Appendix 1

From: Stefan Wolmarans [redacted]
Sent: Friday, January 22, 2021 7:54 AM
To: Jarrah Muller
Cc: Martin Van Wyk; Campbell, Kirsty; Power, Tim; Jozsef Patarica; Joel Georgiou
Subject: Updated water balance for the centrifuge case
Attachments: 5253-30-CAL-PR-00006.xlsx

Hi Jarrah,

I have updated the water balance with the centrifuge tailings streams. I have tracked down the original Mineral Technologies water balance and have used that as the basis so that it is in familiar form to you. Overall the nett make-up water requirement is slightly less than the EES. There is also a change in the amount of water that reports to the sand tailings – this is due to the desliming cut which send approximately 110tph of solids to the fines circuit, rather than the sand tailings. This consequently reduces the water entrained for seepage. I have kept the sand terminal density the same as the EES (85% pulp density).

Regards

Stefan Wolmarans
Principal
wave international
DETERMINE • DESIGN • DELIVER
20 years 1999 - 2019
[redacted]

Mass and Water Balance - 1500 tph mining operation - Separate Fines (-38um) and Sand Fraction disposal

Annual Hours 8000

Stage	Stream	In/Out	Dry TPH Solids	SG Solids	SG Slurry	Slurry (m3/h)	Pulp Density (% Solids)	Water (m3/h)	TPA Solids	Water GL per annum	Notes
MUP	Ore Feed	In	**1500**	2.7	2.49	635	**95.0%**	78.9	12,000,000	631,579	Assumes 4% moisture in the ore feed
	+5mm O/S MUP	Out	**8**	2.7	1.79	6	**70%**	3.4			
	MUP MW + SW	Process	0	0	1.00	1414	0%	**1414**		11,312,000	From Process Water Dam
	WCP Feed	Process	1492	2.7	1.46	2042	50%	1490			
2mm Screens	WCP Feed	Process	1492	2.7	1.46	2042	50%	1490	74.47593985		
	MW and SW Water	Process	0	0	1	2035	0	**2035**	595,808		
	Screen Feed	Process	1492	2.7	1.23	4077	30%	3525			
	Screen Oversize	Out	**22**	2.7	1.98	14	79%	**6.0**			
	Screen Undersize	Process	1470	2.7	1.23	4063	29%	3519			
Desliming Cyclone	MW Water	Process	0	0	1.00	2239	0%	**2239**			
	Undeflow	Process	**1116**	2.7	1.69	1014	**65%**	601			Assume 60% underflow density
	Overflow	Process	354	2.7	1.04	5288	6.4%	5157			Assumes 25% Slimes (Cylcone overflow in feed)
Thickener	Cyclone Overflow	Process	354	2.7	1.04	5288	6%	5157			
	Surge Bin Overflow	Process	**26**	2.7	1.01	359	7.2%	**336**			
	Flocc Plant	Process	0	0	1			30			
	Dilution Water	Process	0	0	1			8000			From Process Water Dam to dilute cyclone overflow to 3% solids
	Total Thickener Feed In	Process	380	2.7	1.02	13663	2.7%	13523			
	Thickener Overflow	Process	3	0	1.00	12825	0%	12822			
	Thickener Underflow	Process	377	2.7	1.28	840	**35%**	700	**5,601**		Assume 40% underflow density
Gravity Circuit	Feed (Screen undersize)	Process	1090	2.7	1.31	2236	37%	**1832**			Assumes 7% of Feed reports to Cons. Dewatering Cyclones produce 78% solids underflow. Assumes that final cons is < 5% moisture and that remainng water is recovered to process.
	HM Cons	Out	77.9	3.8	2.68	34	**85%**	14			
	MW Water							413			
	Tailings	Process	1012	2.7	1.24	2606	31%	2231			
Sand Tails Cyclone	Feed	Process	1012	2.7	1.24	2606	31%	2231	**17,850**	Ml/year	
	Overflow	Process	**22**	2.7	1.01	1706	1%	1698	**13,585**	Ml/year	
	Undeflow to tailings	Process	990	2.7	1.69	900	**65%**	533.1	**4,265**	Ml/year	Assume this is the % solids from dewatering cyclone - based on Krebs estimate
	Drainage Recovery							*319.9*	**2,559**	Ml/year	**Assume that 60% water recovered from undertailings drainage**
Thickener Only	Thickener Underflow	Process	377	2.70	1.28	840	35%	700	**5,601**	Ml/year	
	Post Mudmaster	Process	377	2.70	1.28	403	**73.0%**	139.4	**1,116**	Ml/year	**Assumed final % solids in dewatered fine tailings - based on Residue Solutions estimate**
Tailings Dams	Water Recovered from MM							561	**4,486**	Ml/year	Returned to process water dam
	Water lost to tailings	Out						353	8464	2,821,465	
										1,706	
Overall Water Balance										1,152	554 32%
In Streams	Ore Feed							79	**632**	Ml/year	
Out Streams	+5mm O/S MUP							3	**27**	Ml/year	
	Screen Oversize							6	**48**	Ml/year	
	HM Cons							13.8	**110**	Ml/year	
	Water lost to tailings							353	**2,821**	Ml/year	
Fresh Water Required								**297**		**2,375,341**	

