Leopard Court Building, 1st Floor, South Wing
56 Jerome Street, Lynnwood Glen, Pretoria, South Africa
Tel: +27 (0) 12 348 1114 **Fax:** +27 (0) 12 348 1180 **Web:** www.gcs-sa.biz

Water Balance Update for the Exxaro Matla Coal Mine - Addendum

Report

Version – 2

17 May 2018

Exxaro Matla Coal Mine

GCS Project Number: 13-0400

Client Reference: GCS Water Balance - Exxaro Matla Coal Mine

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	Name	**Signature**	**Date**
Author	Robert Verger		17th of May 2018
Director	Alkie Marais		17th of May 2018

LIST OF ACRONYMS

Acronym	Description
DWS	Department of Water and Sanitation
GCS	GCS Water and Environment (Pty) Ltd
GN704	General Notice 704
IWULA	Integrated Water Use License Application
IWWMP	Integrated Waste and Water Management Plant Report
m^3/year/day	Water consumption – cubic metres per year/day
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PFD	Process Flow Diagram
Tvl	Trans-Natal Corporation and the Clydesdale
WTP	Water Treatment Plant
WUL	Water Use Licence

EXECUTIVE SUMMARY

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Exxaro Matla Coal Mine (Exxaro) to development a site wide water balance model to determine flow volumes for the Matla Coal Mine operations. The Matla Coal Mine is situated in the Mpumalanga Province, approximately 20 kilometres (kms) west of Ga-Nala (Kriel). This water balance report serves as input into the consolidated Integrated Water Use License Application (IWULA) and Integrated Waste and Water Management Plant Report (IWWMP) for the Matla Coal Mine.

A first version of the Matla Coal Mine water balance was developed by SD Hydrological Services and submitted in February 2018 (SD, 2018). Exxaro reviewed this water balance and requested GCS to update the water balance based on comments made by Mr Charles Lindstrom. This report summarises the results of the updated water balance addressing the comments of Exxaro and forms an addendum to the SD Hydrological Services (2018) hydrological assessment.

The development of a water balance is based on an agreed Process Flow Diagram (PFD) as agreed with Mr Charles Lindstrom of Exxaro on the 27th of March 2018. The water balance was developed using an Excel spreadsheet model, taking into consideration average monthly periods during the year

The water balance assumes the following:

- The water balance was developed for the current and 10 year mine situation as described and will be dictated by their respective PFDs;
- Potable water users were confirmed by Exxaro;
- Rainfall/runoff related inflows and evaporation losses were determined for an average year. Hydrological information was obtained from SD (2018) and relevant surface and footprint areas that were assumed for mining infrastructure were measured.
- Runoff coefficients for each surface were fixed and not influenced by antecedent moisture conditions. Average runoff coefficients from the mine area were assumed at 30% of rainfall and for the stockpile areas at 20%.
- The underground workings receive water from recharge (groundwater ingress). The expected groundwater ingress volumes will vary over time and was determined in the groundwater specialist study (MWC, 2015).
- Catchment and surface areas for the current and 10 year future scenario were taken from WSP (2017).
- Information obtained for the New Mine 1 stormwater management plan (SWMP) (WSP, 2017) was incorporated into the new mine 1 water balance and includes dirty water catchment areas, proposed PCD volumes and surface areas.

The following results summarise the current water balance of the Matla Coal Mine:

- Approximately 2 369 721 m^3/year (6 492 m^3/d) is required to send to the Water Treatment Plant (WTP). Treated discharges from the WTP into the Rietspruit were calculated at 1 149 965 m^3/year (3 150 m^3/day) and 1 214 756 m^3/year (3 328 m^3/day) is pumped for potable use on the Matla Coal Mine.
- A total of 2 555 000 m^3/year (7 000 m^3/day) is dewatered from the underground workings at Mine 2 and Mine 3;
- A total of 26 106 m^3/year (71.5 m^3/day) can be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant are potentially discharged into the Rietspruit.

The following results summarise the future water balance of the Matla Coal Mine:

- Approximately 3 681 868 m^3/year (10 0087 m^3/d) would have to be treated at the WTP. Treated discharges from the WTP into the Rietspruit were calculated at 2 256 105 m^3/year (6 181 m^3/day) and 1 420 763 m^3/year (3 892 m^3/day) is pumped for potable use on the Matla Coal Mine.
- The calculated dewatering rate from the underground workings at the New Mine 1, Mine 2 and Mine 3 could be 3 832 500 m^3/year (10 500 m^3/day);
- A total of 26 106 m^3/year (71.5 m^3/day) could be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant could be discharged into the Rietspruit.

The following recommendations have been made based on the outcomes of this water balance study:

- To monitor dewatering volumes from the underground workings. The capacity of the WTP is 10ML/day (10 000 m^3/day) and this may be insufficient if recharge exceeds this volume.
- To monitor all inflows into the PCDs. This will contribute to better insight in potential reuse of water for dust suppression.

- To comply with Water Use License (WUL) conditions, the mine water balance should be updated on an annual basis during operations, preferably at the end of the rainfall period in March. This will enable the mine of make a decision on whether additional water treatment is required in the future.

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1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Exxaro Matla Coal Mine (Exxaro) to development a site wide water balance model to determine flow volumes for the Matla Coal Mine operations. The start of the Matla Colliery dates back to the end of 1973 when Eskom awarded a contract to the Trans-Natal Corporation and the Clydesdale (Tvl) Collieries Ltd. Matla Colliery is an existing underground coal mining operation. The Matla Coal Mine's Mineral Rights are held by Exxaro Coal Mpumalanga. The Matla Coal Mine is situated in the Mpumalanga Province, approximately 20 kilometres (km) west of Ga-Nala (Kriel).

GCS have been contracted to undertake the consolidation process for the existing Integrated Water Use Licenses (IWULs) and the identified amendments and new uses in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). This water balance report serves as input into the consolidated Integrated Water Use License Application (IWULA) and Integrated Waste and Water Management Plant Report (IWWMP) for the Matla Coal Mine.

It was requested that the water balance should consider two different scenarios, namely:

- Current situation – The water balance for the current situation does not take into consideration all future planned new infrastructure areas or water management plans, which includes:
    - the new Mine 1 Area including dewatering of the new Mine 1 underground workings;
    - A new Mine 1 Pollution Control Dam (PCD);
    - Brine Pond 3;
    - Sewage treatment plant at New Mine 1; and
    - Construction of the proposed Megalitre Tanks at Mine 2;
- 10-year mine operation – The 10 year mine operation for which the water balance is developed takes into consideration all the above mentioned proposed infrastructure and increased dewatering requirement from the underground workings.

A first version of the Matla Coal Mine water balance was developed by SD Hydrological Services and submitted in February 2018 (SD, 2018). Exxaro reviewed this water balance and requested GCS to update the water balance based on comments made by Mr Charles Lindstrom.

This report summarises the results of the updated water balance addressing the comments of Exxaro and forms an addendum to the SD Hydrological Services (2018) hydrological assessment.

2 SCOPE OF WORK

The scope of works was the development of a water balance for the Matla Mine project area based on the Depart of Water and Sanitation (DWS, previously Department of Water Affairs or DWA) Best Practice Guidelines, Water and Salt Balance (DWA, 2006).

