ENGENY

MINERAL PROJECTS PTY LTD

Dianne Copper Mine

Water Management Plan

NC1017_001-PLN-001-4

21 NOVEMBER 2024

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	12/03/2024	Draft Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
1	26/04/2024	Draft Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
2	22/07/2024	Client Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
3	13/11/2024	Client Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
4	21/11/2024	Client Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
Signatures:						

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GLOSSARY

TABLE 1.1: GLOSSARY

Term/Abbreviation	Definition
ACARP	Australian Coal Association Research Program
Agglomeration	Agglomeration of ore into coarse, porous masses by tumbling in a drum with water and leach solution (sulphuric acid).
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ARI	Average Recurrence Interval
CWD	Clean Water Dam
DCM	Dianne Copper Mine
DTM	digital terrain model
EA	Environmental Authority
EC	Electrical Conductivity
GDE	Groundwater Dependent Ecosystem
ha	hectare
HDPE	High Density Polyethylene
ILS	Intermediate Liquor Storage
Intermediate Liquor	Leach solution containing elevated concentration of copper produced by Raffinate leaching of old ore heaps (i.e. ore heaps that have previously been leached with Intermediate Liquor)
kL	kilolitre
km	kilometre
L	litre
LoM	Life of Mine
LOR	Limit of Reporting
m	metre
meq	milliequivalent
mg	milligrams
ML	Mining Lease
ML	Megalitre
mm	millimetre

Term/Abbreviation	Definition
mS/cm	micro Siemens per centimetre
Mt	Million metric tonnes
Mt	Megatonne
NATA	National Association of Testing Authorities
pH (CaCl2)	pH test result for an air-dry soil sample is mixed with five times its weight of a dilute concentration (0.01M) of calcium chloride (CaCl2), shaken for 1 hour and the pH is measured using an electrode.
PLS	Pregnant Liquor Storage
Pregnant Liquor	Leach solution containing high concentration of copper produced by Intermediate Liquor leaching of new ore heaps
PWD	Process Water Dam
QWQG	Queensland Water Quality Guidelines
Raffinate	Recycled leaching solution (sulphuric acid) following solvent extraction of the copper from the pregnant liquor
REMP	Receiving Environment Monitoring Programme
RUSLE	Revised Universal Soil Loss Equation
RWD	Raw Water Dam
SD	Sediment Dam
TSS	Total Suspended Solids
WMP	Water Management Plan
WQO	Water Quality Objective

1. INTRODUCTION

1.1 Background

The Dianne Copper Mine (DCM) is an historic copper mine which is currently in care and maintenance. The mine is located in the Cape York Peninsular, Queensland, approximately 160 km northwest of Cairns and 100 km southwest of Cooktown (refer to Figure 1.1).

Mining operations were undertaken at the DCM primarily between 1979 and 1983, with both open cut and open stope underground mining techniques adopted during this time. The DCM has remained in care and maintenance since 1983 when a global decrease in copper prices led to the cessation of mining operations.

The DCM is comprised of mining leases (ML) ML 2810, ML 2811, ML 2831, ML 2832, ML 2833 and ML 2834 under the environmental authority (EA EPML00881213). The total disturbance footprint of the DCM encompasses approximately 14.4 ha across all mining leases and includes an open cut void and portal, mine water management dams, raw water dams, access roads and waste rock dumps. Rehabilitation efforts to date have largely focussed on water management, in particular, the construction and maintenance of infrastructure to isolate the waste rock stockpiles from overland flow and managing mine affected water.

Mineral Projects Australia Pty Ltd (Mineral Projects), the current Operator and 49% owner of the DCM, commenced exploration at the DCM site in 2020 and is now proposing to recommence mining of the ore body as well as on-site extraction of copper using a heap leach, solvent extraction and electrowinning process (the Project).

1.2 Project Overview

Figure 1.2 presents the proposed Project layout that shows the key Project features. Following is an overview of the key Project parameters and features:

- A construction phase of approximately one year.
- A two to three year operational life of mine (LOM) with an additional six month rehabilitation phase.
- Ongoing exploration activities.
- An increase in disturbance area from an existing 14.1 ha to approximately 50.0 ha including an expanded pit that will have an increase in footprint from 1.1 ha to approximately 4.5 ha footprint and be up to approximately 124 m in depth.
- Mining approximately 1.6 Mt of copper ore at a rate of up to 0.9 Mt/year.
- On-site processing of ore and a portion of the existing waste rock (refer to Figure 1.3). The processing infrastructure will include:
  - Crushing plant;
  - Agglomeration plant;
  - Six HDPE lined heap leach pads (overall area of pad will be approximately 300 m by 120 m with beds of agglomerated ore approximately 5 m in height);
  - Process liquor dams (Pregnant Liquor Storage (PLS), Intermediate Liquor Storage (ILS) and Raffinate (leach solution - sulphuric acid));
  - Solvent extraction plant; and
  - Electrowinning plant to produce approximately 18,000 t of Grade A copper cathode over the LOM.
- Infilling of the existing Raw Water Dam 2 to accommodate heap leach pads.
- Topsoil, ROM, crushed ore and agglomerate stockpiles.
- Additional waste rock emplacement areas.
- Access roads.
- An upgraded water management system to accommodate the additional disturbance footprint and ore processing infrastructure including:
  - Overflow dams to capture any spills from the Heap Leach Pad and process liquor storages during high or prolonged rainfall events;

- Process Water Dam;
- A remediated and expanded Release Dam (referred to as the Settling Dam in previous version of this WMP). Remediation will include removal, capping or other approved remediation of material within the Release Dam that is believed to have accumulated over time during previous ownership of the site and is considered to contribute significantly to elevated concentrations of metals in Release Dam water;
- A Sediment Dam;
- Clean water dams;
- Clean water diversion drains; and
- Cutoff drains to capture potentially mine affected runoff from operational areas and disturbed catchments.

- Power generation infrastructure that will include both diesel fuelled generators and solar panels.
- Fuel and chemical storage.
- 1 to 2 truck movements per day to transport copper cathode product to Cairns or Townsville for export.
- Accommodation camp.
- Workshop and site offices.

1.3 Purpose and Scope

This Water Management Plan (WMP) has been prepared for Mineral Projects in accordance with the EA EPML00881213 (the EA) and for compliance with the Department of Environment and Heritage Protection Preparation of water management plans for mining activities guideline (Department of Environment and Heritage Protection, 2012) (the Guideline).

The purpose of this WMP is to:

- Examine and address all issues relevant to the importation, generation, use and management of water at the DCM in order to minimise the quantity of water that is contaminated and released by and from the site.
- Describe the water management system to be implemented at the DCM, including erosion and sediment control measures, following the proposed recommencement of mining and ore processing.
- Identify environmental values of the receiving waters that may be impacted.
- Identify the actual and potential risks of harm to natural water flows; the actual and potential risk of environmental harm posed by water contaminated by the mining activities; and define management actions that will effectively minimise these risks.
- Summarise the site water balance.
- Outline the program for monitoring and review of the effectiveness of the WMP.
- Detail the roles and responsibilities for water management at the DCM.

This WMP was prepared by Chris Bonomini, Principal Engineer – Water, Process and Risk and Certified Professional in Erosion and Sediment Control (CPESC #9621), of Engeny, who is an appropriately qualified person under the *Environmental Protection Act 1994*.

FIGURE 1.1: PROJECT LOCATION (SOURCE: UMWELT: 2022)

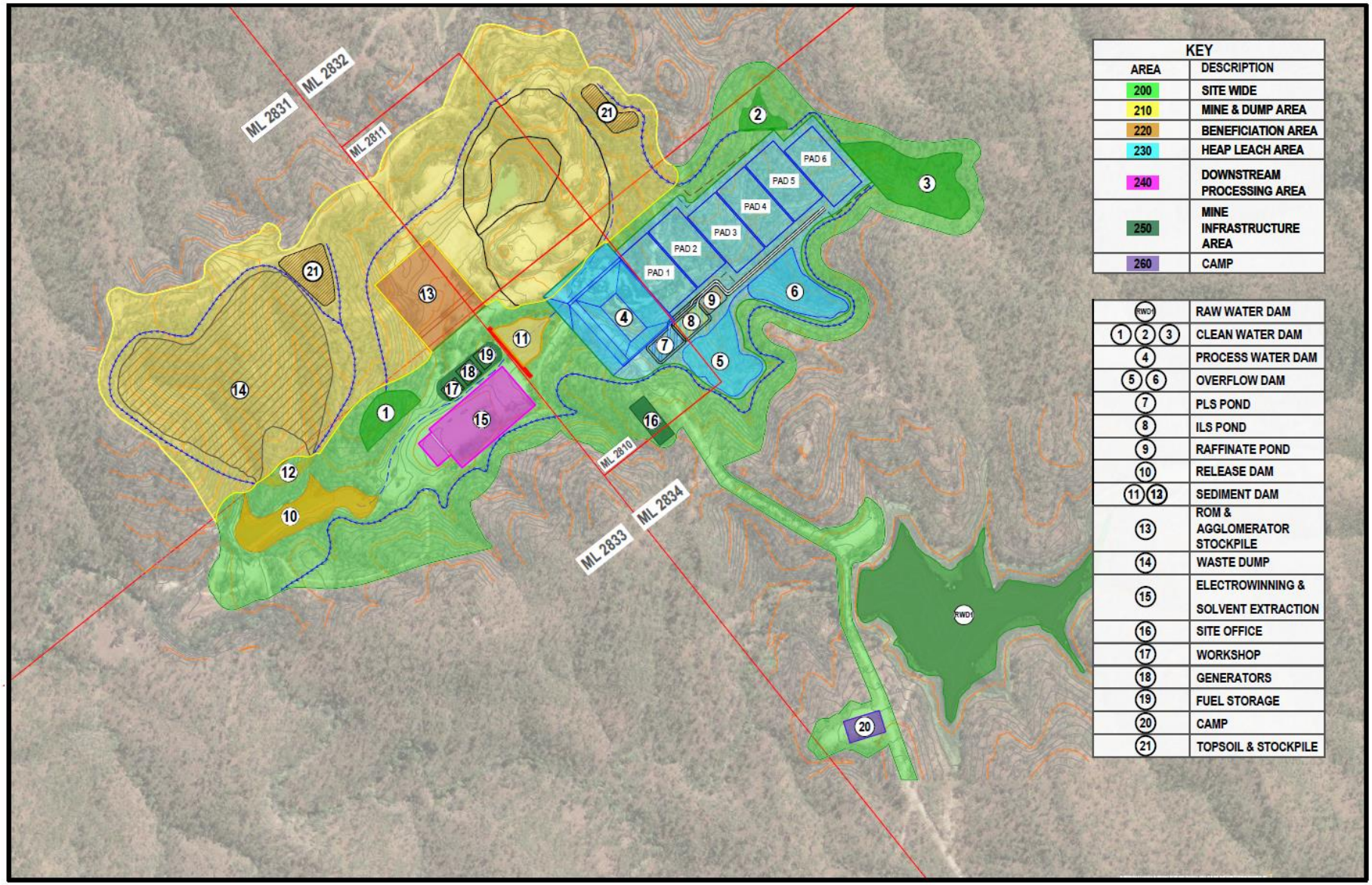


FIGURE 1.2: PROPOSED PROJECT LAYOUT (SOURCE: PROJECTICK, 2024)

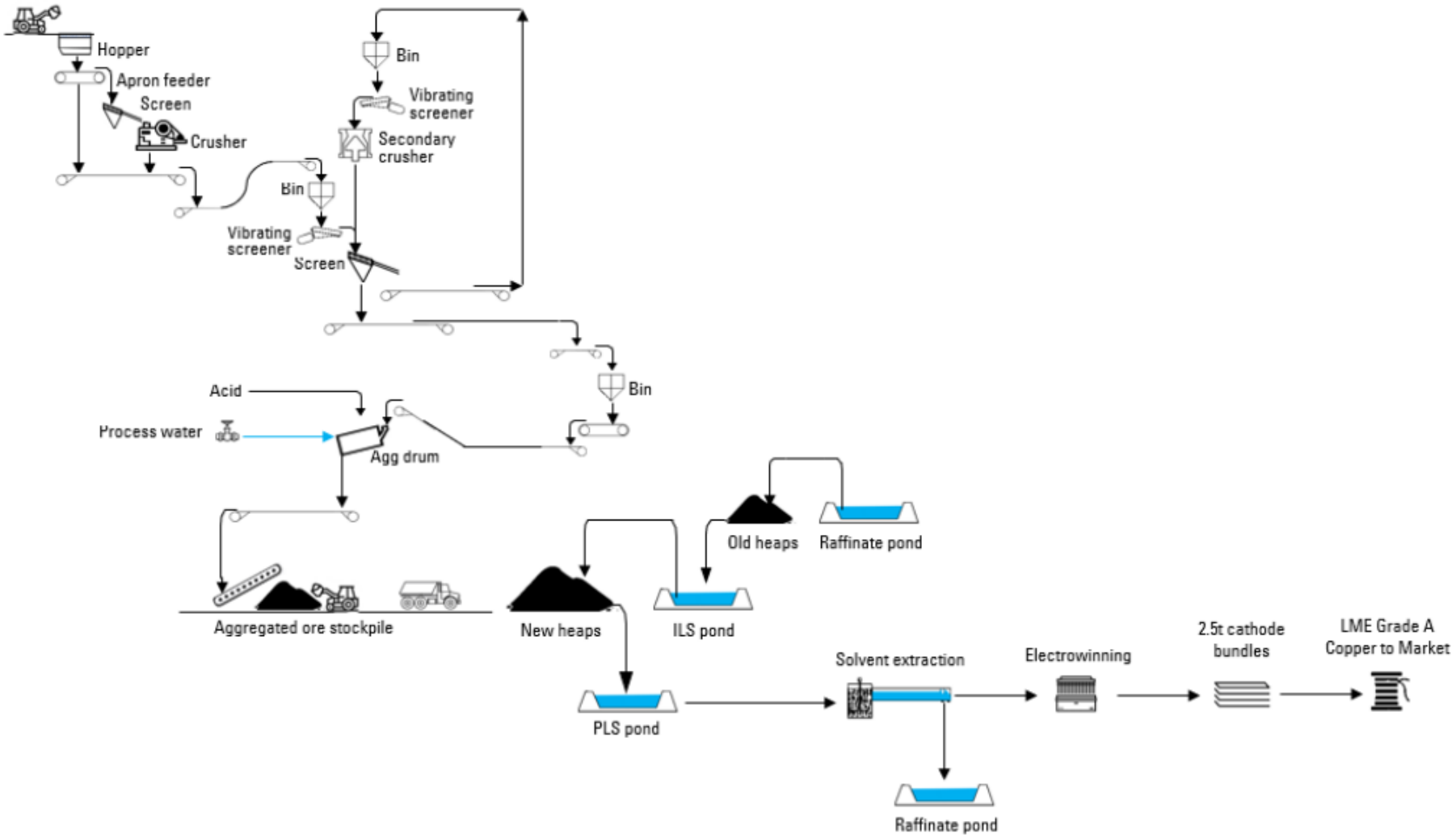


FIGURE 1.3: DESIGNED PROCESS FLOW DIAGRAM

2. REGULATORY REQUIREMENTS

2.1 Environmental Authority

The regulatory requirements stipulated by EA EPML00881213 relating to this WMP are outlined in Table 2.1.

TABLE 2.1: ENVIRONMENTAL AUTHORITY CONDITIONS RELEVANT TO WATER MANAGEMENT AT DCM

Condition	Requirement	Where Addressed in this WMP
Monitoring		
A4	Except where specified otherwise in another condition of this authority, all monitoring records, reports, and other site data generated as a requirement of this authority must be kept for a period of not less than 5 years.	Section 9.2
A5	An environmental monitoring program sufficient to demonstrate compliance with the conditions of this environmental authority must be developed by an appropriately qualified person and implemented by 1 February 2014.	Section 8 and REMP Design Document
A6	All analysis and tests required to be conducted under this environmental authority must be carried out by an appropriately qualified person and analysed by a laboratory that has NATA accreditation for such analysis and tests, expect as otherwise authorised by the Administering Authority.	Section 8 and REMP Design Document
A7	Monitoring and analysis required by this environmental authority must be undertaken in accordance with the requirements of the administering authority's latest guidelines, unless otherwise agreed by the administering authority in writing.	Section 8 and REMP Design Document
Notification of Emergencies, Incidents and Exceptions		
A9	The holder of this environmental authority must notify the administering authority by written notification within 24 hours, after becoming aware of any emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this environmental authority.	Section 9.1.1
A10	Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice must be provided to the administering authority, and must include, but not necessarily be limited to the following: (a) results and interpretation of any samples taken and analysed; (b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; (c) proposed actions to prevent a recurrence of the emergency or incident.	Section 9.1.1

<table>
<tr><th>Condition</th><th>Requirement</th><th>Where Addressed in this WMP</th></tr>
<tr><td colspan="3">Investigation</td></tr>
<tr><td>A15</td><td>If monitoring results indicate an exceedance of any quality objectives specified in a condition of this environmental authority, the holder of this environmental authority must notify the administering authority in accordance with condition A9 and:
(a) complete an investigation to identify the potential cause of the exceedance.
(b) if the investigation demonstrates that the exceedance is not attributable to the mining activities, then no further action is required.
(c) if the cause of the exceedance is inconclusive or attributable to the mining activities, provide a written report to the administering authority within 3 months of the date of receiving the monitoring results showing an exceedance, outlining:
(i) all pertinent details of the investigation carried out.
(ii) actions taken or planned to minimise environmental harm.</td><td>Section 9.1.2</td></tr>
<tr><td colspan="3">Contaminant Release to Water</td></tr>
<tr><td>C1</td><td>The release of contaminants to waters must:
(a) only occur during flow events in the receiving waters;
(b) only occur from the release point specified in Schedule C — Table 1 (Release Point Location).
(c) be monitored at the release point and at the monitoring frequency specified in Schedule C — Table I (Release Point Location) for the total daily volume of water released and for each parameter specified in Schedule C — Table 2 (Release Quality Objectives).
Schedule C - Table 1 (Release Point Location)
<table>
<tr><th rowspan="2">Release Point</th><th rowspan="2">Description of Release</th><th rowspan="2">Description of Source</th><th rowspan="2">Description of Receiving Waters</th><th colspan="2">Co-ordinates GDA 94 MGA Zone 55</th><th rowspan="2">Monitoring Frequency</th></tr>
<tr><th>Easting</th><th>Northing</th></tr>
<tr><td>RPI</td><td>Settling Dam spillway</td><td>Drainage from mine catchment exiting via Settling Dam spillway</td><td>Drainage line originating at Raw Water Dam 1, passing the confluence of the Settling Dam spillway drainage line and reporting to Gum Creek</td><td>234159</td><td>8218214</td><td>For all parameters, 1 sample must be taken within 12 hours of a release event commencing and for events with duration of greater than 24 hours, samples must be taken daily for 1 week and once a week thereafter until the event</td></tr>
</table></td><td>Sections 4, 5.3.2.2, 7 and 8.1</td></tr>
<tr><td>C2</td><td>At the time of release from the authorised release point specified in Schedule C — Table 1 (Release Point Location) the water flow (m^3/hour) in the respective receiving water must be at least 20 times the water flow (m^3/hour) at which respective contaminated waters are released from RPI.</td><td>Section 8.1.2</td></tr>
</table>

Condition	Requirement	Where Addressed in this WMP
Release Event Flow Monitoring		
C3	For any release of contaminants to receiving waters, the environmental authority holder must: (a) record the date and time for both the commencement and cessation of the release event; and (b) determine and record the total daily volume of contaminated waters released; and (c) determine and record receiving waters background flow (m3/hour) at the monitoring point FMP specified in Schedule C - Table 4 (Receiving Waters Monitoring Locations) for the duration of the release event; and (d) if requested by the administering authority, provide this information to the administering authority within 24 hours of any request.	Section 8.1.2
C4	End of pipe quality objectives for water contaminated by mining activities when monitored at the location defined in Schedule C — Table 1 (Release Point Location) must not exceed the release quality objectives specified In Schedule C — Table 2 (Release Quality Objectives). *(Schedule C – Table 2 (Release Quality Objectives) has been reproduced in Section 3.4 of this WMP)*	Table 3.5, Table 3.6 and Sections 4, 5.3.2.2, 7 and 8.1
C5	Water Quality Objectives and Sediment Quality Objectives specified in Schedule C - Table 3 (Receiving Waters and Sediment Quality Objectives) must not be exceeded when measured at the monitoring points as specified in Schedule C - Table 4 (Receiving Waters Monitoring Locations). *(Schedule C – Table 3 (Receiving Waters and Sediment Quality Objectives) has been reproduced in Section 3.4 of this WMP)*	REMP Design Document
Receiving Environment Monitoring Program (REMP)		
C6 to C8	Refer to REMP Design Document for EA conditions relating to the REMP	REMP Design Document
Groundwater		
C9	The holder of this environmental authority must not release contaminants to groundwater.	Section 3.5 and 8.2
C10	A Groundwater Monitoring program must be developed by an appropriately qualified person and implemented by 1 May 2014. The Groundwater Monitoring Program must include adequate information and data to allow the administering authority to make and assessment of compliance with Condition C9.	Section 8.2
Water Management Plan		
C11	A Water Management Plan must be developed by an appropriately qualified person, in accordance with the administering authority's guideline "Preparation of Water Management Plans for Mining Activities" and implemented at the licensed place by 1 November 2013. The Water Management Plan must be reviewed annually, by 1 September, to assess the adequacy of the plan, ensure actual and potential environmental impacts are managed, and identify any necessary amendments to the plan to ensure compliance with this environmental authority.	This WMP and Section 1.3
Erosion and Sediment Control		
C12	An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented at the licensed place before 1 December 2013, to minimise erosion, contamination of stormwater and the release of sediment to receiving waters.	Section 6

2.2 Environmental Protection Act 1984

The guideline for Preparation of water management plans for mining activities (Department of Environment and Heritage Protection, 2012) applies to the DCM as a level 1 mining project in accordance with the Environmental Protection Act 1994.

The requirements for a WMP stipulated by the Guideline are outlined in Table 2.2.

