Vulcan Coal Mine

Water Management Plan

Prepared for Vitrinite Pty Ltd owner of Qld Coal Aust No.1 Pty Ltd and Queensland Coking Coal Pty Ltd

1571-17-A1, 29 November 2021

Report Title	Vulcan Coal Mine Water Management Plan
Client	Prepared for Vitrinite Pty Ltd owner of Qld Coal Aust No.1 Pty Ltd and Queensland Coking Coal Pty Ltd
Report Number	1571-17-A1

Revision Number	Report Date	Report Author	Reviewer
0	26 November 2021	LZ	JO
1	29 November 2021	LZ	JO

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

Julian Orth
Associate

FORM OF CERTIFICATION

Name of Registered Professional Engineer providing certification:

Julian Orth RPEQ No 15706

Employed by WRM Water & Environment Pty Ltd

Address of Registered Professional Engineer providing certification:

WRM Water & Environment

Level 9, 135 Wickham Terrace, Spring Hill

PO Box 10703

Adelaide St Brisbane QLD 4000

Statement of Relevant Experience:

I hereby state that I am a Registered Professional Engineer of Queensland and meet the requirements of the definition of 'suitably qualified and experienced person'.

Statement of Certification:

All relevant material relied upon by me, including subsidiary certifications of specialist components, where required by the environmental authority, is provided in the attached report 'Vulcan Coal Mine - Water Management Plan', dated 29 November 2021.

I hereby certify that the Water Management Plan prepared for the Vulcan Coal Mine has been prepared in accordance with the engineering practice consistent with the standards required for this assessment, and in accordance with the Model Mine Conditions.

I, Julian Orth, declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under Section 480 of the Environmental Protection Act 1994 to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.

Signed: Julian Orth

Date: 29 November 2021

Contents

List of Figures

List of Tables

1 Introduction

1.1 BACKGROUND

The Vulcan Coal Mine (the Project or VCM), which is managed by Vitrinite Pty. Ltd., owner of Qld Coal Aust No.1 Pty. Ltd. and Queensland Coking Coal Pty. Ltd. (Vitrinite), is an open pit coal operation located to the southeast of Moranbah, in Central Queensland. The Project Mining Lease (ML 700060) is situated to the south of the Peak Downs Mine, operated by BMA Australia.

The location of the Project in relation to surrounding mines and regional drainage features is shown in Figure 1.1.

1.2 PURPOSE AND SCOPE

This Water Management Plan (WMP) has been prepared to meet the requirement of conditions F19 and F20 of Environmental Authority (EA) EA0002912 (Department of Environment and Science [DES], 2021) which was issued for the Project.

The WMP examines and addresses all issues relevant to the importation, generation, use, and management of water on a mining project in order to minimise the quantity of water that is contaminated and released by and from the Project.

The actual and potential risks of environmental harm to natural water flows posed by mining activities have been identified and management actions that will effectively minimise these risks have been presented.

1.3 RELATED DOCUMENTS

This WMP should be read in conjunction with the following reports:

- *Receiving Environment Monitoring Program Vulcan Coal Mine* (REMP) (Vitrinite Pty Ltd, 2021); and
- *Vulcan Complex Project Surface water assessment* (WRM Water & Environment, 2020a).

1.4 REPORT STRUCTURE

The report is structured as follows:

- Section 2 describes the environmental values of the regional and local drainage receiving waters;
- Section 3 presents the site operating activities including a study of the potential for generating contaminants on the site;
- Section 4 presents the surface water management system including the management objectives and principles;
- Section 5 provides a description of the site water balance;
- Section 6 describes measures to manage/prevent saline and acid rock drainage;
- Section 7 provides an overview of the surface water monitoring program;
- Section 8 provides a summary of the emergency and contingency planning information related to water management; and
- Section 9 gives a list of references.

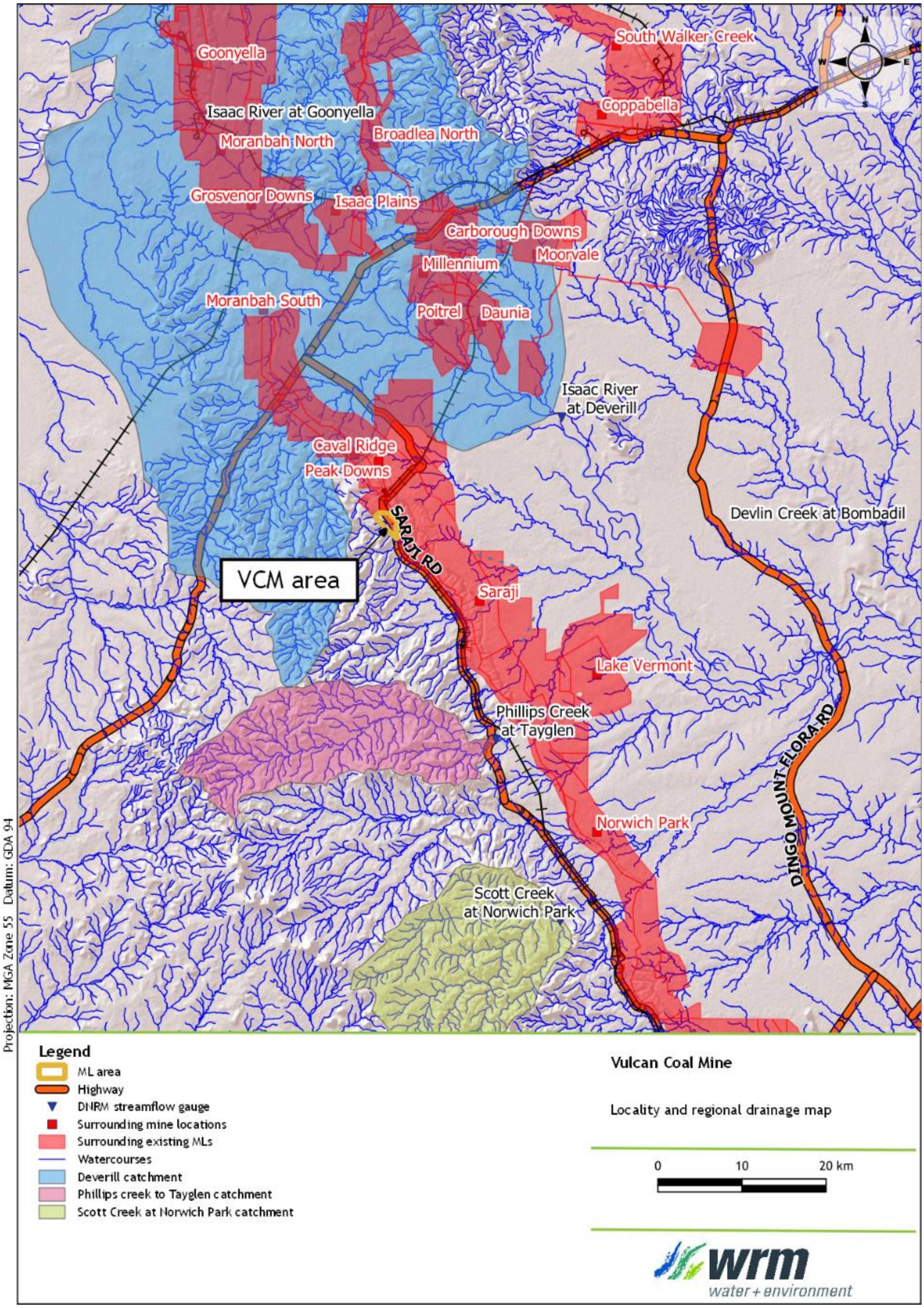

Figure 1.1 – Locality and regional drainage characteristics

2 Catchment hydrology and environmental values

2.1 GENERAL

This section of the WMP describes the regional drainage characteristics in the vicinity of the Project. The environmental values (EVs) and water quality objectives (WQOs), as defined by the various environmental protection policies and guidelines and regulations relevant to these waterways, are also described.

2.2 REGIONAL DRAINAGE NETWORK

The Project is located within the Isaac River sub-basin of the greater Fitzroy Basin. Figure 1.1 shows the Isaac River catchment to the Deverill gauging station. The catchment area of the Isaac River to Boomerang Creek (the main drainage feature in proximity to the Project) is 5,226 square kilometres (km^2).

The Isaac River commences approximately 100 km to the north of the Project within the Denham Range. It drains in a southwesterly direction through the Carborough and Kerlong Ranges before turning in a south easterly direction near the Goonyella Riverside Mine. It drains approximately 30 km to the east of the Project, and eventually flows to the Mackenzie River some 150 km to the southeast. Three open water bodies are located in the upper catchment including Lake Elphinstone, Teviot Creek Dam and Burton Gorge Dam.

Other than along the ranges, the majority of the Isaac River catchment has been cleared for agricultural use or for mining. There are several existing coal mines in the catchment, including Burton, North Goonyella, Goonyella Riverside, Broadmeadow, Broadlea North, Isaac Plains, Moranbah North, Millennium, Daunia, Poitrel, Grosvenor, Peak Downs, Saraji, Norwich Park and Lake Vermont.

2.3 LOCAL DRAINAGE NETWORK

Figure 2.1 and Figure 2.2 show the drainage features in the vicinity of the Project ML. The Project ML is located in the headwaters of the Boomerang Creek catchment. The Project contains an existing drainage diversion which outlets to Boomerang Creek to the southeast of the Project. Boomerang Creek is a watercourse and tributary of the Isaac River. Ripstone Creek is located immediately north of the Project ML. Boomerang Creek and Ripstone Creek are ephemeral streams which experience flow only after sustained or intense rainfall in the catchment.

The Boomerang Creek and Ripstone Creek catchments commence in the Harrow Range to the west of the Project ML and drain in an easterly direction towards Saraji Road and the Norwich Park Branch Railway before entering the existing Peak Downs operations. The predominant catchment land uses include undeveloped with some stock grazing to the west of Saraji Road and stock grazing and coal mining to the east. The catchment area of Boomerang Creek and Ripstone Creek is 788 km^2 and 300 km^2 respectively. The Peak Downs operation has existing diversions of Boomerang Creek and Ripstone Creek and has approval to release to both creeks.

The headwaters of Ripstone Creek are diverted through the Project ML and into Boomerang Creek via the existing drainage diversion, which was built to allow the construction of a Tailings Dam within Peak Downs operations. The diversion flows in a southeasterly direction through the Project ML and has a catchment area of approximately 16.0 km^2.

