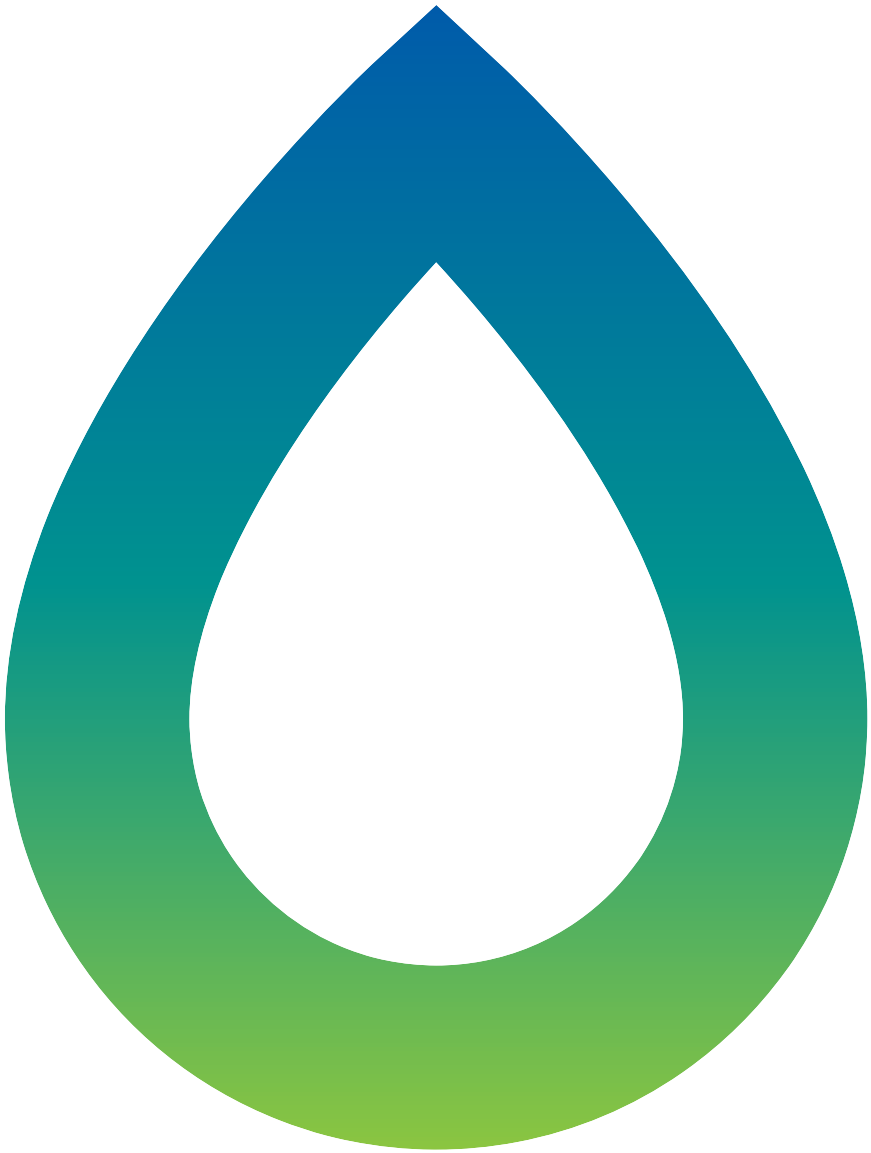
DAUNIA WEST INFRASTRUCTURE PROJECT

Surface Water Assessment

Whitehaven Daunia Pty Ltd

11 May 2026

1583-05-C6



DETAILS

Report Title	Daunia West Infrastructure Project, Surface Water Assessment
Client	Whitehaven Daunia Pty Ltd

THIS REVISION

Report Number	1583-05-C6
Date	11 May 2026
Author	JG/DS
Reviewer	GR

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1 INTRODUCTION

1.1 BACKGROUND

The Daunia Mine (DNM) is located approximately 25 km southeast of Moranbah, Central Queensland, on Mining Leases (ML) 1781, ML70115, and ML70116 (refer to Figure 1.1). DNM was approved in 2009 and is owned and operated by Whitehaven Coal (WHC). It operates under Environmental Authority (EA) EPML00561913 and EPBC Act Approval 2008/4418.

The DNM Operation is an open cut coal mine using a conventional excavator and truck fleet. Mining activities include clearing vegetation, removing overburden and spoil to in pit and out of pit spoil dumps, coal mining and progressive rehabilitation. DNM produces approximately 4.9 million tonnes per annum (Mtpa) of semi hard coking coal and pulverised coal injection (PCI) product coal for the export market and has an expected life of approximately 28 years.

1.2 PROJECT DESCRIPTION

WHC proposes the Daunia West Infrastructure Project (the Project) to enhance site water management and operational efficiency. The Project involves the construction and operation of an Out-of-Pit Dump (OOPD) located west of and adjacent to ML1781, outside the current lease boundary. A new Mining Lease Application (MLA) will be submitted for the Project. Figure 1.2 shows the general arrangement of the Project site, including the OOPD layout.

The Project drains to the Isaac River. The works associated with the Project that could impact on the Isaac River involve:

- Construction of the OOPD.
- Construction of a sediment dam (PW Sed Dam) to intercept and treat sediment-laden runoff from the OOPD.
- Establishment of a dam (PW MAW Dam) to assist in the management of mine affected water and capture and manage runoff from the catchment north of the OOPD.

There are no proposed changes to the current release conditions, as outlined in Schedule F: Water DNM's EA (EPML00716913, dated 29 June 2023).

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 sediment management system, including the PW Sed Dam for capturing sediment from the OOPD.
- Address the Void in Floodplain requirements outlined in Section 3.4 – General Rehabilitation Practices of the DES Guideline (V3.1) and the associated information sheet.
- Assess potential impacts of mining voids located within floodplains, 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 describes the approved and proposed water management strategy, including baseline data on climate, drainage networks, and water quality.
- Section 3 provides an overview of the existing water management system and DNM site characteristics.

- Section 4 provides details on the water management objectives, strategies, and systems, including water management infrastructure and erosion and sediment control measures.
- Section 5 presents the results of the site water balance and evaluates the predicted behaviour of the water management system and final voids under varying climatic conditions.
- Section 6 describes the predicted behaviour of the final voids under varying climatic conditions.
- Section 7 describes the flood behaviour under design events and climate change scenarios.
- Section 8 details the potential impacts of the Project and outlines mitigation and management measures to minimise adverse effects on surface water resources.
- Section 9 provides a list of references.

The report includes five appendices:

- Appendix A provide the water quality monitoring results on which the DNM water quality characterisation is based.
- Appendix B describes the operational water balance model including inflows, outflows, and storage dynamics under varying climatic conditions completed by HydroBalance (2025). It was developed in coordination with groundwater modelling by SLR (2025).
- Appendix C describes the final void water balance model undertaken to provides long-term predictions of water storage, salinity, and groundwater interactions in residual voids.
- Appendix D describes the hydrologic and hydraulic flood modelling, calibration processes, and climate change considerations undertaken for the approved EA.
- Appendix E provides flood model results.
- Appendix A provides a preliminary consequence category assessment for the proposed erosion and sediment control structures.

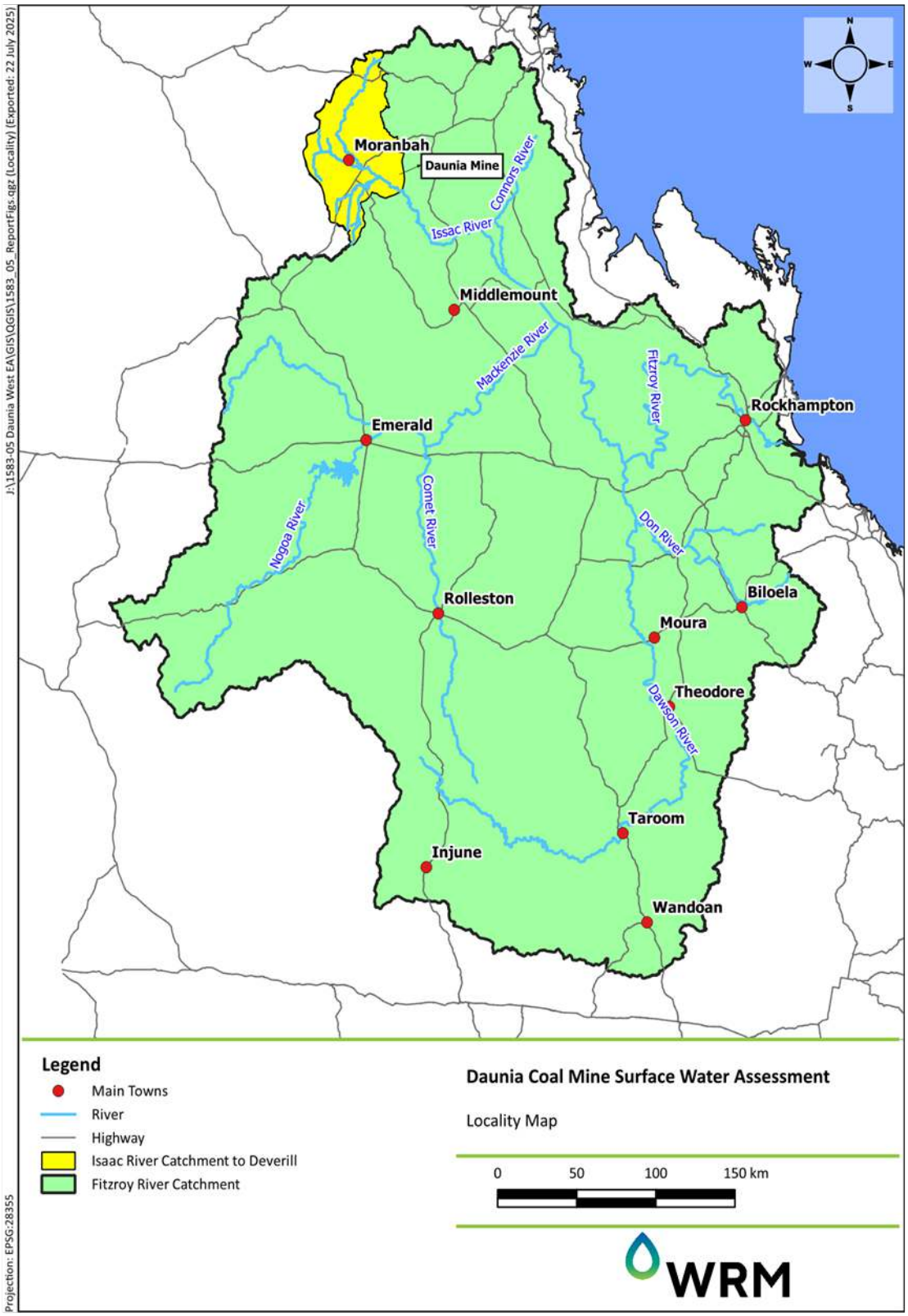

Figure 1.1 Regional Locality

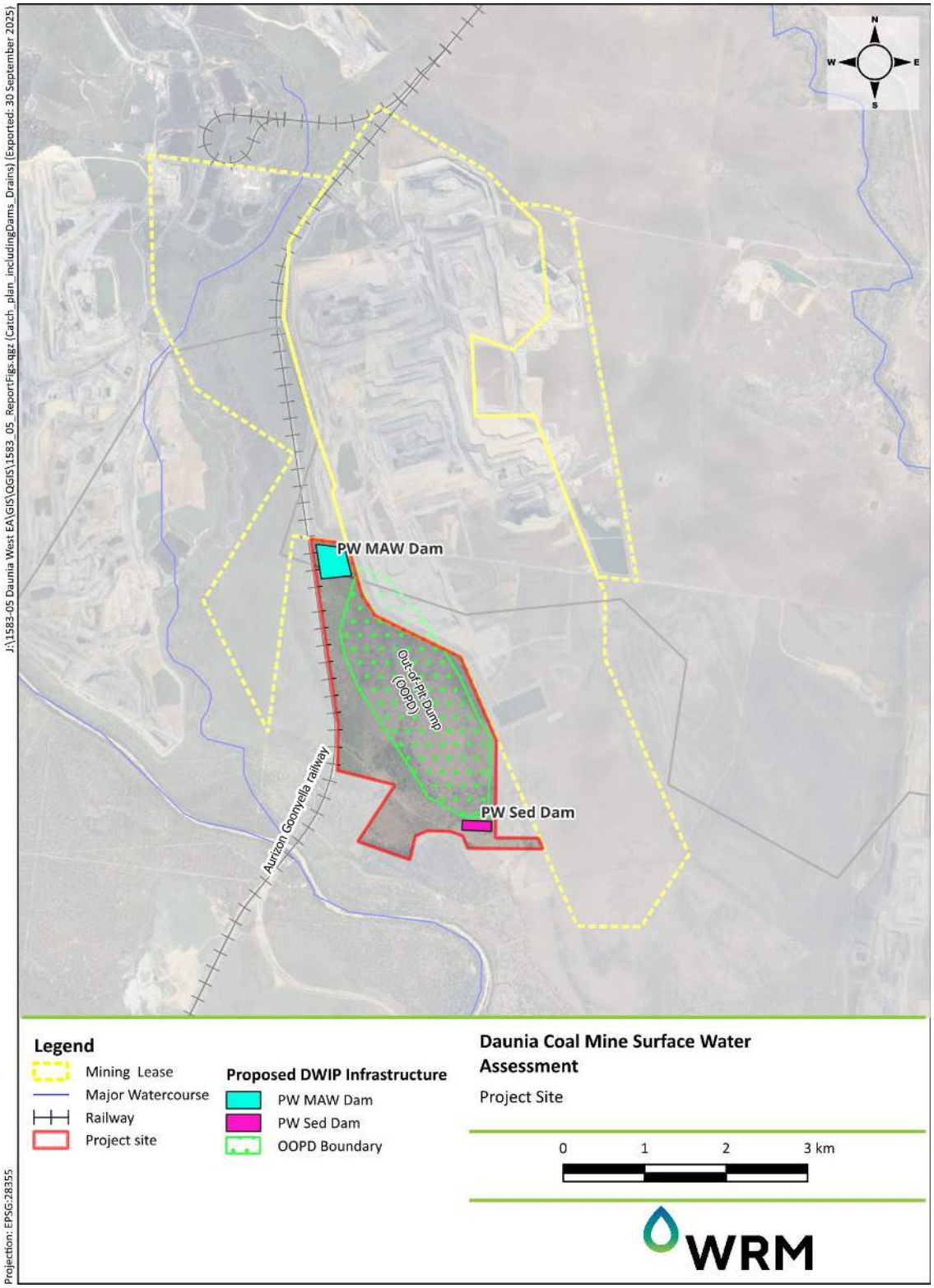

Figure 1.2 Project general arrangement

2 EXISTING SURFACE WATER ENVIRONMENT

2.1 DRAINAGE NETWORK

2.1.1 Overview

There are three waterways and two drainage features within the vicinity of the Project (see Figure 2.2). 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 2 first-order streams join. They are bigger in size due to the water from both first-order streams combining. Third-order streams form when 2 or more second-order streams join. And so on.

Near the Project area, there are three watercourses:

- The Isaac River located southwest (Strahler stream order six (6));
- North Creek located northeast (Strahler stream order four (4)); and
- New Chum Creek located west (Strahler stream order three (3)).

The mine is wholly confined within two minor drainage features (Strahler stream order 1) located along the eastern and western boundary, that drain directly into the Isaac River. Descriptions of the waterways are given below.

2.1.2 Isaac River

The Project is located within the Isaac sub-catchment of the greater Fitzroy Basin. The Isaac River is the main watercourse in the vicinity of the Project area and flows in a south easterly direction to the southwest of the Project. Figure 2.1 presents the drainage characteristics of the Upper Isaac River to the Deverill flow gauge (130410A) located some 14 km downstream from the Project area.

The Isaac River catchment starts at the Denham Range and flows in a south-westerly direction through the Carborough and Kerlong Ranges before turning in a south-easterly direction and converging with the Connors River. The Connors River, which has a catchment area similar to the upstream Isaac River, flows into the Isaac River approximately 155 km downstream of the Project. The Isaac River finally converges with the Mackenzie River a further 45 km downstream.

The catchment area of the Isaac River upstream of DNM is approximately 3,630 km^2 and comprises mainly scattered to medium dense bushland, grazing land and the township of Moranbah. There are several existing coal mines in the Isaac River catchment including, Burton, North Goonyella, Grosvenor, Goonyella-Riverside, Broadmeadow, Broadlea, Isaac Plains, Carborough Downs, Caval Ridge, Poitrel, Daunia, Millennium and Moranbah North.

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 southeast of Rockhampton, near Port Alma. The total Fitzroy River catchment is 142,665 km².

The catchment area of the Isaac River, encompassing the Project area, is approximately 4,100 km². This represents around 2.9% of the overall Fitzroy River catchment. The Project disturbance footprint is approximately 5 km² and represents 0.004% of the overall Fitzroy River catchment area.

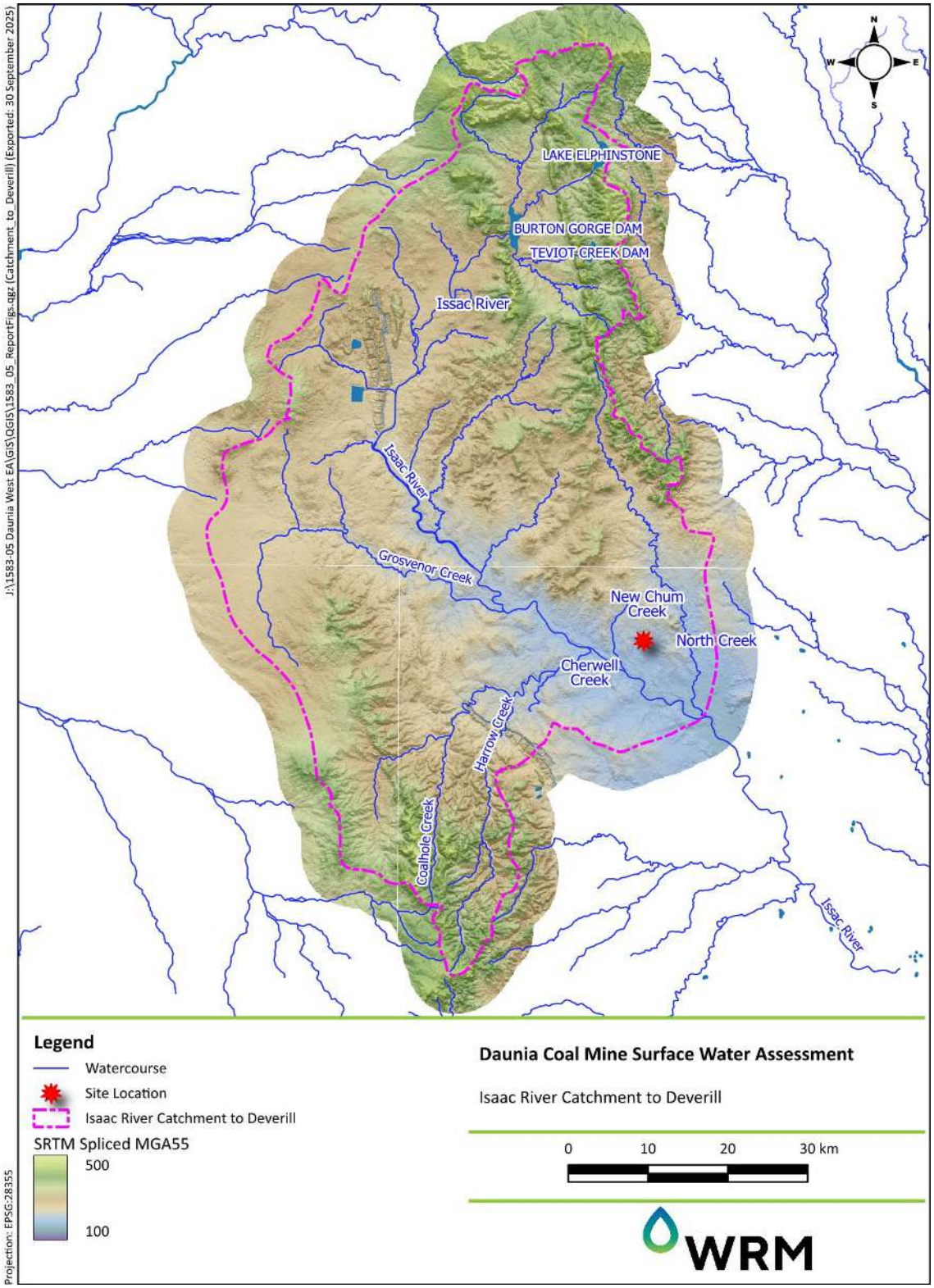

Figure 2.1 Regional drainage features

2.1.3 New Chum Creek

New Chum Creek drains an area of approximately 48 km² to the west of DNM and traverses multiple mining leases. About 3 km of New Chum Creek has been replaced by a diversion channel within the Poitrel mining lease. It is classified as a third-order watercourse at its confluence with the Isaac River. The Aurizon Goonyella rail line runs along the western boundary of the DNM mining lease separating New Chum Creek from the mining works at DNM. The DNM infrastructure area drains into New Chum Creek.

New Chum Creek is highly ephemeral with flows ceasing within a few days of runoff. It is generally dry during winter and early spring, although some pools retain water for extended periods.

Proposed DWIP storages, PW Sediment Dam and PW MAW Dam, are situated within catchments that drain directly to the Isaac River. While existing operations release to New Chum Creek, associated storages are outside the DWIP footprint and are not affected by the Project works. As a result, there is no part of the DWIP area that drains to New Chum Creek and potential environmental impacts are confined to the Isaac River catchment.

2.1.4 Local drainage

Figure 2.2 shows that the Project site is confined to the catchment of unnamed first order drainage features. They generally show no characteristics of being a watercourse because they are ill-defined and do not have enough continuing flow to create a riverine environment. Neither feature has any riparian vegetation of significance.

These drainage features combine downstream of the Project area to form a second order drainage feature, which drains along the edge of the Isaac River floodplain to enter the Isaac River about 6 km downstream of the Project site. This feature is effectively an active flood channel of the Isaac River.

2.2 STREAMFLOW

Historical flow and river height monitoring data (1968-2025) for the Isaac River at Deverill (DNRME monitoring station 130410A), located to the southeast of the Project area, provides an indication of the local flow regime. Figure 2.1 shows the Isaac River catchment to the Deverill gauging station adjacent to the Project.

Figure 2.3 presents a monthly box and whisker plot of stream flows in the Isaac River as recorded at the Deverill gauging station. The box and whisker plots show:

- The lower and upper extents of the ‘whiskers’ show the minimum and maximum 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 small, 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).

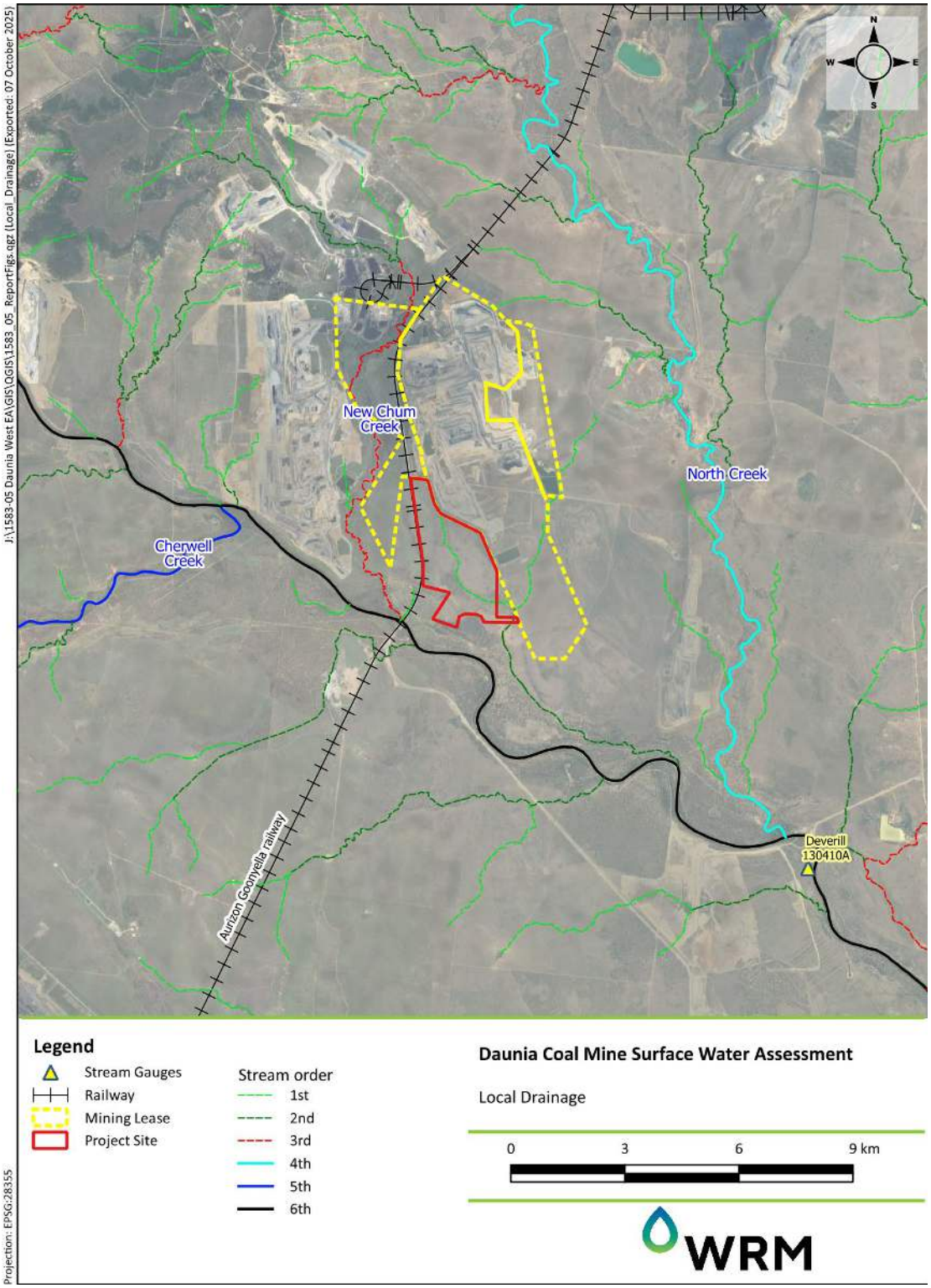

Figure 2.2 Project site drainage characteristics

Data from the Deverill station shows that flows are most likely to occur during the summer months. Stream flows are highly variable, with the river drying out during winter and early spring. Some pools

are expected to hold water for extended periods. Noteworthy observations regarding the recorded stream flows include:

- The average daily flow at Deverill is 753 ML/d.
- At Deverill, the Isaac River is mostly dry, with recorded flows only 27% of the time.
- Stream flows above 100 ML/d occur less than 1% of the days and is not enough to cover the riverbed fully.
- The highest recorded peak flow at this station was 2,638 m^3/s in March 1988.

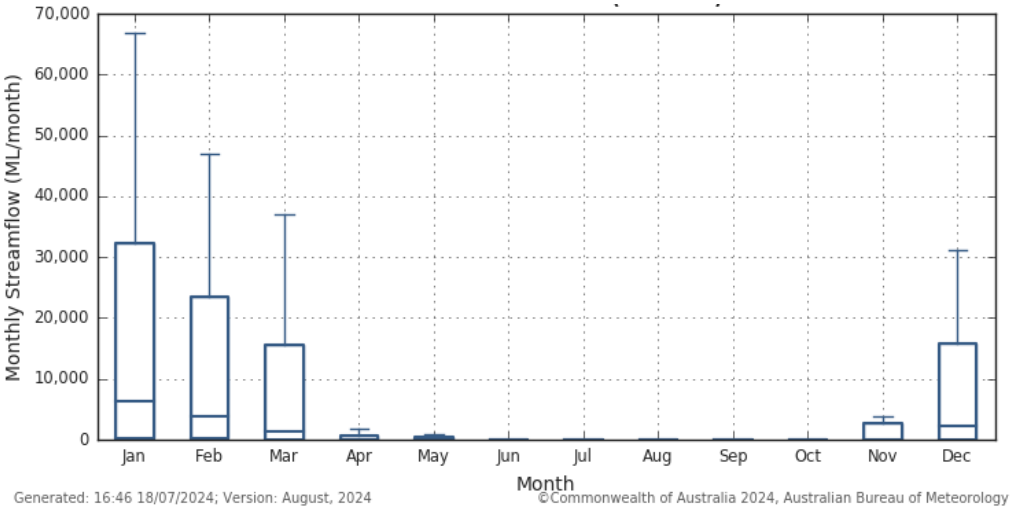

Figure 2.3 Monthly box and whisker plot of flow volume for the Isaac River at Deverill (DNRME station 130410A)

2.3 ENVIRONMENTAL VALUES OF RECEIVING WATERS

2.3.1 Overview of Environmental Values

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water), subordinate to the *Environmental Protection Act 1994* (EP Act) establishes a comprehensive framework for protecting Queensland's waterways and wetlands., The policy outlines processes for identifying environmental values (EVs)—such as aquatic ecosystem health, recreational use, and agricultural needs—and setting water quality objectives (WQOs) to maintain or enhance these values. These objectives are derived using national standards like the ANZG (2018) and the Queensland Water Quality Guidelines and are tailored to the ecological condition of each water body (DES, 2019).

The EV's and WQO's for the project are defined in the Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River) September 2011, which is made pursuant to the provisions of the EPP Water policy. The project is located within two subcatchments defined within the policy:

- The Isaac River channel is located within the Isaac and lower Connors River subcatchment, and
- The minor tributaries and nearby watercourses are located with the Isaac River northern tributaries subcatchment

The EV's defined for both areas are the same and these include:

- Aquatic ecosystem health
- Primary industries (e.g. irrigation, farm supply and stock watering)
- Recreational use (primary, secondary and visual)

- Drinking water supply
- Human consumer
- Industrial use
- Cultural and spiritual values

The WQO's for this region are tailored to protect the physical, chemical, and biological integrity of the watercourses, ensuring their suitability for human use and their capacity to support aquatic ecosystems. These objectives are informed by scientific guidelines and local data and are embedded in statutory decision-making processes for development and environmental management.

Table 2.1 provides an overview of the environmental values for the receiving waters, emphasising the protection of water quality to support ecological health, human uses, and cultural significance.

Table 2.1 Receiving water environmental values

Environmental Value	Description
Aquatic Ecosystems	Protection of water quality to sustain aquatic life and biodiversity.
Primary Industries	Support for agricultural activities, including irrigation, farm use and stock watering.
Recreational Use	Maintenance of water quality for safe recreational activities.
Drinking Water	Ensuring water quality meets standards for human consumption.
Industrial Use	Water quality suitable for industrial processes and mining operations.
Cultural and Spiritual Values	Recognition of water bodies' significance to local communities.

2.3.2 Water quality objectives

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2020) provide scientifically derived default guideline values (DGV's) for toxicants to protect aquatic ecosystems. These values are intended for use in systems that are slightly to moderately disturbed, with a 95% level of protection for species where site specific data is not available. The ANZG guideline is based on the ANZECC and ARMCANZ (2000) guidelines, but they have been updated continuously as more data is available. The DGV WQO's relevant to the identified EV's are provided in Table 2.2.

The Environmental Authority (EA) EPML00561913, granted to Daunia Coal Limited (held by Whitehaven Daunia Pty Ltd), establishes site-specific conditions for environmental management under the EP Act. The EA requires monitoring of release and receiving water analytes through a Receiving Environment Monitoring Program (REMP). The WQO's used in the REMP are derived from the EPP Water Policy. This policy provides a framework for identifying EVs and establishing WQOs to protect or enhance those values. These WQOs serve as operational thresholds, informed by national guidelines such as the ANZG (2018) and the Queensland Water Quality Guidelines, and are tailored to the ecological condition of the receiving waters. As such, they benchmark environmentally sustainable thresholds for water quality management and compliance assessment (DES, 2019).

Where different EVs have varying WQOs, the most conservative value has been adopted to ensure comprehensive protection. These WQOs are displayed for physicochemical parameters only, reflecting the conditions necessary to maintain the integrity of aquatic ecosystems, human uses, and other environmental values.

Additionally, measured concentrations of key physicochemical parameters were compared with the Australian Drinking Water Guidelines (ADWG) to assess potential risks to human health.

Table 2.2 Water quality objectives (source: FRREMP, 2025)

Parameter	WQO	Relevant EV
Ammonia N	< 0.9 mg/L	Aquatic ecosystem[a]
Oxidised N	< 0.06 mg/L	Aquatic ecosystem[b]
Organic N	< 0.42 mg/L	Aquatic ecosystem[b]
Total nitrogen	< 0.5 mg/L	Aquatic ecosystem[b]
Filterable Reactive Phosphorus (FRP)	< 0.02 mg/L	Aquatic ecosystem[b]
Total Phosphorus	< 0.05 mg/L	Aquatic ecosystem[b]
Chlorophyll a	< 0.005 mg/L	Aquatic ecosystem[b]
Dissolved oxygen	85-110% saturation > 4 mg/L at surface	Aquatic ecosystem[b] Drinking water[c]
Turbidity	< 50 NTU	Aquatic ecosystem[b]
Suspended solids	< 55 mg/L	Aquatic ecosystem[b]
pH	pH 6.5-8.5	Aquatic ecosystem[b]
Conductivity (EC) baseflow	< 720 µS/cm	Aquatic ecosystem[b]
Conductivity (EC) high flow	< 250 µS/cm	Aquatic ecosystem[b]
Sulphate	< 25 mg/L	Aquatic ecosystem[b]
Total Dissolved Solids	< 2000 mg/L	Stock watering[d]
Colour	50 Hazen Units	Drinking water[c]
Total Hardness	150 mg/L as $CaCO_3$	Drinking water[c]
Sodium	To be advised	See Section 2.4
Aluminium	< 20 mg/L < 5 mg/L < 0.055 mg/L (pH > 6.5)	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Arsenic	2.0 mg/L 0.5 mg/L up to 5 mg/L < 0.013 mg/L	Irrigation[g, e] Stock watering[f] Aquatic ecosystem[b]
Beryllium	< 0.5 mg/L	Irrigation[g,e]
Boron	< 5 mg/L < 0.94 mg/L	Stock watering[f] Aquatic ecosystem[k]
Cadmium	< 0.01 mg/L < 0.0002 mg/L	Stock watering[f] Aquatic ecosystem[a]
Chromium	< 1 mg/L < 1 mg/L < 0.001 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Cobalt	< 0.1 mg/L < 0.0014 mg/L	Irrigation[g,e] Aquatic ecosystem[h]
Copper	< 5 mg/L < 1 mg/L < 0.0014 mg/L	Irrigation[g,e] Stock watering (cattle)[f] Aquatic ecosystem[a]
Fluoride (total)	< 2 mg/L	Irrigation[g,e]

Parameter	WQO	Relevant EV
Iron	< 10 mg/L < 0.70 mg/L	Irrigation[g,e] Aquatic ecosystem[l]
Lead	< 5 mg/L < 0.1 mg/L < 0.0034 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Lithium	< 2.5 mg/L	Irrigation[g]
Manganese	< 10 mg/L < 1.9 mg/L	Irrigation[g,e] Aquatic ecosystem[a]
Mercury	< 0.002 mg/L < 0.0002 mg/L	Irrigation[g] Aquatic ecosystem[i]
Molybdenum	< 0.05 mg/L < 0.034 mg/L	Irrigation[g,e] Aquatic ecosystem[h]
Nickel	< 2 mg/L < 1 mg/L < 0.011 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Selenium	< 0.05 mg/L < 0.02 mg/L < 0.005 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Silver	< 0.001 mg/L	Aquatic ecosystem[a]
Uranium	< 0.1 mg/L < 0.001 mg/L	Irrigation[g,e] Aquatic ecosystem[i]
Vanadium	< 0.5 mg/L < 0.01 mg/L	Irrigation[g,e] Aquatic ecosystem[i]
Zinc	< 5 mg/L < 0.008 mg/L	Irrigation[g,e] Aquatic ecosystem[a]
Nitrate as N	< 1.1 mg/L	Stock watering[j]

a Trigger values for slightly–moderately disturbed systems (95% protection) are based on ANZG (2020/2025) using Species Sensitivity Distribution (SSD) methods or reference-site percentiles.

b Aquatic ecosystem values (Table 2) are updated using ANZG (2020/2025) toxicant default guideline values and regional reference data.

c Drinking water values (Table 4) are sourced from ADWG (2011, updated 2016).

d Stock watering salinity values (Table 10) follow ANZECC (2000) tolerances retained in ANZG (2020/2025).

e Short-term trigger values (STVs) are applied for occasional exposure scenarios, as per ANZG (2020/2025).

f Heavy metals and metalloids for stock watering (Table 11) are based on ANZECC (2000) values retained in ANZG (2020/2025).

g Heavy metals and metalloids for irrigation (Table 9) use long-term and short-term values from ANZG (2020/2025).

h Low reliability guidelines are based on limited data and should be used with caution and supplemented with site-specific evidence.

i Limits of Reporting (LOR) for ICPMS/CV FIMS methods are typically in the range of 0.05–1.0 µg/L depending on analyte and lab capability.

j Total nitrogen values are based on ambient WQGs (2006) for the Bowen Basin, typically 0.5–1.0 mg/L.

k Boron guideline values are excluded as per user request.

i Total iron guideline value for freshwater ecosystems is 0.3 mg/L (95% protection), based on ANZG (2025).

[k] mg/L = milligrams per litre, NTU = Nephelometric Turbidity Units, µS/cm = microSiemens per centimetre

2.4 SODIUM RELEASE TRIGGER LEVEL

2.4.1 Purpose

A sodium trigger level assessment has been undertaken to demonstrate compliance with the EA and the applicable Queensland and national water quality guidelines. The EA requires a sodium trigger value to support routine water quality monitoring; however, this value is currently identified as "TBA" (to be advised) and therefore must be established through a formal, evidence-based assessment.

This assessment defines an appropriate sodium trigger value for mine water releases by evaluating release water quality in the context of the receiving environment water quality objectives (WQOs). The assessment provides a basis for demonstrating statutory compliance and supporting the protection of downstream environmental values.

2.4.2 Human health assessment framework

The assessment follows the ADWG (2011) framework, which provides health-based and aesthetic guideline values and adopts a risk-management approach to drinking water safety.

This assessment is relevant to potential potable water supplies only and does not imply that receiving waters are used directly for drinking water without treatment.

2.4.3 Drinking water context

The ADWG value for sodium in reticulated drinking water supplies is 180 mg/L, based on the concentration at which taste becomes noticeable. This value is an aesthetic guideline rather than a health-based threshold. At concentrations above this level, sodium may impart a salty taste but does not pose a direct health risk to the general population.

The ADWG notes that sodium salts cannot be readily removed during conventional water treatment processes and recommends that water authorities aim to keep sodium concentrations as low as practicable.

A lower value of 30 mg/L for raw drinking water supply is often applied by Queensland Health and Fitzroy River Water for operational reasons, as rapid changes in sodium concentrations can affect the use, operation, and calibration of medical equipment.

The ADWG (2011) sodium value of 180 mg/L applies solely to potable water and is not intended to be applied directly to ecological assessments or surface water receiving environments.

2.4.4 Groundwater chemistry context

The applicable groundwater chemistry zone for the assessment area is Chemistry Zone 5 (Raymond & McNeil, 2011) under Plan WQ1310. Zone 5 is commonly used in Isaac and Fitzroy Basin assessments to represent saline to highly saline inland groundwater influenced by geology, evapoconcentration, and mining activities, and is therefore appropriate for mine-affected water assessments. The underlying data comprise groundwater samples collected from monitoring bores across the Fitzroy Basin, classified by chemistry zone and depth for percentile-based assessment under Plan WQ1310.

For the Isaac River Sub-basin, 80th-percentile sodium concentrations for Chemistry Zone 5 are reported as 684 mg/L for deep groundwater (greater than 30 m) and 195 mg/L for shallow groundwater (30 m or less). These values represent upper-range ambient salinity conditions rather than ecological thresholds (DES, 2011).

2.4.5 Assessment

No suitable baseline sodium data are available from upstream reference sites, pre-mining monitoring programs, or regional analogue catchments. Consistent with ANZG (2018), sodium has therefore been assessed as a component of overall salinity, with electrical conductivity used as the primary indicator of salinity-related stress. This approach reflects the ecological relevance of total ionic strength and is appropriate where individual ion guideline values are not available or are not meaningful in isolation.

In the absence of site-specific baseline data, an interim benchmark equivalent to an 80th percentile sodium concentration has been adopted, consistent with the ANZG (2018) weight-of-evidence framework. This benchmark is informed by sodium concentrations reported for similarly disturbed inland Australian catchments and is considered conservative until additional monitoring data are available.

For the Isaac River Sub-basin, Table 14 of the Environmental Values and Water Quality Objectives identifies an interim 80th percentile sodium concentration of approximately 350 mg/L for highly saline inland systems. This value provides a regional reference for mining-influenced surface water conditions and supports the assessment of sodium as a salinity-related stressor rather than a toxicant (Queensland Government, 2011).

2.4.6 Data Gap Management

Available sodium data are limited at both upstream reference locations and downstream receiving environment sites, particularly for baseline (pre-mining) and background conditions. In addition, there is insufficient long-term monitoring data to characterise sodium behaviour under a full range of hydrological conditions, including low-flow, baseflow and event-flow scenarios.

These data limitations constrain the ability to fully assess potential impacts and cumulative effects over time. To address the identified gaps and support future assessments, the following approach is recommended:

- Electrical conductivity should continue to be used as the primary compliance and performance indicator for salinity, with sodium assessed as a supporting parameter. A regional benchmark sodium concentration of 350 mg/L, representing highly saline inland systems, should be used for contextual interpretation.

Future monitoring programs should include systematic collection of baseline sodium data at upstream reference sites and downstream receiving environment locations. Monitoring should be conducted across a range of flow conditions, including both low-flow and wet-season event conditions, to capture natural variability and improve confidence in long-term trend assessments. This approach aligns with ANZG (2018) guidance and supports progressive refinement of site-specific baseline conditions as additional data become available.

2.5 SURFACE WATER QUALITY

2.5.1 Monitoring framework and data sources

Figure 2.4 shows the locations of the monitoring sites along the reach of the Isaac River and adjacent to the Project. Descriptions of these monitoring sites are given in Table 2.3.

Table 2.3 Description of monitoring sites

Name	Reference	Proximity to Project	GDA Easting	GDA Northing	Description
Dam 2 release point	RP1	Upstream catchment	631319	7561566	Dam 2 release point and integrated water system.

Name	Reference	Proximity to Project	GDA Easting	GDA Northing	Description
New Chum US	MP1	Upstream catchment	631895	7562009	New Chum Ck on the northern lease boundary (adjoining Millennium Mine), located before release from upstream mines
New Chum DS	MP2	Upstream catchment	630711	7560607	New Chum Ck upstream of diversion. (PTM MP4)
Isaac River DS	MP4	Isaac River upstream	631843	7553698	Isaac River immediately downstream of New Chum confluence
Isaac River US	MP3	Isaac River upstream	627886	7556458	Isaac River upstream of the confluence with New Chum
Isaac River Deverill	130410A	Isaac River downstream	642713	7548620	Historical and near real-time data accessible via the WMIP portal

Key Isaac River monitoring locations include the Deverill gauging station, located near the downstream boundary of the project, as well as the upstream sites MP3 and MP4. These datasets provide comparative statistics to assess water quality trends and potential influences from mining and natural processes throughout the catchment.

DNM is part of the Fitzroy Regional Receiving Environment Monitoring Program (FRREMP), which monitors water quality in the Upper Isaac sub-basin. Participating FRREMP mines in the Upper Isaac sub-basin include Goonyella Riverside/Broadmeadow, Grosvenor, Caval Ridge, Peak Downs, Saraji, Saraji South, and Daunia. These mines contribute data to FRREMP, with monitoring points located upstream and downstream of release points.

There are no stations collecting water quality data not impacted by mining. All stations potentially receive runoff from the surrounding mines and are therefore not background monitoring stations.

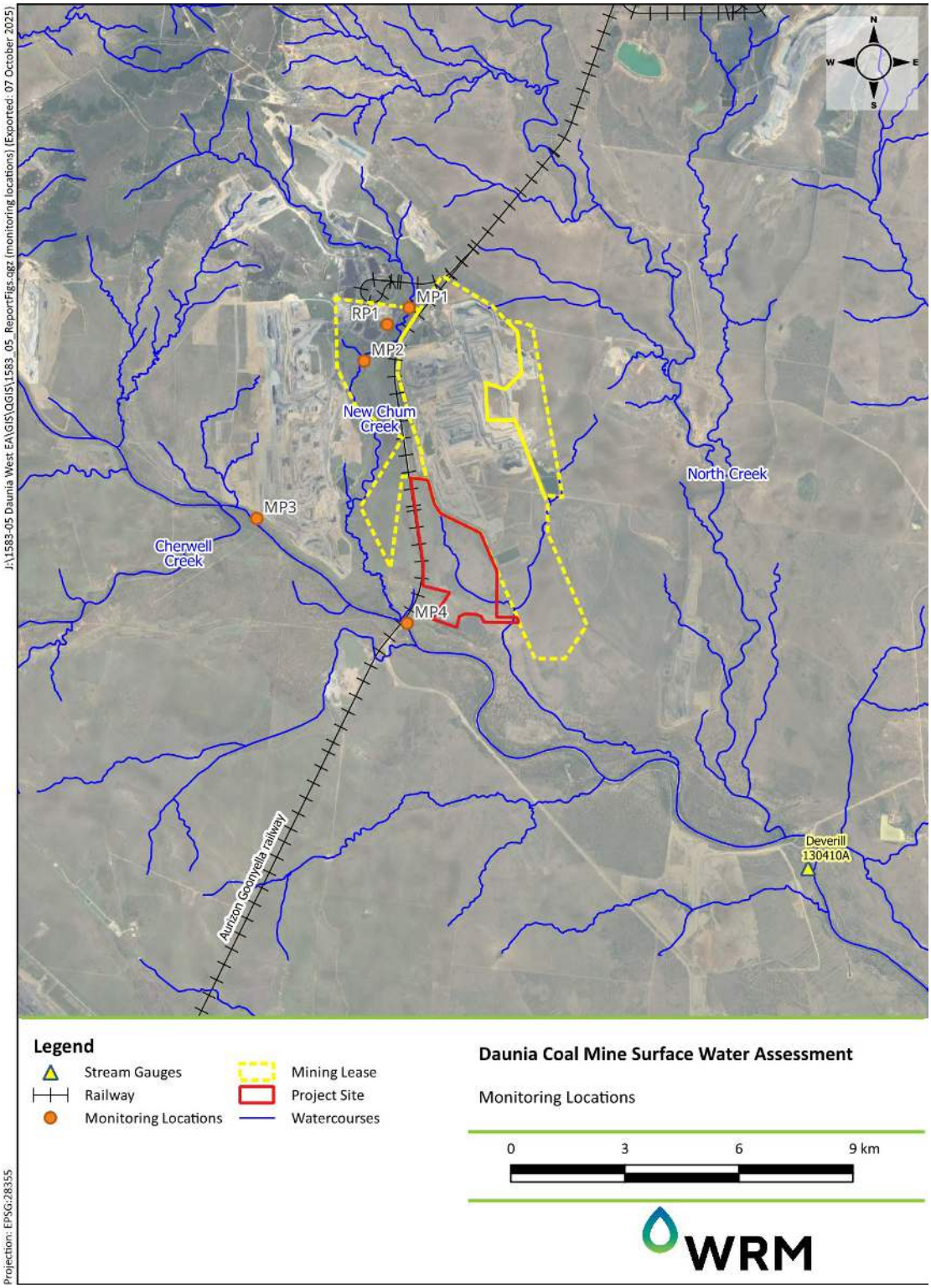

Figure 2.4 **DNM water quality monitoring sites**

2.5.2 Isaac River water quality

DNRME collected daily EC data at the Isaac River at the Deverill gauge, which is representative of the water quality that drains past the site. EC, which measures salt concentration in water, has been used to estimate total dissolved solids (TDS) and to assess potential water quality impacts of the Project. Of all the water quality parameters tested in both the local waterways and at the mine, EC showed the greatest variation from the WQOs.

Figure 2.5 presents historical time series data of recorded EC and stream flow for the Isaac River collected by DNRME at the Deverill gauging station spans the period from 2011 to 2025. Figure 2.6 details the relationship between instantaneous flow and EC at the Isaac River at Deverill gauging station.

Electrical conductivity (EC) shows distinct patterns:

- During high-flow conditions (>200 m³/s), EC values generally remain below the high-flow water quality objective (WQO) of 250 µS/cm.
- In contrast, low-flow conditions (<100 m³/s) exhibit significant variability, with EC values ranging from 50 to 1,870 µS/cm and frequent exceedances of the low-flow WQO of 720 µS/cm.
- These patterns reflect the ephemeral nature of stream flows in the region, with baseflows typically ceasing shortly after runoff events.

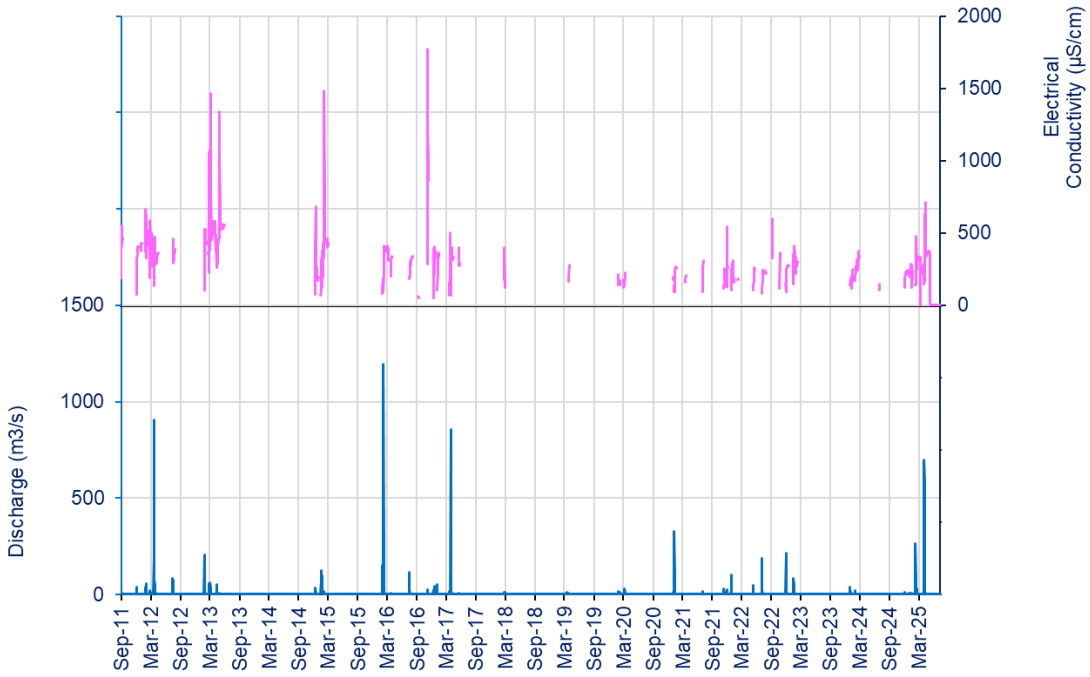

Figure 2.5 Electrical Conductivity and flow (Isaac River at Deverill gauge)

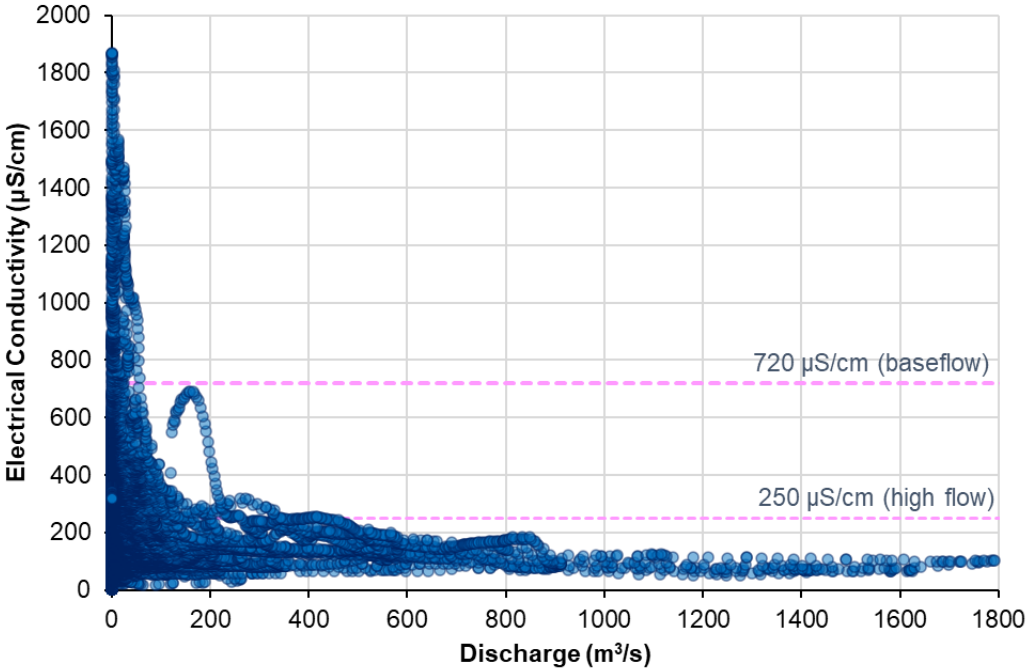

Figure 2.6 Flow vs Electrical Conductivity (Isaac River at Deverill gauge)

2.5.3 REMP water quality results

In the FRREMP water quality datasets, there is an adequate number of water quality samples for the Isaac River upstream of the Project site. These datasets have been statistically analysed for comparison against site-specific WQOs for parameters (see Section 2.2.2).

Monitoring sites and locations are described in Section 2.3.1. Time series graphs of the historical water quality sampling data are provided in Appendix A.

A comparison of water quality data from monitoring sites MP3 and MP4 with the Deverill gauge on the Isaac River shows several exceedances of aquatic ecosystem protection guideline values. Table 2.4 gives the 20th, median and 80th percentile concentrations for water quality monitoring from 2015 to 2025 and assessed against the WQOs.

Water quality monitoring conducted between 2015 and 2025 indicates that variability in results is influenced by seasonal changes, upstream land use, and mining activities. Key observations include:

- Near the Project, median concentrations of sulphate exceed its guideline value, while 80th percentile concentrations for dissolved aluminium, copper, sulphate, zinc, and turbidity (sampled at Deverill) also exceed the relevant WQOs.
- Sulphate concentrations upstream of the site are close to the WQO of 25 mg/L. At MP4, the median sulphate concentration is 26 mg/L, slightly above the guideline, and the 80th percentile reaches 40.6 mg/L.
- Dissolved aluminium exceeds the WQO of 0.055 mg/L, with a median concentration of 0.15 mg/L at Deverill and elevated 80th percentile values at MP3 and MP4.
- Copper shows exceedances, with 80th percentile concentrations above the guideline at Deverill, MP3, and MP4.
- Zinc shows exceedances at MP3, with 80th percentile concentrations reflecting those at Deverill, where the median and 80th percentile values are 0.06 mg/L and 0.2 mg/L, respectively above the relevant WQO.

- Occasional exceedances of ecosystem protection guidelines have also been recorded for pH, electrical conductivity (EC), aluminium, and copper (Gauge, 2020).
- Other metals, including cadmium, cobalt, lead, selenium, silver, mercury, and uranium, generally remained below detection limits (Gauge, 2023).

2.5.4 REMP outcomes at local monitoring locations

A review of water quality sampling data was undertaken for upstream monitoring locations, including MP1, MP2, and the release monitoring point RP1 (see Appendix A). Runoff from the Project site does not directly influence these locations, as it discharges directly into the Isaac River. However sampled water quality data from these location supports the characterisation of Project water quality and provide an indication of water quality, including metal toxicants, in the Isaac River upstream of the Project.

Key observations from FRREMP reports include:

1. The Isaac River predominantly features sandy substrates, with occasional exceedances of metal guideline values (Gauge, 2017).
2. Natural enrichment, seasonal variability, and flow conditions significantly influence water quality parameters (Gauge, 2017).
3. Elevated concentrations of specific analytes are primarily attributed to natural enrichment rather than mining activities (Hydrobiology, 2018).
4. Occasional exceedances of ecosystem protection guidelines have been recorded for pH, electrical conductivity (EC), and certain metals (Gauge, 2020).
5. Seasonal rainfall patterns strongly affect water quality: high-flow periods increase turbidity and nutrient levels, while dry conditions lead to salt accumulation (Gauge, 2021).

Table 2.4 Comparison between EA trigger and analyte concentrations

Parameter	Unit	Deverill				MP3				MP4				Water Quality Objective
		No.	20%ile	Median	80%ile	No	20%ile	Median	80%ile	No.	20%ile	Median	80%ile	
Electrical Conductivity	µS/cm	49	120	261	398	32	120	234	454	38	164	320	456	< 720 (baseflow) < 250 (high flow)
pH	-	12	7.19	7.6	8.0	32	7.58	8.00	8.43	38	7.55	8.07	8.32	6.5–8.5 (aquatic)
Sulphate (total)	mg/L	42	6.92	10	18.8	25	4.0	9.0	30.3	31	7.0	26.0	40.6	< 25 (aquatic)
Nitrate (total)	mg/L	13	0.001	0.01	0.01	31	0.02	0.16	0.30	34	0.01	0.19	0.28	< 1.1 (stock)
Fluoride (total)	mg/L	46	0.10	0.14	0.20	29	0.09	0.10	0.20	34	0.10	0.20	0.20	< 2 (irrigation)
Aluminium (dissolved)	mg/L	14	0.03	0.05	0.15	33	0.010	0.050	0.216	38	0.01	0.02	0.284	< 0.055 (aquatic)
Boron (total)	mg/L	21	0.04	0.06	0.10	17	0.05	0.05	0.06	28	0.05	0.05	0.06	< 5 (stock)
Copper (dissolved)	mg/L	16	0.006	0.03	0.036	33	0.001	0.001	0.002	37	0.001	0.001	0.002	< 0.0014 (aquatic)
Iron (dissolved)	mg/L	17	0.02	0.06	0.34	27	0.05	0.05	0.26	35	0.05	0.08	0.39	< 0.70 (aquatic)
Manganese (dissolved)	mg/L	16	0.006	0.030	0.036	28	0.001	0.002	0.008	31	0.001	0.005	0.013	< 1.9 (aquatic)
Zinc (dissolved)	mg/L	14	0.01	0.02	0.06	28	0.004	0.005	0.010	30	0.005	0.005	0.007	< 0.008 (aquatic)
Sodium (total)	mg/L	49	12	22	40	8	15	24	44	5	26	37	47	< 350 (See Section 2.4)
Turbidity	NTU	19	11	50	910	-	-	-	-	-	-	-	-	< 50 (aquatic)
Total Dissolved Solids	mg/L	47	81	155	224	-	-	-	-	-	-	-	-	< 2,000 (stock)
Total Suspended Solids		41	10	135	1,340	-	-	-	-	-	-	-	-	< 55 (aquatic)

NOTE: values that were recorded as below the limit of reporting, have been assumed to be equal to the limit of reporting, for the purpose of this statistical analysis.

2.5.5 Release criteria

MAW releases from DNM are regulated under Schedule F of the EA. Release of MAW is only permitted by the approve release point and where compliance with the applicable water-quality limits and monitoring requirements can be demonstrated. Table F2 of the EA specifies the release limits for key water-quality parameters (Section 4.4.3).

Electrical conductivity and pH are monitored using real-time telemetry, supplemented by grab sampling at the commencement of a release and weekly thereafter, where safe access is available and appropriate permits are in place. Where telemetry is unavailable for pH monitoring, daily grab samples are required, with the first sample collected as soon as practicable following commencement of release. Additional analytes are monitored via grab sampling at the commencement of release and weekly thereafter for the duration of the release period, but subject to safe access conditions.

Any exceedance of the specified criteria is reported and investigated in accordance with Environmental Authority conditions F16 and F17.

2.5.6 Release water quality

The Daunia RP1 release occurred from 31 March to 9 April 2025 when multiple coal-mine water releases were taking place across the Upper Isaac River basin. Despite the concurrent releases, water quality in the Isaac River remained within applicable WQOs, indicating that potential cumulative impacts were effectively mitigated by dilution and mixing under wet-season flow conditions.

Monitoring undertaken during the 31 March to 9 April 2025 release from RP1 (Dam 2) coincided with elevated streamflows in both New Chum Creek (MP2) and the Isaac River (MP3 and MP4), associated with wet-season event conditions and multiple upstream releases. These hydrological conditions provided substantial dilution capacity within the receiving environment. The monitoring results indicate that hydrological mixing processes, particularly at the confluence of New Chum Creek with the Isaac River, were the primary control on downstream water quality outcomes during the release period.

Electrical conductivity (EC) results show a clear dilution and mixing response across the monitoring network. Mine-affected water released from RP1 (Dam 2) exhibited elevated EC values ranging from 2,120 to 2,780 µS/cm (summarised in Table 2.5). In comparison, EC values in New Chum Creek upstream of the confluence (MP2) ranged from 401 to 1,320 µS/cm, reflecting background variability and episodic catchment inputs (Table 2.6). Following the confluence, EC values in the Isaac River remained consistently low, with values of 168–229 µS/cm recorded at MP3 (upstream Isaac River) and only marginally higher values of 264–331 µS/cm observed at MP4 (downstream Isaac River). These results demonstrate rapid attenuation of salinity through dilution and longitudinal mixing, with downstream EC remaining well below applicable receiving water trigger values throughout the release period (Table 2.6).

Measured pH values further support the conclusion that the RP1 release did not adversely influence receiving water chemistry. Mine-affected water at RP1 was mildly alkaline but stable, with pH values ranging from 8.22 to 8.61 (Table 2.5). In contrast, pH values in New Chum Creek and the Isaac River remained within a narrow and environmentally typical range of approximately pH 7.1 to 7.9 during the monitoring period (Table 2.6). No discernible downstream pH trend or shift attributable to mine-affected water was observed following the confluence, indicating effective buffering and mixing under event flow conditions.

Similarly, sulphate concentrations in the receiving environment remained stable and within relevant guideline values throughout the release period. While elevated sulphate concentrations were present in the mine-affected water at RP1 (Table 2.5), sulphate levels in New Chum Creek and the Isaac River were low and showed no evidence of cumulative or progressive downstream increases during the monitoring period (Table 2.6). This further indicates that dilution and hydrological mixing were effective in mitigating potential water quality impacts associated with the release.

Electrical conductivity, the primary water-quality parameter of concern for coal-mine releases in the Fitzroy Basin, showed clear evidence of effective dilution and mixing. EC at RP1 was elevated relative to background levels. EC values measured in the Isaac River upstream (MP3) and downstream (MP4) of the confluence were low and stable, with no increasing trend during the release. This indicates that the Isaac River had sufficient assimilation capacity and that releases from RP1 did not cause measurable downstream salinity impacts.

Table 2.5 EC, pH and Sulphate concentrations sampled at RP1 (Dam 2) during 31 March to 9 April 2025

Monitoring Point	Date	EC (µS/cm)	pH	Sulphate (mg/L)
RP1 – Dam 2	31/03/2025	2260	8.22	292
RP1 – Dam 2	01/04/2025	2420	8.61	274
RP1 – Dam 2	02/04/2025	2650	8.58	312
RP1 – Dam 2	03/04/2025	2130	8.53	256
RP1 – Dam 2	04/04/2025	2120	8.49	248
RP1 – Dam 2	05/04/2025	2450	8.46	285
RP1 – Dam 2	06/04/2025	2520	8.49	311
RP1 – Dam 2	07/04/2025	2480	8.22	264
RP1 – Dam 2	08/04/2025	2330	8.26	253
RP1 – Dam 2	09/04/2025	2780	8.55	314

Table 2.6 EC, pH and Sulphate concentrations sampled at MP2 (New Chum), MP3 (US Isaac River) and MP4 (DS Isaac River) during 31 March to 9 April 2025

Monitoring Point	Date	EC (µS/cm)	pH	Sulphate (mg/L)
MP2 – New Chum	31/03/2025	515	7.71	40
MP2 –New Chum	05/04/2025	401	7.94	31
MP2 –New Chum	08/04/2025	1320	8.37	149
MP3 – US Isaac River	31/03/2025	168	7.20	9
MP3 – US Isaac River	05/04/2025	182	7.60	6
MP3 – US Isaac River	08/04/2025	229	7.88	9
MP4 – DS Isaac River	31/03/2025	264	7.14	27
MP4 – DS Isaac River	05/04/2025	331	7.86	14
MP4 – DS Isaac River	08/04/2025	303	7.82	18

2.6 CLIMATE

DNM is in a subtropical climate zone, characterised by hot, humid summers and moderately dry winters. Average daily temperatures range from 8.8°C in July to 21.5°C in January, with maximum daily temperatures peaking at 34.9°C in December.

2.6.1 Rainfall

Climate data for the site (latitude 22.05°S, longitude 148.30°E) was sourced from the Department of Science, Information Technology and Innovation's SILO Data Drill (SILO). This dataset provides continuous, gap-free daily records interpolated from Bureau of Meteorology (BoM) observations.

The historic average annual rainfall from 1957 to 2024 is 584 mm (see Figure 2.7). The minimum recorded rainfall during this period was 262 mm in 1982, while the maximum reached 1,082 mm in 2010. The distribution of monthly SILO rainfall is shown in Figure 2.8.

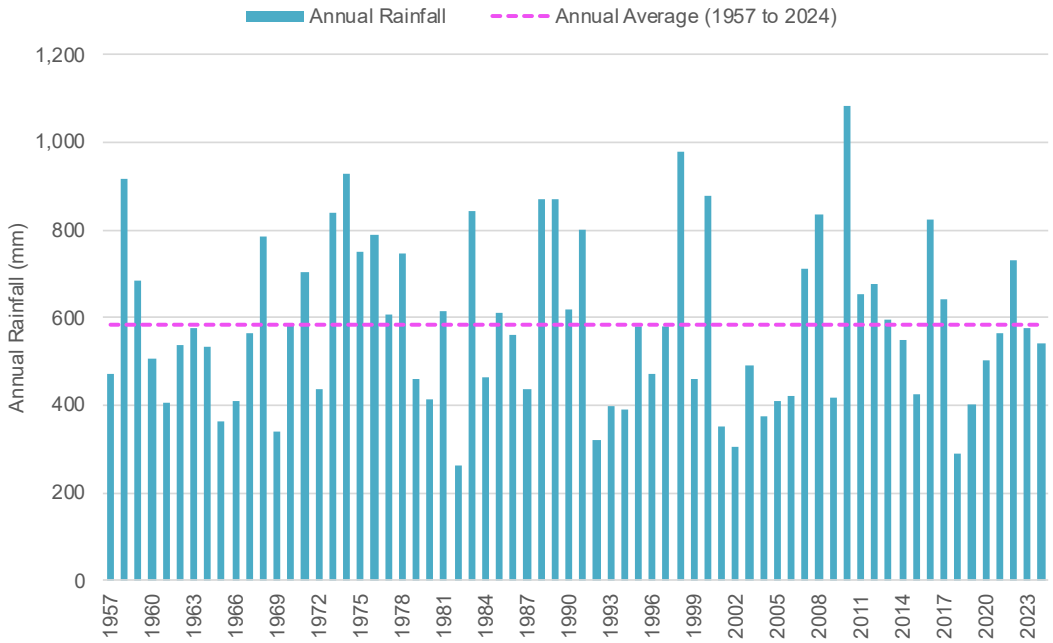

Figure 2.7 Annual rainfall (1957-2024)

Figure 2.8 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.

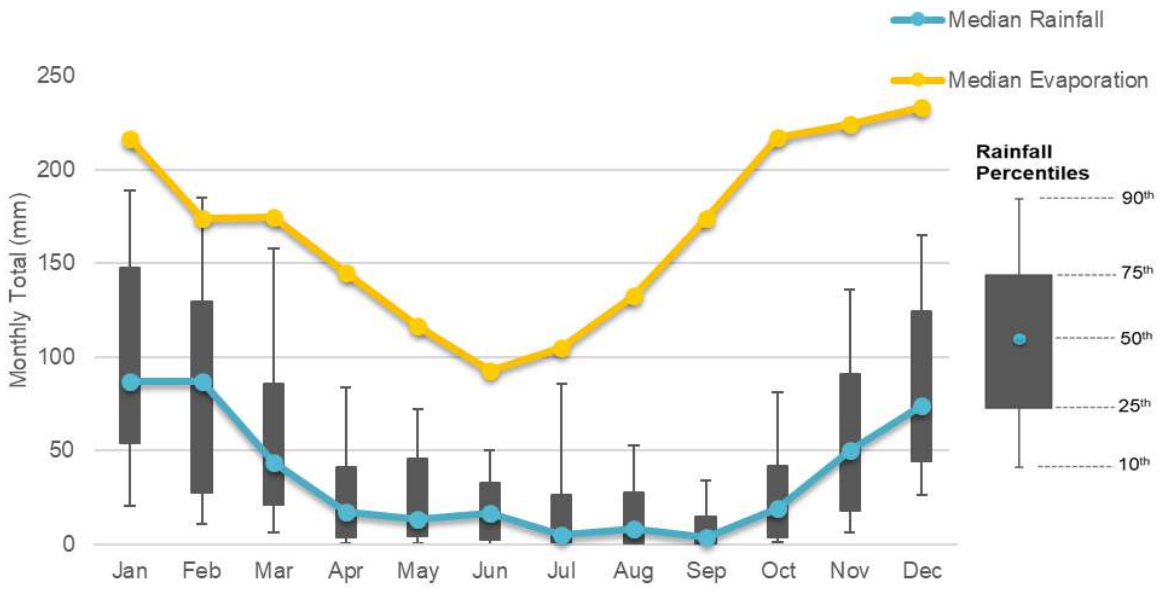

Figure 2.8 Monthly SILO rainfall and evaporation distributions summary

2.6.2 Evaporation

Figure 2.8 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: 2,014 mm.
- Evaporation peaks between October and January, aligning with the warmer months.
- Median monthly evaporation exceeds median monthly rainfall for all months.

2.6.3 Comparative climate data

Table 2.7 shows long term rainfall, evaporation and temperatures at nearby stations and at the DNM Site (MIA AWS). Site data is only available since WHC took ownership of DNM in 2023 whereas a much longer period of record is available at nearby stations. Nearby stations comprise Moranbah Airport (34035), about 22.7 km west of DNM MIA, Moranbah Water Treatment Plant (34038), about 28.7 km northwest, and Seloh Nolem (34086), about 34.3 km southeast. The following is of note:

- Silo rainfall and evaporation monthly data is consistent with recorded data at the nearby stations.
- Site data (MIA AWS) shows a higher annual average rainfall of 744 mm compared to nearby stations reflecting the above average rainfall during June 2023 to June 2025

Table 2.7 Rainfall and evaporation monthly averages, minimum and maximum monthly temperature (1957–2024)

	Long-term Mean Monthly Rainfall (mm)			On-site Mean Monthly Rainfall (mm)		Mean Monthly Evaporation (mm)		Average Daily Temperature (°C)	
	Moranbah Airport (34035)	Moranbah WTP (34038)	Seloh Nolem (34086)	SILO Data Drill	MIA AWS	Moranbah Airport (34035)	SILO Data Drill	Moranbah Airport (34035)	
Period of record	2013 - 2024	1870 - 2013	1980 – 2014	1957 - 2024	June 2023 to June 2025	2013 - 2024	1957 - 2024	2013 - 2024	
January	103	92	91	102	156	222	216	21.5	34.5
February	89	109	81	91	137	186	179	20.9	33.1
March	66	59	56	65	60	177	179	20.4	33.0
April	25	39	41	35	57	145	146	17.1	30.4
May	29	29	38	31	18	120	117	13.0	27.0
June	24	28	29	23	72	96	94	10.0	24.7
July	32	20	22	22	35	106	104	8.8	24.4
August	15	31	26	22	24	143	134	9.3	26.9
September	14	8	12	11	1	179	173	12.8	30.2
October	26	37	37	31	25	219	215	16.6	33.3
November	71	68	62	61	87	232	225	19.1	34.6
December	65	108	99	90	72	240	233	20.7	34.9
Annual Average	559	628	596	584	744	2,065	2,015	Min	Max

3 SITE CHARACTERISTICS

3.1 OVERVIEW

This section describes the objectives and principles of the water management system for the existing operations at DNM, including a description of the water infrastructure and systems.

3.2 EXISTING SITE OPERATING ACTIVITIES

HydroBalance (2025) describes the existing Daunia Water Management System (WMS) in Appendix B. Figure 3.1 shows the existing water storages at DNM. Each water storage is operated according to two key volumes:

- Maximum operating volume (MOV): The volume at which a given storage should be operated to below that the target overtopping risk is not exceeded. When the stored inventory within a water storage exceeds the MOV, pumped inflows into the storage may cease and/or dewatering of the storage may commence.
- Full storage volume (FSV): the full storage capacity of the dam, up to the spillway level.

Operational rules for the MAW dams are outlined in Appendix B.

Table 3.1 summarises the key mine water storages used for water management at DNM.

Table 3.1 Mine Water Storage Inventory and Capacity

Storage Name	Storage Capacity (ML)	Maximum Operating Level (MOL)	Function
Dam 1	118	47	Non-regulated, mine-affected water dam
Dam 2	172	104	Non-regulated, mine-affected water dam, mine water release
Dam 3	670	335	Regulated mine-affected water dam
Dam 5	855	515	Non-regulated, mine-affected water dam
Dam 8	677	610	Regulated mine-affected water dam
Dam 10	118	-	Regulated mine-affected water dam
Calypso Central	2,560	2,175	Inactive Pit, contingency storage
Titan North	6,000		Inactive Pit, contingency storage
Titan East	15,000		Inactive Pit, contingency storage

The following is of note:

- Dam 3 and Dam 8 are identified as regulated structures, subject to specific compliance and monitoring requirements as outlined in DESI (2025).
- Contingency Storage: The Calypso void, with a capacity exceeding 2,500 ML, provides emergency storage during high rainfall events.
- Dam 2 is maintained for MAW release purposes and is the only designated release point, with an outlet pipe facilitating controlled discharge.

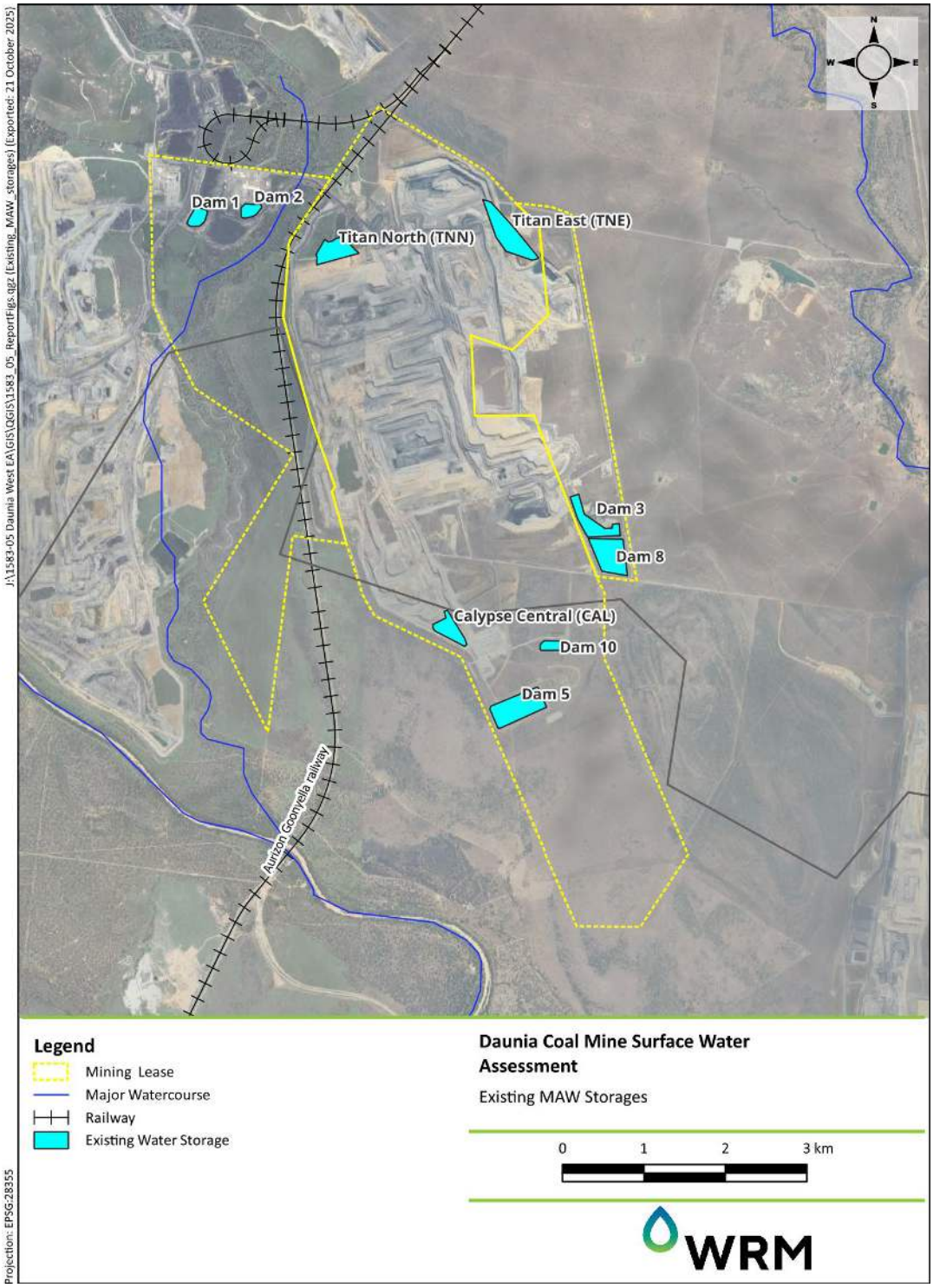

Figure 3.1 Existing MAW storages

3.3 FINAL LANDFORM FOR EXISTING OPERATIONS

Progressive Rehabilitation and Closure Plan (PRCP) final void water balance assessment (WRM, 2025) in Appendix C provides indicative final dimensions of the proposed final voids as presented in Table

3.2. Non-Use Management Areas (NUMAs) has been designated to residual voids that are not intended to support a post-mining land use. Figure 3.2 shows the final landform topography and NUMAs associated with final voids associated with the existing operations.

Table 3.2 Indicative dimensions of the proposed final voids, existing operations

Proposed Void	Indicative Maximum Width (m)	Indicative Maximum Length (m)	Indicative Maximum Depth (m)	NUMA (ha)
Titan North	1276	1048	76	112
Titan Central	165	395	18	64*
Titan East	330	1085	104	
Pandora	1550	1680	134	256

*Titan Central is combined with Titan East, as overflow from Titan Central void discharges into Titan East void

3.4 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 (WHC, 2025).

Definitions of the types of water generated within the Project are shown in Table 3.3.

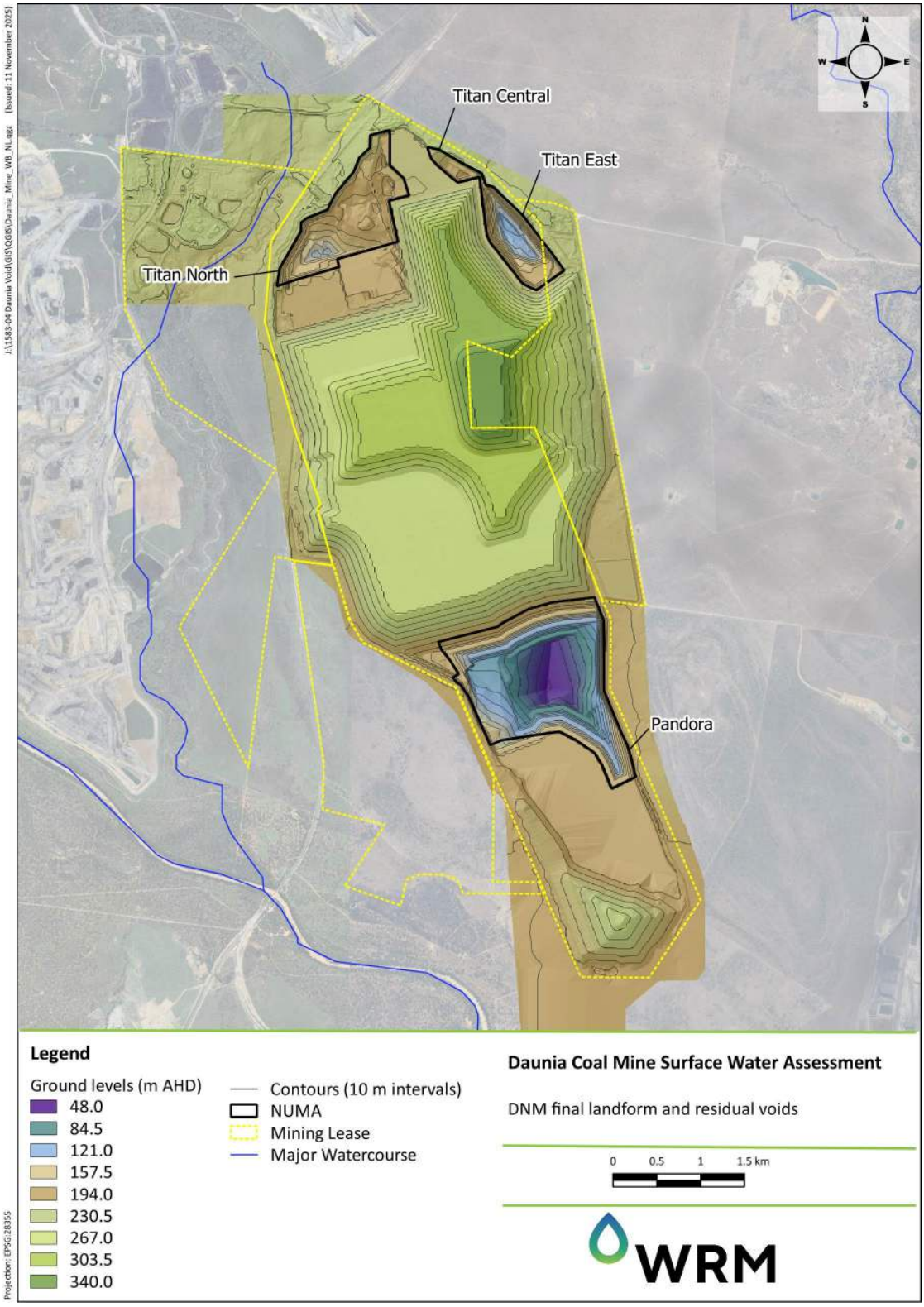

Figure 3.2 DNM final landform and residual voids

Table 3.3 Types of water generated on site

Water type	Definition
Mine-affected water (MAW)	In accordance with the DNMs EA definition for mine-affected water means the following types of water: pit water, tailings dam water, processing plant water 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 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 groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated groundwater from the mine dewatering activities a mix of mine-affected water (under any of paragraphs I to v) and other water.
Sediment water	Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. 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.
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.

3.5 SOURCES OF CONTAMINATION

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

- MAW: Potential contaminants include suspended solids, dissolved solids and metals. Mechanisms include releases from MAW storages.
- Sediment water: Potential contaminants include suspended solids (turbidity), dissolved solids (sodium, chloride, sulphate), metals, and pH variations. Mechanisms include erosion, overland flow, capillary rise of salts, sodic spoils (elevating pH) and sediment dam spills.
- Industrial area runoff: Potential contaminants include hydrocarbons, metals, detergents, and sediment from bunded areas, refuelling stations, and truck wash facilities.
- Sewage effluent: Potential contaminants include nutrients, biological pathogens, biochemical oxygen demand (BOD), altered pH, and chlorine. Mechanisms include ineffective sewage treatment or release from sewage ponds.

- Disturbed land: Potential contaminants include salinity, altered pH, and sediment. Mechanisms include erosion and leaching.
- External Water Supply (Raw Water): Potential contaminants include elevated salinity, iron, and manganese. Mechanisms include leaks or spills.
- Cleared areas and topsoil stockpiles: Potential contaminants include sediment and weed seeds. Mechanisms include erosion and overland flow.

3.6 STORED WATER QUALITY

Limited stored water quality data is available for the site. Table 3.4 shows stored water quality in the dams collected on 30 June 2024 and 30 June 2025. Little can be gleaned from the two results however it indicates that most storages show a decrease in EC values from 2024 to 2025, suggesting improved water quality or dilution effects. Annual reporting on site quality showed reduction in EC as follows:

- Dam 1: EC dropped from 5930 to 4390 µs/cm.
- Dam 3: EC improved from 5160 to 3050 µs/cm.
- Dam 5: EC improved from 3440 to 2550 µs/cm.
- Dam 8: EC improved from 4560 to 3380 µs/cm.
- Calypso Central: EC significantly improved from 5820 to 2510 µs/cm.
- Titan East (North & South) and Titan Central: No water quality data available.
- Dam 2 EC is closely monitored due to its role in the release (RP1) and management of mine water inventory particularly in preparation for the wet season. Salinity may vary significantly throughout the year due to dilution from rainfall runoff and may be altered through mine water transfers. Dam 2 receives water from the integrated mine water system (which includes Dam 1, the Eastern backbone pipeline, and the Western backbone pipeline).

Table 3.4 DNM storage water quality data

Storage Name	Type of Storage - Current Use	pH 30 June 2024	pH 30 June 2025	EC 30 June 2024 (µs/cm)	EC 30 June 2025 (µs/cm)
Dam 1	Mine Water Dam	8.98	8.50	5,930	4,390
Dam 2	Mine Water Dam	7.37	8.48	608	5,110
Dam 3	Mine Water Dam	9.61	8.76	5,160	3,050
Dam 5	Mine Water Dam	9.56	8.80	3,440	2,550
Dam 8	Mine Water Dam	9.41	9.07	4,560	3,380
Calypso Central	Inactive Pit	8.70	8.52	5,820	2,510

4 SURFACE WATER MANAGEMENT SYSTEM

4.1 OVERVIEW

The proposed Project presents only a minor change to the mining operations:

- The PW Sed Dam and associated drains are ESC measures proposed under the Project. It is designed to capture sediment-laden runoff from the OOPD catchment.
- No additional ESC measures are proposed beyond the PW Sed Dam for the Project site.
- The Project does not introduce new release discharge points or expand the MAW footprint. Instead, it formalises the PW MAW Dam that would have otherwise been constructed under operational requirements.

4.2 SURFACE WATER MANAGEMENT DOCUMENTATION

Surface water at DNM is managed in accordance with the following documents:

- DNM Mining Waste Management Plan (MWMP), (WHC, 2025a)
- DNM Water Management Plan (WMP) (WHC, 2025b)
- Erosion and Sediment Control Plan (ESCP) (WHC, 2025c)

Tailings and rejects management at DNM are managed under the DNM MWMP. It characterises the mining waste and outlines measures to minimise surface water impacts from mining waste through proper disposal, monitoring, and management practices. The potential surface water risks are also described.

The WMP identifies the water quality risk and impacts and describes the water management system developed to manage the risk primarily focusing on mine water management. The water monitoring plan proposed to assess the adequacy of the measures is also described.

The ESCP has been specifically developed to manage sediment water runoff. It describes the principals of ESC and sets out the operational requirements to managing runoff from disturbed areas based on the expected risks.

These documents will be updated to include the measures proposed for the project.

4.3 SURFACE WATER MANAGEMENT OBJECTIVES

The water management system at DNM, including the Project, is designed to support operational efficiency while protecting environmental values. The key objectives, as outlined in the WMP (WHC, 2025), are as follows:

- Prevent the release of contaminants into the receiving environment.
- Ensure water resource use does not negatively affect the local and regional environment.
- Separate clean and contaminated waters.
- Capture and treat runoff from disturbed areas in sediment dams for reuse in dust suppression or coal processing.
- Divert runoff from undisturbed areas away from disturbed areas using diversion drains and bunds.
- Establish and maintain a long-term sustainable water balance to minimise risks to the environment and operational activities.
- Maximise water reuse on-site to reduce reliance on external water supplies.
- Fulfil the requirements of the Environmental Authority EPML00561913, including monitoring and reporting obligations.
- Implement contingency procedures for emergencies.

- Transfer water between dams to optimise usage and reduce the risk of uncontrolled discharges.
- Use mine-affected water for operational purposes such as dust suppression and coal handling.

4.4 MINE WATER MANAGEMENT SYSTEM

4.4.1 Overview

Mine water infrastructure is designed to manage water generated from mining activities, including runoff from disturbed areas, groundwater inflows, and process water from coal handling operations. The MWMS includes regulated dams, and pipelines for water storage, transfer, and reuse.

Importantly, the Project does not introduce new release discharge points or expand the MAW footprint. Instead, it formalises infrastructure that would have otherwise been constructed under operational requirements.

4.4.2 Mine water management infrastructure

Figure 4.1 shows the existing and proposed water storages at DNM and summarised in Table 4.1.

- Mining in Pandora Pit is scheduled to commence in 2026.
- Dam 3 and Dam 8 will be continuously dewatered and operated empty between 2025 and 2028, due to mining activities adjacent to these storages. Both dams will be decommissioned in 2028 to allow for the Pandora Pit expansion.
- Dam 5 will be decommissioned in 2031, also due to Pandora Pit expansion.
- Dam 10 is planned for decommissioning in 2041.

Inactive in-pit areas will be used for excess mine water storage over the life of mine (LoM) as follows:

- Calypso Central: available between 2025 and 2026.
- Titan North: available between 2027 and 2044.
- Titan East: available between 2030 and 2044.

The following is of note:

- Dam 2 remains the only designated release point, with an outlet pipe facilitating controlled discharge.
- The Project will continue to operate under the current WMS and requires construction of the PW Sed Dam for capturing sediment-laden runoff from the OOPD.
- The construction of the PW MAW Dam is necessitated by the Pandora Pit expansion intersecting with Dam 5 and is required regardless of the OOPD proposal as part of the Project. The PW MAW Dam will intercept MAW from catchment currently draining to Dam 5. Dam 5 is scheduled for decommissioning in 2031 due to the expansion of Pandora Pit.

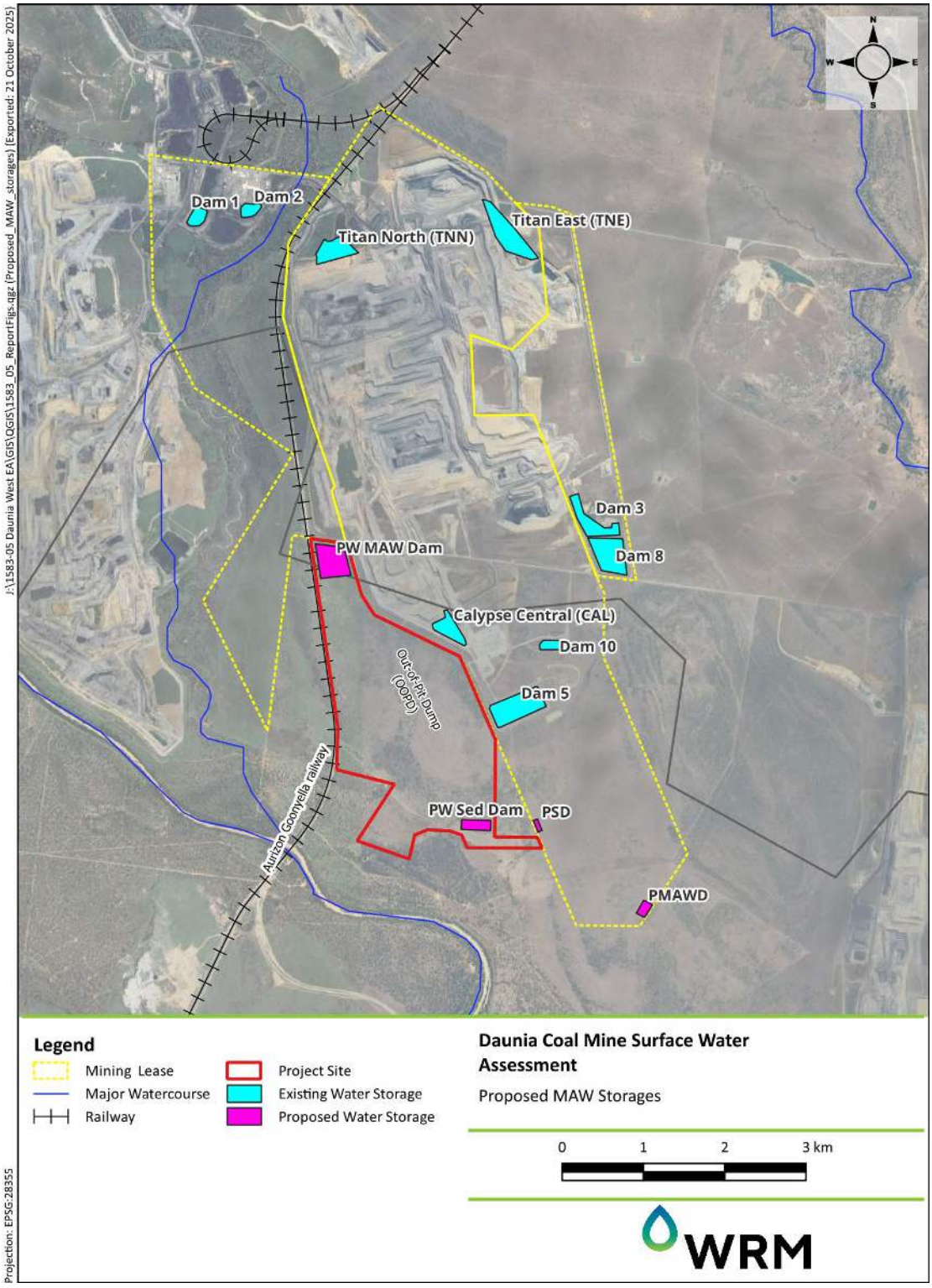

Figure 4.1 Proposed MAW storages

Table 4.1 Mine water management system configuration

Storage Name	Storage Capacity (ML)	Maximum Operating Level (MOL)	Online for storage	Offline for storage
Dam 1	118	47	Current	2042
Dam 2	172	104	Current	2042
Dam 3	670	335	Current	2028
Dam 5	855	515	Current	2031
Dam 8	677	610	Current	2028
Dam 10	118	-	Current	2031
Calypso Central	2,560	2175	Current	2027
Titan North (TNN)	6,000	-	2027	2042
Titan East (TNE)	15,000	-	2030	2042
P Sed Dam[a]	38	-	2026	2042
P MAW Dam[a]	138	100	2027	2042
PW Sed Dam[b]	144	100	2028	2042
PW MAW Dam[b]	513	100	2028	2042

a P Sed Dam and P MAW Dam storages are planned as part of the existing operations at Daunia, not as part of the DWIP.

b The DWIP introduces storages, PW Sed Dam and PW MAW Dam, which are proposed to replace of Dam 10 and Dam 5, respectively. These storages are part of the reconfiguration of the water management system to accommodate the mine plan and the expansion of operations.

4.4.3 Controlled release

Controlled releases are permitted from Dam 2 (RP1) to New Chum Creek, which receives water from the integrated water system (including Dam 1, the Eastern backbone pipeline, and the Western backbone pipeline).

Controlled releases are permitted under the current EA when specific conditions are met:

- All on-site storage capacity has been exhausted, including contingency storage such as the Calypso void.
- No further opportunities for on-site reuse (e.g., dust suppression, CHPP operations) are currently available.
- Releases are conducted following the EA, including compliance with water quality criteria and discharge protocols and summarised as follows:
  - The flow in the Isaac River (at MP3) is ≥3 m^3/s
  - The electrical conductivity in the release dam <5,000 µS/cm
  - Release dam pH Limit: Minimum 6.5, Maximum 9.0
  - Sulphate (SO_4^{2-}) in the release dam <1,000 mg/L
  - Monitoring: Grab samples at the commencement of release and weekly thereafter during the release period, when safe to do so and access permits
  - The mixed downstream Isaac River electrical conductivity (at MP4) is <864 µS/cm.
  - Real-time telemetry for EC and pH is used, with grab samples taken at the commencement of release and weekly thereafter when safe and accessible. If telemetry is unavailable, daily grab samples are required, with the first sample taken as soon as practicable

No changes are proposed to the controlled release conditions as part of the Project.

4.5 TAILINGS AND REJECT RUNOFF MANAGEMENT

Tailings and rejects management at DNM are managed under the DNM Mining Waste Management Plan (MWMP), which outlines measures to minimise surface water impacts from mining waste through proper disposal, monitoring, and management practices. Mining waste will not be placed within the Project. As such the following measures represent the approved MWMP for the existing operation.

As per the EA, runoff and seepage from spoil piles and reject disposal areas must be contained within authorised spoil disposal locations, and leachate/runoff controlled within the MWMS, which collects mine-affected water for reuse (DNM, 2024).

Reject disposal methods involve isolating coarse reject material and fine reject material or tailings produced by the coal processing plant. Tailings consist of a mixture of fine particles of coal and clay minerals, suspended in water. Coarse reject material is transported from the preparation plant to the disposal site using trucks and is used to fill the mining pits from which the coal was extracted. These areas are later capped with topsoil and revegetated as part of the mine rehabilitation process.

4.6 CONTAMINATED WATER MANAGEMENT

4.6.1 Chemical storage

Primary chemical storage areas at DNM are located on the mine infrastructure area at the workshop and the CHPP workshop area. These storage facilities have been constructed and bunded generally in accordance with the relevant specifications of AS1940 – *Storage and Handling of Flammable and Combustible Liquids (AS1940).* Hazardous substances operating procedures are in place at these operations.

4.6.2 Fuel storage

Fuel storage areas are a potential source of hydrocarbons. Primary fuel storage areas at the mine infrastructure area have been constructed and bunded in accordance with the relevant specifications of AS1940 – *Storage and Handling of Flammable and Combustible Liquids (AS1940*). Fuel storage areas have also been constructed at service and operational points across the mining lease.

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

4.6.3 Sewage

DNM has one installed sewerage treatment plant that collects effluent from the main administration building, workshop, project offices and CHPP. Treated effluent from the sewage treatment plant is pumped into Dam 2. Water quality of this effluent will be monitored as per Schedule H: Sewage Treatment of DNM EA.

4.7 SEDIMENT WATER MANAGEMENT

4.7.1 Objectives

The site implements an Erosion and Sediment Control Plan (ESCP) in compliance with EA condition F33 (EPML00561913). The ESCP objectives are to:

- Minimise and mitigate erosion and sedimentation resulting from operations as well as erosion impacts associated with clearing of vegetation near drainage lines.
- Prevent the degradation of water quality resulting from erosion and sedimentation.

- Separate runoff from disturbed and undisturbed areas where practicable.
- Divert water from disturbed catchments into mine water storages or sediment dams constructed to contain runoff.
- Divert clean water from entering areas of planned and existing disturbance.
- Rehabilitate disturbed areas to allow vegetation regrowth.
- Provide information necessary to implement effective erosion control measures.

Surface runoff from the Project Area will be managed under the ESCP. The plan outlines the infrastructure, operational controls, and monitoring systems required to manage dirty water, runoff from disturbed areas that may contain elevated sediment loads or contaminants.

4.7.2 Operational principals

On-site stormwater runoff from the overburden dumps is managed in accordance with the ESCP. The ESCP adopts the three cornerstones of erosion and sediment control:

- Drainage control: prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.
- Erosion control: prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control: trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

The Project will require a combination of the three control measures to effectively manage sediment and erosion at the site.

4.7.3 Design and planning considerations

Erosion and sediment control measures are integrated into the planning stages of all ground-disturbing activities through the Permit to Disturb (PTD) process. This ensures that:

- ESC measures are in place before construction or clearing begins.
- Water from each catchment is assessed to determine whether it should be managed as stormwater or MAW (MAW).
- Catchment areas can be adjusted through design to reduce annualised stored water volumes.
- Design standards for sediment control structures are based on site-specific factors such as soil type, slope, and rainfall intensity. Catchment rehabilitation is the preferred long-term solution, while intermediate and temporary controls such as sediment basins and rock check dams are used during operation.

4.7.4 Erosion and sediment control framework

Catchments within the Project area are defined in accordance with Table 3.3 under the ESCP (Whitehaven, 2022).

Sediment water is assessed to determine whether it may be managed as stormwater or must be classified and managed as MAW. The assessment process includes:

- Identification of the contributing catchment and disturbance status,
- Confirmation of whether runoff has been in contact with disturbed and unrehabilitated mining areas,
- Assessment of whether runoff has mixed with other MAW sources, and
- Consultation with the Environment Department to confirm water classification.

Where sediment water meets the definition of sediment water and has not mixed with other MAW sources, it may be managed as stormwater through erosion and sediment control (ESC) structures installed in accordance with the ESCP. Where sediment water meets the EA definition of MAW, it is managed in accordance with the site Water Management Plan and EA conditions.

Sediment water is considered MAW where monitoring indicates the presence of contaminants derived from mining activities at concentrations that exceed ambient background conditions, or that may pose an environmental risk if released without appropriate controls.

The ESCP applies a risk-based framework that aligns with the principles of the Best Practice Erosion and Sediment Control Guidelines (IECA, 2008).

Under this framework, each site catchment is assessed and assigned a risk category based on factors including slope, soil type, level of disturbance, and hydrological connectivity. Catchment risk categories and assessment criteria are summarised in Table 4.2, and the corresponding sediment control design standards are presented in Table 4.3.

Table 4.2 Catchment risk assessment criteria

Risk Rating	Soil/spoil category	Disturbed Catchment area (ha)	Duration of disturbance	Average catchment slope
Very Low	Competent material	Less than 0.5 ha	Less than 3 months	Less than 1%
Low		0.5 to 1 ha	3 to 6 months	1% to 3%
Medium	Non-dispersive topsoil	1 to 4 ha	6 months to 2 years	3% to 10%
High	Dispersive topsoil	Greater than 4 ha	Greater than 2 years	Greater than 10%
	Non-dispersive spoil			
Very High	Dispersive spoil	Any	Any	Any
MAW	MAW catchment	Any	Any	Any

Adapted from: Whitehaven (2022)

Table 4.3 Adopted Sediment control design standard

Risk Rating	Water balance modelling spill frequency (AEP)
Very Low	No controls
Low	Supplementary sediment controls
Medium	20%
High	10%
Very High	5%
MAW	1%

Adapted from: Whitehaven (2022)

4.7.5 Catchment risk classification

Catchments classified as Very Low or Low risk are managed using temporary erosion and sediment control measures during early disturbance phases, such as construction or exploration. These measures remain in place until permanent stabilisation, including vegetation establishment or soil treatment, has been achieved. Temporary controls typically include sediment fencing, excavated sediment traps, and rock check dams.

Catchments classified as medium risk or higher are managed using dedicated sediment retention infrastructure designed to capture runoff with elevated suspended solids. The Project includes two sediment ponds and two MAW ponds to manage runoff from disturbed areas.

The locations, catchment assignments, and function of these structures are summarised in Table 4.4 and shown in Figure 4.2.

The proposed mining activities associated with the Project would not increase the area draining southeast toward the Isaac River during the mining phase compared to existing site conditions.

ESC and MAW storage structures are designed to intercept and manage runoff from disturbed areas before discharge or reuse within the site water management system. Sediment dams are sized in accordance with their contributing catchment risk classification and are designed to promote sediment capture. MAW ponds are designed to store and manage MAW generated from operational areas.

All storage structures are integrated with the WMS to ensure that runoff and MAW are retained on site unless released in accordance with EA conditions.

Table 4.4 Proposed ESC structure locations and catchment risk

Structures	Easting (AGD84)	Northing (AGD84)	Catchment Risk Classification
PW Sediment Dam	633,863	7,553,762	High
P Sediment Dam	634,589	7,553,809	High
P MAW Dam	635,977	7,552,762	MAW
PW MAW Dam	632,097	7,556,874	MAW

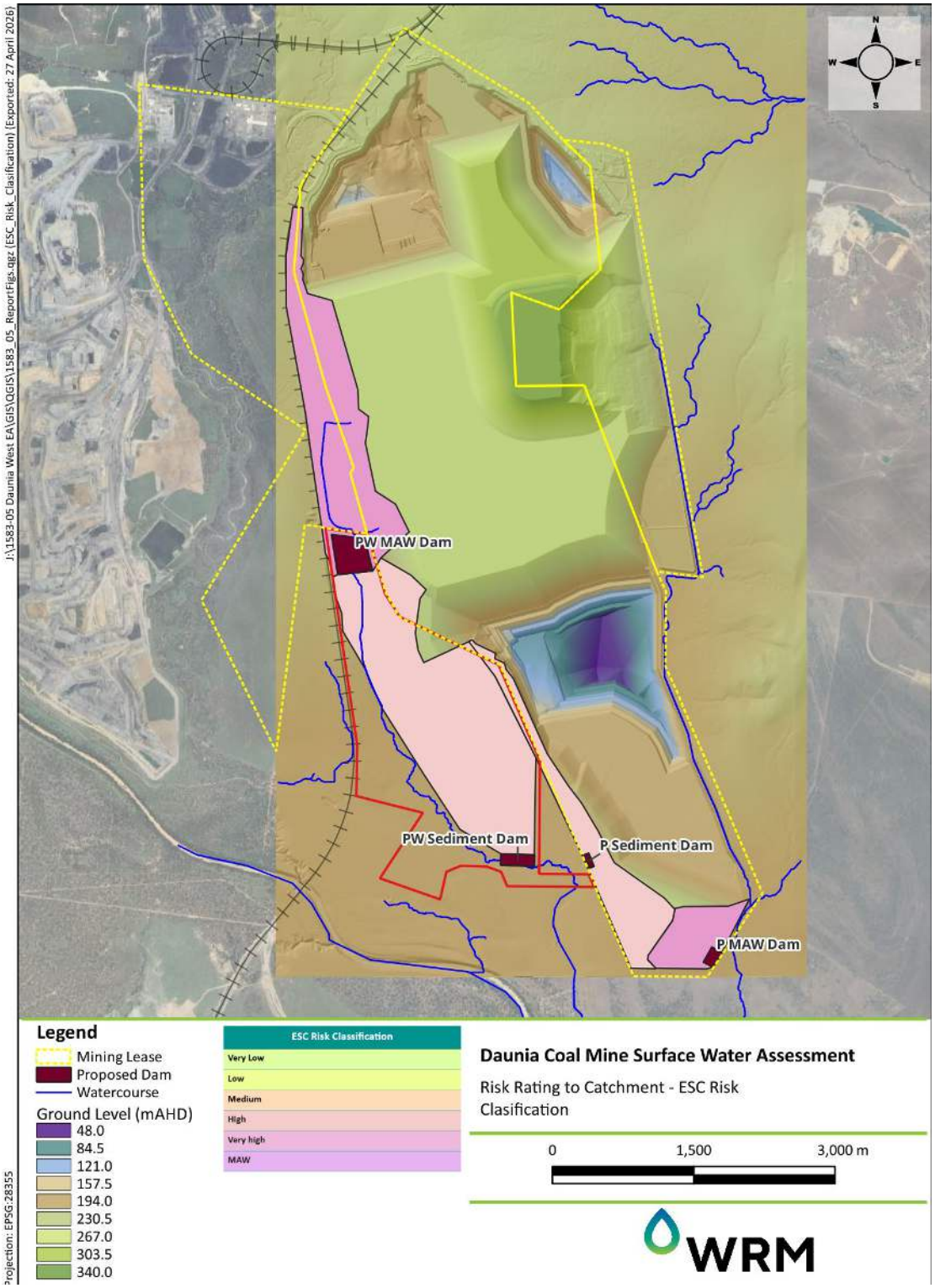

Figure 4.2 Proposed dam catchment ESC risk classification

4.7.6 Sediment dam monitoring

Sediment dam monitoring is undertaken in accordance with the DNM WMP. Monitoring includes sampling and analysis of water quality parameters to confirm water classification and demonstrate compliance with applicable water quality objectives.

Monitoring results, including any water release events, are recorded and reported. Sediment dam monitoring and inspection requirements are implemented in accordance with the ESCP are as follows:

- Water quality sampling undertaken in accordance with the site procedures
- Sediment dams and associated erosion and sediment control structures must be inspected prior to the wet season,, with additional inspections undertaken as required based on site conditions and rainfall events.

5 SITE WATER BALANCE ASSESSMENT

5.1 OVERVIEW

A computer-based operational simulation model (GoldSim) was developed to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the Project.

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 5.1.

Table 5.1 Simulated inflows and outflows to the water management system

Inflows	Outflows
Direct rainfall on the water surface of storages	Evaporation from the water surface of storages
Catchment runoff	Net CHPP losses
External water supply (Burdekin Pipeline)	Haul road suppression losses
Groundwater inflows to mine void	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 given in Appendix B.

5.2 SITE WATER INVENTORY TRIGGER ACTION RESPONSE PLAN (TARP)

The site-wide water security and containment risks at Daunia are managed using a Trigger Action Response Plan (TARP). The TARP has been developed in conjunction with Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide Daunia TARP is summarised in Table 5.2.

Table 5.2 Daunia site-wide water management TARP

Trigger	Action / Response
Red Dry Site inventory < 615 ML	Maximise take from Burdekin pipeline. Maximise all in-pit dewatering into surface storage dams. Implement Red Dry measures (dust suppressants).
Yellow Dry Site inventory > 615 ML and < 905 ML	Maximise take from Burdekin pipeline Consolidate water in Dams 2 and 8. Prepare to implement Red Dry measures (dust suppressants).
Green Dry Site inventory > 905 ML and < 2,100 ML	Target operating level = 1,100 ML. Consolidate water in Dams 2, 5 and 8. Maintain dams below MOV. Begin take of Burdekin pipeline water when site inventory exceeds 1,100 ML.

Trigger	Action / Response
Yellow Wet Site inventory > 2,100 ML and < 4,662 ML	Reduce or cease intake of Burdekin pipeline. Begin undertaking controlled releases. Spread water across site to enhance evaporation (following rain event). Review availability to buy or borrow pumps/pipelines.
Red Wet Site inventory > 4,662 ML	Consider utilising evaporation fans to reduce stocks onsite. Reduce or cease intake of Burdekin pipeline. Continue undertaking controlled releases. Transfer water to low priority active pits. Engage process to acquire additional pumps/pipelines.

The Red Wet TARP changes as the availability of dams and pit storages to store MAW changes over time, as follows:

- From January 2027, Red Wet TARP increases to 4,800 ML as P MAWD becomes available.
- From January 2028, Red Wet TARP increases to 7,625 ML as TNN becomes available.
- From January 2030, Red Wet TARP increases to 22,625 ML as TNE becomes available.
- From January 2031, Red Wet TARP decreases to 21,942 ML with the removal of Dam 5.

5.3 WATER BALANCE MODELLING RESULTS

5.3.1 Overview

An assessment of the Daunia water management system has been undertaken by HydroBalance (2025) and provided in Appendix B. This section summarises the overall water balance for both the approved EA and the Project.

Given this minimal difference in the overall water balance or total site water inventory, the results are presented for the Project, specifically focussing on the PW Sed Dam for sediment capture from the OOPD.

5.3.2 Interpretation of results

In interpreting the results of the water balance assessment, it should be noted that the results provide a statistical analysis of the water management system's performance (HydroBalance, 2025).

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

Whether a percentile trace corresponds to wet or dry conditions depends upon the parameter being considered. For site water storage, where the risk is that available storage capacity will be exceeded, the lower percentiles correspond to wet conditions. For example, there is only a small chance that the 1 percentile storage volume will be exceeded, which would correspond to very wet climatic conditions.

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

5.3.3 Water management system inventory

Figure 5.1 shows the forecast total WMS inventory, which includes all water storages onsite and compared to the WMS inventory TARP levels, which are given in Table 5.2.

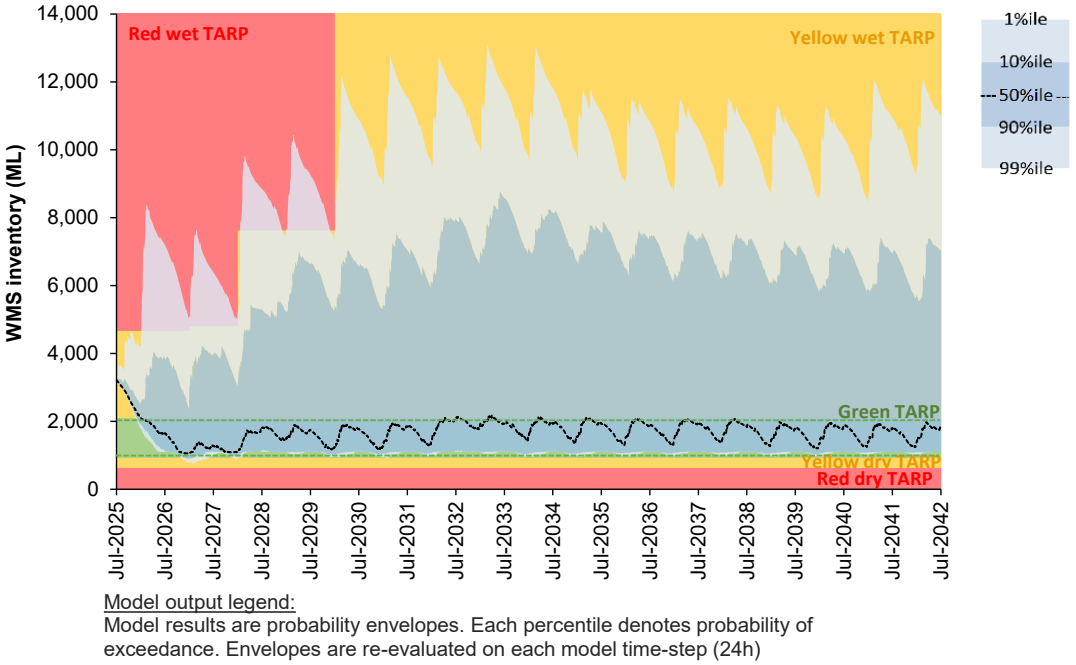

Figure 5.1 Forecast WMS inventory (source: HydroBalance, 2025)

The following is of note regarding the water balance results:

- During very wet (1%ile) climatic conditions, the total WMS may accumulate enough water to exceed the Red Wet TARP up until 2029. From 2030, the available storage capacity increases significantly, and the 1%ile WMS inventory is well below the Red TARP volume.
- During wet (10%ile) climatic conditions, the total WMS may accumulate enough water to exceed the Yellow TARP over the whole LoM but remains below the Red TARP volume.
- During median (50%ile) climatic conditions, the total WMS inventory stays relatively level around 1,000 to 2,000 ML (within the Green TARP volume band).
- During dry (90%ile) and very dry (99%ile) climatic conditions, the total WMS inventory may reduce to below the Yellow Dry TARP volume from time to time but is mostly kept above this volume due to supply from the Burdekin pipeline raw water imports.
- The active pit inventory typically stays below 2,500 ML under very wet (1%ile) climatic conditions, until the final 3 years of the Project, where it may reach approximately 5,500 ML. The active pit inventories generally draw down after the peak of each wet season.

5.3.4 Controlled releases

There are no proposed changes to the current release conditions as outlined in Schedule F of DNM's EA (EPML00716913, dated 29 June 2023).

Controlled releases would be undertaken when the total site inventory exceeds the Yellow Wet TARP (2,100 ML). The total site inventory generally only exceeds the Yellow Wet TARP during conditions wetter than the 50%ile climatic conditions.

The forecast annual controlled release volumes are shown in Figure 5.3. The following is of note regarding the controlled releases:

- Controlled releases are expected to be required in wet (10%ile) and very wet (1%ile) climatic conditions, as well as median (50%) climatic conditions in some years.
- During extreme wet climatic conditions (1%ile), up to 1,690 ML may be released site-wide in the 2029 financial year.

On this basis, the modelling demonstrates that the water management system can be operated in accordance with its EA conditions, which are designed to mitigate any impacts of the Project on downstream water quality and the environmental values of the downstream waterway.

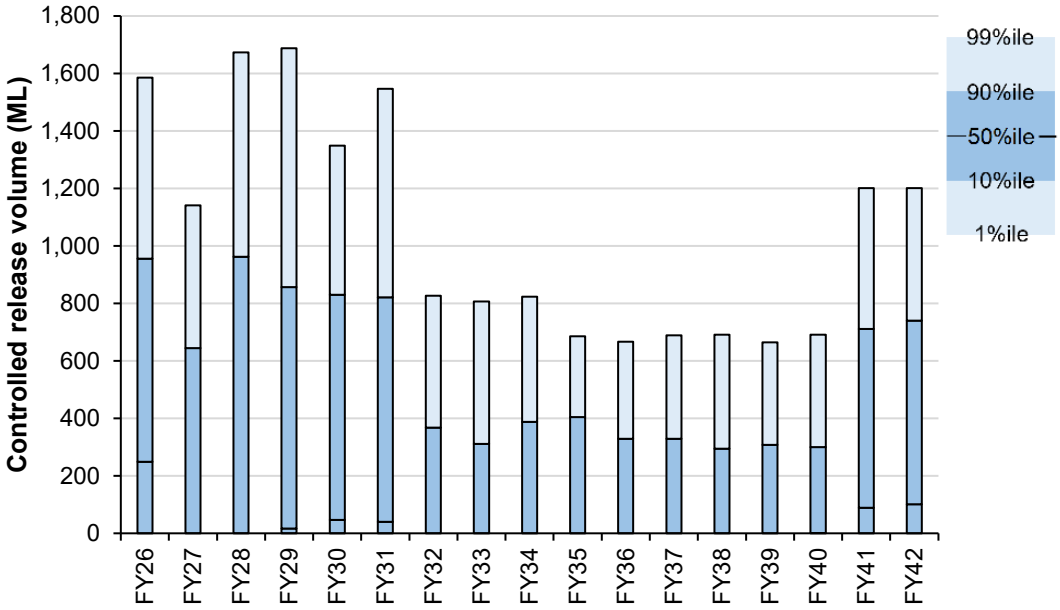

Figure 5.2 Forecast controlled release volumes for the Project (source: HydroBalance, 2025)

5.3.5 Uncontrolled discharges

HydroBalance (2025) found that both the Project and the current EA have a similar risk of uncontrolled discharge from the mine water dams. The P Sediment Dam and P MAW Dam are planned as part of the existing operations at DNM.

The DWIP introduces replacement storages, PW Sed Dam and PW MAW Dam, for Dam 10 and Dam 5, respectively. Dam 10 and Dam 5 are scheduled for decommissioning in 2028 to allow for the Pandora expansion. HydroBalance (2025) identifies the following storages with modelled uncontrolled overflows under specific climatic conditions:

- Dam 3 (MAW dam): Overflows are only expected during very wet (1% AEP) years. Predicted annual overflow volumes: 80 ML to 160 ML.
- P MAW Dam: No predicted overflows.
- P Sed Dam:
  - Overflows are only expected during wet (10% AEP) and very wet (1% AEP) climatic conditions.
  - During wet (10% AEP) years, predicted annual overflow volumes range from 15 ML to 80 ML.
  - During very wet (1% AEP) years, predicted annual overflow volumes increase to 100 ML to 285 ML.
- PW MAW Dam:

- Overflows are restricted to extreme rainfall events corresponding to very wet (1% AEP) years only.
- During these conditions, predicted annual overflow volumes range from 30 ML to 215 ML.

- PW Sed Dam:
  - Overflows are only expected during wet (10% AEP) and very wet (1% AEP) climatic conditions.
  - During wet (10% AEP) years, predicted annual overflow volumes range from 200 ML to 280 ML.

During very wet (1% AEP) years, predicted annual overflow volumes range from 750 ML to 900 ML.

5.4 WATER MANAGEMENT SYSTEM PERFORMANCE

The Project will continue to operate under the existing WMS, with the addition of the new Dams. The proposed system aligns with the current EA water management framework and does not materially change the overall risk profile for uncontrolled discharges of MAW.

The performance of the mine water management system has been assessed using the operational site water balance model. The assessment demonstrates that the WMS provides sufficient capacity and operational flexibility to meet production demands while minimising the risk of uncontrolled releases. Key outcomes of the modelling include:

- Mine-affected water (MAW) stored on site is prioritised for operational reuse, including coal processing and dust suppression;
- Existing in-pit and out-of-pit storages provide adequate capacity to:
  - Prevent uncontrolled spillway discharges to downstream receiving waters under most climatic conditions; and
  - Support effective pit dewatering throughout mining operations.

The likelihood of controlled overflows from sediment and MAW dams has been assessed in terms of annual exceedance probability (AEP), expressed as the probability of a given climatic condition occurring in any year. Likelihood definitions adopted for this assessment are summarised in Table 5.3.

Table 5.3 Likelihood definitions adopted for this assessment

Equivalent Percentile (Non-exceedance)	Chance per Year	Adopted Design AEP
50th percentile	1 in 2	50%
90th percentile	1 in 10	10%
95th percentile	1 in 20	5%
99th percentile	1 in 100	1%

Consistent with regional rainfall variability, modelling indicates that uncontrolled MAW discharges are only possible during very wet years, with an overall spill probability of less than 1% annual exceedance probability (AEP). HydroBalance (2025) concluded that the Project presents a comparable risk of uncontrolled water spills to the currently approved EA.

The proposed sediment and MAW dams have been assessed with the site water balance model (Section 5) against their respective catchment risk classifications and the adopted design AEPs summarised in Table 8.5. The assessment confirms that each structure performs adequately for its assigned catchment risk and design standard, with:

- High ESC risk sediment dams designed to the 10% AEP; and
- MAW dams designed to the 1% AEP.

Table 5.4 Predicted Annual Overflow Volumes of proposed sediment and MAW dams by AEP

Dam	10% AEP (ML/a)	1% AEP (ML/a)	Assessment Outcome
Pandora Sediment Dam (P Sed Dam)	15 – 80	100 – 285	Classified as High ESC risk and sized to contain up to the 10% AEP standard in accordance with the adopted sediment control design criteria.
Pandora West Sediment Dam (PW Sed Dam)	200 – 280	750 – 900	
Pandora MAW Dam (P MAW Dam)	Not expected	Not expected	No quantified overflow volumes reported for assessed climatic conditions.
Pandora West MAW Dam (PW MAW Dam)	Not expected	30 – 215	Classified as MAW and sized to contain up to the 1% AEP standard. Overflows are unlikely and design capacity is consistent with the adopted 1% AEP design capacity for MAW storages.

6 FINAL VOID WATER BALANCE ASSESSMENT

6.1 OVERVIEW

The DNM final landform water balance model (the model), developed using GoldSim software (version 15.0), created by the GoldSim Technology Group LLC (www.goldsim.com), is a probabilistic simulation and modelling software package. GoldSim has been extensively used to develop graphically oriented models with developed network logic, including void water balances.

The model operates at a daily time step, predicting the water level and the salinity of the water in the void. The probability of these outcomes is driven by probabilistically generated rainfall and evaporation to assess the potential impact on the water and salt balance.

GoldSim can model the complexity associated with a dynamic system featuring multiple feedback mechanisms to understand how the system may evolve, considering seasonal variations in climate (rainfall and evaporation).

The final void water balance model setup for the approved EA is detailed in Appendix C. The model simulates water balance dynamics over a 500-year simulation period, with inflows such as rainfall, surface runoff, and groundwater, as well as outflows due to evaporation and seepage. The model accounts for void-specific characteristics, including catchment areas, land use types, and salinity adjustments. For further details on the model setup, including assumptions and methodologies, refer to Appendix C.

6.2 FINAL LANDFORM TOPOGRAPHY

The topographic data used for the assessment included:

- LiDAR data from 2012 and 2019, supplemented by updated LiDAR data captured in January 2025.
- Proposed final landform topographic data (Rev3.1), which incorporates Project infrastructure changes (see Figure 6.1).
- Appendix C provides stage-area-volume relationships for all voids, which are derived from the final landform topography. These relationships remain consistent between the approved EA and the Project.

6.3 CATCHMENT AREAS AND LAND USE MAPPING

The catchment area delineation is based on the proposed final void landform topographic DEM (Rev3.1) provided by Whitehaven. Contours were created, using the final landform DEM, to determine the drainage network in the catchment area of each void. QGIS software was used to subdivide the catchment area of each void based on the final landform DEM contours. The catchment areas were categorised based on the land use type, void or rehabilitated. The sub-catchment area delineation is shown in Figure 6.1 and summarised in Table 6.1.

Appendix C provides an analysis of catchment areas for the approved EA. The total Pandora catchment area is 715.4 ha, while the Project Pandora catchment is 827.4 ha, which is a total increase of 112.0 ha.

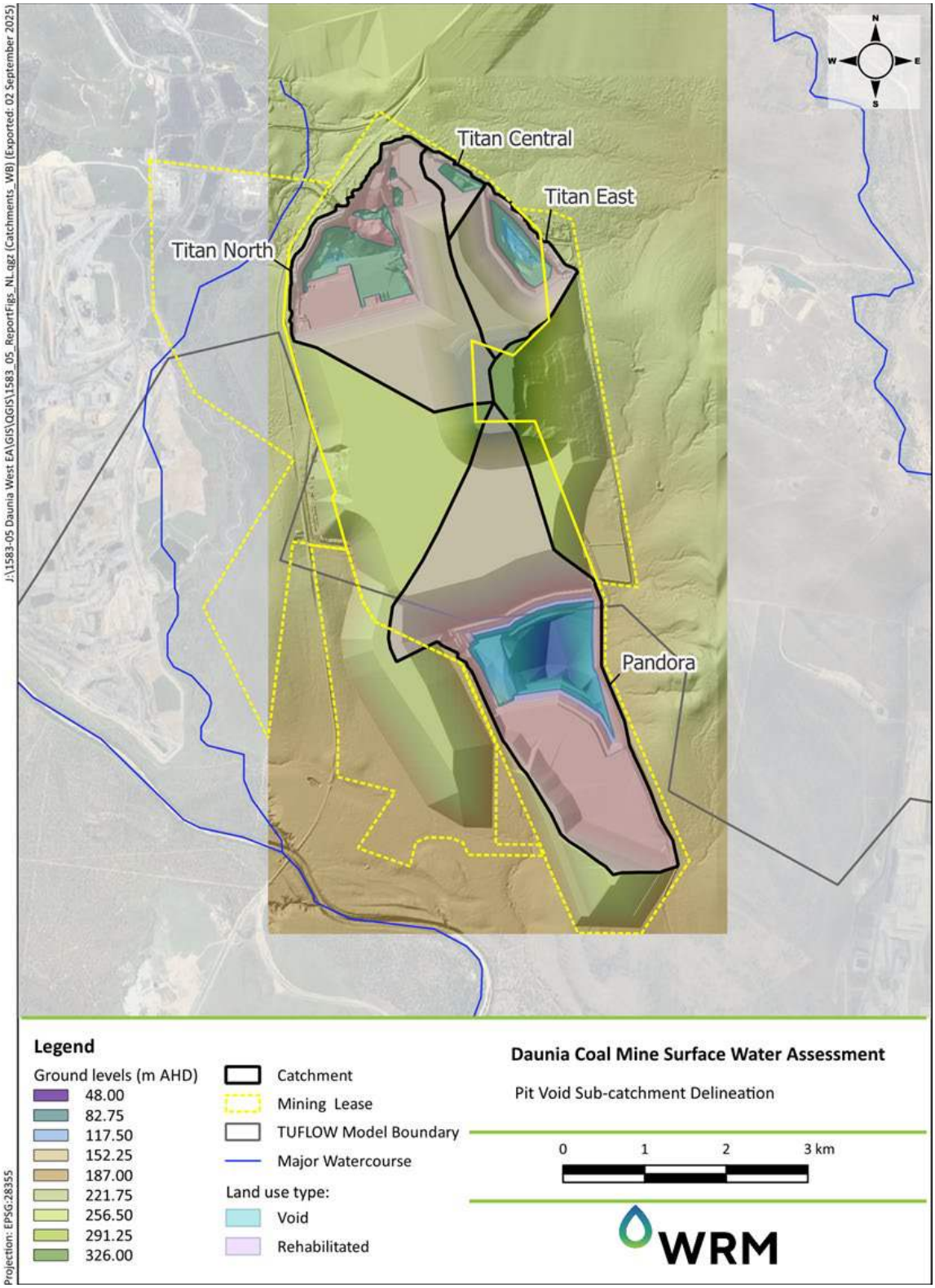

Figure 6.1 Project final landform and pit void sub-catchment delineation

Table 6.1 Pit void catchment and land use areas (ha)

Catchment Type	Titan North	Titan Central	Titan East	Pandora
Natural (ha)	0	0	0	0
Void (ha)	81.3	8.4	35.0	145.4
Rehabilitated (ha)	432.3	29.9	150.1	682.0
Total (ha)	513.6	38.3	185.1	827.4

6.4 CLIMATE CHANGE

Climate change adjusted rainfall, evaporation and temperature sequences were sourced for the DNM from the Government SILO Consistent Climate Scenarios (CCS) project, which transformed historical climate data from the period of 1960 to 2023. The climatic sequences produced by the Q5 v.3 Quantile Matching method were selected. These climatic sequences were processed in the Stochastic Climate Library to produce 250 iterations (realisations) of daily data over 500 years.

The model applies climate change projection SSP2-4.5 as the base scenario, with sensitivity analyses for SSP1-2.6 and SSP5-8.5.

For a detailed climate change adjustment description, refer to Appendix C.

6.5 FINAL VOID WATER BALANCE MODELLING RESULTS

6.5.1 Final void average inflows/outflows

Results show that the void water levels will eventually reach an approximate equilibrium, acting as an evaporative sink, with all dissolved salts concentrating over time. The base climate change projection (SSP2-4.5) was run for 250 realisations and 500 years, from 2045 to 2545.

Table 6.2 gives the average void runoff, groundwater inflow and evaporation for the first 50 years of simulation (before equilibrium). Table 6.3 gives the flows in the last 450 years (at equilibrium). Most of the volume change occurs in the first 50 years and remains relatively consistent thereafter.

DNM final landform voids capture seepage originating from groundwater recharge into spoil emplacements surrounding open voids. Stored water within the northern voids (Titan North, Titan Central, and Titan East) typically seeps into the surrounding spoil material, which ultimately seeps toward the lower-lying Pandora void. Pandora void acts as a groundwater sink, collecting this seepage and losing water through evaporation.

Groundwater modelling confirms that lake levels within these voids will remain well below shallow aquifers, with sufficient freeboard to prevent external discharge. The regional groundwater levels in the vicinity of the DNM show a general northwest to southeast decline in elevation, with local drawdown in the immediate vicinity of active mine pit voids. Regional groundwater flow is predominantly towards the southeast, consistent with the direction of the Isaac River.

Table 6.2 **Average void inflow and outflow for years 2045 to 2095 and 250 realisations**

Void	Avg. Surface Water Runoff (ML/d)	Avg. GW Inflow (ML/d)	Avg. Seepage Inflow (ML/d)	Avg. Total Inflow (ML/d)	Avg. Evaporation (ML/d)	Avg. GW Outflow (ML/d)	Avg. Seepage Outflow (ML/d)	Avg. Total Outflow (ML/d)	Avg. Change in Water Volume (ML/d)
Titan North	1.11	0.00	0.00	1.11	0.12	0.00	0.99	1.11	0.00
Titan Central	0.08	0.00	0.00	0.08	0.01	0.00	0.07	0.08	0.00
Titan East	0.42	0.18	0.00	0.60	0.17	0.00	0.42	0.59	0.01
Pandora	2.59	0.91	1.41	4.91	4.05	0.00	0.00	4.05	0.87
Spoil	-	-	1.48	1.48	-	-	1.41	1.41	0.07
Total	4.20	1.09	2.89	8.18	4.34	0.00	2.89	7.23	0.95

Table 6.3 **Average void inflow and outflow results for year 2095 to 2545 and 250 realisations**

Void	Avg. Surface Water Runoff (ML/d)	Avg. GW Inflow (ML/d)	Avg. Seepage Inflow (ML/d)	Avg. Total Inflow (ML/d)	Avg. Evaporation (ML/d)	Avg. GW Outflow (ML/d)	Avg. Seepage Outflow (ML/d)	Avg. Total Outflow (ML/d)	Avg. Change in Water Volume (ML/d)
Titan North	1.12	0.00	0.00	1.12	0.14	0.00	0.98	1.12	0.00
Titan Central	0.08	0.00	0.00	0.08	0.01	0.00	0.07	0.08	0.00
Titan East	0.43	0.22	0.00	0.65	0.21	0.00	0.41	0.63	0.02
Pandora	2.87	1.04	1.46	5.37	5.25	0.00	0.00	5.25	0.12
Spoil	-	-	1.47	1.47	-	-	1.46	1.46	0.01
Total	4.50	1.26	2.93	8.69	5.61	0.00	2.93	8.54	0.15

6.5.2 Titan North water level

Figure 6.2 displays the yearly void lake levels of Titan North. The graph shows that the median water level of Titan North generally remained constant, ranging from approximately 138.8 mAHD in 2045 to 139.4 mAHD in 2545. The maximum water level per the 95%ile is around 146.6 mAHD, and the minimum 5%ile water level is around 136.2 mAHD. The FSL of Titan North is 210 mAHD.

