.

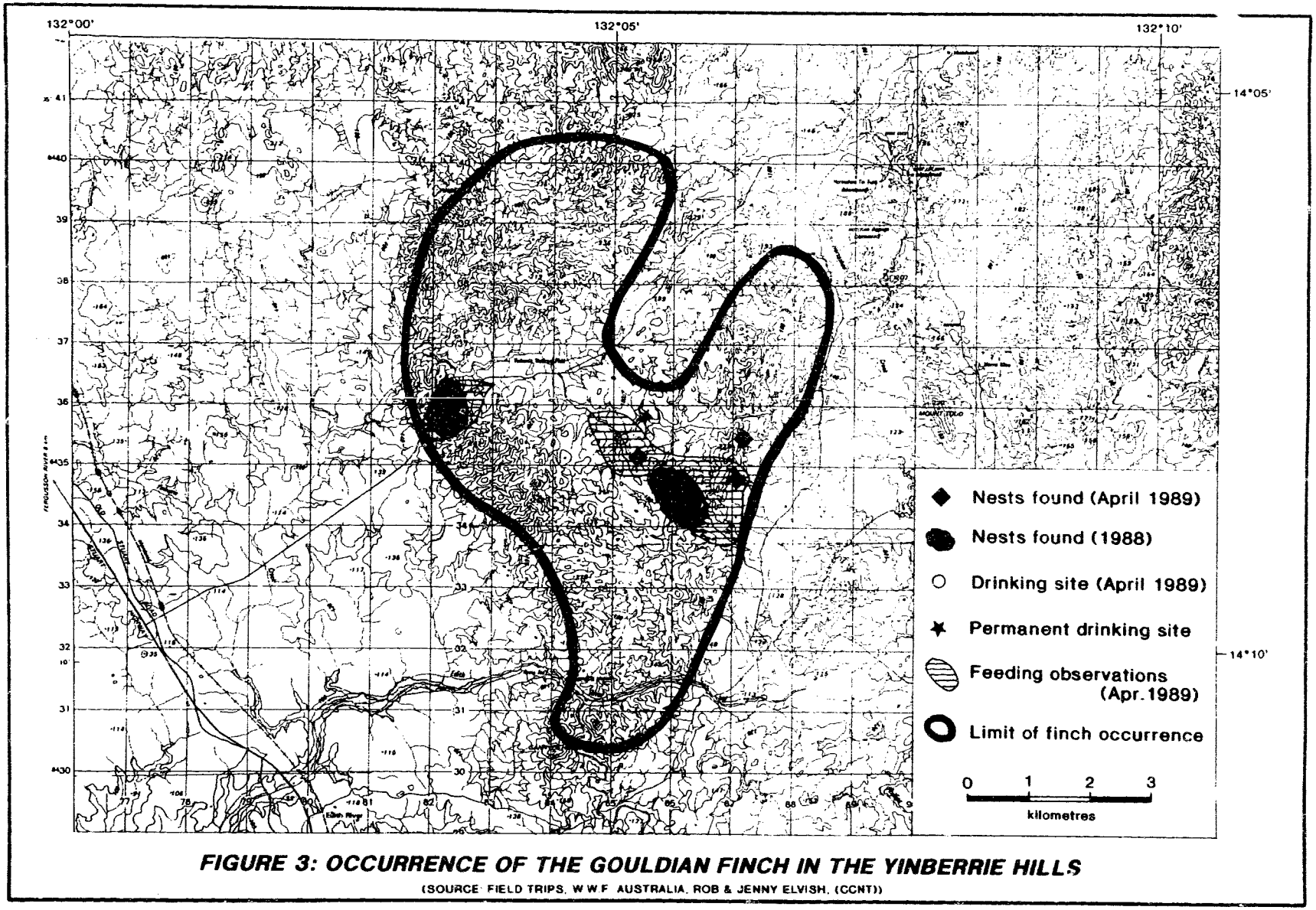

FIGURE 3: OCCURRENCE OF THE GOULDIAN FINCH IN THE YINBERRIE HILLS

(SOURCE: FIELD TRIPS, W.W.F. AUSTRALIA, ROB & JENNY ELVISH, (CCNT))

2.2 Status

This section of the report reviews the status of the Gouldian Finch, concentrating mostly on the Northern Territory. The first part reviews the change that has occurred in the status of the species in recent years and the next part discusses reasons for the decline in its population.

2.2.1 Changes in Status

The Gouldian Finch was once more abundant than it is now. It was first reported as declining by Heumann (1926). Storr (1977) reported that it was "formerly the commonest finch of the semi-arid zone, but [it is] now uncommon to moderately common...". The decline in the species has been most noticeable in Queensland, where its range has contracted considerably as shown on Figure 1 (Blakers, et al., 1984).

Trapping returns to the Western Australian Department of Conservation and Land Management, anecdotal reports from reliable observers, both bird-watchers and ex-trappers (H. Thompson, pers. comm.), and a small study by Evans and Bougher (1987), have demonstrated their recent endangered status (Tidemann, 1987). Evans and Bougher (1987) were told by one of their guides that flocks of several thousand individuals used to occur in the Kimberleys. The largest flock that they saw was of 50 to 100 birds.

Birdwatchers collecting information for the **Atlas of Australian Birds** (Blakers, et al., 1984) sighted Gouldian Finches in a smaller range than those reported before (see Section 2.1.2). Ex-trappers have reported seeing very large flocks numbering several hundred in the Yinberrie Hills/Edith Falls area 12 to 14 years ago but only occasional birds in more recent years (H. Thompson, pers. comm.).

The bird used to be seen in the Darwin area. Neville Cayley (in Immelmann, 1982) painted from specimens collected at Port Darwin in 1906 and 1909, and it has bred behind the old Darwin hospital in the late 1960's (Don Jacobs, pers. comm. to H. Thompson). There is another report of 15 birds in a Fannie Bay yard in April 1974. In 1977, two were seen at Diana Beach and their behaviour suggested that they were wild birds, not aviary escapees (H. Thompson, pers. comm.). There have been no records since from the Darwin area.

Relatively large flocks of Gouldian Finches have been reported occasionally in recent years. J. McKean (unpubl. notes) has reported seeing a flock of 300 birds in the Katherine area in September 1985. P. Maher (pers. comm.) has reported seeing a flock of about 200 individuals at the Fergusson River in June 1988. H. Thompson (pers. comm.) has stated that the species has become more difficult to find over the last twenty years or so.

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The available evidence clearly indicates that the Gouldian Finch has become much rarer in the last fifteen to twenty years. In Darwin and Katherine, the species was common in the late 1960's. By the mid 1970's, there were occasional reports from these towns but none since. The species therefore started to decline in the late 1960's with a crash in numbers occurring in the mid 1970's.

Sonia Tidemann has recently stated that the bird "has declined in numbers by about 80 percent in the last fifteen years". There are probably about 1,000 breeding birds left in the Northern Territory which breed in two areas: Newry Station and the Yinberrie Hills (Tidemann, pers. comm.). Its current breeding status in Western Australia and Queensland is not known.

The species is now classified by wildlife biologists who compile the **Red Data Book** for the International Union for the Conservation of Nature (IUCN) as "endangered" (Collar and Andrew, 1988).

2.2.2 Reasons for Decline

The literature discusses a number of reasons for the decline of the Gouldian Finch population but in few areas is there agreement.

All agree that the proximate cause for the species decline, at least in the Northern Territory and Western Australia is the Air-sac Mite (**Stenostoma tracheacolum**) which infests the respiratory system of birds. This mite has often been found in both captive and wild birds of many species, mostly in the northern hemisphere. Tidemann, Woinarski and Freeland (in press) dissected 367 finches and mannikins, including some Gouldian Finches, from thirteen sites in the Northern Territory and Western Australia between Katherine and Wyndham. They found Air-sac Mite infestation in 58 percent of Gouldian Finches collected. As well, the infestation was observed in one Pictorella Mannikin (**Lonchura pectoralis**). More adult Gouldian Finches than young ones were affected and 70 percent of the sample from Katherine were infested compared with 43 percent from the Kimberley region.

Aviculturalists are familiar with Air-sac Mite, which is widespread in captive populations of birds and becomes a very serious problem when they are under stress. After treatment, and the removal of the stressing conditions, the disease is easily controlled.

Trapping for the avicultural market has been cited as a cause of the decline of the Gouldian Finch (Collar and Andrew, 1988). Tidemann (in press) considers that it may be partly to blame. Other papers suggest that **legal** trapping this century is unlikely to have caused its decline (Tidemann, Woinarski and Freeland, in press). Licenced trapping of Gouldian Finches for the avicultural market was stopped in 1981. Evans and Bougher (1987) found no evidence

for a recovery in numbers after this time, evidenced by survey results in the Kimberleys of 123 birds in 1983 and 125 birds in 1985. Although only a small sample, this suggests that some other factor must be operating to keep the population low.

Burning regimes in the tropical savannahs of northern Australia, originally maintained by the aboriginal population, have probably changed little since European settlement and the arrival of pastoral activities (Stocker and Mott, 1981). Burning practices differ between cattle stations although most areas are burnt at least once per year (Tidemann, in press). The timing of the fire may be important to the survival and regeneration of some annual and perennial grasses of importance as food sources for the Gouldian Finch (Stocker and Mott, 19810. Fire may be an asset to the Gouldian Finch as it removes clumps of grass, making seed on the ground more accessible to feeding finches (Tidemann, in press). Woinarski (in press) reached the same conclusion for early dry-season fires, which tend to be less intense, but believed that late dry-season fires, in August, resulted in the destruction of most ground seed. This would be detrimental to seed eating birds, such as the Gouldian Finch.

Grazing by free-range cattle and feral populations of herbivores (e.g. Donkeys, Water Buffalo) may have influenced the availability of food for the Gouldian Finch. Tidemann (in press) has examined this possibility and has concluded that grazing adversely affects the Gouldian Finch, although it is unlikely to be the only reason for the decline. Grazing acts in two ways. First, it reduces the ground cover of grasses. Second, the grasses which the finch prefers (**Sorghum** spp., see section 2.3) are also preferred by cattle. Cattle and Gouldian Finches are thus in competition.

Although Air-sac Mite appears to be the proximate cause of the decline of the Gouldian Finch, it is possible that the disease has manifested in response to some stress. This stress could be caused by changes in habitat conditions due to a range of human-induced environmental changes, including those mentioned above, which are affecting food supplies. The Gouldian Finch feeds on the narrowest range of grass species of any of the northern Australian Finches and would therefore be most likely to be vulnerable to bottlenecks in food supplies at which time it could be susceptible. The current situation is possibly a result of both changes in food supply caused by environmental change and of the inability of birds to obtain what they need as a result of being weakened by Air-sac Mite infestation.

Excellent steps have been taken by wildlife biologists working with the Conservation Commission of the Northern Territory in isolating and defining more rigorously the possible causes for the species' decline. The current inconclusiveness about the influence of trapping, fire and grazing on the population of the Gouldian Finch arises from a lack of fundamental data on its biology in the wild.

Some has come from the studies quoted in this report but more needs to be generated before the relationship between the bird and its environment is more completely understood. Only with this information can the ultimate causes for the decline of the Gouldian Finch be determined and appropriate habitat management undertaken.

2.3 Habitat

This section of the report looks at the habitat of the Gouldian Finch. Breeding, feeding and drinking habitat is examined throughout Australia, in the Northern Territory and in Yinberrie Hills.

2.3.1. Australia

The Gouldian Finch is a bird of the wet-dry tropics, occurring in **Eucalyptus** open forests and woodlands with a predominantly grassy understorey (Blakers, **et al.**, 1984). The species breeds mostly in the hollows of some eucalypt species, placing a flimsy nest platform of dry grasses at the bottom of the hollow. It has also been observed breeding in the old nests of Crimson Finches (**Neochmia phaeton**) in **Pandanus** sp. (see Appendix I), but this is exceptional. They feed on the seeds of grasses which grow under eucalypts in tropical open forest and woodlands. They have been recorded eating insects (Immelmann, 1982).

They never occur far from water, visiting waterholes at least once per day, like most seed eating birds (Tidemann, 1987). During the wet season, water is widely available but during the dry season, it is restricted to a small number of waterholes and springs which are visited by flocks of large numbers of finches of a range of species, including the Gouldian Finch, where it occurs. (Evans and Bougher, 1987; Tidemann, 1987).

2.3.2 Northern Territory

In the Northern Territory, the Gouldian Finch has been reported breeding in a number of species of eucalypts. At Newry Station, Tidemann (pers. comm.) found 20 nests, all of which were in hollows of **E. brevifolia**. The parameters of these hollows are given in Table 2.

In the Yinberrie Hills, Gouldian Finches have been recorded nesting only in the hollows of **E.alba***. J. McKean (unpubl. notes) found two nests in sandstone ridge 35 kilometres south of Borroloola. One was in **E. miniata** and the other was in **E. dichromophloia**. A trapper (see Appendix I) found them nesting in species of eucalypt other than **E. alba** but could not identify the trees.

The food of the Gouldian Finch in the Northern Territory consists almost entirely of the seeds of grasses. A study of their diet in the Northern Territory by Tidemann (1987;

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* Note that **E. alba** is now known as **E. tintinans**. For the purpose of this report, the name has not been changed.

in prep.) has found that the species eats seeds from a narrower range of species compared with other finches. They eat **Sorghum plumosum** and **S. stipoideum**. Only when these are not available do they take other species, notably **Eriachne obtusa** and **Zerochloa** sp. (Tidemann, pers. comm.). In a study of the occurrence of finches in relation to pastoral practices, Tidemann (in press) found that the seeds of **Sorghum** spp. were more abundant on the ground at sites where Gouldian Finches occurred than at sites where they were absent.

TABLE 2: parameters of Gouldian Finch nesting hollows in **E. brevifolia** at Newry Station, N.T. (20 nests) (Source: Tidemann, pers. comm.).

Parameter	Value
Internal diameter of entrance	32 to 70 millimetres
External diameter at entrance	80 to 180 millimetres
Depth to nest	180 to 670 millimetres
Angle of entrance (from horiz.)	-5 to +35 degrees

Tidemann (pers. comm.) has stated that the requirements of the Gouldian Finch appear to be the presence of suitable breeding hollows in trees and an abundant source of **Sorghum** spp. seed within four kilometres of the breeding sites. This is known to occur in only two places in the Northern Territory, one of which is the Yinberrie Hills.

Although it would be desirable to know the limits of various habitat parameters favourable to the Gouldian Finch (e.g. density of suitable hollows, abundance of **Sorghum** spp., etc.), to guide survey work and management practices, there are too few areas where the species now breeds to enable such generalisations. It is only possible to determine such limits within the suitable areas (Newry Station and Yinberrie Hills) based on the behaviour of the birds within them.

2.3.3 Yinberrie Hills

Figure 3 shows the distribution of the Gouldian Finch in the Yinberrie Hills. In this area, they have been recorded breeding only in hollows of **E. alba**. The parameters of these hollows are given in Table 3. In this area, the species chooses a wider range of hollows than at Newry Station. The nests found by Woinarski occurred in both the western and eastern parts of the area (see Fig 3).

Gouldian Finches, including large numbers of young birds, were observed feeding in an area of **Sorghum** spp. on an area of ridge in the south-eastern part of the hills in 1988 and 1989, including during the current investigation. They have also been observed feeding in similar habitat in the flat lower lying undulating country between the two main ridges of hills in the area.

TABLE 3: Parameters of Gouldian Finch nesting hollows in E. **alba** in the Yinberrie Hills, N.T. (5 nests) (source: J. Woinarski, pers. comm.).

Parameter	Value
Internal diameter at entrance	50 to 120 millimetres
External diameter at entrance	N/A
Depth to nest	N/A
Angle of entrance (from horiz.)	-35 to +90 degrees

The juxtaposition of ridges with suitable nesting habitat (E. **alba**) and abundant **Sorghum** spp. makes the area highly suitable. As habitat parameters were studied during the current investigation, the habitat preferences of the species in the Yinberrie Hills are dealt with in more detail in the next section.

3.0 FIELD STUDY

This section of the report details the aim, methods, results and conclusions of the field investigation. The aim of the investigation was to determine the distribution of suitable breeding habitat for the Gouldian Finch as a basis for assisting in the development of a mine design, management and rehabilitation plan which will minimise or eliminate significant effects on the species. This concentrated on two important habitat components: the availability of nesting hollows in **E.alba** and the presence of appropriate food resources (**Sorghum** spp.). The study area is marked on Figure 4.

The data and conclusions presented in this section of the report refer only to the species' breeding habitat in the Yinberrie Hills and may not abe relevant to the species' ecology outside this area or at other times of year.

3.1 Methods

A brief survey was done of the status of **E. alba** in the region. The percentage of **E. alba** in the tree layer was determined at sites every kilometre along the road between Edith Falls camping ground and the Stuart highway via the old Edith Falls Road through the Yinberrie Hills (see Figure 4). At each station, a sample of fifty trees was counted. The transect represented an environmental gradient from low, undulating country to foothills, then the highest ridges in the eastern part of the Yinberrie Hills and back into the lower country to the west.

Gouldian Finches have been observed breeding in the hollows of **E. alba** on ridges in the Yinberrie Hills area. The relevant parameters of nests are presented in the previous section of this report. To determine the availability of nesting sites, 35 adjacent **E. alba** were inspected on twenty sites (see Figure 4). The size of the area containing these trees was estimated. Two of these (sites 1 and 16) were outside the area currently known to hold Gouldian Finches. The sites covered a range of settings, detailed in Appendix 3. Vegetation descriptions were taken for each site, an estimate of the ground coverage was made and the percentage of this which was **Sorghum** spp. was also determined. The survey was conducted from 7th to 12th February and from 6th to 13th April 1989. During the survey, a watch was kept for Gouldian Finches.

The extent to which the sites chosen represent the density of **E. alba** and **Sorghum** spp. in their respective settings is not known. We believe that the results give a reasonable indication of the extent to which suitable breeding and feeding sites for the finch occur on the mine site compared with other areas.