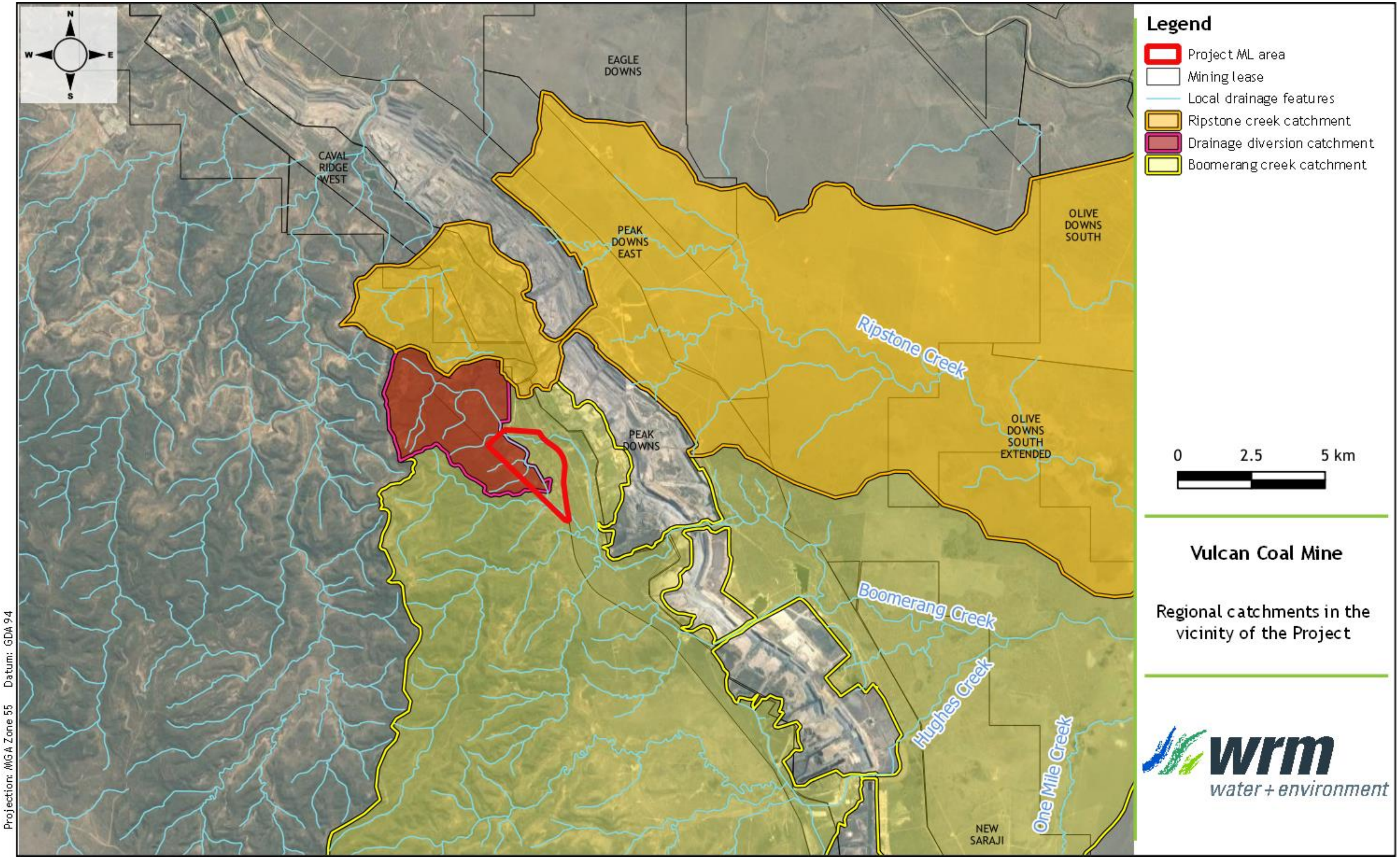

Figure 2.1 – Regional catchments in the vicinity of the Project

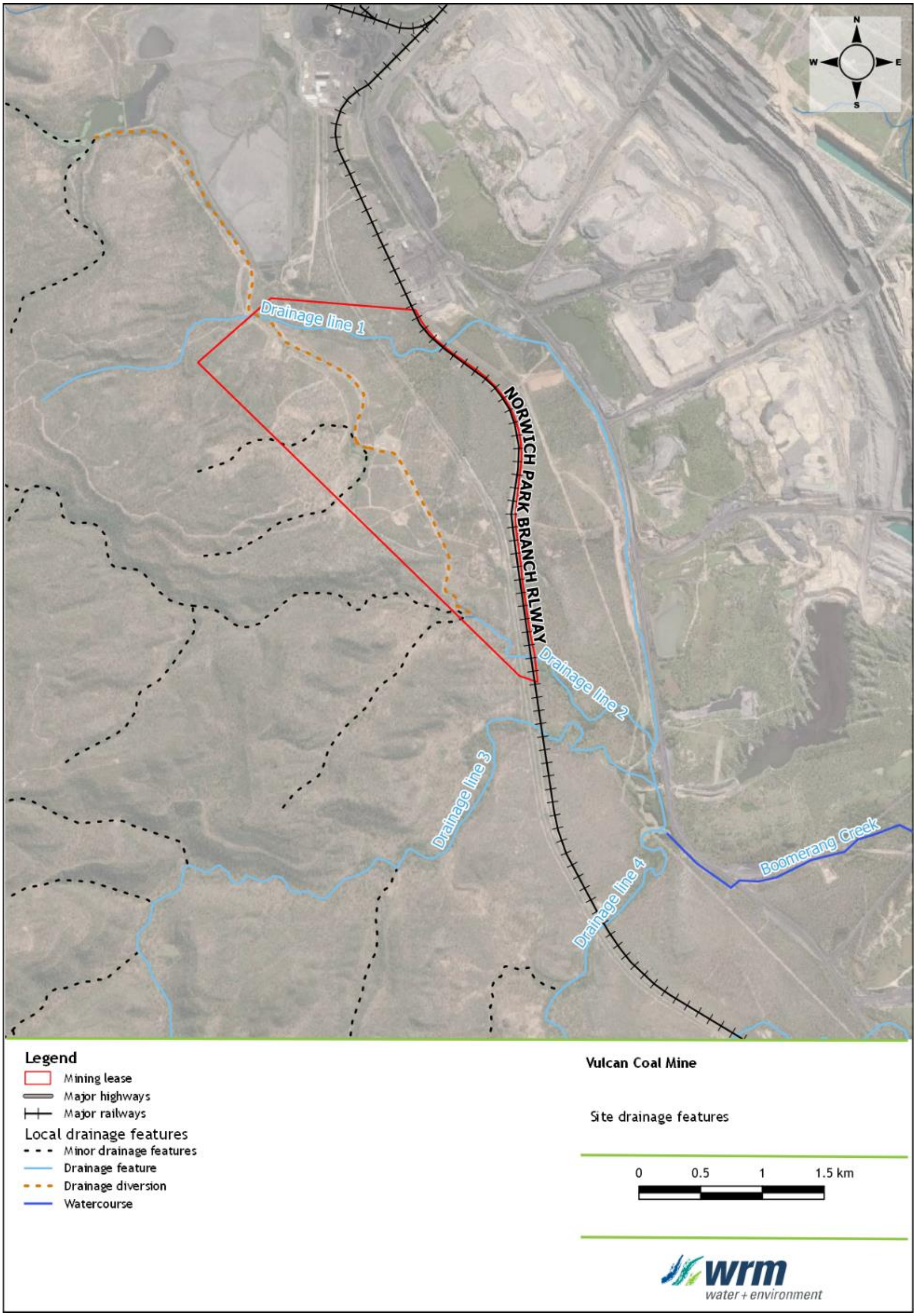

Figure 2.2 – Site drainage features

Runoff from the Project ML drains to three locations as follows (see Figure 2.2):

- The drainage diversion discharges into Drainage line 2, which crosses the southern boundary of the Project ML. The western and southern portions of the Project ML flow into the diversion;
- The railway culvert at the northern corner of the Project ML. The northern and eastern portions of the Project ML flow in a northeasterly direction via Drainage line 1 into Saraji Road, before draining to the railway culverts; and
- Overland across the southeastern corner of the Project ML. The southeastern corner of the Project ML flows towards the Saraji Road culvert before draining south into Drainage 2, upstream of Norwich Park Branch Railway.

All runoff from the Project ML drains towards Boomerang Creek, which commences approximately 1.5 km to the southeast of the Project.

2.4 STREAM FLOW

There are four streamflow gauges operated by the Department of Natural Resources, Mines and Energy (DNRME) in the vicinity of the Project including (see Figure 1.1):

- Isaac River at Deverill (approximately 25 km northeast of the Project);
- Phillips Creek at Tayglen (approximately 30 km southeast of the Project);
- Scott Creek at Norwich Park (approximately 50 km south of the Project); and
- Devlin Creek at Bombandy (approximately 60 km east of the Project).

The closest stream gauge is located on the Isaac River at Deverill (Station ID: 130410A). This gauge is located approximately 20 km upstream of where Boomerang Creek meets the Isaac River.

Historical flow and river height monitoring data (1968-2018) for the Isaac River at Deverill, provides an indication of the flow regime (refer Figure 2.3). Surveyed cross section data for this gauging station in September 2014 (DNRME, 2017) indicates that sediment covers the bottom one metre of the gauge range. The mean river height data shown in Figure 2.3 suggests that surface flow above the sand is more likely to occur only in the wetter months from November to April, reducing to shallow subsurface flows from about May to October in an average year.

The Phillips Creek at Tayglen Creek streamflow gauge (Station ID: 130409A) is located on Phillips Creek. Phillips Creek is an easterly draining tributary of the Isaac River. DNRME maintains data for the gauge between 1968 and 1988. The catchment area to the gauge location (see Figure 1.1) is 344 km^2.

A typical sequence of recorded flows from this station is shown in Figure 2.4. The creek is characterised by brief periods of flow interspersed by long periods of no flow. This ephemeral behaviour is typical for streams in this part of the Fitzroy Basin.

The median annual flow over the period of record was approximately 12,730 ML/a (52 mm of runoff), most of which occurred in the summer months (as shown in Figure 2.5). Figure 2.6 compares flow frequency curves for a number of gauged catchments in the Isaac River catchment which are located in the vicinity of the Project. Figure 2.6 shows that for Phillips Creek at Tayglen, flow only occurred approximately 22% of the time, which would be similar to other creeks in the vicinity of the Project.

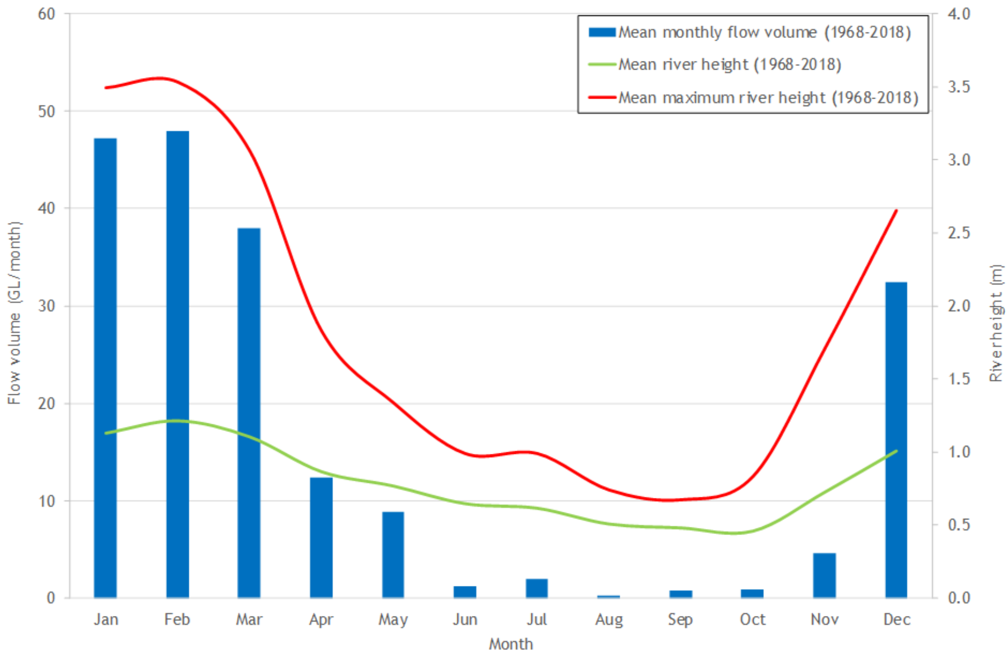

Figure 2.3 - Flow volume and river height in the Isaac River at Deverill

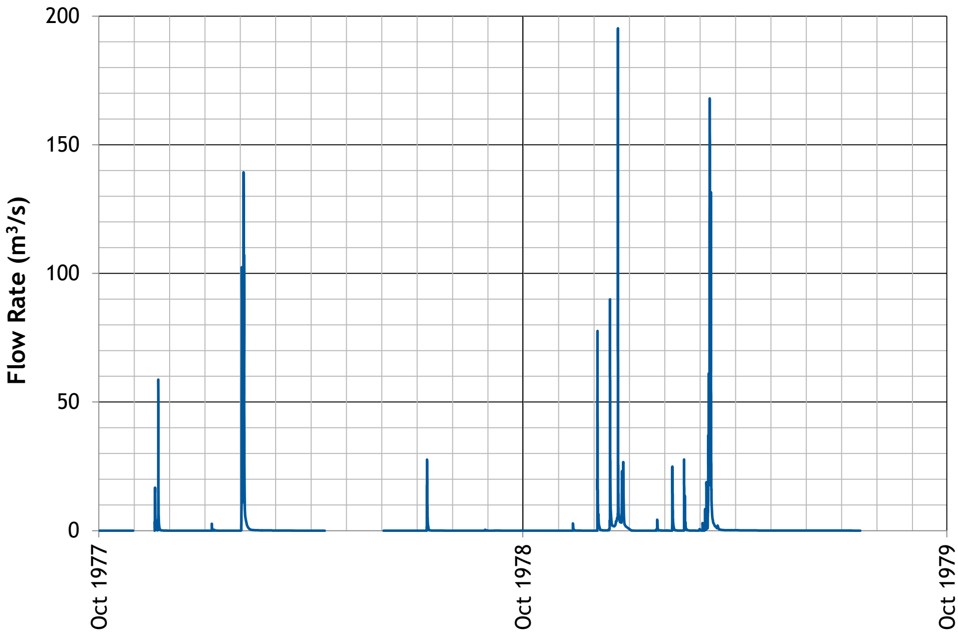

Figure 2.4 - Sample flow sequence - Phillips Creek at Tayglen 1977 - 1979

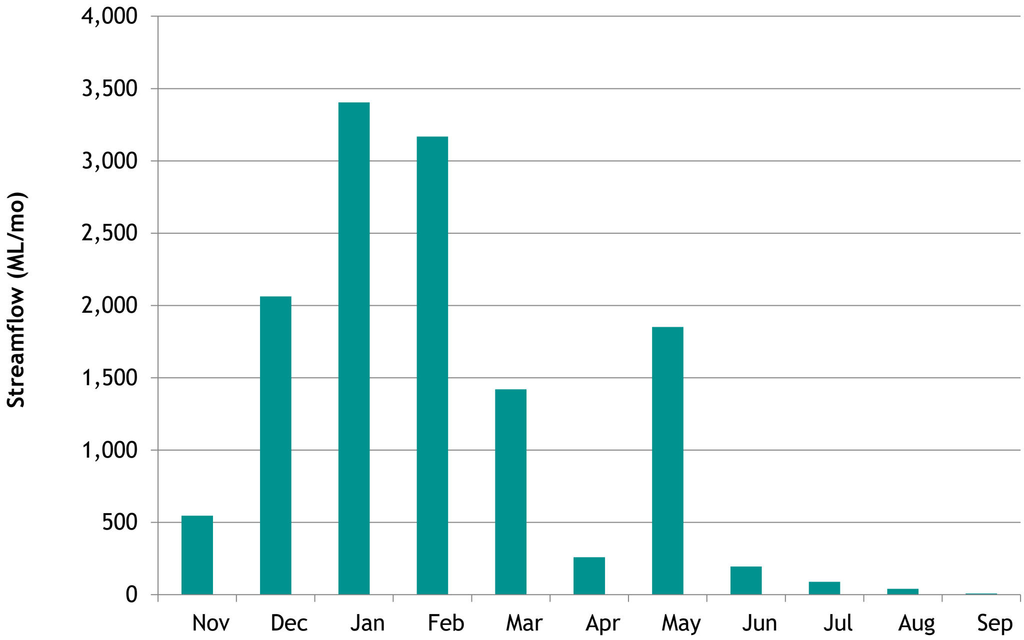

Figure 2.5 - Measured mean monthly streamflow - Phillips Creek at Tayglen 1968-1988

