Whitehaven

Blackwater North Extension Project

Appendix B
Surface Water Assessment



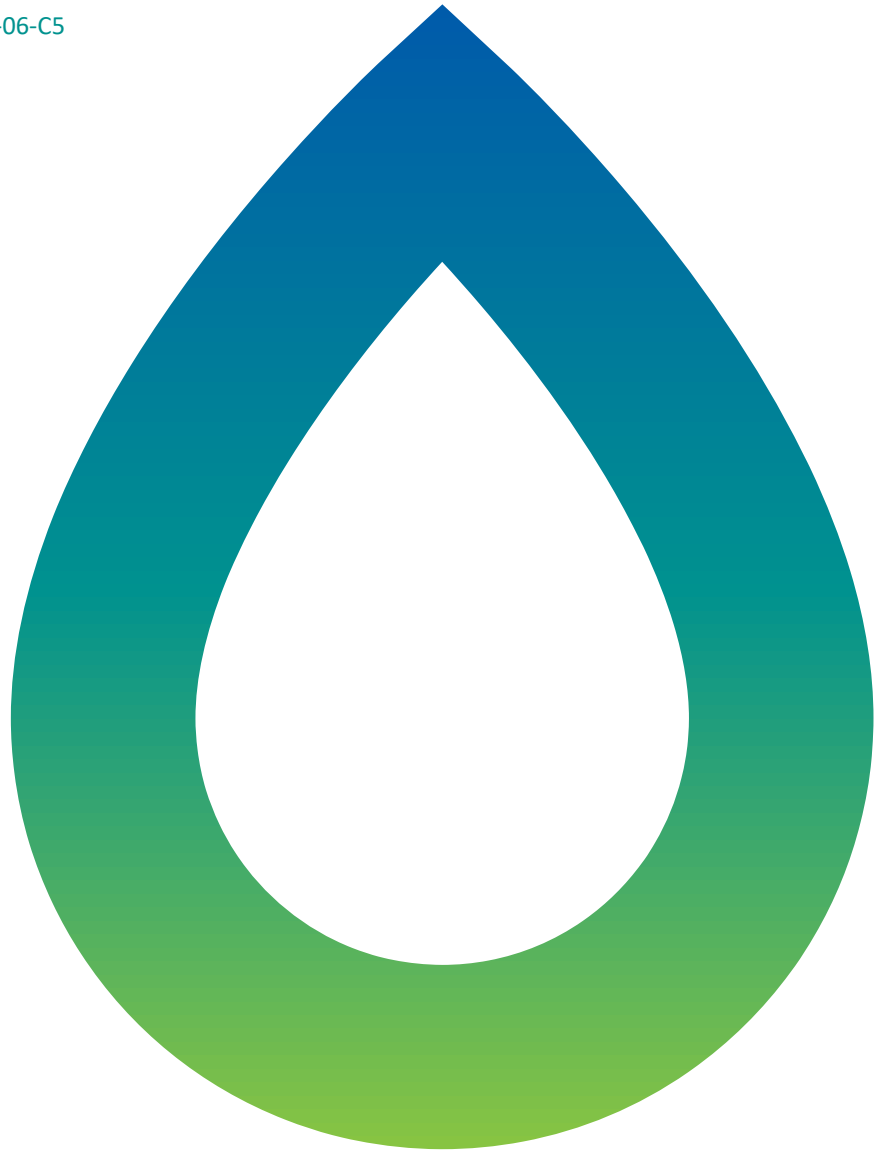
BLACKWATER NORTH EXTENSION PROJECT

Surface Water Assessment

Whitehaven Blackwater Pty Ltd

15 October 2026

1559-06-C5



DETAILS

Report Title	Blackwater North Extension Project, Surface Water Assessment
Client	Whitehaven Blackwater Pty Ltd

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Author	Ardianto Notodirdjo
Reviewer	Michael Batchelor

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1 INTRODUCTION

1.1 BACKGROUND

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (refer to Figure 1.1). BWM's Mining Leases (MLs) include ML 1759, ML 1760, ML 1761, ML 1762, ML 1767, ML 1771, ML 1772, ML 1773, ML 1792, ML 1800, ML 1812, ML 1829, ML 1860, ML 1862, ML 1907, ML 70091, ML 70103, ML 70104, ML 70139, ML 70167 and ML 70329 (refer to Figure 1.1).

The BWM has been in operation since 1967 and is currently owned and operated by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven). It operates under Environmental Authority (EA) EPML00717813, granted under the Queensland *Environmental Protection Action 1994* (EP Act).

The BWM comprises a series of open cut mining pits along an approximately 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, and truck and shovel fleets for overburden removal and haulage. The BWM produces up to 17.6 million tonnes per annum (Mtpa) of product coal, predominantly high-quality coking coal for use in steelmaking as well as high energy thermal coal.

Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

1.2 PROJECT DESCRIPTION

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on ML 1762 and SA 10 on ML 1759 (Figure 1.1). The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML 1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;
- ongoing exploration activities in the Project area; and

- other associated infrastructure, equipment and activities.

Figure 1.2 shows the general arrangement of the Project site, including the open cut pit extents within SA 7 on ML 1762 and SA 10 on ML 1759.

1.3 SCOPE OF WORK

This Surface Water Assessment (SWA) has been prepared to support the environmental approvals for the Project and aims to:

- Describe the existing surface water environment around the Project, including the hydrological setting, surface water quality characteristics, environmental values (EVs) and flooding behaviour.
- Describe the existing BWM Surface Water Management System (SWMS) and the proposed changes to the SWMS required as part of the Project.
- Assess potential impacts of the Project on the surface water environment, identify associated risks, and propose mitigation strategies to protect hydrological and ecological systems.

1.4 REPORT STRUCTURE

This report is structured as follows:

- Section 2 provides an overview of the regulatory framework for the Project.
- Section 3 describes the existing surface water environment, including baseline data on climate, drainage networks, and water quality.
- Section 4 provides an overview of the existing SWMS and the BWM site characteristics.
- Section 5 provides details on the water management objectives, strategies and systems, including water management infrastructure and erosion and sediment control (ESC) measures.
- Section 6 presents the results of the site water balance and evaluates the predicted behaviour of the SWMS and final voids under varying climatic conditions.
- Section 7 describes the predicted behaviour of the final voids under varying climatic conditions.
- Section 8 describes the flood behaviour under existing and future (Project) conditions and assesses the impact of the Project on flooding behaviour around BWM.
- Section 9 describes the impact of catchment loss resulting from the Project on flow regime in the waterways in the vicinity of the Project.
- Section 10 details the potential impacts of the Project and outlines mitigation and management measures to minimise adverse effects on surface water resources.
- Section 11 provides a list of references.

The report includes three appendices:

  - Appendix A describes the development and calibration of the hydrological model used to estimate design flood discharges across the Project area.
  - Appendix B describes the operational water balance model including inflows, outflows, and storage dynamics under varying climatic conditions completed by HydroBalance (2026). It was developed in coordination with groundwater modelling by SLR Consulting Australia Pty Ltd (SLR) (2026).
  - Appendix C assesses the potential for the Project to result in a surface water impact on the Great Barrier Reef World Heritage Property, National Heritage Place, and Marine Park, which are listed as Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Great Barrier Reef (GBR)

surface water impact assessment was undertaken by Water and Environment Pty Ltd (WRM) (2026).

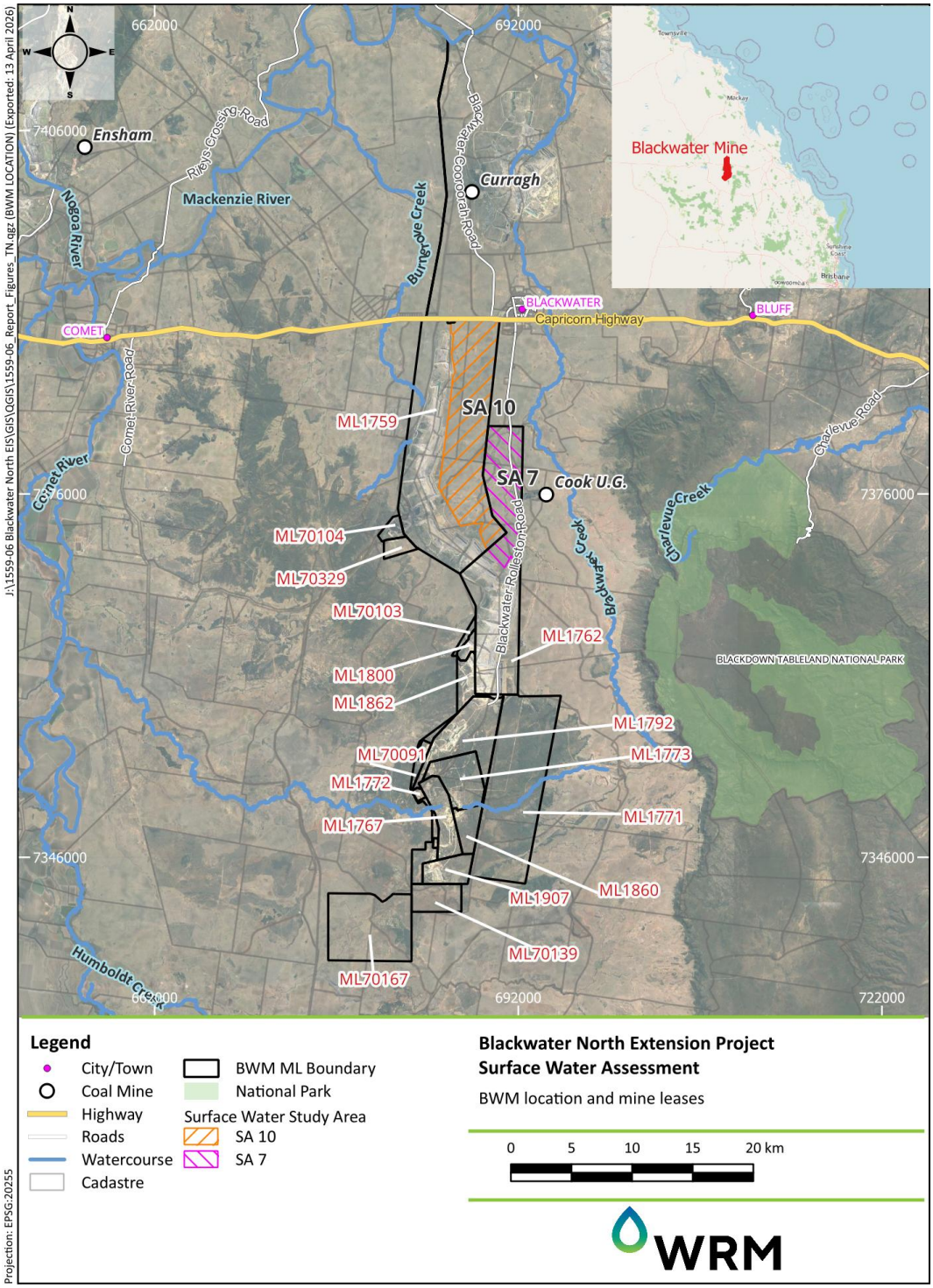


Figure 1.1 BWM Location and Mine Leases

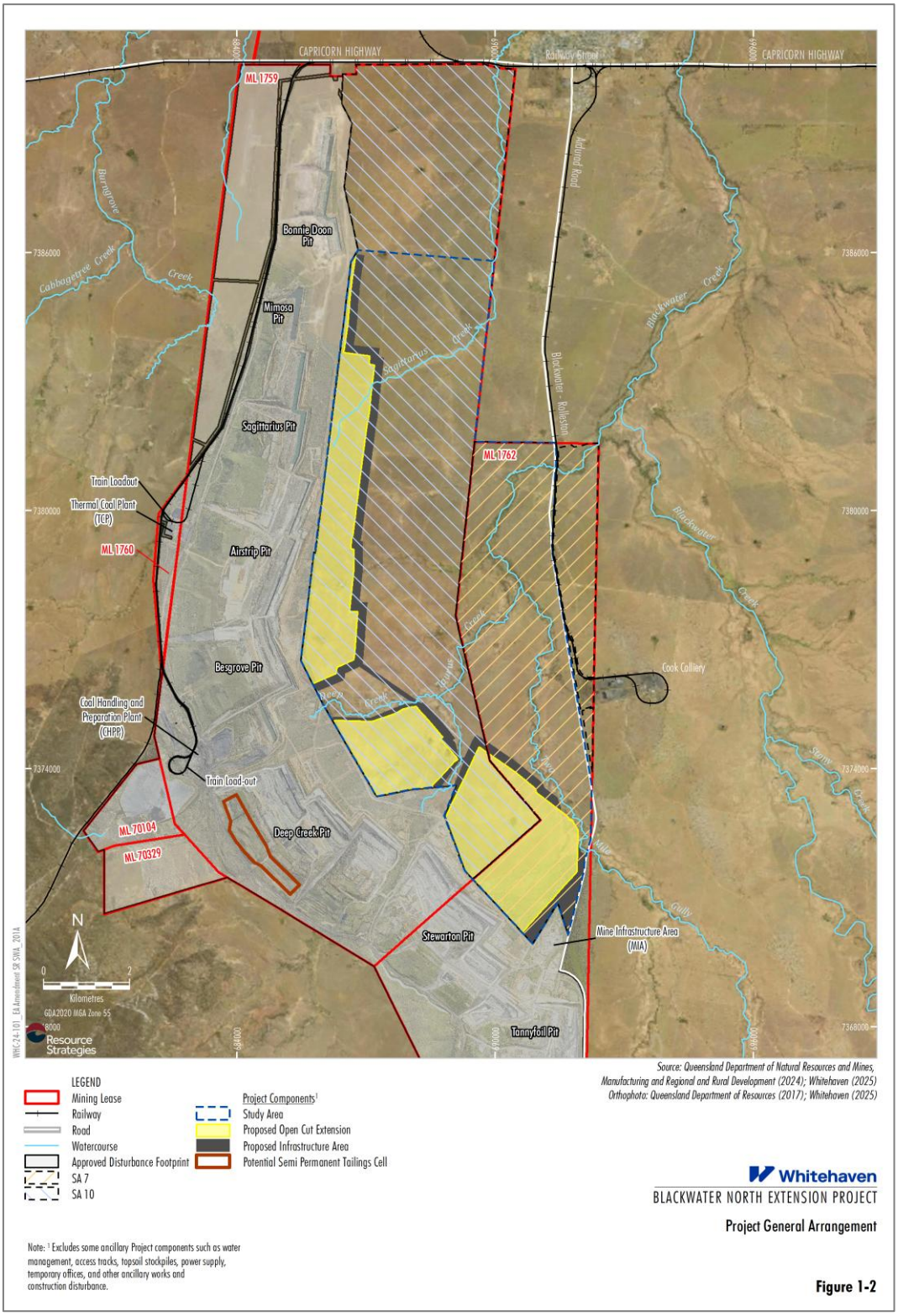


Figure 1.2 Project General Arrangement

2 REGULATORY FRAMEWORK

This section describes the regulatory framework (legislation, policies and standards) at Commonwealth and State level that would apply to surface water management for the Project.

2.1 COMMONWEALTH

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act outlines the requirements relating to the management and protection of MNES.

BM Alliance Coal Operations Pty Ltd (BMA) (former owners of the BWM) previously lodged a referral under the EPBC Act for the Project (EPBC 2023/09723). On 22 March 2024, the Department of Climate Change, Energy, the Environment and Water determined the Project to be a 'Controlled Action.' The controlled action includes 'a water resource, in relation to unconventional gas development and large coal mining development (sections 24D & 24E)' as the controlling provision relevant to this assessment.

Following Whitehaven Blackwater's acquisition of the BWM from BMA, the Referral was withdrawn on 6 November 2025.

2.2 QUEENSLAND

2.2.1 Environmental Protection Act 1994

2.2.1.1 Overview

Resource activities are defined as environmentally relevant activities (ERAs) under the EP Act, and as such, the development and operation of the Project are governed by the EP Act. The objective of the EP Act is to:

> *protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (**ecologically sustainable development**).*

2.2.1.2 Environmental Authority

An EA is granted in accordance with the EP Act and details the conditions that govern the ERA. In the context of surface water management, the EA will set out conditions that will be relevant to the Project, including:

- management of contained water including release;
- Water Management Plan (WMP) requirements;
- regulation of water structures including dams and levees;
- saline drainage management;
- acid rock drainage management; and
- storm water and sediment laden runoff management.

2.2.1.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water) is the primary instrument for surface water management under the EP Act. The EPP Water governs discharge to land, surface water and groundwater, aims to protect EVs and sets water quality guidelines and objectives.

The processes to identify EVs and to determine Water Quality Guidelines (WQGs) and Water Quality Objectives (WQOs) in Queensland waters are based on the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG (2018) guidelines).

2.2.1.4 Mackenzie Sub-basin Environmental Values and Water Quality Objectives 2011

The relevant document, pursuant to the EPP Water, for the Project is the *Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin, September 2011* (Department of Environment and Heritage Protection [DEHP], 2013). The document is made pursuant to the provisions of the EPP Water. It contains EVs and WQOs for waters in the Mackenzie River Sub-basin, and they are listed under Schedule 1 of EPP Water. Refer to Section 3.3 for further details.

2.2.1.5 Guideline – Application Requirements for Activities with Impacts to Water

The EP Act and the *Environmental Protection Regulation 2019* (EP Regulation) specify the regulatory requirements for prescribed ERAs. The *Guideline – Application requirements for activities with impacts to water* (Department of the Environment, Tourism, Science and Innovation [DETSI], 2026) focuses on the types of impacts that ERAs can have on water and outlines the information to be provided to the department as part of the ERA application process.

Section 4 of the guideline requires the applicant to provides details on a number of surface water-related issues, including:

- discharges and releases;
- unplanned and uncontrolled releases;
- water infrastructure;
- wetlands;
- hydrology of receiving waters; and
- mixing zones.

The guideline also refers to the department's technical guideline, *Wastewater release to Queensland waters* (DETSI, 2025a), which is discussed in Section 2.2.1.8.

2.2.1.6 Reef discharge standards for industrial activities

The *Reef discharge standards for industrial activities* (Department of Environment, Science and Innovation [DESI], 2024a) guideline (the Reef Discharge Standards) outlines the additional requirements to address section 41AA of the EP Regulation, regarding the potential impacts to the GBR catchment waters (GBR catchments) from the release of fine sediments (FS) and dissolved inorganic nitrogen (DIN). Section 41AA of the EP Regulation states:

> 3. *The administering authority must refuse to grant the application if the authority considers that –*
>
> *(a) the relevant activity will, or may, have a residual impact; and*
>
> *(b) having regard to the matters mentioned in the water quality offset policy, the residual impact will not be adequately counterbalanced by offset measures for the relevant activity.*
>
> 4. *A residual impact of a relevant activity is the presence of fine sediment, or dissolved inorganic nitrogen, in Great Barrier Reef catchment waters, or waters mentioned in subsection (1)(b), that –*
>
> *(a) was released to the water because of the relevant activity; and*

(b) remains, or is likely to remain in the water despite mitigation measures for the relevant activity.

The intent of section 41AA of the EP Regulation is to achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters as outlined in the *Reef discharge standards for industrial activities* (DESI, 2024a).

2.2.1.7 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures

The *Manual for assessing consequence categories and hydraulic performance of structures* (the Manual) (DETSI, 2025b) defines the methodology and assessment criteria to determine if a structure associated with an ERA should be regulated under the EP Act. The manual details the hydraulic design requirements for regulated structures and this document has been used as a reference in the preliminary design of the SWMS and preliminary sizing of dams associated with the Project.

2.2.1.8 Technical Guideline – Wastewater Release to Queensland Waters

The technical guideline, *Wastewater Release to Queensland Waters* (DETSI, 2025a) is provided to support a risk-based assessment approach to licensing releases of wastewater to surface water and applies the philosophy of the ANZG (2018) guidelines and the intent of the *Environmental Protection (Water) Policy 2009*.

2.2.2 Water Act 2000

2.2.2.1 Overview

In Queensland, the *Water Act 2000* (Water Act) is the primary statutory document that establishes a framework for the planning, allocation and use of non-tidal water. The Water Act is primarily administered by the Department of Local Government, Water and Volunteers (DLGWV).

The main purpose of the Water Act is to provide a framework for the following:

- The sustainable management of Queensland's water resources and quarry material by establishing a system for:
  - the planning, allocation and use of water; and
  - the allocation of quarry material and riverine protection.
- The sustainable and secure water supply for the south-east Queensland region and other designated regions.
- The management of impacts on underground water caused by the exercise of underground water rights by the resource sector.
- The effective operation of water authorities.

A watercourse is defined by the Water Act as a river, creek or stream in which water flows permanently or intermittently and includes the bed and banks and any other element of a river, creek or stream confining or containing water. The DLGWV have published a watercourse identification map of the state that shows: watercourses (other than their lateral limits); the downstream limit of watercourses; drainage features; lakes; and springs.

2.2.2.2 Water Plan (Fitzroy Basin) 2011

The *Water Plan (Fitzroy Basin) 2011* was developed under the Water Act to:

- define the availability of water in the Fitzroy Basin;
- provide a framework for sustainably managing water and the taking of water;
- identify priorities and mechanisms for dealing with future water requirements;
- provide a framework for establishing water allocations;
- provide a framework for reversing, where practicable, degradation in natural ecosystems;
- regulate the taking of overland flow water; and
- regulate the taking of groundwater.

2.2.2.3 Water Regulation 2016

Water Regulation 2016 is subordinate legislation to the Water Act and provides details, protocol and instruction for the following:

- Water rights and planning.
- Statutory authorisations to take or interfere with water.
- Matters relating to water licenses.
- Water allocations.
- Water supply and demand management.
- Declarations about watercourses.

2.2.3 Water Supply (Safety and Reliability) Act 2008

The Water Supply (Safety and Reliability) Act 2008 provides for the safety and reliability of water supply in Queensland. The purpose is achieved primarily by:

- providing a regulatory framework for providing water and sewerage services in the State;
- providing a regulatory framework for providing recycled water and drinking water quality, primarily for protecting public health;
- the regulation of referable dams; and
- stating flood mitigation responsibilities.

3 EXISTING SURFACE WATER ENVIRONMENT

3.1 DRAINAGE NETWORK

3.1.1 Overview

There are seven waterways within the vicinity of the Project. These waterways have been defined from the Ordered Drainage 100K mapping layer from the Queensland Government Qspatial website, which identifies riverine systems, watercourses, waterways or drainage lines (here referred to collectively as waterways) for the Project area. The drainage layer classifies the hierarchy of streams using the Strahler (1957) stream ordering system. A first order stream starts at the top of a catchment and has no other streams flowing into it. Second-order streams form when two first-order streams join. They are bigger in size due to the water from both first-order streams combining. Third-order streams form when two or more second-order streams join, and so on.

In the vicinity of the Study area, there are:

- two waterways of Strahler stream order five, which include Blackwater Creek and Taurus Creek (downstream of Two Mile Gully confluence);
- two waterways of stream order four, which include Two Mile Gully and Taurus Creek (upstream of Two Mile Gully confluence);
- three waterways of stream order three, which include Emu Creek, Deep Creek and Sagittarius Creek; and
- there are also several waterways of stream order one, which are minor drainage features that drain the Project area directly to Two Mile Gully and/or Taurus Creek.

Descriptions of these waterways are given below.

3.1.2 Regional drainage features

Figure 3.2 show the regional drainage characteristics in the vicinity of the Study area. The Project is located within the Mackenzie subcatchment of the greater Fitzroy Basin. Blackwater Creek, a tributary of the Mackenzie River, is the main watercourse in the vicinity of the Project area and flows in a northerly direction to the east of the Project. Figure 3.2 shows Blackwater Creek catchment to the Mackenzie River.

The Blackwater Creek catchment originates at its headwaters from the west of BWM and drains in an easterly direction across the BWM ML. Blackwater Creek drains north and joins the Mackenzie River approximately 33 km north of BWM.

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, discharging into the Coral Sea south-east of Rockhampton, near Port Alma. The total Fitzroy River catchment is 142,665 square kilometres (km²).

The catchment area of Blackwater Creek, encompassing the Project area, is approximately 1,100 km². This represents around 0.8 percent (%) of the overall Fitzroy River catchment. The Project disturbance footprint is approximately 23 km² and represents 2% of the Blackwater Creek catchment and 0.016% of the overall Fitzroy River catchment area.

3.1.3 Local drainage features

3.1.3.1 Overview

Figure 3.3 shows the local drainage features in the vicinity of the Study area, which comprise of several waterways of stream order two to three that are tributaries of Blackwater Creek. Descriptions of these local waterways are given in the below subsections.

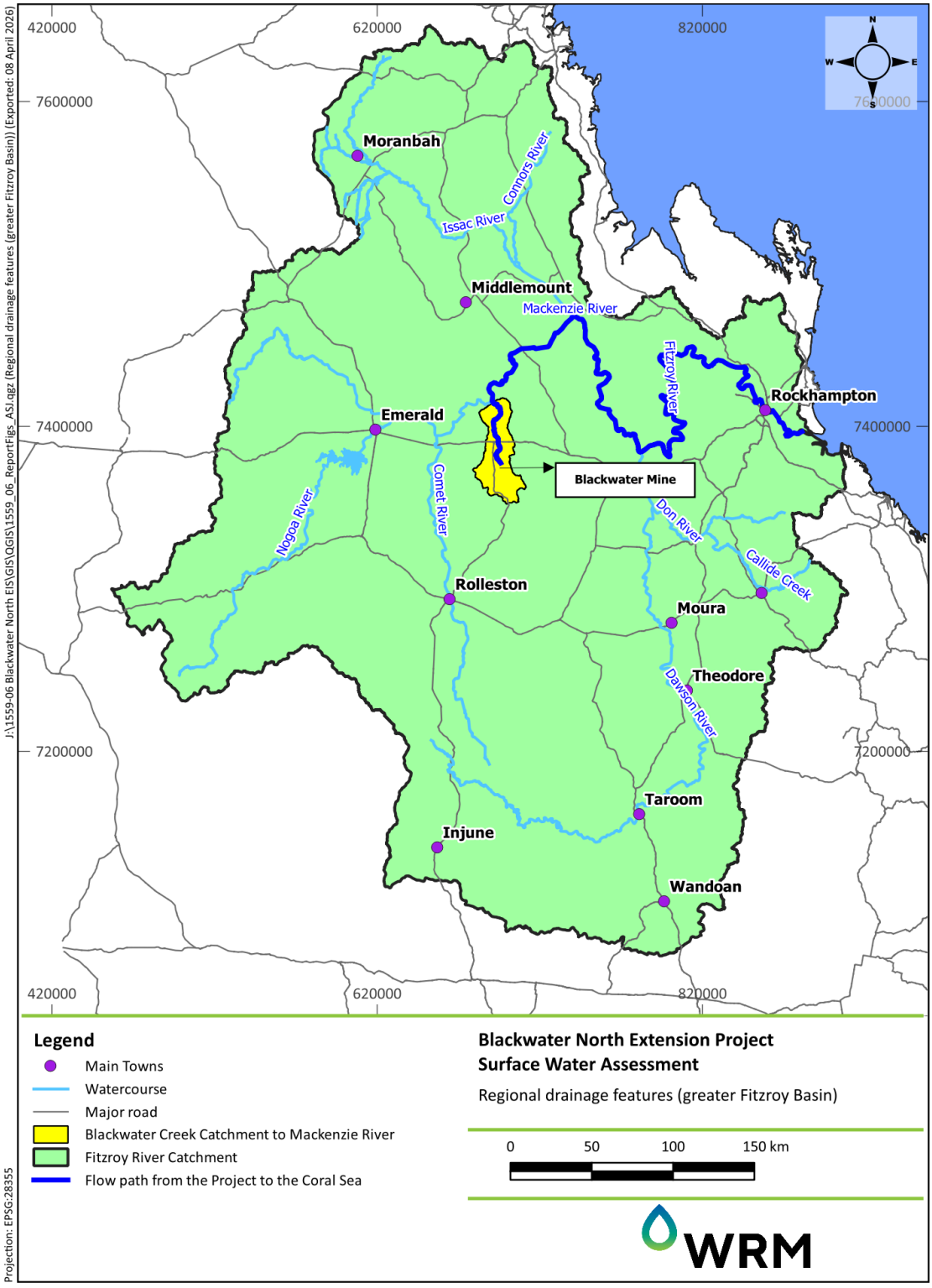


Figure 3.1 Regional drainage features (greater Fitzroy Basin)

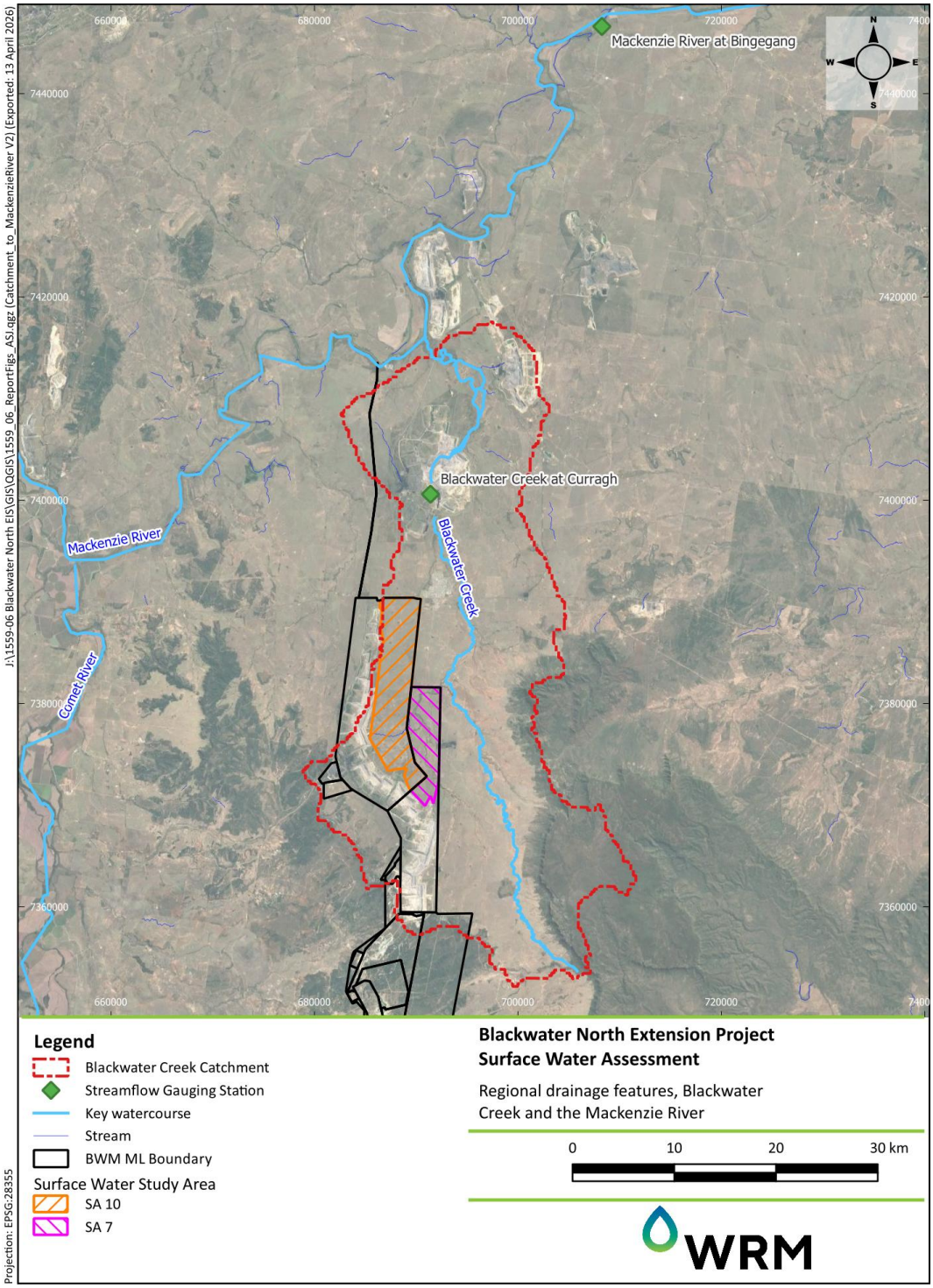


Figure 3.2 Regional drainage features, Blackwater Creek and the Mackenzie River

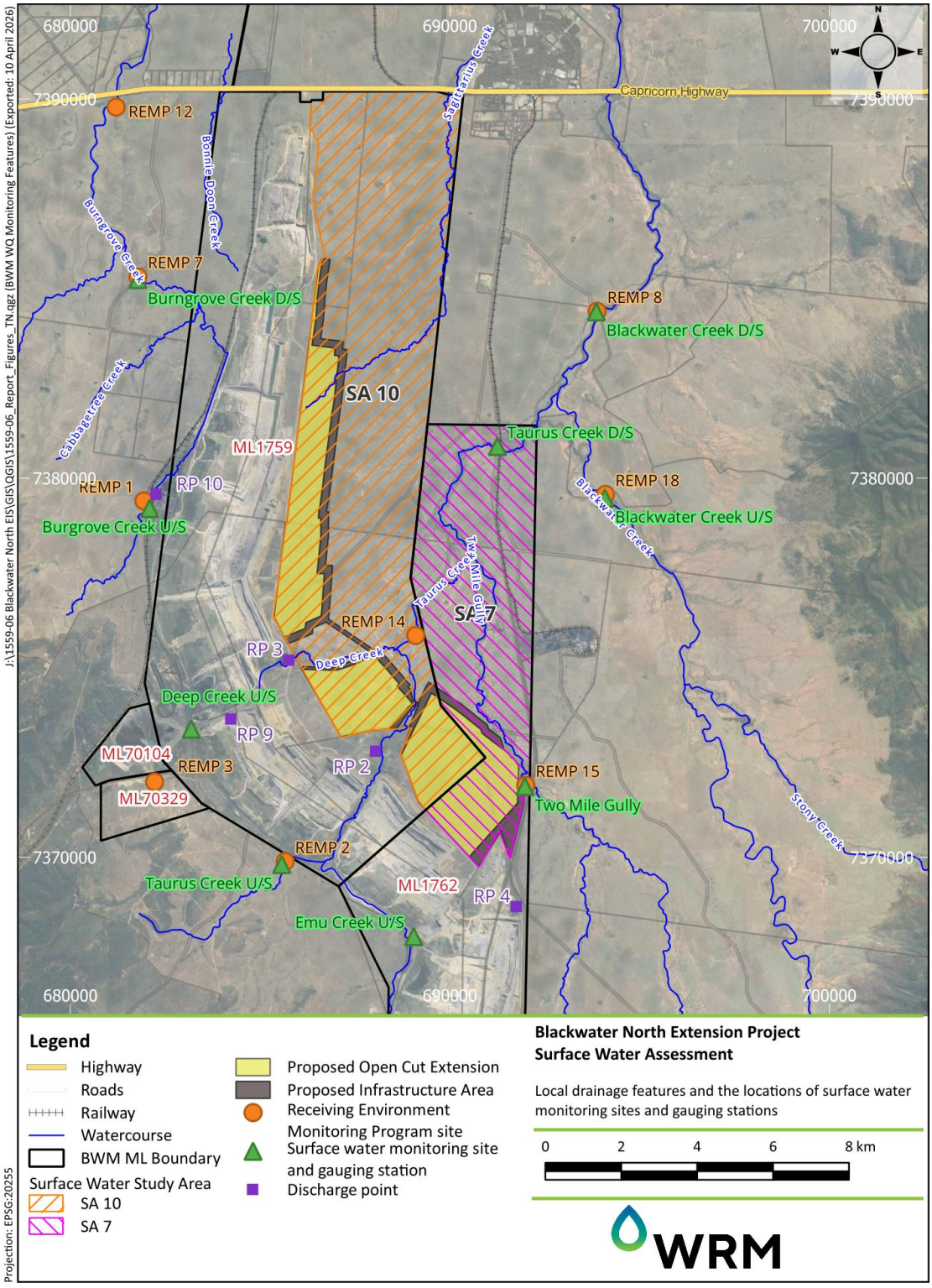


Figure 3.3 **Local drainage features and the locations of surface water monitoring sites and gauging stations**

3.1.3.2 Taurus Creek

Taurus Creek, a major tributary of Blackwater Creek, originates from the east of BWM and drains in a north-easterly direction across BWM. It drains as a stream order three waterway between existing overburden dumps, then between the Deep Creek and Stewarton open cut pits and into the New Taurus Creek Dam. New Taurus Creek Dam is an online water storage dam that forms a key part of the SWMS. Downstream of New Taurus Creek Dam, Taurus Creek continues to drain in a north-easterly direction and becomes a stream order four waterway as it joins Deep Creek immediately downstream of the Project area. Taurus Creek drains to Blackwater Creek approximately 5 km east of the Project area.

3.1.3.3 Emu Creek

Emu Creek, a tributary of Taurus Creek, originates from the west (upstream) of BWM and flows in a north-easterly direction towards BWM. Within the BWM ML, the natural Emu Creek channel has been largely consumed by mining activities. The downstream reaches of Emu Creek have been replaced by the non-regulated Emu Creek Diversion, which diverts the Emu Creek catchment to the north-west into Taurus Creek on the western side of BWM. The Emu Creek diversion is not located on a watercourse as defined under the Water Act. However, it was designed and constructed to be a permanent feature in line with applicable guidelines. Emu Creek, including the Emu Creek Diversion, drains as a stream order two waterway within the BWM ML until it joins Taurus Creek.

3.1.3.4 Deep Creek

Deep Creek, a tributary of Taurus Creek, originates from the west of BWM and drains in a north-easterly direction towards BWM. It drains as a stream order three waterway between existing overburden dumps, then between the Besgrove and Deep Creek open cut pits and into the New Deep Creek Dam. New Deep Creek Dam is an online water storage dam that forms a key part of the SWMS. Downstream of New Deep Creek Dam, Deep Creek continues to drain in a north-easterly direction and then joins Taurus Creek immediately downstream of the Project area.

3.1.3.5 Two Mile Gully

Two Mile Gully, tributary of Taurus Creek, flows in a northerly direction to the east of BWM. It drains as a stream order four waterway adjacent to and along the south-eastern portion of the Project area and then joints Taurus Creek about 5 km east of BWM.

The upper (and western) headwaters of the Two Mile Gully catchment has been consumed by mining activities at BWM. However, the central and lower sections of Two Mile Gully adjacent to the Project area are relatively undisturbed.

3.1.3.6 Sagittarius Creek

Sagittarius Creek, a tributary of Blackwater Creek, flows in a northerly direction along the eastern side of BWM. It drains as a stream order three waterway across the northern BWM ML boundary, passing the western side of Blackwater township and then join Blackwater Creek just downstream of Blackwater township.

The upper headwater of the Sagittarius Creek catchment, comprising several minor streams of order one or two, have been consumed by mining activities. However, the central and lower portions of the Sagittarius Creek catchment are relatively undisturbed.

3.2 STREAMFLOW

Historical flow and water level (river height) monitoring data was assessed to provide an indication of local flow regime in the vicinity of the Project and regional flow regime in the Mackenzie River. Table 3.1 shows the available water level data from two gauges owned by Whitehaven and three gauges owned by the DLGWV in the vicinity of the Project.

Table 3.1 Stream gauging stations

Gauge No.	Gauge name	Catchment area (km²)	Owner	Period of record	Easting (m) (GDA 94)	Northing (m) (GDA 94)
330124	Two Mile Gully	98	Whitehaven	2016 – 2025	692,093	7,372,042
330121	Taurus Creek D/S[a]	246	Whitehaven	2016 – 2025	691,367	7,381,013
130108A	Blackwater Creek at Curragh[b]	777	DLGWV	1972 – 1989	691,299	7,400,395
130108B	Blackwater Creek at Curragh[b]	776	DLGWV	1990 – 2009	691,299	7,400,395
130106A	Mackenzie River at Bingegang	50,860	DLGWV	1971 – present	708,267	7,446,599

[a] D/S = downstream, m = metres

[b] The two Blackwater Creek gauges (130108A and 130108B) are at the same location

Figure 3.4, Figure 3.5, Figure 3.6 and Figure 3.7 present daily discharge exceedance curves of flows (in megalitres per day [ML/d]) in Two Mile Gully, Taurus Creek, Blackwater Creek and the Mackenzie River, respectively, as recorded at the above stream gauging stations.

Figure 3.8, Figure 3.9, Figure 3.10 and Figure 3.11 present monthly box and whisker plots of stream flows (in megalitres per month [ML/month]) in Two Mile Gully, Taurus Creek, Blackwater Creek and the Mackenzie River, respectively, as recorded at the above stream gauging stations. The box and whisker plots show:

- The lower and upper extents of the 'whiskers' show the 10th and 90th percentile recorded monthly flows.
- The box represents the range within which 50% of recorded monthly flows fall. The lower bound of the box is the 25th percentile monthly flow (i.e. 25% of flows are equal to or smaller, 75% of flows are larger) while the upper bound of the box is the 75th percentile flow (i.e. 75% of flows are equal to or smaller, only 25% of flows are larger).
- The middle line in the box represents the median or 50th percentile recorded monthly flow (i.e. 50% of flows are equal to or smaller, 50% of flows are larger).

The data indicates the following:

- At all four watercourses, flows are most likely to occur during the summer months. Stream flows are highly variable, especially during the summer months.

- Two Mile Gully, Taurus Creek and Blackwater Creek are ephemeral streams, where flows occur during the summer months often in short durations, but generally drying out during winter and early spring. Stream flows greater than 10 ML/d occur less than (<) 3% of the time in Two Mile Gully, <6% of the time in Taurus Creek, and <14% of the time in Blackwater Creek. The higher frequency of low flows above 0.1 ML/d in Blackwater Creek at Curragh is likely due to releases from the Blackwater Sewage Treatment Plant, but it could also be due to mine releases.
- The Mackenzie River, around the confluence with Blackwater Creek, exhibits the characteristics of an ephemeral stream. Flows occur more regularly during the summer months and in longer durations, compared to the local creeks in the vicinity of the BWM. However, the river generally dries out during the winter months.

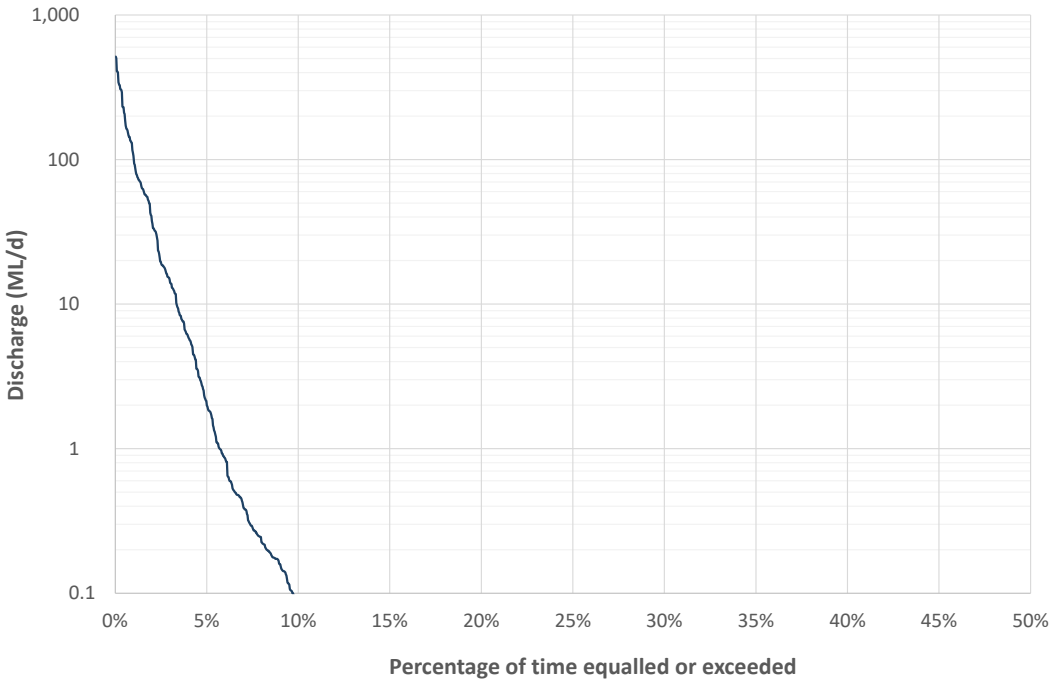


Figure 3.4 Daily discharge exceedance curve (2016 – 2025) at Two Mile Gully (Station No. 330124)

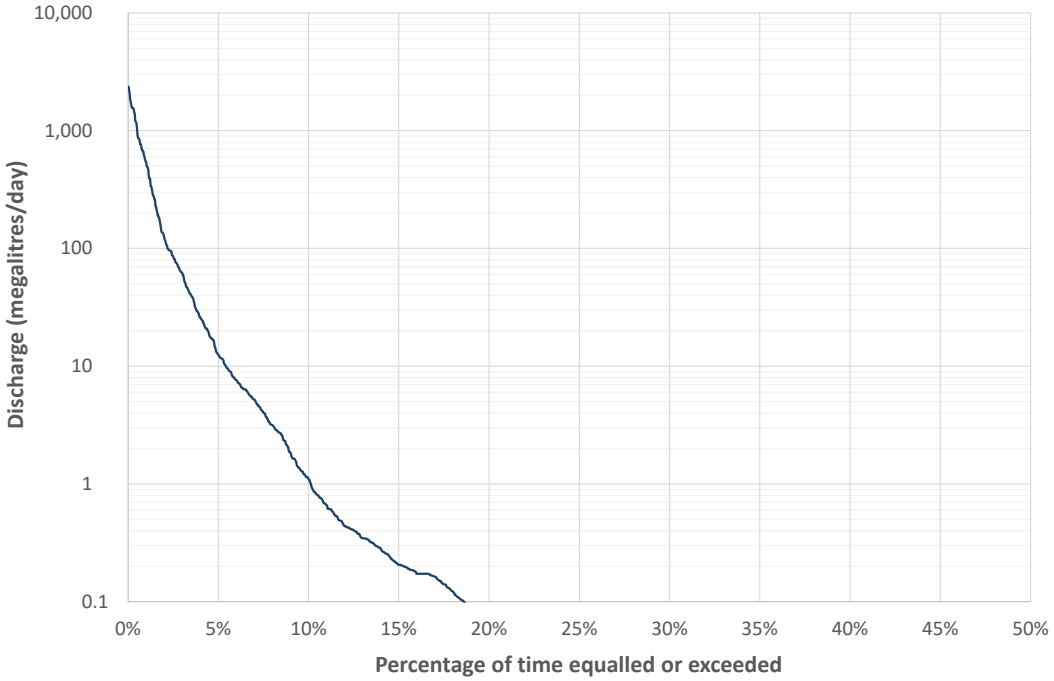


Figure 3.5 **Daily discharge exceedance curve (2016 – 2025) for Taurus Creek at Taurus Creek D/S (Station No. 330121)**

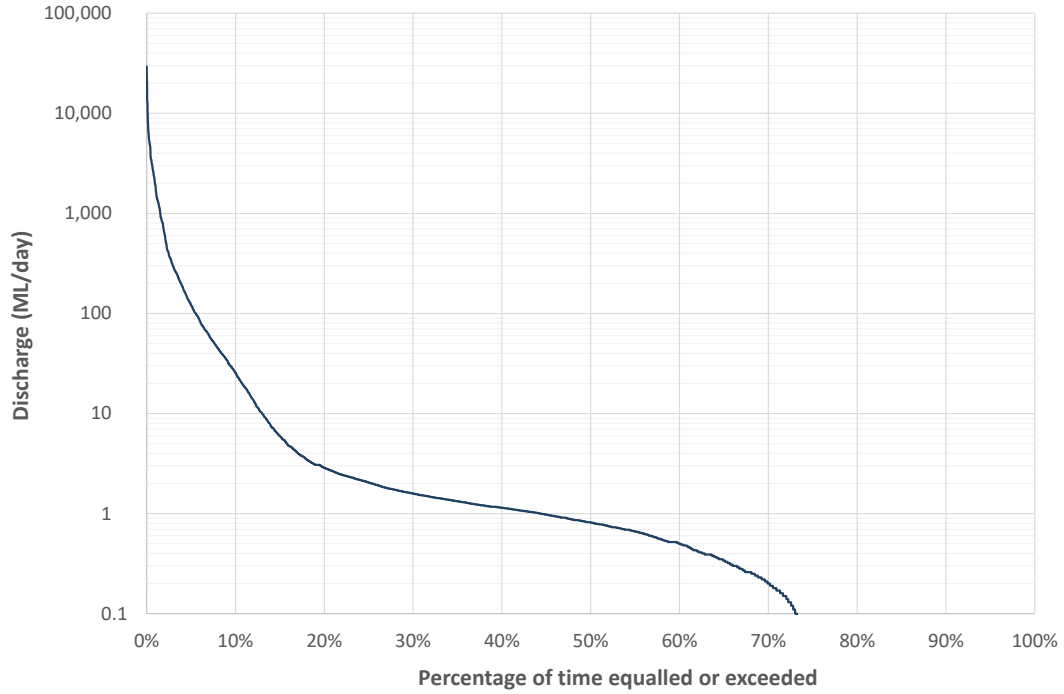


Figure 3.6 **Daily discharge exceedance curve (1971-2023) for Blackwater Creek at Curragh (Station No. 130108A and 130108B)**

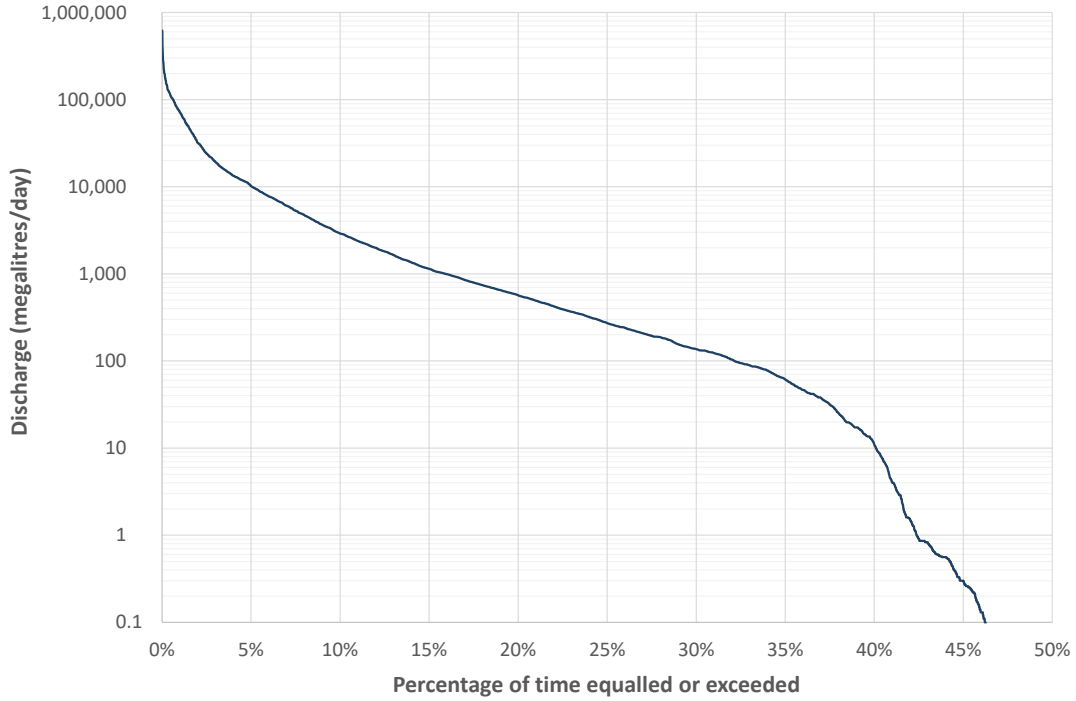


Figure 3.7 **Daily discharge exceedance curve (1971-2023) for the Mackenzie River at Bingegang (Station No. 130106A)**

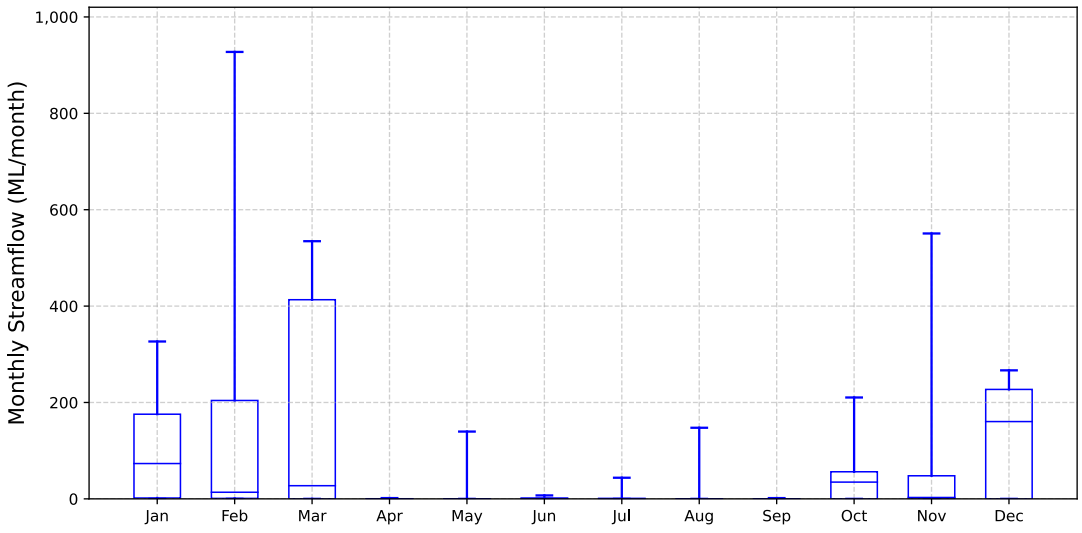


Figure 3.8 **Monthly box and whisker plot of flow volume at Two Mile Gully (Station No. 330124)**

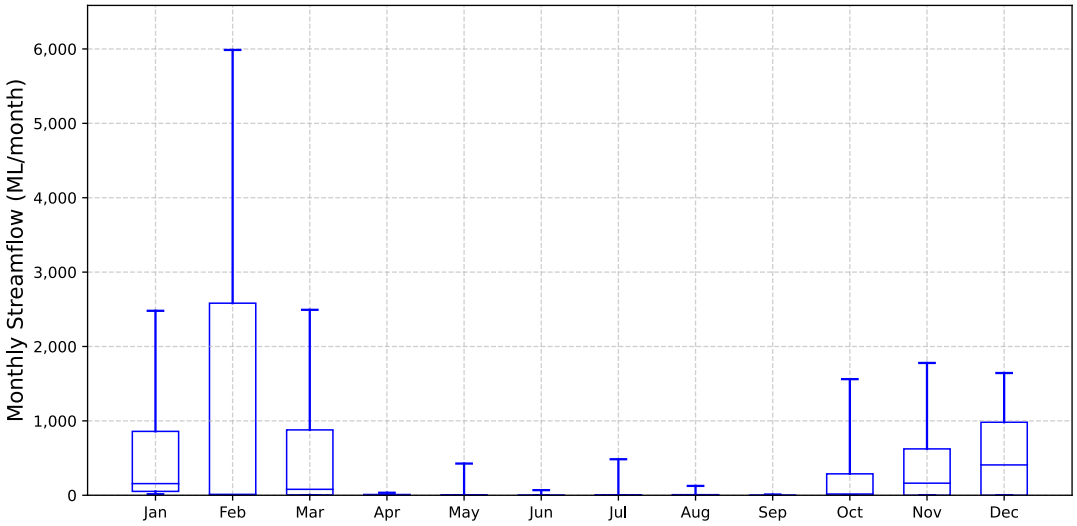


Figure 3.9 **Monthly box and whisker plot of flow volume for Taurus Creek at Taurus Creek D/S (Station No. 330121)**

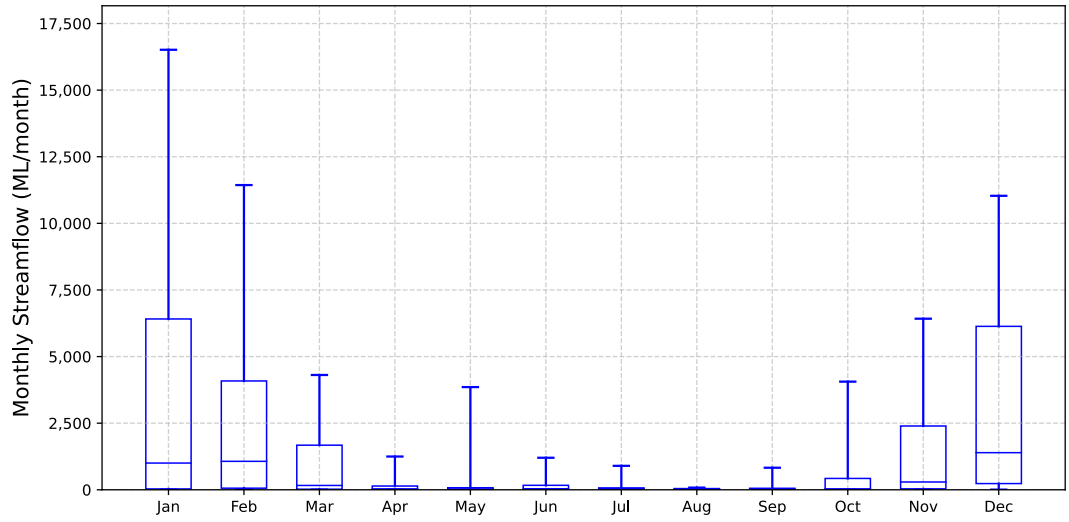


Figure 3.10 **Monthly box and whisker plot of flow volume for Blackwater Creek at Curragh (Station No. 130108A and 130108B)**

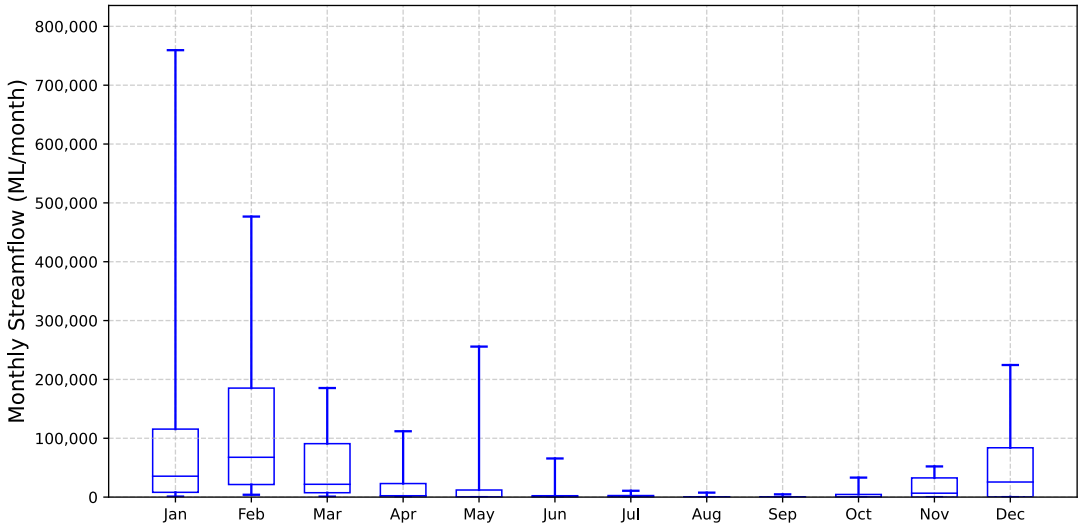


Figure 3.11 Monthly box and whisker plot of flow volume for the Mackenzie River at Bingegang (Station No. 130106A)

3.3 ENVIRONMENTAL VALUES OF RECEIVING WATERS

3.3.1 Overview of environmental values

The EPP Water, which is subordinate legislation to the EP Act, provides a framework for identifying EVs for a waterway and deciding WQOs to protect or enhance those EVs. EVs for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, contaminated runoff and releases and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

The waterways in the vicinity of the Project (Blackwater Creek, Taurus Creek, Two Mile Gully, Deep Creek and Emu Creek) are located within the Mackenzie southern tributaries region of the Mackenzie River Sub-basin (WQ1304).

The EVs selected for protection include:

- aquatic ecosystem protection (slightly to moderately disturbed ecosystems [DEHP, 2009]);
- farm use and stock watering;
- human consumption;
- primary, secondary and visual recreation;
- drinking water;
- industrial use; and
- cultural and spiritual values.

In summary, the key EVs for water that are to be protected are:

- physical, chemical and biological integrity of the watercourses within the catchment and their amenity as potential water sources for human use and to support aquatic ecosystems;
- the qualitive and quantitative integrity of local groundwater as a potential water source for agriculture or other suitable uses; and

- the integrity of raw water supplies and associated infrastructure in the region.

3.3.2 Water quality objectives

The indicators and WQGs relevant to the above EVs are listed in the Queensland Water Quality (QWQ) Guidelines (DEHP, 2009), ANZG (2018) guidelines and the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2013) guidelines. The conditions of waterways located in the vicinity of the Project are classified as 'moderately disturbed' ecosystems under DEHP (2013).

Table 3.2 compares the Mackenzie River WQOs (WQ 1304) nominated in the QWQ Guidelines, the Default Guideline Values (DGVs) nominated in ANZG (2018) based on 95% level of protection as well as the release and receiving waters contaminant trigger levels (trigger values) nominated in the EA (EPML00717813). Table 3.2 also shows the adopted WQOs, which were adopted based on the rationale described in sections 3.3.3 and 3.3.4.

WQOs and DGVs are displayed only for water quality parameters that are nominated in the EA (EPML00717813). The parameters for fine sediments and nutrients, including turbidity, total suspended solids (TSS), total nitrogen (TN) and total phosphorous (TP), have been included as they are the relevant water quality indicators for the GBR.

Table 3.2 Default Guideline Values, EA trigger levels and the adopted water quality objectives

Parameter	Unit [a]	Mackenzie River WQOs (WQ 1304)	Toxicant DGVs [b]	EA Trigger Level	Adopted WQO
pH	-	6.5 - 8.5	6.5 – 8.5	6.5 - 8.5	6.5 - 8.5
EC	µS/cm	310 (baseflow) 210 (high flow)	-	2,000	2,000
Turbidity	NTU	50	-	-	50
TSS	mg/L	110	-	-	110
Sulphate	mg/L	10	-	To be correlated with EC	545 [c]
Fluoride	µg/L	2,000	1,700	2,000	1,700
Nutrients					
Ammonia	µg/L	20	720	1,000 [f]	720
Nitrate	µg/L	-	2,600 – 29,000 [d]	7,600	7,600
TN	µg/L	775	-	-	775
TP	µg/L	160	-	-	160
Dissolved Metals					
Aluminium	µg/L	55	55	1,014 [g]	1,014
Cadmium	µg/L	0.2	0.2	5.6 [h]	0.2
Iron	µg/L	300	280 [e]	1,200 [i]	280
Zinc	µg/L	8	8	17 [f]	8
Boron	µg/L	370	940	370 [f]	940
Molybdenum	µg/L	34	34	34 [i]	34
Selenium	µg/L	5	11 [e]	10 [h]	10
Uranium	µg/L	0.5	0.5	1 [h]	1
Vanadium	µg/L	6	6	10 [h]	10
Hydrocarbons					
Petroleum hydrocarbons (C6-C9)	µg/L	-	-	20	20
Petroleum hydrocarbons (C10-C36)	µg/L	-	-	100	100

a – µS/cm = microSiemens per centimetre, mg/L = milligrams per litre, EC = electrical conductivity, NTU = Nephelometric Turbidity Unit and µg/L = micrograms per litre.

b – ANZG (2018) DGVs for slightly to moderately disturbed freshwater systems, based on protection of 95% of species.

c – Obtained from Dunlop et al (2016) based on protection of 95% of species.

d – Ranges from 2,600 µg/L in moderately hard water (<30 mg/L CaCO3) to 29,000 µg/L for hard water (<30 mg/L CaCO3).

e – Based on total concentration, not dissolved concentration.

f – Based on ANZECC/ARMCANZ (2000) trigger value, which is now superseded by the ANZG (2018) trigger value.

g – Based on 80th percentile of background data.

h – Based on limit of reporting (LOR) for Inductively Coupled Plasma Mass Spectrometry (ICPMS).

i – Noted in the EA as based on low reliability guideline.

3.3.3 Discussion on electrical conductivity (EC) objectives

The following sections describe the outcomes of previous toxicology studies undertaken to assess the tolerances of aquatic organisms to salinity (measured in EC) within the Fitzroy River basin.

3.3.3.1 Prasad et al (2012)

It is understood that the receiving environment EC trigger level of 2,000 µS/cm adopted in the EA was based on the 2012 toxicology study undertaken by Prasad et al (2012). This study assessed the tolerances of aquatic macroinvertebrates collected from Nebo Creek (located in the Fitzroy River catchment, some 200 km north of the Project) to saline solution representative of mine waters. A species sensitivity distribution (SSD) for salinity was derived, which has been reproduced in Figure 3.12. Prasad et al (2012) concluded that the ECs that would be protective of 95% of species was estimated to be 2,010 µS/cm, which is consistent with the EA trigger level for EC.

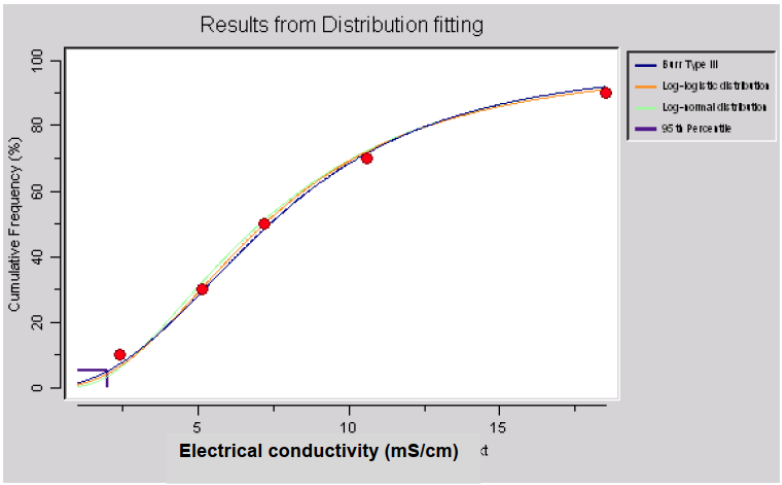


Figure 3.12 SSD for salinity (measured as EC) (Prasad et al, 2012)

3.3.3.2 Hydrobiology (2011)

Prior to the Prasad et al (2012) study, Hydrobiology undertook a site-specific ecotoxicity assessment of mine water discharges for the Caval Ridge Project (Hydrobiology, 2011). The Caval Ridge Project is located within the Fitzroy River catchment, some 175 km northwest of the Project. The objective of this study was to develop and undertake ecotoxicity testing to develop a locally relevant SSD that could be used to predict ECs that would protect a specified percentage of the receiving ecosystem.

Tests were undertaken using commercially available, but locally relevant test species. Test waters were developed to mimic that found in MAW stored at the Peak Downs Mine (adjacent to Caval Ridge), and the diluent water was formulated to approximate Cherwell Creek water.

Hydrobiology (2011) derived an SSD for salinity, which has been reproduced in Figure 3.13. Hydrobiology (2011) concluded that the ECs that would be protective of 95% of species was estimated to be 2,433 µS/cm, which is slightly higher, but generally consistent with the EA trigger level for EC and the DSITIA (2012) study outcomes.

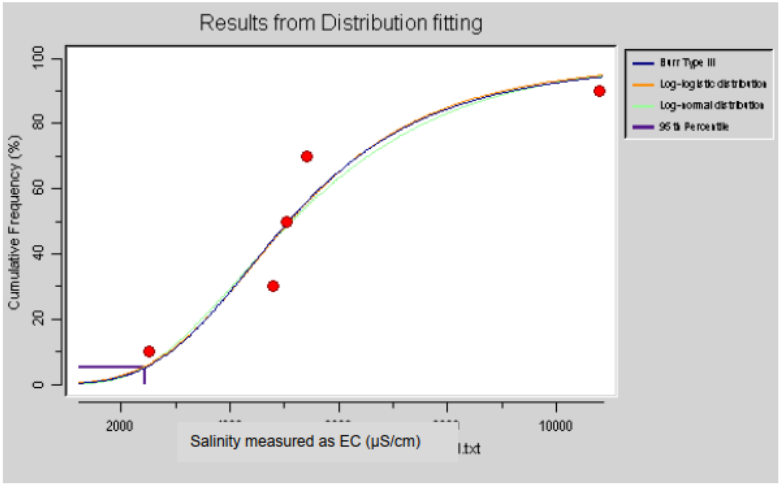


Figure 3.13 SSD for salinity (measured as EC) (Hydrobiology, 2011)

3.3.3.3 Mann (2014)

A study by Mann (2014) investigated the toxicity of mine water with different ionic compositions on specific test species. Two test waters representing coal-mine pit-water (referred to as AMW1 and AMW2) were formulated with chemical salts and differing in the proportions of various ions. Mann (2014) noted that the use of formulated waters permitted the comparison of salinity profiles representing different coal mining areas in Queensland on an equal footing, without the confounding effects of other contaminants that would be found in natural waters.

SSDs were developed for test species exposed to artificial mine waters AMW1 and AMW2, which has been reproduced in Figure 3.14. Mann (2014) noted that based on the trigger values for the protection of 80% to 99% of species, the results suggest that AMW1 was less toxic than AMW2. However, despite substantial differences in ionic composition, and despite individual differences in sensitivity among different test species, the resulting SSDs are of similar shape and position when salinity was measured as EC. More importantly, Mann (2014) noted that ECs that would be protective of 95% of species was estimated to be 3,300 µS/cm for AMW1 and 2,100 µS/cm for AMW2, which are higher than the EA trigger value of 2,000 µS/cm for EC.

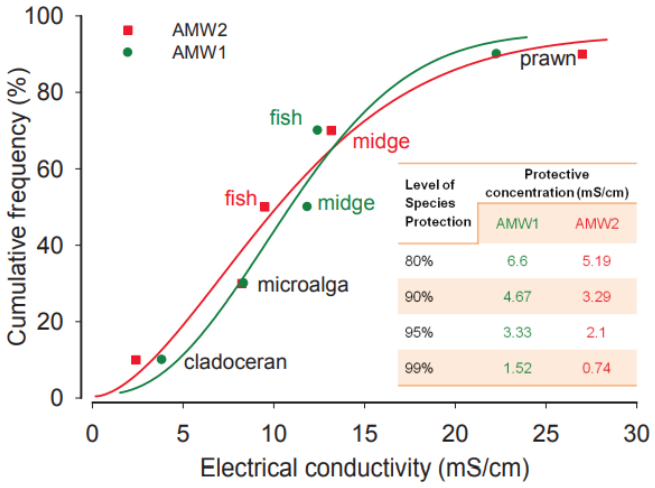


Figure 3.14 SSDs for test species exposed to artificial mine waters AMW1 and AMW2 (Mann, 2014)

3.3.3.4 Dunlop et al (2015)

Dunlop et al (2015) undertook a similar study to Mann (2014). Dunlop et al (2015) defined a test exposure for salinity based on observed ionic composition at the river basin scale and evaluated the 96-hour acute response of 10 macroinvertebrate families. Test organisms were collected from seven sites, four in the Fitzroy River basin, and three within Southeast Queensland. The salt solution used in toxicity testing was representative of an ionic composition typical for the Fitzroy River basin. The final ionic composition used in toxicity testing is subsequently referred to in Dunlop et al (2015) as the Fitzroy Composition (FC).

Dunlop et al (2015) analysed the 96-hour lethal concentration 50% (96-h LC50) for EC of the various test species, and the results have been reproduced in Figure 3.15. It shows that LC50 values for the various test species are generally greater than 6,000 µS/cm, indicating that more than 50% of the test species are tolerant to ECs equal to or higher than 6,000 µS/cm. This provides confidence that the EA trigger value of 2,000 µS/cm for EC is protective of the local aquatic ecosystem.

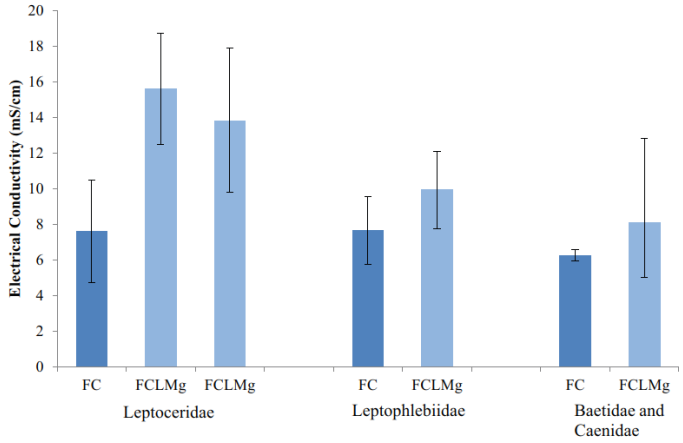


Figure 3.15 Comparison of LC50 results for the FC and Fitzroy Composition with Low Magnesium (FCLMg) with error bars showing the upper 95th and lower 5th confidence limits of LC50 estimates (Dunlop et al, 2015)

3.3.3.5 Adopted WQO for EC

Based on the outcomes of the various toxicity studies described above, the trigger value of 2,000 µS/cm for EC would be protective of local environmental values and was therefore adopted. The evidence from previous studies presented in Sections 3.3.3.1 to 3.3.3.4 suggests that the majority of local aquatic species in the vicinity of the Project would tolerate EC values of up to 2,000 µS/cm.

3.3.4 Discussion on WQOs for parameters other than EC

The WQOs for parameters other than EC were selected based on the rationale presented below.

3.3.4.1 Sulphate

Dunlop et al (2016) evaluated the toxicity of sulphate and then developed preliminary toxicant guidelines for sulphate for the Fitzroy River Basin. Dunlop et al (2016) found that based on a water hardness of 550 mg/L (as $CaCO_3$), the sulphate concentration (as NA_2SO_4) estimated to be protective of 95% of species is 545 mg/L. The Dunlop et al (2016) guideline value has been adopted.

3.3.4.2 Fluoride

The ANZG (2018) DGV for fluoride (based on 95% level of protection) is 1,700 µg/L, which is lower than the EA trigger level of 2,000 µg/L (noted in the EA as being based on guidelines for the protection of livestock and short-term irrigation). The ANZG (2018) DGV has been adopted.

3.3.4.3 Ammonia

The ANZG (2018) DGV for ammonia (based on 95% level of protection) is 720 µg/L, which is lower than the EA trigger level of 1,000 µg/L. The ANZG (2018) DGV has been adopted.

3.3.4.4 Nitrate

ANZG (2018) have published three sets of DGVs for nitrate as its toxicity depends on water hardness. The DGV for nitrate (based on 95% level of protection) is 2,600 µg/L in moderately hard water (30-150 mg/L $CaCO_3$) and 29,000 µg/L for hard water (>150 mg/L $CaCO_3$) (ANZG, 2018). The EA trigger level of 7,600 µg/L is within the range of DGVs for moderately hard to hard water and has been retained as the WQO.

3.3.4.5 Aluminium

The EA trigger level for aluminium (1,014 µg/L) is noted in the EA as being based on 80th percentile of background data. This is consistent with the monitoring data shown in Table 3.4 and therefore, the EA trigger level has been retained as the WQO.

3.3.4.6 Cadmium

The ANZG (2018) DGV for cadmium (based on 95% level of protection) is 0.2 µg/L, which is lower than the EA trigger level (5.6 µg/L). The ANZG (2018) DGV has been adopted.

3.3.4.7 Iron

The ANZG (2018) DGV for iron (based on 95% level of protection) is 280 µg/L, which is lower than the EA trigger level (1,200 µg/L). The ANZG (2018) DGV has been adopted.

3.3.4.8 Zinc

The ANZG (2018) DGV for zinc (based on 95% level of protection) is 8 µg/L**,** which is lower than the EA trigger level (17 µg/L). The ANZG (2018) DGV has been adopted**.**

3.3.4.9 Boron

The ANZG (2018) DGV for boron (based on 95% level of protection) is 940 µg/L, which is higher than the EA trigger level (370 µg/L). The EA trigger level of 370 µg/L is based on the ANZECC/ARMCANZ (2000) DGV, which is now superseded by the ANZG (2018) trigger value. The more contemporary ANZG (2018) DGV has been adopted.

3.3.4.10 Molybdenum

The EA trigger level of 34 µg/L for molybdenum is consistent with the ANZG (2018) DGVs and Mackenzie River WQOs. Therefore, the EA trigger level has been retained as the WQO.

3.3.4.11 Selenium, Uranium and Vanadium

The EA (Table F3) notes that the contaminant investigation levels for selenium, uranium and vanadium are based on the LOR for ICPMS. The EA contaminant investigation levels for selenium, uranium and vanadium are very similar to the respective DGVs, are considered protective of environmental values and have been retained as the WQOs.

3.4 SURFACE WATER QUALITY

3.4.1 Monitoring network and data sources

Figure 3.3 shows the locations of monitoring sites along the local creeks in the vicinity of the Project. Figure 3.2 shows the monitoring site in the Mackenzie River at Bingegang, which is located closest to the Project. Descriptions of these monitoring sites are given in Table 3.3.

Existing surface water quality have been characterised for parameters listed in Table F2 of the EA only, based on water quality monitoring results described in the following reports:

- Receiving Environment Monitoring Program (REMP) Annual Report, July 2021 – June 2022 (BMA, 2023);
- Fitzroy Regional Receiving Environment Monitoring Program (FRREMP) Annual Report, July 2022 – June 2023 (Riethmuller et al., 2023); and
- FRREMP Annual Report, July 2023 – June 2024 (Riethmuller et al., 2025).

It should be noted that after June 2022, Whitehaven Blackwater became a participant in the FRREMP and as such, FRREMP reports were not available for the period before June 2022.

Local monitoring stations at BWM that still contribute data to the FRREMP include the Sirius Creek D/S and the Rockland Creek upstream (U/S) gauges, which are not located within the Project area.

Table 3.3 Description of monitoring sites

Name	Reference	Easting (m) (GDA 94)	Northing (m) (GDA 94)	Description
Upstream monitoring sites				
Emu Creek U/S	EM US	689,049	7,367,899	Upstream end of the Emu Creek clean water drain.
Deep Creek U/S	DP US	681,340	7,371,998	Deep Creek upstream of the haul road.
Taurus Creek U/S	TR US	685,570	7,369,801	Taurus Creek upstream of the haul road.
Two Mile Gully	TM DS	692,093	7,372,042	Two Mile Gully downstream of Blackwater Rolleston Road.
Blackwater Creek U/S	BW US	694,201	7,379,648	Blackwater Creek approximately 2.7 km upstream of the Taurus Creek confluence.
Downstream monitoring sites				
Taurus Creek D/S	TR DS	691,367	7,381,013	Taurus Creek upstream of the railway.
Blackwater Creek D/S	BW DS	693,953	7,384,565	Blackwater Creek at Tantallon Road and downstream of the Taurus Creek confluence.
Mackenzie River at Bingegang	130106A / MAC106	708,267	7,446,600	Mackenzie River just upstream of the Bingegang Weir.

3.4.2 Water quality in local creeks

Table 3.4 shows the water quality monitoring results for the five local monitoring sites upstream of the Project. Table 3.4 also shows the adopted WQOs. It should be noted that whilst the Blackwater U/S monitoring point is geographically located 'downstream' (east) of BWM, this location is upstream of the Taurus Creek confluence and is therefore unaffected by mining activities. The water quality monitoring results shown in Table 3.4 reflect existing site conditions excluding the Project. The data indicates that, upstream of the Project area:

- Median (50th percentile) physiochemical properties such as EC, TSS, turbidity and fluoride in Taurus Creek and Deep Creek are below the WQOs. In Emu Creek, median EC is below the WQOs, but turbidity and TSS exceed the WQOs.
- For nutrients, median concentrations of ammonia and nitrate are below the WQOs. Based on two samples, TN and TP generally exceed the WQOs at Taurus Creek U/S. Based on one sample, TN exceeds the WQOs while TP is below the WQOs at Deep Creek U/S.
- Median concentrations of metalloids upstream of BWM are generally below the WQOs.

Table 3.5 shows the water quality monitoring results for the two local monitoring sites downstream of the Project. Table 3.5 also shows the adopted WQOs. The water quality monitoring results shown in Table 3.5 reflect existing site conditions excluding the Project. The data indicates that, downstream of the Project area:

- For physiochemical properties, median EC and fluoride are below the WQOs. Median TSS and turbidity generally exceed the WQOs and those observed from upstream monitoring sites.
- For nutrients, median concentrations of ammonia and nitrate at Taurus Creek D/S and Blackwater Creek D/S are below the WQOs. Based on one sample, TN and TP in Taurus Creek D/S and Blackwater Creek D/S generally exceed the WQOs and those observed from upstream monitoring sites.
- Median to 80th percentile concentrations of metalloids downstream of BWM are generally below the WQOs.
- Exceedances compared to the WQOs and/or upstream monitoring sites may be due to existing mining activities (excluding the Project) but is also likely due to the larger catchments contributing runoff to these downstream sites.

3.4.3 Regional water quality

Table 3.6 shows the water quality monitoring results for the Mackenzie River at Bingegang (130106A/MAC106). Table 3.6 also shows the local creek WQOs and the Sub-basin WQOs for the Mackenzie River Sub-basin (WQ 1304) (DEHP, 2013). The water quality monitoring results shown in Table 3.6 reflect existing site conditions excluding the Project. The data indicates that, in the Mackenzie River:

- Median physiochemical parameters including EC, turbidity and TSS are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).
- Median nutrient concentrations including ammonia, nitrate, TP and TN are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).
- Median metalloid concentrations are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).

Physicochemical properties, nutrient concentrations and metalloid concentrations in the Mackenzie River are significantly lower than those recorded at the local monitoring sites closer to BWM. This is

due to significantly higher flows, and hence a much higher level of dilution in the Mackenzie River compared to the local creeks in the vicinity of BWM.

Table 3.4 Local waterways surface water quality monitoring results from monitoring sites upstream of the Project

Parameter	Unit	Adopted WQO	Taurus Creek U/S [a]				Deep Creek U/S [a]				Emu Creek U/S [a]				Blackwater Creek U/S [a]				Two Mile Gully [a]			
			Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	39	7.37	7.78	7.99	17	6.95	7.83	7.99	3	7.65	7.88	7.89	13	7.12	7.82	8.04	18	6.75	7.24	7.82
EC	µS/cm	2,000	39	154.4	306	389.4	17	149.4	176.5	283.8	3	121.8	132	151.2	13	113.9	144	174.4	18	128.4	164	212.6
Turbidity	NTU	50	37	112	200	364	14	95.2	240	424	5	418	863	1.968	7	142	250	300	15	222	423	860
TSS	mg/L	110	38	37.8	75	311	13	28.8	75	181.2	6	290	471	950	12	65.2	142	696	21	236	444	1,280
Sulphate	mg/L	545	41	2	6	26	14	2	3	6.8	6	0.5	3	132	12	0.6	2	2.8	24	2	4.5	23.6
Fluoride	µg/L	1,700	33	100	200	300	14	50	100	200	6	100	200	300	12	50	100	200	22	50	100	300
Nutrients																						
Ammonia	µg/L	720	30	10	30	50	11	20	60	90	6	20	35	40	11	20	40	40	17	8	40	50
Nitrate	µg/L	7,600	39	28	80	288	14	8	40	144	6	70	130	330	12	12	40	68	22	52	95	210
TN	µg/L	775	2	1,380 [b]	-	1,620 [b]	1	-	1.700 [c]	-	-	-	-	-	1	-	100 [c]	-	1	-	600 [c]	-
TP	µg/L	160	2	116 [b]	-	224 [b]	1	-	130 [c]	-	-	-	-	-	1	-	20 [c]	-	1	-	120 [c]	-
Dissolved Metals																						
Aluminium	µg/L	1,014	34	102	365	1,100	11	90	340	1.050	6	130	200	290	11	120	180	800	18	84	165	296
Cadmium	µg/L	0.2	33	0.05	0.05	0.05	9	0.05	0.05	0.05	6	0.05	0.08	0.25	11	0.05	0.05	0.05	17	0.05	0.05	0.05
Iron	µg/L	280	34	104	345	748	11	140	320	490	6	150	250	280	11	140	240	510	18	104	175	354
Zinc	µg/L	8	34	<2.5	<2.5	7.4	11	<2.5	<2.5	<2.5	6	<2.5	4.75	12.5	11	<2.5 [d]	<2.5 [d]	<2.5 [d]	18	<2.5 [d]	<2.5 [d]	4.6 [d]
Boron	µg/L	940	30	<25 [c]	60	74	11	<25 [d]	<25 [d]	25 [d]	6	<25 [d]	50	60	11	<25 [d]	<25 [d]	<25 [d]	18	<25 [d]	<25 [d]	52 [d]
Molybdenum	µg/L	34	34	<0.5 [d]	<0.5 [d]	2	11	<0.5 [d]	<0.5 [d]	2	6	<0.5 [d]	<0.5 [d]	2.5	11	<0.5 [d]	<0.5 [d]	<0.5 [d]	18	<0.5 [d]	<0.5 [d]	<0.5 [d]
Selenium	µg/L	10	30	<5 [d]	<5 [d]	<5 [d]	11	<5 [d]	<5 [d]	<5 [d]	6	<5 [d]	<5 [d]	25	11	<5 [d]	<5 [d]	<5 [d]	19	<5 [d]	<5 [d]	<5 [d]
Uranium	µg/L	1	29	<0.5 [d]	<0.5 [d]	<0.5 [d]	11	<0.5 [d]	<0.5 [d]	<0.5 [d]	6	<0.5 [d]	<0.5 [d]	<0.5 [d]	11	<0.5 [d]	<0.5 [d]	<0.5 [d]	18	<0.5 [d]	<0.5 [d]	<0.5 [d]
Vanadium	µg/L	10	29	<5 [d]	<5 [d]	<5 [d]	10	<5 [d]	<5 [d]	<5 [d]	6	<5 [d]	<5 [d]	25	11	<5 [d]	<5 [d]	<5 [d]	18	<5 [d]	<5 [d]	<5 [d]

[a] – Values preceded by the symbol '<' represent concentrations below the LOR.

[b] – Only two samples were analysed. The values shown in the 20th percentile (20%ile) and 80th percentile (80%ile) columns are the minimum and maximum values, respectively.

[c] – Only one sample was analysed, with the value shown in the median column.

[d] – Below the limit of detection.

Table 3.5 Local waterways surface water quality monitoring results from monitoring sites downstream of the Project

Parameter	Unit	Adopted WQO	Blackwater Creek D/S [a]				Taurus Creek D/S [a]			
			Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	88	7.1	7.7	7.96	16	6.88	7.3	7.7
EC	µS/cm	2,000	88	168.88	224.5	373.8	16	151	185.65	265
Turbidity	NTU	50	61	190	450	1,000	8	254	532	2,172
TSS	mg/L	110	72	136.6	269.5	1,041.6	13	164.8	462	1,400
Sulphate	mg/L	545	85	4	11	34.4	15	0.5	6	14.2
Fluoride	µg/L	1,700	84	100	200	300	14	100	200	340
Nutrients										
Ammonia	µg/L	720	67	20	40	60	11	20	50	80
Nitrate	µg/L	7,600	80	60	130	322	13	40	130	230
TN	µg/L	775	3	1,360	2,200	4,240	1	-	4,400 [b]	-
TP	µg/L	160	3	312	660	1,332	1	-	1,300 [b]	-
Dissolved Metals										
Aluminium	µg/L	1,014	68	48	150	418	11	120	180	320
Cadmium	µg/L	0.2	60	0.05	0.05	0.05	9	0.05	0.05	0.05
Iron	µg/L	280	68	94	170	378	11	120	210	300
Zinc	µg/L	8	68	<2.5 [c]	<2.5 [c]	<2.5 [c]	11	<2.5 [c]	<2.5 [c]	<2.5 [c]
Boron	µg/L	940	68	<25 [c]	<25 [c]	60	11	<25 [c]	<25 [c]	<25 [c]
Molybdenum	µg/L	34	68	<0.5 [c]	<0.5 [c]	1	11	<0.5 [c]	<0.5 [c]	<0.5 [c]
Selenium	µg/L	10	68	<5 [c]	<5 [c]	<5 [c]	11	<5 [c]	<5 [c]	<5 [c]
Uranium	µg/L	1	68	<0.5 [c]	<0.5 [c]	<0.5 [c]	11	<0.5 [c]	<0.5 [c]	<0.5 [c]
Vanadium	µg/L	10	66	<5 [c]	<5 [c]	<5 [c]	11	<5 [c]	<5 [c]	<5 [c]

[a] – Values preceded by the symbol '<' represent concentrations below the LOR.

[b] – Only one sample was analysed, with the value shown in the median column.

[c] – Below the limit of detection.

Table 3.6 Regional surface water quality sampling results

Parameter	Unit	Adopted WQO	Mackenzie WQ1304 WQO	Mackenzie River at Bingegang (MAC106)			
				Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	6.5 - 8.5	6	7.3	7.5	7.7
EC	µS/cm	2,000	310	6	163.3	364.7	386.9
Turbidity	NTU	50	50	6	25.7	47.7	208.4
TSS	mg/L	110	110	6	18	21.5	38
Sulphate	mg/L	545	10	6	2	9	9
Fluoride	µg/L	1,700	-	-	-	-	-
Nutrients							
Ammonia	µg/L	720	20	6	5	17.5	30
Nitrate	µg/L	7,600	-	6	10	17.5	170
TN	µg/L	775	775	6	500	750	1200
TP	µg/L	160	160	6	60	125	400
Dissolved Metals							
Aluminium	µg/L	1,014	55	6	10	5	5
Cadmium	µg/L	0.2	0.2	6	0.05	0.05	0
Iron	µg/L	280	300	6	30	25	25
Zinc	µg/L	8	8	6	3	2.5	2.5
Boron	µg/L	940	370	6	25	37.5	60
Molybdenum	µg/L	34	34	6	0.5	0.5	1
Selenium	µg/L	10	5	6	5	5	5
Uranium	µg/L	1	0.5	6	0.5	0.5	1
Vanadium	µg/L	10	6	6	5	5	5

3.5 CLIMATE

3.5.1 Overview

BWM is in a subtropical climate zone, characterised by hot, humid summers and moderately dry winters. Average minimum daily temperatures range from 11.4 degrees Celsius (°C) in July to 22.0°C in January, and average maximum daily temperatures range from 20.7°C in July to 43.7°C in January.

3.5.2 Rainfall

Climate data for the site (latitude 23.74°S, longitude 148.83°E) (easting 686,524, northing 7,373,359 in GDA94) was sourced from the Department of Science, Information Technology and Innovation's (DSITI's) SILO Data Drill (SILO). This dataset provides continuous, gap-free daily records interpolated from the Bureau of Meteorology's (Bureau's) observations.

The historic average annual rainfall from 1957 to 2024 is 536.5 millimetres (mm) (see Figure 3.16). The minimum recorded rainfall during this period was 279 mm in 2019, while the maximum reached 1,403 mm in 2010. The distribution of monthly SILO rainfall is shown in Figure 3.12.

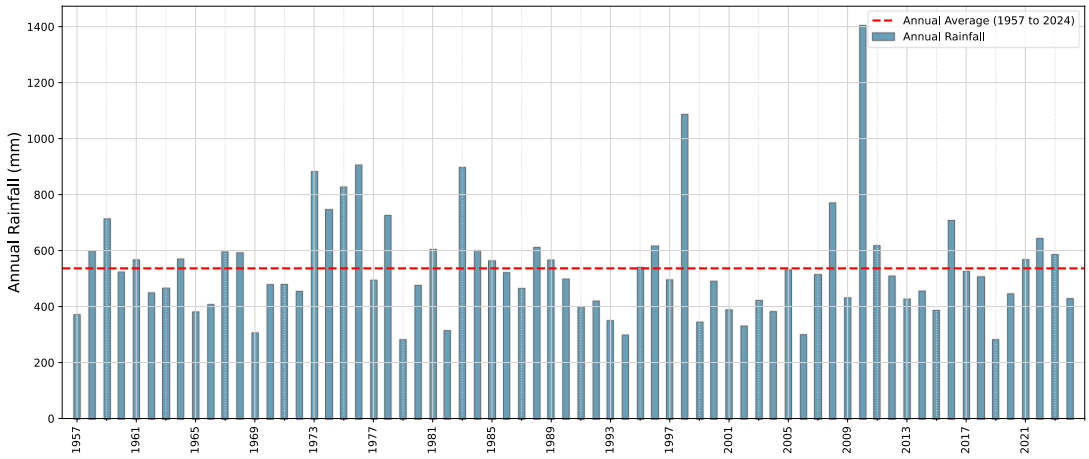


Figure 3.16 Annual rainfall (1957-2024)

Figure 3.17 shows the distribution of monthly rainfalls at the site based on SILO data between 1957 and 2024. Rainfalls predominantly fall during the warmer months from November to March with significantly lower rainfalls recorded during the cooler months.

3.5.3 Evaporation

Figure 3.17 shows the median monthly Class A pan evaporation and rainfall based on SILO data between 1957 and 2024. Evaporation data for the site has been compiled using a combination of synthetic estimates before 1970 and Class A pan evaporation measurements from 1970 onwards. The SILO evaporation estimates were derived using climatological modelling techniques to fill gaps in historical records. Of note:

- Average Annual Pan Evaporation: 2,034 mm.
- Evaporation peaks between October and January, aligning with the warmer months.
- Median monthly evaporation exceeds median monthly rainfall for all months.

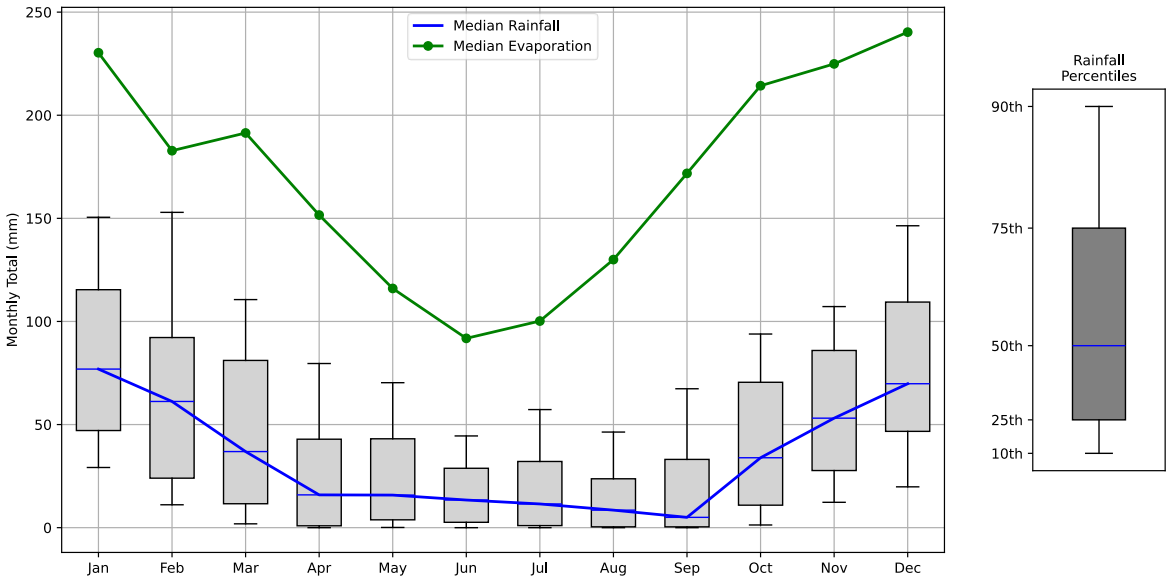


Figure 3.17 Monthly SILO rainfall and evaporation distributions summary

3.5.4 Comparative climate data

Table 3.7 shows long term rainfall, evaporation and temperatures at three nearby Bureau-owned stations and at two on-site weather stations owned by Whitehaven Blackwater, where data is available. The data shows that:

- Silo rainfall and evaporation monthly data is consistent with recorded data at the nearby stations.
- Average annual rainfalls at the two site weather stations are consistent with those recorded at the Bureau's Blackwater Airport station (located adjacent to BWM), but generally lower than those recorded at the Bureau's Springsure and Comet Post Office stations, which are located further away from BWM.

Table 3.7 Rainfall and evaporation monthly averages, minimum and maximum monthly temperature

	Mean monthly rainfall at Bureau rainfall stations (mm)			SILO Data Drill mean monthly rainfall	Mean monthly rainfall at on-site rainfall stations (mm)		Mean Monthly Evaporation (mm)		Average Daily Temperature (°C)	
	Blackwater Airport (35134)	Springsure Creek Junction AL (35276)	Comet Post Office (35021)		Northern Weather Station (330122)	Central Industrial Area Weather Station (330107)	Springsure Comet St (35065)	SILO Data Drill	Blackwater Airport (35134)	
									Min.	Max.
Distance and direction from BWM	1 km	38 km	28 km	-	-	-	85 km	-	1 km	
Period of record	2013 - 2025	2010 - 2025	1895 – 2025	1957 - 2025	2016 - 2025	2016 - 2025	1957 - 2025	1957 - 2025	2013 - 2025	
January	92.3	90.4	99.3	85.5	83.0	81.4	235.5	229.1	21.9	34.7
February	73.1	69.0	88.8	71.8	75.9	82.1	188.9	185.3	21.7	34.3
March	65.6	101.0	59.3	50.4	75.3	72.8	191.0	188.8	21.0	33.3
April	19.7	25.9	32.3	29.3	17.2	12.6	146.3	148.1	16.9	30.3
May	21.0	31.3	29.1	30.6	25.9	29.2	109.8	114.1	13.4	26.8
June	19.0	21.9	27.6	21.1	24.1	23.4	84.5	90.0	10.2	24.2
July	29.9	29.9	25.8	21.7	38.3	31.8	93.4	98.7	9.3	24.0
August	18.4	14.1	17.2	17.5	22.2	16.0	126.5	129.5	10.0	26.2
September	17.5	25.0	21.3	21.8	17.0	16.9	170.8	170.9	13.4	29.5
October	50.3	53.8	36.6	43.6	68.5	58.2	216.0	213.1	17.2	32.4
November	52.4	60.5	54.8	60.4	69.1	72.7	228.8	224.6	19.2	33.8
December	71.3	88.1	81.8	84.2	62.0	67.7	246.4	240.1	21.0	34.8
Annual Average	**534.5**	**572.1**	**578.9**	**536.5**	**529.4**	**516.8**	**2,039.6**	**2,033.8**	-	-

4 EXISTING SITE CHARACTERISTICS

4.1 OVERVIEW

This section describes the objectives and principles of the SWMS for the existing operations at BWM, including a description of the infrastructure and systems that have been designed to achieve the objectives and principles.

4.2 EXISTING SITE OPERATING ACTIVITIES

HydroBalance (2026) describes the existing SWMS in Appendix B. Figure 4.1 to Figure 4.3 show the locations of the existing water storages at BWM. Table 4.1 shows a summary of the existing water storages at BWM including the Operating Capacity (OC) for each of the storages. The OC represents the maximum allowable volume that can be stored in the dam/pit (taking into account factors such as base of weathering). Figure 4.4 to Figure 4.6 shows the existing SWMS schematic.