On each tree on a site, the following measurements and observations were recorded: height in metres; circumference at breast height in centimetres; whether the tree was

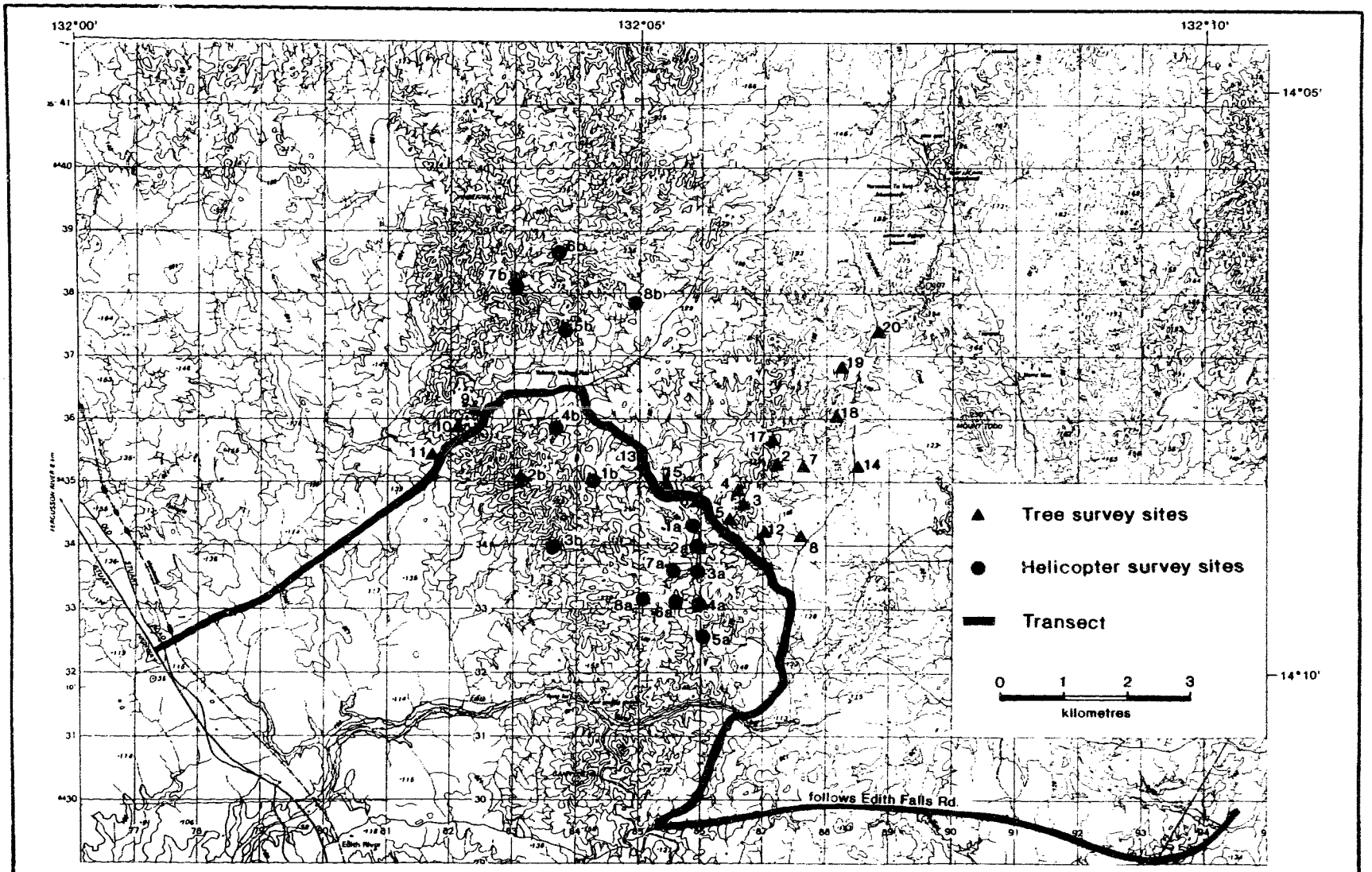

FIGURE 4: MAP OF STUDY AREA SHOWING THE LOCATION OF TRANSECT AND SURVEY SITES

hollow, based on tapping and listening; the angle of the branches (i.e. predominantly vertical versus some horizontal); the presence of dead branches, an index of hollow formation (none, few, some or many); and the presence of hollow entrances, their angles from horizontal and, where appropriate and practical, their internal diameters, and whether they were clogged with termite material.

3.2 Results

Data analysis concentrated on determining the availability of nesting sites in **E. alba** and the presence of suitable food resources. These are discussed separately below.

3.2.1 Distribution of **Eucalyptus alba**

Time constraints did not permit a detailed survey of the distribution of **E. alba** throughout the Yinberrie Hills and adjacent areas. The transect that was taken from Edith Falls into the ridges of the Yinberrie Hills and out again to the Stuart Highway (see Figure 4) indicated that the proportion of **E. alba** in the tree canopy was significantly higher in the Yinberrie Hills than in areas of lower relief (mean %: 16.55 vs 8.33; $t = 2.94$; $df = 27$; $p < 0.01$).

Table 4 gives, among other results, the density of **E. alba** at each of the tree survey sites.

There were no significant differences in the density of **E. alba** in different settings (ridges vs foothills vs flats). Neither was there a significant difference between survey sites in the percentage of **E. alba** in the canopy.

The density of hollow **E. alba** was generally higher on ridge sites than on foothill or flat sites, although the differences were not statistically significant. Similarly, the highest densities of hollows were found on ridge sites and the lowest on flat sites, but, again, the differences were not statistically significant.

At the three nest sites (sites 10, 12 and 15), the density of **E. alba** ranges from 8.75 to 35.00 per hectare. This was from one of the lowest densities to one of the highest of the twenty tree survey sites. Likewise, hollow densities at the three nest sites ranged from one of the lowest to the highest. This suggested that the density of **E. alba** and the density of hollows was not limiting the usage of an area by breeding Gouldian Finches.

TABLE 4: Density of **E. alba** and other parameters at each site surveyed.

SITE	NO.E.ALBA PER HA.	NO.HOLLOW E.ALBA PER HA.	NO.HOLLOWS PER E. ALBA	% E. ALBA WITH HOLLOWS	HOLLOWS PER HA.
1	43.7	7.47	4.5	17.1	33.6
2	23.3	9.32	5.0	40.0	46.6
3	23.3	15.31	4.0	65.7	61.2
4	23.3	11.98	3.3	51.4	39.5
5	12.0	4.67	4.5	40.0	21.0
6	35.0	17.99	2.3	51.4	41.4
7	17.5	8.50	3.0	48.6	25.5
8	38.9	11.12	3.3	28.6	36.7
9	12.0	9.00	3.3	80.0	29.7
10*	8.8	4.50	3.4	51.4	15.3
11	7.0	3.80	3.0	48.6	11.4
12*	17.5	9.50	3.0	54.3	28.5
13	36.0	13.00	2.7	31.4	35.1
14	29.2	6.67	2.4	17.1	16.0
15*	35.0	17.00	3.9	48.6	66.3
16	17.5	9.00	2.4	48.6	21.6
17	6.0	3.33	2.8	51.4	9.3
18	7.0	4.20	3.1	57.1	13.0
19	14.0	6.80	3.5	46.7	23.8
20	29.2	6.67	3.1	22.9	20.1

(* = Gouldian Finch nesting site)

3.2.2 **Sorghum** spp. densities

At tree survey sites, the ground coverage of **Sorghum** spp. was estimated. For the first eight sites, an overall estimate was made for the entire site. For the remaining sites, surveyed during the second field trip, an estimate was made of **Sorghum** spp. ground coverage around each tree (4 m radius). For these, the values were averaged to obtain an estimate for the whole site. The results are presented in Table 5.

The density of **Sorghum** spp. varied. It was highest on the ridge and foothill sites and lowest on the flats. These differences were statistically significant (see Table 6).

The three nest sites all had above 60% ground coverage of **Sorghum** spp. They were above average in all cases. This suggested strongly that Gouldian Finches were chosing to breed in areas with a high availability of **Sorghum** spp.

TABLE 5: Ground coverage of **Sorghum** spp. at tree survey sites.

SITE	COVERAGE OF **SORGHUM** SPP. (%)
1	c. 20
2	c. 50
3	c. 90
4	c. 50
5	c. 95
6	c. 90
7	c. 20
8	c. 20
9	53
10*	64
11	18
12*	60
13	77
14	17
15*	74
16	65
17	71
18	48
19	30
20	26

(* = Gouldian Finch nesting site)

TABLE 6: Mean ground coverage of **Sorghum** spp. at sites in different settings.

SETTING	MEAN GROUND COVERAGE(%)	T-TEST
FLATS	24.0	
		4.05, df=8, p<0.01
FOOTHILLS	55.3	
		2.57, df=6, p<0.05
RIDGES	72.5	
		7.98, df=4, p<0.01
FLATS	24.0	

Viewed together with the results for **E. alba** and hollow densities, these findings indicated that Gouldian Finches were probably selecting breeding sites on the basis of food supply rather than on the basis of a high availability of nesting sites. Food supply is therefore probably more limiting to the species than nesting site availability. Furthermore, food availability was greater on ridges and foothills than on the flats. This would account for why Gouldian Finches have been found breeding only in the ridges and foothills in the area and not on the flats, despite the presence of densities of E. alba and hollows greater than those at one of the breeding sites.

Indeed, the eastern limit of occurrence of the species in the Yinberrie Hills based on information supplied by the Conservation Commission of the Northern Territory and the boundary between areas of less than and greater than 60% ground coverage of **Sorghum** spp. generally coincided. Information on the ground coverage of **Sorghum** in the western part of the Yinberrie Hills was not detailed enough to show if this were the case elsewhere.

A final observation further supports the hypothesis that in the Hills nesting site availability is not limiting the breeding range of Gouldian Finches. There was no correlation between the density of **E. alba** and the ground coverage of **Sorghum** spp. at the tree survey sites ($r = -0.10$, $n = 20$, NS). The two factors are distributed independently. Nesting occurred in sites where only one of these factors, **Sorghum** spp. ground coverage, was different from the range present in the area.

3.2.3 Helicopter Survey

In the light of these results, a helicopter survey was done on 11th and 12th May 1989 to extend the coverage of the habitat survey. It was possible to determine from the low flying helicopter the following parameters: percentage of **E. alba** in the canopy, the number of **E.alba** in a 100m by 100m square and the ground coverage of **Sorghum** spp. at unburnt sites.

Sixteen additional sites were surveyed in this way. As well, five sites surveyed on the ground (2 to 6 inclusive) were covered from the air for validation purposes. The location of the helicopter survey sites is shown on Figure 4 and the results are presented in Table 7.

The results of the ground and helicopter survey results at the five validation sites are presented in Table 8.

The helicopter survey results differed from the ground survey results in the following ways. Estimates of the percentage of **E. alba** in the canopy differed by between -29 and +43 percent. Those of the number of **E. alba** per hectare differed by between -29 and +50 percent. Estimates of the percentage ground coverage of Sorghum differed at the three sites where comparison was possible by between -20 and +44 percent. The range of actual values given a possible error of -30% and +50% is shown in brackets in Table 7.

Even allowing for up to 50% difference in estimates, the helicopter survey results still provide a broad picture of changes in these parameters across the region surveyed. Figure 5 maps the area which includes sites with greater than 8 **E. alba** per hectare and more than 60% ground coverage **Sorghum** spp.. These values have been chosen as they were the minima for known breeding sites.

TABLE 7: Results of the Helicopter survey. (Numbers in brackets are possible ranges of values; see later).

SITE	%E.ALBA IN CANOPY	NO. E.ALBA PER HA.	%GROUND COVERAGE SORGHUM SPP.
1a	30(21-45)	23(16-34)	80(56-100)
2a	30(21-45)	21(15-31)	77(54-100)
3a	15(10-22)	26(18-39)	90(63-100)
4a	15(10-22)	10(7-15)	60(42-90)
5a	35(24-52)	7(5-10)	77(54-100)
6a	5(3-7)	4(3-6)	80(56-100)
7a	15(10-22)	11(8-16)	86(60-100)
8a	5(3-7)	9(6-13)	77(54-100)
1b	40(28-60)	15(10-20)	80(56-100)
2b	15(10-22)	7(5-10)	90(63-100)
3b	15(10-22)	5(3-7)	90(63-100)
4b	5(3-7)	3(2-5)	90(63-100)
5b	5(3-7)	2(1-3)	95(66-100)
6b	10(7-15)	9(6-13)	95(66-100)
7b	10(7-15	6(4-9)	56(39-84)
8b	10(7-15)	7(5-10)	86(60-100)

TABLE 8: Results of ground and helicopter survey at validation sites. (Site numbers are the same as those for the ground survey).

SITE PARAMETER		2	3	4	5	6
% E. ALBA IN CANOPY	(G)	35	35	30	10	35
	(H)	40	50	25	10	25
NO. E. ALBA PER HA.	(G)	23.3	23.3	23.3	12	35
	(H)	20	18	18	18	22
% GROUND COV. SORGHUM SPP.	(G)	50	90	50	95	90
	(H)	72	*	*	86	72

(* = site burnt, ground coverage estimate not possible)

The area where these two parameters overlapped was considered to be the area of highest quality Gouldian Finch breeding habitat. As can be seen from Figure 5, this occurs in an east-west strip across the southern part of the hills. This was broader at its eastern end. It is from this area that Gouldian Finches, and especially breeding, have been most frequently reported. During the habitat survey, the species was seen in this area but not in other areas. This area probably supports the greatest numbers of breeding Gouldian Finches. High quality habitat does not occur throughout the species' range in the Yinberrie Hills. There was also an area of high quality habitat in the north-western part of the Hills but this had not been visited on the ground during the survey.

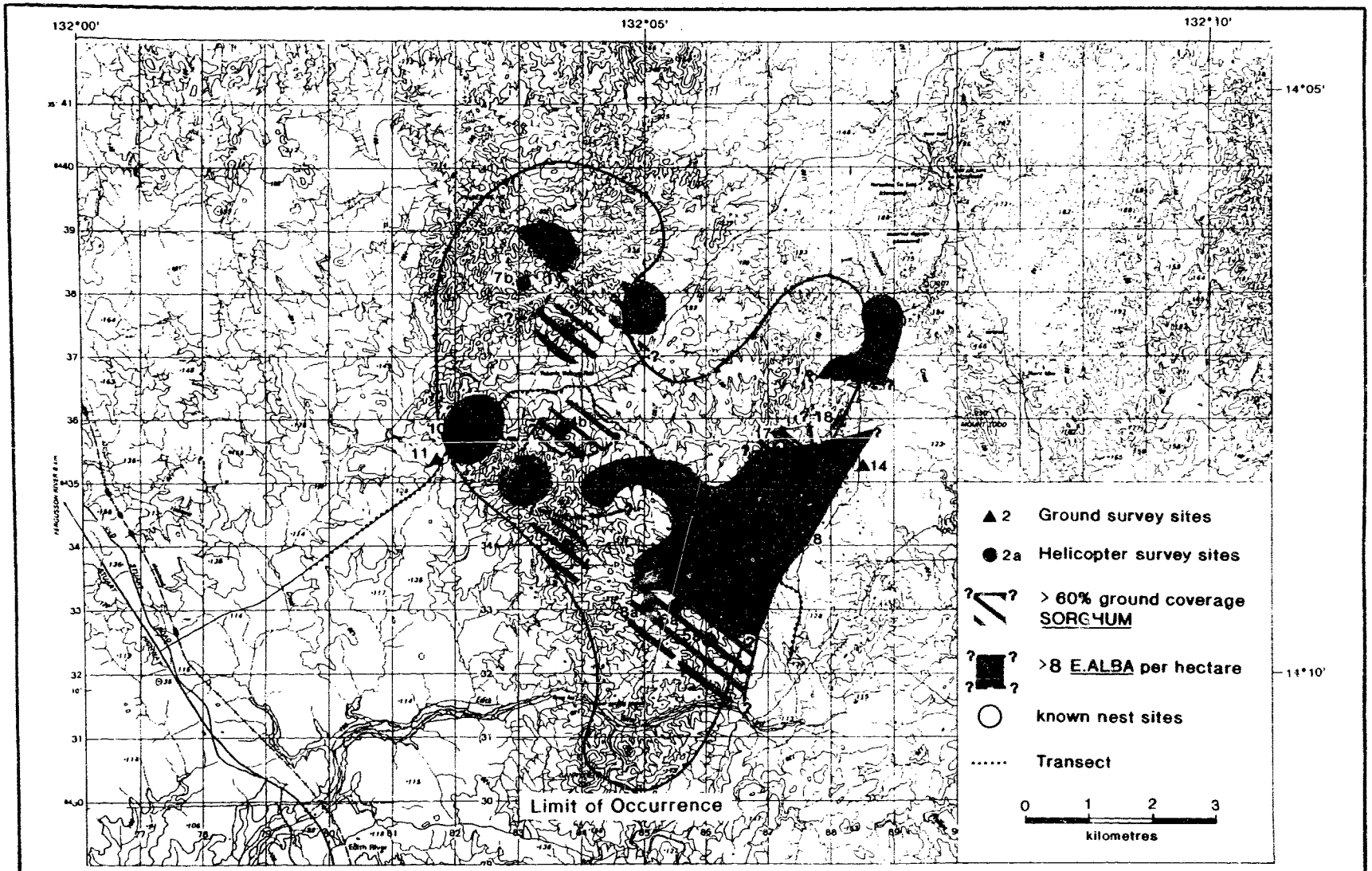

FIGURE 5: MAP SHOWING LOCATION OF TRANSECT, STUDY SITES AND HIGH QUALITY GOULDIAN HABITAT

(N.B. updated version in supplement)

Outside the region surveyed but within the Gouldian Finch's known range in the Hills, there may be more high quality habitat. Based on general observations outside the habitat survey region, this is unlikely to be a large area, as **E. alba** appeared to occur in very low densities across large tracts of lower, flatter country in the northern part of the Hills. Notwithstanding this, the species is likely to move to areas with low **E. alba** densities but with high ground coverage of **Sorghum** spp. to feed.

3.3 Conclusions

The availability of suitable nesting sites for the Gouldian Finch varied at both a regional and local scale in the Pine Creek - Katherine area. There were more **E. alba** in the Yinberrie Hills than in surrounding areas. The pattern of variation in density of **E. alba** within the Yinberrie Hills was not clear. Although higher densities of this tree and of potential nesting hollows tended to occur on the ridges and foothills than on flat country, the differences were not statistically significant.

Food resources (**Sorghum** spp.) were significantly greater on ridges and foothills. It is likely that this is a more influential factor in the finch's choice of a breeding site within the Yinberrie Hills than the availability of tree hollows which does not appear to be limiting. The observed distribution of **Sorghum** spp. probably accounts for the preference of the Gouldian Finch to nest in trees on ridges and foothills rather than on flat country.

