Mt Rawdon Operations

Post-Closure Water Balance Assessment

Evolution Mining Limited

PO Box 1168
Bundaberg, QLD 4670

Prepared by:

SLR Consulting Australia

SLR Project No.: 623.030415.00001

Client Reference No.: PO 552040

23 January 2025

Revision: 02

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
00	13 December 2024	Amelia Basson		
01	18 December 2024	Amelia Basson		
02	23 January 2025	Amelia Basson	Fiona Stark, Fred Sutherland	Walter Rowlands
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Evolution Mining Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Executive Summary

Background

Mt Rawdon Operations Pty Ltd (MRO), a subsidiary of Evolution Mining Limited, is preparing for the cessation of mining and processing activities. SLR Consulting Australia Pty Ltd (SLR) has been engaged to complete a Post-Closure Hydraulic Assessment of the site. The primary objective is to review and update existing site water studies and models to develop a post-mine closure Water Management Plan (WMP) for MRO, which will accompany an updated Progressive Rehabilitation and Closure Plan (PRCP) submission.

Current Study Scope of Work

The current study aims to review and extend the existing site water and salt balance modelling to understand the water-related risks associated with the long-term post-closure landform.

The Water Balance Model (WBM) and linked Salt Balance Model (SBM) was developed in the GoldSim modelling package, incorporating the Contaminant Transport (CT) module. The data inputs to the models were defined and developed through review of previous studies and in consultation with the project team. These included the final landform, the drainage plan, groundwater interaction, representative climate data and the identification and quantification of the water quality source terms.

Total Dissolved Solids (TDS) and sulfate have been used in the SBM as indicator elements. Although all critical analytes have not been assessed within this study, the approach provides an indication of the rate of change of concentration which is expected to be applicable to other contaminants of concern based on the range of modelled scenarios.

Optimization Study

The initial WBM and SBM results, using the original planned external catchment draining to the pit, showed unfavourable sulfate concentrations within the pit void over the mid to long-term (within the first 200 years). The model results indicated that the pit water level will likely reach equilibrium within a 400-year time period. This level will be below the expected long-term local groundwater level, thus resulting in a terminal sink. During the study an opportunity was identified to improve the long-term water quality in the pit void by increasing the rehabilitated area that will drain inwards to the pit and thus freshening this water body. This can only be carried out whilst ensuring that the pit void remains a sink for the local groundwater.

The study found that by increasing the rehabilitated area draining towards the pit to around 100 ha, would improve the long-term water quality, and ensure the predicted sulfate concentrations within the pit void waterbody stay within the low-risk category for cattle drinking over the 200-year period, while maintaining the pit as a sink for local groundwater. As the pit is expected to remain a sink, evapo-concentration effects will cause the water quality to deteriorate further over time.

Study Outcomes

Pit Void

Water Levels: The water level is expected to rise to 56.9m AHD over 200 years post-closure, whilst still remaining 65m below the pit crest and 20m below the surrounding groundwater levels. This will ensure that it remains a groundwater sink, see Figure E1. The pit overtopping probability was determined to be negligible.

Salinity and Sulfate: Concentrations of the water quality indicators will steadily rise but are predicted to stay within the low-risk categories for cattle drinking over the entire 200-year period, see Figures E2 and E3.

Climate Change: The pit void is expected to remain a terminal sink even when taking into account the predicted climate change. Reduced precipitation and increased evaporation will lead to higher salinity levels which may potentially exceed the sulfate low-risk threshold within the 200 years.

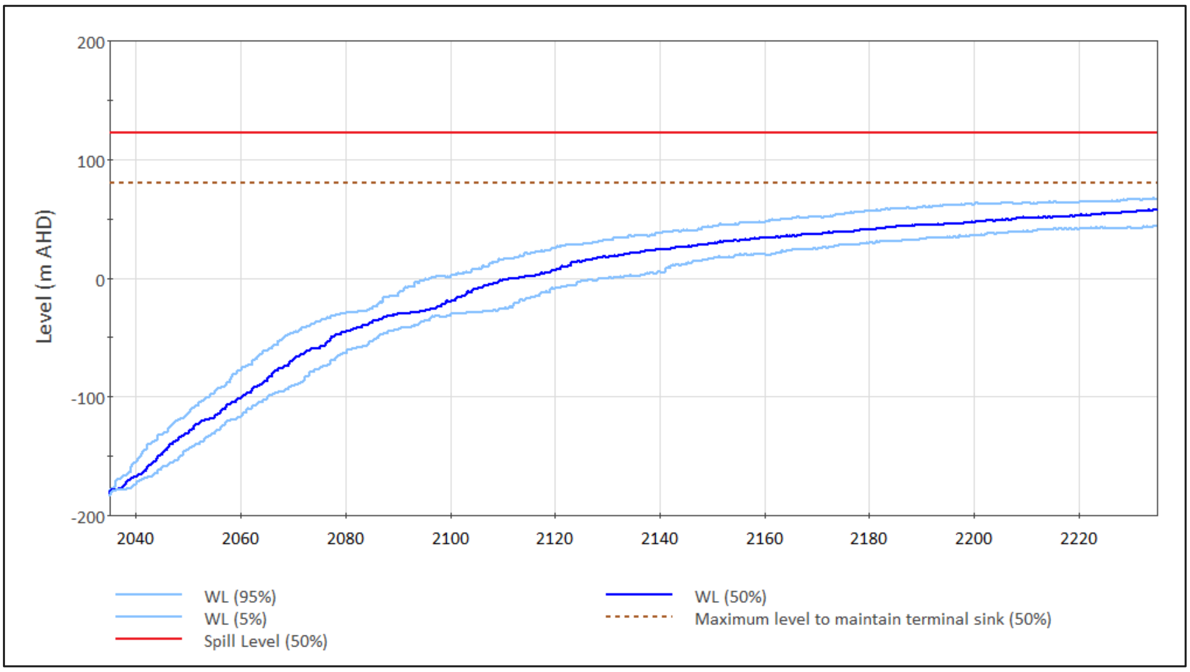


Figure E1: Pit Void Predicted Water Levels

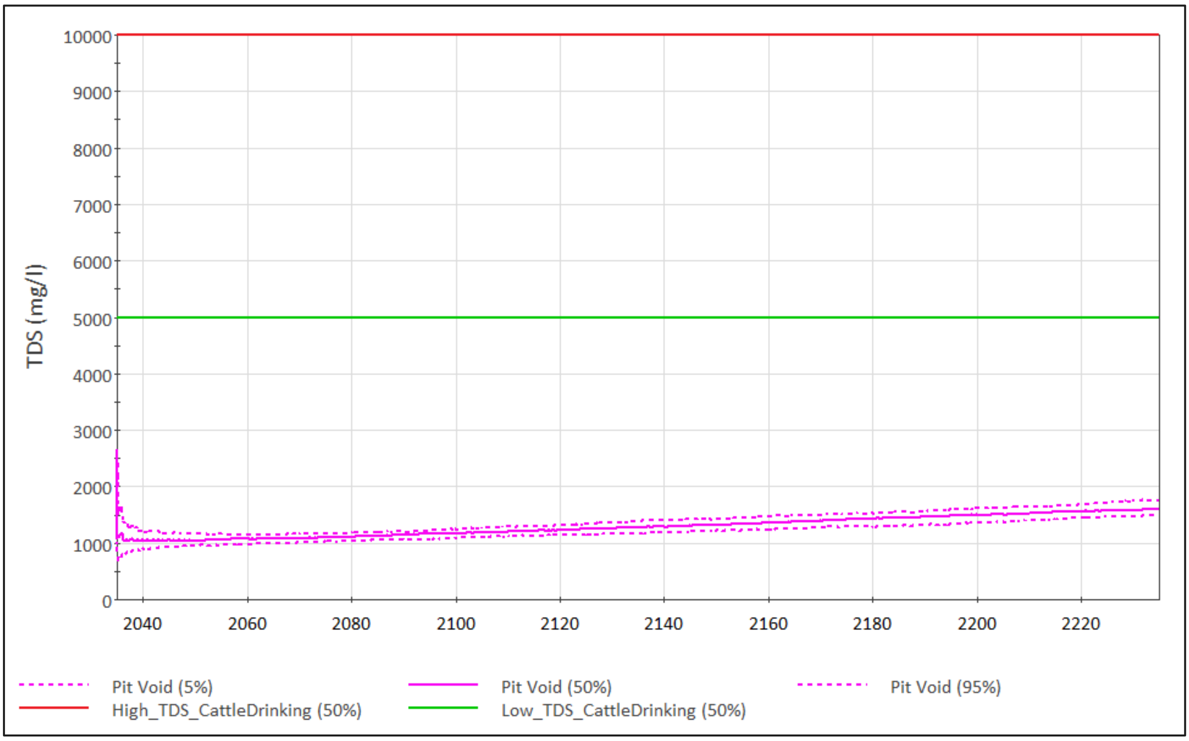


Figure E2: Pit Void Predicted Salinity (TDS)

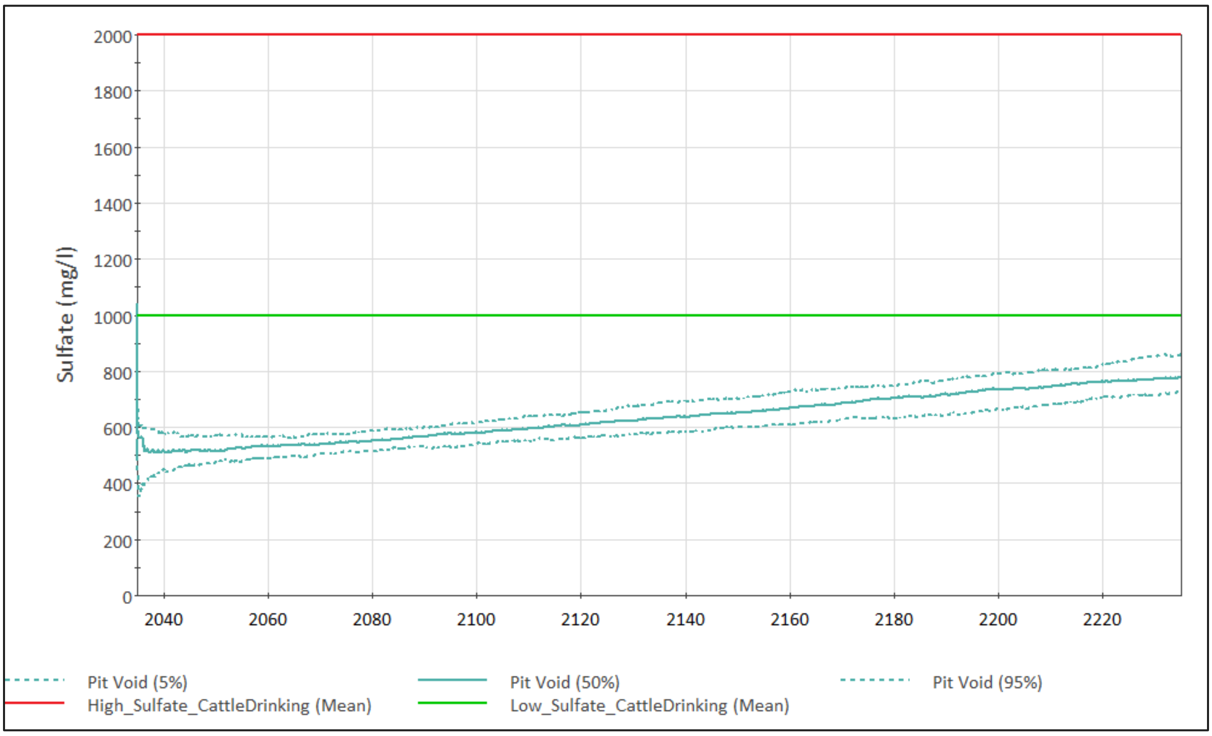


Figure E3: Pit Void Predicted Sulfate Concentration

Externally Draining Catchments

Discharge Volumes: The combined average discharge is expected to be around 1,485 m^3/d, contributing approximately 6% of the average Perry River flows directly downstream of the site.

Salinity and Sulfate: TDS concentrations in the discharge volume are expected to range between 119 and 1,334 mg/L, driven by the static defined source terms for the various land uses. An average concentration of around 277 mg/L is predicted (this is below the Perry River Water Quality Objective (WQO) of 600 mg/L). Sulfate concentrations in the discharge volumes are expected to range between 2.4 and 769 mg/L, driven by the static defined source terms for the various land uses. In reality, these source term concentrations will not be static, but will fluctuate with event size and over time, and will likely reduce as time progresses, as the sulphate and other salt loads within the soil reduce. An average concentration of around 103 mg/L is predicted (this is below the Perry River WQO of 250 mg/L). To ensure consistent compliance with the current Environmental Authorisation (EA) discharge limits and/or the Perry River WQO's, additional management and/or treatment of the runoff will be required prior to discharge.

Passive Treatment: The current proposed constructed wetland systems for these catchments should improve the water quality beyond the current predictions. Adding storage and a slow release to the system, would further assist in reducing the upper limits of the expected discharge concentrations.

Table of Contents

Tables

Figures

Acronyms and Abbreviations

AWBM	Australian Water Balance Model
BOM	Bureau of Meteorology
CCS	Consistent Climate Scenarios
DEM	Digital Elevation Model
EA	Environmental Authorisation
m AHD	meters above the Australian Height Datum
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MRO	Mt Rawdon Operations Pty Ltd
MRPH	Mt Rawdon Pumped Hydro
NAF	Non-Acid Forming
NWRD	North Waste Rock Dump
PAF	Potentially Acid Forming
PRCP	Progressive Rehabilitation and Closure Plan
PRD	Perry River Dam
RCP	Representative Concentration Pathways
SD	Sedimentation Dam
SLR	SLR Consulting Australia Pty Ltd
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
WBM	Water Balance Model
WMP	Water Management Plan
WQ	Water Quality
WQO	Water Quality Objective

1.0 Introduction

1.1 Background

Mt Rawdon Operations Pty Ltd (MRO) is wholly owned by Evolution Mining Limited (Evolution) and is currently preparing for the cessation of mining and processing activities at the site. Concurrent with these activities, studies are ongoing to support the approval of MRO being repurposed to a leading-edge low-cost pumped hydro facility as proposed in the Mt Rawdon Pumped Hydro project (MRPH).

SLR Consulting Australia Pty Ltd (SLR) have been engaged by Evolution to complete a Post-Closure Hydraulic Assessment. The core objective of this project is to review/update the existing site water studies and models to inform the development of a post mine closure Water Management Plan (WMP) for MRO that will accompany an updated Progressive Rehabilitation and Closure Plan (PRCP) submission.

The current studies do not consider any actions or activities related to the proposed MRPH and are limited to assuming the site will undergo conventional closure, surrendering of the Mining Lease and final relinquishment of the site.

1.2 Current Study Scope of Work

To inform and guide the Post-Closure WMP, the existing site water balance modelling needs to be reviewed and extended where necessary. This is necessary to understand the water related risks as the site moves through the closure phases as well as for long-term post-closure.

The phases and timelines listed in Table 1-1 present our current understanding of the operational stages to be modelled during the proposed progression through closure.

Table 1-1 Water Balance Modelling Phases

Phase	Description	Timeline
1	Fully operational	< Sept 2024
2	Mining complete, still processing	Sept 2024 – Oct 2025
3	Processing complete, initial rehab activities, C&M period	Nov 2025 – Jan 2030
4	Final rehab and closure activities	5 years consisting of • 2 years of bulk rehab activities, • 1 year for wetland construction and vegetation establishment; • 2-years of monitoring to confirm that the water quality is appropriate for discharge
5	Long-term post closure	Jan 2035 onward (model 200 years post-closure)

The key objective of the closure process is to ensure that the final landform is conducive to future potential land-uses and any negative outcomes or risks are mitigated as far as possible. Given this objective, it was decided that the Phase 5 model be developed as a starting point to assist in defining the final landform which will have the best long-term outcomes, considering both water quantity as well as quality. Once the preferred final landform has been chosen the steps to progress from the current state to the targeted future state can be defined.

1.3 Scope of Post-Closure Model

The Phase 5 model was developed to represent and be analysed to assess water related risks associated with the following:

- The water body expected to form/expand within the final pit void and its interaction with the environment (volumes and quality);
- The rehabilitated catchments and their interaction with the surface water environment (volumes and quality of discharges).

For the current study, the water quality modelling has been limited to Total Dissolved Solids (TDS) and sulfate and a mass balance approach has been applied. This does not account for any secondary chemical processes such as the precipitation of contaminants or any other iterative chemical reactions.

1.4 Methodology

The Water Balance Model (WBM) and the linked Salt Balance Model (SBM) were developed in the GoldSim modelling package (version 14.0), incorporating the Contaminant Transport (CT) module. GoldSim is a software program developed by the GoldSim Technology Group which can analyse complex time-dependent systems incorporating stochastic inputs and resulting in probabilistic outcome ranges. The primary stochastic input of the current modelling relates to the precipitation applied, as further detailed in Section 2.2.2.

2.0 Modelling Inputs and Assumptions

2.1 Pit Void Conceptual Model

A conceptual model of the pit void water balance flows is shown in Figure 2-1. The diagram shows the various potential water sources and losses that may contribute to the water balance, these are detailed further in Table 2-1.

