BP33 UNDERGROUND MINE

Water Management Plan

Lithium Developments (Grants NT) Pty Ltd

31 May 2024

1727-17-C8

DETAILS

Report Title	BP33 Underground Mine, Water Management Plan
Client	Lithium Developments (Grants NT) Pty Ltd

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Reviewer	JDO

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1 INTRODUCTION

1.1 BACKGROUND

The BP33 Resource Project (BP33) forms a part of the greater Finniss Lithium Project (the Project), which currently encompasses both BP33 underground mine operation and the adjacent Grants operation. The Project is managed by Lithium Developments (Grants NT) Pty Ltd (LD). The BP33 underground area commenced construction in July 2023 and the Grants area is currently operational and. The Bp33 and Grants water management systems (WMSs) will be integrated to enable water transfers between the operations to optimise mine water storage and supply requirements.

This Water Management Plan (WMP) focuses on the BP33 area only. A separate WMP was prepared for Grants (WRM, 2024).

The BP33 project is located approximately 6 km south of the Grants operations in the Northern Territory, approximately 20 km southwest of Darwin and 20 km west of Berry Springs. A locality plan of the Project area is shown in Figure 1.2.

1.2 PURPOSE AND SCOPE

The purpose of the BP33 WMP is to:

- Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected; and
- Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

The scope of the BP33 WMP includes water management aspects for three phases of the BP33 project:

- Phase 1: Construction of the box cut and associated surface infrastructure to support construction.
- Phase 2: Underground mine development including advancement of the decline and underground workings; and
- Phase 3: Operation of the mine.

The WMP also considers:

- Water storages and infrastructure located outside ML32346 within ML32074 (Observation Hill Dam (OHD);
- Water inventory management of site infrastructure across the three phases, including operational Trigger Action Response Plans (TARPs) for site inventory and water quality;
- Surface and groundwater systems influenced by mining operations, including those upstream and downstream the mine area and downstream the OHD; and
- Inclusion of Department of Infrastructure Tourism and Trade (DITT) requirements as noted in departmental correspondence (reference DITT2022/00121-003-011 and DITT2022/00121 003 034).
- Inclusion of the Northern Territory Environment Protection Authority (NT EPA) requirements.

1.3 REPORT STRUCTURE

This report is structured as follows:

- Section 2: A description of the existing environment at BP33.

- Section 3: A description of the potential contaminant sources produced by BP33 activities.
- Section 4: A detailed description on the BP33 water management system
- Section 5: A water balance assessment of the BP33 water management system over the three phases of the project.
- Section 6: A description of the adopted water monitoring plan at BP33.
- Section 7: A description of the acid rock and saline drainage characteristics.
- Section 8: A description of the contingency actions for environmental triggers.
- Section 9: A description of the WMP review and the roles and responsibilities required.
- Section 10: A description of known gaps in information and knowledge.
- Section 11: A list of references.
- Appendix A: Processed water quality results for monitoring stations for baseline and operations (where applicable).
- Appendix B: Operational Trigger Action Response Plans (TARPs) for site water management across the three phases.

1.4 RELATED DOCUMENTS

This WMP forms part of the BP33 Underground Environmental Management System and should be read in conjunction with the following reports:

- Finniss Lithium Project BP33 Underground Mine (LD, 2021);
- Finniss Lithium Project BP33 Underground Mine Mining Operations – Mining Management Plan (LD, 2022b)
- Groundwater modelling assessment (CloudGMS, 2023);
- Static Geochemical Testing of Mine Wastes & Ore (EGI, 2021);
- Grants Water Management Plan (WRM, 2023);
- Surface Water Extraction Licence 8151018 (DEPWS, 2022);
- Waste Discharge Licence Application – Supporting Information (LD, 2023);
- Surface Water Extraction Licence Monitoring Plan Observation Hill Dam (Ecoz, 2022a);
- Groundwater Dependent Ecosystem Management Plan (GE & RDMH, 2022);
- Riparian Vegetation Monitoring Plan (EcOz, 2022b);
- Erosion and Sediment Control Plan (Topo, 2023); and
- Irrigation Management Plan (EcOz, 2023).

1.5 SITE CONFIGURATION AND SCHEDULE

BP33 forms a part of the greater Finniss Lithium Project, which encompasses both BP33 and the adjacent mining operation, Grants. The locations of the two sub-projects are shown in Figure 1.4. BP33 ore will be processed at the Grants facilities and water transfer between the sites may be undertaken to supply demands and provide additional storage capacity as required. Water usage in the processing of all ore sources at the Grants Mining operation is detailed as part of the Grants water management plan.

Construction and development of the BP33 box cut is currently ongoing with ore production commencing in 2025. Table 1.1 shows the predicted completion dates of key site and water infrastructure.

Table 1.1 Key site and water infrastructure completion dates

Phase	Key infrastructure	Estimated completion (project months)
Phase 1 (Construction Phase)	Sediment Basins (SB1/SB2)	24
Phase 2 (Development Phase)	Mine Water Dam (MWD) Cell 1	25
	MWD Cell 2	26
	Start of underground decline development	27
	Box Cut backfill complete	31
	Underground infrastructure	34
Phase 3 (Production Phase)	Start of ore mining/mine progression	43
	Start of production in mill	52

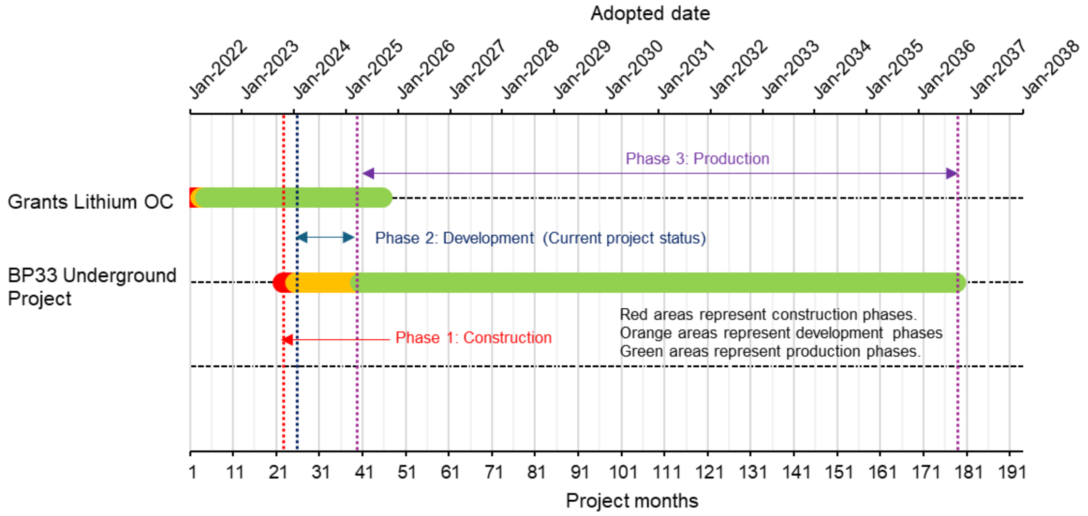

Figure 1.1 Finniss Lithium project schedule and current status

1.6 SUMMARY OF UPDATES

Table 1.2 shows a list of key changes made to the previous BP33 WMP.

Table 1.2 Summary of WMP updates

Section	Description
1.1	Added clarifying statement around the integrated Grants and BP33 WMS.
1.6	Added summary table of changes in the WMP.
2.5	Updated climate analysis with 2023 data.
3.4.3	Updated water quality analysis with SB1 and SB2 water quality samples.
3.5	Updated surface water quality analysis with updated data.
4.4.1	Updated operating rules and schematic with updated storages.
4.4.9	Added proposed culvert crossing specifications for the BP33 to Grants haul road.
4.9	Updated additional potential interactions with the Grants project.
5	Updated water balance section with outcomes of the integrated WMS configuration
6.3.5	Updated the Site Specific Trigger Values based on the WDL.
Appendix A	Extended water quality dataset
Appendix B	Updated wording in Table B.1
General	Updated dates as project months.
Figures	Updated figures with new infrastructure layout

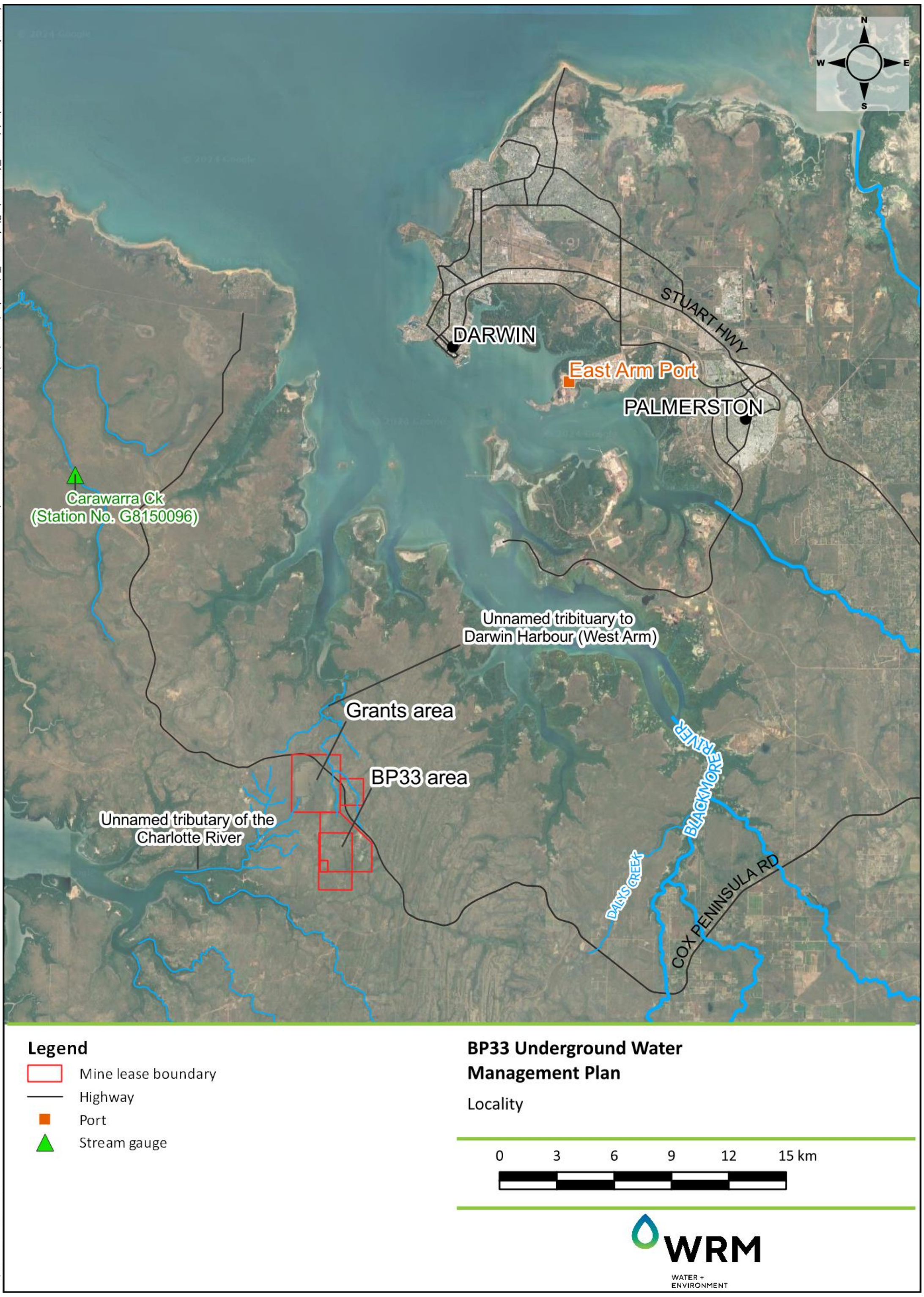

Figure 1.2 Locality plan

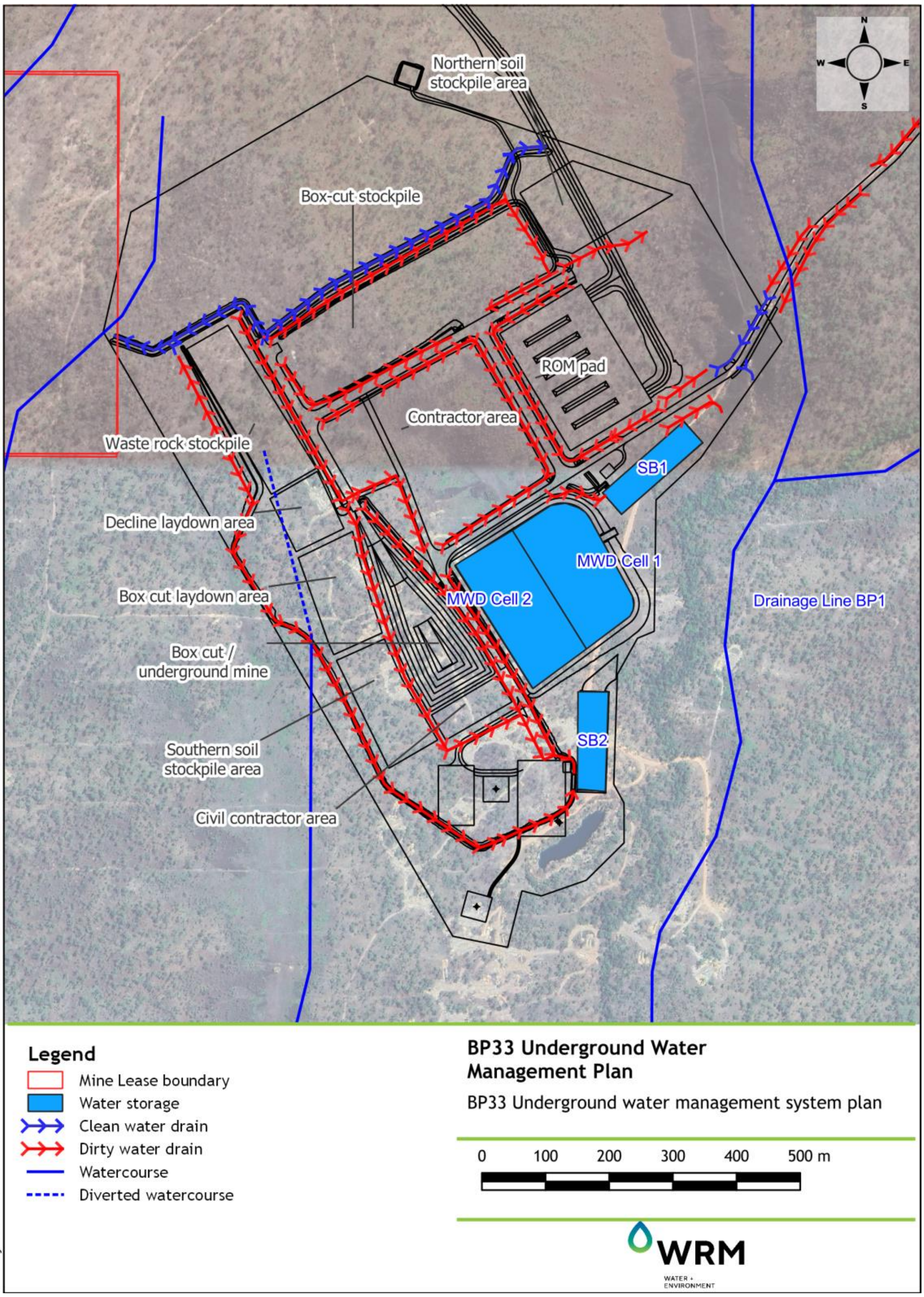

Figure 1.3 BP33 water management system plan

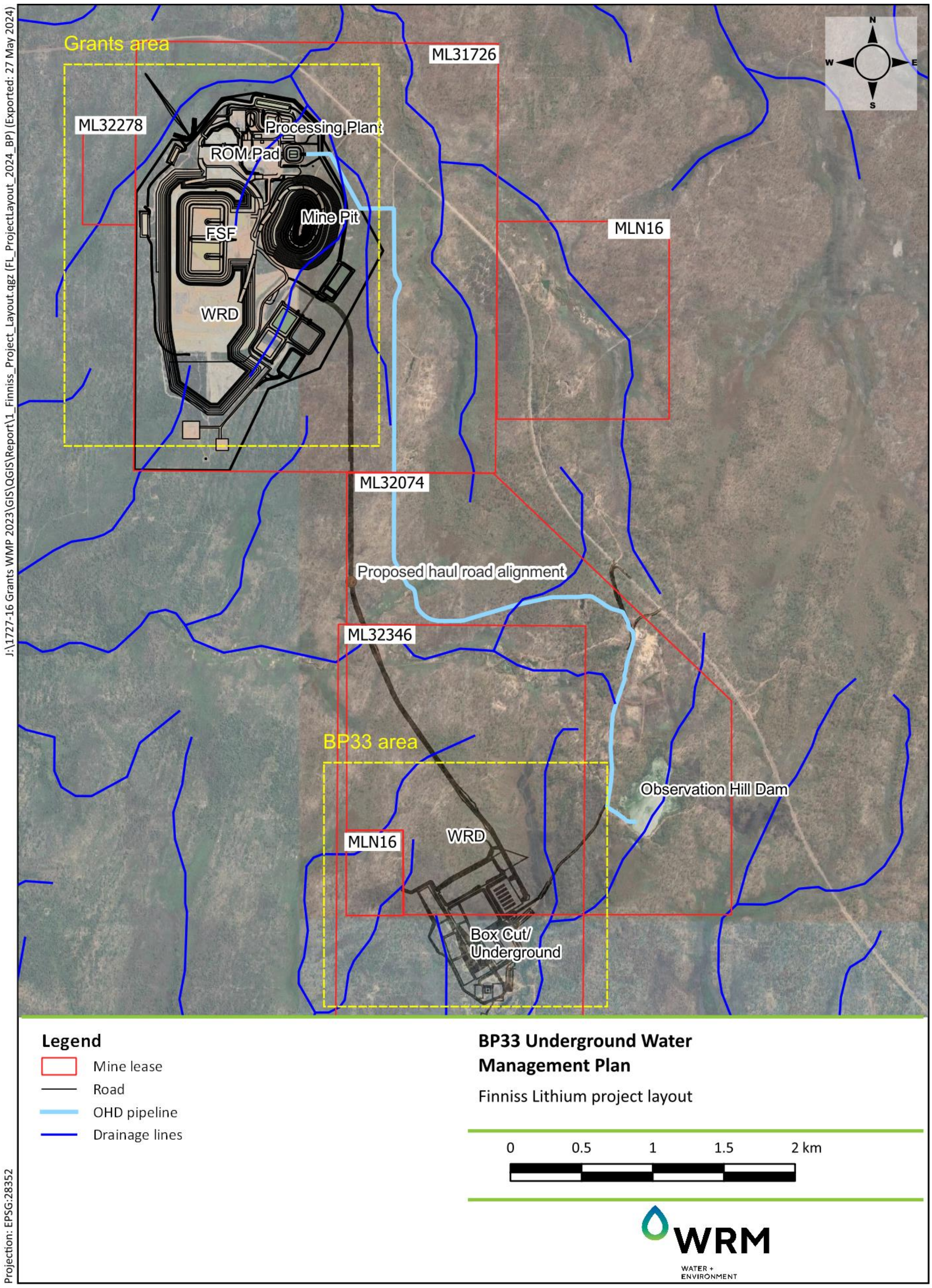

Figure 1.4 Finniss Lithium project layout

2 ENVIRONMENTAL SETTING

2.1 GENERAL

This section of the water management plan describes the regional drainage characteristics in the vicinity of BP33. Environmental values as defined by the ANZECC 2000 guidelines and NT government regulations of these waterways are also described. EcOz (2022) conducted an assessment and description of the relevant environmental values for BP33 which is summarised below.

2.2 ENVIRONMENTAL VALUES

2.2.1 Land use and surface water use

The project area, including both the mine footprint and Observation Hill Dam catchments, are largely undeveloped vacant crown land with only minor disturbances including the sealed Cox Peninsula Road, unsealed access tracks, mineral exploration activities as well as historic mining pits and dams (Frater, 2005).

There are no national parks, conservation areas or any residences, farms or industry within the catchment areas upstream or immediately downstream of the mine or Observation Hill Dam.

No beneficial uses for the water within OHD were identified.

2.2.2 Biodiversity values and Beneficial Uses

Waterways in the project area are largely intact and are considered under ANZECC (2000a) protection level classification as 'slightly disturbed'. They are not considered an example of rare, highly diverse, or significant habitat in the region. Ephemeral drainage lines either side of the mine footprint do not maintain flows into the dry season, and do not have a well-defined channel or riparian vegetation.

The project area also lies within the Bynoe Harbour Region declaration of surface water beneficial uses under the NT Water Act.

An assessment of the riparian vegetation along the waterway downstream of the Observation Hill Dam was undertaken by EcOz (2019). The assessment identified that the vegetation community was in good condition with no major weed populations or fire impacts. The presence of riparian vegetation indicated that the waterway receives a proportion of groundwater inputs to sustain the freshwater-dependant community during the dry season. Although the riparian vegetation communities are not rare, they are considered to be significant vegetation communities as they are spatially restricted and provide habitat to a large number of species.

Riparian vegetation will be monitored in accordance with the Riparian Vegetation Monitoring Plan – Finniss Lithium Project (EcOz, 2022b).

2.2.3 Groundwater environmental and social values

Groundwater environmental and social values been extensively assessed by CloudGMS (2021) and characterised by EcOz (2022). Key aspects are summarised below:

- There is limited use of this aquifer for domestic, stock, or agricultural water supply. The closest registered bore currently in use is located approximately 4.6 km south of BP33 on the Fog Bay Road and is used to provide a domestic water supply.
- The aquifer beneath the BP33 mine site and surrounding areas is a poor groundwater resource. There are medium potential groundwater dependent ecosystems (GDEs) along the waterway to the east of the site.

- Baseline groundwater quality monitoring indicates groundwater is contributing to flows in the drainage line downstream of Observation Hill Dam during the wet season. There is no evidence of spring-fed surface water flows during the dry season.
- Observation Hill Dam is likely a source of recharge to the groundwater aquifer. The well-developed riparian vegetation at this point indicates some level of sub-surface input from groundwater is supporting this vegetation community throughout the dry season.
- Possible GDEs located in proximity to the project will be managed in accordance with the Groundwater Dependant Ecosystem Management Plan – Finniss Lithium Project BP33 Underground Mine (Groundwater Enterprises, 2022).

2.3 REGIONAL DRAINAGE CHARACTERISTICS

BP33 is located within the Finniss River sub-basin of the greater Timor Sea Basin. The Finniss River sub-basin consists of several major streams that discharge into the Timor Sea, as shown in Figure 2.1.

Figure 2.2 also shows the surrounding catchments of the BP33 area. The BP33 area is not located within a named watercourse catchment and would drain into the Bynoe Harbour, via an unnamed tributary of the Charlotte River. Carrawara Creek is located approximately 17 km northwest of BP33 and Charlotte River is located approximately 3 km to the southwest of BP33.

The catchments surrounding BP33 are predominately undisturbed, with some rural residential areas and road infrastructure. Mangroves cover much of the coastal shoreline in the vicinity of BP33.

2.4 LOCAL DRAINAGE NETWORK

Figure 2.2 shows the local drainage features within the vicinity of BP33. Drainage features that cross the BP33 area eventually drain to the Timor Sea. The main tributary that drains through the BP33 area is Drainage Line BP1 (Figure 2.2).

2.4.1 Drainage Line BP1

Drainage Line BP1 has a catchment area of approximately 298 ha and 365 ha to the BPUS SW1 and BPDS SW2 monitoring locations respectively. Of this catchment area, approximately 94 ha is upstream of OHD. The catchment is mostly natural with some grassed areas that were cleared by preliminary exploration activities. The channel is poorly defined, particularly in the upper section of the reach. The channel banks are vegetated with grasses, shrubs and small trees.

The monitoring location at BPDS SW2 records the discharge and water level in Drainage Line BP1. Figure 2.3 and Figure 2.4 shows the recorded flow and water level at BPDS SW2 for the period November 2022 to May 2023. The results shows that the discharge and water level generally correlate with each other.

2.4.2 Unnamed tributary of the Charlotte River

Drainage Line BP1 discharges into a tributary of the Charlotte River, which has a catchment area of approximately 3,193 ha to the BPDS SW6 monitoring location. The tributary discharges into the tidally affected section of the Charlotte River.