3 MATLA MINE WATER BALANCE

3.1 Methodology

The development of the water balance was based on an agreed Process Flow Diagram (PFD). The PFD serves as a basis on how the mine water circuit is represented. A summary figures of the PFD which shows the combined site wide water balance for the two different scenarios are shown in Figure 3-1 to Figure 3-6, respectively.

The water balance was developed using an Excel spreadsheet model, taking into consideration average monthly periods during the year.

A water balance discussion between GCS and Mr Charles Lindstrom of Exxaro took place on the 27th of March 2018. In this meeting all assumptions and input parameters were discussed and agreed on.

A summary of the information used in the water balance include climate data such as rainfall and evaporation (SD, 2018), other data used to develop the PFD and compile the water balance where extracted from the following sources listed below:

- Matla Mines Stormwater Design, Technical Design Report, WSP, 2017 (WSP, 2017);
- Matla Colliery: Update of the Groundwater Balance, Eelco Lukas and Danie Vermeulen, 2015 (MWC, 2015).
- Exxaro Matla Coal, Integrated Water and Waste Management Plan, Golder Associates, December, 2013 (Golder, 2013).
- New Mine 1 Integrated Water Use License (IWUL), 2015: License number: 04/B11E/ACFGIJ/3734.

The following water sources (inflows) were included in the water balance calculations:

- Recharge/Groundwater ingress into the underground working.
- Runoff generated from surface infrastructure areas.
- Direct rainfall over PCDs and any other containment infrastructures; and

- Potable water supply.

The following losses/outflows were included in the water balance calculations:

- Evaporation from an open water surface area (PCD)(natural);
- System losses from sewage treatment plant;
- Losses from the water treatment plant;
- Dust suppression; and
- Discharges unto the receiving watercourse/environment.

3.2 Assumptions and Input Parameters

The water balance assumes the following:

- The water balance was developed for the current and 10 year mine situation as described in Section 1 and will be dictated by their respective PFDs as indicated in Section 3.3.
- Potable water users were confirmed by Exxaro and are presented in Table 3-1.
- Rainfall/runoff related inflows and evaporation losses were determined for an average year. Hydrological information was obtained from SD (2018) and relevant surface and footprint areas that were assumed for mining infrastructure are presented in Table 3-2.
- Runoff coefficients for each surface were fixed and not influenced by antecedent moisture conditions. Average runoff coefficients from the mine area were assumed at 30% of rainfall and for the stockpile areas at 20%.
- The underground workings receive water from recharge (groundwater ingress). The expected groundwater ingress volumes will vary over time and was determined in the groundwater specialist study (MWC, 2015). Assumed groundwater inflow volumes are presented in Table 3-3.
- Catchment and surface areas for the current and 10 year future scenario were taken from WSP (2017) and are presented in Table 3-4.
- Information obtained for the New Mine 1 stormwater management plan (SWMP) (WSP, 2017) was incorporated into the new mine 1 water balance and includes dirty water catchment areas, proposed PCD volumes and surface areas.

All input parameters used for the water balance are presented in Table 3-1 to Table 3-4.

Table 3-1: Assumed potable water users (from Exxaro)

Potable Water User	Volume (m^3/year)
Mine 1 Potable Water Use	488 481
Mine 2 Potable Water Use	520 269
Mine 3 Potable Water Use	206 007
New Mine 1 Potable Water Use	206 007
Water Treatment Plant Offices	22 104

Table 3-2: Assumed surface areas for current and future mining infrastructure

Location	Surface Area (m^2)
Mine 1	
Mine 1 Transfer Coal Stockpile	9 000
Mine 1 Coal Stockpile	302 000
Mine 1 WTP PCD	2 640
Mine 1 Bottom PCD	60 000
Mine 1 Top PCD	24 000
Mine 1 WPT/Office Catchment	62 000
Mine 1 Brine Pond 1	33 667
Mine 1 Brine Pond 2	33 667
Mine 1 Brine Pond 3 (Future)	33 667
New Mine 1 PCD (Future)	7 000
Mine 2	
Mine 2 Emergency Dam	175 000
Mine 2 PCD	27 000
Mine 2 Sludge Beds (4x)	25
Mine 2 Transfer Stockpile	11 650
Mine 2 Emergency Dam Catchment	626 000
Mine 3	
Mine 3 PCD	42 700
Mine 3 Sludge Beds (4x)	15
Mine 3 Transfer Stockpile	3 800
Mine 3 Silo Dam	7 500

Table 3-3: Assumed recharge (groundwater ingress) figures into the underground workings as taken from MWC (2015)

Location	Average Recharge (m^3/d)
Current UG Workings	
Mine 1 (4 Seam)	0
Mine 2 (2 and 5 Seam)	3 500
Mine 3 (2 and 4 Seam)	3 500
Total	*7 000*
10-year future	
Mine 1 (4 Seam)	2 500
Mine 2 (2 and 5 Seam)	4 000
Mine 3 (2 and 4 Seam)	4 000
Total	*10 500*

Table 3-4: Current and future catchment surface areas delineated from WSP (2017)

Location	Catchment Surface Area (m^2)
Current and 10-year future	
Processing Plant	93 970
Mine 1	148 717
Mine 2	232 890
Mine 3	92 510
10-year future	
New Mine 1	43 570

3.3 Process Flow Diagrams

To setup an average water balance model, a PFD was created for each mine and scenario (current and 10-year future) to create insight into all water-linked flows within the Matla Coal Mine operations. All PFDs have been confirmed by Exxaro. The PFDs for the current mine water balances are shown in Figure 3-1 to Figure 3-3 and for the future mine water balance scenarios.