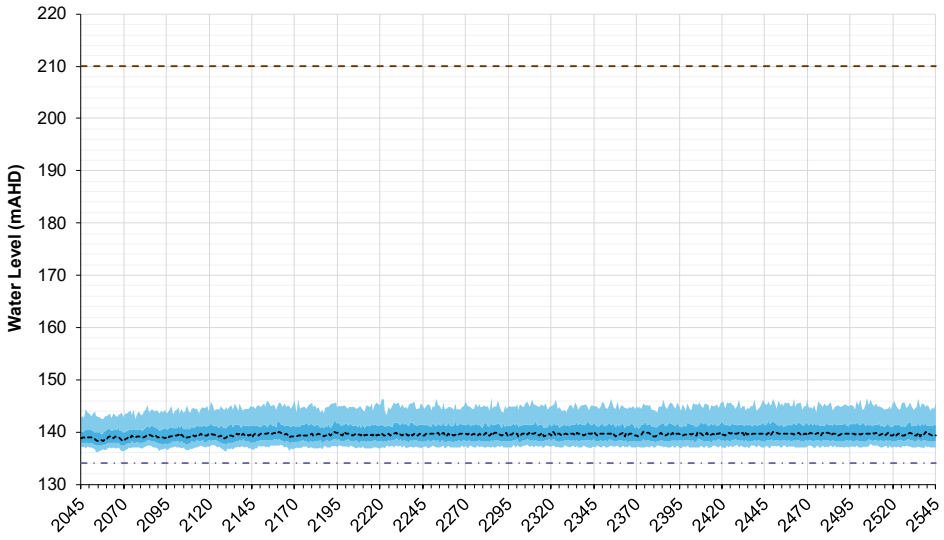

Figure 6.2 Titan North void water level

6.5.3 Titan Central water level

Figure 6.3 displays the yearly void lake levels of Titan Central. The graph shows that the median water level of Titan Central remains at a constant level of approximately 192.2 mAHD from 2045 to 2545. The maximum water level, per the 95%ile, is around 194.1 mAHD, and the minimum 5%ile water level is around 191.2 mAHD. The FSL of Titan Central is 210.0 mAHD.

6.5.4 Titan East water level

Figure 6.4 displays the yearly void lake levels of Titan East. The graph shows that the median water level of Titan East slightly increases from approximately 118.8 mAHD in 2045 to approximately 121.1 mAHD in 2545. The maximum water level, as per the 95%ile, is around 126.3 mAHD, and the minimum 5%ile water level is around 116.2 mAHD. The FSL of Titan East is 220.0 mAHD.

6.5.5 Pandora water level

Figure 6.5 shows the yearly void lake levels of Pandora. The median water level of Pandora increases from approximately 70.6 mAHD in 2045 to 94.8 mAHD in 2545. The maximum water level as per the 95%ile is around 104.6 mAHD, and the minimum 5%ile water level is around 69.9 mAHD. The FSL of Pandora is at 190.0 mAHD.

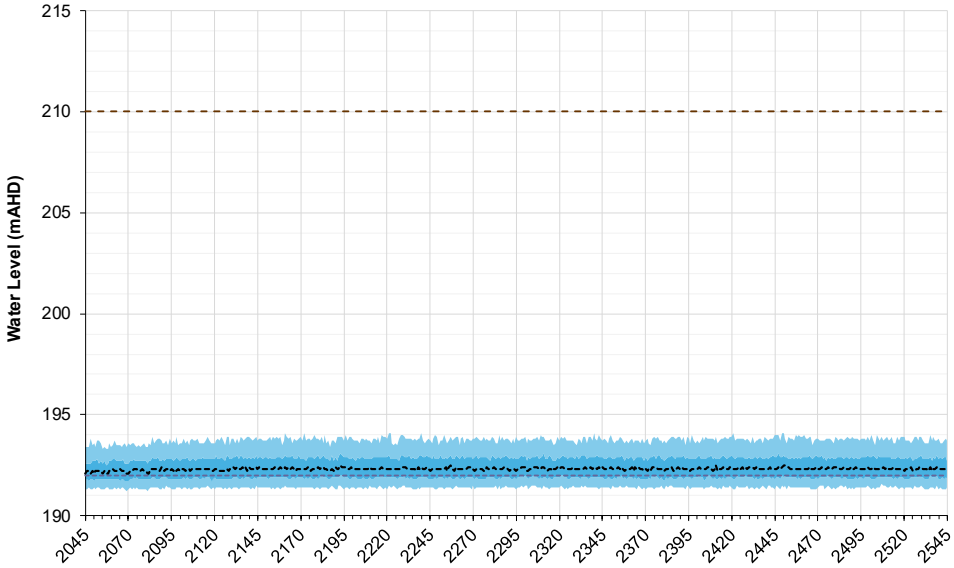

Figure 6.3 Titan Central void water level

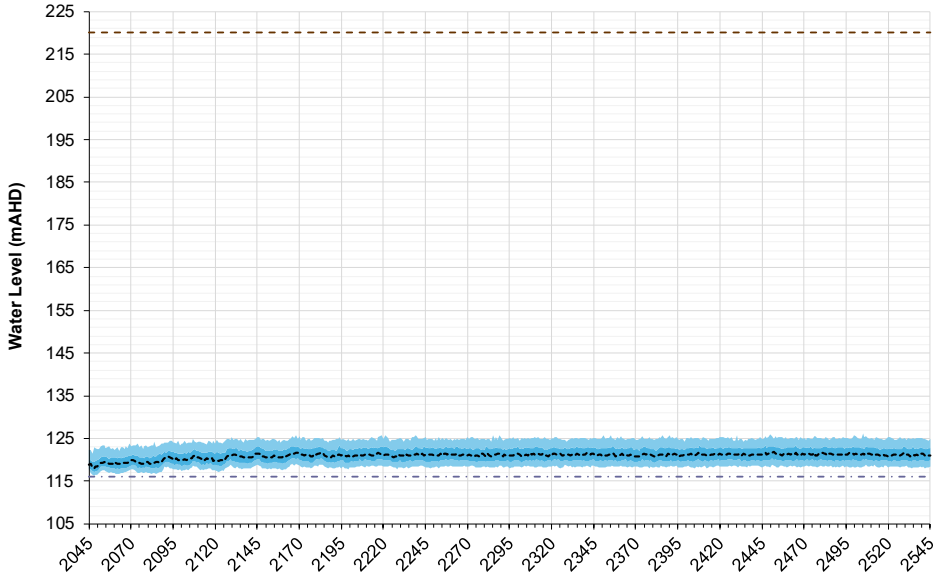

Figure 6.4 Titan East void water level

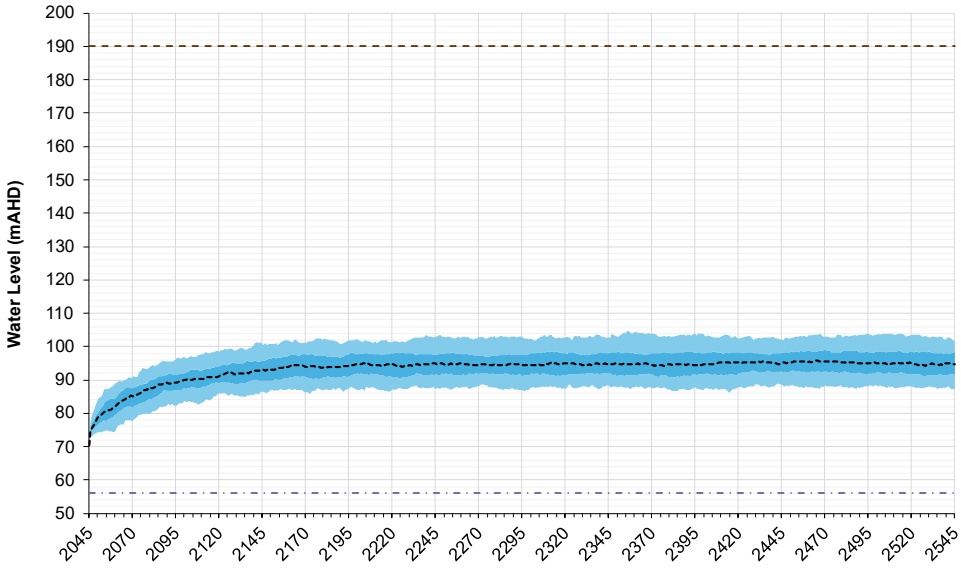

Figure 6.5 Pandora void water level

6.5.6 Void water level comparison

Figure 6.6 shows the mean void water levels for the approved EA and the Project.

- The mean void water levels of Titan North, Titan Central and Titan East show minimal variation between the approved EA and the Project.
- By 2545, the Pandora void reaches a mean water level of approximately 94.8 mAHD for the Project, compared to 92.0 mAHD for the approved EA.
- The mean water level of the Pandora void for the Project is about 2.8 m higher than that of the approved EA, primarily due to the larger catchment area associated with the OOPD (an increase of 112 ha compared to the approved EA).

6.6 SALINITY

Given the relatively low salinity levels and flow-through behaviour, the northern voids may be suitable for agricultural activities, including stock watering.

Figure 6.7 and Figure 6.8 shows the mean salinity concentrations of each void from 2045 to 2545 for the northern voids (Titan North, Titan Central Titan East voids) and the Pandora void, respectively.

The following classifications are used to describe salinity levels:

- Freshwater: < 0.5 g/L — typical of rivers, lakes, and groundwater.
- Brackish Water: 0.5–10 g/L — found in estuaries and transitional zones.
- Moderately Hypersaline: 10–100 g/L — e.g., coastal evaporation ponds.
- Highly Hypersaline: >100 g/L — e.g., Dead Sea, Great Salt Lake.
- Extreme Hypersaline: >300 g/L — where salt may precipitate from solution.

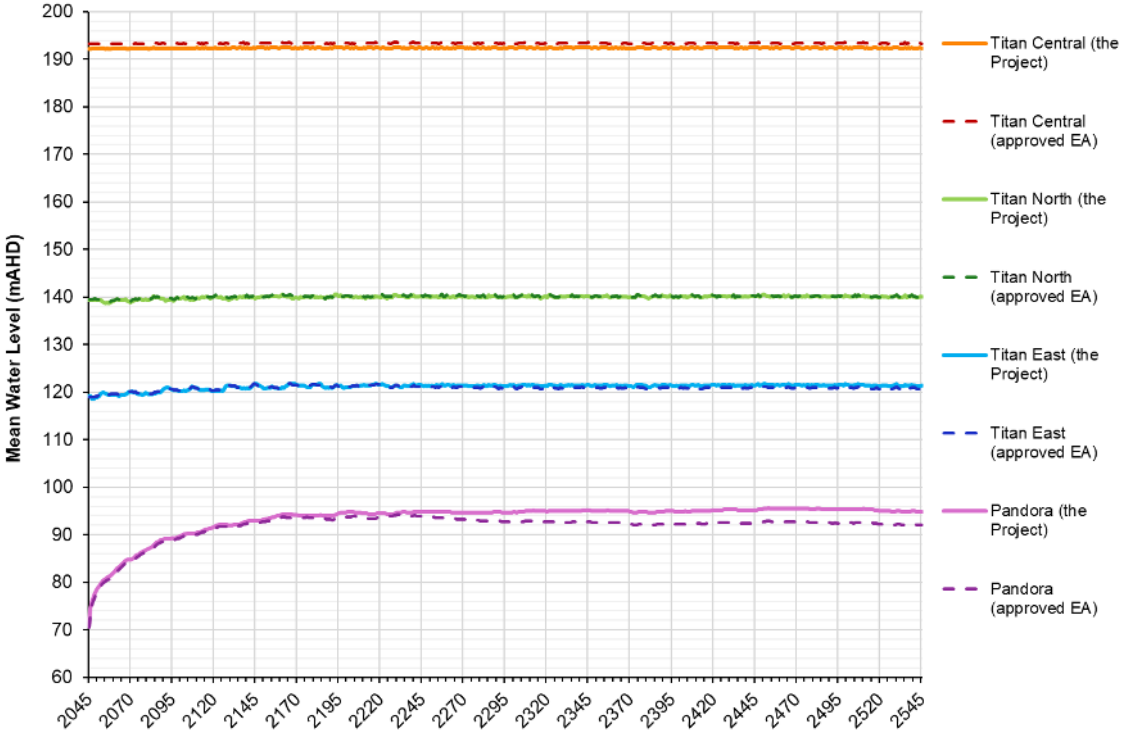

Figure 6.6 Void water levels for the DNM and the Project

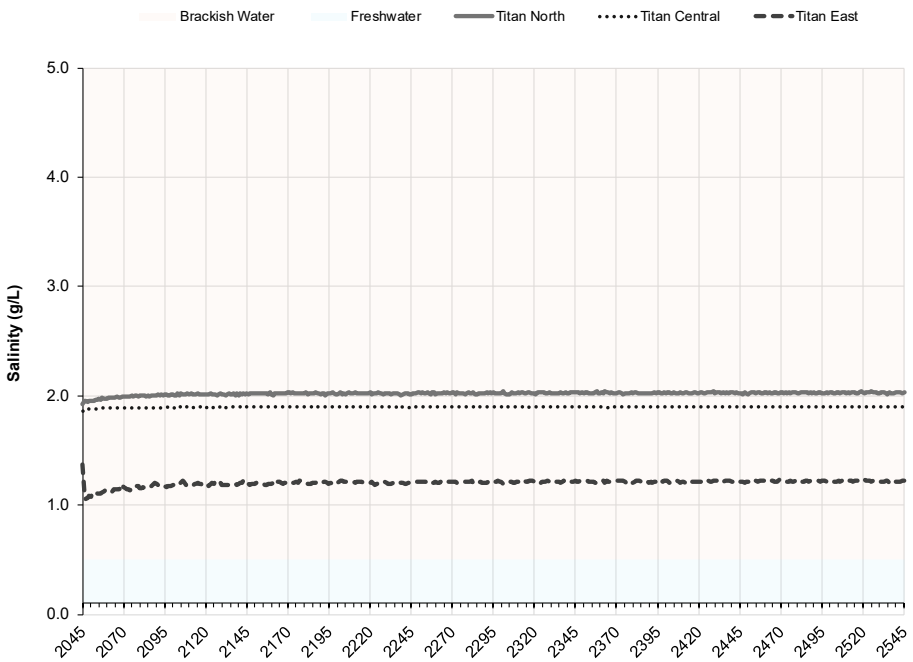

Figure 6.7 Void water salinity concentrations for Titan North, Titan Central and Titan East voids

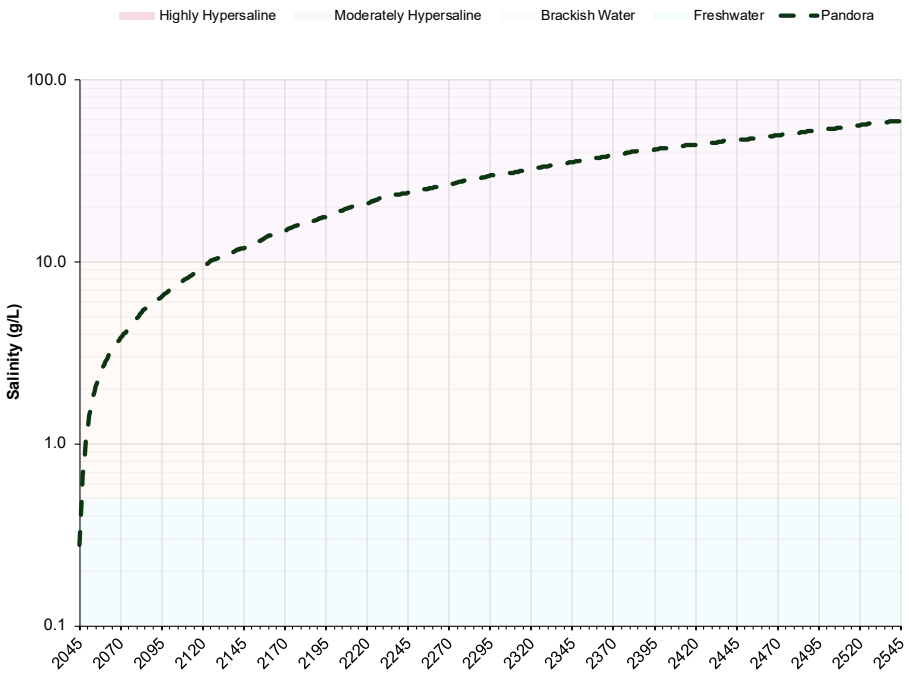

Figure 6.8 Void water salinity concentration for Pandora void

By 2545, the mean solute concentrations of Titan North, Titan East, and Titan Central are projected to remain below the threshold for hypersaline conditions (greater than 10 g/L). The northern voids (Titan North, Titan Central, and Titan East) exhibit flow-through characteristics, with seepage migrating to the Pandora pit, driven by hydraulic gradients. As a result, salinity concentrations within these voids are generally consistent with the assumed concentrations of surface runoff. These salinity concentrations align with the water quality objective for stock watering (ANZECC, 2000) and may be suitable for agricultural activities.

By 2545, the Project estimate for Pandora void's mean salinity concentration is about 58 g/L, classifying it as moderately hypersaline. This is slightly lower than the approved EA estimate of 59 g/L. This reduction in the estimated salinity is attributed to a slightly larger catchment area, which contributes additional runoff and dilution as compared to the approved EA.

7 FLOOD IMPACT ASSESSMENT

7.1 OVERVIEW

WRM previously prepared a flood study to support the Progressive Rehabilitation Closure Plan (PRCP) for DNM's approved EA (WRM, 2025b). The flood study included hydrological modelling to estimate design discharges along the Isaac River and its tributaries and hydraulic modelling to estimate design flood levels for existing and proposed PRCP final landform conditions. A copy of the PRCP final void flood report is provided Appendix D, which provides details of the model development and calibration.

The approved EA flood models (hydrologic and hydraulic) were updated to include the proposed OOPD for the Project configuration, to evaluate the effects of the Project on flood behaviour compared to the approved EA. An overview of the model development and configuration, as well as key changes to the models for the Project, are described in the following sections.

7.2 HYDROLOGIC MODELLING

7.2.1 Methodology

The URBS rainfall-runoff routing software package (Carroll, 2024) was used for hydrologic modelling to estimate design discharges for the Isaac River and its tributaries.

The URBS model was calibrated to historical Isaac River flood events in 2008, 2010 and 2017. An acceptable calibration was achieved across the three historical flood events, with the modelled and recorded peak discharges at the Deverill gauge agreeing within about 5%, and good agreement in both timing and magnitude of peak flow. Details of the model configuration, including available data, sub-catchment details, calibration results and adopted model parameters are provided in the flood report (Appendix D).

The approved EA final void flood report (Appendix D) provided design discharges for the 1 in 1,000 (0.01%) Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events under existing and post-mining (approved EA) conditions using the ensemble approach described in the current Australian Rainfall and Runoff guidelines (ARR2019, version 4.2) (Ball et al., 2019). The approved EA URBS model was updated for the Project assessment to include design events from 50% AEP to 1% AEP, in addition to the 0.01% AEP and PMF events.

7.2.2 Climate change considerations

The current ARR2019 (version 4.2) guidelines contain updated guidance on how to consider the effects of climate change on design hydrology. The guidance is based on the latest Intergovernmental Panel on Climate Change (IPCC) temperature projections for a number of Shared Socioeconomic Pathways (SSPs). SSPs have been defined for warming scenarios based on low (SSP1), medium (SSP2), high (SSP3) and very high (SSP5) emissions pathways. The guidance also states that global average temperatures have risen by a little over 1 degree Celsius since the existing design rainfalls were derived by BOM (2016). For this assessment, the following climate change scenarios were adopted to derive design discharges:

- Existing conditions (present day) hydrology:
- SSP5-8.5;
- Year 2030 time horizon;
- +1.3 degrees of warming;
- Post-mining (approved EA and the Project) conditions hydrology:
  - SSP2-4.5;
  - Year 2100 time horizon;

- +2.5 degrees of warming.

Details of the climate change factors adopted, including design rainfall, losses and uplift factors adopted, are discussed in approved EA flood report (Appendix D).

7.2.3 Design discharges

Table 7.1 shows estimated URBS model peak discharges for historical climate conditions using BOM (2016) design rainfalls (with no climate change factors), as well as existing and post mining hydrologic conditions (accounting for +1.3 degrees and +2.5 degrees of warming respectively).

Design discharges were derived using the ensemble approach where 10 temporal patterns are modelled for each storm duration with the adopted design discharge derived from the temporal pattern that produces a peak discharge that is just above the mean.

Model results show that:

- Peak discharges are about +13% to +20% higher for existing conditions (+1.3 degrees of warming) compared to the FFA validation baseline; and
- Predicted peak discharges are predicted to increase a further +13% to +17% for post-mining conditions (+2.5 degrees warming) compared to existing conditions (+1.3 degrees of warming).

Table 7.1 Design discharge estimates and climate factors for the Isaac River at Deverill

	Historical climate (m^3/s) (no climate change factors)	Existing conditions (m^3/s) (+1.3 degrees warming)	Post mining (approved EA) conditions (m^3/s) (+2.5 degrees warming)
50% AEP	745	973	1,180
20% AEP	1,334	1,655	1,963
10%	1,867	2,245	2,639
5% AEP	2,418	2,869	3,366
1%	4,573	5,359	6,168
0.1% AEP	8,773	9,938	11,136
PMF	29,214	32,685	36,132

A summary of adopted design storm critical duration and temporal patterns is presented in Table 7.2, for both existing (present day) and post-mining conditions. A summary of adopted design storm critical duration and temporal patterns is presented in Table 7.2, for both existing (present day) and post-mining conditions.

Table 7.2 Adopted critical duration design storms

	Existing conditions		Post-mining conditions	
Event	Critical duration (hr)	Critical temporal pattern	Critical duration (hr)	Critical temporal pattern
50% AEP	12	TP1	12	TP4
20% AEP	12	TP1	12	TP8
10% AEP	12	TP3	12	TP3
5% AEP	24	TP9	48	TP3
1% AEP	48	TP3	48	TP3
1 in 1,000 AEP	24	TP5	24	TP5
PMF	24	TP5	24	TP5

7.3 HYDRAULIC MODELLING

7.3.1 Methodology

The TUFLOW hydrodynamic modelling package (BMT, 2025) was used to simulate flood behaviour for the Isaac River and its floodplain in the vicinity of DNM. The flood modelling used the 2025.0.0 version of TUFLOW to take advantage of the latest advancements in modelling capabilities. Details of the development and calibration of the hydraulic model are given in Appendix D.

Models were developed for:

- **Existing conditions** - present-day conditions based on 2025 LiDAR data providing ground levels across DNM and adjacent mine sites, modified to include approved levees for Poitrel, Winchester, Olive Downs and Moorvale mine sites.
- **Approved EA conditions** - post-mining conditions, based on the approved DNM final landform, as well as approved final landforms for adjacent mine sites (Winchester and Moorvale) or approved levees (Olive Downs and Poitrel).
- **Proposed conditions** – Project proposed post-mining conditions based on the proposed project final landform, as well as the approved conditions final landforms or levees at adjacent mine sites.
    - The flood model was run for design events from 50% AEP to 1% AEP, in addition to the 0.1% AEP and PMF events.

7.3.2 TUFLOW model configurations

Figure 7.1 to Figure 7.3 show the existing conditions, approved EA conditions and proposed Project conditions TUFLOW model configurations respectively.

The existing conditions and approved EA conditions model configurations were adopted unchanged from the approved EA flood model report (Appendix D). Details of the TUFLOW model configuration, including calibration results, adopted topographic data, Manning's 'n' mapping and inflow and outflow boundary configurations are presented in the approved EA flood model report in Appendix D.

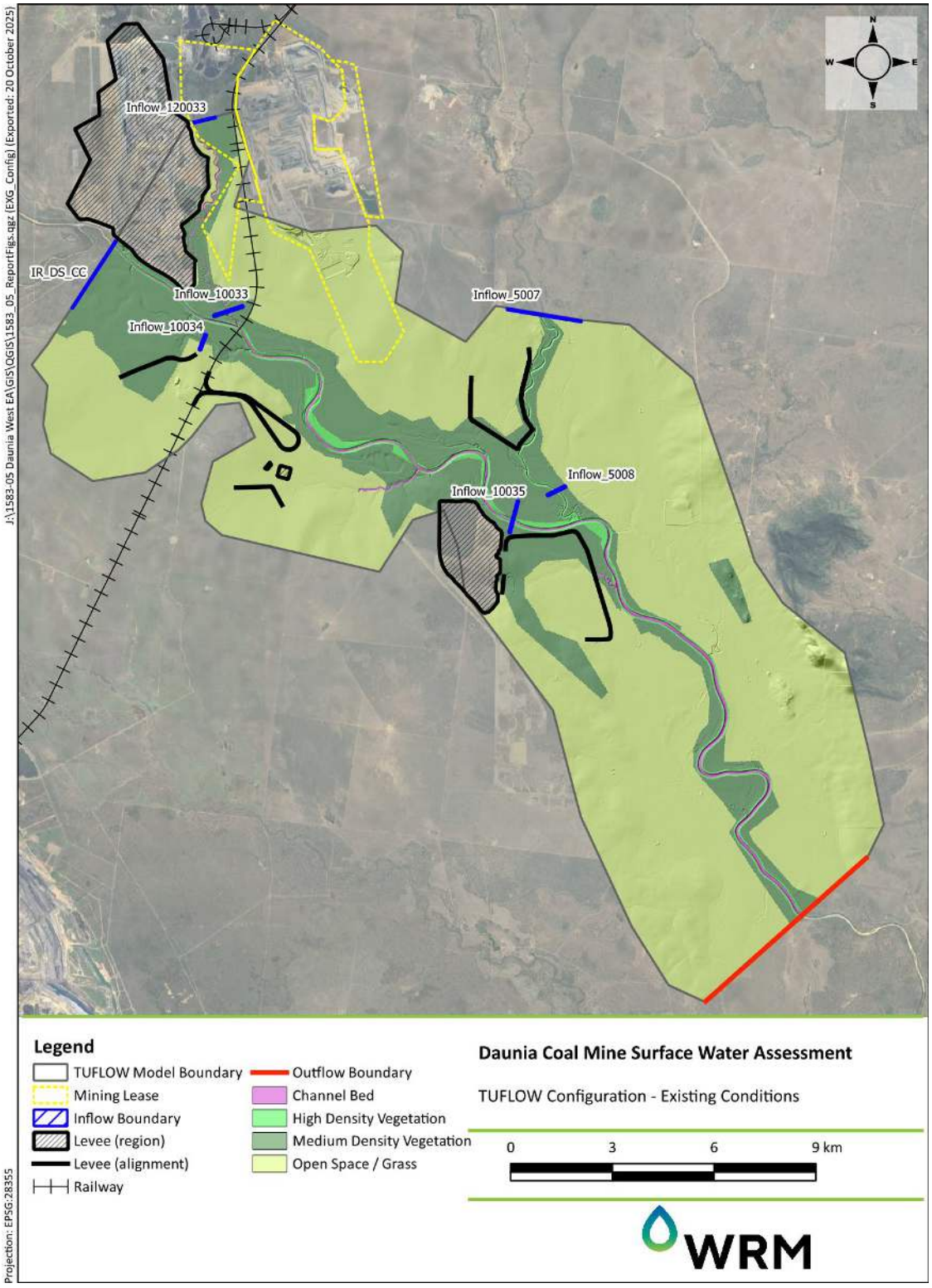

Figure 7.1 Isaac River TUFLOW model configuration – existing conditions

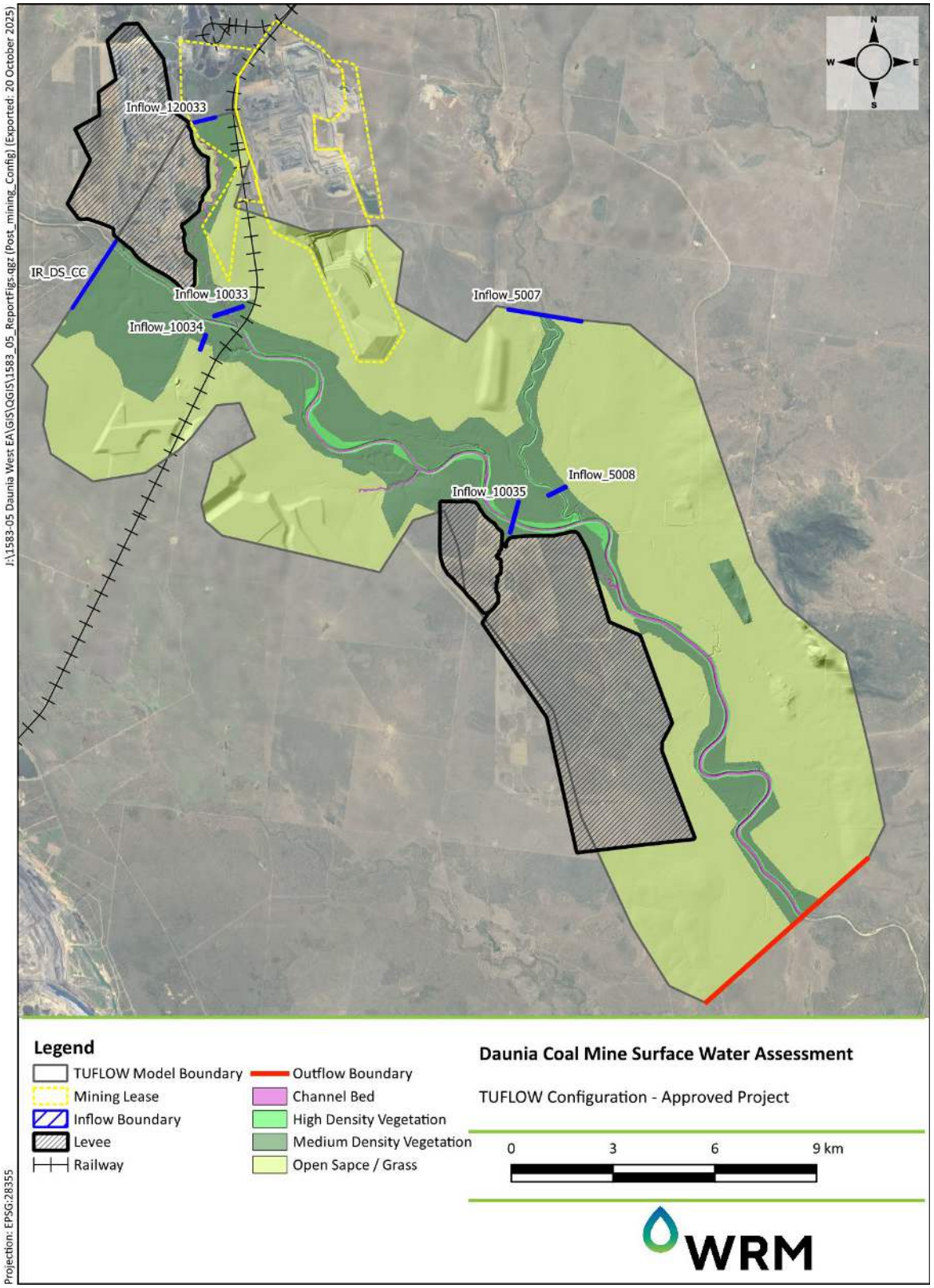

Figure 7.2 Isaac River TUFLOW model configuration – approved EA conditions

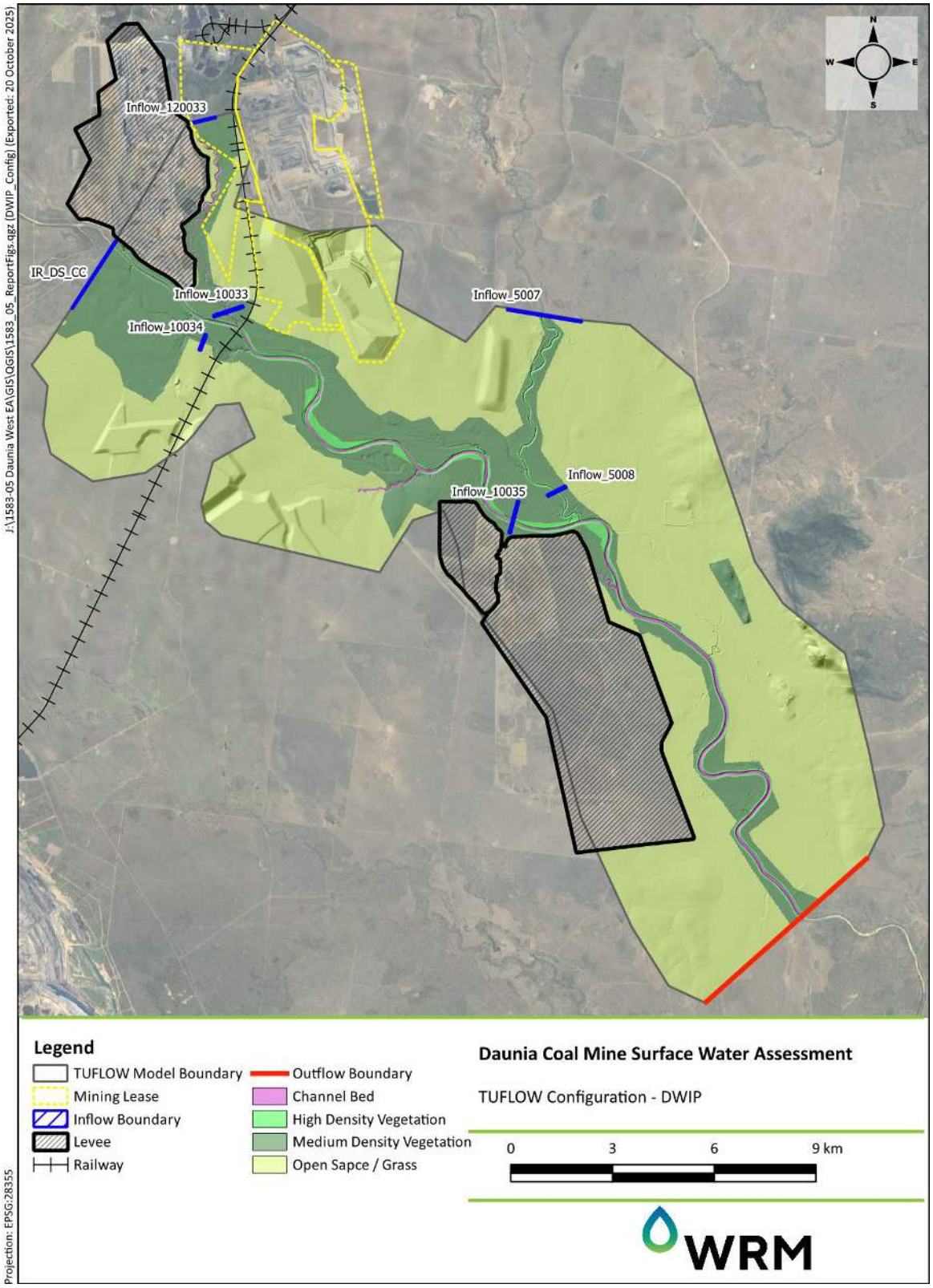

Figure 7.3 Isaac River TUFLOW model configuration – Proposed Project conditions

For the approved EA conditions scenario, the existing conditions model was modified to include the approved EA conditions final (post mining) landform, along with approved levees and final landforms for adjacent mine sites taken from the following studies:

- Olive Downs and Poitrel obtained from Olive Downs Stage 2 Expansion, (WRM, 2025c).
- Moorvale levees and final landform are taken from Moorvale South Mine Progressive Rehabilitation and Closure Plan, (WRM, 2024)
- Winchester levees and final landform obtained from Winchester South Project, (WRM, 2022)

For the Project conditions scenario, the approved EA conditions model was modified to replace the approved EA final landform with the Project final (post mining) landform based on the final landform design surface provided by DNM (*20250630 DNMW LF3.1.1 1x1m grid*).

7.4 FLOOD IMPACT ASSESSMENT

The TUFLOW model was used to simulate design events from 50% AEP to the PMF, for existing, approved and proposed conditions scenarios. Hydraulic modelling was undertaken for the critical duration design storm hydrographs selected from the URBS model at Deverill (refer Table 7.2).

The full set of predicted peak flood extents, depths, and velocities for events from 50% AEP to 1% AEP, as well as 0.1% AEP and PMF events are presented in Appendix E.

7.4.1 Existing conditions flood depths, levels and velocities

Figure 7.4 and Figure 7.5 show the predicted peak flood extents, depths, and velocities for the 0.1% AEP event for the existing conditions. Results for other events (50% AEP, 10% AEP, 5% AEP, 1% AEP, and Probable Maximum Flood (PMF) events) are provided in Appendix E.

The existing conditions model results show:

- The proposed OOPD is situated on the north bank of the Isaac River floodplain, downstream of the confluence of New Chum Creek with the Isaac River.
- The OOPD site is affected by Isaac River flooding for events from 10% AEP (inclusive), with the activation of an Isaac River flood channel (see Section 2.1). For events from 5% AEP, the OOPD site is directly affected by Isaac River flooding.
- 0.1% AEP peak flood depths at the OOPD site are around 2 m or deeper, with peak velocities up to about 1.5 m/s.

7.4.2 Approved EA conditions flood depth, levels and velocities

Figure 7.6 and Figure 7.7 show the predicted peak flood extents, depths, and velocities for the 0.1% AEP event for the approved EA. Results for other events (50% AEP, 10% AEP, 5% AEP, 1% AEP, and Probable Maximum Flood (PMF) events) are provided in Appendix E.

The approved model results indicate that in the vicinity of DNM, the 0.1% AEP peak flood level is approximately 192.9 mAHD, showing minimal variation along the site boundary. The residual voids within the proposed DNM final landform (LFv3.1) remain flood free during this event, with the landform providing more than 7.0 m of freeboard above the predicted peak flood level.

7.4.3 Project flood depth, level and velocities

Figure 7.8 and Figure 7.9 show the predicted peak flood extents, depths, and velocities for the 0.1% AEP event for the proposed Project post-mining conditions. Results for other events - 50% AEP, 10% AEP, 5% AEP, 1% AEP, and Probable Maximum Flood (PMF) events are provided in Appendix E.

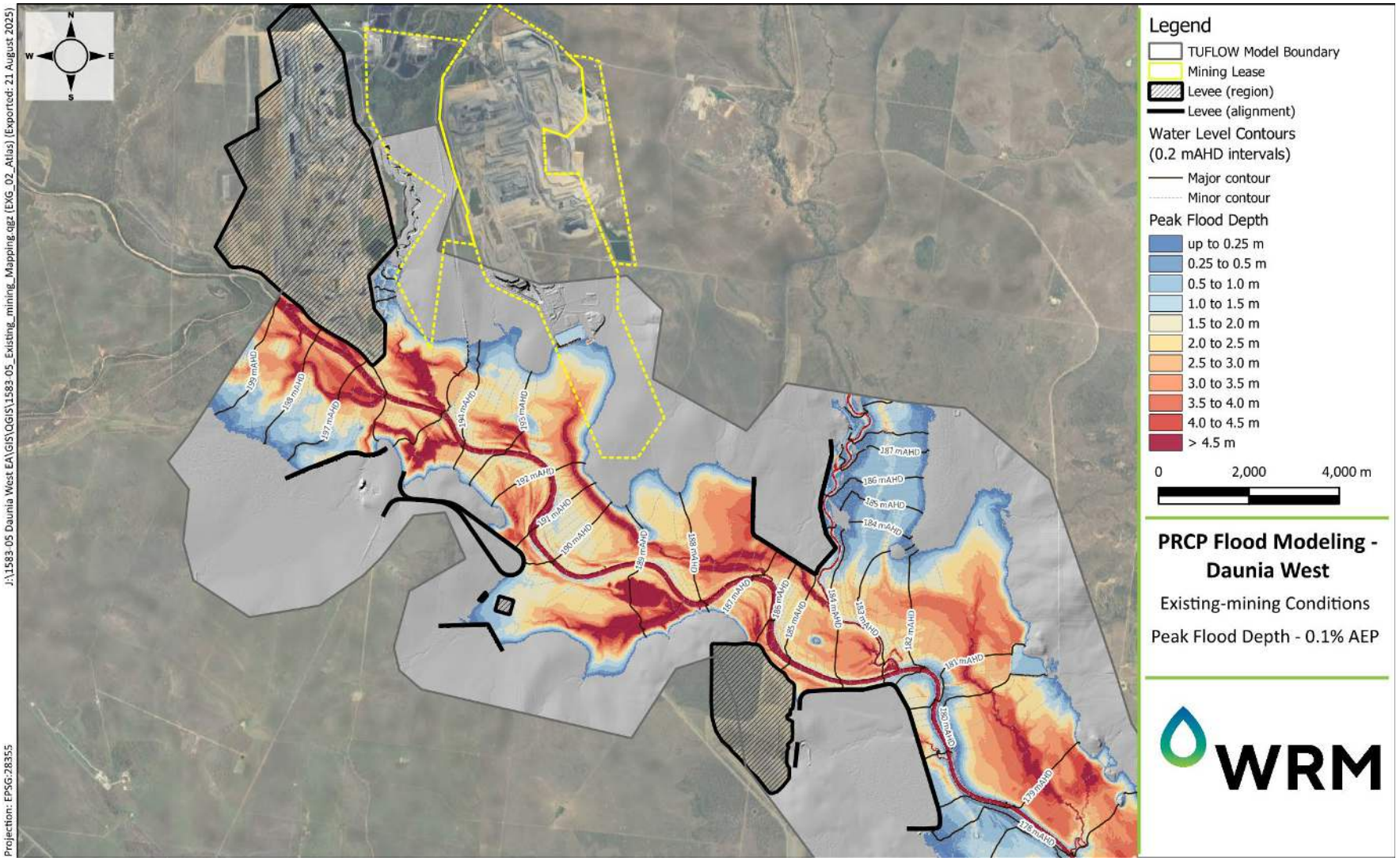

Figure 7.4 0.1% AEP Peak flood depth – existing conditions

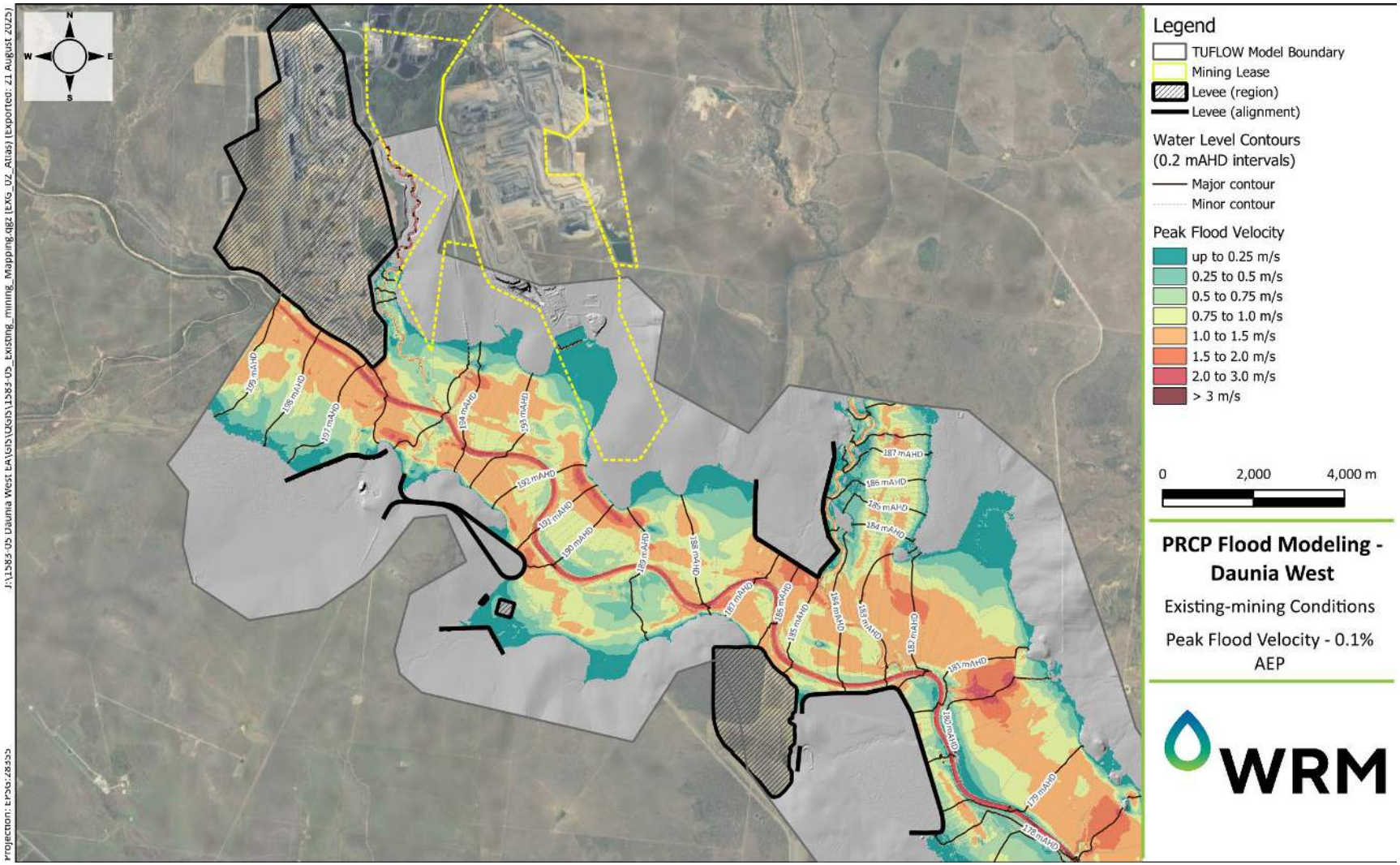

Figure 7.5 0.1% AEP Peak flood velocity – Existing conditions

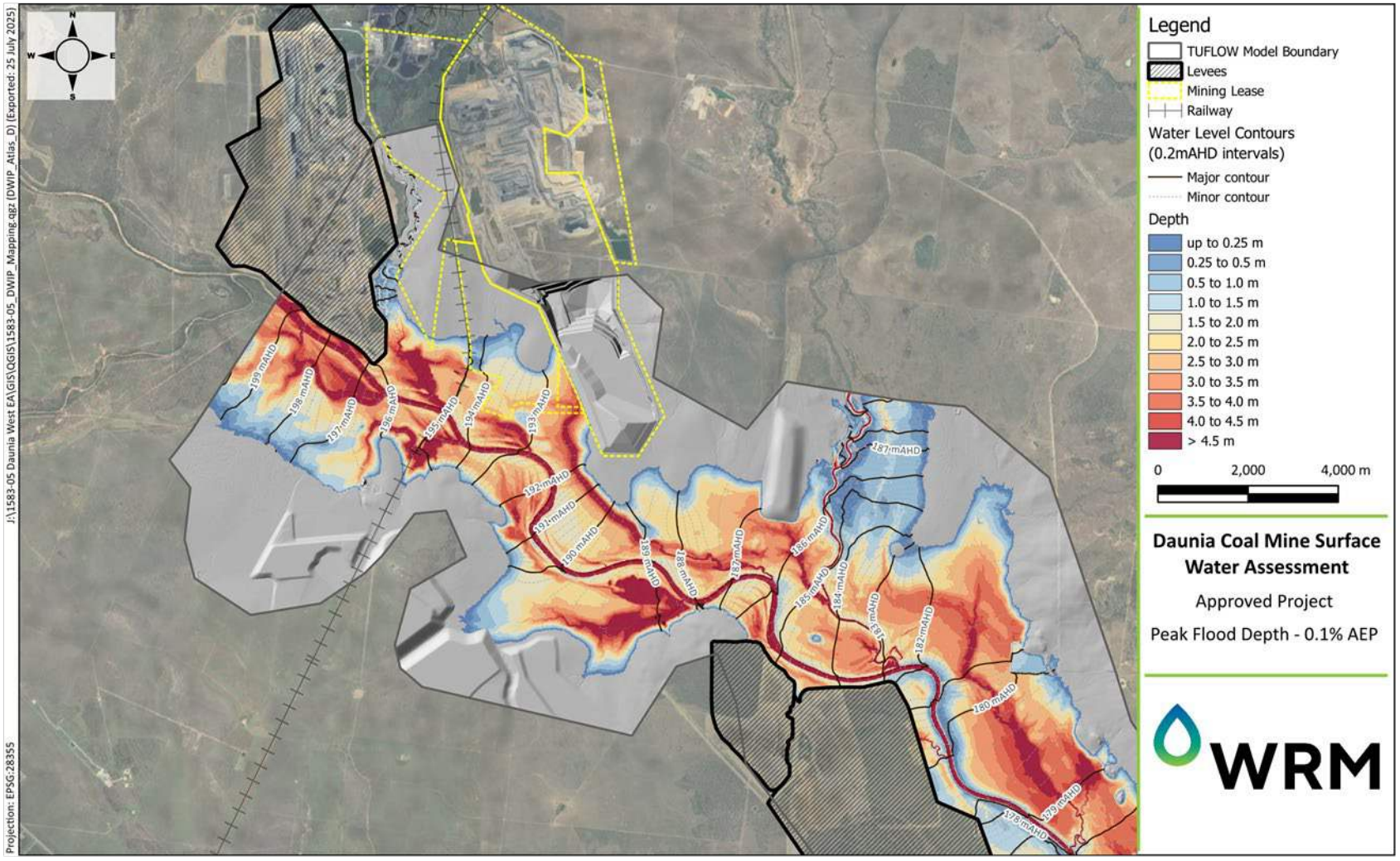

Figure 7.6 0.1% AEP flood depth and extent, Approved EA conditions

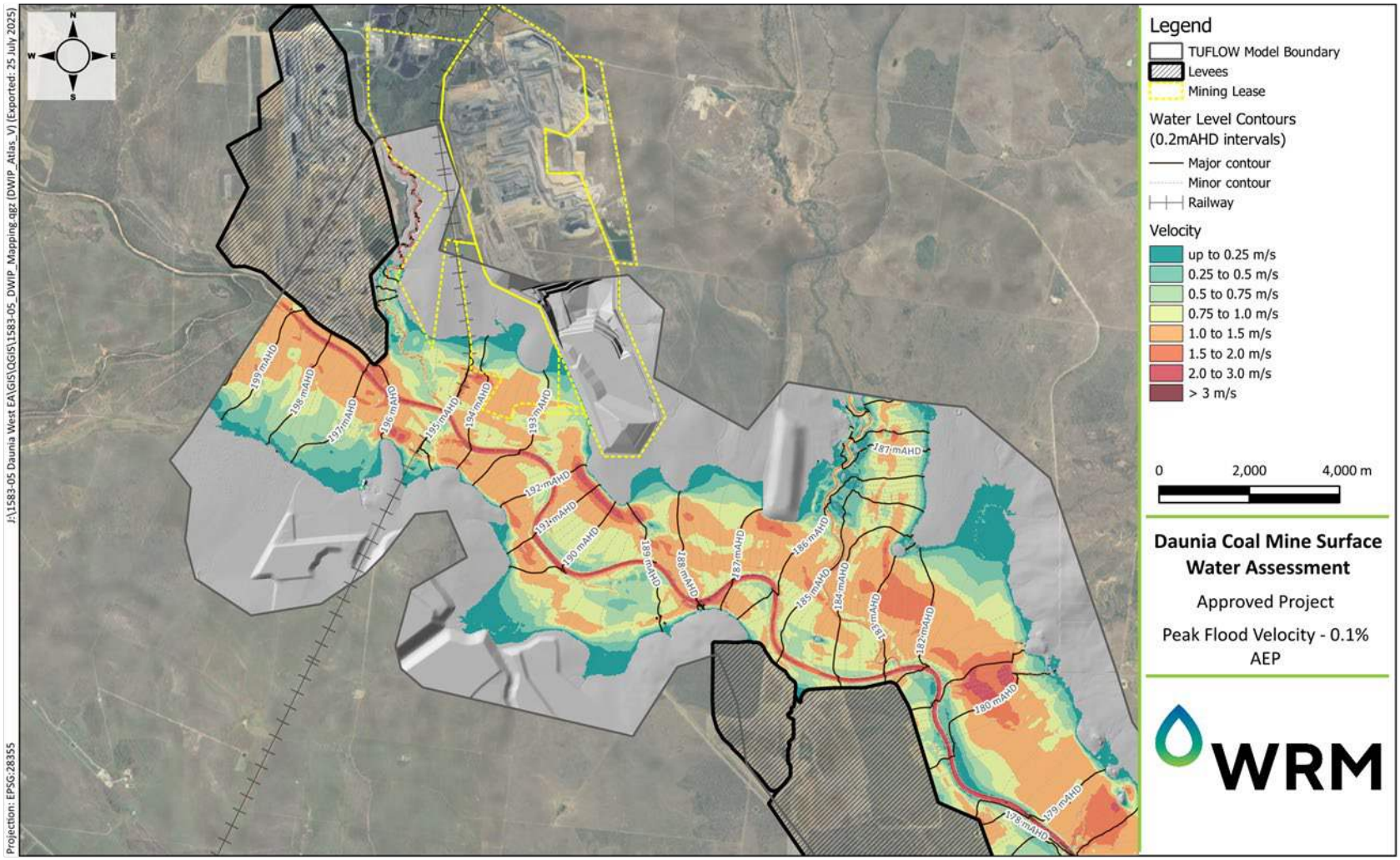

Figure 7.7 0.1% AEP flood velocity, Approved EA conditions

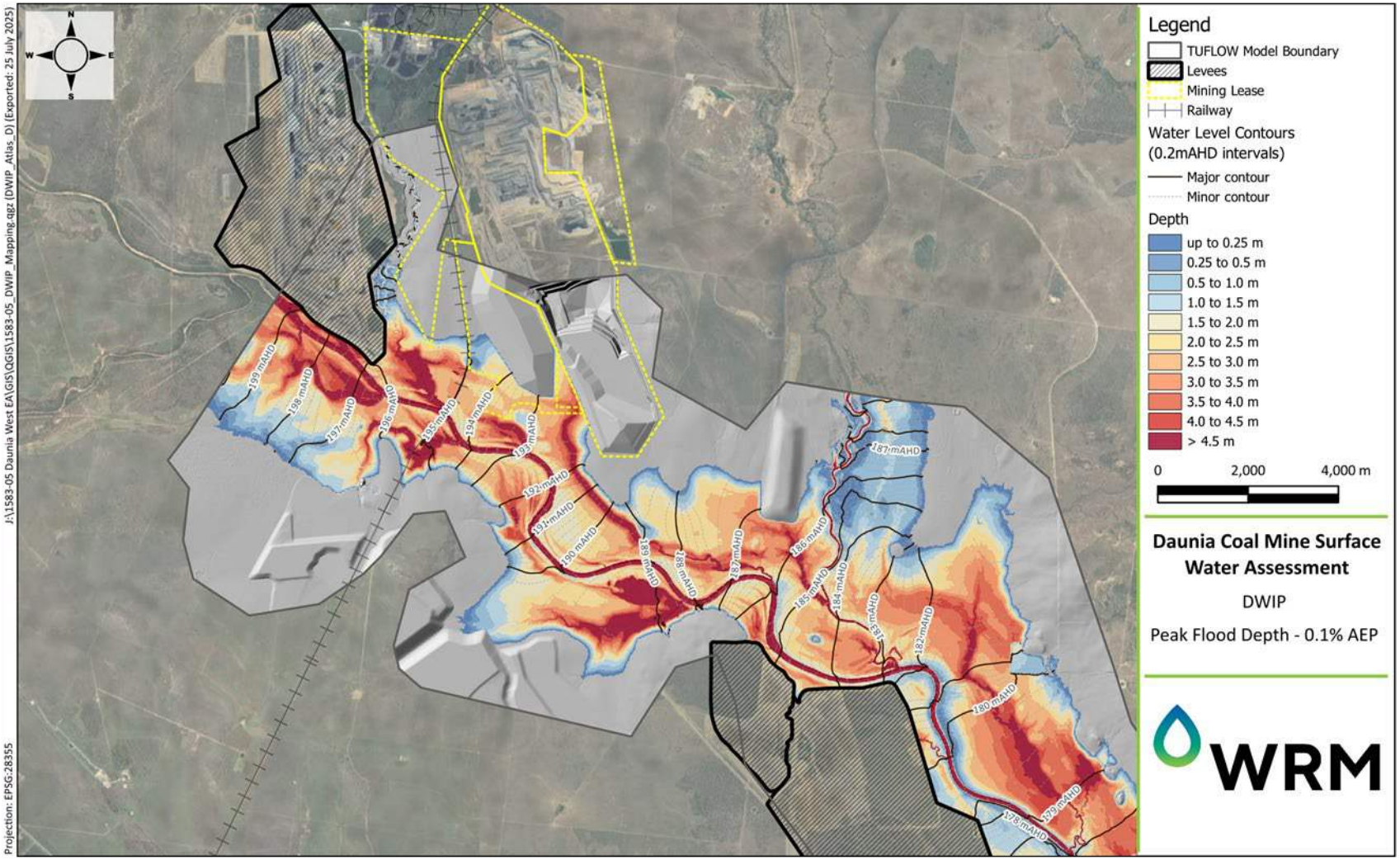

Figure 7.8 0.1% AEP flood depth and extent, Proposed Project conditions

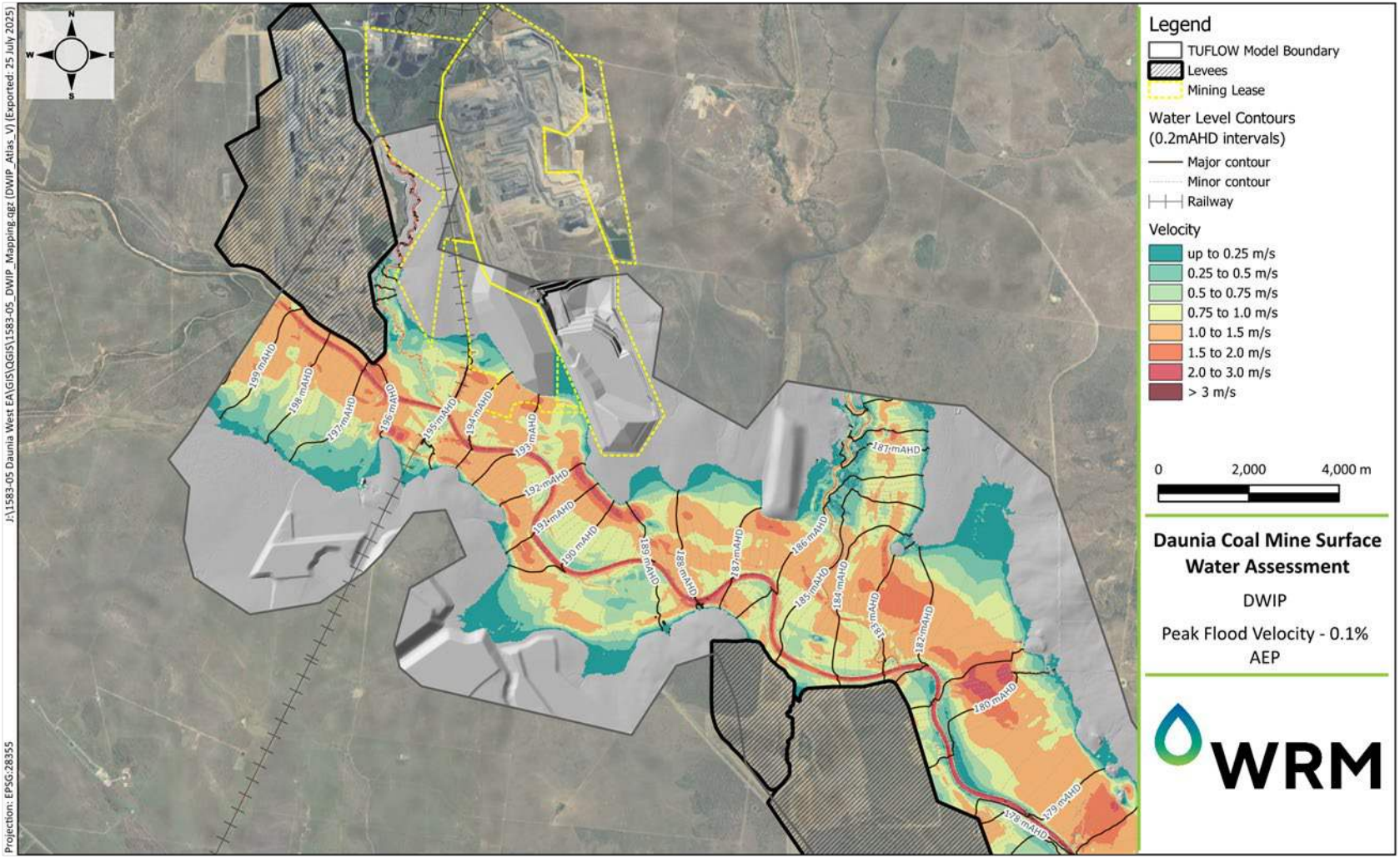

Figure 7.9 0.1% AEP flood velocity, Proposed Project conditions

Model results show:

- The 0.1% AEP peak flood levels vary along the proposed pit dump, ranging from 192.8 mAHD to 194.2 mAHD. Along the residual void, the peak level is approximately 192.8 mAHD, which is closely consistent with the approved model results.
- The 0.1% AEP peak velocities vary along the proposed pit dump and residual void, reaching up to approximately 1.7 m/s around the pit dump and up to 0.4 m/s along the residual void.
- Both the pit dump and the residual voids in the Project final landform remain flood-free during both the 0.1% AEP and PMF events. The proposed final landform provides an estimated freeboard of more than 7 m for the residual voids and 42 m for the pit dump under the 0.1% AEP event, and approximately 3.5 m and 42 m, respectively, under the PMF event.

7.4.4 Potential Project flood risk

Figure 7.10 and Figure 7.11 show the predicted change in peak flood levels and velocities, respectively, under proposed Project conditions compared to approved EA conditions, for the 0.1% AEP event. Predicted water level and velocity impact mapping for other events (50% AEP, 10% AEP, 5% AEP, 1% AEP, and Probable Maximum Flood (PMF) events) are provided in Appendix E.

The model results show that, with consideration for predicted future (year 2100 climatic conditions):

- Localised flooding around the southern end of the OOPD for events up to 5% AEP include changes in peak flood levels less than +0.1m and changes in peak flow velocities less than +0.1 m/s These changes do not materially change the extent or characteristics of flooding, the geomorphic characteristics of New Chum Creek or the Isaac River, nor materially adverse effect on adjacent landholders (Poitrel or Winchester mines) or nearby infrastructure (the railway line).
- Predicted flooding impacts for events from 0.1% AEP (inclusive) extend upstream to the New Chum Creek confluence and the Poitrel Mine site, including at the railway. However, predicted changes in peak levels are minor (up to about +0.2 m at Poitrel, and between +0.02 m to +0.07 m along the already overtopped railway). Changes in peak velocities are confined to the area downstream of the railway, between the Project site and the adjacent Winchester mine, and are generally less than +0.1m/s. Impacts such as these would not have a materially adverse impact on adjacent landholders (Poitrel or Winchester mines) or nearby infrastructure (the railway line). Neither would these impacts materially change the flooding or geomorphic characteristics of New Chum Creek or the Isaac River.
- The proposed OOPD configuration does not increase the risk of pit inundation for the approved EA conditions final void, with the proposed final void configuration remaining flood free for events up to and including the PMF.

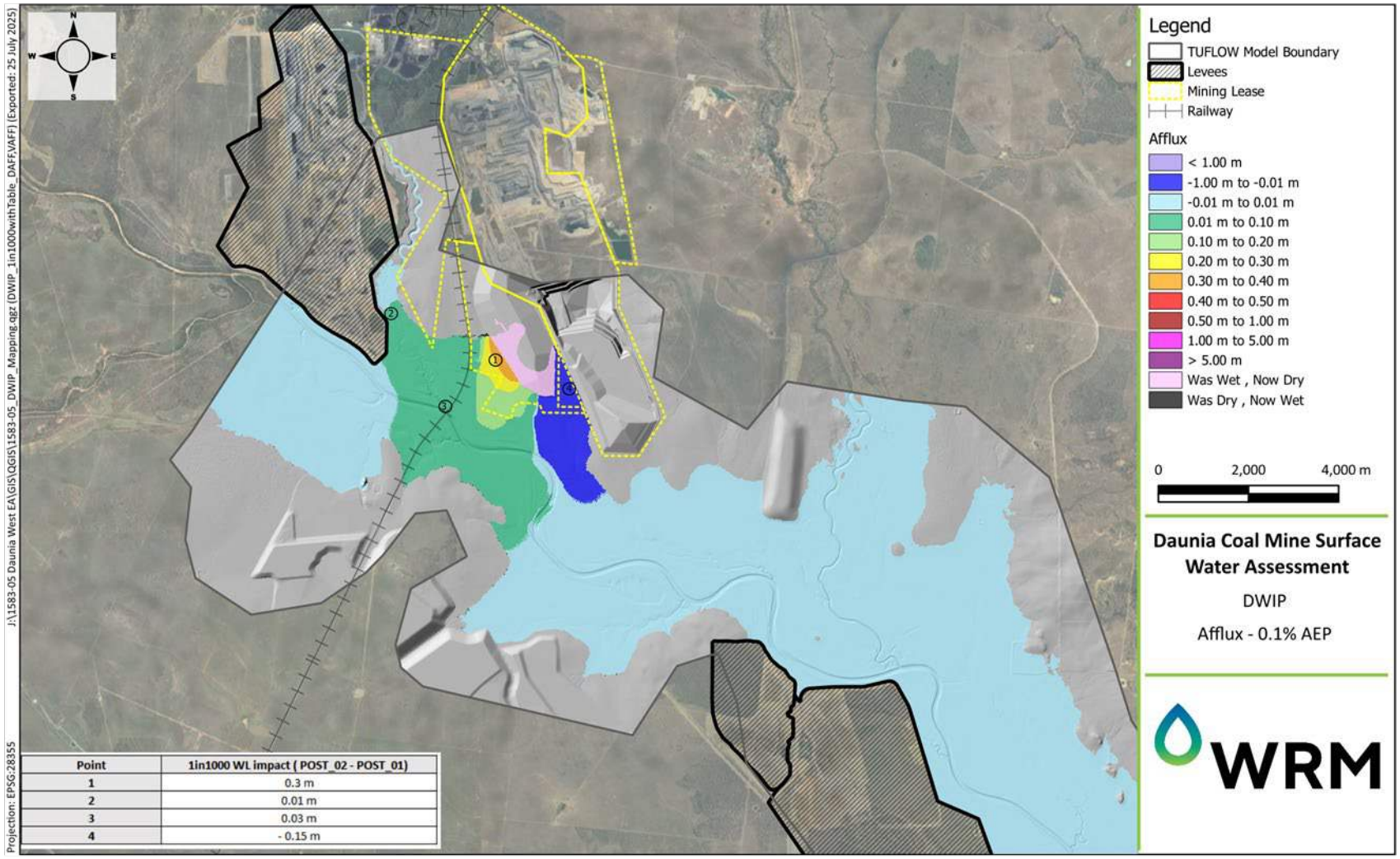

Figure 7.10 0.1% AEP Change in water level (Afflux)

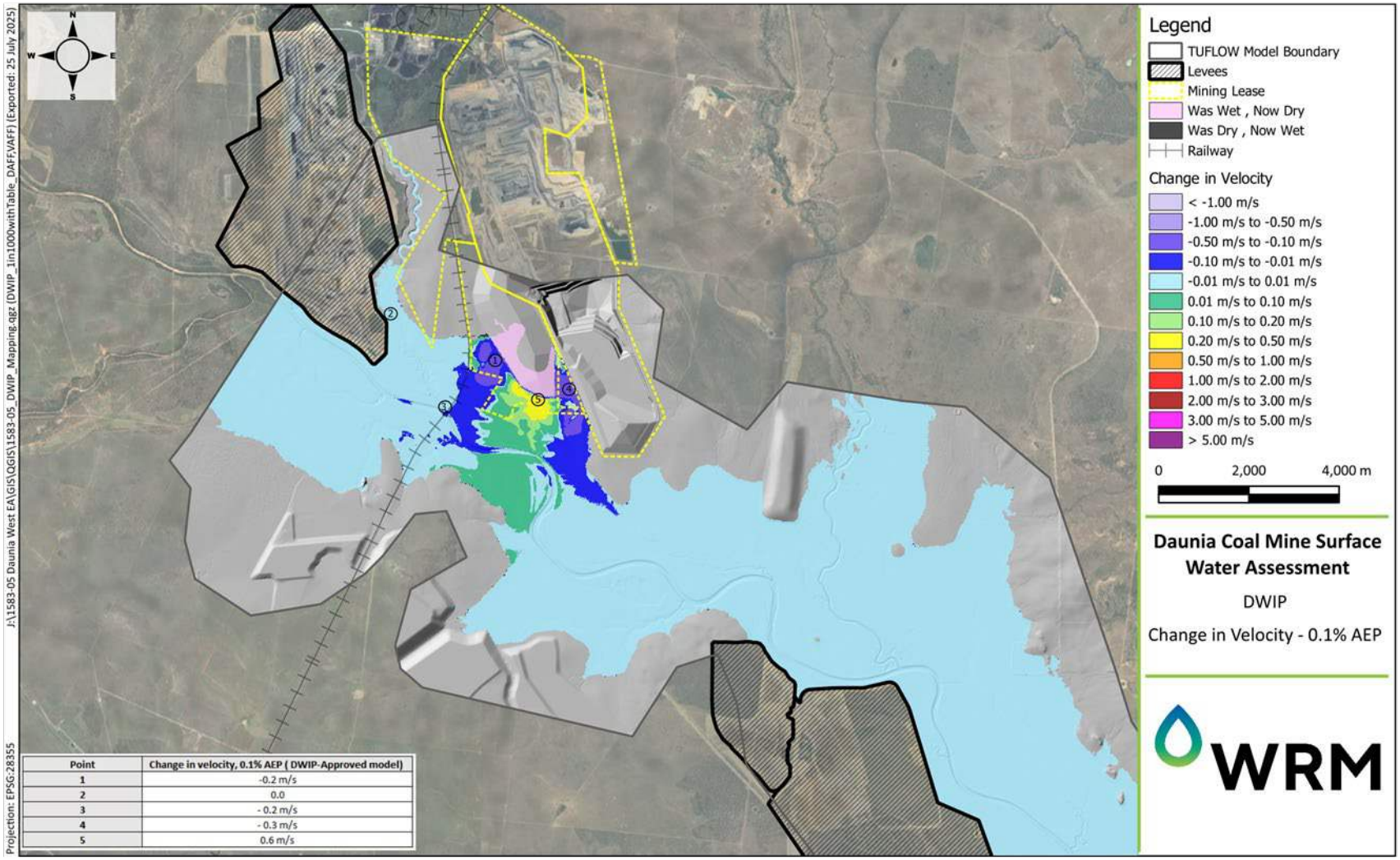

Figure 7.11 0.1% AEP Change in velocity

8 WATER MANAGEMENT RISK AND MITIGATION

The Project introduces minor changes to the hydrologic and hydraulic characteristics of the Daunia Coal Mine (DNM) site. Potential surface water management risk and mitigation are as follows:

8.1 LOCAL CATCHMENT FLOWS

8.1.1 Overview

The Project infrastructure will result in minor alterations to local catchment flows, primarily due to adjustments in drainage patterns and runoff characteristics. These changes will have negligible effects on peak discharges and flow velocities in local waterways, with the majority of catchment runoff returning to the waterway after being treated by the sediment structures. Controlled drainage systems will be implemented to manage runoff and minimise downstream impacts.

Project impacts to local catchment flows are confined to an unnamed second-order drainage feature forming part of the Isaac River floodplain (the drainage feature), functioning as an active flood channel of the Isaac River, as shown in Figure 2.2. This unnamed tributary follows the edge of the Isaac River floodplain and joins the Isaac River approximately 6 km downstream of the Project site.

8.1.2 Local catchment loss

Catchment areas contributing to the drainage feature, from downstream of the Project site to its confluence with the Isaac River, are:

- Approved Project catchment area: 23.8 km²
- Proposed Project catchment area: 16.6 km²

The change in catchment area is due to the increased catchment associated with the OOPD. The proponent will aim to minimise the void catchment when shaping the final landform.

8.1.3 Method

Local surface-water flow impacts due to the Project were assessed based on flow volumes, frequency, and duration, derived from rainfall-runoff modelling.

AWBM rainfall-runoff relationships derived for the Isaac River catchment upstream of Burton Gorge Dam by HydroBalance (2026) were used. The adopted AWBM rainfall–runoff parameters are presented in Table 8.1.

Flow events and associated flow durations were based on the surface runoff component of the AWBM model as no baseflow is expected for this catchment.

Table 8.1 Adopted AWBM rainfall–runoff parameters for the Isaac River catchment at Burton Gorge (HydroBalance, 2026)

Parameter	Burton Gorge
C1 (mm)	10.5
C2 (mm)	60
C3 (mm)	200
A1	0.074
A2	0.493
A3	0.433

Parameter	Burton Gorge
Cav (mm)	117.0
BFI	0.19
Kbase	0.77
Ksurf	0.06
Cv	11.6%

8.1.4 Results

Flow metrics for the drainage feature are provided in Table 8.2. Key findings comprise:

- The Project would reduce the mean annual flow from 393.9 ML/a to 274.7 ML/a. The reduction is consistent with the loss in contributing catchment area of the drainage feature.
- The frequency of flow remains largely unaffected, with the number of flow events predicted to remain at about 6 or 7 times per year.
- Event flow duration is predicted to be about 13 days per event.

Overall, the Project is expected to reduce the drainage flow volumes while maintaining flow duration and frequency.

Table 8.2 Modelled drainage feature flow metrics

	Existing Drainage Conditions	Project
Mean Annual Flow (ML/a)	393.9	274.7
Number of Flow Events (events per year)	about 6 or 7	
Event Flow Duration (days per event)	~13	

8.2 OOPD FLOOD RISK AND MITIGATION

Flood-related risks to the OOPD were assessed for extreme flood events, including the 0.1% AEP and the Probable Maximum Flood (PMF). The assessment considers flood depths, inundation extents, flow velocities and erosion potential to determine whether the proposed rehabilitated final landform would remain stable and consistent with rehabilitation completion criteria under extreme flood conditions (ARR, 2019).

8.2.1 Flood depths, inundation extents and interaction with the final landform

Figure 8.1 and Figure 8.2 present the modelled peak flood depths, water levels and inundation extents across the final landform for the 0.1% AEP and PMF events, respectively. These figures show that inundation during the 0.1% AEP event is largely confined to the floodplain, with interaction limited to the lower toe of the rehabilitated landform. Under PMF conditions, inundation extends further across the floodplain; however, interaction with the rehabilitated landform remains concentrated at the toe, and widespread inundation of upper landform surfaces is not predicted.

8.2.2 Flood velocities and hydraulic behaviour

Figure 8.3 and Figure 8.4 show the modelled peak flood velocities for the 0.1% AEP and PMF events, respectively. The results indicate that velocities adjacent to the rehabilitated landform are generally lower than those predicted toward the centre of the floodplain. Higher velocities are confined to established flood flow paths remote from the landform and do not directly interact with rehabilitated surfaces.

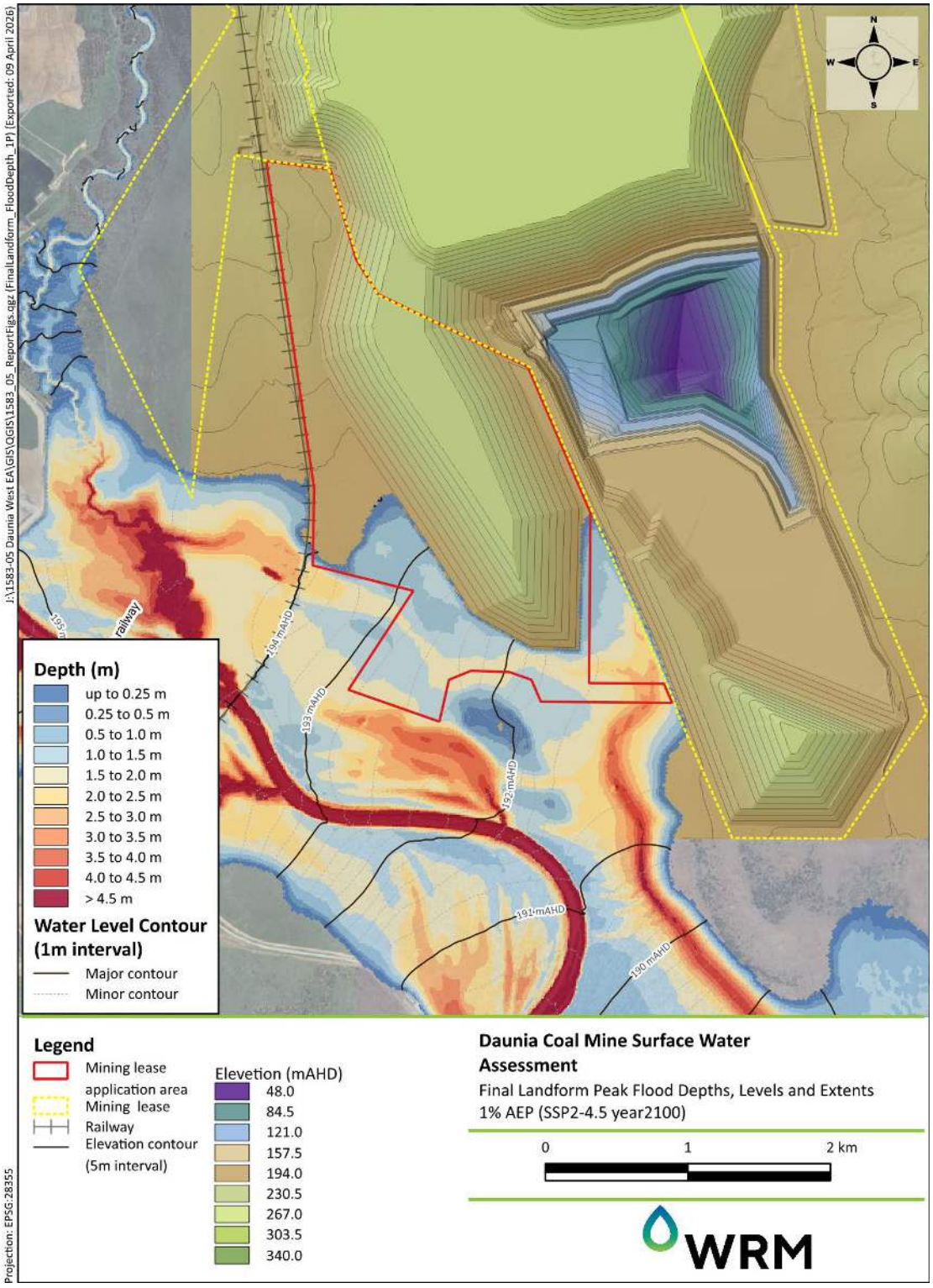

Figure 8.1 Final landform peak flood depths, levels and extents for the 0.1% AEP event

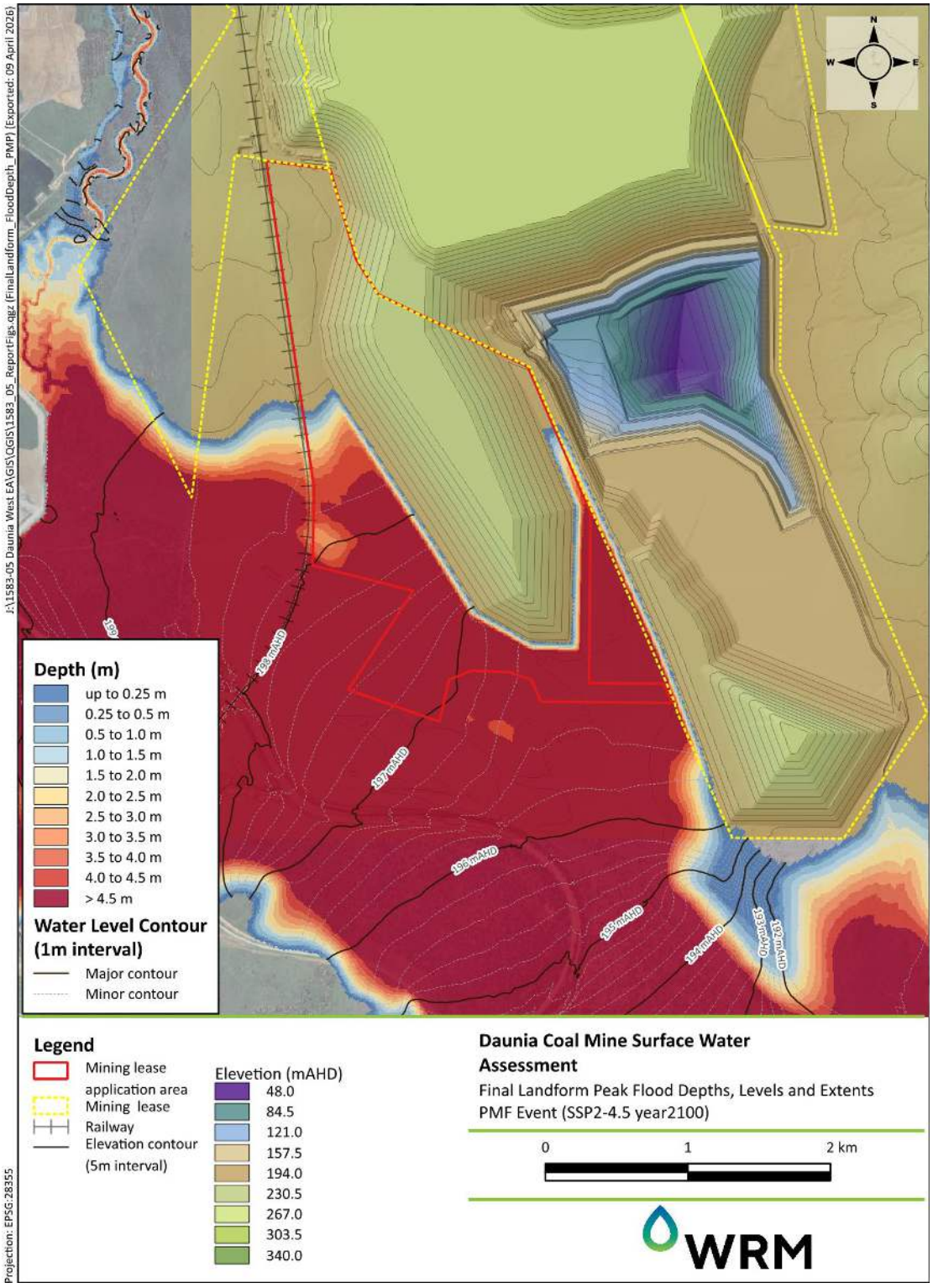

Figure 8.2 Final landform peak flood depths, levels and extents for the PMF event

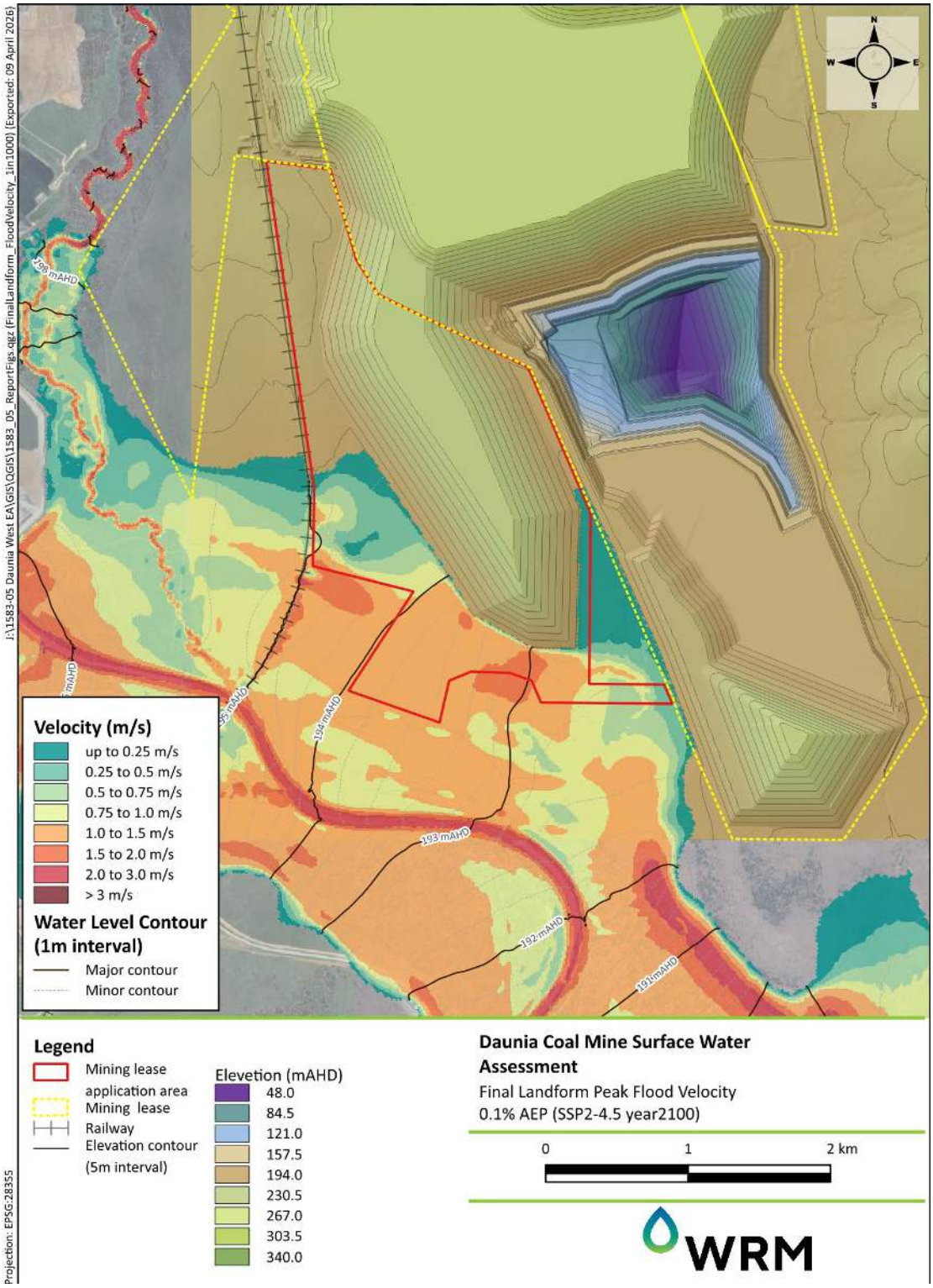

Figure 8.3 Final landform peak velocities for the 0.1% AEP event

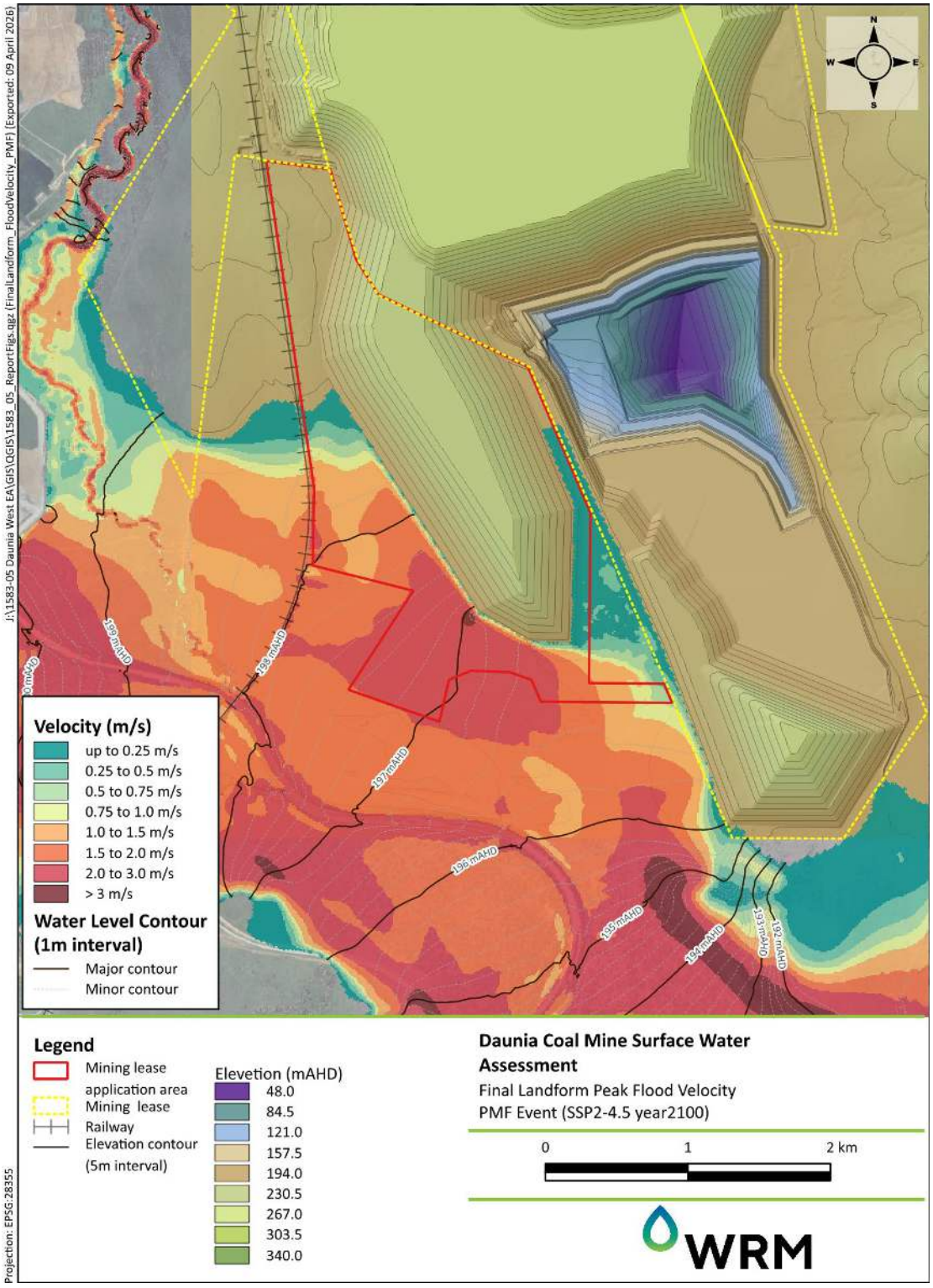

Figure 8.4 Final landform peak velocities for the PMF

8.2.3 Erosion risk and landform stability assessment

Flood-induced erosion risk was assessed to demonstrate consistency with rehabilitation completion criteria, including long-term landform stability, resistance to erosion and the absence of unacceptable

ongoing maintenance requirements. Modelled peak flood velocities adjacent to the rehabilitated landform were compared against maximum allowable velocity thresholds derived from Book 4 – Best Practice Erosion and Sediment Control (IECA, 2008). These thresholds are widely applied benchmarks for assessing erosion potential and post-rehabilitation landform stability under overland flow and flood inundation conditions (IECA, 2008).

The adopted velocity criteria are summarised in Table 8.1. For rehabilitation at closure, the criteria for grassed channels are considered appropriate based on the assumption that the final landform will achieve a minimum of 70% vegetative ground cover, consistent with erosion control and surface stability objectives. The rehabilitation design incorporates erosion-resistant materials at the toe of the landform where direct interaction with floodwater may occur. In areas subject to direct flow, the longitudinal gradient along the landform toe will generally be less than 1%, reducing shear stress and erosion potential (IECA, 2008).

Table 8.3 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

8.2.4 Assessment outcomes for erosion and stability

Hydraulic modelling indicates that flood velocities adjacent to the rehabilitated landform remain below the adopted maximum allowable threshold of 2.1 m/s for grassed surfaces for events up to and including the 0.1% AEP design flood. Although higher velocities are predicted toward the centre of the floodplain, these flows do not directly interact with the rehabilitated landform and therefore do not pose a risk to landform stability or rehabilitation performance (Australian Rainfall and Runoff, 2019).

Predicted flood velocities adjacent to the final voids and rehabilitated dump landform are below the adopted IECA (2008) criteria. On this basis, the final landform is expected to remain stable during flood events up to the 0.1% AEP without progressive erosion, undercutting or structural failure. The

assessment demonstrates that the proposed final landform is consistent with rehabilitation completion criteria relating to physical stability under extreme flood conditions, long-term resistance to erosion, compatibility with surrounding landforms and catchment processes, and the development of a sustainable, low-maintenance post-mining landform suitable for closure (IECA, 2008; Australian Rainfall and Runoff, 2019).

8.2.5 Likelihood framework

Event likelihoods were defined using Annual Exceedance Probability (AEP), which represents the probability of an event of a given magnitude being equalled or exceeded in any year. AEP is the preferred metric for describing flood and extreme event probabilities in Australia and is adopted in Australian Rainfall and Runoff guidance and contemporary flood assessment practice (Australian Rainfall and Runoff, 2019; Bureau of Meteorology, 2025). Discrete AEP values were mapped to qualitative likelihood descriptors commonly used in risk assessment frameworks to enable integration with consequence ratings and overall risk evaluation (Standards Australia, 2018).

The likelihood categories adopted for this assessment, summarised in Table 8.2, range from Almost Certain (50% AEP) to Highly Unlikely (0.1% AEP). These categories align with the application of AEP in Australian flood studies and flood awareness mapping, providing a consistent basis for flood risk communication and decision-making (Brisbane City Council, 2024; WaterConnect, 2023).

Likelihood and consequence are considered together to determine overall flood risk in accordance with risk management principles, where risk is a function of both the probability of occurrence and the severity of impact (Standards Australia, 2018). Low-probability, high-consequence scenarios, including PMF conditions, are retained within the assessment to ensure that extreme but credible events are appropriately considered in landform design, flood resilience, emergency planning and long-term risk management (Australian Rainfall and Runoff, 2019).

Table 8.4 Likelihood definitions adopted for this assessment

Risk-assessment likelihood	Qualitative description	Annual Exceedance Probability (AEP)
Almost Certain	Expected to occur in most circumstances	50%
Likely	Will probably occur at some time	10%
Possible	Might occur at some time	5%
Unlikely	Could occur but not expected	1%
Highly Unlikely	Exceptional circumstances only	0.1%

8.2.6 Dump erosion mitigation measures

Dump erosion mitigation measures may be implemented to minimise erosion, sediment mobilisation, and off-site sediment transport from spoil dumps during construction, operation, rehabilitation, and post-closure phases. These measures are designed to support long-term landform stability, progressive rehabilitation, and mine closure objectives, while minimising the need for ongoing maintenance.

Erosion control measures for spoil dumps are based on the following objectives:

- minimising disturbance and exposed surface area through staged construction and progressive rehabilitation;
- preventing the concentration of runoff;
- controlling flow velocities within acceptable limits for the spoil material class; and

- treating dispersive materials before exposure, where practicable.

Long-term stability and maintenance requirements are considered when selecting erosion control measures. Preference is given to landform and vegetation-based controls over engineered solutions that may require long-term maintenance, and all measures are designed to remain functional for the intended duration of disturbance.

Spoil material is characterised through representative soil testing and classified as dispersive or non-dispersive. Where dispersive spoil is identified, suitable chemical amelioration, such as gypsum application, is undertaken before placement or exposure. Spoil dumps are shaped to minimise slope length and gradient, with final batter configurations determined based on spoil erodibility, slope length, and the sensitivity of the receiving environment.

Primary erosion control measures include surface shaping and stabilisation of dump batters. Batters are flattened where practicable to reduce runoff velocity and erosion risk. Compaction may be applied where structural stability is required, followed by contour roughening, typically 150 to 250 millimetres in depth, to promote infiltration and support vegetation establishment. Surface treatments may include topsoil placement and seeding, rock mulch or armouring in higher-risk areas, organic mulch or debris cover, and surface sealing using soil stabilisers or haul road binders where vegetation cannot be established immediately.

Runoff from dump surfaces is directed to stabilised drainage systems. Concentrated flow paths are avoided wherever possible, and where unavoidable, are appropriately lined or stabilised to prevent scour. Accelerated rehabilitation is undertaken where practicable and involves final shaping during initial spoil placement, followed by vegetation establishment and or rock or debris cover within 24 months.

Buffers are designed in accordance with IECA best practice guidance. Permanent vegetated buffer zones may be used as an alternative to engineered erosion controls where site conditions allow. Buffer zones must provide at least 100 m of separation between the dump and the receiving environment, support a minimum of 70% perennial grass cover, have a consistent slope less than five percent, and contain no depressions, swales, or infrastructure that could concentrate flows.

8.3 WATER INVENTORY

The water balance assessment for the Project identifies several risks as follows:

- Extreme wet conditions may result in excessive water accumulation, potentially exceeding storage capacity and triggering uncontrolled releases.
- Prolonged dry conditions may lead to insufficient water inventory, affecting critical operations such as dust suppression and coal handling and preparation plant (CHPP) processes.
- Reliance on external water sources, particularly the Burdekin pipeline, during dry periods may place pressure on regional water resources.

Mitigation strategies associated with the WMS:

- Establishment of clean water diversion infrastructure, where practical and feasible, to minimise runoff entering voids and mine-affected systems.
- Prioritisation of mine affected water reuse and proactive inventory management to minimise external water demand.
- During dry conditions, Burdekin pipeline imports are prioritised to maintain operational continuity.

8.4 PROPOSED ESC MEASURES

The proposed Project represents only a minor change to the existing mining operations through the formalisation and inclusion of additional ESC and mine-affected water (MAW) management infrastructure. The Project includes the following elements:

The construction and operation of ESC measures:

- Pandora Sediment Dam (P Sed Dam), proposed as part of the Project; and
- Pandora West Sediment Dam (PW Sed Dam), designed to capture sediment-laden runoff from the OOPD.
- MAW dams:
  - Pandora MAW Dam (P MAW Dam); and
  - Pandora West MAW Dam (PW MAW Dam).

The Project does not introduce new external release points or expand the overall MAW footprint beyond what would otherwise occur under approved operational requirements. Instead, it formalises the location and function of the proposed ESC measures, which would have otherwise been constructed to support ongoing mining operations.

8.4.1 Management of MAW Used for Dust Suppression

Runoff from areas where MAW is applied for dust suppression is managed using engineered controls such as berms, diversion drains, and containment bunds. These controls prevent MAW runoff from entering natural drainage lines, waterways, or erosion and sediment control structures not designed to receive MAW.

MAW used for dust suppression is sourced from Dam 1, Dam 2, and the site backbone pipeline network. MAW is applied to haul roads, stockpiles, and other disturbed surfaces to control dust generation and maintain safe operating conditions (Whitehaven Coal, 2022).

Dust suppression practices are restricted to designated areas where runoff can be effectively intercepted and retained within the site water management system. Application rates are managed to minimise the potential for ponding or runoff beyond designated containment areas.

Erosion, sediment, and MAW runoff management are fully integrated with the site Water Management System and the ESCP. Controls and monitoring requirements for MAW dust suppression areas form part of the same management framework used for all disturbed areas on site.

8.4.2 Monitoring, Inspection and Maintenance

Routine inspection and maintenance of sediment controls, MAW storage structures, and distribution infrastructure are undertaken to ensure ongoing performance. Inspections are conducted regularly and are prioritised before the wet season and following significant rainfall events.

Water quality monitoring is undertaken for runoff from MAW application areas to confirm compliance with site-specific water quality objectives. Monitoring parameters include pH, electrical conductivity, turbidity, and total suspended solids. Monitoring results are used to inform ongoing management and continuous improvement of control measures.

8.5 PRELIMINARY CONSEQUENCE CATEGORY ASSESSMENT

8.5.1 Overview

A preliminary consequence category assessment (CCA) (the assessment) has been completed for the following proposed sediment and MAW dams:

- P Sediment Dam;
- PW Sediment Dam;
- P MAW Dam; and
- PW MAW Dam.

The assessment evaluated failure scenarios for these dams based on seepage, overtopping, and dam break scenarios, and then assigns a preliminary consequence category for each dam in accordance

with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (the DETSI Manual) (DETSI, 2025). Active water management strategies are recommended to minimise environmental harm and manage contaminated water.

This section summarises the key outcomes of the CCA. Additional details on the CCA methodology including the rationale behind the consequence categories determined for each dam for the various failure scenarios are provided in Appendix F.

The mining lease application area is north of the Isaac River, downstream of New Chum Creek (see Figure 8.5). Figure 8.5 shows the locations and catchment areas for the proposed dams and runout paths considered for dam-break or operational overflow scenarios.

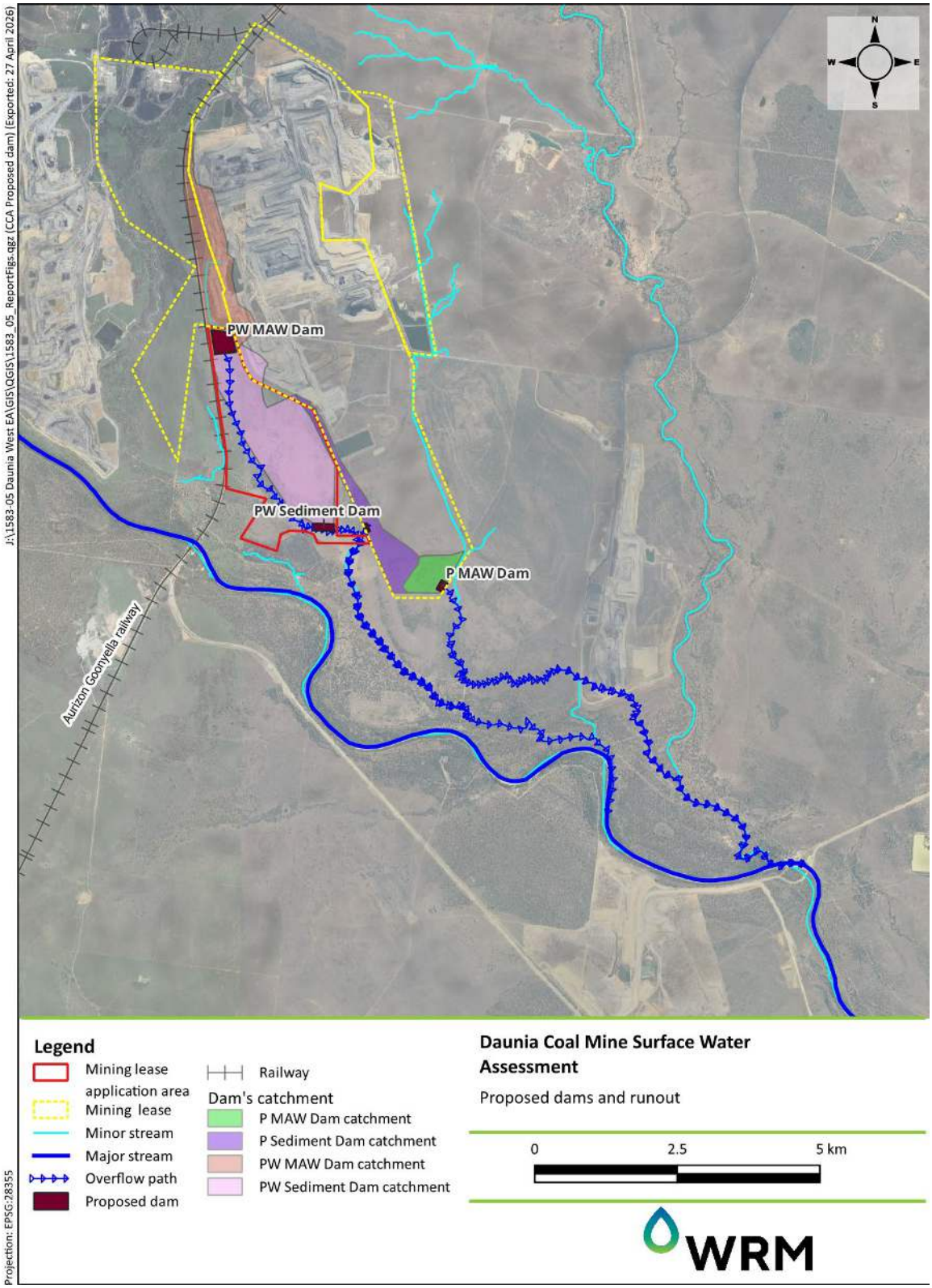

Figure 8.5 Proposed dam catchments and runout paths

8.5.2 Outcome

Table 8.3 presents the assessment outcomes, identifying the preliminary consequence category determined for each assessed dam and the likely regulated status. The assessment results are based on the concept design, the intended operational strategy and expected contaminant concentrations for the proposed dams.

Table 8.5 Summary of the preliminary consequence category assessment

Dam / Structure	Harm to Humans	General Environmental Harm	General Economic Loss or Property Damage	Overall Consequence Category	Regulated Structure
PW Sediment Dam	Low	Low	Low	Low	No
P Sediment Dam	Low	Low	Low	Low	No
P MAW Dam	Low	Low	Low	Low	No
PW MAW Dam	Low	Low	Low	Low	No

A full CCA will be required for regulated structures during the detailed design stage. The final storage and spillway configurations, including embankment heights, will be confirmed prior to completing the full CCA.

8.5.3 Engineering Design Standards and Construction Compliance

Construction documentation will be prepared for water storage dams and associated water management infrastructure. The documentation will define the applicable engineering design standards for each structure, including hydrological and hydraulic design criteria, geotechnical stability requirements, freeboard allowances, seepage control, erosion protection, and operational performance objectives, consistent with Queensland regulatory guidance for regulated structures and contemporary dam engineering practice (Queensland Government, 2024a; ANCOLD, 2012; ANCOLD, 2019).

Design hydrology and hydraulic assessments will be undertaken in accordance with Australian Rainfall and Runoff to ensure appropriate consideration of design storm events, overtopping risk, and spillway capacity, having regard to catchment characteristics and consequence category (ARR, 2019). Sediment dam design will also be informed by recognised erosion and sediment control guidance for mining applications in Queensland, including risk-based sizing and detention requirements (Chrystal et al., 2022; IECA, 2008).

Construction methodologies will be documented in detail, including earthworks sequencing, foundation preparation, material sourcing and placement, compaction standards, spillway and outlet construction, erosion and sediment protection measures, and quality assurance and quality control procedures. Construction approaches will be selected to suit site-specific ground conditions, catchment risk classification, and anticipated hydraulic loading, and will be implemented in accordance with accepted mining and civil engineering practice (ANCOLD, 2012; Queensland Government, 2024a).

Indicative construction schedules will be developed to identify key milestones such as site preparation, construction, commissioning, and integration with the site Water Management System. Scheduling will consider mine sequencing, progressive disturbance, and wet-season risk management

to ensure that adequate sediment and MAW storage capacity is available prior to disturbance of contributing catchments (Queensland Government, 2016b; Whitehaven Coal, 2022).

All design and construction documentation will comply with relevant Queensland legislation and published guidelines for regulated structures and dam safety. Designs will be subject to internal review and certification by suitably qualified and experienced Registered Professional Engineers of Queensland prior to construction (Queensland Government, 2024a; ANCOLD, 2019).

8.6 UNCONTROLLED RELEASE RISK AND MITIGATION MEASURES

HydroBalance (2025) assessed that both the Project and the current EA have a similar risk of uncontrolled water spills. The Project will continue to operate under the current Water Management System.

Overflow likelihood for the proposed dams is expressed in terms of AEP, with predicted volumes discussed in Section 5.3.5.

Mitigation measures for surface water, sediment, and mine-affected water management have been developed to prevent or minimise uncontrolled releases, protect downstream receiving environments, and ensure compliance with Environmental Authority conditions and dam safety requirements.

- Controls have been designed in accordance with accepted engineering practice and industry standards and are implemented through an integrated framework comprising:
  - Engineering design and structural integrity controls;
  - Operational procedures for active water management;
  - Ongoing monitoring and inspection of storages and spillways; and
  - Provision of contingency storage capacity to manage extreme rainfall events.
- These measures are structured to:
  - Minimise both the likelihood and consequences of uncontrolled MAW releases;
  - Protect downstream environmental values and infrastructure;
  - Maintain the safe operation of regulated and other water retaining structures; and
  - Ensure compliance with regulatory, dam safety, and environmental performance requirements.

8.6.1 Mine-Affected Water Containment and Storage

The following controls apply to the collection, storage, and management of MAW across the Project:

- All MAW runoff generated within mining and waste rock dump areas is directed to designated MAW dams or approved pit voids.
- MAW dams are integrated into the site-wide water management system to enable active level control and redistribution of stored water.
- Excess MAW generated during high rainfall periods may be temporarily stored in:
  - Temporary or sacrificial pit storage areas; or
  - Other approved MAW storage facilities to maintain freeboard.
  - To minimise the risk of uncontrolled discharges, particularly under very wet conditions, it is recommended that temporary or sacrificial mining voids are designated at the start of the wet season to manage excess MAW.
- MAW dams that rely on pumping to reduce storage volumes are equipped with:
  - Automated pump start/stop systems; and
  - Remote monitoring capability to enable real-time response to changing storage conditions.

- The proposed MAW dams will be configured so that all routine water transfers occur internally, with no planned releases to receiving waters unless applicable EA conditions are met.
- Investigate rapid discharge pumps to transfer MAW to RP1 particularly for PW MAW Dam levels above the MRL.
- Vehicle wash-down facilities are located away from flood-prone areas and watercourses. Wash water is captured, managed within the MAW system.
- Emergency preparedness measures are in place to manage runoff during extreme rainfall events. These measures include pre-wet-season inspections, storm readiness checks, and verification that storage areas and containment structures have sufficient capacity prior to forecast rainfall.

8.6.2 Water storage overtopping controls

To mitigate the risk of overtopping during extreme rainfall events:

- MAW dams are designed to achieve an overtopping frequency of less than 1% AEP based on seasonal water balance modelling.
- Storage volumes are conservatively sized to accommodate climatic variability and operational inflows.
- Overflow pathways are designed to safely convey overland flows without causing erosion or structural instability.
- For the dam consequence category assessed as having a 'significant' or 'high' for the 'failure to contain, overtopping' scenario, the following requirements apply, consistent with Queensland Department of Environment and Science (DES) guidance:
  - Design Storage Allowance (DSA): The dam must provide sufficient storage to safely contain runoff from a 1:20 Annual Exceedance Probability (AEP) storm event. This ensures operational resilience under moderately extreme rainfall conditions.
  - Extreme Storm Storage (ESS): Where overtopping consequences are significant, the dam must also include additional storage capacity to manage inflows from a 1:10 AEP (72-hour duration) extreme storm event. This provides a safety buffer for more severe, prolonged rainfall that could contribute to overtopping risk.
  - Mandatory Reporting Level (MRL): The dam must be equipped with a defined Mandatory Reporting Level, which is a set water level threshold that, if exceeded, triggers immediate reporting to the relevant regulatory authority and implementation of emergency response protocol.

8.6.3 Protection of water quality and risk to downstream environments

Mitigation measures to protect surface water quality include:

- Sediment dams are used to promote the settlement of suspended solids prior to any discharge during high rainfall events.
- Water quality within dams is monitored in accordance with EA trigger values.
- Seepage through embankments is mitigated by:
  - Compacted embankment construction;
  - Appropriate selection of construction materials; and
  - Routine inspection to identify early signs of seepage or erosion.
- Limited embankment heights and restricted storage volumes above ground level, which reduce dam break release volumes, peak flood depths, and downstream runout extents.

In the event of uncontrolled releases during extreme rainfall events:

- Large downstream catchments provide dilution with receiving waters.

- Impacts are expected to be short-term and localised.

8.6.4 Engineering Design and Structural Integrity Controls

Structural controls applied to all regulated dams include:

- Engineering design in accordance with relevant Australian Standards, guideline documents and accepted industry practice.
- Completion of a CCA as part of the detailed design process.
- Embankment design incorporating:
  - Appropriate slopes and freeboard;
  - Controlled spill arrangements; and
  - Materials suitable for long-term stability.
- Construction quality assurance to confirm compliance with approved design specifications.

8.7 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 New Chum Creek catchment, controlled release of MAW can occur (in compliance with the EA release conditions) at "Licensed Discharge Points" RP1 (Dam 1), as shown in Figure 3.1.

The Project would not change the controlled release strategy; as such, controlled releases would continue to be undertaken in accordance with the EA release conditions.

8.8 PROJECT WATER QUALITY

The Project is unlikely to substantially affect the quality of surface waters in receiving environments. Key findings comprise:

- The additional disturbance footprint associated with the Project site will increase the volume of sediment water that needs to be contained and managed on the mine site. Based on this, it is unlikely that overflows from sediment dams will have a measurable impact on the quality of the receiving waters.
- Analysis of water quality data from the Isaac River indicates that several parameters consistently exceed regional default guideline values (DGVs). These include dissolved aluminium, copper (total and dissolved), iron (total and dissolved), zinc (dissolved) and total suspended solids (TSS). These exceedances suggest that the current DGVs may not accurately reflect the natural background conditions of the Upper Isaac River.
- Variability in water quality parameters is primarily influenced by natural enrichment and seasonal changes, rather than mining activities.

Existing water quality monitoring programs demonstrate compliance with relevant regulatory standards and provide early detection of potential water quality issues and are therefore considered adequate for the Project. Identified data gaps will be addressed through ongoing monitoring, with future programs focussing on the systematic collection of sodium and salinity data across a range of flow conditions. This approach will support progressive refinement of baseline conditions and long-term trend assessment in accordance with ANZG (2018).

8.9 GREAT BARRIER REEF WATER QUALITY

8.9.1 Overview

This Great Barrier Reef (GBR) water quality assessment considers the potential for the Project to result in surface water impacts to the GBR catchment waters. The assessment addresses the

requirements of section 41AA of the *Environmental Protection Regulation 2019* (EP Regulation) and the Reef discharge standards for industrial activities (DES, 2022; DESI, 2024).

The Project is located within the Fitzroy Basin, which forms part of the GBR catchment, as shown in Figure 8.6. The assessment focuses on whether the Project would result in a residual impact to GBR catchment waters through the release of fine sediment (FS) or dissolved inorganic nitrogen (DIN), as defined under section 41AA of the EP Regulation. No data were available for the assessment of total phosphorus (TP).

The GBR is located approximately 600 km downstream of the Project (approximately 300 km to the east in a straight-line distance. As such, the Project would not have any direct impact on the GBR. Therefore, this assessment was prepared to evaluate the potential indirect impacts of the Action arising from runoff and surface water releases.

8.9.2 Environmental Protection Act 1994

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:

a. The administering authority must refuse to grant the application if the authority considers that:
    i. the relevant activity will, or may, have a residual impact; and
    ii. 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.
b. 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 –
    i. was released to the water because of the relevant activity; and
    i. 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).

Figure 8.6 Map of Great Barrier Reef Region, Marine Park and World Heritage Area (Commonwealth of Australia, 2024)

8.9.3 GBR drainage

The Great Barrier Reef catchment comprises all river basins and sub-catchments draining to the Great Barrier Reef lagoon, including the Fitzroy Basin and its tributaries. The GBR receives runoff from six natural resource management regions and 35 catchments, which drain 424,000 km^2 of coastal Queensland (Department of Environment, Tourism, Science and Innovation [DETSI], 2025). Grazing is the dominant agricultural land use (77 %), particularly in the Burdekin and Fitzroy regions.

Figure 2.1 shows the regional drainage characteristics in the vicinity of the Project.

8.9.4 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 8.4).

The 2025 end-of-catchment water quality targets are expressed as percentage reductions in anthropogenic loads and the required reductions is also shown in tonnes (or kilotonnes for fine sediment). The 2025 end-of-catchment water quality targets are expressed as percentage reductions in anthropogenic loads, and the required reductions are also shown in tonnes (or kilotonnes for fine sediment).

Table 8.6 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)

8.9.5 Catchment setting

Surface water from the Project area drains to the Isaac River, a tributary of the Fitzroy River system. Local catchments near the Project include New Chum Creek and North Creek.

Relevant surface water monitoring locations associated with the FRREMP are shown in Figure 8.7.

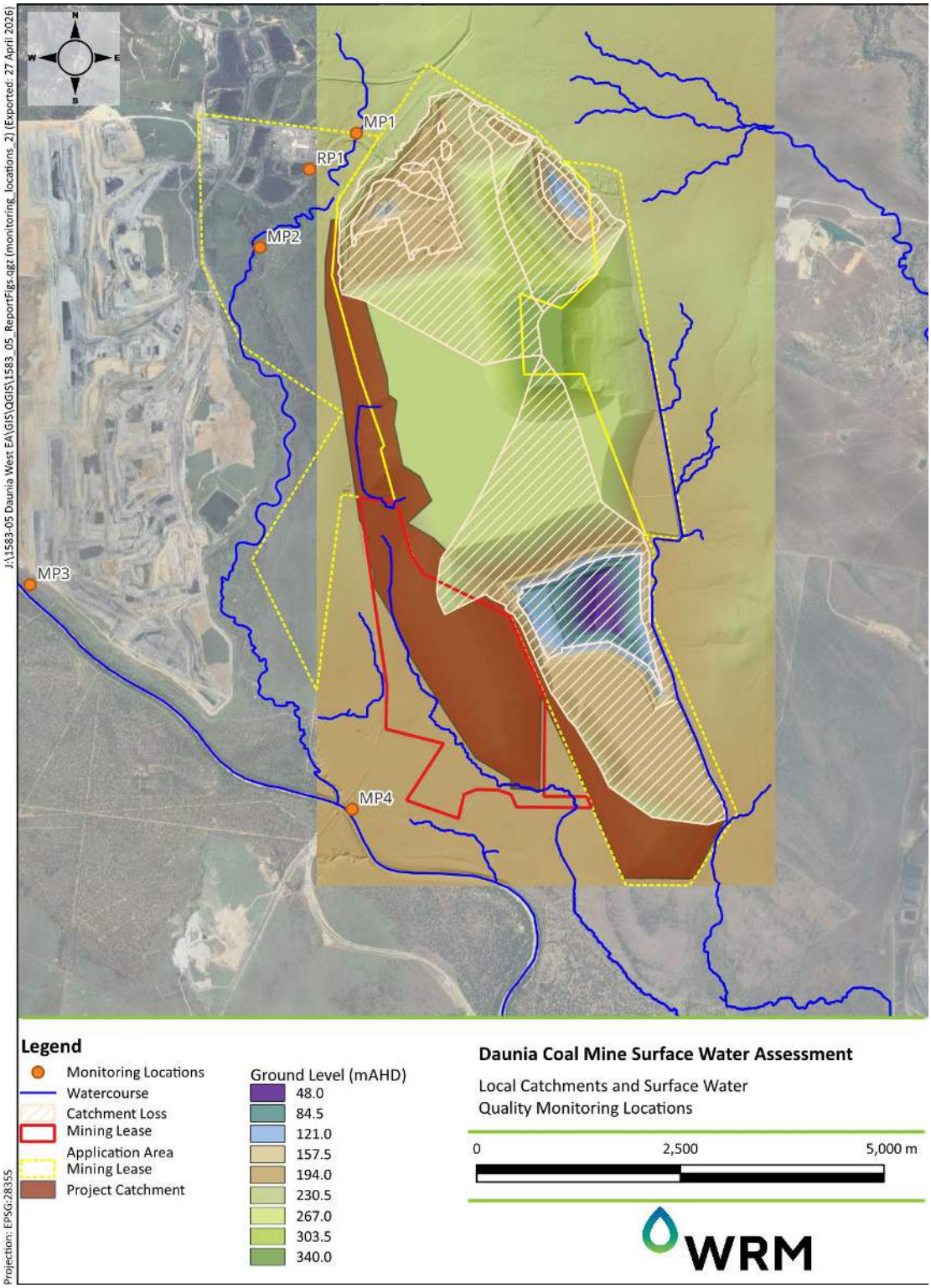

Figure 8.7 Local catchments and surface water quality monitoring locations

8.9.6 Catchment loss

Figure 8.7 compares the New Chum Creek catchment (to MP4) and the North Creek catchment under final Project conditions (including the final landform). The changes in catchment areas are tabulated in Table 8.5.

The Project involves extending existing open-cut mining operations and forming four residual voids under the final landform. These voids drain internally and would permanently excise the contributing external catchment.

The total excised catchment area to the DNM site is about 15.6 km^2, representing approximately 0.4 % of the Isaac River catchment upstream of the Site. Off this, about 5.1 km^2 is excised from the New Chum Creek catchment and 2.2 km^2 is excised from the North Creek catchment.

The Project catchment area for the reaches about 7.0 km^2 representing approximately 0.2 % of the upstream Isaac River catchment (about 3,630 km^2).

Given the small proportional change, the excision is not expected to materially alter downstream flow volumes or hydrologic behaviour.

Table 8.7 Analysis of catchment loss due to the DNM site and Project

Catchment	Area (km^2)		Difference (%)
	Existing conditions	Project conditions	
New Chum Creek (DNM)	48.0	42.9	–10.6
North Creek (DNM)	330.0	327.8	–0.7
Isaac River (DNM)	3,630.0	3,614.4	–0.4
Isaac River (Project)	3,630.0	3,622.8	–0.2

8.9.7 Isaac River Water Quality

Regional Total Suspended Solids (TSS) data from the Deverill site provide important context for interpreting downstream TSS conditions in the Isaac River system. The Deverill dataset indicates an 80th percentile concentration of 1,340 mg/L (Table 2.4). The applicable water quality objective for TSS is < 55 (aquatic).

Water quality monitoring at the downstream Isaac River monitoring location (MP4), presented in Table 8.6, was assessed against relevant Environmental Authority (EA) trigger values to evaluate compliance and potential downstream impacts.

Nitrate (as N) concentrations measured at the downstream monitoring location (MP4) during the release period were low, with a median of 190 µg/L and an 80th percentile of 280 µg/L, both were below the applicable EA trigger value of 1,100 µg/L.

No TSS data were available at MP4 during the monitoring period, and as a result, downstream suspended sediment concentrations could not be directly assessed against the aquatic ecosystem water quality objective. Regional TSS data from the Deverill monitoring site indicate a median concentration of 135 mg/L and an 80th percentile concentration of 1,340 mg/L, reflecting substantial variability in suspended sediment concentrations associated with flow-driven sediment mobilisation within the Isaac River system.

No data were available for total phosphorus (TP) during the monitoring period.

Table 8.8 Water Quality Results at MP4 and Deverill (Isaac River)

Parameter	Unit	Monitoring Point	Median	80th Percentile	EA Trigger / WQO
TSS	mg/L	Deverill	135	1,340	< 55 (aquatic)
		MP4	–	–	
Nitrate (as N)	µg/L	Deverill	10	10	< 1,100
		MP4	190	280	

8.9.8 Simplified assessment of sediment and nutrient loads

A simplified analysis was undertaken to estimate the expected TSS and TN loads (in tonnes or kilotonnes) that would be lost because of the Project 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 Project would result in a net loss of approximately 7.2 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 the Isaac River Deverill D/S gauge (as shown in Figure 3.5), which were factored down in proportion to the catchment area that would be lost.
- Based on a 0.2% reduction in the Isaac River catchment and an average daily flow of 753 ML/day at Deverill, the estimated reduction in median annual discharge volume is approximately 550 ML/a.
- Representative concentrations adopted for the assessment were based on conservative assumptions, using the highest mean concentrations observed during downstream monitoring for TSS (135 mg/L) and TN (190 µg/L).

8.9.9 Results

The Project would result in a reduction in the contributing catchment area due to the extension of the open-cut pit footprint and the formation of four residual voids under the final landform. As outlined in Section 3.3.1 and summarised in Table 3.1, a total of 15.6 km² of catchment would be excised, representing approximately 0.4% of the Isaac River catchment to the Site. This change is minor and is not expected to materially alter peak flows or downstream flow volumes.

The reduction in contributing area would reduce runoff volumes. Consequently, small reductions in TSSand total nitrogen (TN) loads to the broader Fitzroy Basin, and ultimately the Great Barrier Reef (GBR), are predicted. No data were available for total phosphorus (TP) assessment.

Table 8.7 presents a simplified estimate of the annual reduction in sediment and nutrient loads attributable to the reduction in median annual discharge volume associated with the excised catchment area. Load reductions were calculated using the loss of median annual discharge volume and representative contaminant concentrations.

Table 8.9 Simplified calculation of predicted reduction in annual TSS and TN loads to the Great Barrier Reef

Loss of median annual discharge volume (ML/a)	TSS representative concentration (mg/L)	TSS load reduction (kilotonnes)	TN representative concentration (µg/L)	TN load reduction (tonnes)
550	135	0.07	190	0.11

Note: ML/a = megalitres per annum

8.9.10 Outcome

The Project does not:

- introduce new release locations to the GBR catchment waters;
- increase authorised discharge volumes;
- increase the frequency or duration of releases; or
- increase concentrations of fine sediment or dissolved inorganic nitrogen in released waters.

Existing surface water management measures, including capture and reuse of mine-affected water and controlled releases in accordance with Environmental Authority conditions, would continue unchanged.

The reduction in contributing undisturbed catchment area results in a minor reduction, rather than an increase, in sediment and nutrient loads to GBR catchment waters. Post-mining, internal drainage of residual voids further limits potential export of FS and DIN. Accordingly:

- The Project would not result in a residual impact as defined under section 41AA of the EP Regulation; and
- The Project is consistent with the Reef discharge standards for industrial activities and the objective of no net decline in GBR catchment water quality.

8.10 FINAL VOID MANAGEMENT

The Project final landform will include residual voids functioning as groundwater sinks. Key considerations include:

- The expansion of the Pandora catchment area from 715.4 ha to 827.4 ha will result in increased surface water runoff into the final void. This adjustment, coupled with catchment excision and the final landform design, is projected to raise the mean water level in Pandora Pit void by approximately 2.8 m, reaching 94.8 mAHD.
- Void water levels will be influenced by groundwater inflow, rainfall, runoff, and evaporation, with equilibrium levels expected below overflow levels.
- Salinity will increase over time due to evapo-concentration.
- Disturbed areas will be rehabilitated to stabilise landforms and improve water quality.
- Potentially reduce void catchment area through rehabilitation and runoff diversion away from the void.

8.11 MONITORING

A comprehensive management and monitoring program was developed to ensure the long-term sustainability of hydrologic and hydraulic conditions at DNM:

- Flood Monitoring: Regular monitoring of flood behaviour and infrastructure performance during extreme events.
- Water Quality Monitoring: Routine sampling and analysis of surface water to ensure compliance with DNMs EA.
- Infrastructure Maintenance: Periodic inspections and maintenance of drainage systems, levees, and sediment basins.
- Climate Change Adaptation: Continuous evaluation of climate change impacts and implementation of adaptive measures as needed.

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 will be reviewed and updated in accordance with DNM EA.
- Management of erosion and sediment control through implementation of the ESC plan.
- Surface water monitoring would continue in accordance with the WMP. Current monitoring locations are sufficient to cover the any additional disturbance because of the Project.
- Regular inspections and maintenance of dams, pipelines, and sediment control structures.
- Real-time monitoring of controlled release volumes.

8.12 WATER MANAGEMENT PLAN

An updated Water Management Plan (WMP) will be prepared for the Project, subject to the conditions of the EA.

The WMP would describe the operational water management system and include provisions for review of the site water balance, erosion and sediment controls, surface water (and groundwater) monitoring and management. The updated WMP would describe the water management protocols and response procedures for the water management system that would be adhered to throughout the operation of the Project.

The Water Management Plan (WMP) for DNM outlines several policy recommendations to mitigate water quality impacts as follows:

- Risk Management
  - Conduct risk assessments to identify potential environmental risks, including impacts from salts, metals, aquifer contamination, and water management associated with mining activities.
  - Implement controls to mitigate risks, documented in the DNM risk register and tested during the Critical Control Monitoring (CCM) process.
- Water Management System:
  - Separate clean and contaminated water using diversion drains and sediment dams.
  - Maximize water reuse on-site to minimise releases and reliance on external water sources.
  - Use sediment dams to settle suspended solids and ensure water quality before discharge.
  - Install coalescent plate oil-water separators to manage hydrocarbon contamination.
- Saline and Acid Rock Drainage Management:
  - Encapsulate hostile materials with benign spoil during rehabilitation.
  - Direct drainage to retention dams for reuse in mine activities.
  - Conduct ongoing water quality monitoring of storages and pits.
- Monitoring and Measurement:
  - Implement a comprehensive water monitoring program, including dam safety inspections, groundwater and surface water quality monitoring, and weather tracking.
  - Use automated telemetry, in situ probes, and lab analysis for water quality monitoring.
  - Regularly review monitoring data to ensure compliance with legal conditions and environmental standards.
- Water Balance Model:
  - Maintain and update a water balance model to assess storage capacity and water movements on-site.
  - Use the model to identify risks and optimise water management strategies.
- Training and Awareness:
  - Provide environmental awareness training to employees, contractors, and visitors.

- Ensure personnel understand their roles, responsibilities, and the consequences of poor environmental performance.