2.4.3 Drainage Line BP2

Drainage Line BP2 has a catchment area of approximately 53.5 ha to the BPDS SW3 monitoring location and 217 ha to the confluence of the drainage line along BPDS SW3 and Drainage Line BP2. Drainage Line BP2 would discharge into the tidally affected section of the Charlotte River.

2.4.4 Overland flow path

The overland flow path to the southwest of the site has a catchment area of approximately 52 ha to the BPDS SW8 monitoring location. The overland flow path would discharge into the Unnamed Tributary of the Charlotte, slightly downstream of the BPDS SW6 monitoring location.

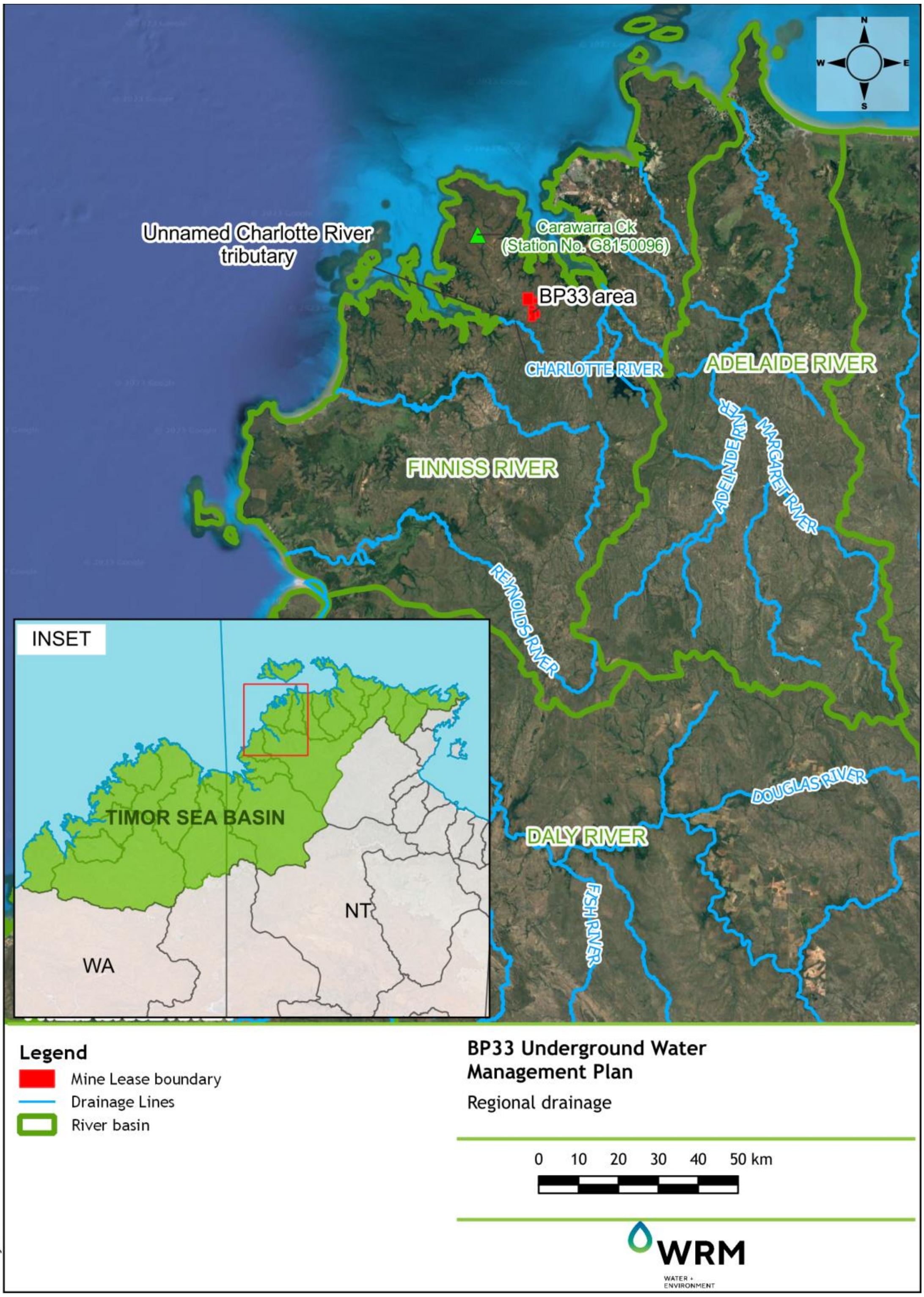

Figure 2.1 Regional drainage

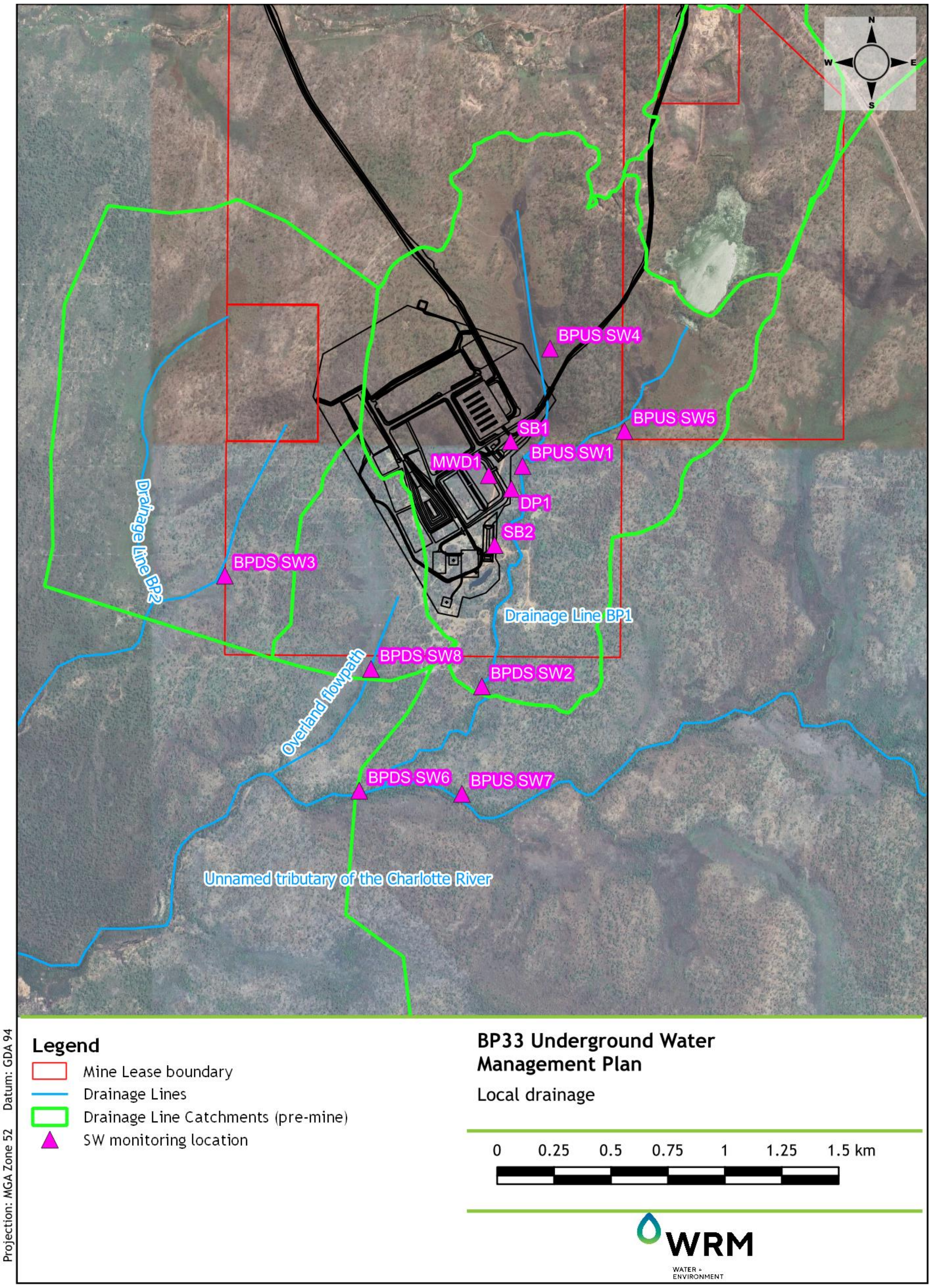

Figure 2.2 Local drainage

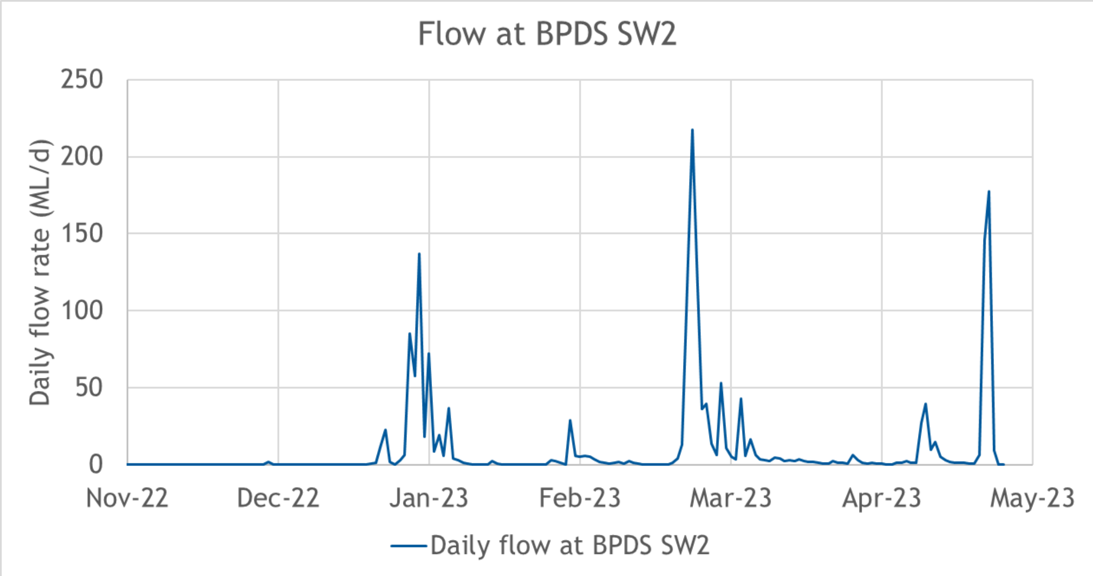

Figure 2.3 BPDS SW2 recorded flow

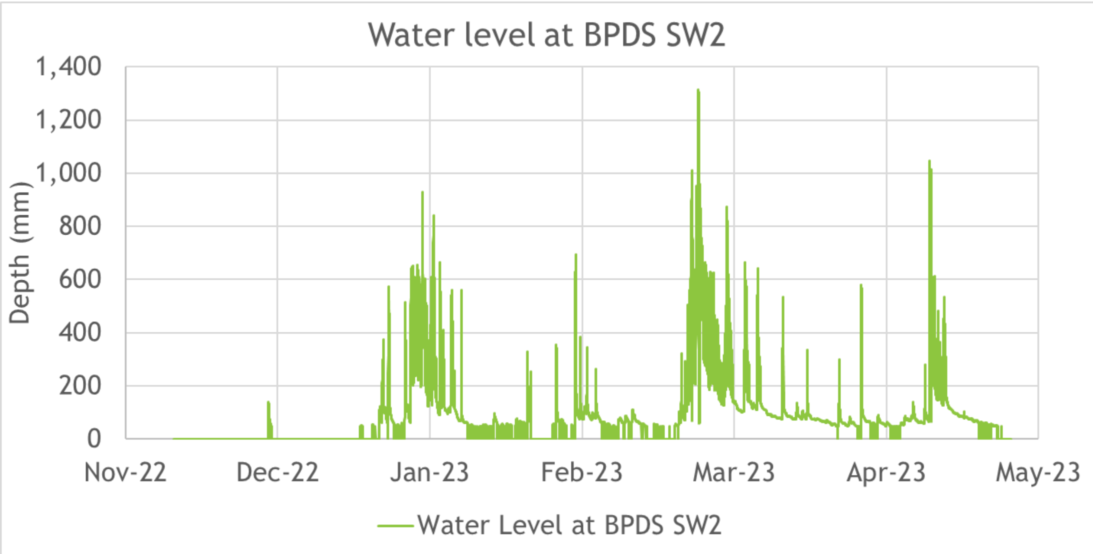

Figure 2.4 BPDS SW2 recorded water level

2.5 CLIMATE

Rainfall and evaporation data was obtained for the Mine site from the Department of Environment and Science (DES) SILO Data Drill Service. The SILO Data Drill data provides a continuous daily data set between 1889 and 2022. Derived daily pan evaporation, lake evaporation and actual evapotranspiration rates were also available for BP33 from the SILO Data Drill Service.

2.5.1 Rainfall

The average monthly rainfalls at BP33 exhibit distinct wet (November to March) and dry (April to October) seasons during the year, with a dry season low of 1.2 mm in July to a wet season high of 389.5 mm in January. The wet season average monthly rainfalls (133 mm to 390 mm) are significantly higher than the equivalent dry season monthly rainfalls (1.2 mm to 57.2 mm). The recorded mean annual rainfall at the Project over the period 1889 to 2023 is approximately 1,528 mm.

Table 2.1 shows the mean monthly and annual SILO Data Drill rainfall, evaporation and Morton's lake evaporation at BP33 based on the available 135 years of data. Figure 2.5 shows the statistical variation of monthly rainfall at BP33.

2.5.2 Evaporation

Table 2.1 shows the mean monthly and annual SILO Data Drill pan evaporation values at Grants based on the available 135 years of data. Figure 2.6 shows the variation of mean monthly evaporation and evapotranspiration at BP33. The average annual pan evaporation at the Project is estimated to be approximately 2,296 mm, which is approximately 1.5 times the average annual rainfall.

Soil moisture evapotranspiration losses in the AWBM model were estimated using Morton's Wet evapotranspiration, which is on average 98% of Morton's Lake evaporation in the vicinity of the project. Figure 2.6 shows the mean monthly evaporation and evapotranspiration at BP33.

Table 2.1 SILO Data Drill mean monthly rainfall, pan evaporation and lake evaporation at BP33

Month	Mean Monthly Rainfall (mm)	Mean Monthly Pan Evaporation (mm)	Mean Morton's Lake Evaporation (mm)
January	389.5	173.4	165.5
February	319.3	148.5	151.2
March	272.3	163.9	179.2
April	84.1	176.8	179.6
May	9.7	186.1	164.1
June	2.4	178.3	142.6
July	1.2	193.2	153.1
August	1.3	211.3	177.7
September	14.0	223.6	198.2
October	57.2	238.1	218.3
November	133.1	210.4	203.4
December	243.4	192.2	186.3
Annual	**1527.6**	**2295.6**	**2119.2**

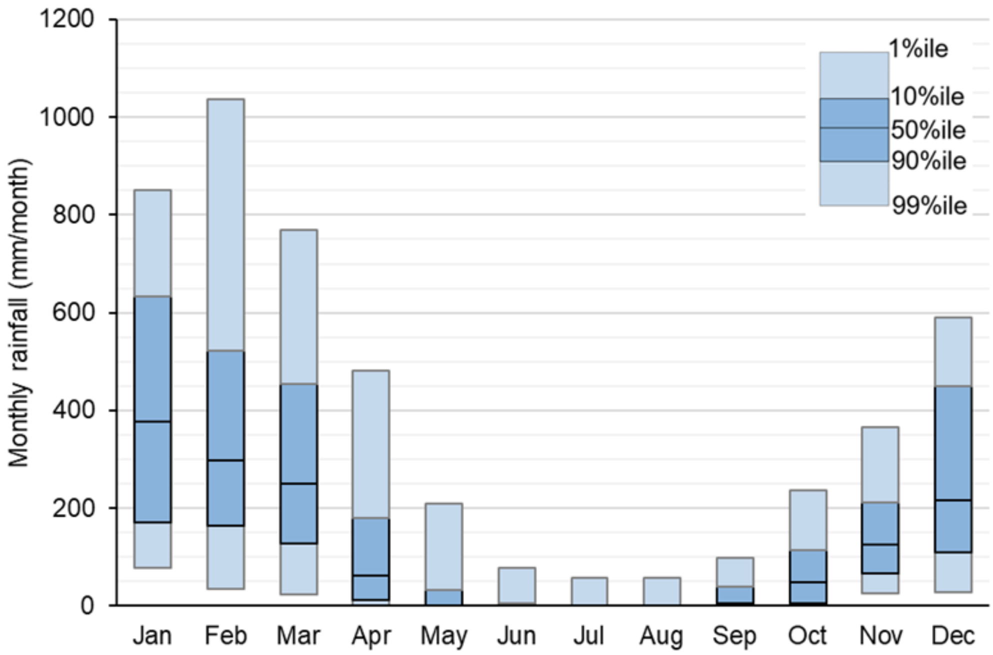

Figure 2.5 Monthly rainfall at BP33 from 135 years of SILO Data Drill rainfall data

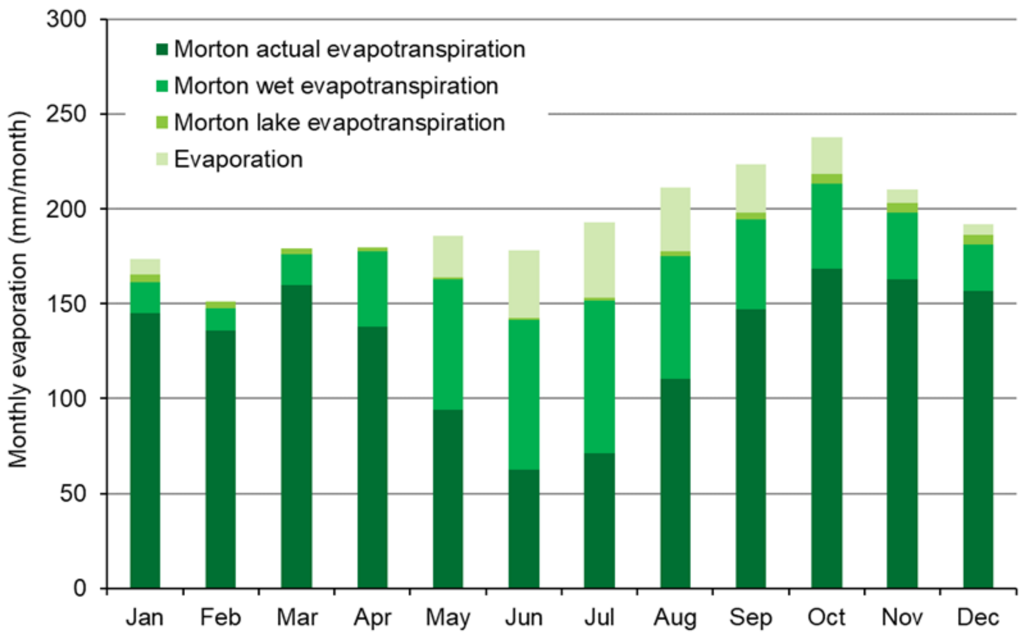

Figure 2.6 Mean monthly evaporation and evapotranspiration at BP33 from 135 years of SILO Data Drill rainfall data

2.6 GEOLOGY AND SOILS

Land units present within the ML boundary were based on mapped land units available on NR Maps (DPEWS, 2022) and described in the Land Resources of the Elizabeth, Darwin and Blackmore Rivers – Greater Darwin Area.

2.6.1 Soil management units

Landform class, land units and associated landform and soil descriptions for the project area, are shown in Table 2.2. The distribution of the land units in the vicinity of the BP33 area is shown in Figure 2.7. Much of the disturbance area comprises rudosol soils associated with land unit 2a1, with small areas of hydrosols associated with land units 6b/5b1 (drainage systems), and 5a (alluvial plains).

Land unit mapping shows the project area has a Nil (Class 1) risk of Acid Sulfate Soils which correlates with the Land Systems of the Northern Part of the Northern Territory which shows there is no potential acid sulfate soils within the project area.

Table 2.2 Land units and soils within the mineral lease boundary (EcOz, 2019)

Landform Class	Land Unit	Landform	Soil Description
Rises	2a1	Low rises and associated upper slopes. Gradient 0.5-4 %. Extensive surface gravels.	Rudosols. Gravelly lithosols, usually shallow with some moderately deep occurrences. Loamy sand or sandy loam surface to sandy clay loam subsoil. 20-40 % gravels in surface, 30-60 % gravels in subsoil. Well drained.
Plains	6b/5b1	Broad drainage floors and creek margins. Gradient < 1.5 %.	Hydrosols Shallow to moderately deep siliceous and earthy sands, minor sandy massive earths. Coarse textured sands to sandy loams. 0-10 % gravel in surface, 5-40 % gravel in subsoil. Well drained.
Alluvial plains	5a	Narrow alluvial plains within upland terrain. Gradient < 1.0 %.	Hydrosols. Hardsetting apedal mottled yellow duplex soils. Fine sandy loam or loam overlaying light clay to medium clay subsoil Minor subsoil ferruginous gravels. Imperfectly drained.

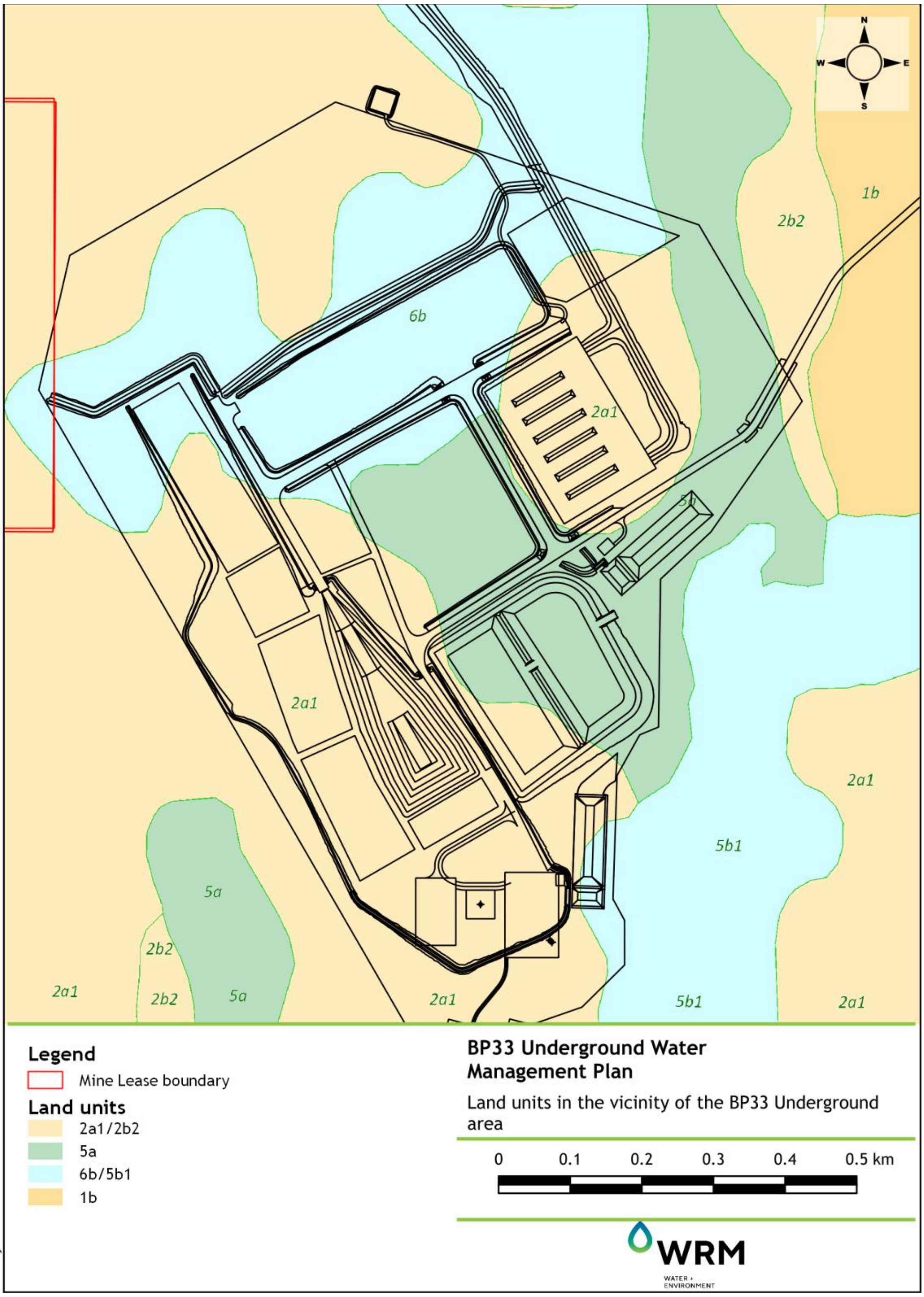

Figure 2.7 Distribution of identified land units

2.6.2 Sodic and dispersive soils

2.6.2.1 Sodicity

Exchangeable sodium percentage (ESP) is a measure of the proportion of sodium ions relative to other cations – referred to as sodicity. Sodicity degrades soil properties by weakening the bonds between soil particles.