TABLE 2.2: WATER MANAGEMENT PLAN GUIDELINE REQUIREMENTS

Requirement	Where Addressed in this WMP
A study of the environmental values and water quality objectives applicable to the locality where the mining project is to take place, including: • background water quality of the waterways proposed to receive discharges and the potential environmental impact of any discharges to the aquatic ecosystem. • identification of downstream uses of the waterways into which water may be discharged including, but not limited to, drinking water, agriculture, and national parks. • a discussion of the environmental impacts resulting from the accumulation of salts and metals in waterways and their sediments including as the discharged water evaporates. • a description of the extent and quality of local and regional groundwater aquifers.	Section 3
A contaminant source study that identifies the origin and chemical composition of different types of water, i.e., different sources and uses, on the mining project. The study should consider options to reduce the level of water contamination, and re-use of contaminated water that is 'fit for purpose'. The study should identify controls that reduce the risk of discharging contaminated water to both surface and groundwaters. The following matters are of particular interest and should be evaluated in the course of the study: • leachate testing of relevant overburden, ore, and waste material from the site to identify sources of water and predictions of the quality and quantity of water that may become contaminated on site. • identification of any contaminants that may bio-accumulate to toxic concentrations in the environment should be considered where these are present in the overburden, ore, and waste material. • the potential for water to be contaminated through contact with saline, dispersive and sodic materials, and management measures to prevent saline drainage and the release of saline waters. • the presence of acid producing material and the potential for acid mine drainage based on sampling of exploration samples and progressive characterisation of material disturbed by mining operations.	Sections 3.4.2 and 3.5.2
A site water balance and model to identify the quantity of clean and contaminated waters (classified according to 'fitness for purpose') produced and used on the site. The model should inform a plan for the appropriate separation, storage, and handling of clean and contaminated waters under the different hydraulic flow events (including wet and dry seasonal events) applicable for the site. The water balance should be calculated based on actual rainfall data for the site in question or from the nearest Bureau of Meteorology rainfall gauging station, with site rainfall data preferred.	Section 5
A discussion of the impacts of the mining project including: • impacts through drawdown and contamination on local and regional aquifers and the associated environments. • a discussion of the cumulative effects of other industries discharging into the same waterways.	Sections 3.4.2 and 3.5.2
Details of water management infrastructure including containment structures, channels, diversions, pipes, pumps, and monitoring facilities. The plan should include: • proposed actions to maintain these facilities. • proposed actions to maintain and monitor of freeboard in containment structures to reduce the risk of contaminants being released. • details of the water pumping equipment that will be available to move water quickly and efficiently around the mine under both normal and emergency conditions. • water treatment methods to be used if highly contaminated water would otherwise be likely to be discharged during the life of the mine.	Section 4

Requirement	Where Addressed in this WMP
A water management system that reduces the risks to the environment identified by both the contaminant source study and the site water balance and model. Water should be managed to minimise the volume of water that is contaminated and maximise the use of any contaminated water for on-site purposes Overland flow should be diverted from operational and disturbed areas to prevent contamination. Uncontaminated water should form part of the natural flows of the receiving catchments and streams. Contaminated water should only be discharged off-site to surface or ground waters where no other feasible method of disposal is available, and then only if it can be demonstrated that unacceptable contamination of downstream water or underground water will not occur. If disposal to ground waters is being considered, appropriate studies will need to be used to demonstrate that any proposed water management system is appropriate given that contamination of aquifers is technically difficult and costly to remediate. A mining project water management system should achieve the following outcomes: • Minimisation of the generation of contaminated water by: – limited site disturbance, including early rehabilitation of mined land. – segregation of water by quality or source. – use of the minimum volume of water necessary for operations. – recycling waters in operations as much as possible. – protection of mine workings and infrastructure from floodwater inundation. • Minimisation of the contaminants discharged from the mining project (having regard to the mass and concentration of contaminants expected to reach the receiving waters) by: – minimising contaminant concentrations using suitable treatment methods e.g., sedimentation dams – avoiding the accumulation of large volumes of contaminated water – substitution of uncontaminated water with contaminated water in operational uses where practicable – avoiding storage of water with a high concentration of contaminants in a dam which constitutes a designated discharge point, or which would discharge directly to the environment if overflow occurred – design of storage dams to control the risk of discharge to appropriate levels – protection of groundwater resources from contamination. • Minimisation of the impact of releases of contaminated water through a strategy for the timing and manner of release	Section 4
Emergency and contingency planning to suit a range of potential emergency scenarios. The scenarios considered must include the potential exceedance of the rainfall characteristics (intensity and duration) used in the design of water management structures, failure of containment structures, loss of electrical supply, inability to obtain critical equipment and spare parts, and inability to access critical control and monitoring points in all weather conditions.	Section 7
Assignment and communication of responsibility for actions under the mining project water management plan including implementation, monitoring, and reporting.	Section 11
Arrangements to review the currency and adequacy of the mining project water management plan and its continual improvement. The plan should be reviewed and updated prior to the end of September each year, and after any event involving the uncontrolled release of water to the environment.	Section 10

3. EXISTING ENVIRONMENT

3.1 Climate

The DCM is located within the Queensland dry tropics region, with highly seasonal rainfall and high temperatures characterising the region's climate. The wet season generally occurs from November through to April, while dry conditions are experienced from May to October.

The closest Bureau of Meteorology (BoM) rainfall gauge is located at Maitland Downs Station (BoM Station 28013), approximately 24 km from the site. The average annual rainfall total from 1965 – 2021 recorded at BoM Station 28013 is 929 mm, however, annual averages are highly variable, ranging from 333.2 mm (1966) to 1,879.0 mm (1981). High, intense rainfall is commonly observed throughout the summer months, with little to no rainfall throughout the dry season.

High temperatures are observed year-round, contributing to high evaporation rates which can exceed 2,000 mm annually. Subsequently, water losses to evaporation typically exceed total rainfall volumes recorded in the region.

Rainfall and evaporation statistics were derived from daily rainfall and evaporation data sourced from the SILO Climate Database for grid point (-16.10° latitude, 144.55° longitude) for the period 1 January 1900 to 31 December 2022 and are presented in Table 3.1 and Figure 3.1.

TABLE 3.1: ANNUAL RAINFALL AND EVAPORATION

Statistic	Rainfall (mm)	Pan Evaporation (mm)
10th percentile	612	1,876
50th percentile	949	1,909
90th percentile	1,301	2,040
Average	957	1,934

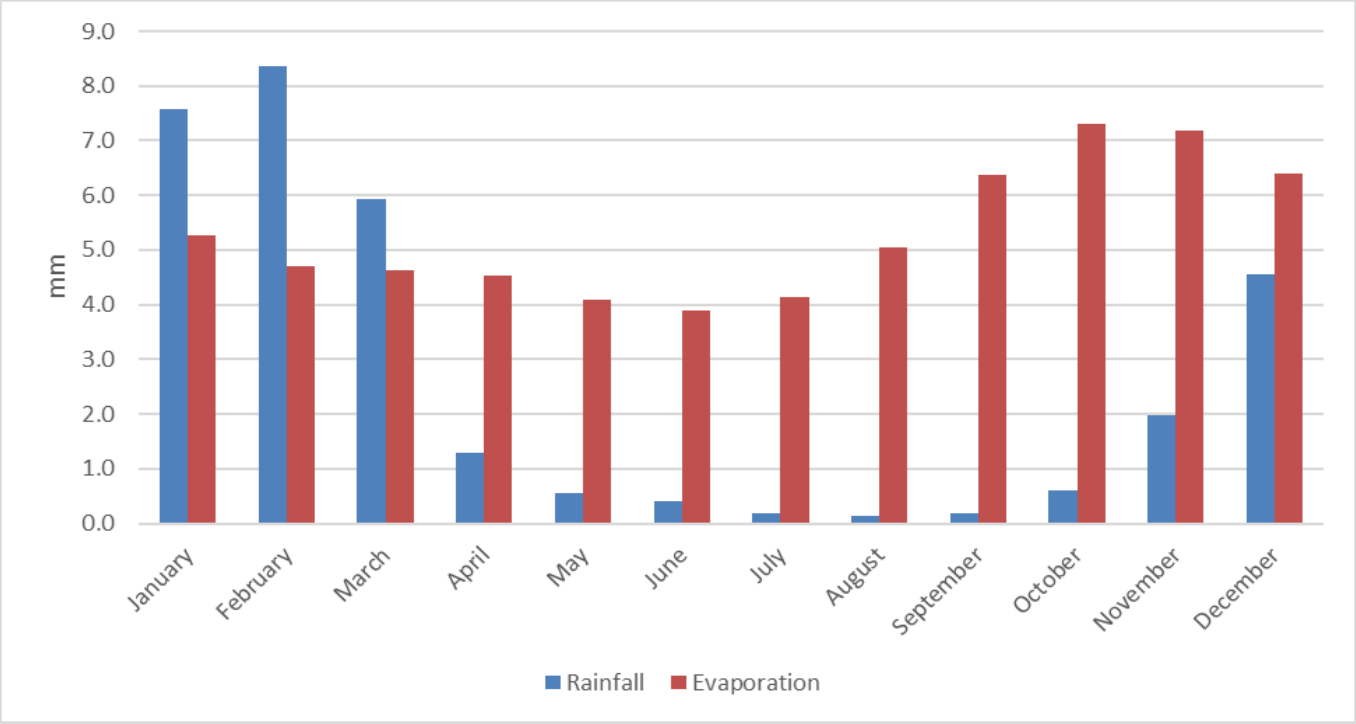


FIGURE 3.1: AVERAGE DAILY RAINFALL AND EVAPORATION

3.2 Geology and Soils

The DCM is located within the Hodgkinson Province, consisting of elongated and deformed sedimentary deposits. The region has small, stratiform lenses of massive and layered pyrite-chalcopyrite-sphalerite.

Available mapping indicates the DCM site is characterised by fine to medium-grained arenite and mudstone, minor conglomerate, minor chert and metabasalt and rare limestone (Queensland Globe, 2021).

Due to historic disturbance and clearing, there is limited topsoil available on site. Previous soil sampling has indicated that the natural loam is slightly acidic and low in sodium. There are no known dispersive sodic soils in the area.

Available mapping indicates that regional soils are shallow bleach loams and are consistent of uniform medium, conspic bleached A2 horizons. These soils closely dissect low hills on volcanics, greywackes and shallow gravelly uniform medium to fine textured soils.

Project site soils have been mapped within the Soil and Landscape Grid of Australia (Terrestrial Ecosystem Network, 2016) which provides a range of soil and landscape attributes across Australia. Table 3.2 provides a summary of the modelled soil properties located within the overarching catchment of the project site from the Soil Landscape Grid of Australia.

TABLE 3.2: MODELLED SOIL PROPERTIES

Parameter	Value	
	0 – 30 cm Depth	30 – 60 cm Depth
Soil Erodibility, k factor (as used in the Revised Universal Soil Loss Equation (RUSLE))	0.0509	
Clay Percentage	12.6 – 26.5%	23.0 – 30.0%
Silt Percentage	7.0 – 12.6%	6.7 – 11.6%
Sand Percentage	55.1 – 71.6%	50.2 – 60.4%
pH ($CaCl_2$)	4.9 – 5.3	5.2 – 5.4
Cation Exchange Capacity (meq+/100g)	3.3 – 3.7	3.6 – 5.8
Soil Organic Carbon	0.7 – 2.2%	0.5 – 0.6%

Source: Soil Landscape Grid of Australia

3.3 Topography and Hydrology

The DCM is located within the Gulf of Carpentaria Drainage Division, the Mitchell drainage basin (71,622 km^2), and the Palmer River drainage sub-basin (8,424 km^2). The Palmer River is approximately 1.8 km from the DCM mining lease boundary (at the closest point of the riverbank) and approximately 3.3 km from the mine pit location, and represents the closest major drainage feature to the DCM (refer to Figure 3.2). The confluence of the Palmer River and the Mitchell River occurs approximately 243 km downstream of the DCM.

The site itself is located high in the upper catchment of a small tributary of Gum Creek. The drainage lines/watercourses in this area are characterised as steep, small valleys formed in between the various hills. The receiving environment of the project site is Gum Creek. Gum Creek is a contributing catchment to the Palmer River sub-basin, which is part of the Mitchell River basin flowing west into the Gulf of Carpentaria.

FIGURE 3.2: CATCHMENT CONTEXT (SOURCE: UMWELT, 2022)

3.4 Surface Water Quality

3.4.1 Environmental Values and Surface Water Quality Objectives

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (the Policy) is a framework within the Environmental Protection Act 1994 with the aim of protecting waters and wetlands in Queensland while also promoting ecological sustainable development. Environmental values and water quality objectives (WQOs) have been formalised under the Policy for specific catchments and basins within Queensland. The Healthy waters for Queensland: Environmental values, management goals and water quality objectives fact sheet (Department of Environment and Science, 2022) defines environmental values as 'the qualities that make water suitable for supporting aquatic ecosystems and human uses', while WQOs are defined as 'the quantitative measures or narrative statements established to protect the EVs of waters'. WQOs are developed based on the findings from scientific studies as well as existing water quality guidelines, such as the Queensland Water Quality Guidelines (Department of Heritage and Environment Protection, 2009) and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia, 2018).

The DCM is located within the Bonny Glen pastoral lease, with cattle grazing undertaken outside of the DCM mining lease areas. Cattle grazing is widely undertaken throughout the greater region and is considered to be the dominant land use. Alluvial gold mining is also undertaken in some areas of Gum Creek and historically across the region. Surface water environmental values in the vicinity of the DCM are considered to be (C&R Consulting, 2021A):

- Aquatic ecology.
- Stock drinking water.
- Drinking water.
- Cultural.
- Industrial use.

At this point in time, WQOs relevant to the DCM study area (i.e., Palmer River sub-basin or Gum Creek) have not been defined under the Policy. However, Table 3 in Schedule C of the current DCM EA provides receiving water WQOs as well as sediment quality objectives for a range of parameters and these are presented in Table 3.3. The DCM EA also provides water quality objectives for release of mine affected water from the Project and these are presented in Table 3.4. The water quality objectives within the DCM EA will be updated to be site specific objectives once sufficient data has been collected, which is expected to occur in 2024.

TABLE 3.3: RECEIVING WATERS AND SEDIMENT QUALITY OBJECTIVES

Parameter[1]	Units	Water Quality[6]	Sediment Quality[7]
pH	-	6.0 – 8.0[4]	N/A
Electrical Conductivity (EC)	µS/cm	125[7] or 80th percentile[9] of reference site concentration[10]	N/A
Dissolved Oxygen (DO)	% saturation	For interpretive purposes only	N/A
Total Suspended Solids (TSS)	mg/L	80th percentile[9] of reference site concentration[10]	N/A
Sulfate	mg/L	770 or 80th percentile[9] of reference site concentration[10]	3 times the reference site concentration[10]
Fluoride	mg/L	80th percentile[9] of reference site concentration[10]	3 times the reference site concentration[10]
Major Anions	mg/L	For interpretive purposes only	3 times the reference site concentration[10]

Parameter[1]	Units	Water Quality[6]	Sediment Quality[7]
Aluminium	mg/L	0.055 of 80th percentile[3] of reference site concentration[4]	N/A
Arsenic[8]	mg/L	0.013[3] or 80th percentile[9] of reference site concentration[10]	70[5] or 3 times the reference site concentration[10]
Boron	mg/L	0.37[3] or 80th percentile[9] of reference site concentration[10], whichever is higher	3 times the reference site concentration[10]
Cadmium	mg/L	0.0002[3] or 80th percentile[9] of reference site concentration[10]	10[5] or 3 times the reference site concentration[10], whichever is higher
Chromium[8]	mg/L	0.001[3] or 80th percentile[3] of reference site concentration[4]	370[5] or 3 times the reference site concentration[10]
Copper	mg/L	0.0014[3] or 80th percentile[3] of reference site concentration[4]	270[5] or 3 times the reference site concentration[10]
Lead	mg/L	0.0034[3] or 80th percentile[3] of reference site concentration[4]	220[5] or 3 times the reference site concentration[10]
Manganese	mg/L	1.9[3] or 80th percentile[3] of reference site concentration[4]	3 times the reference site concentration[10]
Mercury (inorganic)	mg/L	0.00006[3] or 80th percentile[3] of reference site concentration[4]	1[5] or 3 times the reference site concentration[10]
Nickel	mg/L	0.011[3] or 80th percentile[3] of reference site concentration[4]	52[5] or 3 times the reference site concentration[10]
Selenium (total)	mg/L	0.005[3] or 80th percentile[3] of reference site concentration[4]	3 times the reference site concentration[10]
Silver	mg/L	0.000053 or 80th percentile[3] of reference site concentration[4]	3.7[5] or 3 times the reference site concentration[10]
Zinc	mg/L	0.0083 or 80th percentile[3] of reference site concentration[4]	410[5] or 3 times the reference site concentration[10]
Total Hardness	mg/L	For interpretive purposes only	N/A
Total Organic Carbon	mg/L	N/A	For interpretive purposes only
Total Petroleum Hydrocarbons	-	No detectable film or odour	N/A

[1] For water quality objectives parameters, all metals and metalloids must be measured and reported as both total (unfiltered) and dissolved (field filtered) levels.
[2] All stream sediment sampling must be undertaken in accordance with the most recent edition of AS 5667.12 Guidance on Sampling of Bottom Sediments.
[3] ANZECC (2000) table 3.4.1 - Trigger values for toxicants at alternate levels of protection. Values are the trigger values applying to typical slightly-moderately disturbed systems.
[4] Values derived from ANZECC (2000) table 3.3.4 — Default trigger values for physical and chemical stressors for tropical Australia for slightly disturbed ecosystems. Values are the trigger values for upland rivers.
[5] Values derived from ANZECC (2000) table 3.5.1 — Recommended sediment quality guidelines. Values are the trigger values (ISQG High).
[6] Water quality objective limits for all metals refers to dissolved (field filtered) concentrations.
[7] Values derived from QWQG (2009) appendix G — Salinity guidelines for Queensland freshwaters. Value is the proposed preliminary guideline value (75th percentile).

TABLE 3.4: RELEASE WATER QUALITY OBJECTIVES

Parameter[1]	Units	Water Quality[6]
pH	-	Lower limit - 6.0 or 20th percentile of the reference site concentration, whichever is lower. Upper Limit - 8.0 or 80th percentile of the reference site concentration, whichever is higher.
Electrical Conductivity (EC)	µS/cm	2500[2] or 20 times the 80th percentile of reference site concentration[4], whichever is higher.
Dissolved Oxygen (DO)	% saturation	For interpretational purposes only
Total Suspended Solids (TSS)	mg/L	20 times the 80th percentile of reference site concentration[4]
Sulfate	mg/L	15400[7] or 20 times the 80th percentile of reference site Concentration[4], whichever is higher
Fluoride	mg/L	20 times the 80th percentile of reference site concentration[4]
Major Anions	mg/L	20 times the 80th percentile of reference site concentration[4]
Aluminium	mg/L	1.1[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Arsenic[5]	mg/L	0.26[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Boron	mg/L	7.4[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Cadmium	mg/L	0.004[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Chromium[5]	mg/L	0.02[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Copper	mg/L	0.028[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Lead	mg/L	0.068[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Manganese	mg/L	38[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Mercury (inorganic)	mg/L	0.0012[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Nickel	mg/L	0.22[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Selenium (total)	mg/L	0.1[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher

Parameter[1]	Units	Water Quality[6]
Silver	mg/L	0.001[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Zinc	mg/L	0.16[3] or 20 times the 80th percentile of reference site concentration[4], whichever is higher
Total Petroleum Hydrocarbons	-	No detectable film or odour

[1] For water quality objectives parameters, all metals and metalloids must be measured and reported as both total (unfiltered) and dissolved (field filtered) levels.
[2] Twenty times higher than values derived from QWQG (2009) appendix G — Salinity guidelines for Queensland freshwaters.
[3] Twenty times higher than ANZECC (2000) table 3.4.1 - Trigger values for toxicants at alternate levels of protection. Values are the trigger values applying to typical slightly-moderately disturbed systems.
[4] Values derived from reference sites listed in Schedule C — Table 4 (Receiving waters monitoring locations) and in accordance with QWQG (2009) methodology.
[5] Routine analysis for this parameter is based on combined/total species of the element, where the exceedance of the WQO is identified, an additional sample must be taken and analysed as soon as practicable to determine and quantify speciated forms of this element. This does not apply to sediment analysis.
[6] Water quality objective concentrations for all metals refers to dissolved (field filtered) concentrations.
[7] Twenty times higher than values derived from Dunlop, J et.al. (November 2011) Development of Ecosystem Protection Trigger Values for Sodium Sulfate in the Seasonally Flowing Streams of the Fitzroy River Basin. ACARP Project C18033 (95% species protection levels).

3.4.2 Baseline Surface Water Quality

3.4.2.1 Receiving Water

Any water released from the DCM site (mine water and clean water) drains to a tributary of Gum Creek. Due to the nature of historical and current land uses within the region (i.e., metalliferous mining, alluvial gold mining and cattle grazing), the Gum Creek catchment is considered to be moderately to highly disturbed which influences the upstream and downstream water quality relative to the DCM site (C&R Consulting, 2021A). Further, the highly mineralised geology of the catchment contributes to elevated concentrations of some metals in surface water.

Water quality of the Gum Creek tributary is monitored at four locations, including two upstream reference sites (S7 and S13) and two downstream impact sites (S12 and S11) relative to the surface water release point at the DCM (refer to Figure 3.3). Table 3.5 and Table 3.6 present the Gum Creek Tributary upstream (S7 and S13) and downstream (S11 and S12) water quality monitoring statistics respectively, for parameters that have applicable EA WQOs for the period June 2020 to April 2023. Comments and observations with respect to the data presented in Table 3.5 are:

- Reference site (upstream) water quality at times exceeds WQOs for pH, EC and some dissolved metals/metalloids including aluminium, copper and zinc.
- Downstream water quality within the tributary of Gum Creek at times exceeds WQOs for pH, EC and some dissolved metals/metalloids including aluminium, cadmium, copper (all copper results exceeded WQO) and zinc, with metal/metalloid concentrations generally higher than respective reference site concentrations. It is noted that the most recent data (2023/2024 wet season) indicates that water quality returns to background levels within Gum Creek.
- While the statistics indicate reference site WQO exceedances for mercury, selenium (total) and silver, as noted in the table, a number of the results considered in the statistical analysis were recorded as being below the laboratory limit of reporting (LOR) which was greater than the WQO. It is likely that the concentrations of mercury, selenium (total) and silver were an actuality below the WQO given results for laboratory analysis with LORs below the WQO were also recorded as being below the LOR. Reference site results with laboratory limit of reporting values that exceed the WQO should be excluded from any statistical analysis undertaken to determine site specific WQOs as these results may artificially inflate the baseline 80th percentile concentration of mercury, selenium (total) and silver.
- The metal/metalloid WQO exceedances indicate:
  - Naturally elevated concentrations of some metals (i.e., Aluminium, Copper, and Zinc) in broader catchment runoff.
  - Historical and ongoing mine water releases are likely to have impacted downstream water quality.

Since ownership of the site transferred to Mineral Projects in 2019/2020, downstream water quality has significantly improved due to rehabilitation efforts on site and improved mine water management. Water quality improvements are shown in the data sets in addition to being acknowledged by the Department of Environment and Science (DES) during site inspections.

- Water quality variability observed within the dataset is likely to be attributable to the seasonal variability experienced within the region, characterised by long dry periods where stream flow is completely absent, followed by periods of sustained heavy rainfall where stream flows are consistent and may dilute various analytes.
- Site specific WQOs for impact site water quality should be developed based on reference site data (as indicated in Table 3.3) for pH (upper limit), EC, TSS, fluoride, aluminium, copper and zinc.
- Site specific release WQOs should be developed based on reference site data (as indicated in Table 3.4) for pH (upper limit), EC, TSS, fluoride, aluminium, copper and zinc.