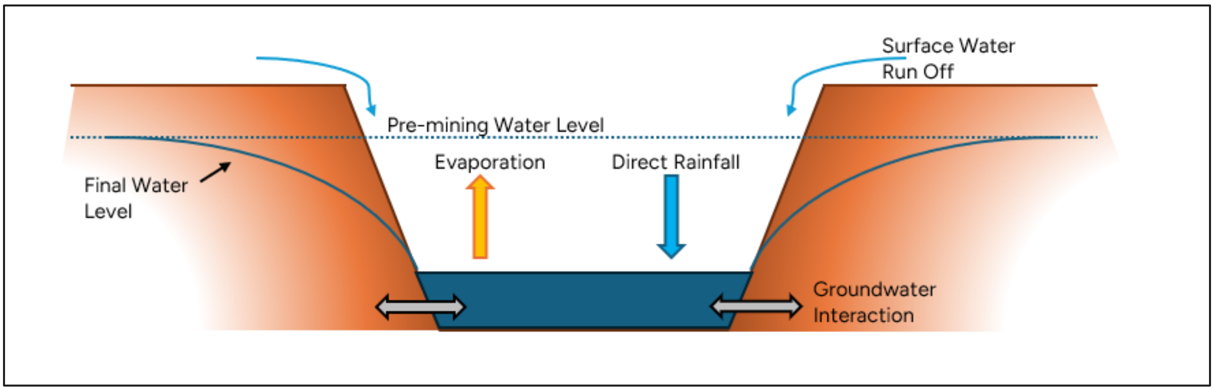


Figure 2-1 Simplified conceptual pit void water balance

Table 2-1 Methodology to estimate WBM flowrates

Inflows	Approach/Section	Outflows	Approach/Section
Direct rainfall	The water balance model tracks the volume of water in the pit void on each day simulated. The associated wetted surface areas are then determined using the stage-storage-area relationships estimated for the void. By applying the daily rainfall depth to this area, a daily inflow volume is determined.	Evaporation	Similar to the rainfall calculation, the daily evaporation rate (as discussed in **Section 2.2.3**), is applied to the surface area of the water body on a daily timestep basis.
Runoff	Runoff associated with rainfall events is calculated using the AWBM rainfall runoff module, as detailed in **Section 2.4**. Runoff volumes from the catchment surrounding the void is estimated based on the land-use (i.e., natural, rehabilitated or pit walls).	Groundwater outflows	An iterative approach was taken for the groundwater modelling. As the surrounding groundwater levels recover the relationship between void water level and groundwater flux rate will change. Thus, both elapsed time and void water level are taken into account to determine the groundwater ingress or outflow rates for each void. **Section 2.5.**
Groundwater inflow	An iterative approach was taken for the groundwater modelling. As the surrounding groundwater levels recover the relationship between void water level and groundwater flux rate will change. Thus, both elapsed	Overtopping	The available digital elevation model (DEM) of the site was used to identify the lowest invert level around the boundary of the pit void, i.e., the spill level. Once the water level in the void reaches this level the excess water is assumed to overtop and be lost from the system.

Inflows	Approach/Section	Outflows	Approach/Section
	time and void water level are taken into account to determine the groundwater ingress or outflow rates for each void. **Section 2.5.**		

2.2 Climate

2.2.1 Historic Records

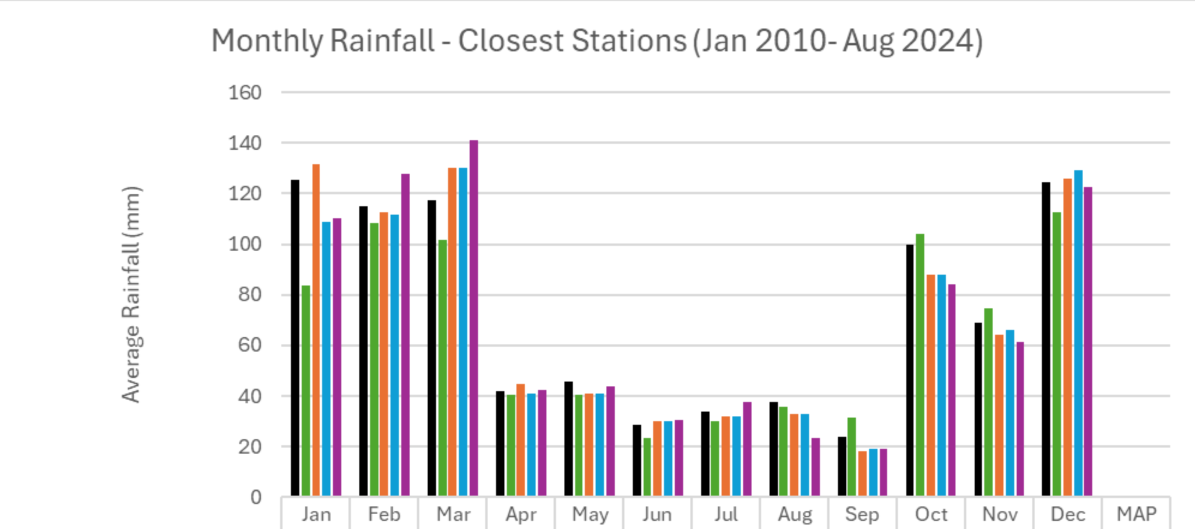
The rain gauges located closest to the site were identified and compared to the patched dataset associated with the site's coordinates as provided on the SILO Long Paddock platform (State of Queensland, 2024a). Data records were sourced for stations both from the SILO platform as well as the Bureau of Meteorology (BOM) platform (Commonwealth, 2024) and are listed along with their Metadata in Table 2-2.

Table 2-2 Closest Rain Gauges - Metadata

Source	Name	Number	Distance to Site	Data Record
SILO	Site Co-ordinate (Patched)	(-25.25; 151.75)	0 km	1889-2024
BOM	Mingo Creek	39340	7 km	2000-2024
SILO	Mount Perry (Patched)	39070	16 km	1890-2024
BOM	Mount Perry	39070	16 km	1887 - 2024
BOM	Dingle Dell	39256	19 km	1973 - 2024

Preference is given to records from an actual rain gauge, above those from an artificial co-ordinate/point dataset, as generated by SILO. The SILO co-ordinate dataset considers records from all the closest stations and applies an appropriate influence scaled based on the distance to the station. To define monthly and annual averages this is effective, however it is not always appropriate when using the data at a daily timestep. The frequency and duration of localized storm events could potentially be skewed within the artificial record. If an adequate record is available from an actual rain gauge which is not too far from the site, but still fits the artificial local record, then this record takes preference.

To confirm that the Mount Perry (SILO) dataset is suitable and representative of the site, the records were compared on a monthly average and cumulative basis over the time period 2010-2024, as indicated in Figure 2-2 and Figure 2-3 respectively.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAP
Co-Ordinate Data (Silo)	125	115	118	42	46	29	34	38	24	100	69	124	864
Mingo Creek (BOM)	84	108	102	40	41	23	30	36	32	104	75	113	787
Mount Perry (Silo)	132	112	130	45	41	30	32	33	18	88	64	126	851
Mount Perry (BOM)	109	112	130	41	41	30	32	33	19	88	66	129	829
Dingle Dell (BOM)	110	128	141	42	44	30	37	23	19	84	61	123	844

Figure 2-2 Monthly average rainfall comparison (2010-2024)

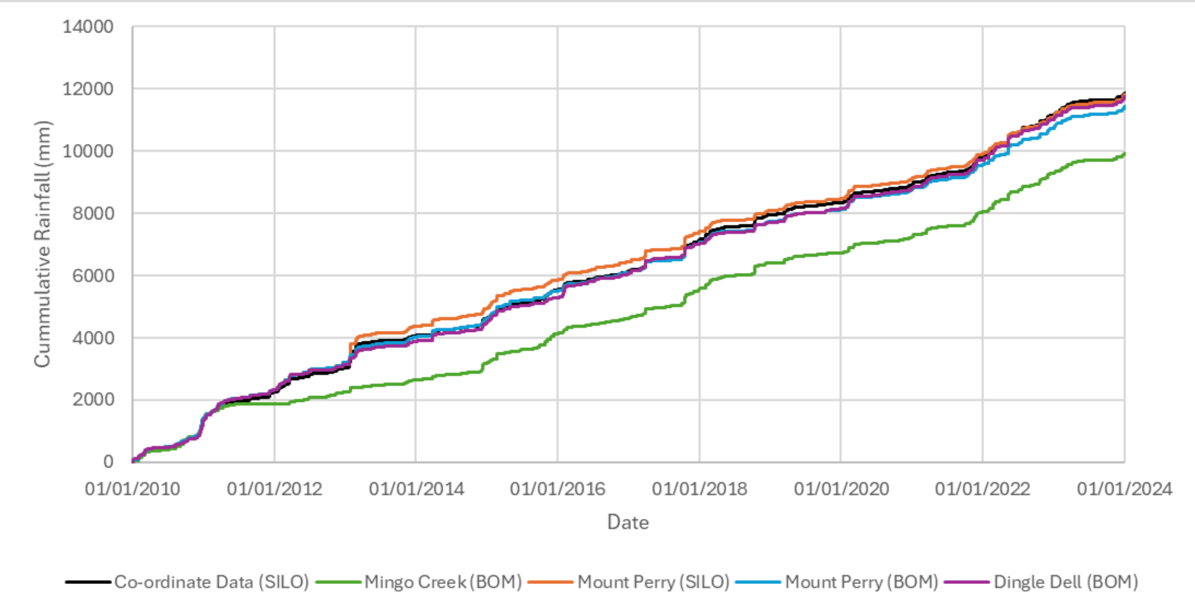


Figure 2-3 Cumulative rainfall comparison (2010-2024)

The comparison indicates that only the Mingo Creek dataset differs significantly from the rest, and the divergence is primarily due to missing data between January and March in 2012 and 2013, where very high rainfall depths were recorded at the other stations.

The Mount Perry (SILO) dataset was thus deemed representative of the local climate and selected as the preferred record to be used to inform the Post-Closure WBM. A 100-year daily rainfall record was sourced (1923-2023) and the monthly averages and mean annual precipitation (MAP) over this period is indicated in Figure 2-4.

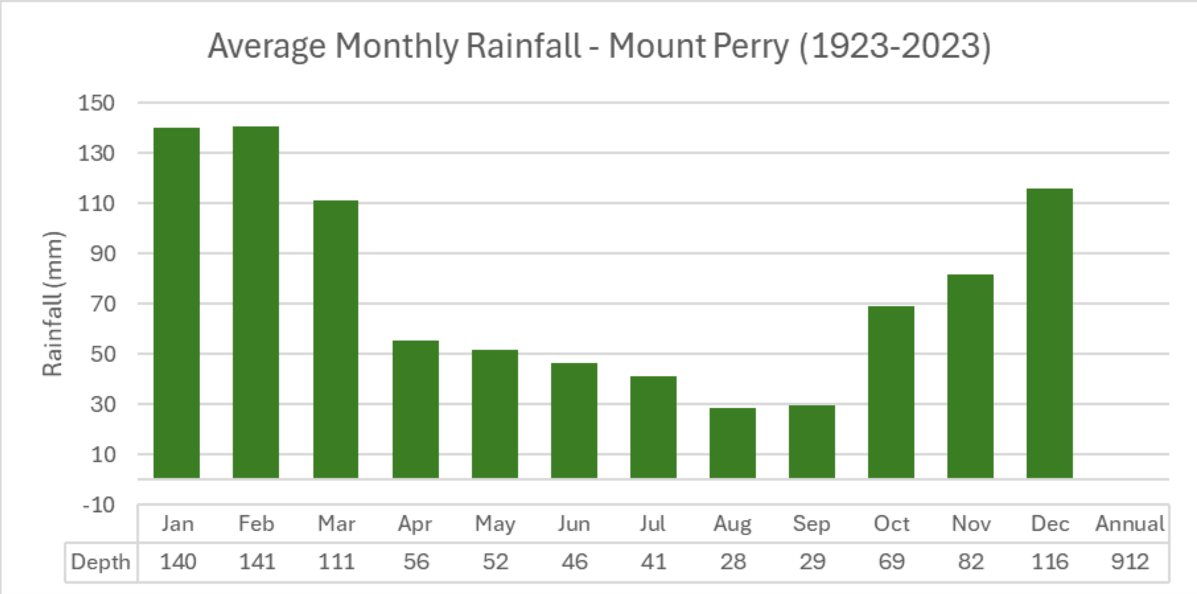


Figure 2-4 Average monthly rainfall data

2.2.2 Probabilistic Rainfall Analysis

Probabilistic climate data for the WBM was generated using the SILO rainfall data (Mount Perry gauge) and the Stochastic Climate Library program (eWater CRC).

The purpose of the probabilistic rainfall generation is to develop multiple climate sequences based on the recorded rainfall data of the area. These sequences have the same statistical characteristics as the historical data set for a range of parameters, including mean, variance, skew, and number of wet days or dry days. Each sequence has an order in which the rainfall has occurred. For example, one sequence may have wetter years at the start of the sequence, where another sequence may have the wetter years towards the end of the sequence. Some sequences may be wetter or dryer than others to account for the variability of the climate which may occur after the mine is rehabilitated. The probabilistic rainfall data replicates the seasonality of the rainfall data.

Probabilistic rainfall data was produced for 100 replicates of 200-year rainfall data (20,000 years of probabilistic data). This allows a wide range of climatic conditions to be simulated, which then provides the mean and median of the assessment. The assessment also yields percentiles which are interpreted as a percentage exceedance probability (i.e., the risk of an event occurring).

The outputs of the stochastically generated rainfall were compared to the historically recorded rainfall data as shown in Figure 2-5 for the full rainfall record.

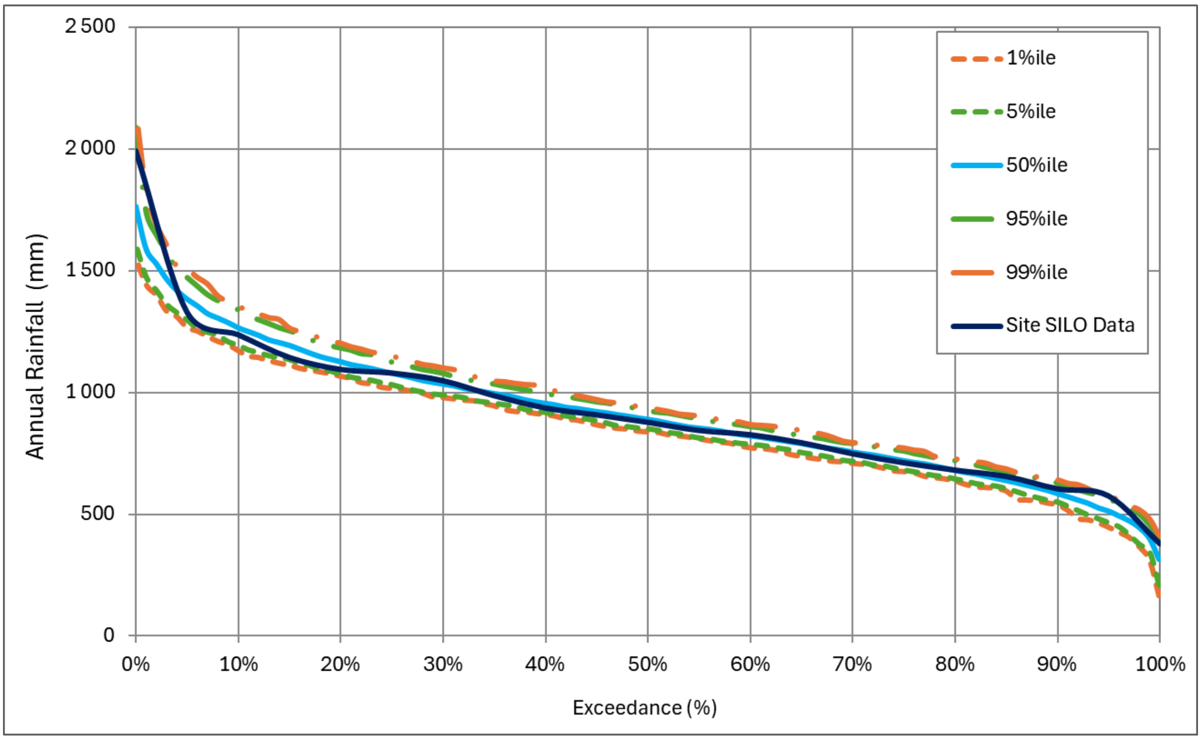


Figure 2-5 Stochastic and historical data comparison – Annual rainfall

The comparison shows a good correlation for typical rainfall conditions through most of the records, i.e., >95%. The probabilistic data representing extreme events >5% includes representation of outlier years similar to those in the historical record but with less frequency.

Given that the purpose of this assessment is to develop an understanding of the long-term average discharge rates and pit void water levels and qualities, which are primarily driven by averages and partially by seasonal or multi-year variances rather than outlier years, the stochastic representative dataset is deemed acceptable. Annual rainfall depths equivalent to and exceeding the wettest year on record (1,994 mm in 1956) are still represented in the stochastic datasets and thus any spills which could have been predicted as a result of a single outlier wet year (such as that historically recorded) will be observed in the modelling results. The results presented in Section 3.0 thus not only reflect the median expected outcomes but also consider the predicted spill probabilities, water levels and water quality under the full range of climatic conditions.

2.2.3 Evaporation Rates

Evaporation rates are generally measured using evaporation pans. Pan evaporation is expected to be higher than open water rates, as the temperatures of smaller water bodies fluctuate more readily. Thus, the measured rates need to be adjusted by applying an appropriate pan-factor to estimate the corresponding open water evaporation rates. The current Operational WBM (ATC, 2024) which has been calibrated by tracking pump rates and water levels in storage facilities, assumes evaporation rates equivalent to the Morton's shallow water lake evaporation (M_{Lake}) rates for the area. This is approximately 90% of the pan evaporation rates.

Given the Australian Water Balance Model (AWBM) parameters, that are being applied in the residual void WBM, have been determined through calibration of the operational model, it would subsequently be appropriate to also use the operational model's evaporation rates. The monthly average open water evaporation rates and mean annual evaporation (MAE) are presented in Figure 2-6.