Environmental Geochemistry International (EGI) (2020) identified that soils at BP33 have little to no evidence of exchangeable sodium in the soils. The exchangeable sodium was less than 0.1 meq/100g limit of analytical detection. In addition, it was found that calcium and magnesium were the dominant exchange cations in the soil.

2.6.2.2 Emerson Class

The Emerson Class is determined from the Emerson Aggregate Test, an eight-class classification describing the behaviour of air-dried aggregates when placed in distilled water. Specifically, it describes whether the soil aggregates slake or disperse. Soil sampling on the site determined the following:

- Four soil samples exhibited an Emerson Class of 7, indicating that soils were generally non-dispersive, infertile, gravelly sandy loam.
- The low organic matter level and sandy texture of the soil indicates that the spoil has poor structure and limited water-holding capacity and could be suspectable to erosion under wet conditions.

To control erosion from sodic dispersive soils, soils will be selectively handled and managed accordingly.

2.6.3 Soil suitability for irrigation

An irrigation management plan was developed for BP33 in October 2023 (EcOz, 2023) to illustrate the suitability for irrigation at BP33. The outcomes of the assessment indicated that all site tested within the land unit 2a1 are suitable for irrigation at a rate up to 5 mm or 5L/m^2/day throughout the lifespan of the operation.

2.7 GROUNDWATER CHARACTERISTICS

Information below is adapted CloudGMS (2021) along with information gained from the sampling the groundwater monitoring bores located across the mine site.

2.7.1 Aquifer geology

The substrate and underlying geology of the area around the proposed mine footprint comprises a thin surface layer (less than 5 m thick) of laterite gravel, sand and clay, underlain by the Burrell Creek Formation (BCF) comprising shales, siltstones, and strongly foliated phyllite. The weathering profile extends to depths of 30 to 50 m before reaching fresh, un-weathered BCF.

Key aspects of the BCF aquifer are provided below:

- The weathered and fractured BCF aquifer is a poor groundwater resource with a lack of primary porosity and open fracturing, and bore yields typically less than 0.5 L/s.
- Localised higher yields can occur where drilling intersects fracture zones or quartz veining; also at the base of the weathered zone.
- The weathered zone is more permeable than the un-weathered fresh BCF, with the highest permeability’s most likely in the overlying Cenozoic sediments and upper-most weathered (laterised) BCF.

- Minor aquifers may occur in the surface Cenozoic sediments in areas with thicker alluvial cover, such as along drainage lines.

2.7.2 Hydraulic conductivity

Slug tests and recovery tests undertaken by GHD (2017b) identified hydraulic conductivity of the following:

- Thin surface laterite aquifer has a moderately high K ranging between 0.068 and 1.7 m/day.
- Weathered zone has a moderate K ranging between 0.022 and 0.16 m/day.
- Fresh BCF has the lowest K ranging between 0.003 and 0.024 m/day.

Slug and recovery tests of the six groundwater monitoring bores installed in September 2020 confirmed that the permeability of the BCF is dependent on secondary porosity i.e., fracture and joint development (Groundwater Enterprises, 2020).

Bores that intersected fractured Burrell Creek Formation (fresh) showed a hydraulic conductivity an order of magnitude higher with a range from 0.15 – 0.28 m/day. No testing was undertaken on the alluvial sediments, which were unsaturated at the time of drilling.

2.7.3 Groundwater levels

Standing water levels (SWLs), measured in metres below ground level (mBGL), have been recorded continuously by loggers. SWL's are also measured manually during water quality sampling rounds. SWL monitoring identified:

- Groundwater levels in the shallow laterite bores are highly responsive to rainfall with water quality reflecting a close connection between surface and groundwater.
- SWLs within the monitoring bores at the end of the dry season range between 4.5 mBGL and 9.8 mBGL for the deeper bores and 4.4 mBGL and 6.6 mBGL for the shallow bores.
- The seasonal change in SWL in the deep BCF bores ranger from 3.7 m to 9.6 m, where the seasonal range is greatest in BPG1 and BPG6.
- The seasonal change in the shallow bores ranges from 3.1 m to 5.5 m.

2.7.4 Groundwater flows and recharge

CloudGMS (2018) identified the following in respect to regional and local groundwater flows:

- Regional groundwater flows were found to be in a north to north-east direction towards Darwin harbour.
- Local groundwater flows are expected to flow from areas of high topography to low topography.
- Diffuse recharge from rainfall is expected to be the dominant recharge mechanism.

3 CONTAMINANT SOURCE STUDY

3.1 OVERVIEW

This section of the water management plan describes the activities at BP33 that could potentially generate contaminants that may impact on Environmental Values of the receiving waters, if not managed. Sources of the potential contaminants have been identified and evaluated based on water quality data that has been collected on site since June 2017.

3.2 SITE CONFIGURATION AND SCHEDULE

Site configuration is shown in Figure 1.3 which is being developed over three phases of the BP33 project. Phases include:

- Phase 1: Construction phase comprising excavation of the box cut, temporary box cut stockpile (WRD 1), contractor laydowns, access roads, office buildings / workshops, sediment basins, required drainage infrastructure and mine water dams;
- Phase 2: Development phase including the decline and underground works and completion of additional surface infrastructure including underground waste rock dump (WRD 2), additional drainage infrastructure and ventilation.
- Phase 3: Production phase comprising of the ongoing mine development, underground exploration activities and extraction of ore.

An updated construction schedule is provided below and details completion dates for key project components and water management infrastructure required.

Table 3.1 Construction schedule – key dates

Task Name	Project month
Vegetation Clearing / Topsoil Removal	17
Site Drainage	24
Sediment Basins (SB1 / SB2)	24
Implementation of ESCP	24
Box Cut Excavation	27
Tunnel Liner Installation	29
Box Cut Backfill	31

3.3 WATER TYPES

BP33 monitors water quality in dams that capture surface runoff. The water quality results are all stored in the sites' water quality database. A summary of water quality in dams with catchments of different water types is provided below.

For water management system purposes, the water generated at BP33 is divided into four types:

- **Raw water:** is water sourced external to the mine operations.
- **Diverted water:** surface runoff from areas where water quality is unaffected by mining operations. Diverted water includes runoff from undisturbed areas and any fully rehabilitated areas (i.e. rehabilitated areas with established vegetation and stable landforms). It also includes

runoff from the surrounding natural catchment that is diverted around the mine site with no direct impact on the water quality from the mining operations.

- **Sediment water:**
  - Means the following types of water:
    - Water dewatered from the box cut during Phase 1 where chemistry indicates minimal groundwater input and meets surface water trigger values;
    - Rainfall runoff from catchments which can discharge through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an ESCP to manage such runoff, provided that this water has not been mixed with mine affected water.
- **Mine affected water (or mine water):**
  - Means the following types of water
    - Water dewatered from the box cut where chemistry suggests significant groundwater input and does not meet surface water trigger values;
    - Groundwater from underground operation dewatering activities during Phase 2 and Phase 3; and
    - A mix of mine affected water and other water.
  - Mine affected water does not include surface water runoff which, to the extent that it has been in contact with areas disturbed by mining activities that have not yet been completely rehabilitated, and has only been in contact with:
    - Land that has been rehabilitated to a stable landform and either capped or revegetated but only still awaiting maintenance and monitoring of the rehabilitation over a specified period of time to demonstrate rehabilitation success; or
    - Land that has partially been rehabilitated and monitoring demonstrates the relevant part of the landform with which the water has been in contact does not cause environmental harm to waters or groundwater; or
    - both.

3.4 WATER TYPE CHARACTERISTICS

3.4.1 Raw water

Raw water is captured and stored in OHD and made available for use at BP33. 26 individual samples measuring pH, EC and various metals were collected from OHD between 2017 and 2023. These are summarised in:

- Table A.2 – water quality of key contaminants for the full monitoring period at OHD.
- Table A.4 – water quality for the full suite of metals and metalloid toxicants for the full monitoring period at OHD.

3.4.2 Diverted water

Diverted runoff areas include the diverted catchments from the site. It is likely that the runoff from the natural catchments would produce runoff with similar characteristics to the baseline water quality conditions (pre-operational monitoring sites).

94 background water quality samples (upstream and downstream of the site at BPUS SW1, BPDS SW2, BPDS SW3, BPUS SW4, BPUS SW5) measuring pH, EC and various metals were taken between 2017 and 2023. These are summarised in:

- Table A.1 – water quality of key contaminants of interest across the monitoring period.
- Table A.3 – water quality for the full suite of metals and metalloid toxicants across the monitoring period.

3.4.3 Sediment water

Sediment water includes runoff from the waste dumps, general mine services areas and backfilled box cut. During Phase 1 construction, the temporary 30 m deep box cut is being excavated as part of the underground mine development before being filled in. Should backfilling of the box cut extend into the 2023 / 2024 wet season, additional excess water from direct rainfall may require management. Excess water from direct rainfall would be dewatered into either SB2 or MWD depending on the chemistry of water within the box cut:

- Where routine sampling of the box cut sump (BCS) water of does not indicate a groundwater signature and surface water trigger values, water can be classed as sediment water and managed through site sediment basins to reduce sediment loads before entering the environment.
- Where water in the BCS indicates the presence of groundwater or water will not meet surface water trigger values, water would be classes as mine affected and be directed to the MWD.

Details of the preliminary geochemical testing of waste rock at BP33 is provided in Section 7.2. The study showed:

- Seepage and runoff from the WRD and groundwater that comes into contact with the waste (which is backfilled) would have neutral pH, low salinity and major cation concentrations similar to baseline concentrations in local surface and ground waters.
- Concentrations of a number of metals including cadmium, chromium, iron, manganese and nickel would be very low and be similar to baseline concentrations in local surface and ground waters.
- Acid drainage from the wastes in the WRD is unlikely.
- There is potential for elevated metals levels which includes arsenic, copper, lead, zinc and possibly aluminium.

A total of nine samples (four samples at SB1 and five samples at SB2) were taken from the sediment basins at BP33. The results show:

- There is potential for elevated levels of nutrients (nitrogen and phosphorus) and aluminium.
- Concentrations of remaining metals would be very low and be similar to baseline concentrations in local surface waters.

The water quality in SB1 and SB2 will be monitored in accordance with the surface water quality monitoring program detailed in Section 6.3.

A Waste Rock Dump Management Plan (Core, 2023) has been developed to provide a general description of the management strategies to be implemented to control acid and metalliferous rock drainage as well as alkaline and saline drainage from the overburden dumps.

The WMP monitoring programs will determine the quality of runoff from the WRDs and provide indications of potential mine drainage impacts. Additional monitoring requirements and TARPs are provided in the waste rock and ore AMD/NMD management plans (LD, 2022b).

3.4.4 Mine affected water

During Phase 1 construction works, where routine sampling indicates a significant groundwater input and water within the BCS does not meet surface water trigger values, water is considered mine affected and dewatered into MWD for release to the environment under a Waste Discharge Licence. The conditions in the Waste Discharge Licence will be followed prior to any discharge of water and before the start of the wet season.

Mine affected water also includes groundwater inflows into the underground mine during underground operations (Phase 2 and Phase 3). It also includes runoff from areas disturbed by mining which are not rehabilitated, except for areas managed under the site's ESCP.

There is currently no available water quality data of the mine affected storages as BP33 as the MWD is not yet operational. It is proposed to monitor the water quality in the MWD in accordance with the surface water quality monitoring program detailed in Section 6.3.

It is proposed to recycle and reuse mine affected water from MWD to meet site demands (haul road dust suppression and underground mine demands). Mine water can also be released from MWD under the conditions of a WDL if water is diluted to meet water quality trigger levels.

Should excess mine water not be able to be released under a WDL, irrigation to land is proposed. An Irrigation Management Plan (EcOz, 2023) has been prepared to provide appropriate management strategies and controls to be implemented to discharge mine water to irrigation areas to manage the risk associated with excess mine water.

Revised Groundwater Modelling (CloudGMS, 2023) suggests that expected groundwater inflows into BP33 may be significantly less than originally. This would have a significant impact on BP33 water management infrastructure requirements such as OHD supply, irrigation and mine water storage. Water monitoring requirements to detect and subsequently monitor reduced groundwater inputs are included in the water balance report (WRM, 2023b).

3.5 SITE BACKGROUND SURFACE WATER QUALITY

Table A.1 summarises the key water quality parameters for each of the key natural catchments in the vicinity of BP33. The median, 20th percentile and 80th percentile was calculated for each of the water quality parameters of interest. The background water quality data collected during the monitoring period shows that:

- TP and TN levels are elevated above the limit of reporting across all sites.
- The pH for the Bynoe Harbour catchment is generally slightly acidic, which correlates to the acidity of fresh rainwater in tropical regions.
- All metal levels, with exception of aluminium are lower the ANZG 95% limit of protection for freshwater species and/or the Limit of Reporting (LOR).
- Aluminium, iron and lithium levels are generally elevated in the environment in comparison to the LOR values.
- OHD has elevated arsenic, iron, and lithium compared to the LOR values.
- OHD baseline water quality indicates a neutral pH when compared to the slightly acidic nature of Bynoe Harbour catchment surface water quality.
- For Total Nitrogen:
    - The concentrations in OHD are generally higher than the Bynoe Harbour catchments.
    - The 80th percentiles are generally higher than or equal to the Darwin Harbour SSTVs (0.3 mg/L).

- The 20th percentile to 80th percentile range for TN concentrations for the Bynoe Harbour catchments and Observation Hill Dam are summarised below:
    - Bynoe Harbour catchments: <0.1 mg/L to 0.3 mg/L.
    - Observation Hill Dam: 0.2 mg/L to 0.48 mg/L.
- For Total Phosphorus:
  - The concentrations in OHD are generally similar to the Bynoe Harbour catchments.
  - The 20th percentile to 80th percentile range for TP concentrations for Bynoe Harbour catchments and Observation Hill Dam are summarised below:
    - Bynoe Harbour catchments: <0.01 mg/L to 0.02 mg/L.
    - Observation Hill Dam: <0.01 mg/L to 0.02 mg/L.
- For Ammonia:
  - The concentrations in OHD are slightly higher than the Bynoe Harbour catchments.
  - The 20th percentile to 80th percentile range for Ammonia concentrations for Bynoe Harbour catchments and Observation Hill Dam are summarised below:
    - Bynoe Harbour catchments: <0.01 mg/L – 0.08 mg/L.
    - Observation Hill Dam: 0.014 mg/L – 0.09 mg/L.

3.6 SITE BACKGROUND GROUNDWATER QUALITY

EcOz (2022) assessed baseline groundwater monitoring data which identified:

- Groundwater in the weathered and un-weathered BCF aquifer has moderate alkalinity (comprising 100% bicarbonate alkalinity), with anion and cation levels increasing with depth into the aquifer.
- Total phosphorus, strontium, lithium and zinc levels were found to be significantly higher than the surface water environment.
- Major anion and cation concentrations measured in the shallow laterite aquifer show the groundwater has negligible levels of alkalinity, hardness and dissolved major cations; similar to those measured in the surface water around the mine footprint.

Table A.5 and Table A.6 shows the statistical summary of key analytes between 2020 and 2023 for the shallow and deep aquifers respectively. Table A.7 and Table A.8 shows statistical summary for the full suite of metals and metalloid analytes between 2020 and 2023 for the shallow and deep aquifers respectively. The results show:

- For Total Nitrogen:
  - The concentrations in the shallow aquifers are similar to the surface water quality of the Bynoe Harbour catchments.
  - The concentrations in the deep aquifers are lower than the Bynoe Harbour catchments and are at the LOR.
  - The 20th percentile to 80th percentile range for TN concentrations for the shallow aquifers and deep aquifers are summarised below:
    - Shallow aquifers: <0.1 mg/L to 0.3 mg/L.
    - Deep aquifers: <0.1 mg/L to 0.2 mg/L.

- For Total Phosphorus:
  - The concentrations in the shallow aquifers are more elevated than the surface water quality of catchments that drain to Bynoe Harbour catchments.
  - The concentrations in the deep aquifers are significantly higher than the Bynoe Harbour catchments.
  - The 20^{th} percentile to 80^{th} percentile range for TP concentrations for the shallow aquifers and deep aquifers are summarised below:
    - Shallow aquifers: <0.01 mg/L to 0.084 mg/L.
    - Deep aquifers: 0.19 mg/L to 1.03 mg/L.

3.7 CHEMICAL AND FUEL STORAGE

Primary chemical storage areas are located within the mine services area. These storage facilities will be constructed and bunded generally in accordance with the relevant specifications of AS1940 – Storage and Handling of Flammable and Combustible Liquids (AS1940).

Incident reporting and the management of spills are undertaken in accordance with the site operational incident reporting forms and procedures. Incidental spills, fuel storage / use and equipment failures are a potential source of hydrocarbons in surface and groundwater.

4 SITE WATER MANAGEMENT

4.1 OVERVIEW

This section of the water management plan describes the objectives and principles of the water management system for the existing and proposed mining operations at BP33, including a description of the infrastructure and systems that will be put in place to achieve the objectives and principles.

4.2 MANAGEMENT OBJECTIVES

Overarching objectives of the WMS is to:

- Ensure mine affected water is appropriately managed to minimise the risk of uncontrolled discharge to the environment;
- Ensure the site has sufficient water available for operation in dry times; and
- Successfully engage with external stakeholders to be seen as a good custodian of society's water resources. The priority areas are the sites impact on surface water and groundwater.

Specific objectives for each water type are as follows:

- **Raw / External water:** Ensure that external water allocation and associated infrastructure is sufficient to meet site demands particularly under low rainfall conditions.
- **Diverted water:** Separate from the mine affected and sediment water systems as much as practicable and allow it to pass uninterrupted through the catchment.
- **Sediment water:**
  - Maintain the quality of water discharging from Erosion and Sediment Control (ESC) structures to as close to background levels as reasonably possible.
- **Mine affected water:**
  - Ensure any controlled releases of mine affected water prevents environmental harm and undertaken in accordance with the conditions of the WDL.
  - Minimise uncontrolled discharges in wet periods to ensure adequate water supplies are maintained for site demand during dry periods.
  - Manage water inventories in wet periods to prevent accidental release of mine affected water offsite and maintain the integrity of mine water storages.

Changes to the water management system during the operational period will continue to be managed in accordance with these objectives.

4.3 SITE WATER MANAGEMENT PRINCIPLES

The general principles to manage site water are as follows:

- The fullest separation of diverted water, sediment water and mine affected water runoff as best as reasonably practicable .
- Reduce the area of surface disturbance, thus minimising the volume of sediment or mine affected runoff.
- Collect and contain all potential mine affected water into dedicated mine water storages. The mine water storages will be used as the primary water source for dust suppression.
- Divert up-catchment water runoff from upstream catchments around the disturbance area;

- Limit external catchment runoff draining into the box cut;
- Manage sediment from disturbed catchment areas (e.g. WRD, cleared/pre strip areas) by using erosion and sediment control (ESC) measures prior to release offsite;
- Release on site sediment water in a controlled manner in compliance with the ESCP.
- Reuse onsite water (e.g. mine affected water) where possible to support mine operational water demands (and therefore limit mine affected inventories under normal operating conditions);
- Prioritise the use of poor-quality water before better quality water, where practicable; and
- Manage mine affected water discharges to the receiving environment in accordance with the WDL.

4.4 WATER MANAGEMENT SYSTEM

4.4.1 BP33 water management system

The BP33 water management system consists of the following storages:

- Box Cut Sump (BCS);
- Mine Water Dam (Cell 1 & Cell 2) (MWD);
- Sediment Basin 1 (SB1);
- Sediment Basin 2 (SB2); and
- Observation Hill Dam (OHD).

A summary of the mine water storages, their proposed capacities and surface areas are provided in Table 4.1. The locations of the above storages are presented in Figure 1.3. Table 4.2 shows the proposed operating rules for the BP33 WMS. A schematic of the BP33 WMS is given in Figure 4.1. The BP33 WMS schematic (base case) assumes that water from the box cut is treated as sediment water and is able to be dewatered to SB2.

The management of each water type within the BP33 WMS is discussed in the following sections.

Table 4.1 BP33 water storages

Dam Name	Proposed storage volume at full supply (ML)	Proposed maximum operating volume (ML)	Dam surface area (ha)	Maximum catchment area (ha)	Overflows to
MWD Cell 1	78	66.3	2.3	2.3	Drainage Line BP1
MWD Cell 2	78	66.3	2.3	2.3	Drainage Line BP1
SB1	13.0	Operated as full	0.8	26.4	Drainage Line BP1
SB2	10.6	Operated as full	0.7	16.2	Drainage Line BP1
BCS[a]	5	-	2.7	2.7	SB2
OHD	620[b]	-	27.8	93.8	Drainage Line BP1

Key:
a the BCS will removed in Month 28 upon backfill of the Box Cut and its surface catchment will drain to SB2.
b the proposed storage for OHD assumes that the wall lift will occur.

Table 4.2 Proposed BP33 WMS operating rules

Item	Node Name	Strategy/purpose	Operating rules
1.0	***External water supply***		
1.1	Observation Hill Dam (OHD)	Clean water dam that collects natural runoff to make-up site demands.	• Transfers make-up water to raw water tanks before transferring to MWD, if required to meet onsite water demands
2.0	**Integrated transfers**		
2.1	Grants MWD1	Transfers water from Grants to BP33 MWD Cell 1 to meet any site water demands prior to using raw water.	• Receives mine-affected water from Grants MWD1 to meet onsite water demands.
2.2	Grants Mill tailings	Transfers tailings from Grants to the BP33 Paste plant for processing.	• Receives tailings from Grants to be processed in the Paste Plant.
3.0	***Supply to demands***		
3.1	Haul road dust suppression	Water required to meet haul road dust suppression demands	• Supplied by BCS • Supplied by MWD Cell 1 • Supplied by MWD Cell 2
3.2	Underground water demand	Water required for underground mine	• Supplied by MWD Cell 1 • Supplied by MWD Cell 2
3.3	Miscellaneous water demand	Water required for vehicle washdown, fire water, etc.	• Supplied by OHD
3.4	Irrigation demand	Water used for irrigation to manage BP33 site inventory	• Supplied by MWD Cell 1 when not able to dewater through the WDL.
3.5	Paste Plant demands	Water required for BP33 Paste plant	• Supplied by MWD Cell 1 • Supplied by MWD Cell 2
4.0	***Operation of construction areas***		

Item	Node Name	Strategy/purpose	Operating rules
4.1	Box Cut Sump (BCS)	Groundwater and runoff entering the BC would be collected in a sump. The BC would be removed (backfilled) from the WMS on the completion of the portal.	• Receives rainfall runoff and groundwater inflows. • Dewaters to SB2 if chemistry indicates sediment water. • Dewaters to MWD Cell 1 if chemistry indicates mine affected water. • To be removed by Month 28
4.0	***Operation of active mining areas***		
4.1	Underground (UG) mine	The UG would be kept as empty as possible by continuous dewatering to prevent any interruptions to mining operations.	• Receives groundwater inflows • Dewaters to MWD Cell 1
5.0	***Operation of water storages***		
5.1	MWD Cell 1	Out of pit storage for UG, as well as the controlled release location for BP33. Proposed to have the ability to transfer Grants Void after completion. Release point for controlled releases under WDL. Proposed to dewater to irrigation scheme, if required.	• Receives dewater inflows from UG • Controlled release to receiving environment • Receives make-up water from OHD (through raw water tanks), if required to meet onsite demands. • Supplies irrigation demand • Supplies underground mine demand • Supplies haul road dust suppression demand • Emergency transfer to Grants void if water is accumulating in the UG (and production at Grants has ceased) • Receives mine-affected water from Grants MWD1. • Overflows to receiving environment at emergency spillway.
5.2	MWD Cell 2	Proposed to receive sediment water from SB1 and SB2 to supply makeup demands for mine water demands	• Receives dewatered inflows from SB1 • Receives dewatered inflows from SB2 • Makes-up any deficits in mine water demands prior to utilising raw water from OHD or Grants.
5.3	SB1	Collects sediment runoff	• Dewaters to MWD Cell 2 until MOV is reached. • Overflows to the receiving environment
5.4	SB2	Collects sediment runoff	• Receives dewatered inflows from BCS, if chemistry indicates sediment water. • Dewaters to MWD Cell 2 until MOV is reached • Overflows to the receiving environment.

