SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Chapter 7
Aquatic Ecology

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7.0 Aquatic ecology

7.1 Introduction

BM Alliance Coal Operations Pty Ltd (BMA) is seeking approval to develop the Saraji East Mining Lease Project (the Project) involving a single-seam underground mine and supporting infrastructure on Mining Lease Application (MLA) 70383 and MLA 70459 adjacent to, and accessed through, the existing open cut mine void within Mining Lease (ML) 1775.

This chapter of the Environmental Impact Statement (EIS) provides an assessment of the potential impacts of the Project on aquatic ecological values within the Project Site and surrounding area. It includes a description of the aquatic environmental values, identification of potential impacts on these values, proposed mitigation measures and the residual risks applicable to each potential impact to aquatic ecology. The underpinning aquatic ecology assessment is presented in **Appendix D-1 Aquatic Ecology Technical Report.**

The scope of this assessment addresses surface water ecology. The assessment of water quality is presented in **Chapter 8 Surface Water Resources**, the assessment of groundwater (including stygofauna) is presented in **Chapter 9 Groundwater** and the assessment of terrestrial ecology in **Chapter 6 Terrestrial Ecology**.

7.2 Legislation and policy

7.2.1 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legal framework for the protection and management of nationally and internationally threatened flora and fauna (including migratory species), ecological communities, internationally important wetlands, heritage places, the Great Barrier Reef, and Commonwealth marine areas, which are collectively defined as Matters of National Environmental Significance (MNES). Water resources and nuclear actions are also regulated under the EPBC Act.

The EPBC Act provides guidance on whether an action (e.g. a proposed development) is likely to have a significant impact on an MNES. The EPBC Act *Significant Impact Guidelines 1.1* (DotE 2013a) provide guidance in the form of assessment criteria, in relation to significant impacts on threatened species under the EPBC Act.

The Project was referred under the EPBC Act on 5 October 2016. On 18 October 2016 the Department of Energy and Environment (DoEE) (now the Department of Climate Change, Energy, the Environment and Water) deemed the Project a controlled action based on the potential for a significant impact to the following controlling provisions:

- listed threatened species and communities (Sections 18 and 18A)
- a water resource, in relation to coal seam gas development and large coal mining development (Section 240 and 24E).

7.2.2 State legislation

Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides the legislative framework for ecologically sustainable development in Queensland, requiring people, companies and government to take all reasonable and practical steps to protect the environment. The EP Act identifies a range of mechanisms to achieve the objectives of the Act, including establishing Environmental Protection Policies that present the strategies for protecting environmental values.

The Environmental Protection Regulation 2019 (EP Regulation), pursuant to the EP Act, specifies Environmentally Relevant Activities (ERAs) that are known to have the potential to cause environmental harm. ERAs require a comprehensive Environmental Impact Statement (EIS) or Impact Assessment Report to be prepared as part of the approvals process. Resource developments, including coal mines, are ERAs listed under the EP Regulation.

Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (Water)) is a strategy for achieving the object of the EP Act. The EPP (Water):

- identifies high ecological value (HEV) waters
- identifies environmental values and management goals for water
- provides water quality guidelines and water quality objectives to enhance or protect the identified environmental values
- provides a framework for decision making about Queensland waters, and requires monitoring of and reporting on the condition of Queensland waters
- provides monitoring and reporting guidelines for the condition of waters.

Environmental values for Queensland waters include the protection of aquatic ecosystems. The components of aquatic ecosystems to be protected are not specified under either the EP Act or the EPP (Water), although the Monitoring and Sampling Manual (DES 2018b), pursuant to the EPP (Water), presents guidelines for survey of:

- water and sediment quality
- hydrology
- aquatic habitat
- aquatic biota (including plankton, aquatic plants, macroinvertebrates and fish)
- physical and biogeochemical processes.

Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) provides for the conservation of Queensland's nature by declaring and managing a protected area network, protecting threatened species and their habitats, regulating the taking of wildlife and co-ordinating nature conservation with Traditional Owners and other landowners.

Protected wildlife listed under the NC Act must be protected from threatening processes, and critical habitat for protected wildlife is required to be protected to the greatest extent possible.

Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act), as updated by the *Vegetation Management and Other Legislation Amendment Act 2018*, regulates the clearing of vegetation to conserve threatened regional ecosystems, protect biodiversity and maintain ecological processes, amongst other purposes.

The VM Act provides for the Department of Resources' (DoR) Chief Executive to certify various classes of regulated vegetation maps, with regulated vegetation identified as a Matter of State Environmental Significance (MSES). Classes of vegetation under the VM Act include:

- vegetation that is remnant and/or threatened (category B)

- high value regrowth vegetation (category C)
- regrowth vegetation in a wetland, watercourse or drainage feature area within a Great Barrier Reef catchment (category R).

Vegetation in wetland areas and vegetation intersecting a watercourse is also regulated vegetation under the VM Act. Vegetation clearing and development is regulated for Category R vegetation areas.

The clearing of native vegetation protected under the VM Act is regulated under the *Planning Act 2016* and regulation as assessable development unless classified as exempt clearing work.

Water Act 2000

Under the *Water Act 2000* (Water Act), a riverine protection permit is required for works involving the excavation of material, the placement of fill or the removal of vegetation within declared watercourses unless the works comply with the exemption requirements.

Additionally, the use of water for activities such as irrigation, stock water, drinking water and industrial use is regulated under the Water Act. The Water Act provides the basis for the planning and allocation of Queensland's water resources. The watercourses potentially affected by the Project are subject to protection under the Water Act. The Water Act and its instruments are administered by The Department of Regional Development, Manufacturing and Water (DRDMW).

The Water Act defines a watercourse as:

- a river, creek or stream in which water flows permanently or intermittently in a natural channel, whether artificially improved or not, or
- an artificial channel that has changed the course of the watercourse.

The creeks within the Project Site which are declared watercourses under the Water Act include Boomerang, Hughes, One Mile, Spring, Plumtree and Phillips Creeks. Resources within a declared watercourse are managed by the State and may be subject to licensing provisions (DSDMIP, 2019).

Water Resource Plans (WRPs) and Resource Operations Plans (ROPs) are governed by the Water Act. WRPs establish a framework for sharing water between human consumptive needs and environmental values. ROPs are developed in parallel with WRPs and provide a framework by which objectives from the WRPs are implemented, including water allocations and administrative directions. The WRP and ROP applicable to the Project are detailed below.

Appendix B-2 Subsidence Modelling sets out the estimated extent of interference and **Appendix K-2 Subsidence Management Plan** provides mitigations related to subsidence. BMA will consult with DoR to ensure residual information requirements are addressed.

Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) provides for the management and protection of fisheries resources, including regulating development that might impact declared fish habitat areas and fish passage. Queensland's native fish require adequate movement along the state's rivers and streams for their survival. Because of this, any in-stream barriers to fish movement in Queensland are regulated under the Fisheries Act. Waterways which provide fish passage are mapped by the level of risk:

- major risk (purple waterway)
- high risk (red waterway)
- moderate risk (orange waterway)
- low risk (green waterway).

Biosecurity Act 2014

The aim of the *Biosecurity Act 2014* is to manage risks associated with exotic pests and diseases that impact plant and animal industries including aquaculture and wild capture fisheries, tourism, infrastructure including water supply, shipping, biodiversity and the natural environment.

The *Biosecurity Act 2014* defines biosecurity matters, (i.e. prohibited matters which are not yet present in Queensland, and restricted matters which are currently present in Queensland); establishes a

general biosecurity obligation and establishes specific obligations in relation to prohibited and restricted matters.

Aquatic pests that are restricted biosecurity matters are identified in Schedule 2 of the *Biosecurity Act 2014* and include:

- diseases
- fish, including but not limited to eastern Gambusia (*Gambusia holbrooki*), carp (*Cyprinus carpio*) and tilapia (*Oreochromis mossambicus*)
- aquatic plants, including but not limited to salvinia (*Salvinia molesta*), water hyacinth (*Eichhornia crassipes*), and cabomba (*Cabomba caroliniana*)
- other plants that are common weeds of riparian areas.

7.3 Methodology

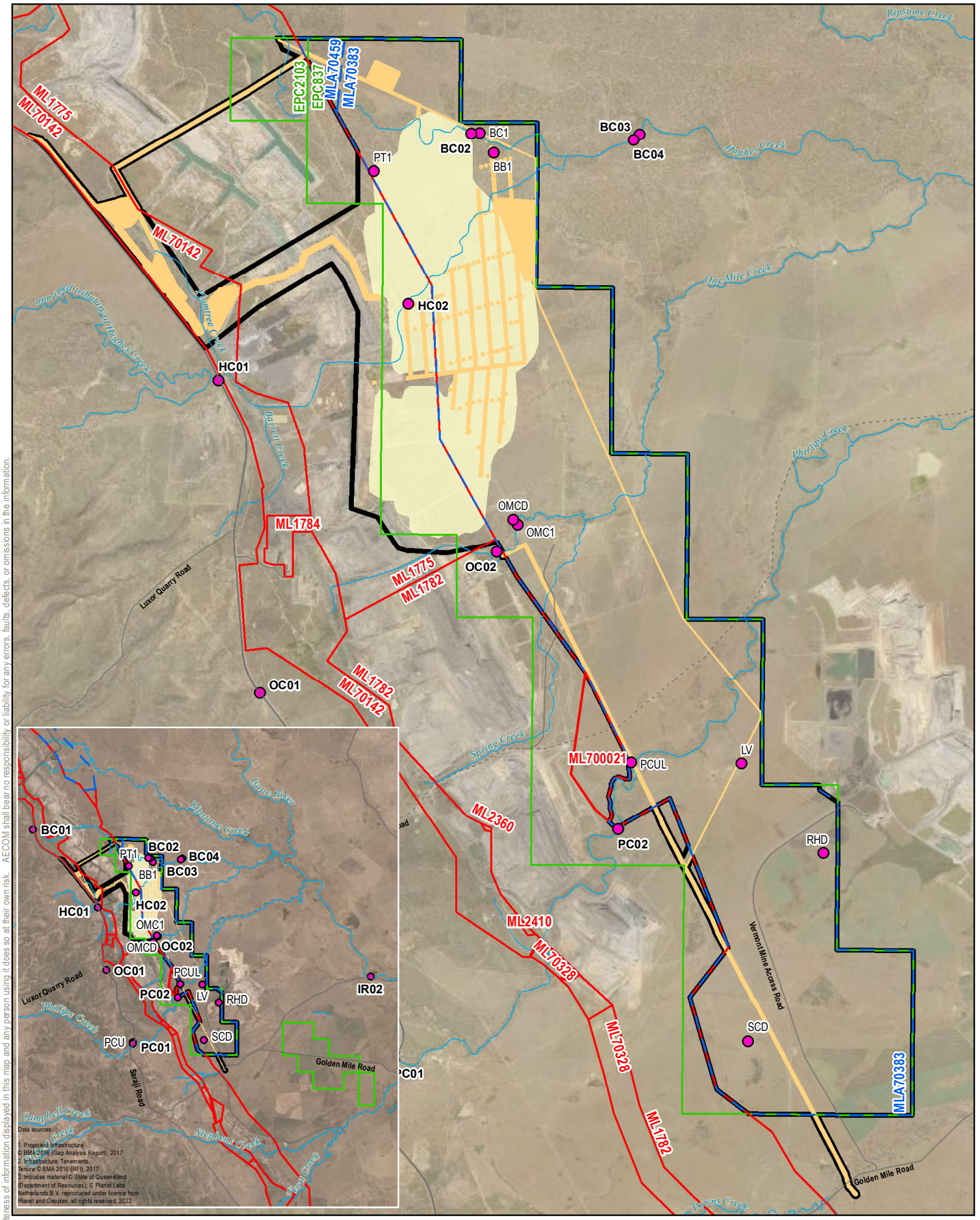
7.3.1 Desktop assessment

A desktop approach was used initially to provide a description of the aquatic ecology and aquatic environmental values in and surrounding the Project Site. This included a review of:

- aquatic MNES under the EPBC Act
- aquatic matters protected under Queensland legislation, including:
  - threatened freshwater species under the NC Act, supported by a search of Queensland's Wildlife Online database
  - features that support fisheries resources (e. g. waterway barrier works layer), pursuant to the Fisheries Act
  - wetland protection areas under the EP Regulation
  - HEV waters as defined under the EPP (Water)
  - freshwater-dependent regulated vegetation (e. g. category B, C or R vegetation) within wetlands, watercourses or drainage features listed under the VM Act.
- mapped aquatic ecological features, including floodplains, wetlands and surface-expression groundwater dependent ecosystems
- publicly available hydrological data for the DNRME gauging station 130410A on the Isaac River at Deverill
- relevant literature, including published and unpublished technical reports, scientific papers, and conservation advice statements for any MNES identified, including:
  - Department of Climate Change, Energy, the Environment and Water (DCCEEW) online EPBC Act Protected Matters Search Tool (PMST)
  - Queensland's Department of Environment and Science (DES) Wildlife Online database
  - DCCEEW species profile and threats database
  - DCCEEW conservation advice for the identified aquatic MNES
  - published scientific literature
- the aquatic ecology baseline studies completed in December 2021 and February 2022 (Hydrobiology, 2023) and historical BMA monitoring sites with survey site locations shown in Table 7-1 and Figure 7-1
- data contained in FRC Environmental's in-house bio-physical database.

Table 7-1 Survey sites for the aquatic ecology baseline studies

System	Treatment	Site Name	Historical Site	Longitude	Latitude
Issac River	Control	IR01		148.0171	-21.7343
		IR03		148.0591	-21.6812
	Test	IR02		148.5677	-22.452
Boomerang Creek	Control	BC01		148.1967	-22.3067
	Test	BC02		148.2853	-22.3283
		BC03		148.3408	-22.3383
		BC04		148.3554	-22.3351
	-		BB1	148.325	-22.338
	-		BC1	148.322	-22.334
Hughes Creek	Control	HC01		148.2663	-22.3838
	Test	HC02		148.3067	-22.3686
One Mile Creek	Control	OC01		148.2755	-22.4475
	Test	OC02		148.3304	-22.4154
	-		OMC1	148.331	-22.413
	-		OMCD	148.330	-22.412
Philips Creek	Test	PC02		148.3533	-22.4745
	Control	PC01		148.305	-22.5214
	-		PCU	148.305	-22.520
	-		PCUL	148.356	-22.461
Plumtree Creek 1	-		PT1	148.299	-22.342
Railway Head Dam	-		RHD	148.398	-22.479
Southern Creek Dam	-		SCD	148.382	-22.517
Lake Vermont	-		LV	148.380	-22.461



Data sources:
1. Proposed Infrastructure
© BMA 2016 (Gap Analysis Report), 2017
2. Infrastructure, Tenements,
Tenure © BMA 2016 (RFI), 2017
3. Includes material © State of Queensland
(Department of Resources); © Planet Labs
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LEGEND

- Project Site
- Project Footprint - Direct Impact
- Project Footprint - Indirect Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Survey Sites
- Private Access Road
- Public Road
- Watercourse

Figure 7-1
Project Area and Survey Sites for the Aquatic Ecology Baseline Studies

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP Mitsubishi Alliance

DATE: 4/06/2024 VERSION: 8

AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

7.3.2 Assessment of environmental values

Based on the desktop assessment, a field program was developed to confirm desktop findings and address identified knowledge gaps relevant to freshwater aquatic ecosystem values as defined in the Aquatic Ecology EIS guideline (DES, 2022). Field investigations were carried out in accordance with the Australian River Assessment System: AusRivAS Physical Assessment Protocol (Parsons et al., 2001) and AusRivAS protocols for Queensland streams (DNRM, 2001).

To assist with interpreting habitat classification, the River Bioassessment Program scores (bioassessment scores) (out of 135) were calculated for all sites based on nine AUSRIVAS categories, including: habitat availability (pool/riffle, run/bend ratio); bank stability; streamside cover; bed substrate composition and embeddedness; channel alteration; and presence of scouring and/or deposition. From these scores, an aquatic habitat condition rating was calculated and categorised into poor, fair, good or excellent habitat conditions.

Threatened species likelihood of occurrence assessment

Habitat assessments were undertaken at each site for conservation significant (State and/or Commonwealth listed) endangered, vulnerable, near threatened, and MNES species identified during the desktop assessment. This included the classification of the likelihood of any species occurring at each site. The likelihood of species occurring was considered under four categories as provided in Table 7-2.

Table 7-2 Criteria used for assigning likelihood of occurrences relevant to EVNT and special least concern species

Likelihood of occurrence category	Criteria
Unlikely	• no suitable habitat present
Possible	• suitable species habitat present
Likely	• suitable species habitat present and; • a record occurs nearby (10 km) in similar habitat.
Known	• species recorded during field surveys or previous past records

7.3.3 Impact assessment

The method used for this impact assessment includes a magnitude × duration × likelihood approach. The assessment of impacts associated with the construction and operation of the Project involved:

- identification of the potential impact
- categorising the impact including
  - phase (construction or operation)
  - whether it is a positive (i.e. beneficial) or negative impact
- screening of potential impacts: the potential (un-mitigated) impacts of the construction and operation was profiled and screened for inclusion in the impact assessment based on magnitude of threat, sensitivity of receptor and severity of potential impact
- identifying avoidance, mitigation and management measures that could reduce the effects of potential impacts
- assessing the residual risk posed by proposed activities and associated impacts, assessing the likelihood and severity of risks associated with aquatic values and assuming the mitigation measures adopted are successful
- recommending management and monitoring based on the results of the impact assessment.

Impacts will be assessed using a standardised method based on a set of criteria as set out in Table 7-3.

Table 7-3 Impact categorisation (Hydrobiology, 2023)

Aspect	Magnitude	Duration/Reversibility	Likelihood/frequency
Environment-biological	• negligible: little noticeable impact to the environment, impacts consistent with existing activities taking place in the area • minor: limited impacts, may affect some common species within a local context but unlikely to change ecological dynamics • moderate: impacts to multiple species or communities requiring complex mitigation or management, widespread impacts • major: impacts to multiple species of communities, possibly including significant impacts to threatened species or critical biological systems, affects may be felt outside of the region.	• short term: effects will be occur over a period of weeks or months; are easily reversible • long term: effects will occur for years • permanent: values will never return to pre-existing state.	• rare: may occur in exceptional circumstances • possible: may occur on this Project, has occurred occasionally or intermittently on similar projects or actions in the past • likely: could be expected to occur, has occurred on similar projects or actions in the past. Intermittent affects have occurred frequently in the past • almost certain: is expected to occur, has occurred recently on similar projects or actions and is very likely to occur again.
Environment-physical	• negligible: little measurable impact to physical environmental features, no additional surface disturbance above that normally created by existing activities • minor: limited physical disturbance or minimal changes which are within the normal range of variability, impacts limited to an immediate area of disturbance • moderate: measurable changes to physical environment which are outside of the range of normal variability, impacts which extend beyond the immediate disturbance area • major: serious physical disturbance or changes which pose a significant risk to physical environment, extensive physical changes well beyond the study area.	• short term: effects will be occur over a period of weeks or months. • long term: effects will occur for years • permanent: values will never return to pre-existing state.	• rare: may occur in exceptional circumstances • possible: may occur on this Project, has occurred occasionally or intermittently on similar projects or actions in the past • likely: could be expected to occur, has occurred on similar projects or actions in the past. Intermittent affects have occurred frequently in the past • almost certain: is expected to occur, has occurred recently on similar projects or actions and is very likely to occur again.

To determine the applicable aquatic MNES species and ecological communities, the PMST database was searched on 10 December 2021 and the following aquatic MNES were listed as potentially occurring within and surrounding the Project Site:

- White-throated snapping turtle (*Elseya albagula*) (critically endangered)
- Fitzroy River turtle (*Rheodytes leukops*) (vulnerable).

All other MNES that the PMST search identified were considered to be outside the scope of this chapter (i.e. not aquatic species). Further information on other MNES can be found in **Chapter 21 Matters of National Environmental Significance**. Following the designation of an impact rating, mitigation measures were considered in order of preference being avoidance, reduction, restoration or offsets.

Following application of the mitigation measures, the impact significance assessment was repeated using the matrix in Table 7-3 to obtain the residual risk rating.

7.4 Description of environmental values

7.4.1 Aquatic habitat features

The Project Site is on a floodplain, with watercourses having well-defined channels that follow an irregular sinuous pattern. The Project Site is located in the Isaac River sub-basin catchment and is crossed by six creek systems:

- Boomerang Creek
- Hughes Creek
- One Mile Creek
- Spring Creek
- Phillips Creek
- Plumtree Creek.

Plumtree Creek was not assessed as this stream has no catchment upstream of the Project, the headwaters having been developed by the existing Saraji mine, and no water quality data was available.

HEV wetlands are mapped within and broader landscape the Project Site, however these are located on the floodplains and not directly within or adjacent to the waterways within the Project Site. There are no HEV waters or surface expression groundwater dependent ecosystems (GDEs) in or surrounding the Project Site. There are mapped lacustrine and palustrine wetlands surrounding the Project Site, but relatively few mapped wetlands within the Project Site. The Isaac River is mapped as a riverine wetland, and Phillips Creek and the Isaac River have mapped riverine regional ecosystems in their riparian zones. Figure 7-2 illustrates the above habitats.

7.4.2 Land use

Land use in the area is dominated by grazing and native vegetation, with historical clearing evident along the creeks within the Project Site and study area.

7.4.3 Hydrology

The Isaac River and associated creeks traversed by the Project Site are ephemeral in nature and are characterised by long periods of no flow, with spikes in flow following short baseflow and low flow periods. Pools left behind after flow events are generally highly temporary. Historical data reviewed in the recent aquatic ecology assessment report (Hydrobiology, 2023) confirmed that some surveyed and regularly monitored creek sites have been completely dry for the majority of sampling events from 2011 to present. Pools generally persist for longer periods within the Isaac main channel.