- Reporting:
  - Notify regulators within 24 hours of environmental incidents or emergencies.
  - Report performance against monitoring programs and compliance requirements.
- Contaminant Management:
  - Conduct leachate testing of overburden, ore, and waste materials to predict potential water contamination.
  - Implement measures to manage saline drainage, acid rock drainage, and bio-accumulative contaminants.
  -

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APPENDIX A WATER QUALITY DATA

APPENDIX A WATER QUALITY DATA

A.1 PH

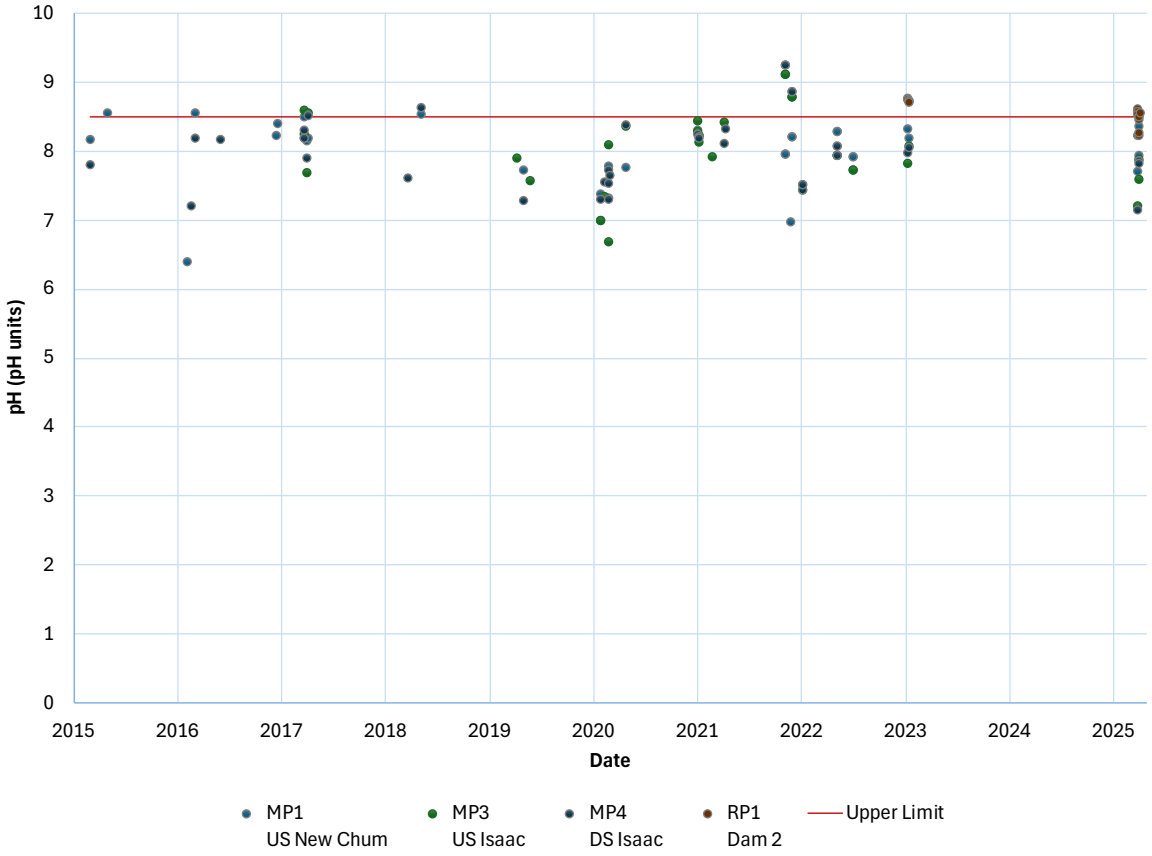

Figure A.1 pH Water Quality Analyte Levels

Table A.1 pH Water Quality Analyte Levels

Monitoring Location	Date	Analyte (pH units)	Upper Limit (pH units)	Lower Limit (pH units)
MP1US New Chum	1/03/2015	8.17	8.5	6.5
MP1US New Chum	1/05/2015	8.55	8.5	6.5
MP1US New Chum	5/02/2016	6.4	8.5	6.5
MP1US New Chum	2/03/2016	8.56	8.5	6.5
MP1US New Chum	12/12/2016	8.22	8.5	6.5
MP1US New Chum	18/12/2016	8.4	8.5	6.5
MP1US New Chum	20/03/2017	8.5	8.5	6.5
MP1US New Chum	30/03/2017	8.15	8.5	6.5

Monitoring Location	Date	Analyte (pH units)	Upper Limit (pH units)	Lower Limit (pH units)
MP1US New Chum	4/04/2017	8.18	8.5	6.5
MP1US New Chum	9/05/2018	8.53	8.5	6.5
MP1US New Chum	2/05/2019	7.73	8.5	6.5
MP1US New Chum	29/01/2020	7.37	8.5	6.5
MP1US New Chum	26/02/2020	7.79	8.5	6.5
MP1US New Chum	27/02/2020	7.33	8.5	6.5
MP1US New Chum	28/04/2020	7.76	8.5	6.5
MP1US New Chum	6/01/2021	8.3	8.5	6.5
MP1US New Chum	11/11/2021	7.95	8.5	6.5
MP1US New Chum	26/11/2021	6.97	8.5	6.5
MP1US New Chum	1/12/2021	8.2	8.5	6.5
MP1US New Chum	1/12/2021	8.2	8.5	6.5
MP1US New Chum	10/01/2022	7.51	8.5	6.5
MP1US New Chum	11/05/2022	8.29	8.5	6.5
MP1US New Chum	12/05/2022	7.93	8.5	6.5
MP1US New Chum	5/07/2022	7.91	8.5	6.5
MP1US New Chum	14/01/2023	8.32	8.5	6.5
MP1US New Chum	19/01/2023	8.18	8.5	6.5
MP1US New Chum	31/03/2025	7.71	8.5	6.5
MP1US New Chum	5/04/2025	7.94	8.5	6.5
MP1US New Chum	8/04/2025	8.37	8.5	6.5
MP3US Isaac	21/03/2017	8.6	8.5	6.5
MP3US Isaac	22/03/2017	8.24	8.5	6.5
MP3US Isaac	31/03/2017	7.69	8.5	6.5
MP3US Isaac	3/04/2017	8.56	8.5	6.5
MP3US Isaac	9/05/2018	-	8.5	6.5
MP3US Isaac	11/04/2019	7.9	8.5	6.5
MP3US Isaac	28/05/2019	7.58	8.5	6.5
MP3US Isaac	27/01/2020	6.99	8.5	6.5
MP3US Isaac	11/02/2020	7.34	8.5	6.5
MP3US Isaac	25/02/2020	6.68	8.5	6.5
MP3US Isaac	28/02/2020	8.1	8.5	6.5
MP3US Isaac	27/04/2020	8.37	8.5	6.5
MP3US Isaac	6/01/2021	8.43	8.5	6.5
MP3US Isaac	6/01/2021	8.28	8.5	6.5
MP3US Isaac	7/01/2021	8.13	8.5	6.5

Monitoring Location	Date	Analyte (pH units)	Upper Limit (pH units)	Lower Limit (pH units)
MP3US Isaac	7/01/2021	8.22	8.5	6.5
MP3US Isaac	8/01/2021	8.22	8.5	6.5
MP3US Isaac	23/02/2021	7.92	8.5	6.5
MP3US Isaac	10/04/2021	8.41	8.5	6.5
MP3US Isaac	11/11/2021	9.11	8.5	6.5
MP3US Isaac	1/12/2021	8.78	8.5	6.5
MP3US Isaac	10/01/2022	7.43	8.5	6.5
MP3US Isaac	11/05/2022	7.93	8.5	6.5
MP3US Isaac	5/07/2022	7.73	8.5	6.5
MP3US Isaac	14/01/2023	7.82	8.5	6.5
MP3US Isaac	19/01/2023	8.07	8.5	6.5
MP3US Isaac	31/03/2025	7.2	8.5	6.5
MP3US Isaac	5/04/2025	7.6	8.5	6.5
MP3US Isaac	8/04/2025	7.88	8.5	6.5
MP4DS Isaac	1/03/2015	7.81	8.5	6.5
MP4DS Isaac	16/02/2016	7.2	8.5	6.5
MP4DS Isaac	2/03/2016	8.18	8.5	6.5
MP4DS Isaac	31/05/2016	8.16	8.5	6.5
MP4DS Isaac	21/03/2017	8.3	8.5	6.5
MP4DS Isaac	22/03/2017	8.19	8.5	6.5
MP4DS Isaac	23/03/2017	8.19	8.5	6.5
MP4DS Isaac	31/03/2017	7.89	8.5	6.5
MP4DS Isaac	3/04/2017	8.52	8.5	6.5
MP4DS Isaac	22/03/2018	7.61	8.5	6.5
MP4DS Isaac	9/05/2018	8.64	8.5	6.5
MP4DS Isaac	3/05/2019	7.29	8.5	6.5
MP4DS Isaac	27/01/2020	7.31	8.5	6.5
MP4DS Isaac	11/02/2020	7.56	8.5	6.5
MP4DS Isaac	25/02/2020	7.31	8.5	6.5
MP4DS Isaac	26/02/2020	7.54	8.5	6.5
MP4DS Isaac	27/02/2020	7.72	8.5	6.5
MP4DS Isaac	2/03/2020	7.64	8.5	6.5
MP4DS Isaac	28/04/2020	8.38	8.5	6.5
MP4DS Isaac	6/01/2021	8.25	8.5	6.5
MP4DS Isaac	7/01/2021	8.2	8.5	6.5
MP4DS Isaac	8/01/2021	8.18	8.5	6.5

Monitoring Location	Date	Analyte (pH units)	Upper Limit (pH units)	Lower Limit (pH units)
MP4DS Isaac	10/04/2021	8.12	8.5	6.5
MP4DS Isaac	14/04/2021	8.33	8.5	6.5
MP4DS Isaac	11/11/2021	9.24	8.5	6.5
MP4DS Isaac	1/12/2021	8.87	8.5	6.5
MP4DS Isaac	10/01/2022	7.43	8.5	6.5
MP4DS Isaac	10/01/2022	7.51	8.5	6.5
MP4DS Isaac	11/05/2022	8.08	8.5	6.5
MP4DS Isaac	11/05/2022	7.93	8.5	6.5
MP4DS Isaac	14/01/2023	7.98	8.5	6.5
MP4DS Isaac	19/01/2023	8.05	8.5	6.5
MP4DS Isaac	31/03/2025	7.14	8.5	6.5
MP4DS Isaac	5/04/2025	7.86	8.5	6.5
MP4DS Isaac	8/04/2025	7.82	8.5	6.5
RP1Dam 2	14/01/2023	8.77	8.5	6.5
RP1Dam 2	15/01/2023	8.75	8.5	6.5
RP1Dam 2	16/01/2023	8.73	8.5	6.5
RP1Dam 2	17/01/2023	8.72	8.5	6.5
RP1Dam 2	18/01/2023	8.72	8.5	6.5
RP1Dam 2	19/01/2023	8.7	8.5	6.5
RP1Dam 2	31/03/2025	8.22	8.5	6.5
RP1Dam 2	1/04/2025	8.61	8.5	6.5
RP1Dam 2	2/04/2025	8.58	8.5	6.5
RP1Dam 2	3/04/2025	8.53	8.5	6.5
RP1Dam 2	4/04/2025	8.49	8.5	6.5
RP1Dam 2	5/04/2025	8.46	8.5	6.5
RP1Dam 2	6/04/2025	8.49	8.5	6.5
RP1Dam 2	7/04/2025	8.22	8.5	6.5
RP1Dam 2	8/04/2025	8.26	8.5	6.5
RP1Dam 2	9/04/2025	8.55	8.5	6.5

A.2 ELECTRICAL CONDUCTIVITY

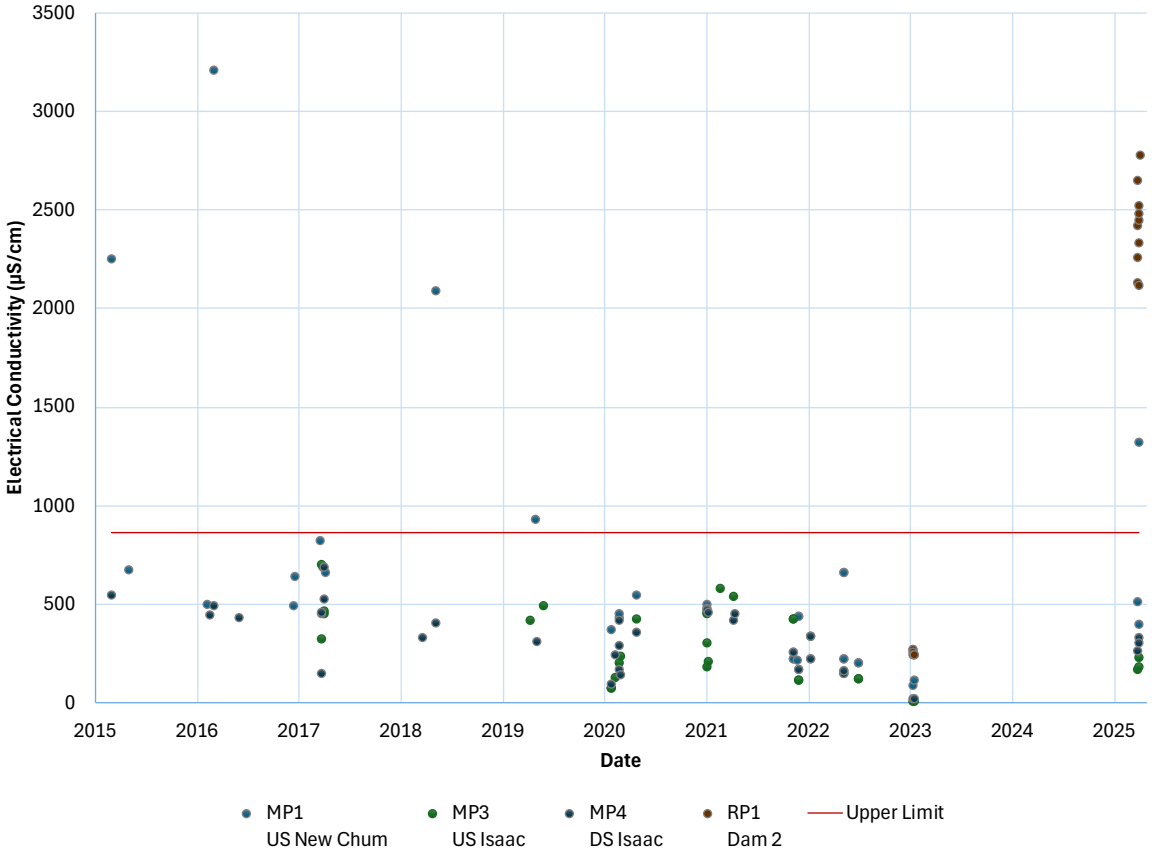

Figure A.2 Electrical Conductivity Water Quality Analyte Levels

Table A.2 Electrical Conductivity Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µS/cm)	Upper Limit (µS/cm)
MP1US New Chum	1/03/2015	2254	864
MP1US New Chum	1/05/2015	676	864
MP1US New Chum	5/02/2016	500	864
MP1US New Chum	2/03/2016	3209	864
MP1US New Chum	12/12/2016	494	864
MP1US New Chum	18/12/2016	638	864
MP1US New Chum	20/03/2017	825	864
MP1US New Chum	30/03/2017	689	864
MP1US New Chum	4/04/2017	658	864
MP1US New Chum	9/05/2018	2092	864
MP1US New Chum	2/05/2019	933.74	864

Monitoring Location	Date	Analyte (µS/cm)	Upper Limit (µS/cm)
MP1US New Chum	29/01/2020	370	864
MP1US New Chum	26/02/2020	429	864
MP1US New Chum	27/02/2020	454	864
MP1US New Chum	28/04/2020	547	864
MP1US New Chum	6/01/2021	500	864
MP1US New Chum	11/11/2021	225	864
MP1US New Chum	26/11/2021	219	864
MP1US New Chum	1/12/2021	441	864
MP1US New Chum	10/01/2022	222	864
MP1US New Chum	11/05/2022	221	864
MP1US New Chum	12/05/2022	659	864
MP1US New Chum	5/07/2022	200	864
MP1US New Chum	14/01/2023	86	864
MP1US New Chum	19/01/2023	114	864
MP1US New Chum	31/03/2025	515	864
MP1US New Chum	5/04/2025	401	864
MP1US New Chum	8/04/2025	1320	864
MP3US Isaac	21/03/2017	705	864
MP3US Isaac	22/03/2017	325	864
MP3US Isaac	31/03/2017	455	864
MP3US Isaac	3/04/2017	463	864
MP3US Isaac	9/05/2018	-	864
MP3US Isaac	11/04/2019	418.11	864
MP3US Isaac	28/05/2019	494.93	864
MP3US Isaac	27/01/2020	75	864
MP3US Isaac	11/02/2020	129	864
MP3US Isaac	25/02/2020	205	864
MP3US Isaac	28/02/2020	238	864
MP3US Isaac	27/04/2020	428	864
MP3US Isaac	6/01/2021	185	864
MP3US Isaac	6/01/2021	460	864
MP3US Isaac	7/01/2021	305	864
MP3US Isaac	7/01/2021	450	864
MP3US Isaac	8/01/2021	210	864
MP3US Isaac	23/02/2021	581.8	864
MP3US Isaac	10/04/2021	543	864

Monitoring Location	Date	Analyte (µS/cm)	Upper Limit (µS/cm)
MP3US Isaac	11/11/2021	428	864
MP3US Isaac	1/12/2021	118	864
MP3US Isaac	10/01/2022	337	864
MP3US Isaac	11/05/2022	152	864
MP3US Isaac	5/07/2022	120	864
MP3US Isaac	14/01/2023	7	864
MP3US Isaac	19/01/2023	8	864
MP3US Isaac	31/03/2025	168	864
MP3US Isaac	5/04/2025	182	864
MP3US Isaac	8/04/2025	229	864
MP4DS Isaac	1/03/2015	548	864
MP4DS Isaac	16/02/2016	444	864
MP4DS Isaac	2/03/2016	490	864
MP4DS Isaac	31/05/2016	432	864
MP4DS Isaac	21/03/2017	148	864
MP4DS Isaac	22/03/2017	449	864
MP4DS Isaac	23/03/2017	460	864
MP4DS Isaac	31/03/2017	528	864
MP4DS Isaac	3/04/2017	688	864
MP4DS Isaac	22/03/2018	328	864
MP4DS Isaac	9/05/2018	406	864
MP4DS Isaac	3/05/2019	311.06	864
MP4DS Isaac	27/01/2020	98	864
MP4DS Isaac	11/02/2020	245	864
MP4DS Isaac	25/02/2020	290	864
MP4DS Isaac	26/02/2020	166	864
MP4DS Isaac	27/02/2020	416	864
MP4DS Isaac	2/03/2020	139	864
MP4DS Isaac	28/04/2020	356	864
MP4DS Isaac	6/01/2021	480	864
MP4DS Isaac	7/01/2021	470	864
MP4DS Isaac	8/01/2021	460	864
MP4DS Isaac	10/04/2021	420	864
MP4DS Isaac	14/04/2021	449	864
MP4DS Isaac	11/11/2021	259	864
MP4DS Isaac	1/12/2021	168	864

Monitoring Location	Date	Analyte (µS/cm)	Upper Limit (µS/cm)
MP4DS Isaac	10/01/2022	337	864
MP4DS Isaac	10/01/2022	222	864
MP4DS Isaac	11/05/2022	162	864
MP4DS Isaac	11/05/2022	152	864
MP4DS Isaac	14/01/2023	20	864
MP4DS Isaac	19/01/2023	20	864
MP4DS Isaac	31/03/2025	264	864
MP4DS Isaac	5/04/2025	331	864
MP4DS Isaac	8/04/2025	303	864
RP1Dam 2	14/01/2023	268	864
RP1Dam 2	15/01/2023	272	864
RP1Dam 2	16/01/2023	260	864
RP1Dam 2	17/01/2023	246	864
RP1Dam 2	18/01/2023	246	864
RP1Dam 2	19/01/2023	242	864
RP1Dam 2	31/03/2025	2260	864
RP1Dam 2	1/04/2025	2420	864
RP1Dam 2	2/04/2025	2650	864
RP1Dam 2	3/04/2025	2130	864
RP1Dam 2	4/04/2025	2120	864
RP1Dam 2	5/04/2025	2450	864
RP1Dam 2	6/04/2025	2520	864
RP1Dam 2	7/04/2025	2480	864
RP1Dam 2	8/04/2025	2330	864
RP1Dam 2	9/04/2025	2780	864

A.3 SULPHATE

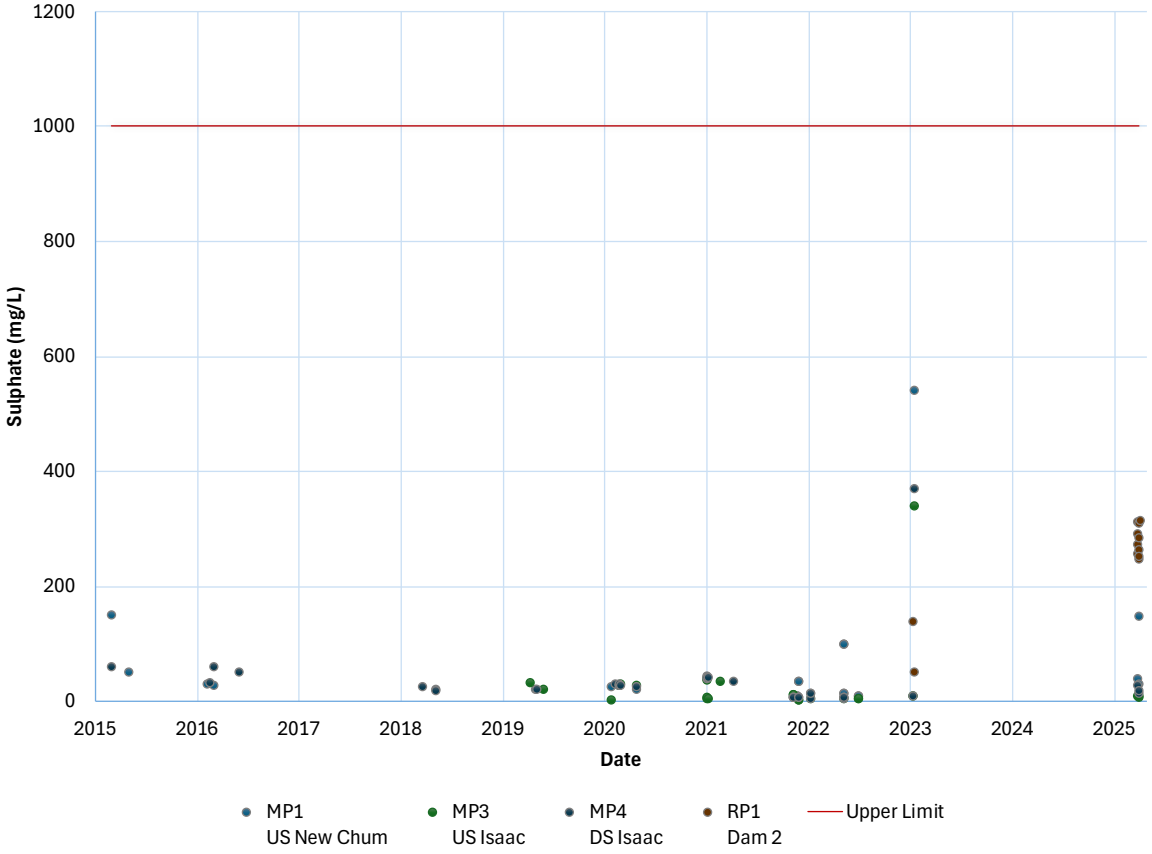

Figure A.3 Sulphate Water Quality Analyte Levels

Table A.3 Sulphate Water Quality Analyte Levels

Monitoring Location	Date	Analyte (mg/L)	Upper Limit (mg/L)
MP1US New Chum	1/03/2015	150	1000
MP1US New Chum	1/05/2015	50	1000
MP1US New Chum	5/02/2016	29.5	1000
MP1US New Chum	2/03/2016	27.41	1000
MP1US New Chum	12/12/2016	-	1000
MP1US New Chum	18/12/2016	-	1000
MP1US New Chum	20/03/2017	-	1000
MP1US New Chum	30/03/2017	-	1000
MP1US New Chum	4/04/2017	-	1000
MP1US New Chum	9/05/2018	19.92	1000

Monitoring Location	Date	Analyte (mg/L)	Upper Limit (mg/L)
MP1US New Chum	2/05/2019	20.7	1000
MP1US New Chum	29/01/2020	25	1000
MP1US New Chum	26/02/2020	29	1000
MP1US New Chum	27/02/2020	28	1000
MP1US New Chum	28/04/2020	20	1000
MP1US New Chum	6/01/2021	45	1000
MP1US New Chum	11/11/2021	7	1000
MP1US New Chum	26/11/2021	10	1000
MP1US New Chum	1/12/2021	35	1000
MP1US New Chum	10/01/2022	13	1000
MP1US New Chum	11/05/2022	13	1000
MP1US New Chum	12/05/2022	100	1000
MP1US New Chum	5/07/2022	10	1000
MP1US New Chum	14/01/2023	10	1000
MP1US New Chum	19/01/2023	540	1000
MP1US New Chum	31/03/2025	40	1000
MP1US New Chum	5/04/2025	31	1000
MP1US New Chum	8/04/2025	149	1000
MP3US Isaac	21/03/2017	-	1000
MP3US Isaac	22/03/2017	-	1000
MP3US Isaac	31/03/2017	-	1000
MP3US Isaac	3/04/2017	-	1000
MP3US Isaac	9/05/2018	-	1000
MP3US Isaac	11/04/2019	31.41	1000
MP3US Isaac	28/05/2019	21.05	1000
MP3US Isaac	27/01/2020	-	1000
MP3US Isaac	27/01/2020	2	1000
MP3US Isaac	11/02/2020	-	1000
MP3US Isaac	25/02/2020	29	1000
MP3US Isaac	28/02/2020	30	1000
MP3US Isaac	27/04/2020	28.7	1000
MP3US Isaac	6/01/2021	4	1000
MP3US Isaac	6/01/2021	38	1000
MP3US Isaac	7/01/2021	8	1000
MP3US Isaac	7/01/2021	39	1000
MP3US Isaac	8/01/2021	5	1000

Monitoring Location	Date	Analyte (mg/L)	Upper Limit (mg/L)
MP3US Isaac	23/02/2021	35	1000
MP3US Isaac	10/04/2021	-	1000
MP3US Isaac	11/11/2021	11	1000
MP3US Isaac	1/12/2021	2	1000
MP3US Isaac	10/01/2022	5	1000
MP3US Isaac	11/05/2022	4	1000
MP3US Isaac	5/07/2022	4	1000
MP3US Isaac	14/01/2023	10	1000
MP3US Isaac	19/01/2023	340	1000
MP3US Isaac	31/03/2025	9	1000
MP3US Isaac	5/04/2025	6	1000
MP3US Isaac	8/04/2025	9	1000
MP4DS Isaac	1/03/2015	60	1000
MP4DS Isaac	16/02/2016	33.1	1000
MP4DS Isaac	2/03/2016	60	1000
MP4DS Isaac	31/05/2016	50	1000
MP4DS Isaac	21/03/2017	-	1000
MP4DS Isaac	22/03/2017	-	1000
MP4DS Isaac	23/03/2017	-	1000
MP4DS Isaac	31/03/2017	-	1000
MP4DS Isaac	3/04/2017	-	1000
MP4DS Isaac	22/03/2018	25.89	1000
MP4DS Isaac	9/05/2018	19.46	1000
MP4DS Isaac	3/05/2019	22.02	1000
MP4DS Isaac	27/01/2020	-	1000
MP4DS Isaac	11/02/2020	30	1000
MP4DS Isaac	25/02/2020	28	1000
MP4DS Isaac	26/02/2020	29	1000
MP4DS Isaac	27/02/2020	31	1000
MP4DS Isaac	2/03/2020	28.5	1000
MP4DS Isaac	28/04/2020	26	1000
MP4DS Isaac	6/01/2021	40	1000
MP4DS Isaac	7/01/2021	42	1000
MP4DS Isaac	8/01/2021	41	1000
MP4DS Isaac	10/04/2021	35	1000
MP4DS Isaac	14/04/2021	-	1000

Monitoring Location	Date	Analyte (mg/L)	Upper Limit (mg/L)
MP4DS Isaac	11/11/2021	7	1000
MP4DS Isaac	1/12/2021	6	1000
MP4DS Isaac	10/01/2022	5	1000
MP4DS Isaac	10/01/2022	13	1000
MP4DS Isaac	11/05/2022	7	1000
MP4DS Isaac	11/05/2022	4	1000
MP4DS Isaac	14/01/2023	10	1000
MP4DS Isaac	19/01/2023	370	1000
MP4DS Isaac	31/03/2025	27	1000
MP4DS Isaac	5/04/2025	14	1000
MP4DS Isaac	8/04/2025	18	1000
RP1Dam 2	14/01/2023	140	1000
RP1Dam 2	15/01/2023	-	1000
RP1Dam 2	16/01/2023	-	1000
RP1Dam 2	17/01/2023	-	1000
RP1Dam 2	18/01/2023	-	1000
RP1Dam 2	19/01/2023	50	1000
RP1Dam 2	31/03/2025	292	1000
RP1Dam 2	1/04/2025	274	1000
RP1Dam 2	2/04/2025	312	1000
RP1Dam 2	3/04/2025	256	1000
RP1Dam 2	4/04/2025	248	1000
RP1Dam 2	5/04/2025	285	1000
RP1Dam 2	6/04/2025	311	1000
RP1Dam 2	7/04/2025	264	1000
RP1Dam 2	8/04/2025	253	1000
RP1Dam 2	9/04/2025	314	1000

A.4 ALUMINIUM

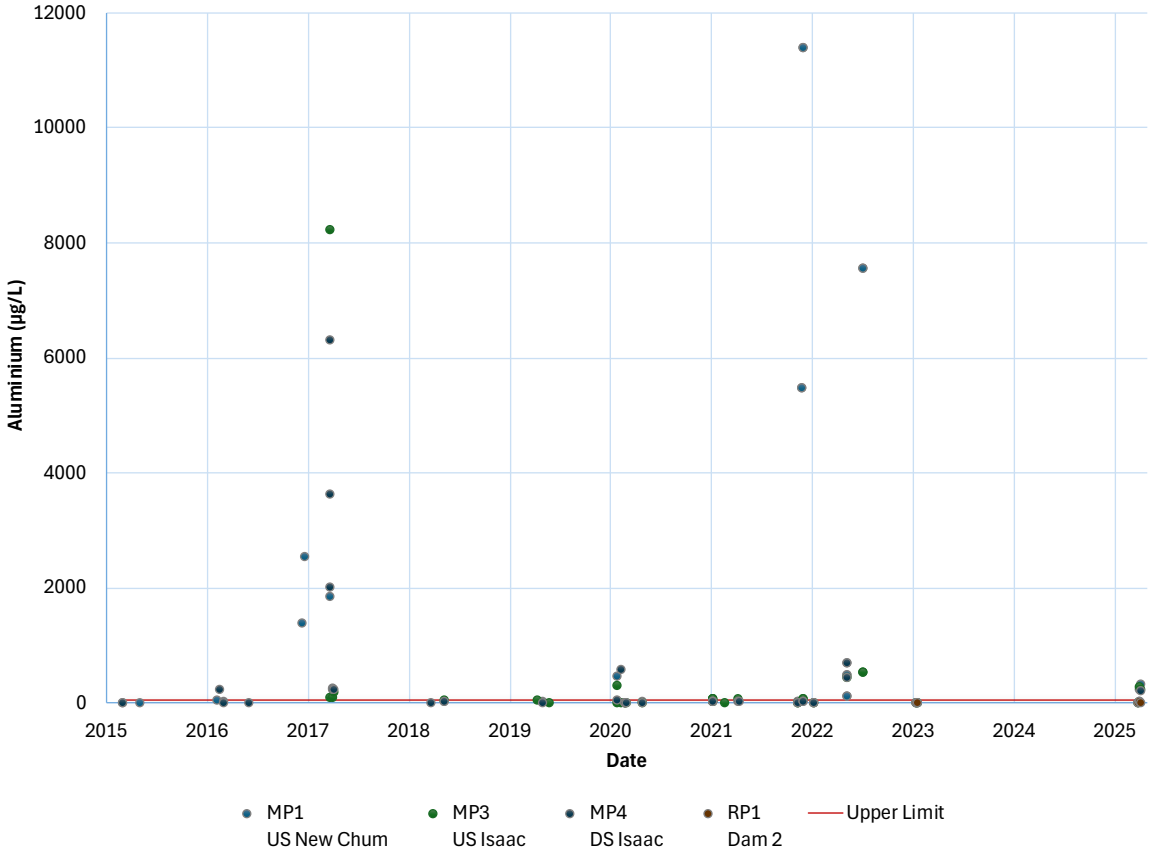

Figure A.4 Aluminium Water Quality Analyte Levels

Table A.4 Aluminium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	10	55
MP1US New Chum	1/05/2015	10	55
MP1US New Chum	5/02/2016	40	55
MP1US New Chum	2/03/2016	20	55
MP1US New Chum	12/12/2016	1390	55
MP1US New Chum	18/12/2016	2550	55
MP1US New Chum	20/03/2017	1850	55
MP1US New Chum	30/03/2017	250	55
MP1US New Chum	4/04/2017	-	55
MP1US New Chum	9/05/2018	20	55
MP1US New Chum	2/05/2019	30	55

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	470	55
MP1US New Chum	26/02/2020	10	55
MP1US New Chum	27/02/2020	10	55
MP1US New Chum	28/04/2020	20	55
MP1US New Chum	6/01/2021	35	55
MP1US New Chum	11/11/2021	20	55
MP1US New Chum	26/11/2021	5490	55
MP1US New Chum	1/12/2021	11400	55
MP1US New Chum	10/01/2022	10	55
MP1US New Chum	11/05/2022	480	55
MP1US New Chum	12/05/2022	110	55
MP1US New Chum	5/07/2022	7560	55
MP1US New Chum	14/01/2023	1	55
MP1US New Chum	19/01/2023	1	55
MP1US New Chum	31/03/2025	10	55
MP1US New Chum	5/04/2025	230	55
MP1US New Chum	8/04/2025	320	55
MP3US Isaac	21/03/2017	8220	55
MP3US Isaac	22/03/2017	100	55
MP3US Isaac	31/03/2017	100	55
MP3US Isaac	3/04/2017	180	55
MP3US Isaac	9/05/2018	40	55
MP3US Isaac	11/04/2019	50	55
MP3US Isaac	28/05/2019	10	55
MP3US Isaac	27/01/2020	300	55
MP3US Isaac	27/01/2020	0.3	55
MP3US Isaac	11/02/2020	10	55
MP3US Isaac	25/02/2020	10	55
MP3US Isaac	28/02/2020	10	55
MP3US Isaac	27/04/2020	10	55
MP3US Isaac	6/01/2021	60	55
MP3US Isaac	6/01/2021	28	55
MP3US Isaac	7/01/2021	60	55
MP3US Isaac	7/01/2021	29	55
MP3US Isaac	8/01/2021	60	55
MP3US Isaac	23/02/2021	10	55

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	10/04/2021	70	55
MP3US Isaac	11/11/2021	10	55
MP3US Isaac	1/12/2021	70	55
MP3US Isaac	10/01/2022	10	55
MP3US Isaac	11/05/2022	450	55
MP3US Isaac	5/07/2022	530	55
MP3US Isaac	14/01/2023	1	55
MP3US Isaac	19/01/2023	1	55
MP3US Isaac	31/03/2025	10	55
MP3US Isaac	5/04/2025	290	55
MP3US Isaac	8/04/2025	240	55
MP4DS Isaac	1/03/2015	10	55
MP4DS Isaac	16/02/2016	240	55
MP4DS Isaac	2/03/2016	10	55
MP4DS Isaac	31/05/2016	10	55
MP4DS Isaac	21/03/2017	2020	55
MP4DS Isaac	22/03/2017	6320	55
MP4DS Isaac	23/03/2017	3620	55
MP4DS Isaac	31/03/2017	230	55
MP4DS Isaac	3/04/2017	242	55
MP4DS Isaac	22/03/2018	10	55
MP4DS Isaac	9/05/2018	30	55
MP4DS Isaac	3/05/2019	10	55
MP4DS Isaac	27/01/2020	40	55
MP4DS Isaac	11/02/2020	570	55
MP4DS Isaac	25/02/2020	10	55
MP4DS Isaac	26/02/2020	10	55
MP4DS Isaac	27/02/2020	10	55
MP4DS Isaac	2/03/2020	10	55
MP4DS Isaac	28/04/2020	10	55
MP4DS Isaac	6/01/2021	30	55
MP4DS Isaac	7/01/2021	32	55
MP4DS Isaac	8/01/2021	31	55
MP4DS Isaac	10/04/2021	25	55
MP4DS Isaac	14/04/2021	20	55
MP4DS Isaac	11/11/2021	10	55

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	1/12/2021	20	55
MP4DS Isaac	10/01/2022	10	55
MP4DS Isaac	11/05/2022	700	55
MP4DS Isaac	11/05/2022	450	55
MP4DS Isaac	14/01/2023	1	55
MP4DS Isaac	19/01/2023	1	55
MP4DS Isaac	31/03/2025	10	55
MP4DS Isaac	5/04/2025	20	55
MP4DS Isaac	8/04/2025	220	55
RP1Dam 2	14/01/2023	4	55
RP1Dam 2	15/01/2023	-	55
RP1Dam 2	16/01/2023	-	55
RP1Dam 2	17/01/2023	-	55
RP1Dam 2	18/01/2023	-	55
RP1Dam 2	19/01/2023	3	55
RP1Dam 2	31/03/2025	10	55
RP1Dam 2	1/04/2025	-	55
RP1Dam 2	2/04/2025	-	55
RP1Dam 2	3/04/2025	-	55
RP1Dam 2	4/04/2025	-	55
RP1Dam 2	5/04/2025	20	55
RP1Dam 2	6/04/2025	-	55
RP1Dam 2	7/04/2025	-	55
RP1Dam 2	8/04/2025	10	55
RP1Dam 2	9/04/2025	-	55

A.5 ARSENIC

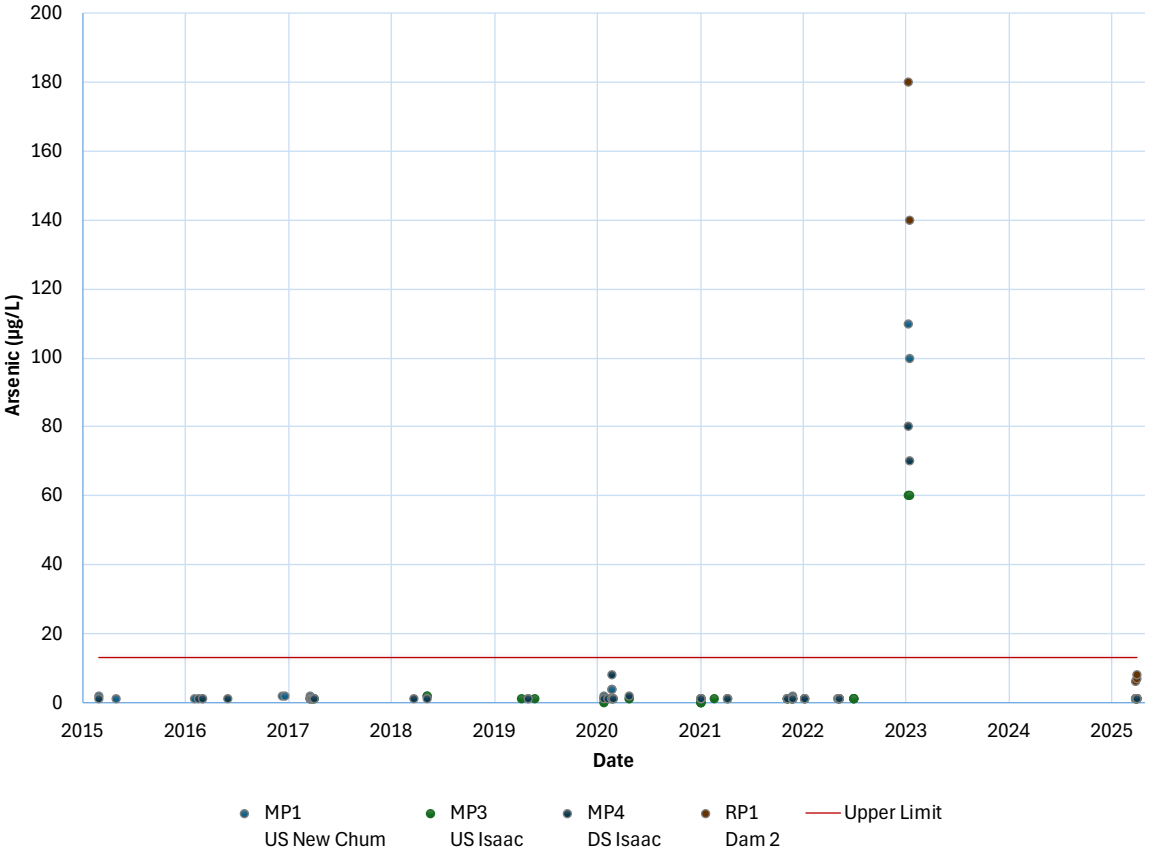

Figure A.5 Arsenic Water Quality Analyte Levels

Table A.5 Arsenic Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	2	13
MP1US New Chum	1/05/2015	1	13
MP1US New Chum	5/02/2016	1	13
MP1US New Chum	2/03/2016	1	13
MP1US New Chum	12/12/2016	2	13
MP1US New Chum	18/12/2016	2	13
MP1US New Chum	20/03/2017	2	13
MP1US New Chum	30/03/2017	1	13
MP1US New Chum	4/04/2017	1	13
MP1US New Chum	9/05/2018	2	13
MP1US New Chum	2/05/2019	1	13
MP1US New Chum	29/01/2020	2	13
MP1US New Chum	26/02/2020	4	13

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	27/02/2020	4	13
MP1US New Chum	28/04/2020	1	13
MP1US New Chum	6/01/2021	1	13
MP1US New Chum	11/11/2021	1	13
MP1US New Chum	26/11/2021	1	13
MP1US New Chum	1/12/2021	2	13
MP1US New Chum	1/12/2021	1	13
MP1US New Chum	10/01/2022	1	13
MP1US New Chum	11/05/2022	1	13
MP1US New Chum	12/05/2022	1	13
MP1US New Chum	5/07/2022	1	13
MP1US New Chum	14/01/2023	110	13
MP1US New Chum	19/01/2023	100	13
MP1US New Chum	31/03/2025	1	13
MP1US New Chum	5/04/2025	1	13
MP1US New Chum	8/04/2025	1	13
MP3US Isaac	21/03/2017	1	13
MP3US Isaac	22/03/2017	1	13
MP3US Isaac	31/03/2017	1	13
MP3US Isaac	3/04/2017	1	13
MP3US Isaac	9/05/2018	2	13
MP3US Isaac	11/04/2019	1	13
MP3US Isaac	28/05/2019	1	13
MP3US Isaac	27/01/2020	1	13
MP3US Isaac	27/01/2020	0.001	13
MP3US Isaac	11/02/2020	1	13
MP3US Isaac	25/02/2020	1	13
MP3US Isaac	28/02/2020	1	13
MP3US Isaac	27/04/2020	1	13
MP3US Isaac	6/01/2021	0.1	13
MP3US Isaac	6/01/2021	1	13
MP3US Isaac	7/01/2021	0.1	13
MP3US Isaac	7/01/2021	1	13
MP3US Isaac	8/01/2021	0.1	13
MP3US Isaac	23/02/2021	1	13
MP3US Isaac	10/04/2021	1	13

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	11/11/2021	1	13
MP3US Isaac	1/12/2021	1	13
MP3US Isaac	10/01/2022	1	13
MP3US Isaac	11/05/2022	1	13
MP3US Isaac	5/07/2022	1	13
MP3US Isaac	14/01/2023	60	13
MP3US Isaac	19/01/2023	60	13
MP3US Isaac	31/03/2025	1	13
MP3US Isaac	5/04/2025	1	13
MP3US Isaac	8/04/2025	1	13
MP4DS Isaac	1/03/2015	1	13
MP4DS Isaac	16/02/2016	1	13
MP4DS Isaac	2/03/2016	1	13
MP4DS Isaac	31/05/2016	1	13
MP4DS Isaac	21/03/2017	1	13
MP4DS Isaac	22/03/2017	1	13
MP4DS Isaac	23/03/2017	1	13
MP4DS Isaac	31/03/2017	1	13
MP4DS Isaac	3/04/2017	1	13
MP4DS Isaac	22/03/2018	1	13
MP4DS Isaac	9/05/2018	1	13
MP4DS Isaac	3/05/2019	1	13
MP4DS Isaac	27/01/2020	1	13
MP4DS Isaac	11/02/2020	1	13
MP4DS Isaac	25/02/2020	1	13
MP4DS Isaac	26/02/2020	1	13
MP4DS Isaac	27/02/2020	8	13
MP4DS Isaac	2/03/2020	1	13
MP4DS Isaac	28/04/2020	2	13
MP4DS Isaac	6/01/2021	1	13
MP4DS Isaac	7/01/2021	1	13
MP4DS Isaac	8/01/2021	1	13
MP4DS Isaac	10/04/2021	1	13
MP4DS Isaac	14/04/2021	1	13
MP4DS Isaac	11/11/2021	1	13
MP4DS Isaac	1/12/2021	1	13

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	10/01/2022	1	13
MP4DS Isaac	11/05/2022	1	13
MP4DS Isaac	14/01/2023	80	13
MP4DS Isaac	19/01/2023	70	13
MP4DS Isaac	31/03/2025	1	13
MP4DS Isaac	5/04/2025	1	13
MP4DS Isaac	8/04/2025	1	13
RP1Dam 2	14/01/2023	180	13
RP1Dam 2	15/01/2023	-	13
RP1Dam 2	16/01/2023	-	13
RP1Dam 2	17/01/2023	-	13
RP1Dam 2	18/01/2023	-	13
RP1Dam 2	19/01/2023	140	13
RP1Dam 2	31/03/2025	6	13
RP1Dam 2	1/04/2025	-	13
RP1Dam 2	2/04/2025	-	13
RP1Dam 2	3/04/2025	-	13
RP1Dam 2	4/04/2025	-	13
RP1Dam 2	5/04/2025	7	13
RP1Dam 2	6/04/2025	-	13
RP1Dam 2	7/04/2025	-	13
RP1Dam 2	8/04/2025	8	13
RP1Dam 2	9/04/2025	-	13

A.6 BORON

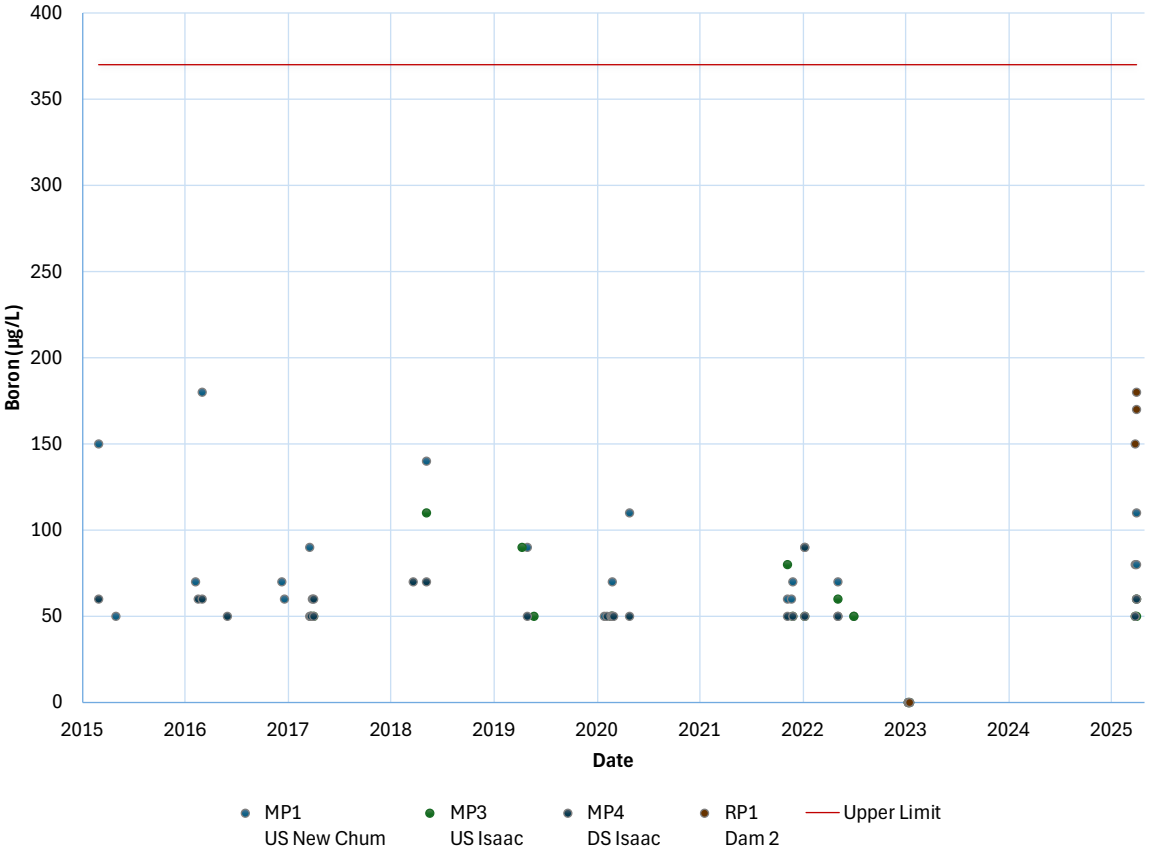

Figure A.6 Boron Water Quality Analyte Levels

Table A.6 Boron Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	150	370
MP1US New Chum	1/05/2015	50	370
MP1US New Chum	5/02/2016	70	370
MP1US New Chum	2/03/2016	180	370
MP1US New Chum	12/12/2016	70	370
MP1US New Chum	18/12/2016	60	370
MP1US New Chum	20/03/2017	90	370
MP1US New Chum	30/03/2017	60	370
MP1US New Chum	4/04/2017	-	370
MP1US New Chum	9/05/2018	140	370
MP1US New Chum	2/05/2019	90	370

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	50	370
MP1US New Chum	26/02/2020	70	370
MP1US New Chum	27/02/2020	50	370
MP1US New Chum	28/04/2020	110	370
MP1US New Chum	6/01/2021	-	370
MP1US New Chum	18/02/2021	-	370
MP1US New Chum	11/11/2021	60	370
MP1US New Chum	11/11/2021	-	370
MP1US New Chum	26/11/2021	60	370
MP1US New Chum	26/11/2021	-	370
MP1US New Chum	1/12/2021	70	370
MP1US New Chum	1/12/2021	-	370
MP1US New Chum	10/01/2022	90	370
MP1US New Chum	11/05/2022	50	370
MP1US New Chum	11/05/2022	-	370
MP1US New Chum	12/05/2022	70	370
MP1US New Chum	12/05/2022	-	370
MP1US New Chum	5/07/2022	50	370
MP1US New Chum	5/07/2022	-	370
MP1US New Chum	14/01/2023	0.1	370
MP1US New Chum	19/01/2023	0.1	370
MP1US New Chum	31/03/2025	80	370
MP1US New Chum	5/04/2025	80	370
MP1US New Chum	8/04/2025	110	370
MP3US Isaac	21/03/2017	-	370
MP3US Isaac	22/03/2017	50	370
MP3US Isaac	31/03/2017	50	370
MP3US Isaac	3/04/2017	-	370
MP3US Isaac	9/05/2018	110	370
MP3US Isaac	11/04/2019	90	370
MP3US Isaac	28/05/2019	50	370
MP3US Isaac	27/01/2020	-	370
MP3US Isaac	27/01/2020	-	370
MP3US Isaac	11/02/2020	-	370
MP3US Isaac	25/02/2020	50	370
MP3US Isaac	28/02/2020	50	370

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	27/04/2020	-	370
MP3US Isaac	6/01/2021	-	370
MP3US Isaac	7/01/2021	-	370
MP3US Isaac	8/01/2021	-	370
MP3US Isaac	23/02/2021	-	370
MP3US Isaac	10/04/2021	-	370
MP3US Isaac	11/11/2021	80	370
MP3US Isaac	11/11/2021	-	370
MP3US Isaac	1/12/2021	50	370
MP3US Isaac	1/12/2021	-	370
MP3US Isaac	10/01/2022	50	370
MP3US Isaac	11/05/2022	60	370
MP3US Isaac	5/07/2022	50	370
MP3US Isaac	5/07/2022	-	370
MP3US Isaac	14/01/2023	0.1	370
MP3US Isaac	19/01/2023	0.1	370
MP3US Isaac	31/03/2025	50	370
MP3US Isaac	5/04/2025	60	370
MP3US Isaac	8/04/2025	50	370
MP4DS Isaac	1/03/2015	60	370
MP4DS Isaac	16/02/2016	60	370
MP4DS Isaac	2/03/2016	60	370
MP4DS Isaac	31/05/2016	50	370
MP4DS Isaac	21/03/2017	50	370
MP4DS Isaac	22/03/2017	50	370
MP4DS Isaac	23/03/2017	50	370
MP4DS Isaac	31/03/2017	50	370
MP4DS Isaac	3/04/2017	60	370
MP4DS Isaac	22/03/2018	70	370
MP4DS Isaac	9/05/2018	70	370
MP4DS Isaac	3/05/2019	50	370
MP4DS Isaac	27/01/2020	-	370
MP4DS Isaac	11/02/2020	50	370
MP4DS Isaac	25/02/2020	50	370
MP4DS Isaac	26/02/2020	50	370
MP4DS Isaac	27/02/2020	50	370

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	2/03/2020	50	370
MP4DS Isaac	28/04/2020	50	370
MP4DS Isaac	6/01/2021	-	370
MP4DS Isaac	7/01/2021	-	370
MP4DS Isaac	8/01/2021	-	370
MP4DS Isaac	10/04/2021	-	370
MP4DS Isaac	14/04/2021	-	370
MP4DS Isaac	11/11/2021	50	370
MP4DS Isaac	11/11/2021	-	370
MP4DS Isaac	1/12/2021	50	370
MP4DS Isaac	1/12/2021	-	370
MP4DS Isaac	10/01/2022	50	370
MP4DS Isaac	10/01/2022	90	370
MP4DS Isaac	11/05/2022	50	370
MP4DS Isaac	11/05/2022	-	370
MP4DS Isaac	11/05/2022	-	370
MP4DS Isaac	14/01/2023	0.1	370
MP4DS Isaac	19/01/2023	0.1	370
MP4DS Isaac	31/03/2025	50	370
MP4DS Isaac	5/04/2025	60	370
MP4DS Isaac	8/04/2025	60	370
RP1Dam 2	14/01/2023	0.1	370
RP1Dam 2	15/01/2023	-	370
RP1Dam 2	16/01/2023	-	370
RP1Dam 2	17/01/2023	-	370
RP1Dam 2	18/01/2023	-	370
RP1Dam 2	19/01/2023	0.1	370
RP1Dam 2	31/03/2025	150	370
RP1Dam 2	1/04/2025	-	370
RP1Dam 2	2/04/2025	-	370
RP1Dam 2	3/04/2025	-	370
RP1Dam 2	4/04/2025	-	370
RP1Dam 2	5/04/2025	170	370
RP1Dam 2	6/04/2025	-	370
RP1Dam 2	7/04/2025	-	370
RP1Dam 2	8/04/2025	180	370

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
RP1Dam 2	9/04/2025	-	370

A.7 CADMIUM

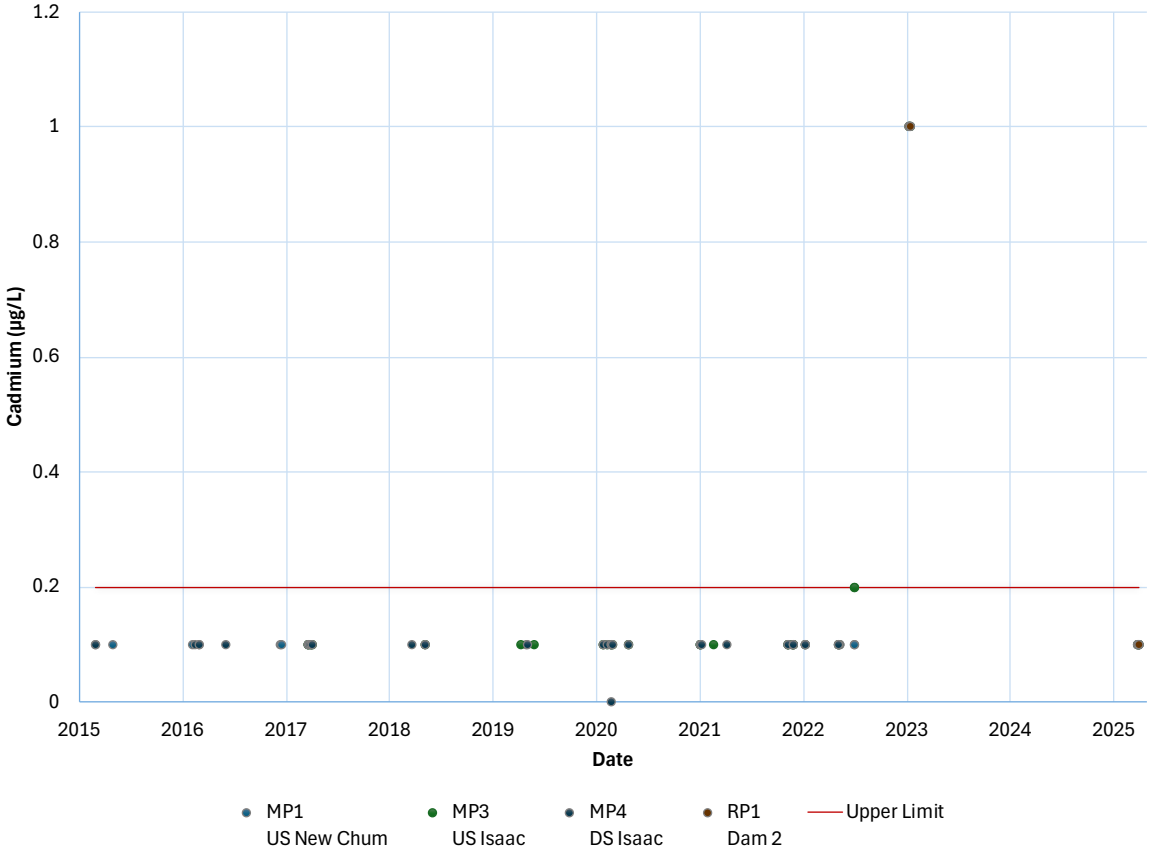

Figure A.7 Cadmium Water Quality Analyte Levels

Table A.7 Cadmium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	0.1	0.2
MP1US New Chum	1/05/2015	0.1	0.2
MP1US New Chum	5/02/2016	0.1	0.2
MP1US New Chum	2/03/2016	0.1	0.2
MP1US New Chum	12/12/2016	0.1	0.2
MP1US New Chum	18/12/2016	0.1	0.2
MP1US New Chum	20/03/2017	0.1	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	30/03/2017	0.1	0.2
MP1US New Chum	4/04/2017	0.1	0.2
MP1US New Chum	9/05/2018	0.1	0.2
MP1US New Chum	2/05/2019	0.1	0.2
MP1US New Chum	29/01/2020	0.1	0.2
MP1US New Chum	26/02/2020	0.1	0.2
MP1US New Chum	27/02/2020	0.1	0.2
MP1US New Chum	28/04/2020	0.1	0.2
MP1US New Chum	6/01/2021	0.1	0.2
MP1US New Chum	11/11/2021	0.1	0.2
MP1US New Chum	26/11/2021	0.1	0.2
MP1US New Chum	1/12/2021	0.1	0.2
MP1US New Chum	10/01/2022	0.1	0.2
MP1US New Chum	11/05/2022	0.1	0.2
MP1US New Chum	12/05/2022	0.1	0.2
MP1US New Chum	5/07/2022	0.1	0.2
MP1US New Chum	14/01/2023	1	0.2
MP1US New Chum	19/01/2023	1	0.2
MP1US New Chum	31/03/2025	0.1	0.2
MP1US New Chum	5/04/2025	0.1	0.2
MP1US New Chum	8/04/2025	0.1	0.2
MP3US Isaac	21/03/2017	0.1	0.2
MP3US Isaac	22/03/2017	0.1	0.2
MP3US Isaac	31/03/2017	0.1	0.2
MP3US Isaac	3/04/2017	0.1	0.2
MP3US Isaac	9/05/2018	0.1	0.2
MP3US Isaac	11/04/2019	0.1	0.2
MP3US Isaac	28/05/2019	0.1	0.2
MP3US Isaac	27/01/2020	0.1	0.2
MP3US Isaac	11/02/2020	0.1	0.2
MP3US Isaac	25/02/2020	0.1	0.2
MP3US Isaac	28/02/2020	0.1	0.2
MP3US Isaac	27/04/2020	0.1	0.2
MP3US Isaac	6/01/2021	-	0.2
MP3US Isaac	6/01/2021	0.1	0.2
MP3US Isaac	7/01/2021	-	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	7/01/2021	0.1	0.2
MP3US Isaac	8/01/2021	-	0.2
MP3US Isaac	23/02/2021	0.1	0.2
MP3US Isaac	10/04/2021	-	0.2
MP3US Isaac	11/11/2021	0.1	0.2
MP3US Isaac	1/12/2021	0.1	0.2
MP3US Isaac	10/01/2022	0.1	0.2
MP3US Isaac	11/05/2022	0.1	0.2
MP3US Isaac	5/07/2022	0.2	0.2
MP3US Isaac	14/01/2023	1	0.2
MP3US Isaac	19/01/2023	1	0.2
MP3US Isaac	31/03/2025	0.1	0.2
MP3US Isaac	5/04/2025	0.1	0.2
MP3US Isaac	8/04/2025	0.1	0.2
MP4DS Isaac	1/03/2015	0.1	0.2
MP4DS Isaac	16/02/2016	0.1	0.2
MP4DS Isaac	2/03/2016	0.1	0.2
MP4DS Isaac	31/05/2016	0.1	0.2
MP4DS Isaac	21/03/2017	0.1	0.2
MP4DS Isaac	22/03/2017	0.1	0.2
MP4DS Isaac	23/03/2017	0.1	0.2
MP4DS Isaac	31/03/2017	0.1	0.2
MP4DS Isaac	3/04/2017	0.1	0.2
MP4DS Isaac	22/03/2018	0.1	0.2
MP4DS Isaac	9/05/2018	0.1	0.2
MP4DS Isaac	3/05/2019	0.1	0.2
MP4DS Isaac	27/01/2020	0.1	0.2
MP4DS Isaac	11/02/2020	0.1	0.2
MP4DS Isaac	25/02/2020	0.1	0.2
MP4DS Isaac	26/02/2020	0.1	0.2
MP4DS Isaac	27/02/2020	0	0.2
MP4DS Isaac	2/03/2020	0.1	0.2
MP4DS Isaac	28/04/2020	0.1	0.2
MP4DS Isaac	6/01/2021	0.1	0.2
MP4DS Isaac	7/01/2021	0.1	0.2
MP4DS Isaac	8/01/2021	0.1	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	10/04/2021	0.1	0.2
MP4DS Isaac	14/04/2021	-	0.2
MP4DS Isaac	11/11/2021	0.1	0.2
MP4DS Isaac	1/12/2021	0.1	0.2
MP4DS Isaac	10/01/2022	0.1	0.2
MP4DS Isaac	11/05/2022	0.1	0.2
MP4DS Isaac	14/01/2023	1	0.2
MP4DS Isaac	19/01/2023	1	0.2
MP4DS Isaac	31/03/2025	0.1	0.2
MP4DS Isaac	5/04/2025	0.1	0.2
MP4DS Isaac	8/04/2025	0.1	0.2
RP1Dam 2	14/01/2023	1	0.2
RP1Dam 2	15/01/2023	-	0.2
RP1Dam 2	16/01/2023	-	0.2
RP1Dam 2	17/01/2023	-	0.2
RP1Dam 2	18/01/2023	-	0.2
RP1Dam 2	19/01/2023	1	0.2
RP1Dam 2	31/03/2025	0.1	0.2
RP1Dam 2	1/04/2025	-	0.2
RP1Dam 2	2/04/2025	-	0.2
RP1Dam 2	3/04/2025	-	0.2
RP1Dam 2	4/04/2025	-	0.2
RP1Dam 2	5/04/2025	0.1	0.2
RP1Dam 2	6/04/2025	-	0.2
RP1Dam 2	7/04/2025	-	0.2
RP1Dam 2	8/04/2025	0.1	0.2
RP1Dam 2	9/04/2025	-	0.2

A.8 CHROMIUM

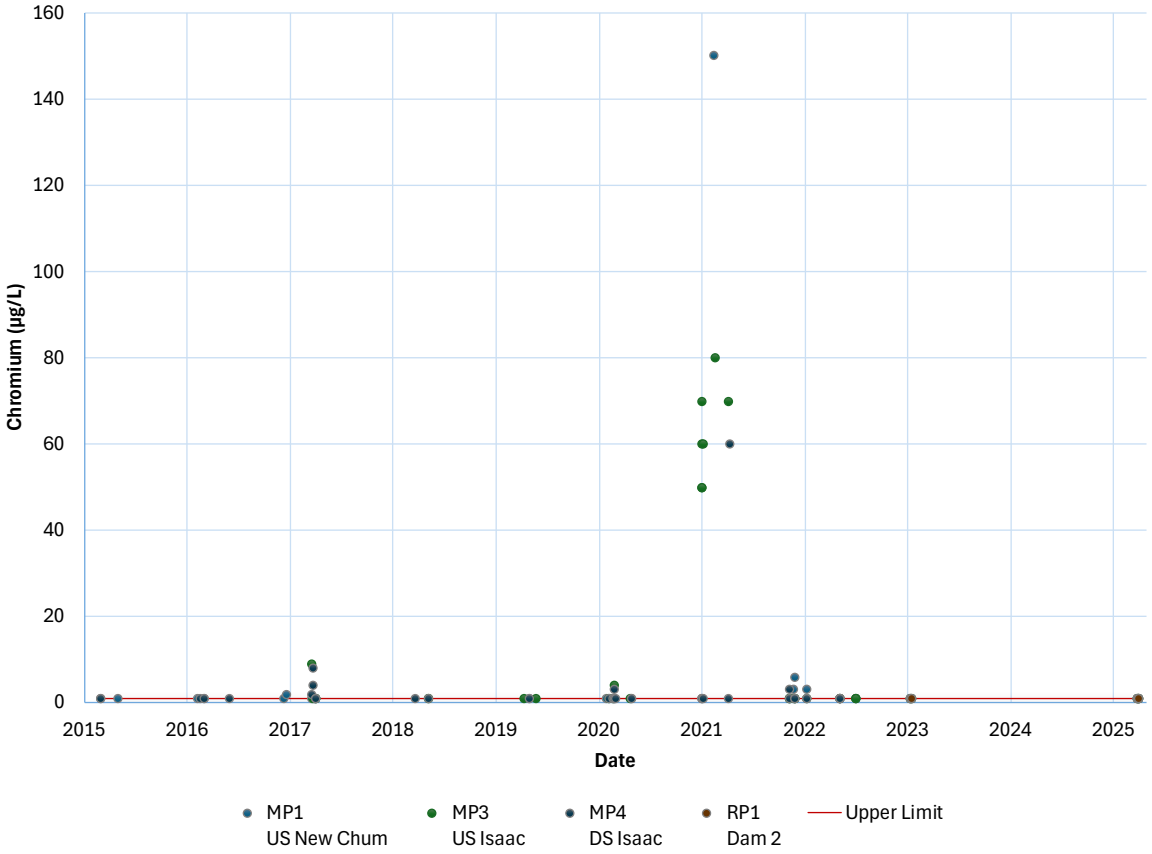

Figure A.8 Chromium Water Quality Analyte Levels

Table A.8 Chromium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	1
MP1US New Chum	1/05/2015	1	1
MP1US New Chum	5/02/2016	1	1
MP1US New Chum	2/03/2016	1	1
MP1US New Chum	12/12/2016	1	1
MP1US New Chum	18/12/2016	2	1
MP1US New Chum	20/03/2017	1	1
MP1US New Chum	30/03/2017	1	1
MP1US New Chum	4/04/2017	1	1
MP1US New Chum	9/05/2018	1	1
MP1US New Chum	2/05/2019	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	1	1
MP1US New Chum	26/02/2020	1	1
MP1US New Chum	27/02/2020	1	1
MP1US New Chum	28/04/2020	1	1
MP1US New Chum	6/01/2021	1	1
MP1US New Chum	18/02/2021	150	1
MP1US New Chum	11/11/2021	1	1
MP1US New Chum	26/11/2021	3	1
MP1US New Chum	26/11/2021	1	1
MP1US New Chum	1/12/2021	6	1
MP1US New Chum	1/12/2021	1	1
MP1US New Chum	10/01/2022	3	1
MP1US New Chum	11/05/2022	1	1
MP1US New Chum	12/05/2022	1	1
MP1US New Chum	5/07/2022	1	1
MP1US New Chum	14/01/2023	1	1
MP1US New Chum	19/01/2023	1	1
MP1US New Chum	31/03/2025	1	1
MP1US New Chum	5/04/2025	1	1
MP1US New Chum	8/04/2025	1	1
MP3US Isaac	21/03/2017	9	1
MP3US Isaac	22/03/2017	1	1
MP3US Isaac	31/03/2017	1	1
MP3US Isaac	3/04/2017	1	1
MP3US Isaac	9/05/2018	1	1
MP3US Isaac	11/04/2019	1	1
MP3US Isaac	28/05/2019	1	1
MP3US Isaac	27/01/2020	-	1
MP3US Isaac	11/02/2020	1	1
MP3US Isaac	25/02/2020	1	1
MP3US Isaac	28/02/2020	4	1
MP3US Isaac	27/04/2020	1	1
MP3US Isaac	6/01/2021	70	1
MP3US Isaac	6/01/2021	50	1
MP3US Isaac	7/01/2021	60	1
MP3US Isaac	7/01/2021	50	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	8/01/2021	60	1
MP3US Isaac	23/02/2021	80	1
MP3US Isaac	10/04/2021	70	1
MP3US Isaac	11/11/2021	1	1
MP3US Isaac	1/12/2021	1	1
MP3US Isaac	10/01/2022	1	1
MP3US Isaac	11/05/2022	1	1
MP3US Isaac	5/07/2022	1	1
MP3US Isaac	14/01/2023	1	1
MP3US Isaac	19/01/2023	1	1
MP3US Isaac	31/03/2025	1	1
MP3US Isaac	5/04/2025	1	1
MP3US Isaac	8/04/2025	1	1
MP4US Isaac	1/03/2015	1	1
MP4US Isaac	16/02/2016	1	1
MP4US Isaac	2/03/2016	1	1
MP4US Isaac	31/05/2016	1	1
MP4US Isaac	21/03/2017	2	1
MP4US Isaac	22/03/2017	8	1
MP4US Isaac	23/03/2017	4	1
MP4US Isaac	31/03/2017	1	1
MP4US Isaac	3/04/2017	1	1
MP4US Isaac	22/03/2018	1	1
MP4US Isaac	9/05/2018	1	1
MP4US Isaac	3/05/2019	1	1
MP4US Isaac	27/01/2020	-	1
MP4US Isaac	11/02/2020	1	1
MP4US Isaac	25/02/2020	1	1
MP4US Isaac	26/02/2020	1	1
MP4US Isaac	27/02/2020	3	1
MP4US Isaac	2/03/2020	1	1
MP4US Isaac	28/04/2020	1	1
MP4US Isaac	6/01/2021	1	1
MP4US Isaac	7/01/2021	1	1
MP4US Isaac	8/01/2021	1	1
MP4US Isaac	10/04/2021	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4US Isaac	14/04/2021	60	1
MP4US Isaac	11/11/2021	3	1
MP4US Isaac	11/11/2021	1	1
MP4US Isaac	1/12/2021	1	1
MP4US Isaac	10/01/2022	1	1
MP4US Isaac	11/05/2022	1	1
MP4US Isaac	14/01/2023	1	1
MP4US Isaac	19/01/2023	1	1
MP4US Isaac	31/03/2025	1	1
MP4US Isaac	5/04/2025	1	1
MP4US Isaac	8/04/2025	1	1
RP1Dam 2	14/01/2023	1	1
RP1Dam 2	15/01/2023	-	1
RP1Dam 2	16/01/2023	-	1
RP1Dam 2	17/01/2023	-	1
RP1Dam 2	18/01/2023	-	1
RP1Dam 2	19/01/2023	1	1
RP1Dam 2	31/03/2025	1	1
RP1Dam 2	1/04/2025	-	1
RP1Dam 2	2/04/2025	-	1
RP1Dam 2	3/04/2025	-	1
RP1Dam 2	4/04/2025	-	1
RP1Dam 2	5/04/2025	1	1
RP1Dam 2	6/04/2025	-	1
RP1Dam 2	7/04/2025	-	1
RP1Dam 2	8/04/2025	1	1
RP1Dam 2	9/04/2025	-	1

A.9 COBALT

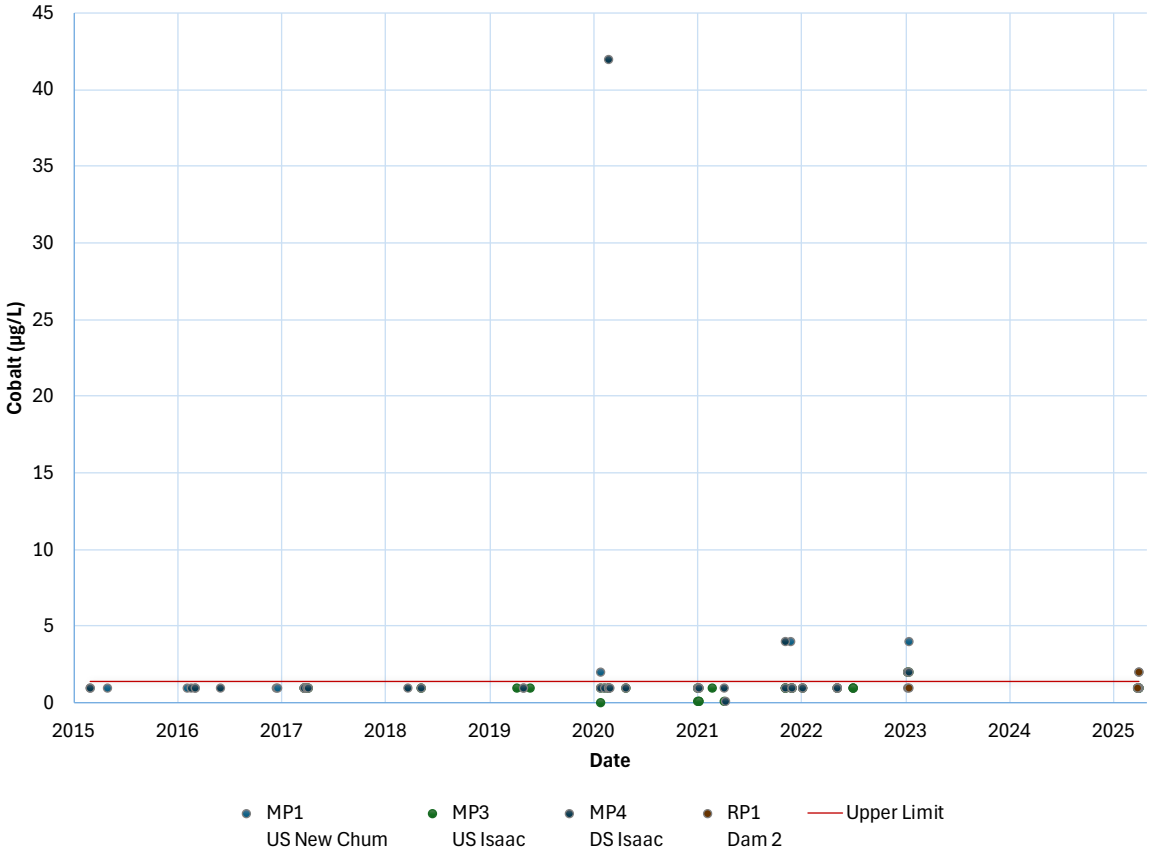

Figure A.9 Cobalt Water Quality Analyte Levels

Table A.9 Cobalt Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	1.4
MP1US New Chum	1/05/2015	1	1.4
MP1US New Chum	5/02/2016	1	1.4
MP1US New Chum	2/03/2016	1	1.4
MP1US New Chum	12/12/2016	1	1.4
MP1US New Chum	18/12/2016	1	1.4
MP1US New Chum	20/03/2017	1	1.4
MP1US New Chum	30/03/2017	1	1.4
MP1US New Chum	4/04/2017	1	1.4
MP1US New Chum	9/05/2018	1	1.4
MP1US New Chum	2/05/2019	1	1.4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	2	1.4
MP1US New Chum	26/02/2020	1	1.4
MP1US New Chum	27/02/2020	1	1.4
MP1US New Chum	28/04/2020	1	1.4
MP1US New Chum	6/01/2021	1	1.4
MP1US New Chum	11/11/2021	1	1.4
MP1US New Chum	26/11/2021	4	1.4
MP1US New Chum	26/11/2021	1	1.4
MP1US New Chum	1/12/2021	1	1.4
MP1US New Chum	10/01/2022	1	1.4
MP1US New Chum	11/05/2022	1	1.4
MP1US New Chum	12/05/2022	1	1.4
MP1US New Chum	5/07/2022	1	1.4
MP1US New Chum	14/01/2023	2	1.4
MP1US New Chum	19/01/2023	4	1.4
MP1US New Chum	31/03/2025	1	1.4
MP1US New Chum	5/04/2025	1	1.4
MP1US New Chum	8/04/2025	1	1.4
MP3US Isaac	21/03/2017	1	1.4
MP3US Isaac	22/03/2017	1	1.4
MP3US Isaac	31/03/2017	1	1.4
MP3US Isaac	3/04/2017	1	1.4
MP3US Isaac	9/05/2018	1	1.4
MP3US Isaac	11/04/2019	1	1.4
MP3US Isaac	28/05/2019	1	1.4
MP3US Isaac	27/01/2020	1	1.4
MP3US Isaac	27/01/2020	0.001	1.4
MP3US Isaac	11/02/2020	1	1.4
MP3US Isaac	25/02/2020	1	1.4
MP3US Isaac	28/02/2020	1	1.4
MP3US Isaac	27/04/2020	1	1.4
MP3US Isaac	6/01/2021	0.1	1.4
MP3US Isaac	6/01/2021	1	1.4
MP3US Isaac	7/01/2021	0.1	1.4
MP3US Isaac	7/01/2021	1	1.4
MP3US Isaac	8/01/2021	0.1	1.4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	23/02/2021	1	1.4
MP3US Isaac	10/04/2021	0.1	1.4
MP3US Isaac	11/11/2021	1	1.4
MP3US Isaac	1/12/2021	1	1.4
MP3US Isaac	10/01/2022	1	1.4
MP3US Isaac	11/05/2022	1	1.4
MP3US Isaac	5/07/2022	1	1.4
MP3US Isaac	14/01/2023	2	1.4
MP3US Isaac	19/01/2023	2	1.4
MP3US Isaac	31/03/2025	1	1.4
MP3US Isaac	5/04/2025	1	1.4
MP3US Isaac	8/04/2025	1	1.4
MP4DS Isaac	1/03/2015	1	1.4
MP4DS Isaac	16/02/2016	1	1.4
MP4DS Isaac	2/03/2016	1	1.4
MP4DS Isaac	31/05/2016	1	1.4
MP4DS Isaac	21/03/2017	1	1.4
MP4DS Isaac	22/03/2017	1	1.4
MP4DS Isaac	23/03/2017	1	1.4
MP4DS Isaac	31/03/2017	1	1.4
MP4DS Isaac	3/04/2017	1	1.4
MP4DS Isaac	22/03/2018	1	1.4
MP4DS Isaac	9/05/2018	1	1.4
MP4DS Isaac	3/05/2019	1	1.4
MP4DS Isaac	27/01/2020	1	1.4
MP4DS Isaac	11/02/2020	1	1.4
MP4DS Isaac	25/02/2020	1	1.4
MP4DS Isaac	26/02/2020	1	1.4
MP4DS Isaac	27/02/2020	42	1.4
MP4DS Isaac	2/03/2020	1	1.4
MP4DS Isaac	28/04/2020	1	1.4
MP4DS Isaac	6/01/2021	1	1.4
MP4DS Isaac	7/01/2021	1	1.4
MP4DS Isaac	8/01/2021	1	1.4
MP4DS Isaac	10/04/2021	1	1.4
MP4DS Isaac	14/04/2021	0.1	1.4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/11/2021	4	1.4
MP4DS Isaac	11/11/2021	1	1.4
MP4DS Isaac	1/12/2021	1	1.4
MP4DS Isaac	10/01/2022	1	1.4
MP4DS Isaac	11/05/2022	1	1.4
MP4DS Isaac	14/01/2023	2	1.4
MP4DS Isaac	19/01/2023	2	1.4
MP4DS Isaac	31/03/2025	1	1.4
MP4DS Isaac	5/04/2025	1	1.4
MP4DS Isaac	8/04/2025	1	1.4
RP1Dam 2	14/01/2023	1	1.4
RP1Dam 2	15/01/2023	-	1.4
RP1Dam 2	16/01/2023	-	1.4
RP1Dam 2	17/01/2023	-	1.4
RP1Dam 2	18/01/2023	-	1.4
RP1Dam 2	19/01/2023	1	1.4
RP1Dam 2	31/03/2025	1	1.4
RP1Dam 2	1/04/2025	-	1.4
RP1Dam 2	2/04/2025	-	1.4
RP1Dam 2	3/04/2025	-	1.4
RP1Dam 2	4/04/2025	-	1.4
RP1Dam 2	5/04/2025	2	1.4
RP1Dam 2	6/04/2025	-	1.4
RP1Dam 2	7/04/2025	-	1.4
RP1Dam 2	8/04/2025	2	1.4
RP1Dam 2	9/04/2025	-	1.4

A.10 COPPER

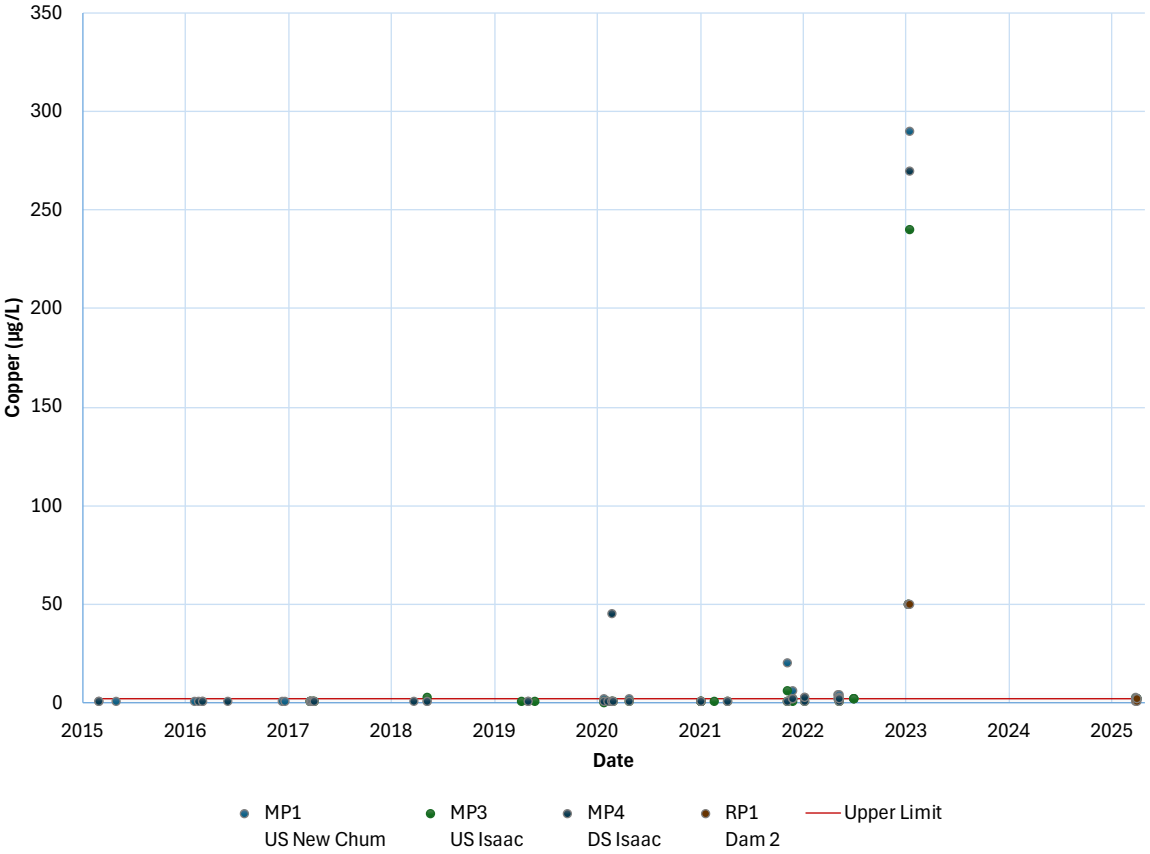

Figure A.10 Copper Water Quality Analyte Levels

Table A.10 Copper Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	2
MP1US New Chum	1/05/2015	1	2
MP1US New Chum	5/02/2016	1	2
MP1US New Chum	2/03/2016	1	2
MP1US New Chum	12/12/2016	1	2
MP1US New Chum	18/12/2016	1	2
MP1US New Chum	20/03/2017	1	2
MP1US New Chum	30/03/2017	1	2
MP1US New Chum	4/04/2017	1	2
MP1US New Chum	9/05/2018	1	2
MP1US New Chum	2/05/2019	1	2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	2	2
MP1US New Chum	26/02/2020	1	2
MP1US New Chum	27/02/2020	1	2
MP1US New Chum	28/04/2020	2	2
MP1US New Chum	6/01/2021	1	2
MP1US New Chum	11/11/2021	1	2
MP1US New Chum	11/11/2021	20	2
MP1US New Chum	26/11/2021	2	2
MP1US New Chum	1/12/2021	6	2
MP1US New Chum	1/12/2021	2	2
MP1US New Chum	10/01/2022	3	2
MP1US New Chum	11/05/2022	4	2
MP1US New Chum	12/05/2022	3	2
MP1US New Chum	12/05/2022	1	2
MP1US New Chum	5/07/2022	2	2
MP1US New Chum	14/01/2023	50	2
MP1US New Chum	19/01/2023	290	2
MP1US New Chum	31/03/2025	3	2
MP1US New Chum	5/04/2025	2	2
MP1US New Chum	8/04/2025	2	2
MP3US Isaac	21/03/2017	1	2
MP3US Isaac	22/03/2017	1	2
MP3US Isaac	31/03/2017	1	2
MP3US Isaac	3/04/2017	1	2
MP3US Isaac	9/05/2018	3	2
MP3US Isaac	11/04/2019	1	2
MP3US Isaac	28/05/2019	1	2
MP3US Isaac	27/01/2020	1	2
MP3US Isaac	27/01/2020	0.001	2
MP3US Isaac	11/02/2020	1	2
MP3US Isaac	25/02/2020	1	2
MP3US Isaac	28/02/2020	1	2
MP3US Isaac	27/04/2020	1	2
MP3US Isaac	6/01/2021	1	2
MP3US Isaac	7/01/2021	1	2
MP3US Isaac	8/01/2021	1	2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	23/02/2021	1	2
MP3US Isaac	10/04/2021	1	2
MP3US Isaac	11/11/2021	6	2
MP3US Isaac	11/11/2021	1	2
MP3US Isaac	1/12/2021	2	2
MP3US Isaac	1/12/2021	1	2
MP3US Isaac	10/01/2022	1	2
MP3US Isaac	11/05/2022	1	2
MP3US Isaac	5/07/2022	2	2
MP3US Isaac	14/01/2023	50	2
MP3US Isaac	19/01/2023	240	2
MP3US Isaac	31/03/2025	2	2
MP3US Isaac	5/04/2025	2	2
MP3US Isaac	8/04/2025	2	2
MP4DS Isaac	1/03/2015	1	2
MP4DS Isaac	16/02/2016	1	2
MP4DS Isaac	2/03/2016	1	2
MP4DS Isaac	31/05/2016	1	2
MP4DS Isaac	21/03/2017	1	2
MP4DS Isaac	22/03/2017	1	2
MP4DS Isaac	23/03/2017	1	2
MP4DS Isaac	31/03/2017	1	2
MP4DS Isaac	3/04/2017	1	2
MP4DS Isaac	22/03/2018	1	2
MP4DS Isaac	9/05/2018	1	2
MP4DS Isaac	3/05/2019	1	2
MP4DS Isaac	27/01/2020	1	2
MP4DS Isaac	11/02/2020	1	2
MP4DS Isaac	25/02/2020	1	2
MP4DS Isaac	26/02/2020	1	2
MP4DS Isaac	27/02/2020	45	2
MP4DS Isaac	2/03/2020	1	2
MP4DS Isaac	28/04/2020	1	2
MP4DS Isaac	6/01/2021	1	2
MP4DS Isaac	7/01/2021	1	2
MP4DS Isaac	8/01/2021	1	2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	10/04/2021	1	2
MP4DS Isaac	14/04/2021	1	2
MP4DS Isaac	11/11/2021	1	2
MP4DS Isaac	1/12/2021	2	2
MP4DS Isaac	10/01/2022	1	2
MP4DS Isaac	10/01/2022	3	2
MP4DS Isaac	11/05/2022	2	2
MP4DS Isaac	11/05/2022	1	2
MP4DS Isaac	14/01/2023	50	2
MP4DS Isaac	19/01/2023	270	2
MP4DS Isaac	31/03/2025	2	2
MP4DS Isaac	5/04/2025	2	2
MP4DS Isaac	8/04/2025	2	2
RP1Dam 2	14/01/2023	50	2
RP1Dam 2	15/01/2023	-	2
RP1Dam 2	16/01/2023	-	2
RP1Dam 2	17/01/2023	-	2
RP1Dam 2	18/01/2023	-	2
RP1Dam 2	19/01/2023	50	2
RP1Dam 2	31/03/2025	1	2
RP1Dam 2	1/04/2025	-	2
RP1Dam 2	2/04/2025	-	2
RP1Dam 2	3/04/2025	-	2
RP1Dam 2	4/04/2025	-	2
RP1Dam 2	5/04/2025	1	2
RP1Dam 2	6/04/2025	-	2
RP1Dam 2	7/04/2025	-	2
RP1Dam 2	8/04/2025	2	2
RP1Dam 2	9/04/2025	-	2

A.11 IRON

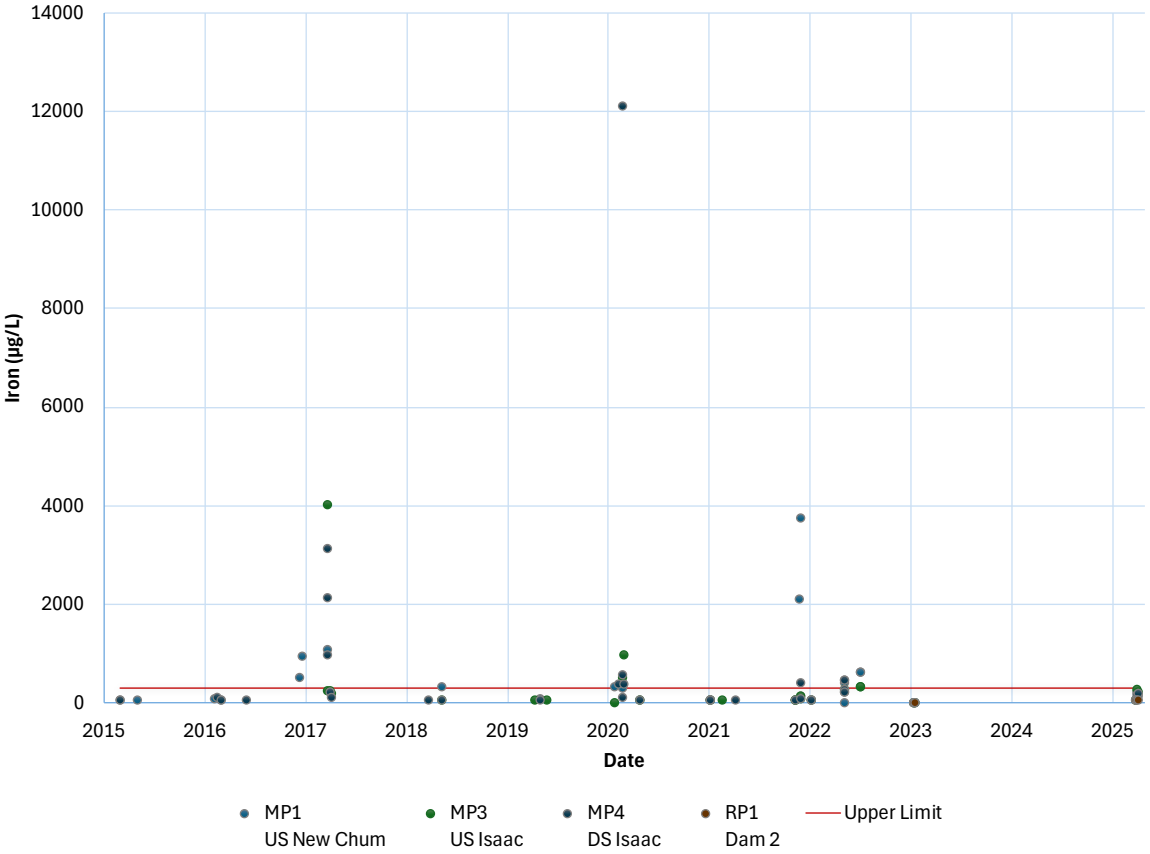

Figure A.11 Iron Water Quality Analyte Levels

Table A.11 Iron Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	50	300
MP1US New Chum	1/05/2015	50	300
MP1US New Chum	5/02/2016	70	300
MP1US New Chum	2/03/2016	50	300
MP1US New Chum	12/12/2016	520	300
MP1US New Chum	18/12/2016	940	300
MP1US New Chum	20/03/2017	1070	300
MP1US New Chum	30/03/2017	210	300
MP1US New Chum	4/04/2017	-	300
MP1US New Chum	9/05/2018	330.4	300
MP1US New Chum	2/05/2019	70	300
MP1US New Chum	29/01/2020	330	300
MP1US New Chum	26/02/2020	410	300

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	27/02/2020	310	300
MP1US New Chum	28/04/2020	50	300
MP1US New Chum	6/01/2021	50	300
MP1US New Chum	11/11/2021	50	300
MP1US New Chum	26/11/2021	2100	300
MP1US New Chum	1/12/2021	3740	300
MP1US New Chum	1/12/2021	130	300
MP1US New Chum	10/01/2022	50	300
MP1US New Chum	11/05/2022	410	300
MP1US New Chum	11/05/2022	460	300
MP1US New Chum	12/05/2022	220	300
MP1US New Chum	12/05/2022	1	300
MP1US New Chum	5/07/2022	620	300
MP1US New Chum	14/01/2023	1	300
MP1US New Chum	19/01/2023	1	300
MP1US New Chum	31/03/2025	50	300
MP1US New Chum	5/04/2025	220	300
MP1US New Chum	8/04/2025	150	300
MP3US Isaac	21/03/2017	4010	300
MP3US Isaac	22/03/2017	250	300
MP3US Isaac	31/03/2017	250	300
MP3US Isaac	3/04/2017	180	300
MP3US Isaac	9/05/2018	50	300
MP3US Isaac	11/04/2019	50	300
MP3US Isaac	28/05/2019	50	300
MP3US Isaac	27/01/2020	-	300
MP3US Isaac	27/01/2020	0.005	300
MP3US Isaac	11/02/2020	-	300
MP3US Isaac	25/02/2020	521	300
MP3US Isaac	28/02/2020	960	300
MP3US Isaac	27/04/2020	50	300
MP3US Isaac	6/01/2021	-	300
MP3US Isaac	6/01/2021	50	300
MP3US Isaac	7/01/2021	-	300
MP3US Isaac	7/01/2021	50	300
MP3US Isaac	8/01/2021	-	300

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	23/02/2021	50	300
MP3US Isaac	10/04/2021	-	300
MP3US Isaac	11/11/2021	50	300
MP3US Isaac	1/12/2021	130	300
MP3US Isaac	1/12/2021	80	300
MP3US Isaac	10/01/2022	50	300
MP3US Isaac	11/05/2022	260	300
MP3US Isaac	5/07/2022	330	300
MP3US Isaac	14/01/2023	1	300
MP3US Isaac	19/01/2023	1	300
MP3US Isaac	31/03/2025	50	300
MP3US Isaac	5/04/2025	260	300
MP3US Isaac	8/04/2025	210	300
MP4DS Isaac	1/03/2015	50	300
MP4DS Isaac	16/02/2016	120	300
MP4DS Isaac	2/03/2016	50	300
MP4DS Isaac	31/05/2016	50	300
MP4DS Isaac	21/03/2017	970	300
MP4DS Isaac	22/03/2017	3120	300
MP4DS Isaac	23/03/2017	2140	300
MP4DS Isaac	31/03/2017	230	300
MP4DS Isaac	3/04/2017	123	300
MP4DS Isaac	22/03/2018	50	300
MP4DS Isaac	9/05/2018	50	300
MP4DS Isaac	3/05/2019	50	300
MP4DS Isaac	27/01/2020	-	300
MP4DS Isaac	11/02/2020	380	300
MP4DS Isaac	25/02/2020	556	300
MP4DS Isaac	26/02/2020	110	300
MP4DS Isaac	27/02/2020	12100	300
MP4DS Isaac	2/03/2020	380	300
MP4DS Isaac	28/04/2020	50	300
MP4DS Isaac	6/01/2021	50	300
MP4DS Isaac	7/01/2021	50	300
MP4DS Isaac	8/01/2021	50	300
MP4DS Isaac	10/04/2021	50	300

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	14/04/2021	-	300
MP4DS Isaac	11/11/2021	50	300
MP4DS Isaac	1/12/2021	80	300
MP4DS Isaac	1/12/2021	410	300
MP4DS Isaac	10/01/2022	50	300
MP4DS Isaac	11/05/2022	460	300
MP4DS Isaac	11/05/2022	260	300
MP4DS Isaac	11/05/2022	220	300
MP4DS Isaac	14/01/2023	1	300
MP4DS Isaac	19/01/2023	1	300
MP4DS Isaac	31/03/2025	60	300
MP4DS Isaac	5/04/2025	170	300
MP4DS Isaac	8/04/2025	200	300
RP1Dam 2	14/01/2023	1	300
RP1Dam 2	15/01/2023	-	300
RP1Dam 2	16/01/2023	-	300
RP1Dam 2	17/01/2023	-	300
RP1Dam 2	18/01/2023	-	300
RP1Dam 2	19/01/2023	1	300
RP1Dam 2	31/03/2025	50	300
RP1Dam 2	1/04/2025	-	300
RP1Dam 2	2/04/2025	-	300
RP1Dam 2	3/04/2025	-	300
RP1Dam 2	4/04/2025	-	300
RP1Dam 2	5/04/2025	50	300
RP1Dam 2	6/04/2025	-	300
RP1Dam 2	7/04/2025	-	300
RP1Dam 2	8/04/2025	50	300
RP1Dam 2	9/04/2025	-	300

A.12 LEAD

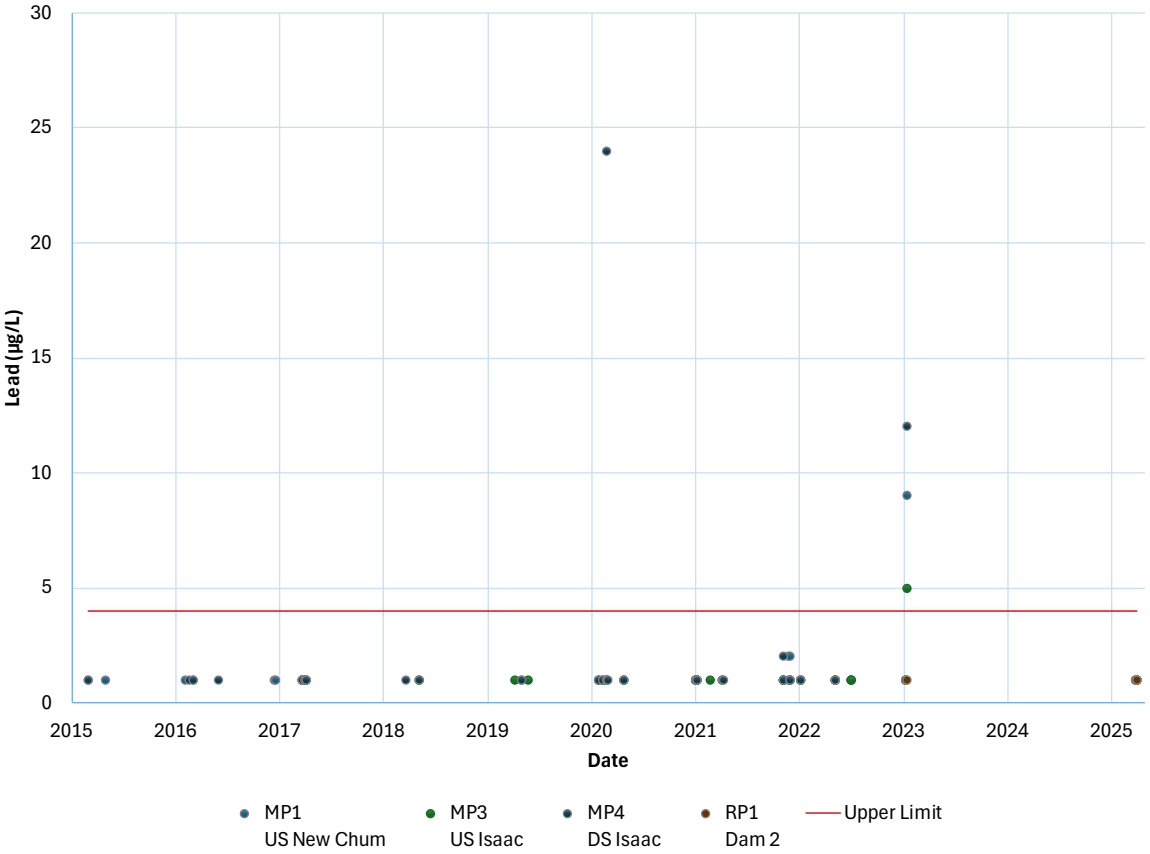

Figure A.12 Lead Water Quality Analyte Levels

Table A.12 Lead Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	4
MP1US New Chum	1/05/2015	1	4
MP1US New Chum	5/02/2016	1	4
MP1US New Chum	2/03/2016	1	4
MP1US New Chum	12/12/2016	1	4
MP1US New Chum	18/12/2016	1	4
MP1US New Chum	20/03/2017	1	4
MP1US New Chum	30/03/2017	1	4
MP1US New Chum	4/04/2017	1	4
MP1US New Chum	9/05/2018	1	4
MP1US New Chum	2/05/2019	1	4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	1	4
MP1US New Chum	26/02/2020	1	4
MP1US New Chum	27/02/2020	1	4
MP1US New Chum	28/04/2020	1	4
MP1US New Chum	6/01/2021	1	4
MP1US New Chum	11/11/2021	1	4
MP1US New Chum	26/11/2021	2	4
MP1US New Chum	26/11/2021	1	4
MP1US New Chum	1/12/2021	2	4
MP1US New Chum	1/12/2021	1	4
MP1US New Chum	10/01/2022	1	4
MP1US New Chum	11/05/2022	1	4
MP1US New Chum	12/05/2022	1	4
MP1US New Chum	5/07/2022	1	4
MP1US New Chum	14/01/2023	1	4
MP1US New Chum	19/01/2023	9	4
MP1US New Chum	31/03/2025	1	4
MP1US New Chum	5/04/2025	1	4
MP1US New Chum	8/04/2025	1	4
MP3US Isaac	21/03/2017	1	4
MP3US Isaac	22/03/2017	1	4
MP3US Isaac	31/03/2017	1	4
MP3US Isaac	3/04/2017	1	4
MP3US Isaac	9/05/2018	1	4
MP3US Isaac	11/04/2019	1	4
MP3US Isaac	28/05/2019	1	4
MP3US Isaac	27/01/2020	1	4
MP3US Isaac	11/02/2020	1	4
MP3US Isaac	25/02/2020	1	4
MP3US Isaac	28/02/2020	1	4
MP3US Isaac	27/04/2020	1	4
MP3US Isaac	6/01/2021	1	4
MP3US Isaac	7/01/2021	1	4
MP3US Isaac	8/01/2021	1	4
MP3US Isaac	23/02/2021	1	4
MP3US Isaac	10/04/2021	1	4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	11/11/2021	1	4
MP3US Isaac	1/12/2021	1	4
MP3US Isaac	10/01/2022	1	4
MP3US Isaac	11/05/2022	1	4
MP3US Isaac	5/07/2022	1	4
MP3US Isaac	14/01/2023	1	4
MP3US Isaac	19/01/2023	5	4
MP3US Isaac	31/03/2025	1	4
MP3US Isaac	5/04/2025	1	4
MP3US Isaac	8/04/2025	1	4
MP4DS Isaac	1/03/2015	1	4
MP4DS Isaac	16/02/2016	1	4
MP4DS Isaac	2/03/2016	1	4
MP4DS Isaac	31/05/2016	1	4
MP4DS Isaac	21/03/2017	1	4
MP4DS Isaac	22/03/2017	1	4
MP4DS Isaac	23/03/2017	1	4
MP4DS Isaac	31/03/2017	1	4
MP4DS Isaac	3/04/2017	1	4
MP4DS Isaac	22/03/2018	1	4
MP4DS Isaac	9/05/2018	1	4
MP4DS Isaac	3/05/2019	1	4
MP4DS Isaac	27/01/2020	1	4
MP4DS Isaac	11/02/2020	1	4
MP4DS Isaac	25/02/2020	1	4
MP4DS Isaac	26/02/2020	1	4
MP4DS Isaac	27/02/2020	24	4
MP4DS Isaac	2/03/2020	1	4
MP4DS Isaac	28/04/2020	1	4
MP4DS Isaac	6/01/2021	1	4
MP4DS Isaac	7/01/2021	1	4
MP4DS Isaac	8/01/2021	1	4
MP4DS Isaac	10/04/2021	1	4
MP4DS Isaac	14/04/2021	1	4
MP4DS Isaac	11/11/2021	2	4
MP4DS Isaac	11/11/2021	1	4

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	1/12/2021	1	4
MP4DS Isaac	10/01/2022	1	4
MP4DS Isaac	11/05/2022	1	4
MP4DS Isaac	14/01/2023	1	4
MP4DS Isaac	19/01/2023	12	4
MP4DS Isaac	31/03/2025	1	4
MP4DS Isaac	5/04/2025	1	4
MP4DS Isaac	8/04/2025	1	4
RP1Dam 2	14/01/2023	1	4
RP1Dam 2	15/01/2023	-	4
RP1Dam 2	16/01/2023	-	4
RP1Dam 2	17/01/2023	-	4
RP1Dam 2	18/01/2023	-	4
RP1Dam 2	19/01/2023	1	4
RP1Dam 2	31/03/2025	1	4
RP1Dam 2	1/04/2025	-	4
RP1Dam 2	2/04/2025	-	4
RP1Dam 2	3/04/2025	-	4
RP1Dam 2	4/04/2025	-	4
RP1Dam 2	5/04/2025	1	4
RP1Dam 2	6/04/2025	-	4
RP1Dam 2	7/04/2025	-	4
RP1Dam 2	8/04/2025	1	4
RP1Dam 2	9/04/2025	-	4

A.13 MANGANESE

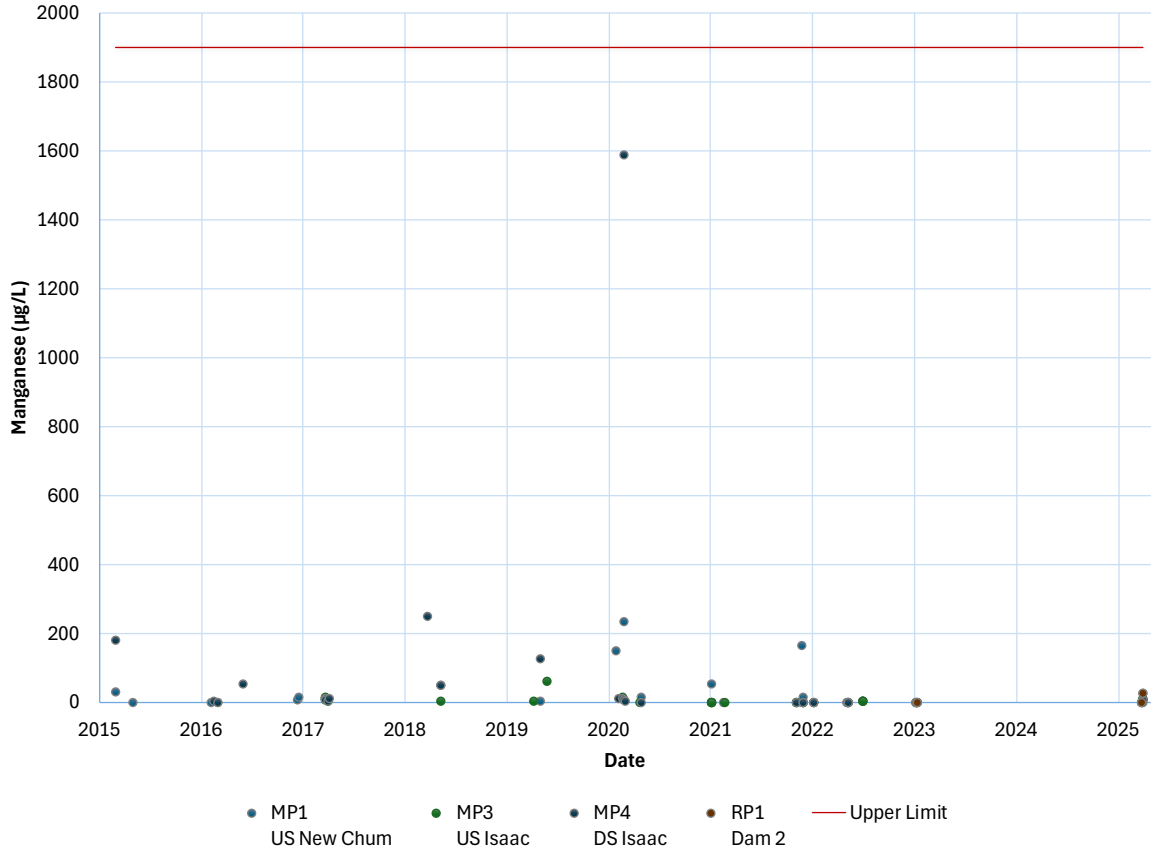

Figure A.13 Manganese Water Quality Analyte Levels

Table A.13 Manganese Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	31	1900
MP1US New Chum	1/05/2015	1	1900
MP1US New Chum	5/02/2016	1	1900
MP1US New Chum	2/03/2016	1	1900
MP1US New Chum	12/12/2016	8	1900
MP1US New Chum	18/12/2016	14	1900
MP1US New Chum	20/03/2017	12	1900
MP1US New Chum	30/03/2017	8	1900
MP1US New Chum	4/04/2017	-	1900
MP1US New Chum	9/05/2018	50	1900
MP1US New Chum	2/05/2019	6	1900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	149	1900
MP1US New Chum	26/02/2020	236	1900
MP1US New Chum	27/02/2020	9	1900
MP1US New Chum	28/04/2020	17	1900
MP1US New Chum	6/01/2021	55	1900
MP1US New Chum	18/02/2021	2	1900
MP1US New Chum	11/11/2021	1	1900
MP1US New Chum	26/11/2021	165	1900
MP1US New Chum	26/11/2021	-	1900
MP1US New Chum	1/12/2021	14	1900
MP1US New Chum	1/12/2021	1	1900
MP1US New Chum	10/01/2022	1	1900
MP1US New Chum	11/05/2022	1	1900
MP1US New Chum	12/05/2022	1	1900
MP1US New Chum	5/07/2022	6	1900
MP1US New Chum	14/01/2023	0.1	1900
MP1US New Chum	19/01/2023	0.1	1900
MP1US New Chum	31/03/2025	1	1900
MP1US New Chum	5/04/2025	7	1900
MP1US New Chum	8/04/2025	8	1900
MP3US Isaac	21/03/2017	16	1900
MP3US Isaac	22/03/2017	8	1900
MP3US Isaac	31/03/2017	6	1900
MP3US Isaac	3/04/2017	-	1900
MP3US Isaac	9/05/2018	4	1900
MP3US Isaac	11/04/2019	3	1900
MP3US Isaac	28/05/2019	60	1900
MP3US Isaac	27/01/2020	-	1900
MP3US Isaac	11/02/2020	-	1900
MP3US Isaac	25/02/2020	14	1900
MP3US Isaac	28/02/2020	8	1900
MP3US Isaac	27/04/2020	2	1900
MP3US Isaac	6/01/2021	1	1900
MP3US Isaac	6/01/2021	2	1900
MP3US Isaac	7/01/2021	2	1900
MP3US Isaac	8/01/2021	2	1900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	23/02/2021	1	1900
MP3US Isaac	10/04/2021	-	1900
MP3US Isaac	11/11/2021	1	1900
MP3US Isaac	1/12/2021	1	1900
MP3US Isaac	10/01/2022	1	1900
MP3US Isaac	11/05/2022	1	1900
MP3US Isaac	5/07/2022	5	1900
MP3US Isaac	14/01/2023	0.1	1900
MP3US Isaac	19/01/2023	0.1	1900
MP3US Isaac	31/03/2025	1	1900
MP3US Isaac	5/04/2025	10	1900
MP3US Isaac	8/04/2025	9	1900
MP4DS Isaac	1/03/2015	181	1900
MP4DS Isaac	16/02/2016	5	1900
MP4DS Isaac	2/03/2016	1	1900
MP4DS Isaac	31/05/2016	56	1900
MP4DS Isaac	21/03/2017	12	1900
MP4DS Isaac	22/03/2017	13	1900
MP4DS Isaac	23/03/2017	7	1900
MP4DS Isaac	31/03/2017	6	1900
MP4DS Isaac	3/04/2017	11	1900
MP4DS Isaac	22/03/2018	252	1900
MP4DS Isaac	9/05/2018	50	1900
MP4DS Isaac	3/05/2019	129	1900
MP4DS Isaac	27/01/2020	-	1900
MP4DS Isaac	11/02/2020	12	1900
MP4DS Isaac	25/02/2020	13	1900
MP4DS Isaac	26/02/2020	8	1900
MP4DS Isaac	27/02/2020	1590	1900
MP4DS Isaac	2/03/2020	4	1900
MP4DS Isaac	28/04/2020	1	1900
MP4DS Isaac	6/01/2021	-	1900
MP4DS Isaac	7/01/2021	-	1900
MP4DS Isaac	8/01/2021	-	1900
MP4DS Isaac	10/04/2021	-	1900
MP4DS Isaac	14/04/2021	-	1900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/11/2021	-	1900
MP4DS Isaac	11/11/2021	1	1900
MP4DS Isaac	1/12/2021	1	1900
MP4DS Isaac	10/01/2022	1	1900
MP4DS Isaac	11/05/2022	1	1900
MP4DS Isaac	14/01/2023	0.1	1900
MP4DS Isaac	19/01/2023	0.1	1900
MP4DS Isaac	31/03/2025	1	1900
MP4DS Isaac	5/04/2025	1	1900
MP4DS Isaac	8/04/2025	7	1900
RP1Dam 2	14/01/2023	0.1	1900
RP1Dam 2	15/01/2023	-	1900
RP1Dam 2	16/01/2023	-	1900
RP1Dam 2	17/01/2023	-	1900
RP1Dam 2	18/01/2023	-	1900
RP1Dam 2	19/01/2023	0.1	1900
RP1Dam 2	31/03/2025	1	1900
RP1Dam 2	1/04/2025	-	1900
RP1Dam 2	2/04/2025	-	1900
RP1Dam 2	3/04/2025	-	1900
RP1Dam 2	4/04/2025	-	1900
RP1Dam 2	5/04/2025	28	1900
RP1Dam 2	6/04/2025	-	1900
RP1Dam 2	7/04/2025	-	1900
RP1Dam 2	8/04/2025	28	1900
RP1Dam 2	9/04/2025	-	1900

A.14 MERCURY

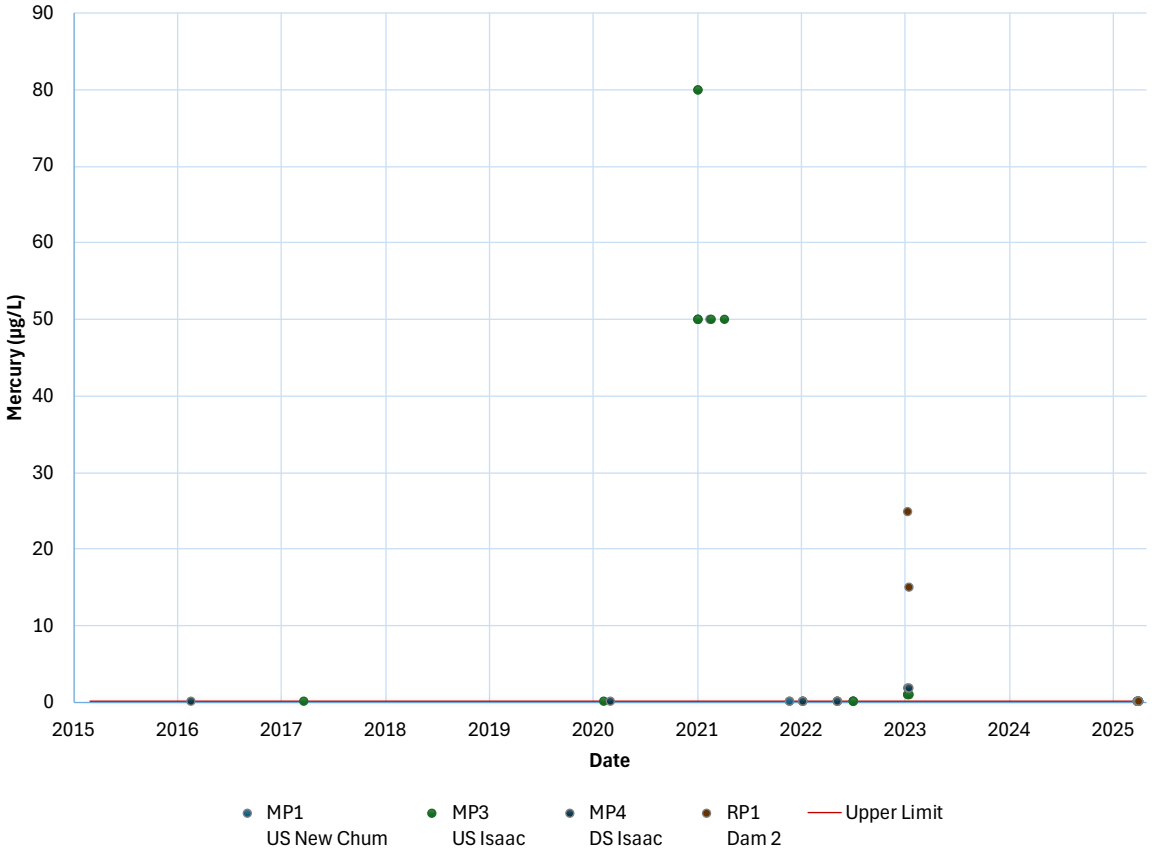

Figure A.14 Mercury Water Quality Analyte Levels

Table A.14 Mercury Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	-	0.2
MP1US New Chum	1/05/2015	-	0.2
MP1US New Chum	5/02/2016	-	0.2
MP1US New Chum	2/03/2016	-	0.2
MP1US New Chum	12/12/2016	-	0.2
MP1US New Chum	18/12/2016	-	0.2
MP1US New Chum	20/03/2017	-	0.2
MP1US New Chum	30/03/2017	-	0.2
MP1US New Chum	4/04/2017	-	0.2
MP1US New Chum	9/05/2018	-	0.2
MP1US New Chum	2/05/2019	-	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	-	0.2
MP1US New Chum	26/02/2020	-	0.2
MP1US New Chum	27/02/2020	-	0.2
MP1US New Chum	28/04/2020	-	0.2
MP1US New Chum	6/01/2021	-	0.2
MP1US New Chum	18/02/2021	50	0.2
MP1US New Chum	11/11/2021	-	0.2
MP1US New Chum	26/11/2021	0.1	0.2
MP1US New Chum	1/12/2021	-	0.2
MP1US New Chum	10/01/2022	0.1	0.2
MP1US New Chum	11/05/2022	-	0.2
MP1US New Chum	12/05/2022	-	0.2
MP1US New Chum	5/07/2022	0.1	0.2
MP1US New Chum	14/01/2023	1	0.2
MP1US New Chum	19/01/2023	1	0.2
MP1US New Chum	31/03/2025	0.1	0.2
MP1US New Chum	5/04/2025	0.1	0.2
MP1US New Chum	8/04/2025	0.1	0.2
MP3US Isaac	21/03/2017	0.1	0.2
MP3US Isaac	22/03/2017	-	0.2
MP3US Isaac	31/03/2017	-	0.2
MP3US Isaac	3/04/2017	-	0.2
MP3US Isaac	9/05/2018	-	0.2
MP3US Isaac	11/04/2019	-	0.2
MP3US Isaac	28/05/2019	-	0.2
MP3US Isaac	27/01/2020	-	0.2
MP3US Isaac	11/02/2020	0.1	0.2
MP3US Isaac	25/02/2020	-	0.2
MP3US Isaac	28/02/2020	-	0.2
MP3US Isaac	27/04/2020	-	0.2
MP3US Isaac	6/01/2021	80	0.2
MP3US Isaac	7/01/2021	50	0.2
MP3US Isaac	8/01/2021	50	0.2
MP3US Isaac	23/02/2021	50	0.2
MP3US Isaac	10/04/2021	50	0.2
MP3US Isaac	11/11/2021	-	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	1/12/2021	-	0.2
MP3US Isaac	10/01/2022	0.1	0.2
MP3US Isaac	11/05/2022	0.1	0.2
MP3US Isaac	5/07/2022	0.1	0.2
MP3US Isaac	14/01/2023	1	0.2
MP3US Isaac	19/01/2023	1	0.2
MP3US Isaac	31/03/2025	0.1	0.2
MP3US Isaac	5/04/2025	0.1	0.2
MP3US Isaac	8/04/2025	0.1	0.2
MP4DS Isaac	1/03/2015	-	0.2
MP4DS Isaac	16/02/2016	0.1	0.2
MP4DS Isaac	2/03/2016	-	0.2
MP4DS Isaac	31/05/2016	-	0.2
MP4DS Isaac	21/03/2017	-	0.2
MP4DS Isaac	22/03/2017	-	0.2
MP4DS Isaac	23/03/2017	-	0.2
MP4DS Isaac	31/03/2017	-	0.2
MP4DS Isaac	3/04/2017	-	0.2
MP4DS Isaac	22/03/2018	-	0.2
MP4DS Isaac	9/05/2018	-	0.2
MP4DS Isaac	3/05/2019	-	0.2
MP4DS Isaac	27/01/2020	-	0.2
MP4DS Isaac	11/02/2020	-	0.2
MP4DS Isaac	25/02/2020	-	0.2
MP4DS Isaac	26/02/2020	-	0.2
MP4DS Isaac	27/02/2020	-	0.2
MP4DS Isaac	2/03/2020	0.1	0.2
MP4DS Isaac	28/04/2020	-	0.2
MP4DS Isaac	6/01/2021	-	0.2
MP4DS Isaac	7/01/2021	-	0.2
MP4DS Isaac	8/01/2021	-	0.2
MP4DS Isaac	10/04/2021	-	0.2
MP4DS Isaac	14/04/2021	-	0.2
MP4DS Isaac	11/11/2021	-	0.2
MP4DS Isaac	1/12/2021	-	0.2
MP4DS Isaac	10/01/2022	0.1	0.2

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/05/2022	0.1	0.2
MP4DS Isaac	14/01/2023	2	0.2
MP4DS Isaac	19/01/2023	2	0.2
MP4DS Isaac	31/03/2025	0.1	0.2
MP4DS Isaac	5/04/2025	0.1	0.2
MP4DS Isaac	8/04/2025	0.1	0.2
RP1Dam 2	14/01/2023	25	0.2
RP1Dam 2	15/01/2023	-	0.2
RP1Dam 2	16/01/2023	-	0.2
RP1Dam 2	17/01/2023	-	0.2
RP1Dam 2	18/01/2023	-	0.2
RP1Dam 2	19/01/2023	15	0.2
RP1Dam 2	31/03/2025	0.1	0.2
RP1Dam 2	1/04/2025	-	0.2
RP1Dam 2	2/04/2025	-	0.2
RP1Dam 2	3/04/2025	-	0.2
RP1Dam 2	4/04/2025	-	0.2
RP1Dam 2	5/04/2025	0.1	0.2
RP1Dam 2	6/04/2025	-	0.2
RP1Dam 2	7/04/2025	-	0.2
RP1Dam 2	8/04/2025	0.1	0.2
RP1Dam 2	9/04/2025	-	0.2

A.15 MOLYBDENUM

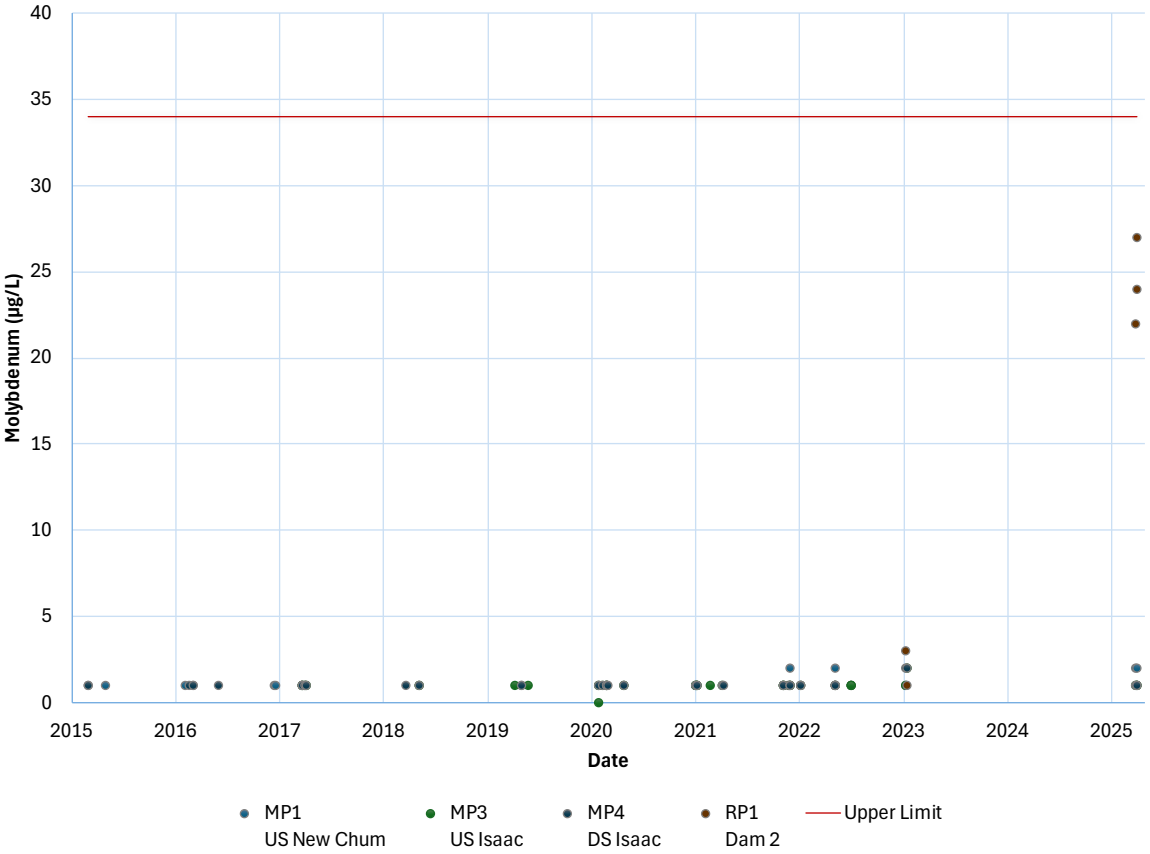

Figure A.15 Molybdenum Water Quality Analyte Levels

Table A.15 Molybdenum Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	34
MP1US New Chum	1/05/2015	1	34
MP1US New Chum	5/02/2016	1	34
MP1US New Chum	2/03/2016	1	34
MP1US New Chum	12/12/2016	1	34
MP1US New Chum	18/12/2016	1	34
MP1US New Chum	20/03/2017	1	34
MP1US New Chum	30/03/2017	1	34
MP1US New Chum	4/04/2017	1	34
MP1US New Chum	9/05/2018	1	34
MP1US New Chum	2/05/2019	1	34
MP1US New Chum	29/01/2020	1	34
MP1US New Chum	26/02/2020	1	34

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	27/02/2020	1	34
MP1US New Chum	28/04/2020	1	34
MP1US New Chum	6/01/2021	1	34
MP1US New Chum	11/11/2021	1	34
MP1US New Chum	26/11/2021	1	34
MP1US New Chum	1/12/2021	2	34
MP1US New Chum	1/12/2021	1	34
MP1US New Chum	10/01/2022	1	34
MP1US New Chum	11/05/2022	1	34
MP1US New Chum	12/05/2022	2	34
MP1US New Chum	12/05/2022	1	34
MP1US New Chum	5/07/2022	1	34
MP1US New Chum	14/01/2023	1	34
MP1US New Chum	19/01/2023	2	34
MP1US New Chum	31/03/2025	2	34
MP1US New Chum	5/04/2025	1	34
MP1US New Chum	8/04/2025	2	34
MP3US Isaac	21/03/2017	1	34
MP3US Isaac	22/03/2017	1	34
MP3US Isaac	31/03/2017	1	34
MP3US Isaac	3/04/2017	1	34
MP3US Isaac	9/05/2018	1	34
MP3US Isaac	11/04/2019	1	34
MP3US Isaac	28/05/2019	1	34
MP3US Isaac	27/01/2020	1	34
MP3US Isaac	27/01/2020	0.015	34
MP3US Isaac	11/02/2020	1	34
MP3US Isaac	25/02/2020	1	34
MP3US Isaac	28/02/2020	1	34
MP3US Isaac	27/04/2020	1	34
MP3US Isaac	6/01/2021	1	34
MP3US Isaac	7/01/2021	1	34
MP3US Isaac	8/01/2021	1	34
MP3US Isaac	23/02/2021	1	34
MP3US Isaac	10/04/2021	1	34
MP3US Isaac	11/11/2021	1	34

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	1/12/2021	1	34
MP3US Isaac	10/01/2022	1	34
MP3US Isaac	11/05/2022	1	34
MP3US Isaac	5/07/2022	1	34
MP3US Isaac	14/01/2023	1	34
MP3US Isaac	19/01/2023	2	34
MP3US Isaac	31/03/2025	1	34
MP3US Isaac	5/04/2025	1	34
MP3US Isaac	8/04/2025	1	34
MP4DS Isaac	1/03/2015	1	34
MP4DS Isaac	16/02/2016	1	34
MP4DS Isaac	2/03/2016	1	34
MP4DS Isaac	31/05/2016	1	34
MP4DS Isaac	21/03/2017	1	34
MP4DS Isaac	22/03/2017	1	34
MP4DS Isaac	23/03/2017	1	34
MP4DS Isaac	31/03/2017	1	34
MP4DS Isaac	3/04/2017	1	34
MP4DS Isaac	22/03/2018	1	34
MP4DS Isaac	9/05/2018	1	34
MP4DS Isaac	3/05/2019	1	34
MP4DS Isaac	27/01/2020	1	34
MP4DS Isaac	11/02/2020	1	34
MP4DS Isaac	25/02/2020	1	34
MP4DS Isaac	26/02/2020	1	34
MP4DS Isaac	27/02/2020	1	34
MP4DS Isaac	2/03/2020	1	34
MP4DS Isaac	28/04/2020	1	34
MP4DS Isaac	6/01/2021	1	34
MP4DS Isaac	7/01/2021	1	34
MP4DS Isaac	8/01/2021	1	34
MP4DS Isaac	10/04/2021	1	34
MP4DS Isaac	14/04/2021	1	34
MP4DS Isaac	11/11/2021	1	34
MP4DS Isaac	1/12/2021	1	34
MP4DS Isaac	10/01/2022	1	34

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/05/2022	1	34
MP4DS Isaac	14/01/2023	2	34
MP4DS Isaac	19/01/2023	2	34
MP4DS Isaac	31/03/2025	1	34
MP4DS Isaac	5/04/2025	1	34
MP4DS Isaac	8/04/2025	1	34
RP1Dam 2	14/01/2023	3	34
RP1Dam 2	15/01/2023	-	34
RP1Dam 2	16/01/2023	-	34
RP1Dam 2	17/01/2023	-	34
RP1Dam 2	18/01/2023	-	34
RP1Dam 2	19/01/2023	1	34
RP1Dam 2	31/03/2025	22	34
RP1Dam 2	1/04/2025	-	34
RP1Dam 2	2/04/2025	-	34
RP1Dam 2	3/04/2025	-	34
RP1Dam 2	4/04/2025	-	34
RP1Dam 2	5/04/2025	27	34
RP1Dam 2	6/04/2025	-	34
RP1Dam 2	7/04/2025	-	34
RP1Dam 2	8/04/2025	24	34
RP1Dam 2	9/04/2025	-	34

A.16 NICKEL

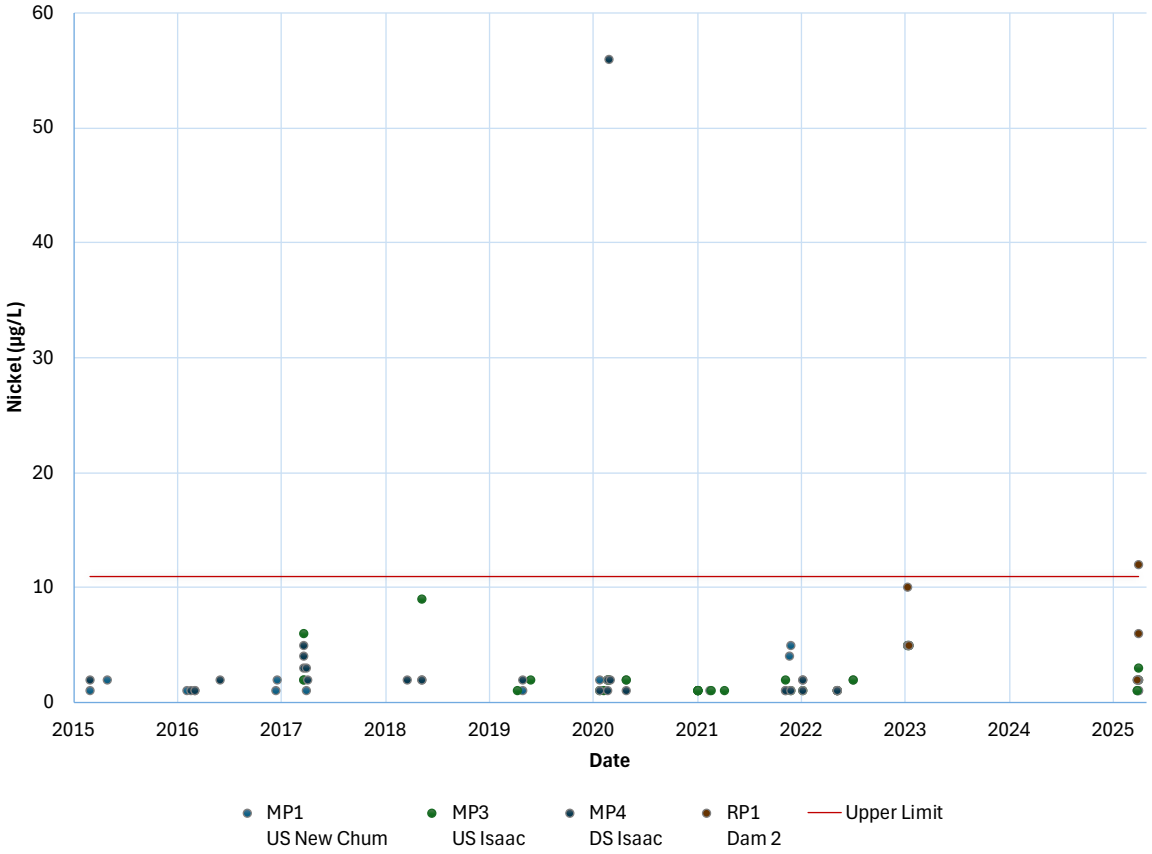

Figure A.16 Nickel Water Quality Analyte Levels

Table A.16 Nickel Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1	11
MP1US New Chum	1/05/2015	2	11
MP1US New Chum	5/02/2016	1	11
MP1US New Chum	2/03/2016	1	11
MP1US New Chum	12/12/2016	1	11
MP1US New Chum	18/12/2016	2	11
MP1US New Chum	20/03/2017	2	11
MP1US New Chum	30/03/2017	1	11
MP1US New Chum	4/04/2017	-	11
MP1US New Chum	9/05/2018	2	11
MP1US New Chum	2/05/2019	1	11