TABLE 3.5: GUM CREEK TRIBUTARY WATER QUALITY STATISTICS – REFERENCE SITES (S7, S13)[1]

Parameter	Units	Environmental Authority WQO	Number of Results	Number of Results >WQO	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
pH	-	6.0 – 8.0	11	0	7.00	7.30	7.79	8.10	8.50
EC	µS/cm	125	11	10	92	180	254	514	713
TSS	mg/L	TBD	9	0	5	5	5	32	75
Sulfate	mg/L	770	8	0	1	1	1	2	3
Fluoride	mg/L	TBD	11	0	0.1	0.1	0.2	0.3	0.5
Dissolved Metals/Metalloids									
Aluminium	mg/L	0.055	14	7	0.006	0.010	0.034	0.238	1.100
Arsenic	mg/L	0.013	14	0	0.001	0.001	0.002	0.003	0.004
Boron	mg/L	0.37	10	0	0.005	0.005	0.028	0.050	0.050
Cadmium	mg/L	0.0002	14	0	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	mg/L	0.001	14	0	0.001	0.001	0.001	0.001	0.001
Copper	mg/L	0.0014	14	12	0.001	0.003	0.005	0.010	0.062
Lead	mg/L	0.0034	14	0	0.001	0.001	0.001	0.001	0.003
Manganese	mg/L	1.9	14	0	0.001	0.004	0.005	0.012	0.279
Mercury (inorganic)[2]	mg/L	0.00006	14	7	0.00005	0.00005	0.00008	0.00010	0.00010

Parameter	Units	Environmental Authority WQO	Number of Results	Number of Results >WQO	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
Nickel	mg/L	0.011	14	0	0.001	0.001	0.001	0.001	0.002
Selenium (total)[2]	mg/L	0.005	10	5	0.001	0.001	0.006	0.010	0.010
Silver[2]	mg/L	0.000053	10	8	0.00005	0.00081	0.00100	0.00100	0.00100
Zinc	mg/L	0.0083	14	1	0.005	0.005	0.005	0.005	0.011

[1] Results recorded below the laboratory limit of reporting were included in the data analysis with a value equal to the laboratory limit of reporting
[2] Statistics for these parameters include results recorded below a laboratory limit of reporting value that exceeds the EA WQO

TABLE 3.6: GUM CREEK TRIBUTARY WATER QUALITY STATISTICS – IMPACT SITES (S11, S12)[1]

Parameter	Units	Environmental Authority WQO	Number of Results	Number of Results >WQO	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
pH	-	6.0 – 8.0	15	0	6.60	6.80	7.19	7.63	8.00
EC	µS/cm	125	15	14	110	286	335	381	495
TSS	mg/L	TBD	13	0	5	5	5	5	50
Sulfate	mg/L	770	10	0	4	44	52	152	190
Fluoride	mg/L	TBD	15	0	0.1	0.1	0.2	0.2	0.4
Dissolved Metals/Metalloids									
Aluminium	mg/L	0.055	18	4	0.006	0.008	0.010	0.088	0.710
Arsenic	mg/L	0.013	18	0	0.001	0.001	0.001	0.003	0.003
Boron	mg/L	0.37	11	0	0.005	0.005	0.007	0.050	0.050
Cadmium	mg/L	0.0002	18	9	0.0001	0.0001	0.0003	0.0008	0.0010
Chromium	mg/L	0.001	18	0	0.001	0.001	0.001	0.001	0.001
Copper	mg/L	0.0014	18	18	0.011	0.022	0.042	0.126	0.281
Lead	mg/L	0.0034	18	0	0.001	0.001	0.001	0.001	0.001
Manganese	mg/L	1.9	18	0	0.001	0.005	0.016	0.043	0.342
Mercury (inorganic)[2]	mg/L	0.00006	18	7	0.00005	0.00005	0.00005	0.00010	0.00010

Parameter	Units	Environmental Authority WQO	Number of Results	Number of Results >WQO	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
Nickel	mg/L	0.011	18	0	0.001	0.001	0.001	0.002	0.003
Selenium (total)	mg/L	0.005	11	5	0.001	0.001	0.002	0.010	0.010
Silver[2]	mg/L	0.000053	11	7	0.00005	0.00005	0.00100	0.00100	0.00100
Zinc	mg/L	0.0083	18	15	0.005	0.011	0.032	0.120	0.136

[1] Results recorded below the laboratory limit of reporting were included in the data analysis with a value equal to the laboratory limit of reporting
[2] Statistics for these parameters include results recorded below a laboratory limit of reporting that exceeds the EA WQO

3.4.2.2 Site Water Quality

Site water quality is monitored within the existing water management system WMS in the Settling Dam (S6), the Seepage Collection Well (S9), at Release Point 1 (RP1) (when safe to access during a release event), the Pit (S4), Raw Water Dam 1 (S1) and Raw Water Dam 2 (S3). Site water quality monitoring results and statistics for the period January 2020 to April 2023 are provided in Appendix A. A summary of the site water quality monitoring results for the January 2020 to July 2021 period are presented in Table 3.7.

TABLE 3.7: SITE WATER QUALITY SUMMARY

Monitoring Location	Comments
S1 (Raw Water Dam 1)	Raw Water Dam 1 (S1) receives runoff from undisturbed catchments only and water quality results are typical of the water quality results recorded in the Gum Creek tributary upstream of RP1. Six exceedances of the copper WQO and three exceedances of the zinc WQO from a total of 10 monitoring events were recorded at S1 which further supports the understanding that concentrations of some metals are elevated in broader catchment runoff (refer to Section 3.4.2.1).
S3 (Raw Water Dam 2)	Raw Water Dam 2 (S3) currently receives runoff from undisturbed catchments only and water quality results are typical of the water quality results recorded in the Gum creek tributary upstream of RP1. Two exceedances of the Aluminium WQO, 10 exceedances of the Copper WQO and two exceedances of the Zinc WQO from a total of 10 monitoring events were recorded at S3 which further supports the understanding that concentrations of some metals are elevated in broader catchment runoff (refer to Section 3.4.2.1). RWD2 will be decommissioned and backfilled as part of the recommencement of operations at DCM (refer to Section 4.2).
S4 (Pit)	Of the three water quality results available for the Pit (S4), all results exceeded the release WQOs for EC, cadmium, copper and zinc. However, unlike the water contained in the Release Dam (S6) (refer to discussion of S6 water quality data below), pH results were slightly above neutral and within the WQO range for pH, there were no exceedances of the aluminium WQO and the metals concentrations were generally lower. The high water level within the Pit limiting exposure of potentially acid generating materials to oxidation is considered to be the likely reason for water stored in Pit being of better quality than that in the Release Dam (S6). The Pit will form part of the new mining operation for the Project.
S6 (Release Dam, referred to as the Settling Dam in previous version of WMP)	The Release Dam currently receives runoff from the waste rock stockpile and disturbed areas across the site. Spills from the Pit and Raw Water Dam 2 also drain to the Release Dam. S6 pH is typically low with only three of the 14 monitoring results being within the EA WQO range. All 14 EC results were above the WQO. Several exceedances of metal/metalloid release WQOs were recorded including aluminium (six of 14 results), cadmium (11 of 14 results), copper (all 14 results) and zinc (all 14 results) which is not unexpected given the waste rock materials within the Release Dam catchment. While waste rock characterisation data was not available, it is understood that the waste rock and open cut excavation has been a historical source of acid mine drainage. TSS concentrations at S6 were low with a maximum result of 29 mg/L, however, higher TSS concentrations are likely to be recorded soon after high or prolonged rainfall events. The Release Dam will be rebuilt (including increased capacity and embankment remediation), desilted/existing sediment capped and remediated as part of the recommencement of operations at DCM (refer to Section 4.2).
S9 (Seepage Collection Well)	The Seepage Collection Well collects seepage through the **Release Dam** wall and as such, water captured at S9 is typical in terms of water quality characteristics of that at S6. All water captured in the Seepage Collection Well is currently returned to the Release Dam. The Release Dam embankment remediated to prevent seepage outflows to the Seepage Collection Well as part of the recommencement of operations at DCM (refer to Section 4.2).

233000 233500 234000 234500 235000 235500

8219000 8218500 8218000

Legend

- Surface Water Monitoring Location
- Groundwater Monitoring Bore
- Watercourse
- Dianne Copper Mine Lease Boundary

Water Storage

- Clean Water Storage
- Mine Water Storage

GW01 S17 S18 Pit S2 S14 S15 S14 S16 GW04 S6 RP1 S11 S9 GW03 S1 S7 S13

Laura Cooktown Project Site Daintree Mount Carbine Port Douglas Cairns

Dianne Copper Mine WMP

Figure 3.3
Care and Maintenance Water Monitoring Locations

REV.	DETAILS	DATE
A	Client Issue	07/03/2024

DRG REF. NC1017-001-SKE-101-A

DRAWN: AW | CHECKED: CB

APPROVED: SL | DATE: 07/03/2024

GENERAL NOTES:
1. Aerial imagery courtesy of Google Maps.
2. Open source datasets provided by QSpatial.
3. Project layout layers provided by client.
4. All dimensions are displayed in metres unless specified otherwise.
5. Surface water monitoring locations digitised from Umwelt figure.

0 50 100 150 200 m

CRS: GDA2020 / MGA zone 55 (EPSG:7855)

REVOLVER RESOURCES

ENGENY

\\online.com\files\NCManagement\Projects\NC1017 Mineral Projects Pty Ltd\NC1017_001 Dianne Copper Mine WMP\05 Design\QGIS\Workspaces\NC1017_001-Dianne_Cu_WMS_Working_V1_AW.qgz

3.4.2.3 Potential Impacts Associated with Releases

The potential impacts associated with release of water from the existing DCM care and maintenance operation on receiving surface water quality are:

- Accumulation metals/metalloids due to deposition of metal/metalloid bearing sediments.
- Possible accumulation of salts within the waterways over time due to evapo-concentration.
- Degradation of water quality that could impact surface water values including aquatic ecosystems and stock watering.

Further detail and discussion relating to the potential and any observed impacts, including impacts on aquatic flora and fauna, associated with release of water from the DCM are provided in the *Dianne Copper Mine Receiving Environment Monitoring Programme (REMP) Design Document* (C&R Consulting, 2021A) and the three REMP assessment reports that have been prepared to date (C&R Consulting, 2021B, 2022 and 2023).

Recommencement of mining will generally have the same potential impacts on the receiving surface water environment as the existing care and maintenance operation, however, the pollutants that may be present in releases will include chemicals used for ore processing (e.g. sulfuric acid, solvent). Further, a catastrophic failure of a process liquid storage, drain or pipe could result in acute impacts to receiving waters and adjacent lands. However, the DCM WMS will be upgraded to manage and mitigate (e.g. secondary containment dams) the additional potential impacts (refer to Section 4.2) and reduce the current impacts to provide best practice ongoing water management.

It is considered that the upgraded DCM (including remediation of the Release Dam) will result in a significant improvement in containment of mine affected water within the WMS, a reduction in the concentration of pollutants in releases from the WMS to Gum Creek Tributary and, as such, an improvement in Gum Creek tributary water quality and stream health downstream of the DCM. Further details of the proposed upgraded WMS and the predicted performance of the upgraded WMS are contained in Sections 4.2 and 5.3 respectively.

3.5 Groundwater

3.5.1 Groundwater Environment

Queensland Globe spatial data indicates that there are 23 registered bores within a 30 km radius of the DCM, however, there are no registered groundwater bores within the DCM mining lease boundary (C&R Consulting, 2021C). Records indicate that nine of the bores are abandoned with eight of these bores associated with the Greasy Bill Creek Mine (ML1002286) (C&R Consulting, 2021C). Bore registration details indicate the purpose of the 23 bores includes:

- Groundwater monitoring.
- Exploration and
- Homestead water supply

The DCM site is located within the Hodgkinson/am formation which according to the available bore records with standing water level measurements has a depth to groundwater of 25 to 29.3 m below ground level (mbgl) (C&R Consulting, 2021C). Based on the available bore level data and surface topography, a westerly groundwater flow direction has been inferred. Groundwater yields associated with four of the bores within a 30 km radius of the DCM ranged from 1 L/s to 6 L/s (C&R Consulting, 2021C).

Groundwater Resources of the Cape York Peninsula (Horn et al., 1995) indicates that the DCM deposit is interbedded with shale and greywacke which is consistent with the records for the bores within a 30 km radius of the DCM site (C&R Consulting, 2021). The primary aquifer is considered to be within the fractured rock with recharge occurring vertically through fractures, veins, and dykes and, as such, groundwater quantity and quality is influenced by rainfall, soil characteristics and vegetative cover (C&R Consulting, 2021C). Groundwater in the Hodgkinson formation has previously been found to be of good quality with an average EC of 700 µS/cm (Horn et al., 1995).

A search of the Groundwater Dependent Ecosystems (GDEs) Atlas did not reveal any GDEs in the vicinity of the DCM (C&R Consulting, 2021C).

3.5.2 Baseline Groundwater Quality and Levels

Groundwater monitoring bores were installed at the DCM in 2022 at two locations upgradient of potential mining impacts (GW01 and GW03) and one potentially impacted location down gradient of the DCM (refer to Figure 3.3).

3.5.2.1 Groundwater Quality

To date, two rounds (October 2022 and April 2023) of groundwater quality monitoring have been undertaken and the results are presented in Table 3.8. The results presented in Table 3.8 indicate:

- Groundwater underlying the DCM mining lease area has a close to neutral pH with high alkalinity
- The concentrations of some metals/metalloids is elevated but exhibit variability between bores and the two sample rounds (for example copper which was below the laboratory limit of reporting for the October 2022 monitoring round but elevated during April 2023). This variability is likely to be associated with variable mineralisation across the catchment (variability between monitoring locations) and natural wetting/drying processes associated with the wet and dry seasons (variability between monitoring rounds).
- No evidence of mine impacts on groundwater down gradient of the DCM.

TABLE 3.8: GROUNDWATER MONITORING WATER QUALITY RESULTS

Parameter	Units	GW01 (reference site)		GW04 (reference site)		GW03 (impact site)	
		October 2022	April 2023	October 2022	April 2023	October 2022	April 2023
pH	-	7.10	7.12	7.10	7.20	7.35	7.46
EC	µS/cm	1,000	1,160	1,840	1,680	1,960	1,450
TSS	mg/L	<5	<5	64	34	38	12
Sulfate	mg/L	15	576	384	290	415	112
Fluoride	mg/L	0.6	0.6	0.6	0.8	0.6	0.8
Dissolved Metals/Metalloids							
Aluminium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	mg/L	0.006	0.006	0.006	0.006	0.006	0.007
Boron	mg/L	0.05	<0.05	0.10	0.11	0.10	0.12
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	<0.001	0.026	<0.001	0.003	<0.001	0.001
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.298	0.150	6.11	7.93	6.96	4.14

Parameter	Units	GW01 (reference site)		GW04 (reference site)		GW03 (impact site)	
		October 2022	April 2023	October 2022	April 2023	October 2022	April 2023
Mercury (inorganic)	mg/L	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.010	0.007	0.017	0.004	0.011	0.003
Selenium (total)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.70	0.018	<0.005	0.011	<0.005	0.011

3.5.2.2 Groundwater Levels

Groundwater levels have been monitored at the three locations (GW01, GW03 and GW04) indicated on Figure 3.3 since June 2022 by continuous level loggers although no data was recorded at GW04 due to a fault with the logger. Figure 3.4 presents a chart of the groundwater level data obtained from the loggers (GW01 and GW03) as well as three manually recorded levels at each location for the period June 2022 to November 2023. The GW04 logger is due to be replaced in Q2 2024.

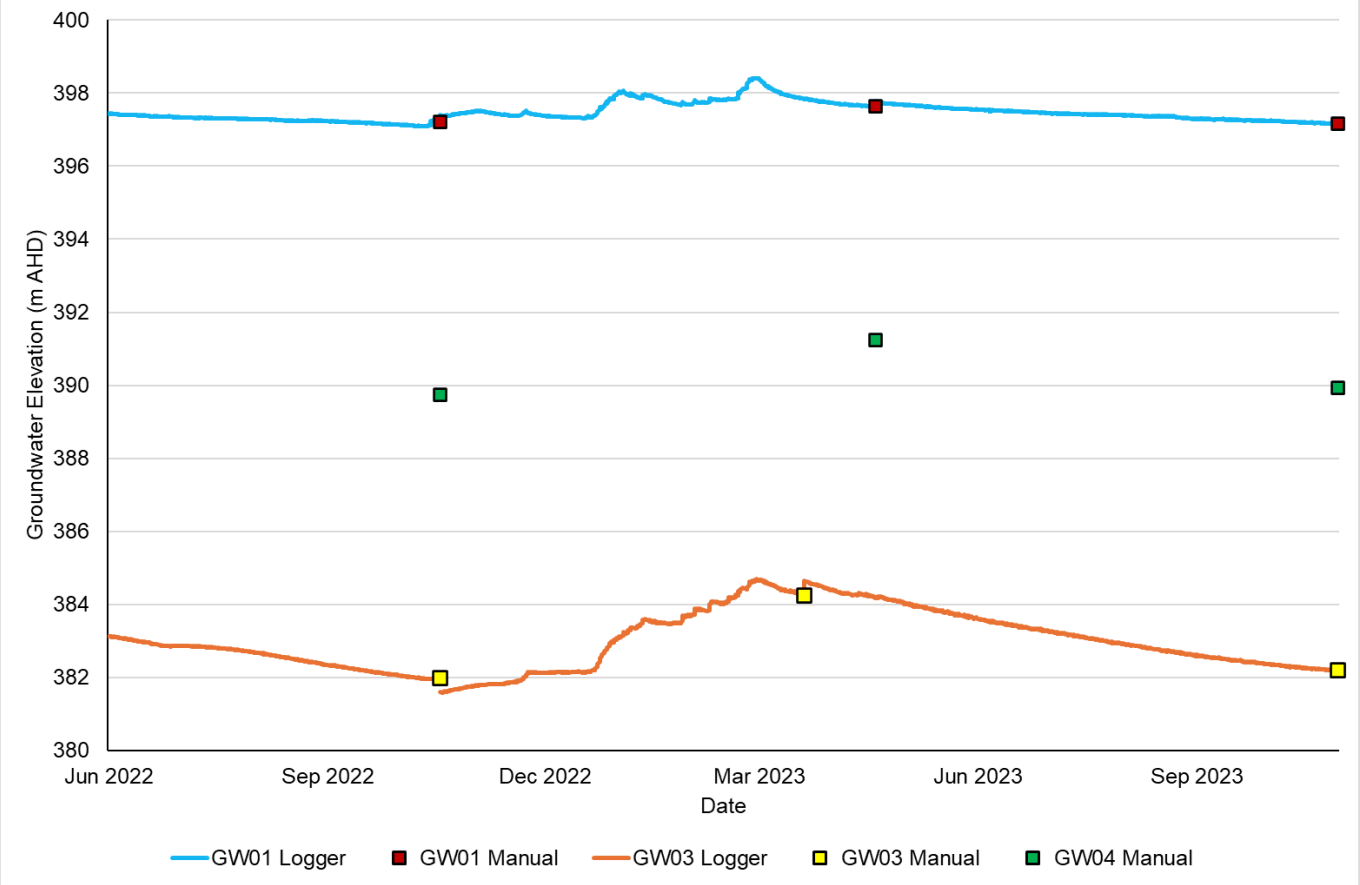


FIGURE 3.4: GROUNDWATER LEVELS

3.5.3 Potential Groundwater Impacts

Although there is currently no evidence of any impacts to groundwater quality from historic mining operations, the potential impacts associated with the care and maintenance DCM operation on receiving groundwater environment are considered to be limited to the local region associated with:

- Degradation of groundwater quality due to possible mine water seepage from the Pit to the aquifer.
- Degradation in groundwater quality due to infiltration of seepage from the waste rock stockpile.

Recommencement of mining will generally have the same potential impacts on the groundwater environment as the existing care and maintenance operation, however, the pollutants that may be result in groundwater quality impacts will include chemicals used for ore processing (e.g. sulphuric acid, solvent). Further, a catastrophic failure of a process liquid storage, drain or pipe could result in acute impacts to the groundwater through seepage. However, the DCM WMS will be upgraded to manage and mitigate the additional potential impacts (refer to Section 4.2).

Groundwater inflows to the open cut pit are expected and preliminary estimates suggest an inflow of up to approximately 32 ML/year, however, further work is required to develop the inflow estimates and assess potential drawdown impacts.

4. WATER MANAGEMENT

4.1 Existing Water Management System

Figure 4.1 and Figure 4.2 present plan and schematic drawings of the existing DCM WMS respectively. The existing WMS is operated with a view to limiting the volume and frequency of mine water discharges to the receiving environment and consist of the key water storages and associated infrastructure described in Table 4.1. Inflows to the WMS are limited to rainfall runoff while outflows are evaporation, spills from water storages and possible seepage to regional groundwater from the Pit (refer to Section 3.5). Spills from water storages occur during high or prolonged rainfall events. Water balance estimates of spill frequency and volume are presented in Section 5.

The terrain surround DCM is steep and does not readily lend itself to diversion of runoff from undisturbed catchments upslope of existing disturbance areas. Significant disturbance to previously undisturbed areas would be required to incorporate clean water diversions directing runoff around the existing WMS. However, the existing WMS does incorporate one clean water diversion drain on the southeastern side of the Waste Rock Stockpile to prevent clean runoff flowing across the stockpile and mobilisation of pollutants

.

TABLE 4.1: EXISTING WMS COMPONENTS

Water Storage	Estimated Capacity (ML)	Associated Infrastructure	Description
Raw Water Dam 1 (Clean Water)	312.0	-	Raw Water Dam 1 (RWD1) receives runoff from undisturbed upslope catchments and water transfers from Raw Water Dam 2 (RWD2). RWD1 spills to a Gum Creek Tributary. There is presently no clean water use for mining activities from RWD1 while DCM is in care and maintenance.
		Transfer Pipeline	Water transfers are undertaken using a common mobile pump and associated generator that is utilised across site. The pump and generator details are provided at the end of this table. The transfer pipeline between RWD1 to RWD2 is a 110 mm poly pipe.
Raw Water Dam 2 (Clean Water)	6.8	-	RWD2 receives runoff from undisturbed upslope catchments. RWD2 is dewatered to RWD1 prior to the onset of the wet season and will spill to the Settling Dam during high or prolonged rainfall events. RWD2 spills through an approximately 900 mm concrete pipe in the dam wall to a surface drain. There is presently no clean water use for mining activities from RWD2 while DCM is in care and maintenance.
		Transfer Pipeline	Water transfers are undertaken using a common mobile pump and associated generator that is utilised across site. The pump and generator details are provided at the end of this table. The transfer pipeline between RWD1 to RWD2 is a 110 mm poly pipe.
Pit Sump (Mine Water)	22.0	-	The Pit Sump receives inflows from: • the immediate disturbed Pit catchment • upslope undisturbed catchments • transfers from the Release Dam While it has not been confirmed, seepage from the Pit to regional groundwater is possible (refer to Section 3.5). However, site observations indicate any decline in Pit water level in the absence of rainfall is limited and likely to be difficult to distinguish from evaporative losses.

Water Storage	Estimated Capacity (ML)	Associated Infrastructure	Description
Release Dam (Mine Water)	22.2	-	The Release Dam receives inflows from: • the Waste Rock Stockpile • disturbed areas downslope of the Pit • upslope undisturbed catchments • Pit spills • RWD2 spills Controlled and uncontrolled releases from the Release Dam drain to Gum Creek Tributary via a rock lined spillway channel (i.e., the release point, RP1). A Farmbot level sensor detects when a spill from the Release Dam occurs. Runoff captured in the Release Dam is able to be transferred to the Pit to minimise the frequency and volume of spills to Gum Creek Tributary. Generally, the Release Dam maintained at the lowest level possible at the commencement of the wet season.
		Transfer Pipeline	Water transfers are undertaken using a common mobile pump and associated generator that is utilised across site. The pump and generator details are provided at the end of this table. The Dewatering Pipeline is a 110 mm PN16 poly pipe between the Settling Dam and the Pit. Much of this pipeline is trenched to reduce risk from vehicles and fire damage.
		Seepage Collection Well, Level Sensor and Pump	Seepage through the Release Dam wall is collected in a well equipped with a submersible pump which returns seepage to the Release Dam. The submersible pump is switched on/off based on level (Farmbot level sensor and controller).
		Irrigation System	Water from the Release Dam is able to be applied for irrigation of former disturbance areas undergoing rehabilitation (i.e., revegetation).
		Farmbot Controller and Sensors	The Farmbot controllers are solar powered with battery backup and provides alerts to DCM personnel via the internet including alerts for Release Dam spills and Seepage Collection Well high level (e.g., indicating a fault with Seepage Collection Well pump)
		Spillway Channel Flow Gauge	The Spillway Channel is equipped with a level sensor that records the depth of flow. Flow depth is converted to a volumetric flow rate based on a flow rating curve developed using hydraulic modelling techniques for the Spillway Channel.

