



CHAPTER 4 – SURFACE WATER AND WATER MANAGEMENT

NEW LENTON COAL PTY LTD
NEW LENTON COAL PROJECT

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4. SURFACE WATER AND WATER MANAGEMENT

4.1 Introduction

This chapter describes the surface water setting of the Project; outlines the water management strategy, system and infrastructure for management of all types of water in the Project area; provides a site water balance; assesses the performance of the water management system; models the residual void water quality and levels; describes the potential for changes in flooding, hydrology and geomorphology; assesses the potential impacts from the Project on environmental values (EVs) relating to surface water; and outlines management measures and mitigation strategies designed to protect those EVs.

The information in this chapter is based on the detailed Surface Water Impact Assessment undertaken by WRM Water & Environment Pty Ltd (WRM) provided in **Appendix 7**, and addresses the relevant information required by the PER guidelines as it relates to surface water (see **Appendix 16**).

4.2 Relevant Legislation, Policy and Guidelines

4.2.1 Commonwealth

A Referral for the Project, under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) was lodged on 23/09/2020 (EPBC 2020/8778). On 22/10/2020, the delegate for the Minister for the Environment determined that the Project was a controlled action for water resource, in relation to coal seam gas development and large coal mining development (sections 24D & 24E).

The Project will be referred to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) to assess the Project against the IESC Guidelines (IESC 2018). **Appendix 17** details how the relevant IESC Guidelines were addressed in relation to surface water.

4.2.2 State (Queensland)

4.2.2.1 Environmental Protection Act 1994

The proponent holds a current environmental authority (EA) EPML00475513 under the *Environmental Protection Act 1994* (EP Act) covering the Project's mining leases (MLs). All Project-related activities are conditioned by this EA, including water releases and management of water systems.

In relation to surface water, Schedule C of the EA conditions:

- the release of mine affected water to the receiving environment, including by specifying: authorised release points
- required water quality of mine affected water
- the frequency, locations, and quality characteristics of water monitoring
- that releases must only take place during periods of natural flow events in accordance with the receiving water flow criteria
- that releases must comply with the Water Management Plan (WMP).

The WMP must be developed and implemented by an appropriately qualified person, in accordance with relevant government guidelines, and must be reviewed and reported on annually by an appropriately qualified person.

Release criteria have been established in accordance with Department of Environment and Science's (DES's) Model Mining Conditions (DES, 2017) which use variable flow rates in the receiving environment

to determine the release volumes and water quality of mine affected water releases, so that downstream EVs and water quality objectives (WQOs) are protected.

Water quality monitoring at specified locations and frequencies must also occur for water storages associated with the release points, and for the receiving environment at upstream background sites and downstream of release points. The EA outlines actions that must be taken if quality characteristics of the mine affected water release or downstream monitoring sites exceed any of the trigger levels. For all water monitoring, information including the date, time, flow rate, and details of any exceedances of the conditions must be submitted annually to the administering authority, being DES.

A receiving environment monitoring program (REMP) and erosion and sediment control plan (ESCP) are required to be developed and implemented by an appropriately qualified person. The REMP must also be reported on annually to DES. A REMP has been provided as **Appendix 25** and an ESCP has been provided as **Appendix 18**.

In relation to water systems, Schedule I of the EA conditions the design, construction and operation of regulated structures, including that they are designed, constructed and operated in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (the Manual) (DES, 2016).

4.2.2.2 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water) under the EP Act governs discharge to surface water, aims to protect EVs and provides guidance for WQOs. Under Schedule 1 of the EPP Water, the relevant guidelines for the Project are 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* (DEHP, 2011) (the Isaac River Sub-basin EVs and WQOs). These guidelines were used in the formation of approved trigger levels specified in the EA, which the Project will utilise to protect EVs. The EPP Water is supported by the *Queensland Water Quality Guidelines 2009* (QWQG) (DEHP, 2013).

4.2.2.3 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures

The Manual (DES, 2016) defines the methodology and assessment criteria to determine if a structure associated with an environmentally relevant activity should be regulated under the EP Act. The Manual details the hydraulic design requirements for regulated structures (e.g. dams and levees) and this document has been used as a reference in the preliminary design of the water management system and preliminary sizing of dams associated with the Project. It has also been used to inform the design of Project levees.

4.2.2.4 Water Act 2000

The *Water Act 2000* (Water Act) is the primary statutory document that establishes a system for the planning, allocation and use of non-tidal water, and it also specifies requirements for licensing of structures requiring disturbance to the bed and banks of watercourses. A watercourse is defined by the *Water Act 2000* (Water Act) as a river, creek or stream in which water flows permanently or intermittently and includes the bed and banks and any other element of a river, creek or stream confining or containing water.

Placing fill or excavating in a watercourse, as required for works associated with construction of the crossings of the Isaac River, will require a riverine protection permit if they do not comply with guidelines for riverine protection permit exemption requirements.

A diversion of Ti-Tree Creek is proposed for the Project. On 10/05/2018 the Department of Natural Resources, Mines and Energy (DNRME) made a determination that Ti-Tree Creek was not a defined watercourse under the Water Act and therefore did not require approval for a diversion under the Water

Act. The diversion of Ti-Tree Creek formed part of the assessment of the EA application for the Project and is therefore authorised under the approved EA.

4.2.2.5 Water Entitlements

No licensed surface water users were identified within a 20 km radius of the Project area. No downstream water users were identified between the Project area and Burton Gorge Dam. Aerial photography was also reviewed, and no farm dams were identified. Downstream water users are therefore expected to be limited to stock and water uses from the Dam. Burton Gorge Dam was to constructed to provide water supply for the nearby North Goonyella Coal Mine and township. The storage capacity of the dam is 14,829 ML at a Full Supply level of RL 297.5 m and the dam has a catchment of 540 km². The dam is owned and operated by North Goonyella Coal Properties, a subsidiary of Peabody Australia. Isaac Regional Council is also involved in some of the dam operation activities. Burton Gorge Dam is a Category 1 referable dam in accordance with the *Water Supply Act 2008*. The dam releases water to the Isaac River.

4.2.2.6 Fisheries Act 1994

Approval under the *Fisheries Act 1994* for waterway barrier works within waterways is not required as mining activities on a mining lease are exempt from the Act. There are no declared fish habitat areas in the area of the Project's activities. The design and construction of the Isaac River bed level crossing will apply the design and construction requirements within the DAF guideline 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (DAF, 2018) for watercourses to manage impacts to watercourse and fish passage.

4.3 Assessment Methodology

The Surface Water Impact Assessment (refer to **Appendix 7**) used a range of methodologies including desktop assessment, analysis of monitoring data, and site specific modelling to assess the potential impacts of the Project on surface water resources.

A summary of the methodologies relating to the development of the water balance model, the water management system assessment, climate change assessments, residual void assessment, and flood and geomorphological modelling are provided in their respective sections of this chapter, with the detailed methodologies provided in **Appendix 7**.

4.4 Surface Water Environmental Values

4.4.1 Water Quality Objectives

As outlined in Section 4.2.2, the relevant document under Schedule 1 of the EPP Water for the Project is the 'Isaac River Sub-basin EVs and WQOs'. Most of the waterways in the vicinity of the Project (Anna Creek, Teviot Creek and Sandy Creek) are located within the Isaac northern tributaries region of the Isaac River Sub-Basin (WQ1301). The Isaac River, Hill Creek, Ti-Tree Creek and Lady Baldwin Gully are located within the Isaac and lower Connors River main channel region. Burton Gorge Dam has its own region and set of EVs. The conditions of waterways located in the vicinity of the Project are classified as slightly to moderately disturbed ecosystems under the QWQG (DEHP, 2013). The EVs selected for protection include:

- aquatic ecosystem protection (slightly to moderately disturbed ecosystems)
- irrigation, farm use and stock watering
- human consumption
- primary, secondary and visual recreation
- drinking water

- industrial use
- cultural and spiritual values.

Burton Gorge Dam has the same set of EVs, with the exception of irrigation and farm use.

The WQOs to protect the EVs of the Project have been developed as part of the existing approvals, and the associated release contaminant trigger investigation levels are provided in Table C3 of the New Lenton EA. This aligns with the PER Guideline which requires that “The PER should refer to water quality objectives approved in the State environmental authority for the proposal where they are relevant to the assessment...”.

Table 3.2 of **Appendix 7** provides the mine affected water release limits and release contaminant trigger investigation levels from Table C2 and Table C3 of the New Lenton EA (**Appendix 4**). These are compared to the trigger values or default guideline values (DGVs) nominated in the QWQG and Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) from 2018 and 2020. This comparison demonstrates that the mine affected water release limits and release contaminant trigger investigation levels from Table C2 and Table C3 of the EA are same or stricter than the QWQG and ANZG.

4.4.2 Regional Catchment Characteristics

4.4.2.1 Watercourses and Drainage

The Project is located within the headwaters of the Isaac River catchment of the greater Fitzroy Basin, upstream of Burton Gorge Dam. The Isaac River catchment commences at the Denham Range located about 15 km to the northeast (upstream) of the Project. The Isaac River flows in a south-westerly direction through the Carborough and Kerlong Ranges before turning in a south-easterly direction near the Goonyella Riverside Mine.

The Connors River, which has a catchment area similar to the upstream Isaac River, flows into the Isaac River approximately 235 km downstream of the Project. The Isaac River finally converges with the Mackenzie River a further 68 km downstream.

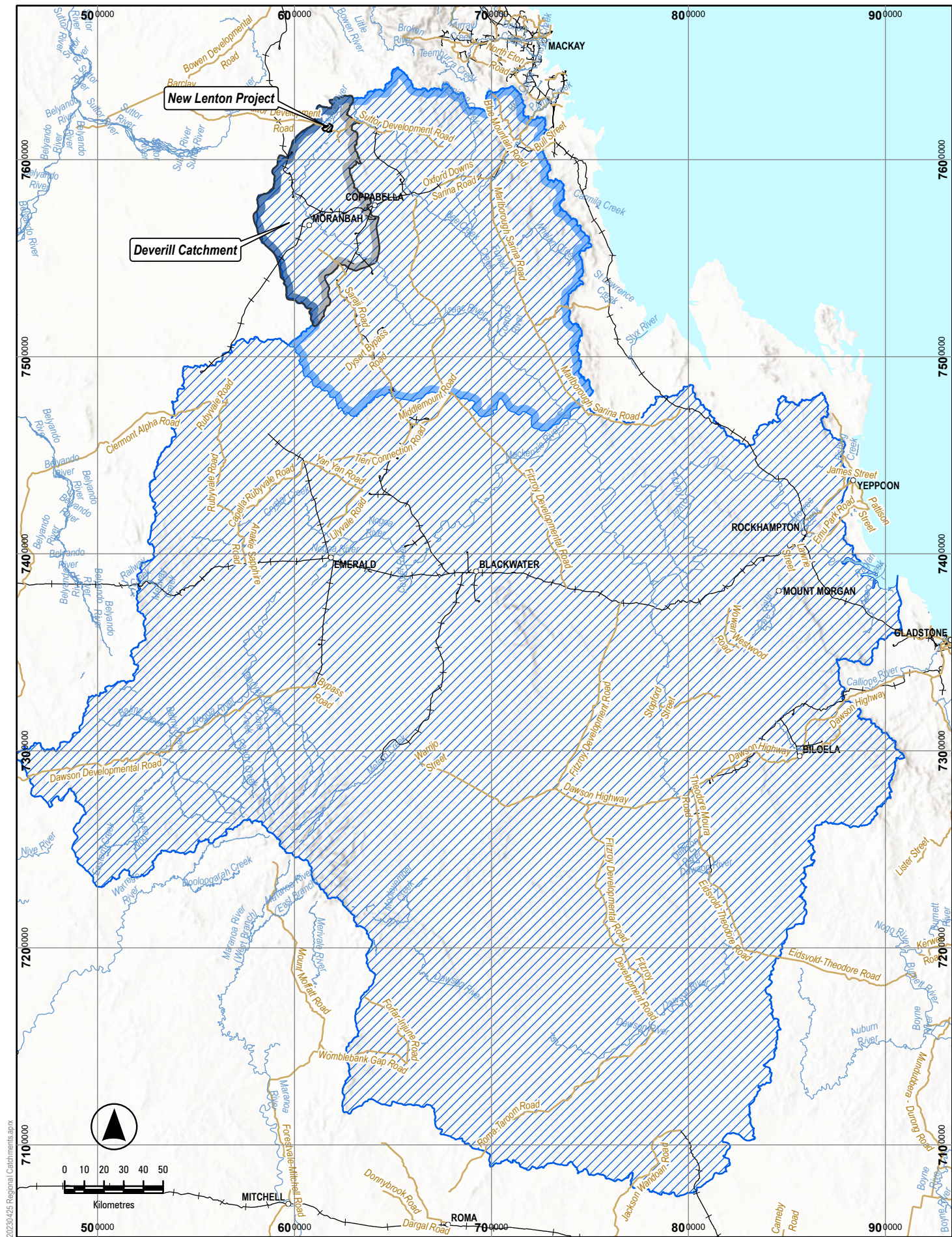
Figure 4-1 shows the location of the Project and Isaac River catchment, in the context of the whole Fitzroy River catchment. Figure 4-2 shows the drainage characteristics of the Upper Isaac River to the Deverill streamflow gauge.

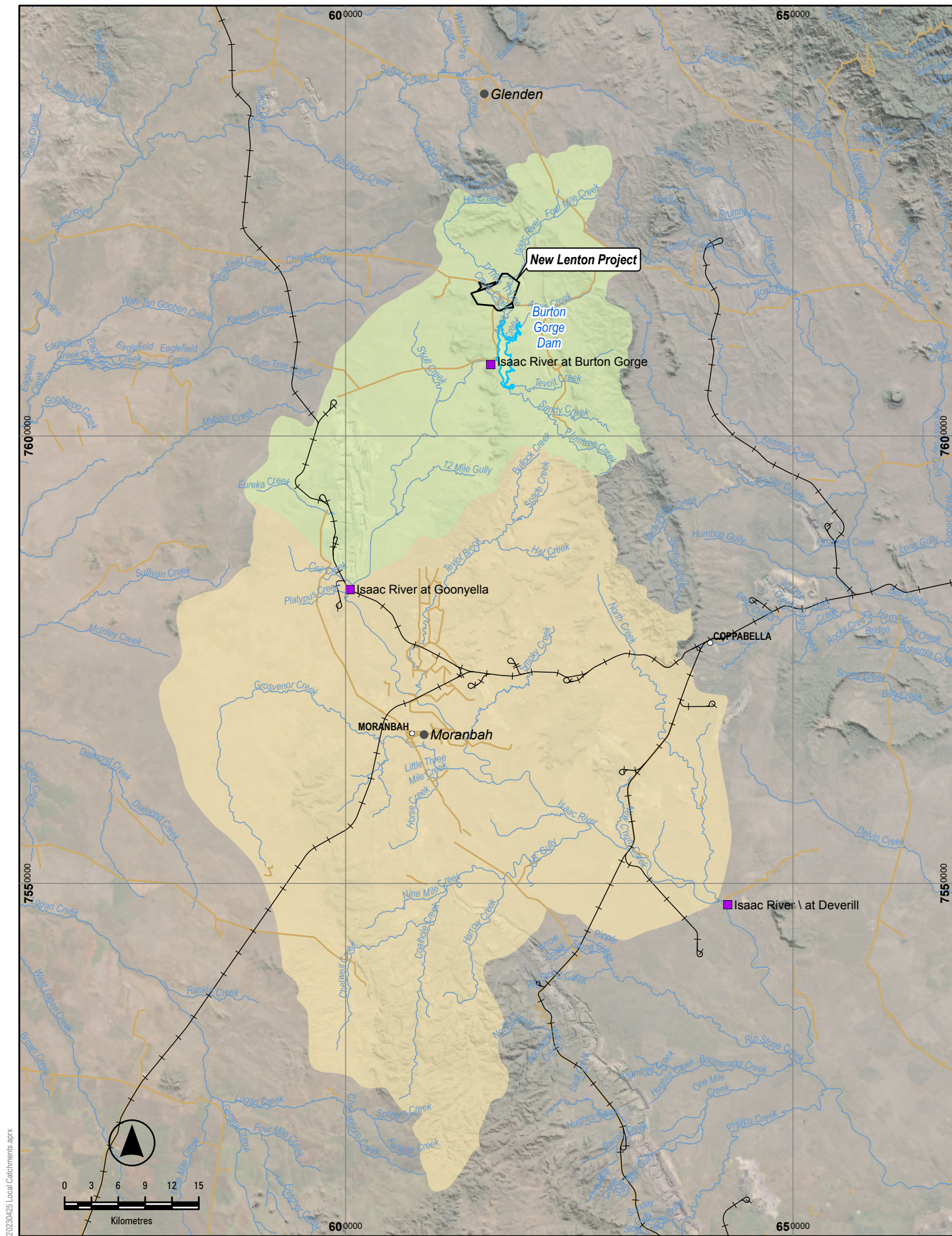
The Isaac River flows into the northern arm of Burton Gorge Dam which is located approximately 3.5 km downstream of the New Lenton MLs. Burton Gorge Dam also receives inflows from Anna Creek (including Lake Elphinstone), Sandy Creek, Plumtree Creek and Teviot Creek (including Teviot Creek Dam). These watercourses flow into the southern arm of Burton Gorge Dam and their catchments are not affected by the Project. Figure 4-3 illustrates the location of the Project relative to the local catchments and waterways. The catchments to the north, east and west of the New Lenton MLs are the upper most catchments in the Isaac River catchments.

The greater Isaac-Connors sub-catchment area is approximately 22,364 km² (to the Mackenzie River confluence), out of a total Fitzroy River catchment of 142,665 km². That is, it represents around 15% of the overall Fitzroy River catchment. The catchment of the Isaac River to the downstream boundary of the New Lenton MLs is about 200 km², which represents about 0.9% of the Isaac-Connors sub-catchment and 0.1% of the Fitzroy River catchment.

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 within the New Lenton MLs 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 pools are expected to hold water for extended

periods. Therefore, physical attributes, water quality, and the composition of aquatic flora and fauna communities are also expected to be highly variable over time.



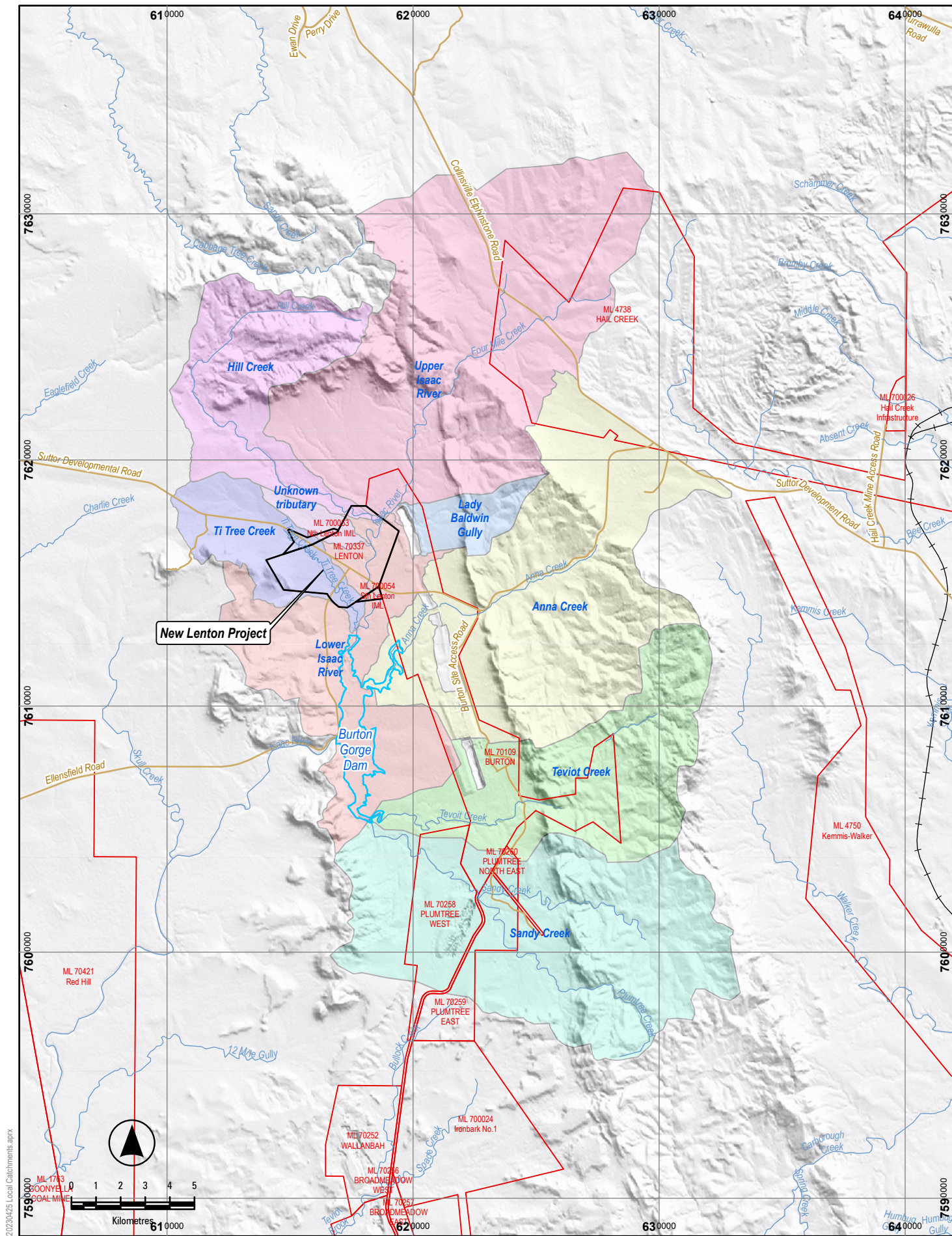


2023/04/25 Local Catchments.aprx

Datum: MGA94 Zone 55
 Scale: See Scale Bar (A4)
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2023/04/25 Local Catchments approx

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LEGEND

- New Lenton Project
- ML
- Waterway
- Roads
- +— Railway

Local Catchment

- Anna Creek
- Hill Creek
- Lady Baldwin Gully
- Lower Isaac River
- Sandy Creek
- Teviot Creek
- Ti Tree Creek
- Unknown tributary
- Upper Isaac River
- Burton Gorge Dam

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Local Catchments

4.4.2.2 Stream Flow

The nearest streamflow gauges on the Isaac River near the Project are located downstream at Burton Gorge Dam and Goonyella (see Figure 4-2), both of which were operated by the Department of Resources (DoR), with data collected to 1988 and 2021 respectively.

Historical flow and river height monitoring data at the Burton Gorge and Goonyella gauges provide an indication of the Isaac River flow regime near the Project. The mean river height data shown in Figure 4-4 suggests that flow at the Burton Gorge gauge is more likely to occur in the wetter months from November to April, reducing to shallow subsurface flows from about May to October in an average year. The same pattern is evident from data at the Goonyella gauge.

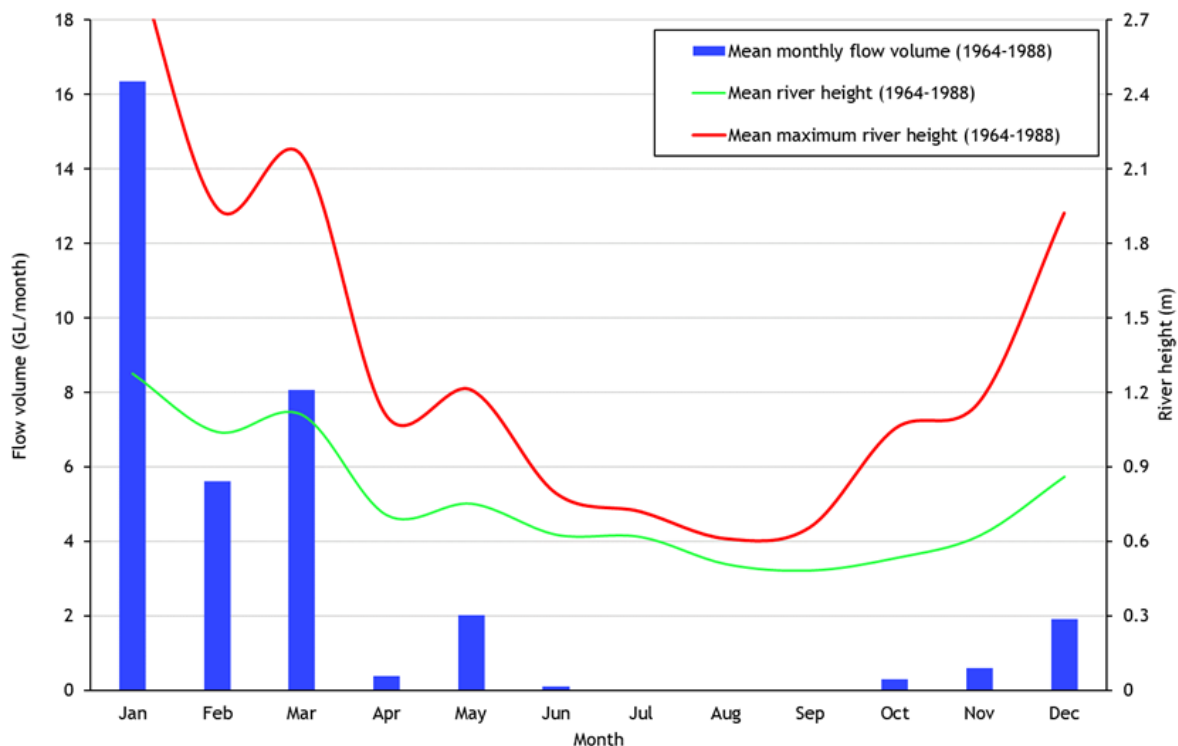


Figure 4-4 *Flow volume and River Height - Isaac River at Burton Gorge*

Figure 4-5 shows a ranked plot of the daily stream flows in the Isaac River recorded at the Goonyella, and Burton Gorge gauges. The following is of note with respect to the recorded stream flows:

- The Isaac River is ephemeral with flows recorded only on 22% of days at Goonyella and 35% of days at Burton Gorge. Flows above 100 megalitres per day (ML/d) occur for less than 7.2% of days at Goonyella and less than 5.4% of days at Burton Gorge. A flow of 100 ML/d would not fully inundate the bed of the Isaac River at either location.
- The mean daily flow (all days) is 143 ML/d and 94 ML/d at Goonyella and Burton Gorge, respectively.
- The highest recorded flow (2,165 m³/s) at the Goonyella gauge occurred in January 2021, which reached a gauge height of 9.92 m. The highest recorded flow (803 m³/s) at the Burton Gorge gauge occurred in March 1988 where the river reached a gauge height of 7.34 m.
- The flow duration at Burton Gorge indicates that low flows are characterised by controlled environmental releases.

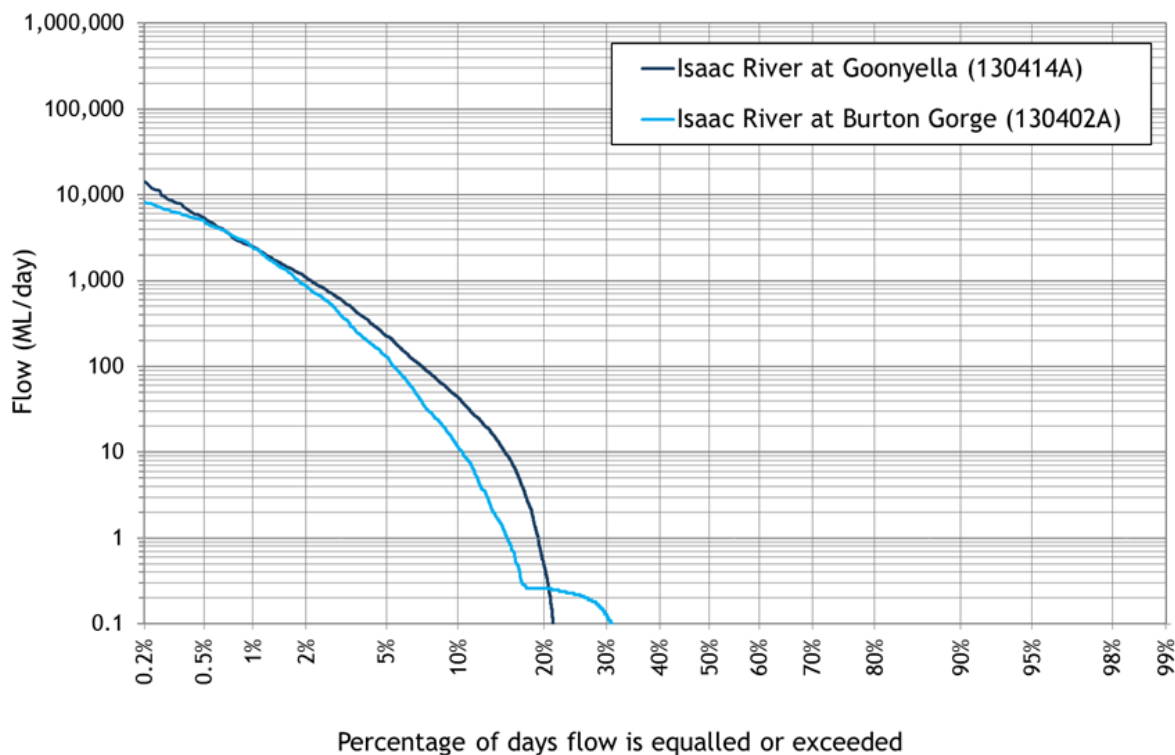


Figure 4-5 Stream Flow Duration Curves, Isaac River at Goonyella and Burton Gorge Gauges

4.4.2.3 Water Quality

The Isaac River catchment has seen significant changes in land use over the past 50 years. Widespread land clearing and coal mine development have occurred throughout the catchment. In 2012, model water conditions were developed by DES for coal mines in the Fitzroy basin (DES 2012), subsequently updated to DES (2017), which were designed to manage water discharges to meet the WQOs set out in the EPP (Water) and to provide consistency between mining operations in the Fitzroy basin. EAs for a number of mining operations, including New Lenton, contain conditions consistent with the model water conditions.

Publicly available regional water quality data for the Isaac River at the Burton Gorge, Goonyella and Deverill gauging stations (see Figure 4-2 for locations) have been analysed and a comparison of 20th percentile, median and 80th percentile water quality at these sites to the WQOs/DGVs is provided in Table 3.3 of **Appendix 7**. The shows that some readings at these monitoring locations are at or above the regional DGVs, including the following:

- Dissolved aluminium at Goonyella and Deverill (80th percentile)
- Dissolved copper at Goonyella and Deverill (median and 20th/80th percentile)
- EC at Goonyella (80th percentile) exceeds the DGV based on the model water conditions
- Dissolved iron at Burton Gorge (median and 80th percentile)
- Nitrate at all three gauges (median and 80th percentile values)
- Total suspended solids at Burton Gorge and Goonyella (80th percentile values)
- Turbidity at Burton Gorge (median and 20th/80th percentile) and Goonyella/Deverill (median and 80th percentile)
- Dissolved zinc at Goonyella/Deverill (median and 20th/80th percentile).

The review of the regional water quality data indicates that there are some water quality indicators that are consistently above the DGVs, in particular aluminium (dissolved), copper (dissolved), zinc (dissolved), iron (dissolved), suspended solids and turbidity. The available data indicates that the current DGVs may not necessarily reflect the typical background water quality within the Upper Isaac River.