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	2	11
MP1US New Chum	26/02/2020	2	11
MP1US New Chum	27/02/2020	2	11
MP1US New Chum	28/04/2020	2	11
MP1US New Chum	6/01/2021	-	11
MP1US New Chum	18/02/2021	1	11
MP1US New Chum	11/11/2021	1	11
MP1US New Chum	11/11/2021	-	11
MP1US New Chum	26/11/2021	4	11
MP1US New Chum	26/11/2021	-	11
MP1US New Chum	1/12/2021	5	11
MP1US New Chum	1/12/2021	-	11
MP1US New Chum	10/01/2022	2	11
MP1US New Chum	11/05/2022	1	11
MP1US New Chum	11/05/2022	-	11
MP1US New Chum	12/05/2022	1	11
MP1US New Chum	12/05/2022	-	11
MP1US New Chum	5/07/2022	2	11
MP1US New Chum	5/07/2022	-	11
MP1US New Chum	14/01/2023	5	11
MP1US New Chum	19/01/2023	5	11
MP1US New Chum	31/03/2025	1	11
MP1US New Chum	5/04/2025	1	11
MP1US New Chum	8/04/2025	1	11
MP3US Isaac	21/03/2017	6	11
MP3US Isaac	22/03/2017	2	11
MP3US Isaac	31/03/2017	-	11
MP3US Isaac	3/04/2017	-	11
MP3US Isaac	9/05/2018	9	11
MP3US Isaac	11/04/2019	1	11
MP3US Isaac	28/05/2019	2	11
MP3US Isaac	27/01/2020	1	11
MP3US Isaac	27/01/2020	-	11
MP3US Isaac	11/02/2020	1	11
MP3US Isaac	25/02/2020	2	11
MP3US Isaac	28/02/2020	2	11

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	27/04/2020	2	11
MP3US Isaac	6/01/2021	1	11
MP3US Isaac	7/01/2021	1	11
MP3US Isaac	8/01/2021	1	11
MP3US Isaac	23/02/2021	1	11
MP3US Isaac	10/04/2021	1	11
MP3US Isaac	11/11/2021	2	11
MP3US Isaac	11/11/2021	-	11
MP3US Isaac	1/12/2021	1	11
MP3US Isaac	1/12/2021	-	11
MP3US Isaac	10/01/2022	1	11
MP3US Isaac	11/05/2022	1	11
MP3US Isaac	5/07/2022	2	11
MP3US Isaac	5/07/2022	-	11
MP3US Isaac	14/01/2023	5	11
MP3US Isaac	19/01/2023	5	11
MP3US Isaac	31/03/2025	1	11
MP3US Isaac	5/04/2025	3	11
MP3US Isaac	8/04/2025	2	11
MP4DS Isaac	1/03/2015	2	11
MP4DS Isaac	16/02/2016	1	11
MP4DS Isaac	2/03/2016	1	11
MP4DS Isaac	31/05/2016	2	11
MP4DS Isaac	21/03/2017	3	11
MP4DS Isaac	22/03/2017	5	11
MP4DS Isaac	23/03/2017	4	11
MP4DS Isaac	31/03/2017	3	11
MP4DS Isaac	3/04/2017	2	11
MP4DS Isaac	22/03/2018	2	11
MP4DS Isaac	9/05/2018	2	11
MP4DS Isaac	3/05/2019	2	11
MP4DS Isaac	27/01/2020	1	11
MP4DS Isaac	11/02/2020	-	11
MP4DS Isaac	25/02/2020	2	11
MP4DS Isaac	26/02/2020	1	11
MP4DS Isaac	27/02/2020	56	11

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	2/03/2020	2	11
MP4DS Isaac	28/04/2020	1	11
MP4DS Isaac	6/01/2021	-	11
MP4DS Isaac	7/01/2021	-	11
MP4DS Isaac	8/01/2021	-	11
MP4DS Isaac	10/04/2021	-	11
MP4DS Isaac	14/04/2021	-	11
MP4DS Isaac	11/11/2021	1	11
MP4DS Isaac	11/11/2021	-	11
MP4DS Isaac	1/12/2021	1	11
MP4DS Isaac	1/12/2021	-	11
MP4DS Isaac	10/01/2022	1	11
MP4DS Isaac	10/01/2022	2	11
MP4DS Isaac	11/05/2022	1	11
MP4DS Isaac	14/01/2023	5	11
MP4DS Isaac	19/01/2023	5	11
MP4DS Isaac	31/03/2025	2	11
MP4DS Isaac	5/04/2025	2	11
MP4DS Isaac	8/04/2025	2	11
RP1Dam 2	14/01/2023	10	11
RP1Dam 2	15/01/2023	-	11
RP1Dam 2	16/01/2023	-	11
RP1Dam 2	17/01/2023	-	11
RP1Dam 2	18/01/2023	-	11
RP1Dam 2	19/01/2023	5	11
RP1Dam 2	31/03/2025	2	11
RP1Dam 2	1/04/2025	-	11
RP1Dam 2	2/04/2025	-	11
RP1Dam 2	3/04/2025	-	11
RP1Dam 2	4/04/2025	-	11
RP1Dam 2	5/04/2025	6	11
RP1Dam 2	6/04/2025	-	11
RP1Dam 2	7/04/2025	-	11
RP1Dam 2	8/04/2025	12	11
RP1Dam 2	9/04/2025	-	11

A.17 ZINC

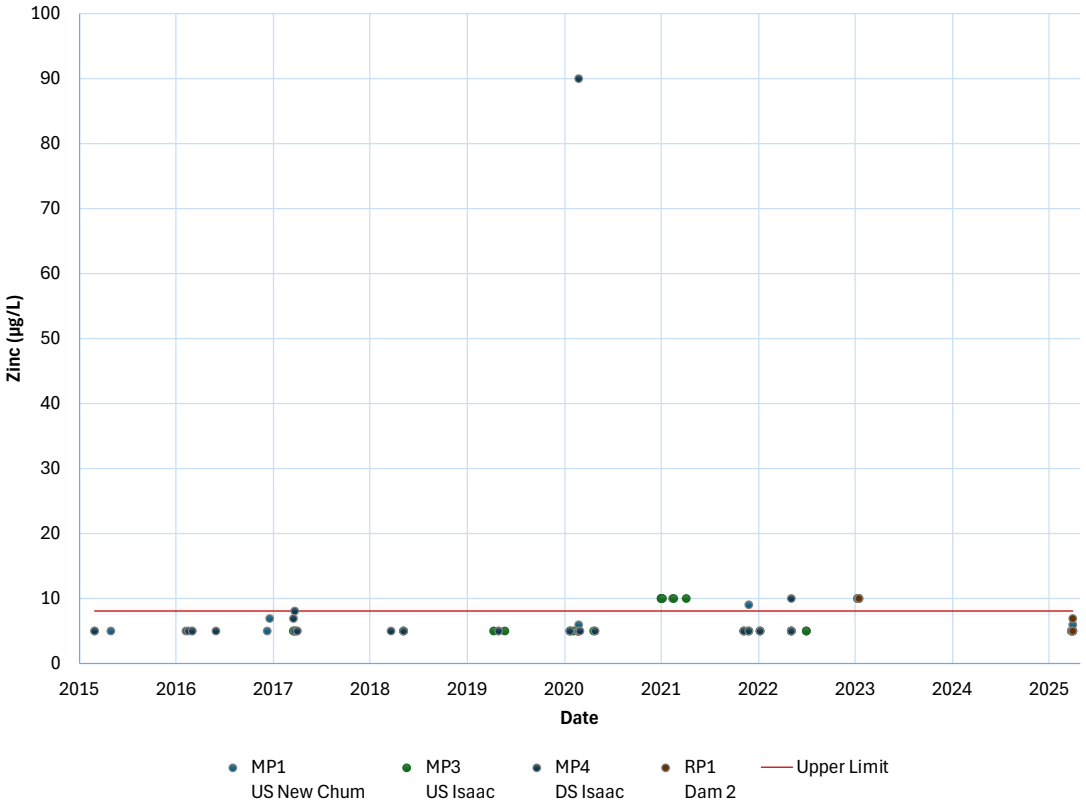

Figure A.17 Zinc Water Quality Analyte Levels

Table A.17 Zinc Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	5	8
MP1US New Chum	1/05/2015	5	8
MP1US New Chum	5/02/2016	5	8
MP1US New Chum	2/03/2016	5	8
MP1US New Chum	12/12/2016	5	8
MP1US New Chum	18/12/2016	7	8
MP1US New Chum	20/03/2017	5	8
MP1US New Chum	30/03/2017	5	8
MP1US New Chum	4/04/2017	-	8
MP1US New Chum	9/05/2018	5	8
MP1US New Chum	2/05/2019	5	8
MP1US New Chum	29/01/2020	5	8

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	26/02/2020	5	8
MP1US New Chum	27/02/2020	6	8
MP1US New Chum	28/04/2020	5	8
MP1US New Chum	6/01/2021	-	8
MP1US New Chum	18/02/2021	10	8
MP1US New Chum	11/11/2021	5	8
MP1US New Chum	11/11/2021	-	8
MP1US New Chum	26/11/2021	5	8
MP1US New Chum	26/11/2021	-	8
MP1US New Chum	1/12/2021	9	8
MP1US New Chum	1/12/2021	-	8
MP1US New Chum	10/01/2022	5	8
MP1US New Chum	11/05/2022	5	8
MP1US New Chum	11/05/2022	-	8
MP1US New Chum	12/05/2022	5	8
MP1US New Chum	12/05/2022	-	8
MP1US New Chum	5/07/2022	5	8
MP1US New Chum	14/01/2023	10	8
MP1US New Chum	19/01/2023	10	8
MP1US New Chum	31/03/2025	5	8
MP1US New Chum	5/04/2025	6	8
MP1US New Chum	8/04/2025	5	8
MP3US Isaac	21/03/2017	5	8
MP3US Isaac	22/03/2017	5	8
MP3US Isaac	31/03/2017	-	8
MP3US Isaac	3/04/2017	-	8
MP3US Isaac	9/05/2018	5	8
MP3US Isaac	11/04/2019	5	8
MP3US Isaac	28/05/2019	5	8
MP3US Isaac	27/01/2020	5	8
MP3US Isaac	27/01/2020	5	8
MP3US Isaac	11/02/2020	5	8
MP3US Isaac	25/02/2020	5	8
MP3US Isaac	28/02/2020	5	8
MP3US Isaac	27/04/2020	5	8
MP3US Isaac	6/01/2021	10	8

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	7/01/2021	10	8
MP3US Isaac	8/01/2021	10	8
MP3US Isaac	23/02/2021	10	8
MP3US Isaac	10/04/2021	10	8
MP3US Isaac	11/11/2021	5	8
MP3US Isaac	11/11/2021	-	8
MP3US Isaac	1/12/2021	5	8
MP3US Isaac	1/12/2021	-	8
MP3US Isaac	10/01/2022	5	8
MP3US Isaac	11/05/2022	5	8
MP3US Isaac	5/07/2022	5	8
MP3US Isaac	5/07/2022	-	8
MP3US Isaac	14/01/2023	10	8
MP3US Isaac	19/01/2023	10	8
MP3US Isaac	31/03/2025	5	8
MP3US Isaac	5/04/2025	5	8
MP3US Isaac	8/04/2025	5	8
MP4DS Isaac	1/03/2015	5	8
MP4DS Isaac	16/02/2016	5	8
MP4DS Isaac	2/03/2016	5	8
MP4DS Isaac	31/05/2016	5	8
MP4DS Isaac	21/03/2017	7	8
MP4DS Isaac	22/03/2017	8	8
MP4DS Isaac	23/03/2017	5	8
MP4DS Isaac	31/03/2017	5	8
MP4DS Isaac	3/04/2017	5	8
MP4DS Isaac	22/03/2018	5	8
MP4DS Isaac	9/05/2018	5	8
MP4DS Isaac	3/05/2019	5	8
MP4DS Isaac	27/01/2020	5	8
MP4DS Isaac	11/02/2020	-	8
MP4DS Isaac	25/02/2020	5	8
MP4DS Isaac	26/02/2020	5	8
MP4DS Isaac	27/02/2020	90	8
MP4DS Isaac	2/03/2020	5	8
MP4DS Isaac	28/04/2020	5	8

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	6/01/2021	-	8
MP4DS Isaac	7/01/2021	-	8
MP4DS Isaac	8/01/2021	-	8
MP4DS Isaac	10/04/2021	-	8
MP4DS Isaac	14/04/2021	-	8
MP4DS Isaac	11/11/2021	5	8
MP4DS Isaac	11/11/2021	-	8
MP4DS Isaac	1/12/2021	5	8
MP4DS Isaac	1/12/2021	-	8
MP4DS Isaac	10/01/2022	5	8
MP4DS Isaac	11/05/2022	10	8
MP4DS Isaac	11/05/2022	5	8
MP4DS Isaac	14/01/2023	10	8
MP4DS Isaac	19/01/2023	10	8
MP4DS Isaac	31/03/2025	5	8
MP4DS Isaac	5/04/2025	5	8
MP4DS Isaac	8/04/2025	5	8
RP1Dam 2	14/01/2023	10	8
RP1Dam 2	15/01/2023	-	8
RP1Dam 2	16/01/2023	-	8
RP1Dam 2	17/01/2023	-	8
RP1Dam 2	18/01/2023	-	8
RP1Dam 2	19/01/2023	10	8
RP1Dam 2	31/03/2025	5	8
RP1Dam 2	1/04/2025	-	8
RP1Dam 2	2/04/2025	-	8
RP1Dam 2	3/04/2025	-	8
RP1Dam 2	4/04/2025	-	8
RP1Dam 2	5/04/2025	5	8
RP1Dam 2	6/04/2025	-	8
RP1Dam 2	7/04/2025	-	8
RP1Dam 2	8/04/2025	7	8
RP1Dam 2	9/04/2025	-	8

A.18 SELENIUM

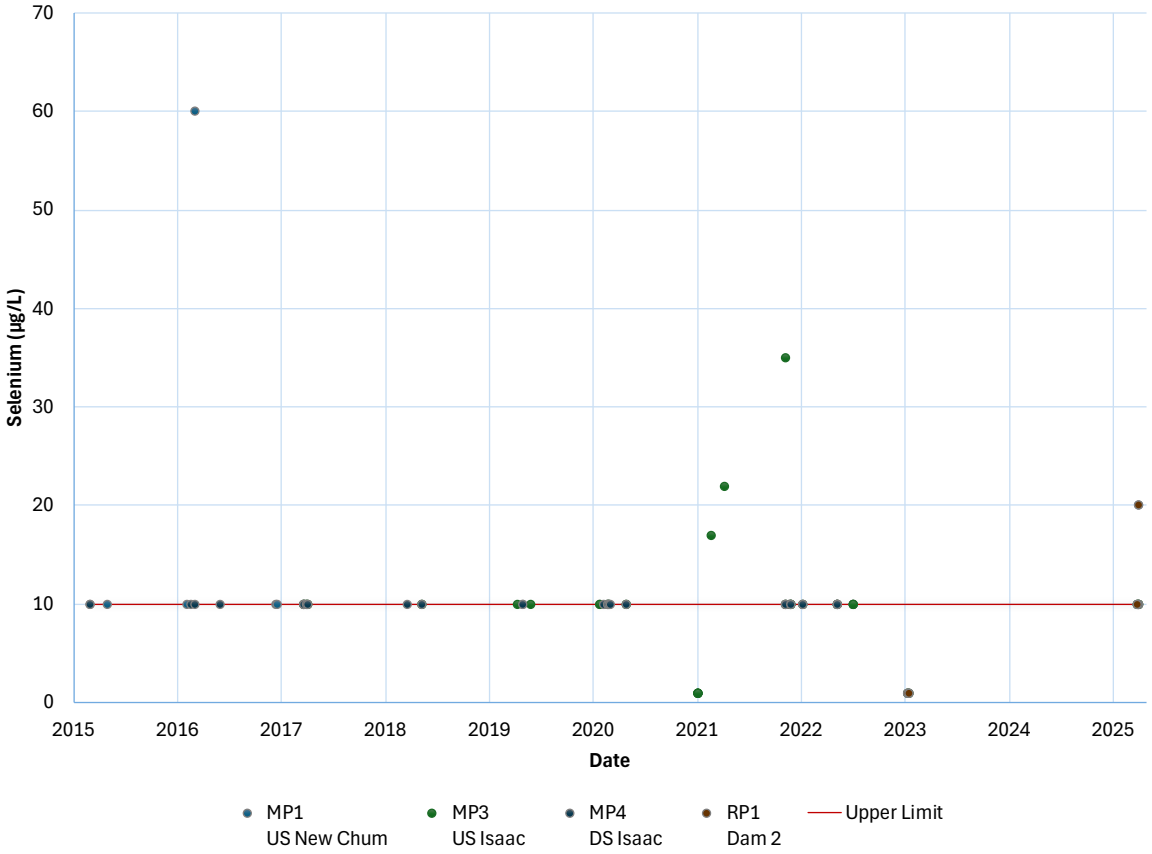

Figure A.18 Selenium Water Quality Analyte Levels

Table A.18 Selenium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	10	10
MP1US New Chum	1/05/2015	10	10
MP1US New Chum	5/02/2016	10	10
MP1US New Chum	2/03/2016	60	10
MP1US New Chum	12/12/2016	10	10
MP1US New Chum	18/12/2016	10	10
MP1US New Chum	20/03/2017	10	10
MP1US New Chum	30/03/2017	10	10
MP1US New Chum	4/04/2017	10	10
MP1US New Chum	9/05/2018	10	10
MP1US New Chum	2/05/2019	10	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	10	10
MP1US New Chum	26/02/2020	10	10
MP1US New Chum	27/02/2020	10	10
MP1US New Chum	28/04/2020	10	10
MP1US New Chum	6/01/2021	-	10
MP1US New Chum	18/02/2021	-	10
MP1US New Chum	11/11/2021	10	10
MP1US New Chum	26/11/2021	10	10
MP1US New Chum	1/12/2021	10	10
MP1US New Chum	10/01/2022	10	10
MP1US New Chum	11/05/2022	10	10
MP1US New Chum	12/05/2022	10	10
MP1US New Chum	5/07/2022	10	10
MP1US New Chum	14/01/2023	1	10
MP1US New Chum	19/01/2023	1	10
MP1US New Chum	31/03/2025	10	10
MP1US New Chum	5/04/2025	10	10
MP1US New Chum	8/04/2025	10	10
MP3US Isaac	21/03/2017	10	10
MP3US Isaac	22/03/2017	10	10
MP3US Isaac	31/03/2017	10	10
MP3US Isaac	3/04/2017	10	10
MP3US Isaac	9/05/2018	10	10
MP3US Isaac	11/04/2019	10	10
MP3US Isaac	28/05/2019	10	10
MP3US Isaac	27/01/2020	10	10
MP3US Isaac	27/01/2020	-	10
MP3US Isaac	11/02/2020	-	10
MP3US Isaac	25/02/2020	10	10
MP3US Isaac	28/02/2020	10	10
MP3US Isaac	27/04/2020	10	10
MP3US Isaac	6/01/2021	1	10
MP3US Isaac	7/01/2021	1	10
MP3US Isaac	8/01/2021	1	10
MP3US Isaac	23/02/2021	17	10
MP3US Isaac	10/04/2021	22	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	11/11/2021	35	10
MP3US Isaac	11/11/2021	10	10
MP3US Isaac	1/12/2021	10	10
MP3US Isaac	10/01/2022	10	10
MP3US Isaac	11/05/2022	10	10
MP3US Isaac	5/07/2022	10	10
MP3US Isaac	14/01/2023	1	10
MP3US Isaac	19/01/2023	1	10
MP3US Isaac	31/03/2025	10	10
MP3US Isaac	5/04/2025	10	10
MP3US Isaac	8/04/2025	10	10
MP4DS Isaac	1/03/2015	10	10
MP4DS Isaac	16/02/2016	10	10
MP4DS Isaac	2/03/2016	10	10
MP4DS Isaac	31/05/2016	10	10
MP4DS Isaac	21/03/2017	10	10
MP4DS Isaac	22/03/2017	10	10
MP4DS Isaac	23/03/2017	10	10
MP4DS Isaac	31/03/2017	10	10
MP4DS Isaac	3/04/2017	10	10
MP4DS Isaac	22/03/2018	10	10
MP4DS Isaac	9/05/2018	10	10
MP4DS Isaac	3/05/2019	10	10
MP4DS Isaac	27/01/2020	-	10
MP4DS Isaac	11/02/2020	10	10
MP4DS Isaac	25/02/2020	10	10
MP4DS Isaac	26/02/2020	10	10
MP4DS Isaac	27/02/2020	10	10
MP4DS Isaac	2/03/2020	10	10
MP4DS Isaac	28/04/2020	10	10
MP4DS Isaac	6/01/2021	-	10
MP4DS Isaac	7/01/2021	-	10
MP4DS Isaac	8/01/2021	-	10
MP4DS Isaac	10/04/2021	-	10
MP4DS Isaac	14/04/2021	-	10
MP4DS Isaac	11/11/2021	10	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	1/12/2021	10	10
MP4DS Isaac	10/01/2022	10	10
MP4DS Isaac	11/05/2022	10	10
MP4DS Isaac	14/01/2023	1	10
MP4DS Isaac	19/01/2023	1	10
MP4DS Isaac	31/03/2025	10	10
MP4DS Isaac	5/04/2025	10	10
MP4DS Isaac	8/04/2025	10	10
RP1Dam 2	14/01/2023	1	10
RP1Dam 2	15/01/2023	-	10
RP1Dam 2	16/01/2023	-	10
RP1Dam 2	17/01/2023	-	10
RP1Dam 2	18/01/2023	-	10
RP1Dam 2	19/01/2023	1	10
RP1Dam 2	31/03/2025	10	10
RP1Dam 2	1/04/2025	-	10
RP1Dam 2	2/04/2025	-	10
RP1Dam 2	3/04/2025	-	10
RP1Dam 2	4/04/2025	-	10
RP1Dam 2	5/04/2025	20	10
RP1Dam 2	6/04/2025	-	10
RP1Dam 2	7/04/2025	-	10
RP1Dam 2	8/04/2025	20	10
RP1Dam 2	9/04/2025	-	10

A.19 SILVER

Figure A.19 Silver Water Quality Analyte Levels

Table A.19 Silver Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	-	1
MP1US New Chum	1/05/2015	-	1
MP1US New Chum	5/02/2016	1	1
MP1US New Chum	2/03/2016	-	1
MP1US New Chum	12/12/2016	1	1
MP1US New Chum	18/12/2016	2	1
MP1US New Chum	20/03/2017	1	1
MP1US New Chum	30/03/2017	1	1
MP1US New Chum	4/04/2017	-	1
MP1US New Chum	9/05/2018	-	1
MP1US New Chum	2/05/2019	-	1
MP1US New Chum	29/01/2020	1	1
MP1US New Chum	26/02/2020	1	1
MP1US New Chum	27/02/2020	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	28/04/2020	1	1
MP1US New Chum	6/01/2021	-	1
MP1US New Chum	18/02/2021	-	1
MP1US New Chum	11/11/2021	1	1
MP1US New Chum	26/11/2021	1	1
MP1US New Chum	1/12/2021	1	1
MP1US New Chum	10/01/2022	1	1
MP1US New Chum	11/05/2022	1	1
MP1US New Chum	12/05/2022	1	1
MP1US New Chum	5/07/2022	1	1
MP1US New Chum	14/01/2023	1	1
MP1US New Chum	19/01/2023	1	1
MP1US New Chum	31/03/2025	1	1
MP1US New Chum	5/04/2025	1	1
MP1US New Chum	8/04/2025	1	1
MP3US Isaac	21/03/2017	1	1
MP3US Isaac	22/03/2017	-	1
MP3US Isaac	31/03/2017	1	1
MP3US Isaac	3/04/2017	-	1
MP3US Isaac	9/05/2018	-	1
MP3US Isaac	11/04/2019	-	1
MP3US Isaac	28/05/2019	-	1
MP3US Isaac	27/01/2020	-	1
MP3US Isaac	27/01/2020	-	1
MP3US Isaac	11/02/2020	-	1
MP3US Isaac	25/02/2020	1	1
MP3US Isaac	28/02/2020	1	1
MP3US Isaac	27/04/2020	1	1
MP3US Isaac	6/01/2021	0.1	1
MP3US Isaac	7/01/2021	0.1	1
MP3US Isaac	8/01/2021	0.1	1
MP3US Isaac	23/02/2021	-	1
MP3US Isaac	10/04/2021	0.1	1
MP3US Isaac	11/11/2021	1	1
MP3US Isaac	1/12/2021	1	1
MP3US Isaac	10/01/2022	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	11/05/2022	1	1
MP3US Isaac	5/07/2022	1	1
MP3US Isaac	14/01/2023	1	1
MP3US Isaac	19/01/2023	1	1
MP3US Isaac	31/03/2025	1	1
MP3US Isaac	5/04/2025	1	1
MP3US Isaac	8/04/2025	1	1
MP4DS Isaac	1/03/2015	-	1
MP4DS Isaac	16/02/2016	1	1
MP4DS Isaac	2/03/2016	-	1
MP4DS Isaac	31/05/2016	-	1
MP4DS Isaac	21/03/2017	1	1
MP4DS Isaac	22/03/2017	1	1
MP4DS Isaac	23/03/2017	1	1
MP4DS Isaac	31/03/2017	1	1
MP4DS Isaac	3/04/2017	1	1
MP4DS Isaac	22/03/2018	-	1
MP4DS Isaac	9/05/2018	-	1
MP4DS Isaac	3/05/2019	-	1
MP4DS Isaac	27/01/2020	-	1
MP4DS Isaac	11/02/2020	1	1
MP4DS Isaac	25/02/2020	1	1
MP4DS Isaac	26/02/2020	1	1
MP4DS Isaac	27/02/2020	1	1
MP4DS Isaac	2/03/2020	1	1
MP4DS Isaac	28/04/2020	1	1
MP4DS Isaac	6/01/2021	-	1
MP4DS Isaac	7/01/2021	-	1
MP4DS Isaac	8/01/2021	-	1
MP4DS Isaac	10/04/2021	-	1
MP4DS Isaac	14/04/2021	-	1
MP4DS Isaac	11/11/2021	1	1
MP4DS Isaac	1/12/2021	1	1
MP4DS Isaac	10/01/2022	1	1
MP4DS Isaac	11/05/2022	1	1
MP4DS Isaac	14/01/2023	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	19/01/2023	1	1
MP4DS Isaac	31/03/2025	1	1
MP4DS Isaac	5/04/2025	1	1
MP4DS Isaac	8/04/2025	1	1
RP1Dam 2	14/01/2023	3	1
RP1Dam 2	15/01/2023	-	1
RP1Dam 2	16/01/2023	-	1
RP1Dam 2	17/01/2023	-	1
RP1Dam 2	18/01/2023	-	1
RP1Dam 2	19/01/2023	2	1
RP1Dam 2	31/03/2025	1	1
RP1Dam 2	1/04/2025	-	1
RP1Dam 2	2/04/2025	-	1
RP1Dam 2	3/04/2025	-	1
RP1Dam 2	4/04/2025	-	1
RP1Dam 2	5/04/2025	1	1
RP1Dam 2	6/04/2025	-	1
RP1Dam 2	7/04/2025	-	1
RP1Dam 2	8/04/2025	1	1
RP1Dam 2	9/04/2025	-	1

A.20 URANIUM

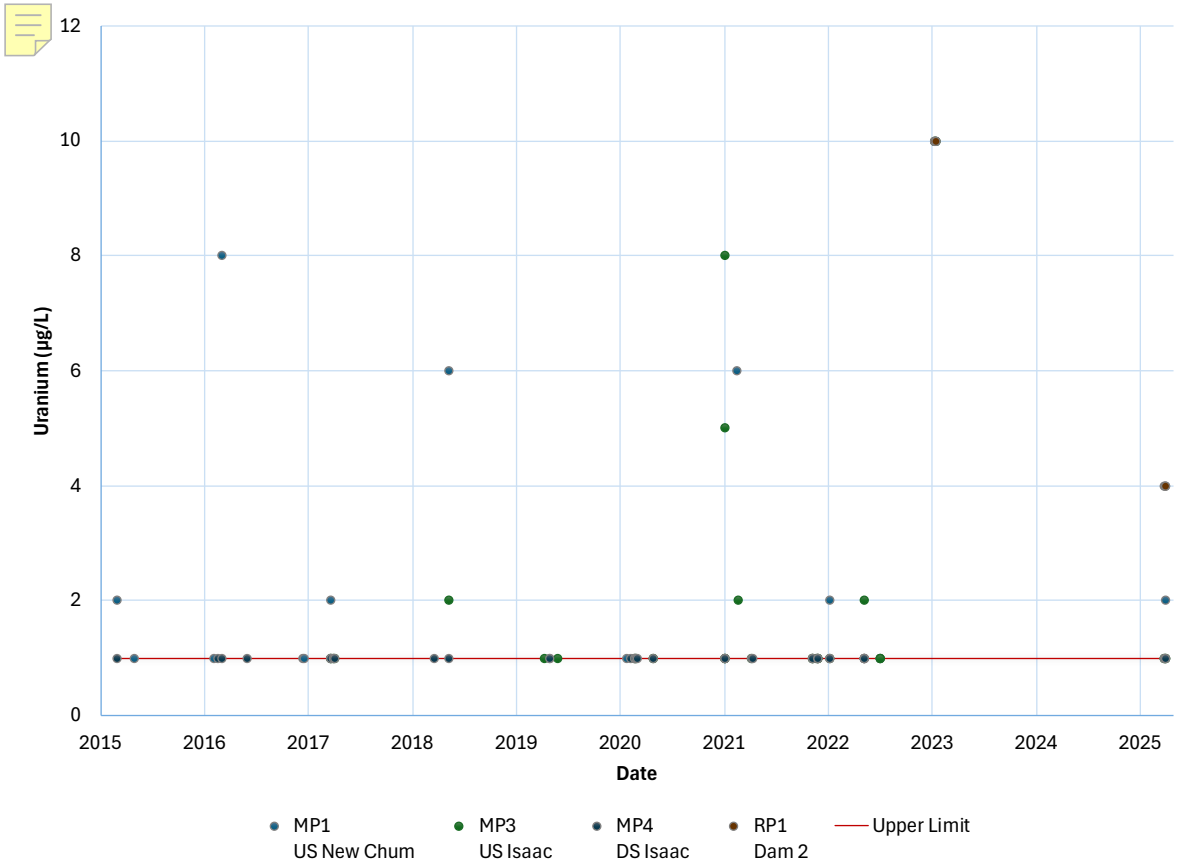

Figure A.20 Uranium Water Quality Analyte Levels

Table A.20 Uranium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	2	1
MP1US New Chum	1/05/2015	1	1
MP1US New Chum	5/02/2016	1	1
MP1US New Chum	2/03/2016	8	1
MP1US New Chum	12/12/2016	1	1
MP1US New Chum	18/12/2016	1	1
MP1US New Chum	20/03/2017	2	1
MP1US New Chum	30/03/2017	1	1
MP1US New Chum	4/04/2017	-	1
MP1US New Chum	9/05/2018	6	1
MP1US New Chum	2/05/2019	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	1	1
MP1US New Chum	26/02/2020	1	1
MP1US New Chum	27/02/2020	1	1
MP1US New Chum	28/04/2020	1	1
MP1US New Chum	6/01/2021	-	1
MP1US New Chum	18/02/2021	6	1
MP1US New Chum	11/11/2021	1	1
MP1US New Chum	26/11/2021	1	1
MP1US New Chum	1/12/2021	1	1
MP1US New Chum	10/01/2022	2	1
MP1US New Chum	11/05/2022	1	1
MP1US New Chum	12/05/2022	1	1
MP1US New Chum	5/07/2022	1	1
MP1US New Chum	14/01/2023	10	1
MP1US New Chum	19/01/2023	10	1
MP1US New Chum	31/03/2025	1	1
MP1US New Chum	5/04/2025	1	1
MP1US New Chum	8/04/2025	2	1
MP3US Isaac	21/03/2017	1	1
MP3US Isaac	22/03/2017	1	1
MP3US Isaac	31/03/2017	1	1
MP3US Isaac	3/04/2017	1	1
MP3US Isaac	9/05/2018	2	1
MP3US Isaac	11/04/2019	1	1
MP3US Isaac	28/05/2019	1	1
MP3US Isaac	27/01/2020	-	1
MP3US Isaac	27/01/2020	-	1
MP3US Isaac	11/02/2020	-	1
MP3US Isaac	25/02/2020	1	1
MP3US Isaac	28/02/2020	1	1
MP3US Isaac	27/04/2020	1	1
MP3US Isaac	6/01/2021	5	1
MP3US Isaac	6/01/2021	8	1
MP3US Isaac	7/01/2021	1	1
MP3US Isaac	8/01/2021	1	1
MP3US Isaac	23/02/2021	2	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	10/04/2021	1	1
MP3US Isaac	11/11/2021	1	1
MP3US Isaac	1/12/2021	1	1
MP3US Isaac	10/01/2022	1	1
MP3US Isaac	11/05/2022	2	1
MP3US Isaac	5/07/2022	1	1
MP3US Isaac	14/01/2023	10	1
MP3US Isaac	19/01/2023	10	1
MP3US Isaac	31/03/2025	1	1
MP3US Isaac	5/04/2025	1	1
MP3US Isaac	8/04/2025	1	1
MP4DS Isaac	1/03/2015	1	1
MP4DS Isaac	16/02/2016	1	1
MP4DS Isaac	2/03/2016	1	1
MP4DS Isaac	31/05/2016	1	1
MP4DS Isaac	21/03/2017	1	1
MP4DS Isaac	22/03/2017	1	1
MP4DS Isaac	23/03/2017	1	1
MP4DS Isaac	31/03/2017	1	1
MP4DS Isaac	3/04/2017	1	1
MP4DS Isaac	22/03/2018	1	1
MP4DS Isaac	9/05/2018	1	1
MP4DS Isaac	3/05/2019	1	1
MP4DS Isaac	27/01/2020	-	1
MP4DS Isaac	11/02/2020	1	1
MP4DS Isaac	25/02/2020	1	1
MP4DS Isaac	26/02/2020	1	1
MP4DS Isaac	27/02/2020	1	1
MP4DS Isaac	2/03/2020	1	1
MP4DS Isaac	28/04/2020	1	1
MP4DS Isaac	6/01/2021	1	1
MP4DS Isaac	7/01/2021	1	1
MP4DS Isaac	8/01/2021	1	1
MP4DS Isaac	10/04/2021	1	1
MP4DS Isaac	14/04/2021	1	1
MP4DS Isaac	11/11/2021	1	1

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	1/12/2021	1	1
MP4DS Isaac	10/01/2022	1	1
MP4DS Isaac	11/05/2022	1	1
MP4DS Isaac	14/01/2023	10	1
MP4DS Isaac	19/01/2023	10	1
MP4DS Isaac	31/03/2025	1	1
MP4DS Isaac	5/04/2025	1	1
MP4DS Isaac	8/04/2025	1	1
RP1Dam 2	14/01/2023	10	1
RP1Dam 2	15/01/2023	-	1
RP1Dam 2	16/01/2023	-	1
RP1Dam 2	17/01/2023	-	1
RP1Dam 2	18/01/2023	-	1
RP1Dam 2	19/01/2023	10	1
RP1Dam 2	31/03/2025	4	1
RP1Dam 2	1/04/2025	-	1
RP1Dam 2	2/04/2025	-	1
RP1Dam 2	3/04/2025	-	1
RP1Dam 2	4/04/2025	-	1
RP1Dam 2	5/04/2025	4	1
RP1Dam 2	6/04/2025	-	1
RP1Dam 2	7/04/2025	-	1
RP1Dam 2	8/04/2025	4	1
RP1Dam 2	9/04/2025	-	1

A.21 VANADIUM

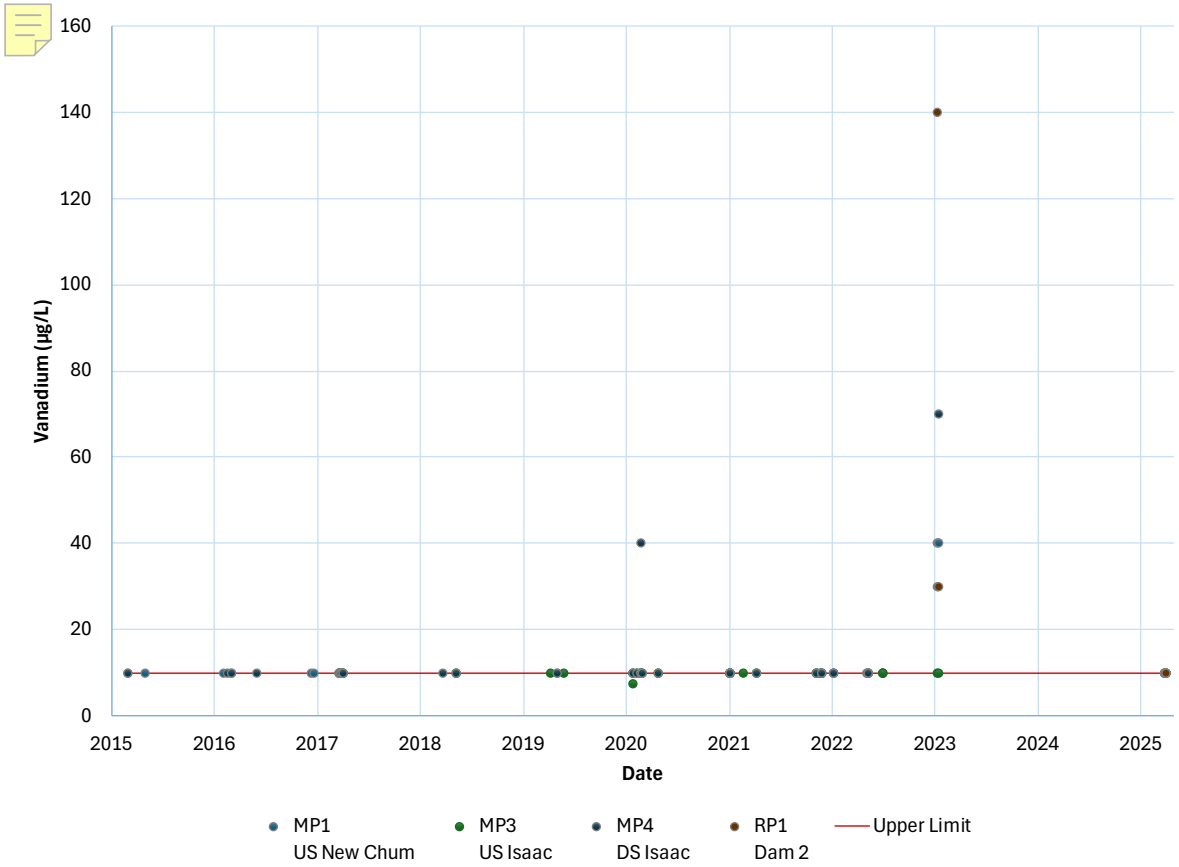

Figure A.21 Vanadium Water Quality Analyte Levels

Table A.21 Vanadium Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	10	10
MP1US New Chum	1/05/2015	10	10
MP1US New Chum	5/02/2016	10	10
MP1US New Chum	2/03/2016	10	10
MP1US New Chum	12/12/2016	10	10
MP1US New Chum	18/12/2016	10	10
MP1US New Chum	20/03/2017	10	10
MP1US New Chum	30/03/2017	10	10
MP1US New Chum	4/04/2017	10	10
MP1US New Chum	9/05/2018	10	10
MP1US New Chum	2/05/2019	10	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	10	10
MP1US New Chum	26/02/2020	10	10
MP1US New Chum	27/02/2020	10	10
MP1US New Chum	28/04/2020	10	10
MP1US New Chum	6/01/2021	10	10
MP1US New Chum	11/11/2021	10	10
MP1US New Chum	26/11/2021	10	10
MP1US New Chum	1/12/2021	10	10
MP1US New Chum	10/01/2022	10	10
MP1US New Chum	11/05/2022	10	10
MP1US New Chum	12/05/2022	10	10
MP1US New Chum	5/07/2022	10	10
MP1US New Chum	14/01/2023	40	10
MP1US New Chum	19/01/2023	40	10
MP1US New Chum	31/03/2025	10	10
MP1US New Chum	5/04/2025	10	10
MP1US New Chum	8/04/2025	10	10
MP3US Isaac	21/03/2017	10	10
MP3US Isaac	22/03/2017	10	10
MP3US Isaac	31/03/2017	10	10
MP3US Isaac	3/04/2017	10	10
MP3US Isaac	9/05/2018	10	10
MP3US Isaac	11/04/2019	10	10
MP3US Isaac	28/05/2019	10	10
MP3US Isaac	27/01/2020	10	10
MP3US Isaac	27/01/2020	7.31	10
MP3US Isaac	11/02/2020	10	10
MP3US Isaac	25/02/2020	10	10
MP3US Isaac	28/02/2020	10	10
MP3US Isaac	27/04/2020	10	10
MP3US Isaac	6/01/2021	10	10
MP3US Isaac	7/01/2021	10	10
MP3US Isaac	8/01/2021	10	10
MP3US Isaac	23/02/2021	10	10
MP3US Isaac	10/04/2021	10	10
MP3US Isaac	11/11/2021	10	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	1/12/2021	10	10
MP3US Isaac	10/01/2022	10	10
MP3US Isaac	11/05/2022	10	10
MP3US Isaac	5/07/2022	10	10
MP3US Isaac	14/01/2023	10	10
MP3US Isaac	19/01/2023	10	10
MP3US Isaac	31/03/2025	10	10
MP3US Isaac	5/04/2025	10	10
MP3US Isaac	8/04/2025	10	10
MP4DS Isaac	1/03/2015	10	10
MP4DS Isaac	16/02/2016	10	10
MP4DS Isaac	2/03/2016	10	10
MP4DS Isaac	31/05/2016	10	10
MP4DS Isaac	21/03/2017	10	10
MP4DS Isaac	22/03/2017	10	10
MP4DS Isaac	23/03/2017	10	10
MP4DS Isaac	31/03/2017	10	10
MP4DS Isaac	3/04/2017	10	10
MP4DS Isaac	22/03/2018	10	10
MP4DS Isaac	9/05/2018	10	10
MP4DS Isaac	3/05/2019	10	10
MP4DS Isaac	27/01/2020	10	10
MP4DS Isaac	11/02/2020	10	10
MP4DS Isaac	25/02/2020	10	10
MP4DS Isaac	26/02/2020	10	10
MP4DS Isaac	27/02/2020	40	10
MP4DS Isaac	2/03/2020	10	10
MP4DS Isaac	28/04/2020	10	10
MP4DS Isaac	6/01/2021	10	10
MP4DS Isaac	7/01/2021	10	10
MP4DS Isaac	8/01/2021	10	10
MP4DS Isaac	10/04/2021	10	10
MP4DS Isaac	14/04/2021	10	10
MP4DS Isaac	11/11/2021	10	10
MP4DS Isaac	1/12/2021	10	10
MP4DS Isaac	10/01/2022	10	10

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/05/2022	10	10
MP4DS Isaac	14/01/2023	30	10
MP4DS Isaac	19/01/2023	70	10
MP4DS Isaac	31/03/2025	10	10
MP4DS Isaac	5/04/2025	10	10
MP4DS Isaac	8/04/2025	10	10
RP1Dam 2	14/01/2023	140	10
RP1Dam 2	15/01/2023	-	10
RP1Dam 2	16/01/2023	-	10
RP1Dam 2	17/01/2023	-	10
RP1Dam 2	18/01/2023	-	10
RP1Dam 2	19/01/2023	30	10
RP1Dam 2	31/03/2025	10	10
RP1Dam 2	1/04/2025	-	10
RP1Dam 2	2/04/2025	-	10
RP1Dam 2	3/04/2025	-	10
RP1Dam 2	4/04/2025	-	10
RP1Dam 2	5/04/2025	10	10
RP1Dam 2	6/04/2025	-	10
RP1Dam 2	7/04/2025	-	10
RP1Dam 2	8/04/2025	10	10
RP1Dam 2	9/04/2025	-	10

A.22 AMMONIA

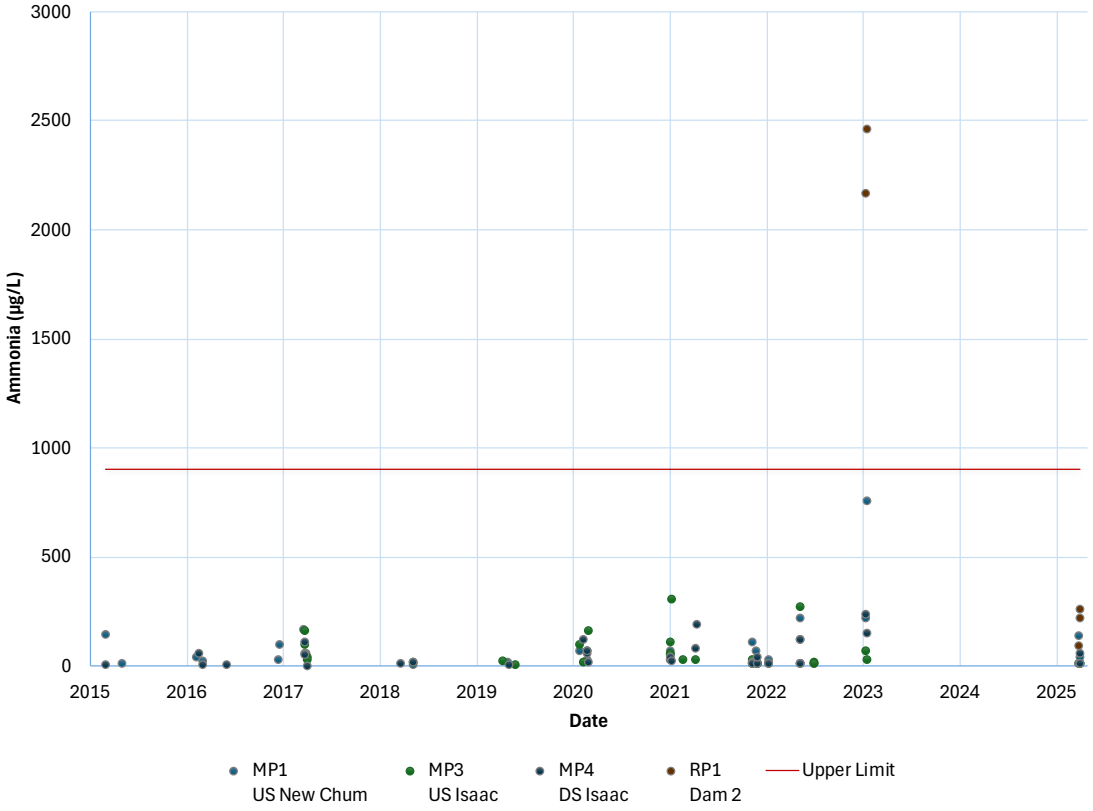

Figure A.22 Ammonia Water Quality Analyte Levels

Table A.22 Ammonia Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	147	900
MP1US New Chum	1/05/2015	12	900
MP1US New Chum	5/02/2016	40	900
MP1US New Chum	2/03/2016	25	900
MP1US New Chum	12/12/2016	28	900
MP1US New Chum	18/12/2016	100	900
MP1US New Chum	20/03/2017	170	900
MP1US New Chum	30/03/2017	60	900
MP1US New Chum	4/04/2017	-	900
MP1US New Chum	9/05/2018	5	900
MP1US New Chum	2/05/2019	18	900
MP1US New Chum	29/01/2020	70	900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	26/02/2020	-	900
MP1US New Chum	27/02/2020	30	900
MP1US New Chum	28/04/2020	-	900
MP1US New Chum	6/01/2021	70	900
MP1US New Chum	11/11/2021	110	900
MP1US New Chum	11/11/2021	10	900
MP1US New Chum	26/11/2021	10	900
MP1US New Chum	26/11/2021	70	900
MP1US New Chum	1/12/2021	10	900
MP1US New Chum	1/12/2021	10	900
MP1US New Chum	10/01/2022	30	900
MP1US New Chum	11/05/2022	10	900
MP1US New Chum	11/05/2022	220	900
MP1US New Chum	12/05/2022	10	900
MP1US New Chum	12/05/2022	120	900
MP1US New Chum	5/07/2022	10	900
MP1US New Chum	14/01/2023	220	900
MP1US New Chum	19/01/2023	760	900
MP1US New Chum	31/03/2025	140	900
MP1US New Chum	5/04/2025	10	900
MP1US New Chum	8/04/2025	40	900
MP3US Isaac	21/03/2017	160	900
MP3US Isaac	22/03/2017	100	900
MP3US Isaac	31/03/2017	40	900
MP3US Isaac	3/04/2017	30	900
MP3US Isaac	9/05/2018	19	900
MP3US Isaac	11/04/2019	23	900
MP3US Isaac	28/05/2019	8	900
MP3US Isaac	27/01/2020	-	900
MP3US Isaac	27/01/2020	98	900
MP3US Isaac	11/02/2020	20	900
MP3US Isaac	25/02/2020	70	900
MP3US Isaac	28/02/2020	160	900
MP3US Isaac	27/04/2020	-	900
MP3US Isaac	6/01/2021	110	900
MP3US Isaac	6/01/2021	30	900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	7/01/2021	60	900
MP3US Isaac	7/01/2021	50	900
MP3US Isaac	8/01/2021	304	900
MP3US Isaac	23/02/2021	30	900
MP3US Isaac	10/04/2021	31	900
MP3US Isaac	11/11/2021	30	900
MP3US Isaac	11/11/2021	10	900
MP3US Isaac	1/12/2021	10	900
MP3US Isaac	10/01/2022	10	900
MP3US Isaac	11/05/2022	270	900
MP3US Isaac	5/07/2022	20	900
MP3US Isaac	5/07/2022	10	900
MP3US Isaac	14/01/2023	70	900
MP3US Isaac	19/01/2023	30	900
MP3US Isaac	31/03/2025	10	900
MP3US Isaac	5/04/2025	10	900
MP3US Isaac	8/04/2025	10	900
MP4DS Isaac	1/03/2015	5	900
MP4DS Isaac	16/02/2016	60	900
MP4DS Isaac	2/03/2016	5	900
MP4DS Isaac	31/05/2016	5	900
MP4DS Isaac	21/03/2017	110	900
MP4DS Isaac	22/03/2017	60	900
MP4DS Isaac	23/03/2017	50	900
MP4DS Isaac	31/03/2017	0	900
MP4DS Isaac	3/04/2017	-	900
MP4DS Isaac	22/03/2018	11	900
MP4DS Isaac	9/05/2018	18	900
MP4DS Isaac	3/05/2019	5	900
MP4DS Isaac	27/01/2020	-	900
MP4DS Isaac	11/02/2020	120	900
MP4DS Isaac	25/02/2020	60	900
MP4DS Isaac	26/02/2020	-	900
MP4DS Isaac	27/02/2020	70	900
MP4DS Isaac	2/03/2020	20	900
MP4DS Isaac	28/04/2020	-	900

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	6/01/2021	30	900
MP4DS Isaac	7/01/2021	40	900
MP4DS Isaac	8/01/2021	24	900
MP4DS Isaac	10/04/2021	80	900
MP4DS Isaac	14/04/2021	190	900
MP4DS Isaac	11/11/2021	20	900
MP4DS Isaac	11/11/2021	10	900
MP4DS Isaac	1/12/2021	10	900
MP4DS Isaac	1/12/2021	40	900
MP4DS Isaac	10/01/2022	10	900
MP4DS Isaac	11/05/2022	10	900
MP4DS Isaac	11/05/2022	120	900
MP4DS Isaac	14/01/2023	240	900
MP4DS Isaac	19/01/2023	150	900
MP4DS Isaac	31/03/2025	10	900
MP4DS Isaac	5/04/2025	60	900
MP4DS Isaac	8/04/2025	10	900
RP1Dam 2	14/01/2023	2170	900
RP1Dam 2	15/01/2023	-	900
RP1Dam 2	16/01/2023	-	900
RP1Dam 2	17/01/2023	-	900
RP1Dam 2	18/01/2023	-	900
RP1Dam 2	19/01/2023	2460	900
RP1Dam 2	31/03/2025	90	900
RP1Dam 2	1/04/2025	-	900
RP1Dam 2	2/04/2025	-	900
RP1Dam 2	3/04/2025	-	900
RP1Dam 2	4/04/2025	-	900
RP1Dam 2	5/04/2025	220	900
RP1Dam 2	6/04/2025	-	900
RP1Dam 2	7/04/2025	-	900
RP1Dam 2	8/04/2025	260	900
RP1Dam 2	9/04/2025	-	900

A.23 NITRATE

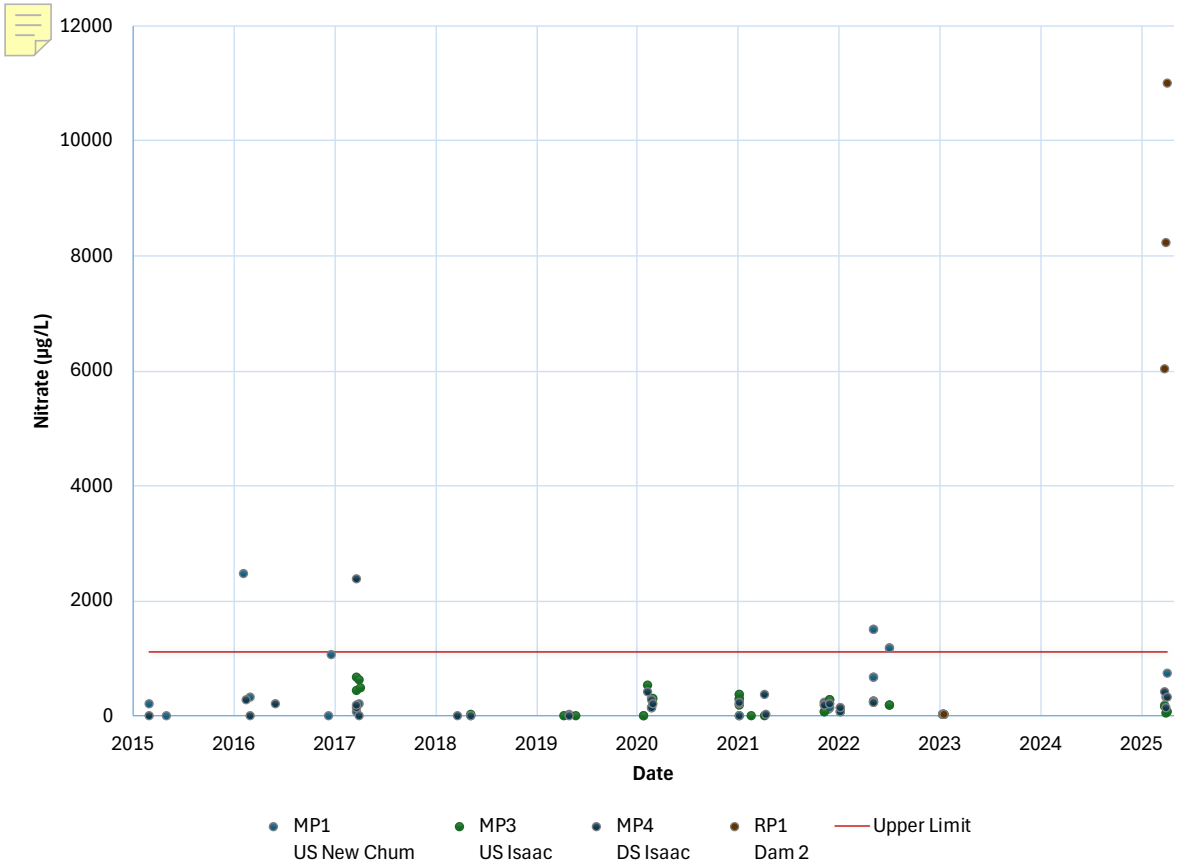

Figure A.23 Nitrate Water Quality Analyte Levels

Table A.23 Nitrate Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	208	1100
MP1US New Chum	1/05/2015	2	1100
MP1US New Chum	5/02/2016	2470	1100
MP1US New Chum	2/03/2016	319	1100
MP1US New Chum	12/12/2016	7	1100
MP1US New Chum	18/12/2016	1070	1100
MP1US New Chum	20/03/2017	60	1100
MP1US New Chum	30/03/2017	200	1100
MP1US New Chum	4/04/2017	-	1100
MP1US New Chum	9/05/2018	10	1100
MP1US New Chum	2/05/2019	17	1100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	10	1100
MP1US New Chum	26/02/2020	-	1100
MP1US New Chum	27/02/2020	310	1100
MP1US New Chum	28/04/2020	-	1100
MP1US New Chum	6/01/2021	370	1100
MP1US New Chum	11/11/2021	230	1100
MP1US New Chum	26/11/2021	120	1100
MP1US New Chum	1/12/2021	150	1100
MP1US New Chum	10/01/2022	130	1100
MP1US New Chum	11/05/2022	670	1100
MP1US New Chum	12/05/2022	1500	1100
MP1US New Chum	5/07/2022	1180	1100
MP1US New Chum	14/01/2023	20	1100
MP1US New Chum	19/01/2023	20	1100
MP1US New Chum	31/03/2025	190	1100
MP1US New Chum	5/04/2025	330	1100
MP1US New Chum	8/04/2025	740	1100
MP3US Isaac	21/03/2017	680	1100
MP3US Isaac	22/03/2017	440	1100
MP3US Isaac	31/03/2017	620	1100
MP3US Isaac	3/04/2017	480	1100
MP3US Isaac	9/05/2018	17	1100
MP3US Isaac	11/04/2019	5	1100
MP3US Isaac	28/05/2019	2	1100
MP3US Isaac	27/01/2020	-	1100
MP3US Isaac	27/01/2020	3	1100
MP3US Isaac	11/02/2020	540	1100
MP3US Isaac	25/02/2020	150	1100
MP3US Isaac	28/02/2020	300	1100
MP3US Isaac	27/04/2020	-	1100
MP3US Isaac	6/01/2021	280	1100
MP3US Isaac	6/01/2021	190	1100
MP3US Isaac	7/01/2021	300	1100
MP3US Isaac	7/01/2021	370	1100
MP3US Isaac	8/01/2021	9	1100
MP3US Isaac	23/02/2021	2	1100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	10/04/2021	2	1100
MP3US Isaac	11/11/2021	80	1100
MP3US Isaac	1/12/2021	270	1100
MP3US Isaac	10/01/2022	70	1100
MP3US Isaac	11/05/2022	250	1100
MP3US Isaac	5/07/2022	190	1100
MP3US Isaac	14/01/2023	20	1100
MP3US Isaac	19/01/2023	20	1100
MP3US Isaac	31/03/2025	160	1100
MP3US Isaac	5/04/2025	50	1100
MP3US Isaac	8/04/2025	80	1100
MP4DS Isaac	1/03/2015	5	1100
MP4DS Isaac	16/02/2016	280	1100
MP4DS Isaac	2/03/2016	2	1100
MP4DS Isaac	31/05/2016	205	1100
MP4DS Isaac	21/03/2017	130	1100
MP4DS Isaac	22/03/2017	190	1100
MP4DS Isaac	23/03/2017	2380	1100
MP4DS Isaac	31/03/2017	0	1100
MP4DS Isaac	3/04/2017	-	1100
MP4DS Isaac	22/03/2018	2	1100
MP4DS Isaac	9/05/2018	5	1100
MP4DS Isaac	3/05/2019	2	1100
MP4DS Isaac	27/01/2020	-	1100
MP4DS Isaac	11/02/2020	420	1100
MP4DS Isaac	25/02/2020	140	1100
MP4DS Isaac	26/02/2020	-	1100
MP4DS Isaac	27/02/2020	280	1100
MP4DS Isaac	2/03/2020	220	1100
MP4DS Isaac	28/04/2020	-	1100
MP4DS Isaac	6/01/2021	200	1100
MP4DS Isaac	7/01/2021	240	1100
MP4DS Isaac	8/01/2021	2	1100
MP4DS Isaac	10/04/2021	360	1100
MP4DS Isaac	14/04/2021	25	1100
MP4DS Isaac	11/11/2021	190	1100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	1/12/2021	220	1100
MP4DS Isaac	10/01/2022	70	1100
MP4DS Isaac	10/01/2022	130	1100
MP4DS Isaac	11/05/2022	240	1100
MP4DS Isaac	11/05/2022	250	1100
MP4DS Isaac	11/05/2022	240	1100
MP4DS Isaac	14/01/2023	20	1100
MP4DS Isaac	19/01/2023	20	1100
MP4DS Isaac	31/03/2025	420	1100
MP4DS Isaac	5/04/2025	140	1100
MP4DS Isaac	8/04/2025	330	1100
RP1Dam 2	14/01/2023	20	1100
RP1Dam 2	15/01/2023	-	1100
RP1Dam 2	16/01/2023	-	1100
RP1Dam 2	17/01/2023	-	1100
RP1Dam 2	18/01/2023	-	1100
RP1Dam 2	19/01/2023	20	1100
RP1Dam 2	31/03/2025	6040	1100
RP1Dam 2	1/04/2025	-	1100
RP1Dam 2	2/04/2025	-	1100
RP1Dam 2	3/04/2025	-	1100
RP1Dam 2	4/04/2025	-	1100
RP1Dam 2	5/04/2025	8220	1100
RP1Dam 2	6/04/2025	-	1100
RP1Dam 2	7/04/2025	-	1100
RP1Dam 2	8/04/2025	11000	1100
RP1Dam 2	9/04/2025	-	1100

A.24 PETROLEUM HYDROCARBONS (C6-C9)

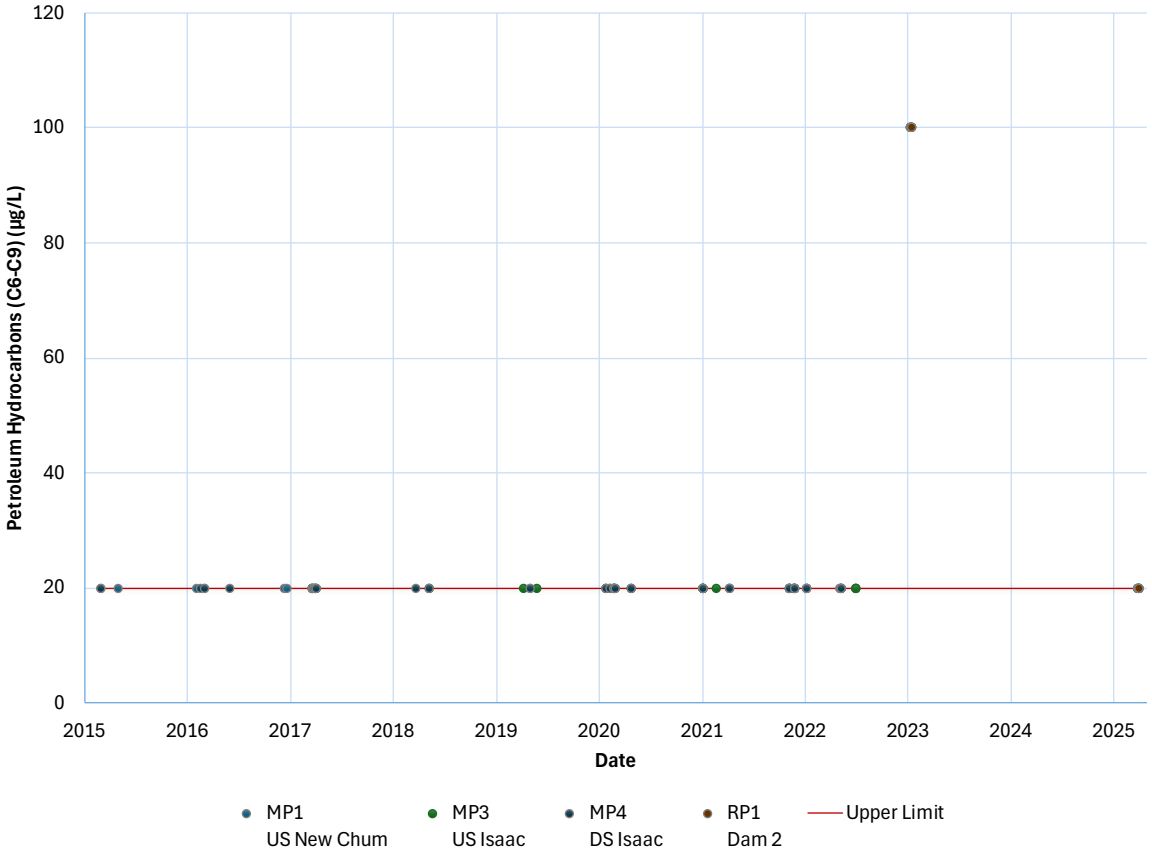

Figure A.24 Petroleum Hydrocarbons (C6-C9) Water Quality Analyte Levels

Table A.24 Petroleum Hydrocarbons (C6-C9) Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	20	20
MP1US New Chum	1/05/2015	20	20
MP1US New Chum	5/02/2016	20	20
MP1US New Chum	2/03/2016	20	20
MP1US New Chum	12/12/2016	20	20
MP1US New Chum	18/12/2016	20	20
MP1US New Chum	20/03/2017	20	20
MP1US New Chum	30/03/2017	20	20
MP1US New Chum	4/04/2017	20	20
MP1US New Chum	9/05/2018	20	20
MP1US New Chum	2/05/2019	20	20

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	20	20
MP1US New Chum	26/02/2020	20	20
MP1US New Chum	27/02/2020	20	20
MP1US New Chum	28/04/2020	20	20
MP1US New Chum	6/01/2021	20	20
MP1US New Chum	11/11/2021	20	20
MP1US New Chum	26/11/2021	20	20
MP1US New Chum	1/12/2021	20	20
MP1US New Chum	10/01/2022	20	20
MP1US New Chum	11/05/2022	20	20
MP1US New Chum	12/05/2022	20	20
MP1US New Chum	5/07/2022	20	20
MP1US New Chum	14/01/2023	100	20
MP1US New Chum	19/01/2023	100	20
MP1US New Chum	31/03/2025	20	20
MP1US New Chum	5/04/2025	20	20
MP1US New Chum	8/04/2025	20	20
MP3US Isaac	21/03/2017	20	20
MP3US Isaac	22/03/2017	20	20
MP3US Isaac	31/03/2017	20	20
MP3US Isaac	3/04/2017	20	20
MP3US Isaac	9/05/2018	20	20
MP3US Isaac	11/04/2019	20	20
MP3US Isaac	28/05/2019	20	20
MP3US Isaac	27/01/2020	20	20
MP3US Isaac	27/01/2020	-	20
MP3US Isaac	11/02/2020	20	20
MP3US Isaac	25/02/2020	20	20
MP3US Isaac	28/02/2020	20	20
MP3US Isaac	27/04/2020	20	20
MP3US Isaac	6/01/2021	20	20
MP3US Isaac	7/01/2021	20	20
MP3US Isaac	8/01/2021	20	20
MP3US Isaac	23/02/2021	20	20
MP3US Isaac	10/04/2021	20	20
MP3US Isaac	11/11/2021	20	20

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	1/12/2021	20	20
MP3US Isaac	10/01/2022	20	20
MP3US Isaac	11/05/2022	20	20
MP3US Isaac	5/07/2022	20	20
MP3US Isaac	14/01/2023	100	20
MP3US Isaac	19/01/2023	100	20
MP3US Isaac	31/03/2025	20	20
MP3US Isaac	5/04/2025	20	20
MP3US Isaac	8/04/2025	20	20
MP4DS Isaac	1/03/2015	20	20
MP4DS Isaac	16/02/2016	20	20
MP4DS Isaac	2/03/2016	20	20
MP4DS Isaac	31/05/2016	20	20
MP4DS Isaac	21/03/2017	20	20
MP4DS Isaac	22/03/2017	20	20
MP4DS Isaac	23/03/2017	20	20
MP4DS Isaac	31/03/2017	20	20
MP4DS Isaac	3/04/2017	20	20
MP4DS Isaac	22/03/2018	20	20
MP4DS Isaac	9/05/2018	20	20
MP4DS Isaac	3/05/2019	20	20
MP4DS Isaac	27/01/2020	20	20
MP4DS Isaac	11/02/2020	20	20
MP4DS Isaac	25/02/2020	20	20
MP4DS Isaac	26/02/2020	20	20
MP4DS Isaac	27/02/2020	20	20
MP4DS Isaac	2/03/2020	20	20
MP4DS Isaac	28/04/2020	20	20
MP4DS Isaac	6/01/2021	20	20
MP4DS Isaac	7/01/2021	20	20
MP4DS Isaac	8/01/2021	20	20
MP4DS Isaac	10/04/2021	20	20
MP4DS Isaac	14/04/2021	20	20
MP4DS Isaac	11/11/2021	20	20
MP4DS Isaac	1/12/2021	20	20
MP4DS Isaac	10/01/2022	20	20

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/05/2022	20	20
MP4DS Isaac	14/01/2023	100	20
MP4DS Isaac	19/01/2023	100	20
MP4DS Isaac	31/03/2025	20	20
MP4DS Isaac	5/04/2025	20	20
MP4DS Isaac	8/04/2025	20	20
RP1Dam 2	14/01/2023	100	20
RP1Dam 2	15/01/2023	-	20
RP1Dam 2	16/01/2023	-	20
RP1Dam 2	17/01/2023	-	20
RP1Dam 2	18/01/2023	-	20
RP1Dam 2	19/01/2023	100	20
RP1Dam 2	31/03/2025	20	20
RP1Dam 2	1/04/2025	-	20
RP1Dam 2	2/04/2025	-	20
RP1Dam 2	3/04/2025	-	20
RP1Dam 2	4/04/2025	-	20
RP1Dam 2	5/04/2025	20	20
RP1Dam 2	6/04/2025	-	20
RP1Dam 2	7/04/2025	-	20
RP1Dam 2	8/04/2025	20	20
RP1Dam 2	9/04/2025	-	20

A.25 PETROLEUM HYDROCARBONS (C10-C36)

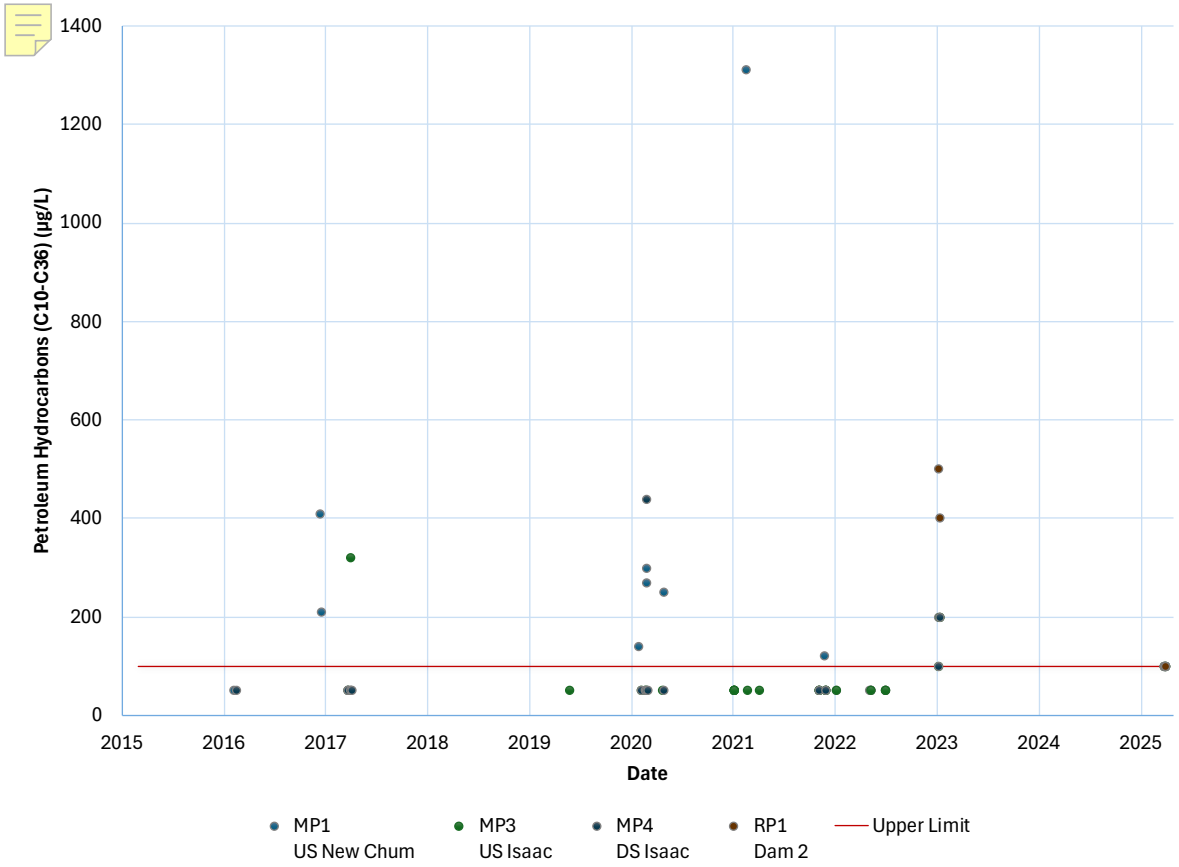

Figure A.25 **Petroleum Hydrocarbons (C10-C36) Water Quality Analyte Levels**

Table A.25 **Petroleum Hydrocarbons (C10-C36) Water Quality Analyte Levels**

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	-	100
MP1US New Chum	1/05/2015	-	100
MP1US New Chum	5/02/2016	50	100
MP1US New Chum	2/03/2016	-	100
MP1US New Chum	12/12/2016	410	100
MP1US New Chum	18/12/2016	210	100
MP1US New Chum	20/03/2017	50	100
MP1US New Chum	30/03/2017	50	100
MP1US New Chum	4/04/2017	-	100
MP1US New Chum	9/05/2018	-	100
MP1US New Chum	2/05/2019	-	100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	29/01/2020	140	100
MP1US New Chum	26/02/2020	270	100
MP1US New Chum	27/02/2020	300	100
MP1US New Chum	28/04/2020	250	100
MP1US New Chum	6/01/2021	50	100
MP1US New Chum	18/02/2021	1310	100
MP1US New Chum	11/11/2021	50	100
MP1US New Chum	26/11/2021	120	100
MP1US New Chum	26/11/2021	-	100
MP1US New Chum	1/12/2021	50	100
MP1US New Chum	1/12/2021	50	100
MP1US New Chum	10/01/2022	50	100
MP1US New Chum	11/05/2022	50	100
MP1US New Chum	12/05/2022	50	100
MP1US New Chum	5/07/2022	50	100
MP1US New Chum	14/01/2023	200	100
MP1US New Chum	19/01/2023	200	100
MP1US New Chum	31/03/2025	100	100
MP1US New Chum	5/04/2025	100	100
MP1US New Chum	8/04/2025	100	100
MP3US Isaac	21/03/2017	-	100
MP3US Isaac	22/03/2017	50	100
MP3US Isaac	31/03/2017	320	100
MP3US Isaac	3/04/2017	-	100
MP3US Isaac	9/05/2018	-	100
MP3US Isaac	11/04/2019	-	100
MP3US Isaac	28/05/2019	50	100
MP3US Isaac	27/01/2020	-	100
MP3US Isaac	27/01/2020	-	100
MP3US Isaac	11/02/2020	50	100
MP3US Isaac	25/02/2020	50	100
MP3US Isaac	28/02/2020	50	100
MP3US Isaac	27/04/2020	50	100
MP3US Isaac	6/01/2021	50	100
MP3US Isaac	7/01/2021	50	100
MP3US Isaac	8/01/2021	50	100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	23/02/2021	50	100
MP3US Isaac	10/04/2021	50	100
MP3US Isaac	11/11/2021	50	100
MP3US Isaac	1/12/2021	50	100
MP3US Isaac	10/01/2022	50	100
MP3US Isaac	11/05/2022	50	100
MP3US Isaac	5/07/2022	50	100
MP3US Isaac	14/01/2023	100	100
MP3US Isaac	19/01/2023	200	100
MP3US Isaac	31/03/2025	100	100
MP3US Isaac	5/04/2025	100	100
MP3US Isaac	8/04/2025	100	100
MP4DS Isaac	1/03/2015	-	100
MP4DS Isaac	16/02/2016	50	100
MP4DS Isaac	2/03/2016	-	100
MP4DS Isaac	31/05/2016	-	100
MP4DS Isaac	21/03/2017	-	100
MP4DS Isaac	22/03/2017	50	100
MP4DS Isaac	23/03/2017	50	100
MP4DS Isaac	31/03/2017	50	100
MP4DS Isaac	3/04/2017	50	100
MP4DS Isaac	22/03/2018	-	100
MP4DS Isaac	9/05/2018	-	100
MP4DS Isaac	3/05/2019	-	100
MP4DS Isaac	27/01/2020	-	100
MP4DS Isaac	11/02/2020	50	100
MP4DS Isaac	25/02/2020	50	100
MP4DS Isaac	26/02/2020	50	100
MP4DS Isaac	27/02/2020	440	100
MP4DS Isaac	2/03/2020	50	100
MP4DS Isaac	28/04/2020	50	100
MP4DS Isaac	6/01/2021	-	100
MP4DS Isaac	7/01/2021	-	100
MP4DS Isaac	8/01/2021	-	100
MP4DS Isaac	10/04/2021	-	100
MP4DS Isaac	14/04/2021	-	100

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/11/2021	50	100
MP4DS Isaac	11/11/2021	-	100
MP4DS Isaac	1/12/2021	50	100
MP4DS Isaac	1/12/2021	-	100
MP4DS Isaac	10/01/2022	-	100
MP4DS Isaac	11/05/2022	-	100
MP4DS Isaac	14/01/2023	100	100
MP4DS Isaac	19/01/2023	200	100
MP4DS Isaac	31/03/2025	100	100
MP4DS Isaac	5/04/2025	100	100
MP4DS Isaac	8/04/2025	100	100
RP1Dam 2	14/01/2023	500	100
RP1Dam 2	15/01/2023	-	100
RP1Dam 2	16/01/2023	-	100
RP1Dam 2	17/01/2023	-	100
RP1Dam 2	18/01/2023	-	100
RP1Dam 2	19/01/2023	400	100
RP1Dam 2	31/03/2025	100	100
RP1Dam 2	1/04/2025	-	100
RP1Dam 2	2/04/2025	-	100
RP1Dam 2	3/04/2025	-	100
RP1Dam 2	4/04/2025	-	100
RP1Dam 2	5/04/2025	100	100
RP1Dam 2	6/04/2025	-	100
RP1Dam 2	7/04/2025	-	100
RP1Dam 2	8/04/2025	100	100
RP1Dam 2	9/04/2025	-	100

A.26 FLUORIDE

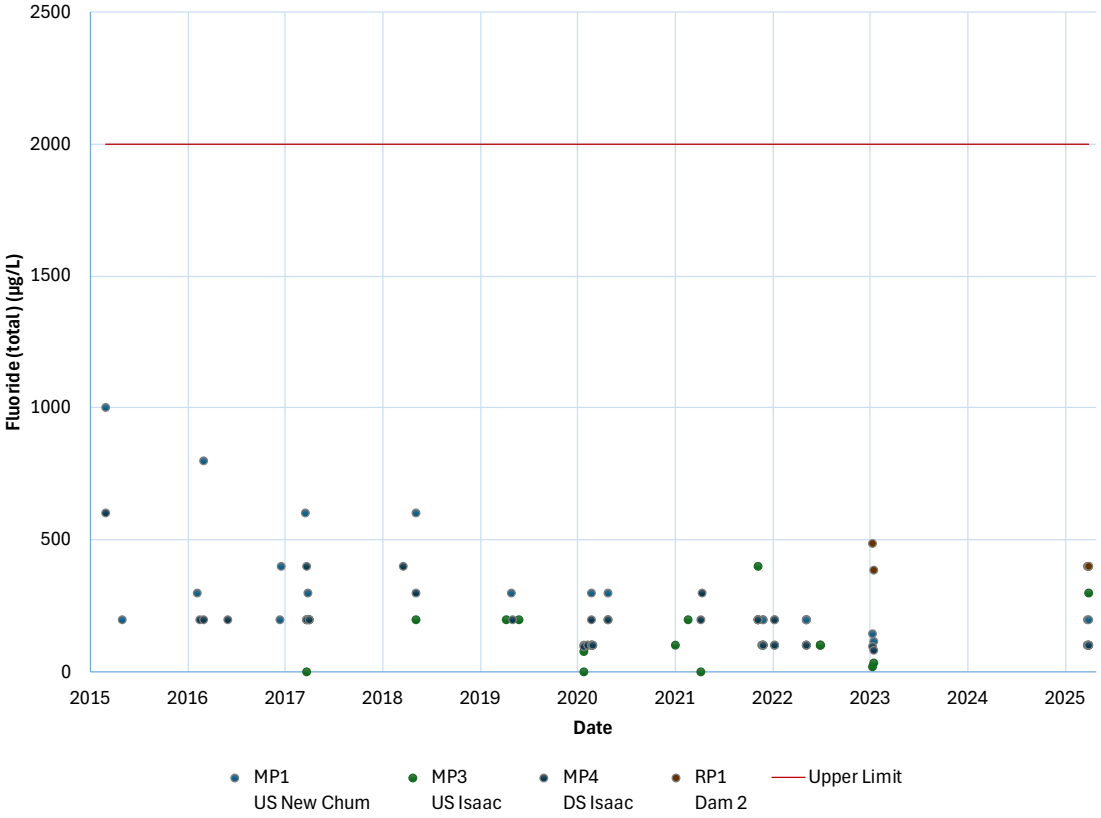

Figure A.26 Fluoride Water Quality Analyte Levels

Table A.26 Fluoride Water Quality Analyte Levels

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	1/03/2015	1000	2000
MP1US New Chum	1/05/2015	200	2000
MP1US New Chum	5/02/2016	300	2000
MP1US New Chum	2/03/2016	800	2000
MP1US New Chum	12/12/2016	200	2000
MP1US New Chum	18/12/2016	400	2000
MP1US New Chum	20/03/2017	600	2000
MP1US New Chum	30/03/2017	300	2000
MP1US New Chum	4/04/2017	-	2000
MP1US New Chum	9/05/2018	600	2000
MP1US New Chum	2/05/2019	300	2000
MP1US New Chum	29/01/2020	100	2000
MP1US New Chum	26/02/2020	300	2000
MP1US New Chum	27/02/2020	100	2000

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP1US New Chum	28/04/2020	300	2000
MP1US New Chum	6/01/2021	-	2000
MP1US New Chum	11/11/2021	200	2000
MP1US New Chum	26/11/2021	100	2000
MP1US New Chum	1/12/2021	200	2000
MP1US New Chum	10/01/2022	200	2000
MP1US New Chum	11/05/2022	200	2000
MP1US New Chum	12/05/2022	200	2000
MP1US New Chum	5/07/2022	100	2000
MP1US New Chum	14/01/2023	146	2000
MP1US New Chum	19/01/2023	116	2000
MP1US New Chum	31/03/2025	200	2000
MP1US New Chum	5/04/2025	100	2000
MP1US New Chum	8/04/2025	200	2000
MP3US Isaac	21/03/2017	0	2000
MP3US Isaac	22/03/2017	200	2000
MP3US Isaac	31/03/2017	200	2000
MP3US Isaac	3/04/2017	200	2000
MP3US Isaac	9/05/2018	200	2000
MP3US Isaac	11/04/2019	200	2000
MP3US Isaac	28/05/2019	200	2000
MP3US Isaac	27/01/2020	75	2000
MP3US Isaac	27/01/2020	0.0001	2000
MP3US Isaac	11/02/2020	100	2000
MP3US Isaac	25/02/2020	100	2000
MP3US Isaac	28/02/2020	100	2000
MP3US Isaac	27/04/2020	200	2000
MP3US Isaac	6/01/2021	100	2000
MP3US Isaac	6/01/2021	-	2000
MP3US Isaac	7/01/2021	-	2000
MP3US Isaac	8/01/2021	-	2000
MP3US Isaac	23/02/2021	200	2000
MP3US Isaac	10/04/2021	0	2000
MP3US Isaac	11/11/2021	200	2000
MP3US Isaac	11/11/2021	400	2000
MP3US Isaac	1/12/2021	100	2000

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP3US Isaac	10/01/2022	100	2000
MP3US Isaac	11/05/2022	100	2000
MP3US Isaac	5/07/2022	100	2000
MP3US Isaac	14/01/2023	22	2000
MP3US Isaac	19/01/2023	36	2000
MP3US Isaac	31/03/2025	100	2000
MP3US Isaac	5/04/2025	100	2000
MP3US Isaac	8/04/2025	300	2000
MP4DS Isaac	1/03/2015	600	2000
MP4DS Isaac	16/02/2016	200	2000
MP4DS Isaac	2/03/2016	200	2000
MP4DS Isaac	31/05/2016	200	2000
MP4DS Isaac	21/03/2017	400	2000
MP4DS Isaac	22/03/2017	200	2000
MP4DS Isaac	23/03/2017	200	2000
MP4DS Isaac	31/03/2017	200	2000
MP4DS Isaac	3/04/2017	-	2000
MP4DS Isaac	22/03/2018	400	2000
MP4DS Isaac	9/05/2018	300	2000
MP4DS Isaac	3/05/2019	200	2000
MP4DS Isaac	27/01/2020	98	2000
MP4DS Isaac	11/02/2020	100	2000
MP4DS Isaac	25/02/2020	100	2000
MP4DS Isaac	26/02/2020	200	2000
MP4DS Isaac	27/02/2020	100	2000
MP4DS Isaac	2/03/2020	100	2000
MP4DS Isaac	28/04/2020	200	2000
MP4DS Isaac	6/01/2021	-	2000
MP4DS Isaac	7/01/2021	-	2000
MP4DS Isaac	8/01/2021	-	2000
MP4DS Isaac	10/04/2021	200	2000
MP4DS Isaac	14/04/2021	300	2000
MP4DS Isaac	11/11/2021	200	2000
MP4DS Isaac	1/12/2021	100	2000
MP4DS Isaac	10/01/2022	100	2000
MP4DS Isaac	10/01/2022	200	2000

Monitoring Location	Date	Analyte (µg/L)	Upper Limit (µg/L)
MP4DS Isaac	11/05/2022	100	2000
MP4DS Isaac	14/01/2023	96	2000
MP4DS Isaac	19/01/2023	80	2000
MP4DS Isaac	31/03/2025	100	2000
MP4DS Isaac	5/04/2025	100	2000
MP4DS Isaac	8/04/2025	100	2000
RP1Dam 2	14/01/2023	489	2000
RP1Dam 2	15/01/2023	-	2000
RP1Dam 2	16/01/2023	-	2000
RP1Dam 2	17/01/2023	-	2000
RP1Dam 2	18/01/2023	-	2000
RP1Dam 2	19/01/2023	388	2000
RP1Dam 2	31/03/2025	400	2000
RP1Dam 2	1/04/2025	-	2000
RP1Dam 2	2/04/2025	-	2000
RP1Dam 2	3/04/2025	-	2000
RP1Dam 2	4/04/2025	-	2000
RP1Dam 2	5/04/2025	400	2000
RP1Dam 2	6/04/2025	-	2000
RP1Dam 2	7/04/2025	-	2000
RP1Dam 2	8/04/2025	400	2000
RP1Dam 2	9/04/2025	-	2000

Table A.27 Sediment Quality Parameters Summary

Parameter	New Chum Creek Upstream (MP1) November 2023	New Chum Creek Upstream (MP1) November 2023	Isaac River Downstream (MP4) February 2020	Isaac River Downstream (MP4) March 2015	Isaac River Downstream (MP4) March 2016	Isaac River Downstream (MP4) March 2018	New Chum Creek Upstream (MP1) February 2020	New Chum Creek Upstream (MP1) March 2015	New Chum Creek Upstream (MP1) March 2016	New Chum Creek Upstream (MP1) March 2018
Aluminium	-	-	2,920 mg/kg	2,180 mg/kg	680 mg/kg	6,470 mg/kg	5,960 mg/kg	10,500 mg/kg	7,360 mg/kg	970 mg/kg
Arsenic	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	6 mg/kg	<5 mg/kg	<5 mg/kg
Boron	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg	<50 mg/kg
Cadmium	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg
Chromium	<2 mg/kg	<2 mg/kg	9 mg/kg	8 mg/kg	12 mg/kg	<2 mg/kg	17 mg/kg	21 mg/kg	18 mg/kg	8 mg/kg
Cobalt	<2 mg/kg	<2 mg/kg	3 mg/kg	3 mg/kg	<2 mg/kg	5 mg/kg	11 mg/kg	17 mg/kg	8 mg/kg	2 mg/kg
Copper	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	20 mg/kg	26 mg/kg	15 mg/kg	<5 mg/kg
Iron	-	-	5,860 mg/kg	6,220 mg/kg	3,920 mg/kg	6,470 mg/kg	22,900 mg/kg	28,000 mg/kg	18,100 mg/kg	6,470 mg/kg
Lead	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	11 mg/kg	15 mg/kg	8 mg/kg	<5 mg/kg
Manganese	-	-	109 mg/kg	88 mg/kg	21 mg/kg	50 mg/kg	469 mg/kg	721 mg/kg	359 mg/kg	50 mg/kg
Mercury	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg
Nickel	47 mg/kg	27 mg/kg	9 mg/kg	5 mg/kg	2 mg/kg	5 mg/kg	15 mg/kg	22 mg/kg	12 mg/kg	5 mg/kg
Selenium	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg	<5 mg/kg
Silver	1 mg/kg	1 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg	<2 mg/kg

Parameter	New Chum Creek Upstream (MP1) November 2023	New Chum Creek Upstream (MP1) November 2023	Isaac River Downstream (MP4) February 2020	Isaac River Downstream (MP4) March 2015	Isaac River Downstream (MP4) March 2016	Isaac River Downstream (MP4) March 2018	New Chum Creek Upstream (MP1) February 2020	New Chum Creek Upstream (MP1) March 2015	New Chum Creek Upstream (MP1) March 2016	New Chum Creek Upstream (MP1) March 2018
Vanadium	-	-	10 mg/kg	11 mg/kg	8 mg/kg	12 mg/kg	36 mg/kg	47 mg/kg	31 mg/kg	12 mg/kg
Zinc	-	-	8 mg/kg	8 mg/kg	<5 mg/kg	-	31 mg/kg	49 mg/kg	28 mg/kg	-

A.27 WATER QUALITY DATA REFERENCE

The water quality data referenced here is derived from monitoring and analysis methodologies adhering to the Queensland Water Quality Guidelines (QWQG, 2009, 2010), the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000; ANZG, 2018), and the Environmental Protection Policy for Water (DEHP, 2013).

Historical data were sourced from Hydrobiology (2016, 2019), Gauge (2020, 2021), and other Receiving Environment Monitoring Program (REMP) reports for assessing water quality, deriving local guidelines, and evaluating environmental impacts:

1. Queensland Water Quality Guidelines (QWQG, 2009): Queensland Department of Environment and Resource Management (DERM), Brisbane.
2. Queensland Water Quality Guidelines (QWQG, 2010): Queensland Department of Environment and Resource Management (DERM), Brisbane.
3. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000): Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).
4. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018): Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Available at: http://www.waterquality.gov.au/anz-guidelines.
5. Environmental Protection Policy for Water (DEHP, 2013): Department of Environment and Heritage Protection, Queensland Government.
6. Queensland Monitoring and Sampling Manual (DERM, 2009): Monitoring and Sampling Manual 2009, QLD Department of Environment and Resource Management, Brisbane.
7. Queensland Monitoring and Sampling Manual (DES, 2018): Department of Environment and Science, Queensland Government.
8. Australian Drinking Water Guidelines (ADWG, 2011): National Health and Medical Research Council, Australia. Available at: https://www.nhmrc.gov.au/guidelines/publications/eh52.
9. Hydrobiology (2016): 2014/2015 Receiving Environment Monitoring Program Annual Report, Daunia Mine. Report prepared for BMA.
10. Hydrobiology (2019): 2017/2018 Receiving Environment Monitoring Program Annual Report.
11. Gauge (2017): Receiving Environment Monitoring Program. Annual Report – end July 2017. Daunia Mine. Report prepared for BMA.
12. Gauge (2020): Historical data for water quality analysis and comparison.
13. Gauge (2021): Historical data for water quality analysis and comparison.
14. Simpson SL, Batley GB and Chariton AA (2013): Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water.
15. Certificate of Analysis (Work Order: EB1603634): Prepared by ALS Environmental Division Brisbane, detailing analytical results for water samples collected from various sites.
16. Certificate of Analysis (Work Order: EB1604302): Prepared by ALS Environmental Division Brisbane, providing analytical results for water samples from specific sites.
17. Certificate of Analysis (Work Order: EB1629620): BM Alliance Ltd. (2016). Analytical results for water quality parameters at DNM_New Chum Creek Up/S (MP1). Sampling date: 12-Dec-2016.

18. Certificate of Analysis (Work Order: EB1705719): BM Alliance Ltd. (2017). Analytical results for water quality parameters at multiple sites including DNM_New Chum Creek Up/S (MP1). Sampling dates: 20-Mar-2017 to 22-Mar-2017.
19. Certificate of Analysis (Work Order: EB1909871): Analytical results for water quality monitoring.
20. Certificate of Analysis (Work Order: EB1906706): Analytical results for water quality monitoring.
21. Certificate of Analysis (Work Order: EB1914106): Analytical results for water quality monitoring, including pH, electrical conductivity, total suspended solids, dissolved metals, and nutrients.
22. Certificate of Analysis (Work Order: EB1914027): Analytical results for water quality monitoring, including pH, electrical conductivity, total suspended solids, dissolved metals, and petroleum hydrocarbons.
23. Certificate of Analysis (Work Order: EB1911358): Analytical results for water quality monitoring, including pH, electrical conductivity, total suspended solids, dissolved metals, and nutrients.
24. Certificate of Analysis (Work Order: EB1911356): Analytical results for water quality monitoring, including pH, electrical conductivity, total suspended solids, dissolved metals, and nutrients.
25. Certificate of Analysis (Work Order: EB2002475): BM Alliance Ltd, Environmental Division Brisbane, Project: DNM_CREEKS & RIVERS, Sampling Date: 29-Jan-2020, Issue Date: 06-Feb-2020.
26. Certificate of Analysis (Work Order: EB2005618): BM Alliance Ltd, Environmental Division Brisbane, Project: CREEKS & RIVERS, Sampling Date: 27-Feb-2020, Issue Date: 06-Mar-2020.
27. Certificate of Analysis (Work Order: EB2002556): BHP Billiton Mitsui Corporation (BMC), Environmental Division Brisbane, Project: PTM_WATER_REMP, Sampling Date: 27-Jan-2020, Issue Date: 07-Feb-2020.
28. Certificate of Analysis (Work Order: EB2005555): BM Alliance Ltd, Environmental Division Brisbane, Project: DNM_CREEKS & RIVERS, Sampling Date: 25-Feb-2020, Issue Date: 05-Mar-2020.
29. Certificate of Analysis (Work Order: EB2004021): BM Alliance Ltd, Environmental Division Brisbane, Project: DNM_CREEKS & RIVERS, Issue Date: 24-Feb-2020.
30. Certificate of Analysis (Work Order: EB2006224): BM Alliance Ltd, Environmental Division Brisbane, Project: PDM_RECIEVING WATERS, Issue Date: 13-Mar-2020.
31. Certificate of Analysis (Work Order: EB2005625): BM Alliance Ltd, Environmental Division Brisbane, Project: AEHP Waters, Issue Date: 09-Mar-2020.
32. Certificate of Analysis (Work Order: EB2006232): BM Alliance Ltd, Environmental Division Brisbane, Project: DNM_CREEKS & RIVERS, Issue Date: 12-Mar-2020.
33. Certificate of Analysis (Work Order: EB2111018): Analytical results for soil matrix samples collected on 14-Apr-2021, analyzed by ALS Environmental Division Brisbane. Issue Date: 21-May-2021.
34. Certificate of Analysis (Work Order: EB2100288): Analytical results for water release samples collected on 06-Jan-2021, analyzed by ALS Environmental Division Brisbane. Issue Date: 21-May-2021.
35. Certificate of Analysis (Work Order: ES2114040): Analytical results for AEHP water samples collected on 14-Apr-2021, analyzed by ALS Environmental Division Sydney. Issue Date: 27-Apr-2021.
36. Certificate of Analysis (Work Order: EB2100904): Analytical results for creek and river water samples collected between 06-Jan-2021 and 08-Jan-2021, analyzed by ALS Environmental Division Brisbane. Issue Date: 21-Jan-2021.

37. Certificate of Analysis (Work Order: EB2104634): BM Alliance Ltd. (2021). Certificate of Analysis for AEHP Water. Environmental Division Brisbane. Issue Date: 23-Apr-2021.

38. Certificate of Analysis (Work Order: EB2104648): BM Alliance Ltd. (2021). Certificate of Analysis for DAU AEHP Soil. Environmental Division Brisbane. Issue Date: 25-Feb-2021.

39. Certificate of Analysis (Work Order: EB2110150): BM Alliance Ltd. (2021). Certificate of Analysis for AEHP Water. Environmental Division Brisbane. Issue Date: 23-Apr-2021.

APPENDIX B OPERATIONAL WATER BALANCE

Daunia West Infrastructure Project

Water Balance Assessment Report

Whitehaven Coal

Doc. Ref.: WHC-038-C

Date: 9 October 2025

Rev. No.	Doc Ref.	Report Date	Report Author	Reviewer
1	WHC-038-C	9 October 2025	MGB	AH

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

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1 Site water balance assessment overview

A computer-based operational simulation model was used to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the DWIP.

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 1.1.

Table 1.1 – 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 CHPP losses
External water supply (Burdekin Pipeline)	Haul road suppression losses
Groundwater inflows to mine void	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 given.

2 Mine plan stages

The DWIP water balance model includes eight (8) representative stages to represent the Life-of-Mine (LoM) period, as shown in Table 1.2. The LoM forecast model was run for 117 climatic realisations, developed using 136 years of rainfall data, to assess a wide range of climatic scenarios.

Table 2.1 – Modelled LoM forecast stages

Stage	Representative project year	Applied date range	Duration
1	FY26	1/7/25 to 30/6/26	1 year
2	FY27	1/6/26 to 30/6/27	1 year
3	FY28	1/7/27 to 30/6/28	1 year
4	FY31	1/7/28 to 30/6/31	3 years
5	FY32	1/7/31 to 30/6/32	1 year
6	FY36	1/7/32 to 30/6/36	4 years
7	FY39	1/7/36 to 30/6/39	3 years
8	FY41	1/7/39 to 30/6/41	2 years

3 Catchment mapping

Catchment mapping for each of the modelled stages has been based on the proposed DWIP mine plan landforms provided by Whitehaven. The catchment and land use mapping for each of the 8 model stages is presented in Figure 3.2 to Figure 3.9.

A breakdown of catchment and land use types and areas reporting to each of the water storages in shown in Table 3.1 to Table 3.8.

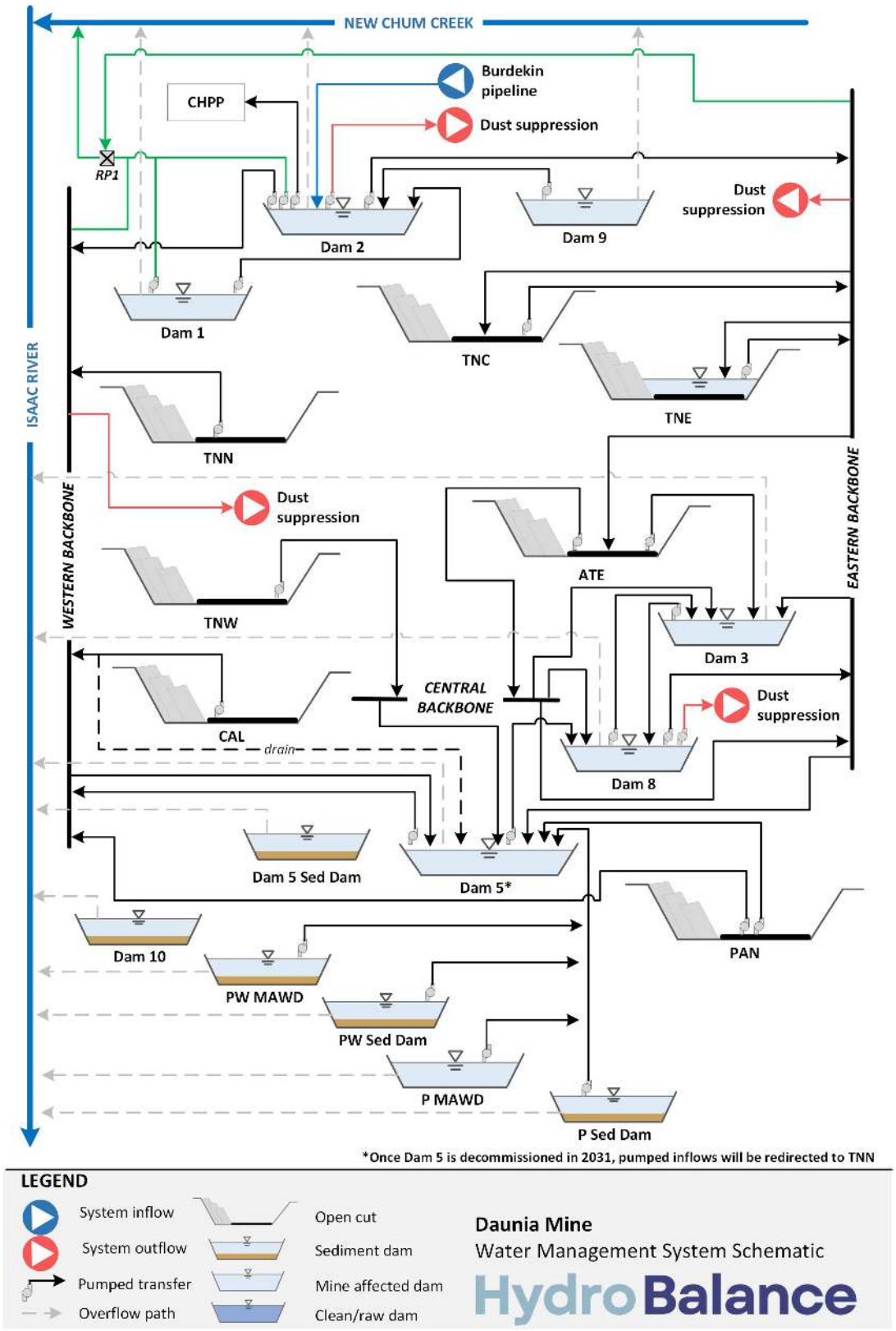
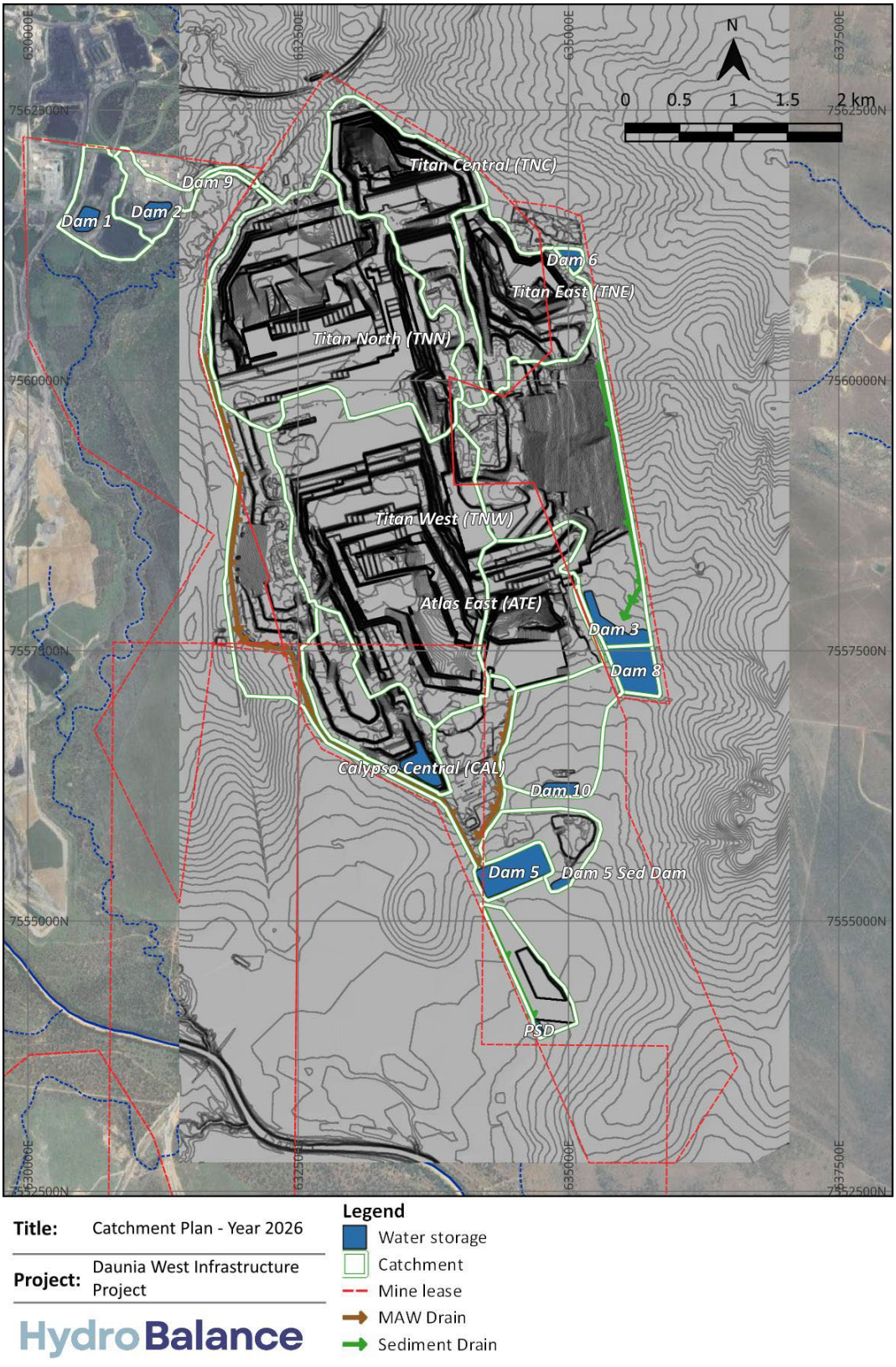


Figure 3.1 – Schematic of Daunia WMS



Title: Catchment Plan - Year 2026

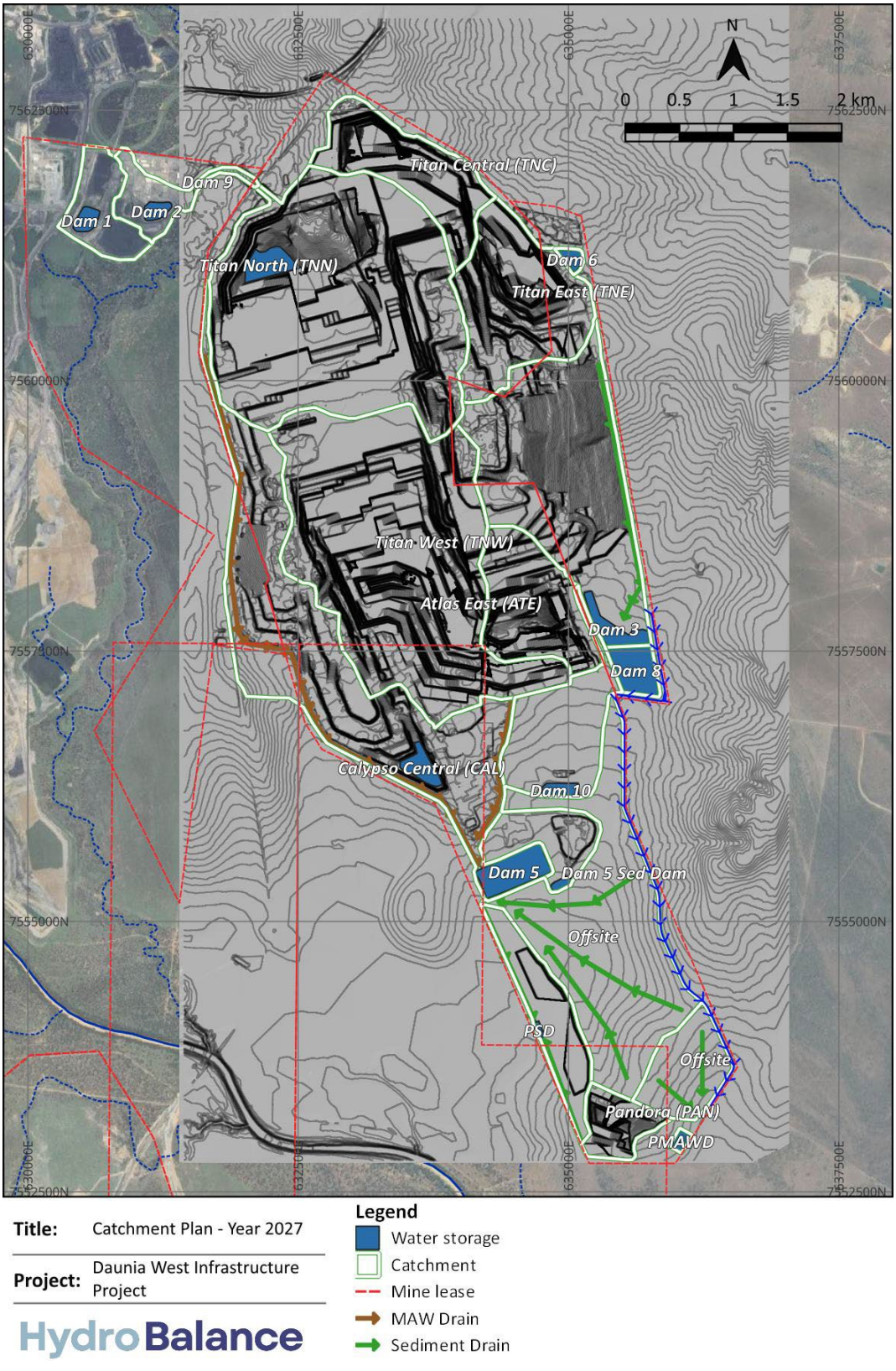
Project: Daunia West Infrastructure Project

HydroBalance

Legend

- Water storage
- Catchment
- Mine lease
- MAW Drain
- Sediment Drain

Figure 3.2 - Catchment plan - FY26 (including DWIP)



Title: Catchment Plan - Year 2027

Project: Daunia West Infrastructure Project

HydroBalance

Legend

- Water storage
- Catchment
- Mine lease
- MAW Drain
- Sediment Drain

Figure 3.3 - Catchment plan - FY27 (including DWIP)

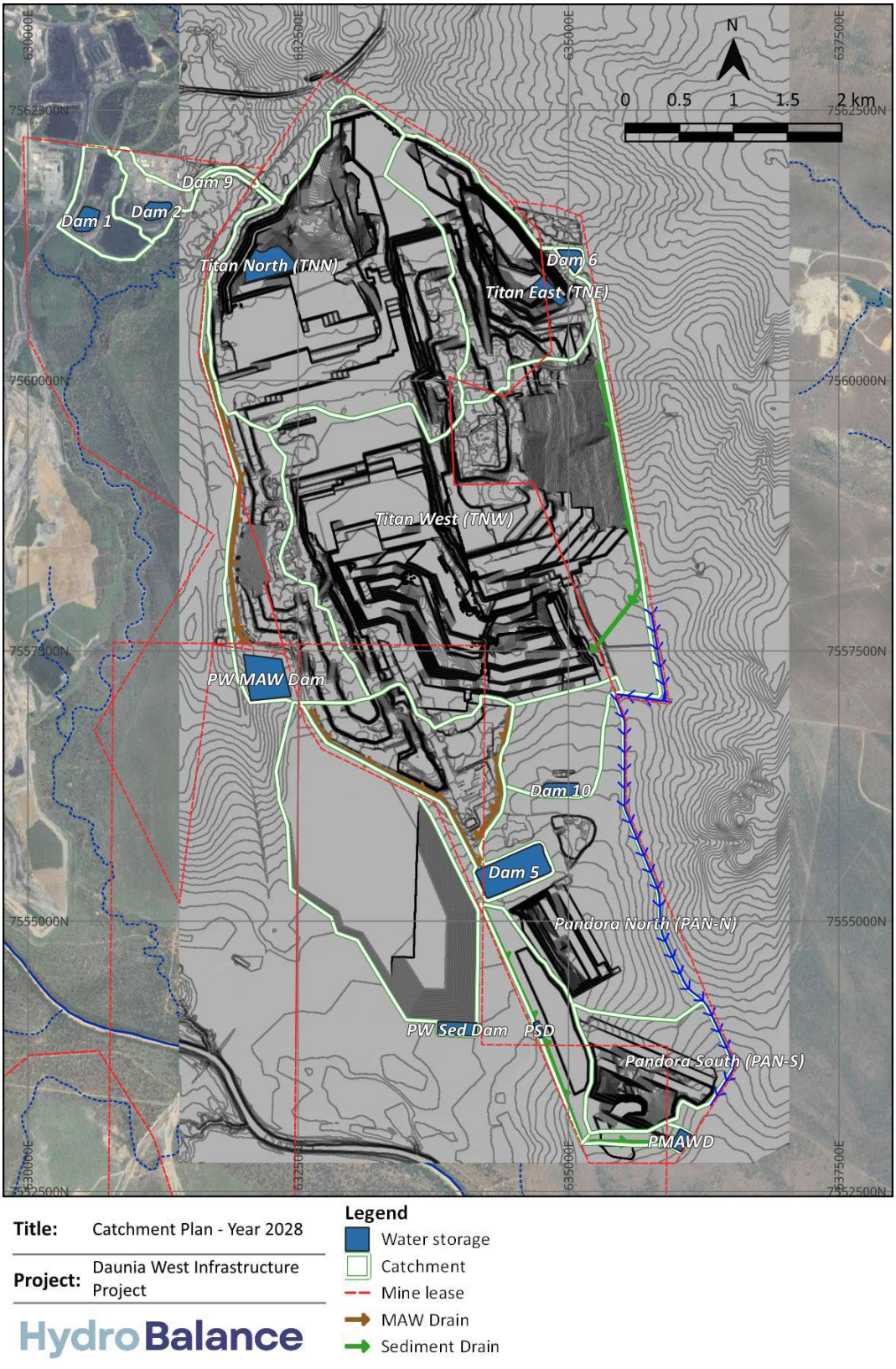
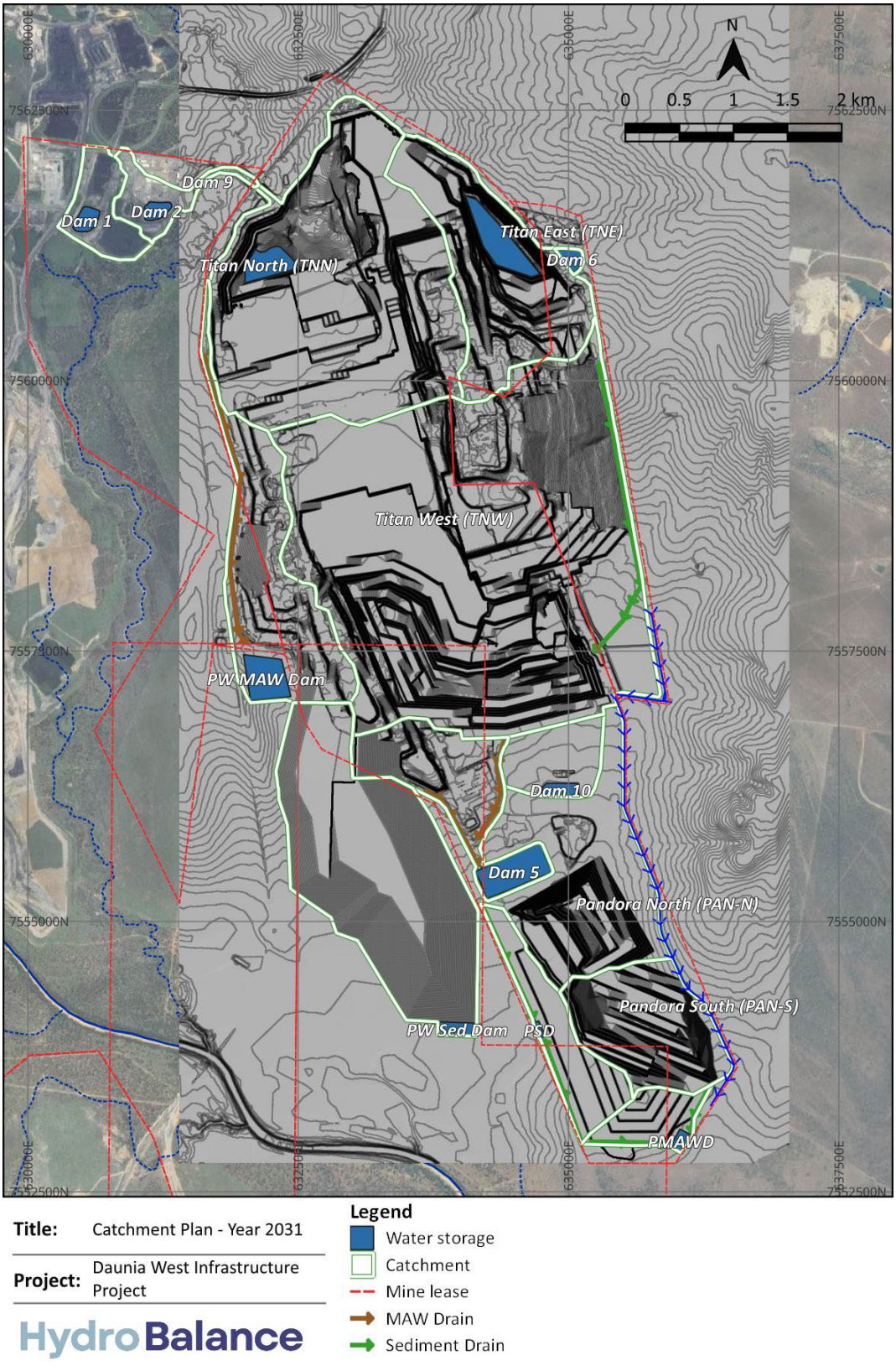


Figure 3.4 - Catchment plan - FY28 (including DWIP)



Title: Catchment Plan - Year 2031

Project: Daunia West Infrastructure Project

HydroBalance

Legend

- Water storage
- Catchment
- Mine lease
- MAW Drain
- Sediment Drain

Figure 3.5 - Catchment plan - FY31 (including DWIP)

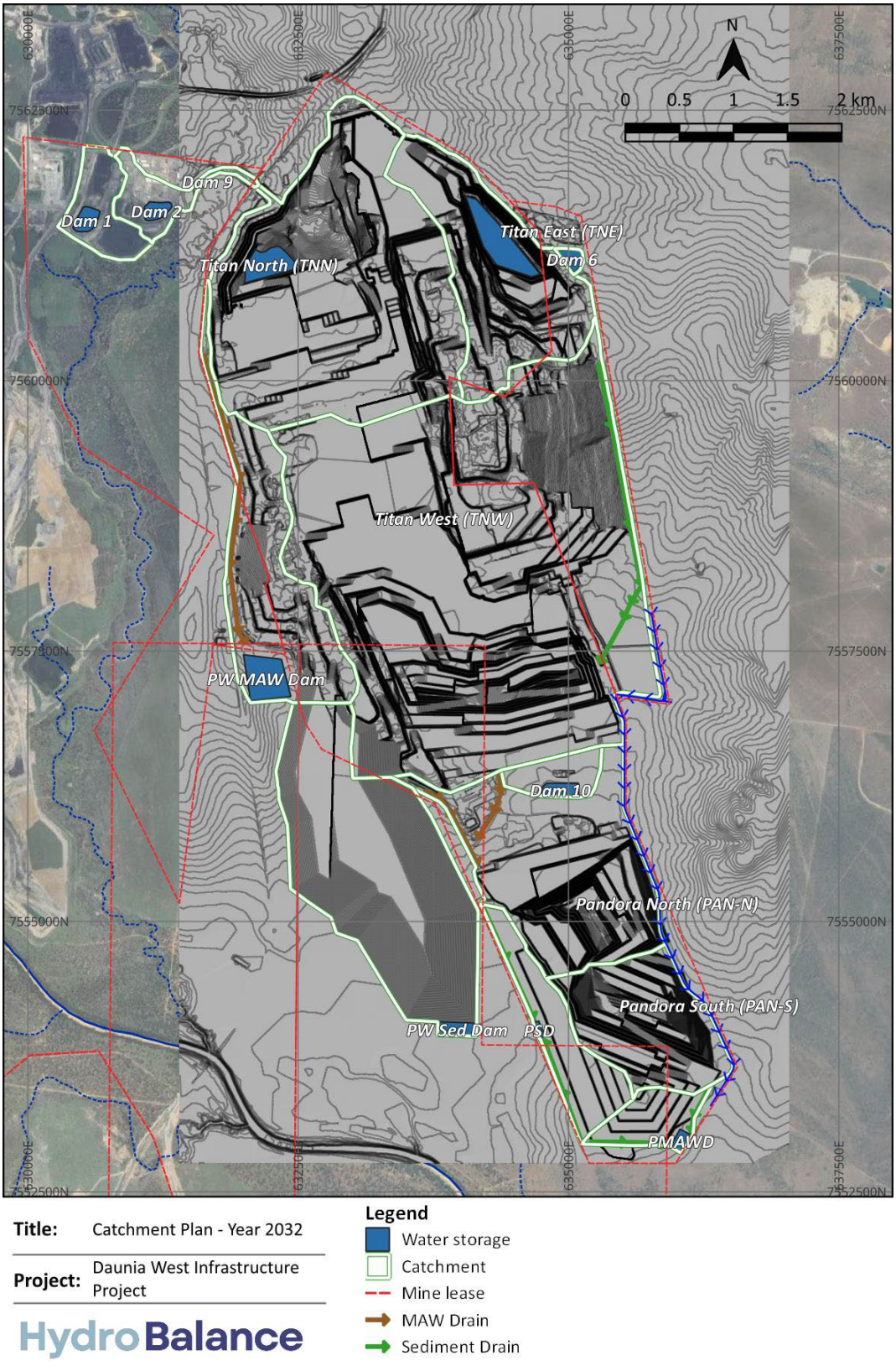


Figure 3.6 - Catchment plan - FY32 (including DWIP)

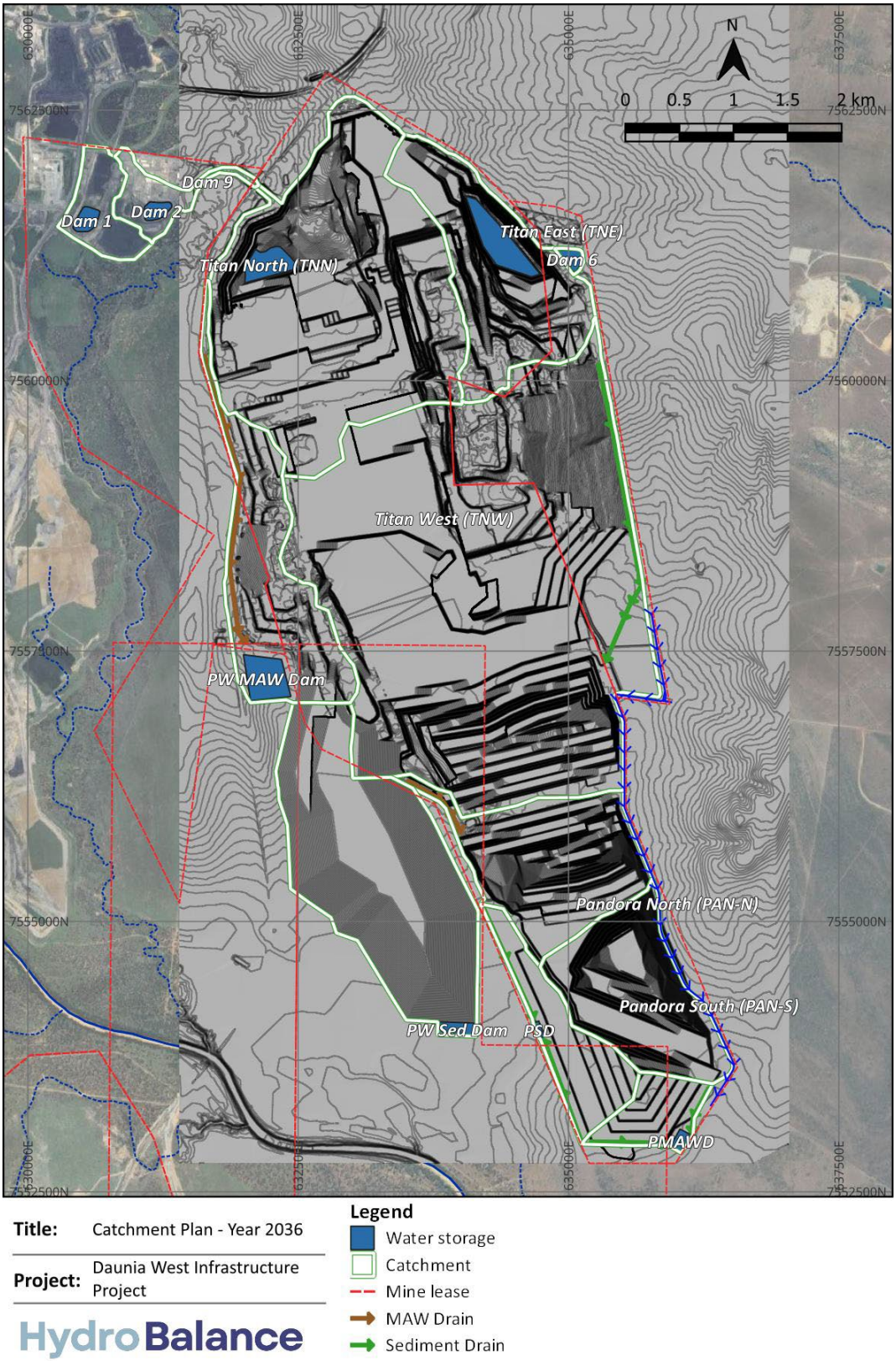


Figure 3.7 - Catchment plan - FY36 (including DWIP)

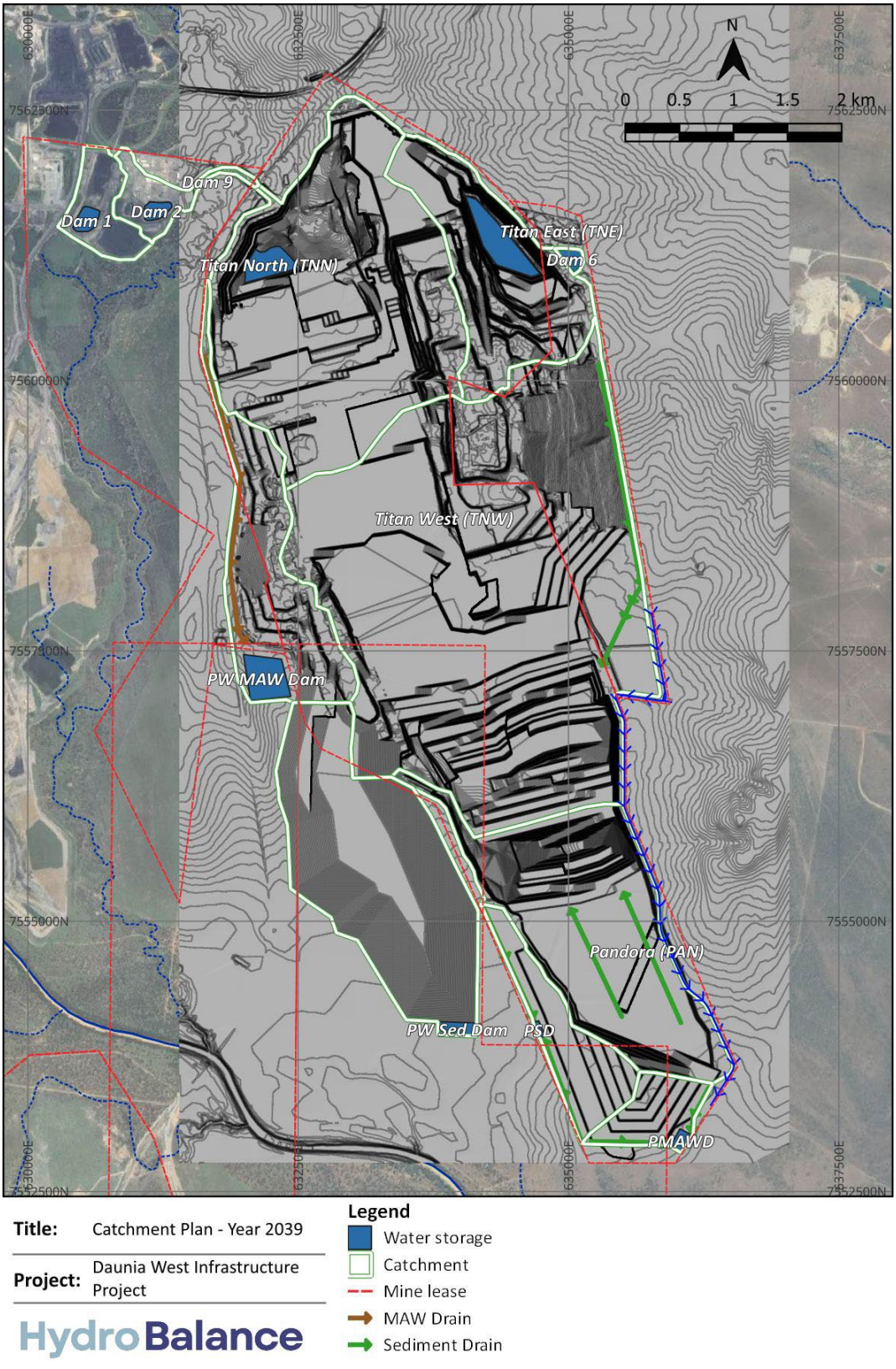


Figure 3.8 - Catchment plan - FY39 (including DWIP)

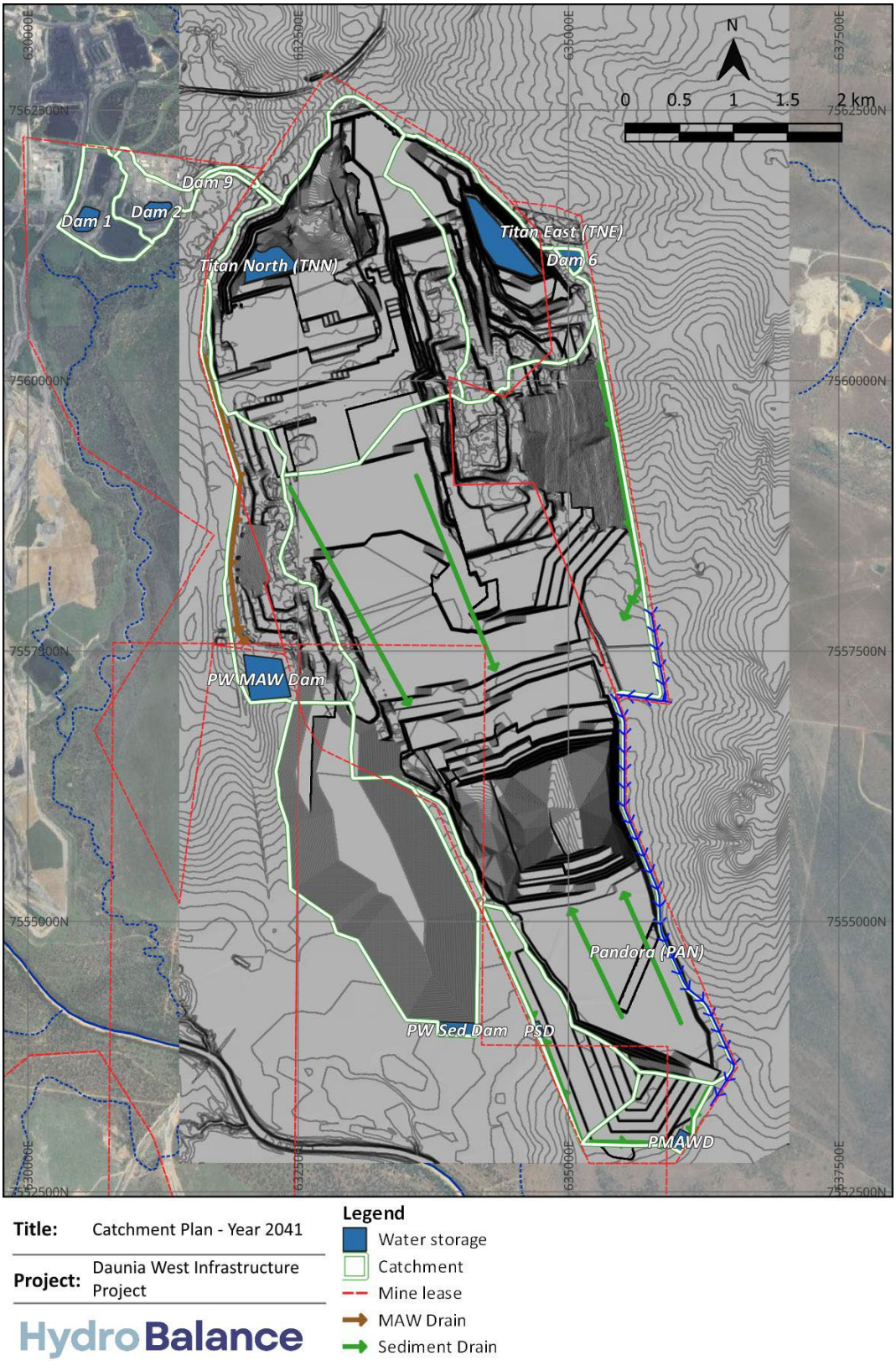


Figure 3.9 - Catchment plan - FY41 (including DWIP)

Table 3.1 – Catchment and land use areas by storage – Stage 1

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
Dam 3	95.0	39.2	117.2	12.1	0.0	**263.6**
Dam 5	21.1	21.8	84.7	22.4	118.1	**268.1**
Dam 8	0.0	17.4	0.0	0.0	0.0	**17.4**
ATE	0.0	39.6	79.6	5.9	0.0	**125.1**
CAL	0.0	21.1	78.3	0.0	0.1	**99.5**
TNC	0.0	56.5	100.8	0.5	12.5	**170.3**
TNE	0.0	45.5	74.2	0.0	11.1	**130.8**
TNN	0.0	209.2	168.4	0.1	4.7	**382.4**
TNW	3.5	176.3	231.3	0.0	22.5	**433.6**
Dam 10	0	0	2	95	6	**102.6**
Dam 5 Sed D	0	4	14	0	45	**63.0**
P SD	0	4	35	0	0	**38.9**

Table 3.2 – Catchment and land use areas by storage – Stage 2

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
Dam 3	95.0	39.2	128.1	9.8	0.0	**272.2**
Dam 5	17.6	43.6	160.7	22.4	116.2	**360.6**
Dam 8	0.0	17.4	0.0	0.0	0.0	**17.4**
ATE	0.0	32.7	62.9	4.8	0.0	**100.4**
TNC	0.0	23.7	65.2	0.0	10.8	**99.7**
TNE	0.0	47.9	92.5	0.0	8.5	**148.9**
TNN	0.0	100.9	357.2	0.0	4.4	**462.5**
TNW	7.0	103.5	320.8	4.3	46.9	**482.5**
PAN	0.0	28.7	0.0	2.4	2.9	**34.0**
Dam 10	0	0	2	91	6	**98.5**
Dam 5 Sed D	0	4	14	0	45	**63.1**
P SD	0	1	66	0	0	**66.5**
P MAWD	0	3	0	0	0	**2.6**

Table 3.3 - Catchment and land use areas by storage - Stage 3

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
Dam 5	0.0	42.6	42.8	0.1	121.9	**207.3**
TNE	0.0	54.9	140.2	0.0	12.5	**207.5**
TNN	0.0	113.7	379.8	0.0	11.0	**504.6**
TNW	102.1	209.1	515.6	12.1	37.1	**876.0**
PAN	0.0	128.6	30.2	192.2	40.4	**391.5**
Dam 10	0	0	2	83	1	**85.2**
P SD	0	1	66	0	0	**66.5**
P MAWD	0	3	9	0	2	**13.7**
PW Sed Dam	0	0	315	0	0	**315.5**
PW MAWD	18	0	116	24	93	**249.9**

Table 3.4 - Catchment and land use areas by storage - Stage 4

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
Dam 5	0.0	22.8	37.8	0.0	73.3	**133.9**
TNE	0.0	48.1	146.2	0.0	12.5	**206.8**
TNN	0.0	50.2	440.9	0.0	10.7	**501.8**
TNW	98.7	198.6	620.9	6.2	29.3	**953.7**
PAN	0.0	207.8	23.1	84.4	37.9	**353.2**
Dam 10	0	0	2	56	0	**58.2**
P SD	0	1	78	0	0	**79.1**
P MAWD	0	3	37	0	2	**41.7**
PW Sed Dam	0	0	322	0	15	**337.6**
PW MAWD	18	0	114	24	91	**246.6**

Table 3.5 – Catchment and land use areas by storage – Stage 5

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
TNE	0.0	48.1	146.2	0.0	12.5	**206.8**
TNN	0.0	50.2	440.9	0.0	10.7	**501.8**
TNW	98.7	198.7	712.9	6.2	46.2	**1062.7**
PAN	0.0	298.2	19.6	39.1	43.9	**400.8**
Dam 10	0	0	2	30	0	**31.3**
P SD	0	1	78	0	0	**79.1**
P MAWD	0	3	37	0	2	**41.7**
PW Sed Dam	0	0	322	0	15	**337.6**
PW MAWD	18	0	114	24	91	**246.6**

Table 3.6 – Catchment and land use areas by storage – Stage 6

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
TNE	0.0	48.1	147.0	0.0	12.5	**207.6**
TNN	0.0	50.2	471.2	0.0	10.7	**532.1**
TNW	98.7	263.6	709.2	6.2	5.1	**1082.7**
PAN	0.0	208.9	145.3	8.1	0.0	**362.3**
P SD	0	1	88	0	0	**89.1**
P MAWD	0	3	46	0	2	**50.0**
PW Sed Dam	0	0	338	0	0	**337.6**
PW MAWD	18	0	173	23	33	**246.6**

Table 3.7 – Catchment and land use areas by storage – Stage 7

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
TNE	0.0	48.1	147.0	0.0	12.5	**207.6**
TNN	0.0	50.2	484.6	0.0	10.7	**545.5**
TNW	98.7	263.6	718.9	6.2	5.1	**1092.3**
PAN	0.0	72.2	259.4	8.1	0.0	**339.6**
P Sed Dam	0	1	88	0	0	**88.9**
P MAWD	0	3	46	0	2	**50.0**
PW Sed Dam	0	0	338	0	0	**337.6**
PW MAW Dam	18	0	173	23	33	**246.6**

Table 3.8 – Catchment and land use areas by storage – Stage 8

Storage	Catchment area per land use type (ha)					Total
	Rehab	Pit	Spoil	Natural/ undisturbed	Disturbed	
Dam 1	0.0	44.6	3.5	0.0	1.0	**49.1**
Dam 2	0.0	33.6	4.5	0.0	0.4	**38.5**
TNE	0.0	48.1	147.0	0.0	12.5	**207.6**
TNN	0.0	50.2	481.9	0.0	10.7	**542.7**
PAN	98.7	277.6	1168.1	14.2	5.1	**1563.6**
P Sed Dam	0	1	88	0	0	**88.7**
P MAWD	0	3	46	0	2	**50.1**
PW Sed Dam	0	0	338	0	0	**337.6**
PW MAW Dam	18	0	173	23	33	**246.7**

4 Model calibration

The water balance model was calibrated for the period between 1 July 2022 to 30 June 2023, and the water balance model results were 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.