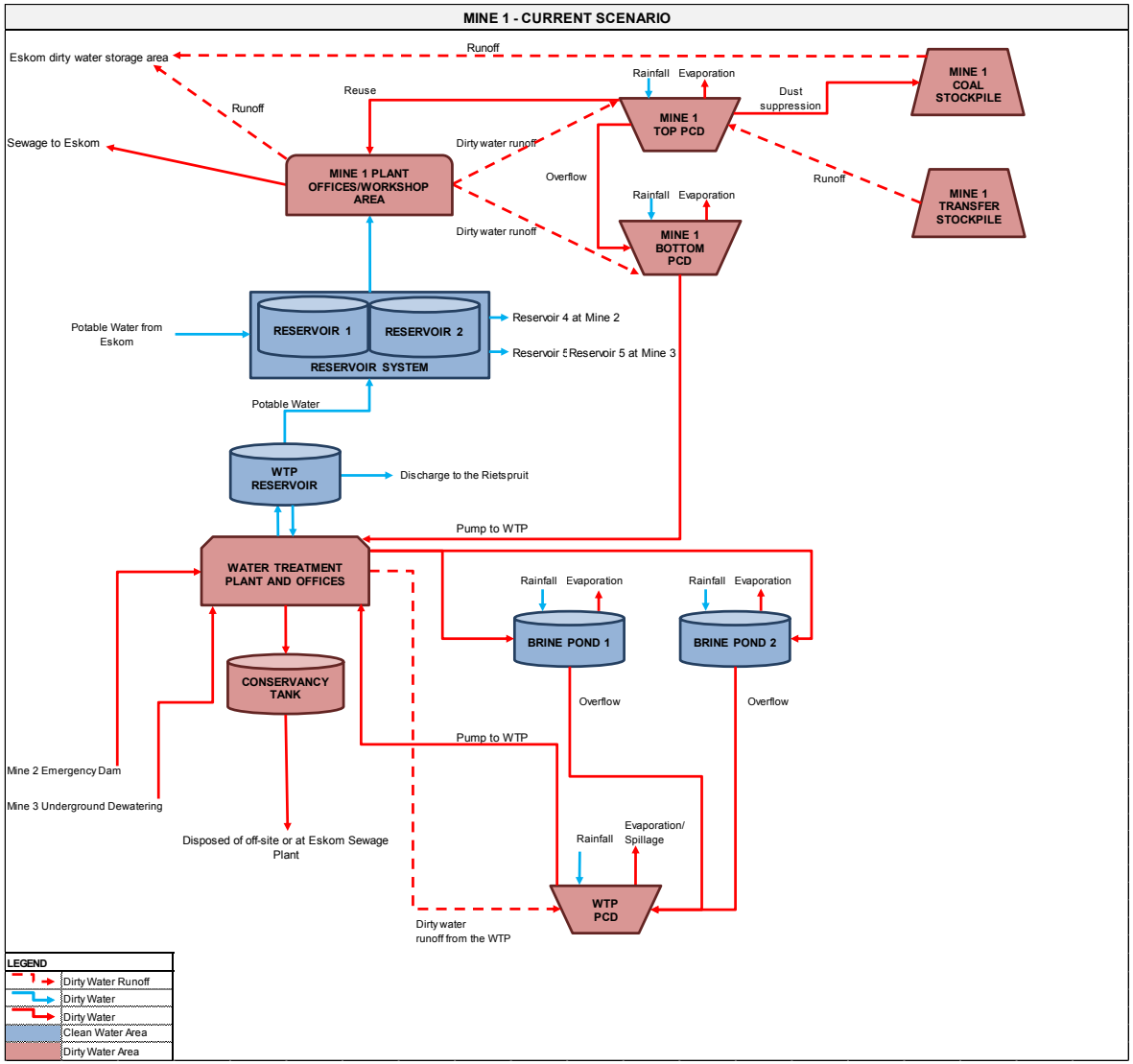

Figure 3-1: PFD for the current Mine 1 water balance

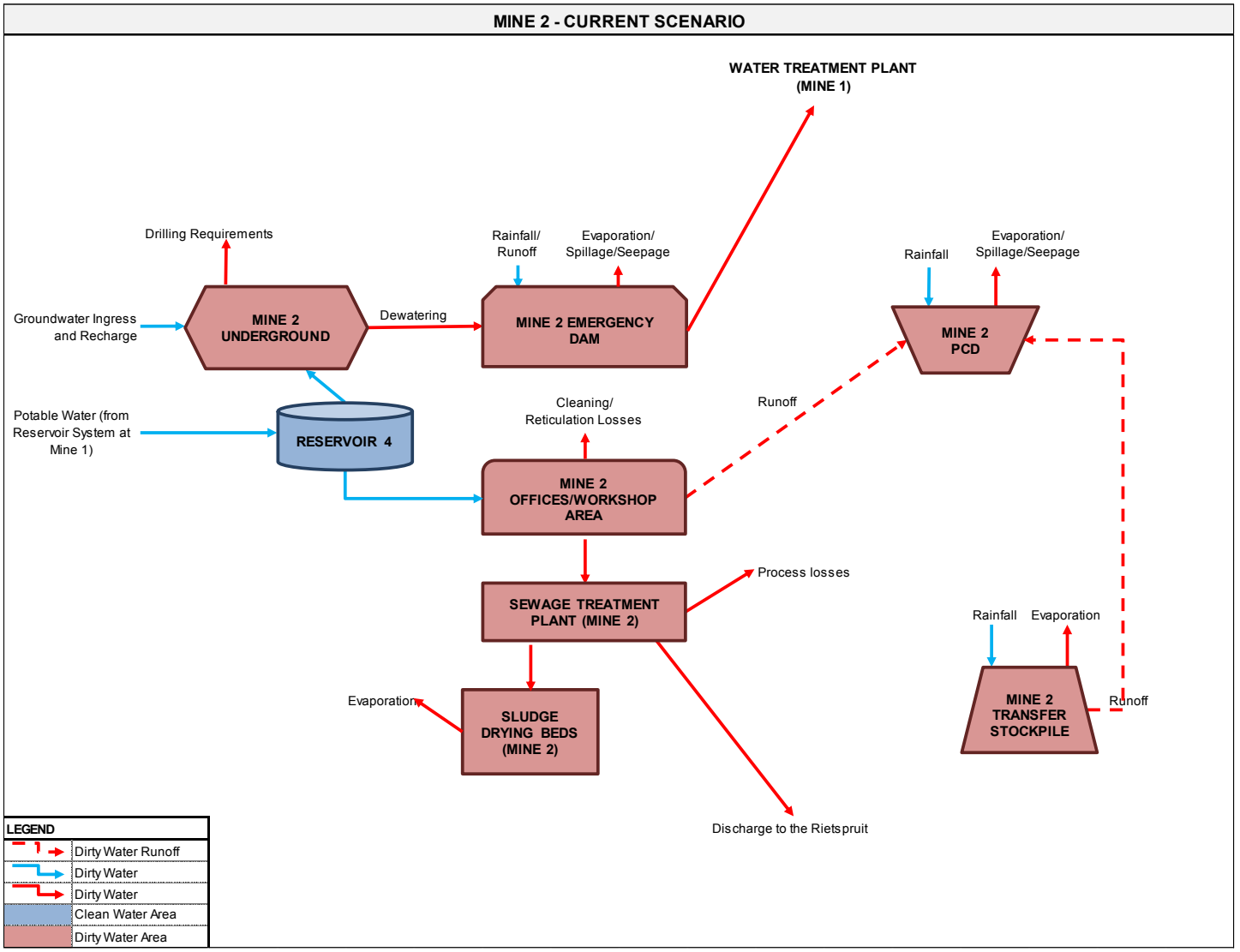

Figure 3-2: PFD for the current Mine 2 water balance

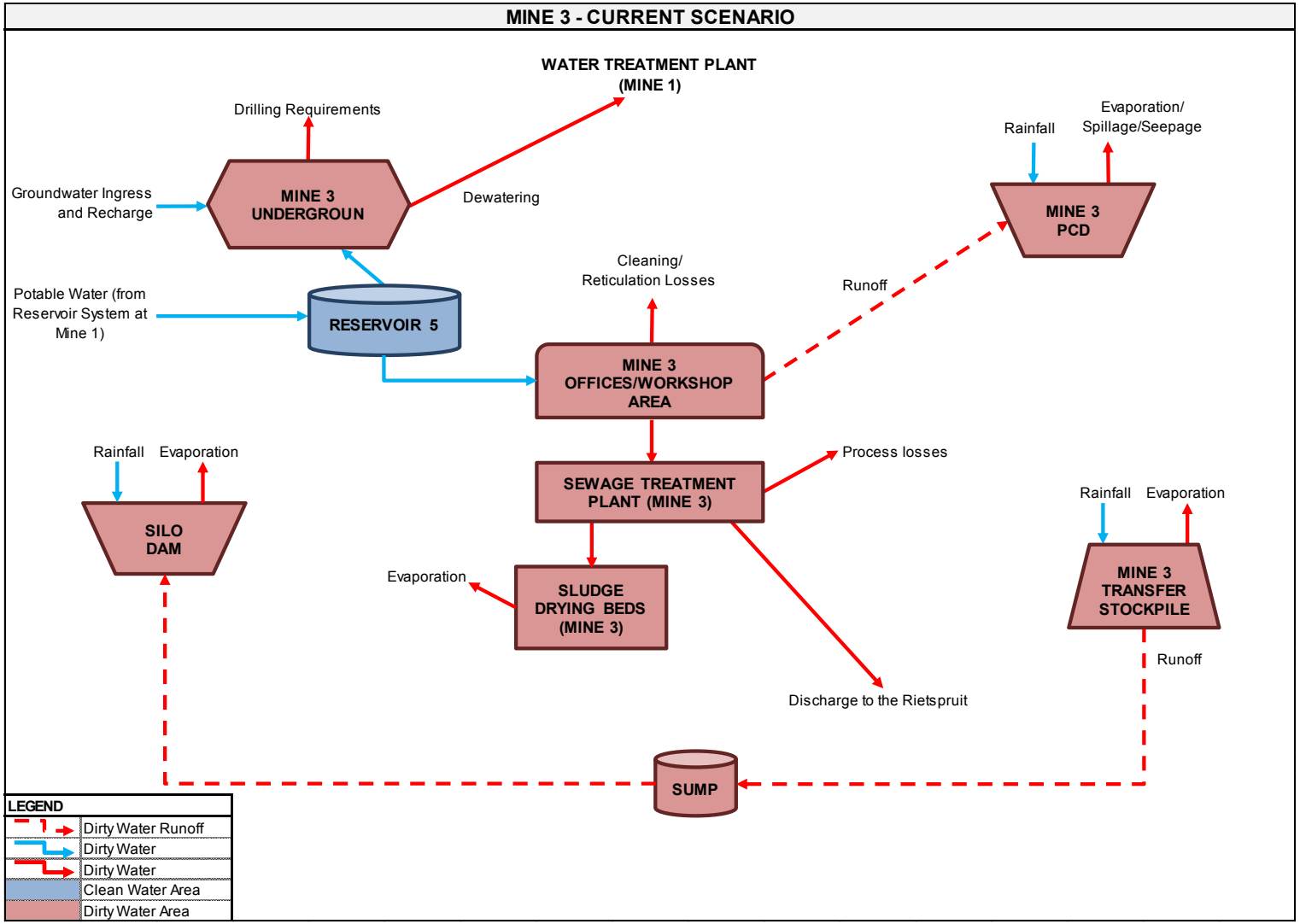

Figure 3-3: PFD for the current Mine 3 water balance

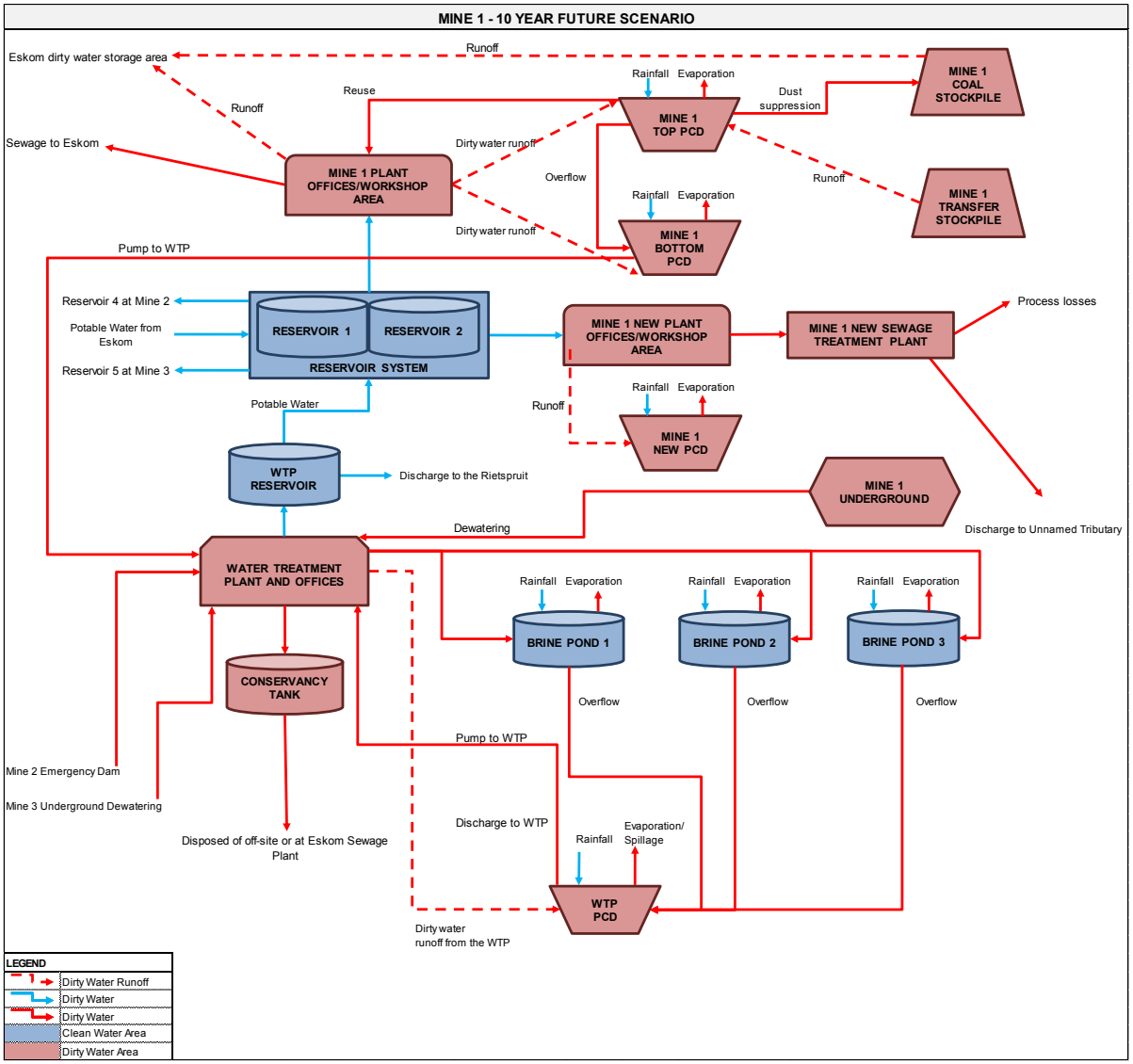

Figure 3-4: PFD for the future Mine 1 water balance

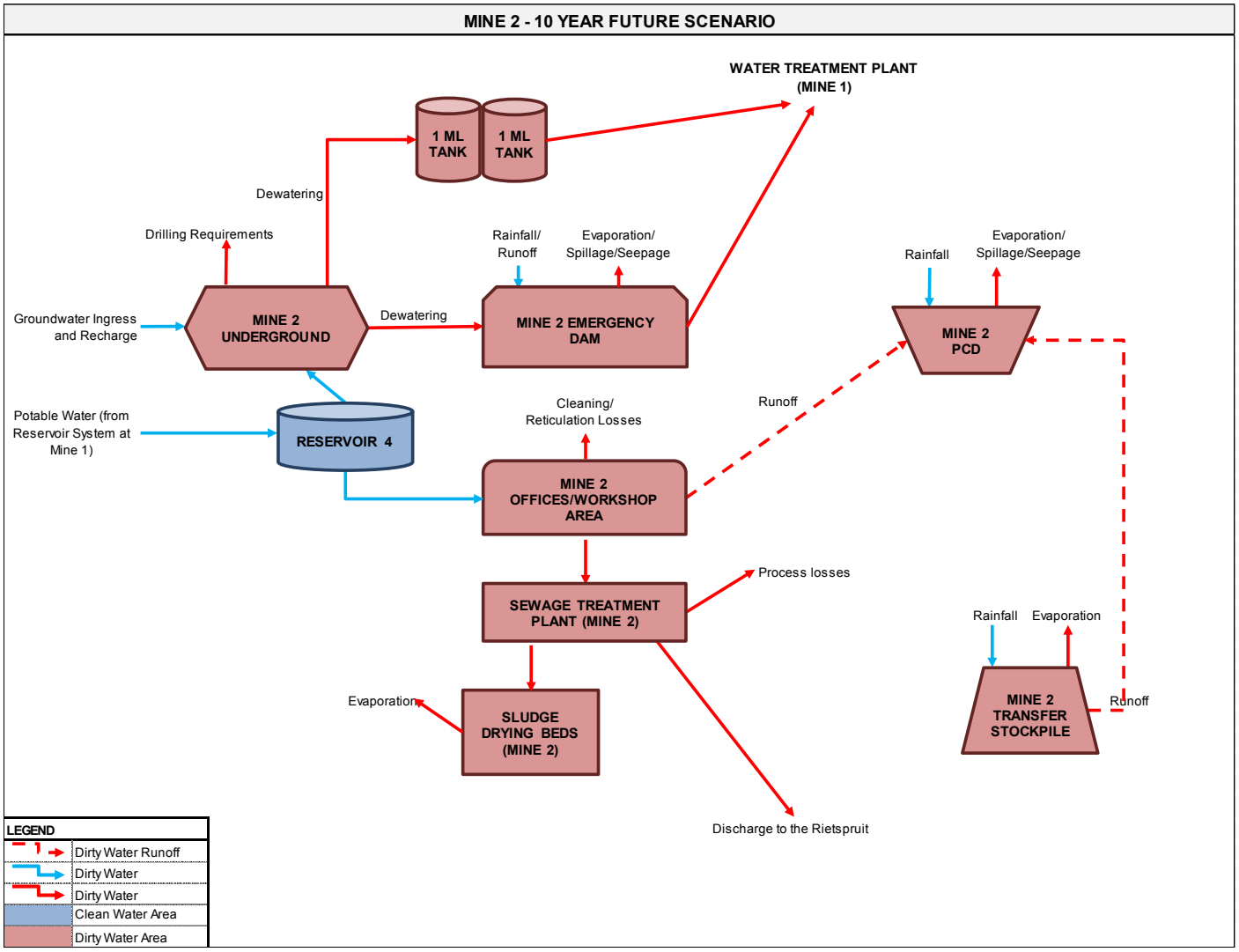

