

SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Appendix D-1 Aquatic Ecology



BHP Mitsubishi Alliance

AQUATIC ECOLOGY BASELINE AND IMPACT ASSESSMENT

BRISBANE | PERTH | SINGAPORE | PAPUA NEW GUINEA

SARAJI EAST MINING LEASE EXPANSION PROJECT



B21079

—
July 2023

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EXECUTIVE SUMMARY

BACKGROUND

This report describes the results of the aquatic ecological baseline study and impact assessment completed by Hydrobiology for the Saraji East Mining Lease Expansion Project located in the Isaac Region, Queensland. The desktop review and field survey involved the assessment of aquatic ecosystems (surface water) and aquatic groundwater-dependent ecosystems (GDE) and associated habitat, water quality (in-situ), macroinvertebrates, macrocrustaceans and fish. The results are summarised below.

This aquatic ecological study was able to draw on existing data (typically associated to compliance monitoring) from previous studies to initially define aquatic values, but also define field survey specifics for the identified knowledge gaps. The field survey involved a number of sampling sites across the mapped waterways relevant to the Project and the ultimate receiving environment, the Isaac River. These sites were assessed over two survey (early and later-wet seasons) for habitat (diversity and condition), groundwater dependency (presence and value), water quality (in-situ physicochemical parameters) and aquatic biota (macrophytes, macroinvertebrates, macrocrustaceans, fish and reptiles).

Based on the concept design of the project, construction and operational impacts are discussed, with appropriate management and mitigation measures detailed to protect aquatic ecosystem values.

HABITAT

The waterways of the Study area and surrounds are 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 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. Habitat condition was broadly similar to those recorded in previous surveys.

There are no defined aquatic groundwater dependent ecosystems, within the Study area.

WATER QUALITY

Electrical conductivity (EC) and pH were typical of similar systems and in most cases remained within defined guidelines. Dissolved oxygen levels fluctuated naturally according to the time of day at some sites but were decreased at other sites due to the small size of the pools sampled and a high level of animal disturbance. Turbidity was similarly elevated at some creek sites where feral animal disturbance was noted.

Physicochemical parameters for the most part remained similar to historical collected data.

MACROINVERTEBRATES

Macroinvertebrate assemblages within the Study area were dominated by taxa that are tolerant of a wide range of conditions. Assemblages and diversity indices such as taxonomic richness, PET richness, SIGNAL2 score and AUSRIVAS OE50 were driven by macrohabitat and microhabitat diversity. Diversity indices were higher at Isaac River sites compared to creek sites due to increased water availability and diverse microhabitat, which included 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 lower than historical REMP data at Hughes Creek and One Mile Creek, likely due to inter-annual differences in flow events.

FISH

A total of 9 native and 2 exotic fish species comprising a total of 604 individuals were recorded across the Study area. All species recorded are common and widespread in the local region and are typical of similar ephemeral systems, where they are tolerant to a wide range of environmental conditions.

Isaac River sites contained the highest fish abundance and taxonomic richness, being influenced by increased water availability (i.e., larger and deeper pools), increased substrate diversity (included bedrock and boulders) and increased microhabitat diversity (e.g., macrophytes and undercut banks).

THREATENED SPECIES

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.

PROJECT IMPACTS

With the implementation of the mitigation and management measures described and referred to throughout, and based on the current/likely impacts the construction and operation 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.

The above is contingent on the successful implementation of the developed Subsidence Management Plan, 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.

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

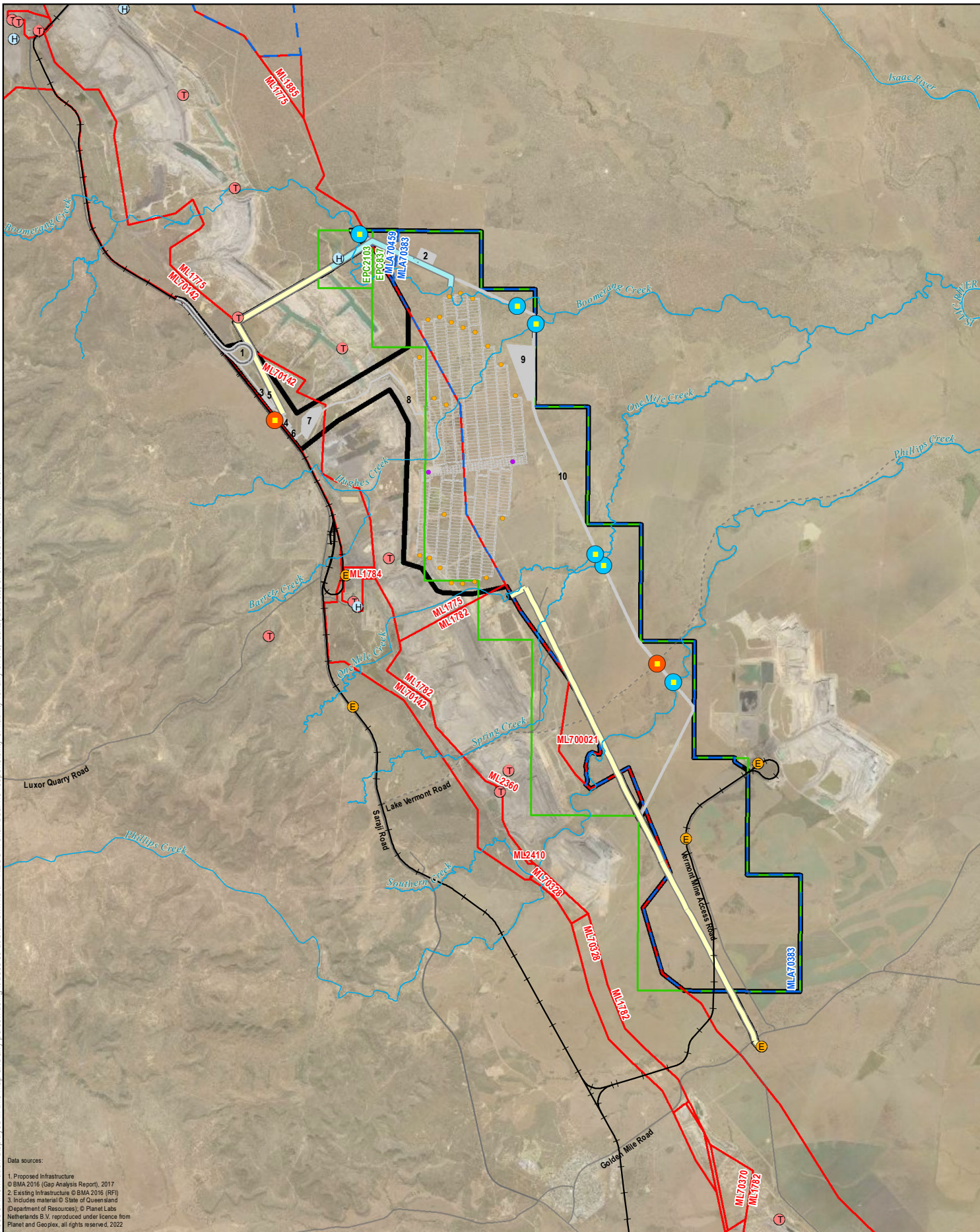
BMA proposes to develop the Project involving a greenfield single-seam underground mine development and supporting infrastructure to produce an estimated 110 Mt of high quality metallurgical product coal by longwall mining methods over the 20-year life of mine.

The key objectives of the Project are to:

- Use BMA-owned land on the adjacent existing Saraji Mine ML to minimise new disturbance and Facilitate Project efficiencies;
- Operate a profitable Project providing high-quality hard coking coal, semi hard coking coal and pulverised coal injection coal to the export market; and
- Design, construct and operate the Project to:
 - minimise adverse impacts on the surrounding bio-physical and social environments.
 - comply with relevant statutory obligations and employ processes to enhance sound environmental management.

The Project will be developed 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. Supporting infrastructure will comprise a new Coal Handling Preparation Plant (CHPP), a Mine Infrastructure Area (MIA), a conveyor system, stockpiles, rail spur and balloon loop, water pipelines and dams, powerlines, incidental mine gas management, supporting transport and infrastructure corridor, and construction accommodation village; to be developed on MLA 70383, MLA 70459 or co-located on the adjacent

Saraji Mine tenure (ML 70142, ML 1775 and ML1782). The key features of the Project are shown in Figure 1-1.



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

- | | | |
|--------------------------------|----------------------|--------------------------|
| Project Site | Private Access Road | Substation |
| Exploration Permit Coal (EPC) | Public Road | Helipad |
| Mining Lease (ML) | Rail Loop | Telecommunications Tower |
| Mining Lease Application (MLA) | 66kV Powerline | Flare |
| Underground Mine Layout | Pipeline | Vent |
| Surface Infrastructure | Entry/Access point | |
| Watercourse | Watercourse crossing | |
| Existing Railway | | |

- 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



**Figure 1-1
Project Layout**

**Environmental Impact Statement
Saraji East Mining Lease Project**

0 0.75 1.5 3
Kilometres

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

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



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1.2 LOCATION

The Project is located approximately 6 km from the township of Dysart and is an expansion of multiple mining projects owned by BMA (Figure 1-2). The Project is located in the Isaac River sub-basin catchment and is crossed by five creek systems; Boomerang Creek, Hughes Creek, One Mile Creek, Spring Creek and Phillips Creek.

The ‘Study area’ for this component of work encapsulated the freshwater aquatic habitats (freshwater creek and river systems) upstream and downstream of both Saraji East footprint and the wider Saraji Coal Mine (SCM) area. This included the detailed watercourses above and the sites located along the Isaac River, both upstream and downstream of the Project site. Note that there are no palustrine or lacustrine waterbodies within the context of the creek or river systems and/or where potential impacts could occur.

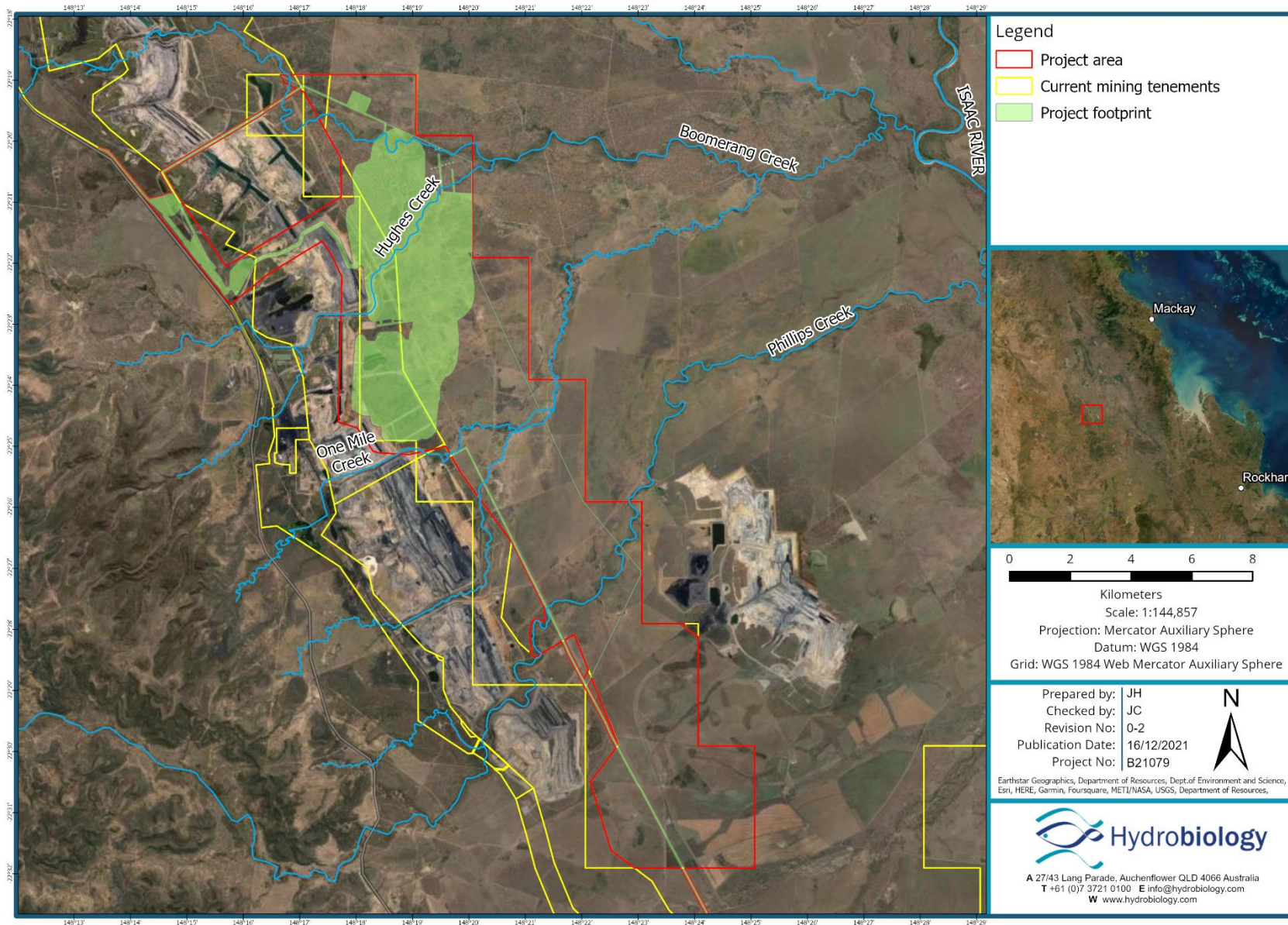


Figure 1-2 Project Location.

1.3 SCOPE AND OBJECTIVES

Hydrobiology was commissioned to assist AECOM with the Project and specifically to address comments and recommendations from the Independent Expert Scientific Committee (IESC). Namely that there was a need for:

Aquatic surveys (water quality, habitat availability and structure, turtles, fish, aquatic macroinvertebrates and relevant riparian biota) at several sites on each of the three creeks to be undermined as well as suitable reference sites where impacts are not predicted. These surveys should coincide with a period of flow as well as a period soon after flow has ceased so that remnant pools can also be assessed.

Justification given for this recommendation was that the initial aquatic ecosystem impact assessment was based on data collected in 2007 and/or 2010 and that without more recent and spatially comprehensive baseline dataset, the proponent was unable to assess whether there have been any changes in composition of the aquatic biota in these creeks in the last decade or reliably predict likely impacts of the project (e.g. altered flow regimes) on aquatic and riparian biota.

The purpose of this assessment was therefore to describe, using existing data supplemented by new field surveys, the existing aquatic ecological values of the Study Area to satisfy the “Aquatic Ecology” section of the wider environmental impact statement (EIS).

To address this requirement, Hydrobiology was commissioned to undertake a three-stage assessment process which included:

- Stage 1 – Desktop assessment (literature review and gap analysis) of the aquatic ecosystem values within the Study Area;
- Stage 2 – Two field surveys to confirm the desktop findings and fill gaps; and
- Stage 3 – An impact and mitigation assessment.

This report presents the findings of the initial desktop assessment, aquatic ecology field assessment and the subsequent impact and mitigation assessment. To fully characterise and assess potential impacts to aquatic ecology values, this report also summarises relevant data from a specific assessment of aquatic groundwater dependent ecosystems (GDE) (3D Environmental, 2023).

This report only assesses water quality as a habitat variable. A more detailed assessment of water and sediment quality values in their own right is documented in a separate report; Saraji East Mining Lease Project - Surface Water Quality Technical Report (AECOM, 2023b).

2.

REGULATORY

ENVIRONMENT

2.1 ENVIRONMENTAL VALUES

Commonwealth and State legislation relevant to the Study area and surrounds are summarised in Table 2-1. They have been used to identify environmental values of relevance to aquatic ecology in the Study area and legislation relating to aquatic matters is discussed below.

2.1.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legal framework for the protection and management of Australia's unique plants, animals, habitats and places. These include heritage sites, marine areas and some wetlands. The Act also protects listed threatened and migratory species. The protected matters are collectively defined as Matters of National Environmental Significance (MNES).

The 9 MNES are:

- World heritage areas;
- National heritage places;
- Wetlands of international importance (listed under the Ramsar Convention);
- Listed threatened species and ecological communities;
- Listed migratory species (protected under international agreements);

- Commonwealth marine areas;
- Great Barrier Reef Marine Park;
- Nuclear actions (including uranium mines); and
- Water resources (that relate to coal seam gas development and large coal mining development).

The Act also protects the environment when actions are taken:

- On Commonwealth land or impact upon Commonwealth land;
- By an Australian Government agency anywhere in the world; and
- That impact Commonwealth heritage places overseas.

For the purposes of this report it is assumed that the MNES of listed aquatic threatened species and ecological communities is relevant. Other MNES may be relevant to other reports (i.e. terrestrial species and communities).

The EPBC Act provides protection for threatened species and ecological communities by:

- Identifying and listing of species and ecological communities as threatened;
- Developing conservation advice and recovery plans for listed species and ecological communities;
- Developing a register of critical habitat;
- Recognising key threatening processes;
- Where appropriate, reducing the impacts of these processes through threat abatement plans and non-statutory threat abatement advice; and by
- Requiring approval for certain actions or activities that will, or are likely to, have a significant impact on an MNES or other protected matter.

Listed threatened species relevant to the Study area are detailed in the below table (Table 2-1).

2.1.2 EPBC ACT ENVIRONMENTAL OFFSET POLICY 2012

This policy outlines the Australian Government's approach to the use of environmental offsets ('offsets') under the EPBC Act.

Offsets are defined as measures that compensate for the residual adverse impacts of an action on the environment. Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the EPBC Act.

In identifying whether an activity will, or is likely to have, a significant residual impact, an administering agency may refer to:

- The Commonwealth Significant Impact Guidelines for what constitutes a significant residual impact on MNES (DoE, 2013).

Typically, environmental offsets delivered under the EPBC Act are required to be proponent driven, land-based offsets (known as direct offsets). Direct offsets of 90 percent are required. The policy is accompanied by the Offsets assessment guide (the guide). The guide has been developed in order to give effect to the requirements of the policy, utilising a balance sheet approach to estimate impacts and offsets for threatened species and ecological communities. The policy and guide provide a decision support framework in order to normalise the judgements associated with determination of proposed offsets for a given impact. The overarching test of both the policy and the guide is that suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.

2.1.3 ENVIRONMENTAL PROTECTION ACT 1994 (EP ACT)

The EP Act provides the legislative framework for ecologically sustainable development in Queensland. Its purpose is to protect Queensland's environment while allowing for development that improves the total quality of life, now and in the future, in a way that maintains the ecological processes on which life depends.

Section 319 of the EP Act defines the General Environmental Duty and states that a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm. Section 320 of the EP Act also includes a duty to notify, where a person is required to give notice where serious or material environmental harm is caused or there is a risk of such harm, and that harm is not authorised.

The mechanisms of the EP Act include to achieve its objectives include the General Environmental Duty, regulation of contaminated land, licencing of Environmentally Relevant Activities (ERAs) as outlined under Schedule 2 of the EP Regulation and issuing the Environmental Protection Policies (EPPs) and Regulations under the Act.

2.1.4 ENVIRONMENTAL PROTECTION (WATER AND WETLAND BIODIVERSITY) POLICY 2019 (EPP (WWB))

The EPP (WWB) provides for the achievement of the objectives of the EP Act in relation to Queensland waters. Environmental values for Queensland waters include the protection of aquatic ecosystems. The components of aquatic ecosystems to be protected are generally specified under the EPP (WWB) for a given waterway if water quality objectives have been listed under Schedule 1 of the EPP (WWB).

2.1.5 NATURE CONSERVATION ACT 1992 (NC ACT)

The purpose of the NC Act is the conservation of nature while allowing for the involvement of indigenous people in the management of protected areas in which they have an interest under Aboriginal tradition or Island custom. The NC Act provides the framework for the declaration and management of protected areas, and the protection of wildlife listed under the Nature Conservation Regulation (Plants) 2020 and Nature Conservation Regulation (Animals) 2020.

The NC Act, section 71 describes the classes of wildlife to which the Act applies as:

protected wildlife, that is:

- Extinct wildlife;
- Extinct in the wild wildlife;
- Critically endangered wildlife;
- Endangered wildlife;
- Vulnerable wildlife;
- Near threatened wildlife;
- Least concern wildlife;
- International wildlife; and
- Prohibited wildlife.

2.1.6 NATURE CONSERVATION REGULATION (PLANTS) 2020 AND NATURE CONSERVATION REGULATION (ANIMALS) 2020

These NC Regulations prescribes the status of particular species in accordance with the categories set out in the Act. Listed threatened species relevant to the Study area are detailed in the below table. It also discusses special least concern animals which are defined as:

- echidna (*Tachyglossus aculeatus*);
- platypus (*Ornithorhynchus anatinus*) – relevant to this study; and
- least concern birds.

It is an offence to 'take' protected wildlife without a license, permit or other authority (section 320), where take is defined in the NC Act. It is also an offence for a person, without a reasonable excuse, to tamper with an animal breeding place that is being used by a protected animal to incubate or rear the animal's offspring.

2.1.7 FISHERIES ACT 1994

The *Fisheries Act 1994* provides for the management and protection of fisheries resources, including regulating development that might impact declared fish habitat areas and fish passage. It regulates the taking and possession of specific fishes, removal of marine vegetation, the control of development in areas of fish habitat and listed noxious fish species.

The Fisheries Act establishes a risk hierarchy for waterway barrier works across Queensland and guides the design and assessment process for the implementation of new and altered waterway crossings. Development potentially impacting fish passage is either:

- Accepted development, where the design of infrastructure strictly conforms to the Department of Agriculture and Fisheries' (DAF) Accepted Development Requirements for Operational Work that is Constructing or Raising a Waterway Barrier Works (2017); or
- Assessable development, where the proposed development requires assessment by DAF and the design of the development is required to demonstrate compliance with the State Development Assessment Provisions (SDAP State code 18).

The Queensland Waterways for Waterway Barrier Works spatial data layer assists in the determination of whether the site of proposed waterway barrier works requires assessment and approval under the Act. Waterways have been colour coded to show the risk of adverse impact from in-stream barriers on fish movement and whether waterway barrier works can potentially proceed under the accepted development code or whether the works will require a development approval. Culverts, bridges, dams and other temporary or permanent waterway barrier works that cannot comply with accepted development requirements will result in waterway barrier works designs requiring approval from the DAF.

2.1.8 ENVIRONMENTAL OFFSETS ACT 2014 (EO ACT) QUEENSLAND

The EO Act provides for environmental offsets to counterbalance significant residual impacts (SRI) of activities on matters of state or local environmental significance (MSES, and MLES respectively) and establishes a framework in relation to environmental offsets. The EO Act defines a significant residual impact in Section 8 as an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

- Remains, or will or is likely to remain, (whether temporarily or permanently) despite on-site mitigation measures for the prescribed activity; and
- Is, or will or is likely to be, significant.

In identifying whether an activity will, or is likely to have, a significant residual impact, an administering agency may refer to:

- The State guideline that provides guidance on what constitutes a significant residual impact for MSES (DES, 2014).

For State matters not gazetted under the EPBC Act and where a Project is deemed to have a SRI on MSES, an environmental offset is required in accordance with the Queensland *Environmental Offsets Act 2014* (EO Act). Environmental offsets under the EO Act can take various forms, including financial settlement offsets, proponent driven offsets or a combination of the two.

2.1.9 QUEENSLAND WATER ACT 2000

The Queensland Water Act 2000 provides for the sustainable management of water resources in Queensland, including requiring permits for works within watercourses and providing for the sustainable allocation of water for environmental purposes (i.e. environmental flows to protect ecological functions in rivers). Many of these functions are documented in Water Plans for a catchment, which include ecological outcomes and obligations for water licence holders or water scheme operators. For example, in relation to the Project, the Water Plan (Fitzroy Basin) 2011 details how the water in the plan area is to be allocated and sustainably managed. They also include obligations on the infrastructure owner to undertake monitoring to assess the performance of implemented management measures. This includes environmental matters such as threatened species.

2.1.10 BIOSECURITY ACT 2014

The purpose of the *Biosecurity Act 2014* (Qld) (Biosecurity Act) is to provide a framework for minimising and managing biosecurity risks in Queensland, ensure the safety of agricultural inputs, align responses to biosecurity events to national and international obligations, and manage risks associated with:

- Emerging, endemic and exotic pests and diseases that impact the built, social and natural environment;
- The transfer of diseases from animals to humans and vice versa; and
- Biological, chemical, and physical contaminants in carriers.

The Biosecurity Act establishes a General Biosecurity Obligation that requires all people in Queensland to be responsible for managing biosecurity risks that are under their control and that they know about or should reasonably be expected to know about. It also defines prohibited and restricted biosecurity matters and places. Prohibited matters are listed in Schedule 1 of the Biosecurity Act, and restricted matters are listed in Schedule 2.

Under the General Biosecurity Obligation, individuals and organisations who undertake activities that present a biosecurity risk must:

- Take all reasonable and practical measures to prevent or minimise the risk;
- Prevent or minimise the adverse effects on a biosecurity consideration;
- Minimise the likelihood of causing a biosecurity event, and limit the consequences of a biosecurity event; and
- Not do or omit to do something if it is known, or ought to reasonably be known, that this may exacerbate adverse effects.

Aquatic pests that are restricted biosecurity matters listed in Schedule 2 of the Act include:

- Various pathogens;
- 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*); and

- Other plants that are common weeds of riparian areas.

2.1.11 BIOSECURITY REGULATION 2016 (QLD)

The *Biosecurity Regulation 2016* (Qld) prescribes the ways in which the General Biosecurity Obligation can be met to prevent or minimise a biosecurity risk, including measures to prevent or control the spread of biosecurity matter and maximum acceptable levels of contaminants in carriers.

2.1.12 WEEDS OF NATIONAL SIGNIFICANCE

Weeds of National Significance (WoNS) is a list of the most problematic plant species in Australia as determined by the federal government. Under the National Weeds Strategy, 32 introduced plants were identified as WoNS. Relevant to this investigation (aquatic plants/macrophytes), those WoNS, include:

- salvinia (*Salvinia molesta*);
- cabomba (*Cabomba caroliniana*);
- hymenachne (*Hymenachne amplexicaulis*); and
- water hyacinth (*Eichhornia crassipes*).

2.1.13 AQUATIC ECOSYSTEM EVS AND MANAGEMENT INTENT

There are a range of environmental values (EVs) applicable to waterways in Queensland. These include the value of the waterways to aquatic ecosystems, primary industries, recreation, and aesthetics, drinking water, industrial uses as well as cultural and spiritual values. The Study area is located within the water management areas deemed the:

- Isaac western upland tributaries
 - Includes Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek
- Isaac and Lower Conners River main channel
 - Includes the Isaac River

Both management areas are considered moderately disturbed (DEHP, 2011). The defined management intent for moderately disturbed systems is to maintain aquatic ecosystem values.

Table 2-1 Legislation relevant to aquatic ecological matters of the Project

Legislation	Environmental value	Notes
Matters of National Environmental Significance		
Environment Protection and Biodiversity Conservation Act 1999	National heritage places	There are no national heritage properties listed under the EBPC act that are located within the Study area or surrounds.
	World heritage properties	No world heritage properties occur within the Study area or surrounds.
	Wetlands of international significance	There are no mapped wetlands of international significance within the Study area and surrounds. The nearest mapped wetland of international significance is Shoalwater Bay, located approximately 190 km to the east of the project.
	Great Barrier Reef Marine Park	The GBRMP does not overlap with the Study area or surrounds and is located approximately 130 km east of the Study area.
	Commonwealth marine waters	There are no Commonwealth marine waters mapped within the Study area or surrounds
	Listed Threatened Species and Ecological Communities	There are two listed threatened species that may occur in the Study area, these are: • White-throated snapping turtle (<i>Elseya albagula</i>) – listed as Critically Endangered; and • Fitzroy River turtle (<i>Rheodytes leukops</i>) – listed as Vulnerable
Wet Tropics World Heritage Protection and Management Act 1993	<i>Wet Tropics World Heritage Protection and Management Act 1993</i>	The Study area and surrounds are not located within any Wet Tropics World Heritage catchments. The most southerly point of the wet tropics world heritage area extends north of Townsville, near Bluewater.
Directory of Important Wetlands in Australia	Directory of Important Wetlands in Australia	There are no wetlands of national importance within the Study area or surrounds. The nearest mapped wetland of national importance is Broad Sound, located approximately 120 km to the east of the project.
Matters of State Environmental Significance from Schedule 2 of the Environmental Offset Regulation 2014		
Environmental Protection Act 1994	A wetland in a wetland protection area (WPA)	There are no mapped WPA within the Study area and surrounds.
	A wetland of high ecological significance (HES) shown on the map of Queensland wetland environmental values	There are mapped HES wetlands within the Study area, however they occur within floodplain areas of the investigated watercourses (Figure 2-1).
	A wetland or watercourse in high ecological value (HEV) waters	There are no mapped HEV wetland within the Study area and surrounds.
Regional Planning Interests Act 2014	A designated precinct in a strategic environmental area	The Study area and surrounds do not traverse any mapped strategic environmental areas.
Nature Conservation Act 1992	A habitat for an animal that is critically endangered wildlife, endangered wildlife or vulnerable wildlife or a special least concern animal	Protected species or species habitat may occur within the Study area and its surrounds (Section 4.2.9)
	A protected area	There are no protected areas within the Study area or surrounds.
Fisheries Act 1994	An area declared under the <i>Fisheries Act 1994</i> to be a fish habitat area	There are no protected fish habitat areas within the Study area or surrounds.

Legislation	Environmental value	Notes
	Any part of a waterway providing for passage of fish only if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the waterway.	The waterways potentially impacted by the Project are classified as follows (Figure 2-2): • Boomerang Creek – Major impact waterway • Hughes Creek – Major impact waterway • One Mile Creek – High/Moderate impact waterway • Philips Creek – Major impact waterway • Spring Creek – High impact waterway If waterway barriers (e.g., road crossings, culverts etc) are proposed for the Project the accepted development requirements for each waterway will require assessment.
Other Relevant Legislation		
Environmental Protection (Water and Wetland Biodiversity) Policy 2019	The policy lists the EVs and WQOs for Queensland waters. These are a part of the legislation and therefore considered by planners and managers when making decisions about waters and/or water quality.	The policy has listed environmental values and water quality objectives for the Fitzroy Basin which include listings for biota. The environmental values and water quality objectives relevant to water quality and biota are included and compared to in this report.
Environmental Offsets Act 2014	Aquatic MNES and MSES listed in Section 8 of the EO Act Environmental Offsets Regulation 2014, Schedule 2	There are aquatic MNES and MSES present with relevance to the Project. Potential impacts and offsets requirements to MNES and MSES are discussed in Section 5.3.
Biosecurity Act 2014	Aquatic pest fauna and flora	Invasive aquatic flora and fauna are known to occur within the Study area and surrounds (Section 4.1.8)
Water Act 2000 Water Plan Fitzroy Basin 2011	Surface and groundwater flow	The Fitzroy basin Water Plan list the following ecological outcomes specific to aquatic species: • To protect flows and water quality for flow-spawning fish and endemic species, including the Fitzroy golden perch (<i>Macquaria ambigua orientis</i>) • To provide for flows necessary for estuarine ecosystem functions, including flows for: – Barramundi (<i>Lates calcarifer</i>) and king threadfin salmon (<i>Polydactylus macrochir</i>) recruitment; and – Banana prawn (<i>Penaeus merguensis</i>) growth. The water plan lists outcomes for groundwater dependent ecosystems (GDEs).

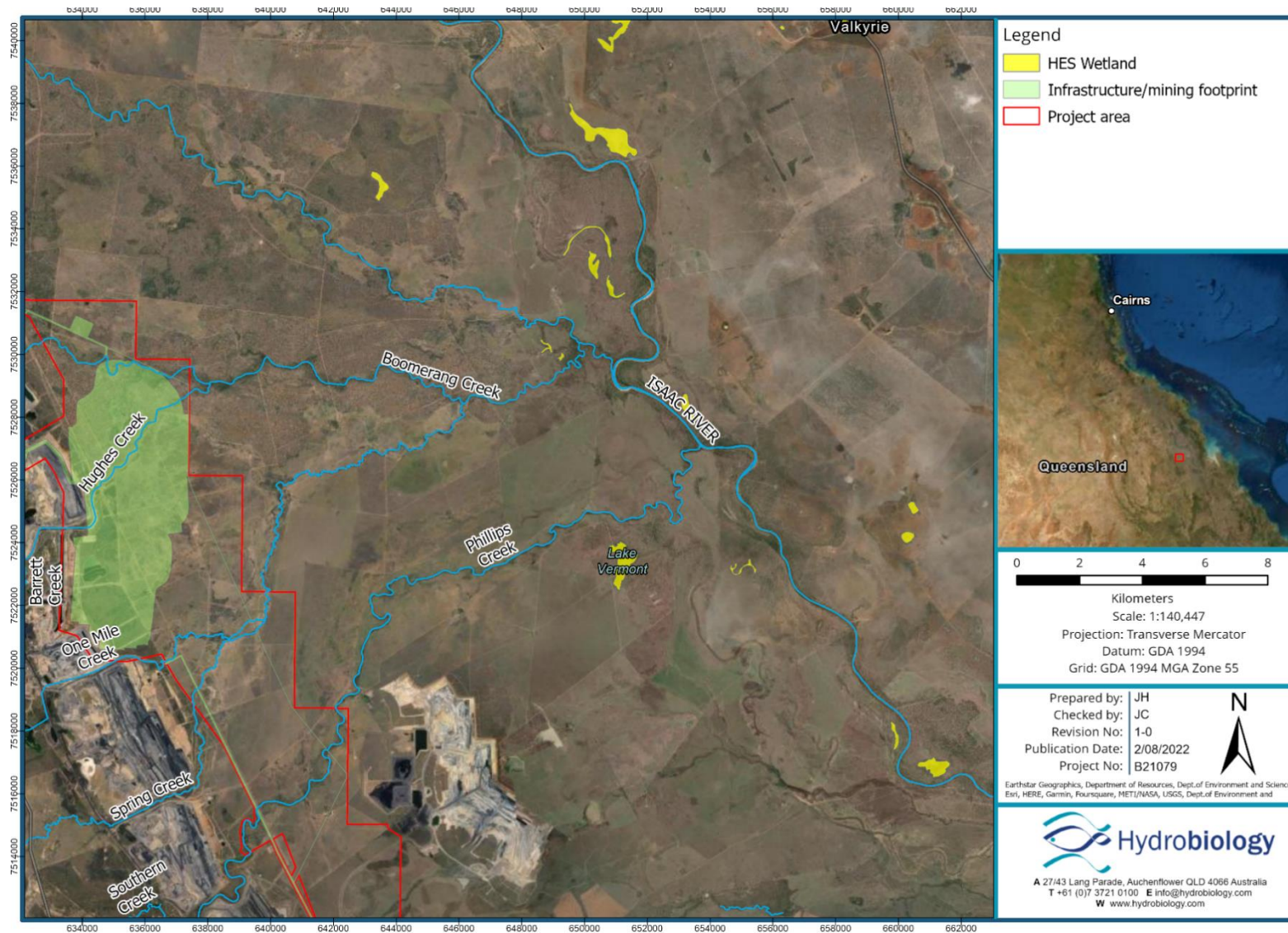


Figure 2-1 HES Wetlands in the project surrounds.

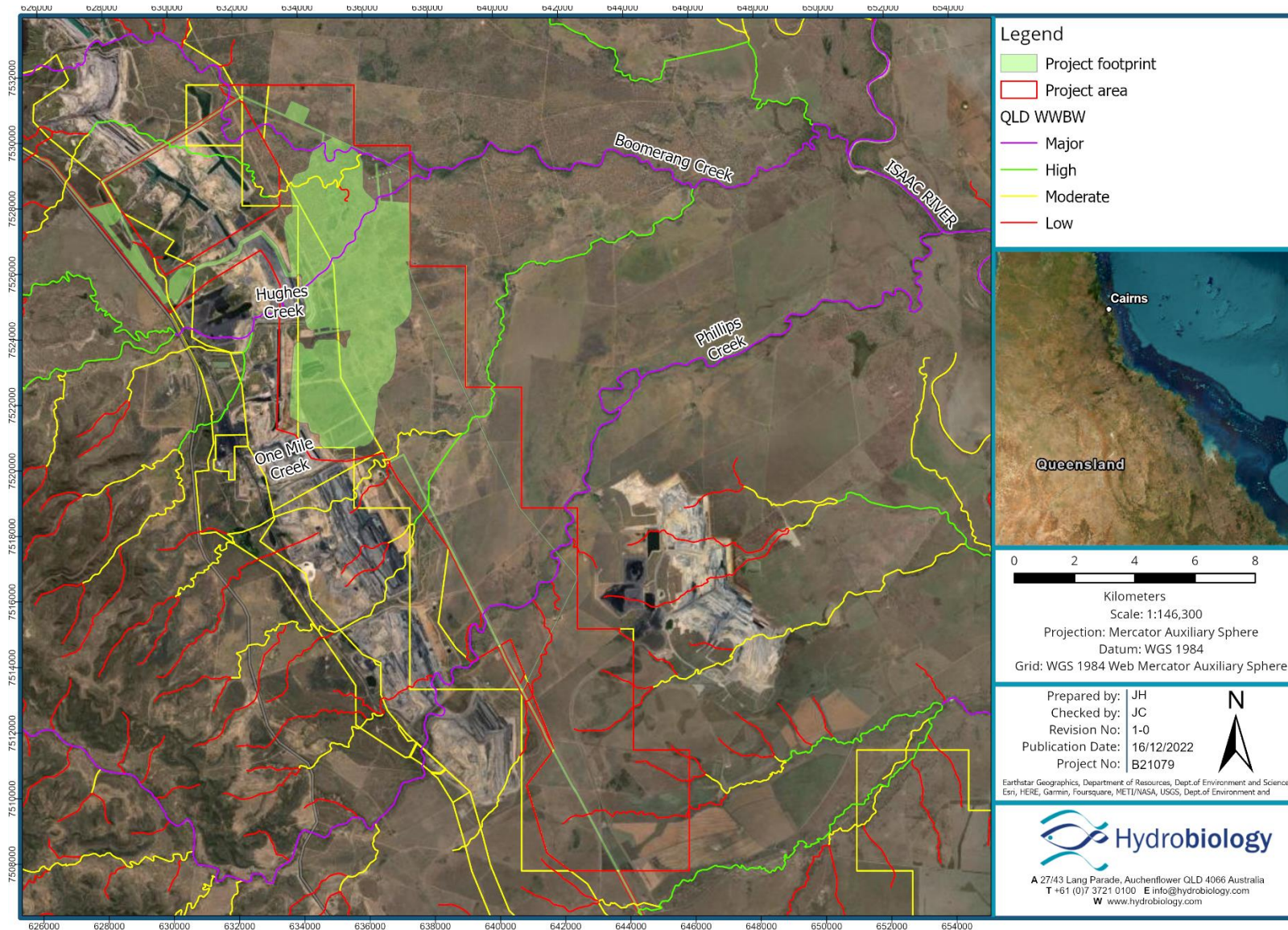


Figure 2-2 Waterway barrier works classification.

3.

METHODOLOGY

3.1 DESKTOP REVIEW

The aquatic ecological values were initially identified through review of regulatory instruments, which have identified the likely relevant MNES, MSES, and biosecurity risks. In this section the mapping and databases associated with those relevant values were further investigated for the Study area. The following were reviewed:

- Commonwealth EPBC Act Species Profile and Threats (SPRAT) database;
- Queensland WildNet database;
- Atlas of living Australia database;
- Recovery plan for the various listed threatened species;
- Schedule 1 of EPP (WWB); and
- Resources such as the EPBC Act Protected Matters Search Tool, the Queensland Matters of State Environmental Significance Search Tool, were used to identify conservation significant species that occur or could occur in the Study area from both the State and Federal government datasets.

Most of the available literature/data are associated with:

- Recovery plans/programs for threatened aquatic species and their habitats;
- Published scientific papers;
- Consultants' reports, including receiving environment reports undertaken for the SCM and surrounding BMA mines;
- Aerial photographs of the Study area;

- River health monitoring programs, which include historical datasets for macroinvertebrates and water quality; and
- Compliance monitoring (largely water quality) and investigation datasets/reports.

3.2 GAP ANALYSIS AND FIELD PLAN

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). Table 3-1 defines the identified knowledge gaps based on the current literature review and proposes suitable investigations to address these gaps.

Table 3-1 Gap analysis.

Items	Comment	Action	Method and/or Reference
Knowledge Gaps			
Habitat	• Data available for some target creeks through regular REMP monitoring	• Undertake systematic habitat and condition assessments	• Parsons et al., (2001) – Australian River Assessment System: AusRivAS Physical Assessment Protocol • DNRM (2001) – AusRivAS protocols for Queensland streams
Macrophytes	• Data available for some target creeks through regular REMP monitoring	• Undertake systematic macrophyte surveys including species identification and cover estimates	• Use of available literature and taxonomic keys to assist with identification where required. • Cover estimate methods implemented as per DNRM (2001) – AusRivAS protocols for Queensland streams
Water quality	• Data available for some target creeks through regular REMP	• In situ physiochemical data to be collected during field surveys.	• DES (2018) – Monitoring and sampling manual • ANZG (2018)
Macroinvertebrates	• Data available for some target creeks through regular REMP monitoring. • No data available from upstream of mining infrastructure on Isaac River	• Undertake systematic surveys of present macroinvertebrates • AusRivAS sampling of both bed & edge habitats	• DNRM (2001) – AusRivAS protocols for Queensland streams • DES (2018) – Monitoring and sampling manual

Items	Comment	Action	Method and/or Reference
Freshwater Fish and Macrocrustaceans	- Outdated and limited information within the Study area - No data collected from: - Isaac River upstream or downstream of the Study area - Hughes Creek - Downstream of the Project in One Mile Creek and Phillips Creek	Undertake systematic freshwater fish and macrocrustacean surveys using both passive and active survey techniques	- DES (2018) – Monitoring and sampling manual - DSEWPC (2011) – Survey guidelines for Australia's Threatened Fish
Turtles	- Outdated and limited information within the Study area - No data collected from: - Isaac River upstream or downstream of the Study area - Hughes Creek - Downstream of the Project in One Mile Creek and Phillips Creek	Undertake systematic turtle surveys and for threatened species undertake likelihood of assessment analysis based on collected habitat information.	- DSEWPC (2011)– Survey guidelines for Australia's threatened reptiles - DES (2018) – Monitoring and sampling manual
Platypus	- Outdated and limited information within the Study area - No data collected from: - Isaac River upstream or downstream of the Study area - Hughes Creek - Downstream of the Project in One Mile Creek and Phillips Creek	Undertake systematic aquatic fauna surveys and likelihood of assessment analysis based on collected habitat information.	DES (2018) – Monitoring and sampling manual

3.3 SURVEY DESIGN

To address the identified gaps and items of importance, 13 survey sites were selected within the Study area and surrounds (Table 3-2, Figure 3-1 & Figure 3-2). During the fieldwork planning phase, potential sites within representative habitats and relevant localities (i.e. within, upstream and downstream of the project footprint) were identified that appeared to be accessible. Specifically, the site locations were selected on the basis:

- They encompass all four creeks relevant to the Project, these being; Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek. They also include the ultimate receiving environment the Isaac River.
- They included sites upstream (control), within the project footprint and downstream as recommended by the IESC. This included sites upstream and downstream of the Isaac River. Note the selected control site on the Isaac River is upstream of any mine affected water releases from other BMA Operations in the Isaac River and/or its tributaries.
- They best represented identified habitat variation within the Study area (determined from aerial imagery and review, historical reports and State and Federal databases);

- They encompassed potential aquatic GDE types present in the Study area (based on the BOM GDE Atlas, BOM 2019; 3D Environmental, 2023);
- They could be readily accessed through existing infrastructure;
- The selected survey techniques could be safely carried out.

Table 3-2 Site coordinates (coordinate system, GDA 94)

System	Treatment	Site name	Longitude	Latitude
Isaac 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
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
Phillips Creek	Test	PC02	148.3563	-22.4613
	Control	PC01	148.305	-22.5214

3.4 SURVEY TIMING

The current EIS survey guideline for aquatic ecological matters (DES, 2022) requires seasonal sampling to assess the full range of aquatic habitats and productivity. This was achieved as aquatic surveys were carried out over two events (December 2021 and February 2022) to represent early-wet and late-wet conditions. Sampling was undertaken following initial seasonal flows in late-November, early December 2021 (Section 4.1.4). The Study area also experienced subsequent flow in early-Jan. We note that the January flow events saw the greatest flow peak in the Isaac River during the designated seasonal sampling events. The sampled periods were also selected to accord with IESC requirements detailed in Section 1.3.

The threatened turtle species that may occur in the Study area have specific nesting and breeding periods, predominately occurring from July to December with the exception of the white-throated snapping turtle which nests during March to August. The nesting and spawning periods coincide with the greatest movement extents. Additionally, turtles slow down substantially in winter with cooler waters and therefore trapping success may be reduced due to reduced movements. In general, surveys for reptiles should be conducted at times when the target species or communities are known to be active (i.e. during breeding and nesting) because periods of reptile activity are more likely to lead to capture success (for most species) (DSWPC, 2011b).

Many of the fish species known to occur in the Study area are potamodromous, meaning that they complete their lifecycle wholly in freshwater but do undertake migrations. The spawning activity of potamodromous species is usually highly related to flow regime. Meaning most species migrate from September to February during months of higher temperatures and rainfall with wet season conditions initiating migration and spawning. DESEWPC (2011), acknowledges the importance of timing surveys to coincide with migratory periods, which was achieved in this study.

The DNRM (2001) AusRivAS protocols for Queensland streams requires a minimum of two sample sets in one year. These are sampled on a 'seasonal' basis that is early wet - when flow has been established and late wet - recessionary baseflows when flow has declined to a sampleable level, without significant flood peaks. This study also conformed with the DNRM (2001) survey guideline, within sampling occurring upon the establishment of seasonal flows and shortly after where flows were reduced and following the end of any peak flows in the Study area.

3.5 MONITORING ASPECTS

Aquatic surveys were carried out at 13 sites (Figure 3-1 and Figure 3-2). A range of parameters were assessed at each site provide an understanding of the aquatic values of the Study area. Despite selecting periods following rainfall and subsequent runoff events, as well as following peak seasonal flows, many of the sites were dry at time of sampling and a subset could only be accessed during the late-wet survey. A summary of the sampling conducted at each site are summarised in (Table 3-3). Relevant to GDEs, only aquatic GDEs (surface water expressions) were scoped as part of this assessment. Method implementation is detailed in Appendix A.