The water balance calibration outcomes are shown in Figure 4.1. Figure 4.1 shows that the modelled total site inventory adequately represents the recorded total site inventory.

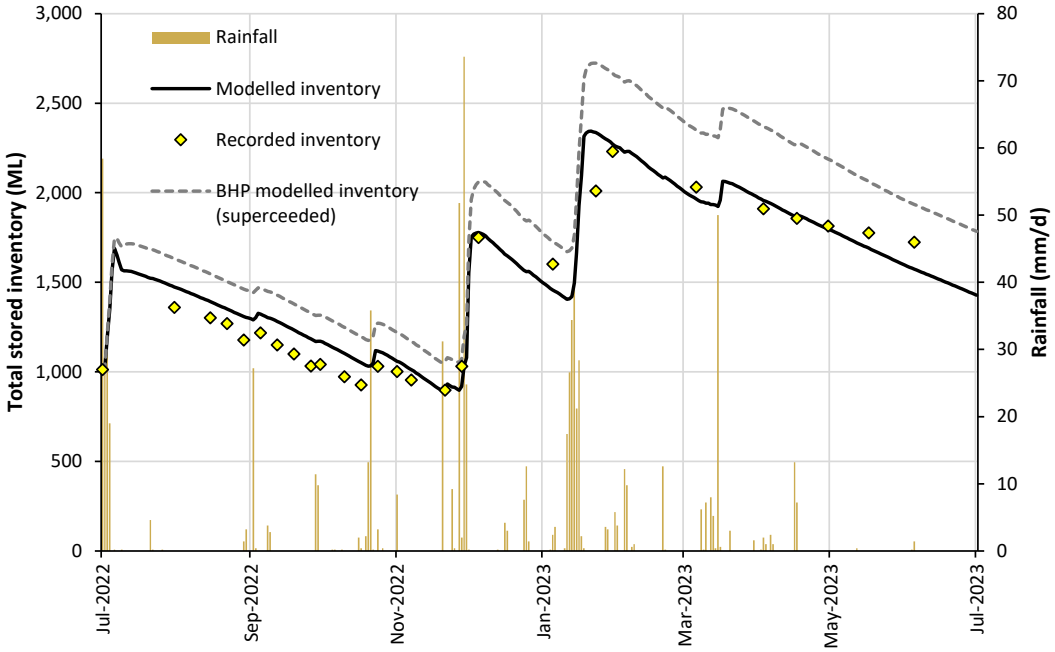


Figure 4.1 - Modelled stored inventory over the calibration period (July 2022 to June 2023)

5 Water management system

5.1 Site storages – existing and proposed

A summary of the existing and proposed storages within the Daunia WMS is provided in Table 5.1. Each water storage is operated according to two key volumes:

- Maximum operating volume (MOV): The volume at which a given storage should be operated to ensure that the target spill risk is not exceeded. When the stored inventory within a water storage exceeds the MOV, pumped inflows into the storage may cease and/or dewatering of the storage may commence. The MOVs for the site storages are summarised in the annual water balance report (HydroBalance, 2025).
- Full storage volume (FSV): the full storage capacity of the dam, up to the spillway level.

The water storages at Daunia would be staged over the LoM period due to progression of the of the active mining areas, summarised in Table 5.1.

Table 5.1 – Daunia WMS storage details – existing and proposed

Storage name	FSV (ML)	MOV (ML)	Overflows to	Online for storage	Offline for storage
Existing storages					
Dam 1	118	90	New Chum Creek	Current	2042
Dam 2	173	137	New Chum Creek	Current	2042
Dam 3	669	300	Isaac River	Current	2028
Dam 5	683	50	Isaac River	Current	2031
Dam 5 Sed Dam	~15	-	Isaac River	Current	2031
Dam 8	843	620	Isaac River	Current	2028
Dam 9	1.9	-	New Chum Creek	Current	2044
Dam 10	118	-	Isaac River	Current	2031
CAL	2,176*		-	Current	2027
TNN	6,000		-	2027	2042
TNC	123*		-	-	-
TNE	15,000		-	2030	2042
Proposed storages					
P SD	38	-	Isaac River	2026	2042
P MAWD	138	100	Isaac River	2027	2042
PW SD	144	100	Isaac River	2028	2042
PW MAWD	513	100	Isaac River	2028	2042

* Capacity available for storage. Water stored above these levels may seep into neighbouring pits.

5.2 Water management system configuration

Figure 3.1 shows a conceptual water circuit schematic for the existing Daunia WMS. In addition to the linkages shown in Figure 3.1, each storage will also receive inflows from direct rainfall and losses from evaporation.

The Daunia WMS is currently operated according to the following approach:

- Mining in Pandora Pit (PAN) to the south will begin in 2026.
- Dam 3 and Dam 8 will be continuously dewatered and operated empty between 2025 and 2028, while mining is occurring adjacent to these storages. Dam 3 and Dam 8 will be decommissioned in 2028, due the expansion of PAN.
- Dam 5 and Dam 5 Sed Dam will be decommissioned in 2031, due the expansion of PAN.
- Dam 10 will be decommissioned in 2041, due the expansion of PAN.
- The inactive in-pit areas will be available for excess mine water storage over the LoM period as follows:
    - CAL available between 2025 and 2026.
    - TNN available between 2027 and 2044.
    - TNE available between 2030 and 2044.

No in-pit storage is projected to be available between 2026 to 2027.

5.3 WMS operating rules

A summary of the modelled water management system operating rules is outlined in Table 5.2 and shown schematically in Figure 3.1.

There are three backbone pipelines onsite, connecting a number of storages across the site:

- Western backbone;
- Eastern backbone; and
- Central backbone.

The pipeline operation rules are outlined in Table 5.2 and the source/destination dams and priorities are summarised in Table 5.3.

Table 5.2 – Operational rules for the Daunia WMS

Source	Destination	Pump rate	Operating rules
External water			
Burdekin pipeline	Dam 2	75 L/s	Annual (YTD) import volume < 1,910 ML Total site inventory < 1,100 ML (Import Trigger)
Site water storages			
Dam 1	Dam 2	100 L/s	Dam 1 volume > 90 ML Dam 2 volume < 137 ML
	RP1	100 L/s	Dam 1 volume > 10ML Total site inventory > 2,100 ML (Yellow Wet TARP) Isaac River conditions and controlled release rules
Dam 2	Dam 5	80 L/s	Dam 2 volume > 137 ML Dam 5 volume < 500 ML
	Western backbone	80 L/s	Dam 2 volume > 137 ML The Western backbone pipeline capacity is not exceeded (see Table 5.3)

Source	Destination	Pump rate	Operating rules
	Eastern backbone	80 L/s	Dam 2 volume > 137 ML Dam 2 is not pumping to Dam 5 The Eastern backbone pipeline capacity is not exceeded (see Table 5.3)
	CHPP	*Variable*	First priority, continuous supply
	Watercart	*Variable*	Dam 2 prioritised for dust suppression when Dam 2 volume > 80% capacity
	RP1	300 L/s	Total site inventory > 2,100 ML (Yellow Wet TARP) Dam 2 volume > 70 ML Isaac River conditions and controlled release rules
Dam 3	Dam 8	180 L/s	Dam 3 volume > 250 ML Dam 8 volume < 600 ML
Dam 5	Western backbone	300 L/s	Dam 5 volume > 100 ML The Western backbone pipeline capacity is not exceeded (see Table 5.3)
	Dam 8	100 L/s	Dam 5 volume > 100 ML Dam 8 volume < 400 ML
	CAL	100 L/s	Dam 5 volume > 500 ML
Dam 8	Dam 3	180 L/s	Dam 8 volume > 200 ML Dam 3 volume < 340 ML
	Western backbone	300 L/s	Dam 8 volume > 380 ML The Western backbone pipeline capacity is not exceeded (see Table 5.3)
	Eastern backbone	150 L/s	Dam 8 volume > 68.3 ML The Eastern backbone pipeline capacity is not exceeded (see Table 5.3)
	Watercart	*Variable*	Dam 2 prioritised for dust suppression when Dam 2 volume > 80% capacity
Dam 9	Dam 2	180 L/s	Dam 2 volume < 137 ML
Dam 10	N/A	N/A	N/A
Dam 5 Sed Dam	N/A	N/A	N/A
P Sed Dam	Dam 5	60 L/s	P Sed Dam volume > 0 ML (until 2031)
	TNN	60 L/s	P Sed Dam volume > 0 ML (from 2031)
P MAWD	Dam 5	60 L/s	P MAWD volume > 100 ML (until 2031)
	TNN	60 L/s	P MAWD volume > 100 ML (from 2031)
PW Sed Dam	Dam 5	60 L/s	PW Sed Dam volume > 100 ML (until 2031)
	TNN	60 L/s	PW Sed Dam volume > 100 ML (from 2031)
PW MAWD	Dam 5	60 L/s	PW MAWD volume > 100 ML (until 2031)
	TNN	60 L/s	PW MAWD volume > 100 ML (from 2031)
Mine pits			
TNN	Western backbone	90 L/s	The Western backbone pipeline capacity is not exceeded (see Table 5.3)
TNW	Central backbone	90 L/s	The Central backbone pipeline capacity is not exceeded (see Table 5.3)
CAL	Western backbone	90 L/s	The Western backbone pipeline capacity is not exceeded (see Table 5.3)

Source	Destination	Pump rate	Operating rules
	Dam 5	90 L/s	Dam 5 volume < 100 ML
TNC	Eastern backbone	90 L/s	The Eastern backbone pipeline capacity is not exceeded (see Table 5.3)
TNE	Eastern backbone	240 L/s	The Eastern backbone pipeline capacity is not exceeded (see Table 5.3)
ATE	Central backbone	90 L/s	The Central backbone pipeline capacity is not exceeded (see Table 5.3)
	Dam 3	180 L/s	Dam 3 volume < 530 ML
Backbone pipelines			
Western backbone	RP1	300 L/s	First priority if Isaac River conditions and controlled release rules met Total site inventory > 2,100 ML (Yellow Wet TARP) Else, no release
	Watercart		Second priority when controlled releases occurring Else, first priority
	Dam 2		Third priority when controlled releases occurring Else, second priority
	Dam 5		Fourth priority when controlled releases occurring Else, third priority
Central backbone	Dam 3	240 L/s	First priority if Dam 3 volume < 340 ML
	Dam 5		Second priority if Dam 5 volume < 550 ML
	Dam 8		Third priority if Dam 8 volume < 620 ML
	Eastern backbone		Last priority if site dams full
Eastern backbone	RP1	240 L/s	First priority if Isaac River conditions and controlled release rules met Total site inventory > 2,100 ML (Yellow Wet TARP) Else, no release
	Watercart		Second priority when controlled releases occurring Else, first priority
	TNE		Second priority if site dams full, otherwise not used
	TNC		Third priority if site dams full, otherwise not used
	Dam 3		Second priority if Dam 3 volume < 340 ML and no controlled releases occurring Else, third priority
	Dam 5		Third priority if Dam 5 volume < 550 ML and no controlled releases occurring Else, fourth priority
	Dam 8		Fourth priority if Dam 8 volume < 620 ML and no controlled releases occurring Else, fifth priority
	ATE		Last priority until ATE offline for mining

Table 5.3 - Backbone pipeline operation

Source			Destination		
Storage	Priority	Pump rate	Storage	Priority	Pump rate
Western backbone - 300 L/s maximum capacity					
CAL	1 (active) 1.5 (inactive)	90 L/s	Release	1 (if conditions allow)	300 L/s
TNN	1 (active) 1.5 (inactive)	90 L/s	Watercart	1 (no releases) 2 (releases active)	300 L/s
PAN	1 (active) 1.5 (inactive)	90 L/s	Dam 2	2 (no releases) 3 (releases active)	300 L/s
Dam 2	2	80 L/s	Dam 5	3 (no releases) 4 (releases active)	300 L/s
Dam 5	3	300 L/s			
Eastern backbone - 240 L/s maximum capacity					
CAL	1 (active) 1.5 (inactive)	90 L/s	Release	1 (if conditions allow)	240 L/s
TNC	1 (active) 1.5 (inactive)	90 L/s	Watercart	1 (no releases) 2 (releases active)	240 L/s
TNE	1 (active) 1.5 (inactive)	90 L/s	Dam 3	2 (no releases) 3 (releases active)	240 L/s
Dam 8	2	150 L/s	Dam 5	3 (no releases) 4 (releases active)	240 L/s
Dam 2	3	80 L/s	Dam 8	4 (no releases) 5 (releases active)	240 L/s
Central backbone	4	90 L/s	TNE	2 (no releases and dams full) 3 (releases active and dams full)	240 L/s
			TNC	3 (no releases and dams full) 4 (releases active and dams full) 6 (no releases) 7 (releases active)	240 L/s
			ATE		240 L/s
Central backbone - 240 L/s maximum capacity					
ATE	1 (active)	90 L/s	Dam 3	1	240 L/s
TNW	1 (active) 2 (inactive)	90 L/s	Dam 5	2	240 L/s
			Dam 8	3	240 L/s
			Eastern backbone	4	240 L/s

5.4 AWBM rainfall runoff modelling

Table 5.4 shows the adopted rainfall runoff parameters for each catchment land use. Catchment runoff was modelled using the Australian Water Balance Model (AWBM).

Table 5.4 – Adopted AWBM rainfall runoff parameters

Parameter	Rehabilitated spoil	Pit/ compacted	Overburden	Natural/ undisturbed	Disturbed/ cleared
C1 (mm)	20	10	20	30	10
C2 (mm)	120	40	110	180	60
C3 (mm)	180	75	170	250	100
A1	0.134	0.3	0.134	0.134	0.3
A2	0.433	0.4	0.433	0.433	0.4
A3	0.433	0.3	0.433	0.433	0.3
Cav	132.6	41.5	123.9	190.2	57.0
BFI	0.35	0	0.8	0	0
Kbase	0.7	0	0.7	0	0
Ksurf	0	0	0	0	0
Cv	6.3%	19.2%	6.7%	4.2%	16.5%

In addition to the AWBM parameters for the site catchments, AWBM parameters have also been developed for the following Isaac River catchments:

- Issac River to Burton Gorge Dam: 363.7 km^2.
- Upper Isaac River to the RP1 release location: 2,476.5 km^2.

The adopted AWBM parameters are presented in Table 5.5 and have previously been developed to reflect the recorded river flow conditions at each of the Isaac River locations. The Isaac River AWBM parameters have been used to estimate the future flow conditions based on the model climate and hence determine the controlled release opportunities.

Table 5.5 – Adopted AWBM rainfall runoff parameters for the Isaac River catchments

Parameter	Burton Gorge	Upper Isaac
C1 (mm)	10.5	12
C2 (mm)	60	120
C3 (mm)	200	250
A1	0.074	0.134
A2	0.493	0.433
A3	0.433	0.433
Cav	117.0	161.8
BFI	0.19	0.35
Kbase	0.77	0.7
Ksurf	0.06	0.2
Cv	11.6%	6.5%

5.5 Site water demands

5.5.1 Dust suppression

Daily haul road and ROM pad dust suppression watering rates for the LoM period were estimated based on haul road surface area and daily rainfall and evaporation rates. The following rules were used to determine the applied dust suppression rate on any given day of the historical rainfall record:

- The assessment used daily evaporation rates sourced from the SILO evaporation dataset;
- 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;
- It was assumed that a haul road width of 35 m would be watered; and
- The haul road length is estimated to be 25.0 km.

The modelled averaged dust suppression is shown in Figure 5.1. The modelled estimate was factored to represent the measured watercart data collected between 2019 and 2025, shown in Figure 5.1. A summer application factor of 0.65 and winter application factor of 0.75 were adopted.

To account for the expansion of operations over the LoM, a scaling factor of 1.35 was applied once Pandora Pit comes online.

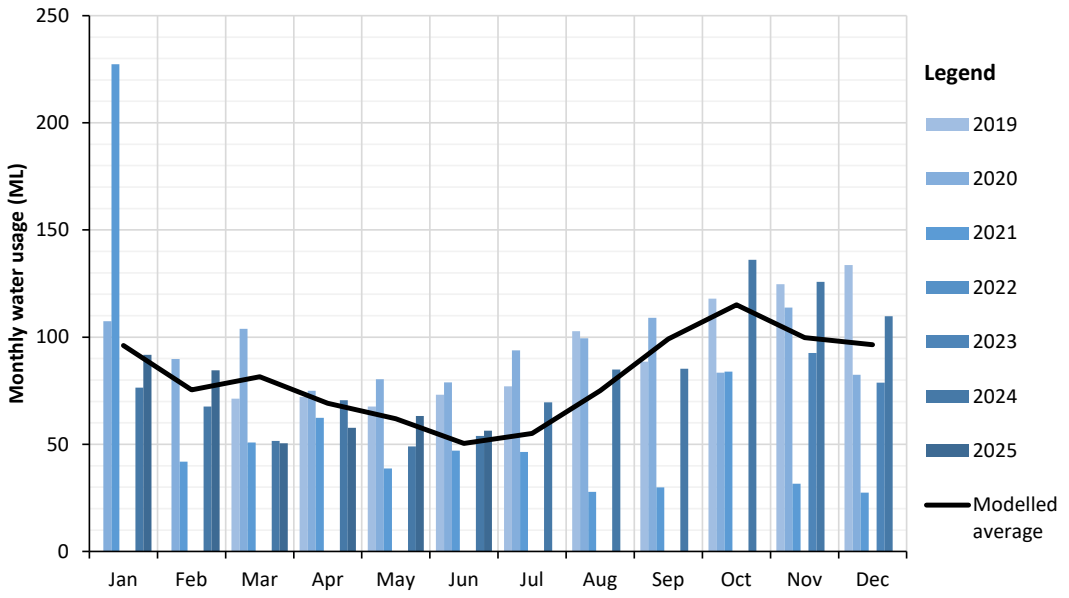


Figure 5.1 - Monthly average dust suppression usage, with recorded usage

Dust suppression water is sourced from Dam 2, Dam 8, the Eastern backbone pipeline and the Western backbone pipeline.

Dust suppressant binders will be implemented when the total site inventory falls into the Red Dry TARP. It has been assumed that the binders would reduce dust suppression demands by up to 40%.

5.5.2 CHPP usage

The forecast ROM coal tonnage for the LoM period is presented in Figure 5.2. The net CHPP loss has been estimated using the following key CHPP parameters:

- Product yield: 75%
- Rejects percent: 66%
- Raw coal moisture content: 6.4% w/w
- Product coal moisture content: 9.6% w/w
- Coarse reject moisture content: 5.4% w/w
- Entrained tailings water loss (% mass of total tailings): 33%.

The net CHPP loss is presented in Figure 5.2 and is based on the above parameters, equating to a net usage rate of 67 L/ROM tonne.

CHPP make up water is supplied continuously by Dam 2.

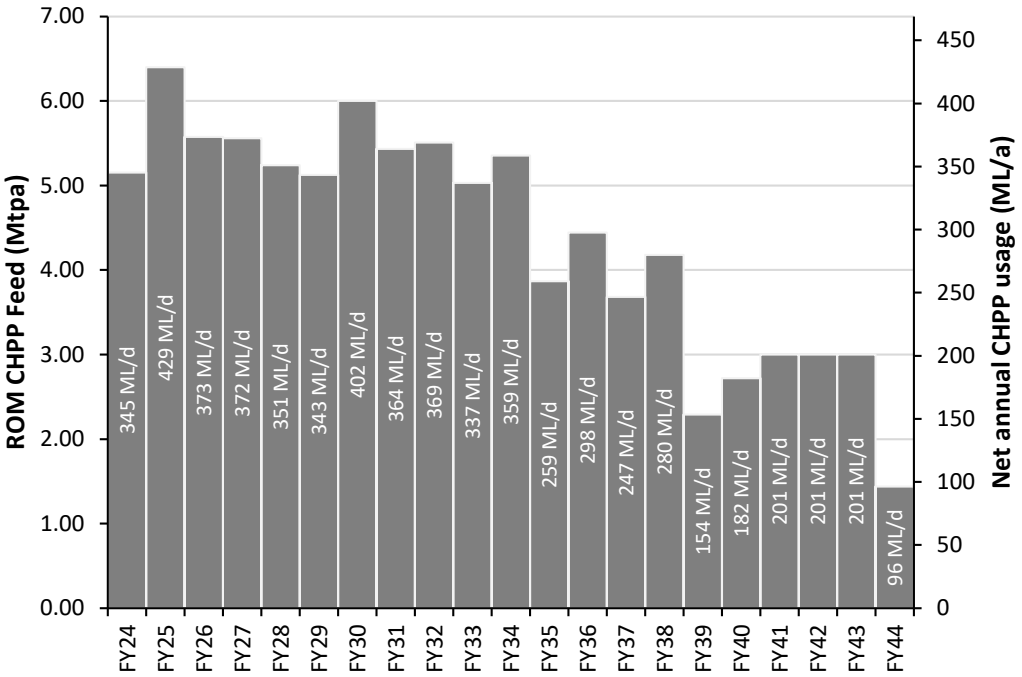


Figure 5.2 – Forecast ROM tonnages and net CHPP water usage

5.6 External water source

The raw water for Daunia comes from the Burdekin pipeline, with an annual allocation of 1,910 ML. Pipeline water is drawn into the site when the site-wide water storage inventory falls below 1,100 ML. A maximum daily supply rate of 6.2 ML/d has been allocated which is currently what rate is achievable to site including an allowance for 85 % availability.

5.7 Groundwater

The adopted total groundwater inflow rates to the mine pits are based on estimates provided from the groundwater model developed by SLR (2025), covering the LoM period. Figure 5.3 and Table 5.6 provide a summary of the groundwater estimates that have been provided for the Proposed Project over the LoM as annual inflows between 2025 and 2041. It is assumed that the inflow rates will be distributed evenly between the online pits.

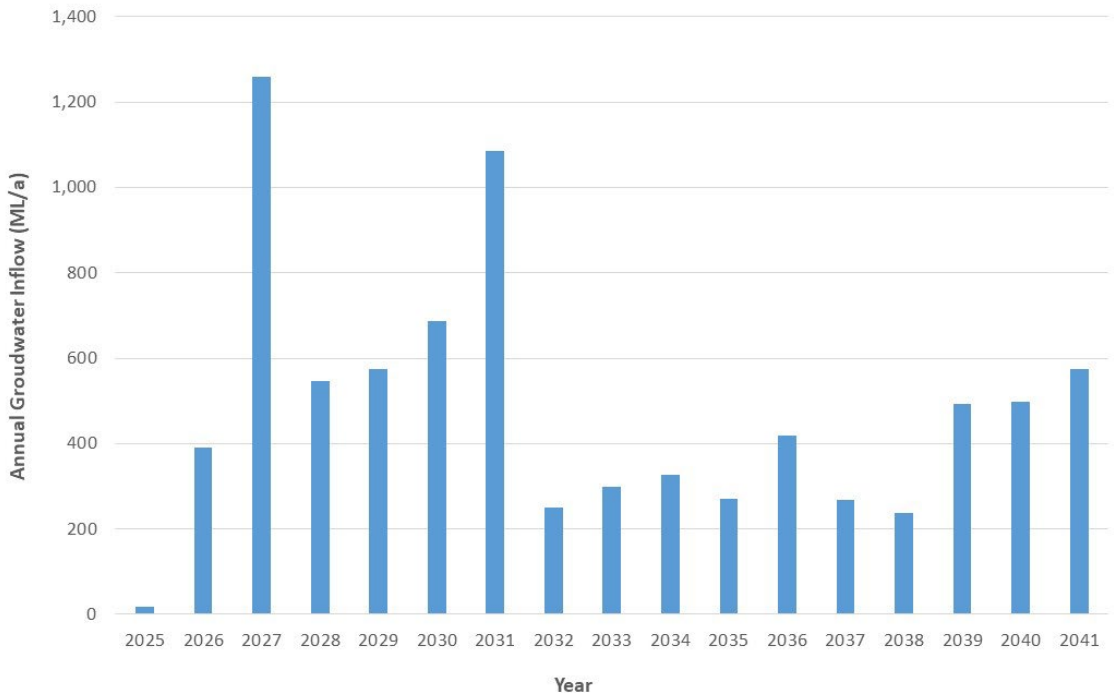


Figure 5.3 - Forecast annual groundwater inflow rate

Table 5.6 - Adopted groundwater inflow rates

Calendar year	Annual groundwater inflow (ML)
2025	18
2026	391
2027	1,258
2028	547
2029	575
2030	688
2031	1,084
2032	251
2033	298
2034	326
2035	271
2036	419
2037	269
2038	237
2039	493
2040	498
2041	574

5.8 Controlled releases

Controlled releases are permitted from RP1 via Dam 2 and the integrated water system (which includes Dam 1 and the Western backbone pipeline). The maximum available release rate (based on the current infrastructure configuration) is 300 L/s. Controlled releases may be undertaken when the following conditions are met per the current Environmental Authority (EPML00561913):

- The flow in the Isaac River (at MP3) is ≥3 m^3/s;
- The electrical conductivity in the release dam is < 5000 µS/cm; and
- The mixed downstream Isaac River electrical conductivity (at MP4) is < 864 µS/cm.

Controlled releases will be undertaken when the total site inventory exceeds 2,100 ML (Yellow Wet TARP).

6 Trigger Action Response Plan (TARP)

The site-wide water security and containment risks at Daunia are managed using a Trigger Action Response Plan (TARP). The TARP has been developed in conjunction with Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide Daunia TARP is summarised in Table 6.1.

Table 6.1 – Daunia site-wide water management TARP

Trigger	Action / Response
Red Dry Site inventory <615 ML	• Maximise take from Burdekin pipeline. • Maximise all in-pit dewatering into surface storage dams. • Implement Red Dry measures (dust suppressants).
Yellow Dry Site inventory >615 ML and <905 ML	• Maximise take from Burdekin pipeline • Consolidate water in Dams 2 and 8. • Prepare to implement Red Dry measures (dust suppressants).
Green Site inventory >905 ML and <2,100 ML	• Target operating level = 1,100 ML. • Consolidate water in Dams 2, 5 and 8. • Maintain dams below MOV. • Begin take of Burdekin pipeline water when site inventory exceeds 1,100 ML.
Yellow Wet Site inventory >2,100 ML and <4,790 ML	• Reduce or cease intake of Burdekin pipeline. • Begin undertaking controlled releases. • Spread water across site to enhance evaporation (following rain event). • Review availability to buy or borrow pumps/pipelines.
Red Wet Site inventory >4,790 ML	• Consider utilising evaporation fans to reduce stocks onsite. • Reduce or cease intake of Burdekin pipeline. • Continue undertaking controlled releases. • Transfer water to low priority active pits. • Engage process to acquire additional pumps/pipelines.

The Red Wet TARP changes as the availability of dams and pit storages to store MAW changes over time, as follows:

- From January 2027, Red Wet TARP increases to 4,800 ML as P MAWD becomes available.
- From January 2028, Red Wet TARP increases to 7,625 ML as TNN becomes available.
- From January 2030, Red Wet TARP increases to 22,625 ML as TNE becomes available.
- From January 2031, Red Wet TARP decreases to 21,942 ML with the removal of Dam 5.

7 Water balance modelling results

7.1 Overview

An assessment of the Daunia 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). The use of a large number of climate sequences, reflecting the full range of historical climatic conditions, indicates how system performance may vary under wet, dry and average climatic conditions.

An overall water balance summary for both the approved project and the DWIP is provided in Section 7.3. This comparison demonstrates the minimal impact of the DWIP on the Daunia water management system.

Given this minimal difference in the water balance, the forecast modelling results provided in the remaining sections are only presented for the DWIP.

7.2 Interpretation of results

The modelling methodology of a forecast simulation is described in Section 1. The results provide a statistical analysis of the water management system's performance over the next year based on 117 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 117 realisations on each day of the simulation).

7.3 Overall water balance summary

The average annual water balance results for all 117 realisations for the approved project and DWIP are presented in Table 7.1 and Table 7.2. The results are the average of all realisations by year, including wet and dry periods distributed throughout the model simulation.

The average annual water balance results show:

- The DWIP results in a minor increase in catchment runoff and direct rainfall when compared to the approved project, as the total site catchment will increase to include the new out-of-pit dump.
- There is a small increase in evaporation when compared against the approved project. This is due to the additional dam surface area associated with the new Project dams.
- There is a very minor increase in haul road dust suppression demand when compared against the approved Project. This is due to the additional out-of-pit dump disturbance area.
- There is a very minor increase in controlled releases when compared against the approved project. This is associated with slightly more water stored for the DWIP, however there is no change required to the controlled release strategy.
- There is a significant increase in sediment dam overflows due to the addition of the new out-of-pit dump and sediment management system.
- Overall, the impact of the DWIP on the average annual water balance is considered very minor.

Table 7.1 – Annual water balance of all realisations – approved Project

Storage	Annual water balance (ML/period)															
	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY35	FY38	FY39	FY40	FY41
WATER INPUTS																
Direct rainfall & catchment runoff	2,076	1,876	2,164	2,194	2,203	2,187	2,250	2,178	2,156	2,084	2,000	2,020	2,017	1,903	1,896	1,910
Burdekin pipeline import	6	706	561	235	450	436	326	186	392	403	392	393	364	437	448	371
Groundwater inflow	57	204	827	901	560	631	889	666	274	312	299	345	344	253	366	495
Total Inputs	**2,139**	**2,786**	**3,553**	**3,330**	**3,213**	**3,255**	**3,465**	**3,030**	**2,822**	**2,799**	**2,691**	**2,757**	**2,725**	**2,593**	**2,710**	**2,776**
WATER OUTPUTS																
Evaporation from water surface	1,283	854	776	866	882	896	881	808	761	739	712	683	680	660	647	683
Dust suppression demand	968	1,428	1,464	1,521	1,535	1,549	1,571	1,601	1,591	1,585	1,590	1,582	1,587	1,571	1,564	1,564
CHPP net loss	376	378	411	413	408	404	437	336	324	327	258	261	271	271	272	271
Controlled release	522	269	314	287	267	216	207	198	217	219	204	201	199	191	195	237
Sediment dam overflows (offsite)	63	74	34	36	37	32	37	35	35	30	32	33	33	33	33	32
Total Outputs	**3,212**	**3,003**	**2,999**	**3,123**	**3,129**	**3,097**	**3,133**	**2,977**	**2,927**	**2,899**	**2,796**	**2,759**	**2,770**	**2,726**	**2,711**	**2,786**
Changed in Stored Volume	**-1,073**	**-217**	**554**	**207**	**84**	**158**	**331**	**53**	**-106**	**-100**	**-105**	**-2**	**-45**	**-133**	**-1**	**-10**

Table 7.2 – Annual water balance of all realisations – DWIP

Storage	Annual water balance (ML/period)															
	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY35	FY38	FY39	FY40	FY41
WATER INPUTS																
Direct rainfall & catchment runoff	2,076	1,876	2,328	2,368	2,378	2,387	2,455	2,377	2,354	2,274	2,183	2,205	2,203	2,089	2,081	2,095
Burdekin pipeline import	6	706	558	234	443	428	320	182	377	385	379	382	353	421	432	356
Groundwater inflow	57	204	827	901	560	631	889	666	274	312	299	345	344	253	366	495
Total Inputs	**2,139**	**2,786**	**3,714**	**3,503**	**3,381**	**3,446**	**3,664**	**3,224**	**3,006**	**2,971**	**2,862**	**2,933**	**2,899**	**2,763**	**2,879**	**2,946**
WATER OUTPUTS																
Evaporation from water surface	1,283	854	805	927	948	967	964	894	847	828	798	769	766	745	732	768
Dust suppression demand	968	1,428	1,467	1,529	1,543	1,557	1,582	1,614	1,605	1,601	1,604	1,601	1,604	1,591	1,583	1,582
CHPP net loss	376	378	411	413	408	404	437	336	324	327	258	261	271	271	272	271
Controlled release	522	269	323	300	283	232	221	209	226	229	210	210	207	199	201	246
Sediment dam overflows (offsite)	63	74	92	97	99	90	111	105	105	92	94	96	96	96	96	95
Total Outputs	**3,212**	**3,003**	**3,096**	**3,265**	**3,282**	**3,251**	**3,315**	**3,158**	**3,106**	**3,077**	**2,965**	**2,937**	**2,944**	**2,902**	**2,884**	**2,962**
Changed in Stored Volume	**-1,073**	**-217**	**618**	**237**	**98**	**195**	**350**	**66**	**-100**	**-106**	**-103**	**-5**	**-44**	**-139**	**-4**	**-15**

7.4 Water management system inventory

Figure 7.1 shows the forecast total WMS inventory, which includes all water storages onsite and compared to the WMS inventory TARP levels, which are given in Table 6.1.

Figure 7.2 shows the forecast active pit inventory. The following is of note regarding the water balance results:

- During very wet (1%ile) climatic conditions, the total WMS may accumulate enough water to exceed the Red Wet TARP up until 2029. From 2030, the available storage capacity increases significantly, and the 1%ile WMS inventory is well below the Red TARP volume.
- During wet (10%ile) climatic conditions, the total WMS may accumulate enough water to exceed the Yellow TARP over the whole LoM but remains below the Red TARP volume.
- During median (50%ile) climatic conditions, the total WMS inventory stays relatively level around 1,000 to 2,000 ML (within the Green TARP volume band).
- During dry (90%ile) and very dry (99%ile) climatic conditions, the total WMS inventory may reduce to below the Yellow Dry TARP volume from time to time but is mostly kept above this volume due to supply from the Burdekin pipeline raw water imports.
- Controlled releases would be undertaken when the total site inventory exceeds the Yellow Wet TARP (2,100 ML). The total site inventory generally only exceeds the Yellow Wet TARP during conditions wetter than the 50%ile climatic conditions.
- The active pit inventory typically stays below 2,500 ML under very wet (1%ile) climatic conditions, until the final 3 years of the Project, where it may reach approximately 5,500 ML. The active pit inventories generally draw down after the peak of each wet season.

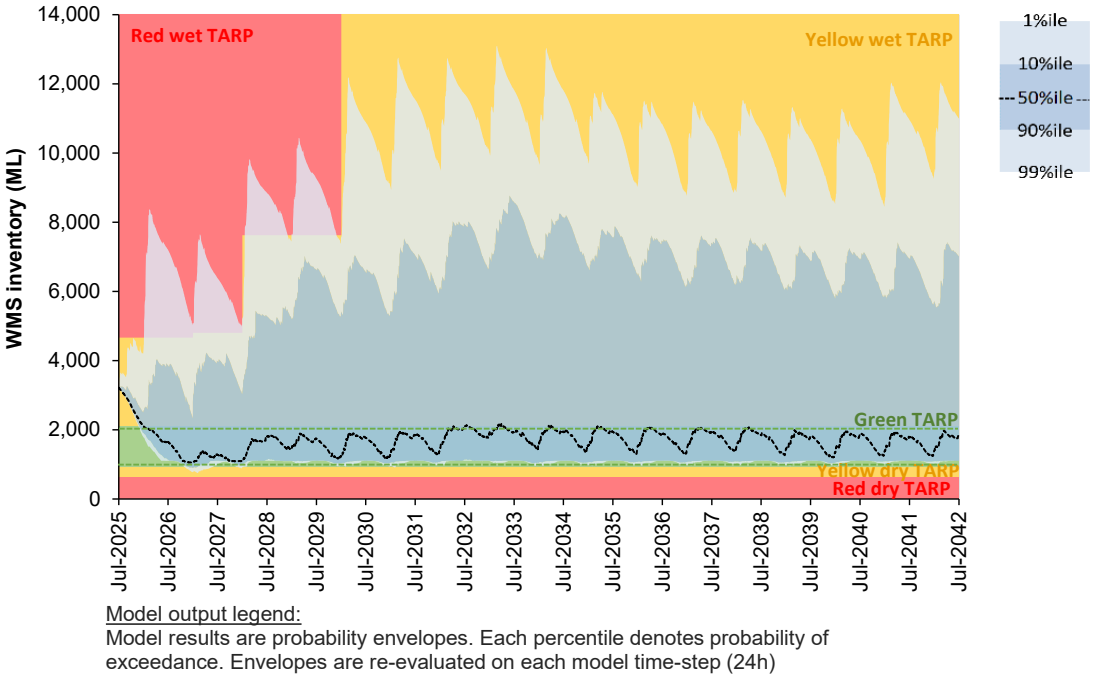


Figure 7.1 – Forecast WMS inventory - DWIP

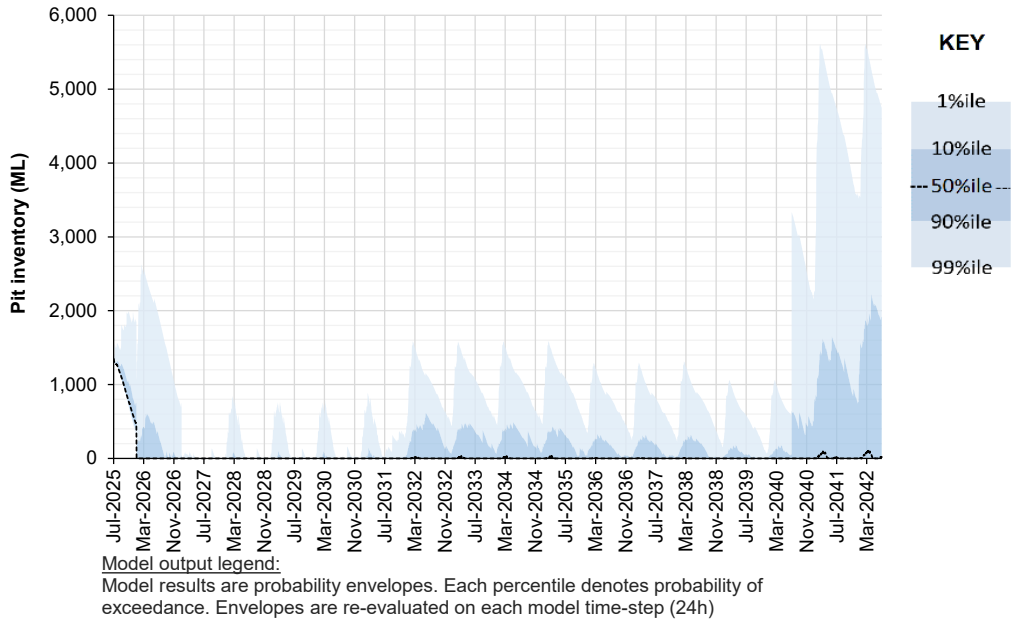


Figure 7.2 - Forecast active pit inventory - DWIP

7.5 External water supply

The forecast annual Burdekin pipeline importation volume is shown in Figure 7.3. The following is of note regarding the external water demand:

- External water would be required to top-up the site water inventory for the majority of climatic conditions assessed.
- During extreme dry climatic conditions (99%ile), up to 1,810 ML of external water may be required during the LoM period. The full annual allocation would not be required even in extreme dry conditions over the LoM period.
- During median climatic conditions (50%ile), between 0 ML to 700 ML would be required during the LoM period.
- No external water would be required during extreme wet climatic conditions (1%ile).

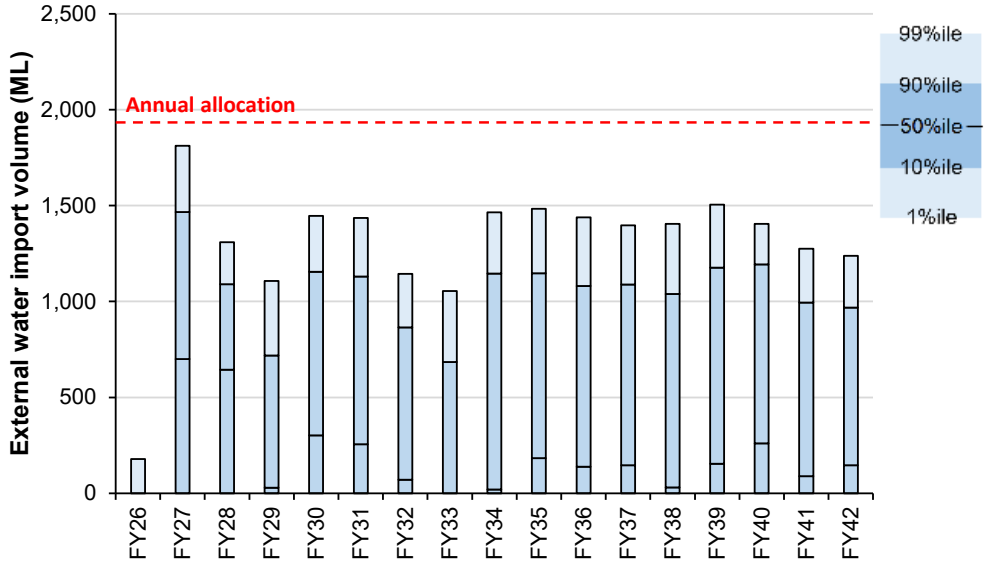


Figure 7.3 - Forecast Burdekin pipeline demand - DWIP

7.6 Controlled releases

The forecast annual controlled release volumes are shown in Figure 7.4. The following is of note regarding the controlled releases:

- Controlled releases are expected to be required in wet (10%ile) and very wet (1%ile) climatic conditions, as well as median (50%) climatic conditions in some years.
- During extreme wet climatic conditions (1%ile), up to 1,690 ML may be released in the 2029 financial year.

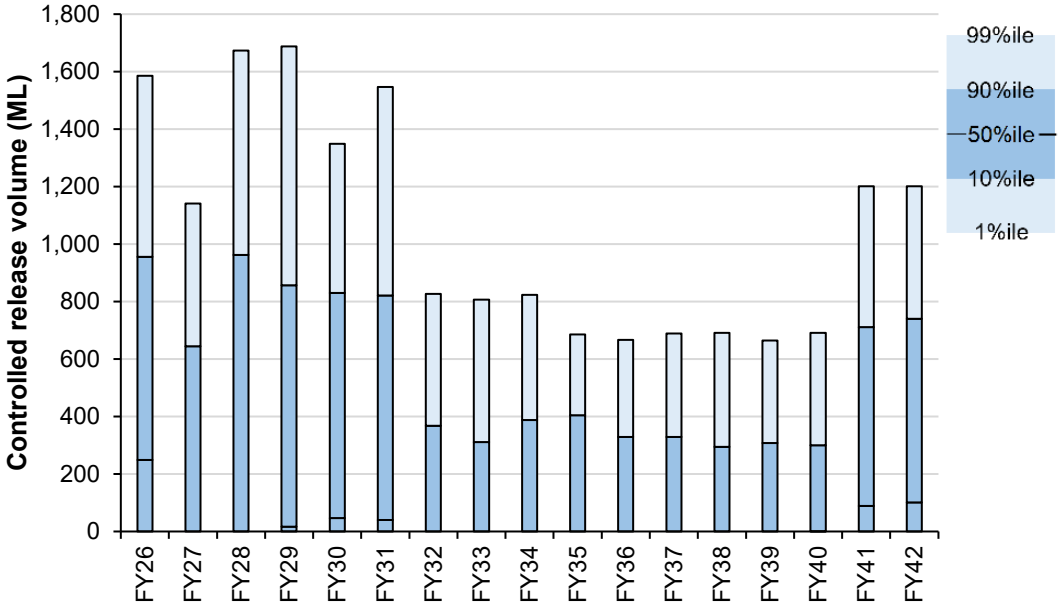


Figure 7.4 - Forecast controlled release volumes - DWIP

7.7 Sediment water overflows

The water balance model was used to assess the risk of uncontrolled spillway discharges off-site from the sediment management system. The sediment dams that could potentially flow directly to the receiving environment include:

- Dam 5 Sed Dam
- Dam 10
- P Sed Dam
- PW Sed Dam
- PW MAWD

Uncontrolled discharges from sediment dams to the receiving environment:

- Overflows from sediment dams are only expected to occur in wet (10%ile) and very wet (1%ile) climatic conditions, as well as minor overflows during median (50%) climatic conditions during the first two years of the DWIP.
- During wet climatic conditions (10%ile), between 140 ML and 330 ML of annual overflows are predicted.
- During extreme wet climatic conditions (1%ile), between 560 ML and 1,440 ML of annual overflows are predicted.

The individual risk of overflows for the new sediment dams proposed as part of the DWIP are as follows:

- P Sed Dam:

  - Overflows from P Sed Dam are only expected to occur in wet (10%ile) and very wet (1%ile) climatic conditions.
  - During wet climatic conditions (10%ile), between 15 ML and 80 ML of annual overflows are predicted
  - During extreme wet climatic conditions (1%ile), between 100 ML and 285 ML of annual overflows are predicted.
- PW Sed Dam:
  - Overflows from PW Sed Dam are only expected to occur in wet (10%ile) and very wet (1%ile) climatic conditions.
  - During wet climatic conditions (10%ile), between 200 ML and 280 ML of annual overflows are predicted
  - During extreme wet climatic conditions (1%ile), between 750 ML and 900 ML of annual overflows are predicted.
- PW MAWD:
  - Overflows from PW MAWD are only expected to occur in very wet (1%ile) climatic conditions.
  - During extreme wet climatic conditions (1%ile), between 30 ML and 215 ML of annual overflows are predicted.

7.8 MAW dam spill risks

The water balance model was used to assess the risk of uncontrolled spillway discharges off-site from the MAW system. The MAW dams that could potentially flow directly to the receiving environment include:

- Dam 3
- Dam 5
- P MAWD

The individual risk of overflows for the new sediment dams proposed as part of the DWIP are as follows:

- Dam 3:
  - Overflows from Dam 3 are only expected to occur in very wet (1%ile) climatic conditions.
  - During extreme wet climatic conditions (1%ile), between 80 ML and 160 ML of annual overflows are predicted.
- Dam 5:
  - There are no modelled overflows from Dam 5 for any of the realisations. This indicates that Dam 5 has a spill risk of less than 1% AEP.
- P MAWD:
  - There are no modelled overflows from P MAWD for any of the realisations. This indicates that P MAWD has a spill risk of less than 1% AEP.

8 References

BHP, 2023 *Daunia Water Balance Modelling Key Inputs Summary*, BHP, 2023

APPENDIX C FINAL VOID WATER BALANCE – APPROVED EA

PROGRESSIVE REHABILITATION AND CLOSURE PLANNING – DAUNIA MINE

Final Void Water Balance Report

Whitehaven Coal Limited

3 November 2025

1583-04-B2

DETAILS

Report Title	Progressive Rehabilitation and Closure Planning – Daunia Mine, Final Void Water Balance Report
Client	Whitehaven Coal Limited

THIS REVISION

Report Number	1583-04-B2
Date	3 November 2025
Author	JG/DS
Reviewer	GR

DOCUMENT REVISION TABLE

Revision number	Revision date	Reviewer	Author
B	9 April 2025	GR	JG/DS
B1	9 October 2025	GR	JG/DS

NOTE: This report has been prepared on the assumption that all information, data and reports provided to us by our client, on behalf of our client, or by third parties (e.g. government agencies) is complete and accurate and on the basis that such other assumptions we have identified (whether or not those assumptions have been identified in this advice) are correct. You must inform us if any of the assumptions are not complete or accurate. We retain ownership of all copyright in this report. Except where you obtain our prior written consent, this report may only be used by our client for the purpose for which it has been provided by us.

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1 INTRODUCTION

Whitehaven Coal Limited (WHC), owner of Daunia Coal Mine (DNM), is proposing to update the Progressive Rehabilitation and Closure Plan (PRCP) for DNM. The DNM metallurgical coal mine is an open-cut coal mine located 30 kilometres southeast of Moranbah and about 170 kilometres southwest of Mackay in Queensland.

The void closure plan presents the outcomes of technical studies conducted to assess the long-term behaviour of the final landform and to prepare a conceptual closure landform drainage system design that provides flood protection to the final voids while also ensuring safety and stability in perpetuity.

1.1 SCOPE AND OBJECTIVES

The scope of this work specifically aims to address the Void in Floodplain requirements outlined in Section 3.4 – General Rehabilitation Practices of the Department of Environment and Science (DES) Guideline (V3.1) – Progressive rehabilitation and closure plans (PRC Guideline) and the Voids in Flood Plains Information Sheet.

The objective of this assessment is to evaluate whether the residual mine voids within the final landform will function as terminal sinks or flow-through systems. This assessment evaluates the final void water balance, salt mass balance, and seepage pathways through spoil emplacements.

1.2 APPLICABLE LEGISLATION AND GUIDELINES

This report is in accordance with the following legislation and guidelines:

- '*Guideline – Progressive Rehabilitation and Closure Plans*', Department of Environment and Science (DES), April 2023 (PRCP Guideline);
- '*Information Sheet – Environmental Protection Act 1994 – Voids in Flood Plains*', Department of Environment and Science, March 2020 (Voids in Flood Plains Information Sheet); and
- '*Australian Rainfall and Runoff (2019)*' (ARR).

2 PROPOSED VOIDS

WHC is modifying the size and location of the approved voids at DNM. Indicative final dimensions of the proposed voids are presented in Table 2.1. Figure 2.1 shows the location and catchment area of each void, which was determined using the final landform topography.

Table 2.1 Indicative dimensions of the proposed voids

Proposed Void	Indicative Maximum Width (m)	Indicative Maximum Length (m)	Indicative Maximum Depth (m)	Void Catchment Area (ha)
Titan North	1276	1048	76	532
Titan Central	165	395	18	56
Titan East	330	1085	104	585
Pandora	1550	1680	134	715

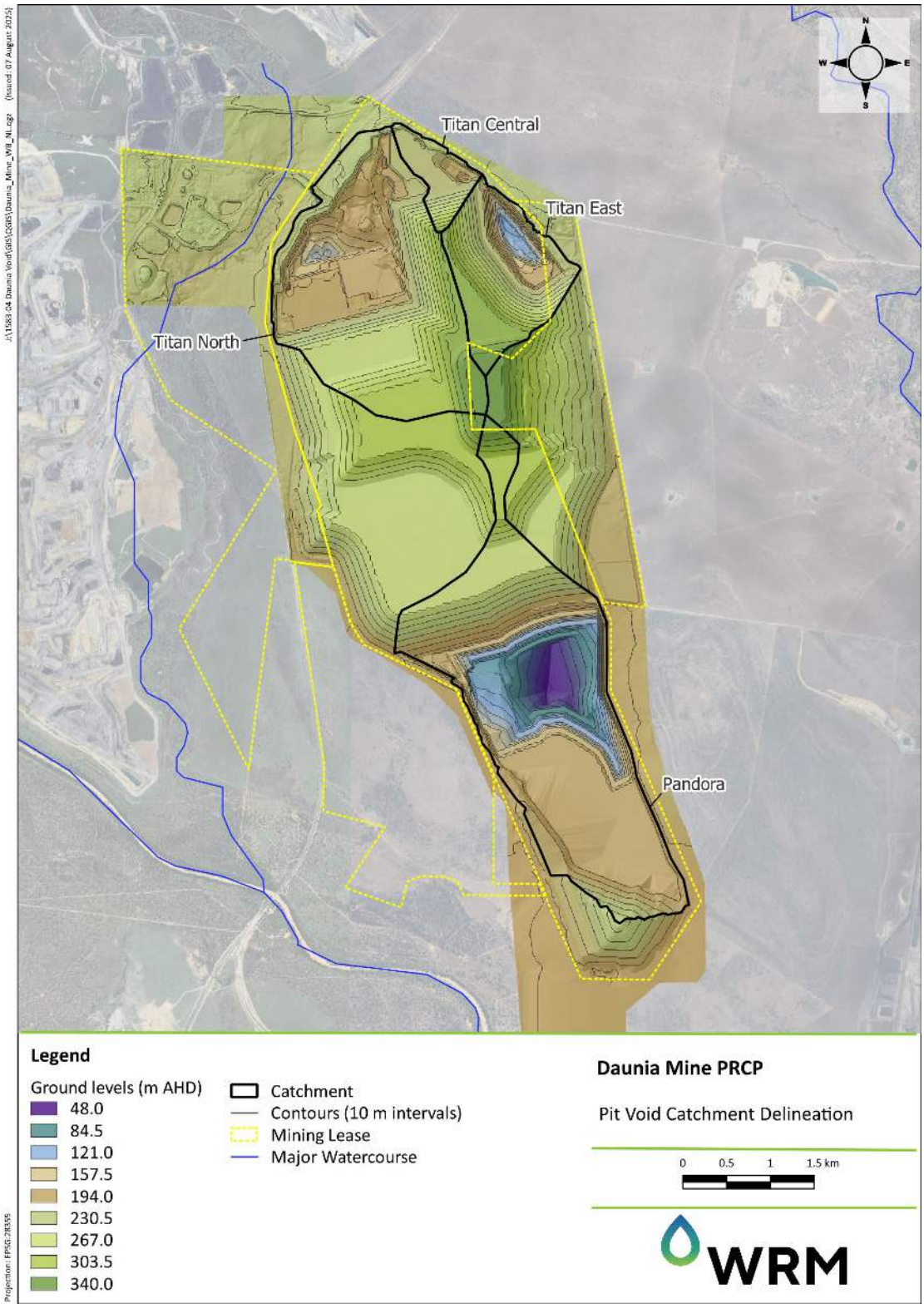

Figure 2.1 DNM residual void catchment delineation

3 VOID WATER BALANCE

3.1 GENERAL

The conceptual water balance for a terminal void lake is shown schematically in Figure 3.1. The depth of the void water and the associated water fluxes into and out of the lake depend on several factors represented in Figure 3.1.

Void water levels are influenced by rainfall, runoff, evaporation, salinity, and groundwater. Void water levels will eventually reach an approximate equilibrium, with the system acting as an evaporative sink or a flow-through system, as represented in Figure 3.2. Should both surface water and groundwater inflows be insufficient to fill the void to a level commensurate with the pre-mining groundwater level, the void will remain a sink, with all dissolved constituents within the void water concentrating over time. Conversely, if the void level reaches the pre-mining groundwater level, void water will both receive and discharge into the regional groundwater system, as shown schematically in Figure 3.2.

The local water table is predicted to remain depressed in the long term, driven by the ongoing groundwater discharge to the void lakes and governed by the lake elevations themselves (SLR, 2025). That is, long-term inwards groundwater flow gradients to the open voids are maintained post-mining.

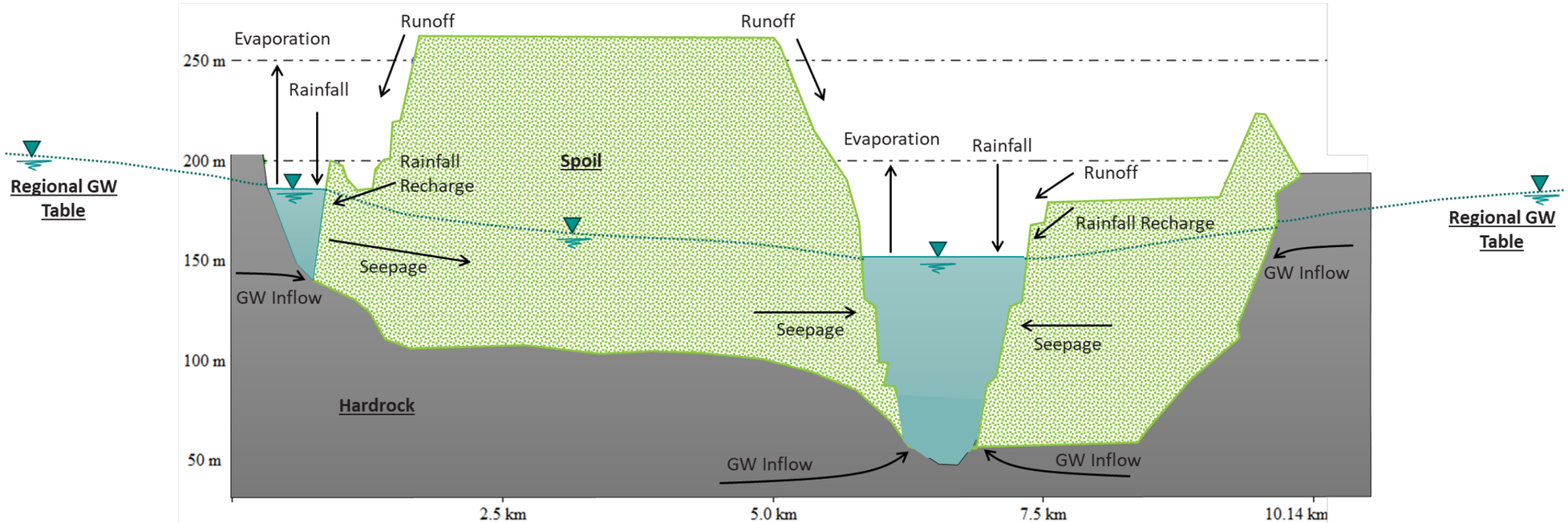

Figure 3.1 Conceptual void water balance model – inflow dominant (normal) conditions

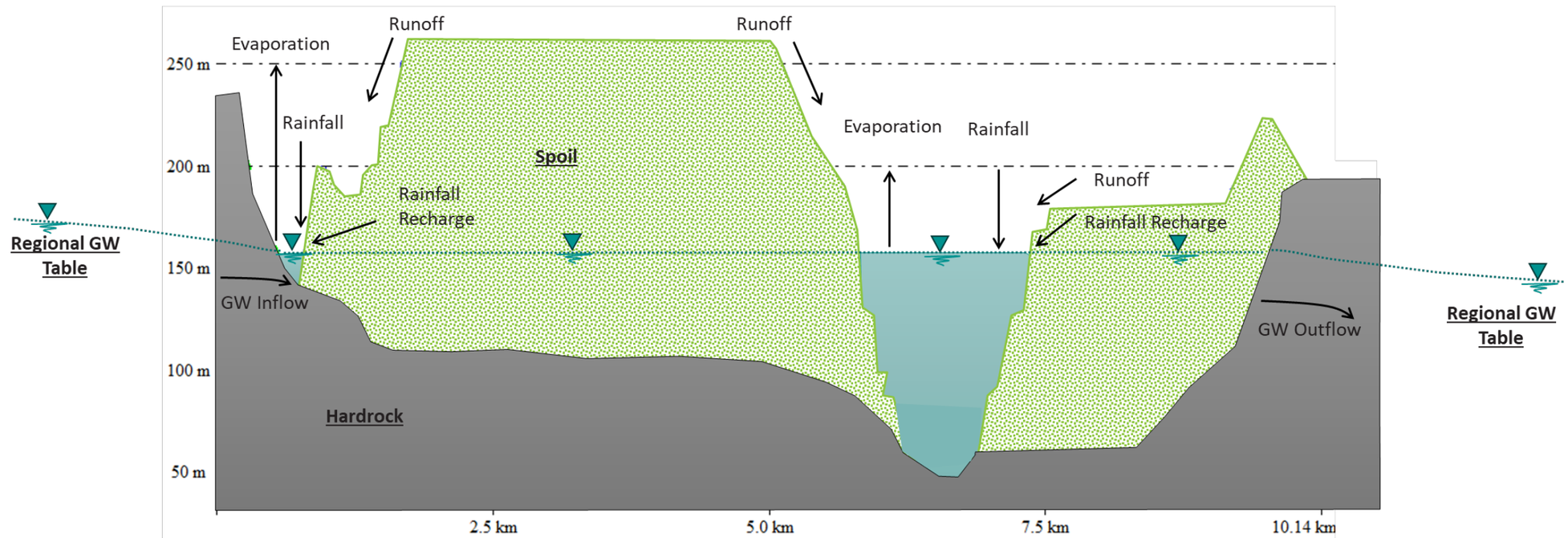

Figure 3.2 Conceptual void water balance model – flowthrough condition

3.2 METHODOLOGY

3.2.1 Overview

The DNM final landform water balance model (the model), developed using GoldSim software (version 15.0), created by the GoldSim Technology Group LLC (www.goldsim.com), is a probabilistic simulation and modelling software package. GoldSim has been extensively used to develop graphically oriented models with developed network logic, including void water balances.

The model operates at a daily time step predicting the water level and the salinity of the water in the void. The probability of these outcomes is driven by probabilistically generated rainfall and evaporation to assess the potential impact on the water and salt balance.

GoldSim can model the complexity associated with a dynamic system featuring multiple feedback mechanisms to understand how the system may evolve, considering seasonal variations in climate (rainfall and evaporation).

The water balance model (WBM) was used to estimate the water quantity and quality over a 500-year simulation period for the final closure landforms using a daily timestep. The WBM calculates the possible water outflows based on the groundwater inflows. Direct rainfall, surface water runoff, groundwater interactions, evaporation and seepage are all incorporated in the WBM (WSP, 2023). The model's start date is 2045, and a model period of 500 years was selected, with 250 realisations being run each year. Post mining, any operational processes, such as pumping or transfers, were assumed to be inactive during the modelled period.

3.2.2 Salt balance

Salinity has been used as a surrogate to model all water quality within the voids using a mass balance approach. The mass balance approach is suitable for salinity but does not account for the chemical, environmental and biological reactions that may affect other water quality constituents such as metals. However, the mass balance approach is suitable to model the overall loads and concentrations of other parameters.

This approach supports the evaluation of whether salinity levels will increase due to evaporation and containment (indicative of a terminal sink) or remain stable due to dilution and outflow (indicative of a flowthrough system).

3.3 CLIMATE CHANGE

In March 2024, Engineers Australia (EA) in partnership with the Australian Government's *Department of Climate Change, Energy, the Environment and Water* (DCCEEW) released a major update to the ARR Guideline known as version 4.2 (Ball et al, 2019) which included a major revision to the chapter relating to Considerations of Climate Change. The guidance has been developed from the latest Intergovernmental Panel on Climate Change (IPCC) temperature projections based on Shared Socioeconomic Pathways (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.

Assessment of any future climate scenarios requires assumptions relating to the rainfall depths, the antecedent conditions of the catchment prior to the onset of rainfall, and the initial lake level at the dam. Due to increasing temperatures, rainfall losses also increase in future climate scenarios.

The study by Riahi et al. (2017) provides a comprehensive overview of the SSP's. SSP2-4.5 was selected as the base and assumes that global development and environmental policies will continue along their current trajectories. SSP2-4.5 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 W/m^2 by 2100.

SSP1-2.6 and SSP5-8.5 were selected for climate change sensitivity analysis to evaluate how different development paths impact water levels and inform climate adaptation strategies.

The SSP1-2.6 scenario, referred to as the "Sustainability" scenario, gradually shifts towards a more sustainable path. SSP1-2.6 emphasises inclusive development and respect for environmental boundaries, focusing on achieving development goals, reducing inequality, and promoting low material growth. It results in low greenhouse gas emissions and radiative forcing of 2.6 W/m² by 2100, aligning with the goals of the Paris Agreement to limit global warming to well below 2°C.

The SSP5-8.5 scenario, referred to as the "Fossil-fuelled Development", assumes rapid and unconstrained economic output and energy use growth, heavily reliant on fossil fuels. SSP5-8.5 assumes high levels of technological advancement but with minimal efforts to reduce greenhouse gas emissions. The SSP5-8.5 scenario is characterised by very high greenhouse gas emissions and a radiative forcing of 8.5 W/m² by 2100, resulting in significant global warming and severe climate adjustments. The Queensland Future Climate dashboard notes that there is a common view among climate scientists that the SSP5-8.5 scenario is very unlikely to be realised.

3.4 HISTORICAL CLIMATE DATA

DNM is in a subtropical climate zone, characterised by hot, humid summers and moderately dry winters. Average daily temperatures range from 8.8°C in July to 21.5°C in January, with maximum daily temperatures peaking at 34.9°C in December.

3.4.1 Rainfall

Historical climate data for the site (latitude 22.05°S, longitude 148.30°E) was sourced from the Department of Science, Information Technology and Innovation's SILO Data Drill. This dataset provides continuous, gap-free daily records interpolated from Bureau of Meteorology (BoM) observations.

In 1957, routine rainfall sampling began, and the number of stations measuring climate variables increased significantly (QNRME, 2004). Therefore, WRM adopted climate data from 1957 for climate modelling and forecasting.

The annual rainfall data from 1957 to 2024 averages 584 mm (view Figure 3.3). Overall, the annual variability in rainfall is moderate. The minimum recorded rainfall during this period was 262 mm in 1982, while the maximum reached 1,082 mm in 2010 (view Figure 3.3).

The monthly rainfall data from 1957 to 2024 are summarised in Figure 3.4.

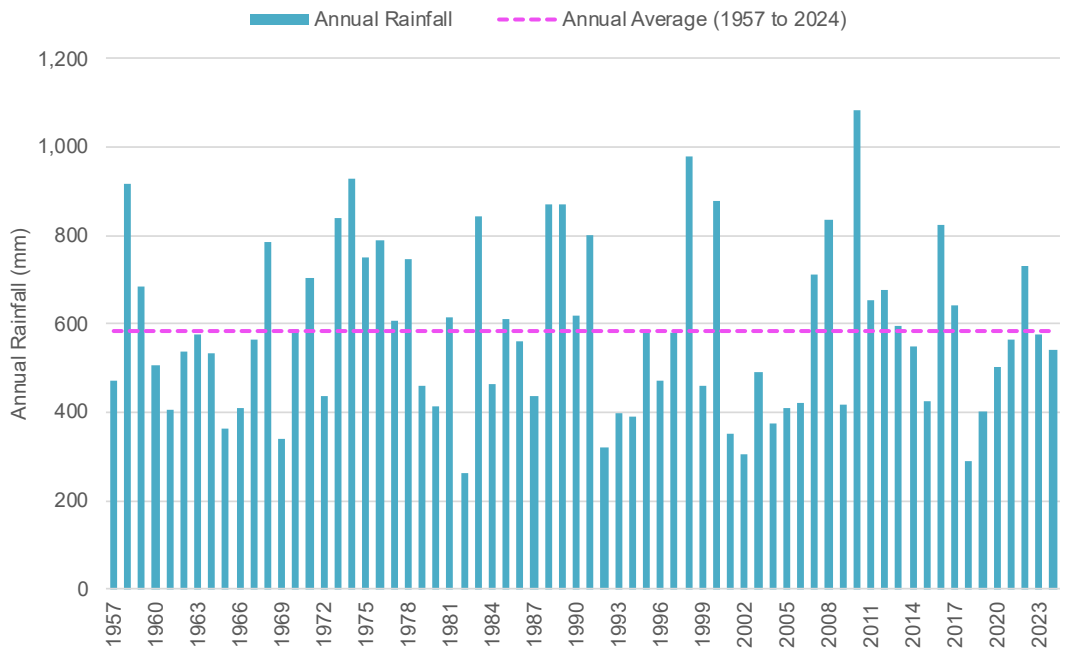

Figure 3.3 Annual rainfall (1957-2024)

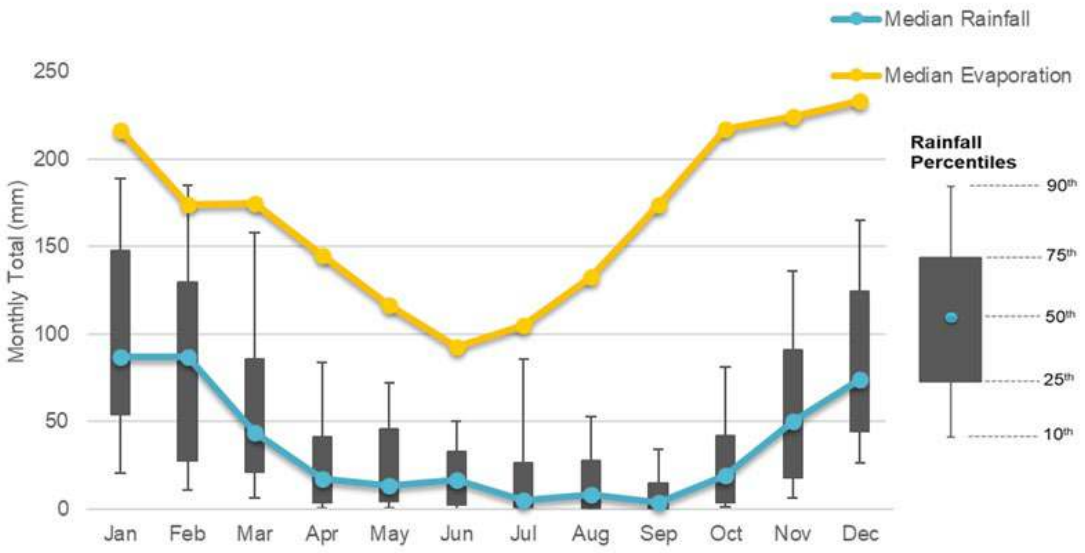

Figure 3.4 Monthly SILO rainfall and evaporation distributions summary

3.4.2 Evaporation

Class A pan evaporation data (1957-2024) is summarised as follows:

- Average Annual Pan Evaporation: 2,014 mm.
- Evaporation peaks between October and January, aligning with the warmer months.

Evaporation data for the site has been compiled using a combination of synthetic estimates prior to 1970 and Class A pan evaporation measurements from 1970 onwards. The synthetic estimates were derived using climatological modelling techniques to fill gaps in historical records for continuity in the dataset.

3.4.3 Comparative climate data

Climate data from nearby stations show consistent patterns with the DNM site (MIA AWS) climate profile (Table 3.1). Nearby stations comprise Moranbah Airport (34035), about 22.7 km west of DNM MIA, Moranbah Water Treatment Plant (34038), about 28.7 km northwest, and Seloh Nolem (34086), about 34.3 km southeast.

The rainfall data in Table 3.1 cannot be directly compared because the datasets have been collected across different time periods. However, the rainfall data for the MIA AWS shows a higher annual average rainfall of 744 mm compared to nearby stations, indicating above average rainfall during June 2023 to June 2025: Moranbah Airport (2013 - 2024) averages 559 mm, Moranbah Water Treatment Plant (1870 - 2013) averages 628 mm, and Seloh Nolem (1980 – 2014) averages 586 mm per annum.

Table 3.1 Monthly rainfall, evaporation, minimum and maximum temperature (1957–2024)

	Long-term Mean Monthly Rainfall (mm)			On-site Mean Monthly Rainfall (mm)		Mean Monthly Evaporation (mm)		Average Daily Temperature (Degrees Celsius [°C])	
	Moranbah Airport (34035)	Moranbah WTP (34038)	Seloh Nolem (34086)	SILO Data Drill	MIA AWS	Moranbah Airport (34035)	SILO Data Drill	Moranbah Airport (34035)	
Period of record	2013 - 2024	1870 - 2013	1980 – 2014	1957 - 2024	June 2023 to June 2025	2013 - 2024	1957 - 2024	2013 - 2024	
January	103	92	91	102	156	222	216	21.5	34.5
February	89	109	81	91	137	186	179	20.9	33.1
March	66	59	56	65	60	177	179	20.4	33.0
April	25	39	41	35	57	145	146	17.1	30.4
May	29	29	38	31	18	120	117	13.0	27.0
June	24	28	29	23	72	96	94	10.0	24.7
July	32	20.0	22	22	35	106	104	8.8	24.4
August	15	31	26	22	24	143	134	9.3	26.9
September	14	8	12	11	1	179	173	12.8	30.2
October	26	37	37	31	25	219	215	16.6	33.3
November	71	68	62	61	87	232	225	19.1	34.6
December	65	108	99	90	72	240	233	20.7	34.9
Annual Average	**559**	**628**	**596**	**584**	**744**	**2,065**	**2,015**	**Min**	**Max**

3.5 WATER BALANCE MODEL SET-UP

3.5.1 Void storage relationships

The relationship between lake volume/surface area and lake elevation for each void has been obtained from stage-storage relationships of the final landforms of the voids, as displayed in in Figure 3.5 to Figure 3.8. The final landform topography was used to determine the stage-storage relationship of each void: 20250502_DNM_PRCP_FinalLandform_v1.tif. Note that the lake surface area is based on the lake volume for each modelled lake water level.

- Titan North has a maximum volume of 41,800 ML, a maximum surface area of 192.4 ha, and a maximum lake elevation of 210 mAHD before overtopping will occur, as shown in Figure 3.5.
- Titan Central has a maximum volume of approximately 450 ML, a maximum surface area of 6.22 ha and a maximum lake elevation of 210 mAHD before overtopping will occur, as shown in Figure 3.6.
- Titan East has a maximum volume of 26,200 ML, a maximum surface area of 54.8 ha, and a maximum lake elevation of 220 mAHD before overtopping will occur, as shown in Figure 3.7.
- Pandora has a maximum volume of 201,850 ML, a maximum surface area of 448.5 ha and a maximum lake elevation of 190 mAHD before overtopping will occur, as shown in Figure 3.8.

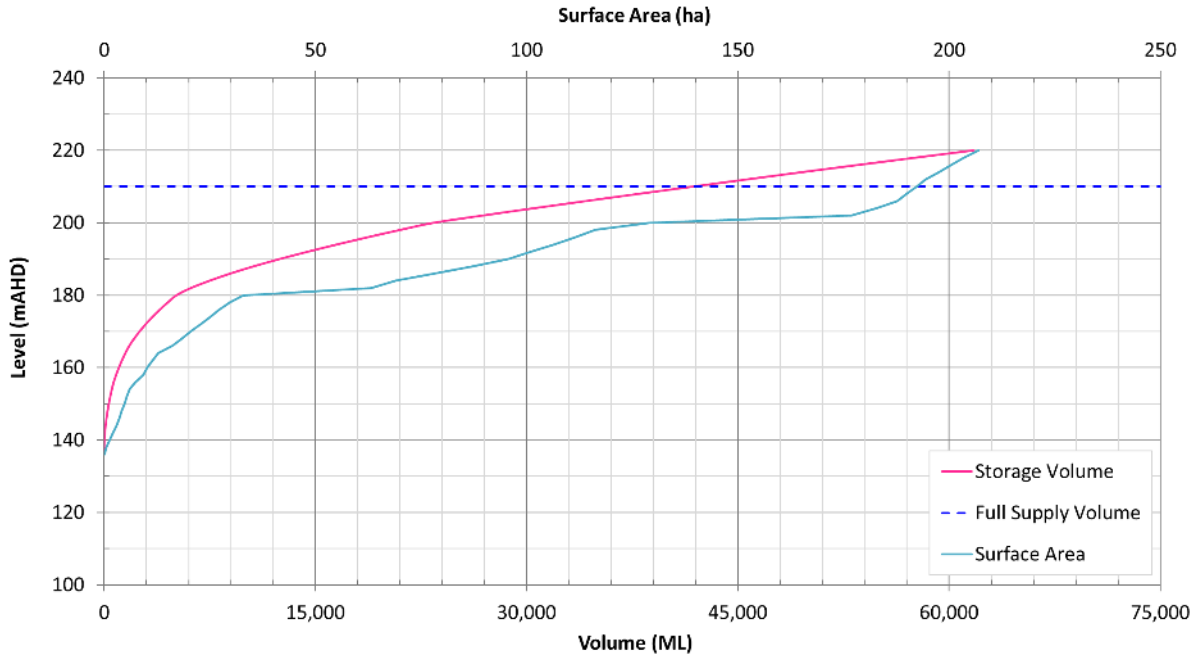

Figure 3.5 Titan North void stage-storage relationship

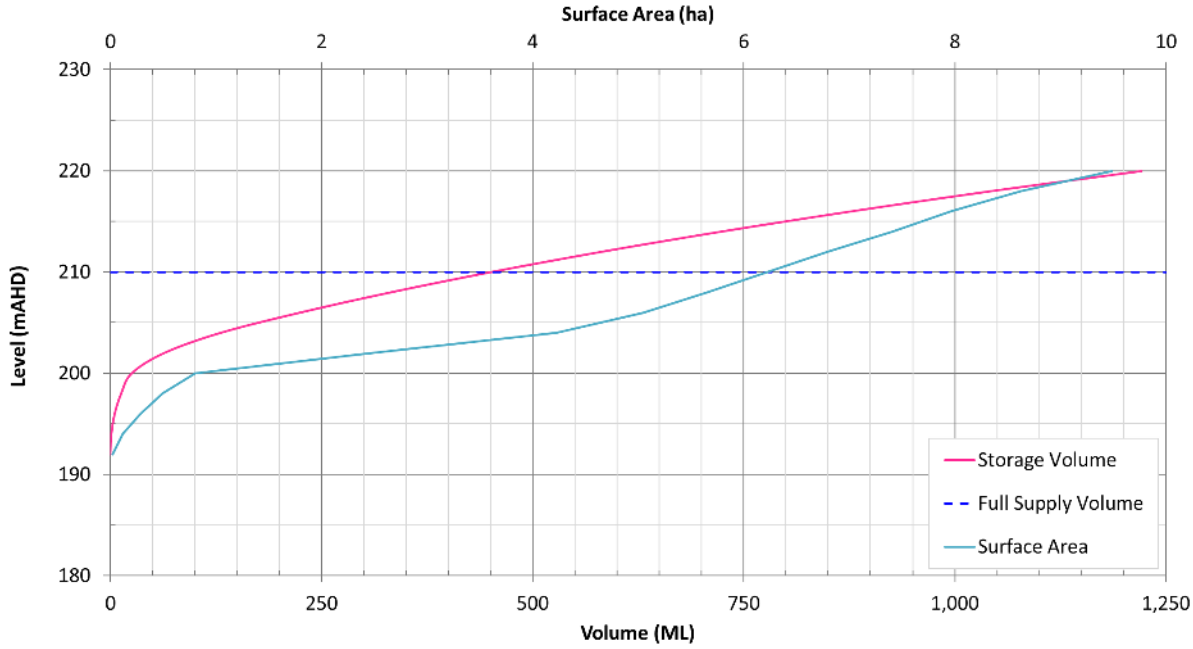

Figure 3.6 Titan Central void stage-storage relationship

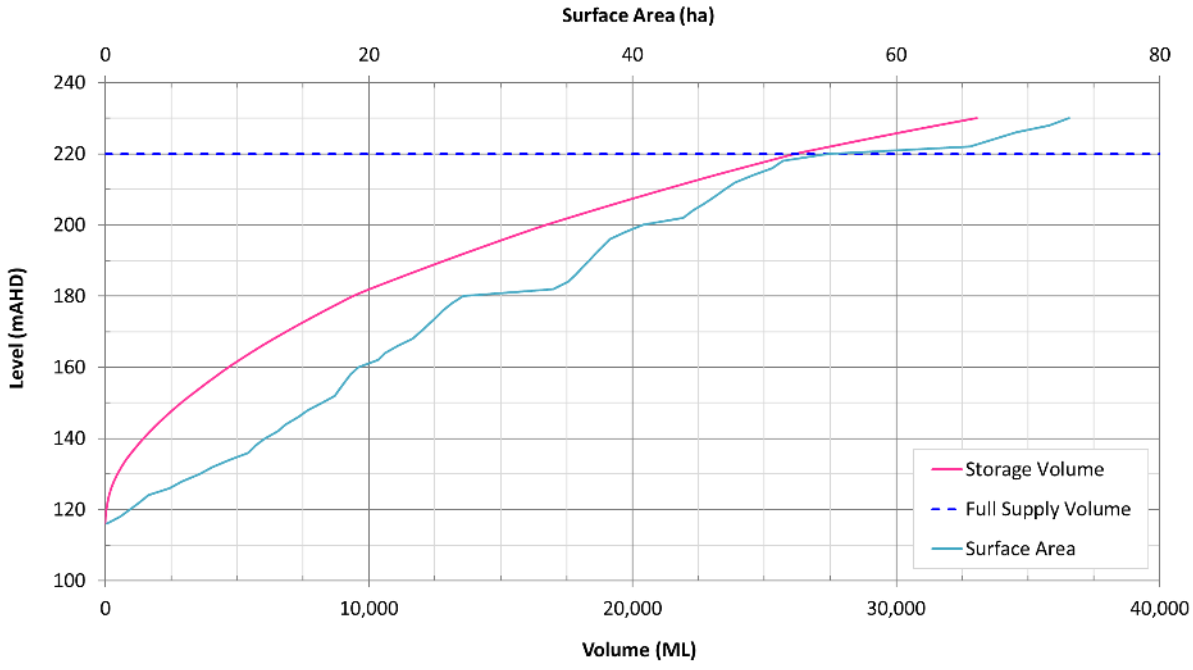

Figure 3.7 Titan East void stage-storage relationship

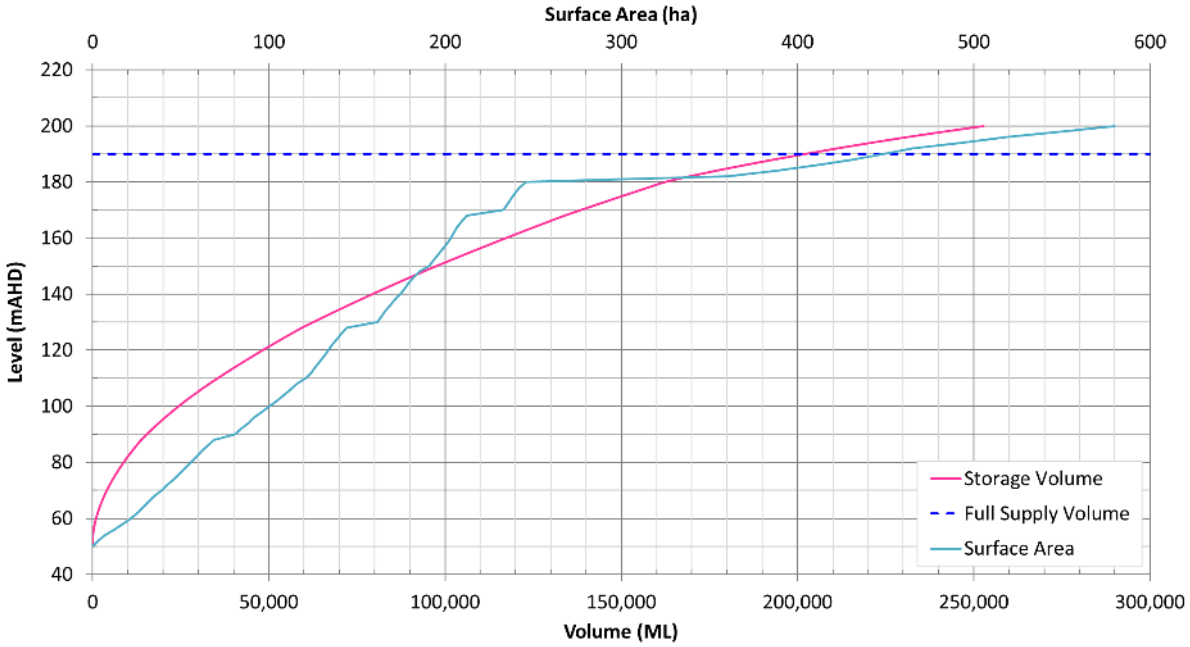

Figure 3.8 Pandora void stage-storage relationship

3.5.2 Initial void levels

The initial void lake level for the proposed voids is provided in Table 3.2 and was selected based on a reasonable level at mine closure.

The spill elevation of each void was also determined by analysing the final void landforms. Refer to Table 3.2, which displays the void spill elevations and initial void lake levels.

Table 3.2 Initial void lake levels and spill levels for each void

Type	Titan North	Titan Central	Titan East	Pandora
Initial void lake level (mAHD)	139	193.1	118.5	70.35
Spill level (mAHD)	210	210	220	190
Water storage capacity at FSL (ML)	41,810	450	26,200	201,850

3.5.3 Climate change adjustments

Climate change adjusted rainfall and evaporation sequences were sourced from the Government SILO Consistent Climate Scenarios (CCS) project, which transformed historical climate data from the period of 1960 to 2024. The potential development scenario chosen was SSP2-4.5 for the IPCC (2007) assessment report AR5, with base case global warming sensitivity for the year 2050, which aligns with the closure of the DNM in 2045.

Climate data was selected according to relevant climate sensitivity and climate change model composites as follows:

- Climate warming sensitivity will be assumed to fall in the high category, and

- The representative future climate cluster was selected as HP, which represents a high level of global warming.

Climate projections are available in a daily time-series format for approximately 4,700 climate stations or for points on a 0.05-degree (approximately 5km) grid across Australia. The daily time-series sequence produced by the Q5 v.3 Quantile Matching method was selected.

Daily probabilistically rainfall and evaporation time series data was generated using the projected climatic sequences for precipitation and evaporation using the Stochastic Climate Library (SCL) software to produce 250 iterations of daily data sequences over 500 years (eWater).

The CCS monthly change factors, which scale the average values, are based on the above and given in Table 3.3.

Table 3.3 DNM CCS climate change factors

Month	Precipitation Change (%)	Evaporation Change (%)
January	-12.5	13.4
February	-9.9	11.3
March	1.1	11.5
April	-5.6	14.1
May	18.6	19.0
June	-17.6	19.3
July	-6.1	6.5
August	-9.9	16.5
September	24.2	18.2
October	-23.6	17.5
November	-17.3	16.3
December	-10.2	14.0
Annual	**-9.1**	**15.2**

3.5.4 Catchment areas and land use mapping

The catchment area delineation is based on the final void landform DEM provided by WHC. Contours were created, using the final landform DEM, to determine the drainage network in the catchment area of each void. QGIS software was used to subdivide the catchment area of each void based on the final landform DEM contours and categorise it based on the land use type; void or rehabilitated. WRM's sub-catchment area delineation is displayed in Figure 2.1 and summarised in Table 3.4.

Table 3.4 Void catchment areas and land use

Catchment Type	Titan North	Titan Central	Titan East	Pandora
Natural (ha)	0	0	0	0
Void (ha)	81.26	8.38	34.99	131.41
Rehabilitated (ha)	451.13	47.45	157.62	584.55
Total (ha)	532.39	55.83	192.61	715.35

3.5.5 Catchment runoff

The Australian Water Balance Model (AWBM) was used to calculate the surface water runoff due to rainfall. An AWBM is a catchment WBM that calculates losses from rainfall for flood hydrograph modelling and relates daily rainfall and evapotranspiration to runoff.

The projected evaporation, temperature and rainfall data were obtained from the SILO database, supplied by the Department of Energy and Climate (DEC), and applied to the AWBM to determine the WBM surface runoff inputs.

Table 3.5 displays the AWBM surface storage parameters, Table 3.6 shows the AWBM surface storage proportions and Table 3.7 shows the AWBM baseflow and channel parameters.

The AWBM contains three surface storages with small, medium and large capacities for each catchment area. The AWBM does not include high-intensity or short-duration events, as surface water runoff flows are calculated based on daily averages according to the model timestep (1 day). The AWBM storage capacities, proportions and parameters for each storage were adopted from Table 3.8 of the HydroBalance Daunia Mine Water Balance Report (2025).

Table 3.5 AWBM surface storage capacities

Landuse Area	Small (mm)	Medium (mm)	Large (mm)
Natural	30	180	250
Void	10	40	75
Spoil	20	120	180
Rehabilitated	20	110	170

Table 3.6 AWBM surface storage proportions

Landuse Area	Small (mm)	Medium (mm)	Large (mm)
Natural	0.134	0.433	0.433
Void	0.3	0.4	0.3
Spoil	0.134	0.433	0.433
Rehabilitated	0.134	0.433	0.433

Table 3.7 WBM baseflow and channel parameters of the proposed voids

Landuse Area	Baseflow index	Channel coefficient (1/day)	Baseflow coefficient (1/day)
Natural	0	0	0
Void	0	0	0
Spoil	0.35	0	0.7
Rehabilitated	0.8	0	0.7

3.5.6 Groundwater inflow

Groundwater inflow to the final voids will vary over time as the void water levels rise. Groundwater inflow data provided by SLR (2025) have been adopted for this assessment.

3.5.7 Spoil water storage and seepage

The model accounts for water stored within both open voids and spoil. Inflows comprise rainfall runoff and groundwater, and stored water is lost from the void storage through evaporation and seepage.

Rainfall recharge is included through groundwater inflow to spoil, and as AWBM baseflow from rainfall on spoil catchments, which is assumed to report directly to the void.

A 1x1 m resolution digital elevation model (DEM) of the void floor surface (total mined floor for DNM [historical + scheduled in the LOM]) was provided by WHC on 3 June 2025, referenced to the AGD84 Zone 55 datum.

The DEM was processed to remove internal depressions within the voids, allowing for the assessment of the spoil as a single in-spoil storage unit, within which open voids are located. A Stage Area Volume (SAV) relationship was developed, presented in Figure 3.9, and a specific yield of 20% was applied to represent the volume of water that can drain freely from the spoil material under gravity.

Seepage interactions between voids and spoil are represented to simulate seepage pathways and void level equalisation. Based on the mined floor surface, spoil seepage is expected to flow progressively from Titan East and Central, through Titan North and West, and ultimately report to the Pandora Void, which functions as an evaporative sink. This approach allows the model to represent the rate at which water levels equalise across the spoil and void storages.

The final void model applied the horizontal hydraulic conductivity (SLR, 2025) for spoil, which was calibrated to 2.48 m/day. This permeability value represents the rate at which water can move horizontally through the spoil material to the open voids.

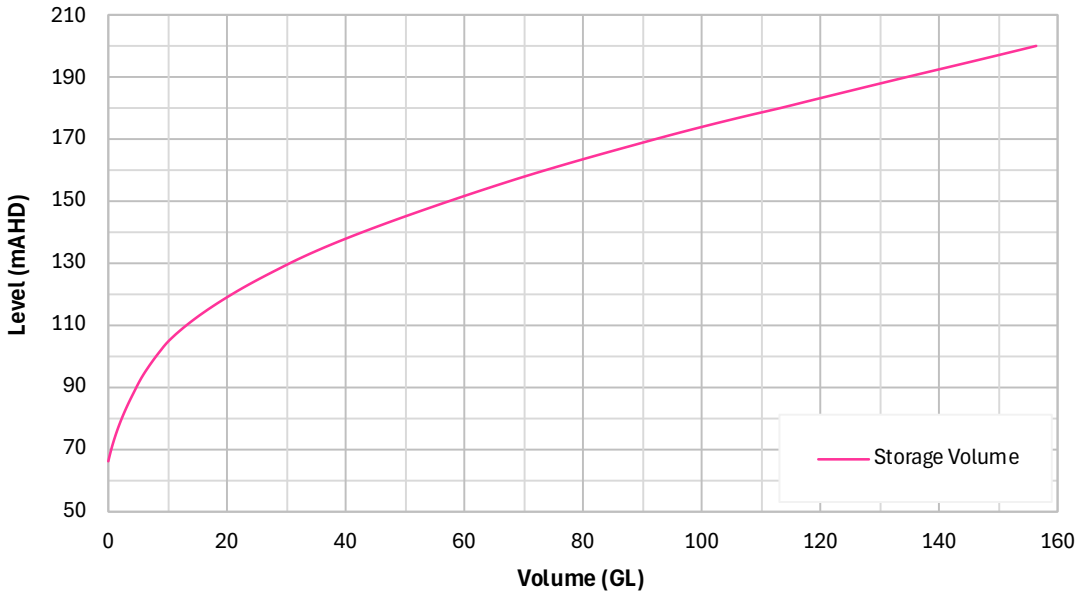

Figure 3.9 Spoil stage-storage relationship

3.5.8 Void water salinity

The representative Salinity for runoff from the various catchment types is primarily based on information from previous studies and by the Project groundwater consultant. The adopted TDS

values have been converted from EC values used in a prior water balance model and are shown in Table 3.8 (WSP, 2013).

Table 3.8 Adopted runoff salinity concentrations

Water source / land use	EC (µs/cm)	TDS (mg/L)
Groundwater	2,630	1,845
Natural/undisturbed	260	185
Rehab	400	280
Void	2,630	1,845

As the water from the void water surface evaporates, the salinity of the stored water increases, leading to reduced evaporation rates. According to Leaney and Christen (2000), the adjusted evaporation rate due to water salinity can be expressed using Equation 1:

$$\boldsymbol{FE}=\mathbf{1.025}-\mathbf{0.0246}\times \mathrm{e}\boldsymbol{xp}\mathbf{0.0087}\times \boldsymbol{Salinity}$$

Where F_E is the evaporation factor for adjusting freshwater evaporation according to salinity, which is expressed in g/L, evaporation will become negligible at a salinity concentration of around 430,000 mg/L. However, the equation is only relevant up to a void water salinity of up to about 300,000 mg/L, assuming sodium chloride is the dominant solute, and it precipitates at that concentration. The concentration is estimated considering that the void water column remains completely mixed applies conservation of mass to account for all salt transfers. The salt balance model assigns representative TDS values to runoff from catchments and sources of water.

4 FINAL VOID WATER BALANCE RESULTS

4.1 OVERVIEW

The water balance model (WBM) was run for 250 realisations and 500 years, from 2045 to 2545 using the historic climate data adjusted using the base climate change projection (SSP2-4.5). The results showed that the void water levels will eventually reach an approximate equilibrium below the regional groundwater table, acting as an evaporative sink, with all dissolved salts concentrating over time.

Table 4.1 gives the average void runoff, groundwater inflow and evaporation for the first 50 years of simulation (before equilibrium). Table 4.2 gives the flows in the last 450 years (at equilibrium). Most of the volume change occurs in the first 50 years and remains relatively consistent thereafter.

DNM final landform voids capture seepage originating from groundwater recharge into spoil emplacements surrounding open voids. Stored water within the northern voids (Titan North, Titan Central, and Titan East) typically seeps into the surrounding spoil material, which ultimately seeps toward the lower-lying Pandora void. Pandora void acts as a groundwater sink, collecting this seepage and losing water through evaporation.

Groundwater modelling confirms that lake levels within these voids will remain well below shallow aquifers, with sufficient freeboard to prevent external discharge. The regional groundwater levels in the vicinity of the DNM show a general northwest to southeast decline in elevation, with local drawdown in the immediate vicinity of active mine pit voids. Regional groundwater flow is predominantly towards the southeast, consistent with the direction of the Isaac River. Groundwater levels in the Permian coal measures range from approximately 191.5 mAHD in the northeast of DNM to approximately 170.5 mAHD in the south (SLR, 2025).

Table 4.1 Average void inflow and outflow for years 2045 to 2095 and 250 realisations

Void	Avg. Surface Water Runoff (ML/d)	Avg. GW Inflow (ML/d)	Avg. Seepage Inflow (ML/d)	Avg. Total Inflow (ML/d)	Avg. Evaporation (ML/d)	Avg. GW Outflow (ML/d)	Avg. Seepage Outflow (ML/d)	Avg. Total Outflow (ML/d)	Avg. Change in Water Volume (ML/d)
Titan North	1.16	0.00	0.00	**1.16**	0.12	0.00	1.03	**1.15**	**0.01**
Titan Central	0.12	0.00	0.00	**0.12**	0.01	0.00	0.11	**0.12**	**0.00**
Titan East	0.44	0.18	0.00	**0.61**	0.17	0.00	0.43	**0.60**	**0.01**
Pandora	2.31	0.83	1.53	**4.67**	3.87	0.00	0.00	**3.87**	**0.80**
Spoil	-	-	1.57	**1.57**	-	-	1.53	**1.53**	**0.05**
Total	4.02	1.01	3.10	**8.13**	4.17	0.00	3.10	**7.27**	**0.86**

Table 4.2 Average void inflow and outflow results for year 2095 to 2545 and 250 realisations

Void	Avg. Surface Water Runoff (ML/d)	Avg. GW Inflow (ML/d)	Avg. Seepage Inflow (ML/d)	Avg. Total Inflow (ML/d)	Avg. Evaporation (ML/d)	Avg. GW Outflow (ML/d)	Avg. Seepage Outflow (ML/d)	Avg. Total Outflow (ML/d)	Avg. Change in Water Volume (ML/d)
Titan North	1.17	0.00	0.00	**1.17**	0.14	0.00	1.03	**1.17**	**0.00**
Titan Central	0.12	0.00	0.00	**0.12**	0.01	0.00	0.11	**0.12**	**0.00**
Titan East	0.44	0.20	0.00	**0.64**	0.20	0.00	0.42	**0.62**	**0.02**
Pandora	2.58	1.03	1.55	**5.16**	5.05	0.00	0.00	**5.05**	**0.11**
Spoil	-	-	1.56	**1.56**	-	-	1.55	**1.55**	**0.01**
Total	4.31	1.23	3.11	**8.65**	5.40	0.00	3.11	**8.51**	**0.14**

4.2 VOID WATER LEVELS

4.2.1 Void water depths

Table 4.3 gives the maximum void water depths. Void water depths within the northern voids (Titan North, Titan Central, and Titan East) are relatively shallow and unlikely to exhibit stratification.

At a maximum water depth of about 38 m, Pandora Pit could potentially exhibit stratification driven by a combination of thermal, chemical, and hydraulic gradients. Due to limited vertical mixing and seasonal temperature variations, the water column may develop thermal layers. Warmer, less dense water tends to remain near the surface, while cooler, denser water settles at depth. This stratification can persist, especially in deeper sections of the pit, reducing oxygen transfer and influencing geochemical conditions.

Seepage from spoil emplacements often carries dissolved ions and particulates, which can accumulate in the lower layers of the pit. Over time, this leads to the formation of chemical gradients, with potentially higher concentrations of solutes at greater depths.

Table 4.3 Maximum void water depths (m)

Void	5%ile	25%ile	median	75%ile	95%ile
Titan North	3.8	6.0	8.4	11.2	16.5
Titan Central	0.7	1.4	2.3	3.3	5.0
Titan East	4.4	6.3	7.7	9.2	11.2
Pandora	32.8	35.8	38.2	40.8	43.4

4.2.2 Titan North Water Level

Figure 4.1 shows the average monthly water levels for Titan North, which remain stable at approximately 139.5 mAHD over the 500-year period. The maximum water level per the 95%ile is around 146.7 mAHD, and the minimum 5%ile water level is around 136.7 mAHD. The full supply level (FSL) of Titan North is 210 mAHD.

4.2.3 Titan Central Water Level

Figure 4.2 hows the average monthly water levels for Titan North, which remain stable at approximately 193.2 mAHD over the 500-year period. The maximum water level, per the 95%ile is around 195.2 mAHD, and the minimum 5%ile water level is around 192.2 mAHD. The FSL of Titan Central is 210.0 mAHD.

4.2.4 Titan East Water Level

Figure 4.3 displays the average monthly void lake levels of Titan East. The graph shows that the mean water level of Titan East slightly increases from approximately 118.5 mAHD in 2045 to approximately 120.4 mAHD in 2545. The maximum water level, as per the 95%ile is around 125.8 mAHD, and the minimum 5%ile water level is around 116.9 mAHD. The FSL of Titan East is 220.0 mAHD.

4.2.5 Pandora Water Level

Figure 4.4 shows the average monthly void lake levels of Pandora. The mean water level of Pandora increases from approximately 70.4 mAHD in 2045 to 91.9 mAHD in 2545. The maximum water level

as per the 95%ile is around 102.2 mAHD, and the minimum 5%ile water level is around 69.8 mAHD. The FSL of Pandora is at 190.0 mAHD.

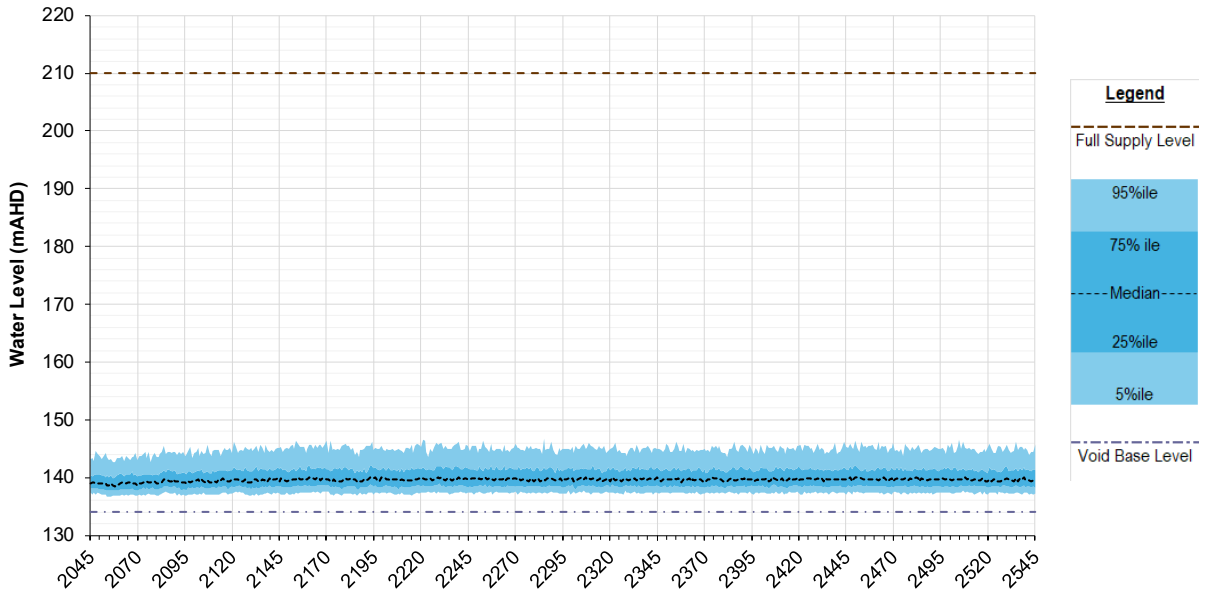

Figure 4.1 Titan North void water level

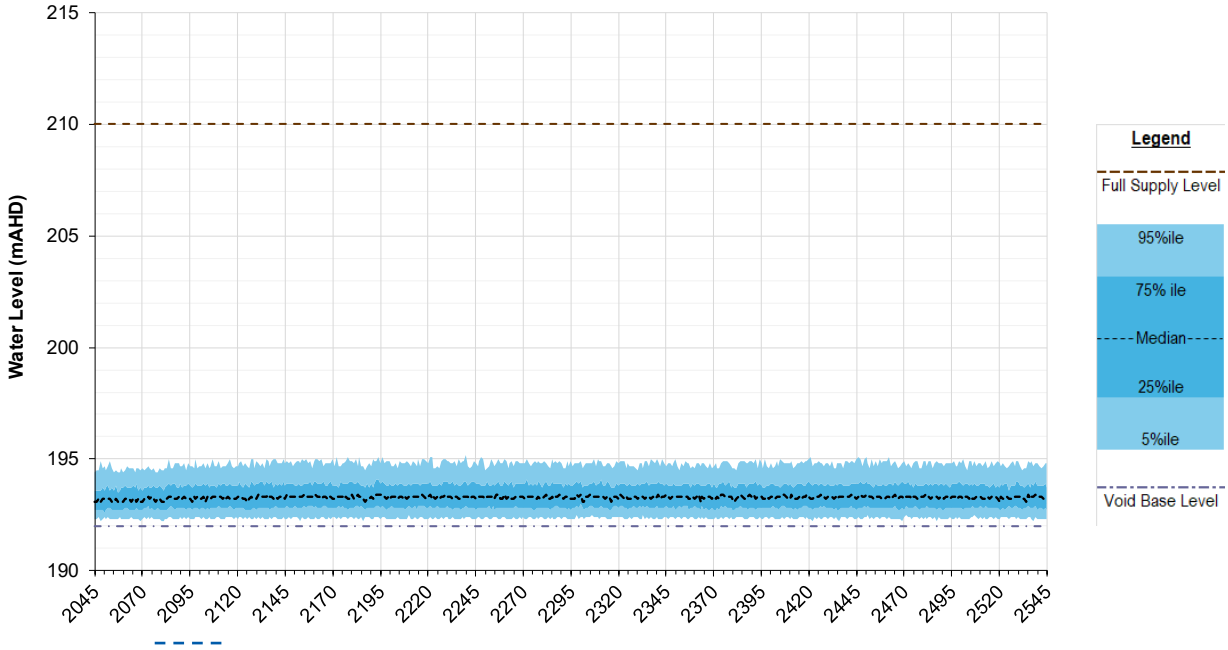

Figure 4.2 Titan Central void water level

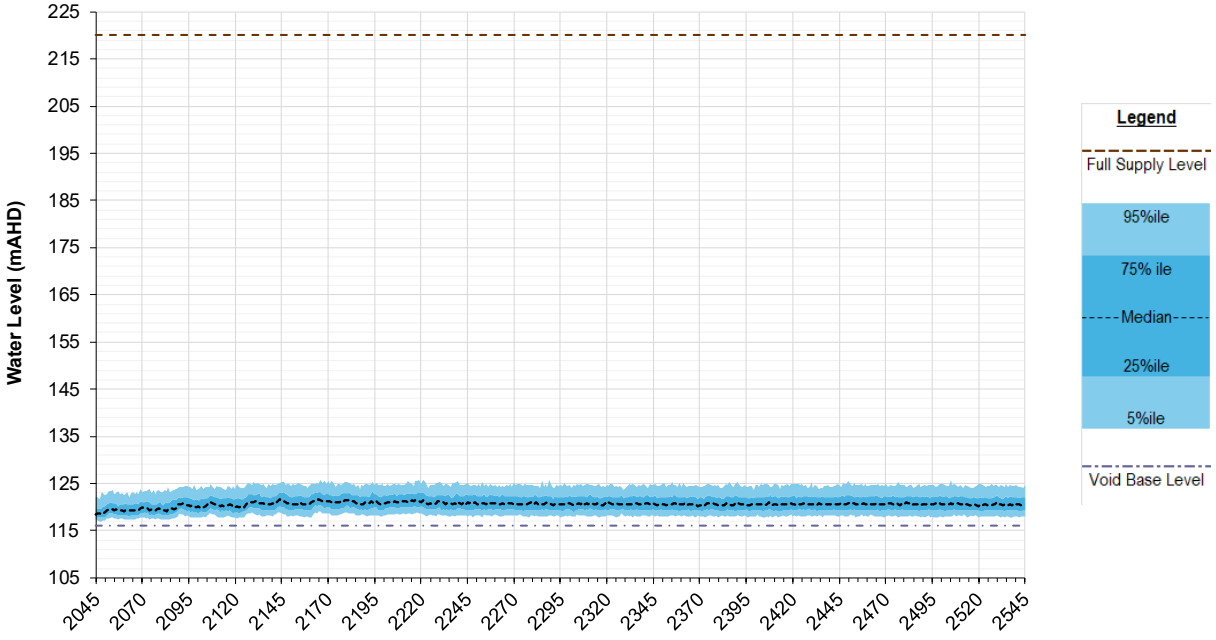

Figure 4.3 Titan East void water level

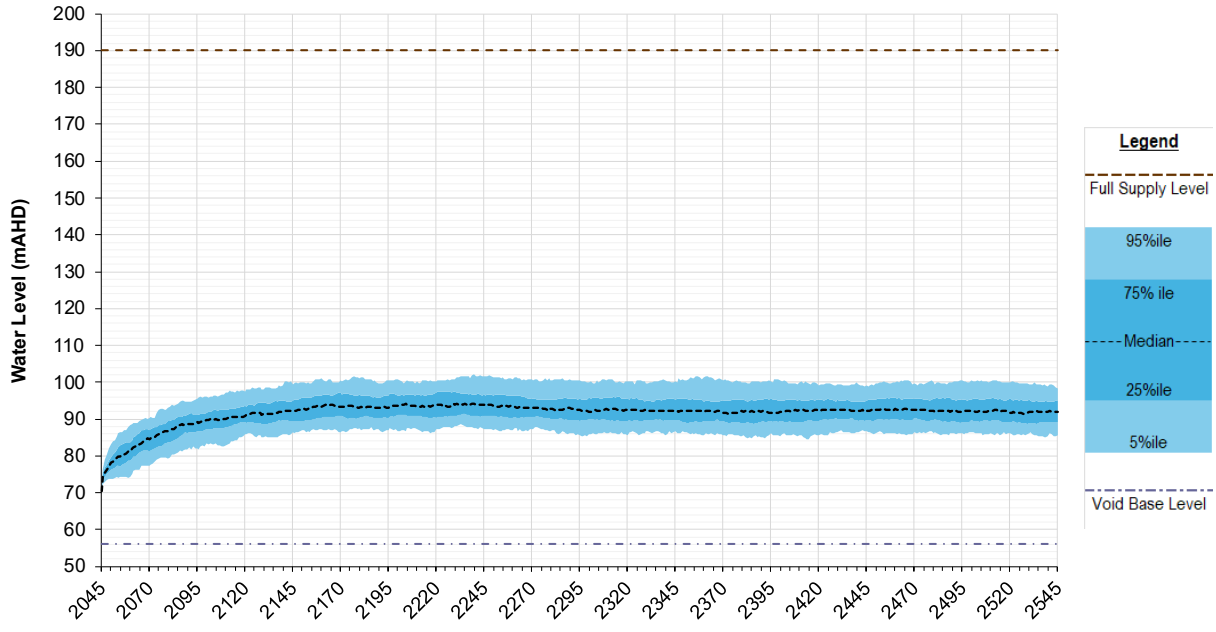

Figure 4.4 Pandora void water level

4.3 SALINITY

Given the relatively low salinity levels and flow-through behaviour, the northern voids may be suitable for agricultural activities, including stock watering.

Figure 4.5 and Figure 4.6 shows the mean salinity concentrations of each void from 2045 to 2545 for the northern voids (Titan North, Titan Central Titan East voids) and the Pandora void, respectively.

The following classifications are used to describe salinity levels:

- Freshwater: < 0.5 g/L — typical of rivers, lakes, and groundwater.
- Brackish Water: 0.5–10 g/L — found in estuaries and transitional zones.
- Moderately Hypersaline: 10–100 g/L — e.g., coastal evaporation ponds.
- Highly Hypersaline: >100 g/L — e.g., Dead Sea, Great Salt Lake.
- Extreme Hypersaline: >300 g/L — where salt may precipitate from solution.

By 2545, the mean solute concentrations in Titan North, Titan East, and Titan Central are projected to remain below the threshold for hypersaline conditions (greater than 10 g/L). The northern voids (Titan North, Titan Central, and Titan East) exhibit flow-through characteristics, with seepage migrating to the Pandora pit. As a result, salinity concentrations within these voids are generally consistent with the assumed concentrations of surface runoff. These salinity concentrations align with the water quality objective for stock watering, < 2 g/L (ANZECC, 2000), and may be suitable for agricultural activities.

By 2545, Pandora will have a mean salinity concentration of around 59 g/L and is projected to be moderately hypersaline with no future use possible.

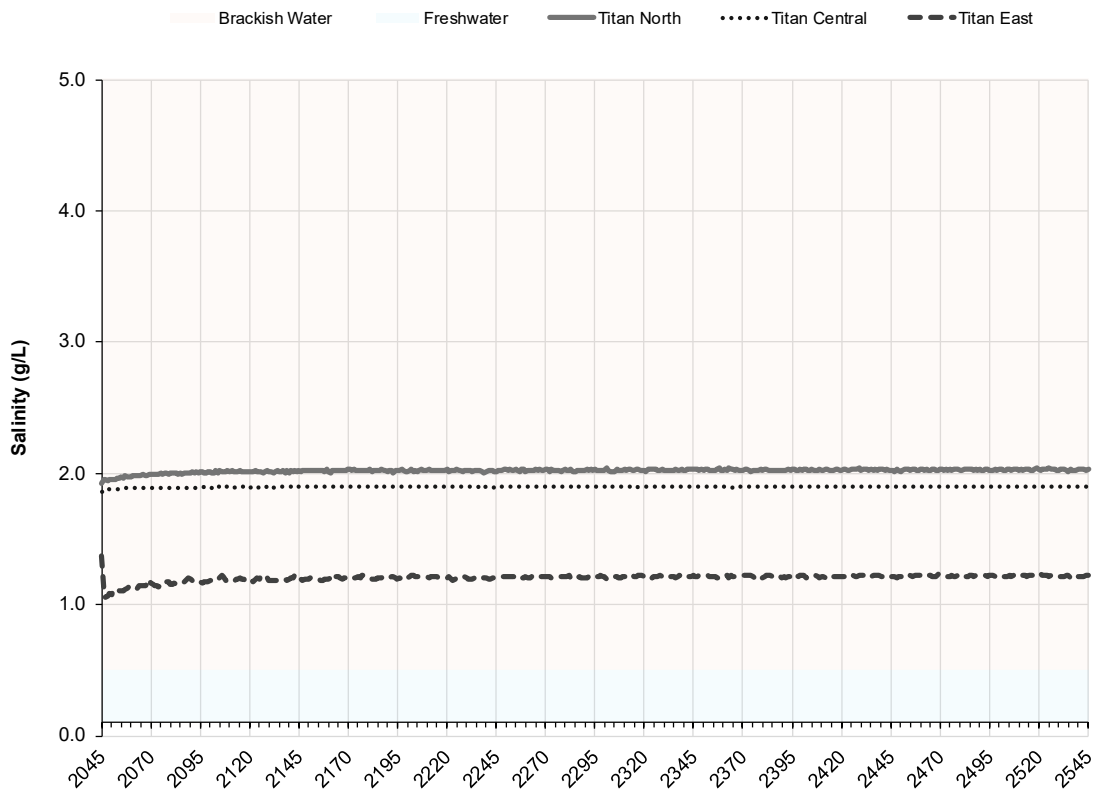

Figure 4.5 Void water salinity concentrations - Titan North, Titan Central and Titan East voids

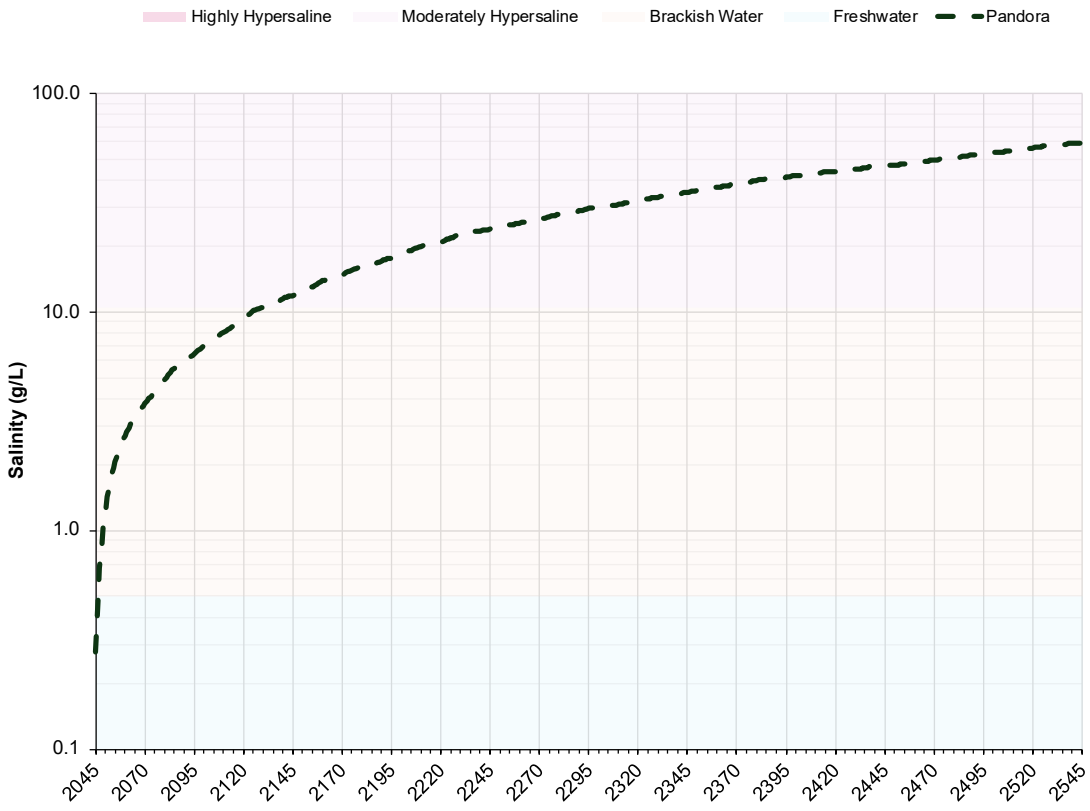

Figure 4.6 Void water salinity concentration - Pandora void

4.4 CLIMATE CHANGE SENSITIVITY ASSESSMENT

The climate change assessment evaluates the impact of different SSPs on the void water levels over a long-term period. The SSPs considered in this assessment are SSP1-2.6, SSP2-4.5 (base), and SSP5-8.5, representing varying degrees of climate change, from green and sustainable to high emission projections.

Figure 4.7 to Figure 4.10 shows the storage levels for the climate sensitivity analysis results for Titan North, Titan Central, Titan East and Pandora. Table 4.4 gives the final void water levels for the year 2545 for the following climate change scenarios: SSP1-2.6, SSP2-4.5, and SSP5-8.5. Table x shows the final void salinity concentrations for the year 2545 for the following climate change scenarios: SSP1-2.6, SSP2-4.5, and SSP5-8.5.

Key observations are as follows:

- Void water levels decrease as emissions increase (from SSP1-2.6 to SSP5-8.5), indicating that higher emissions may lead to reduced recharge or increased evaporation.
- Titan Central remains relatively stable across scenarios due to relatively elevated water levels large seepage gradients toward Pandora Void, with only a 0.2 mAHD difference between SSP1-2.6 and SSP5-8.5
- Pandora void water levels show the most significant adjustment (from 95.7 mAHD in SSP1-2.6 to 87.6 mAHD in SSP5-8.5).

- The Pandora void acts as a terminal catchment, receiving runoff and seepage from surrounding open voids. Consequently, changes in precipitation and evaporation due to climate change significantly influence the Pandora void water level.

Table 4.4 Climate change void water level sensitivity (year 2545)

Climate Change Scenario	Water Level (mAHD)			
	Titan North	Titan Central	Titan East	Pandora
SSP1-2.6	140.8	193.5	121.6	95.7
SSP2-4.5 (base)	140.1	193.3	120.8	92.0
SSP5-8.5	139.6	193.3	120.0	87.6

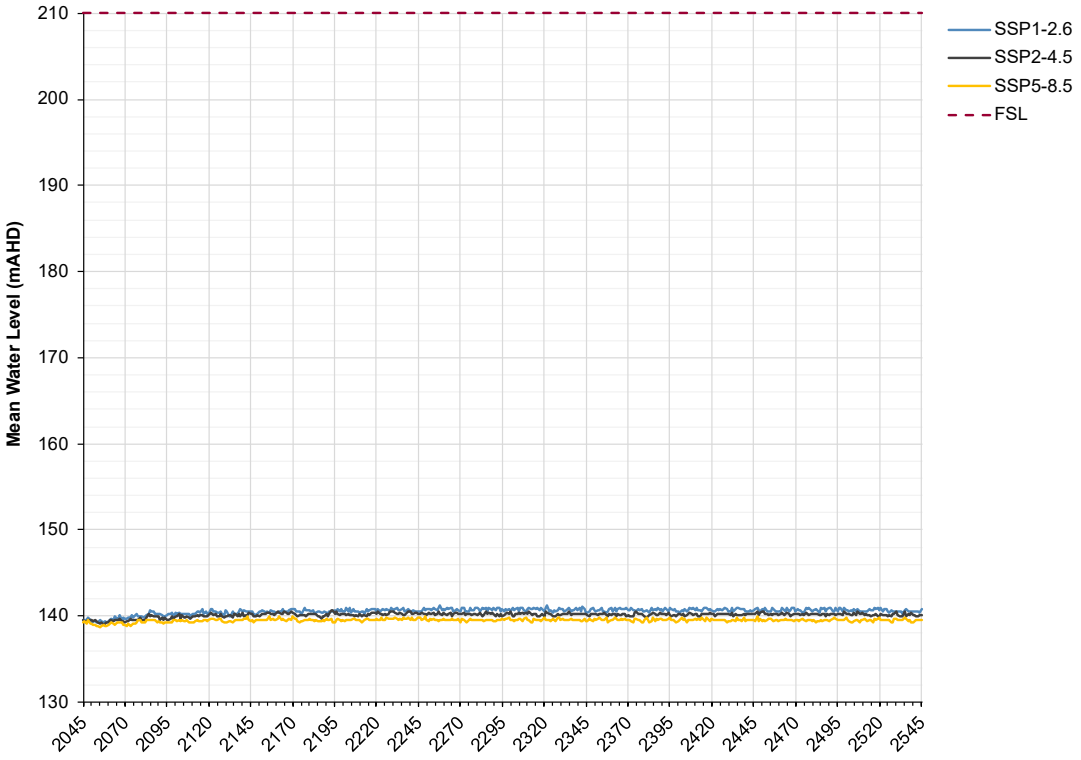

Figure 4.7 Titan North Climate sensitivity analysis

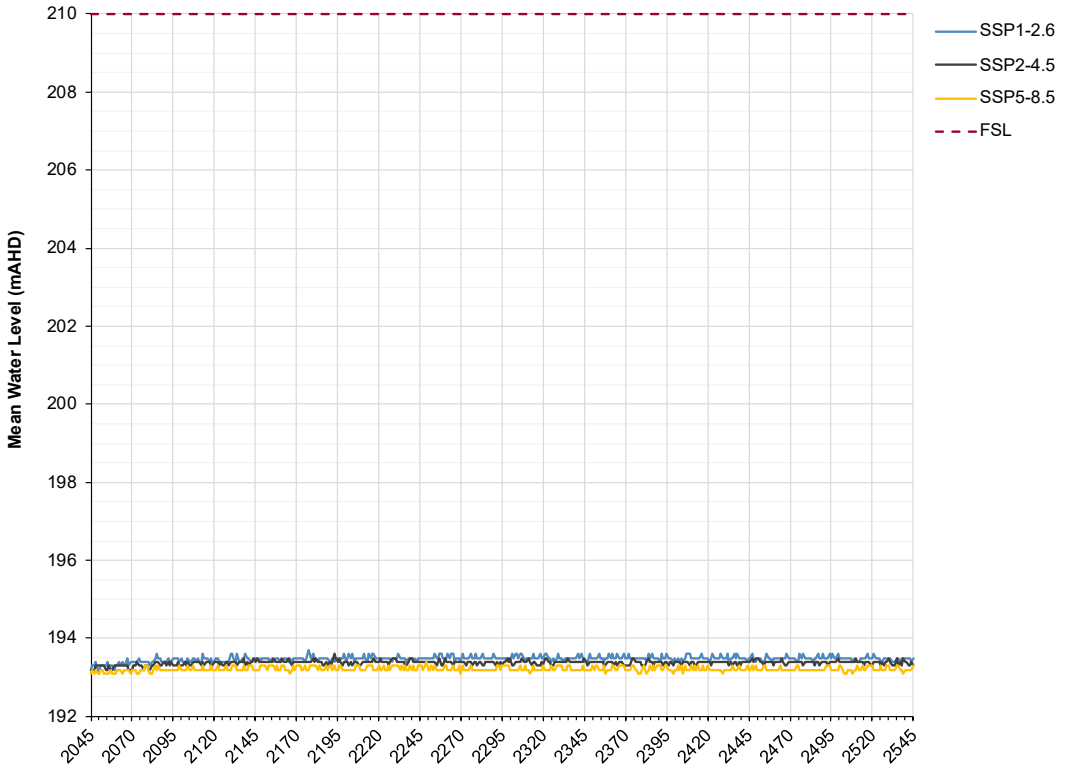

Figure 4.8 Titan Central Climate sensitivity analysis

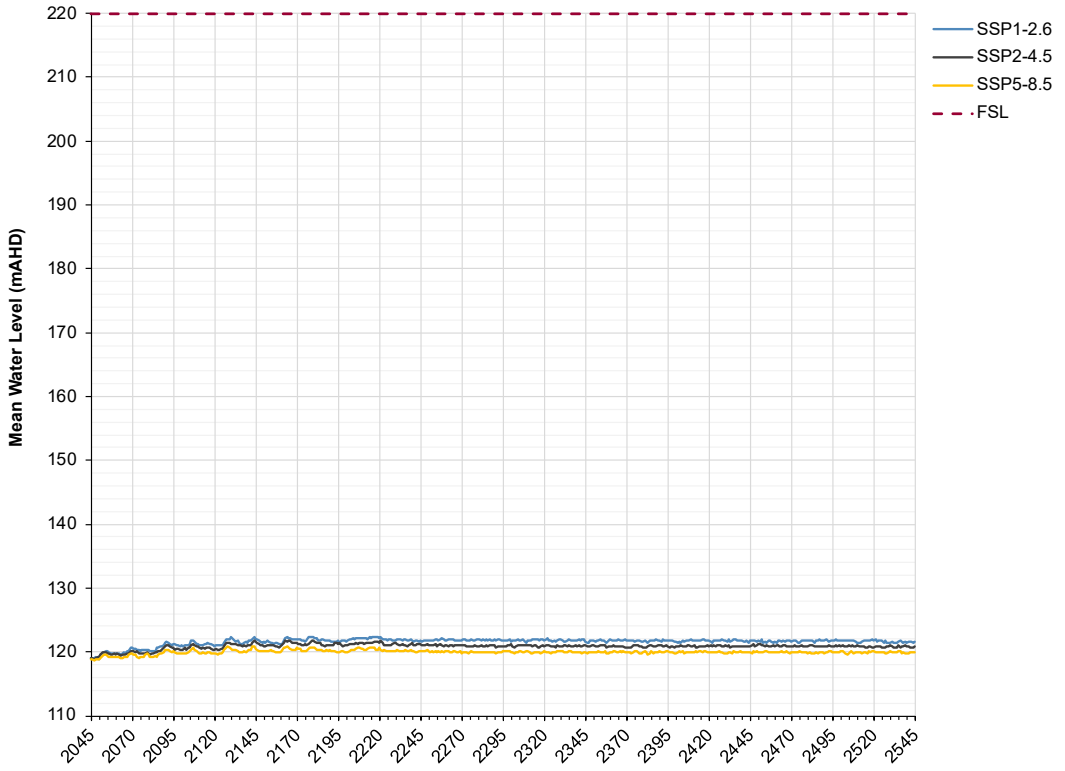

Figure 4.9 Titan East Climate sensitivity analysis

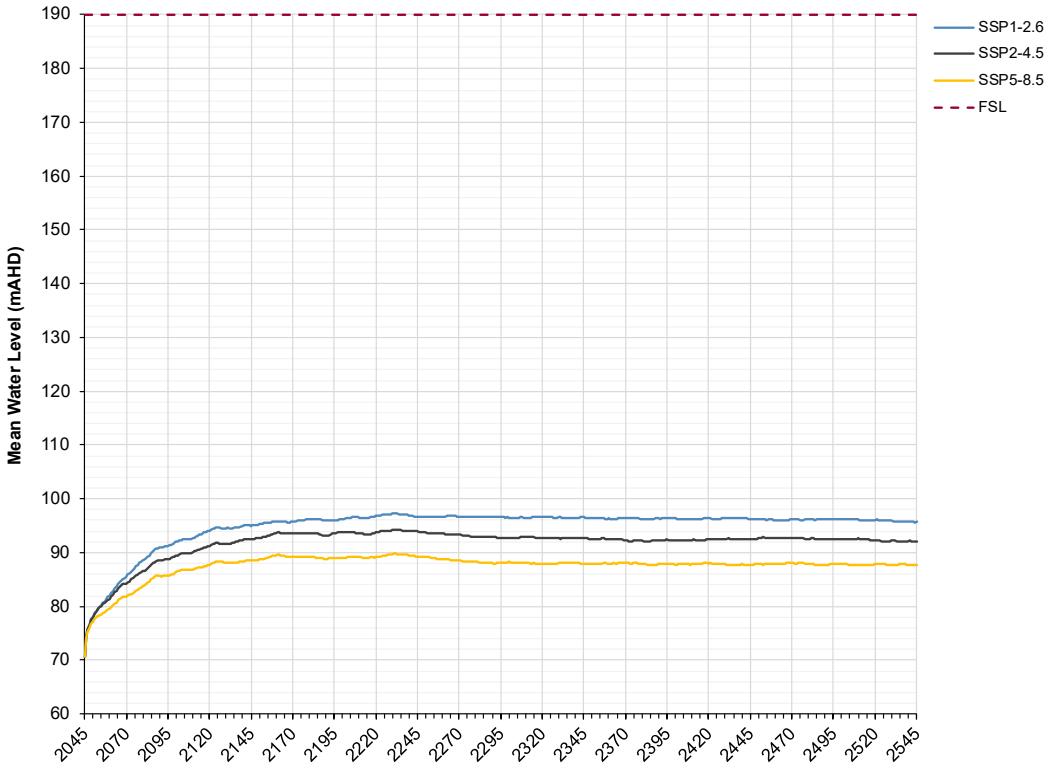

Figure 4.10 **Pandora Climate sensitivity analysis**

5 CONCLUSION

The DNM final void water balance results concludes that the open voids will reach equilibrium water levels over 500 years, acting as evaporative sinks with increasing salinity. Key findings include:

- Water Levels:
  - Titan North equilibrium water level is at about 139.5 mAHD.
  - Titan Central equilibrium water level is at about 193.2 mAHD.
  - Titan East equilibrium water level is at about 120.4 mAHD.
  - Pandora equilibrium water level is at about 91.9 mAHD.
- Salinity:
  - Titan North, Titan Central, and Titan East will all have mean salinity concentrations less than 10 g/L by 2545 and offer some opportunity for a future use.
  - Pandora will be moderately hypersaline with a mean salinity concentration of around 60 g/L by 2545.
- Climate Change Sensitivity: In the high-emission scenario (SSP5-8.5), water levels in the voids are lower than in the low-emission scenario (SSP1-2.6). Pandora shows the biggest change, with water levels dropping from 95.7 mAHD to 87.6 mAHD. This is because Pandora collects water from the open voids and spoil system through runoff and seepage as affected by adjustments in rainfall and evaporation caused by climate change.