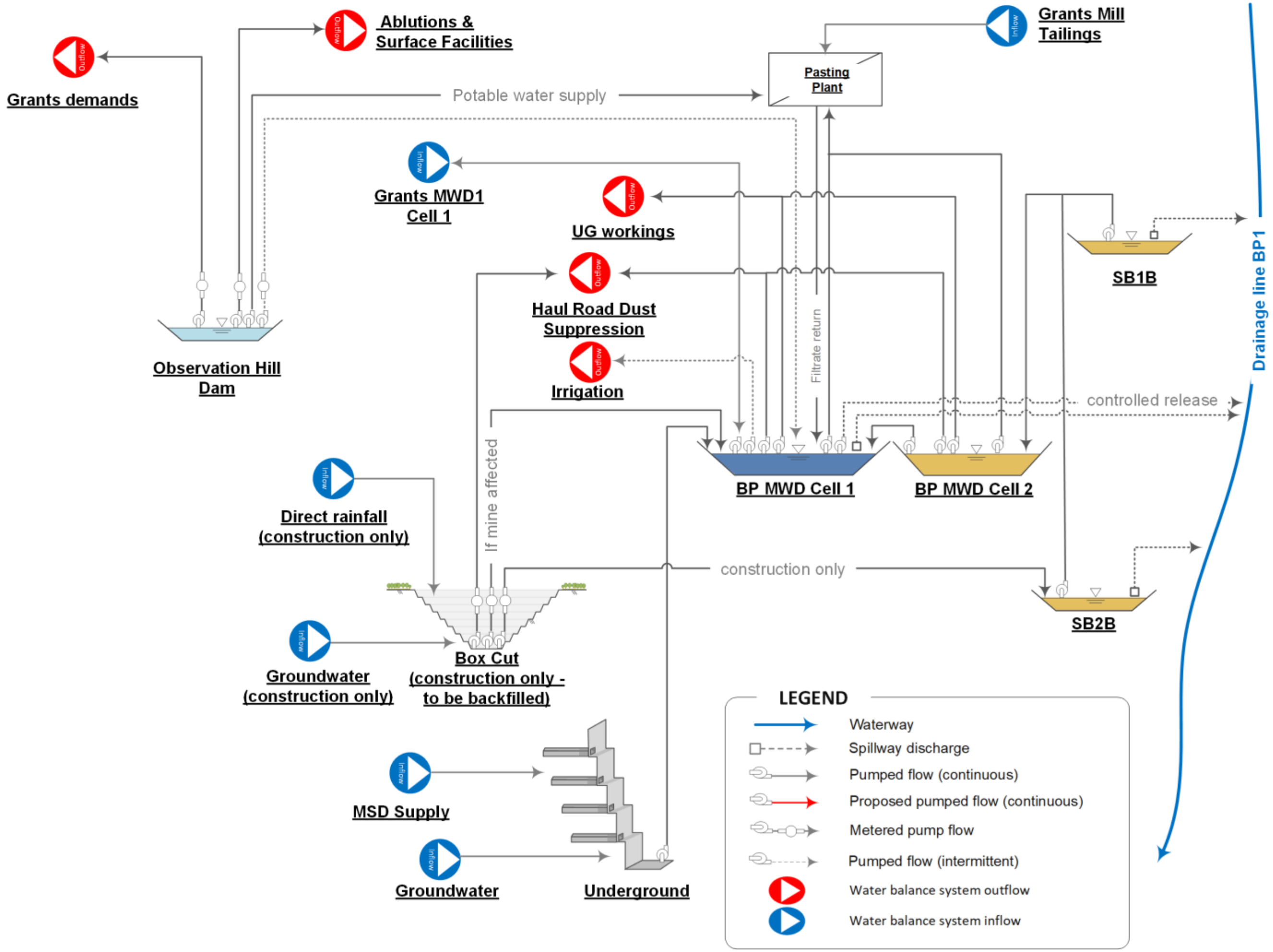

Figure 4.1 BP33 WMS schematic (base case conditions)

4.4.2 Phase 1 box cut construction water management

During Phase 1 construction, the temporary 30 m deep box cut is being excavated as part of the underground mine development before being filled in. The temporary box cut is shallower and smaller in surface area when compared to the permanent 60 m deep box cut that was proposed in the BP33 Environmental Impact Statement (EIS). The reduction in box cut size will have ramifications for the management of water as:

- the 30 m deep box cut is expected to receive significantly less surface water and groundwater inflows when compared to the 60 m box cut due to it being temporary, shallower and smaller in surface area;
- the expected groundwater inflows into the box cut may be significantly less than predicted in the EIS based on actual groundwater inflows to the Grants Pit at similar depths; and
- the 30 m deep box cut excavation is not expected to require blasting and it is unlikely that groundwater into the box cut would interact with any ore body in the ground.

On this basis, minimal ground water ingress into the box cut during construction is expected. During dry season months, this water can be used for dust suppression. Should backfilling of the box cut extend into the 2023 / 2024 wet season, additional excess water from direct rainfall may require management.

During the wet season, it is proposed to manage additional water based on its chemistry:

- Where routine sampling does not indicate a groundwater signature and water within the BCS meets surface water trigger values, water can be classed as sediment water and managed through site sediment basins to reduce sediment loads before entering the environment.
- Where routine sampling indicates a significant groundwater input and water within the BCS does meets surface water trigger values, water can be classed as mine affected and managed through the Mine Settling Dam for release to the environment under a Waste Discharge Licence.

The box cut will be active until Month 28, by which time the box cut will be capped and backfilled to a level similar to the surrounding ground surface. The box cut water quality is being monitored in accordance with the proposed surface water quality monitoring program detailed in Section 6.3.

4.4.3 Raw water management

OHD will be used to supply raw water demands and supplement mine water demands (by pumping to raw water tanks before transferring to MWD), where required.

Water from OHD would be pumped to MWD Cell 1 if there is insufficient site storage to meet the site water demands across the dry season. The intent of pumping raw water to MWD Cell 1 is to ensure enough water is available to sustain normal site operations throughout the dry season. The water balance assessment in Section 5 indicates that during dry climatic conditions, there may be insufficient mine water generated to meet on-site demands and will need to be supplemented with raw water.

Raw water will not be used to dilute mine affected water for releasing into the environment.

4.4.4 Mine water management

Mine affected water containment will be provided in MWD Cell 1. MWD Cell 1 will receive inflows from the underground mine (and the box cut if chemistry indicates mine affected water) during Phase 2 and Phase 3 operations if required. Mine affected water stored in MWD Cell 1 will be used to supply haul road dust suppression and irrigation demands. Controlled releases into Drainage Line BP1 may also be undertaken from MWD per an approved WDL, when there is excess water stored onsite. Construction of the MWD Cell 1 has been completed in Month 25.

Subject to future regulatory approval, it is proposed to install a pipeline between the BP33 MWD and the Grants MWD1 to transfer water between sites to manage mine water inventories. Groundwater and catchment runoff from BP33 will be stored on site, used for site demands, discharged under a WDL or disposed of via woodland irrigation.

4.4.5 Sediment water management

Sediment water will be managed in accordance with the ESCP. The primary purpose of the ESCP is to outline strategies to manage clean water and sediment water at BP33 and attempts to:

- Examine and address all issues relevant to the generation, management, and mitigation of erosion and sediment transport;
- Provide guidance in erosion and sediment related issues and management techniques applicable;
- Determine the appropriate requirements for sediment and erosion control and management for all land uses; and
- Comply with any relevant regulatory requirements.

Surface water and catchment runoff from the disturbance footprint will be managed in accordance with an ESCP. The sediment basins have been sized in accordance with the IECA method (IECA, 2008), and have been based on the design standards and methodology for 'Type B' sediment basins. A level spreader and flocculant dosing device will be installed at each of the sediment basins to improve efficiency.

Several internal surface water drains are proposed to be constructed to capture surface water from the site and divert runoff to the sediment basins or sediment traps. The sediment basins would then discharge into Drainage Line BP1. Figure 1.3 shows the location of the proposed surface water drains.

The adopted design standard does not provide 100% containment for runoff from disturbed areas. Hence, overflows are expected to occur from sediment basins several times during a wet season.

A summary of the design sediment basin capacities and surface areas are provided in Table 4.1. The locations of the sediment basins are shown in Figure 1.3.

4.4.6 Groundwater management

Groundwater inflows into the temporary box cut and the underground mine sump(s) will be dewatered to the BP33 water management system. Groundwater inflows entering the BCS during construction would preferentially be used for haul road dust suppression demands or dewatered to SB2. Groundwater in the underground mine will be dewatered to MWD Cell 1 to supplement site demands, be released via the authorised discharge point per a WDL, transferred to the Grants operations or disposed of via the irrigation scheme.

4.4.7 Diverted Water Management

The water management system has been designed to divert undisturbed catchments around mining operations wherever practicable. The diverted water drains will divert the up-catchment clean runoff around the site and into Drainage Line BP1 (to the east) or Drainage Line BP2 (to the west). Figure 1.3 shows the location of the proposed diverted water drains.

4.4.8 Water management Trigger Action Response Plan

Trigger Action Response Plans (TARPs) have been developed for the management of water inventory for all onsite water storages including sediment dams during three site phases. The TARPs have been developed in consideration of updated water balance modelling and details the conditions under which water will be managed and transferred within, and release offsite. Appendix B shows recommended operational water management TARPs. The operational TARPs cover:

- Table B.1 - Operational TARP for box cut water quality during Phase 1 (construction phase).
- Table B.2 – Operational TARP for sediment basin water quality which addresses the management of water quality within the sediment basins.
- Table B.3 – Operational TARP for mine water site inventory which addresses excess storage inventory in MWD.
- Table B.4 – Operational TARP for total site storage inventory which addresses shortfalls in storages.

4.4.9 BP33 to Grants haul road

A haul road connecting BP33 and Grants will be constructed to transfer ore from BP33 to the Grants Mill. Three cross road culvert crossings will be constructed to pass floodwaters from the upstream catchments. Figure 4.2 shows the planned haul road alignment and cross road culvert locations. Table 4.3 shows the proposed cross road culvert characteristics.

Table 4.3 Proposed BP33 to Grants haul road cross road culvert crossing characteristics

Parameter	Units	Northern Crossing	Central Crossing	Southern Crossing
Configuration	-	2 x 0.75m CSPs	1 x 2.25 CSP 1 x 2.4 CSP	2 x 0.45 CSPs
Upstream invert level	mAHD	19.37	13.35	24.5
Downstream invert level	mAHD	19.25	13.10	24.2
Floodway width	m	100	110	-
Floodway level	mAHD	20.25	17.3	-
Flood immunity/trafficability	-	1% AEP trafficability	5% AEP flood immunity	1% AEP flood immunity
Comment	-	Diversion bund adjacent to the haul road to prevent	0.8 m high safety bund with 1m openings every 10 m.	-

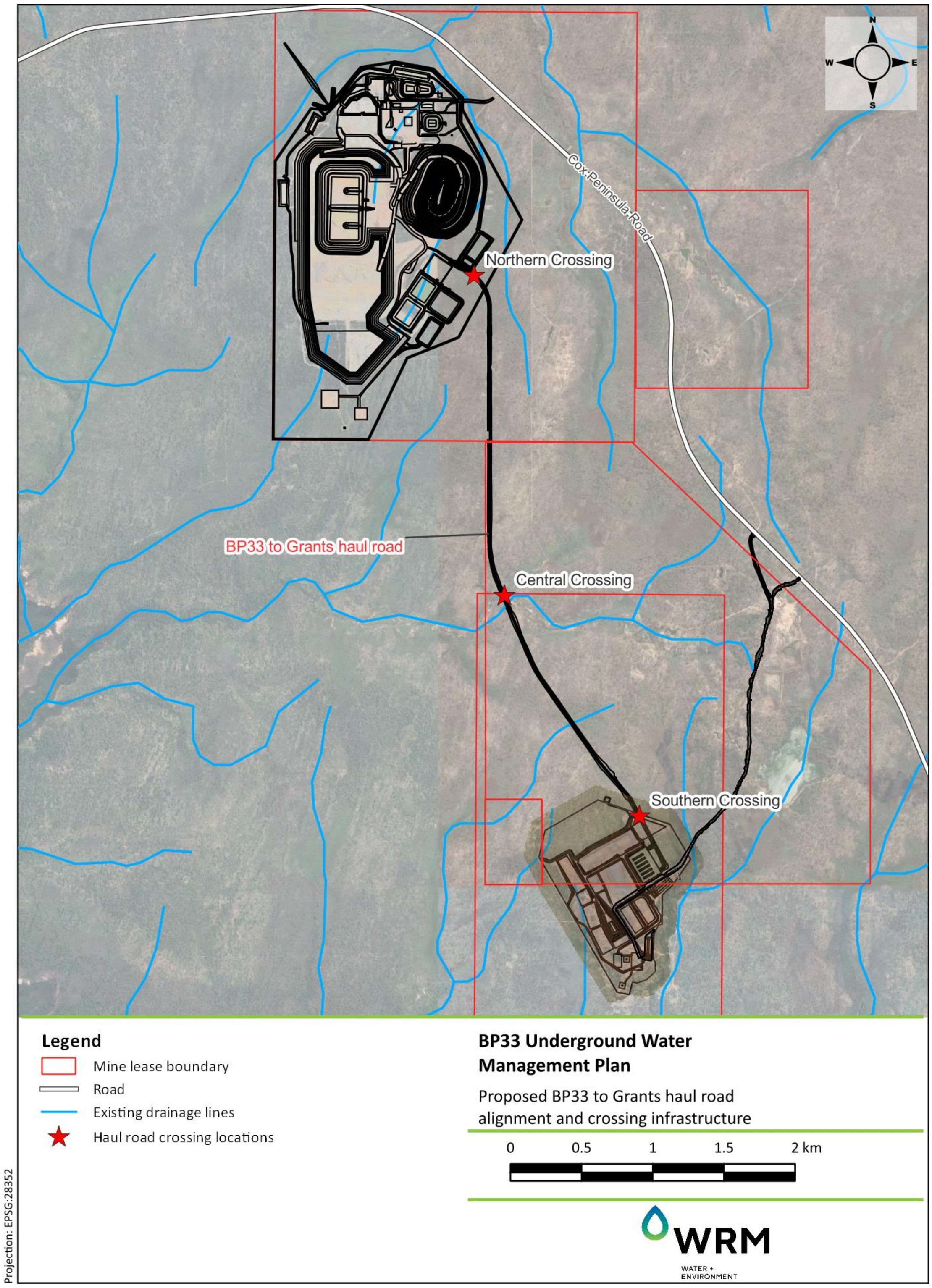

Figure 4.2 Proposed BP33 to Grants haul road alignment and cross-drainage structures

4.5 CONSEQUENCE CATEGORY ASSESSMENT

GHD (2022) had undertaken a preliminary consequence category assessment for OHD and MWD. A summary of the BP33 water storage consequence categories for environmental spills, dam failure and the extreme storm storage (ESS) allowance are provided in Table 4.4. GHD (2022) advise that a design storage allowance (DSA) is not required due to the low consequence of an environmental spill.

Table 4.4 Consequence categories for BP33 water storages (GHD, 2022)

Name	Consequence Category		
	Environmental Spill	*Dam Failure*	*ESS*
OHD	Low	Low	Not required
MWD	Low	Low	Not required

4.6 WASTE DISCHARGE LICENCE

BP33 currently operates under waste discharge licence (WDL) WDL253 for the period February 2024 to February 2029 which allows for the following action to occur:

- Controlled discharge of wastewater from Mine Water Dam (MWD) Cell 1 and into Drainage Line BP1 subject to conditions of the licence.
- Any authorised discharge must:
  a. Not include wastewater generated outside of ML32346 and MLN16;
  b. Not include wastewater treated with polyacrylamide flocculants with more than 0.05% of the neuro-toxin acrylamide monomer;
  c. Occur only when the stream gauge at the compliance point BPDS SW6 shows there is a sufficient amount of water to dilute discharge water to achieve trigger values presented at the compliance point at BPDS SW6;
  d. Occur only when there is flow in Drainage Line BP1;
  e. In the event wastewater is treated, occur only when the treatment process has finished, including allowing sufficient residence time for settlement of flocculants and target contaminants.

In the event wastewater is treated, occurs only when the treatment process has finished, including allowing sufficient residence time for settlement of flocculants and target contaminants.

4.7 IRRIGATION MANAGEMENT

Releases from the MWD into irrigation areas may be undertaken to dispose of surplus water during the event where water is unable to be released under the WDL. Three sites within the land unit 2a1 were considered suitable for irrigation up to 5 mm throughout the lifespan of the operation (EcOz, 2023). The nutrient balancing undertaken shows that each site can suitable accommodate the anticipated hydraulic and nutrient loading of both nitrogen and phosphorus under the maximum irrigation rate of 5 mm without risking degradation to soil structure.

It is proposed that irrigation areas for established by Month 37, if required.

4.8 SURFACE WATER EXTRACTION LICENCE

LD operate under a Surface Water Extraction Licence (SWEL) 8151018, which allows LD to extract water from OHD for use onsite (i.e. supply for dust suppression and Mill processing demand). LD will be requesting an amendment to the SWEL to include expected BP33 requirements. The current SWEL commenced on 1 December 2021 and states that LD is entitled to extract up to:

- 620 ML during the 2022/23 Water Accounting Year (WAY23);
- 121 ML during the WAY24 (2023/24) and WAY25 (2024/25)

Water from OHD is proposed to be transferred to BP33 via dedicated pipeline, as required, to meet onsite demands. OHD was constructed to supply water for tin and tantalite mining and ore processing that occurred in the 1980's and 1990's.

The current estimated Full Storage Volume (FSV) for OHD is 364 ML.

4.9 INTERACTION WITH THE EXISTING GRANTS PROJECT

LD is currently mining the Grants open pit, which forms part of the greater Finniss Lithium Project. The Grants mine is located north north-west of the BP33 project. As part of the Finniss Lithium Integrated WMS, the BP33 and Grants WMSs will be interconnected through:

- BP33 ore would be processed at the Grants facilities;
- Water transfer between the sites would be undertaken to supply demands and provide additional storage capacity as required through a pipeline between Grants MWD1 and BP33 MWD;
- The processing fines slurry from Grants will be transferred at the BP33 Paste plant, where the cemented paste backfill will be used for underground mining.

Figure 1.4 shows the location of the Grants project in relation to BP33 and the whole Finniss Lithium project.

Water management objectives for the Grants project described in the Grants WMP (WRM, 2023).

Grants can source water from the OHD, prior to using water from external sources. Once mining has finished in the Grants area, excess BP33 water may be transferred and stored in the Grants void as required.

5 MINE SITE WATER BALANCE

5.1 OVERVIEW

This section of the WMP describes the water balance model that has been used to assess the performance of the mine site water management system in meeting the WMS objectives. The outcomes of the current site water balance model are summarised in this section.

For further details on the water balance model configuration, refer to the integrated Water Balance Model report (WRM, 2024) and the Operational water balance memo (WRM, 2024b)

5.2 WATER BALANCE MODEL METHODOLOGY

A computer-based operational simulation model (GoldSim) was used to assess the dynamics of the current mine water management system under conditions of varying rainfall, water quality and production rates for the period between Month 27 to Month 178 for the three operational phases of the project:

- Phase 1: Construction of the box cut and associated surface infrastructure.
- Phase 2: Underground mine development including advancement of the decline; and
- Phase 3: Operation of the underground mine

The GoldSim model dynamically simulates the operation of the water management system (WMS) and keeps complete account of all site water volumes and contaminant loads on a daily time step. For the purpose of this assessment, two contaminants, which have been identified as limiting the ability to discharge mine affected water, were tracked through the BP33 WMS. These included:

- Total Nitrogen; and
- Total Phosphorus.

Tracking these contaminants informs key operations, including maximum allowable controlled release rates.

The model has been configured to simulate the operations of all major components of the mine water management system. The simulated inflows and outflows included in the model are given in Table 5.1.

Table 5.1 Simulated inflows and outflows to the mine water management system

Inflows	Outflows
Direct rainfall on water storage surfaces	Evaporation from water surface of storages
Catchment runoff	Underground mine demand
Groundwater inflows	Dust suppression demand
External water supply	Ancillary (misc.) water use
Grants mill tailings	Offsite spills from storages
Grants mine-affected water	Controlled Releases
	Paste plant demands

The model incorporates the Australian Water Balance Model (AWBM) rainfall runoff model (Boughton, 2003) to determine the runoff characteristics of the various catchment types on the mine site. The water and solute balance model was used to determine the behaviour of the mine water management system over time.

5.3 ASSESSMENT CRITERIA

The models are used to predict the performance of the following:

- Site wide mine affected water inventory against the combined full supply capacity;
- The ability to dewater the underground mine (i.e. if the surface storages are too full to enable the underground mine to be dewatered);
- Compliance with the WDL conditions with respect to the frequency and volumes of controlled releases and the risk of uncontrolled discharge; and
- The risk of requiring external water over and above the external supply limit and SWEL.

The adopted performance criteria for the BP33 water balance are as follows:

- All releases from the mine water dams comply with the WDL conditions; and
- Less than 1% risk that the underground mine will be inundated over the model period.¬

5.4 SITE WATER BALANCE MODEL CONFIGURATION

The water balance simulated the period from Month 27 to Month 178 on a daily timestep which includes the Grants area and BP33 area operations. The adopted site storage characteristics are shown in Table 5.2. The adopted catchments and land use reporting to each of the water storages at BP33 is shown in Table 5.3 and Figure 5.1.

Table 5.2 Storage characteristics for BP33 WMS

Dam Name	Phase 2 (Month 27 to Month 39)		Phase 3 (Month 40 to Month 178)	
	FSV (ML)	MOV (ML)	FSV (ML)	MOV (ML)
BCS[a]	Decommissioned		Decommissioned	
MWD Cell 1	78	66	78	66
MWD Cell 2	78	66	78	66
SB1	13.0	-	13.0	-
SB2	10.6	-	10.6	-
OHD[b]	364	-	620	-

[a] the BCS will be backfilled (removed) by Month 28 and its catchment will drain to SB2.

[b] OHD dam wall raised by Month 41.