The highest quality habitat (suitable densities of **E. alba** and ground coverage of **Sorghum** spp.) occurred in the southern part of the Yinberrie Hills.

4. OTHER BIRDS

Two other birds of significance have been recorded from the Yinberrie Hills and surrounding areas: the Hooded Parrot (**Psephotus dissimilis**) and the Crested Shrike-tit (**Falcunculus frontatus**). These are discussed below.

4.1 Hooded Parrot

The Hooded Parrot is classed as an endangered species by the Royal Australasian Ornithologists Union.

It was recorded throughout the areas visited during the field trips in February and April 1989, from Edith Falls to the western part of the Yinberrie Hills. It was found feeding on the seeds of low grasses and herbs in pairs and small family groups beside roads and tracks, or drinking from many pools and streams in the area. It was estimated that in the Edith Falls - Yinberrie Hills area 50 to 60 birds may occur, although a comprehensive survey was not conducted.

The species occurs in northern and central Arnhem Land, from the Katherine River east to the mouth of the Roper River, south to Daly Waters and west to about the Stuart Highway. It was once more widespread, with records from early this century coming from the MacArthur River near the south coast of the Gulf of Carpentaria and from Melville Island, north of Darwin (Blakers, et al., 1984).

It has been heavily trapped for the bird trade but the reasons for its decline are not fully understood. Forshaw (1982) suggested that this decline was more likely to be due to changes in dry season food availability due to grazing and changed fire regimes in the Top End.

The Katherine-Pine Creek region is clearly one of the species' strongholds. It breeds in holes which it excavates in termitaria. There are comparatively few termitaria in the proposed mine site, suggesting that the area may not be significant for breeding. However, the presence of good numbers in April, when breeding commences (Forshaw, 1982), and the fact that most were in pairs or family parties suggests that the area may be important for breeding. More survey work would be needed to determine the significance of the area for the species.

4.2 Crested Shrike-tit

There are three sub-species of Crested Shrike-tit. The least known is the northern sub-species, **whitei**. This was recorded in two localities near the mine-site during the April 1989 field trip:one was recorded in foothills about one kilometre to the south of the proposed mine pit and the other in ridges about one kilometre west of the pit site. In both areas, **Eucalyptus alba, E. dichromophloia** and **E. tectifica** predominated. Ground cover consisted of dense **Sorghum** spp. This vegetation type is widespread in the Yinberrie Hills.

There has been concern for the status of this sub-species in the Northern Territory. The **Atlas of Australian Birds** (Blakers, **et al.**, 1984) gives only two records from between 1977 and 1981: one near Pine Creek and the other near Timber Creek. It was not recorded during the recent fauna survey of Kakadu Stage 3 (Woinarski, **et al.**, 1989).

Earlier records come from Larrimah in the Northern Territory and a number of areas in the Kimberley region and a second population of **whitei** occurs between Cairns and Townsville in north Queensland (Blakers, **et al.**, 1984).

Very little is known about the bird in the Northern Territory and it is rare and may be restricted to a handful of isolated populations. The significance of the current sightings is difficult to gauge without more information on its status. The two sites where the bird was recorded are not going to be affected by the proposed mine.

4.3 Implications for Development

The Hooded Parrot is a seed eater, feeding predominantly from the ground. Every effort should be made to minimise the destruction of ground cover during the development and operation of the mine. The Crested Shrike-tit is a tree dweller and the clearance of trees should be restricted to the minimum necessary for the development.

5. POTENTIAL IMPACT OF PROJECT

The design of the mine has been altered. This section of the report deals only with the modified mine design.

5.1 Area Affected

Of the total area of the Yinberrie Hills used by Gouldian Finches during the breeding season, about 6.5% will be lost with the development of the mine pit and the raw-water storage areas. Of the area of high quality habitat in the southern part of the hills, 6.5% will be lost as a result of the mine pit. The waste rock dump, low grade stockpiles, treatment plant and tailings dam have been moved out of the Hills on to the lower lying areas outside the habitat used by the Gouldian Finch.

The raw-water storage areas are located in areas with very low densities of **E. alba.** Ground coverage of **Sorghum spp.** in these areas is patchy but quite high in places. These developments will reduce available feeding habitat in the hills by about 4 percent. The storages will provide a year-round supply of clean water for drinking.

The impact on the population of the Gouldian Finch in the Yinberrie Hills of the 6.5 percent loss of habitat is difficult to predict. It could result in a corresponding decline in the breeding population in the area. This is more likely to result from a loss of food resources than from a loss of nesting sites as the latter do not appear to be limiting. This assumes that the population in the Hills is currently at carrying capacity level, and it is not possible to know it this is the case without further research (see later).

5.2 Mine Management

This brief section outlines measures which could be taken to minimise the effect of the mine on the birds of the area.

By keeping access road, pipelines and other mine infrastructure to the east of the Hills, disturbance of remaining Gouldian Finch habitat will be minimised.

Noise and dust from the mine will probably render a small, additional area around the pit unsuitable for Gouldian Finches. The extent of the effect of noise on the species is difficult to gauge but in the past, Gouldian Finches have been recorded feeding and drinking very close to roads and settled areas, indicating a degree of tolerance to noise and human activity. It is not possible on available evidence to quantify this effect.

Tree clearing and ground disturbanc should be avoided outside the immediate areas to be developec Around the pit itself, good tree coverage will assist not ıst in slightly reducing noise levels in nearby habitat but i limiting the dispersion of dust.

Areas already disturbed by explorat on activities should be rehabilitated with planted **Sorghum** sp ρ. and **E. alba** propagated from seed collected locally. Similar measures should be taken in other areas which must be disturbed temporarily in the course of mine development, such as around the raw-water storage dams.

Every effort should be made to reduce the area of standing water in the tailings dam. Water is very scarce in the dry season and the contaminated water in the tailings dam would represent one of the few water sources available to fauna at this time of year. Accordingly, measures should be taken to prevent access to any contaminated water by wildlife. A very effective method for doing this is stringing fencing wire across the relevant area at intervals of about 10 metres and hanging squares of Nylex "Paraweb" from them. The edges of wet areas should also be fenced with "Paraweb" on wire and star pickets. This treatment prevents access by birds and other fauna from the shore and from above. It has the added advantage of being easy to move about as the tailing disposal area within the dam is moved. Alternative clean drinking sites could be provided near the tailings dam to attract birds away from it.

6. RESEARCH NEEDS

Mt. Todd Gold has donated money to World Wildlife Fund Australia for research into the biology and conservation needs of the Gouldian Finch. This provides the opportunity to expand knowledge of the species and, if spent appropriately, its requirements. This has the potential to lead to an explanation of why the species has declined over that last two decades or so. Only once the factors which have contributed to this decline have been identified can remedial measures be taken to restore the population to a secure position.

The Conservation Commission of the Northern Territory has conducted a number of research programmes on the species since 1986. These are summarised below.

The Commission has conducted detailed surveys of the northern third of the Northern Territory to determine the current distribution of the Gouldian Finch. These have shown that the species has declined in range and numbers and only two regular breeding sites are now known. Information given to us (H. Thompson, pers. comm.) suggests that there may be other breeding populations in the Northern Territory (see Appendix 1). Furthermore, almost nothing is known of the status and distribution of the Gouldian Finch in central Arnhem Land.

Banding studies have been conducted to determine population numbers through capture-recapture techniques and to gather food samples from the crops of captured birds. Recapture rates were not sufficient to enable accurate estimates of population size. Furthermore, the majority of birds caught using the mist-netting technique were juveniles. The more experienced, wary adults were probably not caught in numbers representative of their proportion in the wild population using this technique. This has been found to be the case in numerous bird species, both in Australia and in other countries.

Some of the Gouldian Finches caught have been banded on the leg with unique combinations of plastic bands and the metal one. Much valuable information on life-history can be obtained from known individuals. To be worthwhile, this requires a considerable effort following up birds and observing their behaviour in the field for at least a whole year. Currently, resources do not stretch to getting the most out of this technique.

Studies have found that the most serious proximate cause of mortality in the species is likely to be infestation with Air-sac Mite. More than 70% of birds in the Yinberrie Hills were infested, and more than 40% in the Kimberley region. This epidemic probably poses the greatest immediate threat to the species. Aviculturalists have extensive experience with Air-sac Mite, and most of those whom we spoke to said that it was widespread in captive populations and that it became a very serious problem when captive birds

were under some form of stress. The species may have become vulnerable to the disease after an environmental change placed stress on them. Once the disease took hold, numbers crashed and infested birds have found it more difficult to obtain the food they need and numbers have continued to decline. Unfortunately, there is no way of confirming this as historical data on the wild population are lacking.

Breeding season surveys at Newry Station and in the Yinberrie Hills have been undertaken since 1986. Characteristics of nesting hollows have been described, and detailed vegetation descriptions have been taken of the sites where the species has been found breeding and feeding. These data await analysis. Sorghum seed has been collected for energetic and nutritional analysis. The vegetation descriptions and the seed analysis are the first steps in describing the food availability and choice of feeding site.

An important and crucial question requiring more research is how the bird exploits the resources available to it in the areas in which is choses to feed. We are not aware of any research being done on the detailed foraging ecology of the species. There has been correlational research on the occurrence of the species in different areas compared with a range of natural and human factors. The causes of these correlations are not known. Finding the answer to the above question will illuminate the causes. It is important that the connection between the finch's behaviour and the phenology and productivity of its food sources is more fully understood. This may help to identify potential bottlenecks in annual food supply which can then be related back to the growing literature on the impact of grazing and fire on tropical grasses. Such research will also clarify if the species is living in numbers approaching the carrying capacity of its habitats and if, therefore, opportunities exist for improving this habitat through management.

The following research recommendations are made:

i. More surveys of areas which might hold breeding populations of the Gouldian Finch should be conducted. This should include those areas mentioned in Appendix 1 and central Arnhem Land and areas of Western Australia and Queensland where the species may occur.

ii. Efforts must be made to determine the foraging ecology of the Gouldian Finch as it relates to the productivity and phenology of its food.

iii. Individually banded birds should be followed up, both in the breeding and non-breeding seasons as a basis for determining the population dynamics of the species (i.e. reproductive rate, survival/mortality rates) and its movements.

iv. Any management work, such as exclusion of grazing, prescribed burning and planting of food resources in an area should be preceeded and followed by detailed studies of their effects on vegetation, food resources

and foraging behaviour of the Gouldian Finch and measurements of the same parameters on control sites.

The above studies necessitate a funding commitment beyond one year. All relevant organisations should investigate ways of jointly providing this security for research. Only with continuity of research personnel, expertise and data collection techniques over more than one year can a fuller picture of the biology of the Gouldian Finch emerge, one upon which effective management measures can be based. The involvement of volunteer bird-watchers from all over Australia should be investigated through the Royal Australasian Ornithologists Union. Their involvement would be particularly relevant to tasks 1 and 3.

7. ACKNOWLEDGEMENTS

This investigation has benefited greatly from detailed discussions on the status and ecology of the Gouldian Finch with Dr. Sonia Tidemann of the Conservation Commission of the Northern Territory. We are grateful to her for her time and interest in our investigation. She also provided yet to be published papers and notes from her file on CCNT Gouldian Finch research.

Rob and Jenny Elvish of the Conservation Commission of the Northern Territory provided detailed information about the location of Gouldian Finch nests and feeding areas - the 1989 field trip. We very much appreciate their time and help.

John Woinarski has provided information on the nesting hollows of Gouldian Finch in **E. alba** and a number of yet to be published papers. We are most grateful for this contribution.

We are very grateful to Hilary Thompson for allowing us access to his records on the status, distribution and behaviour of the Gouldian Finch in the Northern Territory.

John McKean kindly provided his unpublished notes on the species throughout its range.

The Civil Aviation Authority kindly made available information on bird deterrent techniques.

We appreciate the help of John Thorpe of Kinhill Engineers Pty. Ltd. for organising much of the logistics of the field survey and for his help in many ways when in Darwin.

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APPENDIX I

Notes from various sources on the status of the Gouldian Finch in areas other than the Yinberrie Hills

John McKean's personal notes have many records of the Gouldian Finch between 1973 and 1985. He recorded then in an area from Windjana Gorge in Western Australia, east to Georgetown in Queensland.

In the Northern Territory, he reports sightings from Katherine, Darwin, Edith Falls, Fergusson River (52 kilometres north of Katherine), Horse's Hole (16 kilometres west of Katherine), Kapalga (in western Kakadu National Park), on the Western Australian border, Newry Station, Borroloola and from 332 kilometres south-east of Borroloola. Most of his sightings come from Borroloola and Horse's Hole, possibly because there were resident bird-watchers in these areas for several years. He reports them breeding near Borroloola (see main report, section 2.3.2).

Barnard (cited in Matthews, 1910-1927) reports sighting Gouldian Finches on the banks of the MacArthur River in the south-western part of the Gulf of Carpentaria.

Brian Deslandes (a local birdwatcher, pers. comm.) has remarked that Gouldian Finches were common in Maningrida in Arnhem Land in the 1970's and also at the nearby Liverpool River. His opinion is that the birds are almost certainly breeding there but this remains to be confirmed. He has reported sightings of "hundreds" in the Pine Creek - Katherine region in the 1970's and of "dozens" near Pine Creek 2 to 3 years ago.

An ex-trapper reports a population north-east of Hayes Creek (Hilary Thompson, pers. comm.). This is possibly a discrete breeding population as 70 percent of these birds have red heads. Black headed birds predominate in all other flocks (Blakers, et al., 1984).

Another ex-trapper has seen odd birds at Mount Wells, east of Hayes Creek (Hilary Thompson, pers. comm.). Some of these reports may be isolated sightings given the nomadic movements of the species.

Summarized below are records obtained during surveys of the Northern Territory by Sonia tidemann and John Woinarski of the Conservation Commission of the Northern Territory from 1986 to 1988.

Sizeable populations of Gouldian Finches were located at only two sites: between the Fergusson River and Katherine (Yinberrie Hills), and on Newry station.

Between 30 and 50 birds were found in Kakadu Stage III, 15 kilometres west of Katherine, in the Keep River National Park and in the area around Timber Creek.

Less than ten birds were seen along the old highway between Adelaide River and Hayes Creek, on Willeroo Station and at the Manbulloo CSIRO Research Station.

No birds were detected around Adelaide River (10 kilometre radius), Hayes Creek (10 kilometre radius), Pine Creek (20 kilometre radius), Borroloola, between Moline and the head of the Edith River, on the King River 20 kilometres west and 50 kilometres north of Katherine, in Katherine Gorge, between Beswick and Barunga, on Legune, Spirit Hills, Rosewood, Auvergne or Scott Creek Stations, or in the Gregory National Park.

APPENDIX II

Records of the Gouldian Finch in the Yinberrie Hills

The following observations of Gouldian Finches have been made by the authors and others in the Yinberrie Hills in recent years.

D. Goodfellow and H. Thompson saw six Gouldian Finches on the Fergusson River in May 1986. They saw none there on visits in September and December 1988. D. Goodfellow and B. Lane observed three Gouldian Finches at Site 5 in February 1989 during the field work for this investigation. They were in an **E. alba** and appeared to be searching for hollows. All were black headed birds.

J. McKean has records for the area ranging from a flock of 200 birds, including many juveniles, on the Edith River Road, to 2 adults on the Fergusson River, 35 kilometres north of the Edith Falls turnoff. Phil Maher (pers. comm.) saw a flock of about 200 on the Fergusson River in 1988 (see section 2.2.1).

APPENDIX III

Description of Survey Sites

SITE	DESCRIPTION
1	North side of Edith Falls Road, c.5 km. west of Edith Falls; gentle slope; canopy spacing 0 to 10 metres; tree spacing 2-15 metres; canopy species, **Eucalyptus alba** (20-30%), **E. tectifica**, **E. dichromophloia**, **E. confertiflora**, **Erythrophloeum chlorostachys**. Under-storey includes shrubs of **Terminalia ferdinandiana**, **Calytrix achaeta**, **Petalostigma quadriculare**, **Helicteres** sp., as well as juvenile **E. alba**, **E. confertiflora** and **E. chlorostachys**. Ground cover consists of grasses, including **Themeda** sp. and herbs.
2	Undulating foothills just east of mine site; canopy spacing 0 to 10 metres; tree spacing 2-10 metres; canopy species, **Erythrophloeum chlorostachys**, **Eucalyptus alba** (30-40%), **E. dichromophloia**, **E. clavigera** and **E. tectifica** with occasional **E. foelscheana**. Under-storey consists of low grasses, **Sorghum** spp. and some **Themeda** sp., and low herbs, **Galactia** sp., **Ampellocissus** sp. and **Helicteres** sp.; juvenile **Brachychiton paradoxum** present.
3	Steep, westerly sloping side of ridge where mine is to be located; canopy spacing 3 to 10 metres; tree spacing 5 to 15 metres; canopy species, **E. alba** (30-40%), **E. dichromophloia**, **E. tectifica**, **E. clavigera**, **E. foelscheana** and **E. bleeseri**. Few shrubs; ground cover mostly **Sorghum** spp. to 1.5 metres tall and some **Ampellocissus** sp., **Galactia** sp. and **Commelina ensifolia**.
4	Gently undulating site west of mine site; canopy spacing, 0 to 10 metres; tree spacing, 2 to 15 metres; canopy species, **Erythrophloeum chlorostachys**, **Eucalyptus alba** (c.30%), **E. clavigera**, **E. tectifica**, **E. foelscheana** and **Terminalia carpentariae**. Understorey included juvenile **B. Paradoxum** and **T. carpentariae**. Ground cover consisted of **Ampellocissus** sp., **Themeda** sp., **Helicteres** sp., **Heteropogon triciteus** and **Galacia** sp.
5	Steep westerly sloping gully side west of mine site; canopy spacing, 0 to 10 metres; tree spacing 2 to 15 metres; canopy species **Erythrophloeum chlorostachys**, **Eucalyptus alba** (10%), **E. tectifica**, **E. dichromophloia**, **E. bleeseri**. Grassy ground cover including **Sorghum** spp., and some **Themeda** sp., and occasional herbs such as **Helicteres** sp., **Ampellocissus** sp. and **Galactia** sp.
6	Gently southerly sloping site west of mine site; canopy spacing 0 to 10 metres; tree spacing, 2 to 25 metres; canopy species, small **Erythrophloeum chlorostachys**, **Eucalyptus alba** (30 to 40 %) and **E. clavigera**. Little

understorey but ground cover predominantly grasses of **Sorghum** spp. with some **Themeda** sp. and many herbs, including **Petalostigma quadriculare, Helicteres** sp. and **Galactia** sp.