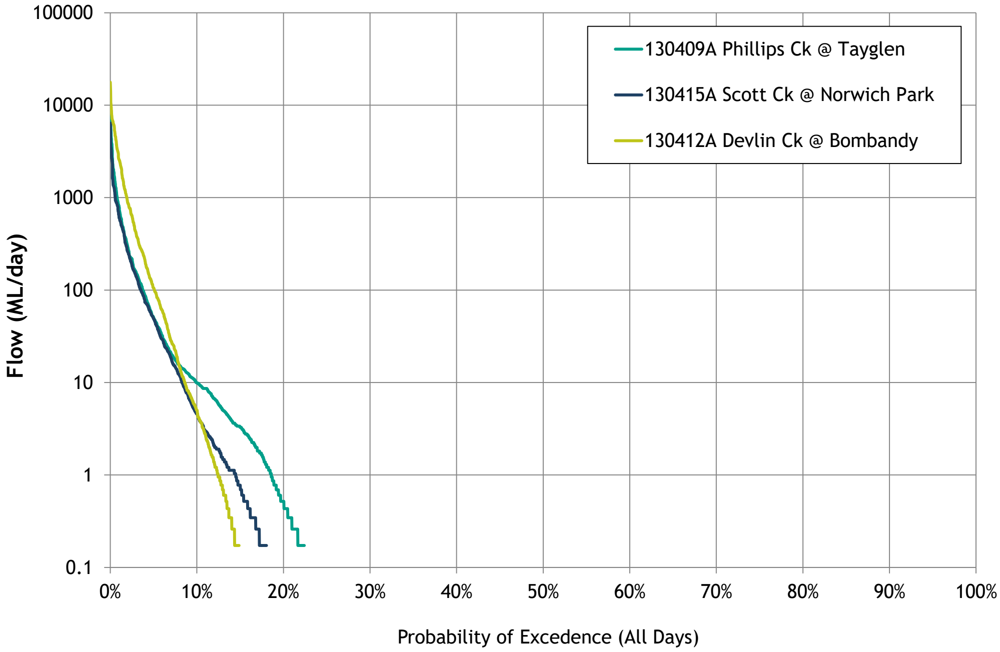

Figure 2.6 - Recorded frequency curves at nearby DNRME gauges (no flow days included)

2.5 EXISTING WATER USE ENTITLEMENTS

There are two active water licences for Boomerang Creek (Authorisation 55570L & 617686) both held by Peak Downs Mine. Licence authorisation #55570L allows impounding of water and licence #617686 allows the take of the impounded water (at a max rate of 2,000 L/s).

2.6 ENVIRONMENTAL VALUES

The Queensland Water Quality Guidelines and Environmental Protection (Water) Policy (EPP Water) guidelines establish EVs and WQOs for natural waters in Queensland. The Project is located within the 'Isaac western upland tributaries' area of the Isaac River sub-basin. Under the EPP Water, the following EVs have been nominated for this area:

- Aquatic ecosystems
- Irrigation
- Farm supply/use
- Stock Water
- Aquaculture
- Human consumption
- Primary recreation
- Secondary recreation
- Visual recreation
- Drinking water
- Industrial use
- Cultural and spiritual values

2.7 GROUNDWATER

Groundwater inflows to the open pits were provided by Hydrogeologist.com.au as a daily rate for six-monthly periods over the mine life. The predicted groundwater inflows were small and were found to have a negligible effect on the water balance.

The modelled groundwater rates to the pits were:

- 4.3 m^3/day for the first 2 years; and
- 26.2 m^3/day for the next 2 years.

2.8 WATER QUALITY

2.8.1 Regional Isaac River water quality

DNRME has collected daily electrical conductivity (EC) data at the Isaac River at Deverill gauge. The Deverill gauge is located upstream of the point where Boomerang Creek drains into the Isaac River. The gauge would therefore be representative of water quality in the receiving waters of the Isaac River from the Project.

Figure 2.7 presents a time history of recorded instantaneous EC and stream flow for the Isaac River at Deverill gauging station. Figure 2.8 details the relationship between instantaneous flow and EC at the Isaac River at Deverill gauging station. The data collected by DNRME at the Deverill gauging station spans the period from 2011 to 2018 and indicates:

- The EC values for high flows greater than 200 m³/s are generally below the high flow WQO EC of 250 µS/cm;
- The EC of instantaneous flows below 100 m³/s vary significantly from 50 µS/cm to 1,870 µS/cm with many recorded values exceeding the low flow WQO EC of 720 µS/cm but are below the Peak Downs EA receiving waters trigger value of 2000 µS/cm;
- The mean daily EC has exceeded the low flow WQO on a total of 23 days over this period and all of these days experienced some flow (not stagnant flow); and
- The stream flows are highly ephemeral with baseflows ceasing within a few days or weeks of a runoff event, or at least flowing below the top of the sandy bed.

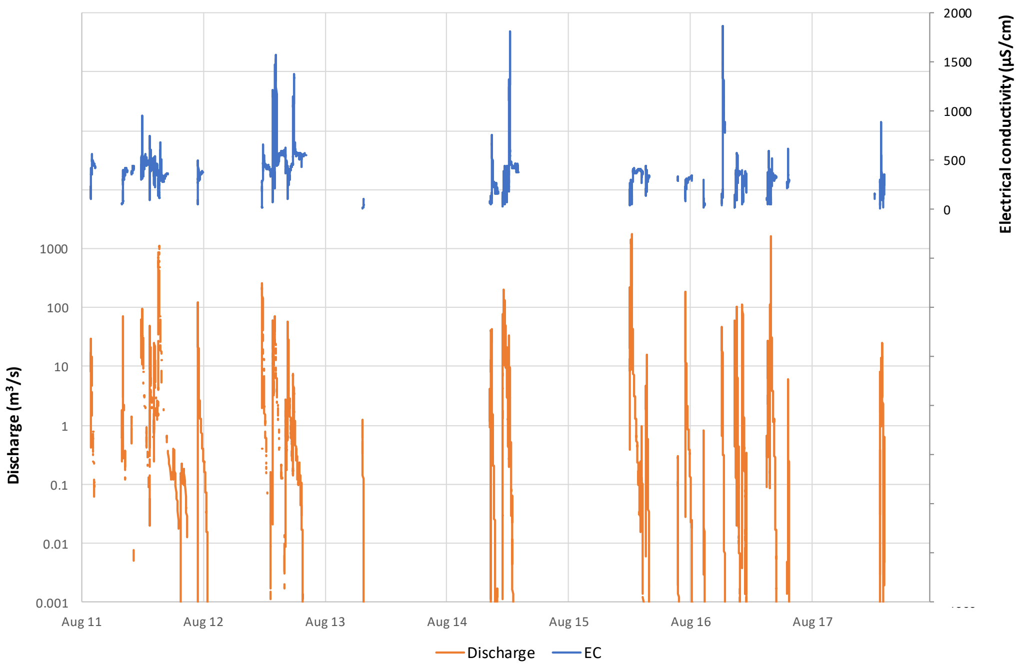

Figure 2.7 - Electrical Conductivity and Flow (Isaac River at Deverill Gauge)

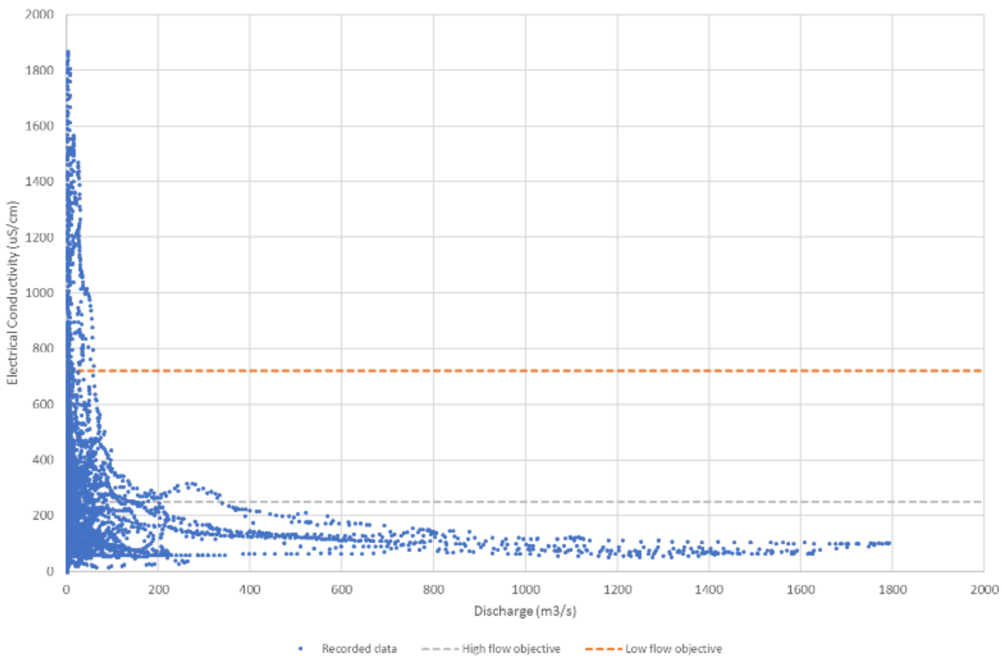

Figure 2.8 - Flow vs Electrical Conductivity (Isaac River at Deverill Gauge)

2.8.2 Local water quality

Water quality sampling was undertaken as a component of the baseline surface water quality sampling in February 2020. Analyses for a range of physico-chemical parameters were completed at sites VSW1, VSW2 and VSW3. The WQO default trigger values for the EVs listed in Section 2.6 are provided in Table 2.1.

Table 2.1 shows that certain baseline water quality values surrounding the Project do not meet the WQO for the region, these include:

- Electrical conductivity;
- Turbidity;
- Total hardness as CaCO3;
- Sulfate as SO4;
- Sodium;
- Ammonia as N;
- Nitrogen (total);
- Phosphorous (total);
- Dissolved Oxygen;
- Aluminium (filtered);
- Copper (filtered);
- Manganese (filtered); and
- Zinc (total).

The local water quality data suggests that a number of parameters may exceed the WQOs. However, it is acknowledged that this is based on only one water quality sampling event.

Table 2.1 – Baseline water quality monitoring

Parameter	Unit	VSW-1 Feb-20	VSW-2 Feb-20	VSW-3 Feb-20	WQO
pH Value	-	7.42	6.74	6.54	6.5 - 8.5 (Aquatic ecosystem)
Sodium Adsorption Ratio	-	6.64	2.92	1.69	-
Electrical Conductivity	µS/cm	1400	310	184	< 720 (baseflow) < 250 (high flow) (Aquatic ecosystem)
Total Dissolved Solids (Calc.)	mg/L	910	202	120	< 2,000 (Stock)
Suspended Solids (SS)	mg/L	10	55	20	< 55 (Aquatic ecosystem)
Turbidity	NTU	42.9	221	90.8	< 50 (Aquatic ecosystem)
Total Hardness as CaCO3	mg/L	191	37	26	< 150 (Drinking water)
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	-
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	-
Bicarbonate Alkalinity as CaCO3	mg/L	63	12	4	-
Total Alkalinity as CaCO3	mg/L	63	12	4	-
Sulfate as SO4 - Turbidimetric	mg/L	212	40	19	< 25 (Aquatic ecosystem)
Chloride	mg/L	275	54	34	-
Calcium	mg/L	27	5	4	-
Magnesium	mg/L	30	6	4	-
Sodium	mg/L	211	41	20	< 30 (Drinking water)
Potassium	mg/L	8	7	7	-
Fluoride	mg/L	<1.0	0.1	<0.1	< 2 (Irrigation)
Ammonia as N	mg/L	0.05	0.1	<0.01	< 0.02 (Aquatic ecosystem)
Nitrite as N	mg/L	0.03	0.01	<0.01	-
Nitrate as N	mg/L	1.7	1.57	1.19	-
Nitrite + Nitrate as N	mg/L	1.73	1.58	1.19	-
Total Kjeldahl Nitrogen as N	mg/L	1.6	1.3	0.9	-
Total Nitrogen as N	mg/L	3.3	2.9	2.1	< 0.5 (Aquatic ecosystem)
Total Phosphorus as P	mg/L	0.04	0.09	0.05	< 0.05 (Aquatic ecosystem)
Reactive Phosphorus as P	mg/L	<0.01	<0.01	<0.01	< 0.02
Total Anions	meq/L	13.4	2.6	1.43	-
Total Cations	meq/L	13.2	2.7	1.58	-
Ionic Balance	%	0.87	----	----	-
Chlorophyll a	mg/m³	<4	<4	<4	-
Dissolved Oxygen	mg/L	6.7	7.3	7.3	> 4 (Drinking water)
			Dissolved Metals		
Aluminium	mg/L	0.11	0.45	0.39	< 0.055 (Aquatic ecosystem)
Arsenic	mg/L	0.001	<0.001	<0.001	< 0.024 (Aquatic ecosystem)
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	< 0.0002 (Aquatic ecosystem)
Chromium	mg/L	<0.001	<0.001	<0.001	< 0.001 (Aquatic ecosystem)

Cobalt	mg/L	<0.001	<0.001	<0.001	-
Copper	mg/L	0.003	0.001	0.002	< 0.0014 (Aquatic ecosystem)
Lead	mg/L	<0.001	<0.001	<0.001	< 0.0034 (Aquatic ecosystem)
Manganese	mg/L	0.039	0.019	0.015	< 1.9 (Aquatic ecosystem)
Molybdenum	mg/L	<0.001	<0.001	<0.001	-
Nickel	mg/L	0.002	0.002	0.002	< 0.011 (Aquatic ecosystem)
Selenium	mg/L	<0.01	<0.01	<0.01	< 0.005 (Aquatic ecosystem)
Silver	mg/L	<0.001	<0.001	<0.001	-
Uranium	mg/L	<0.001	<0.001	<0.001	< 0.1 (Irrigation)
Vanadium	mg/L	<0.01	<0.01	<0.01	< 0.5 (Irrigation)
Zinc	mg/L	0.024	<0.005	0.024	< 0.008 (Aquatic ecosystem)
Boron	mg/L	0.09	<0.05	<0.05	< 0.37 (Aquatic ecosystem)
Iron	mg/L	0.2	0.35	0.35	-
Mercury	mg/L	<0.0001	<0.0001	<0.0001	< 0.00006 (Aquatic ecosystem)
Total Metals					
Aluminium	mg/L	0.89	3.38	1.56	< 5 (Stock)
Arsenic	mg/L	0.001	0.002	0.001	< 0.5 (Stock)
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	< 0.01 (Stock)
Chromium	mg/L	<0.001	0.002	0.001	< 1 (Stock)
Cobalt	mg/L	<0.001	0.001	<0.001	-
Copper	mg/L	0.004	0.004	0.002	< 1 (Stock)
Lead	mg/L	<0.001	0.004	0.002	< 0.1 (Stock)
Manganese	mg/L	0.042	0.034	0.024	< 10 (Irrigation)
Molybdenum	mg/L	0.001	<0.001	<0.001	< 0.05 (Irrigation)
Nickel	mg/L	0.002	0.004	0.003	< 1 (Stock)
Selenium	mg/L	<0.01	<0.01	<0.01	< 0.02 (Stock)
Silver	mg/L	<0.001	<0.001	<0.001	-
Uranium	mg/L	<0.001	<0.001	<0.001	-
Vanadium	mg/L	<0.01	<0.01	<0.01	-
Zinc	mg/L	0.031	0.017	0.029	< 5 (Irrigation)
Boron	mg/L	0.06	<0.05	<0.05	< 5 (Stock)
Iron	mg/L	0.79	3.26	1.62	< 10 (Irrigation)
Mercury	mg/L	<0.0001	<0.0001	<0.0001	< 0.002 (Irrigation)

Note: Recorded exceedances of the WQOs have been shaded in grey.