Electrical conductivity (a measure of the salt concentration) at the Deverill gauge has been used to characterise the regional relationship between flow and salinity. The Deverill gauge is the closest to the Project with a long-term continuous record of stream flow and salinity. Figure 4-6 presents a time history of recorded instantaneous EC and stream flow for the Isaac River at Deverill gauging station. Figure 4-7 details the relationship between instantaneous flow and EC at the Isaac River at Deverill gauging station. The data collected by DoR at the Deverill gauging station spans the period from 2011 to 2022 and indicates:

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

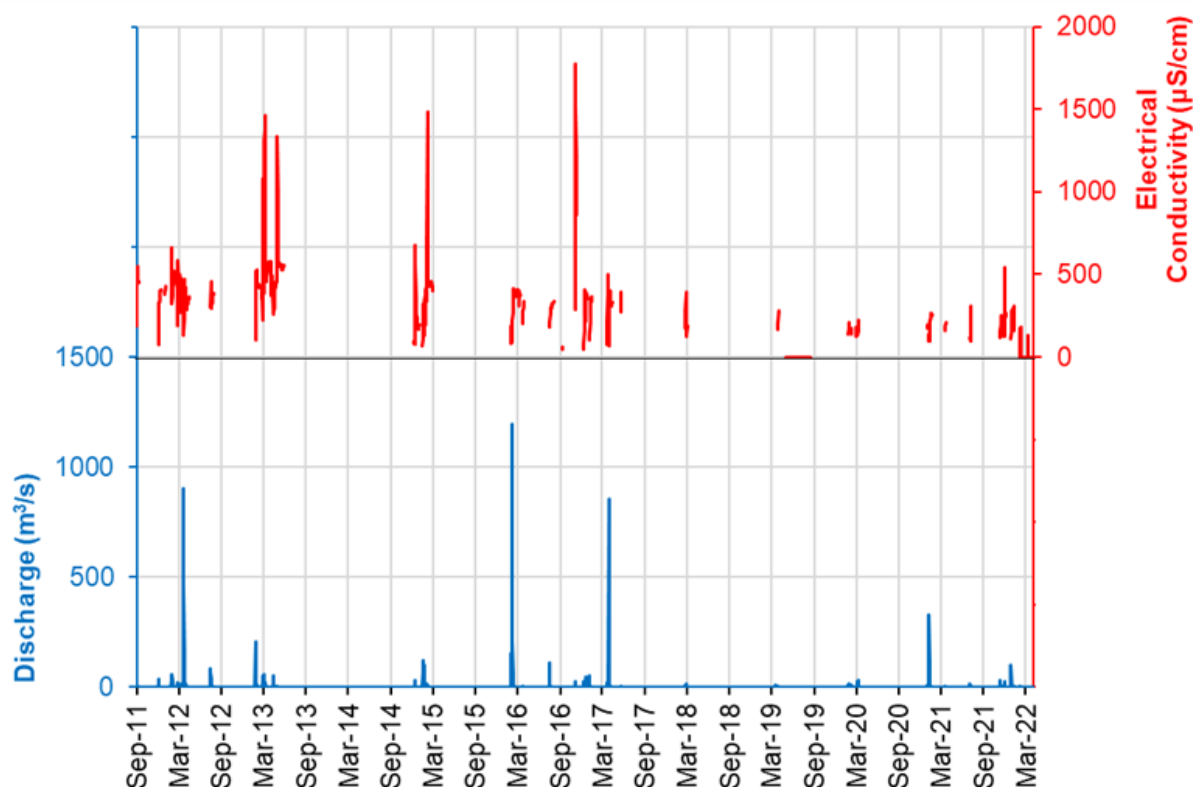


Figure 4-6 **Electrical Conductivity and Flow (Isaac River at Deverill Gauge)**

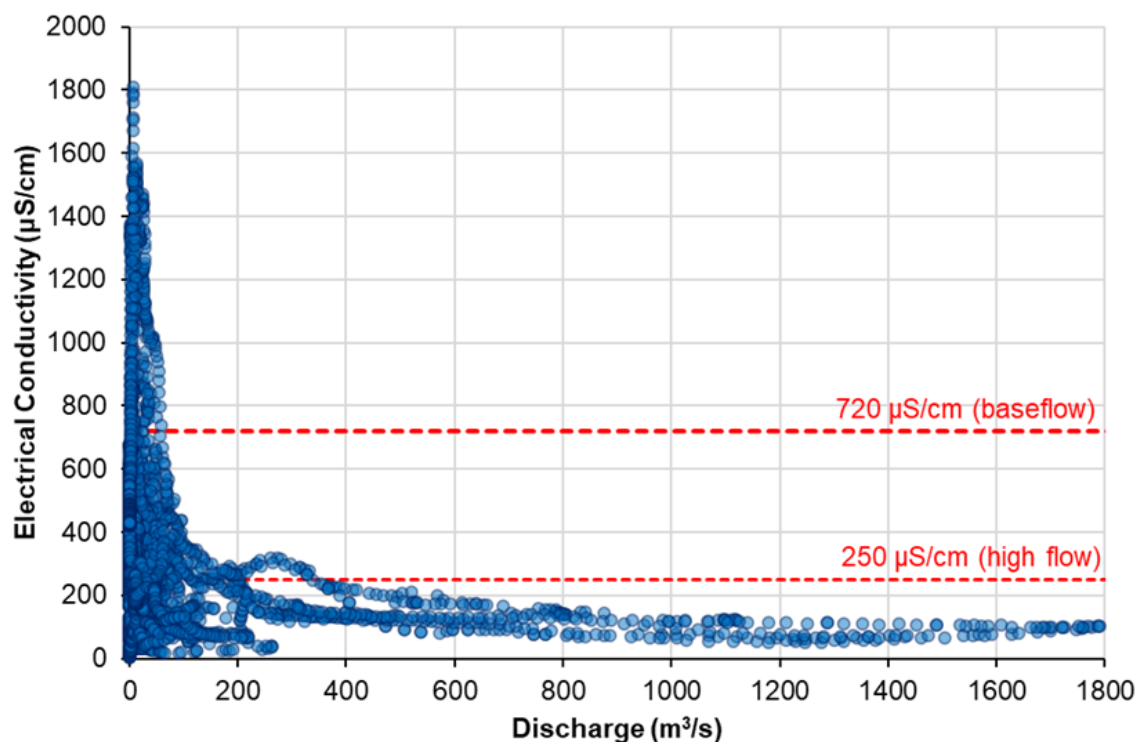


Figure 4-7 *Flow vs Electrical Conductivity (Isaac River at Deverill Gauge)*

4.4.3 Local Catchment Characteristics

4.4.3.1 Local Watercourses and Drainage

The Isaac River is the main watercourse feature which drains through the eastern portion of the New Lenton MLs. Hill Creek joins the Isaac River from the west near the northern end of ML 70337 (Figure 4-8). Hill Creek channel is outside the Project disturbance area and will not be impacted by the Project. Other drainage features within the disturbance area are Ti-Tree Creek and an unnamed tributary of the Isaac River. The alignment of the Ti-Tree Creek channel and the unnamed tributary are shown in Figure 4-8. DNRME determined that Ti-Tree Creek is not a designated watercourse under the Water Act.

The Project disturbance area is relatively flat and encompasses a section of the Isaac River floodplain. The disturbance area is located at an elevation of approximately 300 metres (m) to 340 m Australian Height Datum (AHD). The southern and eastern boundary of New Lenton MLs are generally between 300 and 315 m AHD with the highest point along the northeastern boundary.



20231201 PER CH4 SW WATER AND WATER MANAGEMENT appx

Datum: MGA94 Zone 55
 Scale: See Scale Bar (A4)
 Date: 5/01/2024 2:07 PM
 Drawn: RA (Source: AARC)

- LEGEND**
- Mining Lease
 - Watercourse
 - Roads
 - Proposed Disturbance Area
 - Project Layout

4.4.3.2 Stream Flow

The recorded local stream flow depth data for Hill Creek (SW01 and SW02) and Ti-Tree Creek (SW06) is presented in Figure 4-9 for the period between 2018 and 2023. The flow depth data has been filtered to remove noise from the data. The locations of these monitoring sites are presented in Figure 4-11. SW02 is located in very close proximity to the Isaac River, and may be tailwater-affected during significant Isaac River flow events. This data shows that the local creeks are highly ephemeral and would not flow for an extended time after rainfall.

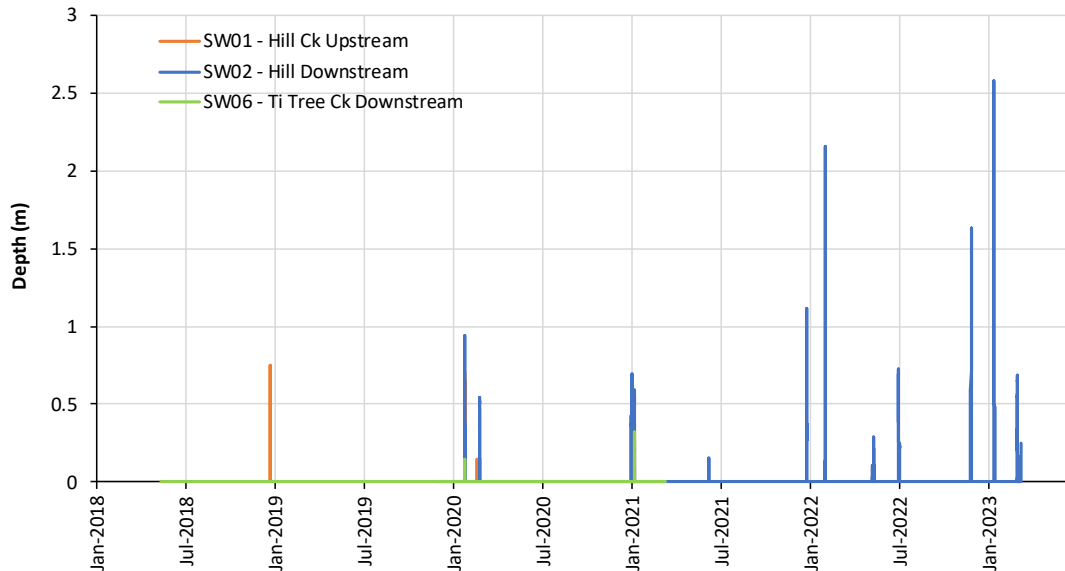


Figure 4-9 Recorded Water Level at Local Creek (SW01, SW02 And SW06) Monitoring Site

Recorded streamflow data for the local Isaac River monitoring site is presented in Figure 4-10. The local Isaac River flow monitoring site is located about 700 m upstream of the New Lenton ML boundary at the “USIR” monitoring site shown in Figure 4-11. The recorded data shows that the Isaac River at this location is highly ephemeral and would only flow for a short duration each wet season.

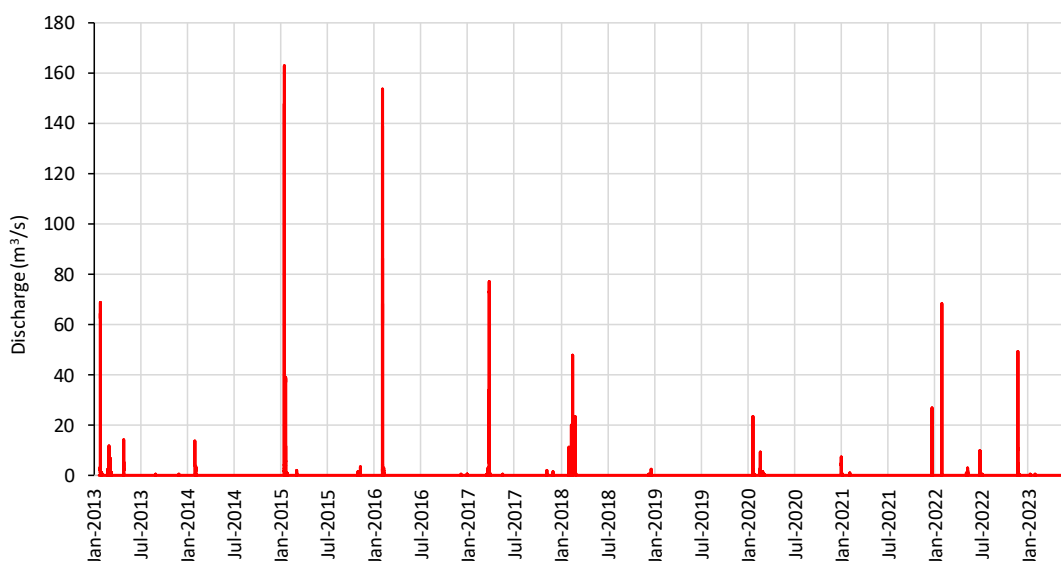


Figure 4-10 Recorded Water Level at Isaac River Monitoring Site

4.4.3.3 Local Isaac River and Creek Water Quality

Water quality sampling was undertaken in the Isaac River, Ti-Tree Creek and Hill Creek between 2005 and 2023 by URS (2013), GHD (2018), AARC (2019) and SGME (2023). Water quality data from these reports has been compiled and included in the sampling results presented in Section 3.7.2 and Appendix D of **Appendix 7**. The water quality data in **Appendix 7** has been further supplemented by water quality data collected by BCC in watercourses and drainages within and surrounding the Project and Burton Mine, between mid 2022 and post the 2024 wet season. Water sampling is dependent on flows, which are highly ephemeral, and safe access. The locations of the local water quality monitoring locations are presented in Figure 4-11. Summary statistics for all available water quality data is provided in Table 4-1 for Isaac River sampling sites and Table 4-2 for local creek (Hill Creek and Ti-Tree Creek) sampling sites.

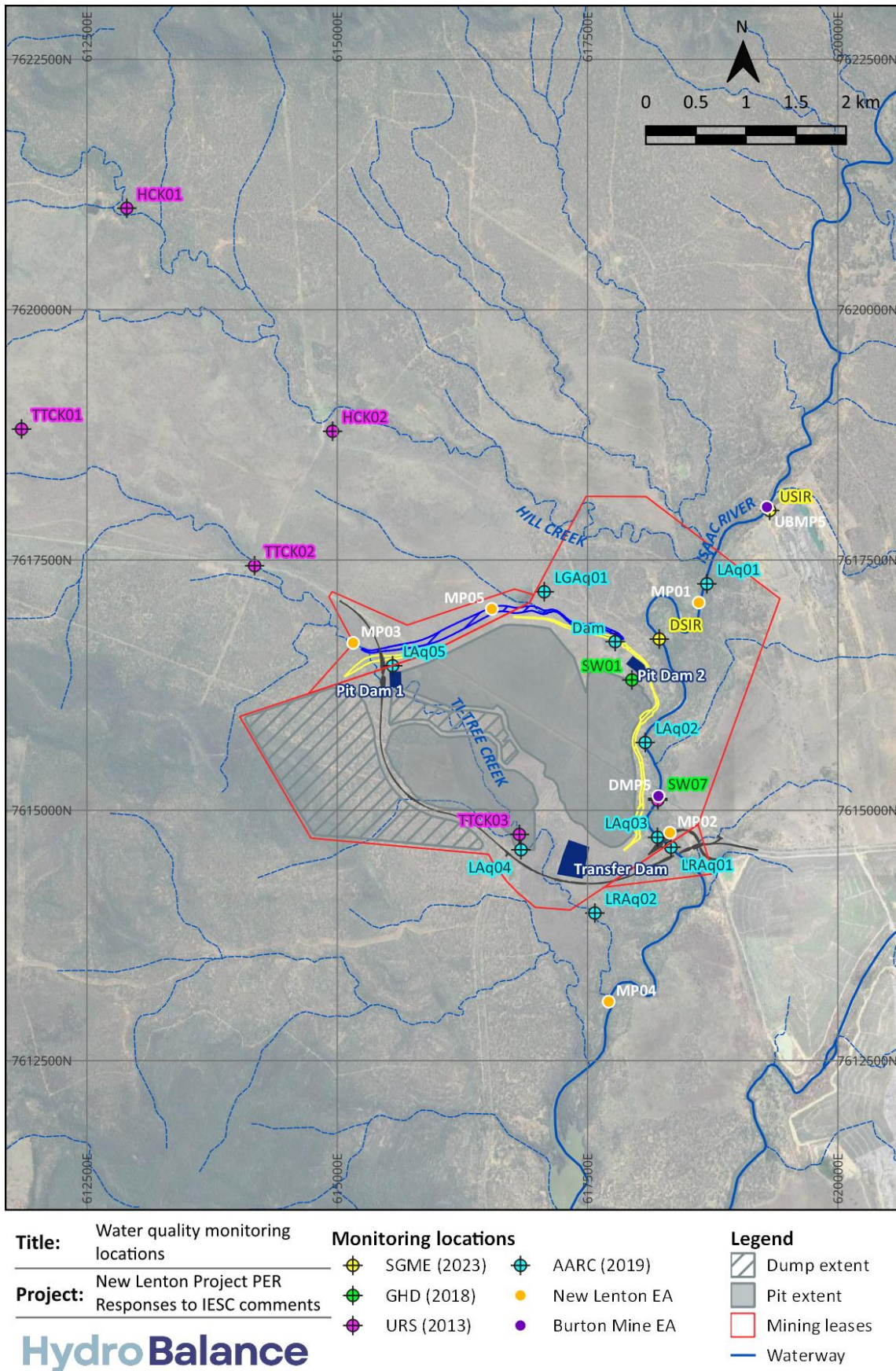


Figure 4-11 *Historical Surface Water Monitoring Locations*

Table 4-1 Local Water Quality Summary – Isaac River Sites

Parameter	Unit	Isaac River upstream of the Project				Isaac River downstream of the Project			
		No. of samples	20 th %ile value	Median value	80 th %ile value	No. of samples	20 th %ile value	Median value	80 th %ile value
Electrical conductivity	µS/cm	4	118	155	370	18	120	144.5	295
pH	-	4	7.22	7.48	8.1	16	7.428	7.82	8.2
Turbidity	NTU	4	70	114.5	290	10	71.44	148.35	419.8
Sulphate	mg/L	3	-	2	-	16	<1	<1	3.6
Aluminium	mg/L	4	<0.01	0.275	2.3	18	<0.01	0.165	0.942
Arsenic	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	<0.001
Cadmium	mg/L	4	<0.0001	<0.0001	<0.001	18	<0.0001	<0.0001	<0.0001
Chromium	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	<0.001
Copper	mg/L	4	<0.001	0.0015	0.002	18	<0.001	0.002	0.003
Iron	mg/L	3	-	0.28	-	16	0.064	0.335	1.056
Lead	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	<0.001
Mercury	mg/L	4	<0.0001	<0.0001	<0.0001	18	<0.0001	<0.0001	<0.0001
Nickel	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	0.002
Zinc	mg/L	4	<0.005	<0.005	0.023	18	<0.005	<0.005	0.0112
Boron	mg/L	4	<0.05	<0.05	0.06	18	<0.05	<0.05	<0.05
Cobalt	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	<0.001
Manganese	mg/L	4	0.002	0.0445	0.1	18	<0.001	0.003	0.103
Molybdenum	mg/L	4	<0.001	<0.001	<0.001	16	<0.001	<0.001	<0.001
Selenium	mg/L	4	<0.01	<0.01	<0.01	18	<0.01	<0.01	<0.01
Silver	mg/L	4	<0.001	<0.001	<0.001	18	<0.001	<0.001	<0.001
Uranium	mg/L	4	<0.001	<0.001	<0.001	13	<0.001	<0.001	<0.001
Vanadium	mg/L	3	-	<0.01	-	8	0.008002	<0.01	0.01
Ammonia	mg/L	3	-	<0.01	-	15	<0.01	<0.01	0.108
Nitrate	mg/L	3	-	<0.01	-	16	<0.01	<0.01	0.24
TRC C6-C9	mg/L	4	<20	<20	<20	17	<20	<20	<20
TRC C10-C36	mg/L	4	<50	<50	100	17	<50	<50	<50

Table 4-2 Local Water Quality Summary – Local Creek Sites

Parameter	Unit	Hill Creek				Ti-Tree Creek upstream of the Project				Ti-Tree Creek downstream of the Project			
		No. of samples	20 th %ile value	Median value	80 th %ile value	No. of samples	20 th %ile value	Median value	80 th %ile value	No. of samples	20 th %ile value	Median value	80 th %ile value
Electrical conductivity	µS/cm	8	87.2	123	179.4	14	120	207	1940	4	187	621	1810
pH	-	8	7.196	7.55	7.796	14	7.84	8.19	8.28	4	7.52	8.065	8.6
Turbidity	NTU	4	58.4	79.3	122.8	6	0.296	4.65	301	4	3	53.16	164.5
Sulphate	mg/L	8	1.8	2	3	13	<1	2	18.2	3	-	8	-
Aluminium	mg/L	6	0.718	1.505	2.002	11	0.06	1.06	2.162	4	0.13	1.25	3.26
Arsenic	mg/L	6	<0.001	<0.001	<0.001	11	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Cadmium	mg/L	6	<0.0001	<0.0001	<0.0001	11	<0.0001	<0.0001	<0.0001	4	<0.0001	<0.0001	<0.0001
Chromium	mg/L	6	<0.001	0.002	0.004	11	<0.001	0.002	0.004	4	<0.001	0.0015	0.006
Copper	mg/L	6	0.0014	0.002	0.004	11	0.002	0.004	0.0052	4	0.002	0.0035	0.004
Iron	mg/L	6	0.704	1.765	3.094	8	0.05	0.385	0.994	2	-	0.3	-
Lead	mg/L	6	<0.001	<0.001	0.0026	11	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Mercury	mg/L	6	<0.0001	<0.0001	<0.0001	9	<0.0001	<0.0001	<0.0001	3	-	<0.0001	-
Nickel	mg/L	6	<0.002	0.0045	0.0062	11	0.0024	0.008	0.0112	4	<0.002	0.006	0.01
Zinc	mg/L	6	<0.005	0.0055	0.0072	11	<0.005	0.009	0.0842	4	<0.005	0.0115	0.018
Boron	mg/L	6	<0.05	<0.05	<0.05	11	<0.05	0.06	0.172	4	<0.05	0.065	0.13
Cobalt	mg/L	6	<0.001	0.002	0.0062	11	<0.001	0.002	0.0036	4	<0.001	0.0015	0.002
Manganese	mg/L	6	0.0282	0.0675	0.3054	11	0.0146	0.038	0.1196	4	0.017	0.0405	0.18
Molybdenum	mg/L	6	<0.001	<0.001	<0.001	11	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Selenium	mg/L	6	<0.01	<0.01	<0.01	11	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01
Silver	mg/L	4	<0.001	<0.001	<0.001	11	<0.001	<0.001	<0.001	4	<0.001	<0.001	<0.001
Uranium	mg/L	0	-	-	-	1	-	<0.001	-	1	-	<0.001	-
Vanadium	mg/L	6	<0.01	<0.01	<0.01	7	0.04	0.05	0.054	3	-	0.03	-
Ammonia	mg/L	4	0.03	0.045	0.06	6	0.034	0.06	0.088	3	-	0.07	-
Nitrate	mg/L	6	<0.01	0.143	0.278	11	0.018	0.04	0.208	3	-	0.09	-
TRC C6-C9	mg/L	6	<20	<20	<20	11	<20	<20	<20	4	<20	<20	<20
TRC C10-C36	mg/L	5	<50	<50	<50	11	<50	<50	<50	4	<50	<50	300

4.4.4 Geomorphology

The majority of the terrain within the Isaac River, Hill Creek and Ti-Tree Creek catchments is undulating and land use is predominately grazing. Ti-Tree Creek in particular has been heavily grazed with very little remnant vegetation remaining. All waterways show evidence of stock movement. The watercourses in and around the New Lenton MLs are ephemeral, since they are dry (or mostly dry) during prolonged periods. After these dry periods, a significant rainfall event is typically required to generate flow in the watercourses.

A comprehensive baseline data assessment was carried out by URS in 2013 (URS, 2013). This was compared with the data collected by SLR in March 2019. Together this forms a baseline assessment of the creeks' geomorphic characteristics and system changes which are evident without the influence of mining activities. A summary of the baseline data is provided in the following sections.

4.4.4.1 Isaac River Geomorphology

The Isaac River has a wide sand-lined base channel with steep vegetated banks. A typical cross section of the Isaac River is shown in Figure 3.14 and Figure 3.15 of **Appendix 7**, with cross section locations shown in Figure 3.18 of **Appendix 7**. The Isaac River has defined benches along straight sections. In locations where the river meanders significantly, well-defined high-flow channels are observed. These channels become engaged during large events causing short cuts to the meander. Along the length of the streams adjacent to the Project disturbance area, the riparian vegetation cover is generally good.

Beyond the riparian zone, the vegetation mainly consists of grazed grasslands and native vegetation. Cattle have formed numerous access tracks along the banks which in some cases has led to localised gully erosion.

The Isaac River has a consistent cross section and longitudinal section with an overall bed slope of 0.2%. Small irregularities in the bed profile appear to be from bedrock outcrops in the river bed. A geomorphic feature summary comparing the URS 2013 survey with field notes from SLR 2019 is provided in Table 3.6 of **Appendix 7**. The SLR 2019 site inspection found some minor changes in the geomorphic features. However, these are likely to be attributable to the length of the channel surveyed which varied from that undertaken by URS in 2013. The Isaac River was assessed from 1.1 km upstream of the confluence with Hill Creek through to the confluence with Ti-Tree Creek. Review of aerial photography indicates the surveyed area is typical of the reach surveyed by URS in 2013.

In both the URS 2013 and SLR 2019 site visits, bank erosion was evident, mainly on the outer edge of river bends located south of the confluence with Hill Creek. This is illustrated in Figure 4-12 which shows bank erosion on the outer banks and Figure 4-13 which shows evidence of bank erosion slumping and gully erosion as well as aggradation of sediments on the river bed.



Figure 4-12 *Bank Erosion Evident on Outer Banks of the Isaac River*



Figure 4-13 *Evidence of Bank Erosion, Slumping, Gully Erosion and Aggradation of Sediments on the Isaac River*

4.4.4.2 Ti-Tree Creek Geomorphology

Ti-Tree Creek has a narrow base width with steep banks which are heavily eroded. The upper sections lack riparian vegetation or ground cover on the bed and banks, with evidence of bank slumping. The channel can typically convey only a relatively small event before spilling onto the floodplain or adjacent high flow channels.

A typical view of a cross section of Ti-Tree Creek is shown in Figure 3.16 and Figure 3.17 of **Appendix 7**, with cross section locations shown in Figure 3.18 of **Appendix 7**. The downstream reaches near the confluence with Isaac River have improved stability. This is due to erosion down to bedrock which reduces future erosion, as well as less evidence of extensive grazing and inclusion of a riparian vegetation corridor.

Ti-Tree Creek is formed in a black soil plain, is heavily eroded and lacks any significant riparian vegetation. The geomorphic feature summary is provided in Table 3.7 of **Appendix 7** and compares the 2013 URS survey to the 2019 SLR site inspection. The inspection found an increase in the erosion of bed and banks and decrease in vegetation cover leading to an increase in channel depths, bed widths and channel widths. While the length of the creek inspected was shorter than the 2013 URS study, aerial photography indicates the geomorphic features indicative of the broader channel. Figure 4-14 shows gully erosion in Ti-Tree Creek.



Figure 4-14 *Gully erosion to Ti-Tree Creek*

4.4.4.3 Unnamed Tributary Geomorphology

The unnamed tributary of the Isaac River has a relatively small catchment which enters the Isaac River from the west, south of the confluence with Hill Creek. This unnamed tributary has significant gully erosion over its entire length. Observations from the SLR site visit in March 2019 noted that tracks made by cattle, outflows from farm dams or any other cause for concentration of flows had resulted in the formation of gully erosion. It is considered that the sodic soils located throughout this area suffered structural decline due to the current farming practices. It was also noted during the site visit that some localised earthworks had been undertaken to direct catchment flows away from areas of extensive gully erosion. Figure 4-15 shows erosion due to concentration of flows.



Figure 4-15 *Gully Erosion in Unnamed Tributary Upstream of Confluence with Isaac River*

4.4.5 Wetlands

There are no internationally or nationally important wetlands in the vicinity of the Project area. The closest wetland of international importance is located approximately 220 km southeast of the Project area (i.e. wetlands of the Shoalwater and Corio Bays Area). Lake Elphinstone is the closest nationally important wetland, located approximately 10 km east and upstream of the Project area. Due to the significant distance from the Project area, neither of the internationally or nationally important wetlands will be impacted by the Project.

4.5 Water Management System

4.5.1 Water Types

For water management system purposes, the water generated at the Project is divided into six types:

- Raw water: sourced external to the mine operations (i.e. from Teviot Dam at Burton Mine).
- Clean water: surface runoff from undisturbed areas.
- Mine affected water: including pit water, processing plant water, groundwater seepage or runoff from areas disturbed by mining activities, and groundwater from dewatering activities.

- Sediment water: rainfall runoff from catchments which discharge through release points associated with erosion and sediment control (ESC) structures.
- Water from the MIA: water potentially contaminated with hydrocarbons or other chemicals (e.g. through run-off from the fuel storage area, that is managed locally at infrastructure areas).
- Potable water: treated water suitable for human consumption (as supplied to Burton Mine accommodation camp).

Details on these water types within the Project area is provided in Section 4.2 of **Appendix 7**.

4.5.2 Strategy

The strategy for the management of surface water at the Project is based on the separation of water from the different sources described in Section 4.5.1. There are two key water management system objectives:

- Ensure the Project minimises mine affected water accumulation, minimises the risk of uncontrolled discharges and that the site has sufficient water available for operation in dry times.
- Successfully engage with external stakeholders to be seen as a good custodian of society's water resources.

Specific objectives for each water type are as follows:

- Raw water: Ensure that external water allocation and associated infrastructure is sufficient to meet site demands particularly under low rainfall conditions.
- Clean water: Separate from the mine affected and sediment water systems as much as practicable and allow it to pass uninterrupted through the catchment.
- Mine affected water:
 - Minimise mine affected water accumulation.
 - Minimise the risk of uncontrolled discharges in wet periods.
 - Maximise water available for operations in dry times.
 - Ensure controlled releases of mine affected water protects environmental values and WQOs through release in accordance with EA conditions.
- Sediment water: Maintain the quality of water discharging from ESC structures to as close to background levels as reasonably possible.
- Water from the MIA: Ensure full separation from other water sources and manage under the specifications of *AS 1940:2017 - Storage and Handling of Flammable and Combustible Liquids*

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

- The fullest separation possible of clean water, sediment water, and mine affected water runoff, within the limitations of operational requirements.
- Minimise the area of surface disturbance, thus minimising the volume of sediment or mine affected water runoff.
- Collect and contain on site all potential mine affected water into dedicated mine water storages. The mine water storages will transfer water to Burton Mine and be used for dust suppression.
- Retain and reuse on site any sediment water runoff, or release in accordance with ESCP requirements.
- Prioritise the use of poor quality water over better quality water.

4.5.3 Overview of Project Water Management System

Mine stage plans have been developed for the Project and are shown in Figure 3-15 to Figure 3-18 of Chapter 3. Water management infrastructure and water catchment by water type are shown in Figure 4-16 to Figure 4-19 for each mine stage (also referred to as phase). The main components of water-related infrastructure include:

- a mine affected water system to store water pumped out of the open cut mining areas and to collect runoff from the ROM coal stockpile and MIA
- sediment dams to collect and treat runoff from out-of-pit waste rock (overburden) dumps
- clean water diversion drains and Ti-Tree Creek diversion to divert runoff from undisturbed catchments around areas disturbed by mining
- drains to divert sediment-laden runoff from out-of-pit waste rock dumps to sediment dams
- localised sediment controls around active construction areas.

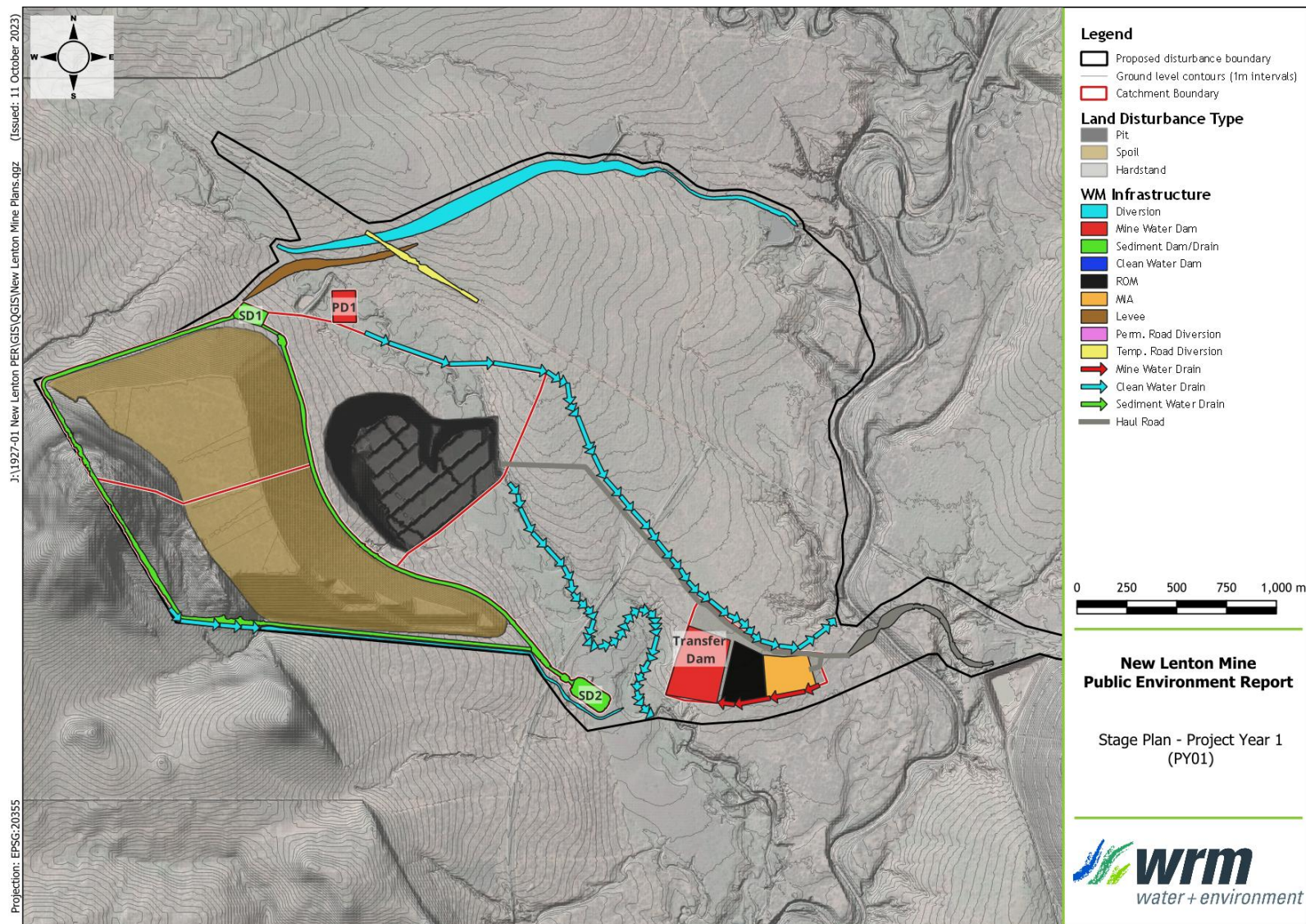


Figure 4-16 Project Catchment and Land Use Mapping – Project Year 1 (Stage / Phase 1)

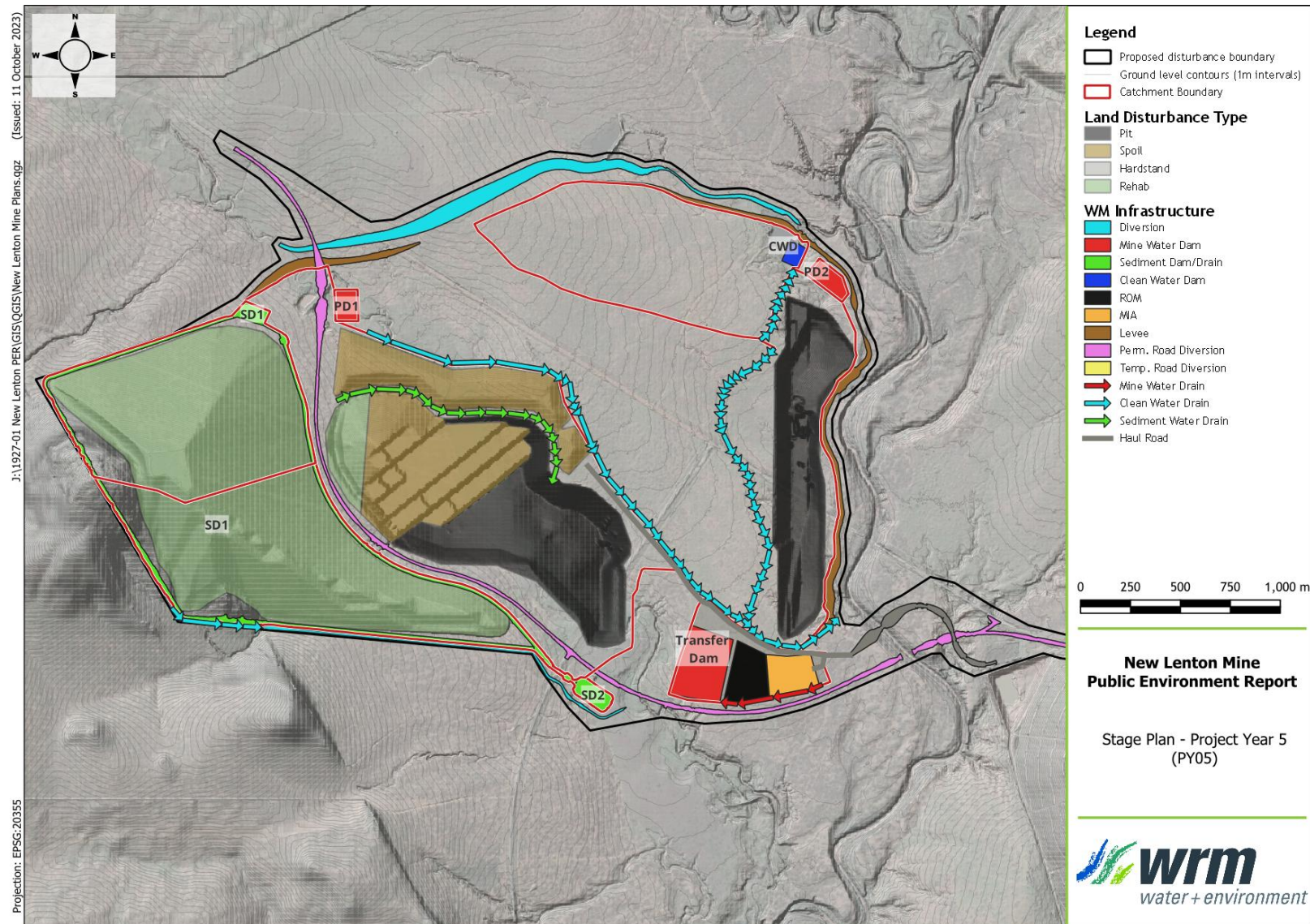


Figure 4-17 Project Catchment and Land Use Mapping – Project Year 5 (Stage / Phase 2)