7 Flat site to the east of the proposed mine site, canopy spacing, 0 to 15 metres; tree spacing, 0 to 20 metres; canopy species, small **Erythrophloeum chlorostachys** and **T. ferdinandiana**, as well as **Eucalyptus alba** (50-60%), **E, dichromophloia, E. foelscheana** and some **E. setosa.** Shrubs and herbs include **Owenia vernicosa, Grevillia decurrens, B. paradoxum, Breynia cernua, Ampellocissus** sp. and **Marsdenia viridiflora**, as well as seedlings of **E. chlorostachys** and **E. alba.**

8 Flat site to south-eash of proposed mine site; canopy spacing, 0 to 7 metres; tree spacing, 2 to 10 metres; canopy species, **Erythrophloeum chlorostachys, Eucalyptus alba** (30 to 35%), **E. dichromophloia** and **E. tectifica, T. ferdinandiana** and **B. paradoxum.** Herbs and ground cover includes **Ampellocissus** sp., **Petalostigma quadriculare** and grasses.

9 Gently northerly sloping site in western part of Yinberrie Hills; canopy cover 10 to 15%; tree spacing 1 - 10 metres; canopy species, **Erythrophloeum chlorostachys, Eucalyptus alba** (16%), **E. tectifica, E. clavigera, T. ferdinandiana, Acacia platycarpa** and **Xanthostemon paradoxus.** Understorey included shrubs of **Grevillea decurrens**, small **X. paradoxus** and **T. ferdinandiana.** Small shrubs and herbs include **P. quadriculare, Desmodium** sp., **Tephrosia** spp., **Galactia** sp., **Helicteres** sp., **Buchnera linearis** and seedlings of **E. chlorostachys** and **E. alba.**

10 Undulating, predominantly westerly facing site in western part of Yinberrie Hills; Gouldian Finch nesting site; canopy cover, 15%; tree spacing, 4-8 metres; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (8%), **E. dichromophloia** and **X. paradoxus**; Herbs and ground cover includes **P. quadriculare, Vigna** sp., **B. linearis, Helicteres** sp. and seedlings of **G. decurrens** and **X. paradoxus** as well as grasses, mostly **Sorghum** spp.

11 Generally flat site with some slopes and rises on western slope of Yinberrie Hills; canopy cover, 10-15%; tree spacing, 4-15 metres; dominant trees are **Erythrophloeum chlorostachys, Eucalyptus alba** (16%), **E. dichromophloia** with some **E. foelscheana**; middle stratum is sparse and consists mainly of **T. pterocarya, A. platycarpa** and **T. ferdinandiana**; ground cover is sparse and patchy.

12 Undulating southerly sloping foothills south of mine site; Gouldian Finch nesting site; canopy cover 15-20%; tree spacing, 8-10 metres; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (20%), **E. tectifica, E. clavigera** and **E. confertiflora**;

shrubs include **C. fraseri, A. acetosa, B. paradoxum, Tacca leontopetaloides** and **Galactia** sp.; grass predominantly **Sorghum** spp.

13 Gently westerly sloping site west of mine site; canopy cover, 10-15%; tree spacing, 10-15 metres; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (20%), **E. tectifica, E. clavigera, E. confertiflora** with some **E. foelscheana** and **E. setosa**; little understorey; ground cover mostly **Sorghum** spp.

14 Flat site with sandy soils north-east of mine site; canopy cover 20%; tree spacing, 8-15 metres; dominant canopy species are **Erythrophloeum chlorostachys, Eucapyptus alba** (18%), **E. tectifica, E. dichromophloia** and some **E. latifolia** and **E. clavigera**; middle stratum consists of **T. ferdinandiana, G. megasperma** and occasional **A. hemignosta.** Ground cover is sparse and presence of sedges suggests some seasonal inundation.

15 Ridge top and adjacent westerly slope west of mine site; Gouldian Finch nesting site; canopy cover, 15-20%; tree spacing, 5-10 metres; dominant trees are **Erythrophloeum chlorostachys, Eucalyptus alba** (20%), **E. clarigera, E. tectifica** and some **E. setosa** and **E. confertiflora**; middle stratum consists of broad-leaved trees such as **C. fraseri** and **G. megasperma**; ground cover is dense and senescent **Sorghum** spp.

16 Southerly sloping hillside near intersection of old and new Edith Falls Roads; canopy cover, 5-10%; tree spacing, 4-10 metres; mostly young trees; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (8%), **E. tectifica, E. clavigera, E. dichromophloia, X. paradoxus** and **T. ferdinanciana**; middle stratum consists of **T. ferdinandiana, C. fraseri** and **G. decurrens**; ground cover mostly dry, senescent **Sorghum** spp.

17 Steep slopes and ridges north of mine site; canopy cover, 10-15%; tree spacing, 4-10 metres; dominant canopy trees are **Erythrophloeum chlorostachys, Eucalyptus tectifica, E. dichromophloia, E. latifolia** and **X. paradoxus** as well as some **E. alba** (5%); middle layer consists of **B. paradoxum, C. arnhemicus** and **C. fraseri**. Most of ground cover is **Sorghum** spp.

18 Undulating site with some steep slopes, north-east of mine site; canopy cover, 20-30%; tree spacing, 8-15 metres; dominant canopy species, **Erythrophloeum chlorostachys, Eucalyptus dichromophloia** and some **E. tectifica** and **E. alba** (6%); middle stratum dense in places, **X. paradoxus** and **T. ferdinandiana**; dense grass and herb understorey in places.

19 Steep to undulating site on west side of small ridge north-east of mine site; canopy cover, 15-20%; tree spacing, 4-10 metres; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (5-10%),

E. tectifica, E. dichromophloia, X. paradoxus and some **E. foelscheana**; middle stratum includes **T. ferdinandiana, G. megasperma** and saplings of the canopy species; ground cover is patchy and consists mostly of **Sorghum** spp.

20 Flat site near watercourse, well north of mine site; canopy cover, 30%; tree spacing, 6-8 metres; canopy species include **Erythrophloeum chlorostachys, Eucalyptus alba** (6%), **E. tectifica, E. dichromophloia** and **E. confertiflora**; middle stratum consists of **T. ferdinandiana, G. megasperma, A. hemignosta, G. decurrens** and saplings of canopy species; ground cover, mixed grasses and herbs, little **Sorghum** spp.

SUPPLEMENT

MOUNT TODD GOLD PROJECT

GOULDIAN FINCH HABITAT IN THE YINBERRIE HILLS, NORTHERN TERRITORY

SUPPLEMENTARY HELICOPTER SURVEY - JUNE 1989

Prepared by:

Brett A. Lane Pty. Ltd. and Denise Goodfellow

for:

KINHILL ENGINEERS PTY. LTD.
BILLITON AUSTRALIA GOLD PTY. LTD.

date:

JULY 1989

SUPPLEMENTARY HELICOPTER SURVEY - JUNE 1989

This brief report supplements previous reports on the Gouldian Finch and its habitat near the Mount Todd Gold Prospect. It contains the results of a further helicopter survey of habitat parameters in the Yinberrie Hills and near Mount Todd and a revised map of suitable Gouldian finch habitat in the area.

The helicopter survey was conducted on 19th June 1989. It covered 21 new sites. These are shown on the attached map along with all past ground and helicopter survey sites. The current survey filled gaps in coverage of the area of the Yinberrie Hills identified by the Conservation Commission of the Northern Territory as holding Gouldian Finches. The method adopted for the survey was identical to that used in the earlier helicopter survey (see previous report, page 18). The table below presents the results of the latest survey.

SITE	**E.ALBA** PER HA.	GROUND COVERAGE OF **SORGHUM** SPP.
1	5 (3-7)	BURNT
2	2 (1-3)	86 (60-100)
3	6 (4-9)	86 (60-100)
4	5 (3-7)	86 (60-100)
5	7 (5-10)	BURNT
6	10 (7-15)	56 (39-84)
7	14 (9-21)	BURNT
8	6 (4-9)	BURNT
9	4 (3-6)	BURNT
10	5 (3-7)	BURNT
11	0	BURNT
12	0	16 (11-23)
13	1 (1-2)	5 (3-7)
14	5 (3-7)	64 (42-90)
15	12 (8-17)	90 (63-100)
16	4 (3-6)	20 (15-30)
17	15 (10-22)	BURNT
18	11 (8-16)	BURNT
19	12 (8-17)	5 (3-7)
20	5 (3-7)	10 (7-15)
21	10 (7-15)	BURNT

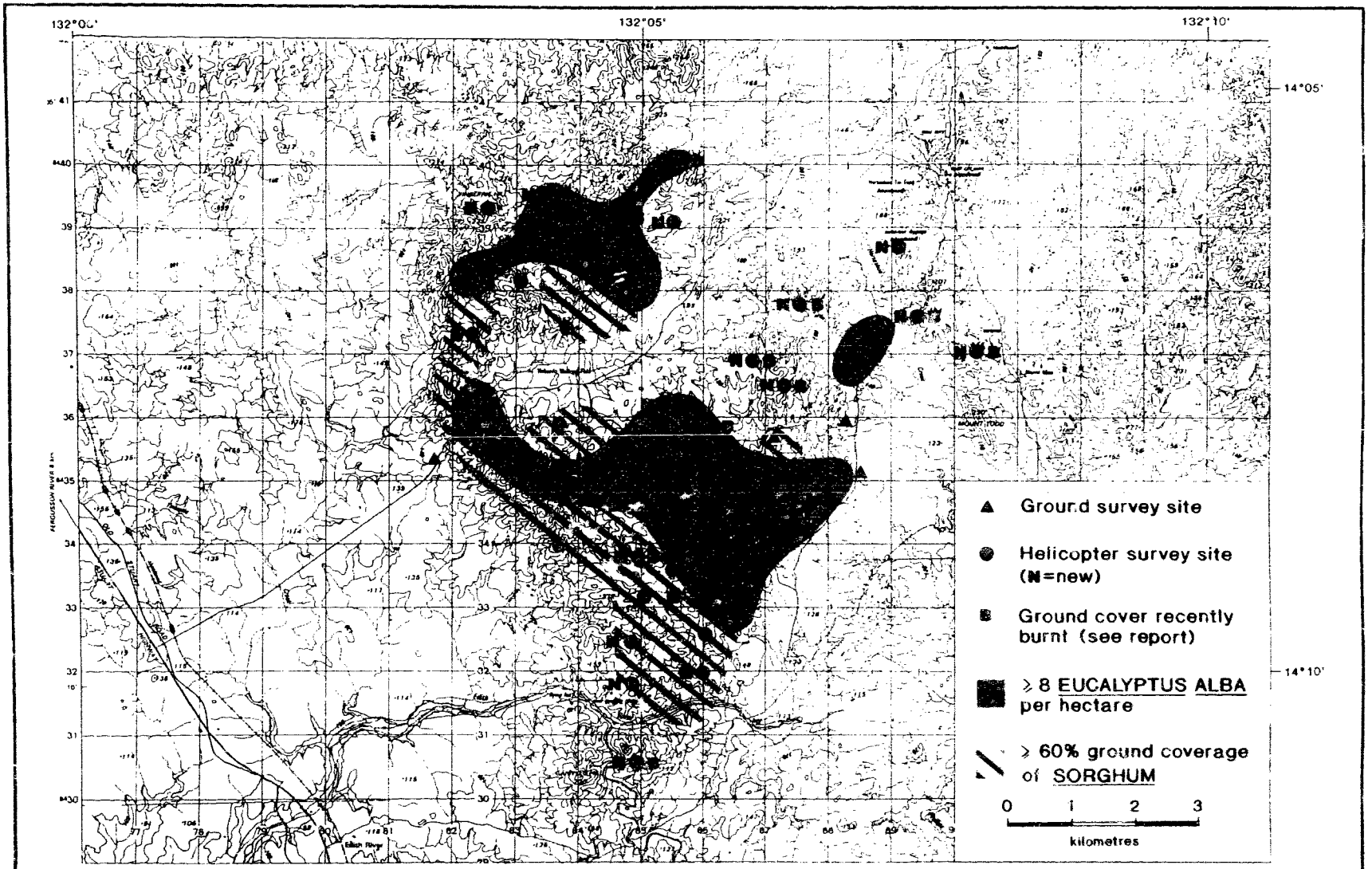
From this, it can be seen that the greatest limitation of the survey was the extent to which ground fires had burnt parts of the study area, making it impossible to quantify ground coverage. Such fires are not uncommon across the north part of the Northern Territory at this time of year. Fire had affected ten of the twenty-one sites covered. These are marked on the map.

Using the criteria established in the earlier investigations, a revised map of suitable Gouldian Finch habitat was prepared. A survey site was considered suitable if it held eight or more **Eucalyptus alba** per hectare, or if it had ground coverage of **Sorghum** spp. of 60 percent or more. These criteria cover nest-site and food availability.

The results of the helicopter survey confirm the broad pattern of distribution of high quality habitat identified during the earlier investigations in the Yinberrie Hills. It occurs in a broad east-west band in the southern part of the Hills and in a patch in the north-west of the Hills.

The area of high quality habitat may be larger than indicated because some sites with normally high ground coverage of **Sorghum** spp. may have been burnt.

The results of the current survey do not change significantly the assessment of the impact of the proposed mine and associated infrastructure on the Gouldian Finch and its habitat. About 6.5 percent of the high quality habitat will be lost because the ore body is located within it. All other infrastructure avoids high quality habitat. The raw water storages, together with the mine pit, will cause the loss of a total of 6.5 percent of all habitat used by the Gouldian Finch in the Yinberrie Hills during the breeding season. As stated in the earlier report, the impact of this loss of habitat on the species is difficult to predict.



MAP OF STUDY AREA WITH SUPPLEMENTARY HELICOPTER SURVEY, JUNE 1989

(refer figure 5 of report)

KINHILL

MOUNT TODD GOLD MINE PROJECT

MINING HISTORY

08.4934

Prepared by:

Kinhill Engineers Pty Ltd
37 McMinn Street, Darwin, NT 0800
GPO Box 250, Darwin, NT 0801

July 1989
A89034

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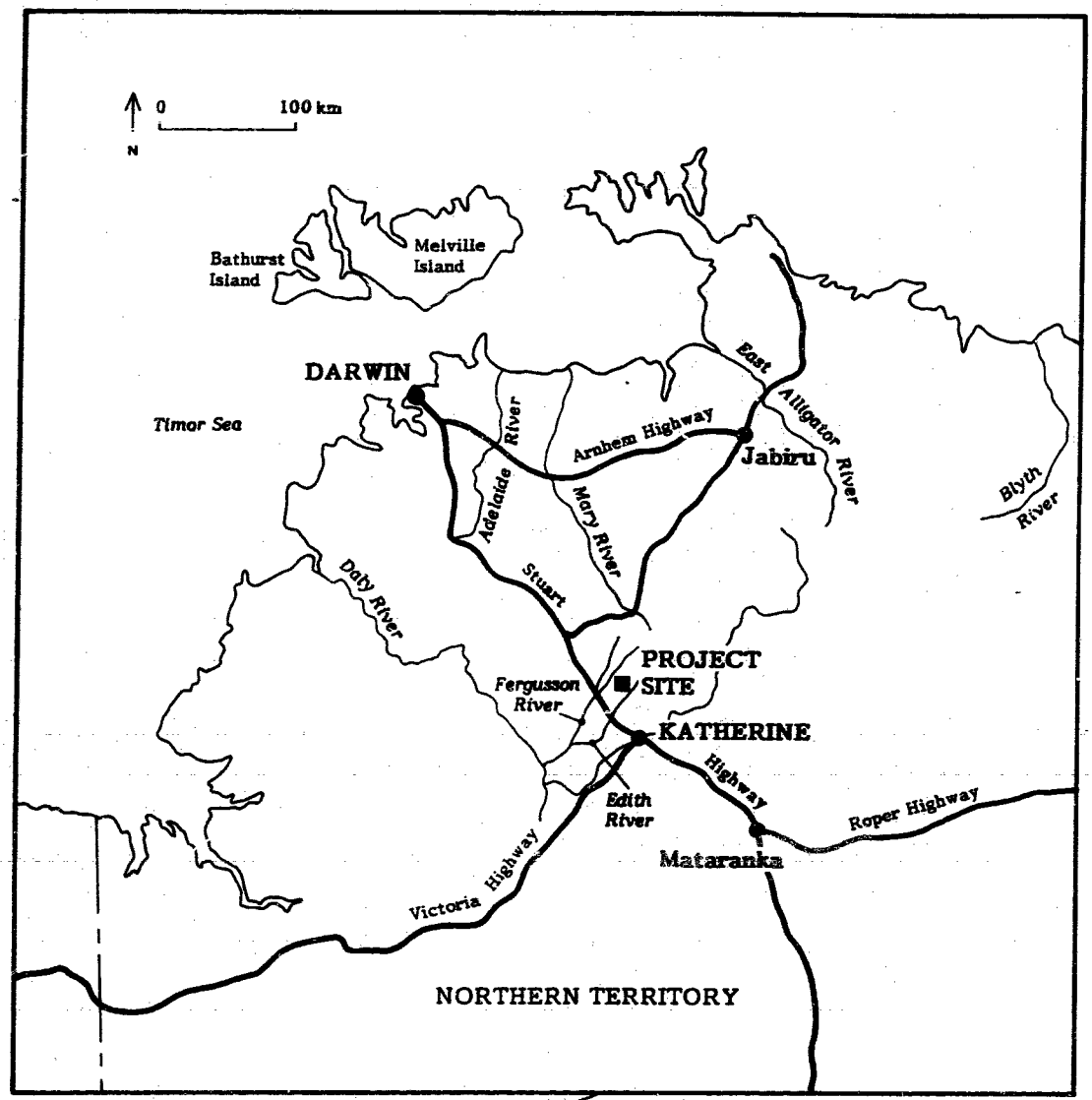
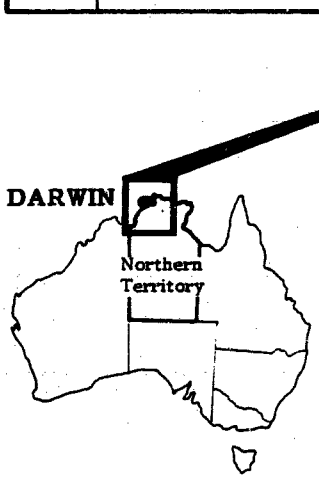
1 INTRODUCTION

The Mount Todd Gold Project is a joint venture by Billiton Australia Gold Pty Ltd and Zapopan NL. The aim of this brief history of mining in the vicinity of the Project is to provide details of the extent of mining, the methods used, and the location and quantities of minerals realised.