2.9 GEOLOGY AND SOILS

2.9.1 Geochemistry

RGS Environmental Pty Ltd (RGS) (2020) completed a geochemical assessment of the material at the site. A suite of representative samples were collected by RGS at the site and tested, and the findings are outlined in Section 6.

The Project is focussed on targets within the Moranbah Coal Measures, with the Alex and Dysart coal seams targeted as the main seams. The interburden material in the Project area generally comprises sandstone, siltstone, claystone and coal. The Alex seam is generally quite shallow and occurs just below the base of weathering in the stratigraphic profile. The Dysart Lower Seam comprises several plys with interburden in between.

2.9.2 Soils and land suitability

AARC Environmental Solutions Pty Ltd (2019) completed a Soil and Land Suitability Assessment (SLSA) for the Project and surrounds. To characterise the soils at the site, AARC collected 42 detailed soil profiles and analysed 12 laboratory samples from the site and surrounds.

The area surrounding the Project is dominated by clastic sedimentary rocks of marine and lacustrine origin, including sandstones, mudstones, siltstones and coal. Surface geology at the site includes Quaternary clay, silt, sand, gravel and soil with colluvial and residual deposits, as well as late Tertiary to Quaternary poorly consolidated sand, silt, clay, minor gravel and high-level alluvial deposits (AARC, 2019). AARC mapped the Soil Management Units (SMUs) across the site using the methodologies specified in the *Guidelines for Surveying Soil and Land Resources* (McKenzie et al, 2008) based on soil morphology, parent material and land attributes.

A description of each SMU found within the Project area is outlined in Table 2.2. The majority of the site consists of the Limpopo SMU, with a small southern portion of the Project site consisting of Crocodile and Zambezi SMUs.

Table 2.2 – Soil Management Units surveyed on site (AARC, 2019)

Soil Management Unit	Description
Crocodile	A shallow rocky soil unit associated with hill slopes and plateaus. Soil textures grade from loam at the surface, to loamy sands with depth; often containing rock material with little to no pedologic development throughout the solum.
Limpopo	The Limpopo unit is a brown texture-contrast soil. Soil textures predominantly grade from sands to clay sands in the surface soils to light clays in deeper horizons.
Zambezi	A predominantly grey coloured texture contrast soil with surface soils consisting of sands, increasing in clay content in deeper horizons. Lower horizons display diffuse orange to yellow mottles.

Sodic soils contain large concentrations of Sodium relative to other cations. These soils have a degree of dispersivity and can accelerate erosion. AARC identified areas of high sodicity on site through the measurement of the Exchangeable sodium percentage and Emerson Class of surveyed soils. The Crocodile SMU was identified as having a low risk of dispersion and was not identified as being sodic.

For the remaining SMUs, AARC (2019) identified the depth horizons with sodic properties as follows:

- Limpopo SMU: Sodic below a depth of 0.5 m; and
- Zambezi SMU: Sodic below a depth of 0.5 m.

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

3 Contaminant source study

3.1 OVERVIEW

This section of the WMP describes the activities on the Project ML which, if not appropriately managed, could generate contaminants which impact on the EVs of the receiving waters.

3.2 SITE OPERATING ACTIVITIES

The major components of the VCM are shown in Figure 3.1 and include:

- an open cut pit on the eastern edge of the Project ML (which will be completely backfilled and is therefore overlain by the in pit spoil dump in Figure 3.1);
- an in pit spoil dump in the pit location on the eastern side of the ML;
- a western out of pit spoil dump;
- a number of topsoil stockpiles which will be located adjacent the in pit and out of pit spoil dumps;
- access and haul roads;
- a mine infrastructure area (MIA) and run-of-mine (ROM) stockpiles;
- a truck laydown area;
- a workshop area in the northwest of the site, including a vehicle washdown area;
- offices and car park in the northwest of the site;
- a creek crossing over the existing drainage diversion;
- a mine access road to the MIA area; and
- erosion and sediment control, and mine water management structures (described in Section 4).

Most of the activities have the potential to impact on the EVs and WQOs, if not appropriately managed.

3.3 SURFACE WATER TYPES

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff in downstream receiving waters through increased sediment loads. In addition, runoff from active mining areas (including coal stockpiles, etc.) may have increased concentrations of salts and other pollutants when compared to natural runoff. The proposed strategy for the management of surface water at the Project is based on the separation of water from different sources based on anticipated water quality.

Definitions of the types of water generated within the Project are outlined in Table 3.1.

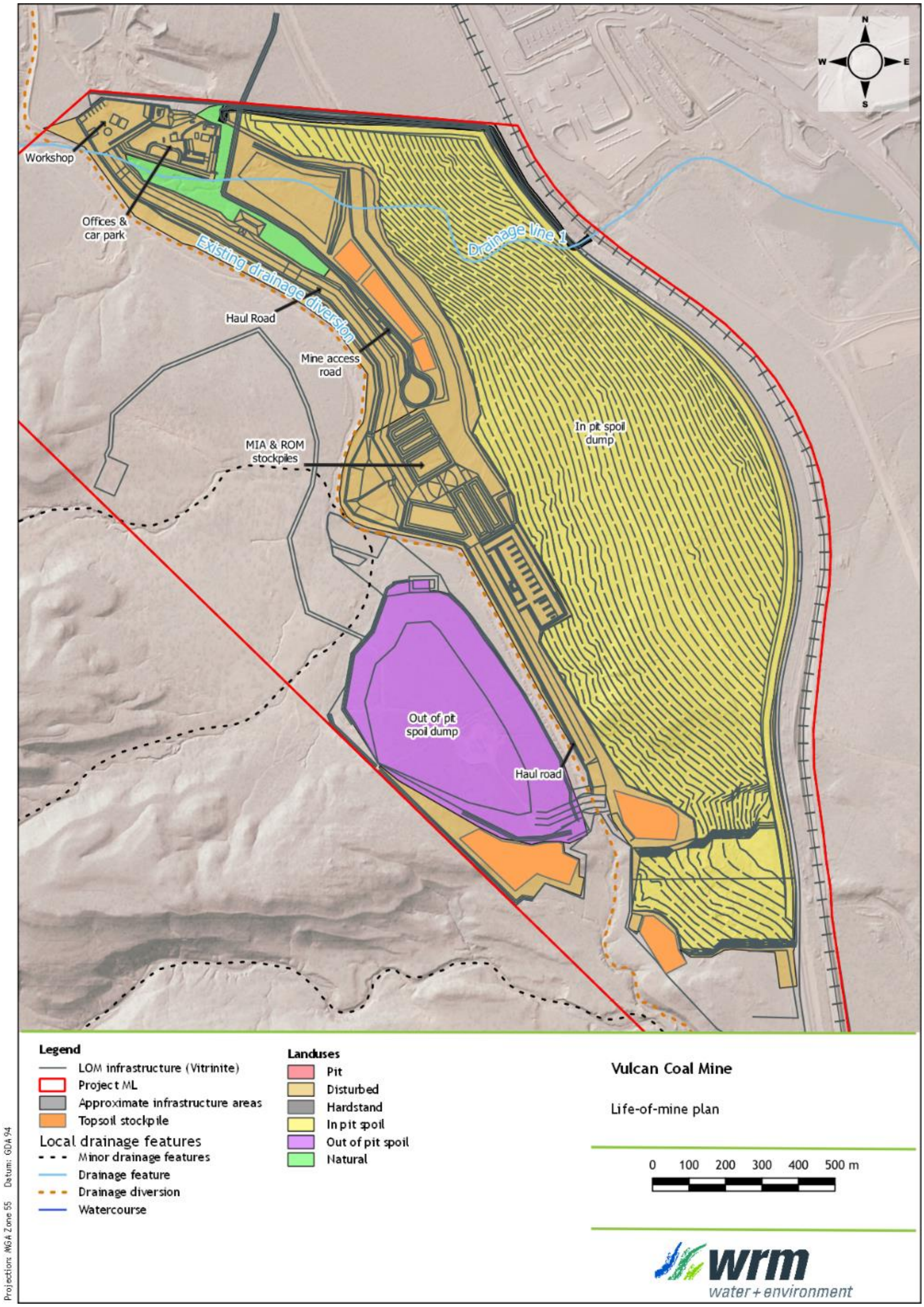

Figure 3.1 – Life-of-mine plan

Table 3.1 – Types of water managed within the Project

Water type	Definition
Mine affected water	In accordance with the Project EA, mine affected water means the following: i) pit water, tailings dam water, processing plant water; ii) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the *Environmental Protection Regulation 2019* if it had not formed part of the mining activity; iii) rainfall runoff which has been in contact with haul roads that have been constructed using coal and/or coal reject material; iv) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water; v) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated; vi) groundwater from the mine dewatering activities; and vii) a mix of mine affected water (under any of paragraphs i to vi) and other water.
Surface water	In accordance with the Project EA, surface water means runoff from areas that are disturbed by mining operations (including out of pit waste rock emplacements and rehabilitated areas). This runoff may contain high sediment loads but would not contain contaminated material or high total dissolved solids (TDS).
Diverted water	Surface runoff from areas unaffected by mining operations. Diverted catchment water includes runoff from undisturbed areas.
Raw water	Untreated water that has not been contaminated by mining activities.
Potable water	Treated water suitable for human consumption.
External water	Water supplied from a source that is external to the Project area to make up water shortfalls for onsite water demands when site water sources cannot meet demand.

3.4 SURFACE WATER SOURCES

The sources of water types defined above are described in the following sub-sections.

3.4.1 Mine-affected water

Mine-affected water is likely to be generated from the following activities/areas (Figure 3.1):

- water which collects in the pit, comprising surface runoff and/or groundwater;
- water which has been dewatered from the pit;
- runoff from the MIA and ROM stockpiles;
- runoff from the truck laydown area;
- runoff from the internal haul road between the mining pit and the MIA which will accommodate trucks hauling coal between the pit and the MIA; and
- runoff from the workshop area.

This water will have the potential to come into contact with coal and hydrocarbons and therefore is mine-affected under the Project EA. Management of mine-affected water is outlined in Section 4.4.1.

3.4.2 Surface water

Surface water is likely to be generated from the following activities/areas (Figure 3.1):

- runoff from the out of pit and in pit spoil dumps which does not runoff into the pit. The runoff from these dumps is not expected to come into contact with coal or other carbonaceous materials. The runoff may contain high sediment loads but is not expected to contain elevated levels of other water quality parameters (e.g. EC, pH, metals, metalloids, non-metals). The runoff will be managed to ensure adequate sediment removal prior to release to receiving waters (i.e. drainage to sediment dams) and will not be mixed with pit water, tailings water or workshop water;
- runoff from the topsoil stockpiles, which is expected to have a high sediment load but will not come into contact with coal or other carbonaceous material;
- runoff from the northern and southern haul roads, between the MIA and the northern infrastructure area, and the MIA and the out of pit emplacement. These roads are not expected to have trucks carrying ROM coal as the main internal haulage for the site will be undertaken on haul roads between the pit and southern infrastructure area (to transport coal from the pits to the stockpiles);
- runoff from the mine access road; and
- runoff from the site offices and carpark.

Runoff from these areas will be managed through erosion and sediment control structures as outlined in Section 4.4.2.

3.4.3 Diverted

Diverted water is water which drains to the Project from offsite, including (Figure 3.1):

- water draining to the out of pit spoil dump from the southwest; and
- to the northern edge of the site from adjacent operations to the north.

This water is managed through diverted water drains as outlined in Section 4.4.3.

4 Surface water management

4.1 OVERVIEW

This section of the WMP describes the objectives and principles of the water management system (WMS), including a description of the infrastructure and systems that have been put in place to achieve the objectives and principles.

4.2 MANAGEMENT OBJECTIVES

The objective of the WMP is to manage all types of water onsite to meet operational, social and environmental objectives given in the Project EA.

