MEMORANDUM

To	Dave Readett		
Copy to	Steven Hoban		
From	BHM Process Consultants		
Subject	PNX Metals DFS update Report, Locked Cycle (Mount Bonnie/Low Grade Carbonate)	Client Ref.	
Date	16th March 2018	Doc. No.	PNX-2017-011

Introduction

A Mount Bonnie / Low Grade Carbonate blend was put through locked cycle after previous sighter tests indicated that a 70:30 blend should be suitable. The following key points from the locked cycle are applicable;

- The Zinc concentrate produced is comparable to the Mount Bonnie material. There is a minor increase in penalty elements, however it is still lower than the PFS
    - The amount of Zn concentrate is less, however this is directly relatedly to the lower Zn head grade. The overall recovery is comparable (84.7 vs 85.25, MB/LGC vs MB) and the Zinc recovery to the concentrate is greater (75.15% vs 64.74%)
    - The greater Zinc recovery can be attributed to an increase in depressant in the Ag Cleaning circuit.
- The Silver/Bulk concentrate has had a substantial increase in penalty element rates. The talc present in the LGC appears to be fine grained and entrained in the silver circuit.
    - A loss in Silver recovery has been observed, which is likely due to the increase in $ZnSO_4$ used in the silver circuit to recover more Zinc.

The results & analysis are summarised below.

Summary of results

A 70:30 blend of Mount Bonnie (MB) and Low Grade Carbonate (LGC) material was prepared. While changes were made during the Iron Blow flowsheet that are believed to have an overall beneficial impact on the Mount Bonnie resource, the MB/LGC locked cycle was conducted with the same flowsheet and condition as the previous Mount Bonnie Locked cycle to maintain consistency. The only change that was introduced was the adjustment of the depressant utilised in the Ag Cleaner stage ($ZnSO_4$). This was increased to 2500 g/t and observed.
This was done as it was observed (from INCA mineralogy on the Ag Cleaner Con) after the Mount Bonnie Locked cycle that there was a substantial amount of sphalerite liberated in the Ag Cleaner Con.
The flowsheet can be seen below in Figure 1.

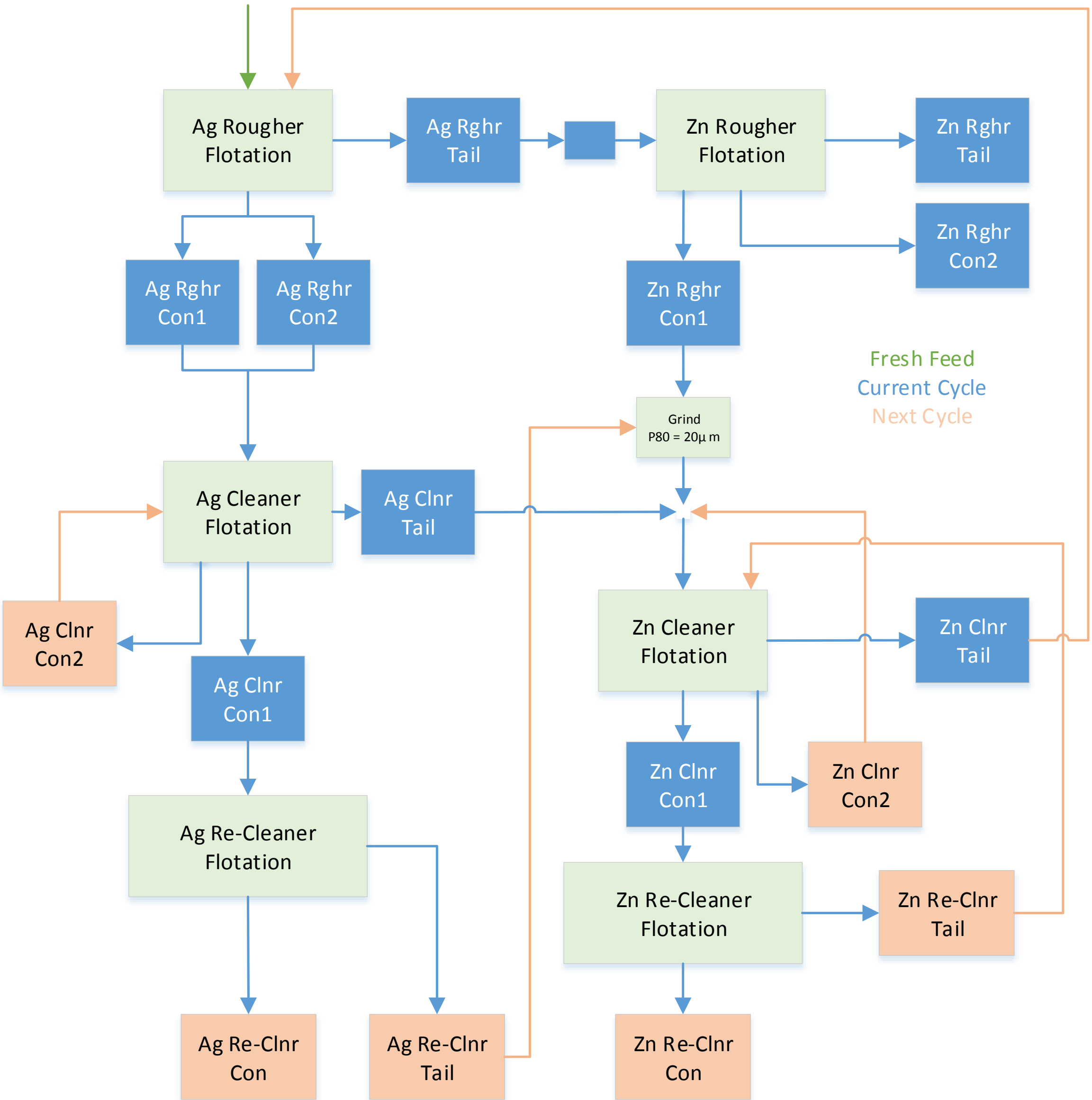


Figure 1 - Locked Cycle Flowsheet

A summary of the results can be seen below.

Table 1 – Mount Bonnie/Low Grade Carbonate Blend Locked Cycle Assay Results

	Mass kg	Au ppm	Ag ppm	Cu %	Pb %	Zn %	Fe %	As %	Mg %	Si %	Ca %
Zn Re-Cleaner Con	0.461	1.27	264.00	0.81	1.46	50.18	10.26	0.33	0.26	0.43	0.26
Ag Re-Cleaner Con	0.234	6.65	1814.93	4.37	11.34	12.57	10.49	0.42	7.09	11.38	0.52
Zn Rghr Tail	5.354	0.49	39.93	0.11	0.48	0.53	23.32	0.53	5.52	11.36	4.35
Zn Rghr Con 2	0.632	1.58	103.97	0.23	0.99	2.98	37.96	1.86	2.76	4.53	1.73
Ag Cleaner Con 2	0.039	3.08	417.00	0.87	3.24	6.40	12.87	0.71	10.01	16.28	0.92
Ag Re-Cleaner Tail	0.020	3.41	425.00	0.87	3.31	4.92	11.62	0.67	11.06	18.10	0.97
Zn Re-Cleaner Tail	0.018	12.95	427.00	1.11	3.30	29.54	16.77	1.16	2.25	3.54	1.47
Zn Cleaner Con 2	0.04	9.08	457.00	1.14	3.32	31.80	17.19	1.11	1.92	3.17	0.79
Zn Cleaner Tail	0.142	2.40	182.00	0.39	1.83	4.25	23.83	1.18	6.62	11.01	2.29
Back Calc Head	6.94	1.00	130.12	0.33	1.03	4.84	23.21	0.66	5.01	9.98	3.61
Assayed Head		1.00	135.00	0.27	1.06	5.12	22.83	0.66	4.85	9.64	3.51

Table 2 – Mount Bonnie/Low Grade Carbonate Blend Locked Cycle Metal Deportment

	Mass	Au	Ag	Cu	Pb	Zn	Fe	As	Mg	Si	Ca
	%	ppm	ppm	%	%	%	%	%	%	%	%
Zn Re-Cleaner Con	6.64%	8.47%	13.48%	16.23%	9.42%	68.85%	2.94%	3.38%	0.34%	0.29%	0.48%
Ag Re-Cleaner Con	3.37%	22.46%	47.01%	44.23%	37.03%	8.75%	1.52%	2.15%	4.77%	3.84%	0.49%
Zn Rghr Tail	77.12%	38.21%	23.67%	25.78%	35.74%	8.41%	77.46%	62.53%	85.06%	87.76%	92.90%
Zn Rghr Con 2	9.11%	14.39%	7.28%	6.20%	8.75%	5.61%	14.89%	25.88%	5.02%	4.13%	4.37%
Ag Cleaner Con 2	0.56%	1.72%	1.78%	1.46%	1.74%	0.73%	0.31%	0.60%	1.11%	0.91%	0.14%
Ag Re-Cleaner Tail	0.29%	0.99%	0.95%	0.76%	0.93%	0.30%	0.15%	0.30%	0.64%	0.53%	0.08%
Zn Re-Cleaner Tail	0.25%	3.31%	0.84%	0.85%	0.81%	1.56%	0.18%	0.45%	0.11%	0.09%	0.10%
Zn Cleaner Con 2	0.61%	5.53%	2.13%	2.09%	1.96%	3.99%	0.45%	1.03%	0.23%	0.19%	0.13%
Zn Cleaner Tail	2.05%	4.93%	2.87%	2.41%	3.63%	1.80%	2.10%	3.68%	2.71%	2.26%	1.30%

As can be seen the results are positive and on par with the Mount Bonnie locked cycle in terms of the Zinc concentrate. However the Ag/bulk concentrate has high concentration of penalty elements, in particular Mg & Si. From previous work this appear to be associated with talc.