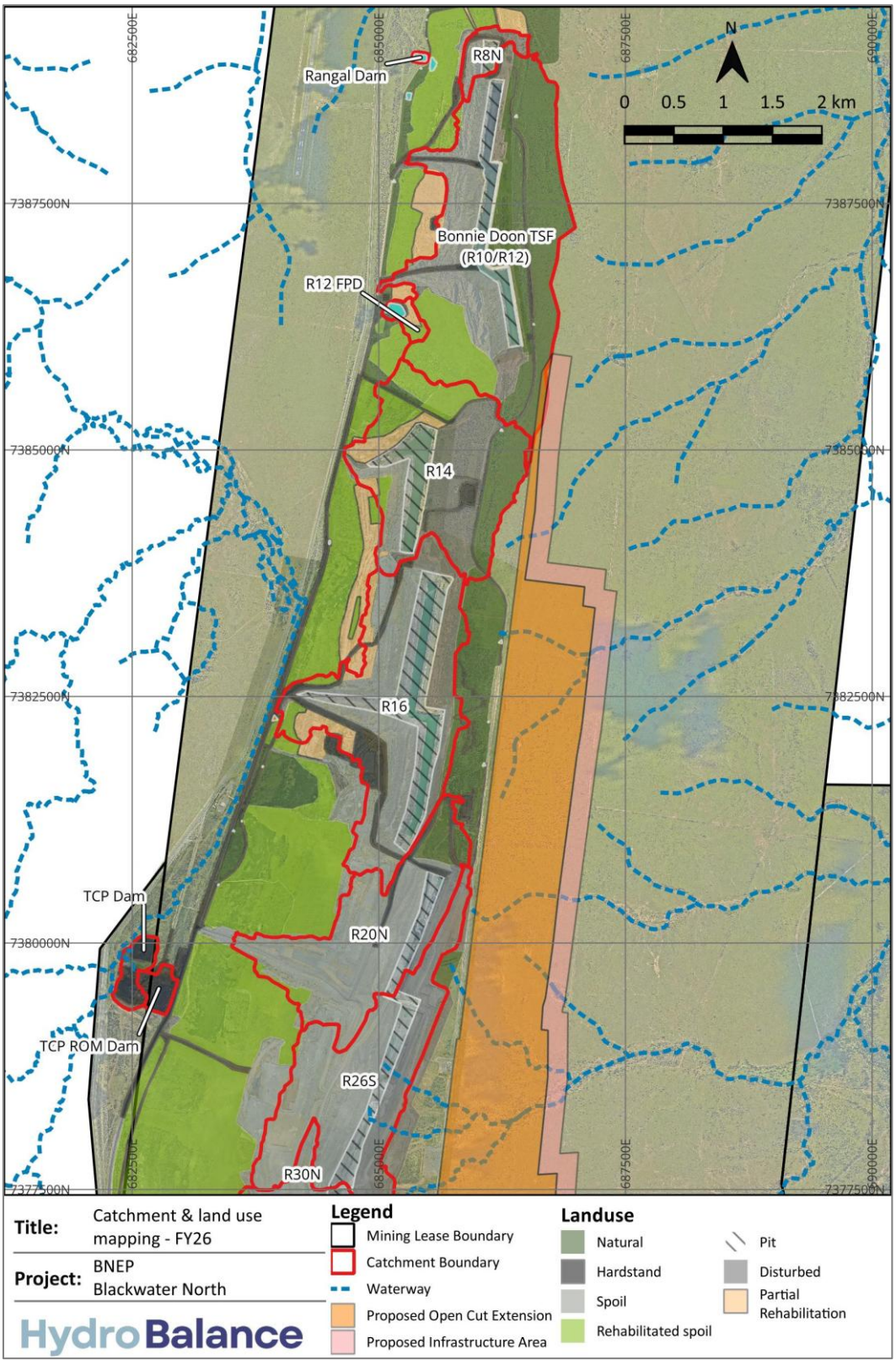


Figure 4.1 **Existing water storages, catchments and land use characteristics – Blackwater North (HydroBalance, 2026)**

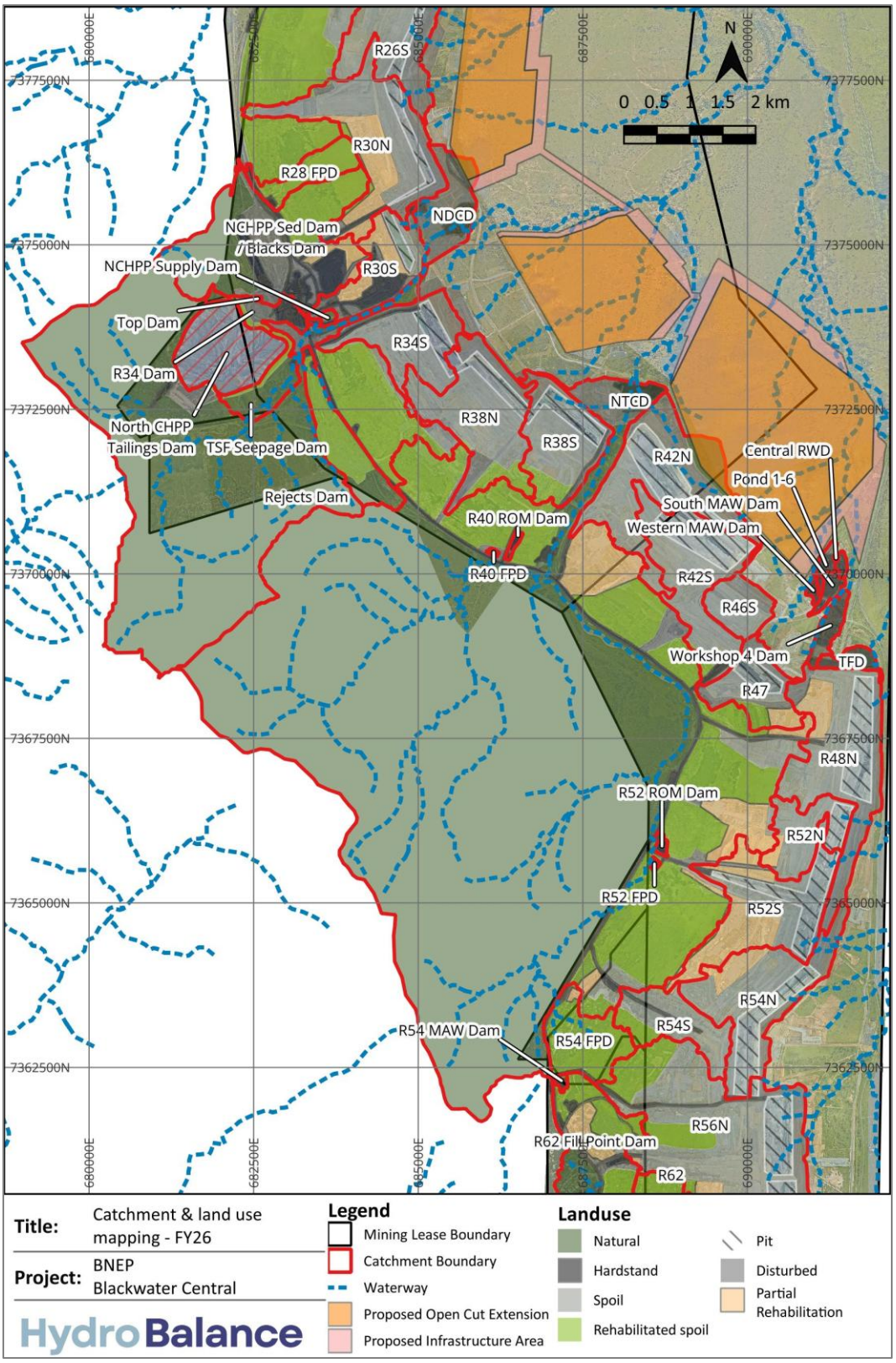


Figure 4.2 **Existing water storages, catchments and land use characteristics – Blackwater Central (HydroBalance, 2026)**

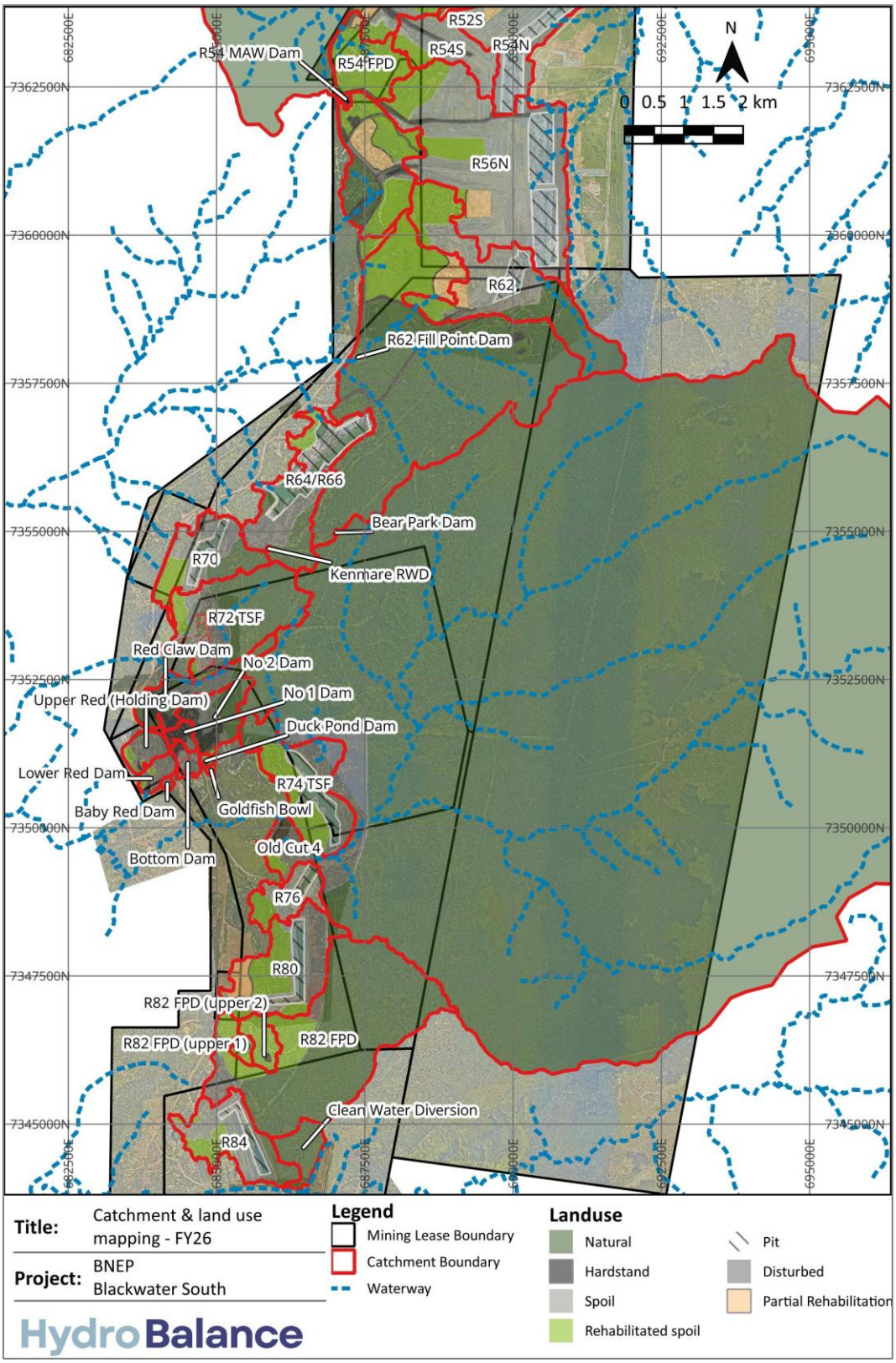


Figure 4.3 **Existing water storages, catchments and land use characteristics – Blackwater South (HydroBalance, 2026)**

Table 4.1 Mine water storage inventory and capacity (HydroBalance, 2026)

Storage name	Operating Capacity (ML)	Overflows to
Dam storages		
BWM North MAW Dams		
R12 FPD	241.8	Offsite
TCP Dam	68	Offsite
TCP ROM Dam	15.5	Offsite
R28 FPD	7.5	Offsite
Top Dam	100	Offsite
NCHPP Sed Dam/Blacks Dam	39.3	Deep Creek
NCHPP Supply Dam	48.7	Offsite
R34 Dam	11.8	-
TSF Seepage Dam	41.3	Offsite
Rejects Dam	16	Offsite
South MAW Dam	13.4	Offsite
Pond 1-6	25.9	Offsite
Western MAW Dam	3.0	Pond 1-6
Workshop 4 Dam	51.3	Offsite
TFD	97.5	Two Mile Gully
Old R40 FPD	-	NTCD
R40 FPD	13.1	NTCD
R40 ROM Dam	12.3	NTCD
R48 FPD	29.8	Offsite
R52 ROM Dam	12.0	Offsite
R52 FPD	20.1	Offsite
R54 FPD	12.0	Offsite
R54 MAW Dam	26.6	Offsite
BWM South MAW Dams		
Upper Red Dam (Holding Dam)	113	Lower Red Dam
Lower Red Dam	80	Offsite
Baby Red Dam	0.5	Offsite
No 1 Dam	7.2	Bottom Dam
No 2 Dam	156	Duck Pond
Bottom Dam TSF	0.45	Duck Pond
Duck Pond	61.9	Goldfish Bowl
Goldfish Bowl	15	Sirius Creek
R56 FPD	157.2	Speculation Creek

Storage name	Operating Capacity (ML)	Overflows to
R62 FPD	15.3	Speculation Creek
R82 FPD	110.3	Rockland Creek
On-stream storages		
NDCD	268.9	Deep Creek
NTCD	533.9	Taurus Creek
Old Cut 4	447.5	Sirius Creek
Rockland Basin	13,800	Rockland Creek
Pit storages		
R14	8,191	R16
R16	11,999	R20
R30S	860	R30N
R64/R66	4,963	Offsite
R70	2,170	Offsite
R76	2,149	Offsite
R80	7,879	Offsite
R84	7,563	Rockland Creek
Tailings dams		
R10/R12 WSP (Bonnie Doon)	5,527	Offsite
North CHPP Tailings Dam	738	Offsite
R72 TSF	487	Offsite
R74 TSF	3,949 (FSV) 3,453 (MOV)	Offsite
Pits		
R8N	<200	Offsite
R20/R26	30,644	Offsite
R30N	5,815	R20
R34	2,773	R38
R38	13,264	Offsite
R42	2,000	Offsite
R46N	1,500	R42
R46S	1,500	R46N
R47	1,500	R46S
R48	2,000	Offsite
R52N	569	Offsite
R52S	2,000	Offsite
R54	5,217	Offsite

Storage name	Operating Capacity (ML)	Overflows to
R56	5,217	Offsite
R62	2,000	R56
Raw Water Dams		
Rangal Dam	5	Offsite
Central RWD	5	Offsite
Kenmare RWD	22	Offsite
Bear Park Dam	22	Offsite
Red Claw Dam	113	Offsite

Notes:

MAW = Mine Affected Water

TSF = Tailings Storage Facility

NCHPP = North CHPP, WSD = water storage dam, MAW = mine-affected water, RWD = raw water dam, TSF = tailings storage facility, TFD = Tannyfoil dam, FPD = fill point dam, NDCD = New Deep Creek Dam, NTCD = New Taurus Creek Dam, WSP = water storage pit, TSD = tailings storage dam

ML = megalitres

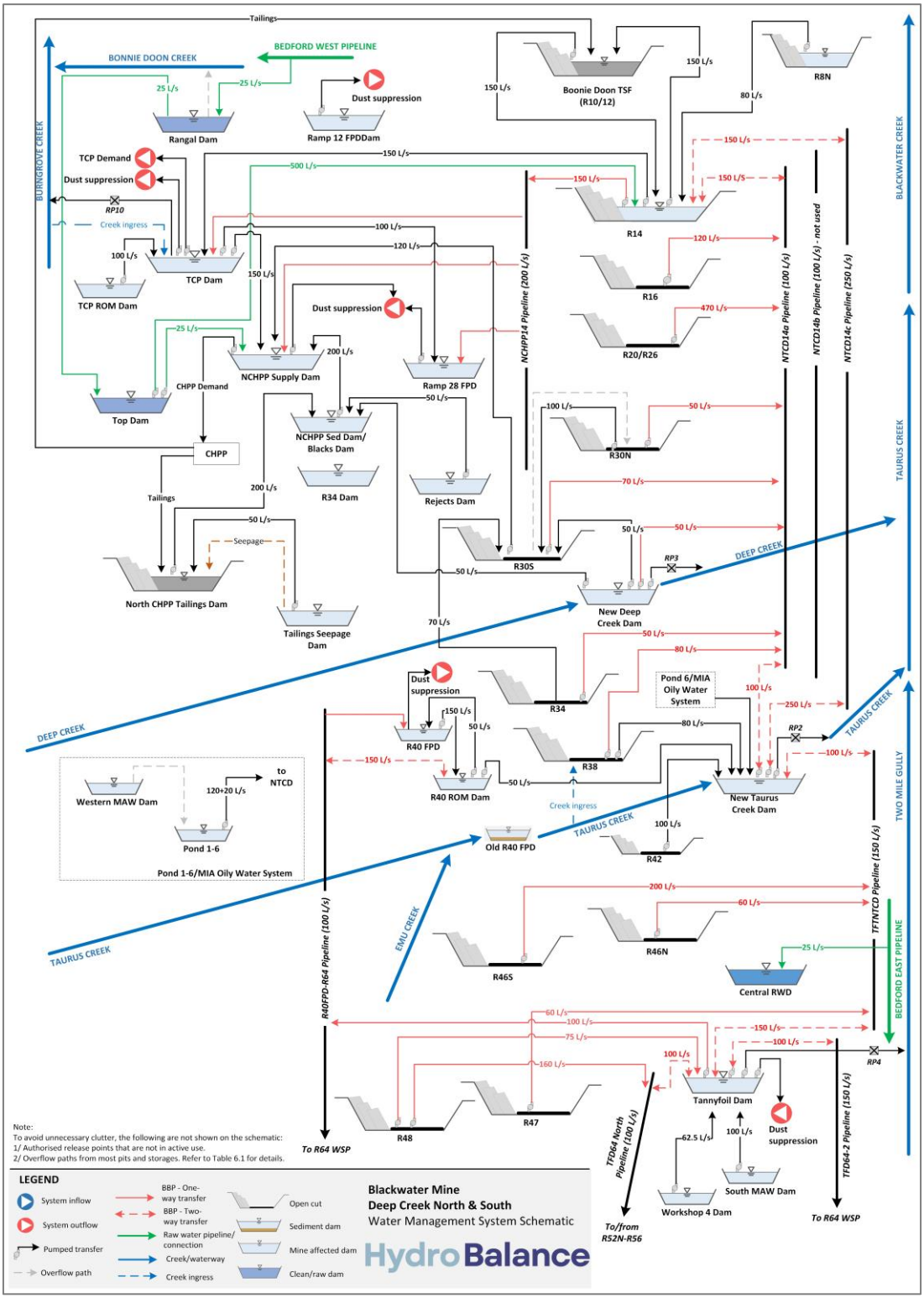


Figure 4.4 Existing SWMS schematic – Deep Creek North and South (HydroBalance, 2026)

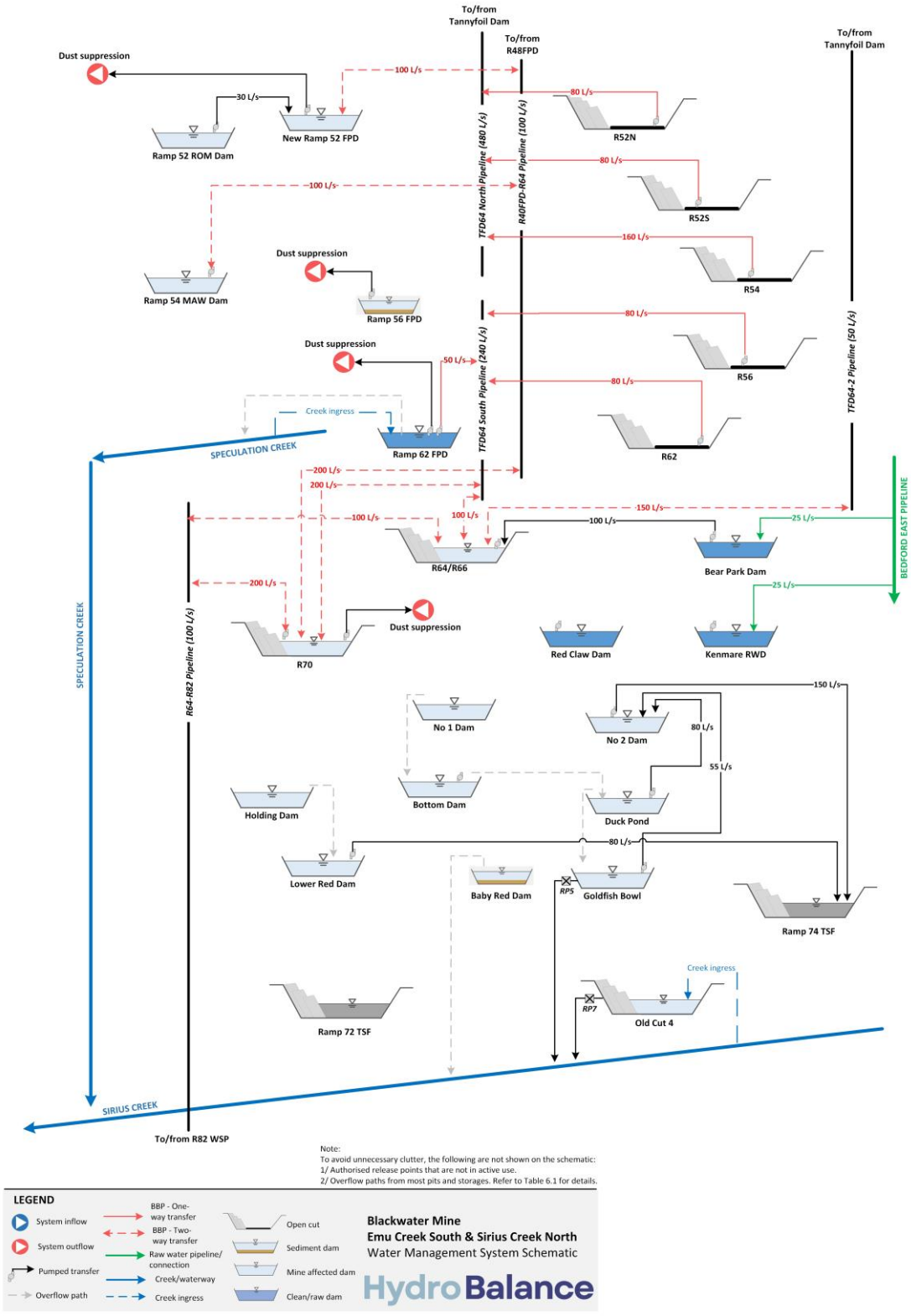


Figure 4.5 Existing SWMS schematic – Emu Creek and Sirius Creek North (HydroBalance, 2026)

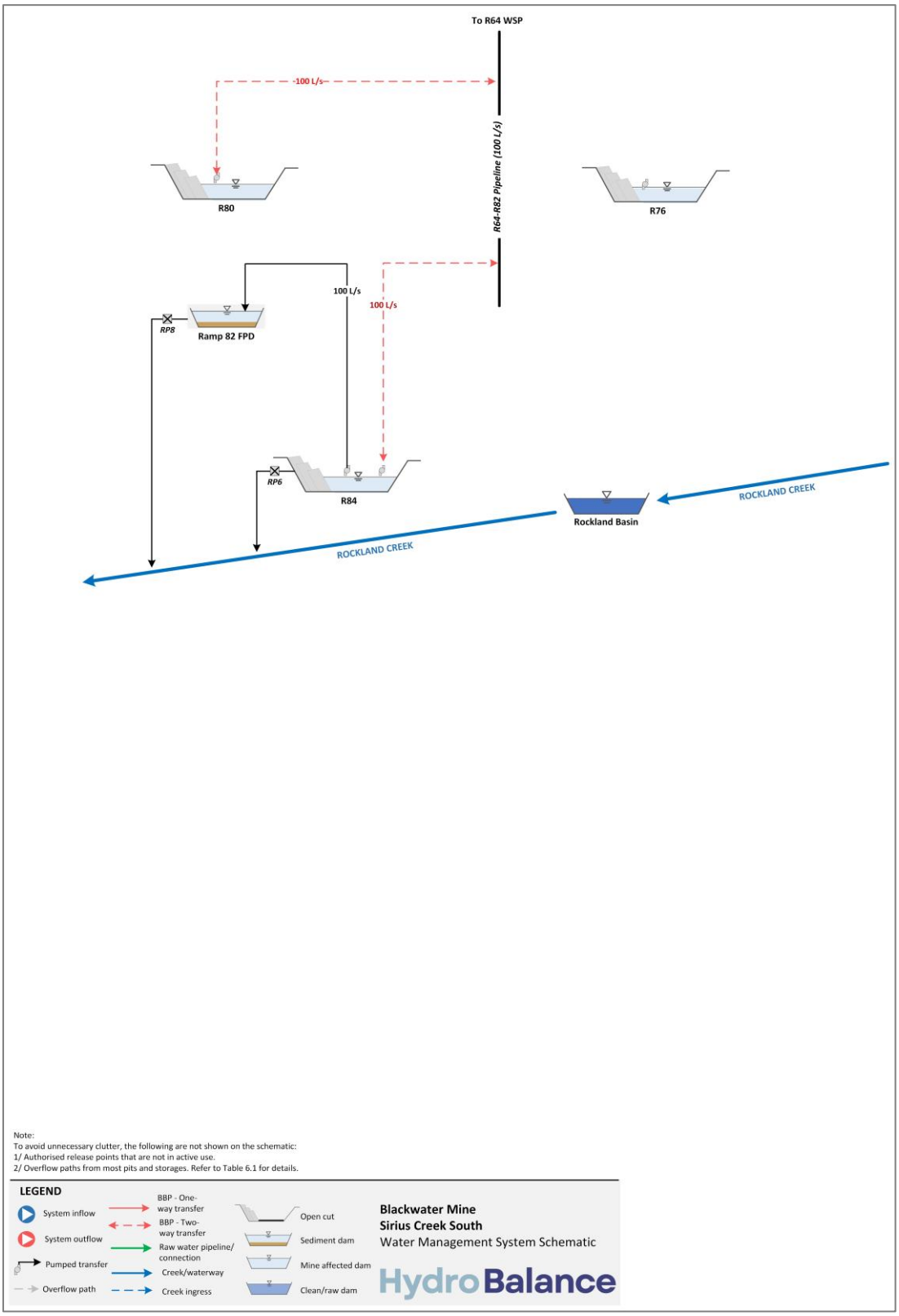


Figure 4.6 Existing SWMS schematic – Sirius Creek South (HydroBalance, 2026)

4.3 TYPES OF WATER GENERATED ON SITE

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 existing and 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.

Potential sources of contamination include runoff from disturbed and rehabilitated land, release of recycled waters from sewage treatment plants and industrial areas, and release of waters from pits, water storages and dams. Contaminants may include suspended solids, dissolved solids (e.g. sodium, chloride, sulphate), altered pH and metals (Whitehaven, 2025).

Definitions of the types of water generated within the Project are shown in Table 4.2.

Table 4.2 Types of water generated on site

Water type	Definition
MAW	In accordance with the DESI's *Model Mining Conditions (*2024b*)*, MAW means the following types of water: *i) pit water, tailings dam water, processing plant water* *ii) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity* *iii) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water* *iv) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated* *v) groundwater from the mine dewatering activities* vi) *a mix of mine-affected water (under any of paragraphs i) - v)) and other water.*
Sediment water	Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. EC, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
Clean catchment water	Surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
Raw water	Untreated water, generally from an external water supply, particularly the Burdekin pipeline.

Water type	Definition
Contaminated water	Contaminated water includes runoff from areas containing explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods, as well as flammable and combustible liquids (including petroleum products).
Potable water	Treated water suitable for human consumption.

4.4 SOURCES OF CONTAMINATION

The following are the primary sources of contamination at BWM, along with their potential contaminants and mechanisms (Whitehaven, 2025):

- Spoil areas - large areas of exposed spoil can be a substantial source of salt and sediment during runoff events and also potential seepage.
- Open pits - a large quantity of saline alkaline water collects in operational pits during intense wet periods. This water must be pumped to other storages to enable mining operations to continue.
- Haul roads and Industrial areas - very high runoff coefficient associated with the heavily compacted road surface can exacerbate sediment loads.
- Tailings Dams and Disposal Areas - dams with insufficient freeboard or structural faults can allow coal wastes to escape an impoundment.
- Topsoil stripped areas - subsoils in the area are often saline, hence topsoil stripped areas can generate saline surface runoff as well as high turbidity colloidal suspensions.
- MAW Management System (storage dams, piping and drainage infrastructure) - collection and transfer of MAW from other contaminant sources, providing risk of release to environment via dam spillways and piping infrastructure.
- Coal stockpiles - storm events can generate saline runoff and coal fines and leachate from stockpiles of coal.
- Reject stockpiles - storm events can generate saline runoff and coal fines and leachate from reject areas.
- Rejects disposal areas - drainage from these areas has potential for acid leachate generation.
- Rehabilitation areas - newly developed rehabilitation – e.g. top-soiled and seeded carries high erosion risk until vegetation cover is satisfactory. Potential for significant sediment yield as well as some saline water.

4.5 STORED WATER QUALITY

Whitehaven Blackwater have been recording pH and EC on a subdaily basis (telemetry) at key storages within BWM. Figure 4.7 and Figure 4.8 are box and whisker plots (box plots), which illustrate a statistical summary of pH and EC, respectively, at the following six BWM storages, for the period between January 2016 and April 2025:

- TFD – location of licensed discharge point RP4;
- NTCD – location of licensed discharge point RP2;
- TCP Dam;
- Rejects Drainage Sump; and
- Ramp 34 Storage Dam.

The box plots represent the following:

- the upper and lower 'whiskers' represent the 5th and 95th percentile range of values;
- the upper and lower extents of the green box represent the 25th and 75th percentile of values; and
- the black line in the green box represents the median (50th percentile value).

The monitoring results show that:

- Stored water quality in all six storages is generally alkaline, with median pH ranging between 8.5 and 9.5, which is above the upper threshold of the adopted WQOs.
- Median EC are above the adopted WQOs at all storages except for the Ramp 34 Storage Dam. However, EC at all six storages has mostly remained below 10,000 µS/cm, which is EA's upper limit for controlled releases (discussed in Section 5.6.7).

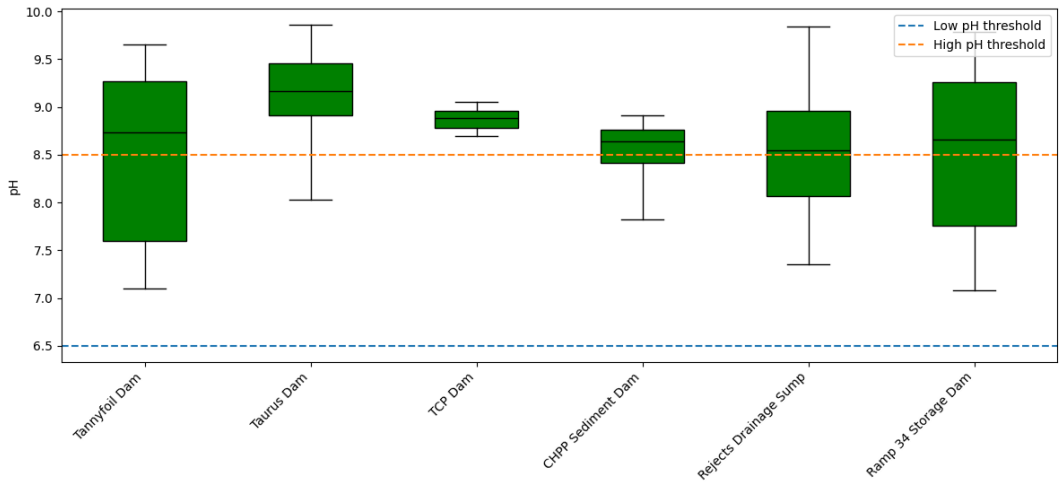


Figure 4.7 Monitoring results for pH at existing BWM storages, 2016 to 2025

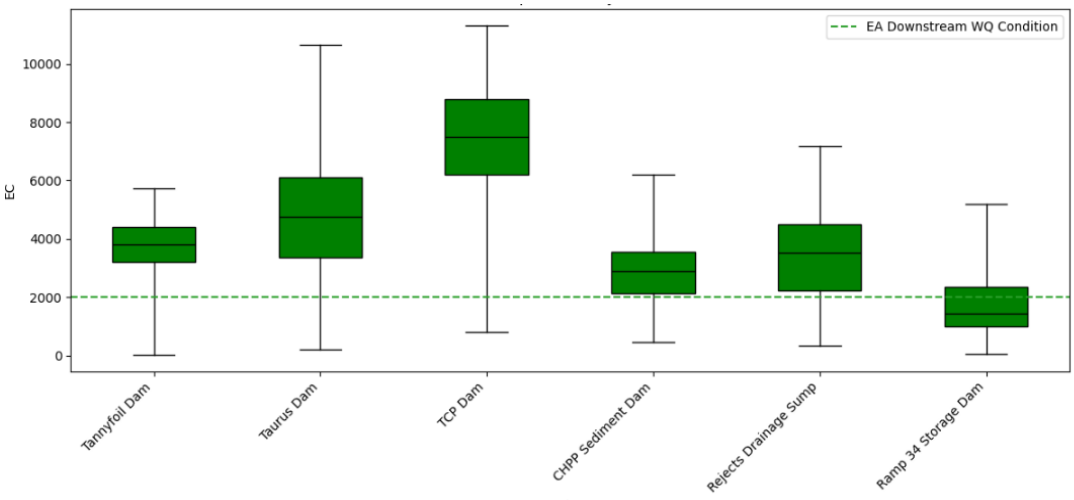


Figure 4.8 Monitoring results for EC (µS/cm) at existing BWM storages, 2016 to 2025

5 SURFACE WATER MANAGEMENT SYSTEM

5.1 OVERVIEW

The SWMS at BWM is designed to manage water resources efficiently while reducing environmental impacts. The system is designed to handle the diverse water sources generated by mining activities, including MAW, tailings runoff, sediment-laden water, and clean catchment water.

The SWMS consists of a network of storage facilities, pipelines, and controlled-release mechanisms. These components work together to ensure compliance with environmental regulations, maintain operational efficiency, and protect local waterways. The SWMS consist of:

- Storage Facilities: The SWMS includes a variety of dams and pits with specific operating capacities. These include dam storages, on-stream storages, tailings dams as well as active and inactive pit storages (refer to Table 4.1). There are no additional storages proposed as part of the Project.
- Pipeline Network: The site has 10 backbone pipelines connecting water storage facilities across the mine (refer to Table 6.2 in Appendix B). There are no additional trunk pipelines proposed as part of the Project.
- Controlled Releases: Controlled releases are permitted under specific conditions. Releases are regulated to ensure minimal impact on downstream water quality. There are no proposed changes to the currently approved controlled release strategy as part of the Project.
- Erosion and Sediment Control:
  - The SWMS includes sediment basins to capture sediment laden runoff from the disturbed areas and provide an area where settlement of suspended sediment in runoff can occur (Whitehaven, 2024).
  - No specific requirements for additional sediment basins have been identified. However, there is potential additional sediment basins may be required for the Project associated with disturbance in advance (to the east) of mining operations including infrastructure corridors, pre-stripping and topsoil stockpiles. The requirement for, and location and sizing of, any new sediment basins would be confirmed during detailed design, having regard to the final disturbance footprint, catchment configuration, drainage design and anticipated sediment-generation risk.

5.2 SURFACE WATER MANAGEMENT DOCUMENTATION

Surface water at BWM is managed in accordance with key guiding documents, including:

- BWM WMP (Whitehaven, 2026a): This plan is developed in compliance with the EA EPML00717813 and serves as the primary framework for site water management. It provides comprehensive guidance on operational principles, design considerations, and management strategies to ensure effective and environmentally responsible water handling.
- Erosion and Sediment Control Plan (ESCP) (Whitehaven, 2026b): This plan outlines specific measures to prevent erosion and manage sediment-laden water.

The WMP includes detailed strategies for water storage, controlled releases, ESC, and tailings management. It is designed to address the unique hydrological challenges of the BWM site, ensuring that water resources are managed sustainably and in line with regulatory requirements.

5.3 SURFACE WATER MANAGEMENT OBJECTIVES

The SWMS at BWM, including the Project, is designed to ensure operational efficiency while safeguarding EVs. The key objectives of the SWMS, as outlined in the WMP (Whitehaven, 2023), are:

- Prevent uncontrolled discharges: Ensure that MAW is effectively managed to prevent uncontrolled discharges into local waterways, thereby protecting aquatic ecosystems and maintaining water quality.
- Ensure regulatory compliance: Adhere to all EA conditions, including those specified under EPML00717813, to meet statutory requirements and uphold environmental standards.
- Optimise water reuse and recycling: Maximise water reuse and recycling on the mine site to reduce reliance on external water sources and promote sustainable water management practices.
- Minimise downstream impacts: Mitigate the effects of mining activities on downstream water quality and hydrology, ensuring that local waterways remain healthy and functional.
- Implement ESC measures: Deploy effective strategies, such as sediment basins and silt fences, to reduce sedimentation and protect the integrity of local waterways.

5.4 CONTAMINATED WATER MANAGEMENT

5.4.1 Chemical storage

Chemical storage facilities at BWM are designed to prevent contamination of surface water resources. These facilities are equipped with secondary containment systems, such as bunds and spill trays, to capture any accidental spills or leaks. Regular inspections and maintenance are conducted to ensure the integrity of storage tanks and associated infrastructure, as outlined in the WMP (Whitehaven, 2023). Additionally, the EA requires compliance with strict guidelines for chemical storage and handling to minimise environmental risks.

5.4.2 Fuel storage

Fuel storage areas are managed to prevent spills and leaks that could contaminate surface water. These areas are equipped with bunding and spill containment systems to capture any accidental releases. Regular inspections and maintenance are carried out to ensure the structural integrity of storage tanks and associated infrastructure. The EA mandates that all fuel storage facilities meet specific standards to prevent environmental harm (Whitehaven, 2025).

5.4.3 Sewage

Sewage generated at BWM is treated in accordance with environmental regulations to prevent contamination of surface water resources. The mine operates and maintains three Sewage Treatment Plants (STPs): the Central STP, the Southern Coal Preparation Plant STP, and the Northern Coal Preparation Plant STP. Treated sewage effluent is released only under strict conditions outlined in the EA. Monitoring of treated effluent quality is conducted by a National Association of Testing Authorities registered laboratory, and all data is stored in the PI Vision system for compliance and reporting purposes (Whitehaven, 2025).

5.5 SEDIMENT WATER MANAGEMENT

5.5.1 Objectives

The sediment water management system at BWM is designed to reduce sediment transport into local waterways, thereby protecting water quality and preserving aquatic ecosystems. This system is a critical component of the SWMS and is implemented in compliance with the EA EPML00717813 (Whitehaven, 2025a).

5.5.2 Operational principles

The sediment water management system employs a range of control measures to capture and treat sediment-laden water before releasing it into the environment. These measures include:

- Sediment Basins: Strategically located basins collect and settle sediment from runoff before discharging into local waterways.
- Silt Fences: Temporary barriers are installed to trap sediment and prevent it from entering watercourses during construction and operational activities.
- Diversion Drains: Clean water is diverted away from disturbed areas to reduce the risk of sediment contamination.
- Vegetative Cover: Rehabilitation of disturbed areas with vegetation helps stabilise soil and reduce erosion, further minimising sediment transport.

5.5.3 Design and planning considerations

Where required, new sediment basins would be designed, constructed, operated and maintained in accordance with *BWM Plan - Erosion and Sediment Control Plan* (Whitehaven, 2022) and relevant contemporary guidance, including the Best Practice Erosion and Sediment Control guideline published by the International Erosion Control Association (Australasia) (IECA, 2008). The erosion and sediment control system would apply a treatment-train approach, incorporating measures such as clean-water diversion, runoff conveyance, erosion controls, sediment controls and appropriately sized sediment basins.

The design and planning of sediment water management measures at BWM consider several factors to ensure their effectiveness:

- Size and Location of Sediment Basins: Basins are designed based on the expected volume of sediment-laden water and are placed in areas with high runoff potential.
- Type of Control Measures: The selection of control measures, such as silt fences or sediment traps, is based on site-specific conditions, including soil type, slope, and rainfall patterns.
- Catchment Characteristics: Detailed catchment mapping is used to identify areas with high erosion risk and to plan appropriate sediment control measures (HydroBalance, 2026).
- Monitoring and Maintenance: Regular inspections and maintenance of sediment control structures are conducted to ensure their continued effectiveness, particularly before and after wet seasons (Whitehaven, 2025a).

5.6 MINE WATER MANAGEMENT SYSTEM

5.6.1 Overview of water management system configuration

The SWMS is designed to manage water generated by mining activities and natural processes, including rainfall, catchment runoff, groundwater inflows and external water supplies. The SWMS ensures that water is safely collected, stored, treated, reused and released in a controlled manner.

The SWMS consists of a connected network of storage facilities, pipelines and pumping systems that manage water across the site. The system services a total catchment area of approximately 10,914 hectares (ha), including natural catchments, spoil areas, rehabilitated land, tailings facilities, pits and other disturbed areas.

Water is stored in a combination of dams and pits before reuse or release. Key storage facilities are fitted with infrastructure that allows water to be released in a controlled manner during extreme wet conditions. The SWMS includes 10 main pipelines that transfer water between storage facilities and operational areas across the site.

5.6.2 Site water demands

Operational demands at BWM include haul road dust suppression and coal washing demand. Details for each demand and loss is provided in the following sections below, which, in the absence of

metered data, was estimated based on daily rainfall and evaporation data sourced from the SILO (HydroBalance, 2026).

5.6.2.1 Dust suppression

The estimated future annual dust suppression demand is 3,000 megalitres per year (ML/year) with adjustments to the model rules as follows:

- Watered haul road length increased to 40 km.
- Watered haul road width = 55 m.
- Summer application factor = 0.85.
- Winter application factor = 0.9.

Figure 5.1 shows the average monthly forecast dust suppression demand.

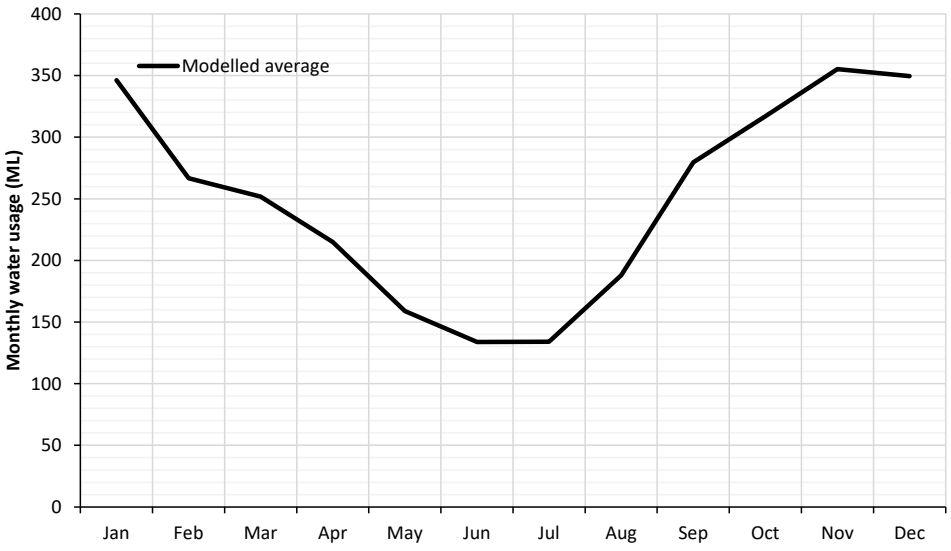


Figure 5.1 Forecast average monthly dust suppression demand (HydroBalance, 2026)

Dust suppression water is sourced from the following storages:

- R14 WSP;
- TCP Dam;
- Top Dam;
- NCHPP WSD;
- R28 FPD;
- R40 FPD;
- TFD;
- R52 FPD;
- R56 FPD;
- R62 FPD; and
- R70 WSP.

5.6.2.2 Coal Handling and Preparation Plant production and demand

CHPP coal processing water demand is generally related to the annual coal production tonnages (HydroBalance, 2026). The estimated net CHPP consumption rate is 188 litres per run-of-mine tonne (L/ROM t) for the coal washed through the BWM CHPP. For bypass coal, the estimated usage is 10 L/ROM t.

The forecast annual production profile for washed and bypass coal between Financial Year (FY)26 and FY55, and the annual net consumption, are summarised in Table 5.1.

The net CHPP process makeup demand is primarily sourced from the MAW system and has minimal raw water demand. MAW continuously supplies CHPP makeup water from NCHPP WSD.

Table 5.1 BWM forecast production profile – washed coal (HydroBalance, 2026)

Period	Washed coal - Annual tonnage (Mtpa)	Washed coal - Annual net CHPP consumption (ML/year)	Bypass coal - Annual tonnage (Mtpa)	Bypass coal - Annual net consumption (ML/year)
FY27	12.6	2,378	2.6	26.1
FY28	13.8	2,603	2.8	27.6
FY29	13.0	2,442	2.0	20.4
FY30	14.1	2,659	1.4	13.9
FY31	15.2	2,858	1.8	18.0
FY32	15.2	2,866	3.8	37.6
FY33	15.2	2,858	3.7	37.2
FY34	15.2	2,858	2.9	29.4
FY35	15.2	2,858	3.8	38.0
FY36	15.2	2,866	3.8	37.6
FY37	15.2	2,858	2.3	23.1
FY38	15.2	2,858	3.8	38.0
FY39	15.2	2,858	3.6	36.2
FY40	15.2	2,866	3.6	35.9
FY41	15.2	2,858	2.1	20.6
FY42	15.2	2,858	3.0	29.8
FY43	15.2	2,858	2.8	28.4
FY44	15.2	2,866	1.9	19.4
FY45	15.2	2,858	2.2	22.3
FY46	15.2	2,866	1.9	19.5
FY47	15.2	2,858	3.6	36.2
FY48	15.2	2,866	0.8	8.0
FY49	15.2	2,858	3.0	30.4
FY50	15.2	2,858	2.7	27.4
FY51	15.2	2,858	2.4	23.7
FY52	15.2	2,866	1.3	12.6

Period	Washed coal - Annual tonnage (Mtpa)	Washed coal - Annual net CHPP consumption (ML/year)	Bypass coal - Annual tonnage (Mtpa)	Bypass coal - Annual net consumption (ML/year)
FY53	12.3	2,317	3.3	32.5
FY54	10.0	1,882	3.5	34.7
FY55	11.1	2,081	3.9	39.4

The following CHPP water and solids assumptions have been made:

- ROM coal moisture content: 6.4% weight per weight (w/w).
- Product coal moisture content: 10.7% w/w.
- Product yield (wet): 77.5%.
- Product yield (dry): 69.7%.
- Coarse rejects moisture content: 10.1% w/w.
- Fine tailings moisture content: 71.8% w/w.
- Waste stream split:
  - Coarse rejects fraction (dry): 85.7%.
  - Fine tailings fraction (dry): 14.3%.
- CHPP makeup water requirement: 188 L/ROM t – note this does not account for any decant return water, it is the water needed to balance the adopted tonnages and moisture contents.

5.6.2.3 Thermal Coal Plant demand

The TCP water demand is not metered. As per the previous modelling, a constant demand of 100 ML/year has been adopted for the TCP (HydroBalance, 2026).

5.6.3 External water supply

The raw water for BWM is supplied from the Bedford West and Bedford East pipelines, with annual available allocations of 1,603 ML and 678 ML, respectively (HydroBalance, 2026). Pipeline water is drawn into the site when the site-wide water storage inventory falls below 14,701 ML (Green Trigger Action Response Plan [TARP]).

A minimum raw water import volume was applied to the model as follows, based on Whitehaven's advice:

- Bedford East supply: 27 ML/month (based on March to August 2025 usage).
- Bedford West supply: 11 ML/month (based on August 2025 usage) – this excludes 6 ML/month that is supplied to Pastoral Agreements (based on March to August 2025 usage).

Maximum daily supply rates of 2.5 ML/d (Bedford East) and 10 ML/d (Bedford West) were allocated based on the rate currently achievable at the site, including an allowance for 85% availability.

5.6.4 Tailings management

The BWM Water Balance Model models the tailings waste stream as follows (HydroBalance, 2026):

- All tailings moisture is sent to R10/12 WSP (Bonnie Doon).

- Water is actively dewatered from R10/12 WSP back to the SWMS. The model accounts for losses such as tailings matrix retention, beach and decant pond evaporation, and seepage.

The tailings and reject runoff management system at BWM is designed to manage water generated during coal processing activities. This system operates in conjunction with the SWMS, allowing water to be recovered, reused and managed in a controlled manner and assumes the following:

- All moisture associated with tailings is directed to the R10/12 WSP (also known as Bonnie Doon), which stores and manages water generated from the tailings stream.
- Water is actively dewatered from the R10/12 WSP and returned to the SWMS. Recovered water is reused in site operations, including coal washing and dust suppression.
- For modelling purposes, HydroBalance (2026) adopted tailings decant return of 40%, which also accounts for losses from beach evaporation, decant pond evaporation, and seepage.
- Coarse rejects are transported from the CHPP to approved disposal locations, such as in-pit voids. These areas are progressively capped with topsoil and rehabilitated to reduce long-term environmental impacts.
- Fine tailings consist of fine coal particles and clay materials suspended in water. These materials are stored in semi-permanent tailings cells or approved tailings storage facilities.
- The management of fine tailings is designed to minimise the risk of acid metalliferous drainage and saline drainage, protecting surrounding surface water and groundwater resources.

5.6.5 Inflows from local waterways

A few creeks that flow past or through BWM interact with the site's storages either as direct catchment inflows or as overflows from the creek. These interactions are as follows:

- TCP Dam – receives direct water ingress from Burngrove Creek.
- R40 FPD – receives direct water ingress from Taurus Creek.
- R38 – receives indirect water ingress from Taurus Creek, via R40 FPD overflows.
- R62 FPD – receives direct water ingress from Speculation Creek.
- Old Cut 4 – receives direct water ingress from Sirius Creek.
- Rockland Basin – receives direct water ingress from Rockland Creek.

5.6.6 Groundwater

Groundwater inflow rates to the mine pits have been estimated based on a groundwater model developed by SLR (2026). The groundwater inflows have been adjusted to account for pit face evaporation losses and losses from in-situ coal extraction during mining (HydroBalance, 2026).

Figure 5.2 and Table 5.2 summarise the annual groundwater estimates for the Project over the simulation period between 2026 and 2055. The inflows have been distributed among the open cut pits in accordance with the provided groundwater data.

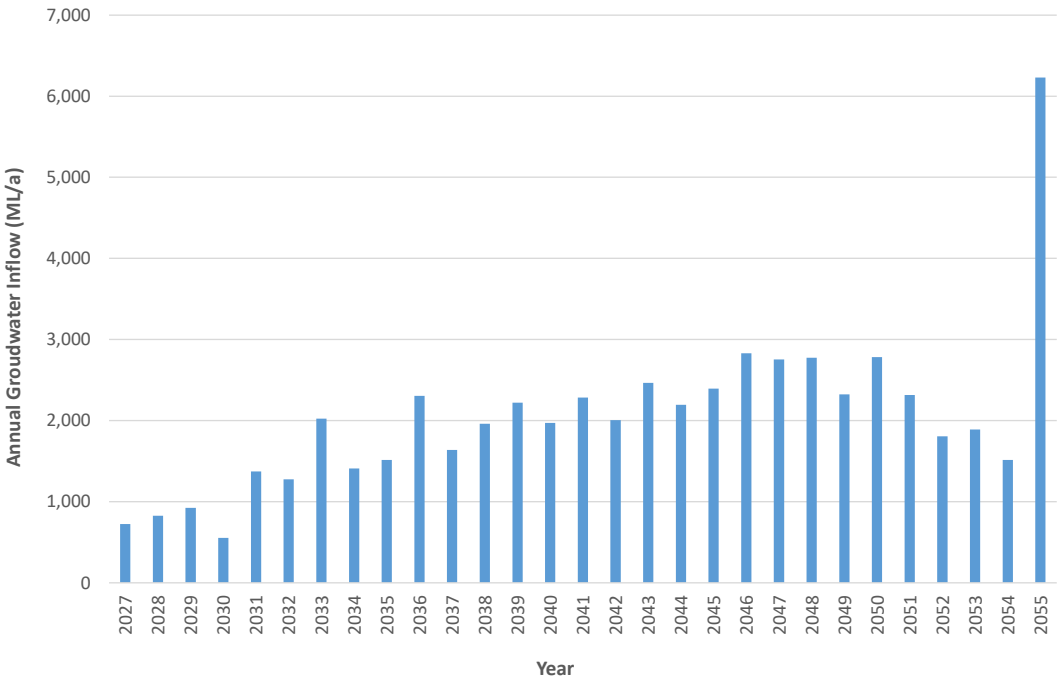


Figure 5.2 **Forecast annual groundwater inflow rate (HydroBalance, 2026)**

Table 5.2 **Adopted groundwater inflow rates (HydroBalance, 2026)**

Calendar year	Annual groundwater inflow (ML/year)
2027	725
2028	828
2029	924
2030	553
2031	1,373
2032	1,275
2033	2,025
2034	1,410
2035	1,514
2036	2,306
2037	1,639
2038	1,962
2039	2,220
2040	1,972
2041	2,285
2042	2,006
2043	2,465

Calendar year	Annual groundwater inflow (ML/year)
2044	2,196
2045	2,395
2046	2,830
2047	2,754
2048	2,774
2049	2,323
2050	2,782
2051	2,316
2052	1,805
2053	1,892
2054	1,515
2055	6,231

5.6.7 Controlled release

Controlled releases are permitted from RP2 via NTCD, RP3 via NDCD and RP4 via TFD. Controlled releases may be undertaken when the following conditions are met per Condition F4 and Conditions F9 to F11 of the current EA :

- For RP2 and RP3:
  - the flow in Blackwater Creek (at Gauging Station 2) is greater than or equal to (≥) 1 cubic metre per second (m^3/s);
  - the EC in the release dam is <10,000 µS/cm;
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm; and
  - Blackwater Creek mixed downstream EC can exceed greater than (>) 2,000 µS/cm during a release if the upstream monitoring point is equal or higher than downstream (i.e. the mine release does not have a measurable impact on downstream water quality during the release).
- For RP4:
  - the flow in Two Mile Gully (at Gauging Station 3) is ≥1 m^3/s;
  - the EC in the release dam is <10,000 µS/cm; and
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm.

The BWM EA also authorises releases from the following storages, which were not modelled as controlled releases:

- RP5 - Goldfish Pond;
- RP6 - Marshmead Pit;
- RP7 - Old Cut 4;
- RP8 - R82 FPD;

- RP10 - TCP Dam;
- RP11 - NCHPP Sediment Dam[1];
- RP12 - Rejects Stockpile Dam[1]; and
- RP13 - R34[1].

5.7 TRIGGER ACTION RESPONSE PLAN

The site-wide water security and containment risks at BWM are managed using a TARP. The TARP has been developed by Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide BWM TARP is summarised in Table 5.3.

Table 5.3 BWM site-wide water management TARP (HydroBalance, 2026)

Trigger	Action / Response
Red - Dry	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Yellow - Dry	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Green	• Import water from Bedford pipelines at 50% allocation.
Yellow - Wet	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release.
Red - Wet	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release. • Allocate emergency storage in pits.

[1] In accordance with Table F1 of the EA, "RP11, RP12 and RP13 are not 'active' until the completion of Deep Creek Diversion Stage 2."

6 SITE WATER BALANCE ASSESSMENT

6.1 OVERVIEW

6.1.1 Water balance assessment methodology

The site water balance assessment for Project (HydroBalance, 2026) provides a detailed evaluation of the water management system's performance under different climatic conditions. This assessment is essential for ensuring the mine's water management system operates effectively and sustainably, even during extreme weather events.

A computer-based operational simulation model was used to assess the dynamics of the BWM water balance under varying rainfall and catchment conditions throughout the duration of the Project. The water balance model developed for this assessment covers the period of July 2025 to June 2055 (30 years in total). The Project commences in 2030, and mining in the Project area ceases in 2055.

The assessment uses the GoldSim model, a dynamic simulation tool, to analyse water inflows and outflows across the site. The model accounts for various water sources and losses, including:

- Inflows: Rainfall, catchment runoff, groundwater inflows, and external water supplies.
- Outflows: Evaporation, seepage, controlled releases, and water usage for operational activities such as coal processing and dust suppression.

6.1.2 Modelled scenarios

The site water balance assessment was undertaken for the following two scenarios:

- Proposed (Project) conditions – This scenario simulates the performance of the BWM SWMS including the increased disturbance footprint by the Project up to June 2055. For this scenario, the performance of the SWMS was assessed in terms of predicted inventory, external water supply requirements, controlled and uncontrolled releases.
- Approved conditions – This scenario represents the Approved BWM operations up to June 2055 excluding the increased disturbance by the Project. This scenario was simulated to compare the predicted volumes of controlled releases from BWM between the proposed (Project) conditions and the Approved operations up to 2055.

6.2 WATER BALANCE MODELLING RESULTS

6.2.1 Overview

Water balance modelling was completed for BWM (incorporating the Project) to assess how the SWMS performs under different climatic conditions. The modelling was undertaken using the GoldSim model and considered system performance over a 30-year simulation period.

The purpose of the modelling was to confirm that water inflows, storage and releases can be managed effectively, while reducing the risk of uncontrolled discharges and environmental impacts.

6.2.2 Water management system inventory

The modelling shows that the combined water inventory, which includes all dam and pit storages, is expected to operate within its available capacity under most climatic conditions.

Figure 6.1 shows the forecast total inventory, which includes all dam and pit storages onsite and is compared to the available SWMS capacity over time. Table 6.1 gives the total SWMS capacity.

The model results show the following:

- For the 5th percentile results (very wet climatic conditions), the peak combined water inventory volume is around 32,000 ML during the first few years of the simulation and around 39,500 ML by the end of the simulation.
- For the 10th percentile results (wet climatic conditions), the peak combined water inventory volume is around 28,000 ML during the first few years of the simulation and around 35,000 ML by the end of the simulation.
- For the 50th percentile results (median climatic conditions), the peak combined water inventory reaches around 17,500 ML during the first few years of the simulation and around 19,000 ML by the end of the simulation.
- The combined water inventory is maintained below the combined water capacity for almost all climatic conditions. There is between a 1% and 5% probability that the combined water inventory will exceed the combined water storage capacity in the first two years of the simulation, and any excess MAW would be temporarily stored in an active pit.

Overall, the results indicate that the SWMS has sufficient storage capacity to manage water over the life of the mine.

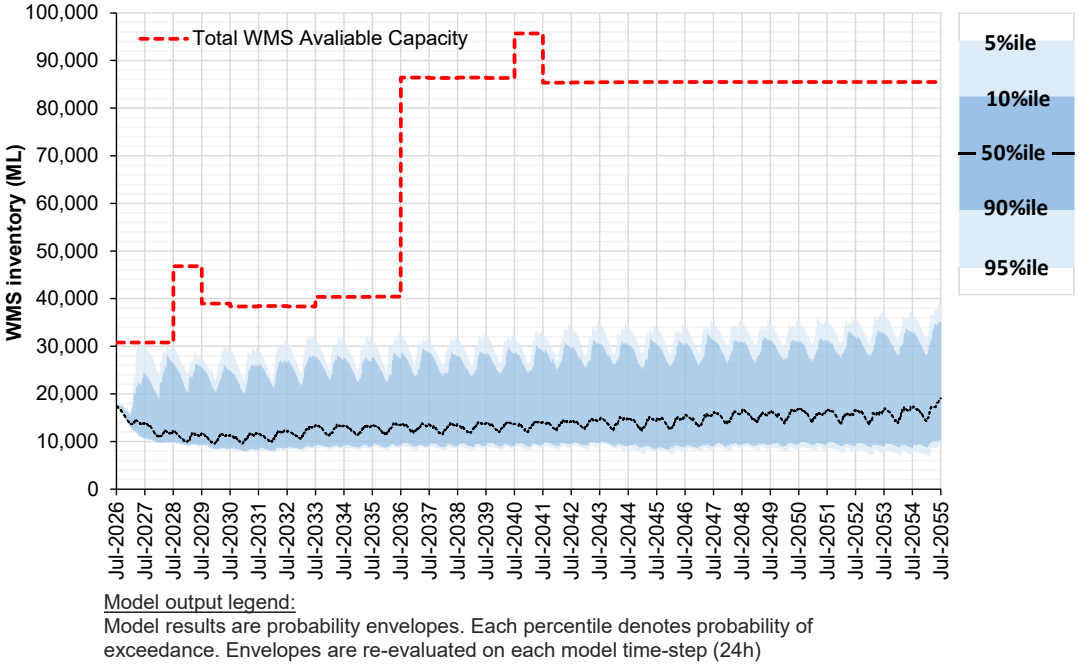


Figure 6.1 Forecast SWMS inventory (HydroBalance, 2026)

Table 6.1 Available storage capacity at BWM (HydroBalance, 2026)

Year/s (inclusive)	Available SWMS storage capacity (ML)
FY27	30,766
FY28	30,766
FY29	30,766
FY30	46,801
FY31	38,972
FY32	38,374
FY33	38,424
FY34	38,374
FY35	40,350
FY36	40,350
FY37	40,400
FY38	86,400
FY39	86,350
FY40	86,400
FY41	86,350
FY42	95,695
FY43	85,334
FY44	85,384
FY45	85,434
FY46	85,471
FY47	85,471
FY48	85,471
FY49	85,471
FY50	85,471
FY51	85,471
FY52	85,471
FY53	85,471
FY54	85,471
FY55	85,471

6.2.3 External water supply

Water imports from the Bedford East and Bedford West pipelines was included in the water balance model to assess operational water demands.

External water supply volumes vary depending on climatic conditions and site water availability. Higher import volumes are generally required during drier conditions, while lower volumes are needed during wetter periods. Figure 6.2 and Figure 6.3 show the forecast annual pipeline import volumes for Bedford East and Bedford West. The following is of note regarding the external water demand:

- The pipelines supply the minimum raw water demands to the site for all climatic conditions (as outlined in Section 3.5).
- For Bedford East pipeline:
  - External water is only imported under median (50th percentile), dry (90th percentile) and very dry (95th percentile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford East external water demands do not exceed the raw water allocation under any climatic conditions.
- For Bedford West pipeline:
  - External water is only imported under median (50th percentile), dry (90th percentile) and very dry (95th percentile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford West external water demands do not exceed the raw water allocation under any climatic conditions.

The existing Bedford West and Bedford East pipeline allocations are sufficient for maintaining operations at BWM. Additional external water supply allocation is not required as a result of the Project.

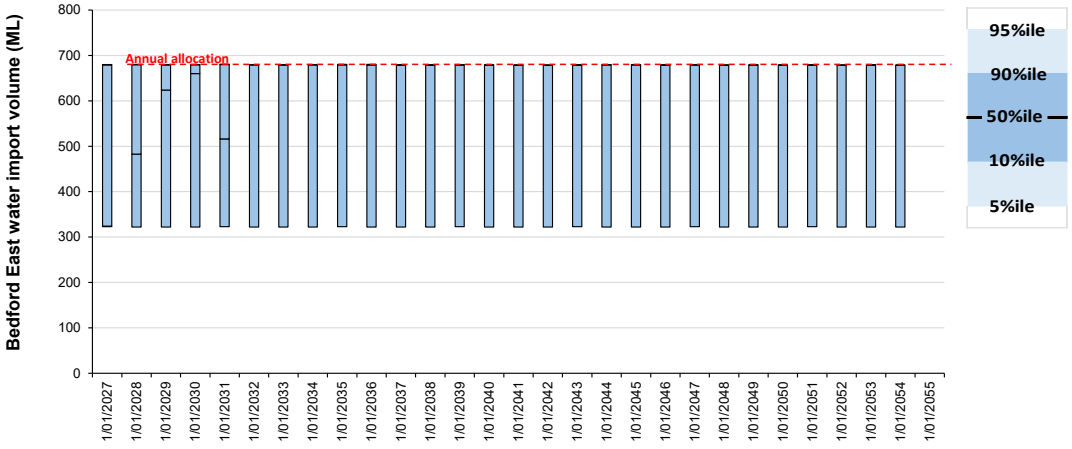


Figure 6.2 Forecast Bedford East pipeline demand (HydroBalance, 2026)

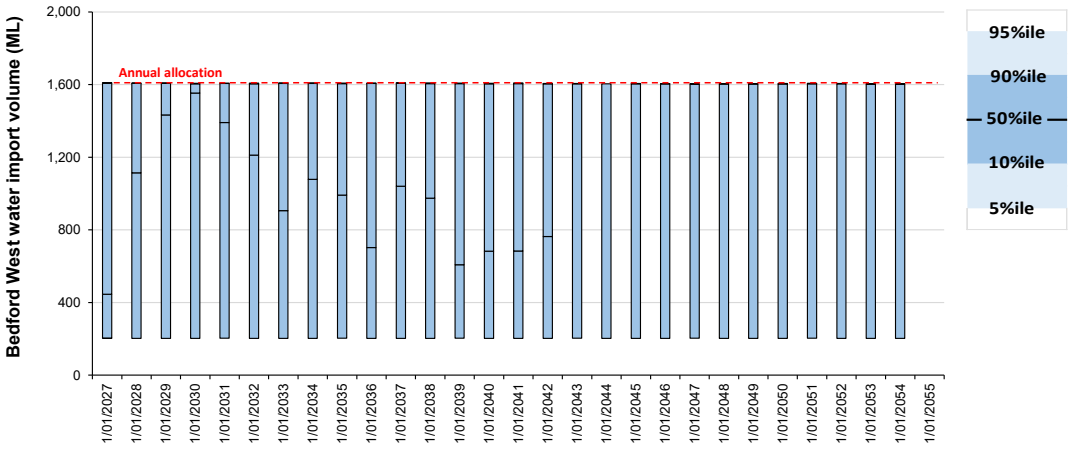


Figure 6.3 Forecast Bedford West pipeline demand (HydroBalance, 2026)

6.2.4 Controlled releases

6.2.4.1 Proposed Project conditions

The forecast annual controlled release volumes, in accordance with EA conditions, are shown in Figure 6.4. The following points are noted in relation to the controlled releases (HydroBalance, 2026):

- Controlled releases are expected to be required in very wet (5th percentile), wet (10th percentile) and median climatic conditions, as well as dry (90th percentile) climatic conditions in some years.
- During very wet climatic conditions (5th percentile), the annual releases volumes range from 2,950 ML to 5,130 ML.
- During wet climatic conditions (10th percentile), the annual releases volumes range from 2,350 ML to 2,930 ML.
- During median climatic conditions (50th percentile), the annual releases volumes range from 760 ML to 1,120 ML.

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

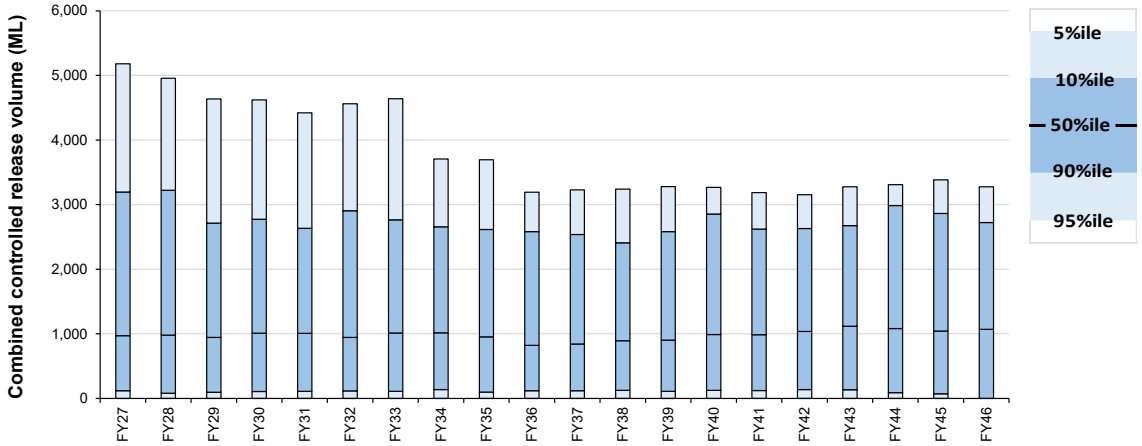


Figure 6.4 Forecast controlled release volumes (HydroBalance, 2026)

6.2.4.2 Comparison against Approved case

The Project results in the following key changes to water inflows within the water management system:

- Estimated 60% increase in groundwater inflows up to Year 2055.
- Minor changes in captured catchment areas.

An assessment of the impact of the Project on controlled release volumes has been undertaken by comparing Project results against an Approved case. The outcomes of this assessment have identified the following changes to controlled releases due to the Project:

- During very wet climatic conditions (5th percentile), the annual releases volumes for the Approved case range from 2,880 ML to 4,940 ML. That is, under very wet climatic conditions (5th percentile), annual controlled release volumes for the Project are predicted to increase by around 2-4% (70-190 ML) compared with the Approved Case.
- During wet climatic conditions (10th percentile), the annual releases volumes for the Approved case range from 2,200 ML to 3,100 ML. That is, under wet climatic conditions (10th percentile), annual controlled release volumes for the Project are predicted to increase by up to 7% (150 ML) compared with the Approved Case.
- During median climatic conditions (50th percentile), the annual releases volumes for the Approved case range from 630 ML to 1,010 ML. That is, under median climatic conditions (50th percentile), annual controlled release volumes for the Project are predicted to increase by around 11-20% (110-130 ML) compared with the Approved Case.

This assessment indicates that the Project would result in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

6.2.4.3 Controlled release rates and dilution requirement

An assessment of potential controlled-release rates and dilution requirements has been undertaken for:

- RP2 and RP3, discharging to Blackwater Creek; and
- RP4, discharging to Two Mile Gully.

For the purposes of this assessment, a downstream mixed EC value of 2,000 µS/cm has been adopted, as per Table F5 of the EA (80th percentile receiving water contaminant trigger level for EC). The adopted value is an assessment assumption only and does not necessarily represent the operational trigger or target applied by BWM Operations during an actual controlled release. Operational releases would continue to be managed in accordance with the EA and site procedures, which include:

- Assess stream flow conditions and applicable release limits in accordance with the EA.
- Check release water quality for compliance with the EA Release Contaminant Limits.
- Check receiving water quality for compliance with the EA Receiving Waters Contaminant Limits.
- Use the BWM Release Contaminant Model to assess opportunities to commence an EA compliant MAW release.
- Continue monitoring water quality and release conditions and model outputs.
- Inform the HSE Superintendent prior to commencing a release.

Typical upstream EC concentrations were estimated from relationships developed using recorded streamflow and EC data for the Blackwater Creek and Two Mile Gully gauges over the period 2016–2025. The assessment considers receiving flows of:

- 1 to 100 m^3/s in Blackwater Creek; and
- 1 to 10 m^3/s in Two Mile Creek.

The indicative release rates and dilution requirements are summarised in Table 6.2.

Table 6.2 Indicative release rates and dilution requirements

Release-water EC	Indicative dilution ratio [1]	Indicative release rate
2,500 µS/cm	Approximately 0.27–0.28	Approximately 3.5–3.7 times the receiving-stream flow
5.000 µS/cm	Approximately 1.63–1.69	Approximately 0.5-0.62 times the receiving-stream flow
10,000 µS/cm	Approximately 4.34–4.52	Approximately 0.22–0.23 times the receiving-stream flow

[1] Dilution ratio is defined as receiving-stream flow divided by release flow.

These results demonstrate that the allowable release rate reduces as the EC of the release water increases. For example, at the minimum assessed receiving flow of 1 m^3/s:

- release water with an EC of approximately 2,500 µS/cm could theoretically be released at approximately 3.5–3.6 m^3/s;
- release water with an EC of approximately 5,000 µS/cm could theoretically be released at approximately 0.6 m^3/s; and
- release water with an EC of approximately 10,000 µS/cm could theoretically be released at approximately 0.2 m^3/s.

For RP2 and RP3, the calculated release rate represents the combined allowable discharge from the two release points, rather than a separate allowable rate for each release point.

At higher receiving-stream flows, the achievable discharge rate would be constrained by the capacity of the release infrastructure rather than the calculated receiving-stream dilution capacity. Consequently, the dilution achieved under these conditions would generally be greater than the minimum values presented in the assessment.

The assessment demonstrates that controlled releases can be managed by adjusting the combined release rate in response to:

- the measured receiving-stream flow;
- the receiving-stream EC;
- the EC of the water proposed for release;
- the applicable downstream EC limit; and
- the hydraulic capacity of the release infrastructure.

The calculations are indicative desktop estimates and assume complete and instantaneous mixing of release water with the receiving stream. Actual releases would continue to be undertaken in accordance with the approved Environmental Authority (EA), including all applicable minimum-flow, water-quality, monitoring and release-point requirements.

6.2.4.4 Implications of dilution requirements on the controlled-release strategy

The assessment demonstrates that controlled releases can be managed by adjusting the combined release rate in response to:

- the measured receiving-stream flow;
- the receiving-stream EC;
- the EC of the water proposed for release;
- the applicable downstream EC limit; and
- the hydraulic capacity of the release infrastructure.

The calculations are indicative desktop estimates and assume complete and instantaneous mixing of release water with the receiving stream. Actual releases would continue to be undertaken in accordance with the approved EA, including all applicable minimum-flow, water-quality, monitoring and release-point requirements.

6.2.5 Uncontrolled releases

The Whitehaven documents *WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water* (Whitehaven, 2024), *BWM Plan – Water Management* (Whitehaven, 2026a) and *BWM Plan – Erosion and Sediment Control Plan* (Whitehaven, 2026b) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in this standard will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons (HydroBalance, 2026):

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.
- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have been identified as having a higher potential for uncontrolled discharge.
- The Project does not modify the catchments of NTCD or NDCD, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

7 FINAL VOID WATER BALANCE ASSESSMENT

7.1 OVERVIEW

Water levels in the final voids will vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater. A final void GoldSim model (separate to the GoldSim model used for the operational modelling) was used to assess the likely long-term water level behaviour of the final voids.

Condition E10 of the EA stipulates that "residual voids must not cause any serious environmental harm to land, surfaces waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself".

The BWM residual voids would be operated as non-use management areas (NUMAs) as part of the Progressive Rehabilitation and Closure Plan (PRCP).

A final void water balance assessment has been undertaken to evaluate the long-term hydrological behaviour of the residual voids. The GoldSim software platform was used to simulate the long-term water level behaviour for the Project voids. Details of the methodology and results of the final void water balance assessment are provided in the HydroBalance (2026) report (Appendix B). The key outcomes from the HydroBalance (2026) report have been reproduced in the following sections.

The assessment considers how water levels and water quality within the voids may change over time following mine closure. The long-term final void hydrology and water quality behaviour of the proposed final voids has been modelled over a 1,000-year post-closure period to assess whether the final voids would be safe and non-polluting.

7.2 FINAL VOID GEOMETRY

The proposed final landform layout relevant to the Project is presented in Figure 7.1 and Figure 7.2, and includes five residual voids:

- Mimosa/Besgrove;
- Ramp 30;
- Deep Creek;
- Stewarton North; and
- Stewarton South.

These residual voids would remain following the completion of mining and rehabilitation activities and would be managed as follows:

The residual voids would be managed as NUMAs under the PRCP, and the voids would not be used for ongoing water supply or operational purposes after mine closure.

Management of the voids is intended to minimise potential risks to surface water and groundwater, while supporting the long-term safety and stability of the final landform.

The final landform forms during mining, incorporating in-pit backfilled spoil within the mining works. A digital elevation model (DEM) of the final landform (i.e. the final surface expected at the end of the mine life) was provided by Whitehaven.

A summary of the residual void geometries is provided in Table 7.1

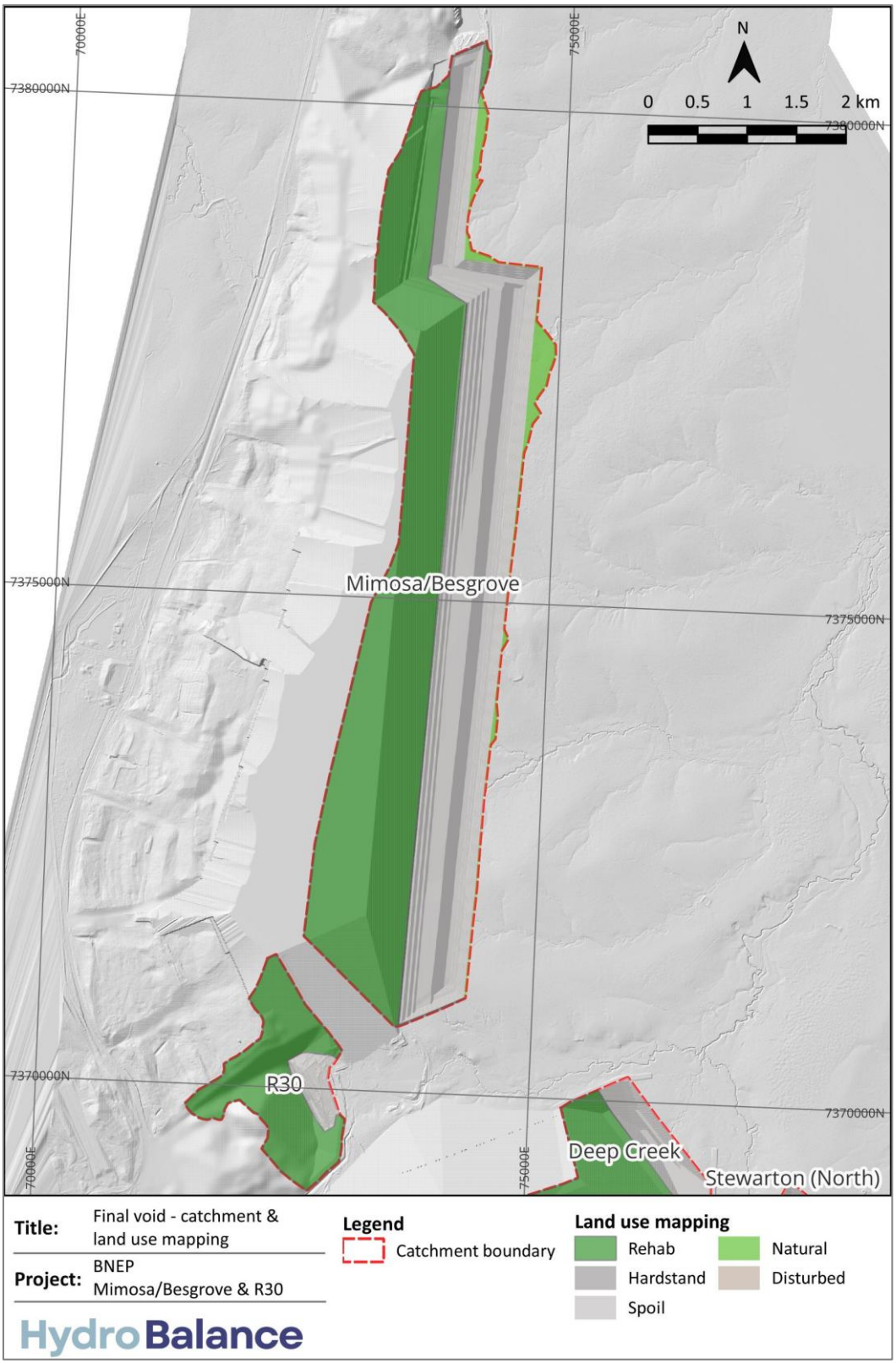


Figure 7.1 Final void configuration – Mimosa/Besgrove & Ramp 30 (HydroBalance, 2026)



Figure 7.2 **Final void configuration – Deep Creek, Stewarton North & South (HydroBalance, 2026)**

Table 7.1 Final void geometries

Void	Floor level (metres Australian Height Datum [mAHD])	Crest level (mAHD)	Depth (m)	Volume to crest (ML)	Surface area at crest (ha)
Mimosa/Besgrove	24	200	176	374,878	597.2
Ramp 30	139	217	78	16,316	59.7
Deep Creek	52	202	150	54,895	109.4
Stewarton North	-4	204	208	302,582	380.1
Stewarton South	92	232	140	42,632	82.5

7.3 CLIMATE DATA

The final void water balance assessment incorporates climate data sourced from the Australian Government Consistent Climate Scenarios (CCS) project. This project provides climate change-adjusted rainfall and evaporation data, transforming historical climate data from 1960 to 2024 into future projections. The CCS project offers daily climate projections across Australia on a 0.05-degree grid, with the grid point closest to the centre of BWM used for this assessment.

The assessment uses the Shared Socioeconomic Pathway (SSP)2-4.5 as the emission pathway, based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) (IPCC, 2014). This pathway assumes moderate global development and environmental policies, leading to moderate greenhouse gas emissions and radiative forcing of 4.5 watts per square metre (W/m^2) by 2100. The year 2070 was selected as the base case for global warming sensitivity, representing a midpoint for the varying void commencement dates (HydroBalance, 2026).

The climate data was adjusted using the following parameters:

- Climate Warming Sensitivity: Assumed to fall within the medium category.
- Future Climate Cluster: High global warming (HP) was selected to represent a high level of warming.
- Long-Term Climate Sequence: Historical climate data was adjusted and looped to create a 1,000-year climate sequence, ensuring robust predictions of rainfall and evaporation patterns. Figure 7.3 shows the long-term monthly averages for the rainfall data and pan evaporation.

The CCS data were used to generate long-term monthly averages for rainfall and pan evaporation. Evaporation data were converted to Morton's Lake (mLake) and Morton's Wet (mWet) evapotranspiration to account for water losses from the pit lake and catchment areas:

- Pan evaporation to mLake factor: 0.883, applied to evaporation on the pit lake surface.
- Pan evaporation to mWet factor: 0.845, applied to evaporation losses from the catchment.

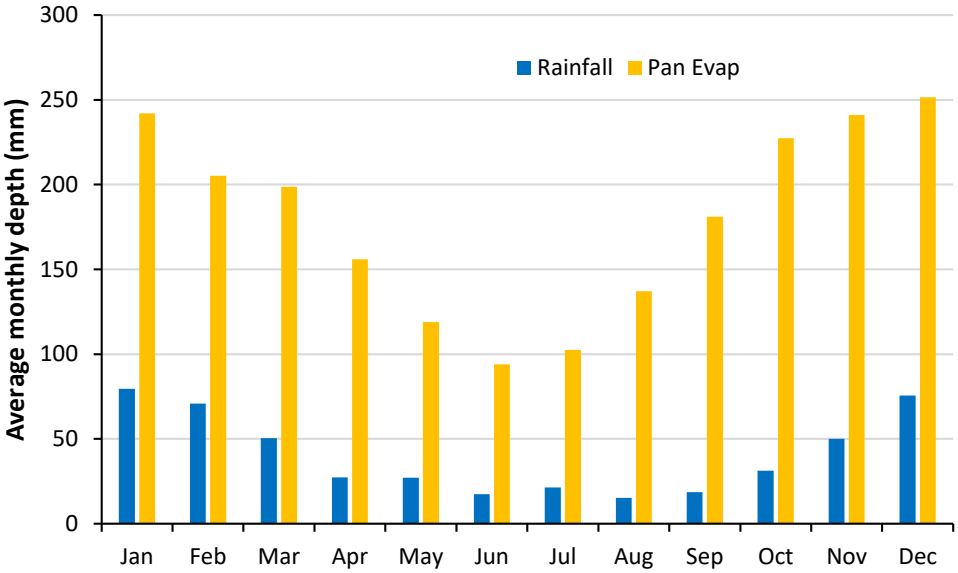


Figure 7.3 **Distribution of monthly rainfall and pan evaporation (CCS 1960 - 2024) (HydroBalance, 2026)**

7.4 CATCHMENT AREAS AND LAND USE MAPPING

Catchment areas and land use maps have been developed for the final voids to predict water inflows and outflows for each void. Each residual void has a specific catchment area that contributes water through rainfall, surface runoff, and groundwater inflows (HydroBalance, 2026). The final landform catchment area was delineated from the final landform surface provided by Whitehaven. The land use of the void floor has been characterised as spoil.

Figure 7.1 to Figure 7.2 show the catchment boundary and land uses adopted for the final void water balance. The catchment and land use values used in the GoldSim model are shown in Table 7.2.

At the completion of mining, surface runoff from rehabilitated in-pit and out of pit waste rock emplacement areas would flow to the receiving environment, with the exception of approximately 2,726 ha (27.3 km^2) which would report to residual voids associated with the Project.

Table 7.2 Final void catchment and land use areas (HydroBalance, 2026)

Void	Area (ha)			
	Undisturbed	Spoil	Rehabilitated spoil	Total
Mimosa/ Besgrove	39.1	596.5	622.4	1,258.0
Ramp 30	0.0	24.1	149.2	173.3
Deep Creek	0.0	52.9	167.3	220.2
Stewarton North	0.0	195.2	678.1	873.3
Stewarton South	0.0	50.9	150.3	201.2

The mapping includes various land use types that influence water flow and quality (HydroBalance, 2026):

- Natural Areas: Undisturbed regions that contribute clean water to the voids.
- Spoil Areas: Disturbed zones where mining waste is stored, which may contribute sediment-laden water.
- Rehabilitated Zones: Areas that have been restored with vegetation to stabilise soil and reduce erosion.
- Tailings Areas: Fine waste material from coal processing is stored, which may contribute water with higher levels of dissolved solids.
- Pit Voids: Active and inactive mining pits that can act as temporary water storage areas.
- Disturbed Areas: Zones affected by mining activities, which may generate sediment-laden runoff.

7.5 GROUNDWATER INFLOWS

Groundwater inflows into the five voids have been provided by the Project groundwater consultants (SLR, 2026). The inflows were provided as a time series over the 1,000 year simulation. Details on the groundwater inflows to the voids are provided in SLR (2026).

7.6 FINAL VOID WATER BALANCE MODELLING RESULTS

7.6.1 Overview

The final void water balance modelling results for Project final landform (HydroBalance, 2026) provide a detailed analysis of the long-term hydrological behaviour of the residual voids. The modelling was conducted using the GoldSim software platform, simulating water levels and salinity over a 1,000-year post-closure period.

The final water levels for the five voids are presented in Figure 7.4 to Figure 7.8. Of the five voids, three are expected by SLR (2026) to become long-term sinks, and the other two are predicted to become flow-through systems reporting to these long-term sinks.

7.6.2 Mimosa/Besgrove void water level

The Mimosa/Besgrove void is expected to reach equilibrium within 100 years post-closure, with a median water level of approximately 83 mAHD. The maximum water level is predicted to be 88.1 mAHD, which is about 112 metres (m) below the pit crest level of 200 mAHD. There is no risk of overtopping or significant water quality impacts during the simulation period (HydroBalance, 2026).

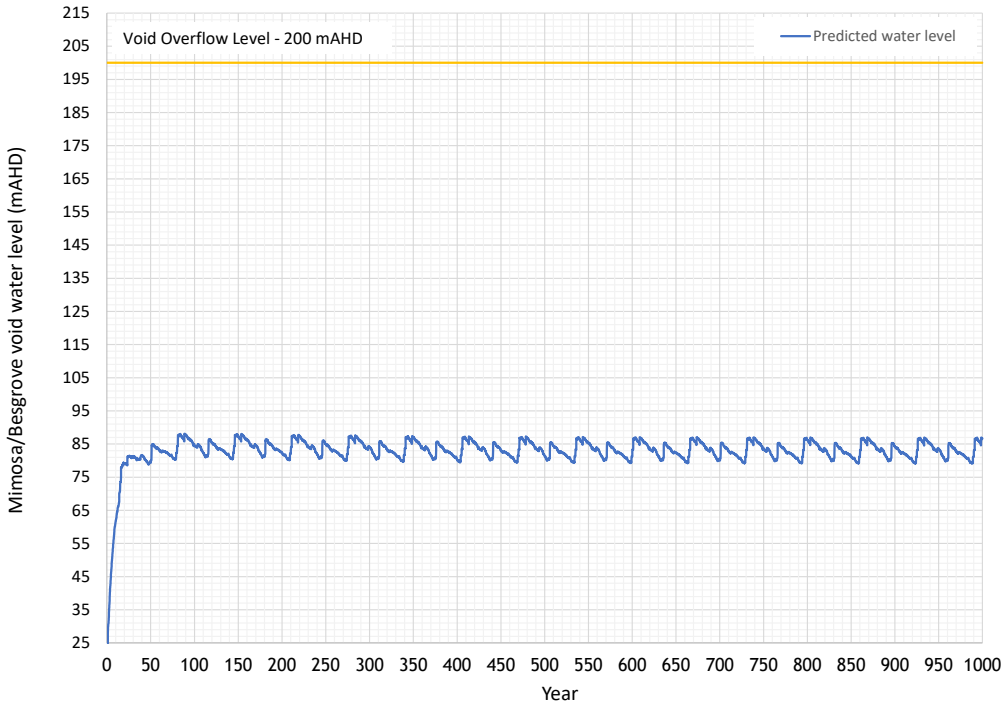


Figure 7.4 Mimosa/Besgrove void – long-term predicted final void water level (HydroBalance, 2026)

7.6.3 Ramp 30 void water level

The Ramp 30 void is expected to achieve equilibrium within 100 years post-closure, with water levels fluctuating between empty (during extended dry periods) and a maximum of around 160 mAHD during wet periods. The maximum water level is 57 m below the pit crest level of 217 mAHD, ensuring no overtopping occurs (HydroBalance, 2026).

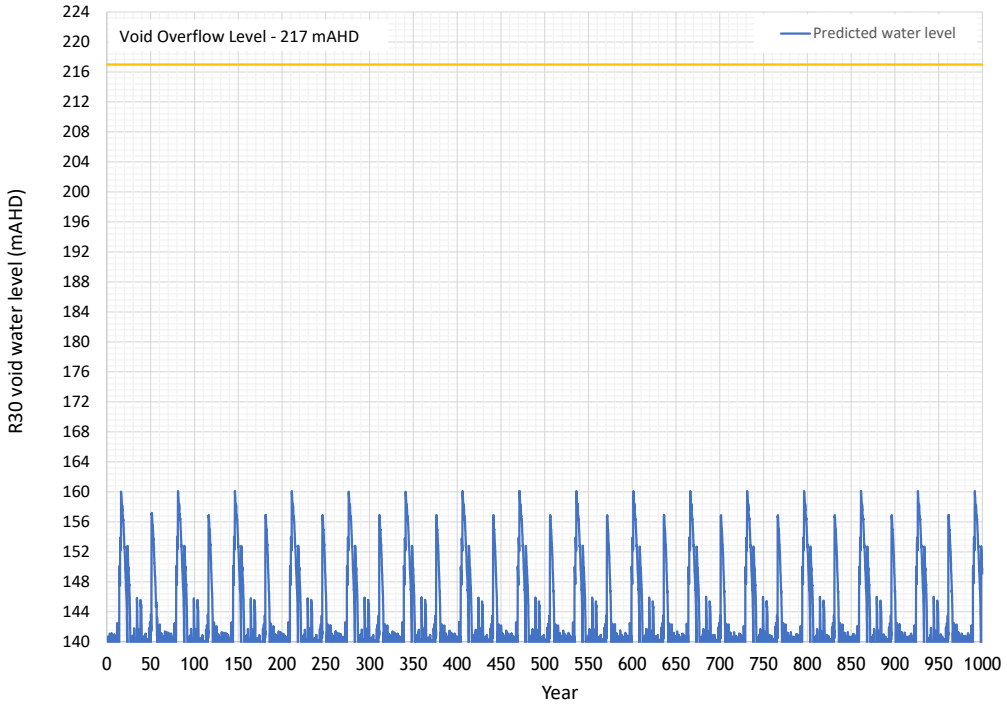


Figure 7.5 Ramp 30 void – long-term predicted final void water level (HydroBalance, 2026)

7.6.4 Deep Creek void water level

The Deep Creek void is anticipated to reach equilibrium within 150 years post-closure, with a median water level of approximately 138 mAHD. The maximum water level is predicted to be 149.8 mAHD, which is 52 m below the pit crest level of 202 mAHD. Water quality parameters are expected to remain within acceptable limits throughout the simulation period (HydroBalance, 2026).

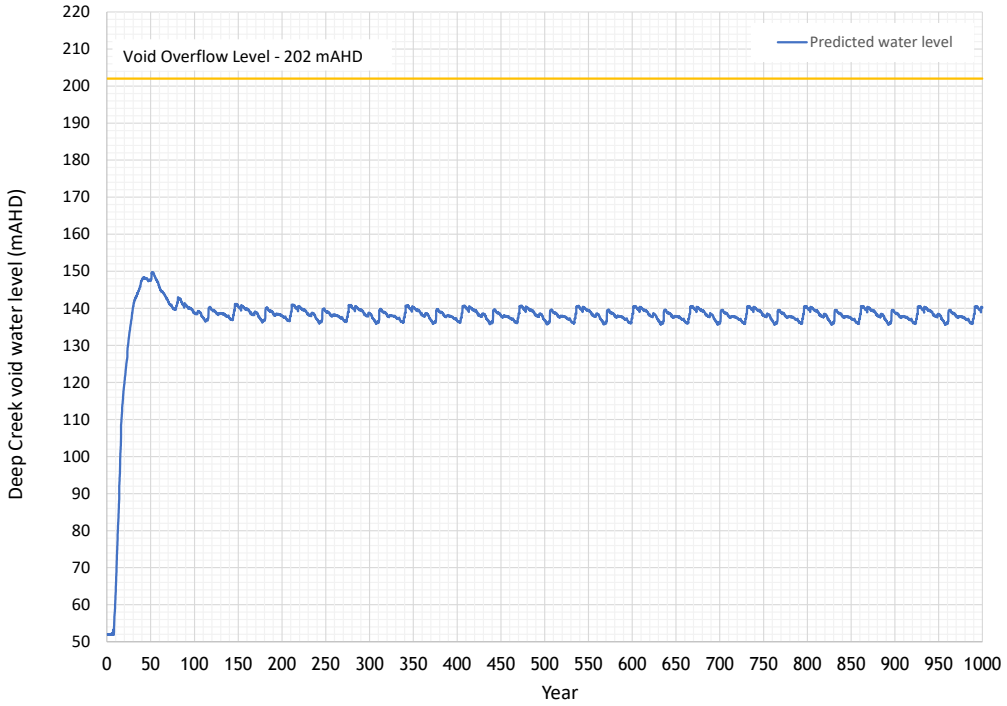


Figure 7.6 Deep Creek void – long-term predicted final void water level (HydroBalance, 2026)

7.6.5 Stewarton North void water level

The Stewarton North void is expected to stabilise within 100 years post-closure, with a median water level of approximately 73 mAHD. The maximum water level is predicted to be 79.4 mAHD, which is 124 m below the pit crest level of 204 mAHD. No significant environmental impacts are anticipated (HydroBalance, 2026).

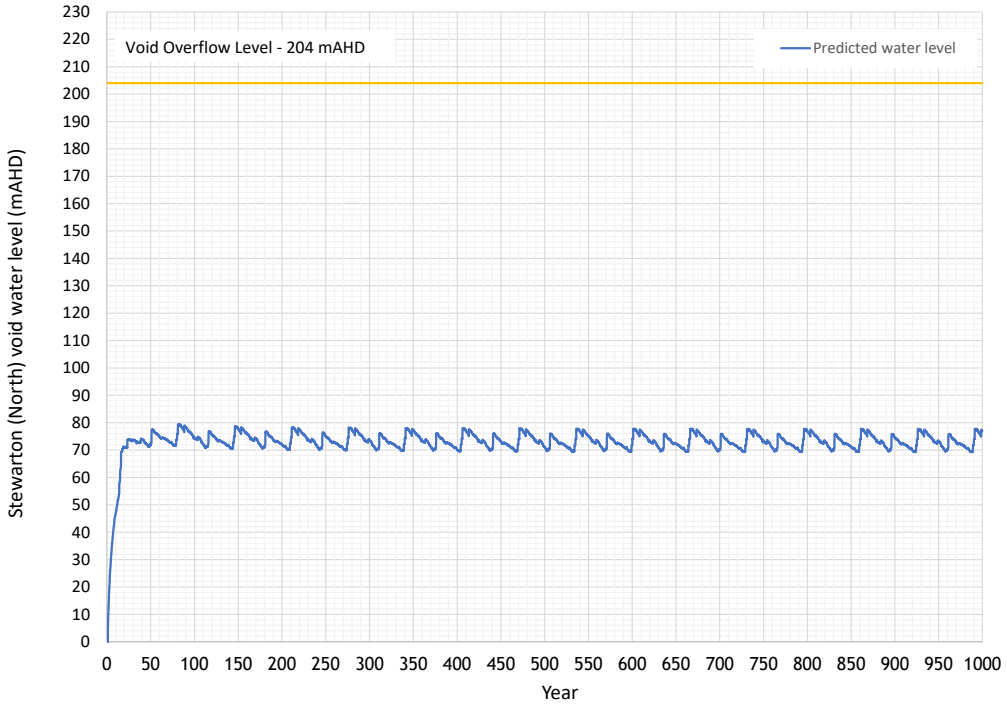


Figure 7.7 Stewarton North void – long-term predicted final void water level (HydroBalance, 2026)

7.6.6 Stewarton South void water level

The Stewarton South void is projected to achieve equilibrium within 100 years post-closure, with a median water level of approximately 104 mAHD. The maximum water level is predicted to be 118.5 mAHD, which is 113 m below the pit crest level of 232 mAHD. Water quality parameters are expected to meet environmental standards throughout the simulation period (HydroBalance, 2026).

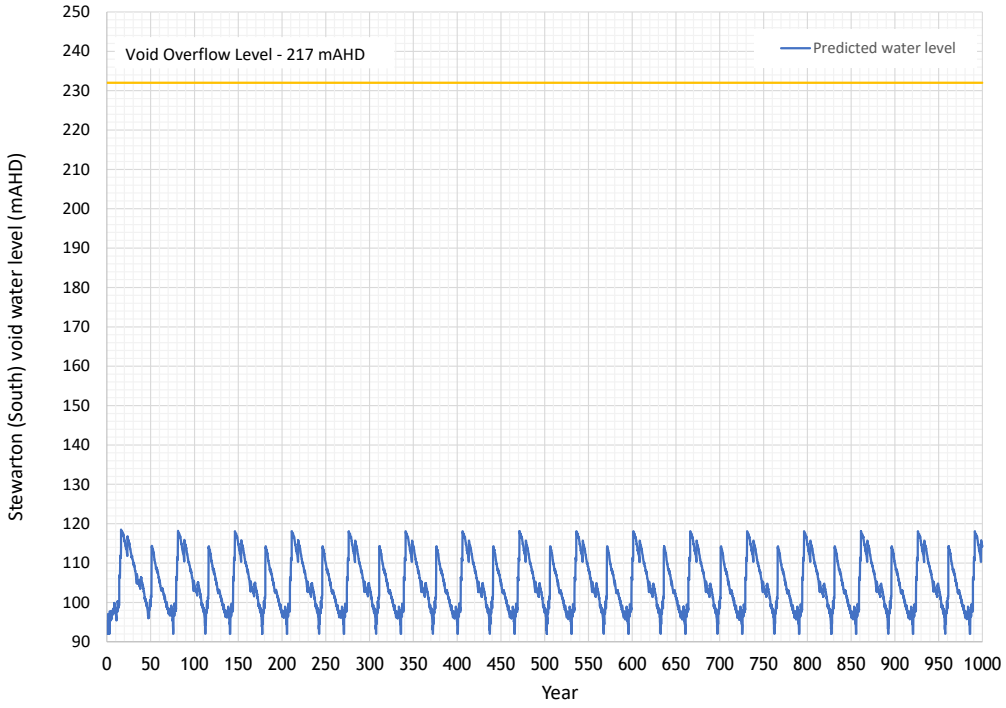


Figure 7.8 Stewarton South void – long-term predicted final void water level (HydroBalance, 2026)

7.6.7 Extreme storm event behaviour

An assessment of the impact of extreme storm events on the water levels in the final voids has been undertaken (HydroBalance, 2026). The potential for discharge of void water during a large storm was assessed for the 1 in 1,000 Annual Exceedance Probability (AEP) (or 0.1% AEP) 72-hour (3 day) design storm. For conservatism, it has been assumed that the extreme storm would occur coincident with the peak modelled long-term water levels.

The results of the storm event analysis are presented in Table 7.3. These results show that, even during extreme short duration storm events, the pit crest would not be overtopped for any of the final voids (HydroBalance, 2026).

Table 7.3 Storm event modelling results

Void	Runoff Volume (ML)	Water level increase (m)	Final Volume (ML)	Final Level (mAHD)	Pit crest level (mAHD)	Freeboard (m)
Mimosa/Besgrove	3,585	3.4	29,316	91.5	200	108.5
Ramp 30	494	6.3	1,124	166.1	217	50.9
Deep Creek	628	2.6	7,884	129.9	202	72.1
Stewarton North	2,489	1.5	59,120	115.0	204	89.0
Stewarton South	573	3.6	4,992	150.0	232	82.0

7.6.8 Salinity

The final void modelled salinity levels for the five voids are presented in Figure 7.9 to Figure 7.13. The long-term salinity generally increases over time, which is expected for closed-loop systems with no mechanism for salt removal. HydroBalance (2026) noted that this assessment is considered conservative, as it:

- Assumes an unlimited source of salt within the catchment and does not include any allowance for potential reduction in the leaching of salts from the catchment over time.
- Does not take into account the potential precipitation of dissolved salts as mineral compounds.

The following is of note regarding these results (HydroBalance, 2026):

- For Mimosa/Besgrove void, the salinity of the pit lake progressively increases, rising to 250,000 µS/cm over the 1,000-year simulation.
- For Ramp 30 void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 5,000 µS/cm.
- For Deep Creek void, the salinity of the pit lake progressively increases, rising to 180,000 µS/cm over the 1,000-year simulation.
- For Stewarton North void, the salinity of the pit lake progressively increases, rising to 195,000 µS/cm over the 1,000-year simulation.
- For Stewarton South void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 10,000 µS/cm.

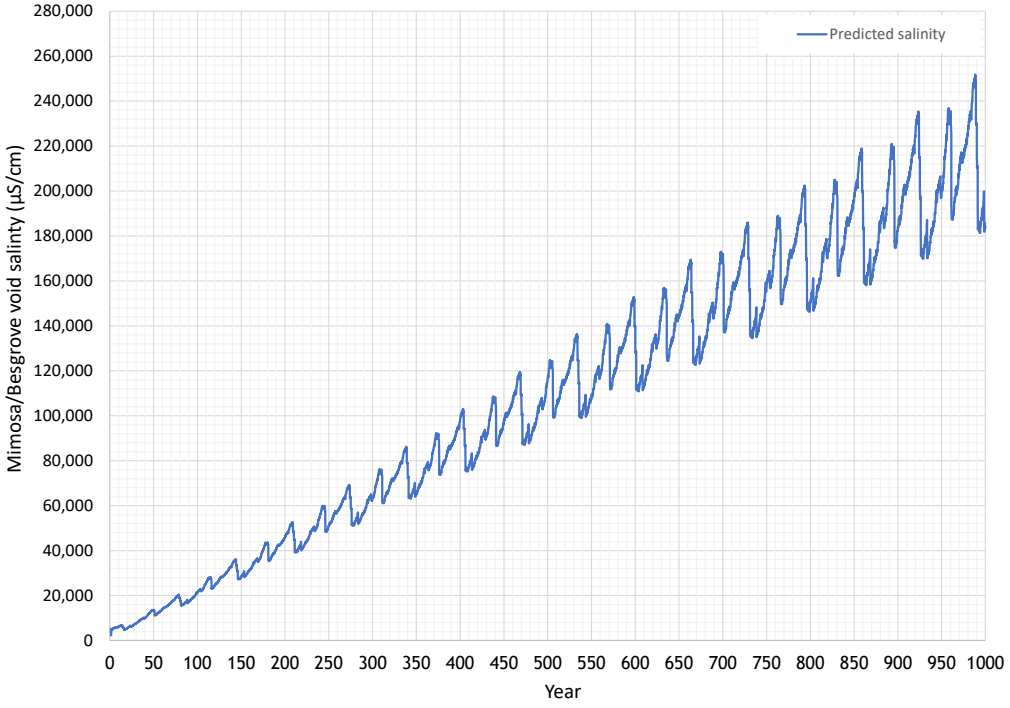


Figure 7.9 Mimosa/Besgrove void – long-term predicted void water salinity (HydroBalance, 2026)

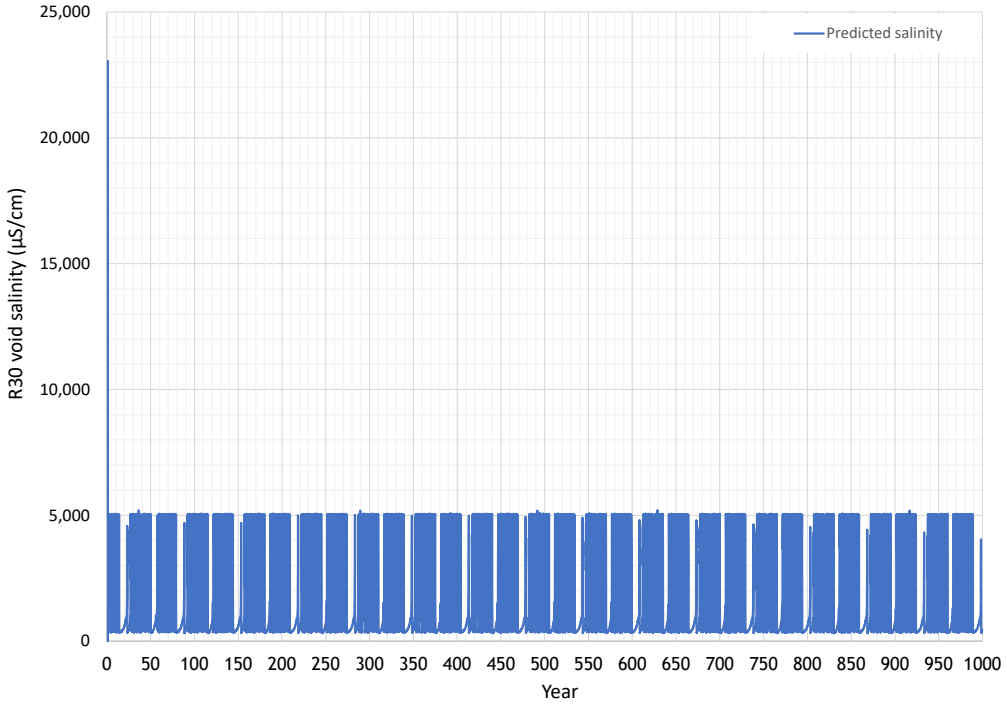


Figure 7.10 Ramp 30 void – long-term predicted final void water salinity (HydroBalance, 2026)

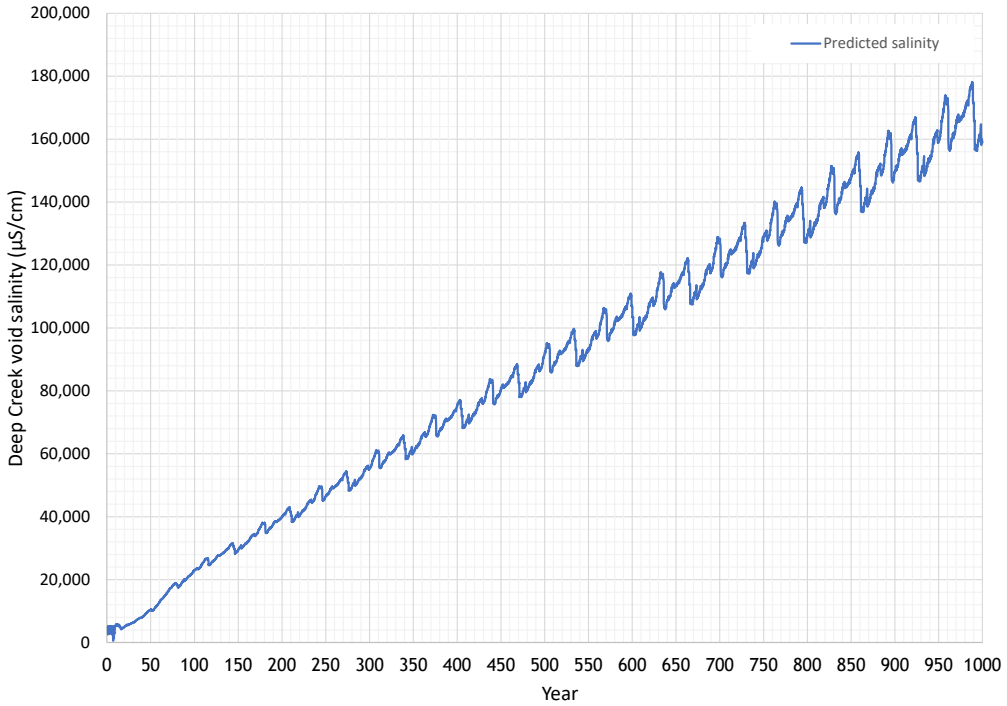


Figure 7.11 Deep Creek void – long-term predicted final void water salinity (HydroBalance, 2026)

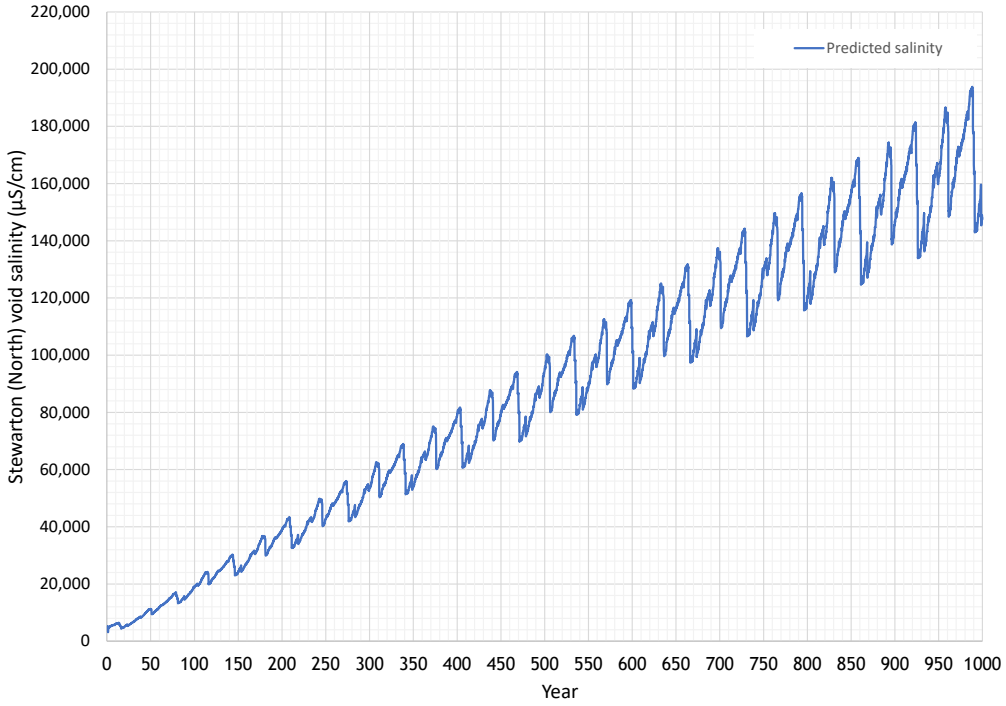


Figure 7.12 Stewarton North void – long-term predicted final void water salinity (HydroBalance, 2026)

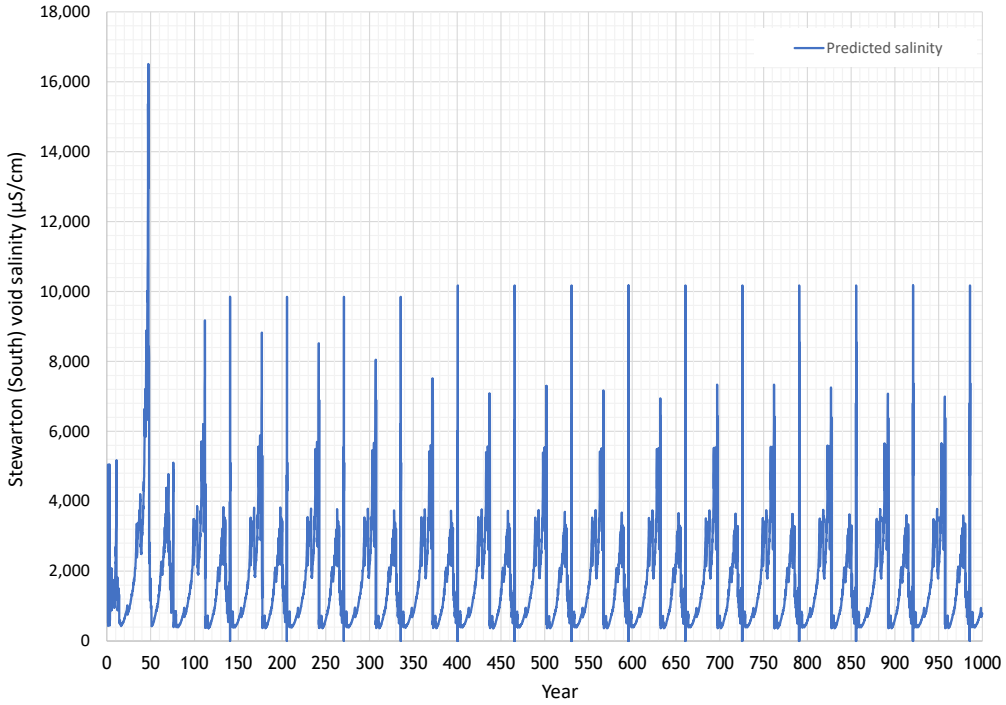


Figure 7.13 Stewarton South void – long-term predicted final void water salinity (HydroBalance, 2026)

8 FLOOD IMPACT ASSESSMENT

8.1 OVERVIEW

8.1.1 Previous studies

Hydrologic models were developed using the Unified River Basin Simulator (URBS) (Carroll, 2024) runoff-routing software to estimate design flood discharges in the vicinity Project for various scenarios. Hydraulic models were developed using the Two-dimensional Unsteady FLOW (TUFLOW) hydrodynamic modelling software (BMT Pty Ltd, 2018) to estimate design flood levels, depths, extents and velocities in the vicinity of the Project for various scenarios.