Water Storage	Estimated Capacity (ML)	Associated Infrastructure	Description
All Water storages	-	Dewatering Pump	The Dewatering Pump is a Franklin FPS 46 – 14 18.5 kW submersible pump with a flow rate of approximately 0.8 ML/day to transfer captured runoff from the Release Dam to the Pit. This pump mobile and is utilised for at RWD1, RWD2 and the Release Dam for water transfers.
		Generator	A 40 kVA silenced diesel generator supplied by 1000 L fuel cells connected in series powers the Dewatering Pump. One fuel cell will supply the generator for approximately one week. Fuel cells can be configured in series to enable the generator to be supplied for extended periods (e.g., when DCM is inaccessible during the wet season).

In addition to the WMS components listed in Table 4.1, Mineral Projects has installed a flow gauge in Gum Creek downstream of the DCM release point. The flow gauging provides an indication of the level of dilution any releases (i.e., spills) from the Settling Dam experience from broader catchment runoff to Gum Creek. The flow gauge was installed in September 2023.

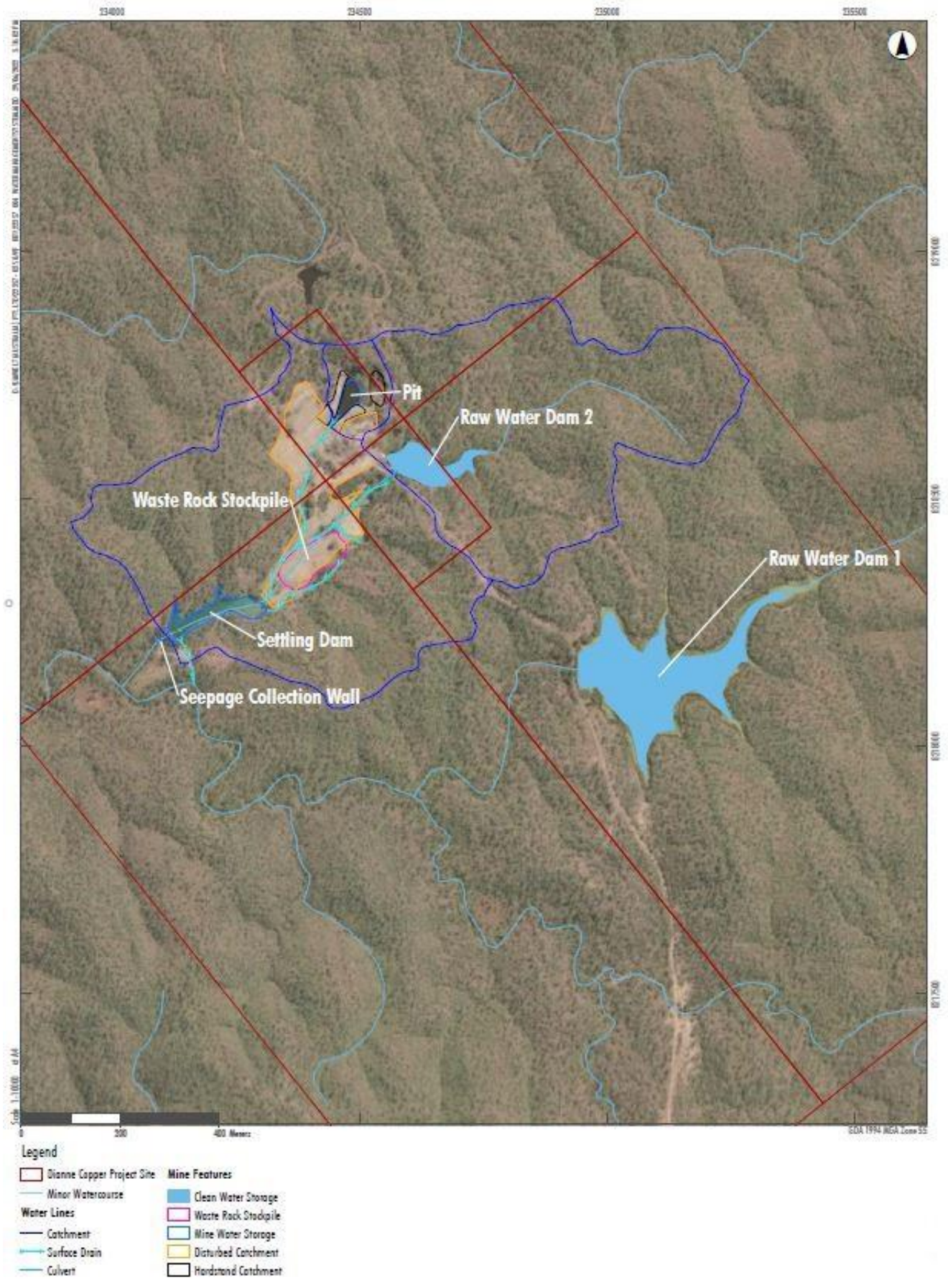


FIGURE 4.1: EXISTING WMS PLAN

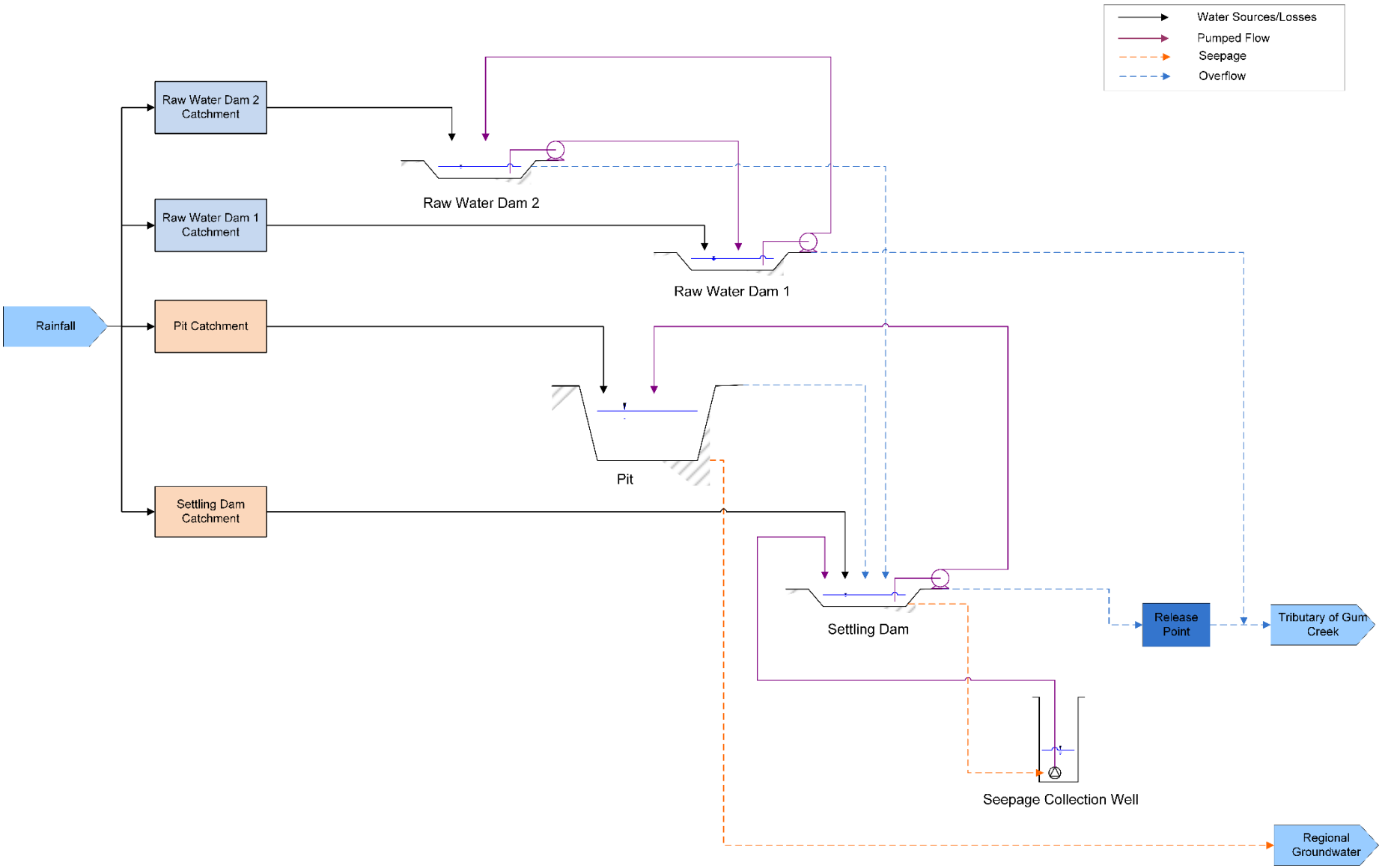


FIGURE 4.2: EXISTING WMS SCHEMATIC

4.2 Proposed Water Management System

Transition from the existing care and maintenance situation to open cut mining and ore processing will require significant changes to the DCM WMS. The changes will include:

- Infilling of RWD 2 to accommodate the Heap Leach Pad.
- A Waste Dump where waste rock (overburden material and leached ore) will be emplaced.
- A Process Water Dam (PWD) that will contain surplus runoff from the Heap Leach Pad and receive transfers from other water storages as required to supply process water demands.
- Overflow dams to store surplus water captured in the PWD.
- An enlarged Release Dam with a remediated embankment to provide additional containment capacity and prevent seepage through the embankment respectively. The Release Dam will also have any sediments from historical operations removed/remediated to improve water quality.
- Decommissioning and removal of the Seepage Collection Well.
- A remediated and expanded Release Dam (referred to as the Settling Dam in previous version of this WMP);
- A Sediment Dam to capture dirty water runoff from the area between the Pit and Heap Leach Pad designed to contain runoff from the 5 day, 95th percentile rainfall event with a sediment storage zone allowance equal to 50% of the settling zone volume;
- A flow through sediment basin (i.e. no active dewatering) to capture coarse sediment in runoff from the Waste Dump.
- Three clean water dams to capture runoff from undisturbed catchments. Two of the clean water dams (CWD 1 and CWD 2) capture runoff that would otherwise drain directly to the Release Dam or Sediment Dam (which spills to the Release Dam) to assist in reducing the frequency and volume of releases from the Release Dam as well as capturing water to supplement operational water demands. The third clean water dam (CWD 3), is for the capture runoff to supplement operational water demands.
- Clean water diversion drains designed to be non-scouring and convey peak flows during storm events up to and including the 1% Annual Exceedance Probability (AEP), time of concentration event;
- Mine water cutoff drains to capture potentially contaminated runoff from operational areas designed to be non-scouring and convey peak flows during storm events up to and including the 1% AEP, time of concentration event; and
- Dirty water cutoff drains to capture potentially sediment laden runoff from disturbed catchments designed to be non-scouring and convey peak flows during storm events up to and including the 5% AEP, time of concentration event.
- Mechanical evaporators to dispose of surplus water contained in the WMS prior to the onset of the wet season.

Figure 4.3 and Figure 4.4 present plan and schematic drawings of the proposed DCM WMS respectively. As with the WMS for the existing care and maintenance operation, the proposed WMS will be operated with a view to limiting the volume and frequency of mine water discharges to the receiving environment. The current proposed WMS design consists of the key water storages and associated infrastructure described in Table 4.1.

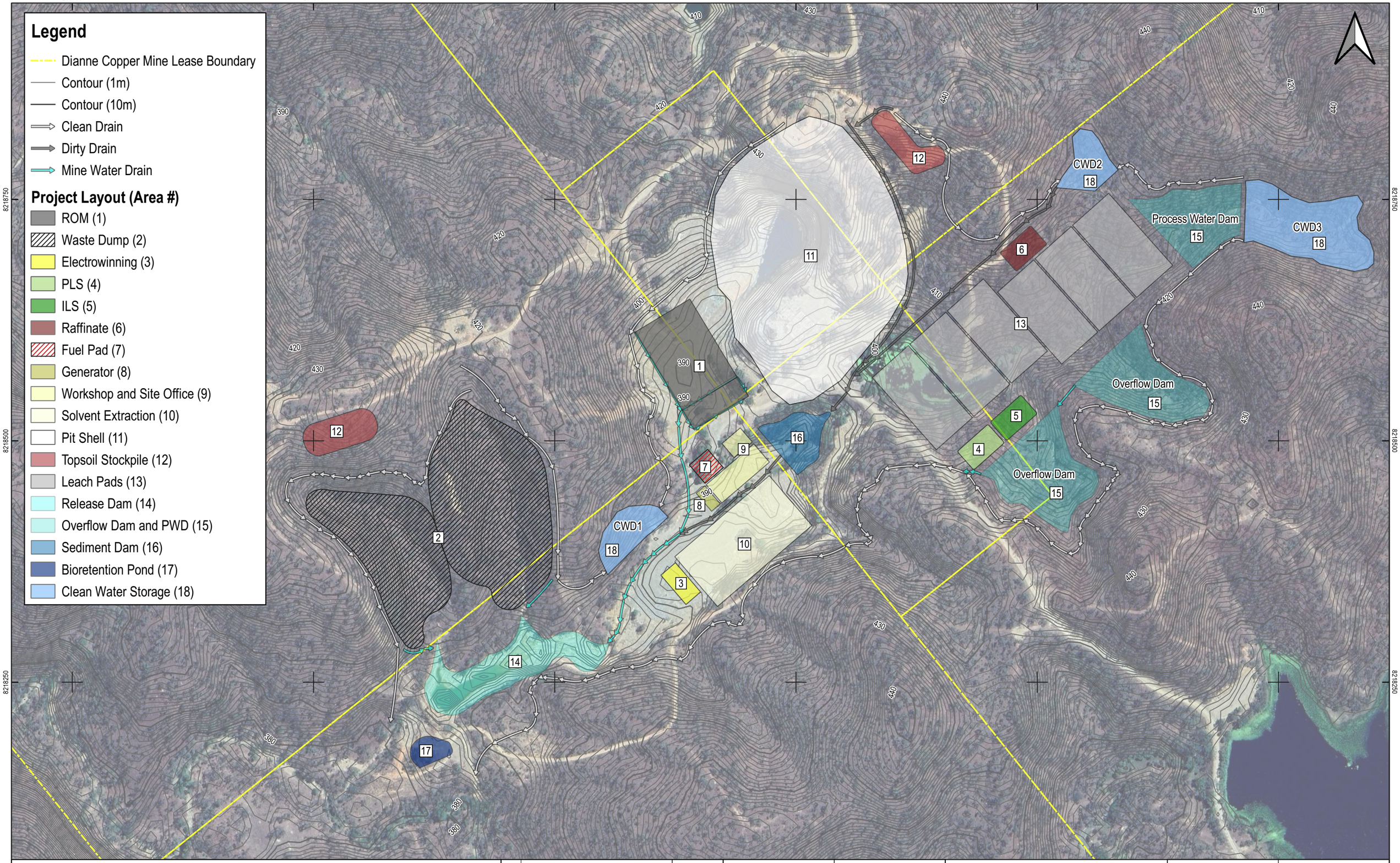
TABLE 4.2: PROPOSED WMS COMPONENTS

Water Storage (Water Type)	Estimated/Proposed Capacity (ML)	Associated Infrastructure	Description
RWD 1 (Clean Water)	312.0	Transfer pump and pipeline(s)	RWD 1 receives runoff from undisturbed upslope catchments. Subject to available freeboard in RWD 1, any water remaining in RWD 2 prior to decommissioning (refer to Section 4.1) will be transferred from to RWD 1. Water from RWD 1 will supplement operational water demands that cannot be met by runoff from disturbed and mine affected catchments captured in the WMS. RWD1 spills to a Gum Creek Tributary.
CWD 1 (Clean Water)	5.3 ML	-	Receives runoff from undisturbed upslope catchments. Water from CWD 1 will supplement operational water demands that cannot be met by runoff from disturbed and mine affected catchments captured in the WMS. CWD 1 will be dewatered to CWD 3 or RWD 1 (which both spill off-site) prior the onset of high or prolonged rainfall events maximise the storage capacity available to capture runoff that could spill to the Release Dam and contribute to the likelihood of an uncontrolled release from the Release Dam. CWD 1 spills to the Release Dam.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
CWD 2 (Clean Water)	5.0	-	Receives runoff from undisturbed upslope catchments. Water from CWD 2 will supplement operational water demands that cannot be met by runoff from disturbed and mine affected catchments captured in the WMS. CWD 2 will be dewatered to CWD 3 or RWD 1 (which both spill off-site) prior the onset of high or prolonged rainfall events to maximise the storage capacity available to capture runoff that could spill to the Release Dam and contribute to the likelihood of an uncontrolled release from the Release Dam. CWD 2 spills to the Sediment Dam.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
CWD 3 (Clean Water)	29.0	-	Receives runoff from undisturbed upslope catchments. Water from CWD 3 will supplement operational water demands that cannot be met by runoff from disturbed and mine affected catchments captured in the WMS.

Water Storage (Water Type)	Estimated/Proposed Capacity (ML)	Associated Infrastructure	Description
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design. CWD 3 spills to the clean water diversion which drains to Release Dam spillway channel and off-site to Gum Creek Tributary.
Sediment Dam (Dirty Water)	2.8	-	The Sediment Dam receives runoff from both disturbed catchment and undisturbed catchment that cannot be readily diverted around the DCM operational areas. Water from the Sediment Dam will be used as the first priority water source to meet dust suppression demands and second priority water source to supplement other operational water demands that cannot be met by runoff from mine affected catchments captured in the WMS. The Sediment Dam spills to the Release Dam.
		Dewatering pump, water cart standpipe and transfer pipeline(s).	Specifications to be determined during detailed design.
Waste Dump Sediment Basin	To be confirmed in detailed design	-	To be designed as a Type C flow through sediment basin for the removal of coarse sediment from Waste Dump runoff thus limiting the rate of sediment accumulation in the Release Dam.
Pit Sump (Mine Affected)	Variable	-	The existing Pit currently contains an estimated 22 ML of water that will be drawn down at a rate to facilitate recommencement of mining. Inflows to the Pit Sump will be limited to runoff from the broader open cut extraction area. The existing Pit Sump water inventory and runoff captured in the Pit Sump will be used to meet ore processing water demands. Presently the Pit Sump spills to the Release Dam, however, as extractive activities progress, the Pit Sump will surcharge to the broader Pit shell which will have increased in capacity to over 2,200 ML over the period of mining. Water balance modelling indicates that spills from the Pit Sump to the Release Dam are will not occur for all modelled historic climate scenarios when the Pit shell volume expands to approximately 75 ML.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.

Water Storage (Water Type)	Estimated/Proposed Capacity (ML)	Associated Infrastructure	Description
Release Dam (Mine Affected)	40.0 ML	-	The Release Dam receives inflows from: • the Waste Rock Stockpile runoff • runoff from disturbed areas downslope of the Pit • runoff from upslope undisturbed catchments • Pit spills • Sediment Dam spills • Transfers from the clean water dams (CWD 1, CWD 2 and CWD 3) and RWD1 (for dilution to meet the release WQOs) Runoff captured in the Release Dam will be used to meet ore processing water demands. The Release Dam inventory will be maintained is low as possible by transferring water to the PWD when the PWD has capacity. Controlled releases to Gum Creek Tributary will occur via RP1 to manage surplus water contained within the DCM WMS prior to forecast rainfall or during rainfall that is considered likely to exceed the WMS containment capacity in accordance with the EA conditions (refer to Table 2.1 and Table 3.4). Should the quality of water contained in the Release Dam not meet the release WQOs and forecast rainfall is considered likely to exceed the WMS containment capacity, the Release Dam will be dewatered to the Pit. Uncontrolled releases from the Release Dam drain to Gum Creek Tributary via RP1. A Farmbot level sensor detects when a spill from the Release Dam occurs.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
		Farmbot Controller and Sensors	The Farmbot controller is solar powered with battery backup and provides alerts to DCM personnel via the internet including alerts for Release Dam spills.
		Spillway Channel Flow Gauge	The Spillway Channel is equipped with a level sensor that records the depth of flow. Flow depth is converted to a volumetric flow rate based on a flow rating curve developed using hydraulic modelling techniques for the Spillway Channel.

Water Storage (Water Type)	Estimated/Proposed Capacity (ML)	Associated Infrastructure	Description
Overflow Dams (Mine Affected)	25.9 ML	-	Inflows to the Overflow Dams are from direct rainfall on surface, and runoff from the Heap Leach Pad that exceeds the capacity of the process liquor storages. Water captured in the Overflow Dams is transferred to the PWD. The Overflow Dams spill to the clean water diversion which drains to the Release Dam spillway channel and off-site to Gum Creek Tributary.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
PWD (Mine Affected)	46 ML	-	The PWD inflows are: • Direct rainfall and runoff from its catchment. • Transfers from the Overflow Dams. • Transfers from the Agglomeration Sump. • Transfers from the Release Dam. Water from the PWD is used as the first priority to supply operational demands. Surplus water from the PWD is transferred to the Overflow Dams to minimise the risk of off-site spills. The PWD spills to the clean water diversion which drains to the Release Dam spillway channel and off-site to Gum Creek Tributary.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
Agglomeration Sump (Mine Affected)	0.75 ML	-	Inflows to the Agglomeration Sump is from Agglomeration catchment runoff. Water captured in the Agglomeration Sump is transferred to the Process Water Dam.
		Dewatering pump and transfer pipeline(s).	Specifications to be determined during detailed design.
-	-	Mechanical Evaporators	Preliminary estimates indicate evaporators will have a capacity to dispose of 1 ML/day of surplus water inventory. Location of evaporators to be determined during detailed design.



Dianne Copper Mine WMP

Figure 4.3
Proposed WMS Plan

REV.	DETAILS	DATE
A	Client Issue	30/04/2024

DRG REF. NC1017-001-SKE-102-A

DRAWN: AW | CHECKED: CB

APPROVED: SL | DATE: 30/04/2024

GENERAL NOTES:
1. Aerial imagery courtesy of Google Maps.
2. Open source datasets provided by QSpatial.
3. Project layout layers provided by client.
4. All dimensions are displayed in metres unless specified otherwise.
5. Surface water monitoring locations digitised from Umwelt figure.