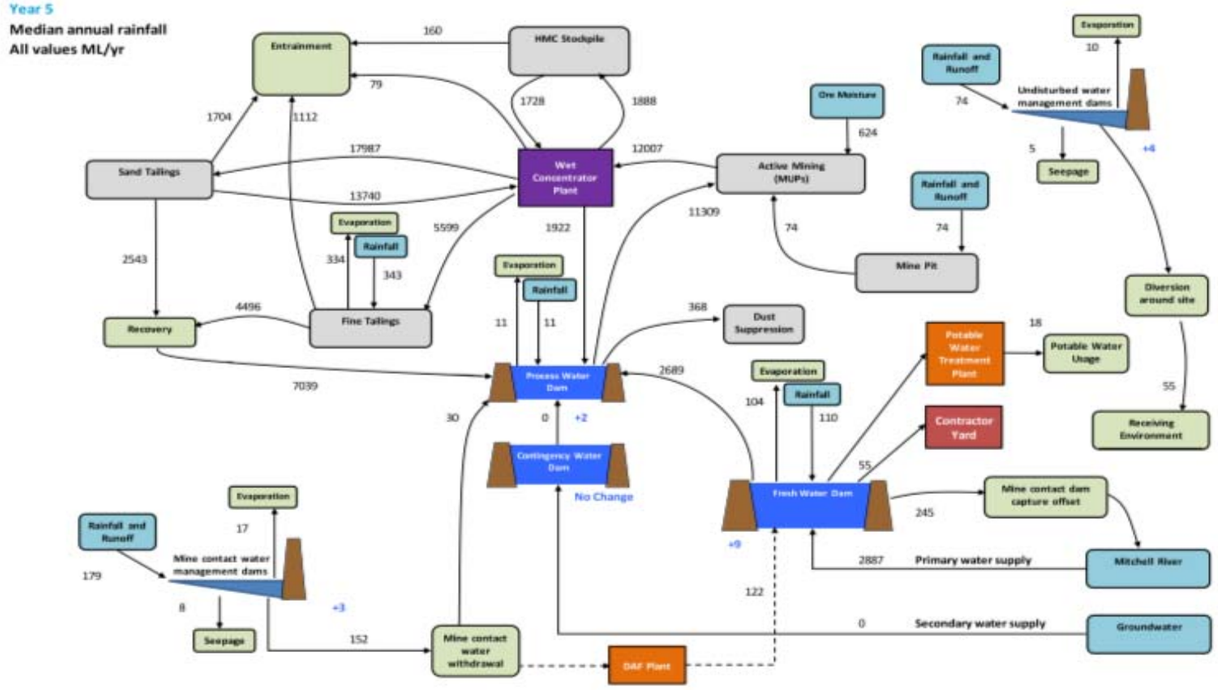

Figure 8.2 Annual Transfer Rates – Year 5 – Median Conditions (black: flow rates, blue: change in storage over the year)