The key WMS objectives are as follows:

- Have a strategy that ensures the Project does not release mine affected water into receiving waters under a controlled release (pumped release).
- Have a strategy that ensures releases to receiving waters does not cause erosion of the bed or banks of the receiving waters or causes a material build-up of sediment.
- The release of water is monitored and reported in line with the Project EA.
- Design and construct sediment dams and mine affected water dams in compliance with quality standards specified in the Project EA.
- Ensure the maintenance and cleaning of vehicles, plant and equipment is not carried out in areas from which contaminants can be released into receiving waters.
- Ensure spillage of wastes, contaminants or other materials is cleaned as quickly as practicable to minimise the release of contaminants to receiving waters.
- Manage and prevent saline and acid rock drainage from the site.

Specific objectives for each water type are as follows:

- External water: Ensure that external water allocation and associated infrastructure is sufficient to meet site demands under low rainfall conditions.
- Mine-affected water: Prevent uncontrolled discharges and ensure adequate water supplies are maintained for site demand during dry periods.
- Surface water: Maintain water quality leaving the Erosion and Sediment Control (ESC) structures to a quality as close to background levels as reasonably possible.
- Diverted water: Ensure that diverted water is separated from the mine-affected and surface water systems, and allowed to pass uninterrupted down the catchment.

4.3 SURFACE WATER MANAGEMENT PRINCIPLES

The general principles to manage surface water for the site are as follows:

- The fullest separation possible of diverted, surface and mine-affected water runoff.
- Minimise the area of surface disturbance, thereby minimising the volume of surface runoff.
- Collect and contain onsite all potential mine-affected water in dedicated mine water storages. The mine water storage will be used as the primary water source for dust suppression.
- Retain and reuse onsite any surface water runoff that has high sediment concentrations whenever possible. If not, release it in a controlled manner in compliance with an Erosion and Sediment Control Plan (ESCP).

- Minimise the potential for generation of mine-affected water by limiting the locations of chemical and fuel storage areas and manage the areas in accordance with relevant specifications of AS1940 *Storage and Handling of Flammable and Combustible Liquids* (AS1940). Implement spill response and management procedures in accordance with relevant TARPS (trigger action response plans) for any accidental spills.
- Maximise the use of onsite water and thereby minimise the need for importing external water.
- Prioritise the use of poor-quality water over superior quality water.

4.4 WATER MANAGEMENT SYSTEM

The site WMS is shown in Figure 4.1, Figure 4.2 and Figure 4.3. The WMS progresses over the entire mine life, as the pit and dumps develop across the site:

- Figure 4.1 shows the WMS during Stage 1 of the mine life (2021 – 2022);
- Figure 4.2 shows the WMS during Stage 2 of the mine life (2023 – 2024); and
- Figure 4.3 shows the WMS under post-mining conditions.

The mine-affected water management, surface water management and diverted water aspects of the WMS are described in Section 4.4.1, 4.4.2 and 4.4.3 respectively.

4.4.1 Mine-affected water management

Mine affected water at the Project is managed as follows:

- There are three mine water storages onsite:
  - **MWD1**: the main mine affected water storage onsite. Dewaters the mine pit. Mine water drains direct runoff into MWD1 from the MIA, ROM stockpiles and truck laydown area, in addition to part of the southern haul road. Receives inflows from MWD3 prior to reaching full capacity.
  - **MWD2**: mine water dam within the southern extent of the backfilled in pit spoil dump. Dewaters the mine pit.
  - **MWD3**: mine water dam adjacent the workshop area. Mine water drains direct runoff from the workshop area to MWD3.
- Mine affected water from the three storages is used as a 1st priority for haul road dust suppression.

The WMS has been designed so that all runoff from activities generating mine affected water onsite (outlined in Section 3.4.1) drains to one of the three mine affected water storages (via overland flow and/or mine water drains) or to the pit, which is dewatered to the storages.

The maintenance and cleaning of vehicles, plant or equipment will only be carried out in areas where runoff drains to mine affected water storages (e.g. the MIA and ROM pad, truck laydown area and workshop area etc.).

Table 4.1 shows the mine affected dam details for the Project, including the full supply volume (FSV) of each dam and the operating rules for each dam which are applied if the operating volume (OV) is exceeded. The mine affected water dams have been designed to retain stormwater runoff generated by a 10% annual exceedance probability (AEP) 72-hour storm event between the OV and FSV.

