Lake Vermont Meadowbrook Project EIS

Site Water Balance and Water Management System Report

Bowen Basin Coal Pty Ltd
0622-30-D3, 29 September 2023

Report Title	Lake Vermont Meadowbrook Project EIS - Site water balance and water management system
Client	Bowen Basin Coal Pty Ltd
Report Number	0622-30-D3

Revision Number	Report Date	Report Author	Reviewer
1	24 November 2022	MPB	MJB
2	3 February 2023	MPB	MJB
3	29 September 2023	MPB	MJB

For and on behalf of WRM Water & Environment Pty Ltd
Level 9, 135 Wickham Tce, Spring Hill
PO Box 10703 Brisbane Adelaide St Qld 4000
Tel 07 3225 0200

Matthew Buckley
Lead Project Engineer

Contents

List of Figures

List of Tables

1 Introduction

1.1 BACKGROUND

The ‘Lake Vermont Meadowbrook Project’ (the Project) is a proposed extension of the existing Lake Vermont Coal Mine, proposed by Bowen Basin Coal Pty Ltd. The Project is located approximately 25 kilometres northeast of Dysart and approximately 160 kilometres southwest of Mackay, within central Queensland (Figure 1.1).

WRM Water & Environment Pty Ltd (WRM) was commissioned by Bowen Basin Coal to undertake a surface water assessment for the Project. The surface water assessment will form part of an Environmental Impact Statement (EIS) for the Project under the Environment Protection Act 1994 (QLD).

This report details the site water management system, water demands and site water balance for the Project.

1.2 PROJECTION DESCRIPTION

The Project is proposed to include the development of a double-seam underground longwall coal mine, along with a small-scale open cut pit targeting coal resources adjacent to the north of the existing Lake Vermont Mine.

To support the operation of the proposed underground development, a new ‘satellite’ Mine Infrastructure Area (MIA) will be constructed. A new infrastructure corridor will also be constructed, linking the new MIA to the existing infrastructure located at Lake Vermont Mine. This infrastructure corridor will enable the delivery of power and water, provide personnel and materials access, as well as facilitate the clearance of ROM coal to the existing Coal Handling and Preparation Plant (CHPP). A conceptual project layout is shown in Figure 1.2.

The Project is expected to produce approximately nine Mtpa of metallurgical product coal (for the export and domestic market) over an operational life of approximately 30 years. The output from the Project will supplement the scheduled decline in production from the existing open cut operations, so that the total output from the Lake Vermont complex will be maintained within the existing EA limit of 12 Mtpa of ROM coal.

The proposed mine development will therefore be comprised of:

- a double seam underground longwall coal mine (supported by some bord and pillar mining development);
- a small open cut pit;
- a mine clean water dam as well as a dewatering dam;
- a new MIA;
- a surface ROM stockpile located within the new MIA;
- a truck haulage road to deliver ROM coal from the new MIA to the existing CHPP;
- an infrastructure corridor for the delivery of power and water as well as an access roadway for the movement of personnel and materials; and
- a network of gas drainage bores and associated surface infrastructure, including access tracks, across the underground mine footprint.

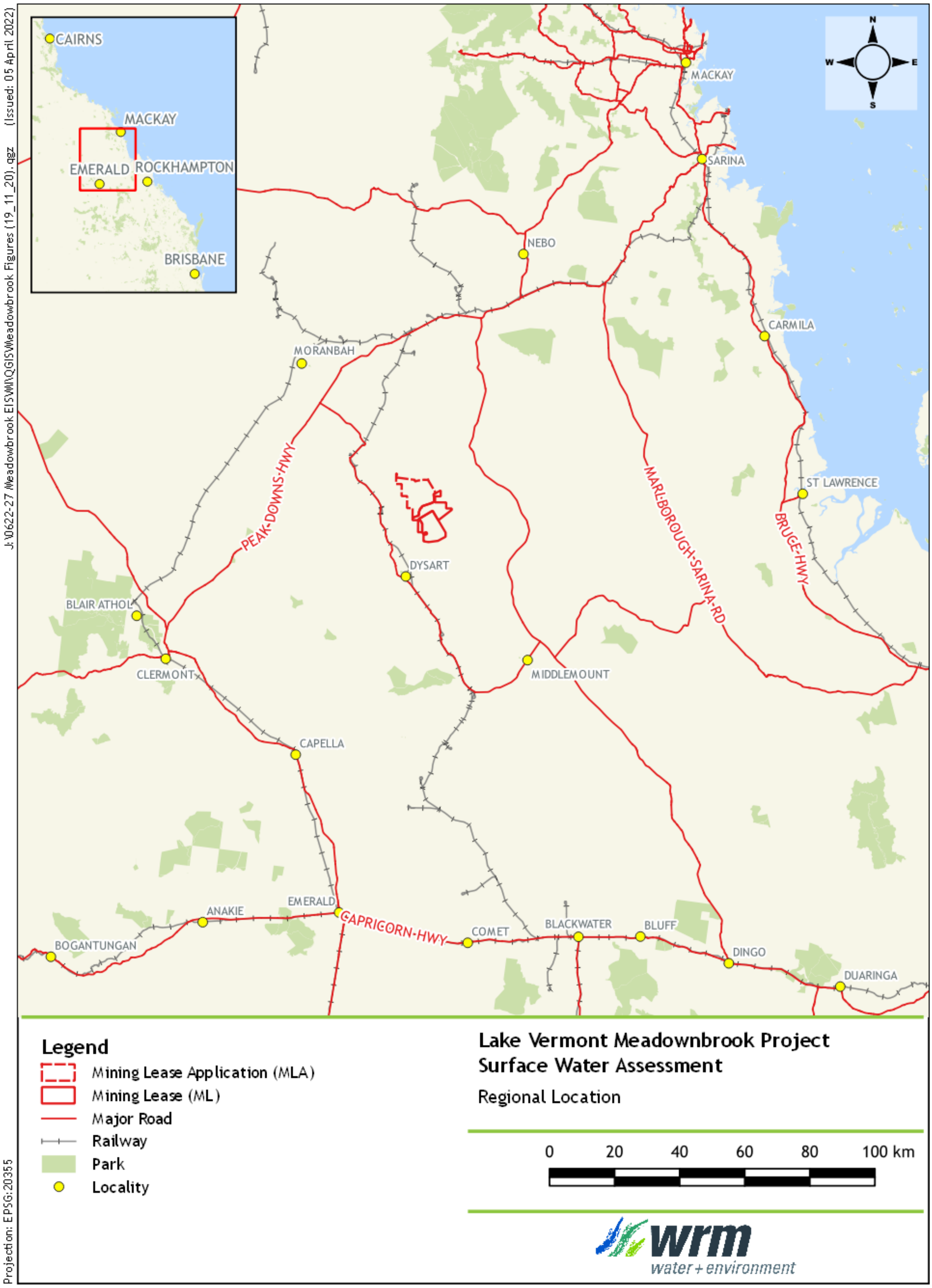

Figure 1.1 – Regional location

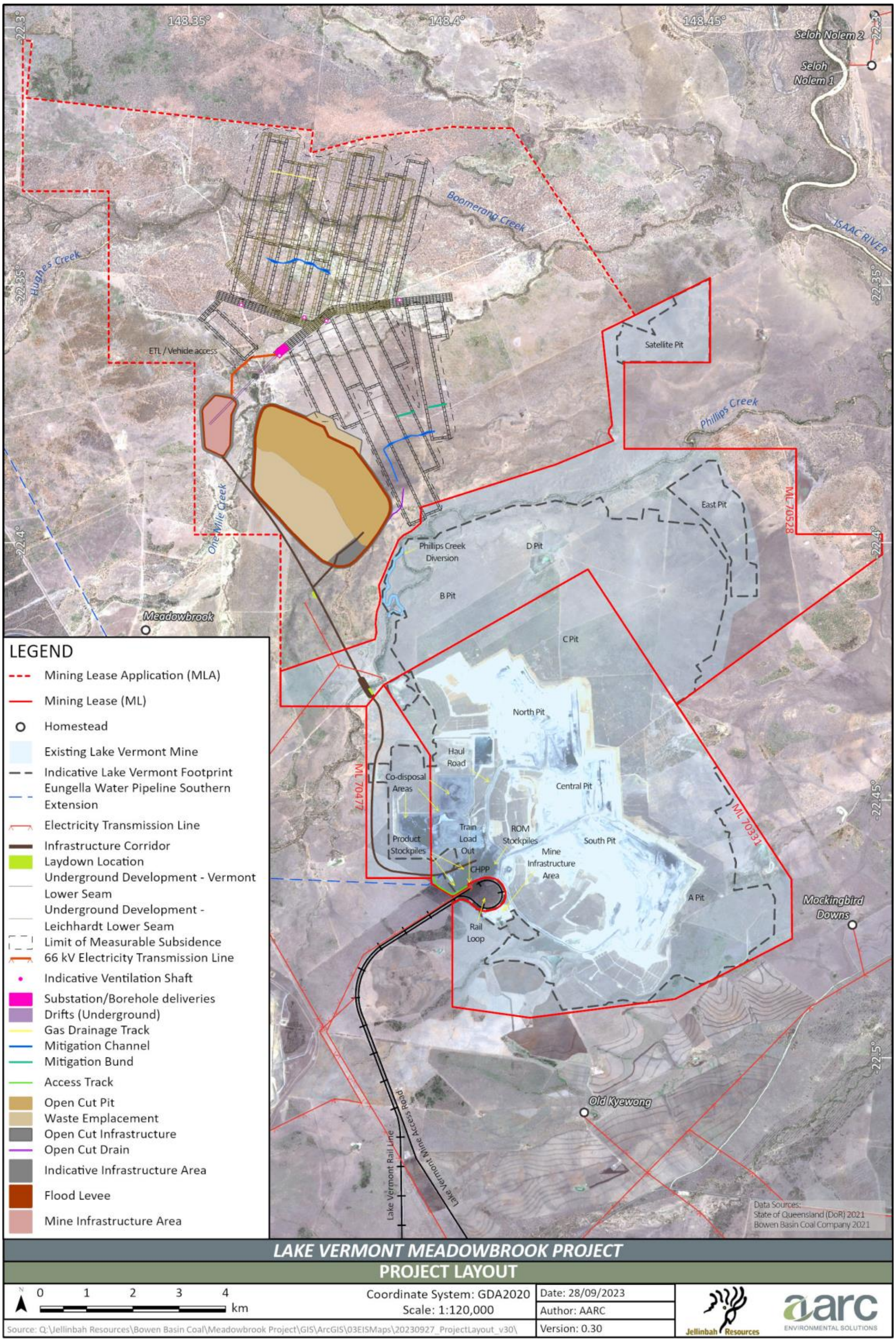

Figure 1.2 – Project layout

The proposed water management system will centre on the Project MIA, which is proposed to be located to the southwest of the underground operations.

The MIA will include mine administration and operations buildings, bathhouse facilities, a warehouse, equipment hardstand and laydown area, maintenance workshops and service bays, diesel storage and refuelling facilities, access to the portals to underground drifts, mustering areas, a water treatment plant, a sewage treatment plant and associated water management infrastructure. The infrastructure corridor linking the new MIA to the existing operation will include sealed access and coal haulage roads, electricity transmission lines and water pipelines. The proposed MIA layout is shown in Figure 1.3.

The underground operations are planned to operate for 23 years (from Year 1 to Year 23). Open cut mining would take place in the 11 years from Project Year 20 to Project Year 30.