Whitehaven Blackwater provided the XP-RAFTS hydrologic and TUFLOW hydraulic models used for the *Blackwater Mine Flood Study* (GHD Group Pty Ltd [GHD], 2021) and the *Blackwater Mine Progressive Rehabilitation and Closure Plan – Rehabilitation Flood Assessments* (SLR, 2024). Upon review, the SLR (2024) flood models appear to have been developed based on the GHD (2021) flood models.

8.1.2 Hydrologic and hydraulic modelling approach

8.1.2.1 Overview

The URBS models were calibrated to recorded rainfall and water level data for the March 2017 and January 2020 events where suitable data is available. Design event hydrologic modelling was undertaken in accordance with Australian Rainfall and Runoff (ARR) 2019 Version 4.2 (Ball et al., 2019) and includes the latest guidance on climate change considerations.

The SLR (2024) hydraulic models were modified to incorporate the most recent Light Detection and Ranging (LiDAR) topographic data (obtained after the GHD [2021] and SLR [2024] studies), as well as updated design inflows from the new URBS hydrologic models described in Section 8.2 and Appendix A.

8.1.2.2 Modelled scenarios

The URBS hydrologic and TUFLOW hydraulic models were developed to simulate riverine flooding in the vicinity of the Project for the following three scenarios:

- 'Existing conditions' – This scenario represents the existing BWM configuration and was adopted as the baseline conditions.
- 'Proposed (Project) conditions' – This scenario represents the proposed BWM configuration incorporating the maximum disturbance area associated with the Project and associated flood protection levees. However, areas outside of the Project area are assumed unchanged from existing conditions.
- 'Final landform conditions' – This scenario represents the BWM configuration pot-closure, incorporating the final landform including the final voids.

8.1.3 Flood impact assessment approach

The hydrologic and hydraulic models were used to estimate design flood discharges, levels, depths, extents and velocities for a range of events from 50% (1 in 2) to 0.1% (1 in 1,000) AEP as well as the Probable Maximum Flood (PMF) event. AEP is a standard measure in floodplain management to define the likelihood of flooding. For instance, a 1% AEP flood has a 1% chance of occurring in any one year, which can also be described as having a 1 in 100 chance in any one year.

Table 8.1 provides a summary of the design flood event AEPs, and scenarios modelled in this SWA.

Table 8.1 Summary of modelled design flood event AEPs and scenarios

AEP % (1 in X)	Existing conditions (baseline) (year 2030 climate)	Proposed (Project) conditions (year 2030 climate)	Final landform conditions (year 2100 climate)
50% (1 in 2)	✓	✓	X
5% (1 in 20)	✓	✓	X
2% (1 in 50)	✓	✓	X
1% (1 in 100)	✓	✓	✓
0.1% (1 in 1,000)	✓	✓	✓
PMF	X	X	✓

The existing conditions flood model results was used to establish the baseline conditions at BWM without the Project, for the 50% to 0.1% AEP events (refer to Section 8.4). The proposed (Project) conditions flood model results was used to assess the flood immunity of the extended open cut pits for all events up to 0.1% AEP.

The impacts of the Project on flood levels and velocities were assessed by comparing design flood levels and velocities between existing and proposed (Project) conditions for the 50% AEP to 0.1% AEP events. The flood impact of the Project was not assessed for the PMF event.

The impact of the Project on waterway stability (geomorphology), including a hydraulic assessment of the proposed clean water drain adjacent to the Stewarton Pit expansion area, was assessed for the 50% AEP and 2% AEP events.

The final landform conditions model results for the 1% AEP, 0.1% AEP and PMF events were used to assess the flood immunity of the final voids and the stability of the rehabilitated dump landforms under extreme flooding conditions.

8.2 ESTIMATION OF DISCHARGES

8.2.1 Overview

URBS hydrologic models were developed to estimate design discharges within the Blackwater Creek catchment (including Taurus Creek and Two Mile Gully) and the Sagittarius Creek catchment.

The Blackwater Creek URBS model was calibrated to recorded data for the March 2017 and January 2020 flood events. The Sagittarius Creek URBS model could not be calibrated due to the absence of any stream gauges within the catchment. Design peak discharges from both models were validated against estimates derived using the Rational Method, the Quantile Regression Technique (Palmen and Weeks, 2015) and the Regional Flood Frequency Estimation method.

Details of the URBS model development, calibration and validation are provided in Appendix A.

The URBS hydrologic models were then used to estimate design discharges for the following design flood events:

- 50% (1 in 2) AEP;
- 5% (1 in 20) AEP;
- 2% (1 in 50) AEP;

- 1% (1 in 100) AEP;
- 0.1% (1 in 1,000) AEP; and
- Probable Maximum Precipitation.

8.2.2 Climate change considerations

In August 2024, ARR was updated to include additional guidance on the incorporation of the impacts on climate change on flood estimates. The guidance has been developed from the latest IPCC temperature projections based on SSPs that cover a broad range of potential future development options. The SSPs are designated low (SSP1-2.6), medium (SSP2-4.5), high (SSP3-7.0) and very high (SSP5-8.5) emissions pathways and have been projected out to 2100.

The IPCC guidance is that temperatures have already risen by one degree since the development of the 2016 intensity frequency-duration (IFD) data. As a result, design rainfall IFDs for existing conditions were scaled up using uplift factors obtained from ARR datahub[2], corresponding to the near-term SSP5-8.5 (year 2030) climate scenario. The associated pre-burst rainfalls were also scaled up accordingly. Similarly, design rainfall IFDs and associated pre-burst rainfalls for the final landform conditions were scaled up to the long-term SSP2-4.5 (year 2100) climate scenario.

The SSP5-8.5 climate adjustments account for approximately 1.3°C of predicted global warming for the current and near-term (2021-2040) since the historical baseline period of 1961-1990. The SSP2-4.5 climate adjustments account for approximately 2.4°C of predicted global warming for the current and near-term (2081-2100) for the same historical baseline period.

Table 8.2 shows the corresponding design rainfall uplift factors for various storm durations (as percentage increases compared to the baseline IFD data [Bureau, 2016]).

Table 8.2 Adopted design rainfall uplift factors

Storm duration	Rainfall uplift factor	
	SSP5-8.5 year 2030	SSP2-4.5 year 2100
<1 Hour	20%	41%
1.5 Hours	18%	37%
2 Hours	17%	35%
3 Hours	16%	32%
4.5 Hours	14%	29%
6 Hours	13%	27%
9 Hours	13%	25%
12 Hours	12%	24%
18 Hours	11%	22%
>24 Hours	11%	21%

[2] https://data.arr-software.org/

8.2.3 Design discharges

Table 8.3 and Table 8.4 show the URBS modelled peak design discharges at Taurus Creek (BWC_03) and Two Mile Gully (TMG) (as shown in Figure 8.1). Table 8.4 and Table 8.6 show the corresponding critical storm durations at BWC_03 and TMG, respectively.

Table 8.3 Design discharge estimates at location BWC_03

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)	Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)
50% (1 in 2)	166	n/a
5% (1 in 20)	398	n/a
2% (1 in 50)	488	n/a
1% (1 in 100)	562	863
0.1% (1 in 1,000)	901	1,361
PMF	4,006	6,219

Table 8.4 Adopted critical duration design storms at location BWC_03

AEP (%) (1 in X)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)		Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)	
	Critical duration (hours)	Representative temporal pattern	Critical duration (hours)	Representative temporal pattern
50% (1 in 2)	3	5	n/a	n/a
5% (1 in 20)	3	8	n/a	n/a
2% (1 in 50)	3	1	n/a	n/a
1% (1 in 100)	3	1	2	1
0.1% (1 in 1,000)	3	4	2	4
PMF	2	4	2	2

Table 8.5 Design discharge estimates at location TMG

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)	Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)
50% (1 in 2)	146	n/a
5% (1 in 20)	361	n/a
2% (1 in 50)	440	n/a
1% (1 in 100)	517	625
0.1% (1 in 1,000)	887	1,025
PMF	4,945	5,718

Table 8.6 Adopted critical duration design storms at location TMG

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)		Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)	
	Critical duration (hours)	Representative temporal pattern	Critical duration (hours)	Representative temporal pattern
50% (1 in 2)	3	3	n/a	n/a
5% (1 in 20)	3	8	n/a	n/a
2% (1 in 50)	4.5	9	n/a	n/a
1% (1 in 100)	6	10	3	1
0.1% (1 in 1,000)	6	4	4.5	4
PMF	3	9	2	9

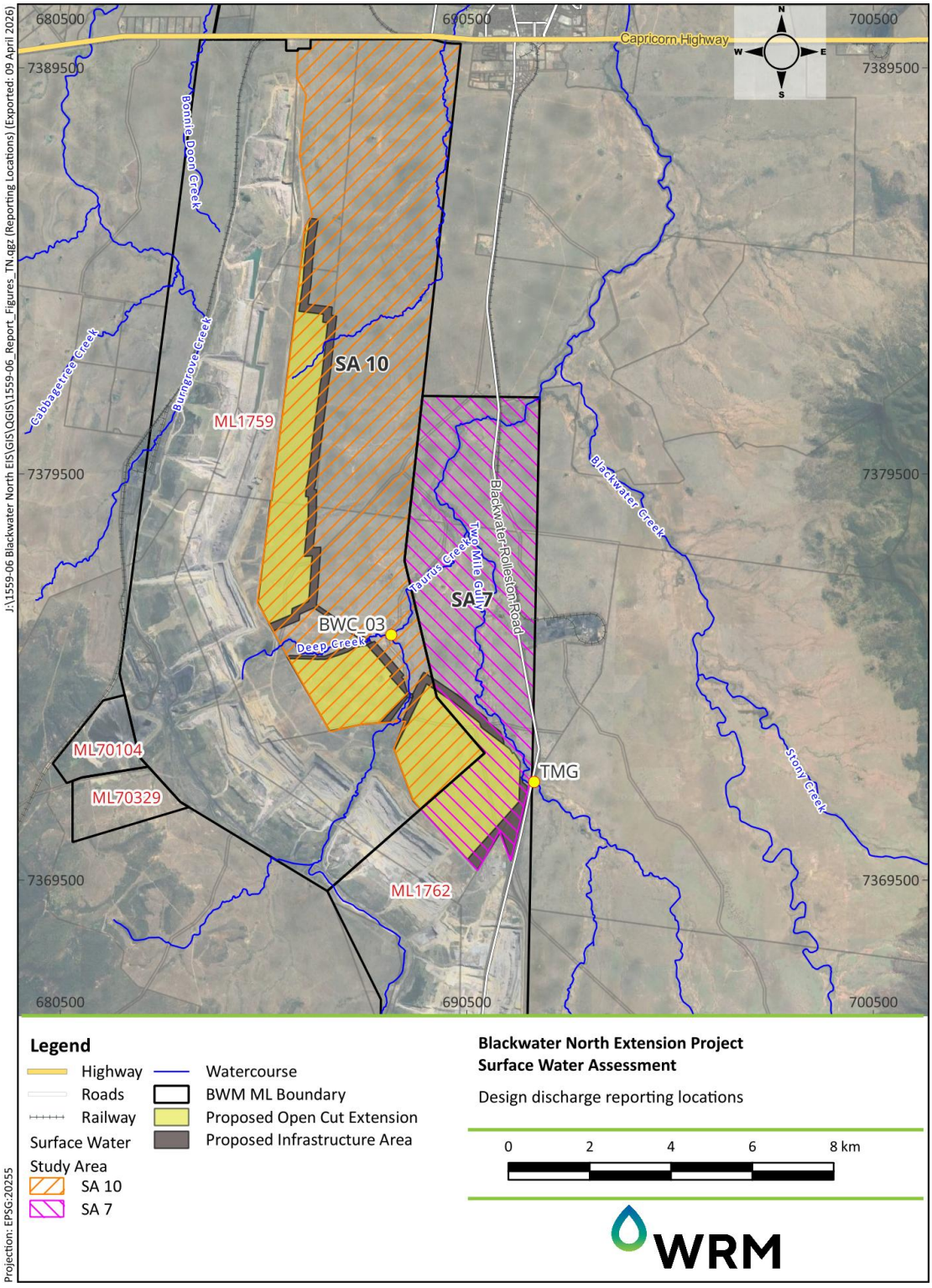


Figure 8.1 Design discharge reporting locations

8.3 HYDRAULIC MODEL DEVELOPMENT

8.3.1 Overview

TUFLOW hydraulic models for Blackwater Creek (including Taurus Creek, Deep Creek and Two Mile Gully) and Sagittarius Creek previously developed by SLR (2024) as part of the BWM PRCP flood assessment, was updated and used for this assessment. Design discharges from the URBS hydrologic models described in Section 8.2 and Appendix A, were applied as inflows to the TUFLOW hydraulic models.

TUFLOW hydraulic models were developed for the following three scenarios:

- 'Existing conditions' – This scenario represents the existing BWM configuration and was adopted as the baseline conditions.
- 'Proposed (Project) conditions' – This scenario represents the proposed BWM configuration incorporating the maximum disturbance area associated with the Project. However, areas outside of the Project area are assumed unchanged from existing conditions.
- 'Final landform conditions' – This scenario represents the BWM configuration post-closure, incorporating the final landform including the final voids within the Project area.

8.3.2 TUFLOW model configuration

8.3.2.1 Extent and topography

The configuration and extent of the TUFLOW hydraulic models developed for this SWA are shown in the following figures:

- For Blackwater Creek (including Taurus Creek and Two Mile Gully):
  - Figure 8.2 for existing conditions;
  - Figure 8.3 for proposed (Project) conditions; and
  - Figure 8.4 for the final landform;
- For Sagittarius Creek:
  - Figure 8.5 for existing conditions; and
  - Figure 8.6 for proposed (Project) conditions.

The TUFLOW models were configured with a grid cell size resolution of 5 m. The base model topography in the models was configured using the following data:

- a 1 m resolution LiDAR data flown in 2024 (the 2024 LiDAR) for the majority of the TUFLOW model extent;
- a 1 m resolution LiDAR data flown in 2025 (the 2025 LiDAR) for areas in the vicinity of the active mining areas, including recent updates to the NTCD;
- a 1 m resolution DEM embedded in previous SLR (2024) hydraulic models provided by Whitehaven Blackwater, for areas not covered by the 2024 and 2025 LiDAR;
- a 30 m resolution Copernicus DEM sourced from the Copernicus Open Access Hub, for areas not covered by the available 1 m LiDAR data; and
- flood protection levees proposed around the proposed Project voids.

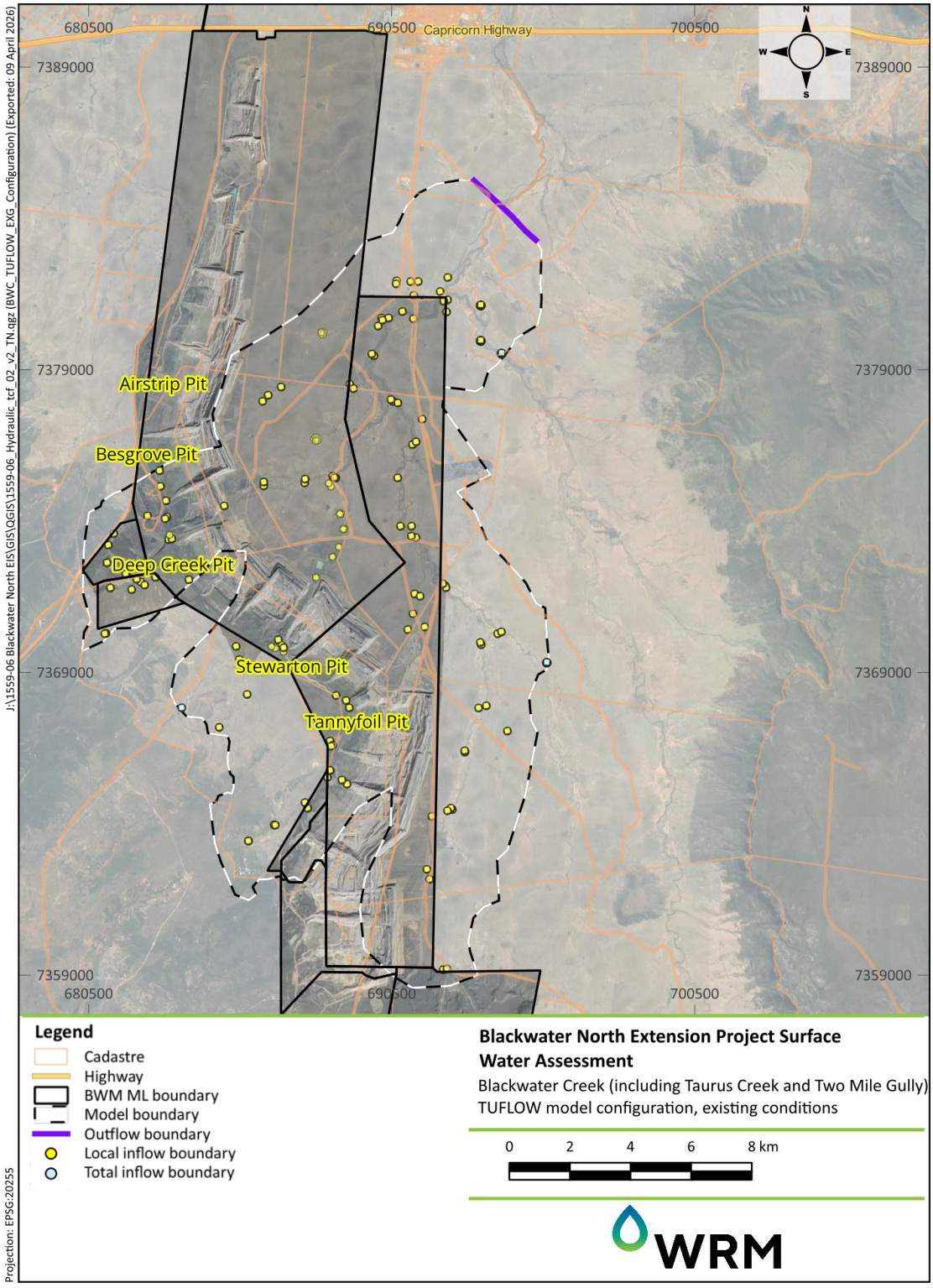


Figure 8.2 **Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, existing conditions**

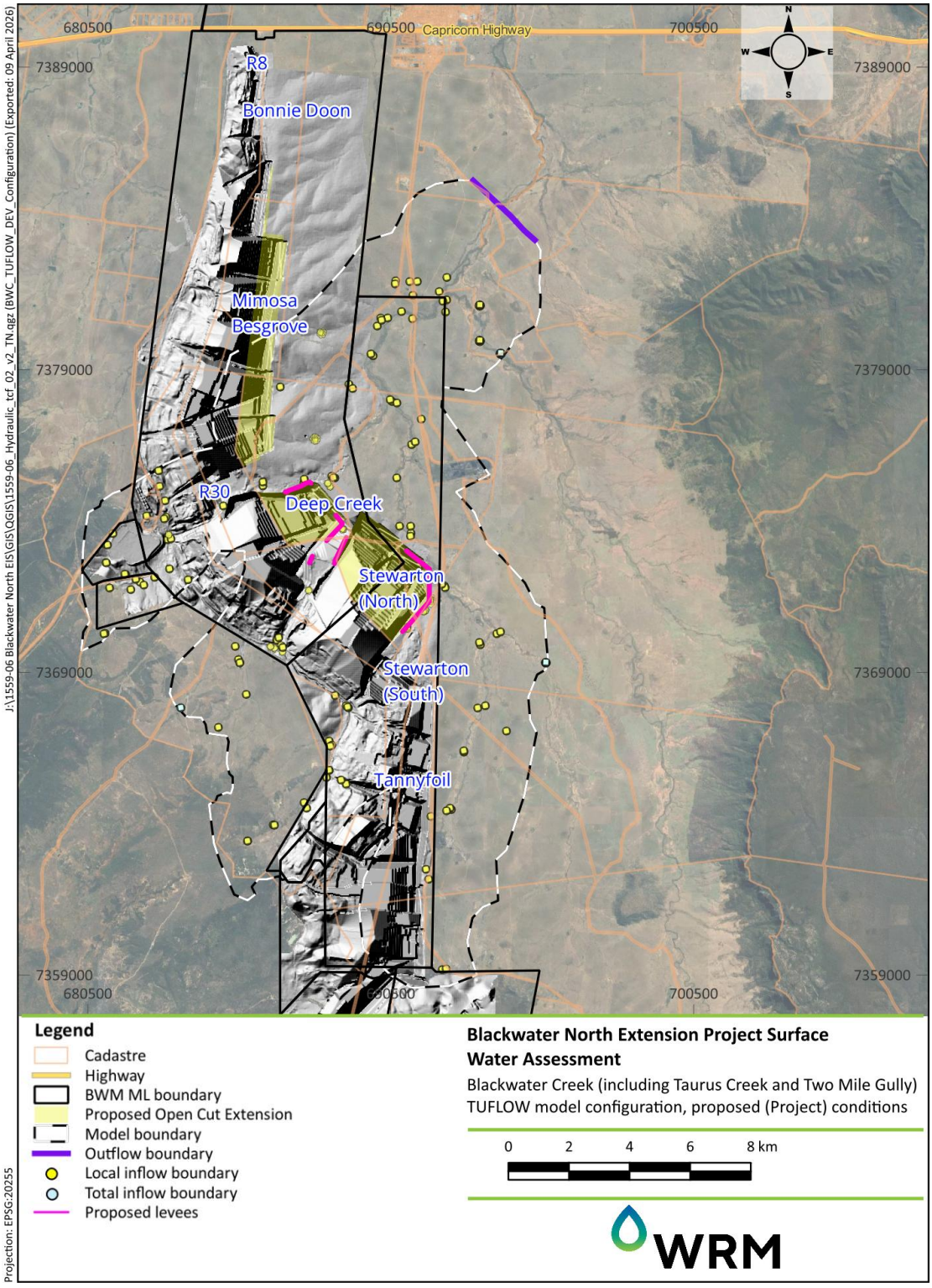


Figure 8.3 **Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, proposed (Project) conditions**

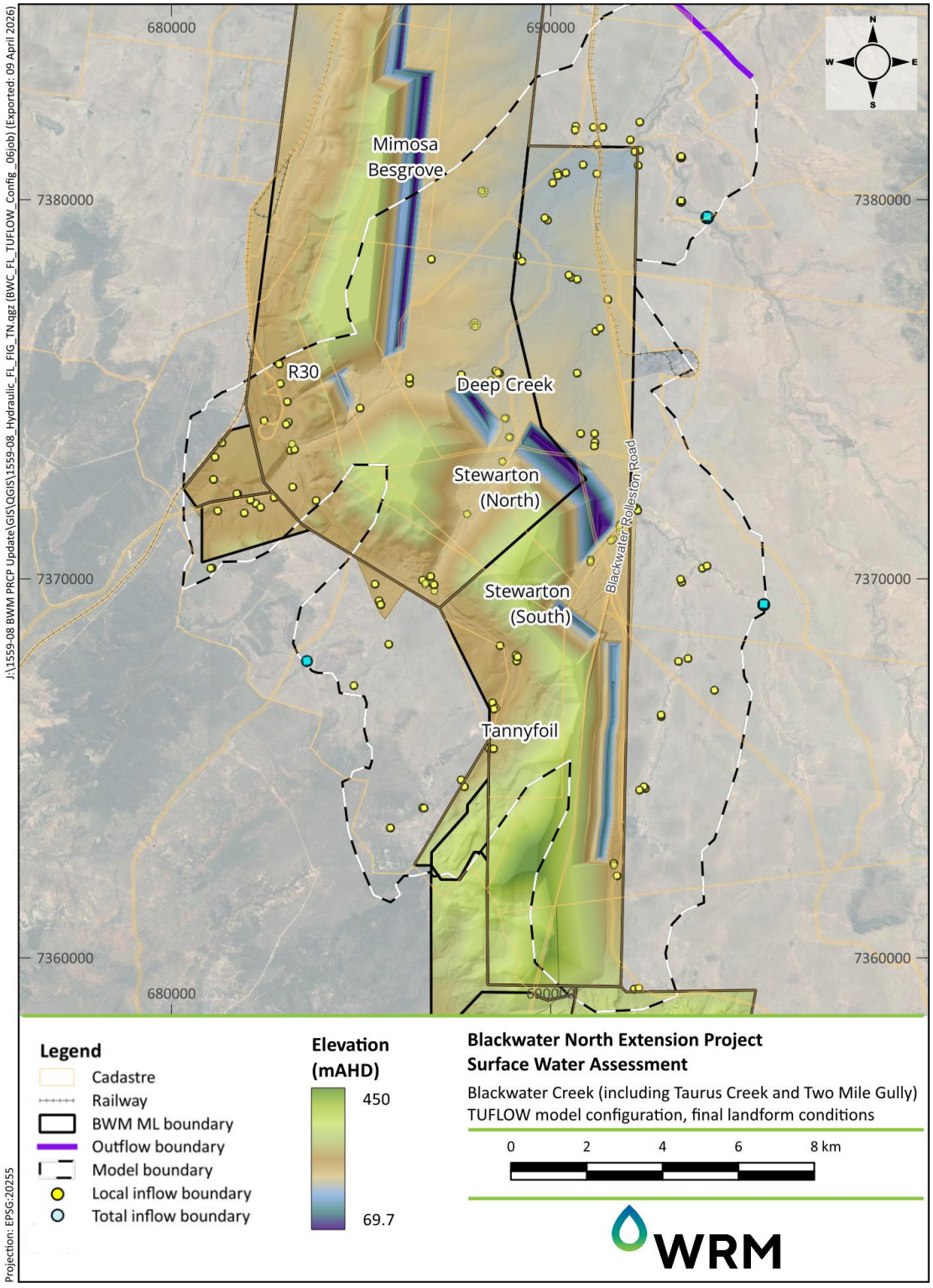


Figure 8.4 Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, final landform conditions

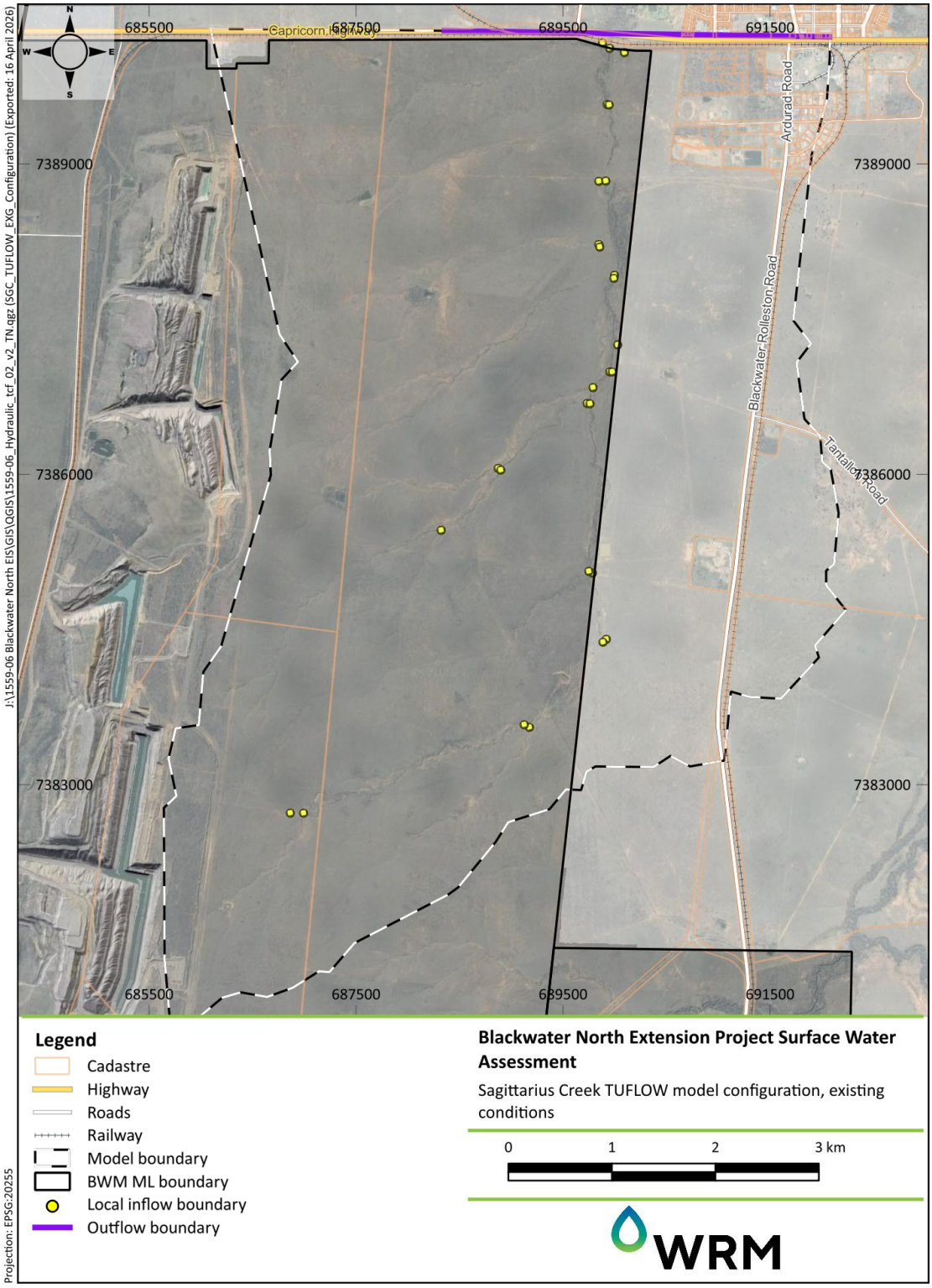


Figure 8.5 **Sagittarius Creek TUFLOW model configuration, existing conditions**

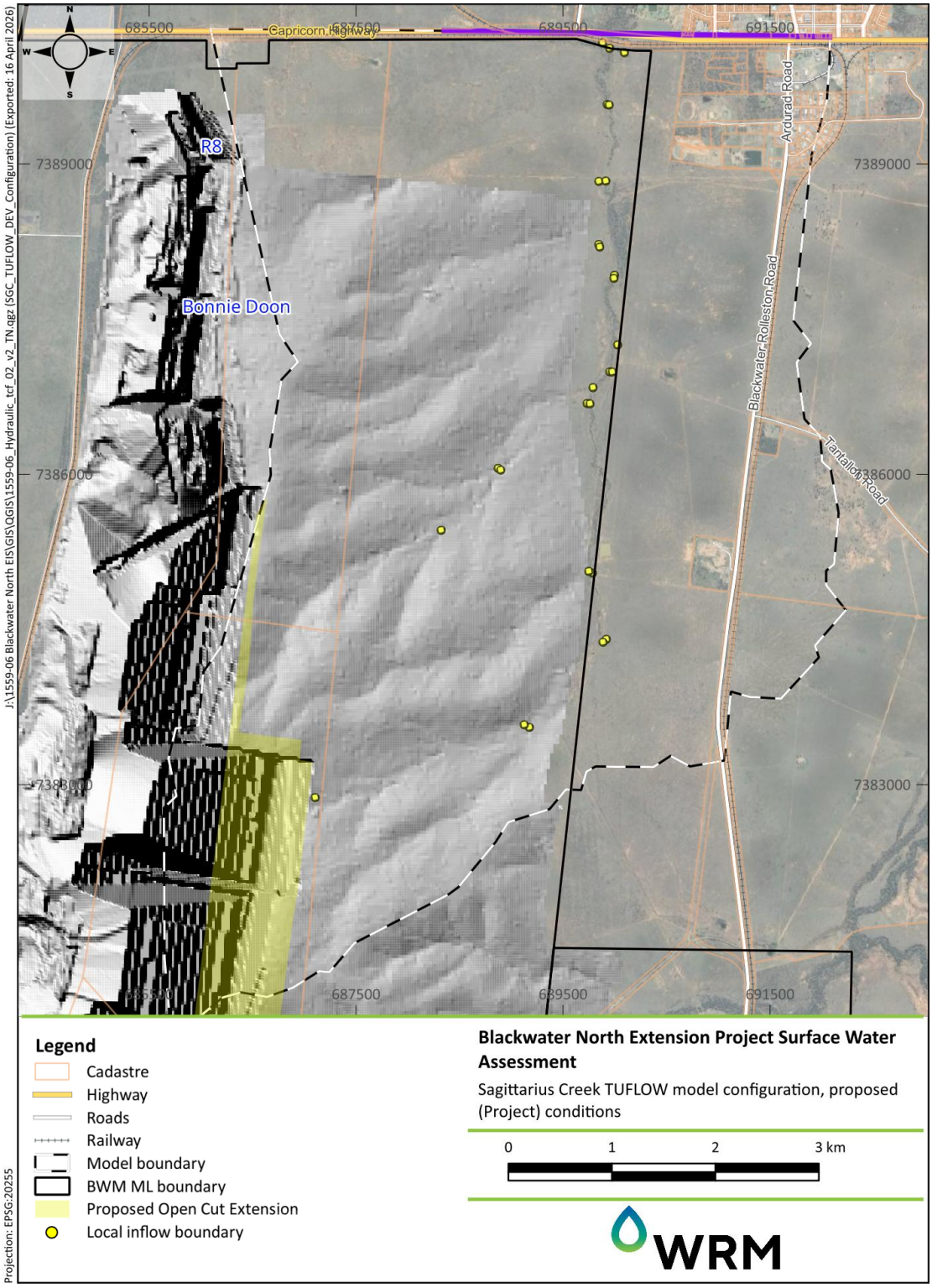


Figure 8.6 **Sagittarius Creek TUFLOW model configuration, proposed (Project) conditions**

8.3.2.2 Inflow and outflow boundaries

Design discharge hydrographs from the URBS hydrologic models (described in Section 8.2 and Appendix A) were applied as inflows to the TUFLOW hydraulic models.

The flow boundaries included in the models are as follows:

1. Blackwater Creek (including Taurus Creek, Deep Creek and Two Mile Gully) (BWC):
    - a total of 129 local inflow boundaries representing inflows from the URBS subcatchments within the hydraulic model boundary;
    - three total inflow boundary representing total inflows from URBS subcatchments outside of hydraulic model boundary; and
    - one 'stage-discharge' downstream outflow boundary, with a fixed downstream flood slope of 0.13%.
2. Sagittarius Creek (SGC):
    - a total of 27 local inflow boundaries representing inflows from the URBS subcatchments within the hydraulic model boundary; and
    - one 'stage-discharge' (HQ) type downstream outflow boundary, with a fixed downstream flood slope of 0.12%.

8.3.2.3 Hydraulic structures

Hydraulic structures including culverts were incorporated into the hydraulic model as one-dimensional network objects embedded within the two-dimensional domain. The hydraulic structures included in the SLR (2024) hydraulic models were maintained in the updated model.

8.3.2.4 Hydraulic roughness

The TUFLOW model uses Manning's 'n' values to represent hydraulic resistance. Table 8.7 shows the adopted Manning's 'n' values in the models.

Table 8.7 Adopted hydraulic roughness coefficients

Land use	Adopted Mannings 'n'
Short grass	0.04
Bare land	0.03
Sparse trees	0.06
Dense trees	0.08
Tailings	0.03
Creeks	0.05
Hardstand	0.02
Access Haul Roads	0.03
Paved Roads	0.02
Rail embankment	0.03
Concrete	0.02
Rehabilitated landform	0.04

8.4 EXISTING CONDITIONS FLOODING

Figure 8.7 to Figure 8.11 are flood maps showing TUFLOW model predicted existing conditions flood extents, levels and depth along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% (1 in 2) AEP to 0.1% (1 in 1,000) AEP design events. Figure 8.12 to Figure 8.16 show the corresponding peak velocities (in metres per second [m/s]).

Figure 8.17 shows the TUFLOW model predicted existing conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.17 shows the corresponding 1% AEP peak velocities.

The model results show that, within the Project area (downstream of the existing mining pits):

- The waterway channels generally have less than 50% AEP flow capacity and overflows from the channel would occur for all modelled events. A significant portion of flood flows would be conveyed along the floodplain for all events ≥50% AEP.
- Peak flood depths along Deep Creek and Tarus Creek (upstream of the Two Mile Gully confluence) are generally less than 1 m along the flood plains and >1 m along the channels for all events up to 1% AEP. Flood depths along Two Mile Gully and Tarus Creek (downstream of the Two Mile Gully confluence) are generally deeper, with larger areas affected by flood depths >1 m for all events up to 1% AEP.
- The existing BWM mining operations are located outside of the Sagittarius Creek flood extent for all modelled events.

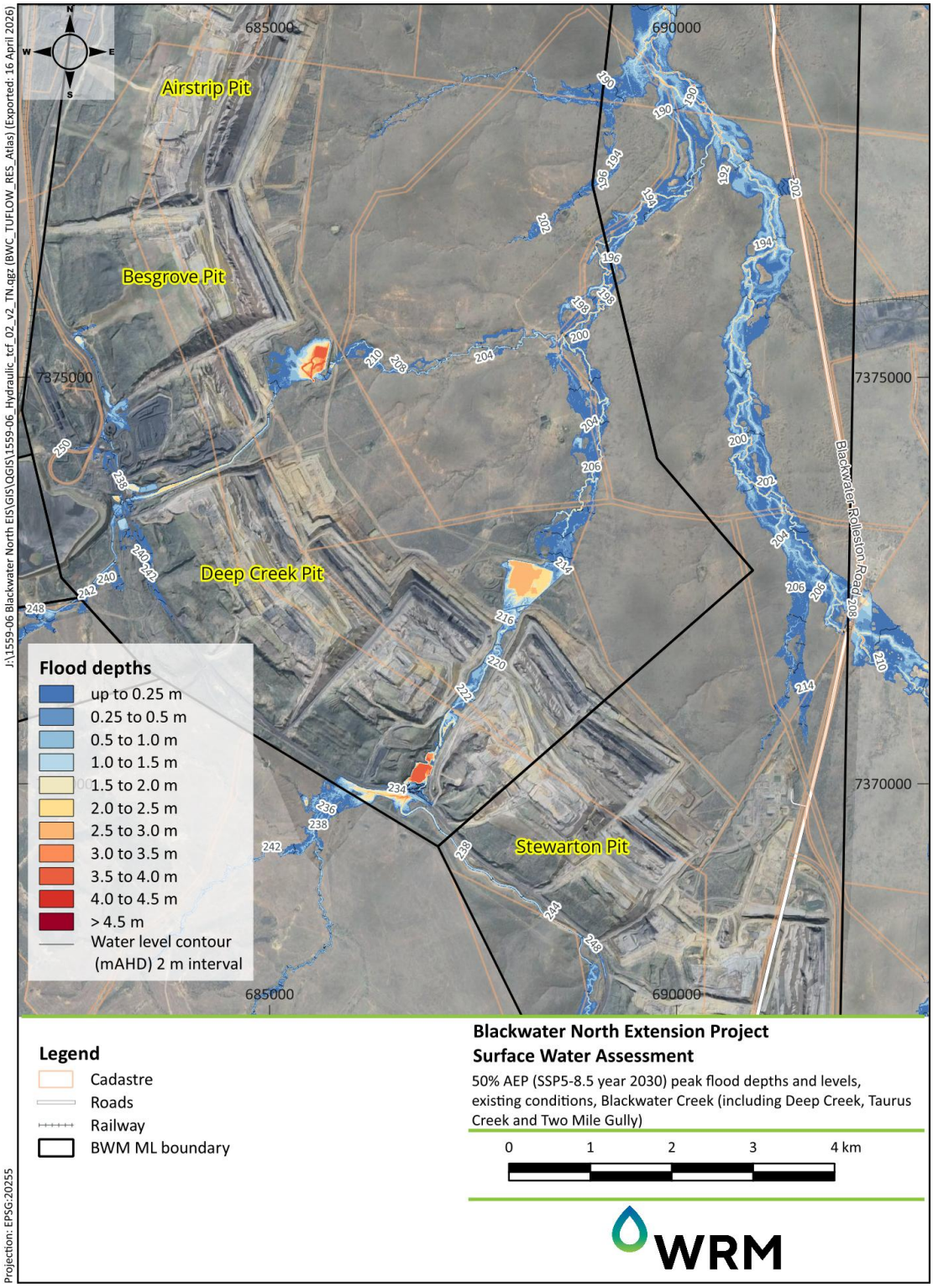


Figure 8.7 **50% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

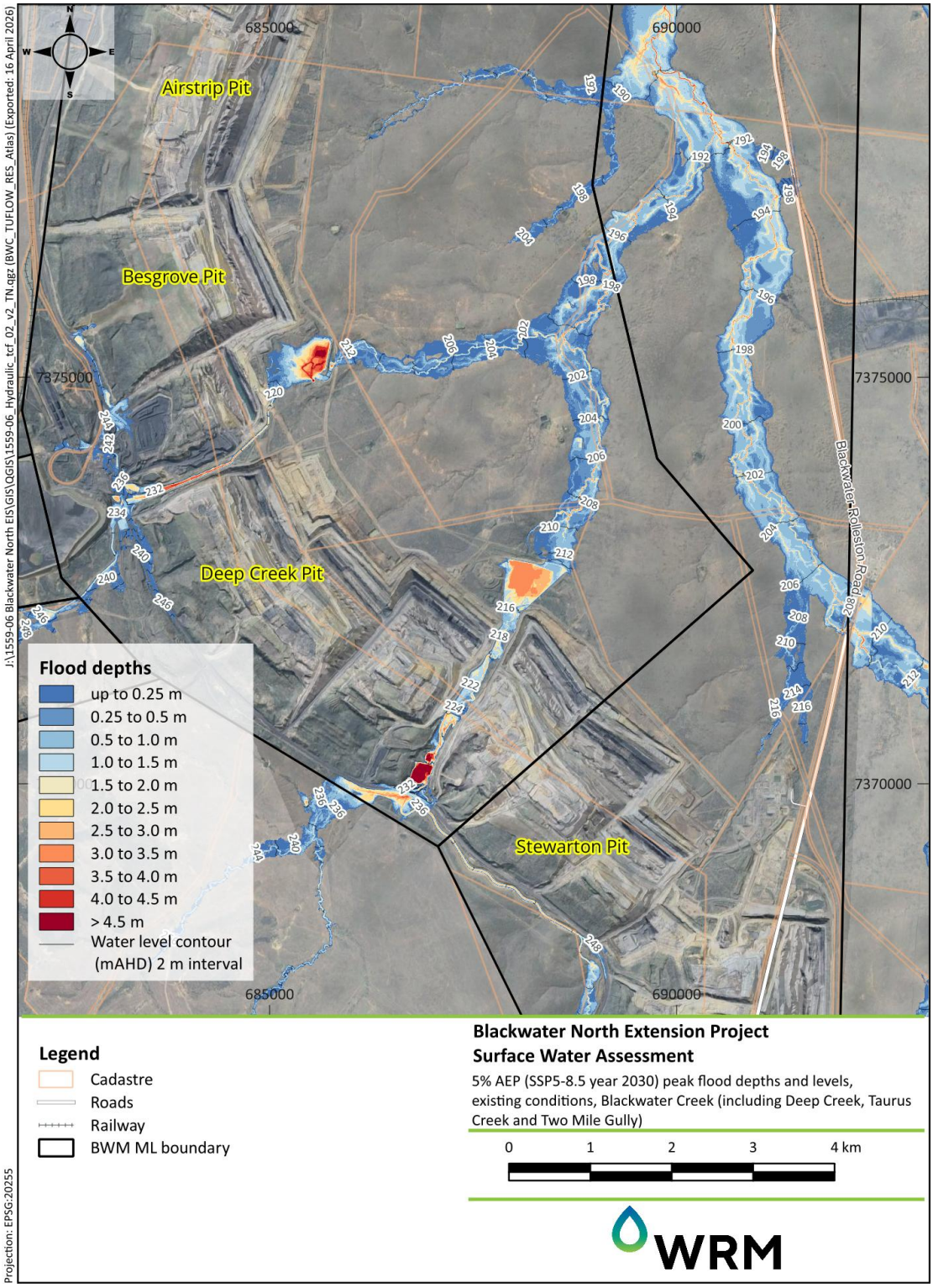


Figure 8.8 **5% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

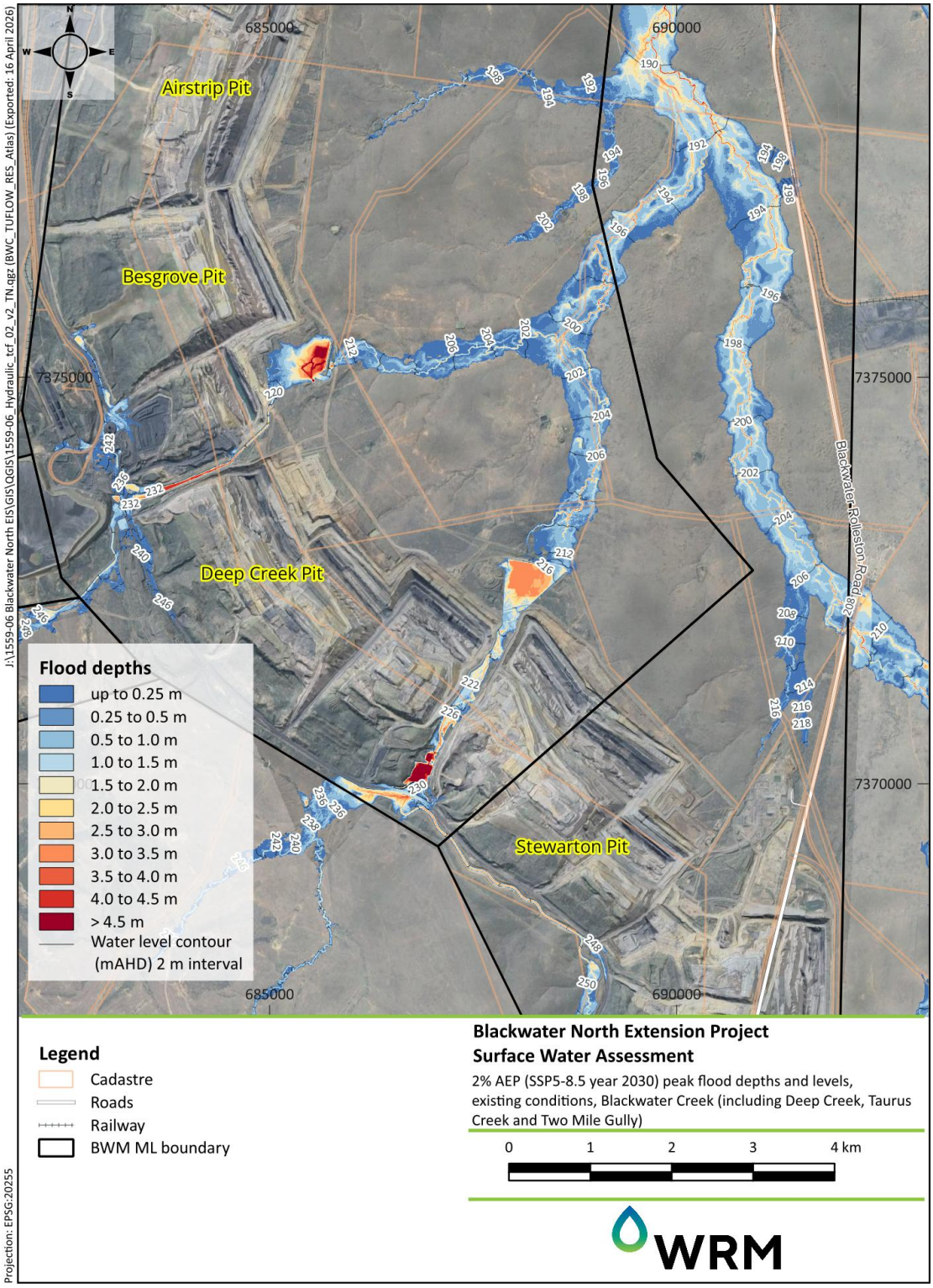


Figure 8.9 **2% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

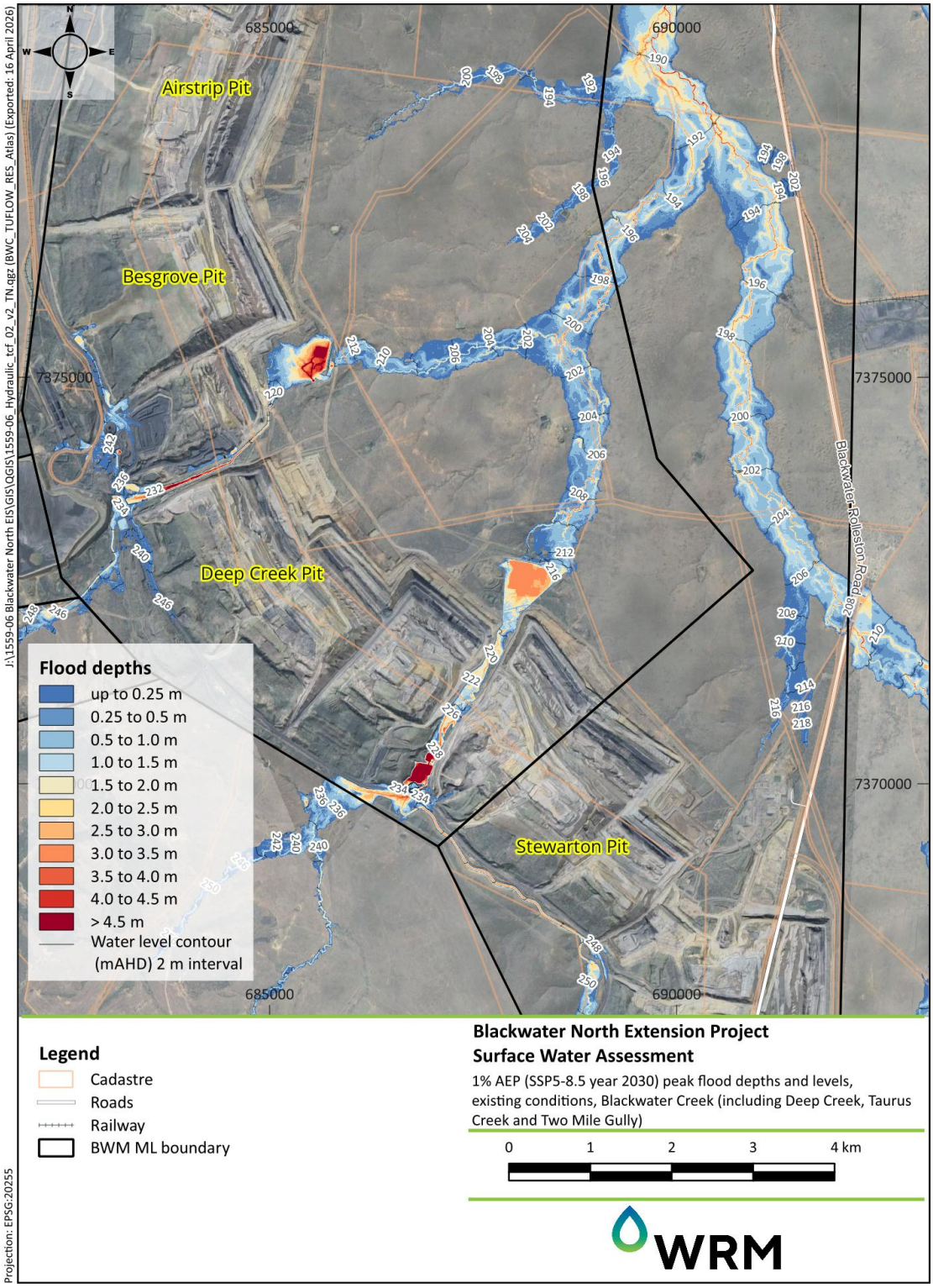


Figure 8.10 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

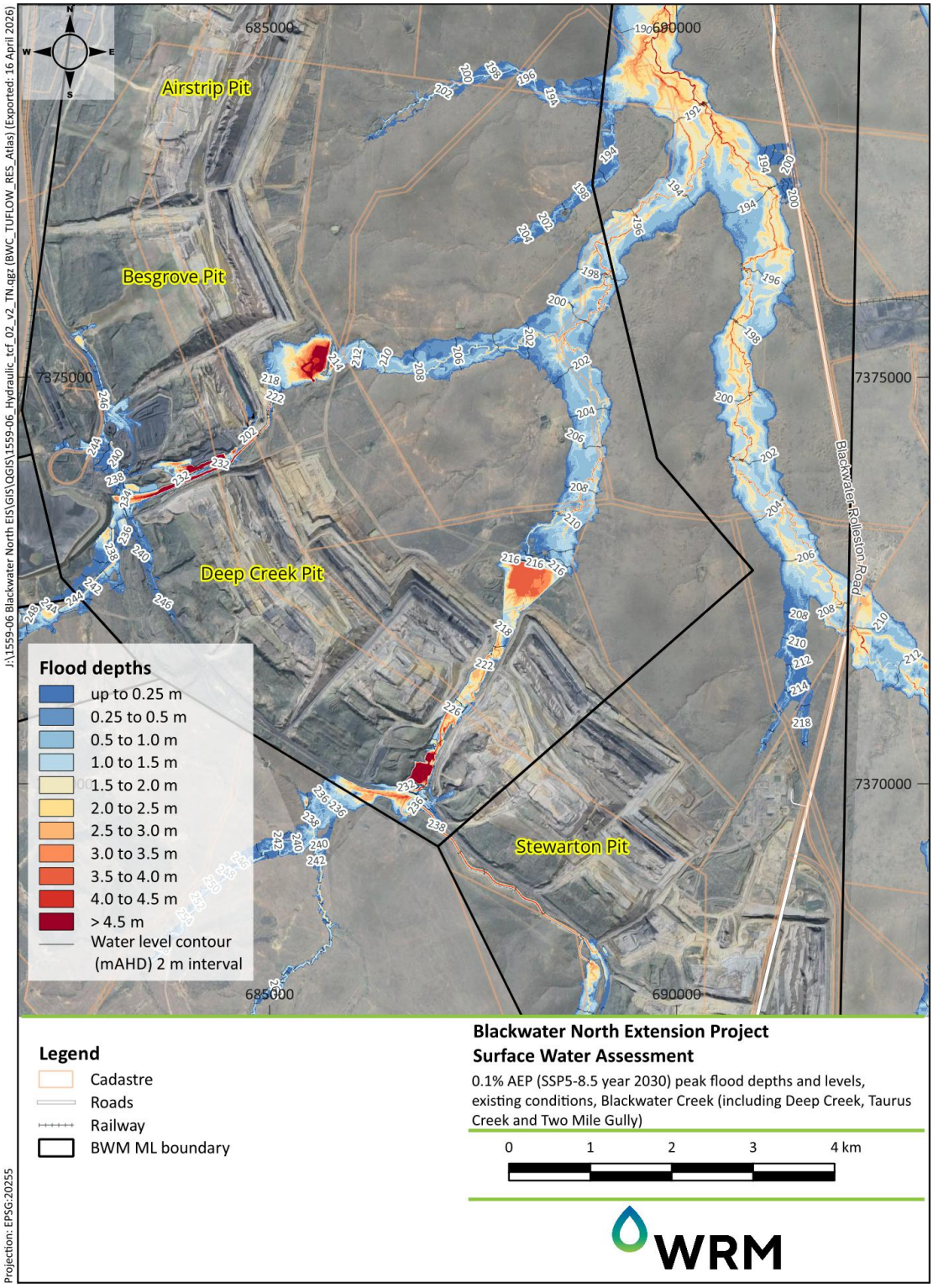


Figure 8.11 **0.1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

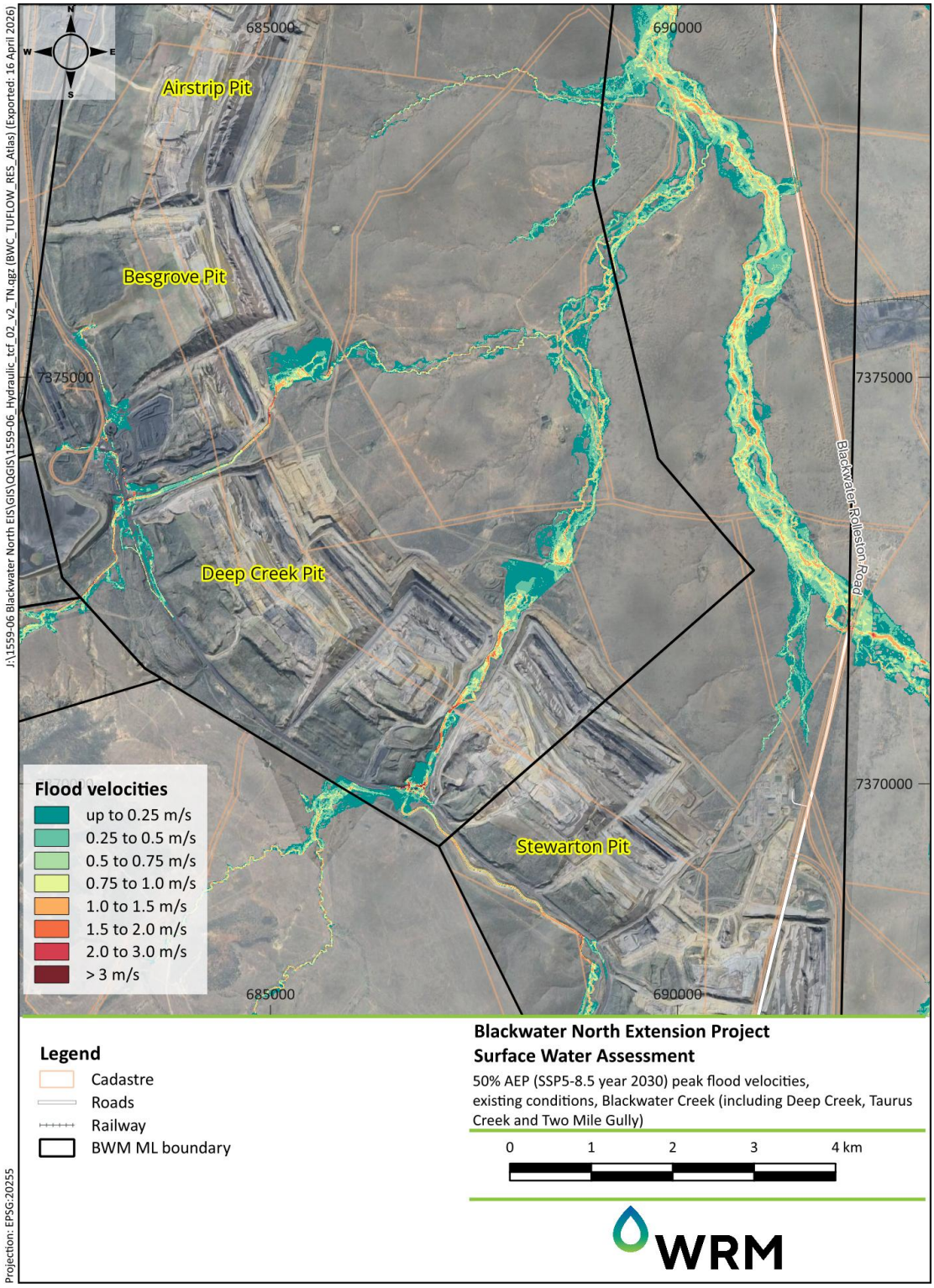


Figure 8.12 **50% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

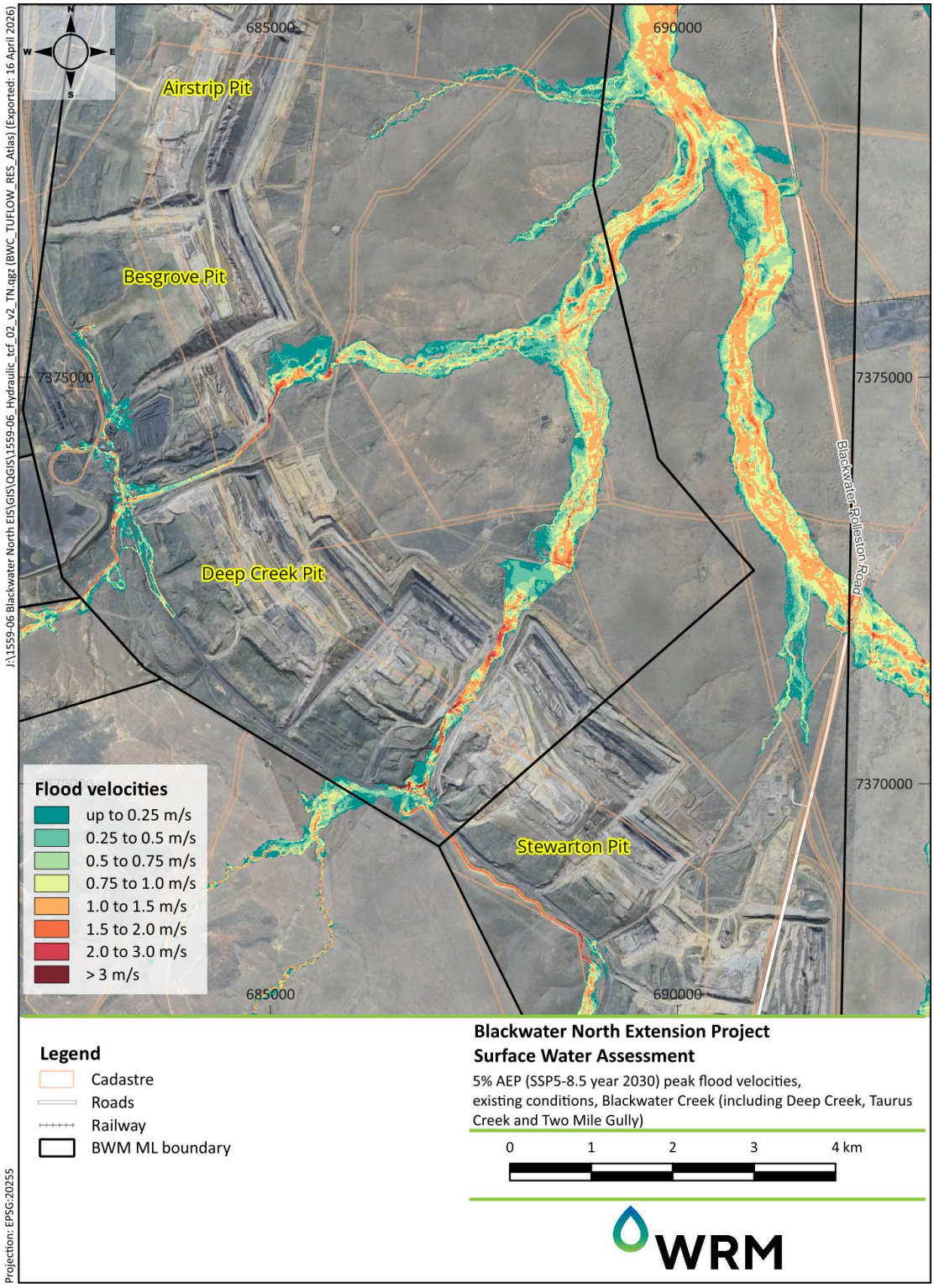


Figure 8.13 **5% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

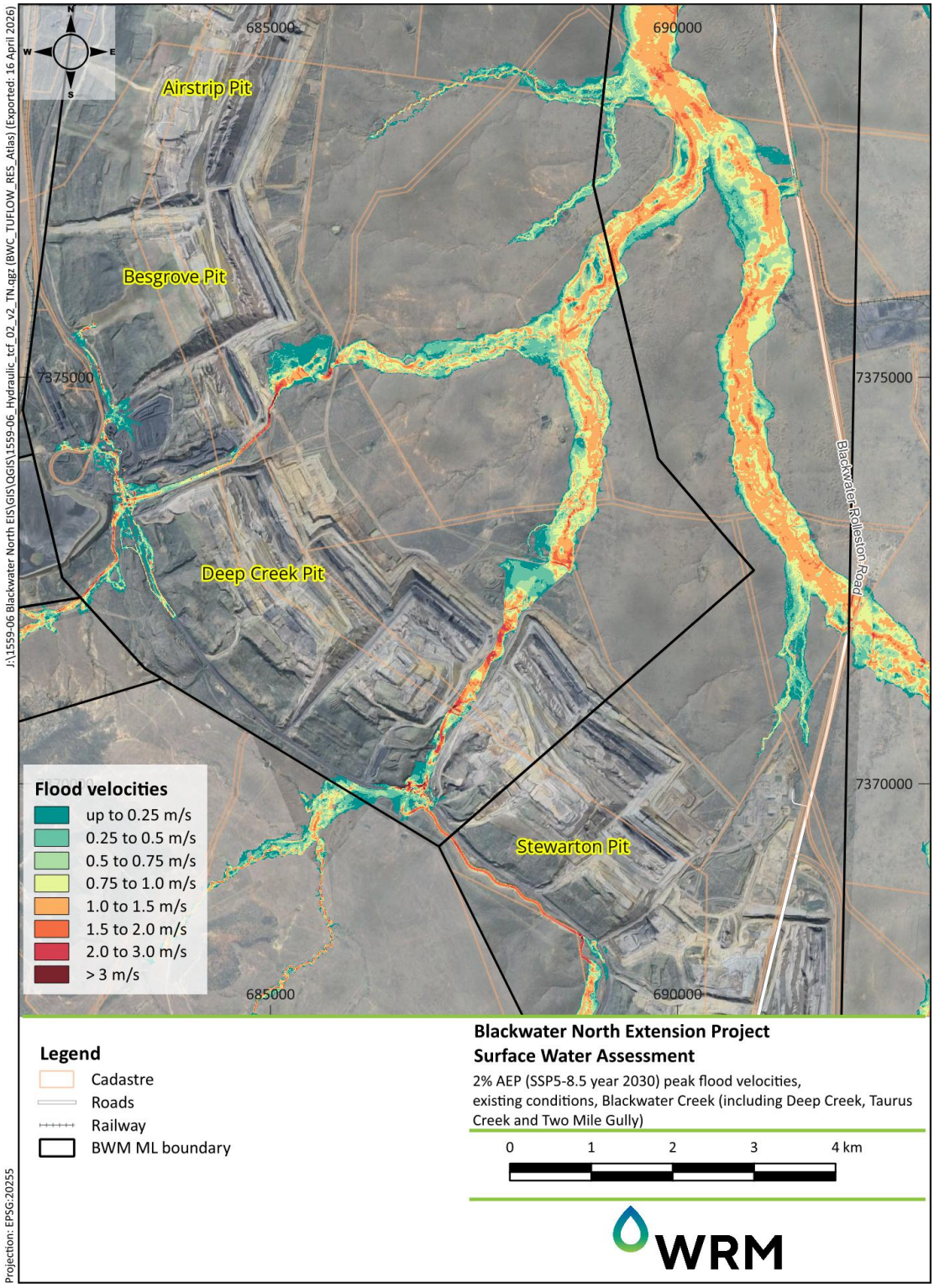


Figure 8.14 **2% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

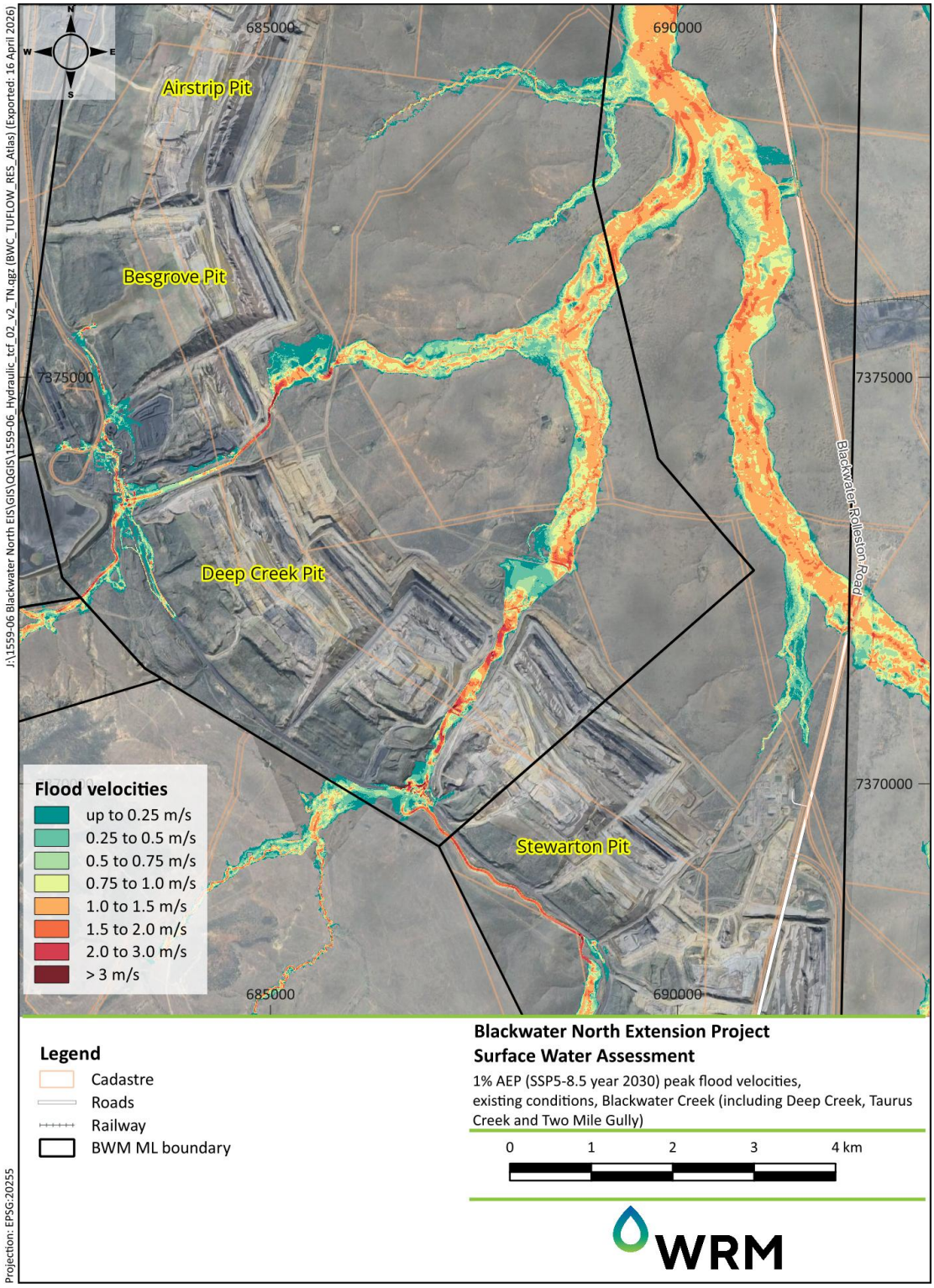


Figure 8.15 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

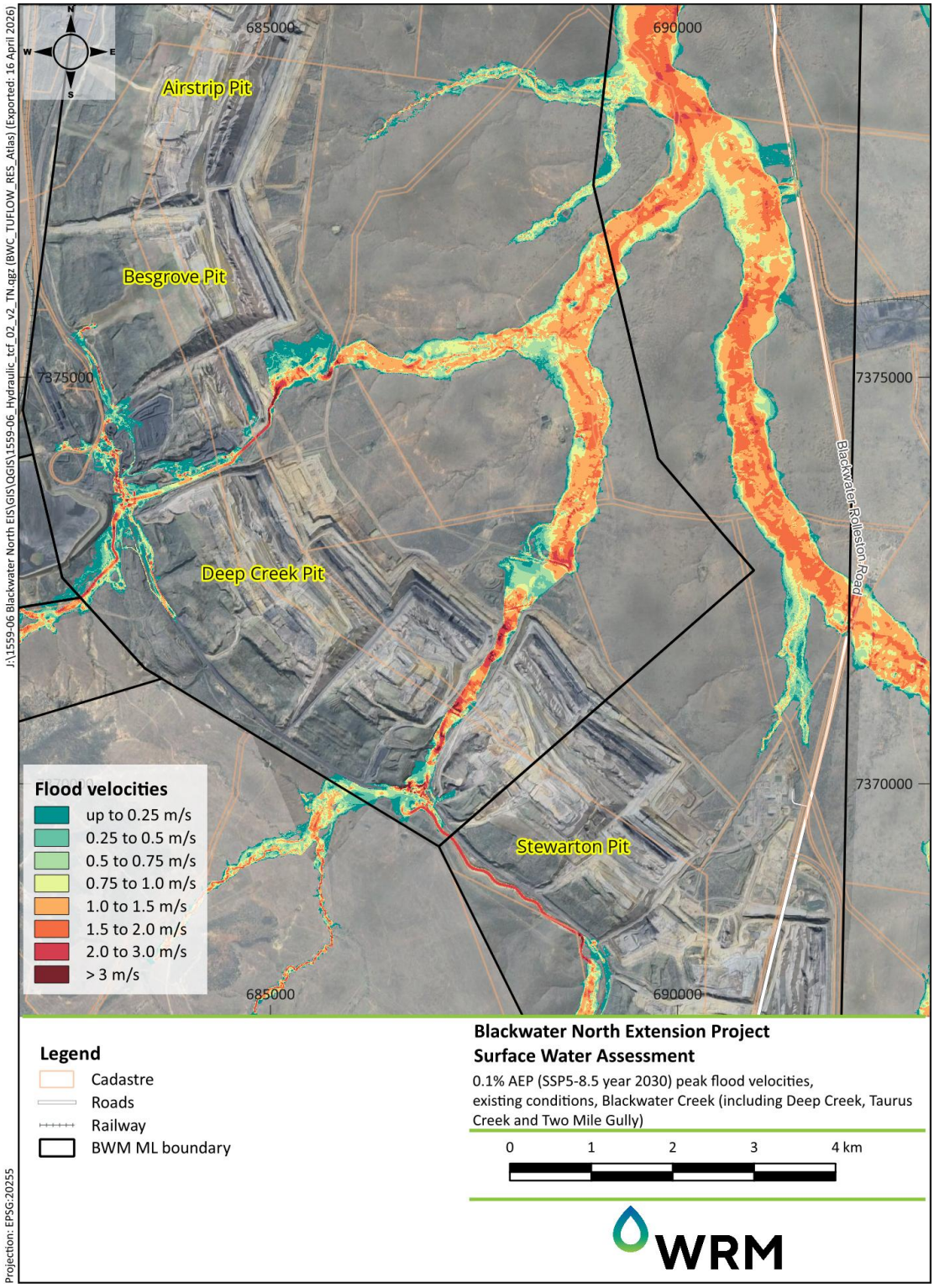


Figure 8.16 **0.1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

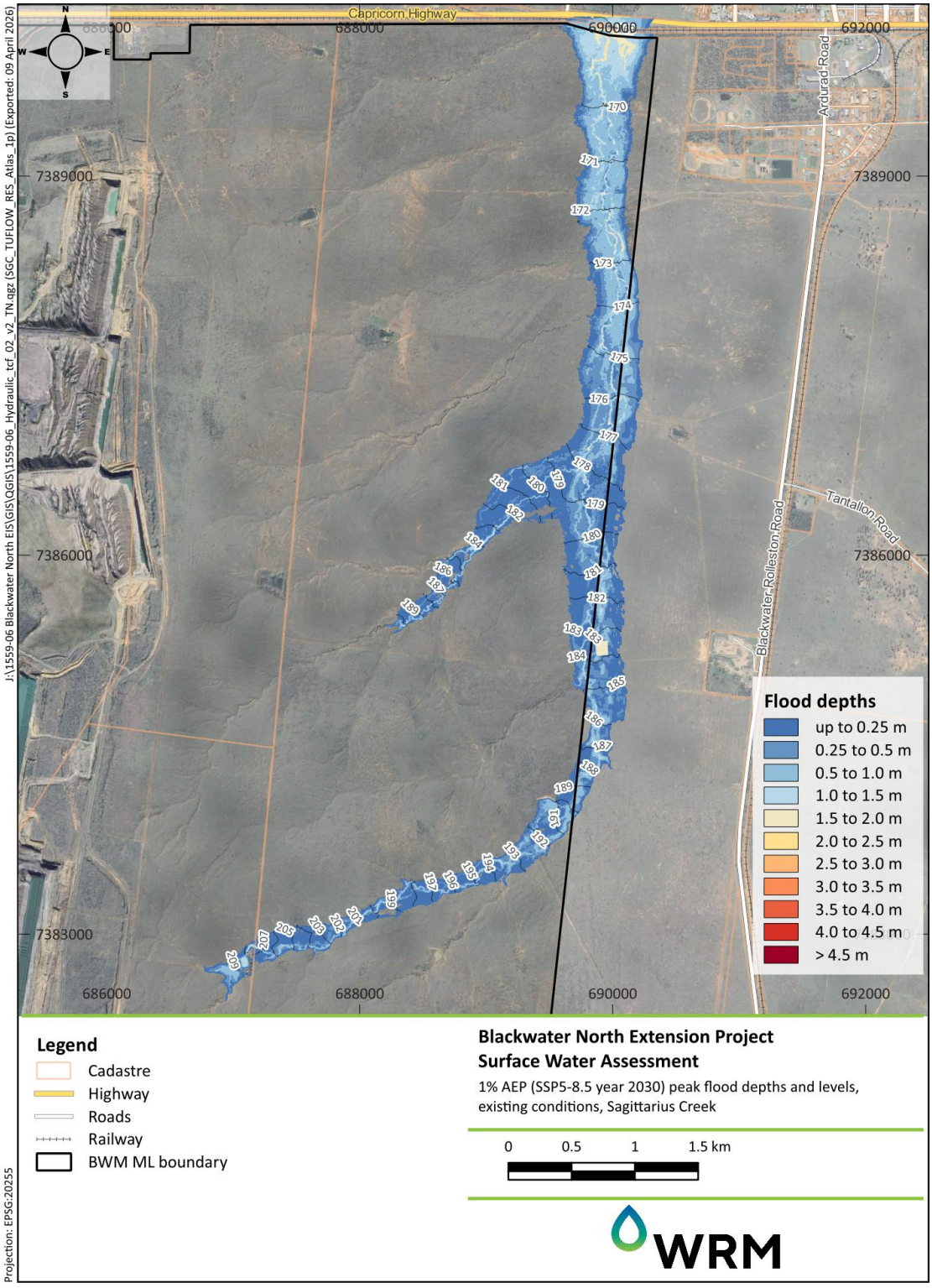


Figure 8.17 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Sagittarius Creek**

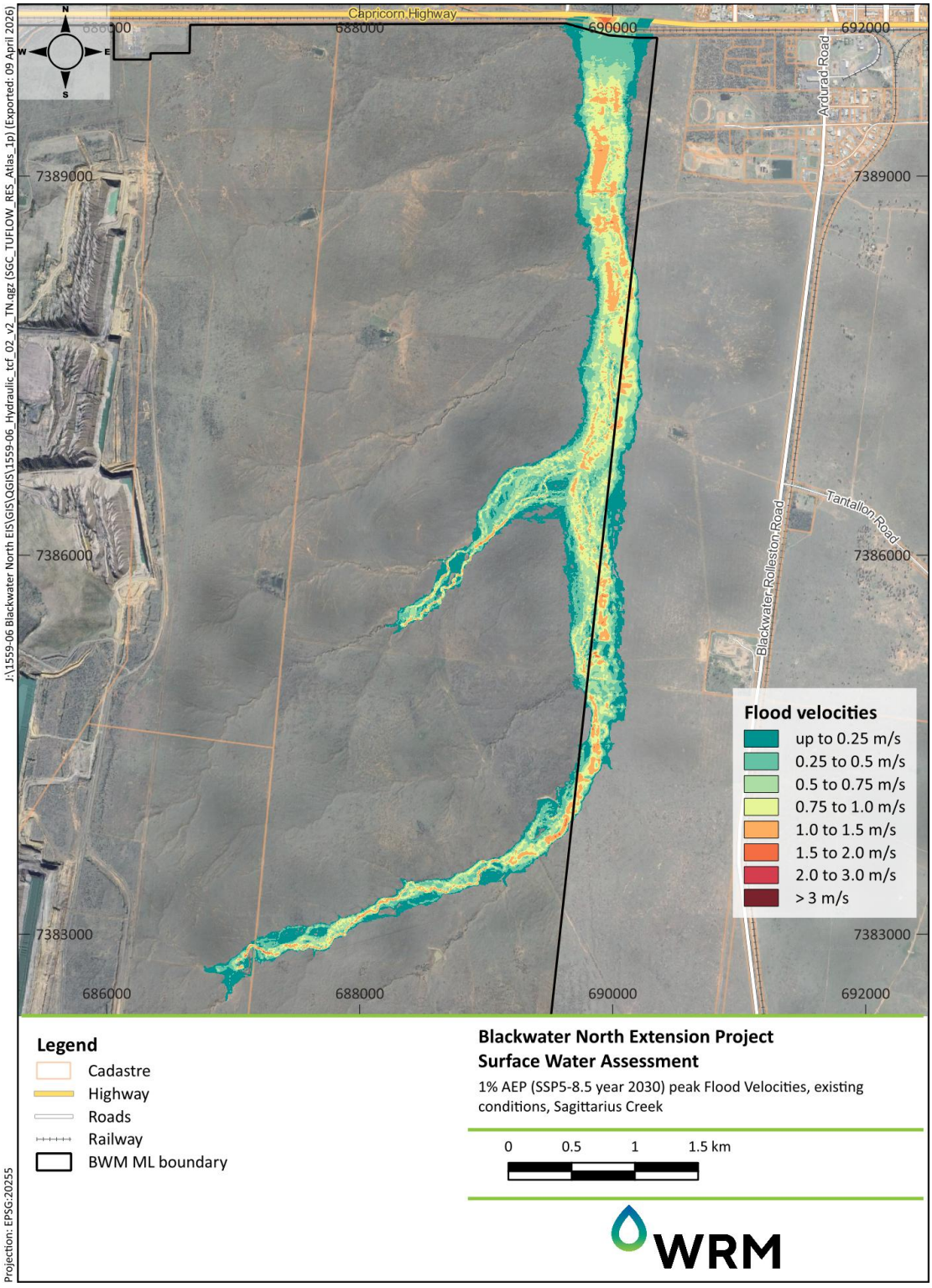


Figure 8.18 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Sagittarius Creek**

8.5 PROPOSED (PROJECT) CONDITIONS FLOODING

Figure 8.19 to Figure 8.23 are flood maps showing TUFLOW model predicted proposed (Project) conditions flood extents, levels and depth along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% to 0.1% AEP design events. Figure 8.24 to Figure 8.28 show the corresponding peak velocities.

Figure 8.19 to Figure 8.28 shows the locations of the following proposed infrastructure:

- proposed temporary flood protection levees that would be in place during the maximum operational disturbance stage of the Project (year 2055). It was assumed that the proposed temporary levees would be constructed with crest levels at least 1 m above the adjacent 0.1% AEP peak flood level; and
- the proposed clean water drain along the southeastern side of the future Stewarton Pit extent, which would be in place during the operational stage of the Project and would also form part of the final landform post-closure.

Figure 8.29 shows the TUFLOW model predicted proposed (Project) conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.30 shows the corresponding 1% AEP peak velocities.

The model results show that, within the Project area:

- The proposed levees would provide the future mining pits with immunity from flooding for all events up to 0.1% (1 in 1,000) AEP.
- The proposed clean water drain would have capacity to convey flood flows from the unnamed Two Mile Gully tributary catchment, for all events up to and including 0.1% AEP.
- The Project maximum disturbance area is located outside of the Sagittarius Creek flood extent for all modelled events.

An assessment of impacts on peak flood levels, velocities and waterway stability due to the Project is provided in Section 8.6. A hydraulic assessment of the proposed clean water drain is provided in Section 8.7.3.