Figure 3-5: PFD for the future Mine 2 water balance

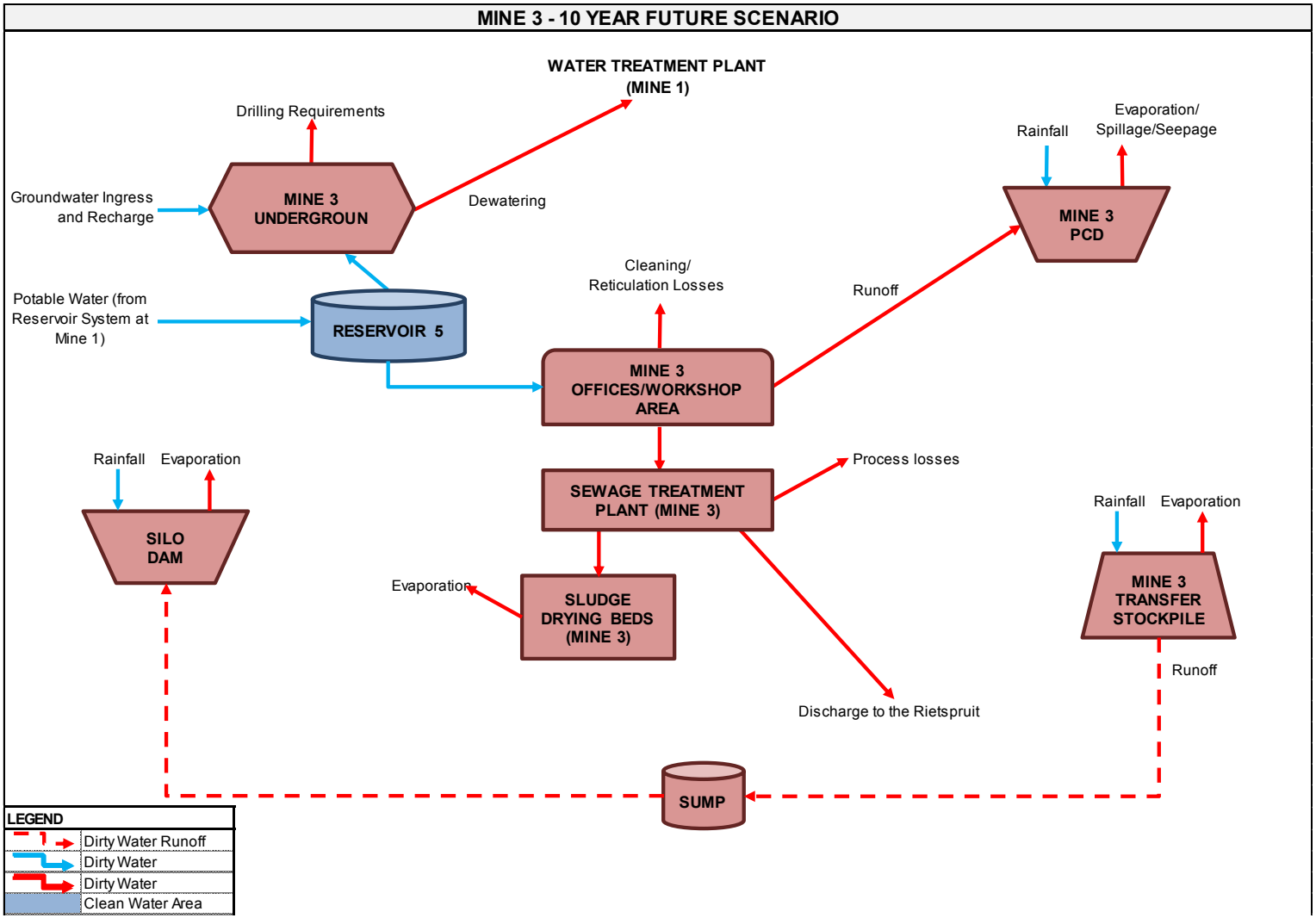

Figure 3-6: PFD for the future Mine 3 water balance

3.4 Current Water Balance

The current mine water balance for the Matla Coal Mine is presented in Table 3-5 to Table 3-7. The following summarises key results of the current water balance:

- Approximately 2 369 721 m^3/year (6 492 m^3/d) is required to send to the Water Treatment Plant (WTP). Treated discharges from the WTP into the Rietspruit were calculated at 1 149 965 m^3/year (3 150 m^3/day) and 1 214 756 m^3/year (3 328 m^3/day) is pumped for potable use on the Matla Coal Mine.
- A total of 2 555 000 m^3/year (7 000 m^3/day) is dewatered from the underground workings at Mine 2 and Mine 3;
- A total of 26 106 m^3/year (71.5 m^3/day) can be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant are potentially discharged into the Rietspruit.