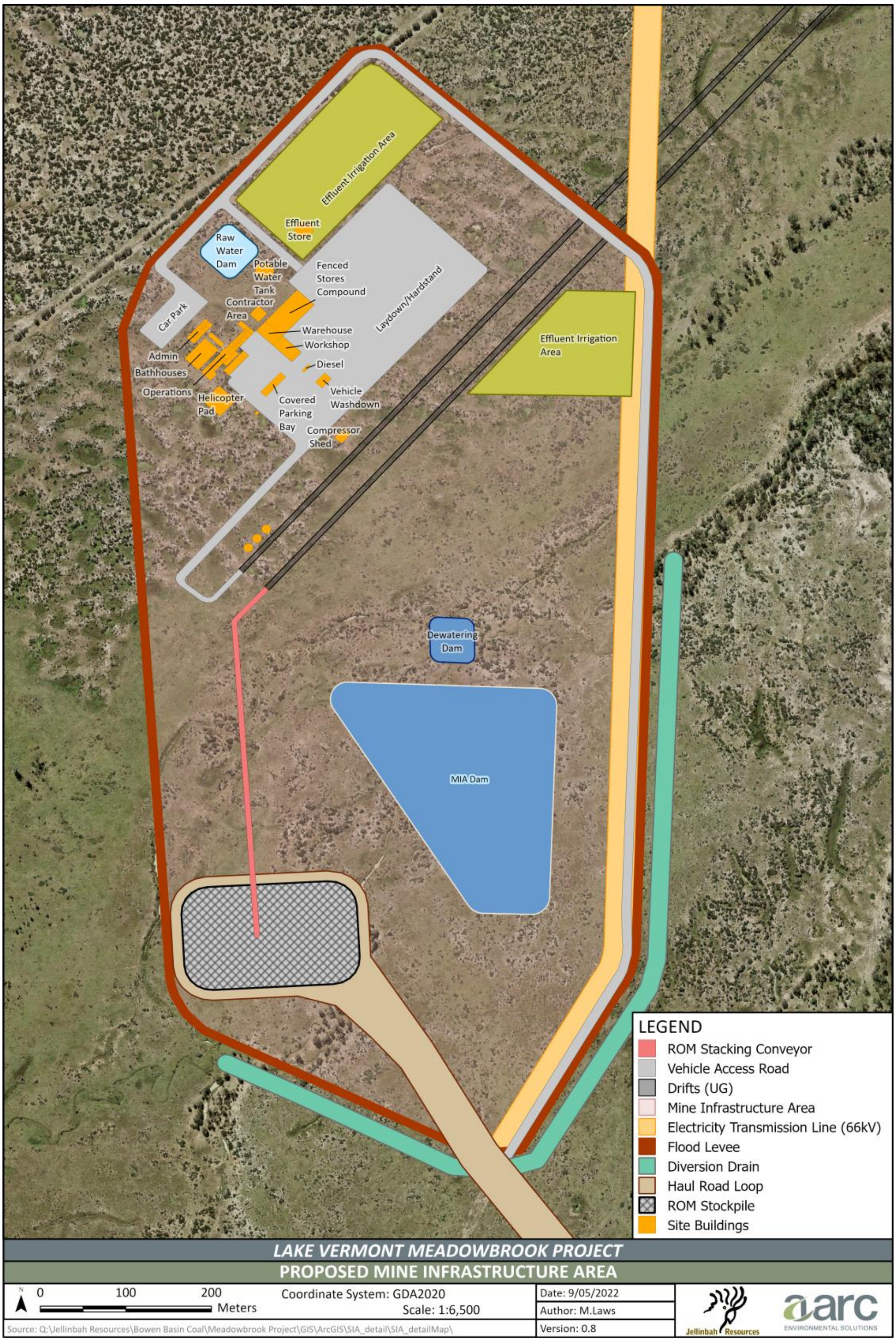

Figure 1.3 – MIA Layout

2 Water management system

2.1 SITE WATER TYPES

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff in downstream receiving waters through increased sediment loads. In addition, runoff from active mining areas (including coal stockpiles, etc.) may have increased concentrations of salts and other pollutants when compared to natural runoff. Site water has been classified into the types shown in Table 2.1 based on likely water quality characteristics.

The site water management system separates water into segregated management systems:

- Mine affected water system - which will manage runoff and groundwater inflows from the underground, open cut pit, ROM stockpile and MIA. This closed system is designed to prevent releases of mine affected water to the environment.

  The principal component of inflows to the mine affected water system would be groundwater seepage to the underground and open cut pit. The groundwater assessment states the median electrical conductivity (EC) of groundwater samples taken from the Rewan Group sediments was 26,290 μS/cm, whereas the median EC of samples from the tertiary sediments was 20,716 μS/cm. For the surface water model, groundwater inflows were assigned an approximately equivalent representative total dissolved salts (TDS) concentration of 17,000 mg/L (based on a conversion factor from EC to TDS of 0.65).

- Sediment water system - the open cut mining activities would see overburden material placed in out-of-pit and in-pit waste rock dumps adjacent to the proposed open cut pit.

  Weathering processes in the waste rock areas result in the dissolution of soluble minerals, partial dissolution of lower solubility minerals (mineral weathering), cation exchange, and reaction. Mining activities increase the hydraulic conductivity and surface area of naturally occurring materials, resulting in a body of waste rock more prone to leaching.

  Previous waste characterisation assessments (AARC, 2013 and AARC, 2014, RGS 2021) described the Lake Vermont overburden as being typical of that overlying the Rangal coal measures. The waste rock predominantly comprises weathered and unweathered Permo-Triassic sediments, containing approximately equal proportions of greyish-green sandstones, siltstones and mudstones. The Rewan Formation was deposited in an upper fluvial environment, with no marine influence. Sulphide is rarely detected, and while the coal seams do contain minor pyrite nodules, this material is not associated with the mine waste, so the risk of acid forming has been assessed as low, with no acid rock drainage issues having been reported during the ~13 years of Lake Vermont Mine operations so far.

  The Geochemical Assessment of Mining Waste Materials Project (RGS, 2021) indicates waste rock at the Meadowbrook Project would have similar characteristics to the existing operation, with:

  - low sulphur content, excess acid neutralising capacity, negligible risk of acid generation and a high factor of safety with respect to potential for the generation of acidity;
  - no significant metal/metalloid enrichment compared to median crustal abundance in unmineralised soils;
  - slightly alkaline to alkaline surface runoff and seepage with relatively low salinity; and
  - low dissolved metal/metalloid concentrations in surface runoff and leachate.

  The water extract solutions were generally dominated by ions of sodium, chloride and sulphate with lesser concentrations of other major ions.

Runoff from the open cut waste rock dumps will be managed under an erosion and sediment control plan which is to be implemented throughout the Project, such that sediment generated and transported by runoff will be settled in a sediment dam.

As overburden runoff quality is expected to be relatively benign, sediment dams could potentially discharge directly into the environment (after the settlement of suspended sediment) with minimal impact to downstream water quality. However, sediment dams have been sized to achieve a relatively high level of containment, and stored water will be returned to the MIA dam for blending with mine affected water before reuse.

- Clean water - from undisturbed areas is generally diverted around the areas of disturbance by levees and drainage systems, including at the proposed MIA and open cut pit.
- Raw water – a pipeline will be constructed within the infrastructure corridor to extend the existing raw water supply pipeline at the Lake Vermont Mine that sources water from the Eungella Water Pipeline Southern Extension. Raw water would be delivered to a dedicated raw water dam at the Meadowbrook MIA for supply to the underground operations and potable water treatment plant.

  Bowen Basin Coal holds a water supply agreement with Sunwater's Eungella Water Pipeline Pty Ltd for the supply of up to 1,500 ML of water per annum to the Lake Vermont Mine and an on-supply contract with Peabody to transfer Peabody's 1,000 ML per year water allocation to the Lake Vermont Mine.

Table 2.1 – Site water types

Water type	Definition
Mine affected water	In accordance with the DEHP Guideline Model Mining Conditions, mine affected water means the following types of water: i) pit water, tailings dam water, processing plant water; ii) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity; iii) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water; iv) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated; v) groundwater from the mine dewatering activities; vi) a mix of mine affected water (under any of paragraphs i to v) and other water.
Sediment water	Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. electrical conductivity, pH, metals, metalloids). Water captured in sediment dams would achieve sufficient sediment removal to allow release to receiving waters. However, for this project, it would be reused on either the Meadowbrook or Lake Vermont Mine operations to avoid off-site release.
Clean catchment water	Surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
Raw water	Untreated water, from an external water supply, that has not been contaminated by mining activities.
Potable water	Treated water suitable for human consumption.
Sewage water	Wastewater from the bathhouse and bathroom facilities across the site will be reticulated to an on-site sewage treatment plant. Treated sewage effluent will be irrigated to dedicated areas adjacent to the MIA.

2.2 WATER MANAGEMENT SYSTEM COMPONENTS

The major components of the proposed Lake Vermont Meadowbrook water management system are described in the following sections. The interconnections between the system components are shown schematically in Figure 2.1, and the locations of the main components within the MIA are shown in Figure 1.3.

2.2.1 MIA and open cut pit levees

The MIA and open cut pit would be protected by levees and associated minor drainage systems to exclude clean water runoff from Phillips Creek and One Mile Creek and their minor tributaries in the 0.1% AEP design flood. The levees would be 'regulated structures' and would be designed, constructed, operated and decommissioned in accordance with the 'Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933)' and 'Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/2016/1934)'.

The MIA levee structures would be developed during the initial Project construction phase, remaining in place until mine closure, at which point they would be removed and the areas rehabilitated. The open cut pit levee structures would also be temporary, required only once open cut mining commences in Project Year 20 until the final overburden profile is achieved and the associated permanent landform established.

2.2.2 Raw water supply pipeline

A raw water supply pipeline will be constructed within the infrastructure corridor to connect to the existing raw water supply pipeline at the Lake Vermont Mine that sources water from the Eungella Water Pipeline Southern Extension. The proposed 12 km raw water supply pipeline will transfer raw water to a Raw Water Dam at the MIA.

2.2.3 Underground mine dewatering system

Water accumulating within the underground workings (groundwater inflows, excess dust suppression and washdown water) would be pumped to the surface to a turkey's nest dam (the Dewatering Dam) located within the MIA. Underground dewatering is anticipated to cease in Project Year 23 at the completion of underground operations.

2.2.4 Open cut mining dewatering

Local runoff and groundwater seepage accumulating within in-pit sumps in the open cut mining pit will be pumped to the Dewatering Dam.

2.2.5 Return water pipeline

Inflows to the underground operations and associated water management system are expected to exceed demands for mine water within the Meadowbrook operation. The return water pipeline will be used to transfer excess mine affected water via the infrastructure corridor to environmental dams at the existing Lake Vermont Mine. The return water pipeline will be located within the proposed infrastructure corridor for the Project.

2.2.6 Potable water supply

The water treatment plant will be located within the MIA and have the capacity to treat raw water from the Raw Water Dam and pipeline at a rate of up to approximately 10 ML/year. Treated water will be stored in 180 kL capacity potable water tanks adjacent to the plant.

Effluent from the water treatment plant will be captured and stored within the mine affected water system and used for dust suppression.

2.2.7 Sewage treatment

Sewage generated at the MIA will be pumped to a package STP. The STP will have secondary treatment capability and the ability to produce Class C effluent for irrigation as defined in the *Queensland Public Health Regulation 2018*. It is conservatively estimated that effluent will be produced at a rate of approximately 40 kL/day (based on 200 workers each generating 200 L/day of effluent on site each day). Wet weather storage will be located adjacent to the plant. Irrigation of treated effluent is proposed to occur with the MIA. Details of the proposed effluent treatment and disposal system are provided in the Land-Based Effluent Disposal Assessment Report (Cardno, 2022).

2.2.8 Raw water dam

The Raw Water Dam is located within the MIA and would temporarily store raw water for use where relatively high quality water is required – for example within the underground operations, in equipment requiring clean water for cooling, and feed water for the potable water treatment plant. The Raw Water Dam would be sized to provide continuation of supply in the event of reasonably foreseeable equipment failure (e.g. pump or pipeline failure).

2.2.9 Mine infrastructure area dam

Runoff from disturbed areas within the MIA would be contained within the levee system and directed via a series of drains to the Mine Infrastructure Area Dam (MIA Dam) which is proposed for the low area to the east of the ROM stockpile. Runoff captured in the MIA Dam could include runoff from the ROM stockpile, laydown areas, workshop areas. For this assessment, it has been conservatively assumed that the MIA Dam would capture runoff from the entire area within the MIA levee. In detailed design, the site drainage system may be configured to minimise the area captured and to direct clean runoff from undisturbed parts of the MIA away from the dam.

The MIA Dam will be sized and operated to contain runoff under all historical events - with a maximum operating level chosen such that pumped inflows would cease when the remaining capacity is equivalent to the 1 in 10 AEP 24 hour rainfall volume.

2.2.10 Dewatering dam

The Dewatering Dam would be located within the MIA and store water transferred from the underground and open cut mining operations. Water stored in the Dewatering Dam would be reused for dust suppression in the surface and underground operations.

Excess water would be transferred via the return water pipeline to the existing Lake Vermont Mine, for reuse within the site water management system – and to offset water otherwise imported via the raw water pipeline.

The Dewatering Dam would be operated to avoid any overflows, however, emergency overflows via the spillway would be captured within the MIA Dam.

2.2.11 Sediment dams

During open cut mining operations, catchment runoff from overburden dumps will be captured in three sediment dams (referred to as Southern Sediment Dam, Northern Sediment Dam 1 and Northern Sediment Dam 2 as shown in Figure 2.2 to Figure 2.4). Sediment dams will be designed and operated in accordance with the Department of Environment and Heritage Protection Guideline - Stormwater and environmentally relevant activities (DEHP, 2017). This guideline states that:

"For events up to and including a 24 hour storm event with an ARI of 1 in 10 years, the following must be achieved:

i. *a sediment basin must be designed, constructed and operated to retain the runoff at the site(s) approved as part of the ERA application;*
ii. *the release stormwater from these sediment basins must achieve a total suspended solids (TSS) concentration of no more than 50mg/L for events up to and including those mentioned above. For events larger than those stated above, all reasonable and*

practical measures must be taken to minimise the release of prescribed contaminants."