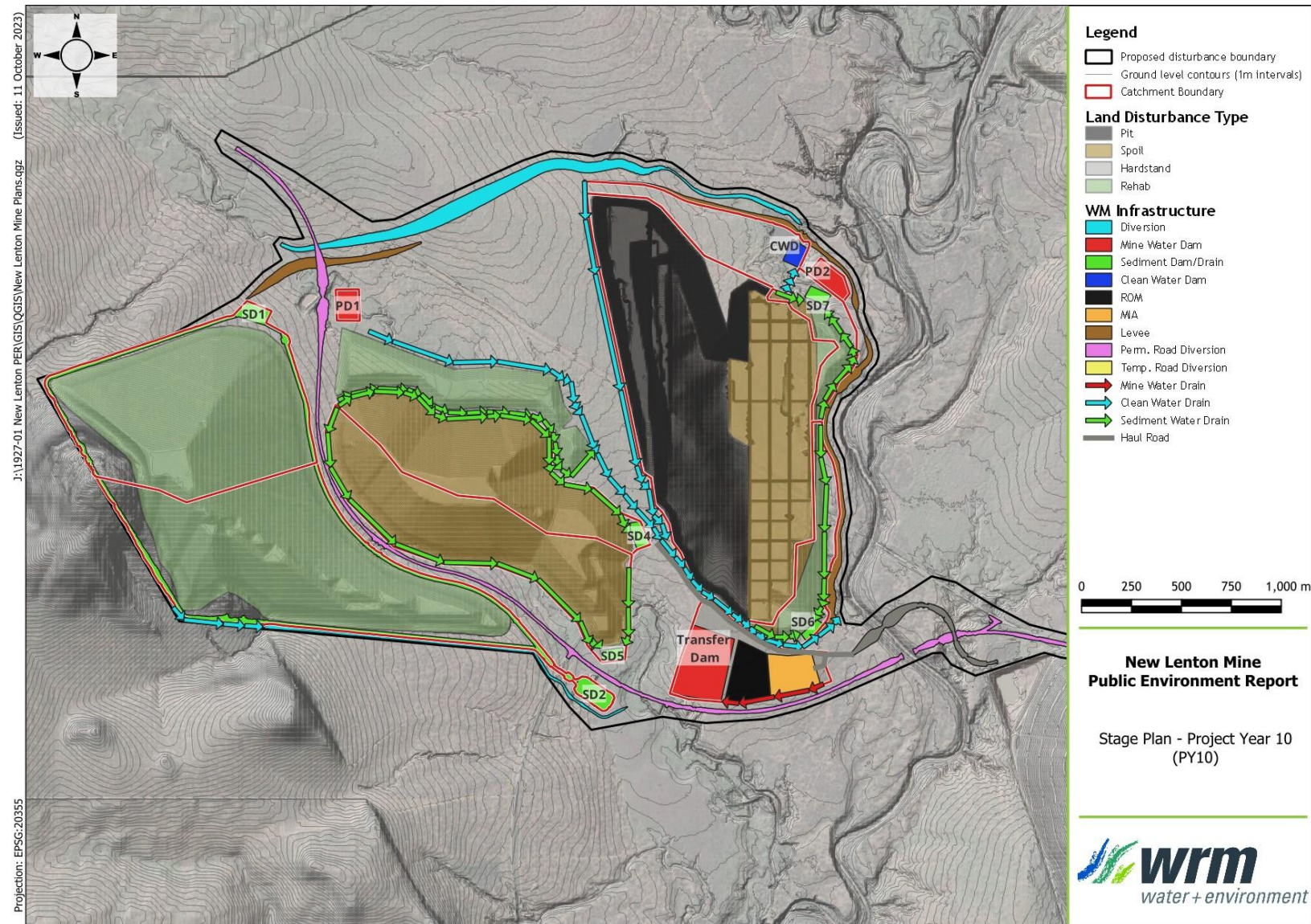


Figure 4-18 Project Catchment and Land Use Mapping – Project Year 10 (Stage / Phase 3)

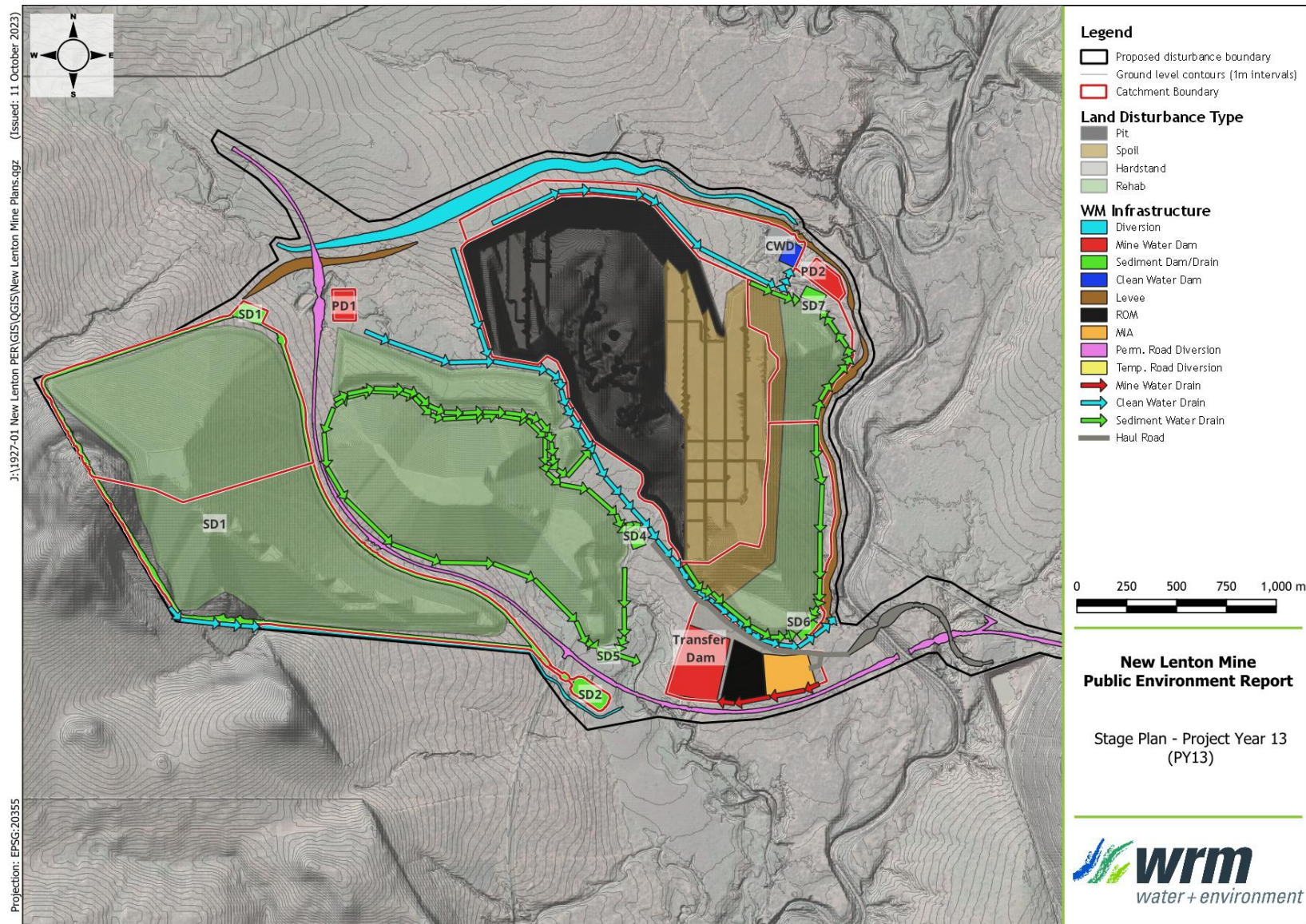


Figure 4-19 Project Catchment and Land Use Mapping – Project Year 13 (Stage / Phase 4)

4.5.4 Integration with Burton Mine Water Management System

The mine affected water management system will be integrated with Burton Mine. A pipeline will connect the mine water dam at the Project to the existing mine affected water pipeline network at Burton Mine. Where excess mine affected water is generated at the Project it will be piped to Burton Mine for storage within the voids. Where there is a shortage of water (e.g. for dust suppression) at the Project, it will be pumped from the storages at Burton Mine. Burton Mine has a surplus of water comprising mine affected water in voids and dams, sediment affected water in dams, and raw water from Teviot Dam.

It is not practical, desirable or effective to have a separate water management system for the Project and Burton Mine, as the overall balance of water supply and demand can be better managed with an integrated system.

The EA for the Project was approved in January 2021. As discussed in Section 4.2.2.1, this EA includes conditions of approval relevant to water management. Condition C35 of the EA authorises transfer of mine affected water and sediment water between the Project and Burton Mine.

Burton Mine contains mine pits / voids where water can be stored, including Ellensfield pit, Burton Widening pit and Burton North pit (see Figure 3-6). The integrated system comprises the following elements:

- Mine affected water from the Project can be transferred to voids at Burton Mine. Water from the Project will be transferred to Burton Mine at 100 L/s to manage excess mine water and reduce the risk of pit inundation at the Project. The Project will only transfer water to Burton Mine when the Project's Transfer Dam exceeds 300 ML.
- Water from Burton Mine will be transferred to the Project at 50 L/s to supply mine water demands at the Project, as and when required.
- Mine affected water can be released subject to the approved EA conditions, noting that the Project does not result in a requirement to modify Burton Mine's EA conditions as they relate to releases of mine affected water.
- Existing dams at Burton Mine for storing mine water for use or release will remain unchanged by the Project, as there is sufficient capacity within the voids to hold all mine affected water, including from the Project. Controlled releases from these structures will occur as and when releases can be undertaken in accordance with EA conditions. This includes water pumped from voids that may contain mine water from the Project.
- Raw water will continue to be supplied to Burton Mine from Teviot Dam, which was established for the purpose of supplying Burton Mine. Therefore there is no risk that Burton Mine or the Project will reduce the availability of regional water supplies to other users.

4.5.5 Mine Affected Water Management System

Containment of mine affected water is provided by the following proposed storages (see Figure 4-16 to Figure 4-19):

- Transfer Dam
- Pit Dam 1
- Pit Dam 2.

Pit dewatering will be pumped to Pit Dam 1 and Pit Dam 2, where it will then be pumped for storage and use within Transfer Dam. Transfer Dam functions as the primary mine affected water storage for the water management system, as well as capturing potentially mine affected runoff from the MIA and ROM stockpile area.

Transfer Dam will have the ability to pump mine affected water between the Project and Burton Mine, depending on the water supply or containment needs for the Project.

4.5.6 Sediment Water Management System

Sediment water containment (runoff from waste rock dumps and areas yet to be rehabilitated) will be managed in accordance with an ESCP, as required by condition C39 of the EA. The ESCP (refer to **Appendix 18**) has adopted 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, nondispersive 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 within the disturbance area.

Catchment runoff from both active and newly rehabilitated waste rock (overburden) dumps will be managed in accordance with the ESCP incorporating the conceptual design of sediment drains and dams described below. The sediment dams have been sized in accordance with the International Erosion Control Association (IECA) method (IECA, 2018), and have been based on the following design standards and methodology:

“Type D” sediment dams ;

- Total sediment dam volume = settling zone + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- Sediment dam settling volume based on 85th percentile 5-day duration rainfall (36.7 mm) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.49 (Group C soils – loamy clay).
- Solids storage volume = 50% of settling zone volume.

The adopted design standard does not provide 100% containment for runoff from disturbed areas. Hence, it is possible that overflows will occur from sediment dams if rainfall exceeds the design standard. However, the water collected by the sediment dams will be preferentially retained for reuse on-site (e.g. dust suppression), thereby reducing stored volumes.

A summary of the conceptual sediment dam capacities and the surface areas (based on average 5 m depth) is provided in Table 4-3. Sediment dams at each Project stage / phase are shown in Figure 4-16 to Figure 4-19.

Table 4-3 Conceptual Sediment Dam Capacities and Surface Areas

Dam name	Max. catchment area (ha)	Settling volume (ML)	Solids storage volume (ML)	Total volume required (ML)	Dam surface area (ha)
SD1	88.8	15.9	7.9	23.8	0.63
SD2	102.7	18.4	9.2	27.6	0.74
SD4	50.1	9.0	4.5	13.4	0.36
SD5	59.9	10.7	5.4	16.1	0.43

Dam name	Max. catchment area (ha)	Settling volume (ML)	Solids storage volume (ML)	Total volume required (ML)	Dam surface area (ha)
SD6	44.9	8.0	4.0	12.1	0.32
SD7	27.7	5.0	2.5	7.4	0.20

4.5.7 Levees and Diversion

The Ti-Tree Creek levee and diversion, and the Isaac River levee are described in Section 3.12.

4.5.8 Clean Water Management System

The section describes clean water management, other than the Ti-Tree Creek diversion. A series of clean water drains are proposed to capture and divert clean catchment runoff through the mining areas. The indicative locations of the proposed drains for the various mine phases are shown on Figure 4-16 to Figure 4-19. The purpose of the clean water diversions is to divert runoff from upslope catchment areas away from the mine and sediment water management systems and directly into the downstream receiving waters.

The proposed design criteria for the clean water diversion drains have been set to minimise the risk of overflows into the water management system and minimise the risk of scour and erosion within the drains during flow events. The adopted design criteria are as follows:

- 1% annual exceedance probability (AEP) design event discharge.
- Batter slopes of 1 vertical to 3 horizontal (1V:3H).
- Bed width of 10 m.
- Scour protection at appropriate locations.

The final alignment and sizing of the clean water diversion drains will be confirmed as part of the detailed design process.

From Phase 2 onwards, a clean water dam (CWD) (and associated clean water drain) is proposed to capture clean runoff from the northern section of the Project disturbance area between the Ti-Tree Creek levee and mining progression. Runoff captured within the CWD will be discharged to the receiving environment via a pumping system. Clean runoff captured within CWD will be pumped to Ti-Tree Creek diversion as soon as practicable following an inflow event. Prior to discharging, the water stored within CWD will be monitored to ensure it has similar quality to other clean water prior to discharge. In the unlikely event that the water captured within CWD is unsuitable for discharge, it will be managed within the sediment or mine water systems.

4.5.9 Contaminated Water Management

Potentially contaminated water collected within the MIA will be collected and treated for reuse via an oil and water separator or similar device. All treated contaminated water will be contained and reused within site operations.

4.6 Water Balance Model

4.6.1 Methodology

A computer-based daily simulation water balance model was used to assess the dynamics of the water balance under historical rainfall and catchment conditions throughout the development of the Project.

The GoldSim model dynamically simulates the operation of the water management system and keeps account of all site water volumes and salt loads on a daily time step. The Project water management system has been integrated with the existing Burton Mine GoldSim model, to accurately simulate the connectivity between the two mines. The development of the Burton Mine GoldSim model is documented in the Burton Mine Water Management Plan, which has been authorised and approved under the EA for Burton Mine.

The Project water management system will change over the approximate 18-year mine life, including changes in catchment areas, mining progression and site water demands. To represent the evolution of the mine layout over time, the Project was modelled in four discrete phases (see Figure 4-16 to Figure 4-19). Three-year to five-year representative periods have been selected to reflect the average conditions over the mine phase.

4.6.2 Water Balance Model Inputs

4.6.2.1 Inflows and Outflows

The inflows and outflows in the mine water management system are:

- inflows:
 - direct rainfall on mine water storage surface
 - catchment runoff to mine water catchments (e.g. pits and voids)
 - groundwater inflows
 - external water supply (Burton Mine)
- outflows:
 - evaporation from water surface of storages
 - dust suppression demand
 - miscellaneous water demand (e.g. vehicle washdown)
 - transfer to Burton Mine
 - offsite releases from sediment dams in accordance with design criteria
 - clean water dam discharges
 - controlled releases of mine affected water, if required.

These estimation of inflows and outflows is described in the following sections.

4.6.2.2 Rainfall and Evaporation

Long term daily rainfall and evaporation data for the Project area was obtained from the SILO database (<https://www.longpaddock.qld.gov.au/silo/>) for the period January 1889 to December 2022 (133 years), with data shown in Section 5.3 of **Appendix 7**.

4.6.2.3 Catchment Yield

The AWBM model was used to represent the runoff characteristics of mine site catchments. AWBM uses a group of connected conceptual storages (3 surface storages and 1 groundwater storage) to represent catchment runoff. Water in the conceptual storages is replenished by rainfall and reduced by evapotranspiration. Simulated surface runoff occurs when any of these storages fill and overflow. The model parameters define the depth and relative area of each of the storages, as well as the rate of water flux from/between storages.

To adequately simulate the site water balance, it is necessary to define the runoff characteristics of the various catchment surface types. Catchments affected by the Project disturbance area were characterised into the following land use types:

- natural, representing areas undisturbed by mining
- hardstand, representing haul roads, hardstand areas, stockpiles and the pit floor

- pit, representing the pit floor cleared or pre-strip areas ahead of mining
- stockpile, representing the ROM stockpile and product stockpile (Burton Mine only) areas
- rehabilitated areas
- spoil dump, representing uncompacted dumped overburden material
- tailings, representing the co-disposal surfaces (Burton Mine only).

4.6.2.4 Catchment Areas and Land Use

The adopted catchment areas and land use types for each modelled stage for the Project are provided in Figure 4-16 to Figure 4-19.

4.6.2.5 Water Management System Configuration

The Project water management system has been configured to minimise the offsite spill risk from mine water dams and to ensure that all site demands are met. The sediment dams would be operated according to best practice ESC principals per the IECA (2008) guidelines, which would include dewatering the sediment dams to the Transfer Dam following significant rainfall events.

A schematised plan of the proposed water management system configuration is provided in Figure 4-20, showing inflows and outflows of mine water, sediment water and clean water. The water management infrastructure operating rules utilised in water balance model are provided in Table 5.5 of **Appendix 7**.

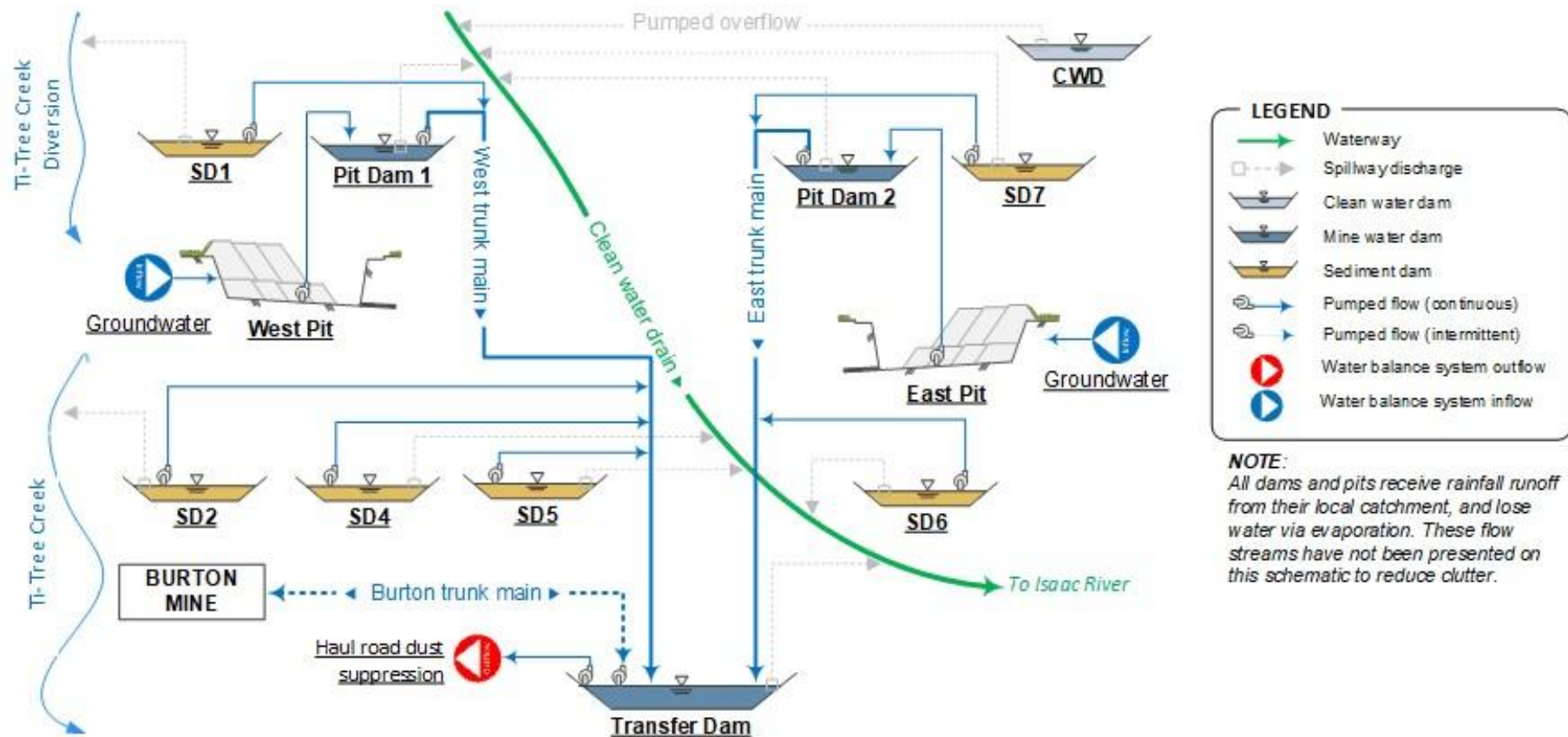


Figure 4-20 Water Management System Configuration

4.6.3 Water Demand

Water for haul road dust suppression at the Project will be sourced from Transfer Dam. Daily haul road dust suppression watering rates were estimated based on haul road surface area and daily rainfall and evaporation rates.

ROM coal extracted from the Project's mine pits will be transported to Burton Mine via haul roads for processing at the Burton CHPP. The CHPP water demands will be supplied by the Burton Mine water management system.

4.6.4 Groundwater Inflows

The net groundwater inflows into the Project's mine pits were estimated using gross groundwater inflows provided from the Project's numerical groundwater model (see Section 5.7 of Chapter 5) that were adjusted to account for:

- evaporative losses from the coal face; and
- moisture extracted with the ROM coal (assumed 5% moisture content).

4.6.5 Controlled Releases

Whilst the release of mine affected water to receiving waters is permitted under the approved EA, the water balance model demonstrates that controlled releases are not required as part of the water management strategy due to the balancing of mine affected water with Burton Mine. That is, the water management system does not rely on using controlled releases to manage water inventories.

4.6.6 Salinity Parameters

The water balance model has been configured to use electrical conductivity (EC) as an indicator for water quality. Each runoff type has been assigned an EC concentration that has been based on the concentrations applied for the Burton Mine water balance model.

4.7 Water Management System Assessment

The water balance model has been used to assess the performance of the water management system. The key performance indicators for this assessment are:

- pit inundation characteristics
- mine affected water inventory
- interaction (transfers to/from) the Burton Mine
- uncontrolled spillway discharges.

An assessment of the overall mine affected water inventory at Burton Mine has also been undertaken. The purpose of this assessment is to confirm that the existing and proposed Burton Mine infrastructure (including dams and pit storages) is able to accommodate the additional water demands, transfers and processing requirements resulting from the Project.

Investigation outcomes are dependent on the accuracy of input assumptions. There is inherent uncertainty with respect to some key site characteristics (e.g. catchment yield/rainfall runoff, mining area groundwater inflows). The use of a large number of climate sequences reflecting the full range of historical climatic conditions provides an indication of the system performance variance under very wet, wet, average, dry, and very dry climatic conditions.

4.7.1 Overall Water Balance

Key outcomes from the overall water balance based on 115 model realisations are as follows:

- Average annual inflows from rainfall runoff are generally consistent between Phase 2 and Phase 4. Rainfall runoff in Phase 1 is generally lower, as the catchment areas reporting to the site storages is significantly less in this phase.
- The spillway overflows from the sediment dams are lowest in Phase 1, and generally increase between Phase 2 and Phase 4.
- The annual import volumes from Burton Mine are, on average, greater than the export volumes to Burton Mine. Hence, the Project is a net importer of water from Burton Mine during average conditions.
- Water requirements from Burton Mine are generally consistent between Phase 1 and Phase 4.
- The total change in inventory is low for all phases, which indicates that the system is generally in balance under “average” climate conditions. It also indicates that the inventory at Project can be successfully managed through the proposed transfers to/from Burton Mine.

A more detailed analysis of the performance of the various components of the water management system is provided in the following sections.

4.7.2 Mine Affected Water Inventory

Figure 4-21 shows the modelled Transfer Dam inventory over the 18-year forecast period. Figure 4-22 shows the combined forecast inventory for Transfer Dam, Pit Dam 1 and Pit Dam 2. To prevent uncontrolled discharges from the mine water storages, maximum operating volumes (MOVs) have been set for the out-of-pit mine affected water storages.

Figure 4-21 shows the following:

- Transfer Dam would be maintained at a minimum inventory of 50 ML via the Burton Mine imports, to supply the site demands.
- The stored inventory in Transfer Dam would exceed the Mine Dam MOV during 5%ile wet climatic conditions, but not the Transfer Dam capacity of 400 ML. This would limit dewatering from Pit Dam 1 and Pit Dam 2, and potentially increase the inundation risk in the mine pits to prevent controlled or uncontrolled releases.

Figure 4-22 shows the following:

- For the 1%ile results (very wet climatic conditions), the peak inventory in the out-of-pit storages reaches a volume of around 570 ML, which is below the combined capacity of Transfer Dam, Pit Dam 1 and Pit Dam 2.
- The combined mine affected water inventory generally appears to recover following the annual wet seasons, and does not accumulate over consecutive wet seasons.

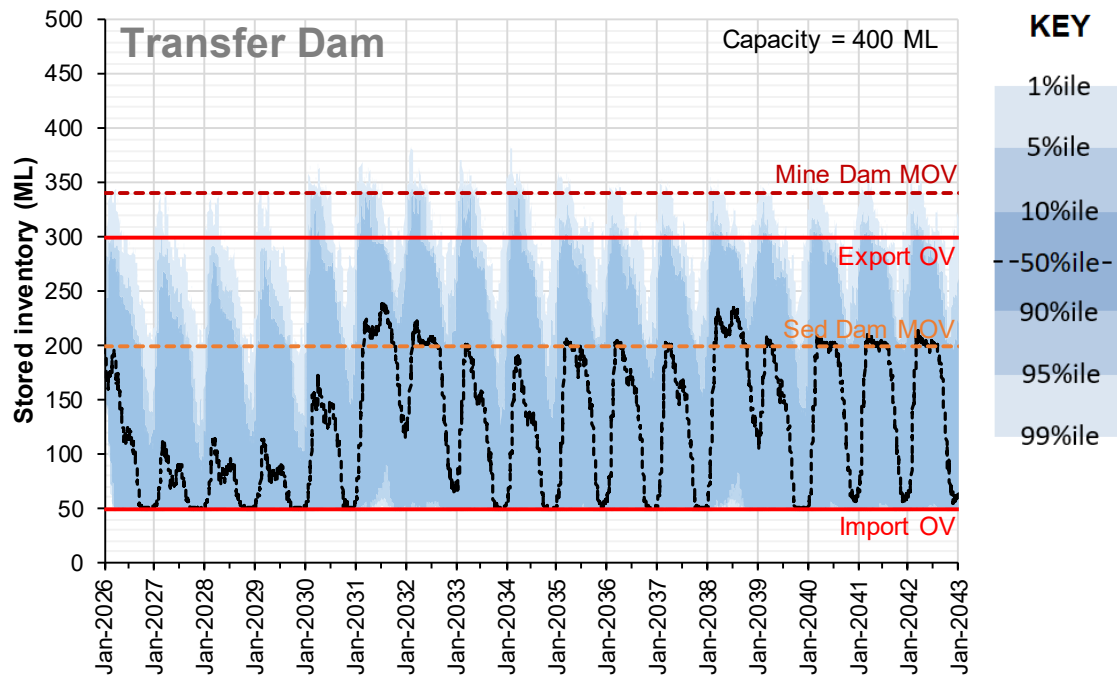


Figure 4-21 Forecast Transfer Dam Inventory

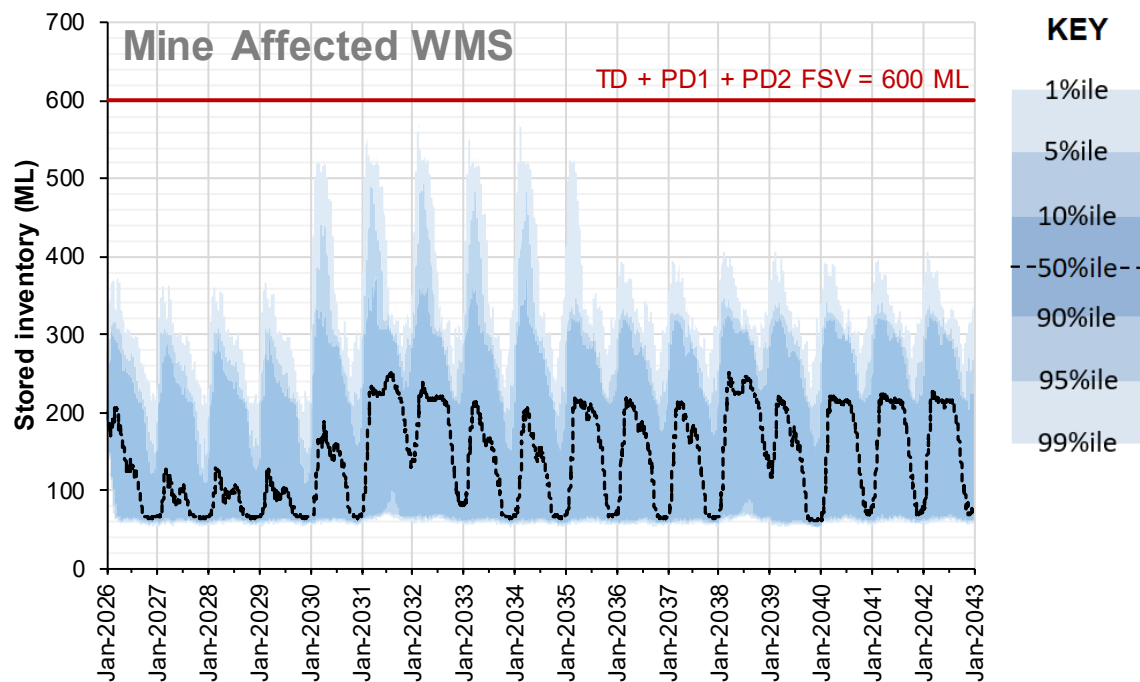


Figure 4-22 Forecast Mine Affected Water Inventory (Excluding Active Mine Pits)

4.7.3 Pit inundation

Figure 4-23 and Figure 4-24 show the forecast inventory for the West Pit and East Pit, respectively, over the 18-year simulation. Both of the mine pits appear to recover after each wet season while they are operational.

The forecast modelling results for the Project's mine pit inventories are summarised as follows for the 18-year simulation:

- When active, West Pit and East Pit would be inundated above the in-pit sump volume (assumed to be 50 ML) during 10%ile wet climatic conditions.
- For the 1%ile results (very wet climatic conditions), the peak inventory in the West Pit reaches a volume of around 600 ML. This represents 3% of the Phase 1 West Pit capacity, hence the risk of West Pit overflowing during operations is negligible.
- For the 1%ile results (very wet climatic conditions), the peak inventory in the East Pit reaches a volume of around 520 ML. This represents 5% of the Phase 5 East Pit capacity, hence the risk of East Pit overflowing during operations is negligible.
- The mine pits would not be inundated for climatic conditions drier than the 10%ile wet climatic conditions.

The ability of the Project's mine pits to recover after each wet season is largely attributed to the capacity of the water management system to transfer water to Burton Mine when required.