An estimated mass balance & unit performance can be seen below in Table 3.

Table 3 – Mount Bonnie/Low Grade Carbonate Blend Locked Cycle Estimated Unit Recoveries (Mass Balanced)

	Mass	Au	Ag	Cu	Pb	Zn	Fe	As	Mg	Si	Ca
	%	ppm	ppm	%	%	%	%	%	%	%	%
Zn Re-Cleaner Con	6.64%	10.14%	14.74%	17.56%	10.35%	75.15%	3.03%	3.60%	0.36%	0.30%	0.49%
Ag Re-Cleaner Con	3.37%	26.89%	51.41%	47.84%	40.72%	9.55%	1.57%	2.29%	5.01%	4.00%	0.50%
Total Recovery To Cons	**10.01%**	**37.03%**	**66.16%**	**65.41%**	**51.08%**	**84.70%**	**4.61%**	**5.89%**	**5.37%**	**4.30%**	**0.99%**
Zn Rghr Tail	77.12%	45.74%	25.88%	27.89%	39.30%	9.18%	80.01%	66.56%	89.36%	91.39%	94.57%
Zn Rghr Con 2	9.11%	17.23%	7.96%	6.71%	9.62%	6.12%	15.38%	27.55%	5.27%	4.30%	4.45%
Total Loss to Tails	**86.23%**	**62.97%**	**33.84%**	**34.59%**	**48.92%**	**15.30%**	**95.39%**	**94.11%**	**94.63%**	**95.70%**	**99.01%**
Recirculating Internal Streams	In respect to Fresh Feed										
Zn Cleaner Tail (to Circuit Feed)	8.16%	22.61%	12.01%	9.99%	15.28%	7.52%	8.33%	15.03%	10.91%	9.02%	5.08%
Ag Clnr Con 2	4.97%	17.68%	16.77%	13.55%	16.51%	6.90%	2.74%	5.51%	10.05%	8.13%	1.24%
Ag Re-Clnr Tail (To Zn Cleaning)	8.16%	32.12%	28.06%	22.14%	27.70%	8.71%	4.06%	8.54%	18.23%	14.84%	2.16%

Analysis & Discussion

A comparison of the relative performance in respect to the Mount Bonnie composite (unblended) can be seen below. As can be seen while the quality of the Zn concentrate is comparable, the Ag/Bulk concentrate has incurred a significant increase in terms of the two main penalty elements.

Table 4 - Comparison with MB locked Cycle

		Grade				Deportment			
	Mass	Zn	Ag	Mg	Si	Zn	Ag	Mg	Si
Zn Re-Cleaner Con	%	%	ppm	%	%	%	%	%	%
MB	7.49%	49.50	366	0.14	0.31	64.74%	17.81%	0.30%	0.27%
MB/LGC	6.64%	50.18	264	0.26	0.43	75.15%	14.74%	0.36%	0.30%
Ag Re-Cleaner Con									
MB	3.92%	29.93	2221	1.68	2.78	20.51%	56.63%	1.86%	1.29%
MB/LGC	3.37%	12.57	1815	7.09	11.38	9.55%	51.41%	5.01%	4.00%
Zn Total Tail									
MB	88.59%	0.95	44	3.93	9.42	14.75%	25.56%	97.85%	98.44%
MB/LGC	86.23%	0.79	47	5.23	10.63	15.30%	33.84%	94.63%	95.70%
Head Grade									
MB		6.04	167	3.53	8.33	-	-	-	-
MB/LGC		4.84	130	5.01	9.98	-	-	-	-

The impact of the increased $ZnSO_4$ addition is visible. With an increase in Zn recovery, there was however a loss in Ag has been incurred.
The variation in terms of concentrate produced (mass wise) can be attributed largely due to the variation in feed grade.
The high penalty elements can in part also be attributed to the increase seen in the head grade, however due to the lower unit rejection to tails it can be assumed that the LGC material has more finely grained talc present. It can also be seen that there is a very large rejection to tails of the talc material, however more cleaning is required.

Comparison to PFS

A comparison between Mount Bonnie, the PFS and the current testwork is shown in Table 5 below:

Table 5 – Comparison of Mount Bonnie Performance

	PFS	MB	MG/LGC
Bulk Con Mass %	4.37	3.92	3.37
Zn Con Mass %	6.34	7.49	6.64
Total	**10.71**	**11.41**	**10.01**
Au to Bulk	44.80	37.10	26.89
Ag to Bulk	64.00	56.63	51.41
Zn to Bulk	17.00	20.51	9.55
Pb to Bulk	65.77	33.16	40.72
Zn to Zinc Con	67.20	64.74	75.15
Total Zn Recovered	84.20	85.25	84.70
Total Ag Recovered	77.00	74.44	66.16

As can be seen, the overall metal recovery of Zn is comparable with a slight decrease. However more Zn is recovered to the Zn concentrate. The application to Mount Bonnie with LGC would expect a Zn concentrate rate. However this has come at the cost of the overall silver decreasing. In addition, there appears to be less Au however more Pb that previously observed.

In terms of penalty elements, there has been a general decrease overall as can be seen in the tables below. This has resulted in a minor decrease with the Zn concentrate, however the Ag/Bulk penalties have increased substantially.

Table 6 - Zinc Concentrate & Penalty elements

				Penalty $US/MT)	
Zn Con	Penalty	MB/LGC	MB	MB/LGC	MB
MgO	0.30	0.43	0.23	2.51	-1.40
SiO2	3.00	0.92	0.66	0.00	0.00
Pb	3.50	1.46	1.69	0.00	0.00
As	0.30	0.33	0.32	0.69	0.40
Fe	9.00	10.26	10.72	2.52	3.44
Total				**5.72**	**2.44**

Table 7 - Bulk Concentrate Penalty elements

Ag Con	Penalty	MB/LGC	MB	MB/LGC	MB
As	0.10	0.42	0.29	6.38	3.80
Fe	8.00	10.49	12.15	4.97	8.30
SiO2	5.00	24.21	5.92	38.42	1.84
Mg	5.00	7.09	1.68	4.18	-6.64
Total				**53.95**	**7.30**
Total					