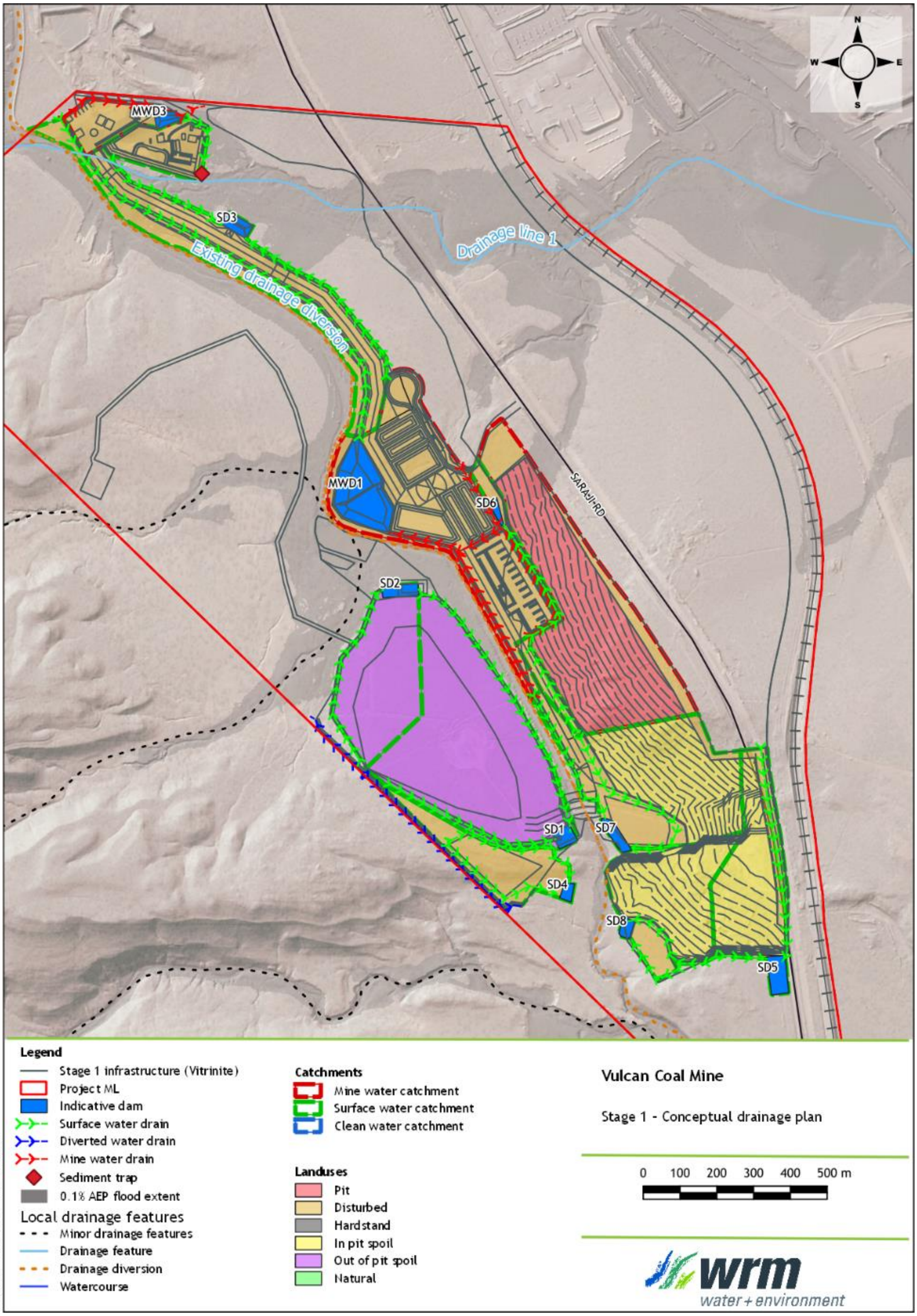

Figure 4.1 – Stage 1 (Year 2022) conceptual drainage plan

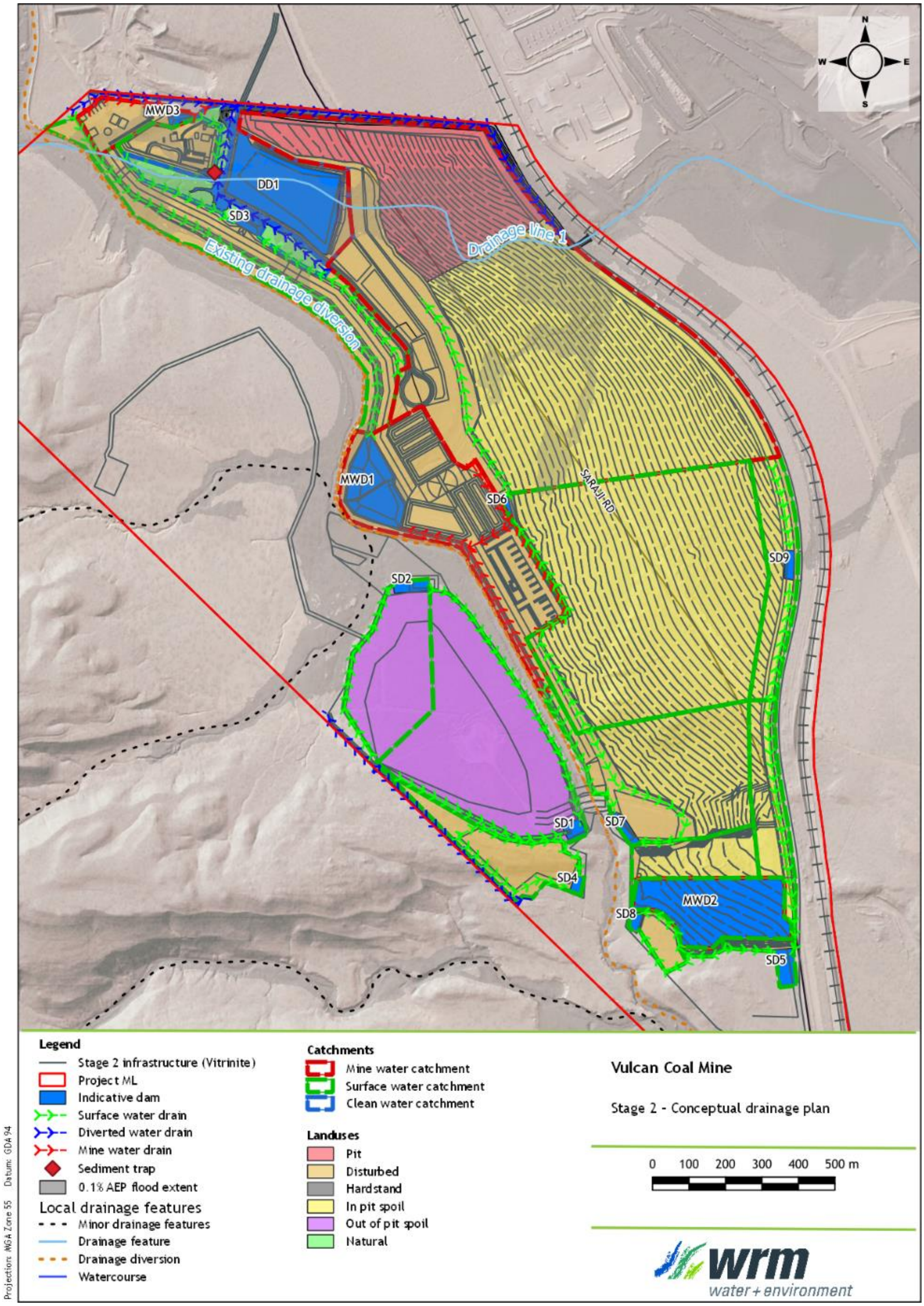

Figure 4.2 – Stage 2 (Year 2024) conceptual drainage plan

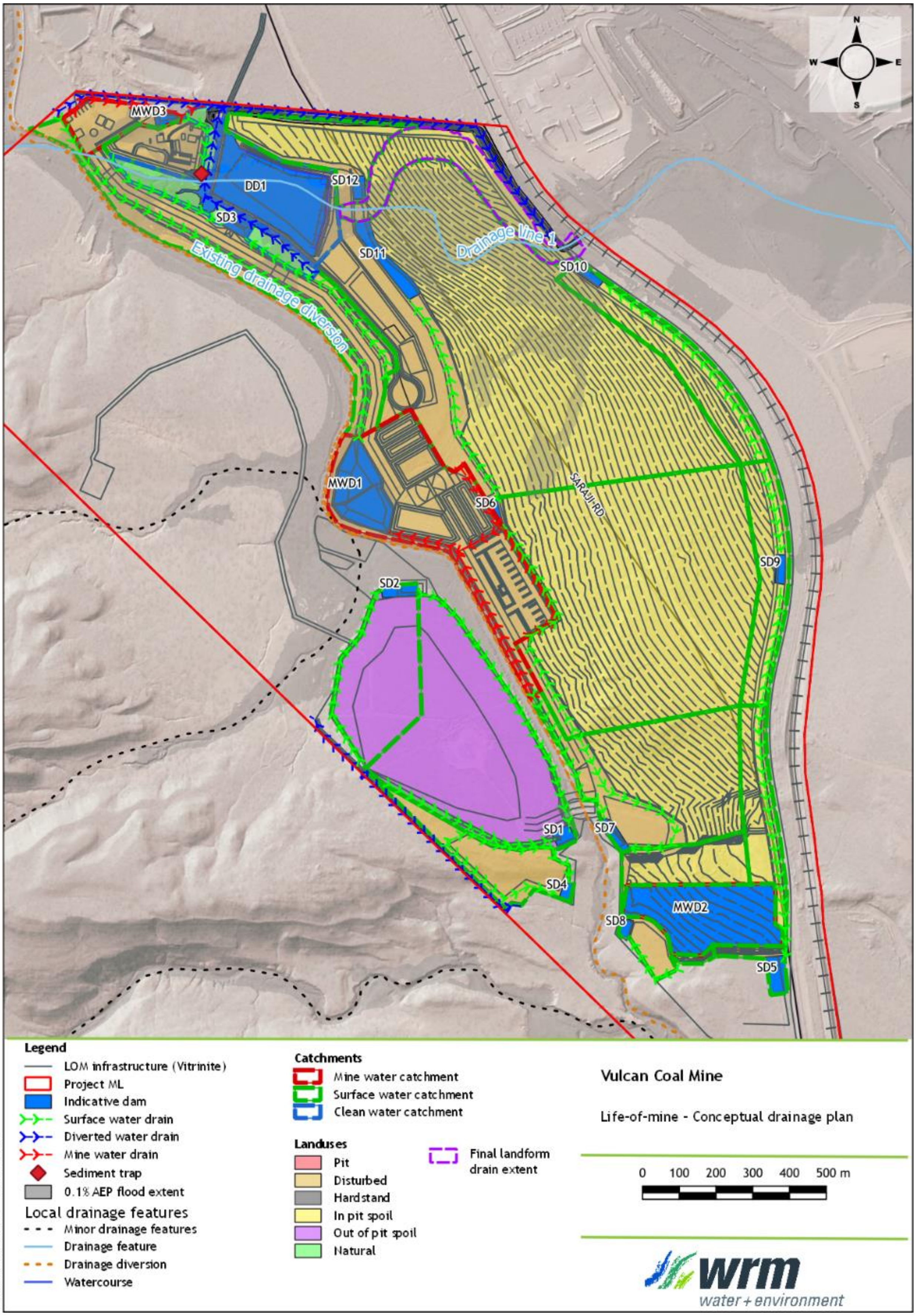

Figure 4.3 – LOM (post-mining conditions) conceptual drainage plan

Table 4.1 – Mine affected water storage details

Storage name	OV (ML)	FSV (ML)	Operating rules
MWD1	73.0	107.4	Above the OV, pit dewatering and MWD3 dewatering to MWD1 ceases. In addition, during Stage 2, MWD1 commences dewatering to MWD2
MWD2	300.0	321.2	Above the OV, pit dewatering to MWD2 ceases
MWD3	1.1	5.4	Above the OV, MWD3 commences dewatering to MWD1

In the event that transfer capacity is not available between the mine affected water storages, excess mine affected water will be pumped to the pit to prevent releases to the receiving environment.

4.4.2 Surface water management

Surface water generated from the Project is managed as follows:

- **the in pit spoil dump**: generates runoff to surface water drains on its perimeter which drain to sediment dams SD5, SD6, SD7, SD8, SD9, SD10, SD11 and SD12.
- **the out of pit dump:** generates runoff to surface water drains on its perimeter which drain to sediment dams SD1 and SD2.
- **topsoil stockpiles:** drain via either overland flow or via surface water drains to sediment dams SD4, SD7, SD8 or SD11.
- **northern haul road:** drains via overland flow and via surface water drains through a culvert to SD3.
- **southern haul road:** partially drains to MWD1 and via surface water drains to SD6 and SD7.
- **site offices and carpark:** drain via a surface water drain on its eastern side to a sediment trap.

The above areas all drain to sediment dams/traps (via overland flow and surface water drains). Table 4.2 provides details for the proposed sediment dams for the Project.

Water from parts of the mine access road and central topsoil stockpiles drain directly into the pit and become mine affected. This water is managed in the mine affected water system.

The sediment dams and traps will be installed and managed in accordance with an ESCP which will be prepared for the Project. In the interim, Vitrinite will generally manage the ESC structures for the Project in line with the *Vulcan Bulk Sampling Project ESCP* (WRM, 2020b). Consistent with the IECA guidelines (2008), the sediment dams are not designed to provide 100% containment of captured runoff. Hence overflows will occur from the sediment dams when rainfall exceeds the design capacity. The sediment dams have been designed to contain an eighty-fifth (85^{th}) percentile 5-day rainfall event plus 50% sediment storage.

The potential for overflows from the proposed sediment dams have been modelled using a passive overflow rather than active release (to regain storage capacity within 5 days). This is with the exception of SD6, which is pumped to the existing drainage diversion at 2.7 ML/d following rainfall events.

Table 4.2 – Sediment dam details

Storage name	Release point		Sediment dam water source	Downstream monitoring point	Receiving waters description
	Latitude	Longitude			
SD1	-22.29316	148.18773	Out of pit spoil dump	VSW2	Drainage line 2 via the existing drainage diversion
SD2	-22.28714	148.18329	Out of pit spoil dump		
SD3	-22.27815	148.17893	Northern mine access road	VSW8	Drainage line 1
SD4	-22.29451	148.18781	Topsoil stockpile south of the out of pit spoil dump	VSW2	Drainage line 2 via the existing drainage diversion
SD5	-22.29651	148.19342	In pit spoil dump		Drainage line 2
SD6	-22.28512	148.18586	In pit spoil dump	VSW8	Drainage line 2 via the existing drainage diversion
SD7	-22.29309	148.18911	In pit spoil dump and topsoil stockpile	VSW2	
SD8	-22.29542	148.18936	In pit spoil dump and topsoil stockpile	VSW2	
SD9	-22.28652	148.19337	In pit spoil dump	VSW8	Drainage line 1
SD10	-22.27929	148.18825	In pit spoil dump		
SD11	-22.27914	148.18291	In pit spoil dump, topsoil stockpiles and mine access road		Drainage line 1 via the final landform drain
SD12	-22.27728	148.18213	In pit spoil dump		

4.4.3 Diverted water management

Diverted water generated from the Project is managed as follows:

- DD1 (operational in Stage 2) – a diverted water dam, located adjacent to the pit, which has been designed to provide the pit with flood immunity during heavy rainfall. DD1 has a spillway at 247.0 mAHD which drains to the north of the dam. A pump transfers water which collects in DD1 to the existing drainage diversion. The dam will only collect direct rainfall and flood runoff which overtops the existing drainage diversion during flood events.
- Northern diverted water drain (operational in Stage 2) - a diversion drain which has been designed to divert water around the northern side of the workshop area and pit. This drain collects the undisturbed catchment to the north of the pit, as well as any overflows from DD1.
- Southern diversion drains (introduced in Stage 1) – two drains on the western side of the out of pit emplacement which will drain the undisturbed catchment to the west of the mining area around the out of pit spoil dump and toward the existing drainage diversion.
- Existing drainage diversion – a bund which runs through the centre of the Project ML, which existed prior to operation of the Project. The drainage diversion collects runoff from the north and west of the Project and outlets at the southern edge of the Project.

4.4.4 External water management

External water at the Project is managed as follows:

- Mine affected water can be imported (assumed to be from Peak Downs) to supplement mine water demands.
- Vitrinite have a contract with Sunwater to receive water via the Bingegang pipeline.
- Potable water will be trucked to site.

4.5 CHEMICAL MANAGEMENT

Any spillages of hazardous materials will be cleaned up as quickly as practicable to minimise the release of wastes, contaminants or hazardous materials to the site WMS and into receiving waters.

4.5.1 Chemical storage

Primary chemical storage areas at the Project will be located in the MIA or in the workshop area. These storage facilities will be constructed and bunded generally in accordance with the relevant specifications of AS1940. Hazardous Substances Standard Operating procedures (SOPs) will be in place at these operations. A register will also be maintained onsite for all chemicals. Where appropriate, Safety Data Sheets (SDS) will be kept in storage areas or accessed online, as required.

4.5.2 Fuel storage

Fuel storage areas are a potential source of hydrocarbons. Primary fuel storage areas at the MIA and workshop area will be constructed and bunded in accordance with the relevant specifications of AS1940. Fuel storage areas will also be constructed at service and operational points across the mining lease.

Fuel storage areas associated with the Project operations will be inspected regularly, with repair and maintenance work completed on an as-needs basis. Bunded areas filled with stormwater are drained (i.e. diesel/oil storage bunding at warehouse drains to oil sump and onto oil separator system) or pumped out by a licensed contractor as soon as practicable to maintain the bunded volume.

4.5.3 Sewage

Sewage will be trucked offsite by registered waste transport contractors.

5 Mine site water balance

5.1 OVERVIEW

A water balance model was developed in the OPSIM water balance modelling software to assess the behaviour of the WMS at the Project over a modelled mine life of 4 years. The model was setup to run over two stages:

- Stage 1 (2 year duration): 1/1/2021 – 31/12/2022; and
- Stage 2 (2 year duration): 1/1/2023 – 31/12/2024.

The model was used to determine:

- the behaviour of the various onsite storages during the life of the Project;
- the ability and reliability of the various onsite storages to supply the mine site water requirements;
- the volume of potential 'surface' and/or 'mine-affected' water overflows from various onsite storages;
- the volume of 'external' (trucked water) water required to meet shortfalls in mine water demands; and
- the overall site water balance.

Details regarding the model setup (e.g. AWBM parameters, site water demands, groundwater inflows and catchment areas) are outlined in the following two reports:

- *Vulcan Complex Project Surface water assessment* (WRM, 2020a); and
- *Vulcan Complex Project Supporting information and responses to the Department of Environment and Science Information Request relating to surface water* (WRM, 2021).

The key model inputs are outlined in Section 5.2 and the key results are outlined in Section 5.3.

5.2 MODELLING CONFIGURATION

The model has been configured to assess the operations of all major components of the WMS. The inflows and outflows included in the model are given in Table 5.1.

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

Inflows	Outflows
Catchment runoff	Evaporation from water surface of storages
External water	Dust suppression demand
Groundwater	Operational water demand
	Releases

The operating models of the water balance model is outlined in Table 5.2.

Table 5.2 – Water balance model operational rules

Item	Node Name	Operating Rules
1	***External water supply***	
1.1	External water	• Mine affected water can be imported (assumed to be from Peak Downs) to supplement mine water demands. • External water received via the Sunwater Bingegang pipeline. • Supplies haul road dust suppression demands (3rd priority).
1.2	Trucked water	• Supplies the potable water demand.
2	***Supply to demands***	
2.1	Haul road dust suppression	• Sourced from the following: - 1st priority: MWD1/MWD2/MWD3. - 2nd priority: Sediment dams. - 3rd priority: External water. • 100% loss assumed; and • Demand values as per WRM (2020a).
2.2	Potable water demand	• Sourced from trucked water delivered to site; • 100% loss assumed; and • Assumed constant rate of 50 ML/yr (as outlined in WRM [2020a]).
3	***Pit water***	
3.1	Jupiter pit	• Proposed mining pit active during all stages. • Dewaters to MWD1/MWD2 at 100 L/s (8.64 ML/d), provided there is available storage. • Receives negligible groundwater inflows as outlined in WRM (2020a).
4	***Operation of mine affected dams***	
4.1	MWD1	• Proposed primary mine affected water storage; • Receives pumped inflows from the Jupiter pit at 100 L/s (8.64 ML/d) until MWD1 reaches its OV, at which point dewatering ceases. Pumped inflows recommence once the inventory drops below its OV. • Receives pumped inflows from MWD3 at 11 L/s (1 ML/d), until it reaches its OV.
4.2	MWD2	• Active in Stage 2. • Receives pumped inflows from the Jupiter pit at 100 L/s (8.64 ML/d) until MWD2 reaches its OV, at which point dewatering ceases. Pumped inflows recommence once the inventory drops below its OV. • Supplies water to haul road dust suppression (1st priority).
4.3	MWD3	• Collects mine affected (potential) runoff from the mine workshop and laydown area. • Pumps to MWD1 at 11 L/s (1 ML/d) if MWD3 is above its OV and MWD1 is below its OV.
5	***Operation of sediment dams***	

5.1	Primary sediment dams (SD1, SD2, SD3, SD4, SD5, SD7, SD8, SD9)	• SD1 & SD2 collect water from the out of pit spoil dump. • SD5, SD7, SD8, SD9 collect runoff primarily from the in pit spoil dump. • SD3 and SD4 collect runoff primarily from topsoil stockpiles and mine access roads. • Supply water to the haul road dust suppression as 2nd priority. • Overflow to Boomerang Creek via Drainage Line 1/Drainage Line 2/existing drainage diversion.
5.2	SD6	• Collects runoff from the in pit spoil dump. • Pumps to the existing drainage diversion at 2.7 ML/d once it exceeds its sediment storage volume; and • Overflows to the pit.
6	***Clean water storages***	
6.1	DD1	• Active in Stage 2. • Diverted water dam used as flood protection for the Jupiter pit. • Transfers water to the existing drainage diversion at 100 L/s (8.64 ML/d) from empty. • Overflows to Drainage Line 1 via a diverted water drain which runs around the northern edge of the pit.

5.3 MINE SITE WATER BALANCE RESULTS

5.3.1 Overall mine site water balance

The annual average water balance for the Project based on the 125 climate realisations assessed are presented in Table 5.3. The results presented in Table 5.3 are the average of all realisations and will include wet and dry periods distributed throughout the mine life. Rainfall yield and evaporation for each stage is affected by the variation in climatic conditions within the adopted climate sequence.

Table 5.3 provides an indication of the long-term average annual inflows and outflows. Key outcomes from the overall water balance are as follows:

- Average annual inflows from rainfall runoff into mine affected and surface water dams increase from Stage 1 to Stage 2, as the pit progresses, and more catchment runoff is collected in mine affected water dams and sediment dams.
- The WMS is in negative balance under 'average' climate conditions. This indicates that the Project will likely require significant volumes of external water to meet mine water demands in drier years.
- External water requirements are greater in Stage 1 compared to Stage 2.