7.5 Field survey results

7.5.1 Habitat condition

The waterways within the study area and surrounds were assessed to be ephemeral in nature, where flow and pool habitat occur following sufficient rainfall. The pool habitat within the surveyed creeks and rivers is short lived, and predominantly consisted of small shallow pool extents. The surveyed creeks and river experience long periods of no flow or any aquatic habitat, which was identified as characteristic of the Isaac River catchment.

Habitat bioassessment scores varied from 'fair' to 'good' with scores being negatively affected by a lack of macrohabitat diversity, particularly the lack of run and riffle habitat given that available water was predominantly limited to shallow isolated pools. The Isaac River survey sites were assessed to be in better condition than creek sites due to improved riparian streamside vegetation cover, increased in-stream habitat diversity such as large woody debris and undercut banks as well as improved bank/bed stability. Habitat condition was considered to be similar to those recorded in previous surveys.

Refer to **Appendix D-1 Aquatic Ecology Technical Report** for a detailed discussion of bank stability, bed stability, riparian condition, substrate condition, macrohabitat, microhabitat, macrophytes and disturbances across the sampling sites. A summary of assessment sites is provided in Table 7-4.

Table 7-4 Summary of assessment sites (Hydrobiology, 2023)

Site	Feature	Upstream/Downstream
IRO1 Early-wet	Could not access site	-
IRO1 Late-wet	**Watercourse:** Isaac River **Local landuse:** native bushland with cleared areas **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, some sand deposits in pools, moderate compaction **Banks:** convex banks 10 m wide. Right bank highly eroded with steep side slopes (80-90°), left bank low slopes (10-30°). Banks unstable, many eroded areas with raw sections along straights and bends. 50-79% bank cover. **Bed substrate:** dominated by sand, with bedrock visible and equal parts boulder, cobble and silt/clay present **Macrohabitat:** main channel with series of sandy/silt pools, secondary channel dry **Microhabitat**: large and small woody debris (LWD and SWD), detritus, periphyton, blanketing silt, undercut banks, macrophytes, algae, trailing vegetation, overhanging boulders and debris providing habitat **Riparian vegetation:** semi-contiguous occurrence of mature trees, landscape dominated by grasses which encroach to pools, and areas equally shrubby or bare **Habitat bioassessment score**: 75, good condition	Upstream:  Downstream: 
IRO3 Early-wet	Could not access site	-

Site	Feature	Upstream/Downstream
IRO3 Late-wet	**Watercourse:** Isaac River **Local landuse:** native vegetation with some cleared areas **Bed erosion and sedimentation**: moderate compaction **Banks:** convex banks 10 m wide with side slopes 10-30°, moderately stable with infrequent and small areas of erosion mostly healed over **Bed substrate:** scours at constrictions and where grades steepen, some sand deposit in pools, largely sand with some silt/clay and equal presence of bedrock, boulder, cobble and pebble **Macrohabitat:** largely dry with some sandy/silt pools remaining **Microhabitat**: LWD, SWD, detritus, periphyton, undercut banks, algae **Riparian vegetation:** semi-contiguous cover of mature trees, with grassed understory with equally bare and shrubby areas **Habitat bioassessment score**: 77, good condition	Upstream:  Downstream: 
IRO2 Early-wet	**Watercourse:** Isaac River **Local landuse:** native bushland **Bed erosion and sedimentation**: >5% of the bottom affected by scouring or deposition, deposits of sand, loose compaction **Banks:** 10 m wide banks, right bank slope 30-80°, left bank slope steep 60-80° with moderate size and frequency of erosion areas but healing and high erosion potential during high flow events, 50-79% stream cover **Bed substrate:** entirely sand **Macrohabitat:** mostly dry, some pools present **Microhabitat**: LWD, SWD, detritus, periphyton, undercut banks, algae, overhanging vegetation **Riparian vegetation:** fairly intact riparian community, contiguous cover of mature trees with an understory dominated by grass with bare areas, some exotic species **Habitat bioassessment score**: 61, fair condition	

Site	Feature	Upstream/Downstream
IRO2 **Late-wet**	**Watercourse:** Isaac River **Local landuse:** native bushland **Bed erosion and sedimentation**: scours at constrictions and bends, some sand deposits in pools, low compaction **Banks:** convex banks 10 m wide, steep side slopes of 60-80°. Banks are unstable, many eroded areas with raw areas frequent among straights and bends. Bank cover >80% **Bed substrate:** predominately sand with some silt/clay **Macrohabitat:** largely dry, some sandy/silt pools present **Microhabitat**: LWD, SWD, detritus, periphyton, undercut banks, algae **Riparian vegetation:** contiguous coverage of mature trees, understory dominated by grasses with some bare areas **Habitat bioassessment score**: 79, good condition	Upstream:  Downstream: 
BCO1 **Early-wet**	**Watercourse:** Boomerang Creek **Local landuse:** Cleared land for railway bridge alongside native bushland **Bed erosion and sedimentation**: scours at bends and at obstructions (railway bridge), some sand and silt deposits in pool, moderate soil compaction **Banks:** convex and stepped banks 5-15 m wide, side slopes in the 30-80° range, moderately stable with infrequent small areas of erosion which are mostly healed over. Bank cover >80% by cobbles and boulders of vegetation **Bed substrate:** predominately sand with some silt/clay **Macrohabitat:** mostly dry with a small pool **Microhabitat**: SWD, detritus **Riparian vegetation:** occasional clumps of native mature trees, sites dominated by exotic grasses with some bare and shrubbed areas **Habitat bioassessment score**: 48, fair condition	Upstream:  Downstream: 

Site	Feature	Upstream/Downstream
BCO1 Late-wet	**Watercourse:** Boomerang Creek **Local landuse:** Cleared land for railway bridge alongside native bushland **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, sand deposits, low bed compaction **Banks:** convex banks with low (10-30°) side slopes that are moderately stable with infrequent and small areas of erosion mostly healed over. Bank cover 50-79% **Bed substrate:** predominately sand with some silt/clay **Macrohabitat:** entirely dry **Microhabitat**: SWD, detritus, macrophytes **Riparian vegetation:** isolated mature trees, landscape dominated by grasses with large area covered by exotic species, with some shrubbery and bare areas present **Habitat bioassessment score**: 40, fair condition	Upstream:  Downstream: 
BCO2 Early-wet	Could not access site	-
BCO2 Late-wet	**Watercourse:** Boomerang Creek **Local landuse:** native bushland with cleared areas **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, some sand deposits, bed packed but not armoured **Banks:** convex banks 10 m with low-moderate side slopes (10-60°). Banks moderately stable with small and infrequent areas of erosion, mostly healed. Bank cover >80% **Bed substrate:** predominately sand with silt/clay present **Macrohabitat:** completely dry **Microhabitat**: LWD, SWD, detritus, macrophytes **Riparian vegetation:** semi-contiguous cover of mature trees, grasses dominate understorey with shrubbery and some bare areas present **Habitat bioassessment score**: 69, good condition	Upstream:  Downstream: 

Site	Feature	Upstream/Downstream
BCO3 Early-wet	**Watercourse:** Boomerang Creek **Local landuse:** Cleared areas alongside native bushland **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, some sand deposits in pools, tightly packed **Banks:** convex banks 10 m wide, side slopes in the >10-30° range, moderately stable with infrequent small areas of erosion which are mostly healed over. Bank cover >80% by vegetation **Bed substrate:** dominated by sand with silt present **Macrohabitat:** site dry **Microhabitat**: LWD, SWD, detritus, undercut banks, macrophytes **Riparian vegetation:** regularly spacing of mature native trees, with understory of exotic grasses and shrubs with some bare patches **Habitat bioassessment score**: 76, good condition	Upstream:  Downstream: 
BCO3 Late-wet	**Watercourse:** Boomerang Creek **Local landuse:** Native bushland **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, vegetation damage suggestive of high flour scours. Some sand deposits against natural log jams, bed packed but not armoured upstream and loosely compact down stream **Banks:** Convex banks 10 m wide, right bank low slope (10-30°) and left bank low-moderately sloped (10-60°). Banks moderately stable with small, infrequent areas of erosion mostly healed, bank cover >80% **Bed substrate:** Predominately sand with some silt/clay **Macrohabitat:** Entirely dry **Microhabitat**: LWD, SWD, detritus, macrophytes **Riparian vegetation:** Semi-contiguous cover of mature trees, understory equally bare and grassed with some shrubs also present **Habitat bioassessment score**: 68, good condition	Upstream:  Downstream: 
BCO4 Early-wet	Could not access site	-

Site	Feature	Upstream/Downstream
BCO4 Late-wet	**Watercourse:** Boomerang Creek **Local landuse:** native bushland **Bed erosion and sedimentation**: 30-50% of site affected, scours at constrictions and bends, no sediment deposits **Banks:** convex slopes 15 m wide, with low-moderate side slopes (10-60°). Banks moderately stable with infrequent and small areas of erosion, mostly healed. Bank cover >80% **Bed substrate:** predominately sand with some silt/clay present **Macrohabitat:** entirely dry **Microhabitat**: LWD, SWD, detritus, macrophytes **Riparian vegetation:** semi-contiguous cover of large mature trees with grassed understory with shrubs and some bare areas **Habitat bioassessment score**: 61, good condition	Upstream:  Downstream: 
HCO1 Early-wet	**Watercourse:** Hughes Creek **Local landuse:** Cleared land with road and rail bridge **Bed erosion and sedimentation**: scours at bends and at obstructions including bridge and log jam, some sandy deposits, loose compaction **Banks:** convex banks 10 m wide, side slopes in the 30-80° range, moderately stable with infrequent small areas of erosion which are mostly healed over. Bank cover >80% **Bed substrate:** dominated by sand with some silt present **Macrohabitat:** site is dry **Microhabitat**: LWD, detritus **Riparian vegetation:** semi-contiguous presence of mature trees, young trees emerging, landscape dominated by exotic grasses and some shrubs **Habitat bioassessment score**: 49, fair condition	Upstream:  Downstream: 
HCO1 Late-wet	**Watercourse:** Hughes Creek **Local landuse:** Cleared land with road and rail bridge **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, some silt deposits with thin layer of clay **Banks:** convex banks 5 m wide, steep side slopes (30-60°). Moderately sloped with infrequent, small areas of erosion mostly healed over. 50-79% bank cover. **Bed substrate:** dominated by sand with silt/clay present	Upstream: 