Project Management

Figure 2 – Laboratory Schedule and Budget Tracker

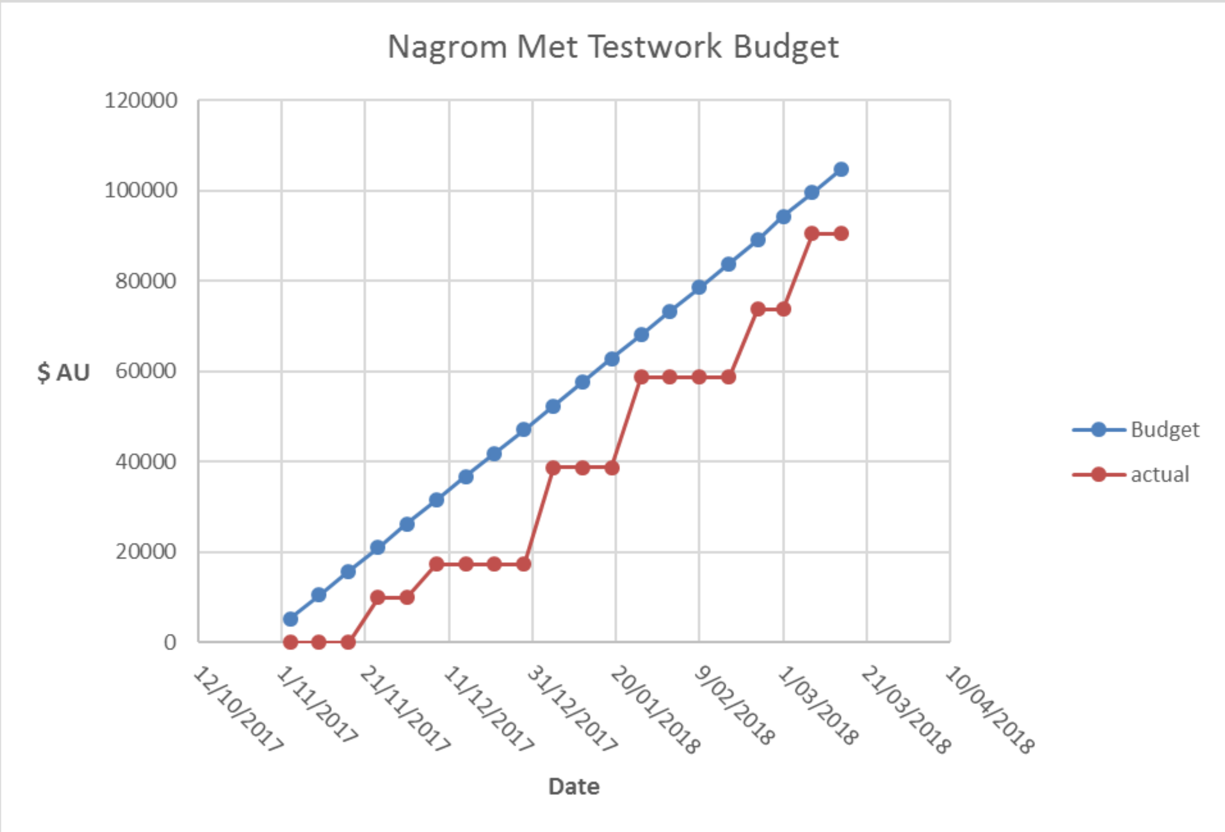
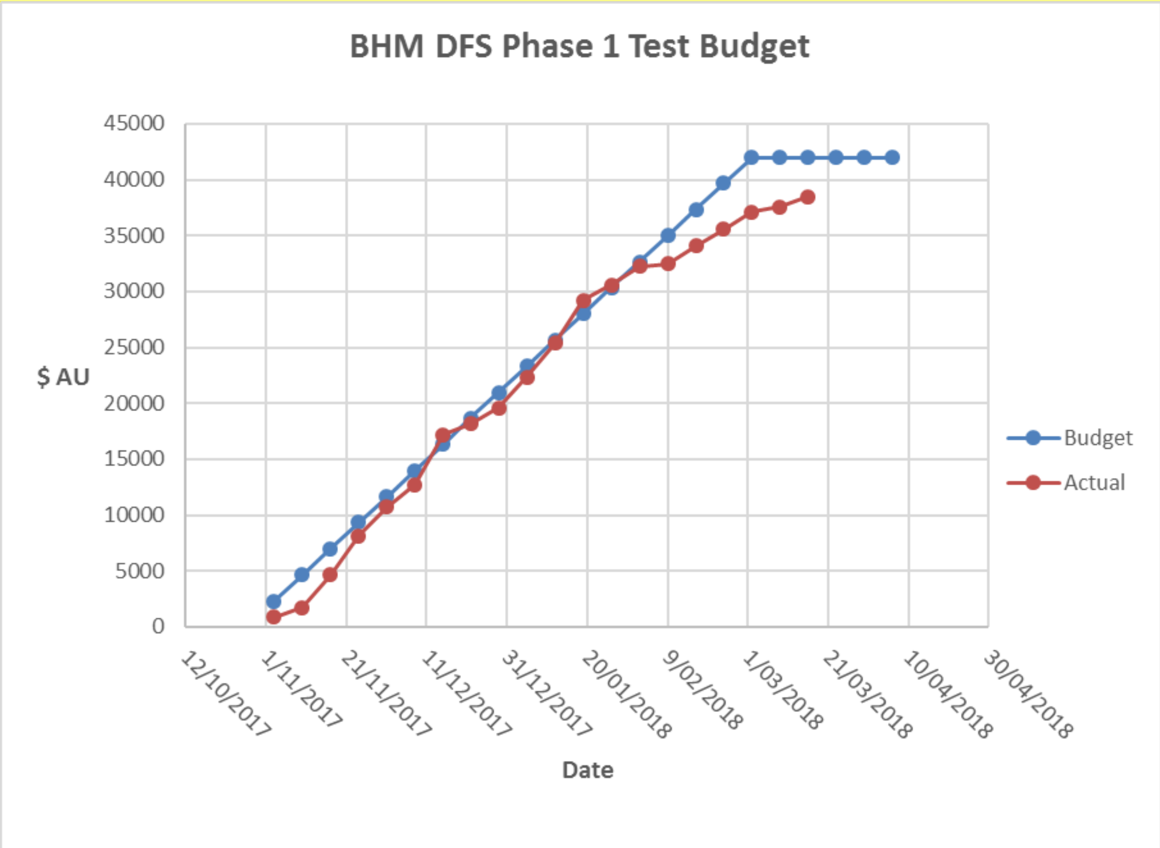


Figure 3 – BHM Management Budget Tracker



Regards,

Robert Kochmanski
Metallurgist

MEMORANDUM

To	Dave Readett		
Copy to	Steven Hoban		
From	BHM Process Consultants		
Subject	PNX Metals Testwork update Report	Client Ref.	
Date	8th November 2018	Doc. No.	1003-PNX-2018-009

Executive Summary

Cleaning stages have been completed for the testwork program to date. Some assays are still outstanding however the bulk of these have been received.

The testwork can be broken down into 3 areas;

- Flotation Test #1 & #3 – Where a single concentrate is being generated
- Flotation Test #2 & #4 – Where differential flotation is being conducted as per the DFS except at 53µm and utilising a Au/Ag scavenger
- Flotation Test #5 & #6 – Differential flotation is conducted as per above utilising the reagent used during scavenger as the primary collector.

While Flotation Test #1 & 3 showed good roughing performance there was little selectivity observed during the cleaning resulting in a poor final concentrate outcome.

	Mass	Au ppm	Ag ppm	Cu %	Pb %	Zn %	Fe %	As %	MgO %	SiO_2 %
Rougher Con (1+2)	47.5	4.09	343	0.69	2.56	11.9	31.2	2.08	N/A	N/A
Cleaner Con (1+2)	33.9	5.10	461	0.90	3.35	16.2	30.5	2.36	N/A	N/A
Cleaner Con Recovery (%)	33.9%	75.5%	89.9%	86.1%	86.2%	92.8%	46.2%	64.8%	N/A	N/A

Differential flotation is necessary due to the difference in mineralogy.

The addition of a scavenger has improved the overall recovery in respect to Au & Ag (predominately Au) as can be seen from the decrease in deportment to the Rougher tail and Zn Ro Con 2.

	Mass	Au %	Ag %	Cu %	Pb %	Zn %	Fe %	As %	MgO %	SiO_2 %
DFS										
Zn Rougher Tail	67.52%	26.19%	9.28%	17.1%	13.8%	5.33%	72.0%	53.0%	71.6%	76.11%
Zn Rghr Con 2	11.04%	11.31%	6.16%	8.31%	6.49%	7.25%	15.2%	23.9%	6.87%	5.74%
Flotation #2 & #4										
Zn Rougher Tail	48.36%	5.54%	3.13%	3.98%	4.09%	1.72%	21.87%	11.69%	75.84%	73.84%
Ag Scav 2 + Zn Ro Con 2	11.08%	7.56%	6.37%	6.31%	6.59%	9.28%	18.76%	13.94%	6.14%	6.13%
Flotation #5 & #6										
Zn Rougher Tail	73.6%	17.7%	9.71%	12.1%	14.8%	4.3%	76.3%	44.4%	85.9%	82.7%
Zn Ro Con 2 + Ag Ro Con 3	6.94%	12.2%	8.28%	8.59%	8.31%	10.2%	9.54%	25.3%	3.47%	3.78%

However the additional mass pulled has cause the Ag/Au Cleaning circuit to become overloaded reducing the overall deportment to the Au/Ag con but has also impacted on the Zn circuit (as the Ag Cleaner Tails reports to the Zn circuit). This has resulted in off-target grades.

The utilisation of MX980 (used in the scavenger), while more selective also has a lower recovery when used as a primary collector.

In light of the potential gains that have been observed in flotation tests #2 & #4 it is recommended to repeat this flotation to generate samples for mineralogical assessment which include;

- Ag/Au Rougher Concentrate
- Ag/Au Scavenger Concentrate
- Ag Cleaner Tailings

This is to be done while extending the cleaning circuit flotation time

Introduction

Following on from the locked cycle testing during the Definitive-Feasibility Study (DFS) that was being conducted for the Hayes Creek project, for PNX Metals Limited, a number of changes to desired concentrate targets and recoveries have required modification of the process flowsheet and thus relevant testwork. BHM Process Consultants are undertaking the metallurgical and flowsheet design components of the study on behalf of PNX Metals of whom Mr David Readett is the overarching Study Manager.

The current metallurgical testwork plan is focused on improving the existing DFS flowsheet in terms of producing a bulk concentrate with a grade of >40% Zn and maximising Au & Ag recovery while minimising the impurities. In addition to this as a bulk concentrate is required a bulk flotation regime is being investigated. The testwork is being conducted predominately on an Iron Blow Master Composite

Latest Results

The testwork conducted in the program can be summarised under the following identifiers;

- Flotation Test #1 – A single concentrate generated from Rougher flotation
- Flotation Test #2 – Following the Ag/Au Rougher Flotation and Zn Rougher regime in the DFS incorporating a Ag/Au Scavenger. Done at 53µm (75µm in the DFS)
- Flotation Test #3 – Cleaner conducted at a P80 of 20µm of the rougher concentrate (Ro1+Ro2) from Test #1
- Flotation Test #4 – Replication of the Ag/Au Cleaner and Zn Cleaner and Recleaner from the DFS. Conducted on Ag/Au Ro1+Ro2+Scav Co1 and Zn Ro Con1
- Flotation Test #5 – Rougher Flotation conducted utilising MX980 to generate a Ag/Au Rougher Con with less talc entrained
- Flotation Test #6 – Cleaning Stages conducted on Flotation test #5. Zn circuit as per DFS

Bulk Concentrate (Test#3)

Following on from the bulk concentrate being generated the previously generated rougher concentrates 1 & 2 were combined and ground to a P_{80} of 20µm and the reagent dosages were halved. The results can be seen in the tables below.