Table 5.3 – Water balance model operational rules

Description	Stage 1	Stage 2
	Inflows (ML/year)	
Rainfall Runoff		
Mine affected water	78.1	134.6
Surface water	91.8	117.6
Diverted water	0.0	16.0
Groundwater inflow	1.6	9.6
BMA Pipeline	113.5	75.4
Trucked potable water	50.0	50.0
Total Inflows	334.9	403.2
	Outflows (ML/year)	
Evaporation	13.7	32.5
Dam overflows		
Mine affected water	0.0	0.0
Surface water	49.8	78.6
Diverted water	0.0	0.0
Haul road dust suppression	216.1	216.1
Potable water demand	50.0	50.0
Total Outflows	329.7	393.2
	Change in stored volume (ML/year)	
Change in stored volume	5.2	9.9

5.3.2 Jupiter pit inventory

Figure 5.1 shows the forecast inventory of the Jupiter mine pit for the 1%ile (wettest climatic conditions), 5%ile, 10%ile, 25%ile and 50%ile percentile traces. The pit is continuously dewatered into MWD1 and MWD2, as long as the mine dams are maintained below their OV. MWD1 and MWD2 have been sized to keep the pit dewatered as long as practical given sizing constraints.

The model results show the following:

- Under very wet (1%ile) conditions, the Jupiter pit will have a forecast inventory of approximately:
    - up to 40 ML during Stage 1; and
    - up to 60 ML during Stage 2.
- Under wet (10%ile conditions), the Jupiter pit will have an inventory under 1 ML during both Stages 1 and 2.

The results suggest that pit dewatering may be constrained under very wet (between 1%ile and 10%ile) conditions in Stages 1 and 2, accumulating (on average) up to 60 ML. The addition of MWD2 in Stage 2 allows the pit to be dewatered under the majority of climate conditions for Stage 2 and is therefore expected to accumulate water under only the wettest (1%ile – 5%ile) conditions.

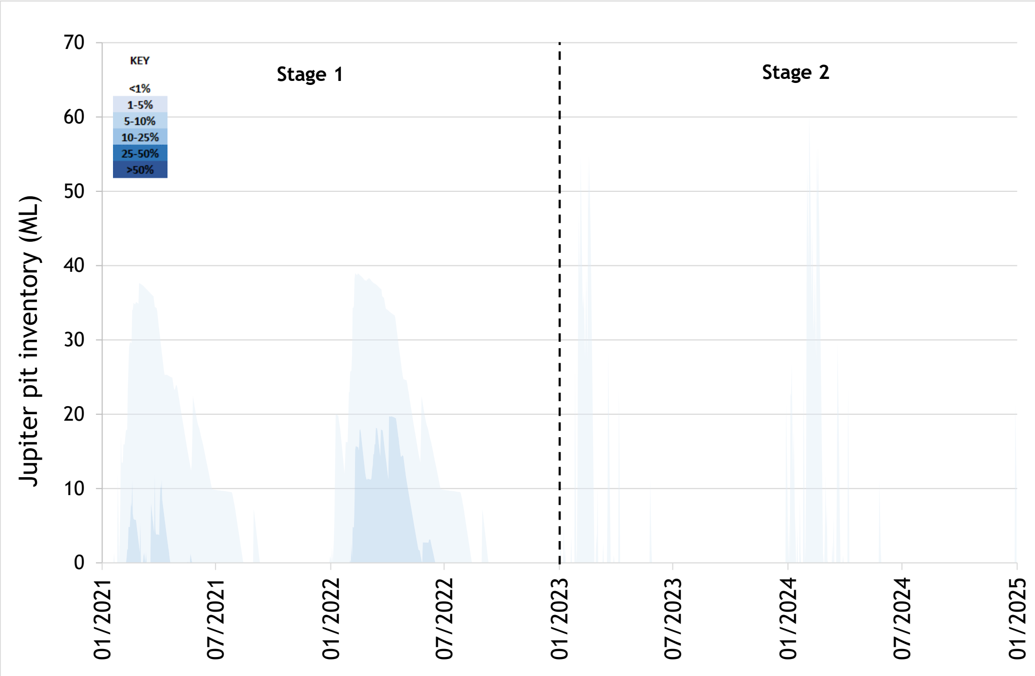

Figure 5.1 – Jupiter forecast mine pit inventory

5.3.3 Mine water dam inventories

MWD1, MWD2 and MWD3 are the mine affected water dams on site. MWD1 and MWD2 dewater the pit following rainfall events. MWD3 collects runoff from the workshop area and dewaters to MWD1 when it rises above its OV. The OVs of these dams have been designed to keep the pit as dry as possible while also limiting the requirement to transfer water back to the pit.

The mine affected water dams are not predicted to spill under any of the 125 modelled realisations.

The forecast combined maximum inventory of the mine affected dams is shown in Figure 5.2. Figure 5.2 also shows the combined OVs and FSVs of the mine affected dams.

The model results show that:

- the combined water inventories in MWD1, MWD2 and MWD3 remain below the combined FSV under all climatic conditions assessed and therefore are not predicted to spill under any modelled climate sequence;
- under 25%ile and drier conditions, the maximum mine water inventory is maintained below the combined OV for all years; and
- under 10%ile conditions, the maximum mine water inventory is above the combined OVs for Stage 1, but under the combined OV for Stage 2.

The results indicate that the mine water dams are utilised, to some extent, under the majority of conditions, but are not at risk of surpassing their FSVs, even under extremely wet (<1%ile) conditions.

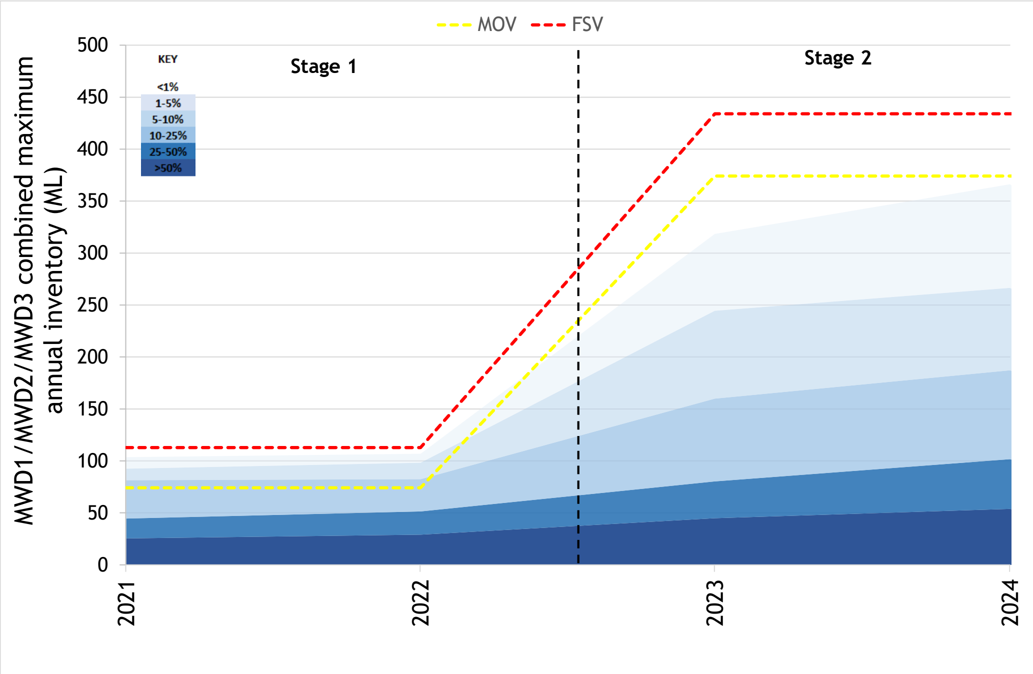

Figure 5.2 - Forecast mine affected water inventory

5.3.4 Sediment dam discharges

Consistent with the IECA guidelines (2008), the sediment dams are not designed to provide 100% containment of captured runoff. Hence overflows will occur when rainfall exceeds the design capacity.

The potential for overflows from the sediment dams have been modelled using a passive overflow rather than active release (to regain storage capacity within 5 days) with the exception of SD6, which is pumped to the existing drainage diversion at 2.7 ML/d following rainfall events.

Figure 5.3 shows the forecast annual sediment dam releases to the receiving waters (including the pumped flows from SD6) which indicate that:

- Under wet (10%ile) conditions, the annual volume of sediment dam releases to the receiving waters are approximately:
  - up to 150 ML/yr during Stage 1; and
  - up to 220 ML/yr during Stage 2.
- Under 50%ile conditions, the annual volume of sediment dam releases to the receiving waters are approximately:
  - up to 30 ML/yr during Stage 1; and
  - up to 50 ML/yr during Stage 2.

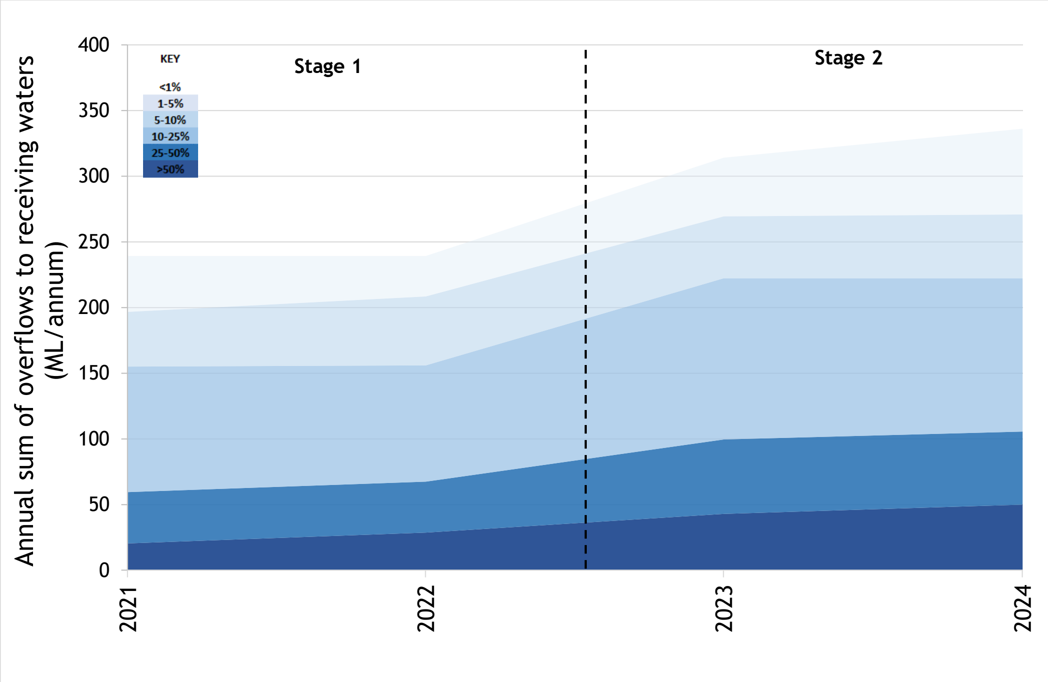

Figure 5.3 – Forecast annual sediment dam overflows to receiving waters

6 Saline and acid rock drainage

6.1 GEOCHEMICAL TESTING

RGS (2020) completed a geochemical assessment of the material at the site.

RGS obtained and tested 138 representative samples of waste rock (overburden and interburden; including roof, floor and parting materials) from 21 drill holes within the Project site and surrounds. Of these drill holes, 7 were located in the Jupiter target area and 14 were located in the surrounding area (specifically from the Vulcan proposed mining area to the south). RGS completed static and kinetic geochemical tests on the samples to determine their potential for acid mine drainage (AMD) and salinity.

RGS (2020) determined the following:

- The overwhelming majority (137 of 138) of the waste rock samples contained negligible sulfide content, had excess acid neutralising capacity (ANC), and were classified as non-acid forming (NAF). One of the samples was classified as uncertain. Overall, the waste rock samples were classified as having a very low risk of acid generation and a high factor of safety with respect to acid drainage.
- coal reject materials have relatively low sulfide content and excess ANC. As a bulk mixed material, it is expected that coal reject will be classified as NAF and have a relatively low risk of generating acidic drainage. Given that coal from the will be washed and processed offsite there is a low likelihood of runoff from coal rejects causing contamination in the Project's receiving waters.
- Initial and ongoing surface runoff and seepage from mine waste materials was expected to be pH neutral to slightly alkaline and have a low level of salinity.

In consideration of the RGS (2020) results, material at the site is expected to be benign and the potential risk of saline and acid rock drainage is expected to be low.

6.2 MANAGEMENT MEASURES

Notwithstanding the low risk of acid rock or saline drainage outlined above, the following measures have been outlined to manage saline and acid rock drainage:

- The WMS has been designed to manage mine affected water separately from other water types at the Project, as outlined in Section 4.4.1. This includes designing specialised mine water storages inline with the Project EA and reusing mine affected water as a priority to avoid spills to receiving waters. Mine water drains ensure mine affected is managed separately from other types of runoff in the Project area.
- Surface water will be managed in the surface water system (as outlined in Section 4.4.2), including drainage through surface water drains to sediment dams which will be managed in accordance with a site ESCP. In consideration of the RGS findings, the runoff from the in pit and out of pit spoil dumps may contain high sediment loads but is not expected to contain elevated levels of electrical conductivity or pH. The runoff will be managed to ensure adequate sediment removal prior to release to receiving waters (i.e. drainage to sediment dams) and will not be mixed with pit water, tailings water or workshop water.
- Water is monitored in the Project at the sediment dam release points and in the receiving waters for a number of water quality parameters, including pH and EC as outlined in Section 7. These parameters are measured against trigger levels, which, if exceeded will trigger the requirement to undertaken an investigation and may require the development of immediate and long-term measures to avoid environmental harm.

7 Water monitoring plan

7.1 OVERVIEW

This section of the WMP provides an overview of the surface water monitoring program which assesses compliance with the Project EA and the objectives of the WMP. Further details regarding the monitoring program, including the sampling methodology and analysis process of the monitoring program, is described in the REMP (Vitrinite, 2021).