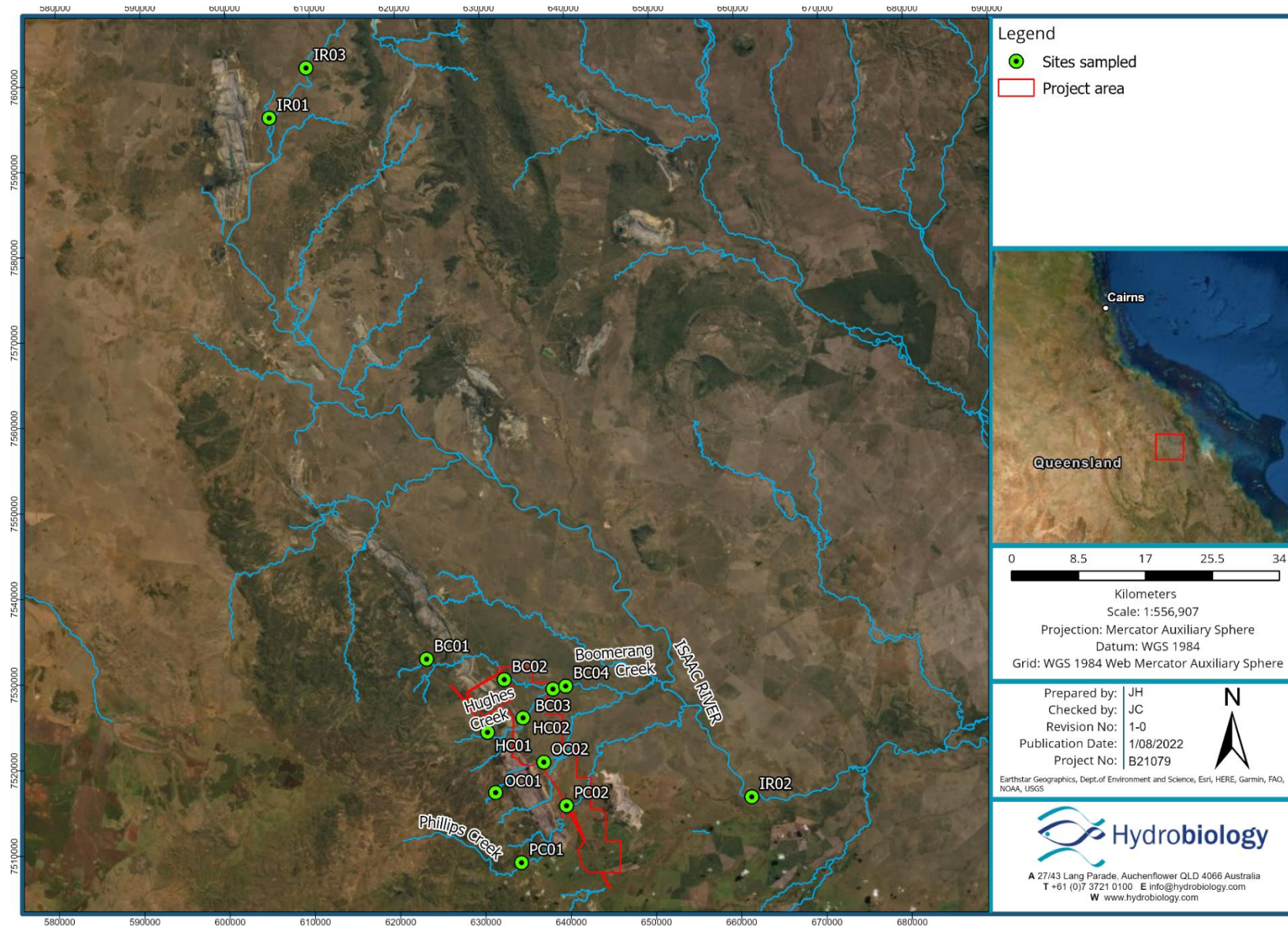


Figure 3-1 Sampling sites in the Study area.

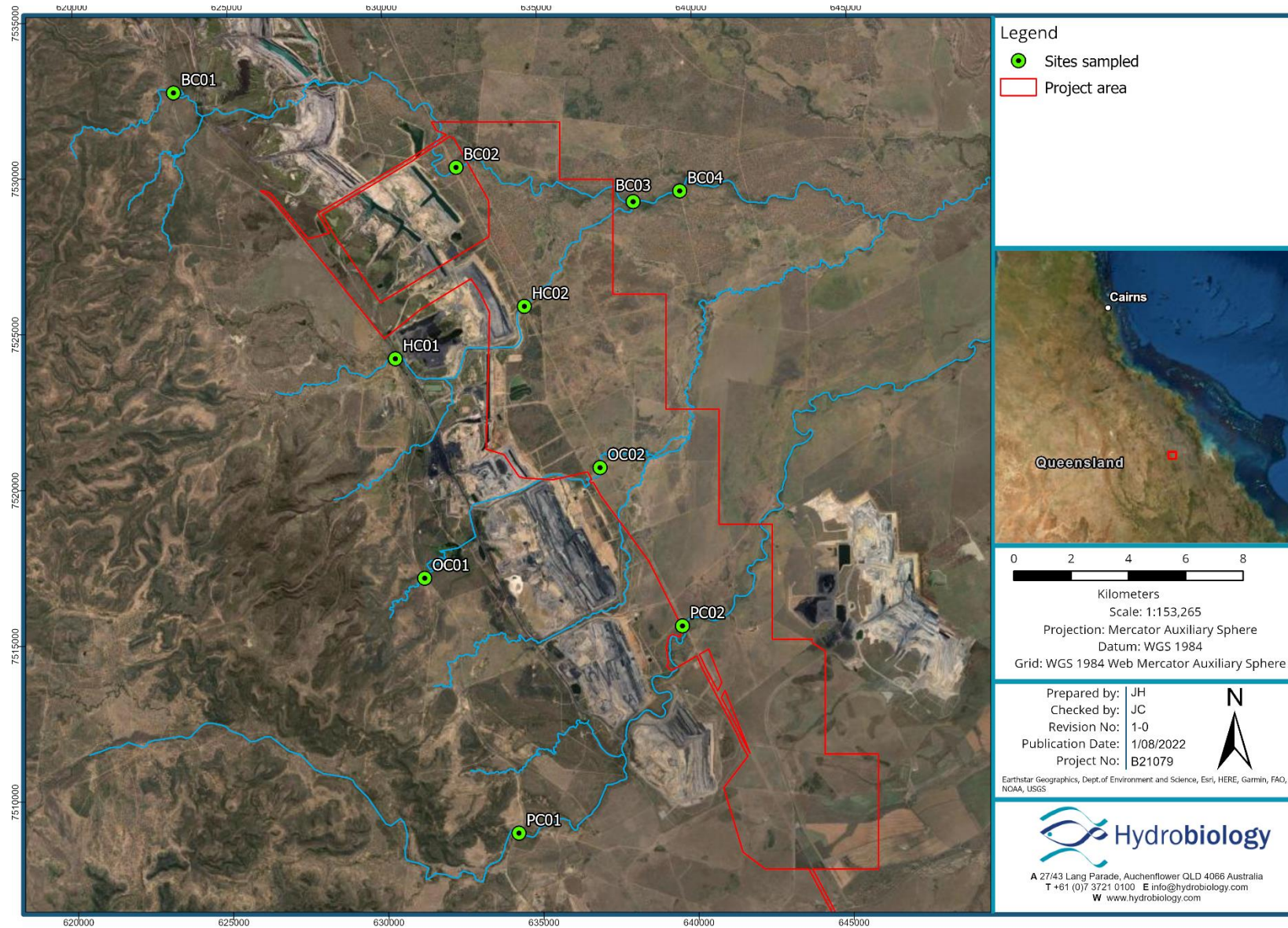


Figure 3-2 Zoomed extent of sites sampled surrounding the Project.

Table 3-3 Parameters surveyed at each site.

System	Treatment	Site	Season	Habitat and Aquatic GDEs	Water quality	Macro-invertebrates	Fish
Isaac River	Control	IR01	Early-wet	*	*	*	*
			Late-wet	✓	✓	✓	✓
		IR03	Early-wet	*	*	*	*
			Late-wet	✓	✓	✓	✓
	Test	IR02	Early-wet	✓	✓	✓	✓
			Late-wet	✓	✓	✓	✓
Boomerang Creek	Control	BC01	Early-wet	✓	✓	✓	✓
			Late-wet	✓	**	**	**
	Test	BC02	Early-wet	*	*	*	*
			Late-wet	✓	**	**	**
		BC03	Early-wet	✓	**	**	**
			Late-wet	✓	**	**	**
		BC04	Early-wet	*	*	*	*
			Late-wet	✓	**	**	**
Hughes Creek	Control	HC01	Early-wet	✓	**	**	**
			Late-wet	✓	**	**	**
	Test	HCO2	Early-wet	✓	✓	✓	✓
			Late-wet	✓	✓	✓	✓
One Mile Creek	Control	OCO1	Early-wet	✓	✓	✓	**
			Late-wet	✓	**	**	**
	Test	OCO2	Early-wet	✓	✓	✓	**
			Late-wet	✓	✓	**	**
Phillips Creek	Control	PCO1	Early-wet	✓	✓	✓	**
			Late-wet	✓	✓	**	**
	Test	PCO2	Early-wet	✓	✓	**	**
			Late-wet	✓	**	**	**

*No access to site; **Insufficient water for sampling

3.6 IMPACT AND MITIGATION 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;
 - The 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, assuming that the mitigation measures adopted are successful. This involves assessing the likelihood and severity of risks associated with aquatic values and
- Recommended management and monitoring. Based on the results of the impact assessment, recommendations have been proposed for management and monitoring.

Further detail regarding the profiling and screening of potential impacts is provided in Appendix A.

4. EXISTING ENVIRONMENT

4.1 BASED ON HISTORIC INFORMATION

4.1.1 CLIMATE

The Study area experiences hot and humid summers and mild winters, with most rainfall occurring between October and March (Figure 4-1). Above average rainfall was experienced in the month prior to both the early-wet and late-wet surveys (December 2021 and February 2022).

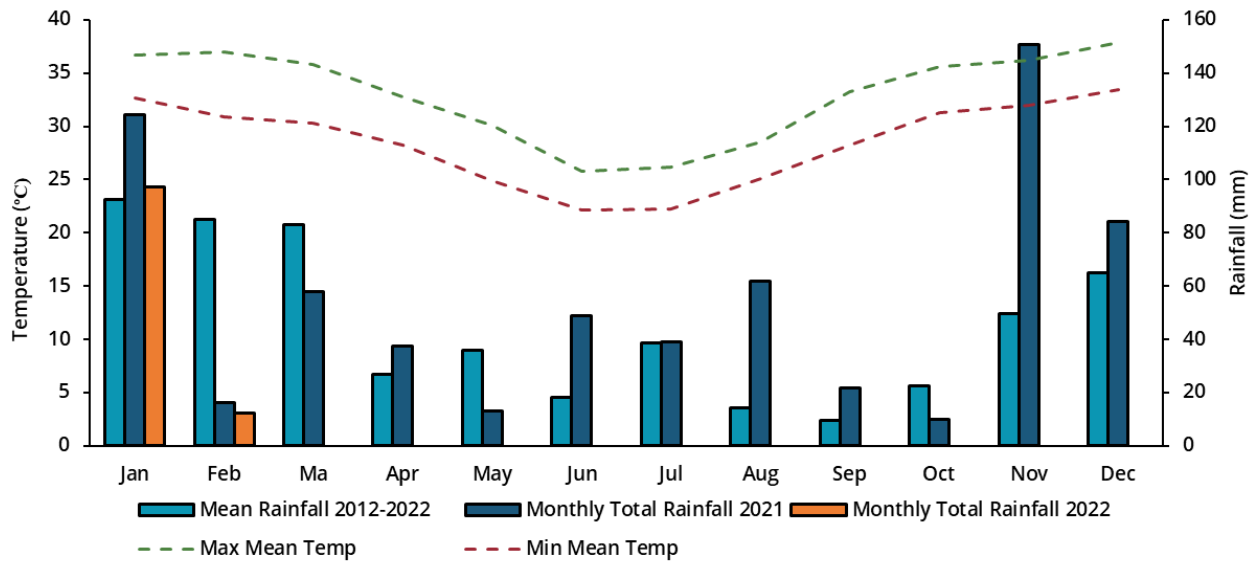


Figure 4-1 Average monthly climate statistics (2012-2022), sourced from Moranbah Airport Station (#034035)

4.1.2 BASINS AND CATCHMENTS

The Project lies within the Isaac River sub-basin of the larger Fitzroy Basin, which ultimately discharges into Keppel Bay. Multiple tributaries of the Isaac River flow from east to west across the Study area, including Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek. Hughes and Phillips Creek are drained by the Isaac River. Within the context of the Study area, the following stream orders apply:

- Boomerang Creek – Stream orders 3 to 5;
- One Mile Creek – Stream orders 1 to 3;
- Phillips Creek – Stream order 4;
- Hughes Creek – Stream orders 3 to 4; and
- Isaac River – Stream order 6.

4.1.3 LANDUSE

Apart from the current mine infrastructure the dominant land use of the Study area is grazing/native vegetation. There are historically cleared areas along the watercourses of each creek within the Study area, limiting riparian vegetation cover.

4.1.4 HYDROLOGY

The Isaac River and associated creeks of the Study area are ephemeral in nature, therefore are characterised by long periods of no flow with spikes in flow, following short baseflow and low flow periods (Figure 4-2 to Figure 4-4). Pools left behind after flow events are generally highly temporary. This is evident by many of the REMP sites which 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.

Analysis of flow data collected in the Isaac River, Hughes Creek and Phillips Creek from January 2021 to February 2022 indicate that peak flow occurred during January 2021 (Figure 4-2, Figure 4-3 and Figure 4-4). Smaller flow events occurred in the periods of March/April and October-December.

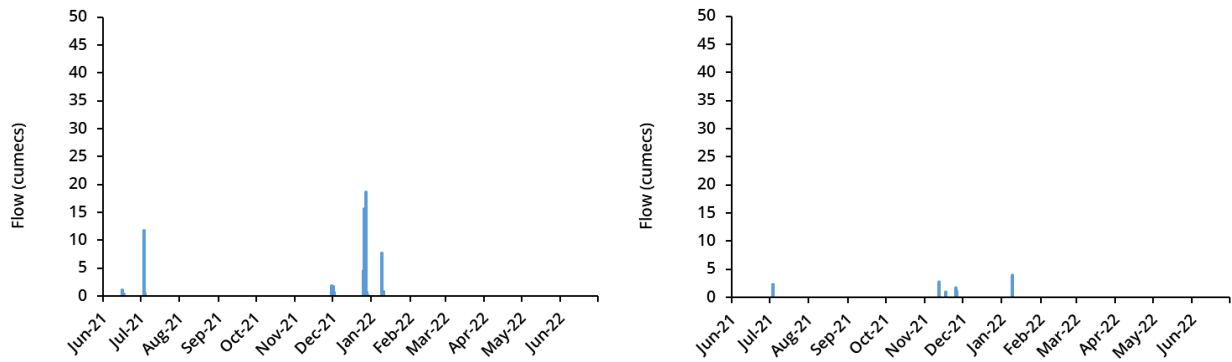


Figure 4-2 Flow recorded at Hughes Creek upstream (left) and downstream (right).

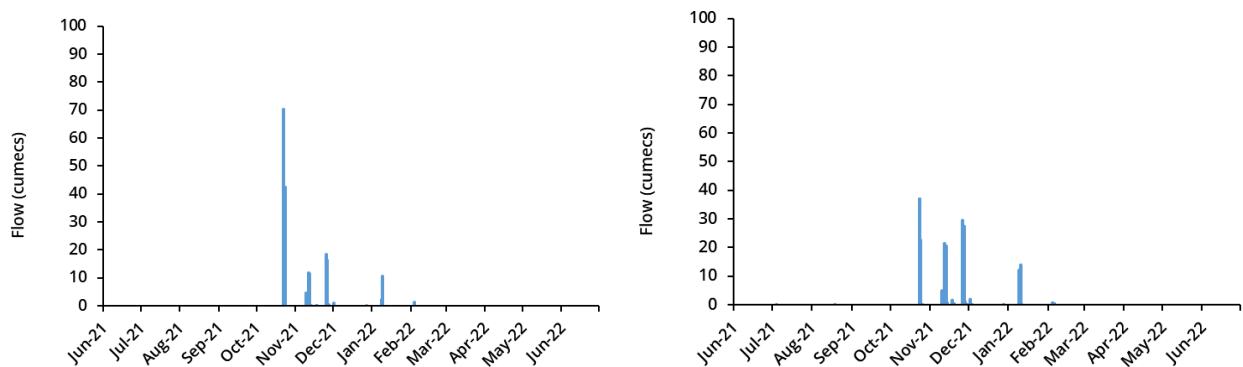


Figure 4-3 Flow recorded at Phillips Creek upstream (left) and downstream (right).

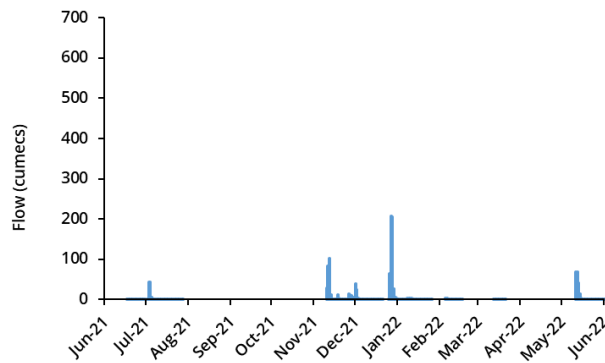


Figure 4-4 Flow recorded at Isaac River at Deverill (station number 130410A).

4.1.5 AQUATIC HABITAT

All tabulated habitat data collected from the historical REMP reports is displayed in Appendix C. The results are summarised below.

Overall habitat condition in the Isaac River scored as 'good' with high bank riparian coverage and bank vegetative stability, and a minimal amount of bottom scour contributing to higher scores. Factors contributing to lower bioassessment scores include limited macrohabitat diversity, such as the lack of riffle and run habitat, in addition to a lack of substrate diversity. It should be noted that there is unlikely to be a significant amount of riffle habitat in the Isaac River due to the sediment parent material of the catchment, that being sand dominated.

Total habitat scores of Hughes, One Mile and Phillips Creeks ranged from 'fair' to 'good', with scores often varying between years. Similar to the Isaac River, scores were negatively influenced by decreased macrohabitat (i.e., a lack of riffle or run habitat) and substrate diversity. Other notable factors decreasing habitat score for creek sites included decreased riparian vegetation cover and bank vegetative stability, indicating an increased degree of riparian clearing at creek sites. Although variable, creek sites generally scored lower due to increased bank erosion, channel alteration and bottom scouring, and sediment deposition.

4.1.6 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 (Figure 4-5). 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.

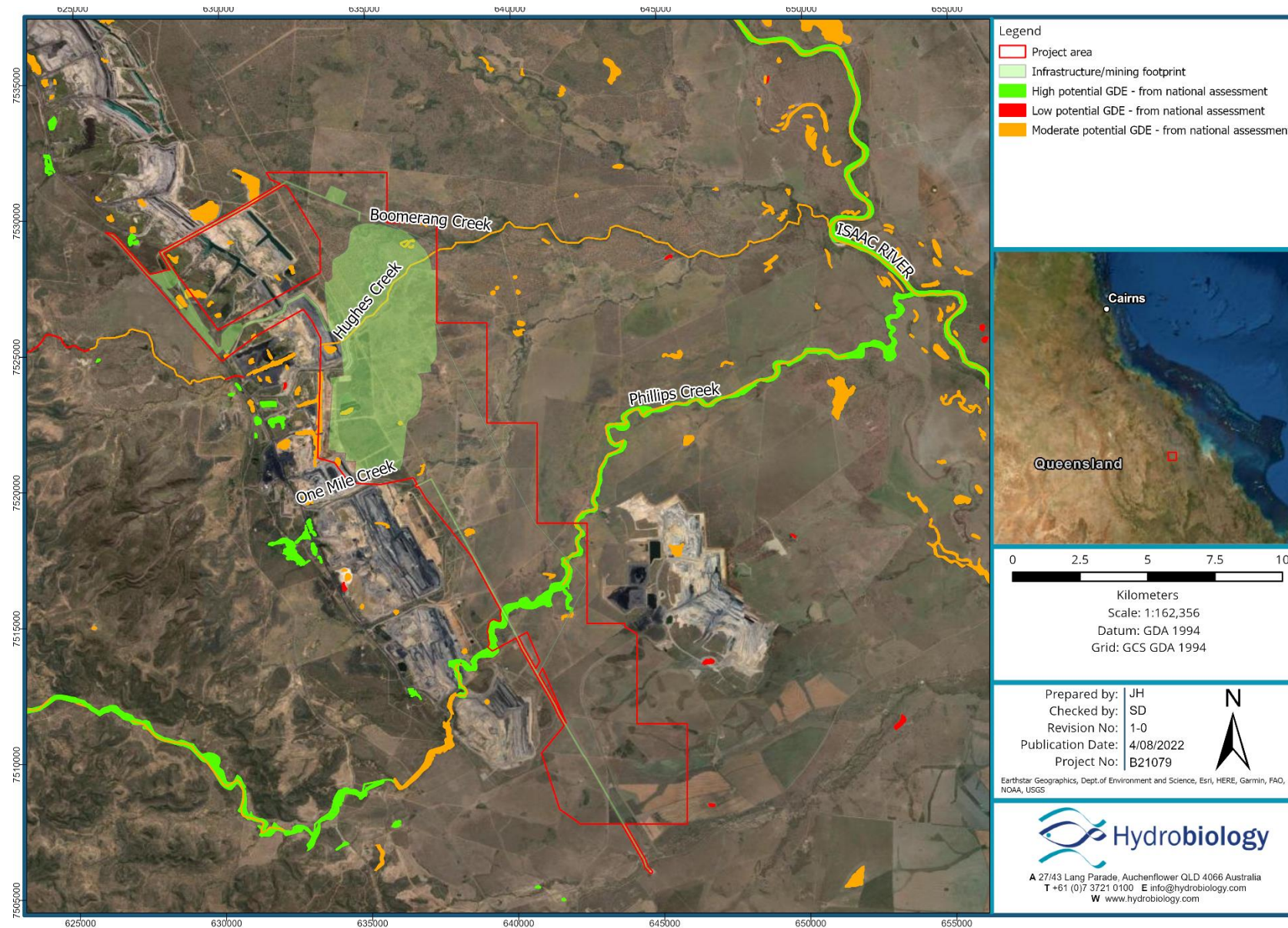


Figure 4-5 Potential GDEs in the Study area and surrounds (BOM, 2022).

4.1.7 WATER QUALITY

All tabulated habitat data taken from the REMP reports is displayed in Appendix C. The results are summarised below.

4.1.7.1 TEMPERATURE

Temperature across all sites were within typical ranges of similar sub-tropical catchments, with median values ranging from 24 to 28 °C.

4.1.7.2 PH

pH was generally circumneutral with a tendency towards alkaline conditions as is typical for the Isaac catchments. There were no notable differences in pH upstream or downstream of the mine and median values for all waterways were within WQOs for the sub-basin (DEHP, 2011).

4.1.7.3 ELECTRICAL CONDUCTIVITY

Electrical conductivity (EC) was generally low across all sites, with a maximum median value of 1,041 $\mu\text{S}/\text{cm}$ downstream of SCM along Boomerang Creek. Median values from all sites were below guideline levels defined in the catchment specific water quality objective (WQO) for the Fitzroy Basin (2,000 $\mu\text{S}/\text{cm}$) (Prasad *et al.*, 2012). This WQO is set for the protection of 95% of biota, which is the required level of protection defined in DES (2011) for the Isaac River sub-basin for slightly to moderately ecosystems.

4.1.7.4 TURBIDITY

Turbidity was generally elevated across all sites sampled, with median values exceeding WQOs for the Isaac River, Hughes Creek and One Mile Creek. There was a noted increase in turbidity during high flow, with Hughes Creek and Boomerang Creek demonstrating greater variation.

It should be noted that the Isaac River is generally a highly turbid system and defined WQOs are unlikely to be met during most flow conditions.

4.1.7.5 DISSOLVED OXYGEN

Dissolved oxygen (DO) was within or above the WQO range at all sites except for Hughes Creek. DO is affected by many factors such as the degree of shading, water body size and the amount of decaying organic material present. It is possible that low DO measurements in Hughes Creek were influenced by small pool size, shaded conditions, and a high level of decaying organic material.

4.1.8 AQUATIC FLORA

A total of 105 native and 11 non-native aquatic plants have been recorded in the Isaac River sub-basin (Table 4-1). It should be noted that state database records cover a wide range of habitats within the sub-basin including palustrine (wetlands), lacustrine (lakes) and larger riverine habitats. Many of these species are unlikely to be present in the ephemeral creek and river systems that characterise the Study area, particularly the submerged species that require prolonged water presence. The distribution of aquatic plants in the Study area is primarily governed by water availability, which is short. Macrophytes are generally present in emergent forms in such temporary systems.

A study encompassing the Isaac River and creek systems just north of the Study area (~40km upstream) found that aquatic plant diversity and coverage was low at most creek and wetland sites, being generally limited to emergent species such as sedges (*Cyperus* spp.) (ESP, 2021). Artificially

dammed lacustrine habitats generally had a higher diversity and coverage of aquatic plants and included a higher diversity of growth forms (including floating and submerged).

An aquatic plant survey conducted for the EIS for the current project found that sites on Boomerang, One Mile and Phillips Creek were characterised by emergent plants such as *Cyperus spp.*, *Eleocharis sp.* and *Carex sp.* growing in shallow water margins or dry areas adjacent to water. The only floating species (*Nymphoides crenata*, *Ottelia ovalifolia* and *Monochoria cyanea*) were recorded in a billabong (lacustrine/palustrine) site off Phillips Creek (FRC Environmental, 2018).

There were no listed threatened or protected aquatic plants present in the Isaac River sub-basin according to the available data.

Table 4-1 Aquatic plants recorded in the Isaac River sub-basin (FRC Environmental, 2018; ESP, 2021; WetlandInfo, 2021b)

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	WetlandInfo (2021)	EIS (2018)	ESP (2021)
Alismataceae	<i>Caldesia oligococca</i>				QA	✓		✓
Amaryllidaceae	<i>Crinum flaccidum</i>	Murray lily			QA	✓		
Apocynaceae	<i>Gymnanthera oblonga</i>				QAI	✓		
Aponogetonaceae	<i>Aponogeton queenslandicus</i>				QA	✓		
Asteraceae	<i>Eclipta prostrata</i> *	white eclipta			IU	✓		
Casuarinaceae	<i>Casuarina cunninghamiana</i>				QA	✓		
	<i>Casuarina cunninghamiana subsp. cunninghamiana</i>				QAI	✓		
Cyperaceae	<i>Carex sp.</i>				-		✓	
	<i>Cyperus alopecuroides</i>				QA	✓		
	<i>Cyperus betchei</i>				Q	✓		
	<i>Cyperus cristulatus</i>				QA	✓		
	<i>Cyperus difformis</i>	rice sedge			QAI	✓		✓
	<i>Cyperus digitatus</i>				QAI	✓		✓
	<i>Cyperus distans</i>				QAI	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
	<i>Cyperus enervis</i>				QA	✓		
	<i>Cyperus esculentus</i> *	yellow nutgrass			IU	✓		
	<i>Cyperus exaltatus</i>	tall flatsedge			QAI	✓		
	<i>Cyperus flaccidus</i>				QAI	✓		
	<i>Cyperus lucidus</i>				QA	✓		✓
	<i>Cyperus nutans</i> var. <i>eleusinoides</i>	flatsedge			QAI	✓		
	<i>Cyperus pilosus</i>				QAI	✓		
	<i>Cyperus polystachyos</i>				QAI	✓		✓
	<i>Cyperus polystachyos</i> var. <i>polystachyos</i>				QAI	✓		
	<i>Cyperus procerus</i>				QAI	✓		
	<i>Cyperus pygmaeus</i>	dwarf sedge			QAI	✓		
	<i>Cyperus scariosus</i>				QAI	✓		
	<i>Cyperus squarrosus</i>	bearded flatsedge			QAI	✓		
	<i>Cyperus</i> spp.				-		✓	
	<i>Eleocharis cylindrostachys</i>				QA	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
	<i>Eleocharis dulcis</i>				QAI	✓		
	<i>Eleocharis pallens</i>	pale spikerush			QA	✓		
	<i>Eleocharis philippinensis</i>				QAI	✓		
	<i>Eleocharis plana</i>	ribbed spikerush			QA	✓		
	<i>Eleocharis sp.</i>				-		✓	
	<i>Fimbristylis microcarya</i>				QA	✓		
	<i>Fimbristylis nuda</i>				QA	✓		
	<i>Fimbristylis nutans</i>				QAI	✓		
	<i>Fimbristylis quinquangularis</i>				QAI	✓		✓
	<i>Fimbristylis sieberiana</i>				QAI	✓		
	<i>Gahnia sieberiana</i>	sword grass			QAI	✓		
	<i>Rhynchospora heterochaeta</i>				QAI	✓		
	<i>Schoenoplectus subulatus</i>				QAI	✓		
Characeae	<i>Nitella spp.</i>				-			✓
Elatinaceae	<i>Elatine gratioloides</i>	waterwort			QAI	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
Haloragaceae	<i>Myriophyllum verrucosum</i>	water milfoil			QA	✓		✓
Hydrocharitaceae	<i>Hydrilla verticillata</i>	hydrilla			QAI	✓		
	<i>Ottelia ovalifolia</i>	swamp lily			Q	✓	✓	✓
Isoetaceae	<i>Isoetes muelleri</i>	quillwort			QA	✓		
Juncaceae	<i>Juncus aridicola</i>	tussock rush			QA	✓		
	<i>Juncus bufonius</i> *	toad rush			IU	✓		
	<i>Juncus subglaucus</i>				QA	✓		
	<i>Juncus usitatus</i>				QAI	✓		✓
Juncaginaceae	<i>Cycnogeton procerus</i>				QAI	✓		
Lythraceae	<i>Lythrum paradoxum</i>				Q	✓		
	<i>Rotala mexicana</i>				QAI	✓		
Marsileaceae	<i>Marsilea drummondii</i>	common nardoo			QAI	✓		
	<i>Marsilea exarata</i>	sway-back nardoo			QA	✓		
	<i>Marsilea hirsuta</i>	hairy nardoo			QAI	✓		✓
	<i>Marsilea mutica</i>	shiny nardoo			QA	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
Melastomataceae	<i>Melastoma malabathricum subsp. malabathricum</i>				QAI	✓		
Menyanthaceae	<i>Nymphoides crenata</i>	wavy marshwort			QA		✓	
	<i>Nymphoides indica</i>	water snowflake			QAI	✓		
Myrtaceae	<i>Eucalyptus camaldulensis</i>				QAI	✓		
	<i>Lophostemon suaveolens</i>	swamp box			QAI	✓		
	<i>Melaleuca bracteata</i>				QAI	✓		
	<i>Melaleuca dealbata</i>	swamp tea-tree			QAI	✓		
	<i>Melaleuca fluviatilis</i>				QA	✓		
	<i>Melaleuca leucadendra</i>	broad-leaved tea-tree			QAI	✓		
	<i>Melaleuca linariifolia</i>	snow-in summer			QA	✓		
	<i>Melaleuca viminalis</i>				QA	✓		
Najadaceae	<i>Najas tenuifolia</i>	water nymph			QAI	✓		✓
Nymphaeaceae	<i>Nymphaea gigantea</i>				QA	✓		
	<i>Nymphaea violacea</i>				QAI	✓		
Onagraceae	<i>Ludwigia octovalvis</i>	willow primrose			QAI	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
	<i>Ludwigia peploides subsp. montevidensis</i>				QAI	✓		✓
Philydraceae	<i>Philydrum lanuginosum</i>	frogsmouth			QAI	✓		
Phrymaceae	<i>Glossostigma diandrum</i>				QA	✓		
Plantaginaceae	<i>Limnophila brownii</i>				QAI	✓		
Poaceae	<i>Brachyachne tenella</i>				QAI	✓		
	<i>Diplachne fusca var. fusca</i>				QAI	✓		
	<i>Echinochloa colona</i> *	awnless barnyard grass			IU	✓		
	<i>Echinochloa crus-galli</i> *	barnyard grass			IU	✓		
	<i>Elytrophorus spicatus</i>				QAI	✓		
	<i>Diplachne fusca var. uninervia</i> *				IU	✓		
	<i>Hemarthria uncinata var. spathacea</i>				QAI	✓		
	<i>Hymenachne amplexicaulis</i> 'Olive' *				IU	✓		
	<i>Leersia hexandra</i>	swamp rice grass			QAI	✓		
	<i>Leptochloa digitata</i>				QA	✓		
	<i>Panicum larcomianum</i>				Q	✓		

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
	<i>Panicum paludosum</i>	swamp panic			QAI	✓		
	<i>Paspalum distichum</i> *	water couch			IU	✓		
	<i>Paspalum vaginatum</i> *	saltwater couch			IU	✓		
	<i>Pseudoraphis paradoxa</i>	slender mudgrass			QA	✓		
	<i>Pseudoraphis spinescens</i>	spiny mudgrass			QAI	✓	✓	
	<i>Stenotaphrum secundatum</i> *	buffalo grass			IU	✓		
	<i>Urochloa mutica</i> *				IU	✓		
	<i>Walwhalleya subxerophila</i>				QA	✓		
Polygonaceae	<i>Duma florulenta</i>				QA	✓		
	<i>Persicaria attenuata</i>				QAI	✓		✓
	<i>Persicaria barbata</i>				QAI	✓		
	<i>Persicaria decipiens</i>	slender knotweed			QAI	✓		✓
	<i>Persicaria hydropiper</i>	water pepper			QAI	✓		
	<i>Persicaria lapathifolia</i>	pale knotweed			QAI	✓		
	<i>Persicaria orientalis</i>	princes feathers			QAI	✓		✓

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	EIS (2018)	ESP (2021)
	<i>Persicaria prostrata</i>	creeping knotweed			QA	✓		
	<i>Persicaria strigosa</i>				QAI	✓		
Pontederiaceae	<i>Monochoria cyanea</i>				QA	✓	✓	✓
Potamogetonaceae	<i>Potamogeton crispus</i>	curly pondweed			QAI	✓		✓
	<i>Potamogeton octandrus</i>				QAI	✓		
	<i>Potamogeton tricarlinatus</i>	floating pondweed			QA	✓		
Pteridaceae	<i>Ceratopteris thalictroides</i>				QAI	✓		
Rubiaceae	<i>Nauclea orientalis</i>	Leichhardt tree			QAI	✓		
Scrophulariaceae	<i>Eremophila bignoniiflora</i>	eurah			QA	✓		
Stylidiaceae	<i>Stylidium velleioides</i>				Q	✓		
Typhaceae	<i>Typha domingensis</i>				QAI	✓		
	<i>Typha sp.</i>				-			✓

Q: Queensland endemic - naturally occurs in Queensland; QA: intranational - naturally occurs in Queensland and interstate; QAI: not endemic to Australia - naturally occurs in Queensland, interstate and overseas; QI: regional endemic - naturally occurs in Queensland and overseas; IU: introduced - unknown origin

4.1.9 MACROINVERTEBRATES

All tabulated macroinvertebrate data collected from the REMP reports is displayed in Appendix C. The results are summarised below.

Taxa richness and PET richness median values were within range or above BQOs for all sites except for the downstream extent of Boomerang Creek. SIGNAL2 scores were within or just below the BQO for all sites except Boomerang Creek downstream. The percentage of tolerant taxa was highly variable, with multiple sites containing an elevated level of tolerant taxa, indicating some degree of disturbance both upstream and downstream of the current SCM.

4.1.10 MACROCRUSTACEANS

Freshwater shrimp (Atyidae), prawns (Palaemonidae), crabs (Parathelphusidae) and redclaw yabbies (*Cherax quadricarinatus*) have been recorded in the Study area and surrounds (FRC Environmental, 2018).

4.1.11 FISH

A total of 29 native and 3 non-native fish species are known to occur in the Isaac River sub-basin (Table 4-2). It should be noted that the state database (Wetlandinfo) includes records from a wide area containing many different habitats (e.g. lakes, wetlands, creeks and riverine reaches) encompassing the entire Isaac River length from headwaters to its confluence with the Mackenzie River. It is highly unlikely that many of these species, particularly those associated with estuarine waters or large perennial reaches will be present in the ephemeral creeks of the Study area and surrounds.

Surveys of the upper Isaac River and associated tributaries (Grosvenor, Goonyella, Platypus and Eureka Creeks) found that sites were dominated by the small-bodied *A. agassizii* and *M. splendida* and the medium-bodied spangled perch (*Leiopotherapon unicolor*). Other commonly caught species included Hyrtl's tandan (*Neosilurus hyrtl*), bony bream (*Nematalosa erebi*) and purple-spotted gudgeon (*Morgurnda adspersa*). These are all highly tolerant species, able to thrive in the small, isolated pools that are characteristic of ephemeral creeks. The paucity of larger bodied fish was generally attributed to lack of deep pool habitat (URS, 2013; ESP, 2021).

A survey of Boomerang, Spring and One Mile Creek (within the current Study area) found that sites were generally dominated by small-bodied fish such as *A. agassizii*, *M. splendida* and carp gudgeon (*Hypseleotris spp.*) (ESP, 2019).

The survey conducted in 2007 and 2010 for the current EIS identified 11 native fish species (FRC Environmental, 2018), all of which were deemed common species that are tolerant of harsh environmental conditions (e.g. variable flow, fluctuating water quality including high turbidity and conductivity) typical of ephemeral watercourses of the region.

There is one EPBC species recorded from the Isaac River sub-basin; the silver perch (*Bidyanus bidyanus*). *B. bidyanus* is endemic to the Murray-Darling system where it is categorised as critically endangered due to human mediated impacts such as river regulation, habitat degradation and the introduction of non-native fish. *B. bidyanus* has been translocated to many different systems in Queensland, usually stocked in artificial impoundments/dams. These translocated fish are thought to make little improvement to the conservation of wild stock. Given that this species is not within its natural distribution, nor does it improve wild stocks where it occurs in the wider Isaac River, they are not considered threatened in the context of the Study area or wider Isaac River sub-basin. Therefore, this species is not considered any further in this assessment.

Table 4-2 Fish recorded from the Isaac River sub-basin (URS, 2013; ESP, 2019, 2021; WetlandInfo, 2021a).

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	WetlandInfo (2021)	URS (2013)	ESP (2021)	ESP (2019)	FRC Environmental (2018)
Ambassidae	<i>Ambassis agassizii</i>	Agassiz's glassfish			QA	✓	✓	✓	✓	✓
Anguillidae	<i>Anguilla reinhardtii</i>	longfin eel			QAI	✓				
Apogonidae	<i>Glossamia aprion</i>	mouth almighty			QAI	✓				
Ariidae	<i>Neoarius graeffei</i>	blue catfish			QAI	✓				
Atherinidae	<i>Craterocephalus stercusmuscarum</i>	flyspecked hardyhead			QA	✓			✓	✓
Belonidae	<i>Strongylura krefftii</i>	freshwater longtom			QAI	✓				
Cichlidae	<i>Oreochromis mossambicus</i>	Mozambique mouthbrooder			II			✓	✓	
Clupeidae	<i>Nematalosa erebi</i>	bony bream			QA	✓	✓	✓		✓
Eleotridae	<i>Hypseleotris compressa</i>	empire gudgeon			QAI	✓				✓
	<i>Hypseleotris galii</i>	firetail gudgeon			QA	✓				
	<i>Hypseleotris klunzingeri</i>	western carp gudgeon			QA	✓				
	<i>Hypseleotris species 1</i>	Midgley's carp gudgeon			QA	✓				
	<i>Hypseleotris species 3</i>	Murray-Darling carp gudgeon			QA	✓				
	<i>Hypseleotris sp.</i>	carp gudgeon			U			✓	✓	✓

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	URS (2013)	ESP (2021)	ESP (2019)	FRC Environmental (2018)
	<i>Mogurnda adspersa</i>	southern purplespotted gudgeon			QA	✓	✓	✓	✓	✓
	<i>Oxyeleotris aruensis</i>	Aru gudgeon			QI	✓				
	<i>Oxyeleotris lineolata</i>	sleepy cod			QA	✓	✓		✓	✓
	<i>Philypnodon grandiceps</i>	flathead gudgeon			QA	✓				
Hemiramphidae	<i>Arrhamphus sclerolepis</i>	snubnose garfish			QAI	✓				
Melanotaeniidae	<i>Melanotaenia splendida splendida</i>	eastern rainbowfish			Q	✓	✓	✓	✓	✓
Osteoglossidae	<i>Scleropages leichardti</i>	southern saratoga			Q	✓				
Percichthyidae	<i>Macquaria ambigua</i>	golden perch			QA	✓				
Plotosidae	<i>Neosilurus ater</i>	black catfish			QAI	✓				
	<i>Neosilurus hyrtlii</i>	Hyrtl's catfish			QA	✓	✓	✓	✓	✓
	<i>Porochilus rendahli</i>	Rendahl's Catfish			QA					✓
	<i>Tandanus tandanus</i>	freshwater catfish			QA	✓				
Poeciliidae	<i>Xiphophorus maculatus</i>	platy			II			✓		
	<i>Gambusia holbrooki</i>	mosquitofish			II				✓	
Pseudomugilidae	<i>Pseudomugil signifer</i>	Pacific blue eye			QA	✓				

Family	Scientific Name	Common Name	NCA	EPBC	Endemicity	Wetlandinfo (2021)	URS (2013)	ESP (2021)	ESP (2019)	FRC Environmental (2018)
Terapontidae	<i>Amniataba percooides</i>	<i>barred grunter</i>			QA	✓				
	<i>Bidyanus bidyanus</i>	<i>silver perch</i>		CE	QA	✓				
	<i>Leiopotherapon unicolor</i>	<i>spangled perch</i>			QA	✓	✓	✓	✓	✓
	<i>Scortum hillii</i>	<i>leathery grunter</i>			Q	✓				

CE = Critically endangered

Q = Queensland endemic - naturally occurs in Queensland

QA = Intranational - naturally occurs in Queensland and interstate

QAI = Not endemic to Australia - naturally occurs in Queensland, interstate and overseas

QI = Regional endemic - naturally occurs in Queensland and overseas

II = Introduced (International) - naturalised from overseas

4.1.12 AQUATIC REPTILES

The following turtle species were reported as sighted within the Study area (FRC Environmental, 2018):

- Eastern long-necked turtle (*Chelodina longicollis*);
- Broad-shelled river turtle (*Chelodina expansa*);
- Krefft's River turtle (*Emydura macquarii krefftii*); and

None of these are listed as threatened species.

4.1.13 THREATENED SPECIES

There are two EVNT species that may occur in the Study area, these are:

- White-throated snapping turtle (*Elseya albagula*) – listed as Critically Endangered; and
- Fitzroy River turtle (*Rheodytes leukops*) – listed as Vulnerable.

Both these species have not been recorded in the Study area. The biology and habitat of both species is discussed below.

4.1.13.1 WHITE-THROATED SNAPPING TURTLE

The preferred habitat of the white-throated snapping turtle is clear, flowing well-oxygenated waters, with increased suspended sediment inhibiting the turtle's ability to utilise dissolved oxygen through cloacal respiration (Schaffer *et al.*, 2015). While this habitat is preferred, they are known to inhabit both clear and turbid waters with varying depths and flow rates. According to Fitzroy and Mary River catchment records, the white throated snapping turtle is regularly associated with shallow riffle zones at night and submerged logs and log jams during the day (Tracey, 2017). Permanent water bodies are extremely important to this species, as it has not yet been recorded in ephemeral systems. A strong preference for certain microhabitats is exhibited in the catch records such as undercut banks/overhanging banks, mid or high density of log jams/submerged boulders, overhanging riparian vegetation, and high cover of (Hamann *et al.*, 2007).

The highly ephemeral waterways of the Study area and surrounds are likely unsuitable for the white-throated snapping turtle. The closest record of the species is in the Connors River approximately 70 km east of the Study area (ALA, 2022a).

4.1.13.2 FITZROY RIVER TURTLE

The Fitzroy River turtle is found in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with beds of ribbonweed (*Vallisneria sp.*) (Tucker *et al.*, 2001). Common riparian vegetation associated with the Fitzroy River turtle includes blue gums (*Eucalyptus tereticornis*), river oaks (*Casuarina cunninghamiana*), weeping bottlebrushes (*Melaleuca viminalis*) and paperbarks (*Melaleuca linariifolia*) (Tucker *et al.*, 2001). It is thought that the Fitzroy River turtle has an affinity for well-oxygenated riffle zones, moving into deeper pools as the riffle zones cease to flow (Tucker *et al.*, 2001). Other studies have captured several turtles from deep pools (Gordos *et al.*, 2004, 2011b, 2011a).

The highly ephemeral waterways of the Study area and surrounds are likely unsuitable for the Fitzroy River turtle. The closest record of the species is in the Connors River approximately 80 km east of the Study area (ALA, 2022b).

4.2 FIELD SURVEY RESULTS

4.2.1 HABITAT

Site photographs and associated habitat data are displayed in Appendix D. A summary of this data is provided in the sections below.

4.2.1.1 HABITAT CONDITION

Habitat bioassessment scores ranged from 'fair' to 'good' (Figure 4-6). Scores were negatively influenced at all sites by a lack of macrohabitat diversity, particularly the lack of run and riffle habitat, as available water was often limited to shallow isolated pools. It should be noted that habitat bioassessment is largely based on perennially flowing systems and that naturally ephemeral systems such as the Isaac will tend to skew towards a negative score.

Isaac River sites scored higher than Hughes, One Mile and Phillips Creek sites due to larger pool habitat, improved riparian streamside vegetation cover, increased in-stream habitat diversity (e.g., large woody debris, undercut banks) and improved bank/bed stability. Conversely, Hughes, One Mile and Phillips Creek scores were lower due to small pool habitat or no aquatic habitat present, increased riparian vegetation clearing, decreased in-stream habitat diversity, evidence of bank erosion and fine sediment deposition. Habitat scores at Boomerang Creek test sites were notably higher than other creek sites as they tended to have intact riparian vegetation, decreased erosion and a relatively large amount of streamside cover through the provision of large woody debris.