The Northern Sediment Dam 1 would be initially constructed by pre-excavating overburden material near the northern corner of the open cut pit levee. Once the existing ground surface is mined out, sediment dams would be formed into localised depressions north and south of the open cut pit. Further details are provided in the following section.

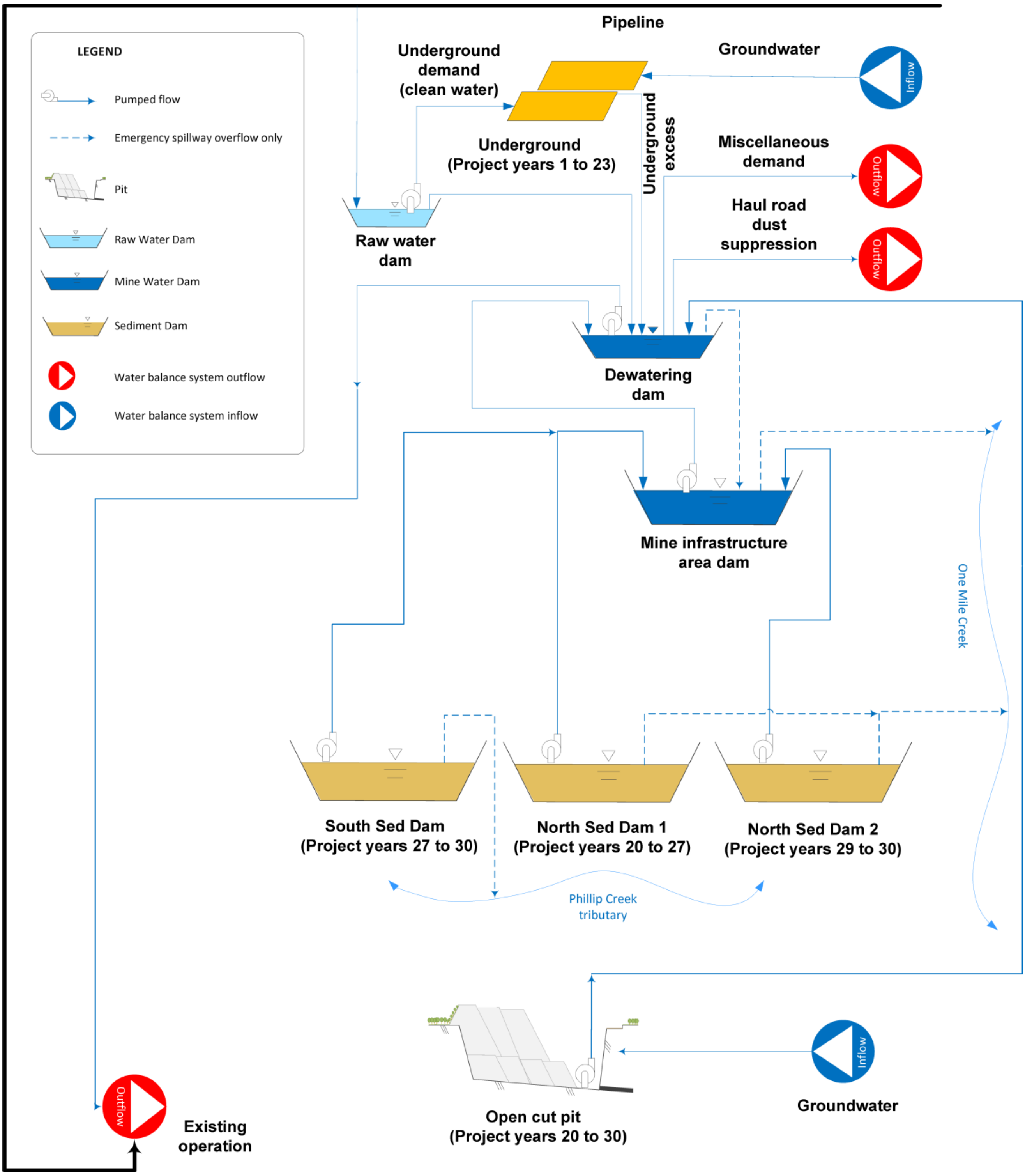

Figure 2.1 – Lake Vermont Meadowbrook WMS schematic

2.3 OPEN CUT MINE DEVELOPMENT AND STAGING

Over the 30-year operating life of the Project, the operation will be staged as indicated in the following series of figures, which show the catchment areas to each mine water storage and the land use types comprising each catchment. These “snapshots” of mine operations have been adopted for the purpose of the site water balance modelling.

The Lake Vermont Meadowbrook Project model was run for 4 stages, as shown in Table 2.2.

In stage 1 only the underground mine is operating so there is no representative mine year for this stage.

The model provides a forecast for Stages 1 to 4 of the storage behaviour, external water demand and spill risks for the 29.5 year period of operations.

Table 2.2 – Lake Vermont Meadowbrook project staging

Stage	Representative Project Year	Modelled period (Project Years)	No. of model years
1	1	1-19	19
2	22	20-26	7
3	27	27-28	2
4	29	29-30	1.5

2.3.1 Catchment areas and land use classifications

Catchment areas for the various pits and site water management infrastructure were based on stage plans provided by Bowen Basin Coal for various mine stages. Adopted catchment areas and land use types for each stage are summarised in Table 2.3 to Table 2.6. The proposed disturbance footprints are shown in Figure 2.2 to Figure 2.4.

Table 2.3 – Catchment areas and land use breakdown summary (Stage 1 – Year 1-Year 19)

Dam	Contributing catchment (ha)					
	Cleared/ Prestrip	Compacted Hardstand	Mining Pit	Unrehabilitated Spoil	Natural	Total
MIA Dam	0.0	54.0	0.0	0.0	19.0	73.0
Dewatering Dam	0.0	0.4	0.0	0.0	0.0	0.4
Total	**0.0**	**54.0**	**0.0**	**0.0**	**19**	**73.4**

Table 2.4 - Catchment areas and land use breakdown summary (Stage 2 – Year 20-Year 26)

Dam	Contributing catchment (ha)					
	Cleared/ Prestrip	Compacted Hardstand	Mining Pit	Unrehabilitated Spoil	Natural	Total
MIA Dam	0.0	54.0	0.0	0.0	19.0	73.0
Dewatering Dam	0.0	0.4	0.0	0.0	0.0	0.4
Pit	136.7	0.0	39.4	98.6	0.0	274.8
North Sed Dam 1	220.1	14.8	0.0	92.1	0.0	327.0
South Sed Dam	0.0	0.0	0.0	0.0	0.0	0.0
North Sed Dam 2	0.0	0.0	0.0	0.0	0.0	0.0
Total	**356.8**	**88.2**	**39.4**	**190.7**	**0.0**	**602.2**

Table 2.5 - Catchment areas and land use breakdown summary (Stage 3 – Year 27-Year 28)

Dam	Contributing catchment (ha)					
	Cleared/ Prestrip	Compacted Hardstand	Mining Pit	Unrehabilitated Spoil	Natural	Total
MIA Dam	0.0	54.0	0.0	0.0	19.0	73.0
Dewatering Dam	0.0	0.4	0.0	0.0	0.0	0.4
Pit	0.0	76.5	75.7	220.3	0.0	372.5
North Sed Dam 1	0.0	0.0	0.0	0.0	0.0	0.0
South Sed Dam	0.0	11.1		244.5	0.0	255.6
North Sed Dam 2	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**160.2**	**75.7**	**438.2**	**0.0**	**674.0**

Table 2.6 - Catchment areas and land use breakdown summary (Stage 4 – Year 29-Year 30)

Dam	Contributing catchment (ha)					
	Cleared/ Prestrip	Compacted Hardstand	Mining Pit	Unrehabilitated Spoil	Natural	Total
MIA Dam	0.0	54.0	0.0	0.0	19.0	73.0
Dewatering Dam	0.0	0.4	0.0	0.0	0.0	0.4
Pit	0.0	72.3	50.6	26.5	0.0	149.4
North Sed Dam 1	0.0	0.0	0.0	0.0	0.0	0.0
South Sed Dam	0.0	10.1	0.0	245.5	0.0	255.6
North Sed Dam 2	0.0	8.6	0.0	214.5	0.0	223.1
Total	**0.0**	**164.4**	**50.6**	**460**	**0.0**	**675.0**

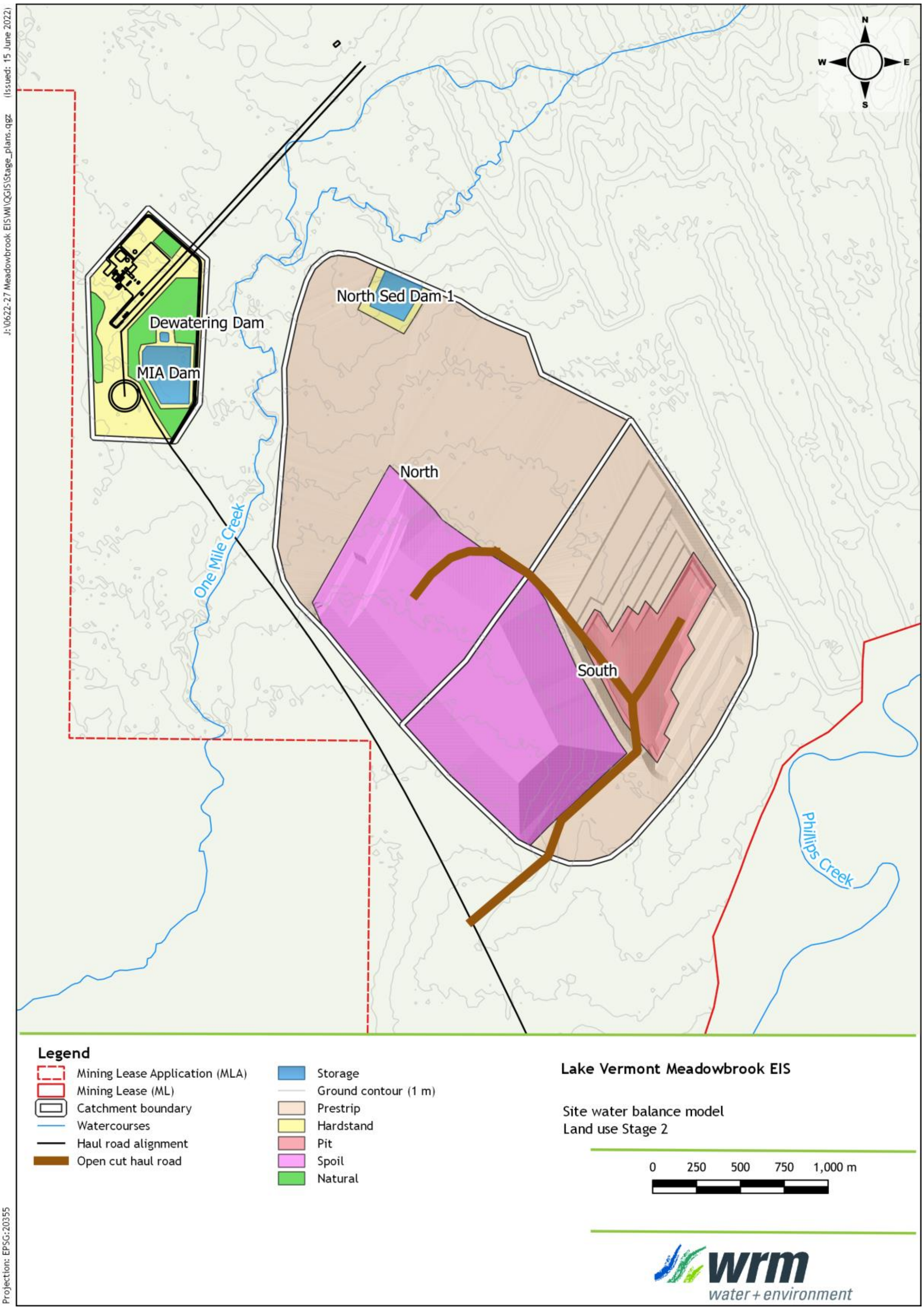

Figure 2.2 – Proposed catchment and land use boundaries (Stage 2 – Year 20-26)