Surface water monitoring locations for the Project are shown in Figure 7.1.

7.2 SURFACE WATER MONITORING

7.2.1 Receiving waters monitoring

In accordance with condition F10 of the Project EA, Vitrinite will monitor the 4 receiving water locations shown in Figure 7.1. These locations will be monitored during natural flow events and release events (i.e. releases from sediment or mine dams) to achieve at least 24 sampling events over a 2-year period. Vitrinite will submit the results of the receiving waters monitoring to DES no more than 2 years from the commencement of activities to evaluate whether the site-specific trigger values prescribed in the Project EA are suitable.

In addition, in accordance with condition F7 of the Project EA, Vitrinite will ensure streamflow gauging stations are operated and maintained at the 4 receiving water locations to determine and record streamflows. The receiving water monitoring points are required to be monitored for the parameters specified in Table 7.1.

Table 7.1 – Contaminant trigger investigation levels

Parameter	Interim dam release point trigger value	Interim downstream monitoring point trigger value	Frequency
pH (pH units)	6.5 - 8.5	6.5 - 8.5	Upon commencement (the first sample must be taken within 2 hours of commencement of release), daily during release, and within 2 hours after cessation of release.
Electrical Conductivity (µS/cm)	Low Flow[1] <864 Medium Flow[2] <600 High Flow[3] <300	Low Flow[1] <720 Medium Flow[2] <500 High Flow[3] <250	
Total suspended solids (mg/L)[4]	109.2	91	
Turbidity (NTU)[4]	243.5	203	
Dissolved oxygen	64% - 132% saturation	80% - 110% saturation	
Sulphate (mg/L)	924	770	
Filtered metals and metalloids			
Filtered Lead (µg/L)	4.8	4	Upon commencement (the first sample must be taken within 2 hours of commencement of release), daily during release, and within 2 hours after cessation of release.
Filtered Mercury (µg/L)	0.72	0.6	
Filtered Arsenic (µg/L)	28.8	24	
Filtered Aluminium (µg/L)	362.4	302	
Filtered Molybdenum (µg/L)	40.8	34	
Filtered Selenium (µg/L)	13.2	11	

Note: [1] = Less than 0.5 m^3/s. [2] = (>0.5 – 5.0 m^3/s). [3] = >5.0 m^3/s where 10 m^3/s is the maximum release rate in a high flow event. [4] = Interim dam release point trigger values for TSS and Turbidity can be exceeded for water discharged from the sediment dam during uncontrolled releases during a heavy rainfall event over and above the sediment dam's design storage capacity specified in condition F21 of the Project EA.

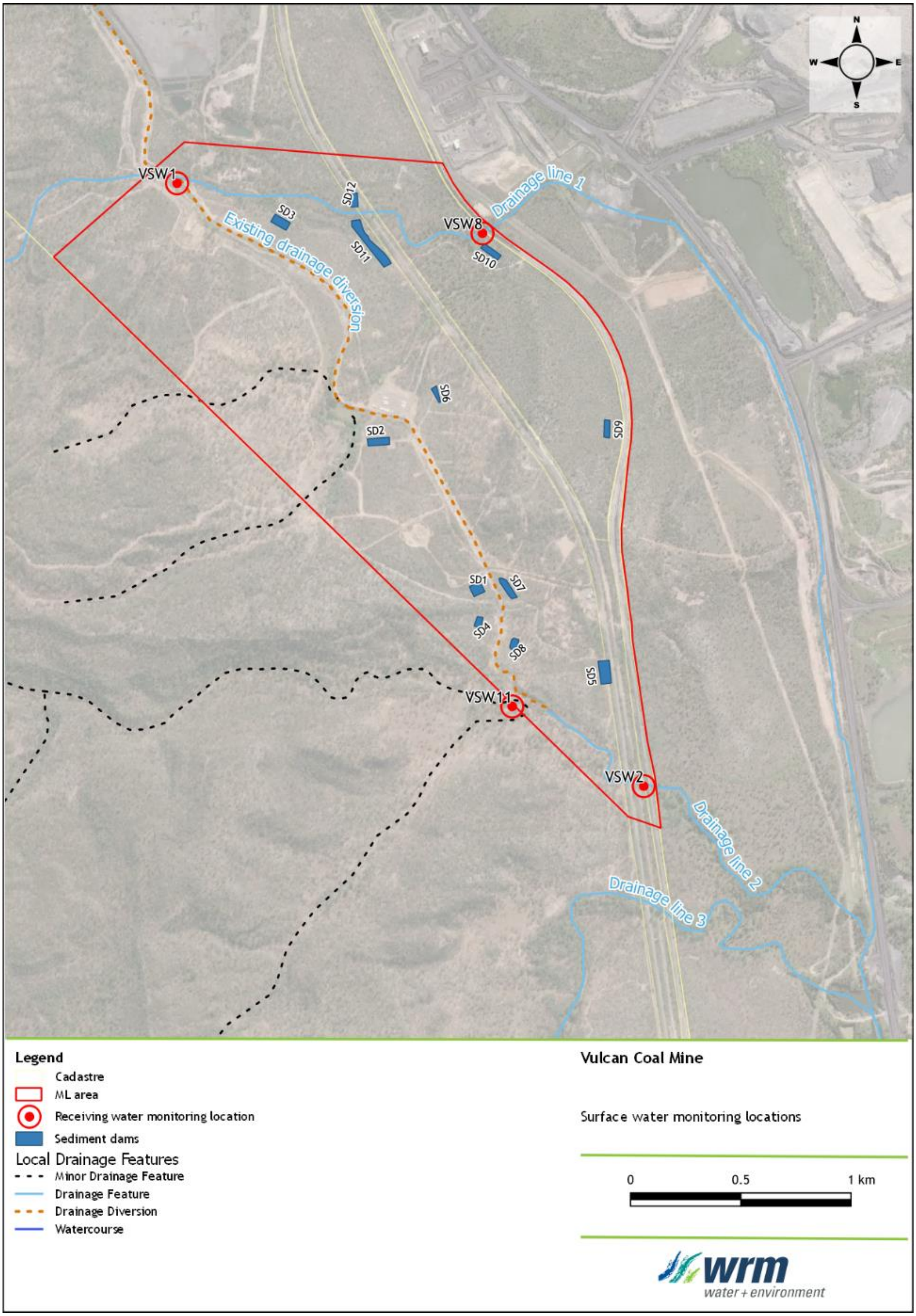

Figure 7.1 – Proposed surface water monitoring locations

Receiving waters monitoring locations are classified as upstream or downstream sites to assist with trigger investigations. The sites are classified as follows:

- VSW1 and VSW11 are classified as upstream sites; and
- VSW2 and VSW8 are classified as downstream sites. These sites are classified as downstream sites corresponding to particular storages, as outlined in Table 4.2.

7.2.2 Sediment water release monitoring

In accordance with condition F5 of the Project EA releases from sediment dams will be monitored at their release points for the water quality parameters specified in Table 7.1. The Project sediment dams are shown in Figure 7.1 and details regarding the sediment dams (including the location of release points) is outlined in Table 4.2.

7.2.3 Mine affected water release

In accordance with condition F13 of the Project EA, in the event of an uncontrolled release from a mine affected water dam as a result of a rainfall event that exceeds design specifications, Vitrinite will:

a) notify the administering authority via WaTERS within 24 hours of the commencement of the release;

b) notify the administering authority via WaTERS within 24 hours of the cessation of the release; and

c) conduct an investigation within 20 business days of cessation of the release.

In accordance with condition F14 of the Project EA, the investigation required under condition c) above must determine:

a) whether environmental harm has or may occur;

b) cause of the uncontrolled release;

c) where relevant, measures to address environmental harm; and

d) where relevant, measures to prevent recurrence of uncontrolled release(s).

Vitrinite will submit the results of the investigation to the administering authority within 28 days after completing the investigation.

7.2.4 Trigger investigation

In accordance with condition F6 of the Project EA, Vitrinite will complete an investigation if water quality sampling identifies 3 consecutive exceedances of:

a) interim sediment dam release trigger values detailed in Table 7.1, at the sediment dams specified in Section 7.2.2; and

b) interim downstream monitoring point trigger values detailed in Table 7.1, at the receiving water locations specified in Section 7.2.1.

In accordance with condition F8 of the Project EA, where the quality characteristics of the release exceed any of the trigger values specified in Table 7.1 on 3 consecutive occasions, the environmental authority holder must compare the downstream results to the upstream results and:

a) where the downstream result is the same or a lower value than the upstream value for the quality characteristic and the trigger values are not exceeded, then no action is to be taken; or

b) where the downstream result exceeds the values specified in Table 7.1:

    1. if the result is less than the upstream monitoring site data, then no action is to be taken, or

2. if the result is greater than the upstream monitoring site data, complete an investigation and provide a written report to the administering authority via WaTERS within 90 days of receiving the result, outlining:

   i. details of the investigations carried out;

   ii. determine if the exceedance is a result of:

      a. activities authorised under the Project EA;

      b. natural variation; or

      c. neighbouring land uses;

3. if exceedances are a result of activities authorised under the Project EA, detail:

   i. level of environmental harm; and

   ii. actions taken to prevent environmental harm.

Where an exceedance of a trigger level has occurred and is being investigated, in accordance with a) and b) (1) above, no further reporting is required for subsequent trigger events for that quality characteristic.

In accordance with condition F9 of the Project EA, if an investigation occurs in accordance with condition b) (3) above, Vitrinite will determine whether environmental harm has or may occur, and detail:

a) strategies to implement immediate measures to reduce the potential for environmental harm; and

b) develop long-term mitigation measures to address any surface water contamination and prevent recurrence of surface water contamination.

Vitrinite must provide details of the measures implemented or to be implemented to reduce the potential for environmental harm as well as the long-term mitigation measures to the administering authority within 28 days after completing the investigation.

8 Emergency and contingency planning

8.1 OVERVIEW

The WMS for the Project has been developed for both normal operation and during extreme wet weather events in order to:

- minimise the risk of uncontrolled releases from mine-affected water dams; and
- ensure compliance with the Project EA.

A summary of the emergency response, should a failure of the WMS occur, is given below.

8.2 EMERGENCY MANAGEMENT

In accordance with condition A14 of the Project EA, all reasonable actions will be taken to minimise environmental harm, or potential environmental harm, resulting from any emergency, incident or circumstances not in accordance with the conditions of the Project EA.

In accordance with condition A11 of the Project EA, Vitrinite will notify the administering authority by written notification within 24 hours, of becoming aware of any emergency or incident or action which:

a) results in the release of contaminants not in accordance; or

b) is reasonably expected to be not in accordance with the conditions of the Project EA.

The notification provided to the administering authority will include, but not be limited to, the following information:

a) the holder of the environmental authority;

b) the location of the emergency or incident;

c) the number of the environmental authority;

d) the name and telephone number of the designated contact person;

e) the time of the release;

f) the time the holder of the environmental authority became aware of the release;

g) the suspected cause of the release;

h) the environmental harm caused, threatened, or suspected to be caused by the release; and

i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the later, written advice will be provided to the administering authority, including the following:

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

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

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

In the event of an uncontrolled release, Vitrinite will notify the administering authority and if required, undertake an investigation (including the implementation of appropriate management measures) as outlined in Section 7.

8.3 DAM MONITORING

The embankments of all dams will be monitored annually before the wet season, and during and after flow events to ensure they are operating satisfactorily and have not been damaged through erosion.

Should a dam become damaged, the stored water will be pumped to a suitable water storage facility to minimise the risk of an uncontrolled release to the downstream waterway. The Mine Site General Manager will be responsible for communicating with regulators. A suitably qualified person shall be used to inspect the dam. Repair work will occur as soon as practicable after damage has occurred.

8.4 WET WEATHER ACCESS

During wet weather, site access may be restricted due to impassable unsealed roads, flooding and safety issues. It is proposed that waterways which have short duration flows and are inaccessible in wet conditions have a rising stage sampler which can be used to take water samples, minimising exposure of personnel to extreme weather events.

8.5 POST-EVENT MONITORING

Dams and drains onsite will be inspected after any significant rainfall event where overflows from sediment dams occur.

Drains and dam spillways will be checked for erosion damage and repaired when required.

9 References

AARC Environmental Solutions Pty Ltd, 2019	*Vulcan Project Soil and Land Suitability Assessment*. October 2019.
DNRME, 2017	Department of Natural Resources, Mines and Energy (DNRME) (2017). Water Information Portal (https://water-monitoring.information.qld.gov.au/).
IECA, 2008	International Erosion Control Association (IECA) (2008). *Best Practice Erosion and Sediment Control Guideline*.
McKenzie NJ, Grundy MJ, Webster R and Ringrose-Voase, 2008	*Guidelines for Surveying Soil and Land Resources*. Australian Soil and Land Survey Handbook Series. CSIRO Publishing, Melbourne.
RGS Environmental Pty Ltd, 2020	*Geochemical Assessment of Waste Rock and Coal Reject Vulcan Complex Project*. Prepared for Vitrinite Pty Ltd.
Vitrinite Pty Ltd, 2021	*Receiving Environment Monitoring Program Vulcan Coal Mine*. November 2021
WRM, 2020a	*Vulcan Complex Project Surface Water Assessment*, WRM Water & Environment Pty Ltd, September 2020, report prepared for MET Serve, Report Number 1571-06-B2.
WRM, 2020b	*Vulcan Bulk Sampling Project Erosion and Sediment Control Plan*. Prepared for Vitrinite Pty Ltd. 1571-02-B3. 9 January 2020.
WRM, 2021	*Vulcan Complex Project Supporting information and responses to the Department of Environment and Science Information Request relating to surface water*. Prepared for Vitrinite Pty Ltd. 1571-12-B1. 14 April 2021.