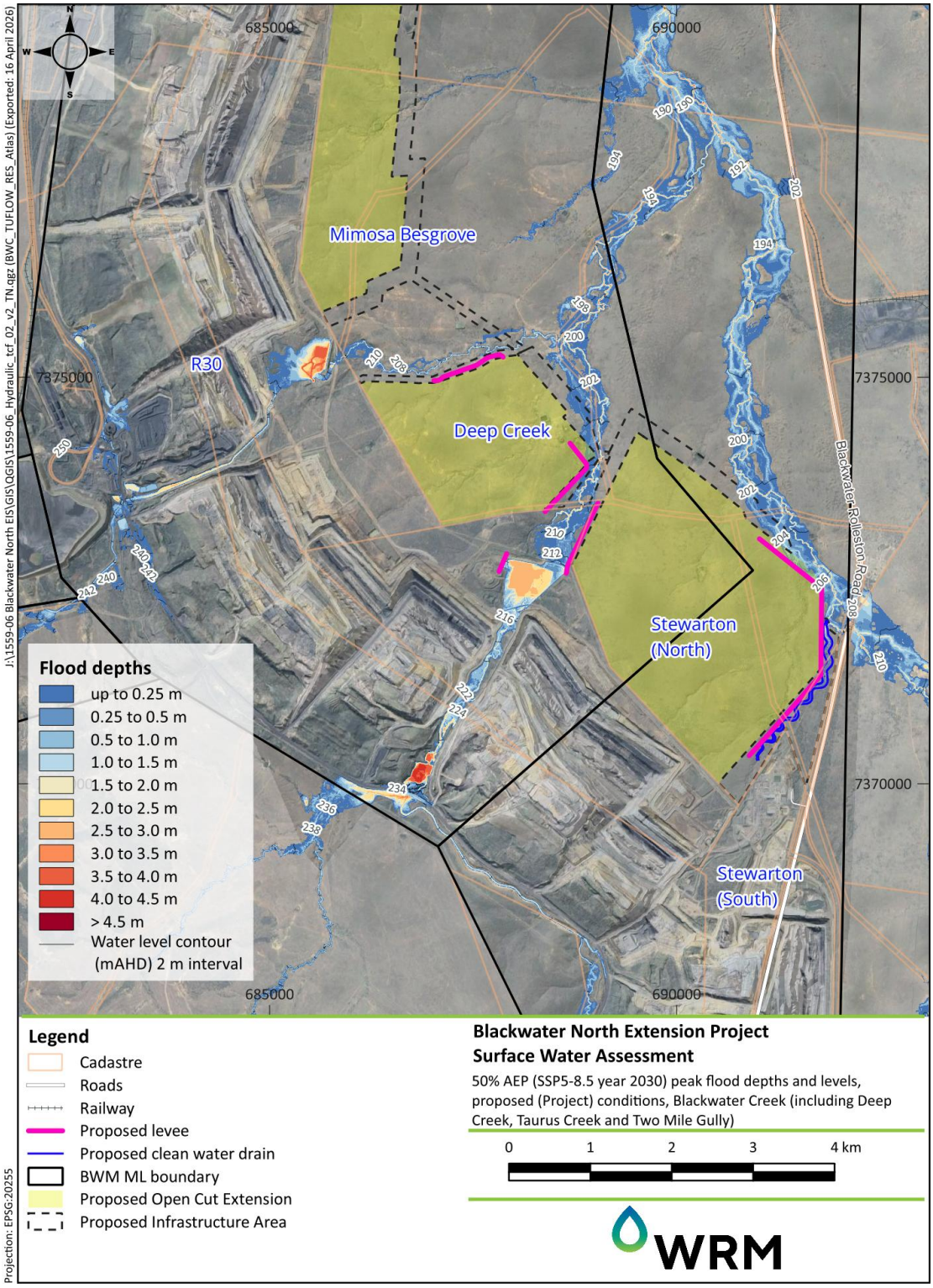


Figure 8.19 **50% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

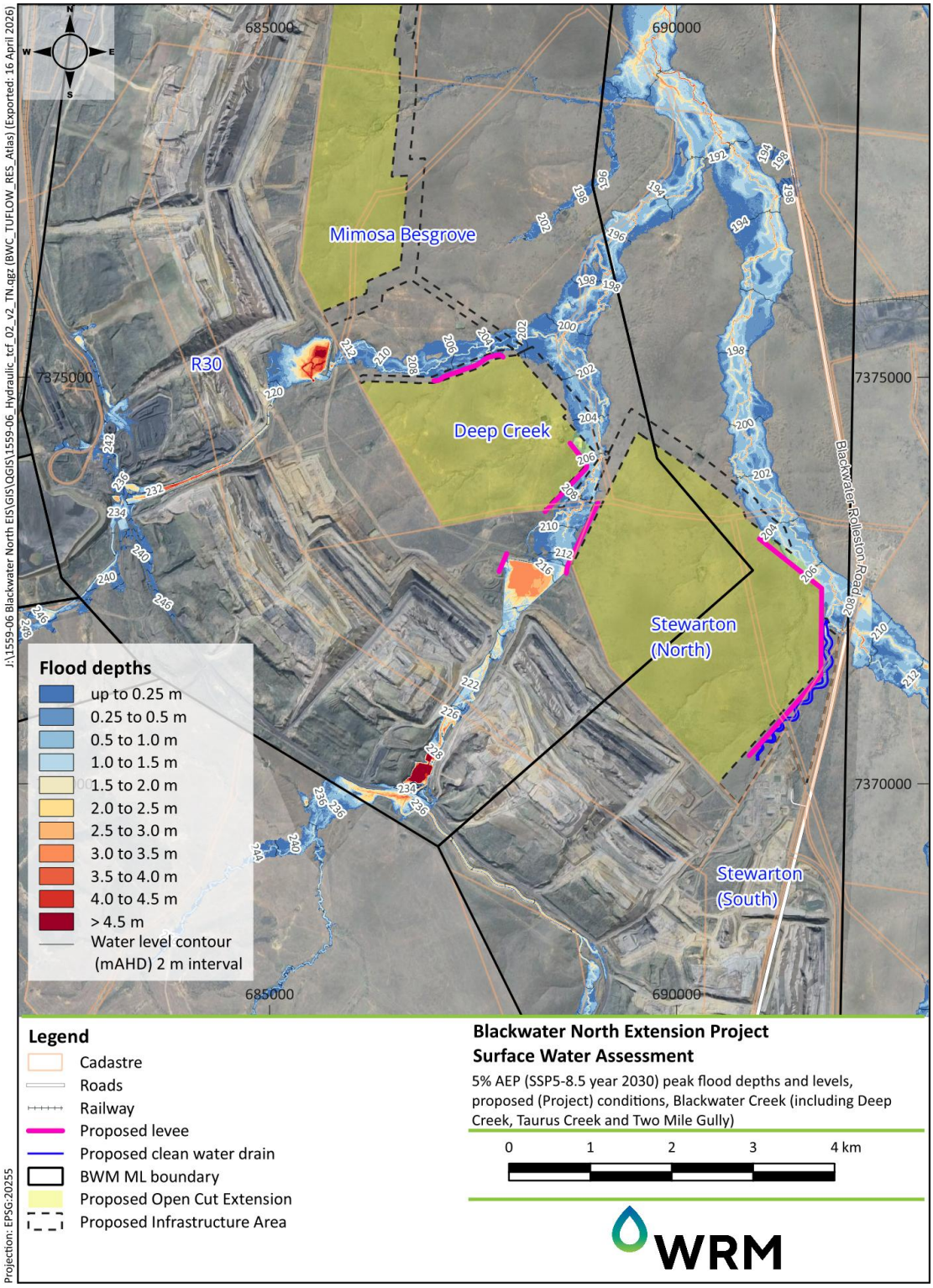


Figure 8.20 **5% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

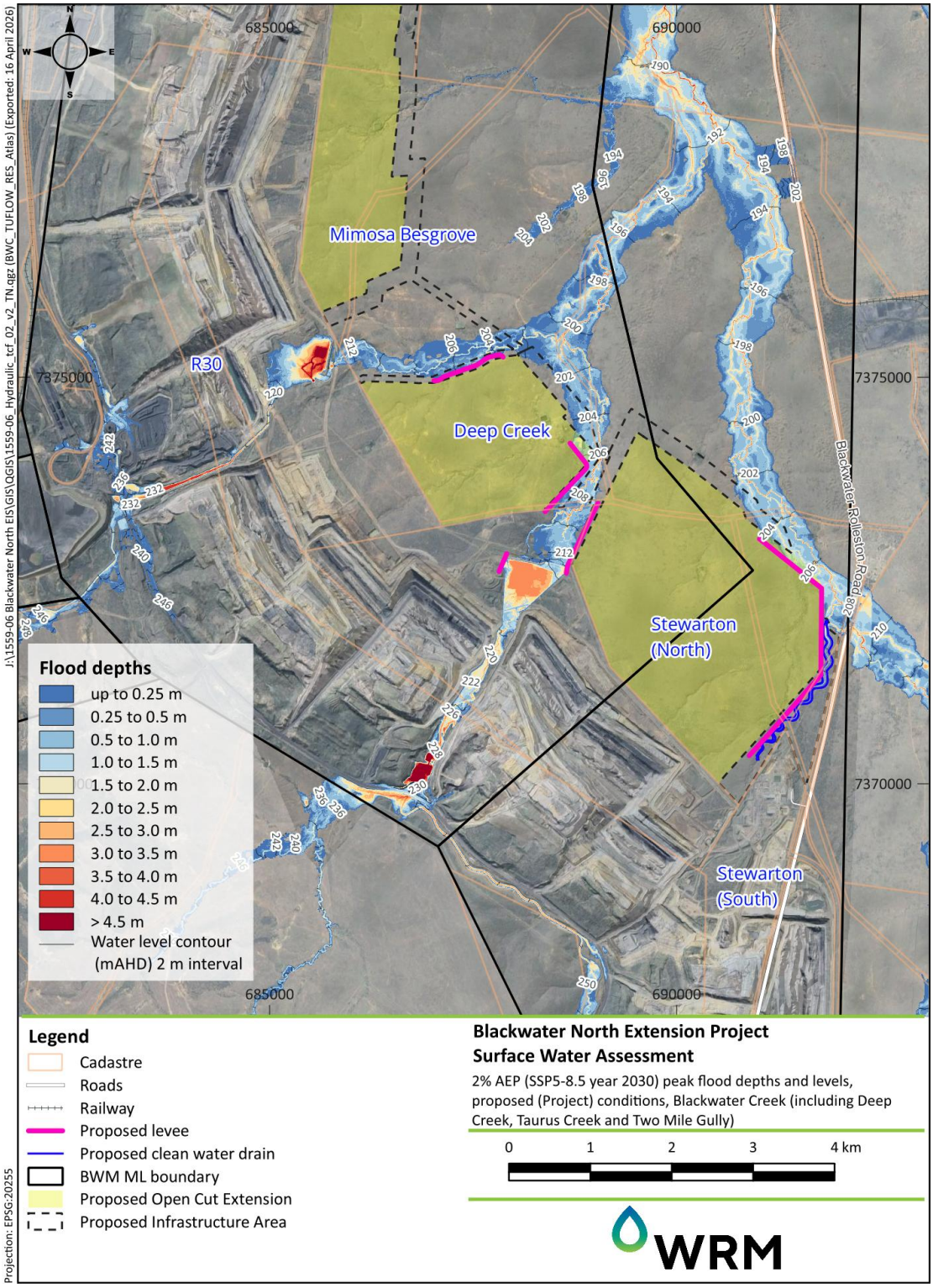


Figure 8.21 **2% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

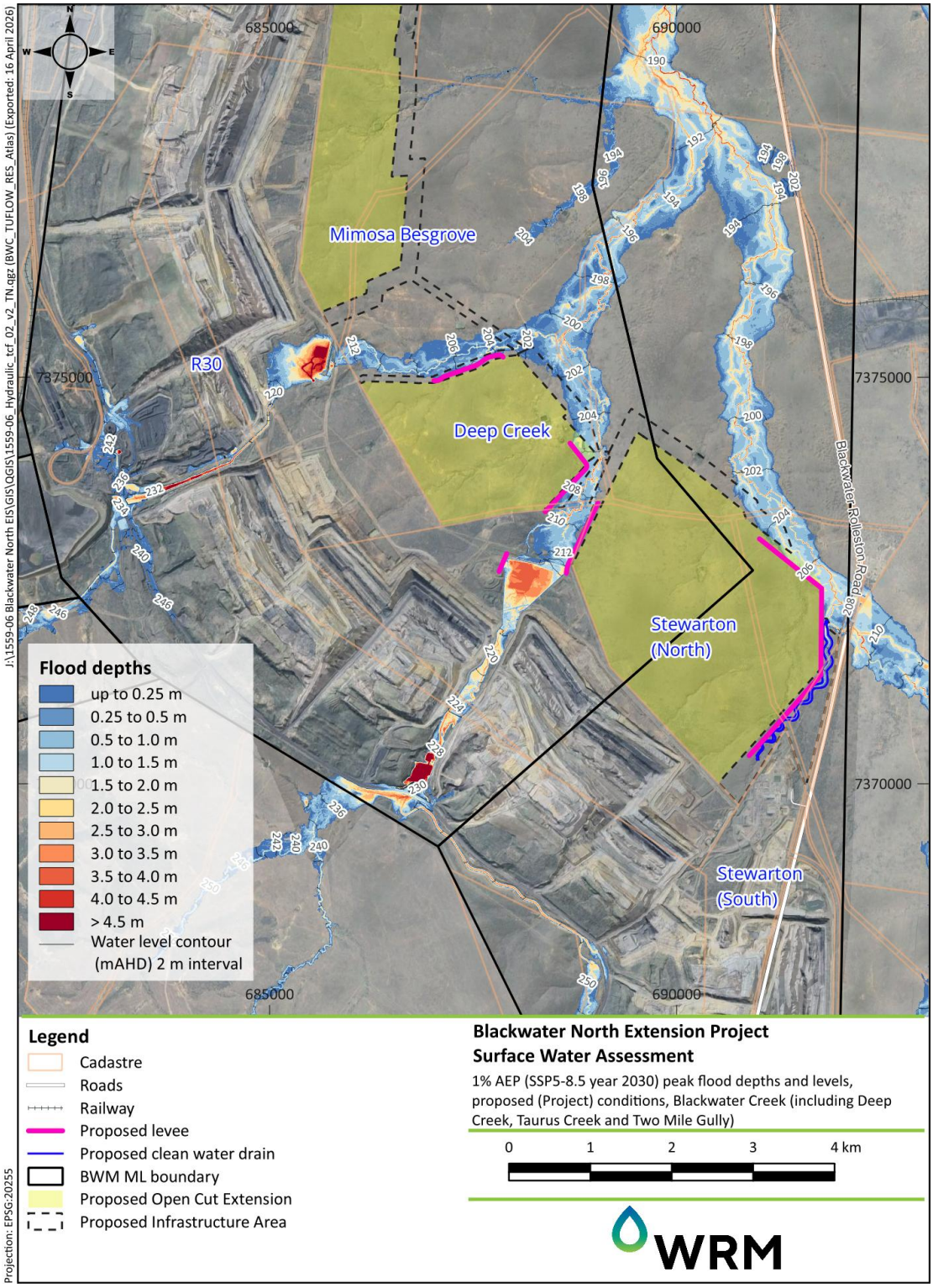


Figure 8.22 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

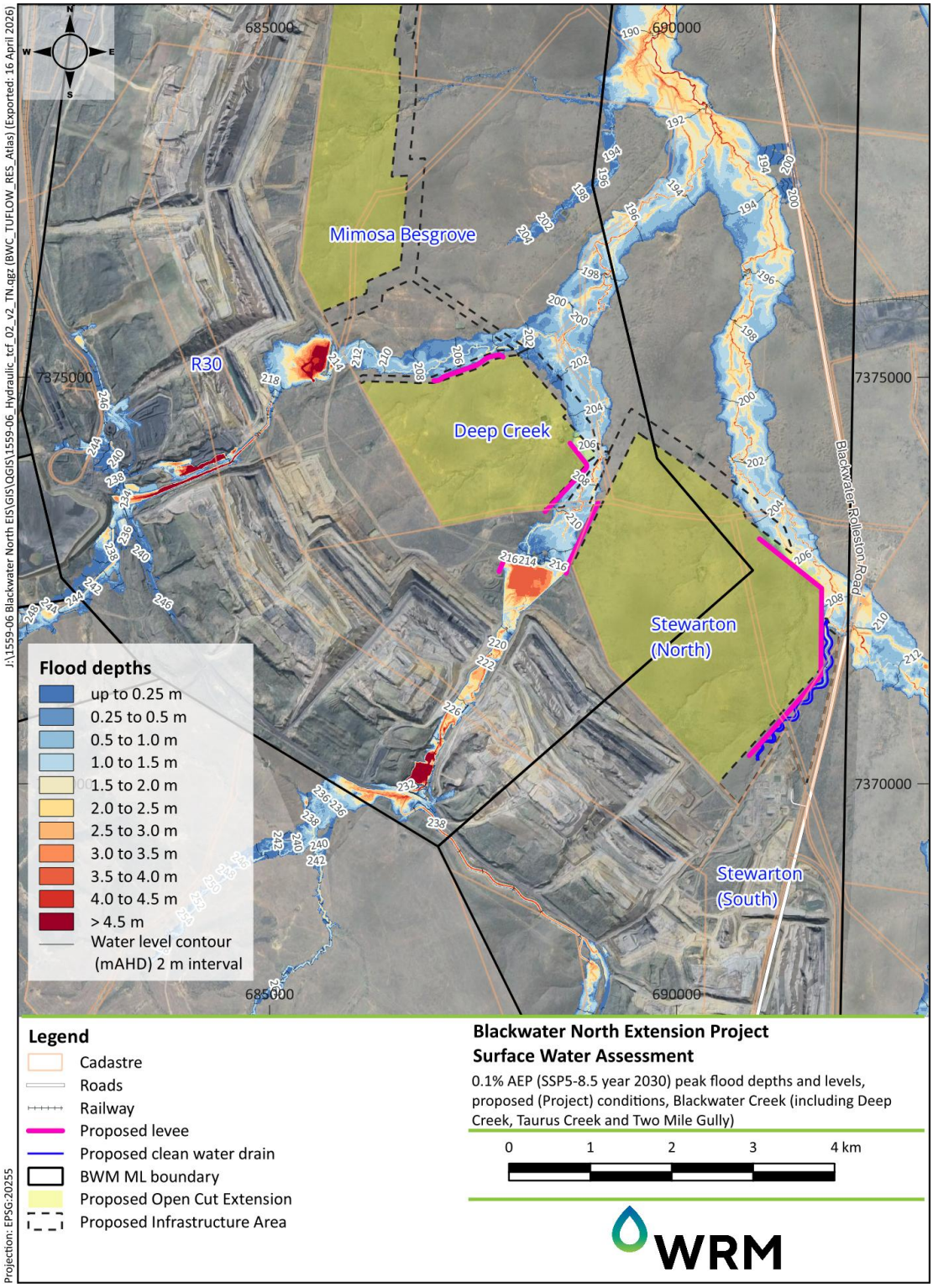


Figure 8.23 **0.1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

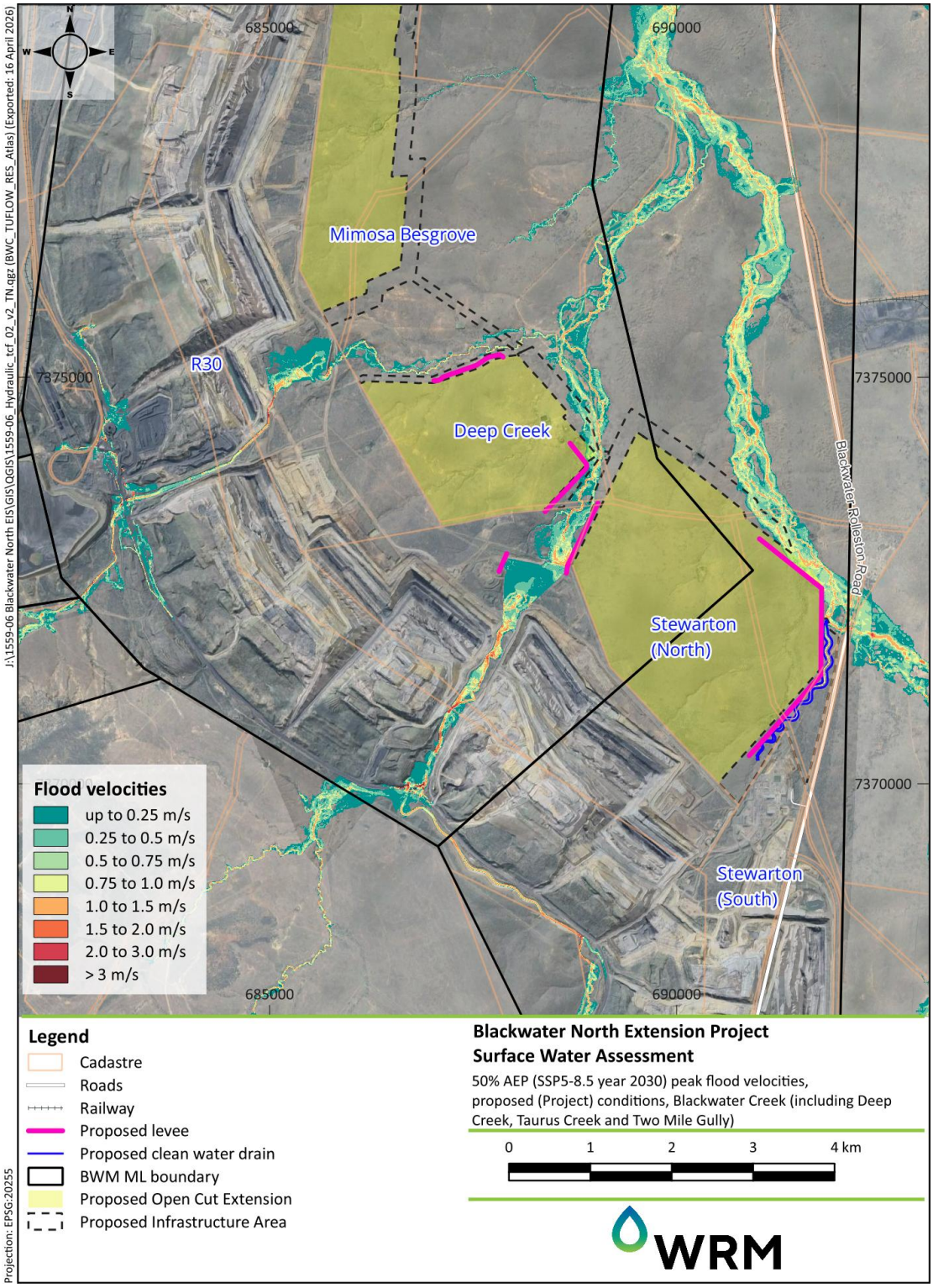


Figure 8.24 **50% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

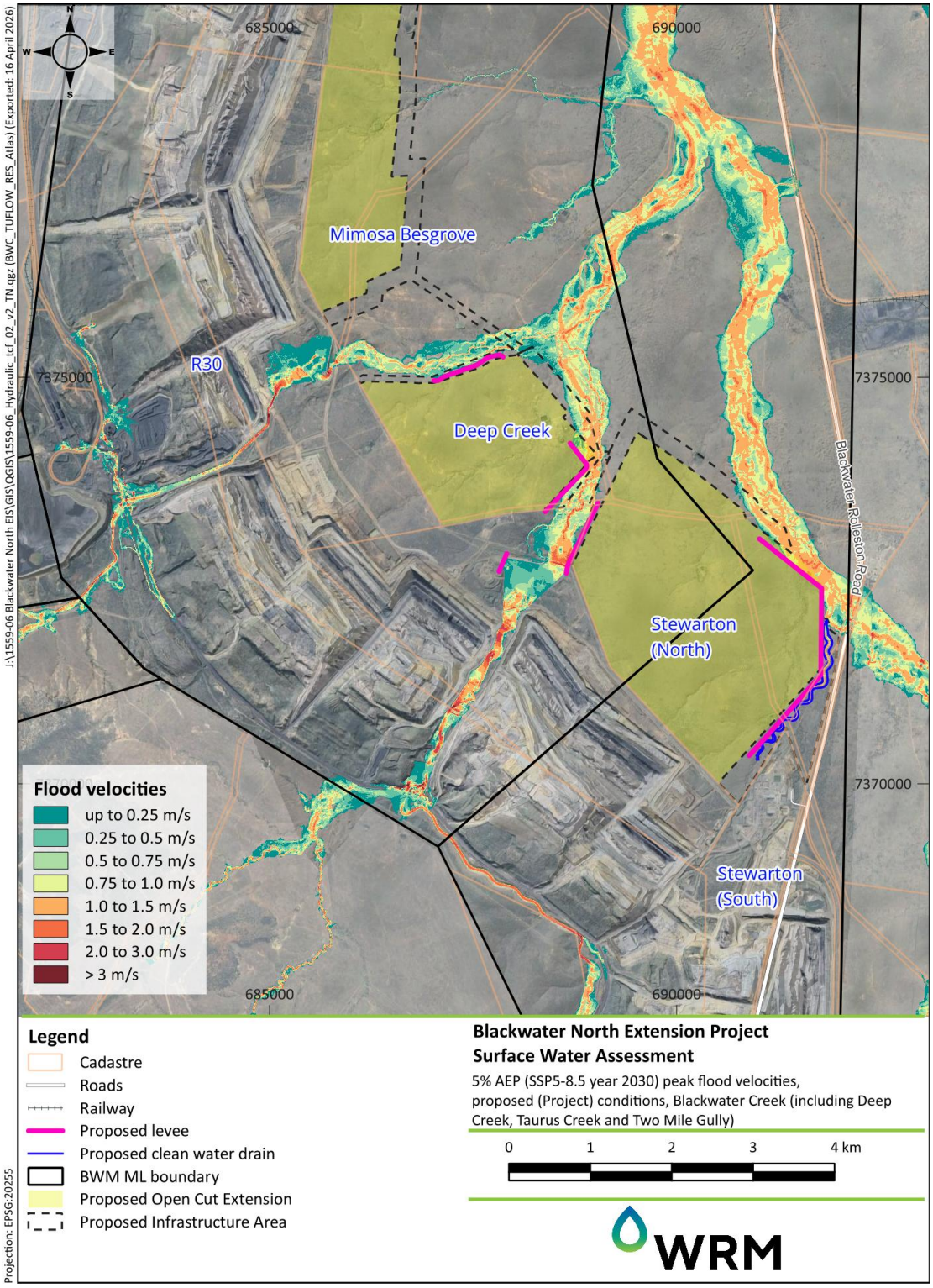


Figure 8.25 **5% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

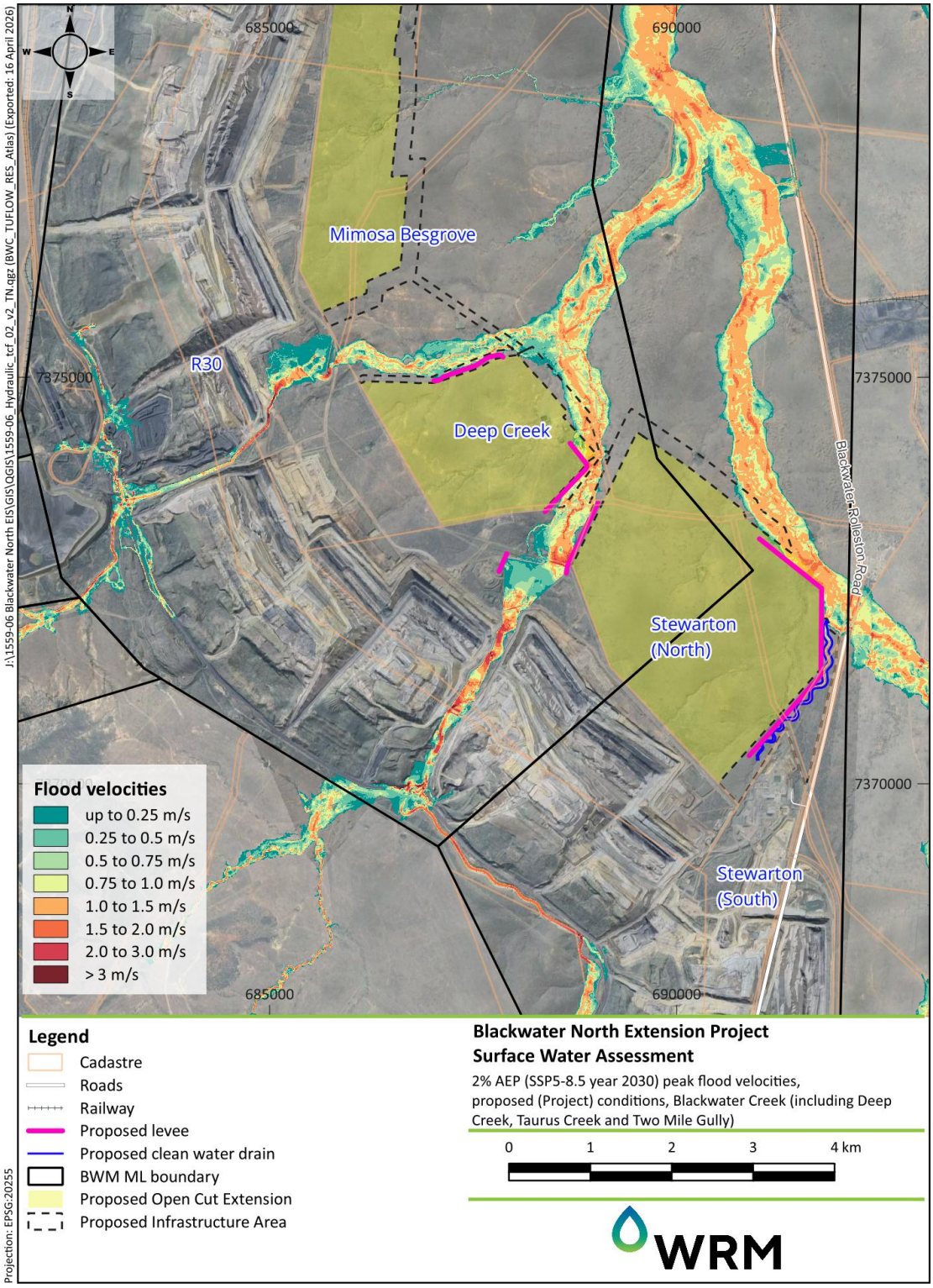


Figure 8.26 **2% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

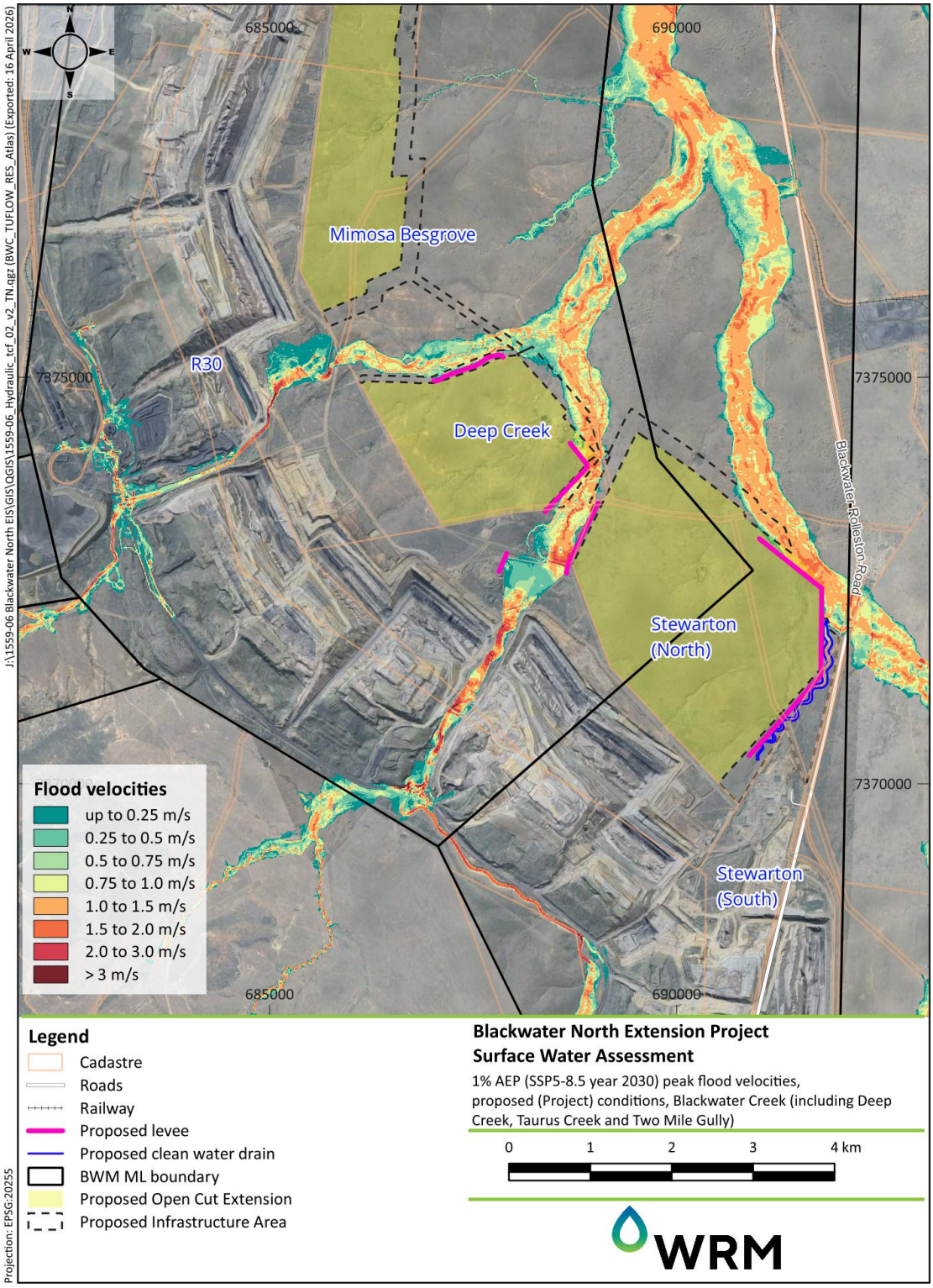


Figure 8.27 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

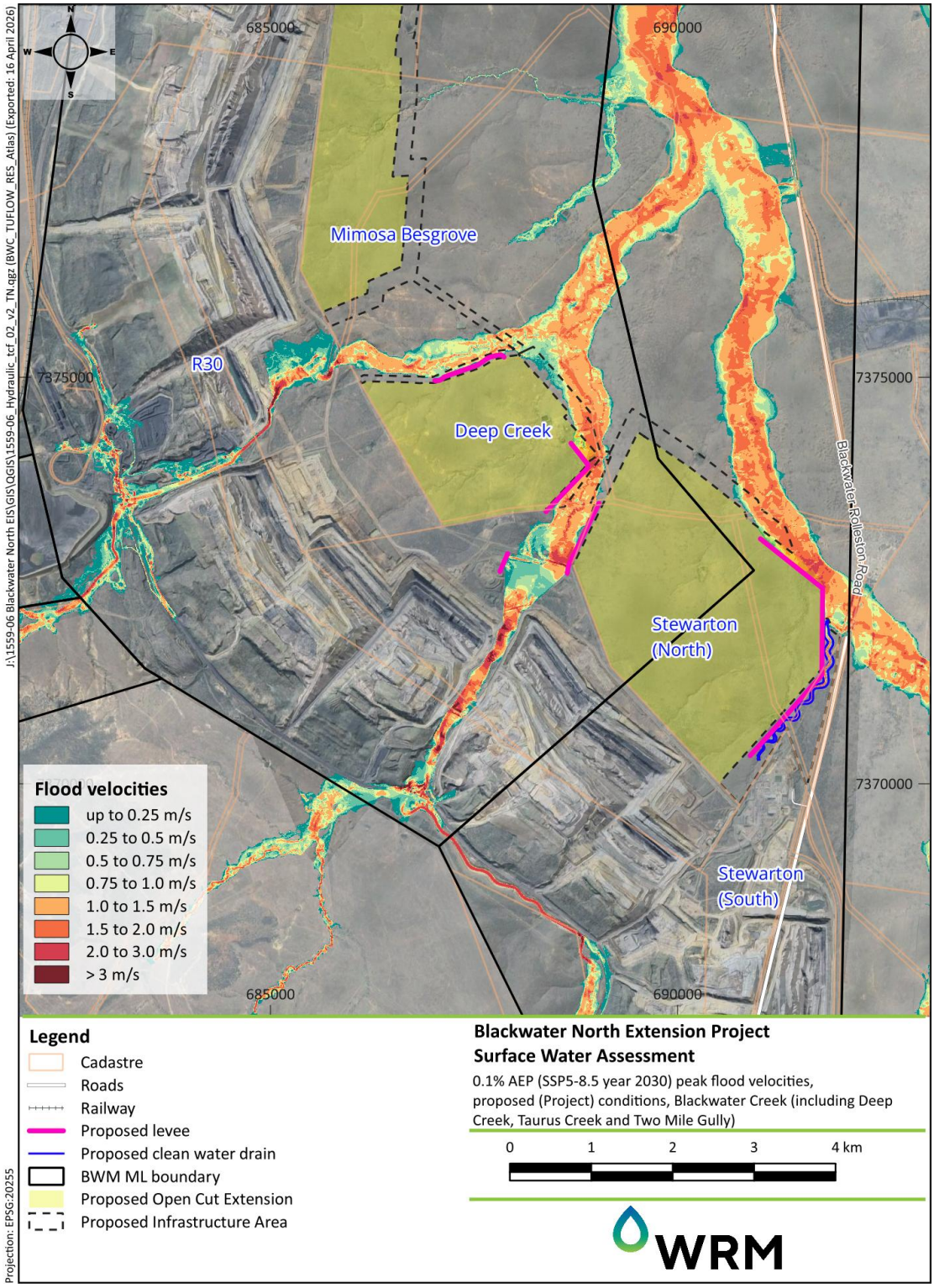


Figure 8.28 **0.1% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

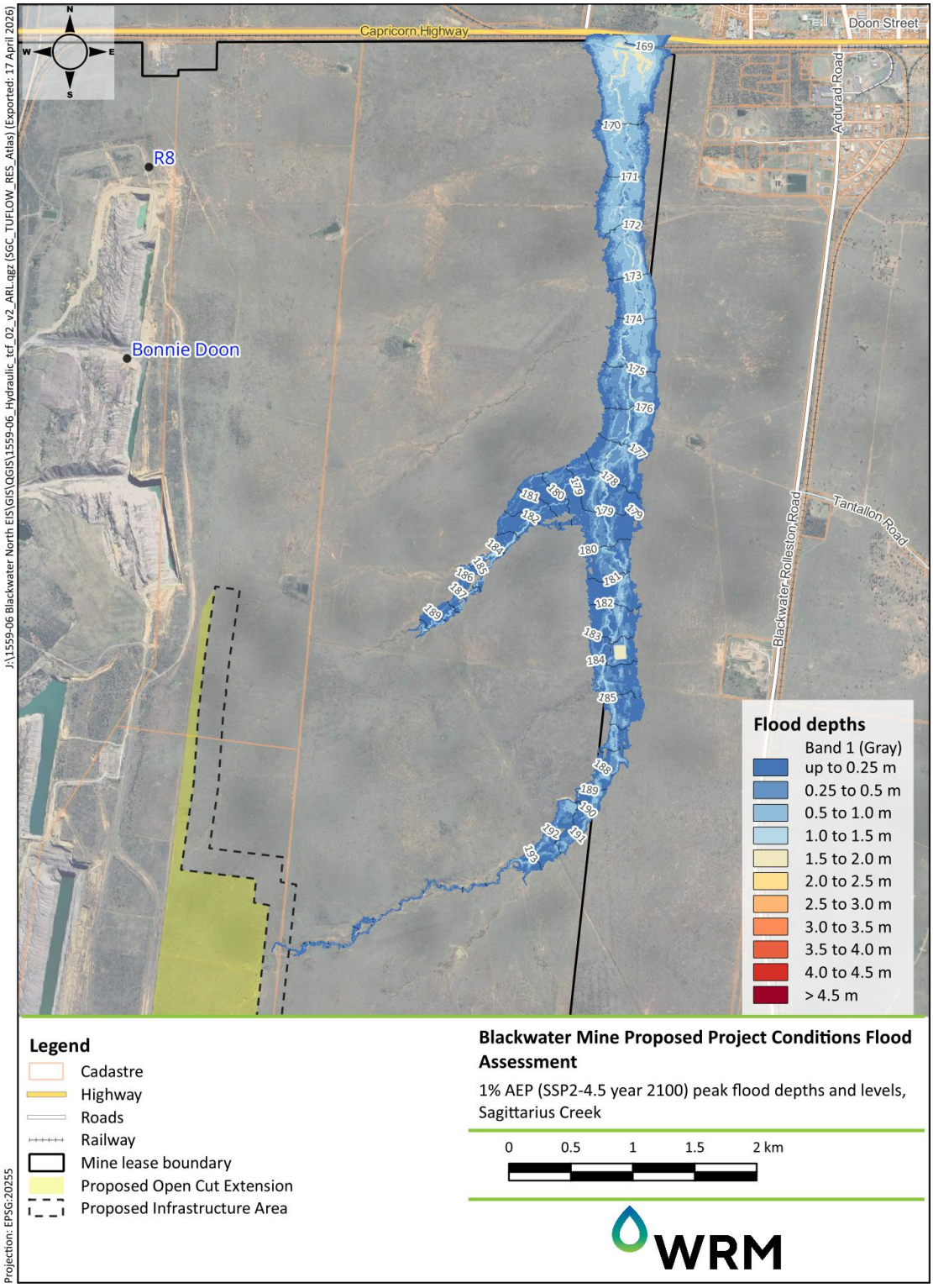


Figure 8.29 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Sagittarius Creek**

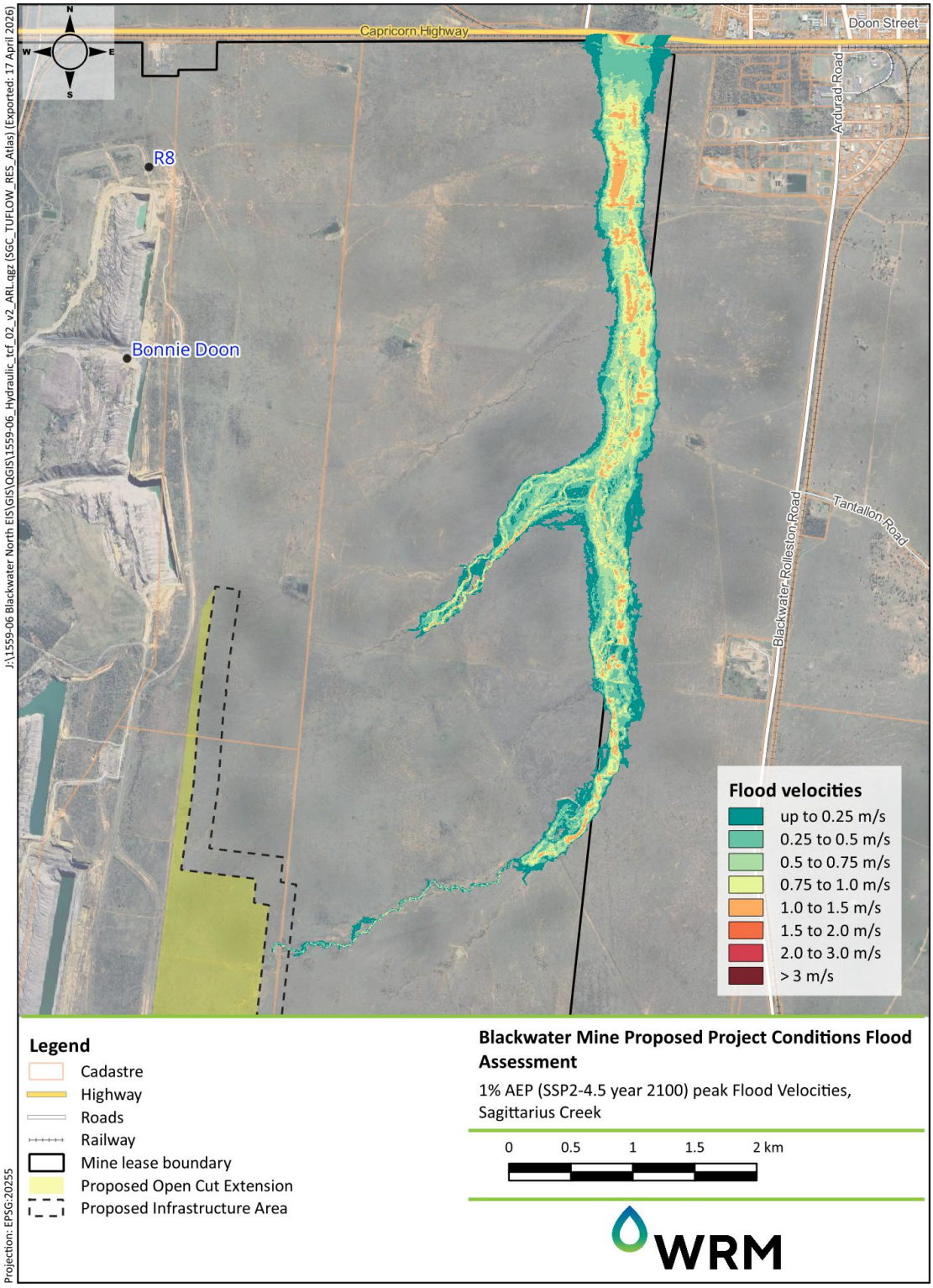


Figure 8.30 **1% AEP (SSP5-8.5 year 2030) peak velocities, proposed (Project) conditions, Sagittarius Creek**

8.6 IMPACTS ON PEAK FLOOD LEVELS AND VELOCITIES

Figure 8.31 to Figure 8.35 are flood maps showing the predicted impacts on peak flood levels (afflux) along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% to 0.1% AEP design events. Figure 8.36 to Figure 8.40 show the corresponding impacts on peak velocities.

Figure 8.41 shows the TUFLOW model predicted proposed (Project) conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.42 shows the corresponding 1% AEP peak velocities.

The model results show that:

- Predicted increases in peak flood levels are generally minor and contained on-lease for all events up to 0.1% AEP. There are minor off-lease impacts upstream of the confluence between the existing Taurus Creek temporary diversion and the existing Emu Creek diversion. There are no predicted increases in peak flood levels and events at existing dwellings/homesteads in the vicinity of the Project area.
- Downstream of the Project area, peak flood levels are predicted to reduce due to the reduction in design discharges as a result of additional catchment excision from expansion of the mining pits. The predicted reduction in peak flood levels is greatest within a short section in the upper headwaters of Sagittarius Creek as a result of the open cut pit extension.
- Flood level increases are predicted to occur adjacent to the proposed levees due to constriction of the floodplain by these levees. Flood level impacts are also predicted to occur along the Deep Creek and Taurus Creek temporary diversions, due to increased runoff from additional areas of rehabilitation dump landform upstream of mining pits.
- Any predicted increases in peak flood levels are generally <0.1 m along the floodplains within the Project area. Given that existing conditions flood depths are between 0.5 m and 1.5 m for events up to 1% AEP, these predicted flood level increases are not considered significant.
- Increases in flood levels >0.1 m are generally localised to areas adjacent to the proposed levees, and along the Taurus Creek temporary diversion.
- Predicted increases in peak velocities along the floodplains within the Project area generally <0.1 m/s for all events up to 1% AEP. Existing conditions peak velocities along the floodplain typically range between up to 0.5 m/s for the 50% AEP event and up to existing conditions velocities are up to 1 m/s for the 1% AEP event. Hence the predicted velocity impacts are not significant.
- Localised increases in peak velocities of up to 0.5 m/s are predicted adjacent to the proposed levees. The impact of these flood velocity increases on erosion potential and stream stability was assessed and are described in Section 8.7.
- The Project would reduce peak flood levels along the Sagittarius Creek floodplain for all events, due to the reduction in catchment area and flood discharges. Flood impacts along Sagittarius Creek were assessed for the 1% AEP event only. As the Project disturbance area is outside of the Sagittarius Creek flood extent, flood impacts for other events were not assessed.

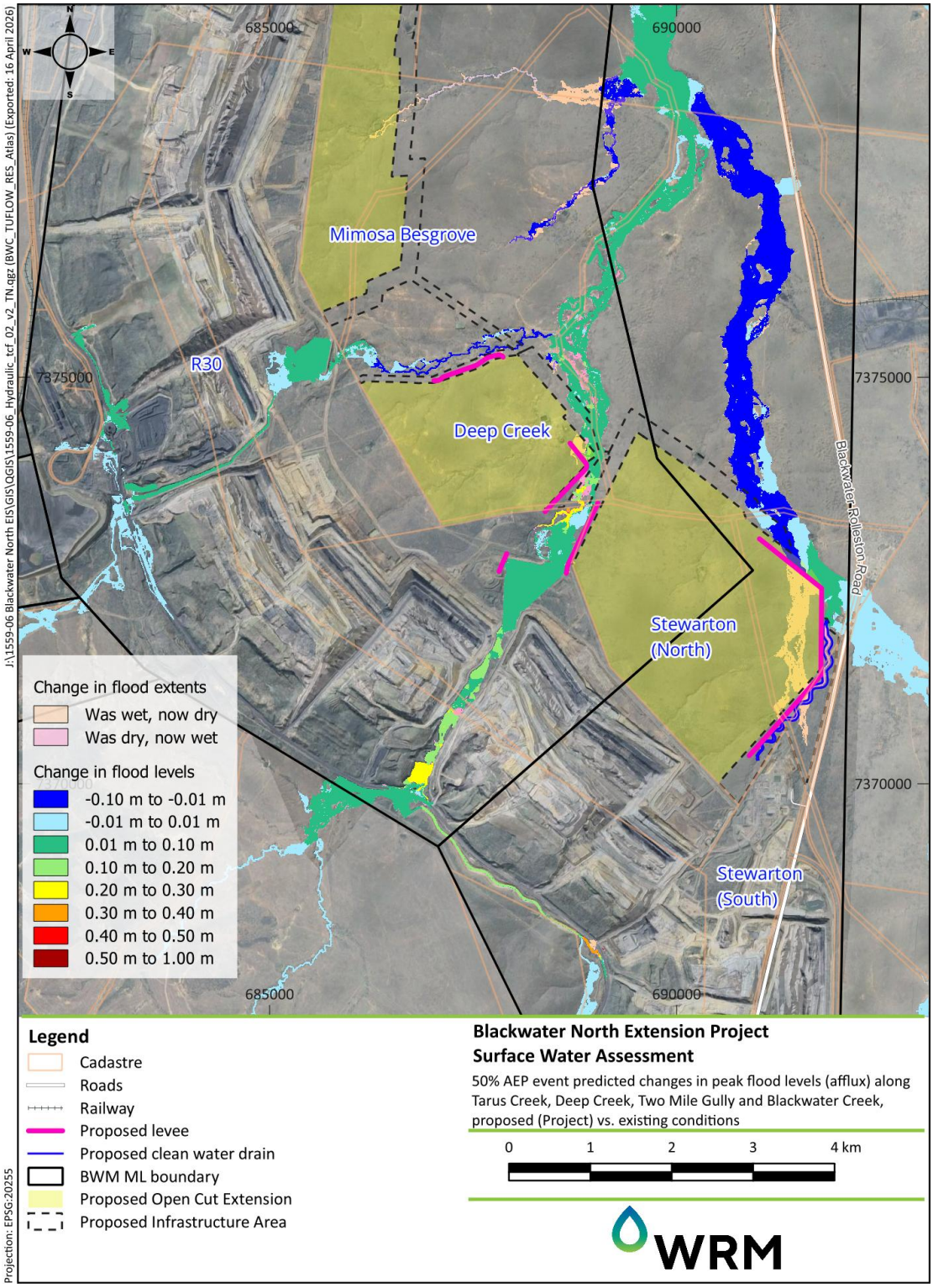


Figure 8.31 **50% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

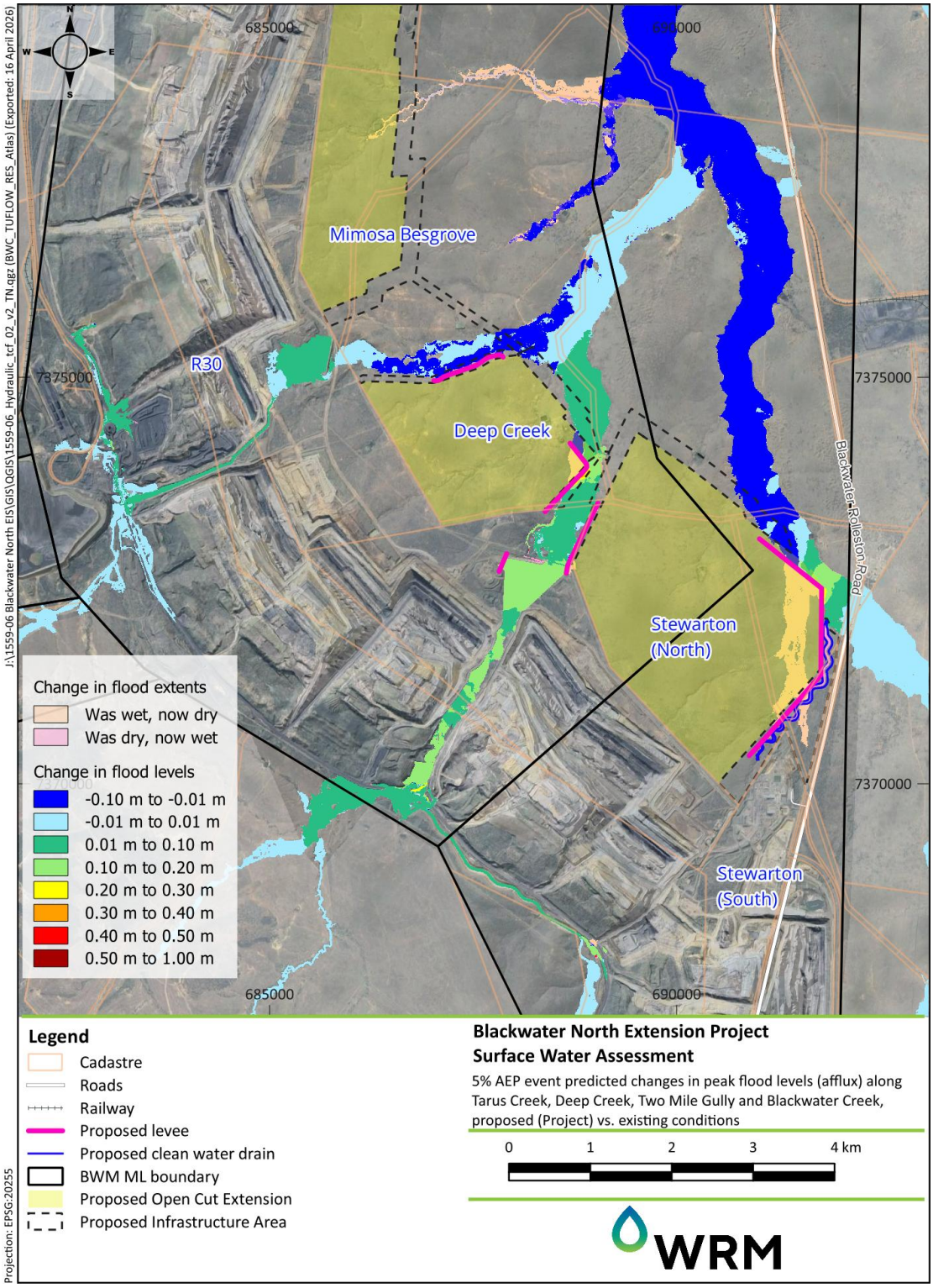


Figure 8.32 **5% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

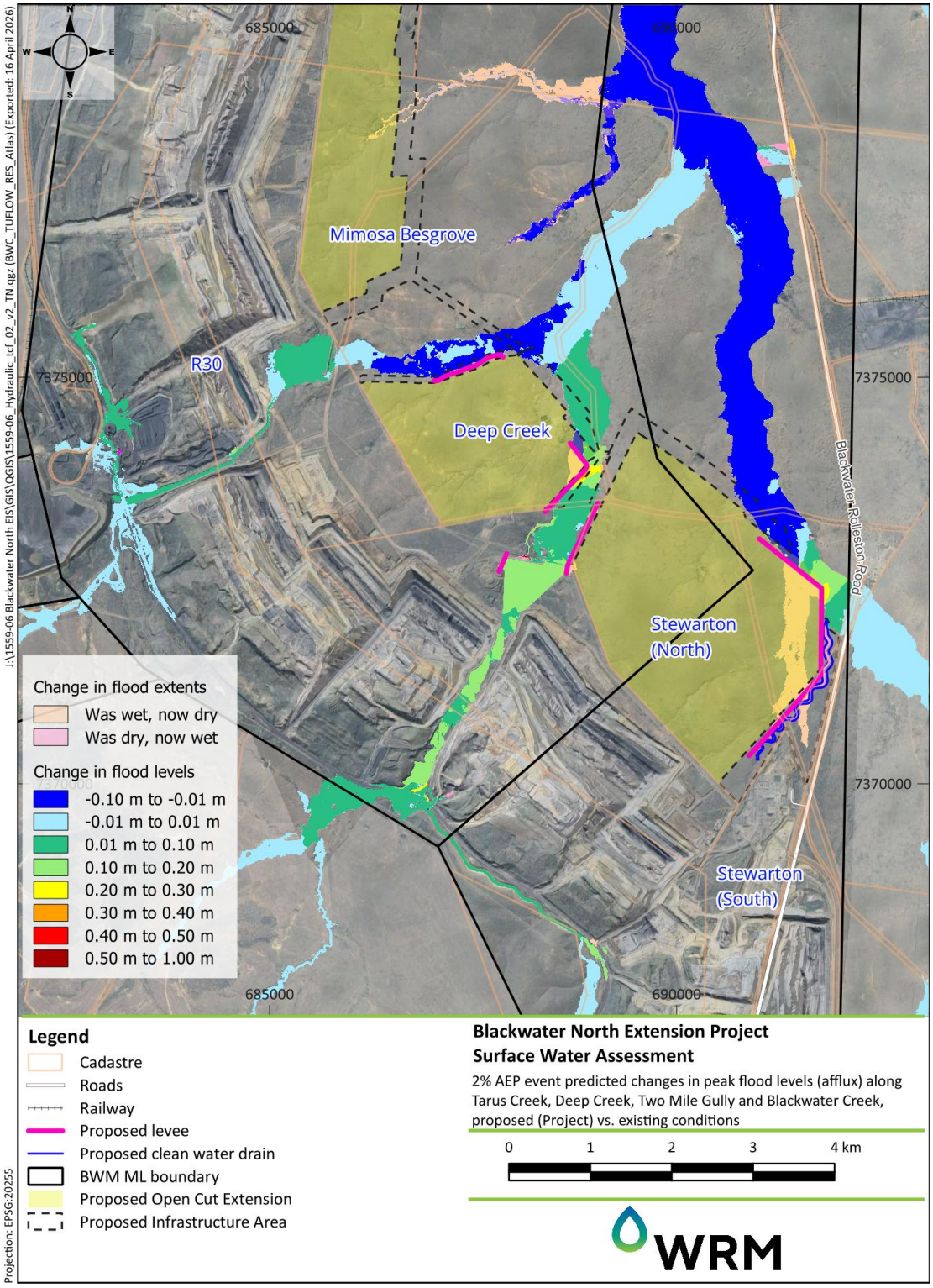


Figure 8.33 **2% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

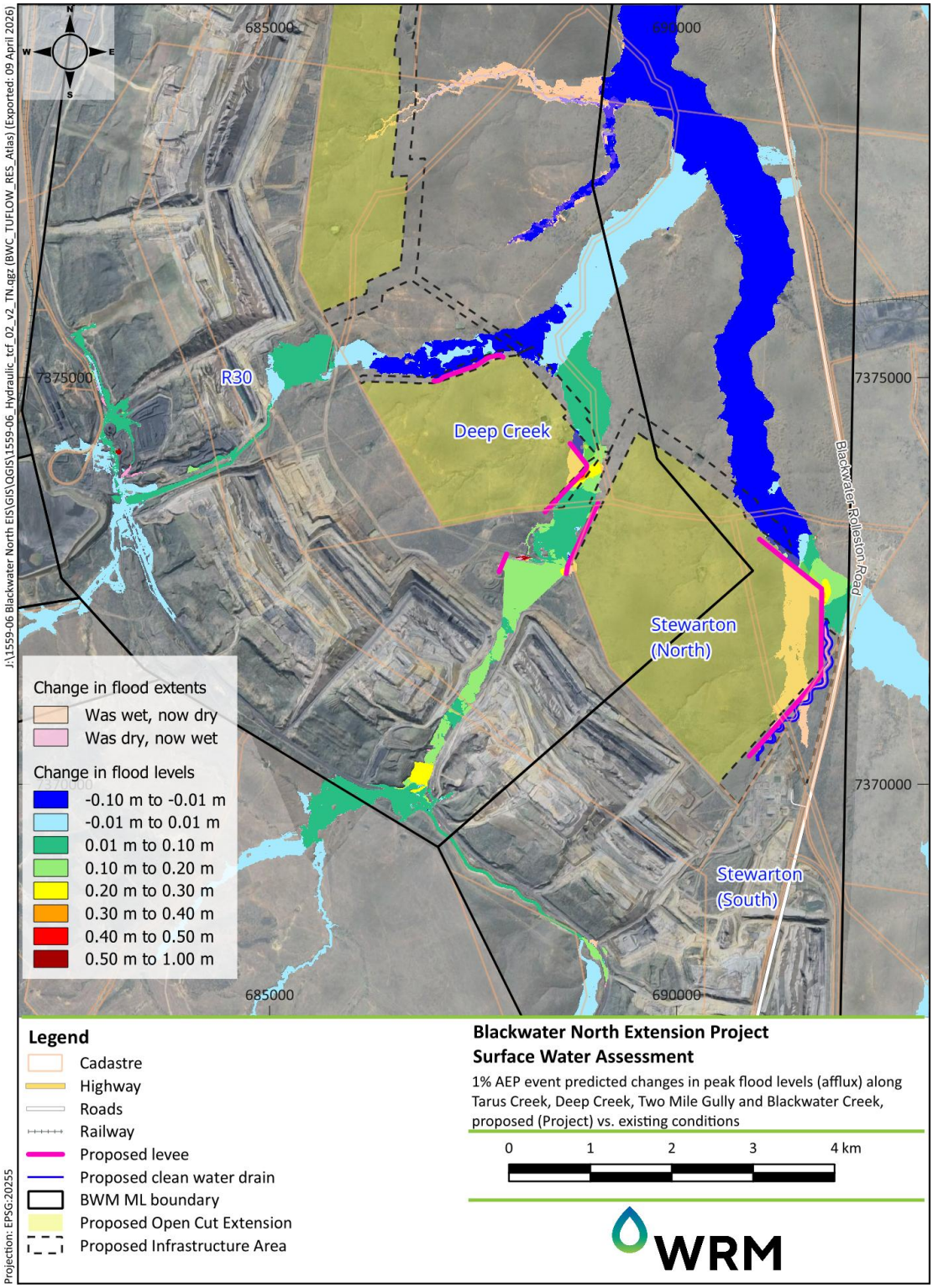


Figure 8.34 **1% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

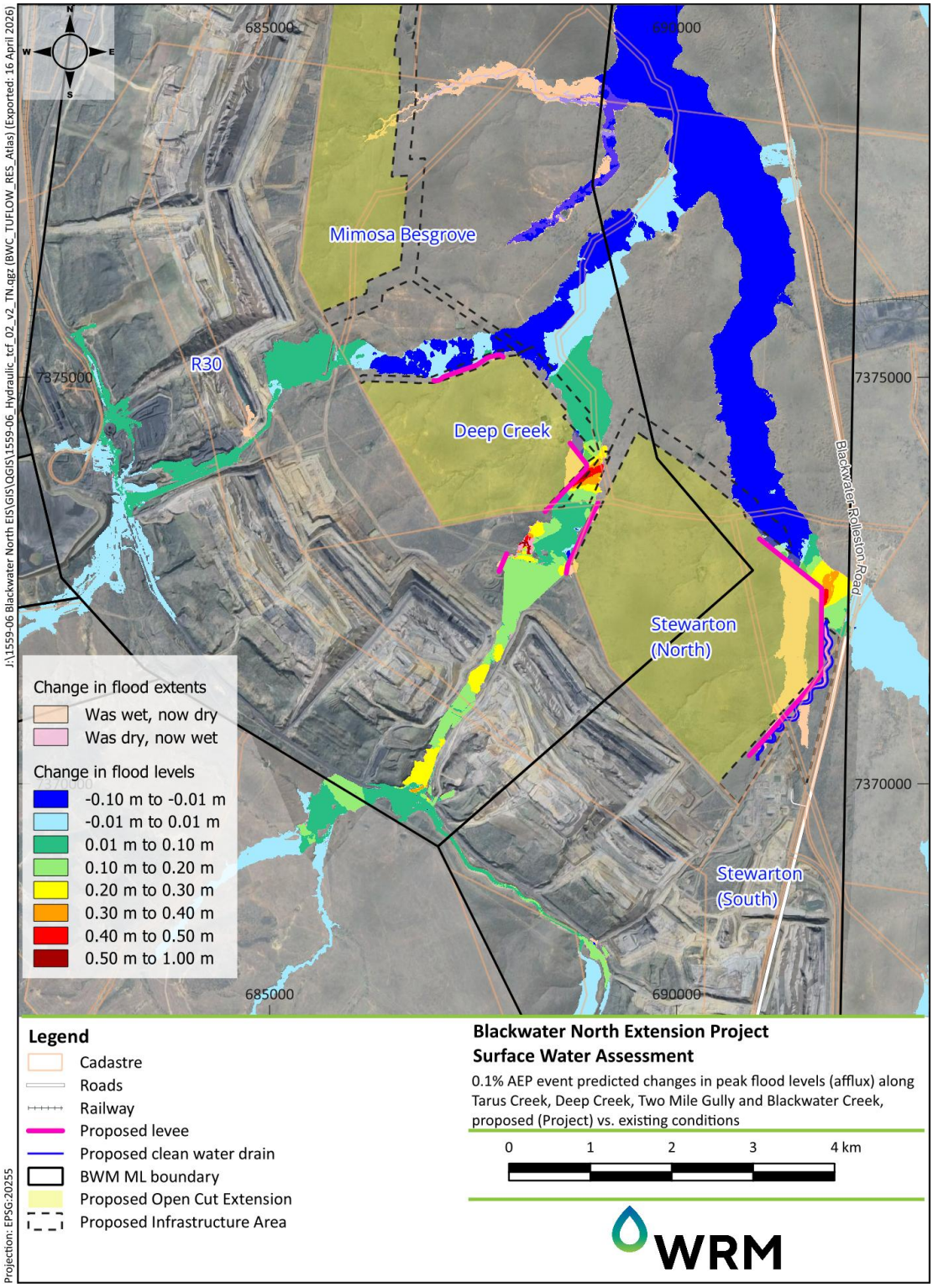


Figure 8.35 **0.1% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

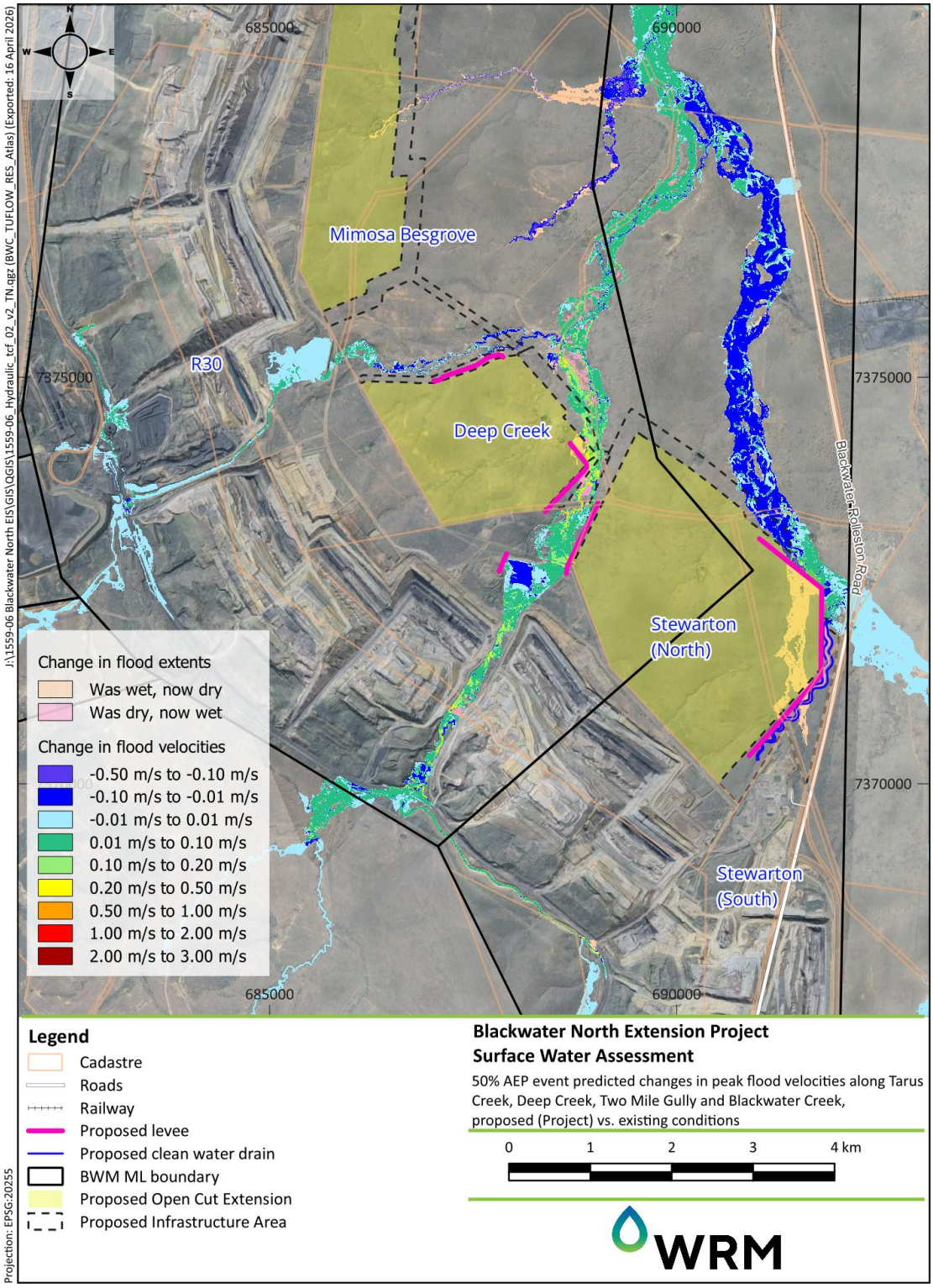


Figure 8.36 **50% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

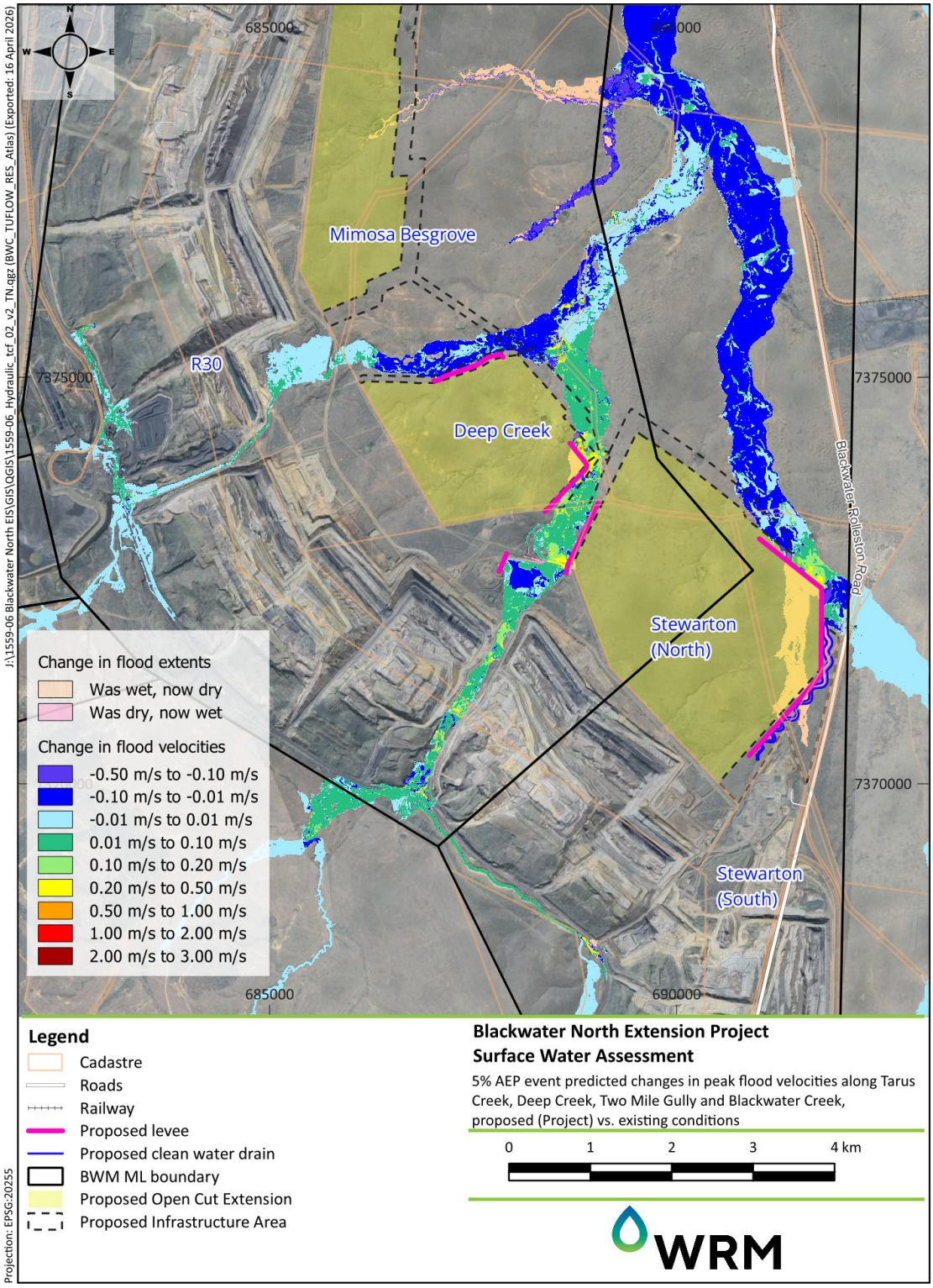


Figure 8.37 **5% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

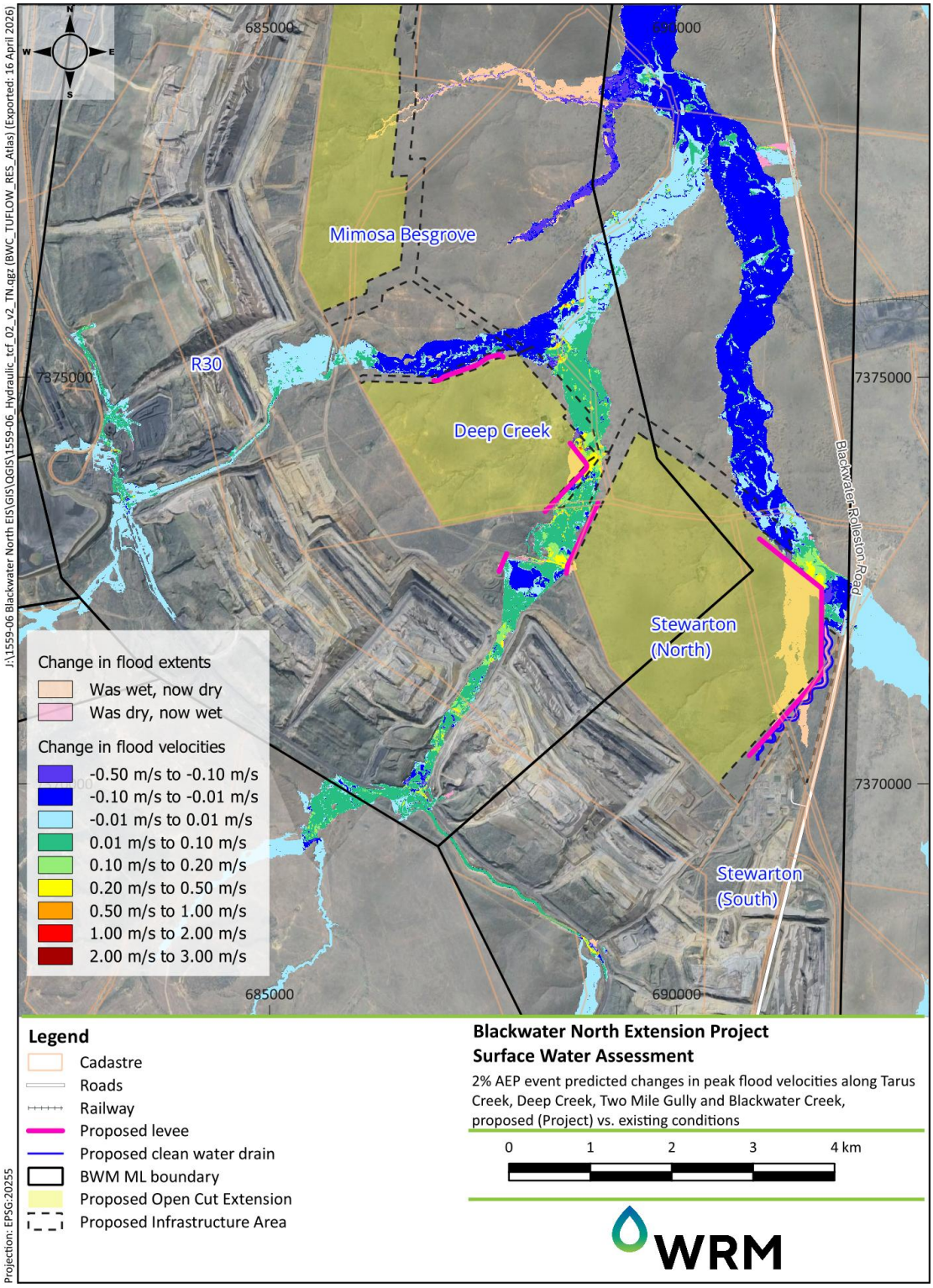


Figure 8.38 **2% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

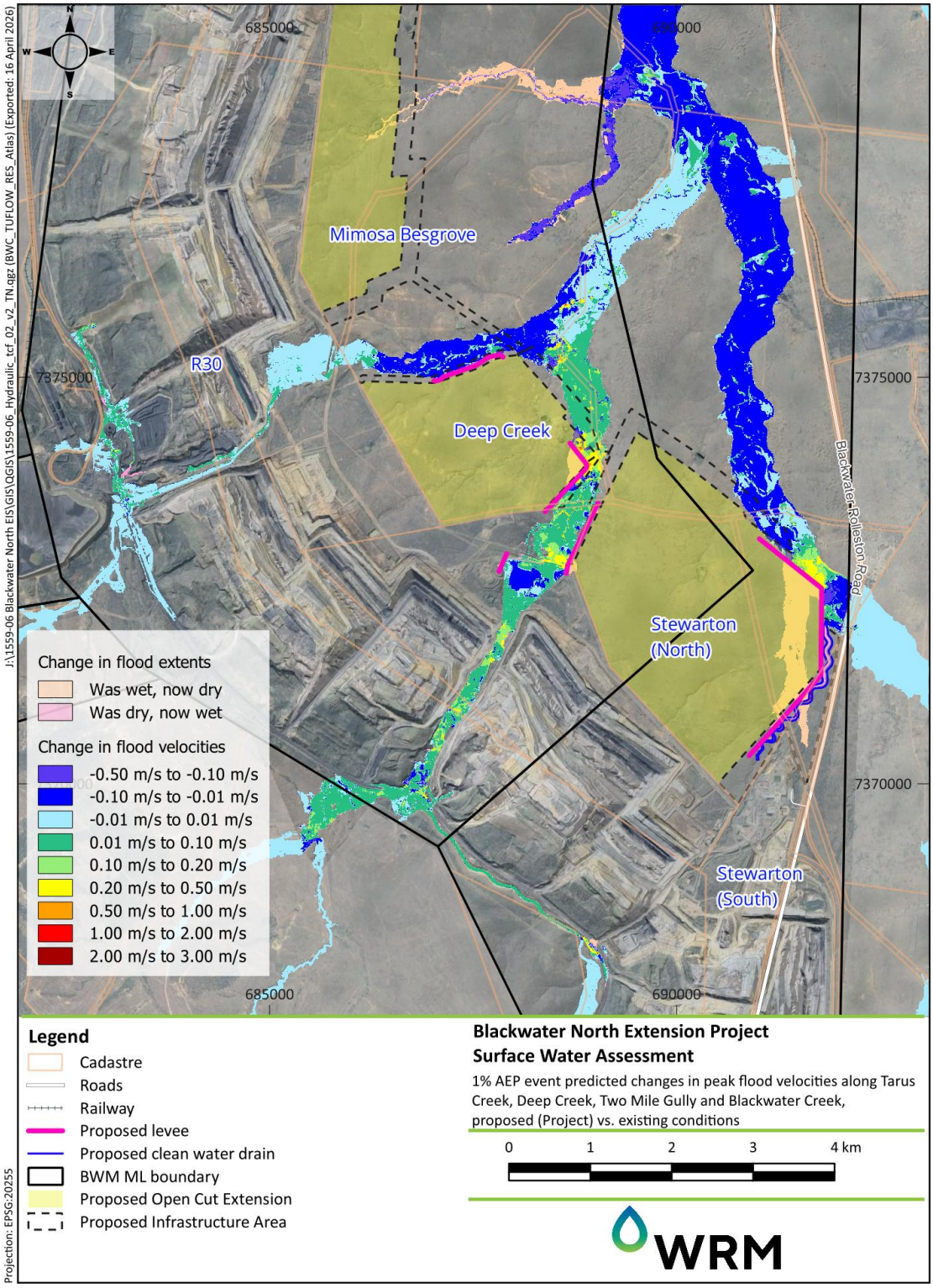


Figure 8.39 **1% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

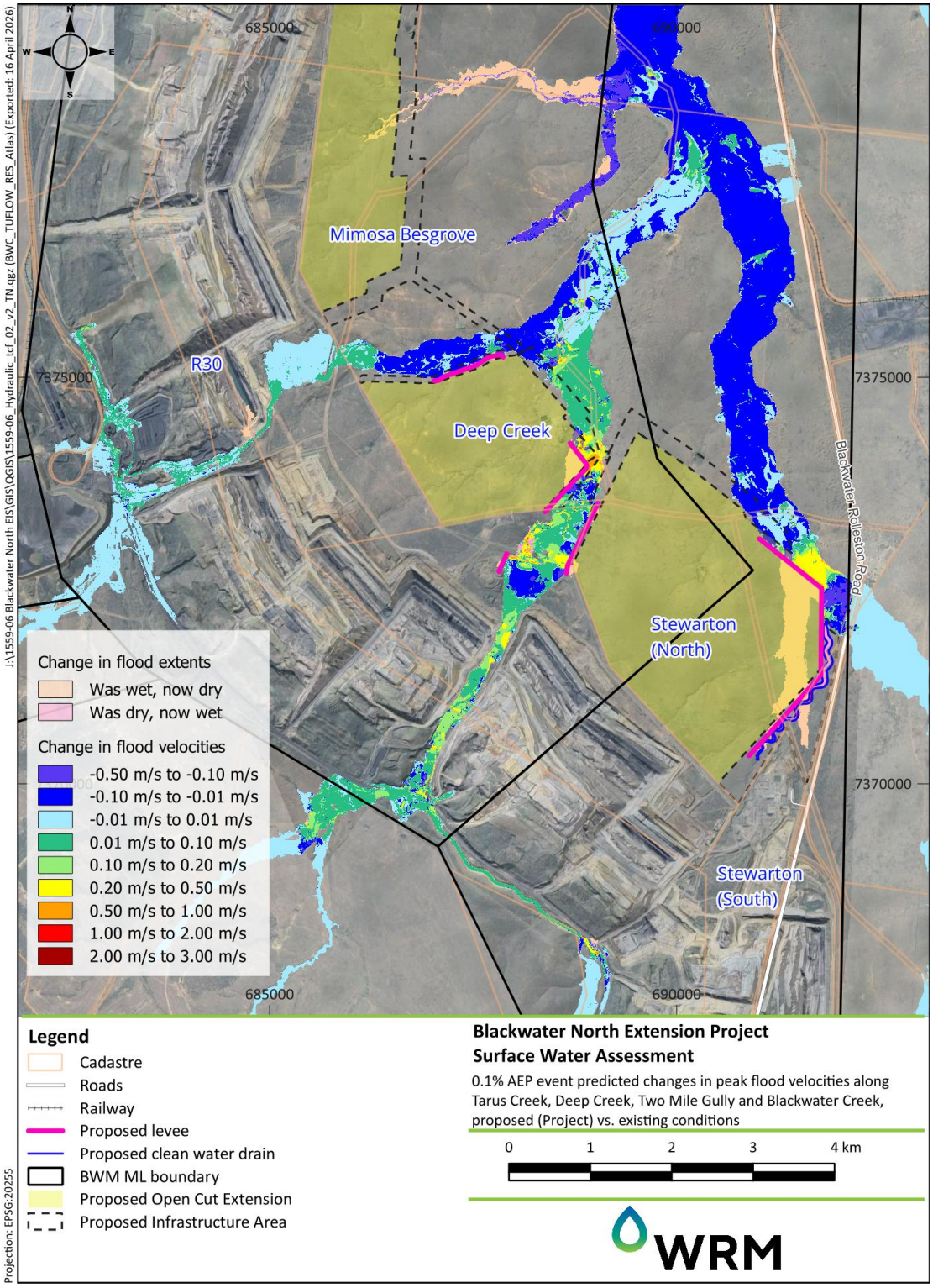


Figure 8.40 **0.1% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

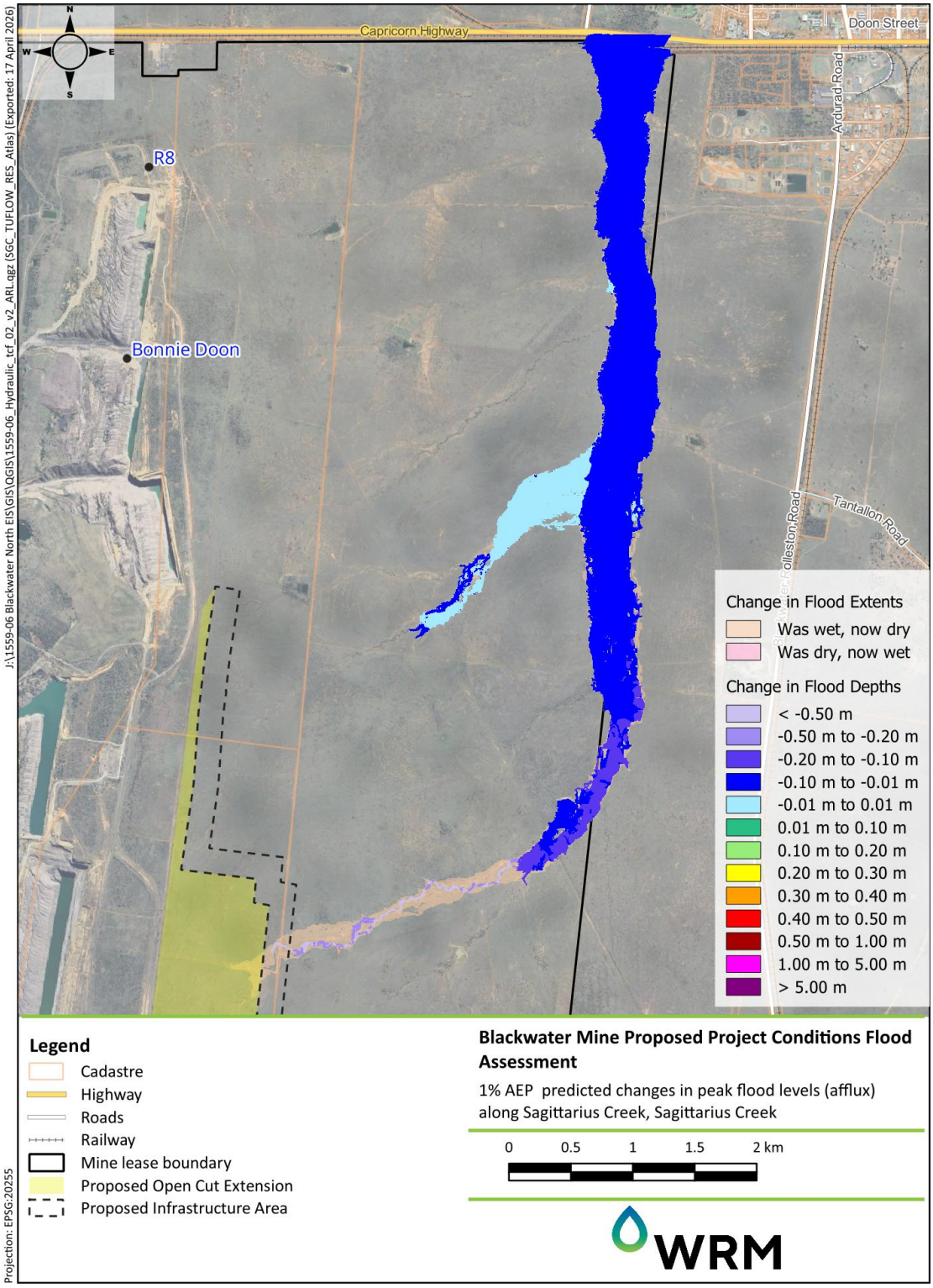


Figure 8.41 **1% AEP event predicted changes in peak flood levels (afflux), proposed (Project) vs. existing conditions, Sagittarius Creek**

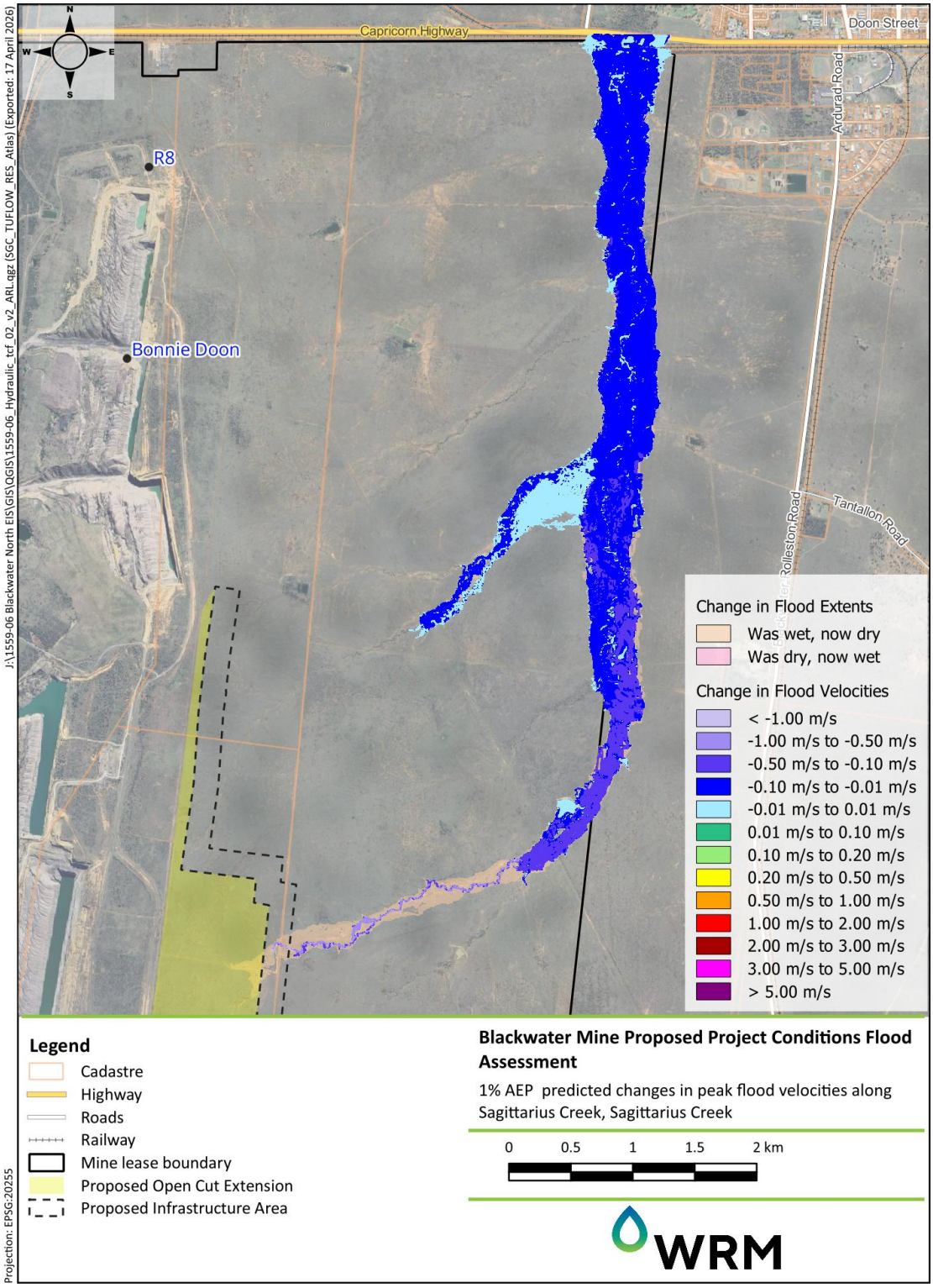


Figure 8.42 **1% AEP event predicted changes in peak flood velocities, proposed (Project) vs. existing conditions, Sagittarius Creek**

8.7 WATERWAY STABILITY ASSESSMENT

8.7.1 Overview

The TUFLOW hydraulic model results were analysed in more detail to assess:

- the potential impacts of increased flood velocities due to the Project (described in Section 8.6) on the channel stability including sediment transport characteristics of the existing creek channels in the vicinity of the Project; and
- the hydraulic characteristics of the proposed clean water drain (adjacent to and southeast of the Stewarton Pit expansion area).

The hydraulic assessment was undertaken based on guidance in *Criteria for Functioning River Landscape Units in Mining and Post Mining Landscapes* (Alluvium Consulting Australia Pty Ltd [Alluvium], 2014). The Alluvium (2014) guideline was developed for the design and assessment of watercourse diversions in the Bowen Basin region of Central Queensland.

The metrics used to assess channel hydraulic characteristics are velocities (in m/s) and stream power (in W/m^2). Stream power is defined in Alluvium (2014) as the rate of energy dissipation against the bed and banks of a river or stream and is used as a surrogate for sediment transport characteristics.

In line with the Alluvium (2014) guideline, channel hydraulic characteristics were assessed for the 50% AEP event (a representative small flow event) and the 2% AEP event (a representative large flow event), for existing and proposed (Project) conditions.

8.7.2 Hydraulic impact assessment of existing creek channels

Figure 8.43 shows locations of six representative creek sections (reaches) where channel hydraulic characteristics were assessed. Figure 8.43 also shows the predicted flood velocity impacts for the 2% AEP event. The six representative sections are described as follows:

- Section 1 – the existing Emu Creek Diversion;
- Section 2 – the Taurus Creek temporary diversion;
- Section 3 – Taurus Creek between the Deep Creek Pit and Stewarton North Pit;
- Section 4 – Taurus Creek downstream of the Deep Creek confluence;
- Section 5 – Two Mile Gully downstream of the Project area; and
- Section 6 – Two Mile Gully east of the Stewarton North pit.

Table 8.8 to Table 8.13 compare the statistical summaries of velocities and stream power along representative Sections 1 to 6 under existing and proposed (Project) conditions, for the 50% and 2% AEP design events. It should be noted that the velocities and stream power shown in Table 8.8 to Table 8.13 are section-averaged values along the six representative reaches.

The model results show that the 25^{th} to 75^{th} percentile range of velocities and stream power along all six representative sections would not be changed significantly as a result of the Project. The 25^{th} to 75^{th} percentile range of channel velocities and stream power would generally be increased by less than 5% and 10%, respectively, for the 39% AEP and 2% AEP events. Therefore, the erosion potential and sediment transport characteristics of the existing waterway channels under proposed (Project) conditions would be similar to existing conditions.

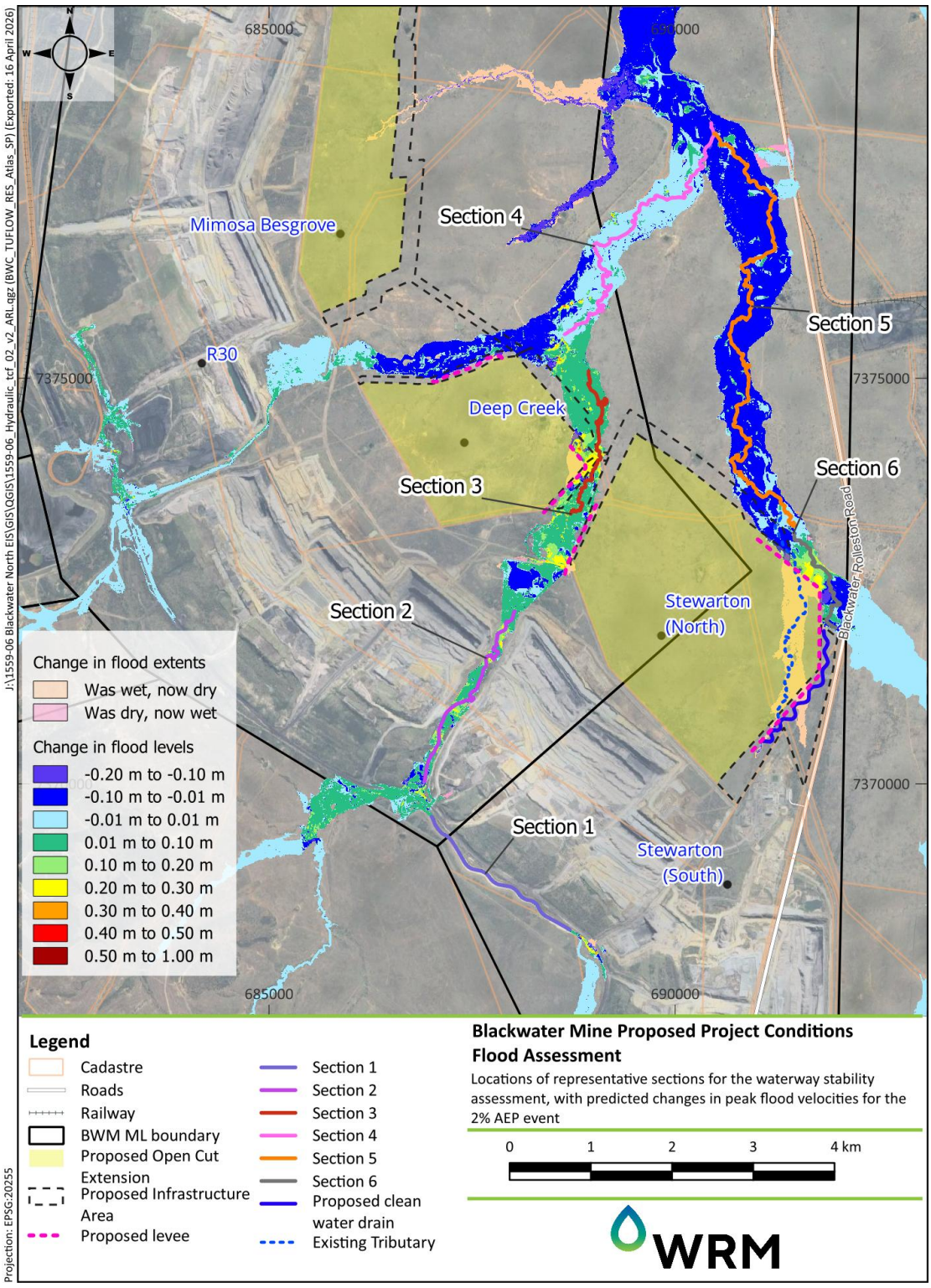


Figure 8.43 **Locations of representative sections for the waterway stability assessment, with predicted changes in peak flood velocities for the 2% AEP event**

Table 8.8 Comparison of velocities and stream power along Section 1 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 1			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	1.4	1.4	38.8	39.9
	50%ile	1.3	1.3	56.4	62.9
	75%ile	1.3	1.4	70.8	76.9
2% AEP	25%ile	2.1	2.1	115.1	118.6
	50%ile	1.9	1.9	150.2	154.6
	75%ile	2.0	2.1	193.2	198.6

Table 8.9 Comparison of velocities and stream power along Section 2 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 1			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.9	0.8	9.6	9.8
	50%ile	1.1	1.1	29.3	30.2
	75%ile	1.4	1.5	64.4	72.3
2% AEP	25%ile	0.9	0.9	14.8	16.4
	50%ile	1.4	1.4	53.0	57.5
	75%ile	1.9	2.0	139.5	156.8

Table 8.10 Comparison of velocities and stream power along Section 3 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 3			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	1.0	0.9	15.9	17.9
	50%ile	0.9	0.9	24.4	26.1
	75%ile	0.8	0.8	29.8	31.1
2% AEP	25%ile	0.9	1.0	19.5	20.4
	50%ile	0.8	0.8	31.9	32.3
	75%ile	0.7	0.7	39.7	39.7

Table 8.11 Comparison of velocities and stream power along Section 4 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 4			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.7	0.7	8.0	8.0
	50%ile	1.0	1.0	16.0	16.3
	75%ile	1.1	1.1	27.6	28.2
2% AEP	25%ile	0.7	0.7	7.0	7.0
	50%ile	1.0	1.0	19.3	19.3
	75%ile	1.2	1.2	35.7	35.7

Table 8.12 Comparison of velocities and stream power along Section 5 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 5			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.7	0.7	7.3	7.4
	50%ile	0.9	0.9	15.0	14.8
	75%ile	1.0	1.0	24.4	24.1
2% AEP	25%ile	0.8	0.8	9.1	9.1
	50%ile	1.1	1.1	21.2	20.9
	75%ile	1.3	1.3	38.1	37.5

Table 8.13 Comparison of velocities and stream power along Section 6 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 6			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.9	0.9	12.8	13.1
	50%ile	1.0	1.0	19.2	20.0
	75%ile	1.2	1.2	27.6	27.9
2% AEP	25%ile	0.8	0.9	8.5	9.4
	50%ile	1.1	1.1	24.2	23.2
	75%ile	1.3	1.4	39.5	43.0

8.7.3 Hydraulic assessment of the proposed clean water drain

8.7.3.1 Overview

The proposed clean water drain would realign an unnamed tributary of Two Mile Gully (referred to as the existing tributary), which is mapped as a second order stream. The existing tributary is not mapped as a watercourse per the Water Act. As such, a functional design assessment and report in accordance with the *Guideline: Works that interfere with water in a watercourse for a resource activity* (Department of Natural Resources, Mines and Energy, 2019) would not be required. Notwithstanding this, a hydraulic assessment was undertaken to assess the stability of the proposed clean water drain due to the following reasons:

- the proposed clean water drain potentially impacts flood flows to Two Mile Gully, which is a fourth order stream and considered a watercourse under the Water Act; and
- the proposed clean water drain would form a permanent feature of the final landform.

The concept design for the proposed clean water drain has been developed to support the environmental approvals for the Project. It is anticipated the design would be further optimised during Preliminary and Detailed Design prior to construction.

Figure 8.44 shows the proposed clean water drain channel extent configuration. Figure 8.45 shows a longitudinal section plot along the proposed clean water drain alignment. Figure 8.46 and Figure 8.47 show cross section plots along representative cross sections A-A and B-B, respectively (cross section locations are shown in Figure 8.44).

The proposed clean water drain will be a trapezoidal channel with base width of 5 m, a maximum top width of 65 m, 1V:5H (vertical rise to horizontal run) internal batter slopes and a longitudinal slope of 0.7%.

In comparison, the existing tributary (that the proposed clean water drain would replace), has a longitudinal slope of 0.35% to 0.61%. The existing tributary channel has a base width between <2 m and up to 5 m, with bank slopes of between 1V:5H to 1V:10H.

In summary, the proposed clean water drain is slightly steeper than the steepest section of the existing tributary that it would replace. The clean water drain channel shape generally would not replicate the existing tributary channel, which is due to the constraints of the site.

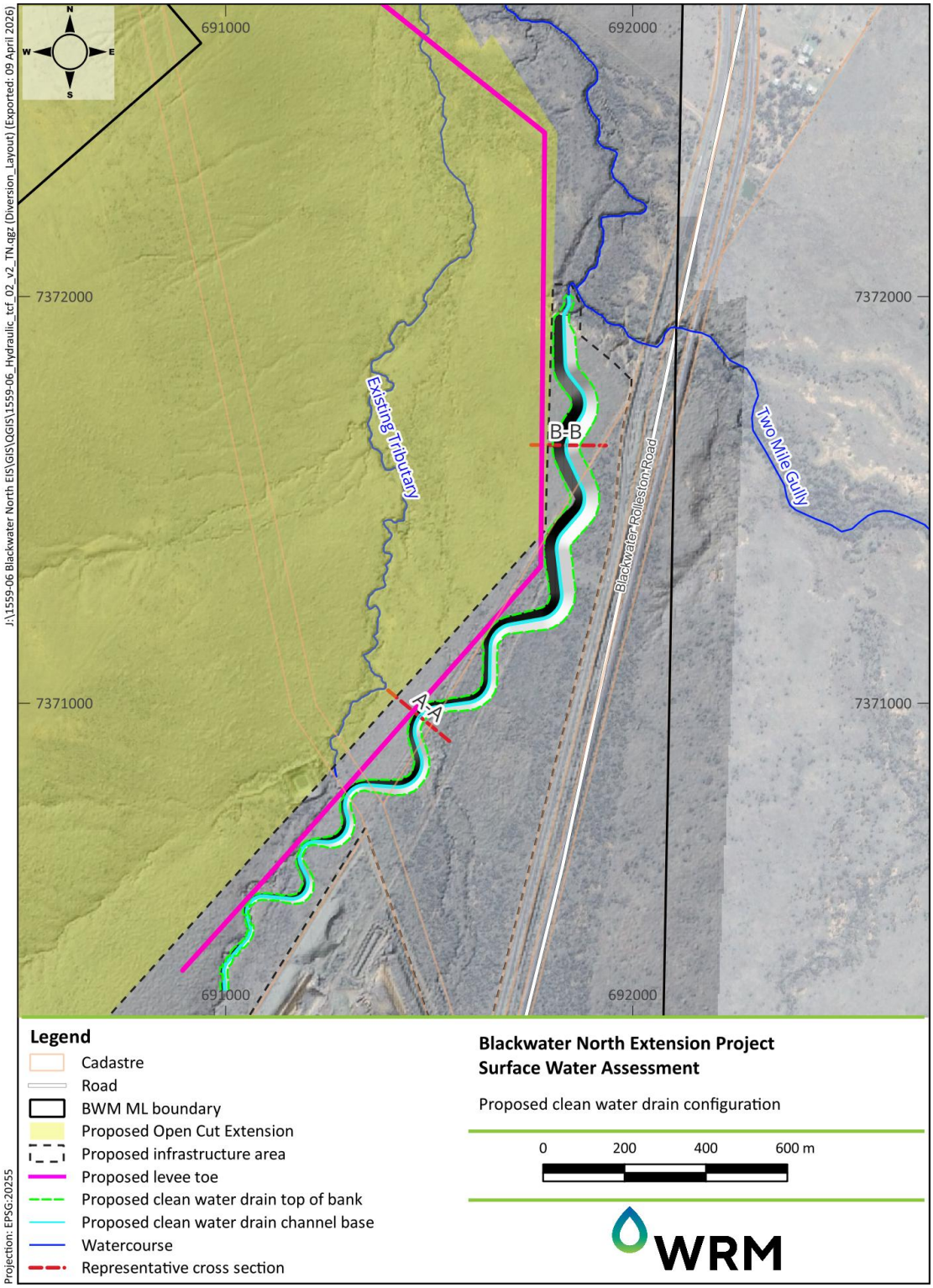


Figure 8.44 Proposed clean water drain configuration

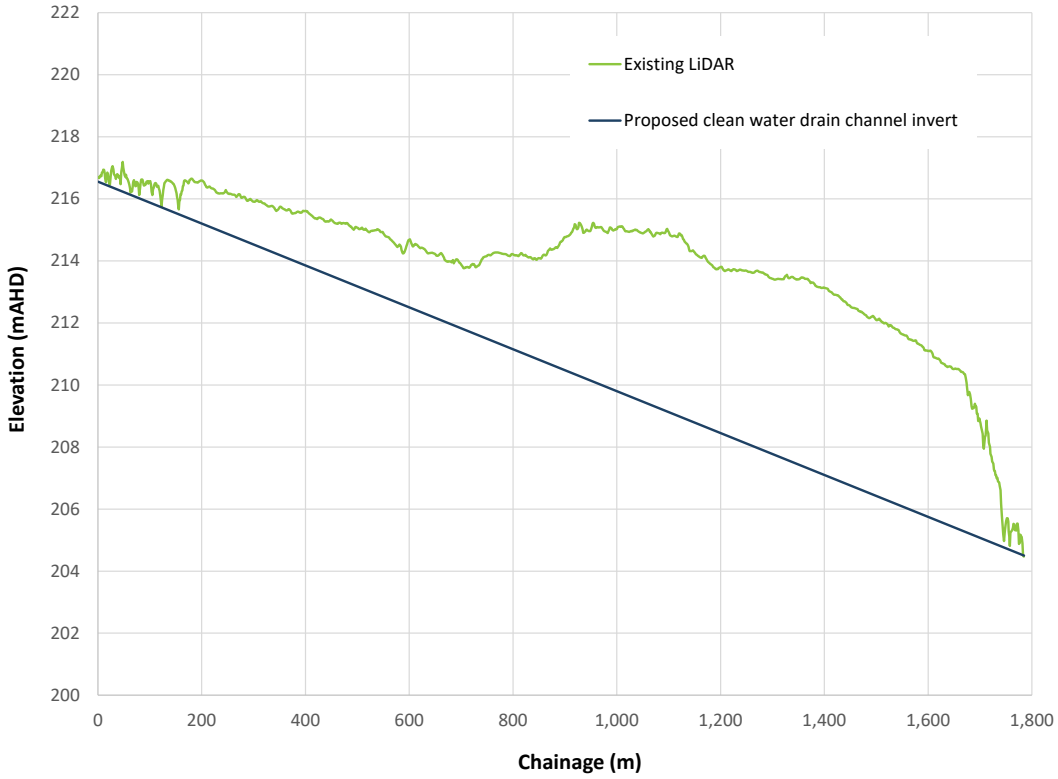


Figure 8.45 Longitudinal section plot along the proposed clean water drain alignment

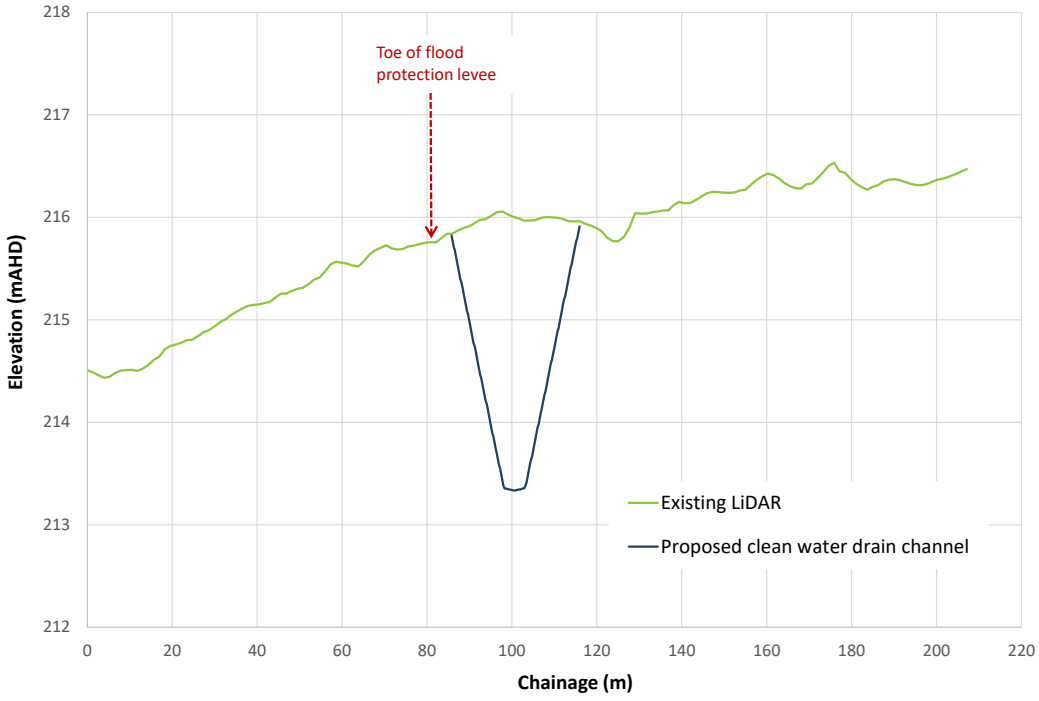


Figure 8.46 Proposed clean water drain cross section A-A (left to right in the direction of flow)

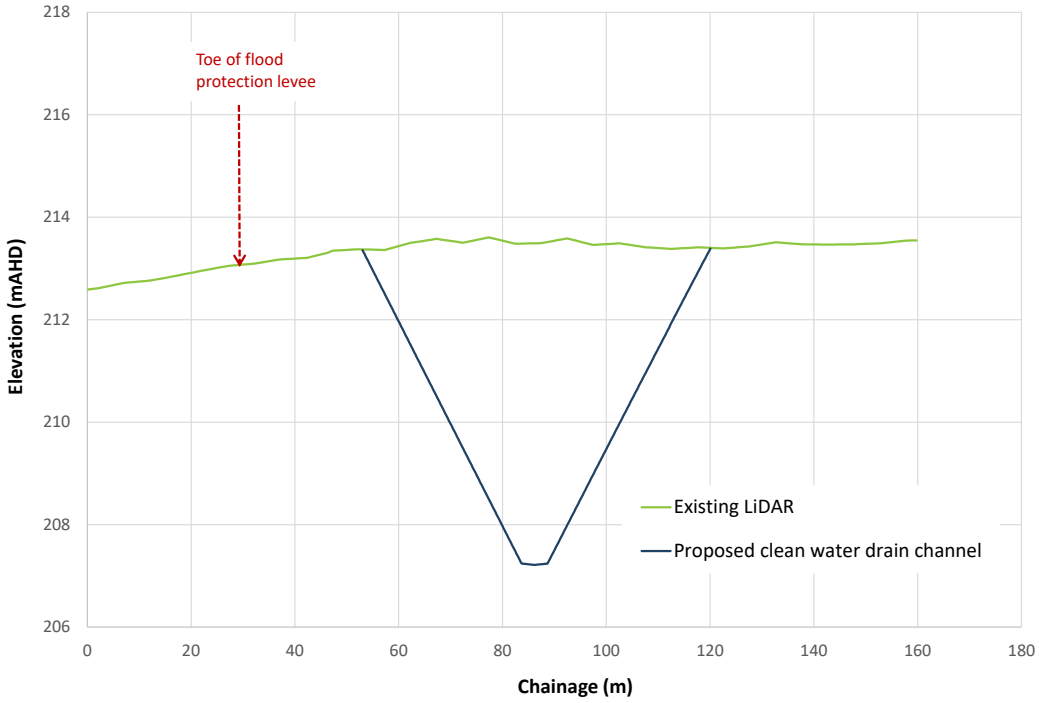


Figure 8.47 Proposed clean water drain cross section B-B (left to right in the direction of flow)

8.7.3.2 Hydraulic design criteria

Alluvium (2014) noted that sediment supply and bed load transport was found to be a critical factor in the performance of diversions. The volume of bed load sediment transported by a watercourse system is controlled by both the amount of sediment delivered to the watercourse and the capacity of the watercourse to transport sediment. Bed load transport in a watercourse can be broadly described as being either supply limited (can transport more sediment than is available) or transport limited (sediment supply exceeds transport capacity) (Alluvium, 2014).

For the purpose of constructed waterway diversion design, Alluvium (2014) recommends that mean reach stream power within a constructed waterway diversion lie within the ranges provided in Table 8.14. Further, Alluvium (2014) recommends that no cross section within a constructed waterway diversion exceed the adopted reach mean stream power by more than 50%.

Alluvium (2014) noted that a large proportion of natural watercourses in the Bowen Basin can be classified as transport limited with elevated and excess sediment supply available within the channel extent. Therefore, the mean reach stream power upper limits for transport limited alluvial streams given in Table 8.14, are applicable to the proposed clean water drain.

The proposed clean water drain would replace a section of the existing tributary during the operational phase of the Project and for the final landform. Therefore, velocities and stream power along the proposed clean water drain (under proposed [Project] conditions) were also compared against those within the existing tributary channel (under existing conditions).

Table 8.14 Mean reach stream power identified for sample stream reaches (Alluvium, 2014)

Stream type	Sediment transport group	Stream power (W/m²)	
		2-year Average Recurrence Interval (ARI) (1 in 1.44 AEP)	50-year ARI (1 in 50 AEP)
Alluvial	Supply limited (low sediment supply)	15 – 35	50 – 100
	Transport limited (high sediment supply)	35 – 60	80 – 150
Prevalent bedrock controls	n/a	50 – 100	100 – 350

8.7.3.3 Hydraulic assessment

Table 8.15 compares the statistical summaries of velocities and stream power along the existing tributary (under existing conditions) and the proposed clean water drain (under proposed [Project] conditions), for the 50% and 2% AEP design events. In the absence of hydraulic modelling for the 2 year ARI (1 in 1.44 AEP) event, the 50% (1 in 2) AEP hydraulic model results were assessed against the 2 year ARI (1 in 1.44 AEP) design criteria in the Alluvium (2014) guideline.

The model results show that the mean and maximum stream power along the proposed clean water drain are within the Alluvium (2014) design criteria for the 2 year ARI (1 in 1.44 AEP) event (35 - 60 W/m^2) and the 50 year ARI (1 in 50 AEP) event (80 – 150 W/m^2), based on transport limited alluvial streams. Therefore, the proposed clean water drain would satisfy the Alluvium (2014) design criteria.

Compared to the hydraulic characteristics of the existing tributary, predicted velocities and stream power in the proposed clean water drain would be higher. This is due to the significant constriction of the floodplain compared to existing conditions. As shown in Figure 8.43, a large proportion of flood flows along the existing tributary would be conveyed along the floodplain, with only a small proportion being conveyed within the existing tributary channel. The design of the clean water drain may be revised during Detailed Design, so that the hydraulic characteristics of the proposed clean water drain can better replicate the existing tributary's hydraulic behaviour.

Whilst the proposed clean water drain cannot replicate the hydraulic characteristics of the existing tributary, predicted velocities and stream power along the proposed clean water drain are well below the Alluvium (2014) upper limits of velocities and stream power for transport limited streams. Therefore, the proposed clean water drain is expected to be a stable and self-sustaining structure during the operational phase of the Project and post-closure. The design of the clean water drain would be improved during Detailed Design.

Table 8.15 Comparison of velocities and stream power along the existing tributary and the proposed clean water drain, 50% and 2% AEP design events

Event	Statistic	Velocity and stream power along the existing tributary and proposed clean water drain				Alluvium (2014) stream power thresholds (W/m²)	
		Velocity (m/s)		Stream power (W/m²)			
		Existing tributary	Proposed clean water drain	Existing tributary	Proposed clean water drain	Supply limited alluvial stream (low sediment supply)	Transport limited alluvial stream (high sediment supply)
50% AEP	25%ile	0.5	1.0	3.0	25.2	15 – 35 [a]	35 – 60 [a]
	50%ile	0.6	1.1	6.2	35.3		
	75%ile	0.8	1.2	11.9	44.9		
	Mean	0.8	1.1	9.3	34.1		
	Max.	1.2	1.3	42.9	75.7		
2% AEP	25%ile	0.7	1.3	8.1	44.4	50 – 100	80 – 160
	50%ile	0.8	1.4	14.9	56.4		
	75%ile	1.1	1.6	26.8	75.5		
	Mean	1.0	1.4	20.5	56.2		
	Max.	1.7	1.7	91.2	107.1		

[a] – Alluvium (2014) provides stream power thresholds for the 2 year ARI event (equivalent to a 39% AEP event). The 50% AEP event hydraulic model results were used as a proxy for the 2 year ARI (39% AEP) event.

8.8 FINAL LANDFORM FLOOD ASSESSMENT

8.8.1 Final landform configuration

Figure 8.48 to Figure 8.50 show the proposed final landform configuration and the extent of flooding for the 1% AEP, 0.1% AEP and PMF design flood events, respectively. The final landform for the Project would include five residual voids as previously described in Section 7.1.

- The final landform around the final voids would be constructed to prevent floodwater from entering. The temporary flood protection levees (in place during mining) adjacent to the Ramp 30, Deep Creek and Stewarton North pits would be removed such that the rehabilitated out-of-pit overburden areas would prevent floodwater from entering the voids.
- The landform features around the proposed voids would be constructed to be at least 60 m wide at the crest.
  - For the Ramp 30 void, the landform feature would have a crest height above the adjacent 0.1% AEP peak flood level in Deep Creek.
  - For the Mimosa/Besgrove, Deep Creek, and Stewarton North and Stewarton South voids, the landform feature would have a crest height above the adjacent PMF peak flood level.
- At the end of mining, the south-eastern corner of the Deep Creek void would be backfilled. As a result, the toe of the landform at this location would be located further away from Deep Creek compared to the maximum Deep Creek Pit extent during operations. This approach provides additional floodplain conveyance for the final landform compared to mining stage.
- Similarly, the south-eastern corner of the Stewarton North pit would be backfilled and as a result, the toe of the landform at this location would be located further away from Taurus Creek

compared to the maximum Stewarton North Pit extent during operations. In addition, the proposed clean water drain described in Section 8.7.3 would be retained for the final landform.

- It is assumed that the final landform, including the out-of-pit overburden dumps, would be rehabilitated to achieve at least 70% vegetal cover (in line with Whitehaven Blackwater's rehabilitation schedule), using erosion resistant materials at the toe of the landform that would be in contact with floodwater.

8.8.2 Assessment methodology

Hydraulic modelling was undertaken for the 1% AEP, 0.1% AEP and PMF design flood events under proposed final landform conditions, and for the SSP2-4.5 (year 2100) future climate scenario.

A summary of the model results is presented in the following sections, focusing on the flood immunity of the proposed voids and the risk of erosion and scour in the vicinity of the proposed final voids and sections of rehabilitated dump landform in contact with floodwater.

8.8.3 Peak flood levels, depths, extents and velocities

Figure 8.48 to Figure 8.50 show the predicted peak flood extents, levels and depths along Taurus Creek, Two Mile Gully, Emu Creek and Deep Creek in the vicinity of the final landform, for the 1% AEP, 0.1% AEP and PMF events. Figure 8.51, Figure 8.52 and Figure 8.53 show the corresponding peak velocities.

The model results indicate that:

- The Mimosa/Besgrove void would be located outside of the riverine flood extents in Sagittarius Creek for all flood events up to the PMF.
- The Deep Creek, Stewarton North and Stewarton South voids would have immunity from flooding for all events up to and including the PMF.
- The Ramp 30 void would have immunity from flooding for all events up to and including the 0.1% AEP event. Floodwater ingress into the Ramp 30 voids is predicted to occur during the PMF event. The predicted depths of overtopping during the PMF event vary at approximately 0.25 m on average up to a maximum of 1 m above the crest of the landform.
- The model predicted flood velocities along the toe of the proposed flood protection landform adjacent to the voids for all events up to 0.1% AEP are as follows:
  - Adjacent to the Ramp 30 void, flood velocities are generally <1 m/s, with higher velocities contained within creek channel further away from the landform.
  - Adjacent to the Deep Creek void, flood velocities are generally <0.5 m/s, with velocities of up to 1.6 m in some sections.
  - Adjacent to the Stewarton void, flood velocities along the Two Mile Gully floodplain range between <0.4 m/s and up to 1.3 m/s.
- Flood velocities along the toe of rehabilitated dumps (adjacent to Deep Creek, Taurus Creek and Emu Creek) are generally <2 m/s for events up to 0.1% AEP.