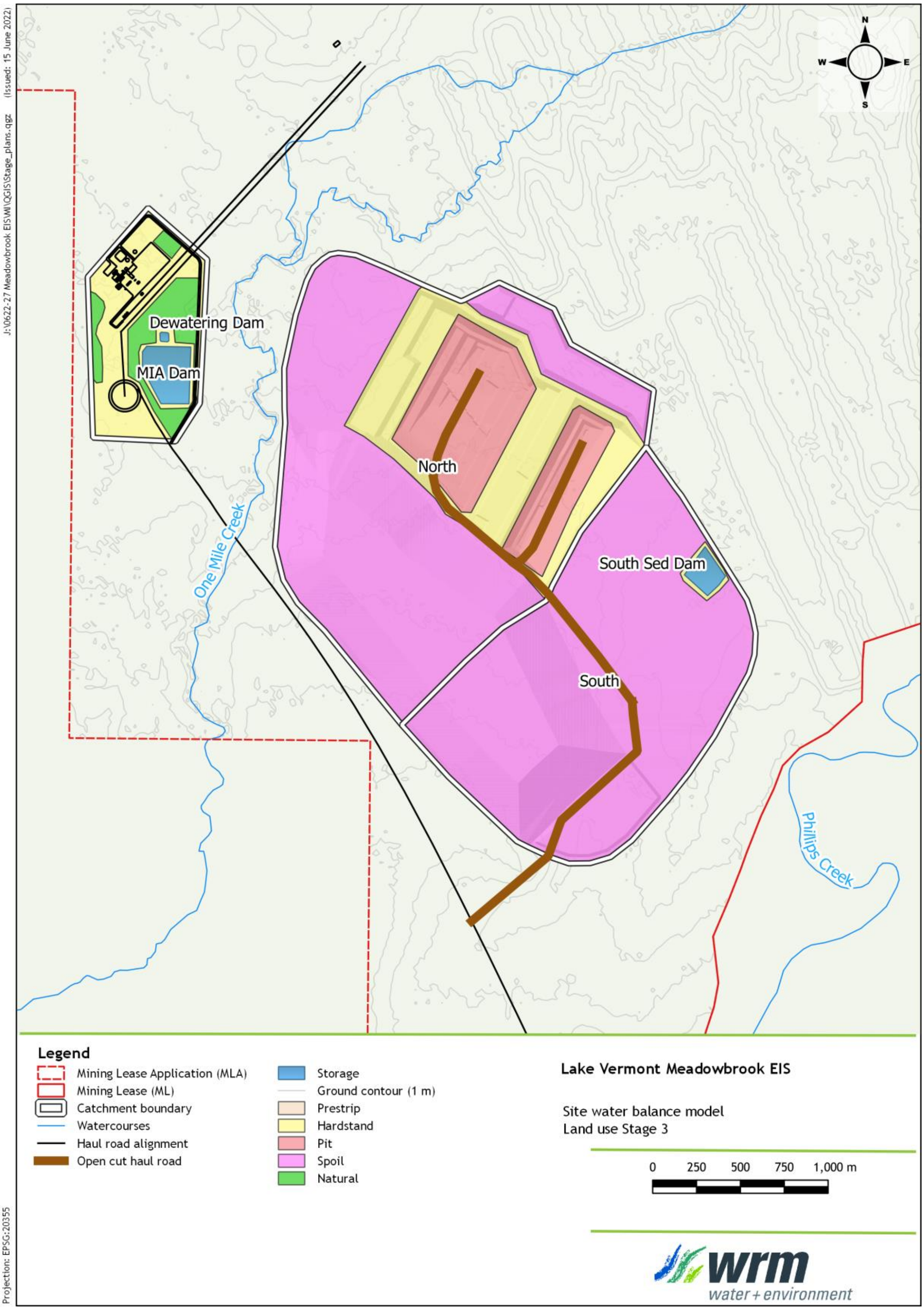

Figure 2.3 – Proposed catchment and land use boundaries (Stage 3 – Year 27-28)

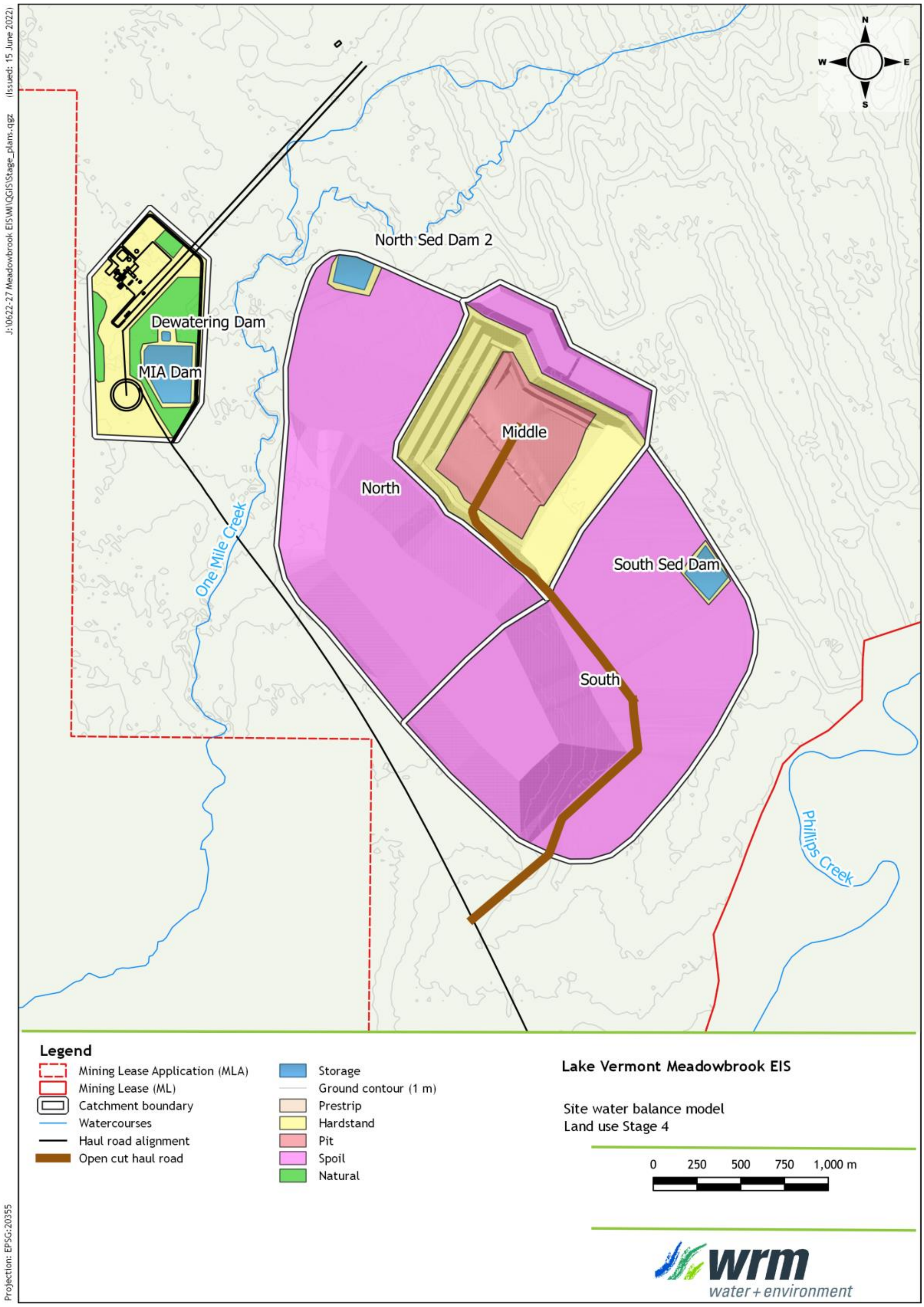

Figure 2.4 – Proposed catchment and land use boundaries (Stage 4 – Year 29-30)

2.4 DAM CAPACITIES

The capacities of the proposed water storage dams and their associated maximum catchment areas are summarised in Table 2.7.

Sediment dams were sized to capture runoff from the 1 in 10 AEP 24 hour design rainfall event. The MIA dam was sized through trial and error to that there would be no modelled discharges under historical climate conditions.

Table 2.7 – Proposed Lake Vermont Meadowbrook storage details

Storage name	Storage type	Maximum catchment area (ha)	Water Storage capacity (ML)	Overflows to
Raw Water Dam	Raw water	0.4	20	One Mile Creek
Dewatering dam	Mine affected water	0.4	20	One Mile Creek
MIA Dam	Mine affected water	73	440	One Mile Creek
North Sed Dam 1	Sediment dam	327	240	One Mile Creek
North Sed Dam 2	Sediment dam	223	155	One Mile Creek
South Sed Dam	Sediment dam	256	180	Phillips Creek Northern floodplain tributary

3 Modelling methodology

3.1 OVERVIEW

A GoldSim water balance model was developed for the proposed Lake Vermont Meadowbrook site water management system (WMS). The GoldSim model dynamically simulates the operation of the water management system and keeps complete account of all site water volumes and representative water quality on a daily time step.

The model was designed to simulate the operation of all major components of the WMS at Lake Vermont Mine, including:

- Climatic variability – rainfall and evaporation;
- Catchment runoff and capture;
- Groundwater inflows to the open cut pit and underground operations;
- Water use in underground and surface operations, including dust suppression and processing uses;
- Dewatering of the underground and open cut operations;
- Pump transfers between storages, including the transfer of excess water to the existing Lake Vermont operations; and
- Water storage inflows/outflows.

The simulated inflows and outflows included in the model are summarised in Table 3.1

Table 3.1 – Simulated inflows and outflows to the water management system

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	Dust suppression demand
Groundwater inflows to the open cut pit	Miscellaneous usage
Groundwater inflows to the underground operations	ROM moisture loss
Pumped inflows from the existing operation	Vent shaft loss
	Water returned to existing operation

The model configuration and operating parameters are summarised in the following sections.

3.2 SIMULATION METHODOLOGY

The forecast model was run for 133 climate sequences, each referred to as a “realisation”. Each realisation is based on a 29.5 year sequence extracted from the historical rainfall data. The first realisation was based on rainfall data from 1889 to 1918. The second used data from 1890 to 1919 and so on. This approach provides the widest possible range of climate scenarios covering the full range of climatic conditions represented in the historical rainfall record. The data was ‘wrapped’ so that a realisation could commence at the start of each year in record. A realisation commencing on 1 January 2021 therefore uses data commencing 1 January 1889 from the second year of the simulation. Statistical analysis of the results from all realisations provides a probability distribution of key hydrologic parameters.

3.3 RAINFALL AND EVAPORATION

Long term daily rainfall and evaporation data for the area from January 1889 to December 2021 (133 years) obtained from the SILO database (https://longpaddock.qld.gov.au/silo/) formed the basis of the simulation.

Morton’s Lake evaporation was used to estimate evaporation losses from storages. Daily evaporation was calculated from a storage versus surface area relationship developed for each dam. For the open cut pit, an adjustment factor of 0.7 was applied to account for shading and sheltering by the pit walls. Table 3.2 shows the long-term monthly averages for Morton’s evaporation and monthly SILO rainfall data.

Figure 3.1 shows the annual distribution of monthly rainfall and evaporation. Rainfall across Lake Vermont Meadowbrook is greatest during the summer months with the lowest rainfalls occurring mid-winter, as shown in Figure 3.1.

