

Australian & New Zealand Gold Operations

September Quarter 2019 - Final Report

Overview

The average All-in Sustaining Cost (AISC) for Australia and New Zealand was A\$1,335/oz, which is up 4.7% (A\$60/oz) on the previous quarter average AISC of A\$1,275/oz. Evolution Mining's part of the Ernest Henry operations was the lowest cost producer reporting an AISC of **A\$-414/oz** followed by Newcrest's Cadia Valley operations with an AISC of A\$306/oz, then by Kirkland Lakes' Fosterville mine (A\$421/oz). The average gold spot price for the quarter was A\$2,146/oz (US\$1,472/oz). It should be noted that Ernest Henry and Cadia Valley benefit from significant base metal by-products. Aurum Analytics' estimate of these operations AISC on a co-product basis (Co-AISC) is as follows; Ernest Henry Co-AISC of A\$801/oz and Cadia Valley Co-AISC of A\$896/oz. The lowest cost "gold only" operations were Kirkland Lakes' Fosterville mine with an AISC of A\$421/oz, then Saracen's Thunderbox mine (A\$682/oz) and Evolution's Cowal mine (A\$885/oz).

Newcrest's Cadia Valley operation took out top spot as Australia's largest gold producer with 171,730 oz for the quarter, followed by Newmont's Boddington (167,000 oz) then Kirkland Lake's Fosterville operation (158,327 oz). Of the mines where gold is a by-product, BHP's Olympic Dam produced the most gold 43,205 oz followed by OZ Minerals' Prominent Hill and Evolution's part of Ernest Henry with 23,378 oz.

Grade wise for the companies that report AISC, the average reported mill head/feed grade was 3.59 g/t (Open Pit (OP) - 1.54 g/t, Underground (UG) - 5.45 g/t, Open Pit & Underground (OP/UG) - 2.48 g/t) which was up on the previous quarter, 3.58 g/t (0.3%). Kirkland Lake's Fosterville mine again took out the honour as the operation with the highest average feed grade with 41.80 g/t, followed by St Barbara's Gwalia mine 7.20 g/t. The lowest grade mine was Evolution's Ernest Henry processing an average head grade of 0.55 g/t. The high-grade operations that do not report an AISC were Mandalay Resources' Costerfield mine with 5.11 g/t and LionGold Corp's Ballarat mine with 3.80 g/t.

Top 10 Gold Producing Operations

Rank	Operation	Company	Mine Type	Au Produced (oz)
1	Cadia Valley	Newcrest Mining Limited	UG	171,730
2	Boddington	Newmont Goldcorp Corporation	OP	167,000
3	Fosterville	Kirkland Lake Gold Limited	UG	158,327
4	Tropicana	JV AngloGold Ashanti Limited/Independence Group NL	OP	123,320
5	Kalgoorlie	JV Newmont Goldcorp Corporation/Barrick Gold Corporation	OP/UG	116,000
6	Tanami	Newmont Goldcorp Corporation	UG	114,000
7	Jundee	Northern Star Resources Limited	OP/UG	84,846
8	Telfer	Newcrest Mining Limited	OP/UG	79,309
9	Cowal	Evolution Mining Limited	OP	75,807
10	St Ives	Gold Fields Limited	OP/UG	75,200