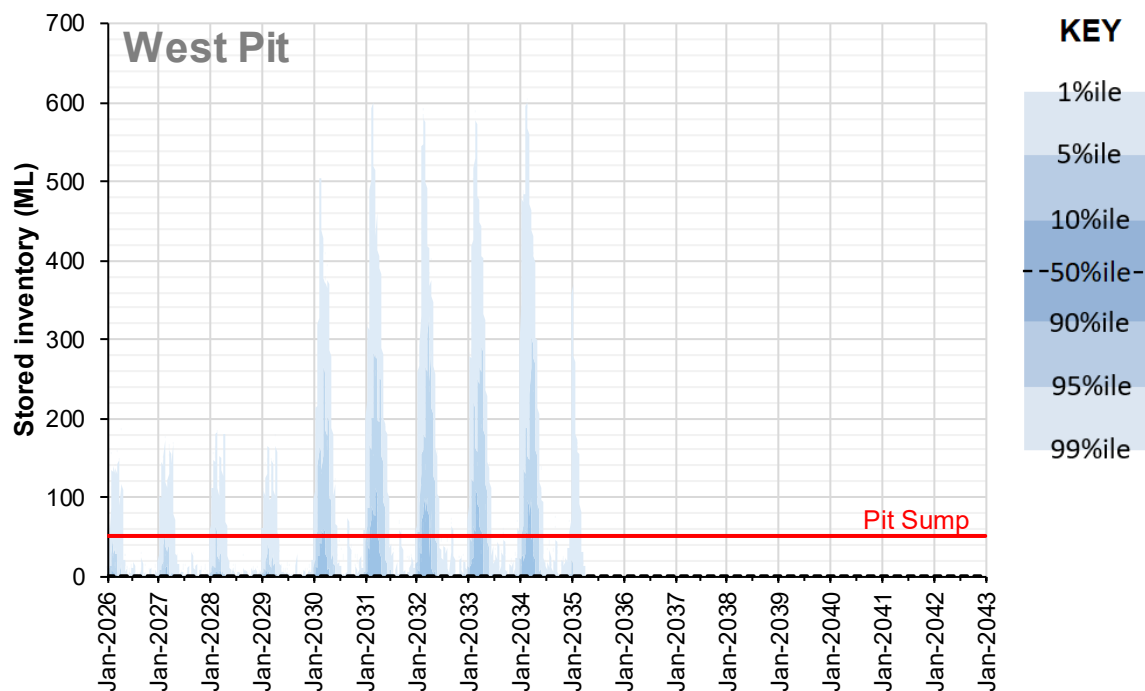


Figure 4-23 Forecast West Pit Inventory

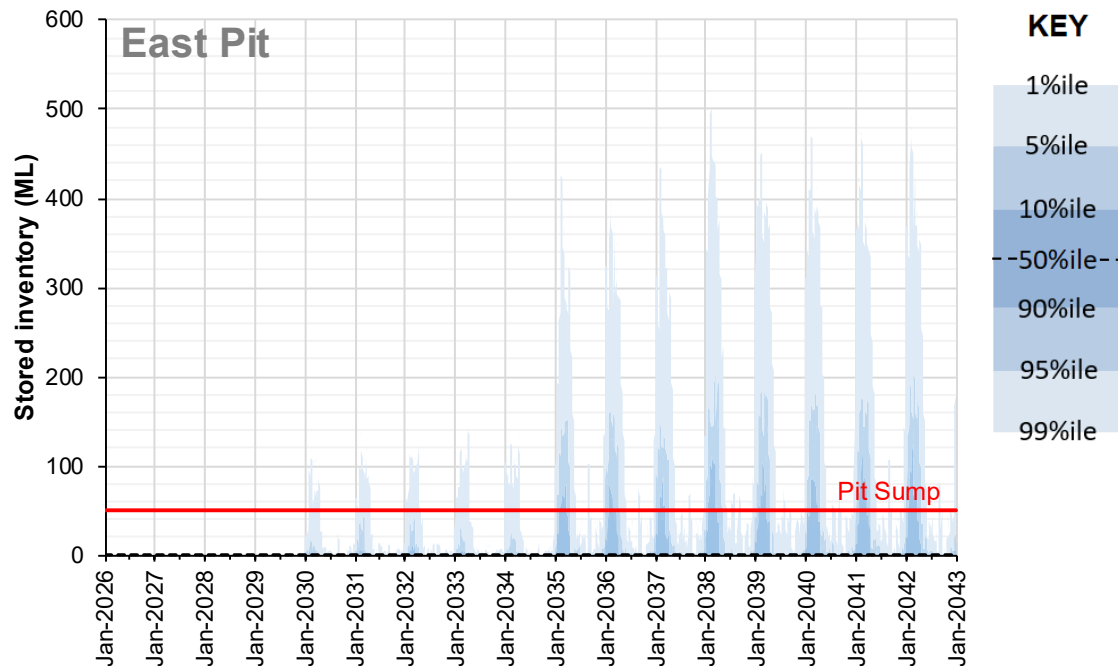


Figure 4-24 Forecast East Pit Inventory

4.7.4 Interaction with Burton Mine

Figure 4-25 shows the annual volumes transferred from Transfer Dam at the Project to Burton Mine for storage over the 18-year simulation. The following is of note regarding this result:

- Transfer Dam would generally only need to transfer to Burton Mine during climatic conditions wetter than the 50%ile.
- During 1%ile extreme wet climatic conditions, Transfer Dam may transfer an annual volume up to 1,250 ML to Burton Mine.
- Transfer from New Lenton to Burton Mine would be lowest prior to 2030, when the catchments reporting the New Lenton water management system are the smallest.

Figure 4-26 shows the annual volumes transferred from Burton Mine to Transfer Dam to supplement demands at New Lenton over the 18-year simulation. This figure shows that import volume from Burton Mine to New Lenton are consistent over the 18-year simulation, generally ranging between 0 ML/a for 1%ile wet climatic conditions to 700 ML/a in 99%ile dry climatic conditions.

The import volumes from Burton Mine are typically greater than the export volumes from Burton Mine. Hence, the Project is generally a net importer of water from Burton Mine.

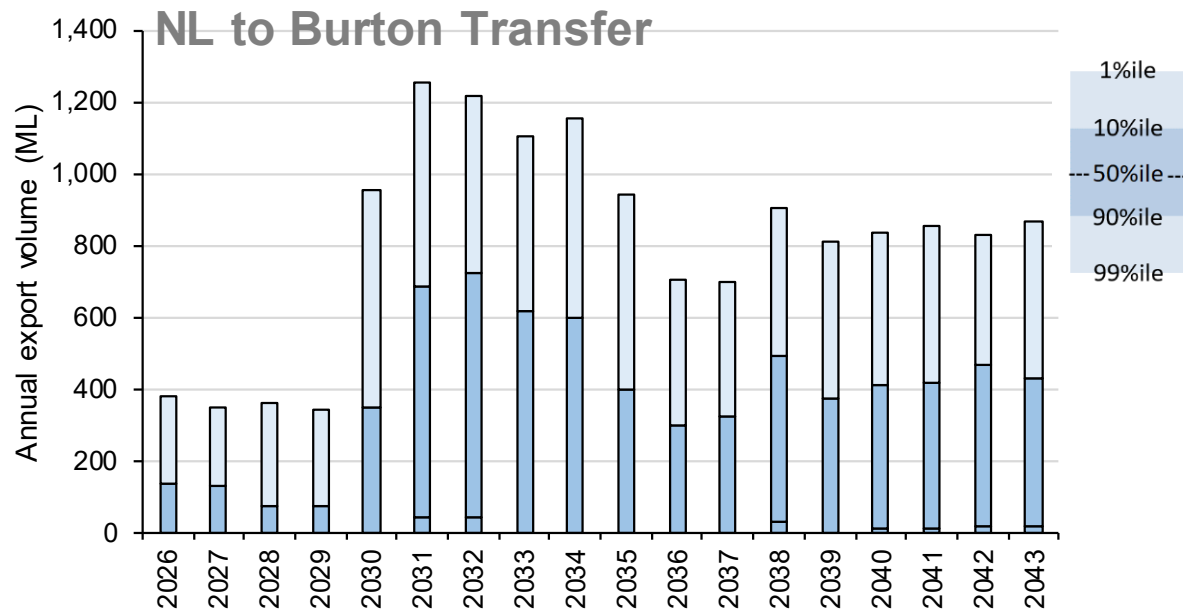


Figure 4-25 Forecast Transfer Volumes from New Lenton Transfer Dam to Burton Mine

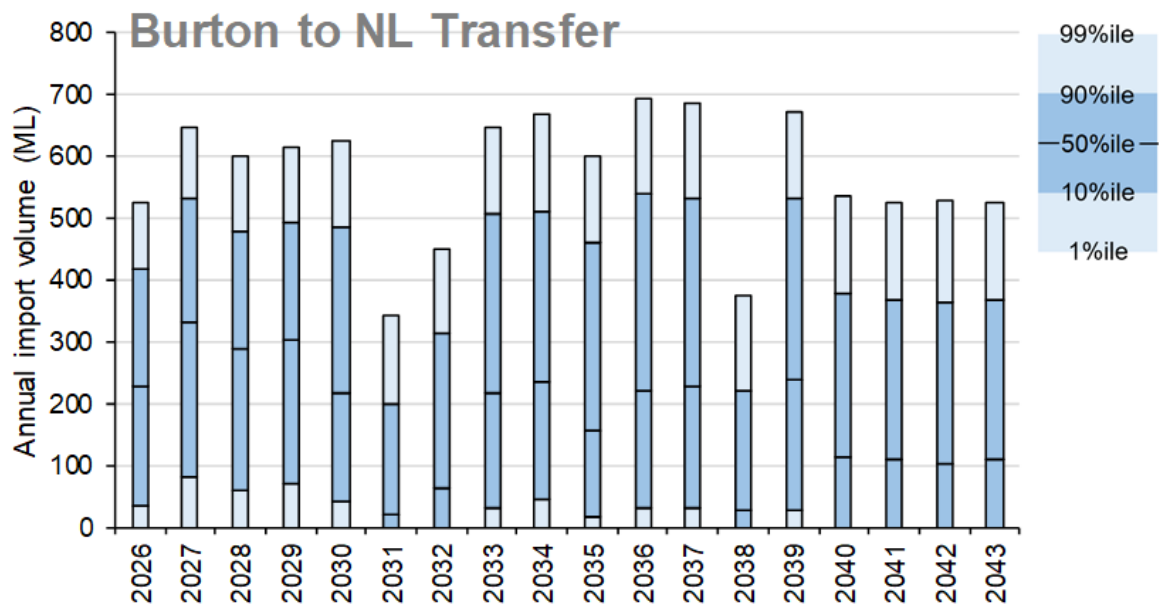


Figure 4-26 Forecast Transfer Volumes from Burton Mine to New Lenton Transfer Dam

4.7.5 Uncontrolled Mine Affected Water Releases

The water balance model was used to assess the risk of uncontrolled releases from the proposed mine affected water storages (i.e. Transfer Dam, Pit Dam 1 and Pit Dam 2). There were no modelled uncontrolled releases from Transfer Dam, Pit Dam 1 or Pit Dam 2 during any of the model realisations over the life of the Project.

4.7.6 Sediment Dam Overflows

Consistent with the IECA design standard, the Project's sediment dams do not provide 100% containment for captured runoff. Hence overflows will occur from sediment dams when rainfall exceeds the design

standard. The potential for overflows from the proposed sediment dams has been assessed using a forecast assessment simulation.

The predicted annual combined sediment dam overflows under this scenario are provided in Figure 4-27, which show that:

- During very wet climatic conditions (1%ile) where rainfall events often exceed the dam design standard, modelled sediment dam overflows are between 690 ML/year and 1,420 ML/year.
- During wet climatic conditions (10%ile) where rainfall events sometimes exceed the dam design standard, modelled sediment dam overflows are between 310 ML/year and 620 ML/year.
- During median and dry climatic conditions, there are no modelled sediment dam overflows.

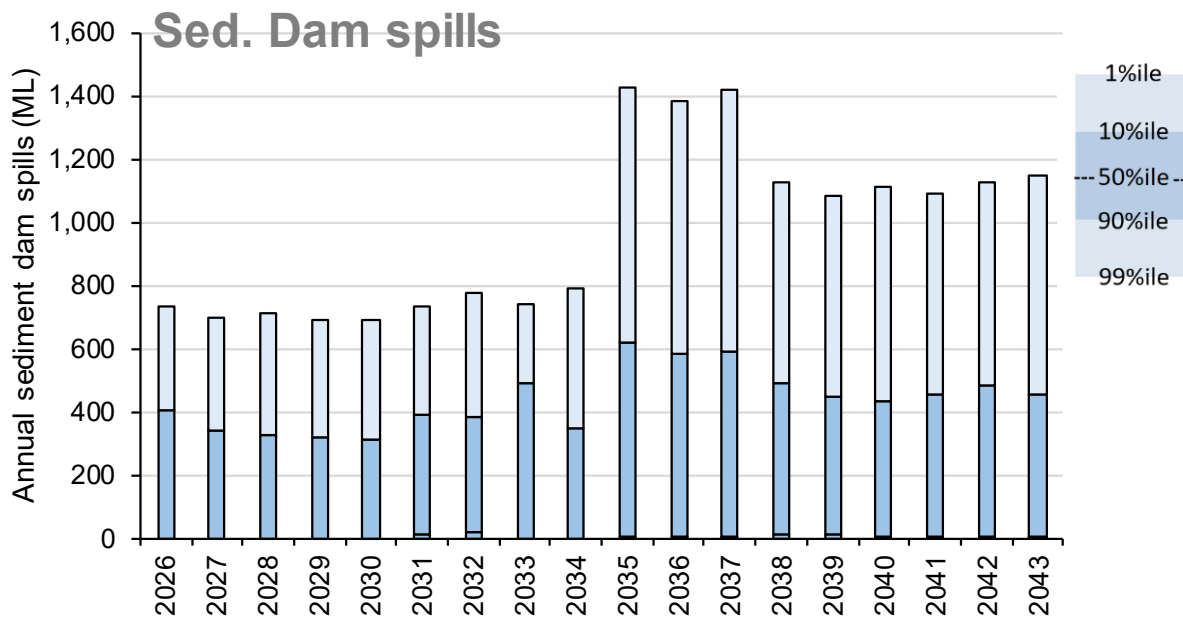


Figure 4-27 Forecast Annual Sediment Dam Overflow Volumes

An assessment of the predicted salinity of overflows from the sediment dams to the receiving environment has been undertaken. The modelling indicates that salinity of sediment dam overflows will typically be between 300 to 580 $\mu\text{S}/\text{cm}$ (typically during wet or very wet climatic conditions). Figure 4-28 shows the modelled Isaac River water quality immediately downstream of the Project on sediment dam spill days. This plot shows that mixed downstream EC would generally be similar to background levels, with 99.3% of the modelled values below the median EC recorded at the Isaac River (Burton Gorge) gauge (458 $\mu\text{S}/\text{cm}$).

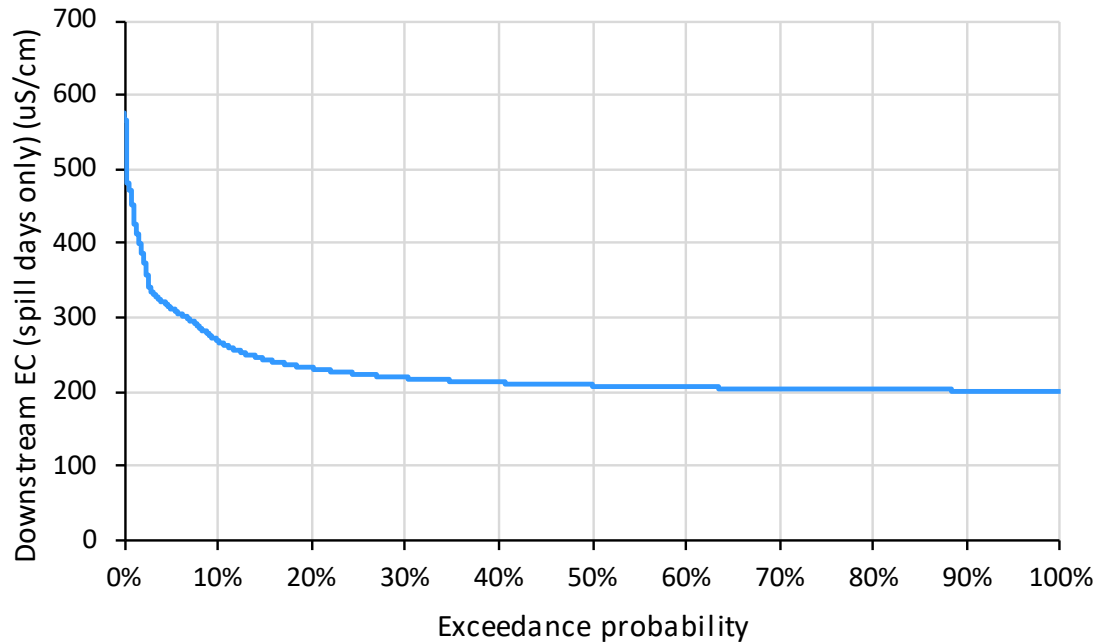


Figure 4-28 Downstream Isaac River Salinity on Sediment Dam Spill Days

4.7.7 Burton Mine inventory

Figure 4-29 presents the forecast inventory in Ellensfield Pit, which is a key mine water storage at Burton Mine. For the purpose of this assessment, it has been assumed that all transfers to and from Burton Mine would be undertaken via Ellensfield Pit. Other, larger pit voids (e.g. Burton Widening) are also available at Burton Mine for water storage should Ellensfield Pit be utilised for other operational purposes at Burton Mine.

This result shows that Ellensfield Pit would have sufficient inventory to manage the excess mine water from the Project. Ellensfield Pit reaches a maximum inventory of 14,300 ML over the 18-year mine life in 1%ile wet climatic conditions, which is more than 2,000 ML below the storage capacity.

Ellensfield Pit at Burton Mine would also have sufficient inventory to supplement all Project water demands. The results show that the Ellensfield pit would not empty during any climatic conditions assessed. Ellensfield Pit may need to source water from Burton Mine's Teviot Dam to make up inventories during dry climatic conditions.

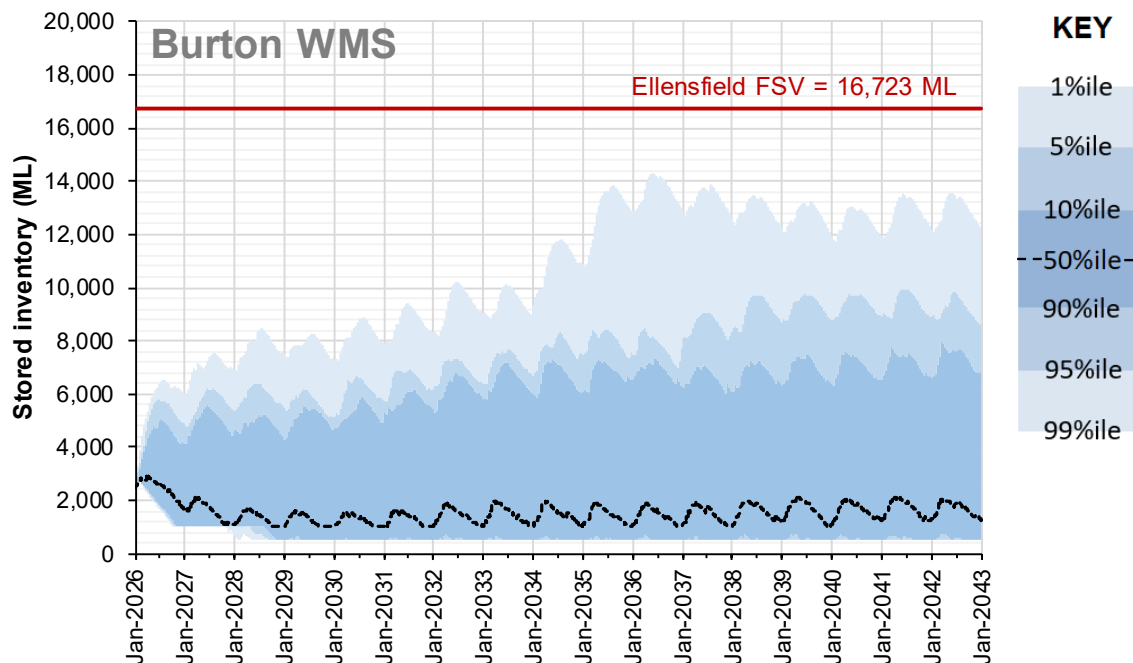


Figure 4-29 Forecast Burton Mine (Ellensfield Pit) Inventory

4.7.8 Salt Balance Model Results

Sources of salt for the Project include the groundwater inflows, catchment runoff, direct rainfall, and transfers from Burton Mine. Salt outputs for the Project includes losses through dust suppression, transfer to Burton Mine and discharges from sediment dams from the water management system.

The results of the average annual salt balance for the Project, for each phase, indicate the following:

- Significant salt loads are transferred to and from the Burton Mine through the pumped transfers between the two operations. Hence, the salt loads associated with the Burton Mine interactions would be considered as net inflows/outflows from the Project's water management system only, and would not be lost/gained by the wider New Lenton/Burton Mine interconnected water management system. The salt loads would be managed by the water management infrastructure at the Project and Burton Mine. Post-mining, any residual salt loads would be stored indefinitely within the proposed non-polluting residual voids at the Project (see Section 4.8) and Burton Mine.
- The largest external contributor to the Project salt load is rainfall runoff from the various surfaces on-site.
- The largest external losses of salt from the Project is through dust suppression and sediment dam overflows.
- The change in stored salt load is generally low in comparison to the total inputs and outputs, which suggests salt would not accumulate onsite during operations.

4.7.9 Model Sensitivity Assessment

A sensitivity analysis has been undertaken to assess the potential impact of variations in the rainfall runoff parameters on the performance of the proposed water management system. The sensitivity scenarios that have been assessed are as follows:

- Scenario 1: Global increase in AWBM soil capacity by 20%.
- Scenario 2: Global decrease in AWBM soil capacity by 20%.

Under Scenario 1:

- The water management system inventory would be slightly decreased under Scenario 1.
- The transfers to/from Burton Mine are generally similar to the base case, however, the Project would tend towards drawing more water from Burton Mine.
- No uncontrolled mine affected releases are projected to occur for any of the modelled simulations.

Under Scenario 2:

- The water management system inventory would be slightly increased under Scenario 2.
- The transfers to/from Burton Mine are generally similar to the base case, however, the Project would tend towards sending more water to Burton Mine. The Project would, however remain a net importer of water from Burton Mine.
- No uncontrolled mine affected releases are projected to occur for any of the modelled simulations.

4.8 Residual Void Assessment

4.8.1 Overview

Water levels in the residual void will vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater. A GoldSim model was developed to assess the likely long-term water level and salinity behaviour of the residual void.

A single residual void will remain at the end of mine life, as shown in Figure 4-30, along with the residual void catchment.

Section 7 of **Appendix 7** describes the inputs and outputs into the residual void model, including void configuration, salinity inputs and groundwater inflows. Groundwater inflows to the residual void were provided as a time series based on the groundwater model developed for the Project (see Chapter 5).

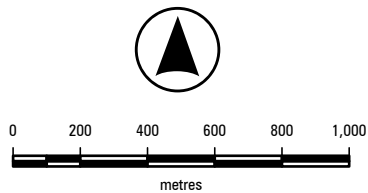


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DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.



- LEGEND**
- Mining Lease
 - Cadastral Boundary
 - Proposed Disturbance Boundary
 - Pit Highwall
 - Pit Floor and Low Wall
 - Rehabilitation
 - Permanent Road Diversion
 - Diversion
 - Final Void Catchment Area

NEW LENTON COAL PROJECT
 Public Environment Report 2026

Residual Void and Catchment

Figure | 4-30

4.8.2 Modelled Long Term Void Levels

Figure 4-31 shows the simulated long-term water levels in the residual void, compared against the void overflow level. The model results show the following:

- The water level reaches equilibrium between 270 mAHD and 278 mAHD after approximately 300 years and generally remains at these levels throughout the remainder of the simulation.
- The maximum modelled water level (278.4 mAHD) is around 42 m below the void overflow level (321 mAHD).

The residual void water balance modelling results show that the residual void at the Project is not at risk of overflowing to the receiving environment.

Section 5.8 of Chapter 5 presents modelling demonstrating that groundwater levels in each aquifer unit surrounding the residual void remain above the predicted void lake level, meaning no potential for outflow from the void lake to the groundwater system and permanent inflow only (sink) conditions are maintained post-mining.

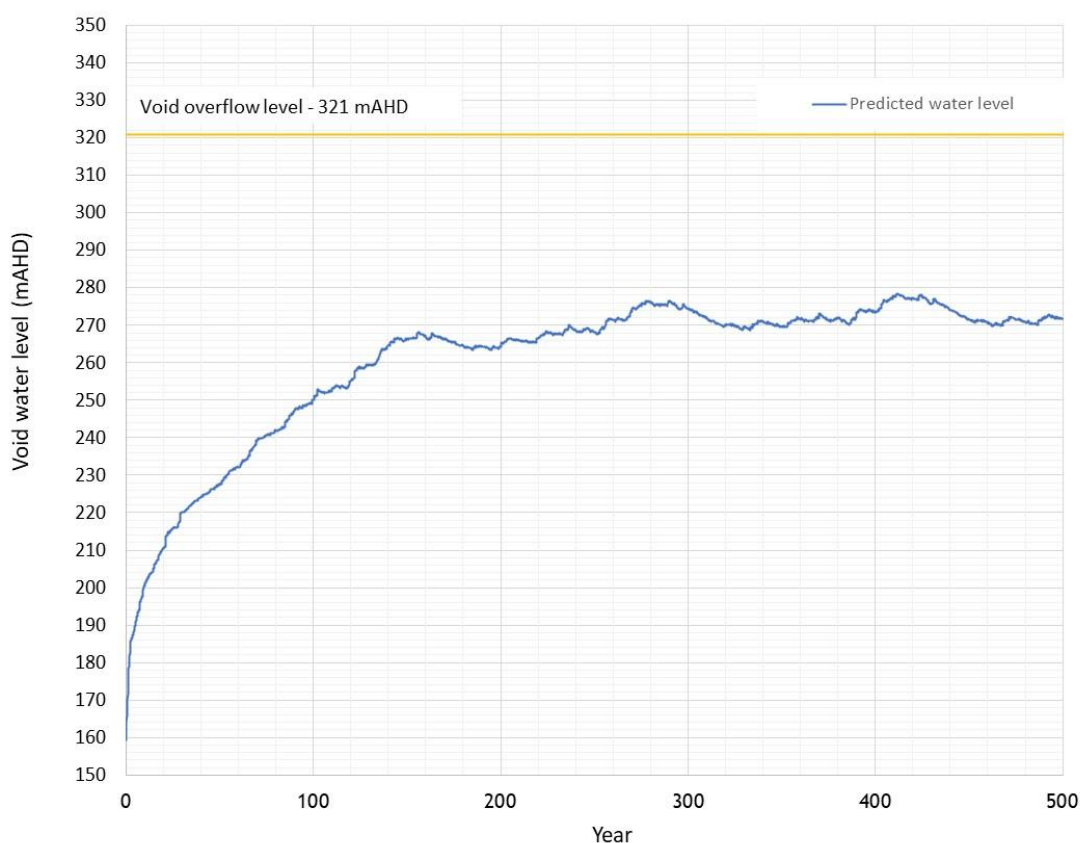


Figure 4-31 *Residual Void Water Level Behaviour*

4.8.3 Modelled Long Term Salinity in the Residual Void

Figure 4-32 shows the simulated long-term water salt load and concentrations in the residual void. The model results show the void becomes hyper-saline ($>53,850 \mu\text{S}/\text{cm}$) after around 480 years of simulation.

However, as demonstrated in the groundwater assessment (see Section 5.8 of Chapter 5), the void will be a groundwater sink and hence saline water will be contained within the void in the long term.

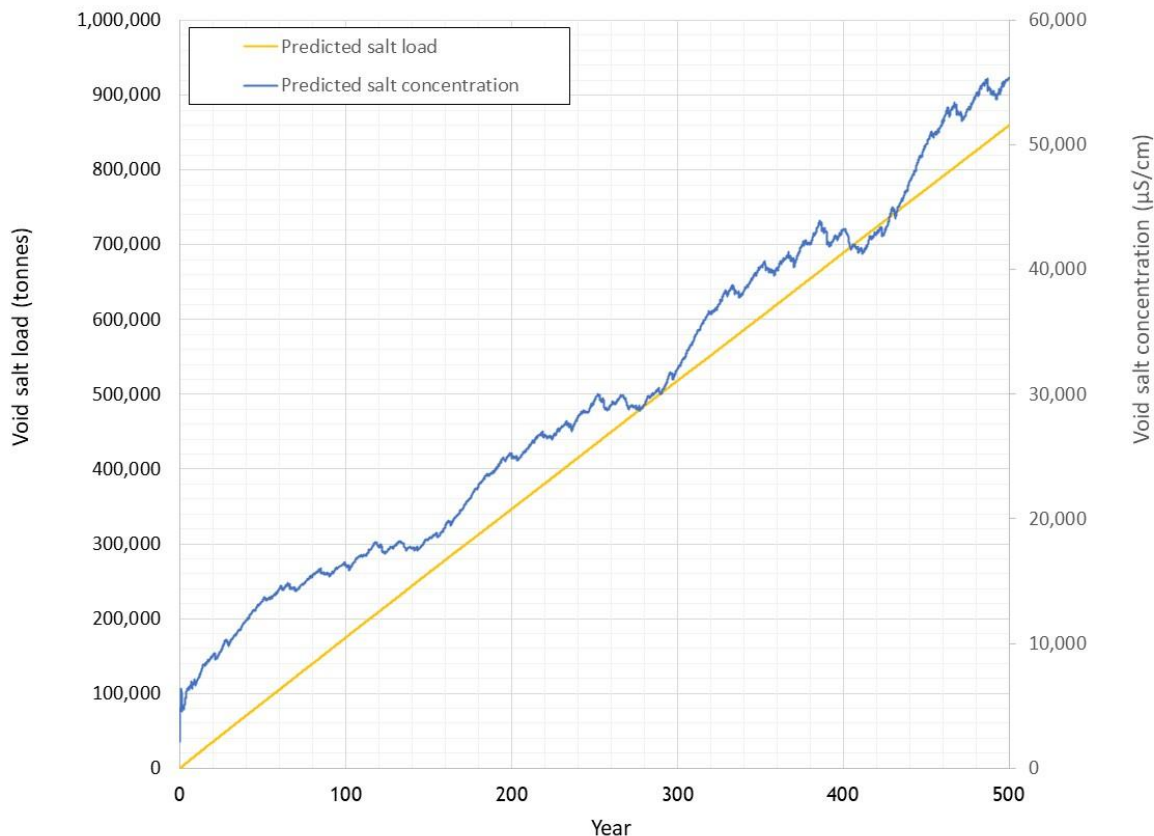


Figure 4-32 *Residual Void Salt Load and Concentration*

4.8.4 Climate Change Scenarios

4.8.4.1 Methodology

The potential impacts of climate change on residual void behaviour were assessed using the projections and methodologies given in the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Commonwealth Bureau of Meteorology (BoM) report entitled *Climate Change in Australia Technical Report* (CSIRO, 2015). The CSIRO report provides guidance on the possible projections of future climate for the Australian East Coast based on a current understanding of the climate system, historical trends and model simulations of the climate response to changing greenhouse gas and decreasing aerosol emissions.

Projections are given for a number of climatic variables including (but not limited to) temperature, rainfall, wind speed and potential evapotranspiration. CSIRO (2015) presents a number of possible approaches to quantify risks associated with climate change impacts.

For the Project's residual void assessment, the conservative Representative Concentration Pathway 8.5 (RCP8.5) emissions scenario has been adopted. The year 2090 was selected as the representative year, being approximately 50 years post-mine closure. Year 2090 is the current limit of climate change projections as defined by CSIRO (2015). Potential changes in climate have been obtained using the projection builder tool provided in the *Climate Change Australia* website. Climate variable inputs for the 'best case', 'maximum consensus' case and 'worst case' as defined by CSIRO (2015) for the RCP8.5 climate change scenarios were utilised for residual void modelling.

Rainfall is expected to change by between plus 19.1% and minus 34.0% and evapotranspiration is expected to increase by between 8.3% and 15.2%. The climate variable inputs (rainfall and evaporation) to the water balance model were adjusted to undertake the climate change impact assessment. All three scenarios have been assessed for the proposed residual void.

4.8.4.2 Climate Change Influence on Residual Void Levels

The impact of the potential changes in rainfall and evapotranspiration for the proposed residual void water levels are presented in Figure 4-33. The water balance modelling results show that the residual void water levels will be lower than under baseline climatic conditions for the 'best case' and 'maximum consensus' climate scenarios. This is expected given the significant decrease in rainfall and increase in evapotranspiration for these climate scenarios. For the 'worst case' climate scenario, the residual void water levels will be slightly higher (less than 4.5m) than under baseline climatic conditions.

The climate change assessment demonstrates that there is no risk of overflow even under the most conservative climate change scenarios. Furthermore, as demonstrated in the groundwater assessment (see Section 5.8 of Chapter 5), the void will remain a groundwater sink under climate change scenarios.

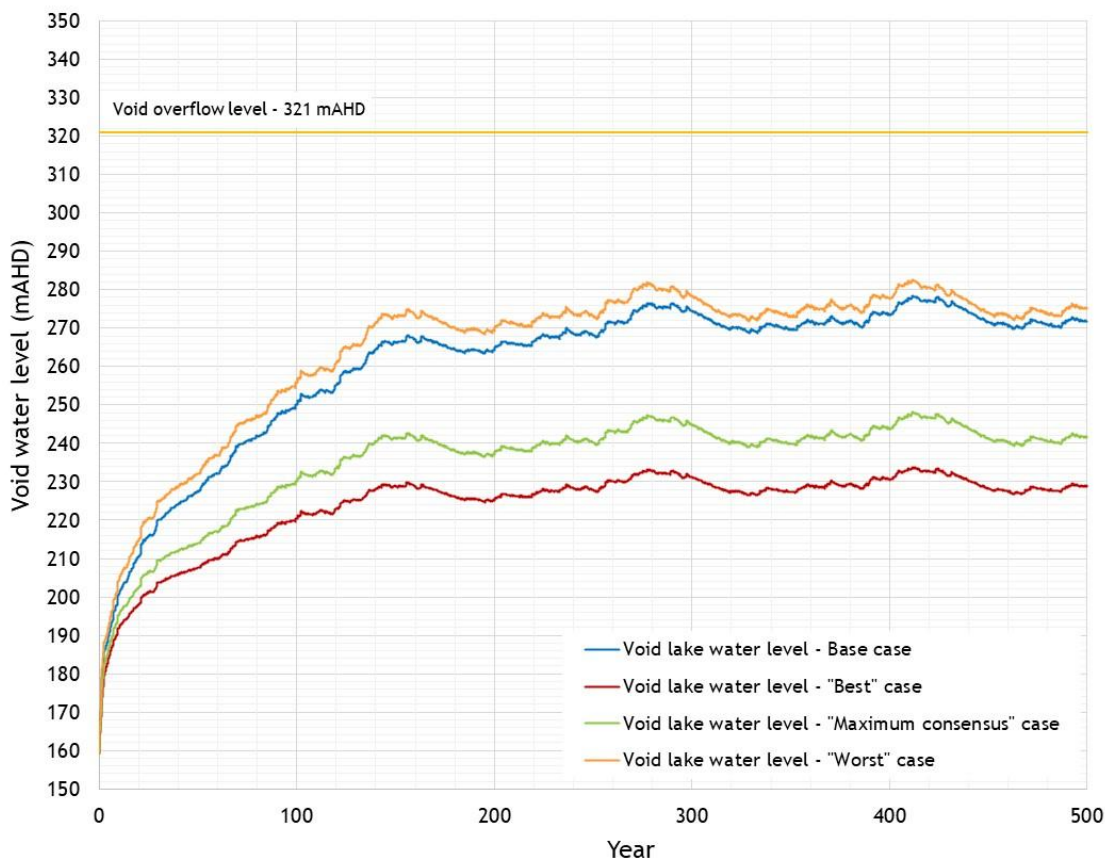


Figure 4-33 *Residual Void Water Level – Climate Change Assessment*

4.8.4.3 Climate Change Influence on Residual Void Salinity

The water balance modelling results show that the residual void salinity will be higher than under baseline climatic conditions for the 'best case' and 'maximum consensus' climate scenarios. This is expected given the significant decrease in rainfall and increase in evapotranspiration for these climate scenarios, resulting in lower stored volumes and higher concentrations. For the 'worst case' climate scenario, the residual void salinity will be slightly lower than under baseline climatic conditions.