Table 3.2 – Long term average rainfall and evaporation (SILO 1889 – 2020)

Month	Rainfall (mm)	Morton’s lake evaporation (mm)
Jan	107.0	198.9
Feb	94.4	167.1
Mar	66.1	167.2
Apr	30.2	132.6
May	26.0	101.5
Jun	29.8	80.7
Jul	20.7	91.0
Aug	18.3	118.8
Sep	16.8	152.0
Oct	31.8	188.6
Nov	52.1	200.1
Dec	84.1	210.2
TOTAL	**569**	**1,814**

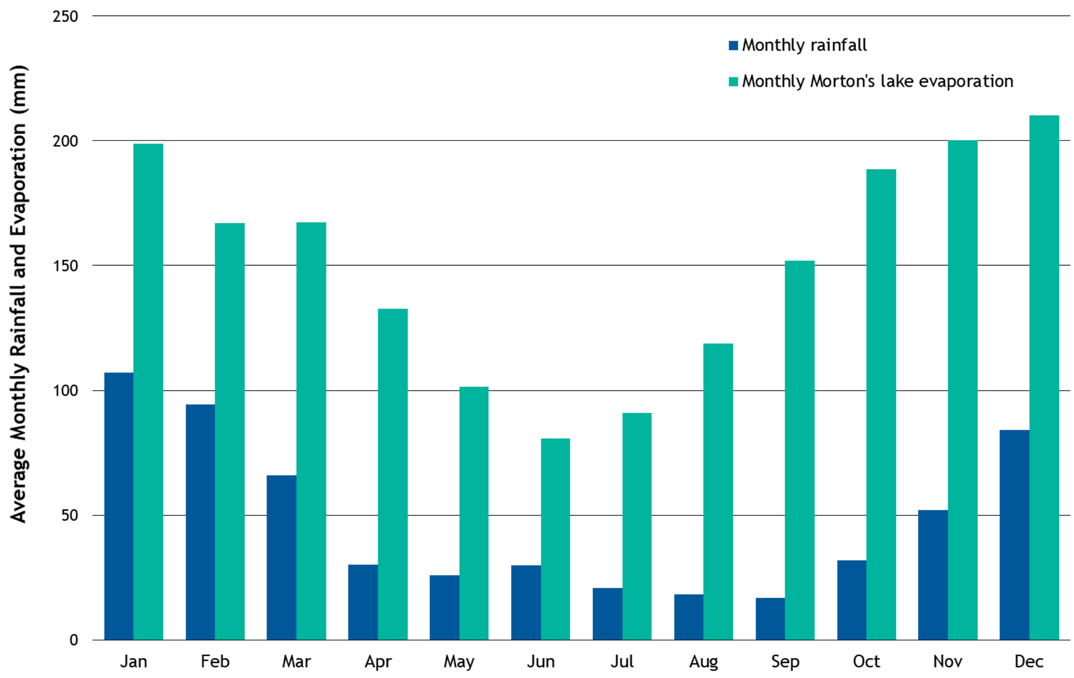

Figure 3.1 – Distributions of monthly rainfall and evaporation (SILO 1889-2021)

3.4 CATCHMENT RUNOFF

3.4.1 Overview

The Australian Water Balance Model (AWBM) (Boughton, 2003) was used to represent the runoff characteristics of mine site catchments. AWBM uses a group of connected conceptual storages (three surface storages and one groundwater storage) to represent catchment runoff. Water in the conceptual storages is replenished by rainfall and reduced by evaporation. Simulated surface runoff occurs when any of these storages fill and overflow. The model parameters define the depth and relative area of each of the storages, as well as the rate of water flux from/between storages.

The model uses daily rainfalls and estimates of catchment evaporation to calculate daily values of runoff using a daily water balance of soil moisture. The model has a baseflow component which simulates the recharge and discharge of a shallow subsurface store. Runoff depth calculated by the AWBM model is converted into runoff volume by multiplying the contributing catchment area.

Because the AWBM model runs on a daily timestep a daily timeseries of the catchment runoff volumes were derived in a separate GoldSim model so that the operational GoldSim model could insert unscheduled sub daily timesteps.

3.4.2 AWBM parameters

The model parameters define the storage depths (C1, C2 and C3), the proportion of the catchment draining to each of the storages (A1, A2 and A3), and the rate of flux between them (Kbase, Ksurf and BFI).

To adequately simulate the site water balance, it is necessary to define the runoff characteristics of the various catchment surface types. Catchments across the site were characterised into the following land use types:

- Undisturbed/Natural, representing areas largely undisturbed by mining activity – generally rural landuse;
- Compacted, representing hauls roads, hardstand areas;
- Cleared or pre-strip areas ahead of mining;
- Spoil dump, representing uncompacted dumped overburden material; and
- Pit area representing the active mining pit.

Compacted catchments (roads/hardstand and stockpile/industrial areas) are characterised by hard surfaces which inhibit water infiltration, resulting in much higher rates of surface runoff. To represent compacted catchments, the depth of the model surface stores was substantially reduced and baseflow eliminated.

The adopted model parameters for “spoil dump” assume lower opportunities for evapotranspiration than natural catchments and also assume that a significant component of runoff will seep through the spoil, discharging over several weeks rather than running off within a few hours of rainfall.

The AWBM parameters were derived during the development of the operational water balance model for the Lake Vermont Mine existing operations, and were derived by calibrating to observed water levels in the major storages. The adopted AWBM parameters used for modelling are summarised in Table 3.3

Table 3.3 – Adopted AWBM parameters

Parameter	Undisturbed/ Natural	Cleared/ Pre-strip	Compacted Hardstand	Spoil	Pit
A1	0.134	0.1	0.1	0.1	0.1
A2	0.433	0.9	0.9	0.4	0.3
A3	0.433	0	0	0.5	0.6
C1 (mm)	5.7	12	12	15	2
C2 (mm)	57.8	54	38	80	8
C3 (mm)	115.7	0	0	100	32
C_{av} (mm)	75.9	49.8	35.4	83.5	21.8
K_{base}	-	-	-	0.8	-
K_{surf}	-	-	-	0.1	-
BFI	-	-	-	0.9	-
C_v	14.2%	16.0%	20.8%	10.4%	31.4%

3.5 MODELLING OF WATER QUALITY

The water balance model was configured to use total dissolved salts (TDS) as an indicator of water quality. Each runoff type or water source was assigned a representative TDS concentration. Water quality values were based on observations of changes in stored water quality following inflows to the water storages at the existing Lake Vermont operations.

Table 3.4 – Adopted runoff salinity by land use type

Catchment land use	TDS (mg/L)
Pit	3,900
Hardstand	1,100
Spoil	650
Cleared/pre-strip	390
Undisturbed/Natural	200

The groundwater assessment (JBT, 2022) states the median electrical conductivity (EC) of groundwater samples taken from the Rewan Group sediments was 26,290 mS/cm, whereas the median EC of samples from the tertiary sediments was 20,716 mS/cm. For the surface water model, groundwater inflows were assigned an approximately equivalent representative total dissolved salts (TDS) concentration of 17,000 mg/L (based on a conversion factor from EC to TDS of 0.65).

4 Water management system details and assumptions

4.1 UNDERGROUND WATER BALANCE

The schematic diagram in Figure 4.1 below indicates the major components of inflow and outflow to the underground operation.

Inflows to the underground workings include:

- Raw water (and treated water) to supply the underground mining equipment, dust suppression and washdown. Based on benchmarking against similar Bowen Basin mining operations, the adopted inflow rate is 200 L/t ROM;
- Groundwater seeping into the operation (as predicted in the Project groundwater impact assessment (JBT,2022)); and
- In-situ moisture within the ROM coal prior to extraction by the operation (4.5% (as advised by Bowen Basin Coal)).

Outflows include:

- Moisture in the ROM coal extracted from the operation (which tends to increase due to the application of dust suppression water) (7.5% (as advised by Bowen Basin Coal));
- Minor losses such as moisture in humid air extracted via vent shafts (120 ML/year based on experience at similar operations); and
- Water captured within the underground dewatering system and returned to the surface (calculated as the balance of the other inflows and outflows).

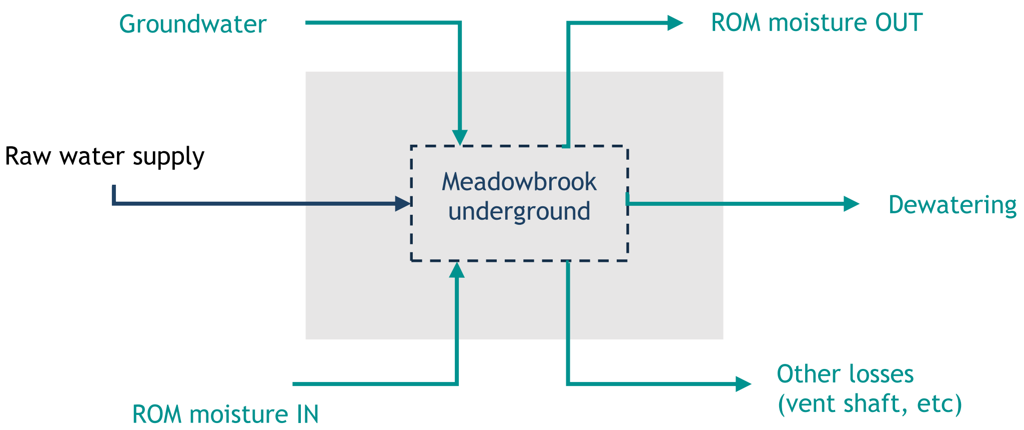

Figure 4.1 – Underground water balance schematic

Based on the above assumptions, the estimated annual underground return volumes are provided in Table 4.1, which shows the underground dewatering volumes would be expected to vary between approximately 940 ML/year and 1,840 ML/year.

Table 4.1 – Estimated annual underground water balance

Year	Underground ROM production rate (tonne/d)	Inflows (ML/year)			Outflows (ML/year)			
		Groundwater	Raw water	Total inflows	Increase in ROM coal moisture	Vent shaft extraction	Dewatering	Total outflows
1	330	-	24	24	4	20	-	24
2	1,117	13	82	94	12	82	-	94
3	10,559	54	771	824	116	120	589	824
4	17,507	139	1,282	1,421	192	120	1,108	1,421
5	18,378	224	1,342	1,565	201	120	1,244	1,565
6	18,983	224	1,386	1,610	208	120	1,282	1,610
7	17,371	186	1,268	1,454	190	120	1,144	1,454
8	14,622	228	1,070	1,298	161	120	1,017	1,298
9	14,676	224	1,071	1,295	161	120	1,014	1,295
10	13,338	243	974	1,216	146	120	950	1,216
11	14,922	277	1,089	1,367	163	120	1,083	1,367
12	10,771	313	789	1,101	118	120	863	1,101
13	13,319	309	972	1,281	146	120	1,015	1,281
14	14,732	265	1,075	1,340	161	120	1,059	1,340
15	16,250	233	1,186	1,420	178	120	1,122	1,419
16	12,301	228	900	1,128	135	120	873	1,128
17	12,984	208	948	1,156	142	120	894	1,156
18	13,879	186	1,013	1,199	152	120	927	1,199
19	12,541	183	916	1,098	137	120	841	1,098
20	12,969	183	949	1,133	142	120	870	1,133
21	15,686	186	1,145	1,331	172	120	1,039	1,331
22	12,085	195	882	1,078	132	120	825	1,078
23	8,126	205	593	798	89	120	589	798

4.2 GROUNDWATER INFLOW RATE

The results of groundwater modelling undertaken for the Project groundwater impact assessment (JBT,2022) were used to derive time series of net groundwater inflows to the underground and open cut pit. Table 4.2 shows the groundwater inflows to the underground for the life of the underground operation and open cut pit.

Table 4.2 – Groundwater inflows to the underground an open cut operations (ML/year)

Year	Underground inflow	Open cut inflow
1	-	0
2	13	0
3	54	0
4	139	0
5	224	0
6	224	0
7	186	0
8	228	0
9	224	0
10	243	0
11	277	0
12	313	0
13	309	0
14	265	0
15	233	0
16	228	0
17	208	0
18	186	0
19	183	0
20	183	14
21	186	29
22	195	23
23	205	51
24	231	106
25	205	86
26	176	162
27	-	152
28	-	115
29	-	32
30	-	0

4.3 WATER DEMANDS FOR SURFACE OPERATIONS

4.3.1 Miscellaneous usage in the mine infrastructure area

Water will be required for miscellaneous purposes such as washdown and dust suppression within the MIA. Based on experience at other similar operations, allowance has been made for use of 100 ML/year of water sourced from the site dams.

4.3.2 Haul road dust suppression usage

During open cut operations, water for haul road dust suppression will be sourced from the proposed site dams. Forecast dust suppression rates are calculated on a daily basis using the estimated length of watered haul road (varying between 5.1 km in Stage 1, 4.5 km in Stage 2 and 3.4 km in Stage 3), watered road width of 26 m, and a usage rate of the daily evaporation rate (adjusted to zero when daily rainfall exceeds 5 mm based on operations at Lake Vermont).

4.4 OPERATING RULES

The operating rules developed for the Project and applied in the water balance model are provided in Table 4.3.