Mass and Water Balance - 1500 tph mining operation - Separate Fines (-38um) and Sand Fraction disposal

375

Annual Hours 8000

Stage	Stream	In/Out	Dry TPH Solids	SG Solids	SG Slurry	Slurry (m3/h)	Pulp Density (% Solids)	Water (m3/h)	TPA Solids	Water GL per annum	Notes
MUP	Ore Feed	In	**1500**	2.7	2.49	635	**95.0%**	78.9	12,000,000	631,579	Assumes 4% moisture in the ore feed
	+5mm O/S MUP	Out	**8**	2.7	1.79	6	**70%**	3.4			
	MUP MW + SW	Process	0	0	1.00	1414	0%	**1414**		11,312,000	From Process Water Dam
	WCP Feed	Process	1492	2.7	1.46	2042	50%	1490			
2mm Screens	WCP Feed	Process	1492	2.7	1.46	2042	50%	1490	74.47593985		
	MW and SW Water	Process	0	0	1	2035	0	**2035**	595,808		
	Screen Feed	Process	1492	2.7	1.23	4077	30%	3525			
	Screen Oversize	Out	**22**	2.7	1.98	14	79%	**6.0**			
	Screen Undersize	Process	1470	2.7	1.23	4063	29%	3519			
Desliming Cyclone	MW Water	Process	0	0	1.00	2239	0%	**2239**			
	Undeflow	Process	**1116**	2.7	1.69	1014	**65%**	601			Assume 60% underflow density
	Overflow	Process	354	2.7	1.04	5288	6.4%	5157			Assumes 25% Slimes (Cylcone overflow in feed)
Thickener	Cyclone Overflow	Process	354	2.7	1.04	5288	6%	5157			
	Surge Bin Overflow	Process	**26**	2.7	1.06	343	7.2%	**336**			
	Flocc Plant	Process	0	0	1			30			
	Dilution Water	Process	0	0	1			8000			From Process Water Dam to dilute cyclone overflow to 3% solids
	Total Thickener Feed In	Process	380	2.7	1.02	13663	2.7%	13523			
	Thickener Overflow	Process	3	0	1.00	12825	0%	12822			
	Thickener Underflow (Pre-Cyclone O/F)	Process	377	2.7	1.28	840	**35%**	700			Assume 40% underflow density
Gravity Circuit	Feed (Screen undersize)	Process	1090	2.7	1.31	2236	37%	**1832**			
											Assumes 7% of Feed reports to Cons. Dewatering Cyclones produce 78% solids underflow. Assumes that final cons is < 5% moisture and that remainng water is recovered to process.
	HM Cons	Out	77.9	3.8	2.68	34	**85%**	14			
	MW Water							413			
	Tailings	Process	1012	2.7	1.24	2606	31%	2231			
Sand Tails Cyclone	Feed	Process	903	2.7	1.31	1808	38%	1473.3	**11,787**	Ml/year	
	Overflow	Process	**109**	2.7	1.06	1226	8%	**1185.3**	**9,483**	Ml/year	
	Undeflow to tailings	Process	794	2.7	1.86	582	73.4%	288.0	**2,304**	Ml/year	**Increased U/F density from stacking testwork - 2 stage dewatering cyclone**
	Drainage Recovery							*144.0*	**1,152**	Ml/year	**~ 50% water recovered from undertailings drainage min 73% to 85% final density**
Fines Centrifuge Circuit	Centrifuge Feed	Process	486	2.70	1.28	1088	35%	909	**7,272**	Ml/year	
	UF Centrifuge Plant	Out	486	2.70	1.28	1090	35%	909	**7,272**		
	Centrifuge Cake	Out	486	2.70	1.84	363	72.7%	183	**1,460**		1,152
Tailings	Water Recovered from Fine Tailings Streams	**In**						726	**5,812**	Ml/year	Returned to process water dam
	Water lost to tailings	**Out**						327	7836	2,612,006	
Overall Water Balance				132							
In Streams	Ore Feed		1500					79	**632**	Ml/year	
Out Streams	+5mm O/S MUP							3	**27**	Ml/year	
	Screen Oversize							6	**48**	Ml/year	
	HM Cons							13.8	**110**	Ml/year	
	Water lost to tailings							327	**2,612**	Ml/year	
Fresh Water Required								**271**		**2,165,881**	-9%