4.8.5 Storm Surge

An assessment of the impact of storm events on the water level and volume of water in the residual void has been undertaken to determine the probability of overtopping during extreme climate conditions. The potential for discharge has been assessed for the 1 in 1,000 AEP design rainfall event, using the 72-hour (3 day) rainfall depth.

The modelled results show that even during a storm event with a rainfall depth equivalent to the 1 in 1,000 AEP design event, there would be minimal impact (less than 3.5 m) on the water level within the residual void.

4.9 Flood Modelling Assessment

4.9.1 Methodology

Section 8 and Appendix B of **Appendix 7** describe the methodology used to develop the flood model for the watercourses and drainage features potentially impacted by the Project.

The TUFLOW hydraulic model was used to assess the impacts of the Project on flooding over a range of design events. The following development scenario/event combinations were modelled:

- Existing conditions (i.e. prior to the Project):
 - 50% (1 in 2 year), 10% (1 in 10 year), 2% (1 in 50 year), 1% (1 in 100 year), and 0.1% (1 in 1,000 year) annual exceedance probability (AEP).
- Developed conditions (i.e. maximum impact during Project operations):
 - 50%, 10%, 2%, 1% and 1 in 1,000 AEP.
- Post-closure conditions (i.e. maximum impact for the post mining closure landform)
 - 1 in 1,000 AEP and probable maximum flood (PMF).

To determine the change in flood behaviour, the modelled existing conditions flood levels and velocities were subtracted from the flood levels and velocities modelled under the developed conditions and post closure conditions. A positive value of impact therefore represents an increase in peak flood levels and velocities and conversely a negative value of impact represents a reduction in peak flood level or velocity.

Appendix E of **Appendix 7** provides figures showing the results for all flood modelling. Selected figures are included in this section.

4.9.2 Flood Hydrographs

Design flood hydrographs of Ti-Tree Creek and the Isaac River immediately downstream of the Project area for a range of events are shown in Figure 4-34 and Figure 4-35 respectively. The event duration that produces peak flows in Ti-Tree Creek and the Isaac River is less than 24 hours (i.e. flood events in the region around the Project have a very short duration for minor to extreme rainfall events).

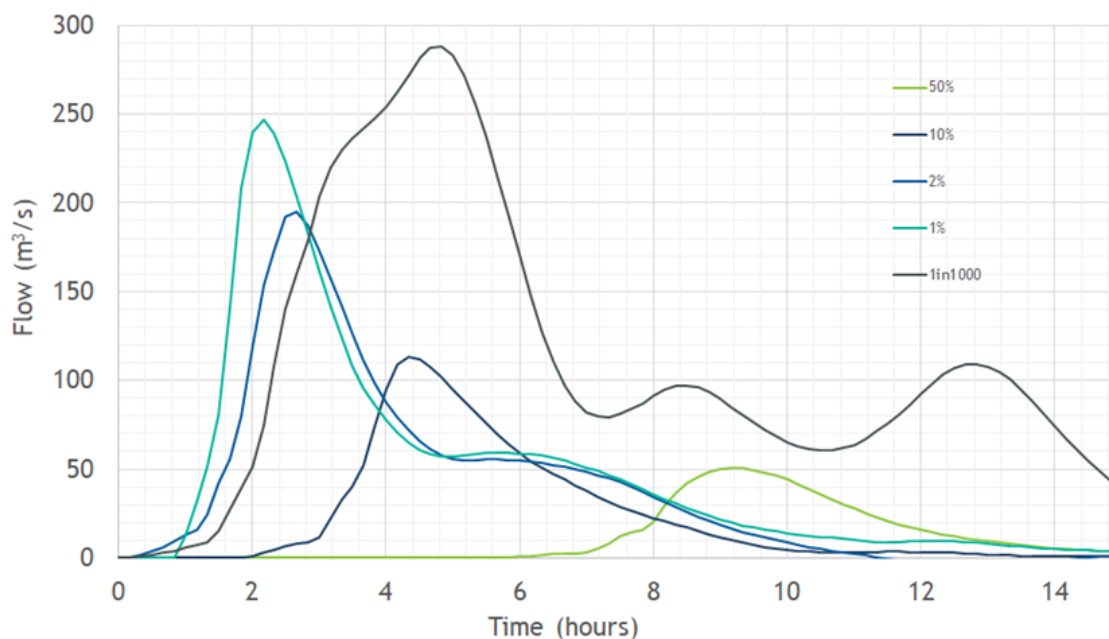


Figure 4-34 *Ti-Tree Creek Design Hydrographs*

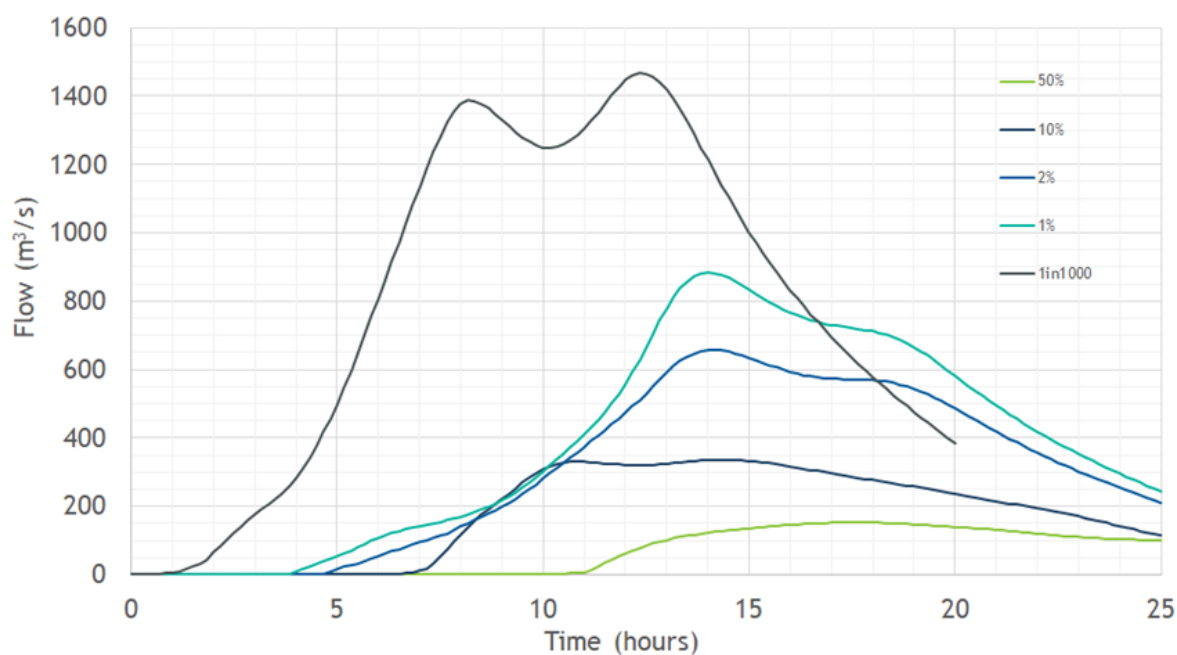


Figure 4-35 *Isaac River Design Hydrographs*

4.9.3 Existing Conditions

Section 8 and Appendix E of **Appendix 7** provide figures showing modelled flood levels and velocities under existing conditions. In the Isaac River, velocities in the main channel in a 1 in 1,000 AEP event typically range from 2.0 to 3.0 m/s and in the 1% AEP event from 1.8 to 2.3 m/s. In Ti-Tree Creek in the 1 in 1,000 AEP event, point channel velocities typically range from 1.5 m/s to 2.6 m/s and in the 1% AEP from 1.3 to 2.5 m/s. Within the New Lenton MLs in both Ti-Tree Creek and the Isaac River there are isolated ‘hotspots’ that experience velocities greater than 3.0 m/s.

4.9.4 Developed Conditions

4.9.4.1 Project Activities Impacting Flood Behaviour

The following Project activities and infrastructure are predicted to alter flood behaviour during operations:

- A levee along the western bank of the Isaac River to prevent ingress of floodwaters to the Project disturbance area in a 1 in 1,000 AEP event reducing floodplain conveyance and storage. This would have the effect of locally increasing flood levels in the Isaac River.
- A levee intercepting the flow path of Ti-Tree Creek with flow diverted to an unnamed tributary of the Isaac River via a diversion channel. This would have the effect of increasing flood levels in the unnamed tributary as well as the Isaac River into which it drains. It would also decrease flood levels in the downstream reach of Ti-Tree Creek because the contributing catchment has been diverted.
- A realignment of the Suttor Developmental Road with a new bridge crossing the Isaac River approximately 700 metres downstream of the existing bridge. Additionally, in the vicinity of the new road crossing there will be a low flow crossing for a ROM haul road. The addition of the bridge and abutments would have the effect of increasing upstream flood levels and decreasing downstream flood levels.

4.9.4.2 Model Outputs

Section 8 and Appendix E of **Appendix 7** provide figures for the 50%, 10%, 2%, 1% and 1 in 1,000 AEP flood events showing:

- modelled flood levels and velocities under developed conditions
- change in flood levels (flood afflux) and velocities between developed and existing conditions.

Details of the modelled changes in flood levels and velocities are summarised in the following sections.

4.9.4.3 Flood level impacts

This section summaries the modelled changes in flood level for developed conditions in the 10%, 2%, 1% and 1 in 1,000 AEP events. The modelled changes in flood level for developed conditions for the 1% AEP and 1 in 1,000 AEP events are shown in Figure 4-36 and Figure 4-37 respectively.

The flood modelling results show:

- For the Isaac River:
 - For the 10% AEP flood event, level changes are insignificant (< 0.25 m), have minimal interaction with the levee and new bridge, and result in an insignificant change in the areas that are subject to flooding.
 - For the 1% AEP and 1 in 1,000 AEP events level changes are minor (< 0.5 m to < 1 m) adjacent the levee and upstream of the new bridge, dissipating to insignificant (< 0.25 m) upstream and downstream of the levee. There are minor changes in the areas that are subject to flooding.
- For Ti-Tree Creek and Ti-Tree Creek diversion:
 - Upstream of the Ti-Tree Creek diversion and levee, there are increases in flood levels by 2.2 m (10% AEP) to about 3 m (1 in 1,000 AEP), with these impacts dissipating within about 600 m upstream. The diversion and levee are operating in accordance with their conceptual design to channel water around active mining areas and prevent ingress of flood water up to the 1 in 1,000 AEP event.
 - Water levels along the unnamed tributary downstream of the Ti-Tree Creek diversion channel increase by up to about 2.3 m for the range of modelled flood events. These changes dissipate once the unnamed tributary joins the Isaac River. There are minor

changes in the areas that are subject to flooding around the downstream portion of the unnamed tributary.

- Water levels are reduced along Ti-Tree Creek downstream of the Project disturbance area by 2.8 m to 3.5 m over the range of modelled events due to the diversion of flow to the unnamed tributary. These changes dissipate once the remaining portion of Ti-Tree Creek enters the Isaac River.

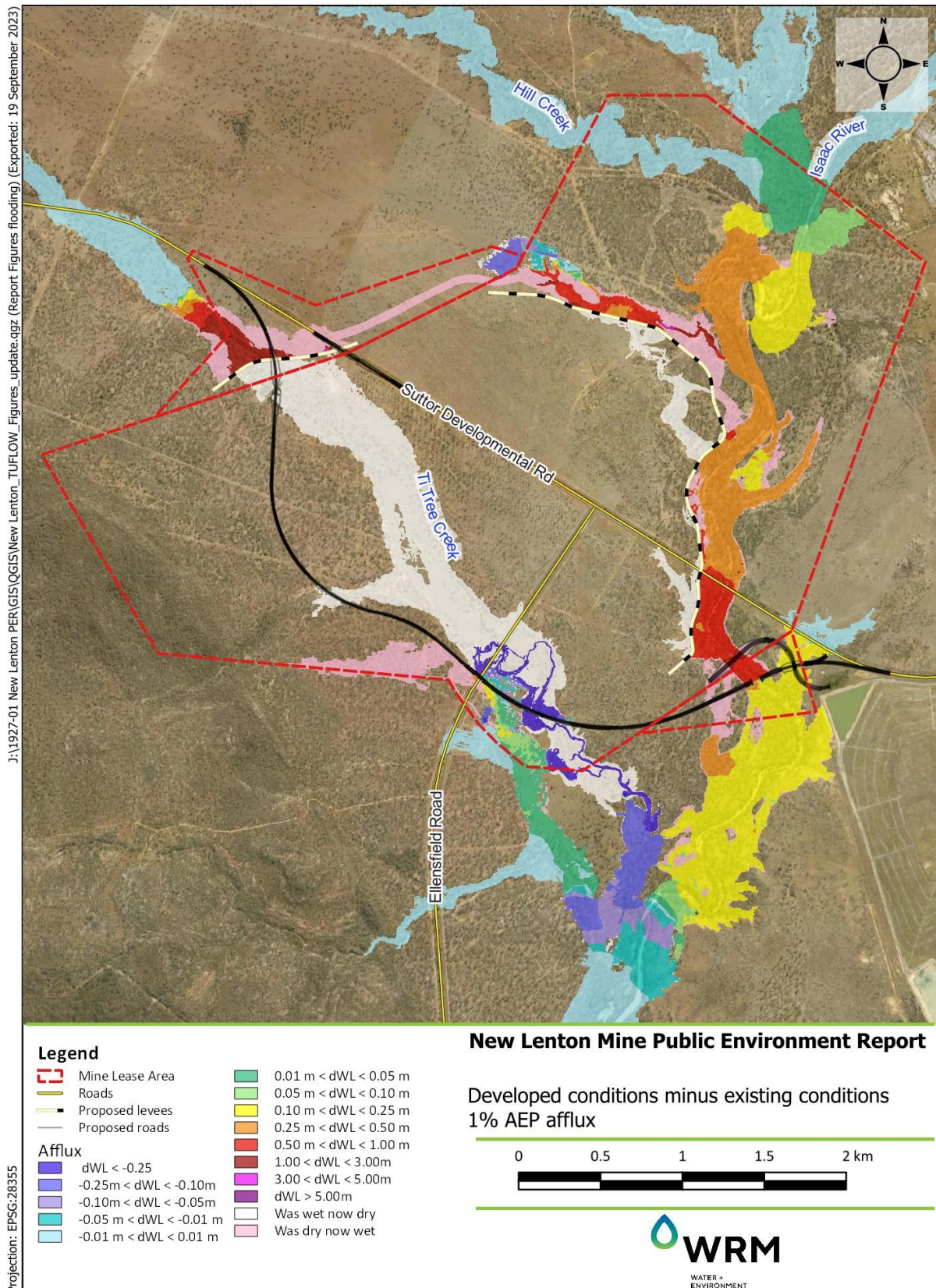


Figure 4-36 Afflux 1% AEP (Developed Minus Existing Conditions)

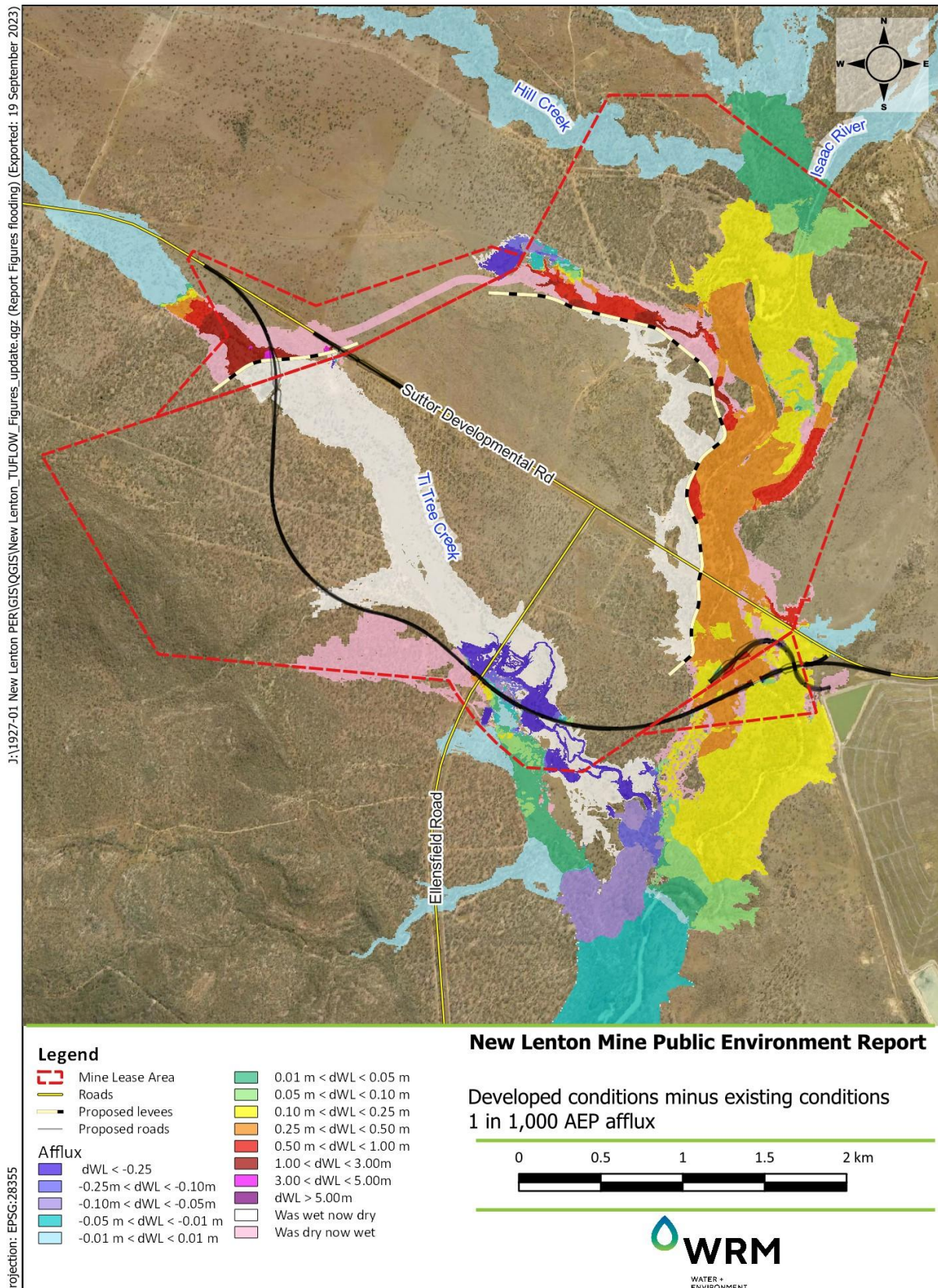


Figure 4-37 Afflux 1 in 1,000 AEP (Developed Minus Existing Conditions)

4.9.4.4 Velocity impacts

This section summaries the modelled changes in flood velocities for developed conditions in the 10%, 2%, 1% and 1 in 1,000 AEP events. The modelled changes in flood level for developed conditions for the 1% AEP and 1 in 1,000 AEP events are shown in Figure 4-38 and Figure 4-39, respectively.

The flood modelling results show:

- For the Isaac River:
 - For the 10% and 2% AEP flood event there are nil to insignificant velocity changes, with changes confined to very small areas.
 - For the 1% AEP and 1 in 1,000 AEP velocity changes range from nil to minor ($< 0.3\text{m/s}$) with some very localised areas of around 0.5 m/s to 1 m/s near the levee and River crossings. Detailed design of the levees and road embankments will consider appropriate erosion protection measures for locations of potentially higher velocity. Velocity changes dissipate to insignificant ($<0.3\text{ m/s}$) upstream of the levee and downstream of confluence with the residual Ti-Tree Creek channel.
- For Ti-Tree Creek and Ti-Tree Creek diversion:
 - Upstream of the Ti-Tree Creek diversion and levee, there are reductions in velocity as the diversion and levee slow the flow of water from Ti-Tree Creek.
 - Velocities along the unnamed tributary downstream of the Ti-Tree Creek diversion channel increase by up to 2.3 m/s for the range of modelled flood events. These changes dissipate once the unnamed tributary joins the Isaac River. The potential geomorphological impacts of this change are assessed in Section 4.10.
 - Velocities are reduced along Ti-Tree Creek downstream of the Project disturbance area. These changes dissipate once the remaining portion of Ti-Tree Creek enters the Isaac River.

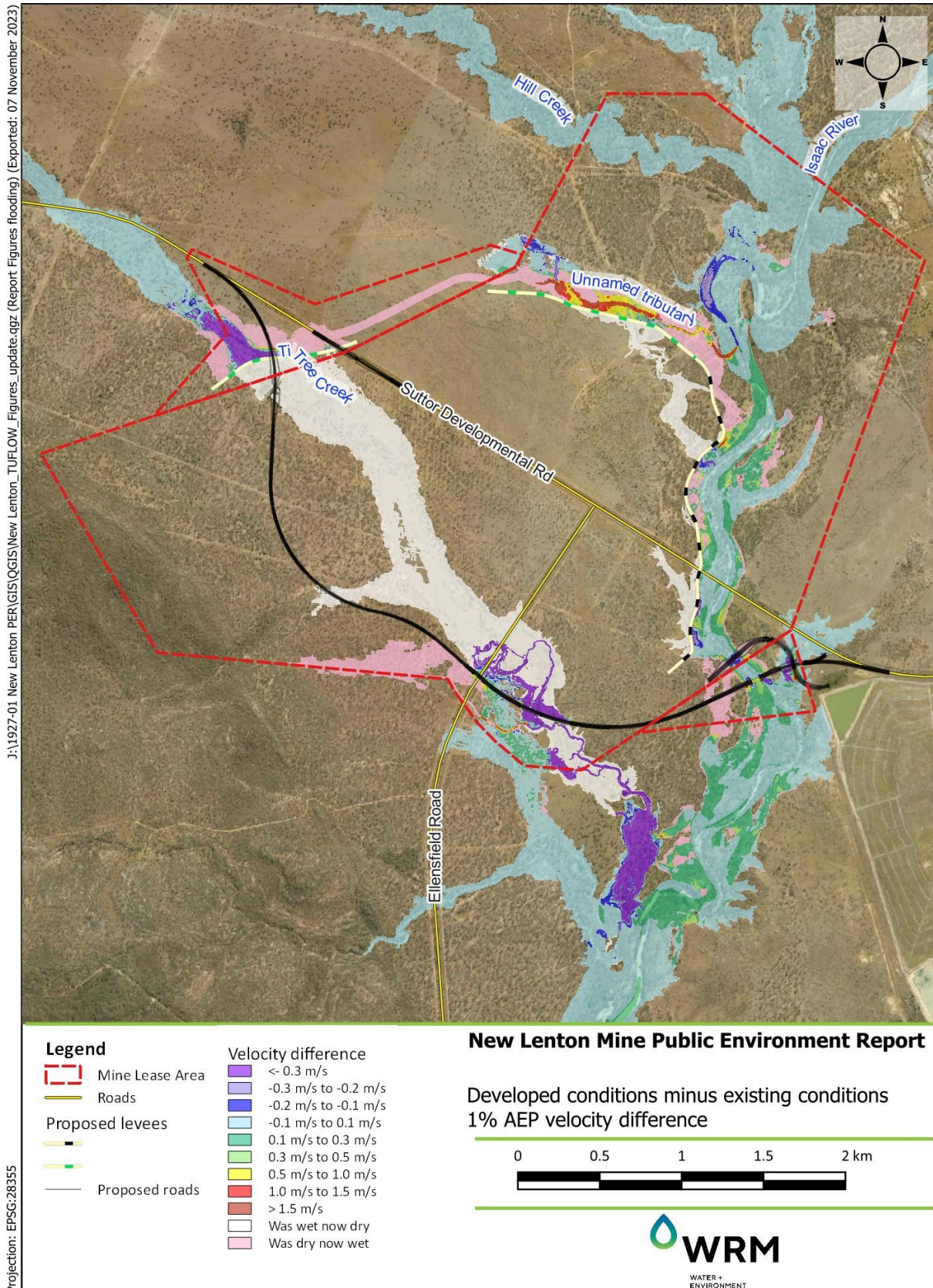


Figure 4-38 Velocity Difference 1% AEP (Developed Minus Existing Conditions)

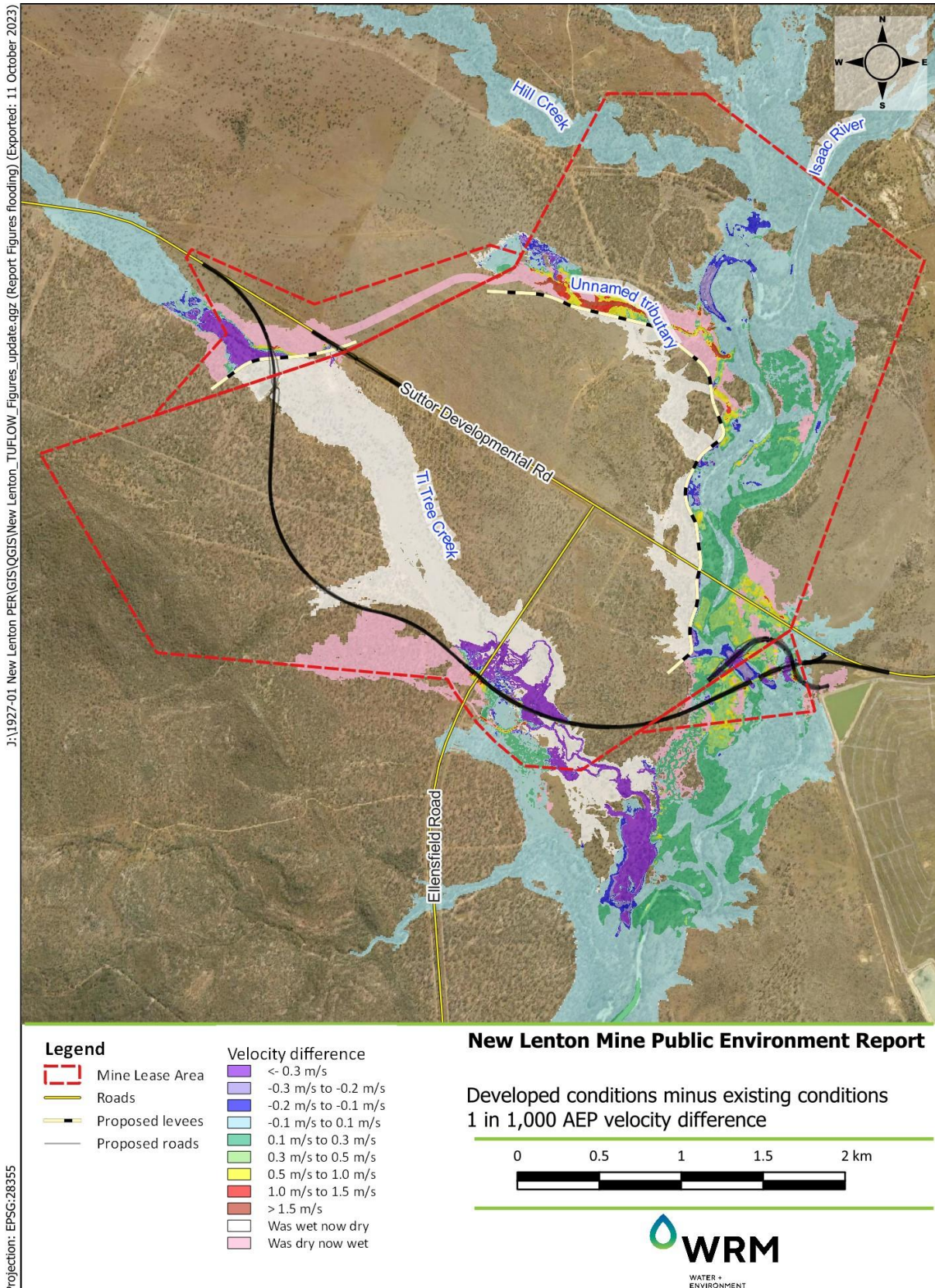


Figure 4-39 Velocity Difference 1 in 1,000 AEP (Developed Minus Existing Conditions)

4.9.4.5 Impacts of Proposed River Crossings

The new Suttor Developmental Road bridge has flood immunity for the 2% AEP flood and is overtopped in a 1% AEP or larger event. The new bridge results in minor flood afflux of between 0.1 m (50% AEP) and 0.57 m (1:100 AEP).

The low flow crossing has low flood immunity and is overtopped by several metres in all flood events. Afflux at the low flow crossing is not caused by the crossing itself, but by the combined effects of increased flow in the river due to the Ti-Tree Creek diversion, the effects of the proposed Isaac River levee, and afflux generated by the new Isaac River bridge downstream.

4.9.4.6 Flood Hydrographs

Flood hydrographs for existing conditions are provided in Section 4.9.2. An assessment of potential changes in flood hydrographs (i.e. duration and flow volumes) due to Project activities was undertaken for a section of the Isaac River adjacent the Project. It was determined that any change in duration in developed conditions is negligible. While a height hydrograph (water level vs time) shows the increase in height (that can be seen as the afflux in Figure 4-36 and Figure 4-37) there are negligible changes in duration hydrographs (i.e. flood flows are not attenuated or lengthened). Therefore the duration of flooding for developed conditions is similar to existing conditions, which in both cases demonstrates that flood events in the region around the Project have a very short duration for minor to extreme rainfall events.

4.9.5 Post Closure Conditions

The proposed Ti-Tree Creek diversion will remain as a permanent feature of the drainage network following the completion of mining operations. The Ti-Tree Creek and Isaac River levees will become part of the post-mining landform. Hence, post-mining drainage and floodplain conditions will be virtually identical to the operational phases of mining. Consequently, geomorphological characteristics for post-mining conditions will be the same as for operational conditions and predictions of changes in flood levels, velocities and flood durations will be consistent with the results presented in Section 4.9.4.

Flood modelling shows that the residual void lies outside of the 0.1% AEP and PMF flood extents for Ti-Tree Creek and the Isaac River (see Figure 4-40 and Figure 4-41, respectively). As such, the Project will have no impact on Ti-Tree Creek or Isaac River flows resulting from ingress of water to the residual void.

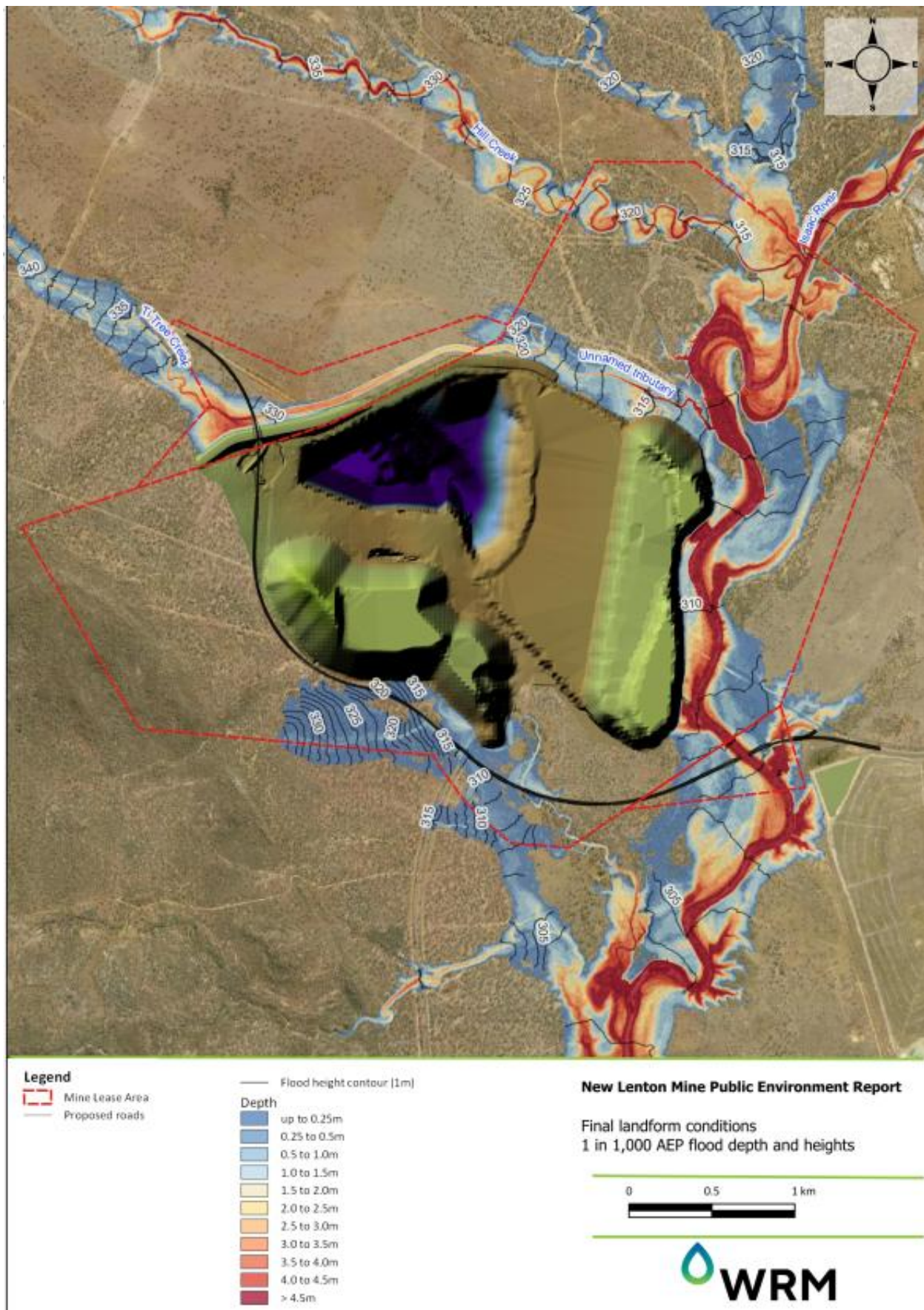


Figure 4-40 Final landform 1:1,000 AEP

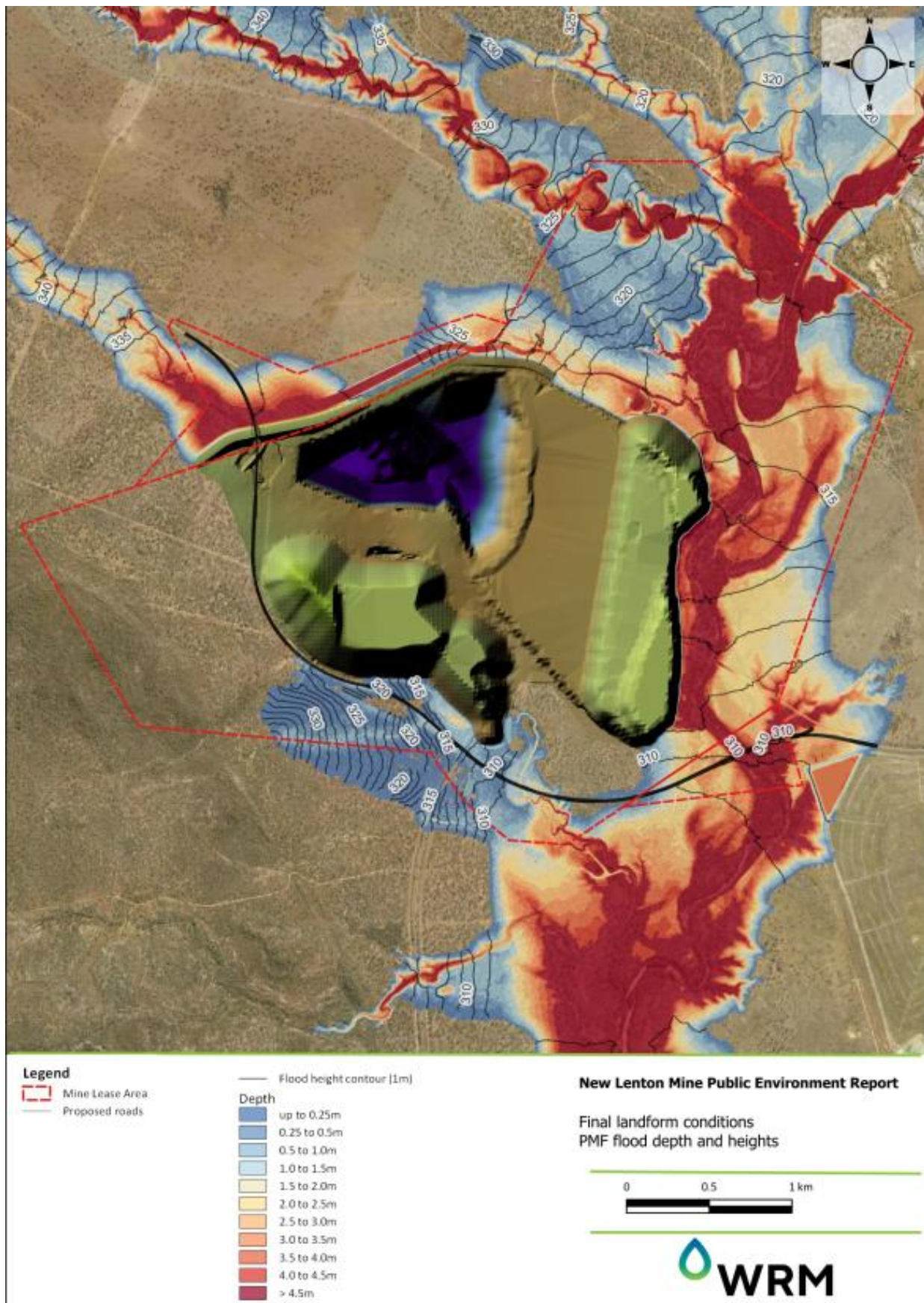


Figure 4-41 Final landform PMF

4.10 Geomorphology Assessment

4.10.1 Overview

The development of the Project requires the diversion of Ti-Tree Creek. The Ti-Tree Creek diversion diverts flow from Ti-Tree Creek in a west to east direction along the northern side of the mining development to an unnamed tributary of the Isaac River. A general arrangement drawing for the Ti-Tree Creek diversion and levee, is presented in Figure 4-42. The general arrangement is an engineered design that considers topography and modelled flood levels. The design cross-section is based on a trapezoidal excavated channel with bank slopes of 1V:3H. The diversion has been input into the TUFLOW model for the development and post closure scenarios.