Mount Todd is located on the old Katherine to Pine Creek government road, and is approximately 56 km by road from Katherine (Figure 1). The township of Pine Creek, which has a well documented history as a gold mining township of the late 19th century, lies 64 km to the north. The regional terrain changes from rough and difficult in the Horseshoe Creek tin field and Yinberrie Hills wolfram field, to more open and undulating around Mount Todd itself.

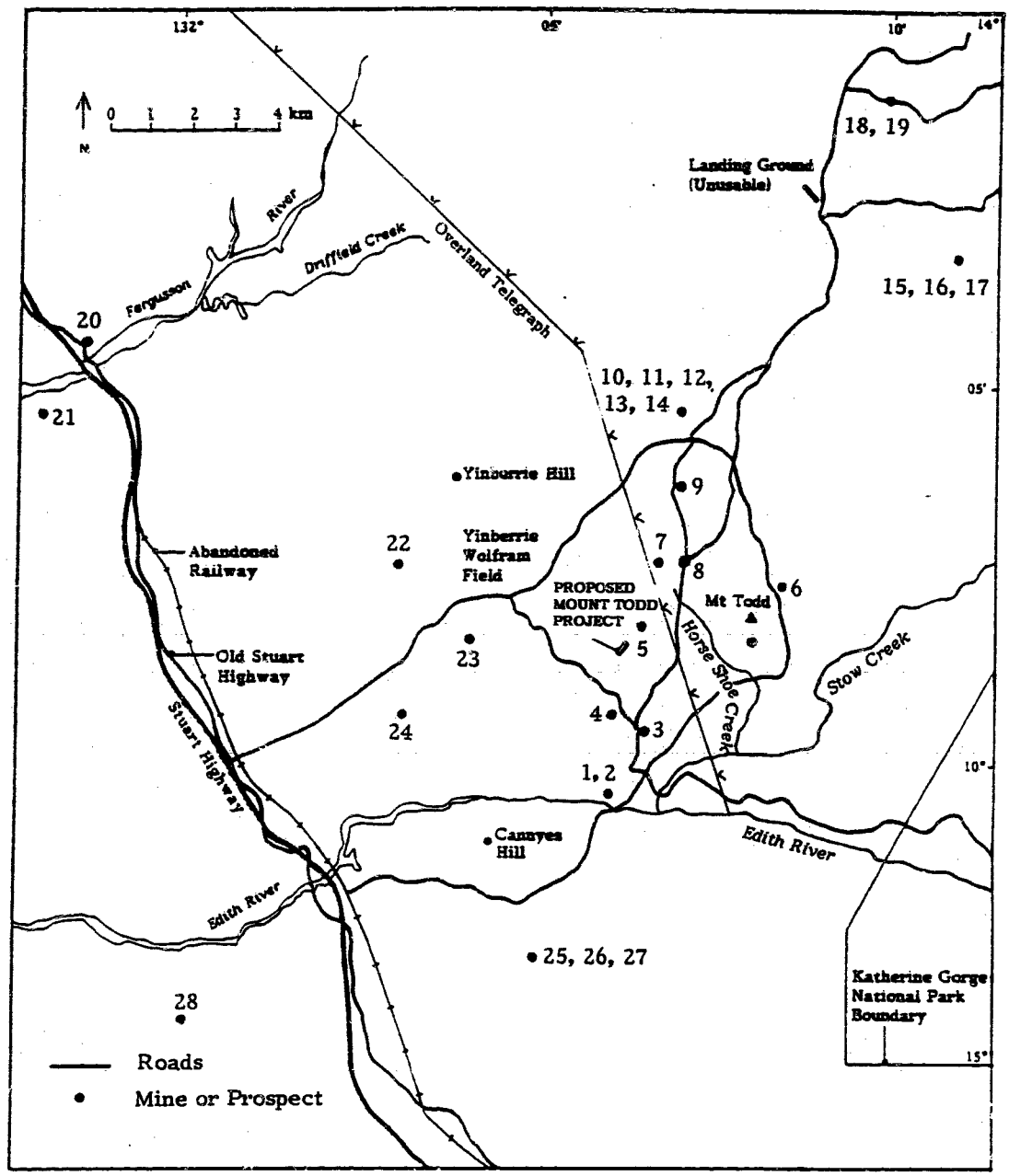
The open cut for the project being considered by the joint venturers is located approximately 3.5 km west of Mount Todd, and is part of an extensive and well-known gold and tin field which has been worked since late in the 19th century. Figure 2 shows mines within a 15 km radius of the Project.





KINHILL ENGINEERS
MOUNT TODD GOLD PROJECT

Figure 1
LOCATION MAP



1 Thistle
2 Doolan
3 Shamrock
4 Edith River Recovery
5 Tollis Reef
6 Morris
7 Jones Bros
8 Mount Todd
9 Quigley's
10 Marie
11 Stew
12 Surprise
13 Clean Sweep
14 Horshoe Creek
15 Creers
16 Lady May
17 Passys
18 Emerald Hill
19 Emerald Creek
20 Fergusson River
21 Woolgni
22 Southern Cross
23 Yenberri
24 Emerald River
25 Leap Year
26 Quartz Blow
27 Niagra
28 Tennyson

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MOUNT TODD GOLD PROJECT

Figure 2
MINES WITHIN 15 km OF THE MOUNT TODD GOLD PROJECT

2 MINERAL DISCOVERY AND EARLY DEVELOPMENT

It has been said that 'the discovery of gold permanently influenced the history of several colonies' [1] and this is true of the Northern Territory. Unfortunately, Australian history books have usually ignored mineral exploration in the north altogether, or given it only the most cursory attention, and there are few miners records.

There are three main reasons for the initial discovery of minerals in the Northern Territory, and subsequently the Mount Todd area:

- The failure to find gold in South Australia and the loss to the South Australian economy of thousands of its working class and much revenue to the Victorian goldfields during the 1850s;
- The determination of the Victorian and South Australian Governments to seek extensive pastoral lands between the centre of Australia and the Gulf of Carpentaria, leading directly to the ill-fated Burke and Wills expedition in 1860–61;
- The survey and construction of the Overland Telegraph line from Adelaide to Darwin, which was built for the South Australian Government in less than two years by teams working from both ends. It was completed in 1872.

Up until 1863, northern central Australia was technically part of New South Wales. In that year South Australia took over what then became known as the Northern Territory, and set up its administrative centre in Darwin. In 1911, administration passed to the Commonwealth, which still retains control over certain aspects of government. Limited self–government was granted to the Territory in 1978.

Copper had been found in South Australia in 1842 [2], followed by several minor gold strikes, each causing pandemonium, although none of the discoveries led to the establishment of permanent, viable fields. From the 1850s Victoria and New South Wales were gripped by gold fever, and many thousands of men and women, from ne'er do wells to theatrical performers and shopkeepers, flocked to the goldfields in search of a better life.

The South Australian Government tried through the *Bullion Assay Act* in 1852 to bring home some of the revenue being lost to Victoria. The Act sought to prevent speculation in gold in Adelaide unless the proceeds were used for investment in South Australia [3]. This response was inadequate in terms of revenue raised, and the Government saw a need to search for gold in the Territory, and to encourage the development of a mining industry.

Within a few years of the deaths of Burke and Wills, squatters were giving serious thought to occupation of the grazing land in the Gulf country and central Australia. Aided with the knowledge obtained by John McDouall Stuart, who had finished exploring a route from Adelaide to Darwin in 1862, these pastoralists were the first permanent European population of the Territory outside the small northern port of Palmerston (now Darwin). Stations near Alice Springs and Darwin were first stocked with cattle in 1872, the same year that the Overland Telegraph was completed.

In 1865 an exploration party led by F.H. Litchfield brought back specks of gold found on the Finniss River. In 1870 alluvial gold was found in the post holes being dug for the Overland Telegraph Line at Yam Creek, near Pine Creek, and in the same year, a Government Survey Party led by G.G.Mclachlan found a few specks of gold in the Fergusson River. (4)

In the early 1870s, rich gold reefs were being worked by scores of miners at Driffield, immediately to the north of Mount Todd. Some lucky prospectors had found about 19 ozs of gold near Stow Creek merely by gully raking in shallow grounds. (5)

By 1882 the gold rush to the Mount Todd area was well and truly underway — there were 700 Chinese working at the Stow Creek alluvial field. (6)

What an exciting, if at times extremely hard, life the people in the 50 square miles or so around Pine Creek and Mount Todd must have had. For almost 40 years, as new finds were confirmed, mineral prices rose and fell, and new technology was brought to the fields, literally hundreds of people moved their camps around constantly, often solely on the basis of a rumour.

Mineral discovery has always excited the Australian people and one can easily imagine the gleam in many a miner's eye as he slogged through the steaming bush of the Top End, remote from civilisation as he knew it, searching for valuable gold, wolfram, or tin. The heartbreak and joy that followed often depended on the availability of water during the Dry season and enough capital to keep going in the face of the adversities of the terrain.

Tom Gash found a silver-lead lode near Mount Todd in 1886 (7), and the Mount Todd Gold Field was discovered in 1889 by Walden and Rennett. (8) Tin was being mined at Mount Todd and Horseshoe by 1902 (9), and wolfram, molybdenite and copper ore with a trace of bismuth were being mined 5 miles west of the Project site by 1911. (10)

It is not known when wolfram was discovered, but as it lay easily visible in the shed from several prominent Yinberrie hilltops (11), it may have been noticed in passing by miners and geologists on their way to and from the main wolfram field at Horseshoe Creek, 5 km to the north–east.

Up until the early 20th century, the miners worked virtually unsupervised and unassisted in the Mount Todd area. Speculative and almost nefarious activities in the Territory mining industry seem to have been common-place in the 1890s. (12)

A picture of development for the sole operator at the time can be sketched — shallow shafts dug to water level (only to be filled during the Wet by surface runoff), no roads

through the bush, no transport, no equipment, no supplies. Sorting ore and using foot-dollies, panning, then bagging it for transport by handcart or dray to the battery for crushing, followed possibly by roasting and cyanidation. If he could afford it, the claim holder might have labour to help, but it was more likely that he saved his money for the battery charges, explosives, firewood and supplies.

At a higher level of development were the genuine miners, such as George Buttle and his daughter Maud, described by Timothy Jones in **Pegging the Territory** [13]:

'After severing his connection with Northern Territory Mining and Smelting in 1906, Buttle decided to do some mining on his own account and formed the Venture Syndicate. He bought Jolly's old ten-head battery at Wandi and arranged for Jack McCarthy to move it to Mount Todd,... during a heavy wet season when everyone else said it could not be done. At the field, Chinese outnumbered whites twelve to one and plenty of stone was available for crushing. R.Webb was called in from Wolfram Camp (in the Yenberrie Hills) and adjusted the plant to give a satisfactory recovery. It then crushed on, closing from time to time because of a shortage of water, and also treated wolfram ore with profit right through to 1910.' Maud Buttle ran the whole plant, gave the Chinese labourers their orders and supervised loading and despatch of concentrates by wagon to the railway when her father was ill in Pine Creek Hospital for three weeks.

Women on the fields were few and far between, and Maud Buttle must have been a brave and determined woman.

On the eastern lode of the Jones Bros mine an experimental cyanide plant was erected in 1908 [14]. The cyanide process for the recovery of gold from low grade ores and ores containing minute, particle sized gold was first used in South Africa in 1890. [15]. It was regarded as a major factor in the global supply of gold at the time. [16].

The use of the cyanidation at Mount Todd when so many aspects of life there were primitive indicates that miners were anxious to get the maximum return from the low grade ores often found there. The prompt use of new technology has been a hallmark of the exploitation of minerals in the Northern Territory, despite its remoteness and problems of transport and communication.

3 MINING PRACTICES AND THE ROLE OF GOVERNMENT

Exploration and mining in the Northern Territory have been as intertwined and as colourful as elsewhere in the world. Explorers, geologists and miners all faced the same problems — no roads for 5–6 months of the year during the Wet season,no supplies, and remote, primitive conditions. These were often accompanied by danger from the fierce storms and unfamiliar wildlife. Fortunately, problems such as foot fungus and fever can be easily treated now, and are regarded as a common by-product of working in the bush of the Top End during the Wet.

The legacy of early 'frontier' life is a paucity of surviving documentation from the miner's side of things with which to piece together a picture of their practices. Government reports do describe the methods, but not the conditions. It is evident that from very early on both the South Australian and Commonwealth Governments saw the necessity of assisting the development of the mining industry by identifying minerals, carrying out assay tests, drilling wells, building bridges, roads, and the railway.

The role of government has changed considerably and the industry is much more self-sufficient. The Department of Mines and Energy is more interested now in ensuring the use of safe mining practices and the orderly management of the industry than providing capital-intensive assistance.

In 1912, Dr.Woolnough, a geologist from Sydney University, travelled around the Pre-Cambrian fields of the Territory. Upon touring Irwin's claim about 3 km east of Horseshoe Creek, he noted the tenacity and purpose of the tin miner in working a shaft to 70 feet at a very steep angle, but recorded that 'the mine has been worked on the hand-to-mouth principle ...so marked a feature of Territory mining'. [17] The nearest well had been put in by the Government 1.5 km away, and the Government battery to which Irwin would have had to get his ore was 3.5 km away.

To the southeast, on the Mount Todd Fields, Woolnough noted that the Government was trying to sink a well, but had struck solid granite. Lack of water and difficulty of transport were holding up exploration of the lodes by several claim holders. [18]

In 1916, Government geologists Gray and Winter noted that 'mine workings and treatment methods [were] primitive' on the Yenberrie reefs. [19] When Dr Jensen, the Chief Geologist, visited the Horseshoe Creek field during the following year, they had already collapsed. This was due, in his view, to the system of tributing by the Chinese [20]. By this he meant that there were no pumps being used, that shafts were not

reinforced with timber, and that lodes were not worked in a systematic manner. The ground would have looked gouged and have been marked with shallow, uneven, open pits.

A similar state of collapse had been found to the northwest of Mount Todd at Woolngi, where the battery on the banks of the Fergusson River was already in disuse. Tunnels and shafts gave evidence of extensive working of gold reefs, although the field had been abandoned. At the time, the price of wolfram was high, and it was common for a field to be temporarily deserted by miners as they sought to exploit a more rewarding mineral. Dr Jensen urged the government to tunnel in search of what he felt was 'very rich (gold bearing) ore'. (21)

Mining in the early 20th century in the Mount Todd area is characterized by shallow scrapes, short shafts down to water level at 30–40 feet, alluvial panning and the presence of Chinese miners. No mention has been found of the presence of aborigines at that time, although their camps around Pine Creek and the work which they carried out for the miners there has been given some attention. (22)

Several lead shows were noted in the Mount Todd area in 1916. These also carried good gold values. It was anticipated that the lead treatment works then in operation at Mount Bonnie, near Yam Creek, could have been used to process the ore. (23)

Activity slumped for a time following the high prices experienced during World War I, and the loss of many of the miners to the war effort. The Australian economy had difficulty recovering from the after effects of the War, and the Great Depression was the inevitable consequence.

Men took to the roads trying to find work, and the government sought ways to employ people. Geological survey teams looked around the Territory and West Queensland hoping to revive the smaller mines.

In late 1936 a geological survey of the area was attempted by the Electrical Prospecting Co. of Sweden, but was hampered by the severe rainstorms of the Build-up season, difficulties of transport and a lack of supplies (24). Furthermore, the Chinese workings around the Jones and Tollis reefs prevented a survey being carried out at all.

4 THE CHINESE AND TERRITORY MINING

It would not be possible to write about mining in the Northern Territory without special attention to the contribution made by Chinese people, most of them originally from Singapore. It is generally known that the Chinese worked in the goldfields, having been brought in on contract during the gold boom at Pine Creek in 1872. By 1881 the population comprised 670 Europeans and 2,781 Chinese — no statistics are available for the Aboriginal population. Many of the Chinese went on to become storekeepers and property owners, their descendants forming an important part of the present population of the Top End.

The Chinese were in fact the backbone of the early mining industry. They often worked in stifling and hot conditions in pits which European miners found impossible. Some of the Chinese cut and carted wood for pits and fires, operated tiny stores, and could be found during the Wet carrying parts for broken machinery in their drays. They were often the only engineers available for taking down pit heads and building batteries [25].

Chinese miners worked in the diggings in three ways — as employees of the claim holder, as employees of a Chinese subcontractor, and as tributers. It is the tribute system that has attracted the most attention, but their role as employees was an important one too. In the early records of the Mount Todd area, there are many references to both the tribute system and the presence of Chinese day labourers.

There can be no doubt that the enormous numbers of Chinese in the Territory in the late 19th century caused concern amongst the white population and the Government. Legislation such as the *Chinese Exclusion Act* and amendments to the *Mining Act* were brought down to restrict the movement around the goldfields by Chinese people and prevent them from taking up leases to work gold reefs. However, during the 1890s many experienced white miners brought to the region returned home, unable to cope with the heat and isolation [26].

The tribute system was essentially simple, but its critics have described it as the treatment of the Chinese as an exploited coolie workforce by parasitic Europeans at a time when the Chinese were vulnerable. The tributers went after everything, with no regard for existing or possible future mine workings. It was undoubtedly efficient, although it meant and end to systematic working of a field.

According to the records kept by Edwin Tamblyn [27], there were two types of tribute agreement:

- A percentage base where the proportion of tribute paid to the claim holder rose with the higher yield of gold to ore. Tributers also then paid a crushing charge for use of the battery;

- The halves system where the tributers raised what stone they could, the ore was crushed without charge by the claim holder, and the gold was divided equally between the parties.

There were also charges for the use of machinery, stores and firewood — it seems that the tributers felt able to abandon the workings if prices rose in another mineral and move to another field.