Table 1 - Flotation Test #3, Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	Ppm	Ppm	ppm	%	%	%	%	%	%
Cl Con 1	35.60%	4.66	688	13200	4.966	28.0775	20.57	1.22	1.382	2.61
Cl Con 2	35.87%	3.45	234	4600	1.597	6.306	38.56	3.04	3.5125	6.11
Cl Con 3	7.17%	2.06	92	2270	0.802	2.2895	43.36	2.2	3.569	6.17
Cl Con 4	2.76%	2.40	75	1970	0.691	1.7735	42.12	1.945	4.24	7.42
Cl Con 5	1.60%	1.56	73	2080	0.747	2.1125	39.96	1.825	4.9035	8.55
Cl Tail	17.00%	0.67	18	930	0.406	0.5055	24.59	0.67	9.812	14.62

Table 2 - Flotation Test #3, Metal Recovery

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	%	%	%	%	%	%	%	%	%
Cl Con 1	35.60%	51.1%	71.7%	69.5%	70.8%	79.4%	24.2%	23.1%	12.7%	14.5%
Cl Con 2	35.87%	38.1%	24.6%	24.4%	22.9%	18.0%	45.7%	58.0%	32.5%	34.3%
Cl Con 3	7.17%	4.5%	1.9%	2.4%	2.3%	1.3%	10.3%	8.4%	6.6%	6.9%
Cl Con 4	2.76%	2.0%	0.6%	0.8%	0.8%	0.4%	3.8%	2.9%	3.0%	3.2%
Cl Con 5	1.60%	0.8%	0.3%	0.5%	0.5%	0.3%	2.1%	1.6%	2.0%	2.1%
Cl Tail	17.00%	3.5%	0.9%	2.3%	2.8%	0.7%	13.8%	6.1%	43.1%	38.9%

The overall metal recovery (in respect to rougher feed material) and subsequent grades can be seen in the table below.

Table 3 - Flotation Test #3, in respect to Rougher Feed material

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	Ppm	ppm	ppm	%	%	%	%	%	%
Cl Con1										
Overall Recovery (%)	16.9%	43.2%	66.9%	63.7%	65.1%	75.7%	16.0%	18.5%	2.9%	3.5%
Grade		4.66	688	13200	4.97	28.08	20.57	1.22	1.38	2.61
Cl Con 1 + Con 2										
Overall Recovery (%)	33.9%	75.5%	89.9%	86.1%	86.2%	92.8%	46.2%	64.8%	10.5%	11.9%
Grade		4.05	460	8884	3.28	17.15	29.60	2.13	2.45	4.37

As can be seen there is substantial metal recovery to the final concentrate (Cl Con1 + Con2) however there is still substantial penalty elements entrainment. In addition the grades are below the desired target grades.

DFS Flowsheet Improvement (Test #4)

Following on from the previous tests (Float #2) the Ag Rougher Con 1 & 2 and the first Scavenger con were combined for the Ag/Au cleaner. Note that for the Ag cleaner there are still some outstanding assays to be reported (MgO and SiO_2).

Table 4 – Flotation #4, Ag/Au Cleaner Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Ag Cl Con 1	16.07%	12.02	1519.00	2.85	10.36	13.78	22.09	2.11	N/A	N/A
Ag Cl Con 2	14.42%	8.34	1094.00	1.91	7.76	12.04	25.18	2.40	N/A	N/A
Ag Cl Tail	69.50%	5.94	257.28	0.39	2.26	3.00	39.36	2.62	N/A	N/A

Table 5 – Flotation #4, Ag/Au Cleaner Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	%	%	%	%	%	%	%	%	%
Ag Cl Con 1	16.07%	26.6%	42.0%	45.7%	38.2%	36.7%	10.3%	13.5%	N/A	N/A
Ag Cl Con 2	14.42%	16.6%	27.2%	27.5%	25.7%	28.8%	10.5%	13.8%	N/A	N/A
Ag Cl Tail	69.50%	56.9%	30.8%	26.8%	36.1%	34.5%	79.2%	72.6%	N/A	N/A

As can be seen from the above, the performance of the Ag cleaner is significantly different from what has been observed in the DFS. The Ag grade is comparable, albeit lower. The mass distribution is vastly different, with the DFS typically showing a 35/25/50 mass split between the Con1/Con2/Tail. This can be attributed somewhat to the increased mass to the Ag/Au cleaning circuit. While typically in the DFS this was around the 8-10% mark (which is comparable to what was observed in Test #2 in respect to Ro Con1 & 2) with the addition of the Ag/Au Scav con 1 this has increased the mass reporting to the Ag/Au Cleaner to ~22%. This increased mass and the nature of the cleaning operation needs some revision to get a comparable mass pull to the concentrates.

As per the DFS flowsheet the Ag/Au Cl tail is combined with the Zn Rougher concentrate from Flotation test #2 (which was ground to a P_{80} of 20µm) and underwent the same flotation regime as per the DFS program. The results can be seen in the tables below.

Table 6 – Flotation #4, Zn Re-Cleaner Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Zn Re-Cl Con	26.14%	2.55	263.00	0.70	1.96	33.84	19.50	1.41	1.87	3.32
Zn Re-Cl Tail	41.34%	3.92	165.00	0.32	1.47	9.30	36.34	2.59	3.17	5.55
Zn Cl Tail	32.53%	1.38	34.00	0.08	0.41	0.50	43.38	1.85	4.16	7.15

Table 7 – Flotation #4, Zn Re-Cleaner Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Zn Re-Cl Con	26.14%	24.4%	46.4%	53.9%	40.9%	68.8%	14.9%	18.1%	15.5%	15.8%
Zn Re-Cl Tail	41.34%	59.2%	46.1%	38.5%	48.5%	29.9%	43.9%	52.4%	41.5%	41.8%
Zn Cl Tail	32.53%	16.4%	7.5%	7.6%	10.6%	1.3%	41.2%	29.5%	43.0%	42.4%

The upgrade in respect to Zn is lower than anticipated however the tails streams are recirculating loads that are difficult to interpret without a locked cycle. As the Ag Cl tail reports to the Zinc cleaning circuit, the sub-optimal performance is likely to have impacted on the load of the Zn Cleaning circuits.

Roughers & Cleaners conducted with MX980 first (Test #5 & #6)

With the previous results observed in Flotation #2, the scavengers conducted utilising MX980 showed there was potential utilising MX980 as opposed to Aerophine 3418A. The Rougher tests (as Per Flotation #2) were repeated utilising MX980. The results can be seen in the tables below.

Table 8 –Rougher Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Ag Ro Con 1	4.73%	20.40	1979	2.99	14.31	6.05	16.51	1.93	8.88	17.34
Ag Ro Con 2	3.73%	10.57	892	1.64	6.41	8.00	21.73	2.92	7.65	13.81
Ag Ro Con 3	2.04%	5.59	416	0.78	3.08	8.99	24.18	2.97	6.61	10.45
Zn Ro Con 1	11.03%	2.23	146	0.53	0.97	39.28	14.69	1.49	1.25	2.18
Zn Ro Con 2	4.90%	3.36	121	0.25	0.97	8.19	34.05	4.98	2.88	4.59
Zn Ro Tail	73.57%	0.55	23	0.05	0.27	0.34	23.49	0.73	9.29	13.04

Table 9 – Rougher Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Ag Ro Con 1	4.73%	42.1%	53.7%	43.0%	50.9%	5.0%	3.4%	7.6%	5.3%	7.1%
Ag Ro Con 2	3.73%	17.2%	19.1%	18.6%	18.0%	5.2%	3.6%	9.0%	3.6%	4.4%
Ag Ro Con 3	2.04%	5.0%	4.9%	4.8%	4.7%	3.2%	2.2%	5.0%	1.7%	1.8%
Zn Ro Con 1	11.03%	10.8%	9.2%	17.8%	8.0%	75.4%	7.2%	13.7%	1.7%	2.1%
Zn Ro Con 2	4.90%	7.2%	3.4%	3.8%	3.6%	7.0%	7.4%	20.3%	1.8%	1.9%
Zn Ro Tail	73.57%	17.7%	9.7%	12.1%	14.8%	4.3%	76.3%	44.4%	85.9%	82.7%

Table 10 - Ag Rougher Con1, Comparison of Metal Recovery

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Flotation #2	5.30%	31.5%	41.8%	36.8%	39.3%	5.6%	6.2%	9.4%	4.1%	5.0%
Flotation #5	4.73%	42.1%	53.7%	43.0%	50.9%	5.0%	3.4%	7.6%	5.3%	7.1%

It can be seen there has been a substantial improvement in terms of precious metals (Au/Ag/Cu/Pb) with a higher degree of selectivity in respect to Fe & As. However, the talc rejection appears to be less selective.