Table 3-5: Average annual water balance for Mine 1 (current)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m3/a)	Water Circuit/stream	Quantity (m3/a)	
Water Treatment Plant (10ML)	Mine 2 Emergency Dam	1 161 317	Brine Pond 1	75 629	
	Mine 3 Underground Dewatering	1 277 500	Brine Pond 2	75 629	
	WTP PCD Spillage	-	WTP Reservoir	2 369 721	
	Mine 1 Bottom PCD Spillage	82 163			
	Total	**2 520 980**		**2 520 980**	**-**
Water Treatment Plant Offices (conservancy tank)	WTP Reservoir (Potable Water) / Potable water from Eskom	5 000	Disposed of off-site/at Eskom Sewage Plant	2 550	
			Consumption (potable)	2 450	
	Total	**5 000**		**5 000**	**-**
WTP Reservoir	Water Treatment Plant and offices	2 369 721	Reservoir System (Reservoir 1 & 2)	1 214 756	
			Water Treatment Plant Offices	5 000	
			Discharges to Rietspruit	1 149 965	
	Total	**2 369 721**		**2 369 721**	**-**
Reservoir System (Reservoir 1 & 2)	WTP Reservoir (Potable Water) / Potable water from Eskom	1 214 756	Mine 1 Plant, Offices & Workshop area	488 481	
			Reservoir 4 at Mine 2	520 269	
			Reservoir 5 at Mine 3	206 007	
	Total	**1 214 756**		**1 214 756**	**-**
Mine 1 Plant, Offices & Workshop area	Reservoir System	488 481	Disposed of off-site/at Eskom Sewage Plant	341 936	
			Consumption (potable)	146 544	
	Total	**488 481**		**488 481**	**-**
Mine 1 Top PCD	Dirty water runoff (Mine 1 plant, offices &workshops)	16 407	Dust suppression (Mine 1 Coal Stockpile)	26 106	
	Rainfall	13 968	Mine 1 Bottom PCD (overflow)	17 404	
	Runoff (Mine 1 Transfer Stockpile)	1 571	Evaporation	32 400	
	Consumptive Return (9%)	43 963	Reuse (Mine 1)	-	
	Total	**75 910**		**75 910**	**-**
Mine 1 Bottom PCD	Rainfall	34 920	Evaporation	81 000	
	Mine 1 Top PCD (overflow)	17 404	Pump to WTP	82 163	
	Dirty water runoff (Mine 1 plant, offices &workshops)	8 259			
	Consumptive Return (21%)	102 581			
	Total	**163 163**		**163 163**	**-**
Mine 1 Transfer Stockpile	Rainfall	5 238	Evaporation/Seepage/Entrainment	3 667	
			Runoff (Mine 1 Top PCD)	1 571	
	Total	**5 238**		**5 238**	**-**
Mine 1 Coal Stockpile	Dust supression (Mine 1 Top PCD)	26 106	Evaporation/Seepage/Entrainment	149 141	
	Rainfall	175 764	Runoff (Eskom dirty water storage area)	52 729	
	Total	**201 870**		**201 870**	**-**
Brine Pond 1	Water Treatment Plant and offices	75 629	Evaporation	40 500	
	Rainfall	19 594	Overflow to WTP PCD (emergency)	-	
			Storage	54 724	
	Total	**95 224**		**95 224**	**-**
Brine Pond 2	Water Treatment Plant and offices	75 629	Evaporation	40 500	
	Rainfall	19 594	Overflow to WTP PCD (emergency)	-	
			Storage	54 724	
	Total	**95 224**		**95 224**	**-**
WTP PCD	Runoff (Water Treatment Plant & Offices)	1 804	Evaporation	3 341	
	Rainfall	1 536	Spillage to WTP	-	
	Overflow from Brine Pond 1 (emergency)	-			
	Overflow from Brine Pond 2 (emergency)	-			
	Total	**3 341**		**3 341**	**-**
Total Water Balance		**7 238 907**		**7 238 907**	**-**

Table 3-6: Average annual water balance for Mine 2 (current)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m3/a)	Water Circuit/stream	Quantity (m3/a)	
Mine 2 Underground	Groundwater Ingress & Recharge	1 277 500	x	1 277 500	
	Total	**1 277 500**		**1 277 500**	**-**
Reservoir 4	Potable water from Reservoir System at Mine 1	520 269	Mine 2 Offices & Workshop Area	156 081	
			Potable Underground Users	364 188	
	Total	**520 269**		**520 269**	**-**
Mine 2 Emergency Dam	Mine 2 Underground Dewatering	1 277 500	Evaporation/Seepage/Spillage	236 250	
	Rainfall	101 850	Water Treatment Plant Mine 1	1 161 317	
	Runoff	18 217			
	Total	**1 397 567**		**1 397 567**	**-**
Mine 2 Offices & Workshop Area	Reservoir 4 (Potable water supply)	156 081	Sewage Treatment Plant Mine 2	52 027	
			Consumption (Potable)	104 054	
	Total	**156 081**		**156 081**	**-**
Mine 2 PCD	Dirty water runoff (Mine 2 offices & workshop area)	10 705	Evaporation	27 775	
	Rainfall	15 714			
	Mine 2 Transfer stockpile runoff	1 356			
	Total	**27 775**		**27 775**	**-**
Sewage Treatment Plant Mine 2	Mine 2 Offices & Workshop Area Sewage	52 027	Process losses	1 951	
			Discharge to Rietspruit	**50 000**	
			Sludge beds 2a - 2d at Mine 2	76	
	Total	**52 027**		**52 027**	**-**
Sludge Drying beds 2a - 2d	Sewage Treatment Plant Mine 2	76	Evaporation	134	
	Rainfall	58			
	Total	**134**		**134**	**-**
Mine 2 Transfer Stockpile	Rainfall	6 780	Evaporation/Seepage/Spillage	5 424	
			Runoff to Mine 2 PCD	1 356	
	Total	**6 780**		**6 780**	**-**
Total Water Balance		**3 438 132**		**3 438 132**	**-**