It is interesting that the system of tributing had a role in securing the capital investment which was as vital to the mining industry at the turn of the century as it is today. As a miner reached water level, the prospect of needing a pump was inevitable, although some Chinese miners went down to 130 feet using only a bucket and windlass [28]. There was also the need for crushing and treatment plant, timber and of course cash for wages. The lack of progress in some lodes due solely to insufficient funds was often commented upon in the government reports. The tribute system meant that a quick and often valuable return from a field could be shown to shareholders. As Tamblyn records [29]:

'Once a company, either through extravagant surface development, mismanagement or fraudulent dealing by its directors, ran short of capital so that remittances from England ceased, mine managers had no money to pay day wages but had to keep the mine working or face forfeiture. The only practical solution was to stop development and let tributes... [Further], if tributers could prove a mine productive, the syndicate could publicise returns to promote a sale leading to company flotation.'

A Chinese man named Ah Que(e) was a persistent tributer at Zapopan and Eleanor at Pine Creek in 1897 according to the Tamblyn diaries. He also seems to have been a wood contractor and carter, and in 1909 ran the store at Mount Todd [30]. Many Chinese miners had moved there in 1907 following rises in the prices of base metals.

5 GENERAL MINING ACTIVITY IN THE AREA AROUND MOUNT TODD

Given the extent of mining within the vicinity of the proposed Mount Todd Gold Project, only a general history of the mines surrounding the Project area will be given. Greater detail will be provided for the mines closest to the Project site.

5.1 WOOLNGI

This field lies east of the railway line between the bridge over the Fergusson River and Yenberrie Creek. Refer Figure 2 for location. Gold was worked both in alluvia and reefs at Woolngi, mainly between 1896 and 1908. Gold production was first reported in the Chief Mining Warden's report of 1898, which stated that 20 oz of gold was recovered from a crushing of 82 tons of ore [31]). There are several shafts, at least one to 90 feet, and two adits, 160 feet and 90 feet long.

Apparently the population on this field reached 1,000 at the turn of the century [32], but it had been abandoned by 1908.

When Dr Jensen visited in 1915, he recommended tunnelling to 100 feet to find what he anticipated would be rich ore. Activity on the field did not pick up after World War I however [33], and no further mining has been done apart from the occasional gougings by prospectors.[34]. Recorded production of the field is incomplete, but in 1968 was about 4,600 oz of gold. [35]

5.2 DRIFFIELD

The Driffield gold field lies about 12 km north-east of the proposed Mount Todd Gold project (Figure 2). Gold was found at Mount Evelyn, about 3 km north-east, in 1870 by a Government Survey Party [36]. For 30 years from 1882, five major mines operated from numerous shafts and open cuts, the deepest to about 90 feet [37]. It hardly mattered that tributers worked on the Driffield mines — the lodes were uneven in the way they ran through the ore bodies and systematic development was almost impossible. Nevertheless, recorded production for the area is 5,500 ozs from 15,000 tons of ore.[38]

Production peaked in 1903, and the five-bead battery was in almost constant operation. The grade of ore decreased markedly after 1903, and the field was abandoned in 1911. [39]

In 1955, prospectors were occasionally sampling the quartz reefs, but were hampered by the lack of water during the dry season.[40]

When Commonwealth geologists surveyed the area in 1968, no work had been done at Driffield for many years. However, the Wandaroo Mining Corp. Pty Ltd held a gold mining licence from 1973 to 1977. Results of their works, if any, are not available. [41]

5.3 HORSESHOE CREEK

No work has been done at the Horseshoe Creek field since the late 1930s, it having been virtually abandoned in 1921. The many small mines peppering the hills were, however, well known between the turn of the century and the start of World War I (Figure 2).

The early history of the field is obscure as it seems to have been regarded as part of the Mount Todd field in early records. The Scotchman Mine formed part of the Horseshoe field, and yet records in 1941 referred to it as Mount Todd No.1.

Like the Driffield lodes, all the payable shoots were highly variable, ranging from '20 to 200 feet, and the width from a few inches to about 4 feet' [42]. No wonder tributing was in vogue here [43] — it was possibly the most efficient method of exploitation of the resource [44]. Between 1906 and 1910 high grade ores were recovered and several crushings averaged 30% metallic tin.

The deepest shafts are 150 feet and the lodes were worked out to the watertable, (at 30–40 feet), by World War I. The old battery for this field lay about 9 km north of the Mount Todd Battery (Figure 2).

Rattigan and Clark [45] reported that in 1953 one prospect was working a 'leader' for tin with aboriginal help.

In the 1950s, CSIRO tested the ore from the Scotchman Mine for the leaseholders — Young, Mazlin and Cousin — who also held the lease over the Morris workings. The sample supplied assayed 3.25% tin, 12.1% copper and 42.3% iron, with the balance insoluble, and CSIRO concluded that the recovery of tin and copper from the mine was barely worthwhile [46]. Total recorded production for the Horseshoe Creek field is about 650 tons of tin concentrate.[47]

5.4 YENBERRIE

Now known as the Yinberrie Wolfram Field, this series of mines was originally called New Wolfram, and by 1912 was officially known as Yenberrie. [48]

It is not known when wolfram was first discovered at Yenberrie. By late 1911 several parties were actively engaged in 'surfacing', with evidence of workings over a distance of a half mile. [49] Gold had been discovered there earlier in the same year by H. Morris, of Morris' Mine next to Mount Todd. The area was gazetted as a goldfield on 12 May 1911. [50]

To assist the goldminers, the Government attempted to sink a well near the eastern lode to provide drinking water. However, they struck granite and were unsuccessful.[51]

By 1916, activity had increased considerably — wolfram and molybdenite were needed urgently for war materials. The effort in mining the molybdenite, which cut in just below water level, was justified by its rising price. There were still no pumps in use but excellent income could be had for a few weeks work — Gray and Winter met a miner who had earned 80 pounds for five weeks work on the Yenberrie wolfram field. [52]

Other minerals at Yenberrie included copper carbonates, arsenical pyrites, a little bismuth and enriched copper sulphides, especially bornite although with some covellite, but these were towards water level, owing to the complete oxidation of the sulphide minerals above that point.[53]

Mine workings and treatment methods were primitive — richer shoots were followed down by shafts and underhand stopes to water level and the ore raised by windlass. Quartz and richer patches were then sorted out, dollied and panned off. [54]

There were three main claims at Yenberrie in 1915:

- Hore's on lodes 1, 2 and 3;
- Guy's on lodes 4, 5 and 6; and
- Jones' on lodes 7, 8 and 9.[55]

These claims incorporated the three main elements in mining in the region at the time — hard working loners, lack of capital for expansion, and the Chinese tribute system.

Hore's claim had a number of shafts — half of them down to 30 feet — for 150 yards along lode 1 and 250 yards along lode 2. One shaft was equipped with a whip (and was known as the 'whipshaft'). There were also shallow workings. [56]

Guy's claim was being worked by Chinese. Their method of shallow pot-holes, trenches and surfacing was a direct result of the tribute system [57] — and meant that the claim would have looked like a 'rabbit warren [making it] well nigh impossible to trace the continuity of any particular leader or reef in the underground workings' [58].

Attempts were made by the Yinberrie Wolfram Co. NL to develop the field whilst tungsten was again at a high price during the Korean War after 1950, but it abandoned the field in 1953.[59]

Recorded production to 1968 of the Yenberrie Mines was about 160 tons of wolfram, 2.5 cwt of molybdenite, and a small quantity of bismuth. [60] The reefs, which averaged 1 foot thick, had been worked in numerous shallow shafts and open cuts to 30–40 feet (water level).

From 1973 to 1978 Jimmy Ah Toy, of the well known Ah Toy family from Pine Creek, held a mining licence over the 9 ha at Yinberrie Hills known as Three Jays mine. He was

seeking copper, tin, and wolfram, but ceased in 1978, and transferred the lease to Christopher Moody.

The area has been at times included within the Exploration Licenses covering the Mount Todd fields since 1978. No further details of works done since that time are available.

6 MOUNT TODD THEN AND NOW

6.1 JONES' BROS MINE

It is important to distinguish this area, which is part of the Mount Todd field, from the Jones' lode, which was part of the Yenberrie Hills field.

The government geologist's report in 1908 places this mine as '4 miles south-west of Mount Todd' [61] but there can be little doubt that this was incorrect. It lay south-west of the Mount Todd tin workings, and was identified in 1941 as being 3 km west of Mount Todd [62]. The main lode was a true fissure vein 74 cm wide of gossany quartz [63], and ran parallel to another lode about 1.5 km south (Figure 3).

In 1908 the principal workings comprised a crushing and concentrating plant and a shaft to 30 feet — deeper exploratory work being prevented by lack of capital.

Thirty-four tons of ore taken to the Government battery at Horseshoe Creek [64], and crushed yielded 9 tons of concentrated ore, which on treatment in the cyanide plant returned 8 oz gold. The inspecting geologist's view was that leaching had probably occurred.[65] A sample assay yielded 2 oz 12 dwts per ton of silver and 24.4% lead. Gold was not visible in the quartz, but deeper sinking and systematic prospecting was recommended. [66]

The ore at Jones Bros was complex, and a second parcel was treated by cyanidation in 1908 after being roasted and hand broken. [67]

By 1912 the Foote Mining Company was working on the lodes and renting the battery. It had been specifically formed with local capital to work the Jones Bros reef. The Company commenced work on a new lode [68] which was about 2.5 m wide in outcrop with occasional developments of mica. The quartz carried about 10 dwts of gold per ton. [69] See Table 1 for production results, which show that 867.14 oz of gold were recovered from 879 tons of ore.

It was the view of the Government geologist that the nature of the ore and difficulty of treatment, hindered and finally caused a cessation of mining operations on the reef. This was despite assistance from the government in the form of shaft sinking and tunnelling. No further work was done after 1936.

By 1916 the cyanide works had fallen into disrepair, but the claim was being actively worked by the claim holder who had shafts down to water level along each lode, and

FIGURE 3

WORKINGS ON JONES BROS REEF 1937

MT TODD PLATE I
(SUPPLEMENTARY)

PLAN AND PROJECTIONS
JONES BROS REEF
SHOWING
WORKINGS, DRILL HOLES, SAMPLING RESULTS (1937)

SCALE OF FEET
200 100 0 200 400 600

REEF MAPPING BY V.M.COTTLE & A.W. REEDMAN

SAMPLING BY V.M.COTTLE

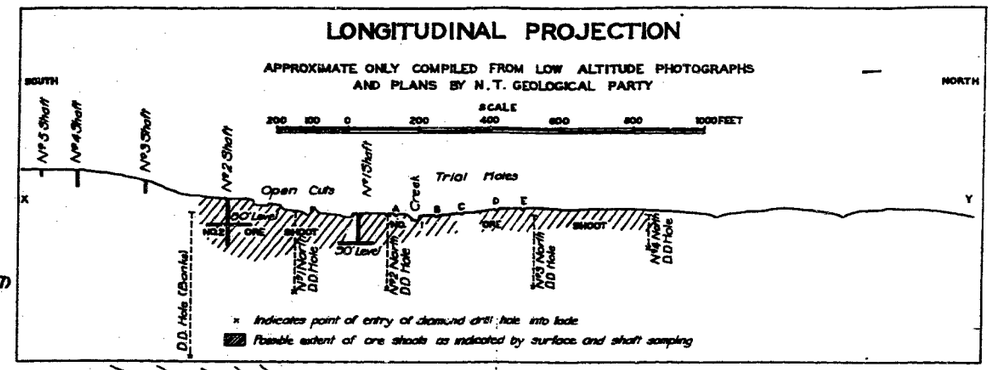
Width in inches ft. in. c.c.
Assay values shown (by dwt. per ton for gold & silver) (As a percentage for lead)

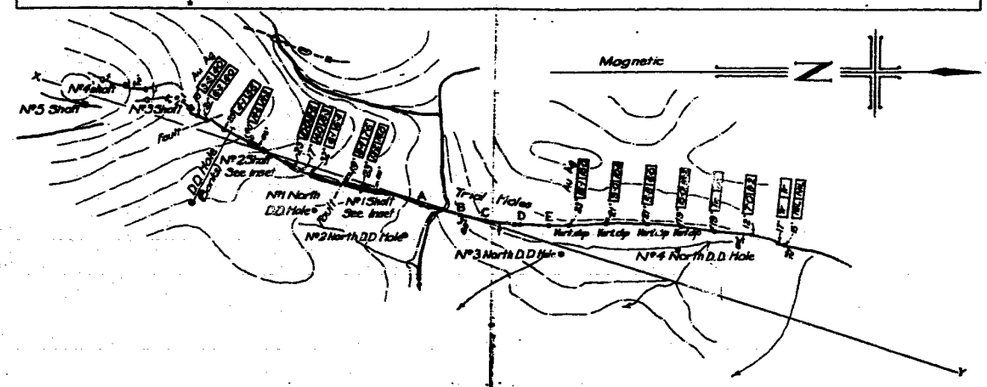
Revd. Mountford
SENIOR GEOLOGIST
10-6-41

LONGITUDINAL PROJECTION
APPROXIMATE ONLY COMPILED FROM LOW ALTITUDE PHOTOGRAPHS AND PLANS BY N.T. GEOLOGICAL PARTY

SOUTH — NORTH

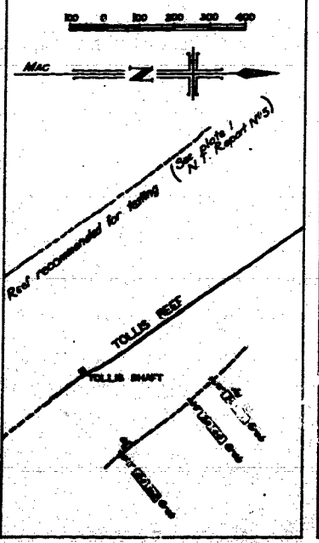
SCALE
200 100 0 200 400 600 800 1000 FEET



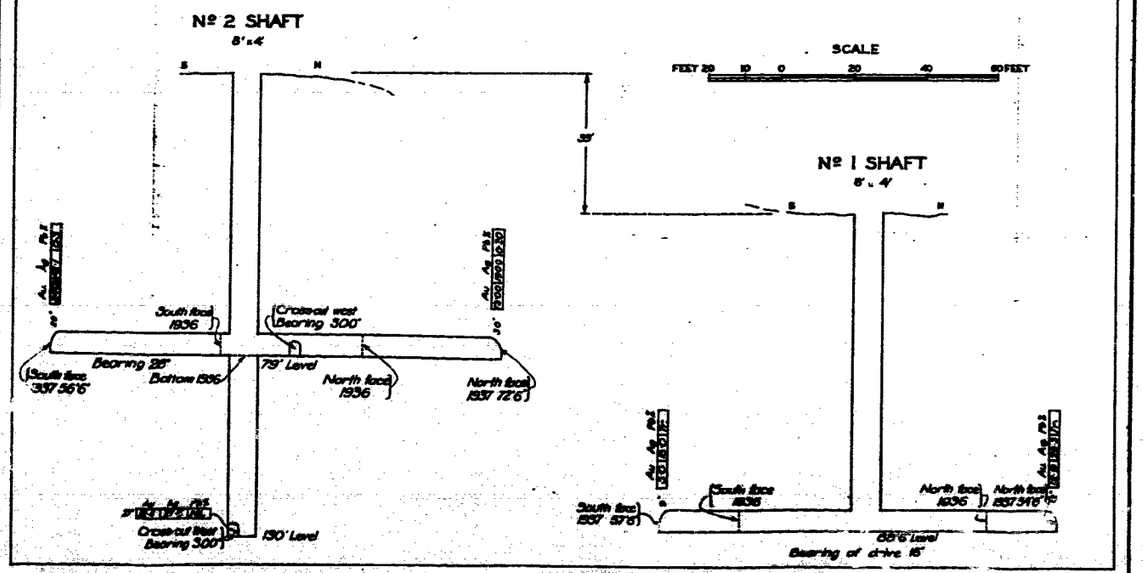


TOLLIS CLAIM
— SHOWING —
SAMPLING RESULTS (1937)

SCALE OF FEET
100 0 100 200 300 400



SHAFTS NOS. 1 AND 2
LONGITUDINAL PROJECTIONS
— SHOWING —
SAMPLING AND OPERATIONS DURING 1937



shallow workings as well. Dumped material was also being picked over for wolfram. [70] Refer Figure 3 for details of the shafts, open cuts, and trial holes.

Table 1 Production — **Jones Bros Reef 1912** (from Cottle *op.cit* p.1)

Year	Miner	Treatment	Ore tons	Gold oz
1908	Jones, P.A Mt Todd battery	Crushed, cyanided	80.25	56.87
1908	Jones, P.A	Roasted, hand-broken and cyanided at the mine	46.75	70.77
1909	Jones, P.A.	Roasted, hand-broken and cyanided at the mine	172.00	217.50
1910	Foote Gold M.C.	Crushed at Mt.Todd battery, probably roasted and cyanided	400.00	332.00
1911	Foote Gold M.C.		180.00	190.00
Total			879.00	867.14

There was quite a bit of disturbed ground typical of Chinese workings about 1.5 km to the north with reefs carrying gold which were believed to be continuations of the Foote lode. [71]

In 1937, five diamond drill holes for trial sampling were put down by the Mines Branch of the Northern Territory Administration in the northern portion of the reef, but in fact no ore was taken until the following year. [72] When CSIRO tested the assays from the site for E.G.Banks in 1937, it reported that 'the ore (from Mount Todd) is amenable to treatment by roasting and cyanidation, giving recoveries of the order of 98%'. [73] The sample of 60 lb gave a gold (Au) result of 18.7 dwts per ton. [74]

From 1938 to 1940 mining operations were conducted by the Mount Todd Mining Company NL, which sought to work the downward extension of the reef [75]. The Company deepened the No. 2 shaft from 50 feet to 80 feet [76], but the results were disappointing. [77]

Table 2 provides details of the shaft depths and open cut sizes at completion of the Mount Todd Mining Company's work.

Table 2 **Shaft and open cut details at Jones Bros reef 1937** (from Cottle *ibid*)

Shaft no.	Depth (feet)	Drives	Length (feet)
1	90	north south	30 30
2	80	north south	30 3
3	50		
4	40		
5	15		

Open cut Location	Length (feet)	Width (feet)	Depth (feet)
north	100	2	6–8
central	90	2–3	30 ft. rising to the south
south	40	2–3	12

In 1941, the area was again surveyed, and assays taken. In the No. 2 shaft, the north drive of 72 feet returned 13.0 dwt of gold per ton across 30 inches, and the south drive of 50 feet returned 34.0 dwt of gold across 29 inches. Refer Table 3 for full assay results from the samples taken on this trip.