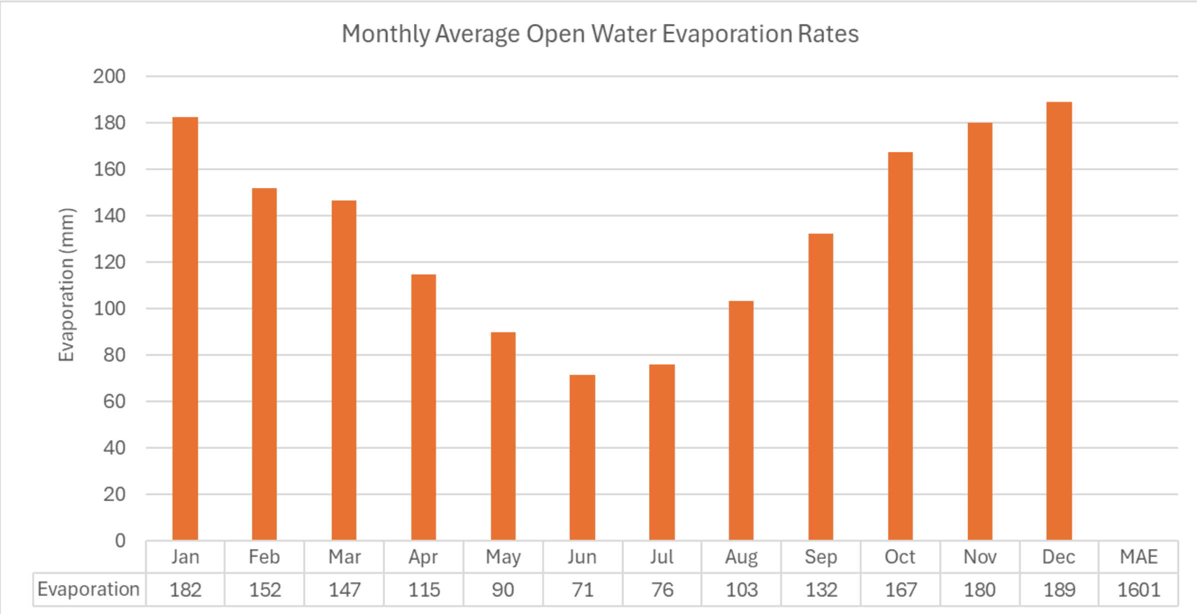


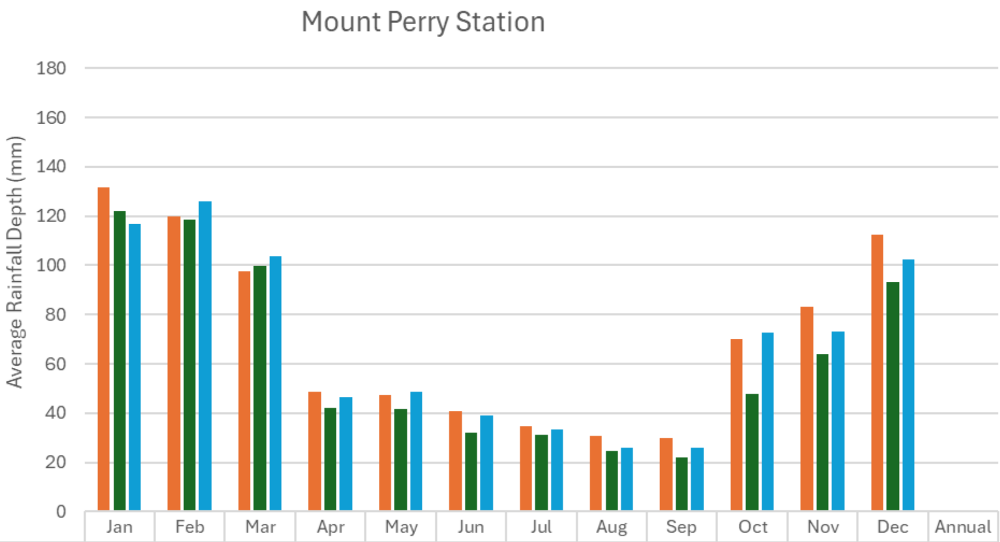
Figure 2-6 Monthly average open water evaporation rates

2.2.4 Climate Change Data

The Biophysical Modelling Consistent Climate Scenarios (CCS) Tool (State of Queensland, 2024b) was used to obtain daily rainfall sequences accounting for expected climate change. The Climate – EIS Information Guideline (DESI, 2024) advises that the potential change in climate at a project site be assessed, and that a conservative approach should be taken, by assuming the worst-case scenario for climate change projection at the site. Thus, the climate data sourced from the CCS Tool was based on the following emissions scenario and climate models:

- Projection year 2070
- RCP 8.5 (Worst case emissions scenario)
- 2 Different composite models:
    - HP: High Global warming and a warm Pacific Ocean
    - WI: Smaller global warming and a warm Indian Ocean

The sourced climate change rainfall sequences were compared to the base case (Mount Perry (SILO)) sequence as shown in Figure 2-7 and Figure 2-8, on a monthly and annual basis respectively.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Base Case (2070-2234)	132	120	98	49	47	41	35	31	30	70	83	112	847
RCP 8.5 HP (2070-2234)	122	118	100	42	42	32	31	24	22	48	64	93	738
RCP 8.5 WI (2070-2234)	117	126	104	46	49	39	33	26	26	73	73	103	814

Figure 2-7 Monthly average rainfall – Base case vs climate change scenarios

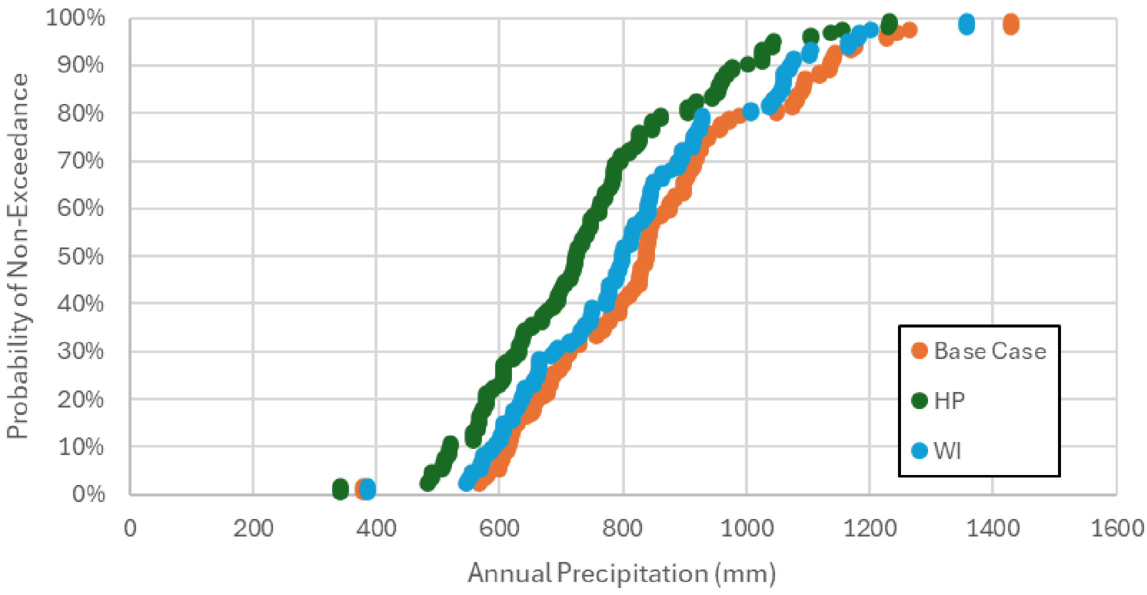
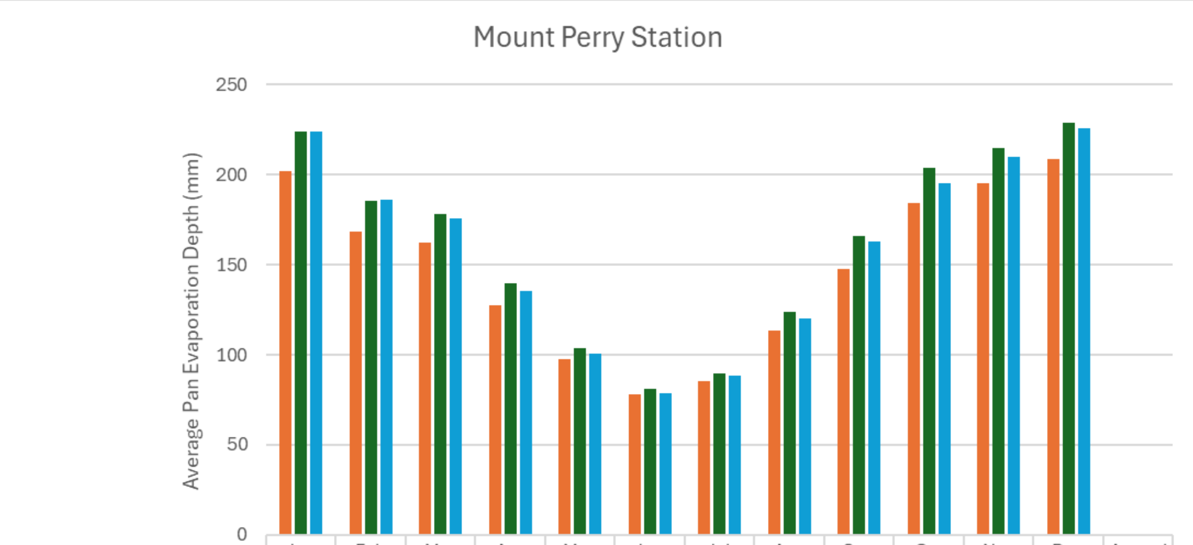


Figure 2-8 Annual rainfall probability of non-exceedance – Base case vs climate change

The comparison with the HP model outcomes shows a decrease in expected precipitation throughout the year, except for March, which indicated a slight increase. The monthly average changes associated with the WI composite model are less pronounced and fluctuate more throughout the year. The annual total precipitation depths associated with both composite models indicate an expected decrease.

Evaporation rates are expected to increase throughout the year for both of the composite models considered, with the MAE increasing by approximately 10%, as indicated in Figure 2-9. These increases are expected to be driven by the increase in ambient temperatures predicted for the region.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Base Case (2070-2234)	202	168	162	127	97	78	85	113	148	184	195	209	1770
RCP 8.5 HP (2070-2234)	224	185	178	139	104	81	90	124	166	204	215	229	1939
RCP 8.5 WI (2070-2234)	224	186	176	135	100	79	89	120	163	195	210	226	1903

Figure 2-9 Monthly average evaporation – Base case vs climate change scenarios

2.3 Landform and Characteristics

2.3.1 Pit Void

A digital elevation model (DEM) was created using LiDAR survey data from June 2024, as shown in Figure 2-10. Shortly after this survey was conducted a pit slope failure occurred and the mining operations within the pit ceased. There is currently no intention to conduct any further mining/excavation within the pit.

A more recent geometry dataset was provided by MRO, which is representative of the pit post-failure (Deswik, 2024). This survey was limited to levels below 15.7 m AHD and thus the two datasets were merged to generate representative data for the entire pit. The stage-storage data is presented in Figure 2-11. As no further mining is planned, this geometry is expected to be applicable to the post-closure conditions and has been used in the Post-Closure WBM to predict runoff, rainfall and evaporation volumes associated with the pit void and water body over time.

Using this data the lowest elevation on the pit's crest was determined (122.2m AHD), which has been defined as the spill level for the pit void. The geometric data below this level was further analysed to determine the required geometric relationships for the pit.

Key outcomes of the analysis are:

- Pit void spill level = 122.2m AHD
- Max water surface (at spill level) = 51.3 ha
- Storage between -184.0m AHD (lowest point per survey) and spill level = 62,374 ML

There is a possibility that further slope failures may occur within the pit during the closure phase or following closure. These geometric changes may have a slight impact on the long-term water levels and water quality, however, given the catchment area is expected to remain constant, and the exposed water surface should not change significantly, the impacts on the WBM outcomes are expected to be minor.

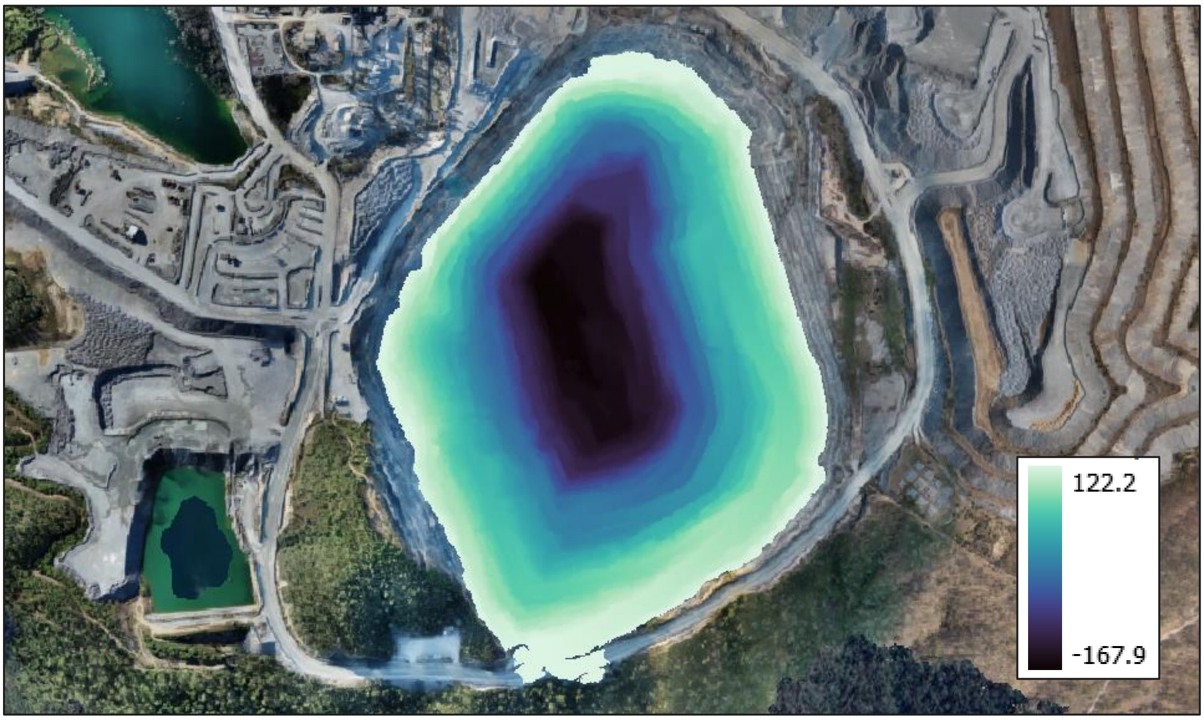


Figure 2-10 Pit DEM (June 2024)

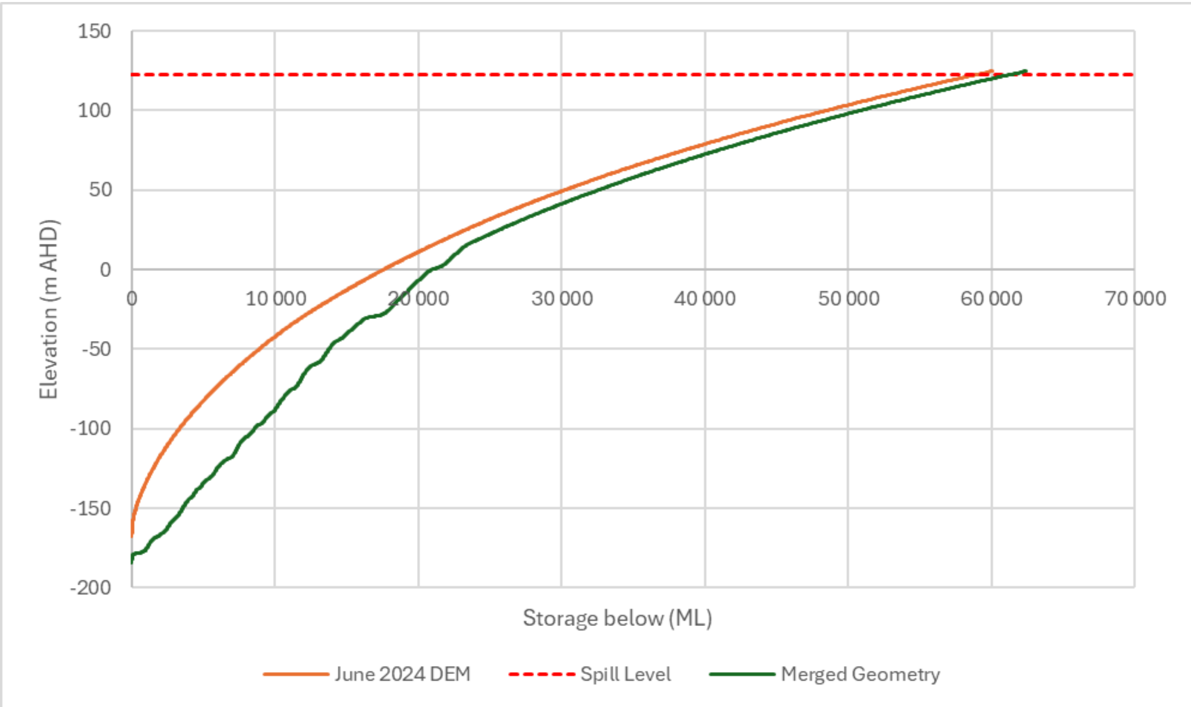


Figure 2-11 Pit Void Stage-Storage Relationship

The current plan is to fully dewater the pit prior to closure and thus the starting volume within the WBM has been set to 0 ML.

2.3.2 Surface Catchments

The final landform catchments have been delineated for the site based on the current landform and the information presently available for the proposed final grading of the site. The modelling assumes that all site dams will be decommissioned at closure. This approach is being reviewed, however for the purposes of the post-closure WBM, the extent of the modelling ends with the calculation of the runoff volumes generated from the catchment.

The catchments' landuse types consist primarily of rehabilitated surfaces and some expected access road areas. The "Natural Sparse" hydrologic parameters have been assumed for the long-term rehabilitated surfaces, as this is a more conservative approach (generating higher runoff rates) compared with Natural Dense, which the landscape will likely return to after 10+ years of natural vegetation growth.

Details of the delineated catchments are provided in Table 4.3, and the catchments are shown in Figure 4.3.