Site	Feature	Upstream/Downstream
	Macrohabitat: entirely dry **Microhabitat**: LWD, SWD, detritus **Riparian vegetation:** isolated presence of mature trees, landscapes dominated by grasses, with some shrubs and small bare areas, gamba grass present **Habitat bioassessment score**: 43, fair condition	Downstream: 
HCO2 Early-wet	**Watercourse:** Hughes Creek **Local landuse:** highly cleared, road crossing **Bed erosion and sedimentation**: scours at constrictions and where grades steepen, some silt deposits **Banks:** banks 5 m wide, right bank convex with slopes of 10-30°, left bank highly eroded, with wide lower bench and slopes of 80-90°. Banks unstable, many eroded areas with raw areas along straight sections and bends. Bank cover 25-49%. **Bed substrate:** silt/clay dominate but with sand and gravel also present **Macrohabitat:** mostly dry, some sandy/silt pool habitats remain **Microhabitat**: LWD, SWD, detritus, periphyton, blanketing silt, undercut banks, algae **Riparian vegetation:** occasional clumps of mature trees, invasive grasses dominate the landscape with some shrubbery and bare areas **Habitat bioassessment score**: 54, fair condition	Upstream:  Downstream: 
HCO2 Late-wet	**Watercourse:** Hughes Creek **Local landuse:** highly cleared, road crossing **Bed erosion and sedimentation**: scours at constrictions and bends, thin surface clay deposits in pools. Channelisation at old road crossing. **Banks:** left bank flat (<10° slope) and convex. Right bank shows fresh erosion and sign of bank collapse, currently has vertical slopes (80-90°) banks with wide lower bench. Both banks 10 m wide, and are unstable, with raw areas along straight sections and bends. Bank cover 25-49% **Bed substrate:** largely silt/clay with equal presence of gravel and sand **Macrohabitat:** dry with series of sandy/silt pools **Microhabitat**: SWD, detritus, periphyton, blanketing silt, undercut banks, macrophytes	Upstream: 

Site	Feature	Upstream/Downstream
	Riparian vegetation: isolated presence of mature trees, landscape dominated by grass with bare areas and some shrubs present. Large portion of coverage from exotics. **Habitat bioassessment score**: 38, fair condition	Downstream: 
OCO1 Early-wet	**Watercourse:** One Mile Creek **Local landuse:** highly cleared for railway track, roads and pathways **Bed erosion and sedimentation**: scouring and deposition at obstructions and along bends, sand and mud deposits in pools, loose bed compaction **Banks:** convex banks 5 m wide, side slopes in the 10-30° range, moderately stable with infrequent small areas of erosion which are mostly healed over. Bank cover 50-79% **Bed substrate:** Dominated by sand with some silt/clay present **Macrohabitat:** Largely dried, scattered sandy/silt pools **Microhabitat**: LWD, SWD, detritus, macrophytes **Riparian vegetation:** isolated and scattered occurrence of small trees among exotic grasses and shrubs with some bare areas **Habitat bioassessment score**: 45, fair condition	Upstream:  Downstream: 
OCO1 Late-wet	**Watercourse:** One Mile Creek **Local landuse:** heavily cleared for railway track, roads and pathways **Bed erosion and sedimentation**: deposits and scours at obstructions and bends, silt and sand deposits, loose bed compaction **Banks:** convex banks, left bank low-moderate side slopes (10-60°) and right bank with low side slopes (10-30°). Banks moderately stable with small, infrequent areas of erosion mostly healed. Bank cover 50-79%. **Bed substrate:** largely sand with some silt/clay present **Macrohabitat:** mostly dry, two small pools remain **Microhabitat**: LWD, SWD, detritus, macrophytes **Riparian vegetation:** isolated trees with landscape dominated by grasses with equally parts bare and shrubbery present, mostly exotic species **Habitat bioassessment score**: 45, fair condition	Upstream:  Downstream: 

Site	Feature	Upstream/Downstream
OCO2 Early-wet	**Watercourse:** One Mile Creek **Local landuse:** cleared areas of native bushland **Bed erosion and sedimentation**: some scouring at constrictions and where grades steepen, some sand and silt deposits in pools, nutrient rich (cows) sediment odour, moderate bed compaction **Banks:** convex banks 5-8 m wide with low (10-30°) slopes, moderately stable banks, infrequent, small areas of erosion that has healed over **Bed substrate:** dominated by sand with some silt/clay **Macrohabitat:** nearly entirely dry, small sandy/silt pool presence remains **Microhabitat**: LWD, SWD, detritus, blanketing silt, undercut banks, macrophytes **Riparian vegetation:** occasional clumps of mature trees, landscapes dominated by invasive grasses with equal amounts of bare and shrubbed areas **Habitat bioassessment score**: 53, fair condition	Upstream:  Downstream: 
OCO2 Late-wet	**Watercourse:** One Mile Creek **Local landuse:** Cleared land **Bed erosion and sedimentation**: silt deposits and scours at bends and obstructions, bed packed but not armoured **Banks:** 5 m wide with moderate (30-60°) side slopes, moderately stable with small, infrequent sites of erosion, mostly healed over. Bank cover >80% **Bed substrate:** equal cover of sand and silt/clay **Macrohabitat:** Entirely dry, pool filled with cracking clay **Microhabitat**: LWD, SWD, detritus **Riparian vegetation:** isolated mature trees, landscape dominated by grasses and shrubs, with some bare areas **Habitat bioassessment score**: 48, fair condition	Upstream:  Downstream: 
PCO1 Early-wet	**Watercourse:** Phillips Creek **Local landuse:** native bushland partially cleared **Bed erosion and sedimentation**: scouring and deposits at obstructions including road crossing and bends, some sand deposits in pools, loose bed compaction **Banks:** steep convex banks 5-10 m wide with slope range from 30-80°, infrequent, small areas of erosion mostly healed over. Bank cover >80%	Upstream: 

Site	Feature	Upstream/Downstream
	Bed substrate: Predominately sand with silt/clay pools, lack of habitat obvious **Macrohabitat:** Reach mainly dry, with scattered sandy/silt pools present **Microhabitat**: LWD, detritus **Riparian vegetation:** occasional clumps of mature trees, vegetation dominated by exotic grasses and shrubs **Habitat bioassessment score**: 44, fair condition	Downstream: 
PCO1 **Late-wet**	**Watercourse:** Phillips Creek **Local landuse:** native bushland with cleared areas and road infrastructure **Bed erosion and sedimentation**: scours at constraints and where grade steepens, deep scour around road column, some sand and silt deposits, low bed compaction **Banks:** convex banks 10-15 m wide. Left bank has low side slopes (10-30°) and right bank has steep (60-80°) side slopes. Banks moderately stable, infrequent and small areas of erosion mostly healed over. Bank cover >80% **Bed substrate:** Predominantly sand with smaller equal presence of silt/clay, pebbles and gravel **Macrohabitat:** entirely dry **Microhabitat**: LWD, SWD, blanketing silt **Riparian vegetation:** Occasional clumps of mature trees, landscape dominated by grasses with some shrubbery. **Habitat bioassessment score**: 57, fair condition	Upstream:  Downstream: 
PCO2 **Early-wet**	**Watercourse:** Phillips Creek **Local landuse:** riparian clearing for road crossing backed by native vegetation **Bed erosion and sedimentation**: sand and silt deposits **Banks:** 10 m wide convex banks, right bank moderately sloped 30-60°, left bank steeply sloped (60-80°), banks stable with no evidence of bank failure **Bed substrate:** dominated by sand with equal cover from bedrock, cobble and silt/clay, low compaction. Bed sloped towards left bank to expose bedrock. **Macrohabitat:** nearly entirely dry, very small highly turbid silty/sand pool remains **Microhabitat**: LWD, SWD, detritus **Riparian vegetation:** occasional clumps of mature trees present, understory of grasses and shrubs with some bare patches, exotic species present **Habitat bioassessment score**: 66, fair condition	Upstream:  Downstream: 

Site	Feature	Upstream/Downstream
PCO2 Late-wet	**Watercourse:** Philips Creek **Local landuse:** native bushland with cleared areas **Bed erosion and sedimentation**: 5-30% of site affected, scours and deposits at constrictions and where grades steepen. Moderate compaction of bed. **Banks:** convex banks 15 m wide, left bank steeply sloped (60-80°) and right bank moderately sloped (30-60°). Banks moderately stable with small, infrequent areas of erosion mostly healed over. Bank cover >80% **Bed substrate:** equal parts sand and silt/clay **Macrohabitat:** entirely dry **Microhabitat**: LWD, SWD **Riparian vegetation:** isolated mature trees, grasses dominate landscape with some bare and shrubbed areas present **Habitat bioassessment score**: 47, fair condition	Upstream:  Downstream: 

7.5.2 Aquatic groundwater dependent ecosystems

Aquatic GDEs are river, spring and wetland systems that interact with and/or rely on groundwater to account for any part of their water balance. Interrogation of the GDEs database (BOM, 2022) shows that the Study area and surrounds contains low, moderate and high potential aquatic GDEs. High potential GDEs are focussed along Phillips Creek and the Isaac River main channel, whereas medium potential GDEs are found along Hughes and Boomerang Creeks. Isolated wetlands of moderate potential GDE are scattered within all catchments and are generally focussed on the downstream extents of the creek systems, and the Isaac River main channel.

Based on the previous desktop and field assessments (Eamus et al. 2006 and Doody, et al. 2019) and more recent assessments conducted by 3D Environmental (2022) indicate aquatic GDEs (surface water expressions) are unlikely to occur within the Study area. A separate GDE assessment conducted by 3D Environmental (2022) also found there were no aquatic GDEs present in the Study area. Further information on GDE is presented in **Chapter 9 Groundwater**.

7.5.3 Water quality

Electrical conductivity (EC) and pH were assessed to be typical of similar systems. Streams with higher EC values tended to be smaller pools where evaporation had occurred resulting in an increase of salt concentration. Turbidity was also found to be elevated above water quality objectives at some creek sites where evidence of feral animal disturbance such as pig wallowing, was observed which resulted in higher turbidity. Temperature range was found to be comparable to similar systems. Dissolved oxygen (DO) levels were found to be highly variable across the study area, and to fluctuate naturally according to the time of day.

Physicochemical parameters were considered to be similar to historical collected data, with the exception of DO which was found the be lower across the study area. This was considered to be due to the time of sampling, highly reduced pool size, a high level of feral animal disturbance, or higher levels of nutrients.

7.5.4 Macroinvertebrates

Macroinvertebrate assemblages within the Study area were found to be dominated by species which are tolerant of a wide range of conditions such as highly variable stream flow, habitat and water clarity

values. Taxonomic richness was found to be within defined catchment specific biological quality objectives (BQO), Plecoptera, Ephemeroptera, and Trichoptera (PET) richness was within BQO values at almost all sites. Signal2 scores were slightly below BQO's across the sites and the percentage of tolerant species was generally elevated. Assemblages and diversity indices such as taxonomic richness, PET richness, SIGNAL2 score and AUSRIVAS OE50 were found to be correlated with macrohabitat and microhabitat diversity. Diversity indices were higher at Isaac River sites compared to creek sites, which was identified to be due to increased water availability and diverse microhabitats including periphyton, filamentous algae, macrophytes and woody debris. Macroinvertebrate communities at creek sites were limited by the small size of available pools and a general lack of habitat diversity. Diversity indices were found to be comparable with historical data for Isaac River and Phillips Creek sites. Diversity indices were found to be lower at Hughes Creek and One Mile Creek compared with historical data. This was considered to be due to inter-annual differences in flow events.