Table 4.3 – Meadowbrook water management system operating rules

Item	Node name	Operating Rules
1.0	***External Raw Water***	
1.1	Raw water pipeline	• Supplies the underground operations with raw water • Supply assumed to be unlimited by allocation constraints
2.0	***Supply to Demands***	
2.1	Meadowbrook Underground	• Demands of 200L/t ROM supplied from raw water pipeline based on production schedule • Raw water demands are not consumptive - raw water mixes with groundwater in underground • Groundwater inflows offset losses to ROM coal and vent shaft losses • Daily excess inflow delivered to dewatering dam
2.2	Haul road dust suppression	• Supplied to open cut operation only - haul road and access road between LV and Meadowbrook is sealed • Demands supplied from dewatering dam • Supplied based on applying at the daily evaporation rate to 26 m wide watered road surface (set to zero when daily rainfall exceeds 5 mm)
2.3	Miscellaneous Meadowbrook demand	• 100 ML/year for miscellaneous demands supplied from dewatering dam
3.0	***Transfer of pit water***	

Item	Node name	Operating Rules
3.1	Open cut pit	• In-pit sump receives groundwater inflows and runoff from local catchment • Pumping from pit dewatering pumps at a nominal maximum rate of 75 L/s (6,450 kL/d) • Pit dewatering is delivered to the dewatering dam when the dewatering dam is less than 75% full
4.0	***Operation of site dams***	
4.1	Dewatering Dam	• Mine affected water dam • Supplies dust suppression demand • Supplies miscellaneous demand • Returns water to Lake Vermont at nominal maximum rate of 150 L/s (12,900 kL/d) • Additional raw water added when stored volume falls below 3 ML • Dam overflows to MIA Dam
4.1	MIA Dam	• Mine affected water dam • Receives pumped inflows from all sediment dams • Transfers to the dewatering dam when the dewatering dam is less than 75% full (equivalent to the 1 in 10 AEP 24 hour rainfall volume). • Dam overflows to One Mile Creek
4.2	North Sed Dam 1	• Sediment water dam • Transfers to the MIA dam when the MIA dam volume is less than 345 ML • Continuous pumping from dam at a nominal maximum rate of 75 L/s (6,450 kL/d) • Dam overflows to One Mile Creek
4.3	South Sed Dam	• Sediment water dam • Transfers to the MIA dam when the MIA dam volume is less than 345 ML • Continuous pumping from dam dewatering pumps at a nominal maximum rate of 75 L/s (6,450 kL/d) • Dam overflows to Phillips Creek tributary
4.2	North Sed Dam 2	• Sediment water dam • Transfers to the MIA dam when the MIA dam volume is less than 345 ML • Continuous pumping from dam at a nominal maximum rate of 75 L/s (6,450 kL/d) • Dam overflows to One Mile Creek
5.0	***Receiving water***	

Item	Node name	Operating Rules
5.1	One Mile Creek	• May receive uncontrolled overflows from the following storages: ○ MIA dam ○ North Sed Dam 1 ○ North Sed Dam 2
5.2	Phillips Creek tributary	• May receive uncontrolled overflows from the following storages: ○ South Sed Dam
6.0	***General***	• All storages and pits receive local runoff and lose water through evaporation - calculated on a daily basis

5 Water balance results

5.1 OVERVIEW

The water balance model was used to assess the performance of the Project water management system, using the following key performance indicators:

- overall water balance – the average inflows and outflows of the water management system;
- spillway overflows – the risk and associated volumes (and salt loads) of uncontrolled discharge from the mine affected water storages and sediment dams to the receiving environment; and
- likelihood of disruptions to mining due to open cut pit inundation;
- salinity – the average salt loads in and out of the water management system;
- annual raw water pipeline supply volume;
- annual volume of transfers to Lake Vermont operation.

The use of a large number of climate sequences reflecting the full range of historical climatic conditions provides an indication of the system performance under very wet, very dry and average climatic conditions.

5.2 INTERPRETATION OF MODEL RESULTS

In interpreting the results of the site water balance it should be noted that the results provide a statistical analysis of the water management system's performance over the 30 years of mine life, based on 133 realisations with different climatic sequences.

The model results are presented as a probability of exceedance. For example, the 10th percentile represents a 10% probability of exceedance and the 90th percentile results represent a 90% probability of exceedance. There is an 80% chance that the result would lie between the 10th and 90th percentile traces.

Whether a percentile trace corresponds to wet or dry conditions depends upon the parameter being considered. For site water storage, where the risk is that available storage capacity would be exceeded, the lower percentiles correspond to wet conditions. For example, there is only a small chance that the 1 percentile storage volume would be exceeded, which would correspond to very wet climatic conditions. For off-site site water supply volumes (for example), where the risk is that insufficient water would be available, there is only a small chance that more than the 1 percentile water supply volume would be required. This would correspond to very dry climatic conditions.

It is important to note that a percentile trace shows the likelihood of a particular value on each day and does not represent continuous results from a single model realisation. For example, the 50th percentile trace does not represent the model time series for median climatic conditions.

5.3 OVERALL WATER BALANCE

Water balance results for all 133 model realisations are presented in Table 5.1 averaged over each model phase. The averages include wet and dry periods distributed throughout the Project life. It should be recognised that the following items are subject to climatic variability:

- Rainfall runoff;
- Evaporation;
- Haul road dust suppression;
- Return water; and
- Spills from dams.

Table 5.1 – Average annual site water balance

Component	Process	Volume (ML/year)	
		Underground operations Project Years 1-23	Open cut operations Project Years 20-30
Inflows	Rainfall and runoff	127.0	527.5
	Net groundwater inflow	197.4	193.3
	External supply pipeline	1,051.0	310.5
	Total	**1,375.5**	**1031.2**
Outflows	Dam evaporation	7.3	16.7
	Haul road dust suppression	10.8	158.1
	ROM coal moisture	144.7	24.6
	Vent shaft losses	113.5	26.6
	Miscellaneous surface demands	98.8	94.1
	Return to Lake Vermont	997.3	693.6
	Spill from MIA Dam	0.0	0.0
	Spill from Sediment Dams	2.0	16.1
	Total	1,374.3	1,029.9
Change in Site Water Inventory		**1.2**	**1.3**

*Includes inflow to underground during start of open cut operations

5.4 LIKELIHOOD OF SPILLWAY OVERFLOWS

5.4.1 MIA Dam

The results of the water balance model presented in Figure 5.1 show the adopted storage capacity is sufficient to contain inflows throughout the Project life without overflow. The likelihood of approaching the dam capacity increases once open cut operations commence.

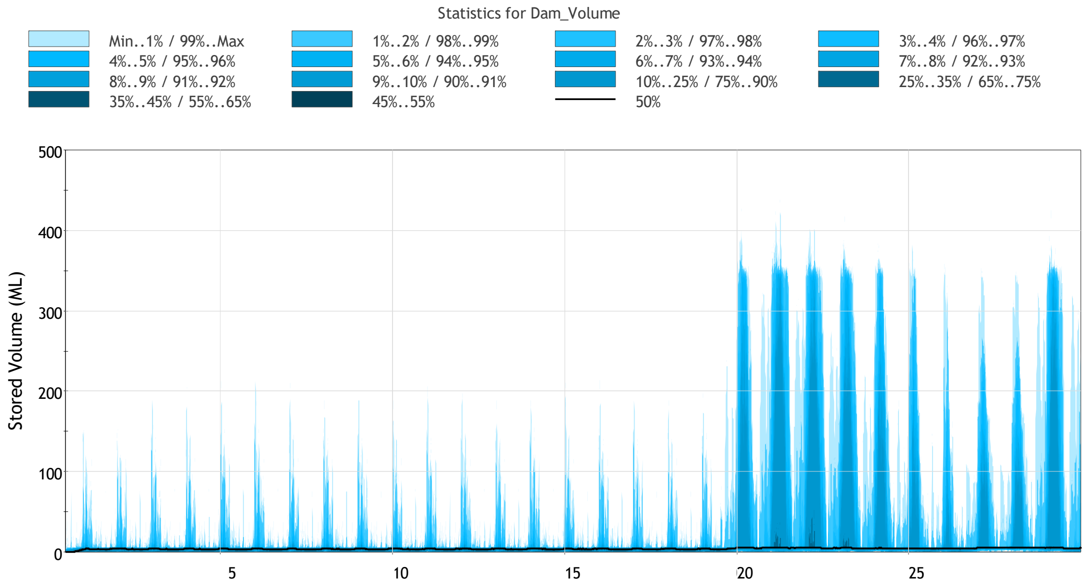

Figure 5.1 – MIA Dam – stored water volume

5.4.2 Sediment dams

Figure 5.2 to Figure 5.4 indicate the annual magnitude and likelihood of overflow from each of the sediment dams. The results show that overflows would only be expected in the 10th percentile (wet) conditions.