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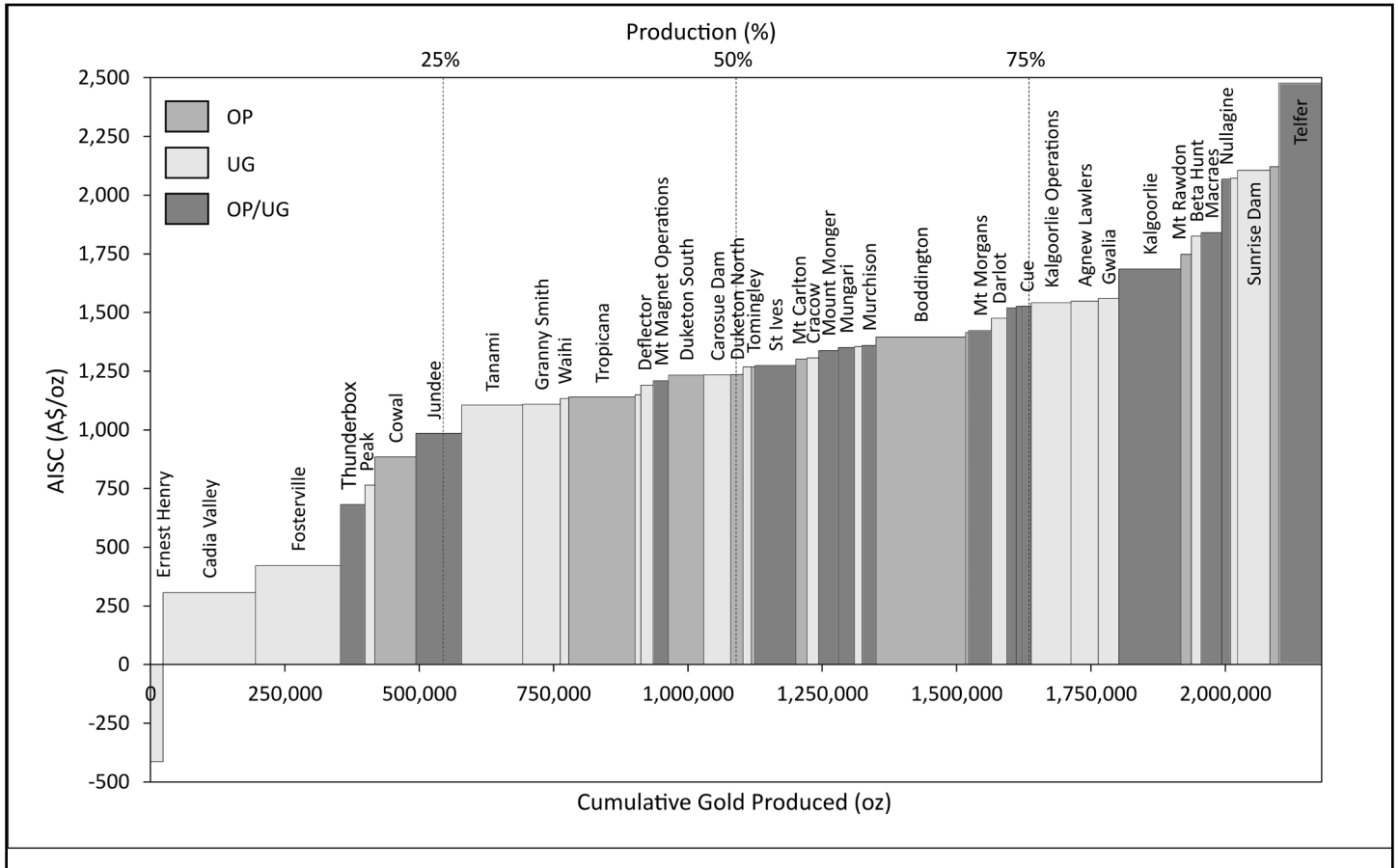
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Gold Operations That Report AISC