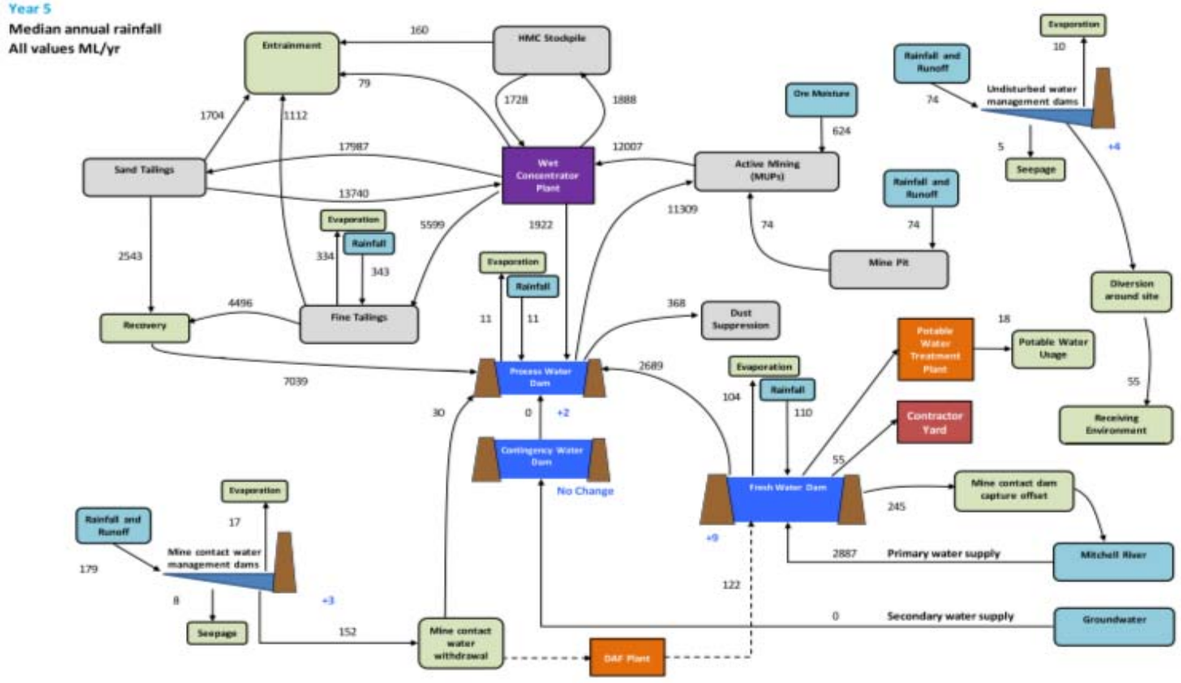

Figure 8.2 Annual Transfer Rates – Year 5 – Median Conditions (black: flow rates, blue: change in storage over the year)