Table 2-3 Catchment Areas

	Area (ha)						
	TSF	Pit	South Dam / West Dam	SD1 / SD3	NWRD North	NWRD South	Perry River Dam (PRD)
Hardstand/Road	2.59	5.5	7.4	3.4	0	0	0
Natural Dense	0	0	0	0	0	0	9,275
Natural Sparse	147.85	28.6	91.35	57.1	40.4	71.6	0
Open Cut	0	65.4	0	0	0	0	0

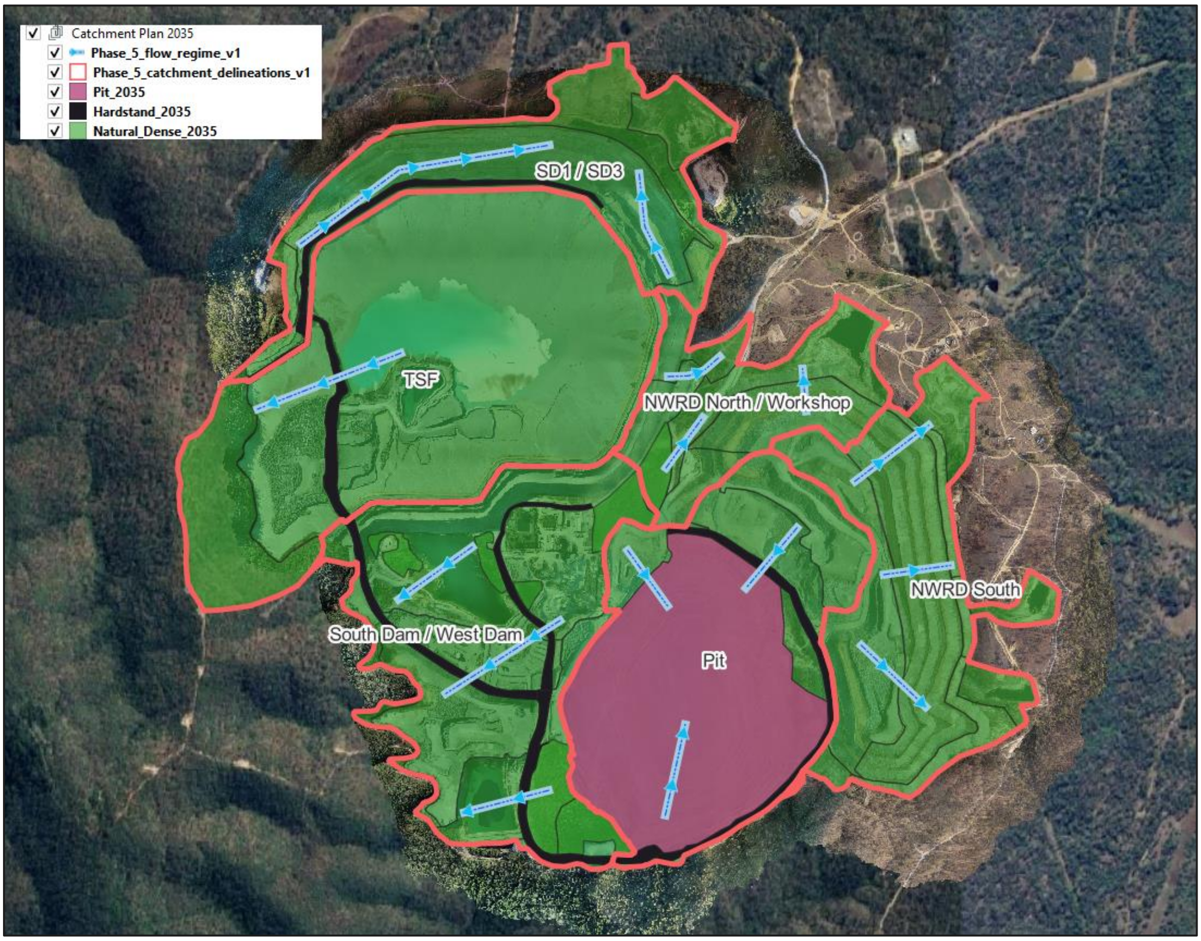


Figure 2-12 Surface Water Catchments

Following the initial model runs, an optimization study was done to improve the predicted long-term water quality outcomes for the pit void water body, see Section 2.7. The study concluded that expanding the catchment area draining inwards to the pit, is likely to provide significant beneficial outcomes on the water quality, while it was still possible to ensure that the pit void remains a terminal sink for the local groundwater. Subsequently, it was recommended that the external catchment of 28.6 ha of rehabilitated surfaces be increased to around 100 ha. At the date of this report, these proposed drainage changes have not been investigated further to confirm the feasibility thereof.

2.4 Surface Water Runoff

The WBM uses the AWBM rainfall runoff module to estimate the runoff depths for each catchment. There are three AWBM modules in the Phase 5 WBM representing the runoff response for the following land use types:

- Natural Sparse (Which includes the rehabilitated surfaces over the long-term modelling),
- Open Cut, and
- Hardstand/Roads.

The rainfall is converted to runoff using the AWBM, as illustrated in Figure 2-13. This runoff can be split into two forms:

- Surface runoff which travels overland to the destination, or
- Sub-surface which travels through the ground to reach the destination.

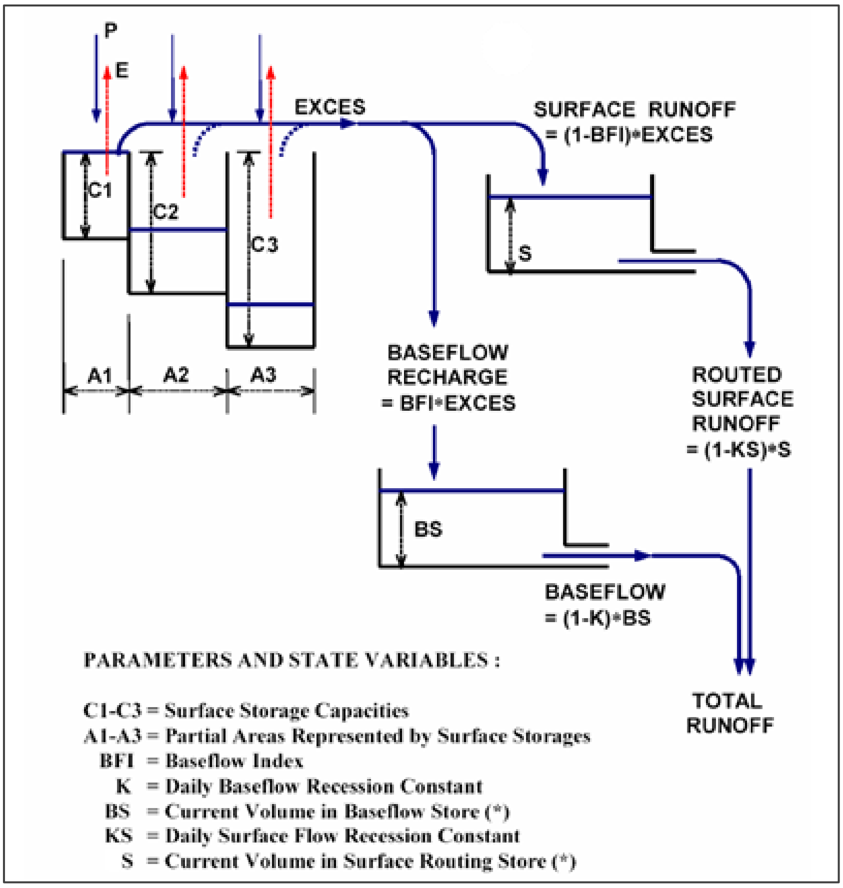


Figure 2-13 AWBM rainfall runoff model

The AWBM parameters which were adopted, based on the most recent calibrated operational model values (ATCW, 2024), are presented in Table 2-4.

Table 2-4 Adopted AWBM parameters

Parameter	Abbreviation	Land use		
		Natural Sparse	Open Cut	Hardstand/Roads
Small storage capacity (mm)	C1	20	5	5
Medium storage capacity (mm)	C2	120	20	0
Large storage capacity (mm)	C3	200	0	0
Small partial area portion	A1	13.3	10	100
Medium partial area portion	A2	43.3	90	0
Large partial area portion	A3	43.4	0	0
Daily streamflow recession	K_s	0.1	0	0
Baseflow Index (%)	BFI	10	5	0
Baseflow recession	K_b	0.95	1	1

2.5 Groundwater Interaction

Groundwater inflows or outflows to/from the pit void were derived from the groundwater model developed specifically for the current post-closure water management planning (SLR, 2025).

An iterative approach was followed to estimate the future groundwater-void flux rates, as the void fills, and the groundwater levels recover:

- The WBM was initially run with zero groundwater interaction, given the current observations at the site which indicate minimal ingress to the pit void.
- It was found that after 200 years, the void water level had not reached equilibrium yet and the climatic sequences were therefor looped once to generate 400-year records. The new results indicated a quasi-equilibrium state after 400 years. It should be noted that the bounds of uncertainty increase with time, and thus the uncertainty associated with the predicted levels over 400 years is much higher than over a 100 or 200-year timeframe. For this reason, the water quality modelling was limited to a 200-year period, see Section 3.3.3.
- The predicted void water levels over time were then used as input for the groundwater model and the predicted flux rates over time were generated.
- The resultant groundwater flux rate timeseries datasets where then included in the WBM, accounting for both the predicted net inflow and outflow rates over the 400-year simulation period, and new pit water levels were generated.
- These steps were repeated until the two datasets converged to a single set of void levels and corresponding flux rates.

Given the potential implication on the predicted salinity within the void waterbodies, the flux rates were split into two timeseries datasets - inflow rates and outflow rates – to enable the WBM to accurately represent these fluxes and the associated salt migration.

The predicted in and out flux rates associated with the pit void over a 400 year period are indicated in Figure 2-14. The pit void is expected to remain a terminal sink when steady state conditions are reached.

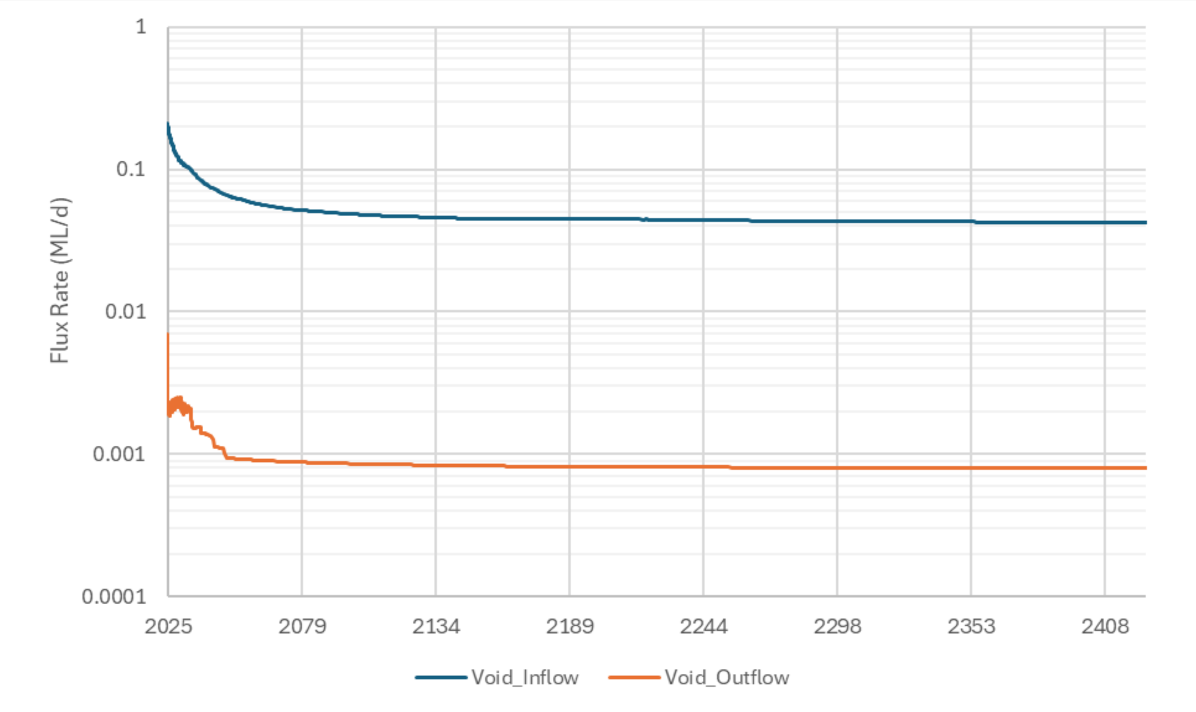


Figure 2-14 Groundwater flux rates

Further information relating to the derived groundwater flux rates can be found in the MRO Post-Closure Groundwater Modelling report (SLR, 2025).

Note: Following evaluation of the initial model outcomes and further optimization of the proposed final landform and drainage (see Section 2.7), the following changes were recommended:

- Dewater the pit void during closure, to ensure there is not a large body of saline water to start with.
- Increase the catchment draining inward to the pit void to improve the long-term water quality within the pit.

These changes were recommended after the completion of the groundwater modelling and have thus not been incorporated in the groundwater model. Given the relatively small volumes of groundwater expected to seep into the pit post-closure, the impacts of these proposed changes on the groundwater flux rates and subsequently the WBM and SBM outcomes are expected to be negligible.

2.6 Water Quality

The WBM includes a linked high-level salt balance model (SBM) to track both the quantity and quality of water on site. The SBM tracks the salinity (total dissolved solids (TDS) in mg/L) as well as the sulfate concentrations for all the site water sources and mixing locations and subsequently the effects from evaporation and any releases.

For the purposes of this assessment, TDS and sulfate have been used as indicator elements. Although all critical analytes have not been assessed within this report, the approach provides an indication of the rate of change of concentration which could apply to other contaminants of concern based on the range of modelled scenarios.

Each land use type was represented by specific source term TDS and sulfate values. These values were then applied to the runoff from each land use type. In addition to this, the groundwater inflow to the pit void had specified water quality characteristics. The water quality loading parameters adopted in this study were primarily informed by:

- the values developed by RGS for the Mine Material Management Plan and accompanying WBM (RGS, 2022); and
- pit sump water quality monitoring data 2004 – 2023.

Adopted water quality source term parameters are indicated in Table 2-5.

Table 2-5 Water Quality Source Terms

Source	TDS (mg/L)		Sulfate (mg/L)		Data Source
	Avg	95th	Avg	95th	
Runoff: Rehabilitated areas (Improves to Natural conditions after 10 years)	309	309	146	146	RGS (NWRD post-closure surface)
Runoff: Natural	119	192	2.4	3.4	RGS
Runoff: Pit Walls and Hardstand	1,334	2,430	769	1,213	RGS
Groundwater ingress	2,659	5,366	678	2,035	RGS
Rainwater	17	18	2	3.8	RGS

In reality, the source term concentrations will not be static, but will fluctuate with event size and over time, and will likely reduce as time progresses, as the sulphate and other salt loads within the soils and on the surfaces reduce.

The ANZECC & ARMCANZ (2000) Water Quality Guidelines for livestock drinking water quality recommends up to 5,000 mg/L TDS for beef cattle. The guideline suggests that animals may experience an initial reluctance to drink or there may be some scouring, with such salinity levels, but the animals should adapt without loss of production. Water with salinity levels between 5,000 and 10,000 mg/L TDS may lead to a loss of production for beef cattle, and a decline in animal condition and health may be expected. Beef cattle may tolerate these levels for short periods if introduced gradually.

To evaluate the salinity modelling outcomes associated with the pit void water body, three risk categories were defined:

- Low: TDS < 5,000 mg/L (cattle drinking - no loss of production)
- Medium: TDS > 5,000 and < 10,000 mg/L (cattle drinking - some loss of production)
- High: TDS > 10,000 mg/L (Not expected to support cattle drinking).

To evaluate the sulfate modelling outcomes associated with the pit void water body, three risk categories were defined based on the ANZECC & ARMCANZ (2000) Water Quality Guidelines:

- Low: < 1,000 mg/L (cattle drinking – only temporary effects and may cease once stock become accustomed to the water)
- Medium: > 1,000 and < 2,000 mg/L (cattle drinking – adverse effects may occur, especially in young or lactating animals or in dry, hot weather when water intake is high. These effects may be temporary and may cease once stock become accustomed to the water)

- High: > 2,000 mg/L (cattle drinking – may cause chronic or acute effects).

These risk classifications have been applied in Section 3.3.3.

Draft Livestock drinking water guidelines were published in November 2023 (ANZG, 2023). These guidelines align with the 2000 ANZECC & ARMCANZ guidelines for TDS, however they differ for sulfate. When the proposed new guidelines are finalised, the risk classifications should be reviewed.

The current Environmental Authorisation (EA) (EPML00712113, 15 April 2024) specifies the following limits:

- TDS
  - Release Limit: 1,000 mg/L
  - Perry River Water quality Objective (WQO): 600 mg/L
- Sulfate
  - Release Limit: 100 mg/L
  - Perry River Water quality Objective (WQO): 250 mg/L

Although the applied risk categories within the WBM analysis for the long-term pit void water quality are driven by the Water Quality Guidelines, the EA limits should be considered the target to inform and guide the long-term rehabilitation and closure measures, specifically for the catchments that will discharge to the surrounding environment.

2.7 Void Water Body Optimization Study

Initial WBM and SBM results, using the original 28.6 ha external catchment (as indicated in Section 2.3.2) showed unfavourable sulfate concentrations within the pit void over the mid to long-term (within the first 200 years), see Figure 2-15. The model results indicated that within a 400-year time period the pit water level will likely reach equilibrium (± 45m AHD), below the expected long-term local groundwater levels (± 80m AHD), thus resulting in a terminal sink, see Figure 2-16.