0 50 100 150 200 m

CRS: GDA2020 / MGA zone 55 (EPSG:7855)

REVOLVER RESOURCES

ENGENY

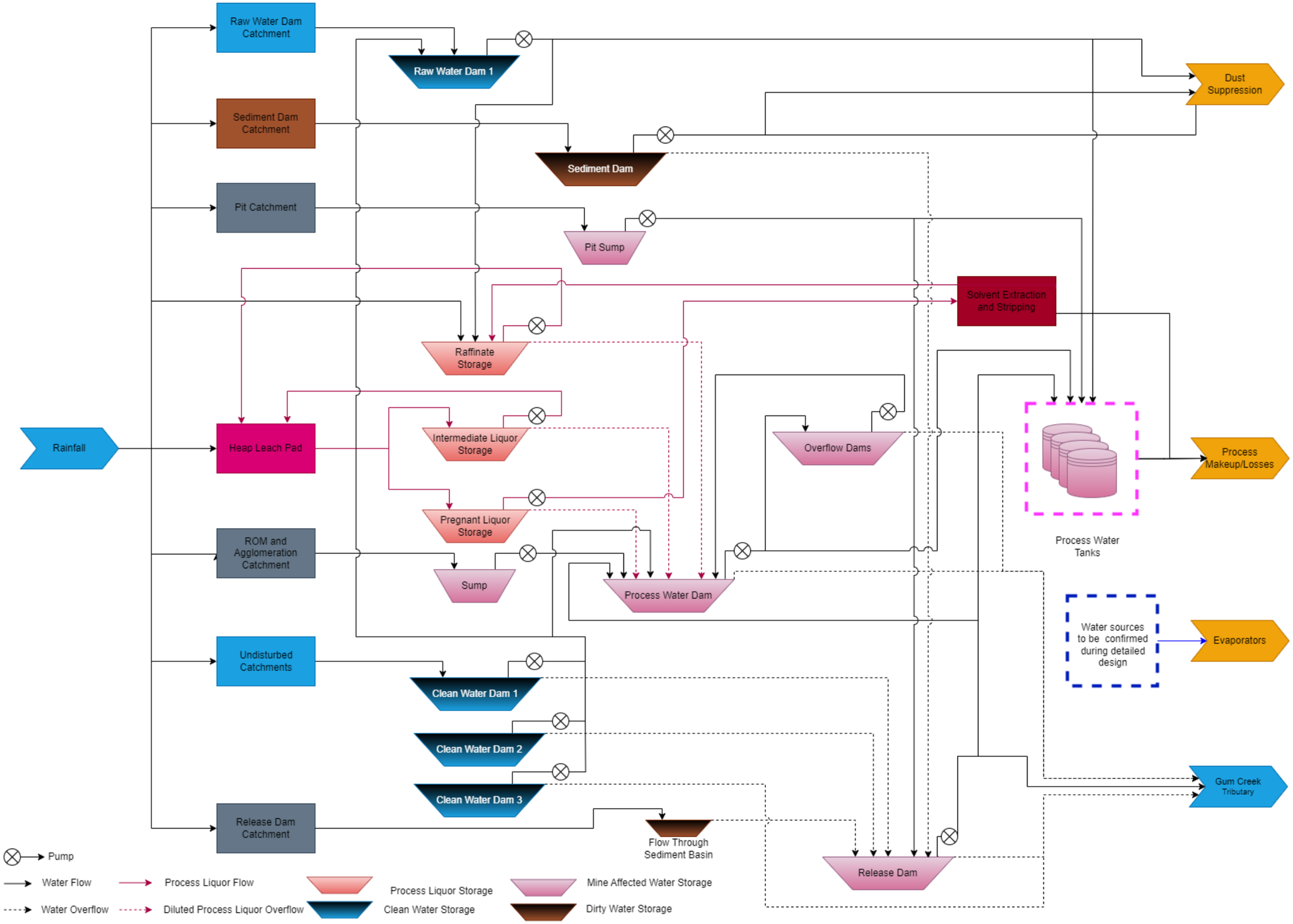


FIGURE 4.4: PROPOSED WMS SCHEMATIC

5. WATER BALANCE

5.1 Existing Water Balance

5.1.1 Overview

A daily time step water balance model (the Model) was developed in the GoldSim software modelling platform to simulate the performance of the DCM WMS during the care and maintenance operating scenario. Model inputs, assumptions and results are detailed in the following sections.

Inflows to the care and maintenance DCM WMS model were limited to rainfall runoff and these inflows were estimated as follows:

- Runoff using the Australian Water Balance Model (AWBM) based on daily rainfall and evaporation data from 1 January 1900 to 31 December 2021 sourced as gridded data from the SILO Climate Database for grid point (-16.10° latitude, 144.55° longitude). Catchment types and AWBM parameters used in the rainfall runoff model are presented in Table 5.4. Catchment types (i.e., mine water, dirty water and clean water) and areas were determined using aerial imagery and a site digital terrain model (DTM).
- Direct rainfall on water storages was also estimated based on the SILO climate data.

Outflows from the care and maintenance DCM WMS included:

- Evaporation from water storages;
- Transfers from RWD 1 to RWD 2 prior to the wet season;
- Spills from the Release Dam; and
- Irrigation of site areas being rehabilitated.

5.1.2 Key Results

Given the care and maintenance operation has limited water demands, the water balance model indicated a water surplus for the DCM WMS except during dry years. Table 5.1 presents the overall gross water balance (excludes off-site releases from the Release Dam).

TABLE 5.1: CARE & MAINTENANCE GROSS WATER BALANCE

Statistic	Result (ML/year)
Minimum	0.0
10th percentile	0.0
50th percentile	71.3
90th percentile	252.9
Maximum	462.2

Table 5.2 and Table 5.3 present the predicted annual off-site release (i.e. release from the Release Dam via RP1) volume and frequency statistics for the care and maintenance operation respectively. The predicted off-site release volumes are equivalent to the gross water balance results. Release event frequency ranges from no off-site release events in dry years up to nine off-site release events during the wettest years. Note that a single release event is considered to have occurred where the water balance predicts off-site release on consecutive days.

Any off-site releases from the Release Dam will by their nature only occur during rainfall events that result in broader catchment runoff and subsequent high water flows in the Gum Creek tributary and downstream Gum Creek. Flows in the Gum Creek tributary, Gum creek and subsequent downstream water course will contribute to dilution of the DCM off-site release. The dilution ratios are dependent on the temporal and spatial distribution of rainfall across the broader catchment. Based on the approximate catchment upstream of the DCM that contributes flow in the Gum Creek tributary at the Release Dam spillway channel discharge, the dilution ratio would be approximately 5:1 (upstream catchment to DCM WMS catchment). As releases will occur during high or prolonged rainfall events during the wet season, the water released from the DCM WMS will comprise a significant proportion of fresh rainfall runoff relative to water that has resided for extended periods in mine water storages. Mineral Projects installed flow gauging on the Release Dam spillway channel and at monitoring location S11 in the Gum Creek Tributary (refer to Section 8) to provide an understanding of the dilution ratios during discrete off-site release events as well identify flow conditions in Gum Creek Tributary that would enable controlled releases from the DCM WMS in accordance with EA conditions.

TABLE 5.2: ANNUAL RELEASE DAM SPILL VOLUMES

Statistic	Result (ML/year)
Minimum	0.0
10th percentile	0.0
50th percentile	71.3
90th percentile	252.9
Maximum	462.2

TABLE 5.3: ANNUAL RELEASE DAM SPILL FREQUENCY

Statistic	Result (ML/year)
Minimum	0.0
10th percentile	0.0
50th percentile	2
90th percentile	4
Maximum	9

5.2 Australian Water Balance Model

AWBM parameters for runoff from undisturbed catchments were adjusted to achieve an average annual runoff of 1.9 ML/ha. The target average annual runoff of 1.9 ML/ha is based on published runoff coefficient data in *Rainfall-runoff modelling across northern Australia* (CSIRO, 2009) for the Mitchell River catchment. A runoff coefficient of 0.2 was selected using a chart showing runoff coefficient versus mean annual rainfall from *Appendix 6* of *Rainfall-runoff modelling across northern Australia* (CSIRO, 2009) and the runoff coefficient applied to the average (mean) annual rainfall for the DCM site derived from the data sourced from the SILO climate database (refer to Section 5.1) to arrive at the average annual runoff of 1.9 ML/ha. Pit/hardstand catchment AWBM parameters were based on parameters applied in water balance models for other sites. AWBM parameters used in the rainfall runoff model are presented in Table 5.4.

It should be noted that ongoing site water quantity monitoring (refer to Section 8), including the frequency and volume of off-site release, will be required to better understand the rainfall runoff response of the DCM WMS catchment and allow a more accurate calibration of the Model.

TABLE 5.4: CATCHMENT TYPES AND AWBM PARAMETERS

Catchment Type	Surface Store Area Split			Surface Store Capacities			BFI[1]	Kb[2]	Ks[3]	Evap%[4]
	A1	A2	A3	C1	C2	C3				
Undisturbed	0.134	0.433	0.433	15.75	160.81	321.62	0.15	0.750	0.2	1.00
Disturbed	0.185	0.430	0.385	9.46	134.30	300.00	0.05	0.985	0.0	0.85
Pit/Hardstand	0.185	0.430	0.385	2.70	38.37	85.71	0.00	0.985	0.0	0.85

[1] Base flow index
[2] Baseflow recession constant
[3] Surface runoff recession constant
[4] Pan factor to potential evapotranspiration

5.3 Operational Water Balance

The care and maintenance water balance model has been updated to reflect the proposed DCM WMS (as presented in Section 4.2) following recommencement of mining and ore processing activities to:

- Inform the required capacity of DCM water storages (in particular the Overflow Dams, PWD and Release Dam) to minimise the frequency and volume of discharges;
- Estimate site water security (i.e. whether water sources are capable of meeting operational demands) across a range of climatic conditions; and
- Estimate the volumes and frequency of controlled releases and spills from the Release Dam and the Overflow Dams.

Further to the updates to reflect the proposed DCM WMS, the water balance model was modified to run multiple climate scenario realisations (123 realisations) for a 3 year operational life of mine (LoM) starting on 1 August. The 123 climate scenarios modelled are based on the SILO climate data rainfall record for the period 1 January 1900 to 31 December 2022 with the model applying consecutive daily rainfall and evaporation depths for a 3 year period but with a different starting year with each realisation.

The following sections outline the water sources, demands and assumptions applied in the model.

5.3.1 Model Inputs and Assumptions

5.3.1.1 Inflows

As with the care and maintenance operation water balance model, inflows to the operational WMS are limited to rainfall and runoff within the WMS catchment and the AWBM runoff estimation approach outlined in Section 5.2 has been applied.

5.3.1.2 Outflows

Modelled outflows from the WMS are listed below:

- Evaporation from water storages – estimated based on the SILO climate data and a pan evaporation factor of 0.75;
- Ore processing make up water demands;
- Dust suppression (haul roads, exposed areas and stockpiles).
- Surplus water disposal via mechanical evaporators.

5.3.1.3 Operating Rules and Assumptions

Operating Rules

Table 5.5 presents the operating rules applied in the operational water balance model.

TABLE 5.5: WATER BALANCE OPERATING RULES

Model Component	Operation	Rules/Settings
Dust Suppression	Water Supply Source Priority	(1) Sediment Dam (2) CWD (3) RWD1
	Demand	• 300 kL/day when rainfall 0-5 mm/day • 250 kL/day when rainfall 5-15 mm/day. • 150 kL/day when rainfall 15-40 mm/day • 0 kL/day when rainfall > 40mm/day
Processing Demands	Water Supply Source Priority	(1) Overflow and Process Water Dams (2) Release Dam (3) Sediment Dam (4) CWD (5) RWD1
	Heap Leach Make Up Demand (based on a "dripper" leach solution irrigation system)	• If rainfall - evaporation > 7.68 mm/day, no make up water required • If rainfall > evaporation but rainfall – evaporation < 7.68 mm/day, makeup water = 7.68 mm/day – (rainfall – evaporation) • If rainfall < evaporation, makeup water = 7.68 mm/day - Rainfall Notes: – 7.68 mm/day is based on a base leach solution application rate of 8 L/h/m2 and 4% evaporative loss rate for a "dripper" leach solution irrigation system. – The make up rate for heap leaching in mm/day is applied to the pad area of four active heaps being leached (i.e. 4 x 5,000 m^2)
	Miscellaneous Process Water Demand	100 kL/day
Release Dam Water Transfer	Initiation of water transfers to the PWD Maximum water transfer rate	If Overflow Dams <12 ML 2 ML/day
Surplus Water Disposal	Initiation of mechanical evaporators Maximum disposal rate	If PWD inventory >15 ML 1 ML/day

Assumptions

- As all water from the Agglomeration Sump will be transferred to the PWD, the Agglomeration Sump catchment and capacity has been modelled as part of the PWD catchment.
- The Waste Dump Sediment Basin is assumed to have negligible storage capacity as it is not actively dewatered and as such, the entire Waste Dump catchment has been modelled as draining to the Release Dam.
- As no area – volume relationships for water storages was available, the surface areas for all water storages have been estimated at each modelled time step based on a linear relationship from zero surface area when the storage is empty up to the maximum surface area when the storage is full.
- While the water source(s) for the mechanical evaporators is yet to be confirmed, for the purpose of the water balance model it has been assumed that water is sourced from the PWD.
- Table 5.6 presents the assumed inventory of water contained in each water storage at the start of a modelled climate scenario realisation.

TABLE 5.6: WATER STORAGE INITIAL INVENTORIES

Water Storage	Initial Capacity (ML)
RWD 1	250
CWD 1	0
CWD 2	0
CWD 3	0
Sediment Dam	0
Pit Sump	0
Release Dam	5
Overflow Dams	0
PWD	0

5.3.2 Results

5.3.2.1 Operational Water Security

Water balance modelling indicates that water deficits will occur in some of the 123 modelled climate scenario realisations indicating that additional water sources may be required to supplement operation demands or ore processing rates may need to be scaled down should a dry 3 year climate scenario be experienced.

Of the climate scenarios where a water deficit is predicted, the magnitude of the cumulative water deficits predicted for the modelled 3 year LoM are summarised as follows and also presented in Figure 5.1.

No deficits or negligible deficits (<0.001 ML) are predicted for the 83% of the modelled climate scenarios.

- 17^{th} percentile result of less than 1 ML
- 10^{th} percentile deficit of approximately 40 ML
- 5^{th} percentile deficit of approximately 80 ML
- Maximum deficit of less than 125 ML

Should water deficits be forecast when operations recommence, DCM will source additional water from either groundwater bores, large existing dams on the property outside of the mining leases and/or the Palmer River to cover the shortfall (subject to any necessary approvals).

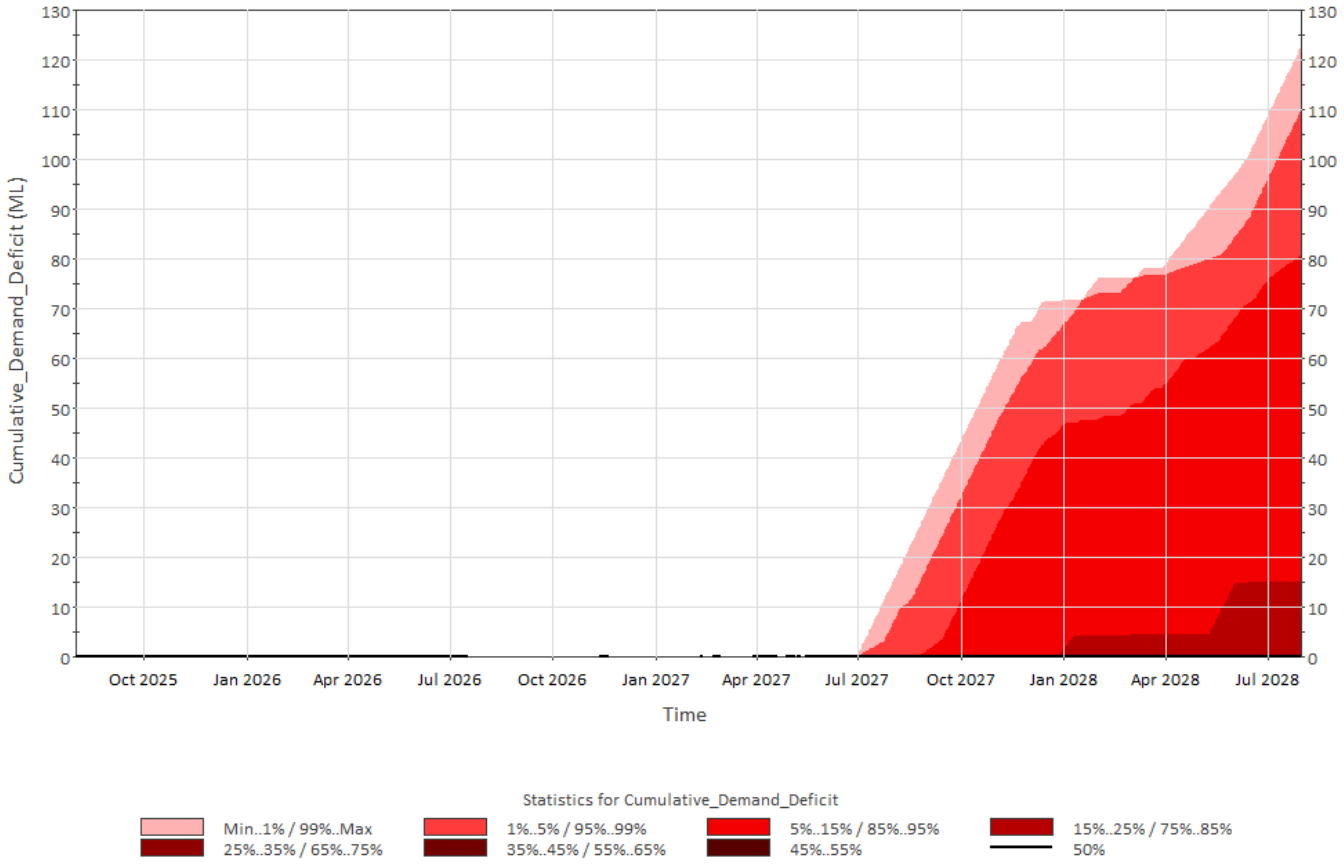


FIGURE 5.1: PREDICTED WATER DEFICITS

5.3.2.2 Release Volumes and Frequencies

5.3.2.2.1 Release Dam

Water balance modelling indicates that releases (controlled and uncontrolled) from the Release Dam will occur in up to 27% of modelled climate scenarios. Figure 5.2 presents the range in release volumes for the 123 modelled climate scenario realisations over the modelled 3 year LoM. Release Dam inventories will be managed with controlled releases when release WQOs (refer to Table 3.4) can be achieved (which is anticipated) otherwise the contingencies outlined in Section 7 will be implemented to mitigate the potential for non-compliant releases.

Predicted release frequencies and volumes for the operational DCM are significantly lower than those modelled for the care and maintenance scenario. Modelling indicated that under the care and maintenance scenario up to approximately 460 ML of releases to Gum Creek Tributary would occur and releases would occur for the median water balance result. Figure 5.2 shows that the maximum cumulative volume released over the three year operational life of mine is limited to approximately 70 ML and would only occur under the wetter historically recorded climatic conditions. The 10th percentile release volume is predicted to be less than 13 ML. It is considered that the significant reduction in release volume and frequency under the operational scenario will have a significant impact on improving Gum Creek Tributary water quality. Also, the remediation of the Release Dam and the ability to dilute controlled releases of surplus water contained in Release Dam with clean water captured in the WMS (i.e. from clean water dams or RWD 1) will further reduce negative impacts on Gum Creek Tributary water quality.

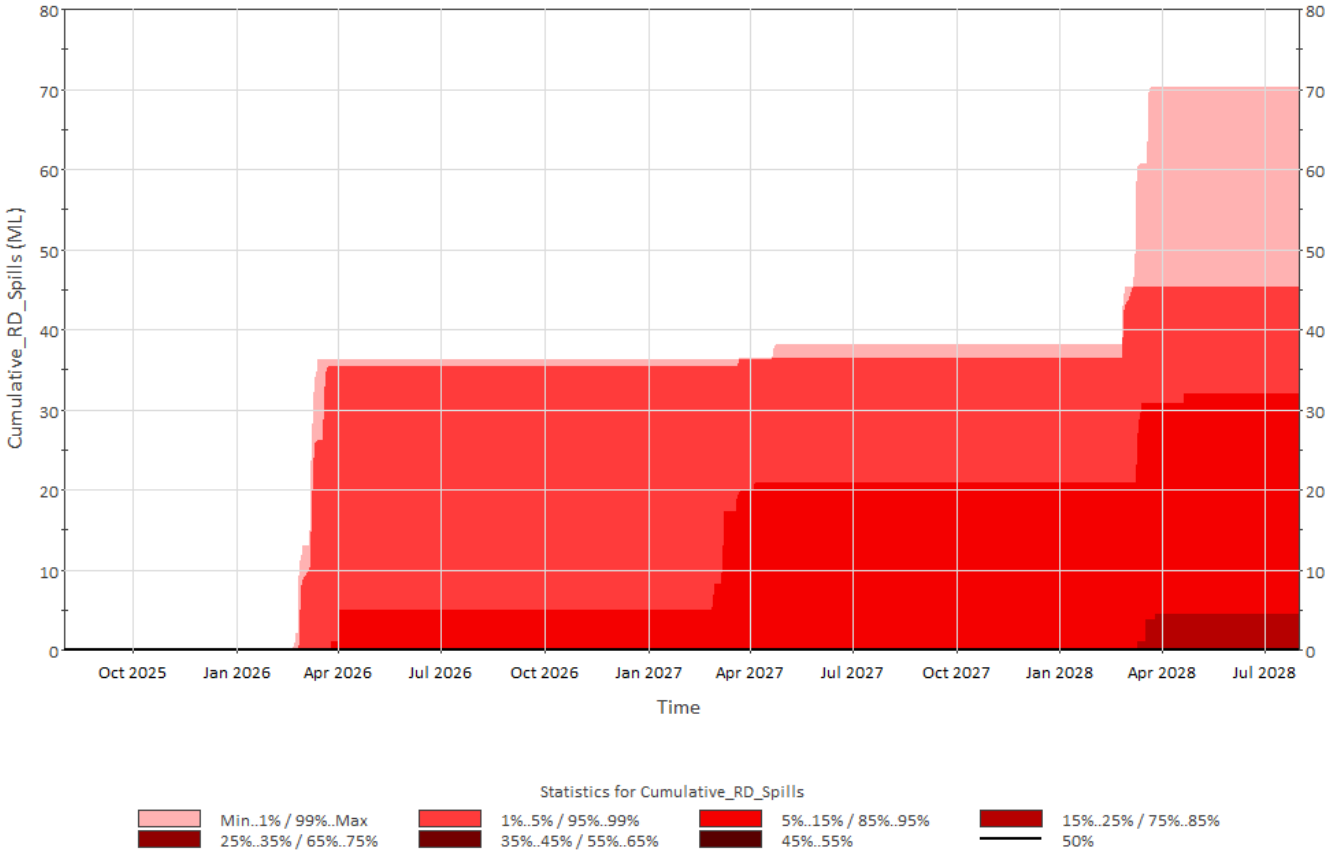


FIGURE 5.2: PREDICTED RELEASE VOLUMES FROM RELEASE DAM

5.3.2.2.2 Process Water Dam

Water balance modelling indicates that releases from the PWD will not spill during any of the 123 modelled climate scenario realisations.

6. EROSION & SEDIMENT CONTROL PLAN

This erosion and sediment control plan (ESCP) will largely apply for areas where temporary disturbance will occur that is not within the DCM WMS catchment and where the primary pollutant associated with runoff from the disturbed area is limited to suspended sediment. Runoff from mine operation impacted areas must be managed within infrastructure designed to accommodate flows from more significant design storm events.

6.1 Design Standards

The following design standards have been developed based on *Best Practice in Erosion and Sediment Control* (International Erosion Control Association (Australasia) (IECA), 2008) (IECA 2008). Where additional controls are required which are not referenced within this WMP, reference should be made to IECA 2008. The IECA 2008 volumes are available for download at https://www.austieca.com.au/publications/bestpractice-erosion-and-sediment-control-bpesc-document .

6.1.1 Drainage Design Standard

Table 6.1 presents the drainage design standard for temporary drainage structures.