This was, of course, during World War II. Darwin was bombed in 1942, and the consequent takeover of the railway line for troop transportation, the roads for aircraft landing strips, and evacuation of some of the civilian population, meant that no further works or inspections were done until 1949 — well after the War.

In 1946 the mining industry in the Territory had slumped to the point where there were only thirty-nine gold mining leases, and forty-five mineral leases. As might be expected, production was at a very low level. When the geologist L.C. Noakes surveyed the area in 1949, he believed that the lack of mining was directly attributable to the lack of venture capital, the remoteness, and the availability of easy employment elsewhere. [78]

Nevertheless, Mount Todd Gold Mine NL leased the areas covering Jones Bros from 1947–1951. They allowed the leases to lapse, perhaps for the reasons identified by Noakes.

In 1953, the YMC syndicate removed the old Mount Todd Battery to a site on the Edith River and used it to treat dumps from old workings for tin [79] at Boylings and Morris.

To 1968, the recorded production of the Jones Bros Reef was 915 oz of gold. (80) The main reef has been traced on the surface for about 70 m, ranging in width from 30 cm to 1.25 m.

Table 3 **Assay results Jones Bros. Reef 1938**
(from Hossfeld and Nye *op cit* p.4 ff)

Assay site	Result dwt of gold	Width inches per ton
Between No. 1 shaft	13.28	21.0
and a point 50 ft.	8.4	19.0
south of No.2 shaft	6.1	32.0
	14.0	17.0
	10.0	23.0
	14.6	
Between the above	4.1	23.0
point and No. 3 shaft	6.2	21.0
	3.6	18.0
North of No.1 shaft	16.1	23.0
	9.0	21.0
	5.8	21.0
(820 ft. north)	15.0	19.0
Further north of No.1.	19.0	
Trace shaft	7.0	12.0
Trace	17.0	
	Nil	15.0

Australian Ores and Minerals Ltd was interested in the Mount Todd mines from 1973 to 1975, and took out a number of gold mining leases in joint venture with Wandaroo Mining Corporation and Esso Standard Oil. These may have been purely speculative, as the Commonwealth refused at least one licence application made by the Company. Despite determining that the gold potential of the reefs in the area was most promising, Australian Ores and Minerals ceased working around Mount Todd. The Arafura Mining Corporation, CRA Exploration, and Marnaz Pty Ltd, all had a look at Mount Todd No 1 at different times between 1975 and 1983.

From 1977 to 1983 Destiny Prospecting Pty.Ltd held Exploration Licence No. 1510 over Jones 1 and Jones 2. Under the self-reporting requirements of the *Mining Act,* Destiny was required to lodge particulars of its activities with the Department of Mines and Energy, however the information is regarded by the Department as confidential.

The same situation is true of CRA Exploration Pty.Ltd, which held Exploration Licence No. 3283 covering 13 sq.km abutting the Destiny lease, from 1981 to 1987.

Pacific Goldmines NL worked the Jones Bros Reef for almost 7 months from July 1987, but appear to have been unsuccessful, and left the area. See the notes on the Quigley reefs for more particulars.

6.2 MORRIS' CLAIM

In 1916, when the Chief Geologist Dr Jensen toured the fields, tin was still being mined on the Morris claim, whereas the Horseshoe field had been abandoned. [81] Tin was also being taken at the Scotchman mine immediately to the north (Figure 2). The tin ore found was associated with malachite and native copper. Figure 4 indicates workings on the reef.

Again the lodes were uneven and difficult to mine in a systematic manner. Total recorded production is 180 tons of tin concentrate, about 5 tons of which have been won since 1958.

During 1952–53 the YMC syndicate trucked material from the ore dumps at the Morris workings for recovery of tin at the Mount Todd battery [82]. These dumps were reported to carry up to 1% tin.

The licence holder for the area originally known as the Morris Workings, and now known as Morris No.1 from 1953–1974 was Group Suppliers Pty Ltd, which was looking for tin.

6.3 TOLLIS' REEF

This reef lies about 1.5 km south of the Jones Bros mine and has been worked on a small scale with the shaft to 35 feet. This mine was in operation in about 1911, along with several other small holdings in the area, Chinese and Clean Sweep.

No details of production have been recorded, although it seems that some ore may have been sent to the Pine Creek battery very early on.

When the Government Geologist sampled the shaft in 1936, an average assay value of 14.39 dwt of gold per tone across an average width of 23 inches was found. [83]

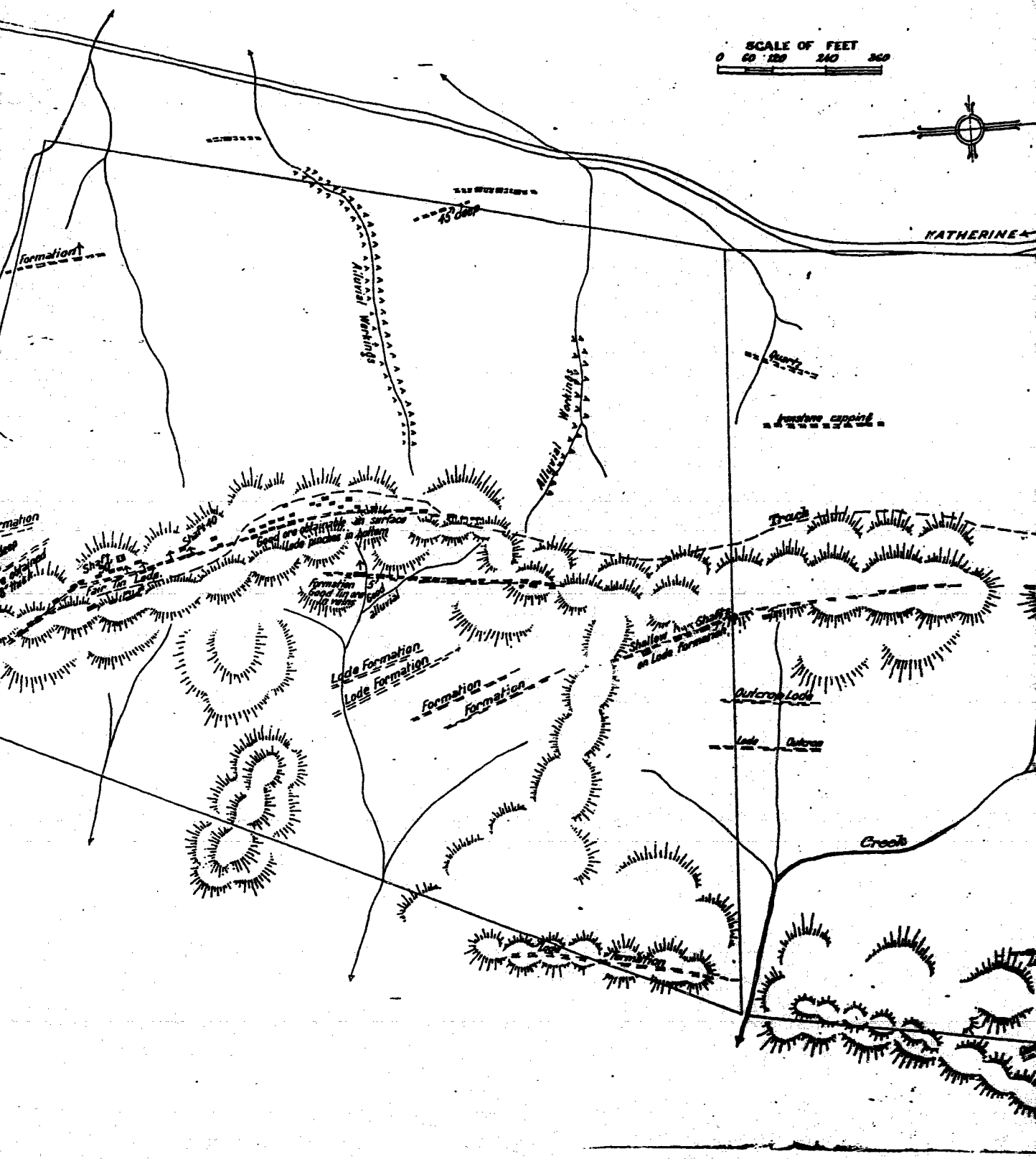
Refer Figure 3 for layout of reef.

FIGURE 4

WORKINGS ON MORRIS REEF

Mt. Todd.—Morris' Leases.

Compass Surveys by T. G. OLIVER.



6.4 QUIGLEY'S REEF

In the early part of the century these reefs were known as New Mount Todd, and were discovered before 1919, probably by Jones [84]. They lie almost 2 km north-east of Jones Bros. The reef runs for over 1 km and has a maximum width of 2 m. Refer Figure 5 for layout.

There are many openings — a 110 foot adit, numerous small open cuts, and several shafts, the deepest to 80 feet. The adit and the deeper shaft tested the central part of the of the southern portion of the reef where it appeared to be more than 6 feet wide. Four samples taken from the adit in 1940 gave an average grade of 13.7 dwt of gold over a width of about 20 inches. [85]

The Commonwealth geologists in 1940 suggested that adits driven in from valleys to the west of the reef could be worked together with the Jones Bros reef to provide a satisfactory return [86], although at the time there was no connecting road to the Mount Todd gold mine .

Certainly, the Quigley family at least took notice of this advice, because in October 1940, Gavin Quigley took out gold mining leases over both the 9 ha area known as Quigleys and the adjoining area known as Quigley's North. He kept these going until 1950.

In July 1987 work resumed on the Quigley reef and three nearby sites known as Golf West, Golf, and Regatta. Pacific Goldmines NL undertook a comprehensive exploration programme, and thought that the area had significant potential. See Table 4 for a geological resource summary.

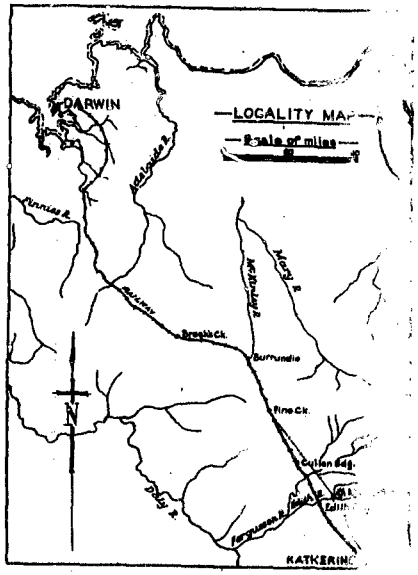
The Company's Annual Report indicates that heap leaching at Mount Todd did not bring as high a yield as processing in the carbon-in-pulp plant owned by Pacific at Moline, and so all ores were carted to the plant. This continued until December 1987, when the ore grade fell, and transporting became uneconomic.

Mining continued, creating a stockpile of 15,000 tons of ore, but Pacific Goldmines ceased operations in the area in February 1988. [87]

FIGURE 5

WORKINGS ON QUIGLEY'S REEF 1937

MT. TODD PLATE 2
(SUPPLEMENTARY)



SKETCH PLAN

OF

QUIGLEY REEF

MT TODD AREA

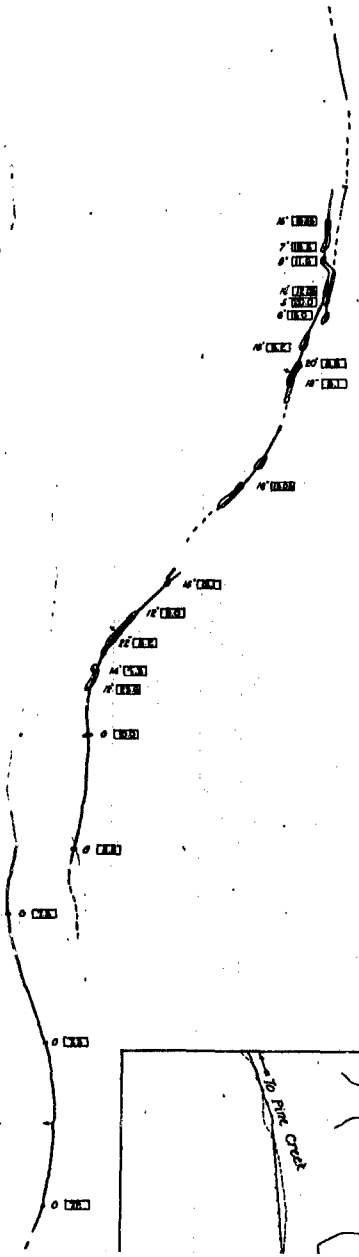
PINE CREEK DISTRICT N.T.

SHOWING

WORKINGS & ASSAYS

SCALE OF FEET

100 0 100 200 300



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Paul Hossfeld

SENIOR GEOLOGIST.

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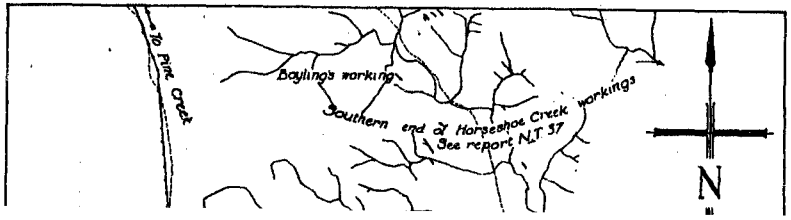

Table 4 **Resource summary** (from Pacific Goldmines NL *op cit*)

Area	Tonnes	Grade (g/t)	Resource	Depth (m)	Status
Golf West	121,000	1.22	Indicated	30	
Golf Results incomplete (sulphide ore)					
Quigley's South	71,000	4.4	Measured	30	
Quigley's North	6,920	4.7	Measured	15	
Quigley's North ext'd	14,680	3.77	Measured	15	
Regatta	14,150	9.8	Indicated	30	
Total	227,750	3.04			

7 SUMMARY

It can be said that mining in the Mount Todd region has been extensive in the past and has always held interest for gold miners. Its history encompasses all of the influences upon mining which occurred throughout the Northern Territory.

Until recently, times were indeed hard in the bush of the Top End, and the spirit of those people who struggled to extract some wealth from the earth around Mount Todd may still be felt at the old battery, the sites of the Chinese workings, and the old shafts.

The area is presently experiencing a revival of interest. It is unlikely, however, that these modern times will bring back the aura created by the whinnying of horses pulling drays, the smell of woodsmoke from the miners fires, the clink of pickaxe against rock, and the hubbub of the tributers.

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MT TODD GOLD PROJECT

REVIEW OF ALTERNATIVE

TAILINGS DAM SITES

08.4692

Prepared by:

Kinhill Engineers Pty Ltd
645 Harris Street, Ultimo NSW 2007
Tel. (02) 212 1244; Telex AA25519; Fax (02) 2126252

May 1989

MT TODD GOLD PROJECT

REVIEW OF ALTERNATIVE

TAILINGS DAM SITES

CONTENTS

1. DESCRIPTION
2. ASSUMPTIONS
3. COMPARISON OF SITES
4. CONCLUSION

APPENDIX

. Sketches of Dam Sites

. Elevation/Capacity Curves for Dam Sites

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REVIEW OF ALTERNATIVE

TAILINGS DAM SITES

1. DESCRIPTION

Three alternative tailings disposal sites are compared in broad terms for 30 mil tonnes of tailings.

The sites are:

1. In mountain areas to the north of the mine.
2. The presently proposed site in the mountains to the south of the mine.
3. A site to the east of Mt Todd.

The comparison is based on the criteria listed below. No attempt has been made to refine layouts or operation details or method of dam construction because such refinements will effect all alternatives similarly.

The comparative costs shown are therefore not necessarily definitive costs for the work.

2. ASSUMPTIONS

Assumptions made for the comparison are:-

(i) Dam capacity is based on level tailings surface.

(ii) Embankment construction is based on downstream construction.

(iii) Embankment costs $5/m^3.

(iv) Pipeline costs $150/m.

(v) Relative power costs are calculated on the relative static heads for 3.0 M.T.Y. at 8000 hrs. per year x 12 cents/unit.

(vi) A plant site elevation of RL 130.

3. COMPARISON OF SITES

Table 1 shows the comparison of broad details. The following points should be noted:-

(i) initial dams and initial pipeworks could be reduced but are based on works required to provide about 10 mil m^3 capacity

(ii) during operations there is likely to be pipe relocation and extensions required. The probable ranking of most to least is:

Site 2
Site 1
Site 3

(iii) for a production of 3.0 M.T.Y. a tailings surface area of 100 to 120 Ha should be aimed for to achieve drying and for 5.0 M.T.Y. and area of 150 to 200 Ha. Site 3 area could be increased but Sites 1 and 2 could not readily be increased.

(iv) All sites can be operated so that run-off from upstream catchments does not pass over the disposal area.

(v) Dams required for process water or reclaim water storage are not included in the comparison. Sites are available for each alternative.

(vi) Unit cost for embankment construction is likely to be lower for Site 3 than other sites because of easier access.

TABLE 1: COMPARATIVE DETAILS

	Site 1 (Northern area)	Site 2 (Original)	Site 3 (Mt Todd)
ULTIMATE CAPACITY (30 M.T. = 23Mm^3)			
Top elevation	RL 190	RL 184	RL 163
Capacity	23,500,000m^3	24,000,000m^3	23,000,000m^3
Surface area	155 Ha	150 Ha	130 Ha
Catchment area	169 Ha	236 Ha	147 Ha
Dam earthworks	1,340,000m^3	1,862,000m^3	2,907,000m^3
INITIAL DAM (Approx. 2 year capacity)			
Top elevation	RL 190	RL 180	RL 150
Capacity	9,900,000m^3	8,700,000m^3	10,000,000m^3
Catchment area	53 Ha	176 Ha	147 Ha
Dam earthworks	636,000m^3	536,000m^3	700,000m^3
PIPEWORKS (Initial)			
Tailings pipe	6.0 Km	5.75 Km	5.25 Km
Reclaim pipe	6.0 Km	3.25 Km	3.5 Km
Static head (tailings)	60 m	54 m	33 m
COMPARATIVE COSTS			
Initial dam	$3.1 mil	$ 2.7 mil	$ 3.5 mil
Ultimate dam	$6.7 mil	$ 9.3 mil	$14.5 mil
Pipeworks	$1.8 mil	$ 1.4 mil	$ 1.3 mil
Relative power costs	$120,000/year	$110,000/year	Nil

4. CONCLUSION

- All three sites could be developed for tailings disposal provided geotechnical conditions are suitable.
- Site 3 requires the most earthworks for dam embankments however because of availability of materials and accessibility, unit costs for construction could be less than other sites which is not refelected in Table 1.
- The ability to expand beyond 30 M.T. is similar in each site.
- Operation and control of water is easier on Sites 1 and 3 than on Site 2.
- From test results tailings are expected to settle well and will be similar to Pine Creek and Goodall projects. Suitability for upstream construction has not been investigated at this stage.