The design of diversion includes:

- diversion channel length of 2.8 km.
- a low flow channel consisting of a 5m base and 1 in 3 side slope batters.
- a larger channel with a 35 m base and 1 in 3 side slope batters.

A geomorphological assessment has assessed:

- the hydraulic performance of the diversion and the unnamed Isaac River tributary for the developed (i.e. operational) and post closure scenarios against the:
 - existing conditions in Ti-Tree Creek (i.e. prior to diversion)
 - and relevant guideline values
- what impact, if any, the diversion has on the Isaac River.

The values of hydraulic parameters were compared against design criteria specified in the Queensland Government Guideline: Works that interfere with water in a watercourse for a resource activity – watercourse diversions under the Water Act 2000, (DNRME, 2019). These criteria were developed from research carried out by the Australian Coal Association Research Program (ACARP) Projects (Project C8030 and C9068 – Maintenance of Geomorphic Processes in Bowen Basin River Diversion) (ACARP, 2001). The 'ACARP Guideline' criteria are summarised in Table 4-4.

Table 4-4 ACARP Guideline Criteria

AEP (%)	Velocity (m/s)	Shear Stress (N/m ²)	Stream Power (W/m ²)
50	1.5	40	60
2	2.5	80	220

The ACARP Guideline criteria provide guidance as to the relative channel velocities, stream power and shear stress that would be expected across the Bowen Basin. These hydraulic parameters and their significance are summarised as follows:

- Stream velocity has been used as an indicator of stream impacts, where increases in velocities would suggest some change in the stream characteristics may occur. There is not a direct relationship between velocity and the force exerted on soil particles at the boundary and thus stream power and shear stress are used as more reliable indicators of erosion potential.
- Shear stress provides a measure of the tractive force acting on sediment particles at the boundary of the stream and is used to determine the threshold of motion for bed material. It provides an indication of the potential for erosion of cohesive sediments or movement of non-cohesive sediments at the channel boundary.

- Stream power is a function of discharge, hydraulic gradient and flow width. It represents the energy that is available to do work in and on the channel. High stream powers are indicative of elevated erosion potential.

The modelling included:

- An assessment of the 50% AEP design flood to represent the behaviour of the creek channels at bank full flow conditions. The bank full flow is the maximum flow that the channel can carry before it overflows onto the adjacent floodplain. In geomorphologic studies, the bank full flow is often considered to be the stream forming flow, because it often exerts the greatest influence on channel geometry.
- An assessment of the 2% AEP design flood to represent the behaviour of the creeks and associated floodplains during large floods. It can be used to identify whether the changed out of bank flood behaviour could inadvertently cause an avulsion of the channel.

Because the length and alignment of the diversion are different to the existing Ti-Tree Creek, a direct comparison of results on a per chainage basis is not possible. Results have been plotted separately for the existing reach of Ti-Tree Creek and the Ti-Tree Creek diversion. Results for the unnamed Isaac River tributary comparing developed conditions to existing conditions have been plotted together. Results for the Isaac River comparing developed conditions to existing conditions have been plotted together.

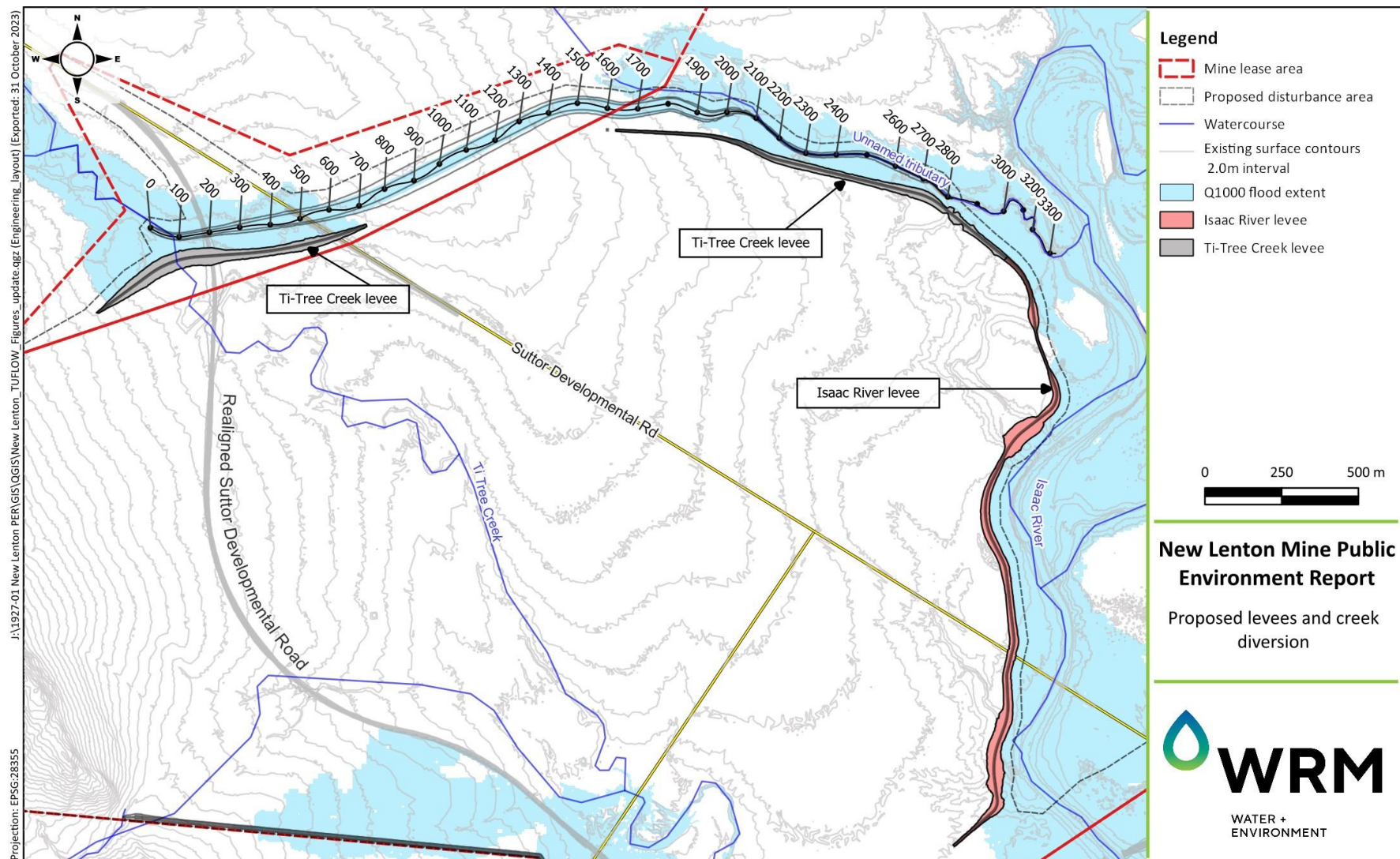


Figure 4-42 Ti-Tree Creel Levee and Diversion – General Arrangement

4.10.2 Ti-Tree Creek Existing Conditions

Section 9.2 of **Appendix 7** provides graphs showing the results for the existing (i.e. prior to diversion) Ti-Tree Creek for velocity, shear stress and stream power for the 50% and 2% AEP events. Examples are provided in Figure 4-43 and Figure 4-44 for shear stress for the 50% and 2% AEP events, with a comparative to the ACARP Guideline criteria. For all existing (pre-mining) conditions, the velocity, shear stress and stream power in Ti-Tree Creek exceed ACARP Guideline criteria.

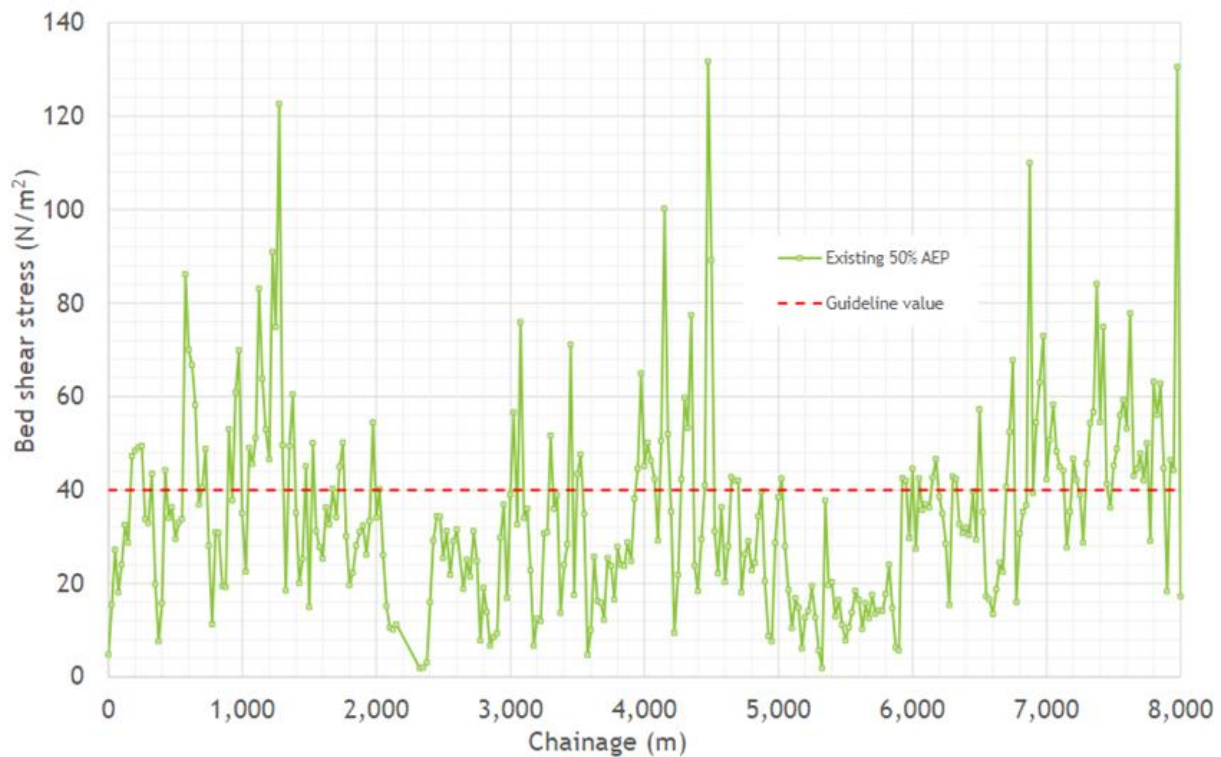


Figure 4-43 *Ti-Tree Creek Longitudinal Profile of 50% AEP Section-Averaged Shear Stress*

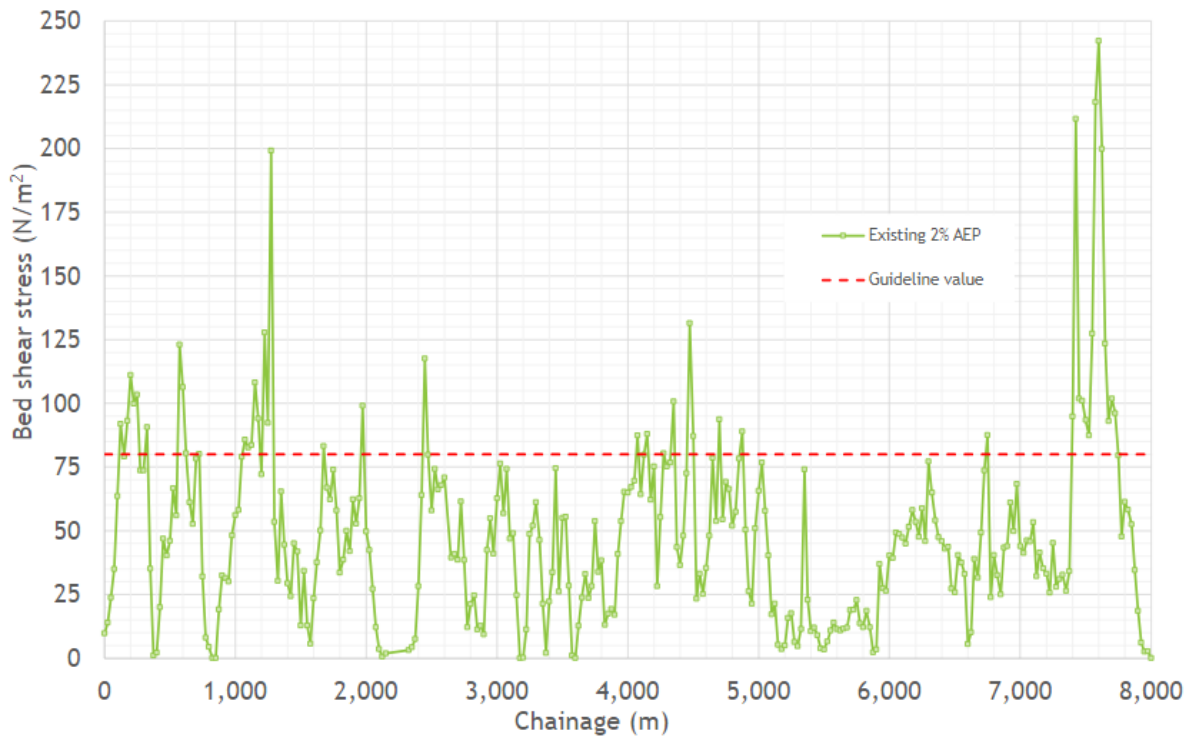


Figure 4-44 *Ti-Tree Creek Longitudinal Profile of 2% AEP Section-Averaged Shear Stress*

4.10.3 Ti-Tree Creek Diversion Developed Conditions

Section 9.2 of **Appendix 7** provides graphs showing the results for the developed Ti-Tree Creek diversion for velocity, shear stress and stream power for the 50% and 2% AEP events. Examples are provided in Figure 4-45 and Figure 4-46 for shear stress for the 50% and 2% AEP events, with a comparative to the ACARP Guideline criteria. Figure 4-45 and Figure 4-46 show shear stress along the length of the diversion and the unnamed tributary of the Isaac River. The existing (i.e. pre-mining) conditions along the unnamed tributary are also shown in Figure 4-45 and Figure 4-46. These results are mirrored for velocity and stream power.

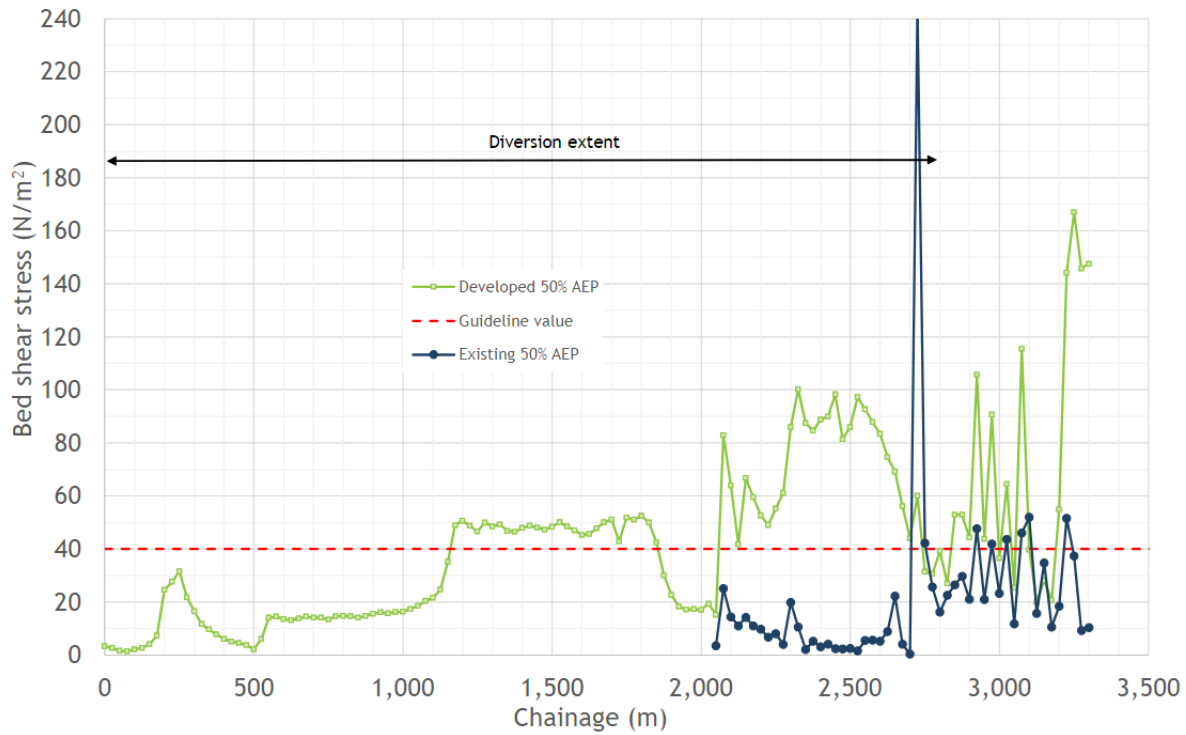


Figure 4-45 *Ti-Tree Creek Diversion Longitudinal Profile Of 50% AEP Section-Averaged Shear Stress*

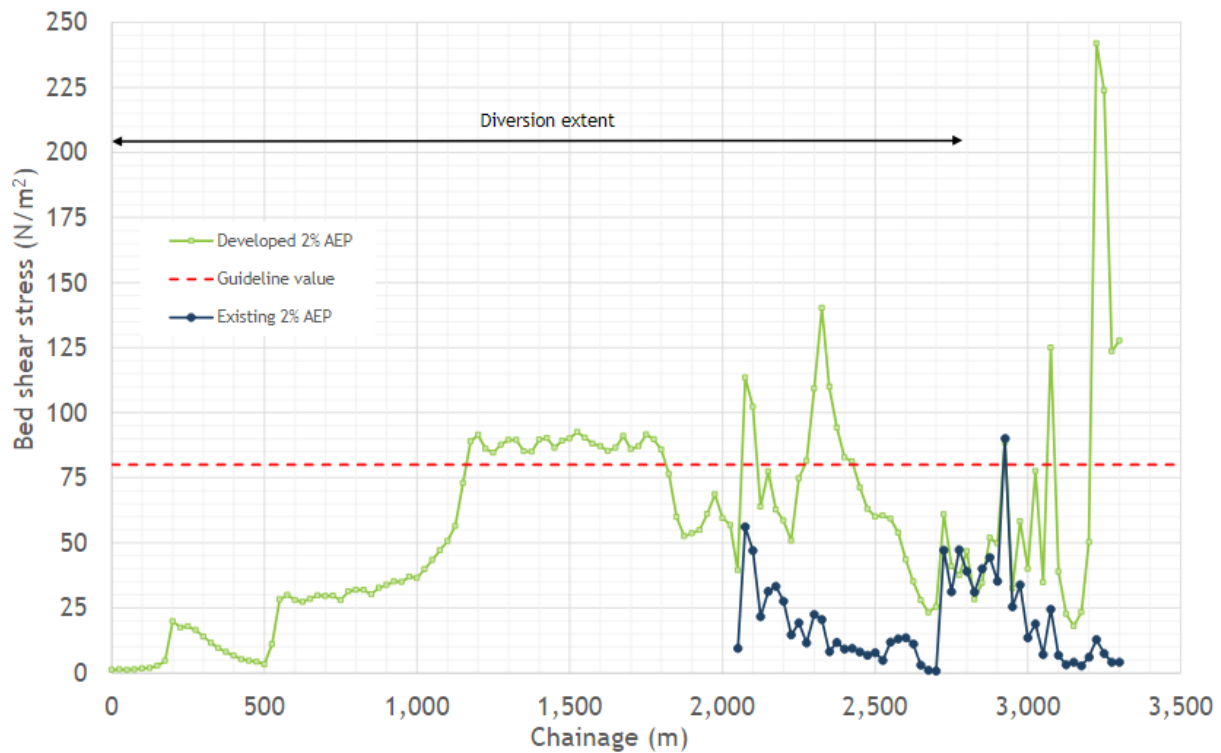


Figure 4-46 *Ti-Tree Creek Diversion Longitudinal Profile Of 2% AEP Section-Averaged Shear Stress*

4.10.3.1 50% AEP Event

The following summarises the model findings for the 50% AEP event:

Velocity:

- Velocity in the existing Ti-Tree Creek varies from 0.3 m/s to 2.8 m/s (i.e. pre-mining conditions are above ACARP Guideline value of 1.5 m/s).
- Velocity along the diversion channel varies from 0.3 m/s to 2.25 m/s (i.e. similar to or less than velocities in the existing Ti-Tree Creek).
- Along 2 km of the 2.8 km long diversion channel, velocities are below the guideline value of 1.5 m/s.
- Velocities are in the range of 1.5 m/s to 2.3 m/s along the final portion of the diversion.
- Velocities along the diversion are generally more uniform and lower than along the existing Ti-Tree creek.
- The maximum velocities along the diversion (2.5 m/s) are less than the maximum velocities in Ti-Tree Creek (2.8 m/s) in existing conditions.
- Velocity in the unnamed Isaac River tributary in existing conditions generally ranges from 0.2 to 1.4 m/s. Under existing conditions, there is a localised hotspot with a velocity of approximately 3.0 m/s. This hotspot is removed with the implementation of the diversion channel.
- The velocity in the unnamed Isaac River tributary downstream of the diversion in developed conditions generally ranges from 0.7 to 2.4 m/s, with increases of up to 1.0 m/s compared to existing conditions.
- These velocity values are similar too but generally less than the range of velocities in the existing Ti-Tree Creek.
- An erosion monitoring plan will be developed for the unnamed Isaac River tributary to assess changes in bed levels and the impact of increased velocities.
- Bank protection measures will be considered if monitoring indicates the increase in erosion is having an identifiable impact on the channel form.

Shear Stress and Stream Power:

- Shear stress and stream power in the existing Ti-Tree Creek are highly variable with shear stress and stream power peak values up to 130 N/m² and 340 W/m² respectively (i.e. pre-mining conditions are above ACARP Guideline values of 40 N/m² and 60 W/m²).
- From chainage 1,200 to 2,800 the Ti-Tree diversion has shear stress values above the guideline value of 40 N/m².
- Between chainage 2,000 and 2,800 there are a couple of localised spikes in stream power that are above the guideline value of 60 W/m².
- However, shear stress and stream power values within the diversion are generally lower than in the existing Ti-Tree Creek and therefore within the bounds of what are typical for local conditions.
- Shear stress and stream power in the unnamed Isaac River tributary in existing conditions generally range from 10 to 50 N/m² and from 20 to 70 W/m² respectively.
- There is one, existing localised hotspot with a bed shear value of 245 N/m² and stream power value of 730 W/m². This hotspot is removed with the implementation of the diversion channel.
- Shear stress and stream power in the Isaac River tributary downstream of the diversion in developed conditions generally ranges from 40 to 170 N/m² and 60 to 310 W/m² respectively (i.e. similar to existing Ti-Tree Creek).

4.10.3.2 2% AEP Event

The following summarises the model findings for the 2% AEP event:

Velocity:

- Velocity in existing Ti-Tree Creek is highly variable from near still waters to 3.6 m/s (i.e. pre-mining conditions are above ACARP Guideline value of 2.5 m/s).

- Velocity along the diversion channel varies from 0.5 m/s to 2.8 m/s.
- Along 2.3 km of the 2.8 km long diversion channel, velocities are below the guideline value of 2.5 m/s.
- There is a localised peak of 2.8 m/s along the final portion of the diversion but values are otherwise within the ACARP Guideline value and similar to typical peak values in the existing Ti-Tree Creek.
- Velocities along the diversion are generally more uniform than Ti-Tree Creek.
- The maximum velocity along the diversion (2.8 m/s) is less than the maximum velocities in Ti-Tree Creek (3.6 m/s) in existing conditions.
- Velocity in the unnamed Isaac River tributary in existing conditions generally ranges from 0.2 to 2.1 m/s.
- The velocity in the unnamed Isaac River tributary downstream of the diversion in developed conditions generally ranges from 0.9 m/s to 2.4 m/s with increases of up to 2.0 m/s compared to existing conditions but under the guideline value of 2.5 m/s.
- An erosion monitoring plan will be developed for the unnamed Isaac River tributary to assess changes in bed levels and the impact of increased velocities.
- Bank protection measures will be considered if monitoring indicates the increase in erosion is having an identifiable impact on the channel form.

Shear Stress and Stream Power:

- Shear stress and stream power in existing Ti-Tree Creek are highly variable with peak values for shear stress and stream power up to 240 N/m² and 810 W/m² respectively (i.e. pre-mining conditions are above ACARP Guideline values of 80 N/m² and 220 W/m²).
- From chainage 1,200 to 2,350 the Ti-Tree Creek diversion has a shear stress value above the guideline value of 80 N/m².
- Between chainage 2,000 and 2,350 there are a couple of localised spikes in stream power that are above the guideline value of 220 W/m².
- However, shear stress and stream power values within the diversion are generally lower than in the existing Ti-Tree Creek with lower maximum values than are typical in the existing watercourse.

4.10.4 Isaac River Existing Conditions and Developed Conditions

Section 9.2 of **Appendix 7** provides graphs comparing the existing and developed scenarios in the Isaac River (for an 8 km section of the Isaac River upstream to downstream of the Project disturbance area) for velocity, shear stress and stream power for the 50% and 2% AEP events. Examples are provided in Figure 4-47 and Figure 4-48 for shear stress for the 50% and 2% AEP events. These results are mirrored for velocity and stream power.

The results for velocity, shear stress and stream power show immaterial change between existing and developed conditions in the 50% AEP event.

The results for velocity, shear stress and stream power show insignificant to minor change between existing and developed conditions in the 2% AEP event, with some very minor increases and decreases. On this basis, the Project is not expected to have adverse impacts on the geomorphology of the Isaac River.

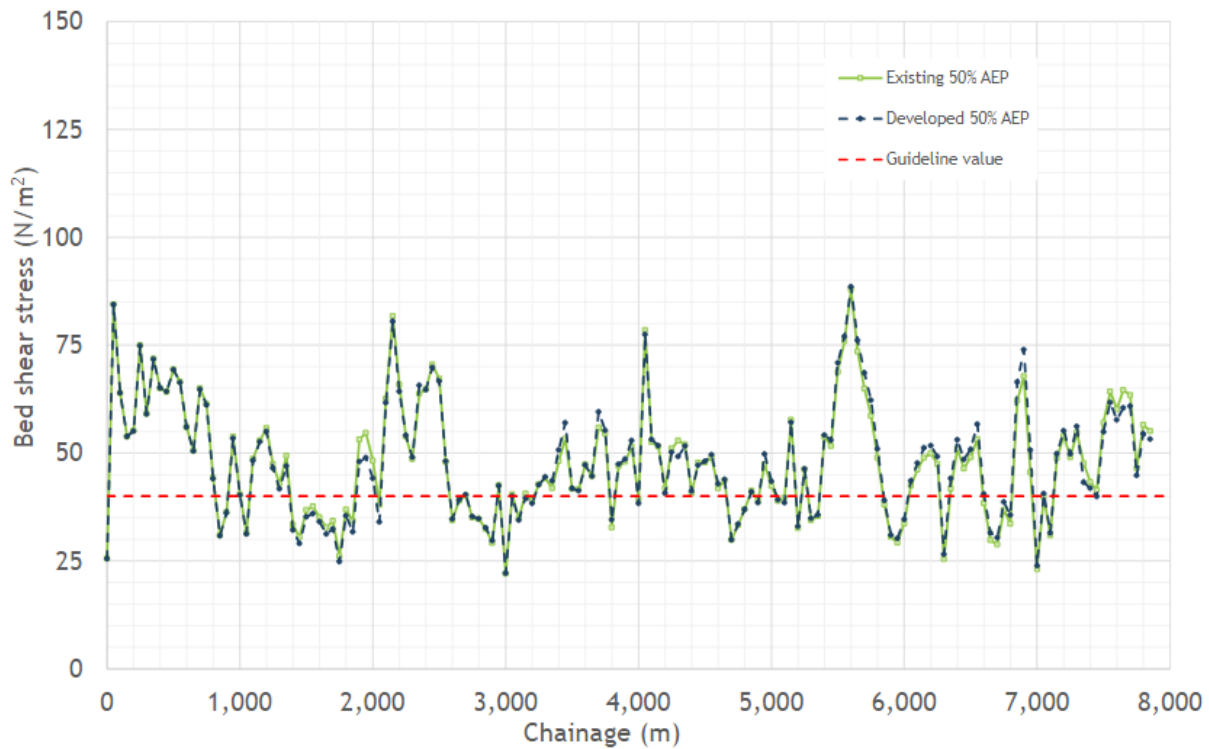


Figure 4-47 *Isaac River Longitudinal Profile Of 50% AEP Section-Averaged Shear Stress*

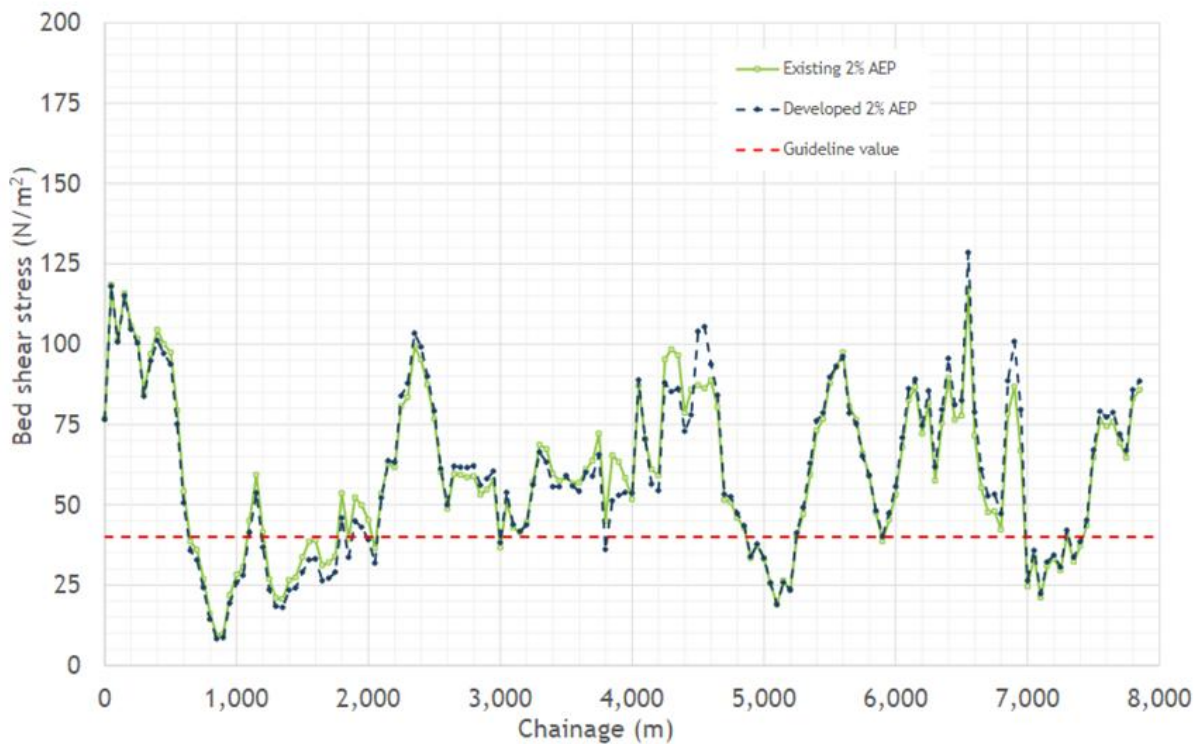


Figure 4-48 *Isaac River Longitudinal Profile Of 2% AEP Section-Averaged Shear Stress*

4.10.5 Post Closure Conditions

The proposed Ti-Tree Creek diversion will remain as a permanent feature of the drainage network following the completion of mining operations. The Ti-Tree Creek and Isaac River levees will become part of the post-mining landform. Hence, post-mining drainage and floodplain conditions will be virtually identical to the operational phases of mining. Consequently, geomorphological characteristics for post-mining conditions will be the same as for operational conditions and predictions of changes in velocities, shear stress and steam power will be consistent with the results presented in Section 4.10.3 and Section 4.10.4.