Table 5.3 BP33 catchment areas

Dam name	Undisturbed area (ha)	Hardstand area (ha)	Waste Rock area (ha)	Box cut/ Cleared area (ha)	Total area (ha)
BCS	-	-	-	2.7	2.7
MWD Cell 1	-	2.3	-	-	2.3
MWD Cell 2	-	2.3	-	-	2.3
SB1	-	15.1	6.3	5.1	26.5
SB2	-	1.5	-	12.0	13.5
Total	**-**	**21.2**	**6.3**	**19.8**	**47.3**
OHD	92.8	1.0	-	-	93.8

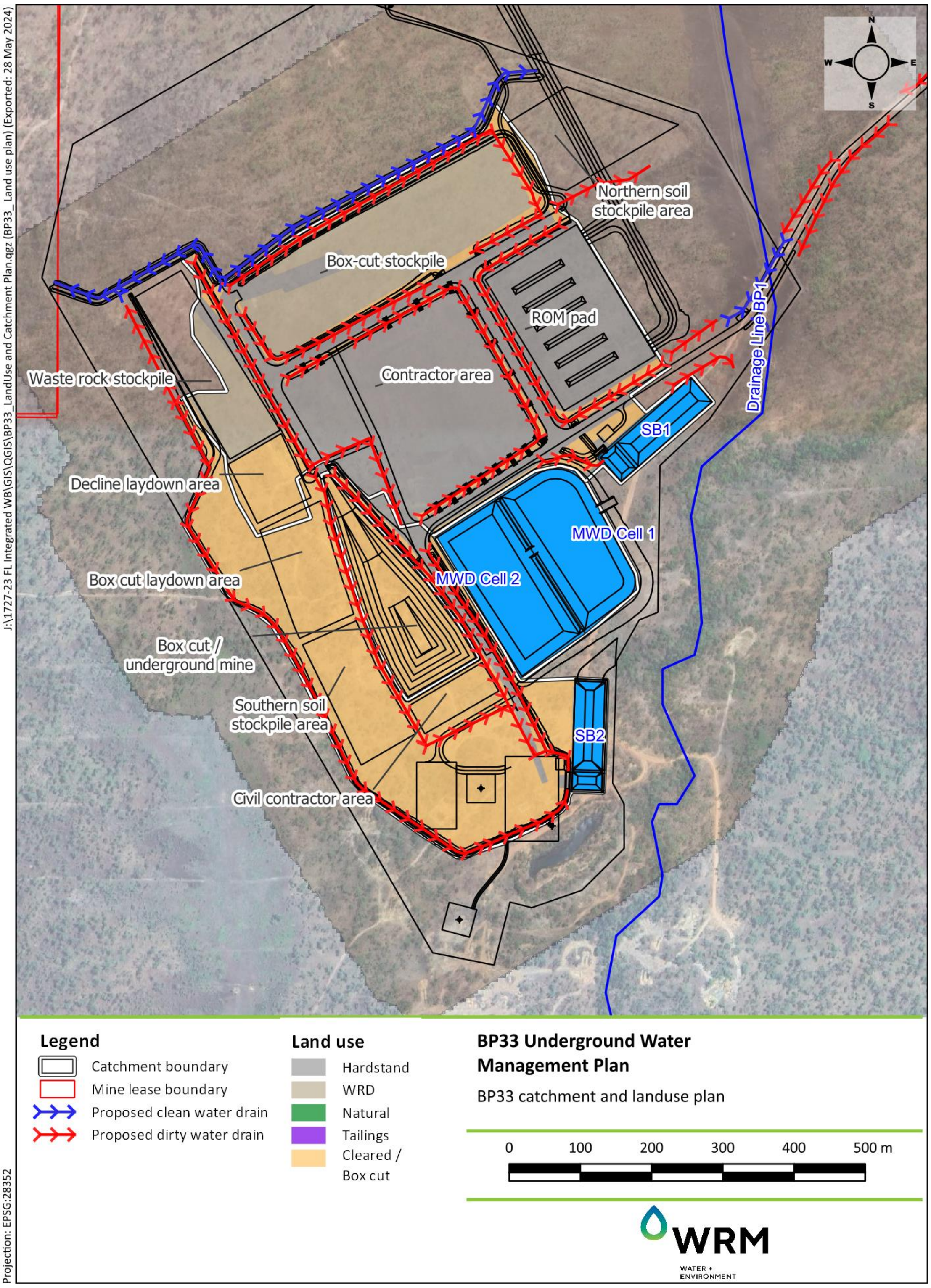

Figure 5.1 Proposed BP33 catchment areas and land use mapping

5.5 MODEL OUTCOMES

The key outcomes from the water balance modelling assessment for Phase 2 (Stage 5 of the Finnis Lithium Project) and Phase 3 (Stage 6 of the Finnis Lithium Project) as follows:

- Figure 5.2 shows the total storage inventory for all storages in the BP33 WMS during the LOM. The results show:
  - For very wet climatic conditions (1%ile), up to 155 ML would be stored at BP33.
  - For median climatic conditions (50%ile), up to 150 ML would be stored at BP33.
  - For Phase 3, there is a risk of running out of water at BP33 for dry climatic conditions.
- Figure 5.3 shows the external water required to make up site deficits, even with OHD import considered. The results show:
  - For very dry climatic conditions (99%ile), up to 4 ML/month (m) and 4 ML/annum (a) would be required in Phase 2.
  - For very dry climatic conditions (99%ile), up to 40 ML/m and 160 ML/a would be required in Phase 3.
- Figure 5.4 shows the controlled releases under WDL253 to manage the direct rainfall and catchment runoff in the WMS. It is predicted that:
  - For very wet climatic conditions (1%ile), up to 40 ML/m and 70 ML/a will be released during the wet seasons of the forecast period.
  - The dilution ratio is predicted to fluctuate between 1:4 and 1:6 (1 part mine water to X parts receiving water) depending on the amount of dilution from rainfall runoff.
- The site inventory would generally follow cyclic trends across the wet and dry periods.
- Primarily sediment water from SB1, and SB2 would be stored in MWD Cell 2 and used to supply site mine water demands before sourcing water from OHD.
- There are no predicted spills from mine water storages for the two phases for all climatic conditions.

Table 5.4 shows the summary of inflows and outflows of the water management system for the base case scenario for average climatic conditions.

Further information regarding the water balance modelling results and the sensitivity assessment is documented in WRM (2024b).

Table 5.4 BP33 site water balance (average climatic conditions)

	Description	Phase 2 (ML/a)	Phase 3 (ML/a)
Water sources	Surface water inflow	401	380
	Groundwater inflow	37	37
	Pumped inflows from OHD	58	73
	Pumped inflows from Grants	236	347
	Grants tailings	0	255
	External water required	0	9
	Total inflow	**732**	**1,100**
Water losses and mine usage	Evaporation (from water storage)	79	90
	Site dust suppression	41	42
	BP33 to Grants haul road dust suppression	142	172
	Underground demands	41	183
	Ablution/Facility demands	44	44
	Potable water for paste plant	0	26
	Cleanup water for paste plant	0	26
	Sediment dam overflows	230	220
	Total loss	**576**	**803**
Pasting plant losses	Filtrate cake	0	41
	Paste	0	215
	Total loss	**0**	**255**
Water disposal measures	Controlled releases offsite	22	18
	Total disposal	**22**	**18**
Site water balance including water disposal measures		**134**	**23**

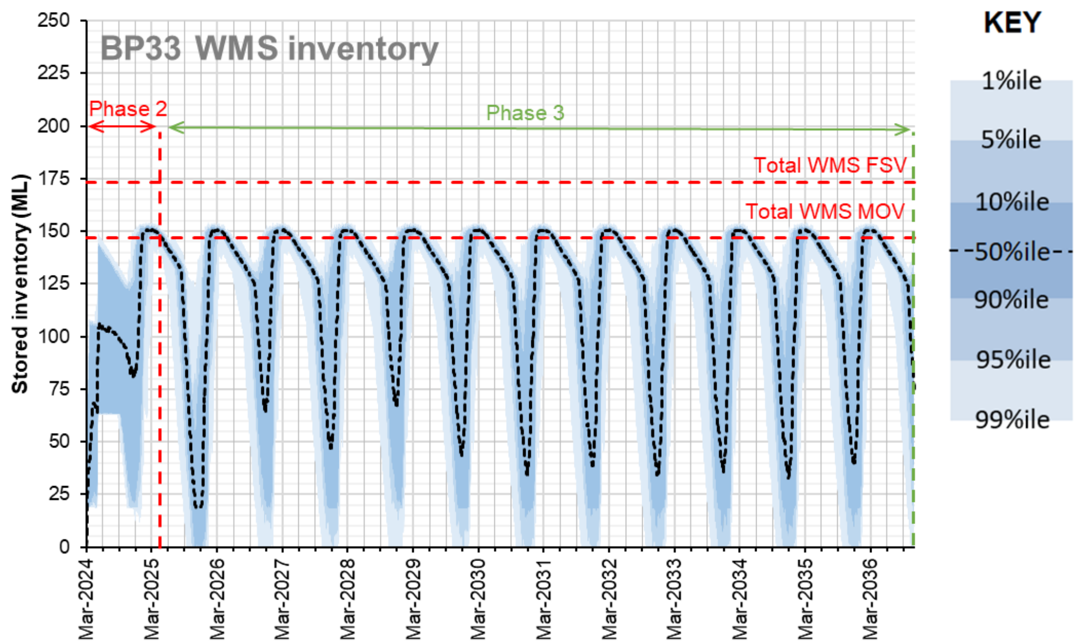

Figure 5.2 Total storage inventory in the WMS

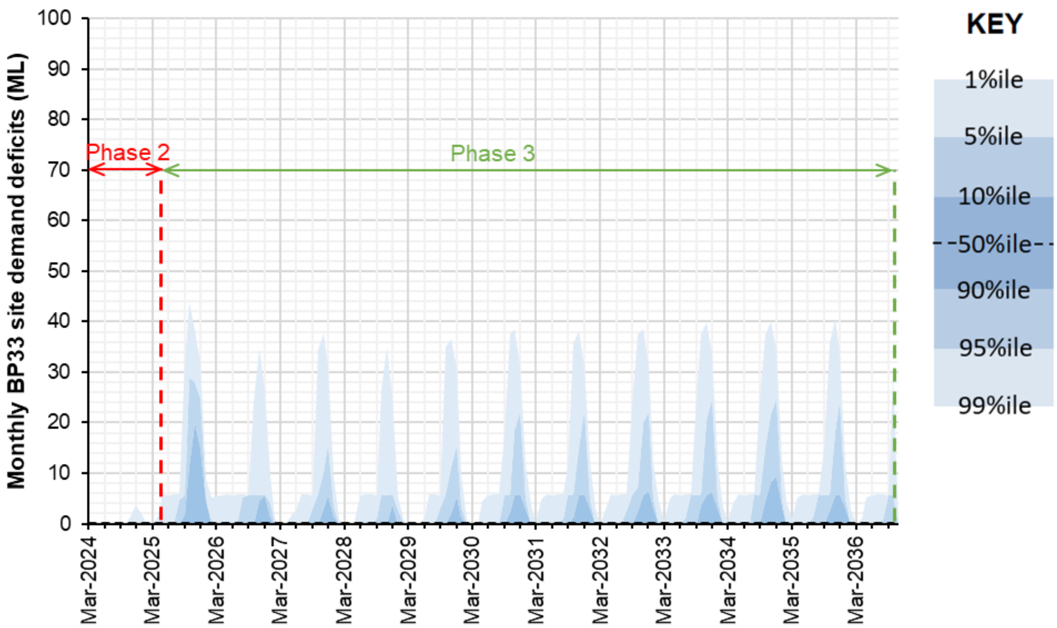

Figure 5.3 Monthly site demands deficits

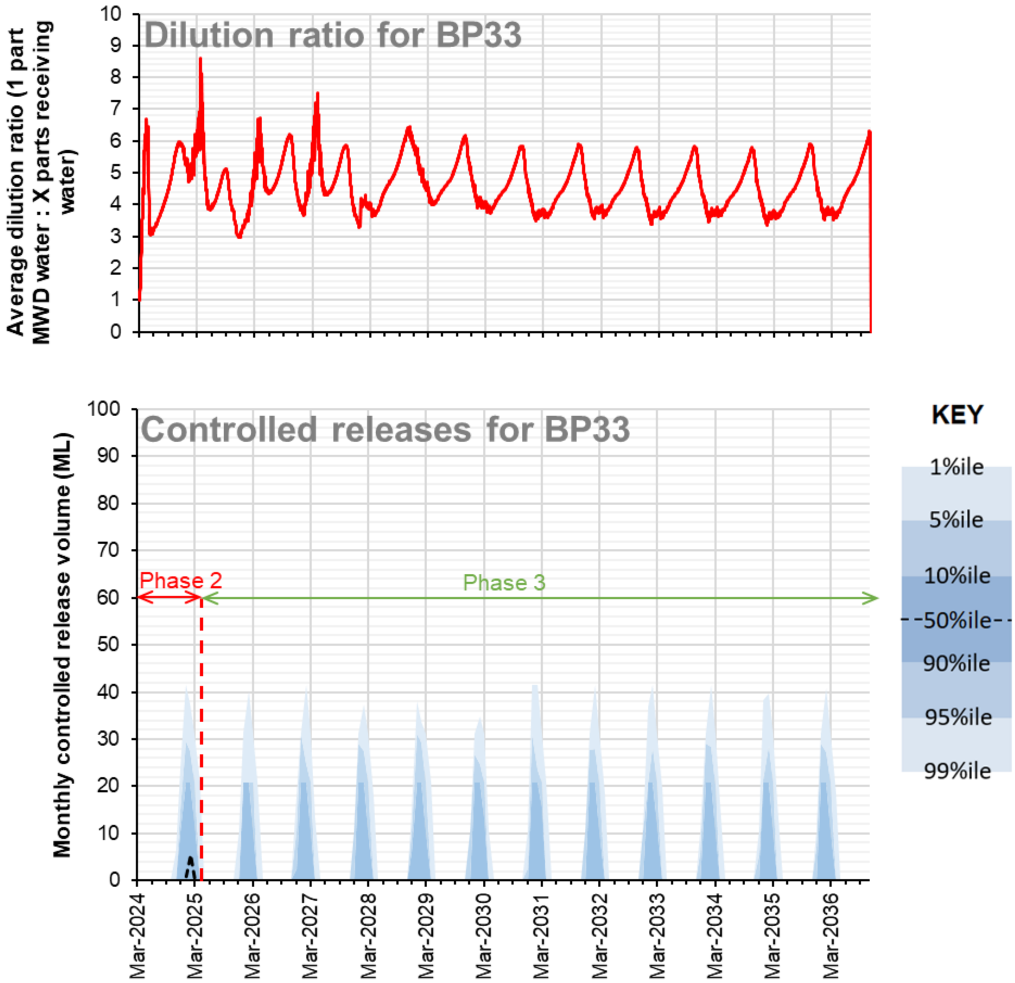

Figure 5.4 Monthly controlled releases

6 WATER QUALITY MONITORING PLAN

6.1 OVERVIEW

The objective of the water quality monitoring plans is to provide early warning and trigger management actions for preventing impacts to surface waters and/or groundwater aquifers. Surface water and groundwater monitoring plans are detailed below.

Water monitoring program design, sampling methods, data assessment criteria and reporting follow the guidance recommended in:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy Paper No 4 (ANZECC, 2000a);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy Paper No 7 (ANZECC, 2000b); and
- AS/NZ Standards 5667:1998 – Water Quality Sampling Parts 1, 4, 6, 10 and 11 (AS/NZS, 1998).

6.2 PARAMETERS MEASURED

Table 6.1 outlines field and laboratory parameters measured at all surface water and groundwater monitoring locations. An extended metals suited, comprising 30+ metals, is required to be undertaken annually in late wet season recessional flows.

Selected parameters aim to detect all identified surface water and groundwater quality-related impacts detailed in this WMP.

Table 6.1 Surface water and groundwater quality field and laboratory parameters

Type	Parameters (Surface Water)	Parameters (Groundwater)
Field	• pH (pH units) • Electrical Conductivity (uS/cm) • Total Dissolved Solids (mg/L) • Turbidity (NTU) • Temperature (°C) • Oxidation Reduction Potential (mV) • Dissolved Oxygen (%saturation)	• pH (pH units) • Electrical Conductivity (uS/cm) • Total Dissolved Solids (mg/L) • Turbidity (NTU) • Temperature (°C) • Oxidation Reduction Potential (mV) • Dissolved Oxygen (%saturation) • Standing Water Levels

Laboratory	• Nutrients (ammonia, Nitrate, Nitrite, total nitrogen, total phosphorus, reactive phosphorus)
	• Chlorophyll-a
	• Dissolved and total metals:
	  ○ Aluminium
	  ○ Arsenic
	  ○ Cobalt
	  ○ Copper
	  ○ Iron
	  ○ Lithium
	  ○ Lead
	  ○ Nickel
	  ○ Zinc
	• Dissolved and total metals extended suite of 30+ metals in addition to the above (annually)
	• Major anions (sulfate, chloride and alkalinity)
	• Major cations (calcium, magnesium, sodium and potassium)
	• Hydrocarbons TPH/TRH, BTEXN (Sediment basins only)
	• Constituents contained within the flocculants /chemicals used to treat water in sediment basins or MWD.
		• Nutrients (ammonia, Nitrate, Nitrite, total nitrogen, total phosphorus, reactive phosphorus).
		• Dissolved and total metals:
		  ○ Aluminium
		  ○ Arsenic
		  ○ Cobalt
		  ○ Copper
		  ○ Iron
		  ○ Lithium
		  ○ Lead
		  ○ Nickel
		  ○ Zinc
		• Dissolved and total metals extended suite of 30+ metals in addition to the above (annually)
		• Major anions (sulfate, chloride and alkalinity)
		• Major cations (calcium, magnesium, sodium and potassium)
		• Hydrocarbons TPH/TRH, BTEXN
		• Constituents contained within the flocculants /chemicals used to treat water in sediment basins or MWD.

Field Notes	• Weather condition • Flow condition • Any visible items to note i.e. pollutants, algae etc. • Clarity • Odour • Riparian vegetation condition • Photos.	• Weather condition • Bore condition • Any visible pollutants i.e. algae, organisms, hydrocarbons, sheen • Clarity • Odour

6.3 SURFACE WATER MONITORING PROGRAM

The surface water quality monitoring aims to achieve:

- Early detection of contaminants originating from mining operations entering drainage lines and waterways. Potential contaminant sources include:
  - WRD seepage;
  - Water dewatered from the box cut excavation (construction only)
  - Flocculants/chemicals used to treat water across site;
  - Stormwater runoff from the mine site; and
  - Fuel or chemical spills/leaks.
- Monitor box cut water during Phase 1 construction;
- Monitor underground water during Phase 2 and Phase 3 underground operations;
- Detect traces of acid mine drainage from the WRD underground mine water, although there is a very low risk of seepage based on the EGI geochemical assessment (EGI, 2022);
- Detect secondary effects on waterways from physical stressors, such as excess nutrient and organic matter inputs from mine run-off/discharge causing eutrophication and algal blooms.
- Monitor contaminant levels in the box cut (during the construction phase) and underground mine (during the mining phase) for guiding water treatment strategies to meet water quality objectives.
- Verify water quality in mine site storages meets discharge criteria prior to release or use in dust suppression.

6.3.1 Surface water quality monitoring sites

Proposed surface water monitoring site locations are shown in Figure 6.1 and detailed in Table 6.2.

Table 6.2 Surface water quality monitoring sites details

Site ID	Purpose	Sampling frequency
BPUS SW1	• **Impact location** • Monitors impacts from BP33 release into drainage line	• **Monthly**: Field and lab parameters during wet season (November to April).
BPDS SW2	• **Impact location** • Monitors impacts from OHD water extraction on downstream waterways and from BP33 mine site operations.	
BPUS SW4	• **Reference location** • Site upstream of any BP33 mine site impacts	
BPUS SW5	• **Reference location** • Monitors impacts from OHD water extraction on downstream watercourses	
BPUS SW7	• **Reference location** • Site upstream of any BP33 mine site impacts	
BPDS SW3	• **Impact location** • Monitors potential impacts from WRDs.	
BPDS SW6	• **Impact location** • Monitors potential impacts from OHD water extraction on downstream waterways and from BP33 mine site operations	

BPDS SW8	• **Impact location** • Monitors potential impacts from WRDs.	
OHD	• Monitor raw water source for site use.	• **Monthly**: Field and lab parameters year round.

Table 6.3 Operational water quality monitoring sites details

<table>
<tr><th>Site ID</th><th>Purpose</th><th>Sampling frequency</th></tr>
<tr><td>SB1 and SB2</td><td>• Monitor water quality in sediment basins to assess treatment options, upstream controls and to ensure compliance with IECA (2008) criteria prior to release.</td><td rowspan="2">• Prior to controlled release: Field parameters
• Weekly: Field parameters during wet season (regardless of discharge)
• Weekly: Lab parameters when discharging (passive and / or controlled)
• Monthly: lab parameters during wet season (November – April) regardless of discharge</td></tr>
<tr><td>MWD Cells 1 and 2</td><td>• Monitor water quality to assess treatment options and ensure compliance with irrigation and / or WDL criteria prior to release</td></tr>
</table>

6.3.2 Sampling frequency

Sampling frequency will be undertaken as per that outlined in Table 6.2 and Table 6.3.

6.3.3 Sampling methods

Sampling must adhere to the following:

- All surface water quality monitoring must be undertaken by qualified professionals in accordance with the standards listed in Section 6.1.
- All hand-held field parameter meters must be calibrated immediately prior to commencing sampling or in accordance with frequency recommended in the operating manual.
- All laboratory samples are to be placed into the appropriate laboratory supplied bottles and handled in accordance with the standards listed in Section 6.1.
- Samples must be kept cool in eskies until delivered to a NATA accredited laboratory within required holding times.

6.3.4 Surface water flow gauging

LD monitors surface water flow in the BP33 catchment at a number of gauging stations to provide information for flood assessments, engineering designs and waste discharge calculations.

There are two primary water level loggers in the BP33 catchments in the vicinity of the Project:

- OHD (depth only);
- OHD Spillway located at the Observation Hill Dam; and
- BPDS SW2 located downstream of OHD and the BP33 site.

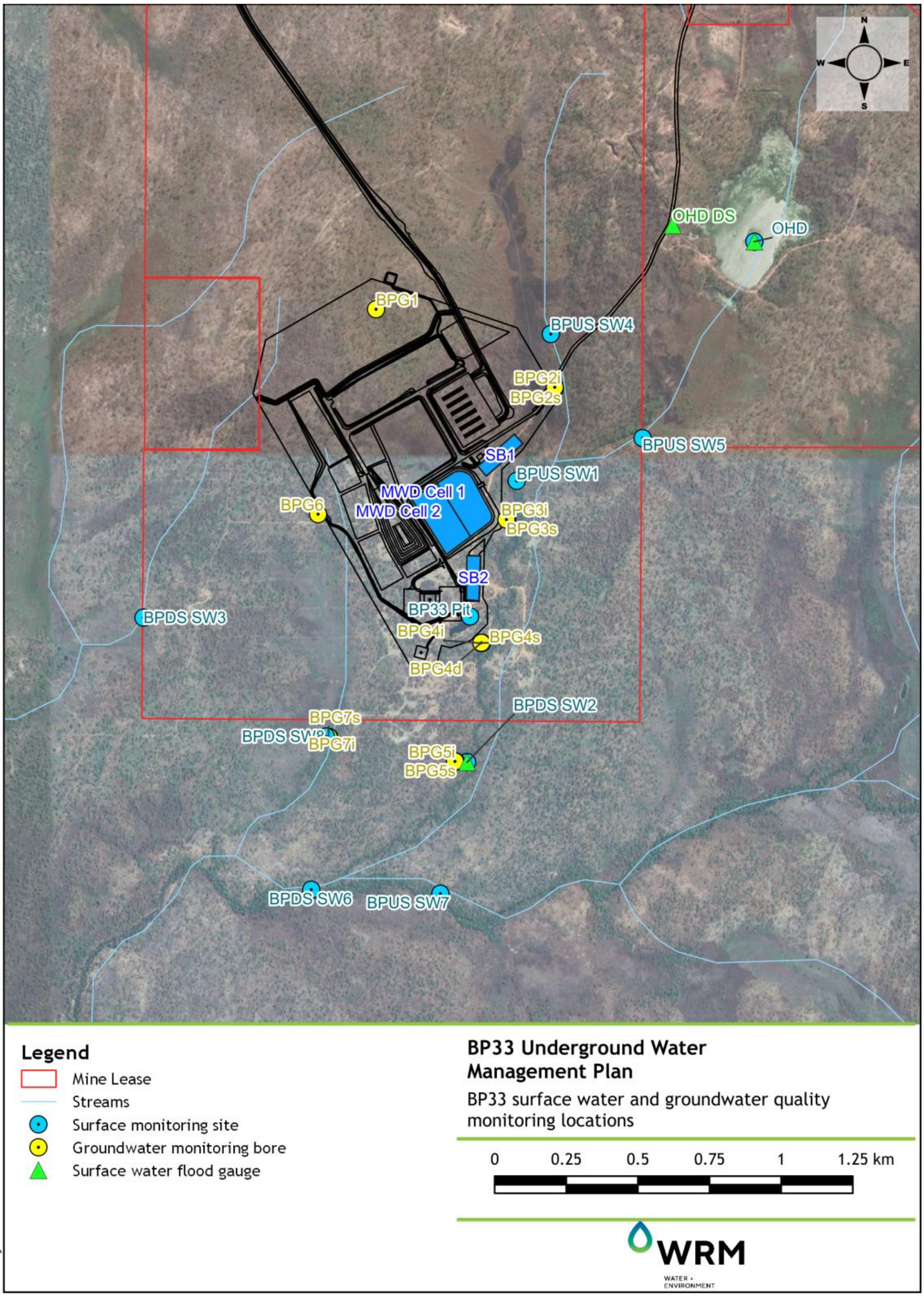

Figure 6.1 Surface water and ground water quality monitoring sites

6.3.5 Assessment criteria

6.3.5.1 Downstream surface water SSTVs

Table 6.4 lists the SSTVs to apply to surface water sites listed in Table 6.2 per the WDL.