7.5.5 Macrocrustaceans

A total of 4 species and 84 individuals of macrocrustaceans were collected over the study area. All species recorded are typical of ephemeral systems and are tolerant of a wide range of conditions. The most widespread and abundant species was the freshwater prawn (*Macrobrachium sp.*). Isaac River sites tended to have higher species richness than Boomerang, Hughes and One Mile Creeks likely due to improved macro- and microhabitat diversity. There were no obvious patterns noted between upstream and downstream sites of Project Site or between seasons.

7.5.6 Fish

A total of 9 native and 2 exotic fish species comprising a total of 604 individuals were recorded across the study area. All the species recorded were considered to be common, typical of similar ephemeral systems, widespread in the local region, and tolerant to a wide range of environmental conditions. The most common species were the eastern rainbowfish (*Melanotaenia splendida splendida*), spangled perch (*Leiopotherapon unicolor*) and western carp gudgeon (*Hypseleotris klunzingeri*). During peak and low flow periods, Agassizi's Glassfish (*Ambasis agassizi*), Bony Bream (*Nematolosa eribi*), Purple-spotted Gudgeon (*Mogurnda adspersa*) and Sleepy Cod (Oxeleotris lineolata) are known to continue to migrate upstream to forage, nest and spawn. This indicates that these species are resilient to highly variable flow conditions.

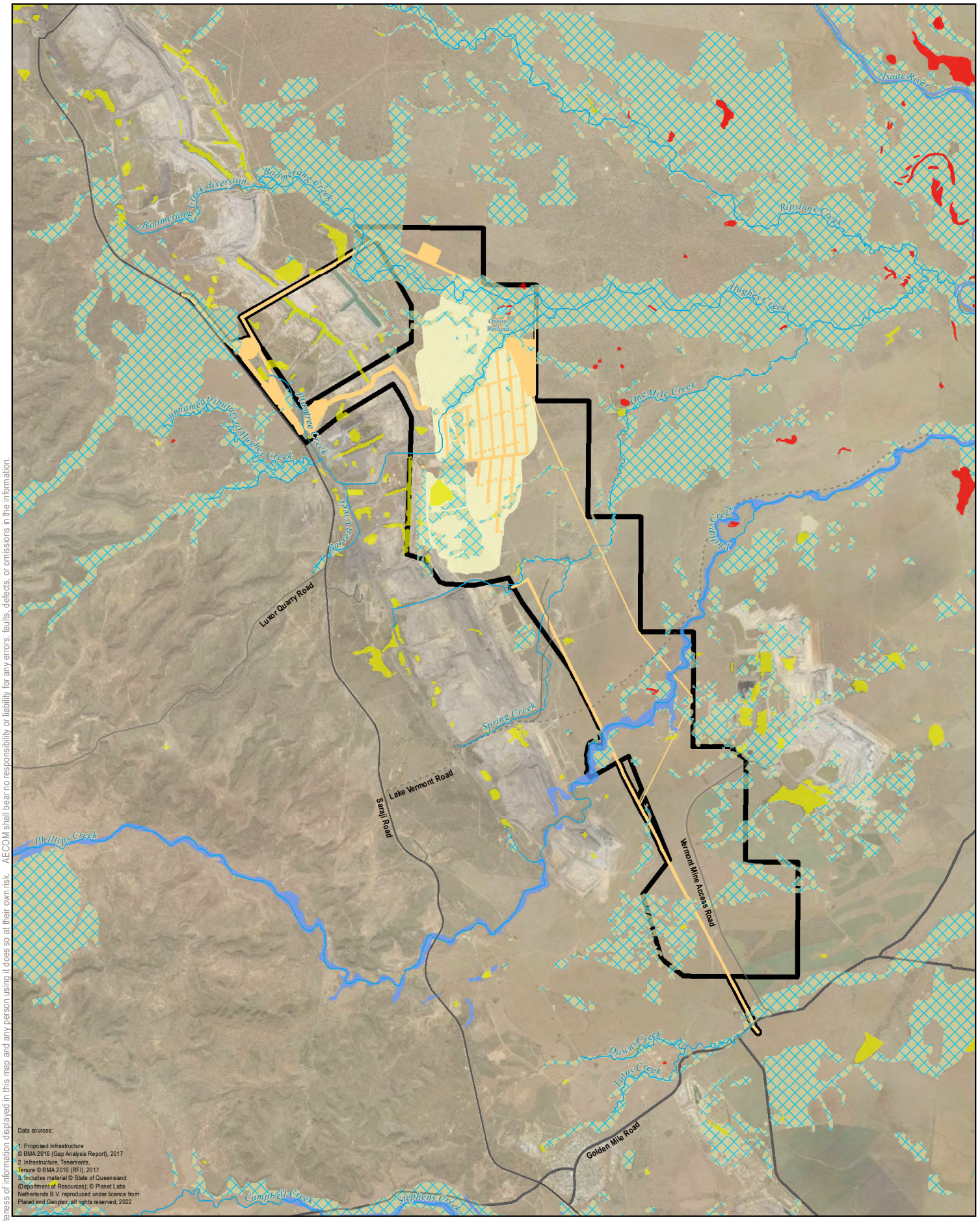
The Isaac River sites contained the highest fish abundance and taxonomic richness. This was assessed as being influenced by the increased water availability in larger and deeper pools, increased substrate diversity such as bedrock and boulders, and increased microhabitat diversity such as macrophytes and undercut banks. The assessment found no obvious differences in the fish communities found between the upstream and downstream sites.

7.5.7 Aquatic reptiles and other vertebrates

No turtles or other aquatic vertebrates, including the platypus, were captured during either of the surveys.

7.5.8 Threatened species

No threatened aquatic species were recorded over the sampling events. Furthermore, based on known records, the current surveys and the habitat suitability assessments, the assessment concluded that the Study area does not support either the critically endangered white-throated snapping turtle or the vulnerable Fitzroy River turtle. Refer to Table 4-6 and 4-7 for the habitat suitability assessment provided within **Appendix D-1 Aquatic Ecology Technical Report**.



Data sources:

1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report), 2017
2. Infrastructure, Tenements, Tenure © BMA 2016 (RFI), 2017
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LEGEND

- Project Site
- Project Footprint - Direct Impact
- Project Footprint - Indirect Impact
- Private Access Road
- Public Road
- Oxbow Wetland
- Watercourse

Wetlands

- Riverine RE
- Lacustrine Waterbody
- Palustrine Waterbody
- Palustrine RE
- RE 1-50% Wetland

N

Figure 7-2

Other Mapped Aquatic Features

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:158,094 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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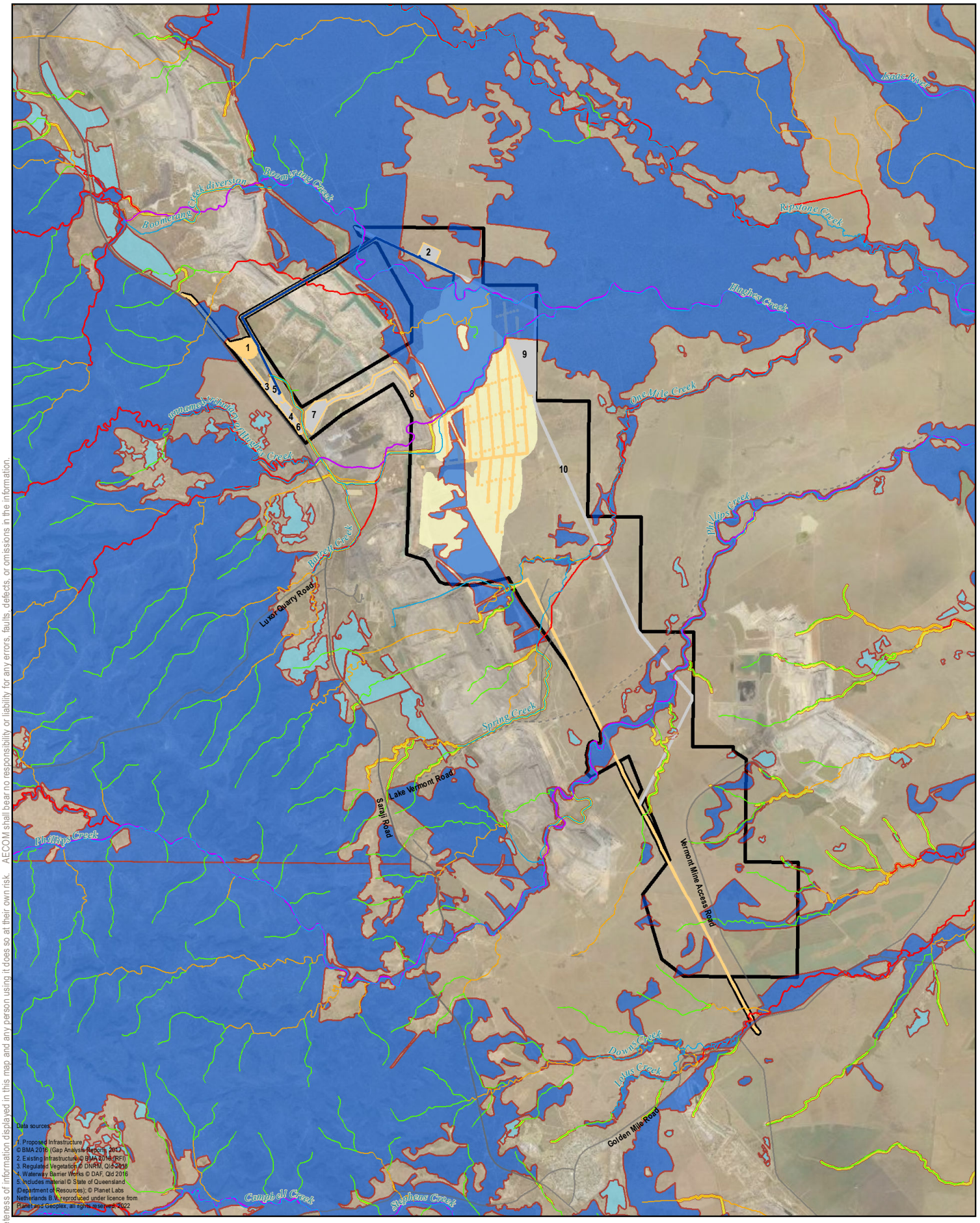

Data sources:
1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report, 2017
2. Existing Infrastructure © BMA 2016 (RFI)
3. Regulated Vegetation © DNRM, Qld 2016
4. Waterway Barrier Works © DAF, Qld 2016
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LEGEND

- Project Site
- Project Footprint - Direct Impact
- Project Footprint - Indirect Impact
- Surface Infrastructure
- Private Access Road
- Public Road
- Pipeline
- Watercourse

Risk of Impact

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

Regulated Vegetation

- Category B area
- Category C area
- Category R area

Surface Infrastructure

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 7-3

Regulated Vegetation and Fish Passage

Environmental Impact Statement Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:158,094 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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7.5.9 Fish passage

Fisheries resources within and surrounding the Project Site are protected under the Fisheries Act. The Fisheries Act regulates, among other things, risk to fish passage from instream development in waterways.