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APPENDIX D FLOOD REPORT – APPROVED EA

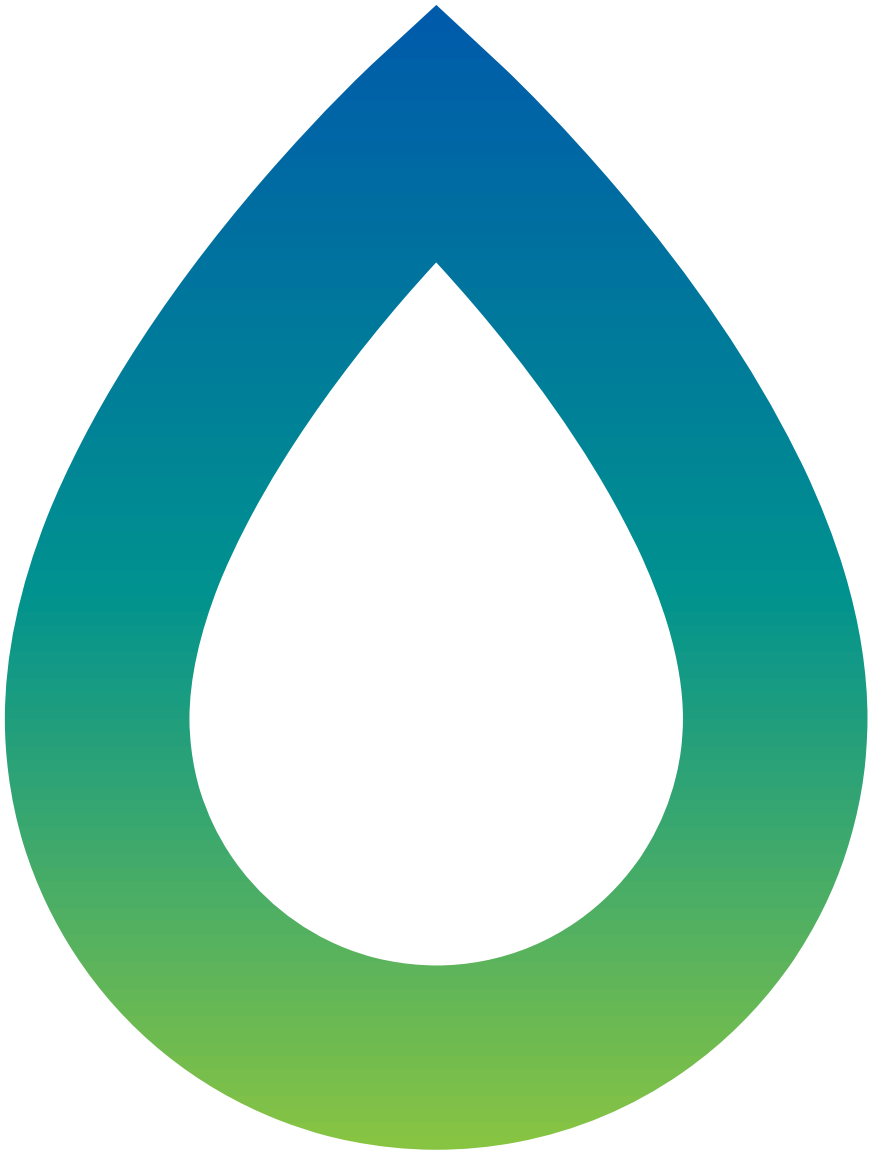
PRCP FLOOD MODELLING DAUNIA MINE

PRCP Flood Report

Whitehaven Coal Limited

19 June 2025

1583-04-C1



DETAILS

Report Title	PRCP Flood Modelling Daunia Mine, PRCP Flood Report
Client	Whitehaven Coal Limited

THIS REVISION

Report Number	1583-04-C1
Date	19 June 2025
Author	SG
Reviewer	DS

NOTE: This report has been prepared on the assumption that all information, data and reports provided to us by our client, on behalf of our client, or by third parties (e.g. government agencies) is complete and accurate and on the basis that such other assumptions we have identified (whether or not those assumptions have been identified in this advice) are correct. You must inform us if any of the assumptions are not complete or accurate. We retain ownership of all copyright in this report. Except where you obtain our prior written consent, this report may only be used by our client for the purpose for which it has been provided by us.

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1 INTRODUCTION

1.1 BACKGROUND

WRM Water & Environment Pty Ltd (WRM) previously undertook a flood study for Daunia Mine (DNM), located approximately 24 km east-southeast of Moranbah in the upper Isaac River catchment, in the Fitzroy River basin – see Figure 1.1. The study, completed in November 2019, involved hydrologic and hydraulic modelling of the Isaac River and nearby local catchments to define baseline flood behaviour at the site.

Following a change in ownership, Whitehaven Coal is now progressing updates to the mine's final landform as part of a revised Progressive Rehabilitation and Closure Plan (PRCP). WRM has been engaged to update the previous flood models and reporting to reflect current site conditions, modelling standards, and regulatory requirements.

DNM have asked WRM to update the previous (WRM, 2019) hydrologic and hydraulic modelling to:

- take advantage of updated and improved model versions;
- include updates to the Australian Rainfall and Runoff (ARR) guidelines on accounting for the effects of climate change;
- Update the Flood Frequency Analysis (FFA) to include the five (5) years of additional recorded data; and
- undertake a PRCP flood modelling assessment.

,

1.2 SCOPE OF WORKS

Key scope of works items include:

- Updated hydrologic modelling, including:
  - Converting the model from XP-RAFTS to URBS;
  - Re-calibrating the model;
  - Reconciling the model to an updated Flood Frequency Analysis (FFA) at the Deverill gauge; and
  - Applying updated ARR 2019 (version 4.2) (referred to as ARR2019 v4.2) climate change factors to estimate design hydrology for existing and post-mining conditions.
- Updated hydraulic modelling, including:
  - Updating the TUFLOW hydraulic model to the 2025.0.0 version;
  - Recalibrating the model;
  - Using hydrologic modelling design inflows to assess peak design flooding conditions for existing, pre-mining and post-mining conditions;
- Prepare a report documenting the methodology and findings of the assessment, suitable for submission in support of the DNM PRCP submission.

Note, for this assessment, the following hydrologic and hydraulic design scenarios are considered:

- Hydrology:
  - Validation – design hydrology suitable for validation against FFA, using design rainfalls and losses without any adjustments to account for climate change.

- Existing – present day design hydrology, based on the 'validation' hydrology and adjusted for climate change which has already occurred between the design data baseline period, and the present day.
- Post-mining – predicted future conditions design hydrology for the time period after the cessation of mining and establishment of the final landform, based on the 'validation' hydrology and adjusted for climate change which is predicted to occur between the design data baseline period and the planned post-mining period.

- Flooding (hydraulics):
  - Existing – present day conditions at DNM, using 'Existing' hydrology and current site topographic data;
  - Pre-mining – defining the floodplain for the PRCP, using 'Existing' hydrology and pre-mining topographic data at DNM (i.e., excluding any artificial features inside the mining tenure); and
  - Post-mining – proposed conditions after the cessation of mining and establishment of the final landform, using 'post mining' hydrology and the proposed final landform for DNM, as well as for any adjacent mining sites.

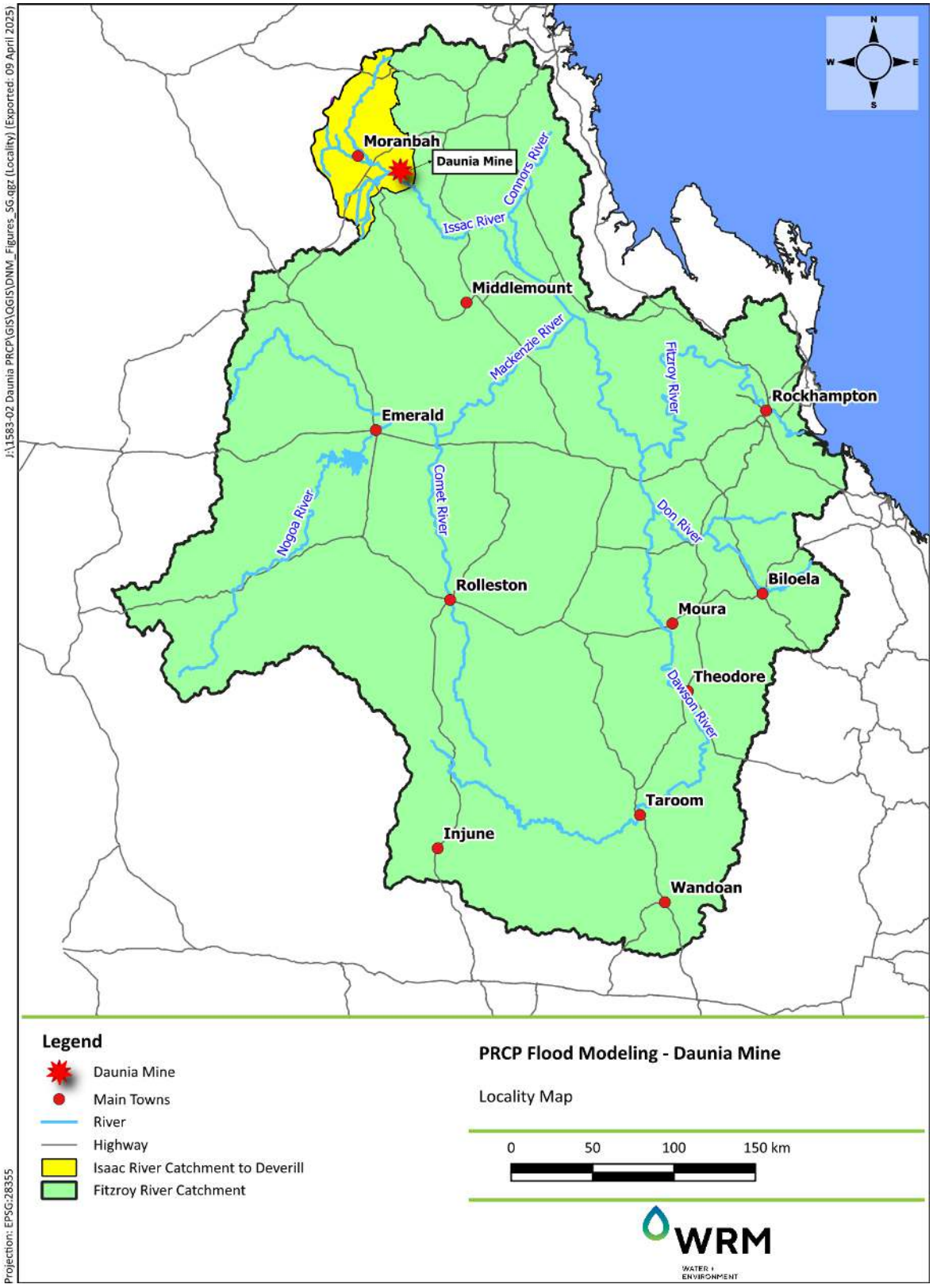

Figure 1.1 Locality plan with Fitzroy River catchment

2 EXISTING DRAINAGE

The following sections present an overview of the regional and local drainage in the vicinity of DNM, as well as a summary of the PRCP definitions relevant to the study.

2.1 REGIONAL DRAINAGE

DNM is located within the headwaters of the Isaac sub-catchment of the greater Fitzroy Basin. The Isaac River is the main watercourse in the vicinity of DNM and flows in a south-easterly direction to the south of DNM. Figure 2.1 presents the drainage characteristics of the Upper Isaac River to the Department of Natural Resources, Mining and Energy's (DNRME's) Deverill gauging station (GS130410A).

The catchment commences at the Denham Range located about 69 km to the north of DNM. The Isaac River flows in a southwesterly direction through the Carborough and Kerlong Ranges before turning in a southeasterly direction near the Goonyella Riverside Mine. The Isaac River eventually flows to the Mackenzie River some 160 km to the southeast of DNM.

The Isaac River is a seasonally flowing watercourse, typically with surface flows in the wetter months from November to April, reducing to shallow subsurface flows from about May to October. All other waterways in the vicinity of DNM are ephemeral and experience flow only after sustained or intense rainfall in the catchment. Stream flows are highly variable, with most channels drying out during winter to early spring when rainfall and runoff is historically low, although with some pools hold water for extended periods.

The catchment area of the Isaac River upstream of DNM is approximately 3,630 km^2 and comprises mainly scattered to medium dense bushland, grazing land and the township of Moranbah. There are several existing coal mines in the Isaac River catchment including Burton, North Goonyella, Grosvenor, Goonyella-Riverside, Broadmeadow, Broadlea, Isaac Plains, Carborough Downs, Caval Ridge, Poitrel, Daunia, Millennium and Moranbah North.

Three storages are located in the Isaac River upper catchment: Lake Elphinstone, Teviot Dam and Burton Gorge Dam. Lake Elphinstone is a natural lake formed behind the Carborough Range whereas Teviot Dam and Burton Gorge Dam are man-made structures that supply water to Burton and North Goonyella mines.

2.2 LOCAL DRAINAGE

Key local drainage features in the vicinity of DNM are shown in Figure 2.2 and include:

- Cherwell Creek
- North Creek; and
- New Chum Creek.

Cherwell Creek drains an area of about 698 km^2, to the west of DNM, and meets the Issac River about 6 km northwest (upstream) of DNM. According to Queensland Government mapping, North Creek at the confluence with the Isaac River is a fifth order watercourse.

North Creek drains an area of about 330 km^2, to the north and east of DNM. North Creek drains to the Isaac River, about 11 km southeast (downstream) of DNM. According to Queensland Government mapping, North Creek at the confluence with the Isaac River is a fourth order watercourse.

New Chum Creek, a tributary of the Isaac River, drains in a southerly direction to the west of DNM. New Chum Creek has a catchment area of approximately 48 km^2 to its confluence with the Isaac River. New Chum Creek traverses through multiple mining leases including Mavis Downs, Millennium East, Red Mountain and Poitrel. According to Queensland Government mapping, New Chum Creek at

the confluence with the Isaac River is a third order watercourse. Approximately 3.0 km of New Chum Creek between Poitrel and DNM (but within the Poitrel mining lease) has been replaced by a diversion channel. There are no permanent watercourse diversions within the DNM.

In addition to the watercourses discussed above, the Aurizon Goonyella rail line runs along the western boundary of the DNM mining lease and crosses the Isaac River immediately downstream of the Isaac River's confluence with New Chum Creek.

The QLD Government information sheet on *Voids in flood plains* (DES, 2024) provides guidance on the floodplain definition as applicable to the PRCP process. For the PRCP, the floodplain definition is based on:

- The 0.1% (1 in 1,000) annual exceedance probability (AEP) flood event, determined in accordance with ARR guidelines;
- Considering relevant watercourses only , where a relevant watercourse is classified as stream order 4 or higher under the Strahler stream order classification system; and
- Excluding any artificial features on the land subject to the PRCP.

For the purposes of this assessment, relevant watercourses include Cherwell Creek, North Creek and the Isaac River only.

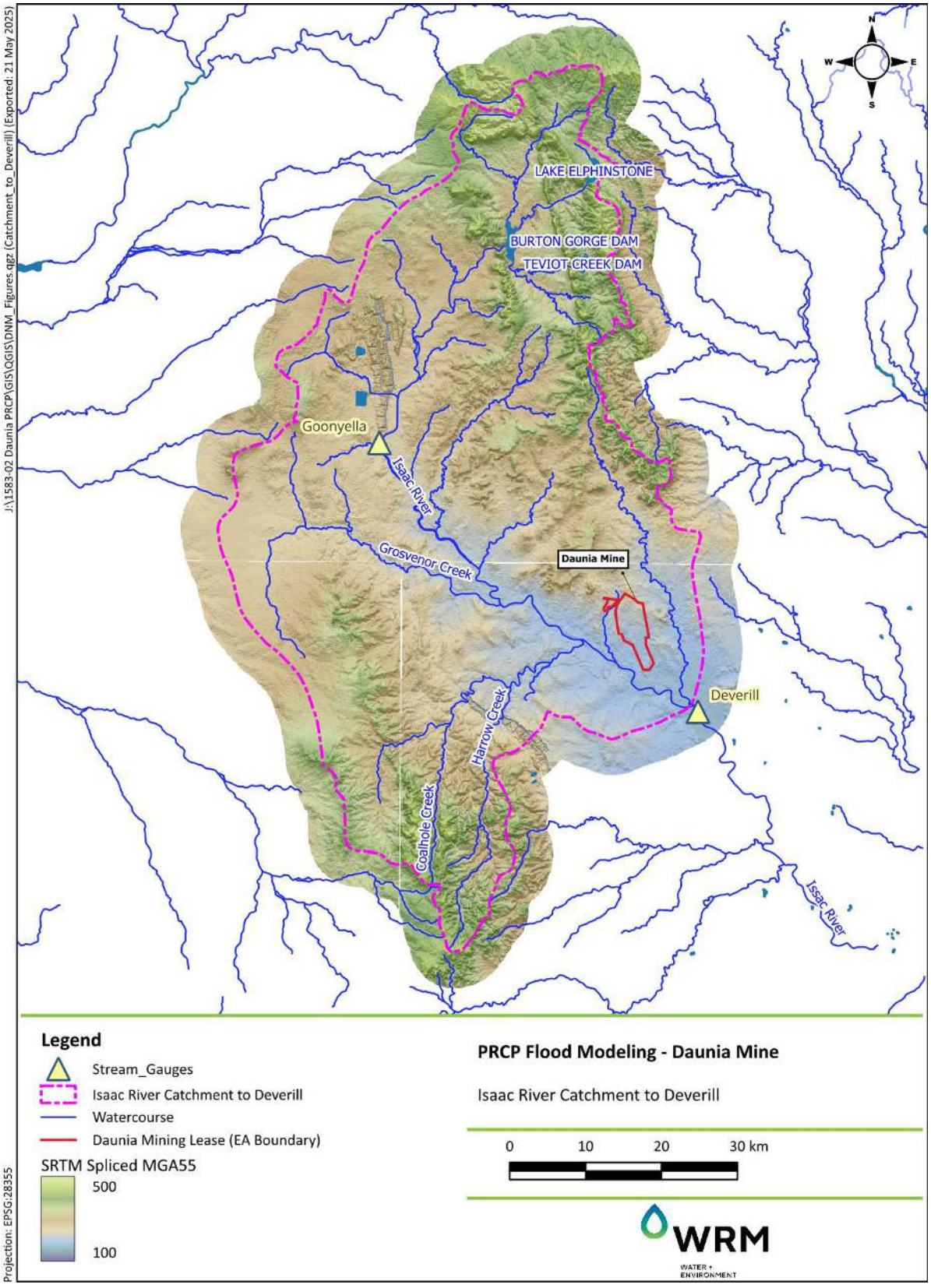

Figure 2.1 Regional drainage features

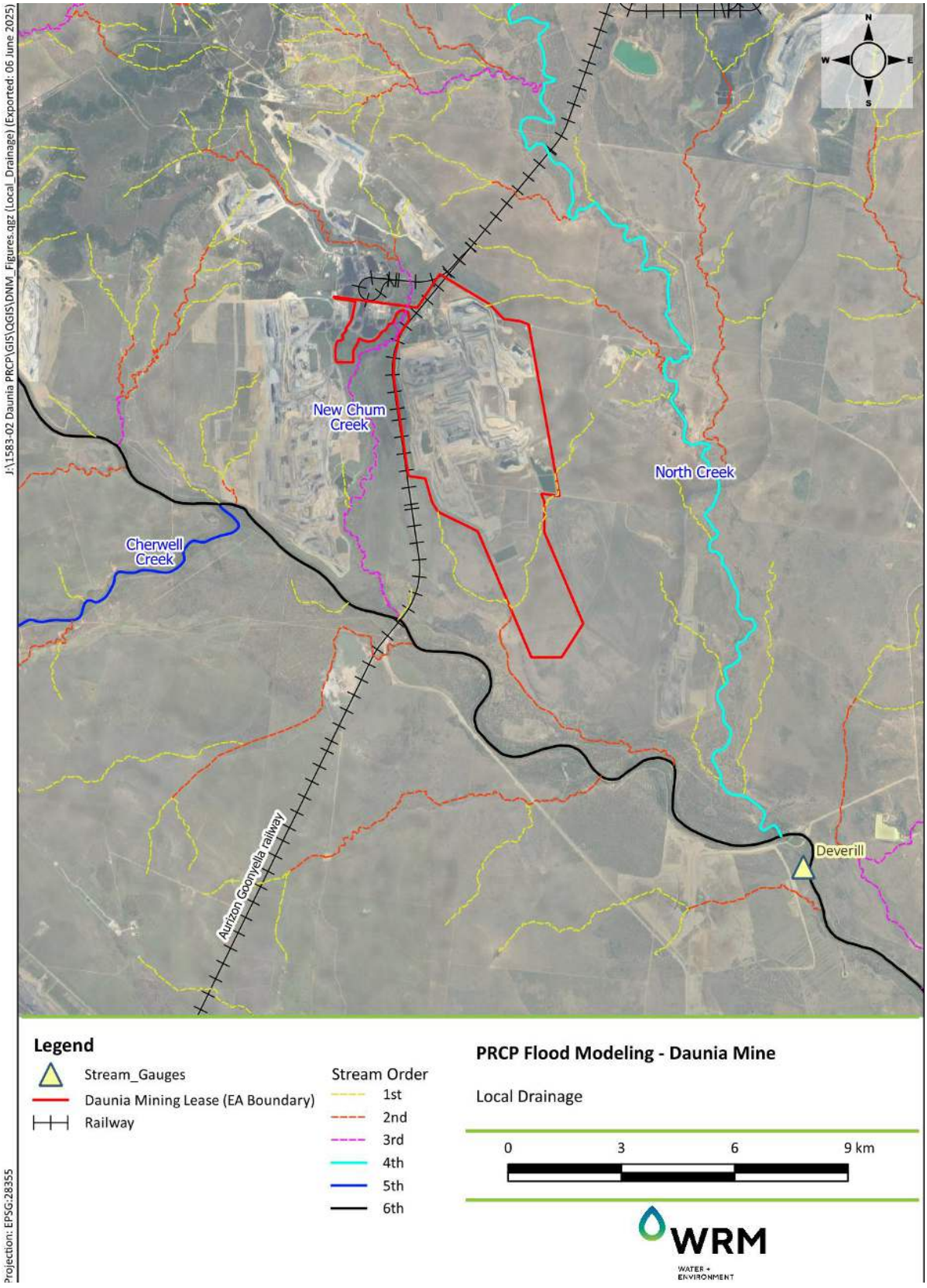

Figure 2.2 Local drainage features

3 HYDROLOGIC MODELLING

3.1 OVERVIEW

Previous modelling of the Isaac River (WRM, 2019) was done using the XP-RAFTS software package, which is no longer actively developed or supported. Consequently, the Isaac River hydrologic model was updated and converted to the widely used URBS rainfall-runoff routing software package (Carroll, 2024).

URBS is a runoff-routing computer program 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. Adopted rainfall losses are subtracted from the total rainfall hyetograph to obtain rainfall excess. The rainfall excess is then routed through conceptual catchment storage to determine the local runoff hydrograph for each sub-catchment of the model before being added to the creek or river channel. Routing through the creek or river system uses the non-linear Muskingum method, whose lag time is assumed proportional to the stream length.

URBS allows the user to select from several standard loss models. The initial and continuing loss model was adopted for the catchment. This model assumes that there is an initial loss (IL) in mm before any rainfall becomes runoff. After this, a continuing loss (CL) rate in mm per hour is applied to the rainfall. Full details of the URBS model and its features are given in the URBS User Manual (Carroll, 2021).

URBS models have three principal routing parameters:

- channel routing – alpha;
- catchment routing – beta; and
- non-linearity parameter - m.

3.2 METHODOLOGY

The Isaac River URBS model was updated in accordance with the current ARR2019 guidelines (Ball et al., 2019). Similar to the previous XP-RAFTS model, the URBS model was calibrated against recorded stream flows within the Isaac River catchment for historical floods in 2008, 2010 and 2017.

The FFA for the Isaac River at Deverill gauge (130410A) was updated to include the five years of additional data (2020 to 2024, inclusive) recorded since the previous study, (WRM, 2019). The FFA was revised using the latest version of FLIKE (Version 5.0.306.0) and the updated results compared with those from the previous study to assess any changes.

Three different hydrology scenarios were developed to represent different conditions:

- Validation hydrology: The calibrated URBS model was reconciled with FFA results for the range of Isaac River design flood events from 10% AEP to 1% AEP, without any consideration of climate change. Design event Initial Loss (IL) and Continuing Loss (CL) values were adjusted to reconcile the peak URBS design discharge estimates with FFA estimates of peak design discharge.
- Existing conditions' hydrology: The calibrated, FFA reconciled URBS model was updated with ARR2019 climate change factors (Ball et al., 2019) for design losses and design rainfalls and used to produce existing conditions design event discharge hydrographs as inflows to the hydraulic model of the study area for the 0.1% AEP and PMF events.
- Post mining conditions' hydrology: Similar to existing conditions, the calibrated, FFA reconciled URBS model was updated with relevant ARR2019 climate change factors (Ball et al., 2019) to

produce post-mining conditions design event discharge hydrographs for 0.1% AEP and PMF events.

Details of the adopted climate change scenarios and representative time horizons are discussed in Section 3.4.

3.3 FLOOD FREQUENCY ANALYSIS

The FFA from the previous study (WRM, 2019) was updated include additional recorded flow data available since the completion that study (years 2020 to 2024).

The FFA was carried out using annual peak discharges recorded at the Deverill gauge. Annual peak discharges were determined based on the water year, from October to September. FLIKE software (BMT, 2022) was used fit the data to a Log Pearson III (LP3) distribution using the Bayesian inference methodology recommended in the current ARR2019 guidelines (Ball et al., 2019).

3.3.1 Rating curve review

The WRM study (WRM, 2019) determined that the DNRME rating curve provided for the Deverill gauge was not representative of the range of flow conditions at the gauge, especially larger (out of bank flows). An updated rating curve was derived, based on hydraulic modelling for the study.

Figure 3.1 shows the historical gaugings, the provided DNRME rating curve, and the revised rating curve derived from TUFLOW modelling results for the WRM study, (WRM, 2019).

The WRM rating curve, (WRM, 2019), has been adopted for this study.

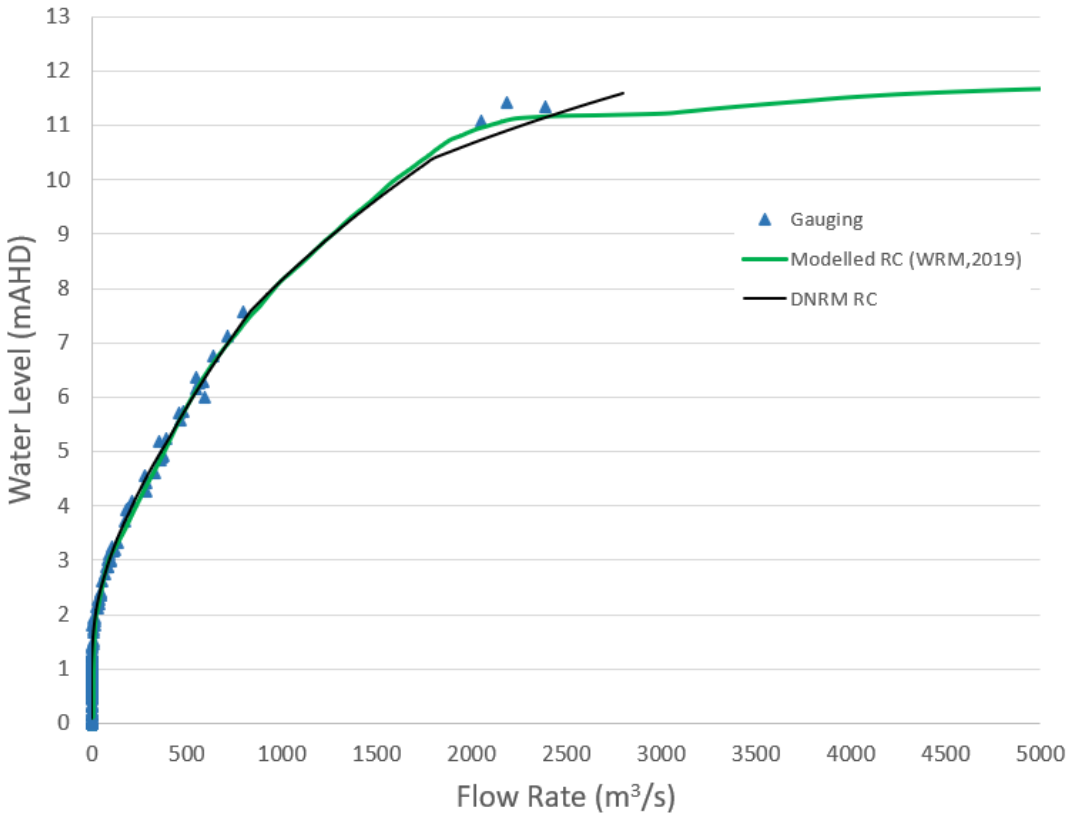

Figure 3.1 Comparison of DNRME, modelled rating curves (WRM,2019) and historical gaugings at Deverill

Table 3.1 shows the adopted annual maximum discharge series for the Deverill gauge, from 1968 to 2024, adopted for the FFA. Annual maxima from 1968 to 2019 were adopted from the WRM study, (WRM, 2019), while annual maxima from 2020 to 2024 were derived from recorded data, using the revised rating curve.

Table 3.1 Annual maximum discharges at Isaac River at Deverill stream gauge

Year (Oct-Sep)	Peak flow (m^3/s)	Year (Oct-Sep)	Peak flow (m^3/s)	Year (Oct-Sep)	Peak flow (m^3/s)
1968/69	3	1987/88	2,638	2006/07	401
1969/70	511	1988/89	2,137	2007/08	2,142
1970/71	102	1989/90	235	2008/09	466
1971/72	188	1990/91	2,429	2009/10	501
1972/73	233	1991/92	110	2010/11	1,827
1973/74	1,261	1992/93	1	2011/12	1,121
1974/75	424	1993/94	753	2012/13	263
1975/76	533	1994/95	30	2013/14	1
1976/77	156	1995/96	236	2014/15	205
1977/78	1,703	1996/97	1,198	2015/16	1,791
1978/79	2,113	1997/98	1,706	2016/17	1,625
1979/80	179	1998/99	581	2017/18	25
1980/81	608	1999/00	144	2018/19	30
1981/82	83	2000/01	638	2019/20	30
1982/83	1,124	2001/02	68	2020/21	56
1983/84	307	2002/03	195	2021/22	610
1984/85	137	2003/04	350	2022/23	214
1985/86	142	2004/05	20	2023/24	353
1986/87	184	2005/06	308		

3.3.2 Updated FFA

Table 3.2 and Figure 3.2 compare the updated FFA results, with WRM FFA results, (WRM, 2019). The FFA results show:

- The additional years of data had annual maxima between 56 m^3/s (2020/21 water year) and 610 m^3/s (the 2021/22 water year);
- These values are (at/below) the recoded median annual maxima, and tended to reduce the FFA estimates for smaller AEP (larger magnitude) events;
- Estimated peak 10% AEP peak discharges are reduced only slightly (-3%), while 1% AEP peak discharges are reduced by -13%.

Table 3.2 Comparison of FFA design discharges

	Peak discharge (m^3/s)		
Design event	**Updated FFA**	**Previous Study (WRM,2019)**	**Difference (%)**
10% AEP (10 Year ARI)	1,826	1,880	-3
5% AEP (20 Year ARI)	2,551	2,699	-6
1% AEP (100 Year ARI)	4,207	4,750	-13

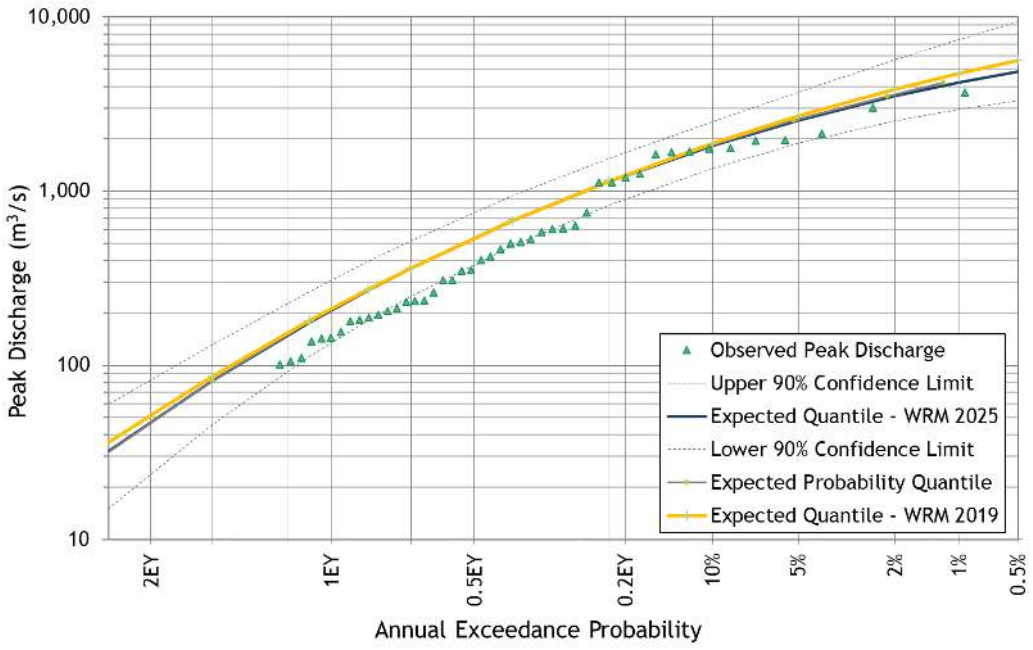

Figure 3.2 Isaac River at Deverill FFA, updated and previous (WRM, 2019) results

3.4 CLIMATE CHANGE CONSIDERATIONS

3.4.1 Overview

ARR2019 guidelines (Ball et al., 2019) contain updated guidance on consideration of the effects of climate change on estimates of design hydrology. Key climate change considerations include:

- Design rainfall data provided by BoM is centred on a period from 1960 to 1990. Since that time, global average temperatures have risen by a little over 1 degree C.
- Increasing global average temperatures impact on design rainfall depths, with warming conditions increasing the atmosphere's capacity to carry moisture and thus increasing rainfalls. These

increases extend up to and include estimates of the Probable Maximum Precipitation (PMP) depths (which were previously assumed to be unaffected by warming).

- Increasing global average temperatures lead to drying antecedent conditions and thus to increasing initial and continuing losses.
- It is possible that increasing global average temperatures are impacting on spatial and temporal patterns of rainfall distribution, but there is currently insufficient evidence on which to recommend changes to guidelines on these.
- Consequenly, the current design rainfall data must be adjusted to account for warming that has already occurred, in estimating existing conditions (present day) design discharges, as well as for estimating predicted future climatic conditions.

Figure 3.3 (reproduced from ARR2019), shows the latest IPCC temperature projections based on Shared Socioeconomic Pathways (SSPs). The best estimate for the mid-point of the current design rainfall data are shaded in grey. The SSPs shown are projections warming scenarios referred to as low (SSP1), medium (SSP2), high (SSP3) and very high (SSP5) emissions pathways.

Further details of the projected impacts of increased global average temperatures on temperature and losses, as well as the basis for the guidance, are provided in ARR2019 Book 1 (Ball et al., 2019).

For this study, the following climate change scenarios were adopted:

- Existing conditions (present day) hydrology:
  - SSP5-8.5;
  - Year 2030 time horizon;
  - +1.3 degrees of warming;
- Post-mining conditions hydrology:
  - SSP2-4.5;
  - Year 2100 time horizon;
  - +2.5 degrees of warming.

Uplift factors for rainfall and losses were obtained for each scenario from the ARR Datahub portal (Geoscience Australia, 2024).

Note, given the significant overlap between the FFA data period and the rainfall data baseline period (see Figure 3.3), no rainfall or loss factors were applied to hydrologic modelling for validation against FFA results (the ‘validation’ hydrology conditions).

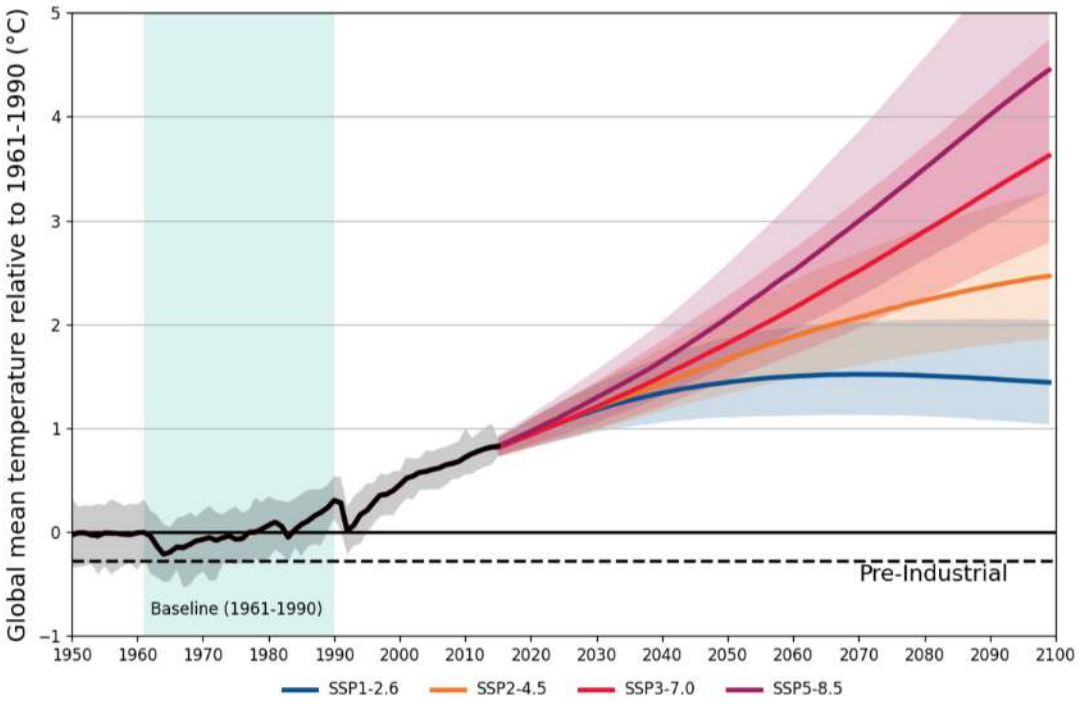

Figure 3.3 Projected temperature increases associated with AR6 socioeconomic pathways relative to 1961-1990 (shaded vertically in grey) and their associated uncertainty.

3.4.2 Rainfall depth adjustment

Table 3.3 shows the adopted rainfall depth uplift factors adopted for the study. Note, in accordance with the updated ARR2019 guidance (Ball et al., 2019), rainfall uplift factors were applied to all design rainfalls, up to and including the PMP. Note, previous WRM modelling (WRM, 2019), showed that critical durations for the design event AEPs of interest were longer than 24 hours, so factors for shorter durations are not shown here.

Table 3.3 Adopted rainfall depth uplift factors

		Duration > 24 Hours		
Scenario	**Time horizon**	**SSP**	**Projected change in temperature (C)**	**Rainfall depth uplift factor**
Existing Conditions	2030	SSP5-8.5	+1.3	1.11
Post-mining Conditions	2100	SSP2-4.5	+2.5	1.41

3.4.3 Loss parameters

Table 3.4 shows the adopted initial and continuing loss uplift factors adopted for the study. Note, in accordance with the updated ARR2019 guidance (Ball et al., 2019), loss uplift factors were applied to all design rainfalls, up to and including the PMP.

Table 3.4 Adopted initial and continuing loss uplift factors

Scenario	Time horizon	SSP	IL uplift factor	CL uplift factor
Existing Conditions	2030	SSP5-8.5	1.03	1.05
Post-mining Conditions	2100	SSP2-4.5	1.05	1.1

3.4.4 Temporal and spatial patterns

The updated ARR2019 (Ball et al., 2019), does not alter the existing guidance regarding consideration of temporal and spatial distribution of rainfall. The selection of areal reduction factors, and selection of design storm temporal patterns is discussed in following sections.

3.5 URBS MODEL DEVELOPMENT

3.5.1 Spatial configuration

The catchment configuration used in the URBS model is consistent with the configuration from the WRM (2019) XP-RAFTS model. As shown in Figure 3.4 , the model covers the Isaac River catchment upstream of the Deverill stream gauge and includes 93 sub-catchments, ranging in size from 1.9 km² to 204 km². Note, mining areas (including DNM) were not excluded from model sub-catchments, even though mining operations tend to reduce catchment areas and capture of runoff.

Minor adjustments were made to sub-catchment delineation., and sub-catchment naming was updated to meet URBS naming requirements. Table 3.5 shows the URBS model sub-catchment areas, matched against the WRM (2019) XP-RAFTS sub-catchment IDs.

Table 3.5 Isaac River URBS model sub-catchments

XPRAFTS ID	URBS ID	Area(km²)	XPRAFTS ID	URBS ID	Area(km²)	XPRAFTS ID	URBS ID	Area(km²)	XPRAFTS ID	URBS ID	Area (km²)
CC1	2001	49.4	CC23	20023	23.7	IR2	1002	122.7	IR26	10026	10.7
CC2	2002	63	CG1	3001	8.8	IR3	1003	24.3	IR27	10027	18.2
CC3	2003	45.3	CG1a	31001	4.2	IR4	1004	54.2	IR28	10028	24
CC4	2004	13.3	CG1b	32001	1.9	IR5	1005	30.9	IR29	10029	15.1
CC5	2005	43.2	CG2	3002	17.1	IR6	1006	48	IR30	10030	44.3
CC6	2006	21.5	CG3	3003	12.6	IR7	1007	41.1	IR31	10031	21.2
CC7	2007	78.2	CG4	3004	7.9	IR8	1008	102.9	IR32	10032	24.7
CC8	2008	55.3	CG4a	31004	2.5	IR9	1009	110.8	IR33a	110033	20.8
CC9	2009	13.2	CG4b	32004	6.3	IR10	10010	57.8	IR33b	120033	15
CC10	20010	14.1	CG5	3005	9.7	IR11	10011	110.1	IR33c	130033	11.6
CC11	20011	50.9	GC1	4001	78.5	IR12	10012	114.4	IR34	10034	50
CC12	20012	56.9	GC2	4002	109.5	IR13	10013	184	IR35	10035	128.6
CC13	20013	9.1	GC3	4003	104.4	IR14	10014	56.7	NC1	5001	15.2
CC14	20014	29	GC4	4004	112.9	IR15	10015	166.8	NC2	5002	20.9
CC15	20015	39.5	GC5	4005	77.8	IR16	10016	204.3	NC3	5003	37.6

XPRAF TS ID	URBS ID	Area(km²)	XPRAF TS ID	URBS ID	Area(km²)	XPRAF TS ID	URBS ID	Area(km²)	XPRAF TS ID	URBS ID	Area (km²)
CC16	20016	9.1	GC6	4006	72	IR17	10017	126.5	NC4	5004	57.8
CC17	20017	14.8	GC7	4007	80	IR18	10018	19.4	NC5	5005	93.3
CC18	20018	7.4	GC8	4008	37.5	IR19	10019	7.8	NC6	5006	52.3
CC19	20019	5.4	GC9	4009	22.1	IR20	10020	34.1	NC7	5007	29.4
CC20	20020	14	GC10	40010	6.7	IR21	10021	23	NC8	5008	24.9
CC21	20021	11.1	GC11	40011	3	IR22	10022	17.3	Teviot	600	40.5
CC22	20022	8.3	GC12	40012	21.5	IR23	10023	7.1			
CC22a	210022	15.5	GC13	40013	25.6	IR24	10024	36.4			
CC22b	220022	7.1	IR1	1001	82.7	IR25	10025	25.1			

3.5.2 Model parameters

Key URBS model sub-catchment parameters were determined from the available topographic and aerial imagery data, including area, degree of urbanisation and percentage imperviousness. Global urbanization (0) and percentage imperviousness (10%) values were adopted.

URBs model loss and routing parameters were determined through the calibration process.

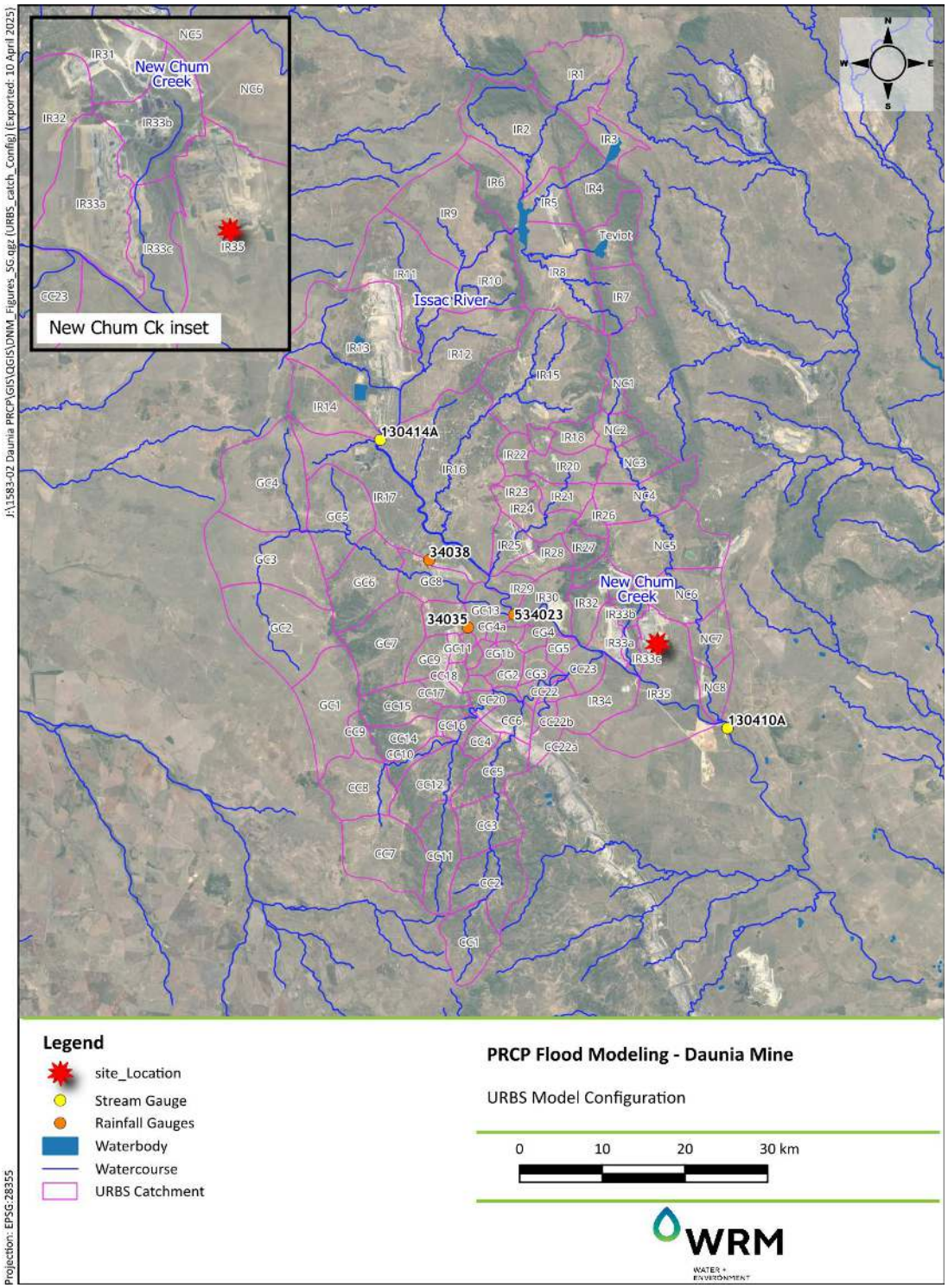

Figure 3.4 URBS Model Sub-catchments for the Isaac River to Deverill

3.6 URBS MODEL CALIBRATION

3.6.1 Overview

Similar to the previous study's XPRAFTS model, (WRM, 2019), the URBS model was calibrated to discharge hydrographs derived from water level data recorded at the Deverill and Goonyella stream flow stations for three flood events (2008, 2010 and 2017). The primary objective of the model calibration process was to determine a representative set of URBS model parameters (*alpha, beta, m*) providing the best possible fit between predicted and recorded discharge hydrographs at key stream gauge locations in the Isaac River catchment, for a range of historical flood events.

The quality of the calibration fit was assessed based on how well the predicted discharge hydrograph matched the timing and magnitude of flood peaks, as well as how well the overall shape of the hydrograph was matched.

3.6.2 Available data

To calibrate the model in this study, the same data used in the previous study (WRM, 2019) was applied. This included rainfall data from both public stations and private sources via data sharing agreements. The available rainfall and streamflow calibration data is shown in Table 3.6

Table 3.7 shows the recorded total rainfall depths and peak discharges for each of the calibration events.

Table 3.6 Available rainfall and streamflow data

Station ID	Station name	Data type	Data frequency	Source	Calibration event		
					Feb-08	Dec-10	Mar-17
130410A	Isaac River at Deverill	Rainfall	Sub-daily	DNRME	✓	✓	✓
		Discharge	Sub-daily		✓	✓	✓
130414A	Isaac River at Goonyella	Discharge	Sub-daily	DNRME	✓	✓	✓
534023	Isaac River Bridge	Rainfall	Sub-daily	BOM	✓	✓	-
34038	Moranbah WTP	Rainfall	Sub-daily	BOM	✓	✓	-
34035	Moranbah Airport	Rainfall	Sub-daily	BOM	-	-	✓

Table 3.7 Calibration event details

Flood event	Start date	Event duration	Recorded peak discharge (m^3/s)		Total event rainfall (mm)	
		(days)	Goonyella	Deverill	Goonyella	Deverill
February 2008	09/02/2008	9	1,070	2,142	n/a	567
December 2010	18/01/2010	15	910	1,827	n/a	518
March 2017	27/03/2017	7	199	1,614	n/a	168

3.6.3 Calibration results

The calibration of the URBS model was achieved by adjusting the URBS parameters (*alpha, beta, m*), initial and continuing rainfall losses to obtain the best fit between recorded and predicted discharge hydrographs.

The adopted calibration event losses and URBS parameters for the three events are shown in Table 3.8 The variation of initial and continuing loss values for the calibration events reflects the differing antecedent catchment conditions during each event, as well as the selection of simulation start time, which may not be the same as the commencement of the flood producing storm burst.

Table 3.9 compares recorded and predicted peak discharges in the Isaac River at the Goonyella and Deverill gauging stations. A discussion of the calibration results is given below.

Table 3.8 Adopted URBS parameters and initial and continuing loss rates, calibration events

Flood event	IL (mm)	CL (mm)	α	β	m
February 2008	20	4	0.2	3	0.8
December 2010	9	3	0.2	3	0.8
March 2017	50	2.7	0.2	3	0.8

Table 3.9 Comparison of recorded and URBS modelled peak flood discharges, Isaac River at Goonyella and Deverill gauging stations

Calibration event	Peak discharge at Goonyella (m^3/s)		Difference	Peak discharge at Deverill (m^3/s)		Difference
	Recorded	Modelled		Recorded	Modelled	
February 2008	1,070	1,212	11.7%	2,142	2,153	0.5%
December 2010	910	947	4%	1,827	1,895	3.5%
March 2017	199	216	7.8%	1,624	1,595	-1.1%

3.6.3.1 February 2008 calibration

Figure 3.5 and Figure 3.6 show comparisons of recorded and predicted discharge hydrographs at the Goonyella and Deverill gauging stations for the February 2008 event. The model reproduced the timing and shapes of the hydrographs relatively well. However, it overestimates the peak discharge and flood volume at Goonyella and underestimates them at Deverill. This is likely due to spatial variation in rainfall that was not covered by the recorded rainfall data.

3.6.3.2 December 2010 calibration

Figure 3.7 and Figure 3.8 show comparisons of recorded and predicted discharge hydrographs at the Goonyella and Deverill gauging stations for the December 2010 event. A good calibration was achieved for both gauges, with the URBS model satisfactorily reproducing the flood peaks, timing and shapes of the hydrographs.

3.6.3.3 March 2017 calibration

Figure 3.9 and Figure 3.10 show comparisons of recorded and predicted discharge hydrographs at the Goonyella and Deverill gauging stations for the March 2017 event. A good calibration was achieved at the Deverill station, with the URBS model satisfactorily reproducing the flood peaks, and the timing and shapes of the hydrographs. However, the model slightly underestimates the peak flows at both gauges.

The three key storages, Burton Gorge Dam, Teviot Dam, and Lake Elphinstone were also included in the model for the 2017 event. The following conditions were reported for the three storages in the WRM (2019) study, for the 2017 event:

- Lake Elphinstone is not gauged but was not observed to spill in the 2017 event. The dam did not spill in the URBS model;
- Teviot Dam did not record a spill during the 2017 event, and did not spill in the URBS model; and
- Burton Gorge Dam had a spill event, with a recorded peak discharge of about 235 m^3/s at the Burton Gorge Dam gauging station, compared to a peak discharge of about 167 m^3/s in the URBS model.

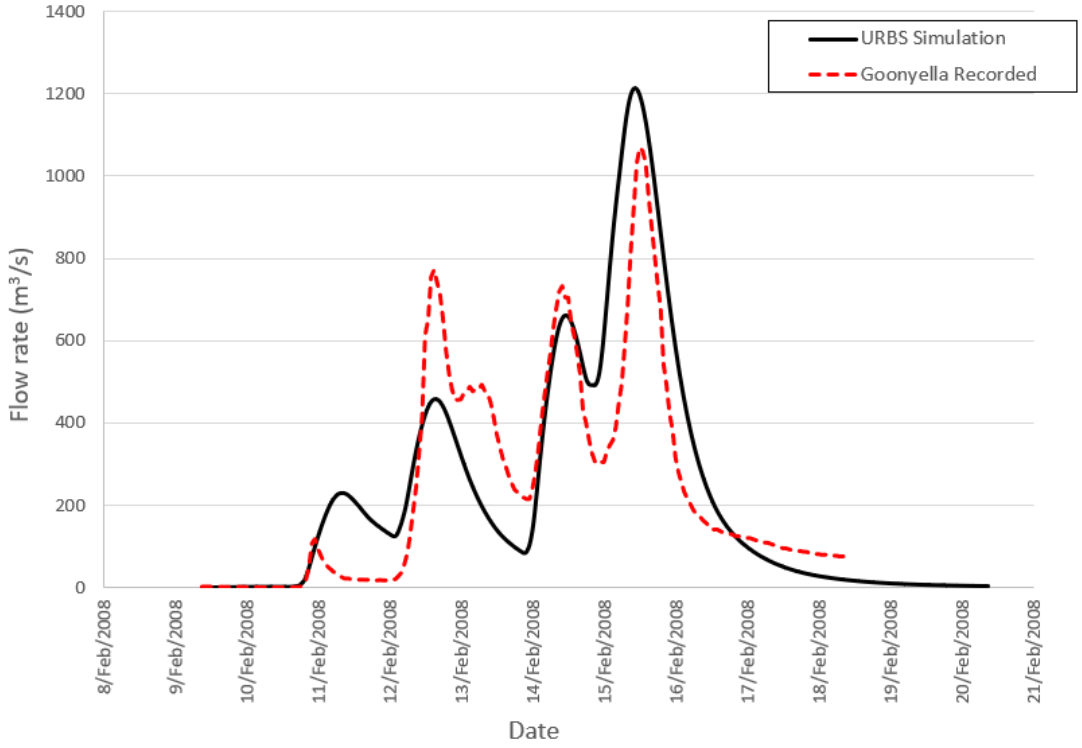

Figure 3.5 Comparison of recorded and modelled discharge hydrographs, February 2008, Isaac River at Goonyella

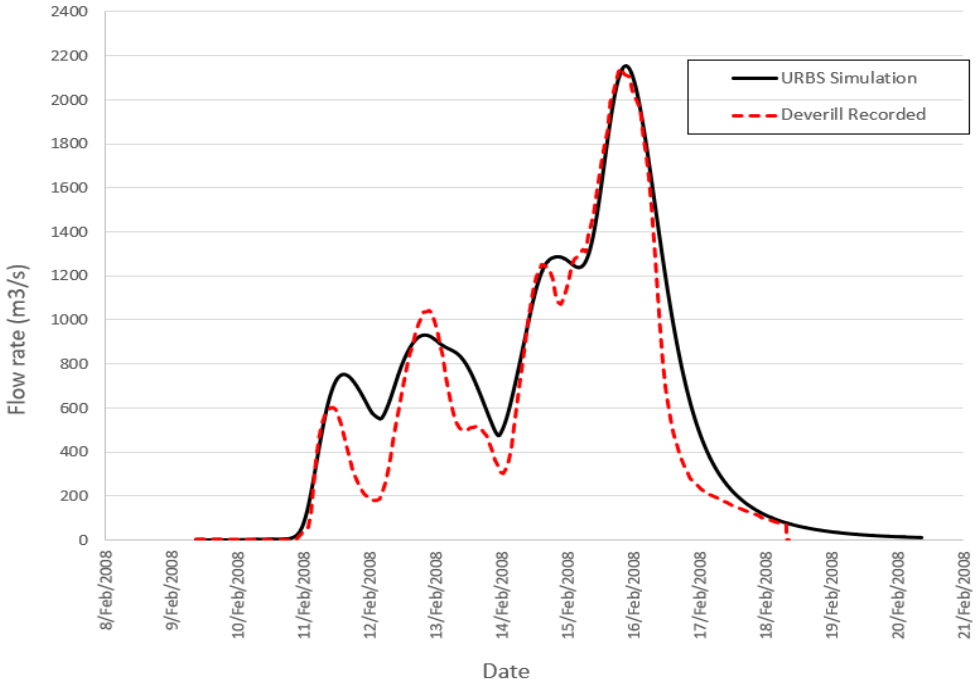

Figure 3.6 Comparison of recorded and modelled discharge hydrographs, February 2008, Isaac River at Deverill

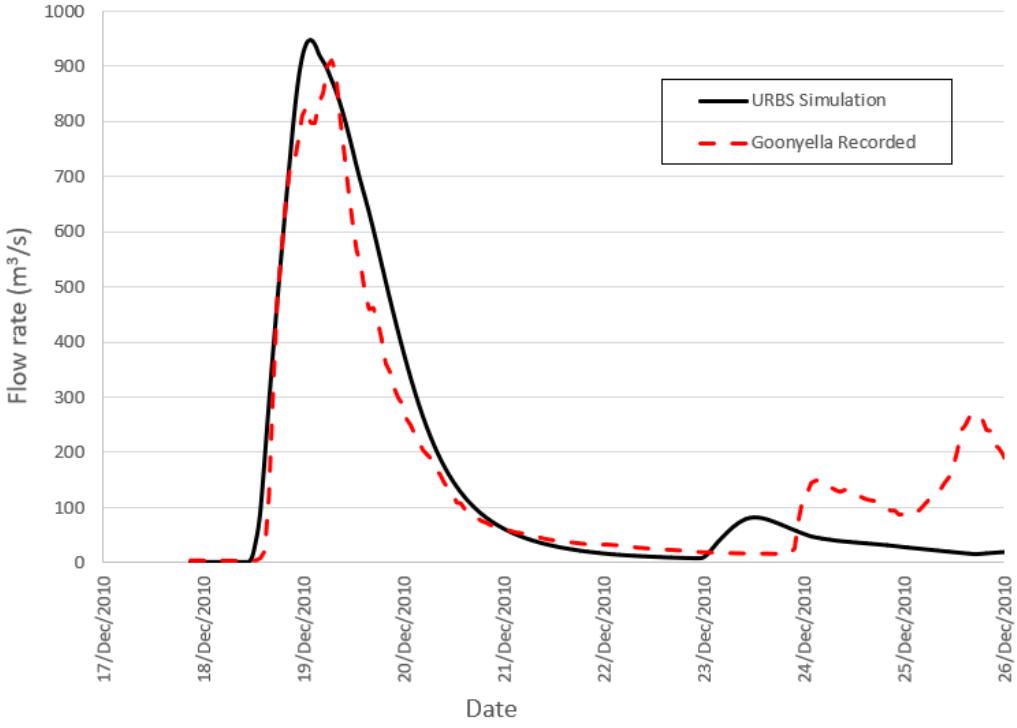

Figure 3.7 Comparison of recorded and modelled discharge hydrographs, February 2010, Isaac River at Goonyella

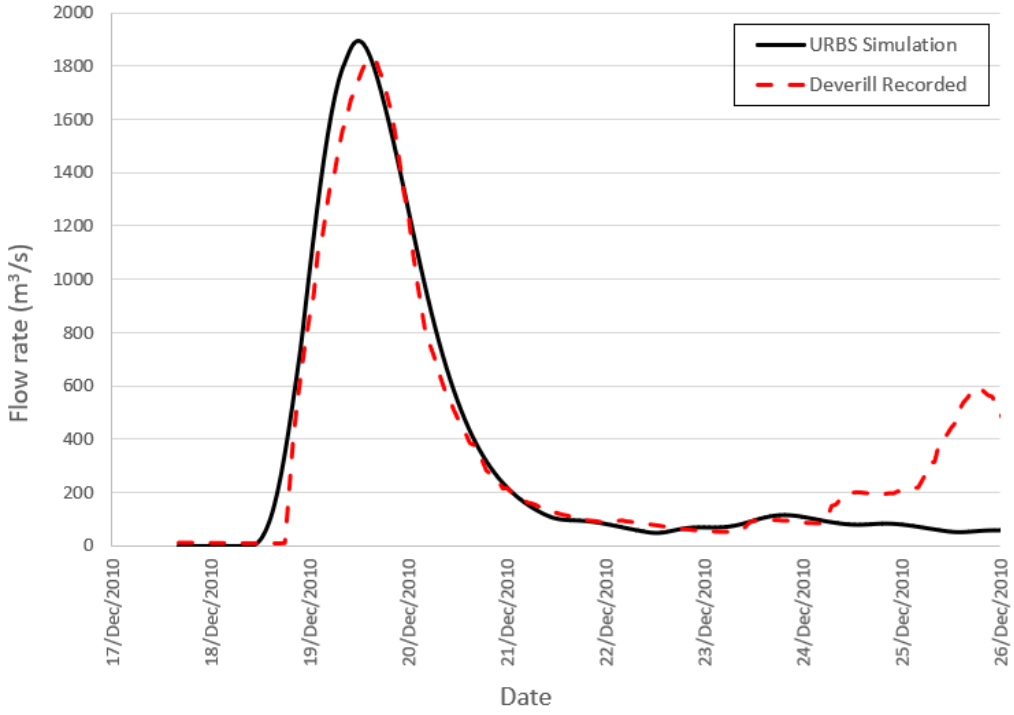

Figure 3.8 Comparison of recorded and modelled discharge hydrographs, February 2010, Isaac River at Deverill

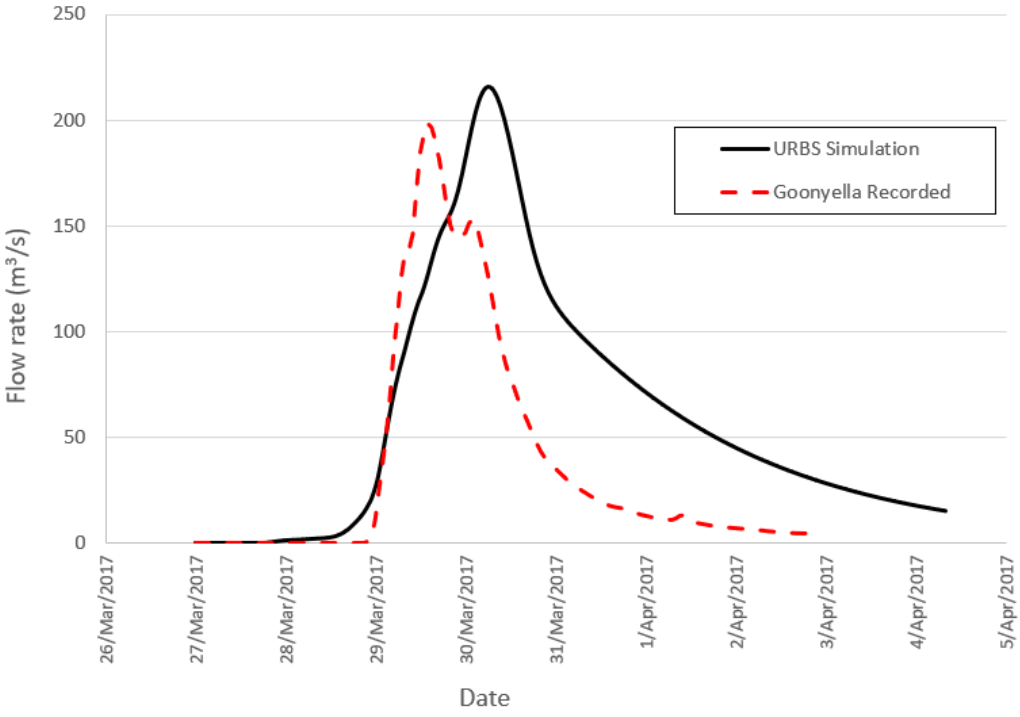

Figure 3.9 Comparison of recorded and modelled discharge hydrographs, February 2017, Isaac River at Goonyella

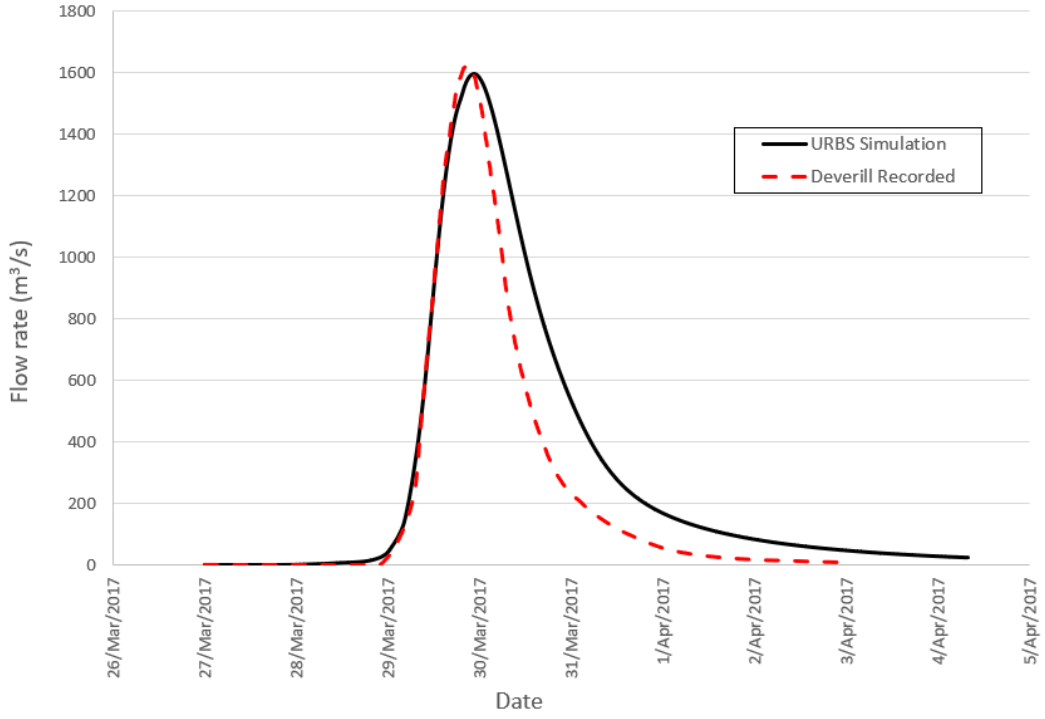

Figure 3.10 Comparison of recorded and modelled discharge hydrographs, February 2017, Isaac River at Deverill

3.6.4 Summary

Overall, the calibration of the URBS hydrological model is considered acceptable. For all three calibration events, the difference between the modelled and recorded peak discharges at the Deverill gauge was less than 5%, with good agreement in both timing and magnitude of peak flow. The results were also consistent with previous (WRM, 2019) study.

3.7 DESIGN DISCHARGE ESTIMATION

3.7.1 Overview

The calibrated URBS model was validated by comparing estimates of peak design discharges for a range of design events, with estimates of peak design discharges derived using an alternative methodology. For this study, an FFA at the Deverill Gauge was used as the alternative design discharge estimation methodology. For the FFA validation, initial and continuing losses were varied, within the range of calibration event losses, and no climate change uplift factors were applied.

The validated URBS model was then updated using the appropriate rainfall and losses uplift factors to represent both existing (present day) and post-mining hydrologic conditions. This design URBS model was then used to estimate design flood discharge hydrographs for the 0.1% AEP and PMP design event, for a range of storm durations up to 72 hours. Note, upstream storages in the model were assumed to start full for design event modelling.

3.7.2 Design rainfalls

Design rainfall depths for events up to and including 0.1% AEP, and durations up to and including 72 hours were obtained from the Commonwealth Bureau of Meteorology (BoM, 2016) in the form of Intensity, Frequency, Duration (IFD) data[1].

Estimates of Probable Maximum Precipitation (PMP) depths were previously derived by WRM (2019) for the study area. As the design guidelines for the estimate of PMP depths have not changed, the WRM (2019) PMP depth estimates were adopted for this study.

3.7.3 Spatial variability

URBS allows different IFD data to be assigned to each sub-catchment individually, improving the representation of spatial rainfall variation across the model area. A comparison of the Isaac River IFDs at the southern, northern, eastern and western catchment boundaries, and at the centroid, revealed on average more than 10% variance in rainfall for the 1% AEP event, across all durations. Consequently, 93 individual IFD datasets were obtained for the study, each located near the centroid of its respective sub-catchment.

3.7.4 Temporal pattern

As the catchment area to the study area exceeds 72 km², areal temporal patterns were applied for all events up to the 1 in 1,000 AEP, in accordance with ARR guidelines (Ball et al., 2019). For events equal to or greater than 1 in 1,000 AEP, the PMP temporal pattern was adopted.

3.7.5 Climate change factors

Climate change factors were obtained from the ARR Datahub portal (Geoscience Australia, 2024), for the design scenarios described previously for existing conditions (present day) hydrology and post-mining conditions hydrology.

Table 3.10 shows the adopted rainfall and loss uplift factors for the nominated design scenarios. Note, in accordance with the updated ARR2019 guidance, uplift factors were applied to all design events, including the PMP.

Table 3.10 Adopted climate change scenario factors

Scenario	Projected temperature change (C)	Rainfall depth uplift factor	IL uplift factor	CL uplift factor
Existing Conditions (Yr 2030, SSP5-8.5)	+1.3	1.11	1.03	1.05
Post-mining Conditions (Yr 2100, SSP2-4.5)	+2.5	1.41	1.05	1.1

3.7.6 Initial and Continuing losses

A reconciliation process was undertaken using URBS and Flood Frequency Analysis (FFA) results, to refine the calibration initial and continuing loss values and obtain representative design initial loss (IL) and continuing loss (CL) values for events up to 1% AEP (inclusive). In accordance with ARR guidelines, IL and CL values of 1 mm and 0 mm/hr were adopted for PMF event modelling, and losses for intermediate (rare to extremely rare) design events such as 0.1% AEP were determined by

[1] http://www.bom.gov.au/water/designRainfalls/revised-ifd/

interpolation. Table 3.11 shows the adopted IL and CL values. These design loss values are comparable to the losses adopted previously by WMR (2019).

Table 3.11 Design event initial and continuing losses

	Initial loss (mm)	Continuing loss (mm/hr)
Design (FFA reconciliation)	25	2.5
0.1% AEP	2	0
PMF	1	0

3.7.7 Design discharges

Table 3.12 shows a comparison between peak design discharge estimates for the Isaac River at Deverill, from the FFA, the updated URBS model and previous WRM (2019) study.

Table 3.12 Comparison of design discharge estimates for the Isaac River at Deverill

Design event	Updated FFA Design Peak Discharge (m^3/s)	URBS Design Peak Discharge (m^3/s)	WRM (2019) Design Peak Discharge (m^3/s)
10% AEP	1,826	18,70	1,936
5% AEP	2,551	2,455	2,886
1% AEP	4,207	4,576	5,067

The design URBS model was then developed by updating the FFA validated URBS model with the rainfall and losses climate change factors, and re-run for existing and post mining hydrologic conditions, for the 0.1% AEP and PMF events. Table 3.13 shows the estimated 0.1% AEP and PMF peak discharges under FFA validation (with no climate change factors), as well as existing and post mining hydrologic conditions (accounting for +1.3 degrees and +2.5 degrees of warming respectively).

Table 3.13 Design discharge estimates for the Isaac River at Deverill, 0.1% AEP and PMF events

	Validation (m^3/s) (no climate change factors)	Existing conditions (m^3/s) (+1.3 degrees warming)	Post mining conditions (m^3/s) (+2.5 degrees warming)
0.1% AEP	8,719	9,928	11,121
PMF	29,131	32,580	36,013

Model results show that:

- For existing conditions, peak discharges are increased compared to the baseline FFA by +13% and +11% for the 0.1% AEP and PMF events respectively; and
- For post mining conditions, peak discharges are increased comparted to existing conditions by a further +12% and +10% for the 0.1% AEP and PMF events respectively.

4 HYDRAULIC MODELLING

4.1 OVERVIEW

The WRM (2019) study developed and calibrated a TUFLOW hydrodynamic model to simulate flood behaviour for the Isaac River and its floodplain in the vicinity of DNM, using the 2018-03-AD version of TUFLOW (BMT, 2018a).

For the current study, the WRM (2019) TUFLOW model was updated to version 2025.0.0 of TUFLOW (BMT, 2025), to incorporate advancements in modelling capabilities. The model was recalibrated using the updated hydrologic inputs described in section3.2.

The updated hydraulic model was run for the 0.1% AEP and Probable Maximum Flood (PMF) event, for the following scenarios:

- Existing conditions:
  - Present day conditions at DNM, using 'Existing' hydrology and current site topographic data;
  - Used to inform final landform planning;
- Pre-mining conditions:
  - 'Existing' hydrology and pre-mining topographic data at DNM (i.e., excluding any artificial features inside the mining tenure), with current topographic data outside DNM;
  - Used to define the floodplain for the PRCP;
- Post-mining conditions:
  - 'Post mining' hydrology and the proposed final landform for DNM, as well as for any adjacent mining sites;
  - Used to assess flooding risk for residual voids and the proposed final landform.

For each scenario and event, predicted flooding characteristics in the vicinity of DNM were assessed, including predicted peak flood extents, levels, depths and extents.

4.2 TUFLOW MODEL CONFIGURATION

The Isaac River TUFLOW model covers an area of approximately 252 km^2. It extends west approximately 5 km upstream of DNM to include the Aurizon rail bridge and rail embankment, Poitrel flood protection levee and New Chum Creek. The model extends 19 km to the southeast to include Deverill stream gauge. The model outflow boundary is located 12 km south-southeast of the Deverill stream gauge.

To ensure the model accurately represents the defined scenarios, the levees and the final landforms from the surrounding mines (Moorvale, Olive down, Poitrel and Winchester mining areas) were incorporated into the model. Adopted TUFLOW model configuration for Pre-mining , Existing and Post-mining scenarios are shown in Figure 4.1 to Figure 4.3 respectively. Key model updates include:

- Updated TUFLOW solver from version 2018-03-AD to version 2025.0.0
- Use of Sub Grid Sampling (SGS) functionality to enable the model to better utilise topographic data detail at a resolution below the model grid cell size;
- Use of Quadtree (QPC) functionality to vary the model cell size, providing additional detail where required. A base model grid cell size of 10 m was adopted, consistent with the WRM (2019) modelling, reducing to 5 m (nesting level 2) for areas along key drainage features.

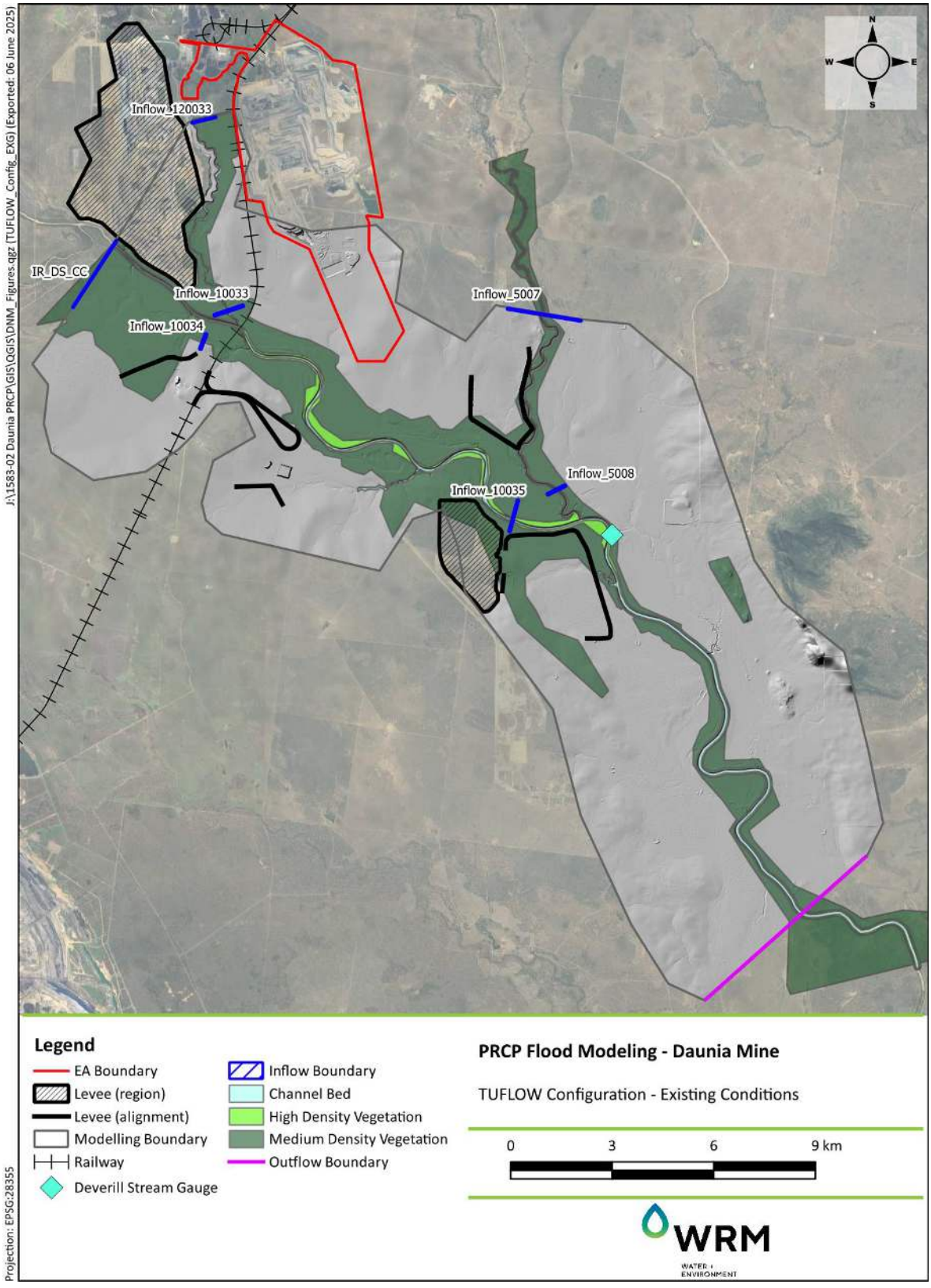

Figure 4.1 Isaac River TUFLOW model configuration- Existing conditions

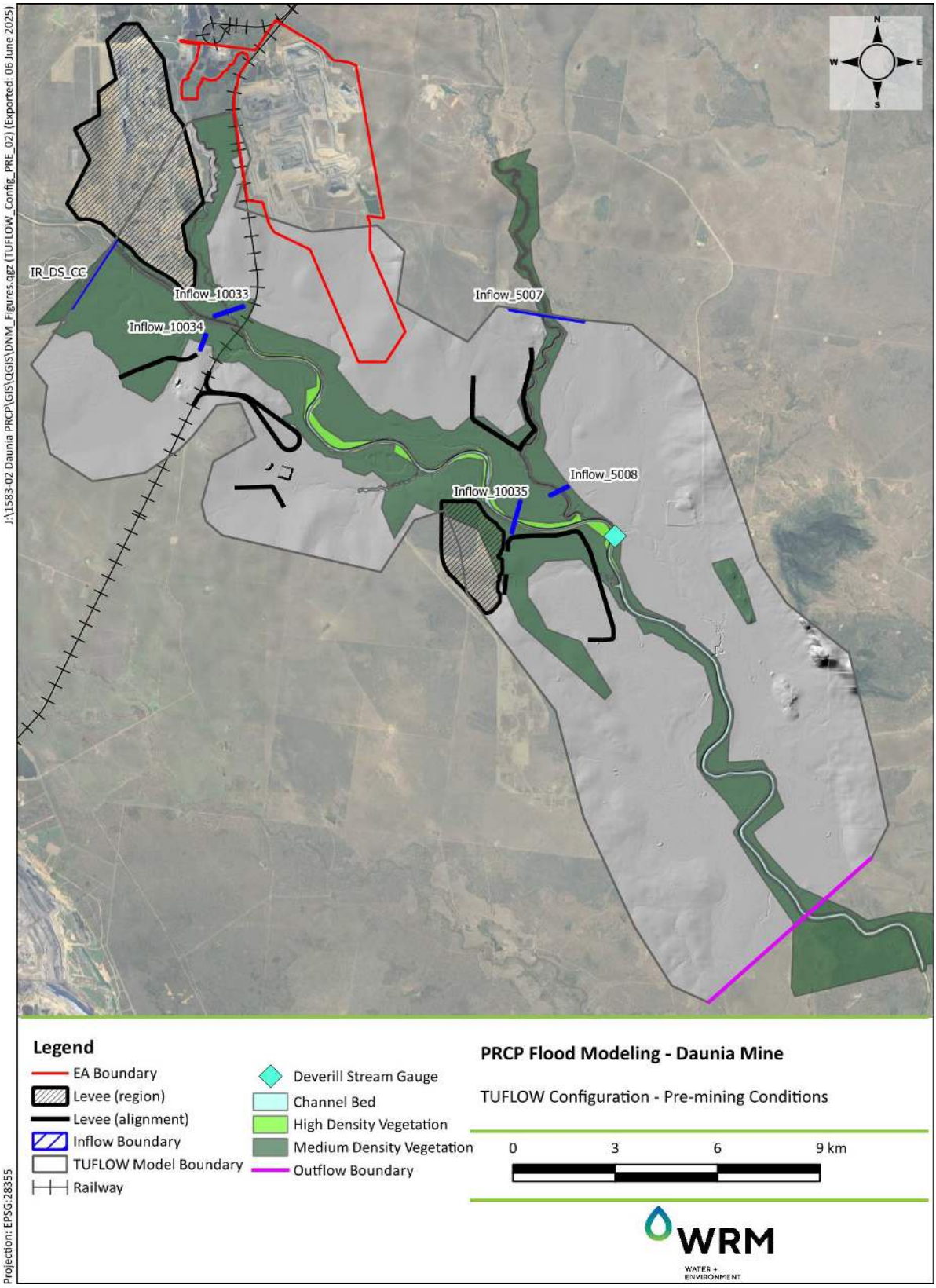

Figure 4.2 Isaac River TUFLOW model configuration- Pre-mining conditions

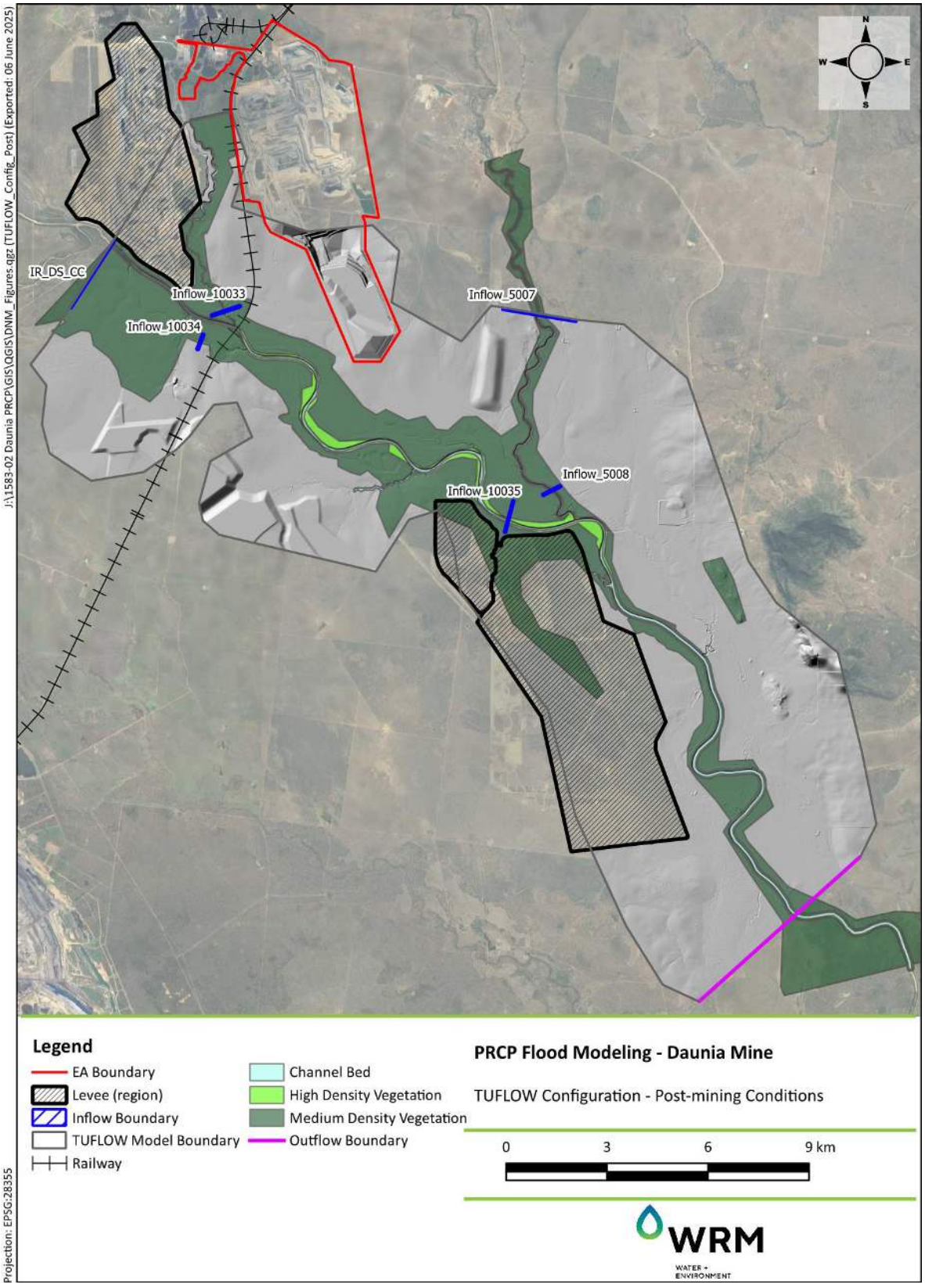

Figure 4.3 Isaac River TUFLOW model configuration- Post-mining conditions

4.2.1 Topography

Base topographic data available from the WRM (2019) study includes:

- Shuttle Radar Topography Mission (SRTM) Digital Elevation Model captured in 2000, used to fill in a few outer edges of the flood plain. This data was normalised to the other LiDAR sources to make the elevations matched as close as possible.
- LiDAR data captured in 2012 (referred to as the 2012 LiDAR data). This data covers areas of the Isaac River floodplain that were not covered by LiDAR data from 2019 (see below).
- LiDAR data captured in August 2019 (referred to as the 2019 LiDAR data). This data covers most of the DNM operational areas, including most the Isaac River within and in the immediate vicinity of DNM.

In addition to the topographic data available from the WRM (2019) study, DNM provided updated LiDAR data for the DNM site, captured in January 2025. Preliminary review showed that there were no material differences between the 2019 and 2025 LiDAR data sets, within the Isaac River flood floodplain.

DNM also provided proposed final landform topographic data. Proposed final landform version 1.2 (provided by DNM on 9 May 2025) forms the basis for this assessment and is shown in Figure 4.4.

Information on proposed final landforms for nearby mines were obtained from the relevant PRCPs (where available) and via data sharing agreements between proponents (see Figure 4.3).

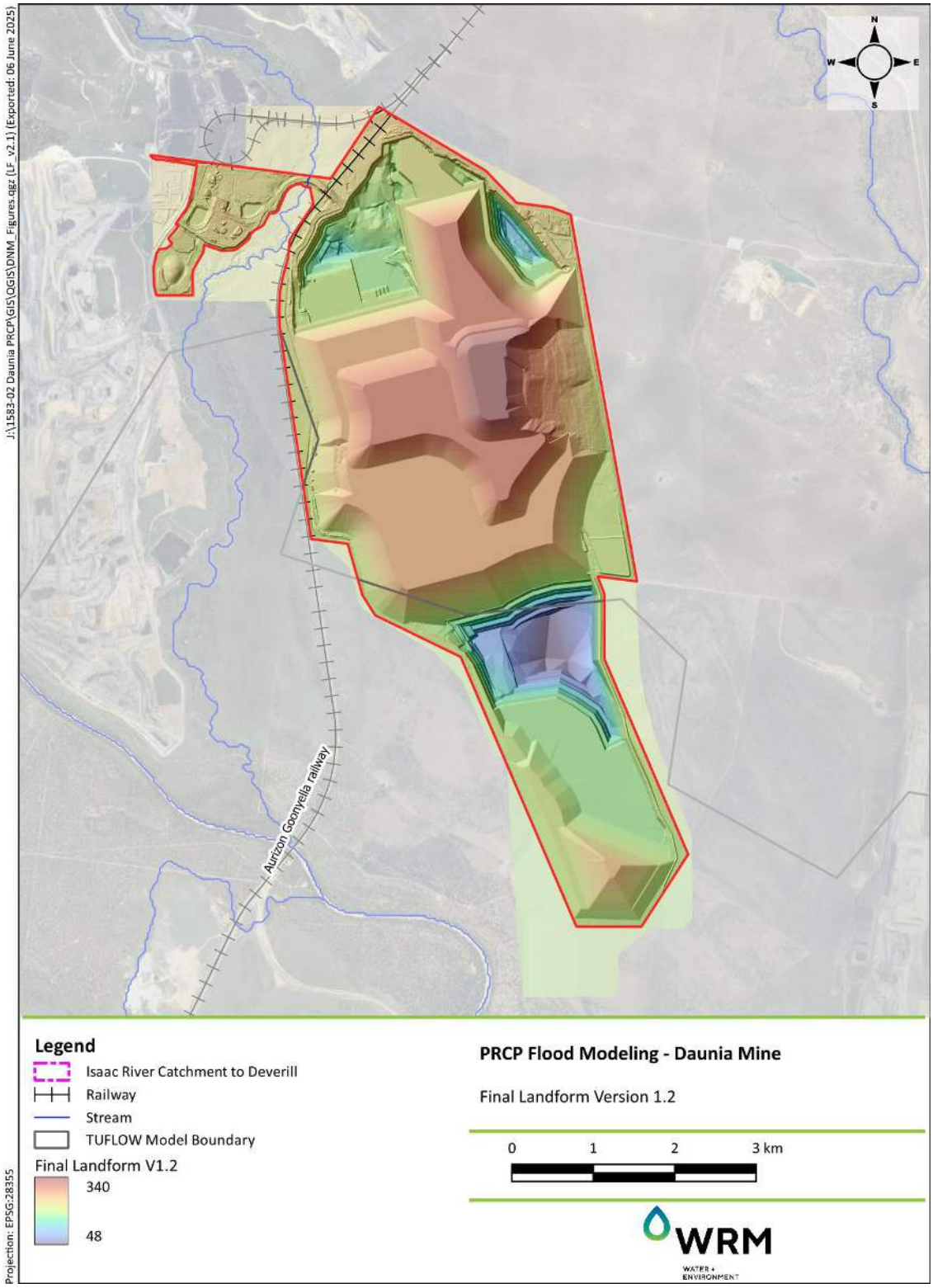

Figure 4.4 Proposed DNM final landform

4.2.2 Inflow boundaries

Figure 4.1 to Figure 4.3 show the model inflow boundaries for three defined scenarios. For all scenarios, the model boundary configuration was adopted consistent with the WRM (2019) configuration.

To show the existing conditions, inflows from the Isaac River, North Creek, Cherwell Creek, and New Chum Creek were incorporated into the model, Figure 4.1. However, in the Pre-mining and Post-mining scenarios, New Chum Creek was excluded to meet PRCP requirements, as it is classified as a third-order stream, Figure 4.2 and Figure 4.3.

4.2.3 Outflow boundaries

Figure 4.1 shows the model outflow boundary. The model boundary configuration was adopted consistent with the WRM (2019) configuration for all three scenarios and includes a normal depth boundary across the Isaac River floodplain, about 12 km downstream of the Deverill gauge. Consistent with the WRM (2019) study, a downstream flood slope of 0.1% was adopted.

4.2.4 Adopted Manning's 'n' values

The TUFLOW model uses Manning's 'n' values to represent hydraulic resistance of different material types. Figure 4.1 shows the adopted land use mapping, and Table 4.1 shows the corresponding Manning's 'n' values. Note, the area not assigned a land use in Figure 4.1 is the default land use area.

Due to differences in the operation of the TUFLOW solvers between the WRM (2019) study and the present study, WRM (2019) Manning's 'n' values were adjust through the calibration process to provide an improved match to both the historical calibration event, and the Deverill gauge rating curve.

Table 4.1 Adopted Manning's 'n' values

Land use	Manning's 'n'
Channel bed (sand)	0.025
Cleared land, grass areas (Default)	0.04
Medium density vegetation	0.06
High density vegetation	0.09

4.2.5 Hydraulic structures and levees

Key hydraulic structures from the WRM (2019) study, including the Aurizon Goonyella railway, have been retained in the current study.

Mine levees information in the vicinity of DNM was updated for the study, including the addition of levees from Moorvale, Olive Downs, and Winchester mines, as well as the adjacent Poitrel Mine (see Figure 4.1 to Figure 4.3).

4.3 TUFLOW MODEL CALIBRATION

4.3.1 Overview

The Isaac River model was calibrated to the recorded water levels and discharges in the Isaac River at the Deverill stream gauge for the March 2017 event. The discharge hydrographs obtained from the URBS model for the March 2017 event were used as inflows in the TUFLOW model. The Isaac River

model was calibrated by adjusting the hydraulic model parameters (particularly Manning's 'n' values) until a satisfactory match was achieved between modelled and observed discharge rating curves at Deverill stream gauge.

4.3.2 2017 event calibration

Figure 4.5 and Figure 4.6 show the recorded and predicted water levels and gauged discharges respectively, at Deverill for the March 2017 event. Figure 4.7 shows a comparison between the adopted rating curve (WRM, 2019), historical gauging data, and TUFLOW simulation results for the 2017 calibration event as well as the 0.1% AEP design flood event.

The model results show that a good calibration was achieved for the TUFLOW model, with a good match achieved to the timing and magnitude of peak flows and water levels, as well as good matches to the hydrograph shape and stage-discharge characteristics.

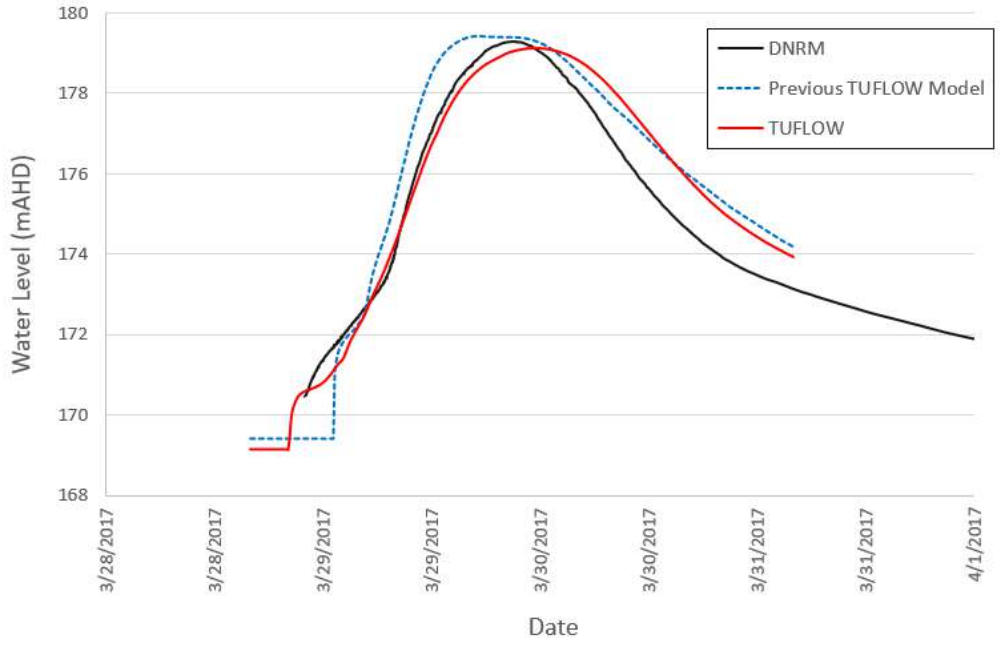

Figure 4.5 Comparison of recorded and modelled water level hydrographs, March 2017, Isaac River at Deverill

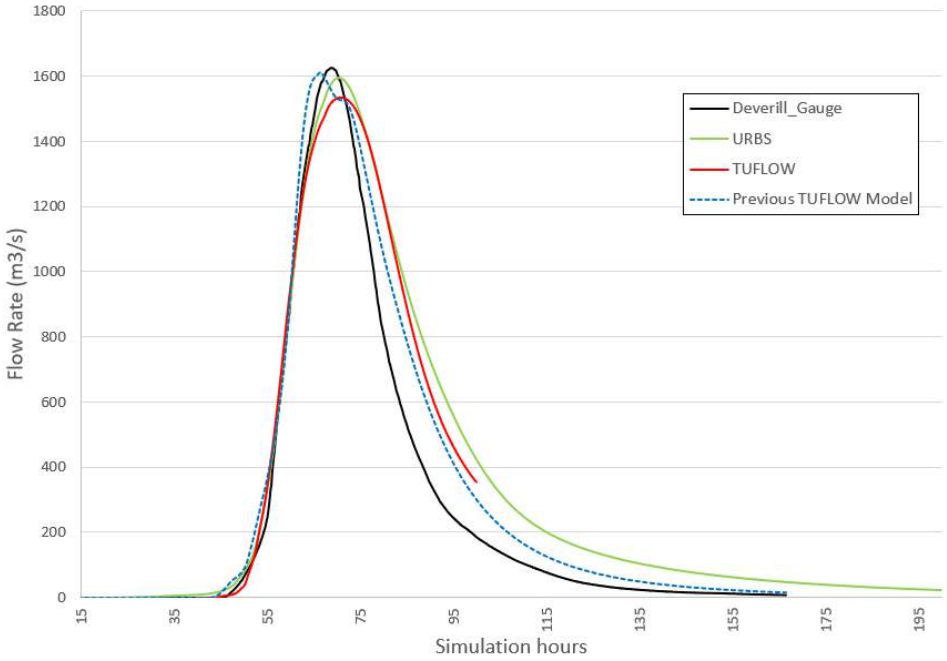

Figure 4.6 Comparison of recorded and modelled discharge hydrographs, March 2017, Isaac River at Deverill

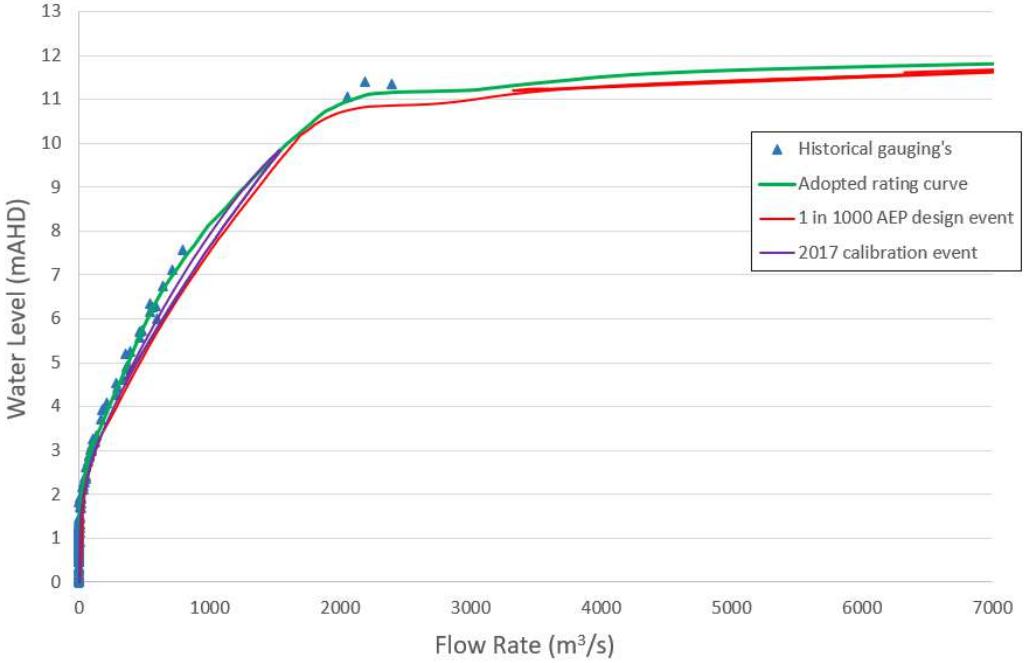

Figure 4.7 Comparison of stage-discharge behaviour, Isaac River at Deverill

5 DESIGN EVENT FLOOD MAPPING

5.1 OVERVIEW

The calibrated TUFLOW model was undertaken to simulate Existing, Pre-mining and Post-mining scenarios for the 0.1% (1 in 1,000) AEP and PMF design flood events, based on critical duration design storm hydrographs selected from the URBS model at Deverill, Table 5.1.

The results of the design events for different scenarios are presented below.

Table 5.1 Adopted critical duration and Temporal pattern

Scenario	Critical Duration (hr)		Critical TP	
	1in1000	PMP	1in1000	PMP
Pre-mining	24	24	TP05	TP04
Existing	24	24	TP05	TP04
Post-mining	24	24	TP05	TP04

5.2 EXISTING CONDITIONS FLOODING

Figure 5.1 to Figure 5.4 show predicted peak flood extents, depths and velocities, for the 0.1% AEP and PMF events, under existing conditions.

The model results show that in the vicinity of DNM:

- 0.1% AEP peak flood levels are about 192.6 mAHD and do not vary much along the (western) site boundary; and
- The PMF peak flood levels are about 196.3 mAHD and, like the 0.1% AEP event, do not change significantly across the DNM site area.

5.3 PRE-MINING CONDITIONS FLOODING

Figure 5.1 to Figure 5.4 show predicted peak flood extents, depths and velocities, for the 0.1% AEP (i.e., the floodplain as defined for the PRCP) and PMF events, under pre-mining conditions.

The model results show that in the vicinity of DNM:

- 0.1% AEP peak flood levels are about 192.6 mAHD and show little variation along the site boundary, similar to the existing conditions; and
- The PMF peak flood levels vary slightly across the DNM, ranging between 196.1 and 196.3 mAHD, which is also consistent with the existing results.

5.4 POST-MINING CONDITIONS FLOODING

Figure 5.9 to Figure 5.12. show predicted peak flood extents, depths and velocities, for the 0.1% AEP and PMF events, under predicted post-mining conditions.

The model results show that in the vicinity of DNM:

- 0.1% AEP peak flood levels are about 192.9 mAHD and show little variation along the site boundary.
- The PMF peak levels at about 196.6 mAHD and show little variation along the site boundary.
- The residual voids in the proposed DNM final landform is not inundated for either the 0.1% AEP or the PMF events. The proposed final landform provides an estimated freeboard of more than 7 m

for the 0.1% AEP event and more than 3 m for the PMF event above the predicted peak flood levels.

Table 5.2 shows predicted peak flood levels and velocities along the proposed final landform. For 0.1% AEP and PMF events under predicted post-mining conditions.

Table 5.2 Predicted peak flood levels, velocities and freeboard,0.1% AEP and PMF events under post-mining conditions

Event	Post-mining landform elevation[1] (mAHD)	Peak flood level (mAHD)	Peak flood velocity (m/s)	Freeboard[2] (m)
0.1%	200	193	0.6	7
PMF	200	197	1.3	3

1. Minimum proposed final landform level at locations with predicted adjacent Isaac River flooding

2. Indicative minimum available freeboard

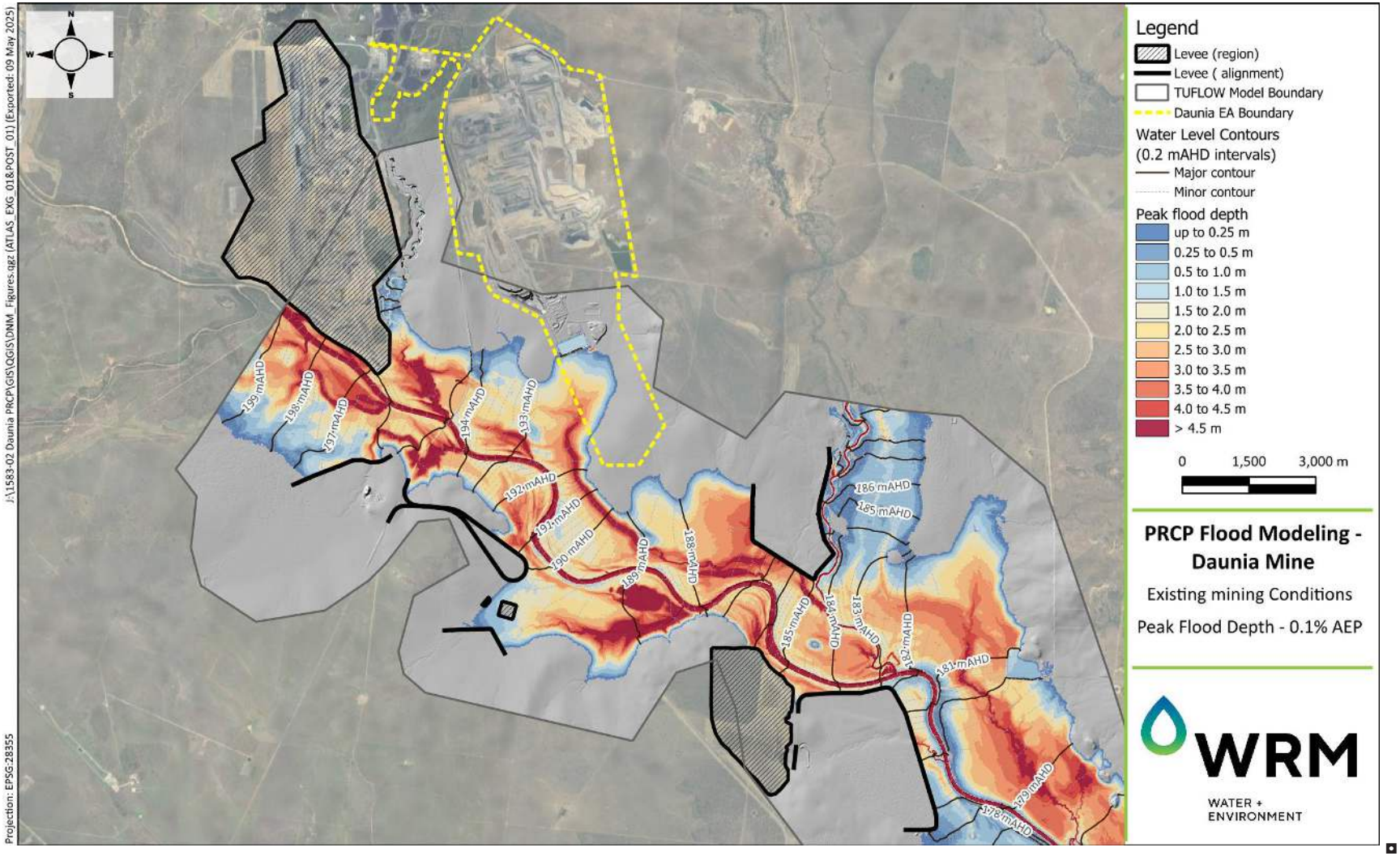

Figure 5.1 Peak flood depth – existing conditions – 0.1% AEP design event

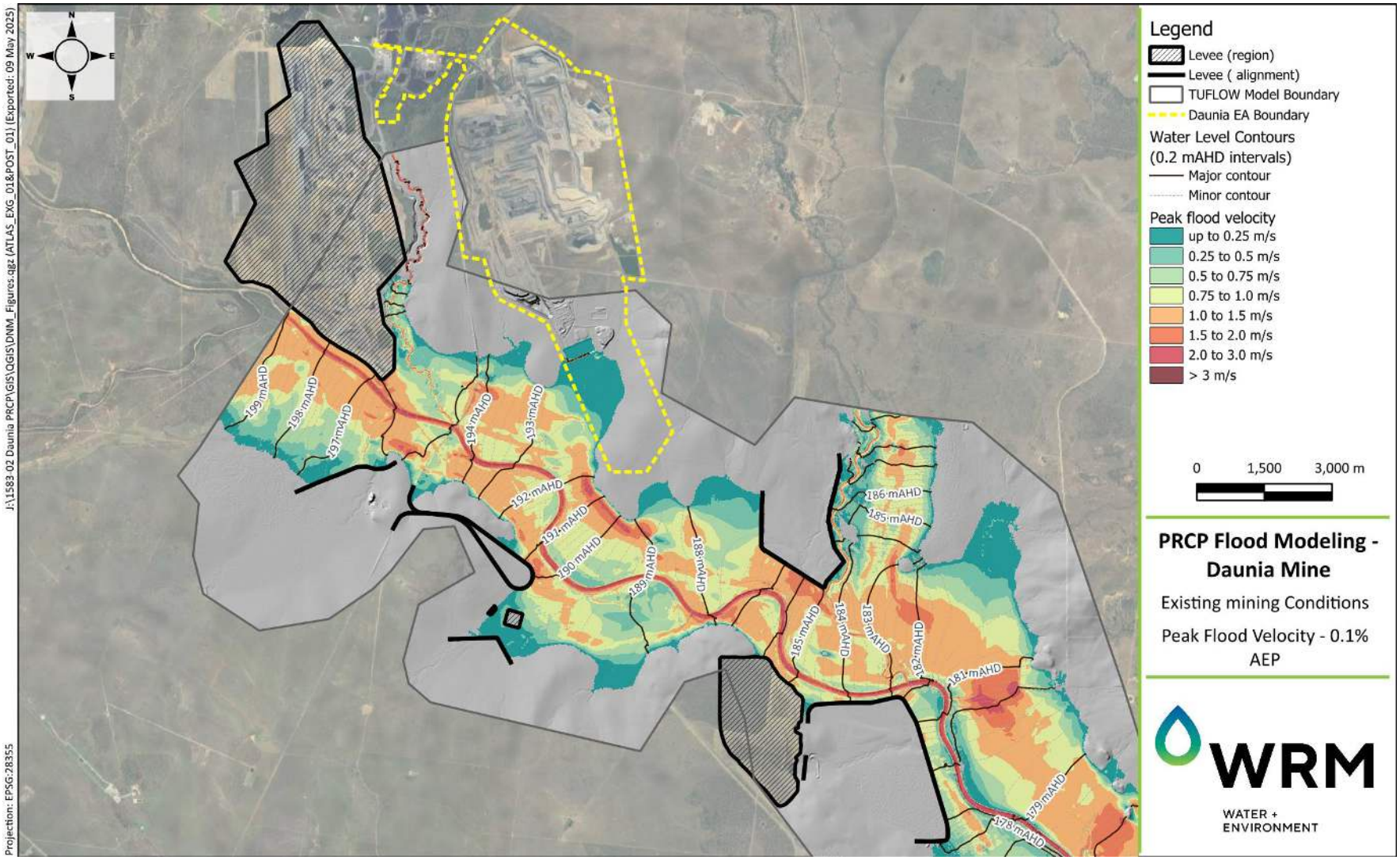

Figure 5.2 Peak flood velocity – existing conditions – 0.1% AEP design event

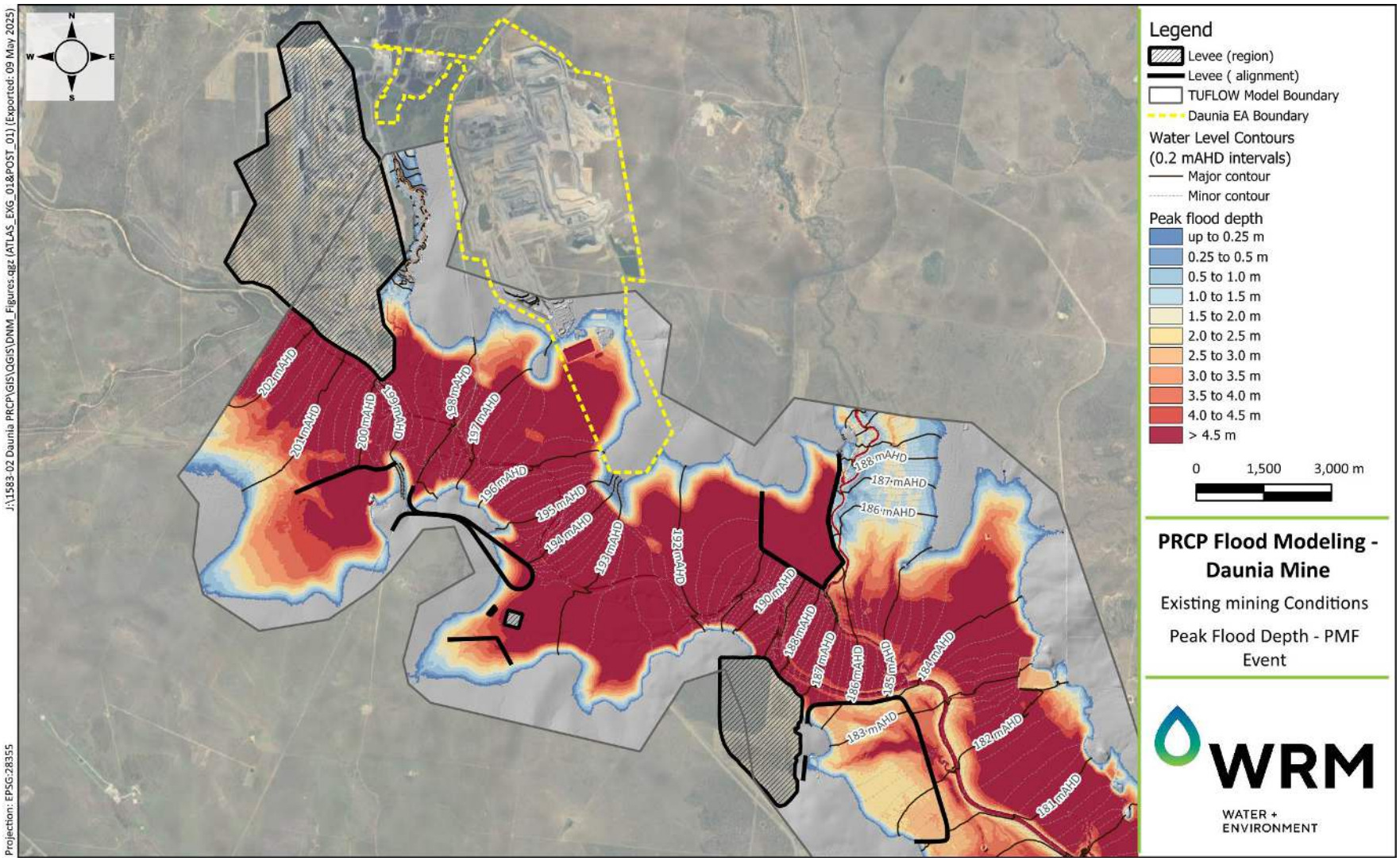

Figure 5.3 Peak flood depth – existing conditions – PMF event

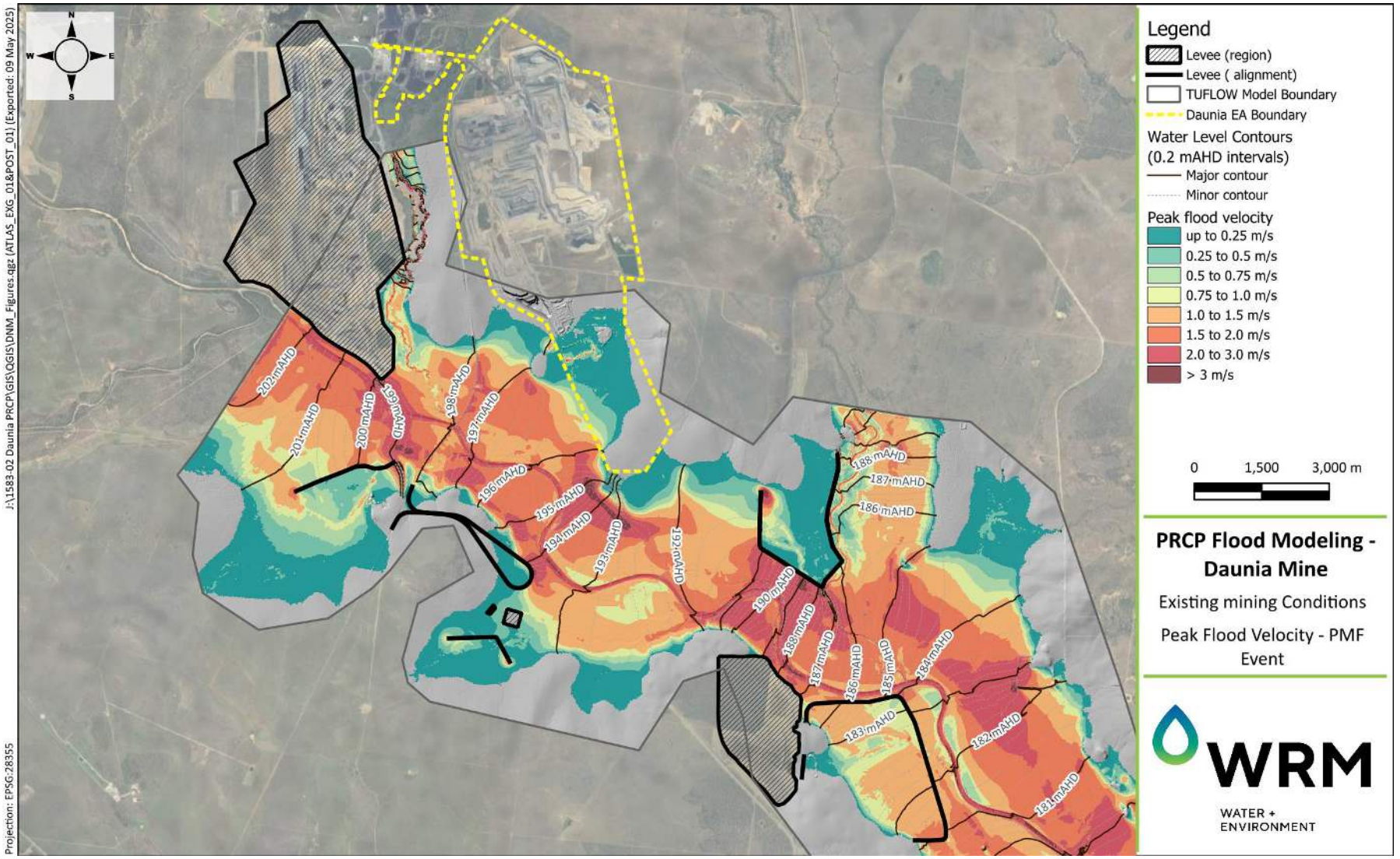

Figure 5.4 Peak flood velocity – existing conditions – PMF event

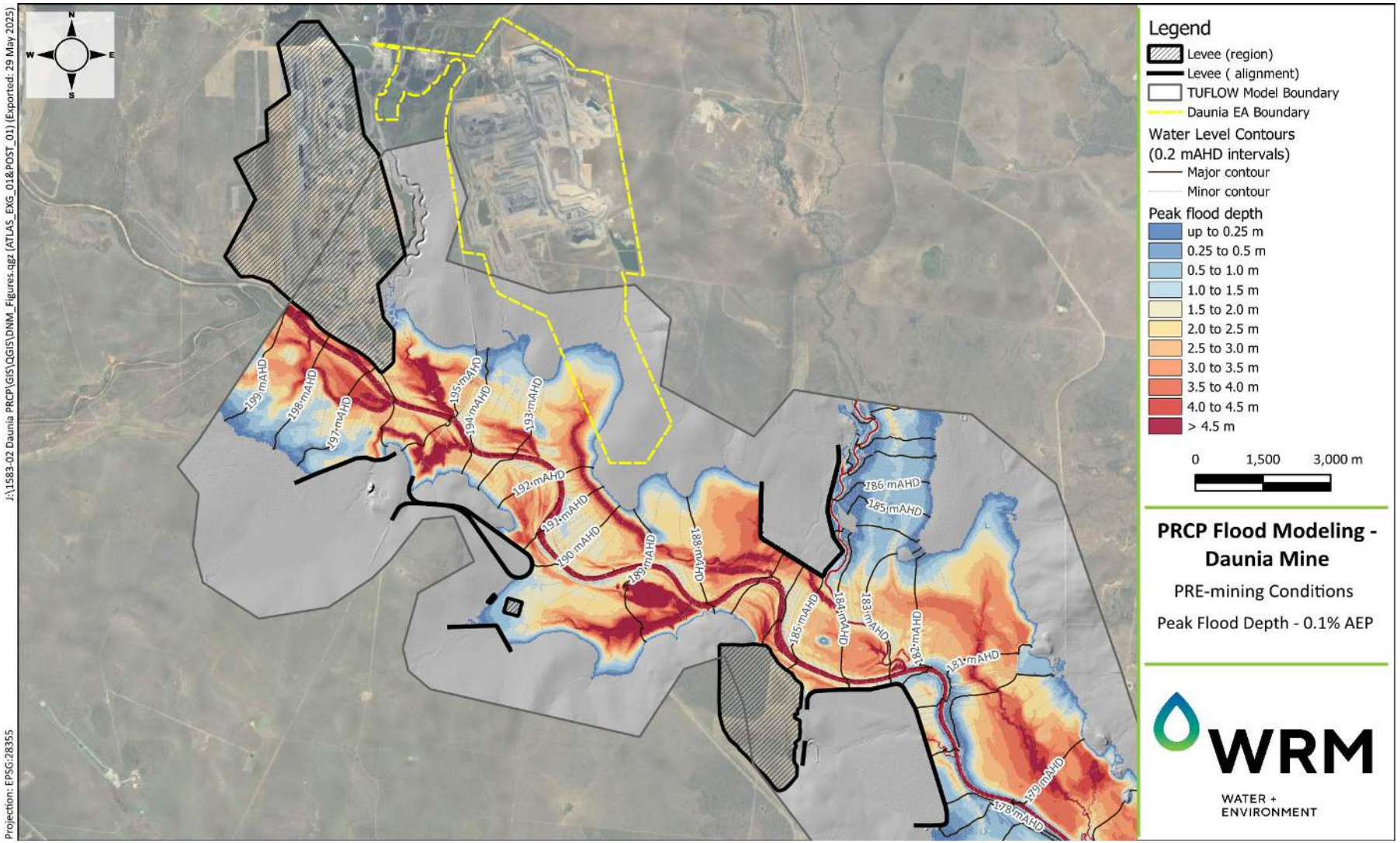

Figure 5.5 Peak flood depth – Pre-mining conditions – 0.1% AEP design event

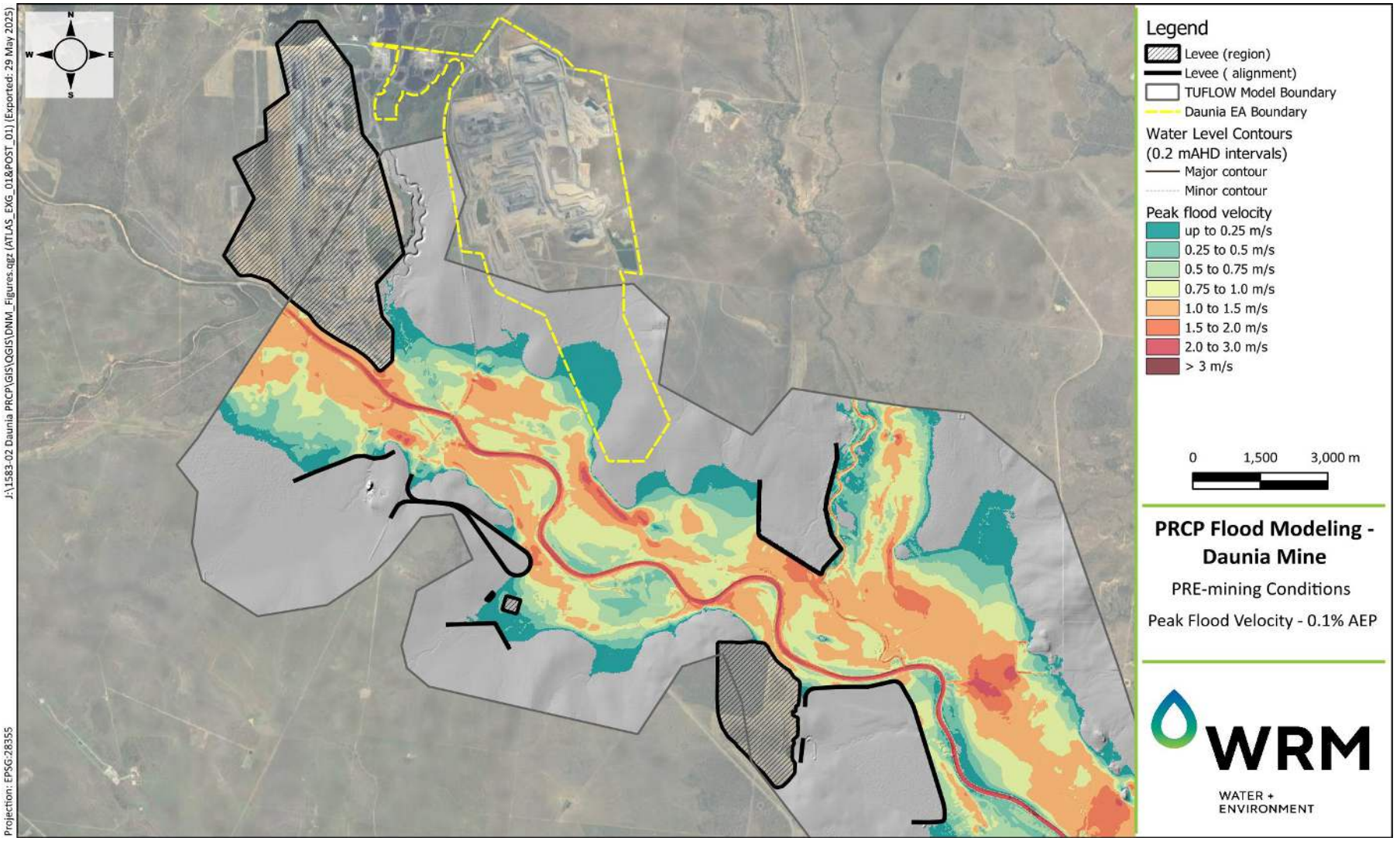

Figure 5.6 Peak flood velocity – Pre-mining conditions – 0.1% AEP design event

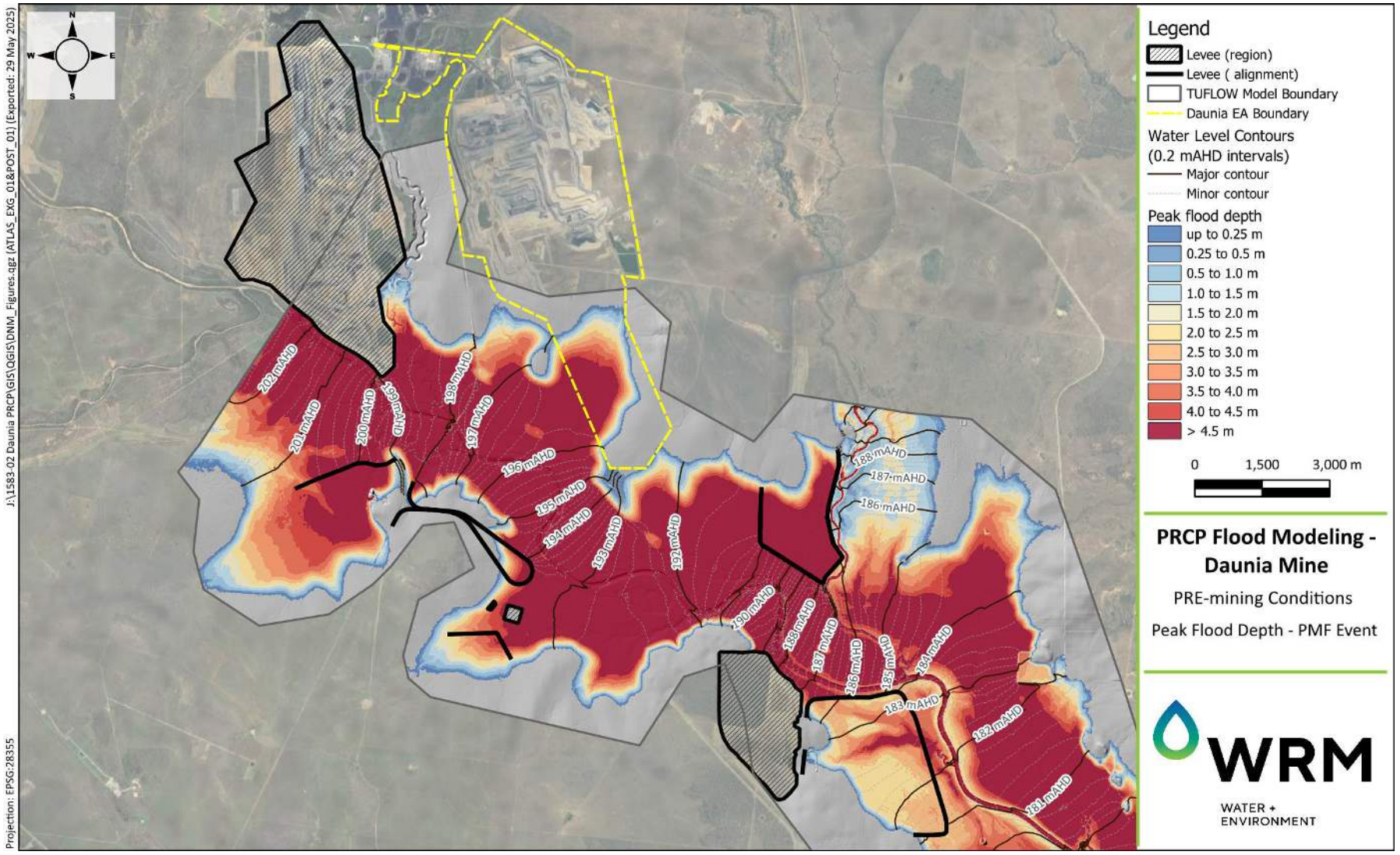

Figure 5.7 Peak flood depth – Pre-mining conditions – PMF event

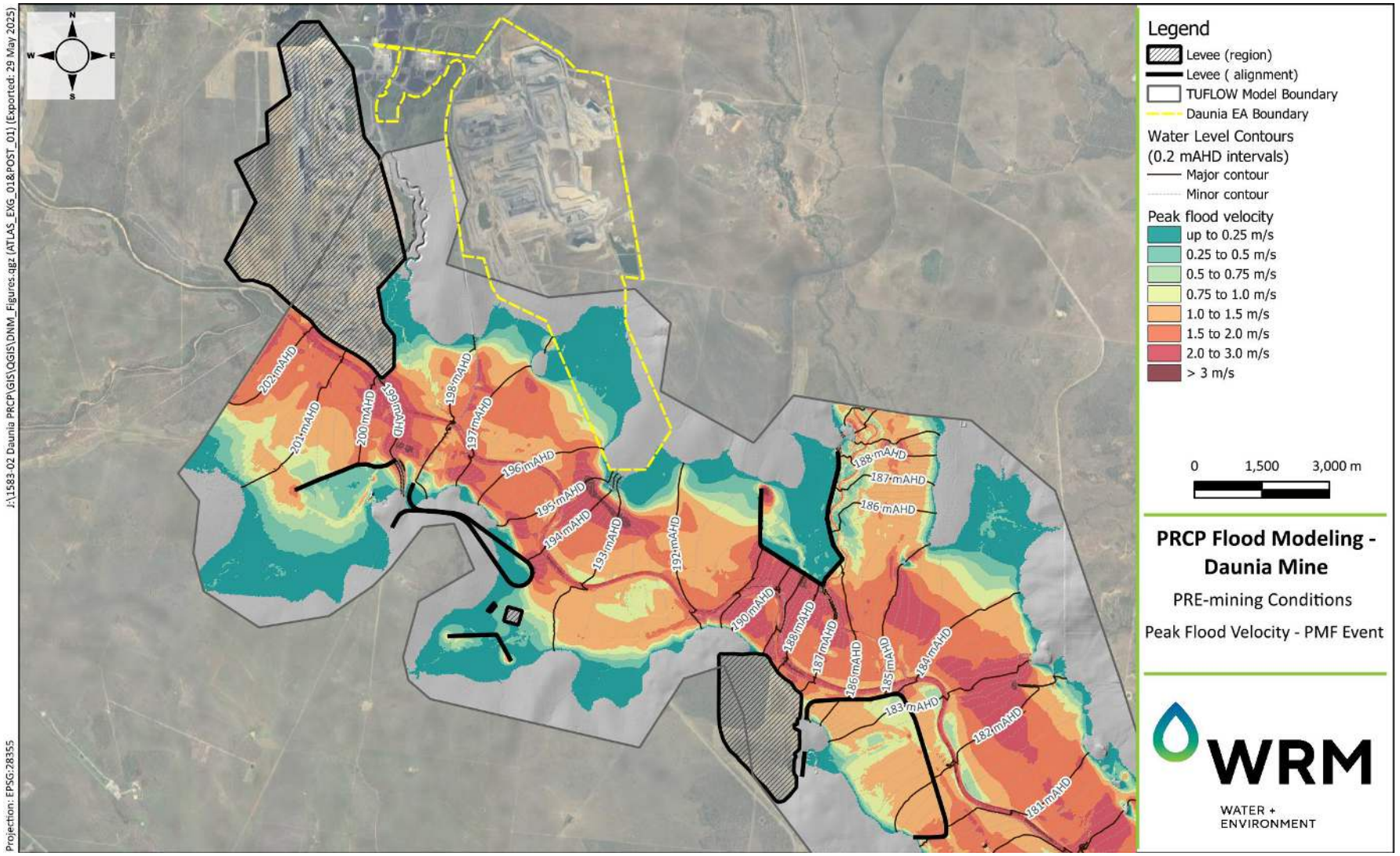

Figure 5.8 Peak flood velocity – Pre-mining conditions – PMF event

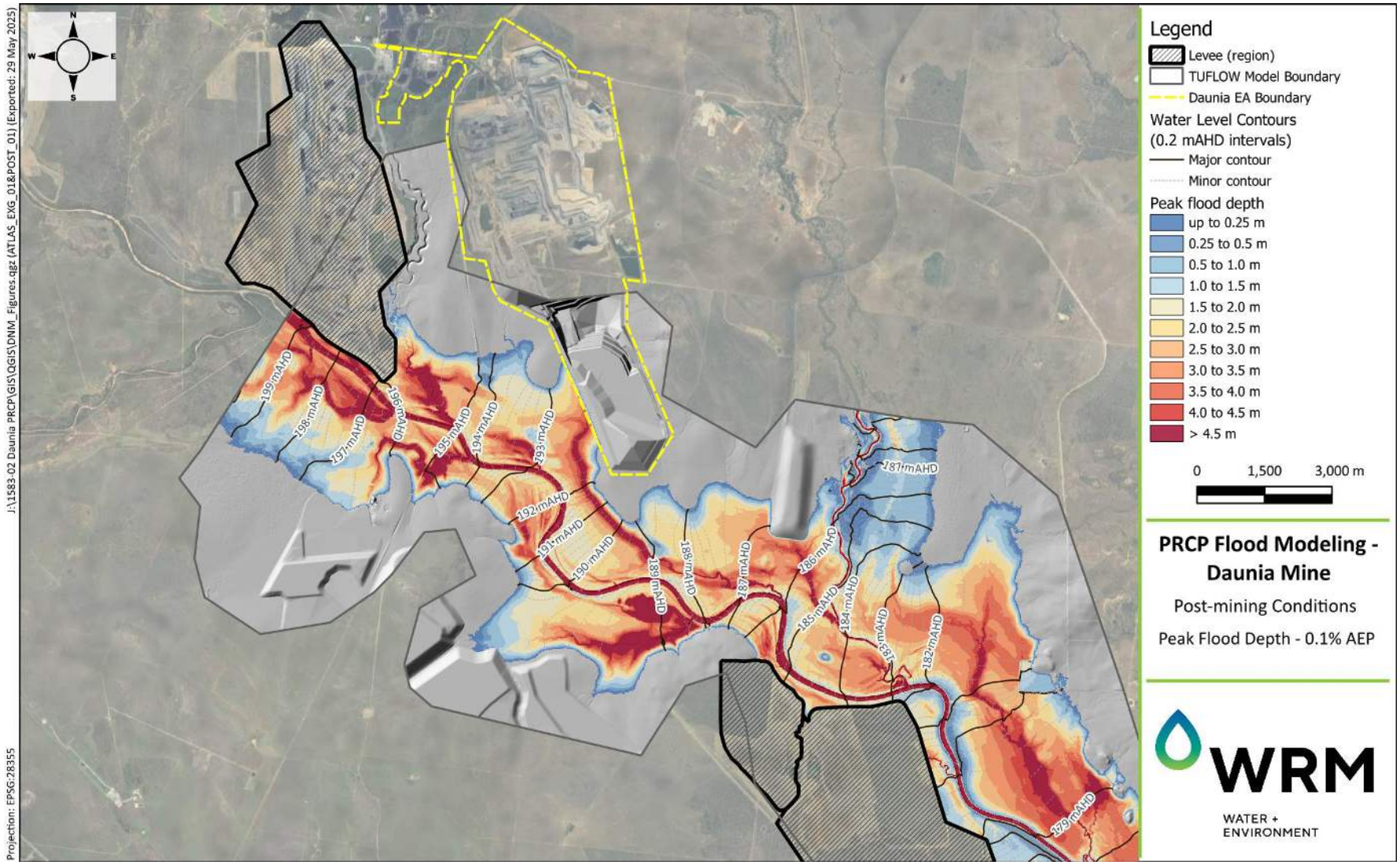

Figure 5.9 Peak flood depth – Post-mining conditions – 0.1% AEP design event

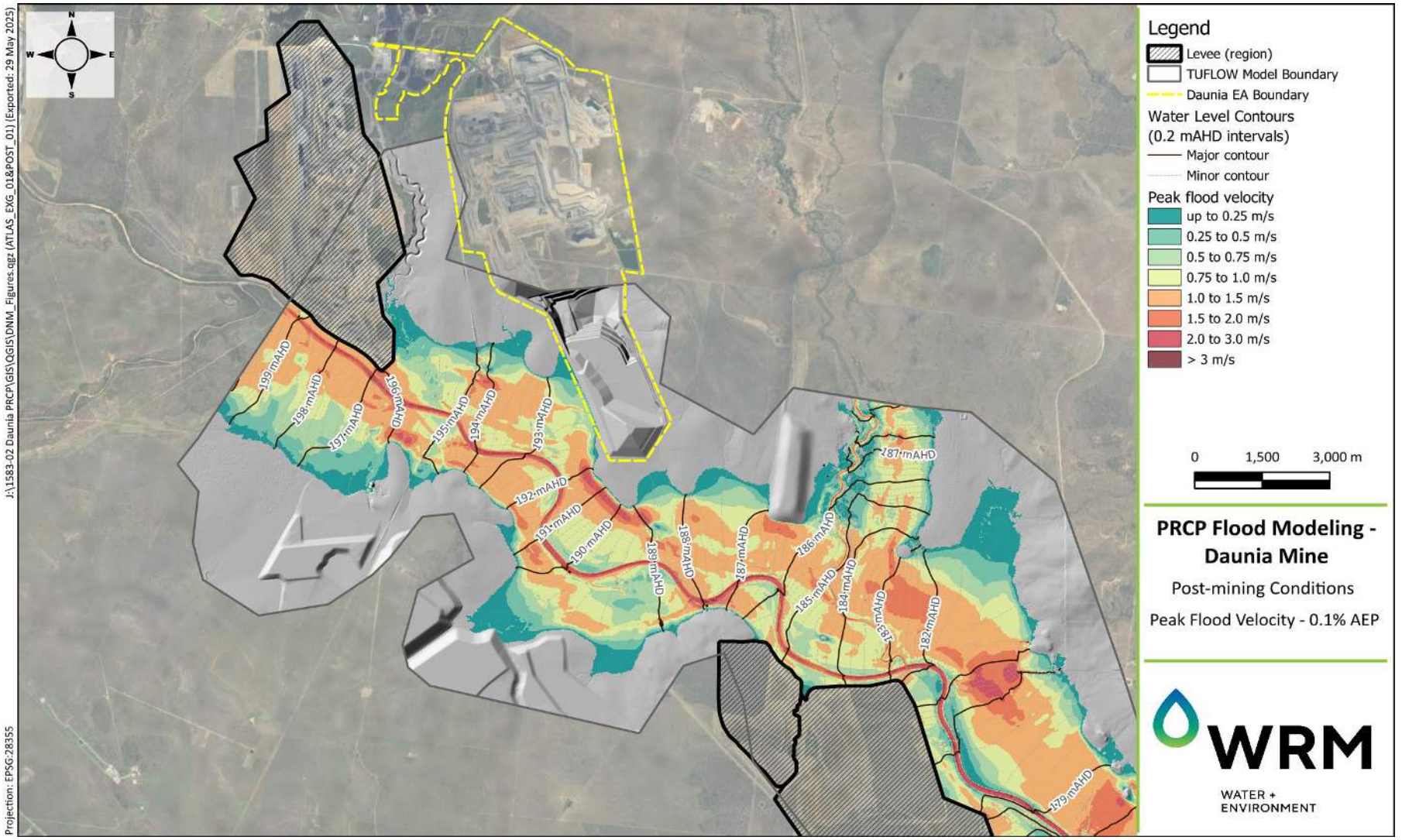

Figure 5.10 **Peak flood velocity – Post-mining conditions – 0.1% AEP design event**