Table 6.4 Downstream Surface Water Trigger Values

Parameter	Units	Analysis	Trigger Value
Environmental Field Data			
pH	pH	In situ	5.4-6.7 [2,3]
Electrical conductivity	µS/cm	In situ	250 [1]
Turbidity	NTU	In situ	20 [5]
Dissolved Oxygen	Mg/L	In situ	50 – 100 [1]
Nutrients			
Total Nitrogen	µg/L	Unfiltered	300 [3]
Total Phosphorus	µg/L	Unfiltered	20 [3]
Metals and Metalloids			
Aluminium	µg/L	Filtered (0.45 µm)	70 [3]
Arsenic	µg/L	Filtered (0.45 µm)	13 [1]
Cadmium	µg/L	Filtered (0.45 µm)	0.2 [1]
Chromium (CrVI)	µg/L	Filtered (0.45 µm)	1 [1]
Cobalt	µg/L	Filtered (0.45 µm)	1.4 [1]
Copper	µg/L	Filtered (0.45 µm)	1.4 [1]
Iron	µg/L	Filtered (0.45 µm)	380 [3]
Lead	µg/L	Filtered (0.45 µm)	3.4 [1]
Lithium	µg/L	Filtered (0.45 µm)	430 [4]
Nickel	µg/L	Filtered (0.45 µm)	11 [1]
Zinc	µg/L	Filtered (0.45 µm)	8 [1]

[1] ANZG (2018) 95% species protection, freshwater

[2] 20th percentile of background data for surface water quality

[3] 80th percentile of background data for surface water quality

[4] Ecotoxicology Assessment section 8.3 and 8.4 of the Grants Water Management Plan

6.3.5.2 MWD discharge water quality criteria

Discharge water quality from MWD will aim to meet the WDL criteria. Water treatment will be undertaken prior to release if initial water quality does not meet these criteria. Verification testing after treatment must be undertaken to ensure criteria is met prior to release.

6.3.5.3 Dust suppression / irrigation water quality criteria

The quality of water used from MWD for dust suppression should meet the irrigation water quality trigger values as outlined in Chapter 4 Primary Industries of the ANZECC (2000a) guidelines. This includes:

- Metals: Short-term trigger values outlined in Table 4.2.10 in ANZECC (2000a);
- Salinity, sodicity: the approach outlined in Section 4.2.4 of ANZECC (2000a); and
- Nitrogen and Phosphorus: short-term trigger values outlined in Table 4.2.11 in ANZECC (2000a);
- Site-specific assessment requirements outlined in Volume 3, Section 9.2.6, ANZECC (2000c).

A site capability assessment and Irrigation Management Plan are currently under preparation.

6.3.5.4 Sediment basin discharge water criteria

Turbidity in the sediment basins will be reduced as much as possible, but final discharge from the sediment basins is not always expected to achieve the very low turbidity levels in the receiving drainage lines. As such, the discharge standard recommended for sediment basins in IECA (2008) is adopted:

- *90th percentile NTU reading not exceeding 100, and 50th percentile NTU reading not exceeding 60*

Once discharged, the turbidity of water from the sediment basins is expected to reduce rapidly with dilution in the receiving drainage lines, combined with the filtering effect of the vegetation.

6.3.6 Surface water quality Trigger Action Response Plan

An operational TARP for surface water quality has been developed for the BP33 operation and is provided in Table B.5. The TARP will be employed to mitigate and minimise the risk of impacting the environment from a reduction in offsite water quality. The proposed strategy would involve undertaking an investigation to identify the source of contaminants and to develop a more targeted and appropriate management measure depending on the outcomes of the investigation. Surface water quality will be measured at the surface water monitoring locations listed in Table 6.2 which includes the downstream compliance point BPDS SW6.

6.4 GROUNDWATER MONITORING PROGRAM

Table 6.3 outlines field and laboratory parameters measured in all bores during all quarterly sampling rounds. An extended metals suite (both total and dissolved) comprising 30+ metals is to be analysed annually.

The parameters aim to allow the detection of all identified groundwater quality-related impacts discussed in the preceding sections of this WMP, such as AMD, or any other contaminants potentially in seepage from the WRD.

Continuous measurement of groundwater levels using Troll Loggers in all bores will allow detection of any groundwater mounding associated with the WRD or any other water storages on site as well as any potential groundwater drawdown around the Box cut.

6.4.1 Groundwater monitoring sites

Proposed groundwater monitoring site locations are shown in Figure 6.1 and detailed in Table 6.5.

Table 6.5 Groundwater monitoring site details

Site ID	Purpose	Sampling frequency
BPG1	• Assess groundwater conditions up-gradient of the site	• **Quarterly**: Field and lab parameters. • **Continuous**: Standing water levels
BPG2s	• Assess groundwater conditions up-gradient between box-cut and OHD in the area of mapped GDE potential.	
BPG2i		
BPG3s	• Assess groundwater conditions and establish a groundwater monitoring point at field-verified GDE and vegetation monitoring site.	
BPG3i		
BPG4s	• Establish a nested monitoring site to investigate the degree of vertical connection between BCF aquifer, the weathered zone in the BCF and the alluvial aquifer in the immediate vicinity of the underground mine	
BPG4i		
BPG4d		
BPG5s	• Assess groundwater conditions and establish monitoring at field-verified GDE and surface water monitoring site BPUS SW2	
BPG5i		
BPG6	• Assess conditions down-gradient of box-cut	
BPG7s	• Assess groundwater conditions down-gradient of mine site in area of mapped GDE potential	
BPG7i		
BPG8	• Geotechnical piezometer to assess ground conditions prior to decline construction.	n/a

6.4.2 Sampling frequency

Sampling frequency will be undertaken as per that outlined in Table 6.5.

6.4.3 Sampling methods

Sampling must adhere to the following:

- All surface water quality monitoring must be undertaken by qualified professionals in accordance with the standards listed in Section 6.1.
- All hand-held field parameter meters must be calibrated immediately prior to commencing sampling or in accordance with frequency recommended in the operating manual.
- All laboratory samples are to be placed into the appropriate laboratory supplied bottles and handled in accordance with the standards listed in Section 6.1.
- Samples must be kept cool in eskies until delivered to a NATA accredited laboratory within required holding times.

6.4.4 Assessment criteria

Groundwater quality will be assessed via trend analysis not SSTVs. Management actions as per Table B.6 will be triggered by a greater than 10% variation from baseline conditions.

The range of natural baseline conditions (based on measured 20th and 80th percentile values in accordance with ANZG (2018) guidelines) have been determined for two distinct groundwater units and are defined in Table 6.6 below:

- for the shallow aquifer (bores screened at depths less than 36 mBGL);
  - based on 3 years of data at BPG1, BPG2s, BPG2i, BPG4s, BPG5s and BPG7s.
- and deeper BCF aquifer, given the differing water quality of these systems.

- based on 3 years of data at BPG3i, BPG4i, BPG4d, BPG5i, BPG6 and BPG7i.

Table 6.6 Groundwater analyte background ranges

Parameter	Units	Analysis	Background Range (shallow)	Background Range (deep)
Environmental Field Data				
pH	pH	In situ	4.9 - 5.56	6.46 – 6.84
Electrical conductivity	µS/cm		53.2 – 80.4	208.8 – 271.9
Nutrients				
Total Nitrogen	µg/L	Unfiltered	100[a] – 300	<100
Total Phosphorus			10[a] – 78	190 – 1,040
Metals and Metalloids				
Aluminium	µg/L	Filtered (0.45 µm)	10[a] – 20	<10
Arsenic			1[a] – 8	124 – 219
Cobalt			<1	<1
Copper			1[a] – 2	<1
Iron			50[a] – 60	160 – 1,600
Lead			<1	<1
Lithium			18 – 97	91 – 708
Nickel			2 – 5	<1
Zinc			7 – 26	5[a] – 10
Hydrocarbons			Below detection limit	Below detection limit

[a] Below limit of reporting

6.4.5 Additional groundwater monitoring

It is proposed to increase the reporting of volumes and/or water levels in the box cut and underground mine across the dry season to record the daily groundwater inflows to achieve a better dataset and understanding on how groundwater affects the site. The dry season is a key period for recording groundwater data as rainfall doesn't occur frequently and the only movement of water would be from evaporation, pumped water to other storages or groundwater.

The following attributes/data should be captured to understand the groundwater interactions better:

- Box cut storage volumes;
- Box cut water levels;
- Box cut surface bathymetry;
- Pumped volumes from the box cut to other storages/demands; and
- Pumped volumes from the underground mine to other storages/demands.

The above attributes would increase the quality of the groundwater data across the mining period, which would provide a dataset to improve calibration of the water balance model.

6.4.6 Groundwater quality Trigger Action Response Plan

An operational TARP for ground water quality has been developed to continually monitor the groundwater quality and determine the impact of operations on the receiving environment. The TARP recommends actions to minimise the risk of impacting the environment. The proposed strategy would involve undertaking an investigation to identify the source of contaminants and to develop a more targeted and appropriate management measure depending on the outcomes of the investigation.

Table B.6 shows the recommended operational TARP for groundwater quality.

6.5 SURFACE WATER AND GROUNDWATER QUALITY AND HYDROLOGIC RECORDING AND REPORTING

All results from surface water and groundwater quality monitoring are automatically uploaded into the LD management program (Esdat). The database contains all baseline and operational field and laboratory data.

Reporting requirements will align with those required for annual Environmental Mining Report and additional reporting required under WDL and SWEL conditions.

6.6 WASTE DISCHARGE LICENCE

WDL monitoring will be undertaken in accordance with requirements of WDL253.

6.7 SURFACE WATER EXTRACTION LICENCE

SWEL monitoring requirements are documented in the following monitoring plans:

- Surface Water Extraction Licence 8151018 (DEPWS, 2022);
- Surface Water Extraction Licence Monitoring Plan Observation Hill Dam (Ecoz, 2022c); and
- Riparian Vegetation Monitoring Plan (EcOz, 2022b)

7 ACID ROCK AND SALINE DRAINAGE

7.1 OVERVIEW

A summary of the current understanding of acid rock and saline drainage at BP33 is provided in the following section.

7.2 WASTE ROCK CHARACTERISTICS

Material characterisation studies indicates that the waste rock geochemistry would be considered material with no AMD potential, primarily due to the absence of sulfur which is typical of the sedimentary environment in which it was deposited. The study by EGI (2020, 2021, 2022) had found the waste rock samples:

- Oxidised waste rock samples are devoid of sulphur and classified as non-acid forming (NAF). The oxidised rock which forms majority of the rock excavated, will have a very low risk of acid rock drainage or saline drainage.
- Drainage from the oxidised rock may contain low concentrations of aluminium and zinc.
- Transitional waste rock, which will comprise a small portion of rock removed in the development of box cut and the mine decline, is generally low in sulphur content and can be classified as NAF.
- Fresh waste rock, which will comprise a large portion of the rock removed during development of the underground mine, is generally low in sulphur content but does contain areas which has higher sulphur concentrations. Most fresh waste rock can be classified as NAF however, there is evidence that fresh phyllite may contain PAF material.
- The waste rock extracts from the waste rock samples generally have low salinity concentrations, however the fresh waste rock water extract is generally higher than the other waste rock types.

Considering the results of surface and groundwater monitoring at the BP33 Project, waste characterisation by EGi is corroborated by baseline water quality data:

- pH in groundwater varies between 6.3 and 7.5, indicative of a circumneutral pH environment with sulfate concentrations generally less than 1 mg/L;
- The BP historic Open Cut has a pH of 8.2 and TDS of 14.3 mg/L.

7.3 MONITORING AND MANAGEMENT

Continuation of ground and surface water monitoring programs will assist in the identification of potential acid or saline drainage from the WRD in the unlikely event of occurrence. The frequence and analytes are considered appropriate to provide early indicators of potential issues so that management actions, as detailed in the BP33 WRD/AMD Management Plan and Care and Maintenance Management Plan, can be applied.

8 EMERGENCY AND CONTINGENCY PLANNING

8.1 OVERVIEW

The BP33 water management strategy has been developed for both normal operation periods and during extreme wet weather events in order to:

- Ensure mine affected water accumulation is appropriately managed to minimise the risk of uncontrolled discharge to the environment; and
- Manage and monitor ground and surface waters to ensure risk of environmental harm is minimised and social and environmental objectives are maintained.

The emergency response plan for site is managed in the sites Safety and Health Management System. A summary of the emergency response, should a failure of the water management system occur, is provided below.

8.2 CONTINGENCY ACTIONS

Contingency actions for a number of specific WMS-related trigger events are provided in Table 8.1.

Table 8.1 Surface water management contingency actions

Trigger	Action
Raw water supply pipeline flow meters indicate abnormally low flow rate	• Check for pipeline damage and leakage
Mechanical failure of pumping equipment prevents scheduled transfers	• Ensure adequate spares are available. Source temporary equipment if possible.
Damage to water storage infrastructure	• Regular visual inspections of infrastructure, especially following significant rainfall. • Annual geotechnical inspection.
Failure of water storage structures	• Notify downstream residents (if applicable) and NT EPA and DITT of the failed structure. • Investigate the downstream impacts of the failure and complete a detailed report on the impacts of the failure, including an assessment of likely water volume and quality, and required remedial actions. • Investigate the reason for failure of the structure and ensure the stability of other water storages at risk. • Assess the effects of the failure on the WMS and implement mitigation measures
Forecasts of significant rainfall / storm event or water storages nearing capacity.	• Pump water from any storage at risk of unlicensed or uncontrolled discharges. • If groundwater inflows are significant, investigate the implementation of a pipeline between BP33 and Grants to increase the amount of available storage between sites. • Measured groundwater inflows into the BP33 system will guide the decision for the pipeline. • Once the Grants OC has been completed, there would be an opportunity to store mine water from BP33 to reduce the active storage volume on site.
Exceedances in groundwater inflows into the underground works/box cut	• Increase the pumping infrastructure to MWD. • Dewater mine-affected water through controlled releases (under the WDL) or irrigation measures (under the Irrigation management plan).

Trigger	Action
	• If the above measures are not possible, there will be flooding of the underground mining works to prevent uncontrolled releases into the environment.
Water demands or catchment yield depart from assumed values used in modelling	• Investigate reasons. • Revisit site water balance modelling if required. •
Water quality in sediment basin(s) indicates mine-affected water.	• Investigate potential sources of contaminants in the catchment (e.g., WRD, box cut stockpile, contractor area, box cut, etc.) that are contributing to poor water quality. • Inspect the WRD and, if necessary, sample seepage and/or runoff to determine if the WRD is affecting sediment basin water quality. • If WRD is found to be impacting on water quality, investigate geochemistry of the WRD. • Investigate options to divert runoff from the source of poor water quality to a mine water storage if required. • Investigate the option of converting the sediment basin into a mine-affected water storage (and prevent uncontrolled spills into the environment) if the sources cannot be diverted or remediated. • Investigate the option of constructing an additional mine water storage and drains to capture runoff from the contaminated area.
Routine monitoring indicates siltation is causing loss of water storage capacity in water management dams (including Observation Hill Dam, Mine Water Dams and Sediment Dams)	• Undertake desilting operation to reinstate design storage volume.
Short-term water demand forecast may approach the entitlement under high security water licences	• Further improvements in water use efficiency. • Investigate procurement of additional water licenses.
Water monitoring indicates an exceedance of the Mine Affected Water Release Limits required to ensure mine water is adequately diluted to meet SSTVs at the downstream compliance point (BPDS SW6) per the proposed WDL.	• Cease any discharges which may be causing non-compliance. • Contain any contaminated water where possible to prevent environmental harm. • Continue to monitor water quality in the area of interest. • Undertake an investigation to ascertain the cause of the non-compliance. • Report the non-compliance to the Administrating Agency and other relevant parties.
Receiving water quality monitoring indicates exceedance of Receiving Waters Contaminant Trigger Levels	• Cease any controlled discharges which may be causing the non-compliance until further analysis is undertaken. • Undertake an investigation in accordance with the WDL.
Exceedances in groundwater bore water quality indicating an impact on groundwater bores.	• Undertake an investigation to ascertain the cause of the non-compliance. (from waste rock or underground works) • Report the non-compliance to the Administrating Agency and other relevant parties. • Investigate drainage options to redirect any waste rock contaminants to the MWD. • A risk-based approach consistent with the GARD Guide (INAP, 2014), will use the results of long-term kinetic testing to inform development of prevention and mitigation measures required in the detailed mine design to prevent metalliferous mine drainage.

Trigger	Action
Community complaints received of impacts to stock and domestic water supply.	• Undertake an investigation in accordance with the WDL.
Uncontrolled discharge	• Monitor water quality and quantity of the discharge and assess the potential for environmental harm. • Contain any contaminated water where possible to prevent environmental harm. • Investigate the use of the discharge and modify the water management system where necessary to prevent future uncontrolled discharges. • Report the non-compliance to the Administering Agency and other relevant parties.
Exceedances in volume extraction from OHD in comparison to the SWEL entitlement volume and period.	• Monitor downstream environment. • Review the OHD operational rules. • Investigate and initiate options to source water from alternate locations. • Investigate and initiate options to reduce water use and onsite, including options to recycle water. • Undertake an assessment to characterise the nature of impacts to surface water conditions and riparian vegetation. • Initiate investigation into reasons for system failure, including assessment of environmental harm. • Investigation options for potential additional water sources. • Take actions recommended by investigation to prevent recurrence.
Riparian vegetation monitoring – Change in covered riparian vegetation exceedances	• Undertake investigation in accordance with Table 4.1 of the Riparian Vegetation Monitoring Plan (EcOz, 2022b). • Implement response to surface water flows monitoring program (WRM, 2022b). • Report on the outcomes of the actions undertaken to the regulator.
GDE Management	• Undertake works in accordance with the GDE Management Plan (EcOz, 2022a).

8.3 OTHER RELEVANT CONTINGENCY ACTIONS

8.3.1 No offsite discharge – mine affected water

It is unlikely that during a significant rainfall event, water will be needed to be discharge from the release dam (MWD) to the receiving waters. MWD is a turkey's nest and is only driven by direct rainfall and the groundwater inflows from underground operations. It is likely that groundwater inflows into MWD will control the frequency and rate at which water will be able to be discharged into the receiving waters in compliance the WDL conditions. In the event where water quality within the release dams exceeds the release criteria for the observed flow event, no releases will be made to the downstream waterways.

9 REPORTING AND REVIEW

9.1 REVIEW OF THE WMP

The water management plan will be updated/revised in accordance with the conditions of the BP33 Environmental Assessment and if there are any material changes to the operation of the BP33 water management system.

9.2 ROLES AND RESPONSIBILITIES

Table 9.1 shows responsibilities for implementation of various aspects of the WMP.

Table 9.1 Roles and responsibilities

Role	Responsibility/Accountability

HSE Manager	• Ensure a site WMP is prepared, implemented and maintained.
	• Ensure water management projects are planned and budgeted for.
	• Ensure adequate storage is available to enable ongoing production through wet and dry climatic conditions.
	• Manage implementation of water management improvement projects.
	• Ensure that water is managed in accordance with the WMP.
	• Design, budget for and arrange the construction of sediment, erosion control and mine water drains/dams.
	• Communicate the WMP to the Project Management team and other relevant stakeholders.
	• Ensure the Plan of Operations addresses water management. Specifically plan to ensure that:
	  ○ Adequate storage is available to enable ongoing production through wet and dry climatic conditions;
	  ○ Contingencies are in place for climatic extremes;
	  ○ Interaction with waste disposal strategies is understood;
	  ○ Closure planning is incorporated.
	• Ensure that planned infrastructure is in compliance with the WMP.
	• Ensure planned maintenance schedules are implemented to maximise the availability of fixed and mobile pumps in the mining area.
	• Ensure all water pipelines and control structures in the maintenance area are regularly inspected, maintained and promptly repaired.
	• Communicate the WMP to operational teams

Environmental Superintendent	• Ensure that water is managed in compliance with the Water Management Plan.
	• Ensure all water pipelines and control structures are regularly inspected, maintained and promptly repaired. Specifically:
	  ○ Prevent spills, leaks and unlicensed discharges;
	  ○ Maintain adequate dewatering capability for high rainfall events;
	  ○ Ensure systems to protect against sudden inrushes of water are fully operational at all times;
	  ○ Maintain storage capacity in runoff capture dams;
	  ○ Ensure efficient recycling and preferential use of mine water.
	  ○ Ensure water supply meets supply demands.
	• Ensure all storages are maintained and operated in accordance with the WDL.
	• Ensure contingency plans for climatic extremes are adhered to.

Environmental Advisor	• Preparation, implementation & maintenance of the site Water Management Plan. • Advise the Environmental Superintendent on water management control & planning requirements. • Prepare site water balances to define water use, storage & discharges; and to monitor and forecast site water management needs.

Role	Responsibility/Accountability
	• Arrange the inspection & maintenance of clean, sediment, erosion control & mine water drains & dams. • Communicate requirements for incident reporting to Project team. • Advise the Environmental Superintendent on water metering requirements. • Design, implement and maintain the water monitoring program. • Report on and communicate performance against water plans and targets. • Audit record report.
Environmental Officer / Technician	• Water quality sampling and data entry. • Inform the Environmental Advisor on water quality samples. • Communicate water quality outcomes to environmental department.

10 INFORMATION/KNOWLEDGE GAPS

10.1 GAPS IN INFORMATION

This WMP has been prepared based on the mine site design and operational assumptions, consistent with the current stage of mine planning. Throughout the document, information and knowledge gaps have been identified that required further work to inform the development of risk management strategies. Information and knowledge gaps and actions proposed to address these are summarised in Table 10.1.

Table 10.1 Information/knowledge gaps, how and when they will be addressed

Information/knowledge gap	Work required	Timing
Toxicant (metal) concentrations in seepage from temporary WRDs	• Long term kinetic testing results to determine if specific design controls required on WRDs and/or ROM to capture and treat contaminated water. • Provide detailed WRD and ROM designs in MMP. • Incorporate contaminants of concerns and monitoring locations into surface water monitoring program. • Redirect internal capture drains to discharge into MWD instead of SB1 if there are exceedances in contaminants of potential concern.	• Kinetic Column Leach (KCL) test results under free draining, oxidising conditions (designed to simulate conditions during surface storage of waste materials throughout the operational stage) completed. Results of KLC testing under saturated conditions (designed to simulate backfill conditions on closure) is expected to be available June/July 2023.
Water management system	• Detailed feasibility assessment of the water storage, treatment and disposal options identified in site water balance study. • Detailed design of site water management system and update the Water Management Plan.	• Prior to commencement of operations.
Groundwater inflows	• Monitor groundwater dewatering from BCS and underground mine to determine if it's required to increase site storage volumes.	• Prior and during commencement of operations.
Forecast v actual water use	• Install automated flow gauges to monitor extraction from OHD and MWD.	• Prior to extraction of water during the dry season.
	• Install automated flow gauges to record water use across the mine site for mining operations and dust suppression.	• Progressively as mine site is constructed.
	• Review forecast versus actual water use.	• End of each year of operations as part of annual reporting.
	• Establish water use targets and actions	• End of year 1 and reviewed annually.

10.2 WATER MANAGEMENT SYSTEM – OPTIONS UNDER CONSIDERATION

Section 4 and Section 5 provides details of water management strategies and forecast surplus water volumes. Water will be pumped to the MWD storage and used as a water supply for the mine operations, which will minimise the need to extract water from OHD and will account for most of the site water inflows. Table 10.2 lists potential options to manage water on site and provides details of the further work required to inform detailed design of the site water management system.

The management strategies in Table 10.2 are based on the assumption that groundwater inflows exceed the predicted amount and require management strategies to reduce the risk of uncontrolled spills and impacts to the environment.