Figure 7-3 and Table 7-5 indicates the mapped colour of waterways within and adjacent to the Project Site for accepted development requirement purposes, as shown on the spatial data layer, Queensland waterways for waterway barrier works.

Table 7-5 Fish passage ratings

Creek name	Mapped colour of waterway
Boomerang Creek	Purple (major)
Hughes Creek	Red (high)
One Mile Creek	Red (high)
Phillips Creek	Purple (major)

7.5.10 Assessment of environmental values

The in-stream aquatic environmental value of watercourses within and surrounding the Project Site was assessed as moderate using the criteria presented in Table 7-3. The watercourses provide favourable habitat for common species of fish, invertebrates and aquatic plants, noting that in-stream aquatic habitat is typically temporary and restricted to isolated pools. Aquatic MNES, threatened aquatic species and HEV waters are not reported to occur within or surrounding the Project Site, although regulated vegetation types occur in the riparian zone and watercourses of the Project Site, which are important corridors for fish passage.

All aquatic species recorded from watercourses within and surrounding the Project Site are tolerant of ephemeral flow and variable water quality and all are common and widespread in the region.

Refer to **Appendix D-1 Aquatic Ecology Technical Report** for a detailed discussion on the existing environmental values.

7.6 Potential impacts

The Project's construction and operational phases have the potential to cause a number of potential impacts upon the aquatic ecology of the Project Site and surrounds. The following sections describe these potential impacts.

7.6.1 Construction

7.6.1.1 Water quality

Water quality has the potential to be impacted by clearing, grubbing, and earthworks as well as ancillary activities such as stockpiling, sediment dam releases effluent releases from construction amenities and the use and storage of hazardous substances and contaminants.

There is a high potential for soil erosion and sedimentation of watercourses following vegetation clearing and earthworks, especially during the wet season when rainfall and run-off intensity is greatest. Stockpiles of soil may also cause increased turbidity and sedimentation of watercourses where rainfall and run-off washes soil into watercourses.

The salinity and water quality predicted concentrations, including turbidity for the Project receiving environment present a negligible risk to local fish species including Agassizi's Glassfish, Bony Bream, Purple-spotted Gudgeon and Sleepy Cod.

7.6.1.2 Aquatic fauna

Instream works have the potential to impact aquatic fauna, particularly the waterway crossings inhibit streamflow and cause a barrier to movements of aquatic fauna during flow events. Where dewatering is required to construct waterway crossing infrastructure it presents the highest risk to fauna due to potential for entrapment and drowning.

The introduction of sediments from unsealed and cleared areas could increase suspended sediments, nutrients and algal growth. Increased turbidity may negatively impact fish and macroinvertebrates, because highly turbid water reduces respiratory and feeding efficiency (Schlosser 1978, cited in Russell and Hales 1993). Increased turbidity may also adversely affect submerged aquatic plants as light penetration (required for photosynthesis) is reduced. Reduced light penetration can also lead to a reduction in temperature throughout the water column (DNRM, 1998).

Small increases in turbidity would be unlikely to have a significant impact on aquatic ecology, as aquatic species of the region are tolerant of moderate turbidity. However, significant increases in turbidity could adversely impact the health, feeding and breeding ecology of some species of macroinvertebrates and fishes, and aquatic plant growth within and downstream of the Project Site.

Sedimentation of watercourses can impact aquatic ecology by smothering stream beds with fine material and decreasing bed roughness and reducing habitat diversity (e.g. smothering divers substrate types such as sand, and gravels and cobbles, smothering woody debris, making pools shallower, and in-filling under-cut banks that provide important habitat for fish). Decreases in available habitat for aquatic fauna due to sedimentation could reduce breeding opportunities and increase predation (e.g. by birds); thus, may cause a localised decline in abundance and diversity of aquatic species.

The turbidity resilience of the Agassizi's Glassfish, Bony Bream, Purple-spotted Gudgeon and Sleepy Cod species are considered high. This is reflected in Table 7-6, which defines the maximum and minimum physiochemical ranges for the various fish species. These species proliferate throughout the wider Fitzroy Basin, which is a largely cleared catchment for which sediment delivery to watercourses is omnipresent (i.e. resulting in high turbidity in watercourses). This indicates that these species are inherently tolerant to fluxes and increases in turbidity.

As supported by Table 7-6, the various fish species present in the Project environment are known to naturally occur throughout a wide range of both saline and turbid environments. The Purple-spotted Gudgeon has been naturally recorded in waters with electrical conductivity levels of 2,495 microsiemens per centimetre (µS/cm), whereas Agassizi's Glassfish, Bony Bream and Sleepy Cod can tolerate salinity levels ranging between brackish water and in some instances, conductivity approaching seawater. Relevant to the Project, the modelled conductivity concentrations from licensed releases of mine affected waters in the receiving environment are <660 µS/cm in Boomerang Creek <450 µS/cm in Hughes Creek (AECOM, 2022). These modelled conductivity values are well below any acute or chronic information available and noted values for which all four species have been recorded in the field.

Table 7-6 Physiochemical parameters for four species across North – Eastern Queensland (Pusey et al., 2004) (Hydrobiology, 2023)

Species	Common Name	Electrical Conductivity (µS/cm)		Turbidity (Nephelometric Turbidity Units (NTU))	
		Minimum	Maximum	Minimum	Maximum
Ambassis agassizi	Agassizi's Glassfish	20 - 145	1,138 - 15,102	0.2	144
Nematalosa erebi	Bony Bream	2 - 295	780* - 1,138	0.3	360
Mogurnda adspersa	Purple – spotted Gudgeon	72	2,495	0.2	200
Oxyeleotris lineolata	Sleepy Cod	4 - 145	650 - 1,138	0.1	579

Table note: * to conductivity approaching sea water

7.6.1.3 Disturbance of watercourses

Macrohabitat

Construction of watercourse crossings for proposed access roads, haul roads, rail lines and pipelines (or other linear infrastructure) may disturb bank and bed sediments from earthworks, leading to increases in localised turbidity and sediment deposition. Unmanaged stockpiling and unsealed roads may also contribute to sediment transport into creeks and habitat. This is especially pertinent where

construction occurs during the wet season. Increased sediment supply into the waterways has the potential to smother and reduce pool depths in receiving creeks. Clearing and grubbing may reduce available habitat, reduce breeding opportunities and increase predation resulting in a decline in the abundance and diversity of species.

Microhabitat

Sedimentation has the potential to impact on the growth and species composition of emergent macrophyte communities. However, within the Study area, identified macrophytes were all emergent forms and are far less susceptible to sedimentation impacts. Additionally, emergent forms were identified along the mid to upper bank margins where they will also be less susceptible to sedimentation.

Impacts to riparian vegetation through clearing has the potential to impact on the availability of detritus which was the dominant microhabitat within the Project Area. However, it is considered that the impact of roads and linear infrastructure to reduce vegetation was insignificant / negligible compared with the overall availability throughout the creek systems.

7.6.1.4 Hydrology and hydraulics

Dewatering activities have the potential to impact hydrology and hydraulics of aquatic ecosystems where systems are groundwater dependent. The assessments undertaken to date indicate that the ecosystems present are not groundwater dependent, so this impact is expected to be low. Additionally, water is not expected to be taken from creeks for construction.

7.6.1.5 Fish passage

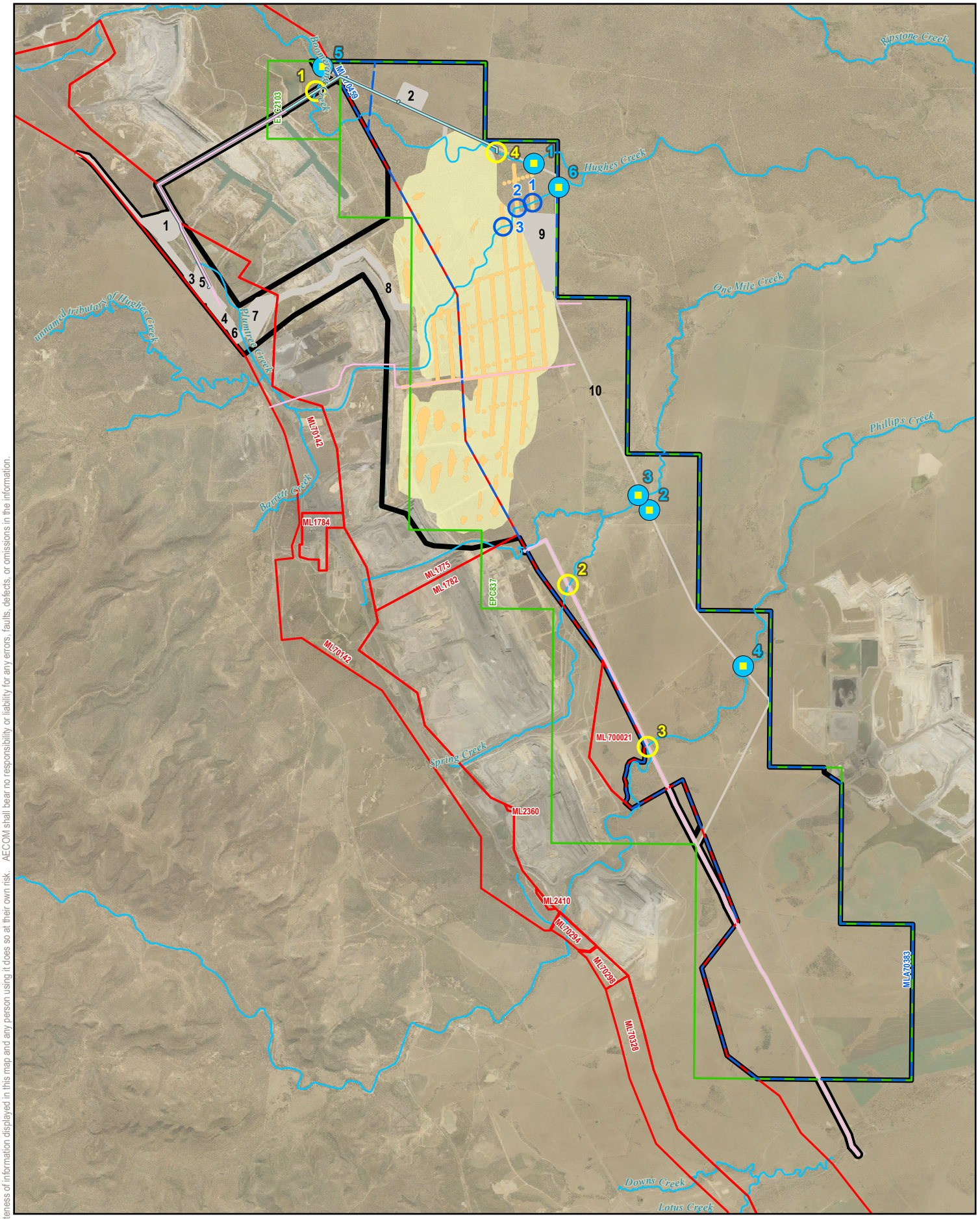
Waterways within the Project Site are mapped as moderate, high or major risk of impact to fish passage. While creeks associated with the Project are not consistently flowing, the design of waterway crossings has the potential to present a barrier to movement of fish to access breeding, feeding, nesting and spawning resources where not designed and constructed appropriately.