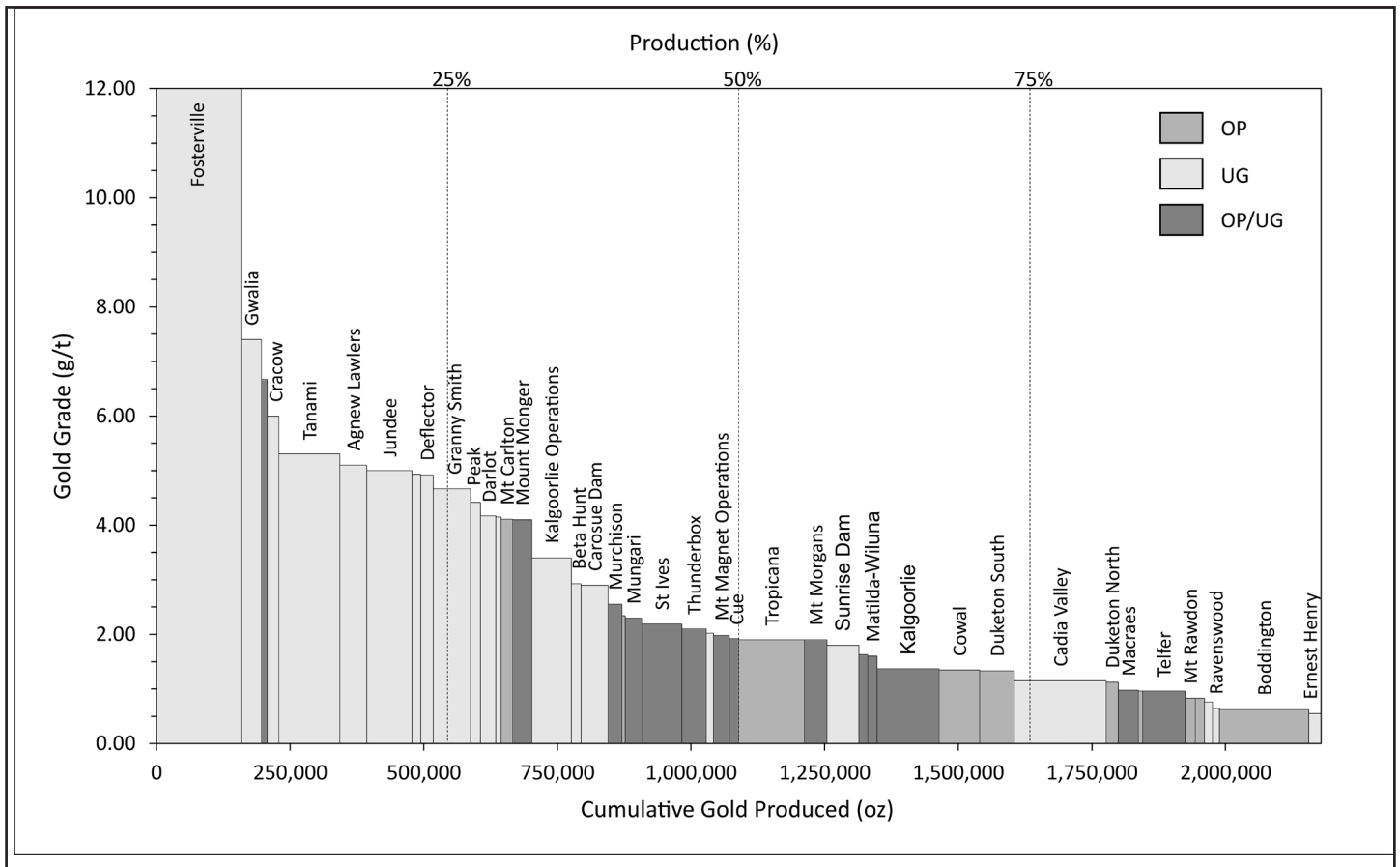
AISC Rank	Operation	Company	Mine Type	AISC (A\$/oz)	Grade (g/t)	Grade Rank	Au Produced (oz)
1	Ernest Henry	Evolution Mining Limited	UG	-414	0.55	45	23,378
2	Cadia Valley	Newcrest Mining Limited	UG	306	1.15	35	171,730
3	Fosterville	Kirkland Lake Gold Limited	UG	421	41.80	1	158,327
4	Thunderbox	Saracen Mineral Holdings Limited	OP/UG	682	2.10	23	45,735
5	Peak	Aurelia Metals Limited	UG	764	4.42	11	18,772
6	Cowal	Evolution Mining Limited	OP	885	1.35	33	75,807
7	Jundee	Northern Star Resources Limited	OP/UG	985	5.00	7	84,846
8	Tanami	Newmont Goldcorp Corporation	UG	1,105	5.31	5	114,000
9	Granny Smith	Gold Fields Limited	UG	1,109	4.67	10	69,700
10	Waihi	OceanaGold Corporation	UG	1,134	4.93	8	16,021
11	Tropicana	JV AngloGold/Independence	OP	1,140	1.90	27=	123,320
12	Hera	Aurelia Metals Limited	UG	1,149	4.15	13	10,535
13	Deflector	Silver Lake Resources Limited	UG	1,190	4.92	9	23,230
14	Mt Magnet Operations	Ramelius Resources Limited	OP/UG	1,209	1.98	25	29,013
15	Duketon South	Regis Resources Limited	OP/UG	1,233	1.33	34	64,890
16	Carosue Dam	Saracen Mineral Holdings Limited	UG	1,234	2.90	18	50,590
17	Duketon North	Regis Resources Limited	OP	1,236	1.12	36	22,743
18=	Edna May	Ramelius Resources Limited	UG	1,268	0.76	42	15,151
18=	Tomingley	Alkane Resources Limited	OP	1,268	0.96	38=	7,497
20	St Ives	Gold Fields Limited	OP/UG	1,275	2.19	22	75,200
21	Mt Carlton	Evolution Mining Limited	OP	1,301	4.11	14	20,877
22	Cracow	Evolution Mining Limited	UG	1,307	6.00	4	21,917