4.11 Surface Water Impacts

4.11.1 Overview

The potential impacts of the Project on surface water resources include:

- changes to flows and the flooding regime in the Isaac River and Ti-Tree Creek due to changes in catchment area and drainage network associated with the Ti-Tree Creek diversion and proposed levees
- local impacts on flood levels and velocities associated with a proposed new bridge crossing and low-level haul road crossing of the Isaac River
- impacts on regional water availability due to the need to obtain water from external sources to meet operational water requirements of mining operations
- impacts on stream flows due to catchment area excision (due to capture of runoff within onsite storages and the open cut pits)
- impact on stream flows due to ingress of floodwater into the residual void (based on model results in Section 4.9 this is not expected to occur)
- impact on receiving environment due to overtopping of the residual void (based on model results in Section 4.8 this is not expected to occur)
- adverse impacts on the quality of stormwater runoff draining from the disturbance areas to the various receiving waters surrounding the Project, during both construction and operation of the Project
- adverse impacts on water quality due to accidental release of contaminants stored on site, such as hydrocarbons
- adverse impacts on environmental values in Isaac River and Ti-Tree Creek associated with controlled and uncontrolled releases from the mine water management system (based on model results in Section 4.6 and Section 4.7 this is not expected to occur)
- cumulative impacts of all projects in the region on the environmental values of the receiving waters.

These potential impacts are further described below, with reference to modelling results described in the above sections.

The assessment of surface water impacts has been undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach is considered suitable for quantifying impacts to a level of accuracy consistent with current industry practice and deemed to be appropriate for this PER assessment. Certain aspects of the Project, such as changes to landforms due to construction of waste rock dumps, would create changes to the environment that are permanent, although this does not mean that any such change would necessarily be detrimental to the environmental values of surface water resources.

4.11.2 Changes in Flooding and Geomorphology

Potential impacts of the Project on flood levels, velocities and the geomorphic characteristics of the Isaac River and Ti-Tree Creek channels and floodplains (including the Ti-Tree Creek diversion) are described in Section 4.9 and Section 4.10.

The results of the flood modelling show that the impacts of the Project (e.g. levees and Isaac River crossings) on the hydraulic characteristics (such as levels, extents, velocity, bed shear stress and stream power) of the Isaac River are insignificant to minor. The new bridge for the realigned Suttor Developmental Road and the bed level crossing of the Isaac River for the haul road are predicted to have negligible to minor impacts on flood behaviour.

The results for velocity, shear stress and stream power in the Isaac River show insignificant to minor change between existing and developed conditions in the 2% AEP event, with some very minor increases and decreases. On this basis, the Project is not expected to have adverse impacts on the geomorphology of the Isaac River.

For the Ti-Tree Creek diversion, hydraulic parameters are generally within the range of existing (i.e. pre-mining) values and ACARP Guideline values for operational and post-mining conditions. Based on the above geomorphological assessment:

- Velocity, shear stress and stream power values within the diversion generally performed well against ACARP Guideline values.
- Peak modelled velocity, shear stress and stream power values within the diversion were less than the peak modelled values within the existing Ti-Tree Creek.
- Velocity, shear stress and stream power values were greatest within the unnamed Isaac River tributary into which the Ti-Tree Creek diversion flows. However, modelled velocity, shear stress and stream power values within this reach of the tributary are less than those modelled in the existing Ti-Tree Creek.
- Excessive erosion or deposition of sediment within the diversion system is not expected to occur.

Mitigation measures to manage localised erosional risks in Ti-Tree Creek diversion are described in Section 4.12.3.

Flood hydrographs show that the event duration that produces peak flows in Ti-Tree Creek and the Isaac River is less than 24 hours (i.e. flood events in the region around the Project have a very short duration even for extreme rainfall events). The Project results in negligible changes to flood duration hydrographs (i.e. flood flows are not attenuated or lengthened). Therefore the duration of flooding for developed conditions is similar to existing conditions, which in both cases demonstrates that flood events in the region around the Project have a very short duration for minor to extreme rainfall events.

4.11.3 Catchment Changes

During active mining operations, the water management system will capture runoff from areas that would have previously flowed to the receiving waters of Ti-Tree Creek and the Isaac River. The captured catchment area will change as the mine develops. A breakdown of the catchment areas reporting to the mine water management system is provided in Table 4-5.

The total catchment area of Ti-Tree Creek to the confluence of the Isaac River is approximately 22.4 km². The catchment area of the Isaac River to downstream of the Project's MLs is approximately 224.7 km². The maximum captured catchment areas represent:

- Between 9.7% and 18.4% of the Ti-Tree Creek catchment to the confluence of the Isaac River, depending on the stage of mine development.
- Between 1.4% and 2.5% of the Isaac River catchment to downstream of the Project's MLs, depending on the stage.
- The maximum area captured within the pits and mine affected water dams represents around 0.2% of the Isaac River catchment at Goonyella (1,214 km²).

The remaining catchment drains off site through the sediment and clean water management systems. Given that areas managed under the ESCP would drain from the site in wet conditions, and the sediment dam catchments typically have higher runoff coefficients than under natural conditions, the loss of stream flows would likely be less than the total loss of catchment area (proportionally).

There is likely to be a measurable reduction in flow rates and volumes in the downstream reach of Ti-Tree Creek as a result of the diversion of Ti-Tree Creek. This applies to the approximate 1 km length of the residual portion of Ti-Tree Creek between the Project disturbance area and the Isaac River.

The loss of catchment flows in the Isaac River (<2.5%) would be indiscernible (i.e. negligible). In addition, any potential impact on flows in the Isaac River would be dissipated by Burton Gorge Dam, the operation of which controls flows in the Isaac River downstream of the Project. The Project disturbance area represents about 1% of the total catchment area draining to Burton Gorge Dam (551 km²).

Table 4-5 Catchment Area Captured Within the Whole Mine Water Management System

Catchment	Total catchment area (km ²)	Captured catchment area (km ²)			
		Phase 1	Phase 2	Phase 3	Phase 4
Ti-Tree Creek	22.4	3.2 (14.1%)	4.1 (18.4%)	3.3 (14.6%)	2.2 (9.7%)
Isaac River	224.7	3.2 (1.4%)	5.7 (2.5%)	5.3 (2.4%)	4.9 (2.2%)
* Percentage in brackets represent percentage of total catchment area captured					

At the completion of mining, permanent drainage of waste rock dump areas will be installed to minimise capture of surface runoff into the residual void in general accordance with the configuration shown in Figure 4-30. Following rehabilitation:

- the catchment draining to Ti-Tree Creek (to the confluence with the Isaac River) will reduce by around 2.4 km² (compared to pre-mining conditions), a decrease of less than 11%.
- the catchment draining to the Isaac River (to downstream of the Project's MLs) will reduce by around 2.4 km² (compared to pre-mining conditions), a decrease of less than 1.1%.

Post mining, the loss of catchment flows in the upper Isaac River (<1.1%) would be indiscernible. In addition, any potential impact on flows in the Isaac River would be dissipated by Burton Gorge Dam, the operation of which controls flows in the Isaac River downstream of the Project.

4.11.4 Regional Water Availability

A significant proportion of Project's water requirements would be sourced from water collected on the site, including rainfall runoff and groundwater inflows to the open cut pits which will be stored in the mine affected water storages for recycling and reuse. Any shortfall in site water demands will be sourced from Burton Mine.

The results of the water balance modelling (see Section 4.7) indicate between 0 ML/year and 700 ML/year would be required to be supplied from Burton Mine. Modelling shows that the Burton Mine water management system is capable of supplying any potential water deficit for the Project, without detrimentally affecting the performance of the Burton Mine operations.

Based on the results of the impact assessment, the Project will have no impact on regional water availability.

4.11.5 Ingress of Floodwater into the Residual Void

Flood modelling presented in Section 4.9.5 shows that the residual void lies outside of the 1:1,000 AEP and PMF flood extents for Ti-Tree Creek and the Isaac River. As such, the Project will have no impact on Ti-Tree Creek or Isaac River flows resulting from ingress of water to the residual void.

4.11.6 Overtopping of the Residual Void

The residual void water balance assessment in Section 4.8 shows that the residual void equilibrium water level lies well below the void crest level. As such, the Project will have no impact on receiving water quality resulting from overtopping of the residual void.

4.11.7 Receiving Water Quality and Environmental Values

4.11.7.1 Overview

The water management system is the primary mitigation for impacts to surface water resources. The system has been designed to protect water quality and the environmental values of the waterways potentially affected by the Project.

Sections 4.5, 4.6 and 4.7 describe the design of the water management system and the water balance model for the Project, and provide an assessment of the performance of the water management system. The general principles of the water management system that will protect surface water environmental values are:

- A catchment runoff water management system that separates clean water from mine affected water and sediment water wherever possible.
- A sediment water management system that contains runoff that potentially has high sediment concentrations in sediment dams. Water collected in the sediment dams will be managed in accordance with the ESCP and used for dust suppression or will overflow to receiving watercourses after a period of settling.
- A mine affected water management system that contains potentially saline runoff from the pit and MIA (including ROM coal stockpile) in mine affected water dams. Mine affected water will be used as a priority in meeting dust suppression demands. Whilst the current EA authorises controlled releases of mine affected water, the water balance modelling shows that controlled releases of mine affected water are not required to manage on-site water stores.
- A diversion of Ti-Tree Creek around the mining operations, designed to be geomorphically stable.
- A system of levees to protect mining operations from the 1:1,1000 AEP flood event, designed in accordance with EA requirements for regulated structures.

The mine water management system includes three mine affected water dams and six sediment dams. The mine water management system includes a connection to existing pit voids at Burton Mine which have capacity to store mine affected water transferred from the Project. This enables the Project to export water under wet conditions and import water during dry conditions.

4.11.7.2 Mine Affected Water Management System – Controlled and Uncontrolled Releases

An assessment of the mine affected water management system is provided in Section 4.7. Controlled releases of mine affected water to the receiving environment are permitted under the approved EA, subject to release quality and receiving environment flow and water quality conditions designed to protect downstream WQOs and environmental values. Never-the-less, the water balance model shows that controlled releases are not required to manage mine affected water storages at the Project, even under extremely wet rainfall conditions.

The Project will have the ability to transfer mine affected water to and from Burton Mine. Modelling demonstrates that this interconnected mine water management system can manage any potential mine affected water accumulation, and there is sufficient capacity at Burton Mine to accept any transfers from the Project. The Project will not result in a requirement for additional controlled releases of mine affected water from Burton Mine.

The results of the water balance modelling indicate that, under the model assumptions and configuration, the Project's mine affected water dams will not have uncontrolled releases for any of the climatic sequences assessed.

4.11.7.3 Sediment Water Management System

During operations, progressive rehabilitation of the out-of-pit waste rock dumps will minimise the potential generation of sediment. An ESCP has been developed (refer to **Appendix 18**) and will be implemented throughout construction and operation of the Project. A 'best practice' approach has been adopted for the ESCP that is consistent with the IECA recommendations. Section 4.5.6 describes the design of the sediment water management system, following the IECA recommendations. The following principles apply to the ESCP:

- Minimise the area of disturbance.
- Apply local temporary erosion control measures.
- Intercept run-off from undisturbed areas and divert around disturbed areas.
- Where temporary measures are likely to be ineffective, divert run-off from disturbed areas to sedimentation basins prior to release from the site.

Consistent with the IECA design standard, the Project's sediment dams do not provide 100% containment for captured runoff. Hence overflows will occur from sediment dams when rainfall exceeds the design standard.

An assessment of the predicted salinity of overflows from the sediment dams to the receiving environment is provided in Section 4.7.6. The modelling indicates that mixed downstream salinity in the receiving environment (i.e. the Isaac River) would generally be similar to background levels, with 99.3% of the modelled values below the median EC recorded at the Isaac River (Burton Gorge) gauge. With the implementation of this strategy, the potential impact of sediment dam discharges on the Isaac River water quality would be negligible.

With the effective design and implementation of the ESCP, risks to downstream environmental values from disturbed area runoff are expected to be low.

4.11.8 Cumulative Impacts

4.11.8.1 Overview

The objective of this assessment is to identify the potential for impacts from the Project to have compounding interactions with similar impacts from other projects, including activities proposed, under development or already in operation within a suitable region of influence of the Project.

4.11.8.2 Projects for Cumulative Impact Assessment

Projects which are currently operating within the Isaac River catchment upstream of the (now closed) Isaac River at Goonyella gauging station have been included in the cumulative impacts assessment for the Project, and are listed in Table 10.2 of **Appendix 7**.

Relevant projects that have been considered include:

- Projects within the predicted sphere of influence of the Project, as listed on the Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) website that are undergoing assessment under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) for which an Initial Advice Statement (IAS) or an EIS are available.
- Projects within the predicted sphere of influence of the Project, which are listed on the DES website that are undergoing assessment under the EP Act for which an IAS or an EIS are available.

Projects currently undergoing assessment, or having recently completed assessment under these processes, and included in the cumulative impact assessment for the Project are listed in Table 10.3 of **Appendix 7**.

With the exception of parts of Burton Mine, all other projects are located downstream of the Project. Based on the incorporation of Burton Mine into the water management system for the Project it has been demonstrated that the Project does not result in changes to the performance of the mine water

management system at Burton Mine, and hence does not result in cumulative impacts on environmental values with Burton Mine.

4.11.8.3 Cumulative Impacts to Water Quality

The Project is located in the Isaac River catchment, which is a major tributary within the Fitzroy basin. The Fitzroy basin is the largest catchment in Queensland draining into the Pacific Ocean and also the largest catchment that drains to the Great Barrier Reef, although it contributes smaller freshwater flows to the coastal environment when compared to river systems further north.

In 2008, the Queensland Government undertook an investigation into the cumulative effects of coal mining in the Fitzroy River basin on water quality. The investigation found that:

- There were inconsistencies in discharge quality limits and operating requirements for coal mine water discharges as imposed through environmental authorities.
- In some cases, discharge limits and operating conditions of coal mines were not adequately protecting downstream environmental values.

These conclusions led to a number of inter-related actions by Queensland Government and other stakeholders:

- WQOs were developed for the Fitzroy Basin and added to Schedule 1 of the EPP (Water) in October 2011.
- Model water conditions were developed for coal mines in the Fitzroy basin as part of the Model Mining Conditions. These model water conditions are designed to manage water discharges to meet the WQOs set out in the EPP (Water) and to provide consistency between mining operations in the Fitzroy basin.
- Environmental authorities for a number of mining operations were amended to introduce conditions consistent with the model water conditions.
- A number of mining operations entered into transitional environmental programs (TEPs) under the EP Act. These TEPs were focussed on actions that would allow mines to achieve compliance with new environmental authority conditions and upgrade operating conditions.

With these measures in place, a strong strategic and policy framework is now in place for management of cumulative water quality impacts from mining activities. This framework allows for management of individual mining activities in such a way that overarching water quality objectives can be achieved.

The Queensland Government commissioned an assessment of mine affected water releases in the Fitzroy River basin during the 2012–2013 wet season (known as the Pilot Scheme). The report concluded that the Fitzroy as a whole is not currently ‘at capacity’ in terms of salt load at a catchment or sub-catchment scale.

The operational policy of the Pilot Scheme aims to manage the cumulative impact of mine affected water releases across the Fitzroy Basin. To achieve this, trigger values have been derived for six monitoring locations across the basin. If in-stream EC triggers are exceeded during times when mine affected water releases are being undertaken upstream, the regulator has the ability to issue a ‘cease release’ notification to all coal mines in the Fitzroy Basin with conditions that authorise the release of mine affected water.

Mine affected water from the proposed Project will be managed through a mine water management system which is designed to operate in accordance with approved EA conditions that are based on Model Mining Conditions.

The water balance modelling assessment (Section 4.6 and Section 4.7) demonstrates that the proposed Project water management system is able to successfully operate without actively discharging mine affected water to the receiving environment (as approved in the EA). Given this, the proposed management approach for mine water from the Project will have no cumulative impact on surface water quality and associated environmental values of the Isaac River.

4.11.8.4 Cumulative Loss of Catchment and Stream Flows in the Isaac River

As detailed in Section 4.11.3, the Project would result in a loss of catchment to the upper Isaac River catchment during operations and post-mining. The surface runoff volume lost from the catchment would generally be in proportion to the excision of the catchment area. The Project area captured within the water management system is less than 2.5% of the catchment area of the Isaac River to downstream of the Project's MLs. Of this, around 50% is managed through the ESCP and then released to the downstream environment following capture and treatment.

The cumulative impact assessment includes mining operations within the Isaac River that are adjacent or downstream of the Project. The catchment of the Isaac River to the Goonyella Gauge confluence is around 1,214 km².

There are approximately 4 existing coal mines adjacent to or downstream of the Project (within the sphere of influence) that also capture runoff from the Isaac River catchment, as shown in Figure 10.1 of **Appendix 7**. The total estimated captured area of all these projects (including the Project) combined represents around of 13.0% of the Isaac River catchment to the Goonyella gauge. If the same percentage of ESCP for the Project is applied to the other mines, then the estimated captured catchment areas reduce to around 50% of the total area (around 6.5% of the Isaac River catchment to the Goonyella Gauge).

In addition, these mines have discharge licences which return captured surface water, as well as groundwater collected in underground workings, to the Isaac River catchment, that would further reduce the impacts on surface water flows.

A comparison of the captured catchment areas of the existing mining projects considered in the cumulative impact assessment with the Isaac River catchment to the Goonyella gauge indicates the following:

- The combined total catchment area of the existing mines (including the Project) represents around 13% of the total catchment area of the Isaac River to the Goonyella gauge.
- The combined mine affected catchment area (estimated) represents less than 6.5% of the total Isaac River catchment area to the Isaac River to the Goonyella gauge.

When taking into account potential discharges from the operating mines in accordance with their current release rules, the overall loss of catchment area and associated stream flow is relatively small.

In addition, any potential impact on flows in the Isaac River from the Project or Burton Mine would be somewhat dissipated by Burton Gorge Dam, the operation of which controls flows in the Isaac River downstream of the Project.

4.12 Mitigation and Management Measures

4.12.1 Environmental Authority Requirements

The EA (see **Appendix 4**) requirements for water management are described in Section 4.2.2.1. Implementation of these requirements will mitigate impacts to surface waters.

The Project's water management system, as described in Section 4.5 and **Appendix 7**, provides the key elements of the WMP and ESCP required by the EA. The REMP is provided in **Appendix 25**.

The EA criteria in schedule C of the EA are specific, measurable and time bound. They include:

- Specific locations for monitoring mine affected water releases (EA Table C1)
- Specific and measurable mine affected water release limits, with a time bound monitoring frequency (EA Table C2)
- Specific and measurable release contaminant trigger investigation levels, with a time bound monitoring frequency (EA Table C3)
- Specific locations for flow gauging stations, with measurable flow rates in receiving waters for controlled releases (EA Table C4)

- Daily measurements and recording of mine water release volumes during releases (EA C7)
- Release limits for electrical conductivity that if exceeded would require cessation of releases (EA C9).
- Investigations and actions, within a specified timeframe, should there be an exceedance of release contaminant trigger investigation levels (EA C10)
- Specific locations for monitoring upstream and downstream water quality (EA Table C5)
- Time bound notification requirements to DES for releases (EA C11, C12, C13)
- Investigations, within a specified timeframe, should there be an exceedance of mine affected water release limits (EA C14, C15, C16)
- Specific and measurable receiving waters contaminant trigger levels, with a time bound monitoring frequency (EA Table C6)
- Investigations and actions, within a specified timeframe, should there be an exceedance of receiving waters contaminant trigger levels (EA C19)
- Specific locations for water storage monitoring, with frequency of monitoring and parameters for monitoring (E Table C7).

The EA criteria are achievable – they will be implemented by site personnel, in particular the site environmental officer, with adequate resources (e.g. monitoring equipment and gauging stations) provided by the proponent to undertake the relevant tasks.

4.12.2 Water Management System

The water management system is the primary mitigation for impacts to surface water resources. The system has been designed to protect water quality and the environmental values of the waterways potentially affected by the Project.

The water management systems will be monitored to ensure that they are operating as designed, including the following:

- Regular monitoring of water quality and storage volumes in the mine affected storages will be undertaken to ensure that uncontrolled spills do not occur.
- The pit and dam pumps will be inspected and operated regularly to ensure they will operate when required.
- Sediment dams will be cleaned out on a regular basis to maintain the available sediment storage volume.
- Clean water and sediment water drains will be monitored regularly to ensure they are operating as designed and do not allow mixing of clean and sediment water.
- Contaminated water sumps and interceptors will be inspected and cleaned out regularly.

The water balance model results represent the application of the proposed water management system rules over the mine life, regardless of management measures to respond to climatic conditions. In reality, there are numerous options for adaptive management of the mine water system to respond to climatic conditions and the current site water inventory in a way that will reduce the risks of impacts to surface water resources or requirement for external water supply. The site water balance model will be updated regularly (annually or biennially) using site monitoring data.

The Project's water management system, provides the key elements of the WMP required by the EA. The WMP will be developed prior to operations commencing and include the following aspects that are specific, measurable and time bound.

- Water storages will have specific design criteria for the full supply volume contained within the storage, as well as a maximum operating volume for operational purposes.
- Dam operating rules will be established, which define the actions to be taken when the maximum operating volume or full supply volume is reached, or when specific rainfall events are forecast. This includes rules for:
 - pumping water between storages

- metering of water flows across the system
 - reducing inflows to water storages, through contingency measures such as storing water within the mine pits (i.e. reducing or ceasing operations)
 - dewatering dams following rainfall events
 - regular (e.g. weekly, monthly) inspections of water management infrastructure.
- Pump and pipeline designs will allow for transfer of water in accordance with the design criteria for the water management system.

The proponent will provide the necessary resources to implement the WMP, including financing the construction of water management infrastructure (e.g. dams, pipelines, etc), and defining roles and responsibilities for monitoring water management infrastructure. In general the following roles will apply to the WMP:

- General Manager:
 - ensure preparation, implementation and maintenance of the WMP
 - design, budgeting and construction of water management infrastructure
 - communication of the WMP to all relevant parties
 - corrective actions if there are departures from the WMP.
- Asset Manager:
 - adequate storage volumes are maintained in accordance with WMP
 - inspection and maintenance of water management infrastructure
 - contingency planning.
- Site Environmental Officer:
 - monitoring in accordance with EA requirements
 - monitoring of water levels and water quality
 - investigations and actions in response to EA requirements
 - advice to Asset Manager and General Manager on system performance.

4.12.3 Ti-Tree Creek Diversion

The Ti-Tree diversion design aims to control flood velocities to mimic the existing channel and thereby minimise subsequent impacts on Ti-Tree Creek and the Isaac River. The diversion will release through an engineered structure to control water flows and velocity, into the unnamed Isaac River tributary approximately 400 m before the Isaac River. The diversion will be rehabilitated with vegetation similar to that within the existing local waterways, which will further reduce the potential for scour and erosion.

Ongoing monitoring of the performance of the diversion (e.g. changes to channel levels and channel form resulting from erosion) will be undertaken and, if necessary, mitigation measures will be implemented to prevent excessive erosion or sediment deposition. Potential mitigation measures to repair and stabilise any areas of localised impact would include minor earthworks, such as filling scour areas, reprofiling banks or removing accumulated sediment, and revegetation of areas subject to erosion. The condition of the diversion will be monitored on a regular basis (e.g. quarterly) and following rainfall events resulting in flows in the diversion.

In accordance with the approved PRCP schedule for the Project, the diversion must achieve a set of criteria, which are specific, measurable and time bound (e.g. velocity (m/s), shear stress (N/m²) and stream power (W/m²)), to be geomorphically stable in the long term (i.e. post mining), including:

- incorporate natural features (including geomorphic and vegetation) present at the location of the diversion
- maintain the pre-existing hydrologic characteristics of surface water and groundwater systems for the area in which the drainage feature diversion is located
- maintain the hydraulic characteristics of the permanent drainage feature diversion that are equivalent to other local watercourses and are suitable for the area in which the diversion is located without using artificial structures that require on-going maintenance

- maintain sediment transport and water quality regimes that allow the diversion to be self-sustaining, while minimising any impacts to upstream and downstream water quality, geomorphology or vegetation
- maintain equilibrium and functionality in all substrate conditions at the location of the diversion
- certification by an appropriately qualified person that the diversion meets the above criteria and is operating in accordance with ACARP (C20017, 2014) “Criteria for functioning river landscape units in mining and post mining landscapes”.

The Ti-Tree Creek diversion monitoring program will be conducted using the process documented by ACARP (2001) which includes the following that are specific, measurable and time bound:

- Baseline monitoring prior to the construction of the diversion to provide a reference data set for evaluation of monitoring data collected throughout the life of the monitoring program. During the baseline monitoring period, a control reach located on Ti-Tree Creek upstream of the diversion and a downstream reach on the unnamed tributary will be established. Baseline monitoring will include:
 - site photography
 - aerial photography
 - index of diversion condition
 - survey
 - vegetation characterisation and assessment.
- Operations monitoring will be conducted after construction works have been completed to maintain channel condition and to identify the need for remedial works. The operations monitoring is a combination of visual assessments and survey data and will include:
 - survival of works
 - site photography
 - aerial photography
 - visual assessment
 - index of diversion condition
 - site survey
 - post- event monitoring.

A trigger action response plan (TARP) has been developed for Ti-Tree Creek diversion, which provides specific, measurable and time bound measures (refer to Table 4-6).

Table 4-6 *Ti-Tree Creek Diversion TARP*

Level	Trigger	Action	Response
Level 1 (Normal)	Dry weather	Monitor diversion in accordance with monitoring plan. Review recommendations of any previous investigations. Inspect and document channel condition at any identified ‘hot-spots’. Document diversion condition as per monitoring plan. Assess inspection findings against Level 3 Trigger.	Document any identified ‘hot-spots’ where active erosion, deposition or loss of vegetation is evident or likely. Undertake Level 3 actions if required.

Level	Trigger	Action	Response
Level 2 (Flow event in diversion channel)	Site rainfall > 50 mm per day; OR Rainfall sufficient to generate flow in diversion channel	Post-event inspection of diversion within 21 days. Prepare inspection report in accordance with monitoring plan within 14 days of inspection.	Review findings of inspection report to assess whether diversion has experienced noticeable erosion, deposition or loss of vegetation. Assess suitability of site rainfall trigger and revise if necessary.
Level 3 (Potential erosion, deposition or loss of vegetation)	Inspection identifies noticeable areas of erosion, deposition or loss of vegetation	Undertake further investigation to confirm extent of issue, such as survey or comparison of ground or aerial photographs. Obtain specialist advice if necessary. Engage suitably qualified expert to undertake IDC ^a assessment and compare to baseline. Prepare investigation report.	Evaluate findings of investigation report to assess whether the identified issue requires remediation works, or can continue to be monitored.
Level 4 (Remediation works required)	Investigation report indicates reduction in IDC score and/or recommends remediation works to address impacts and/or improve channel stability.	Prepare a project plan for remediation works. Obtain specialist advice from a suitably qualified expert. Obtain specialist peer review of proposed project plan. Implement project plan.	Inspect remediation works 1 month, 3 months and 6 months after completion. Undertake any necessary maintenance to ensure stability and effectiveness of remediation works.

^a Index of Diversion Condition

The proponent will provide the necessary resources to design, construct and operate the Ti-Tree Creek diversion, including providing the necessary financing, and defining roles and responsibilities for monitoring and maintaining the diversion in accordance with their design specifications.

4.12.4 Levee Design

The levees will be fully engineered structures and will be constructed using compacted clay lifts and top-soiled and grass-covered to minimise the potential for erosion. As described in Chapter 3, the levees will be regulated structures. As such they will be designed, constructed and operated in accordance with Schedule I (conditions I1 to I35) of the EA (see **Appendix 4**). These conditions require the following, which are specific, measurable and time bound:

- A consequence category assessment by a suitably qualified and experienced person in accordance with the Manual, with certification provided by the suitably qualified and experienced person who undertook the assessment.
- Designed by, and constructed under the supervision of, a suitably qualified and experienced person in accordance with the Manual, with certification provided by the suitably qualified and experienced person who oversees the preparation of the design plan.
- Certification by a suitably qualified and experienced person who supervises the construction must be submitted to the administering authority on the completion of construction of the regulated structure.
- Operation of a regulated structure is prohibited unless the EA holder has satisfied the requirements under I12 of the EA.
- Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person, with the inspection report certified.
- Include the regulated structure on a Register of Regulated Structures.

In accordance with the approved PRCP schedule for the Project, the levees will be incorporated into the final rehabilitated landform design for the Project, which will be designed to be geotechnically and erosionally stable.

The proponent will provide the necessary resources to design, construct and operate regulated structures, including providing the necessary financing, and defining roles and responsibilities for monitoring and maintaining regulated structures in accordance with their design specifications.

4.12.5 Construction of Isaac River Crossings

The Project involves the construction of a new bridge across the Isaac River for the realignment of the Suttor Developmental Road, and a bed level haul road crossing of the Isaac River.

The conceptual design for the bridge crossing is to replicate the existing Suttor Developmental Road bridge crossing, as shown in Figure 3.23 of Chapter 3.

The conceptual design for the bed level includes the following which are specific and measurable:

- aligned perpendicular (within approximately 10°) to the water flow
- the level of the crossing will be at or around the low flow level
- rock chutes downstream of the bed level crossing to control erosion caused by overtopping flows
- stream bed scour protection that abuts the surface edge of the crossing at the same level installed at a gradient similar to the natural channel gradient.

The construction of the crossings will require the clearing of riparian vegetation and excavation of the banks of the River. Banks will be recompacted and shaped, the up and down batters will have geofabric then armour rock placed on them. Rehabilitation of banks will occur once construction is completed. Crossings will preferentially be constructed in the dry season, when the River is dry, to minimise the risk of waterway flows interfering with construction and mobilising sediment.

The following are acceptable solutions, which are specific and measurable, when working in or around a watercourse to limit erosion and sedimentation. Any one or a combination of the following will be deployed if and when deemed necessary:

- Limit the activities to the extent necessary by minimising the number of bank cuttings and fills.
- Avoid or limit the removal or destruction of ground cover over areas of water flow.
- Divert water runoff around areas of disturbance.
- Aim to maintain the natural bed and bank profile when constructing or maintaining drainage structures.
- Use bed and bank stabilisation measures such as rock revetment, reinforced matting and large woody debris, log piling or similar.

Construction within watercourses will be undertaken in accordance with requirements of a Riverine Protection Permit if they do not comply with guidelines for Riverine Protection Permit exemption requirements. These are designed to minimise impacts from erosion and sedimentation. Remediation works will be undertaken to minimise bank instability at crossings.

In general, excavation within a watercourse and the development of a crossing can have deleterious impacts on downstream aquatic ecosystems, as well as resident aquatic flora and fauna, due to increases in erosion and sediment transportation. Although erosion and sedimentation from the crossings can potentially give rise to impacts on aquatic ecosystems, the impacts on the ecological values of the Project area are expected to be minor. This is because the Isaac River within the Project area is highly ephemeral, and already experiences high rates of deposition and transportation of sediments during the wet season.

The bed level crossing is unlikely to impact on the aquatic environment through the creation of barriers to fish movement, as River flows will be unimpeded. The design and construction of the crossing will apply the design and construction requirements within the DAF 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (DAF, 2018) for watercourses to manage impacts to watercourse and fish passage.

Monitoring of water quality, including total suspended solids and turbidity, will be undertaken upstream and downstream of crossing locations during construction, if and when there is water in the Isaac River. Where monitoring indicates that construction of crossings is contributing to an increase in sedimentation, above background levels and natural variability, then construction practices will be amended to reduce sedimentation. These measures are specific, measurable and time bound.

An inspection and maintenance program for crossings will be implemented so infrastructure condition is retained and erosion and sedimentation is minimised.

4.12.6 Rehabilitation

Progressive rehabilitation will be undertaken in accordance with the approved PRCP schedule (see **Appendix 5**). The PRCP schedule contains rehabilitation milestone criteria, which are specific, measurable and time bound, for all rehabilitation areas to reduce sediment and erosion to levels similar to the pre-mining environment. Control of sediment and erosion through rehabilitation will result in similar sediment runoff to surrounding waterways as existing prior to mining.

4.12.7 Erosion and Sediment Control

Sediment water containment will be managed in accordance with the site ESCP (see **Appendix 18**), required under the EA. Section 4.5.6 describes the design of the sediment water management system, following the IECA recommendations. The ESCP has adopted the three cornerstones of ESC, as follows:

- 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, nondispersive 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 utilise a combination of these three control measures to effectively manage sediment and erosion at the site.

The ESCP (refer to **Appendix 18**), includes environmental objectives (Section 1), measures to be implemented and timing/frequency/duration of measures (Section 5 – 9), responsibilities (Section 2), and reporting and corrective actions (Section 10).

The objective of the ESCP is to clearly outline methods and strategies to control soil erosion and minimise sediment transport. The most effective method of controlling soil erosion is to establish either a grass cover or other vegetation cover.

Monitoring will take the form of annual inspections of the status of progressive rehabilitation, completed post the wet season (May - July), and annual erosion inspections for all major elements of the water management infrastructure. The annual rehabilitation inspection will include an assessment of the diversion drains which includes checks for signs of cracking, scouring and rills. The inspections will be undertaken with sufficient time for any repairs to be completed before the start of the wet season.

Land disturbances will be managed by a 'permit to disturb' system. This permit system generates a register of disturbances on the mine site, allowing management staff to keep track of works that may increase the disturbance footprint of the mine. This allows for erosion and sediment controls to be placed around any works that risk increasing the volume or rate of sediment delivery to local waterways.

4.12.8 Spill Management

The MIA will be the primary location for storage and handling of hydrocarbons and other chemicals. Typical control measures include bunding around fuel or chemical storage tanks to capture leaks or spills and prevent contaminants leaving the site.