TABLE 6.1: DRAINAGE DESIGN STANDARD FOR TEMPORARY DRAINS

Drainage Structure	Anticipated Design Life		
	<12 months	12 – 24 months	> 24 months
Temporary drainage structures[1]	1 in 2 year ARI[3]	1 in 5 year ARI[3]	1 in 10 year ARI[3]
Temporary drainage structures (e.g., catch drain, flow diversion bank) located immediately up-slope of an occupied property that would be adversely affected by the failure or overtopping of the structure[1, 2]	1 in 10 year ARI[3]		
Temporary culvert crossing	Minimum 1 in 1 year ARI hydraulic capacity wherever reasonable and practicable		

[1] Design capacity excludes minimum 150 mm freeboard.
[2] Design flow rate based on up-slope drainage structures operating in accordance with their design capacity excluding freeboard, i.e., any constructed freeboard is assumed to have been washed away or otherwise deactivated.
[3] Design flow based on peak flow from a critical duration storm event of the indicated average recurrence interval (ARI)

6.1.1.1 Velocity Control Structures

Wherever reasonable and practicable, drainage channels, whether temporary or permanent, will be designed and constructed at a gradient that limits the maximum flow velocity to a value not exceeding the maximum allowable flow velocity for the given surface material. Appendix A in Book 2 of IECA 2008 provides drainage channel design guidance including allowable flow velocities for a range of drainage channel lining types.

6.1.1.2 Drainage Controls on Unsealed Roads

Wherever reasonable and practicable, stormwater will be allowed to shed from unsealed access roads at regular intervals. The runoff will be discharged into a sediment trap and/or released as sheet flow via a level spreader into adjacent grassland or bushland.

6.1.2 Erosion Control Standard

IECA 2008 indicates that the erosion control standard can be based on:

- the monthly rainfall erosivity OR
- the average monthly rainfall depth OR
- the estimated rate of soil loss.

The erosion control standard for the DCM has been determined based on the estimated rate of soil loss as calculated in Section 6.1.2.1.

6.1.2.1 Soil Loss Rate

The annual rainfall erosivity factor (R-factor) for the site was calculated using the following formula (Section E3.2 of IECA 2008):

$$R = 164.74 \times 1.1177^{S} \times S^{0.6444}$$

where

S	is the 2 year, 6 hour duration 1987 Australian Rainfall and Runoff (AR&R) Average Recurrence Interval (ARI) storm event intensity (source: Bureau of Meteorology (BoM) Intensity Frequency Duration Design Rainfall Data System 2016)	12.1 mm/h

$$R = 164.74 \times 1.1177^{12.1} \times 12.1^{0.6444}$$

$$\boldsymbol{R = 3,157}$$

The annual Project site soil loss for the currently disturbed area for the Project site has been estimated using the Revised Universal Soil Loss Equation (RUSLE) as presented below.

RUSLE

$$A = R \times k \times LS \times C \times P$$

where

Symbol	Definition	Value
A	is the annual soil loss rate in tonnes/ha/year	to be calculated
R	is the annual average rainfall erosivity calculated based on the 2 year, 6 hour duration ARI storm event intensity	3,157
K	Is the soil erodibility (refer to Table 3.2)	0.0509
LS	is the slope length gradient factor sourced from Table E3 of Best Practice Erosion and Sediment Control (IECA, 2008) and is dependent on the maximum slope length (use 80 m) and gradient (average slope of 15.5% for the current disturbed area)	5.29
C	is the ground cover factor sourced from Figure A5 of Managing Urban Stormwater Volume 1 (Landcom, 2004) (assume no ground cover in this case)	1.0
P	is the erosion control practise factor sourced from Table A2 of Managing Urban Stormwater Volume 1 (Landcom, 2004) and is dependent on level of compaction and roughness of the disturbed surface (assume Compacted and smooth)	1.3

$$A = 3{,}157 \times 0.0509 \times 5.29 \times 1.0 \times 1.3$$

$$\boldsymbol{A = 1,105 \frac{tonnes}{ha.year}}$$

Table 6.2 presents the erosion risk rating based on the estimated soil loss rate (source: IECA 2008 Table 4.4.3). Based on an estimated Project Site Annual Soil Loss of 1,105 t/ha/yr, the erosion risk for currently disturbed areas at the DCM is considered High. Where new areas of the Project site are to be disturbed an assessment of the annual soil loss and associated risk rating will be undertaken on a catchment-by-catchment basis.

TABLE 6.2: EROSION RISK RATING

Erosion Risk Rating	Soil Loss Rate (tonnes/ha/year
Very Low	0 to 150
Low	150+ to 225
Moderate	225+ to 500
High	**500+ to 1,500**
Extreme	>1,500

Source: IECA 2008

6.1.2.2 Best Practice Land Clearing and Rehabilitation

Based on an erosion risk rating of High (determined using the estimated soil loss rate for the currently disturbed area of the DCM), the best practice land clearing and rehabilitation requirements presented in Table 6.3 will be implemented as described in IECA 2008.

TABLE 6.3: BEST PRACTICE LAND CLEARING AND REHABILITATION REQUIREMENTS

Risk	Best Practice Requirements
All cases	• All reasonable and practicable steps taken to apply best practice erosion control measures to completed earth works, or otherwise stabilise such works, prior to anticipated rainfall – including existing unstable, undisturbed, soil surfaces under the management or control of the construction/operational works.
High	• **Disturbed areas are rehabilitated as soon as practicable. Staged construction and stabilisation of earth batters (steeper than 6H:1V) in maximum 3 m vertical increments wherever reasonable and practicable.** • Soil stockpiles and unfinished earthworks are suitably stabilised if disturbance is expected to be suspended for an extended period and significant rainfall is predicted.

[1] Erosion risk based on soil loss rate.

[2] Minimum cover requirement may be reduced if the natural cover of the immediate land is less than the nominated value, for example in arid and semi-arid areas or on coastal sand dunes.

6.1.3 Sediment Control Standard

The sediment control standard for the site is presented in Table 6.4. Using this approach, the required sediment control (broken down into three types, type 1, type 2, or type 3) for a given catchment is dependent on the area of the catchment and the associated soil loss rate as calculated for that catchment. Examples of each type of sediment control are presented in Table 6.5.

TABLE 6.4: SEDIMENT CONTROL STANDARD

Area Limit (m^2)[1]	Soil Loss Rate Limit (tonne/ha/year)[2]			Soil Loss Rate Limit (tonne/ha/month)[3]		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
250	N/A	N/A	-[4]	N/A	N/A	-[4]
1,000	N/A	N/A	All cases	N/A	N/A	All cases
2,500	N/A	>75	>75	N/A	>6.25	6.25
>2,500	>150	150	75	>12.5	12.5	6.25

[1] Area is defined by the catchment area draining to a given location. The area does not include any "clean" water catchment that bypasses the sediment trap.
[2] Soil loss rate limit defines the maximum allowable soil loss rate from a given catchment area draining to a given sediment trap at any given instant within the construction phase.
[3] Soil loss rate limit defines the maximum allowable soil loss rate from a given catchment area raining to a given sediment trap at any given instant within a given month in those cases where the actual time of construction is regulated.
[4] The default standard is a Type 3 sediment trap.

TABLE 6.5: CLASSIFICATION OF SEDIMENT CONTROL TECHNIQUES BY TYPE[1]

Type 1	Type 2	Type 3	Supplementary Techniques
Sheet flow treatment techniques			
• Buffer zone capable of infiltrating 100% of stormwater runoff or process water. • Infiltration basin or sand bed capable of infiltrating 100% of flow	• Buffer zone2 capable of infiltrating the majority of flows from design storms • Compost/mulch berm	• Buffer zone[2] • Filter fence • Modular sediment trap • Sediment fence	• Grass filter strips • Fibre rolls • Stiff grass barrier
Concentrated flow treatment techniques			
• Sediment basin[3] (sized in accordance with standard design)	• Block & aggregate drop inlet protection • Excavated sediment trap with Type 2 outlet • Filter sock • Filter tube dam • Mesh & aggregate drop inlet protection • Rock & aggregate drop inlet protection • Rock filter dam • Sediment trench • Sediment weir	• Coarse sediment trap • Excavated drop inlet protection4 • Excavated sediment trap with Type 3 outlet • Fabric drop inlet protection • Fabric wrap field inlet sediment trap • Modular sediment trap • Straw bale barrier • U-shaped sediment trap	• Check dam sediment traps • Kerb inlet sediment traps (on-grade and sag inlet traps, including gully bags) • Straw bale barrier
Dewatering sediment control techniques			
• Type F/D sediment basin • Silting pond	• Filter bag or filter tube • Filter pond • Filter tube dam • Portable sediment tank • Settling pond • Sump pit	• Compost berm • Filter fence • Grass filter bed • Hydrocyclone • Portable sediment tank • Sediment fence	• Grass filter bed

Type 1	Type 2	Type 3	Supplementary Techniques
Instream sediment control techniques (selection not based on soil loss rate)			
• Pump sediment-laden water to an off-stream Type F or Type D Sediment Basin or high filtration system	• Filter tube barrier • Modular sediment barrier • Rock filter dam • Sediment weir	• Modular sediment barrier • Sediment filter cage	• Straw bale barrier (short-term device only)
Other sediment control types			
-	-	-	• Construction exits (rock pads, vibration grids, wash bays)

Source: IECA 2008

[1] Classification is based on the technique being sized in accordance with best practice standards, otherwise the technique attracts a lower classification. The classification of a sediment control technique within a given set of site conditions must, wherever practicable be based on the classification system provided in Technical Note 4.1 of IECA, 2008.

[2] Buffer Zone must be able to infiltrate all inflow into the ground such that there is no surface discharge from the Buffer Zone. The term "process water" refers to 100% of runoff from cleaning operations, or such things as runoff from water cooling or cutting tools.

[3] The design of infiltration basins, sand filter beds and hydro-cyclones are not discussed within this document.

[4] Classification depends on design details.

[5] Supplementary sediment traps are not effective enough to be classified as Type 3 system. Even though these sediment traps are relatively ineffective, their incorporation into ESCPs is considered a relevant part of best practice sediment control; however, it is not sufficient for a sediment control scheme to rely solely on supplementary sediment traps.

Table 6.6 outlines the general classification of sediment traps based on the ability to trap a specific particle size.

TABLE 6.6: SEDIMENT TRAP CLASSIFICATION BASED ON PARTICLE SIZE

Classification	Minimum Particle Size (mm)	Typical Trapped Particles
Type 1	<0.045	Clay, Silt and Sand
Type 2	0.045 to 0.14	Silt and Sand
Type 3	>0.14	Sand
Supplementary	>0.42	Coarse Sand

Source: IECA 2008

6.1.3.1 Dewatering

Table 6.7 presents the recommended water quality standard for de-watering operations of sediment structures.

TABLE 6.7: DISCHARGE STANDARD FOR DEWATERING OPERATIONS

Site Conditions	Discharge Water Quality Standard
All cases	Take all reasonable and practicable measures to achieve a 90th percentile solids concentration not exceeding 50 mg/L
Soil disturbances exceeding 2,500 m^2 Post-storm de-watering of Sediment Basins	**90th percentile total suspended solids (TSS) concentration not exceeding 50 mg/L** Water pH between 6.5 – 8.5

Source: IECA 2008

6.2 Erosion and Sediment Controls

The erosion and sediment controls to be implemented at the Project are outlined in the following sections.

6.2.1 General Controls

All ESCs are to be installed, managed, and maintained in accordance with IECA 2008 to:

- Divert clean water around site.
- Prevent sediment moving off-site and sediment laden water entering any watercourse, drainage line, or drain inlet as a result of the project.
- Reduce water velocity and capture sediment on site as a result of the project.
- Minimise the amount of material transported from site to surrounding pavement surfaces as a result of the project.

Additional ESC measures must be implemented and a revised WMP must be prepared in the event that site conditions change significantly from those considered within this WMP or the implemented works fail to achieve the desired objective of preventing environmental harm.

6.2.2 General Site Management

Table 6.8 outlines the general erosion and sediment controls for site management for the DCM.

TABLE 6.8: GENERAL SITE MANAGEMENT EROSION AND SEDIMENT CONTROL

No.	Control
1	To minimise ground disturbance, construction activities including vehicle and machinery movements, stockpiling, temporary vehicle parking and material laydown will be restricted to designated work areas where possible.
2	Vehicle wash down is to occur in a designated bunded area where required. This bunded area is to be located at least 5 m from any on-site drain and 50 m from any drainage line. Excess debris from cleaning and washing is to be removed using hand tools.
3	All fuels, chemicals and liquids are to be stored in an impervious bunded area, a minimum of 50 m away from: • any areas of concentrated water flow. • flooded or poorly drained areas.
4	Refuelling of plant and equipment is to be undertaken in an impervious bunded area located a minimum of 50 m from drainage lines or waterways.
5	Emergency spill kits are to be kept on site at all times. All workers are to be made aware of the location of the spill kits and trained in their use.
6	Site access will be restricted to the minimum practical number of locations and site exit points will be appropriately managed to minimise the risk of sediment being tracked onto sealed, public roadways.

6.2.3 Land Clearing

Table 6.9 outlines the general erosion and sediment controls for site management for the DCM.

TABLE 6.9: GENERAL SITE MANAGEMENT EROSION AND SEDIMENT CONTROLS

No.	Control
1	Land clearing (small scale) will be delayed as long as practicable and will be undertaken in conjunction with the development of each stage of works.
2	All reasonable and practicable efforts will be taken to delay the removal of, or disturbance to existing ground cover (organic and inorganic) prior to land disturbing activities.
3	No land clearing will be undertaken unless preceded by the installation of adequate drainage and sediment control measures, unless such clearing is required for the purpose of installing such measures, in which case, only the minimum clearing required to install such measures will occur.
4	Prior to land clearing, all areas of protected vegetation, and significant areas of retained vegetation will be clearly identified (e.g., with high-visibility tape or light fencing) for the purpose of minimising unnecessary land clearing.
5	Avoid where possible scheduling works for months that are expected to have high rainfall.

6.2.4 Soil and Stockpile Management

The diversion of up-slope stormwater around stockpiles will be undertaken during periods where rainfall is possible, and the up-slope catchment area exceeds 1500 m^2 and the average monthly rainfall exceeds 45 mm. Table 6.10 outlines the recommended erosion control measures applied to sand and soil stockpiles.

TABLE 6.10: PROTECTION OF SAND AND SOIL STOCKPILES FROM WIND AND RAINFALL (SOURCE: IECA, 2008)

Material	Stockpile Cover[1]	Comments
Sand	No Cover	• When wind erosion and dust control is not an issue.
	Synthetic cover, porous or not porous	• When control of wind erosion is essential for reasons of safety.
Soil	No cover	• When wind erosion and dust control are not an issue.
	Mulching, vegetative cover, chemical stabilisers, soil binders or impervious blanket[2]	• Long term (>28 days) stockpiling of dispersive soils. • Long-term (>28 days) stockpiles of clayey soils when turbidity control is desirable. • Long term (>5/10 days) soil stockpiles during months of Extreme/High erosion risk as per Section 50. • Short and long term-stockpiles of clayey soils when turbidity control is essential.

[1] Applicable only when displacement of the stockpiled material has the potential to cause environmental harm. The practice of covering stockpiles may need to be modified if theft or damage to covers becomes excessive.
[2] Mulching will be applied at the first opportunity that mulch or hydro mulch can be introduced to the site. Minimum 70% cover is required for both mulch and vegetative covers. Though still desirable, a cover may not be required if runoff from the stockpile is directed to a Type 1 sediment trap.

Table 6.11 outlines the recommended minimum sediment control practices downslope of stockpiles.

TABLE 6.11: SEDIMENT CONTROL PRACTICES DOWNSLOPE OF STOCKPILES (SOURCE: IECA, 2008)

Materials	Sediment Control	Comments
Sand or Gravel	Woven sediment fence or equivalent	• Sediment control is only required if stockpiled material could be displaced and cause safety risks or environmental harm.
Topsoil	Woven sediment fence or equivalent	• If the topsoil is moderately to highly erodible and is likely to release significant clay-rich (turbid) runoff, refer to the recommendations below for subsoil stockpiles
Subsoil	Woven sediment fence or equivalent	• Stockpiles located up-slope of suitably grassed areas that will allow for the infiltration of stormwater runoff for the stockpile (minimum 15 m of flow length), or all runoff is directed to a Type 1 or Type 2 sediment trap.
	Compost berm, filter fence, composite (non-woven) sediment fence, or equivalent	• Stockpiles not located up-slope of a suitable grassed area, or Type 1 or Type 2 sediment trap. • Soil stockpiles located adjacent to permanent drainage channels or waterways.

6.2.5 Drainage and Erosion Controls

Table 6.12 outlines the typical drainage and erosion controls for the DCM.

TABLE 6.12: DRAINAGE AND EROSION CONTROLS

No.	Control
1	Wherever reasonable and practicable, “clean” surface waters must be diverted away from sediment control devices and any untreated, sediment-laden waters.
2	Limit construction equipment activity to disturbed areas. Minimise disturbance and retain as much existing ground cover as practicable. The disturbance boundary is to be clearly delineated with construction fencing or barrier tape or similar.
3	To the maximum degree reasonable and practicable, all waters discharged must discharge in accordance with the EA.

6.2.6 Sediment Controls

Table 6.13 outlines the typical sediment controls for DCM.

TABLE 6.13: SEDIMENT CONTROLS

No.	Control
1	All runoff from the disturbance areas created by the project is to be passed through sediment controls.
2	Sediment traps should be located as close to the source of the sediment as practicable.
3	Sediment removed from any trapping device is to be disposed of in locations where further erosion and consequent pollution to downslope lands and waterways will not occur.
4	Temporary soil and water management structures are to be removed only after the disturbed area is stabilised appropriately in accordance with the requirements of this WMP and IECA 2008.
5	Sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after a sediment-producing event. Sediment traps should be maintained to ensure that no more than 30% of their design capacity is lost to accumulated sediment.
6	Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.
7	Any concrete washout undertaken on site will be in a bunded area that is not within 50 m of a waterway and at least 10 m from site drains.

6.2.7 Dust Suppression

Table 6.14 outlines the typical dust suppression controls for the DCM.

TABLE 6.14: DUST SUPPRESSION CONTROLS

No.	Control
1	Where construction works generate dust, all reasonable and practicable measures are to be undertaken to prevent dust.
2	Areas are to be stripped progressively and only where it is necessary for works to occur.
3	Disturbed areas are to be stabilised as soon as practical.
4	Disturbed areas are to be dampened with a light water spray as required.
5	Vehicle movements are to be restricted to designated access roads.
6	All loads are to be covered when transporting material where practical.

6.2.8 Site Stabilisation

Table 6.15 outlines the typical site stabilisation controls for the DCM.

TABLE 6.15: SITE STABILISATION CONTROLS

No.	Control
1	Disturbed areas are to be stabilised as soon as practicable following the completion of ground disturbing works.
2	All ESC measures shall be maintained in a functioning condition during construction until all construction activities are complete and full stabilisation of the site is achieved (i.e. complete sealing of the whole of the disturbed area with asphalt).

7. CONTINGENCY PLANNING

As indicated in Section 5.3.2.2.1 predicted release frequencies and volumes for the operational DCM are significantly lower than those modelled for the care and maintenance scenario. Modelling indicated that under the care and maintenance scenario up to approximately 460 ML of releases to Gum Creek Tributary would occur and releases would occur for the median water balance result. Releases under the operational scenario are only predicted to occur in 15% of the 123 modelled climate scenarios and the maximum cumulative volume released over the three year operational life of mine is limited to approximately 70 ML. It is considered that the significant reduction in release volume and frequency under the operational scenario will have a significant impact on improving Gum Creek Tributary water quality. Also, remediation of the Release Dam and the ability to dilute controlled releases of surplus water contained in Release Dam with clean water captured in the WMS (i.e. from clean water dams or RWD 1) will further reduce negative impacts on Gum Creek Tributary water quality.

Notwithstanding the anticipated improvements to mine water containment performance and the reduction in impacts to Gum Creek Tributary, contingencies will be established to further mitigate the potential for releases from the WMS and the impact of releases should they occur. Contingency planning at the DCM involves minimising the inventory of water within storages that may contribute to off-site mine water releases prior to the onset of significant rainfall. As detailed in Section 4.2, controlled mine water releases may occur from the RP1 to Gum Creek Tributary during flow events in Gum Creek Tributary and when the water to be released meets the release WQOs (refer to Table 3.4). As detailed in Section 5.3.2.2, the operational water balance predicts that releases will occur during 18% of modelled climate scenarios. To mitigate the risk of releases exceeding the release WQOs and as far as practicable ensure controlled releases can occur in accordance with EA conditions, the following measures will be implemented as required:

- Utilise clean runoff from the clean water dams (CWD1, CWD 2 and CWD 3) and/or RWD 1 and/or the Sediment Dam (if sediment concentrations a suitably low) to dilute the mine affected water to be discharged such that it meets the release WQOs; and/or
- Increase the pH of acidic mine affected water to the within the release WQO range (6.0 to 8.0) to facilitate precipitation of dissolved metals that exceed the release WQOs.
- Any surplus water inventory in the PWD will be transferred to the Overflow Dams prior to the onset of significant rainfall to minimise the volume of any spills from the PWD.
- Any surplus clean water inventory in the CWD 1 and CWD 2 will be transferred to CWD 3 or RWD 1 prior to the onset of significant rainfall to minimise the volume of any spills from the CWD 1 and CWD 2 that drain to the Release Dam and the Sediment Dam (spills to Release Dam) respectively.
- In the unlikely event that release WQOs cannot be achieved and significant forecast rainfall is likely to result in a non-compliant release of water, surplus mine water from the Release Dam and the PWD (if there is no surplus capacity in the Overflow Dams) will be transferred to the Pit.

8. MONITORING

Monitoring and analysis required by this WMP will be undertaken in accordance with the requirements of the administering authority's latest guidelines, unless otherwise agreed by the administering authority in writing. All water quality analysis and tests are to be carried out by an appropriately qualified person and analysed by a laboratory that has NATA accreditation for such analysis and tests.

Surface water and groundwater monitoring locations for the DCM operational WMS are shown in Figure 8.1.

8.1 Surface Water

8.1.1 Water Quality

The surface water quality monitoring locations and frequency of monitoring are presented in Table 8.1. Table 8.2 presents the analytes to be tested for during routine water quality monitoring.

TABLE 8.1: SURFACE WATER MONITORING PROGRAM

Monitoring Location	Frequency (targeted)
Site Water	
S1 (RWD 1)	Quarterly
S3 (RWD 2) Note: Monitoring at this location will cease when RWD2 is decommissioned as part of construction for the recommencement of mining and ore processing.	
S6 (Release Dam)	
S9 (Seepage Collection Well) Note: Monitoring at this location will cease when Seepage Collection Well is decommissioned as part of construction for the recommencement of mining and ore processing.	
S14 (Process Water Dam)	
S15 (Sediment Dam)	Quarterly
S16 (CWD 1)	As required prior to use of water from CWDs for dilution of controlled releases (to determine required blend ratio of clean water and mine affected water in Release Dam).
S17 (CWD 2)	
S18 (CWD 3)	
RP1 (Release Point 1)	Within 12 hours of a stream flow event commencing and daily during flow events with a duration of greater than 24 hours for one week, then weekly thereafter until the flow event ceases (when site and monitoring location safely accessible).