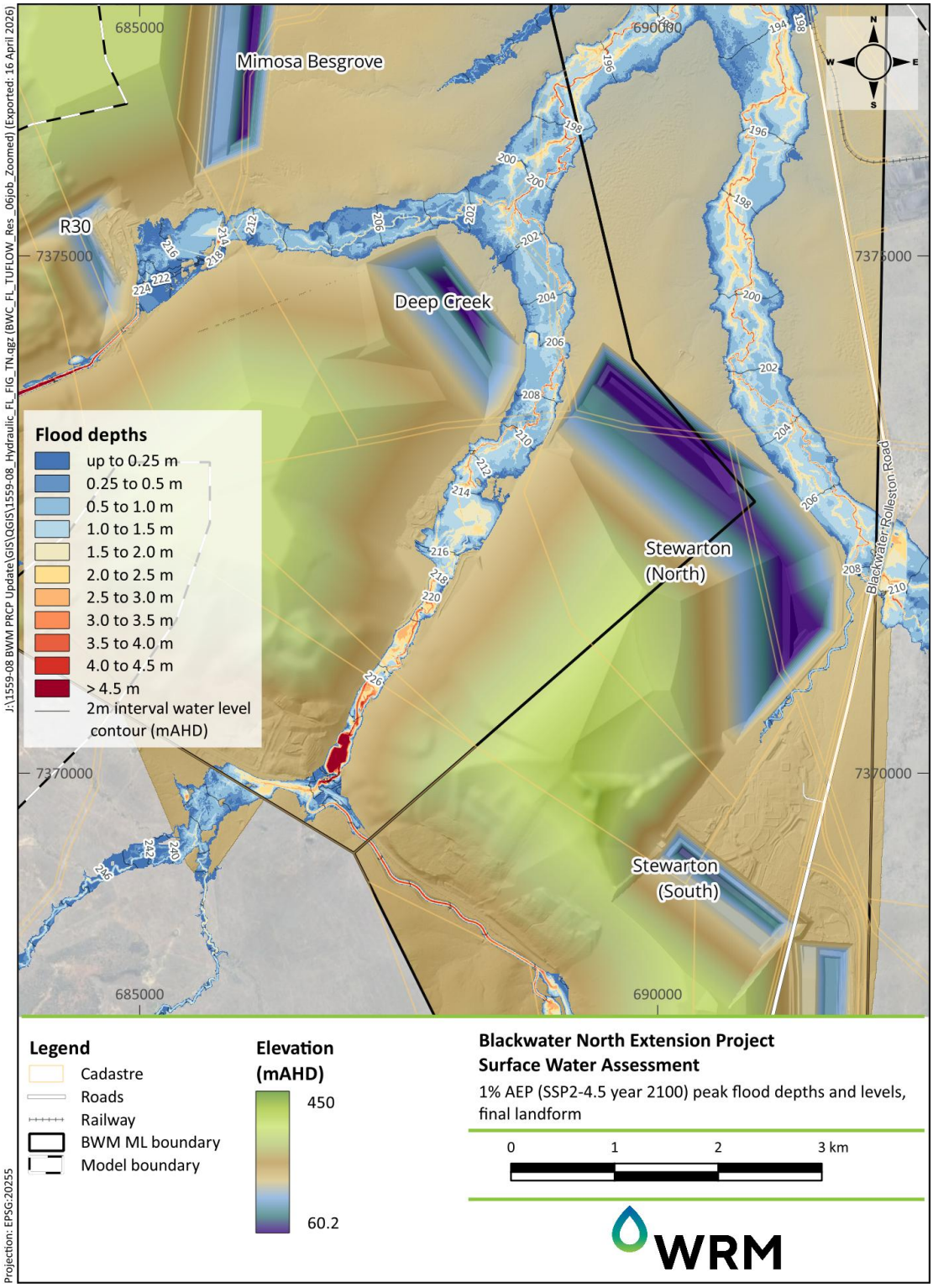


Figure 8.48 1% AEP (SSP2-4.5 year 2100) peak flood depths and levels, final landform

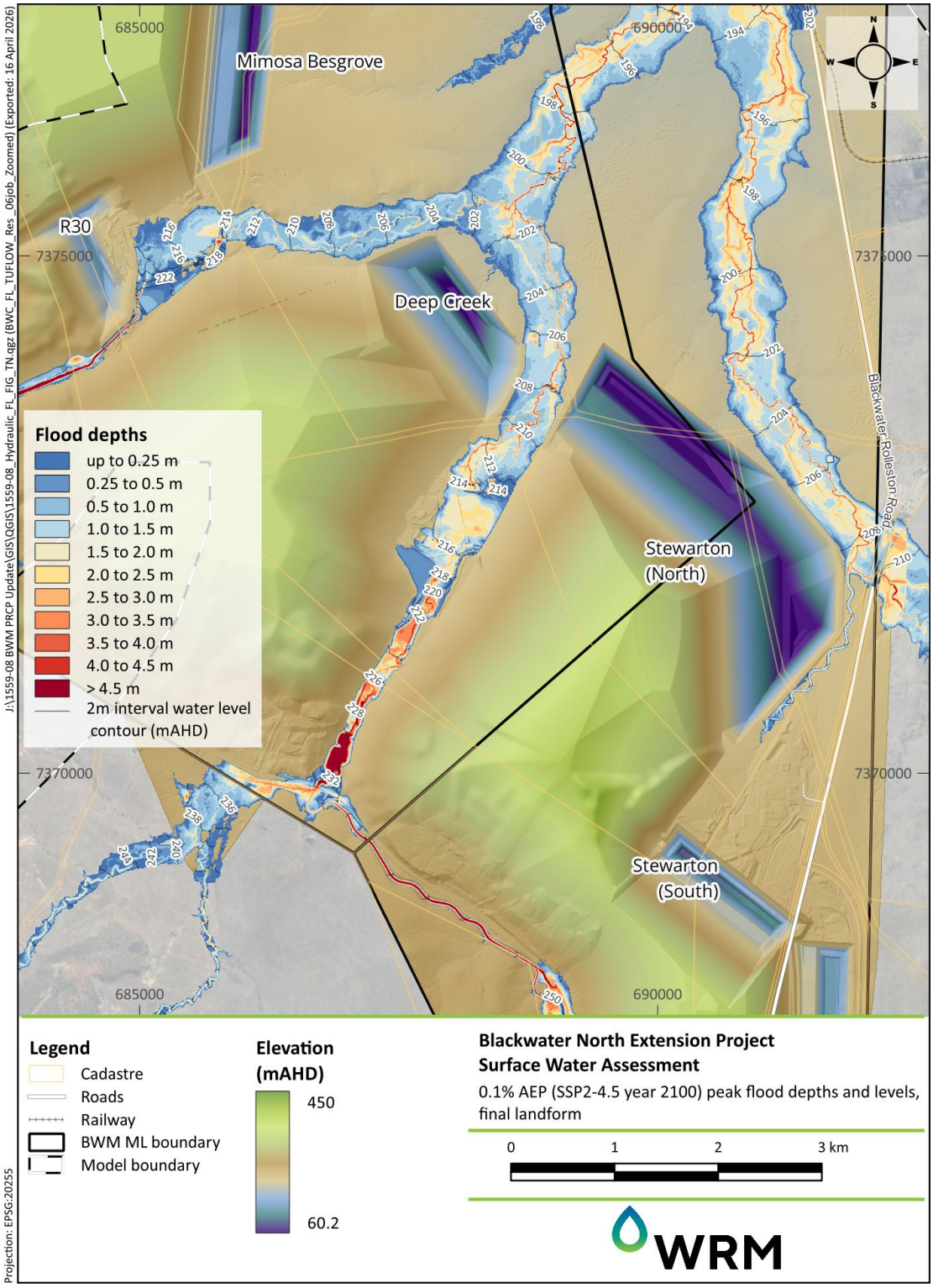


Figure 8.49 0.1% AEP (SSP2-4.5 year 2100) peak flood depths and levels, final landform

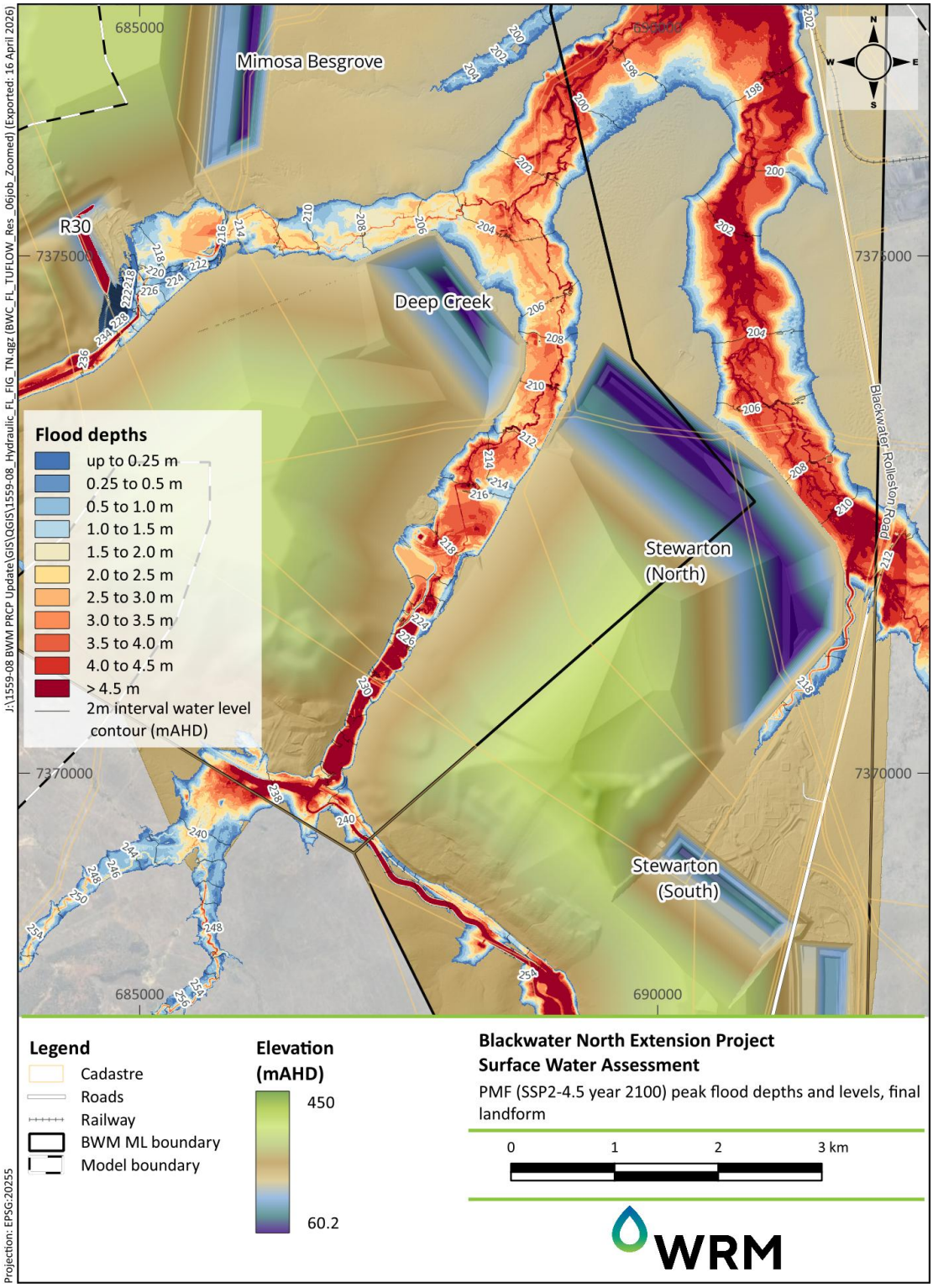


Figure 8.50 PMF (SSP2-4.5 year 2100) peak flood depths and levels, final landform

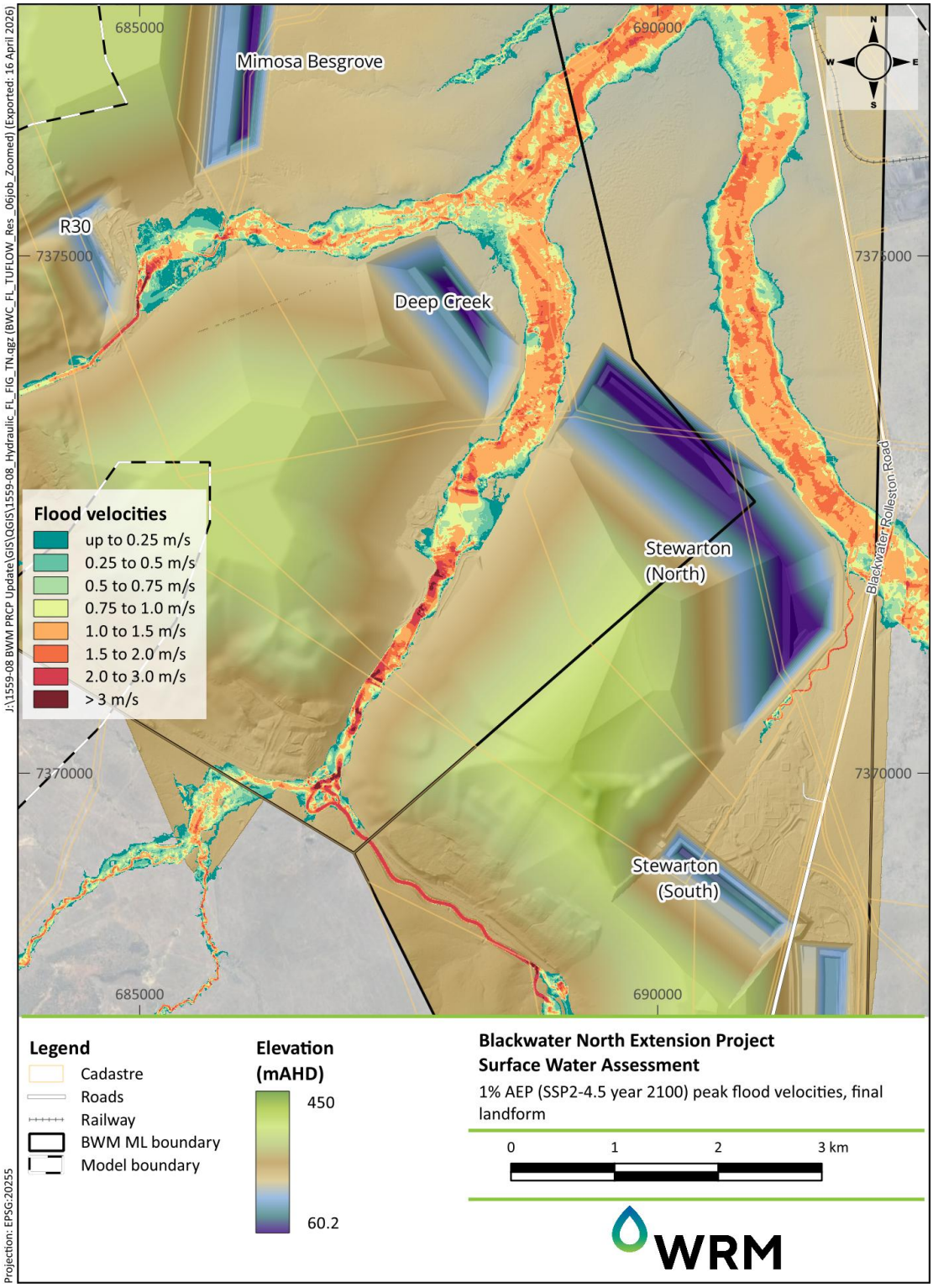


Figure 8.51 1% AEP (SSP2-4.5 year 2100) peak flood velocities, final landform

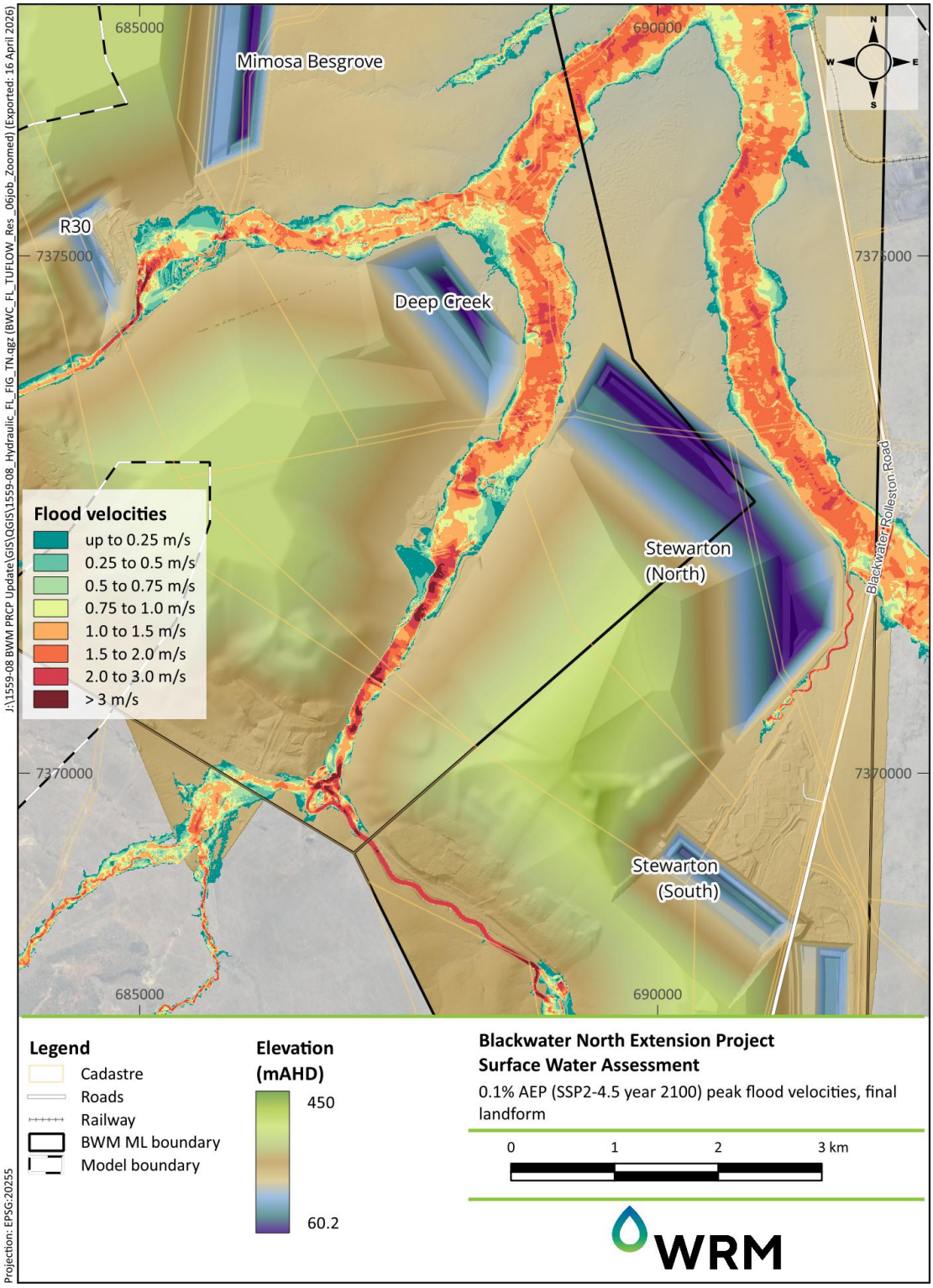


Figure 8.52 0.1% AEP (SSP2-4.5 year 2100) peak flood velocities, final landform

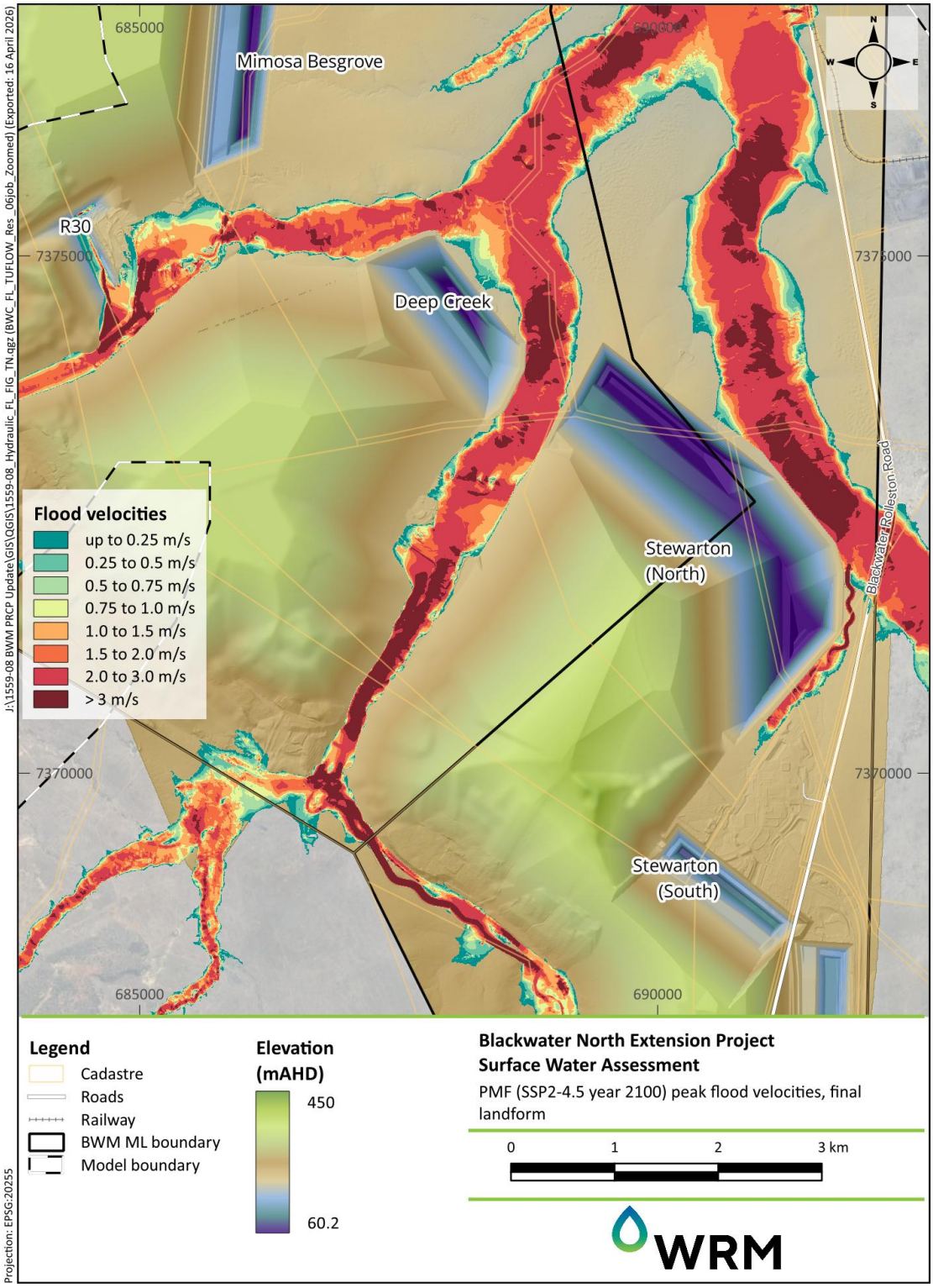


Figure 8.53 PMF (SSP2-4.5 year 2100) peak flood velocities, final landform

8.8.4 Risk of erosion and scour

The risk of erosion on the post-mining rehabilitated landform was assessed by comparing the model-predicted flood velocities adjacent to the final landform against the maximum allowable velocity threshold given in *Book 4 – Best Practice Erosion and Sediment Control* guideline (International Erosion Control Association [IECA], 2008).

Table 8.16 shows the maximum allowable velocities for bare earth and grassed channels obtained from IECA (2008), which are considered applicable to rehabilitated landform surfaces subjected to flooding.

Table 8.16 Adopted criteria for maximum allowable velocities adjacent to rehabilitated landform in contact with floodwater, adopted from IECA (2008)

Channel gradient (%)	Percentage of stable vegetal cover			
	0%	50%	70%	100%
Erosion resistant soils:				
1	0.7	1.6	2.1	2.8
2	0.6	1.4	1.8	2.5
3	0.5	1.3	1.7	2.4
4		1.3	1.6	2.3
5		1.2	1.6	2.2
6			1.5	2.1
8			1.5	2.0
10			1.4	1.9
15			1.3	1.8
20			1.3	1.7
Easily eroded soils:				
1	0.5	1.2	1.5	2.1
2	0.5	1.1	1.4	1.9
3	0.4	1.0	1.3	1.8
4		1.0	1.2	1.7
5		0.9	1.2	1.6
6			1.1	1.6
8			1.1	1.5
10			1.1	1.5
15			1.0	1.4
20			0.9	1.3

2.1 – Adopted velocity threshold above which flood-induced erosion would likely occur

It is assumed that the final landform achieves at least 70% vegetative cover, combined with the use of erosion resistant materials at the toe of the landform, that would be in contact with floodwater during flooding. The topographic gradient along the toe of the landform, in the direct flow, would be <1% in general.

On this basis of the above, the risk of flooding-induced erosion of the rehabilitated landform is expected to be low for velocities up to 2.1 m/s at the toe of the landform in contact with floodwater. Flood velocities towards the centre of the floodplain are generally higher than at the toe of the rehabilitated landform, but these higher velocities would not trigger erosion of the landform itself.

As described in Section 8.8.3, velocities adjacent to the final voids and rehabilitated dump landform are lower than the adopted maximum allowable velocity (2.1 m/s) from IECA (2008). Therefore, the final landform is expected to be stable during flood events up to the 0.1% AEP event.

9 CATCHMENT EXCISION ANALYSIS

9.1 OVERVIEW

The Project would involve an expansion of the mining pits, which would result in the loss of undisturbed catchment reporting to Taurus Creek and Sagittarius Creek. The following sections describe impact of the predicted catchment loss on:

- flow regime in the waterways in the vicinity of the Project; and
- fine sediment and nutrient loads to the GBR catchment waters.

9.2 CATCHMENT LOSS

Figure 9.1 shows the existing Taurus Creek catchment (to Taurus Creek D/S gauge), the existing Sagittarius Creek catchment (to the northern ML boundary) and the existing Two Mile Gully catchment to the Blackwater-Rolleston Road. Figure 9.1 also shows the portions of the existing Taurus Creek and Sagittarius Creek catchments that would be lost as a result of the Project during mining. The changes in catchment areas between existing and proposed (Project) conditions are tabulated in Table 9.1.

The Project would involve an extension of the open cut pit footprint towards the east, which would reduce the Taurus Creek and Sagittarius Creek catchments during mining, as a greater portion of undisturbed land would drain to the open cut pits.

The Project, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and a 7.9% reduction in the Sagittarius Creek catchment compared to existing conditions.

Table 9.1 Analysis of catchment loss due to the Project

Catchment	Catchment area (km^2)		Difference (%)
	Existing conditions	Project conditions	
Taurus Creek to Taurus Creek D/S gauge	250.4	228.2	-8.9
Sagittarius Creek to northern ML boundary	42.7	39.3	-7.9

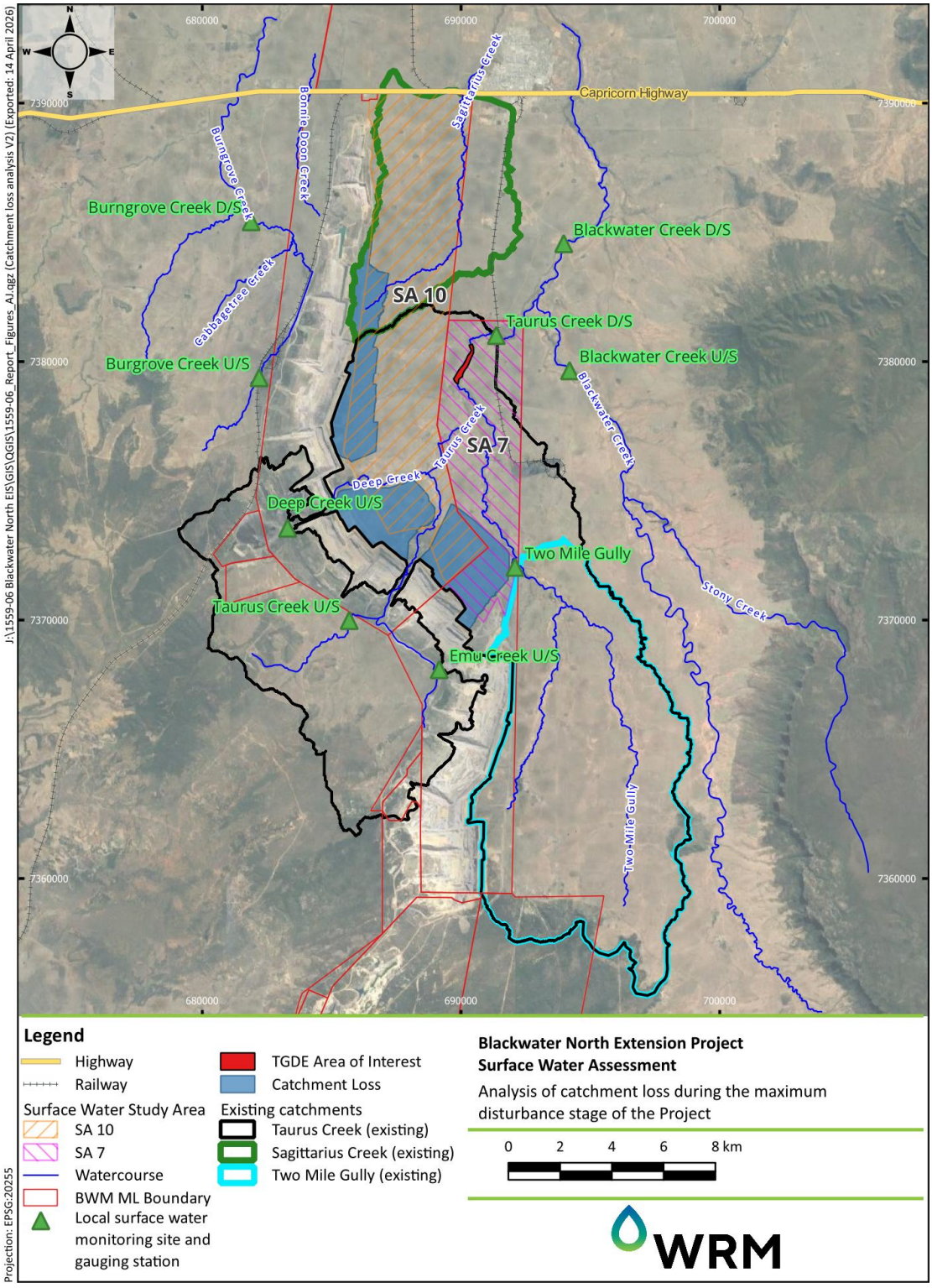


Figure 9.1 Analysis of catchment loss during the maximum disturbance stage of the Project

9.3 IMPACTS ON FLOW REGIME

9.3.1 Taurus Creek

Figure 9.2 shows the derived existing conditions flow-duration relationship for Taurus Creek at the Taurus Creek D/S gauge, based on recorded stream flow data at this gauge. Figure 9.2 also shows the Project conditions flow-duration relationship, which was derived by factoring the recorded flows based on the loss of catchment to the Taurus Creek D/S gauge.

Figure 9.2 shows that Taurus Creek is ephemeral, with flows <0.1 ML/d occurring <19% of the time and flows >1 ML/d occurring <10% of the time. Figure 9.2 also shows the impact of the Project on the magnitude of flows in Taurus Creek is insignificant.

Figure 9.2 also shows the location of an identified Terrestrial Groundwater Dependent Ecosystems (TGDE). The Taurus Creek D/S gauge is located just downstream of the TGDE area of interest and as such, the flow-duration relationship at this gauge is representative of flow characteristics at the TGDE area of interest. The *Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment* (DPM Enviroscences Pty Ltd, 2026) noted that based on the insignificant impact on Taurus Creek flow regime predicted in this surface water assessment, the TGDEs of the Study area are unlikely to be affected by the Project.

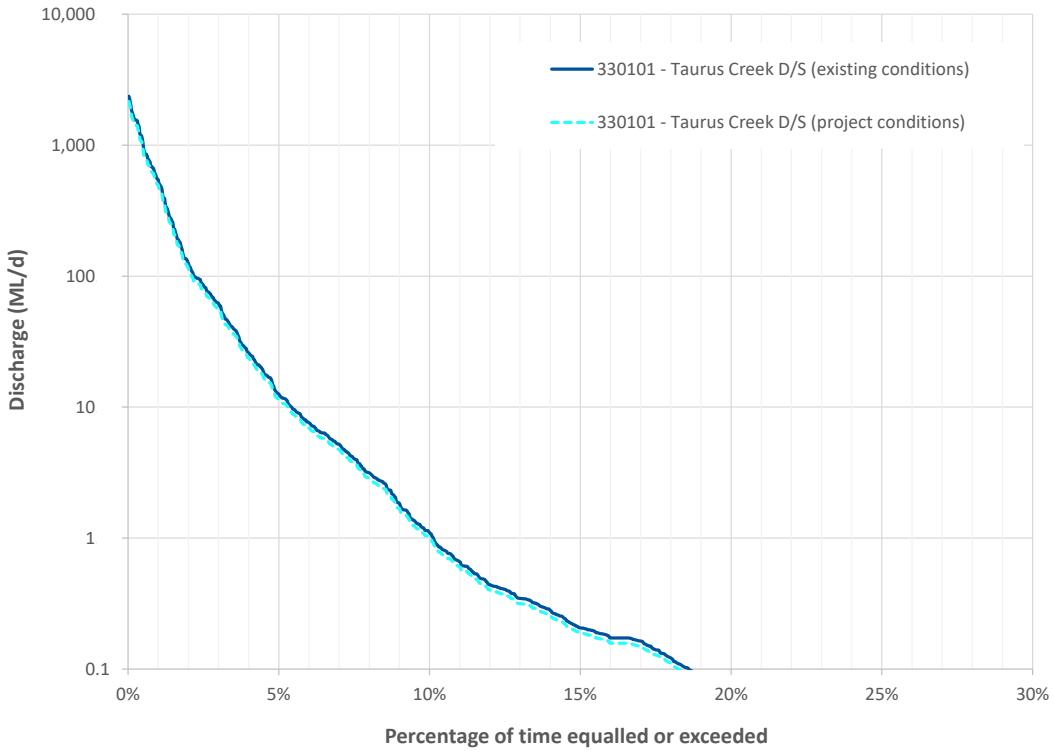


Figure 9.2 Derived flow-duration relationship for Taurus Creek at the Taurus Creek D/S gauge (existing vs. Project conditions)

9.3.2 Two Mile Gully

Figure 9.3 shows the derived existing conditions flow-duration relationship for Two Mile Gully at the Two Mile Gully gauge, based on recorded stream flow data at this gauge.

Figure 9.3 shows that Two Mile Gully is ephemeral, with flows >0.1 ML/d occurring less than 10% of the time and flows >1 ML/d occurring less than 6% of the time. The Two Mile Gully catchment to this gauge would not be changed as a result of the Project, hence the flow regime in Two Mile Gully would be unaffected by the Project.

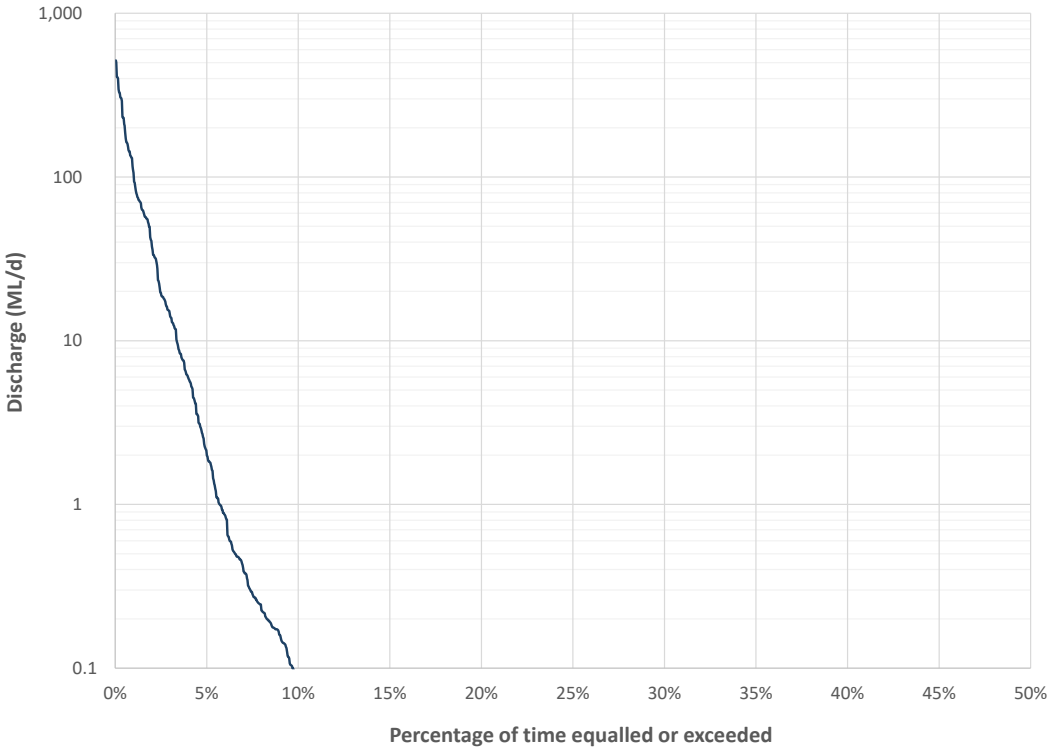


Figure 9.3 Derived flow-duration relationship for Two Mile Gully

9.3.3 Sagittarius Creek

Recorded stream flow data in Sagittarius Creek is not available to generate a data-based flow-duration relationship. Sagittarius Creek is likely to be ephemeral, behaving similarly to Taurus Creek and Two Mile Gully and would only flow after significant rain events.

The predicted percentage loss of Sagittarius Creek catchment due to the Project is similar to, and slightly smaller than, the predicted loss of Taurus Creek catchment (refer to Table 9.1). On this basis, the impact on flow regime in Sagittarius Creek due to the Project is expected to be similar to those predicted in Taurus Creek and is likely to be insignificant.

10 ASSESSMENT OF SURFACE WATER IMPACTS, MITIGATION AND MANAGEMENT MEASURES

The following sections describe the key potential water management risk and mitigation measures.

10.1 IMPACT ON FLOW REGIME

The Project would result in minor alterations to flow regimes in the local creeks, primarily due to the loss of catchment area draining to Taurus Creek and Sagittarius Creek resulting from the expansion of the mining pits.

The impacts on flow regime in Taurus Creek and Sagittarius Creek are insignificant, and the Project would not impact on flow regime in Two Mile Gully.

The loss of catchment area due to the Project would occur in the middle reaches of Taurus Creek, while the headwaters of the Taurus Creek catchment would be unaffected by the Project. As a result, the duration and frequency of flows would not be materially changed.

10.2 IMPACT ON WATER QUALITY

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of MAW. Surface water management measures include separation of clean and contaminated water, ESC structures, operational water balance controls, and TARPs to prevent uncontrolled releases.

10.2.1 Impact of controlled releases

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

The controlled release of MAW is restricted by the EA release conditions (Schedule F) and relevant WQOs. Water balance modelling results indicate that:

- The approved controlled release strategy is sufficient for maintaining excess MAW volumes at BWM during the operational phase of the Project.
- Compared to the Approved operations, the water balance modelling results indicate that the Project would result in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

Controlled releases under Schedule F of the EA would only occur when receiving waterways have recorded a natural flow event in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

An assessment of potential controlled-release rates and dilution requirements has been undertaken for RP2 and RP3 (discharging to Blackwater Creek) and RP4 (discharging to Two Mile Gully). The assessment results demonstrate that the allowable release rate reduces as the EC of the release water increases. At higher receiving-stream flows, the achievable discharge rate would be constrained by the capacity of the release infrastructure rather than the calculated receiving-stream dilution capacity. Consequently, the dilution achieved under these conditions would generally be greater than the minimum values presented in the assessment.

The assessment demonstrates that controlled releases can be managed by adjusting the combined release rate in response to:

- the measured receiving-stream flow;
- the receiving-stream EC;
- the EC of the water proposed for release;
- the applicable downstream EC limit; and
- the hydraulic capacity of the release infrastructure.

BWM's current and proposed controlled-release strategy is to monitor receiving-stream flow, EC and pH at the relevant stream gauges and manage the release rate accordingly. The release flow rates are adjusted based on predictions from a RCM that BWM maintain onsite.

During a controlled release, downstream flow, EC and pH are monitored against compliance limits using automated remote telemetry stations which record data in near-real time. The release rate is reduced, or the release is ceased, based on a combination of RCM predictions and real time monitoring results where monitoring indicates that the applicable flow or water-quality trigger is being approached or exceeded.

10.2.2 Impact of uncontrolled releases

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways. The proposed eastward expansion of existing pits would result in catchment changes that are confined to the expanding pits, which drain internally. The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge. Additionally, the Project does not modify the catchments of NTCD or NDCD, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

In conclusion, the Project is unlikely to substantially affect the quality of surface waters in receiving environments compared to current conditions and the Approved operations.

10.3 IMPACT ON DOWNSTREAM WATER USERS

Given the ephemeral nature of the local waterways in the vicinity of the Project as well as the insignificant impacts on flow regime and water quality in these waterways compared to the approved operations, there would not be any downstream water users that would be impacted by the Project.

10.4 IMPACT ON FLOODING

10.4.1 Flood impacts during mining

Flooding impacts from the Project during mining were assessed for events up to 0.1% AEP. The results show that:

- There would no ingress of floodwater into the mining pits for all events up to the 0.1% AEP design event with the construction of the proposed temporary flood protection levees.
- Predicted increases in peak flood levels are generally minor and mostly contained to the lease area for all events up to 0.1% AEP. There are minor localised off lease impacts upstream of BWM. There are no predicted increases in peak flood levels and events at existing dwellings/homesteads in the vicinity of the Project area.
- Predicted peak velocities on the floodplain remain within acceptable limits.
- The Project is not expected to result in a material change to flood behaviour downstream of the Project.

10.4.2 Waterway stability

Hydraulic modelling results show that the erosion potential and sediment transport characteristics of the existing waterway channels under proposed (Project) conditions would be similar to existing conditions.

The hydraulic characteristics of the proposed clean water drain were analysed, and the results are as follows:

- Compared to the hydraulic characteristics of the existing tributary, predicted velocities and stream power in the proposed clean water drain would be higher. This is due to the significant constriction of the floodplain compared to existing conditions.
- The predicted velocities and stream power along the proposed clean water drain are well below the Alluvium (2014) upper thresholds of velocities and stream power for transport limited streams. Therefore, the proposed clean water drain is expected to be a stable and self-sustaining structure during the operational phase of the Project and post-closure. The design of the clean water drain would be refined during Detailed Design, prior to construction.

10.4.3 Flooding for the final landform

Flooding for the final landform was assessed for a range of events up to the PMF. The results show that:

- There would be no ingress of floodwater into the Mimosa/Besgrove, Deep Creek, Stewarton North and Stewarton South voids for all events up to and including the PMF.
- There would no ingress of floodwater into the Ramp 30 void for all events up to and including the 0.1% AEP event.
- Predicted peak velocities adjacent to the final landform are non-erosive. Therefore, the final landform is expected to be stable and self-sustaining post-closure from a flood perspective.

10.5 IMPACT ON GREAT BARRIER REEF CATCHMENT WATERS

10.5.1 Overview

A separate SWA memorandum has been prepared to support a Referral for the Project under the EPBC Act (WRM, 2026). This memorandum (provided in Appendix C) specifically addresses the potential for the Project to result in surface water impacts on the GBR. The key findings of the WRM (2026) have been summarised below.

10.5.2 Contribution of sediments to the GBR due to specific land uses

The 2022 Scientific Consensus Statement (Prosser, 2024) investigated how much anthropogenic sediment and particulate nutrients are exported from GBR catchments, the most important characteristics of anthropogenic sediments and particulate nutrients and the primary sources. The findings in Posser (2024) are summarised below.

Concentrations of sediment and particulate nutrients have been measured in subcatchments dominated by particular land uses. The findings from Packett et al (2009) found a strong correlation in the Fitzroy River between the concentration of suspended sediment and the proportion of cropland in the contributing catchment, suggesting that cropland is the more significant sediment source. Prosser (2024) noted that in the Fitzroy River, mines make up a very small proportion of the basin and located much further inland.

Bartley et al (2017) quantified the contributions of suspended sediment by land use by region. Bartley et al (2017) fond that in the Fitzroy River catchment, the estimated proportion of total fine sediment loads exported to the GBR from each land use are approximately 40% from grazing, approximately

40% from streambank erosion, approximately 10% from dryland cropping, approximately 5% from nature conservation and the remainder of approximately 5% from forestry, irrigated cropping, dairy, horticulture, sugarcane, urban and other land uses.

10.5.3 Project impacts

The Project would result in a reduction in undisturbed catchment runoff volumes. This in turn, is expected to reduce the TSS, TN and TP loads generated from undisturbed land to the greater Fitzroy basin and ultimately to the GBR.

There are no proposed changes to the currently approved controlled release strategy as a result of the Project and as such, controlled releases would continue to be undertaken in accordance with the EA release conditions. Additionally, the Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways.

The site water balance assessment (HydroBalance, 2026) predicted that the Project would increase controlled releases by around 11% - 20% (110 - 130 ML) under median climate conditions compared to the Approved operations. However, the potential increase in controlled releases is primarily due to the groundwater modelling outputs that predict an increase in groundwater inflows during the operation of the Project. Groundwater inflows are not anticipated to result in a significant increase in the TSS load to the mine water management system. Potential releases of fine sediments from controlled releases will be partially offset by the loss of undisturbed catchment that would otherwise contribute to sediment loads to the GBR.

Bartley et al (2017) estimated that approximately 1,805 kilotonnes (kt) of suspended sediment is released annually to the GBR from the Fitzroy River catchment. Assuming that controlled releases discharge an additional 130 ML per year at a TSS concentration of 462 mg/L (the median TSS at Taurus Creek D/S), this equates to approximately 0.06 kt of sediments annually. This represents less than 0.01% of the estimated total sediment load to the GBR from the Fitzroy River catchment. The BWM mine water storages including NTCD (RP2), NDCD (RP3) and TFD (RP4) provide extended detention and settling opportunities that promote sediment deposition. Therefore, the above estimate of sediment loads from controlled releases may be conservative and would need to be reviewed with additional monitoring for TSS. Surface water monitoring of the receiving environment (which already includes TSS) would continue in accordance with the FRREMP.

The water balance assessment (HydroBalance, 2026) indicates that the Project can be managed within the existing water management system and existing controlled release framework, with releases continuing to occur only in accordance with the approved EA (Schedule F) release conditions. Accordingly, the Project is not expected to result in a material residual impact to GBR catchment waters.

10.6 CUMULATIVE IMPACTS

The proposed release strategy to Blackwater Creek and the Mackenzie River is informed by existing release conditions applied to nearby operating coal mines. These conditions are embedded within a broader strategic framework designed to manage the cumulative impacts of water releases and mining activities. As such, the cumulative effects on surface water quality and associated EVs are expected to be negligible.

The site's water management system has been designed to minimise the need for controlled releases. When releases are required, they are conducted under strict release conditions, ensuring minimal impact on receiving water quality. With the implementation of the proposed mitigation measures, including sediment control, any potential contribution to salinity in the Mackenzie River from sediment dam discharges is expected to be minimal.

Given that the incremental impacts associated with the Project are not expected to be material, these impacts would not compound into significant cumulative impacts and a detailed cumulative impact

assessment, including sediment and water releases from other mining operations in the Blackwater Creek catchment, is not considered necessary.

Releases from coal mines typically occur during high-flow conditions, which help dilute discharge concentrations and reduce environmental risks. During the 2023–24 reporting period, 27% of coal mines in the Fitzroy Basin participated in the FRREMP program, with 25 authorised releases recorded. During the 2023–24 reporting period, 27% of coal mines in the Fitzroy Basin participated in the FRREMP program, with 25 authorised releases recorded. The total salinity load discharged in the Mackenzie sub-basin was approximately 1,292 tonnes, primarily during high-flow events. When considering potential discharges from these operations under current release rules, the overall reduction in catchment area and associated streamflow is relatively minor.

Receiving water quality was analysed for the Mackenzie River at Bingegang (refer to Section 3.4.3), which is located downstream of all active mining operations within the Blackwater Creek catchment. The water quality monitoring data indicates that physiochemical parameters and the concentration of nutrients and metalloids in the Mackenzie River at Bingegang have stayed below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).

10.7 FINAL VOID CHARACTERISTICS

The final landform for the Project would include five residual voids. Water balance modelling results for the final landform show that:

- Void water levels would be influenced by groundwater inflow, rainfall, runoff, and evaporation, with equilibrium levels expected below overflow levels at all five residual voids, even after extreme long-duration storm events.
- The salinity of the pit lake in the Mimosa/Besgrove, Deep Creek and Stewarton North voids would increase over time due to evapoconcentration.
- The salinity of the pit lake in the Ramp 30 and Stewarton South voids fluctuates over time as the void empties in cycles.
- The modelling confirms that the residual voids would comply with EA EPML00717813, which requires that voids must not cause serious environmental harm to land, surface waters, or recognised groundwater aquifers, other than the harm constituted by the existence of the void itself.

10.8 MONITORING

The existing water management and monitoring regime for the approved EA would be continued for the Project with ESC as appropriate. Key elements of surface water management and monitoring include:

- The WMP would be updated as mine plans are refined, and new water management infrastructure is designed and constructed.
- Management of erosion and sediment control through implementation of the ESCP.
- Surface water monitoring would continue in accordance with the WMP. Current monitoring locations are sufficient to cover any additional disturbance due to the Project.
- Regular inspections and maintenance of dams, pipelines, and sediment control structures ensure system reliability.
- Real-time monitoring of water inventory, sediment dam overflow, and controlled release volumes ensures timely responses to changing conditions.

10.9 SUMMARY OF MITIGATION MEASURES

The proposed mitigation measures are summarised as follows:

- The controlled release of MAW would continue to be restricted by the existing EA release conditions for the duration of the Project.
- The Project would not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge.
- Temporary flood protection levees would be constructed for the operational stage of the Project to provide flood immunity to the open cut pits for flood events up to and including the 0.1% AEP design event. These temporary flood protection levees would be removed post-closure, and the final landform would be configured such that the rehabilitated out-of-pit overburden areas would prevent floodwater from entering the residual voids.
- A proposed clean water drain along the southeastern side of the future Stewarton Pit expansion area would be in place during the operational stage of the Project and would also form part of the final landform post-closure. The proposed clean water drain has been designed to be geomorphically stable and self-sustaining.
- Whitehaven Blackwater will continue to be a participant in the FRREMP.
- Surface water quality monitoring of receiving waters would continue to be undertaken in accordance with the requirements of EA EPML00717813. Current monitoring locations are sufficient to cover the any additional disturbance because of the Project.
- The existing *BWM Water Management Plan* would be updated, as required as mine plans are refined, to reflect any changes to the site water management system and surface water monitoring locations resulting from the Project.

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APPENDIX A HYDROLOGIC MODEL DEVELOPMENT

A.1 OVERVIEW

Hydrologic models were developed using the Unified River Basin Simulator (URBS) software package (Carroll, 2024), for the Blackwater Creek catchment (including Deep Creek, Emu Creek, Two Mile Gully and Taurus Creek) and the Sagittarius Creek catchment. The URBS models incorporate the latest climate change guidance from Australian Rainfall and Runoff (ARR) 2019 Version 4.2 (Ball et al., 2019). The following sections describe the development, calibration and validation of the Blackwater Creek and Sagittarius Creek URBS hydrologic models.

A.2 EXISTING DRAINAGE CHARACTERISTICS

The existing drainage characteristics in the vicinity of the Blackwater North Extension Project (the Project) area are described in Section 3.1 and shown in Figure 3.3.

A.3 AVAILABLE DATA

A.3.1 Overview

The following data was provided by Whitehaven Coal Limited (Whitehaven) for this study:

- previous hydrologic and hydraulic studies;
- recorded rainfall and water level data; and
- Light Detection and Ranging (LiDAR) topographic data.

A.3.2 Previous studies

A.3.2.1 Blackwater Mine Flood Study (2021)

The Blackwater Mine (BWM) Flood Study, undertaken by GHD Group Pty Ltd (GHD) (2021), assessed existing flood risks across BWM. XP-RAFTS hydrologic and Two-Dimensional Unsteady FLOW (TUFLOW) hydraulic models were developed for this study. The GHD (2021) study report was provided for this study, but the XP-RAFTS and TUFLOW models were not available.

A.3.2.2 Blackwater Mine Progressive Rehabilitation and Closure Plan (2024)

The XP-RAFTS hydrologic and TUFLOW hydraulic models used by SLR Consulting Australia Pty Ltd for the previous *Progressive Rehabilitation and Closure Plan Rehabilitation flood assessment* (SLR, 2024) were provided for this study. These models appear to have been developed based on the GHD (2021) hydrologic and hydraulic models. Separate models were provided for the Sagittarius Creek and Blackwater Creek catchments.

A.3.3 Rainfall and water level data

Figure A.1 shows the location of three subdaily rainfall (pluviograph) stations and six stream gauging stations across BWM. Table A.1 and Table A.2 show details of these stations.

Within the Project area, the Two Mile Gully (Station Number – 330124) and Taurus Creek downstream (D/S) (Station Number – 330101) stream gauging stations are located within the Blackwater Creek catchment. There are no stream gauging stations within the Sagittarius Creek catchment.

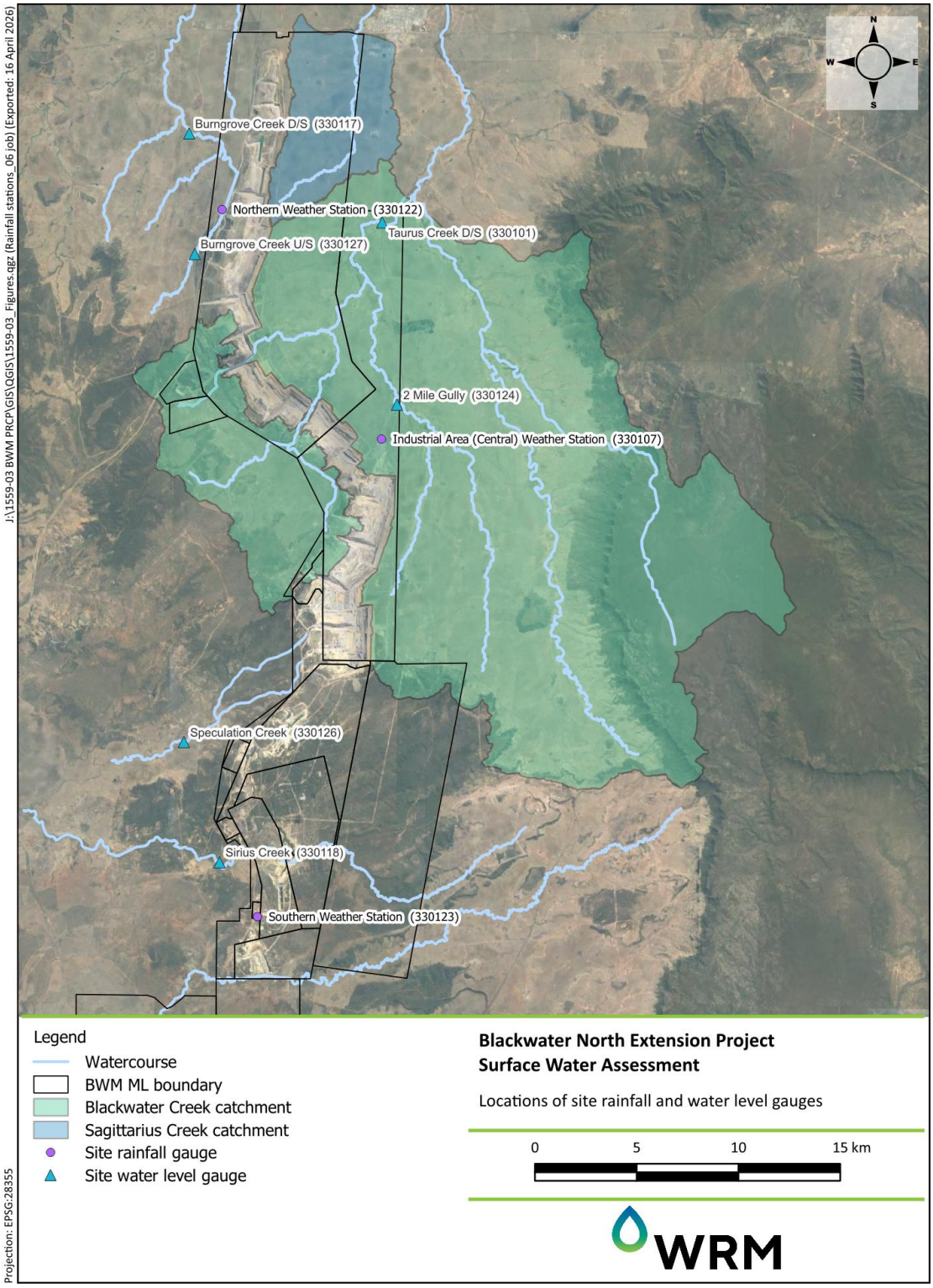


Figure A.1 Locations of site rainfall and water level gauges

Table A.1 Details of available sub-daily rainfall (pluviograph) stations

Station Number	Station Name
330122	Northern Weather Station
330107	Industrial Areal (Central) Weather Station
330123	Southern Weather Station

Table A.2 Details of available stream gauging stations

Station Number	Station Name	Supplied data period
330101	Taurus Creek D/S	January 2016 – January 2025
330118	Sirius Creek D/S	January 2016 – January 2025
330124	Two Mile Gully	January 2016 – January 2025
330126	Speculation Creek	January 2016 – January 2025
330127	Burngrove Creek U/S[a]	January 2016 – January 2025
330117	Burngrove Creek D/S	January 2016 – January 2025

[a] – U/S = upstream

A.3.4 Rating curves

Whitehaven provided rating curves for the Taurus Creek D/S and Two Mile Gully gauges relevant to the Project area (referred to in this report as the Whitehaven rating curves). It was uncertain if the Whitehaven rating curves were derived from actual gaugings or from hydraulic modelling. For this study, the rating curves were verified and then modified and/or extended if necessary, using hydraulic modelling where detailed LiDAR data is available.

Figure A.2 and Figure A.3 compare the Whitehaven rating curves, the TUFLOW model generated rating curves and the final adopted rating curves for the Taurus Creek D/S and Two Mile Gully gauges, respectively. For these four gauges, the “adopted” rating curves were used to convert recorded water levels (in metres AHD [mAHD]) into discharges (in cubic metres per second [m^3/s]) for the hydrologic model calibration.

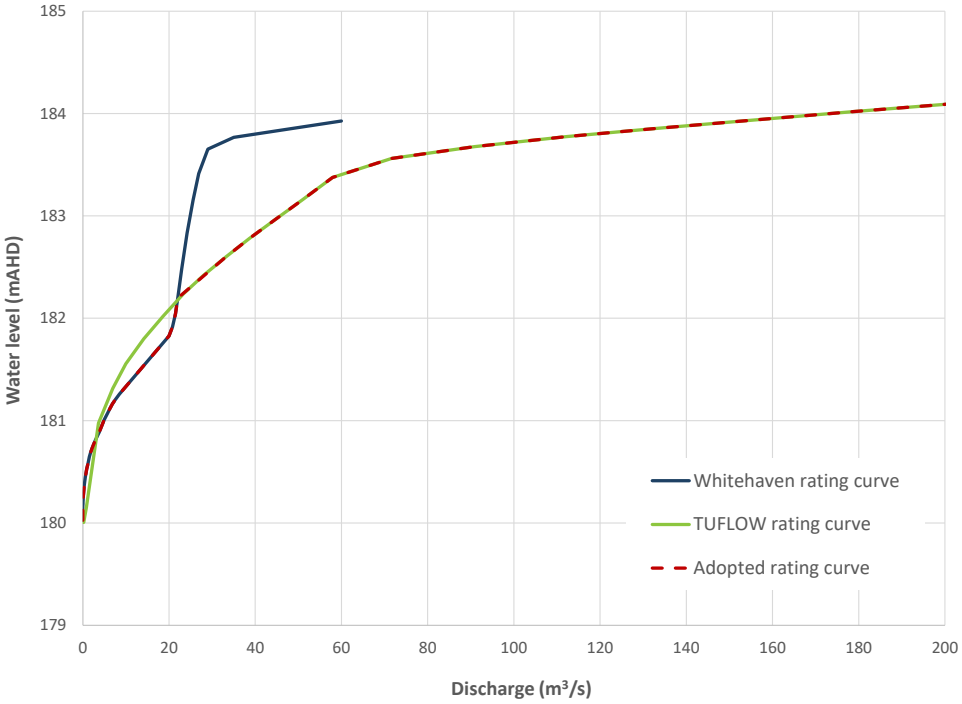


Figure A.2 **Comparison of Whitehaven-supplied, TUFLOW and adopted rating curves, Taurus Creek D/S gauging station**

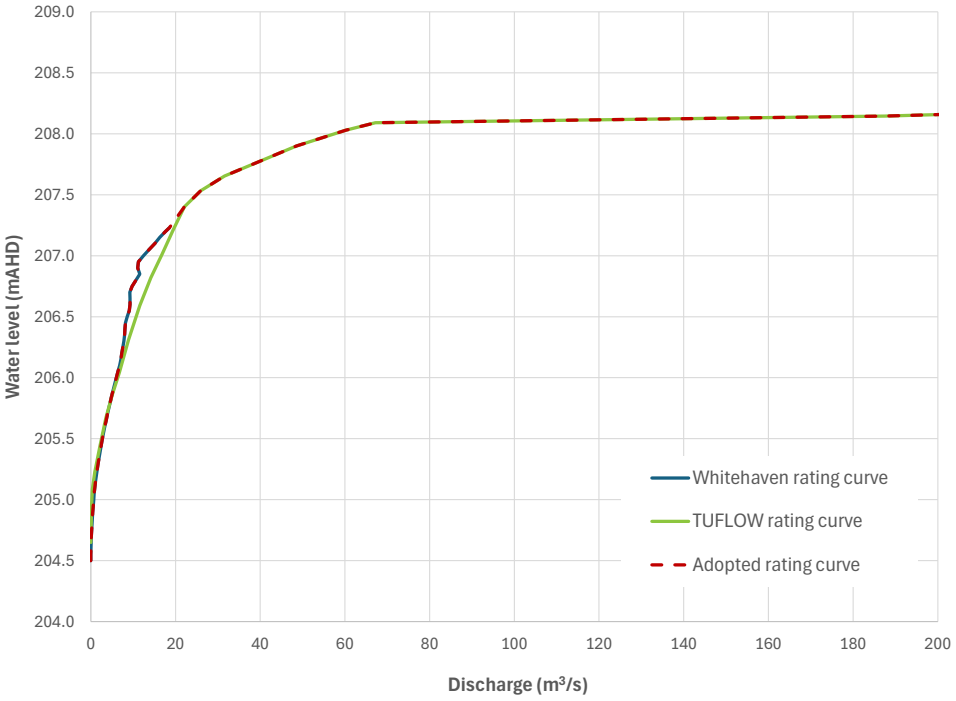


Figure A.3 **Comparison of Whitehaven-supplied, TUFLOW and adopted rating curves, Two Mile Gully gauging station**

A.3.5 Topographic data

The available topographic data used for this study is described as follows:

- A 1 metre (m) resolution LiDAR covering the BWM mining lease area captured in February 2024 (referred to as the 2024 LiDAR data);
- A 1 m resolution LiDAR captured in February 2025, covering the active mining pits of BWM and the recent upgrade to the New Taurus Creek Dam (referred to as the 2025 LiDAR data); and
- A 30 m resolution Copernicus Digital Surface Model (DSM) satellite ground level observation data obtained from the European Space Programme on 31 January 2025 (referred to as the Copernicus DSM data).

A.4 HYDROLOGIC MODEL DEVELOPMENT

A.4.1 Overview

URBS hydrologic models were developed for the Blackwater Creek catchment (including Taurus Creek and Two Mile Gully) and the Sagittarius Creek catchment.

URBS is a runoff-routing computer model that uses a network of conceptual storages to represent the routing of rainfall excess through a catchment. The URBS model was used in the "split mode" which enables the separate simulation of catchment and channel routing.

The URBS split model approach, which separates the channel and catchment storage components of each subcatchment for routing purposes, was adopted. Subcatchment routing was computed using the Aitken's equation, allowing the URBS model to provide higher resolution local subcatchment inflow hydrographs for the TUFLOW hydraulic model.

Routing was undertaken using Laurenson's (1964) procedure based on isochrones. Channel routing link lengths were estimated for each subcatchment in a boundary-boundary approach, and the inflow from the sub-catchment into the channel was assumed to occur at the boundary rather than at the centroid of the subcatchments.

The initial and continuing loss method was adopted for this study. This model assumes that there is an initial loss (IL) in millimetres (mm) before any rainfall becomes runoff. After this, a continuing loss (CL) rate in millimetres per hour (mm/h) is applied to the rainfall.

Full details of the URBS model and its features are given in the URBS User Manual (Carroll, 2024).

The Blackwater Creek URBS model was calibrated to recorded data for the March 2017 and January 2020 flood events. The Sagittarius Creek URBS model could not be calibrated due to the absence of any stream gauges within the catchment.

URBS models were developed for the following scenarios:

- 'Existing conditions' – This scenario was simulated based on year 2030 near-term climate conditions, for the current configuration of BWM (excluding the Project).
- 'Operational (2055) conditions' – This scenario was simulated based on year 2030 near-term climate conditions, for the year 2055 BWM configuration where the Project is it its maximum disturbance footprint.
- 'Final landform conditions' – This scenario was simulated based on year 2100 long-term climate conditions, for the final landform stage of BWM.
- The 'existing conditions' and 'operational (2055) conditions' URBS models were simulated for the following design flood events:
  - 50% (1 in 2) annual exceedance probability (AEP);

- 5% (1 in 20) AEP;
- 2% (1 in 50) AEP;
- 1% (1 in 100) AEP; and
- 0.01% (1 in 1,000) AEP.

- The 'final landform conditions' URBS models were simulated for the following design flood events:
  - 1% (1 in 100) AEP;
  - 0.01% (1 in 1,000) AEP; and
  - Probable Maximum Precipitation (PMP).

The 50% to 1% AEP design discharge estimates (2030 climate conditions) were validated against estimates derived using the Rational Method (RM), the Quantile Regression Technique (QRT) (Palmen and Weeks, 2015) and the Regional Flood Frequency Estimation (RFFE) method.

A.4.2 Model configuration

A.4.2.1 Subcatchment parameters

The URBS model subcatchments were assigned with area, slope, imperviousness, and Pervious Area Manning's 'n' (PERN) parameters. Subcatchment slopes were calculated based on the available topographic data.

Figure A.4 shows the existing conditions URBS model subcatchments adopted for the Sagittarius Creek. The model covers an area of 42.7 square kilometres (km^2) and consists of 28 subcatchments, ranging in size from 0.02 km^2 to 3.34 km^2. Table A.3 shows the subcatchment parameters adopted in the model under existing land use conditions.

Figure A.5 shows the existing conditions URBS model subcatchments adopted for the Blackwater Creek model. The model covers an area of 509.8 km^2 and consists of 226 subcatchments, ranging in size from 0.02 km^2 to 17.8 km^2. Table A.4 shows the subcatchment parameters adopted in the model under existing land use conditions.

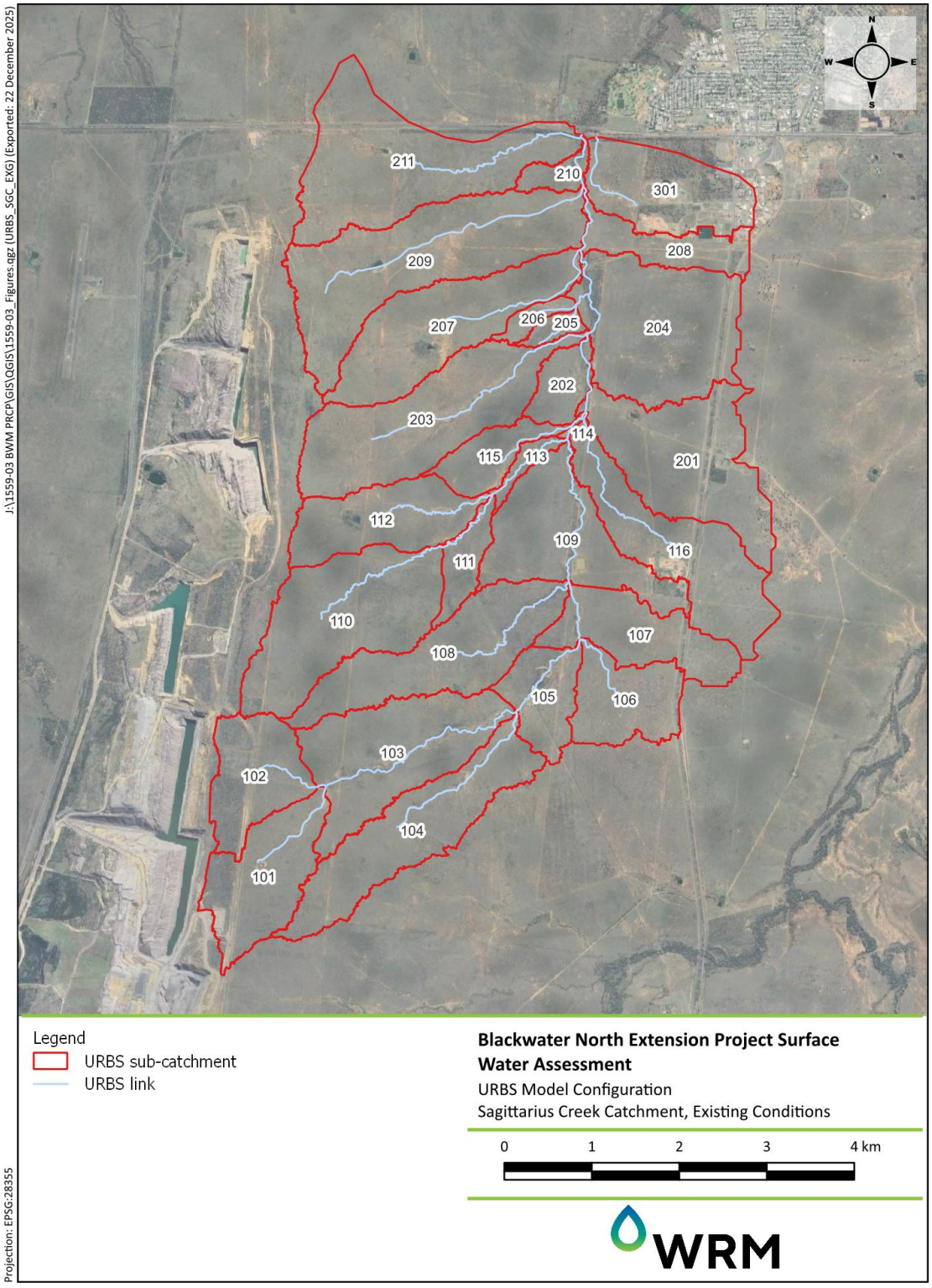


Figure A.4 URBS model configuration, Sagittarius Creek catchment, existing conditions

Table A.3 URBS model subcatchment parameters for the Sagittarius Creek catchment

ID	Area (km^2)	Percentage Impervious (percent [%])	PERN	Catchment Slope (metres per metre [m/m])
101	1.58	0	0.07	0.009
102	1.29	0	0.07	0.008
103	2.37	0	0.07	0.007
104	2.19	0	0.07	0.007
105	0.87	0	0.07	0.007
106	1.14	0	0.07	0.008
107	1.37	0	0.07	0.009
108	2.20	0	0.07	0.008
109	2.02	0	0.07	0.007
110	2.69	0	0.07	0.008
111	0.46	0	0.07	0.009
112	1.46	0	0.07	0.009
113	0.19	0	0.07	0.007
114	0.02	0	0.07	0.005
115	0.63	0	0.07	0.007
116	2.12	0	0.07	0.007
201	2.44	0	0.07	0.010
202	0.51	0	0.07	0.004
203	2.72	0	0.07	0.007
204	2.69	0	0.07	0.010
205	0.17	0	0.07	0.007
206	0.20	0	0.07	0.007
207	2.22	0	0.07	0.008
208	0.81	0	0.07	0.008
209	3.34	0	0.07	0.007
210	0.27	0	0.07	0.003
211	3.14	0	0.07	0.005
301	1.58	0	0.07	0.008

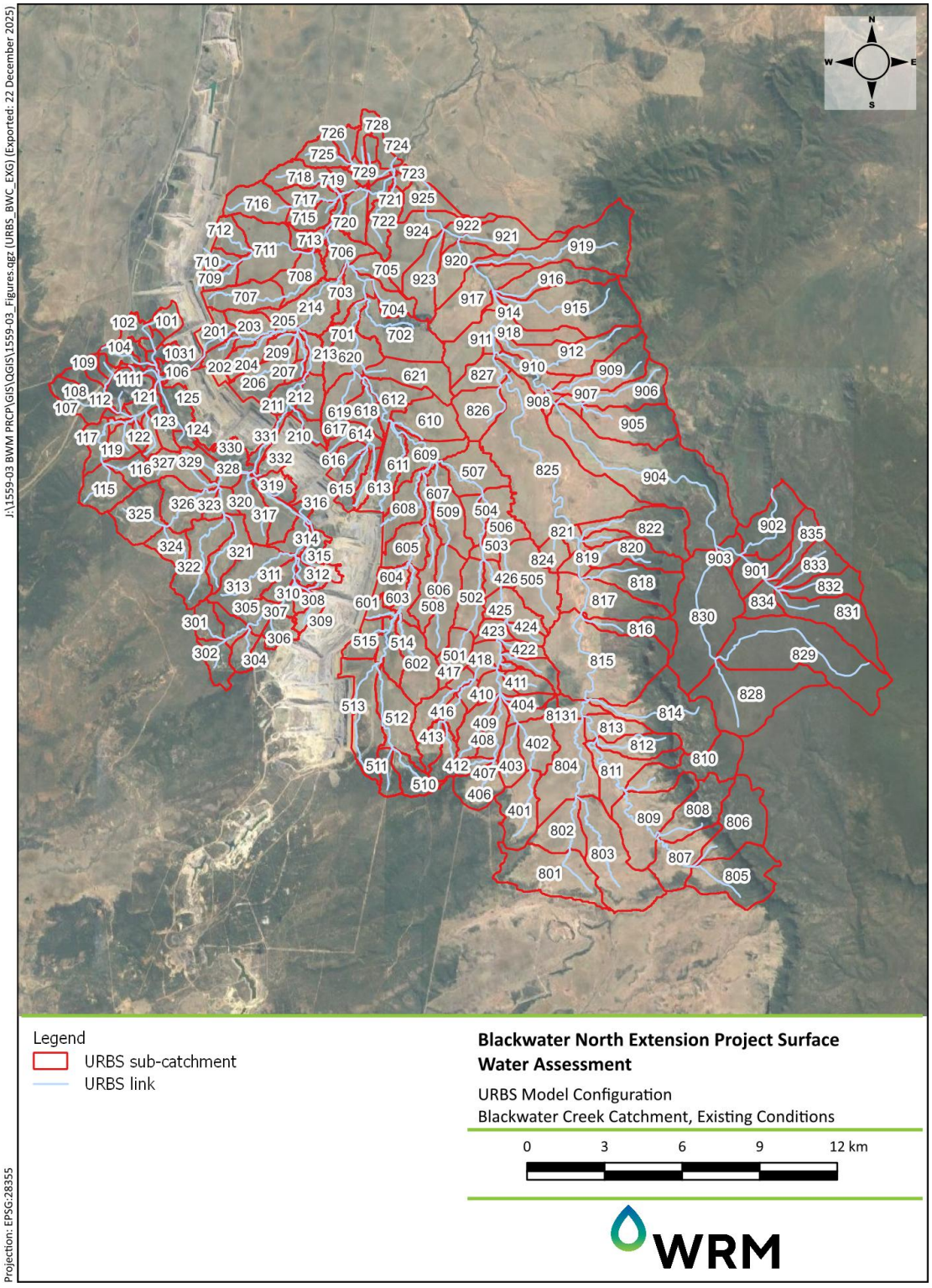


Figure A.5 URBS model configuration, Blackwater Creek catchment, existing conditions

Table A.4 URBS catchment parameters of the Blackwater Creek catchment model

ID	Area (km^2)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
101	1.11	0	0.07	0.019
102	0.88	0	0.07	0.009
103	0.47	0	0.07	0.022
104	0.97	0	0.07	0.028
105	0.51	0	0.07	0.021
106	0.37	0	0.07	0.004
107	2.02	0	0.07	0.030
108	1.10	0	0.04	0.070
109	0.65	0	0.07	0.028
110	0.42	0	0.07	0.044
111	0.02	0	0.07	0.006
112	0.10	0	0.07	0.009
113	1.94	0	0.07	0.005
114	0.33	0	0.07	0.020
115	2.55	0	0.07	0.017
116	1.21	0	0.07	0.015
117	1.61	0	0.07	0.012
118	0.28	0	0.07	0.010
119	1.14	0	0.07	0.036
120	0.50	0	0.07	0.029
121	0.95	0	0.07	0.009
122	0.79	0	0.07	0.023
123	1.05	0	0.07	0.018
124	0.60	0	0.07	0.027
125	1.72	0	0.07	0.013
201	1.45	0	0.07	0.006
202	1.26	0	0.07	0.012
203	1.77	0	0.07	0.007
204	1.65	0	0.07	0.008
205	0.32	0	0.07	0.002
206	2.94	0	0.07	0.008
207	0.46	0	0.07	0.007
208	0.39	0	0.07	0.003
209	0.67	0	0.07	0.008

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
210	0.83	0	0.07	0.010
211	1.36	0	0.07	0.006
212	1.54	0	0.07	0.011
213	1.04	0	0.07	0.004
214	3.78	0	0.07	0.004
301	1.34	0	0.07	0.033
302	1.71	0	0.07	0.018
303	1.05	0	0.07	0.026
304	1.20	0	0.07	0.026
305	1.23	0	0.07	0.009
306	1.29	0	0.07	0.019
307	0.62	0	0.07	0.019
308	0.56	0	0.07	0.037
309	0.83	0	0.07	0.044
310	0.10	0	0.07	0.016
311	1.08	0	0.07	0.015
312	0.69	0	0.07	0.030
313	4.53	0	0.07	0.017
314	1.21	0	0.07	0.004
315	1.44	0	0.07	0.007
316	0.39	0	0.07	0.074
317	1.80	0	0.07	0.009
318	0.78	0	0.07	0.053
319	0.35	0	0.07	0.085
320	2.47	0	0.07	0.013
321	2.35	0	0.07	0.017
322	4.18	0	0.07	0.016
323	1.05	0	0.07	0.013
324	1.70	0	0.07	0.019
325	3.44	0	0.07	0.023
326	3.05	0	0.07	0.013
327	2.58	0	0.07	0.013
328	0.66	0	0.07	0.004
329	1.04	0	0.07	0.015
330	1.44	0	0.07	0.018

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
331	0.80	0	0.07	0.006
332	0.57	0	0.07	0.029
401	3.50	0	0.07	0.015
402	2.59	0	0.07	0.011
403	1.73	0	0.07	0.012
404	0.92	0	0.07	0.017
405	0.74	0	0.07	0.032
406	2.38	0	0.07	0.018
407	0.62	0	0.07	0.027
408	1.72	0	0.07	0.012
409	2.13	0	0.07	0.015
410	1.21	0	0.07	0.007
411	1.35	0	0.07	0.030
412	1.33	0	0.07	0.022
413	1.28	0	0.07	0.024
414	0.97	0	0.07	0.016
415	0.66	0	0.07	0.015
416	1.65	0	0.07	0.013
417	0.55	0	0.07	0.011
418	0.57	0	0.07	0.011
419	0.21	0	0.07	0.018
420	1.00	0	0.07	0.015
421	1.25	0	0.07	0.026
422	0.87	0	0.07	0.015
423	1.00	0	0.07	0.008
424	0.79	0	0.07	0.016
425	2.31	0	0.07	0.009
426	1.00	0	0.07	0.005
501	2.03	0	0.07	0.01
502	2.62	0	0.07	0.006
503	0.56	0	0.07	0.005
504	1.46	0	0.07	0.005
505	4.78	0	0.07	0.007
506	2.93	0	0.07	0.006
507	3.35	0	0.07	0.004

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
508	3.88	0	0.07	0.006
509	3.46	0	0.07	0.006
510	1.80	0	0.07	0.032
511	1.23	0	0.07	0.031
512	3.76	0	0.07	0.015
513	4.77	0	0.07	0.013
514	1.85	0	0.07	0.007
515	1.57	0	0.07	0.012
601	0.63	0	0.07	0.012
602	3.63	0	0.07	0.008
603	1.13	0	0.07	0.005
604	1.69	0	0.07	0.011
605	2.43	0	0.07	0.006
606	2.29	0	0.07	0.007
607	0.69	0	0.07	0.004
608	2.44	0	0.07	0.005
609	2.66	0	0.07	0.006
610	3.38	0	0.07	0.006
611	2.97	0	0.07	0.007
612	2.44	0	0.07	0.006
613	1.09	0	0.07	0.009
614	0.38	0	0.07	0.006
615	1.36	0	0.07	0.007
616	1.19	0	0.07	0.010
617	1.02	0	0.07	0.013
618	1.58	0	0.07	0.003
619	2.57	0	0.07	0.009
620	3.14	0	0.07	0.008
621	3.18	0	0.07	0.009
701	1.23	0	0.07	0.005
702	4.86	0	0.07	0.007
703	1.79	0	0.07	0.005
704	1.35	0	0.07	0.006
705	1.22	0	0.07	0.012
706	2.13	0	0.07	0.005

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
707	2.90	0	0.07	0.008
708	2.27	0	0.07	0.007
709	0.93	0	0.07	0.010
710	0.89	0	0.07	0.012
711	4.49	0	0.07	0.008
712	1.47	0	0.07	0.012
713	1.27	0	0.07	0.004
714	0.55	0	0.07	0.002
715	1.15	0	0.07	0.006
716	2.84	0	0.07	0.011
717	1.89	0	0.07	0.009
718	2.25	0	0.07	0.008
719	0.73	0	0.07	0.007
720	1.69	0	0.07	0.005
721	0.77	0	0.07	0.004
722	2.29	0	0.07	0.009
723	0.36	0	0.07	0.002
724	0.88	0	0.07	0.008
725	1.67	0	0.07	0.007
726	1.07	0	0.07	0.007
727	0.61	0	0.07	0.008
728	0.92	0	0.07	0.012
729	0.52	0	0.07	0.004
730	0.46	0	0.07	0.012
801	6.29	0	0.07	0.011
802	3.02	0	0.07	0.013
803	7.28	0	0.07	0.009
804	6.31	0	0.07	0.009
805	5.39	0	0.07	0.075
806	4.86	0	0.07	0.108
807	3.45	0	0.07	0.040
808	3.68	0	0.07	0.107
809	5.80	0	0.07	0.044
810	4.62	0	0.07	0.106
811	3.55	0	0.07	0.008

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
812	2.30	0	0.07	0.059
813	1.92	0	0.07	0.021
814	7.10	0	0.07	0.074
815	11.57	0	0.07	0.015
816	2.31	0	0.07	0.104
817	4.75	0	0.07	0.072
818	3.83	0	0.07	0.076
819	0.74	0	0.07	0.010
820	3.15	0	0.07	0.039
821	0.75	0	0.07	0.005
822	4.47	0	0.07	0.062
824	1.24	0	0.07	0.010
825	17.8	0	0.07	0.004
826	2.94	0	0.07	0.014
827	2.01	0	0.07	0.008
828	8.08	0	0.07	0.019
829	12.06	0	0.07	0.015
830	10.24	0	0.07	0.009
831	4.87	0	0.07	0.030
832	2.36	0	0.07	0.039
833	2.38	0	0.07	0.070
834	1.62	0	0.07	0.034
835	2.01	0	0.07	0.045
901	2.16	0	0.07	0.037
902	4.27	0	0.07	0.034
903	0.86	0	0.07	0.031
904	15.68	0	0.07	0.028
905	4.65	0	0.07	0.041
906	3.15	0	0.07	0.034
907	0.56	0	0.07	0.006
908	0.42	0	0.07	0.010
909	3.92	0	0.07	0.027
910	2.02	0	0.07	0.005
911	0.34	0	0.07	0.005
912	4.87	0	0.07	0.022

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
914	0.39	0	0.07	0.004
915	8.00	0	0.07	0.022
916	3.12	0	0.07	0.022
917	5.05	0	0.07	0.006
918	5.11	0	0.07	0.005
919	7.07	0	0.07	0.030
920	2.75	0	0.07	0.007
921	3.07	0	0.07	0.011
922	0.80	0	0.07	0.002
923	3.09	0	0.07	0.007
924	4.33	0	0.07	0.005
925	2.19	0	0.07	0.002
1031	0.72	0	0.07	0.012
1111	0.44	0	0.07	0.021
3091	0.20	0	0.07	0.036
8131	1.06	0	0.07	0.021
8211	0.76	0	0.07	0.026

A.4.2.2 Adopted global Unified River Basin Simulator model parameters

The global URBS model parameters included channel lag parameter (alpha [α]), catchment storage parameter (beta [β]), catchment non-linearity (M) and channel routing exponent (N). The following global URBS parameters were adopted for all seven models:

- Channel routing α = 0.1
- Catchment routing β = 1.0
- Catchment routing exponent M = 0.715
- Channel routing exponent N = 1.0

Sub-catchment routing was computed using the Aitken's equation, allowing the URBS model to provide local subcatchment inflow hydrographs of reasonable resolution. The non-linear routing parameter 'M' was set to 0.715, as recommended in URBS user manual for when the Aitken's equation is used.

A.4.2.3 Initial and continuing losses

The IL and CL method of accounting for rainfall losses was adopted for this study. For the calibration events, different initial and continuing losses were derived for each calibration event to reflect different antecedent catchment conditions (refer to Section A.5.4). Design event ILs and CLs were derived during the model validation process (refer to Section A.6.2).

A.5 HYDROLOGIC MODEL CALIBRATION

A.5.1 Methodology

The URBS models for the Blackwater Creek catchment was calibrated for the March 2017 and January 2020 flood events. The purpose of the model calibration was to achieve the best possible match between URBS-modelled discharge hydrographs against the recorded discharge hydrographs, using a common set of model parameters between flood events.

A.5.2 Selection of calibration events

A.5.2.1 Overview

The March 2017 and January 2020 flood events were selected for calibration due to the availability of data and because the rainfalls during these events triggered similar responses at adjacent catchments for which data is available. The March 2017 and January 2020 events were also the selected calibration events in the GHD (2021) study.

Table A.5 shows the adopted historical event simulation periods for the calibration events in the URBS model. Table A.6 shows the recorded rainfall depths at each station for the calibration events. Table A.7 shows the recorded peak discharges at each gauging station for the calibration events.

Table A.5 Calibration event simulation periods

Calibration Event	Simulation period
March 2017	28 March (0000 hours) – 1 April (0000 hours) - 4 days
January 2020	24 January (0000 hours) – 27 January (0000 hours) - 3 days

Table A.6 Total rainfall depths recorded during the 2017 and 2020 events

Station Number	Station Name	Rainfall depth (mm)	
		March 2017	January 2020
330107	Central Weather Station	119.0	148.0
330122	Northern Weather Station	139.5	78.5
330123	Southern Weather Station	142.5	49.5

Table A.7 Peak discharges recorded during calibration events

Station Number	Station Name	Peak discharge (m^3/s)	
		March 2017	January 2020
330101	Taurus Creek D/S	117	156.8
330124	Two Mile Gully	16.2	50.4

A.5.2.2 March 2017 event

Figure A.6 and Figure A.7 show the recorded rainfall intensities (in mm/h) at the Northern Weather Station and Central Weather Station site pluviograph stations, respectively, for the March 2017 event. Figure A.8 and Figure A.9 show the recorded water levels (in metres Reduced Level [m]) at the Two Mile Gully and Taurus Creek D/S gauges, respectively, for the March 2017 event.

A.5.2.3 January 2020 event

Figure A.10 and Figure A.11 show the recorded rainfall intensities at the Northern Weather Station and Central Weather Station site pluviograph stations, respectively, for the January 2020 event. Figure A.12 and Figure A.13 show the recorded water levels at the Two Mile Gully and Taurus Creek D/S gauges, respectively, for the January 2020 event.

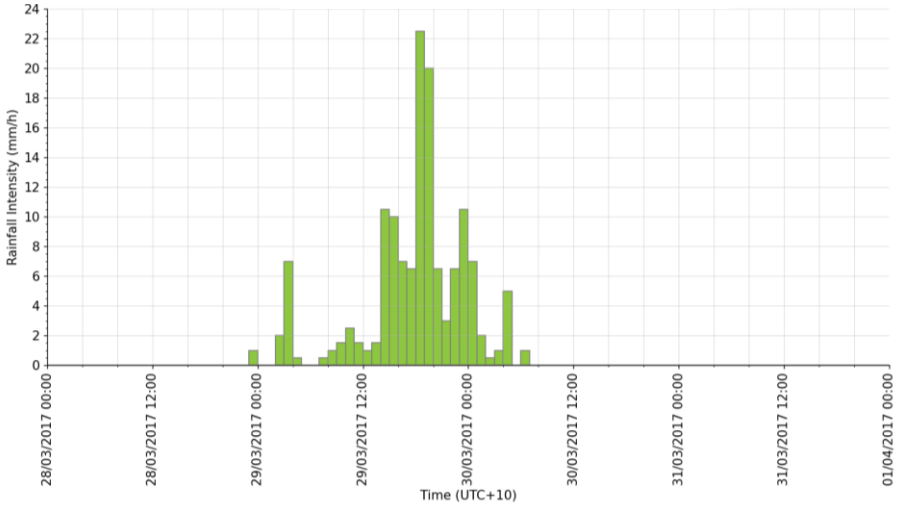


Figure A.6 Recorded rainfall at Northern Weather Station (330122), 2017 event

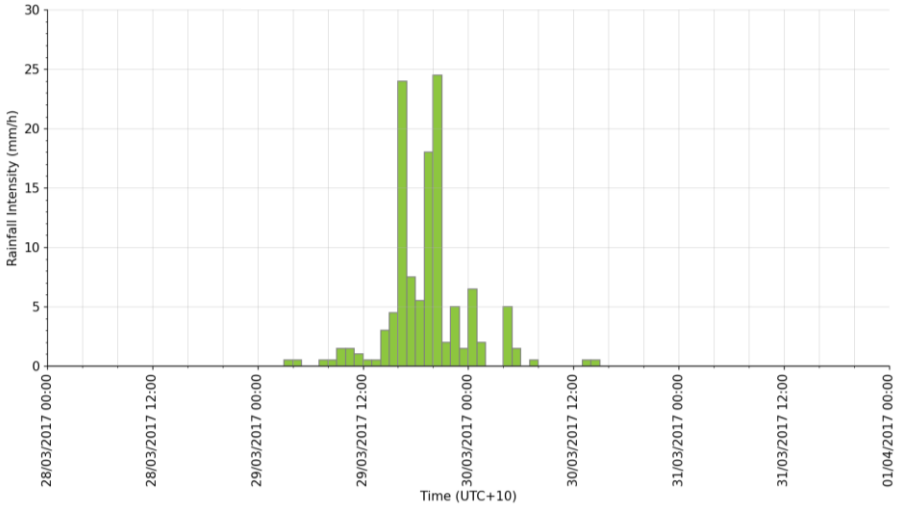


Figure A.7 Recorded rainfall at Central Weather Station (330107), 2017 event

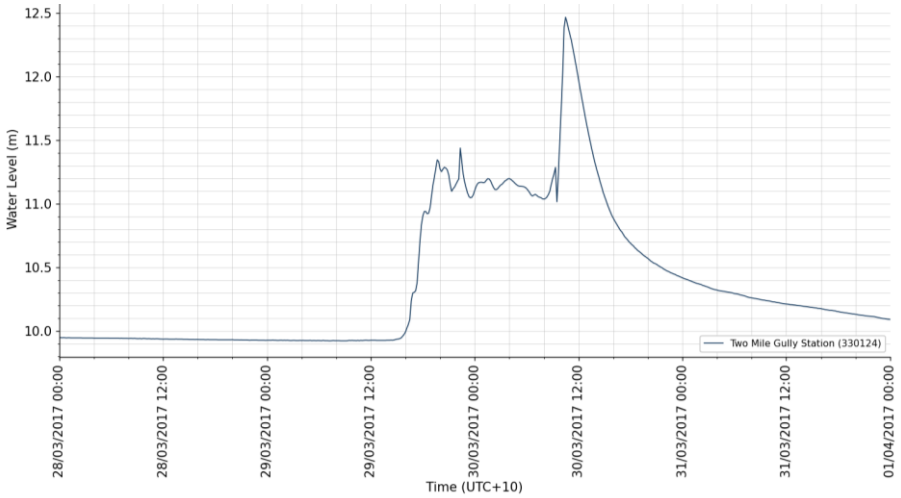


Figure A.8 Recorded water level at Two Mile Gully Station (330124), 2017 event

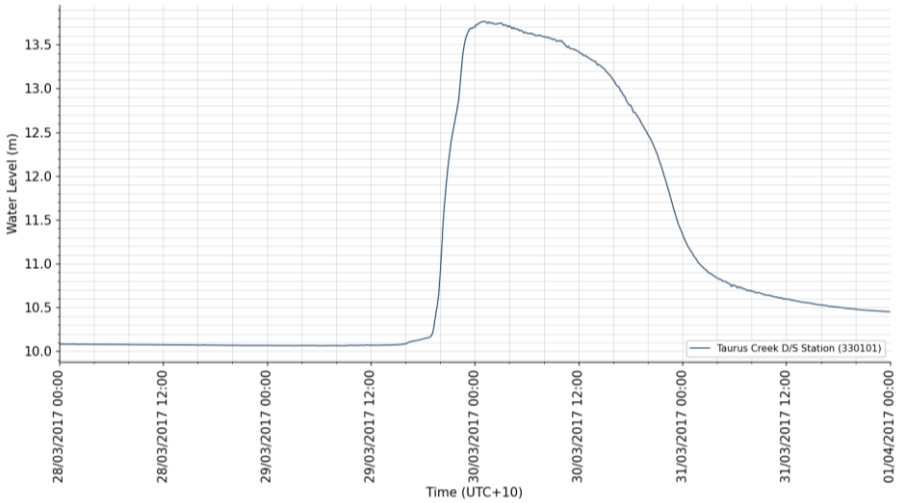


Figure A.9 Recorded water level at Taurus Creek D/S Station (330101), 2017 event

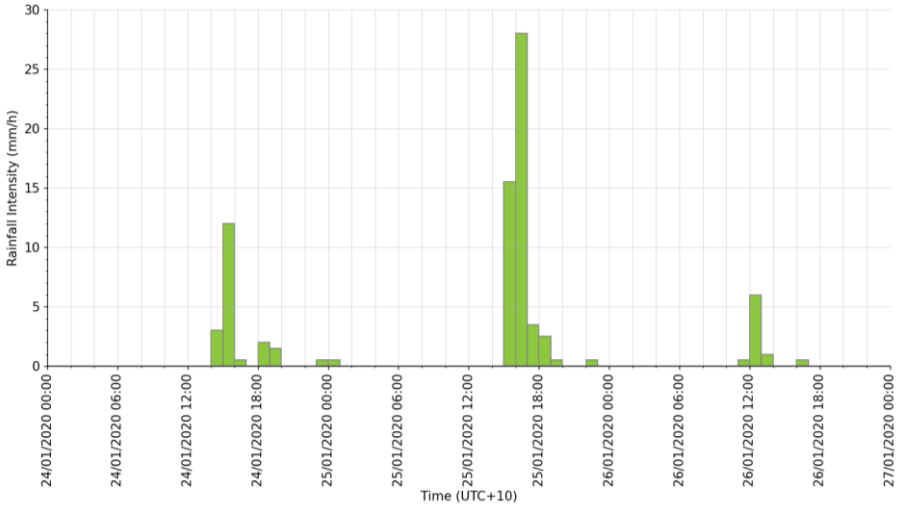


Figure A.10 Recorded rainfall at Northern Weather Station (330122), 2020 event

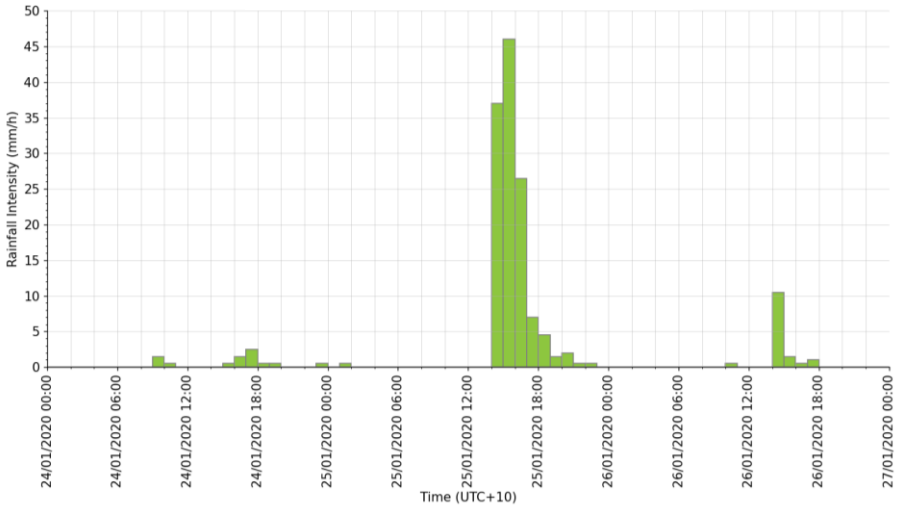


Figure A.11 Recorded rainfall at Central Weather Station (330107), 2020 event

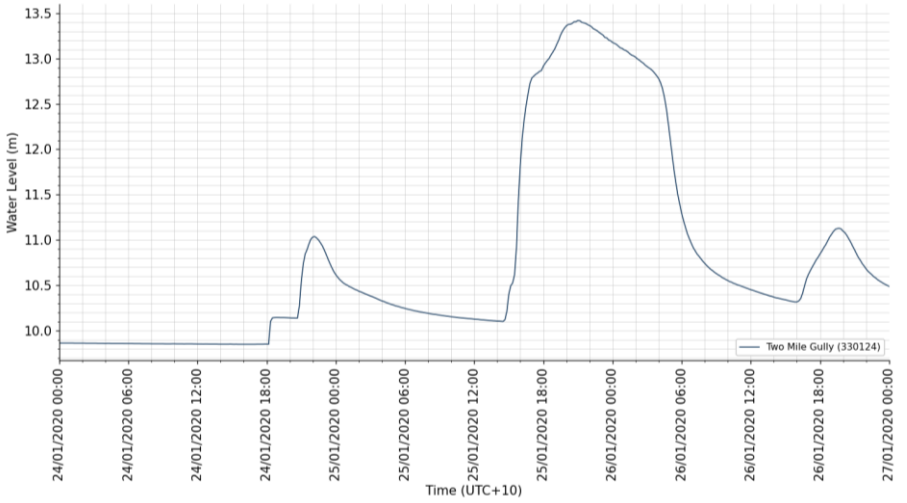


Figure A.12 Recorded water level at Two Mile Gully Station (330124), 2020 event

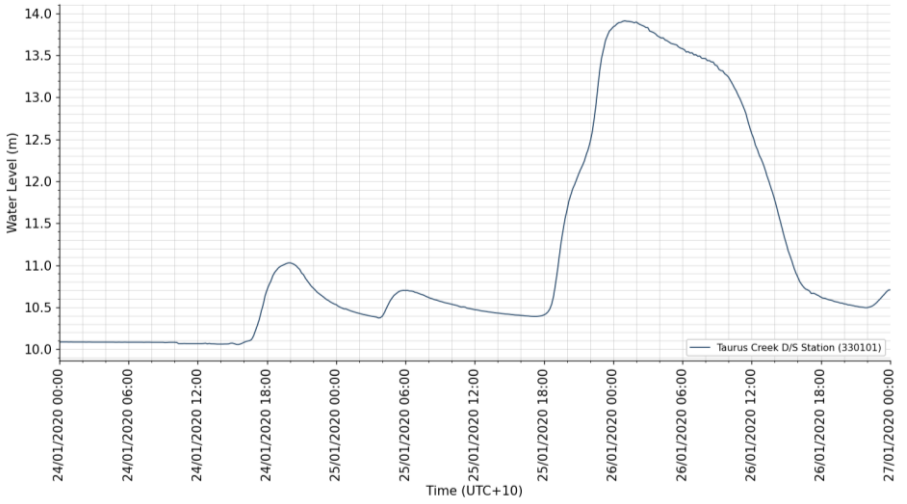


Figure A.13 Recorded water level at Two Mile Gully Station (330124), 2020 event

A.5.3 Assignment of subcatchment rainfalls

Each URBS subcatchment was assigned a rainfall hyetograph based on the three nearest pluviograph stations, using the URBS SUBRAIN utility. The SUBRAIN utility calculates the weighted average rainfall depth for each subcatchment using an inverse distance squared method based on the relative distance between the rainfall station location and the subcatchment centroid.

A.5.4 Initial and continuing losses

Table A.8 shows the IL and CL adopted for the Blackwater Creek catchment for the two calibration events. A CL of 3.5 mm/h was for both events. Different ILs were adopted for each event which reflect the different antecedent conditions prior to each event.

Table A.8 Adopted calibration event initial and continuing losses

March 2017		January 2020	
IL (mm)	CL (mm/h)	IL (mm)	CL (mm/h)
82	3.5	75	3.5

A.5.5 Model calibration results

Table A.9 shows the comparison of the calculated and recorded peak discharges at the two gauging stations within the Blackwater Creek catchment for the 2017 and 2020 events.

Table A.9 Summary of calibration results

Station Number	Station Name	Peak discharge (m^3/s)					
		March 2017			January 2020		
		Calculated	Recorded	Difference (%)	Calculated	Recorded	Difference (%)
330101	Taurus Creek D/S	116.6	117.0	-0.3%	155.6	156.8	-1%
330124	Two Mile Gully	46.9	16.2	189.4%	79.1	50.4	57%

A.5.5.1 March 2017 event calibration results

Figure A.14 and to Figure A.15 compare the modelled/calculated (C – orange) and recorded (R – blue) discharge hydrographs for the March 2017 event.

The modelled (calculated) hydrograph matches well with the recorded hydrograph peak and shape at the Taurus Creek D/S gauge. However, the URBS model could not reproduce the recorded hydrograph shape, peak or timing further upstream at the Two Mile Gully gauge.

The recorded data suggests that the Two Mile Gully gauge appears to have malfunctioned during the event, as indicated by the following:

- The recorded water level hydrograph shape and timing at the Two Mile Gully gauge is inconsistent with the recorded water levels at the Taurus Creek D/S gauge (refer to Figure A.8 and Figure A.9).
- The catchment area to Two Mile Gully is around 27% of the catchment area to the Taurus Creek D/S gauge. Despite this, the recorded peak discharge at Two Mile Gully D/S is only 14% of the recorded peak discharge at Taurus Creek D/S. This indicates that the Two Mile Gully gauge likely did not capture the peak water level (and hence the peak discharge) during this event.

In consideration of the above, the calibration in Two Mile Gully and Taurus Creek is considered acceptable.