Table 3-7: Average annual water balance for Mine 3 (current)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m3/a)	Water Circuit/stream	Quantity (m3/a)	
Mine 3 Underground	Groundwater Ingress & Recharge	1 277 500	Dewatering (Water Treatment Plant Mine 1)	1 277 500	
	Total	**1 277 500**		**1 277 500**	**-**
Reservoir 5	Potable water from Reservoir System at Mine 1	206 007	Mine 3 Offices & Workshop Area	123 604	
			Potable Underground Users	82 403	
	Total	**206 007**		**206 007**	**-**
Mine 3 Offices & Workshop Area	Reservoir 5 (Potable water supply)	123 604	Sewage Treatment Plant Mine 3	36 051	
			Consumption (Potable)	87 553	
	Total	**123 604**		**123 604**	**-**
Mine 3 PCD	Dirty water runoff (Mine 3 offices & workshop area)	9 095	Evaporation/Seepage/Spillage	33 946	
	Rainfall	24 851			
	Total	**33 946**		**33 946**	**-**
Sewage Treatment Plant Mine 3	Mine 3 Offices & Workshop Area Sewage	36 051	Process losses	1 028	
			Discharge to Rietspruit	35 000	
			Sludge beds 3a - 3d at Mine 3	23	
	Total	**36 051**		**36 051**	**-**
Sludge Drying beds 3a - 3d	Sewage Treatment Plant Mine 3	23	Evaporation	81	
	Rainfall	58			
	Total	**81**		**81**	**-**
Mine 3 Transfer Stockpile	Rainfall	2 212	Evaporation/Seepage/Spillage	1 548	
			Runoff to to Sump	663	
	Total	**2 212**		**2 212**	**-**
Sump	Mine 3 Transfer Stockpile	663	Silo Dam	663	
	Total	**663**		**663**	**-**
Silo Dam	Sump	663	Evaporation	5 028	
	Rainfall	4 365			
	Total	**5 028**		**5 028**	**-**
Total Water Balance		**1 685 093**		**1 685 093**	**-**

3.5 Future Water Balance (10 year)

The future water balance for the Matla Coal Mine is presented in Table 3-8 to Table 3-10. The following summarises key results of the future water balance:

- Approximately 3 681 868 m^3/year (10 0087 m^3/d) would have to be treated at the WTP. Treated discharges from the WTP into the Rietspruit were calculated at 2 256 105 m^3/year (6 181 m^3/day) and 1 420 763 m^3/year (3 892 m^3/day) is pumped for potable use on the Matla Coal Mine.
- The calculated dewatering rate from the underground workings at the New Mine 1, Mine 2 and Mine 3 could be 3 832 500 m^3/year (10 500 m^3/day);
- A total of 26 106 m^3/year (71.5 m^3/day) could be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant could be discharged into the Rietspruit.

Table 3-8: Average annual water balance for future Mine 1 water balance (future - 10 year)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m³/a)	Water Circuit/stream	Quantity (m³/a)	
New Mine 1 Underground	Groundwater Ingress & Recharge	912 500	Dewatering (Water Treatment Plant)	912 500	
	Total	**912 500**		**912 500**	**-**
Water Treatment Plant (10ML)	Mine 2 Emergency Dam	730 000	Brine Pond 1	78 338	
	Megalitre Tank 1	365 000	Brine Pond 2	78 338	
	Megalitre Tank 2	365 000	Brine Pond 3	78 338	
	Mine 3 Underground Dewatering	1 460 000	WTP Reservoir	3 681 868	
	New Mine 1 Underground Dewatering	912 500			
	WTP PCD	-			
	Mine Bottom PCD	84 381			
	Total	**3 916 881**		**3 916 881**	**-**
Water Treatment Plant Offices (conservancy tank)	WTP Reservoir (Potable Water) / Potable water from Eskom	5 000	Disposed of off-site/at Eskom Sewage Plant	2 550	
			Consumption (potable)	2 450	
	Total	**5 000**		**5 000**	**-**
WTP Reservoir	Water Treatment Plant and offices	3 681 868	Reservoir System (Reservoir 1 & 2)	1 420 763	
			Discharge to Rietspruit	2 256 105	
			Water Treatment Plant Offices	5 000	
	Total	**3 681 868**		**3 681 868**	**-**
Reservoir System (Reservoir 1 & 2)	WTP Reservoir (Potable Water) / Potable water from Eskom	1 420 763	Mine 1 Plant, Offices & Workshop area	488 481	
			Reservoir 4 at Mine 2	520 269	
			Reservoir 5 at Mine 3	206 007	
			New Mine 1 Plant, Offices & Workshop area	206 007	
	Total	**1 420 763**		**1 420 763**	**-**
Mine 1 New Plant, Offices & Workshop Area	Reservoir System	206 007	Disposed of off-site/at Eskom Sewage Plant	30 901	
			Consumption (potable)	175 106	
	Total	**206 007**		**206 007**	**-**
Mine 1 New Sewage Treatment Plant	Mine 1 New Plant, Offices & Workshop Area	30 901	Process Losses	1 236	
			Discharge to Unnamed Tributary	29 665	
	Total	**30 901**		**30 901**	**-**
Mine 1 New PCD	Runoff (Mine 1 New Plant, Offices & Workshop Area)	7 607	Evaporation	9 450	
	Rainfall	4 074	Storage	2 231	
	Total	**11 681**		**11 681**	**-**
Mine 1 Plant, Offices & Workshop area	Reservoir System	488 481	Disposed of off-site/at Eskom Sewage Plant	341 936	
			Consumption (potable)	146 544	
	Total	**488 481**		**488 481**	**-**
Mine 1 Top PCD	Dirty water runoff (Mine 1 plant, offices &workshops)	16 407	Dust suppression (Mine 1 Coal Stockpile)	26 106	
	Rainfall	13 968	Mine 1 Bottom PCD (overflow)	17 404	
	Runoff (Mine 1 Transfer Stockpile)	1 571	Evaporation	32 400	
	Consumptive Return (9%)	43 963	Reuse (Mine 1)	-	
	Total	**75 910**		**75 910**	**-**
Mine 1 Bottom PCD	Rainfall	34 920	Evaporation	81 000	
	Mine 1 Top PCD (overflow)	17 404	Pump to WTP	84 381	
	Dirty water runoff (Mine 1 plant, offices &workshops)	10 476			
	Consumptive Return (21%)	102 581			
	.	**165 381**		**165 381**	**-**
Mine 1 Transfer Stockpile	Rainfall	5 238	Evaporation/Seepage/Entrainment	3 667	
			Runoff (Mine 1 Top PCD)	1 571	
	Total	**5 238**		**5 238**	**-**
Mine 1 Coal Stockpile	Dust supression (Mine 1 Top PCD)	26 106	Evaporation/Seepage/Entrainment	29 598	
	Rainfall	4 365	Runoff (Eskom dirty water storage area)	873	
				-	
	Total	**30 471**		**30 471**	**-**
Brine Pond 1	Water Treatment Plant and offices	78 338	Evaporation	45 450	
	Rainfall	19 594	Overflow to WTP PCD (emergency)	-	
			Storage	52 481	
	Total	**97 932**		**97 932**	**-**
Brine Pond 2	Water Treatment Plant and offices	78 338	Evaporation	45 450	
	Rainfall	19 594	Overflow to WTP PCD (emergency)	-	
			Storage	52 481	
	Total	**97 932**		**97 932**	**-**
Brine Pond 3	Water Treatment Plant and offices	78 338	Evaporation	45 450	
	Rainfall	19 594	Overflow to WTP PCD (emergency)	-	
			Storage	52 481	
	Total	**97 932**		**97 932**	**-**
WTP PCD	Runoff (Water Treatment Plant & Offices)	1 804	Evaporation	3 341	
	Rainfall	1 536	Spillage to WTP	-	
	Overflow from Brine Pond 1 (emergency)	-			
	Overflow from Brine Pond 2 (emergency)	-			
	Overflow from Brine Pond 3 (emergency)	-			
	Total	**3 341**		**3 341**	**-**
Total Water Balance		**11 243 217**		**11 243 217**	**-**