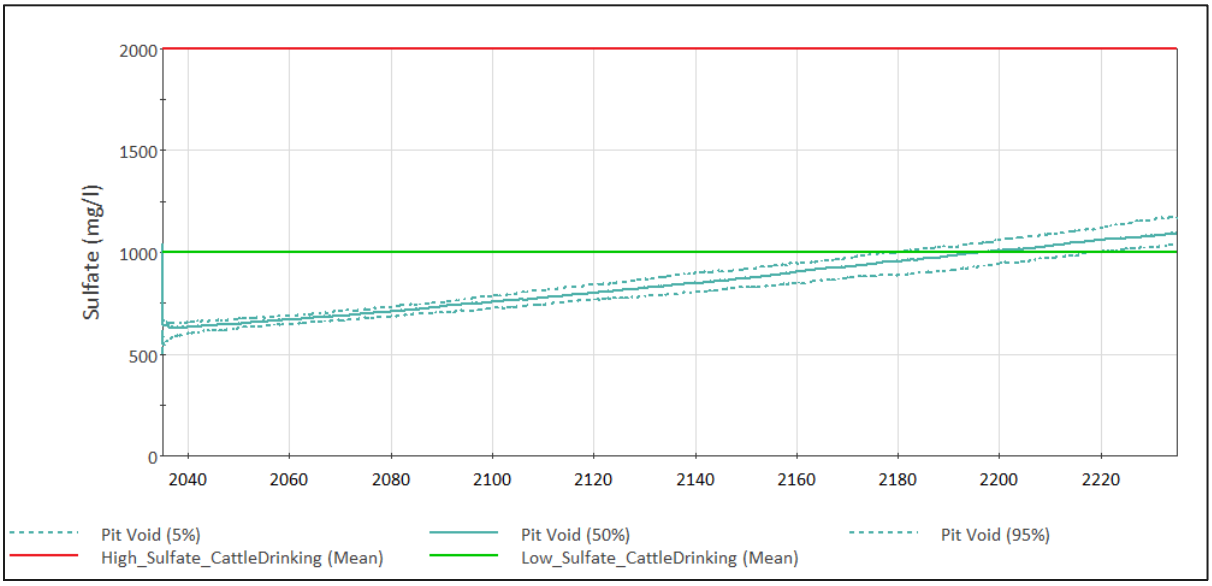


Figure 2-15 Pit Void Predicted Sulfate Concentration (External Catchment = 28.6 ha)

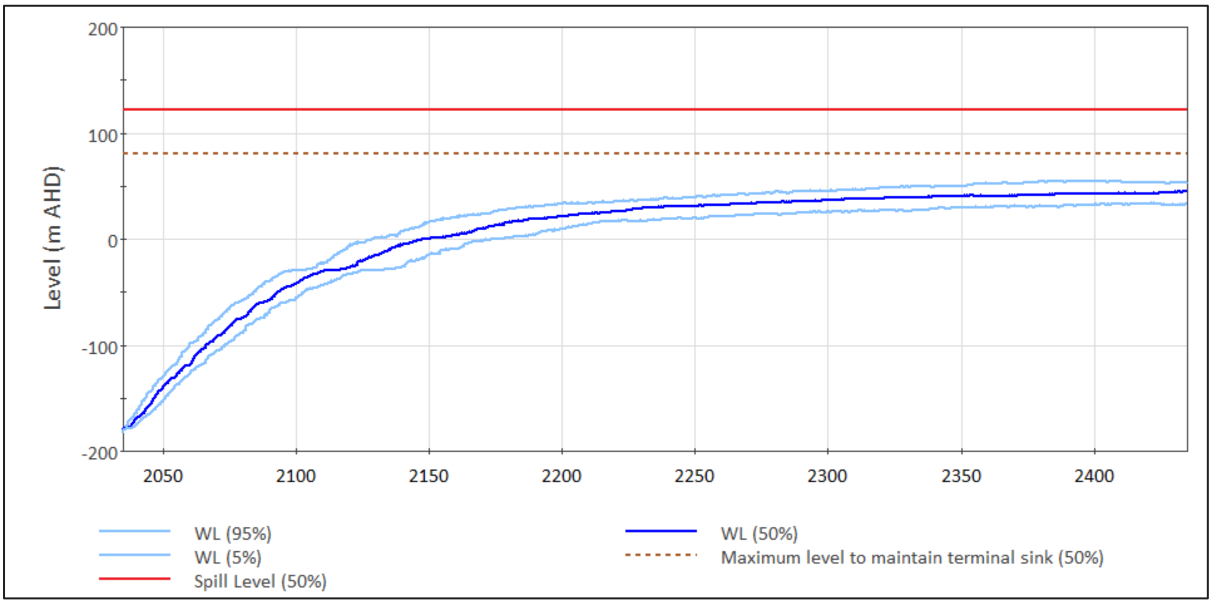


Figure 2-16 Pit Void Predicted Water Levels (External Catchment = 28.6 ha)

An opportunity was identified to improve the long-term water quality in the pit void by increasing the rehabilitated area draining inwards to the pit and thus freshening this water body. However, the focus would be to ensure that the pit void remains a sink for local groundwater.

A simplistic scenario analysis was done comparing the predicted outcomes for the base case external catchment (28.6 ha), to 50 ha and 100 ha arrangements. The results were compared over a 200-year post-closure timeframe, as shown in Figure 2-17, Figure 2-18 and Figure 2-19.

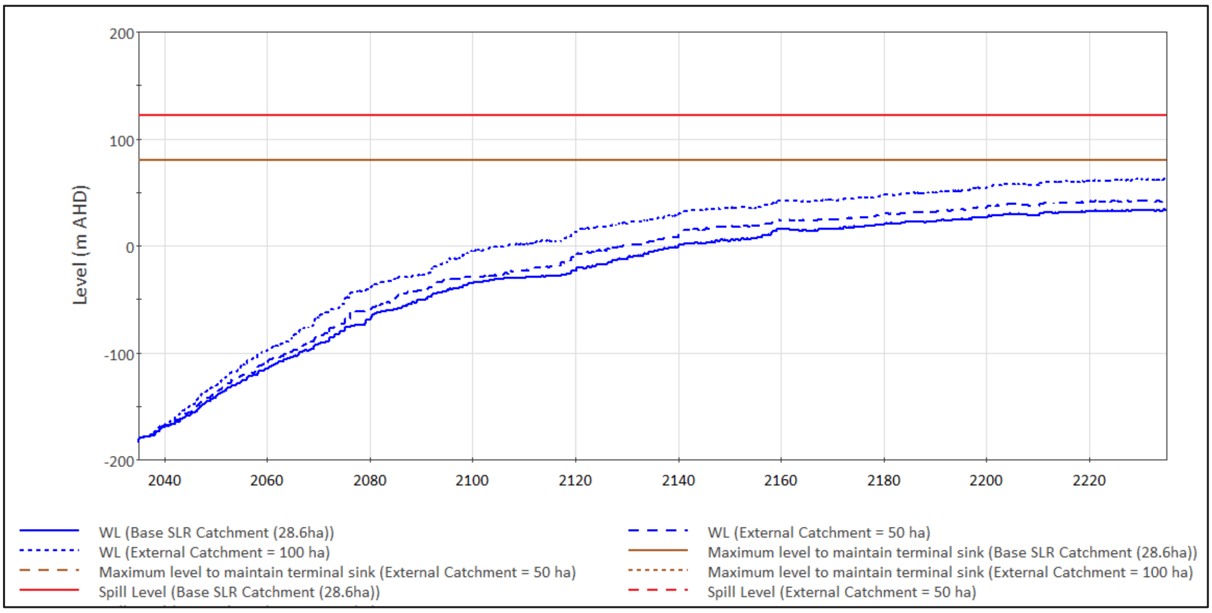


Figure 2-17 Pit Void Predicted Water Levels (Scenario Analysis)

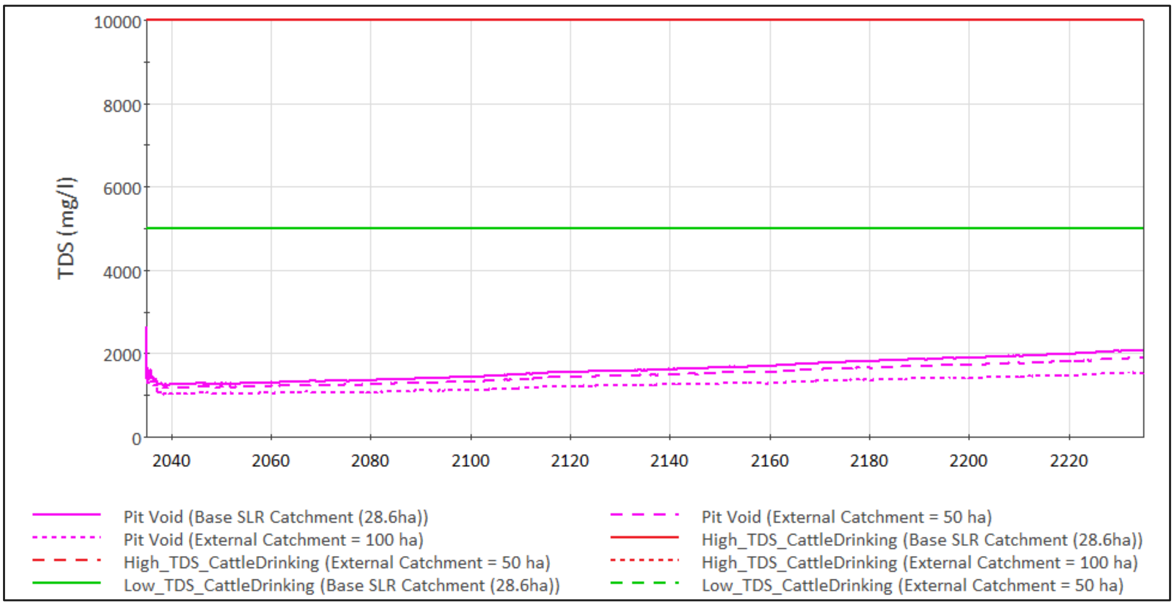


Figure 2-18 Pit Void Predicted Salinity (TDS) (Scenario Analysis)

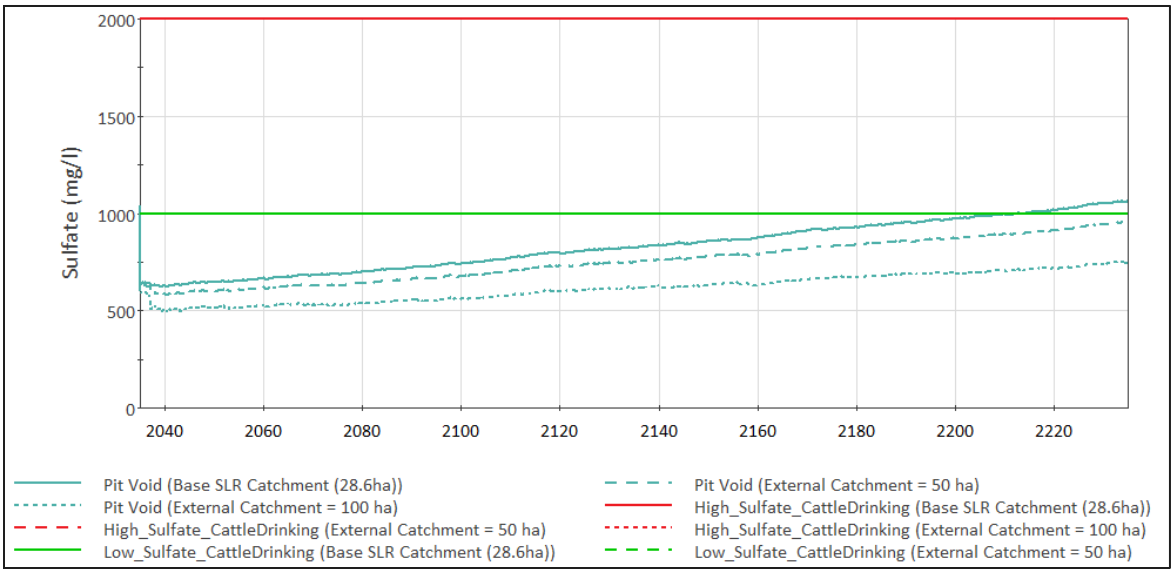


Figure 2-19 Pit Void Predicted Sulfate Concentration (Scenario Analysis)

The predicted water levels for the 100-ha catchment scenario start nearing the local predicted long-term groundwater levels, with the possibility of switching the waterbody from a sink to a source. The water quality predictions however improve significantly, with the sulfate concentrations remaining in the low-risk category over the entire modelled period.

A 200-year modelling timeframe remains extensive and any inaccuracies in the underlying assumptions will be compounded over time. It is recommended that the more favourable arrangement based on the short to mid-term results be pursued, i.e. extending the external rehabilitated catchment draining to the pit to around 100 ha. However, as monitoring data becomes available post-closure, the groundwater and water balance models should be revised and re-calibrated to re-evaluate the possibility of switching to a groundwater source in the future. Allowance should be made within the current closure drainage planning that, if needed, the catchment draining inwards can be reduced at a later stage with minimal earthworks requirements.

At the date of this report, these proposed drainage changes have not been investigated further to confirm the feasibility thereof.

3.0 Results

3.1 Site Water Balance

The system response was simulated over a period of 400 years (starting on 1 Jan 2035) and with 100 different sequences of daily rainfall. This approach allows us to estimate the full probable range of results when considering future volumes and water quality within the pit void and the catchments, assuming static climate conditions (i.e., with no inherent trend in the climate data as associated with climate change scenarios).

The results presented and assessed in this report have been limited to a 200-year post-closure timeframe. Although the groundwater interaction has not reached equilibrium at this stage, the robustness of the data underlying the model is deemed insufficient to support a longer model run. During and directly after closure, monitoring data should be collected and used to calibrate and validate the data to improve confidence in the long-term predictions.

The results presented for the pit void water body were generated following the optimization study (Section 2.7), thus already incorporating the recommended final landform and drainage changes:

- Dewater the pit void during closure, to ensure there is not a large body of saline water to start with.
- Increase the catchment draining inward to the pit void to improve the long-term water quality within the pit.

The predicted post-closure water balance (average flowrates over the simulated period) is shown in Figure 3-1.

For the pit void, the source volumes indicate that the predicted runoff volumes are approximately 50% more than the direct rainfall, with a small groundwater contribution. This is balanced by the expected evaporation from the pit lake water surface as well as the increasing volume in storage.

For the remaining catchments, the largest contributor in runoff flows is the TSF catchment, given that this catchment also has the largest surface area. Comparing the expected volumes that will be generated by the rehabilitated catchments to the flows generated by the Perry River catchment upstream of the site, the ratio is approximately 1:15 (or 6% of the total volume).

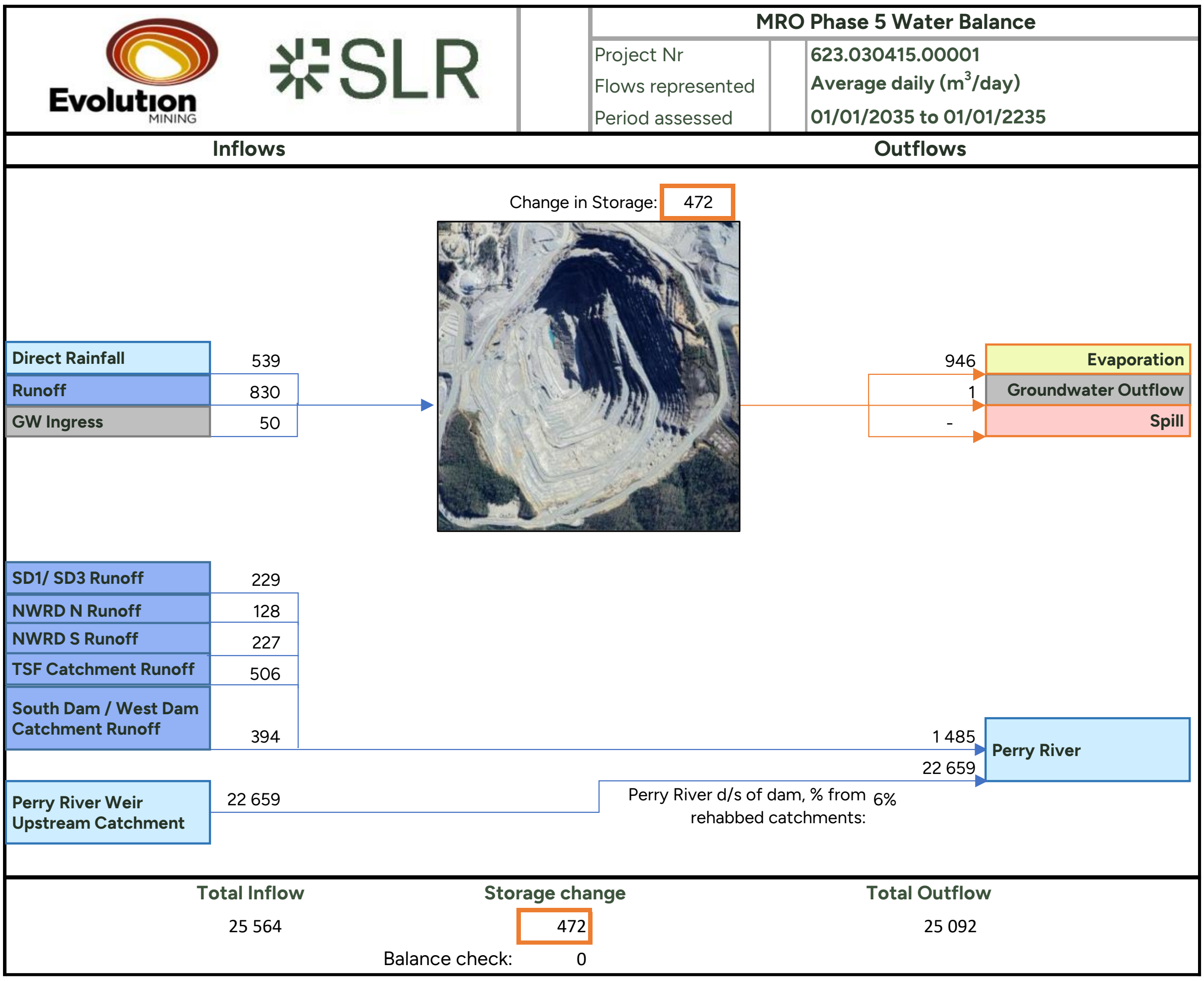


Figure 3-1 Post-Closure Water Balance

3.2 Salt Balance

The predicted post-closure water balance (average salt (TDS) load transfer rate over the simulated period) is shown in Figure 3-2.

The results indicate that the predicted average concentration of the runoff volumes entering the pit void is approximately 745 mg/L. The average TDS concentration associated with runoff from the rehabilitated catchments draining externally is much less, with every one of the catchments' average runoff concentrations less than the Perry River WQO for TDS of 600 mg/L. The variation in average concentration from these catchments is driven by the fractional portion of hardstand/roads expected to remain within the catchments.