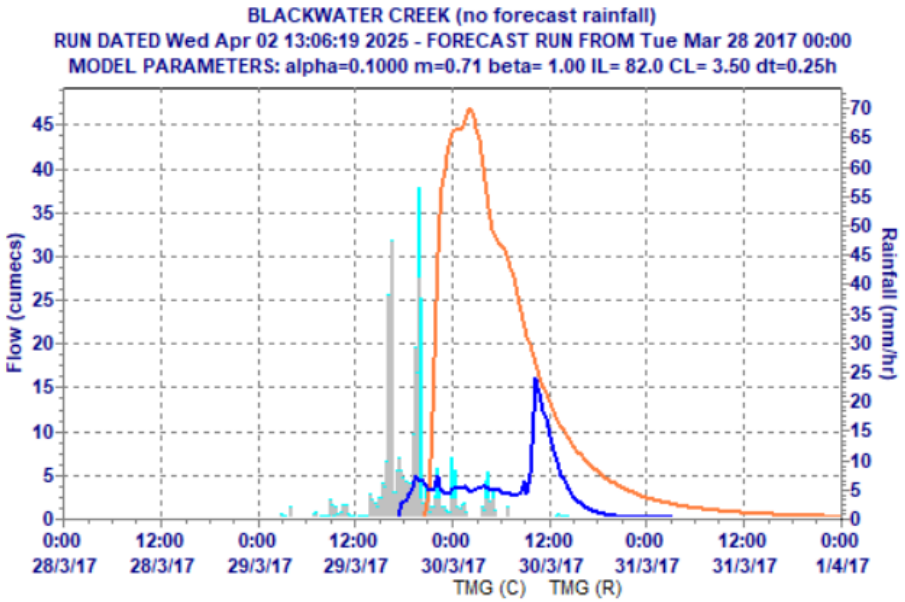


Figure A.14 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for March 2017 event at the Two Mile Gully gauge

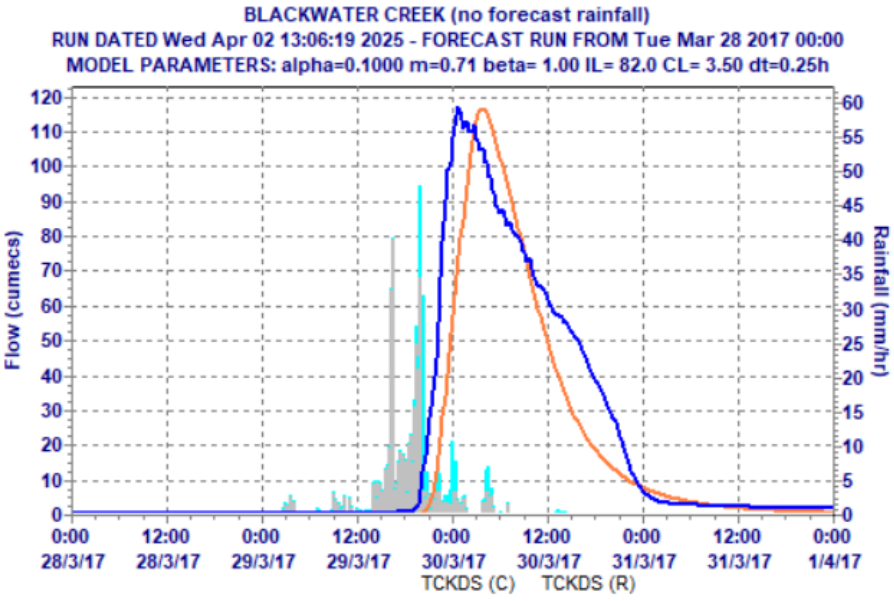


Figure A.15 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for March 2017 event at the Taurus Creek D/S gauge

A.5.5.2 January 2020 event calibration results

Figure A.16 and Figure A.17 compare the modelled/calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event.

The modelled (calculated) hydrograph matches well with the recorded hydrograph peak and shape at the Taurus Creek D/S gauge. However, the URBS model could not reproduce the recorded hydrograph shape, peak or timing further upstream at the Two Mile Gully gauge.

Compared to the March 2017 event, there are similar discrepancies observed between the recorded water level hydrographs at Two Mile Gully and Taurus Creek D/S for the January 2020 event. This suggests that the Two Mile Gully gauge may not have accurately captured the peak flood level (and hence the peak discharge) during the January 2020 event, due to similar reasons described in Section A.5.5.1 for the March 2017 event.

In consideration of the above, the calibration in Two Mile Gully and Taurus Creek is considered acceptable.

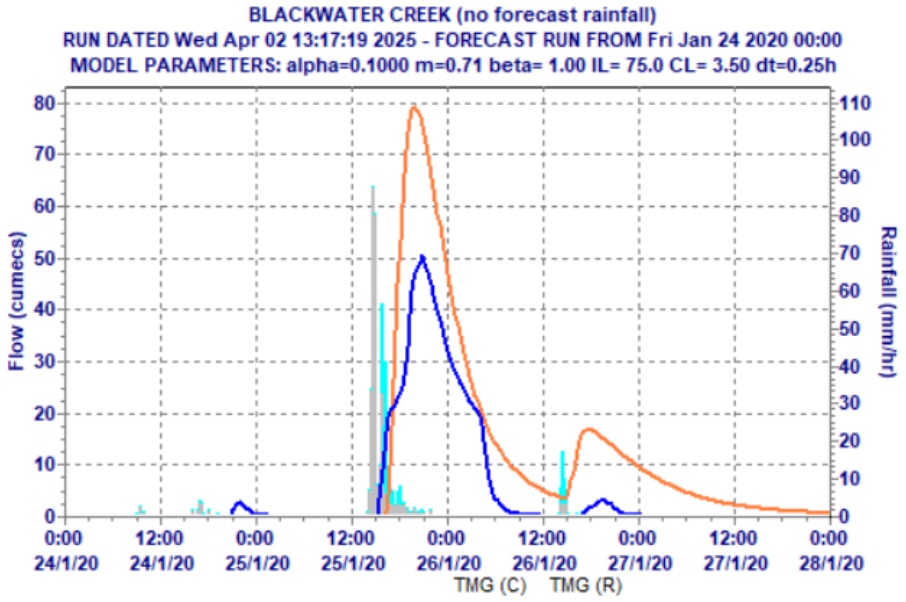


Figure A.16 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event at the Two Mile Gully gauge

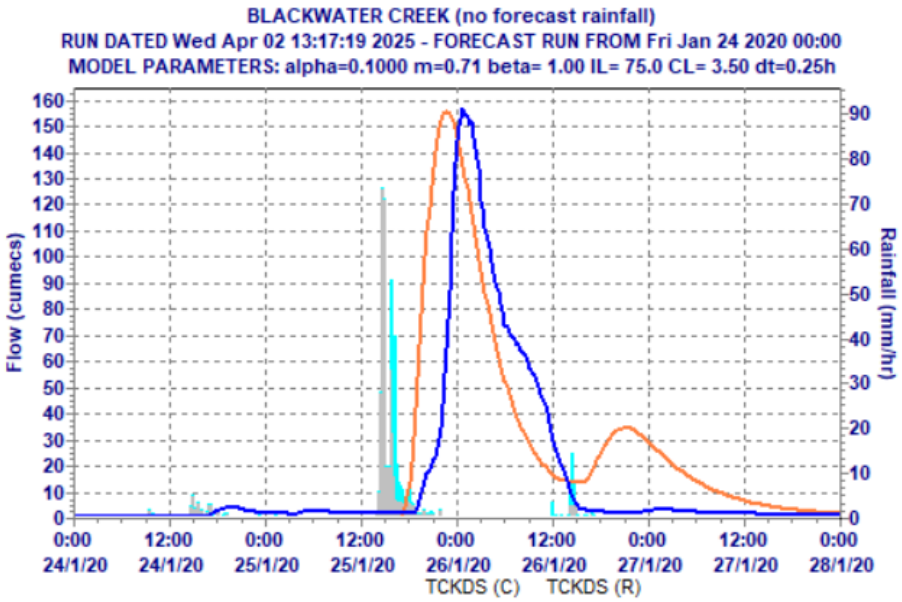


Figure A.17 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event at the Taurus Creek D/S gauge

A.6 DESIGN DISCHARGE ESTIMATION

A.6.1 Methodology

The URBS models for the Blackwater Creek and Sagittarius Creek catchments were used to estimate design discharges for the 50% (1 in 2) AEP, 5% (1 in 20) AEP, 2% (1 in 50) AEP, 1% (1 in 100) AEP, 0.01% (1 in 1,000) AEP and PMP design flood events. Design event hydrology was undertaken in accordance with ARR 2019 version 4.2 (Ball et al, 2019).

URBS model design discharge estimates were validated against discharge estimates derived using the RM, the QRT and the RFFE methods. Design peak discharges were validated for the 50%, 5%, 2% and 1% AEP events at key validation locations shown in Figure A.18.

The RM is no longer supported in the latest by ARR update as it has been updated by the RFFE method. However, it remains a useful methodology for catchments that are smaller than the dataset that has been used to define the design discharges in the RFFE methodology.

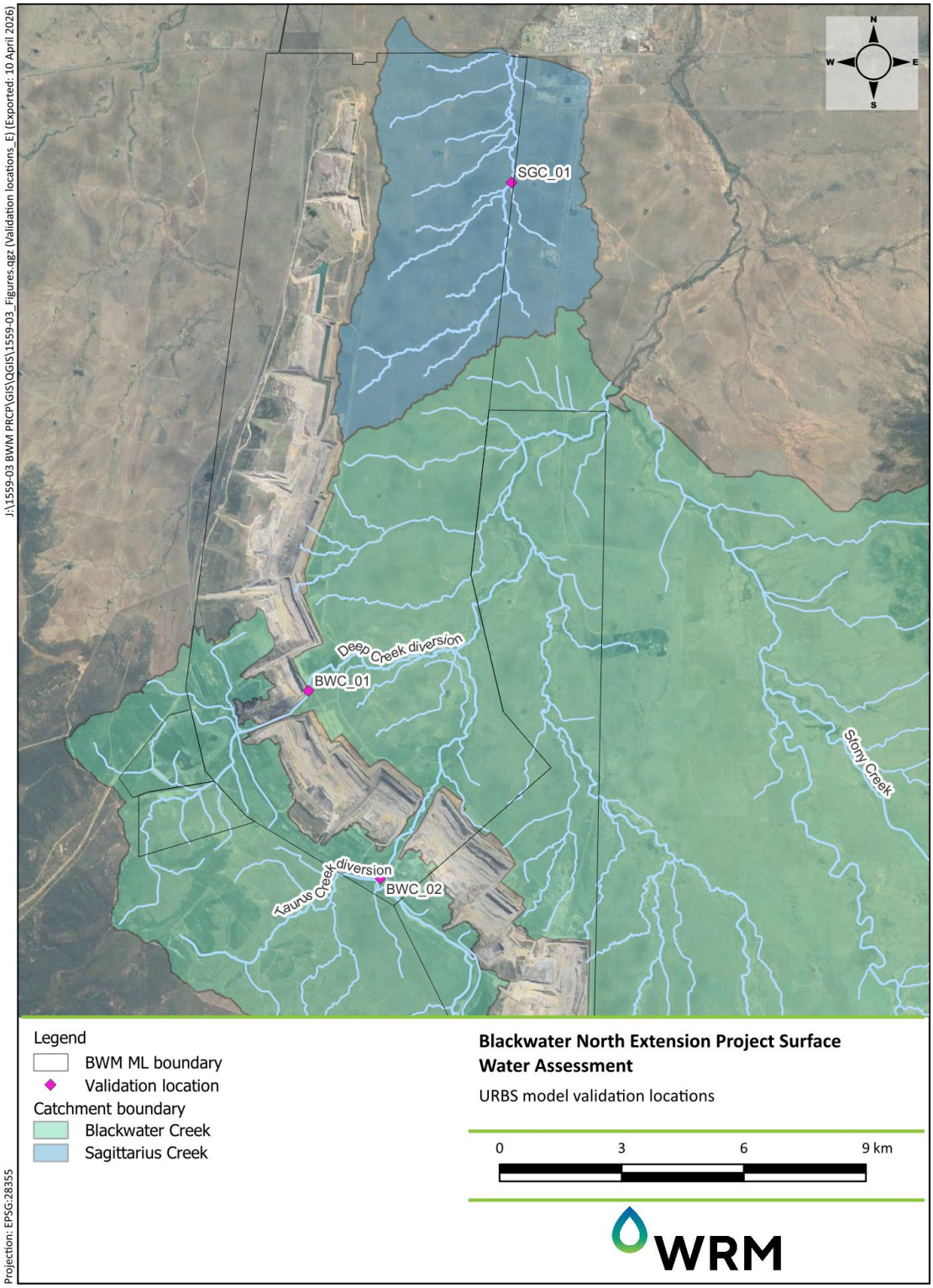


Figure A.18 URBS model validation locations

A.6.2 URBS model parameters

A.6.2.1 Global model parameters

The global URBS model parameters (α, β, M and N) given in Section A.4.2.2 were adopted for design event modelling for all models.

A.6.2.2 Design rainfalls

Desing rainfall depths was obtained from the Bureau of Meteorology (Bureau) for all events up to 0.1% AEP.

PMP rainfall depths for durations up to 6 hours were estimated using the methodology given in *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method* (Bureau, 2003).

PMP rainfall depths for durations 24 hours and longer were estimated using the standard methodology given in the *Generalised Tropical Storm Method – Revised Edition* (Bureau, 2005).

A.6.2.3 Initial and continuing losses

The adopted ILs and CLs adopted for the design event modelling are shown in Table A.10.

For the Blackwater Creek catchment, a CL of 3.5 mm/h was used which is consistent with the adopted CL for the March 2017 and January 2020 calibration events.

The Sagittarius Creek URBS model was not calibrated due the lack of data. A CL of 2.0 mm/h was adopted based on the model validation outcomes (refer to Section C.6.3).

For the extreme events rarer than 1% AEP, minimal losses (IL = 0.0 mm and CL = 1.0 mm/h) were adopted as recommended in ARR.

Table A.10 Adopted design event initial (IL) and continuing (CL) losses

Event	Blackwater Creek URBS model		Sagittarius Creek URBS model	
	IL (mm)	CL (mm/h)	IL (mm)	CL (mm/h)
50% (1 in 2) AEP to 1% (1 in 100) AEP	0.0	3.5	0.0	2.0
0.1% (1 in 1,000) AEP to PMP	0.0	1.0	0.0	1.0

A.6.3 Model validation

Table A.11, Table A.12 and Table A.13 compare the URBS model predicted peak discharges against RM, QRT and RFFE estimates for the 50% (1 in 2) AEP to 1% (1 in 100) AEP events at validation locations BWC_01, BWC_02 and SGC_01, respectively (refer to Figure A.18 for these locations).

The URBS model predicted peak discharges are similar to the RM and QRT peak discharges for the 5% to 1% AEP events. Compared to the RFFE peak discharges, the URBS model predicted peak discharges for the 5% to 1% AEP events are lower but are within the 90% confidence bounds of the RFFE estimates. For the 50% AEP event, the URBS model peak discharges are similar to the RM but are significantly higher than the QRT and RFFE peak discharges, despite adopting minimal losses.

Given the similarities in design peak discharge between URBS, the RM and QRT and the significant uncertainties in the RFFE peak discharges, the validation is considered adequate for the purpose of this flood impact assessment. Therefore, the URBS model would produce reasonable estimates of design discharges within the Blackwater Creek and Sagittarius Creek catchments.

Table A.11 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location BWC_01

AEP % (1 in X)	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	45	52	11	10	4	24
5% (1 in 20)	117	122	88	167	70	359
2% (1 in 50)	147	161	133	315	105	863
1% (1 in 100)	172	191	174	471	130	1,596

Table A.12 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location BWC_02

AEP	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	58	47	12	9	4	24
5% (1 in 20)	135	113	95	179	75	385
2% (1 in 50)	165	149	145	343	113	948
1% (1 in 100)	190	177	189	520	140	1,796

Table A.13 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location SGC_01

AEP	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	40	44	12	9	3	22
5% (1 in 20)	99	107	92	169	70	367
2% (1 in 50)	125	141	140	339	110	953
1% (1 in 100)	147	168	182	535	141	1,868

A.6.4 Design discharges

The URBS models were used to estimate design discharges for the following scenarios:

- 'Existing conditions' – Design discharge hydrographs were produced as input to the existing conditions TUFLOW hydraulic model (described in Section 8.3) to establish the baseline flooding characteristics in the vicinity of the Project.
- 'Operational (2055) conditions' – Design discharge hydrographs were produced for the local catchments in the vicinity of the Project, reflecting the changes to local catchments due to expansion of the mining pits.
- 'Final landform conditions' – Design discharge hydrographs were produced as input to the final landform conditions TUFLOW hydraulic model (described in Section 8.3) to simulate flooding characteristics in the vicinity of the Project post-closure.

The URBS model predicted design discharges are provided in Section 8.2.

APPENDIX B WATER BALANCE ASSESSMENT REPORT

Blackwater North Extension Project

Water Balance Assessment Report

Whitehaven Blackwater Pty Ltd

Doc. Ref.: WHC-037-C11

Date: 2 October 2026

Rev. No.	Doc Ref.	Report Date	Report Author	Reviewer
11	WHC-037-C11	2 October 2026	MGB	AH

For and on behalf of **HydroBalance**
Environmental and Mine Water Management Solutions

Matthew Briody
Principal Engineer

HydroBalance
Environmental and Mine Water Management Solutions
HydroBalance.au

Matthew Briody (Principal Engineer) E: Matt@HydroBalance.au M: 04 0614 4514
Ashleigh Hackett (Senior Engineer) E: Ashleigh@HydroBalance.au M: 04 6699 2924

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1 Introduction

HydroBalance was engaged by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater) to undertake a water balance assessment for the Blackwater North Extension Project (the Project), for incorporation into an application for an Environmental Authority (EA) Amendment and an application for an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval. Whitehaven Blackwater is a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven).

The Project is an extension of mining into Surface Area (SA) 10 on Mining Lease (ML) 1759 and SA7 on ML1762 utilising existing Blackwater Mine (BWM) mining methods, mining fleet, mine infrastructure and facilities.

2 Site water balance assessment overview

A computer-based operational simulation model was used to assess the dynamics of the BWM water balance under conditions of varying rainfall and catchment conditions throughout the development of the Project duration. The water balance model developed for this assessment covers the period of July 2025 to June 2055 (30 years in total). The Project commences in 2030, and mining in the Project area ceases in 2055. GoldSim was selected to represent the operational water balance, enabling dynamic simulation of the site water management system over the assessment period.

The GoldSim model dynamically simulates the operation of the water management system and keeps a complete account of all site water volumes and representative water quality on a daily time step. The model has been configured to simulate the operations of all major components of the water management system. The simulated inflows and outflows included in the model are given in Table 2.1.

Table 2.1 – Simulated inflows and outflows to the water management system

Inflows	Outflow
Direct rainfall on the water surface of storages	Evaporation from the water surface of storages
Catchment runoff	Net Coal Handling and Preparation Plant (CHPP) losses
External water supply (Bedford East and Bedford West pipelines)	Haul road dust suppression losses
Groundwater inflows to pits	Controlled releases
	Dam overflows
	Seepage from storages

Details of the development of the GoldSim model, including a description of the inflows and outflows to the water management system, are provided in the following sections.

3 Mine plan stages

The BWM water balance model includes ten representative stages to represent the progression of mining over the 30-year simulation, as shown in Table 2.1. Stage 0 was used to calibrate the water balance model against data recorded between July 2024 and June 2025. Stage 1 is an interim stage that covers the 1-year period between the end of the calibration and the start of the Project forecast simulation. Stages 2 to 9 have been set up to provide a forecast of the BWM Water Management System (WMS) performance over the simulation period.

The forecast model was run for 107 climatic realisations developed using 136 years of stochastic rainfall data in order to assess a wide range of climatic scenarios.

Table 3.1 – Modelled Life-of-Mine forecast stages

Representative stage	Description	Applied date range	Duration
Stage 0	Calibration	1 July 2024 – 30 June 2025	1 year
Stage 1 (financial year [FY]26)	Interim period	1 July 2025 – 30 June 2026	1 years
Stage 2 (FY27)	Forecast	1 July 2026 – 30 June 2027	1 year
Stage 3 (FY28)	Forecast	1 July 2027 – 30 June 2028	1 year
Stage 4 (FY29)	Forecast	1 July 2028 – 30 June 2029	1 year
Stage 5 (FY30-FY34)	Forecast	1 July 2029 – 30 June 2034	5 years
Stage 6 (FY35-FY40)	Forecast	1 July 2034 – 30 June 2040	6 years
Stage 7 (FY41-FY45)	Forecast	1 July 2040 – 30 June 2045	5 years
Stage 8 (FY46-FY50)	Forecast	1 July 2045 – 30 June 2050	5 years
Stage 9 (FY51-FY55)	Forecast	1 July 2050 – 30 June 2055	5 years

4 Catchment mapping

4.1 Existing conditions mapping

Figure 4.1 to Figure 4.3 show the catchment areas and land use types at BWM for current condition (FY26). A breakdown of catchment land use types and areas reporting to each of the water storages is shown in Table 3.1.

Table 4.1 – Catchment areas by storage for the BWM WMS

Storage	Catchment area per landuse type (hectare [ha])						Total (ha)
	Natural	Spoil	Rehab	Tailings	Hardstand/ pit	Disturbed	
R8N	0.0	0.0	6.8	0.0	9.2	7.3	**23.3**
Rangal Dam	0.6	0.0	0.0	0.0	1.0	0.0	**1.6**
R10	190.7	104.1	61.3	41.4	17.5	24.2	**493.1**
R12 FPD	1.0	0.0	7.1	0.0	2.7	0.0	**10.8**
R14	48.4	22.4	65.1	0.0	50.4	81.3	**267.6**
R16	23.8	113.4	29.2	0.0	135.5	47.2	**349.1**
R20	23.2	154.1	6.2	0.0	29.8	52.2	**265.5**
R26	0.0	134.8	1.1	0.0	32.4	85.0	**253.2**
Thermal Coal Plant (TCP) Dam	3.8	0.0	0.0	0.0	14.0	1.7	**19.6**
R28 FPD	1.3	0.0	60.0	0.0	4.6	0.0	**65.9**
R30N	0.0	126.9	102.1	0.0	41.5	59.0	**329.5**
R30S	0.9	10.3	44.6	0.0	53.3	29.9	**139.0**
R34	0.0	128.9	1.7	0.0	53.2	45.1	**228.9**
R34 Dam	3.7	0.0	8.4	0.0	16.1	0.0	**45.8**
New Deep Creek Dam (NDCD)	1444.7	24.2	255.1	0.0	65.4	122.9	**1,912.4**
Top Dam	0.0	0.0	0.0	0.0	0.6	0.8	**1.4**
NCHPP Supply Dam	1.9	0.0	0.0	0.0	1.4	2.6	**5.9**
NCHPP Sed Dam/ Blacks Dam	0.0	0.3	0.0	0.0	0.1	1.6	**2.0**
Rejects Dam	27.4	58.3	0.0	0.0	16.0	8.2	**110.0**
North CHPP Tailings Dam	0.0	0.0	0.0	156.7	0.0	0.0	**156.7**
TSF Seepage Dam	2.1	0.0	0.0	14.6	37.0	6.0	**59.8**
New Taurus Creek Dam (NTCD)	3,834.2	74.8	1,106.6	0.0	117.7	77.0	**5,210.3**
R38	0.0	128.7	29.4	0.0	24.1	51.1	**233.4**
R40 FPD	0.0	0.0	0.0	0.0	0.8	0.6	**1.4**
R42	37.8	128.3	0.0	0.0	84.5	84.4	**335.0**
R46N/S	0.0	22.1	0.0	0.0	28.1	40.1	**90.3**

Storage	Catchment area per landuse type (hectare [ha])						Total (ha)
	Natural	Spoil	Rehab	Tailings	Hardstand/ pit	Disturbed	
R47	0.0	25.2	30.4	0.0	26.8	55.5	**137.9**
R48	0.0	115.3	32.7	0.0	76.4	77.8	**302.1**
South MAW Dam	1.6	0.0	0.0	0.0	11.9	0.9	**14.4**
Pond 1-6	0.0	0.0	0.0	0.0	10.4	2.6	**13.0**
Western MAW Dam	0.0	0.0	0.0	0.0	5.8	0.0	**5.8**
Workshop 4 Dam	0.0	0.0	0.0	0.0	24.9	3.9	**28.8**
Tannyfoil Dam (TFD)	0.0	0.0	0.0	0.0	18.7	3.6	**22.3**
Central RWD	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**
R52N	0.0	78.4	9.7	0.0	23.1	13.8	**125.0**
R52S	0.0	45.7	122.2	0.0	82.1	75.9	**325.9**
R52 FPD	0.0	0.0	0.0	0.0	2.0	0.0	**2.0**
R52 ROM Dam	0.0	0.0	0.0	0.0	5.1	0.0	**5.1**
R54 FPD	0.0	0.0	114.0	0.0	9.6	0.7	**124.3**
R54 MAW Dam	0.0	0.0	1.1	0.0	2.7	0.0	**3.8**
R54	0.0	102.9	31.7	0.0	78.2	46.1	**258.8**
R56	2.7	350.7	123.9	0.0	127.3	72.4	**677.0**
R62	119.8	93.9	95.1	0.0	32.4	38.1	**379.3**
R62 FPD	936.3	3.5	297.4	0.0	61.2	10.9	**1,309.3**
R64/66	3.6	0.7	18.8	0.0	62.7	8.0	**93.8**
Kenmare RWD	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**
Red Claw Dam	44.5	0.0	0.0	0.0	22.3	32.0	**98.7**
Bear Park Dam	0.0	0.0	0.0	0.0	0.6	0.0	**0.6**
R70 WSP	40.8	34.4	30.2	0.0	30.2	25.4	**161.0**
Upper Red Dam (Holding Dam)	2.0	0.0	6.7	0.0	2.0	26.1	**36.7**
Lower Red Dam	0.0	0.0	4.6	0.0	1.3	20.2	**26.1**
Baby Red Dam	0.0	0.0	0.0	0.0	0.1	3.6	**3.7**
No 1 Dam	0.2	0.0	0.0	0.0	13.2	4.4	**17.7**
No 2 Dam	37.1	0.0	1.6	0.0	26.4	24.8	**90.0**
Bottom Dam	0.0	0.0	0.0	0.0	10.9	9.6	**20.4**
Duck Pond	0.0	0.0	2.6	0.0	0.4	1.1	**4.2**
Goldfish Bowl	0.0	0.0	2.2	0.0	0.3	0.0	**2.5**
Old Cut 4	10,841.8	0.0	9.6	0.0	8.9	192.8	**11,052.7**
R72 TSF	168.0	21.9	24.2	27.4	0.0	45.0	**286.5**
R74 TSF	45.2	0.0	75.9	51.5	0.0	63.9	**236.6**
R76	0.0	47.0	20.8	0.0	14.9	0.0	**82.6**

Storage	Catchment area per landuse type (hectare [ha])						Total (ha)
	Natural	Spoil	Rehab	Tailings	Hardstand/ pit	Disturbed	
R80	8.5	21.9	102.3	0.0	41.9	58.5	**233.1**
R82 FPD	524.7	0.0	90.3	0.0	1.1	37.3	**653.5**
R84	23.8	68.9	35.3	0.0	25.2	13.2	**166.3**
TOTAL	**18,441**	**2,442**	**3,059**	**292**	**1,623**	**1,789**	**27,445**

Notes: WSP = Water Storage Pit
FPD = Fill Point Dam
RWD = Raw Water Dam
TSD = Tailings Storage Dam

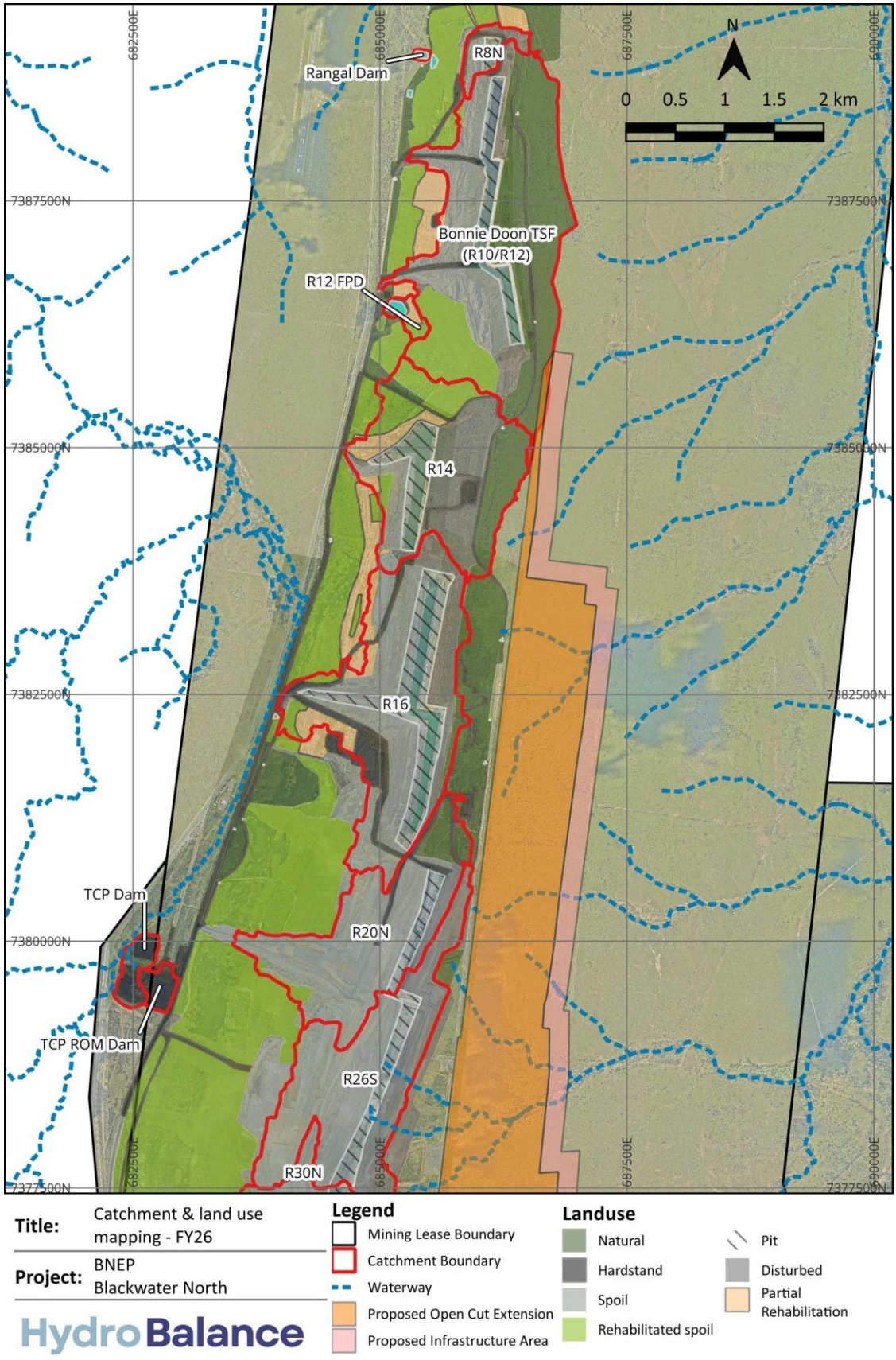


Figure 4.1 – Catchment and land use mapping – Blackwater North (FY26)

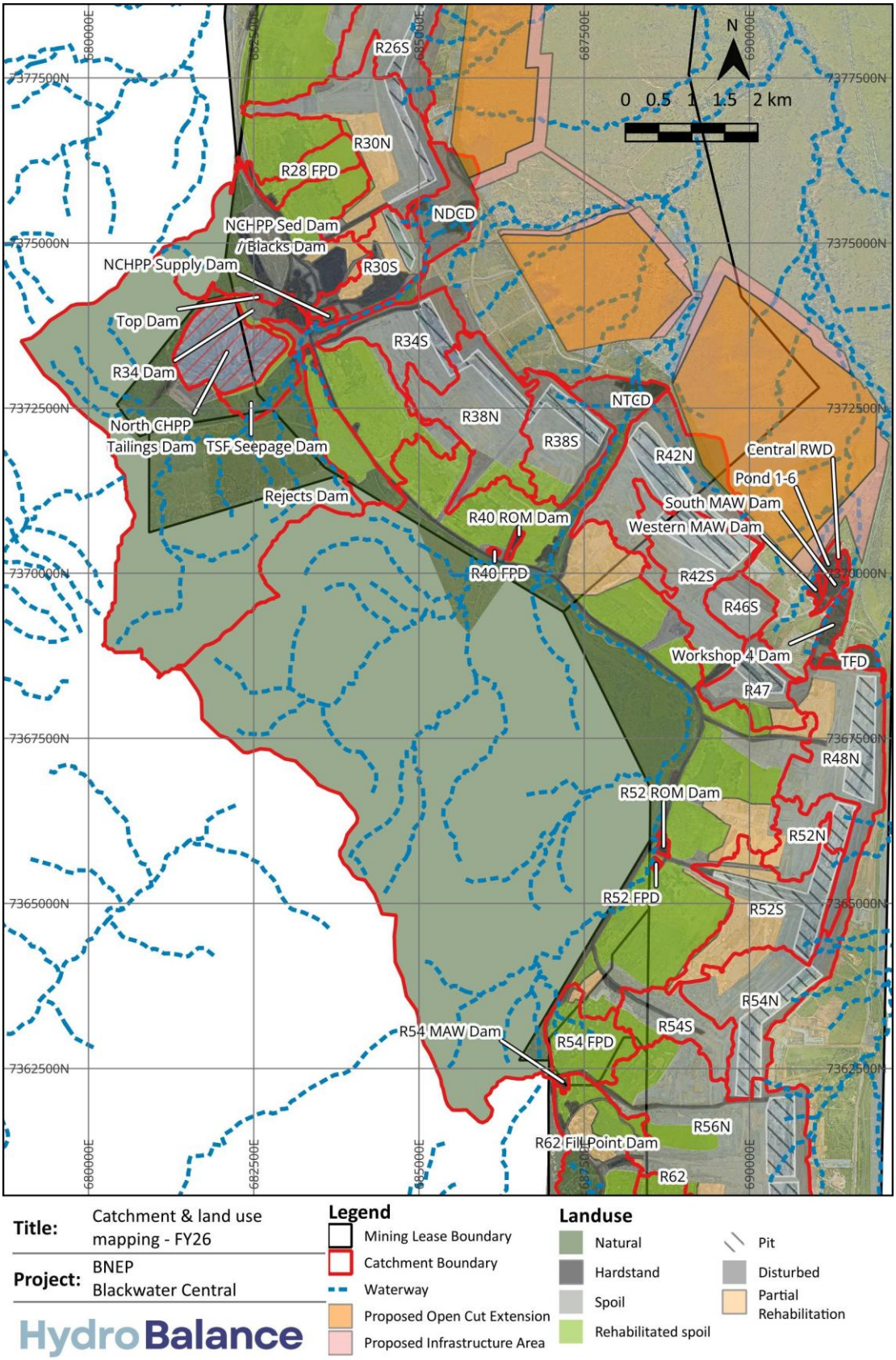


Figure 4.2 – Catchment and land use mapping – Blackwater Central (FY26)

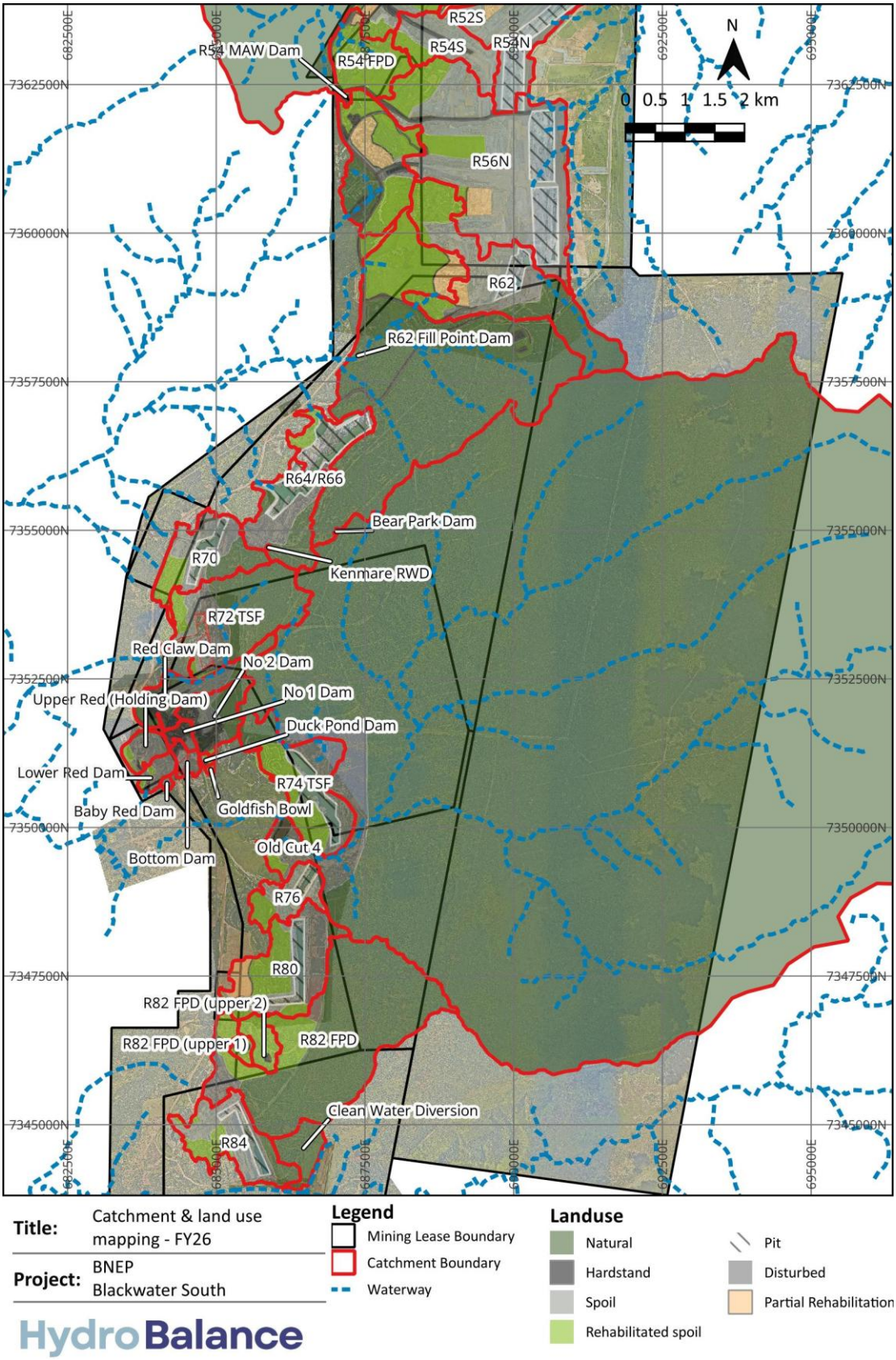


Figure 4.3 - Catchment and land use mapping - South (FY26)

4.2 Forecast catchment mapping

A set of catchment maps have been developed for selected snapshots between FY27 and FY55, in line with the model stages shown in Table 3.1. These maps have been based on staged mine plans provided by Whitehaven.

The catchment mapping for each of the eight future model stages is presented in Figure 4.4 to Figure 4.30.

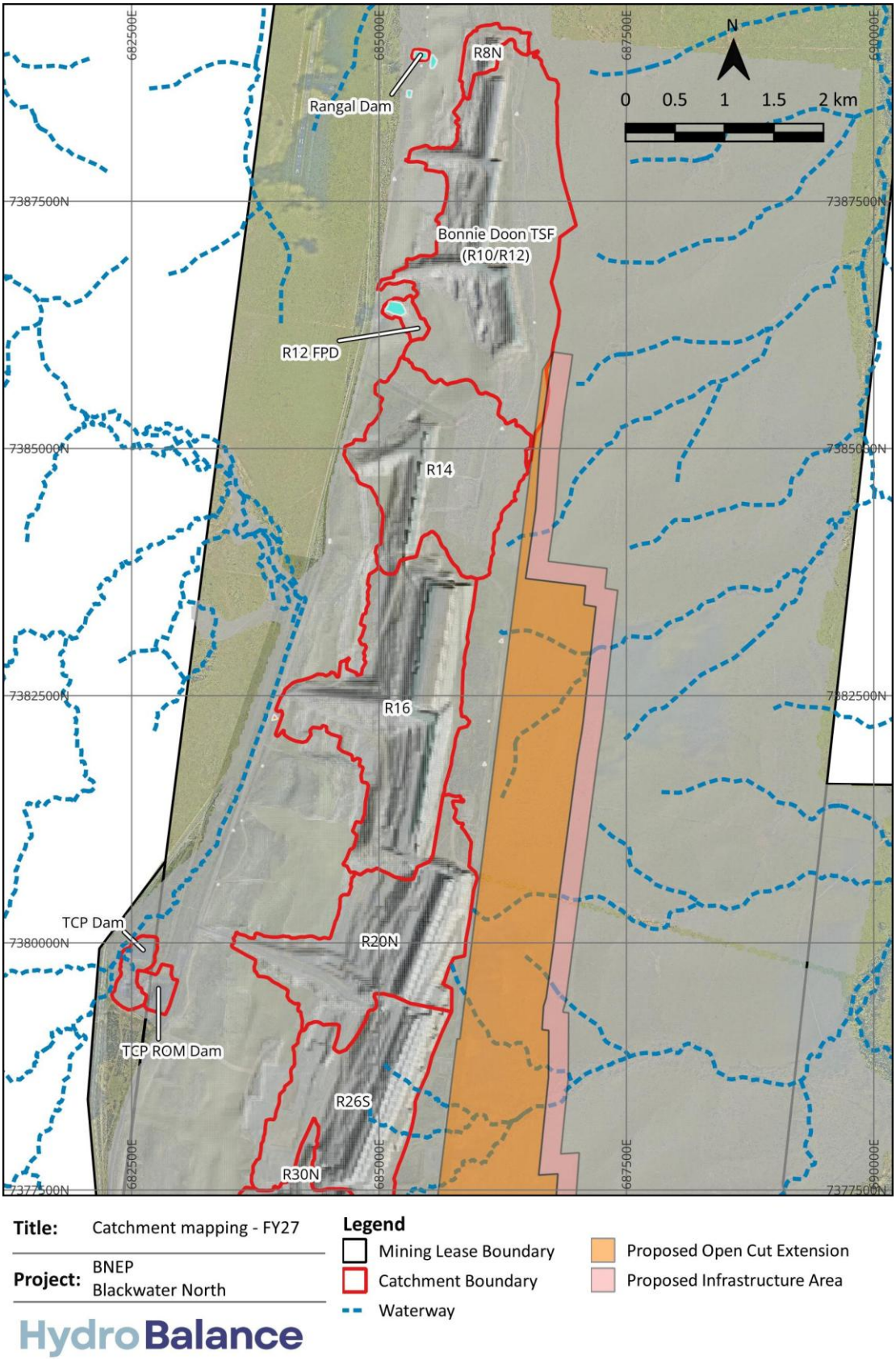


Figure 4.4 - Catchment mapping - Blackwater North - FY27

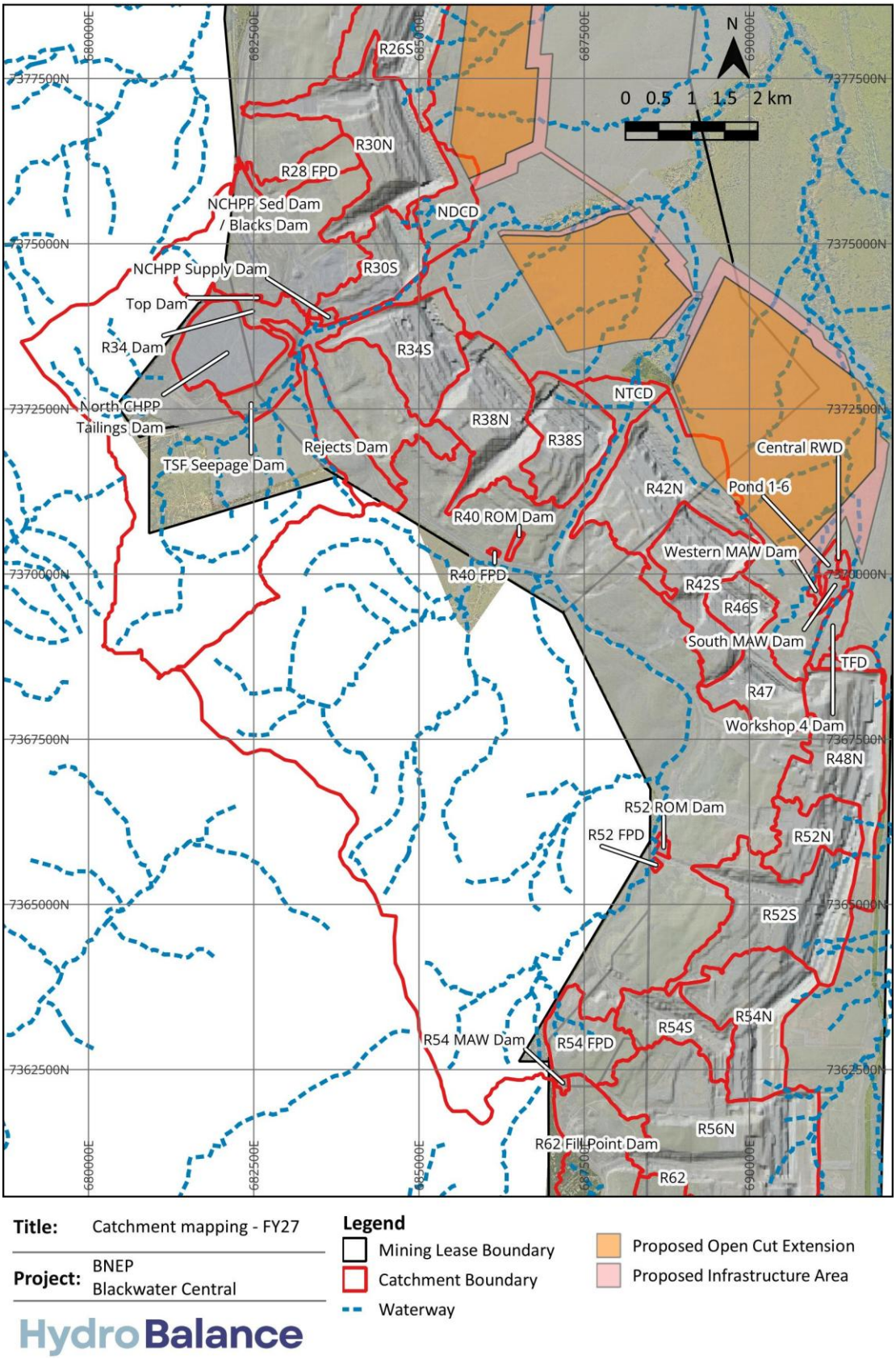
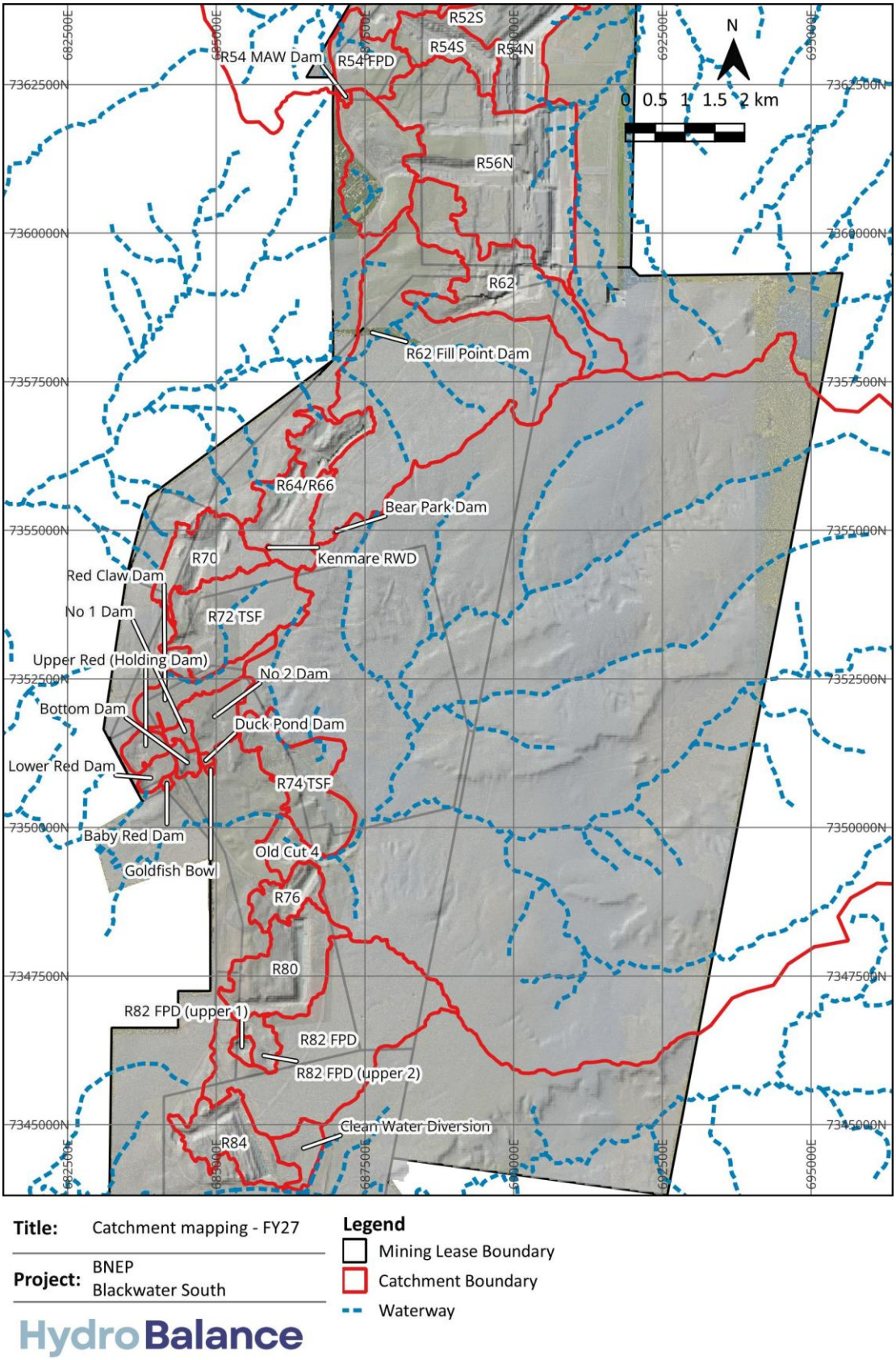


Figure 4.5 - Catchment mapping - Blackwater Central - FY27



Title: Catchment mapping - FY27

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway

Figure 4.6 - Catchment mapping - Blackwater South - FY27

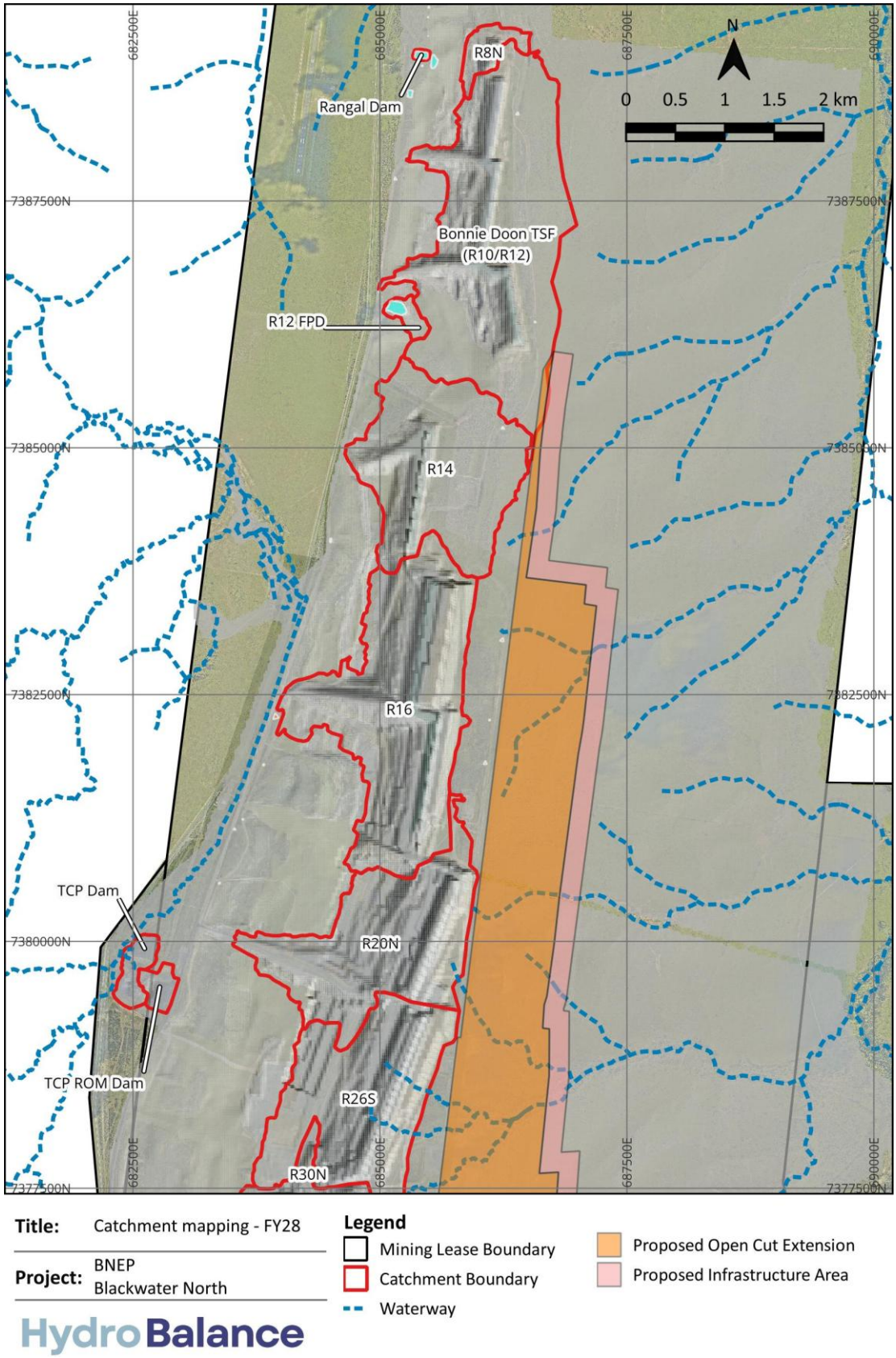
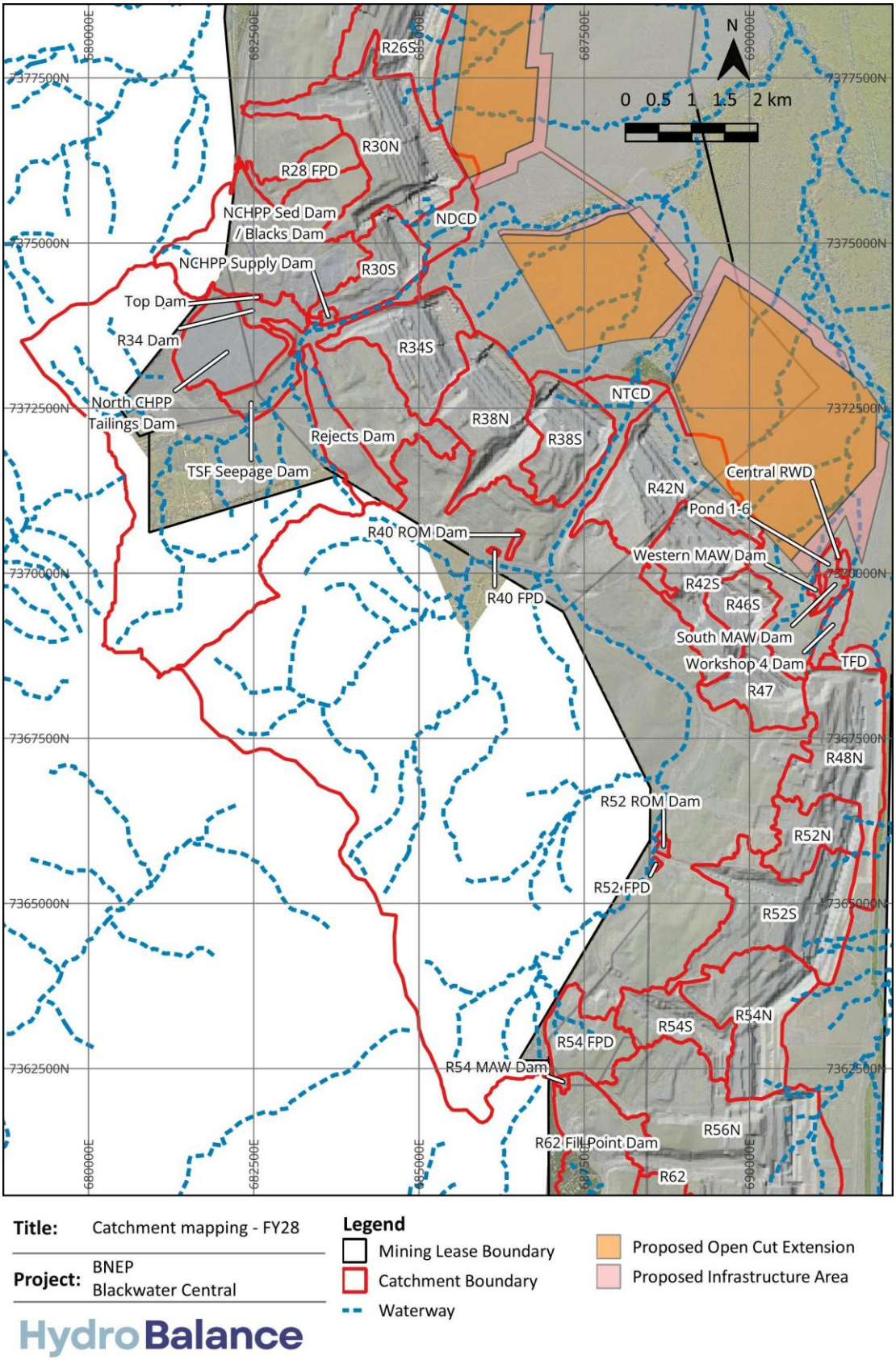


Figure 4.7 - Catchment mapping - Blackwater North - FY28



Title: Catchment mapping - FY28

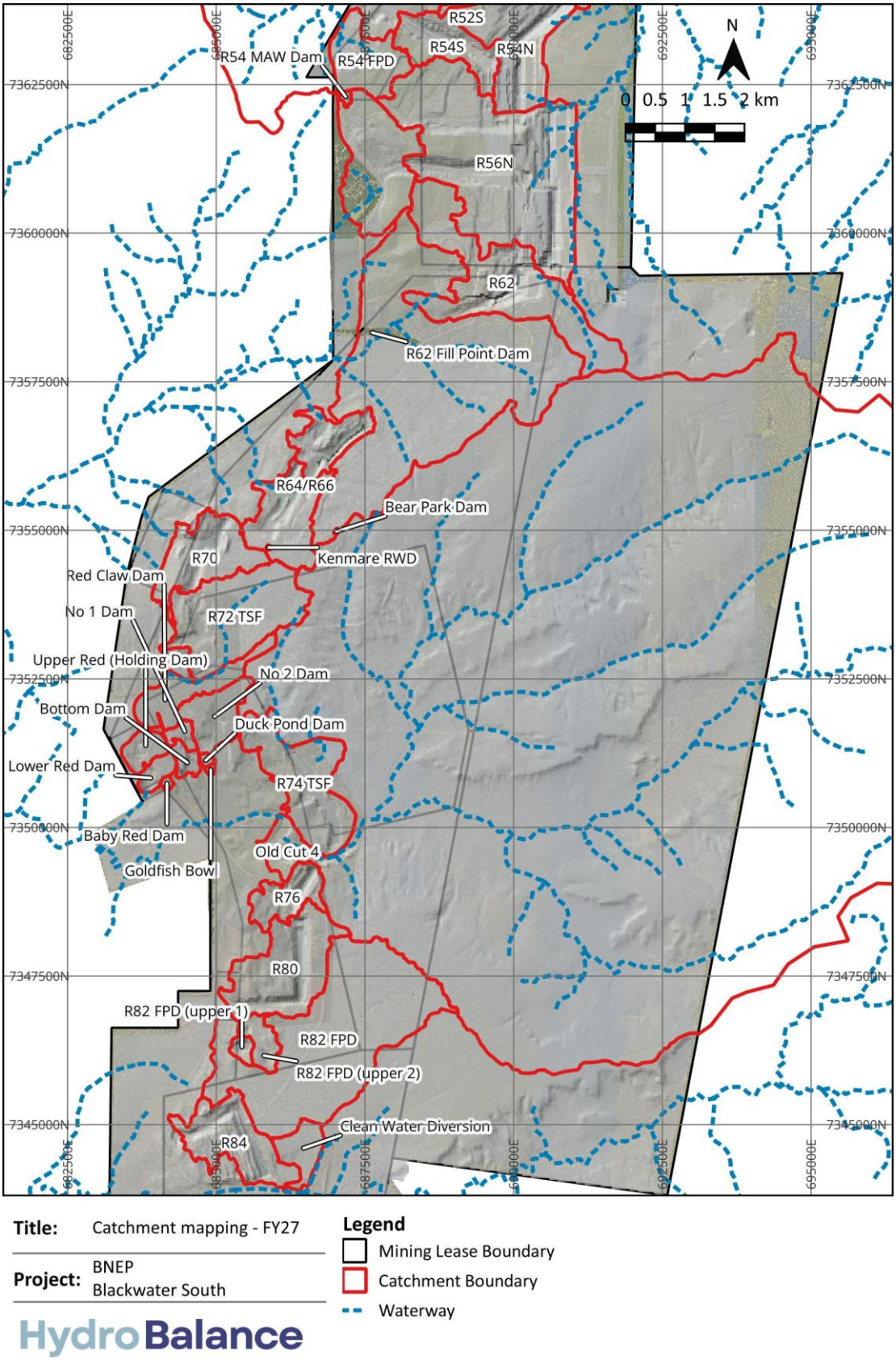
Project: BNEP Blackwater Central

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Figure 4.8 - Catchment mapping - Blackwater Central - FY28



Title: Catchment mapping - FY27

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway

Figure 4.9 - Catchment mapping - Blackwater South - FY28

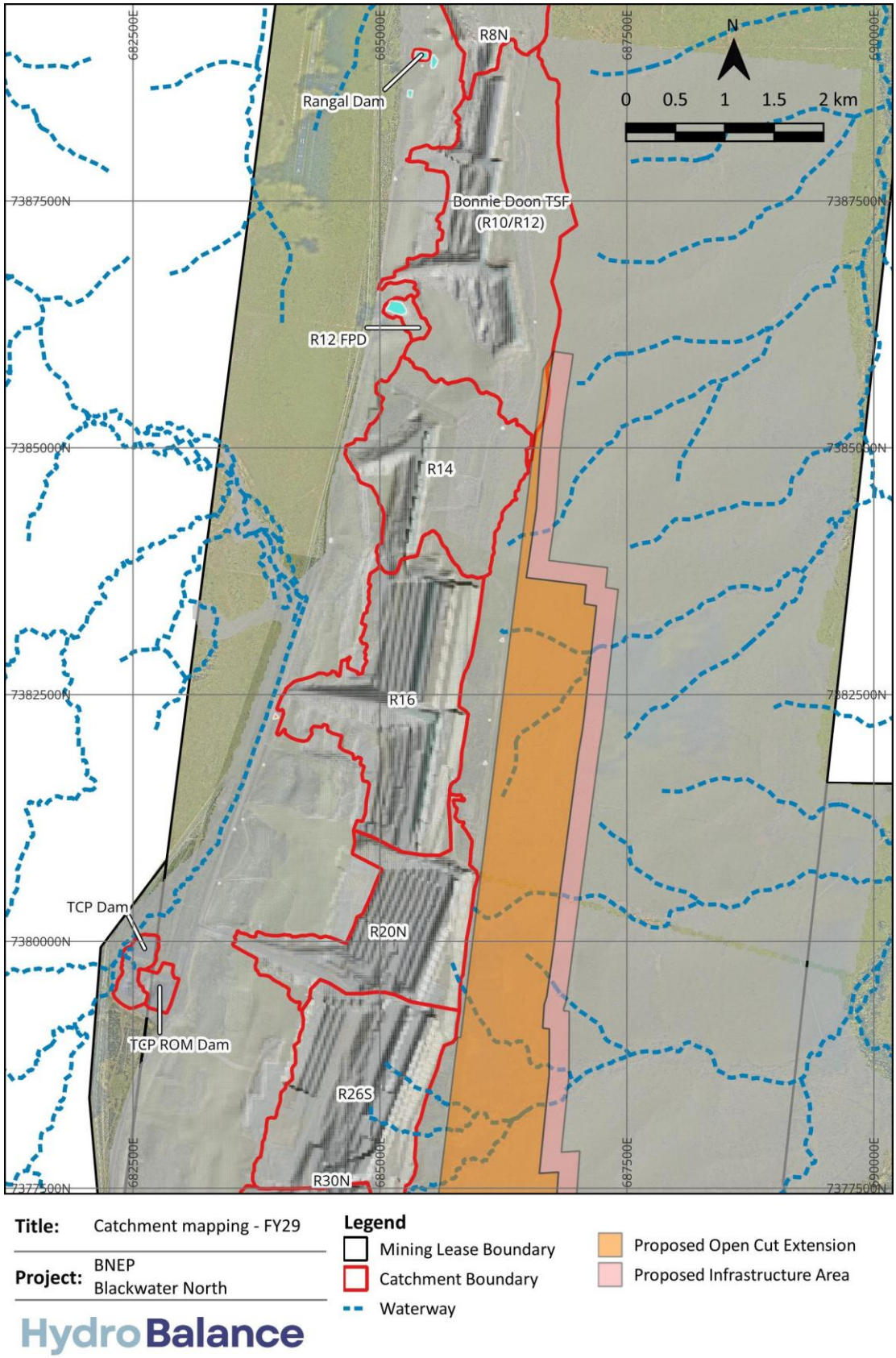


Figure 4.10 - Catchment mapping - Blackwater North - FY29

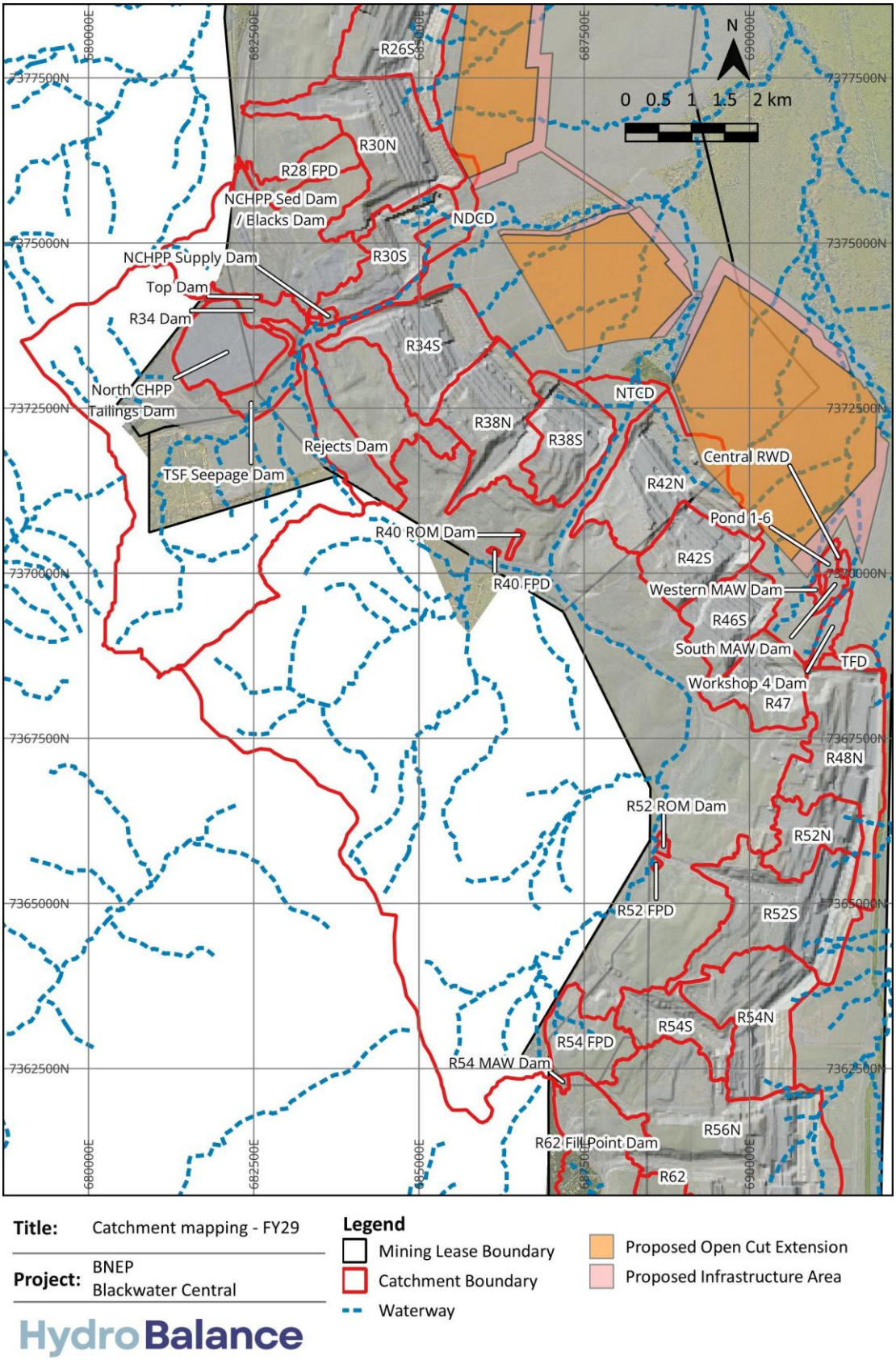


Figure 4.11 - Catchment mapping - Blackwater Central - FY29

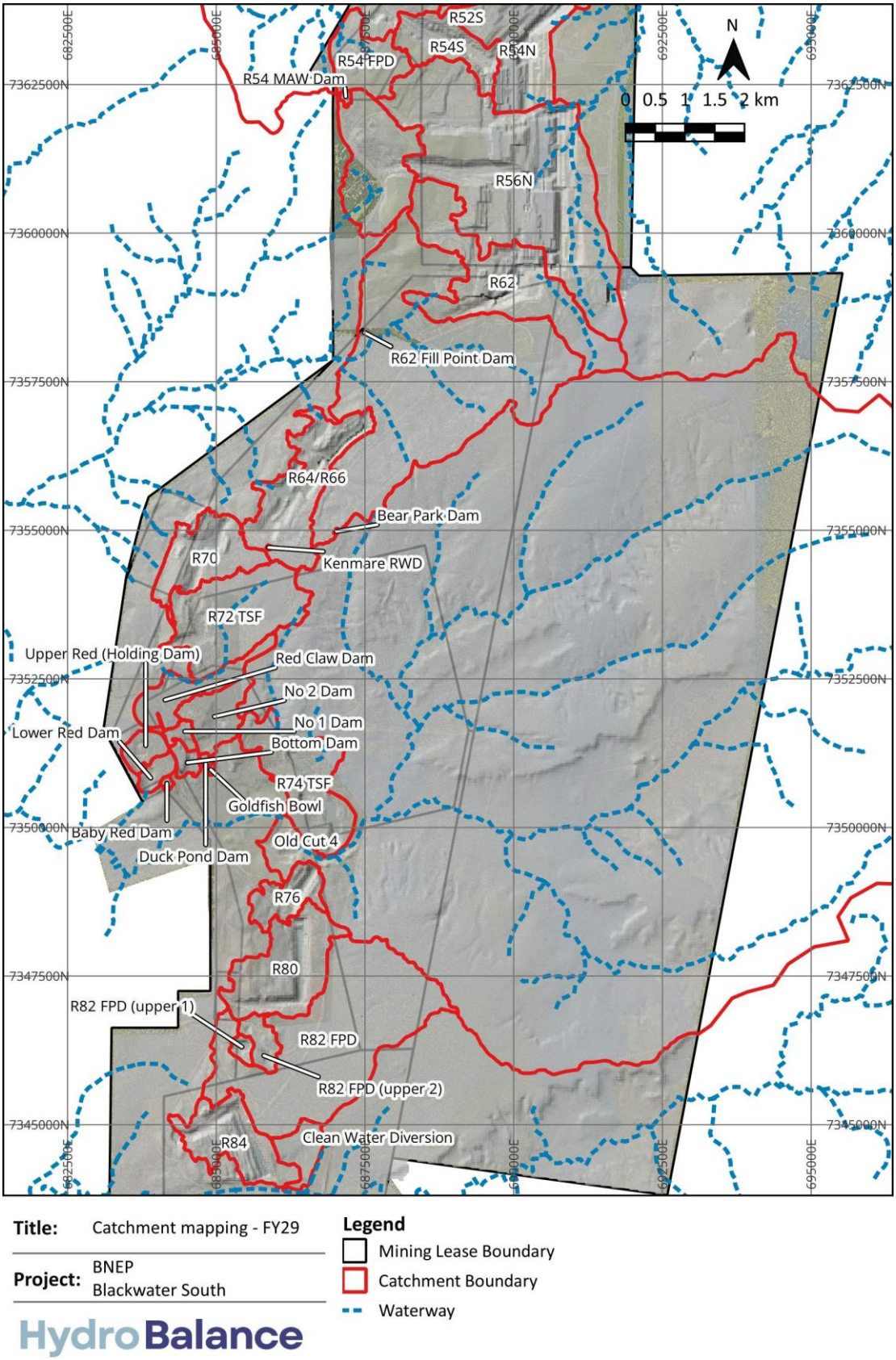


Figure 4.12 - Catchment mapping - Blackwater South - FY29

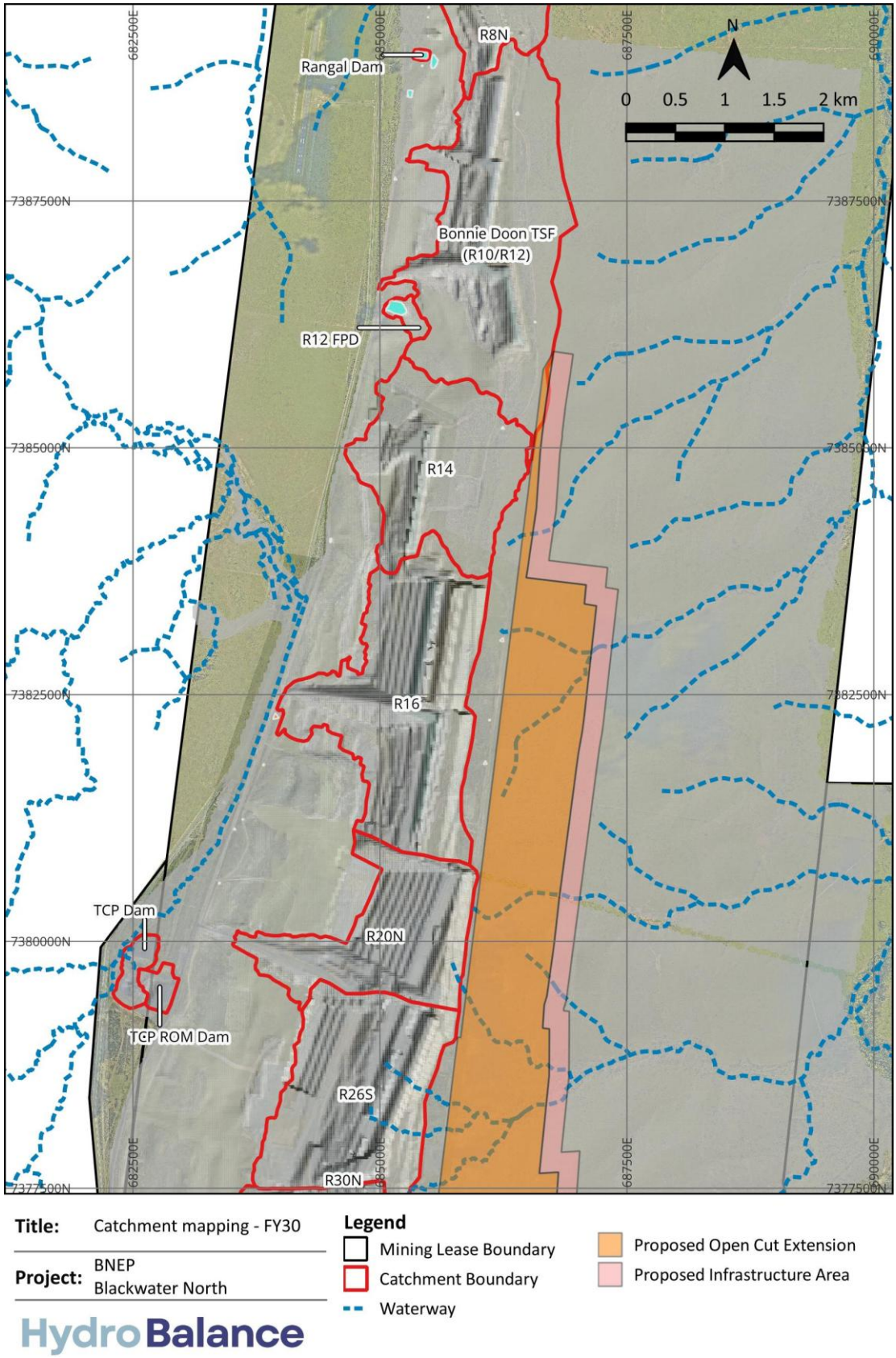


Figure 4.13 - Catchment mapping - Blackwater North - FY30

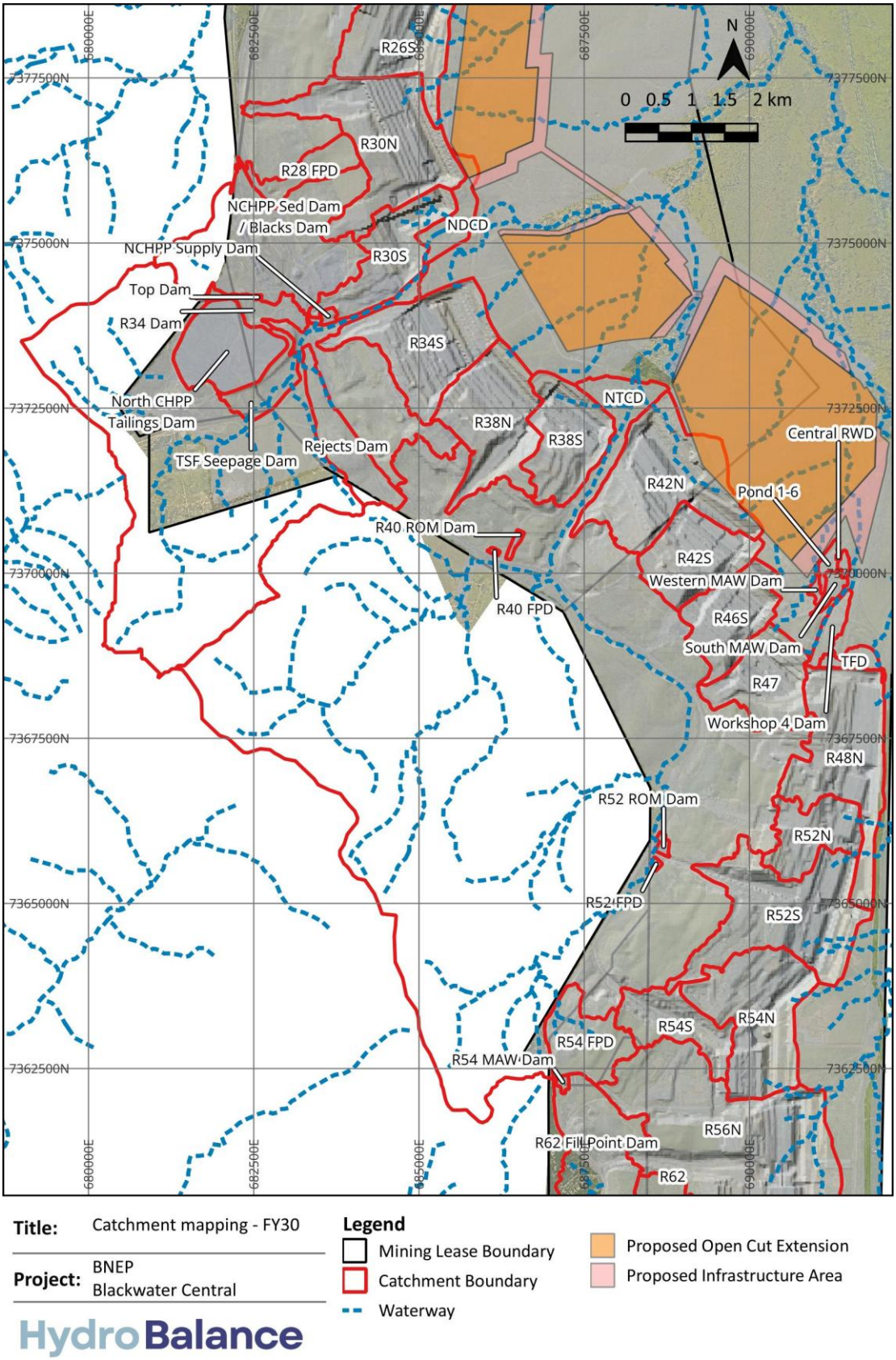
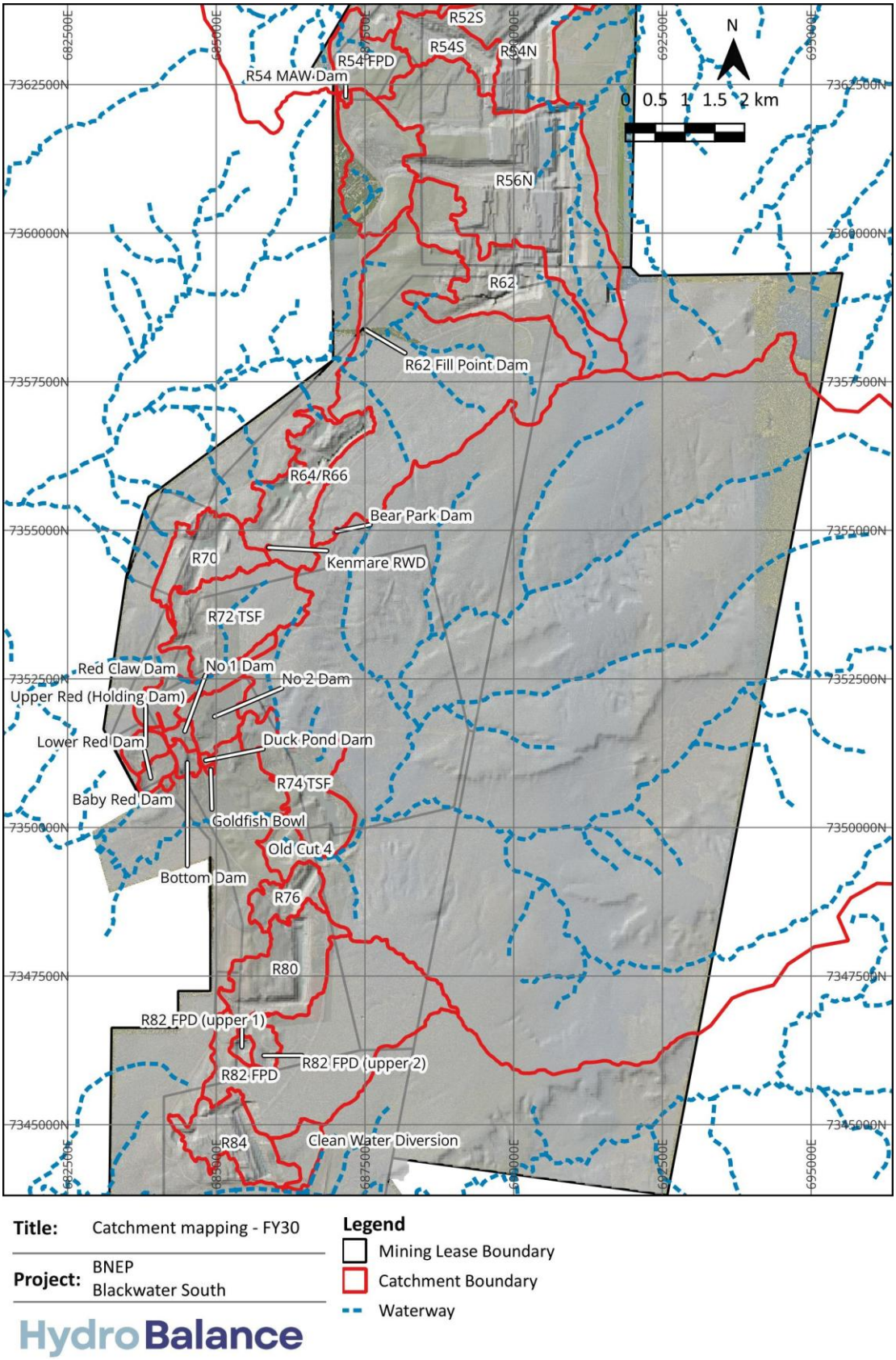


Figure 4.14 - Catchment mapping - Blackwater Central - FY30



Title: Catchment mapping - FY30

Project: BNEP Blackwater South

Legend
- Mining Lease Boundary
- Catchment Boundary
- Waterway

HydroBalance

Figure 4.15 - Catchment mapping - Blackwater South - FY30

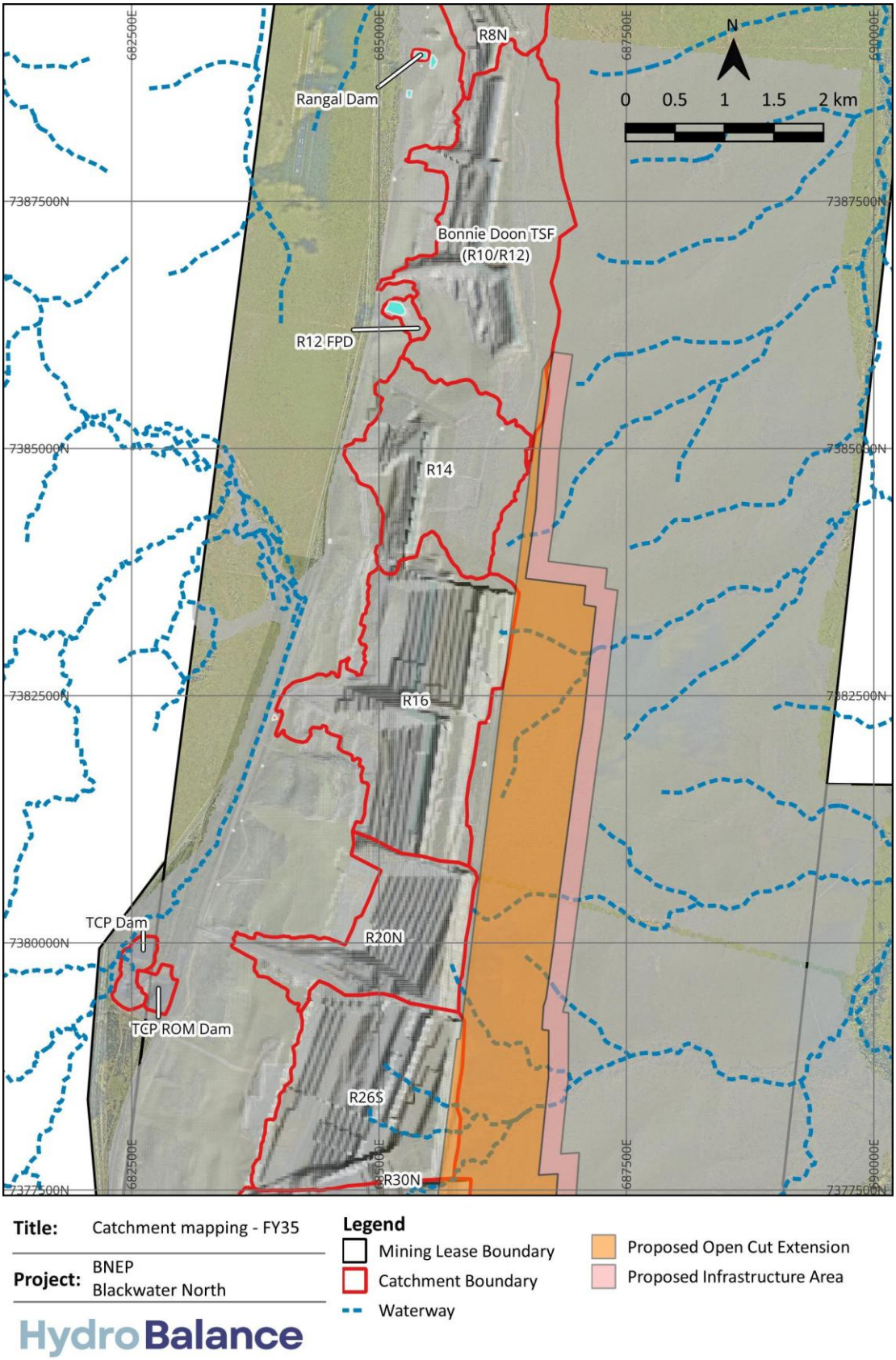


Figure 4.16 - Catchment mapping - Blackwater North - FY35

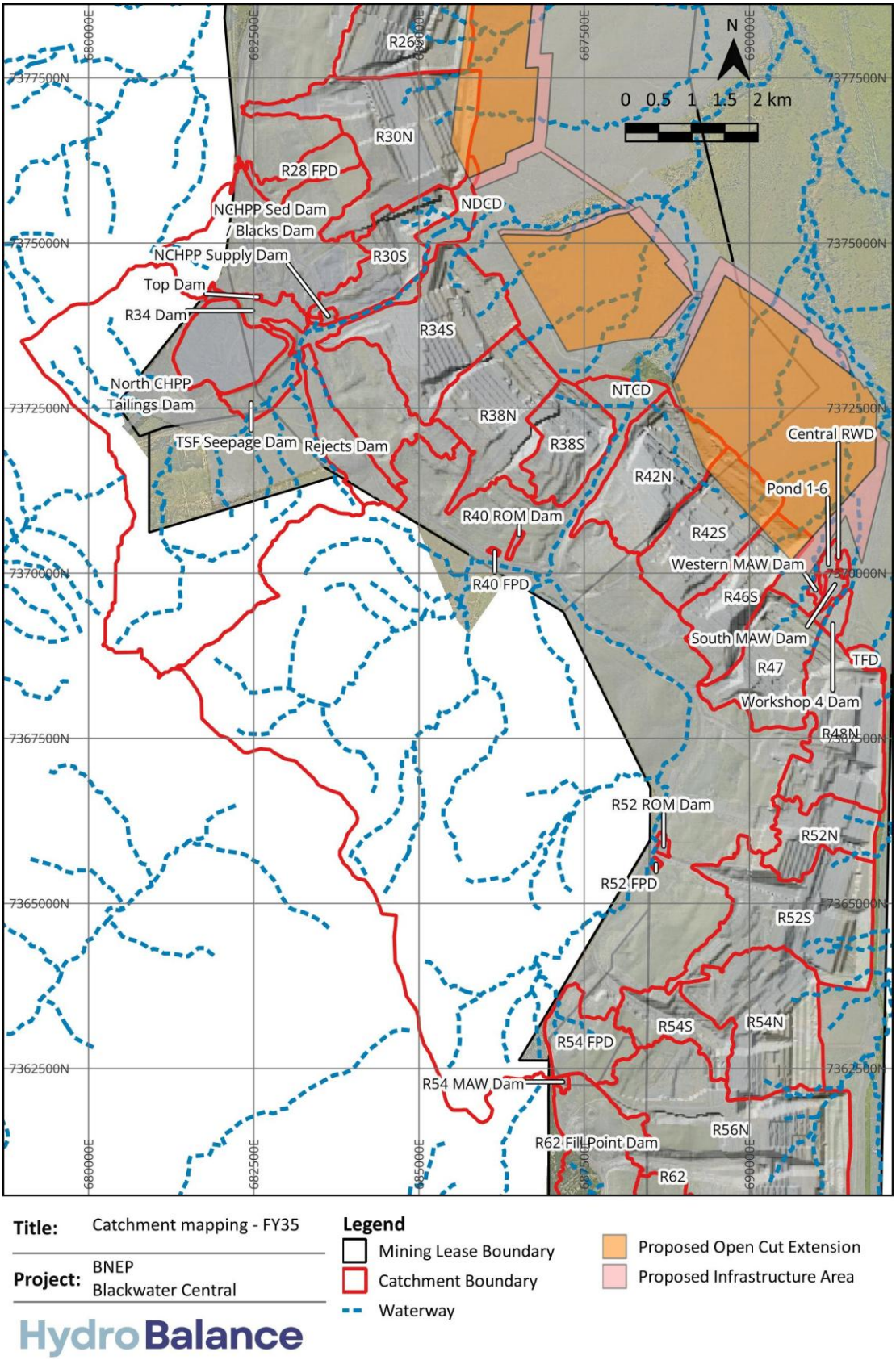
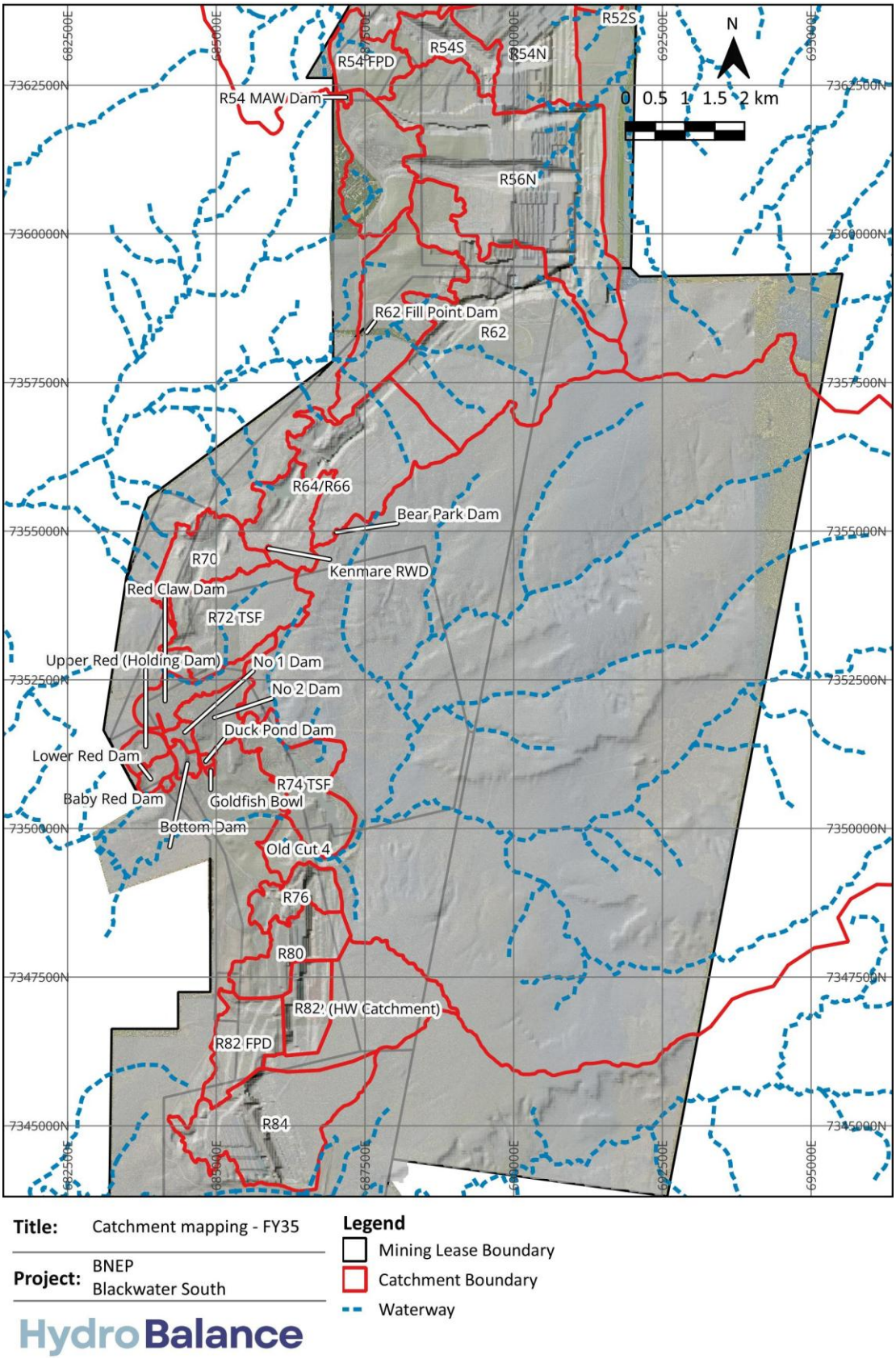