Monitoring Location	Frequency (targeted)
Receiving Water	
S7 (Gum Creek Tributary Upstream)	Within 12 hours of a stream flow event commencing and daily during flow events with a duration of greater than 24 hours for one week, then weekly thereafter until the flow event ceases (when site and monitoring locations are safely accessible).
S13 (Gum Creek Tributary Upstream)	
S11 (Gum Creek Tributary Downstream)	
S12 (Gum Creek Tributary Downstream)	

TABLE 8.2: SURFACE WATER QUALITY PARAMETERS

Parameter[1]	Units	Required Limit of Reporting
General Parameters		
pH	-	0.1
Electrical Conductivity (EC)	µS/cm	5
Dissolved Oxygen (DO)	% saturation	1
Total Suspended Solids (TSS)	mg/L	5
Sulfate	mg/L	1
Fluoride	mg/L	0.1
Major Anions (Calcium, Magnesium, Potassium, Sodium, Chloride, Carbonate, Bicarbonate)	mg/L	1
Total Hardness	mg/L	1
Total Organic Carbon	%	0.01
Total Petroleum Hydrocarbons	-[1]	-[1]
Metals/Metalloids (analyse for both total and dissolved concentrations)		
Aluminium	mg/L	0.01
Arsenic	mg/L	0.001
Boron	mg/L	0.05
Cadmium	mg/L	0.0001
Chromium	mg/L	0.001
Copper	mg/L	0.001

Parameter[1]	Units	Required Limit of Reporting
Lead	mg/L	0.001
Manganese	mg/L	0.001
Mercury (inorganic)	mg/L	0.00005
Nickel	mg/L	0.001
Selenium	mg/L	0.01
Silver	mg/L	0.00005
Zinc	mg/L	0.001

[1] Total Petroleum Hydrocarbons to be assessed based on detectable film or odour (i.e. no quantitative analysis required)

8.1.2 Water Quantity

Table 8.3 presents the surface water quantity monitoring program.

TABLE 8.3: SURFACE WATER QUANTITY MONITORING

Monitoring Location	Parameter	Methodology	Frequency (targeted)
RWD1	Freeboard and Inventory	Survey water level and spillway elevation. Survey water elevation and stage storage relationship (water elevation vs volume)	Annually prior to the wet season
RWD 2 Note: Monitoring at this location will cease when RWD 2 is decommissioned as part of construction for the recommencement of mining and ore processing.	Freeboard	Survey water level and spillway elevation.	Annually prior to the wet season
Release Dam	Volume	Water level sensor calibrated to stage storage relationship (water elevation vs volume)	Continuous during transfer
Sediment Dam	Water Volume Sediment Volume	Fixed staff gauge and stage storage relationship (water elevation vs volume)	Monthly and prior to forecast rainfall >20 mm and following runoff generating rainfall.
PWD	Volume	Water level sensor calibrated to stage storage relationship (water elevation vs volume)	Continuous during transfer
Agglomeration Sump Pump (transfer to Overflow Dams)	Volume	Calculation - pump run time and rated flow	Daily during transfers
Overflow Dams Pump (reuse and transfer to Release Dam)	Volume	Flow Meter	Continuous during transfer
RWD1 Pump (transfers to process water tanks and for dilution)	Volume	Flow Meter	Continuous during transfer
CWD Pump (transfers to process water tanks and for dilution)	Volume	Calculation - pump run time and rated flow	Daily during transfers
PWD Spillway	Volume	Water level sensor and flow rating curve	Continuous during discharge
Release Point 1	Volume	Water level sensor and flow rating curve	Continuous during discharge
S11 (Gum Creek Tributary)	Volume	Water level sensor and flow rating curve	Continuous during flow events

Should a release occur, DCM will:

(a) record the date and time for both the commencement and cessation of the release event; and

(b) determine and record the total daily volume of contaminated waters released via RP1; and

(c) determine and record receiving waters background flow (m^3/hour) at S11 for the duration of the release event; and

(d) if requested by the administering authority, provide this information to the administering authority within 24 hours of any request.

8.2 Groundwater

8.2.1 Groundwater Quality

Groundwater quality is monitored at the three locations monitoring bores (GW01, GW03 and GW04) indicated on Figure 3.3 on a quarterly basis. The water quality parameters at the groundwater monitoring locations are presented in Table 8.4.

TABLE 8.4: GROUNDWATER QUALITY PARAMETERS

Parameter	Units	Required Limit of Reporting
General Parameters		
pH	-	0.1
EC	µS/cm	5
TSS	mg/L	5
Sulfate	mg/L	1
Fluoride	mg/L	0.1
Dissolved Metals		
Aluminium	mg/L	0.01
Arsenic	mg/L	0.001
Boron	mg/L	0.05
Cadmium	mg/L	0.0001
Chromium	mg/L	0.001
Copper	mg/L	0.001
Lead	mg/L	0.001
Manganese	mg/L	0.001
Mercury (inorganic)	mg/L	0.00005
Nickel	mg/L	0.001
Selenium (total)	mg/L	0.01
Silver	mg/L	0.00005
Zinc	mg/L	0.001

8.2.2 Groundwater Level

Groundwater levels are monitored continuously with level loggers at the three locations monitoring bores (GW01, GW03 and GW04) indicated on Figure 8.1. Level logger data is downloaded and reviewed on a quarterly basis with a manual level measurement undertaken at the same time.

234000 234500 235000 235500

8219000 8218500 8218000

Legend

- Surface Water Monitoring Location
- Groundwater Monitoring Bore
- Watercourse
- Dianne Copper Mine Lease Boundary
- Clean Drain
- Dirty Drain
- Mine Water Drain

Water Storage

- Clean Water Storage
- Mine Water Storage
- Dirty Water Storage

GW01
Pit
S17
PWD
S18
S14
S14
S15
S16
S6
RP1
S9
S11
GW03
GW04
S1
S7
S13

Dianne Copper Mine WMP

Figure 8.1
Operational Water Monitoring Locations

REV.	DETAILS	DATE
A	Client Issue	30/04/2024

DRG REF. NC1017-001-SKE-103-A

DRAWN: AW | CHECKED: CB

APPROVED: SL | DATE: 30/04/2024

GENERAL NOTES:
1. Aerial imagery courtesy of Google Maps.
2. Open source datasets provided by QSpatial.
3. Project layout layers provided by client.
4. All dimensions are displayed in metres unless specified otherwise.
5. Surface water monitoring locations digitised from Umwelt figure.

0 50 100 150 200 m

CRS: GDA2020 / MGA zone 55 (EPSG:7855)

REVOLVER RESOURCES

ENGENY

\\online.com\files\NCManagement\Projects\NC1017 Mineral Projects Pty Ltd\NC1017_001 Dianne Copper Mine WMP\05 Design\QGIS\Workspaces\NC1017_001-Dianne_Cu_WMS_Working_V1_AW.qgz

9. REPORTING & RECORD KEEPING

9.1 Reporting

9.1.1 Notification of Emergencies, Incidents and Exceptions

If monitoring results indicate an exceedance of any water quality objectives (refer to Table 3.3), Mineral Projects will notify the administering authority by written notification within 24 hours after becoming aware of an emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of the EA.

Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, DCM will provide further written advice to the administering authority that will include, but not necessarily be limited:

(a) results and interpretation of any samples taken and analysed;

(b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm;

(c) proposed actions to prevent a recurrence of the emergency or incident.

9.1.2 Investigation

Monitoring results indicate an exceedance of any quality objectives specified in a condition of this environmental authority, Mineral Projects will notify the administering authority in accordance with Section 9.1.1 and:

(a) complete an investigation to identify the potential cause of the exceedance

(b) if the investigation demonstrates that the exceedance is not attributable to the mining activities, then no further action is required; or

(c) if the cause of the exceedance is inconclusive or attributable to the mining activities, provide a written report to the administering authority within 3 months of the date of receiving the monitoring results showing an exceedance, outlining:

- all pertinent details of the investigation carried out; and
- actions taken or planned to minimise environmental harm.

9.2 Record Keeping

Monitoring records, reports and other site data generated as a requirement of this authority must be kept for a period of not less than 5 years.

10. PLAN REVIEW

This WMP will be reviewed and updated as required based on the following events:

- Following completion of detailed DCM WMS design for the recommencement of mining and ore processing.
- Prior to September each year.
- Following water management related incidents.
- Following material changes to the DCM WMS and/or operations that impact site water management.

11. WMP IMPLEMENTATION

Environmental management at the DCM is the responsibility of all employees with the Mineral Projects directors having overall responsibility for environmental management of the operations. Roles and responsibilities for implementation of this WMP for all personnel are outlined in Table 11.1.

TABLE 11.1: ROLES AND RESPONSIBILITIES

Role	Responsibility
Mineral Projects Directors	• Provide sufficient resources for the implementation of this plan. • Be aware of the environmental legislative requirements associated with the DCM and take measures to ensure compliance. • Ensure employees are competent through training and awareness programs. • Evaluate and report monitoring results as required by the EA. • Provide primary contact for complaints and supply follow-up information to any complainant. • Initiate investigations of complaints as received from the public or government agency. • Coordinate water related incident investigations and reporting as required by legislation. • Facilitate the preparation of a report to government agencies following incidents/non-compliances.
Mine Site Senior Executive (SSE)	• Undertake the surface water monitoring program described in this plan. • Maintain records of monitoring results as required by the EA. • Assist with water related incident investigations and reporting as required.
All Employees and Contractors	• Comply with all requirements in this plan. • Report all potential environmental incidents to the Mineral Projects Directors and/or Mine SSE immediately. • Operate in a manner that minimises risks of incidents to themselves, fellow workers, or the surrounding environment. • Follow any instructions provided by the Mineral Projects Directors or Mine SSE.

12. REFERENCES

Dianne Copper Mine Waste Rock Management Plan, Mineral Projects and Tableland Resources, 2021

Preparation of water management plans for mining activities guideline, Department of Environment and Heritage Protection, 2012

Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Conservation Council, 2000

Dianne Copper Mine Receiving Environment Monitoring Programme (REMP) Design Document, C&R Consulting, 2021A

Dianne Copper Mine REMP Assessment Report, C&R Consulting, 2021B

Dianne Copper Mine REMP Assessment Report, C&R Consulting, 2022C

Dianne Copper Mine REMP Assessment Report, C&R Consulting, 2023D

Dianne Copper Mine Progressive Rehabilitation and Closure Plan (PRCP) Hydrogeology (DRAFT), C&R Consulting 2022E

Groundwater Resources of the Cape York Peninsula, Horn et al., 1995

Rainfall-runoff modelling across northern Australia, CSIRO, 2009

Best Practice in Erosion and Sediment Control, International Erosion Control Association (Australasia), 2008

13. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

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(g) This Report does not provide legal advice.

APPENDIX A: WATER QUALITY DATA

Gum Creek Tributary - Dissolved Metals and Metalloids

Location/Type	Site	Parameter	Units	LOR	WQO	# Results	#>WQO	Minimum	20th %ile	Median	80th %ile	Maximum	Average	Jun-20	Jul-20	Aug-20	Mar-21	May-21	Oct-21	Mar-22	May-22	Jun-22	Jul-22	Oct-22	Apr-23	Oct-23
Upstream/	S7	Aluminium	mg/L	0.01	0.055	8	4	0.006	0.008	0.034	0.126	1.100	0.180	0.057			0.120	0.010		1.100	0.010	0.007	0.006		0.130	
Reference		Arsenic	mg/L	0.001	0.013	8	0	0.001	0.001	0.001	0.003	0.003	0.002	0.003			0.003	0.001		0.003	0.001	0.001	0.001		0.001	
		Boron	mg/L	0.05	0.37	5	0	0.005	0.005	0.006	0.050	0.050	0.023							0.006	0.05	0.005	0.005		0.05	
		Cadmium	mg/L	0.0001	0.0002	8	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001			0.0001	0.0001		0.0001	0.0001	0.0001	0.0001		0.0001	
		Chromium	mg/L	0.001	0.001	8	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001			0.001	0.001		0.001	0.001	0.001	0.001		0.001	
		Copper	mg/L	0.001	0.0014	8	6	0.001	0.002	0.005	0.006	0.033	0.007	0.001			0.001	0.003		0.033	0.005	0.005	0.007		0.004	
		Iron	mg/L	0.05	-																0.05				0.25	
		Lead	mg/L	0.001	0.0034	8	0	0.001	0.001	0.001	0.001	0.002	0.001	0.001			0.001	0.002		0.001	0.001	0.001	0.001		0.001	
		Manganese	mg/L	0.001	1.9	8	0	0.001	0.003	0.005	0.005	0.010	0.005	0.005			0.005	0.002		0.005	0.001	0.005	0.005		0.01	
		Mercury (inorganic)	mg/L	0.0001	0.00006	8	3	0.00005	0.00005	0.00005	0.00010	0.00010	0.00007	0.00005			0.00005	0.0001		0.00005	0.0001	0.00005	0.00005		0.0001	
		Nickel	mg/L	0.001	0.011	8	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001			0.001	0.001		0.001	0.001	0.001	0.001		0.001	
		Selenium (total)	mg/L	0.01	0.005	5	2	0.001	0.001	0.002	0.010	0.010	0.005							0.002	0.01	0.001	0.001		0.01	
		Silver	mg/L	0.001	0.000053	5	4	0.00005	0.00081	0.00100	0.00100	0.00100	0.00081							0.001	0.001	0.001	0.00005		0.001	
		Zinc	mg/L	0.006	0.0083	8	1	0.005	0.005	0.005	0.005	0.011	0.006	0.005			0.011	0.005		0.005	0.005	0.005	0.005		0.005	
	S13	Aluminium	mg/L	0.01	0.055	6	3	0.010	0.010	0.036	0.400	0.700	0.199					0.010		0.700	0.010		0.011	0.400	0.060	
		Arsenic	mg/L	0.001	0.013	6	0	0.001	0.002	0.002	0.003	0.004	0.002					0.002		0.003	0.002		0.001	0.004	0.002	
		Boron	mg/L	0.05	0.37	5	0	0.005	0.006	0.050	0.050	0.050	0.032							0.006	0.05		0.005	0.05	0.05	
		Cadmium	mg/L	0.0001	0.0002	6	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001					0.0001		0.0001	0.0001		0.0001	0.0001	0.0001	
		Chromium	mg/L	0.001	0.001	6	0	0.001	0.001	0.001	0.001	0.001	0.001					0.001		0.001	0.001		0.001	0.001	0.001	
		Copper	mg/L	0.001	0.0014	6	6	0.003	0.004	0.005	0.015	0.062	0.016					0.003		0.015	0.004		0.006	0.062	0.004	
		Iron	mg/L	0.05	-																0.13			0.93	0.16	
		Lead	mg/L	0.001	0.0034	6	0	0.001	0.001	0.001	0.001	0.003	0.001					0.001		0.001	0.001		0.001	0.003	0.001	
		Manganese	mg/L	0.001	1.9	6	0	0.001	0.005	0.010	0.030	0.279	0.056					0.005		0.001	0.03		0.005	0.279	0.014	
		Mercury (inorganic)	mg/L	0.0001	0.00006	6	4	0.00005	0.00005	0.00010	0.00010	0.00010	0.00008					0.0001		0.00005	0.0001		0.00005	0.0001	0.0001	
		Nickel	mg/L	0.001	0.011	6	0	0.001	0.001	0.001	0.001	0.002	0.001					0.001		0.001	0.001		0.001	0.002	0.001	
		Selenium (total)	mg/L	0.01	0.005	5	3	0.001	0.002	0.010	0.010	0.010	0.007							0.002	0.01		0.001	0.01	0.01	
		Silver	mg/L	0.001	0.000053	5	4	0.00005	0.00081	0.00100	0.00100	0.00100	0.00081							0.001	0.001		0.00005	0.001	0.001	
		Zinc	mg/L	0.006	0.0083	6	0	0.005	0.005	0.005	0.005	0.005	0.005					0.005		0.005	0.005		0.005	0.005	0.005	
Downstream/	S11	Aluminium	mg/L	0.01	0.055	7	2	0.007	0.009	0.010	0.104	0.710	0.130				0.041	0.010		0.710	0.010	0.007	0.009		0.120	
Receiving		Arsenic	mg/L	0.001	0.013	7	0	0.001	0.001	0.001	0.003	0.003	0.002				0.003	0.001		0.003	0.001	0.001	0.001		0.001	
		Boron	mg/L	0.05	0.37	5	0	0.005	0.007	0.007	0.050	0.050	0.024							0.007	0.05	0.005	0.007		0.05	
		Cadmium	mg/L	0.0001	0.0002	7	2	0.0001	0.0002	0.0002	0.0003	0.0010	0.0003				0.0002	0.0002		0.0003	0.0002	0.0002	0.0001		0.001	
		Chromium	mg/L	0.001	0.001	7	0	0.001	0.001	0.001	0.001	0.001	0.001				0.001	0.001		0.001	0.001	0.001	0.001		0.001	
		Copper	mg/L	0.001	0.0014	7	7	0.011	0.016	0.022	0.105	0.273	0.073				0.011	0.046		0.12	0.022	0.021	0.015		0.273	
		Iron	mg/L	0.05	-																0.05				0.15	
		Lead	mg/L	0.001	0.0034	7	0	0.001	0.001	0.001	0.001	0.001	0.001				0.001	0.001		0.001	0.001	0.001	0.001		0.001	
		Manganese	mg/L	0.001	1.9	7	0	0.005	0.005	0.020	0.036	0.046	0.020				0.005	0.02		0.039	0.023	0.005	0.005		0.046	
		Mercury (inorganic)	mg/L	0.0001	0.00006	7	3	0.00005	0.00005	0.00005	0.00010	0.00010	0.00007				0.00005	0.0001		0.00005	0.0001	0.00005	0.00005		0.0001	
		Nickel	mg/L	0.001	0.011	7	0	0.001	0.001	0.001	0.001	0.002	0.001				0.001	0.001		0.001	0.001	0.001	0.001		0.002	
		Selenium (total)	mg/L	0.01	0.005	5	2	0.001	0.001	0.002	0.010	0.010	0.005							0.002	0.01	0.001	0.001		0.01	
		Silver	mg/L	0.001	0.000053	5	3	0.00005	0.00005	0.00100	0.00100	0.00100	0.00062							0.001	0.001	0.00005	0.00005		0.001	
		Zinc	mg/L	0.006	0.0083	7	7	0.011	0.013	0.022	0.037	0.129	0.037				0.022	0.031		0.039	0.017	0.012	0.011		0.129	
	S12	Aluminium	mg/L	0.01	0.055	11	2	0.006	0.008	0.009	0.010	0.660	0.079	0.008	0.008	0.006	0.008	0.010		0.660	0.010	0.009	0.006	0.010	0.130	
		Arsenic	mg/L	0.001	0.013	11	0	0.001	0.001	0.001	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.001		0.003	0.001	0.001	0.001	0.001	0.001	
		Boron	mg/L	0.05	0.37	6	0	0.005	0.005	0.029	0.050	0.050	0.028							0.007	0.05	0.005	0.005	0.05	0.05	
		Cadmium	mg/L	0.0001	0.0002	11	7	0.0001	0.0001	0.0003	0.0008	0.0010	0.0005	0.0008	0.0007	0.0009	0.0003	0.0002		0.0003	0.0001	0.0001	0.0001	0.0005	0.001	
		Chromium	mg/L	0.001	0.001	11	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		0.001	0.001	0.001	0.001	0.001	0.001	
		Copper	mg/L	0.001	0.0014	11	11	0.022	0.031	0.053	0.130	0.281	0.086	0.053	0.066	0.083	0.031	0.037		0.13	0.038	0.022	0.025	0.182	0.281	
		Iron	mg/L	0.05	-																0.05			0.05	0.14	
		Lead	mg/L	0.001	0.0034	11	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		0.001	0.001	0.001	0.001	0.001	0.001	
		Manganese	mg/L	0.001	1.9	11	0	0.001	0.001	0.011	0.046	0.342	0.051	0.021	0.038	0.046	0.011	0.007		0.001	0.001	0.001	0.005	0.342	0.093	
		Mercury (inorganic)	mg/L	0.0001	0.00006	11	4	0.00005	0.00005	0.00005	0.00010	0.00010	0.00007	0.00005	0.00005	0.00005	0.00005	0.0001		0.00005	0.0001	0.00005	0.00005	0.0001	0.0001	
		Nickel	mg/L	0.001	0.011	11	0	0.001	0.001	0.001	0.002	0.003	0.002	0.002	0.002	0.002	0.001	0.001		0.001	0.001	0.001	0.001	0.003	0.002	
		Selenium (total)	mg/L	0.01	0.005	6	3	0.001	0.001	0.006	0.010	0.010	0.006							0.002	0.01	0.001	0.001	0.01	0.01	
		Silver	mg/L	0.001	0.000053	6	4	0.00005	0.00005	0.00100	0.00100	0.00100	0.00068							0.001	0.001	0.00005	0.00005	0.001	0.001	
		Zinc	mg/L	0.006	0.0083	11	8	0.005	0.006	0.041	0.120	0.136	0.059	0.12	0.12	0.13	0.041	0.014		0.041	0.006	0.006	0.005	0.033	0.136	

Notes

Results recorded below the limit of reporting (LOR) have been assigned a value equal to 50% of the LOR