23	Mount Monger	Silver Lake Resources Limited	OP/UG	1,338	4.10	15	36,058
24	Mungari	Evolution Mining Limited	OP/UG	1,351	2.30	21	30,738
25	Fortnum	Westgold Resources Limited	UG	1,354	2.02	24	13,764
26	Murchison	Westgold Resources Limited	OP/UG	1,360	2.55	19	25,958
27	Boddington	Newmont Goldcorp Corporation	OP	1,396	0.62	44	167,000
28	Higginsville	Royal Nickel Corporation (RNC Minerals)	OP	1,415	2.34	20	5,756
29	Mt Morgans	Dacian Gold Limited	OP/UG	1,423	1.90	27=	42,002
30	Darlot	Red 5 Limited	UG	1,476	4.17	12	28,649
31	Matilda-Wiluna	Blackham Resources Limited	OP/UG	1,519	1.60	31	17,565
32	Nicolsons	Pantoro Limited	OP/UG	1,526	6.67	3	10,631
33	Cue	Westgold Resources Limited	OP/UG	1,528	1.92	26	17,750
34	Kalgoorlie Operations	Northern Star Resources Limited	UG	1,542	3.40	16	73,861
35	Agnew Lawlers	Gold Fields Limited	UG	1,548	5.10	6	50,400
36	Gwalia	St Barbara Limited	UG	1,559	7.40	2	38,153
37	Kalgoorlie	JV Newmont/Barrick	OP/UG	1,685	1.37	32	116,000
38	Mt Rawdon	Evolution Mining Limited	OP	1,748	0.83	40=	19,250
39	Beta Hunt	Royal Nickel Corporation (RNC Minerals)	UG	1,825	2.93	17	18,460
40	Macraes	OceanaGold Corporation	OP/UG	1,840	0.98	37	37,918
41	Nullagine	Millennium Minerals Limited	OP/UG	2,068	1.63	30	16,286
42	Ravenswood	Resolute Mining Limited	UG	2,072	0.64	43	13,206
43	Sunrise Dam	AngloGold Ashanti Limited	UG	2,105	1.80	29	60,000
44	Dalgaranga	Gascoyne Resources Limited	OP	2,121	0.83	40=	17,016
45	Telfer	Newcrest Mining Limited	OP/UG	2,477	0.96	38=	79,309