Table 10.2 Management of surplus water strategies

Water management system options	Information considered	Uncertainties/information gaps
Transfer of MWD water via a pipeline to Grants mine	• BP33 start up mining schedule commencement October 2023. • Grants mining schedule ceases October 2025. • Overlap of BP33 start up with Grants mining schedule. • No water will be pumped into the Grants pit until Grants mining ceases.	• Investigate feasibility of daily pumping to Grants pit or interaction with the Grants WDL. • Investigate the possibility of transferring water from BP33 to Grants and discharging under the Grants WDL. • Regulatory approval required for pipeline (DITT) • Confirm ability to transfer water between operations (NT EPA)
Irrigation of woodland environment and/or suitable infrastructure	• Proposed releases to irrigation if the pipeline to Grants Pit is not installed or the transfer is not possible. • Irrigation management plan includes site soil information, water and nutrient balances, and management measures, to identify areas suitable for irrigation and mitigate risks associated with irrigation.	• Investigate timing of the implementation of the proposed irrigation areas in accordance with the Irrigation Management Plan.
Controlled discharge of water from MWD during the wet season.	• Controlled releases from MWD into the environment (discharging to Discharge Line BP1). • Dilution ratios will be tied with the trigger values listed in the WDL once applied. • If it is not possible to dilute, treatment options can be applied.	• If dilution ratio cannot be achieved in stream, investigate treatment options of water, to discharge water. This will include additional bench test of Phoslock to confirm dosage rates and treated wastewater quality (ie. Achievable reduction in phosphorus and arsenic concentrations).
Additional internal water storage capacity	• If groundwater inflows exceed predicted amount it, it may be required to increase site storages.	• Investigate if increases of internal water storages is possible in the current footprint. • Investigate if pumping rate to Grants pit can be increased. • Regulatory approvals required (DITT / NT EPA)

Water management system options	Information considered	Uncertainties/information gaps
Water quality treatment	• If water quality on site exceeds the SSTVs, it may be required to treat the water by: ○ Reverse Osmosis plant; ○ Resin filtration; ○ Flocculating/Coagulating agents. • After treatment, controlled discharge into the environment or prioritise usage for site demands.	• Investigate contaminants of potential concern and select appropriate water treatment process. • Investigate other methodologies of removing specific contaminants (ie. Phoslock for phosphorus, UV or chlorine disinfection for bacteria, carbon filters for iron).

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APPENDIX A WATER QUALITY RESULTS

Table A.1 Bynoe Harbour catchment water quality results

Contaminant	Units	No. of samples	20%ile	Median	80%ile
Environmental Field Data					
pH (field)	pH	47	5.43	5.90	6.69
Electrical Conductivity (field)*	µS/cm	47	15.8	19.4	27.3
Turbidity (field)*	NTU	44	2.16	5.20	17.14
Total Anions	meq/L	43	53.74	73.00	81.56
Total Cations	meq/L	79	0.13	0.18	0.29
Nutrients					
Total Nitrogen	mg/L	79	0.1	0.2	0.34
Total Phosphorus	mg/L	73	<0.01	<0.01	0.02
Ammonia	mg/L	79	<0.01	0.02	0.07
Metals and Metalloids					
Aluminium (total)	mg/L	40	0.08	0.16	0.53
Aluminium (filtered)	mg/L	79	0.01	0.03	0.06
Arsenic (total)	mg/L	49	0.001	0.002	0.004
Arsenic (filtered)	mg/L	79	<0.001	0.002	0.002
Cadmium (total)	mg/L	12	<0.001	<0.001	<0.001
Cadmium (filtered)	mg/L	25	<0.001	<0.001	<0.001
Chromium (total)	mg/L	49	<0.001	<0.001	<0.001
Chromium (filtered)	mg/L	79	<0.001	<0.001	<0.001
Cobalt (total)	mg/L	40	0.62	0.95	2.13
Cobalt (filtered)	mg/L	79	0.116	0.19	0.38
Copper (total)	mg/L	49	<0.001	<0.001	<0.001
Copper (filtered)	mg/L	79	<0.001	<0.001	<0.001
Iron (total)	mg/L	40	0.002	0.004	0.006
Iron (filtered)	mg/L	77	0.001	0.003	0.006
Lead (total)	mg/L	49	<0.001	<0.001	<0.001
Lead (filtered)	mg/L	79	<0.001	<0.001	<0.001
Lithium (total)	mg/L	45	<0.005	<0.005	<0.005
Lithium (filtered)	mg/L	79	<0.005	<0.005	<0.005
Nickel (total)	mg/L	40	0.08	0.16	0.53
Nickel (filtered)	mg/L	79	0.01	0.03	0.06
Zinc (total)	mg/L	49	0.001	0.002	0.004
Zinc (filtered)	mg/L	79	<0.001	0.002	0.002

Key:
* Field samples were analysed for this dataset as there were no available lab samples during this period.
Note: Shaded cells represent an exceedance of the proposed SSTV.

Table A.2 Water quality sampling results - OHD

Contaminant	Units	No. of samples	20%ile	Median	80%ile
Environmental Field Data					
pH (field)	pH	33	6.15	6.59	7.71
Electrical Conductivity (lab)	µS/cm	20	12.0	15.0	18.2
Turbidity (lab)	NTU	20	2.18	3.25	5.72
Nutrients					
Total Nitrogen	mg/L	35	0.2	0.3	0.5
Total Phosphorus	mg/L	35	<0.01	0.02	0.02
Ammonia	mg/L	36	0.01	0.03	0.11
Metals and Metalloids					
Aluminium (total)	mg/L	28	0.02	0.05	0.07
Aluminium (filtered)	mg/L	35	<0.01	<0.01	<0.01
Arsenic (total)	mg/L	29	0.003	0.004	0.005
Arsenic (filtered)	mg/L	35	0.002	0.002	0.0032
Cadmium (total)	mg/L	29	<0.0001	<0.0001	<0.0001
Cadmium (filtered)	mg/L	35	<0.0001	<0.0001	<0.0001
Chromium (total)	mg/L	29	<0.001	<0.001	<0.001
Chromium (filtered)	mg/L	35	<0.001	<0.001	<0.001
Copper (total)	mg/L	29	<0.001	<0.001	<0.001
Copper (filtered)	mg/L	35	<0.001	<0.001	<0.001
Iron (total)	mg/L	28	0.30	0.42	0.84
Iron (filtered)	mg/L	35	<0.05	0.1	0.2
Lead (total)	mg/L	29	<0.001	<0.001	<0.001
Lead (filtered)	mg/L	35	<0.001	<0.001	<0.001
Lithium (total)	mg/L	28	<0.001	0.001	0.003
Lithium (filtered)	mg/L	35	<0.001	0.001	0.002
Mercury (total)	mg/L	29	<0.0001	<0.0001	<0.0001
Mercury (filtered)	mg/L	35	<0.0001	<0.0001	<0.0001
Nickel (total)	mg/L	29	<0.001	<0.001	<0.001
Nickel (filtered)	mg/L	35	<0.001	<0.001	<0.001
Zinc (total)	mg/L	23	<0.005	<0.005	<0.005
Zinc (filtered)	mg/L	35	<0.005	<0.005	<0.005

* Field samples were analysed for this dataset as there were no available lab samples during this period.

Note: Shaded cells represent an exceedance of the proposed SSTV.

Table A.3 Bynoe Harbour catchment toxicant summary results

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Arsenic Acid, As (V) (filtered)	µg/L	-	13	<0.001	<0.001	0.0016
Arsenious Acid, As (III) (filtered)	µg/L	-	3	1.3	1.3	1.66
Dimethylarsinic Acid (DMA) (filtered)	µg/L	-	1	<1	<1	<1
Methylarsonic acid (MMA) (filtered)	µg/L	-	1	<1	<1	<1
Arsenobetaine (ASB) (filtered)	µg/L	-	1	<1	<1	<1
Benzene	µg/L	-	31	<1	<1	<1
Toluene	µg/L	-	31	<2	<2	<2
Ethylbenzene	µg/L	-	31	<2	<2	<2
Xylene (m & p)	µg/L	-	31	<2	<2	<2
Xylene (o)	µg/L	-	31	<2	<2	<2
Xylene Total	µg/L	-	31	<2	<2	<2
Total BTEX	µg/L	-	31	<1	<1	<1
C6-C10 Fraction (F1)	µg/L	-	31	<20	<20	<20
C6-C10 (F1 minus BTEX)	µg/L	-	31	<20	<20	<20
>C10-C16 Fraction (F2)	µg/L	-	31	<100	<100	<100
>C10-C16 Fraction (F2 minus Naphthalene)	µg/L	-	31	<100	<100	<100
>C16-C34 Fraction (F3)	µg/L	-	31	<100	<100	<100
>C34-C40 Fraction (F4)	µg/L	-	31	<100	<100	<100
>C10-C40 Fraction (Sum)	µg/L	-	31	<100	<100	<100
Faecal Coliforms	CFU/100mL	-	3	1116	1800	4320
E. Coli	CFU/100mL	-	11	66	600	1800
Enterococci	org/100mL	-	11	75	300	700
Total Phosphorus as P (Organic Phosphate as P)	mg/L	0.02	73	<0.01	<0.01	0.02
Sulfate as SO4 - Turbidimetric (filtered)	mg/L	-	79	<1	<1	<1
Nitrite + Nitrate as N	mg/L	-	79	<0.01	<0.01	0.02
Alkalinity (Bicarbonate as CaCO3)	mg/L	-	79	2	4	8
Alkalinity (Carbonate as CaCO3)	mg/L	-	79	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	-	79	<1	<1	<1
Alkalinity (total) as CaCO3	mg/L	-	79	2	4	8
Ammonia as N	mg/L	0.9	79	<0.01	0.02	0.07
Anions Total	meq/L	-	79	0.13	0.18	0.29
Cations Total	meq/L	-	79	0.09	0.13	0.17

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Chloride	mg/L	-	79	2	3	4
Kjeldahl Nitrogen Total	mg/L	-	79	0.1	0.2	0.34
Nitrate (as N)	mg/L	-	79	<0.01	<0.01	0.02
Nitrite (as N)	mg/L	-	79	<0.01	<0.01	<0.01
Nitrogen (Total)	mg/L	0.3	79	0.1	0.2	0.34
Reactive Phosphorus as P (Orthophosphate as P)	mg/L	-	24	<0.01	<0.01	<0.01
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	-	70	0.0018	0.003	0.006
Sodium (filtered)	mg/L	-	79	2	3	3
Hardness as CaCO3 (filtered)	mg/L	-	20	<1	<1	<1
Aluminium	mg/L	-	40	0.08	0.16	0.532
Aluminium (filtered)	mg/L	0.05	79	0.01	0.03	0.06
Arsenic	mg/L	-	49	0.001	0.002	0.004
Arsenic (filtered)	mg/L	0.013	79	<0.001	0.002	0.002
Barium	mg/L	-	12	0.018	0.0195	0.0276
Barium (filtered)	mg/L	-	25	0.007	0.009	0.0142
Beryllium	mg/L	-	12	<0.001	<0.001	<0.001
Beryllium (filtered)	mg/L	-	25	<0.001	<0.001	<0.001
Boron	mg/L	-	12	<0.05	<0.05	<0.05
Boron (filtered)	mg/L	-	25	<0.05	<0.05	<0.05
Cadmium	mg/L	-	49	<0.0001	<0.0001	<0.0001
Cadmium (filtered)	mg/L	0.0002	79	<0.0001	<0.0001	<0.0001
Calcium (filtered)	mg/L	-	79	<1	<1	<1
Cesium	µg/L	-	12	<1	<1	<1
Cesium (filtered)	µg/L	-	25	<1	<1	<1
Chromium (III+VI)	mg/L	-	49	<0.001	<0.001	<0.001
Chromium (III+VI) (filtered)	mg/L	0.001	79	<0.001	<0.001	<0.001
Cobalt	mg/L	-	12	<0.001	<0.001	<0.001
Cobalt (filtered)	mg/L	0.0014	25	<0.001	<0.001	<0.001
Copper	mg/L	-	49	<0.001	<0.001	<0.001
Copper (filtered)	mg/L	0.0014	79	<0.001	<0.001	<0.001
Iron	mg/L	-	40	0.618	0.945	2.13
Iron (filtered)	mg/L	0.264	79	0.116	0.19	0.38
Lead	mg/L	-	49	<0.001	<0.001	<0.001

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Lead (filtered)	mg/L	0.0034	79	<0.001	<0.001	<0.001
Lithium	mg/L	-	40	0.002	0.004	0.0064
Lithium (filtered)	mg/L	0.43	77	0.001	0.003	0.0058
Magnesium (filtered)	mg/L	-	79	<1	<1	<1
Mercury	mg/L	-	49	<0.0001	<0.0001	<0.0001
Mercury (filtered)	mg/L	-	79	<0.0001	<0.0001	<0.0001
Nickel	mg/L	-	49	<0.001	<0.001	<0.001
Nickel (filtered)	mg/L	0.011	79	<0.001	<0.001	<0.001
Potassium (filtered)	mg/L	-	79	<1	<1	<1
Selenium	mg/L	-	18	<0.01	<0.01	<0.01
Selenium (filtered)	mg/L	-	41	<0.01	<0.01	<0.01
Silver	mg/L	-	12	<0.001	<0.001	<0.001
Silver (filtered)	mg/L	-	25	<0.001	<0.001	<0.001
Strontium	mg/L	-	12	0.0022	0.0035	0.008
Strontium (filtered)	mg/L	-	25	0.0018	0.002	0.003
Thorium	µg/L	-	12	<1	<1	<1
Thorium (filtered)	µg/L	-	25	<1	<1	<1
Tin	mg/L	-	14	<0.001	<0.001	<0.001
Tin (filtered)	mg/L	-	37	<0.001	<0.001	<0.001
Titanium	mg/L	-	12	<0.01	<0.01	<0.01
Titanium (filtered)	mg/L	-	25	<0.01	<0.01	<0.01
Uranium	mg/L	-	12	<1	<1	<1
Uranium (filtered)	mg/L	-	25	<1	<1	<1
Vanadium	mg/L	-	12	<0.01	<0.01	<0.01
Vanadium (filtered)	mg/L	-	25	<0.01	<0.01	<0.01
Zinc	mg/L	-	45	<0.005	<0.005	<0.005
Zinc (filtered)	mg/L	0.008	79	<0.005	<0.005	<0.005
Naphthalene	µg/L	-	18	<5	<5	<5
C6-C9 Fraction	µg/L	-	31	<20	<20	<20
C10-C14 Fraction	µg/L	-	31	<50	<50	<50
C15-C28 Fraction	µg/L	-	31	<100	<100	<100
C29-C36 Fraction	µg/L	-	31	<50	<50	<50
C10-C36 Fraction (Sum)	µg/L	-	31	<50	<50	<50

Note: Shaded cells represent an exceedance of the proposed SSTV.

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Table A.4 Observation Hill Dam toxicant summary results

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Arsenic Acid, As (V) (filtered)	µg/L	-	2	<0.5	<0.5	<0.5
Arsenious Acid, As (III) (filtered)	µg/L	-	2	5.08	5.65	6.22
Dimethylarsinic Acid (DMA) (filtered)	µg/L	-	1	<1	<1	<1
Methylarsonic acid (MMA) (filtered)	µg/L	-	1	<1	<1	<1
Arsenobetaine (ASB) (filtered)	µg/L	-	1	<1	<1	<1
Benzene	µg/L	-	21	<1	<1	<1
Toluene	µg/L	-	21	<2	<2	<2
Ethylbenzene	µg/L	-	21	<2	<2	<2
Xylene (m & p)	µg/L	-	21	<2	<2	<2
Xylene (o)	µg/L	-	21	<2	<2	<2
Xylene Total	µg/L	-	21	<2	<2	<2
Total BTEX	µg/L	-	21	<1	<1	<1
C6-C10 Fraction (F1)	µg/L	-	21	<20	<20	<20
C6-C10 (F1 minus BTEX)	µg/L	-	21	<20	<20	<20
>C10-C16 Fraction (F2)	µg/L	-	21	<100	<100	<100
>C10-C16 Fraction (F2 minus Naphthalene)	µg/L	-	21	<100	<100	<100
>C16-C34 Fraction (F3)	µg/L	-	21	<100	<100	<100
>C34-C40 Fraction (F4)	µg/L	-	21	<100	<100	<100
>C10-C40 Fraction (Sum)	µg/L	-	21	<100	<100	<100
Faecal Coliforms	CFU/100mL	-	3	54.6	84	153.6
E. Coli	CFU/100mL	-	8	24.2	69.5	96
Enterococci	org/100mL	-	8	11.2	36	59.2
Total Phosphorus as P (Organic Phosphate as P)	mg/L	0.02	35	<0.01	0.02	0.02
Sulfate as SO4 - Turbidimetric (filtered)	mg/L	-	35	<1	<1	<1
Nitrite + Nitrate as N	mg/L	-	35	<0.01	<0.01	0.022
Alkalinity (Bicarbonate as CaCO3)	mg/L	-	35	2	3	4.2
Alkalinity (Carbonate as CaCO3)	mg/L	-	35	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	-	35	<1	<1	<1
Alkalinity (total) as CaCO3	mg/L	-	35	2	3	4.2
Ammonia as N	mg/L	0.9	36	0.01	0.03	0.11
Anions Total	meq/L	-	35	0.1	0.14	0.184
Cations Total	meq/L	-	35	0.09	0.09	0.09

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Chloride	mg/L	-	35	2	3	3
Kjeldahl Nitrogen Total	mg/L	-	35	0.2	0.3	0.5
Nitrate (as N)	mg/L	-	35	<0.01	<0.01	0.022
Nitrite (as N)	mg/L	-	35	<0.01	<0.01	<0.01
Nitrogen (Total)	mg/L	0.3	35	0.2	0.3	0.5
Reactive Phosphorus as P (Orthophosphate as P)	mg/L	-	15	<0.01	<0.01	<0.01
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	-	33	<0.001	0.002	0.003
Sodium (filtered)	mg/L	-	35	2	2	2
Hardness as CaCO3 (filtered)	mg/L	-	9	<1	<1	<1
Aluminium	mg/L	-	28	0.02	0.045	0.07
Aluminium (filtered)	mg/L	0.05	35	<0.01	<0.01	<0.01
Arsenic	mg/L	-	29	0.003	0.004	0.005
Arsenic (filtered)	mg/L	0.013	35	0.002	0.002	0.0032
Barium	mg/L	-	8	0.0054	0.0065	0.008
Barium (filtered)	mg/L	-	15	0.0028	0.005	0.0052
Beryllium	mg/L	-	8	<0.001	<0.001	<0.001
Beryllium (filtered)	mg/L	-	15	<0.001	<0.001	<0.001
Boron	mg/L	-	8	<0.05	<0.05	<0.05
Boron (filtered)	mg/L	-	15	<0.05	<0.05	<0.05
Cadmium	mg/L	-	29	<0.0001	<0.0001	<0.0001
Cadmium (filtered)	mg/L	0.0002	35	<0.0001	<0.0001	<0.0001
Calcium (filtered)	mg/L	-	35	<1	<1	<1
Cesium	µg/L	-	8	<1	<1	<1
Cesium (filtered)	µg/L	-	15	<1	<1	<1
Chromium (III+VI)	mg/L	-	29	<0.001	<0.001	<0.001
Chromium (III+VI) (filtered)	mg/L	0.001	35	<0.001	<0.001	<0.001
Cobalt	mg/L	-	8	<0.001	<0.001	<0.001
Cobalt (filtered)	mg/L	0.0014	15	<0.001	<0.001	<0.001
Copper	mg/L	-	29	<0.001	<0.001	<0.001
Copper (filtered)	mg/L	0.0014	35	<0.001	<0.001	<0.001
Iron	mg/L	-	28	0.3	0.42	0.844
Iron (filtered)	mg/L	0.264	35	<0.05	0.1	0.2
Lead	mg/L	-	29	<0.001	<0.001	<0.001

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Lead (filtered)	mg/L	0.0034	35	<0.001	<0.001	<0.001
Lithium	mg/L	-	28	<0.001	0.001	0.003
Lithium (filtered)	mg/L	0.43	35	<0.001	0.001	0.0022
Magnesium (filtered)	mg/L	-	35	<1	<1	<1
Mercury	mg/L	-	29	<0.0001	<0.0001	<0.0001
Mercury (filtered)	mg/L	-	35	<0.0001	<0.0001	<0.0001
Nickel	mg/L	-	29	<0.001	<0.001	<0.001
Nickel (filtered)	mg/L	0.011	35	<0.001	<0.001	<0.001
Potassium (filtered)	mg/L	-	35	<1	<1	<1
Selenium	mg/L	-	11	<0.01	<0.01	<0.01
Selenium (filtered)	mg/L	-	19	<0.01	<0.01	<0.01
Silver	mg/L	-	8	<0.001	<0.001	<0.001
Silver (filtered)	mg/L	-	15	<0.001	<0.001	<0.001
Strontium	mg/L	-	8	0.002	0.002	0.002
Strontium (filtered)	mg/L	-	15	0.0018	0.002	0.002
Thorium	µg/L	-	8	<1	<1	<1
Thorium (filtered)	µg/L	-	15	<1	<1	<1
Tin	mg/L	-	9	<0.001	<0.001	<0.001
Tin (filtered)	mg/L	-	17	<0.001	<0.001	<0.001
Titanium	mg/L	-	8	<0.01	<0.01	<0.01
Titanium (filtered)	mg/L	-	15	<0.01	<0.01	<0.01
Uranium	mg/L	-	8	<1	<1	<1
Uranium (filtered)	mg/L	-	15	<1	<1	<1
Vanadium	mg/L	-	8	<0.01	<0.01	<0.01
Vanadium (filtered)	mg/L	-	15	<0.01	<0.01	<0.01
Zinc	mg/L	-	23	<0.005	<0.005	<0.005
Zinc (filtered)	mg/L	0.008	35	<0.005	<0.005	<0.005
Naphthalene	µg/L	-	6	<5	<5	<5
C6-C9 Fraction	µg/L	-	21	<20	<20	<20
C10-C14 Fraction	µg/L	-	21	<50	<50	<50
C15-C28 Fraction	µg/L	-	21	<100	<100	<100
C29-C36 Fraction	µg/L	-	21	<50	<50	<50
C10-C36 Fraction (Sum)	µg/L	-	21	<50	<50	<50
Naphthalene (VOC)	mg/L	-	15	<0.005	<0.005	<0.005
Dissolved Oxygen (Lab)	mg/L	-	20	9.08	10.1	10.66

Contaminant	Units	SSTV	No. of samples	20%ile	Median	80%ile
Electrical Conductivity (Lab)	uS/cm	-	20	12	15	18.2
Ionic Balance	%	-	-	-	-	-
pH (Lab)	-	-	20	5.462	5.945	6.282
Total Dissolved Solids (Lab)	mg/L	-	9	17	22	37.2
Total Suspended Solids (Lab)	mg/L	-	9	<5	<5	10.8
Turbidity (Lab)	mg/L	-	20	2.18	3.25	5.72
Antimony	mg/L	-	6	<0.001	<0.001	<0.001
Antimony (filtered)	mg/L	-	5	<0.001	<0.001	<0.001
Bismuth	mg/L	-	6	<0.001	<0.001	<0.001
Bismuth (filtered)	mg/L	-	5	<0.001	<0.001	<0.001
Manganese	mg/L	-	6	0.007	0.0095	0.011
Manganese (filtered)	mg/L	-	5	0.0014	0.005	0.0062
Molybdenum	mg/L	-	6	<0.001	<0.001	<0.001
Molybdenum (filtered)	mg/L	-	5	<0.001	<0.001	<0.001
Thallium	mg/L	-	6	<0.001	<0.001	<0.001
Thallium (filtered)	mg/L	-	5	<0.001	<0.001	<0.001
Rubidium	mg/L	-	6	0.002	0.002	0.003
Rubidium (filtered)	mg/L	-	5	0.002	0.002	0.002
Acrylamide	mg/L	-	-	-	-	-

Note: Shaded cells represent an exceedance of the proposed SSTV.