Table 3-9: Average annual water balance for future Mine 2 water balance (future - 10 year)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m3/a)	Water Circuit/stream	Quantity (m3/a)	
Mine 2 Underground	Groundwater Ingress & Recharge	1 460 000	Dewatering (Mine 2 Ememergency Dam)	730 000	
			Dewatering (2 Megalitre Tanks)	730 000	
	Total	**1 460 000**		**1 460 000**	**-**
Reservoir 4	Potable water from Reservoir System at Mine 1	520 269	Mine 2 Offices & Workshop Area	156 081	
			Potable Underground Users	364 188	
	Total	**520 269**		**520 269**	**-**
Megalitre Tanks 1 & 2	Dewatering of Mine 2 underground	730 000	Water Treatment Plant mine 1	730 000	
	Total	**730 000**		**730 000**	**-**
Mine 2 Emergency Dam	Mine 2 Underground Dewatering	730 000	Evaporation/Seepage/Spillage	155 925	
	Rainfall	101 850	Water Treatment Plant Mine 1	694 142	
	Catchment Runoff	18 217			
	Total	**850 067**		**850 067**	**-**
Mine 2 Offices & Workshop Area	Reservoir 4 (Potable water supply)	156 081	Sewage Treatment Plant Mine 2	52 027	
			Consumption (Potable)	104 054	
	Total	**156 081**		**156 081**	**-**
Mine 2 PCD	Dirty water runoff (Mine 2 offices & workshop area)	10 705	Evaporation	27 775	
	Rainfall	15 714			
	Mine 2 Transfer stockpile runoff	1 356			
	Total	**27 775**		**27 775**	**-**
Sewage Treatment Plant Mine 2	Mine 2 Offices & Workshop Area Sewage	52 027	Process losses	1 951	
			Discharge to Rietspruit	50 000	
			Sludge beds 2a - 2d at Mine 2	76	
	Total	**52 027**		**52 027**	**-**
Sludge Drying beds 2a - 2d	Sewage Treatment Plant Mine 2	76	Evaporation	134	
	Rainfall	58			
	Total	**134**		**134**	**-**
Mine 2 Transfer Stockpile	Rainfall	6 780	Evaporation/Seepage/Spillage	5 424	
		-	Runoff to Mine 2 PCD	1 356	
	Total	**6 780**		**6 780**	**-**
Total Water Balance		**3 073 132**		**3 073 132**	**-**

Table 3-10: Average annual water balance for future Mine 3 water balance (future - 10 year)

Facility Name	Water In		Water Out		Balance
	Water Circuit/stream	Quantity (m3/a)	Water Circuit/stream	Quantity (m3/a)	
Mine 3 Underground	Groundwater Ingress & Recharge	1 460 000	Dewatering (Water Treatment Plant Mine 1)	1 460 000	
	Total	**1 460 000.00**		**1 460 000.00**	**-**
Reservoir 5	Potable water from Reservoir System at Mine 1	206 007	Mine 3 Offices & Workshop Area	133 904	
			Potable Underground Users	72 102	
	Total	**206 006.72**		**206 006.72**	**-**
Mine 3 Offices & Workshop Area	Reservoir 5 (Potable water supply)	133 904	Sewage Treatment Plant Mine 3	41 201	
			Consumption (Potable)	92 703	
	Total	**133 904.37**		**133 904.37**	**-**
Mine 3 PCD	Dirty water runoff (Mine 3 offices & workshop area)	9 095	Evaporation/Seepage/Spillage	33 946	
	Rainfall	24 851			
	Total	**33 946.31**		**33 946.31**	**-**
Sewage Treatment Plant Mine 3	Mine 3 Offices & Workshop Area Sewage	41 201	Process losses	6 125	
			Discharge to Rietspruit	35 000	
			Sludge beds 3a - 3d at Mine 3	77	
	Total	**41 201.34**		**41 201.34**	**-**
Sludge Drying beds 3a - 3d	Sewage Treatment Plant Mine 3	77	Evaporation	135	
	Rainfall	58			
	Total	**135.00**		**135.00**	**-**
Mine 3 Transfer Stockpile	Rainfall	2 212	Evaporation/Seepage/Spillage	1 548	
			Runoff to to Sump	663	
	Total	**2 211.60**		**2 211.60**	**-**
Silo Dam	Sump	663	Evaporation	5 028	
	Rainfall	4 365			
	Total	**5 028.48**		**5 028.48**	**-**
Total Water Balance		**1 882 433.83**		**1 882 433.83**	**-**

4 CONCLUSIONS

The following conclusions can be drawn for the current water balance:

- Approximately 2 369 721 m^3/year (6 492 m^3/d) is required to send to the Water Treatment Plant (WTP). Treated discharges from the WTP into the Rietspruit were calculated at 1 149 965 m^3/year (3 150 m^3/day) and 1 214 756 m^3/year (3 328 m^3/day) is pumped for potable use on the Matla Coal Mine.
- A total of 2 555 000 m^3/year (7 000 m^3/day) is dewatered from the underground workings at Mine 2 and Mine 3;
- A total of 26 106 m^3/year (71.5 m^3/day) can be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant are potentially discharged into the Rietspruit.

The following conclusions can be drawn for the future water balance (10 year):

- Approximately 3 681 868 m^3/year (10 0087 m^3/d) would have to be treated at the WTP. Treated discharges from the WTP into the Rietspruit were calculated at 2 256 105 m^3/year (6 181 m^3/day) and 1 420 763 m^3/year (3 892 m^3/day) is pumped for potable use on the Matla Coal Mine.
- The calculated dewatering rate from the underground workings at the New Mine 1, Mine 2 and Mine 3 could be 3 832 500 m^3/year (10 500 m^3/day);
- A total of 26 106 m^3/year (71.5 m^3/day) could be reused for dust suppression on the Mine 1 Coal Stockpile from the Top PCD. If more dust suppression is required, the pumping to the WTP from the Bottom PCD can be reduced;
- Approximately 50 000 m^3/year (137 m^3/day) from Mine 2 Sewage Treatment Plant and 35 000 m^3/year (96 m^3/day) from Mine 3 Sewage Treatment Plant could be discharged into the Rietspruit.

5 RECOMMENDATIONS

The following recommendations have been made based on the outcomes of this water balance study:

- To monitor dewatering volumes from the underground workings. The capacity of the WTP is 10ML/day (10 000 m^3/day) and this may be insufficient if recharge exceeds this volume.
- To monitor all inflows into the PCDs. This will contribute to better insight in potential reuse of water for dust suppression.
- To comply with Water Use License (WUL) conditions, the mine water balance should be updated on an annual basis during operations, preferably at the end of the rainfall period in March. This will enable the mine of make a decision on whether additional water treatment is required in the future.

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