Table 11 - Ag Rougher Con1+Con2, Comparison of Metal Recovery

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Flotation #2	11.74%	49.42%	64.46%	57.29%	62.02%	12.77%	15.86%	24.11%	8.22%	9.63%
Flotation #2 + Scav	23.53%	71.41%	80.19%	71.61%	78.75%	23.83%	37.86%	48.29%	13.09%	14.71%
Flotation #5	8.45%	59.34%	72.77%	61.57%	68.82%	10.16%	7.02%	16.61%	8.86%	11.50%
Flotation #5 + Ro3	10.50%	64.32%	77.64%	66.40%	73.55%	13.36%	9.20%	21.65%	10.56%	13.33%

Following the same philosophy as flotation test #2 #4 the results for the cleaner circuits (Ag/Au & Zn) can be seen in the tables below.

Table 12 - Ag/Au Cleaner, Flotation #6 - Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Ag Cl Con 1	53.21%	NA	2333	3.51	14.72	8.76	15.16	1.82	8.33	16.33
Ag Cl Con 2	19.90%	NA	1060	1.59	8.61	8.00	20.64	2.50	8.21	15.51
Ag Cl Tail	26.89%	NA	221	0.82	5.08	2.37	24.47	3.30	8.50	15.05

Table 13 - Ag/Au Cleaner, Flotation #6 – Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Ag Cl Con 1	53.21%	N/A	82.1%	77.6%	71.8%	67.7%	43.0%	41.1%	53.1%	54.9%
Ag Cl Con 2	19.90%	N/A	14.0%	13.2%	15.7%	23.1%	21.9%	21.2%	19.6%	19.5%
Ag Cl Tail	26.89%	N/A	3.9%	9.2%	12.5%	9.2%	35.1%	37.7%	27.3%	25.6%

In comparison to the flotation tests #2 & #4 it appears the performance is closer and on par with what was observed in the DFS.

Table 14 – Zn Re-Cleaner, Flotation #6 - Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Zn Re-Cl Con	29.57%	NA	130	0.57	0.76	50.71	9.60	0.61	0.51	1.04
Zn Re-Cl Tail	33.20%	NA	199	0.61	1.36	40.34	13.24	1.44	1.84	3.33
Zn Cl Tail	37.23%	NA	189	0.43	1.65	16.29	25.22	3.04	4.35	7.13

Table 15 – Zn Re-Cleaner, Flotation #6 – Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Zn Re-Cl Con	29.57%	N/A	22.0%	32.1%	17.5%	43.5%	17.1%	10.0%	6.4%	7.6%
Zn Re-Cl Tail	33.20%	N/A	37.8%	38.0%	34.9%	38.9%	26.4%	26.7%	25.6%	27.2%
Zn Cl Tail	37.23%	N/A	40.2%	29.9%	47.6%	17.6%	56.5%	63.3%	68.0%	65.3%

Note the high Zn grades in the re-cleaner con and tail, indicating a Concentrate can be generated at a grate of 43-44% Zn without the need for a re-cleaner (ie cleaner only).

Overall Interpretation

While the individual tests highlight their relative performance, there is a requirement to ascertain the performance relative to the feed and the previous flowsheets. The below tables take an overall look at the comparative recoveries in the 3 potential respective flowsheets.
Note that MgO and SiO_2 assays are not available for all samples and have thus been excluded in the tables below.

Table 16 - Calculated Overall Recoveries based on Feed - Flotation 1 & 3

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Rougher Con (1+2)	47.5%	84.7%	93.4%	91.6%	92.0%	95.3%	66.0%	79.9%	23.1%	24.4%
Cleaner Con (1+2)	33.9%	75.5%	89.9%	86.1%	86.2%	92.8%	46.2%	64.8%	10.5%	11.9%
Rougher Tail	52.5%	15.2%	6.50%	8.50%	8.00%	4.60%	33.9%	20.0%	77.0%	75.7%
Cleaner Tail	13.5%	9.19%	3.52%	5.54%	5.80%	2.52%	19.8%	15.1%	12.6%	12.5%

Table 17 - Backcalculated Grades based on estimates - Flotation 1 & 3

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	ppm	ppm	%	%	%	%	%	%	%
Rougher Con (1+2)	47.5	4.09	343	0.69	2.56	11.9	31.2	2.08	N/A	N/A
Cleaner Con (1+2)	33.9	5.10	461	0.90	3.35	16.2	30.5	2.36	N/A	N/A
Rougher Tail	52.5	0.66	22	0.06	0.20	0.52	14.49	0.47	N/A	N/A
Cleaner Tail	13.5	1.56	45	0.15	0.56	1.10	32.88	1.38	N/A	N/A
Feed (Adjusted)	100	2.29	174	0.36	1.32	5.92	22.4	1.24	N/A	N/A

While the rougher performance was admirable, the cleaning stage did not appear to have a substantial impact in terms of selectivity and upgrade. This to a certain degree is to be expected when looking at the success of the differential floats previously. The success of the performance of the Ag/Au circuit has been while utilising a regime in the pH range of 5 with limited reagents (mostly ZnSO4 for sphaelerite depression). Alternatively the Zn circuit has utilised a higher pH range (11-12) and traditional methods for sphalerite recovery and pyrite depression.

Table 18 & Table 19 below show the impact when taking the current DFS flowsheet and starting at 53µm and utilising an Ag/Au Scavenger

Table 18 - Calculated Overall Recoveries based on Feed - Flotation 2 & 4

		Au	Ag	Cu	Pb	Zn	Fe	As
	Mass	%	%	%	%	%	%	%
Ag Cl Con 1	3.78%	18.99%	33.71%	32.74%	30.09%	8.75%	3.89%	6.54%
Ag Cl Con 2	3.39%	11.82%	21.79%	19.69%	20.23%	6.86%	3.98%	6.67%
Zn-Re-cleaner Con	8.73%	13.67%	16.26%	20.08%	15.97%	50.50%	7.67%	11.06%
Zn Rougher Tail	48.36%	5.54%	3.13%	3.98%	4.09%	1.72%	21.87%	11.69%
Zn Cleaner Tail	10.86%	9.20%	2.62%	2.84%	4.12%	0.93%	21.23%	18.05%
Zn Re-Cleaner Tail	13.80%	33.22%	16.13%	14.36%	18.91%	21.96%	22.60%	32.06%
Ag Scav 2 + Zn Ro Con2	11.08%	7.56%	6.37%	6.31%	6.59%	9.28%	18.76%	13.94%

Table 19 - Backcalculated Grades based on estimates - Flotation 2 & 4

		Au	Ag	Cu	Pb	Zn	Fe	As
	Mass	ppm	ppm	%	%	%	%	%
Ag Cl Con 1	3.78	12.01	1516	2.84	10.35	13.78	22.10	2.11
Ag Cl Con 2	3.39	8.33	1092	1.90	7.75	12.04	25.19	2.40
Zn-Re-cleaner Con	8.73	3.74	317	0.76	2.38	34.48	18.87	1.55
Zn Rougher Tail	48.4	0.27	11	0.03	0.11	0.21	9.71	0.30
Zn Cleaner Tail	10.9	2.03	41	0.09	0.49	0.51	41.97	2.03
Zn Re-Cleaner Tail	13.8	5.75	199	0.34	1.78	9.48	35.16	2.84
Ag Scav 2 + Zn Ro Con 2	11.1	1.63	98	0.19	0.77	4.99	36.37	1.54
Feed (Adjusted)	100	2.39	170	0.33	1.30	5.96	21.47	1.22

While the results are not positive in regards to the final concentrate grades, as has been discussed earlier the Ag Cleaner performance was sub-optimal and the mass splits and performance were vastly different to what has been previously observed under the same regime. The additional mass from the scavenger has contributed negatively to its performance. As a direct comparison the Iron Blow metal deportment when conducting the locked cycle was substantially different in terms of the tailings streams.

Table 20 - Comparison to DFS

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
DFS										
Zn Rougher Tail	67.52%	26.19%	9.28%	17.1%	13.8%	5.33%	72.0%	53.0%	71.6%	76.11%
Zn Rghr Con 2	11.04%	11.31%	6.16%	8.31%	6.49%	7.25%	15.2%	23.9%	6.87%	5.74%
Flotation #2 & #4										
Zn Rougher Tail	48.36%	5.54%	3.13%	3.98%	4.09%	1.72%	21.87%	11.69%	75.84%	73.84%
Ag Scav 2 + Zn Ro Con 2	11.08%	7.56%	6.37%	6.31%	6.59%	9.28%	18.76%	13.94%	6.14%	6.13%
Flotation #5 & #6										
Zn Rougher Tail	73.6%	17.7%	9.71%	12.1%	14.8%	4.3%	76.3%	44.4%	85.9%	82.7%
Zn Ro Con 2 + Ag Ro Con 3	6.94%	12.2%	8.28%	8.59%	8.31%	10.2%	9.54%	25.3%	3.47%	3.78%

A substantial decrease in the losses to tail of the precious metals is observed in respect to #2 & #4, which is quite substantial in respect to Au. However there is also less removal of Fe and As bearing gangue.