Bioassessment scores recorded in the current study were broadly similar to those recorded historically in the REMP (see Section 4.1.5) in that scores were higher at Isaac River sites than those at Hughes, One Mile and Phillips Creek. Notably similar scores were identified between sites upstream of and downstream of the current SCM.

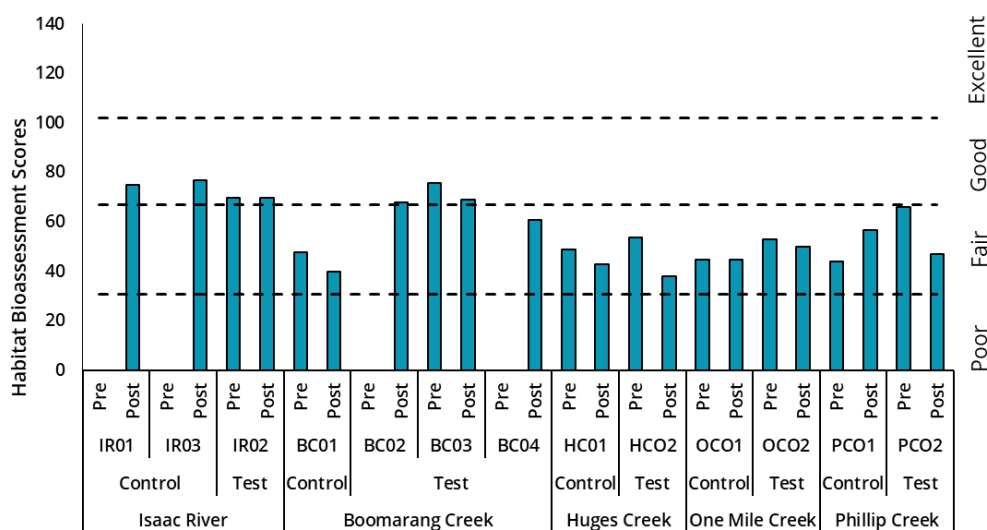


Figure 4-6 Habitat bioassessment scores.

4.2.1.2 BANK STABILITY

Banks were generally moderately stable, with infrequent, small areas of erosion that were mostly healed over. Bank erosion was notably high at Hughes Creek test site HC02, with areas of near vertical slope likely exacerbated by a lack of riparian vegetation to fortify bank stability (Figure 4-7). It was noted that parts of the bank had collapsed in the period between the early-wet and late-wet surveys. Bank erosion potentially contributes to higher median turbidity exhibited in Hughes Creek.



Figure 4-7 Bank collapse at site HC02 noted during the late-wet survey.

4.2.1.3 BED STABILITY

Bed stability scored from 'fair' to 'good' with some deposits and scours at obstruction and bends and some deposition within pools.

4.2.1.4 RIPARIAN CONDITION

Riparian zones were generally more intact and in better condition at Isaac River sites and Boomerang Creek test sites. These were generally characterised by mature paperbark (*Meleleuca sp.*), she-oak (*Casuarina cunninghamiana*) and eucalypts with a relatively low cover of exotics. Hughes, One Mile and Phillips Creek sites tended to have a higher amount of riparian clearing and a relatively high cover of exotic species such as gamba grass (*Andropogon gayanus*), Leucaena (*Leucaena leucocephala*) and other exotic pasture grasses.

4.2.1.5 SUBSTRATE

Substrate was generally dominated by sands and silts (Figure 4-8). Isaac River control sites tended to have higher substrate diversity compared to other sites, and included rocky material such as bedrock, boulders and cobbles. It should be noted that the cobbles present at Hughes Creek test site HC02 were of artificial origin and formed part of a road crossing.

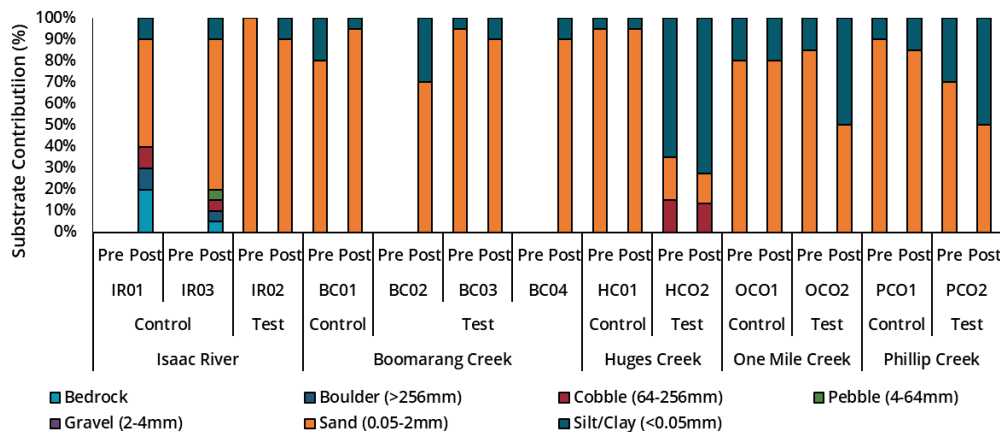


Figure 4-8 Substrate composition.

4.2.1.6 MACROHABITAT

Due to the absence of run and riffle habitats, microhabitat diversity was considered limited. The majority of the assessed reach at each site was dry during sampling, with macrohabitat otherwise restricted to isolated pools (generally shallow) (Figure 4-9). This is characteristic of tributary and riverine systems within deposition environments of the Isaac River catchment.

The significance of the low macrohabitat diversity is not easy to interpret without further understanding the morphology of the river and tributary systems. The analysis of the data collected during the survey is based on the concept that the more habitat types recorded within a surveyed reach, the better the habitat. Due to the lack of coarser material in the catchment and the historic modification of the landscape, the streams in the study area consist of low habitat diversity (two habitat types recorded) regardless of the presence of the mine. The absence of larger substrates (cobbles, boulders) at test or control sites indicates that these monitoring sites are unlikely to contain riffle habitat during flowing conditions.

Despite sampling following considerable rainfall and runoff events, many sites that contained isolated pool habitat during the early-wet season were completely dry on the subsequent late-wet visit. This is not considered atypical where such losing stream, hold water only for short (two to three weeks) periods following rainfall and runoff events.

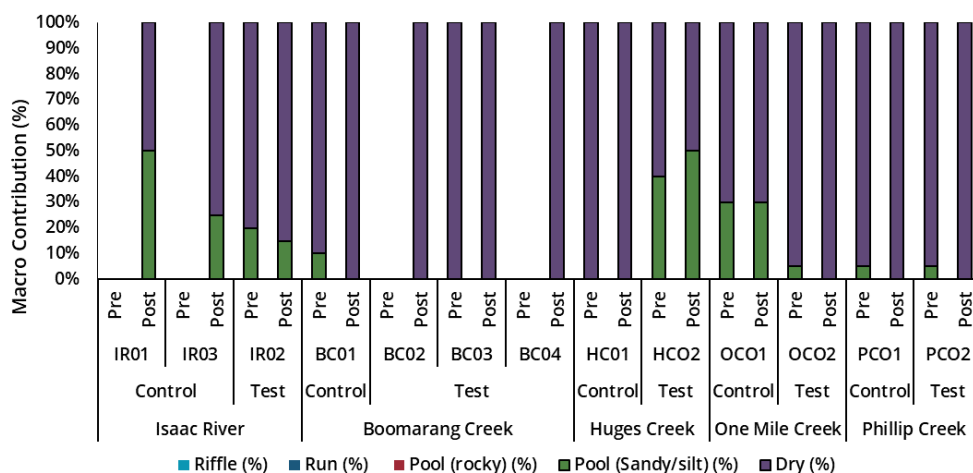


Figure 4-9 Macrohabitat composition.

4.2.1.7 MICROHABITAT

Microhabitat at all sites was dominated by large and small woody debris (LWD and SWD) (Figure 4-10). Isaac River sites and Hughes Creek test site HC02 were relatively diverse in terms of microhabitat, containing undercut banks and periphyton. Conversely, all other sites contained relatively low microhabitat diversity, largely characterised by woody debris and detritus (e.g., leaf litter)

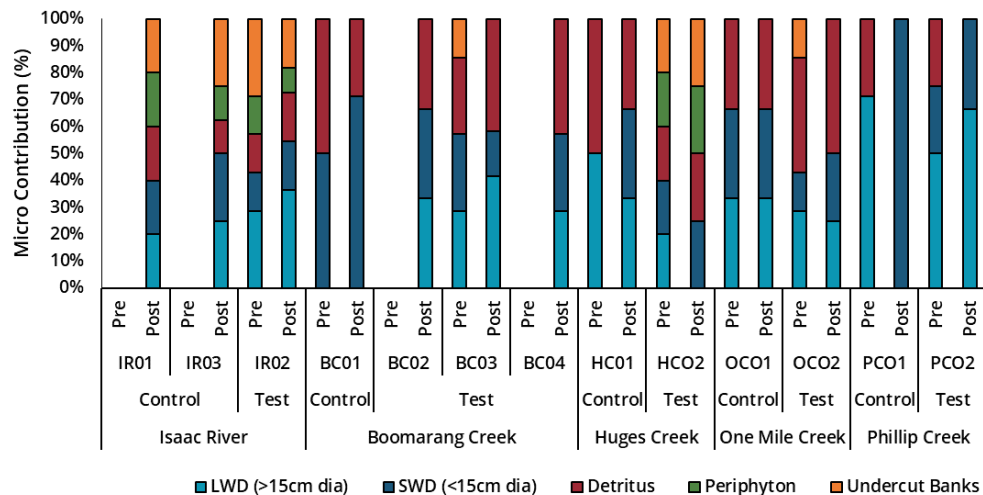


Figure 4-10 Microhabitat composition.

4.2.1.8 MACROPHYTES

Macrophyte coverage was generally low across all sites with communities largely comprising of emergent sedges such as *Lomandra*, *Juncus* and *Cyperus*. There were no in-stream floating or submerged macrophytes recorded. This is consistent with the ephemeral nature of the sampled tributaries and riverine habitats, where pool habitat is limited and short-lived. Thus, limiting the establishment of floating, semi-emergent or submerged macrophytes.

4.2.1.9 DISTURBANCES

Disturbances by feral animals was noted at most sites but was notably high at One Mile and Phillips Creek sites, where pig wallowing was evident within the shallow pool habitat.

4.2.2 AQUATIC GROUNDWATER DEPENDENT ECOSYSTEMS

Based on the desktop and field assessment for aquatic GDEs (surface water expressions) presented by Eamus et al. (2006) and Doody et al. (2019) it was determined that aquatic GDEs (surface water expressions) are unlikely to occur in the waterways of the Study area. A separate GDE assessment conducted by 3D Environmental (2022) also found that there were no aquatic GDEs present in the Study area.

The most significant control on groundwater dependence with the Study Area is a consistent lack of well-developed alluvial deposits, with only thin slivers attenuating along the larger drainage lines of Phillips Creeks (3D Environmental, 2022). The lack of significant alluvium means that away from the drainage channels, groundwater is confined to the base of the Tertiary sediments, as well as coal seams.

The potentiometric surface of the coal seams ranges from 17.4 to 38.01 mbgl (excluding MB31 which is up-gradient from the Saraji operation), roughly comparable to groundwater levels measured in the Tertiary sediments which range from 17.02 to 28.2 mbgl (excluding MB37 which is also up gradient). SWLs for monitoring bores installed in the alluvium range from 7.45 to 13.2mbgl, although most

monitoring bores are dry. Based on differences in potentiometric surface alone, there is limited potential for upward propagation of groundwater into the alluvium reinforcing the likelihood that recharge of groundwater in the alluvium will be predominantly from rainfall and associated surface runoff, or bank recharge following overbank flooding events (3D, Environmental).

4.2.3 WATER QUALITY

4.2.3.1 pH

pH at all sites apart from the Hughes Creek test site (post wet) remained within WQO. There were no obvious spatial differences (upstream vs. downstream) between creek and river sites (Figure 4-11).

pH levels recorded in the current study were generally similar to those recorded historically as part of the REMP (See Appendix C).

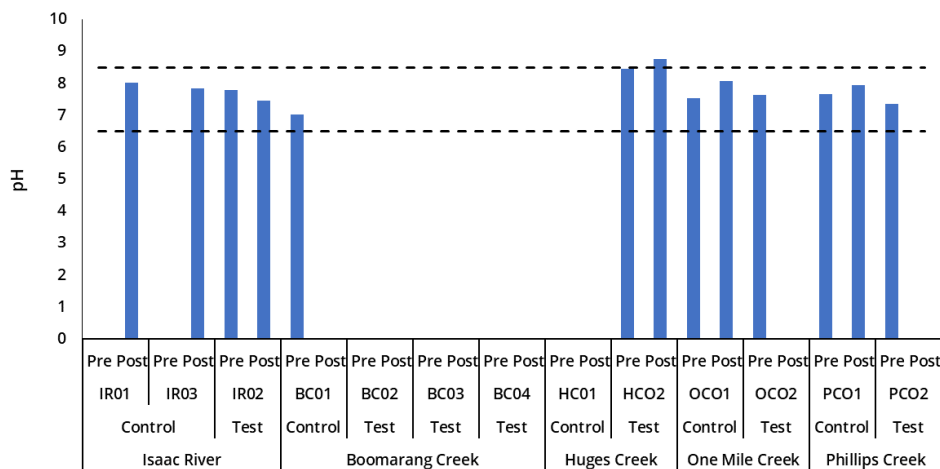


Figure 4-11 pH recorded at each site during the early-wet and late-wet surveys. Dotted line represents WQOs for the Isaac River sub-basin (DEHP, 2011).

4.2.3.2 ELECTRICAL CONDUCTIVITY

Electrical Conductivity (EC) remained within WQO values (catchment specific WQO for the protection of 95% of biota) for all sites (Figure 4-12). Hughes and One Mile Creek tended to have higher EC than Isaac River sites, likely due to the smaller pools present at the creek sites. This size of the pools indicates that they had been influenced by evaporation, resulting in an increase in the concentration of salts and subsequently EC.

There was some seasonal variation at Hughes Creek test site HC02, with higher EC recorded during the late-wet survey. It was noted that the pool had decreased in size between surveys, and it is likely that EC had increased due to evaporation and subsequent concentration of salts.

EC levels recorded in the current study are slightly higher than those recorded historically at Hughes Creek test site HC02 and both One Mile Creeks, although values were below the WQO (See Appendix C). EC levels will vary depending on pool size at the time of measurement and it may be that previous sampling events have occurred when water levels were higher.

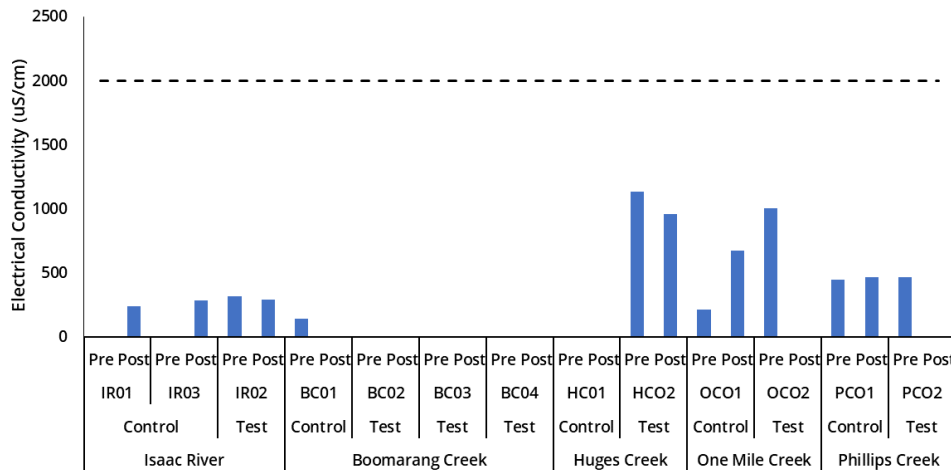


Figure 4-12 Electrical conductivity recorded at each site during the early-wet and late-wet surveys. Dotted line represents WQOs for the Fitzroy basin (Prasad et. al, 2012).

4.2.3.3 TURBIDITY

Except for Isaac River sites and Hughes Creek test HCO2, all sites (both upstream and downstream of the mine) recorded turbidity concentrations above the WQO (Figure 4-13). This is unsurprising given the noted historical turbidity levels in these systems. Turbidity was variable and showed no clear pattern between seasons, with levels either decreasing (OCO1) or increasing (HCO2) during the late-wet survey.

Comparison to historical REMP data shows that turbidity values were higher (>95th percentile) at One Mile Creek control and test sites (OCO1 and OCO2) and Phillips Creek test site (PC02) during the early-wet survey (see Appendix C). Turbidity levels at these sites was likely impacted (increased) by the evidence of feral animal disturbance (i.e. pig wallowing).

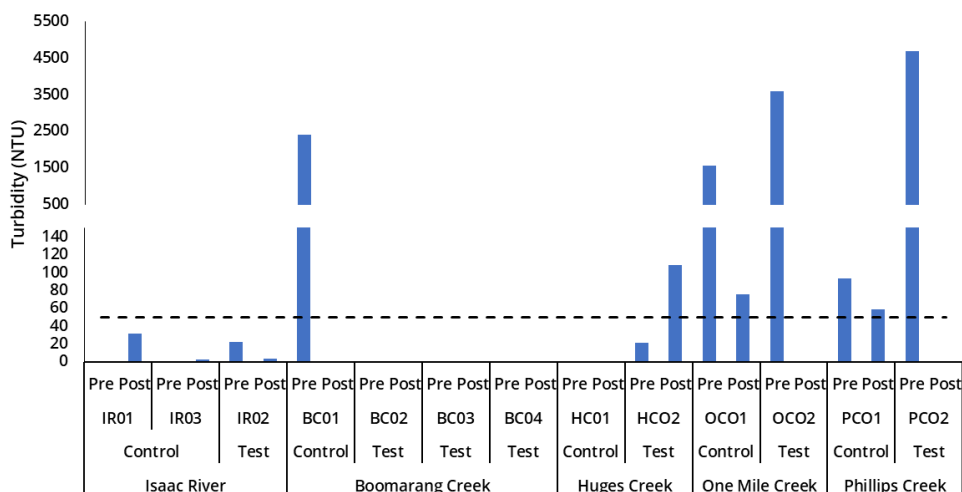


Figure 4-13 Turbidity recorded at each site during the early-wet and late-wet surveys. Dotted line represents WQOs for the Isaac River sub-basin (DEHP, 2011).

4.2.3.4 TEMPERATURE

Temperature remained within typical ranges (23-33°C) for similar sub-tropical systems (Figure 4-14).

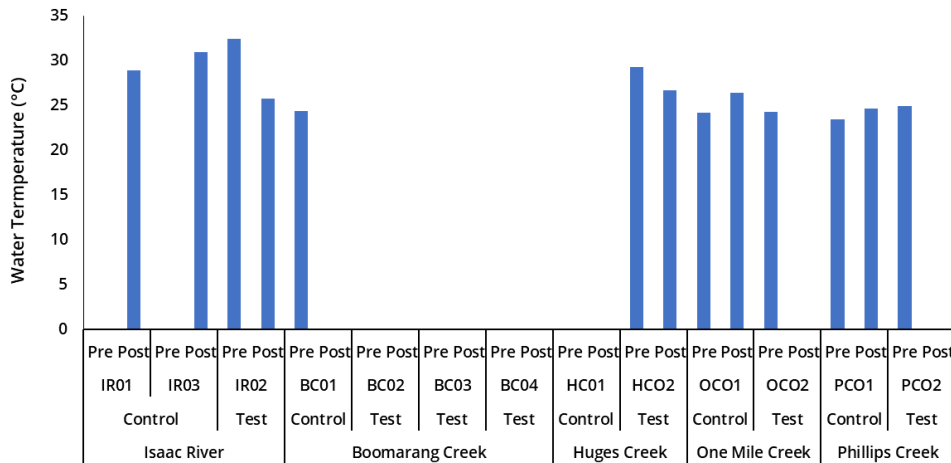


Figure 4-14 Temperature recorded at each site during the early-wet and late-wet surveys.

4.2.3.5 DISSOLVED OXYGEN

Dissolved oxygen (DO) was highly variable across the Study area (Figure 4-15). Low oxygen recorded at many of the sites (IR02 in the late-wet and OC01, PC01 and PC02 in the early-wet) and was due to the readings being taken early in the morning. Oxygen levels naturally decrease over-night as photosynthesis is replaced by respiration as the dominant process.

Boomerang and One Mile Creek control sites were comprised of small, highly turbid pools that were likely impacted by increased nutrients. It was noted that both sites had evidence of feral pig activity and that site OC01 had a notable organic rotting smell in addition to a high concentration of algae in the water column. Increased nutrients decrease oxygen levels through increased microbial activity.

DO levels were lower in the current study compared to historical REMP data (see Appendix C). Some of these differences are likely due to the time of day when readings were taken (Isaac River test site IR03) or as a result of highly reduced pool size, increased nutrients and recent disturbance from feral animals.

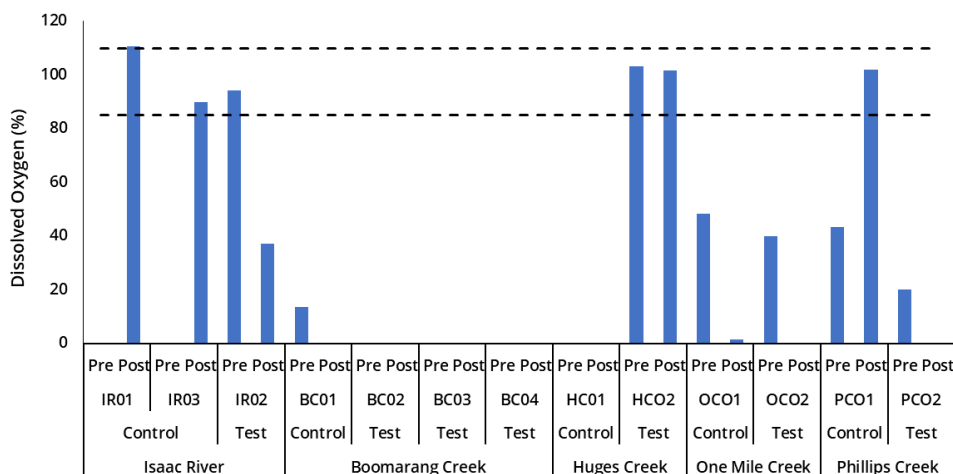


Figure 4-15 Dissolved oxygen recorded at each site during the early-wet and late-wet surveys. Dotted line represents WQOs for the Isaac River sub-basin (DEHP, 2011).

4.2.4 MACROINVERTEBRATES

4.2.4.1 UNIVARATE ANALYSIS

EDGE

Macroinvertebrate taxonomic richness was within defined catchment specific BQOs (Figure 4-16). PET richness was within BQOs at all sites except for Hughes Creek test site HC02. SIGNAL2 scores were generally slightly low across the Study area (often just below BQOs) and conversely, the percentage of tolerant taxa was generally elevated above BQOs. This suggests that communities within the Study area are dominated by macroinvertebrate taxa that are tolerant of a wide range of conditions and that taxa with specific habitat and/or water quality condition requirements (e.g., fast flow, high clarity water) were lower in number. It should be noted that Isaac River test site IR02 tended to have higher taxonomic richness and a lower percentage of tolerant taxa than control sites IR01 and IR03, indicating improved habitat conditions.

Seasonal variation was noted at IR02, with an increase in taxonomic richness and decrease in percentage tolerant taxa during the late-wet survey. This change was likely influenced by variations in microhabitat composition (e.g., presence of trailing vegetation and debris) between seasons.

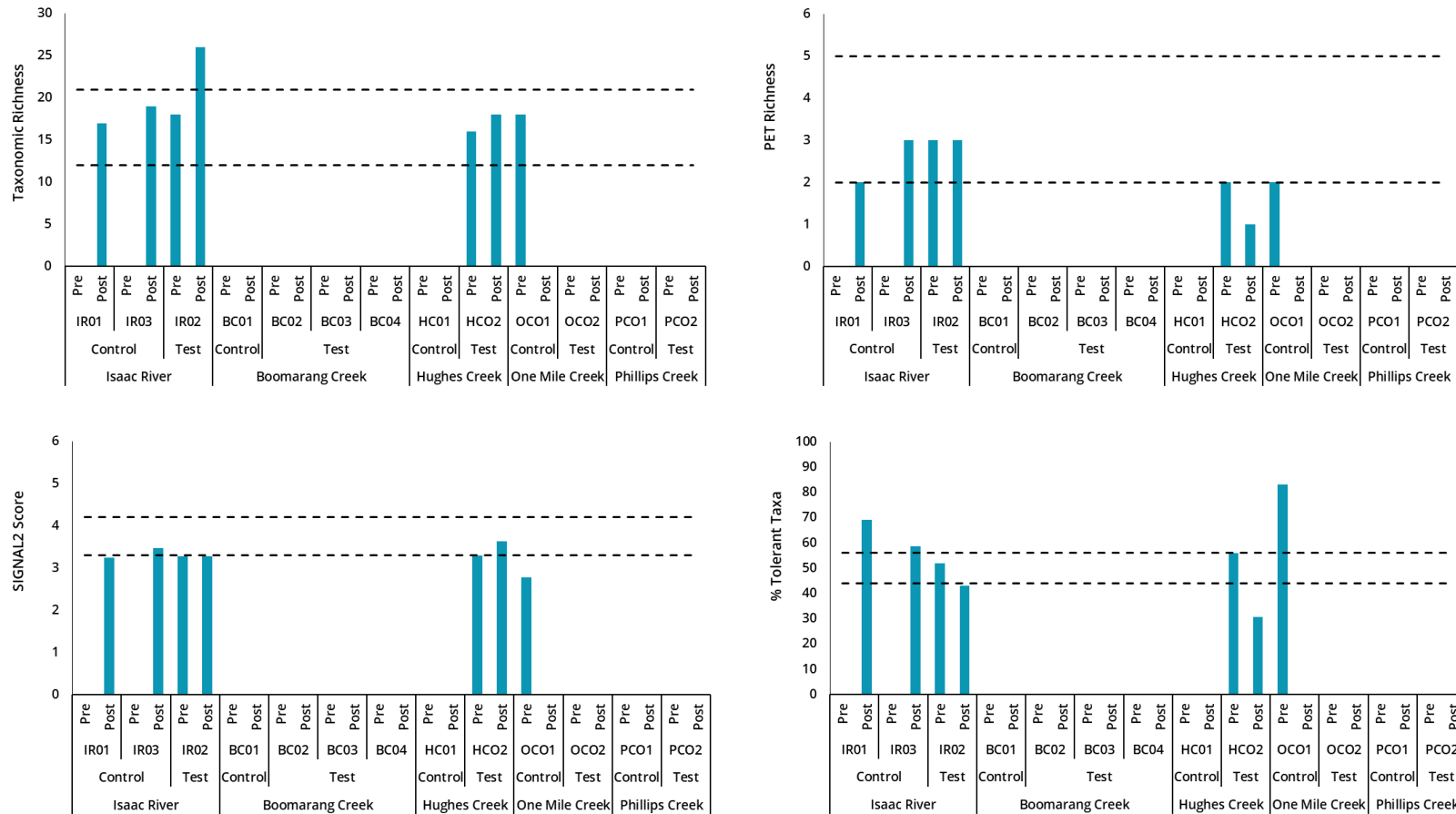


Figure 4-16 Edge macroinvertebrate univariate analysis. Dotted lines represent catchment specific BQOs (DES, 2011).

BED

Taxonomic richness and PET richness was variable between systems, with levels tending to be within BQOs at Isaac River sites and below WQOs at creek sites. This difference was largely driven by increased available macrohabitat (larger open pool habitat) and microhabitat diversity at Isaac River sites. Microhabitat at Isaac River sites generally comprised of greater periphyton, filamentous algae, macrophytes and woody debris cover compared to creek sites.

The percentage of tolerant taxa was notably high at control sites on Boomerang, One Mile and Phillips Creeks in addition to low SIGNAL2 scores, meaning that these sites were dominated by non-sensitive taxa able to withstand a wide range of habitat and/or water quality conditions. This was likely due to the small shallow pools present, feral animal disturbance and limited microhabitat diversity.

Hughes Creek test site HC02 and Boomerang Creek control site BC01 contained no PET taxa, indicating limited habitat diversity and/or decreased habitat condition.

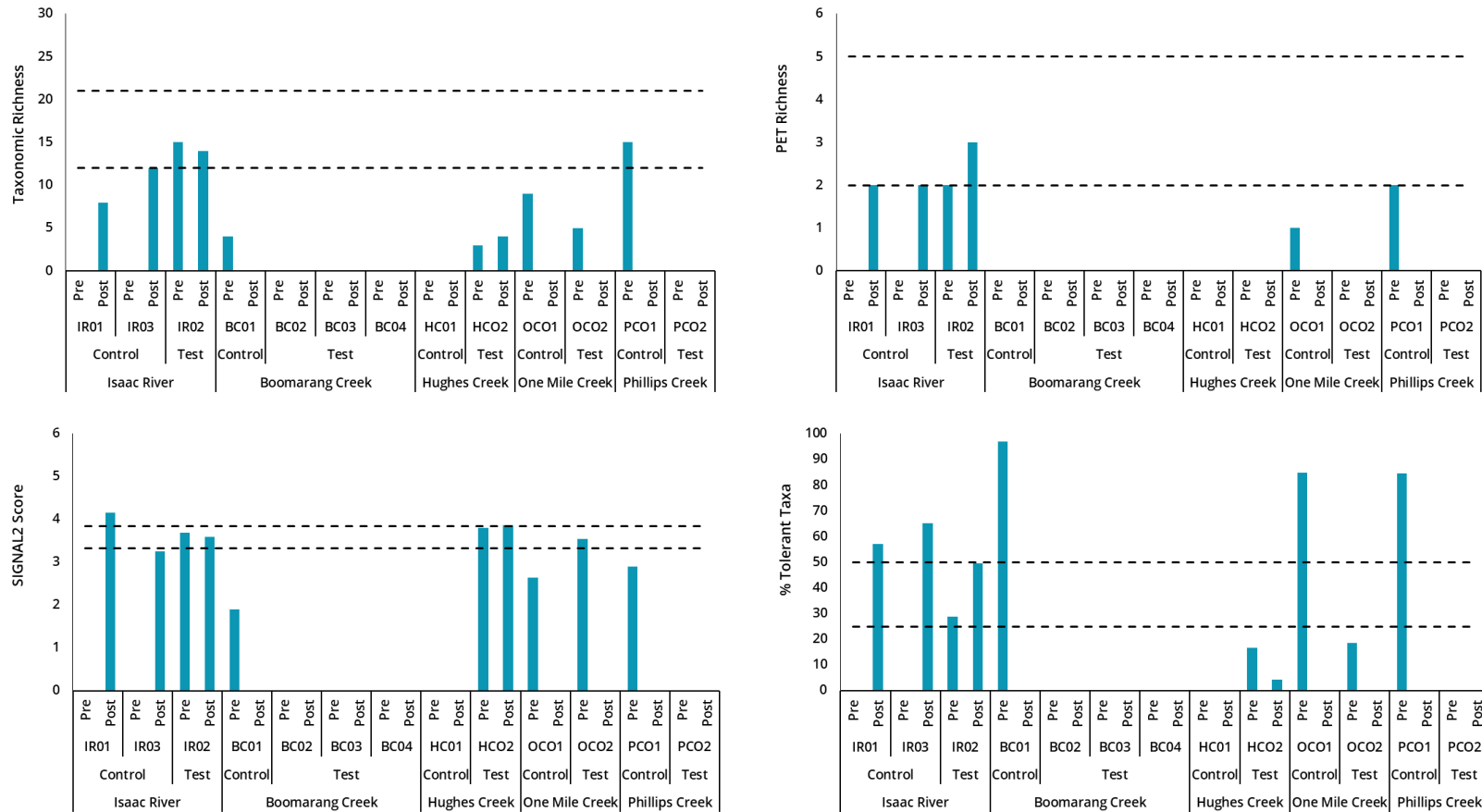


Figure 4-17 Bed macroinvertebrate univariate analysis. Dotted lines represent catchment specific BQOs (DES, 2011).

4.2.4.2 AUSRIVAS MODELLING

EDGE

The results of the AUSRIVAS analysis show edge samples were mostly in band A, meaning that the macroinvertebrate community were similar to reference sites and that expected families for the noted habitat niches were generally present (Table 4-3). Notably, test site IR02 was more biologically diverse than reference sites (band X) indicating either improved habitat and/or water quality conditions or nutrient increases have resulted in a spike in species diversity. High AUSRIVAS scores largely reflect the available habitat at each site, with Isaac River and Hughes Creek sites containing a high diversity of microhabitat such as woody debris, undercut banks and trailing/overhanging vegetation. Conversely, One Mile Creek test sites had limited edge habitat that mainly comprised of debris, this likely influenced the lower score (band B). A score of band B indicates some impairment through decreased habitat and/or water quality condition.

BED

Bed scores for Isaac River sites were mainly in band A therefore indicating favourable habitat. Isaac River sites generally had a higher diversity of microhabitat that included woody debris, periphyton and macrophytes. Conversely, creek sites generally scored lower (bands B and C) indicating decreased habitat condition. This is unsurprising as creek sites such as those on Hughes Creek and Boomerang Creek were particularly lacking in microhabitat diversity, being comprised of small, turbid pools essentially comprised of boggy sands and a small amount of debris (e.g. leaves and twigs). Scores were highly variable (ranging from band A to C) at creek sites and there was a noted decrease in condition between control and test sites on One Mile Creek. It was noted that One Mile Creek test site OC02 was highly disturbed by feral pigs and showed evidence of trampling by cows.

Table 4-3 AURIVAS scores.

System	Treatment	Site	Sampling event	OE50 Score	
				Edge Habitat	Bed Habitat
Isaac River	Control	IR01	Late-wet	0.98 (A)	0.78 (B)
		IR03	Late-wet	0.98 (A)	0.9 (A)
	Test	IR02	Early-wet	0.99 (A)	1.03 (A)
			Late-wet	1.26 (X)	0.91 (A)
Boomerang Creek	Control	BC01	Early-wet	-	0.31 (B)
Hughes Creek	Test	HC02	Early-wet	0.99 (A)	0.31 (B)
			Late-wet	0.84 (A)	0.27 (C)
One Mile Creek	Control	OC01	Early-wet	0.74 (B)	0.82 (A)
	Test	OC02	Early-wet	-	0.21 (C)
Phillips Creek	Control	PC01	Early-wet	-	0.93 (A)

4.2.4.3 COMMUNITY STRUCTURE

EDGE

Early-wet edge Isaac River and Hughes Creek characterised by taxa such as the mayflies Caenidae, Baetidae and the caddisfly Leptoceridae, generally associated by perennial systems with a relatively high diversity of microhabitats (e.g., macrophytes, woody debris, etc.) (Figure 4-18).

Early-wet edge OC01 tended to be characterised by highly tolerant taxa typical of fine-sediment dominated ephemeral systems such as microcrustaceans (Cladocera and Copepoda), chironomid larvae and beetles (Sperchidae).

Similar to the early-wet survey, late-wet edge Isaac River sites contained taxa associated with higher water availability and microhabitat diversity such as mayfly and caddisfly larvae (Figure 4-19).

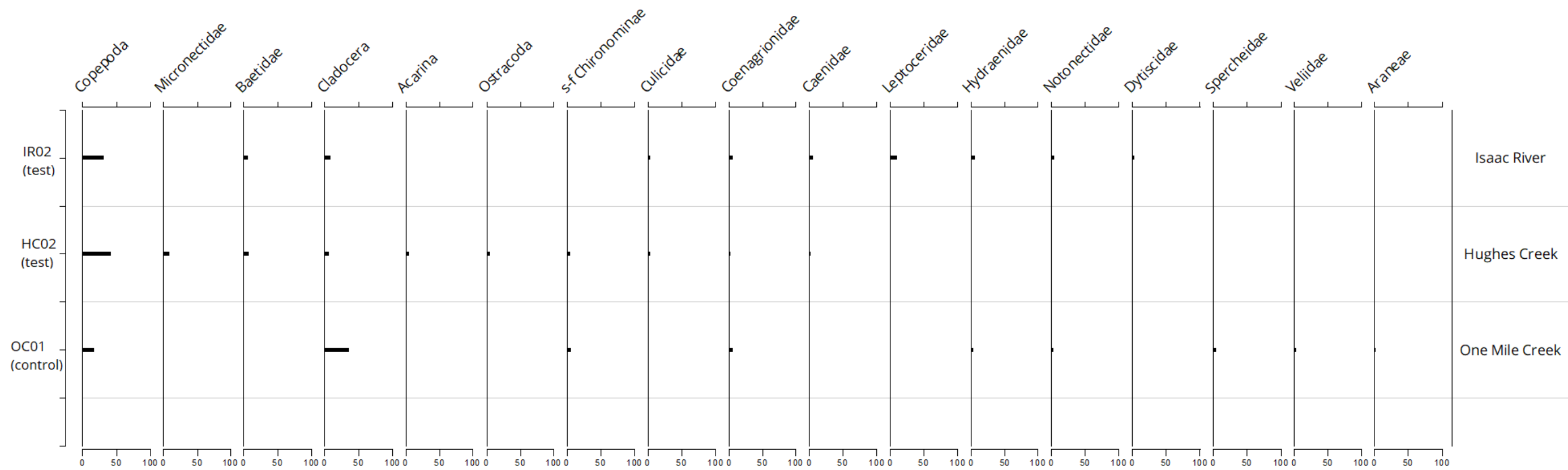


Figure 4-18 Early-wet edge macroinvertebrate community composition (%). Data represents 90% contributing taxa.

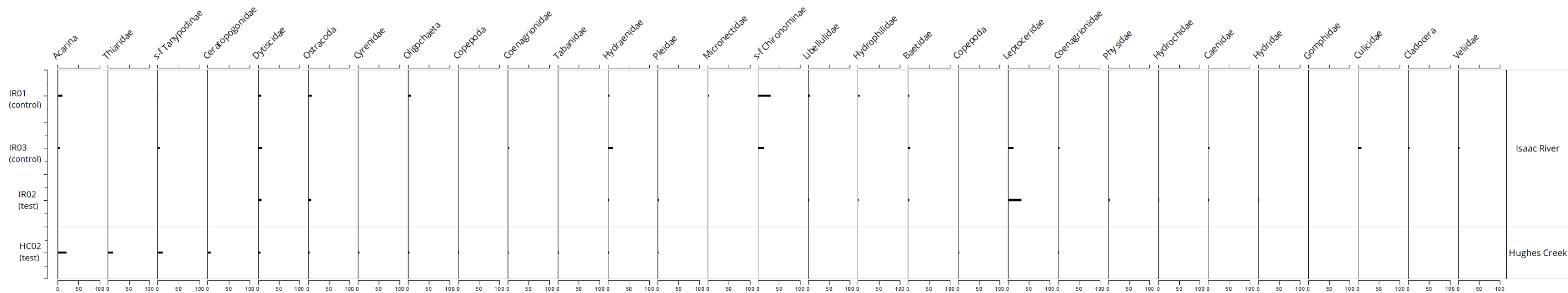


Figure 4-19 Late-wet edge macroinvertebrate community composition (%). Data represents 90% contributing taxa.

BED

Bed samples across the Study area were generally characterised by microcrustaceans, chironomid larvae (Tanypodinae and Chironominae) and beetles (Dytiscidae) (Figure 4-20 and Figure 4-21). These taxa are typical of ephemeral systems and are able to tolerate a wide range of conditions. Similar to edge samples, mayfly larvae (Caenidae) and caddisfly larvae were restricted to Isaac River sites, likely due to increased microhabitat diversity and water availability.

There was a decrease in community diversity at One Mile Creek test site (OC02) compared to the control site (OC01). Test site OC02 was dominated by just three taxa, likely due to the limited shallow pool habitat and lack of suitable microhabitat.

Hughes Creek test site HC02 showed a decrease in species evenness in the late-wet survey, becoming dominated by a single sub-family (Tanypodinae).

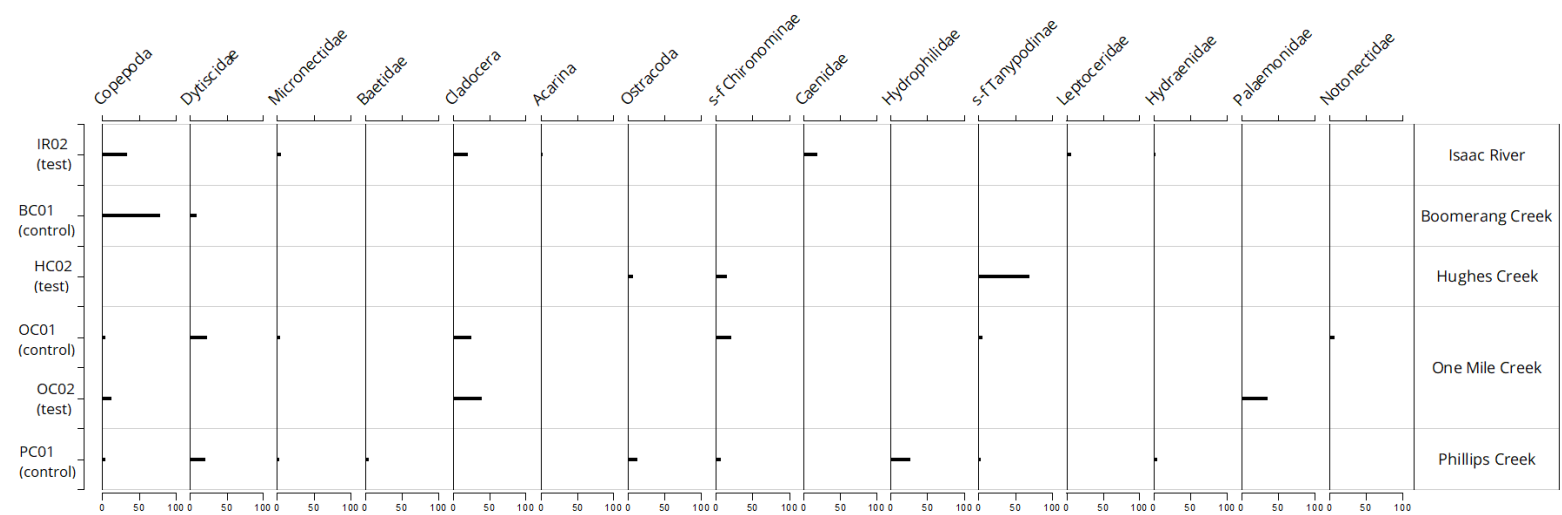


Figure 4-20 Early-wet bed macroinvertebrate communities. Data represents 90% contributing taxa.

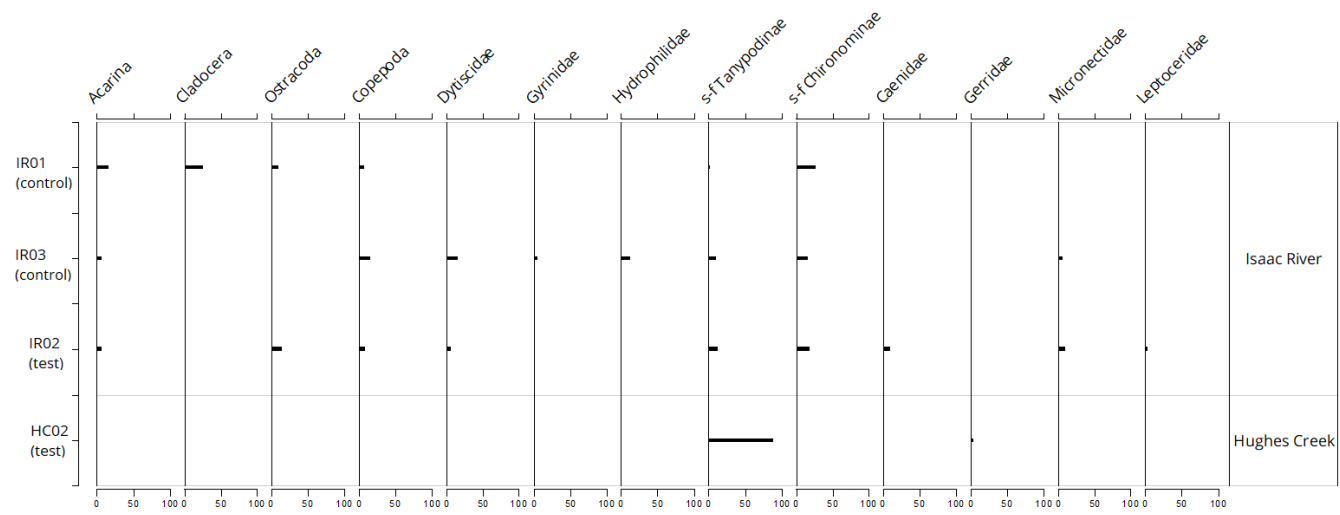


Figure 4-21 Late-wet bed macroinvertebrate communities. Data represents 90% contributing taxa.

4.2.4.4 FUNCTIONAL FEEDING GUILDS

There were no obvious patterns observed in Functional Feeding Guilds (FFGs) between control and test sites, systems or seasons (Figure 4-22 and Figure 4-23). Macroinvertebrates of the Study area were characterised by a broad range of FFGs that included filtering collectors, predators, scrapers, gathering collectors, shredders.