Original EES Mineral Technologies Water Balance				Revised Centrifuge Water Balance				% Change	Comments
Water out in sand slurry to cyclone	- 17,850	- 2,242	100.0%	Water out in sand slurry to cyclone	- 11,787	- 1,481	100.0%	-34.0%	Silt cut to fines is `100tph more in the centrifuge model and 38% slurry vs 31% slurry density
Water in from Cyclone O/F	13,585	1,707	76.1%	Water in from Cyclone O/F	9,483	1,191	80.5%	-30.2%	Less water in due to lower inflow, but higher recover % due to increase to 73% U/F density
Water out in Cyclone U/F	- 4,265	- 536	-23.9%	Water out in Cyclone U/F	- 2,304	- 289	-19.5%	-46.0%	Less due to increased UF density
Water in from sand underdrainage recov	2,559	321	14.3%	Water in from sand underdrainage recov	1,152	145	9.8%	-55.0%	Less due to increased UF density
Total Recovery	**90.4%**	**90.4%**		**Total Recovery**	**90.2%**	**90.2%**			
Water lost to entrainment and seepage	- 1,706	- 214	-9.6%	Water lost to entrainment and seepage	- 1,152	- 145	-9.8%	-32.5%	Less due to lower water out in cyclone U/F -final pulp density still the same at 85%
As a percentage of Cyclone U/F water	**40.0%**	**40.0%**		As a percentage of Cyclone U/F water	**50.0%**	**50.0%**		25.0%	Less because final density is the same and centrifuge starting density is higher
Fines				**Fines**					
Water out	5,601	704		Water out	7,272	914		29.8%	More in centrifuge because of silt cut higher to centrifuge
Water in	4,486	564		Water in	5,812	730		29.6%	Relative increase
Recovery	**80.1%**	80.1%		Recovery	**79.9%**	79.9%		-0.2%	72.7% modelled pulp density vs 73% in EES

From: Stefan Wolmarans [redacted]
Sent: Friday, January 22, 2021 11:33 AM
To: Jarrah Muller
Subject: Re: Updated water balance for the centrifuge case

Hi Jarrah,

The fines backfill now occurs in pit so any rainfall would be treated the same as the sand tails and runoff that does occur we intercepted input or would report to the mine contact water dam for the area of catchment outside the direct pit footprint.

Regards
Stefan

Get Outlook for iOS

Stefan Wolmarans
Principal
[redacted]

From: Jarrah Muller [redacted]
Sent: Friday, January 22, 2021 1:37:21 PM
To: Stefan Wolmarans [redacted]
Subject: RE: Updated water balance for the centrifuge case

CAUTION: This is an external email

Hi Stefan,

You said that rainfall on the fine tails would no longer be harvested.

If a heavy rainfall event occurred, where would runoff from the fine tails area go?

- Would the area be completely bunded? In this case, if a heavy rain event occurred and the tails cell was saturated, would water be removed to the process dam or left to evaporate?
- Would runoff report to the adjacent sand tails area?
- Would runoff flow overland and enter water management dams?

Regards,

Jarrah Muller | Associate Civil and Environmental Engineer
[redacted]

[redacted]

From: Stefan Wolmarans [redacted]
Sent: Friday, 22 January 2021 1:15 PM
To: Jarrah Muller [redacted]
Subject: RE: Updated water balance for the centrifuge case

CAUTION: This email originated outside of the Organisation.

Hi Jarrah,

Its just a duplication, one can be deleted.

Cheers

Stefan Wolmarans
Principal

[redacted]

From: Jarrah Muller [redacted]
Sent: Friday, 22 January 2021 10:36 AM
To: Stefan Wolmarans [redacted]
Subject: RE: Updated water balance for the centrifuge case

CAUTION: This is an external email

Thanks Stefan,

Row 39 and 40 in the updated water balance have identical data. Is this intentional?

Regards,

Jarrah Muller | Associate Civil and Environmental Engineer

[redacted]

[redacted]

From: Stefan Wolmarans [redacted]
Sent: Friday, 22 January 2021 12:54 PM
To: Jarrah Muller [redacted]
Cc: Martin Van Wyk [redacted]; Campbell, Kirsty [redacted]; Power, Tim [redacted]; Jozsef Patarica [redacted]; Joel Georgiou [redacted]
Subject: Updated water balance for the centrifuge case

Hi Jarrah,

I have updated the water balance with the centrifuge tailings streams. I have tracked down the original Mineral Technologies water balance and have used that as the basis so that it is in familiar form to you. Overall the nett make-up water requirement is slightly less than the EES. There is also a change in the amount of water that reports to the sand tailings – this is due to the desliming cut which send approximately 110tph of solids to the fines circuit, rather than the sand tailings. This consequently reduces the water entrained for seepage. I have kept the sand terminal density the same as the EES (85% pulp density).

Regards

Stefan Wolmarans
Principal

wave international
DETERMINE • DESIGN • DELIVER
20 years 1999 - 2019

[redacted]