Figure 4.17 - Catchment mapping - Blackwater Central - FY35



Title: Catchment mapping - FY35

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway

Figure 4.18 - Catchment mapping - Blackwater South - FY35

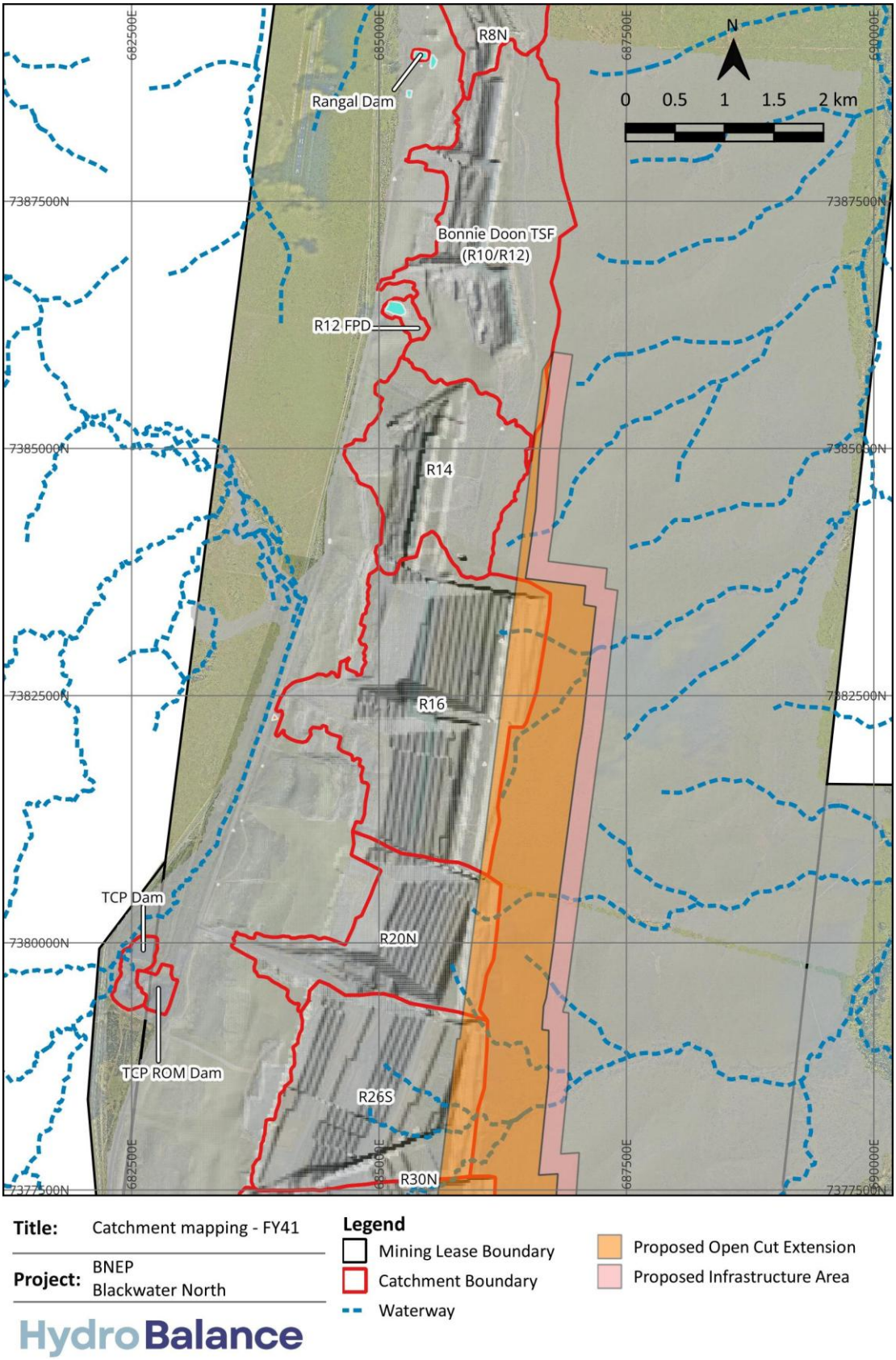


Figure 4.19 - Catchment mapping - Blackwater North - FY41

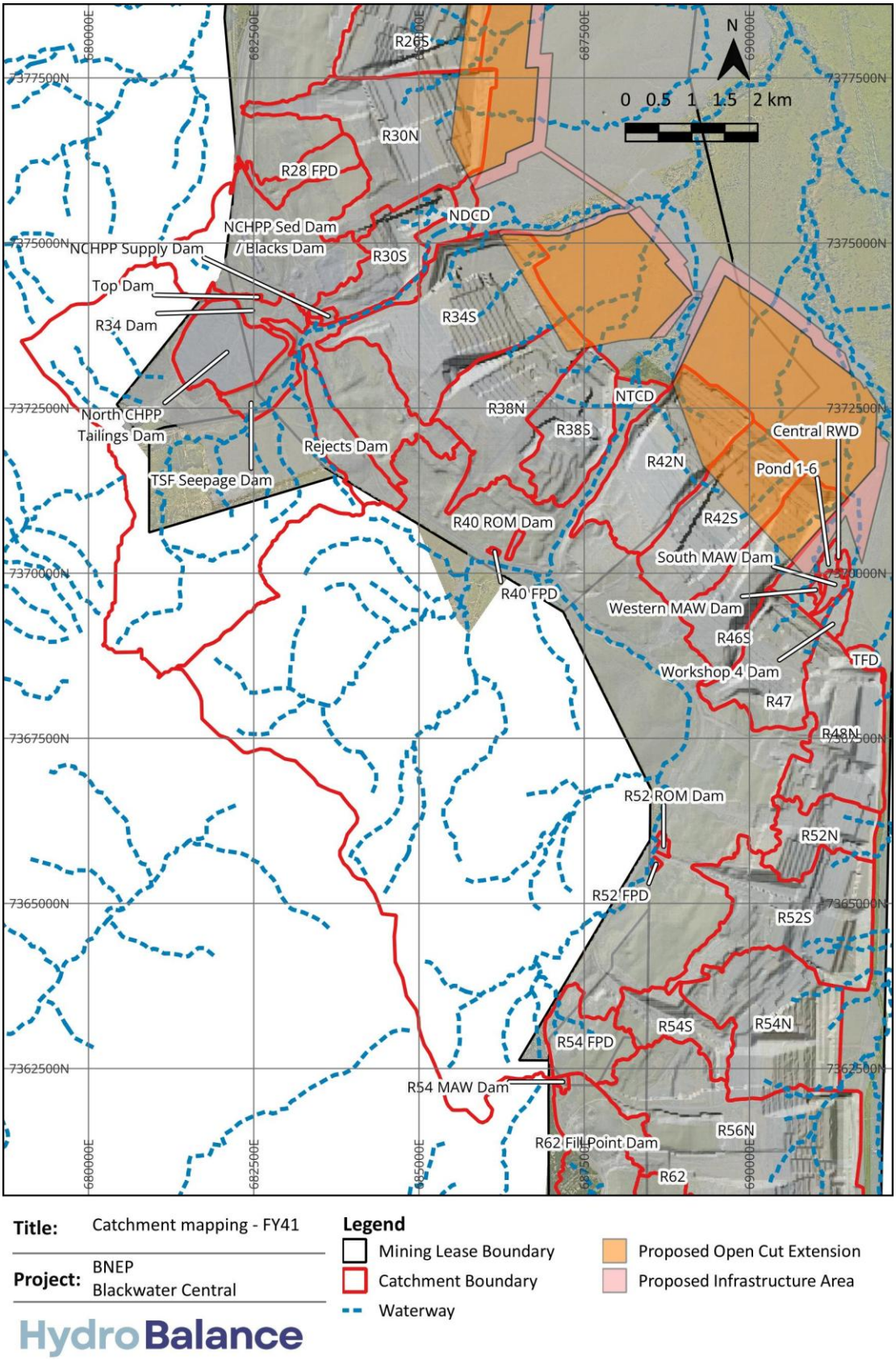


Figure 4.20 - Catchment mapping - Blackwater Central - FY41

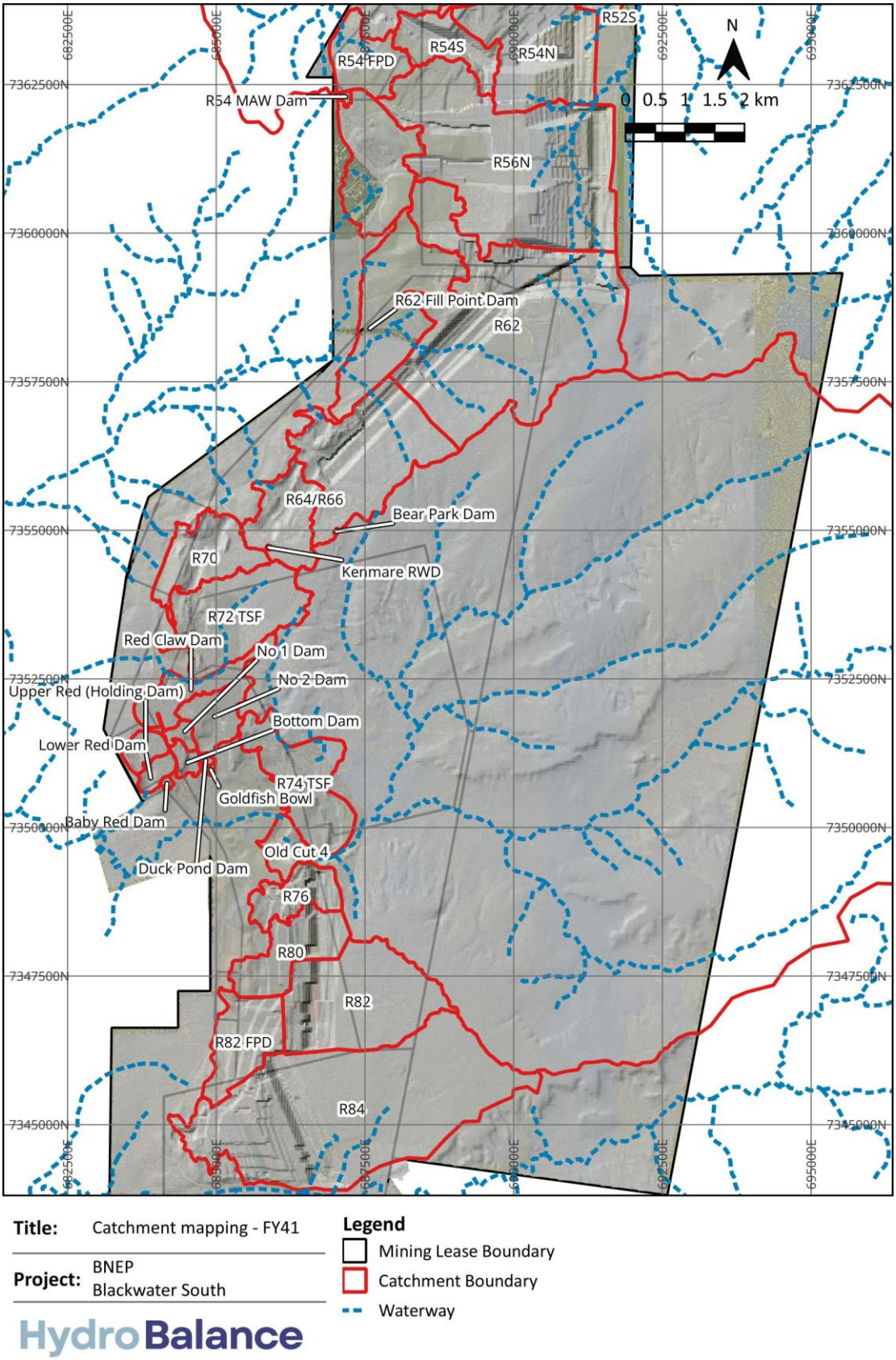


Figure 4.21 - Catchment mapping - Blackwater South - FY41

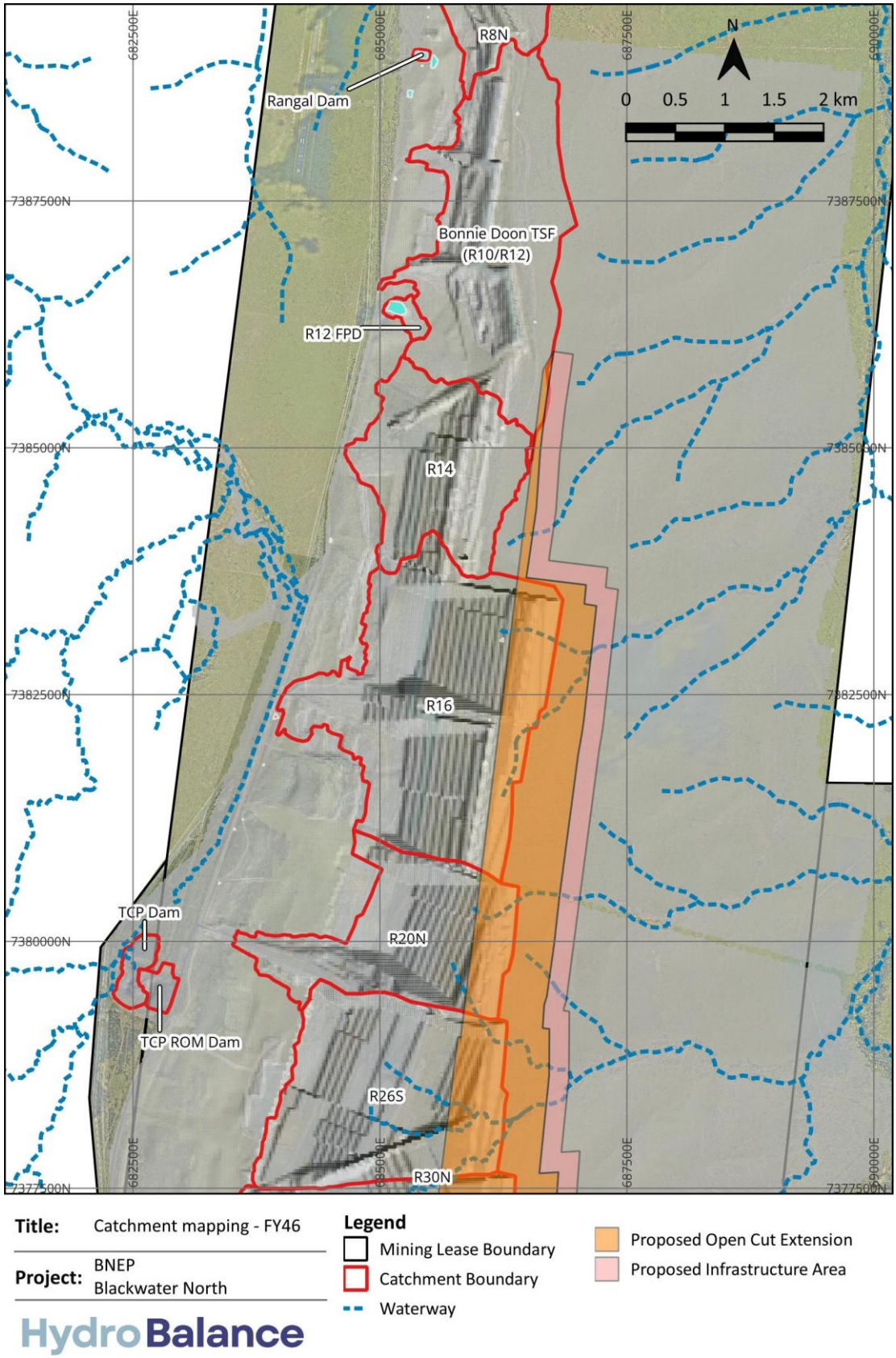


Figure 4.22 - Catchment mapping - Blackwater North - FY46

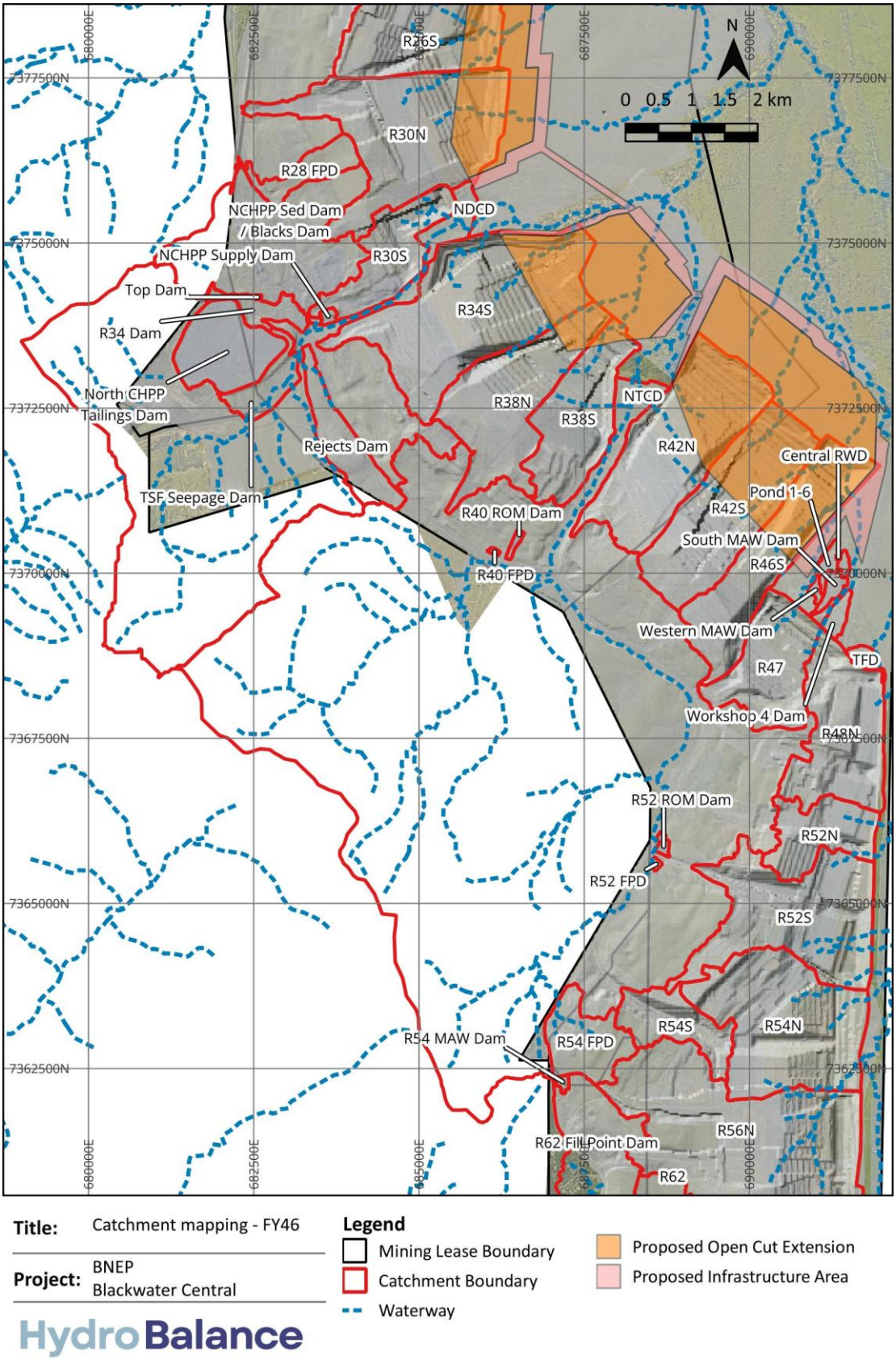


Figure 4.23 - Catchment mapping - Blackwater Central - FY46

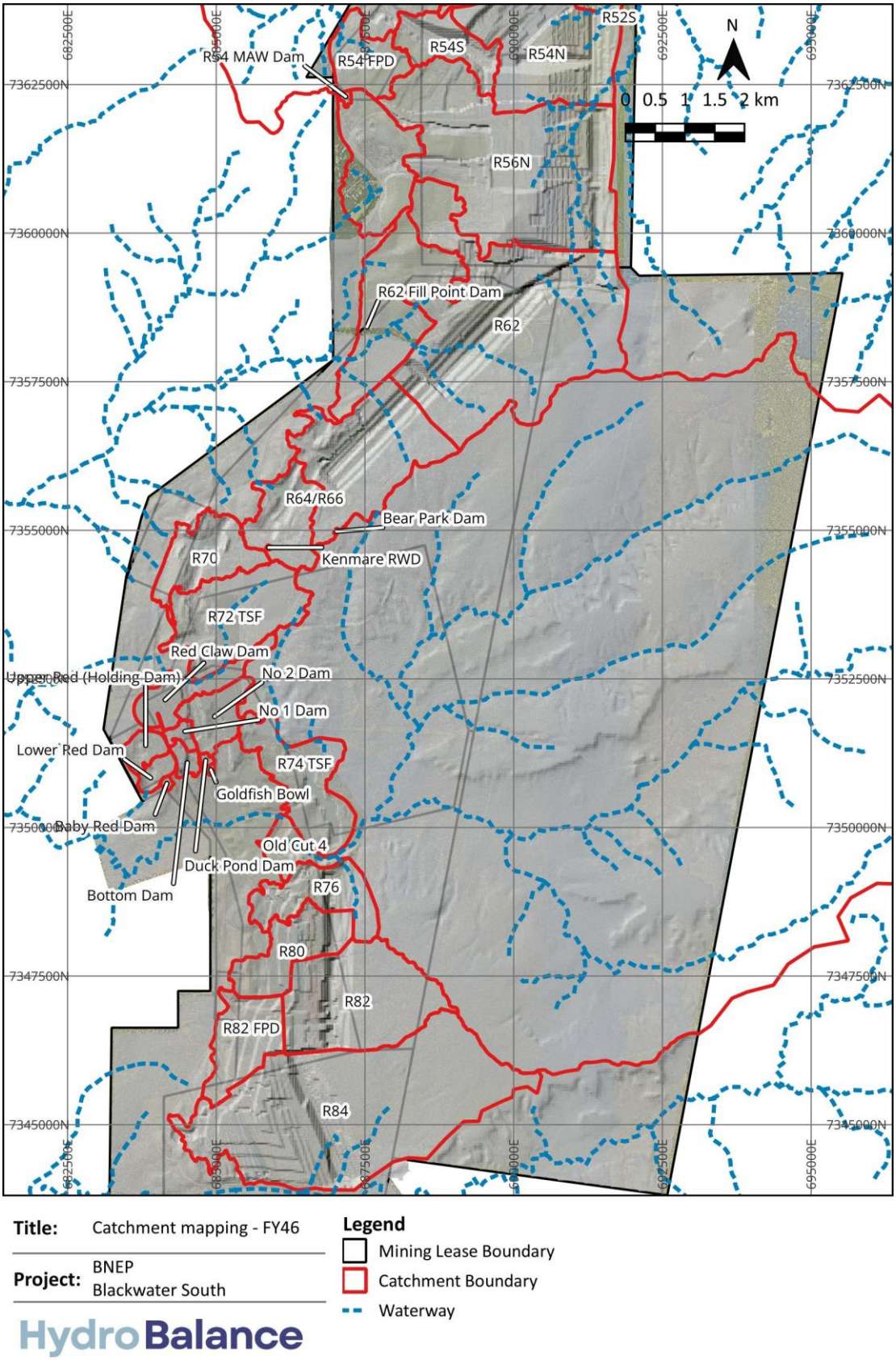


Figure 4.24 - Catchment mapping - Blackwater South - FY46

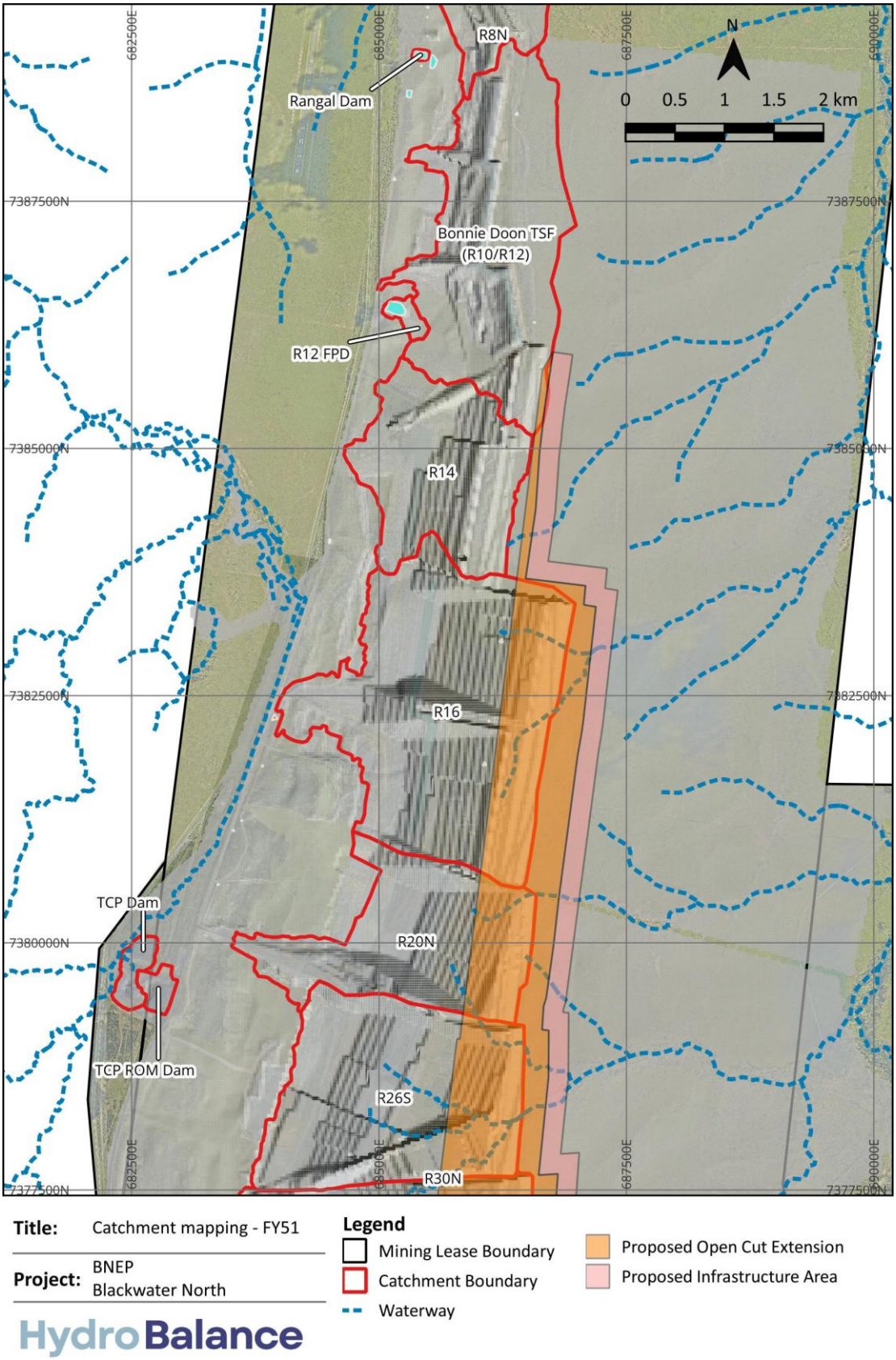


Figure 4.25 - Catchment mapping - Blackwater North - FY51

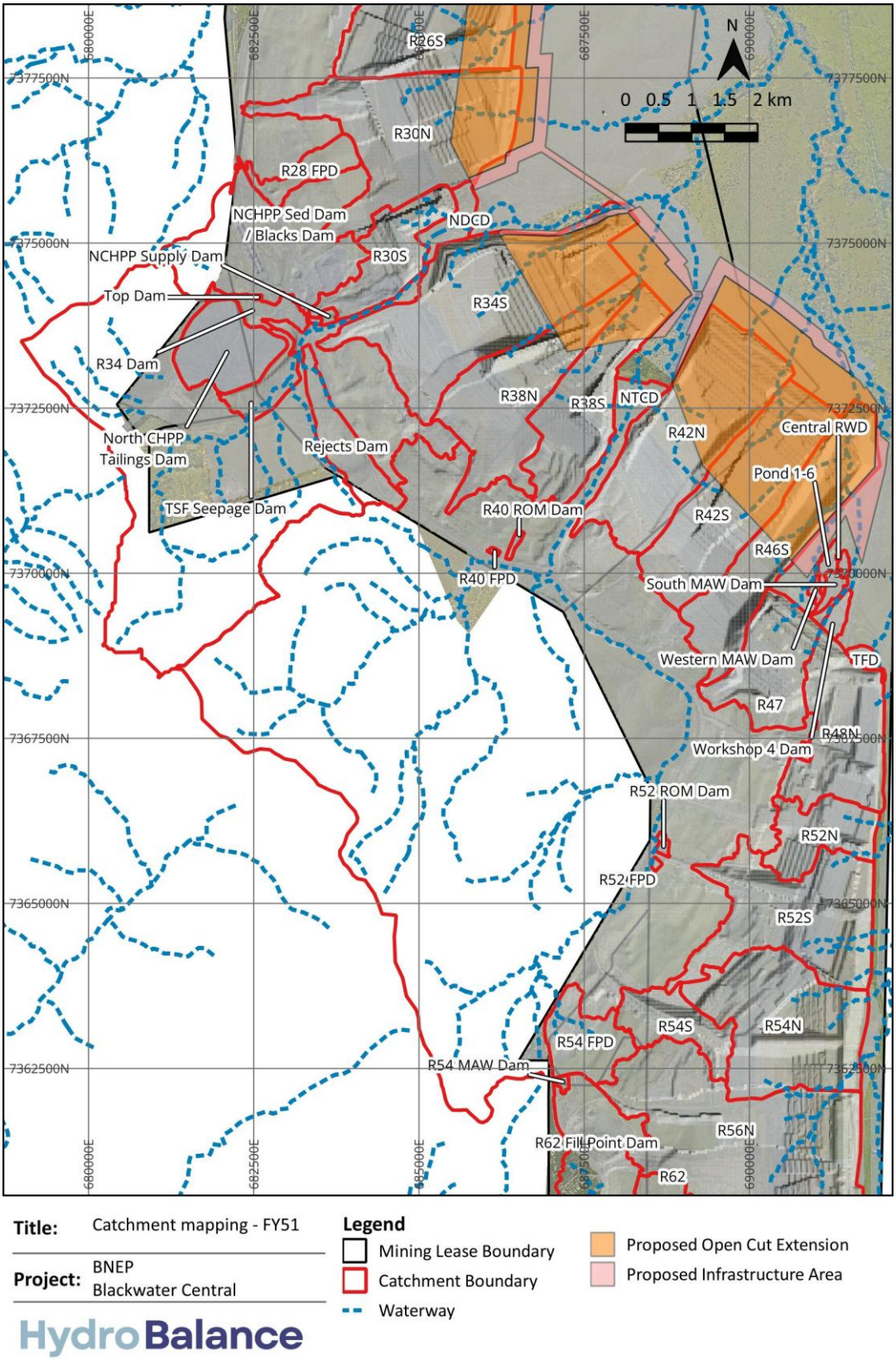
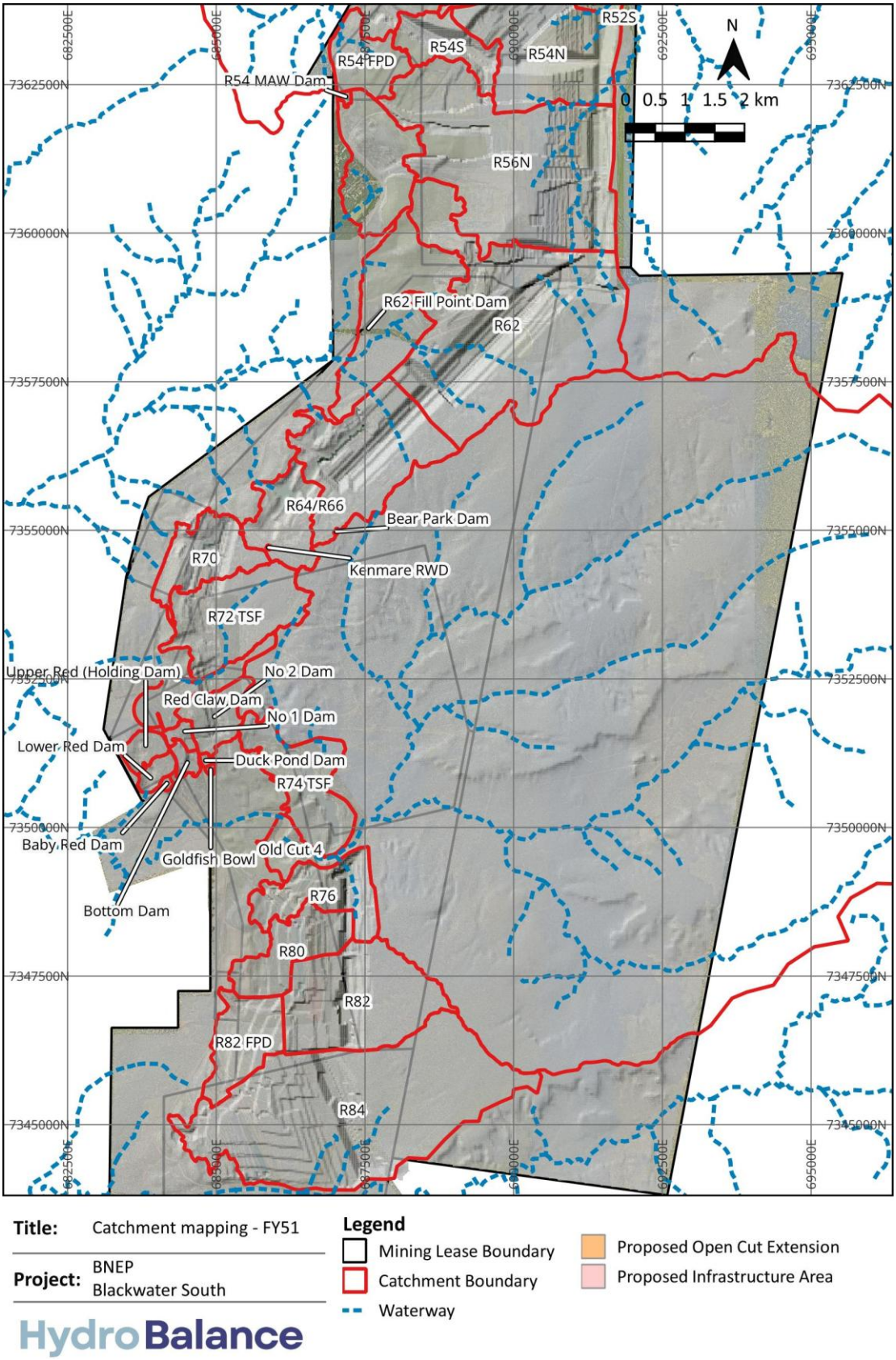


Figure 4.26 – Catchment mapping – Blackwater Central – FY51



Title: Catchment mapping - FY51

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Figure 4.27 - Catchment mapping - Blackwater South - FY51

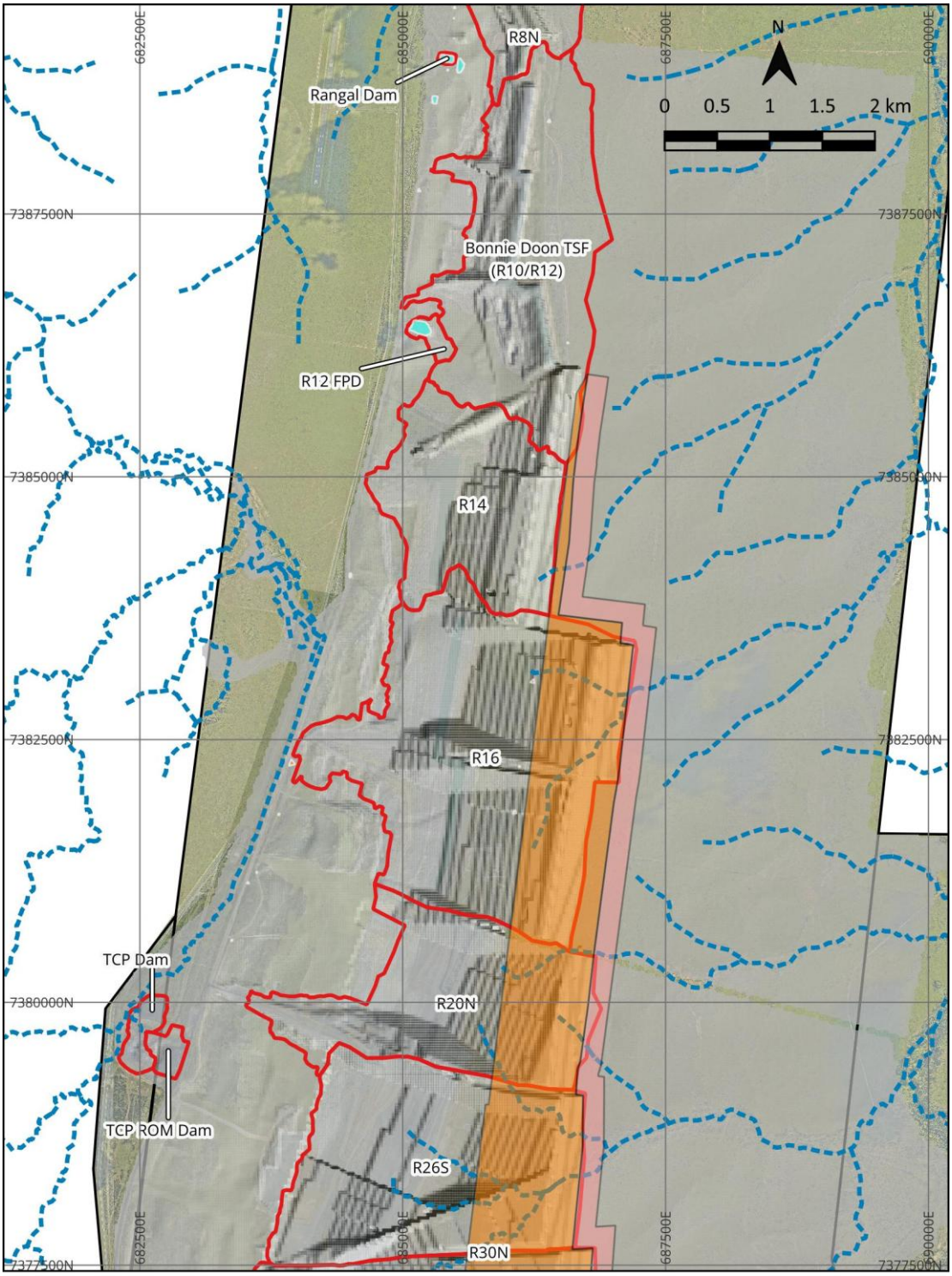


Figure 4.28 - Catchment mapping - Blackwater North - FY55

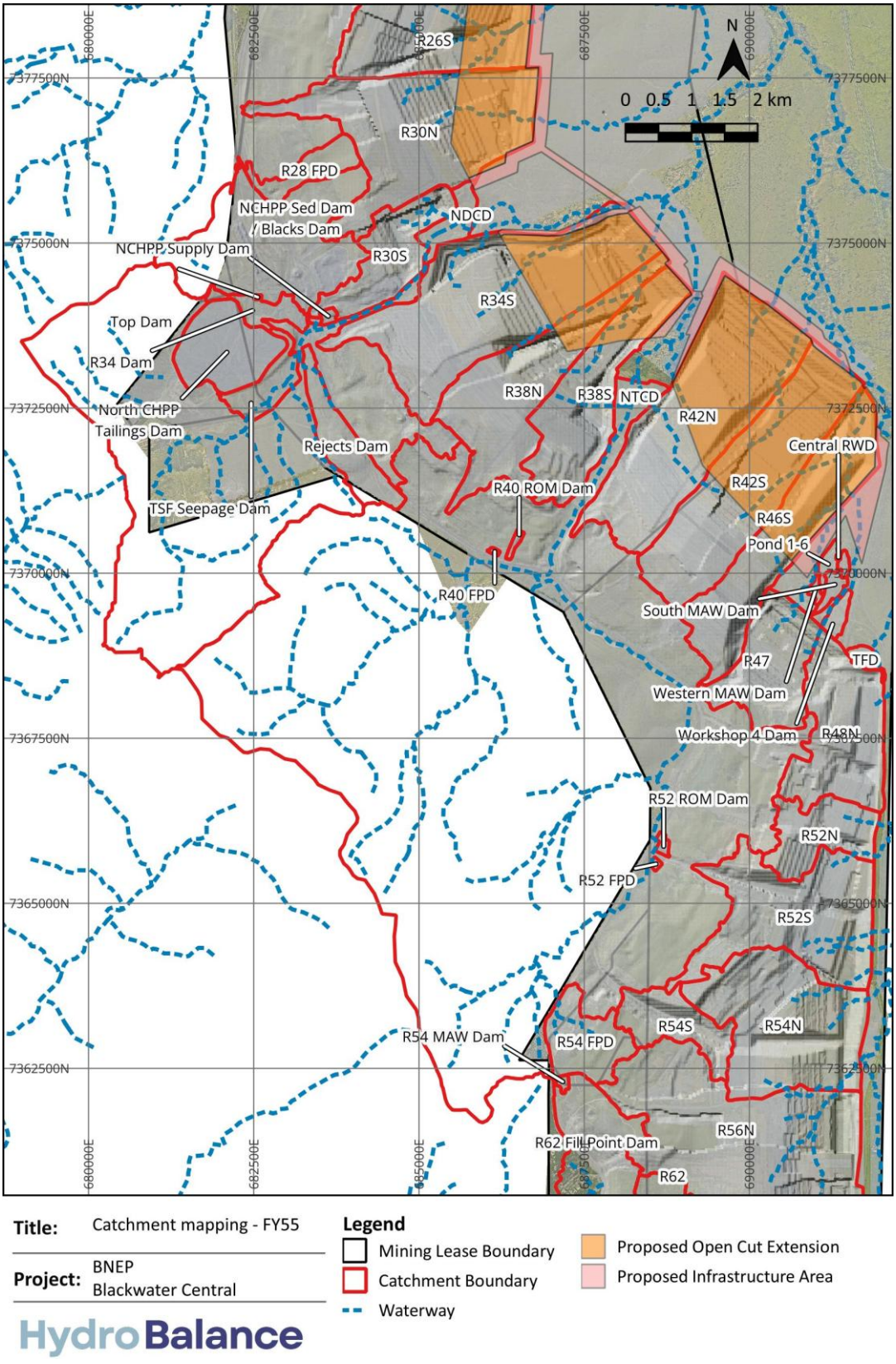
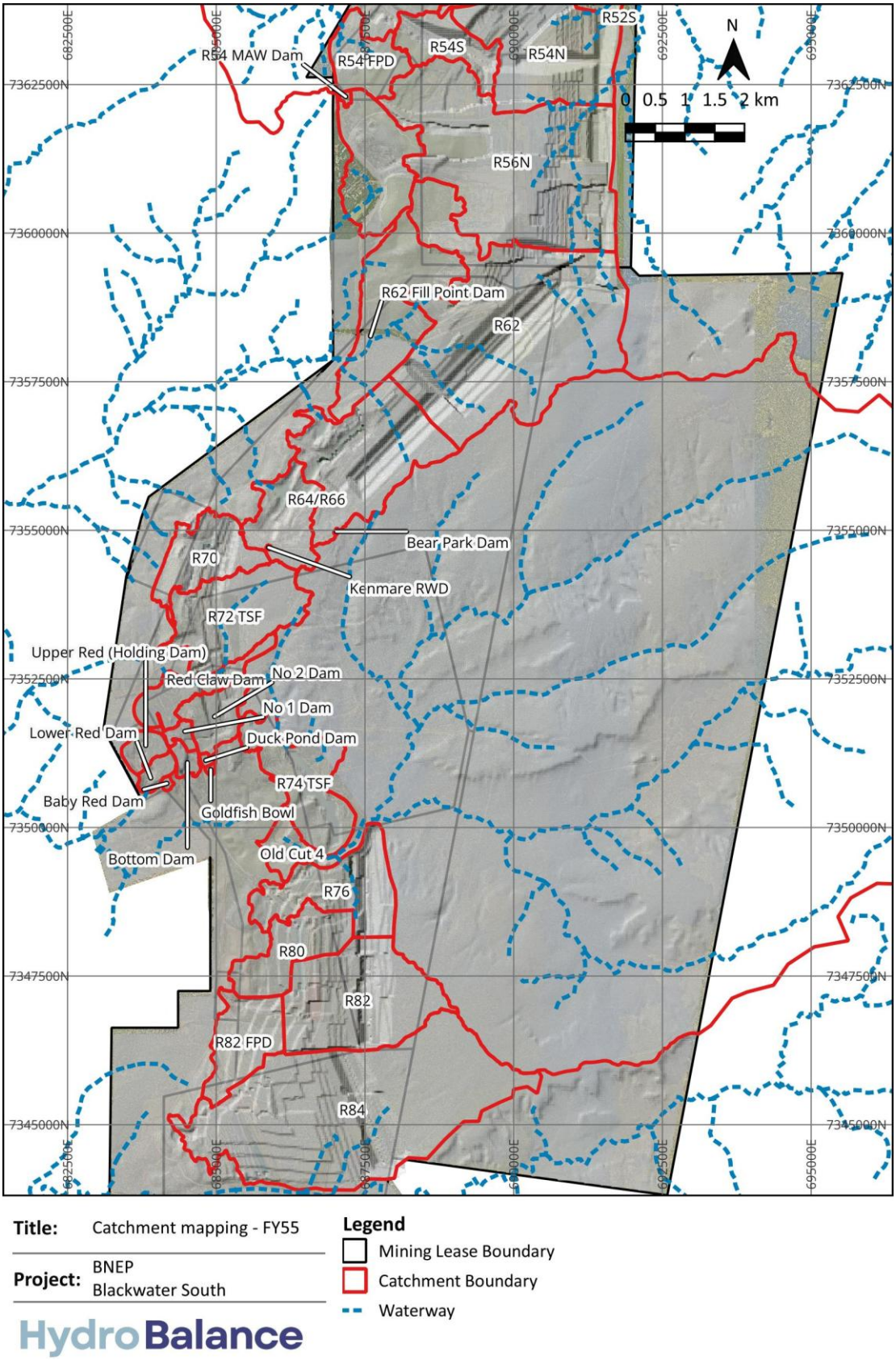


Figure 4.29 – Catchment mapping - Blackwater Central - FY55



Title: Catchment mapping - FY55

Project: BNEP Blackwater South

Legend
- Mining Lease Boundary
- Catchment Boundary
- Waterway

HydroBalance

Figure 4.30 - Catchment mapping - Blackwater South - FY55

5 Model calibration

5.1 Overview

The water balance model was calibrated for the period between July 2024 and June 2025 using site rainfall data, with the water balance model results compared to the recorded site inventories over the calibration period. The calibration was undertaken to improve the confidence of the model predictions for the forecast conditions and the sensitivity of the model parameters.

5.2 Results

Figure 5.1 shows the model calibration results, comparing the observed and modelled total site inventory. The following model parameters were adjusted to achieve this calibration result:

- Net groundwater inflow of 2.25 megalitres per day (ML/d) (821 megalitres [ML] over the calibration period). This was based on Engeny Australia Pty Ltd's (2025) estimate of the BWM 2025 associated water take, which utilised inflow data from the BWM groundwater model developed by SLR Consulting Australia Pty Ltd [SLR].
- An annual haul road dust suppression demand of 1,360 ML over the calibration period. This value was adjusted to better reflect the observed drawdown during dry periods (e.g. August to October 2025).
- A net CHPP consumption of 2,282 ML over the calibration period. This was based on a CHPP water/solids balance using CHPP run-of-mine (ROM) and production data provided by Whitehaven.

The model calibration is satisfactory and represents the performance of the BWM WMS (in terms of total inventory) over the FY25 calibration period. It simulates the drawdown during dry periods and increases during wet periods relatively well.

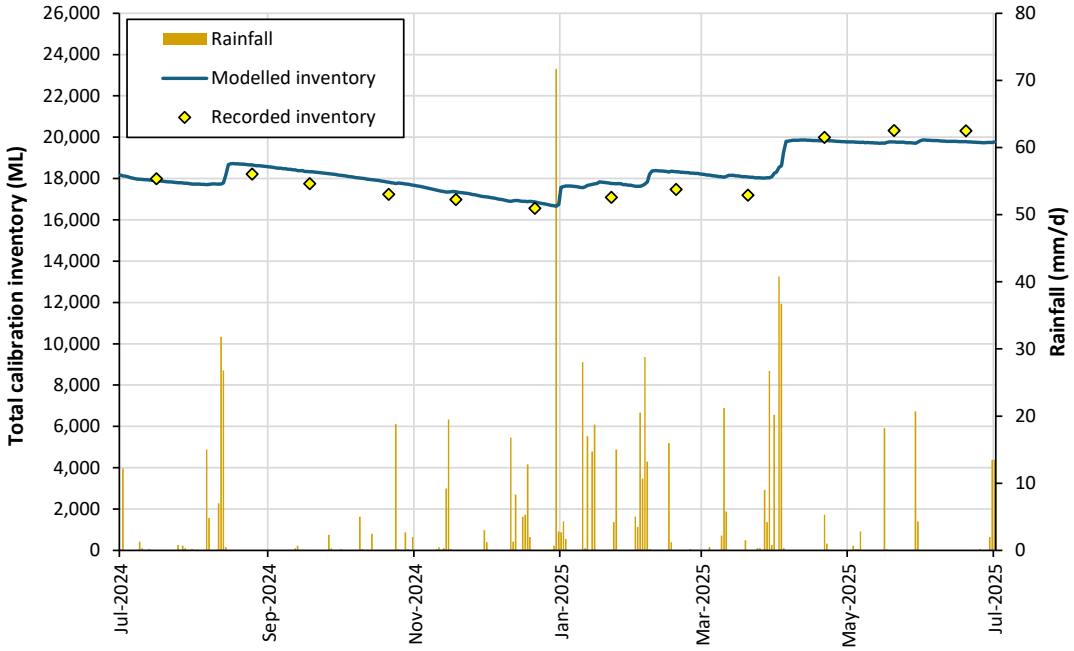


Figure 5.1 - Modelled vs recorded inventory over the calibration period (July 2024 to June 2025)

6 Water management system

6.1 Existing site storages

A summary of the existing storages within the BWM WMS is provided in Table 6.1, including the Operating Capacity (OC) for each of the storages. The OC represents the maximum allowable volume that can be stored in the dam/pit (taking into account factors such as base of weathering).

There are no additional storages proposed as part of the Project.

Table 6.1 – BWM storage details

Storage name	Operating Capacity (ML)	Overflows to
Dam storages		
BWM North MAW Dams		
R12 FPD	241.8	Offsite
TCP Dam	68	Offsite
TCP ROM Dam	15.5	Offsite
R28 FPD	7.5	Offsite
Top Dam	100	Offsite
NCHPP Sed Dam/Blacks Dam	39.3	Deep Creek
NCHPP Supply Dam	48.7	Offsite
R34 Dam	11.8	-
TSF Seepage Dam	41.3	Offsite
Rejects Dam	16	Offsite
South MAW Dam	13.4	Offsite
Pond 1-6	25.9	Offsite
Western MAW Dam	3.0	Pond 1-6
Workshop 4 Dam	51.3	Offsite
TFD	97.5	Two Mile Gully
Old R40 FPD	-	NTCD
R40 FPD	13.1	NTCD
R40 ROM Dam	12.3	NTCD
R48 FPD	29.8	Offsite
R52 ROM Dam	12.0	Offsite
R52 FPD	20.1	Offsite
R54 FPD	12.0	Offsite
R54 MAW Dam	26.6	Offsite
BWM South MAW Dams		
Upper Red Dam (Holding Dam)	113	Lower Red Dam
Lower Red Dam	80	Offsite
Baby Red Dam	0.5	Offsite
No 1 Dam	7.2	Bottom Dam
No 2 Dam	156	Duck Pond
Bottom Dam TSF	0.45	Duck Pond
Duck Pond	61.9	Goldfish Bowl

Storage name	Operating Capacity (ML)	Overflows to
Goldfish Bowl	15	Sirius Creek
R56 FPD	157.2	Speculation Creek
R62 FPD	15.3	Speculation Creek
R82 FPD	110.3	Rockland Creek
On-stream storages		
NDCD	268.9	Deep Creek
NTCD	533.9	Taurus Creek
Old Cut 4	447.5	Sirius Creek
Rockland Basin	13,800	Rockland Creek
Pit storages		
R14	8,191	R16
R16	11,999	R20
R30S	860	R30N
R64/R66	4,963	Offsite
R70	2,170	Offsite
R76	2,149	Offsite
R80	7,879	Offsite
R84	7,563	Rockland Creek
Tailings dams		
R10/R12 WSP (Bonnie Doon)	5,527	Offsite
North CHPP Tailings Dam	738	Offsite
R72 TSF	487	Offsite
R74 TSF	3,949 (FSV) 3,453 (MOV)	Offsite
Pits		
R8N	<200	Offsite
R20/R26	30,644	Offsite
R30N	5,815	R20
R34	2,773	R38
R38	13,264	Offsite
R42	2,000	Offsite
R46N	1,500	R42
R46S	1,500	R46N
R47	1,500	R46S
R48	2,000	Offsite
R52N	569	Offsite
R52S	2,000	Offsite
R54	5,217	Offsite
R56	5,217	Offsite
R62	2,000	R56
Raw Water Dams		
Rangal Dam	5	Offsite
Central RWD	5	Offsite
Kenmare RWD	22	Offsite

Storage name	Operating Capacity (ML)	Overflows to
Bear Park Dam	22	Offsite
Red Claw Dam	113	Offsite

Notes: MAW = Mine Affected Water
TSF = Tailings Storage Facility

6.2 Water management system configuration

Figure 6.1 to Figure 6.3 show a conceptual water circuit schematic of the existing BWM WMS. In addition to the linkages shown in these figures, storages will also receive inflows from direct rainfall and losses from evaporation.

There are ten backbone pipelines onsite, connecting a number of storages across the site (from north to south):

- NTCD14a pipeline;
- NTCD14b pipeline;
- NTCD14c pipeline;
- NCHPP14 pipeline;
- TFD NTCD pipeline;
- R40FPD_R64 pipeline;
- TFD64_North pipeline;
- TFD64_South pipeline;
- TFD64_2 pipeline; and
- R64_R82 pipeline.

The backbone pipeline operation rules, source/destination dams and pumping priorities are summarised in Table 6.2.

Table 6.2 – Backbone pipeline operation

Source			Destination		
Storage	Priority	Pump rate (litres per second [L/s])	Storage	Priority	Pump rate (L/s)
NTCD14a pipeline – 100 L/s maximum capacity					
R16	3	120	NTCD	1 (if conditions allow)	100
R20/R26	6	470	Pits	Reverse order of source priority	
R30N	4	50			
R30S	4	70			
R34S	5	50			
R38	2	80			
R14 WSP	1	150			
NTCD14b pipeline – not used					
NTCD14c pipeline – 250 L/s maximum capacity					
R14 WSP	1	150	NTCD	1 (if conditions allow)	250
NCHPP14 pipeline – 200 L/s maximum capacity					

Source			Destination		
Storage	Priority	Pump rate (litres per second [L/s])	Storage	Priority	Pump rate (L/s)
R14 WSP	1	150	NCHPP WSD	1 (if conditions allow)	200
			R28 FPD	1 (if conditions allow)	200
			TCP Dam	1 (if conditions allow)	200
TFDNTCD pipeline - 150 L/s maximum capacity					
NTCD	1	100	TFD	1 (if conditions allow)	150
R46N	2	60			
R46S	2	200			
R47	2	60			
R40FPD_R64 pipeline - 100 L/s maximum capacity					
R40 ROM Dam	1	150	NCHPP WSD	1 (if conditions allow)	100
R64 WSP	1	200	R52 FPD	2 (if conditions allow)	100
TFD	1	100	R54 FPD	3 (if conditions allow)	100
TFD64 North pipeline - 480 L/s maximum capacity					
R48	1	160	TFD	1 (if conditions allow)	480
R52N	1	80			
R52S	1	80			
R54	1	160			
TFD64 South pipeline - 240 L/s maximum capacity					
R56	1	80	R64 WSP	1 (if conditions allow)	240
R62	1	80			
R62_FPD	1	50			
TFD64_2 pipeline - 150 L/s maximum capacity					
TFD	1	100	R64 WSP	1 (if conditions allow)	150
R64-R82 pipeline - 100 L/s maximum capacity					
R64 WSP	1	100	R80 WSP	1 (if conditions allow)	100
R70 WSP	1	200	R82 WSP	1 (if conditions allow)	100

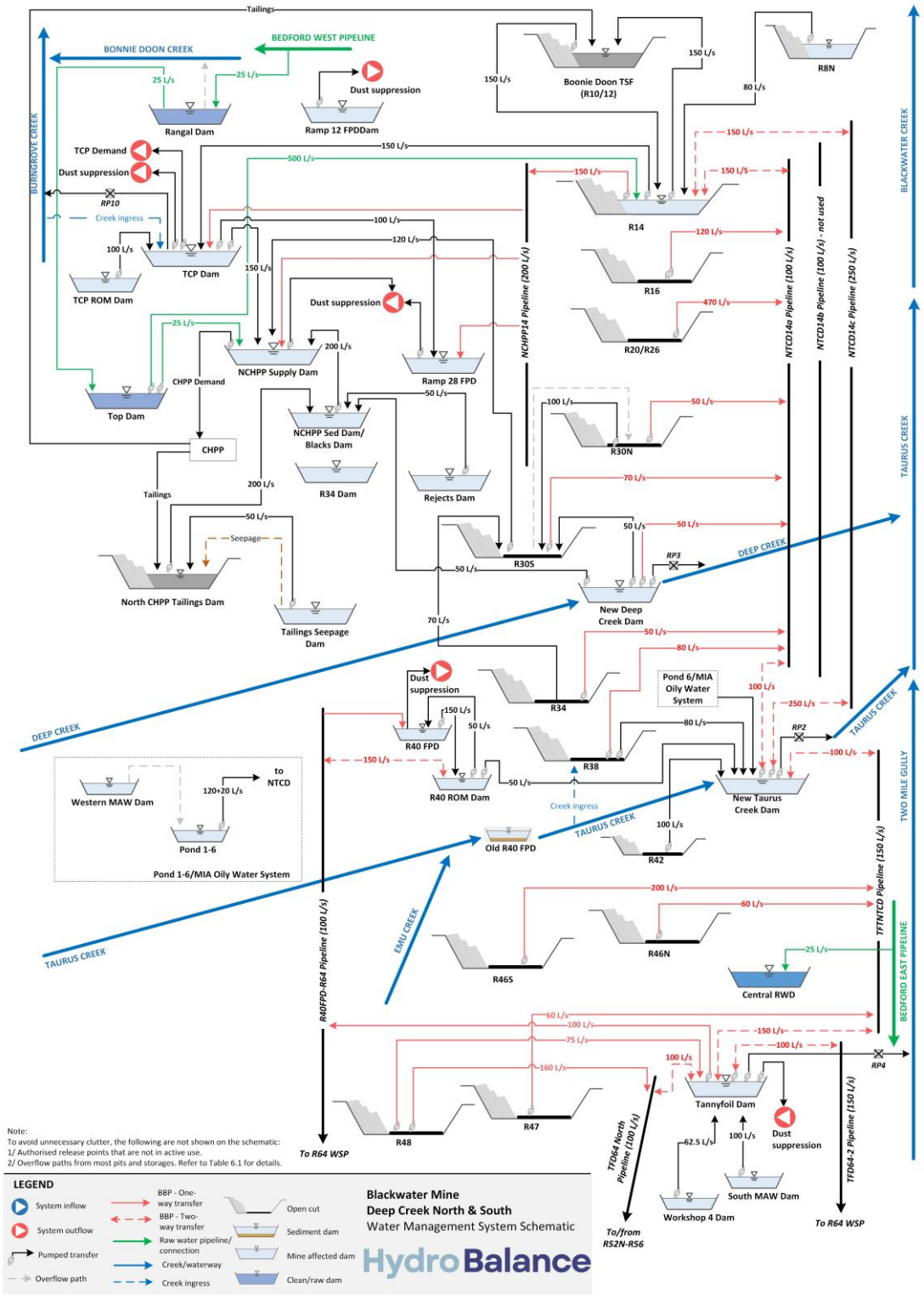


Figure 6.1 – Schematic of BWM WMS – Deep Creek North and South

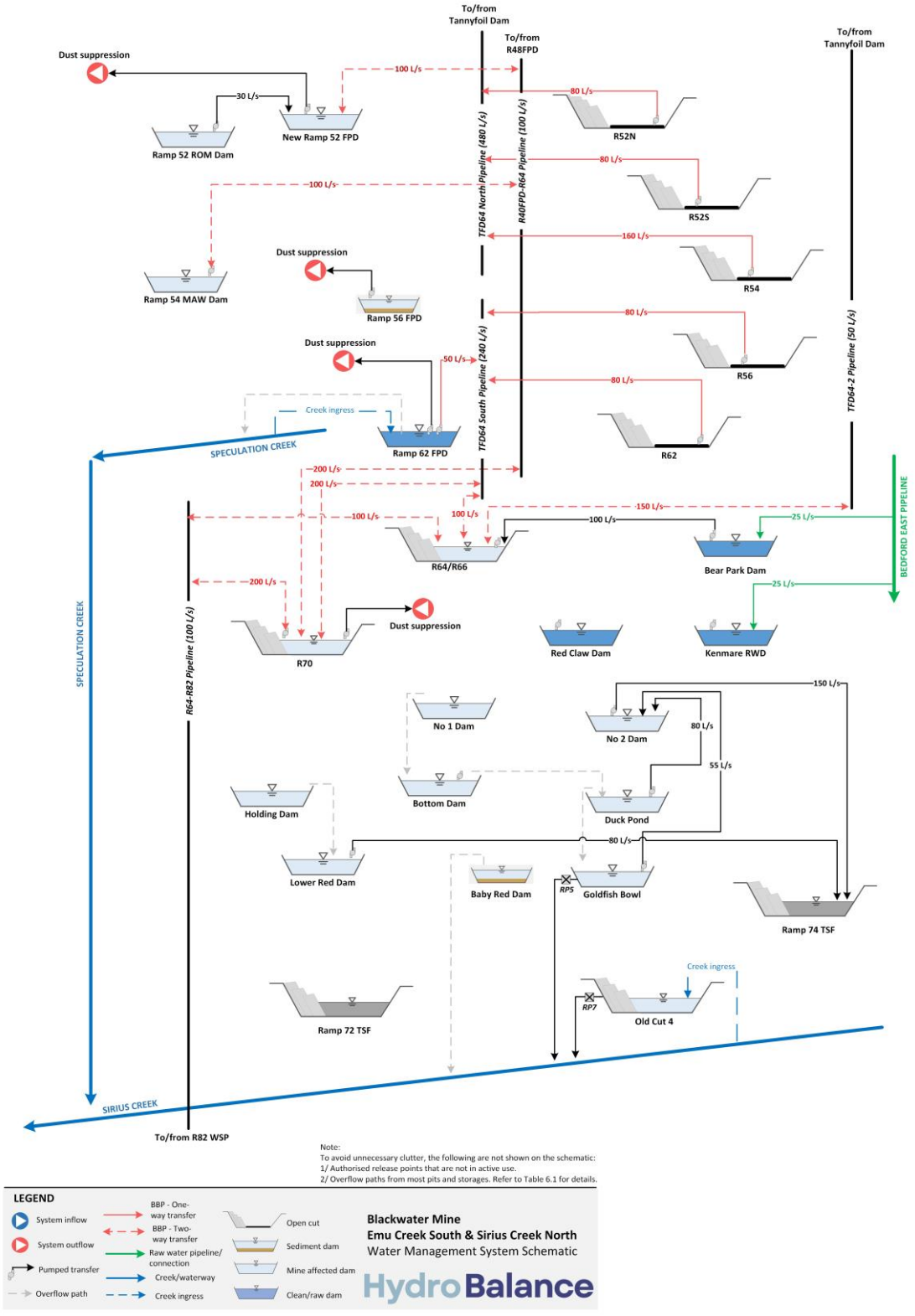
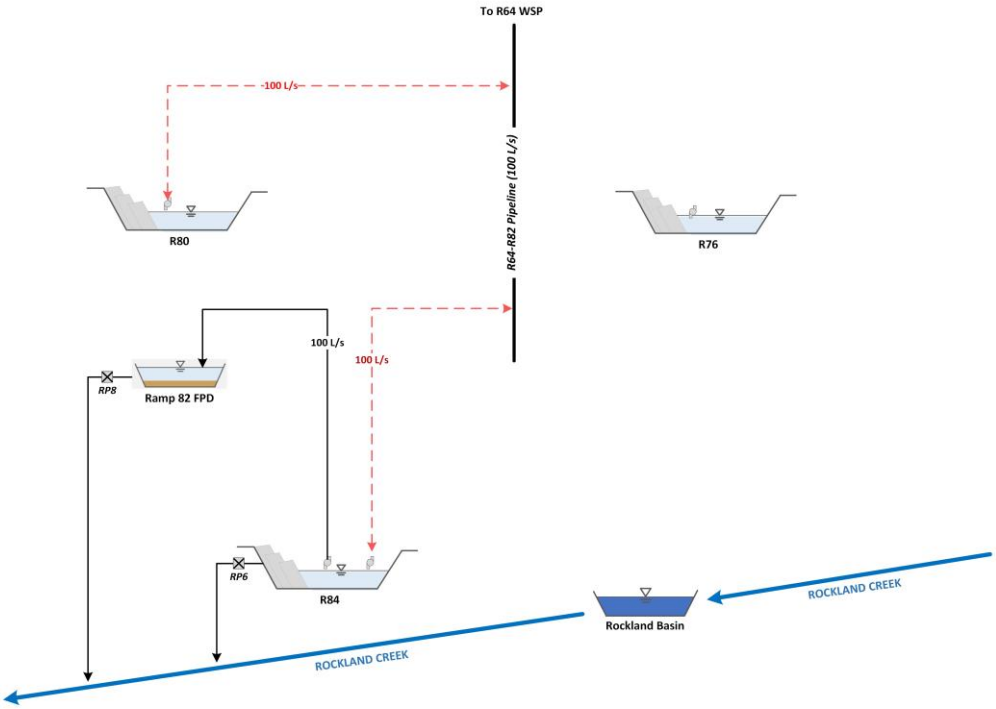


Figure 6.2 – Schematic of BWM WMS – Emu Creek South and Sirius Creek North



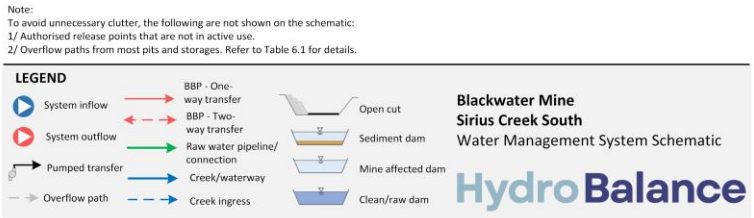


Figure 6.3 – Schematic of BWM WMS – Sirius Creek South

6.3 AWBM rainfall runoff modelling

Table 6.3 shows the adopted rainfall runoff parameters for each catchment land use. Catchment runoff was modelled using the Australian Water Balance Model (AWBM).

Table 6.3 – Adopted AWBM rainfall runoff parameters

Parameter	Natural	Spoil	Rehab (& partial rehab)	Tailings	Hardstand/ pit	Disturbed
C1 (millimetres [mm])	30	100	20	5	10	10
C2 (mm)	180	200	120	15	40	60
C3 (mm)	250	300	180	25	50	100
A1	0.134	0.134	0.134	0.134	0.3	0.3
A2	0.433	0.433	0.433	0.433	0.4	0.4
A3	0.433	0.433	0.433	0.433	0.3	0.3
C_{av}	190.2	229.9	132.6	18.0	34.0	57.0
BFI	-	0.8	0.35	-	-	-
K_{base}	-	0.98	0.98	-	-	-
K_{surf}	-	0.1	0.1	-	-	-
Cv (percent [%])	4.2	1.6	6.5	32.2	23.3	18.2

Notes: C1/C2/C3 – Surface storage capacities
A1/A2/A3 – Partial area fraction
C_{av} – Catchment averaged surface storage capacity
BFI – Baseflow index
K_{base} – Baseflow recession constant
K_{surf} – Surface flow recession constant
C_v – Long-term coefficient of runoff

6.4 Site water demands

Operational demands at BWM include haul road dust suppression and coal washing demand. Details for each demand and loss is provided in the following sections below.

6.4.1 Dust suppression

In the absence of metered data, haul road dust suppression rates have been estimated using daily rainfall and evaporation data sourced from the SILO database (Jeffrey et al., 2001).

The following rules are used to determine the applied dust suppression rate on any given day:

- For a dry day (zero rainfall), the haul road watering rate is equal to the daily evaporation rate.
- For a rain day when rainfall is less than the daily evaporation rate, the watering rate is reduced and is only required to make up the remaining depth to the daily evaporation rate.
- For a rain day when rainfall exceeds the daily evaporation rate, no haul road watering is required.

The estimated future annual dust suppression demand is 3,000 megalitres per year (ML/year). Adjustments to the model rules for the forecast simulation are as follows:

- Watered haul road length increased to 40 kilometres.

- Watered haul road width = 55 metres.
- Summer application factor = 0.85.
- Winter application factor = 0.9.

The average monthly forecast dust suppression demand is shown in Figure 6.4.

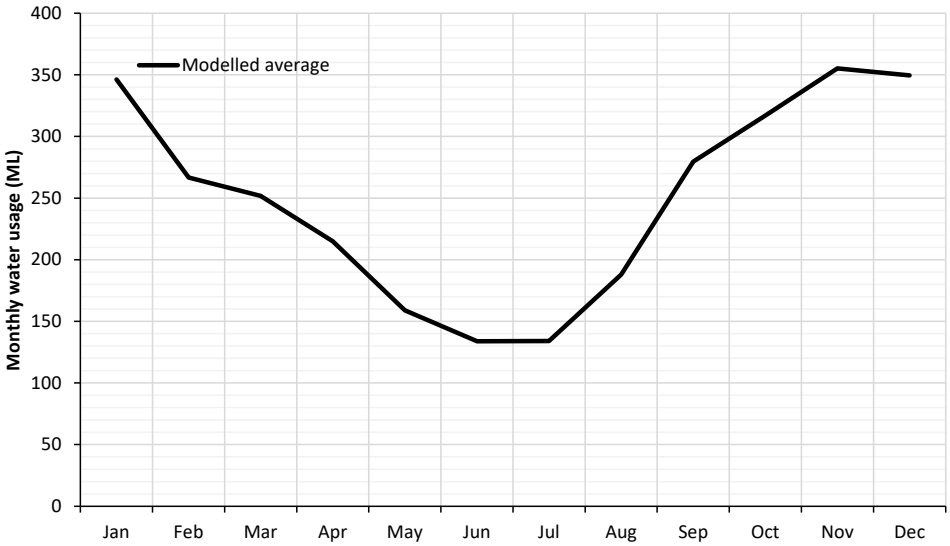


Figure 6.4 – Forecast average monthly dust suppression demand

Dust suppression water is sourced from the following storages:

- R14 WSP;
- TCP Dam;
- Top Dam;
- NCHPP WSD;
- R28 FPD;
- R40 FPD;
- TFD;
- R52 FPD;
- R56 FPD;
- R62 FPD; and
- R70 WSP.

6.4.2 CHPP production and demand

Water is required at the BWM CHPP for coal processing, wash down and other associated uses. The volume of water required for CHPP makeup is generally related to the annual coal production tonnages.

The estimated net CHPP consumption rate is 188 litres per run-of-mine tonne (L/ROM t) for the coal washed through the BWM CHPP. For bypass coal, the estimated usage is 10 L/ROM t.

The forecast annual production profile for washed and bypass coal between FY27 and FY55 and annual net consumption is summarised in Table 6.4.

Table 6.4 - BWM forecast production profile - washed coal

Period	Washed coal		Bypass coal	
	Annual tonnage (Million tonnes per annum [Mt/a])	Annual net CHPP consumption (ML/a)	Annual tonnage (Mt/a)	Annual net consumption (ML/a)
FY27	12.6	2,378	2.6	26.1
FY28	13.8	2,603	2.8	27.6
FY29	13.0	2,442	2.0	20.4
FY30	14.1	2,659	1.4	13.9
FY31	15.2	2,858	1.8	18.0
FY32	15.2	2,866	3.8	37.6
FY33	15.2	2,858	3.7	37.2
FY34	15.2	2,858	2.9	29.4
FY35	15.2	2,858	3.8	38.0
FY36	15.2	2,866	3.8	37.6
FY37	15.2	2,858	2.3	23.1
FY38	15.2	2,858	3.8	38.0
FY39	15.2	2,858	3.6	36.2
FY40	15.2	2,866	3.6	35.9
FY41	15.2	2,858	2.1	20.6
FY42	15.2	2,858	3.0	29.8
FY43	15.2	2,858	2.8	28.4
FY44	15.2	2,866	1.9	19.4
FY45	15.2	2,858	2.2	22.3
FY46	15.2	2,858	1.9	19.5
FY47	15.2	2,858	3.6	36.2
FY48	15.2	2,866	0.8	8.0
FY49	15.2	2,858	3.0	30.4
FY50	15.2	2,858	2.7	27.4
FY51	15.2	2,858	2.4	23.7
FY52	15.2	2,866	1.3	12.6
FY53	12.3	2,317	3.3	32.5
FY54	10.0	1,882	3.5	34.7
FY55	11.1	2,081	3.9	39.4

The net CHPP process makeup demand is primarily sourced from the MAW system and has a minimal raw water demand (see Section 6.5). CHPP MAW make up water is supplied continuously by NCHPP WSD.

6.4.3 Thermal Coal Plant demand

The TCP demand is not metered. As per the previous modelling, we have adopted a constant demand of 100 ML/year for the TCP water demand.

6.5 External water source

The raw water for BWM comes from the Bedford West and Bedford East pipelines, with an annual available allocation of 1,603 ML and 678 ML, respectively. Pipeline water is drawn into the site when the site-wide water storage inventory falls below 14,701 ML (Green Trigger Action Response Plan [TARP]).

A minimum raw water import volume will be applied to the model as follows, based on Whitehaven's advice:

- Bedford East supply: 27 megalitres per month (ML/month) (based on March to August 2025 usage).
- Bedford West supply: 11 ML/month (based on August 2025 usage) – this excludes 6 ML/month that is supplied to Pastoral Agreements (based on March to August 2025 usage).

A maximum daily supply rate of 10 ML/d (Bedford West) and 2.5 ML/d (Bedford East) has been allocated, which is currently what rate is achievable to site including an allowance for 85% availability.

6.6 Tailings management

The BWM Water Balance Model models the tailings waste stream as follows:

- All tailings moisture is sent to R10/12 WSP (Bonnie Doon).
- Water is actively dewatering from R10/12 WSP back to the WMS. The model accounts for loss such as tailings matrix retention, beach and decant pond evaporation, and seepage. The remaining water is then available for decant to the WMS.

The following CHPP water and solids assumptions have been made:

- ROM coal moisture content: 6.4% weight per weight (w/w).
- Product coal moisture content: 10.7% w/w.
- Product yield (wet): 77.5%.
- Product yield (dry): 69.7%.
- Coarse rejects moisture content: 10.1% w/w.
- Fine tailings moisture content: 71.8% w/w.
- Waste stream split:
  - Coarse rejects fraction (dry): 85.7%.
  - Fine tailings fraction (dry): 14.3%.
- CHPP makeup water requirement: 188 L/ROM t – note this does not account for any decant return water, it is the water needed to balance the adopted tonnages and moisture contents.

For tailings decant return, Whitehaven advise that between 30 to 50% of the water sent to Bonnie Doon in the tailings stream is decanted back to the WMS. We have adopted a return rate of 40%, which includes loss associated with beach evaporation, decant pond evaporation and seepage.

6.7 Sediment management

No specific requirements for additional sediment basins have been identified. However, there is potential additional sediment basins may be required for the Project associated with disturbance in advance (to the east) of mining operations including infrastructure corridors, pre-stripping and topsoil stockpiles.

The requirement for, and location and sizing of, any new sediment basins would be confirmed during detailed design, having regard to the final disturbance footprint, catchment configuration, drainage design and anticipated sediment-generation risk.

Where required, new sediment basins would be designed, constructed, operated and maintained in accordance with *BWM Plan - Erosion and Sediment Control Plan* (Whitehaven, 2026) and relevant contemporary guidance, including the Best Practice Erosion and Sediment Control guideline published by the International Erosion Control Association (Australasia). The erosion and sediment control system would apply a treatment-train approach, incorporating measures

such as clean-water diversion, runoff conveyance, erosion controls, sediment controls and appropriately sized sediment basins.

In areas with a high potential for sediment generation, sediment-laden runoff would be captured and directed to suitable sediment control infrastructure prior to discharge or reuse. Controls would be selected and implemented based on the nature, extent and duration of disturbance and may include measures such as progressive stabilisation, diversion drains, contour banks, check dams, sediment fences, sediment traps and sediment basins. These measures would be subject to routine inspection, maintenance and adaptive management to confirm their ongoing effectiveness.

6.8 Interactions with local waterways

A number of creeks that flow past or through BWM interact with the site's storages. These interactions are included in the model either as direct catchment inflows, or as creek ingress rating curves. These interactions are as follows:

- TCP Dam – receives creek ingress from Burngrove Creek.
- NDCD – receives direct catchment inflows from Deep Creek.
- NTCD – receives direct catchment inflows from Taurus Creek.
- R38 – receives creek ingress from Taurus Creek.
- R62 FPD - receives creek ingress from Speculation Creek.
- Old Cut 4 - receives creek ingress from Sirius Creek.
- Rockland Basin - receives direct catchment inflows from Rockland Creek.

6.9 Groundwater

The adopted total groundwater inflow rates to the mine pits are based on estimates provided from the groundwater model developed by SLR (2026), covering the simulation period. The groundwater inflows have been adjusted to account for pit face evaporation losses, and losses due to moisture within the in-situ coal being extracted during mining.

Figure 6.5 and Table 6.5 provide a summary of the groundwater estimates that have been provided for the Project over the simulation period as annual inflows between 2026 and 2055. The inflows have been distributed between the open cut pits in accordance with the provided groundwater data.

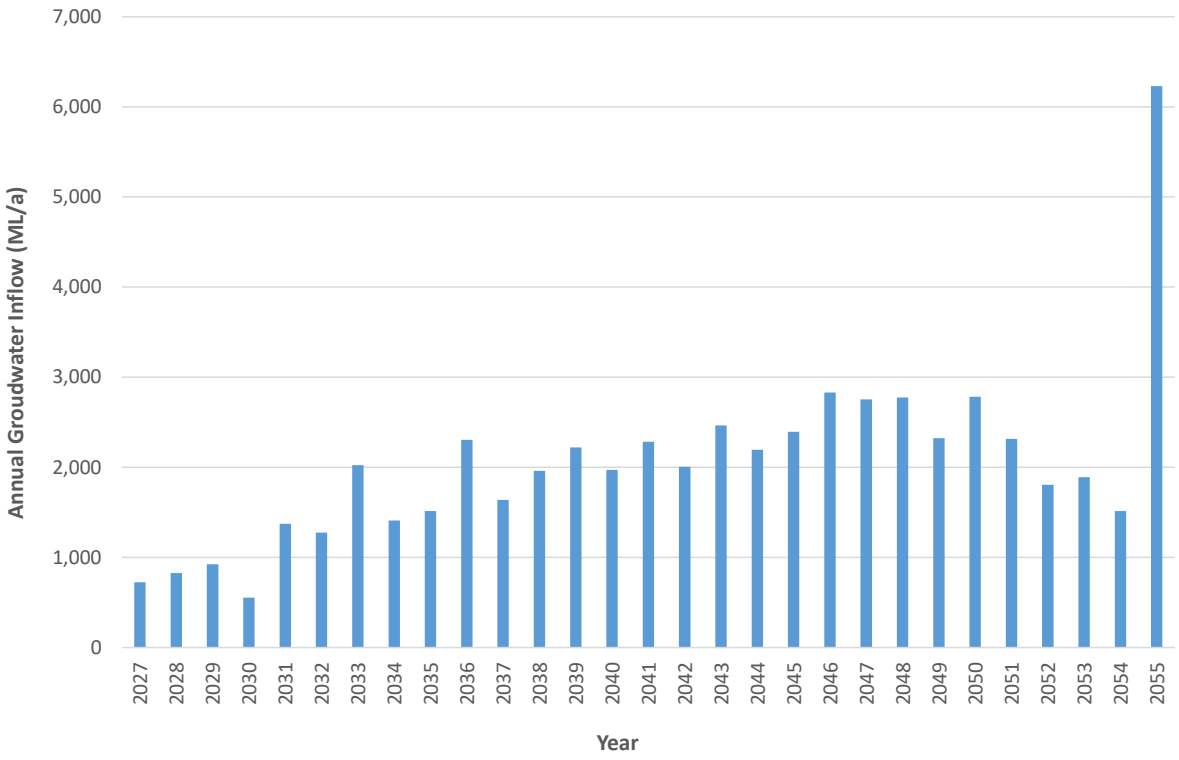


Figure 6.5 - Forecast annual groundwater inflow rate

Table 6.5 - Adopted groundwater inflow rates

Calendar year	Annual groundwater inflow (ML/a)
2027	725
2028	828
2029	924
2030	553
2031	1,373
2032	1,275
2033	2,025
2034	1,410
2035	1,514
2036	2,306
2037	1,639
2038	1,962
2039	2,220
2040	1,972
2041	2,285
2042	2,006

Calendar year	Annual groundwater inflow (ML/a)
2043	2,465
2044	2,196
2045	2,395
2046	2,830
2047	2,754
2048	2,774
2049	2,323
2050	2,782
2051	2,316
2052	1,805
2053	1,892
2054	1,515
2055	6,231

6.10 Controlled releases

Controlled releases are permitted from RP2 via NTCD, RP3 via NDCD and RP4 via TFD. Controlled releases may be undertaken when the following conditions are met per Condition F4 and Conditions F9 to F11 of the current EA (EPML00717813) (the EA):

- For RP2 and RP3:
  - the flow in Blackwater Creek (at Gauging Station 2) is greater than or equal to (≥) 1 cubic metres per second (m^3/s);
  - the electrical conductivity (EC) in the release dam is less than (<) 10,000 microSiemens per centimetre (µS/cm);
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm; and
  - Blackwater Creek mixed downstream EC can exceed greater than (>) 2,000 µS/cm during a release if the upstream monitoring point is similar or higher than downstream (i.e. the mine release is not having a measurable impact on downstream water quality during the release).
- For RP4:
  - the flow in Two Mile Creek (at Gauging Station 3) is ≥1 m^3/s;
  - the EC in the release dam is <10,000 µS/cm; and
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm.

The EA also authorises releases from the following storages, however these are not modelled as controlled releases:

- RP5 - Goldfish Pond;
- RP6 - Marshmead Pit;
- RP7 - Old Cut 4;
- RP8 - R82 FPD;
- RP10 – TCP Dam;
- RP11 - NCHPP Sediment Dam[1];
- RP12 - Rejects Stockpile Dam[1]; and
- RP13 - R34[1].

[1] In accordance with Table F1 of the EA, "RP11, RP12 and RP13 are not 'active' until the completion of Deep Creek Diversion Stage 2."

6.11 Trigger Action Response Plan

The site-wide water security and containment risks at BWM are managed using a TARP. The TARP has been developed by Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide BWM TARP is summarised in Table 6.6.

Table 6.6 - BWM site-wide water management TARP

Trigger	Action / Response
Red [Dry]	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Yellow [Dry]	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Green	• Import water from Bedford pipelines at 50% allocation.
Yellow [Wet]	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release.
Red [Wet]	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release. • Allocate emergency storage in pits.

7 Water balance modelling results

7.1 Overview

An assessment of the BWM water management system has been undertaken using the water balance model with the adopted rainfall runoff parameters. Investigation outcomes depend on the accuracy of input assumptions. There is inherent uncertainty with respect to some key site characteristics (e.g. catchment yield/rainfall runoff, groundwater inflows). To manage this uncertainty, a large number of climate sequences are used, reflecting the full range of historical climatic conditions, indicates how system performance may vary under wet, dry and average climatic conditions.

7.2 Interpretation of results

The modelling methodology of a forecast simulation is described in Section 2. The results provide a statistical analysis of the water management system's performance over the next year based on 107 different climatic realisations.

The 50th percentile probability envelope represents the median results; the 10th percentile represents 10% exceedance (i.e. wet conditions) and the 90th percentile represent 90% exceedance (i.e. dry conditions). There is an 80% chance that the result will fall within the 10th and 90th percentiles, and a 98% chance that the result will fall between the 1st and 99th percentiles. Importantly, note that a percentile envelope shows the percentage chance of exceeding particular value on any specific day, and does not represent continuous results from a single model realisation (e.g. the 90th percentile trace does not represent a single continuous 90th percentile climate scenario, rather it shows the volume/rate exceeded by 90% of the 107 realisations on each day of the simulation).

7.3 Water management system inventory

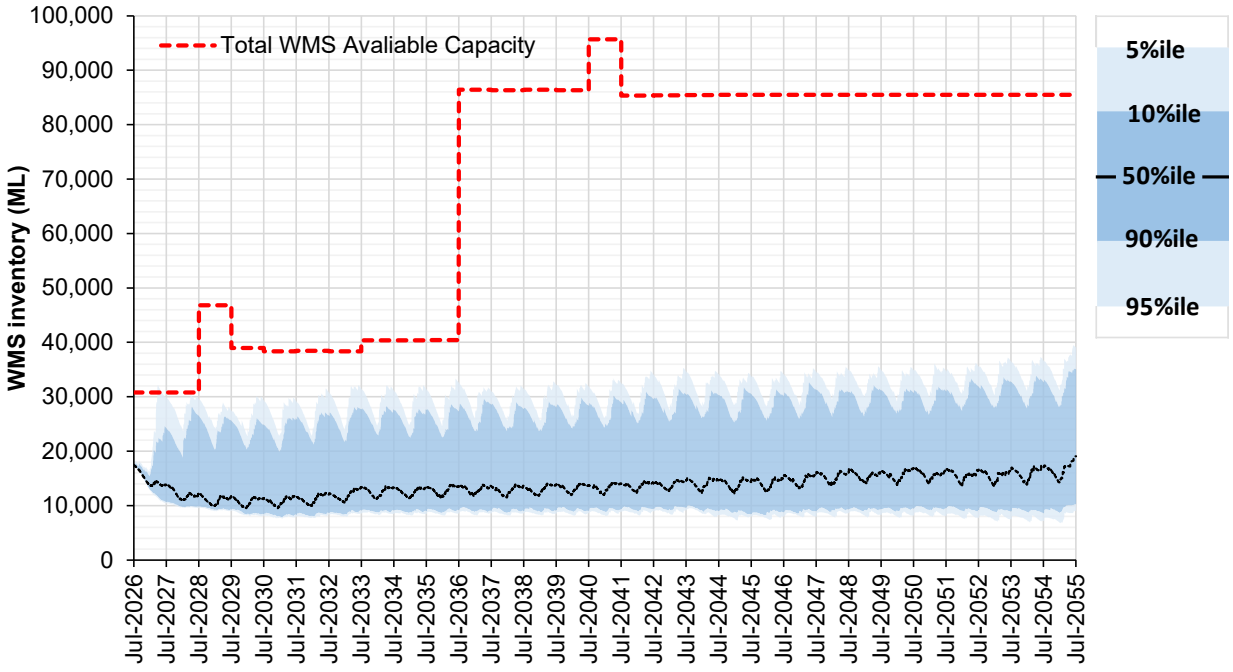
Figure 7.1 shows the forecast total WMS inventory, which includes all dam and pit storages onsite and is compared to the available WMS capacity over time. The total WMS capacity is provided in Table 7.1.

The model results show the following:

- For the 5%ile results (very wet climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 32,000 ML during the first few years of the simulation and reaching around 39,500 ML by the end of the simulation.
- For the 10%ile results (wet climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 28,000 ML during the first few years of the simulation and reaching around 35,000 ML by the end of the simulation.
- For the 50%ile results (median climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 17,500 ML during the first few years of the simulation and reaching around 19,000 ML by the end of the simulation.
- The combined WMS inventory is maintained below the combined WMS capacity for almost all climatic conditions. There is between a 1% and 5% probability that the combined WMS inventory will exceed the combined WMS capacity in the first two years of the simulation. This means there is a low (1-5% AEP) probability that excess MAW would need to be temporarily stored within an active pit or contingency pit storage for a short period of time

Table 7.1 – Available storage capacity at BWM

Year/s (inclusive)	Available WMS storage capacity (ML)
FY27	30,766
FY28	30,766
FY29	30,766
FY30	46,801
FY31	38,972
FY32	38,374
FY33	38,424
FY34	38,374
FY35	40,350
FY36	40,350
FY37	40,400
FY38	86,400
FY39	86,350
FY40	86,400
FY41	86,350
FY42	95,695
FY43	85,334
FY44	85,384
FY45	85,434
FY46	85,471
FY47	85,471
FY48	85,471
FY49	85,471
FY50	85,471
FY51	85,471
FY52	85,471
FY53	85,471
FY54	85,471
FY55	85,471



Model output legend:
Model results are probability envelopes. Each percentile denotes probability of exceedance. Envelopes are re-evaluated on each model time-step (24h)

Figure 7.1 - Forecast WMS inventory

7.4 External water supply

The forecast annual Bedford East and Bedford West pipeline importation volumes are shown in Figure 7.2 and Figure 7.3. The following is of note regarding the external water demand:

- The pipelines supply the minimum raw water demands to the site for all climatic conditions (as outlined in Section 6.5).
- For Bedford East pipeline:
  - External water is only imported under median (50%ile), dry (90%ile) and very dry (95%ile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford East external water demands do not exceed the raw water allocation under any climatic conditions.
- For Bedford West pipeline:
  - External water is only imported under median (50%ile), dry (90%ile) and very dry (95%ile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford West external water demands do not exceed the raw water allocation under any climatic conditions.

The existing Bedford West and Bedford East pipeline allocations are sufficient for maintaining operations at BWM. Additional external water supply allocation is not required as a result of the BNEP.

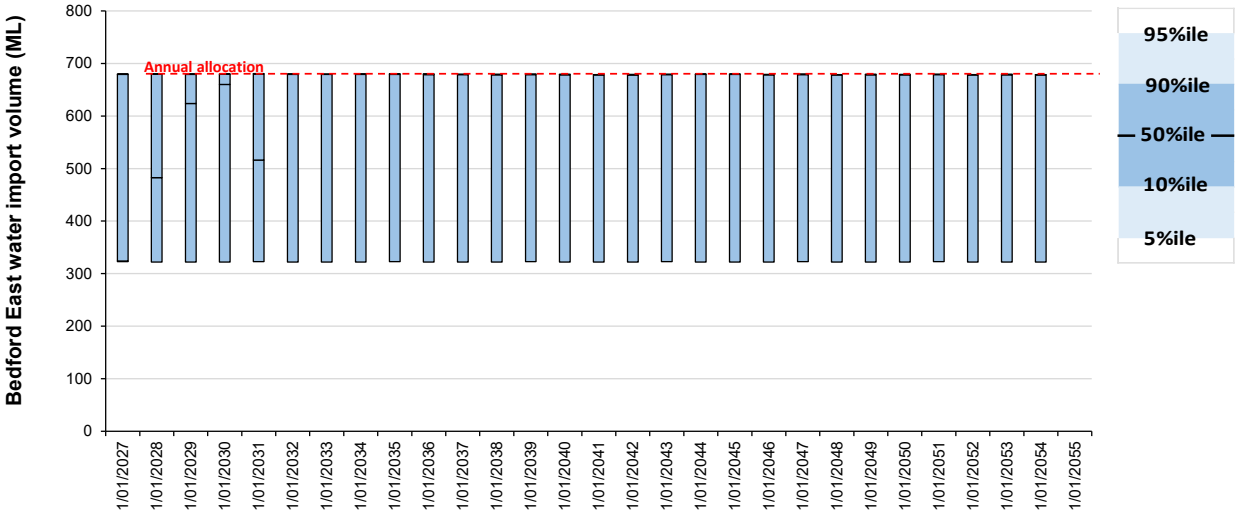


Figure 7.2 - Forecast Bedford East pipeline demand

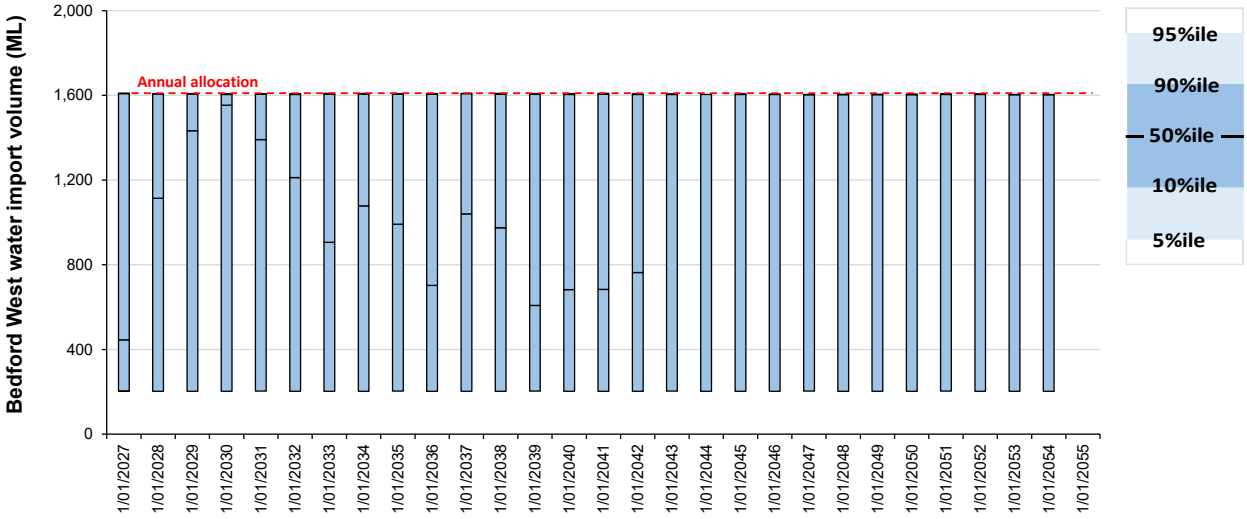


Figure 7.3 - Forecast Bedford West pipeline demand

7.5 Controlled releases

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of MAW. Surface water management measures include separation of clean and contaminated water, sediment and erosion control structures, operational water balance controls, and TARPs to prevent uncontrolled releases.

Modelling of site water balances and flooding behaviour indicates that controlled releases, where required, would occur in accordance with existing EA conditions (Schedule F) and relevant water quality objectives.

Controlled releases under Schedule F of EA EPML00717813 would only occur when receiving waterways have recorded a natural flow event in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher

velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

The forecast annual controlled release volumes, in accordance with EA conditions, are shown in Figure 7.4. The following points are noted in relation to the controlled releases:

- Controlled releases are expected to be required in very wet (5%ile), wet (10%ile) and median climatic conditions, as well as dry (90%) climatic conditions in some years.
- During very wet climatic conditions (5%ile), the annual releases volumes range from 2,950 ML to 5,130 ML.
- During wet climatic conditions (10%ile), the annual releases volumes range from 2,350 ML to 2,930 ML.
- During median climatic conditions (50%ile), the annual releases volumes range from 760 ML to 1,120 ML.

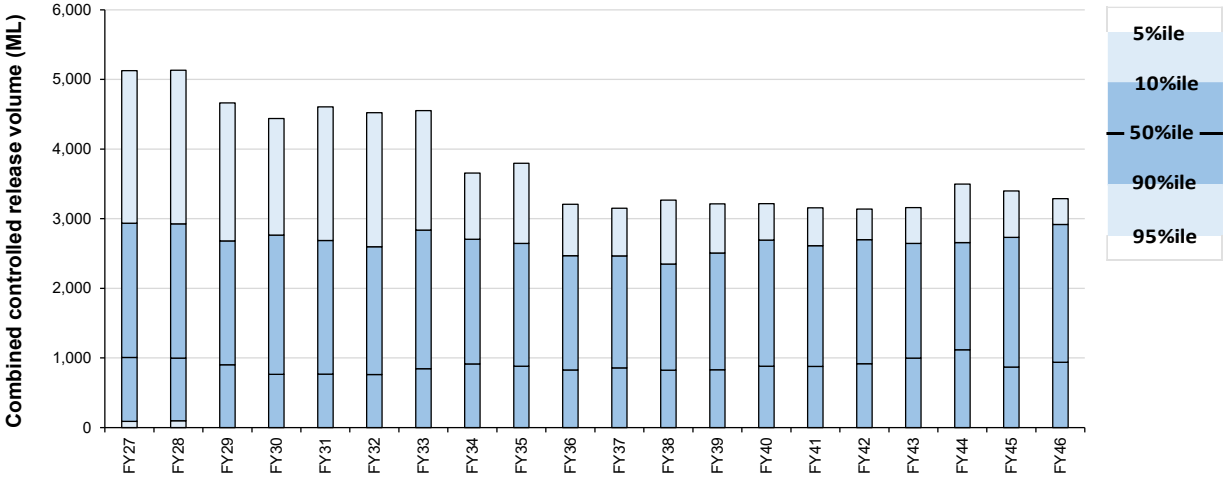


Figure 7.4 - Forecast controlled release volumes - Project

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

7.5.1 Comparison against Approved case

The Project results in the following key changes to water inflows within the water management system:

- Estimated 60% increase in groundwater inflows up to Year 2055.
- Minor changes in captured catchment areas.

An assessment of the impact of the Project on controlled release volumes has been undertaken by comparing the Project results against an Approved case. The outcomes of this assessment have identified the following changes to controlled releases due to the Project:

- During very wet climatic conditions (5%ile), the annual releases volumes for the Approved case range from 2,880 ML to 4,940 ML. That is, under very wet climatic conditions (5%ile), annual controlled release volumes for the Project are predicted to increase by around 2-4% (70-190 ML) compared with the Approved Case.
- During wet climatic conditions (10%ile), the annual releases volumes for the Approved case range from 2,200 ML to 3,100 ML. That is, under wet climatic conditions (10%ile), annual controlled release volumes for the Project are predicted to increase by up to 7% (150 ML) compared with the Approved Case.

- During median climatic conditions (50%ile), the annual releases volumes for the Approved case range from 630 ML to 1,010 ML. That is, under median climatic conditions (50%ile), annual controlled release volumes for the Project are predicted to increase by around 11-20% (110-130 ML) compared with the Approved Case.

This assessment indicates that the Project would result in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

7.5.2 Controlled release rates and dilution requirement

An assessment of potential controlled-release rates and dilution requirements has been undertaken for:

- release point (RP) 2 and RP3, discharging to Blackwater Creek; and
- RP4, discharging to Two Mile Gully.

For the purposes of this assessment, a downstream mixed EC value of 2,000 µS/cm has been adopted, as per Table F5 of the EA (80th percentile receiving water contaminant trigger level for EC). The adopted value is an assessment assumption only and does not necessarily represent the operational trigger or target applied by BWM Operations during an actual controlled release. Operational releases would continue to be managed in accordance with the EA and site procedures, which include:

- Assess stream flow conditions and applicable release limits in accordance with the EA.
- Check release water quality for compliance with the EA Release Contaminant Limits.
- Check receiving water quality for compliance with the EA Receiving Waters Contaminant Limits.
- Use the BWM Release Contaminant Model to assess opportunities to commence an EA compliant MAW release.
- Continue monitoring water quality and release conditions and model outputs.
- Inform the HSE Superintendent prior to commencing a release.

Typical upstream EC concentrations were estimated from relationships developed using recorded streamflow and EC data for the Blackwater Creek and Two Mile Gully gauges over the period 2016–2025. The assessment considers receiving flows of:

- 1 to 100 m^3/s in Blackwater Creek; and
- 1 to 10 m^3/s in Two Mile Gully.

The indicative release rates and dilution requirements are summarised in Table 7.2.

Table 7.2 – Indicative release rates and dilution requirements

Release water EC	Indicative dilution ratio[1]	Indicative release rate
2,500 µS/cm	Approximately 0.27–0.28	Approximately 3.5–3.7 times the receiving-stream flow
5.000 µS/cm	Approximately 1.63–1.69	Approximately 0.5-0.62 times the receiving-stream flow
10,000 µS/cm	Approximately 4.34–4.52	Approximately 0.22–0.23 times the receiving-stream flow

[1] Dilution ratio is defined as receiving-stream flow divided by release flow.

These results demonstrate that the allowable release rate reduces as the EC of the release water increases. For example, at the minimum assessed receiving flow of 1 m^3/s:

- release water with an EC of approximately 2,500 µS/cm could theoretically be released at approximately 3.5–3.6 m^3/s;

- release water with an EC of approximately 5,000 µS/cm could theoretically be released at approximately 0.6 m^3/s; and
- release water with an EC of approximately 10,000 µS/cm could theoretically be released at approximately 0.2 m^3/s.

For RP2 and RP3, the calculated release rate represents the combined allowable discharge from the two release points, rather than a separate allowable rate for each release point.

At higher receiving-stream flows, the achievable discharge rate would be constrained by the capacity of the release infrastructure rather than the calculated receiving-stream dilution capacity. Consequently, the dilution achieved under these conditions would generally be greater than the minimum values presented in the assessment.

The assessment demonstrates that controlled releases can be managed by adjusting the combined release rate in response to:

- the measured receiving-stream flow;
- the receiving-stream EC;
- the EC of the water proposed for release;
- the applicable downstream EC limit; and
- the hydraulic capacity of the release infrastructure.

The calculations are indicative desktop estimates and assume complete and instantaneous mixing of release water with the receiving stream. Actual releases would continue to be undertaken in accordance with the approved EA, including all applicable minimum-flow, water-quality, monitoring and release-point requirements.

7.6 Uncontrolled releases

The Whitehaven documents "*WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water*" (Whitehaven, 2024), "*BWM Plan – Water Management*" (Whitehaven, 2026) and "*BWM Plan – Erosion and Sediment Control Plan*" (Whitehaven, 2026) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in these documents will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons:

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.
- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge.
- The Project does not modify the catchments of New Taurus Creek Dam or New Deep Creek Dam, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

8 Final void behaviour

8.1 Overview

Water levels in the final voids will vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater. A final void GoldSim model (separate to the GoldSim model used for the operational modelling) was used to assess the likely long-term water level behaviour of the final voids.

The proposed final landform layout relevant to the Project is presented in Figure 8.1 and Figure 8.2, and includes five residual voids:

- Mimosa/Besgrove (MB);
- Ramp 30 (R30);
- Deep Creek (DC);
- Stewarton North (ST-N); and
- Stewarton South (ST-S).

BWM is operated under Environmental Authority EPML00717813 (EA). Condition E10 of the EA stipulates that "residual voids must not cause any serious environmental harm to land, surfaces waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself".

The BWM residual voids will be operated as non-use management areas (NUMAs) as part of the Progressive Rehabilitation Closure Plan (PRCP).

The long-term final void hydrology and water quality behaviour of the proposed final voids has been modelled over a 1,000-year post-closure period to assess whether the final voids would be safe and non-polluting. This report outlines the methodology and assessment of the expected final void pit lake behaviour, which has been modelled using the GoldSim water balance simulation software.

8.2 Final void geometry

The proposed Project final landform incorporates five residual voids that span across the reaches of the Sagittarius Creek, Blackwater Creek, Taurus Creek and Two Mile Gully catchments.

This final landform would form during mining, incorporating in-pit backfilled spoil sitting atop a mined pit shell. A digital elevation model (DEM) of the final landform (i.e. the final surface expected at the end of the mine life) was provided by Whitehaven.

A summary of the residual void geometries is provided in Table 7.1, including the year that the void commences.

Table 8.1 - Final void geometries

Void	Floor level (metres Australian Height Datum [mAHD])	Crest level (mAHD)	Depth (m)	Volume to crest (ML)	Surface area at crest (ha)
MB	24	200	176	374,878	597.2
R30	139	217	78	16,316	59.7
DC	52	202	150	54,895	109.4
ST-N	-4	204	208	302,582	380.1
ST-S	92	232	140	42,632	82.5

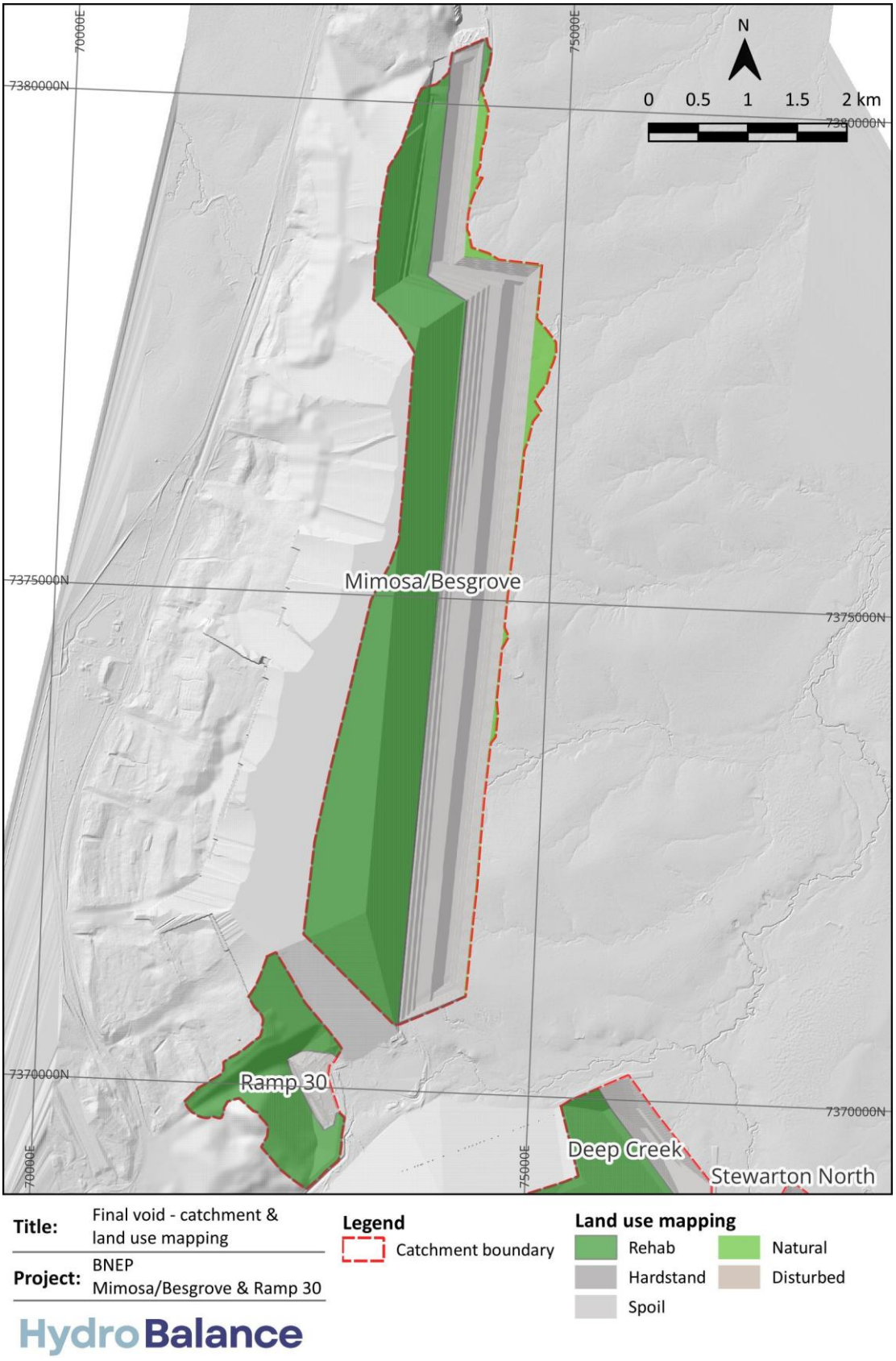


Figure 8.1 - Final void configuration - Mimosa/Besgrove & Ramp 30

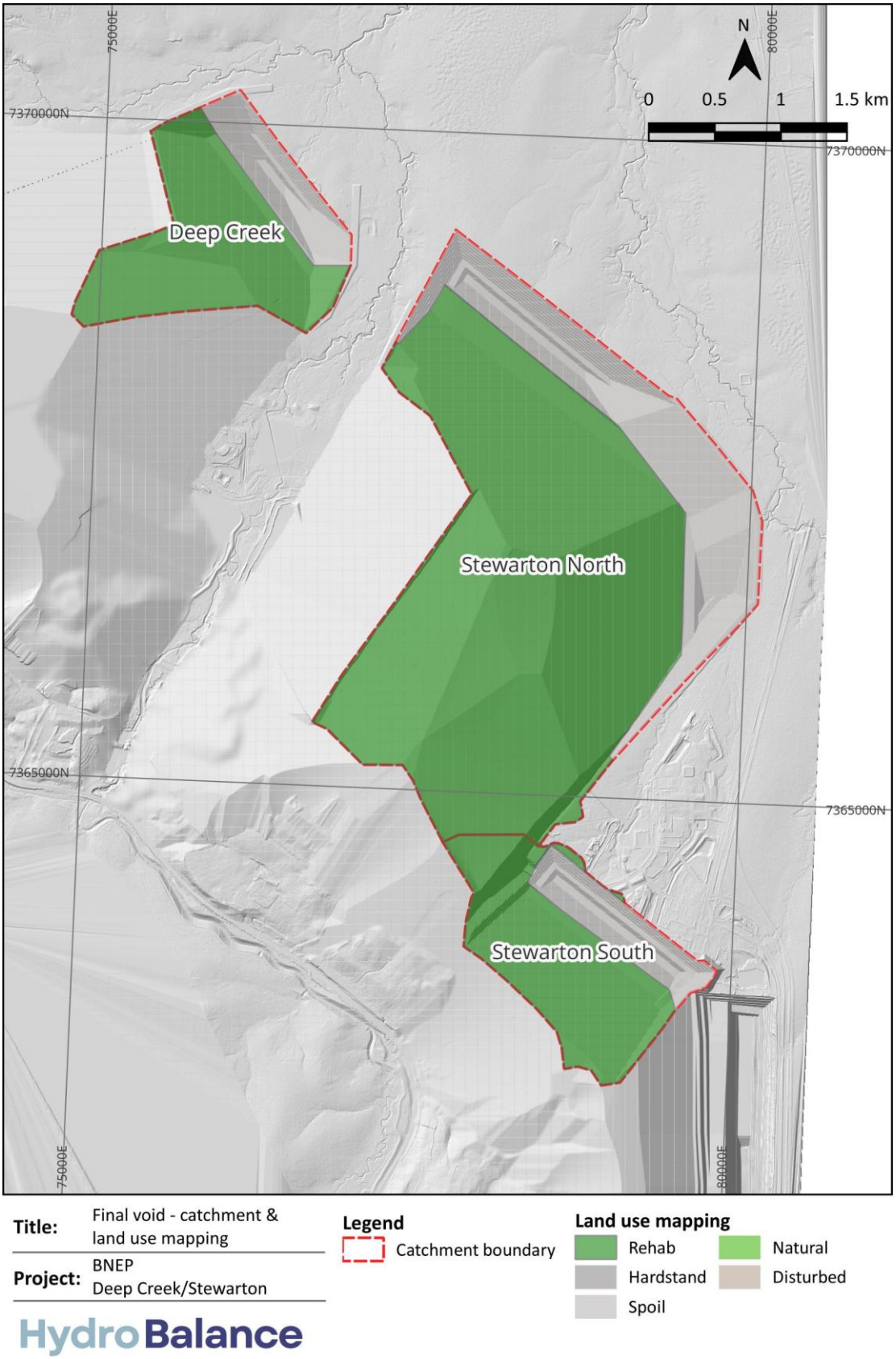


Figure 8.2 -Final void configuration - Deep Creek, Stewarton North & South

8.3 Model configuration

8.3.1 Modelling approach

The GoldSim software platform was used to simulate the long-term water level behaviour for the five Project voids. Water levels in the residual voids would vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater.

The GoldSim model was used to simulate the generation, movement, and loss of water on a daily time-step within the final void, over a 1,000-year period. The volume of water in the voids was calculated at each time step as the sum of direct rainfall to the void surface, catchment runoff, and groundwater flux, less evaporation losses. The model also tracks the quantity of salt captured and stored within the system.

Key components of the model are summarised in the following sub-sections, including descriptions of key model inputs, assumptions, and sensitivity parameters.

8.3.2 Climate data

The Australian Government Consistent Climate Scenarios (CCS) project was used to generate climate change adjusted rainfall and evaporation data, which transformed historical climate data from the period between 1960 and 2024 (64 years). The CCS project provides climate projections as a daily time series across Australia on a 0.05-degree grid. The grid point closest to the central of BWM was used for this assessment.

The Shared Socioeconomic Pathway SSP2-4.5 was selected as the emission pathway for the Intergovernmental Panel on Climate Change (IPCC) assessment report AR5, with a base case global warming sensitivity for the Year 2070. The Year 2070 was selected as it represents a general mid-point for the varying void commencement dates.

SSP2-4.5 assumes that global development and environmental policies will continue along their current trajectories, and represents a moderate path where social, economic and technological trends do not shift markedly from historical patterns. It leads to moderate greenhouse gas emissions and radiative forcing of 4.5 Watts per square metre (W/m^2) by 2100.

The climate data was selected according to the following climate sensitivity and climate change model composites:

- climate warming sensitivity assumed to fall in the medium category; and
- the representative future climate cluster was selected as HP, which represents a high level of global warming.

The 64 years of historical climate data adjusted rainfall and evaporation data was looped to create a long-term (1,000-year) climate sequence.

Figure 8.3 shows the long-term monthly averages for the rainfall data and pan evaporation.

Pan evaporation has been converted to Morton's Lake (mLake) and Morton's Wet (mWet) evapotranspiration to account for evapotranspiration losses from the pit lake and catchment as follows:

- Pan evaporation to mLake factor: 0.883 – applied to the evaporation acting on the surface of the pit lake.
- Pan evaporation to mWet factor: 0.845 – applied to the evaporation.