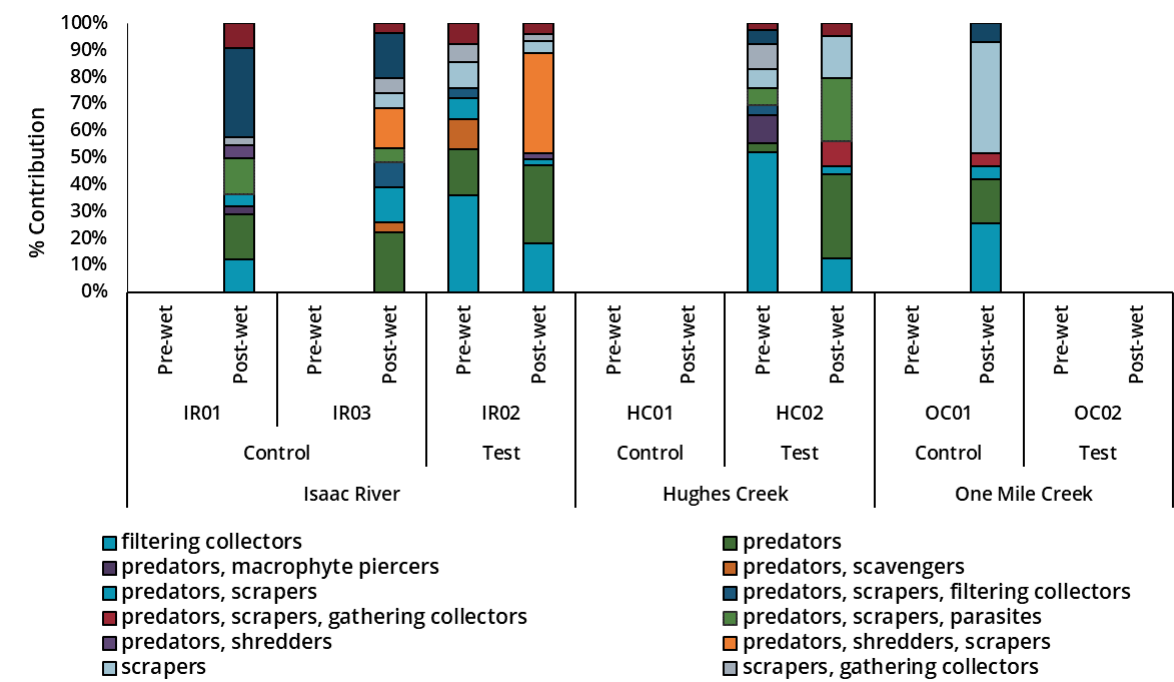


Figure 4-22 FFG composition of edge sites.

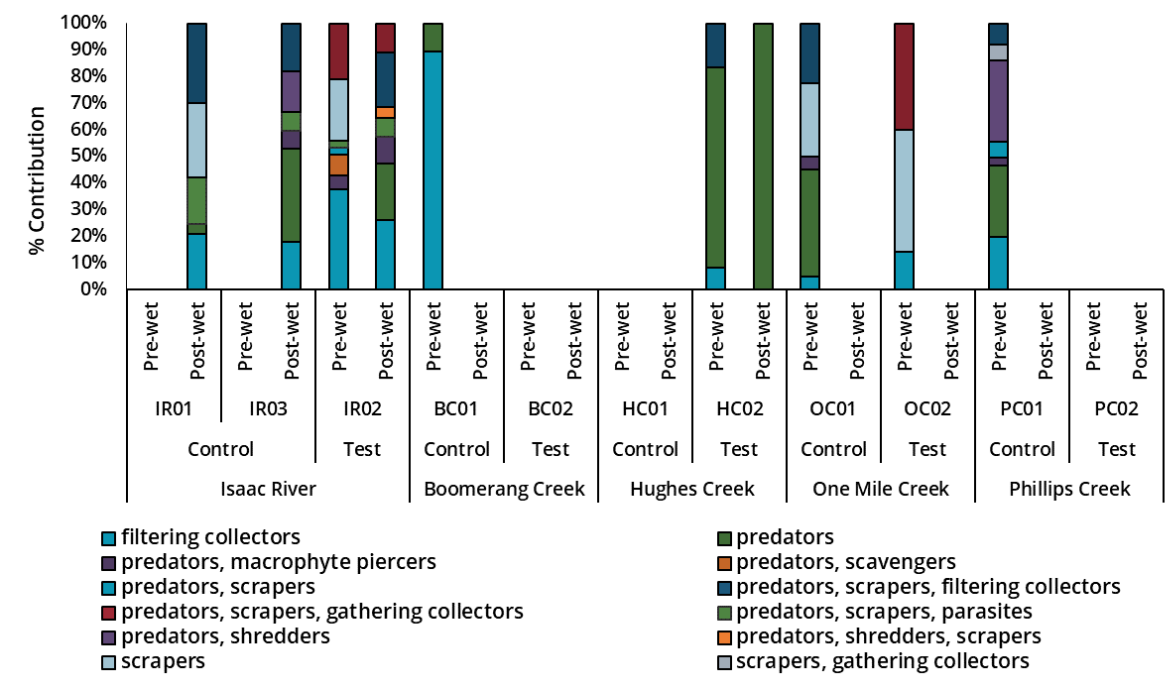


Figure 4-23 FFG composition of bed sites.

4.2.4.5 HISTORICAL COMPARISON

Taxonomic richness (Figure 4-24), PET richness (Figure 4-25) and SIGNAL2 score (Figure 4-26) results from bed samples were broadly similar to historical results at Isaac River and Phillips Creek sites but were lower from Hughes Creek and One Mile Creek sites. The percentage of tolerant taxa were highly variable across sites in the current study, with values being lower than historical results at Hughes Creek and One Mile Creek, but higher than historical results at Phillips Creek. It was noted that significant flow events occurred within Hughes Creek in the period before historical sampling took place (January and March 2021) suggesting that water availability, and therefore habitat availability was likely higher during sampling. This may have resulted in more favourable pool habitat conditions.

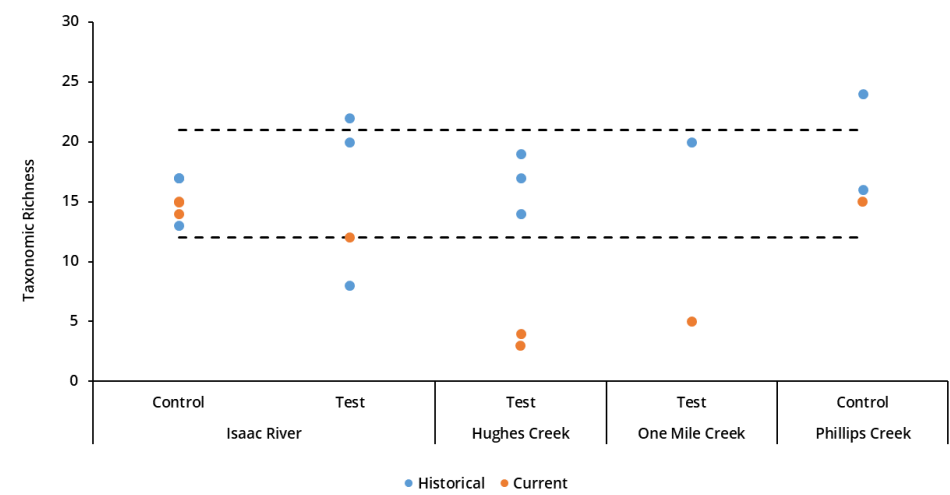


Figure 4-24 Taxonomic richness of bed samples of current study compared to historical data. Dotted lines represent BQOs.

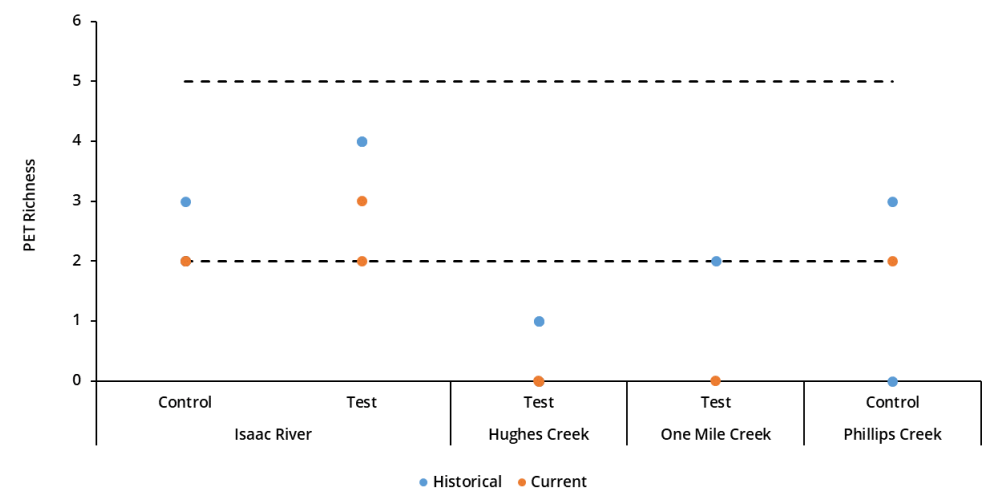


Figure 4-25 PET richness of bed samples in the current study compared to historical data. Dotted lines represent BQOs.

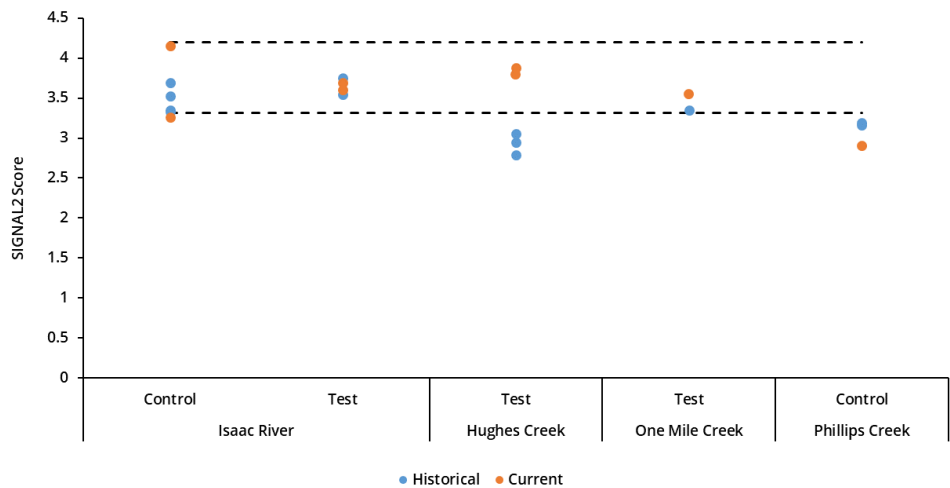


Figure 4-26 SIGNAL2 scores of bed samples in the current study compared to historical data. Dotted lines represent BQOs.

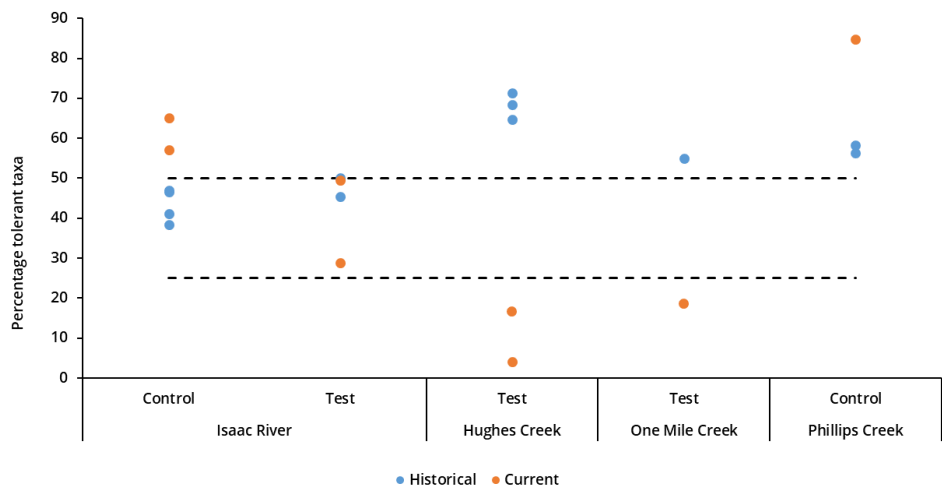


Figure 4-27 Percentage of tolerant taxa in bed samples of current study compared to historical data. Dotted lines represent BQOs.

4.2.5 MACROCRUSTACEANS

4.2.5.1 COMMUNITY COMPOSITION

A total of 4 species and 84 individuals of macrocrustaceans were collected over the Study area (Table 4-4). 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 SCM or between seasons.

Table 4-4 Macrocrustaceans caught at all sites sampled.

Scientific name	Common name	Isaac River				Boomerang Creek	Hughes Creek		One Mile Creek
		Control		Test		Control	Test		Control
		Late-wet	Late-wet	Early-wet	Late-wet	Early-wet	Early-wet	Late-wet	Early-wet
		IR01	IR03	IR02	IR02	BC01	HC02	HC02	OC01
Atyidae									
Atyidae sp.	Freshwater shrimp			1	1				
Gecarcinucidae									
<i>Austrothelphusa transversa</i>	Freshwater crab	1	6			6	1		
Palaemonidae									
<i>Macrobrachium sp.</i>	Freshwater prawn		3	14	28			1	8
Parastacidae									
<i>Cherax sp.</i>	Yabby		2			12			

4.2.6 FISH

4.2.6.1 SUMMARY

A total of 9 native and 2 exotic fish species comprising a total of 604 individuals were recorded across the Study area (Table 4-5). The most widespread species were eastern rainbowfish (*Melanotaenia splendida splendida*) and spangled perch (*Leiopotherapon unicolor*) and western carp gudgeon (*Hypseleotris klunzingeri*). All species recorded are common and widespread in the local region and are typical of similar ephemeral systems, where they are tolerant to a wide range of environmental conditions. Fish abundance was highest at Isaac River control site IR03 (n=161) and was largely comprised of *M. splendida splendida* and *L. unicolor* (Figure 4-28). Fish taxonomic richness was highest at Isaac River test site IR02 (n=6) (Figure 4-29). There were no obvious differences in fish communities between upstream and downstream sites of SCM.

ISAAC RIVER

Although abundance and taxonomic richness varied between sites, overall, the Isaac River system contained the highest fish abundance and taxonomic richness, with purple-spotted gudgeon (*Mogurnda adspersa*), Hyrtl's catfish (*Neosilurus hyrtlii*) and blue catfish (*Neoarius graeffei*) recorded only at Isaac River sites. The high abundance and richness of fish communities in the Isaac River was likely influenced by increased water availability (i.e., larger and deeper pools), increased substrate diversity and increased microhabitat diversity (e.g., macrophytes and undercut banks). The Isaac main channel is also likely to experience flow events of a higher frequency and magnitude to the other creeks sampled, providing additional habitat and connectivity between pools. Boomerang, Hughes, and One Mile Creek sites generally comprised of smaller pools, with less diverse substrate types and lower habitat diversity.

BOOMERANG CREEK

Sampling at Boomerang Creek control site BC01 yielded no fish catch although macrocrustaceans were recorded (see Section 4.2.5). This site consisted of a single pool with low habitat diversity that was dry during the late-wet survey. The highly ephemeral nature of this reach likely means that fish presence is likely highly sporadic and the ecological value in terms of fish habitat is relatively low.

ONE MILE CREEK

Fish habitat at One Mile Creek control site OC01 comprised of one small (3m diameter pool) and could not be fished using conventional methods due to its size, however a small number of *H. klunzingeri* and the exotic eastern mosquitofish (*G. holbrooki*) were incidentally captured while sampling for macroinvertebrates. This pool provided little microhabitat/substrate diversity and was completely dry during the late-wet survey therefore offers limited ecological value in terms of fish habitat.

HUGHES CREEK

Hughes Creek test site HC02 had relatively high fish abundances and taxonomic richness despite containing limited habitat diversity. This site contained the highest abundance of bony bream (*Nematolosa erebi*) recorded from any site (n=40) and the highest abundance of the exotic Mozambique tilapia (*Oreochromis mossambicus*). The site comprised of a relatively small (~10-15m) pool situated at an old road crossing with some artificially placed rocks, for scour and erosion protection, providing the only visible fish habitat.

4.2.6.2 SEASONAL COMPARISON

There was a notable decrease in fish abundance at Hughes Creek test site HC02 between the early-wet and late-wet surveys. This was particularly evident for *N. erebi*, where a population of 40 fish dropped to just one individual. The pool had decreased in size due to evaporative losses between survey events. Decreases in fish abundance within drying pools of ephemeral systems are known to be caused by decreases in water depth, changes in temperature, loss of habitat, increases in predation, competition for food and increased pressure from diseases/parasites (Unmack *et al.*, 2013).

4.2.7 AQUATIC REPTILES

No turtles were captured during either the early or late-wet surveys.

4.2.8 OTHER AQUATIC VERTEBRATES

No other aquatic vertebrates, including the special least concern platypus were captured during either the early or late-wet surveys.

Table 4-5 Fish caught at all sites sampled.

Scientific name	Common name	Isaac River				Boomerang Creek	Hughes Creek		One Mile Creek
		Control		Test		Control	Test		Control
		Late-wet	Late-wet	Early-wet	Late-wet	Early-wet	Early-wet	Late-wet	Early-wet
		IR01	IR03	IR02	IR02	BC01	HC02	HC02	OC01
Ambassidae									
<i>Ambassis agassizii</i>	Agassiz's glassfish	2	11				10	6	
Ariidae									
<i>Neoarius graeffei</i>	Blue catfish				1				
Cichlidae									
<i>Oreochromis mossambicus*</i>	Tilapia			1	2		96	20	
Clupeidae									
<i>Nematalosa erebi</i>	Bony bream			1			40	1	
Eleotridae									
<i>Hypseleotris klunzingeri</i>	Purple spotted gudgeon	8	12	2					1
<i>Mogurnda adspersa</i>	Sleepy cod				1				
<i>Oxyeleotris lineolata</i>	Western carp gudgeon			1	1		10	9	
Melanotaeniidae									

Scientific name	Common name	Isaac River				Boomerang Creek	Hughes Creek		One Mile Creek
		Control		Test		Control	Test		Control
		Late-wet	Late-wet	Early-wet	Late-wet	Early-wet	Early-wet	Late-wet	Early-wet
		IR01	IR03	IR02	IR02	BC01	HC02	HC02	OC01
<i>Melanotaenia splendida splendida</i>	Eastern rainbowfish	20	99	23	25		40	20	
Plotosidae									
<i>Neosilurus hyrtl</i>	Hyrtl's catfish			1					
Poeciliidae									
<i>Gambusia holbrooki</i> *	Eastern mosquitofish				2				2
Terapontidae									
<i>Leiopotherapon unicolor</i>	Spangled perch	47	46	10	10		12	11	

* Exotic

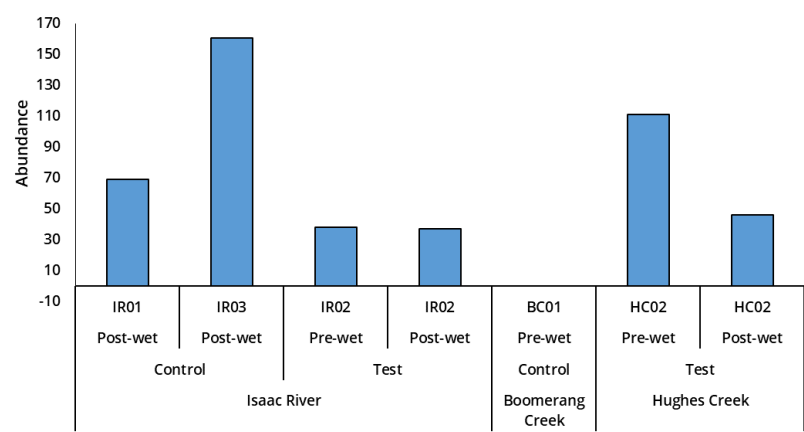


Figure 4-28 Fish abundance.

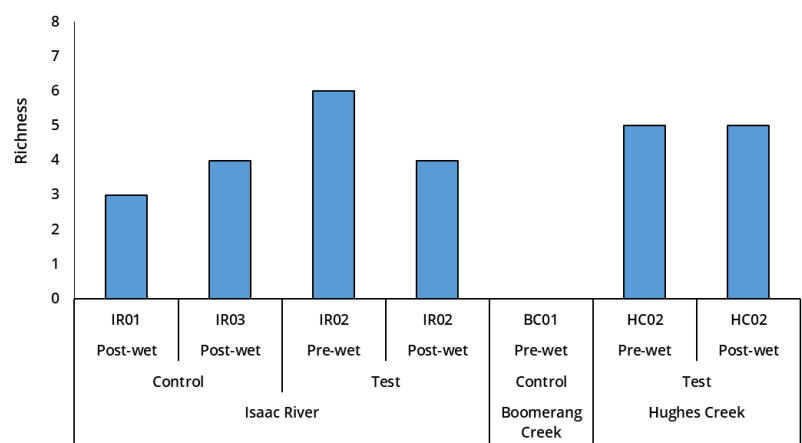


Figure 4-29 Fish taxonomic richness.

4.2.9 THREATENED SPECIES

Based on known records, the current surveys and habitat suitability assessments (Table 4-6, Table 4-7), the Study area does not support either the white throated snapping turtle or the Fitzroy River turtle. This is largely based on the absence of a perennial sufficiently deep pool habitat.

Table 4-6 White-throated turtle habitat suitability assessment.

Attribute	Ref.	Isaac River			Boomerang Creek				Hughes Creek		One Mile Creek		Phillips Creek	
		Control		Test	Control	Test			Control	Test	Control	Test	Control	Test
		IR01	IR03	IR02	BC01	BC02	BC03	BC04	HC01	HCO2	OCO1	OCO2	PCO1	PCO2
Submerged/ emergent vegetation	8,11	✓	✓							✓		✓	✓	
Undercut banks	20		✓	✓						✓	✓	✓		
Overhanging vegetation	9	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓
Riffles	9,11													
Permanent water body	10		*	**										
Fast/slow flow waters	10, 11													
Sand-gravel substrate with crevices		✓	✓											
Large woody debris	10, 12	✓	✓	✓		✓	✓	✓	✓		✓			✓
Impoundment of stream	8, 13													
Extensive riparian clearing	9, 13				✓	✓			✓	✓	✓	✓	✓	✓

Attribute	Ref.	Isaac River			Boomerang Creek				Hughes Creek		One Mile Creek		Phillips Creek	
		Control		Test	Control	Test			Control	Test	Control	Test	Control	Test
		IR01	IR03	IR02	BC01	BC02	BC03	BC04	HC01	HCO2	OCO1	OCO2	PCO1	PCO2
Livestock/ feral animals	9, 13	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓

References: 8, (Hamann *et al.*, 2004); 9, (Limpus, 2011); 10, (Gordos *et al.*, 2007); 11, (Micheli-Campbell, 2012); 12, (Tucker *et al.*, 2000); 13, (Beukeboom, 2015); 20, (DAWE, 2020).

* review of historical imagery (QLD Globe) shows that in 2020 and 2018, the reach at this site dried out and is therefore not perennial. Where it may persist for parts of the dry season the pool is reduced to small shallow extents. We also note that upstream and downstream extents from this site are also dry and would not provide any refugia for Fitzroy River turtle turtles. Therefore, does not provide suitable habitat for this species.

**Despite water occurring during both surveys, review of historical imagery (QLD Globe) shows that in 2019, 2018, 2017, 2016, 2015, etc. the reach at this site dried out and is therefore not perennial. We also note that upstream and downstream extents from this site are also dry and would not provide any refugia for white-throated snapping turtles. Therefore, does not provide suitable habitat for this species.

Table 4-7 Fitzroy turtle habitat suitability assessment.

Attribute	Ref.	Isaac River			Boomerang Creek				Hughes Creek		One Mile Creek		Phillips Creek	
		Control		Test	Control	Test			Control	Test	Control	Test	Control	Test
		IR01	IR03	IR02	BC01	BC02	BC03	BC04	HC01	HCO2	OCO1	OCO2	PCO1	PCO2
Large deep permanent pools	1													
Rocky, gravelly or sandy substrates	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shallow riffles	1													
High water clarity	1													

Attribute	Ref.	Isaac River			Boomerang Creek				Hughes Creek		One Mile Creek		Phillips Creek	
		Control		Test	Control	Test			Control	Test	Control	Test	Control	Test
		IR01	IR03	IR02	BC01	BC02	BC03	BC04	HC01	HCO2	OCO1	OCO2	PCO1	PCO2
Ribbonweed beds	1													
Riparian vegetation (blue gums, river oaks, weeping bottle brushes, paperbark)	1	✓	✓	✓		✓	✓	✓	✓	✓				
Impoundment of stream	8,13													
Extensive riparian clearing	9,13				✓	✓			✓	✓	✓	✓	✓	✓
Livestock/ feral animals	9,13	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

References: 1, (DCCEEW, 2022).

5.

POTENTIAL IMPACTS

The Project comprises of a greenfield single-seam underground mine and supporting infrastructure on MLA 70383 and MLA 70459 adjacent to, and accessed through, the existing open cut mine void within ML 1775. The Project includes the following phases, which are discussed below:

- Construction phase; and
- Operational phase
- Decommissioning and rehabilitation.

Impacts of underground mining on aquatic ecosystems may be direct or indirect (Figure 5-1). Direct impacts are those in which the extraction of material is directly responsible for the ecosystem impact, such as subsidence and associated aquatic habitat changes. Indirect impacts are related to ecosystem changes propagated through the system due to the physical changes; for example, indirect impacts of subsidence alterations to hydraulic patterns in the affected area limiting fish movement through the system.

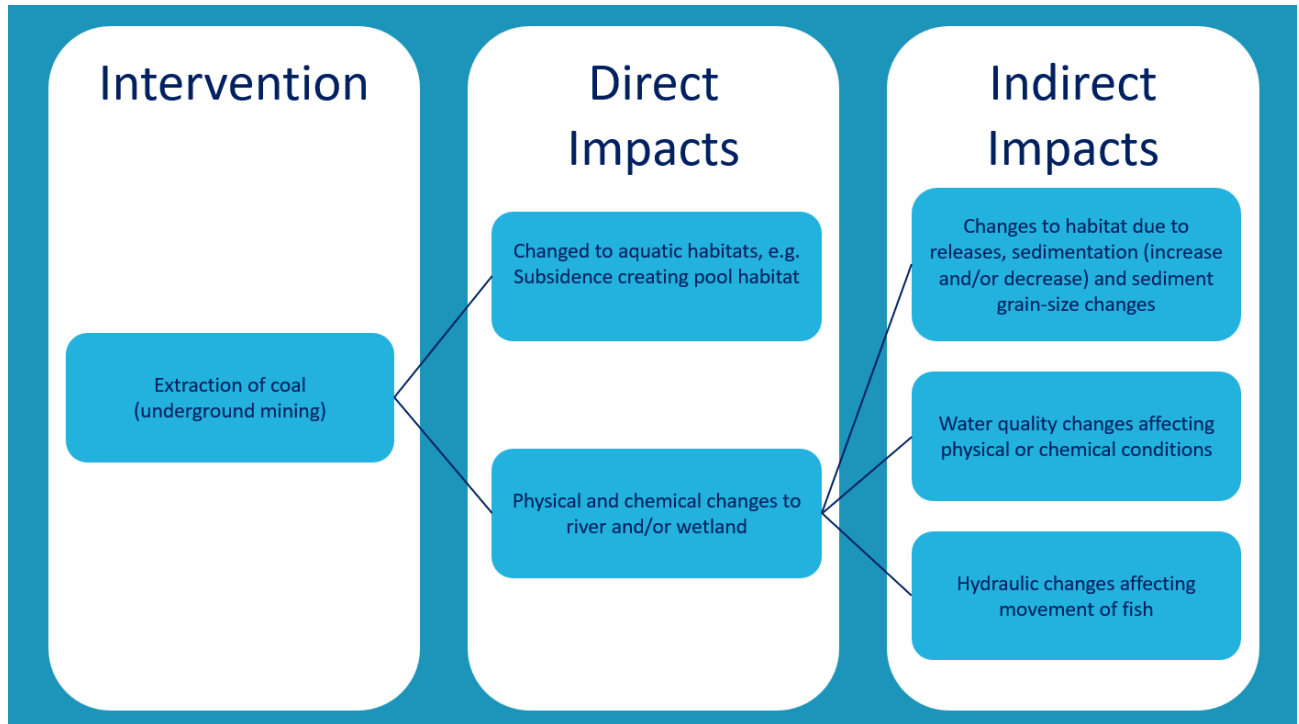


Figure 5-1 Schematic of the impact assessment approach

5.1 CONSTRUCTION PHASE

Construction phase impacts on aquatic ecological values of the Project relate mainly to aquatic habitat, biota, flow (habitat connectivity), water quality and the spread and introduction of exotic species. Consideration has also been given in this assessment to the presence and general condition of riparian vegetation that provides habitat values as well as important stabilisation and water quality functions. Impacts are considered with regards to the aquatic values or sensitivity of the affected waterways. Provided that the proposed mitigation measures are implemented successfully, the construction phase of the project are largely minor in nature and present a negligible to low residual risk to the aquatic ecosystem values.

These impacts are discussed below with brief detail of mitigation measures (where appropriate) also mentioned to understand any residual risks. Detailed mitigation measures and the overall residual impact assessment can be viewed in Appendix E. Impacts to aquatic MNES and MSES are detailed in Section 5.3. Monitoring and inspection requirements are detailed in Section 6.

5.1.1 PHYSICAL DISTURBANCE OF WATERCOURSE BEDS AND BANKS

MACROHABITAT

Clearing and grubbing can increase sediment supply into local waterways which could smother and reduce pools depths in receiving creeks. Note there is no identified riffle habitat which would be more susceptible to sedimentation impacts. Decreases in available habitat for aquatic fauna due to sedimentation could reduce breeding opportunities and increase predation (e.g. by birds), potentially causing a localised decline in abundance and diversity of aquatic species.

Stockpiles of sediment and soil may also cause increased sedimentation of waterways where rainfall and run-off washes material to waterways. Relevant to the Project, areas at most risk which provide seasonal aquatic habitat include downstream freshwater extents of Hughes and One Mile Creek. These at the very least hold water for a number of weeks following rainfall.

Any sediment movement from unsealed areas may largely be trapped by the cover afforded by the terrestrial vegetation, though inputs to receiving waters are possible where the unsealed areas are close to waterways. The construction footprint for the proposed supporting transport and/or infrastructure corridor will occupy both riparian and instream habitat extents. This infrastructure footprint is considered minor in the context of the creeks affected and will occupy habitat features which are ubiquitous to the Study area. Sediment inputs will be minimised via appropriate erosion and sediment control measures, which will be defined in accordance with Best Practice Erosion and Sediment Control (IECA, 2008) and achieve the pollutant load reduction requirements defined in DES (2021).

MICROHABITAT

The dominant microhabitat in the Study area was found to be detritus, followed by LWD and SWD. The riparian zone is expected to provide the greatest material input relevant to microhabitat. Clearing within the riparian zone is mostly associated to the proposed supporting transport and/or infrastructure corridor. These areas represent a very small portion of riparian zone within the affected waterways. As such, the impact on microhabitat (logs, snags, detritus, etc.), which support aquatic biota in terms of habitat (foraging, protection, etc.), nutrient cycling and water quality, resulting from the project are expected to be insignificant/negligible.

Sedimentation can affect the growth and species composition of submerged macrophyte communities. 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.

5.1.2 INSTREAM INFRASTRUCTURE DEVELOPMENT

Typically to avoid impeding access to feeding, nesting and spawning resources, design and construction of watercourse crossings and any temporary or permanent waterway barrier works will adopt the principals of maintaining fish passage and cater for the range of expected flows.

The Queensland Department of Agriculture and Fisheries provide the most relevant guidelines (Waterway Barrier Works Codes) for adoption. The maintenance of upstream-downstream connectivity of aquatic habitats is central to the maintenance of aquatic ecological processes and provisioning services. Proposed road crossings for Phillips, Spring, One Mile, Hughes and Boomerang Creeks may potentially impact fish movement. These creeks are classified as follows (as per the QLD waterways for waterway barrier works):

- Boomerang Creek – Major impact waterway;
- Hughes Creek – Major impact waterway;
- One Mile Creek – Moderate waterway (where the proposed road crossing intersects); and
- Phillips Creek – Major impact waterway.

Provided fish movement is accounted for in accordance with these guidelines relevant to each impact category, there should be negligible impact on fish movement from any waterway barrier works. Where possible, watercourse crossings should be constructed during dry periods and regularly inspected and maintained.

5.1.3 CHANGES TO HYDROLOGY AND HYDRAULICS

DEWATERING

Dewatering can potentially impact the hydrology and/or hydraulics of aquatic ecosystems, where any portion of the surface water balance within the local waterways is attributed to groundwater (i.e. groundwater surface expressions). Regarding the Study area there are unlikely to be any aquatic (groundwater surface expressions) GDEs (3D, environmental, 2022).

CONSTRUCTION WATER SUPPLY

Construction water will be required to facilitate activities such as earthworks, dust suppression and concrete production. The project will not take from watercourses within the Study Area or surrounds.

5.1.4 CHANGES TO WATER QUALITY

INPUTS FROM CLEARING

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

Sediments mobilised by erosion may have other contaminants associated with sediment particles including heavy metals derived from the local geology. When sediment particles containing heavy metals enter water, the metals may, under certain conditions, be released into the water column and become bioavailable. This in turn can affect the health of aquatic plants and animals and potentially impact other environmental values.

The water quality results indicate that the majority of metals detected are bound to sediment particles, since total metal concentrations are typically much higher than dissolved metal concentrations. Metals released from sediments to the water column can be influenced by lower pH; however, pH results indicate that surface water pH is generally within the range of 6.5 to 9.0, thus minimising this mechanism for metal release from sediment particulates. This is particularly relevant to aluminium given the naturally high concentrations both upstream and within the project footprint.

Sediment inputs will largely be mitigated via appropriate erosion and sediment control measures which will be in accordance with Best Practice Erosion and Sediment Control (IECA, 2008) and achieve the pollutant load reduction requirements defined in DES (2021).

EFFLUENT AND WASTE RELEASE

A number of waste sources will be generated from camps and construction amenities which will have the potential to impact aquatic ecosystem values, including:

- Effluent generation; and
- Liquid and putrescible waste.

Liquid and putrescible waste would be expected to be managed through on-site landfill facility and wastewater treatment plant(s). Any releases from STPs and the like would be managed in accordance with licence conditions so would not be expected to cause significant impacts.

HAZARDOUS SUBSTANCES AND CONTAMINANTS

During the construction phase, potential contamination of surface waters and therefore to aquatic ecosystem values may result from:

- Accidental spills and leaks of hydrocarbons (oils, fuels and hydraulic fluids) and other contaminants associated with mobile plant and heavy equipment (BTEXN, TRH, PAHs);
- Accidental discharge of chemicals and detergents associated with washdown areas (i.e. potassium, phosphates, ammonia, surfactants);
- Stored bulk chemicals used during construction;
- Leakage or spills from temporary diesel fuel storage areas (BTEXN, TRH, PAHs); and
- Use of contaminated water onsite (i.e. water extracted from groundwater sources or brought to site; is of suitable quality to protect defined environmental values).

Potential impacts as a result of spills of hazardous substances will be managed in accordance with relevant legislation, guidelines and standards. All hazardous materials will be contained in appropriately engineered and fully lined/bunded storage areas, appropriate management measures for emergency response, etc.

The risk of imported materials creating potential contaminated land issues are considered low as the project will only import materials classified as 'clean earth' under the *QLD Environmental Protection Regulation 2019*.

5.1.5 DAMAGE AND/OR DEATH OF AQUATIC FAUNA

Damage and or death of aquatic fauna may occur where works in watercourses are required. In particular, the instatement of the proposed supporting transport and/or infrastructure corridor and associated potential dewatering (should pool habitat be present) presents the greatest risk of aquatic biota death due to entrapment and drowning.

To mitigate these potential impacts, aquatic fauna salvage efforts will occur during dewatering and on a needs basis during the construction period. Salvage efforts will be in accordance with Fish Salvage Guidelines described for least concern (DAF, 2022) and developed low-risk species management plans.

5.1.6 INTRODUCTION AND SPREAD OF AQUATIC WEEDS

There is an increased risk of introduction of aquatic weeds (salvinia, water hyacinth, cabomba etc.) through transient populations, plant and equipment associated with the construction phase. The Weed and Pest Management Plan will detail specific management measures in accordance with BMA weed management and mitigation guidelines, recommended Biosecurity Queensland (BQ) methods (Department of Agriculture and Fisheries 2020) and the Isaac Regional Council Biosecurity Plan 2020-2023. Control measures that will be outlined within the Plan include:

- Management measure to remove and control new weed infestations
- Containment and treatment measures, including appropriate hygiene for vehicles, machinery and other construction equipment; and
- Monitoring and corrective actions.

5.1.7 INTRODUCTION AND SPREAD OF EXOTIC FISH

The presence of tilapia along Hughes Creek may pose biodiversity risk to native species where the construction phase may create further depauperate conditions creating more favourable conditions for this species.

The impacts of tilapia in Australian waterways are not well understood largely due to the lack of data from before introduction for comparison. This has led to a lack of quantifiable results and limited impacts to speculation only. A review by Russel et al. (2012) of the impacts of tilapia on aquatic ecosystems of Australia found that the tilapia will have little impact on native fish species in Australia through competition for food or predation. Rather, they may displace native species through aggressive behaviour during mating periods when the males vigorously defend their display pits or females defend their brood (Moran et al., 2004). Arthington and McKenzie (1997) demonstrated that *Oreochromis mossambicus* kept indigenous species out of their breeding territories.

Given the ephemeral nature of the Study area and lack of persistent water through these reaches, there will unlikely be opportunities for tilapia to establish nests or persist with mouth broods. The potential increase in numbers due to more favourable conditions (reduced water quality) should be restricted with appropriate erosion and sediment controls. Additionally, where tilapia were recorded in Hughes Creek so was some of the highest diversity in native fish, further supporting the above conclusion that tilapia in Australia have little impact on native fish species in Australia through competition for food or predation.

5.1.8 INCREASED FISHING PRESSURE

The risk of increased fishing pressure is unlikely as the resident populations in the Study area are not considered to be preferred angling species. Nevertheless, employees of the Project should be prohibited from fishing.

5.2 OPERATIONAL PHASE IMPACTS

Provided that the proposed mitigation measures are implemented successfully, the operational phase of the project are largely minor in nature and present a negligible to low residual risk to the aquatic ecosystem values. Relevant to subsidence, impacts cannot be mitigated; however they will be adaptively managed in accordance with the developed Subsidence Management Plan (BMA, 2023).

These impacts are discussed below with brief detail of mitigation measures (where appropriate) also mentioned to understand any residual risks. Detailed mitigation measures and the overall residual impact assessment can be viewed in Appendix E. Impacts to aquatic MNES and MSES are detailed in Section 5.3. Monitoring and inspection requirements are detailed in Section 6.

5.2.1 PHYSICAL DISTURBANCE OF WATERCOURSE BEDS AND BANKS

Alluvium Consulting Australia (2022) identified subsidence pooling, increased bank and bed erosion and bank instability and downstream aggradation as key impacts from the Project.

Subsidence of up to 3.4 m are expected as of Year six of the Project within One Mile and Hughes Creeks (Appendix F). Beyond Year six of the Project the majority of subsidence is expected to range from 1 to 2 m in depth. In Boomerang Creek, subsidence is not expected to exceed 1.5 m. 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. Ultimately additional pool habitat will form (Alluvium Consulting Australia, 2022).

Initially, the noted subsidence will allow for the development of pool habitat, such as the 0.5-1 km pool expected to form in One Mile and Hughes Creek. This may be beneficial as it provides deep pool habitat within a system where such habitat is scarce. These pools are likely to persist longer than the largely shallow pools identified in the affected creeks. Given the likelihood of overflow (annual

overflow probability of more than 99%, (Engeny, 2023)), some of the deeper formed pools with present biota may persist for sufficient time where they overflow allowing for the trapped fish to move through the affected reaches to complete their lifecycles. Where this isn't the case aquatic biota in these pools will eventually perish either due to complete drying of pool habitat (drainage and evaporative losses) and or water quality degradation. This process is similar to aquatic biota retained in seasonal pools currently in the mentioned creeks. We note that the potentially impacted aquatic fauna are ubiquitous in the Study area and wider sub-basin. Additionally, there will be no impacts to threatened aquatic species, as they do not occur within the Study area.

Impacts from subsidence will be managed through the developed Subsidence Management Plan (BMA, 2023). This includes an adaptive management strategy to proactively manage and mitigate the discussed habitat impacts above. The adaptive management approach is able to accommodate the wide range of environmental responses to subsidence that might be experienced (e.g. impacts to riparian zones, changes to sediment transport regimes, impacts to bed and banks etc.). This adaptive approach aligns with the proposed strategy during operations for routine subsidence monitoring and reporting (BMA, 2023). Any amelioration works are to occur during the dry seasons where watercourse flows are negligible, so not to disrupt ecological processes of ephemeral creeks.

It should also be noted that the naturally elevated sediment supply within these systems will eventually overwhelm the pools and will progress until there is a smooth bed profile and the pools are filled (Alluvium Consulting Australia, 2022).

5.2.2 MICROHABITAT

The developed subsidence pools will likely become traps for microhabitat such as large wood debris which are important habitat structures from macroinvertebrates and fish. Where these subsidence pools are ameliorated, any deposited large wood debris is to be reinstated in the reprofiled watercourse.

5.2.3 CHANGES TO HYDROLOGY AND HYDRAULICS

SUBSIDENCE

The ponding areas will reduce the annual volume of surface water generated from the Project that is allowed to flow into Boomerang Creek, Hughes Creek and One Mile Creek (Engeny, 2023). This will reduce the available macrohabitat (largely shallow pool habitat), though we note that affected areas provide seasonal pool habitat and support aquatic biota that are ubiquitous in the Study area and wider sub-basin. Additionally, there will be no impacts to threatened aquatic species, as they do not occur within the Study area.

No detectable impacts relevant to hydrology and hydraulics are defined for the Isaac River (Engeny, 2023).

GROUNDWATER DRAWDOWN

There are no aquatic GDEs (surface water expressions) within the Study, therefore impacts to surface water expressions are not anticipated. Further, there are no predicted net flow changes to creeks and river systems within the receiving environment and surrounds (SLR, 2023).

MINE AFFECTED WATER RELEASES

The proposed Water Management System (WMS) is documented in detail within the *Mine Water Balance Technical Report* (AECOM, 2022). The proposed WMS dams have been developed to meet containment criteria for MAW dams for a 5% AEP wet season criterion, consistent with a preliminary consequence category of 'significant'.

The Process Water Dam (PWD) was assessed to hold a capacity of 125 ML and modelling indicates that it would contain less than 40 ML of mine affected water during general operating conditions, with volumes accumulating to up to 100 ML in wetter than average rainfall scenarios. The spill probability of the PWD was assessed to be < 0.2% which indicates that no spill was modelled during the 500 different climate scenarios. Detailed information about PWD parameters is described in AECOM (2022).

Any mine affected water releases to Boomerang Creek will be required to be released at locations and rates that do not increase peak flood flows downstream. This will occur through retention, attenuation and control of flows through the planned water management system (AECOM, 2022).

5.2.4 LOSS OR REDUCED ACCESS TO FEEDING, NESTING AND SPAWNING RESOURCES

The continual performance of crossing infrastructure (i.e. road infrastructure) is required to allow for migration and movement to upstream feeding, nesting and spawning resources. In time, crossing infrastructure can become clogged with debris and damaged from peak flow events. This in turn, may create unfavourable hydraulics which can limit fish passage. To mitigate these potential impacts, crossing related infrastructure is to be regularly inspected and maintained in accordance with DES (2018) requirements for the maintenance of existing culvert crossings and associated infrastructure.

5.2.5 CHANGES TO WATER QUALITY

SUBSIDENCE

The expected subsequent change in flow and macrohabitats, deterioration of water quality and increased rates of erosion with associated effects on riparian vegetation and turbidity is expected to occur without any management of developed subsidence. In this instance, trapping of sediment in pool habitat overtime may also lower downstream total suspended solids/turbidity leading to increased light availability and increase in algal growth in pools if nutrient concentrations are high, which they typically are in agricultural settings.

The initial increase in suspended solids as a result of subsidence occurring, will unlikely significantly increase suspended solid concentrations with the Study area, given the already high concentrations, as demonstrated by turbidity in the two surveys. As such, expected impacts in food-web interactions (bottom up through reduced photosynthesis and top-down by limiting visual foraging efficiency of many fish) are unlikely. The identified aquatic fauna, including fish, are highly tolerant of depauperate water quality (high conductivity, turbidity, temperatures, nutrients, etc.) and are adapted to the boom and bust production afforded by such ephemeral habitat (Pusey et al. 2014).

Water balance modelling within the affected waterways suggests that overflows from the subsidence pools will remain below 1,500 $\mu\text{S}/\text{cm}$. The current catchment specific objective for conductivity is 2,000 $\mu\text{S}/\text{cm}$ (Prasad et al., 2012) for the protection of 95% of aquatic biota. The level of protection afforded

by this objective is consistent with the protection level defined for the catchment for slightly to moderately disturbed ecosystems (DES, 2011). It should also be noted that these systems can naturally experience concentration above 1,000 $\mu\text{S}/\text{cm}$ during drying of pool habitat.

The proposed management and mitigation measures defined in the Subsidence Management Plan (BMA, 2023) for reducing impacts of subsidence pools will further mitigate/minimise any potential impacts to water quality.

GROUNDWATER DRAWDOWN

Ground and surface water interactions are not expected to occur within the watercourses of the Study area as there is no surface expression of regional groundwater tables. Additionally, wetland features rely on rainfall events and overland flow to recharge (3D Environmental, 2022). 3D Environmental (2022) found that terrestrial GDEs occurred along Philips and Boomerang creek; however increased drawdown of groundwater in the alluvium was predicted to be insignificant. Therefore the moderating water quality values (i.e. reduced temperatures, less fluctuations in dissolved oxygen reduced turbidity, etc.) provided by riparian zones is not expected to change from the existing scenario.

LICENSED RELEASE OF MINE AFFECTED WATER

All mine water produced during the operation phase would be stored and managed through the proposed mine water management system (WMS) (AECOM, 2023a), which has been developed to minimise the likelihood of uncontrolled spills. Assessment of the hydraulic performance of the WMS has been completed in the Mine Water Balance Technical report (AECOM, 2023a). Under a variety of scenarios, no spills from site dams were predicted. Notwithstanding, BMA are pursuing a licensed release point, located at the PWD, to allow for contingent management of Mine Affected Water for unforeseen conditions. The conditions for these licensed releases are as follows:

- Boomerang Creek $\geq 0.1 \text{ m}^3/\text{s}$; and
- Isaac River (Deverill Station MP19) $\geq 3 \text{ m}^3/\text{s}$.