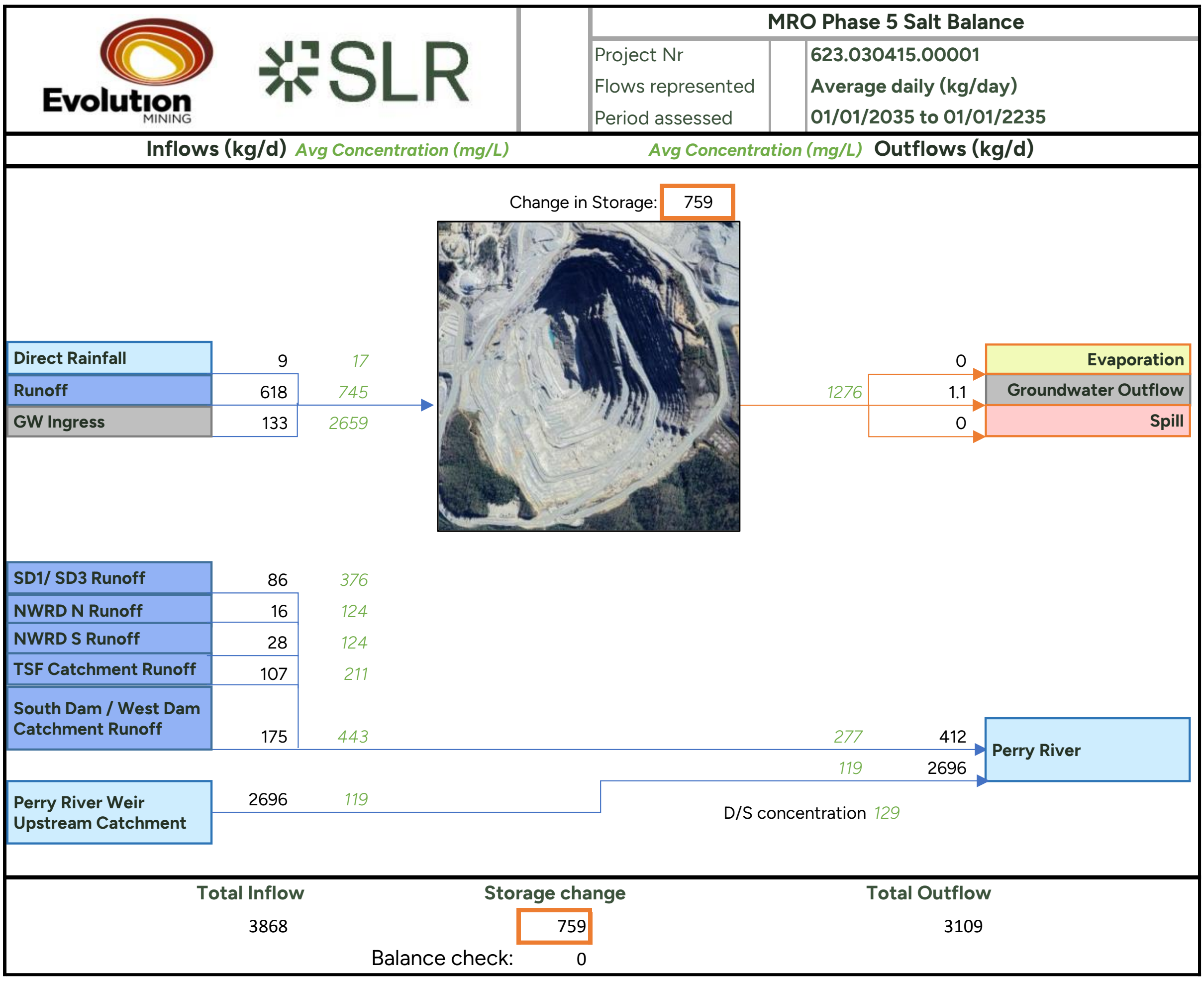


Figure 3-2 Post-Closure Salt Balance

3.3 Pit Void Water body

3.3.1 Predicted Water Levels

The simulated 5th percentile, median and 95th percentile water levels and water volumes, after 200 years, are provided in Table 3-1. The daily median water volumes over this period are graphed in Figure 3-3.

Table 3-1 Predicted Water Levels and Volumes in Pit Void (after 200 years)

Water level (m)			Volume (ML)			Total capacity in residual void below spill level (ML)
5%	50%	95%	5%	50%	95%	
43.4	56.9	66.3	30,603	34,709	37,840	61,165

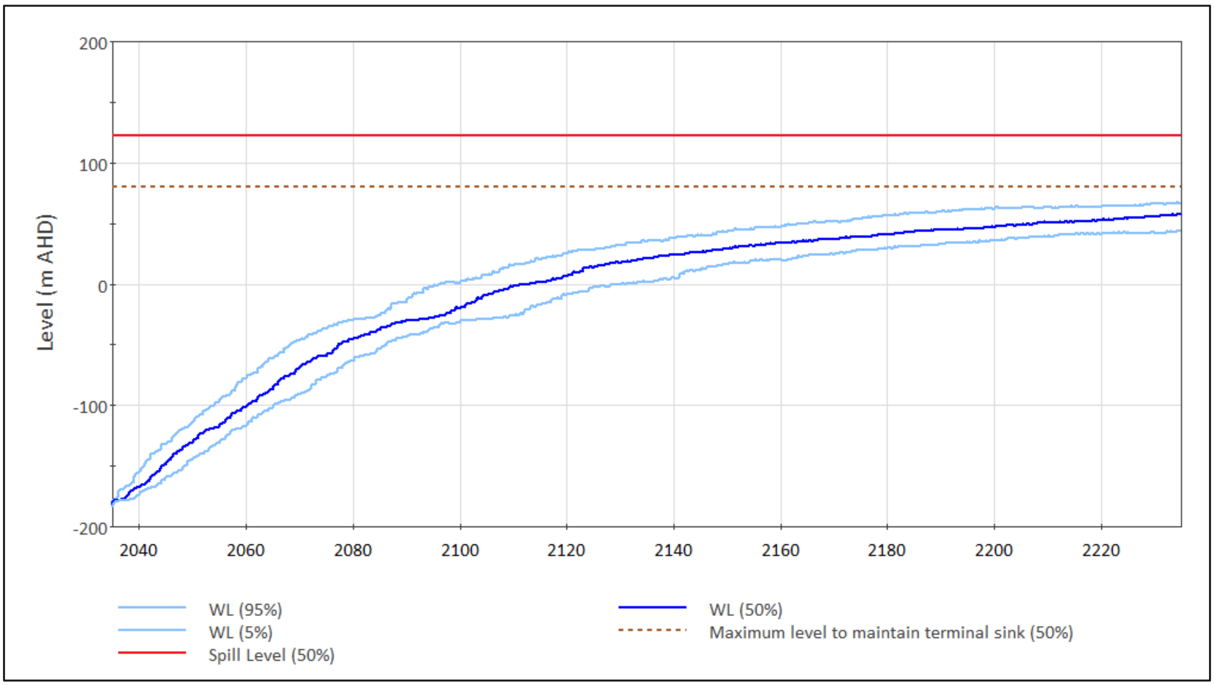


Figure 3-3 Pit Void Predicted Water Levels

The predicted water levels within the pit have not reached equilibrium within the 200-year timeframe. The pit however is predicted to remain a groundwater sink for at least this time period. Following closure, monitoring of the pit water levels should continue and be used to re-calibrate the WBM and the groundwater model. With time, the confidence in future climate change predictions is expected to improve, and these should also be taken into consideration when reviewing the WBM. If the models predict a potential switch from a sink to a groundwater source in the future, the catchment draining inward to the pit should be adjusted to ensure the pit remains a terminal sink.

3.3.2 Spill/Overtopping Probability

The probability of overtopping or spilling from the pit void was assessed over the 100 realizations of the 200-year simulation period (20,000 years). No overtopping events were simulated for the pit void, even during the extreme wet years, and thus the risk of spilling is deemed negligible.

The ability to contain a single large rainfall event was also assessed. The 1 in 1,000 year 24-hour event for the site was sourced from the Design Rainfall Data System (2016) (BOM, 2025) and is estimated at 379 mm. Conservatively applying a runoff factor of 1 (100% of rainfall runs off) to the entire proposed pit catchment (170.9 ha), a runoff volume of 648 ML would need to be stored. Under 95th percentile wet conditions and after 200 years, the remaining storage capacity within the pit is predicted to be around 23,325 ML, thus only 3% of this available storage will be needed to contain the runoff from the event. This reiterates that the overtopping probability from the pit is indeed negligible.

3.3.3 Water Quality

The predicted salinity and sulfate concentrations are indicated in Table 3-2, Figure 3-4 and Figure 3-5. The results indicate that both the TDS and sulfate concentrations are expected to remain in the low-risk category for at least the next 200 years (i.e., suitable for cattle watering).

Table 3-2 Simulated Long-term Median Salinity and Sulfate

100 years post mining		200 years post mining	
TDS (mg/L)	Sulfate (mg/L)	TDS (mg/l)	Sulfate (mg/L)
1,280	630	1,600	780

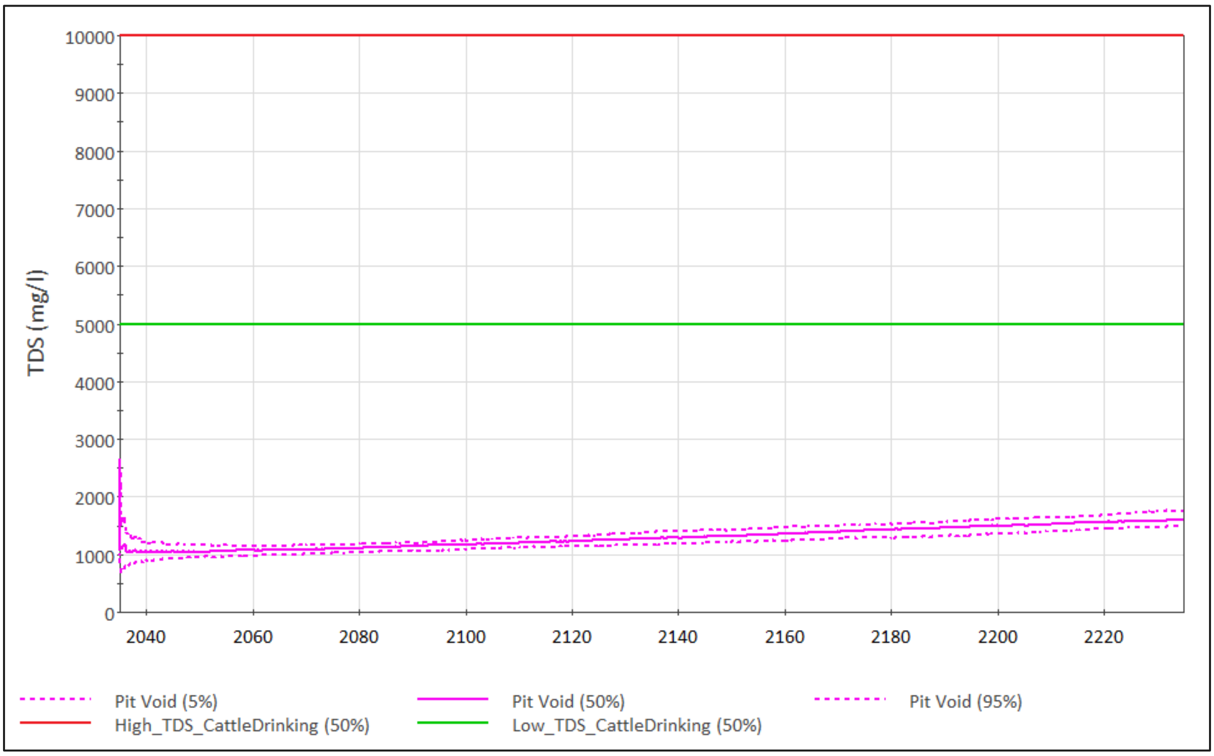


Figure 3-4 Pit Void Predicted Salinity (TDS)

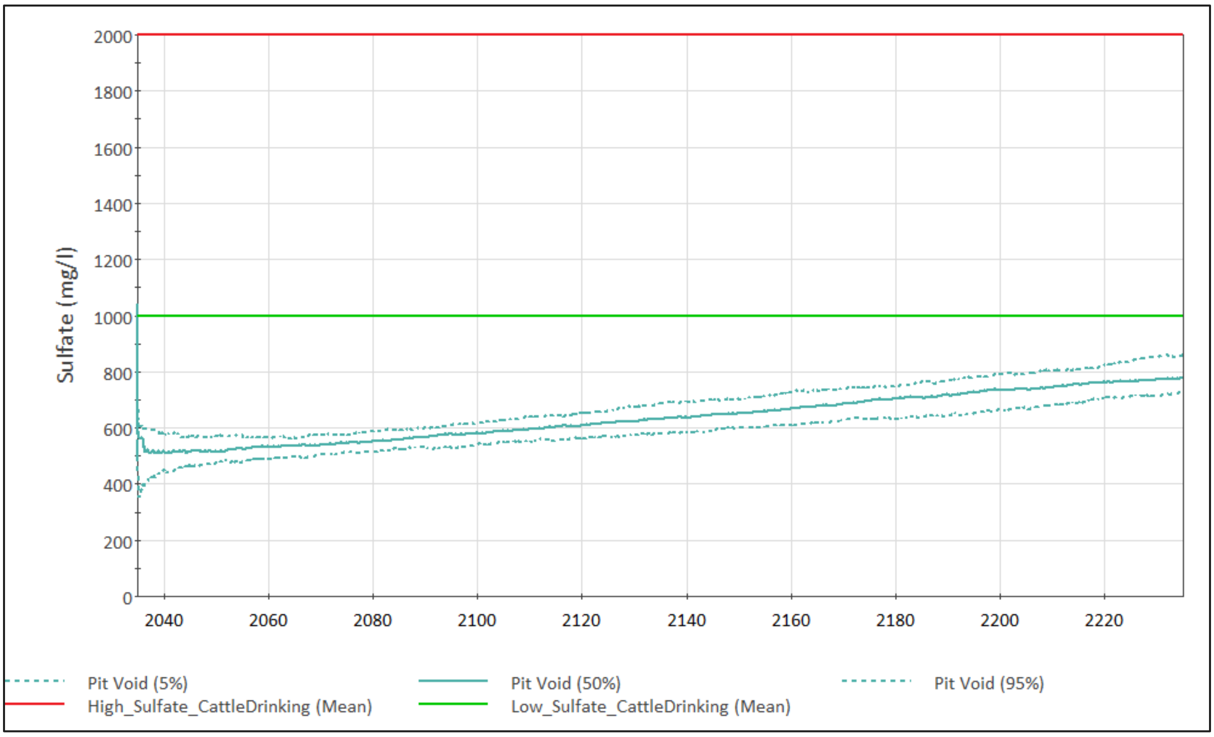


Figure 3-5 Pit Void Predicted Sulfate Concentration

3.3.4 Benchmarking

As part of a previous study conducted by RGS on behalf of Evolution Mining, a Final Void Assessment was undertaken (RGS, 2022). This study included the development of a WB/WQ model for the site and the final void at MRO. Three scenarios were considered in this assessment, the one closest to the current proposed post-closure water management approach was Scenario 1:

- All runoff and seepage water diverted to the pit during closure. Following closure, the rehabilitated NWRD and TSF runoff water (from cover) to be released to the environment.

The outcomes from the RGS study have been compared to the current study's results and where significant differences have been observed the causes for these have been investigated.

3.3.4.1 Predicted Pit Void Water Levels

RGS Study: Pit water level rises from a starting level of -170m AHD to an RL of +22m AHD (mean) during closure and then to an RL of +77m AHD after 100 years (year 2123).

Current SLR study: Pit water level rises from a starting level of -184m AHD following closure to an RL of +21m AHD after 100 years (year 2135).

Primary causes for differing results:

- A lower starting water level was applied for the current study (14m difference; 1,430 ML).
- The RGS study used static factors to estimate the runoff volumes generated in response to the rainfall (50% from the rehabilitated catchments and 90% from the pit walls). The current study uses the AWBM hydrological model, with input factors that have been calibrated using the operational WBM, resulting in average runoff proportions of 40% for the pit walls and 28% for the rehabilitated surface, further reducing to 13% once the vegetation has been established.
- The RGS study had the entire site discharging to the pit during closure, which results in the water level jumping to 22m AHD within a short timeframe. Post-closure a portion of this catchment is diverted away, however the remaining pit catchment still covers a surface area of 148 ha. Even though this is smaller than the current study's recommended catchment (170.9 ha), the other contributing factors outweigh this.
- The RGS study has an initial groundwater inflow rate of 0.9 ML/d reducing to 0 ML/d after 25 years and then seeping out at 0.05 ML/d, this was informed by an empirical calculation included within the model. The current study has an initial inflow rate of 0.2 ML/d reducing to 0.04 ML/d after 100 years.

Commentary:

- The final water levels in the pit will be heavily influenced by the area of the catchment discharging to the pit as well as the resulting hydrology of the changing site.
- The ongoing modelling and subsequent outcomes will further guide the development of the preferred final landform to ensure that the expected post-closure water body will firstly, cause the least amount of impact on the surrounding receptors and secondly, if possible, become a viable water source for the post-closure landuse.

3.3.4.2 Predicted Pit Void Salinity

RGS Study: The pit water body has a mean TDS concentration of 662 mg/L after 100 years.

Current SLR study: The pit water body has a mean TDS concentration of 1,280 mg/L after 100 years.

Primary causes for differing results:

- The RGS study had a starting mean TDS concentration of 228 mg/L for the pit water body. The current study assumes the pit is left empty following the closure activities.
- The defined source terms for the natural runoff and groundwater salinity are the same in both studies – SLR adopted the RGS source term values. However, the TDS concentrations associated with the pit wall runoff differ. SLR have adopted a static concentration of 1,334 mg/L, taken from the average source term value as defined by RGS as the starting concentration for the pit wall runoff. The RGS model has defined source terms informed by the leachate testing with different values for the NAF, M-PAF and H-PAF sections of the exposed and saturated pit walls. The module also incorporates a solute reservoir where the mass builds up until a rainfall event larger than 10mm is experienced, during which the entire built-up load is released. These concentrations are generally a lot lower than the static source term as defined by SLR.
- The different catchment areas discharging runoff to the pit voids impact the predicted water quality heavily. Where a large, rehabilitated catchment contributes significant amounts of water to the water body, the local pit wall runoff loads will be diluted.

Commentary:

- The RGS pit void water quality modelling which uses the KLC test results likely underestimates the loads which will come off the pit walls post-closure. (This has been discussed and agreed on with the RGS consultants).
- Given the present absence of more representative source terms linked to each of the rock lithologies, it was determined that a static concentration dataset associated with the runoff and informed by the historical in-pit water qualities, while likely being conservative, is the most suitable way forward at this stage.
- Following closure, the loads associated with the contributing sources will likely reduce with time. Ongoing monitoring should be done to verify this.

3.3.4.3 Predicted Pit Void Sulfate

RGS Study: The pit water body has a mean sulfate concentration of 223 mg/L after 100 years.

Current SLR study: The pit waterbody has a mean sulfate concentration of 630 mg/L after 100 years.

Primarily causes for differing results:

- The RGS study had a starting mean sulfate concentration of 628 mg/L for the pit water body. The current study assumes the pit is left empty following the closure activities.
- The defined source terms for the natural runoff and groundwater sulfate loads are the same in both studies – SLR adopted the RGS source term values. The sulfate concentrations associated with the pit wall runoff differs. SLR have adopted a static concentration of 769 mg/L, taken from the average source term value as defined by RGS as the starting concentration for the pit wall runoff. The RGS model has defined source terms informed by the leachate testing with different values for the NAF, M-PAF and H-PAF sections of the exposed and saturated pit walls. The module also incorporates a solute reservoir where the mass builds up until a rainfall event larger than 10mm is experienced, during which the entire built-up load is released. These

concentrations are generally a lot lower than the static source term as defined by SLR.