Note that the DFS in the table above is from a locked cycle, in which the Zn loses would be reduced due to the recirculation.

The same recovery and grade tables can be seen below for Flotation tests #5 & #6. Of Note is that with a locked cycle these results would appear to be comparable to the DFS.

Table 21 - Calculated Overall Recoveries based on Feed - Flotation 5 & 6

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Ag Cl Con 1	4.50%	N/A	59.8%	47.8%	49.4%	6.88%	3.02%	6.82%	4.70%	6.31%
Ag Cl Con 2	1.68%	N/A	10.2%	8.11%	10.8%	2.35%	1.54%	3.52%	1.73%	2.24%
Zn-Re-cleaner Con	3.93%	N/A	2.66%	7.52%	2.91%	33.21%	1.64%	2.00%	0.27%	0.38%
Zn Rougher Tail	73.6%	17.7%	9.71%	12.1%	14.8%	4.3%	76.3%	44.4%	85.9%	82.7%
Zn Cleaner Tail	4.95%	N/A	4.87%	7.01%	7.92%	13.4%	5.43%	12.6%	2.83%	3.27%
Zn Re-Cleaner Tail	4.42%	N/A	4.57%	8.90%	5.82%	29.7%	2.54%	5.32%	1.07%	1.36%
Zn Ro Con 2 + Ag Ro Con 3	6.94%	12.2%	8.28%	8.59%	8.31%	10.2%	9.54%	25.3%	3.47%	3.78%

Table 22 - Backcalculated Grades based on estimates - Flotation 5 & 6

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	ppm	ppm	%	%	%	%	%	%	%
Ag Cl Con 1	4.50		2315	3.49	14.6	8.79	15.2	1.82	8.32	16.3
Ag Cl Con 2	1.68		1052	1.58	8.54	8.02	20.7	2.51	8.20	15.5
Zn-Re-cleaner Con	3.93		118	0.63	1.0	48.5	9.5	0.61	0.54	1.12
Zn Rougher Tail	73.6		23	0.05	0.3	0.34	23.5	0.73	9.29	13.0
Zn Cleaner Tail	4.95		171	0.47	2.1	15.6	24.8	3.07	4.54	7.67
Zn Re-Cleaner Tail	4.42		180	0.66	1.8	38.6	13.0	1.45	1.92	3.58
Zn Ro Con 2 + Ag Ro Con 3	6.942152471		208	0.41	1.59	8.43	31.1	4.39	3.98	6.31
Feed (Adjusted)	100	2.29	174	0.33	1.33	5.75	22.7	1.20	7.95	11.6

When looking at the comparative metal deportment to the Ag/Au (or 1^{st}) rougher concentrate the following can be seen.

Table 23 - Comparative Metal Deportment to Rougher Concentrate

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Flotation #1	47.5%	84.7%	93.4%	91.6%	92.0%	95.3%	66.0%	79.9%	23.1%	24.4%
Flotation #2	23.5%	71.4%	80.2%	71.6%	78.7%	23.8%	37.9%	48.3%	13.1%	14.7%
Flotation #5	8.45%	59.34%	72.77%	61.57%	68.82%	10.16%	7.02%	16.61%	8.86%	11.50%

Utilising MX980 upfront is clearly the most selective for the removal of the impurities however suffers from less recovery.

Conclusions & Recommendations

From the flotation tests conducted the following relevant points can be surmised;

- Differential flotation is necessary. While a rougher concentrate can be generated, the upgrade is relatively minimal. There can be roughly a 20% rejection of As & ~35% rejection of Fe upfront with little to no precious metal loss. With this is an associated Mg & Si entrainment of ~25%. There is potential to utilise this as a first stage of roughing to remove before splitting the flowsheet into two paths (the Ag/Au concentrate and the Zn circuit)
- Flotation tests #2 & #4 have fallen apart predominately due to the increased load to the Ag/Au cleaner which then impacts upon the Zn cleaning circuits
- The flotation conducted at 53µm has shown a substantial decrease in metal losses to the tails streams however also a reduced effectiveness at removing the gangue
- While the addition of MX980 for scavenging has been successful its use should be utilising as a supplementary collector with 3418A, as its recovery is too low for use as a primary collector

The following recommendations for the testwork are relevant;

- Flotation tests #2 & #4 should be repeated and the Zn portions put on hold in order to generate the following samples for mineralogical assessment;
  - Ag/Au Rougher Con
  - Ag/Au Scav Con
  - Ag/Au Cleaner Tails

MEMORANDUM

To	Dave Readett		
Copy to	Steven Hoban, Tony McKay		
From	BHM Process Consultants		
Subject	PNX Metals Testwork update Report	Client Ref.	
Date	12th December 2018	Doc. No.	1003-PNX-2018-010

Executive Summary

A series of Cleaning stages have been completed for the testwork program to date and for full detail on these tests, please refer to the 8th November update report 1003-PNX-2018-009. From BHM's perspective, a high level interpretation of the conducted works is as follows :

The testwork can be broken down into 3 areas;

- Flotation Test #1 & #3 – Where a single "Bulk" rougher concentrate has been generated. Whilst the roughing stage generated very high recoveries, there appears no viable cleaning regime that can generate the necessary separation, upgrade and yield to the required high grade products.
- Flotation Test #2 & #4 – Where differential flotation is being conducted as per the DFS except at 53µm and utilising an Au/Ag scavenger. Whilst the Ag Cleaner stage failed in this test due to an increase in mass and differing mineralogy, it remains the basis of the process flowsheet and metal recovery as per the PFS Locked Cycles. 53 um has shown no improvement over 75 um and 75 um should remain the basis for Rougher Flotation.
- Flotation Test #5 & #6 – Differential flotation is conducted as per above utilising the reagent used during scavenger as the primary collector. Ultimately the test proved that the MX 980 gold scavenging reagent cannot be simultanteously used in the Ag Cleaning Stage.

The addition of a scavenger has improved the overall recovery in respect to Au & Ag (predominately Au) as can be seen from the decrease in deportment to the Rougher tail and Zn Ro Con 2.

Table 1 – Flotation #4, Ag/Au Cleaner Grades

	Mass	Au %	Ag %	Cu %	Pb %	Zn %	Fe %	As %	MgO %	SiO_2 %
DFS										
Zn Rougher Tail	67.52%	26.19%	9.28%	17.1%	13.8%	5.33%	72.0%	53.0%	71.6%	76.11%
Zn Rghr Con 2	11.04%	11.31%	6.16%	8.31%	6.49%	7.25%	15.2%	23.9%	6.87%	5.74%
Flotation #2 & #4										
Zn Rougher Tail	48.36%	5.54%	3.13%	3.98%	4.09%	1.72%	21.87%	11.69%	75.84%	73.84%
Ag Scav 2 + Zn Ro Con 2	11.08%	7.56%	6.37%	6.31%	6.59%	9.28%	18.76%	13.94%	6.14%	6.13%
Flotation #5 & #6										
Zn Rougher Tail	73.6%	17.7%	9.71%	12.1%	14.8%	4.3%	76.3%	44.4%	85.9%	82.7%
Zn Ro Con 2 + Ag Ro Con 3	6.94%	12.2%	8.28%	8.59%	8.31%	10.2%	9.54%	25.3%	3.47%	3.78%

However the additional mass pulled has cause the Ag/Au Cleaning circuit to become overloaded reducing the overall deportment to the Au/Ag con but has also impacted on the Zn circuit (as the Ag Cleaner Tails reports to the Zn circuit). This has resulted in off-target grades.

In light of the potential gains that have been observed in flotation tests #2 & #4 it was recommended to repeat the test # 2 & 4 flotation to generate samples for mineralogical assessment which include;

- Ag/Au Rougher Concentrate
- Ag/Au Scavenger Concentrate
- Ag Cleaner Tailings

These mineralogical results have been received and this report focuses on the information gained from the

Introduction

Following on from the locked cycle testing during the Definitive-Feasibility Study (DFS) that was being conducted for the Hayes Creek project, for PNX Metals Limited, a number of changes to desired concentrate targets and recoveries have required modification of the process flowsheet and thus relevant testwork. BHM Process Consultants are undertaking the metallurgical and flowsheet design components of the study on behalf of PNX Metals of whom Mr David Readett is the overarching Study Manager.

The current metallurgical testwork plan is focused on improving the existing DFS flowsheet in terms of producing a bulk concentrate with a grade of >40% Zn and maximising Au & Ag recovery while minimising the impurities. In addition to this as a bulk concentrate is required a bulk flotation regime is being investigated. The testwork is being conducted predominately on an Iron Blow Master Composite

Latest Results

The mineralogical investigation associated with increasing the project gold recovery via scavenging with MX 980 carry the following identifiers

- 20 µm Ag Rougher Con
- 20 um Ag Scav Con
- 20 µm Ag Cleaner Tail

The commentary and grade / recovery figures relating to Test # 2&4 has been left in this report to add context and meaning to the mineralogical results provided.