Consistent with current mine modelling conditions (DES, 2013), mine affected water releases containing 10,000 $\mu\text{S}/\text{cm}$ is proposed. The impact on surface water quality from licensed releases is described in the Surface Water Quality Technical Report (AECOM, 2023b). This modelled approach determined that licensed release of mine affected water based on a discharge rate of $>0.1 \text{ m}^3/\text{s}$ in Boomerang Creek and a release rate of 100 L/s or 8% of flow rate in Boomerang Creek would result in an expected conductivity of (assuming full mixing):

- $<660 \text{ }\mu\text{S}/\text{cm}$ in Boomerang Creek; and
- $<450 \text{ }\mu\text{S}/\text{cm}$ in Hughes Creek.

Predicted conductivity assuming full mixing is expected to be considerably below the current Fitzroy Basin specific guideline (2,000 $\mu\text{S}/\text{cm}$) (Prasad et al. 2012) defined for the protection of 95% of species.

Licensed releases will occur during flow conditions in coordination with proximate mines and will not exceed the Model Mining Conditions for coal mines in the Fitzroy Basin (DES, 2017) in Table 5-1. While subregional guideline values (ANZG, 2018; DES, 2011) are exceeded, these values are not based on biota responses to conductivity levels, and represent an aspirational value to be achieved based on wider catchment conductivity levels and not specifically focusing on Hughes and Boomerang Creeks.

The release of mine affected water will afford in most cases protection to 95% of species as required for slightly to moderately disturbed systems. This level of protection is also consistent with that defined by DES (2011) for which Saraji East is located (i.e. Upper Isaac River catchment waters contain moderately disturbed ecosystems).

Table 5-1 Mine affected water release limits and select contaminant trigger investigation levels based on Model Mining Conditions (DES, 2017) (AECOM, 2023b).

WQ Parameter	ANZG (2018) and/or EPP WQO (DES, 2011) or Fitzroy Basin specific guideline	Model Mining Conditions 2017
Electrical conductivity ($\mu\text{S}/\text{cm}$)	2,000 (Prasad et al. 2012). <720 during base flow and <250 during high flow (DES, 2011).	$\leq 10,000$
pH (pH Unit)	6.5-8.5	6.5 (minimum) 9.0 (maximum)
Turbidity (NTU)	<50 (DES, 2011)	50
Suspended solids (mg/L)	<55 (DES, 2011)	55
Sulfate (mg/L)	545 (Dunlop et al. 2016) <25 (DES, 2011)	250

HAZARDOUS SUBSTANCES AND CONTAMINANTS

The risk of impact from the storage and handling of hazardous substances is considered low, and consistent with that described for the Construction phase.

5.2.6 DAMAGE AND/OR DEATH OF AQUATIC FAUNA

Damage and or aquatic fauna death because of entrainment in pool habitat created by subsidence is discussed in Section 5.2.1. Proposed management and mitigation measures (where pools may be drained or infilled) to proactively deal with subsidence pools (BMA, 2023) may result in fish death. Where such measures are employed, it is recommended that aquatic fauna salvage efforts occur. Salvage efforts will be in accordance with Fish Salvage Guidelines described for least concern (DAF, 2022) and developed low-risk species management plans.

5.2.7 INTRODUCTION AND SPREAD OF AQUATIC WEEDS

During operation the risk of the introduction and spread of aquatic weeds are considered negligible due to the limited works within the local waterways. Should works commence at such areas then a weed management plan (WMP) will also be required and will include (but not be limited to):

- Monitoring and control frequencies at each crossing; and
- Hygiene procedures for vehicles, machinery and other construction equipment.

5.2.8 INTRODUCTION AND SPREAD OF AQUATIC FAUNA

Based on the lack of expected significant changes to water quality (Section 5.2.5), subsidence pools are not expected to create significantly more favourable conditions for noted exotics (tilapia and mosquito fish).

Again it is noted that in Australia, tilapia are unlikely to compete for food resources or impact native populations and diversity through predation. This conclusion is further supported by the data collected in Hughes Creek, where the highest abundances of tilapia and native fish, including diversity, were recorded relative to all other surveyed creek systems which are drained by the Isaac River.

5.2.9 INCREASED FISHING PRESSURE

The risk of adverse impacts to fish populations due to increased fishing pressure are considered negligible and consistent with the Construction phase.

5.3 IMPACTS ON MNES AND MSES

The following section provides an SRI assessment for relevant MNES and MSES. Where relevant, National (DoE, 2013) and State (DES, 2014) significant residual impact (SRI) criteria have been applied.

The residual impact to the following National and State Matters have not been assessed:

- Threatened aquatic species gazetted under both National (EPBC Act) and State (NC Act) legislation. Both the white-throated snapping turtle and Fitzroy River turtle do not occur in the Study area, nor are any impacts expected to occur to any known habitat or populations, which occur some 60 km from the Study area;
- Protected animal wildlife habitat for special least concern species (platypus) gazetted under the NC Act. This species does not occur in the Study area, nor are any impacts expected to occur to any known habitat or populations, which occur some 80 km from the Study area; and
- Other MNES and MSES (excluding HES and Waterway Providing for Fish Passage) listed in Table 2-1. These do not overlap the Study area nor are any impacts expected to occur to such matters.

WETLANDS AND WATERCOURSES

Based on the discussed impacts, the construction and operation of the Project is unlikely to result in a significant residual impact to wetlands of HES located in the Isaac River floodplain and adjacent to Hughes and Boomerang Creek, and Phillips Creek (Lake Vermont). As per the SRI impact criteria, the Project will not result in the environmental values of the mapped HES being affected in any of the following ways:

- Areas of the wetland being destroyed or artificially modified;
- A measurable change in water quality of the wetlands—for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters;
- The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected;
- A substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; and
- An invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland.

WATERWAYS PROVIDING FOR FISH PASSAGE

Should the implementation of the developed Subsidence Management Plan (BMA, 2023) and allroad crossing accommodate fish passage in accordance with relevant QLD waterway barrier works codes be successful then there should be no SRIs to waterways providing for fish passage. If they are not, then the operational phase of the Project may result in an SRI to fish passage. The following SRI criteria impacts from may occur:

- Result in the mortality and injury of fish;

- Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish;
- Reduce the extent, frequency or duration of fish passage previously found at a site;
- Substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish;
- Result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows; and
- Lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues for movement in local fish species.

Offsets may be required should an SRI eventuate. Financial settlement can be provided to the State or notional offset areas which is a 1:1 impact:ratio for fish passage.

6.

MONITORING AND INSPECTIONS

The below points provide monitoring context for both the construction and operational phases, which will be further detailed in the respective construction environment management plan (CEMP) and receiving environment monitoring plan (REMP). Planned monitoring includes:

- Environmental monitoring, involving the collection of quantitative data to establish whether aquatic values are being impacted as a result of project activities;
- Monitoring water quality within the mine site and upstream and downstream of mine water releases; and
- Reporting and analysis of regulated releases and any other prescribed monitoring in accordance with relevant conditions and management plans.

6.1 CONSTRUCTION PHASE

A receiving environment monitoring program (REMP) will be developed and implemented prior to construction. The aim of the REMP is to monitor and assess the potential impacts of the controlled and uncontrolled releases of MAW and associated contaminants to the environment from a regulated activity. This will provide the basis for evaluating whether the discharge limits have been successful in maintaining or protecting receiving environment values over time.

The effectiveness of construction impact mitigation and management measures will be verified during the development and implementation of the CEMP. These will include, but not limited to:

- 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;
- Routine audits to ensure appropriately provisioned spill containment controls and spill response kits are in place during construction;
- 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; and
- Monitoring flow, physicochemical and contaminant parameters upstream and downstream of any releases from stormwater infrastructure. Monitoring surface water quality in accordance with AECOM (2023b).

6.2 OPERATIONAL PHASE

The effectiveness of operational impact mitigation and management measures be verified during the development and implementation of management plans to:

- Assess appropriate bioindicators relevant to the potential contaminants in mine affected water releases, as well as the monitoring of aquatic habitat variables and their condition. The developed program is to contain sufficient statistical rigour to ensure that impacts to aquatic ecosystem values can be identified;
- Monitor flow, physicochemical and contaminant parameters upstream and downstream of any releases of mine affected waters. Monitoring surface water quality in accordance with AECOM (2023b);
- Monitor subsidence in watercourses in accordance with the developed subsidence management plan (BMA, 2023);
- 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; and
- Routine monitoring of any release infrastructure to identify and correct any scour, erosion and/or sedimentation. Identified issues are to be investigated and remedied.

6.3 RESPONSE MECHANISMS

Should aquatic habitat, water quality and/or aquatic biota impacts be detected from project activities, a response mechanism will be followed. This will include:

- Reporting of the incident according to internal incident reporting procedures;
- Assessment of activities, including stop work for significant events;
- Photo records of impacts and corrective works;
- Review of existing erosion and sediment controls and management plans; and
- Implementation of corrective actions and rehabilitation.

7.

CONCLUSIONS

HABITAT

The waterways of the Study area and surrounds are 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 for the most part provide typically small shallow pool extents. The surveyed 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. Habitat condition was broadly similar to those recorded in previous surveys.

There are no defined aquatic groundwater dependent ecosystems, within the Study area.

WATER QUALITY

Electrical conductivity (EC) and pH were typical of similar systems and in most cases remained within defined guidelines. Dissolved oxygen levels fluctuated naturally according to the time of day at some sites but were decreased at other sites due to the small size of the pools sampled and a high level of feral animal disturbance. Turbidity was similarly elevated at some creek sites where feral animal disturbance was noted.

Physicochemical parameters for the most part remained similar to historical collected data.

MACROINVERTEBRATES

Macroinvertebrate assemblages within the Study area were dominated by taxa that are tolerant of a wide range of conditions. Assemblages and diversity indices such as taxonomic richness, PET richness, SIGNAL2 score and AUSRIVAS OE50 were driven by macrohabitat and microhabitat diversity. Diversity indices were higher at Isaac River sites compared to creek sites due to increased water availability and diverse microhabitat, which included 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 lower than historical REMP data at Hughes Creek and One Mile Creek, likely due to inter-annual differences in flow events.

FISH

A total of 9 native and 2 exotic fish species comprising a total of 604 individuals were recorded across the Study area. All species recorded are common and widespread in the local region and are typical of similar ephemeral systems, where they are tolerant to a wide range of environmental conditions.

Isaac River sites contained the highest fish abundance and taxonomic richness, being influenced by increased water availability (i.e., larger and deeper pools), increased substrate diversity (included bedrock and boulders) and increased microhabitat diversity (e.g., macrophytes and undercut banks).

THREATENED SPECIES

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.

PROJECT IMPACTS

With the implementation of the mitigation and management measures described and referred to throughout, and based on the current/likely impacts the construction and operation 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.

The above is contingent on the successful implementation of the developed Subsidence Management Plan, 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.

8.

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APPENDIX A. SURVEY METHODOLOGY



GDE PRESENCE AND VALUE

In order to identify the presence of GDEs at each site, an assessment relative to that developed by Eamus et al. (2006) was implemented. The below assessment was undertaken specifically for surface GDEs and the series of questions relevant to Queensland and freshwater systems (Table A1). Questions relevant to terrestrial GDEs are being assessed by other consultants. In addition to Eamus et al. (2006), the presence of cracking clays can also indicate that a waterbody is less likely to be groundwaters (Doody et al. 2018). As this could be easily identified in the field, it was included in the GDE presence assessment.

Table A1 Questions to guide the assessment of groundwater use in ecosystems (Eamus et al. 2006; Doody et al. 2018).

Item	Positive answers to the following questions suggest an ecosystem may use groundwater:
1	Does a stream/river continue to flow all year, despite prolonged periods of zero or very low rainfall?
2	Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?
3	Is the level of water in a wetland/swamp maintained during extended dry periods?*
4	Were cracking clays present? Where cracking clay soils exist or Holocene muds, waterbodies are less likely to be groundwater fed

In order to define the inherent value of any identified GDEs, The Serov et al (2012) method for attributing low, moderate or high value to GDEs was adopted as defined in Doody et al. (2018), including:

- The sensitivity of GDE communities to changes in groundwater (i.e. *high value* - GDEs for which only slight changes in groundwater level can result in loss of biota or services; *moderate value* - GDEs that require a moderate change in groundwater to cause change in their distribution, composition or condition);
- Location of GDEs (i.e. *high value* - within State Reserves);
- Condition (i.e. *high value* - GDE is relatively unaltered with good condition; *low value* - highly modified from natural state and declining in ecosystem condition);
- Uniqueness (i.e. *high value* - GDE contains endemic, rare or endangered species; *moderate value* - GDEs contain vulnerable or threatened biota); and
- Services (i.e. *high value* - GDEs that provide multiple ecosystem services to society).

HABITAT

DATA COLLECTION

Modified State of the River-style and AUSRIVAS habitat descriptions of bed, banks, and riparian zones were completed along a 100m reach at each site. This included descriptions of:

- Macro and microhabitat;

- Bed and bank conditions as well as the identification of the major types of instability (eroding, slumping and aggrading). Information relating to the slope and shape of the banks.
- Bed substrate composition and embeddedness;
- Adjacent land use and the condition that prevailed at the time of sampling;
- Riparian cover and composition, noting percentage cover of trees, shrubs, grasses/herbs/sedges and bare areas; and
- Channel alteration, including presence of scouring and/or deposition.

Additional notes regarding the level and types of disturbance evident (human habitation, activity, feral animals, etc), diversity and abundance of weeds and the general bank morphology were made at each site. Site information sheets were compiled for each monitoring site, which describe the above listed features.

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.

DATA ANALYSIS

Qualitative habitat assessment sheets were digitised and along with photos and field observations, supported a narrative assessment of in-stream and riparian habitat types. This information is used to contextualise results of the aquatic fauna sampling and also provide a basis of monitoring.

WATER QUALITY

DATA COLLECTION

At each site, physicochemical parameters were measured in-situ with a calibrated YSI DSS Pro water quality meter. The following parameters were assessed:

- Temperature (°C);
- Electrical conductivity @ 25°C (µS/cm);
- pH (pH unit);
- Turbidity (NTU); and
- Dissolved oxygen (% saturation and mg/L).

Physicochemical measurements were collected from below the water's surface (0.2 to 0.4 m). The following in-situ QA/QC measures were used to ensure the accuracy and reliability of collected samples:

- The water quality meter was fully calibrated a day prior to use. The water quality meter was checked prior to the collection of data at each site to assess for any anomalies;
- The water quality meter was cleaned at the end of each field day and between sites; and
- Physico-chemical readings were recorded once values stabilised (approximately three minutes).

Water samples for laboratory analysis were also taken at each site and sent to a NATA accredited laboratory. The results of this analysis will form part of an additional surface water report.

DATA ANALYSIS

Collected water quality data was compared to the Environment Protection Policy (Water) – Water Quality Objectives (WQOs) defined for the Isaac River sub-catchment (DEHP, 2011) and wider Fitzroy basin (Prasad *et al.*, 2012).

MACROINVERTEBRATES

SAMPLE COLLECTION AND PROCESSING

Macroinvertebrate sampling was undertaken in accordance with AUSRIVAS protocols for Queensland streams (DNRM, 2001) and more recent macroinvertebrate sampling manuals (DES, 2018). In order to target macroinvertebrates occurring in different freshwater habitats and to assess varying impacts processes, both kick (pool/bed habitat) and sweep (edge habitat) samples were collected from each site (where habitat was available). Collected samples were live-picked and returned to the laboratory for identification to family and sub-family (chironomids only) level, where possible.

DATA ANALYSIS

GUIDELINE COMPARISON

Collected macroinvertebrate data were used to calculate several diversity indices including:

- Taxonomic richness (the number of individual taxa recorded at each site);
- Total abundance (the number of macroinvertebrates at each site);
- Plecoptera, Ephemeroptera and Trichoptera (PET) richness (the number of pollution-sensitive taxa at each site); and
- SIGNAL (the condition score calculated for each site based on present macroinvertebrates and their associated sensitivity grades).

Calculated diversity index values were compared to relevant biological quality objectives (BQO) for edge and composite (includes run, riffle, pools) habitats, which for all catchments in the Isaac River sub-basin are based on the 20:80 percentile values defined in DEHP (2011).

AURIVAS PREDICTIVE MODEL

The macroinvertebrate and predictor variable (habitat) data were analysed using the AUSRIVAS macroinvertebrate predictive modelling program, version 3.2.2 (Ransom and Blackman, 2003).

AUSRIVAS predictive model produces various outputs, of which the most valuable for interpretation is the observed to expected ratio (OE50) score. It provides a measure of biological impairment at each site (Coyush *et al.*, 2000). The OE50 scores are assigned to band sections provided by the model, ranging from Band X (better than AUSRIVAS database reference condition) to Band D (extremely impaired).

FUNCTIONAL FEEDING GUILDS

Macroinvertebrates are often grouped into functional feeding guilds (FFGs) for ease of conceptualisation. FFGs classification of aquatic organisms enhances the knowledge of trophic dynamics in streams by simplifying the benthic community into FFGs. The pattern of FFG distribution has been related to the environmental gradient in the river (River Continuum Concept) (Vannote *et al.*, 1980) and can therefore provide an indication of the health of a river system (i.e. should there be changes to the expected distribution of guilds).

Functional feeding guilds were assigned to each taxa recorded in edge and bed habitat, graphed and compared visually among sites and habitats. Taxa were assigned to FFGs on the basis of those described in MDFRC (2021).

VERTEBRATES AND MACROCRUSTACEANS

DATA COLLECTION

Vertebrate surveys were conducted in accordance with Hydrobiology's current General Fisheries Permit (no. 206951), Animal Ethics approval (CA 2021/02/1462) and Research Permit (WA0047340).

The selected range of gear is suitable and commonly used apparatus for the survey of fish (small and large bodies species), aquatic reptiles and platypus (DES, 2018a). The below methods are also efficient methods for the capture of macrocrustaceans, and while not specifically used for this reason, were commonly caught as by-catch.

All native species were released after identification and measurement near to where they were captured. All exotic and voucher specimens were euthanised via a lethal dose of Anqui-S® solution in accordance with Hydrobiology's Animal Ethics approval. Exotics were disposed of in accordance with current State legislative requirements.

FYKE NETTING

Where sufficient water levels were present, a single fyke net was deployed at each site. Two fyke net sizes were used in this study. One had two 5 m wings, with a 0.9 m drop and the other with a single 5 m wing and a 0.6 m drop. Both nets had 2 mm mesh. The fyke net size deployed was dependent on the water level and habitat present at each site. A float was placed in the cod end of each fyke net to provide an air space for air breathing fauna (turtles, etc). Fyke nets were set in the afternoon and cleared the following morning.

BAIT TRAPS

Five box-style bait traps were set at each site where water levels were sufficient. Traps were baited with dry cat food, placed within a range of available habitats and collected the next morning.

CATHEDRAL TRAPS

Cathedral traps could not be deployed at any site due to the limited water depths noted at all sites.

SNORKELLING

Both traps and snorkelling are identified as suitable survey methods for threatened freshwater turtles DSEWPC (2011b). As detailed above, a range of traps were used to target white-throated snapping turtles and Fitzroy River turtles. Due to the lack of depth in each pool and high turbidity limiting visibility, snorkelling was not employed at any site.

CATCH PROCESSING

The following processing methods were employed at all sites:

- Fish and macrocrustaceans were identified to species level, enumerated, and assessed for obvious wounds, lesions, or deformities; and
- Each specimen was weighed and measured until 20 individuals of each species were recorded for the particular site and capture method. Following this, the individuals would be counted.

DATA ANALYSIS

Total species richness and abundances was summarised from all methods and all sites. The conservation significance of collected fauna was assessed by reference to State and Federal databases and in-house knowledge of the distribution of species from previous studies in the area.

THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT

At each site habitat assessments were undertaken for conservation significant (State and/or Federally listed endangered, vulnerable, near threatened, and MNES species identified during the desktop assessment which included the classification of the likelihood of any one species occurring at each site. The likelihood of species occurring was considered under four categories; (i) unlikely; (ii) possible; (iii) likely; and (iv) Known. The criterion used to define each category is provided in Table A2.

Table A2. 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.

IMPACT ASSESSMENT

IDENTIFYING THE IMPACT

Each identified impact was categorised, and the significance of the impact determined using the methodology set out below.

CATEGORISING THE IMPACT

PHASE

Impacts will be categorised into either or both of the following phases.

- Construction
- Operation

Where an impact exists in both construction and operation phases, it will be included in both categories (i.e. twice)

DIRECTION

The impact will be identified as positive or negative

RATING THE IMPACT

Impacts will be assessed using a standardised method, which is based on a set of criteria as set out in Table A3. The assessment matrix presented as Table A4 demonstrates how the impact rating is derived.

Table A3 Impact categorisation

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

Table A4 Impact rating matrix

Magnitude	Duration	Likelihood	Impact Significance
Negligible	Short Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
	Long Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
	Permanent	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
Minor	Short Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Low
		Almost Certain	Low
	Long Term	Rare	Low
		Possible	Low
		Likely	Medium
		Almost Certain	Medium
	Permanent	Rare	Low
		Possible	Medium
		Likely	Medium
		Almost Certain	Medium
Moderate	Short Term	Rare	Low
		Possible	Low
		Likely	Medium

Magnitude	Duration	Likelihood	Impact Significance
		Almost Certain	Medium
	Long Term	Rare	Low
		Possible	Low
		Likely	Medium
		Almost Certain	High
	Permanent	Rare	Low
		Possible	Medium
		Likely	High
		Almost Certain	High
Major	Short Term	Rare	Low
		Possible	Medium
		Likely	Medium
		Almost Certain	High
	Long Term	Rare	Low
		Possible	Medium
		Likely	High
		Almost Certain	High
	Permanent	Rare	Medium
		Possible	High
		Likely	High
		Almost Certain	High

SENSITIVITY/IMPORTANCE

The intrinsic sensitivity or importance of the environmental or social was assessed by the subject expert. The rating was derived depending on the type of value, and each subject expert provided definition within the subject chapter to demonstrate how the relative sensitivity/importance has been derived.

Sensitivity/Importance encompassed the intrinsic worth of the value, and related to legal protection e.g. red listed species, or was defined by individual or community perception of social or cultural worth. Rarity or uniqueness was considered to increase the importance of a value. In this way a moderate impact on an irreplaceable value was considered alongside a high impact on a value that is replicated many times in the local area to determine the relative significance of the impact.

Values were rated as low, moderate, high or extreme sensitivity/importance.

IMPACT SIGNIFICANCE

The significance of the impact was derived based on the matrix below. Positive impacts have been excluded from the matrix but were reported in the impact assessment.

Table A5 Impact significance matrix

		Sensitivity/Importance			
		Low sensitivity	Moderately sensitive	Highly sensitive	Extremely sensitive
Impact rating	Insignificant	Minor	Minor	Minor	Minor
	Low	Minor	Minor	Moderate	Moderate
	Medium	Minor	Moderate	Moderate	Major
	High	Moderate	Moderate	Major	Major

The impact significance categories were defined as follows:

Minor: Impact is acceptable on the value; impact is consistent with accepted good practice. Monitoring may be required to assess whether impacts remain acceptable.

Moderate: Impact is acceptable although not ideal. Mitigation can be expected to be required to minimise impacts on the values. Impact is likely to require monitoring if there are opportunities to further reduce impact level.

Major: Impact on the value is unacceptable, is likely to exceed accepted or legislated thresholds, is not in compliance with good practice outcomes. Mitigation is required to reduce the impact. Impacts at this level should not be permitted unless all practicable mitigation measures have been considered.

MITIGATION

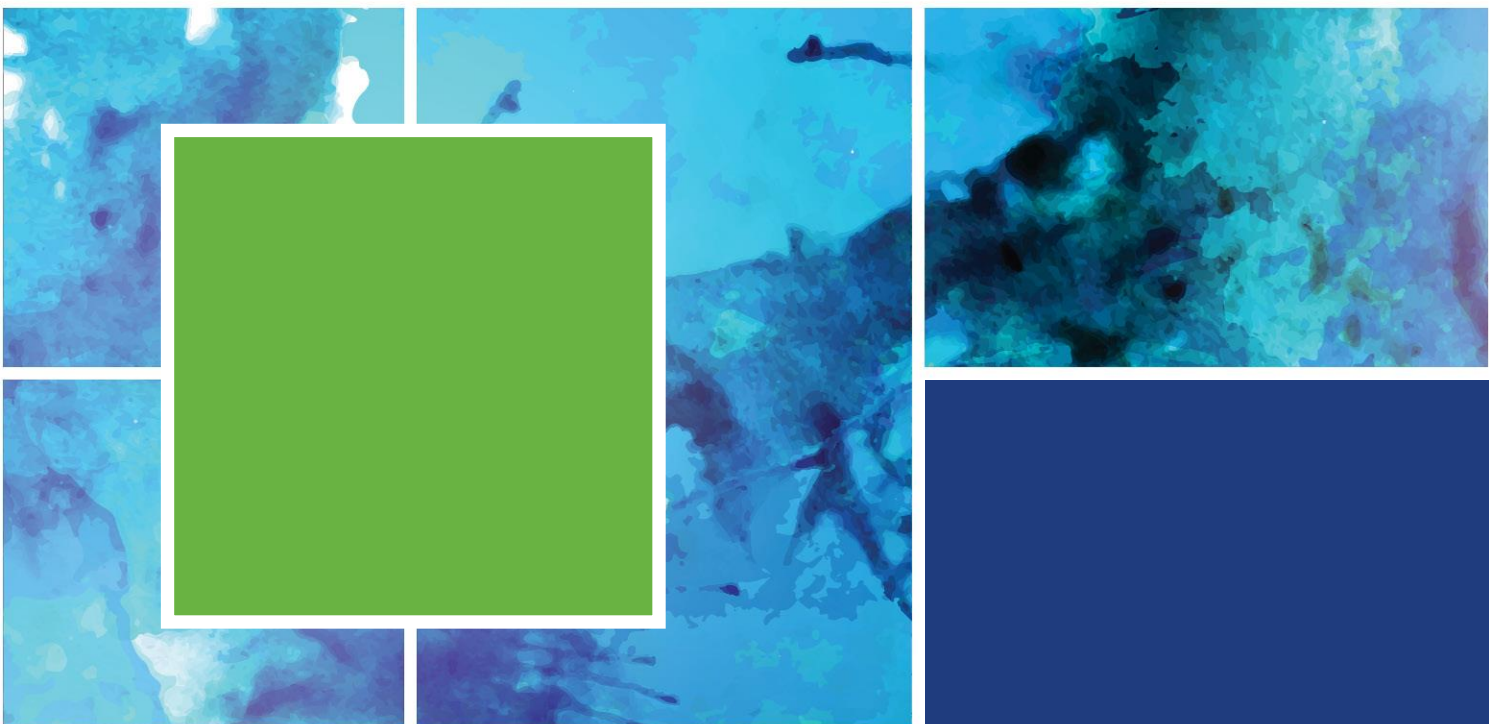
Mitigation measures were nominated by the subject expert for each impact. Mitigation options were generally considered in the following order of preference:

1. Avoidance of impacts altogether;
2. Reduction of impacts where unavoidable;
3. Restoration of the environmental or social or cultural value following the impact; and
4. Offset or enhancements delivered elsewhere.

RESIDUAL IMPACT RATING

Following the nomination of appropriate mitigation measures, the impact significant assessment process was repeated, considering the proposed mitigation measure, and a residual impact classification was derived using the same matrix presented above. The objective of mitigation was to reduce the impact significance to as low as reasonably practicable.

APPENDIX B. DATABASE EXTRACTS





Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Lot: 201 Plan: SP321205

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website <https://www.dnrme.qld.gov.au/>

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Lot: 201 Plan: SP321205

Size (ha)	16,069.31
Local Government(s)	Isaac Regional
Bioregion(s)	Brigalow Belt
Subregion(s)	Northern Bowen Basin, Isaac - Comet Downs
Catchment(s)	Fitzroy

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	393.56	2.45
Of concern	1,060.44	6.6
No concern at present	1,404.31	8.74
Total remnant vegetation	2,858.31	17.79

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

<https://www.dnrme.qld.gov.au/>

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
11.10.1	Corymbia citriodora woodland on coarse-grained sedimentary rocks	No concern at present	22.02	0.14
11.10.3	Acacia shirleyi or A. catenulata open forest on coarse-grained sedimentary rocks. Crests and scarps	No concern at present	40.9	0.25
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	Of concern	0.19	less than 0.01
11.3.1	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Endangered	44.81	0.28
11.3.2	Eucalyptus populnea woodland on alluvial plains	Of concern	358.14	2.23
11.3.25	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Of concern	582.16	3.62
11.3.27b	Freshwater wetlands	Of concern	9.81	0.06
11.3.37	Eucalyptus coolabah fringing woodland on alluvial plains	No concern at present	43.46	0.27
11.4.13	Eucalyptus orgadophila open woodland on Cainozoic clay plains	Of concern	96.05	0.6
11.4.4	Dichanthium spp., Astrebla spp. grassland on Cainozoic clay plains	Of concern	14.08	0.09
11.4.8	Eucalyptus cambageana woodland to open forest with Acacia harpophylla or A. argyrodendron on Cainozoic clay plains	Endangered	143.24	0.89
11.4.9	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Endangered	205.5	1.28
11.5.3	Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	1,005.41	6.26
11.5.9b	Eucalyptus crebra and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	204.6	1.27
11.8.5	Eucalyptus orgadophila open woodland on Cainozoic igneous rocks	No concern at present	23.89	0.15
11.9.2	Eucalyptus melanophloia +/- E. orgadophila woodland to open woodland on fine-grained sedimentary rocks	No concern at present	64.03	0.4
non-remnant	None	None	13,210.98	82.21

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
11.10.1	Pre-clearing 1008000 ha; Remnant 2019 873000 ha	10a	None	High
11.10.3	Pre-clearing 382000 ha; Remnant 2019 336000 ha	24a	None	Medium
11.10.8	Pre-clearing 13000 ha; Remnant 2019 8000 ha	7a	None	Medium
11.3.1	Pre-clearing 780000 ha; Remnant 2019 77000 ha	25a	None	Low
11.3.2	Pre-clearing 1914000 ha; Remnant 2019 503000 ha	17a	Contains palustrine wetland (e.g. in swales).	Low
11.3.25	Pre-clearing 797000 ha; Remnant 2019 514000 ha	16a	Riverine wetland or fringing riverine wetland.	Low
11.3.27b	Pre-clearing 58000 ha; Remnant 2019 42000 ha	34d	Lacustrine wetland (e.g. lake).	Low
11.3.37	Pre-clearing 52000 ha; Remnant 2019 30000 ha	16a	Riverine wetland or fringing riverine wetland.	Low
11.4.13	Pre-clearing 23000 ha; Remnant 2019 12000 ha	11a	None	No representation
11.4.4	Pre-clearing 71000 ha; Remnant 2019 27000 ha	30b	None	No representation
11.4.8	Pre-clearing 724000 ha; Remnant 2019 67000 ha	25a	Contains palustrine wetland (e.g. in swales).	Low
11.4.9	Pre-clearing 999000 ha; Remnant 2019 90000 ha	25a	Contains palustrine wetland (e.g. in swales).	Low
11.5.3	Pre-clearing 979000 ha; Remnant 2019 370000 ha	17a	None	Low
11.5.9b	Pre-clearing 366000 ha; Remnant 2019 239000 ha	18b	None	Low
11.8.5	Pre-clearing 632000 ha; Remnant 2019 346000 ha	11a	None	Low
11.9.2	Pre-clearing 378000 ha; Remnant 2019 143000 ha	17b	None	Medium
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
11.10.1	Potential habitat for NCA listed species: <i>Acacia argentina</i> , <i>Acacia calantha</i> , <i>Acacia handonis</i> , <i>Acacia islama</i> , <i>Acacia pedleyi</i> , <i>Acacia</i> sp. (Ruined Castle Creek P.I.Forster+ PIF17848), <i>Apatophyllum teretifolium</i> , <i>Calytrix islensis</i> , <i>Capparis humistrata</i> , <i>Cerbera dumicola</i> , <i>Cryptandra ciliata</i> , <i>Eucalyptus beaniana</i> , <i>Homoranthus tricolor</i> , <i>Livistona nitida</i> , <i>Macrozamia crassifolia</i> , <i>Melaleuca groveana</i> , <i>Melaleuca irbyana</i> , <i>Micromyrtus rotundifolia</i> , <i>Ozothamnus eriocephalus</i> , <i>Pomaderris coomingalensis</i> , <i>Pseudanthus pauciflorus</i> subsp. <i>arenicola</i> , <i>Rutidosis crispata</i> , <i>Samadera bidwillii</i> , <i>Sannantha brachypoda</i> , <i>Zieria inexpectata</i>
11.10.3	Habitat for threatened flora species including <i>Acacia deuteroneura</i> , <i>A. wardellii</i> and <i>Bertya calycina</i> .
11.10.8	Potential habitat for NCA listed species: <i>Cerbera dumicola</i> , <i>Cossinia australiana</i> , <i>Sannantha brachypoda</i>
11.3.1	Habitat for threatened fauna species including painted honeyeater, <i>Grantiella picta</i> particularly in subregion 35 (Oliver et al. 2003).
11.3.2	Habitat for threatened flora species <i>Homopholis belsonii</i> . This ecosystem is also known to provide suitable habitat for koalas (<i>Phascolarctos cinereus</i>).
11.3.25	Shown to be associated with a high fauna species richness in the Taroom area (Venz et al. 2002). Within parts of the Fitzroy catchment, this RE is known habitat for the threatened freshwater turtle <i>Rheodytes leukops</i> . Known to be important habitat for other riparian freshwater turtle species. This ecosystem is also known to provide suitable habitat for koalas (<i>Phascolarctos cinereus</i>).
11.3.27b	Habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. 11.3.27a: Provides wetland habitat for a flora and fauna.
11.3.37	None
11.4.13	None
11.4.4	Habitat for threatened plant species including <i>Dichanthium queenslandicum</i> . Often occurs adjacent to lower lying areas dominated by regional ecosystems 11.4.11 and 11.3.3.
11.4.8	Larger gilgai provides ephemeral wetland habitat.
11.4.9	Potential habitat for NCA listed species: <i>Cadellia pentastylis</i> , <i>Solanum adenophorum</i> , <i>Solanum dissectum</i> , <i>Solanum elachophyllum</i> , <i>Solanum johnsonianum</i> , <i>Xerothamnella herbacea</i>
11.5.3	Potential habitat for NCA listed species: <i>Sannantha brachypoda</i>
11.5.9b	Potential habitat for NCA listed species: <i>Cerbera dumicola</i> , <i>Cossinia australiana</i> , <i>Cycas ophiolitica</i> , <i>Solanum elachophyllum</i>
11.8.5	In southern part of bioregion, habitat for a number of threatened plant species including <i>Picris evae</i> and <i>Thesium australe</i> and near threatened species <i>Digitaria porrecta</i> and <i>Discaria pubescens</i> . This ecosystem is also known to provide suitable habitat for koalas (<i>Phascolarctos cinereus</i>). 11.8.5a: This ecosystem is known to provide suitable habitat for koalas (<i>Phascolarctos cinereus</i>).
11.9.2	Potential habitat for NCA listed species: <i>Solanum elachophyllum</i>
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

<https://publications.qld.gov.au/dataset/redd/resource/>

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	13,210.98	82.21
10a	Dry woodlands to open woodlands dominated by <i>Corymbia citriodora</i> (spotted gum). (land zones 10, 7, 12, 11, [8]) (BRB, NET, [DEU])	22.02	0.14
11a	Moist to dry open forests to woodlands dominated by <i>Eucalyptus orgadophila</i> (mountain coolibah). Some areas dominated by <i>E. tereticornis</i> (blue gum), <i>E. melliodora</i> (yellow box), <i>E. albens</i> (white box), <i>E. crebra</i> (narrow-leaved red ironbark) or <i>E. melanophloia</i> (silver-leaved ironbark). (land zones 8, 11, 4, [3]) (BRB, SEQ, EIU)	119.94	0.75
16a	Open forest and woodlands dominated by <i>Eucalyptus camaldulensis</i> (river red gum) (or <i>E. tereticornis</i> (blue gum)) and/or <i>E. coolabah</i> (coolabah) (or <i>E. microtheca</i> (coolabah)) fringing drainage lines. Associated species may include <i>Melaleuca</i> spp., <i>Corymbia tessellaris</i> (carbeen), <i>Angophora</i> spp., <i>Casuarina cunninghamiana</i> (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded. (land zone 3) (MGD, BRB, GUP, CHC, MUL, DEU, EIU, NWH, SEQ, [NET, WET]) (All bioregions except CYP and CQC)	625.62	3.89
17a	Woodlands dominated by <i>Eucalyptus populnea</i> (poplar box) (or <i>E. brownii</i> (Reid River box)) on alluvium, sand plains and footslopes of hills and ranges. (land zones 3, 5, 10, 9, 4, 11, 12, [8]) (BRB, MUL, DEU, MUL, EIU)	1,363.55	8.49
17b	Woodlands to open woodlands dominated by <i>Eucalyptus melanophloia</i> (silver-leaved ironbark) (or <i>E. shirleyi</i> (shirley's silver-leaved ironbark)) on sand plains and footslopes of hills and ranges. (land zones 5, 12, 3, 11, 9, 7) (BRB, DEU, EIU, SEQ, NET, GUP, NWH)	64.03	0.4
18b	Woodlands dominated <i>Eucalyptus crebra</i> (sens. lat.) (narrow-leaved red ironbark) frequently with <i>Corymbia</i> spp. or <i>Callitris</i> spp. on flat to undulating plains. (land zones 5, 3) (BRB, DEU, EIU, GUP, CYP)	204.6	1.27
24a	Low woodlands to tall shrublands dominated by <i>Acacia</i> spp. on residuals. Species include <i>A. shirleyi</i> (lancewood), <i>A. catenulata</i> (bendee), <i>A. microperma</i> (bowyakka), <i>A. clivicola</i> , <i>A. sibirica</i> , <i>A. rhodoxylon</i> (rosewood) and <i>A. leptostachya</i> (Townsville wattle). (land zones 7, 10, 5, 12, 11, [9, 3]) (MUL, CHC, BRB, GUP, EIU, MGD, DEU, NWH, [CYP])	40.9	0.25

BVG (1 Million)	Description	Area (Ha)	% of AOI
25a	Open forests to woodlands dominated by <i>Acacia harpophylla</i> (brigalow) sometimes with <i>Casuarina cristata</i> (belah) on heavy clay soils. Includes areas co-dominated with <i>A. cambagei</i> (gidgee) and/or emergent eucalypts (land zones 4, 9, 3, 11, 7, 12, [5, 8]) (BRB, MUL, MGD, DEU, [SEQ])	393.56	2.45
30b	Tussock grasslands dominated by <i>Astrelba</i> spp. (mitchell grass) or <i>Dichanthium</i> spp. (bluegrass) often with <i>Iseilema</i> spp. on undulating downs or clay plains. (land zones 9, 3, 4, 8, [5]) (MGD, CHC, GUP, BRB, [EIU, DEU, NWH])	14.08	0.09
34d	Palustrine wetlands. Freshwater swamps/springs/billabongs on floodplains ranging from permanent and semi-permanent to ephemeral. (land zone 3) (GUP, EIU, BRB, CYP, CHC, [MGD])	9.81	0.06
7a	Semi-evergreen vine thickets on wide range of substrates. (land zones 8, 9, 11, 12, 5, 4, 3, 10, [7]) (BRB, EIU, SEQ, CQC, [WET, GUP]) (Tracey 1982 11)	0.19	less than 0.01

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF)* section 3.3 of:

<https://publications.qld.gov.au/dataset/redd/resource/>

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

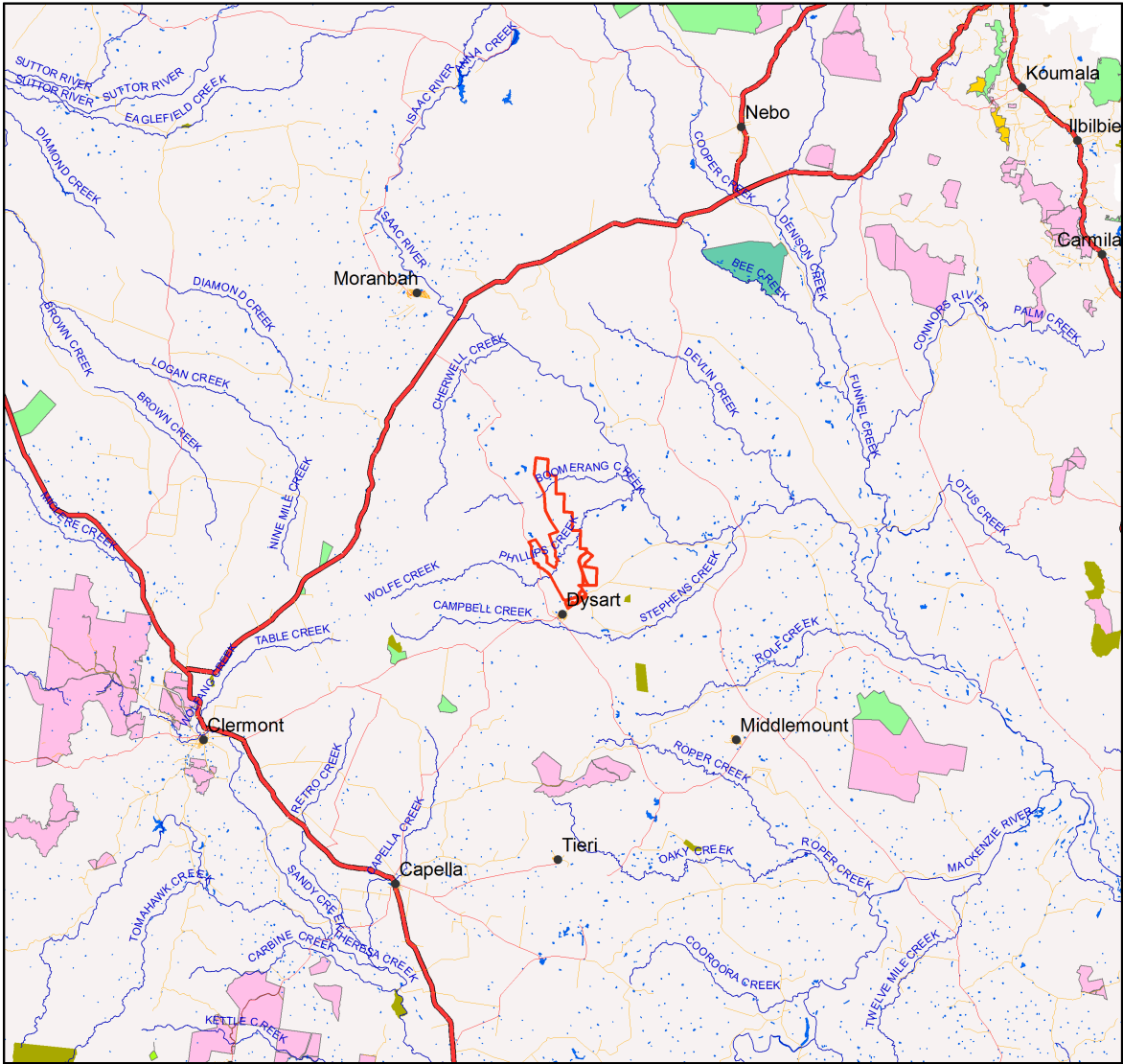
Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
11.10.1	Available	Available
11.10.3	Available	Available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
11.10.8	Available	Not currently available
11.3.1	Available	Available
11.3.2	Available	Available
11.3.25	Available	Available
11.3.27b	Available	Not currently available
11.3.37	Available	Available
11.4.13	Available	Not currently available
11.4.4	Available	Available
11.4.8	Available	Available
11.4.9	Available	Available
11.5.3	Available	Available
11.5.9b	Available	Not currently available
11.8.5	Available	Available
11.9.2	Available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

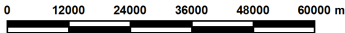
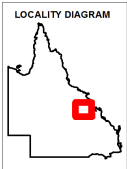
Map 1 - Location



Locality Map

Legend

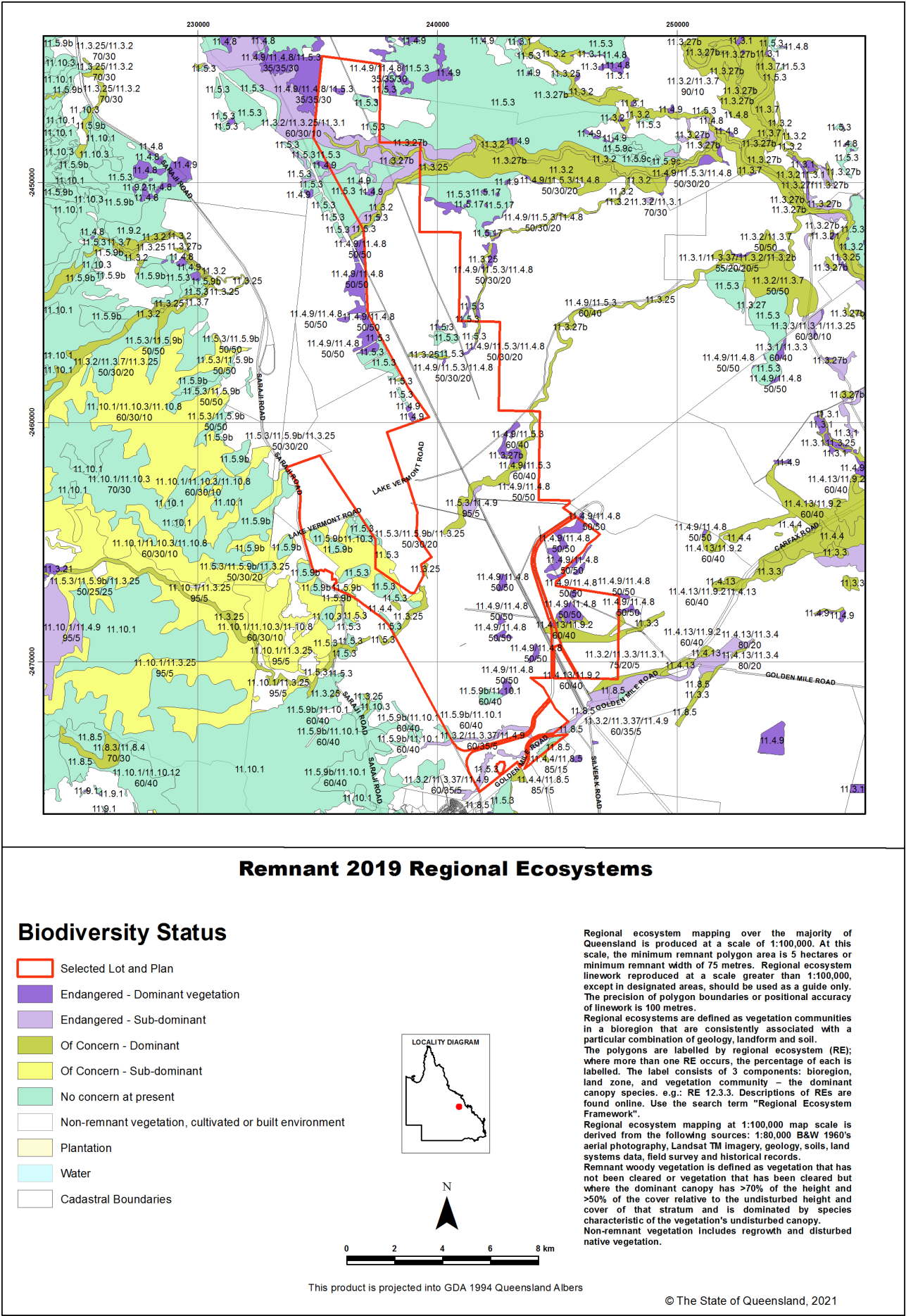
- Selected Lot and Plan
- Towns
- Highway
- Connector
- Street/Local Road
- Reservoirs
- Lakes
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Coordinated Conservation Areas
- Major rivers/creeks
- Queensland