Notes: Operations are shown on a 100% basis, except Northern Star's Kalgoorlie Operations. Ballarat and Plutonic usually reports AISC but had not reported at the time this report was compiled.

Gold Production Cost Curve Ranked By Reported AISC



Gold Production Grade Curve Ranked By Average Mill Feed/Head Grade



Gold Mines That Did Not Report All-in Sustaining Costs

Rank	Operation	Company	Mine Type	Grade (g/t)	Au Produced (oz)
1	Gruyere	JV Gold Fields Limited/Gold Road Resources Limited ¹	OP	1.00	29,107
2	Kundana EKJV	JV Tribune Resources Limited/Rand Mining Limited	UG	NA	25,016
3	Plutonic	Superior Gold Inc ²	OP/UG	1.46	16,627
4	Ballarat	LionGold Corp Ltd ²	UG	3.80	7,387
5	Widgiemooltha	Mincor Resources NL	OP	2.24	7,055
6	Costerfield	Mandalay Resources Limited	UG	5.11	3,103
7	Comet Vale	JV Orminex Limited/Sand Queen Gold Mines Pty Ltd ³	UG	3.53	1,818
8	Morning Star	AuStar Gold Limited	UG	NA	673
9	Penny's Find	Orminex Limited	NA	2.75	251
NR	Trouser Legs	JV Hawthorn Resources Limited/Gel Resources Pty Ltd ⁴	OP	NA	NA
NR	Pajingo	Minjar Gold Pty Ltd ⁵	UG	NA	NA
NR	Marvel Loch	Minjar Gold Pty Ltd ⁵	OP/UG	NA	NA
NR	Paddington	Zijin Mining Group Company Limited ⁵	OP/UG	NA	NA

1. Gruyere is a joint venture between Gold Fields Limited (50%) and Gold Road Resources Limited (50%)
2. These companies usually report AISC but had not at the time of compiling this report.
3. Comet Vale is a joint venture between Orminex Limited (51%) and Sand Queen Gold Mines Pty Ltd (49%).
4. Trousers Legs is a joint venture between Hawthorn Resources Limited (75%) and Gel Resources Pty Ltd (25%)
5. These companies do not provide detailed quarterly production statistics for these mines.

Mines Where Gold Is A By-Product

Rank	Operation	Company	Mine Type	Au Produced (oz)
1	Olympic Dam	BHP Group Limited	UG	43,205
2	Prominent Hill	OZ Minerals Limited	UG	28,844
3	Ernest Henry	Evolution Mining Limited	UG	23,378
4	DeGrussa	Sandfire Resources NL	UG	8,647
5	North Parkes ¹	JV China Molybdenum Co Ltd/Sumitomo Australia Pty Ltd	UG	6,068
6	Rosebery	MMG Limited	UG	2,171
7	Kanmantoo	Hillgrove Resources Limited	NM	858
NR	Golden Grove	EMR Capital	UG	NA
NR	Jaguar	Washington H. Soul Pattinson and Company Limited	UG	NA

1. North Parkes is a joint venture between China Molybdenum Co Ltd (80%) and Sumitomo Australia Pty Ltd (20%).

Quarter on Quarter Change in AISC and Grade

Statistic	AISC (A\$/oz)	Change (%)	Grade (g/t)	Change (%)
Average (Simple) ¹	1,335	4.7%	3.59	0.3%
Average (Weighted) ²	1,218	9.7%	1.62	5.2%
Minimum	-414	35.7%	0.55	-8.3%
First Quartile ³	1,002	4.3%	1.15	-5.7%
Median ³	1,183	-1.7%	1.90	-5.0%
Third Quartile ³	1,331	-7.8%	4.67	1.5%
Maximum	2,477	4.3%	41.80	4.8%

1. Simple averages done by number of mining operations.
2. AISC weighted by gold ounces produced, Au grade weighted by ore tonnes milled.
3. First Quartile, Median and Third Quartile values are based on production in the AISC Cost Curve and Grade Curve.