DFS Flowsheet Improvement (Test #4)

Following on from the previous tests (Float #2) the Ag Rougher Con 1 & 2 and the first Scavenger con were combined for the Ag/Au cleaner. Note that for the Ag cleaner there are still some outstanding assays to be reported (MgO and SiO_2).

Table 2 – Flotation #4, Ag/Au Cleaner Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Ag Cl Con 1	16.07%	12.02	1519.00	2.85	10.36	13.78	22.09	2.11	4.31	7.80
Ag Cl Con 2	14.42%	8.34	1094.00	1.91	7.76	12.04	25.18	2.40	5.08	9.13
Ag Cl Tail	69.50%	5.94	257.28	0.39	2.26	3.00	39.36	2.62	4.28	7.79

Table 3 – Flotation #4, Ag/Au Cleaner Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO2
	Mass	%	%	%	%	%	%	%	%	%
Ag Cl Con 1	16.07%	26.6%	42.0%	45.7%	38.2%	36.7%	10.3%	13.5%	15.7%	15.7%
Ag Cl Con 2	14.42%	16.6%	27.2%	27.5%	25.7%	28.8%	10.5%	13.8%	16.7%	16.5%
Ag Cl Tail	69.50%	56.9%	30.8%	26.8%	36.1%	34.5%	79.2%	72.6%	67.6%	67.8%

As can be seen from the above, the performance of the Ag cleaner is significantly different from what has been observed in the DFS. The Ag grade is comparable, albeit lower. The mass distribution is vastly different, with the DFS typically showing a 35/25/50 mass split between the Con1/Con2/Tail. This can be attributed somewhat to the increased mass to the Ag/Au cleaning circuit. While typically in the DFS this was around the 8-10% mark (which is comparable to what was observed in Test #2 in respect to Ro Con1 & 2) with the addition of the Ag/Au Scav con 1 this has increased the mass reporting to the Ag/Au Cleaner to ~22%. This increased mass and the nature of the cleaning operation needs some revision to get a comparable mass pull to the concentrates.

As per the DFS flowsheet the Ag/Au Cl tail is combined with the Zn Rougher concentrate from Flotation test #2 (which was ground to a P_{80} of 20µm) and underwent the same flotation regime as per the DFS program. The results can be seen in the tables below.

Table 1 – Flotation #4, Zn Re-Cleaner Grades

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	Ppm	ppm	%	%	%	%	%	%	%
Zn Re-Cl Con	26.14%	2.55	263.00	0.70	1.96	33.84	19.50	1.41	1.87	3.32
Zn Re-Cl Tail	41.34%	3.92	165.00	0.32	1.47	9.30	36.34	2.59	3.17	5.55
Zn Cl Tail	32.53%	1.38	34.00	0.08	0.41	0.50	43.38	1.85	4.16	7.15

Table 2 – Flotation #4, Zn Re-Cleaner Metal Recoveries

		Au	Ag	Cu	Pb	Zn	Fe	As	MgO	SiO_2
	Mass	%	%	%	%	%	%	%	%	%
Zn Re-Cl Con	26.14%	24.4%	46.4%	53.9%	40.9%	68.8%	14.9%	18.1%	15.5%	15.8%
Zn Re-Cl Tail	41.34%	59.2%	46.1%	38.5%	48.5%	29.9%	43.9%	52.4%	41.5%	41.8%
Zn Cl Tail	32.53%	16.4%	7.5%	7.6%	10.6%	1.3%	41.2%	29.5%	43.0%	42.4%

The upgrade in respect to Zn is lower than anticipated however the tails streams are recirculating loads that are difficult to interpret without a locked cycle. As the Ag Cl tail reports to the Zinc cleaning circuit, the sub-optimal performance is likely to have impacted on the load of the Zn Cleaning circuits.

Mineralogical Interpretation

The Pre-cursor to the mineralogical investigation was the significant improvement in gold recovery observed in Test # 2&4 vs the PFS study as displayed in Table 1, namely a 20.65 % increase in gold recovery through the roughing stage via the addition of MX 980 in an Au/Ag scavenger.

Cleaner Test 4 failed to realise the improved rougher recoveries through to the Bulk metal concentrate, so the test was repeated in order to dispatch samples for detailed mineralogy in an attempt to identify the mineralogical differences effecting flotation performance.

On the following page is the side by side mineral comparisons of the aforementioned target streams. The below table references key flotation test performance data in order to qualify some of the mineralogical content.

Original Stream Mass	156	190.5	35.1	g
Stream Mass % of Feed	12.39	10.6	61.9	%
Au Grade	2.82	9.88	2.23	g/t

Mineral name	20 um Ag Scav Con Mineral Abundance	20 um Ag Ro Con Mineral Abundance	20 um Cl Tail Mineral Abundance
Pyrite/Pyrrhotite	68.65%	38.15%	61.43%
Talc	4.67%	11.92%	1.39%
Arsenopyrite	7.39%	7.68%	14.10%
Sphalerite	6.12%	12.08%	10.98%
Chlorite/Amphibole	2.75%	2.14%	1.33%
Sulphide mineral	4.16%	3.11%	1.83%
Quartz	0.43%	0.99%	0.70%
Galena	1.30%	9.32%	1,40%
Dolomite	1.22%	2.34%	2.44%
Iron Oxide	0.64%	2.31%	1.85%
Iron Silicate	1.75%	1.47%	1.83%
Calcite	0.09%	0.20%	0.24%
Chalcocite	0.32%	3.24%	0.20%
Lead Antimony Sulphide	0.151%	0.033%	0.159%
Iron Antimony Sulphide	0.029%	0.047%	0.139%
Apatite	0.02%	0.10%	0.03%
Aluminium oxide	0.127%	0.020%	0.026%
Tin sulphide	0.05%	0.20%	0.05%
Lead mineral	0.041%	0.473%	0.100%
Orpiment/Realgar	0.01%	0.06%	0.00%
Pyrargyrite	0.02%	0.01%	0.00%
Tetrahedrite (Ag)	0.007%	0.990%	0.011%
Stibnite	0.010%	0.043%	0.004%
Cassiterite	0.006%	0.050%	0.011%
Schreyerite	0.037%	0.210%	0.00%
Uranium Mineral	0.00%	0.000%	0.00%
Polybasite	0.00%	0.14%	0.00%
Bismuthinite	0.000%	0.026%	0.00%

Discussion

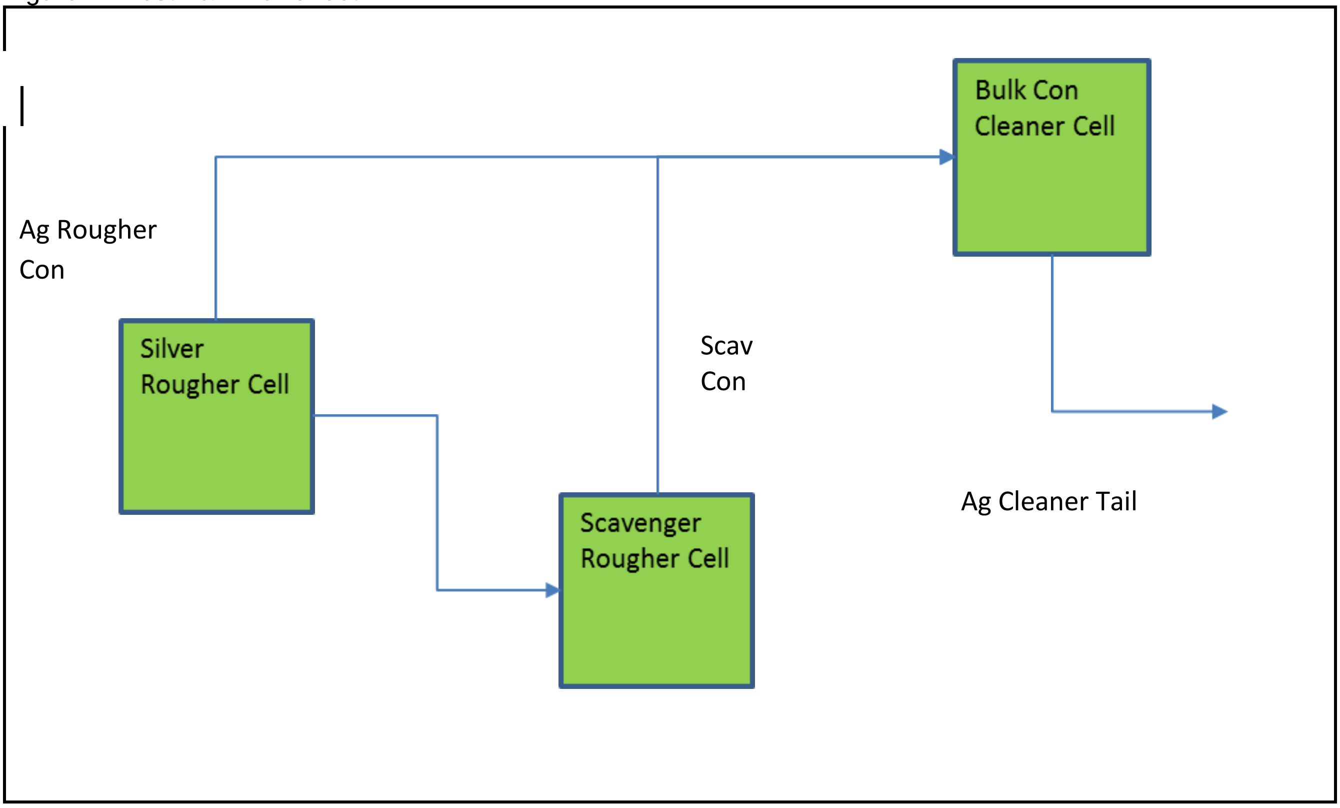
The project has developed over a number of years and the economic requirements of Concentrate grade has been a moving target.