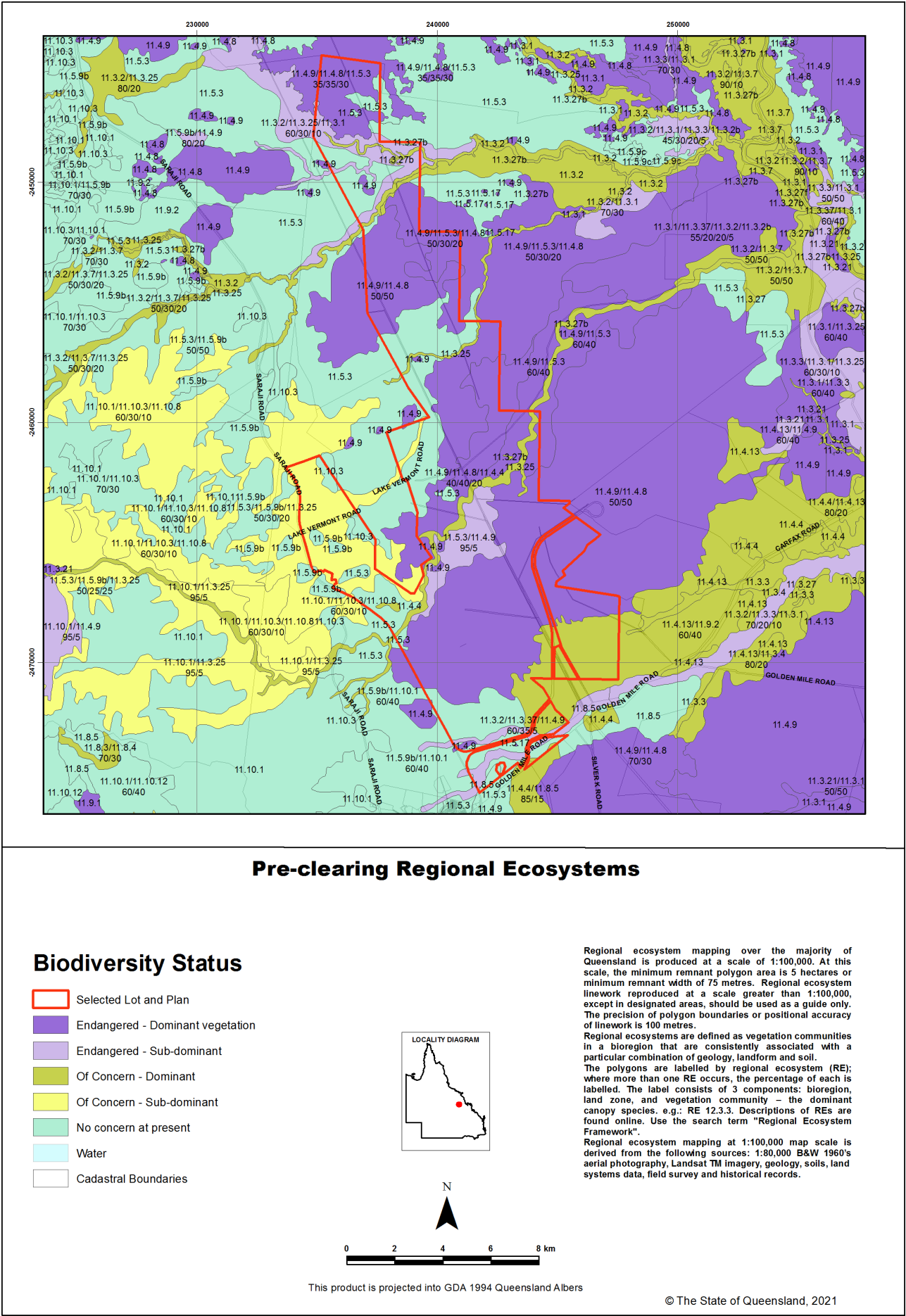
DISCLAIMER:
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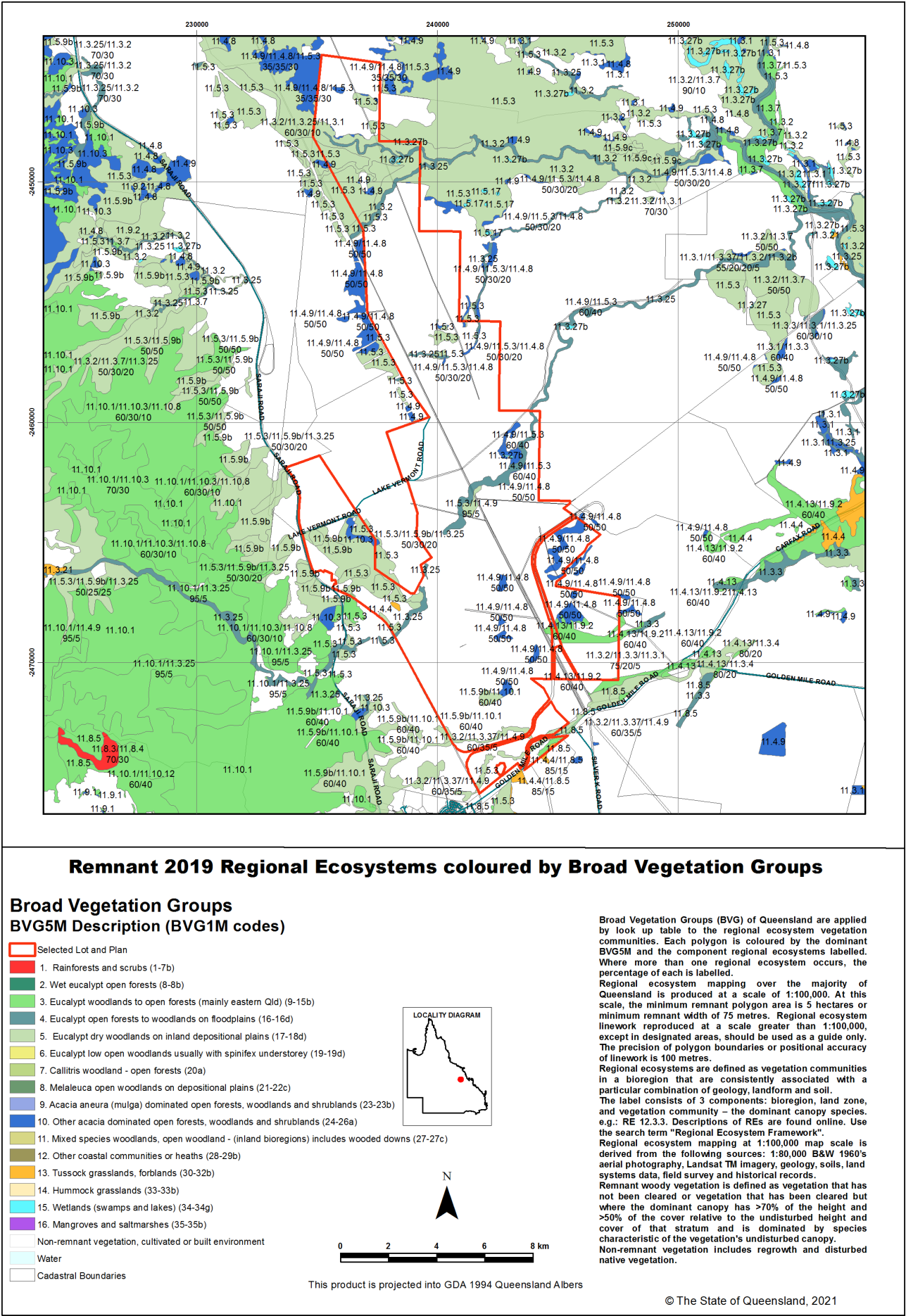
Map 2 - Remnant 2019 regional ecosystems



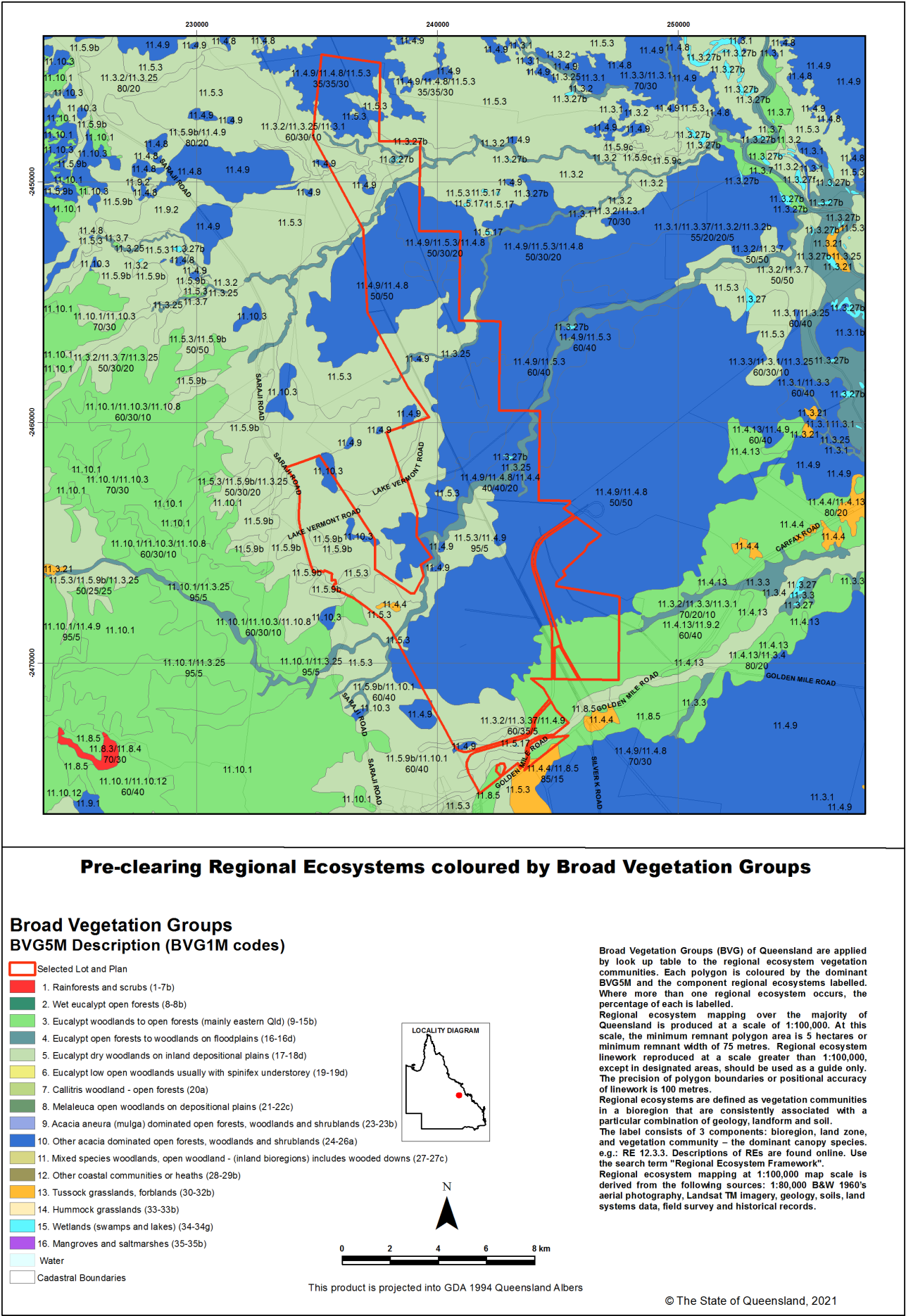
Map 3 - Pre-clearing regional ecosystems



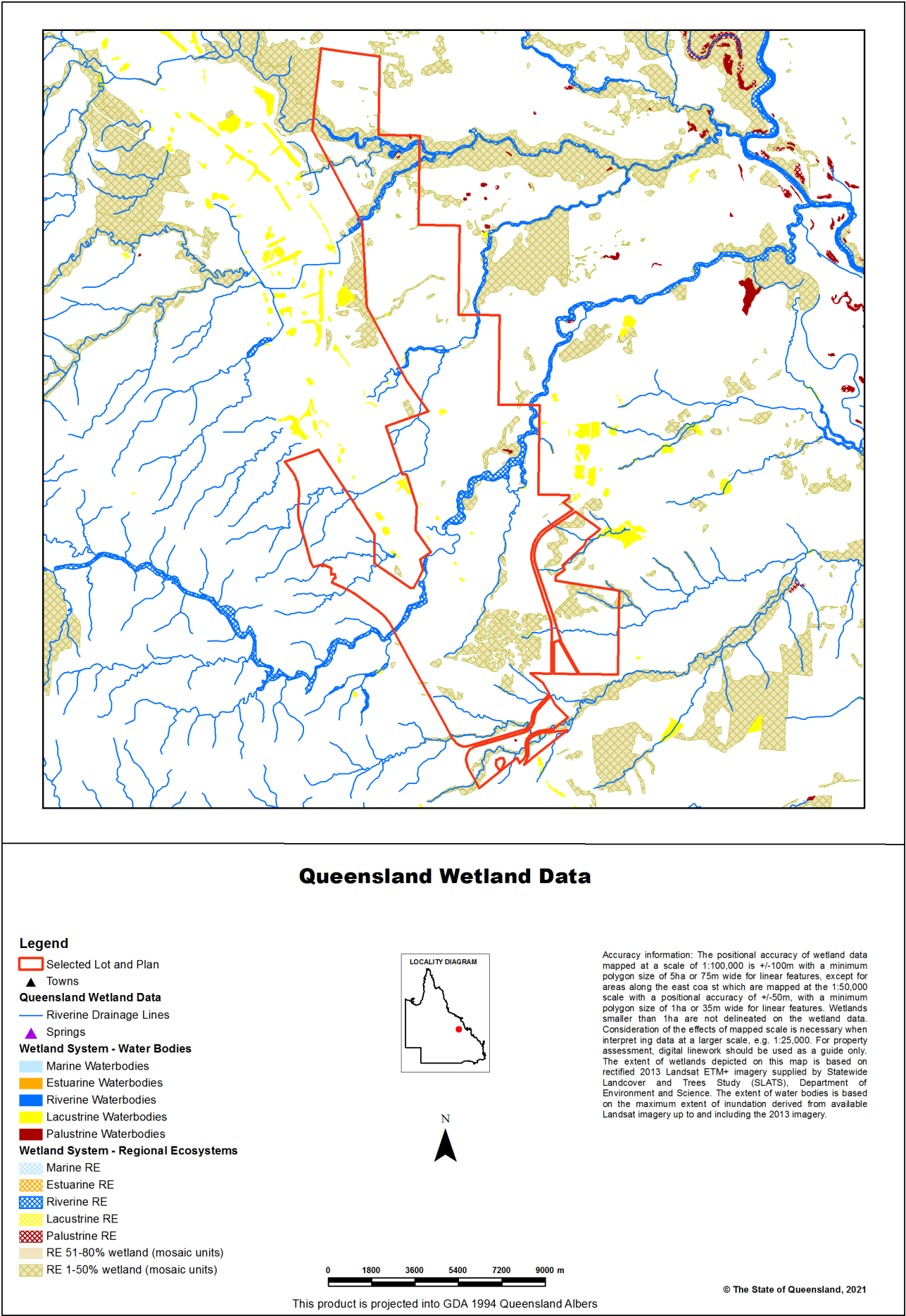
Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of Environment and Science's Website -

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

The methodology for mapping regional ecosystems can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

Technical descriptions for regional ecosystems can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

Benchmarks can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

<http://dds.information.qld.gov.au/dds/>

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

<http://www.dnrm.qld.gov.au/mapping-data/queensland-globe>

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2019). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 4.0. Queensland Herbarium, Department of Environment and Science.

<https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086>

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F., Addicott, E.P. and Appelman, C.N. (2020). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

<https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4>

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/>

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

<http://dds.information.qld.gov.au/dds/>

- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- <i>Vegetation Management Act 1999</i>



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 10-Dec-2021

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	26
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	22
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area	In feature area
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In buffer area only

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.

Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythroriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area	In feature area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
PLANT			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aristida annua [17906]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat may occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat may occur within area	In feature area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat may occur within area	In feature area
REPTILE			
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area	In feature area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area	In feature area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In feature area
Lerista allanae Allan's Lerista, Retro Slider [1378]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Migratory Terrestrial Species

Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area	In feature area

Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]		
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat may occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Coolibah	Nature Refuge	QLD	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Arrow Bowen Pipeline (CSG), QLD	2012/6459	Controlled Action	Post-Approval	In buffer area only
Bowen Gas Project	2012/6377	Controlled Action	Post-Approval	In feature area
Eagle Downs Coal Mine Central Queensland	2008/3945	Controlled Action	Post-Approval	In buffer area only
install & operate gas pipeline	2005/2059	Controlled Action	Post-Approval	In feature area
Lake Vermont Meadowbrook Coal Mine Project, Qld	2019/8485	Controlled Action	Assessment Approach	In feature area
Lake Vermont open cut coal northern extension project, central Qld	2016/7701	Controlled Action	Post-Approval	In feature area
New Saraji Coal Mine Project	2007/3845	Controlled Action	Completed	In feature area
Norwich Park & Blackwater CSG Fields & supporting infrastructure Bowen Basin	2011/6032	Controlled Action	Completed	In feature area
Olive Downs Project Electricity Transmission Line	2017/7869	Controlled Action	Post-Approval	In buffer area only
Olive Downs Project Mine Site and Access Road	2017/7867	Controlled Action	Post-Approval	In buffer area only
Olive Downs Project Rail Spur	2017/7870	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Olive Downs Project Water Pipeline	2017/7868	Controlled Action	Post-Approval	In buffer area only
Relocation of approximately 16km of Dysart Road and associated service infrastructure	2013/6868	Controlled Action	Post-Approval	In buffer area only
Saraji East Mining Lease Project, Qld	2016/7791	Controlled Action	Assessment Approach	In feature area
Spring Creek to Phillips Creek Diversion	2019/8576	Controlled Action	Post-Approval	In buffer area only
Vulcan Complex Project	2020/8676	Controlled Action	Proposed Decision	In buffer area only
Winchester South Project Electricity Transmission Line, near Moranbah, Qld	2019/8458	Controlled Action	Assessment Approach	In buffer area only
Winchester South Project Mine Site and Access Road, near Moranbah, Qld	2019/8460	Controlled Action	Assessment Approach	In buffer area only
Winchester South Project Water Pipeline, near Moranbah, Qld	2019/8459	Controlled Action	Assessment Approach	In buffer area only
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Vulcan Bulk Sample Project	2019/8504	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Dysart East multi seam open cut coal mine project, Qld	2014/7224	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Lot: 201 Plan: SP321205

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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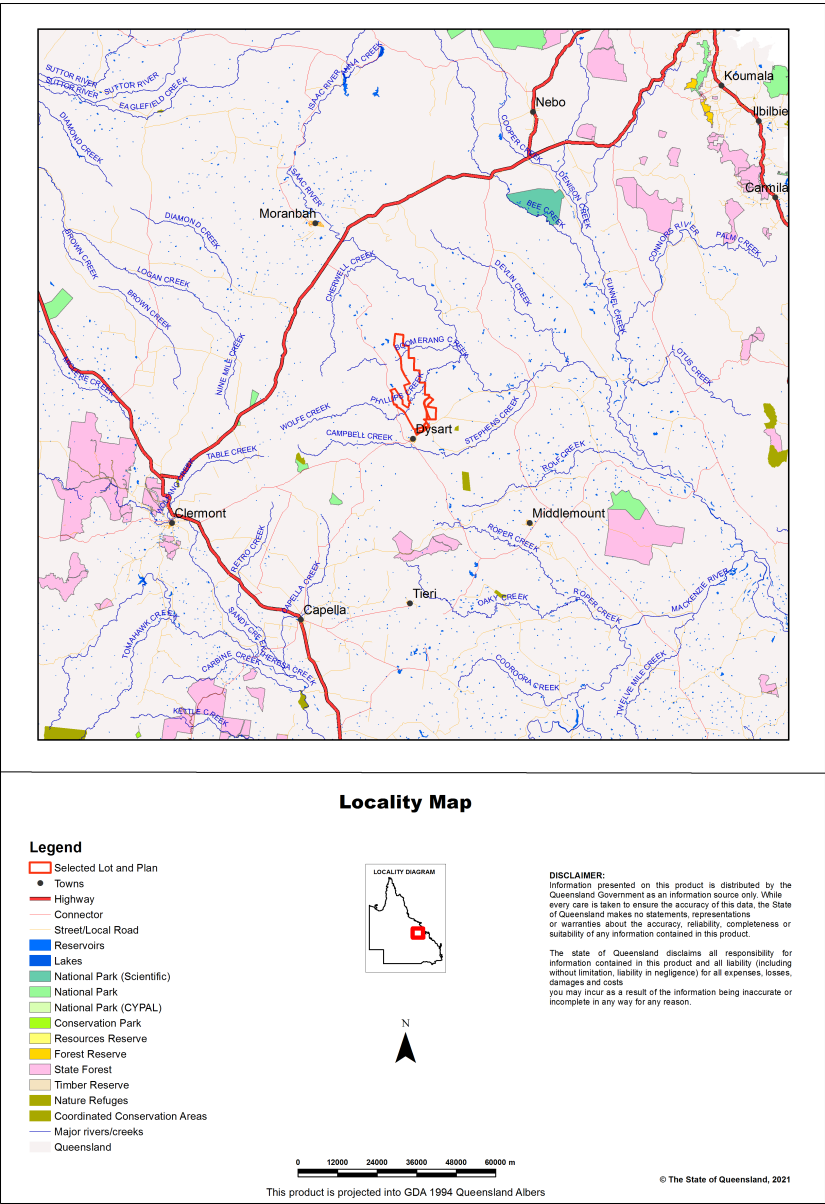
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI Lot: 201 Plan: SP321205

Size (ha)	16,069.31
Local Government(s)	Isaac Regional
Bioregion(s)	Brigalow Belt
Subregion(s)	Northern Bowen Basin, Isaac - Comet Downs
Catchment(s)	Fitzroy



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;
- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;
- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;
- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;
- Regulated vegetation under the *Vegetation Management Act 1999* that is:
 - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
 - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
 - Category R areas on the regulated vegetation management map;
 - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
 - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;
- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;
- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;
- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	1730.22 ha	10.8%
7b Special least concern animals	0.0 ha	0.0 %
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	1001.66 ha	6.2%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	20.88 ha	0.1%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	210.63 ha	1.3%
8d Regulated Vegetation - Essential habitat	2159.02 ha	13.4%
8e Regulated Vegetation - intersecting a watercourse **	101.0 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	48.78 ha	0.3%
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
<i>Boronia keysii</i>		V	None
<i>Calyptorhynchus lathamii</i>	Glossy black cockatoo	V	None
<i>Casuarus casuarus johnsonii</i>	Sthn population cassowary	E	None
<i>Crinia tinnula</i>	Wallum froglet	V	None
<i>Denisonia maculata</i>	Ornamental snake	V	Core
<i>Litoria freycineti</i>	Wallum rocketfrog	V	None
<i>Litoria olongburensis</i>	Wallum sedgefrog	V	None
<i>Melaleuca irbyana</i>		E	None
<i>Petaurus gracilis</i>	Mahogany Glider	E	None
<i>Petrogale persephone</i>	Proserpine rock-wallaby	E	None
<i>Phascolarctos cinereus</i>	Koala - outside SEQ*	V	None
<i>Pezoporus wallicus wallicus</i>	Eastern ground parrot	V	None
<i>Taudactylus pleione</i>	Kroombit tinkertoad	E	None
<i>Xeromys myoides</i>	Water Mouse	V	Core

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)	V	V	
<i>Phascolarctos cinereus</i>	koala	V	V	

Special least concern animal species records

(no results)

*Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL).
Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

<https://www.qld.gov.au/environment/plants-animals/species-list/>

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

<https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

<https://environment.ehp.qld.gov.au/regional-ecosystems/>

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
11.3.2/11.3.37/11.4.9	E-subdom	rem_end
11.3.2/11.3.25/11.3.1	E-subdom	rem_end
11.3.2	O-dom	rem_oc
11.4.9/11.4.8/11.5.3	E-dom	rem_end
11.4.9/11.5.3	E-dom	rem_end
11.4.9/11.4.8	E-dom	rem_end
11.4.9/11.5.3/11.4.8	E-dom	rem_end
11.4.9/11.4.8/11.4.4	E-dom	rem_end
11.4.9	E-dom	rem_end
11.10.1/11.10.3/11.10.8	O-subdom	rem_oc
11.5.3/11.4.9	E-subdom	rem_end

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Regional ecosystem	Vegetation management polygon	Vegetation management status
11.3.2/11.3.25/11.3.1	E-subdom	hvr_end
11.4.9/11.4.8/11.4.4	E-dom	hvr_end
11.4.9/11.5.3	E-dom	hvr_end
11.4.9/11.4.8	E-dom	hvr_end

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Regulated vegetation map category	Map number
R	8552
R	8553

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Regulated vegetation map category	Map number
B	8553

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

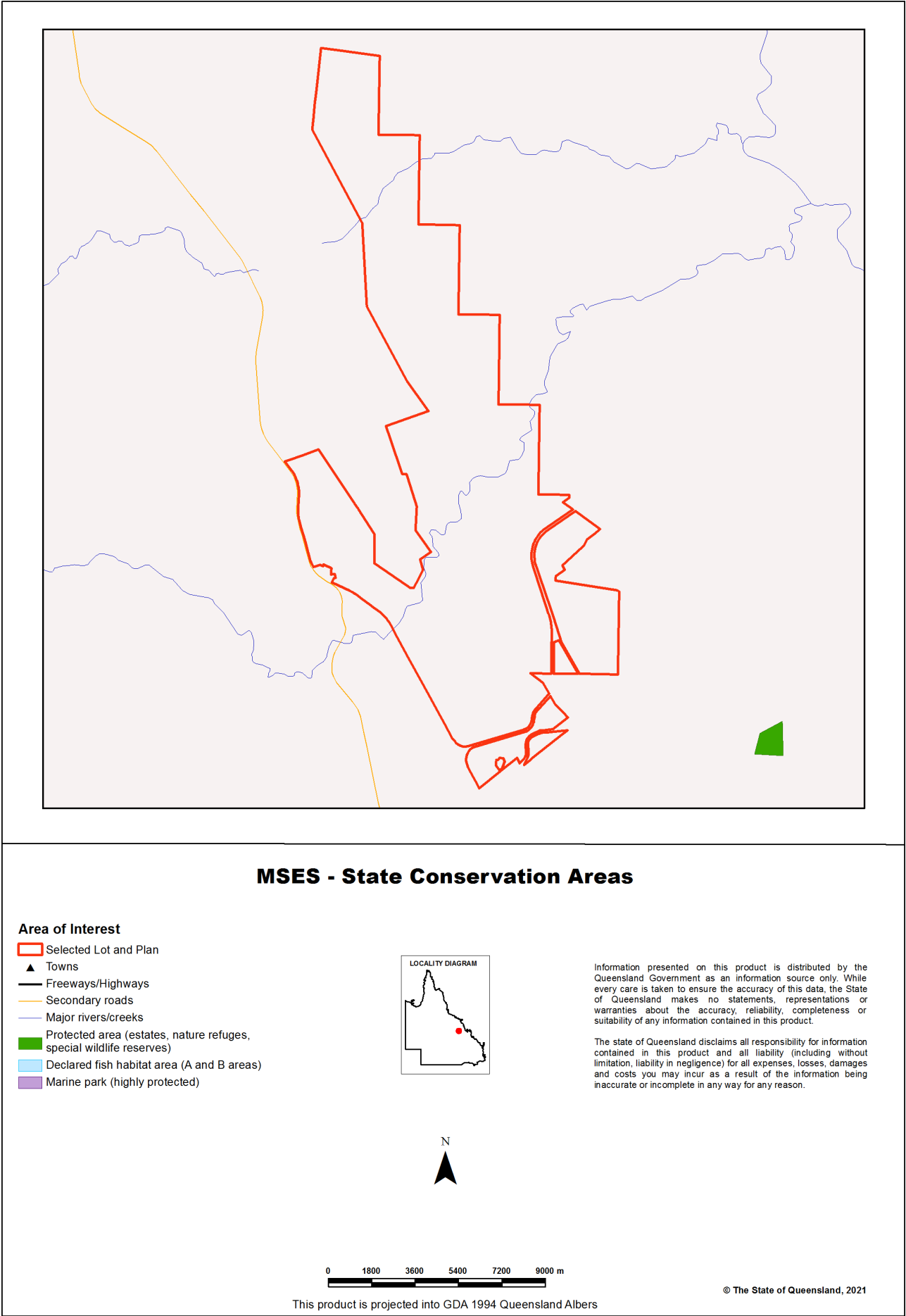
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

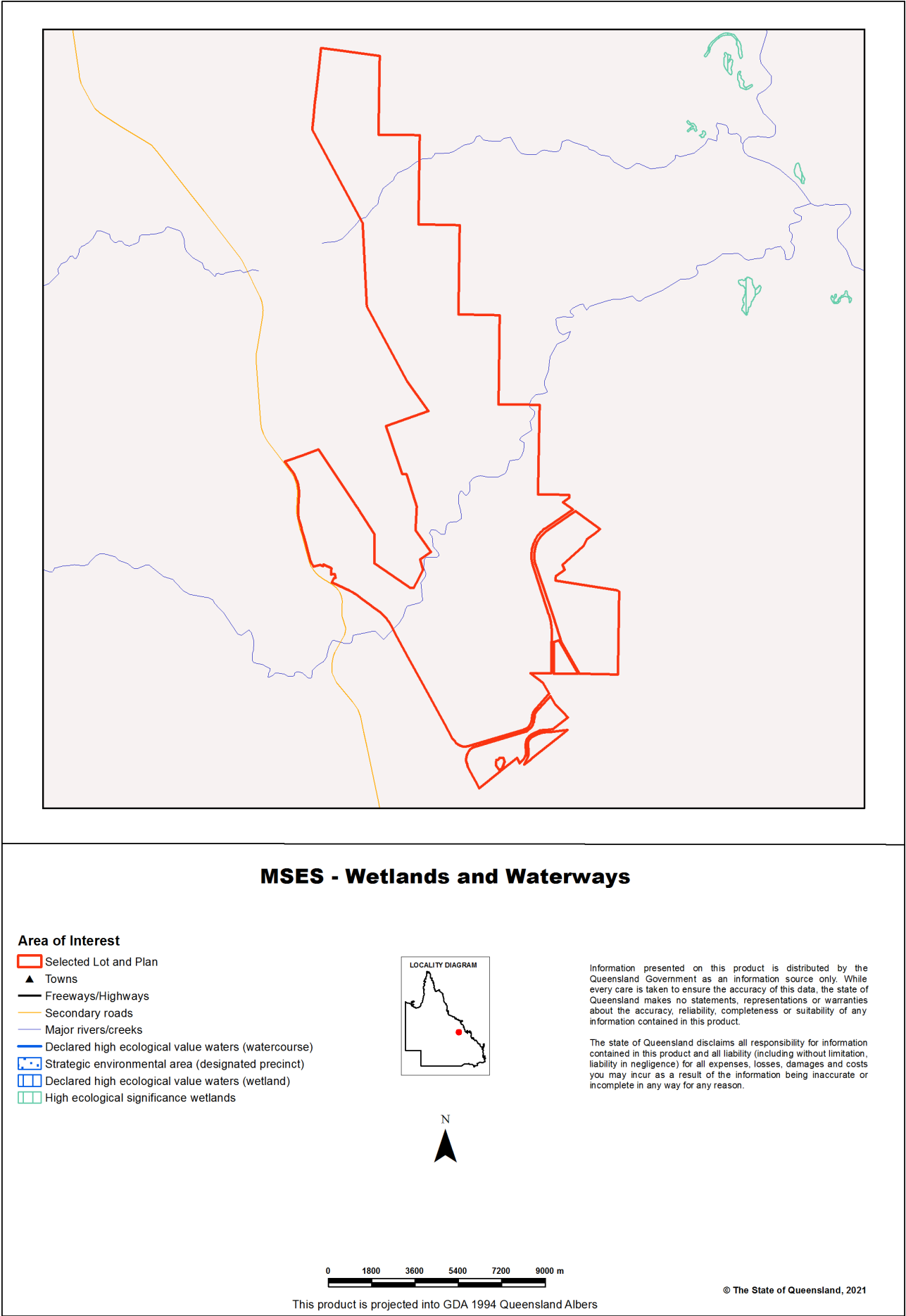
(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

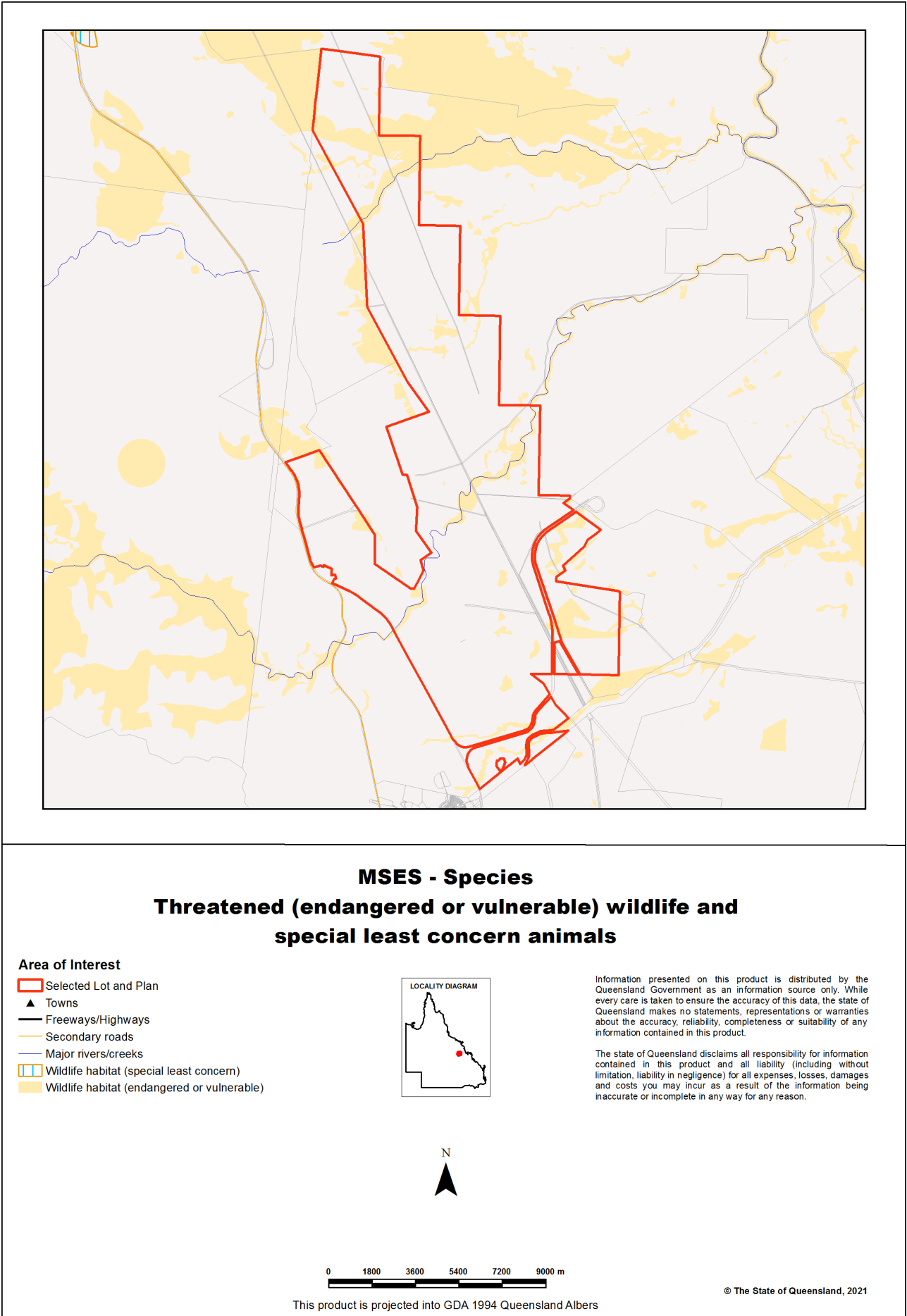
Map 1 - MSES - State Conservation Areas



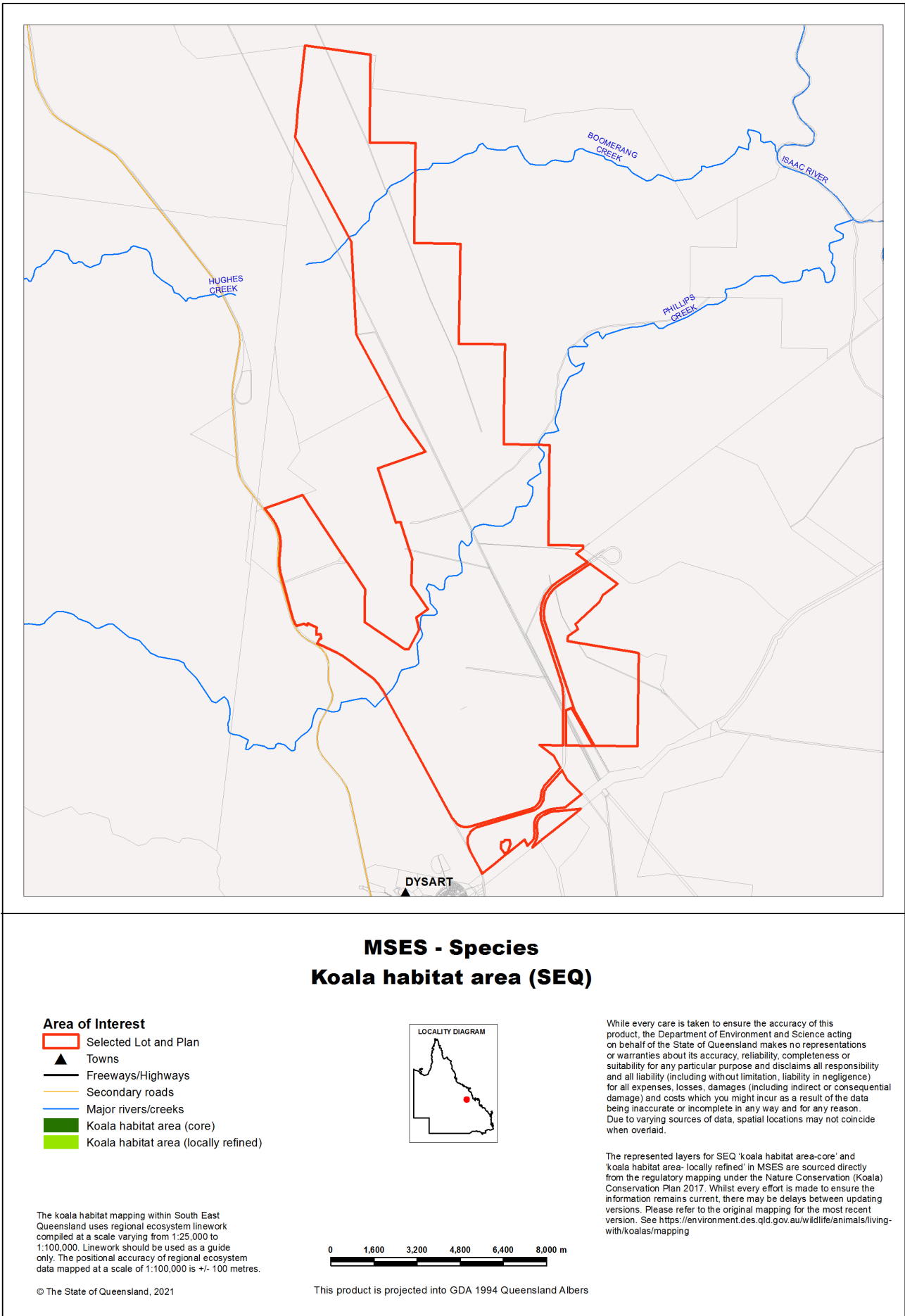
Map 2 - MSES - Wetlands and Waterways



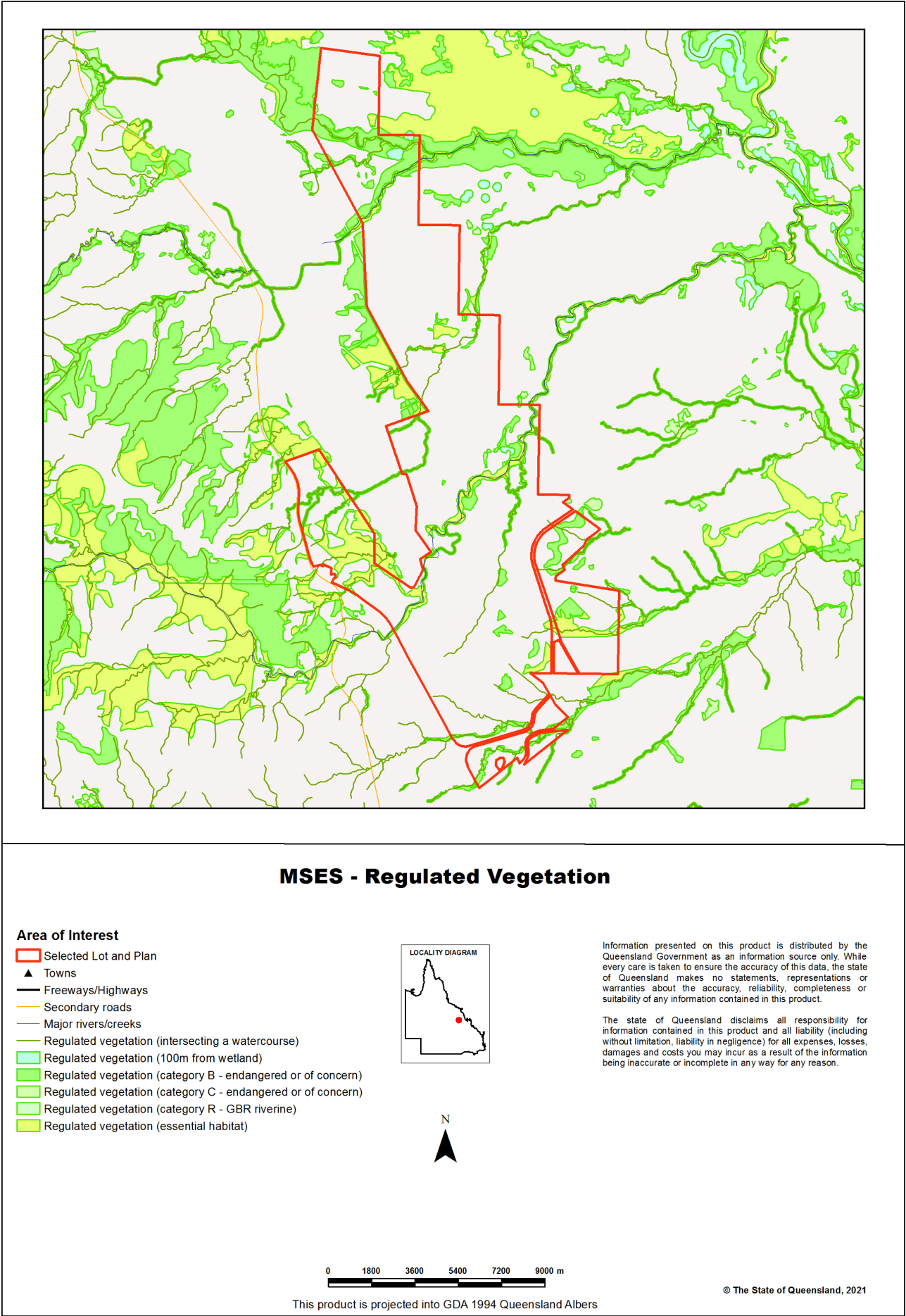
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



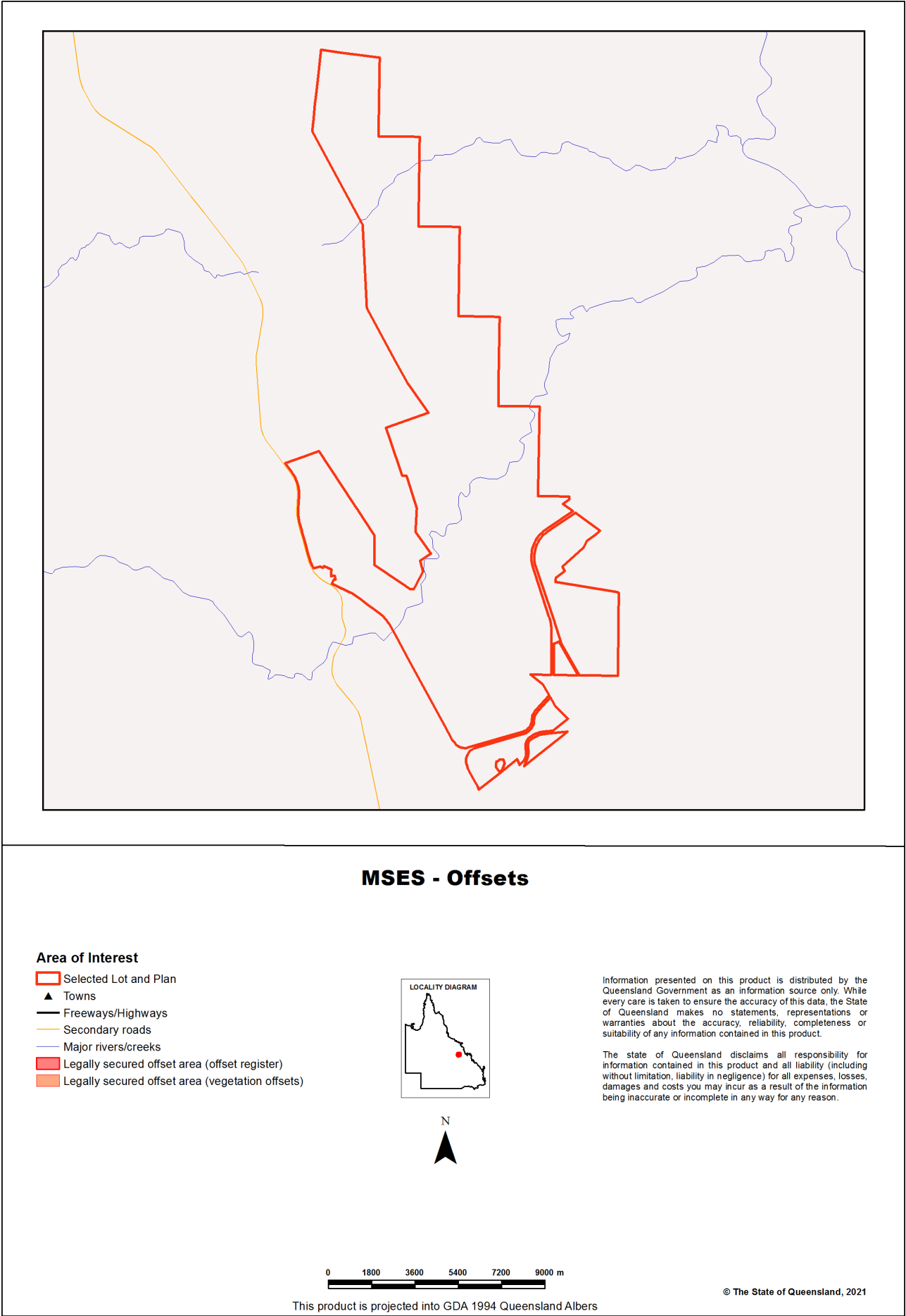
Map 3b - MSES - Species - Koala habitat area (SEQ)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

<http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html> .