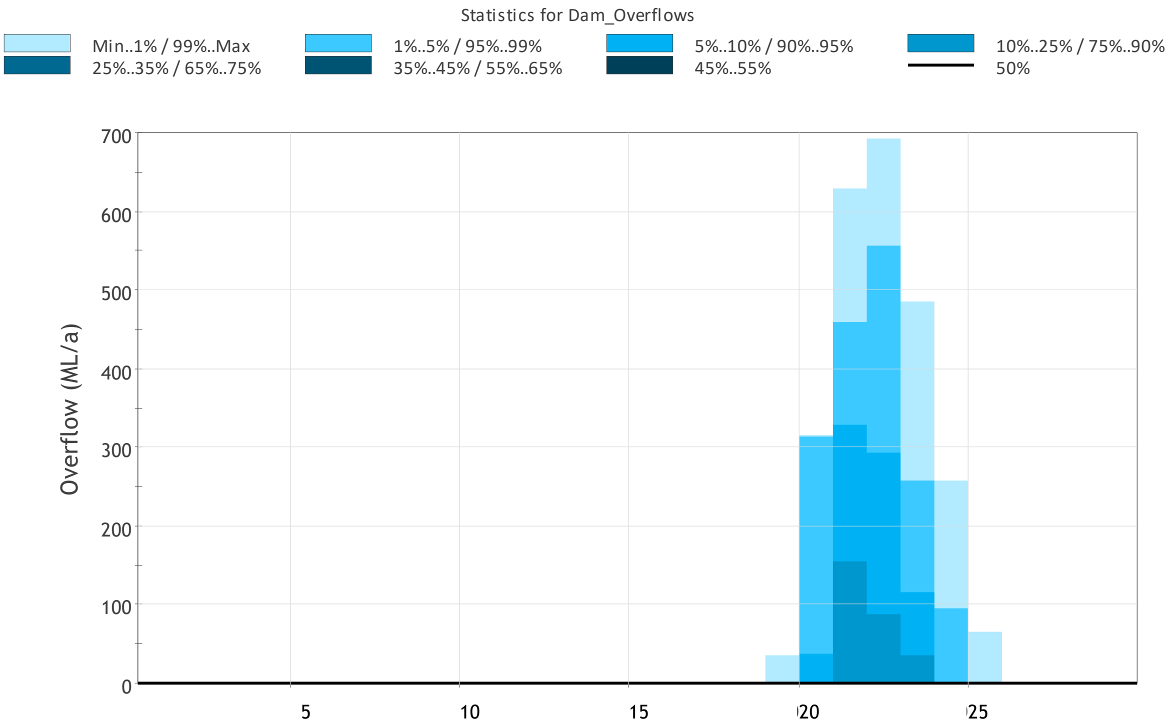

Figure 5.2 – North Sediment Dam 1 – modelled annual overflow

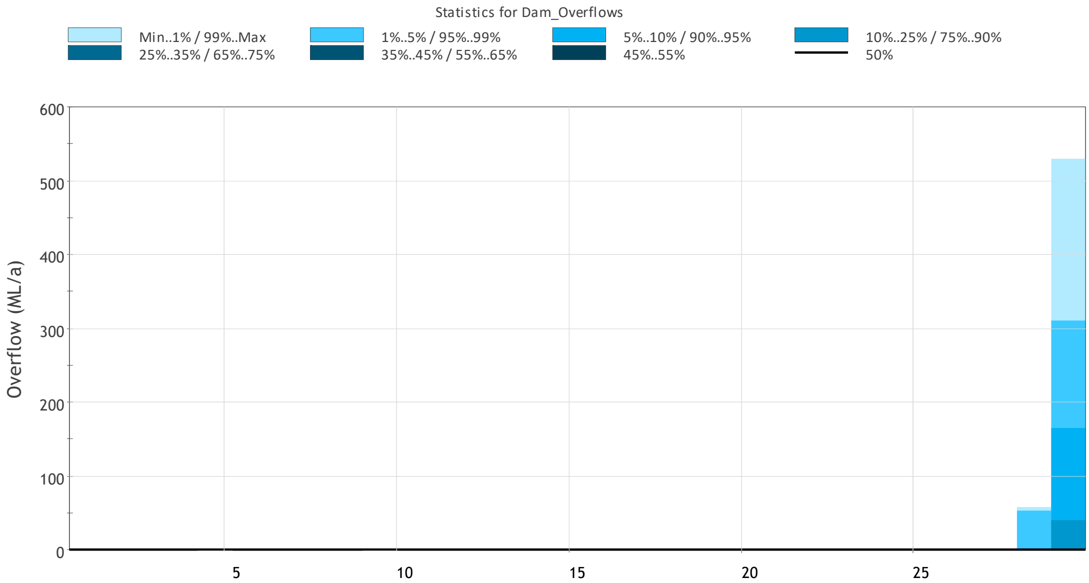

Figure 5.3 – North Sediment Dam 2 – modelled annual overflow

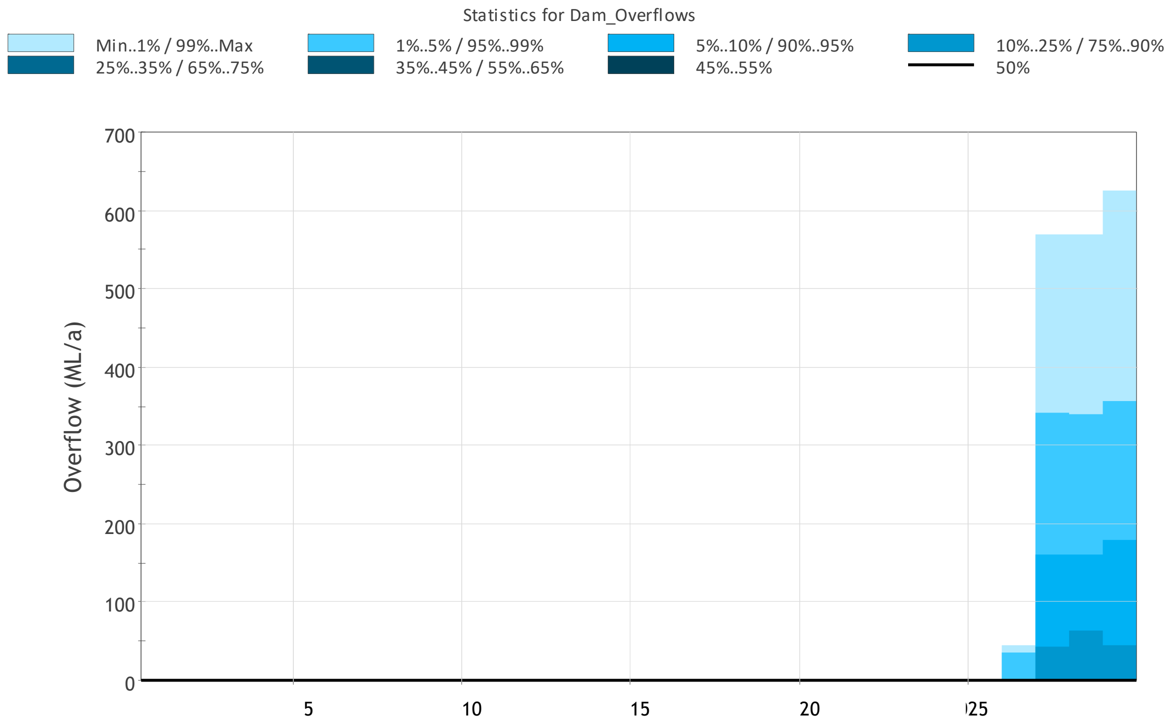

Figure 5.4 – South Sediment Dam – modelled annual overflow

Table 5.2 summarises the likelihood and magnitude of sediment dam overflows over the entire life of the project. The largest modelled total sediment dam release during open cut operations was 1,038 ML from North Sediment Dam under very wet climate conditions. Median total project releases are expected to be much smaller – less than 140 ML from each dam over the total project life.

Table 5.2 Modelled sediment dam overflow volumes during project

	Probability of any overflows	Median total overflow (ML)	Max total overflow (ML)	Max daily overflow (ML/d)	Max number of spilldays	90th percentile number of spilldays
North Sed Dam 1	49%	110	1,038	240	37	19
North Sed Dam 2	14%	93	587	64	23	8
South Sed Dam	36%	140	681	73	32	19

5.4.3 Sediment dam overflow salinity and dilution

As shown in Table 5.3, the modelled salinity of sediment dam overflows ranged up to a maximum of 691 mg/L at the North Sediment Dam.

The overflows would be diluted in coincident streamflow in One Mile Creek and Phillips Creek. Coincident streamflow in these streams was estimated using the AWBM parameters adopted for undisturbed/natural catchments. Assuming complete mixing in an assumed receiving water salinity of 200 mg/L, the estimated maximum salinities during sediment dam overflows were estimated to be 377 mg/L and 253 mg/L in One Mile Creek and Phillips Creek respectively. However, during most overflow events, modelled salinities were significantly less (the corresponding 80th percentiles of maximum modelled release salinities over the project life were 222 mg/L and 231 mg/L). Increases in downstream concentrations of such a magnitude would have minimal impact on downstream environmental values, and are well below recent background levels (which ranged between 696 mg/L and 2,138 mg/L in field measurements taken by the proponent during 2021).

Table 5.3 Modelled salinity of sediment dam overflow and downstream waterways

Dam	Maximum overflow salinity (mg/L)	Maximum downstream salinity (mg/L)	80th percentile downstream salinity (mg/L)	Receiving stream
North Sed Dam 1	518	377	222	One Mile Creek
North Sed Dam 2	691	377	222	One Mile Creek
South Sed Dam	687	269	231	Phillips Creek

In addition to considering the potential salinity from overflows of sediment dams, the potential for nitrogen transportation has also been considered. Based on the expected characteristics of overburden runoff, there would not be significant accumulation of nutrients in the sediment dams, and the transportation of nitrogen through the catchments and streams crossing the project would not be significantly affected.

5.5 OPEN CUT PIT INUNDATION

Figure 5.5 shows water volumes in the open-cut pit over the Project life. The plot shows the median stored volume is minimal. Stored water volumes would generally be maintained at relatively low volumes which would not interrupt mining operations. The 90th percentile in-pit inventory is always less than 380 ML. In very wet years, up to 1,091 ML of water could be stored in the open cut at the 1% confidence level. Pumping to the dewatering dam would ensure the pit is empty prior to the following wet season.

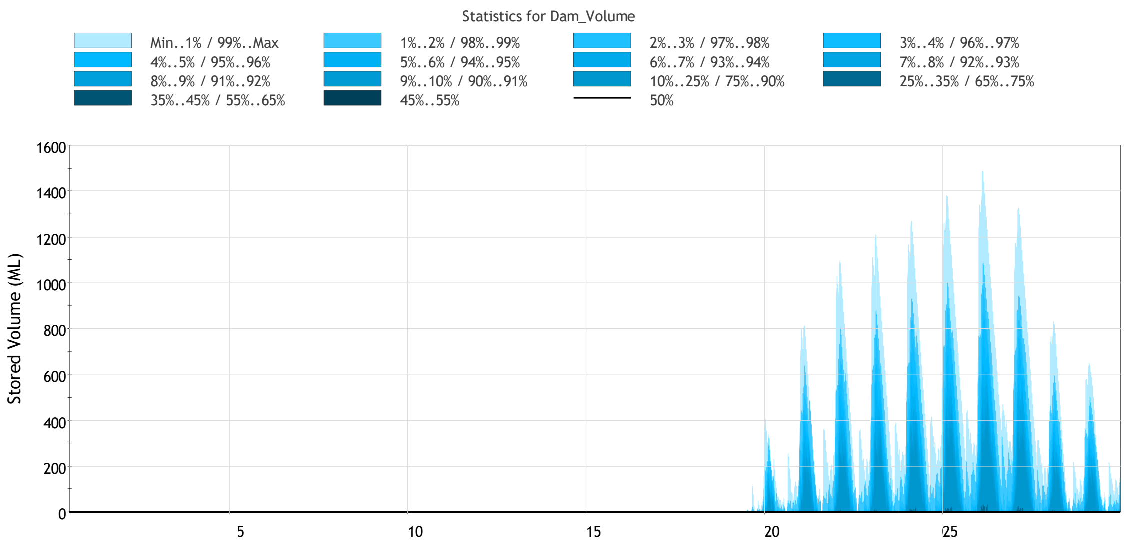

Figure 5.5 – Open cut pit – stored water volume

5.6 RAW WATER PIPELINE SUPPLY VOLUME

Figure 5.6 shows annual volumes of raw water supplied via the raw water supply pipeline. The need for imported water is expected to decrease from a peak of nearly 1,500 ML/a around Year 5 to less than 200 ML/a in the last 5 years of open cut operations.

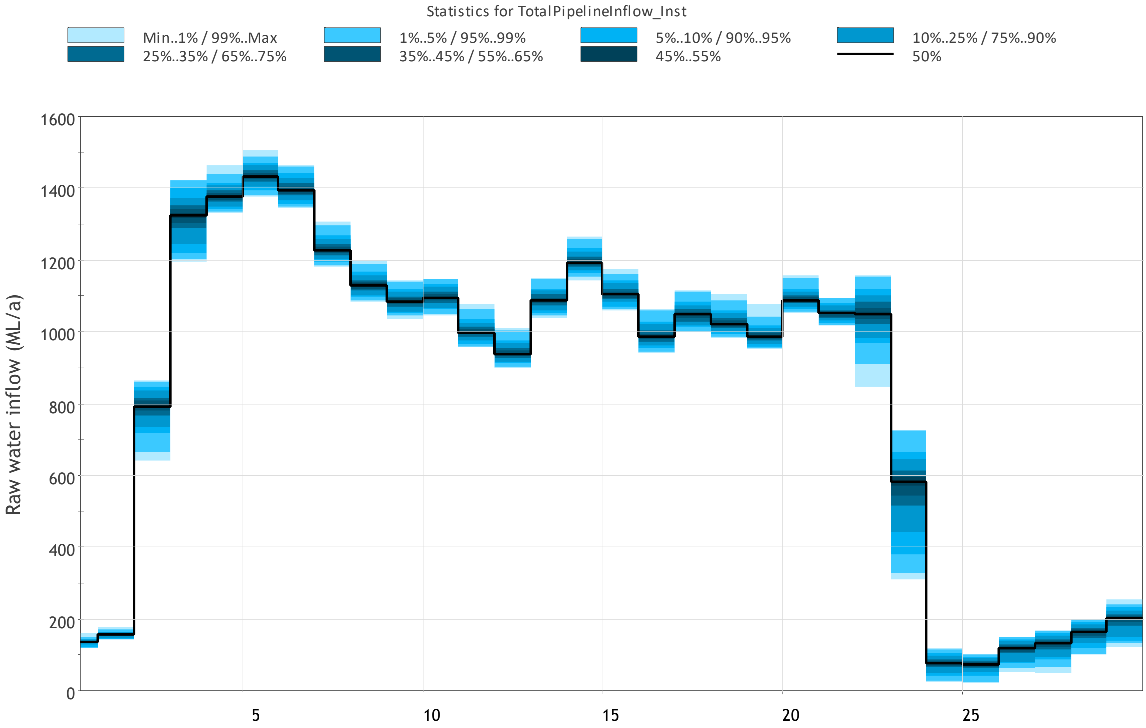

Figure 5.6 - Annual volume of water imported from the raw water pipeline

5.7 ANNUAL TRANSFER TO LAKE VERMONT OPERATION

Figure 5.6 shows annual volumes of excess water to be transferred for use in the Lake Vermont operation.

Mean transfer volumes decrease slightly (from a peak around 1,320 ML/a at Year 5 to less than 950 ML/a in Year 19) as the project proceeds, but if the commencement of open cut operations (prior to the end of underground operations) coincides with very wet weather, there could be a need to transfer as much as 3,060 ML around Year 22.

Mine water storage in existing environmental dams at the Lake Vermont Mine totals 4.9 GL. Following extreme wet periods, up to 200 GL of storage in the mine voids could potentially be used for emergency surface water storage - though this would be undesirable - as it would cause significant disruption to the open cut mining operations.

With careful management of the land bridges separating the North and South Pits. there is sufficient capacity to store as much as 15 GL without overflows into the adjacent operating mining areas - this would allow mining operations to continue at Lake Vermont even if water was stored in the pits as a contingency. The potential available storage will likely increase as the Lake Vermont Open cut continues to advance.