LOR>WQO

Gum Creek Tributary - General Parameters

Location/Type	Site	Parameter	Units	LOR	WQO	# Results	#>WQO	Minimum	20th %ile	Median	80th %ile	Maximum	Average	Jun-20	Jul-20	Aug-20	Mar-21	May-21	Oct-21	Mar-22	May-22	Jun-22	Jul-22	Oct-22	Apr-23	Oct-23
Upstream/	S7	pH	-	0.01	6.0-8.0	7	0	7.2	7.3	7.5	8.0	8.2	7.6	8.2			7.3	8.1		7.2		7.5	7.4		7.79	
Reference		Electrical Conductivity (EC)	µS/cm	1	125	7	6	92	188	250	388	487	272	420			180	487		92		250	220		258	
		Total Dissolved Solids	mg/L	10	-																				142	
		Dissolved Oxygen (DO)	%sat	?	-	1	0	71.3	71.3	71.3	71.3	71.3	71.3					71.3								
		Total Suspended Solids (TSS)	mg/L	5	TBD	6	0	5	5	8	16	55	16.16667	11			5			55		16	5		5	
		Turbidity	mg/L	?	-	1	0	1.09	1.09	1.09	1.09	1.09	1.09					1.09								
		Hydroxide Alkalinity	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Carbonate Alkalinity	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Bicarbonate Alkilinity	mg/L	1	-	1	0	123	123	123	123	123	123												123	
		Total Alkalinity	mg/L	1	-	1	0	123	123	123	123	123	123												123	
		Sulfate	mg/L	1	770	5	0	0.6	0.92	1	2.74	2.9	1.64	0.6			2.7	1		2.9					1	
		Fluoride	mg/L	0.1	TBD	7	0	0.1	0.1	0.1	0.2	0.3	0.157143	0.2			0.1	0.3		0.1		0.1	0.1		0.2	
		Choride	mg/L	1	-	1	0	7	7	7	7	7	7												7	
		Calcium	mg/L	1	-	1	0	14	14	14	14	14	14												14	
		Magnesium	mg/L	1	-	2	0	11	21	36	51	61	36					61							11	
		Sodium	mg/L	1	-	1	0	27	27	27	27	27	27												27	
		Potassium	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Total Hardness	mg/L	1	-	1	0	80	80	80	80	80	80												80	
	S13	pH	-	0.01	6.0-8.0	4	0	7.0	7.6	8.0	8.3	8.5	7.9					8.5					8.1	7	7.98	
		Electrical Conductivity (EC)	µS/cm	1	125	4	4	150	306	515	657	713	473					713					620	150	410	
		Total Dissolved Solids	mg/L	10																				135	224	
		Dissolved Oxygen (DO)	%sat	?	-	1	0	121.4	121.4	121.4	121.4	121.4	121.4					121.4								
		Total Suspended Solids (TSS)	mg/L	5	TBD	3	0	5	5	5	47	75	28.33333										5	75	5	
		Turbidity	mg/L	?	-	1	0	1.83	1.83	1.83	1.83	1.83	1.83					1.83								
		Hydroxide Alkalinity	mg/L	1	-	2	0	1	1	1	1	1	1											1	1	
		Carbonate Alkalinity	mg/L	1	-	2	0	1	1	1	1	1	1											1	1	
		Bicarbonate Alkilinity	mg/L	1	-	2	0	67	95.4	138	180.6	209	138											67	209	
		Total Alkalinity	mg/L	1	-	2	0	67	95.4	138	180.6	209	138											67	209	
		Sulfate	mg/L	1	770	3	0	1	1	1	2	2	1					2						1	1	
		Fluoride	mg/L	0.1	TBD	4	0	0.1	0.2	0.3	0.4	0.5	0.3					0.5					0.2	0.1	0.4	
		Choride	mg/L	1	-	2	0	5	6	8	9	10	8											5	10	
		Calcium	mg/L	1	-	2	0	12	15	19	23	26	19											12	26	
		Magnesium	mg/L	1	-	2	0	7	9	13	16	18	13											7	18	
		Sodium	mg/L	1	-	3	0	9	23	43	69	86	46					86						9	43	
		Potassium	mg/L	1	-	2	0	1	2	3	4	5	3											5	1	
		Total Hardness	mg/L	1	-	2	0	59	75	99	123	139	99											59	139	
Downstream/	S11	pH	-	0.01	6.0-8.0	6	0	6.8	6.9	7.1	7.3	7.6	7.1				7.3	7.6		7.1		6.9	6.8		7.19	
Receiving		Electrical Conductivity (EC)	µS/cm	1	125	6	5	110	200	323	380	382	286				200	382		110		350	380		295	
		Total Dissolved Solids	mg/L	10																					170	
		Dissolved Oxygen (DO)	%sat	?	-	1	0	93.3	93.3	93.3	93.3	93.3	93.3					93.3								
		Total Suspended Solids (TSS)	mg/L	5	TBD	5	0	5	5	5	14	50	14				5			50		5	5		5	
		Turbidity	mg/L	?	-	1	0	1.58	1.58	1.58	1.58	1.58	1.58					1.58								
		Hydroxide Alkalinity	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Carbonate Alkalinity	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Bicarbonate Alkilinity	mg/L	1	-	1	0	87	87	87	87	87	87												87	
		Total Alkalinity	mg/L	1	-	1	0	87	87	87	87	87	87												87	
		Sulfate	mg/L	1	770	3	0	4	21	46	50	53	34				4.1	46							53	
		Fluoride	mg/L	0.1	TBD	6	0	0.1	0.1	0.2	0.2	0.4	0.2				0.1	0.2		0.1		0.1	0.4		0.2	
		Choride	mg/L	1	-	1	0	7	7	7	7	7	7												7	
		Calcium	mg/L	1	-	1	0	17	17	17	17	17	17												17	
		Magnesium	mg/L	1	-	1	0	11	11	11	11	11	11												11	
		Sodium	mg/L	1	-	2	0	27	31	37	43	47	37					47							27	
		Potassium	mg/L	1	-	1	0	1	1	1	1	1	1												1	
		Total Hardness	mg/L	1	-	1	0	88	88	88	88	88	88												88	
	S12	pH	-	0.01	6.0-8.0	9	0	7	7	7	8	8	7	6.8	6.6	6.6	7.5	8				7.8	7.4	6.91	7.74	
		Electrical Conductivity (EC)	µS/cm	1	125	9	9	270	305	360	436	495	367	360	400	490	270	364				320	290	495	315	
		Total Dissolved Solids	mg/L	10																				317	184	
		Dissolved Oxygen (DO)	%sat	?	-	1	0	110.8	110.8	110.8	110.8	110.8	110.8					110.8								
		Total Suspended Solids (TSS)	mg/L	5	TBD	8	0	5	5	5	5	5	5	5	5	5	5					5	5	5	5	
		Turbidity	mg/L	?	-	1	0	1.39	1.39	1.39	1.39	1.39	1.39					1.39								
		Hydroxide Alkalinity	mg/L	1	-	2	0	1	1	1	1	1	1											1	1	
		Carbonate Alkalinity	mg/L	1	-	2	0	1	1	1	1	1	1											1	1	
		Bicarbonate Alkilinity	mg/L	1	-	2	0	49	60	76	92	103	76											49	103	
		Total Alkalinity	mg/L	1	-	2	0	49	60	76	92	103	76											49	103	
		Sulfate	mg/L	1	770	7	0	36	48	140	156	190	110	140	150	190	36	50						158	47	
		Fluoride	mg/L	0.1	TBD	9	0	0.1	0.1	0.2	0.2	0.4	0.2	0.1	0.1	0.1	0.2	0.2				0.2	0.4	0.1	0.2	
		Choride	mg/L	1	-	2	0	7	8	10	11	12	10											12	7	
		Calcium	mg/L	1	-	2	0	19	21	25	29	31	25											31	19	
		Magnesium	mg/L	1	-	2	0	12	14	16	18	20	16											20	12	
		Sodium	mg/L	1	-	3	0	30	33	38	40	41	36					38						41	30	
		Potassium	mg/L	1	-	2	0	1	2	3	3	4	3											4	1	
		Total Hardness	mg/L	1	-	2	0	97	110	129	147	160	129											160	97	

Notes

Results recorded below the limit of reporting (LOR) have been assigned a value equal to 50% of the LOR

TBD - To Be Determined based on 80th percentile of reference site concentration

Gum Creek Tributary - Nutrients

Location	Site	Parameter	Units	LOR	WQO	# Results	#>WQO	Minimum	20th %ile	Median	80th %ile	Maximum	Average	Jun-20	Jul-20	Aug-20	Mar-21	May-21	Oct-21	May-22	Oct-22	Apr-23	Oct-23
Upstream	S7	Ammonia	mg/L	0.01	0.9	2	0	0.02	0.02	0.02	0.02	0.02	0.02					0.02				0.02	
		Nitrite	mg/L	0.01	-	1	0	0.01	0.01	0.01	0.01	0.01	0.01									0.01	
		Nitrate	mg/L	0.01	1.1	2	0	0.01	0.01	0.01	0.01	0.01	0.01					0.01				0.01	
		NOx	mg/L	0.01	-	1	0	0.01	0.01	0.01	0.01	0.01	0.01									0.01	
		Total Kjeldahl Nitrogen	mg/L	0.1	-	1	0	0.6	0.6	0.6	0.6	0.6	0.6									0.6	
		Total Nitrogen	mg/L	0.1	1.1	2	0	0.3	0.4	0.5	0.5	0.6	0.5					0.3				0.6	
		Total Phosphorus	mg/L	0.01	0.01	2	1	0.01	0.01	0.02	0.02	0.02	0.02					0.01				0.02	
		Total Reactive Phosphorus	mg/L	0.01	0.05	1	0	0.010	0.010	0.010	0.010	0.010	0.010									0.01	
	S13	Ammonia	mg/L	0.01	0.9	3	0	0.03	0.04	0.05	0.06	0.06	0.05					0.03			0.06	0.05	
		Nitrite	mg/L	0.01	-	2	0	0.01	0.01	0.01	0.01	0.01	0.01								0.01	0.01	
		Nitrate	mg/L	0.01	1.1	3	0	0.01	0.01	0.01	0.01	0.01	0.01					0.01			0.01	0.01	
		NOx	mg/L	0.01	-	2	0	0.01	0.01	0.01	0.01	0.01	0.01								0.01	0.01	
		Total Kjeldahl Nitrogen	mg/L	0.1	-	2	0	0.3	0.5	0.9	1.2	1.4	0.9								1.4	0.3	
		Total Nitrogen	mg/L	0.1	1.1	3	1	0.0	0.1	0.3	1.0	1.4	0.6					0.03			1.4	0.3	
		Total Phosphorus	mg/L	0.01	0.01	3	2	0.01	0.01	0.02	0.29	0.47	0.17					0.01			0.47	0.02	
		Total Reactive Phosphorus	mg/L	0.01	0.05	2	1	0.010	0.022	0.040	0.058	0.070	0.040								0.07	0.01	
Downstream	S11	Ammonia	mg/L	0.01	0.9	2	0	0.01	0.02	0.03	0.03	0.04	0.03					0.01				0.04	
		Nitrite	mg/L	0.01	-	1	0	0.01	0.01	0.01	0.01	0.01	0.01									0.01	
		Nitrate	mg/L	0.01	1.1	2	0	0.01	0.01	0.01	0.01	0.01	0.01					0.01				0.01	
		NOx	mg/L	0.01	-	1	0	0.01	0.01	0.01	0.01	0.01	0.01									0.01	
		Total Kjeldahl Nitrogen	mg/L	0.1	-	1	0	0.2	0.2	0.2	0.2	0.2	0.2									0.2	
		Total Nitrogen	mg/L	0.1	1.1	2	0	0.2	0.2	0.2	0.2	0.2	0.2					0.2				0.2	
		Total Phosphorus	mg/L	0.01	0.01	2	1	0.01	0.01	0.02	0.02	0.02	0.02					0.01				0.02	
		Total Reactive Phosphorus	mg/L	0.01	0.05	1	0	0.010	0.010	0.010	0.010	0.010	0.010									0.01	
	S13	Ammonia	mg/L	0.01	0.9	3	0	0.02	0.04	0.08	0.09	0.09	0.06					0.02			0.08	0.09	
		Nitrite	mg/L	0.01	-	2	0	0.01	0.02	0.03	0.04	0.05	0.03								0.05	0.01	
		Nitrate	mg/L	0.01	1.1	3	0	0.01	0.01	0.01	0.12	0.20	0.07					0.01			0.2	0.01	
		NOx	mg/L	0.01	-	2	0	0.01	0.06	0.13	0.20	0.25	0.13								0.25	0.01	
		Total Kjeldahl Nitrogen	mg/L	0.1	-	2	0	0.2	0.5	1.0	1.4	1.7	1.0								1.7	0.2	
		Total Nitrogen	mg/L	0.1	1.1	3	1	0.2	0.2	0.3	1.3	2.0	0.8					0.3			2	0.2	
		Total Phosphorus	mg/L	0.01	0.01	3	2	0.01	0.01	0.02	0.06	0.09	0.04					0.01			0.09	0.02	
		Total Reactive Phosphorus	mg/L	0.01	0.05	2	0	0.010	0.010	0.010	0.010	0.010	0.010								0.01	0.01	

Notes

Results recorded below the limit of reporting (LOR) have been assigned a value equal to 50% of the LOR

Site Water - Dissolved Metals and Metalloids

Location/Type	Site	Parameter	Units	LOR	# Results	#>WQO	Minimum	20th %ile	Median	80th %ile	Maximum	Average	Jan-20	Mar-20	Aug-20	Oct-20	Nov-20	Mar-21	Jul-21	Nov-21	Mar-22	May-22	Jun-22	Jul-22	Oct-22	Apr-23	Oct-23
Raw Water Dams (Clean Water)	S1 (RWD 1)	Aluminium	mg/L	0.01	10	0	0.005	0.005	0.007	0.015	0.027	0.011	0.027	0.024	0.005	0.005	0.005	0.013	0.013		0.009		0.005	0.005			
		Arsenic	mg/L	0.001	10	0	0.0010	0.0026	0.0030	0.0030	0.0040	0.0027	0.004	0.003	0.003	0.003	0.003	0.003	0.003		0.003		0.001	0.001			
		Boron	mg/L	0.05	10	0	0.005	0.0066	0.0095	0.019	0.039	0.0135	0.039	0.009	0.005	0.018	0.023	0.009	0.007		0.01		0.005	0.01			
		Cadmium	mg/L	0.0001	10	0	0.0001	0.0001	0.0001	0.0001	0.0002	0.00011	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001		0.0001		0.0001	0.0001			
		Chromium	mg/L	0.001	10	0	0.0005	0.001	0.001	0.001	0.001	0.00095	0.001	0.001	0.001	0.001	0.0005	0.001	0.001		0.001		0.001	0.001			
		Copper	mg/L	0.001	10	6	0.001	0.001	0.002	0.005	0.007	0.0028	0.007	0.005	0.003	0.002	0.002	0.005	0.001		0.001		0.001	0.001			
		Iron	mg/L	0.05																							
		Lead	mg/L	0.001	10	0	0.001	0.001	0.001	0.001	0.002	0.0011	0.001	0.001	0.001	0.001	0.002	0.001	0.001		0.001		0.001	0.001			
		Manganese	mg/L	0.001	10	0	0.005	0.005	0.005	0.005	0.06	0.0105	0.06	0.005	0.005	0.005	0.005	0.005	0.005		0.005		0.005	0.005			
		Mercury (inorganic)	mg/L	0.0001	10	0	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005		0.00005		0.00005	0.00005			
		Nickel	mg/L	0.001	10	0	0.001	0.001	0.001	0.0012	0.002	0.0012	0.001	0.001	0.001	0.001	0.002	0.002	0.001		0.001		0.001	0.001			
		Selenium (total)	mg/L	0.01	10	0	0.001	0.0018	0.002	0.002	0.002	0.0018	0.002	0.002	0.002	0.002	0.002	0.002	0.002		0.002		0.001	0.001			
		Silver	mg/L	0.001	10	8	0.00005	0.00009	0.0001	0.0001	0.001	0.00018	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		0.001		0.00005	0.00005			
		Zinc	mg/L	0.006	10	3	0.005	0.005	0.0055	0.0108	0.03	0.0091	0.005	0.03	0.014	0.006	0.01	0.006	0.005		0.005		0.005	0.005			
	S3 (RWD2)	Aluminium	mg/L	0.01	10	2	0.005	0.005	0.012	0.086	0.310	0.069	0.012	0.310	0.006	0.032	0.042	0.012	0.005		0.260		0.005	0.005			
		Arsenic	mg/L	0.001	10	0	0.0010	0.0028	0.0030	0.0030	0.0050	0.0029	0.003	0.003	0.003	0.003	0.005	0.003	0.003		0.003		0.002	0.001			
		Boron	mg/L	0.05	10	0	0.005	0.0066	0.008	0.0132	0.037	0.0122	0.007	0.008	0.005	0.026	0.037	0.01	0.007		0.008		0.005	0.009			
		Cadmium	mg/L	0.0001	10	0	0.0001	0.0001	0.0001	0.0001	0.0002	0.00011	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001		0.0001		0.0001	0.0001			
		Chromium	mg/L	0.001	10	0	0.0005	0.001	0.001	0.001	0.001	0.00095	0.001	0.001	0.001	0.001	0.0005	0.001	0.001		0.001		0.001	0.001			
		Copper	mg/L	0.001	10	10	0.002	0.002	0.0055	0.0124	0.016	0.0072	0.014	0.004	0.009	0.012	0.016	0.006	0.005		0.002		0.002	0.002			
		Iron	mg/L	0.05																							
		Lead	mg/L	0.001	10	0	0.001	0.001	0.001	0.001	0.002	0.0011	0.001	0.001	0.001	0.001	0.002	0.001	0.001		0.001		0.001	0.001			
		Manganese	mg/L	0.001	10	0	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005		0.005		0.005	0.005			
		Mercury (inorganic)	mg/L	0.0001	10	0	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005		0.00005		0.00005	0.00005			
		Nickel	mg/L	0.001	10	0	0.001	0.001	0.001	0.001	0.002	0.0011	0.001	0.001	0.001	0.001	0.002	0.001	0.001		0.001		0.001	0.001			
		Selenium (total)	mg/L	0.01	10	0	0.001	0.0018	0.002	0.002	0.003	0.0019	0.002	0.002	0.002	0.003	0.002	0.002	0.002		0.002		0.001	0.001			
		Silver	mg/L	0.001	10	8	0.00005	0.00009	0.0001	0.0001	0.001	0.00018	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		0.001		0.00005	0.00005			
		Zinc	mg/L	0.006	10	2	0.005	0.005	0.0055	0.0076	0.024	0.0078	0.024	0.007	0.006	0.005	0.01	0.006	0.005		0.005		0.005	0.005			
Mine Water Dams (Mine Affected Water)	S4 (Pit)	Aluminium	mg/L	0.01	3	0	0.015	0.016	0.017	0.018	0.019	0.017									0.015		0.017	0.019			
		Arsenic	mg/L	0.001	3	0	0.0010	0.0010	0.0010	0.0022	0.0030	0.0017									0.003		0.001	0.001			
		Boron	mg/L	0.05	3	0	0.008	0.01	0.013	0.0136	0.014	0.011667									0.013		0.008	0.014			
		Cadmium	mg/L	0.0001	3	0	0.0024	0.00268	0.0031	0.00328	0.0034	0.002967									0.0024		0.0031	0.0034			
		Chromium	mg/L	0.001	3	0	0.001	0.001	0.001	0.001	0.001	0.001									0.001		0.001	0.001			
		Copper	mg/L	0.001	3	0	0.15	0.194	0.26	0.266	0.27	0.226667									0.15		0.26	0.27			
		Iron	mg/L	0.05																							
		Lead	mg/L	0.001	3	0	0.001	0.001	0.001	0.001	0.001	0.001									0.001		0.001	0.001			
		Manganese	mg/L	0.001	3	0	0.013	0.0678	0.15	0.216	0.26	0.141									0.013		0.26	0.15			
		Mercury (inorganic)	mg/L	0.0001	3	0	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005									0.00005		0.00005	0.00005			
		Nickel	mg/L	0.001	3	0	0.002	0.0028	0.004	0.004	0.004	0.003333									0.002		0.004	0.004			
		Selenium (total)	mg/L	0.01	3	0	0.002	0.002	0.002	0.0032	0.004	0.002667									0.004		0.002	0.002			
		Silver	mg/L	0.001	3	0	0.00005	0.00005	0.00005	0.00062	0.001	0.000367									0.001		0.00005	0.00005			
		Zinc	mg/L	0.006	3	3	0.22	0.336	0.51	0.51	0.51	0.413333									0.22		0.51	0.51			
	S6 (Release Dam)	Aluminium	mg/L	0.01	14	6	0.016	0.542	1.1	1.986	8.400	1.888	8.400	0.260	0.890	1.100	1.100	0.870	0.016	1.710	0.079	1.400	1.500	2.400	5.970	0.730	
		Arsenic	mg/L	0.001	14	0	0.0010	0.0010	0.0030	0.0030	0.0030	0.0023	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.003	0.001	0.001	0.001	0.002	0.001	
		Boron	mg/L	0.05	14	0	0.005	0.0062	0.0145	0.05	0.05	0.022	0.008	0.005	0.005	0.018	0.021	0.011	0.019	0.05	0.007	0.05	0.005	0.009	0.05	0.05	
		Cadmium	mg/L	0.0001	14	11	0.0023	0.00498	0.0077	0.0158	0.0255	0.010229	0.02	0.0023	0.0069	0.0075	0.0079	0.0061	0.0069	0.0170	0.0024	0.0127	0.0033	0.015	0.0255	0.0097	
		Chromium	mg/L	0.001	14	0	0.0005	0.001	0.001	0.001	0.001	0.000964	0.001	0.001	0.001	0.001	0.0005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
		Copper	mg/L	0.001	14	14	1.1	3.52	7.69	11.54	29.2	9.343571	23	1.2	5.5	6.6	6.7	5	1.3	8.68	1.1	9.83	8.8	14	29.2	9.9	
		Iron	mg/L	0.05																0.29		0.42			0.28	0.27	
		Lead	mg/L	0.001	14	0	0.001	0.001	0.001	0.001	0.002	0.001143	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
		Manganese	mg/L	0.001	14	0	0.24	0.6752	1.15	2.088	22.6	2.978714	2	0.24	0.85	1	1.1	0.5	6.2	22.6	0.32	1.28	1.2	1.4	2.22	0.792	
		Mercury (inorganic)	mg/L	0.0001	14	0	0.00005	0.00005	0.00005	0.0001	0.0001	0.000065	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.0001	0.00005	0.0001	0.00005	0.00006	0.0001	0.0001	
		Nickel	mg/L	0.001	14	0	0.001	0.0056	0.016	0.034	0.21	0.031571	0.046	0.005	0.015	0.017	0.018	0.014	0.019	0.051	0.005	0.026	0.006	0.009	0.001	0.21	
		Selenium (total)	mg/L	0.01	14	0	0.002	0.0036	0.006	0.01	0.014	0.006643	0.014	0.002	0.006	0.006	0.005	0.005	0.006	0.01	0.003	0.01	0.004	0.002	0.01	0.01	
		Silver	mg/L	0.001	14	0	0.00005	0.0001	0.0001	0.001	0.001	0.000414	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.00005	0.00005	0.001	0.001	
		Zinc	mg/L	0.006	14	14	0.43	1.16	1.66	3.142	5.31	2.125714	4.5	0.43	1.2	1.3	1.4	1.1	1.3	2.97	0.52	2.31	2.1	3.4	5.31	1.92	

Notes

Results recorded below the limit of reporting (LOR) have been assigned a value equal to 50% of the LOR

LOR>WQO

Release Dam - General Parameters

Location/Type	Site	Parameter	Units	LOR	WQO		# Results	#>WQO	Minimum	20th %ile	Median	80th %ile	Maximum	Average	Jan-20	Mar-20	Aug-20	Oct-20	Nov-20	Mar-21	Jul-21	Nov-21	Mar-22	May-22	Jun-22	Jul-22	Oct-22	Apr-23	Oct-23
	S6	pH	-	0.01	6.0-8.0		14	0	4.0	4.3	4.9	5.9	7.1	5.1	4.00	6.40	4.70	4.80	5.10	5.40	7.10	4.21	6.60	4.12	4.80	5.50	4.34	4.93	
		Electrical Conductivity (EC)	µS/cm	1	2500		14	1	130	304	474	787	4060	785	800	130	340	390	420	250	1500	4060	130	525	590	660	778	422	
		Total Dissolved Solids	mg/L	10	-																	3800					553	282	
		Dissolved Oxygen (DO)	%sat	?	-		0	0	0	#NUM!	#NUM!	#NUM!	0	#DIV/0!															
		Total Suspended Solids (TSS)	mg/L	5	TBD		12	0	5	5	6	15.8	29	10.33333	5	16	5	7	5	15	5		11		16	29	5	5	
		Turbidity	mg/L	?	-		0	0	0	#NUM!	#NUM!	#NUM!	0	#DIV/0!															
		Hydroxide Alkalinity	mg/L	1	-		4	0	1	1	1	1	1	1								1		1			1	1	
		Carbonate Alkalinity	mg/L	1	-		4	0	1	1	1	1	1	1								1		1			1	1	
		Bicarbonate Alkilinity	mg/L	1	-		4	0	1	1	1	1.8	3	1.5								1		1			1	3	
		Total Alkalinity	mg/L	1	-		4	0	1	1	1	1.8	3	1.5								1		1			1	3	
		Sulfate	mg/L	1	770		4	1	170	201.2	290	1126.8	2280	757.5								2280		222			358	170	
		Fluoride	mg/L	0.1	TBD		14	0	0.1	0.1	0.15	0.2	0.3	0.157143	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.3	0.2	
		Choride	mg/L	1	-		4	0	7	7.6	8.5	40.6	88	28								88		8			9	7	
		Calcium	mg/L	1	-		4	0	22	25	36.5	146.8	298	98.25								298		27			46	22	
		Magnesium	mg/L	1	-		4	0	16	17.8	24	97.4	200	66								200		19			29	16	
		Sodium	mg/L	1	-		4	0	24	27.6	33	177.6	390	120								390		30			36	24	
		Potassium	mg/L	1	-		4	0	2	2.6	4	15	30	10								30		3			5	2	
		Total Hardness	mg/L	1	-		4	0	121	136	190	768.4	1570	517.75								1570		146			234	121	

Notes

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LOR>WQO