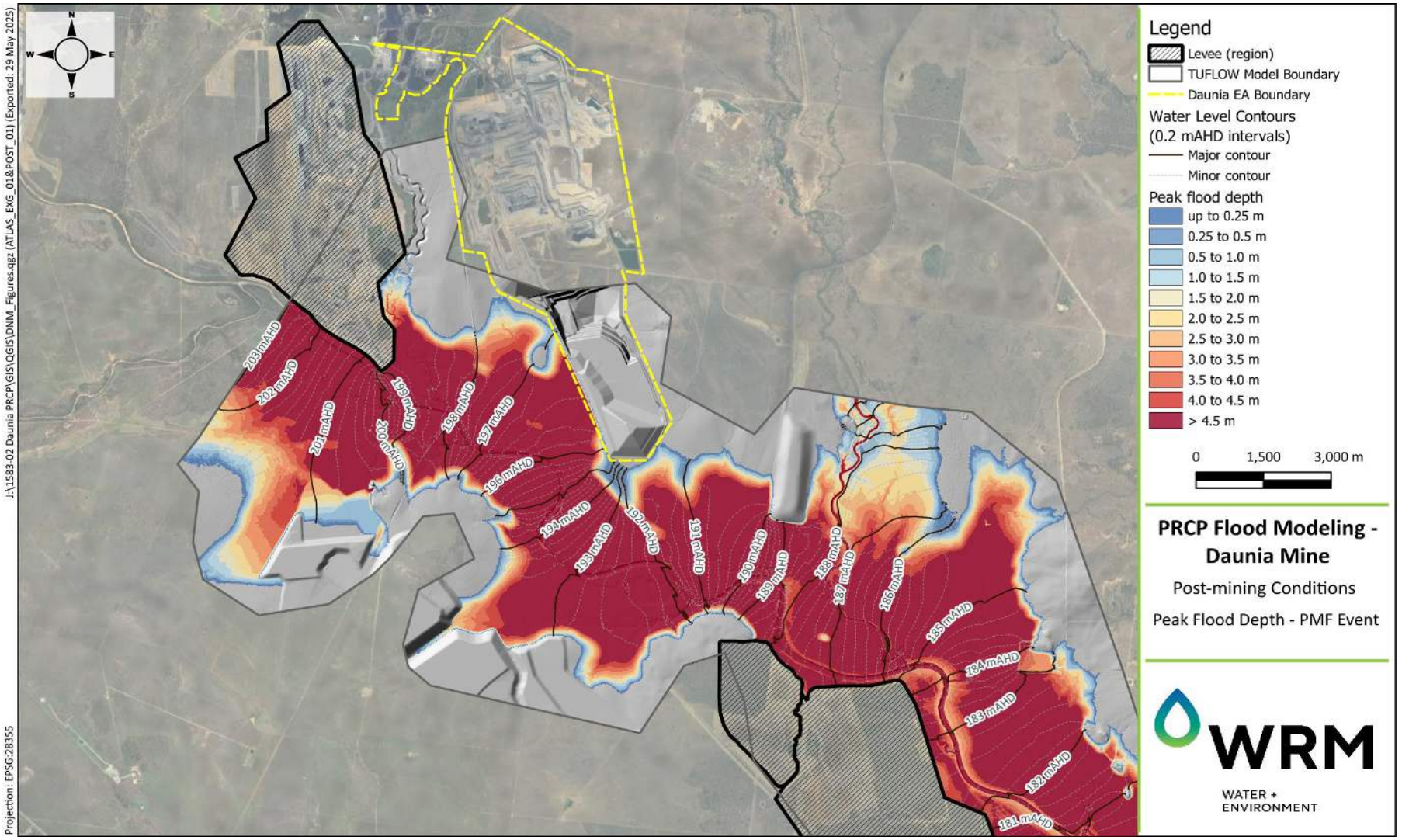

Figure 5.11 **Peak flood depth – Post-mining conditions – PMF event**

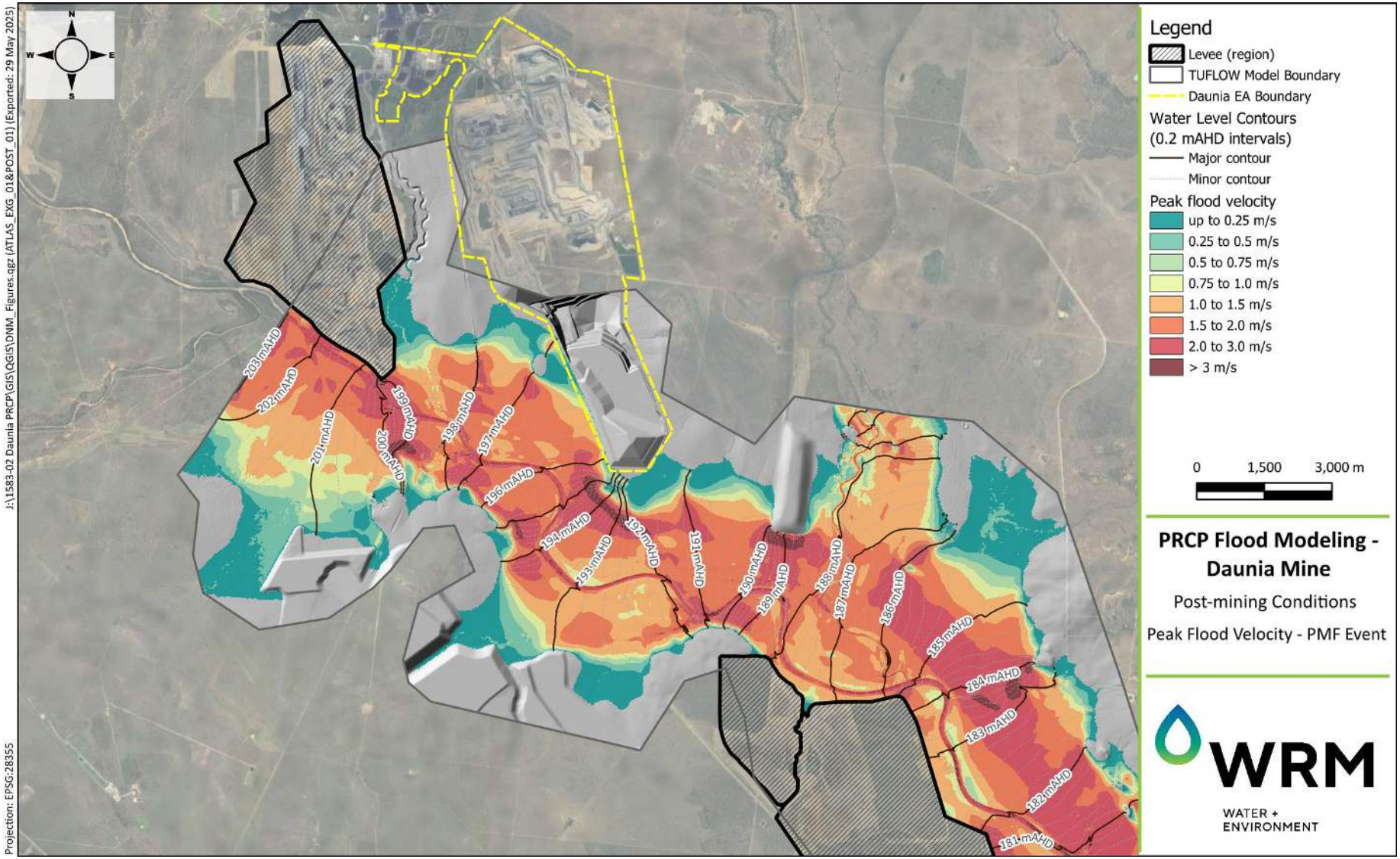

Figure 5.12 **Peak flood velocity – Post-mining conditions – PMF event**

5.5 SENSITIVITY ASSESSMENT

The sensitivity of predicted flooding characteristics at DNM to changes in key model parameters was assessed by varying key model parameters. The sensitivity assessment considered:

- Changes in model hydraulic roughness, assessed by running additional 0.1% AEP post-mining conditions scenarios, varying model Manning's 'n' parameters by +/- 20%; and
- Changes to predicted hydrologic conditions as a result of predicted future climate change, assessed by comparing 0.1% AEP design event results with existing and post mining hydrology.

Figure 5.13 shows the predicted change in peak flood levels and extents for the 0.1% AEP event, for a +20% increase in hydraulic roughness.

Figure 5.14 shows the predicted change in peak flood levels and extents for the 0.1% AEP event, for the predicted +1.2 degrees of warming between present day and post mining (year 2100) conditions. Note, although this comparison between Existing and Post-mining conditions includes impacts from changing landforms at DNM and adjacent sites, the primary change between the scenarios is the +12% increase in peak discharges (see Table 3.13).

Table 5.3 and Table 5.4 shows the predicted change in peak flood levels and velocities respectively, at a representative location on the western boundary of DNM, for each of the sensitivity cases.

The model results show:

- Changes to hydraulic roughness (+/-20% changes to Manning's 'n') could see peak flood levels vary by +0.4 m to -0.4 m, and peak velocities vary by approximately +/-0.02 m/s;
- Changes to flows (+12% increase in flows) could see peak flood levels increase by about +0.3m, and peak velocities vary by +0.3m/s (from 0.3 m/s for existing conditions to 0.6 m/s for post-mining conditions).

The sensitivity assessment illustrates the potential range of predicted peak flooding levels under a range of potential predicted conditions and highlights the importance of a suitable freeboard allowance in final landform design. The available freeboard (see Table 5.2) is well in excess of the potential change in peak flood levels estimated by this sensitivity analysis.

Note, modelling results show that the DNM proposed final landform is not predicted to be inundated for either the 0.1% AEP or the PMF events, under predicted future climate change conditions (up to +2.5 degrees warming by year 2100).

Table 5.3 Sensitivity assessment results, change in peak flood level, 0.1% AEP design event

	Design level (mAHD)	Sensitivity level (mAHD)	Change (m)
Decreased Mannings' 'n'	192.9	192.5	-0.4
Increased Manning's 'n'	192.9	193.3	+0.4
Increased flows	192.6	192.9	+0.3

Table 5.4 Sensitivity assessment results, change in peak velocity, 0.1% AEP design event

	Design velocity (m/s)	Sensitivity velocity (m/s	Change (m/s)
Decreased Mannings' 'n'	0.61	0.62	+0.01
Increased Manning's 'n'	0.61	0.59	-0.02
Increased flows	0.30	0.60	+0.3

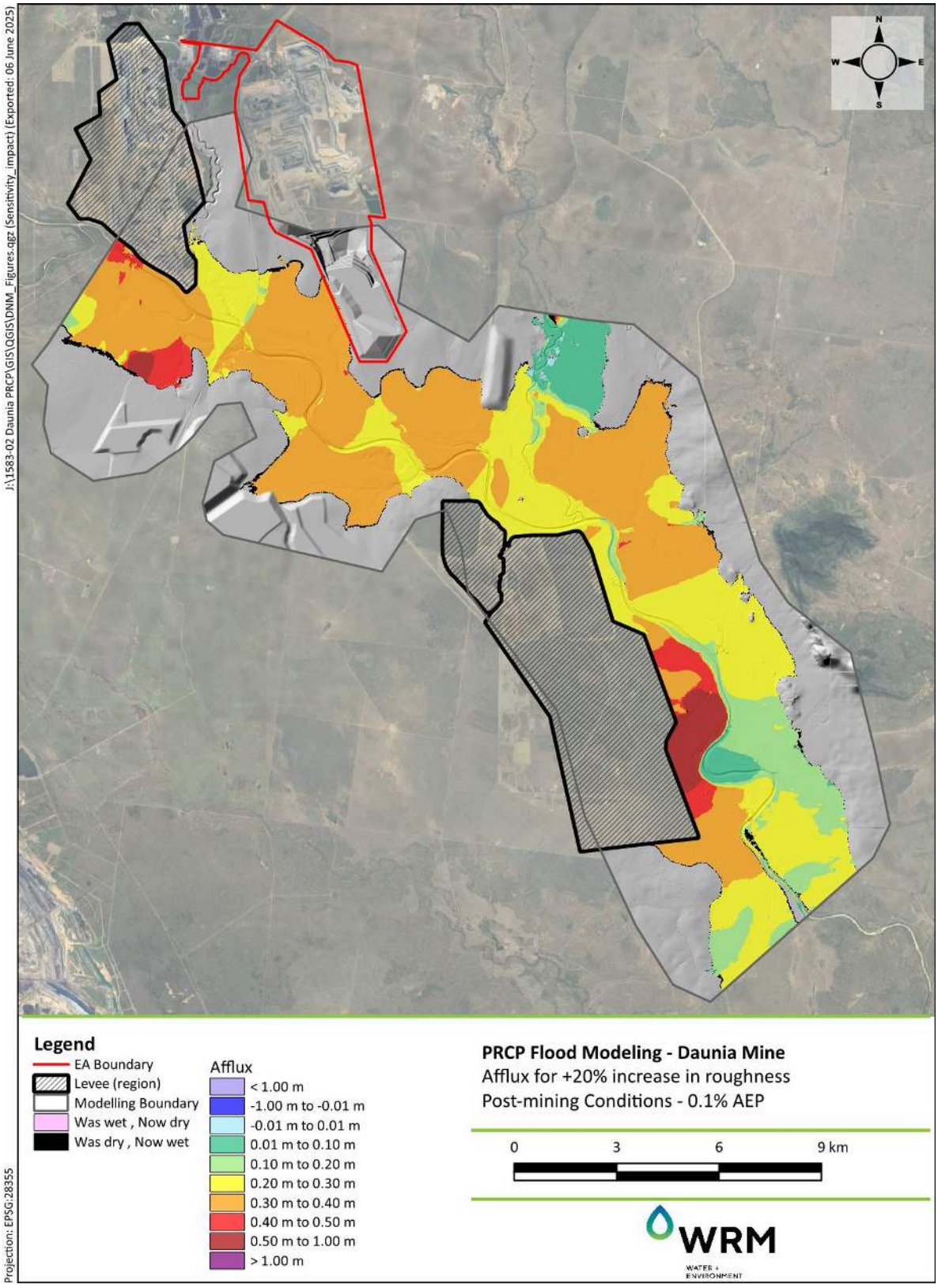

Figure 5.13 **Sensitivity impacts, increased hydraulic roughness**

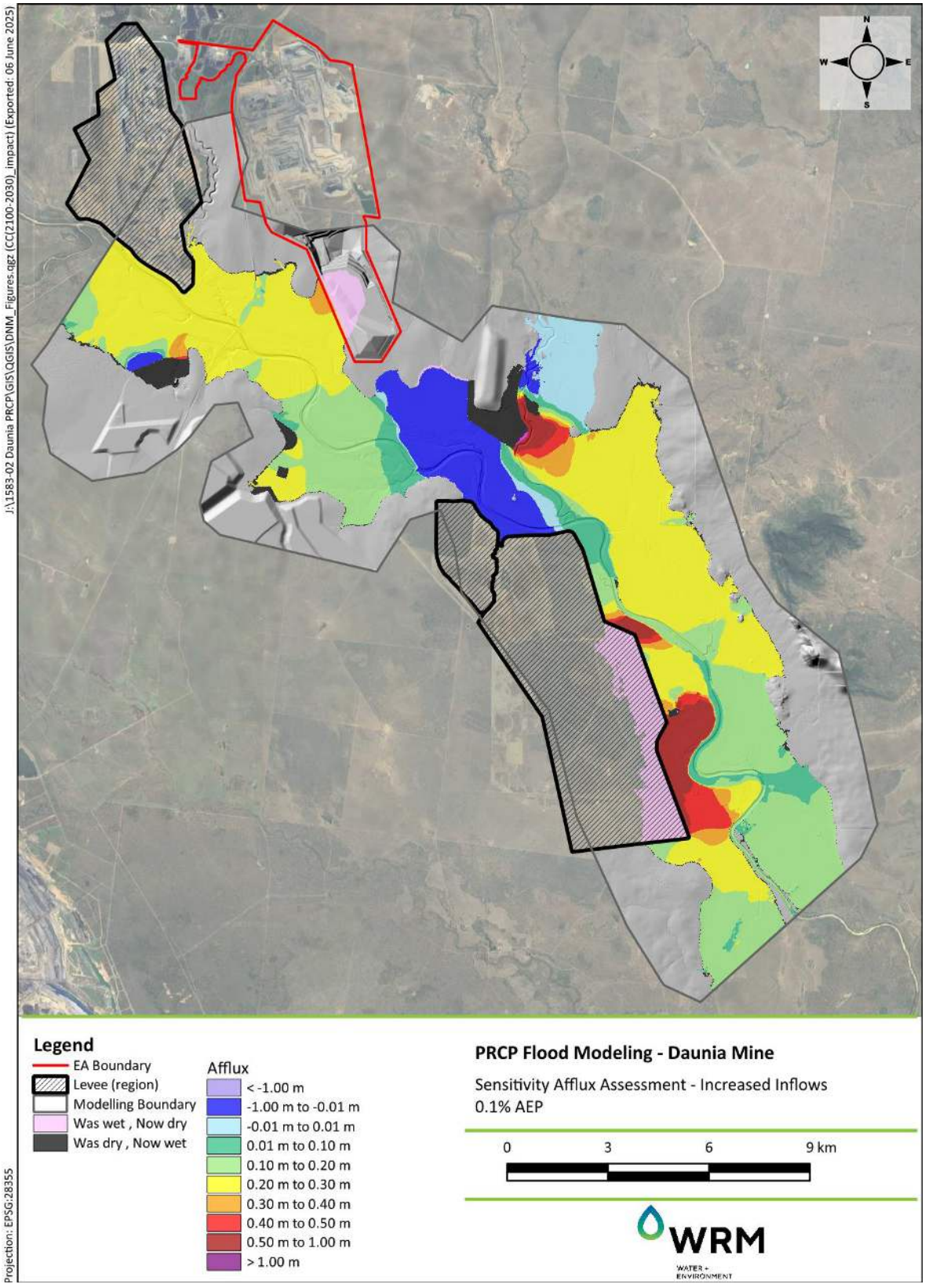

Figure 5.14 **Sensitivity impacts, increased discharges**

6 CONCLUSION

The Isaac River hydrologic and hydraulic models developed by WRM (2019) were updated to take advantage of updated and improved model versions. The FFA at Deverill was updated, to include the five (5) years of additional recorded data. The hydrologic and hydraulic models were updated to incorporate updated ARR2019 guidelines (Ball et al., 2019) on accounting for the effects of climate change on design discharges both in the present day and for projected future conditions

The updated models were re-calibrated, and validated against FFA results, before being used to predict peak existing conditions design flood extents, depths and velocities in the vicinity of DNM for the 0.1% AEP and PMF events.

The Isaac River hydrologic and hydraulic models developed by WRM (2019) were updated to take advantage of improved modelling tools and data. The flood frequency analysis (FFA) at Deverill was updated to include five (5) additional years of recorded streamflow data. The hydrologic and hydraulic models were also updated to incorporate the latest ARR2019 guidelines (Ball et al., 2019), accounting for the impacts of climate change under both present-day and future (post mining) conditions.

The updated models were recalibrated and validated against the revised FFA results before being used to predict flood behaviour for the 0.1% AEP and PMF events. Peak flood extents, depths, and velocities were predicted for each of the three scenarios (existing, pre-mining and post-mining).

Results show that there is no predicted ingress of Isaac River floodwaters into the residual void for the DNM final landform, for events up to and including the PMF, under post mining (+2.5 degrees warming at year 2100) conditions, and predicted peak velocities are less than 1.5 m/s. Results also show that the available freeboard for the proposed DNM final landform is more than the predicted potential change in peak flood levels estimated by the sensitivity analysis, and the predicted potential change in peak velocities is minor.

7 REFERENCES

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APPENDIX E FLOOD MODELLING

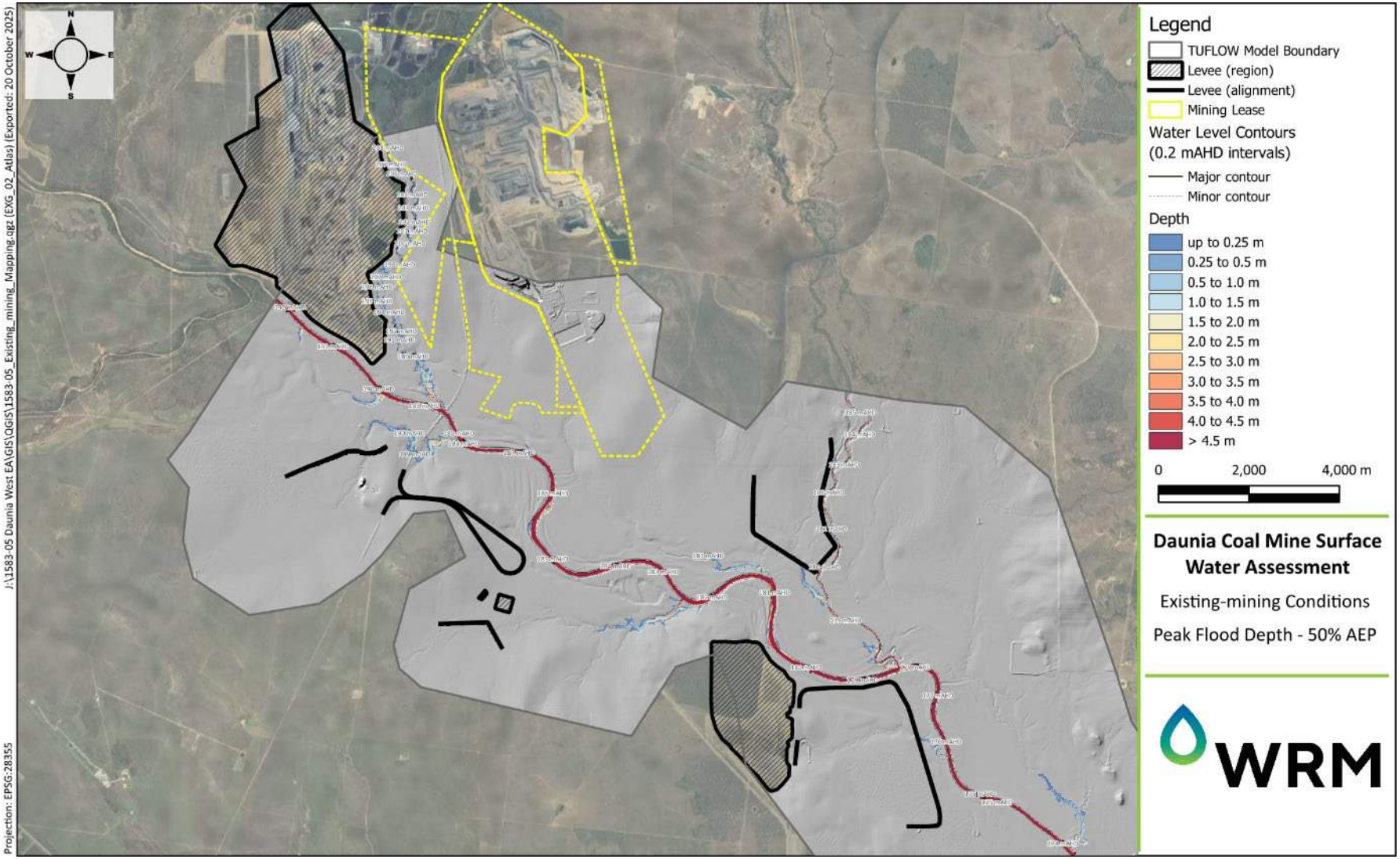


Figure E.1 Peak Flood Depth – 50% AEP – Existing-mining Conditions

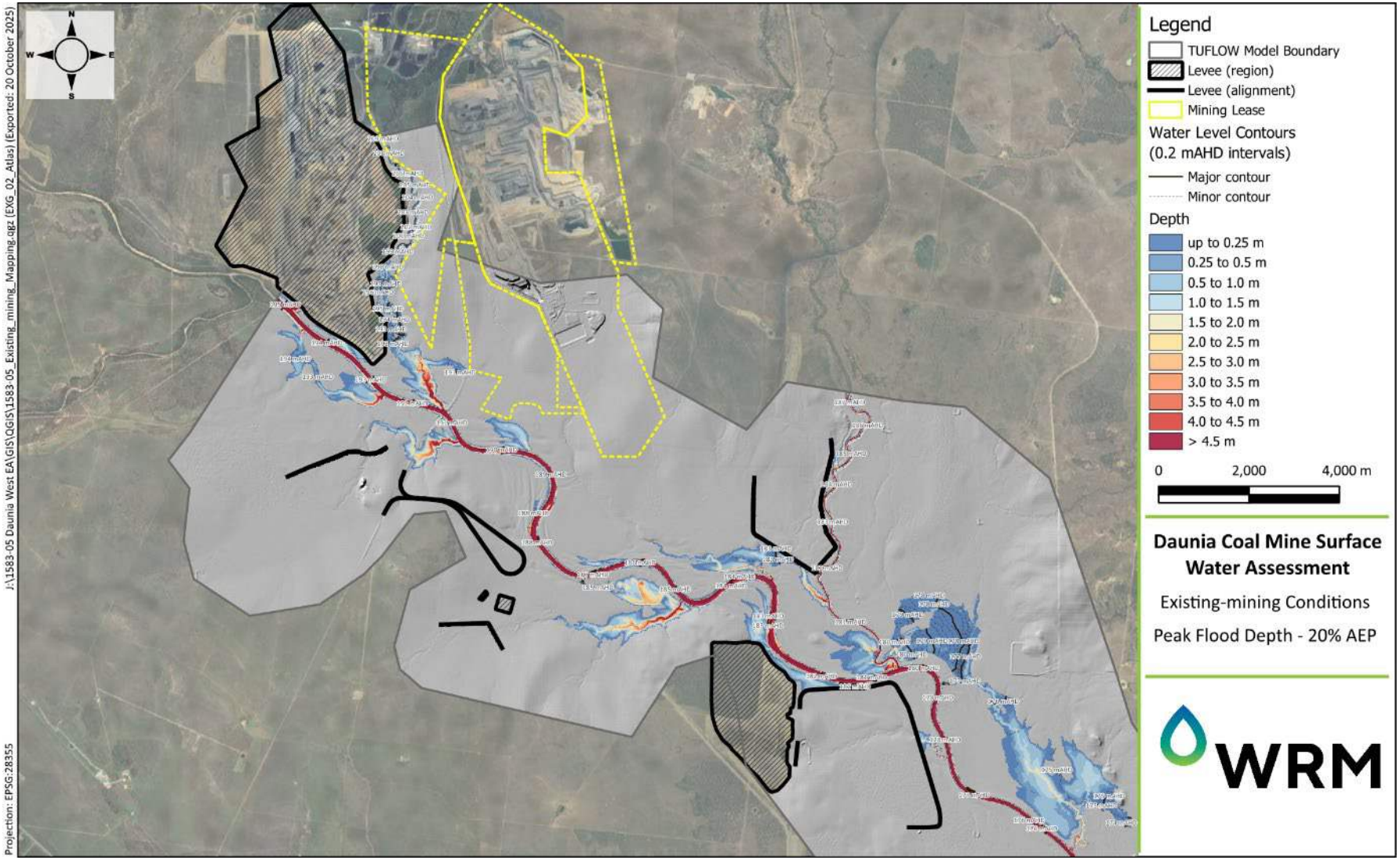


Figure E.2 Peak Flood Depth – 20% AEP – Existing-mining Conditions

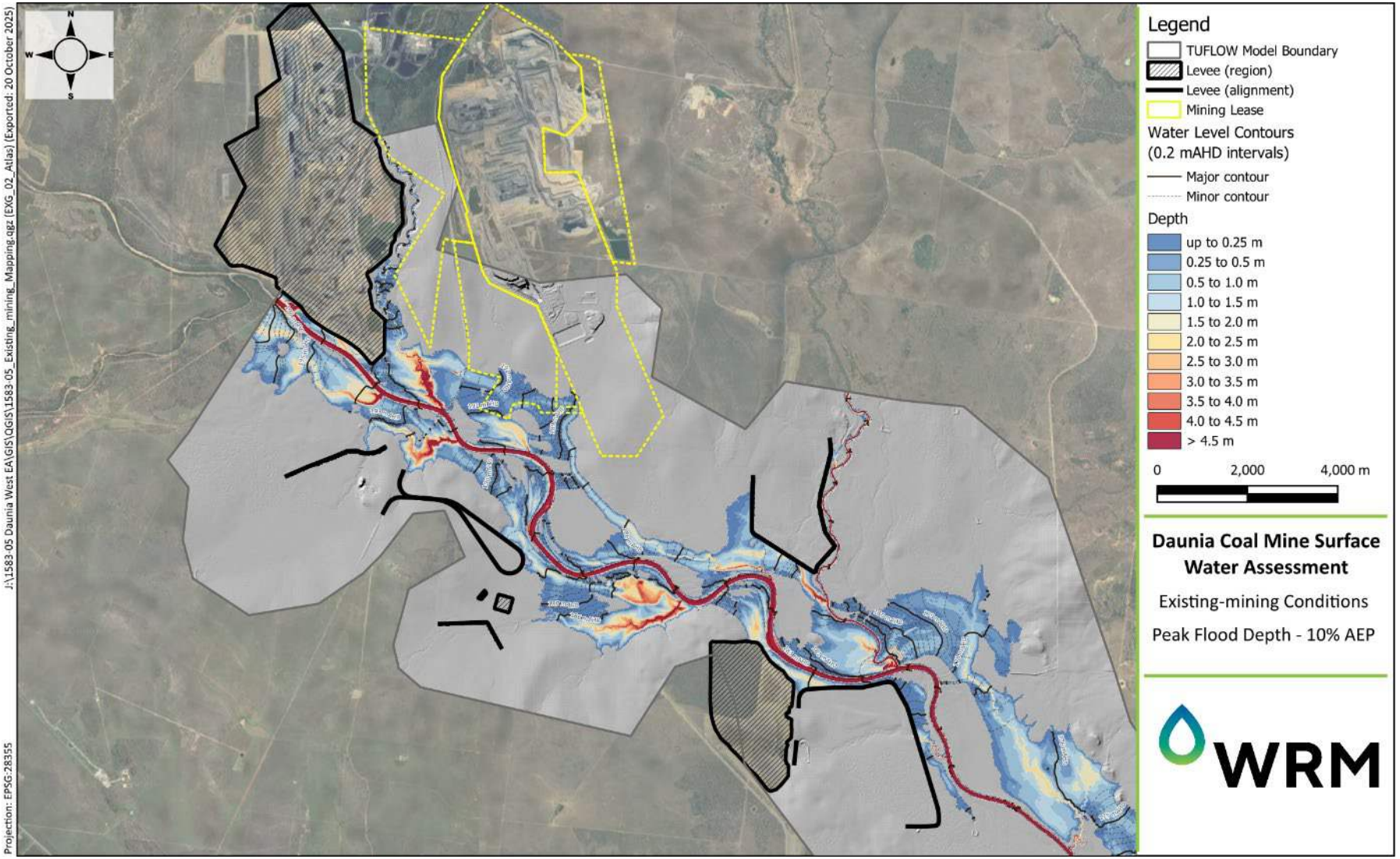


Figure E.3 Peak Flood Depth – 10% AEP – Existing-mining Conditions

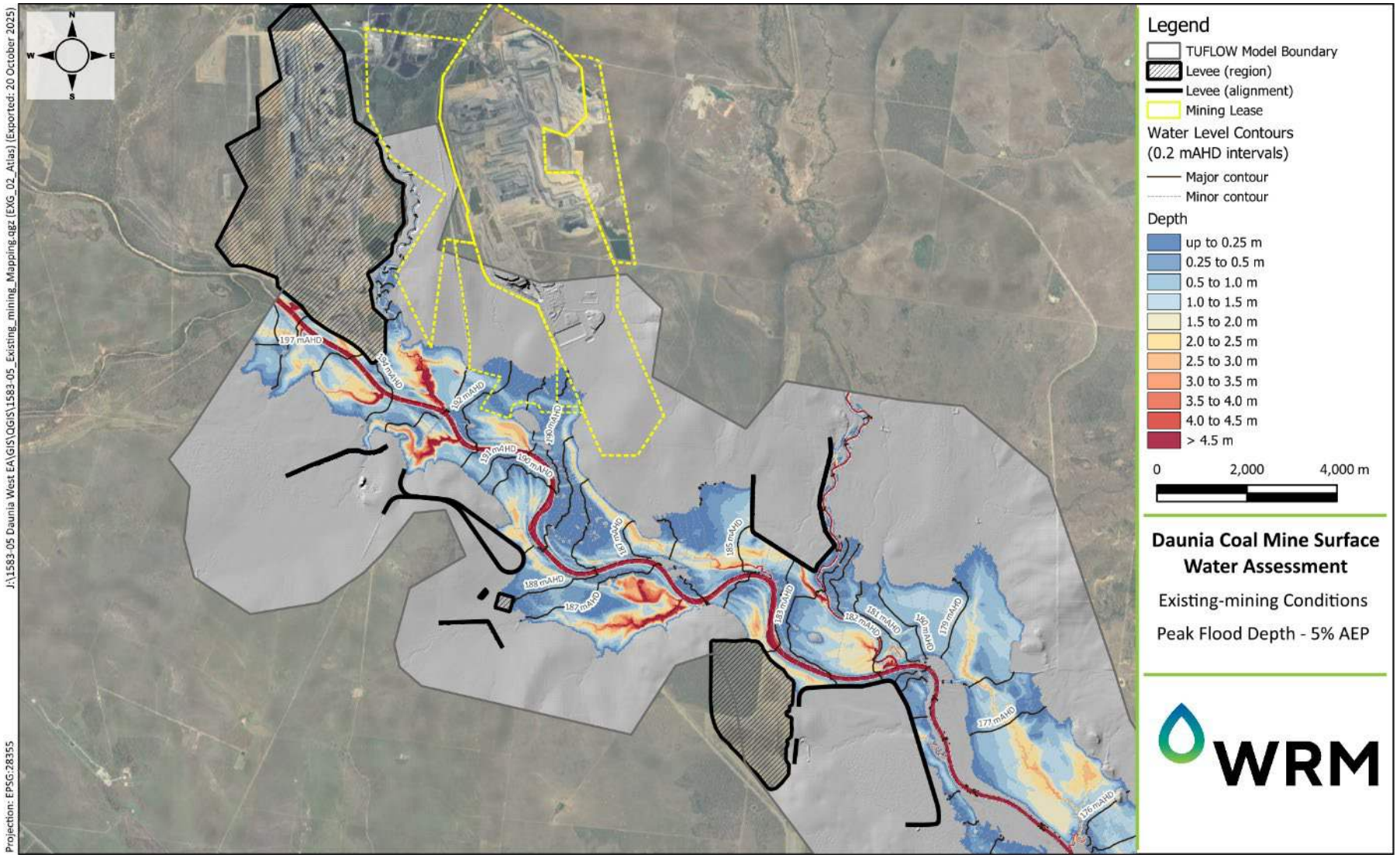


Figure E.4 Peak Flood Depth – 5% AEP – Existing-mining Conditions

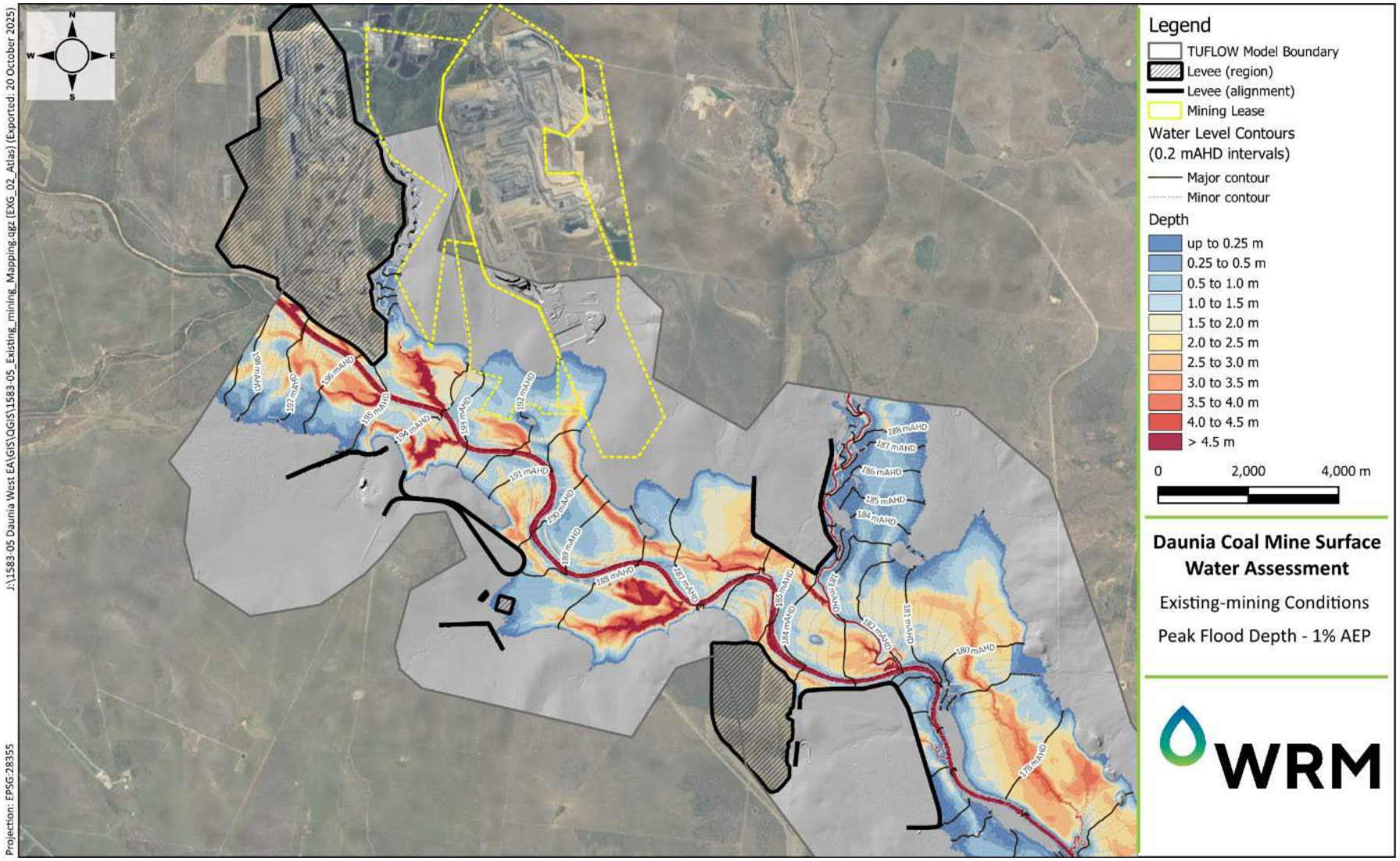


Figure E.5 Peak Flood Depth – 1% AEP – Existing-mining Conditions

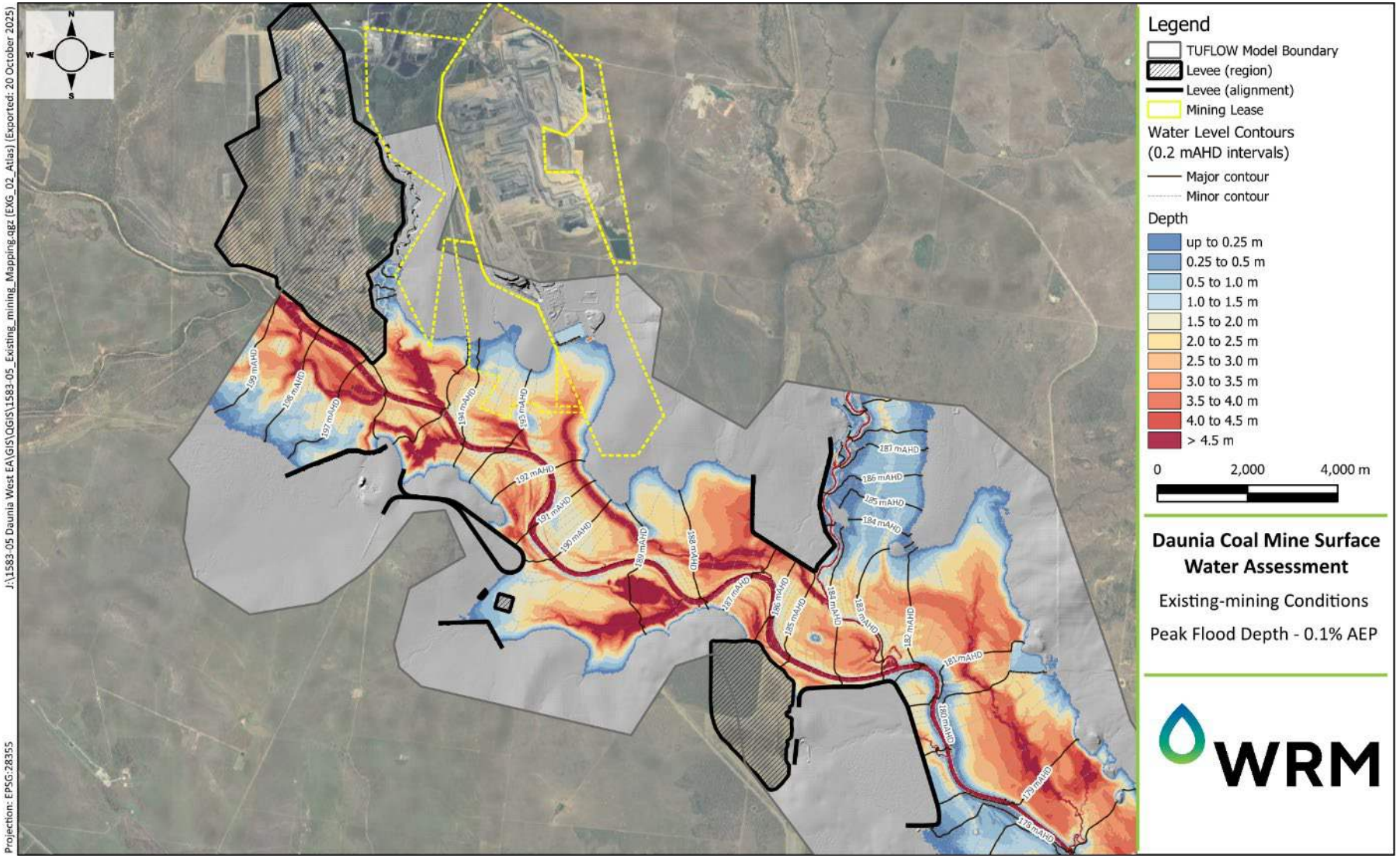


Figure E.6 Peak Flood Depth – 0.1% AEP – Existing-mining Conditions

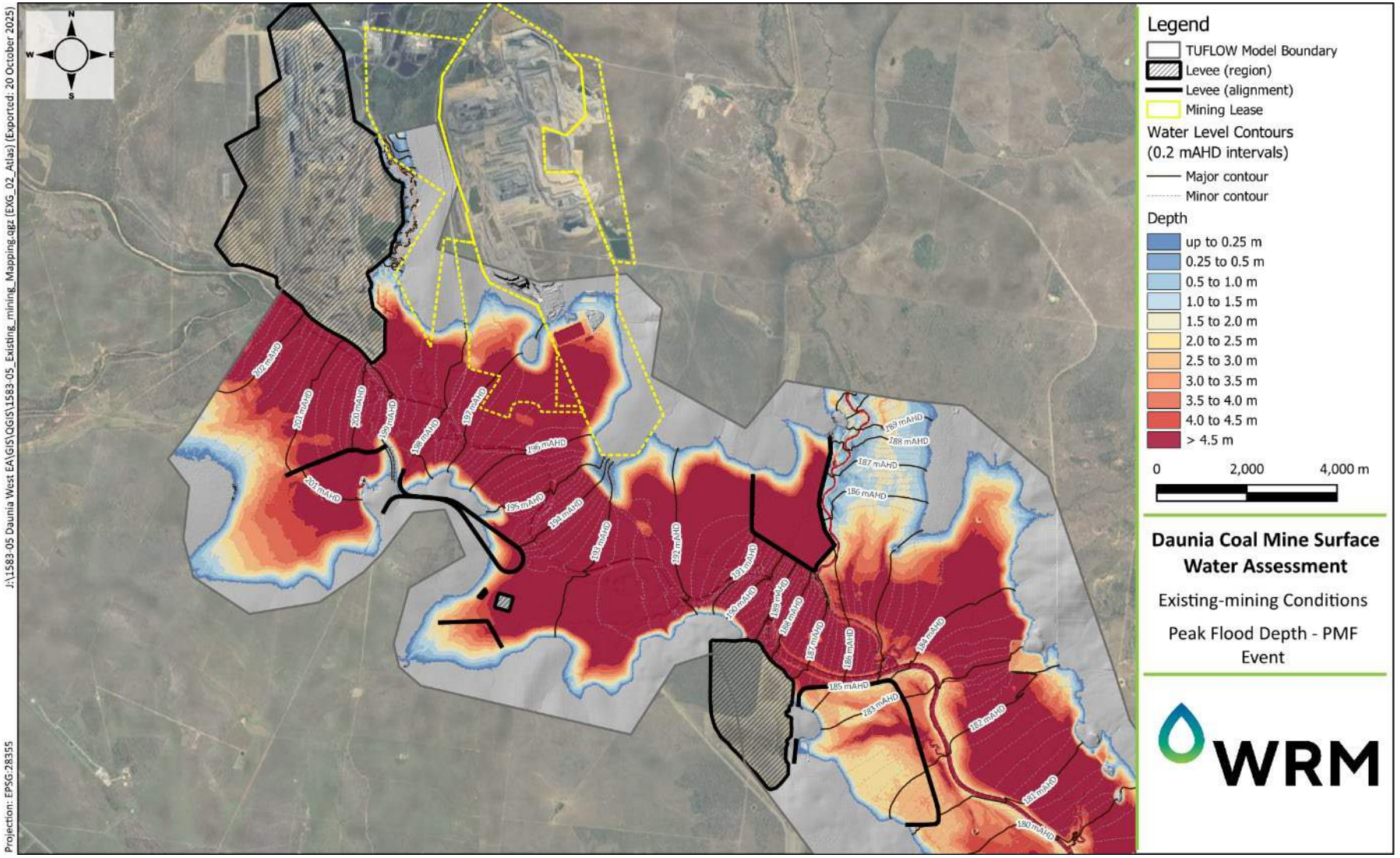


Figure E.7 Peak Flood Depth – PMF Event – Existing-mining Conditions

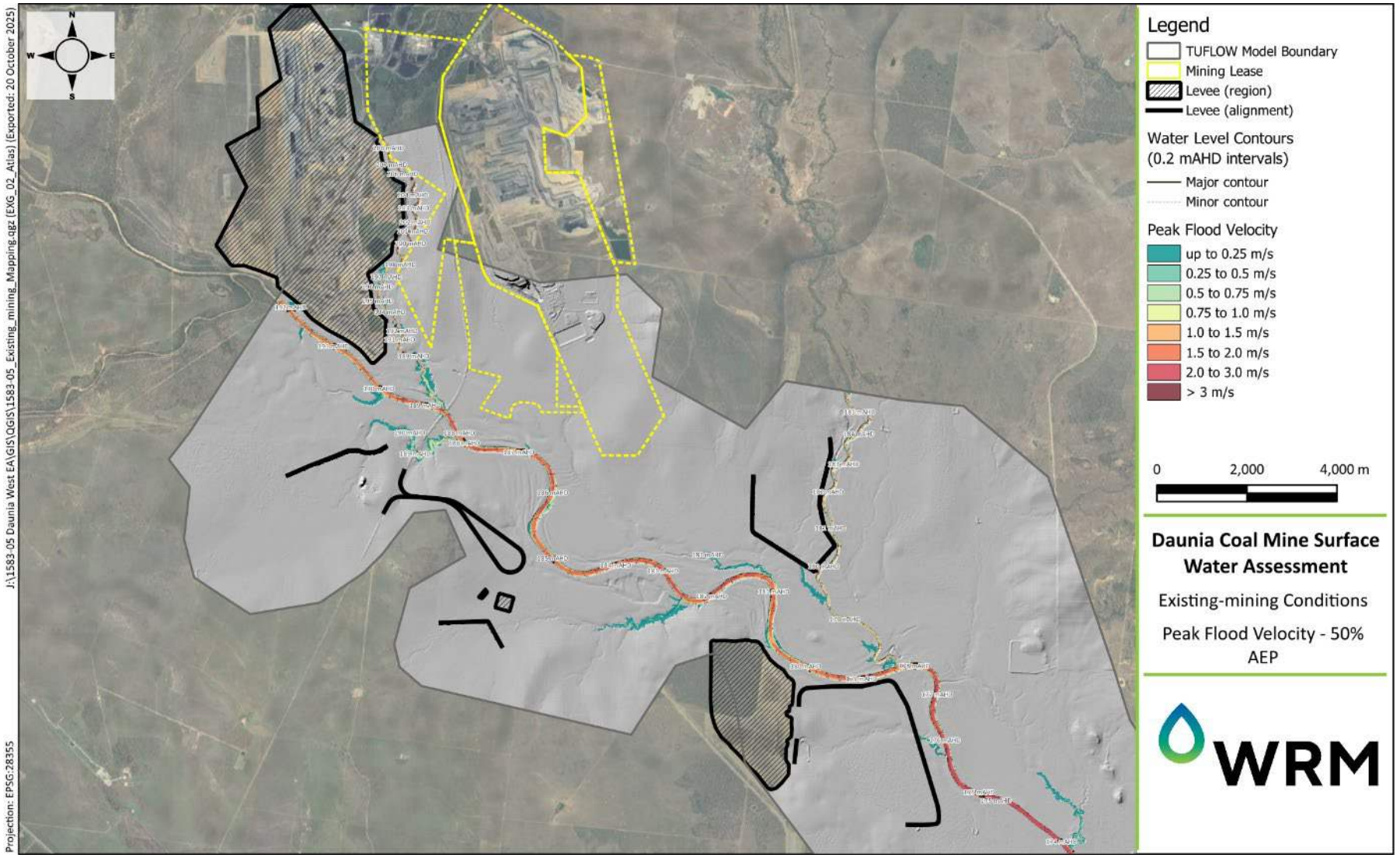


Figure E.8 Peak Flood Velocity – 50% AEP – Existing-mining Conditions

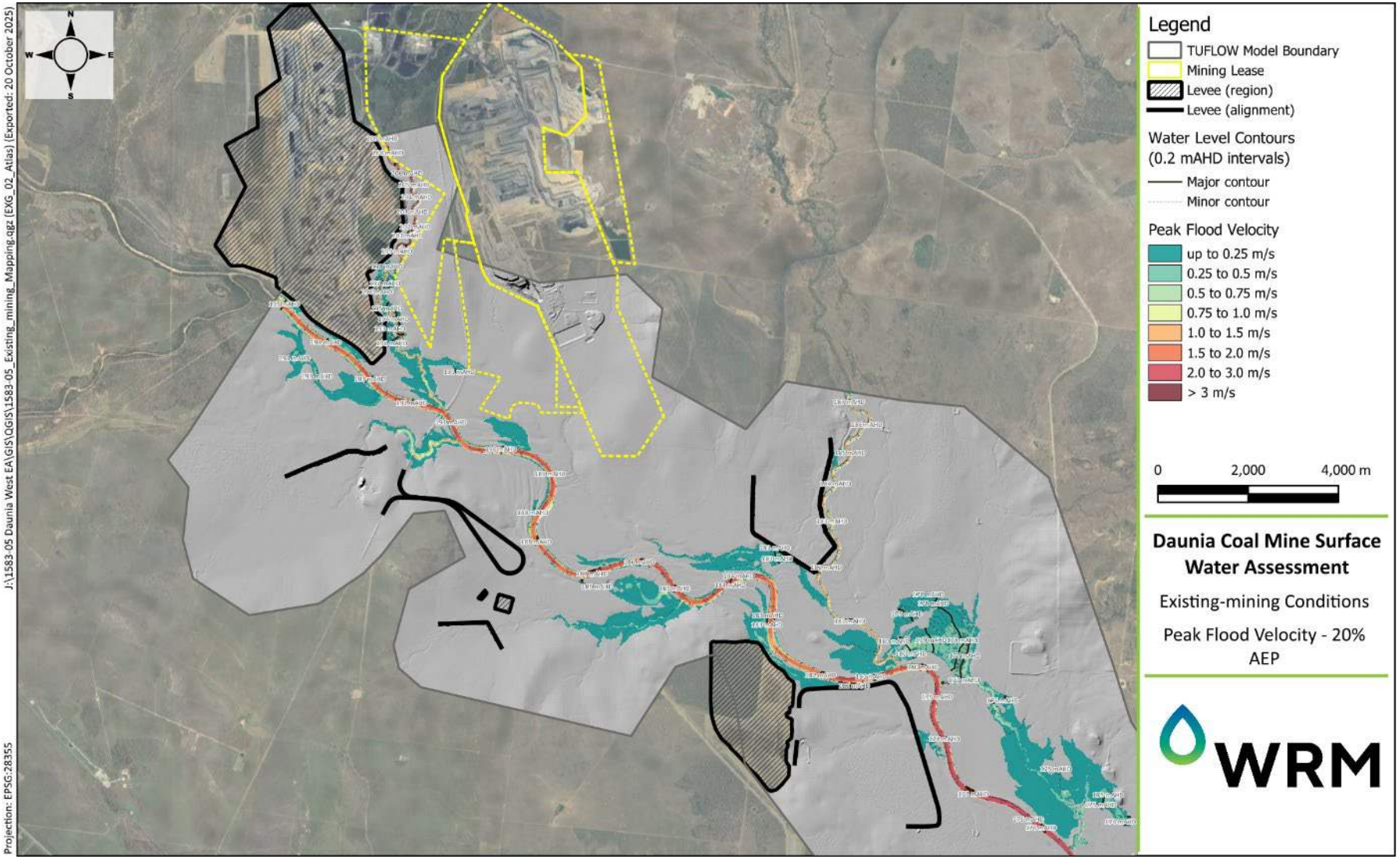


Figure E.9 Peak Flood Velocity – 20% AEP – Existing-mining Conditions

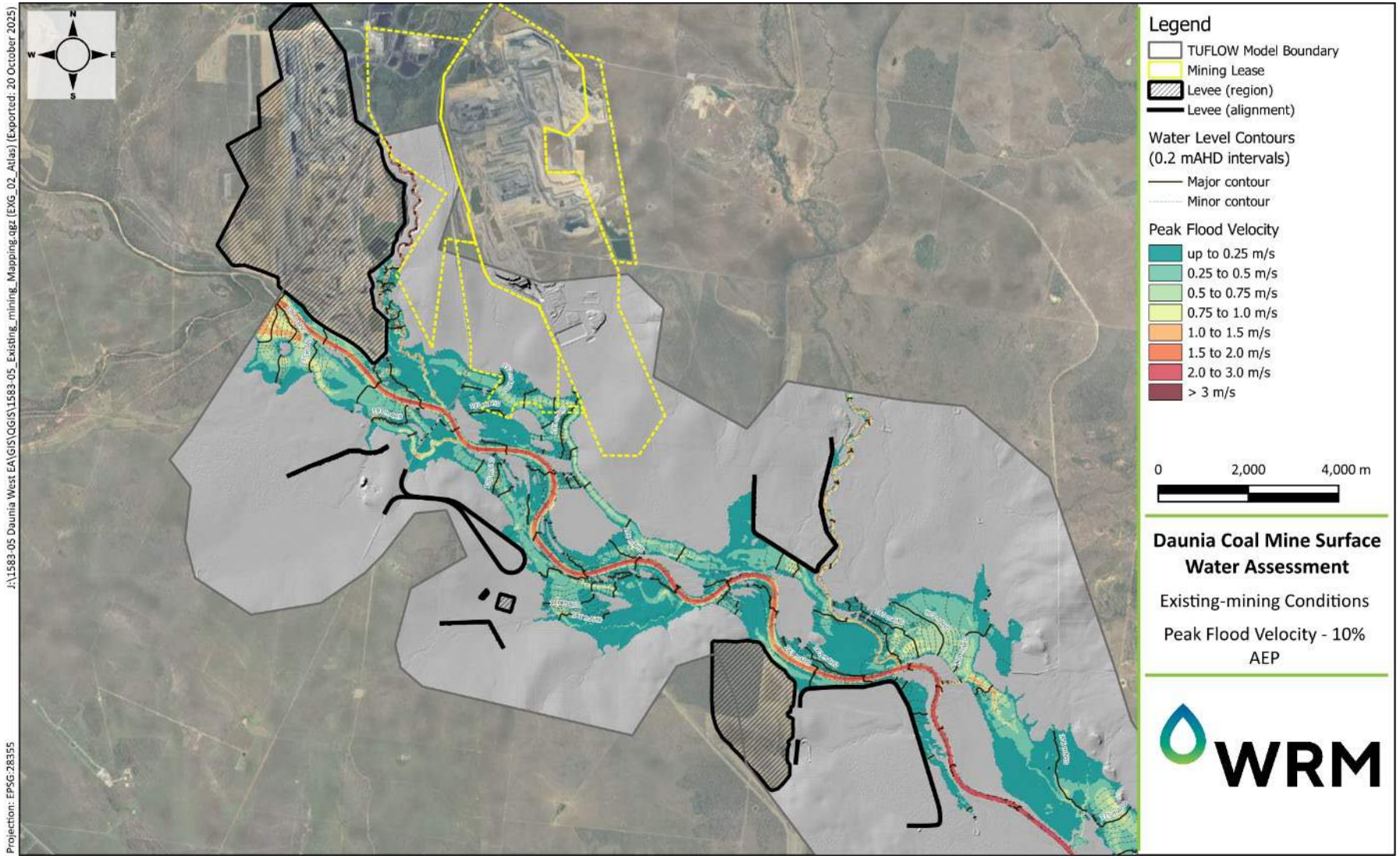


Figure E.10 **Peak Flood Velocity – 10% AEP – Existing-mining Conditions**

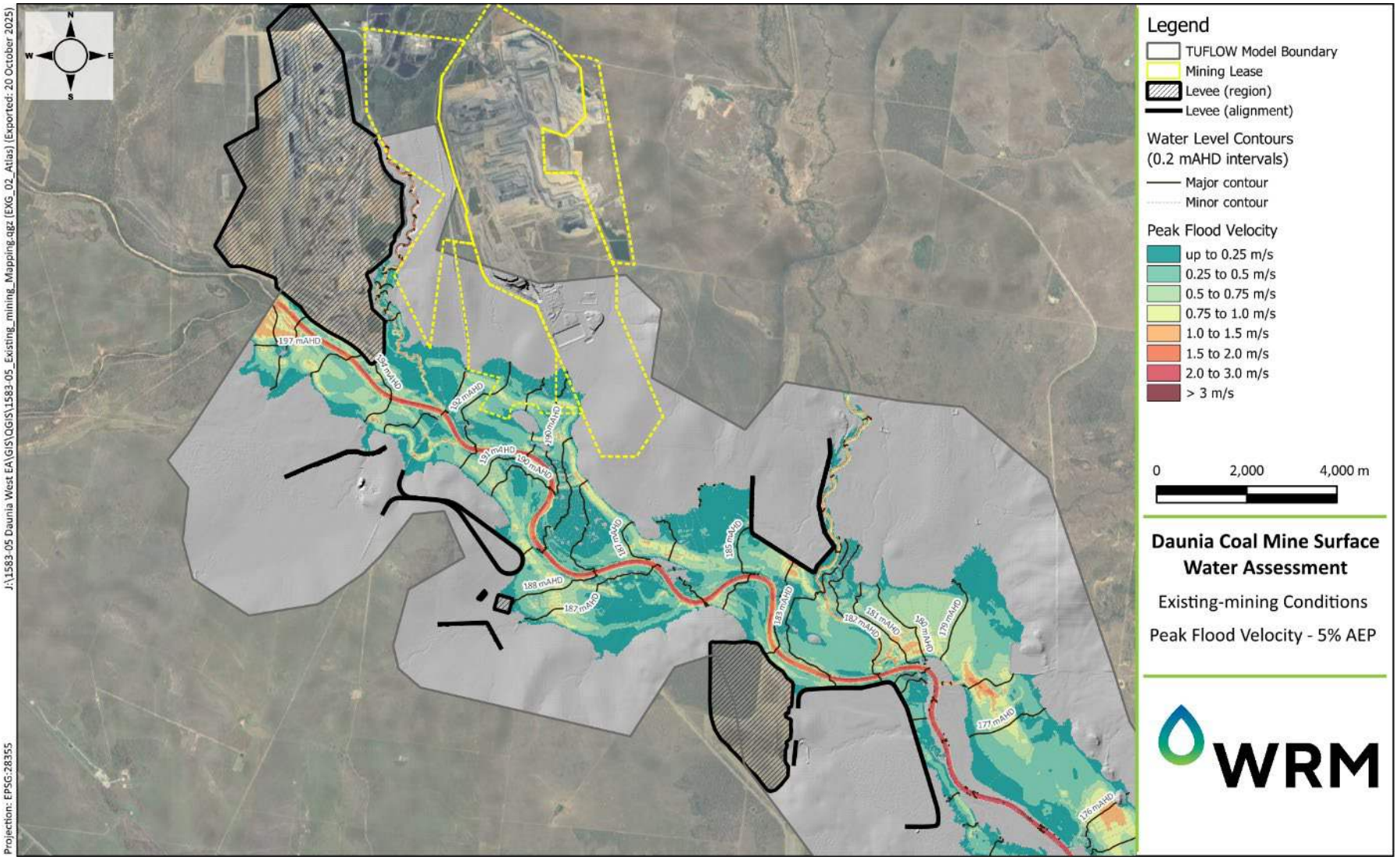
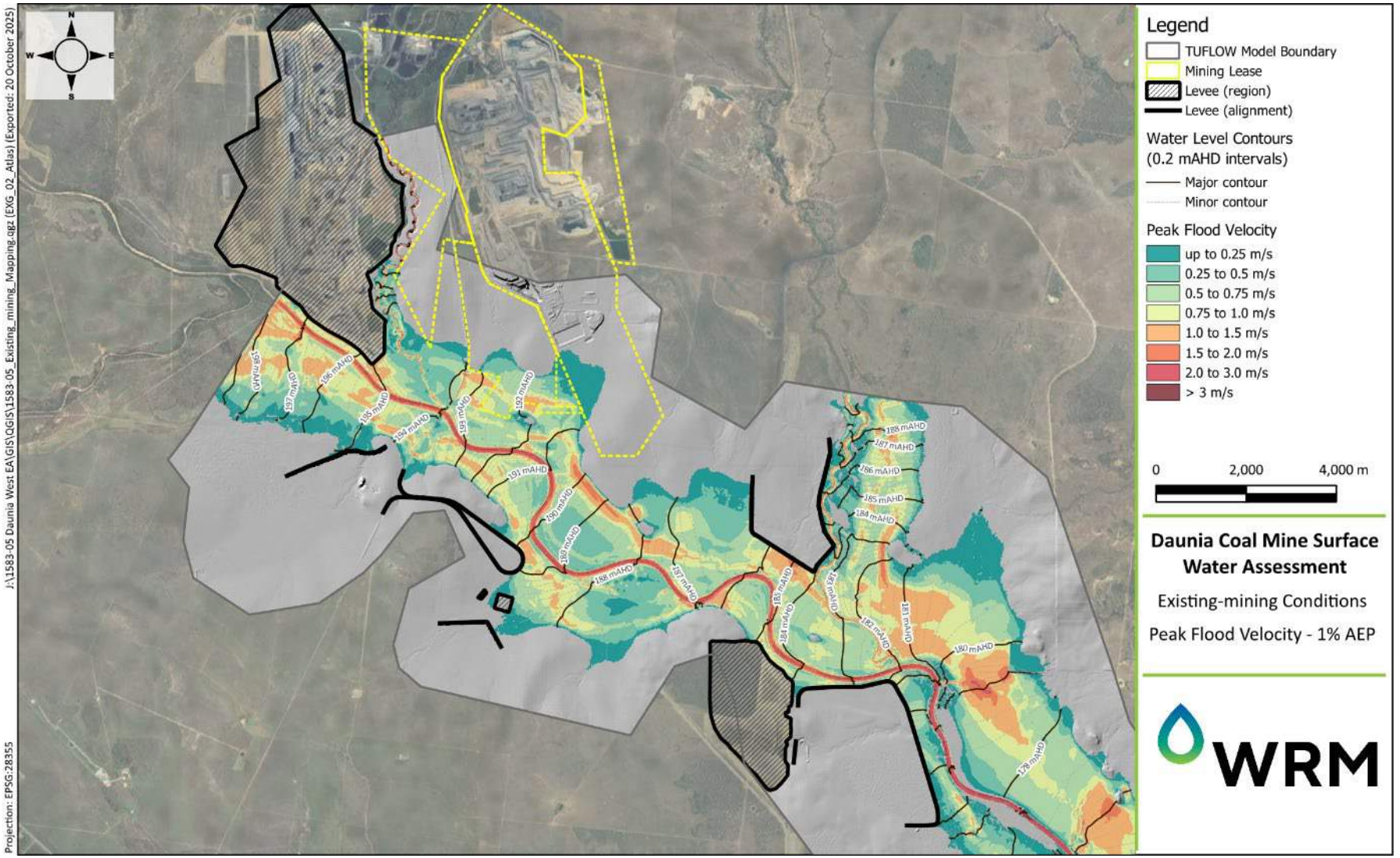


Figure E.11 **Peak Flood Velocity – 5% AEP – Existing-mining Conditions**



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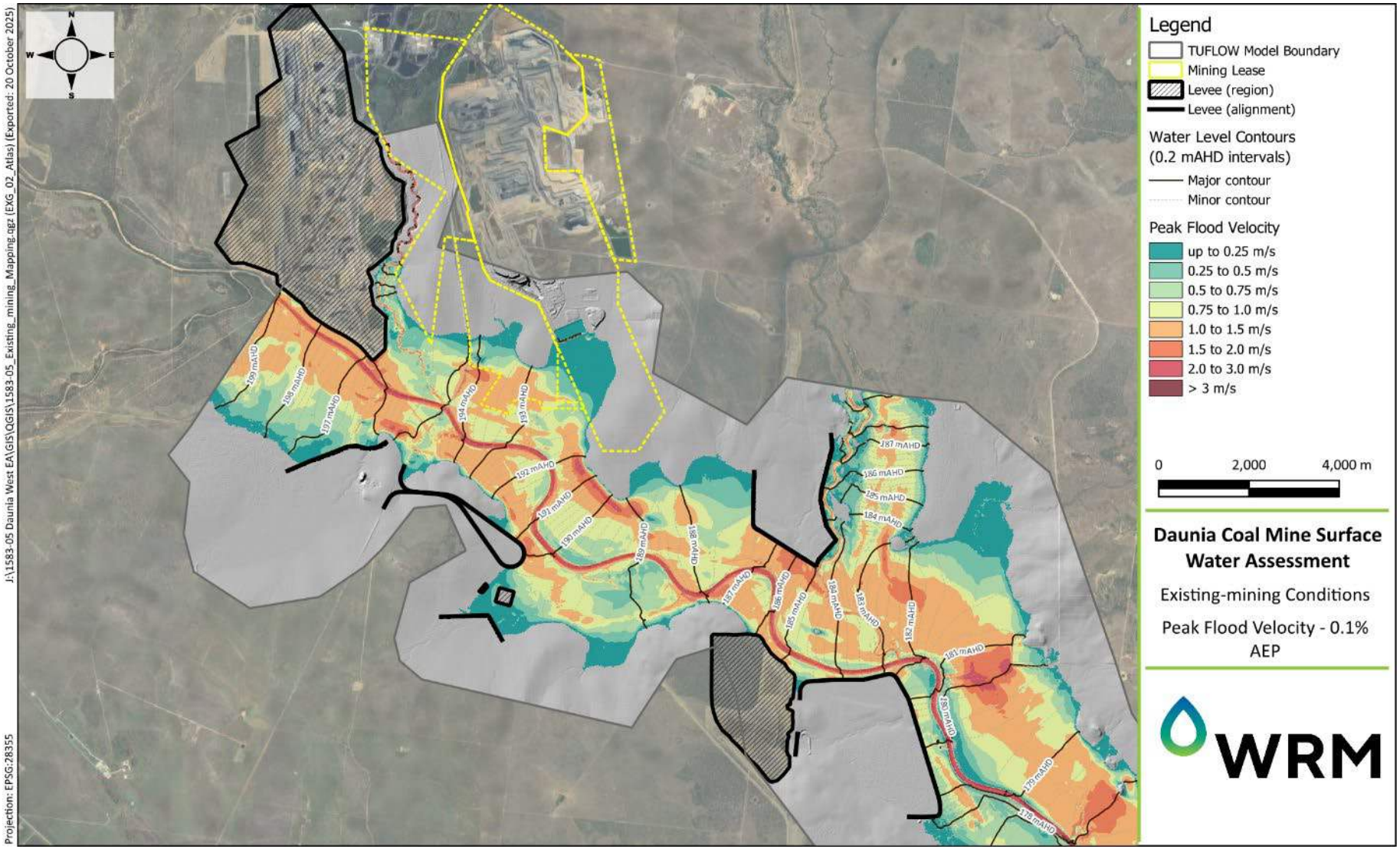


Figure E.13 **Peak Flood Velocity – 0.1% AEP – Existing-mining Conditions**

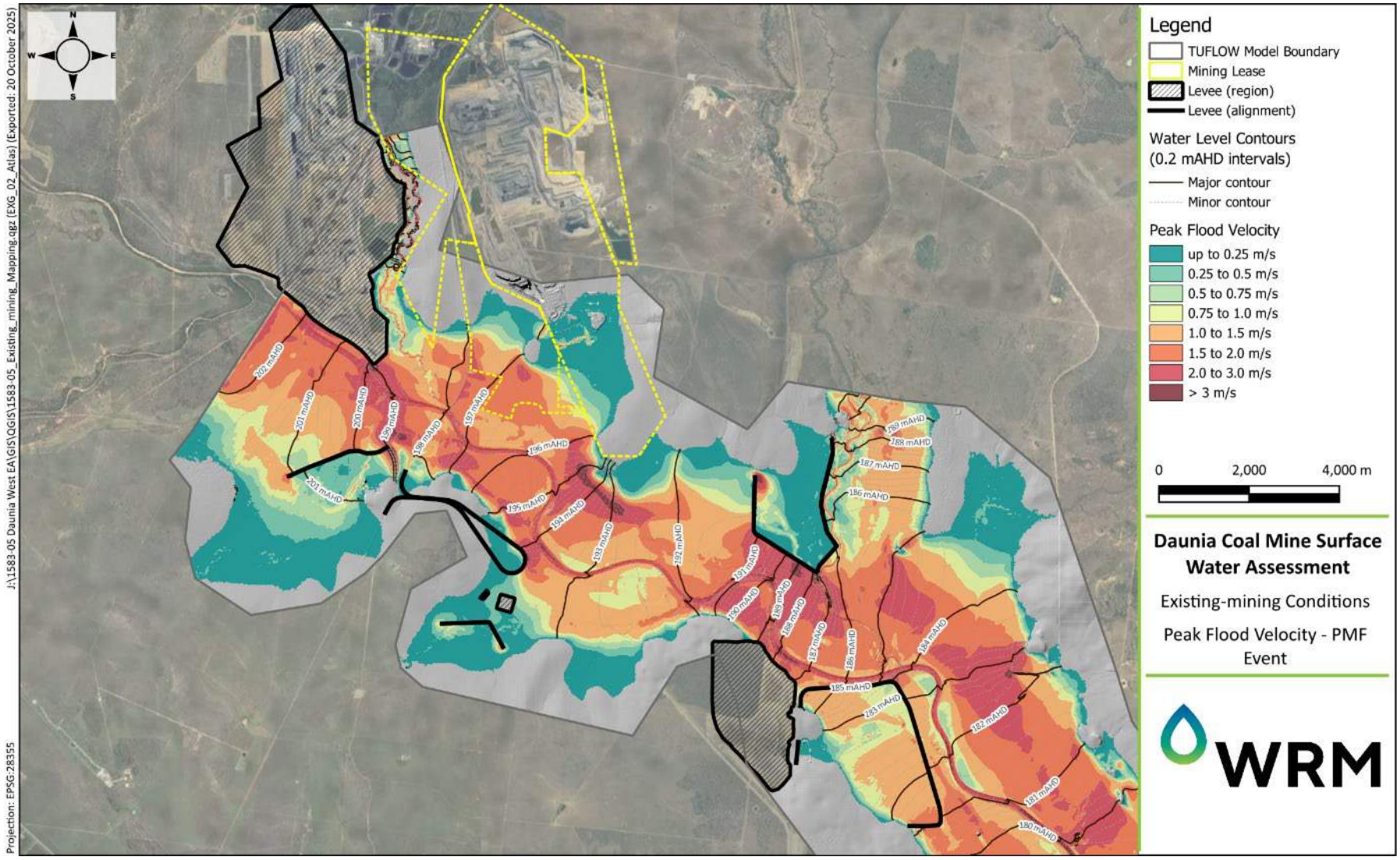


Figure E.14 **Peak Flood Velocity – PMF Event – Existing-mining Conditions**

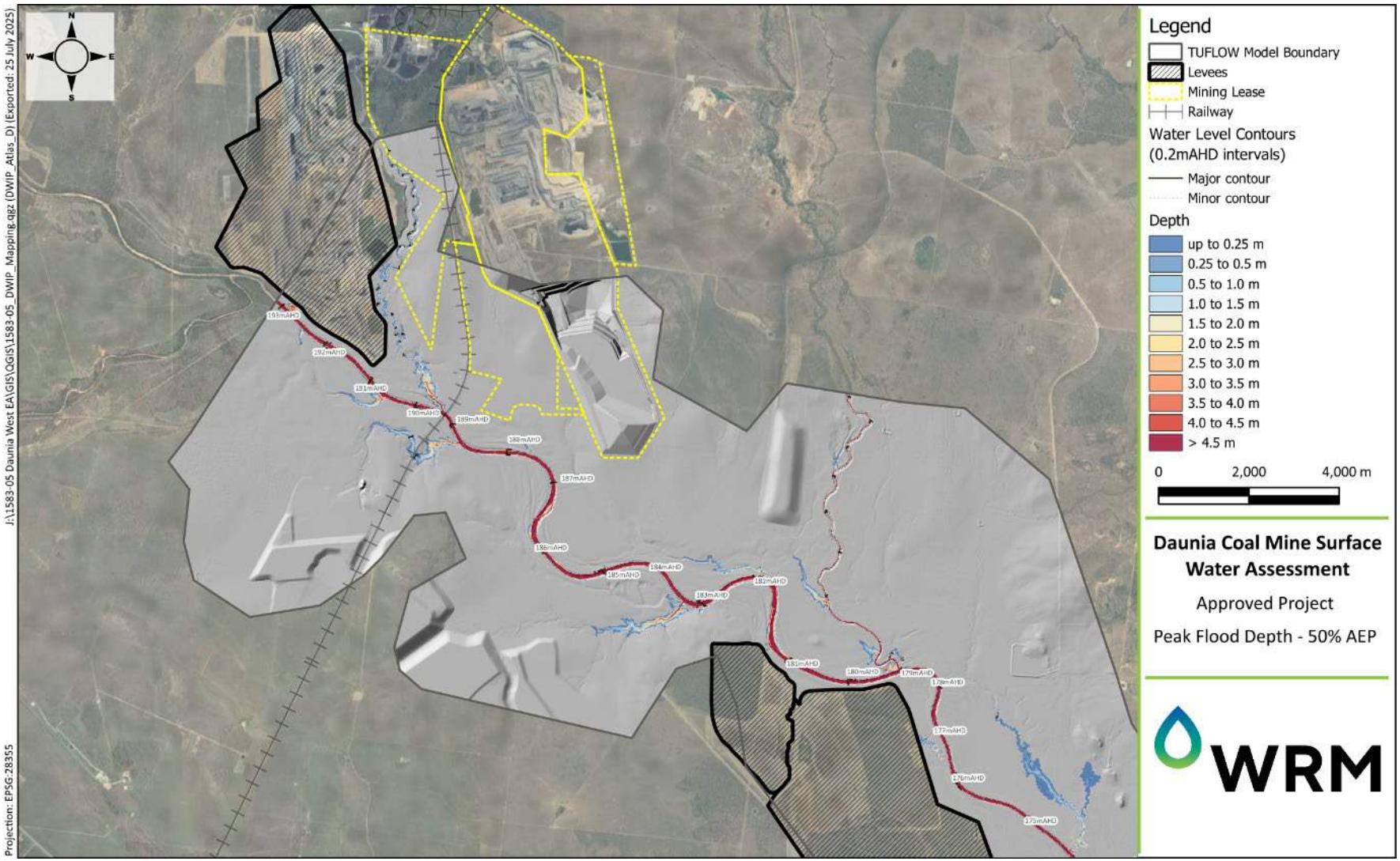


Figure E.25 **Peak Flood Depth – 50% AEP – Approved EA**

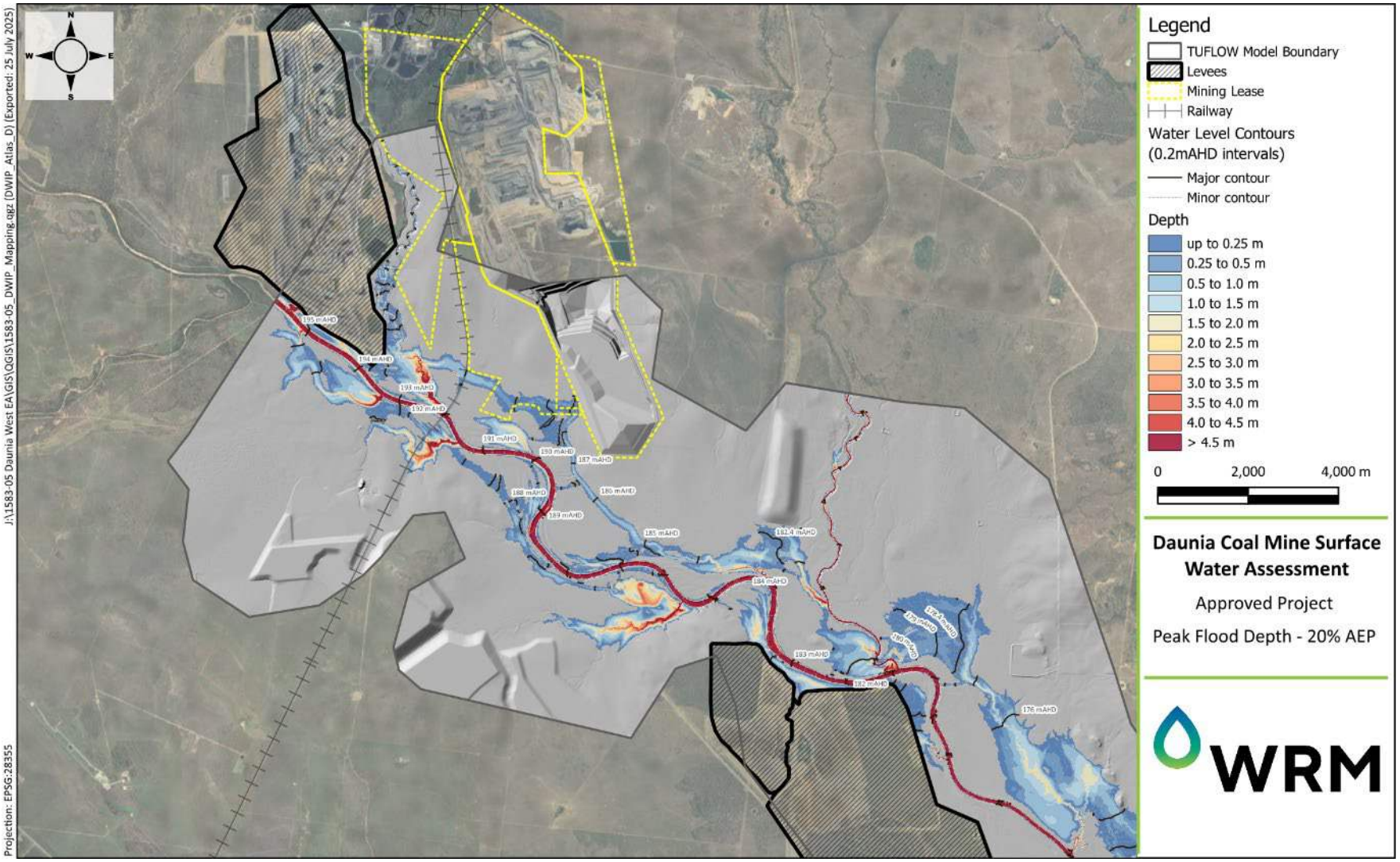
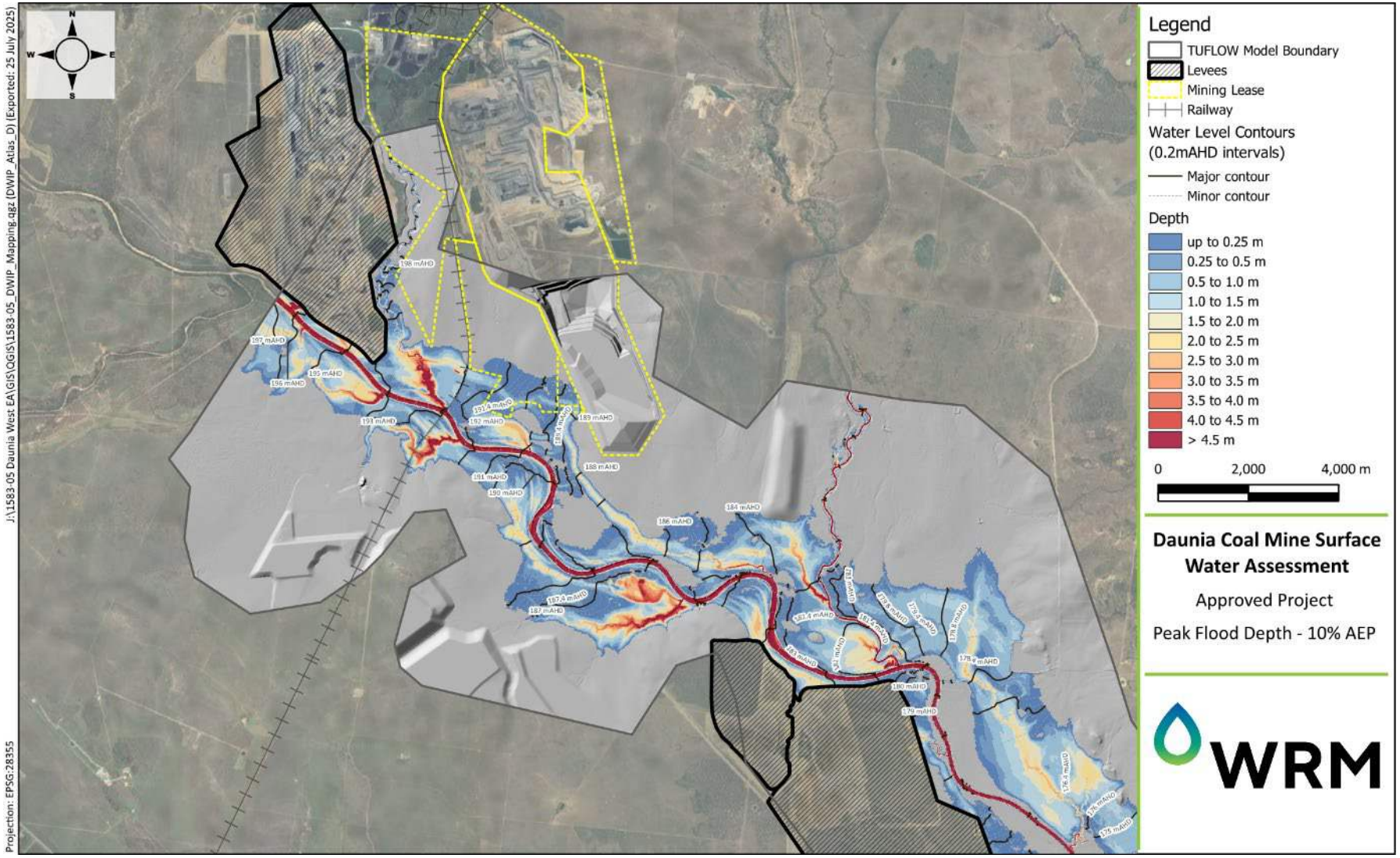


Figure E.16 **Peak Flood Depth – 20% AEP – Approved EA**



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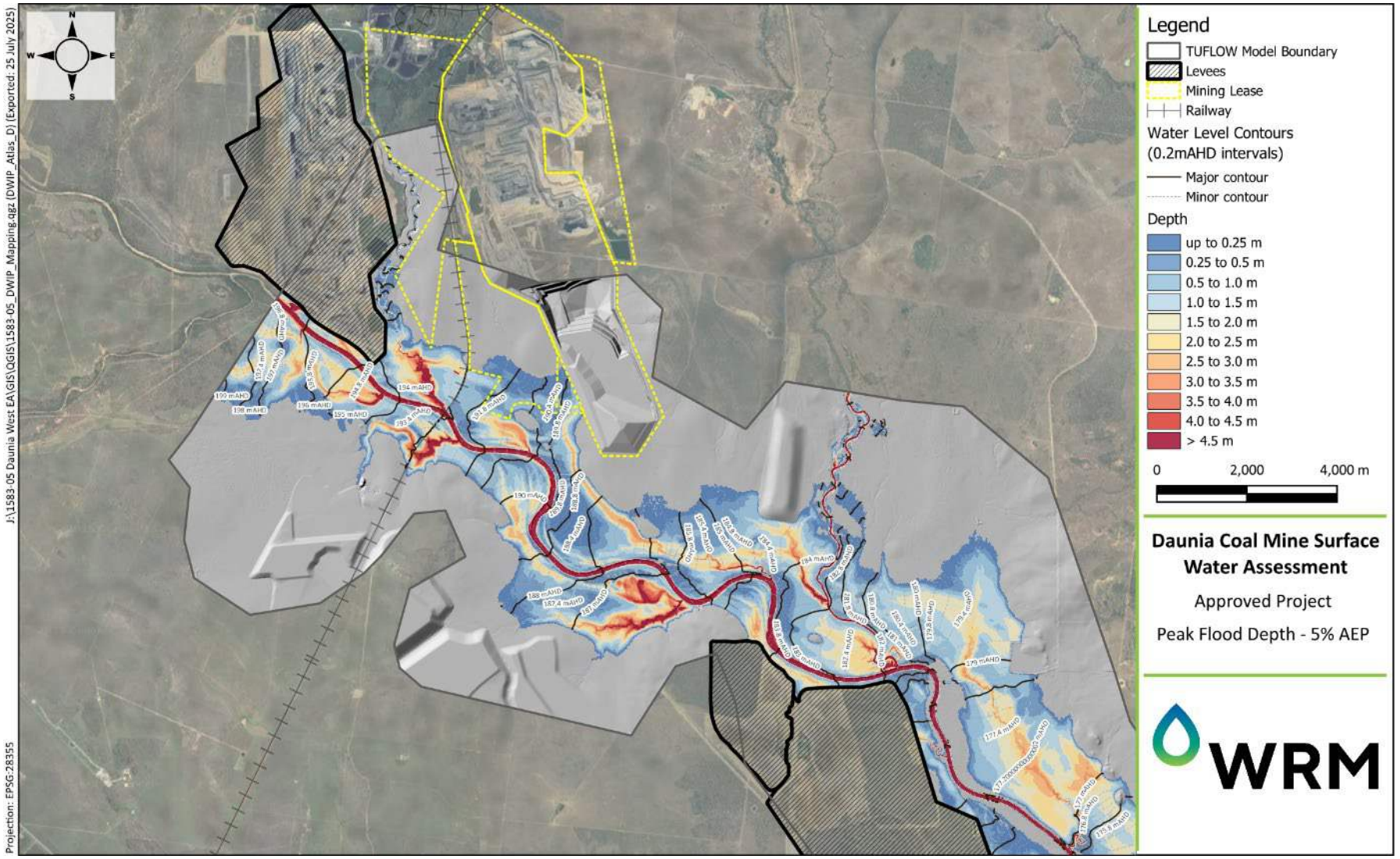

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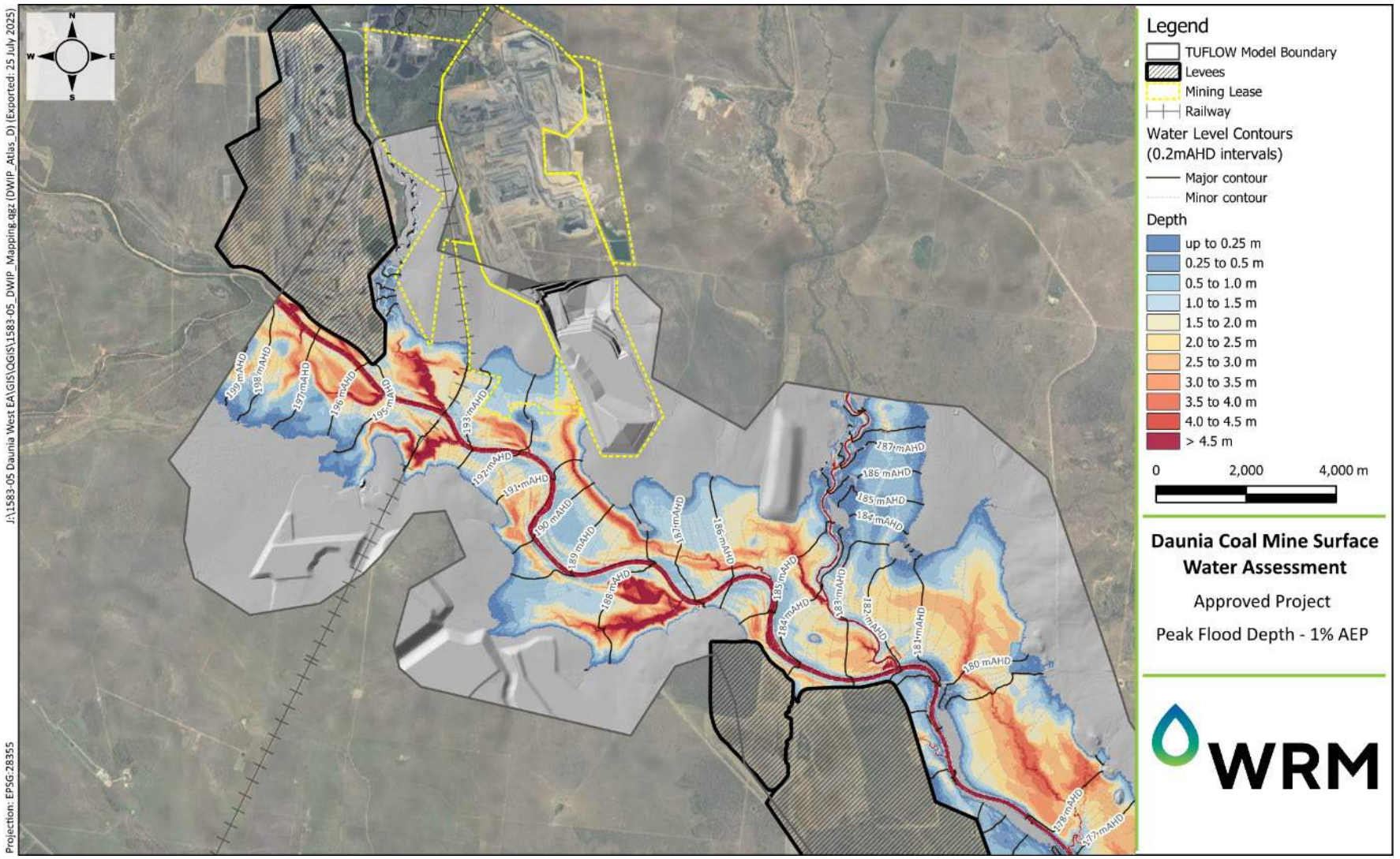

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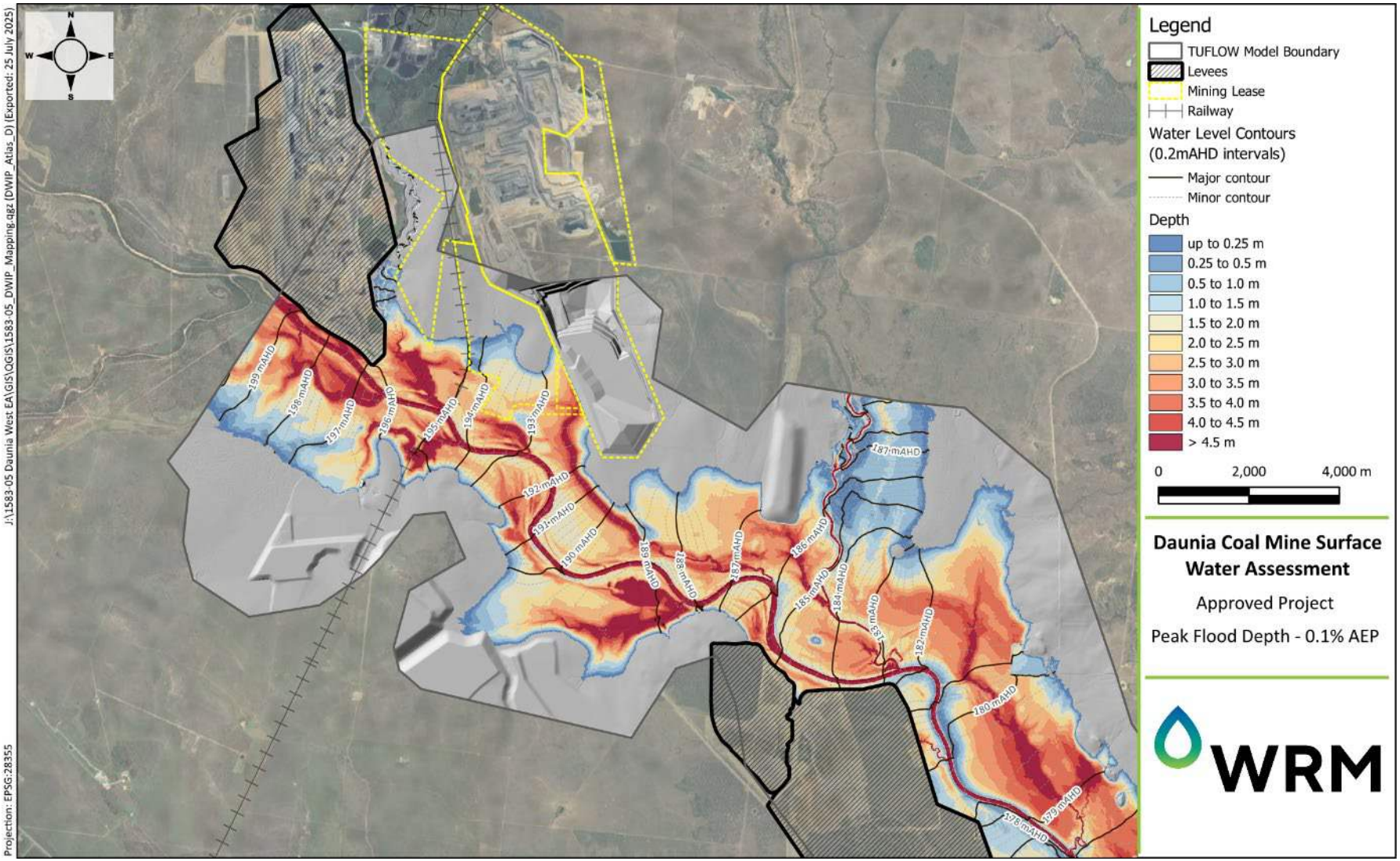

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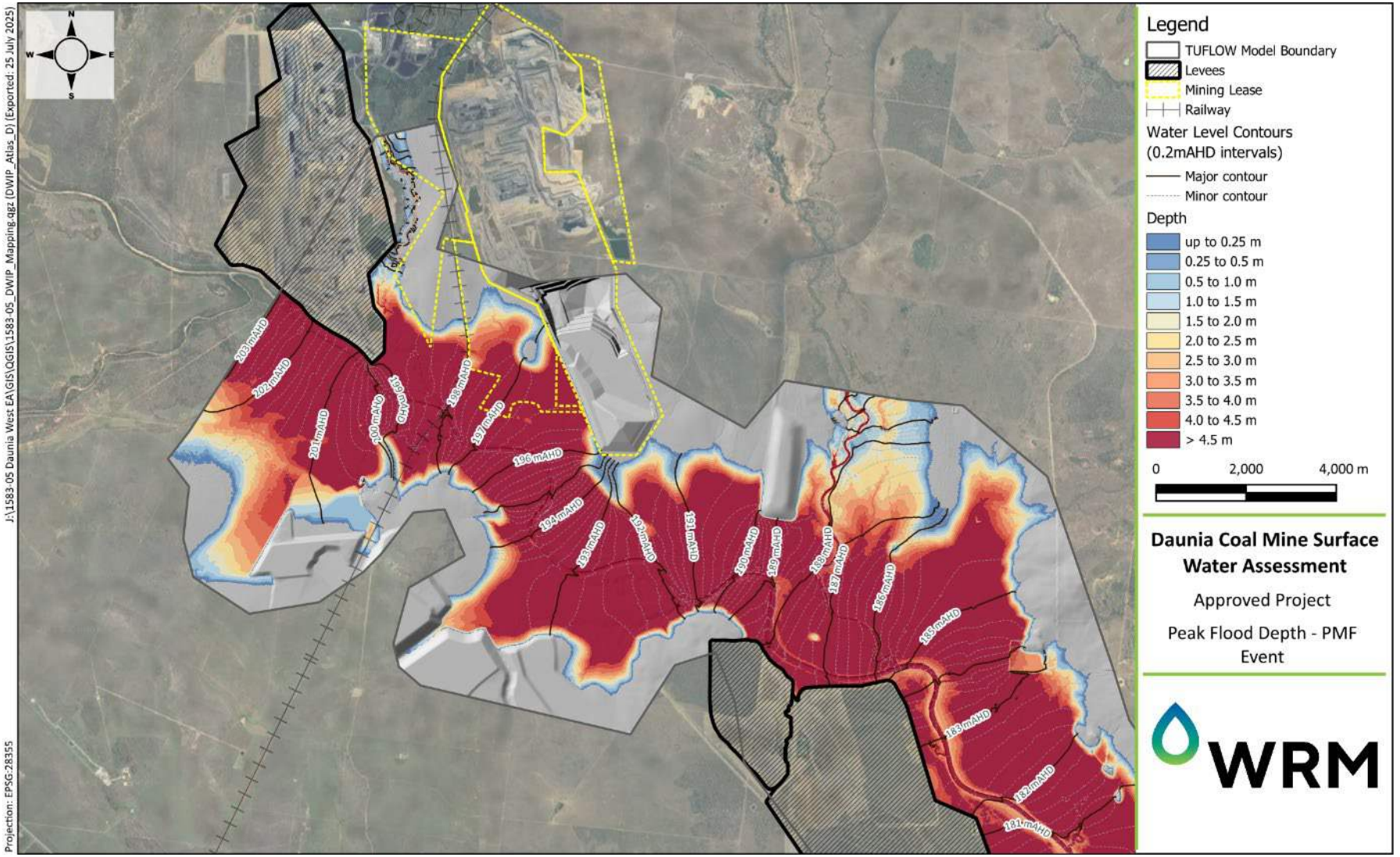

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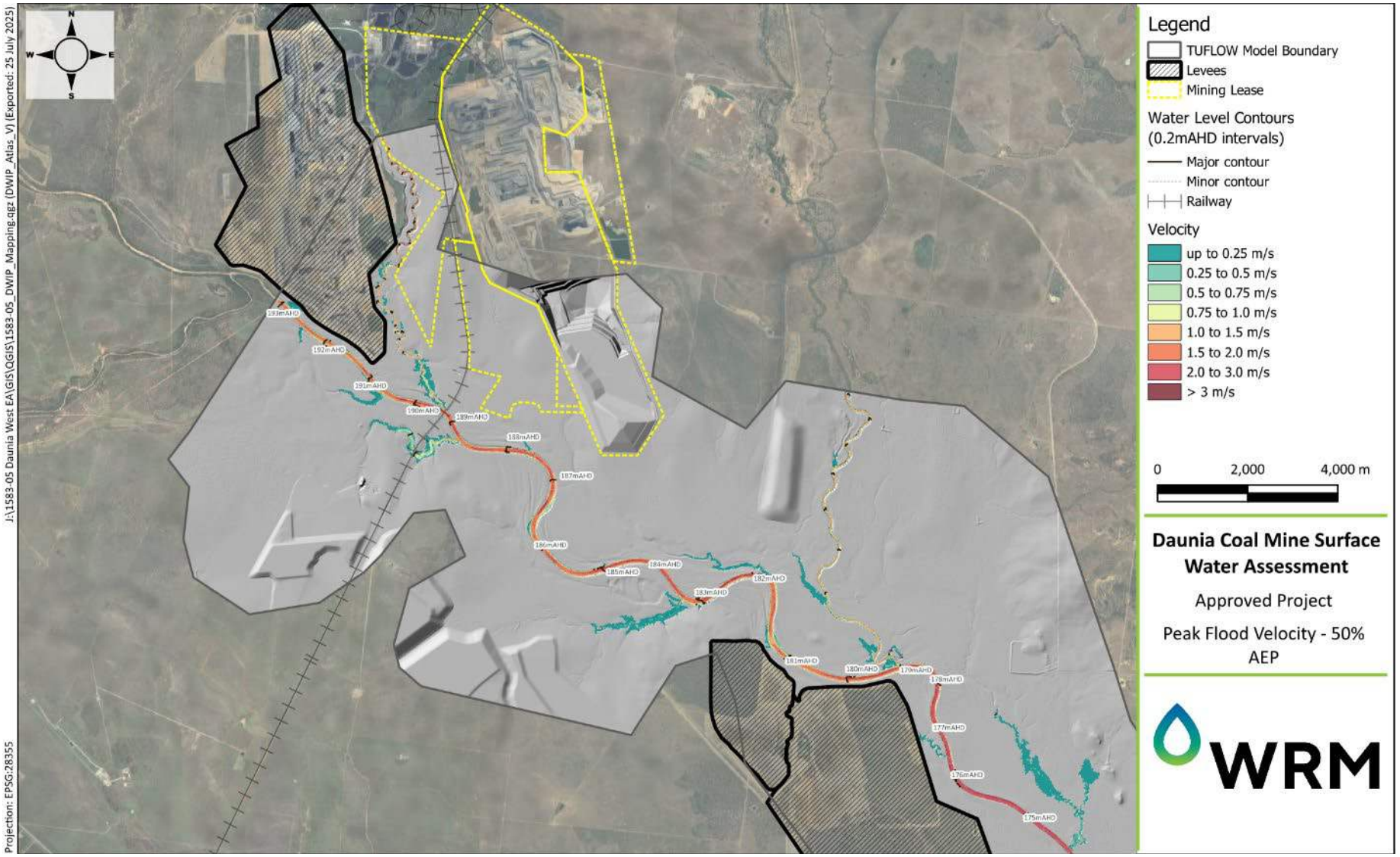
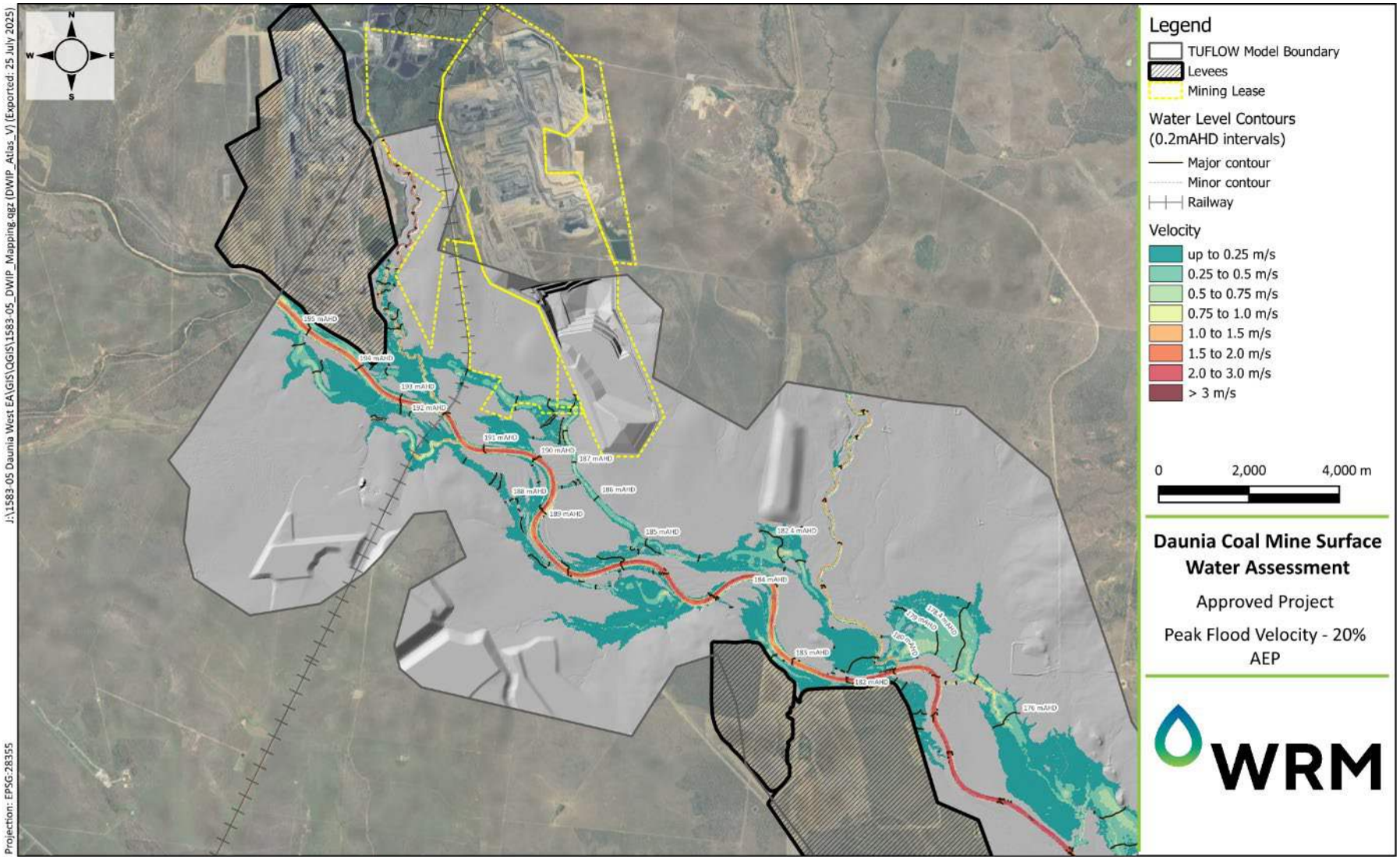


Figure E.22 **Peak Flood Velocity – 50% AEP – Approved EA**



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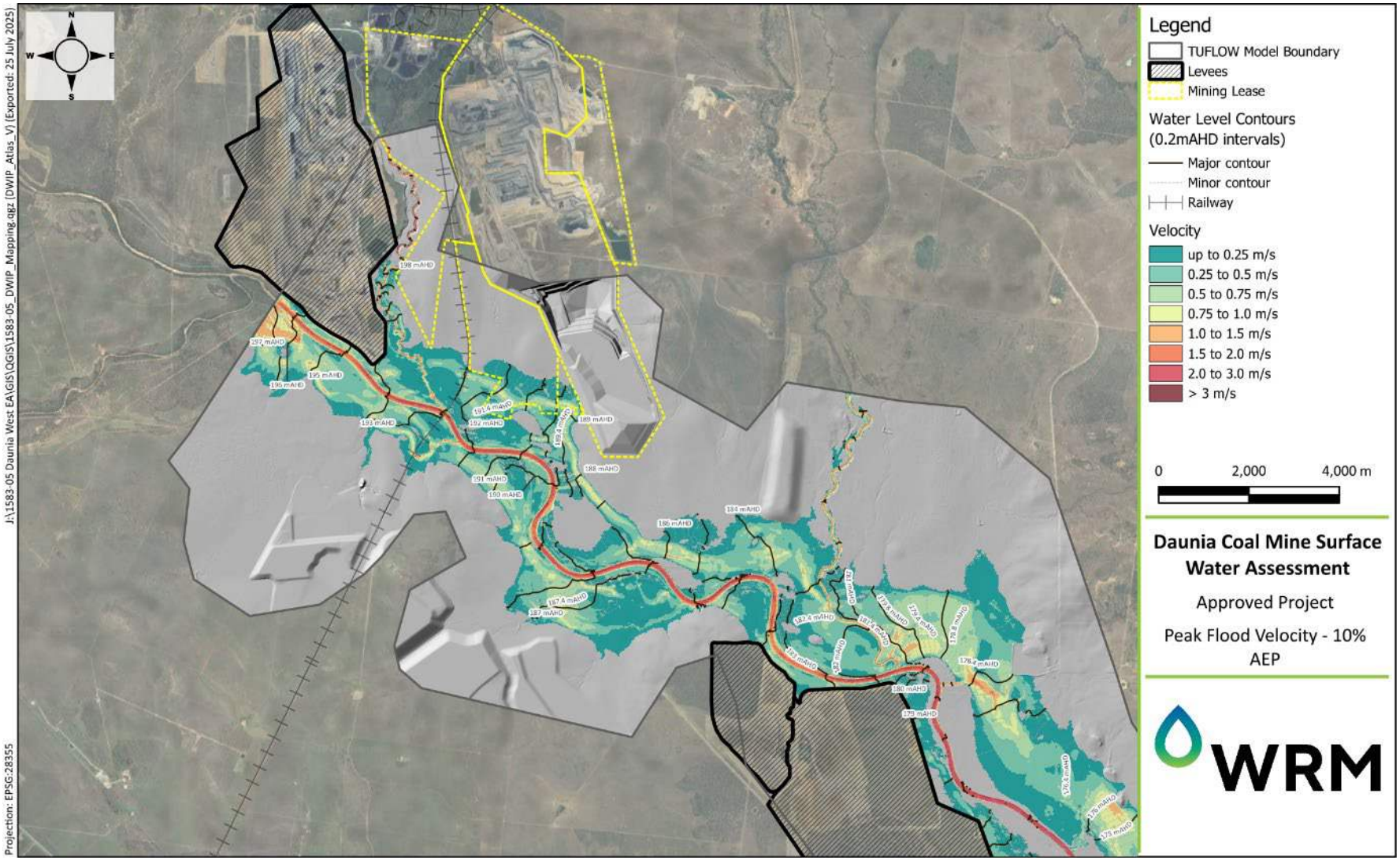

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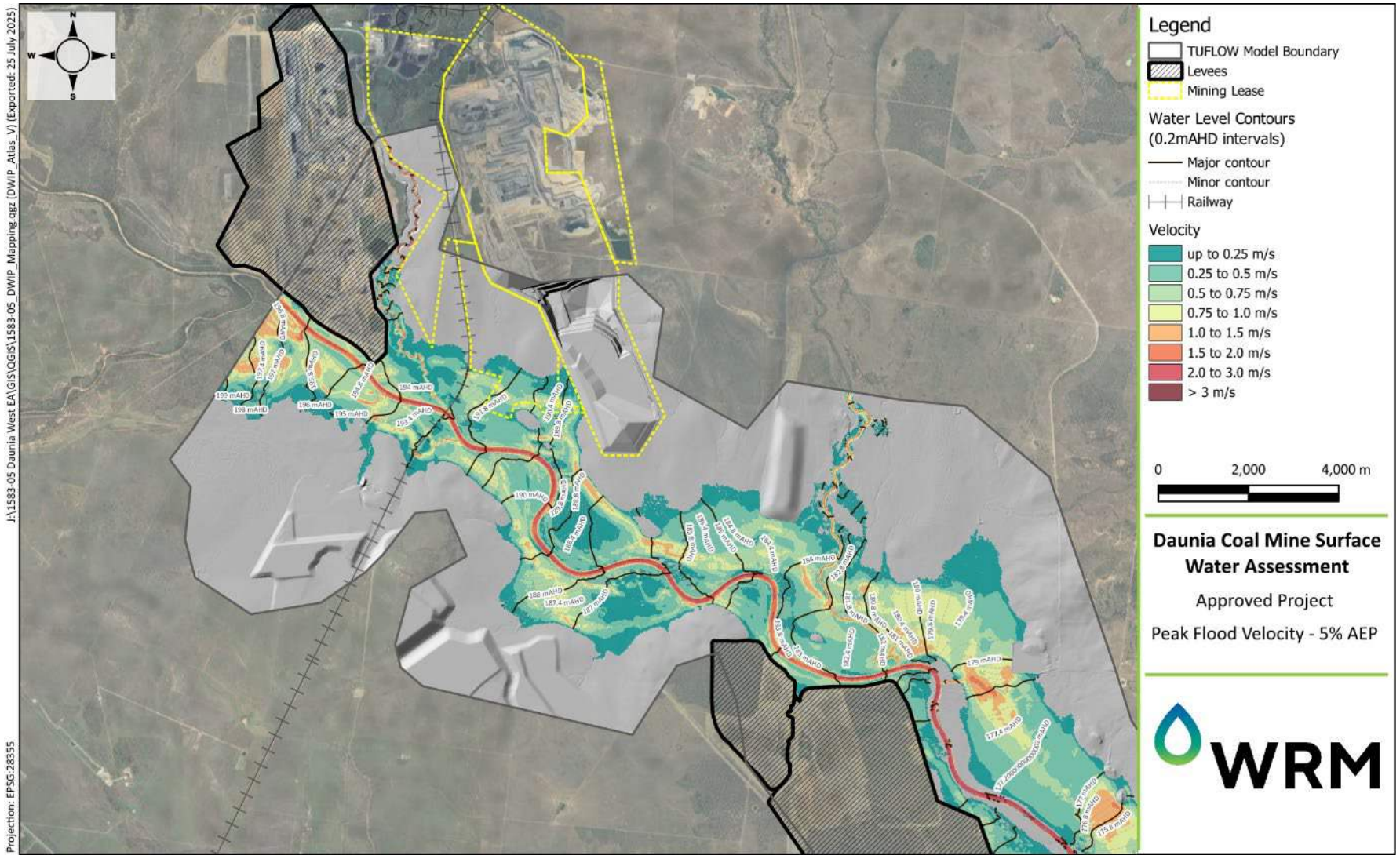

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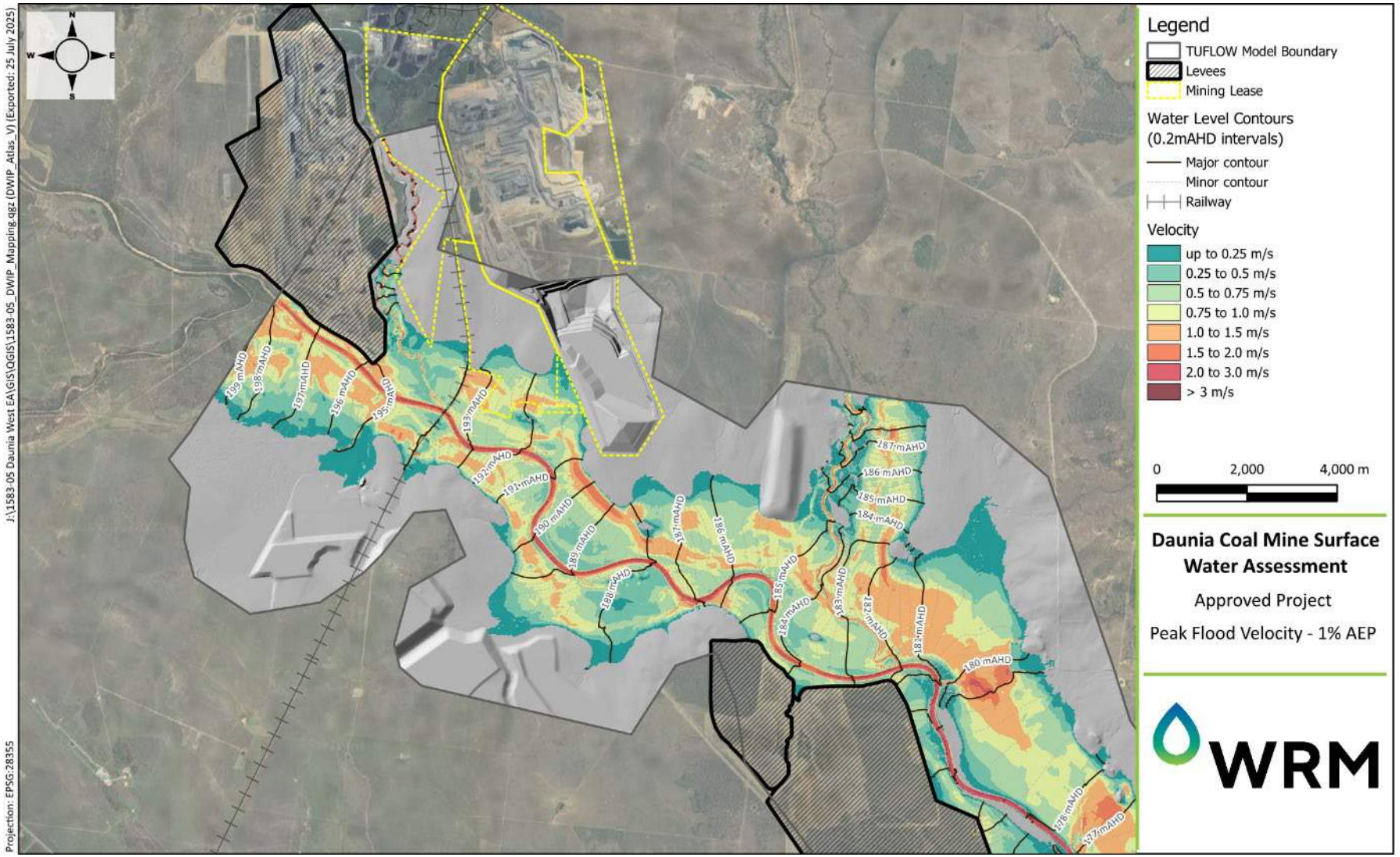