- The different catchment areas discharging runoff to the pit voids also impact the predicted water quality heavily. Where a large, rehabilitated catchment contributes significant amounts of water to the water body, the local pit wall runoff loads will be diluted.

Commentary:

- As per the commentary on the salinity comparison above.

3.4 Rehabilitated Catchments

Note: As a result of the void water body optimization study (Section 2.7), the catchment boundaries and discharge locations associated with the externally draining catchments may change, affecting the predicted volumes that will be discharged to the Perry River. These changes will not affect the key outcomes presented below.

3.4.1 Discharge flowrates

The daily discharge rates were modelled for all of the rehabilitated catchments (defined in Section 2.3.2), as well as the Perry River Catchment upstream of the weir, using the AWBM parameters defined in the operational WBM (see Section 2.4). The average volumes expected to discharge from each of these catchments are indicated in the site water balance diagram (Figure 3-1) as well as Table 3-3 below.

Table 3-3 Discharge Flowrates (m^3/d)

	TSF	South Dam / West Dam	SD1 / SD3	NWRD North / Workshop	NWRD South	Total
Median	11.5	7.2	4.5	2.9	5.1	31.2
Average	506	394	229	128	227	1,485

The AWBM hydrological modelling results in relatively consistent flow regimes across the catchments, with flow volumes scaled based on the catchment surface area. The predicted flow duration curves for the discharge from each of the modelled catchments are provided in Figure 3-6. The predicted contribution from the rehabilitated mining catchments to the flow in the Perry River at a point directly downstream of the discharge location(s) is approximately 6% on average.

Given the catchment sizes, the low flow predictions are likely overestimated, as “cease to flow” conditions are expected to occur much more frequently that what is currently predicted. The AWBM parameters were defined during the calibration of the model, using site monitoring data. As hydrological model calibration is generally focussed on matching high flow events, there is a much greater confidence in the higher flow rate predictions i.e. > 1 m^3/d.

The likely overestimation of low flows by the current model is not expected to significantly influence the predicted results and modelling outcomes. The assumed runoff water quality within the SBM is not affected by the flow rate and the predicted water quality or volume associated with any receiving water storages would not be significantly influenced by these low flow conditions.

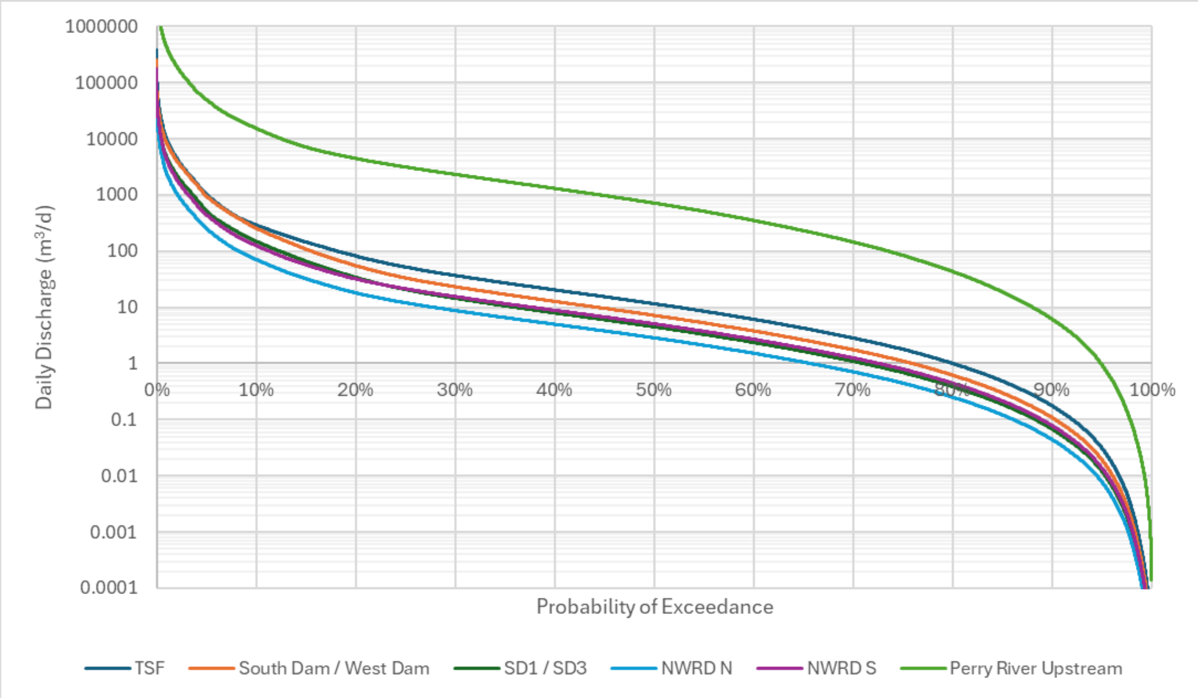


Figure 3-6 Rehabilitated Catchments Runoff - Flow Duration Curves

3.4.2 Water Quality

By applying the source terms defined in Section 2.6, the discharge water quality associated with the different catchments can be predicted at a point before any mixing with other water sources. The average TDS loads and concentrations for each catchment across the full post-closure simulation period are indicated in Figure 3-2 and the TDS and sulfate concentrations are summarised in Table 3-4. The average predicted TDS concentrations are below both the current EA release limit (1,000 mg/L) as well as the Perry River WQO (600 mg/L).

Similarly, the average predicted sulfate concentrations are below the Perry River WQO (250 mg/L), however the average combined discharge as well as the discharge from the South Dam/West Dam and SD1/SD3 catchments are expected to exceed the current EA release limit of 100 mg/L.

Table 3-4 Average Discharge Water Quality (mg/L)

	TSF	South Dam / West Dam	SD1 / SD3	NWRD North / Workshop	NWRD South	Combined Discharge	Perry River WQO
TDS	211	443	376	124	124	277	600
Sulfate	61	207	165	6	6	103	250

The salinity of the runoff water discharging from the catchments will fluctuate depending on the storm event size, duration and time since previous event. The current modelling outcomes are only impacted by changes in the storm event size.

For those catchments which are expected to include roads and/or hardstand areas (SD1/SD3, TSF and the South Dam / West Dam catchment), the salinity of the discharge resulting from smaller events is expected to be higher and larger events lower. This is because there is a greater initial abstraction and storage of the rainfall depth in the rehabilitated soil coverage vs the hardstand and thus flow from the rehabilitated areas will commence only during larger rainfall events which will dilute the higher saline road runoff. For these catchments the modelled TDS concentrations thus vary between 1,334 mg/L (purely road runoff) and 119 mg/L (large rainfall events, where the rehabilitated runoff governs the total water quality), as shown in Figure 3-7 for the TSF catchment. For the catchments with a single landuse (i.e., NWRD North and NWRD South) the modelled water quality remains consistent (119 mg/L) driven by the defined static source term.

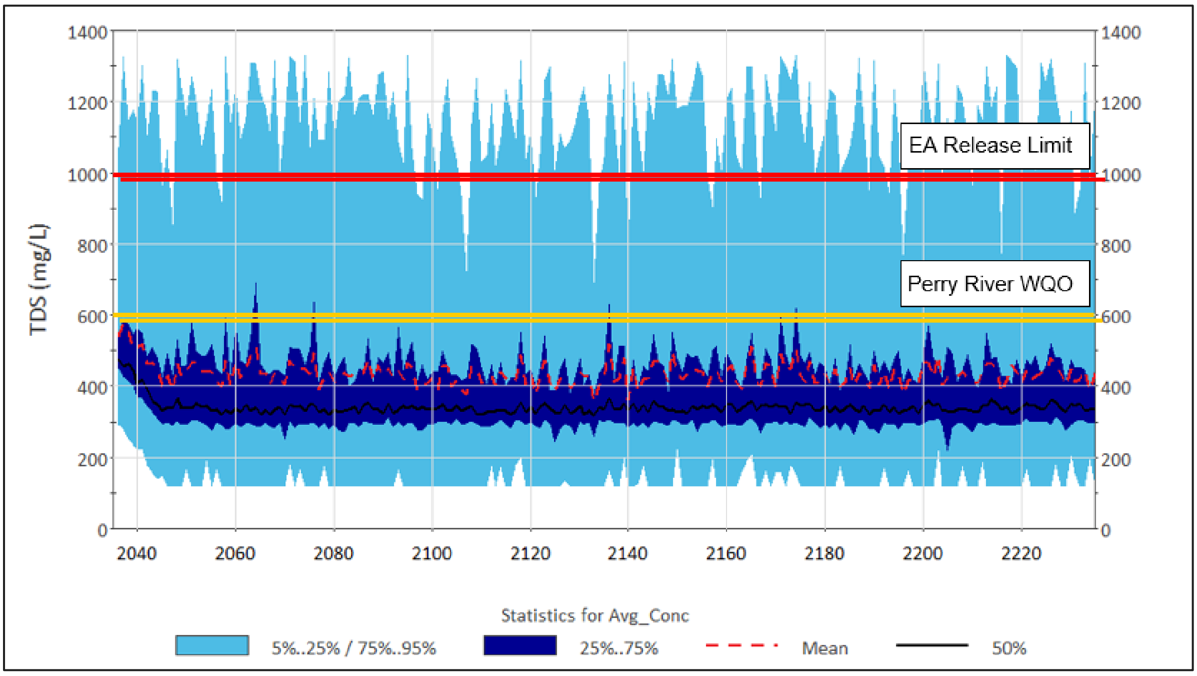


Figure 3-7 TSF Catchment Discharge – TDS Concentration (Predicted Range)

Similarly, when considering the predicted sulfate concentrations, the modelled discharge concentrations vary between the defined concentration for the road runoff and that defined for the rehabilitated and natural landuse runoff. An example of the results is provided in Figure 3-8, showing the predicted sulfate concentration over the first 50 years post-closure for the TSF catchment for a single rainfall realisation.

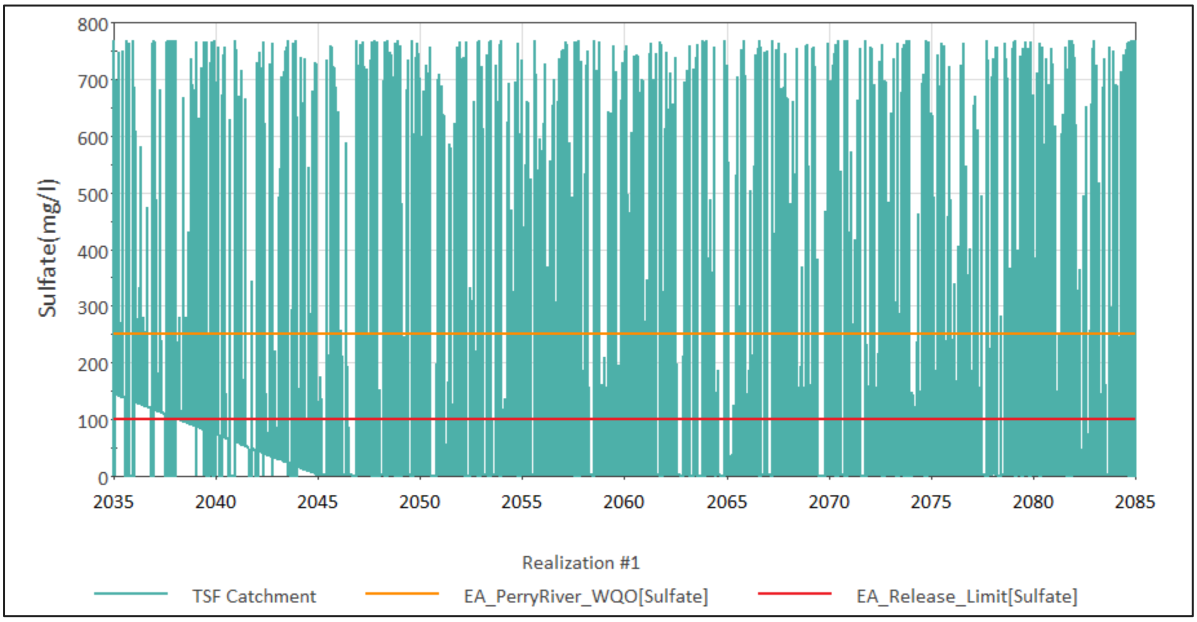


Figure 3-8 TSF Catchment Discharge – Predicted Sulfate Concentration (Single realization)

To ensure consistent compliance with the current EA discharge limits and/or the Perry River WQO's, additional management and/or treatment of the runoff will be required prior to discharge. Given that the major exceedances are expected to be driven by the runoff from the roads, the road surfaces should be adequately rehabilitated and, if found necessary, treated to stabilise the surface and suppress any transport of pollutants from these surfaces.

Evolution is currently investigating options to passively treat the discharging runoff via constructed wetland systems. Any installed treatment processes should improve the water quality beyond the current presented predictions. These systems would provide localized storage and mixing as well, which will result in lowering the predicted upper limits of the discharging concentrations.

3.5 Climate Change

All three climatic scenarios (Base Case, HP model and WI model) were simulated for a single climatic realization and the comparative results for the pit void water body are shown in Figure 3-9. The simulated rainfall prior to 2070 was kept the same with the transition to the adjusted climate dataset occurring on 1 Jan 2070 in the simulations. It should be noted that the groundwater flux relationships have not been adjusted to account for potentially longer recovery periods or lower long term groundwater levels which could positively impact the salinity levels under the climate change conditions.

The results indicate a lower water level for both of the assessed climate change scenarios. The most significant differences are associated with the HP composite model, with approximately a 50 m difference in water level after the 200-year simulated period. Thus, reaffirming that the pit void is still expected to remain a terminal sink even with climate change considered.

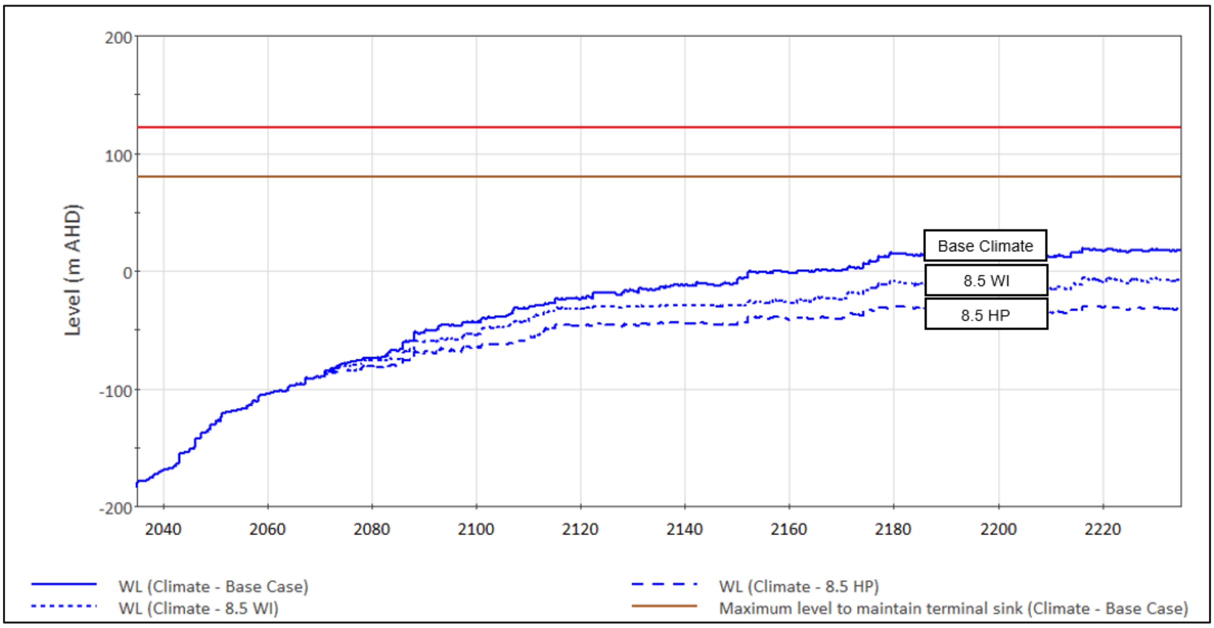


Figure 3-9 Climate Change Results – Pit Void Water Level

The expected reduction in precipitation and increase in evaporation is likely to lead to a more saline water body in the future, this is seen in the pit void salinity and the sulfate concentration results shown in Figure 3-10 and Figure 3-11. The TDS and sulfate concentrations are expected to increase, compared to the base case climate, by between 16% (WI model) and 32% (HP model) over the 200-year period.