These storage facilities will be constructed and bunded in accordance with the relevant specifications of AS 1940:2017 - *Storage and Handling of Flammable and Combustible Liquids*. Refuelling will be in designated bunded areas. These will be inspected regularly, with repair and maintenance work completed as required. Bunds filled with stormwater will be drained or pumped out by a licensed contractor as soon as practicable to maintain the bund volume.

A waste oil system will collect all waste oils for transfer offsite or recycling onsite, so that waste oils are not released to the environment. Lubricants will be stored in a bunded concrete area with a sump to collect any spills.

All runoff from areas with potential contaminants will pass through water management controls such as an oily water separator or sediment trap.

Hazardous substances safe operating procedures will be in place and a register will be maintained on site for all chemicals. Where appropriate, material safety data sheets will be kept in storage areas or be available for on-line access, as required.

Incident reporting and the management of spills will be undertaken in accordance with the site operational incident reporting forms and the procedures.

4.12.9 Surface Water Monitoring

4.12.9.1 Overview

Monitoring of surface water quality both within and surrounding the Project disturbance area will form a key component of the surface water management system. Monitoring of upstream, on-site and downstream water quality will assist in demonstrating that the water management system is effective in meeting its objective of minimal impact on receiving water quality and would allow for early detection of any impacts and appropriate corrective action.

Surface water monitoring will:

- aid with compliance with the EA conditions
- provide valuable information on the performance of the water management system
- facilitate adaptive management of water resources on-site.

Surface water quality sampling will be undertaken in accordance with the protocols and QA/QC procedures outlined in the:

- DES Monitoring and Sampling Manual (DES, 2018)
- the Australian/New Zealand Standard (AS/NZS) 5667.11:1998 for water quality – sampling Part 11 guidance on sampling groundwater.

Field measurement of water quality parameters will be undertaken using appropriate field equipment that is maintained and calibrated in accordance with the manufacturer's recommendations.

Surface water sample analysis will be undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA). The sample analysis will include duplicates and blanks consistent with industry standard QA/QC procedures.

4.12.9.2 Water Quality and Flow Monitoring Locations

The proponent has previously monitored surface water locations in the vicinity of the Project (see Figure 4-11). The surface water monitoring program would include the continued monitoring of a number of these sites to monitor surface water flows and quality upstream and downstream of the Project.

The water quality monitoring program would also include monitoring of dams which contain mine affected water, namely Transfer Dam, Pit Dam 1 and Pit Dam 2.

The proposed surface water monitoring locations are shown in Figure 4-49 and summarised in Table 4-7.

Table 4-7 Proposed Surface Water Monitoring

Monitoring point	Waterway	Location		
		Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Parameters
Upstream monitoring points				
MP01	Isaac River 1,000 m upstream of Project disturbance areas	-21.545222	148.145438	Quality only
MP02	Isaac River upstream of nominated mine water release point 1 (RP1) in the EA	-21.565999	148.142814	Quality only
MP03	Ti-Tree Creek upstream of nominated mine water release point (RP2) in the EA	-21.549080	148.112127	Quality only
USIR	Isaac River 700 m upstream of New Lenton ML boundary	-21.537001,	148.151725	Flow / levels only
Downstream monitoring points				
MP04	Isaac River downstream of RP1 and RP2	-25.581287	148.137026	Quality only
MP05	Ti-Tree Creek diversion	-21.545931	148.125478	Quality & flow / levels



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Datum: MGA94 Zone 55
 Scale: See Scale Bar (A4)
 Date: 20/08/2026 3:52 PM
 Drawn: RA (Source: AARC)

- LEGEND**
- Mining Lease
 - Watercourse
 - Roads
 - Proposed Disturbance Area
 - Project Layout
 - ▲ Downstream Monitoring Point
 - ▲ Upstream Monitoring Point
 - Streamflow Monitoring Locations

4.12.9.3 Water Quality Monitoring Schedule

EA Table C2 and Table C3 (**Appendix 4**) define the frequency and parameters to be sampled at the authorised release points during the discharge of mine affected water, noting that releases of mine affected water are not predicted to occur. EA Table C2 sets mine affected water release limits. EA Table C3 sets release contaminant trigger investigation levels.

EA Table C6 (**Appendix 4**) defines receiving water contaminant triggers levels. These trigger levels will be measured at the upstream and downstream monitoring stations. Monitoring at these locations will allow for an accurate evaluation of the impact of any releases from the Project and allow for identification of any upstream influences that are not associated with the Project.

Based on the water storages developed as part of the water management system, Table 4-8 defines the frequency and parameters to be sampled across the dams which can discharge to the receiving environment. The proposed water quality monitoring program provides regular monitoring of key mine affected water storages and sediment dams.

The event-based sampling will enable quantification of pollutant loads from the site and their corresponding impact on the water quality of receiving waters. On-site quarterly sampling from the water storages allows for pollutant generation on-site to be identified in advance ensuring appropriate remedial action can be taken.

Table 4-8 Water Storage Monitoring

Water storage	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Monitoring location	Frequency of monitoring	Parameter ^{1,2}
Transfer Dam	-21.569	148.134	Spillway	Quarterly	pH, EC, Turbidity, Sulphate, Major Ions, Arsenic, Aluminium, Molybdenum and Selenium
Pit Dam 1	-21.552	148.116			
Pit Dam 2	-21.551	148.140			
SD1	-21.553	148.112			
SD2	-21.570	148.128			
SD4	-21.563	148.130			
SD5	-21.568	148.129			
SD6	-21.567	148.139			
SD7	-21.552	148.139			
CWD	-21.550	148.138			
Notes: 1/ Monitoring against receiving environment limits is for interpretation only to ensure adequate management of water storages to prevent environmental harm. 2/ All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered).					

If water quality sampling of the sediment dam water shows contaminant concentrations materially higher than those predicted through baseline geochemical analysis, and exceed the release contaminant trigger investigations levels specified in the Project's EA, a combination of the following mitigation measures will be implemented:

- Quarterly monitoring will continue to be undertaken.
- Pump back all sediment dam water to the water management system.

- Treat the sediment water through flocculation prior to release.

The proposed mitigation measures are practical and appropriate to manage the risk of elevated contaminant levels in sediment dam water. The application of coagulation and flocculation would be targeted towards sediment dams with elevated levels of suspended solids. For sediment dams with elevated levels of dissolved metals or other contaminants, the water would be pumped back to the mine water management system for containment.

4.12.9.4 Receiving Environment Monitoring Program

A REMP must be developed and implemented for the Project in accordance with EA Conditions C21 to C23. The REMP is provided in **Appendix 25**.

4.13 Assessment of Significance of Impacts

4.13.1 Methodology

Potential impacts of the Project in relation to water resources were assessed with reference to ‘Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources’ (DCCEEW, 2022)¹ (the Guidelines).

A ‘significant impact’ is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the water resource which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

The impacts on surface water from the Project have been summarised in Section 4.11, with proposed mitigation measures, including monitoring programs, summarised in Section 4.12. These outputs have been assessed against the criteria for significant residual impacts in the Guidelines using a consequence and likelihood matrix to rate each impact’s significance. Those with a rating of high or extreme are considered to constitute a significant residual impact. Those with a rating of very low, low, or medium are considered to be unlikely to have a significant residual impact. This assessment considered the sensitivity of the environment, and the Guidelines.

4.13.2 Sensitivity

The sensitivity of an environmental value is determined from its susceptibility or vulnerability to threatening processes, and as a consequence of its intrinsic value. The attributes of sensitivity that were considered are:

- conservation status
- intactness
- uniqueness or rarity
- resilience to change
- replacement potential.

Applying these attributes enables the sensitivity of an environmental value to be ranked as high, moderate or low, as per Table 4-9. The sensitivity of an environmental value, once determined, does not change unless proposed actions or activities reduce the sensitivity of the value to adverse effects.

¹ Note that the PER Guideline references the 2013 version of the ‘Significant impact guidelines 1.3’, but provides a link to the 2022 version. The 2022 version has therefore been adopted in this draft PER.

Table 4-9 Criteria for Sensitivity

Sensitivity	Description
High	- The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance. - The environmental value is intact and retains its intrinsic value. - The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area which is poorly represented in the region, territory, country or the world. - It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value. Proposed activities would have an adverse effect on the value.
Moderate	- The environmental value is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers. - The environmental value is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. - It is relatively well represented in the systems/areas in which it occurs but its abundance and distribution are limited by threatening processes. - Threatening processes have reduced its resilience to change. Consequently, changes resulting from Project activities may lead to degradation of the prescribed value. - Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	- The environmental value is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations. - It is in a poor to moderate condition as a result of threatening processes which have degraded its intrinsic value. - It is not unique or rare and numerous representative examples exist throughout the system/area. - It is abundant and widely distributed throughout the host systems/areas. - There is no detectable response to change or change does not result in further degradation of the environmental value. - The abundance and wide distribution of the environmental value ensures replacement of unavoidable losses is achievable.

4.13.3 Impact Assessment Ranking

The qualitative impact analysis was conducted in accordance with *AS ISO 31000:2018 – Risk Management Standard* and *HB 203:2012 Environmental Risk Management Principals and Processes*. It involves consideration of impact consequences and the likelihood to determine an impact significance rating.

Specific consequence ratings have been developed, as described in Table 4-10, which considers sensitivity and the consequence criteria, including intensity, duration, magnitude and geographic extent of impacts.

Consequence is defined as the outcome of an event which may have the potential to change the existing environmental values.

As an event can have one or more occurrences and can have several causes and several consequences the most probable worst-case consequences are defined after the application of mitigation and management measures. This was determined from the assessment of impacts predicted through modelling in the surface water and groundwater impact assessments, and professional judgement from specialists. ‘Moderate’, ‘major’ and ‘catastrophic’ consequences are considered as potential to be a ‘significant impact’ for changes to the hydrology or water quality of a water resource, once combined with the likelihood of occurrence.

Table 4-10 Consequence Definitions

Descriptor	Environmental Impact
Insignificant	- Negligible environmental impact. Minor transient release within the WQOs and environmental approval limits. - No impact to water users. - Negligible change in flows or hydrology. No users or 3rd party infrastructure affected. - No change to surface and groundwater interactions.
Minor	- Controlled or planned release in accordance within the WQOs and environmental approval limits. - Onsite unplanned contaminant spill immediately contained without outside assistance. - No ongoing or repeat exceedances of water quality release limits or persistent or increasing exceedances of the WQOs detected in receiving waters. - Reduces utility of 1 to 2 water users, which can be compensated through make good arrangements. - Minor changes in flows or hydrology with potential for localised or short-term impacts on downstream or upstream users or 3rd party infrastructure. - Minor / localised impact to groundwater dependent ecosystems (GDEs) and localised impact to aquatic ecosystems. - Possible minor interactions with surface and groundwater with very minor impacts.
Moderate (potentially significant)	- Short term unplanned release that exceeds the WQOs or release limits but does not have lasting impacts to aquatic ecosystems. - Onsite contaminant spill contained with outside assistance. - Long term discharge of pollutant, non-persistent, but possible widespread water quality impacts above the WQOs however the receiving environment remains within the 80% of the ecosystem protection guideline. - Impact can be remediated without long term loss or very localised long persistent damage. - Surface and groundwater interaction caused by mining activities with no risk of contaminant transfer or mobilization. - Moderate changes in flows or hydrology, with potential for -sub-catchment scale or medium-term impacts on downstream or upstream users or 3rd party infrastructure. - Significantly reduces utility of less than 5 downstream water users. - Changes to groundwater levels and / or baseline surface flows with potential to impact GDEs or aquatic ecosystems. - Alterations to floodplains, without no major change in flood behaviour and no loss of riparian vegetation causing creek destabilizing.
Major (potentially significant)	- Short to medium term off-site or long-term release that exceeds exposure limits known for downstream aquatic ecosystems. - Long term change in water quality is greater than that required for 'slightly to moderately disturbed' systems. - Significantly reduces current utility of more than 10 downstream water users with minor future impacts. - Surface and groundwater interaction cause contaminant mobilization or hydrological flow changes that have regional impacts 10 to 50 years beyond the life of the Project. - Major changes in flows or hydrology, with potential for regional or long term downstream or upstream impacts on users or 3rd party infrastructure. - Major impacts to regulating services by material alterations to the watercourse flows or floodplains, loss of riparian vegetation causing creek destabilizing, changes to groundwater levels and baseline surface flows, causing impacts to aquatic ecosystems or GDEs.
Catastrophic (potentially significant)	- Significant extensive detrimental long-term impacts on the local environment, with moderate impacts in the regional catchment.

Descriptor	Environmental Impact
	- Catastrophic and/or extensive chronic discharge or persistent hazardous pollutant that frequently or continuously exceed water quality trigger levels for aquatic ecosystem protection causing impacts to downstream ecosystem health and resilience. - Catastrophic changes in flows or hydrology, with potential for permanent regional scale downstream or upstream impacts on users or 3rd party infrastructure. - Damage to an extensive portion of aquatic ecosystem or GDEs through major combined impacts to surface water and groundwater resources. - Current and long-term future impact on water resource utility.

Table 4-11 sets out the frequency categories for the risk assessment. The Guidelines state that to be ‘likely’, it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on a water resource is a real or not remote chance or possibility. Thus, ‘likely’ has been considered to include unusual (3) to frequent (5) likelihood events in this impact assessment, which when combined with consequence have the potential to be a significant residual impact.

The likelihood considers the frequency of the consequence severity occurring from a casual event or activity and not the frequency of the event or activity. Where the impact or risk exposure is limited in duration or carries long-term potential consequences, then probability scores have been adopted; and where the impacts or risks are generated from ongoing activities over the life of the Project then frequency of occurrence has been applied.

Table 4-11 Frequency Categories for Likelihood

Category	Frequency	Probability
5	Frequent Event – certain impact will occur	99% chance
4	Normal Event – occur once in a year	50% chance
3	Unusual Event - less than once in 5 years	10% chance
2	Rare Event – less than once per 10 years	1% chance
1	Very Rare Event – less than once per 50 years and unlikely to occur during project life (20 years)	0.1% chance

The impact significance is ranked by combining consequence and likelihood and applying the risk analysis matrix in Table 4-12. Those risks which are considered likely to have a significant impact, in accordance with the Guidelines, are those ranked as either high or extreme risks.

Table 4-12 Risk Analysis Matrix

Likelihood	Consequence				
	5 Catastrophic	4 Major	3 Moderate	2 Minor	1 Insignificant
5 Frequent	25	23	20	16	11
4 Normal	24	21	17	12	7
3 Unusual	22	18	13	8	4
2 Rare	19	14	9	5	2
1 Very Rare	15	10	6	3	1
Key:					
Very Low			High (Significant Residual Impact Likely)		
Low			Extreme (Significant Residual Impact Likely)		

Medium

4.13.4 Sensitivity of the Receiving Environment

A summary of the key surface water values and qualities at the Project and surrounds, which determine and influence the sensitivity of the receiving environment are provided in Table 4-13. These were compared to sensitivity criteria to determine the level of sensitivity.

Table 4-13 Sensitivity of Surface Water Resource Values

Aspect	Description of Sensitivity, Value and Quality	Sensitivity
Surface water values	• Low value for provisioning services with no use of local creeks and limited downstream use of Isaac River due to highly ephemeral supply. • Limited supporting value for local aquatic habitat with no permanent aquatic habitat. • Moderate local and regional supporting services with riparian vegetation health along watercourse dependent on flows. This provides a biodiversity corridor, connected with downstream regional watercourses supporting aquatic fauna which require environmental flows during dry conditions to maintain health and habitat. • Low regulating services for the downstream discharge to the Great Barrier Reef coastal environment due to the minimal impact on the very large Fitzroy Basin catchment, and with even larger rivers in the north (e.g. Burdekin River) providing greater volumes of fresh water. • No cultural services, recreation or tourism provided by local channels and limited downstream in the Isaac River.	Low to Moderate
Catchment runoff and stream flow	• Local drainage channels are in a poor to moderate condition as a result of threatening processes which have degraded their intrinsic value. • The ephemeral flows provide resilience to temporal flow changes.	Low
Flood regime river-floodplain connectivity	• Ti-Tree Creek, subject to diversion, has very low environmental value. • Riparian vegetation along Isaac River continues to receive flood flows. • Land use is not sensitive to changes in flood regime with one local landholder, limited infrastructure or assets within the mining lease area or surrounding areas where minor changes in floodplain are predicted. • Levees designed for 1:1,000 flood event required to prevent flooding of the pits. • Sediment movement downstream has low sensitivity with downstream impacts to aquatic habitat and environments. • No flood dependent ecosystems or wetlands present.	Low
Water quality	• Threatening processes (e.g. catchment wide resource activities and agricultural practices) have reduced resilience to change in regional or local watercourses. • Water quality in the vicinity of the Project area is considered to be slightly alkaline, with low to moderate variable EC. The concentrations of some metals are also elevated above the WQOs for the area. • No change in EA conditions for managing water releases is required. EA conditions established in accordance with Model water conditions to protect downstream environmental values and WQOs. • Model water conditions were developed for coal mines in the Fitzroy basin. These model water conditions are designed to manage water discharges to meet the WQOs set out in the EPP (Water) and to provide consistency between mining operations in the Fitzroy basin. • Cumulative impacts from resource managed through basin wide application of Model water conditions.	Low to Moderate

4.13.5 Residual Significant Impact Assessment

An assessment of the significance of the Project's residual impacts to surface water resources is provided in Table 4-14, which demonstrates that residual impacts of the Project on surface water resource values are either very low, low or medium, and do not result in significant impacts to surface water resources.

Table 4-14 Assessment of Significance of Residual Impacts to Water Resources

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Hydrology of Surface Water Resource							
Reduction in catchment size for local and regional watercourses during and post mining.	The Project results in a reduction in 2.5% of upper Isaac River catchment and 0.2% of the Isaac River catchment at Goonyella. Impacts to flow will be negligible. Post mining the reduction in catchment due to the Project would reduce further to around 1% of the upper Isaac River catchment. There is negligible change in flows from the small residual void catchment compared to total catchment area.	- Mine water captured during operations and used onsite. - Post mining residual void captures direct rainfall.	- Minimise mine affected water catchments during operations. - Release sediment water in accordance with EA approved ESCP. - Release mine water in accordance with EA approved criteria linked to flows and water quality in the receiving environment. - Minimise the size of the catchment of the residual void in accordance with the approved PRCP schedule.	1	5	Medium (11)	No Significant Residual Impact - Negligible to minor impacts on flows, unlikely to be detectable in local and regional catchments. - No surface water users likely to be affected. - Not predicted to impact on water resource availability or cause significant impacts to hydrogeological regime locally or regionally. - Low / moderate sensitivity of local and regional watercourses subject to negligible changes in flows. - Minimal contribution of the Project to cumulative impacts from other resource projects in the region.
Changes in flood flows (depths and velocities)	Minor change in flood depths, extent and velocity of Isaac River. Very minor increases to extent and depth of flooding over agricultural lands, and does not pose risks to receptors or 3 rd party infrastructure. Flood flows in Ti-Tree Creek diversion similar to existing Ti-Tree Creek.	- New bridge and bed level crossing of Isaac River. - Levees designed for the 1:1,000 flood event. - Post mine life final landform encroaches onto floodplain.	- Stable approved final landform design post mine life. - New bridge design mirrors existing bridge design	2	2	Low (5)	No Significant Residual Impact - Insignificant to minor changes in flood depths, velocities and geomorphology are predicted as a result of Project infrastructure, with changes limited to localised area. - No users or 3rd party infrastructure affected.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Changes to flows – inundation of mine pit by floodwater during operations	Capture and / or release of additional surface waters that would become mine affected water if pit inundated, requiring release under approved release criteria. Cessation of mining in affected pits.	- Flood levels overtop 1:1,000 flood level required for levee designs.	- All levees will be designed to 1:1,000 flood level in accordance with the Manual. - Levee design and construction subject to strict EA conditions on standards and certification for regulated structures. - Annual inspections and certifications required under EA conditions for regulated structures (levees).	4	1	Medium (10)	No Significant Residual Impact - Levees will be designed, constructed and operated to prevent overtopping by floods to the 1:1,000 flood event.
Changes to flows – inundation of residual void by floodwater post mine life	Capture and / or release of additional surface waters that would become mine affected water and potentially inundate the residual void.	- Post mine life flood levels exceed the 1:1,000 flood level in the final landform.	- Safe, stable final landform designed so that residual void is outside the 1:1,000 and PMF flood level. - Final landform designed in accordance with approved PRCP schedule.	4	1	Medium (10)	No Significant Residual Impact - Final landform designed so that residual void is outside the 1:1,000 and PMF flood event.
Additional demand on the State's surface water resources for mine operations	Allocation of State water resources to mining operations results in less volume available to other State water users.	- External allocation of water (other than supply from Burton Mine which is self-contained) for the Project is required.	- Maximise re-use of onsite water. - Modelling shows that water demand will not exceed the supply available from the Project and Burton Mine.	2	1	Very Low (3)	No Significant Residual Impact - No additional external water supply required. - No impact on surface water resources available under State water resource plans.
Surface Water Quality							
Release of mine affected water and sediment affected water	Potential change in downstream water quality results in impacts on WQOs and environmental values.	- Uncontrolled releases of mine affected water during very wet climatic conditions - Releases of sediment affected water that is	- Controlled releases of mine affected water undertaken in accordance with EA flow and quality criteria designed to protect environmental values and WQOs.	2	2	Low (5)	No Significant Residual Impact - Low to moderate sensitivity of receiving environment. - No predicted uncontrolled mine affected water releases

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
		not in accordance with ESCP.	- Modelling demonstrates controlled and uncontrolled releases of mine affected water are not required. - Sediment dams designed in accordance with recognised engineering standards. - Releases from sediment dams in accordance with ESCP. - Annual REMP to monitor potential impacts on aquatic environment. - Regular water quality monitoring at established monitoring points, and investigations if there are exceedances of relevant criteria.				- Sediment affected water releases modelled to be within receiving water quality background values. - Cumulative impacts managed under State EA release criteria for all mine sites in the Fitzroy Basin, developed in accordance with the Model Mining Conditions.
Changes in water quality – residual void lake water overtops to surface drainages post mine life	Release of mine affected water post mine life. Additional flows to local drainages, which would partially restore minor catchment losses.	- Residual void water balance stabilises at a level that results in overtopping to surface drainages.	- Modelling for residual void water levels demonstrates that residual void water levels will stabilise well below the surface overtopping level.	3	1	Low (6)	No Significant Residual Impact - No predicted overtopping of residual void water to surface water post mine life.
Construction of road crossings of Isaac River	Increased sedimentation of downstream watercourses. Potential barriers to fish passage.	- Construction of haul road crossings. - Design of crossings.	- Construction in dry season where possible (i.e. no flows). - Scour protection to minimize obstruction of waterway flow and control erosion. - Construction in accordance with recognised standards and guidelines to minimise potential for sedimentation.	2	4	Medium (12)	No Significant Residual Impact - Control measures established. - Low sensitivity of Isaac River watercourses to sedimentation. - Low sensitivity of Isaac River as fish habitat (see Chapter 6). - No MNES aquatic species (see Chapter 6).

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
			- Bed level crossing allows low flows and fish passage.				
Spills of fuels or chemicals	Localised water contamination	- Accidental spills or releases	- Spill control procedures will be implemented. - Locations of fuel and chemical storages designed in accordance with relevant Australian Standards, bunded and with runoff control structures.	2	3	Low (8)	No Significant Residual Impact - Low to moderate sensitivity of receiving environment. - Controls in place. - Any accidental release likely to be localised and easily contained and remediated.

4.14 Conclusion

The New Lenton MLs are located in the upper Isaac River catchment, a sub-catchment of the upper Fitzroy Basin. The Project disturbance area is relatively flat and encompasses a section of the Isaac River floodplain. Other than the Isaac River floodplain, the other drainage features within the proposed disturbance area are Ti-Tree Creek and an unnamed tributary of the Isaac River. DNRME determined that Ti-Tree Creek is not a designated watercourse under the Water Act. Hill Creek also intersects the New Lenton MLs, however it is upstream of the proposed disturbance area and will not be impacted by the Project.

The catchment of the Isaac River to the downstream boundary of the New Lenton MLs is about 200 km², which represents about 0.9% of the Isaac-Connors sub-catchment and 0.1% of the Fitzroy River catchment. The Isaac River (and its tributaries) exhibit highly ephemeral surface water flows that are typically restricted to short periods following rainfall in the wet season (i.e. November to April). Surface waters typically exhibit low to moderate salinity, high to very high turbidity, and with some naturally elevated levels of some metals.

Ti-Tree Creek and the unnamed tributary of the Isaac River have small catchments upstream of the Project disturbance area, are highly ephemeral, and are degraded due to historical pastoral activities. Ti-Tree Creek has a narrow base width with steep banks which are heavily eroded. The upper sections lack riparian vegetation or ground cover on the bed and banks. The unnamed tributary has significant gully erosion over its entire length. Ti-Tree Creek exhibits low to moderate salinity and turbidity, with some naturally elevated levels of some metals.

There is currently minimal use of surface water in the upper Isaac River and Ti-Tree Creek. Burton Gorge Dam, which is located approximately 3.5 km downstream of the New Lenton MLs, was constructed to supply water for mining operations in the region. No licensed surface water users were identified within a 20 km radius of the Project area.

The EA for the New Lenton MLs, inclusive of Project activities, was approved by DES in January 2021 and includes conditions of approval relevant to water management. The WQOs to protect the EVs of the Project have been developed as part of the EA. The PRCP schedule for the Project was approved in November 2023 and includes rehabilitation milestones and criteria designed to protect surface water environmental values following mine closure and rehabilitation.

For water management system purposes, the water generated at the Project is divided into six types:

- Raw water: sourced external to the mine operations (i.e. from Teviot Dam at Burton Mine).
- Clean water: surface runoff from undisturbed areas.
- Mine affected water: including pit water, processing plant water, groundwater seepage or runoff from areas disturbed by mining activities, and groundwater from dewatering activities.
- Sediment water: rainfall runoff from catchments which discharge through release points associated with ESC structures.
- Water from the MIA: water potentially contaminated with hydrocarbons or other chemicals (e.g. through run-off from the fuel storage area, that is managed locally at infrastructure areas).
- Potable water: treated water suitable for human consumption (as supplied to Burton Mine accommodation camp).

The water management system for the Project has been integrated with the existing water management system at Burton Mine. It is not practical, desirable or effective to have separate water management systems for the Project and Burton Mine, as overall balance of water supply and demand can be better managed with an integrated system. Burton Mine contains mine pits / voids where water can be stored. Mine affected water will be transferred to and from Burton Mine depending on supply and demand at the Project. Mine affected water will be stored in three dams at the Project. There is no change to mine

affected water storages at Burton Mine. The Project will have no impact on regional water availability, with any water requirements supplied by Burton Mine's storages.

Six sediment dams will be constructed as part of the Project to capture sediment water runoff, primarily from the overburden dumps. The proposed sediment dams have been sized in accordance with the Best Practice Erosion and Sediment Control Guidelines (IECA, 2008). Runoff collected in the dams will be released to the downstream environment in accordance with the ESCP or pumped back into the mine water system to maintain capacity.

Water collected on the site will be used as first priority to satisfy site demands, such as dust suppression, and to supplement the CHPP water requirements.

The key components of the Project's flood protection infrastructure are:

- a constructed channel to divert Ti-Tree Creek
- a levee to protect mine operations from flooding of Ti-Tree Creek diversion
- a levee to protect mine operations from Isaac River flooding.

The Ti-Tree Creek flood levee will be constructed to prevent the ingress of water into the pit from flows that exceed the capacity of the Ti-Tree Creek diversion channel. The levee is designed to protect the pits from the 0.1% (1:1,000) AEP flood event. The Ti-Tree Creek diversion design aims to control flood velocities to mimic the existing channel and thereby minimise subsequent impacts on Ti-Tree Creek and the Isaac River. The diversion will release through an engineered structure to control water flows and velocity, into a natural drainage channel of the unnamed tributary approximately 400 m before the Isaac River.

The Isaac River levee will merge with the Ti-Tree Creek levee and is designed to protect the pits from the 0.1% AEP flood event. All levees will be regulated structures and hence will require design, construction and operation in accordance with Schedule I of the EA conditions for regulated structures.

Upon completion of mining the Ti-Tree Creek diversion is proposed to remain in its diverted state with final landforms established to protect the residual void from a probable maximum precipitation design event. The Isaac River levee will be incorporated into the adjoining rehabilitated overburden dump which will form the final landform structure providing flood immunity post closure.

A mine water management system and water balance has been developed for the Project and Burton Mine, over the life of Project activities. The performance of the mine water management system has been investigated using a site water balance operational simulation model. The model simulated water inflows and outflows through the various stages of mine development under different climatic sequences.

The water balance model has been used to assess the performance of the water management system for pit inundation characteristics, mine affected water inventory, interaction (transfers to/from) the Burton Mine, controlled releases and uncontrolled releases.

The water balance model demonstrates that the Project's mine affected water dams have sufficient capacity, even under very wet climatic conditions (1st percentile). Excess mine affected water will either be transferred to Burton Mine or stored in the Project's mined pits. Even under very wet climatic conditions less than 5% of the capacity of the Project's mined pits is required to store excess mine water.

The water balance model demonstrates that import volumes from Burton Mine are typically greater than the export volumes to Burton Mine. Hence, the Project is generally a net importer of water from Burton Mine. Burton Mine would have sufficient inventory to supplement all the Project's water demands. The results show that water in Burton Mine's pits would not empty during any climatic conditions assessed. Any surplus water requirements during dry climatic conditions will be sourced from Burton Mine's Teviot Dam.

The water balance model demonstrates that controlled releases are not required as part of the water management strategy due to the balancing of mine affected water with Burton Mine. Furthermore, there

were no modelled uncontrolled releases from the Project's mine affected water dams during any of the model realisations over the life of the Project.

Consistent with the IECA design standard, the Project's sediment dams do not provide 100% containment for captured runoff. Hence overflows will occur from sediment dams when rainfall exceeds the design standard. An assessment of the predicted salinity of overflows from the sediment dams to the receiving environment showed that mixed downstream EC would generally be similar to background levels, with 99.3% of the modelled values below the median EC recorded at the Isaac River (Burton Gorge) gauge.

The final steady-state pit void water level elevation in the Project's residual void was modelled as part of the groundwater assessment (refer to **Chapter 5**). This demonstrates that long term void water levels will remain below the groundwater source sink level and well below the surface spill level. Long term salinity modelling indicates that the void will become highly saline after approximately 50 – 500 years. However the water will be contained in the residual void as it acts as a groundwater sink. Residual void water levels were modelled under various climate change scenarios. The water balance modelling results show that the residual void water levels will be lower than, or similar to, baseline climatic conditions. This is expected given the significant decrease in rainfall and increase in evapotranspiration for climate change scenarios.

A flood model was developed to assess the impact of the Project on flood extents, depths and velocities for the 50% (1 in 2 year), 10% (1 in 10 year), 2% (1 in 50 year), 1% (1 in 100 year), and 0.1% (1 in 1,000 year) AEP design flood events for the Isaac River and Ti-Tree Creek. Flood models were developed for three scenarios:

- existing conditions (i.e. prior to the Project)
- developed conditions (i.e. maximum impact during Project operations)
- post-closure conditions (i.e. maximum impact for the post mining closure landform).

The results of the flood modelling show that the impacts of the Project (e.g. levees and Isaac River crossings) on the hydraulic characteristics (such as levels, extents, velocity, bed shear stress and stream power) of the Isaac River are insignificant to minor. The new bridge for the realigned Suttor Developmental Road and the bed level crossing of the Isaac River for the haul road are predicted to have negligible to minor impacts on flood behaviour. The Project results in negligible changes to flood duration which, for both existing and developed conditions, demonstrates that flood events in the region around the Project have a very short duration (i.e. less than 24 hours) for minor to extreme rainfall events.

A geomorphic assessment was completed for the Isaac River and Ti-Tree Creek diversion. The results for velocity, shear stress and stream power in the Isaac River show insignificant to minor change between existing and developed conditions. On this basis, the Project is not expected to have adverse impacts on the geomorphology of the Isaac River. The Ti-Tree Creek assessment demonstrated that hydraulic parameters are generally within the range of existing (i.e. pre-mining) values and ACARP Guideline values for operational and post-mining conditions.

The post mining landform is similar to the operational landform and hence the post-closure conditions flood model results were predicted to be the same as the developed conditions flood model (i.e. insignificant to minor impacts). The loss of catchment flows in the Isaac River, from collection of mine affected water and sediment water during and post mine life, is predicted to be negligible.

The water management system is the primary mitigation for impacts to surface water resources. The system has been designed to protect water quality and the waterways potentially affected by the Project. The Project's water management system, provides the key elements of the WMP and ESCP required by the EA.

The EA for the Project conditions the management of mine affected water, through release limits, release trigger investigation levels, environment contaminant trigger levels, monitoring requirements for flows and water quality, notifications and investigations. These EA conditions have been established in

accordance with DES's Model water conditions for coal mines in the Fitzroy basin, designed to protect regional environmental values and WQOs from all mines in the Fitzroy basin.

Sediment water containment will be managed in accordance with the Project's ESCP, as required under the EA. The proposed sediment dams will form a key component of the ESCP.

The Project involves the construction of a new bridge across the Isaac River for the realignment of the Suttor Developmental Road, and a bed level haul road crossing of the Isaac River. Design and construction methodologies will be adopted to reduce sedimentation and erosion from construction activities. The bed level crossing will allow for low flows and hence fish passage.

The diversion will be rehabilitated with vegetation similar to that within the existing local waterways, which will reduce the potential for scour and erosion. Ongoing monitoring of the performance of the diversion (e.g. changes to channel levels and channel form resulting from erosion) will be undertaken and, if necessary, mitigation measures will be implemented to prevent excessive erosion or sediment deposition. In accordance with the approved PRCP schedule for the Project, the diversion must achieve a set of criteria to be geomorphically stable in the long term (i.e. post mining).

Systems and procedures will be implemented to prevent release, and / or manage any accidental release, of contaminants.

Monitoring of surface water quality both within and external to the Project disturbance area will form a key component of the surface water management system. Monitoring will be undertaken at upstream and downstream monitoring locations in the Isaac River and Ti-Tree Creek. This allows for the characterisation of background water quality, as well as the assessment of potential impacts of the Project on these waterways downstream of the mine. These sites will be monitored in accordance with the requirements in the EA for water quality and flows.

Potential impacts of the Project to surface water resources were assessed with reference to *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DCCEEW, 2022) (the Guidelines). The assessment demonstrates that residual impacts of the Project on surface water resource values are either very low, low or medium; and hence are not likely to result in a significant impact to surface water resources.

4.15 References

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