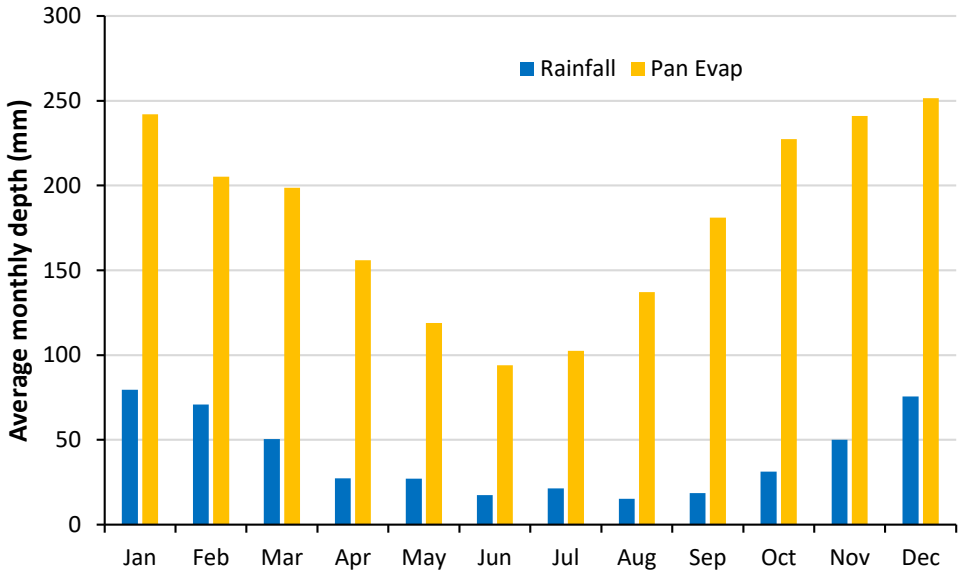


Figure 8.3 - Distribution of monthly rainfall and pan evaporation (CCS 1960 - 2024)

8.4 Catchment runoff

8.4.1 Catchment areas

The final landform catchment area was delineated from the final landform surface provided by Whitehaven. The landuse of the void floor has been characterised as spoil. Figure 8.1 to Figure 8.2 show the catchment boundary and land uses adopted for the final void water balance. The catchment and land use values used in the GoldSim model are shown in Table 8.2.

Table 8.2 - Final void catchment and land use areas

Void	Catchment area (ha)			
	Undisturbed	Spoil	Rehabilitated spoil	Total
MB	39.1	596.5	622.4	1,258.0
R30	0.0	24.1	149.2	173.3
DC	0.0	52.9	167.3	220.2
ST-N	0.0	195.2	678.1	873.3
ST-S	0.0	50.9	150.3	201.2

8.4.2 AWBM parameters

The final void GoldSim model uses the same AWBM parameters as per the operational model. Refer to Section 6.3 for further details.

8.4.3 Groundwater inflows

Groundwater water inflows into the five voids have been provided by the project groundwater consultants (SLR, 2026). The inflows were provided as a time series over the 1,000 year simulation. Refer to SLR (2026) for further details on the groundwater inflows to the voids.

8.5 Final void model results

8.5.1 Water level

The final void modelled water levels for the five voids are presented in Figure 8.4 to Figure 8.8. The following is of note regarding these results:

- MB void reaches equilibrium within 100 years post mining, with a median water level of around 83 mAHD. The maximum void water level (88.1 mAHD) is 112 m below the pit crest level (200 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- R30 void reaches equilibrium within 100 years post mining, with an inventory cycling between empty (during extended dry periods) and a maximum void water level of around 160 mAHD during extended wet periods. The maximum void water level (160.1 mAHD) is 57 m below the pit crest level (217 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- DC void reaches equilibrium within 150 years post mining, with a median water level of around 138 mAHD. The maximum void water level (149.8 mAHD) is 52 m below the pit crest level (202 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- ST-N void reaches equilibrium within 100 years post mining, with a median water level of around 73 mAHD. The maximum void water level (79.4 mAHD) is 124 m below the pit crest level (204 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- ST-S void reaches equilibrium within 100 years post mining, with a median water level of around 104 mAHD. The maximum void water level (118.5 mAHD) is 113 m below the pit crest level (232 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.

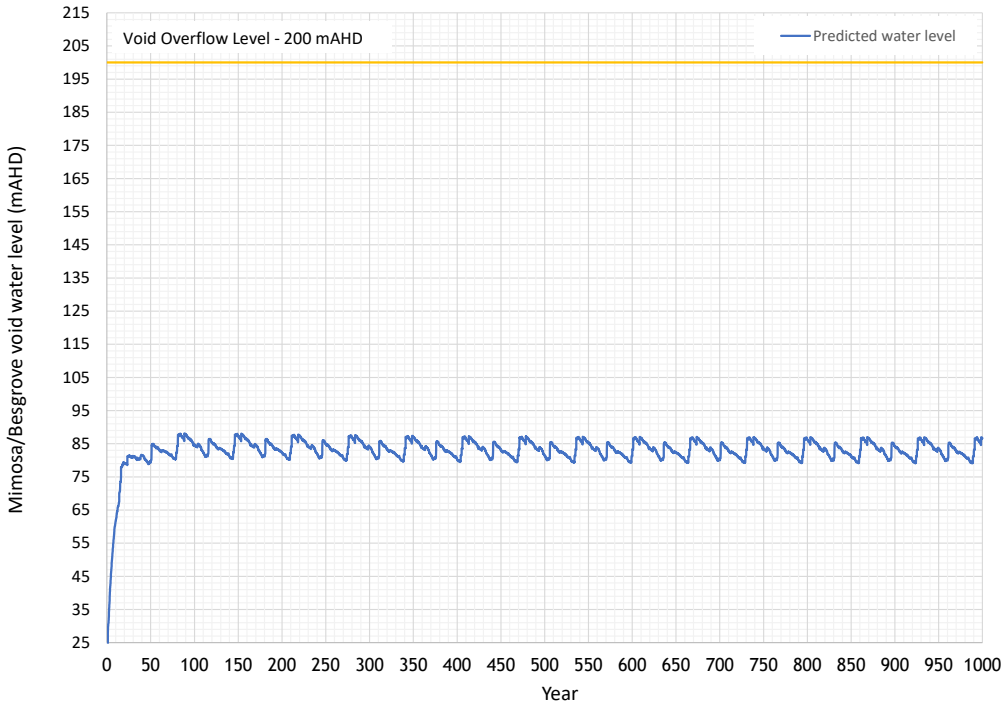


Figure 8.4 - Mimosa/Besgrove void - long term predicted final void water level

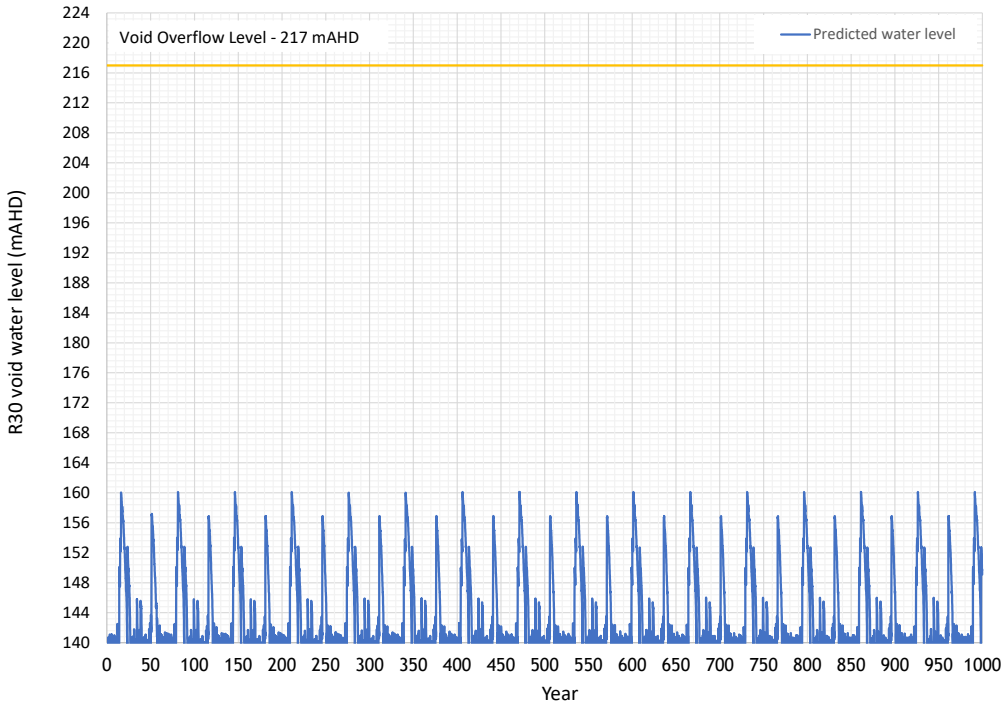


Figure 8.5 - Ramp 30 void - long term predicted final void water level

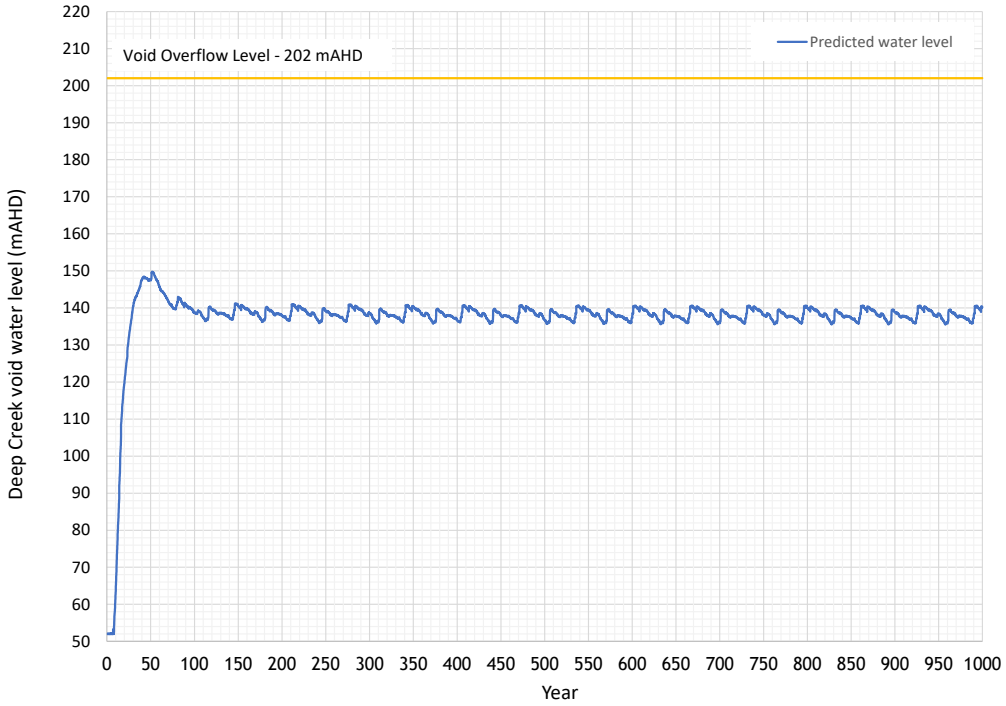


Figure 8.6 - Deep Creek void - long term predicted final void water level

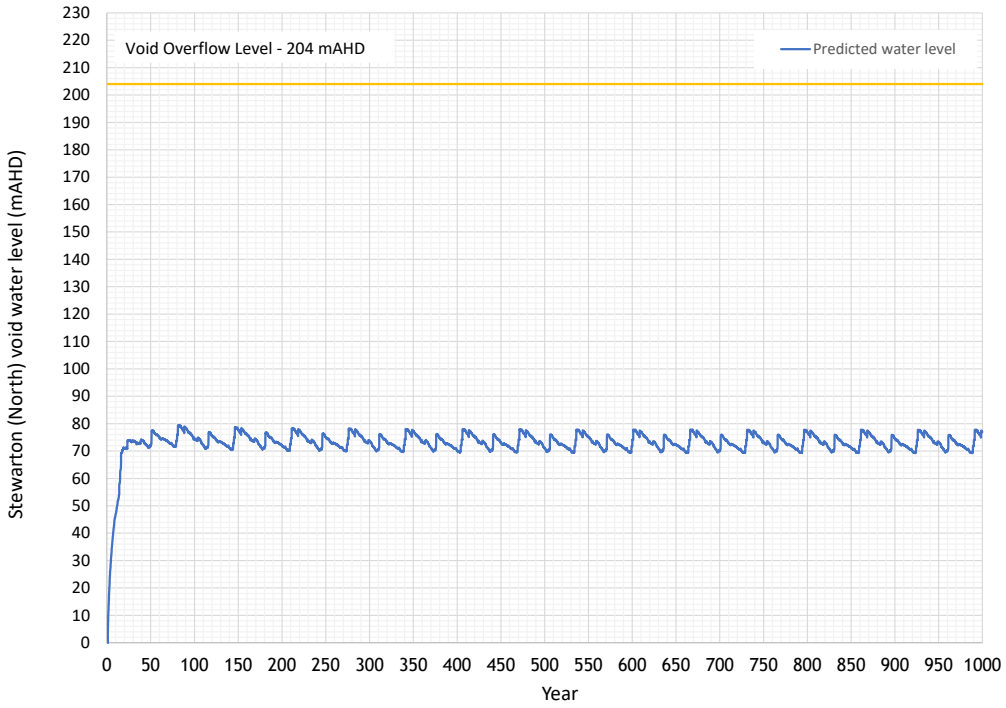


Figure 8.7 - Stewarton North void - long term predicted final void water level

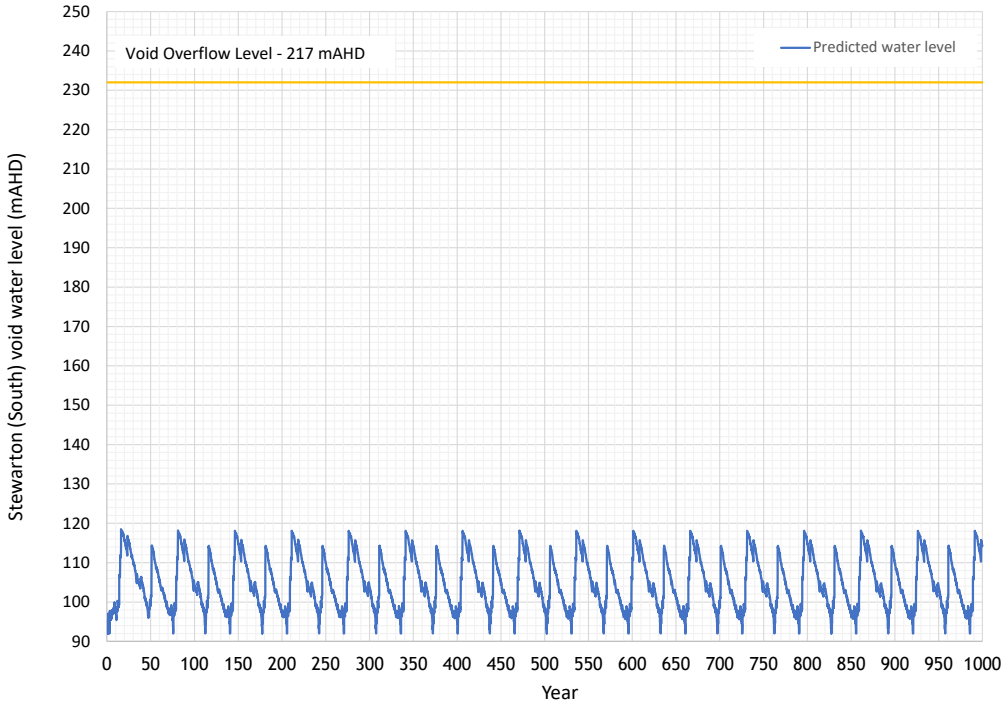


Figure 8.8 - Stewarton South void - long term predicted final void water level

8.5.2 Salinity

The final void modelled salinity levels for the five voids are presented in Figure 8.9 to Figure 8.13. The long-term salinity generally increases over time, which is expected for closed-loop systems with no mechanism for salt removal. This assessment is considered conservative, as it:

- Assumes an unlimited source of salt within the catchment and does not include any allowance for potential reduction in the localised leaching of salts from the catchment over time.
- Does not take into account the potential precipitation of dissolved salts as mineral compounds.

The following is of note regarding these results:

- For Mimose/Besgrove void, the salinity of the pit lake progressively increases, rising to 250,000 µS/cm over the 1,000-year simulation.
- For Ramp 30 void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 5,000 µS/cm.
- For Deep Creek void, the salinity of the pit lake progressively increases, rising to 180,000 µS/cm over the 1,000-year simulation.
- For Stewarton North void, the salinity of the pit lake progressively increases, rising to 195,000 µS/cm over the 1,000-year simulation.
- For Stewarton South void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 10,000 µS/cm.

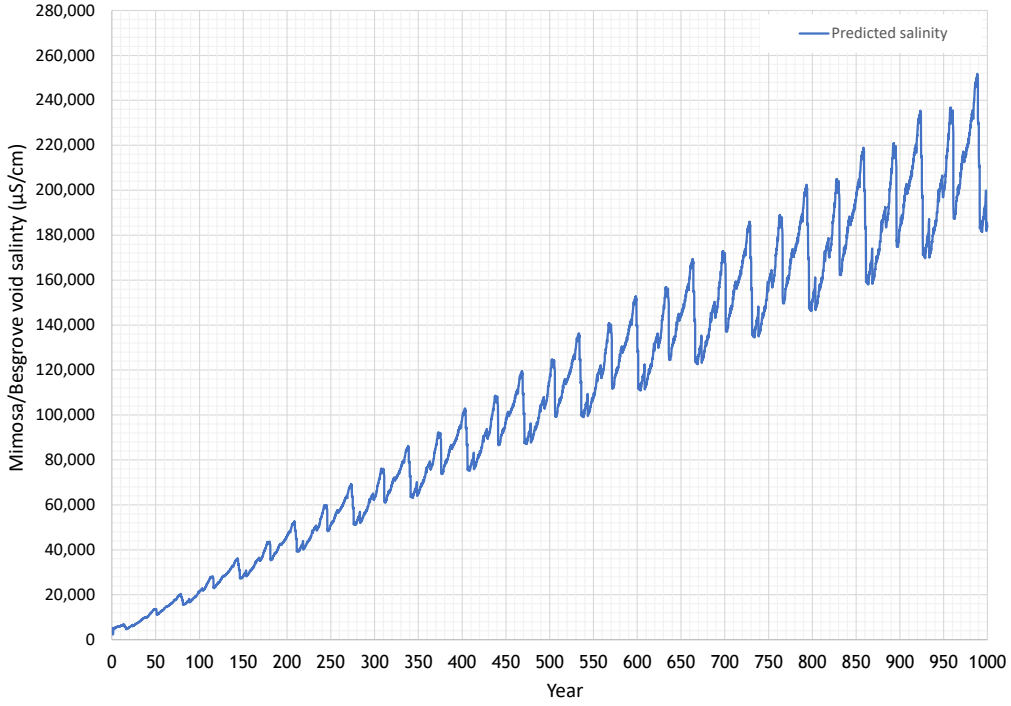


Figure 8.9 - Mimosa/Besgrove void - long term predicted void water salinity

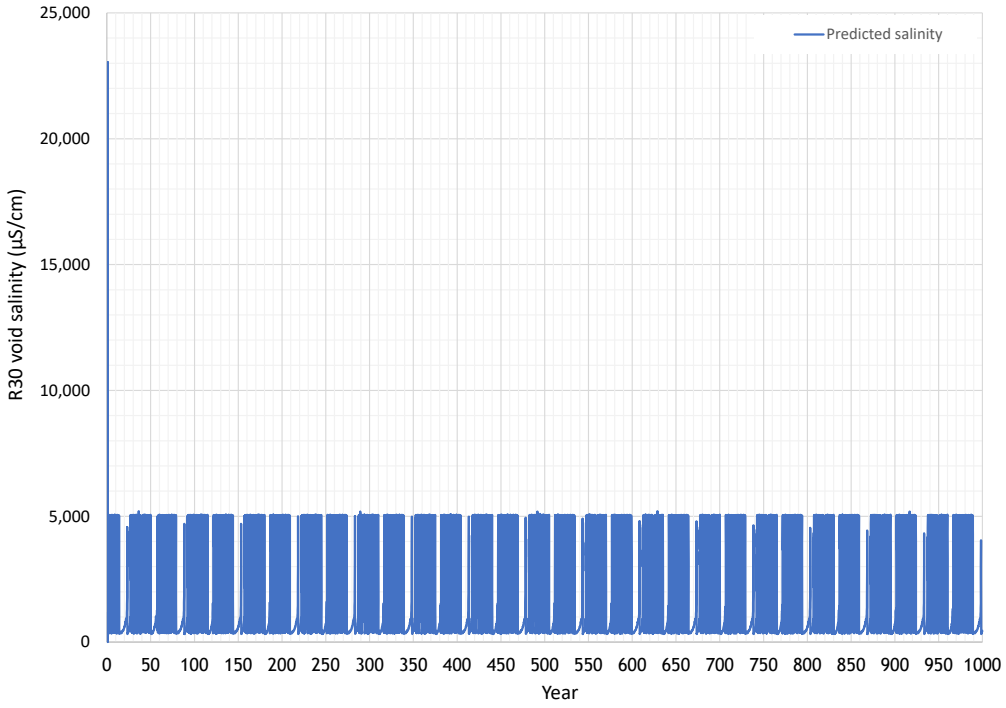


Figure 8.10 - Ramp 30 void - long term predicted final void water salinity

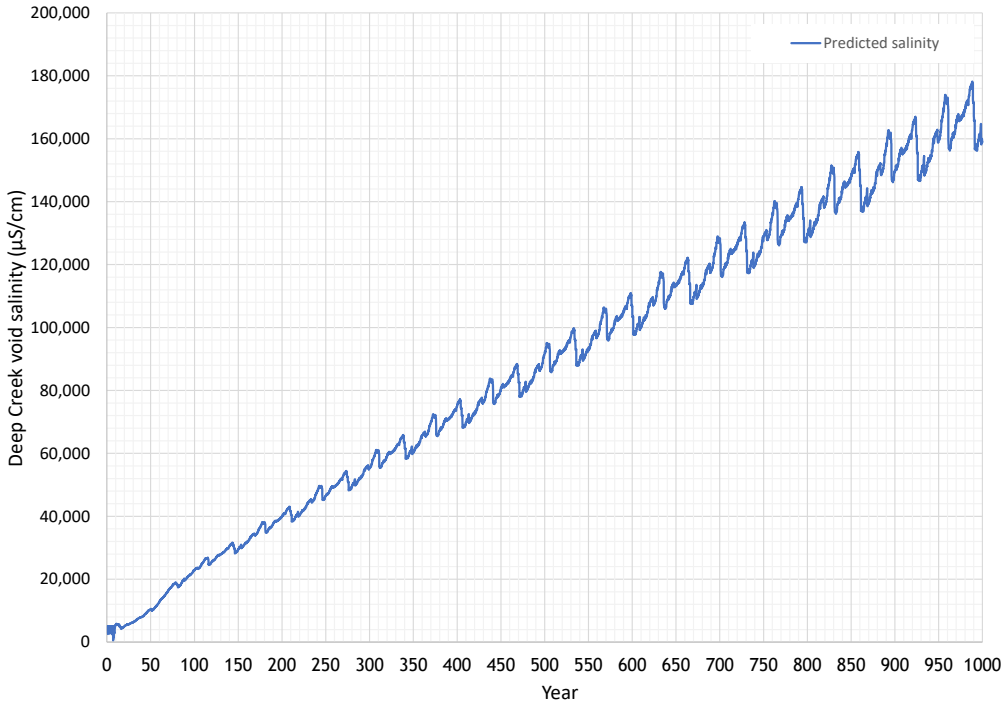


Figure 8.11 - Deep Creek void - long term predicted final void water salinity

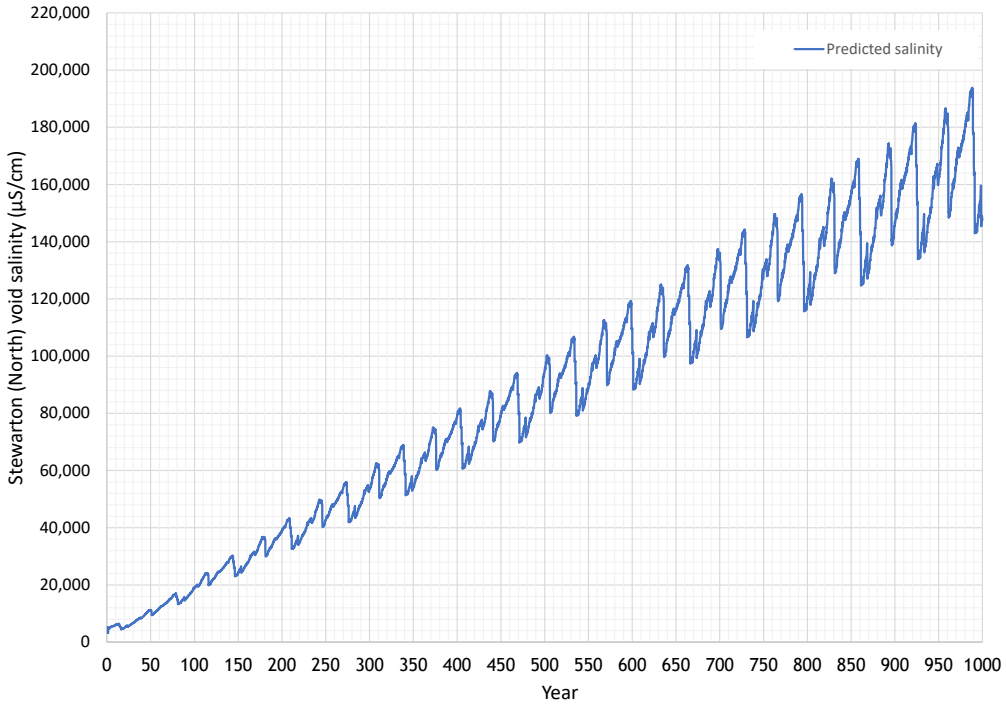


Figure 8.12 – Stewarton North void – long term predicted final void water salinity

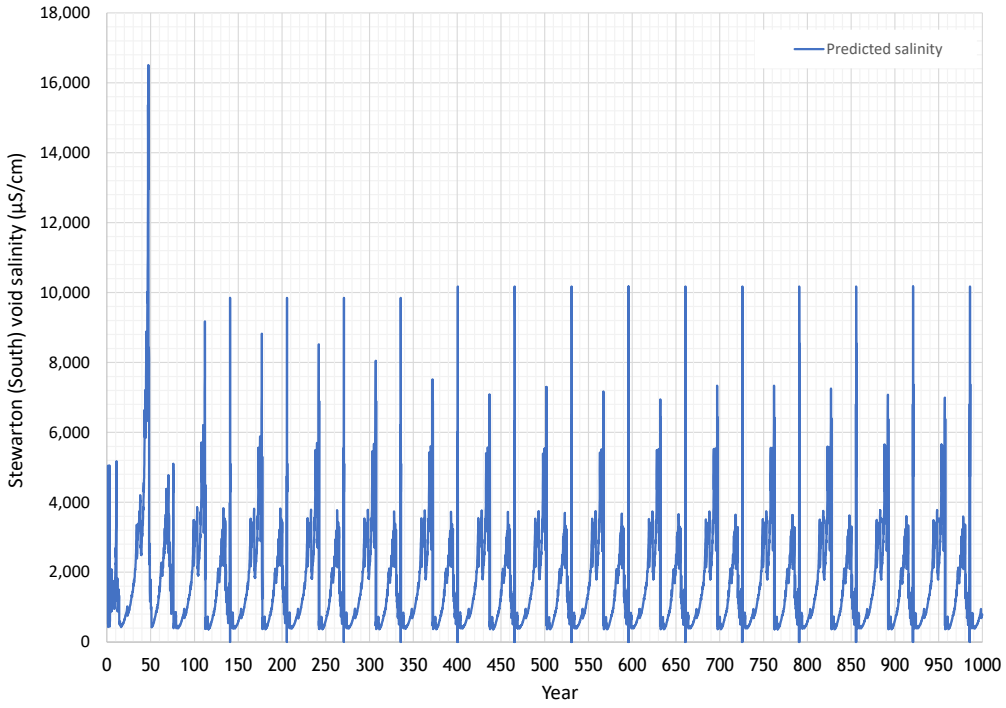


Figure 8.13 – Stewarton South void – long term predicted final void water salinity

8.6 Extreme storm event behaviour

8.6.1 Methodology

An assessment of the impact of extreme storm events on the water levels in the final voids has been undertaken. The potential for discharge of void water during a large storm was assessed for the 1 in 1,000 Annual Exceedance Probability (AEP) (or 0.1% AEP) 72-hour (3 day) design storm. For conservatism, it has been assumed that the extreme storm would occur coincident with the peak modelled long-term water levels.

Design rainfall depths for the above events were estimated using standard procedures in Australian Rainfall and Runoff (ARR) (Ball et al., 2019). The runoff generated from the storm events has been conservatively calculated assuming 100% of runoff reports to the voids (i.e. no losses) from the surface catchment reporting to the voids.

8.6.2 Results

The results of the storm event analysis are presented in Table 8.3. These results show that, even during extreme short duration storm events, the pit crest would not be overtopped for any of the final voids.

Table 8.3 – Storm event modelling results

Void	Runoff Volume (ML)	Water level increase (m)	Final Volume (ML)	Final Level (mAHD)	Pit crest level (mAHD)	Freeboard (m)
MB	3,585	3.4	29,316	91.5	200	108.5
R30	494	6.3	1,124	166.1	217	50.9
DC	628	2.6	7,884	129.9	202	72.1
ST-N	2,489	1.5	59,120	115.0	204	89.0
ST-S	573	3.6	4,992	150.0	232	82.0

9 References

Ball et al. (2019)	Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (Editors) (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation*. Commonwealth of Australia (Geoscience Australia), Canberra.
Engeny Australia Pty Ltd (2025)	Engeny Australia Pty Ltd. (2025). *Summary of 2025 AWT Methods*. Prepared for Whitehaven Coal Limited.
Jeffrey et al. (2001)	Jeffrey, S. J., Carter, J. O., Moodie, K. B., & Beswick, A. R. (2001). *Using spatial interpolation to construct a comprehensive archive of Australian climate data*. Environmental Modelling & Software, 16(4), 309-330.
SLR (2026)	SLR Consulting Australia Pty Ltd. (2023). *Blackwater North Extension Project Groundwater Impact Assessment*. Prepared for Whitehaven Blackwater Pty Ltd.
Whitehaven (2024)	Whitehaven Coal Limited. (2024). *WHC QLD Standard: Erosion & Sediment Control and Mine Affected Water*.
Whitehaven (2026a)	Whitehaven Coal Limited. (2026a). *BWM Plan – Erosion and Sediment Control Plan*.
Whitehaven (2026b)	Whitehaven Coal Limited. (2026b). *BWM Plan – Water Management Plan*.

APPENDIX C GREAT BARRIER REEF SURFACE WATER IMPACT ASSESSMENT MEMORANDUM

Level 1
369 Ann Street
Brisbane

PO Box 10703
Brisbane Adelaide Street
Qld 4000

WRM
WATER +
ENVIRONMENT

07 3225 0200
wrm@wrmwater.com.au
wrmwater.com.au

ABN 96 107 404 544

MEMORANDUM

Date	15 October 2026
Attention	Brendan Dillon
Company	Whitehaven Blackwater Pty Ltd
WRM ref.	1559-11-B5
Subject	Blackwater North Extension Project – Great Barrier Reef (GBR) surface water impact assessment

Dear Brendan,

1 INTRODUCTION

1.1 BACKGROUND

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) southwest of Blackwater, Central Queensland (refer to Figure 1.1). The BWM produces up to 17.6 million tonnes per annum (Mtpa) of product coal, predominantly high-quality coking coal for use in steelmaking as well as high energy thermal coal. The BWM is currently owned and operated by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven), and operates under Environmental Authority (EA) EPML00717813.

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759 (refer to Figure 1.2). The Project would involve an indicative mining rate of up to 19 Mtpa of run-of-mine coal. Figure 1.2 shows the general arrangement of the Project site, including the open cut pit extents within SA 7 and SA 10.

1.2 PURPOSE AND SCOPE

This surface water assessment was prepared to support the Referral for the Project under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It addresses the potential for the Project to result in surface water impacts on the Great Barrier Reef World Heritage Property, National Heritage Place, and Marine Park, which are listed as Matters of National Environmental Significance under the following sections of the EPBC Act:

- sections 12 and 5A – World Heritage Property;
- sections 15B and 15C – National Heritage Place; and
- sections 24B and 24C – Great Barrier Reef Marine Park.

For the purpose of this assessment, the Project is also referred to as ‘the Action', defined broadly in the EPBC Act as either ‘a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things.’

This assessment addresses whether the potential surface water impacts associated with the Action on the Great Barrier Reef Marine Park meets the ‘substantial cause’ requirement of an indirect impact as outlined in section 527E(2) of the EPBC Act.

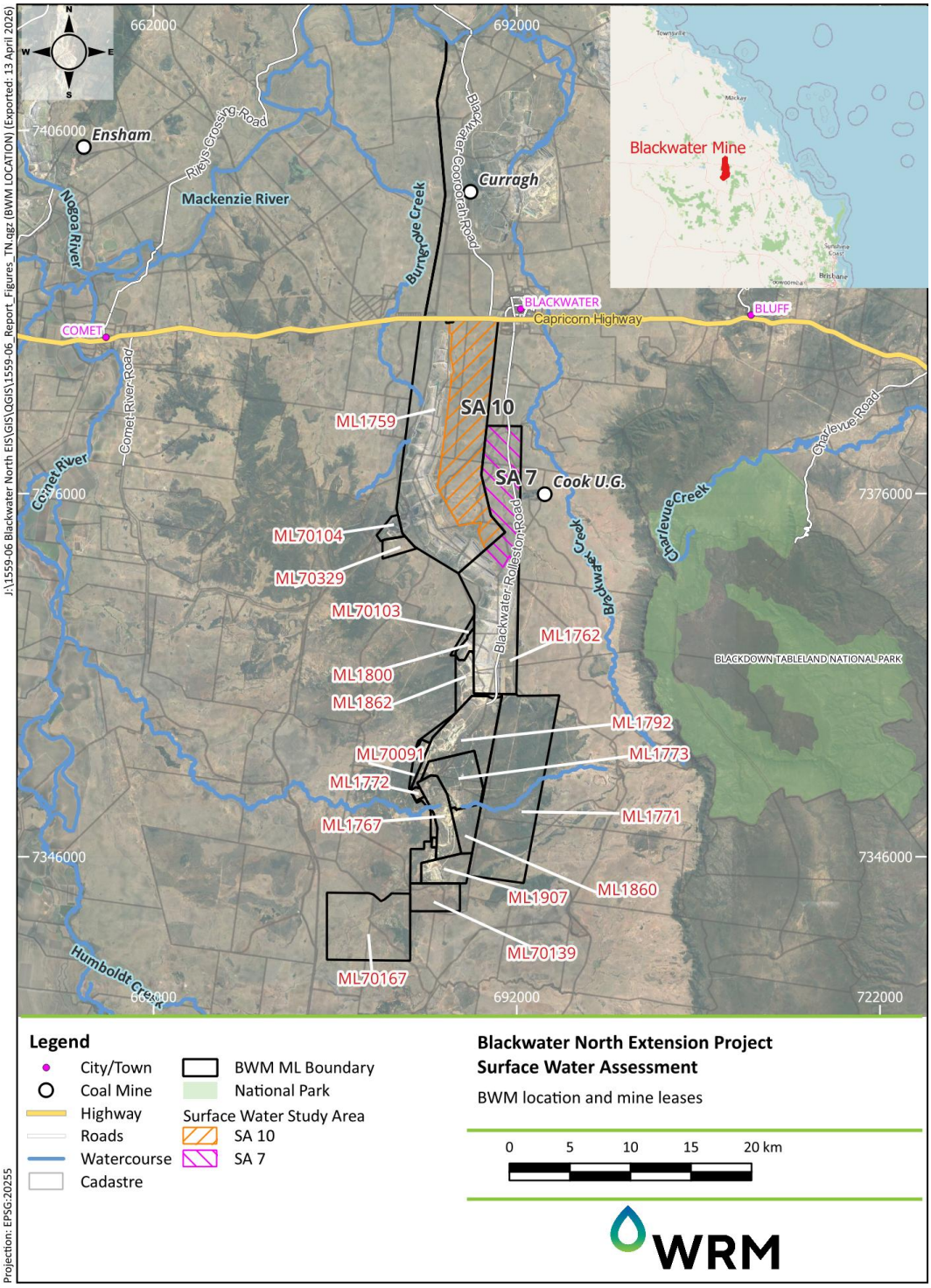


Figure 1.1 BWM locality

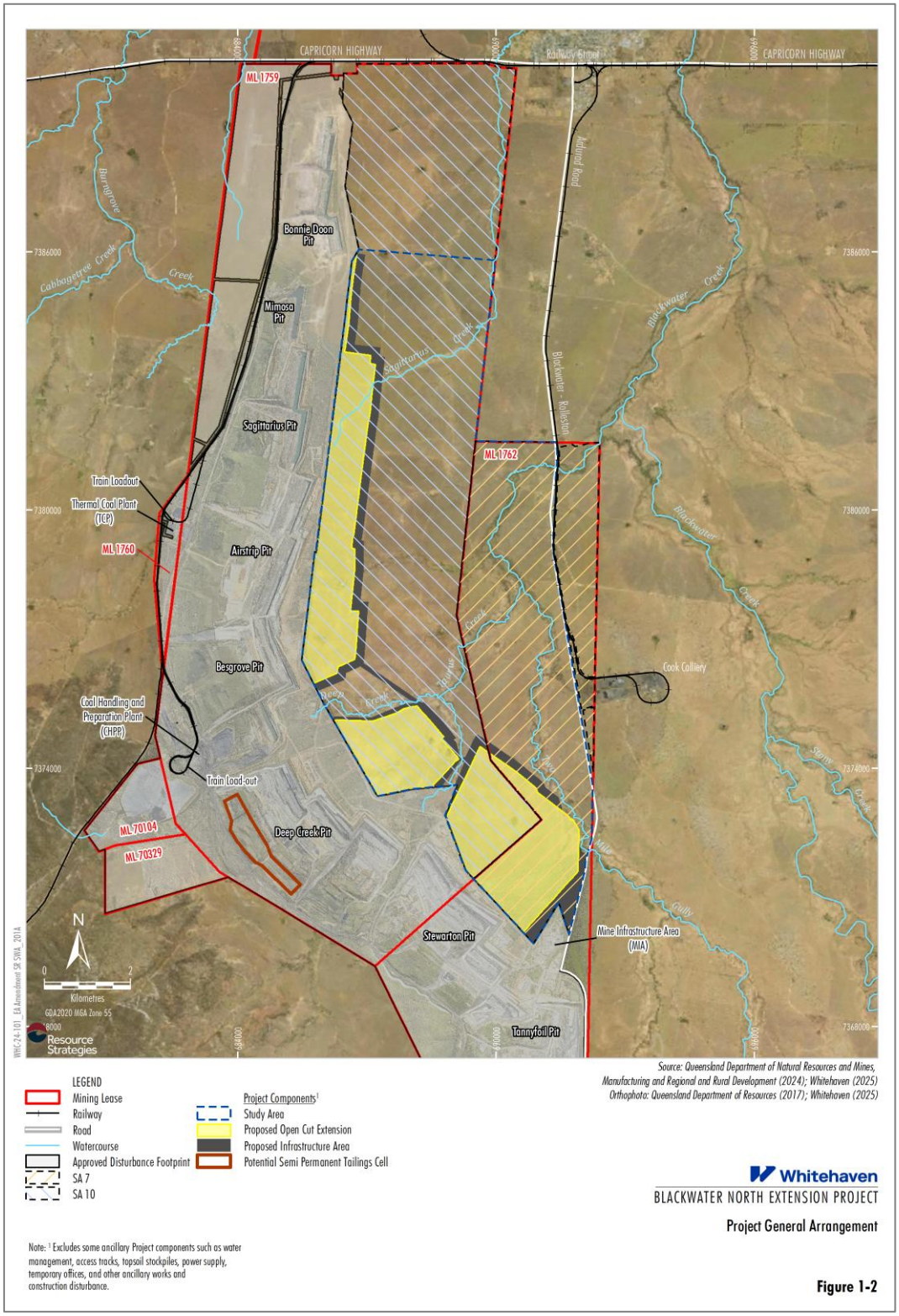


Figure 1.2 Project General Arrangement

2 REGULATORY FRAMEWORK

2.1 OVERVIEW

This memorandum has been prepared in consideration of the following:

- *EPBC Act 1999 Referral Preparation Guideline* (Commonwealth Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2024);
- *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Commonwealth of Australia, 2013);
- *Significant Impact Guidelines 1.3 Coal Seam Gas and Large Coal Mining Developments — Impacts on Water Resources* (Commonwealth of Australia, 2022);
- *EPBC Act Referral Guidelines for the Outstanding Universal Value of the Great Barrier Reef World Heritage Area* (Commonwealth of Australia, 2014);
- *Reef 2050 Water Quality Improvement Plan 2017–2022* (Queensland Government, 2018);
- *Reef Water Quality Report Card 2021 and 2022* (Queensland Government, 2024);
- *Environmental Protection Act 1994 Guideline – Reef discharge standards for industrial activities* (DESI, 2024); and
- *Best Practice Erosion and Sediment Control* (International Erosion Control Association [IECA], 2008).

2.2 COMMONWEALTH

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The Action is being referred to the Commonwealth Minister for the Environment and Water for consideration as to whether the Project is a 'controlled action' and requires approval under the EPBC Act. This memorandum forms part of the Referral.

With regards to the Great Barrier Reef (GBR) World Heritage property, National Heritage Place and Marine Park, the *Significant Impact Guidelines 1.1* (Commonwealth of Australia, 2013) identifies that:

- *Approval under the EPBC Act is required for any action occurring within or outside a declared World Heritage property that has, will have, or is likely to have a significant impact on the World Heritage values of the World Heritage property.*
- *An action will require approval if:*
    - *the action is taken in the Great Barrier Reef Marine Park and the action has, will have, or is likely to have a significant impact on the environment, or*
    - *the action is taken outside the Great Barrier Reef Marine Park and the action has, will have, or is likely to have a significant impact on the environment in the Great Barrier Reef Marine Park.*

The GBR is located approximately 600 river km downstream (and 210 km east "as the crow flies") of the Action (as shown in Figure 2.1). As such, the Action would not result in any direct impacts to the GBR. Therefore, this assessment was prepared to assess the potential indirect impacts of the Action due to runoff and surface water releases.

Regarding indirect impacts, section 527E of the EPBC Act describes that an event or circumstance is considered an 'impact' of an Action only if the Action is a 'substantial cause' of that event or circumstance.



Figure 2.1 Map of Great Barrier Reef Region, Marine Park and World Heritage Area (Commonwealth of Australia, 2024)

2.3 QUEENSLAND

2.3.1 Environmental Protection Act 1994

In addition to approval of the Action under the EPBC Act, Whitehaven Blackwater is currently seeking to obtain an EA Amendment for the Project (including the Action) under the *Environmental Protection Act 1994* (EP Act).

The EP Act and the *Environmental Protection Regulation 2019* (EP Regulation) specify the regulatory requirements for prescribed environmentally relevant activities (ERAs). Regarding the potential impacts to the 'GBR catchment waters', section 41AA of the EP Regulation states:

3. *The administering authority must refuse to grant the application if the authority considers that –*
    a. *the relevant activity will, or may, have a residual impact; and*
    b. *having regard to the matters mentioned in the water quality offset policy, the residual impact will not be adequately counterbalanced by offset measures for the relevant activity.*
4. *A residual impact of a relevant activity is the presence of fine sediment (FS), or dissolved inorganic nitrogen (DIN), in Great Barrier Reef catchment waters, that –*
    a. *was released to the water because of the relevant activity; and*
    b. *remains, or is likely to remain in the water despite mitigation measures for the relevant activity.*

The intent of section 41AA of the EP Regulation is to achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters as outlined in the *Reef discharge standards for industrial activities* (DESI, 2024) (the Reef Discharge Standards).

3 EXISTING SURFACE WATER ENVIRONMENT

3.1 DRAINAGE CHARACTERISTICS

3.1.1 Regional drainage features

The GBR receives runoff from six natural resource management regions and 35 catchments which drain 424,000 square kilometres (km^2) of coastal Queensland (Department of Environment, Tourism, Science and Innovation [DETSI], 2025). Grazing is the dominant agricultural land use (77 percent [%]), particularly in the Burdekin and Fitzroy regions.

Figure 3.1 shows the regional drainage characteristics in the vicinity of the Action. Figure 3.1 also shows the locations of surface water monitoring sites that are active as part of the Fitzroy Regional Receiving Environment Monitoring Program (FRREMP) and are relevant to the Action.

The Action is located within the Mackenzie River catchment, part of the greater Fitzroy Basin, and is approximately 600 river km upstream of the GBR. The Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, ultimately discharging into the Coral Sea southeast of Rockhampton, near Port Alma. The total Fitzroy River catchment is 142,665 km^2.

Blackwater Creek, a tributary of the Mackenzie River, is the main watercourse in the vicinity of the Action and flows in a northerly direction to the east of the Action. Figure 3.2 shows the Blackwater Creek catchment to the Mackenzie River.

The catchment area of Blackwater Creek, encompassing the Action, is approximately 1,100 km^2. This represents around 0.8% of the overall Fitzroy River catchment. The disturbance footprint of the Action is approximately 23 km^2 and represents 2% of the Blackwater Creek catchment and 0.016% of the overall Fitzroy River catchment area.

3.1.2 Local drainage features

Figure 3.3 shows the local drainage features in the vicinity of the Action. Figure 3.1 also shows the locations of local surface water monitoring sites in the vicinity of the Action.

The Action is drained by several tributaries of Blackwater Creek, including Deep Creek, Taurus Creek, Emu Creek, Two Mile Gully and Sagittarius Creek. These local tributaries generally drain in a northeasterly direction and join Blackwater Creek to the east of the Action.

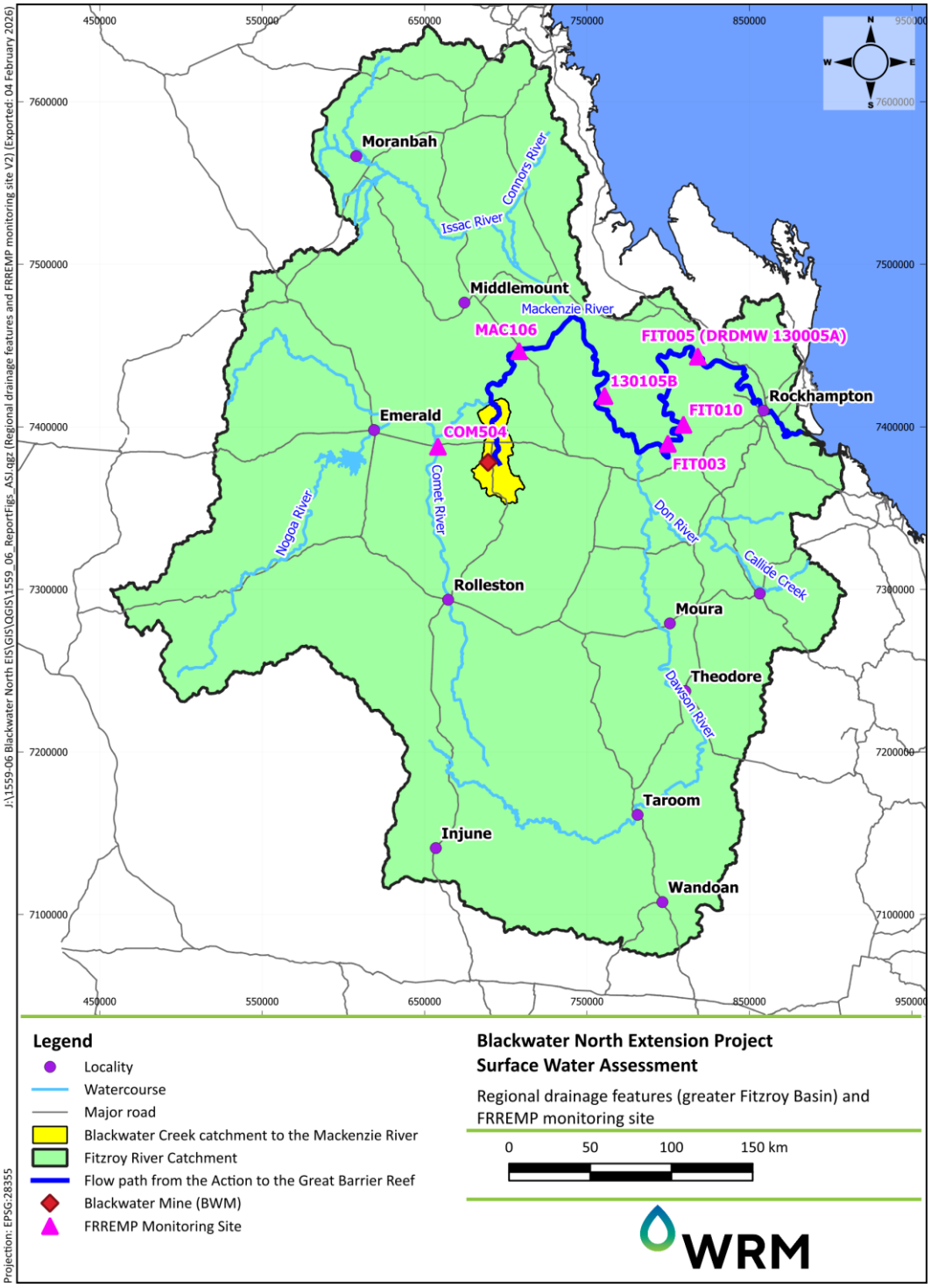


Figure 3.1 Regional drainage features (greater Fitzroy basin) and FREEMP monitoring sites

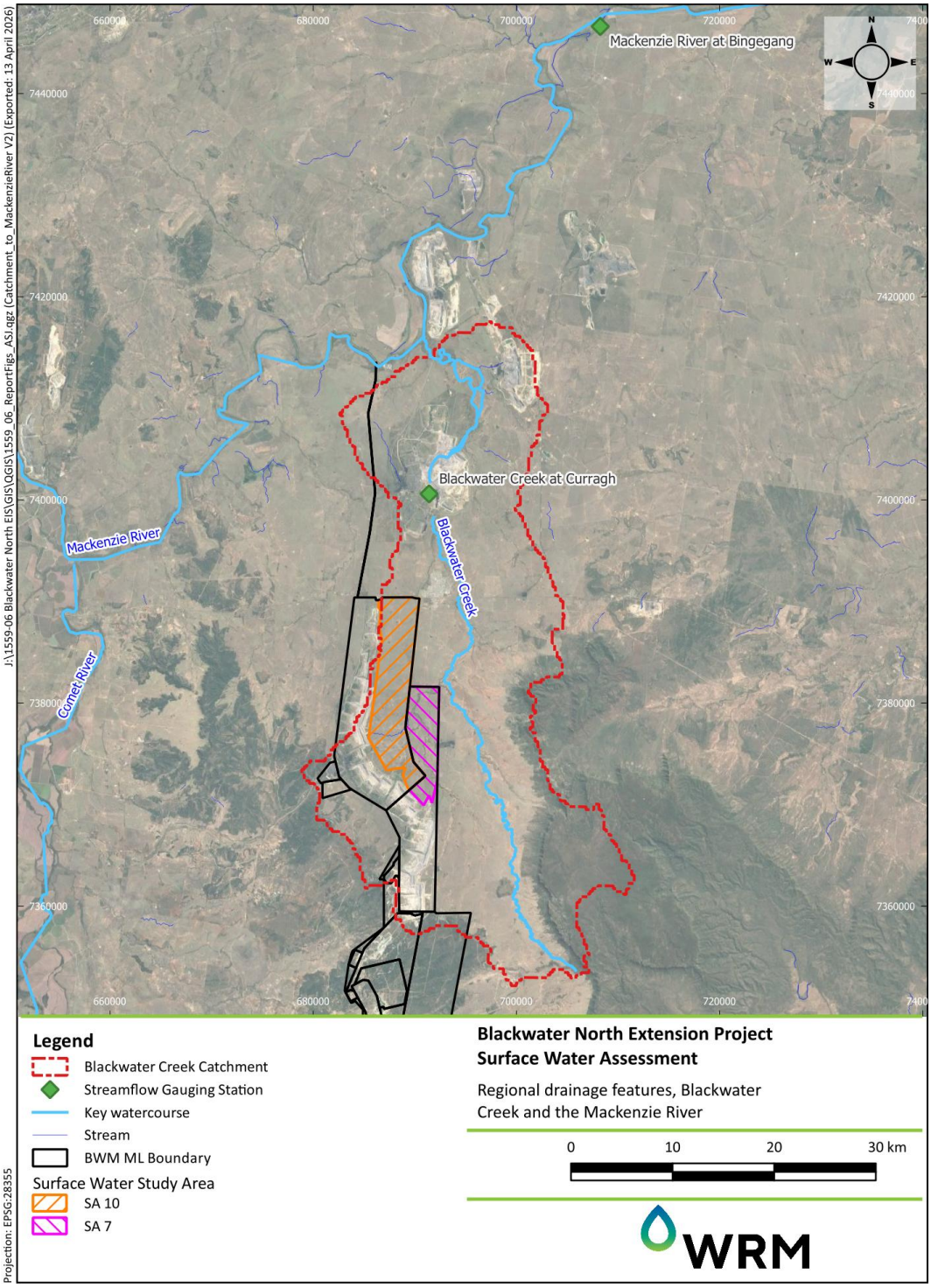


Figure 3.2 Regional drainage features, Blackwater Creek and the Mackenzie River

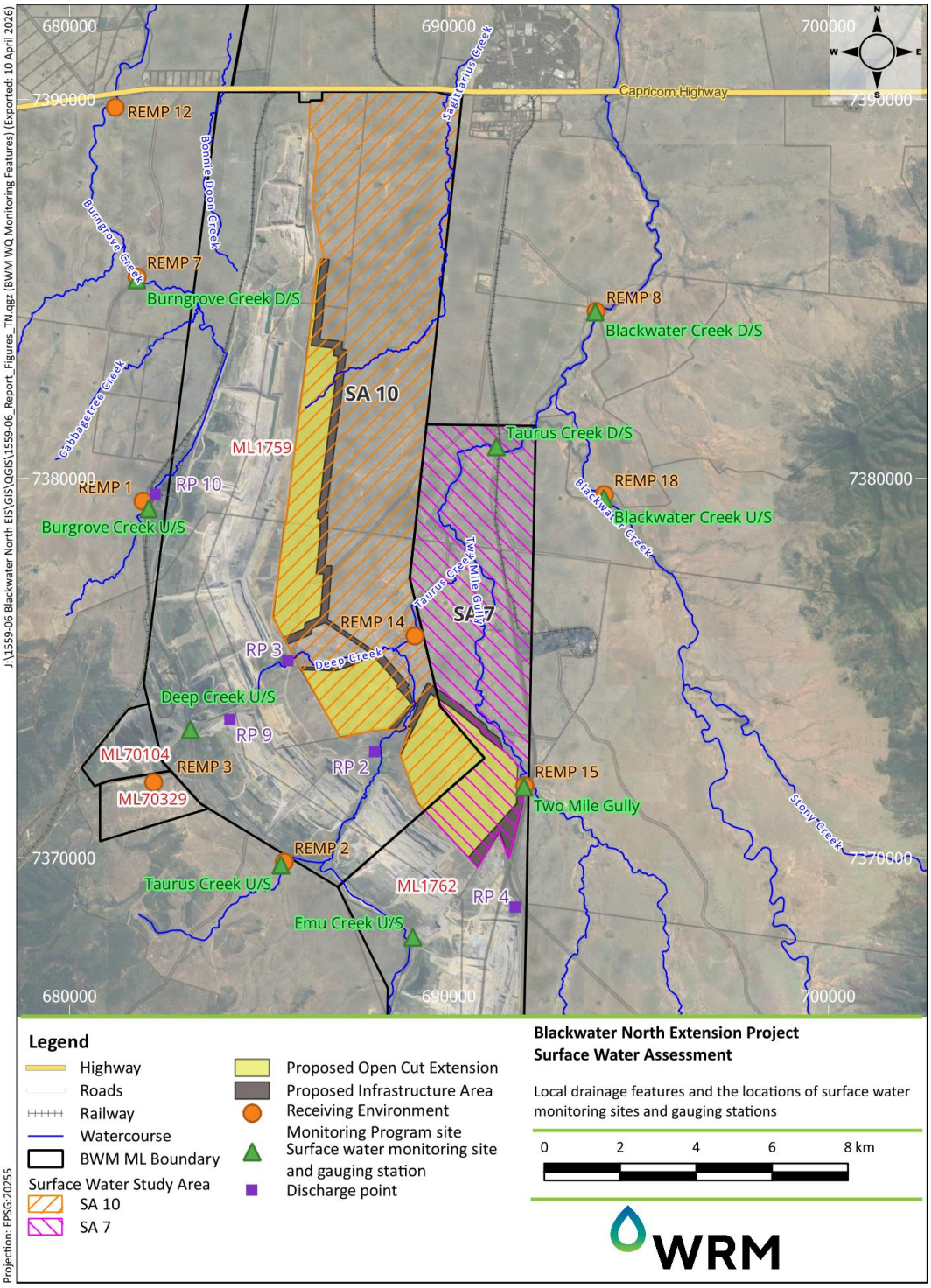


Figure 3.3 Local drainage features and surface water quality monitoring locations

3.2 STREAMFLOW

Historical flow and water level (river height) monitoring data was assessed to provide an indication of local flow regime in the vicinity of the Action and regional flow regime in the Fitzroy River at the following locations:

- Taurus Creek at Taurus Creek D/S gauge (WHC station no. 330101) (2016 – 2025) (refer to Figure 3.3);
- Blackwater Creek at Curragh (DRDMW station no. 130108A/130108B) (1972 – 2009) (refer to Figure 3.2); and
- Fitzroy River at The Gap (DRDMW station no. 130005A) (1971-2025) (refer to Figure 3.1).

Figure 3.4, Figure 3.6 and Figure 3.8 present daily discharge exceedance curves of flows (in megalitres per day) in Taurus Creek, Blackwater Creek and the Fitzroy River as recorded at the above three stream gauging stations.

Figure 3.5, Figure 3.7 and Figure 3.9 present monthly box and whisker plots of stream flows in Taurus Creek, Blackwater Creek and the Fitzroy River as recorded at the above three stream gauging stations. The box and whisker plots show:

- The lower and upper extents of the 'whiskers' show the 10th and 90th percentile recorded monthly flows.
- The box represents the range within which 50% of recorded monthly flows fall. The lower bound of the box is the 25th percentile monthly flow (i.e. 25% of flows are equal to or smaller, 75% of flows are larger) while the upper bound of the box is the 75th percentile flow (i.e. 75% of flows are equal to or smaller, only 25% of flows are larger).
- The middle line in the box represents the median or 50th percentile recorded monthly flow (i.e. 50% of flows are equal to or smaller, 50% of flows are larger).

The data indicates the following:

- At all three watercourses, flows are most likely to occur during the summer months. Stream flows are highly variable, especially during the summer months.
- Taurus Creek and Blackwater Creek are ephemeral streams, where flows to the greater Fitzroy basin occur during the summer months often in short durations, but generally drying out during winter and early spring. Stream flows greater than 10 megalitres per day occur less than 6% of the time in Taurus Creek, and less than 14% of the time in Blackwater Creek.
- The Fitzroy River, located in the lower Fitzroy basin, is more perennial, providing permanent flows entering the GBR Marine Park.

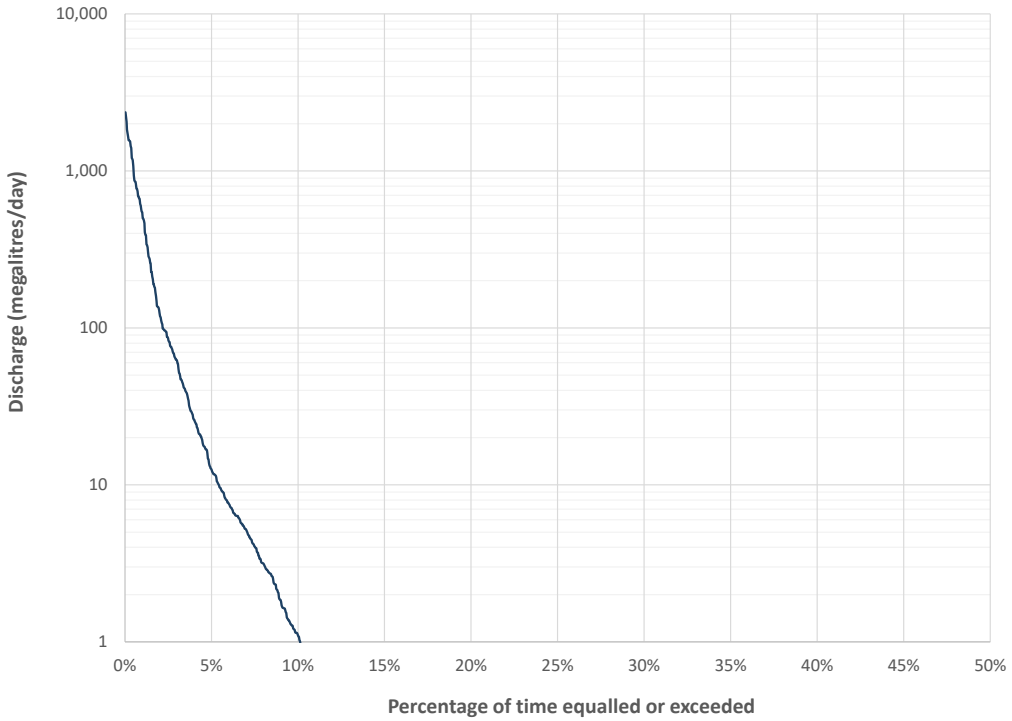


Figure 3.4 Daily discharge exceedance curve (2016 – 2025) for Taurus Creek at the Taurus Creek D/S gauge

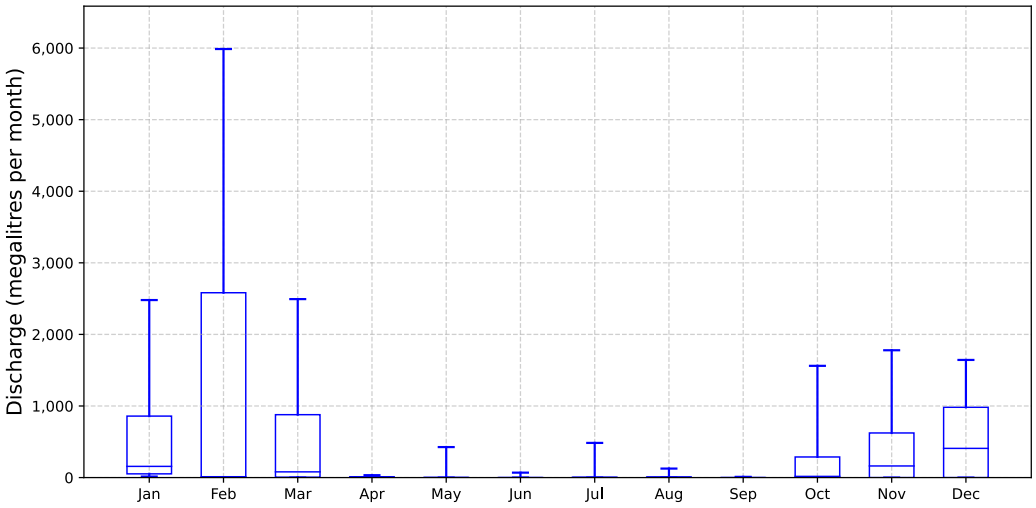


Figure 3.5 Monthly box and whisker plot of flow volume (2016 – 2025) for Taurus Creek at the Taurus Creek D/S gauge

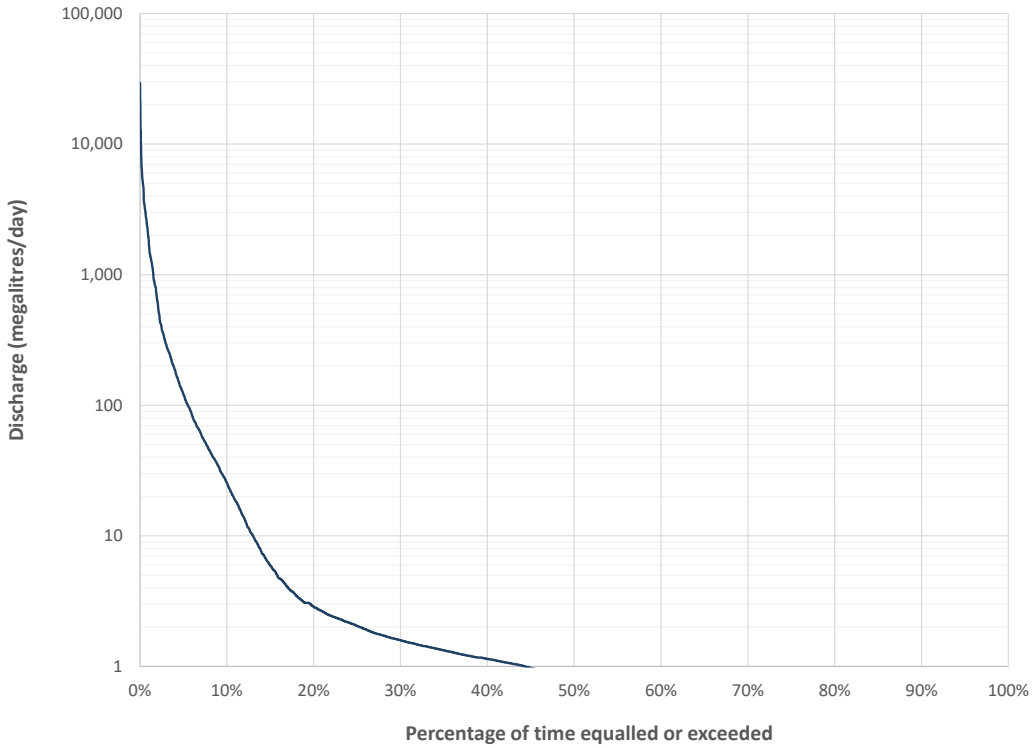


Figure 3.6 Daily discharge exceedance curve (1972 – 2009) for Blackwater Creek at Curragh (DRDMW station No. 130108A and 130108B)

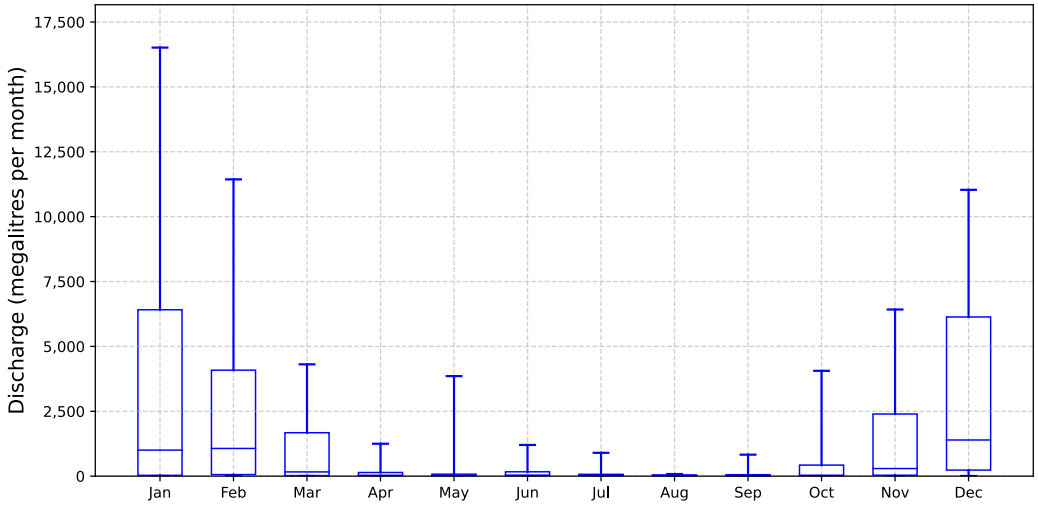


Figure 3.7 Monthly box and whisker plot of flow volume (1972 – 2009) for Blackwater Creek at Curragh (DRDMW station No. 130108A and 130108B)

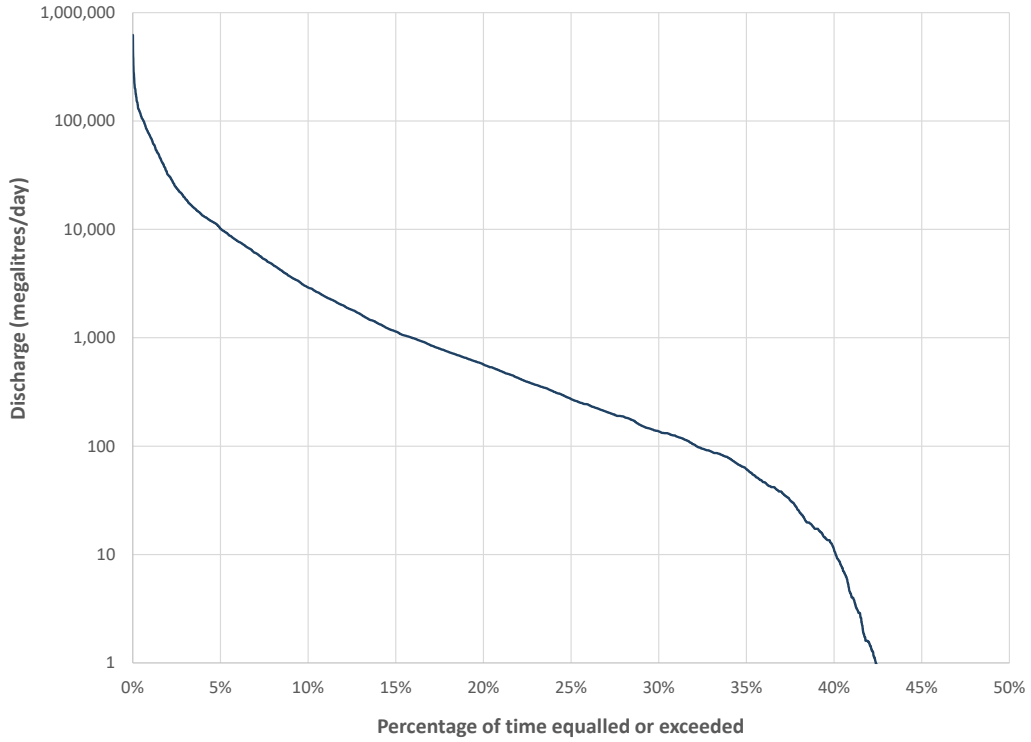


Figure 3.8 Daily discharge exceedance curve (1971 – 2025) for the Fitzroy River at the Gap stream gauging station

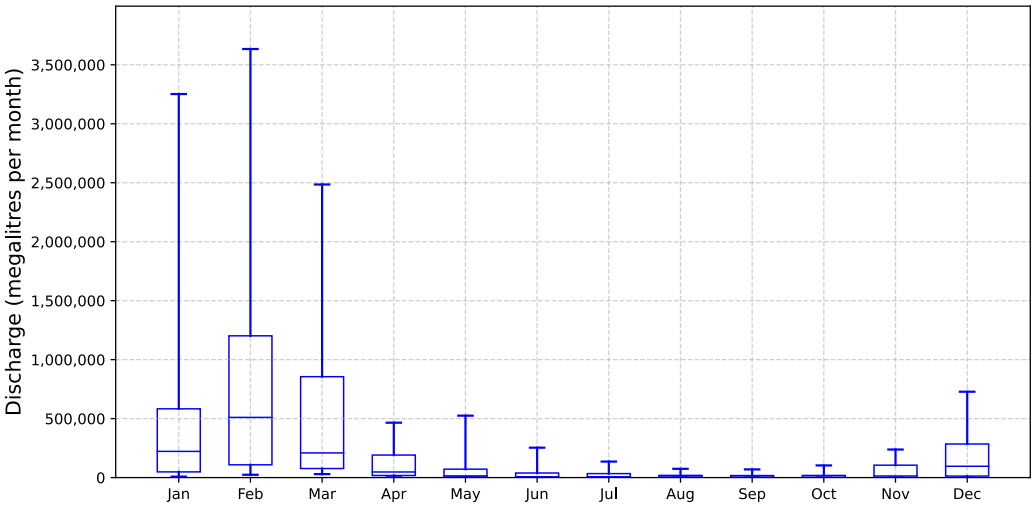


Figure 3.9 Monthly box and whisker plot of flow volume (1971 – 2025) for the Fitzroy River at the Gap stream gauging station

3.3 SURFACE WATER QUALITY

3.3.1 Overview

The following sections describe the water quality characteristics of the local creeks and regional waterways in the vicinity of the Action, based on surface water quality monitoring results.

The *Reef 2050 Water Quality Improvement Plan*, prepared by the Queensland Government (2018) states that the greatest water quality risks to the GBR are from nutrients, fine sediments and pesticides. Water quality targets have been set for dissolved inorganic nitrogen (DIN), fine sediment (which is measured as total suspended solids [TSS]), particulate phosphorous and particulate nitrogen. This report also states that:

'There is insufficient science to set quantitative water quality targets for other pollutants, including plastics. As the science is refined, quantitative measures can be developed for other pollutants.'

Further, the *Reef discharge standards for industrial activities* (DESI, 2024) states that:

'In the absence of data or information on DIN that would be sufficient to support an application, the administering authority may consider the use total nitrogen (TN) as the contaminant of interest for the purposes of section 41AA of the EP Reg. This will ensure that the intent of 'no net decline' of DIN to GBR catchment waters is met.'

In consideration of the above and the availability of data, existing surface water quality have been characterised for TSS, total nitrogen (TN) and total phosphorus (TP) only, based on water quality monitoring results described in the following reports:

- *Receiving Environment Monitoring Program (REMP) Annual Report, July 2021 – June 2022* (BMA, 2023);
- *Fitzroy Regional Receiving Environment Monitoring Program Annual Report, July 2022 – June* 2023 (FRREMP, 2023); and
- *Fitzroy Regional Receiving Environment Monitoring Program Annual Report, July 2023 – June 2024* (FRREMP, 2025).

It should be noted that after June 2022, Whitehaven Blackwater became a participant in the FRREMP and as such, FRREMP reports were not available for the period before June 2022.

Local monitoring stations at BWM that still contribute data to the FRREMP include the Sirius Creek downstream (D/S) and the Rockland Creek upstream (U/S) gauges, which are not located within the Project area (including the Action). However, data from these local monitoring sites reported in the FRREMP (2023 and 2025) is limited to electrical conductivity and pH and does not include TSS, TP and TN.

3.3.2 Sub-basin Water Quality Objectives

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water)), which is subordinate legislation to the EP Act, provides a framework for identifying environmental values (EVs) for a waterway and deciding Water Quality Objectives (WQOs) to protect or enhance those EVs.

WQOs from the following documents, pursuant to the EPP (Water), are relevant for the Action:

- *the Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin, September 2011* (DEHP, 2013a).
- *the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin, September 2011* (DEHP, 2013b).
- *the Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin, September 2011* (DEHP, 2013c).

The "Sub-basin WQOs" from the above documents have also been referred to in the FRREMP (2025) report.

3.3.3 Water quality in local creeks

Table 3.1, Table 3.2 and Table 3.3 show the water quality monitoring results for the local monitoring sites in the vicinity of the Action for TSS, TN and TP respectively. These tables also show the Sub-basin WQOs for the Comet River Sub-basin (Water Quality [WQ] 1307), the Mackenzie River Sub-basin (WQ 1304) and the Fitzroy River Sub-basin (WQ 1305), obtained from the FRREMP (2025).

The water quality monitoring results shown in Table 3.1, Table 3.2 and Table 3.3 reflect existing site conditions excluding the Action. The data indicates that:

- At the two upstream sites not affected by mining activities (Taurus Creek U/S and Deep Creek U/S), the median (50th percentile) concentrations of TSS, TN and TP generally exceed the WQOs. At Emu Creek U/S, median pollutant concentrations are even higher.
- Median concentrations of TSS, TN and TP at gauges downstream of BWM are generally higher than concentrations upstream of BWM, which may be due to existing mining activities (excluding the Action), but is also likely due to the larger catchments contributing runoff to these downstream sites.
- Whilst median TSS concentrations at the downstream monitoring sites appear to be elevated compared to the upstream sites, mean TSS concentrations at the downstream monitoring sites are broadly similar to those recorded at the upstream monitoring sites Emu Creek U/S, Two Mile Gully and Blackwater Creek U/S. Mean TSS concentrations are generally higher than median concentrations at all monitoring sites, likely due to occasional high TSS concentrations recorded during larger flow events.

3.3.4 Regional water quality

Table 3.1, Table 3.2 and Table 3.3 show the water quality monitoring results for the regional FRREMP monitoring sites for TSS, TN and TP, respectively. The statistical summary of the FRREMP data is presented separately for the July 2022 to June 2023 and the July 2024 to June 2025 reporting periods, as that is how the data was reported in the FRREMP annual reports.

The water quality monitoring results shown in Table 3.1, Table 3.2 and Table 3.3 reflect existing site conditions excluding the Action. The data indicates that at the FRREMP monitoring sites:

- Median TSS concentrations are generally below the WQOs.
- Median TN concentrations generally exceed the WQOs.
- Median TP concentrations are generally within or slightly above the WQOs in the Mackenzie and Fitzroy rivers for the 2022/23 reporting period. However, TP concentrations in the Mackenzie and Fitzroy rivers are significantly higher for the 2023/24 reporting period. The

reason for elevated TPs during the 2023/24 period compared to the previous year is unknown.

- Median concentrations of TSS, TN and TP in the Mackenzie and Fitzroy rivers are significantly lower than those recorded at the local monitoring sites closer to the Action. This is due to significantly higher flows, and hence a much higher level of dilution in the Mackenzie and Fitzroy rivers compared to the local creeks in the vicinity of the Action.

3.4 CONTRIBUTION OF SEDIMENTS TO THE GBR DUE TO SPECIFIC LAND USES

The 2022 Scientific Consensus Statement (Prosser, 2024) investigated how much anthropogenic sediment and particulate nutrients are exported from GBR catchments, the most important characteristics of anthropogenic sediments and particulate nutrients and the primary sources. The findings in Posser (2024) are summarised below.

Concentrations of sediment and particulate nutrients have been measured in subcatchments dominated by particular land uses. The findings from Packett et al (2009) found a strong correlation in the Fitzroy River between the concentration of suspended sediment and the proportion of cropland in the contributing catchment, suggesting that cropland is the more significant sediment source. Prosser (2024) noted that in the Fitzroy River, mines make up a very small proportion of the basin and located much further inland.

Bartley et al (2017) quantified the contributions of suspended sediment by land use by region. Bartley et al (2017) fond that in the Fitzroy River catchment, the estimated proportion of total fine sediment loads exported to the GBR from each land use are approximately 40% from grazing, approximately 40% from streambank erosion, approximately 10% from dryland cropping, approximately 5% from nature conservation and the remainder of approximately 5% from forestry, irrigated cropping, dairy, horticulture, sugarcane, urban and other land uses.

Table 3.1 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total suspended solids

Monitoring site	Analyte	Sub-Basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min	Max	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	38	75	496	8	10,000	38	311
Deep Creek U/S					13	75	399	12	3,850	29	181
Emu Creek U/S					6	471	895	248	2,940	290	950
Blackwater Creek U/S					12	142	622	8	3,620	65	696
Two Mile Gully					21	444	722	21	2,340	236	1,280
Sites downstream (east) of BWM											
Blackwater Creek D/S	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	72	270	716	6	6,010	137	1,042
Taurus Creek D/S					13	462	795	42	2,420	165	1,400
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	6	31	99	10	382	18	122
Mackenzie River at Bingegang (MAC106)					6	38	45	3	86	28	62
Mackenzie River at Coolmaringa (130105B)					6	26	51	7	146	10	92
Fitzroy River at Riverslea (FIT003)					6	20	33	9	90	16	46
Fitzroy River at The Gap (FIT005)					5	27	58	10	178	19	80
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	6	33	-	3	372	12	92
Mackenzie River at Bingegang (MAC106)					6	22	-	11	69	18	38
Fitzroy River at Riverslea (FIT010)					6	22	-	10	103	16	42
Fitzroy River at The Gap (FIT005)					5	27	-	11	146	16	88

Note: mg/L = milligrams per litre

Table 3.2 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total nitrogen

Monitoring site	Analyte	Sub-basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min.	Max.	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	2	-	1,500	1,300	1,700	-	-
Deep Creek U/S					1	-	1,700	1,700	1,700	-	-
Emu Creek U/S					n/a	n/a	n/a	n/a	n/a	n/a	n/a
Blackwater Creek U/S					1	-	100	100	100	-	-
Two Mile Gully					1	-	600	600	600	-	-
Sites downstream (east) of BWM											
Blackwater Creek D/S	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	3	2,200	2,867	800	5,600	1,360	4,240
Taurus Creek D/S					1	-	4,400	4,400	4,400	-	-
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	6	950	1,000	400	1,900	800	1,000
Mackenzie River at Bingegang (MAC106)					6	850	830	500	1,200	500	1,100
Mackenzie River at Coolmaringa (130105B)					6	850	820	500	1,200	600	900
Fitzroy River at Riverslea (FIT003)					6	500	570	400	800	400	800
Fitzroy River at The Gap (FIT005)					5	800	960	500	1,500	580	1,420
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	6	600	-	400	1,800	600	1,600
Mackenzie River at Bingegang (MAC106)					6	750	-	400	4,200	500	1,200
Fitzroy River at Riverslea (FIT010)					6	950	-	400	1,200	500	1,000
Fitzroy River at The Gap (FIT005)					5	900	-	500	1,000	580	1,000

Note: µg/L = micrograms per litre

Table 3.3 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total phosphorus

Monitoring site	Analyte	Sub-basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min.	Max.	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TP (µg/L)	< 50 µg/L	< 160 µg/L	< 50 µg/L	2	-	170	80	260	-	-
Deep Creek U/S					1	-	130	130	130	-	-
Emu Creek U/S					n/a	n/a	n/a	n/a	n/a	n/a	n/a
Blackwater Creek U/S					1	-	20	20	20	-	-
Two Mile Gully					1	-	120	120	120	-	-
Sites downstream (east) of BWM (East)											
Blackwater Creek D/S	TP (µg/L)	< 50 µg/L	< 160 µg/L	< 50 µg/L	3	660	840	80	1,780	312	1,332
Taurus Creek D/S					1	-	1,300	1,300	1,300	-	-
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TP (µg/L)	< 50 µg/L	<160 µg/L	< 50 µg/L	6	95	107	30	180	60	180
Mackenzie River at Bingegang (MAC106)					6	55	90	5	260	30	160
Mackenzie River at Coolmaringa (130105B)					6	20	61	5	220	20	80
Fitzroy River at Riverslea (FIT003)					6	55	73	10	200	30	90
Fitzroy River at The Gap (FIT005)					5	60	60	5	80	49	80
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TP (µg/L)	< 50 µg/L	<160 µg/L	< 50 µg/L	6	190	-	40	700	80	290
Mackenzie River at Bingegang (MAC106)					6	125	-	20	500	60	400
Fitzroy River at Riverslea (FIT010)					6	245	-	30	360	40	350
Fitzroy River at The Gap (FIT005)					5	220	-	50	370	146	330

Note: µg/L = micrograms per litre

4 SURFACE WATER IMPACT ASSESSMENT

4.1 OVERVIEW

The following sections assessed the potential changes to TSS, TN and TP loads to the GBR as a result of the Action during the maximum disturbance stage of its mining operations, to ultimately determine if the Action would cause an 'impact' to the GBR as defined in section 527E of the EPBC Act.

4.2 CATCHMENT LOSS ANALYSIS

Figure 4.1 compares the Taurus Creek catchment (to Taurus Creek D/S gauge) and the Sagittarius Creek catchment (to the northern ML boundary) under existing and Project conditions (including the Action during mining). The changes in catchment areas are tabulated in Table 4.1.

The Action would involve an extension of the open cut pit footprint towards the east, which would reduce the Taurus Creek and Sagittarius Creek catchments during mining, as a greater portion of undisturbed land would drain to the open cut pits.

The Action, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and a 7.9% reduction in the Sagittarius Creek catchment. The Action would result in a reduction in catchment runoff volumes from undisturbed land. This in turn, is expected to reduce the TSS, TN and TP loads generated from undisturbed land to the greater Fitzroy basin and ultimately to the GBR.

Table 4.1 Analysis of catchment loss due to the Action

Catchment	Area (km^2)		Difference (%)
	Existing conditions	Project conditions (including the Action)	
Taurus Creek to Taurus Creek D/S gauge	250.4	228.2	-8.9
Sagittarius Creek to northern ML boundary	42.7	39.3	-7.9

Whitehaven Blackwater is committed to undertaking progressive rehabilitation as land becomes available. Rehabilitation would include re-establishing the majority of the Taurus Creek and Sagittarius Creek catchments.

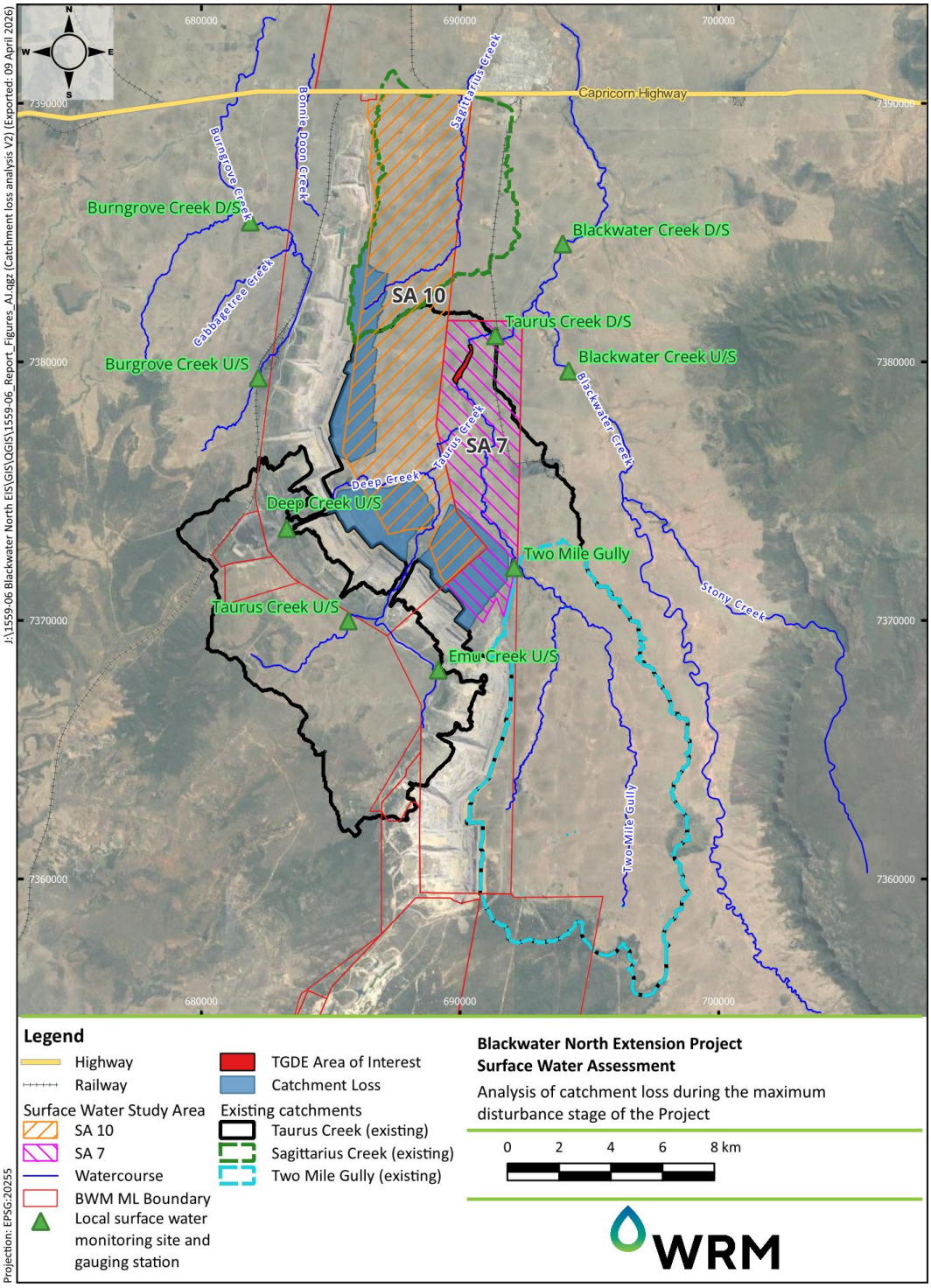


Figure 4.1 Analysis of catchment loss due to the Action during the maximum disturbance stage of its mining operations

4.3 SIMPLIFIED ESTIMATION OF TSS, TN AND TP LOAD REDUCTONS

4.3.1 Water quality targets

The *Reef 2050 Water Quality Improvement Plan*, prepared by the Queensland Government (2018), describes end-of-catchment water quality targets for nutrients and sediments based on the GBR Marine Park Authority's *Water Quality Guidelines for the Great Barrier Reef Marine Park*. They are expressed as end-of-catchment load reductions (see Table 4.2).

The 2025 end-of-catchment water quality targets are expressed as percentage reductions of anthropogenic loads and the required reduction is also shown in tonnes (or kilotonnes for fine sediment).

Table 4.2 End-of-catchment anthropogenic water quality targets for the Reef catchments by 2025 and relative priorities for water quality improvement

Region	Catchment / Basin	Area (ha)	Targets							
			Dissolved inorganic nitrogen		Fine sediment		Particulate phosphorus		Particulate nitrogen	
			tonnes	% reduction	kilotonnes	% reduction	tonnes	% reduction	tonnes	% reduction
Fitzroy	Styx River	301,340	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Shoalwater Creek	360,180	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Waterpark Creek	183,650	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Fitzroy River	14,254,470	MCL	MCL	390	30	380	30	640	30
	Calliope River	224,060	MCL	MCL	15	30	54	30	107	30
	Boyne River	249,630	MCL	MCL	6	40	5	40	9	40

Note: MCL = maintain current load

Source: Queensland Government (2018)

4.3.2 Simplified calculation methodology

Section 4.2 demonstrated that the Action, during its operational phase, would result in a 8.9% reduction of the Taurus Creek catchment and 7.9% reduction in the Sagittarius Creek catchment. This would result in a reduction in catchment runoff from undisturbed land that would otherwise report directly to Taurus Creek and Sagittarius Creek.

A simplified analysis was undertaken to estimate the expected reduction in TSS, TN and TP loads from undisturbed land (in tonnes or kilotonnes) as a result of the Action during mining, based on recorded flow data (described in Section 3.2) and water quality monitoring data (described in Section 3.3).

The simplified calculation was undertaken based on the following assumptions:

- The Action, during mining, would result in a net loss of approximately 25.5 km^2 of undisturbed land that currently contributes runoff, including fine sediments and nutrients, to the GBR.
- An annual median runoff volume from these 'loss' undisturbed areas was estimated based on the total of the recorded median monthly flow volumes in Taurus Creek at the Taurus Creek D/S gauge (as shown in Figure 3.5), which were factored down in proportion to the catchment area that would be loss.
- Representative pollutant concentrations were adopted for TSS (496 mg/L), TN (1,700 micrograms per litre [µg/L]) and TP (170 µg/L), based on the highest mean concentration of samples between the Taurus Creek U/S and Deep Creek D/S local monitoring sites given in Table 3.1, Table 3.2 and Table 3.3. Runoff reporting to these local monitoring sites is relatively unaffected by mining activities and is therefore representative of 'undisturbed' land.

4.3.3 Results

Table 4.3 shows the estimated annual reduction of TSS, TN and TP loads (in tonnes) from undisturbed land as a result of the Action. The Action would result in minor reductions in TSS, TN and TP loads from undisturbed land which is in line with the Queensland Government (2018) end-of-catchment water targets.

The loss of undisturbed catchment to the GBR adds additional catchment reporting to the BWM water management system (WMS). However, current investigations indicate that the Action would not result in material changes to the frequency and volume of releases from the BWM due to the additional catchment reporting to the WMS.

Table 4.3 Simplified calculation of predicted reduction in annual total suspended solids, total nitrogen and total phosphorus loads to the Great Barrier Reef

Loss of median annual discharge volume (ML/a)	TSS		TN		TP	
	Representative concentration (mg/L)	Load reduction (kilotonnes)	Representative concentration (µg/L)	Load reduction (tonnes)	Representative concentration (µg/L)	Load reduction (tonnes)
73.9	496	0.04	1,700	0.13	170	0.01

Note: ML/a = megalitres per annum

4.4 WATER RELEASES

4.4.1 Overview

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of Mine Affected Water (MAW). Surface water management measures include separation of clean and contaminated water, sediment and erosion control structures, operational water balance controls, and Trigger Action Response Plans (TARPs) to prevent uncontrolled releases.

4.4.2 Controlled release strategy

Controlled release of MAW is currently authorised under the EA. Releases shall only occur in compliance with the EA release conditions to ensure no environmental impacts from MAW to the receiving environment. Within the Taurus Creek catchment, controlled release of MAW can occur

(in compliance with the EA release conditions) at "Licensed Discharge Points" RP2 (Taurus Dam), RP3 (New Deep Creek Dam) and RP4 (Tannyfoil Dam), as shown in Figure 3.3.

Modelling of the site water balance (HydroBalance, 2026) and flooding behaviour (WRM, 2026) indicates that controlled releases, where required, would occur in accordance with existing EA conditions (Schedule F) and relevant WQOs.

Controlled releases under Schedule F of the EA EPML00717813 would only occur during periods when receiving waterways have recorded a natural flow in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

There are no proposed changes to the currently approved controlled release strategy as a result of the Action. In addition, there are no proposed changes to release infrastructure (release dams and pipelines). In summary, controlled releases would continue to be undertaken in accordance with the EA release conditions.

The site water balance assessment (HydroBalance, 2026) predicted that the Action would increase controlled releases by around 11% - 20% (110 - 130 ML) under median climate conditions compared to the Approved operations. However, the potential increase in controlled releases is primarily due to the groundwater modelling outputs that predict an increase in groundwater inflows during the operation of the Action. Groundwater inflows are not anticipated to result in a significant increase in the TSS load to the mine water management system.

Bartley et al (2017) estimated that approximately 1,805 kt of suspended sediment are released annually to the GBR from the Fitzroy River catchment. Assuming that controlled releases from BWM discharge an additional 130 ML/a at a TSS concentration of 462 mg/L (the median TSS at Taurus Creek D/S), this equates to approximately 0.06 kt of sediments annually. This represents less than 0.01% of the estimated total sediment load to the GBR from the Fitzroy River catchment. The BWM mine water storages including NTCD (RP2), NDCD (RP3) and TFD (RP4) provide extended detention and settling opportunities that promote sediment deposition and therefore the above estimate of sediment loads from controlled releases may be conservative and would need to be reviewed with additional monitoring for TSS.

The water balance assessment (HydroBalance, 2026) indicates that the Action can be managed within the existing water management system and existing controlled release framework, with releases continuing to occur only in accordance with the approved EA (Schedule F) release conditions. Accordingly, the Action is not expected to result in a material residual impact to GBR catchment waters.

4.4.3 Uncontrolled releases

The Whitehaven documents *WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water* (Whitehaven, 2024), *BWM Plan – Water Management* (Whitehaven, 2026a) and *BWM Plan – Erosion and Sediment Control Plan* (Whitehaven, 2026b) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in this standard will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons (HydroBalance, 2026):

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.

- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have been identified as having potential for uncontrolled discharge.
- The Project does not modify the catchments of New Taurus Creek Dam or New Deep Creek Dam, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

4.5 EROSION AND SEDIMENT CONTROL STRATEGY

4.5.1 Erosion and Sediment Control Plan

The *BWM Erosion and Sediment Control Plan* (ESC Plan) by Whitehaven (2026b), outlines the current ESC strategy for BWM. The selection of sediment control requirements is guided by the catchment 'risk matrix' shown in Table 4.4 (Whitehaven, 2026b). Catchments are assigned a risk rating ranging between 'Very Low', 'Low', 'Medium', 'High', 'Very High' and 'MAW' depending on the catchment characteristics.

For catchments classified as 'Very Low' to 'Low' risk rating, small-scale or supplementary sediment controls or supplementary sediment controls may be appropriate controls on a temporary basis during small-scale, short-term construction/exploration stages prior to implementing erosion protection measures such as revegetation. Typical supplementary sediment controls are listed in the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008), but may include:

- excavated sediment traps;
- rock check dams; and
- sediment fencing/bunds.

For catchments classified with a risk rating of 'Medium' or higher, sediment basins are used as a sediment control measure.

The Action would not increase the catchment draining southwest into Deep Creek and Taurus Creek (downslope of the overburden dumps) during mining, compared to current conditions. No specific requirements for additional sediment basins have been identified. However, there is potential additional sediment basins may be required for the Project associated with disturbance in advance (to the east) of mining operations including infrastructure corridors, pre-stripping and topsoil stockpiles. The requirement for, and location and sizing of, any new sediment basins would be confirmed during detailed design, having regard to the final disturbance footprint, catchment configuration, drainage design and anticipated sediment-generation risk.

Table 4.4 Catchment risk assessment criteria and sediment control design standard (Whitehaven, 2026b)

Risk Rating	Soil/spoil category	Disturbed Catchment area (ha)	Duration of disturbance	Average catchment slope	Sediment control design standard
Very Low	Competent material	Less than 0.5 ha	Less than 3 months	Less than 1%	No controls
Low		0.5 to 1 ha	3 to 6 months	1% to 3%	Supplementary sediment controls
Medium	Non-dispersive topsoil	1 to 4 ha	6 months to 2 years	3% to 10%	FT Sediment basin (80%ile 5 day)
High	Dispersive topsoil	Greater than 4 ha	Greater than 2 years	Greater than 10%	FT Sediment basin (90%ile 5 day)
	Non-dispersive spoil				
Very High	Dispersive spoil	Any	Any	Any	Containment basin (95%ile 5 day)
MAW	Per MAW definition	Any	Any	Any	MAW Dam

4.5.2 ESC implementation plan

The *Blackwater Mine Water Management Plan* (WMP) by Whitehaven (2025), outlines the BWM's ESC 'implementation plan', which include the actions to mitigate potential environmental harm for each catchment discharging to Burngrove Creek, Deep Creek, Taurus Creek, and Emu Creek during rainfall events. The Water Management Plan (WMP) states that these actions include both permanent controls and temporary mitigating works, which may be undertaken while further studies and design work are completed to inform the final permanent controls required.

Figure 4.2 shows the catchments included in the ESC implementation plan and whether ESC measures are in place or proposed in each catchment (Whitehaven, 2025). As operations at the mine progress, these catchments are likely to change. Figure 4.2 shows that ESC measures are already in place in the catchments immediately adjacent to receiving waterways. Rehabilitation and/or installation of appropriate erosion and sediment controls is planned to be completed over significant areas of the BWM by June 2031.

In summary, the ESC implementation plan as described in the WMP would minimise the release of fine sediments to the receiving waterways and ultimately to the GBR, resulting from currently approved operations as well as the Action.

4.6 POST-CLOSURE

At the completion of mining, surface runoff from rehabilitated in-pit and out of pit waste rock emplacement areas would flow to the receiving environment, with the exception of approximately 27.3 km^2 which would report to five residual voids associated with the Project (WRM, 2026).

There would be no releases from the Action post-closure. SLR (2026) predicted that of the five residual voids, three are expected to become long-term sinks, and the other two are predicted to become flow-through systems reporting to these long-term sinks.

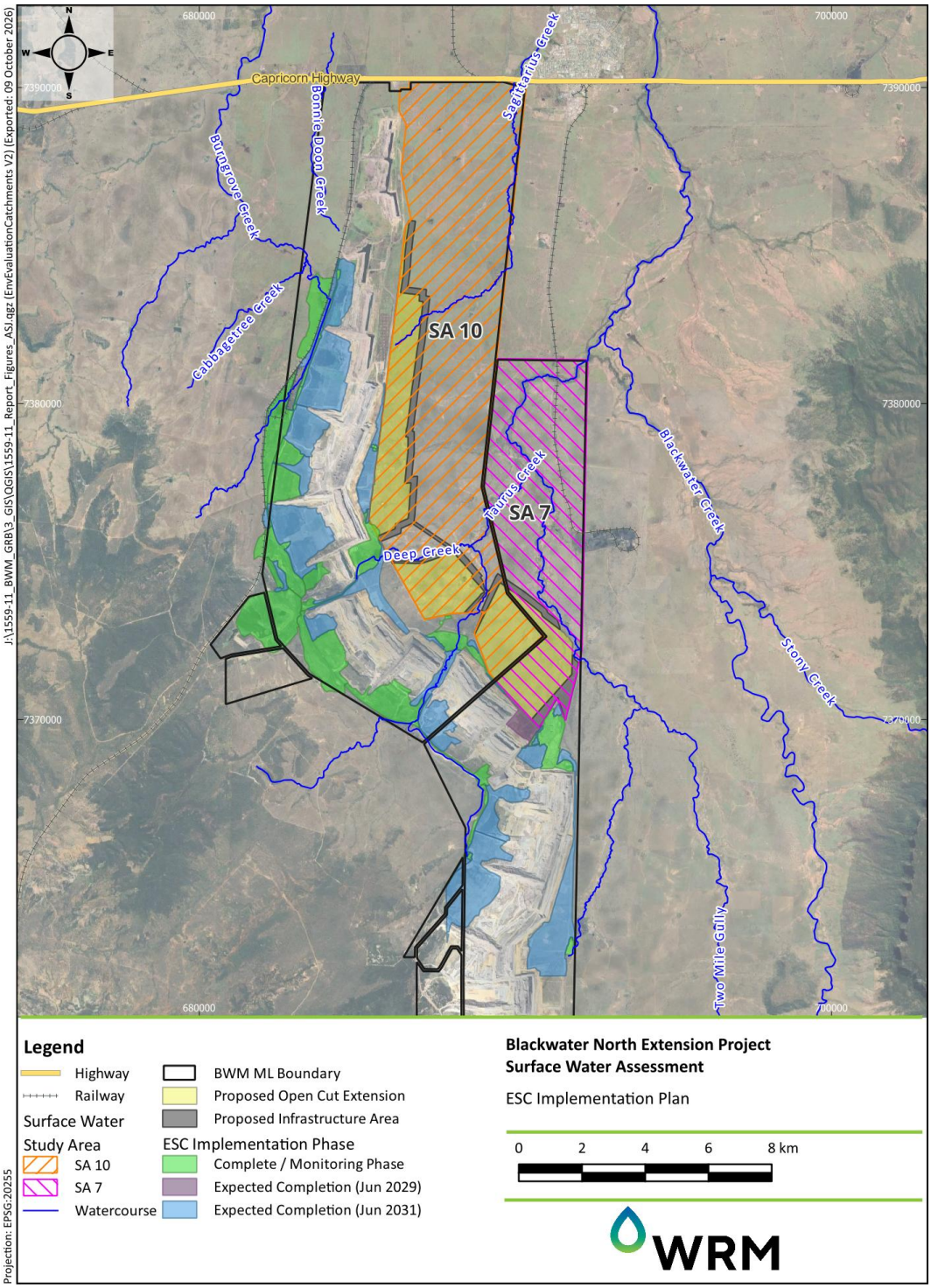


Figure 4.2 ESC Implementation Plan

5 SUMMARY

The GBR is located approximately 600 river km downstream (and 210 km east) of the Action. As such, the Action would not result in any direct impacts to the GBR. Therefore, only the potential indirect impacts of the Action due to runoff and surface water releases were assessed.

The greatest water quality risks to the GBR are from nutrients, fine sediments and pesticides. Water quality targets have been set for DIN, fine sediment (which is measured as TSS), particulate phosphorous and particulate nitrogen. Based on the availability of data, potential impacts on surface water quality were assessed for TSS, TN and TP only.

The Action, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and 7.9% reduction in the Sagittarius Creek catchment. The Action would result in a reduction in catchment runoff volumes from undisturbed land. This in turn, is expected to reduce the TSS, TN and TP loads generated from undisturbed land to the Greater Fitzroy Basin and ultimately to the GBR. The minor loss of annual TSS, TN and TP loads from undisturbed land to the GBR as a result of the Action is in line with the Queensland Government (2018) end-of-catchment water targets.

There are no proposed changes to the currently approved controlled release strategy as a result of the Action. In addition, there are no proposed changes to release infrastructure (release dams and pipelines). Controlled releases would continue to be undertaken in accordance with the EA release conditions.

The ESC implementation plan as described in the WMP (Whitehaven, 2025) would minimise the release of fine sediments to the receiving waterways and ultimately to the GBR, resulting from currently approved operations as well as the Action (Whitehaven, 2025).

The potential surface water impacts associated with the Action on the GBR Marine Park would be insignificant and would not meet the ‘substantial cause’ requirement of an indirect impact as outlined in section 527E(2) of the EPBC Act.

With regards to the Reef Discharge Standards (DESI, 2024), the water balance assessment (HydroBalance, 2026) indicates that the Action can be managed within the existing water management system and existing controlled release framework, with releases continuing to occur only in accordance with the approved EA (Schedule F) release conditions. Accordingly, in view of the Reef Discharge standards, the Project is not expected to result in a residual impact to GBR catchment waters for the purposes of section 41AA of the EP Regulation.

Regards,

Ardianto Notodirdjo

Principal Engineer

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