Appendix 2 - Source Data

The datasets listed below are available on request from:

<http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	current QSpatial data (http://qspatial.information.qld.gov.au)
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- <i>Environmental Protection Act 1994</i>
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- <i>Vegetation Management Act 1999</i>

WildNet Records

Conservation Significant Species List

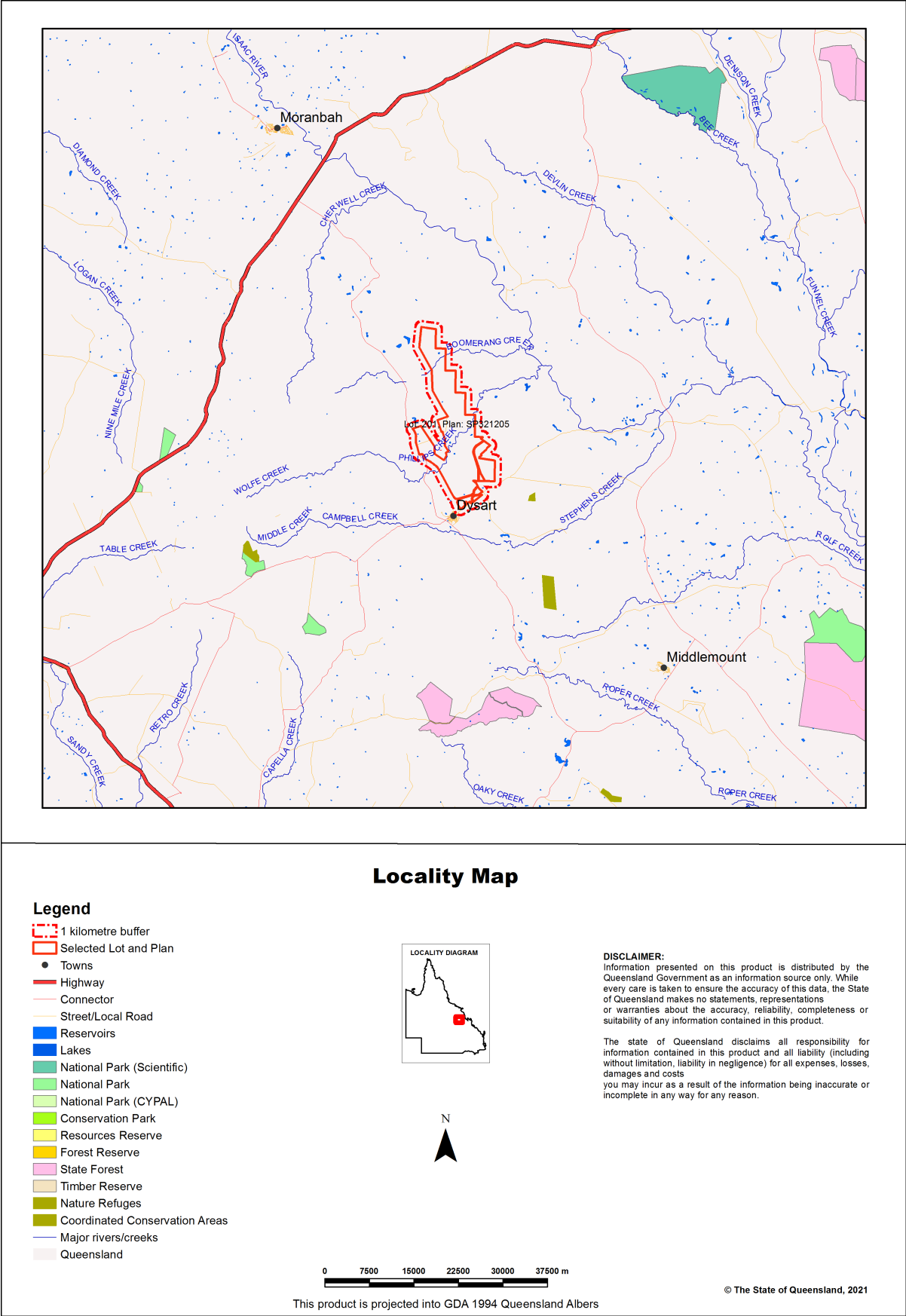


For the selected area of interest 16069.31ha Lot: 201 Plan: SP321205

Current as at 05/11/2021

WildNetCSSpeciesList

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest Lot: 201 Plan: SP321205.

Table 1. Area of interest details

Size (ha)	16,069.31
Local Government(s)	Isaac Regional
Bioregion(s)	Brigalow Belt
Subregion(s)	Northern Bowen Basin, Isaac - Comet Downs
Catchment(s)	Fitzroy

Protected Area(s)

No estates or reserves are located within the area of interest.

World Heritage Area(s)

No World Heritage Areas are located within the area of interest.

Ramsar Area(s)

No Ramsar Areas are located within the area of interest.

Conservation Significant Species List

Introduction

This report is derived from a spatial layer generated from the [WildNet database](#) managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

Conservation significant species are species listed:

- as [threatened](#) or near threatened under the Nature Conservation Act 1992;
- as threatened under the [Environment Protection and Biodiversity Conservation Act 1999](#) or
- [migratory species](#) protected under the following international agreements:
 - o Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
 - o China-Australia Migratory Bird Agreement
 - o Japan-Australia Migratory Bird Agreement
 - o Republic of Korea-Australia Migratory Bird Agreement

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

Table 2 lists the species recorded within the area of interest and its one kilometre buffer.

Table 2. Conservation significant species recorded within the area of interest and its one kilometre buffer

Taxon Id	Kingdom	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1785	Animalia	Aves	Columbidae	<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)	V	V	0	3	07/08/2020
860	Animalia	Mammalia	Phascolarctidae	<i>Phascolarctos cinereus</i>	koala	V	V	0	6	07/08/2020
838	Animalia	Mammalia	Tachyglossidae	<i>Tachyglossus aculeatus</i>	short-beaked echidna	SL	None	0	1	07/08/2020
483	Animalia	Reptilia	Elapidae	<i>Denisonia maculata</i>	ornamental snake	V	V	0	10	31/12/2010

Taxon Id: Unique identifier of the taxon from the WildNet database.

NCA: Queensland conservation status of the taxon under the *Nature Conservation Act 1992* (Least Concern (C), Critically Endangered (CR), Endangered (E), Extinct (EX), Near Threatened (NT), Extinct in the Wild (PE), Special Least Concern (SL), and Vulnerable (V)).

EPBC: Australian conservation status of the taxon under the *Environment Protection and Biodiversity Conservation Act 1999* (Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Vulnerable (V), and Extinct in the Wild (XW)).

Specimens: The number of specimen-backed records of the taxon.

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Links and Support

Other sites that deliver species information from the [WildNet database](#) include:

- [Species profile search](#) - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- [Species lists](#) - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- [Biomaps](#) - view biodiversity information, including WildNet records approved for publication, and generate reports
- [Queensland Globe](#) - view spatial information, including WildNet records approved for publication
- [Old wildlife data API](#) - access WildNet species information approved for publication such as notes, images and records etc.
- [WetlandMaps](#) - view species records, survey locations etc. approved for publication
- [WetlandSummary](#) - view wildlife statistics, species lists for a range of area types, and access WildNet species profiles
- [WildNet wildlife records - published - Queensland](#) - spatial layer of WildNet records approved for publication generated weekly
- [Generalised distribution and densities of Queensland wildlife](#) - Queensland species distributions and densities generalised to a 10 km grid resolution
- [Conservation status of Queensland wildlife](#) - access current lists of priority species for Queensland including nomenclature and status information
- [Queensland Confidential Species](#) - the list of species flagged as confidential in the WildNet database.

Please direct queries about this report to the [WildNet Team](#).

Other useful sites for accessing Queensland biodiversity data include:

- [Useful wildlife resources](#)
- [Queensland Government Data](#)
- [Atlas of Living Australia \(ALA\)](#)
- [Online Zoological Collections of Australian Museums \(OZCAM\)](#)
- [Australia's Virtual Herbarium \(AVH\)](#)
- [Protected Matters Search Tool](#)

Disclaimer

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WildNet Records

Pest List

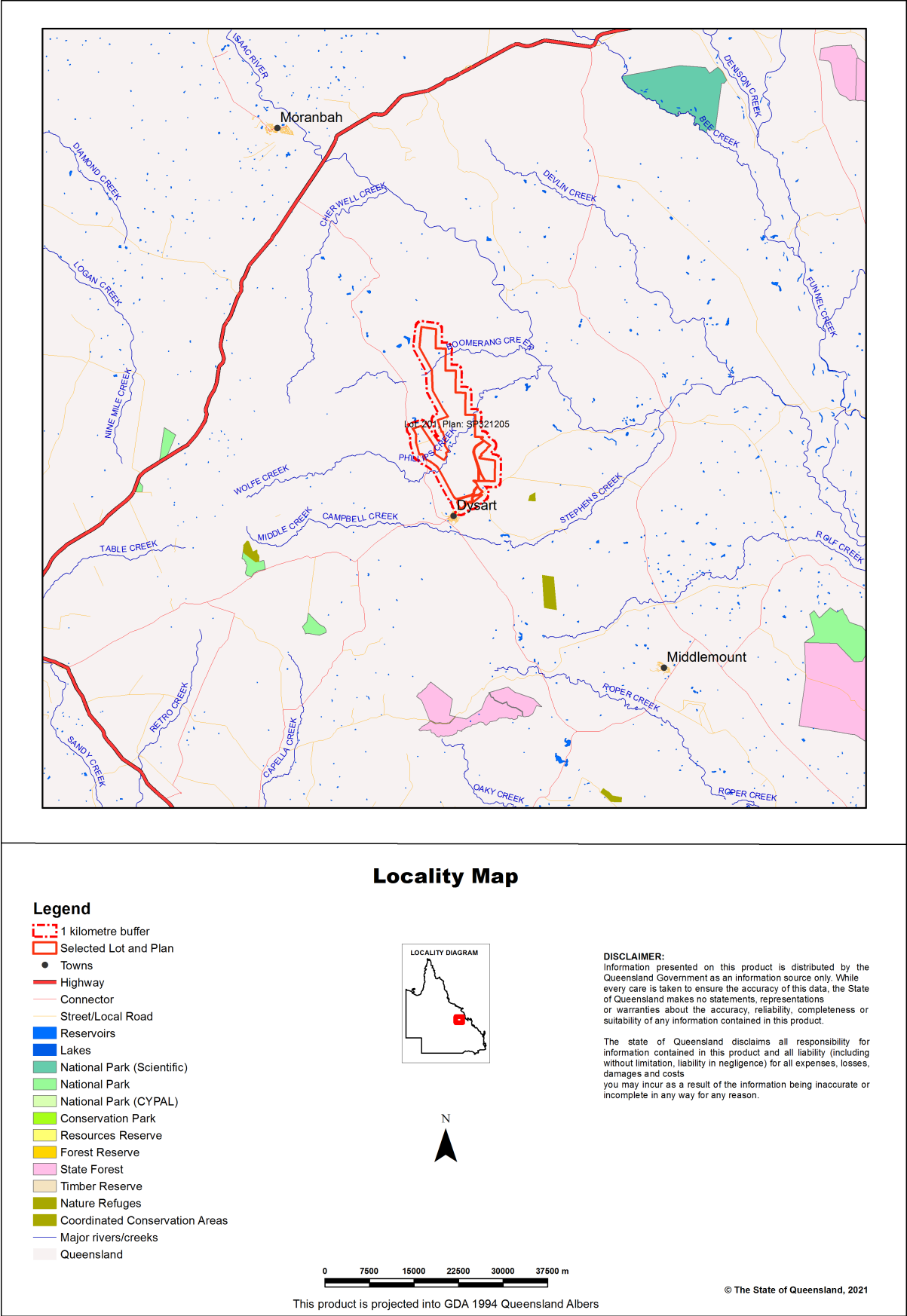


For the selected area of interest 16069.31ha Lot: 201 Plan: SP321205

Current as at 05/11/2021

WildNetPestList

Map 1. Locality Map



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No estates or reserves are located within the area of interest.

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Pest List

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This report is derived from a spatial layer generated from the [WildNet database](#) managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

Species Data

Contextual location information is presented in Map 1.

A summary of the pests recorded within the area of interest and its one kilometre buffer is presented in Table 2.

Table 2. Pests recorded within the area of interest and its one kilometre buffer

Taxon Id	Kingdom	Class	Family	Scientific Name	Common Name	Specimens	Records	Last record	Endemicity
716	Animalia	Amphibia	Bufoidea	<i>Rhinella marina</i>	cane toad	0	1	07/08/2020	II
832	Animalia	Mammalia	Leporidae	<i>Lepus europaeus</i>	European brown hare	0	1	07/08/2020	II
834	Animalia	Mammalia	Leporidae	<i>Oryctolagus cuniculus</i>	rabbit	0	3	07/08/2020	II
10959	Plantae	Equisetopsida	Asteraceae	<i>Parthenium hysterophorus</i>	parthenium weed	0	4	26/04/2017	IU
4734	Plantae	Equisetopsida	Euphorbiaceae	<i>Euphorbia hyssopifolia</i>	None	0	1	28/11/2016	IU
15235	Plantae	Equisetopsida	Fabaceae	<i>Macroptilium atropurpureum</i>	siratro	0	2	28/11/2016	IU
18221	Plantae	Equisetopsida	Fabaceae	<i>Macroptilium lathyroides</i> var. <i>semierectum</i>	None	0	1	28/11/2016	IU

Taxon Id	Kingdom	Class	Family	Scientific Name	Common Name	Specimens	Records	Last record	Endemicity
12877	Plantae	Equisetopsida	Fabaceae	<i>Stylosanthes hamata</i>	None	0	1	28/11/2016	IU
12876	Plantae	Equisetopsida	Fabaceae	<i>Stylosanthes scabra</i>	None	0	4	26/04/2017	IU
22230	Plantae	Equisetopsida	Malvaceae	<i>Malvastrum americanum</i>	None	0	4	26/04/2017	IU
15606	Plantae	Equisetopsida	Poaceae	<i>Bothriochloa pertusa</i>	None	0	1	28/11/2016	IU
15540	Plantae	Equisetopsida	Poaceae	<i>Cenchrus ciliaris</i>	None	0	5	26/04/2017	IU
15551	Plantae	Equisetopsida	Poaceae	<i>Chloris gayana</i>	rhodes grass	0	3	28/11/2016	IU
15552	Plantae	Equisetopsida	Poaceae	<i>Chloris inflata</i>	purpletop chloris	0	2	28/11/2016	IU
29093	Plantae	Equisetopsida	Poaceae	<i>Megathyrsus maximus</i>	None	0	2	26/04/2017	IU
9154	Plantae	Equisetopsida	Poaceae	<i>Melinis repens</i>	red natal grass	0	2	28/11/2016	IU
10158	Plantae	Equisetopsida	Poaceae	<i>Sporobolus natalensis</i>	None	1	1	31/05/2012	IU
14562	Plantae	Equisetopsida	Polygonaceae	<i>Fallopia convolvulus</i>	black bindweed	0	1	26/04/2017	IU
16359	Plantae	Equisetopsida	Portulacaceae	<i>Portulaca oleracea</i>	pigweed	0	1	28/11/2016	IU

Species table headings and codes

Taxon Id: Unique identifier of the taxon from the WildNet database.

Specimens: The number of specimen-backed records of the taxon.

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Endemicity: The endemicity code for the taxon (Introduced (Intranational) (IA), Introduced (International) (II), Introduced (Unknown), Exotic (Intranational) (XA), Exotic (International) (XI) and Exotic (Unknown) (XU)).

Links and Support

Other sites that deliver species information from the [WildNet database](#) include:

- [Species profile search](#) - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- [Species lists](#) - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- [Biomaps](#) - view biodiversity information, including WildNet records approved for publication, and generate reports
- [Queensland Globe](#) - view spatial information, including WildNet records approved for publication
- [Old wildlife data API](#) - access WildNet species information approved for publication such as notes, images and records etc.
- [WetlandMaps](#) - view species records, survey locations etc. approved for publication
- [WetlandSummary](#) - view wildlife statistics, species lists for a range of area types, and access WildNet species profiles
- [WildNet wildlife records - published - Queensland](#) - spatial layer of WildNet records approved for publication generated weekly
- [Generalised distribution and densities of Queensland wildlife](#) - Queensland species distributions and densities generalised to a 10 km grid resolution
- [Conservation status of Queensland wildlife](#) - access current lists of priority species for Queensland including nomenclature and status information
- [Queensland Confidential Species](#) - the list of species flagged as confidential in the WildNet database.

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- [Australia's Virtual Herbarium \(AVH\)](#)
- [Protected Matters Search Tool](#)

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government, to the maximum extent permitted by law, makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



WildNet Records Species List

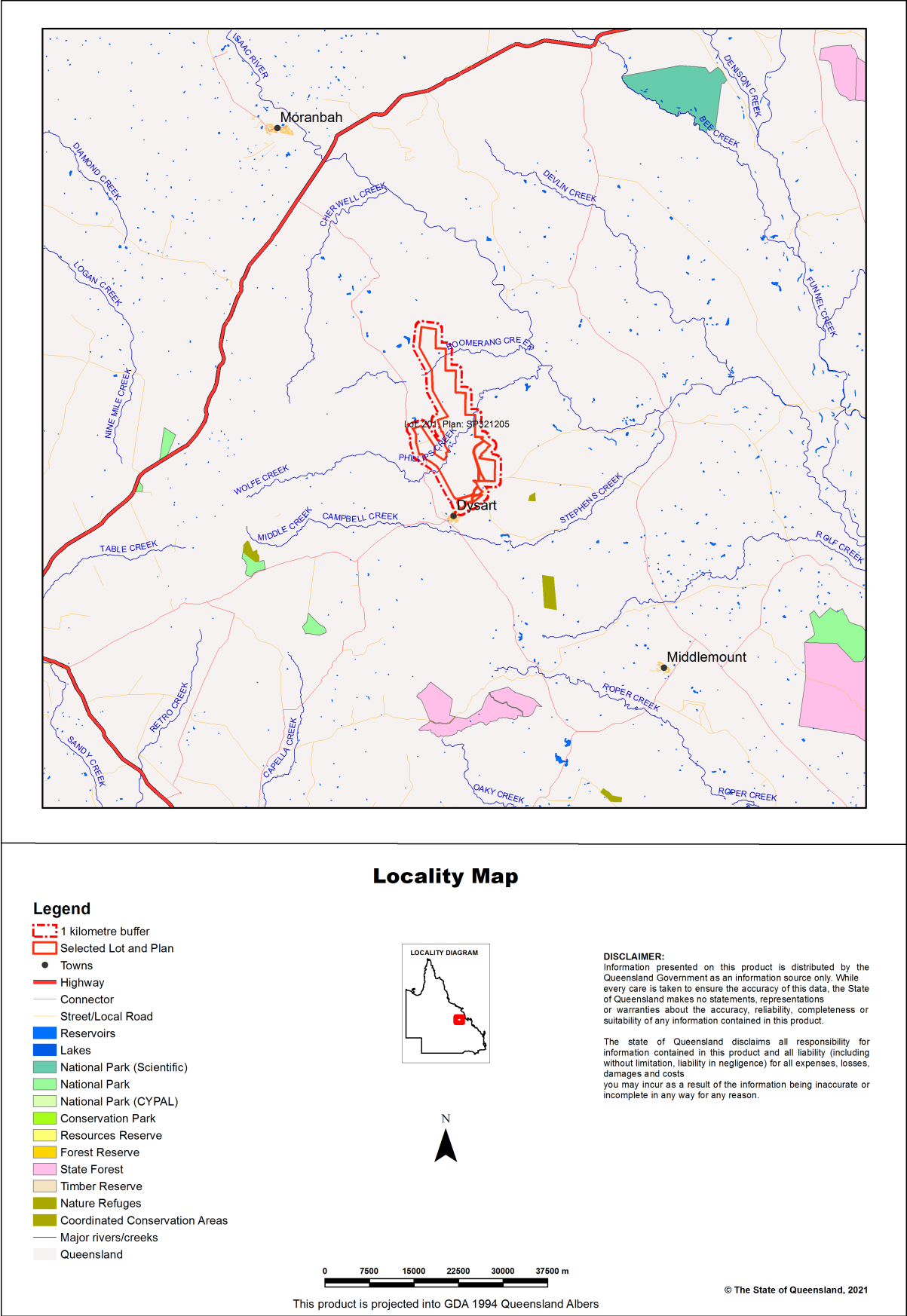


For the selected area of interest 16069.31ha Lot: 201 Plan: SP321205

Current as at 05/11/2021

WildNetSpeciesList

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest Lot: 201 Plan: SP321205.

Table 1. Area of interest details

Size (ha)	16,069.31
Local Government(s)	Isaac Regional
Bioregion(s)	Brigalow Belt
Subregion(s)	Northern Bowen Basin, Isaac - Comet Downs
Catchment(s)	Fitzroy

Protected Area(s)

No estates or reserves are located within the area of interest.

World Heritage Area(s)

No World Heritage Areas are located within the area of interest.

Ramsar Area(s)

No Ramsar Areas are located within the area of interest.

Species List

Introduction

This report is derived from a spatial layer generated from the [WildNet database](#) managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

Table 2 lists the animals recorded within the area of interest and its one kilometre buffer.

Table 3 lists the plants recorded within the area of interest and its one kilometre buffer.

Table 4 lists the fungi recorded within the area of interest and its one kilometre buffer.

Table 5 lists the protists recorded within the area of interest and its one kilometre buffer.

Table 2. Animals recorded within the area of interest and its one kilometre buffer

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
716	Amphibia	Bufonidae	<i>Rhinella marina</i>	cane toad	None	None	0	1	07/08/2020
1396	Aves	Acanthizidae	<i>Gerygone olivacea</i>	white-throated gerygone	C	None	0	1	07/08/2020
1371	Aves	Acanthizidae	<i>Smicrornis brevirostris</i>	weebill	C	None	0	1	07/08/2020
1742	Aves	Accipitridae	<i>Accipiter cirrocephalus</i>	collared sparrowhawk	C	None	0	1	07/08/2020
1729	Aves	Accipitridae	<i>Accipiter fasciatus</i>	brown goshawk	C	None	0	1	07/08/2020
1721	Aves	Accipitridae	<i>Aviceda subcristata</i>	Pacific baza	C	None	0	1	07/08/2020
1718	Aves	Accipitridae	<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle	C	None	0	1	07/08/2020

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1707	Aves	Accipitridae	<i>Haliastur sphenurus</i>	whistling kite	C	None	0	1	07/08/2020
1714	Aves	Accipitridae	<i>Milvus migrans</i>	black kite	C	None	0	1	07/08/2020
1993	Aves	Anatidae	<i>Anas gracilis</i>	grey teal	C	None	0	1	07/08/2020
1998	Aves	Anatidae	<i>Anas superciliosa</i>	Pacific black duck	C	None	0	1	07/08/2020
1999	Aves	Anatidae	<i>Aythya australis</i>	hardhead	C	None	0	1	07/08/2020
2003	Aves	Anatidae	<i>Chenonetta jubata</i>	Australian wood duck	C	None	0	1	07/08/2020
1279	Aves	Anhingidae	<i>Anhinga novae hollandiae</i>	Australasian darter	C	None	0	1	07/08/2020
1829	Aves	Ardeidae	<i>Ardea alba modesta</i>	eastern great egret	C	None	0	1	07/08/2020
1832	Aves	Ardeidae	<i>Ardea pacifica</i>	white-necked heron	C	None	0	1	07/08/2020
1826	Aves	Ardeidae	<i>Egretta novaehollandiae</i>	white-faced heron	C	None	0	1	07/08/2020
1654	Aves	Artamidae	<i>Cracticus nigrogularis</i>	pied butcherbird	C	None	0	1	07/08/2020
1656	Aves	Artamidae	<i>Cracticus torquatus</i>	grey butcherbird	C	None	0	1	07/08/2020
1644	Aves	Artamidae	<i>Gymnorhina tibicen</i>	Australian magpie	C	None	0	1	07/08/2020
1191	Aves	Cacatuidae	<i>Cacatua galerita</i>	sulphur-crested cockatoo	C	None	0	1	07/08/2020
1193	Aves	Cacatuidae	<i>Eolophus roseicapilla</i>	galah	C	None	0	1	07/08/2020
1173	Aves	Cacatuidae	<i>Nymphicus hollandicus</i>	cockatiel	C	None	0	1	07/08/2020
1635	Aves	Campephagidae	<i>Coracina maxima</i>	ground cuckoo-shrike	C	None	0	1	07/08/2020
1636	Aves	Campephagidae	<i>Coracina novae hollandiae</i>	black-faced cuckoo-shrike	C	None	0	1	07/08/2020
1940	Aves	Charadriidae	<i>Elseayornis melanops</i>	black-fronted dotterel	C	None	0	1	07/08/2020
1294	Aves	Cisticolidae	<i>Cisticola exilis</i>	golden-headed cisticola	C	None	0	1	07/08/2020
1810	Aves	Columbidae	<i>Geopelia humeralis</i>	bar-shouldered dove	C	None	0	1	07/08/2020
1785	Aves	Columbidae	<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)	V	V	0	3	07/08/2020
1793	Aves	Columbidae	<i>Ocyphaps lophotes</i>	crested pigeon	C	None	0	1	07/08/2020
1605	Aves	Corcoracidae	<i>Struthidea cinerea</i>	apostlebird	C	None	0	1	07/08/2020
1609	Aves	Corvidae	<i>Corvus orru</i>	Torresian crow	C	None	0	1	07/08/2020
1751	Aves	Cuculidae	<i>Centropus phasianinus</i>	pheasant coucal	C	None	0	1	07/08/2020
1342	Aves	Estrildidae	<i>Taeniopygia bichenovii</i>	double-barred finch	C	None	0	1	07/08/2020

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1716	Aves	Falconidae	<i>Falco berigora</i>	brown falcon	C	None	0	1	07/08/2020
1704	Aves	Falconidae	<i>Falco cenchroides</i>	nankeen kestrel	C	None	0	1	07/08/2020
1691	Aves	Falconidae	<i>Falco longipennis</i>	Australian hobby	C	None	0	1	07/08/2020
1678	Aves	Gruidae	<i>Antigone rubicunda</i>	brilga	C	None	0	1	07/08/2020
1766	Aves	Halcyonidae	<i>Dacelo leachii</i>	blue-winged kookaburra	C	None	0	1	07/08/2020
1767	Aves	Halcyonidae	<i>Dacelo novaeguineae</i>	laughing kookaburra	C	None	0	1	07/08/2020
1760	Aves	Halcyonidae	<i>Todiramphus macleayii</i>	forest kingfisher	C	None	0	1	07/08/2020
1572	Aves	Hirundinidae	<i>Hirundo neoxena</i>	welcome swallow	C	None	0	1	07/08/2020
18459	Aves	Maluridae	<i>Malurus assimilis</i>	purple-backed fairy-wren	C	None	0	1	07/08/2020
1558	Aves	Maluridae	<i>Malurus melanocephalus</i>	red-backed fairy-wren	C	None	0	1	07/08/2020
1694	Aves	Megapodiidae	<i>Alectura lathamii</i>	Australian brush-turkey	C	None	0	1	07/08/2020
1539	Aves	Meliphagidae	<i>Entomyzon cyanotis</i>	blue-faced honeyeater	C	None	0	1	07/08/2020
1496	Aves	Meliphagidae	<i>Gavicalis virescens</i>	singing honeyeater	C	None	0	1	07/08/2020
1500	Aves	Meliphagidae	<i>Manorina melanocephala</i>	noisy miner	C	None	0	1	07/08/2020
1493	Aves	Meliphagidae	<i>Philemon citreogularis</i>	little friarbird	C	None	0	1	07/08/2020
1589	Aves	Monarchidae	<i>Grallina cyanoleuca</i>	magpie-lark	C	None	0	1	07/08/2020
1586	Aves	Monarchidae	<i>Myiagra rubecula</i>	leaden flycatcher	C	None	0	1	07/08/2020
1455	Aves	Motacillidae	<i>Anthus novaeselandiae</i>	Australasian pipit	C	None	0	1	07/08/2020
1442	Aves	Oriolidae	<i>Oriolus sagittatus</i>	olive-backed oriole	C	None	0	1	07/08/2020
1437	Aves	Pachycephalidae	<i>Pachycephala rufiventris</i>	rufous whistler	C	None	0	1	07/08/2020
1392	Aves	Pardalotidae	<i>Pardalotus striatus</i>	striated pardalote	C	None	0	1	07/08/2020
1284	Aves	Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian pelican	C	None	0	1	07/08/2020
1263	Aves	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	little black cormorant	C	None	0	1	07/08/2020
1955	Aves	Podargidae	<i>Podargus strigoides</i>	tawny frogmouth	C	None	0	1	07/08/2020
1318	Aves	Pomatostomidae	<i>Pomatostomus temporalis</i>	grey-crowned babbler	C	None	0	1	07/08/2020
1182	Aves	Psittacidae	<i>Aprosmictus erythropterus</i>	red-winged parrot	C	None	0	1	07/08/2020

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1136	Aves	Psittacidae	<i>Platyercus adscitus</i>	pale-headed rosella	C	None	0	1	07/08/2020
1125	Aves	Psittacidae	<i>Trichoglossus moluccanus</i>	rainbow lorikeet	C	None	0	1	07/08/2020
1160	Aves	Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	spotted bowerbird	C	None	0	1	07/08/2020
1893	Aves	Recurvirostridae	<i>Himantopus himantopus</i>	black-winged stilt	C	None	0	1	07/08/2020
1575	Aves	Rhipiduridae	<i>Rhipidura albiscapa</i>	grey fantail	C	None	0	1	07/08/2020
1576	Aves	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail	C	None	0	1	07/08/2020
1800	Aves	Threskiornithidae	<i>Threskiornis spinicollis</i>	straw-necked ibis	C	None	0	1	07/08/2020
1081	Aves	Turnicidae	<i>Turnix varius</i>	painted button-quail	C	None	0	1	07/08/2020
1108	Aves	Tytonidae	<i>Tyto delicatula</i>	eastern barn owl	C	None	0	1	07/08/2020
832	Mammalia	Leporidae	<i>Lepus europaeus</i>	European brown hare	None	None	0	1	07/08/2020
834	Mammalia	Leporidae	<i>Oryctolagus cuniculus</i>	rabbit	None	None	0	3	07/08/2020
901	Mammalia	Macropodidae	<i>Macropus giganteus</i>	eastern grey kangaroo	C	None	0	1	07/08/2020
903	Mammalia	Macropodidae	<i>Osphranter robustus</i>	common wallaroo	C	None	0	1	07/08/2020
885	Mammalia	Macropodidae	<i>Wallabia bicolor</i>	swamp wallaby	C	None	0	1	25/07/2019
36762	Mammalia	Petauridae	<i>Petaurus notatus</i>	Kreff's glider	C	None	0	1	07/08/2020
859	Mammalia	Phalangeridae	<i>Trichosurus vulpecula</i>	common brushtail possum	C	None	0	1	07/08/2020
860	Mammalia	Phascolarctidae	<i>Phascolarctos cinereus</i>	koala	V	V	0	6	07/08/2020
838	Mammalia	Tachyglossidae	<i>Tachyglossus aculeatus</i>	short-beaked echidna	SL	None	0	1	07/08/2020
556	Reptilia	Agamidae	<i>Pogona barbata</i>	bearded dragon	C	None	0	2	07/08/2020
483	Reptilia	Elapidae	<i>Denisonia maculata</i>	ornamental snake	V	V	0	10	31/12/2010

Table 3. Plants recorded within the area of interest and its one kilometre buffer

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
16015	Equisetopsida	Aizoaceae	<i>Trianthema triquetra</i>	red spinach	C	None	0	1	28/11/2016
9698	Equisetopsida	Apocynaceae	<i>Carissa ovata</i>	currantbush	C	None	0	1	26/04/2017
10959	Equisetopsida	Asteraceae	<i>Parthenium hysterophorus</i>	parthenium weed	None	None	0	4	26/04/2017
21988	Equisetopsida	Caesalpiniaceae	<i>Cassia brewsteri</i>	None	C	None	0	2	26/04/2017
13995	Equisetopsida	Casuarinaceae	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	None	C	None	0	1	26/04/2017

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
10044	Equisetopsida	Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	None	C	None	0	1	28/11/2016
33924	Equisetopsida	Chenopodiaceae	<i>Salsola australis</i>	None	C	None	0	2	28/11/2016
10033	Equisetopsida	Commelinaceae	<i>Commelina diffusa</i>	wandering jew	C	None	0	1	26/04/2017
17288	Equisetopsida	Erythroxylaceae	<i>Erythroxylum australe</i>	cocaine tree	C	None	0	1	26/04/2017
18050	Equisetopsida	Euphorbiaceae	<i>Alchornea ilicifolia</i>	native holly	C	None	0	1	26/04/2017
4734	Equisetopsida	Euphorbiaceae	<i>Euphorbia hyssopifolia</i>	None	None	None	0	1	28/11/2016
15471	Equisetopsida	Fabaceae	<i>Crotalaria montana</i>	None	C	None	0	1	26/04/2017
15356	Equisetopsida	Fabaceae	<i>Glycine tabacina</i>	glycine pea	C	None	0	1	26/04/2017
15235	Equisetopsida	Fabaceae	<i>Macroptilium atropurpureum</i>	siratro	None	None	0	2	28/11/2016
18221	Equisetopsida	Fabaceae	<i>Macroptilium lathyroides</i> var. <i>semirectum</i>	None	None	None	0	1	28/11/2016
14257	Equisetopsida	Fabaceae	<i>Rhynchosia minima</i>	None	C	None	0	3	28/11/2016
12877	Equisetopsida	Fabaceae	<i>Stylosanthes hamata</i>	None	None	None	0	1	28/11/2016
12876	Equisetopsida	Fabaceae	<i>Stylosanthes scabra</i>	None	None	None	0	4	26/04/2017
14952	Equisetopsida	Fabaceae	<i>Vigna lanceolata</i>	None	C	None	0	1	26/04/2017
17628	Equisetopsida	Lamiaceae	<i>Clerodendrum floribundum</i>	None	C	None	0	1	26/04/2017
16776	Equisetopsida	Laxmanniaceae	<i>Lomandra longifolia</i>	None	C	None	0	1	26/04/2017
13048	Equisetopsida	Malvaceae	<i>Abutilon leucopetalum</i>	None	C	None	0	3	28/11/2016
22230	Equisetopsida	Malvaceae	<i>Malvastrum americanum</i>	None	None	None	0	4	26/04/2017
16151	Equisetopsida	Malvaceae	<i>Sida</i>	None	None	None	0	1	28/11/2016
15791	Equisetopsida	Mimosaceae	<i>Acacia cowleana</i>	None	C	None	1	1	25/06/1999
15694	Equisetopsida	Mimosaceae	<i>Acacia salicina</i>	doolan	C	None	0	1	26/04/2017
17144	Equisetopsida	Moraceae	<i>Ficus opposita</i>	None	C	None	0	1	26/04/2017
6574	Equisetopsida	Myrtaceae	<i>Corymbia erythrophloia</i>	variable-barbed bloodwood	C	None	0	1	26/04/2017
6572	Equisetopsida	Myrtaceae	<i>Corymbia tessellaris</i>	Moreton Bay ash	C	None	0	1	26/04/2017
17188	Equisetopsida	Myrtaceae	<i>Eucalyptus populnea</i>	poplar box	C	None	0	1	26/04/2017
26471	Equisetopsida	Myrtaceae	<i>Eucalyptus tereticornis</i> subsp. <i>tereticornis</i>	None	C	None	0	1	26/04/2017
16469	Equisetopsida	Phyllanthaceae	<i>Phyllanthus maderaspatensis</i> var. <i>maderaspatensis</i>	None	C	None	0	2	28/11/2016
11126	Equisetopsida	Poaceae	<i>Aristida contorta</i>	bunched kerosene grass	C	None	0	1	26/04/2017
15605	Equisetopsida	Poaceae	<i>Bothriochloa ewartiana</i>	desert bluegrass	C	None	0	2	26/04/2017
15606	Equisetopsida	Poaceae	<i>Bothriochloa pertusa</i>	None	None	None	0	1	28/11/2016
15540	Equisetopsida	Poaceae	<i>Cenchrus ciliaris</i>	None	None	None	0	5	26/04/2017
15551	Equisetopsida	Poaceae	<i>Chloris gayana</i>	rhodes grass	None	None	0	3	28/11/2016

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
15552	Equisetopsida	Poaceae	<i>Chloris inflata</i>	purpletop chloris	None	None	0	2	28/11/2016
15467	Equisetopsida	Poaceae	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	None	C	None	1	1	20/04/2021
15330	Equisetopsida	Poaceae	<i>Eriochloa crebra</i>	spring grass	C	None	0	2	26/04/2017
15336	Equisetopsida	Poaceae	<i>Eulalia aurea</i>	silky browntop	C	None	0	1	26/04/2017
15320	Equisetopsida	Poaceae	<i>Heteropogon contortus</i>	black speargrass	C	None	0	1	26/04/2017
29093	Equisetopsida	Poaceae	<i>Megathyrsus maximus</i>	None	None	None	0	2	26/04/2017
9154	Equisetopsida	Poaceae	<i>Melinis repens</i>	red natal grass	None	None	0	2	28/11/2016
9599	Equisetopsida	Poaceae	<i>Panicum decompositum</i>	None	C	None	0	3	28/11/2016
12587	Equisetopsida	Poaceae	<i>Paspalum</i>	None	None	None	0	1	28/11/2016
10158	Equisetopsida	Poaceae	<i>Sporobolus natalensis</i>	None	None	None	1	1	31/05/2012
14974	Equisetopsida	Poaceae	<i>Themeda triandra</i>	kangaroo grass	C	None	0	1	26/04/2017
14562	Equisetopsida	Polygonaceae	<i>Fallopia convolvulus</i>	black bindweed	None	None	0	1	26/04/2017
16359	Equisetopsida	Portulacaceae	<i>Portulaca oleracea</i>	pigweed	None	None	0	1	28/11/2016
17906	Equisetopsida	Sapindaceae	<i>Atalaya hemiglauc</i>	None	C	None	0	1	26/04/2017
17603	Equisetopsida	Sparrmanniaceae	<i>Corchorus trilocularis</i>	None	C	None	0	2	28/11/2016
40981	Equisetopsida	Sparrmanniaceae	<i>Grewia savannicola</i>	None	C	None	0	1	26/04/2017

Table 4. Fungi recorded within the area of interest and its one kilometre buffer

No species found within the area of interest and its one kilometre buffer.

Table 5. Protists recorded within the area of interest and its one kilometre buffer

No species found within the area of interest and its one kilometre buffer.

Species table headings and codes

Taxon Id: Unique identifier of the taxon from the WildNet database.

NCA: Queensland conservation status of the taxon under the *Nature Conservation Act 1992* (Least Concern (C), Critically Endangered (CR), Endangered (E), Extinct (EX), Near Threatened (NT), Extinct in the Wild (PE), Special Least Concern (SL), and Vulnerable (V)).

EPBC: Australian conservation status of the taxon under the *Environment Protection and Biodiversity Conservation Act 1999* (Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Vulnerable (V), and Extinct in the Wild (XW)).

Specimens: The number of specimen-backed records of the taxon.

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Links and Support

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- [Protected Matters Search Tool](#)

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WildNet Records

Weed List

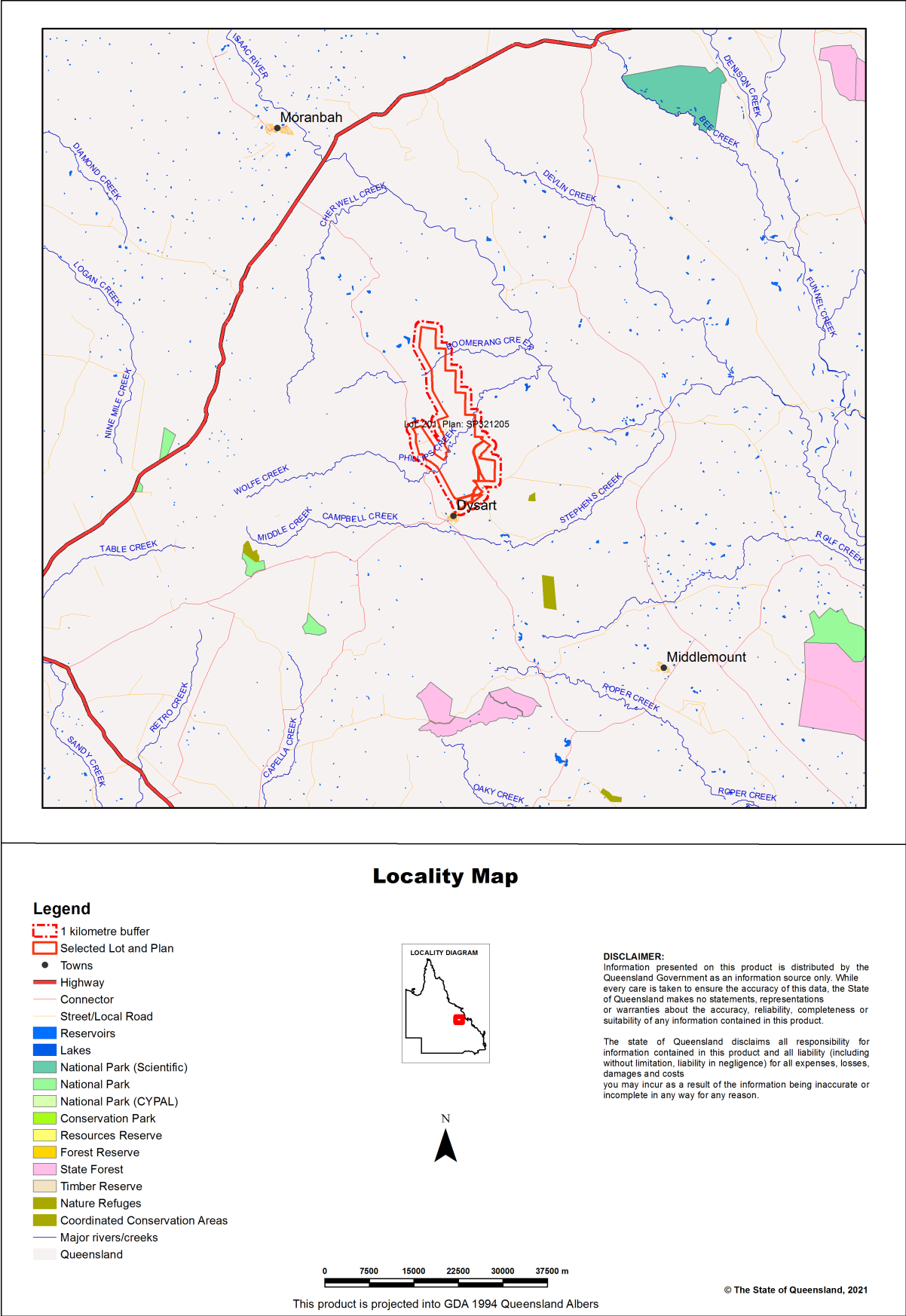


For the selected area of interest 16069.31ha Lot: 201 Plan: SP321205

Current as at 05/11/2021

WildNetWeedList

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest Lot: 201 Plan: SP321205.