Top 5 Gold Operations - Major Gold Miners

Gold Production (Attributable)			All-in Sustaining Costs		
Rank	Operation	oz	Rank	Operation	A\$/oz
1	Cadia Valley	171,730	1	Cadia Valley	306
2	Boddington	167,000	2	Tanami	1,105
3	Tropicana ¹	123,320	3	Granny Smith	1,109
4	Kalgoorlie	116,000	4	Tropicana ¹	1,140
5	Tanami	114,000	5	St Ives	1,275

1. Tropicana is a joint Venture between AngloGold Ashanti Limited (70%) and Independence Group NL (30%).

Top 5 Gold Operations - Mid-Tier Gold Miners

Gold Production (Attributable)			All-in Sustaining Costs		
Rank	Operation	oz	Rank	Operation	A\$/oz
1	Fosterville	158,327	1	Ernest Henry	-414
2	Jundee	84,846	2	Fosterville	421
3	Cowal	75,807	3	Thunderbox	682
4	Kalgoorlie Operations ¹	73,861	4	Cowal	885
5	Duketon South	64,890	5	Jundee	985

1. Kalgoorlie Operations gold produced represents Northern Star Resources Limited's attributable gold production.

Top 5 Gold Operations - Junior Gold Miners

Gold Production (Attributable)			All-in Sustaining Costs		
Rank	Operation	oz	Rank	Operation	A\$/oz
1	Mt Morgans	42,002	1	Peak	764
2	Mt Magnet Operations	29,013	2	Hera	1,149
3	Darlot	28,649	3	Mt Magnet Operations	1,209
4	Peak	18,772	4=	Edna May	1,268
5	Kundana EKJV ¹	18,762	4=	Tomingley	1,268

1. Kundana EKJV gold produced represents Tribune Resources Limited's and Rand Mining Limited's attributable gold production.

Top 5 Pure Gold Operations (No Base Metal By or Co-Products)

Gold Production (Total)			All-in Sustaining Costs		
Rank	Operation	oz	Rank	Operation	A\$/oz
1	Fosterville	158,327	1	Fosterville	421
2	Tropicana ¹	123,320	2	Thunderbox	682
3	Kalgoorlie ²	116,000	3	Cowal	885
4	Tanami	114,000	4	Jundee	985
5	Jundee	84,846	5	Tanami	1,105

1. Tropicana is a joint venture between AngloGold Ashanti Limited (70%) and Independence Group NL (30%).

2. Kalgoorlie is a joint venture between Newmont Goldcorp Corporation (50%) and Barrick Gold Corporation (50%).

General Notes

Data was sourced from company quarterly reports. Aurum Analytics created the cost and grade curves. Mine Type reflects the source of the ore mined for the quarter, OP - Open Pit, UG - Underground, OP/UG - Open Pit and Underground and NM - No Mining.

For operations in joint venture such as Kalgoorlie and Tropicana AISC values were apportioned by equity ownership percentages. Kalgoorlie Operations is based on Northern Star Resources Limited's reported AISC only as Tribune Resources Limited and Rand Mining Limited do not report an AISC.

Where AISC values were reported in US\$ and no A\$ equivalent provided, the quarterly average US\$/A\$ exchange rate (0.6860) from the Reserve Bank of Australia was used.

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About Aurum Analytics

Aurum Analytics is an independent business providing information and analysis on the Australian and New Zealand gold industry. The information and analysis given is a by-product of Sam Ulrich's PhD research at The University of Western Australia's Centre for Exploration Targeting titled "Geological drivers and strategic implications of competitive advantage in Australian and New Zealand gold mines, linking geology to mine economics."

Contact

Sam Ulrich

Aurum Analytics

E sam@aurumanalytics.com.au
W www.aurumanalytics.com.au
T +61 439 997 814

Liam Twigger

PCF Capital Group

E liam@pcfcapital.com.au
W www.pcfcapital.com.au
T +61 8 9486 7111