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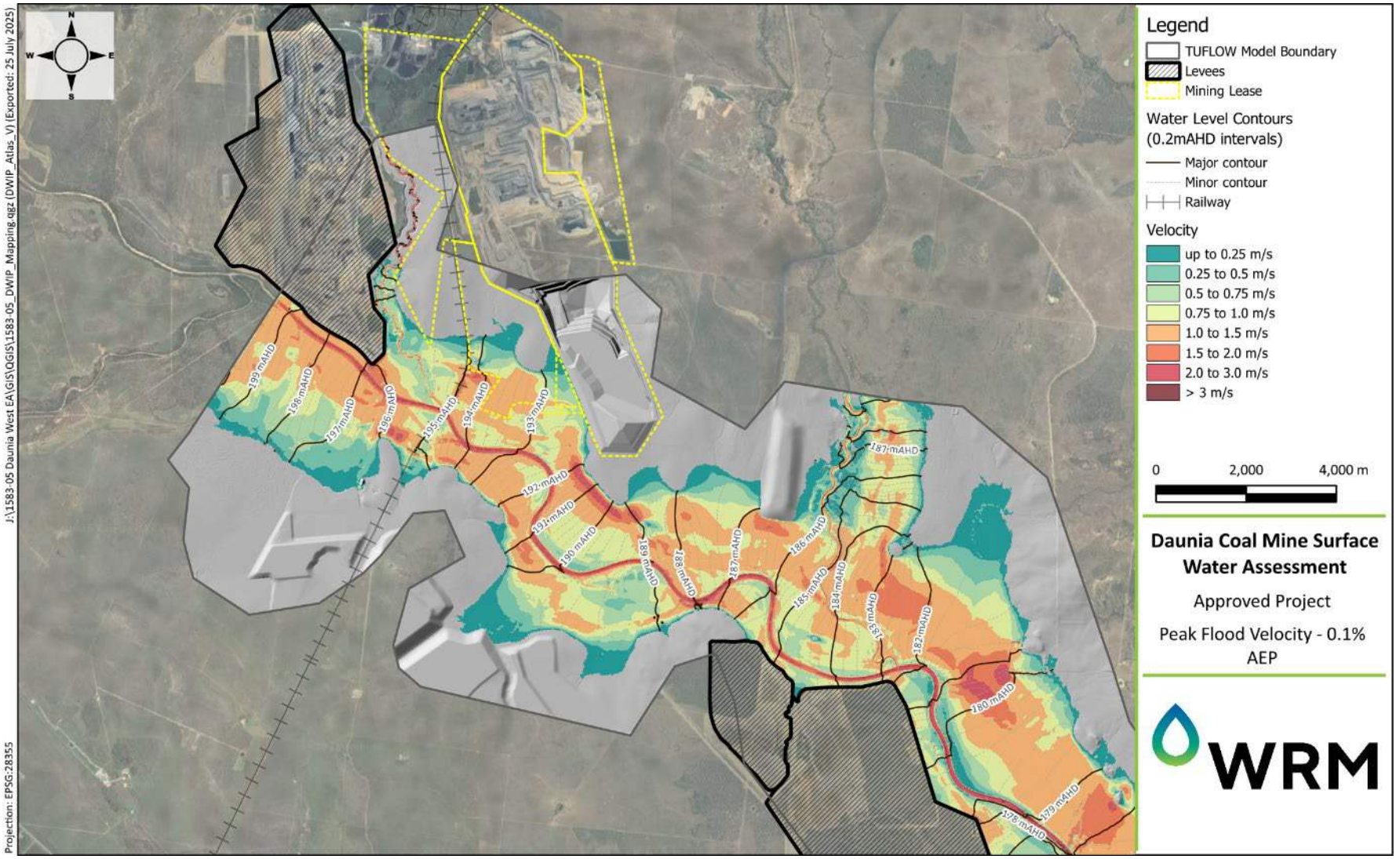

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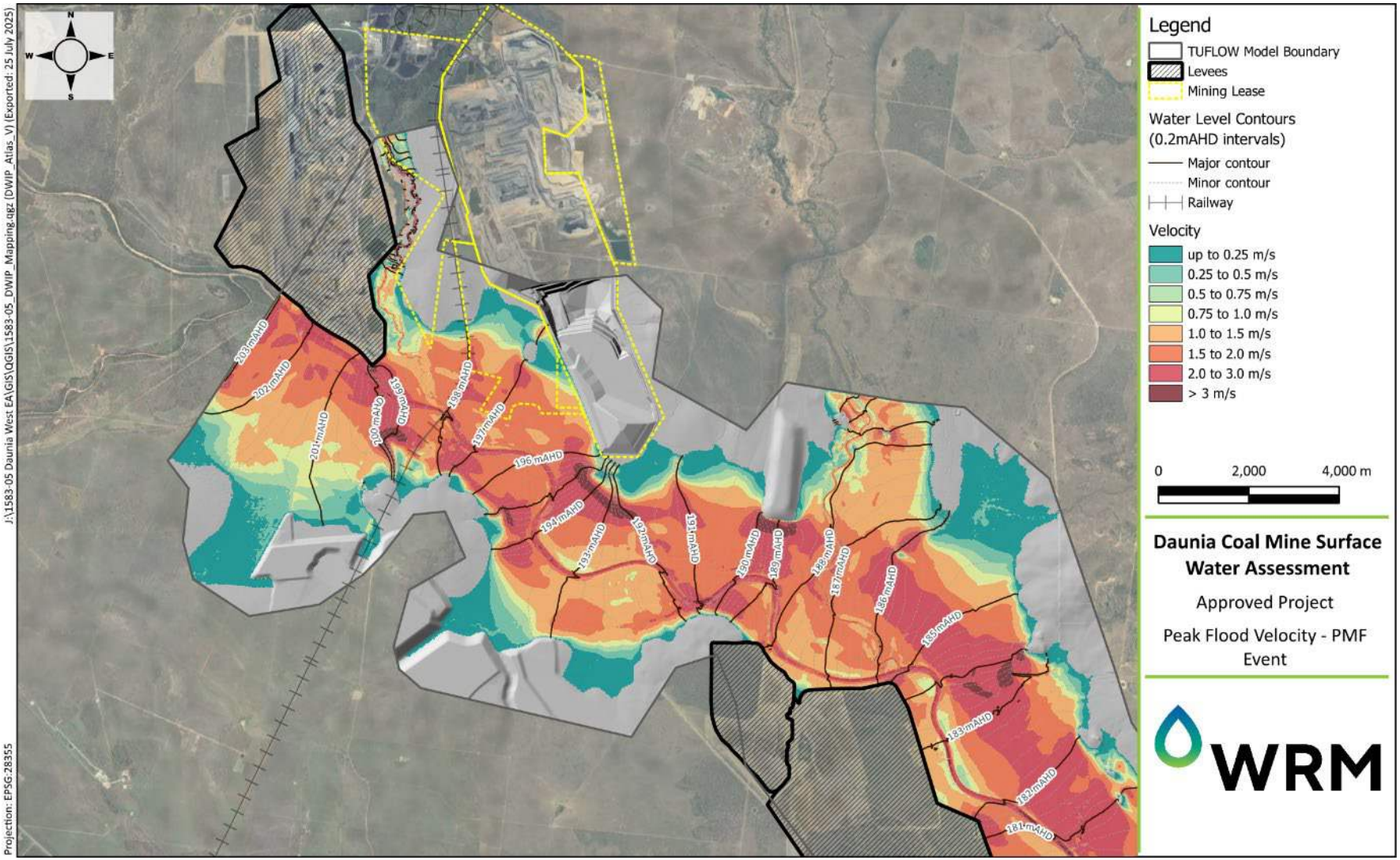


Figure E.28 **Peak Flood Velocity – PMF Event– Approved EA**

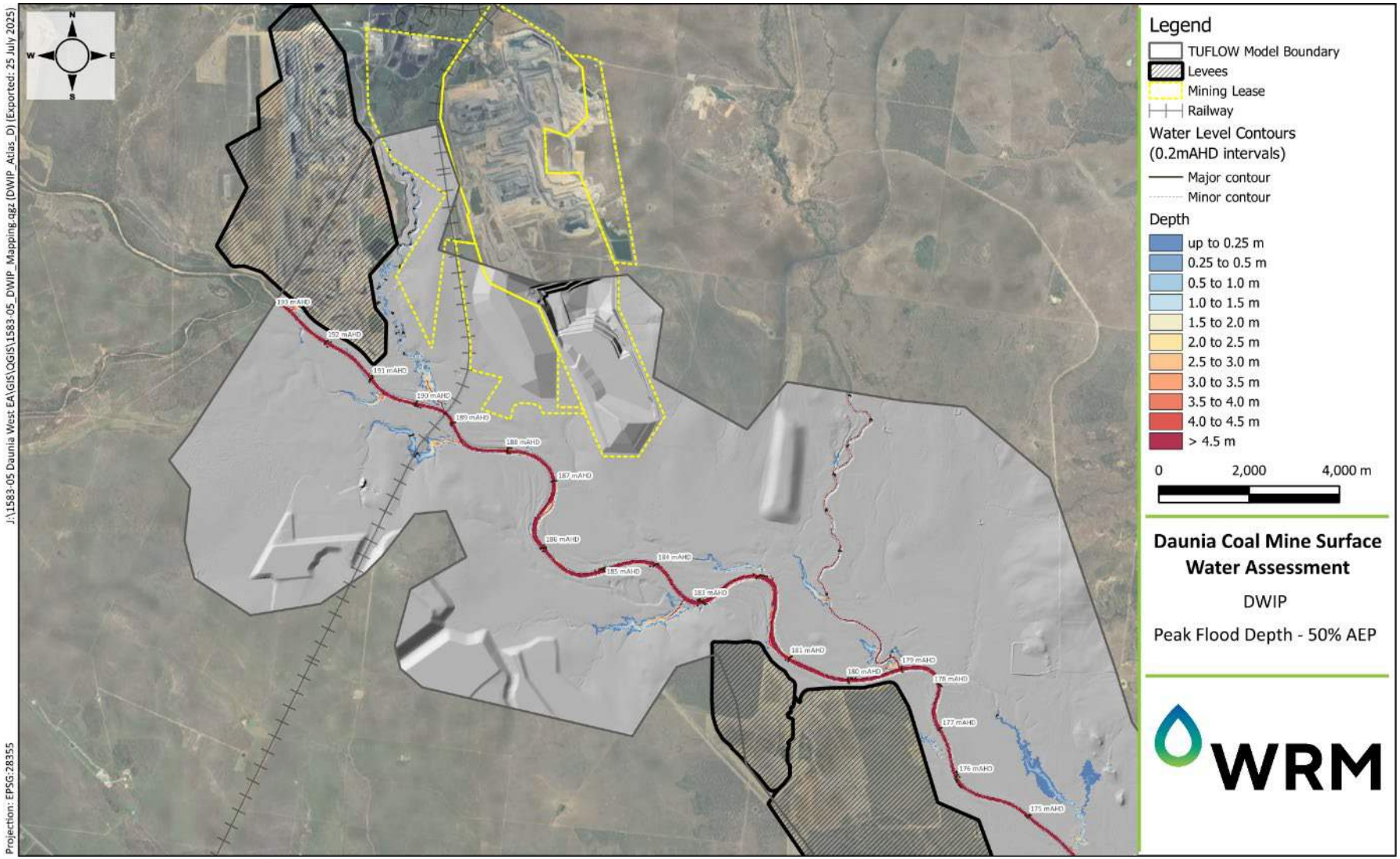


Figure E.29 **Peak Flood Depth – 50% AEP– DWIP**

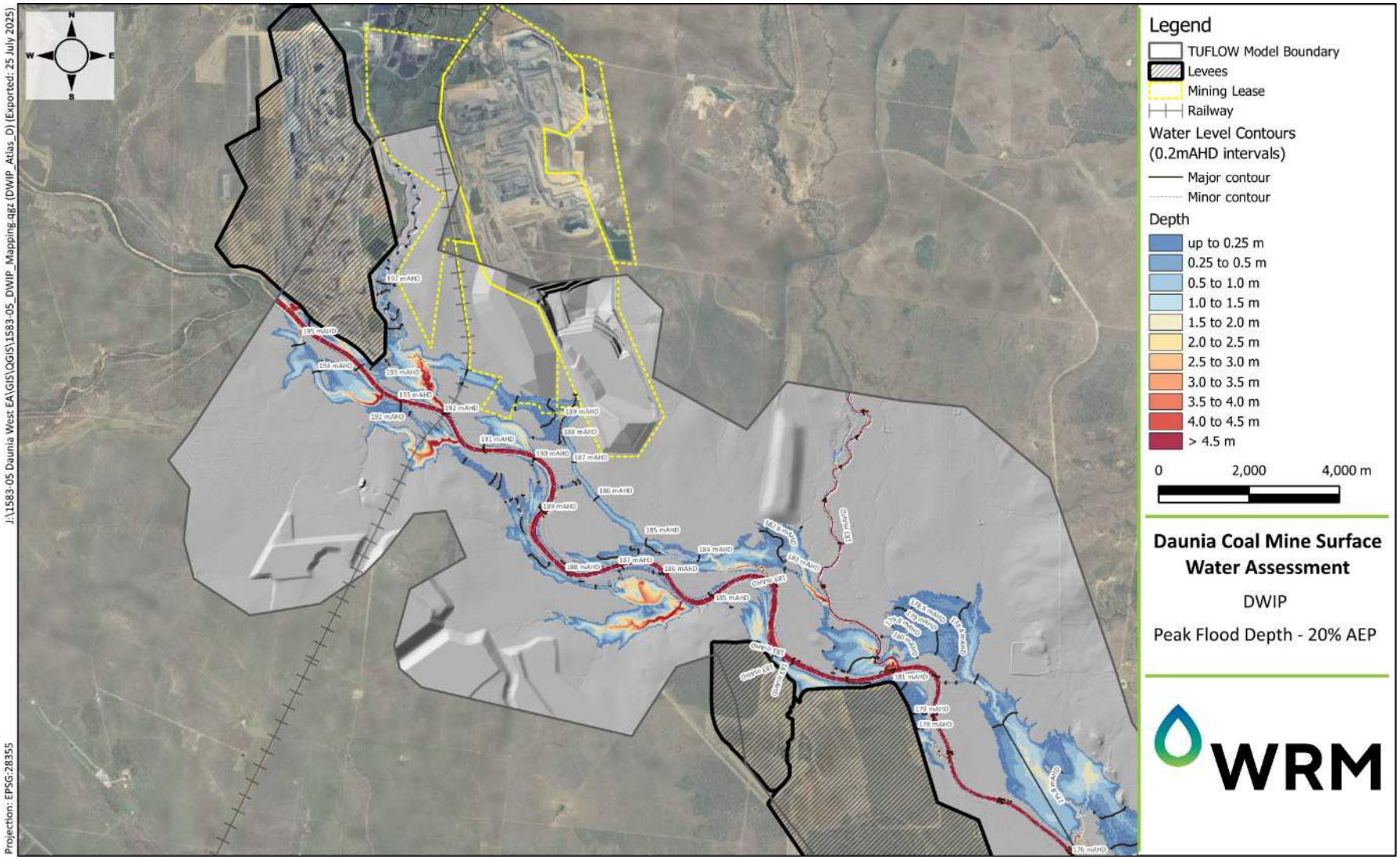
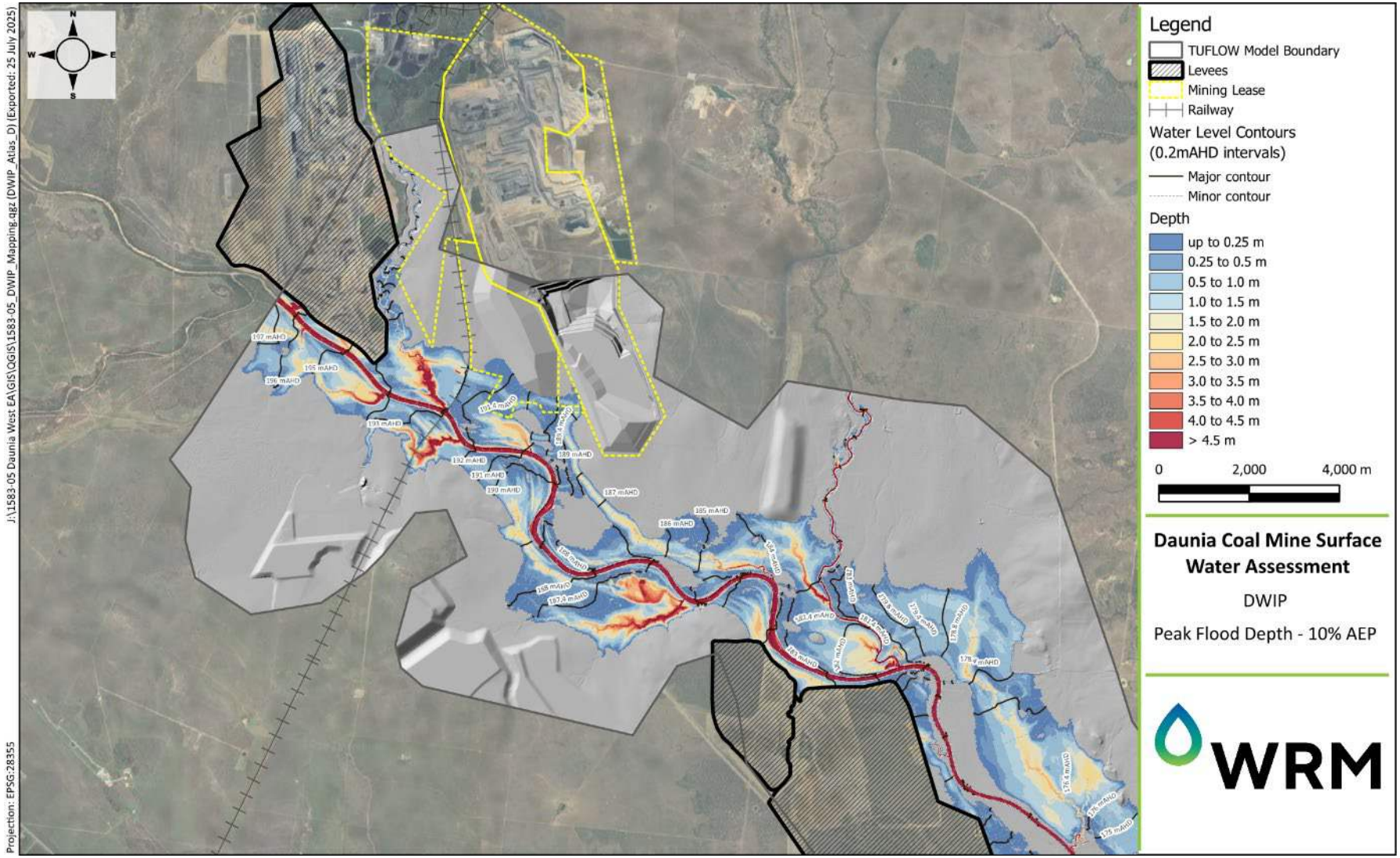


Figure E.30 **Peak Flood Depth – 20% AEP– DWIP**



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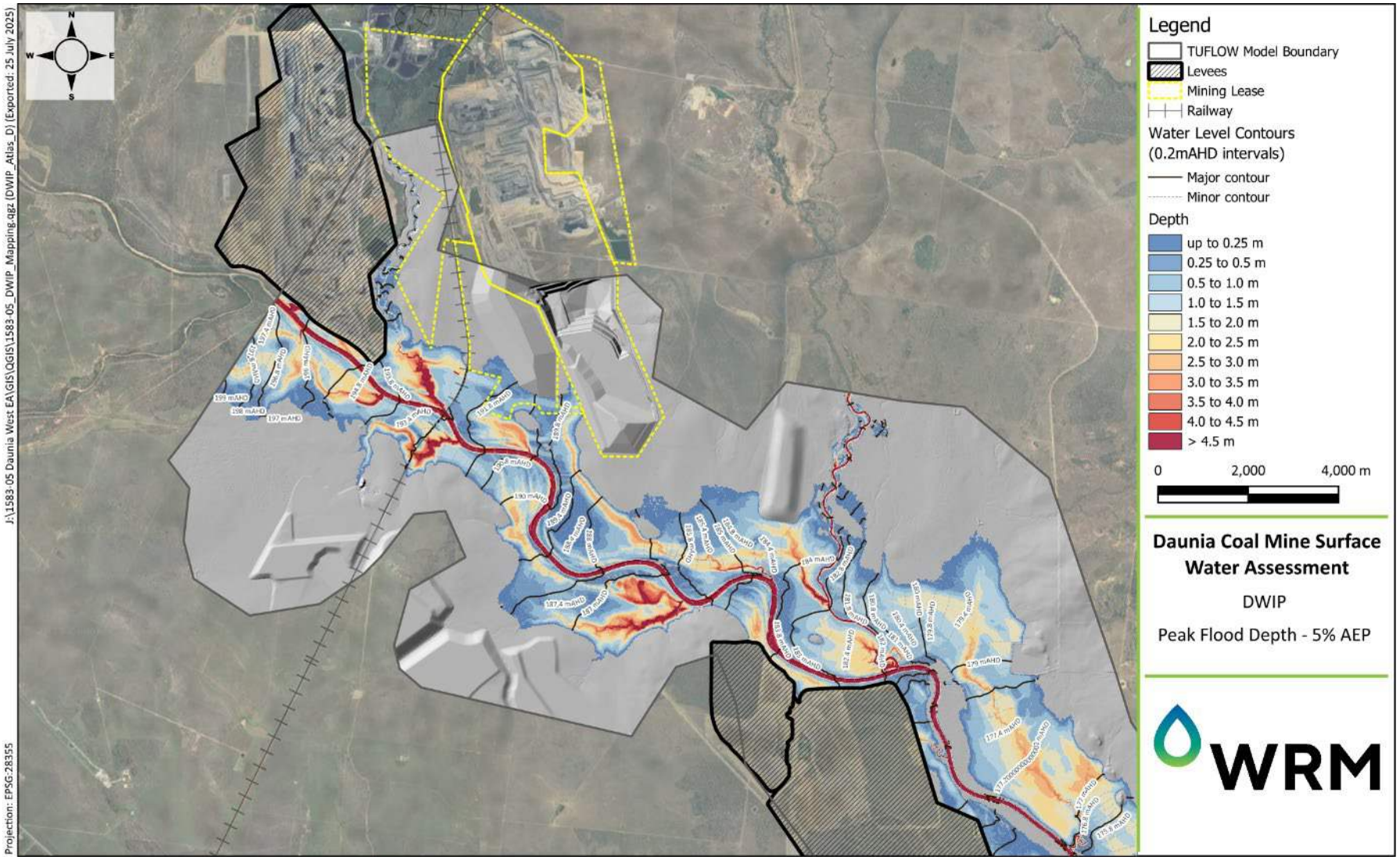

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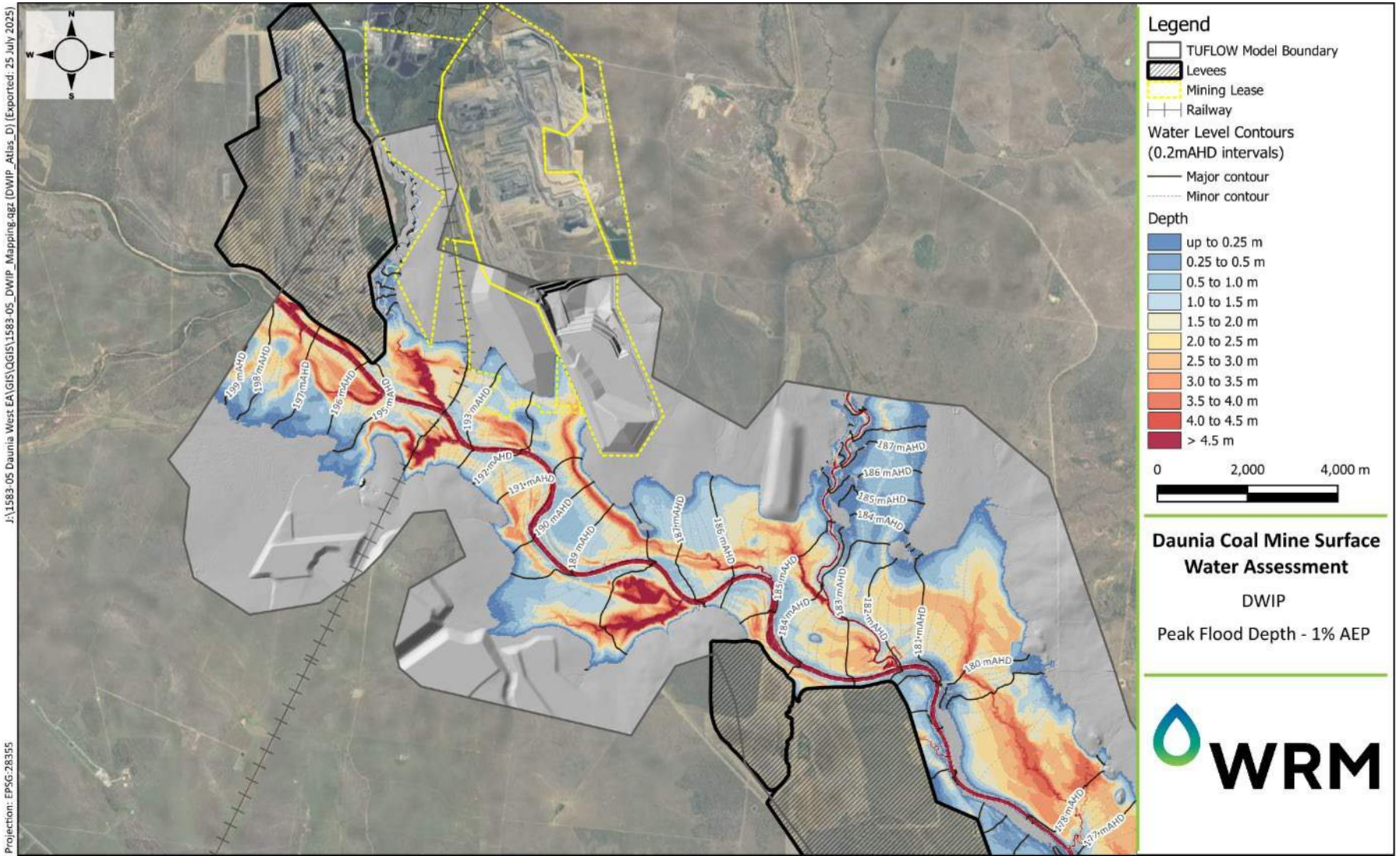

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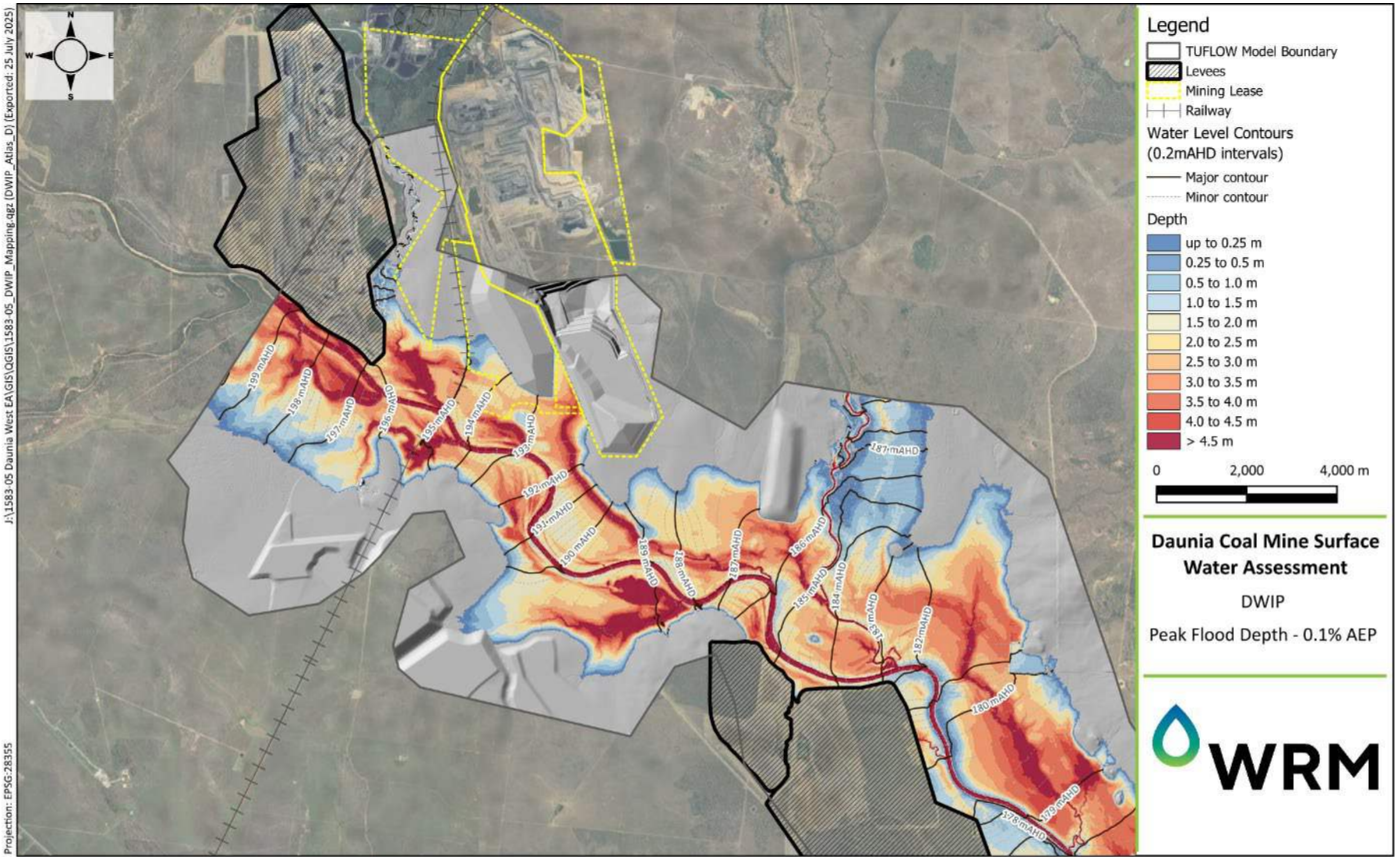

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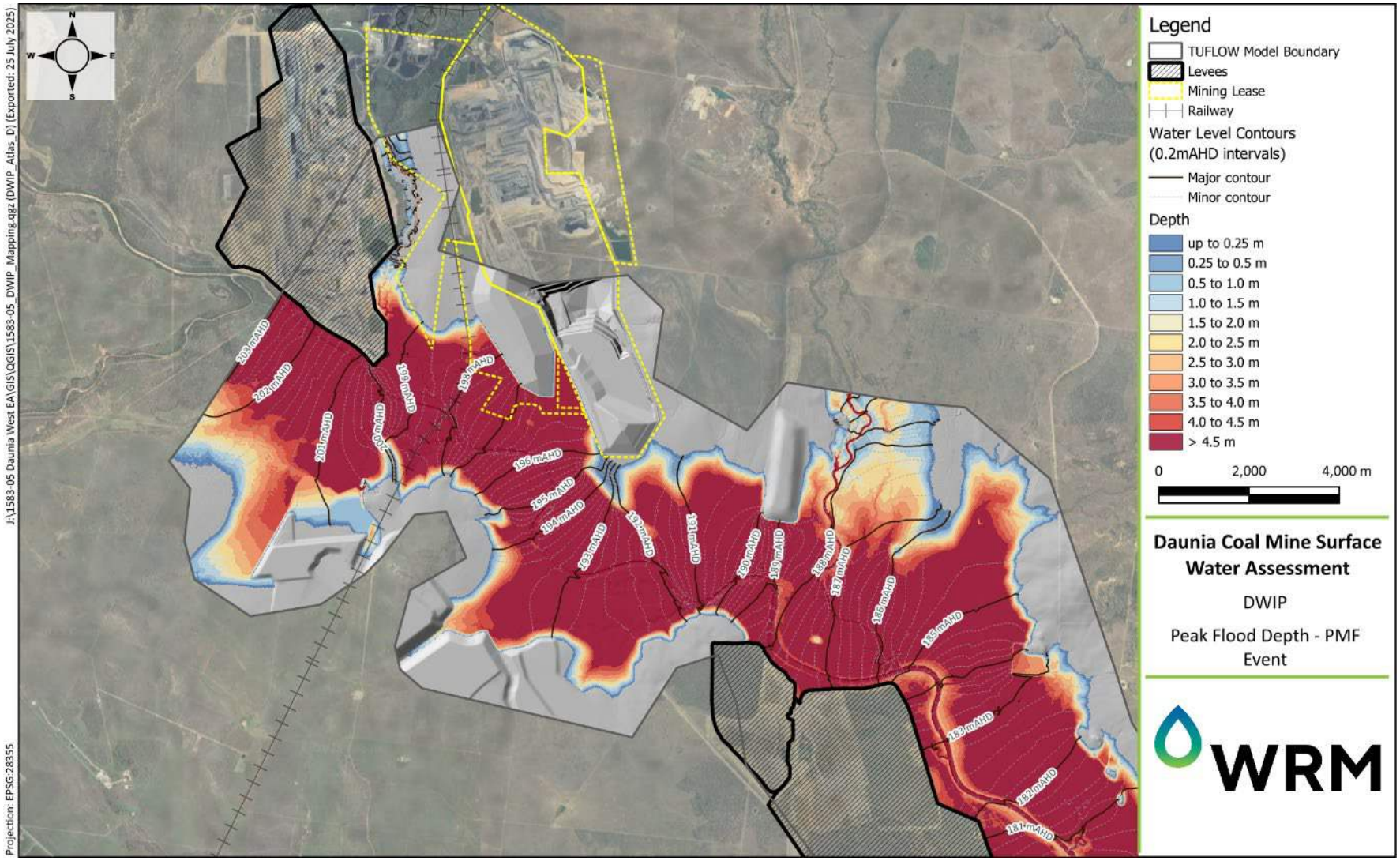


Figure E.35 **Peak Flood Depth – PMF Event– DWIP**

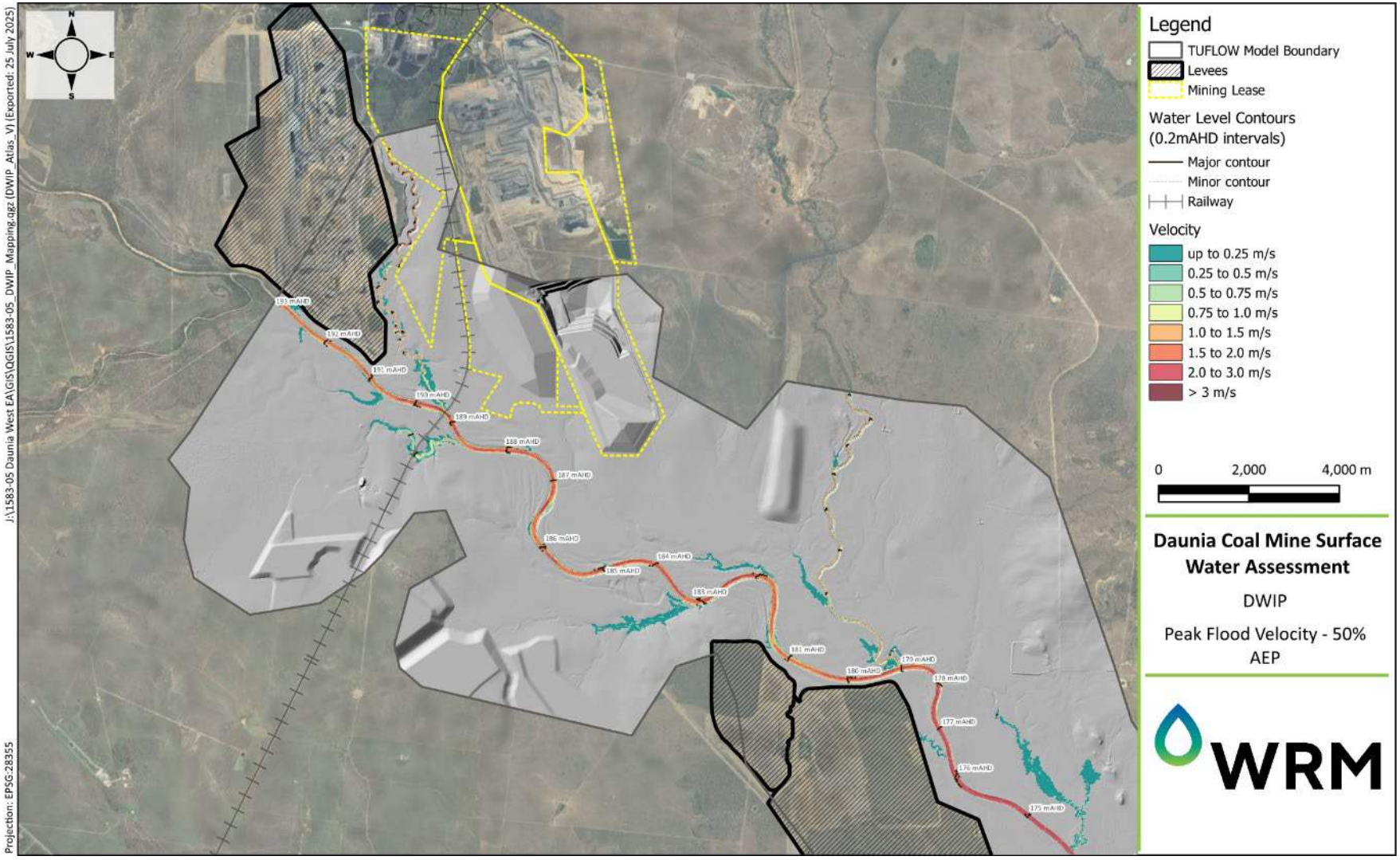


Figure E.36 Peak Flood Velocity – 50% AEP– DWIP

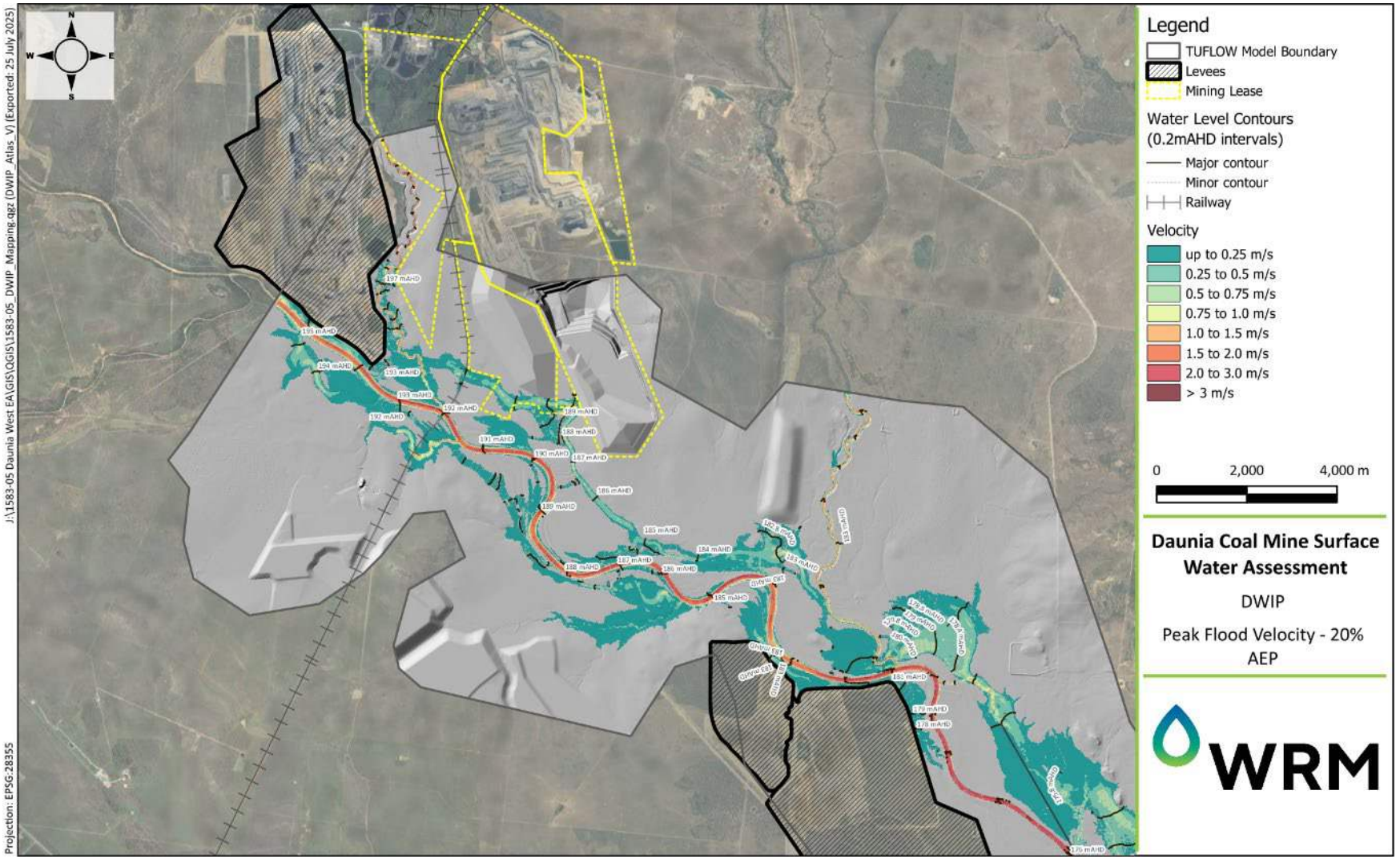
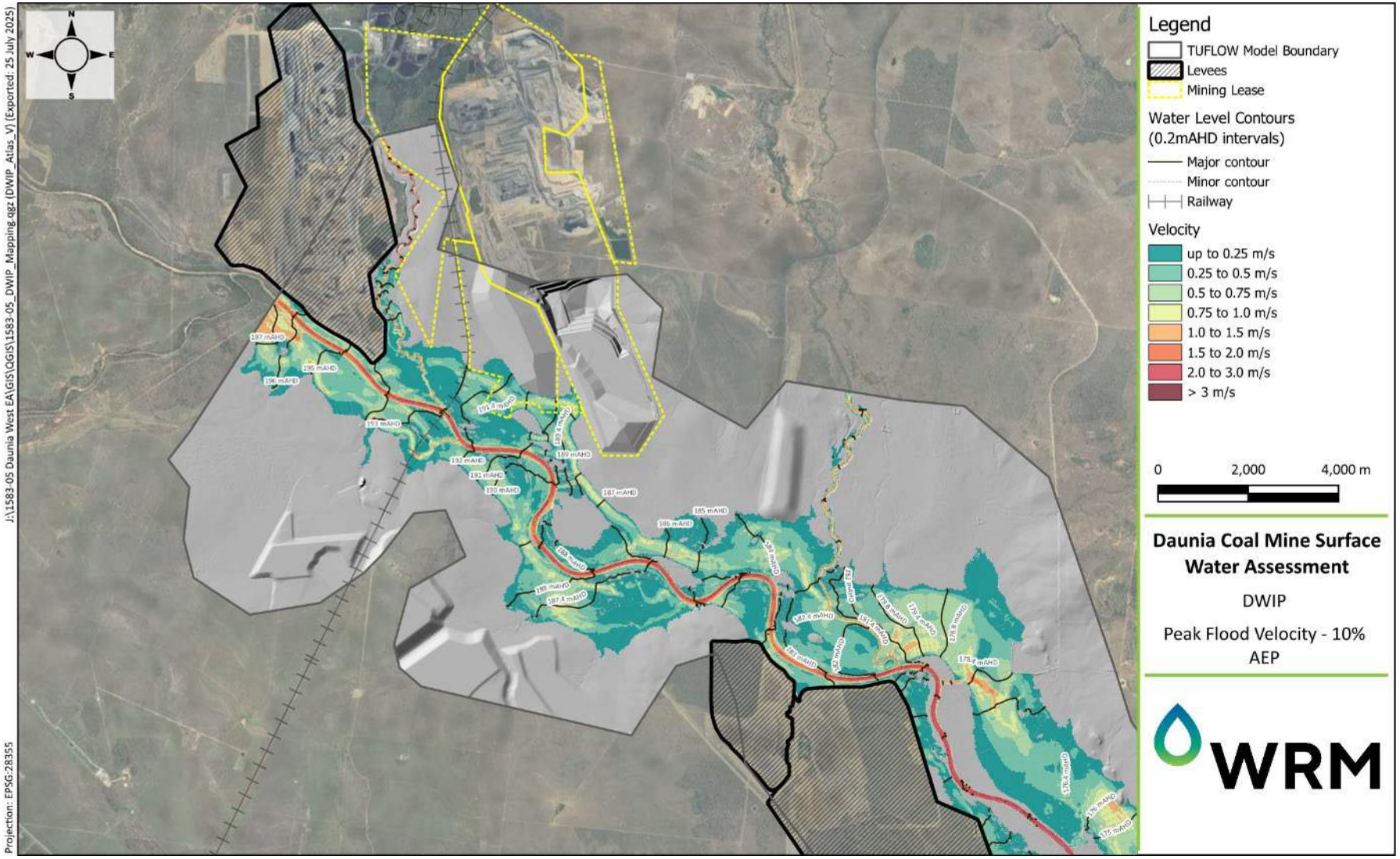


Figure E.37 **Peak Flood Velocity – 20% AEP– DWIP**



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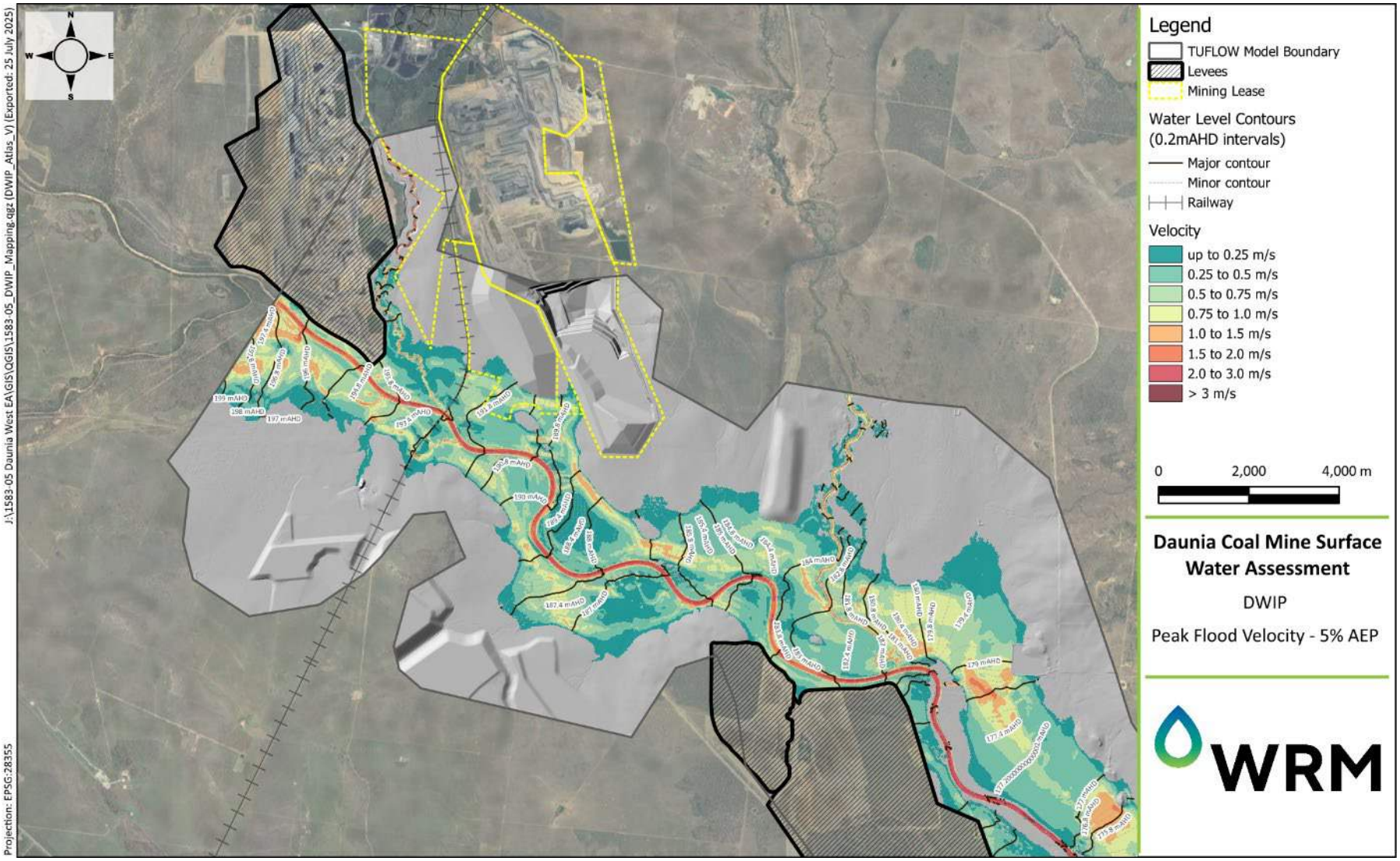
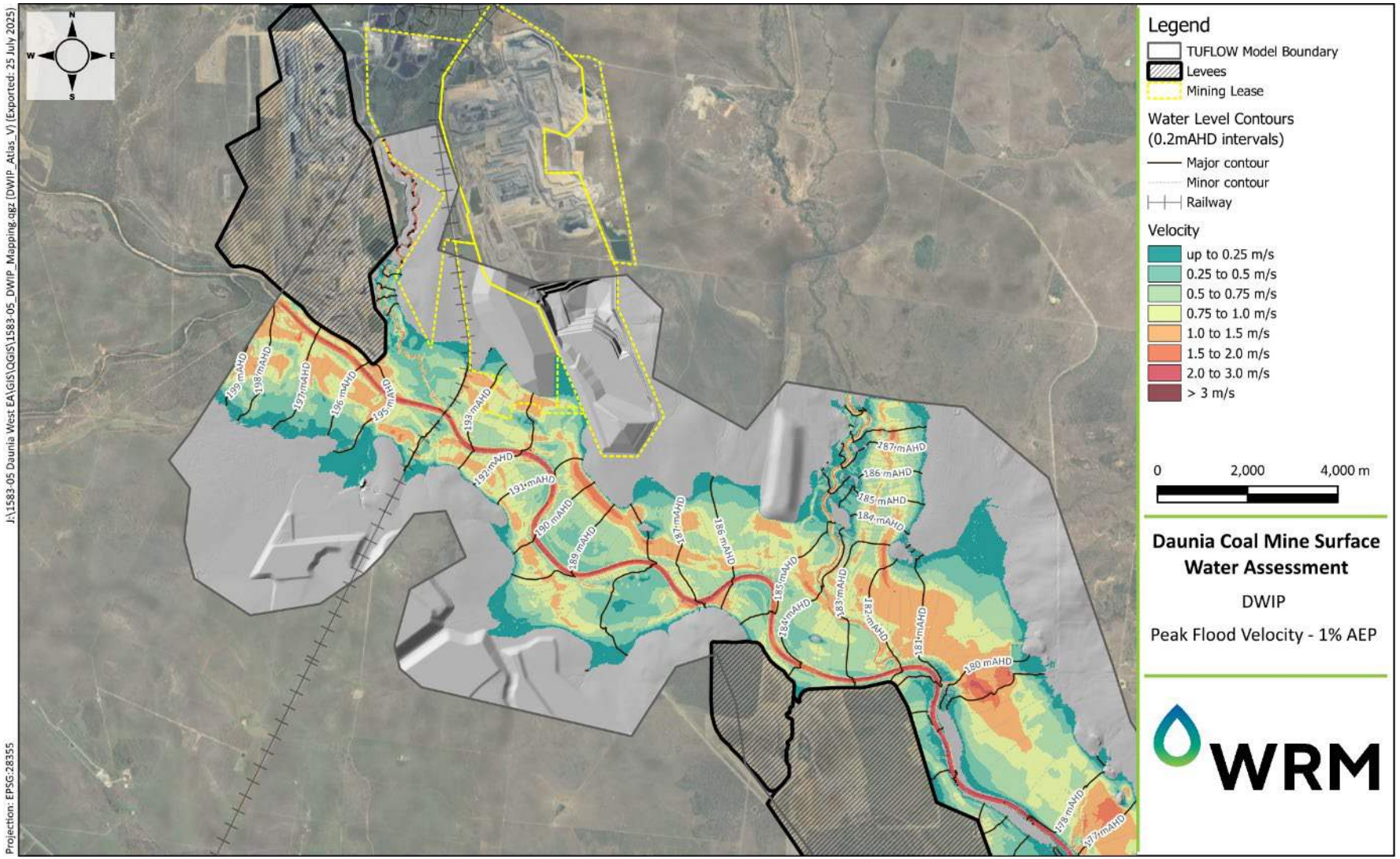


Figure E.39 **Peak Flood Velocity – 5% AEP– DWIP**



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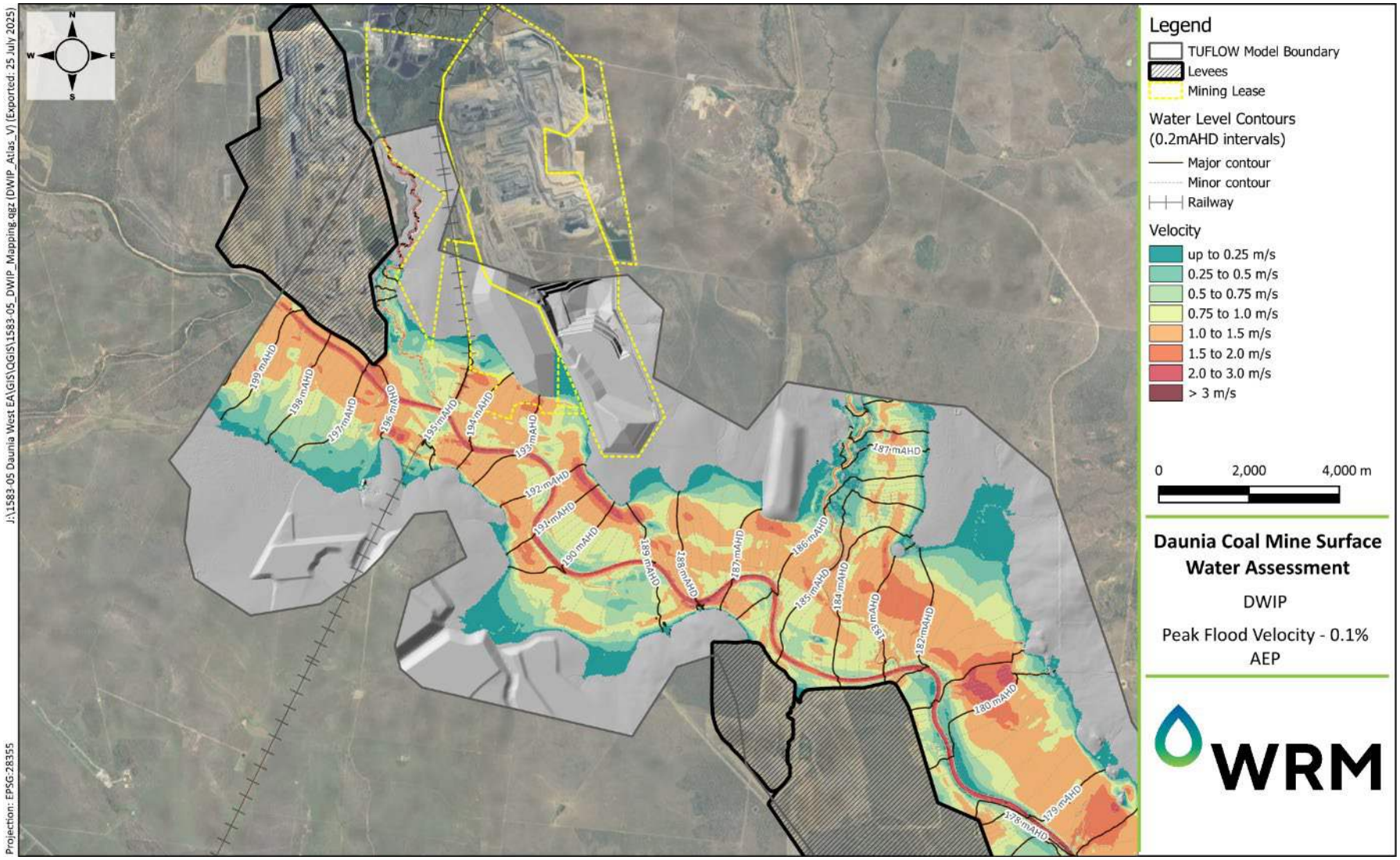


Figure E.41 **Peak Flood Velocity – 0.1% AEP– DWIP**

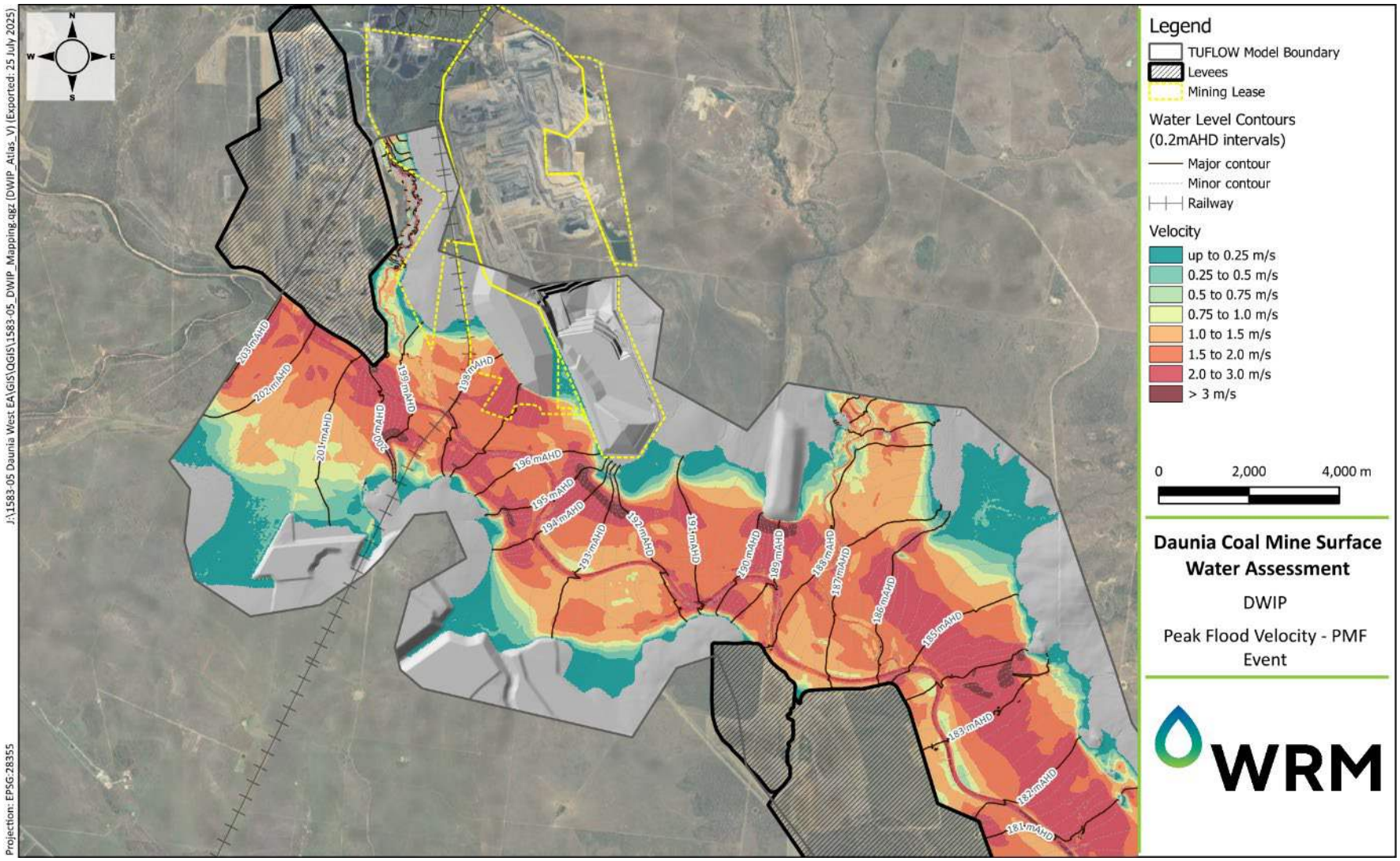


Figure E.42 **Peak Flood Velocity – PMF Event– DWIP**

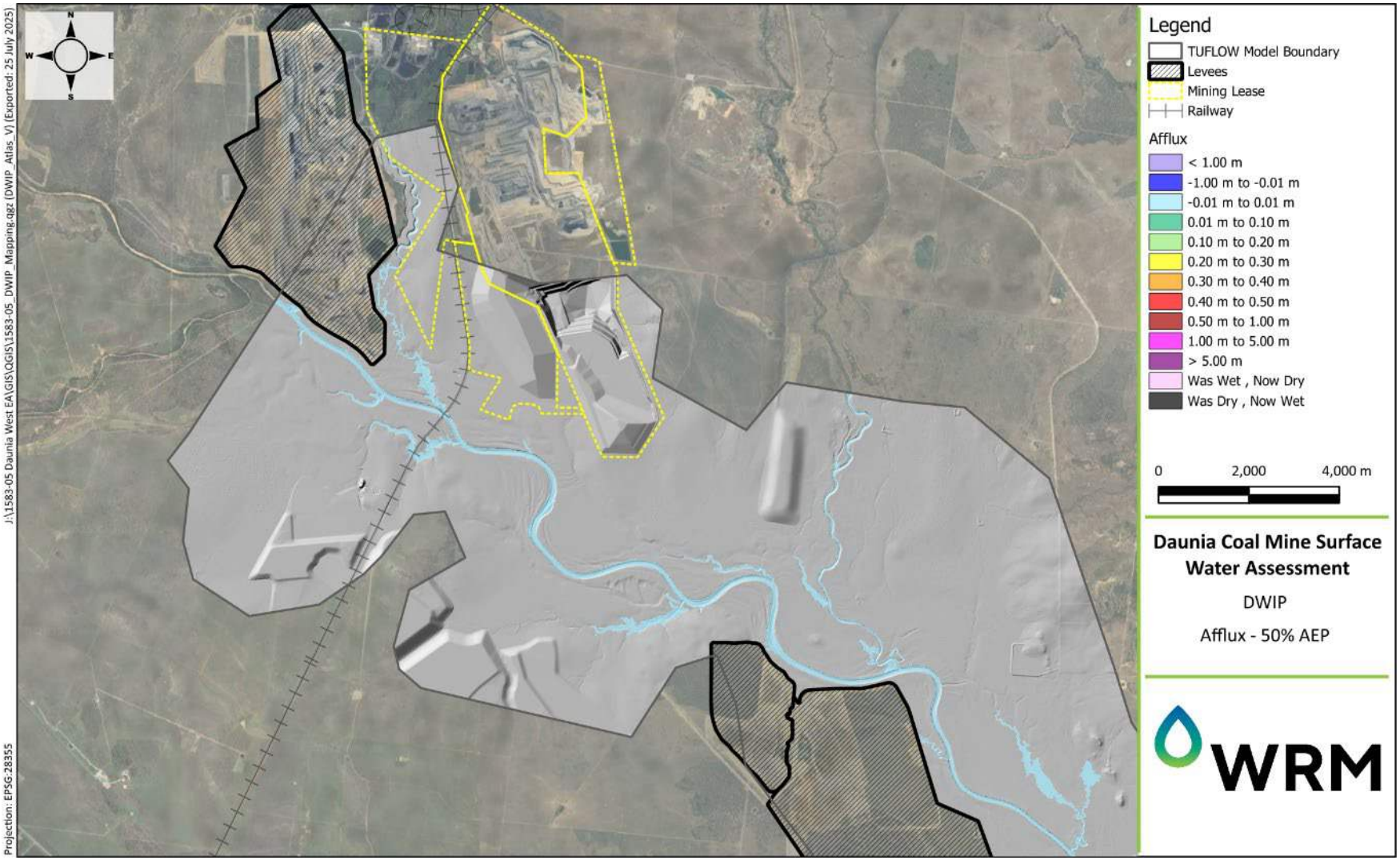
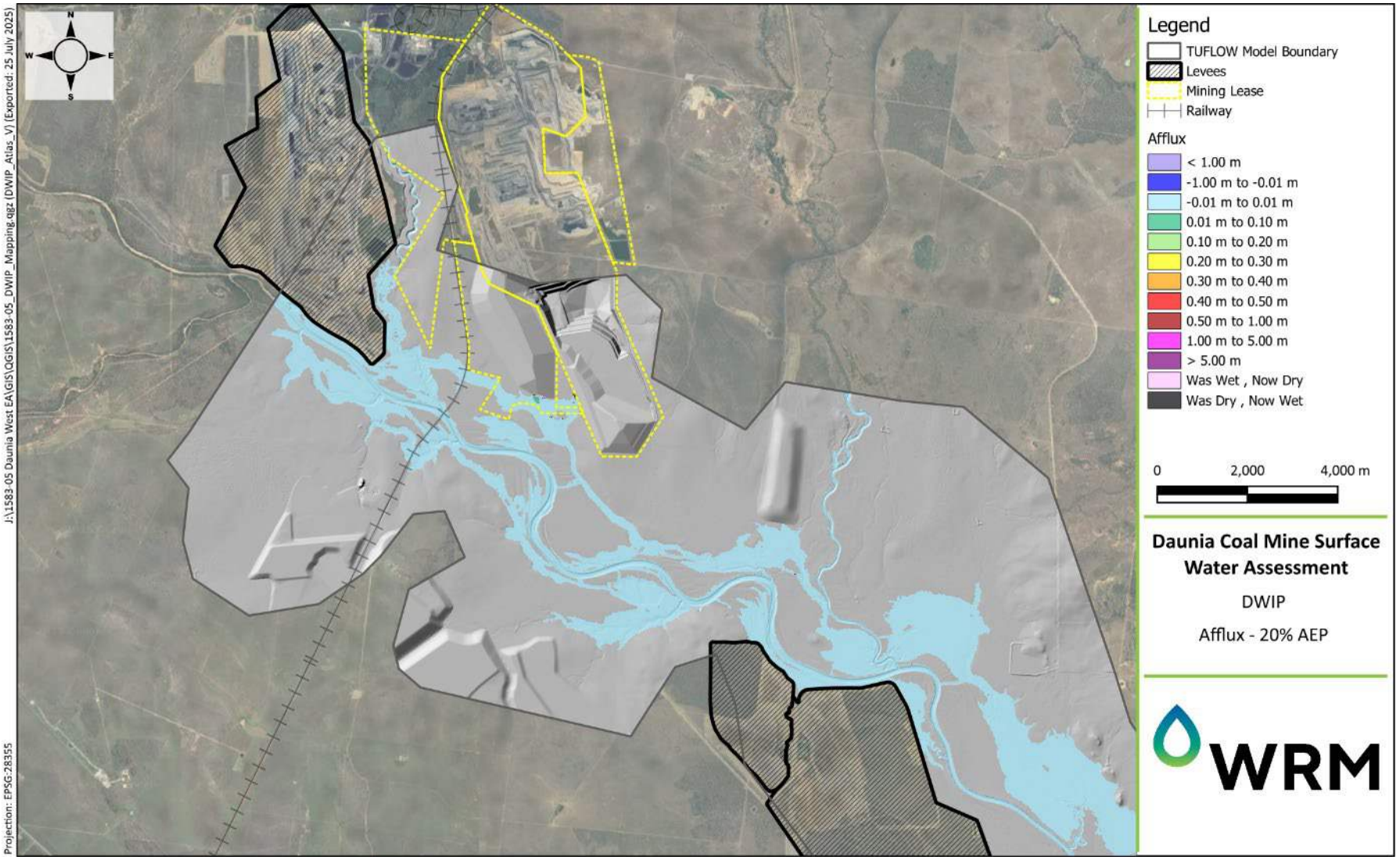


Figure E.43 Afflux – 50% AEP– DWIP



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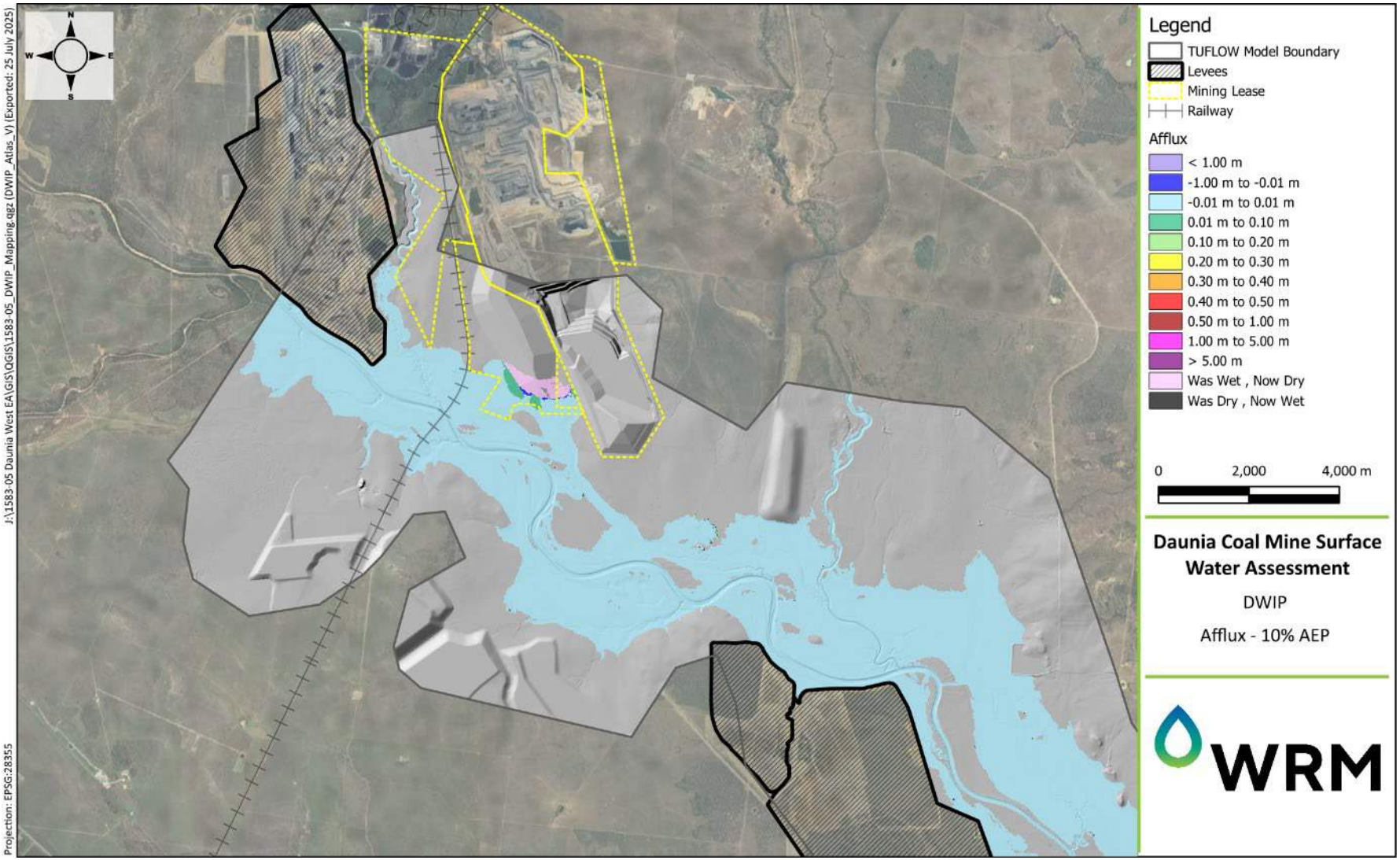

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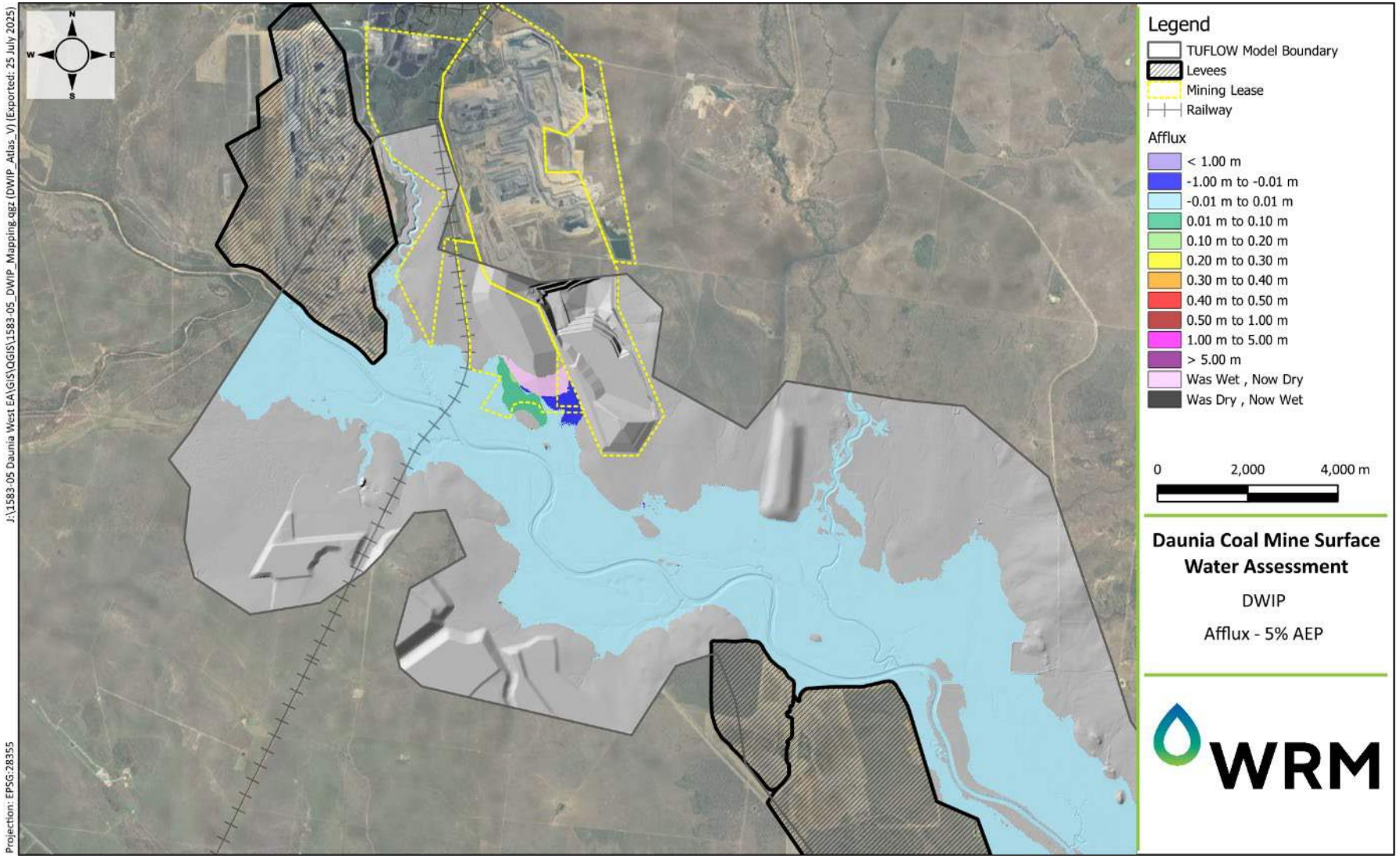

Figure E.46 Afflux – 5% AEP– DWIP

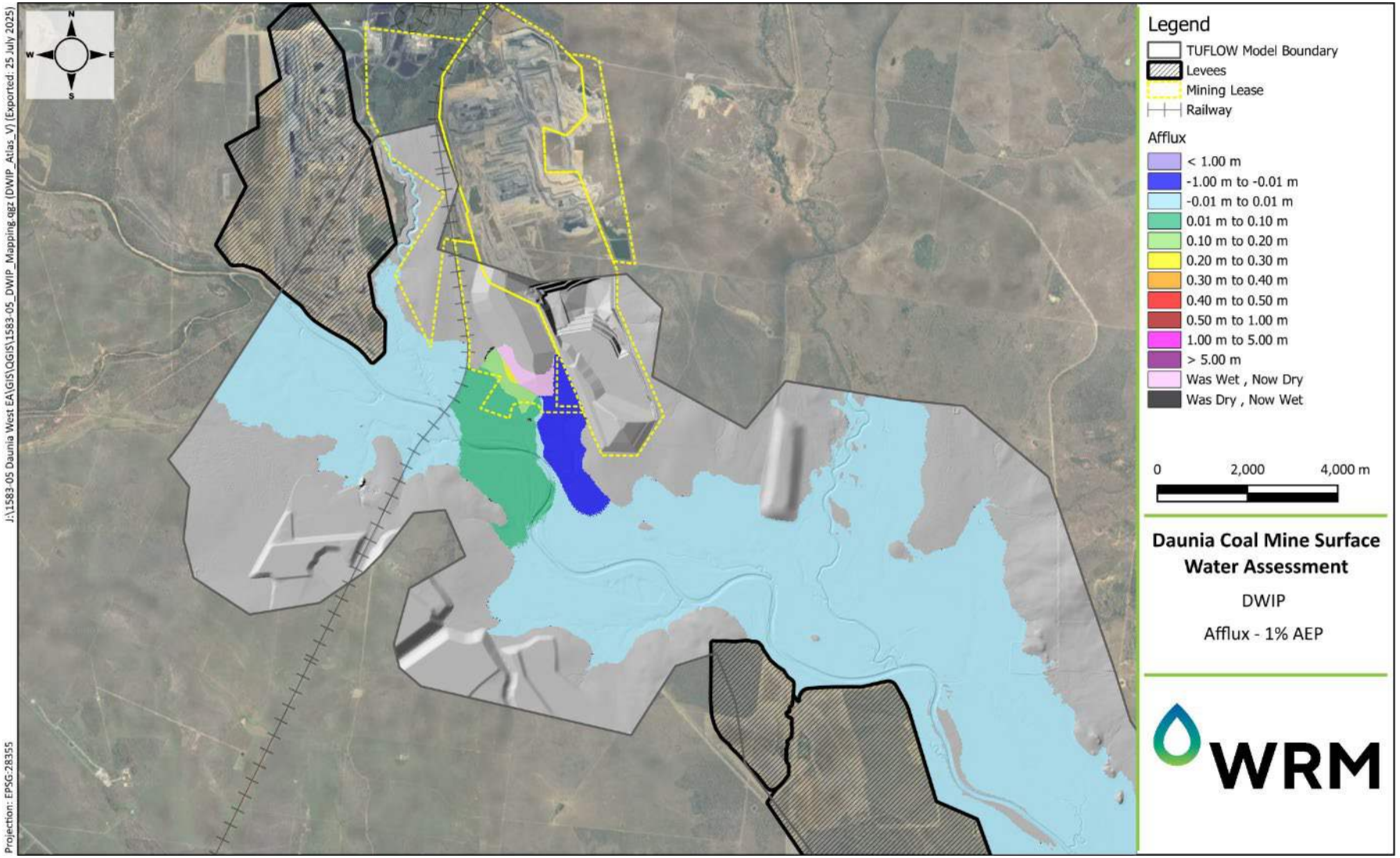

Figure E.47 Afflux – 1% AEP– DWIP

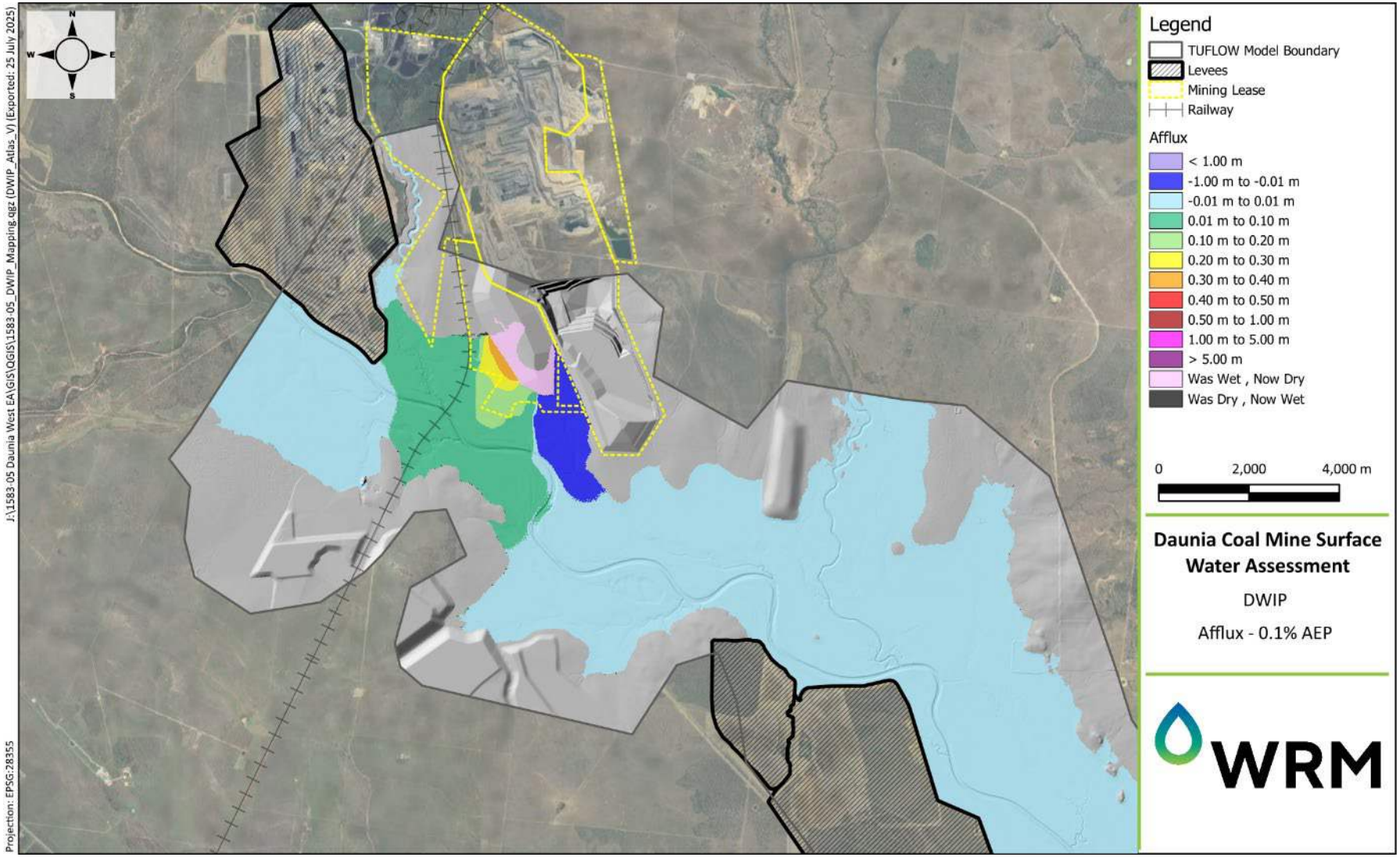

Figure E.48 Afflux – 0.1% AEP– DWIP

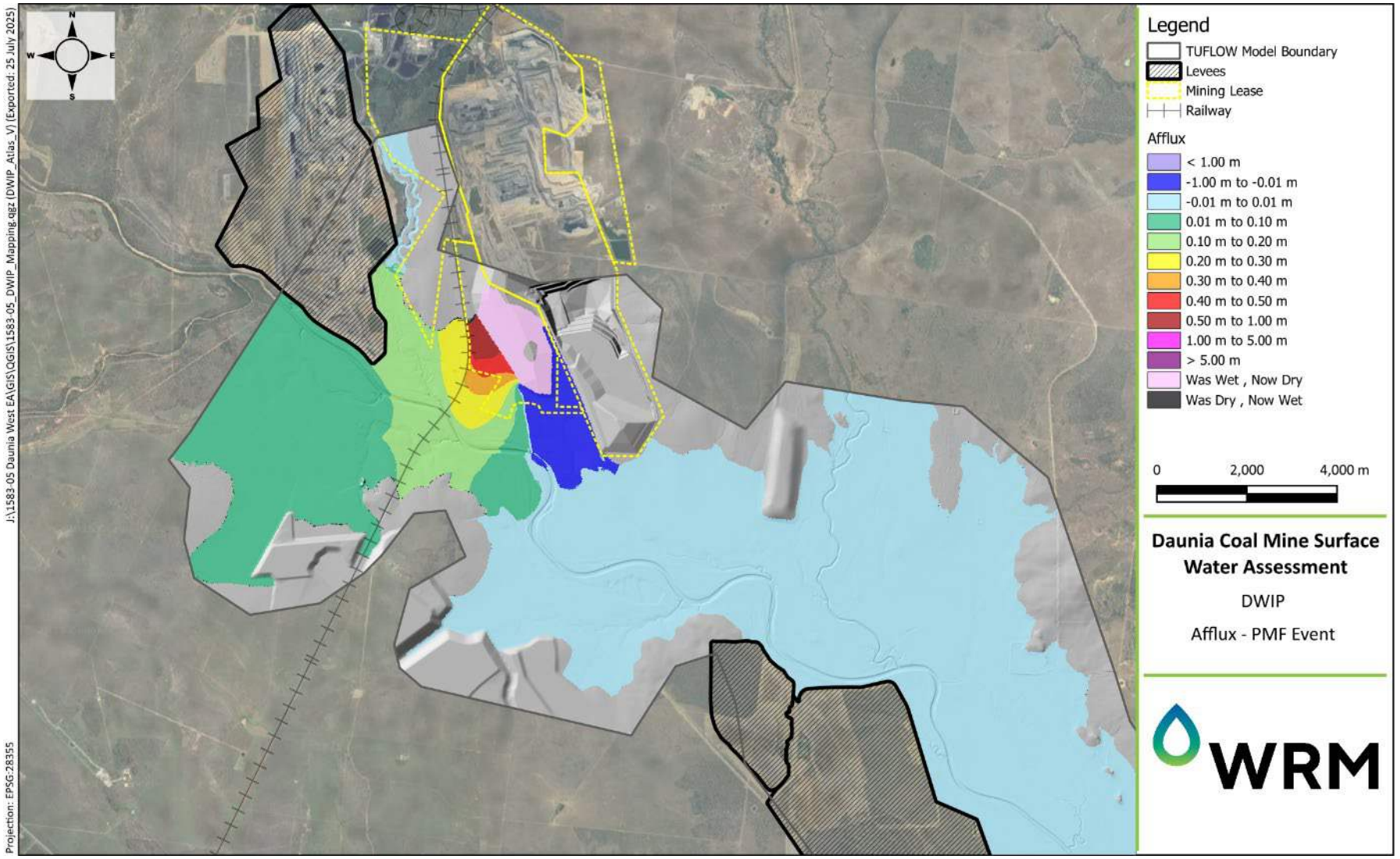

Figure E.49 **Afflux – PMF Event– DWIP**

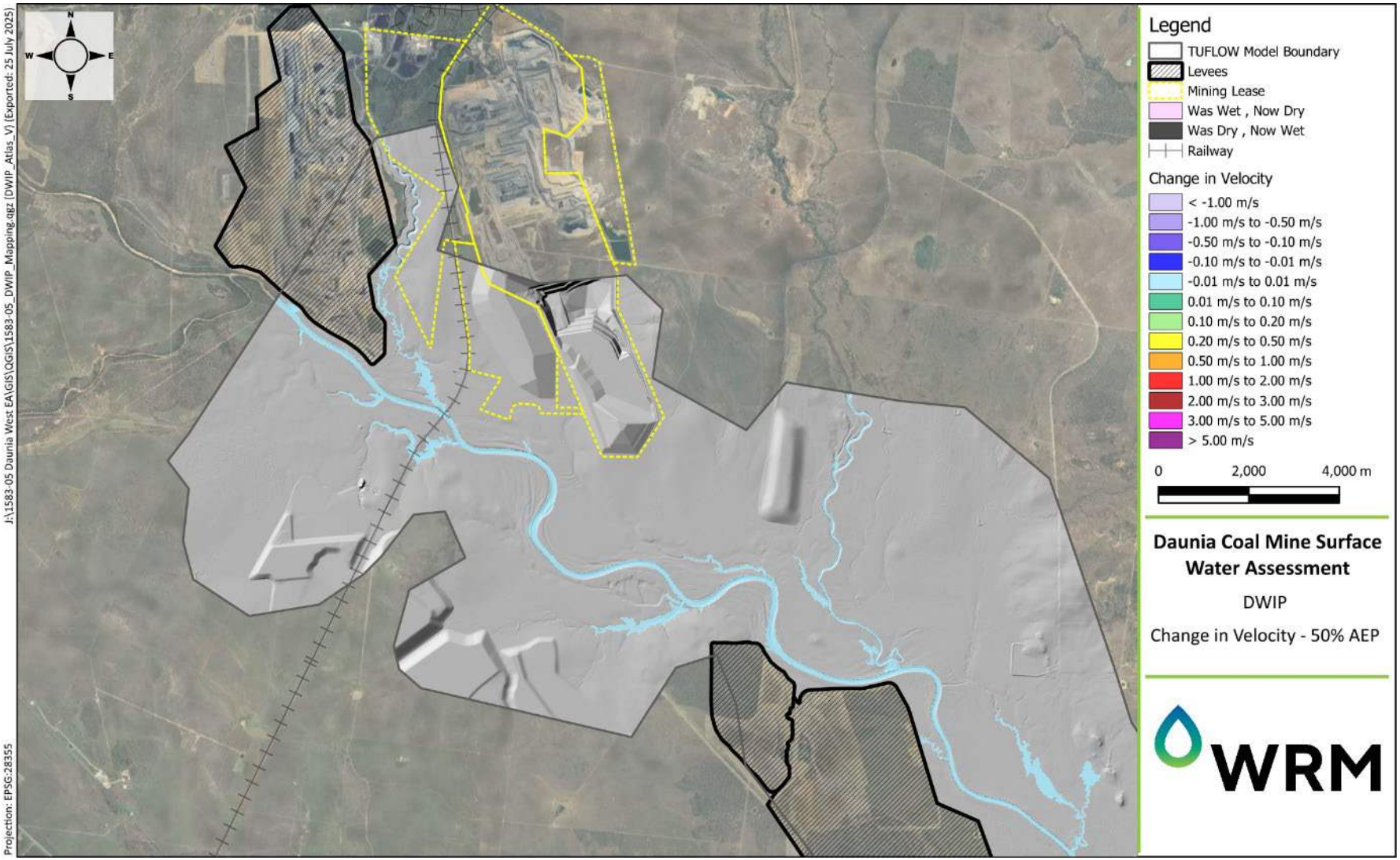

Figure E.50 **Change in Velocity – 50% AEP– DWIP**

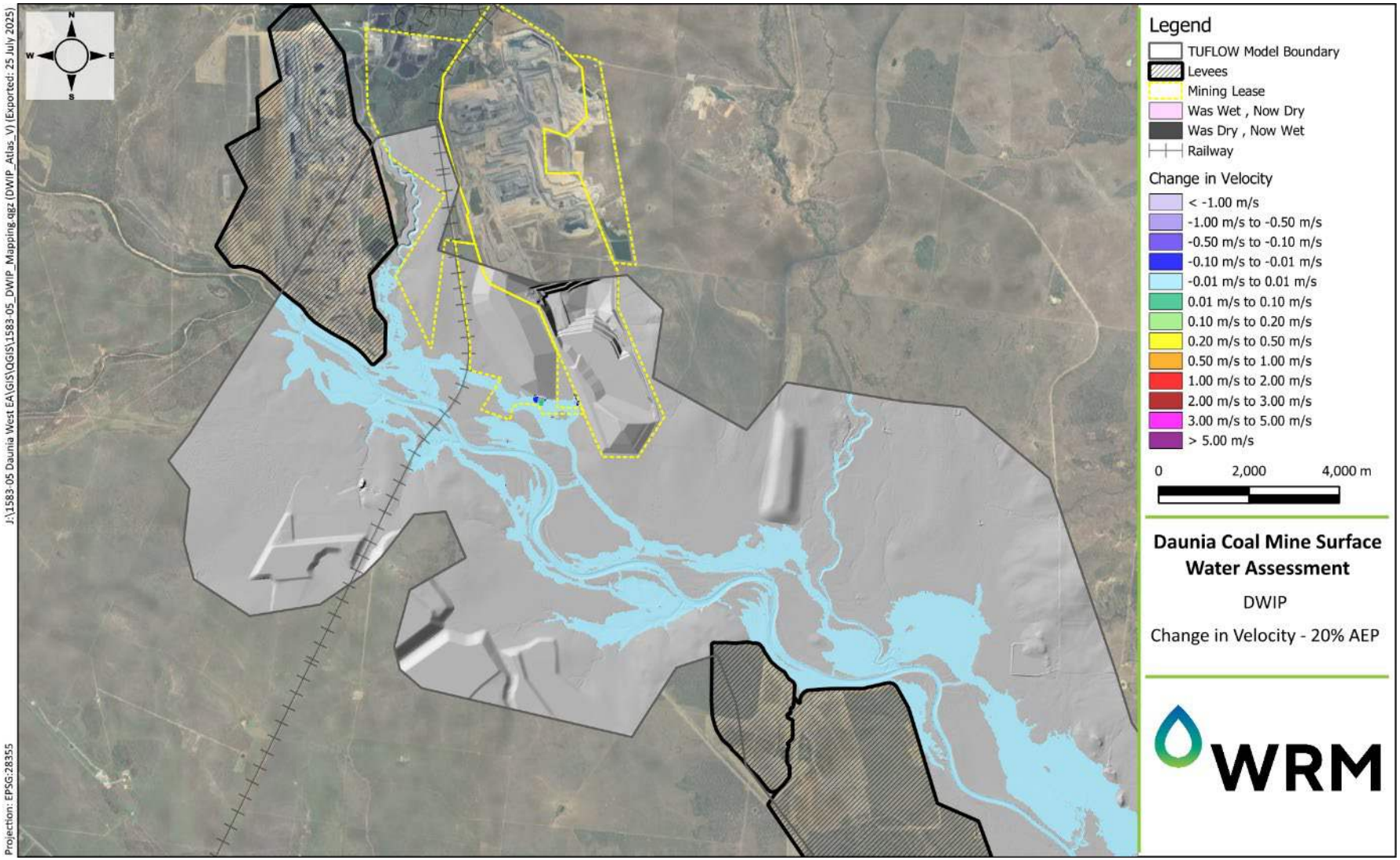

Figure E.51 Change in Velocity – 20% AEP– DWIP

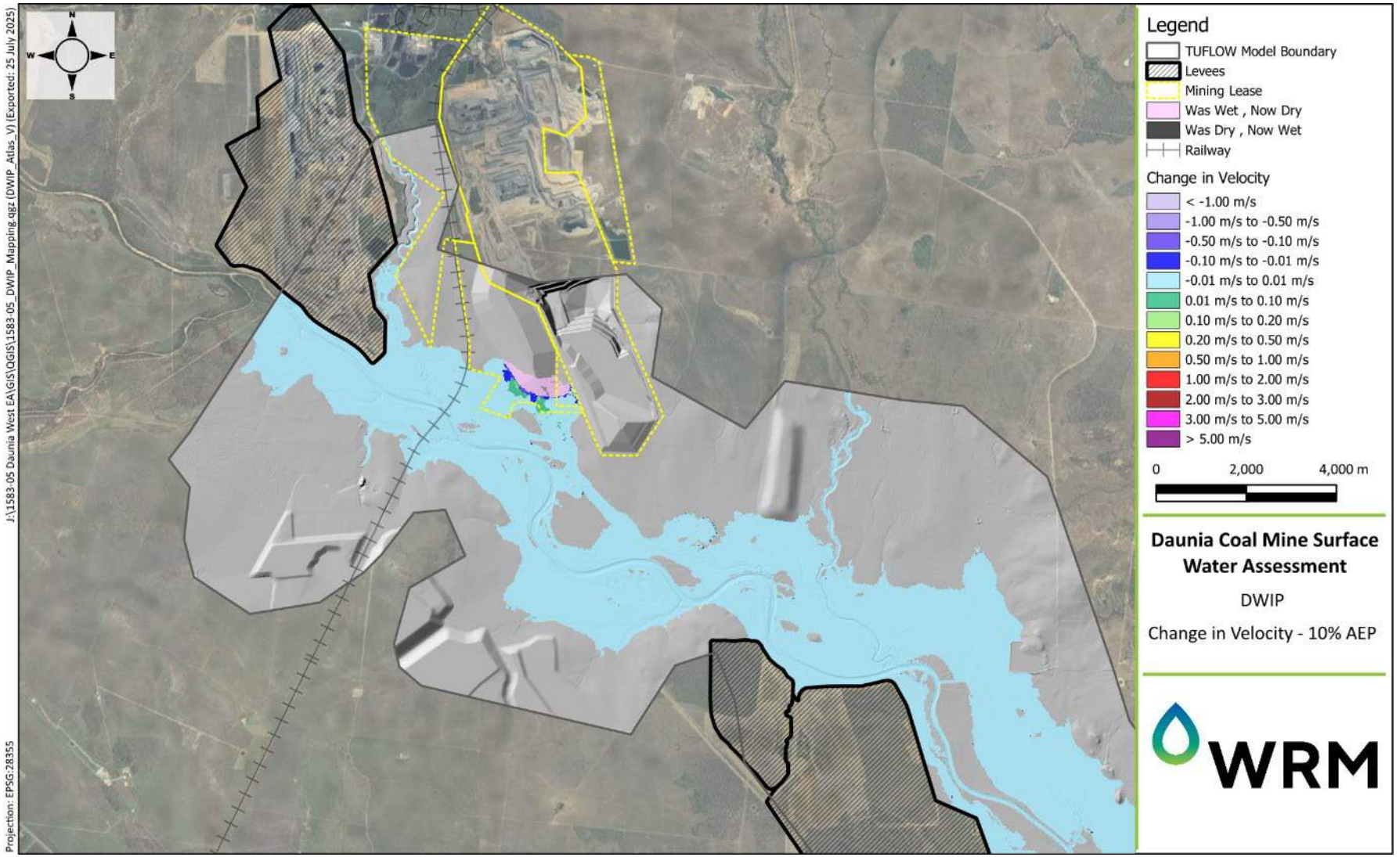

Figure E.52 **Change in Velocity – 10% AEP– DWIP**

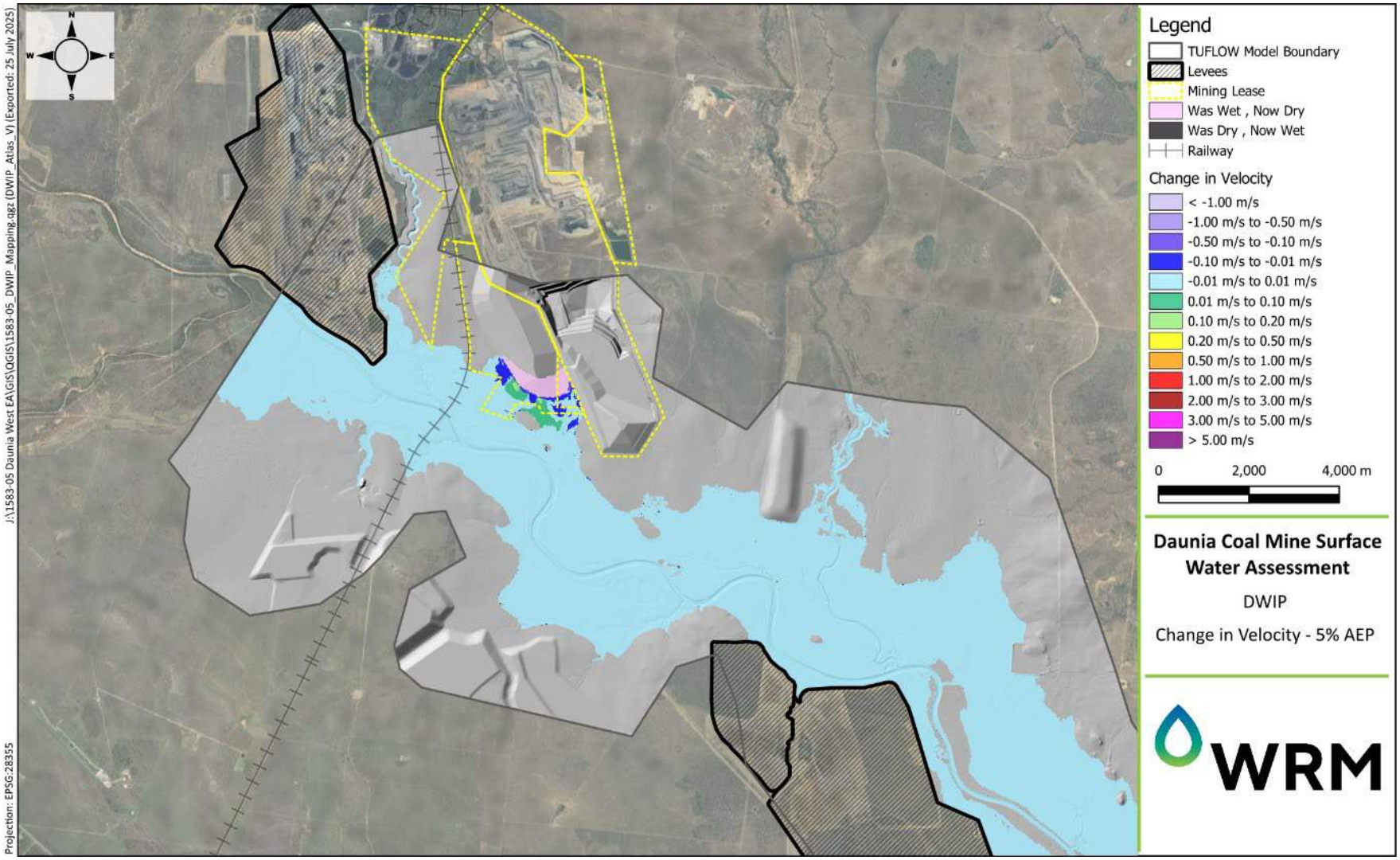

Figure E.53 **Change in Velocity – 5% AEP– DWIP**

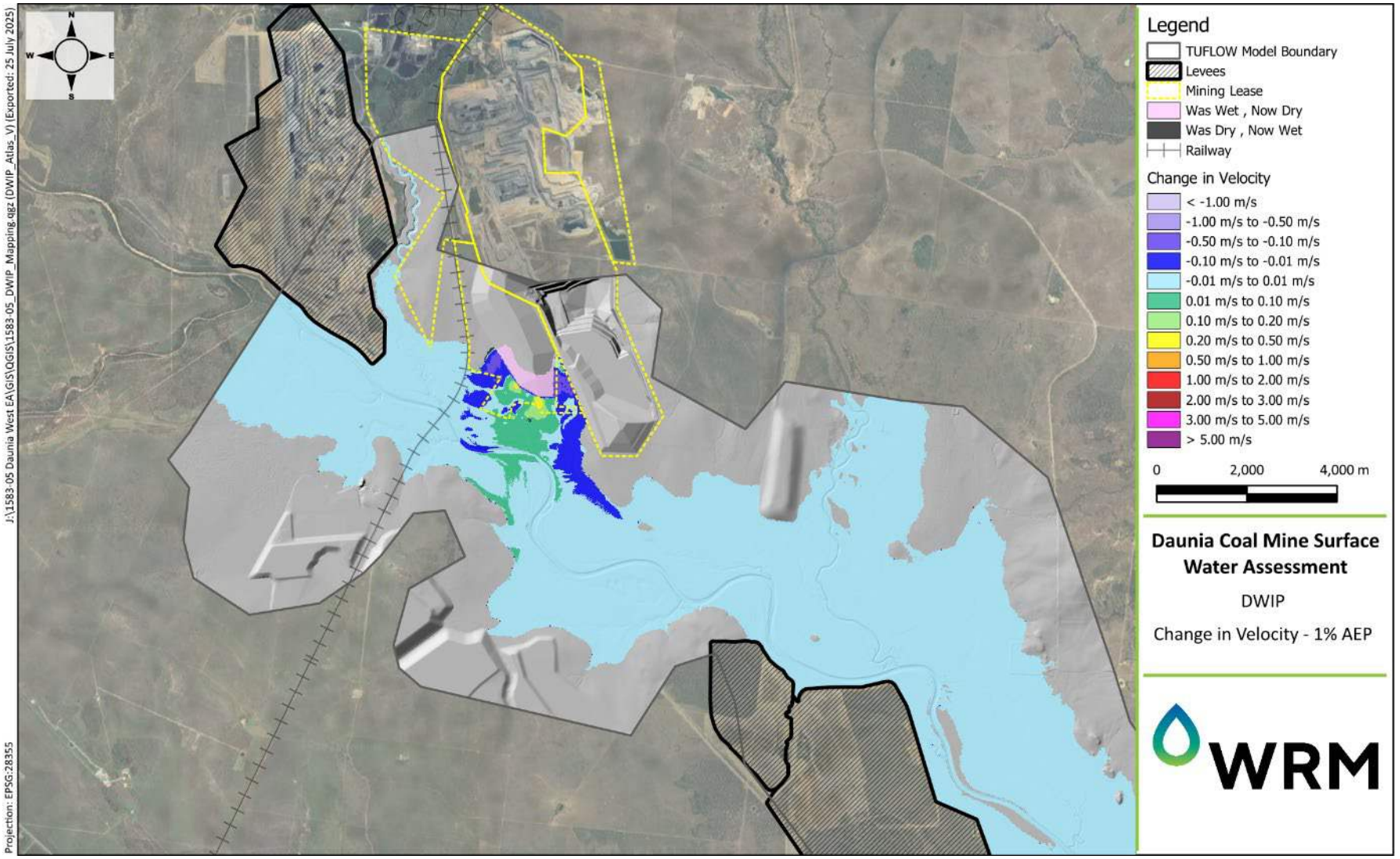

Figure E.54 **Change in Velocity – 1% AEP– DWIP**

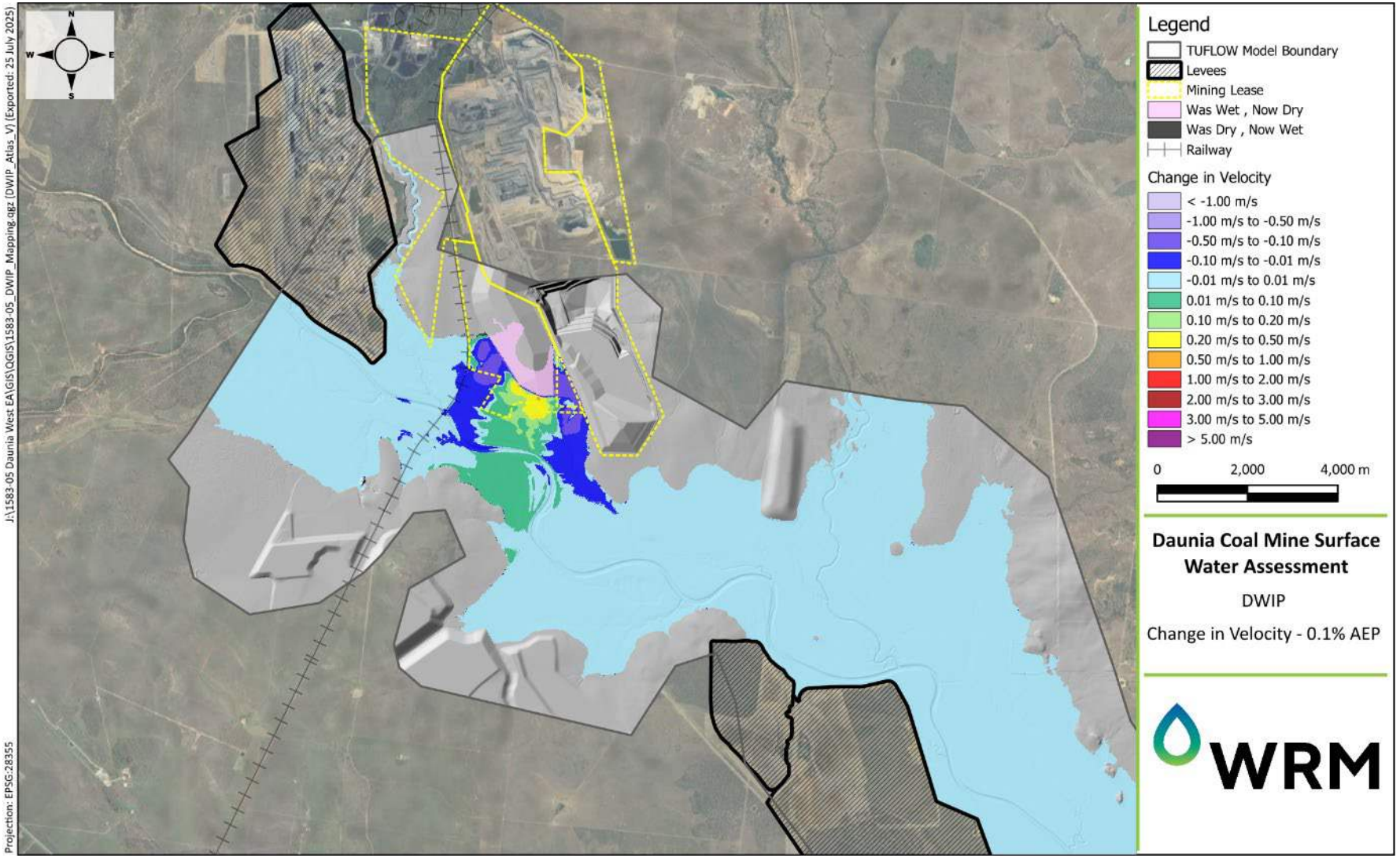

Figure E.55 **Change in Velocity – 0.1% AEP– DWIP**

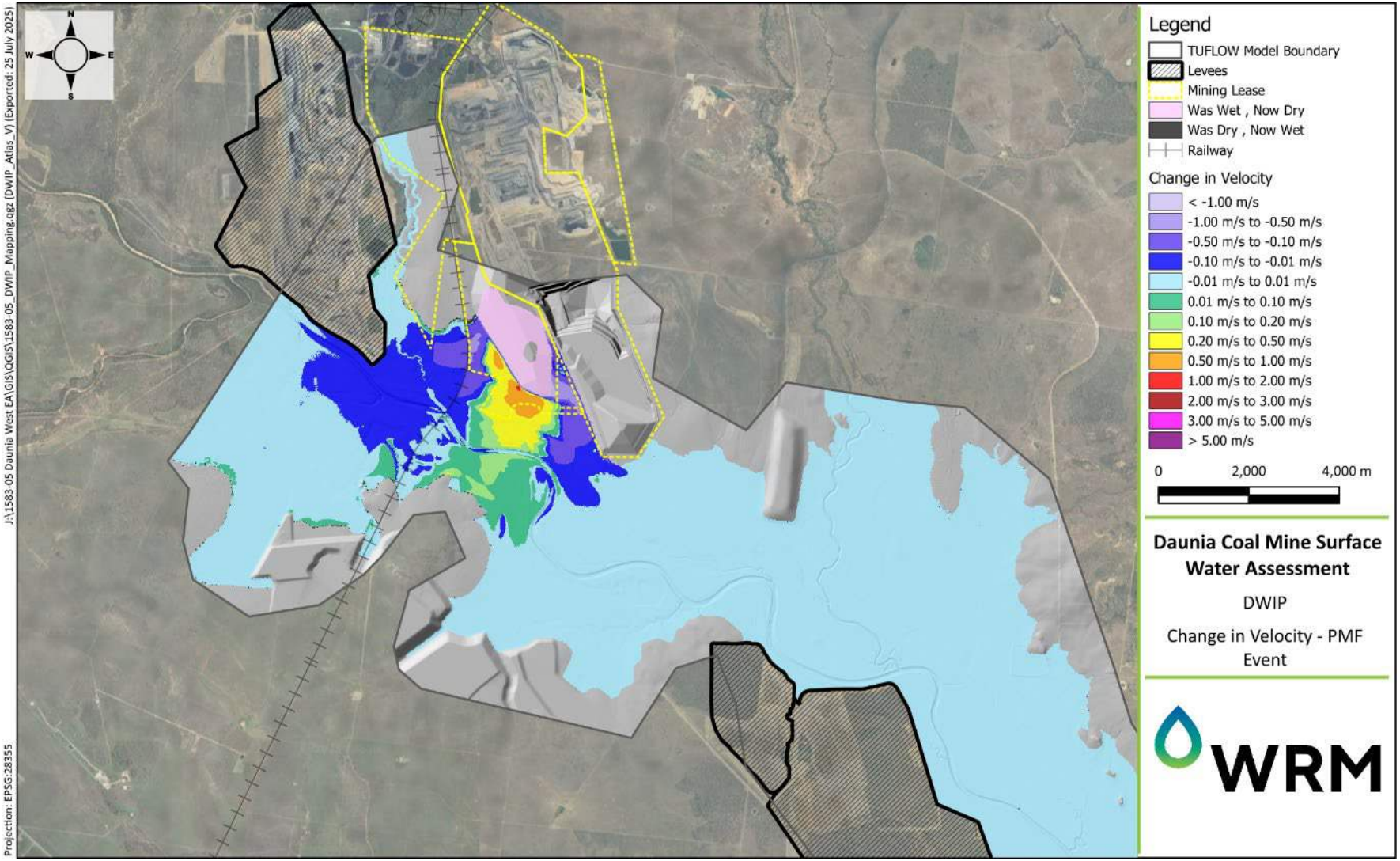

Figure E.56 **Change in Velocity – PMF Event– DWIP**

APPENDIX F PRELIMINARY CONSEQUENCE CATEGORY ASSESSMENT

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DAUNIA WEST INFRASTRUCTURE PROJECT

Preliminary Consequence Category Assessment

Whitehaven Coal Limited

11 May 2026

1583-05-C6_AppendixF

DETAILS

Report Title	Daunia West Infrastructure Project, Preliminary Consequence Category Assessment
Client	Whitehaven Coal Limited

THIS REVISION

Report Number	1583-05-C6_AppendixF
Date	11 May 2026
Author	JG
Reviewer	GR

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1 CONSEQUENCE CATEGORY ASSESSMENT

1.1 OVERVIEW

Regulated structures include land-based containment structures, levees, bunds, and voids. Tanks or containers built to an Australian Standard for strength and integrity are not included. Each structure must be assigned a consequence category in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (the DETSI Manual) (DETSI, 2025). The consequence category, along with the structure's purpose and stored water quality, determine whether the structure is a 'regulated structure' under the *Environmental Protection Act 1994* (EP Act). If a structure is determined to be regulated, it would need to comply with design, operational and monitoring requirements under the DETSI Manual and Environmental Authority (EA) conditions.

In accordance with the DETSI Manual, structures are categorised into three consequence categories: low, significant, or high. Structures classified as significant or high consequence are referred to as regulated structures. The DETSI manual emphasises the importance of early identification of consequence potential to determine the reliability standards required for design, construction, and operation. It also provides guidance on hydraulic performance criteria but does not prescribe site planning standards. Active water management strategies are recommended to minimise environmental harm and manage contaminated waters effectively.

Based on the criteria in the DETSI Manual, each structure was assessed based on three failure event scenarios:

- **'Failure to contain – seepage'** – spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure;
- **'Failure to contain – overtopping' –** spills or releases from the structure that result from loss of containment due to overtopping of the structure; and
- **'Dam break'** – collapse of the structure due to any possible cause.

1.2 PROJECT DESCRIPTION

A preliminary consequence category assessment (CCA) (the assessment) has been completed for the following proposed sediment and mine-affected water (MAW) as part of the Daunia West Infrastructure Project (DWIP):

- Pandora Sediment Dam (P Sediment Dam);
- Pandora West Sediment Dam (PW Sediment Dam);
- Pandora MAW Dam (P MAW Dam); and
- Pandora West MAW Dam (PW MAW Dam).

The assessment evaluated failure scenarios for these dams based on seepage, overtopping, and dam break scenarios, and then assigns a preliminary consequence category for each dam. Active water

management strategies are recommended to minimise environmental harm and manage contaminated water.

The mining lease application area is north of the Isaac River, downstream of New Chum Creek (see Figure 1.1). Figure 1.1 shows the locations and catchment areas for the proposed dams and runout paths considered for dam-break or operational overflow scenarios. Table 1.1 presents the hydrologic design criteria for the assessed dams.

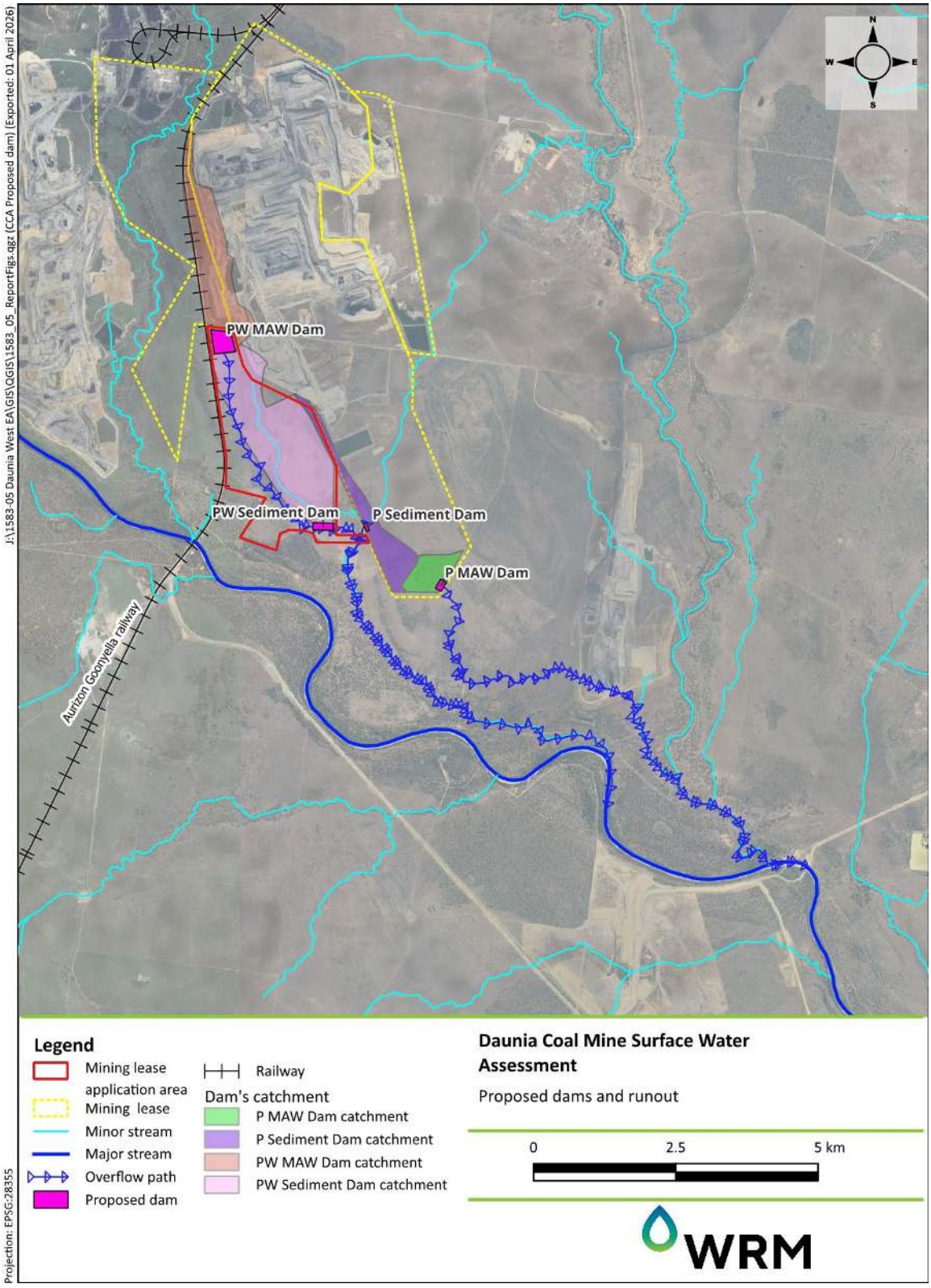

Figure 1.1 Proposed dam catchments and runout paths

Table 1.1 Hydrologic Design Criteria for PW Sediment Dam, P Sediment Dam, P MAWD, and PW MAW Dam

Structure	Total Catchment Area (ha)	Proposed Storage Capacity (ML)	Maximum Operating Volume (ML)	Preliminary Overflow Destination	Construction Year
Pandora West Sediment Dam (PW Sediment Dam)	337.6	144	100	Isaac River	2028
Pandora Sediment Dam (P Sediment Dam)	88.7	38	-	Isaac River	2026
Pandora MAW Dam (P MAW Dam)	50.1	138	100	Isaac River	2027
Pandora West MAW Dam (PW MAW Dam)	246.7	513	100	Isaac River	2028

2 RECEIVING ENVIRONMENT

2.1 LOCAL DRAINAGE

The catchment area of the Isaac River upstream of DNM is approximately 3,630 km^2 and comprises mainly scattered to medium dense bushland, grazing land and the township of Moranbah. There are several existing coal mines in the Isaac River catchment including, Burton, North Goonyella, Grosvenor, Goonyella-Riverside, Broadmeadow, Broadlea, Isaac Plains, Carborough Downs, Caval Ridge, Poitrel, DNM, Millennium and Moranbah North.

For the overtopping and dam break scenarios assessed for each dam, the receiving environment consists of the areas adjacent to each dam and the downstream waterways including the Isaac River, which runs along the southwestern side of DNM. The Isaac River is a defined watercourse under the Water Act 2000 (Queensland) (the Act).

The Isaac River begins in the Central Highlands of Queensland near the mining and agricultural region near Moranbah and Nebo. The river's headwaters are in relatively undeveloped areas characterised by open woodland and grazing land. From its source, the Isaac River flows generally south-eastward, traversing through rural, pastoral, and mining landscapes.

2.2 ISAAC RIVER DRAINAGE TO THE GREAT BARRIER REEF

The Isaac River collects runoff from numerous smaller streams and tributaries, including Denison Creek and Goonyella Creek. The river continues its journey southward until it joins the Mackenzie River. The Mackenzie River, in turn, merges with the Dawson River near Duaringa, and together they form the Fitzroy River.

The Fitzroy River flows eastward to the coast and passes through Rockhampton. The Fitzroy Basin drains about 142,665 km^2, making it the largest river catchment draining into the Great Barrier Reef lagoon. The Isaac River, as one of its key sub-catchments, provides significant water, sediment, and dissolved material during both normal river flow conditions and flood events.

The Fitzroy River eventually empties into Keppel Bay, a coastal area of the Coral Sea just north of the city of Rockhampton. Keppel Bay forms part of the southern Great Barrier Reef lagoon. The river's mouth is characterised by extensive estuarine and mangrove habitats, which act as transitional zones between the freshwater riverine environment and the marine waters of the Coral Sea.

After the Fitzroy River empties into Keppel Bay, its water and any sediments, nutrients, and contaminants spread into the coastal zone of the Great Barrier Reef World Heritage Area.

2.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (MNES)

The Australian Government Department of Agriculture, Water and the Environment Protected Matters Search Tool (PMST) indicates that Matters of National Environmental Significance (MNES) are located downstream of the Project area (refer to Figure 2.1). The drainage path from the Project is about 600 km to the boundary of the Great Barrier Reef World Heritage Area.

Figure 2.1 Matters of National Environmental Significance (Source: Protected Matters Search Tool)

2.4 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE (MSES)

Matters of State Environmental Significance (MSES) are located along the receiving waterways downstream of the Project (refer to Figure 2.2). These values are primarily associated with regional ecosystems classified as 'endangered' and 'essential habitat', as well as 'wildlife habitat'.

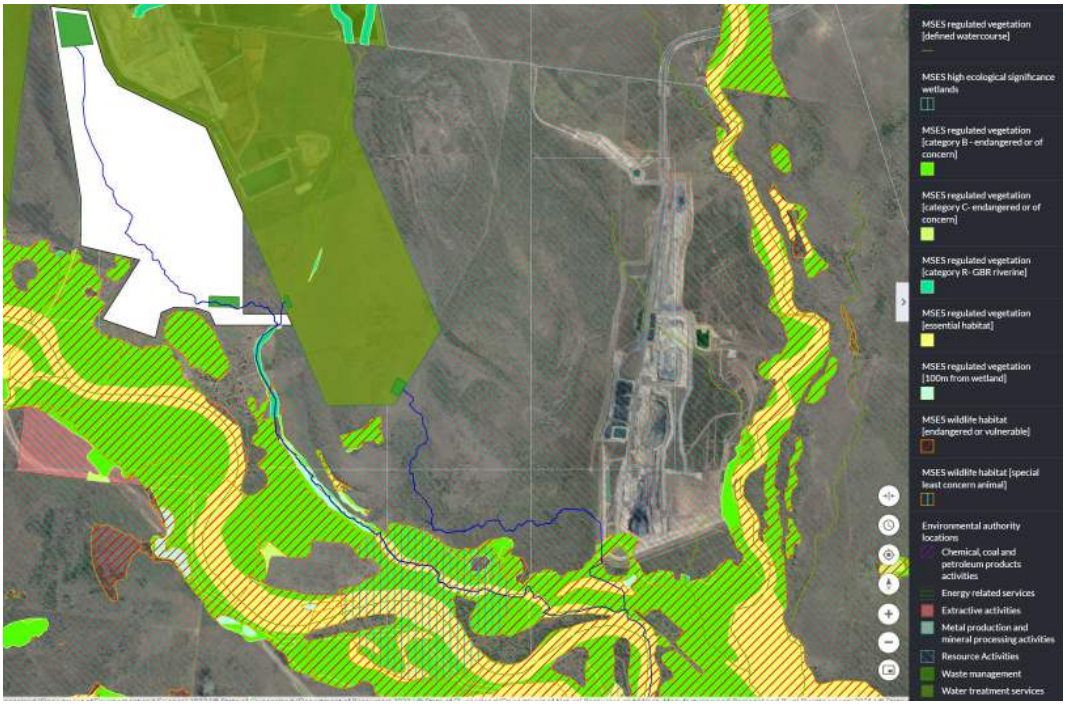

Figure 2.2 Matters of State Environmental Significance (Source: Queensland Globe)

2.5 HABITABLE DWELLINGS

Figure 2.3 shows the location of habitable dwellings near the Project area.

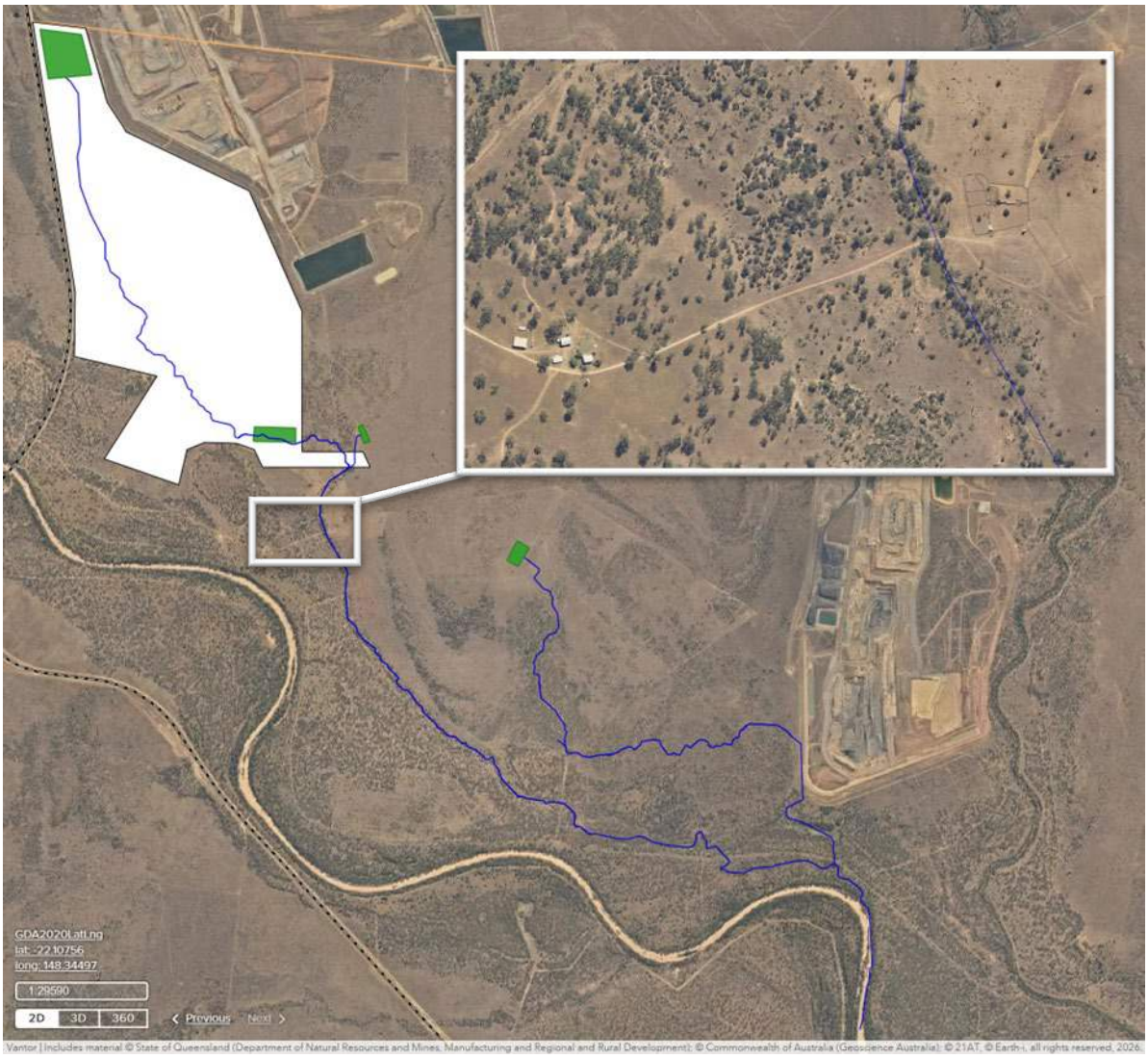

Figure 2.3 Habitable Dwellings in the vicinity of the Project Area (Source: Queensland Globe)

3 PRELIMINARY CCA RESULTS

3.1 HARM TO HUMANS

The consequence category for harm to humans was assessed as Low for all dams, based on the following considerations:

- Topographic data and associated downstream runout pathways indicate that dwellings located approximately 0.5 km downstream of the proposed dams are unlikely to be at risk of inundation resulting from the failure of any proposed water containment dams. On this basis, loss of life is not expected under a dam break scenario. Notwithstanding this finding, a dam break study would be required to confirm this assessment as part of subsequent project phases.
- The potential dam break volumes and embankment heights are limited, and failure is not expected to result in inundation capable of causing significant damage to roads or other infrastructure.
- Accordingly, loss of life is not expected, and any contamination of waters used for human consumption would be expected to affect fewer than 10 people, if any.

3.2 GENERAL ENVIRONMENTAL HARM

Based on the preliminary assessment undertaken in accordance with the DETSI Manual, all proposed sediment and MAW dams are assessed as Low consequence for harm to humans, general environmental harm, and general economic loss or property damage, based on the following:

- Water quality within the sediment dams is generally good or only slightly elevated and is not expected to result in adverse environmental effects under any assessed failure scenario.
- For MAW dams, electrical conductivity and pH are managed in accordance with Environmental Authority controlled release conditions; while values may be elevated relative to background conditions, any release under seepage, overtopping, or dam-break scenarios would be limited in volume and duration and would result in only minor and temporary downstream water-quality changes.
- Potential environmental impacts associated with any dam failure scenario would be localised to the immediate downstream environment, short-term in nature, and reversible, and would not result in persistent or irreversible degradation of environmental values.
- Under a dam-break scenario, the limited embankment heights and storage volumes, together with downstream topography, constrain flood depths and velocities to levels that would not result in significant environmental harm or damage.
- While MNES are present downstream of the Project, the substantial separation distance, combined with hydrological dilution and attenuation along the drainage pathway, means that no material or measurable impacts to these values are expected.

- The predicted impacts do not meet the spatial extent, duration, cost, or irreversibility thresholds required to trigger a Significant or High consequence category under the DETSI Manual.

3.3 GENERAL ECONOMIC LOSS OR PROPERTY DAMAGE

The consequence category for general economic loss or property damage was assessed as Low for all dams, based on the following:

- There are no significant third-party assets located within the downstream failure pathways of the dams.
- In the event of a dam failure, any rehabilitation, compensation, repair, or rectification costs are expected to be less than $1 million, consistent with the Low consequence category.

3.4 PRELIMINARY CCA OUTCOMES

Table 3.1 presents the assessment outcomes, identifying the preliminary consequence category determined for each assessed dam and the likely regulated status. The assessment results are based on the concept design, the intended operational strategy and expected contaminant concentrations for the proposed dams.

Based on the preliminary assessment undertaken in accordance with the DETSI Manual, all proposed sediment and mine-affected water dams are assessed as Low consequence for harm to humans, general environmental harm, and general economic loss or property damage under all credible failure scenarios. On the preliminary CCA outcomes, none of the proposed dams are considered to meet the definition of a regulated structure.

Table 3.1 Summary of the preliminary consequence category assessment

Dam / Structure	Harm to Humans	General Environmental Harm	General Economic Loss or Property Damage	Overall Consequence Category	Regulated Structure
PW Sediment Dam	Low	Low	Low	Low	No
P Sediment Dam	Low	Low	Low	Low	No
P MAW Dam	Low	Low	Low	Low	No
PW MAW Dam	Low	Low	Low	Low	No

A full CCA will be required for regulated structures during the detailed design stage. The final dam and spillway configurations, including embankment heights, will be confirmed prior to completing the full CCA.

4 REFERENCES

Department of Environment, Science and Innovation (DETSI), 2025. Manual for assessing consequence categories and hydraulic performance of structures. Version 5.04. ESR/2016/1933. Available at: https://www.des.qld.gov.au/policies?a=272936:policy_registry/era-mn-assessing-consequence-hydraulic-performance.pdf

HydroBalance, 2025. Daunia West Infrastructure Project, Water Balance Assessment Report. Doc. Ref.: WHC-038-C. Date: 9 October 2025.

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