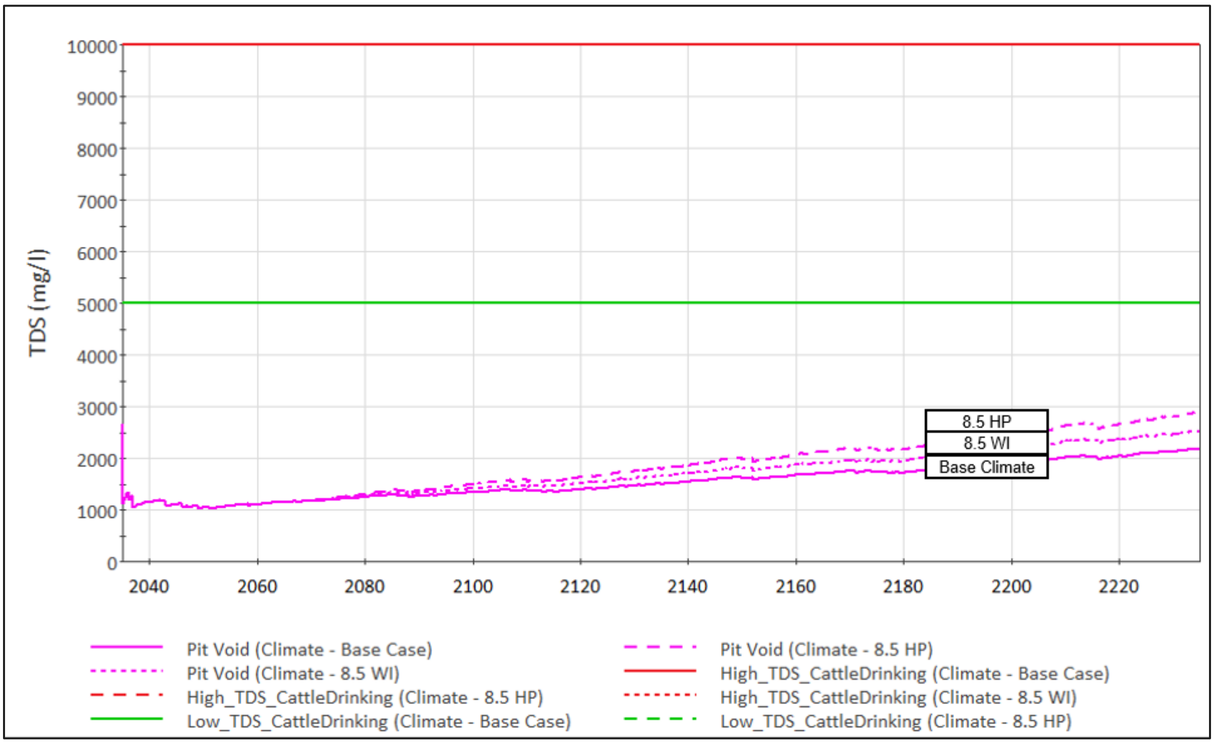


Figure 3-10 Climate Change Results – Pit Lake Salinity

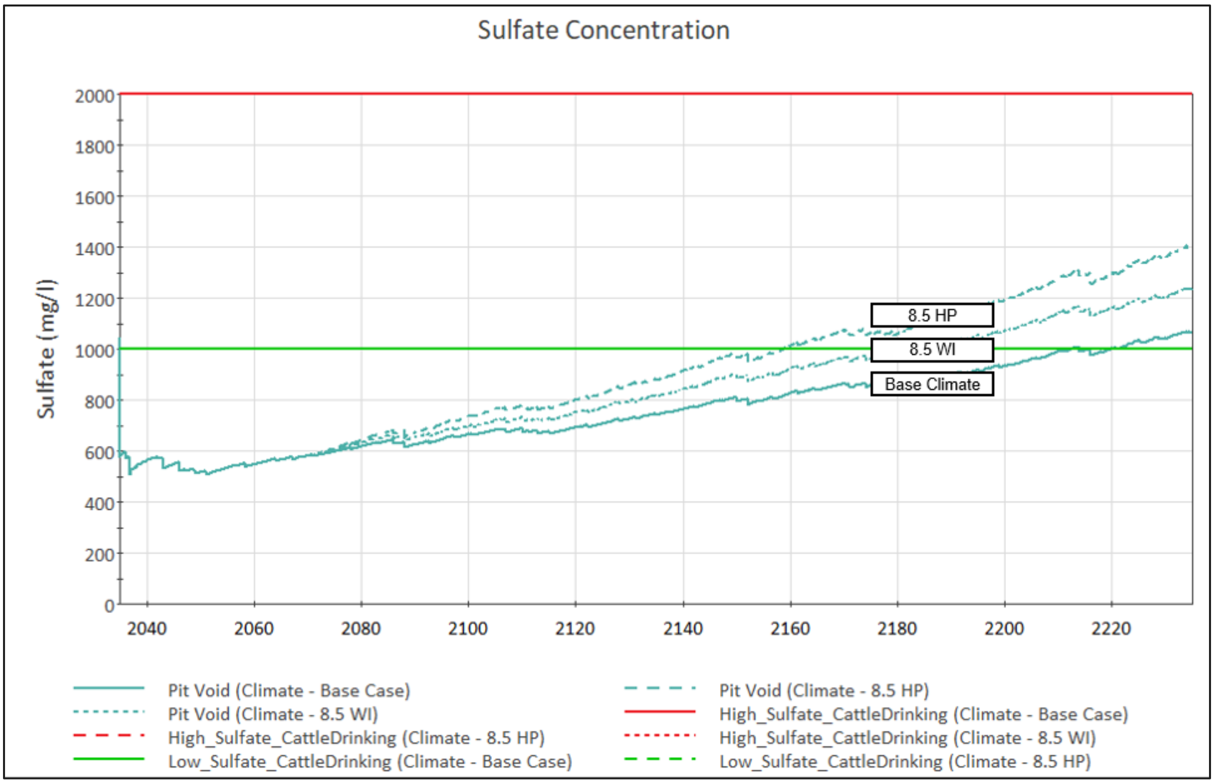


Figure 3-11 Climate Change Results – Pit Lake Sulfate Concentration

To understand the potential impact from climate change on the discharges from the externally draining catchments, the comparative average monthly discharge rates over the final simulated year (2234) for the TSF catchment were reviewed, as shown in Figure 3-12. The modelling results indicate generally lower discharge volumes throughout the year, with some variation in the degree of reduction for each month. The average predicted discharge rates over year 2234 were 464 m³/d, 250 m³/d and 350 m³/d respectively for the base case, the HP case and the WI case. This indicates a reduction in discharge of between 25 and 46%. The upstream catchment will likely be similarly affected, and so the proportionate flow volume downstream in the Perry River should not change significantly.

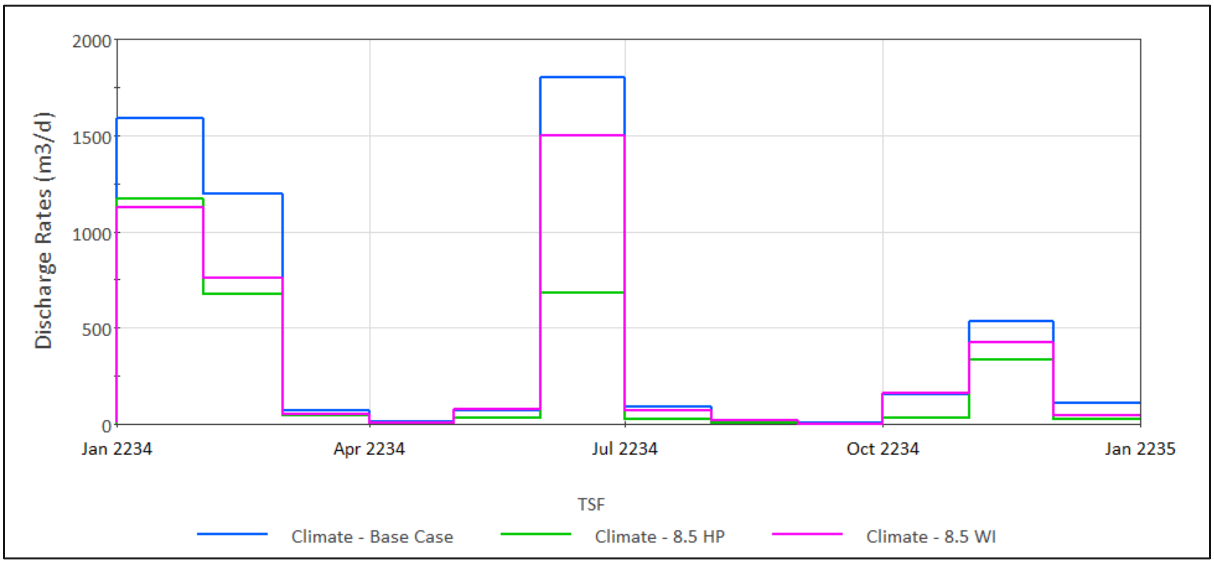


Figure 3-12 Climate Change Results – TSF Monthly Discharge Rates (Year 2234)

The comparative predicted average monthly TDS concentrations for the TSF catchment discharge are shown in Figure 3-13, indicating a more sporadic impact from climate change on the predicted concentrations, but generally showing that concentrations are expected to increase.

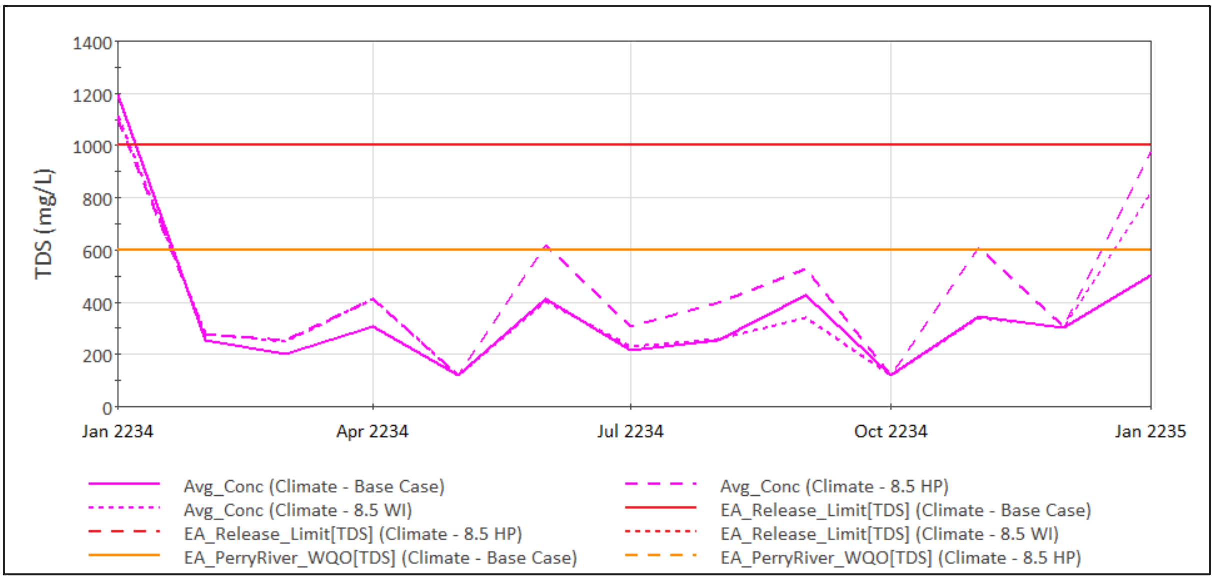


Figure 3-13 Climate Change Results – TSF Monthly Average TDS Concentrations (Year 2234)

These outcomes suggest that the results associated with the base case comprehensive modelling, as per Sections 3.1 through 3.4, may be underestimating the long-term predicted salinity levels, however, the pit lake water body is likely to be smaller in size and volume and the discharge rates from the catchments draining externally, will likely reduce.

4.0 Limitations of the Assessment

The accuracy of the assessment is reliant on the accuracy of the utilised data, as detailed in Sections 2.0. SLR has assumed all source data to be fit for purpose and sufficiently accurate for the purpose of this assessment. Except where noted, no verification of accuracy of the information has been conducted. If some of the information which was relied upon for this assessment is found to be inaccurate, then some or all of the findings may change.

Several assumptions have been made to inform the development of the WBM and SBM. Sensitivity assessments provide insight into the significance of these assumptions on the model results. However, the passage of time and additional further studies may refine these assumptions leading to improvements in model accuracy, and changes to the conclusions drawn in this report.

Although the analyses undertaken as detailed in this report were carried out with due care and professionalism, this report should only be used for the purposes intended. The analyses detailed in this report were undertaken solely for the purpose of addressing the requirements of the MRO post-closure water management planning in accordance with the relevant documentation as detailed in Section 1.2.

This report should be read in full, and no excerpts are to be taken as representative of the findings. This report has been prepared on behalf of Evolution and SLR accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

This assessment, in combination with the Groundwater Modelling report (SLR, 2025) represents the complexities of the post-closure landform through modelling, which has included feedback between ground and surface water models through a series of iterations. While the model represents key processes which influence the expected water level and water quality within the void, there remains both uncertainty and unknowns in the model and its parameterisation. In particular, the following is noted:

- The groundwater interaction between the void and the surrounding aquifer, as they fill and recover post-closure, results in transient groundwater flux rates at the void. The objective of the iterative approach followed, alternating between the groundwater and surface water modelling, was intended to result in a more accurate representation of these fluctuating rates.
- Several recent studies have been conducted attempting to increase our confidence in estimating evaporation from void waterbodies. These studies are still generating mixed results, particularly at smaller depths, volumes, and surface areas when the localised effects of the final landform topography are unknown.
- A conservative approach has been taken with respect to predicting the salinity development over time within the void waterbody as full conservation of mass has been assumed. In reality, due to the chemical processes transpiring within the waterbodies, a portion of the dissolved salts may precipitate and accumulate on the void floor or walls. Some of these salts may readily re-dissolve in the water during wetter periods, however a portion may remain insoluble. Thus, any predicted future water quality predictions are deemed highly conservative.
- Uncertainty around the potential rate and extent of climate change remains. Several accepted models predict varying levels of climate change impacts, each model would result in a different relative change when considering volumes stored and the salinity thereof.

Based on the above it is considered likely that the water storage volumes identified in this report will be conservative and the true volumes of water within each void could potentially be less.

5.0 Conclusions and Recommendations

The water and salt balance modelling concluded the following with regards to the future pit void water levels and qualities:

- An optimal balance between the predicted long-term water level and water quality can be achieved through:
  - Ensuring the pit void is fully dewatered following the completion of site closure activities.
  - Increasing the external catchment from the rehabilitated areas that drain inward to the pit up to approximately 100 ha.
- With these starting conditions and the proposed long-term site drainage arrangement, the following is predicted:
  - The pit water level will rise to a level of 56.9m AHD (median result) over a 200-year period post-closure. This is 65m below the pit crest, with 26,455 ML of free storage still available. It also remains approximately 20m below the surrounding recovered groundwater levels, thus remaining as a groundwater sink. Over the 20,000 years simulated by the WBM, no overtopping events at the pit void occurred, thus the risk of spilling from the pit is deemed negligible.
  - The salinity (TDS) and sulfate concentrations will rise steadily post-closure but remain within the ANZEC & ARMCANZ (2000) low risk category for cattle drinking purposes over the 200-year post-closure period.
  - Applying climate data associated with the two “worst-case” climate change models, results in lower pit void water levels but a steeper increase in salinity and sulfate over time, potentially leading to the sulfate concentrations exceeding the low-risk category limit within 200 years following closure.

The modelling concluded the following with regards to the future rehabilitated catchments which will discharge to the environment:

- The combined average discharge from these catchments is expected to be approximately 1,485 m^3/d, which will contribute to around 6% of the predicted flow in the Perry River directly downstream of the site. (Note that the catchments modelled have not been adjusted to accommodate the recommended larger area draining to the pit, and that the total external discharge volume is thus expected to be less than indicated).
- For the three catchments which are expected to contain hardstand areas (i.e. access roads), the water quality upper limits will be driven by the contaminant loads emanating from these areas during minor rainfall events. This is because the loading rates from these areas are expected to be higher than from the rehabilitated surfaces in the long-run, and even though the hardstand surface areas are significantly smaller than the rehabilitated areas, during smaller rainfall events runoff will be generated only from these areas, as the rehabilitated surfaces have a much larger initial abstraction.

  The water quality modelling is thus currently indicating an upper TDS concentration limit of 1,334 mg/L for these catchments, which is informed by the source term defined for the hardstand surfaces. During more significant rainfall events the discharge will be diluted with runoff from the rehabilitated surfaces (which has a TDS source term defined as 119 mg/L). The average discharge TDS is expected to be around 277 mg/L, which is below the Perry River WQO of 600 mg/L.

Similarly, the current predicted sulfate concentration range for the discharge from these catchments is between 2.4 and 769 mg/L. The average discharge sulfate concentration is expected to be around 103 mg/L, which is below the Perry River WQO of 250 mg/L.

- For the catchments with a single landuse (i.e., the NWRD North and NWRD South) the current predicted TDS and sulfate concentrations remain consistent (119 mg/L and 2.4 mg/L, respectively) driven by the defined static source terms.
- Climate change considerations lead to a predicted decrease in the discharge volumes with a varying impact on associated water quality but generally an increase in salinity and sulfate concentrations.

The following future work is recommended to progress this study, to optimize the closure planning and to improve the confidence in the long-term predicted results:

- Review and confirm the feasibility of increasing the external catchment draining inwards towards the pit void. The possible future need to reduce this catchment should also be considered and planned for.
- Investigate other options to improve the long-term predicted water quality within the pit void, for example:
  - An initial water body can be established in the pit, using fresher water from other dams on site, specifically water bodies with lower sulfate concentrations.
  - If an abstraction, i.e. for cattle drinking, is added to the pit, some of the salt loads will be removed as an outflow from the system.
- Conduct on-site testing of the pit wall runoff to define appropriate source terms for each of the exposed rock lithologies. These results can be used to dynamically represent the expected runoff water quality within the model which will change as sections of the pit walls become submerged.
- As monitoring data becomes available post-closure, the groundwater and water balance models should be revised and re-calibrated to evaluate the possibility of switching to a groundwater source in the future.

Sincerely,

SLR Consulting Australia

Amelia Basson, CPEng
Principal Water Engineer

6.0 References

- ANZG 2023, *Livestock drinking water guidelines. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Governments and Australian state and territory governments, Canberra.
- ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- ATCW 2024, *MRO_WBM_GS14 v2.8 – 2024 (To Client).gsm* as supplied by ATCW, via MRO on 2/10/2024
- Commonwealth of Australia 2024, *Bureau of Meteorology – Climate Data Online*, http://www.bom.gov.au/climate/data/ (accessed 16/09/2024)
- DESI 2024, *Climate – EIS Information Guideline*, Queensland Government Department of Environment, Science and Innovation, ESR/2020/5298, Version 1.02, 20 Jun 2024
- Deswik 2024, Mount Rawdon Operations : Deswik data file "2024 09 Pit Water Level Calculator.xlsx"
- RGS 2022, *Mine Material Management Plan – Landform, cover system and final void design and assessment*, Project number 2021081, 11/11/2022 (Accompanying WBM: MROv11.gsm)
- SLR 2025, *Mt Rawdon Operations – Post Closure Groundwater Modelling*, 623.030415.00002 rev 2
- The State of Queensland 2024a, *The Long Paddock*, https://www.longpaddock.qld.gov.au/silo/point-data/ (accessed 16/09/2024)
- The State of Queensland 2024b, *Department of Science, Information Technology and Innovation (DSITI), Biophysical Modelling Consistent Climate Scenarios*, https://www.longpaddock.qld.gov.au/seasonal-climate-outlook/CCS/ (accessed 5/11/2024)
- Tomlin et al, 2023: Tomlin, J., Phillipson, K., Lenahan, M., Durick, A., Manewell, N., Newton, D., Briody, M., and Dunlop, J. 2023. *Review of current approaches to model residual mine voids for rehabilitation planning: Technical paper 1*. Brisbane. Office of the Queensland Mine Rehabilitation Commissioner.

7.0 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our client needs.

To achieve this, your feedback on the team's performance, deliverables and service are valuable and SLR welcome all feedback via https://www.slrconsulting.com/en/feedback. We recognise the value of your time, and we will make a $10 donation to our Charity Partner - Lifeline, for every completed form.

Making Sustainability Happen