Table A.5 Groundwater quality (shallow aquifer) sampling results

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Environmental Field Data							
pH (field)	pH	81	4	4.9	5.31	5.68	13.33
Electrical Conductivity (field)*	µS/cm	81	5.16	50.1	63.3	80.4	403
Nutrients							
Total Nitrogen	mg/L	123	<0.5	<0.1	0.2	0.3	2
Total Phosphorus	mg/L	119	<0.05	<0.01	0.05	0.084	0.63
Ammonia as N	mg/L	123	<0.01	<0.01	0.03	0.07	0.59
Metals and Metalloids							
Aluminium (total)	mg/L	69	<0.01	0.03	0.2	0.84	10.9
Aluminium (filtered)	mg/L	113	<0.01	<0.01	0.01	0.02	5.81
Arsenic (total)	mg/L	76	<0.001	<0.001	0.002	0.008	0.041
Arsenic (filtered)	mg/L	123	<0.001	<0.001	0.002	0.0086	0.079
Cadmium (total)	mg/L	26	<0.001	<0.001	<0.001	0.002	0.004
Cadmium (filtered)	mg/L	33	<0.001	<0.001	<0.001	0.002	0.005
Chromium (total)	mg/L	76	<0.001	<0.001	0.002	0.006	0.02
Chromium (filtered)	mg/L	123	<0.001	<0.001	<0.001	0.0026	0.027
Cobalt	mg/L	69	<0.05	<0.05	0.19	2.088	18.9
Cobalt (filtered)	mg/L	113	<0.05	<0.05	<0.05	0.07	7.85
Copper (total)	mg/L	76	<0.001	<0.001	<0.001	0.001	0.016
Copper (filtered)	mg/L	123	<0.001	<0.001	<0.001	<0.001	0.009
Iron (total)	mg/L	69	0.002	0.018	0.05	0.0956	0.239
Iron (filtered)	mg/L	113	0.002	0.015	0.048	0.0888	0.21
Lead (total)	mg/L	76	<0.001	0.003	0.004	0.008	0.019
Lead (filtered)	mg/L	123	<0.001	0.002	0.003	0.005	0.012
Lithium (total)	mg/L	76	<0.005	0.011	0.022	0.046	0.123
Lithium (filtered)	mg/L	123	<0.005	0.007	0.014	0.028	0.087
Nickel (total)	mg/L	69	<0.01	0.03	0.2	0.84	10.9
Nickel (filtered)	mg/L	113	<0.01	<0.01	0.01	0.02	5.81
Zinc (total)	mg/L	76	<0.001	<0.001	0.002	0.008	0.041
Zinc (filtered)	mg/L	123	<0.001	<0.001	0.002	0.0086	0.079

* Field samples were analysed for this dataset as there were no available lab samples during this period.

Table A.6 Groundwater quality (deep aquifer) sampling results

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Environmental Field Data							
pH (field)	pH	92	5.63	6.36	6.6	6.868	12.29
Electrical Conductivity (field)*	µS/cm	92	83.6	200.2	241.55	274.84	427.7
Nutrients							
Total Nitrogen	mg/L	137	<0.1	<0.1	<0.1	0.2	2.5
Total Phosphorus	mg/L	136	0.08	0.17	0.29	1.03	1.67
Ammonia as N	mg/L	137	<0.01	<0.01	0.03	0.08	2.49
Metals and Metalloids							
Aluminium (total)	mg/L	78	<0.01	0.02	0.03	0.3	7.45
Aluminium (filtered)	mg/L	126	<0.01	<0.01	<0.01	<0.01	1.38
Arsenic (total)	mg/L	84	0.017	0.1416	0.1705	0.2402	0.337
Arsenic (filtered)	mg/L	137	0.017	0.1006	0.149	0.218	0.338
Cadmium (total)	mg/L	24	<0.001	<0.001	<0.001	<0.001	0.003
Cadmium (filtered)	mg/L	30	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (total)	mg/L	84	<0.001	<0.001	<0.001	0.001	0.02
Chromium (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.017
Cobalt	mg/L	78	0.17	<0.05	0.84	2.5	13.3
Cobalt (filtered)	mg/L	126	<0.05	0.14	0.255	1.6	10.2
Copper (total)	mg/L	84	<0.001	<0.001	<0.001	<0.001	0.006
Copper (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.003
Iron (total)	mg/L	78	0.055	0.0996	0.139	0.7372	1.59
Iron (filtered)	mg/L	126	0.052	0.091	0.1425	0.708	1.47
Lead (total)	mg/L	84	<0.001	<0.001	<0.001	<0.001	0.005
Lead (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.002
Lithium (total)	mg/L	84	<0.005	<0.005	0.008	0.0148	0.05
Lithium (filtered)	mg/L	137	<0.005	<0.005	<0.005	0.01	0.049
Nickel (total)	mg/L	78	<0.01	0.02	0.03	0.3	7.45
Nickel (filtered)	mg/L	126	<0.01	<0.01	<0.01	<0.01	1.38
Zinc (total)	mg/L	84	0.017	0.1416	0.1705	0.2402	0.337
Zinc (filtered)	mg/L	137	0.017	0.1006	0.149	0.218	0.338

* Field samples were analysed for this dataset as there were no available lab samples during this period.

Table A.7 Groundwater quality (shallow aquifer) toxicant summary results

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Chlorophyll a	mg/L	6	<0.002	<0.001	<0.001	<0.001	<0.001
Escherichia coli (Colilert)	orgs/100mL	2	1	1	1	1	1
E. Coli	cfu/100 ml	77	<2	<1	1	1	1600
Enterococci	org/100ml	79	<2	<1	<1	<1	290
Total Phosphorus as P (Organic Phosphate as P)	mg/L	119	<0.05	<0.01	0.05	0.084	0.63
Sulfate as SO4 - Turbidimetric (filtered)	mg/L	111	<10	<1	<1	<1	7
Nitrite + Nitrate as N	mg/L	123	<0.01	0.08	0.11	0.16	0.52
Alkalinity (Bicarbonate as CaCO3)	mg/L	111	1	13	20	33	206
Alkalinity (Carbonate as CaCO3)	mg/L	111	<1	<1	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	111	<1	<1	<1	<1	<1
Alkalinity (total) as CaCO3	mg/L	111	1	13	20	33	206
Ammonia as N	mg/L	123	<0.01	<0.01	0.03	0.07	0.59
Anions Total	meq/L	111	0.08	0.44	0.58	0.84	4.73
Cations Total	meq/L	111	0.09	0.38	0.46	0.81	4.48
Chloride	mg/L	111	2	5	6	8	18
Ionic Balance	%	3	2.65	2.81	3.05	3.416	3.66
Kjeldahl Nitrogen Total	mg/L	123	<0.5	<0.1	<0.1	0.2	1.5
Nitrate (as N)	mg/L	123	<0.01	0.07	0.11	0.16	0.52
Nitrite (as N)	mg/L	123	<0.01	<0.01	<0.01	<0.01	0.1
Nitrogen (Total)	mg/L	123	<0.5	<0.1	0.2	0.3	2
Total Phosphorus (Organic Phosphate)	mg/L	4	<0.01	<0.01	0.005	0.172	0.4
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	123	<0.001	0.006	0.032	0.0622	0.122
Sodium (filtered)	mg/L	111	2	4	6	9	97
Aluminium	mg/L	69	<0.01	0.03	0.2	0.84	10.9
Aluminium (filtered)	mg/L	113	<0.01	<0.01	0.01	0.02	5.81
Arsenic	mg/L	76	<0.001	<0.001	0.002	0.008	0.041
Arsenic (filtered)	mg/L	123	<0.001	<0.001	0.002	0.0086	0.079
Barium	mg/L	26	0.029	0.032	0.082	0.156	0.168

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Barium (filtered)	mg/L	33	0.013	0.022	0.031	0.099	0.138
Beryllium	mg/L	26	<0.001	<0.001	<0.001	0.002	0.006
Beryllium (filtered)	mg/L	33	<0.001	<0.001	<0.001	0.002	0.004
Boron	mg/L	26	<0.05	<0.05	<0.05	<0.05	<0.05
Boron (filtered)	mg/L	33	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	76	<0.0001	<0.0001	<0.0001	<0.0001	0.0006
Cadmium (filtered)	mg/L	123	<0.0001	<0.0001	<0.0001	<0.0001	0.0008
Calcium (filtered)	mg/L	111	<1	<1	<1	2	18
Cesium	µg/L	26	<1	<1	<1	1	88
Cesium (filtered)	µg/L	33	<1	<1	<1	<1	<1
Chromium (III+VI)	mg/L	76	<0.001	<0.001	<0.001	0.001	0.023
Chromium (III+VI) (filtered)	mg/L	123	<0.001	<0.001	<0.001	<0.001	0.006
Cobalt	mg/L	26	<0.001	<0.001	<0.001	0.002	0.004
Cobalt (filtered)	mg/L	33	<0.001	<0.001	<0.001	0.002	0.005
Copper	mg/L	76	<0.001	<0.001	0.002	0.006	0.02
Copper (filtered)	mg/L	123	<0.001	<0.001	<0.001	0.0026	0.027
Iron	mg/L	69	<0.05	0.01	0.19	2.088	18.9
Iron (filtered)	mg/L	113	<0.05	<0.05	<0.05	0.07	7.85
Lead	mg/L	76	<0.001	<0.001	<0.001	0.001	0.016
Lead (filtered)	mg/L	123	<0.001	<0.001	<0.001	<0.001	0.009
Lithium	mg/L	69	0.002	0.018	0.05	0.0956	0.239
Lithium (filtered)	mg/L	113	0.002	0.015	0.048	0.0888	0.21
Magnesium (filtered)	mg/L	111	<1	<1	1	2	4
Mercury	mg/L	76	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (filtered)	mg/L	123	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	76	<0.001	0.003	0.004	0.008	0.019
Nickel (filtered)	mg/L	123	<0.001	0.002	0.003	0.005	0.012
Potassium (filtered)	mg/L	111	<1	1	3	4	8
Selenium	mg/L	26	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (filtered)	mg/L	33	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	26	<0.001	<0.001	<0.001	<0.001	<0.001
Silver (filtered)	mg/L	33	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	26	0.006	0.009	0.011	0.04	0.23
Strontium (filtered)	mg/L	33	0.002	0.0048	0.009	0.0312	0.173

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Thorium	µg/L	26	<1	<1	<1	2	18
Thorium (filtered)	µg/L	33	<1	<1	<1	<1	<1
Tin	mg/L	26	<0.001	<0.001	<0.001	<0.001	0.002
Tin (filtered)	mg/L	33	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	mg/L	26	<0.01	<0.01	<0.01	0.02	1.1
Titanium (filtered)	mg/L	33	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	µg/L	26	<1	<1	<1	<1	2
Uranium (filtered)	µg/L	33	<1	<1	<1	<1	<1
Vanadium	mg/L	26	<0.01	<0.01	<0.01	<0.01	0.01
Vanadium (filtered)	mg/L	33	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	76	<0.005	0.011	0.022	0.046	0.123
Zinc (filtered)	mg/L	123	<0.005	0.007	0.014	0.028	0.087

Table A.8 Groundwater quality (deep aquifer) toxicant summary results

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Chlorophyll a	mg/L	4	<0.001	<0.001	<0.001	<0.001	<0.001
Escherichia coli (Colilert)	orgs/100mL	2	0	0	0	0	0
E. Coli	cfu/100 ml	86	<2	<1	1	1	10
Enterococci	org/100ml	88	<2	<1	<1	<1	12
Total Phosphorus as P (Organic Phosphate as P)	mg/L	136	0.08	0.17	0.29	1.03	1.67
Sulfate as SO4 - Turbidimetric (filtered)	mg/L	122	<1	<1	<1	<1	7
Nitrite + Nitrate as N	mg/L	137	<0.01	<0.01	0.01	0.04	0.56
Alkalinity (Bicarbonate as CaCO3)	mg/L	122	53	91	112.5	122.8	165
Alkalinity (Carbonate as CaCO3)	mg/L	122	<1	<1	<1	<1	134
Alkalinity (Hydroxide) as CaCO3	mg/L	122	<1	<1	<1	<1	<1
Alkalinity (total) as CaCO3	mg/L	122	75	92	113	123	187
Ammonia as N	mg/L	137	<0.01	<0.01	0.03	0.08	2.49
Anions Total	meq/L	122	1.71	2.04	2.49	2.71	4.03
Cations Total	meq/L	122	1.49	1.81	2.185	2.544	4.17
Chloride	mg/L	122	5	6	7	8	62
Ionic Balance	%	11	1.66	1.93	5.07	5.6	9.24
Kjeldahl Nitrogen Total	mg/L	137	<1	<0.1	<0.1	0.2	2.5
Nitrate (as N)	mg/L	137	<0.01	<0.01	<0.01	0.04	0.56
Nitrite (as N)	mg/L	137	<0.01	<0.01	<0.01	<0.01	0.02
Nitrogen (Total)	mg/L	137	<1	<0.1	<0.1	0.2	2.5
Total Phosphorus (Organic Phosphate)	mg/L	1	1.03	1.03	1.03	1.03	1.03
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	137	0.006	0.0802	0.158	0.5592	1.4
Sodium (filtered)	mg/L	122	20	28	35	39	71
Aluminium	mg/L	78	<0.01	0.02	0.03	0.3	7.45
Aluminium (filtered)	mg/L	126	<0.01	<0.01	<0.01	<0.01	1.38
Arsenic	mg/L	84	0.017	0.1416	0.1705	0.2402	0.337
Arsenic (filtered)	mg/L	137	0.017	0.1006	0.149	0.218	0.338
Barium	mg/L	24	0.018	0.027	0.0395	0.062	0.095

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Barium (filtered)	mg/L	30	0.013	0.0228	0.0325	0.054	0.062
Beryllium	mg/L	24	<0.001	<0.001	<0.001	<0.001	0.001
Beryllium (filtered)	mg/L	30	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	mg/L	24	<0.05	<0.05	<0.05	<0.05	<0.05
Boron (filtered)	mg/L	30	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	84	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium (filtered)	mg/L	137	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium (filtered)	mg/L	122	1	5	9	10	15
Cesium	µg/L	24	1	2	2	7	21
Cesium (filtered)	µg/L	30	<1	1	2	2	6
Chromium (III+VI)	mg/L	84	<0.001	<0.001	<0.001	<0.001	0.014
Chromium (III+VI) (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.011
Cobalt	mg/L	24	<0.001	<0.001	<0.001	<0.001	0.003
Cobalt (filtered)	mg/L	30	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	84	<0.001	<0.001	<0.001	0.001	0.02
Copper (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.017
Iron	mg/L	78	0.17	0.22	0.84	2.5	13.3
Iron (filtered)	mg/L	126	<0.05	0.14	0.255	1.6	10.2
Lead	mg/L	84	<0.001	<0.001	<0.001	<0.001	0.006
Lead (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.003
Lithium	mg/L	78	0.055	0.0996	0.139	0.7372	1.59
Lithium (filtered)	mg/L	126	0.052	0.091	0.1425	0.708	1.47
Magnesium (filtered)	mg/L	122	1	3	3	4	5
Mercury	mg/L	84	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (filtered)	mg/L	137	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	84	<0.001	<0.001	<0.001	<0.001	0.005
Nickel (filtered)	mg/L	137	<0.001	<0.001	<0.001	<0.001	0.002
Potassium (filtered)	mg/L	122	2	4	4	5	24
Selenium	mg/L	24	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (filtered)	mg/L	30	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	24	<0.001	<0.001	<0.001	<0.001	<0.001
Silver (filtered)	mg/L	30	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	24	0.024	0.052	0.0975	0.108	0.15
Strontium (filtered)	mg/L	30	0.011	0.049	0.0825	0.1076	0.143

Contaminant	Units	No. of samples	Min	20%ile	Median	80%ile	Max
Thorium	µg/L	24	<1	<1	<1	<1	6
Thorium (filtered)	µg/L	30	<1	<1	<1	<1	<1
Tin	mg/L	24	<0.001	<0.001	<0.001	<0.001	<0.001
Tin (filtered)	mg/L	30	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	mg/L	24	<0.01	<0.01	<0.01	<0.01	0.79
Titanium (filtered)	mg/L	30	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	µg/L	24	<1	<1	<1	<1	<1
Uranium (filtered)	µg/L	30	<1	<1	<1	<1	<1
Vanadium	mg/L	24	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (filtered)	mg/L	30	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	84	<0.005	<0.005	0.008	0.0148	0.05
Zinc (filtered)	mg/L	137	<0.005	<0.005	<0.005	0.01	0.049

APPENDIX B WATER MANAGEMENT TARPS

Table B.1 Box Cut water quality (Phase 1: Construction Phase) TARP

Level	Triggers	Action/Response
Level 1	Box cut water quality is within than 90% of the SSTVs (Table 6.4 of the WMP).	• No action/response required
Level 2	Box cut water quality is between 90% and 100% of the SSTVs (Table 6.4 of the WMP).	• Review laboratory QA/QC and look for potential quality control issue and request a review if a suspected lab error. • Investigate management measures or treatment procedures to manage any unexpected increases in contaminant concentrations. • Investigate to determine if additional controls or management actions are necessary to achieve compliance. • Increase frequency of monitoring.
Level 3	Box cut water quality exceeds one or more of the SSTVs (Table 6.4 of the WMP).	• Investigate potential cause of elevated trigger values. • Identify the potential source associated with the trigger exceedance. • Increase frequency of monitoring. • Apply relevant mitigation, treatment and contingency measures in level 2 before discharging to SB2.
Level 4	Box cut water quality exceeds one or more of the SSTVs by more than for three consecutive samples or more than 50% for one sample (Table 6.4 of the WMP).	• Cease pumping to SB2. • Apply any treatment additives to achieve compliance with sediment water releases. • Truck box cut water to Grants mine water storages. • Investigate potential cause of elevated trigger values. • Identify the potential source associated with the trigger exceedance by qualified personnel. • Review current management plans and update if necessary. • Notify the regulator in accordance with approval and licence conditions.

Table B.2 Sediment basin water quality TARP

Level	Triggers	Action/Response
Level 1	Sediment basin water quality is within than 90% of the SSTVs (Table 6.4 of the WMP).	• No action/response required
Level 2	Sediment basin water quality is between 90% and 100% of the SSTVs (Table 6.4 of the WMP).	• Review laboratory QA/QC and look for potential quality control issue and request a review if a suspected lab error. • Investigate management measures or treatment procedures to manage any unexpected increases in contaminant concentrations. • Investigate to determine if additional controls or management actions are necessary to achieve compliance. • Increase frequency of monitoring.
Level 3	Sediment basin water quality exceeds one or more of the SSTVs (Table 6.4 of the WMP).	• Investigate potential sources of contaminants in the catchment (e.g., WRD, box-cut stockpile, contractor area, box cut, etc.) that are contributing to poor water quality. • Inspect the WRD and, if necessary, sample seepage and or runoff to determine if WRD is affecting sediment basin water quality. • If WRD is found to be impacting on water quality, investigate geochemistry of the WRD. • Investigate options to divert runoff from the source of poor water quality to a mine water storage if required. • Investigate the option of converting the sediment basin into a mine-affected water storage (and prevent uncontrolled spills into the environment) if the sources cannot be diverted or remediated. • Investigate the option of constructing an additional mine water storage and drains to capture runoff from the contaminated area. • Apply relevant mitigation, treatment and contingency measures in level 2 before discharging from sediment basins.
Level 4	Sediment basin water quality exceeds one or more of the SSTVs by more than for three consecutive samples or more than 50% for one sample (Table 6.4 of the WMP).	• Apply any treatment additives to achieve compliance with sediment water releases. • Cease discharging from the sediment basins. • Apply appropriate controls, measures and diversion/remediation options depending on outcomes of investigations in level 3. • Review current management plans and update if necessary. • Notify the regulator in accordance with approval and licence conditions.

Table B.3 Proposed mine water site storage inventory exceedances (Phase 2 & 3: Development and Production phase) TARP

Level	Triggers	Action/Response
Level 1	MWD Cell 1 storage volume < 65 ML	• No action/response required
Level 2	MSWD Cell 1 storage volume exceeds 65 ML (85% of Cell 1 FSV) with current or forecast heavy rainfall (>50 mm)	• Continue environmental releases (from MWD Cell 1) where possible. • Monitor storage levels in accordance with the monitoring plan. • Maximise pumping capacity for dewatering of storage. • Prevent pumping from sediment basins to MWD Cell 2 • Dewatering sediment water from MWD Cell 2 to sediment basins, to increase the total available storage of the MWD Cells. • Pump from MWD Cell 1 to MWD Cell 2. • Post-event review to confirm event was well managed with the appropriate resources in place. • Investigate any management and contingency measures to prevent uncontrolled spills or underground inundation.
Level 3	MWD Cell 1 and Cell 2 combined storage volume exceeds 125 ML (80% of the combined Cell 1 and Cell 2 FSV) with inflows still occurring	• Continue environmental releases (including irrigation) where possible. • Apply management and contingency measures in Level 2. • Transfer water from BP33 to Grants via proposed pipeline. • Post-event review to confirm suitability of water transfer infrastructure and operational rules. • Update operational rules if required. • Prepare recommendations for modifications or upgrades to water transfer infrastructure.
Level 4	Uncontrolled discharge of mine water from MWD to the environment.	• Record start and finish times of the overflow. • Advise regulator of spill. • Collect water quality samples of spills at dam overflow points and in receiving waterways. • Remediate any environmental harm where possible. • Truck mine water from the underground mine to Grants. • Investigate structural risks of underground mine. • Initiate investigation into reasons for system failure. • Take actions recommended by investigation to prevent recurrence.

Table B.4 Proposed site storage inventory shortfalls (Phase 2 & 3: Development and Production phase) TARP

Level	Triggers	Action/Response
Level 1	Total site inventory greater or equal to 30 ML	• No action/response required.
Level 2	Total site inventory is between 20 ML to 30 ML	• Monitor site storage levels. • Maximise use of sediment water for mine site demands prior to raw water use. • Post-event review to confirm event was well managed with the appropriate resources in place. • Transfer mine-affected water from Grants MWD1, if available. • Investigate any management and contingency measures to prevent deficiencies in site inventory or make-up demands.
Level 3	Total site inventory is between 10 ML to 20 ML	• Conserve water use for non-essential operations. • Investigate the feasibility of increasing the storage size of current site storages (to increase the amount of water stored on site towards the end of the wet season). • Investigate the feasibility of constructing an additional water storage. • Investigate procedures which decreases the site water demands. • Investigate the feasibility of trucking water externally from other sites. • Post-event review to confirm suitability of water transfer infrastructure and operational rules. • Update operational rules if required. • Prepare recommendations for infrastructure modifications or upgrades to water transfer infrastructure.
Level 4	Total site inventory < 10 ML or there is a deficit in site demands after receiving inflows from OHD and from bore water	• Truck water from Grants (or externally) to meet site water demands. • Implement any water management strategy in level 3.

Table B.5 Operational surface water quality TARP

Level	Triggers	Action/Response
Level 1	No exceedances in surface water quality within the adopted trigger values for all parameters at the downstream monitoring point (BPDS SW6).	• No action/response required
Level 2	Exceedance in surface water quality parameter trigger values for one monitoring event	• Review laboratory QA/QC and look for potential quality control issue and request a review if a suspected lab error. • Implement investigation to determine potential cause of elevated trigger value. • Investigate the potential source associated with the trigger exceedance. • Investigate any mitigation strategy and contingency measures to mitigate any contamination sources based on the outcomes of the investigation on the potential contamination source.
Level 3	Exceedance in surface water quality parameter trigger values for two consecutive monitoring events	• Investigate potential cause of elevated trigger values. • Identify the potential source associated with the trigger exceedance. • Increase frequency of monitoring. • Apply mitigation and contingency measures in level 2. • Apply relevant water quality treatment procedures in water storages prior to release.
Level 4	Exceedance in surface water quality parameter trigger values for three consecutive monitoring events; or Exceedance greater than three times the trigger value.	• Validate relevant data to confirm trigger exceedance. • Investigate potential cause of elevated trigger values. • Identify the potential source associated with the trigger exceedance by qualified personnel. • Review current management plans and update if necessary. • Initiate investigation for reasons of increase water quality concentrations. • Notify the regulator in accordance with approval and licence conditions.

Table B.6 Proposed groundwater bore water quality TARP

Level	Triggers	Action	Response
Level 1	No exceedances greater than 10% in any background water quality range.	• No action required.	• No response required.
Level 2	Background WQ variation greater than 10% in two consecutive quarterly samples for any analyte	• Investigate surrounding bores monitoring data. • Investigate any operational events which may affect groundwater quality. • Investigate source of contamination on contaminants of concern and bore location. • Review historical monitoring data to determine any trend.	• Investigate any mitigation strategy and contingency measures to mitigate contamination of groundwater bores based on the outcomes of the investigation on the contamination source.
Level	Background WQ variation greater than: 10% in four consecutive quarterly samples or 20% for two consecutive samples for any analyte.	• Review historical monitoring data to determine historical trends. • Conduct water quality trend analysis with surrounding bores. • Investigate source of contamination on contaminants of concern and bore location.	• Increase frequency of monitoring. • Investigation on potential causes from operation on groundwater quality. • Apply mitigation and contingency measures in level 2.
Level 4	Background WQ variation greater than: 20% in four consecutive quarterly samples or 50% for two consecutive samples for any analyte.	• Investigate surrounding bores monitoring data. • Investigate potential sources of contaminants on the environment and implement mitigation measures at the source if possible. • Implement controls at receptors if modelling indicates potential impact.	• Initiate investigation for reasons of increased water quality concentrations. • Assessment of plume extent and fate by qualified hydrogeologist. • Notify the regulator in accordance with approval and licence conditions.

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