Based on conceptual layout of the Project, the indicative location of proposed watercourse crossings for the Project are listed in Table 7-7 and illustrated in Figure 7-4 to facilitate linear infrastructure such as access roads, pipelines and above-ground powerlines. Watercourse crossing locations will aim to prioritise existing crossings, or otherwise accessible locations, with crossings designed to minimise barriers inhibiting stream flow and prevent or impede movements of aquatic fauna during flow events. Without proper design of crossings, stream beds and banks may continue to erode during high flows increasing channel width and a loss in channel definition, resulting in loss of aquatic habitat for fauna.

Table 7-7 Watercourse crossing locations

Watercourse crossing	Watercourse name	Northing (GDA94)	Easting (GDA94)
Powerline and pipeline crossings			
1	Boomerang Creek	7531026.506	631707.7
2	Spring Creek	7519344.927	637673.1
3	Phillips Creek	7515510.473	639559
4	Boomerang	7529576.414	635977.7
Road infrastructure crossings			
1	Boomerang Creek	7529309.487	636867.7463
2	One Mile Creek	7521111.154	639600.524
3	One Mile Creek	7521463.771	639336.0616
4	Phillips Creek	7517418.739	641821.5838
5	Boomerang Creek	7531601.494	631872.3461
6	Hughes Creek	7528751.178	637455.4404

Watercourse crossing	Watercourse name	Northing (GDA94)	Easting (GDA94)
IMG drainage network crossings			
1	Hughes Creek	7528386.345	636835.5874
2	Hughes Creek	7528263.354	636474.269
3	Hughes Creek	7527817.51	636136.0136



LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Surface Infrastructure
- Watercourse
- 66kV Powerline
- Pipeline

Watercourse Crossings

- IMG Crossings
- Pipelines and Powerline Crossings
- Road Crossings

Surface Infrastructure

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 7-4
Proposed Watercourse Crossings

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometers
Scale: 1:116,222 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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Filename: L:\Secure\Projects\605X\60507031\4. Tech Work Area\4.98 GIS 2021\02_MXDs\01 Environmental Impact Statement\03 Project Description\60507031_G448_v1_A4P_StreamCrossings.aprx Layout: F7_4_60507031_G448_v0_A4P_StreamCrossings

7.6.1.6 Spread of introduced species of plants and animals

Construction activities have the potential to increase the risk of spread or introduction of aquatic weeds such as salvinia, water hyacinth and others, as well as the potential to spread or increase the numbers of exotic fish such as tilapia, by reducing water quality which is more favourable for these species. The potential for exotic fish to flourish is low given the ephemeral nature of the watercourses and the persistent lack of water.

7.6.2 Operation

7.6.2.1 Subsidence

Subsidence within Hughes Creeks has been estimated up to 3.4 m as of Year 6, and up to 2 m beyond Year 6. Subsidence is not expected to exceed 1.5 m within Boomerang Creek. Subsidence within the mentioned creeks is expected to reduce bank stability and increase bed and bank erosion, which in turn increases sedimentation and promote riparian vegetation loss.

7.6.2.2 Habitat

Persistent ponding forming in the subsided landscape will be drained to ensure the annual volume of surface water through the catchment is not reduced. Threatened species have not been identified through recent or historic surveys and are therefore not expected to be impacted.

7.6.2.3 Water quality

Subsidence related changes in flow and macrohabitats, increased erosion from stream bed and bank instability and subsequently decline in water quality has the potential to occur in watercourses without management. However, initial increases in suspended solids are considered unlikely to affect food web interactions given the species known to occur and their ability to survive in ephemeral conditions with poor water quality. Water balance modelling undertaken for the Project Site indicates that electroconductivity will remain below the catchment of objectives naturally and the implementation of mitigation measures within the **Appendix K-2 Subsidence Management Plan** will further improve water quality conditions.

7.6.2.4 Groundwater

Groundwater drawdown is not expected to be impacted significantly as a result of the Project Site given that creeks within the Project Area rely on rainfall and overland flow to recharge. GDEs along Phillips and Boomerang Creek are present, however, the impact of groundwater drawdown on these ecosystems was assessed to be in the range of minor to insignificant.

7.6.2.5 Releases

Uncontrolled releases of mine affected water (MAW) to watercourses have potential occur from overspilling, seepage or failure of the water management dams under extreme conditions. Uncontrolled releases of MAW may not have the same water quality and flow conditions to control impacts to the receiving environment, including water quality and aquatic ecology in the receiving environment. Using the water balance model, preliminary water storage capacities were calculated for each structure to accommodate Extreme Storm Storage (ESS) and Design Storage Allowance (DSA) volumes and minimise potential for uncontrolled releases of MAW to the receiving environment.

To allow flexibility and contingency management of MAW inventories, BMA will be seeking authority and licence conditions to conduct the controlled release of MAW from the Process Water Dam (PWD). The indicative location for controlled release of MAW is located on Boomerang Creek adjacent to the proposed PWD. Dam capacity is designed such that operational spillway flows are not planned to occur, however proposed dams will include emergency spillway structures to protect the integrity of the embankments should excess water inventories accumulate. Potential spills from emergency spillway structures from the PWD will be directed to Boomerang Creek. Similarly, any unplanned release from emergency spillway structures associated with the process area dams will be directed to the Plumtree and Hughes Creeks diversion. Where dam overflow locations cannot deliver flows directly to Hughes Creek or its tributaries, conveyance channels are proposed to convey the discharge.

The potential release water quality of MAW from the PWD has been assessed in a simple dilution assessment. Subject to appropriate controls, coordination with proximate mining proponents and flow criteria, water quality objectives for downstream waterways were demonstrated to be achievable. Model

results show that the implementation of managed releases complying with predefined conditions reduces the likelihood of uncontrolled releases, which may lead to significant downstream impacts. See **Appendix E-1 Surface Water Quality Technical Report** for further information.

7.6.2.6 Operation and maintenance of vehicles

Fuels, oils and other chemicals required for the operation of vehicles and mining machinery are potentially toxic to aquatic flora and fauna at relatively low concentrations. Fuel spills are most likely to enter watercourses via an accidental spill on the roads near watercourse crossings; or when there are construction activities adjacent to watercourses. A significant fuel spill to waterways (in the order of hundreds of litres) is likely to have a locally significant impact on both flora and fauna, with the size of spill and the volume of water in the creeks being the most significant factors influencing the length of stream impacted. Other wastes associated with vehicle and machine maintenance also have the potential to contribute to the degradation of aquatic ecosystems.

Vehicles and machinery can also be vectors of dispersal for aquatic biosecurity matters such as listed aquatic weeds. Aquatic weeds can reduce the habitat quality of watercourses for native fish, and dense growth of aquatic weeds can cause a barrier to fish passage. The spread of aquatic weeds (e.g. through vehicle movements) listed under the *Biosecurity Act 2014*, is a breach of this legislation.

7.7 Mitigation measures

7.7.1 Construction

7.7.1.1 Water quality

The impact of increased turbidity on aquatic ecology associated with vegetation clearing, earthworks and stockpiles of soil is anticipated to be minimal because the extent of clearing needed is low; the Mine Industrial Area (MIA) will be constructed on land that is already cleared and mining will be underground. However, further mitigation will be achieved by implementation an erosion and sediment control plan (ESCP) to be developed in line with Australian Standards and conditions of the Environmental Authority to achieve the pollutant load reduction requirements defined in DES (2021). Additionally, the Project will implement a rehabilitation management plan to stabilise disturbed areas and reduce potential for sediment transport.

As shown on Figure 7-4, watercourse crossings will occur as a result of the IMG drainage network. To minimise impact, erosion and sediment controls will be implemented at these crossings. Efforts will be made to reduce the number of crossings, and where crossings are unavoidable, their width will be minimised to limit the disturbance area prone to erosion.

The ESCP will be developed prior to construction and include:

- sediment dams will be constructed prior to vegetation clearing and earthworks
- vegetation clearing and earthworks will be undertaken in incremental stages over the life of the mine where practical
- timing clearing and earthworks for construction of creek crossings or diversions to occur in the dry season where practical
- where practical, erosion control devices will be placed in ditches and drainage lines running from cleared areas, especially on slopes and levee banks
- where practical, contour banks, ditches or similar will be formed across cleared slopes to direct runoff towards surrounding vegetation or sediment dams, and away from creeks
- where appropriate, buffer zones will be retained to maintain and enhance riparian vegetation
- ongoing, proactive erosion and sediment control, including in-stream controls at strategic locations (such as stream crossings) during significant earthworks, installation and operation of incidental mine gas management infrastructure to minimise release of sediment to waterways
- routine inspection and monitoring to ensure the effective implementation of erosion and sediment controls.

When working in the riparian zone associated with Phillips Creek, use of low impact work (i.e. pruning vegetation instead of clearing) will be implemented where practical.

Potential impacts from spills of hazardous substances will be required to be managed in accordance with relevant legislation, guidelines and standards under an approved environmental management plan, with all hazardous substances being housed in appropriately engineered storage areas. The environmental management plan will contain appropriate management measures for emergency response requirements.

Monitoring that will be conducted to ensure effectiveness of mitigation and management measures during the construction phase include:

- visual inspection of hazardous substance storage areas and erosion and sediment control measures. Visual inspections are to be carried out during works and following rainfall events to identify any issues and remedy actions;
- visual inspection of bank stability, bed stability, water quality, any water diversion infrastructure on each day of construction through a waterway. Visual inspections will also be carried out prior to the commencement of the works, and following the commencement of works;
- routine monitoring, in accordance with a developed WMP
- routine audits to ensure appropriately provisioned spill containment controls and spill response kits are in place during construction; and
- monitoring flow, physicochemical and contaminant parameters upstream and downstream of any releases from stormwater infrastructure. Monitoring surface water quality in accordance with AECOM (2023).

7.7.1.2 Fish passage

While creeks associated with the Project do not always flow, the design and construction of road crossings, as well as any other waterway crossing by linear infrastructure (e.g. pipes for water supply, IMG network), will ensure fish passage is maintained. Powerlines will generally be above ground with towers constructed outside of watercourses such that waterway barrier works will not be required.

For each watercourse crossing, BMA will review and optimise siting within the conservatively proposed infrastructure corridor to minimise instream barriers and bank disturbance. Where crossings do not meet the definitions within the What is not a waterway barrier work? factsheet (DAF, 2023), the design will comply with Accepted Development Requirements (ADR) for constructing or raising waterway barrier works (DAF, 2018); generally this will apply to culverts or bed level crossings. If the proposed works does not comply with the accepted development requirements, the work is assessable development and requires development approval; pre-lodgement advice will be sought from the State Assessment and Referral Agency.

Reduced light within culverts wider than 50 metres (m) can potentially impact fish passage; however, crossings associated with the Project will be much less than 50 m in width.