The original “Silver Rougher” conditions were predominantly targeting the minerals of silver (argentite), copper (chalcopyrite and chalcocite) and lead (galena). The flotation conditions and reagents selected of pH 6 were aimed at separating more highly “active” sulphides whilst depressing the zinc (sphalerite) for separate recovery, and the bulk of the mass being iron sulphides.

The associated and further developed “Bulk Concentrate” was aiming at an Ag grade of >2000 ppm with an associated Au grade of >12 g/t.

The flowsheet highlighting the mineralogy test points and attempted process of Test # 2&4 is shown below.

Figure 1 : Test 2&4 Flowsheet



Of key focus, is the amount of pyrite, pyrrhotite and arsenopyrite that is picked up in the scavenger concentrate, and is ultimately “unrecoverable” in the Bulk Concentrate Cleaner as it is clear that the bulk of these minerals are passed straight to the Cleaner Tails stream.

Whilst “mass balancing” mineralogy is fraught with dangers due to so many overlying associations and interactions as well non-perfect identifications, we can draw some broad conclusions as to the what occurs in the Bulk Concentrate Cleaner stage.

- Pyrite / pyrrhotite recovery is very poor.
- Arsenopyrite recovery is very poor.
- Sphalerite recovery, whilst our Bulk concentrate reports an appreciable assay, is actually very low.
- Galena, chalcocite, lead mineral and sulphide mineral recovery is high (>85%).

The extra gold recovery from the Scavenger cell would appear to be totally associated with arsenopyrite or pyrite. The nature of differential flotation is such that this style of mineralisation cannot be treated by the as designed bulk concentrate cleaning system.

The above data and mineralogical recovery assessments suggest that the Ag or Bulk Cleaner cell is fulfilling it’s purpose by which it is upgrading silver, lead and copper minerals through the rejection of all less active iron sulphides.

If we presume that the gold in the Scav con is associated with arsenopyrite, then the below table of arsenopyrite association clearly shows that even at 20 µm grind size, it is intimately associated and locked with the pyrrhotite lattice.

Arsenopyrite Liberation by phase						
	Mass Distribution (%)	Liberated	High Mid	Low Mid	Locked	
		≥ 90 %	≥ 60 %	≥ 30 %	<30 %	
Phase		Phase Distribution %				Total
Scav Con	7.394%	2.2	43.7	18.9	35.3	100
Rougher Con	7.679%	1.1	4.5	36.2	58.2	100
Cleaner Tail	14.097%	8.1	20.8	30.6	40.4	100

Thus, to realise any of the extra rougher flotation gold recovery to a marketable or economic value stream will be impossible via flotation, there is just no minerals separation to take place.

Works undertaken to date have focused on a lot of changes within the system and the re-work of ascertaining a new zinc recovery mark given the specification limit has been lowered to 40 % contained Zn has had minimal focus and requires further works to be undertaken.

Conclusions & Recommendations

From the flotation tests conducted the following relevant points can be surmised;

- The recovery improvements at 53 um rougher grind size do not warrant the increase in gangue, particularly Si and Mg, being dragged into the cleaners. The PFS grind size of 75 µm should be maintained for the project.
- The PFS recoveries still stand as the current benchmark for Ag, Cu and Pb.
- Further tests are required (Locked Cycle repeat) to determine a new recovery for Zn given the specification drop to 40 %. Decreasing zinc grade will definitely increase the levels of other elements, particularly arsenic which must be traded off against revenue.
- The increased gold recovered in the Scav Con cannot be treated through the Bulk Con cleaner circuit. The stream is very border line economically at 2.8 g/t Au and minimal silver content, however diagnostic leach tests via Acacia and pressure oxidation are required to qualify any trade off study.
- The proposed Jameson Testing has been postponed (prioritised) to a letter phase of work as it was always going to be border line on mass requirements, the necessary information being generated, and potential for project improvement.

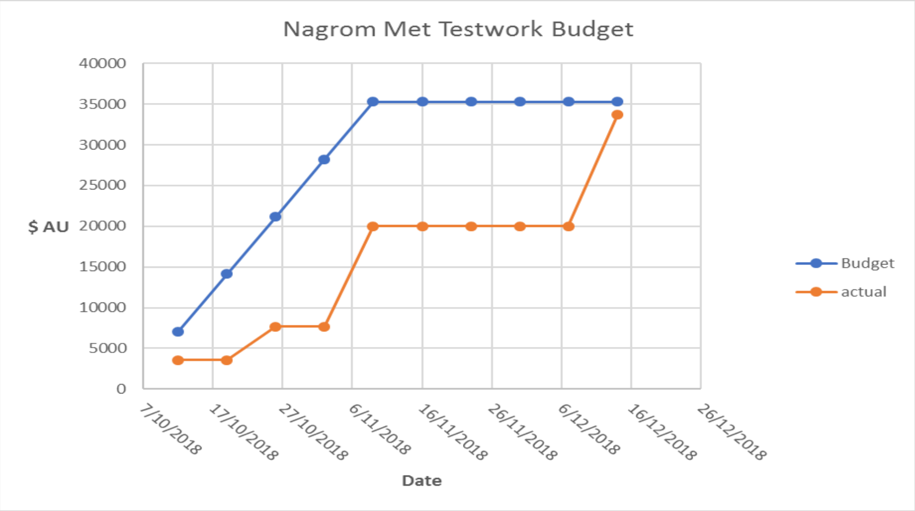
Current Works

As per dot point 4 above, a 4 kg batch of sample is being rougher prepared to generate a minimum of 400 g of Scav con to undertake the diagnostic leach testwork. This component of the works was budgeted in the original plan as part of the Jameson cell investigation which BHM deem of a lower priority.

Scheduling for the leaching is in negotiation but we expect it to commence next week (18th-21st Dec).

Budget & Scheduling

The testwork budget to date for physical testwork is as follows. The most recent invoice from Nagrom is accompanying this report and approved for payment.

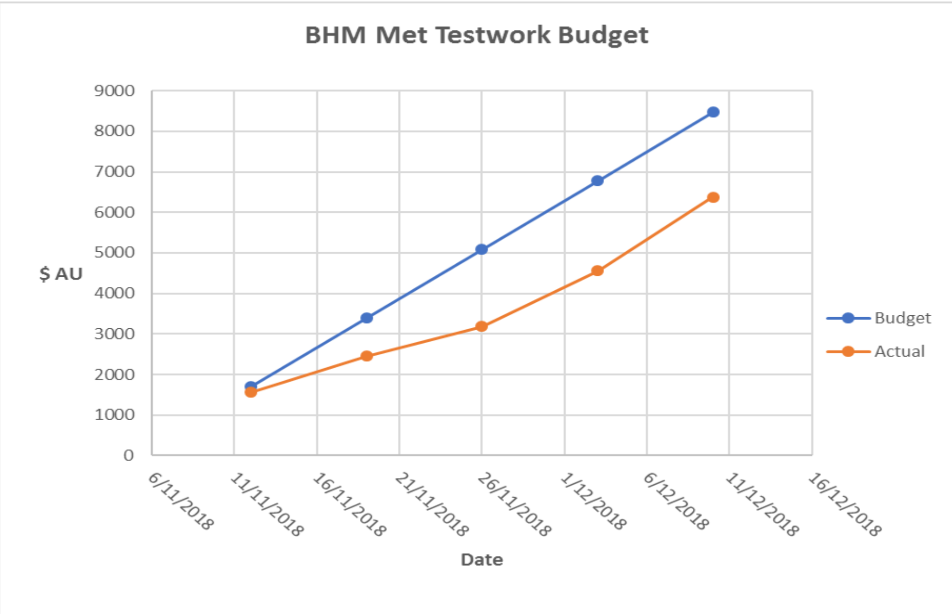


Whilst the entire program is not complete we are fast approaching the initial budget estimate of $35 K. Significant variations are that the external mineralogy provider indicated that the turnaround would be in the order of 3 weeks and thus, BHM authorised an "express" delivery at 100 % cost in order to present any results and direction prior to Christmas.

The inclusion of the Scav Con as an independent stream has increased the cost of all cleaning tests requiring extra ultra-fine grinds and cleaning tests over that budgeted.

BHM see that an additional $ 4,000-6,000 will be required to complete the gold leach investigation and that the proposed Jameson Flotation cleaning should be delayed to a latter stage of investigation.

The BHM management budget was estimated from the over-arching DFS proposal as re-issued April 2018. BHM see that with the issue of the final report everything is on track and budget from the management perspective.



Regards ,

Steve Hoban
Principal Metallurgist
BHM Process Consultants