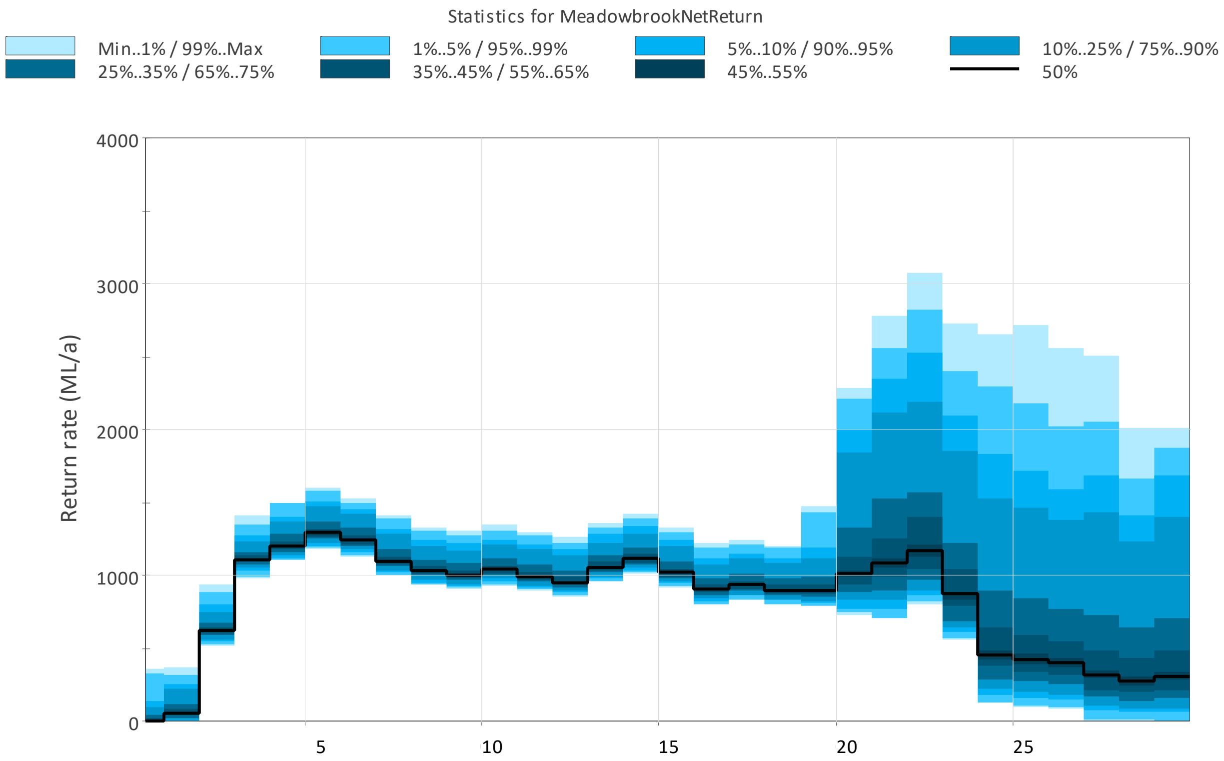

Figure 5.7 – Annual volume of water transferred to Lake Vermont

6 Preliminary consequence category assessment

6.1 CONSEQUENCE ASSESSMENT - DAMS

A consequence assessment has been completed for the dams making up the proposed water management system, in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (DES, 2016) (the Manual).

The Manual sets out the requirements of the administering authority, for consequence category assessment and certification of the design of 'regulated structures', constructed as part of environmentally relevant activities (ERAs) under the Environmental Protection Act 1994 (EP Act).

Each dam is assigned a Consequence Category of High, Significant or Low depending on its potential to cause harm. A structure categorised as a Significant or High consequence, is referred to as a regulated structure. Such structures must comply with hydraulic performance objectives set out in the Manual.

6.1.1 Assessment protocols

The manual requires an assessment of the potential for harm under the following failure event scenarios:

(a) **'Failure to contain – seepage'** – spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure;

(b) **'Failure to contain – overtopping'** – spills or releases from the structure that result from loss of containment due to overtopping of the structure; and

(c) **'Dam break'** – collapse of the structure due to any possible cause.

6.1.2 Assessment criteria

For each failure event scenario, a consequence category is assigned depending on the potential to cause:

- Harm to Humans;
- General Economic Loss; or
- General Environmental Harm.

The potential for harm at the Meadowbrook Project is described in general terms in the following section, and the adopted Consequence Categories are summarised in Table 6.1.

6.1.2.1 Harm to humans

Consumption of contaminated water

The nearest known surface town water supply systems are on the Fitzroy River and would not be materially affected by discharge of the contents of any of the dams at the Project (due to the total stored volume being less than 500 ML, and the very large dilution potential during wet season flows).

Due to the ephemeral nature of the nearby streams, surface water is generally not used as a source of potable water in the region. All dams at the Project are located such that human consumption of any contaminated waters is very unlikely and would not meet the 'Significant' threshold of potentially affecting the health of 10 or more people. ***Consequence Category: Low***

Dam Break

For the purposes of the Manual, the assessment excludes site personnel engaged by the resource operation and located on the tenements. Due to the sparse population in the region, there are no workplaces or dwellings in the potential failure impact zone of the site water dams. All dams are located such that people are not routinely present in the potential failure path if an embankment was to fail. ***Consequence Category: Low***

6.1.2.2 General Economic Loss

There are no significant commercial operations in the immediate downstream reaches of Isaac River or its tributaries likely to be affected by contamination under any of the potential failure impact scenarios.

The potential damage caused by dam-break of the MIA Dam embankment is likely limited due to its limited height (planned to be less than 5 m) and storage capacity. ***Consequence Category: Low***

6.1.2.3 Environmental Harm

Stored water quality in the Dewatering Dam, and MIA Dam, are likely to be similar to mine water dams at other Central Queensland mine sites, with elevated salinity, and pH, and some dissolved metals. As there are no High Environmental Value (HEV) Zones identified in the downstream receiving environment, there is limited potential to cause harm to Significant Environmental Values. ***Consequence Category: Low***

6.1.3 Failure to contain - seepage

Localised impacts of seepage to the ecology of the on-site reaches of One Mile Creek and its tributaries is possible, but any significant impact would be limited in extent. The MIA Dam and Dewatering Dam have therefore been assigned a Low Consequence Category; however, a detailed groundwater assessment should be carried out to further inform the detailed design of seepage management measures or reclassification of structures if appropriate. ***Consequence Category: Low (to be confirmed through seepage assessment)***

6.1.3.1 Failure to Contain - Dam Break and Overtopping

The manual states that a dam is to have a Significant Consequence Category if it meets the following criteria:

> *Location such that contaminants may be released so that adverse effects …would be likely to be caused to Significant Values – and at least one of the following:*
>
> *i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or*
>
> *ii) remediation of damage is likely to take more than 6 months but less than 3 years; or*
>
> *iii) significant alteration to existing ecosystems; or*
>
> *iv) the area of damage (including downstream effects) is likely to be at least 1 km^2 but less than 5 km^2*

Given the relatively small volume and concentrations of contaminants, it is unlikely that remedial measures would meet these criteria. Therefore, a Significant Consequence Category is not justified for the Environmental Harm trigger for the MIA dam. Given the very small catchment of the Dewatering Dam, a Significant Consequence Category is not justified for this dam. ***Consequence Category: Low***

Table 6.1 - Summary of consequence assessment - dams

Failure to contain - seepage	Dewatering Dam	MIA Dam	Raw Water Dam	Sediment Dams
Harm to humans	L	L	L	L
General environmental harm	L	L	L	L
General economic loss/damages	L	L	L	L
Failure to contain - overtopping				
Harm to humans	L	L	L	L
General environmental harm	L	L	L	L
General economic loss/damages	L	L	L	L
Dam break				
Harm to humans	L	L	L	L
General environmental harm	L	L	L	L
General economic loss/damages	L	L	L	L
OVERALL CCA RATING	L	L	L	L
Requires DSA/MRL	N	N	N	N
Requires engineered spillway	Y	Y	Y	Y
Requires lining (unless detailed groundwater investigation indicates risks are low)	Y	Y	N	N

L = Low consequence

S = Significant consequence

7 Conclusions

The key outcomes of the Lake Vermont Meadowbrook water balance model are as follows:

- The water management system will cater for both underground operations - which are planned to operate for 23 years between Project Year 1 and Project Year 23, and open cut mining – which would take place in the 11 years from Project Year 20 to Project Year 30.
- The site water management system would separate water into segregated management systems:
  - Clean water runoff from undisturbed areas would be diverted around the Mine Infrastructure Area and open cut pit by levees and drainage systems. These levees would be regulated structures with a Significant Consequence Category.
  - Raw water system – a pipeline will be constructed within the infrastructure corridor to extend the existing raw water supply pipeline at the Lake Vermont Mine sourcing water from the Eungella Water Pipeline Southern Extension. Bowen Basin Coal holds a water supply agreement with Sunwater's Eungella Water Pipeline Pty Ltd for the supply of up to 1,500 ML of water per annum to the Lake Vermont Mine and an on-supply contract with Peabody to transfer Peabody's 1,063 ML per year water allocation to the Lake Vermont Mine. Raw water would be delivered to a dedicated raw water dam at the Meadowbrook MIA for supply to the potable water treatment plant and underground operations.
  - Mine affected water system - which will manage runoff and groundwater inflows and recycled raw water from the underground, open cut pit, ROM stockpile and MIA. This closed system is designed to prevent releases of mine affected water to the environment. The relatively saline groundwater pumped from the underground operation and open cut pit would be delivered to a small, dedicated turkeys nest dam (the Dewatering Dam). Neither the Dewatering Dam or MIA Dam would be regulated dams on the basis of their Consequence Categories under the 'Failure to contain-overtopping' scenario.
  - Sediment water system - the open cut mining activities would see overburden material placed in out-of-pit and in-pit waste rock dumps adjacent to the proposed open cut pit. Runoff from the overburden material will be directed to sediment dams. As this runoff is expected to be relatively benign, the sediment dams could potentially discharge directly into the environment (after the settlement of suspended sediment) with minimal impact to downstream water quality and the receiving environment.
- During underground operations, the average annual demand for water is estimated to be up to approximately 1,390 ML/year. The principal water demand would be for raw water for underground operations. This water is not consumed in the process of use – however would become mine affected water after use in the underground operation. Minor quantities of water captured in the water management system would be used for washdown and dust suppression in the surface operations.
- During open cut operations (and after the cessation of underground mining), the average annual water demand would be significantly reduced (to approximately 180 ML/year). While the infrastructure corridor linking the new MIA to the existing operation will include sealed access and coal haulage roads (which will not require watering for dust suppression during operations), water would be used for dust suppression on haul roads in the active mining area.
- If on-site supplies are insufficient during dry periods, they would be supplemented with additional imported raw water. However, there will generally be an excess of water on-site – particularly during underground operations, and excess water would be returned to the existing Lake Vermont Mine for reuse within the site water management system via a pipeline along the infrastructure corridor.

- The results of the water balance model show:
  - The need for imported water from the raw water supply pipeline is expected to decrease from a peak of nearly 1,500 ML/a around Year 5 to less than 200 ML/a in the last 5 years of open cut operations. The available pipeline water allocation is sufficient to maintain supplies.
  - The adopted MIA Dam storage capacity is sufficient to contain inflows throughout the Project life without overflow. The likelihood of nearing the available capacity increases once open cut operations commence in Project Year 20.
  - In-pit water volumes would generally be maintained at relatively low volumes which would not interrupt mining operations. The 90th percentile in-pit inventory is always less than 380 ML. In very wet years, up to 1,091 ML of water could be stored in the open cut at the 1% confidence level. Pumping to the Dewatering Dam would ensure the pit is empty prior to the following wet season.
  - During underground operations, the average annual quantity of water returned to the existing Lake Vermont operation would be approximately 1,000 ML/year (ranging from 518 ML/year to 1595 ML/year). During open cut operations, the average would reduce to approximately 404 ML/year (but could range from 0 ML/year to 3,078 ML/year depending on the prevailing weather conditions). Water delivered from Meadowbrook would offset Lake Vermont mine's use of pipeline water. The Lake Vermont Mine water management system has significant potential storage capacity available (with careful planning, as much as 15 GL could be stored in part of the mine pits while maintaining mining in some areas). Water transferred from Meadowbrook following wet periods could therefore be accommodated within the existing capacity.
  - The model results show sediment dam overflows would only be expected in the wettest 10% of historical climate periods The largest modelled total sediment dam release during open cut operations was 1,038 ML from North Sediment Dam under very wet climate conditions. Median total project releases are expected to be much smaller – less than 140 ML from each dam over the total project life. The maximum modelled salinity of sediment dam releases was 691 mg/L at the North Sediment Dam. Dilution by flows in the receiving waters would likely result in an indiscernible impact to the downstream environment.

8 References

AARC, 2013	*Lake Vermont Progressive Waste Characterisation Assessment*, AustralAsian Resource Consultants, 2013
AARC, 2014	*Lake Vermont Northern Extension Geochemical Waste Rock Characterisation*, AustralAsian Resource Consultants, June 2014
Boughton & Chiew, 2003	Calibrations of the AWBM for Use on Ungauged Catchments, Technical Report 03/15, Cooperative Research Centre for Catchment Hydrology, December 2003
Cardno, 2022	M31991 Lake Vermont Meadowbrook Project Land-Based Effluent Disposal Assessment Report, Cardno (Qld) Pty Ltd, 16 March 2022
JBT, 2022	*Meadowbrook Project Groundwater Impact Assessment*, JBT Consulting Pty Ltd, July 2022
RGS, 2021	*Geochemical Assessment of Mining Waste Materials Lake Vermont Meadowbrook Project*, RGS Environmental Pty Ltd, June 2021
WRM, 2022	*Meadowbrook Project Flood Impact Assessment*, WRM Water and Environment Pty Ltd, April 2022