APPENDIX

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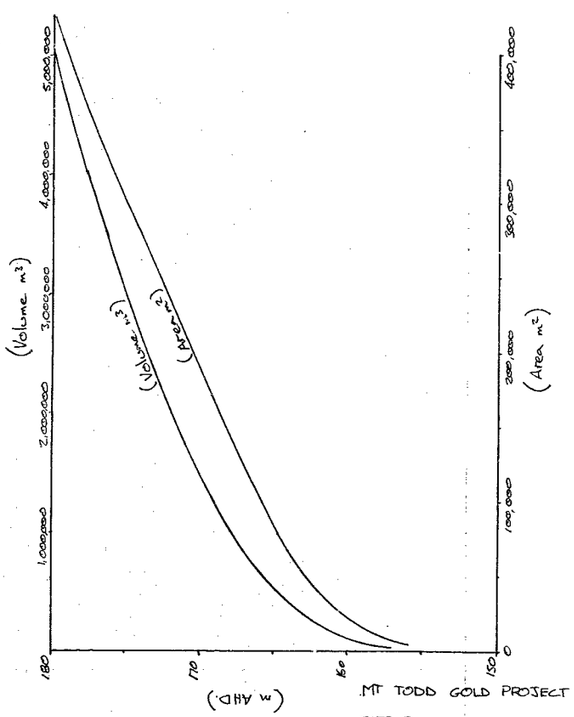

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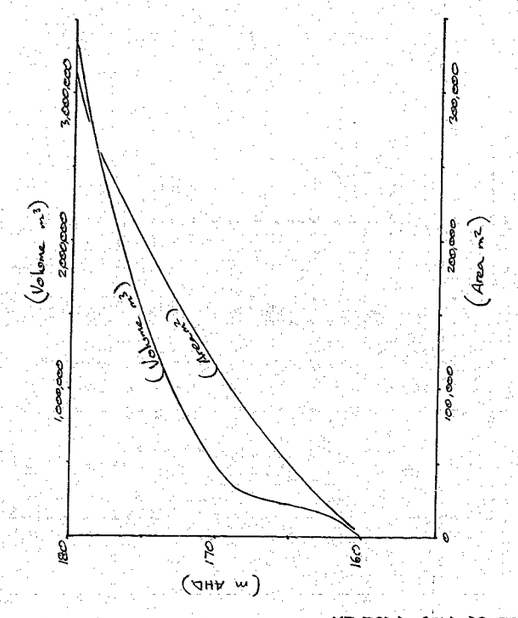

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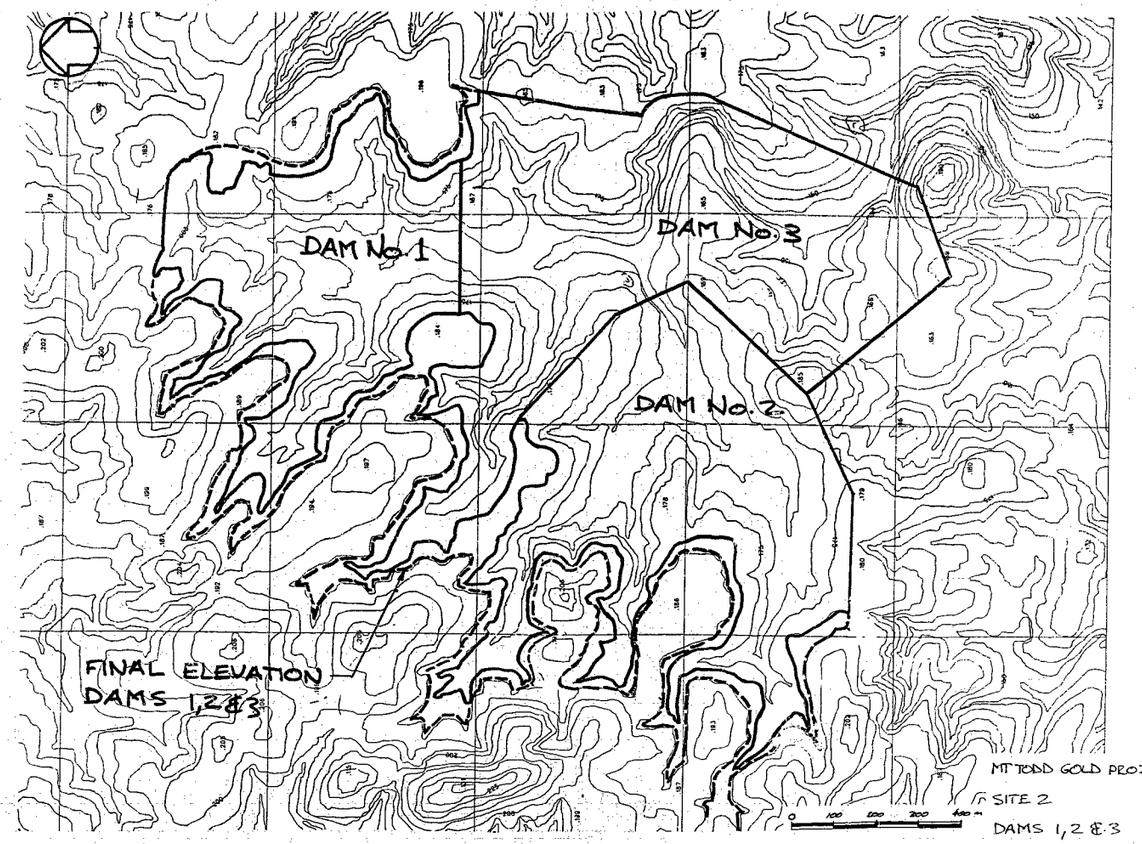
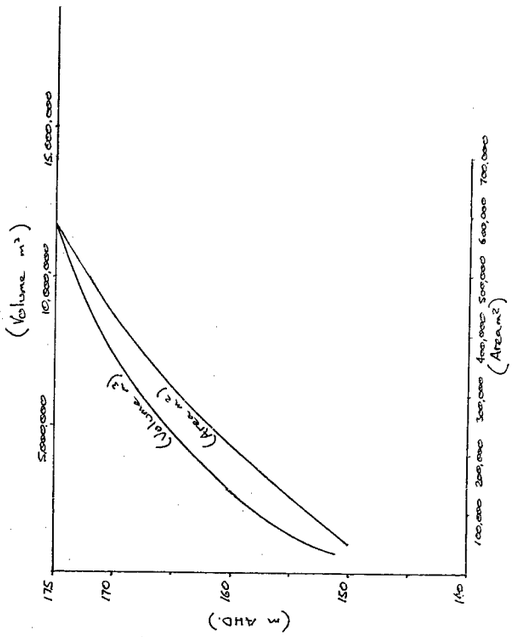
DAM No.1



MT TODD GOLD PROJECT
SITE 2
DAMS 1,2 & 3

KINHILL



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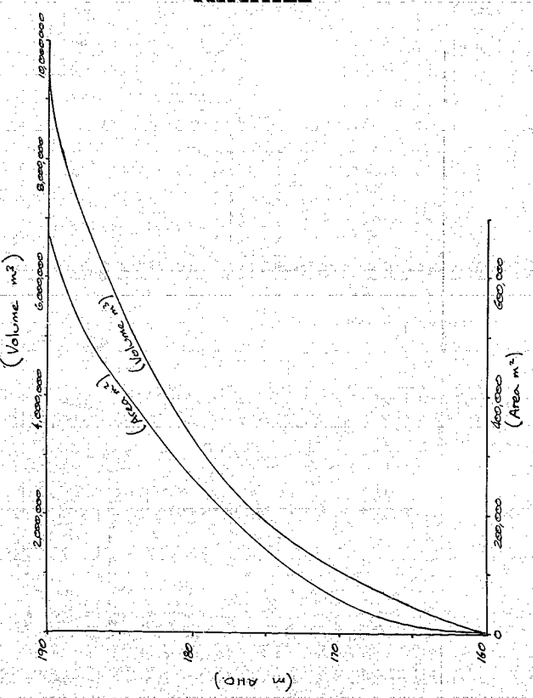
SITE 1.
DAM No. 2

KINHILL



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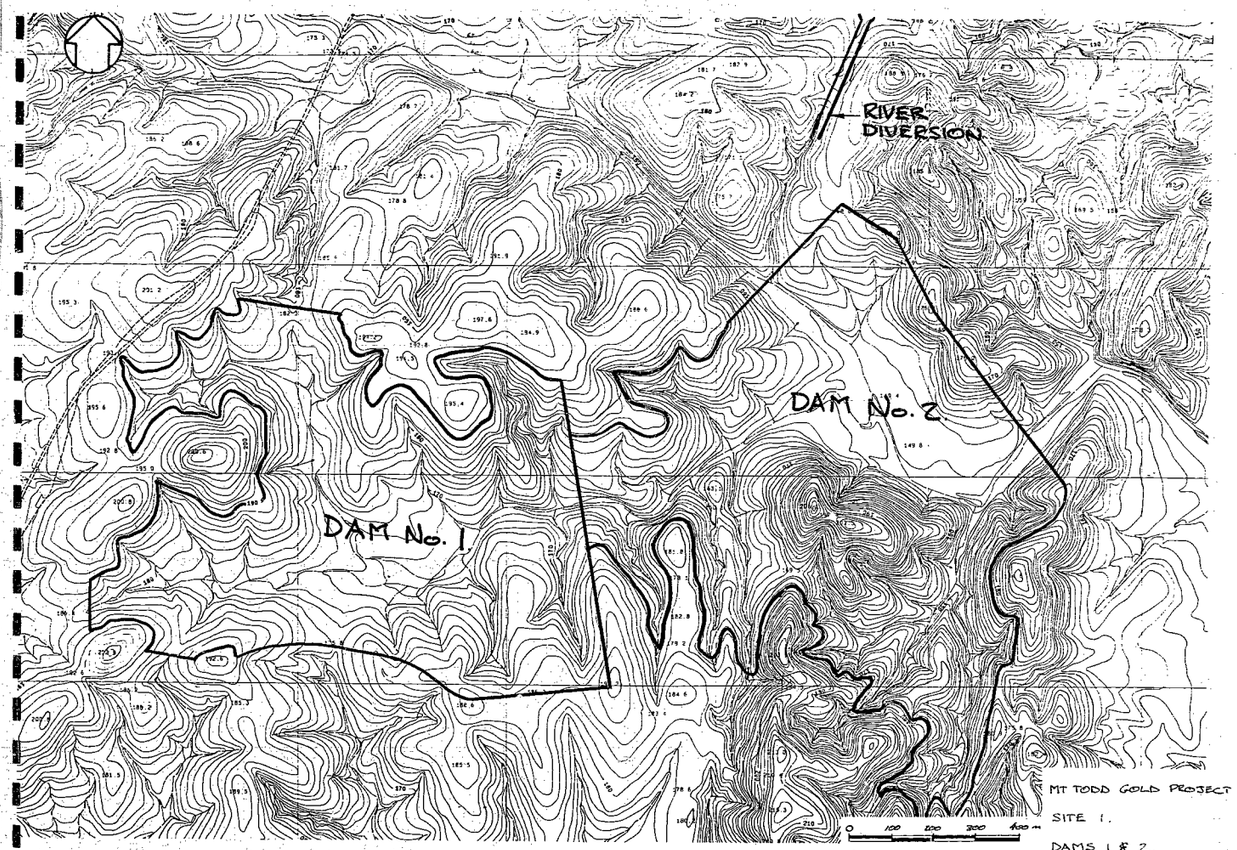

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SITE 1.
DAMS 1 & 2.

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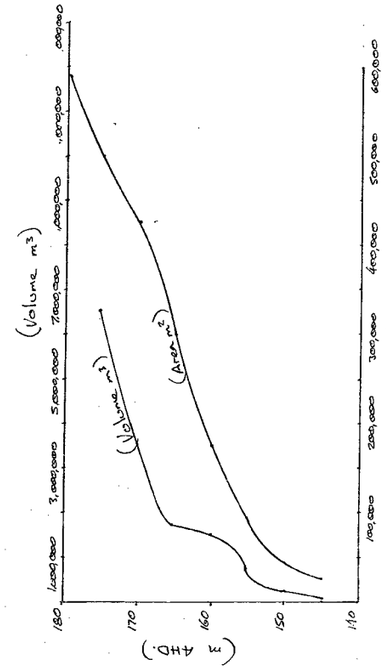

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SITE 2
DAM No. 3

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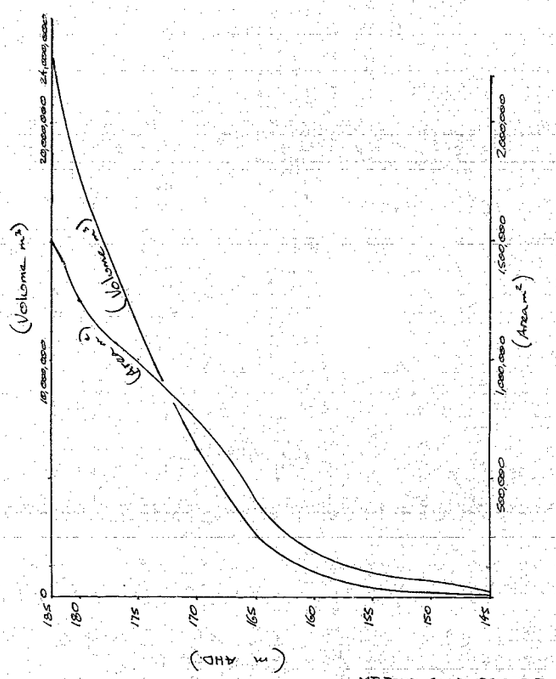

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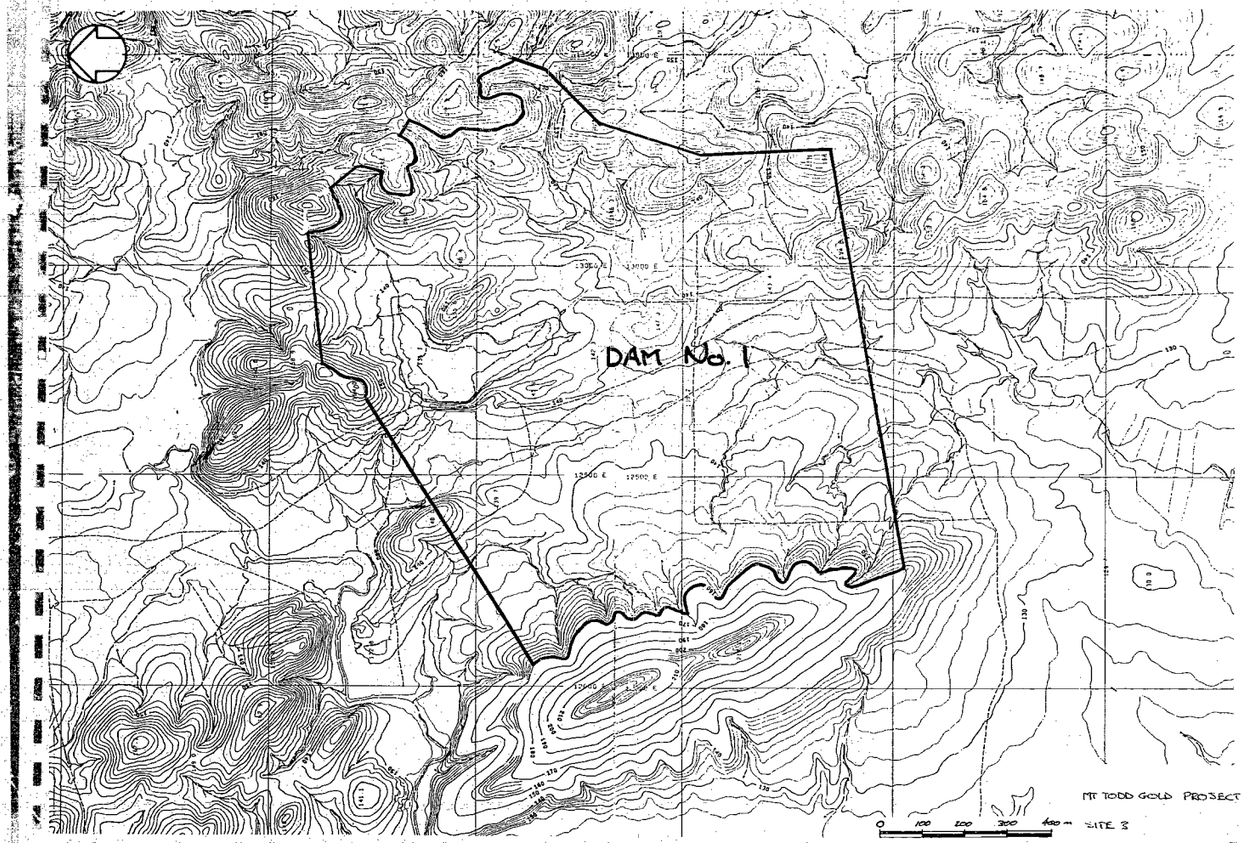
SITE 2

DAMS 1, 2 & 3



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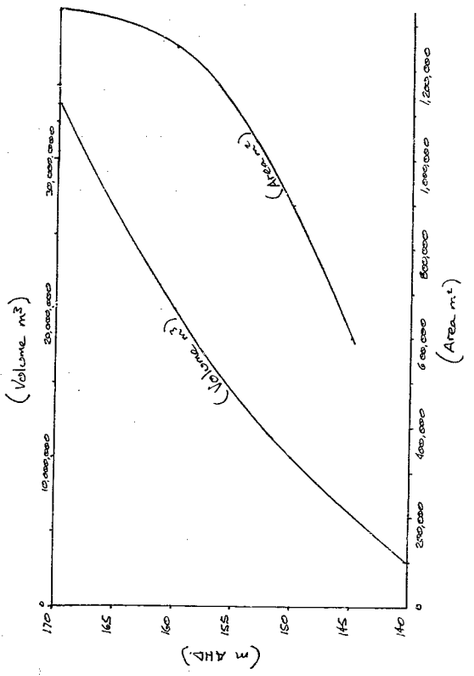

MT TODD GOLD PROJECT

SITE 3

DAM No 1.