Where practical, road, rail and pipeline crossings of waterways will be constructed in the dry season, when waterways are dry, and rainfall is unlikely. Crossing locations will preferentially be selected in areas where the bank gradient is low, and areas where riparian vegetation in good condition will be avoided as far as practical. Ongoing impacts associated with erosion or failing banks can be mitigated by implementing appropriate rehabilitation (refer **Chapter 5 Land Resources** and **Appendix K-1 Rehabilitation Management Plan**). Similarly, for some infrastructure (for example IMG network) the disturbance area will be minimised through re-establishment of vegetation (in accordance with **Appendix K-1 Rehabilitation Management Plan**) where appropriate to stabilise banks.

Where creek crossings are in areas with either pooled or flowing water, isolation of the workspace will minimise impacts to water quality – for example:

- it is completed within one work-day
- downstream flow is maintained around the workspace by using appropriately sized pumps and flumes

- sediment-laden water is pumped into sumps or onto grassed areas that will trap sediments
- upon completion of construction, the downstream dam is removed first, then the upstream dam is slowly removed, to allow water to flush the sediment from the workspace area.

7.7.1.3 Aquatic fauna

To mitigate the potential impacts to aquatic fauna, salvage efforts will be required to be implemented during dewatering activities and on a needs basis during the construction period. Salvage efforts will be undertaken in accordance with the Fish Salvage Guidelines described for least concern species (DAF, 2022). Both low and high risk species management plans will also be developed and adhered to during all construction activities.

7.7.1.4 Watercourses

Watercourses traversed by the Project are also declared watercourses under the Water Act. Works within declared watercourses will comply with a riverine protection permit or the riverine protection permit exemption requirements.

Under section 218 of the Water Act, a riverine protection permit is required for works involving excavation of material, placement of fill or the removal of vegetation. A riverine protection permit is not required if the works comply with the riverine protection permit exemption requirements.

7.7.1.5 Spread of introduced species of plants and animals

A weed management plan (WMP) will be required to include as a minimum, decontamination procedures for vehicles, machinery and other construction equipment and monitoring and corrective actions.

Erosion and sediment controls will assist in maintaining water quality, which in turn will assist in keeping water quality higher, which is less favourable for introduced species such as tilapia to breed.

7.7.2 Operations

7.7.2.1 Subsidence

The extent of subsidence was predicted using modelling detailed in **Appendix B-2 Subsidence Modelling**. Based on this modelling a conceptual assessment of the maximum impact of ponded areas was completed in **Appendix E-4 Subsidence Ponding Assessment**. Four ponds occurring on Hughes Creek, N07, S19 and W03, were modelled to demonstrate the typical behaviour of ponding areas. The model found that the catchment areas range in size from 3.1 ha (S03) to 17,348 ha (W01). Water stored in the watercourse pond fluctuates based on rainfall but contains water most of the time. However, because of infilling the waterway ponding areas on Hughes Creek are not expected to be there for an extended period of time.

Impacts from subsidence will be managed through development and implementation of the **Subsidence Management Plan** (**Appendix K-2**) applying:

- an adaptive and iterative approach to management including assessment of risk, identification and implementation of measures and importantly, subsidence monitoring, the evaluation of mitigation measures and provision for the adjustment of plans and practices as required
- key management strategies for ponding and surface crack repairs as well as water quality, bank and bed erosion, bank instability and downstream aggradation
- erosion protection measures, including revegetation as appropriate
- where practical, riverbed earthworks will be undertaken to re-profile waterways to a natural state
- development and implementation of a receiving environment monitoring program (REMP)
- design of waterway structures and features to facilitate fish passage and connectivity of waterways providing for fish passage
- provision for ongoing commitments to ensure subsidence does not continue to impact MSES after the mine closure, including:

  - maintenance of fish passage and connectivity within waterways affected by subsidence from the Project
  - mitigation and other works to restore waterway connectivity including remediation of drops in elevation, maintaining stream bed slopes of less than 5% where waterways are regraded, and design of erosion control structures to facilitate fish passage.
- monitoring methodologies, parameters and frequencies for landform, surface water, groundwater, ecology and infrastructure,
- a monitoring program review schedule to ensure that the program is capable to enable identification of subsidence impacts and assessing mitigation measure effectiveness in a timely manner; includes review of monitoring locations, parameters, methodologies and frequencies; is collecting the required data and meets the requirements of approvals
- reporting on the condition of the site including all monitoring results and assessments.

Based on the aquatic baseline and impact assessment report prepared for the Project, it is considered that the successful implementation of the Subsidence Management Plan, the residual risk to aquatic values will be negligible to low. Additionally, given that the timing and severity of potential subsidence impacts cannot always be accurately predicted, therefore an adaptive and iterative approach towards identifying and managing potential subsidence impacts is required.

Refer to Section 4 of **Appendix K-2 Subsidence Management Plan** for detailed information on the specific mitigation measures to be implemented for this Project.

7.7.2.2 Water quality

All dams for the Project will be constructed in accordance with the Department of Environment and Science (DES) Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES, 2016). Seepage from, and failure of, these dams is unlikely because they will be compliant with regulator approved engineering and design specifications.

Surface runoff and leachate from the overburden waste dumps will be captured by drains and sediment basins, run-off from potentially contaminated areas will be collected through a segregated mine water management system that drains to an appropriately sized water storage (further information on the mine water balance is provided in **Chapter 8 Surface Water Resources**). Surface water quality will be monitored in accordance with a site Water Management Plan. The Water Management Plan will be developed prior to construction and include collection of additional baseline data on surface water flows and quality, trigger levels for investigations and a monitoring program.

Monitoring that will be conducted to ensure effectiveness of mitigation and management measures during the operation phase for water quality include:

- monitoring of flow, physicochemical and contaminant parameters upstream and downstream of any releases of mine affected waters, monitoring surface water quality in accordance with **Appendix E-1 Surface Water Quality Technical Report**;
- routine monitoring of any release infrastructure to identify and correct any scour, erosion and/or sedimentation. Identified issues are to be investigated and remedied; and
- visual inspection for debris and sedimentation at crossing related infrastructure (i.e. road infrastructure). Identified debris and sediment will be remedied to allow for connectivity to upstream environment.

7.7.2.3 Fish passage in waterways

There is potential for significant residual impact (SRI) to waterways providing for fish passage as a result of subsidence when located within waterways, including the impacts on upstream sections of the waterways impacted as a result of severed connectivity. However, BMA is committed to maintaining fish passage within waterways during operation of the mine and also to providing mitigation and restoration to areas of waterways where connectivity and passage has been impacted, refer to **Appendix K-2 Subsidence Management Plan** for details of mitigation measures and design parameters where fish passage has been impacted by subsidence.

7.7.2.4 Operation and maintenance of vehicles

The storage and use of fuels, oils and batteries will be in accordance with Australian Standard 1940:2017 – The storage and handling of flammable and combustible liquids.

Use of equipment that is susceptible to spills and/or leakages of fuels will have appropriate spills kits located local to the equipment, with kits that can contain and cleans spills on land, in dry watercourses and wet watercourses being available at all times.

It is unlikely that a direct spill will occur within a watercourse; however, should a spill occur then this will be reported in line with the BMA operating procedures with relevant stakeholders being contacted as necessary. All vehicles and machinery arriving to and leaving site will be subject to specific control measures in line with the Weed and Pest Management Plan (refer to **Chapter 6 Terrestrial Ecology**).

7.8 Residual impacts

A significant residual impact assessment was undertaken by Hydrobiology (2023) for relevant MNES and MSES which include HES wetlands and waterways for fish passage.

7.8.1 Waterways for fish passage

There is potential for SRI to waterways providing for fish passage as a result of subsidence, however BMA is committed to maintaining fish passage within the waterways during operation of the mine and also to providing mitigation and restoration to areas of waterways where connectivity and passage has been impacted. A **Subsidence Management Plan** (**Appendix K-2**) has been prepared for the Project which covers all potential impacts as a result of future subsidence and proposed management and mitigation measures, including maintaining drainage across the landscape. If management and mitigation measures are not successfully implemented and an SRI (see **Appendix D-1 Aquatic Ecology Technical Report** for list of SRI criteria impacts) occurs, offsets may be required to be provided to the State. All reasonable mitigation measures will be attempted prior to an offset being considered.

7.8.2 HES wetlands

HES wetlands are mapped in the Isaac River floodplain and adjacent to Hughes, Boomerang and Phillips Creek (Lake Vermont) though not within the Project area. However, the SRI assessment indicates that construction and operation of the Project Site will not impact the HES wetlands in terms of wetlands being modified or destroyed, altering water quality, impacting habitat and lifecycle of species dependent on the wetlands, substantially affecting the hydrology of the wetlands or by spread of invasive species.

7.8.3 MNES and MSES assessment exclusions

The assessment excluded the following matters:

- Threatened aquatic species under the EPBC Act and NC Act. The two aquatic MNES identified in the PMST (white-throated snapping turtle and Fitzroy River turtle) are unlikely to be impacted by the Project given they do not occur in the study area. The nearest known population of white-throated snapping turtle is approximately 80 km (straight-line distance) downstream from the Project Site, and the nearest known population of Fitzroy River turtle is approximately 90 km (straight-line distance) downstream from the Project Site. The nearest likely population of both of these MNES species is approximately 60 km (straight-line distance) downstream of the Project Site.
- Protected animal wildlife habitat for special least concern species (platypus) protected under the NC Act. This species does not occur in the Project Site or surrounding area, nor are any impacts expected to occur to any known habitat or populations
- Other MNES and MSES as impacts are not expected to occur to these matters.

7.9 Summary and conclusion

The waterways of the Study area and surrounds are ephemeral in nature, where flow and pool habitat occur only following sufficient rainfall. The pool habitat within the surveyed creeks and rivers is short lived, and for the most part provide typically small shallow pool extents. The surveys creeks and river

experience long periods of no flow or any aquatic habitat as is characteristic for the Isaac River catchment.

Habitat condition varied from ‘fair’ to ‘good’ with scores being negatively influenced by a lack of macrohabitat diversity, particularly the lack of run and riffle habitat, as available water was often limited to shallow isolated pools. Isaac River sites were generally in better condition than creek sites due to improved riparian streamside vegetation cover, increased in-stream habitat diversity (e.g., large woody debris, undercut banks) and improved bank/bed stability.

No threatened aquatic species were recorded over the sampling events. Based on the current survey, lack of historical records (nearest record located 60 km from the Study area) and the habitat suitability assessments, the critically endangered white-throated snapping and the vulnerable Fitzroy River turtle do not occur in the Study area or surrounds.

With the implementation of the mitigation and management measures described and referred to throughout, and based on the current/likely impacts, the construction and operational stages of the Project are expected to have negligible to low residual impact on the aquatic ecosystem values of the receiving environments. There will also be no significant residual impact on any aquatic related State or National matters. This is contingent on the successful implementation of the developed **Subsidence Management Plan (Appendix K-2)**, which is critical to moderating potential impacts from subsidence which would include, subsidence pooling, water quality degradation, increased bank and bed erosion and bank instability and downstream aggradation.