Table 1. Area of interest details

Size (ha)	16,069.31
Local Government(s)	Isaac Regional
Bioregion(s)	Brigalow Belt
Subregion(s)	Northern Bowen Basin, Isaac - Comet Downs
Catchment(s)	Fitzroy

Protected Area(s)

No estates or reserves are located within the area of interest.

World Heritage Area(s)

No World Heritage Areas are located within the area of interest.

Ramsar Area(s)

No Ramsar Areas are located within the area of interest.

Weed List

Introduction

This report is derived from a spatial layer generated from the [WildNet database](#) managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

Species Data

Contextual location information is presented in Map 1.

A summary of the weeds recorded within the area of interest and its one kilometre buffer is presented in Table 2.

Table 2. Weeds recorded within the area of interest and its one kilometre buffer

Taxon Id	Family	Scientific Name	Common Name	Specimens	Records	Last record	Endemicity
10959	Asteraceae	<i>Parthenium hysterophorus</i>	parthenium weed	0	4	26/04/2017	IU
4734	Euphorbiaceae	<i>Euphorbia hyssopifolia</i>	None	0	1	28/11/2016	IU
15235	Fabaceae	<i>Macroptilium atropurpureum</i>	siratro	0	2	28/11/2016	IU
18221	Fabaceae	<i>Macroptilium lathyroides</i> var. <i>semierectum</i>	None	0	1	28/11/2016	IU
12877	Fabaceae	<i>Stylosanthes hamata</i>	None	0	1	28/11/2016	IU
12876	Fabaceae	<i>Stylosanthes scabra</i>	None	0	4	26/04/2017	IU
22230	Malvaceae	<i>Malvastrum americanum</i>	None	0	4	26/04/2017	IU
15606	Poaceae	<i>Bothriochloa pertusa</i>	None	0	1	28/11/2016	IU
15540	Poaceae	<i>Cenchrus ciliaris</i>	None	0	5	26/04/2017	IU
15551	Poaceae	<i>Chloris gayana</i>	rhodes grass	0	3	28/11/2016	IU
15552	Poaceae	<i>Chloris inflata</i>	purpletop chloris	0	2	28/11/2016	IU

Taxon Id	Family	Scientific Name	Common Name	Specimens	Records	Last record	Endemicity
29093	Poaceae	<i>Megathyrsus maximus</i>	None	0	2	26/04/2017	IU
9154	Poaceae	<i>Melinis repens</i>	red natal grass	0	2	28/11/2016	IU
10158	Poaceae	<i>Sporobolus natalensis</i>	None	1	1	31/05/2012	IU
14562	Polygonaceae	<i>Fallopia convolvulus</i>	black bindweed	0	1	26/04/2017	IU
16359	Portulacaceae	<i>Portulaca oleracea</i>	pigweed	0	1	28/11/2016	IU

Species table headings and codes

Taxon Id: Unique identifier of the taxon from the WildNet database.

Specimens: The number of specimen-backed records of the taxon.

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Endemicity: The endemicity code for the taxon (Introduced (Intranational) (IA), Introduced (International) (II), Introduced (Unknown), Exotic (Intranational) (XA), Exotic (International) (XI) and Exotic (Unknown) (XU)).

Links and Support

Other sites that deliver species information from the [WildNet database](#) include:

- [Species profile search](#) - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- [Species lists](#) - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- [Biomaps](#) - view biodiversity information, including WildNet records approved for publication, and generate reports
- [Queensland Globe](#) - view spatial information, including WildNet records approved for publication
- [Old wildlife data API](#) - access WildNet species information approved for publication such as notes, images and records etc.
- [WetlandMaps](#) - view species records, survey locations etc. approved for publication
- [WetlandSummary](#) - view wildlife statistics, species lists for a range of area types, and access WildNet species profiles
- [WildNet wildlife records - published - Queensland](#) - spatial layer of WildNet records approved for publication generated weekly
- [Generalised distribution and densities of Queensland wildlife](#) - Queensland species distributions and densities generalised to a 10 km grid resolution
- [Conservation status of Queensland wildlife](#) - access current lists of priority species for Queensland including nomenclature and status information
- [Queensland Confidential Species](#) - the list of species flagged as confidential in the WildNet database.

Please direct queries about this report to the [WildNet Team](#).

Other useful sites for accessing Queensland biodiversity data include:

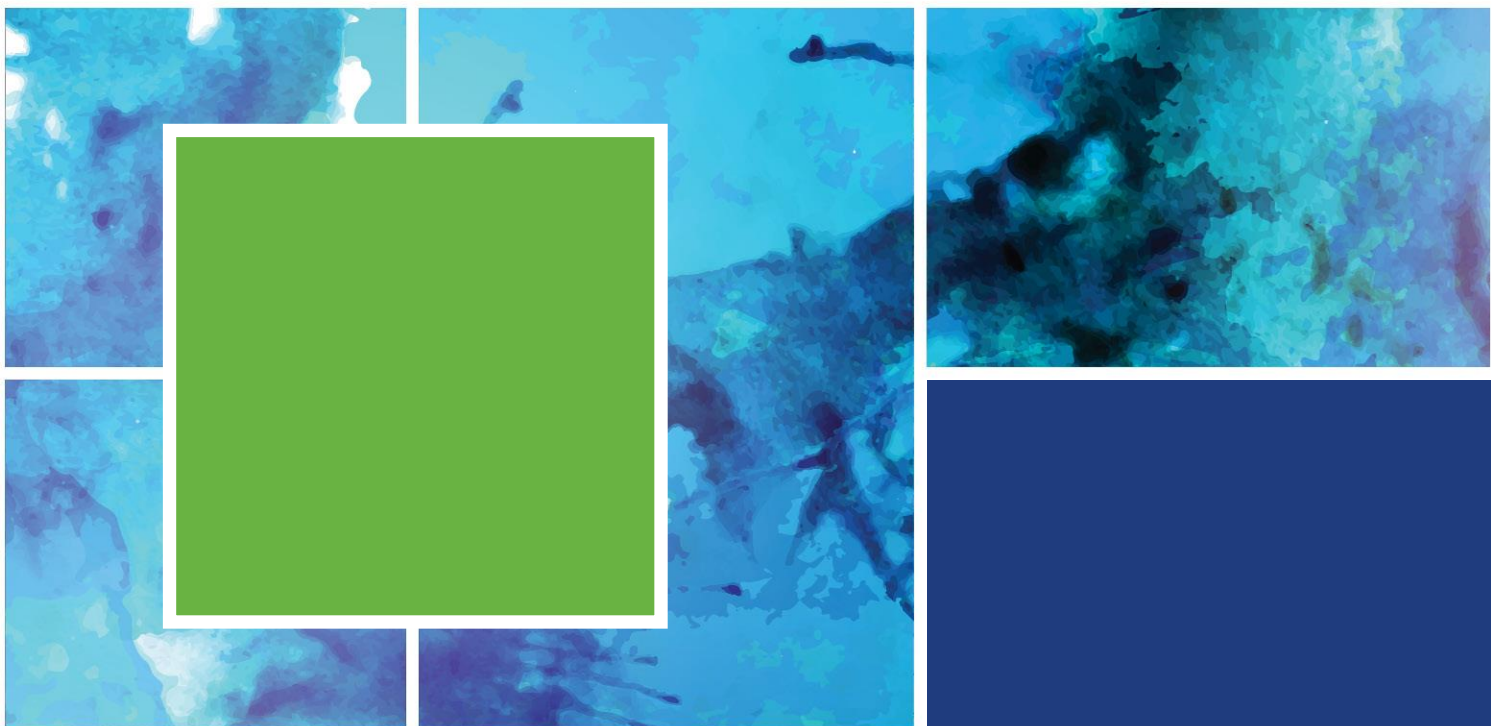
- [Useful wildlife resources](#)
- [Queensland Government Data](#)
- [Atlas of Living Australia \(ALA\)](#)
- [Online Zoological Collections of Australian Museums \(OZCAM\)](#)
- [Australia's Virtual Herbarium \(AVH\)](#)
- [Protected Matters Search Tool](#)

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APPENDIX C. HISTORICAL DATA ANALYSIS



OVERVIEW

Historical data was sourced from Receiving Environment Monitoring Programme (REMP) reports undertaken between 2011 and 2021 at Saraji Mine (Gauge, 2021b). This includes data for the following systems:

- Isaac River (test);
- Hughes Creek;
- One Mile Creek; and
- Phillips Creeks.

This was supplemented by REMP reports for Peak Downs Mine (Gauge, 2021a) for the following systems:

- Isaac River (control); and
- Boomerang Creek.

HABITAT ASSESSMENT

Habitat bioassessment scores recorded over the REMP reports from 2011-2021 are displayed in Table 8-1.

Table 8-1Historical Habitat assessment data summary.

Watercourse	Position	Date	Substrate Available Cover	Embeddedness	Velocity Depth Category	Channel Alteration	Bottom Scouring and Deposition	Pool Riffle Run Bend Ratio	Bank Stability	Bank Vegetative Stability	Streamside Vegetation Cover	Total Habitat Score
Isaac River	U/S	Feb-21	Fair	Good	Poor	Excellent	Good	Fair	Good	Excellent	Excellent	Good
		Apr-21	Fair	Excellent	Poor	Excellent	Good	Fair	Good	Excellent	Excellent	Good
	D/S	Mar-20	Poor	Excellent	Good	Good	Good	Fair	Good	Good	Excellent	Good
		Feb-21	Fair	Good	Poor	Fair	Good	Fair	Fair	Good	Excellent	Good
		Apr-21	Fair	Excellent	Poor	Excellent	Good	Fair	Fair	Excellent	Excellent	Good
Hughes Creek	U/S	Jul-11	Poor	Poor	Poor	Poor	Excellent	Poor	Excellent	Excellent	Good	Fair
		Mar-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-20	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Apr-20	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
	D/S	Jun-11	Poor	Poor	Fair	Fair	Good	Poor	Fair	Good	Fair	Fair
		Jul-11	Poor	Poor	Fair	Fair	Good	Poor	Fair	Good	Fair	Fair
		Mar-16	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair	Excellent	Good
		May-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-18	Fair	Fair	Fair	Poor	Fair	Poor	Fair	Good	Fair	Fair
		May-18	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Good	Fair
		Mar-19	Good	Fair	Poor	Good	Fair	Fair	Good	Fair	Fair	Fair
		May-19	Fair	Fair	Poor	Excellent	Excellent	Poor	Good	Good	Fair	Good

Watercourse	Position	Date	Substrate Available Cover	Embeddedness	Velocity Depth Category	Channel Alteration	Bottom Scouring and Deposition	Pool Riffle Run Bend Ratio	Bank Stability	Bank Vegetative Stability	Streamside Vegetation Cover	Total Habitat Score
		Mar-20	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Excellent	Fair	Fair
		Apr-20	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Excellent	Fair	Fair
		Feb-21	Fair	Excellent	Fair	Excellent	Excellent	Fair	Good	Good	Fair	Good
		Apr-21	Good	Fair	Fair	Excellent	Good	Good	Fair	Fair	Fair	Good
One Mile Creek	D/S	Jun-13	Poor	Fair	Poor	Good	Good	Fair	Fair	Fair	Fair	Fair
		Mar-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-19	Poor	Fair	Poor	Excellent	Excellent	Poor	Excellent	Excellent	Fair	Fair
		Mar-20	Fair	Fair	Fair	Excellent	Fair	Fair	Excellent	Excellent	Excellent	Good
		Apr-20	Fair	Fair	Fair	Excellent	Fair	Fair	Excellent	Excellent	Excellent	Good
Phillips Creek	U/S	Jun-11	Excellent	Good	Good	Good	Excellent	Good	Excellent	Excellent	Fair	Good
		Feb-13	Good	Good	Good	Good	Excellent	Fair	Good	Good	Fair	Good
		Jun-13	Fair	Good	Fair	Good	Good	Fair	Excellent	Excellent	Fair	Good
		Mar-16	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Excellent	Good
		May-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-20	Fair	Good	Poor	Fair	Fair	Poor	Good	Excellent	Excellent	Fair

Watercourse	Position	Date	Substrate Available Cover	Embeddedness	Velocity Depth Category	Channel Alteration	Bottom Scouring and Deposition	Pool Riffle Run Bend Ratio	Bank Stability	Bank Vegetative Stability	Streamside Vegetation Cover	Total Habitat Score
		Apr-20	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Apr-21	Poor	Good	Poor	Excellent	Good	Fair	Fair	Good	Excellent	Good
	D/S	Jun-11	Poor	Poor	Fair	Fair	Excellent	Poor	Good	Excellent	Fair	Fair
		Feb-13	Fair	Fair	Fair	Excellent	Good	Fair	Fair	Good	Fair	Good
		Jun-13	Poor	Fair	Poor	Fair	Excellent	Poor	Good	Excellent	Fair	Fair
		Mar-16	Good	Good	Fair	Good	Fair	Good	Good	Good	Good	Good
		May-16	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-18	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		May-19	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Mar-20	Fair	Fair	Poor	Fair	Fair	Fair	Good	Excellent	Excellent	Fair
		Apr-20	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result	No Result
		Feb-21	Good	Good	Poor	Good	Fair	Fair	Fair	Good	Fair	Good

WATER QUALITY

Historical pH, electrical conductivity, turbidity, temperature and dissolved oxygen data is provided in Figure 8-1, Figure 8-2 and Figure 8-3. Data from the current early-wet and late-wet surveys are provided for comparison.

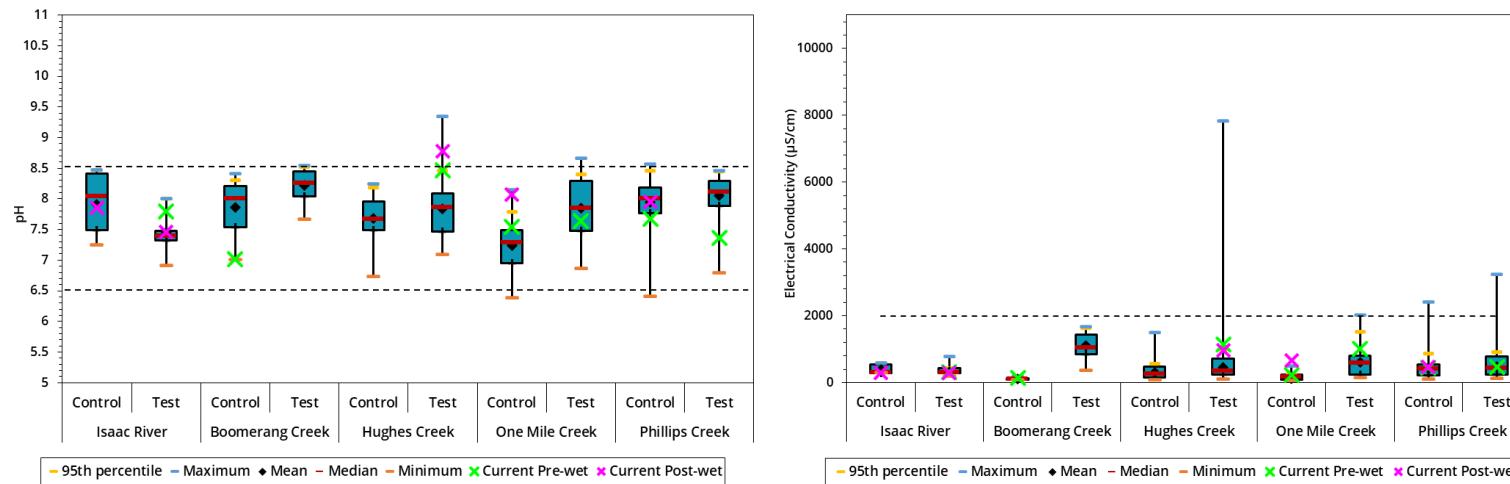


Figure 8-1 Historical pH (left) and electrical conductivity (right) data compared to data from the current study. Dotted lines represent pH WQOs for the Isaac River sub-catchment (DEHP, 2011) and EC values from Prasad et. al (2012).

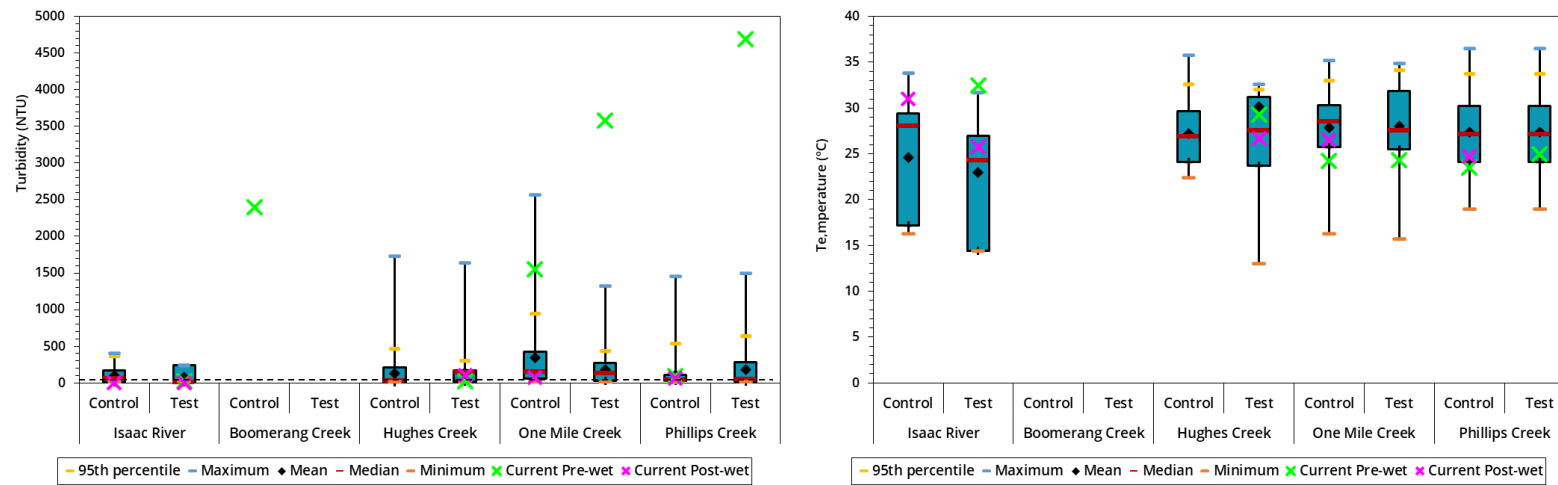


Figure 8-2 Historical turbidity (left) and temperature (right) data compared to data from the current study. Dotted lines represent WQOs for the Isaac River sub-catchment (DEHP, 2011).

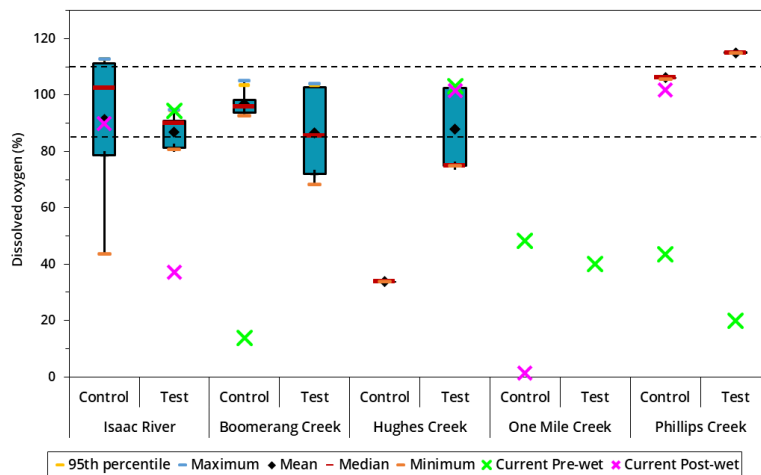


Figure 8-3 Historical dissolved oxygen data. Dotted lines represent WQOs for the Isaac River sub-catchment (DEHP, 2011).

MACROINVERTEBRATES

Historical macroinvertebrate data from bed habitat is provided in Figure 8-4 and Figure 8-5. It should be noted that this data was generated based on a combination of field-picked and lab-picked methodologies, meaning that live-picking of each sample was conducted in the field and the remaining residue further picked in the laboratory. This increase in sample processing is likely to produce macroinvertebrate data of higher diversity indices (e.g., taxonomic richness) than field-picking alone.

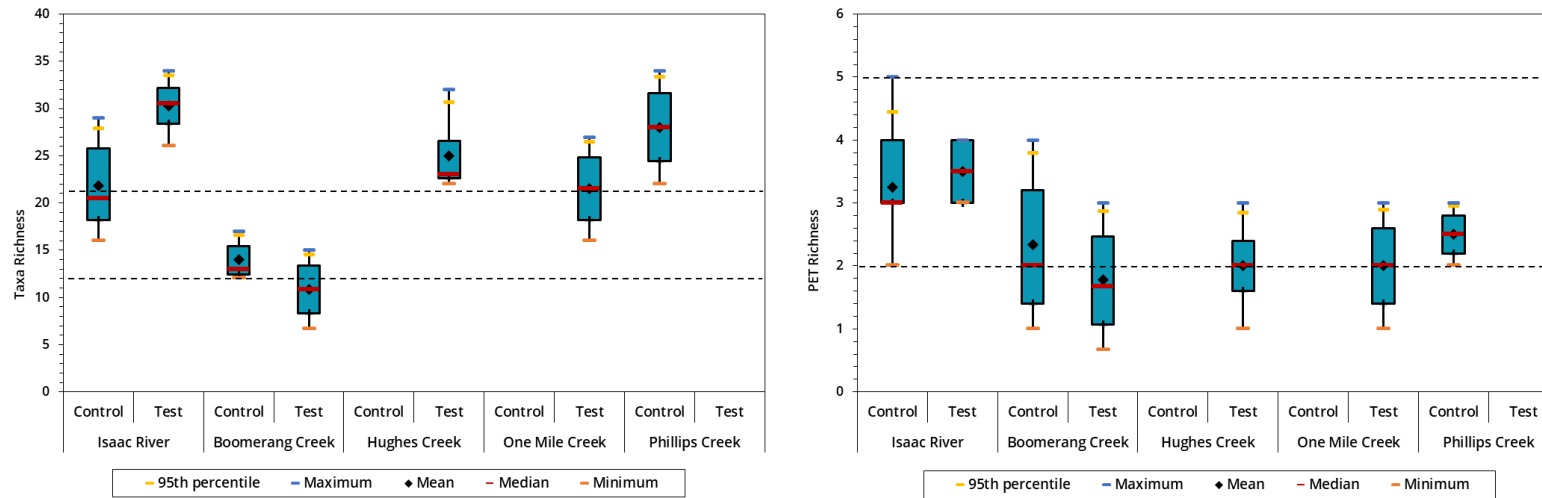


Figure 8-4 Historical macroinvertebrate bed taxa richness (left) and PET taxa richness (right) data. Dotted lines represent WQOs for the Isaac River sub-catchment.

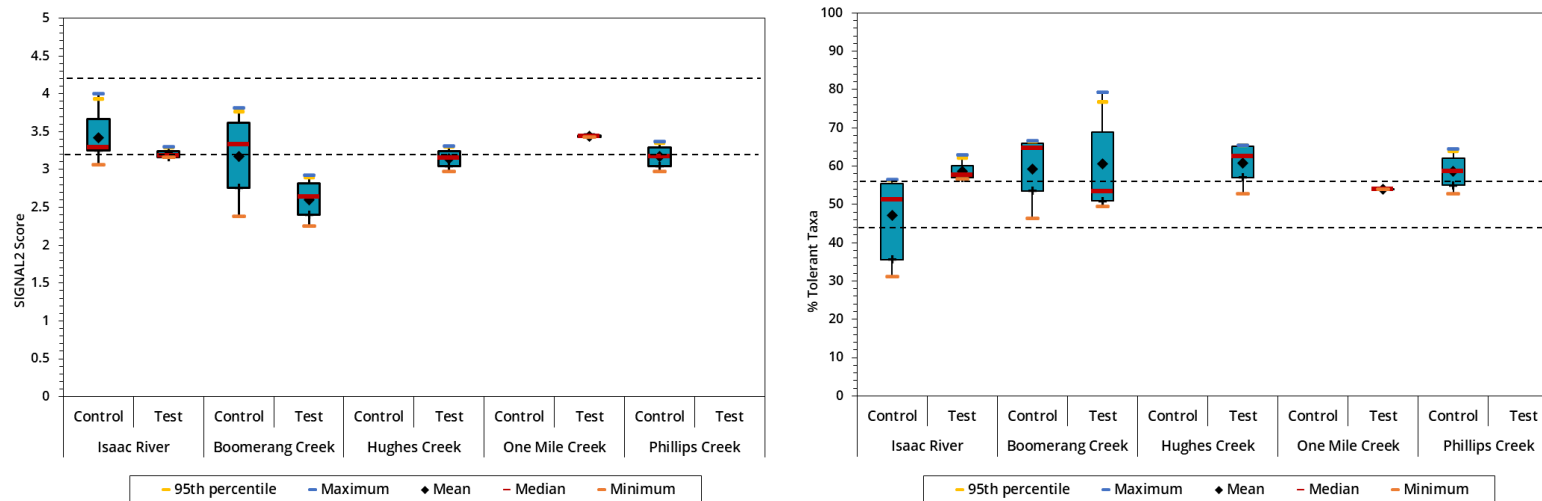
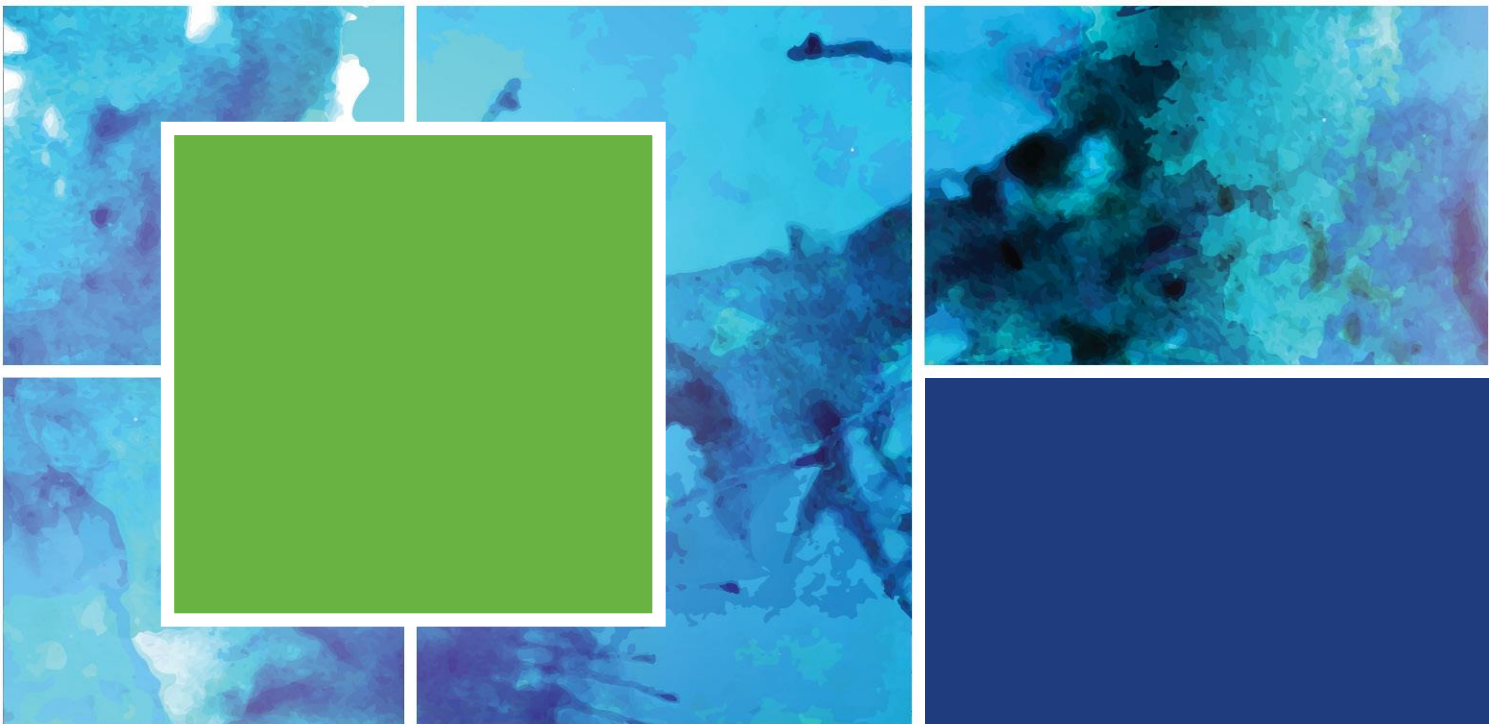


Figure 8-5 Historical macroinvertebrate bed SIGNAL2 score (left) and % tolerant taxa (right) data. Dotted lines represent WQOs for the Isaac River sub-catchment.

APPENDIX D. HABITAT SUMMARY TABLE



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 10m 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: LWD, 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		
IRO3 Early-wet	Could not access site	-	-
IRO3 Late-wet	Watercourse: Isaac River Local landuse: native vegetation with some cleared areas Bed erosion and sedimentation: moderate compaction Banks: convex banks 10m 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		

Site	Feature	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: 10m 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		
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 10m 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		
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 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		

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		
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 10m 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		

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 10m 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		
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 10m 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		
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 15m 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		
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 10m 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		

Site	Feature	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 5m 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 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		
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 5m 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		

Site	Feature	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 10m 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 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		
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 5m 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		
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 shrubby present, mostly exotic species Habitat bioassessment score: 45, fair condition		

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 5-8m 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		
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: 5m 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		
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 5-10m wide with slope range from 30-80°, infrequent, small areas of erosion mostly healed over. Bank cover >80% 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		

Site	Feature	Upstream	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 10-15m 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		
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: 10m 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		
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 15m 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		

APPENDIX E. RESIDUAL IMPACT ASSESSMENT

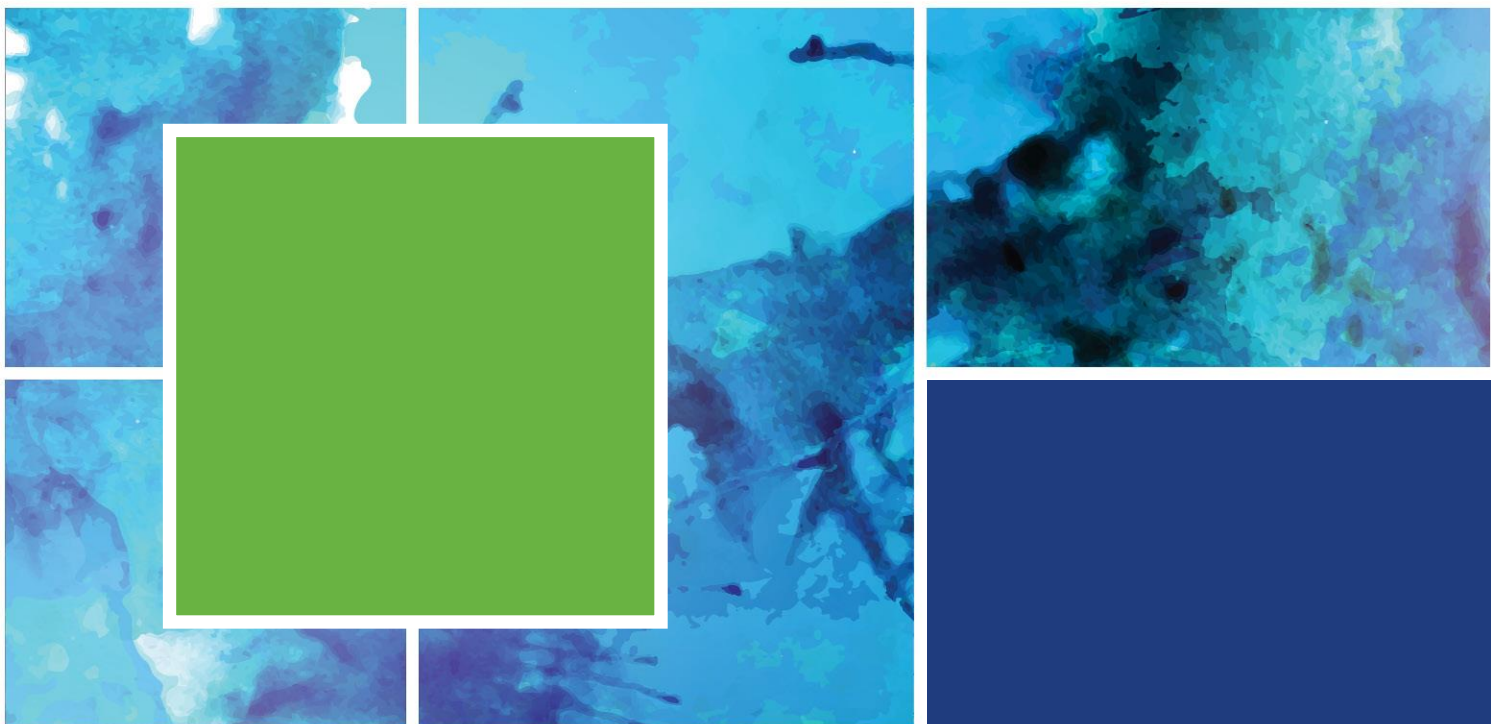


Table E1 - Residual Impact Assessment Matrix

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
Loss of Macrohabitat										
Clearing, grubbing and infrastructure instatement	Construction	Moderate	Short term	Almost certain	Medium	• The clearing footprint will clearly be delineated and minimised as far as practicable. • Existing access roads and tracks will be used where practicable. • At the planned watercourse crossings, mature trees will be retained, where possible, and shall be trimmed in preference to removal. • The use of excavators or other suitable machinery will be no greater than the capacity required for the purpose. • Vehicle access to and across the waterways will be by the designated access way only. • New access ways will be designed to accommodate intended traffic types and volumes. • Vegetative material will be stockpiled away from the waterways. • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP). The implemented erosion and sediment controls will be inspected regularly, including after rainfall or significant flow events, and maintained to ensure their ongoing functionality. • At crossing points, where the stream bed comprises coarse substrates (boulder, cobble, pebble or gravel) overlaying finer substrates (silt / clay or sand), this material shall be removed and stockpiled separately for reinstatement. • At crossing points, where possible promote a heterogeneous substrate in watercourse crossings, including: – replacing large woody debris to stabilize banks and to provide in-stream complexity. – using a combination of rocks, gravels and cobbles in the stream bed, including bed material salvaged prior to construction. – use large rocks and logs to moderate flow. • At crossing points, the stream bed and banks will be graded away (upslope) from the watercourse and placed in temporary stockpiles beyond the top of the bank. • Photos of all waterways crossings will be taken to provide record for the restoration process.	Moderate	Short term	Possible	Low

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
Subsidence in watercourses	Operation	Moderate	Short term – adaptive management will occur following impact	Almost certain	Medium	- Subsidence management in accordance with BMA (2023). The developed management plan accommodates all forms of potential impacts and associated mitigation and management measures relevant to macrohabitat. - Any amelioration works are to occur during the dry seasons where watercourses flows are negligible, so not to disrupt ecological processes of ephemeral creeks. - Monitoring of aquatic habitat and geomorphology in accordance with the developed Subsidence Management Plan (BMA, 2023).	The impact rating does not change from the unmitigated scenario. The impact will occur; however the impact will be ameliorated in accordance with the developed management plan (BMA, 2023).			
Loss of Microhabitat										
Clearing and grubbing and infrastructure instatement	Construction	Moderate	Short term	Almost certain	Medium	- The clearing footprint will clearly be delineated and minimised as far as practicable. - Vegetative material will be stockpiled away from the waterways. - Any instream snags or other woody debris located at the proposed access track crossings shall be removed and set aside for re-instatement after the conclusion of construction.	Minor	Short term	Possible	Insignificant
Subsidence in watercourse	Operations	Moderate	Short term – adaptive management will occur following impact	Almost certain	Medium	Large woody debris deposited in subsidence pools which are ameliorated is to be instated within the reprofiled watercourse.	The impact rating does not change from the unmitigated scenario. The impact will occur; however the impact will be ameliorated in accordance with the developed management plan (BMA, 2023).			
Loss or Reduced Access to Feeding, Nesting and Spawning Habitat										
Waterway crossing infrastructure	Construction	Moderate	Short term	Almost Certain	Medium	- Construction of crossing related infrastructure will avoid where possible periods of flow (commonly December to April) to avoid disruption to movement and essential feeding patterns. - Vehicles and plant will be parked outside of the watercourse (i.e. landward of the top of the bank). - Ancillary plant and equipment (e.g. water pumps) will be placed outside the riparian zone. - Care shall be taken with the placement of any materials used to stabilise the bed or banks to ensure that the original conditions are re-instated and that the materials will not limit access to habitat, and food and nesting resources. - Installed watercourse crossings will be designed and constructed in accordance with DAF (2018) for new infrastructure within waterways identified as having a moderate (amber watercourses) and major impact (purple) to fish migration.	Moderate	Short term	Possible	Low

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
						• Flow condition will be re-established prior to non-construction cycle. If flow is present, water may be conveyed around the crossing. • Diverted flow will be returned to the watercourse in a controlled manner, with scour protection measures employed as required. • Where possible, scour protection in the bed of the watercourse will be partially buried to provide continuity with the adjacent undisturbed bed of the watercourse. • Diversion berms to be placed at top of bank and 10 m from top of bank. Design to ensure water does not pond behind berms. Diverted surface flow from diversion berms to be discharged on undisturbed bank material within the approved workspace and dispersed on the downstream side of the easement. • Temporary cross berms shall be constructed after clearing and grading and be reinstated after each operation which disturbs them. Any permanent cross berms shall be constructed during final rehabilitation. • Dams and crossing related infrastructure will remain in place for as short a time as construction necessitates. • Ensure uninterrupted low flows and minimise the occurrence of blockage of access ways caused by flood-borne debris by selecting culverts of sufficient size. • During flowing conditions, crossing infrastructure will be inspected daily and maintained to ensure they remain free of debris and sediment. Any substantial accumulation of debris will be removed and stockpiled away from the watercourse, for later use in reinstatement and rehabilitation. • Weed monitoring and control will continue during the construction and post construction of the project in accordance with the developed plans. • Direct temporary lighting away from light-sensitive areas. Light shades and low lighting will be applied to construction and located at waterway crossings. • Any instream stabilising material will be placed to avoid interrupting low flow along the watercourse. • Where possible promote a heterogeneous substrate in watercourse crossings, including: – Replacing large woody debris to stabilize banks and to provide in-stream complexity.				

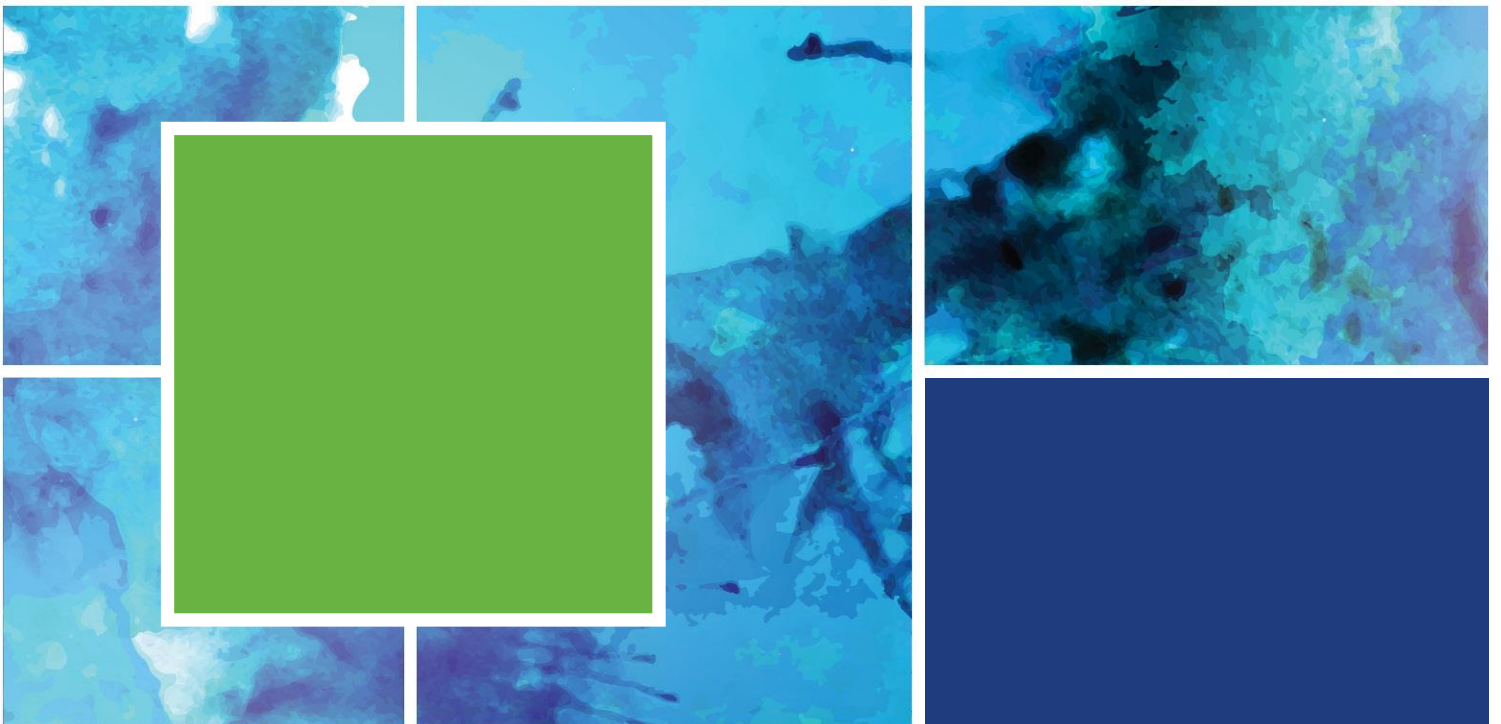
Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
						- Using a combination of rocks, gravels and cobbles in the stream bed, including bed material salvaged prior to construction. - Use large rocks and logs to moderate high flow.				
	Operation	Moderate	Long term	Almost certain	High	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	Moderate	Short-term	Possible	Low
Damage and or Fish Death										
Waterway crossing infrastructure	Construction	Moderate	Short term	Almost Certain	Medium	- Where possible, crossing related infrastructure will be scheduled during the drier months (commonly July to November in these systems), to minimise encountering water and as such fish and other aquatic vertebrates. - If works cannot be scheduled during creek dry state, then construction will be programmed to minimise the amount of time works are undertaken within the watercourse. - Should dewatering be required, then it is to cease when water levels within the impoundment area reach the critical level necessary to sustain aquatic fauna such as fish. Once fish and other aquatic fauna have been salvaged and translocated, then dewatering may recommence. - Should dewatering occur, suction hoses connected to pump intakes shall be fitted with inlet filters or screens (10 mm) to prevent ingress of biota. Inspections shall be undertaken as necessary to ensure that the pump remains operational, including sufficient fuel for overnight use. - Should any dewatering be required an experienced aquatic ecologist is to be present during dewatering activities to manage and translocate aquatic fauna. Suitable habitat for translocation will be determined prior to construction. - Entrapped fish will be salvaged (native species only) or destroyed (noxious and non-indigenous species only). Salvage efforts will be in accordance with Fish Salvage Guidelines described for least concern species (DAF, 2022).	Moderate	Short term	Possible	Low
Subsidence in watercourses	Operation	Moderate	Short term – adaptive management will occur following impact	Almost Certain	Medium	- Fish and turtles entrained in subsidence which are evidently drying will be salvage in accordance with Fish Salvage Guidelines described for least concern (DAF, 2022) and developed low-risk species management plans. - An experienced aquatic ecologist is to be present during salvage activities to manage and translocate aquatic fauna. Suitable habitat for translocation will be determined prior to construction.	Minor	Short term	Possible	Low
Impacts to Aquatic Biota from Exotics										

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
Introduction and spread of aquatic weeds	Construction	Moderate	Short term	Likely	Medium	- Education and awareness training regarding the impacts of aquatic weeds to aquatic ecosystem values to be held with contractors as detailed in the CEMP. - A Weed and Pest Management Plan (WMP) will be required and should include (but not limited to): - Monitoring and control frequencies (treatment methods and number of treatments required). - Appropriate hygiene procedures for vehicles, machinery and other construction equipment internal to and those vehicles and equipment leaving the site.	Moderate	Short term	Possible	Low
	Operation	Moderate	Long term	Likely	Medium	As per mitigation measure detailed for construction	Moderate	short term	Possible	Low
Introduction and spread of exotic aquatic fauna	Construction	Negligible	Short term	Rare	Insignificant	n/a				
	Operation	Negligible	Long term	Rare	Insignificant	n/a				
Impacts from Increased Fishing Pressure										
Impacts from overfishing	Construction	Minor	Short term	Possible	Insignificant	• Employees are not to take part in recreational fishing	Minor	Short term	Rare	Insignificant
	Operation	Minor	Long term	Possible	Low	• Employees are not to take part in recreational fishing	Minor	Long term	Rare	Insignificant
Changes to Hydrology and Hydraulics of Waterways and Wetlands										
Water supply	Construction	Minor	Short-term	Almost certain	Low	• Construction water supply will not be extracted from local or regional waterways or from groundwater which contribute to the water balance of any waterway.	Negligible	Short term	Almost certain	Insignificant
	Operation	Minor	Long-term	Almost certain	Low	• Construction water supply will not be extracted from local or regional waterways or from groundwater which contribute to the water balance of any waterway.	Negligible	Long term	Almost certain	Insignificant
Groundwater drawdowns and associated impacts to surface aquatic GDEs	Operation	Negligible	Short term	Rare	Insignificant	• No aquatic GDEs (surface water expression) occur within the Study area or surrounds. Further, there are no predicted net flow changes to creeks and river systems within the receiving environment and surrounds (SLR, 2023).	The impact rating does not change. There are not predicted impacts to aquatic GDEs (surface water expressions).			
Subsidence in watercourses	Operation	Moderate	Short term – adaptive management will occur following impact	Almost certain	Medium	• Subsidence management in accordance with BMA (2023).	The impact rating does not change from the unmitigated scenario. The impact will occur; however the impact will be ameliorated in accordance with the developed management plan (BMA, 2023).			
Mine affected water releases	Construction	Moderate	Short term	Rare	Low	• Releases are to be managed in a way which will not increase peak discharge rates to local waterways.	Minor	Short term	Possible	Insignificant

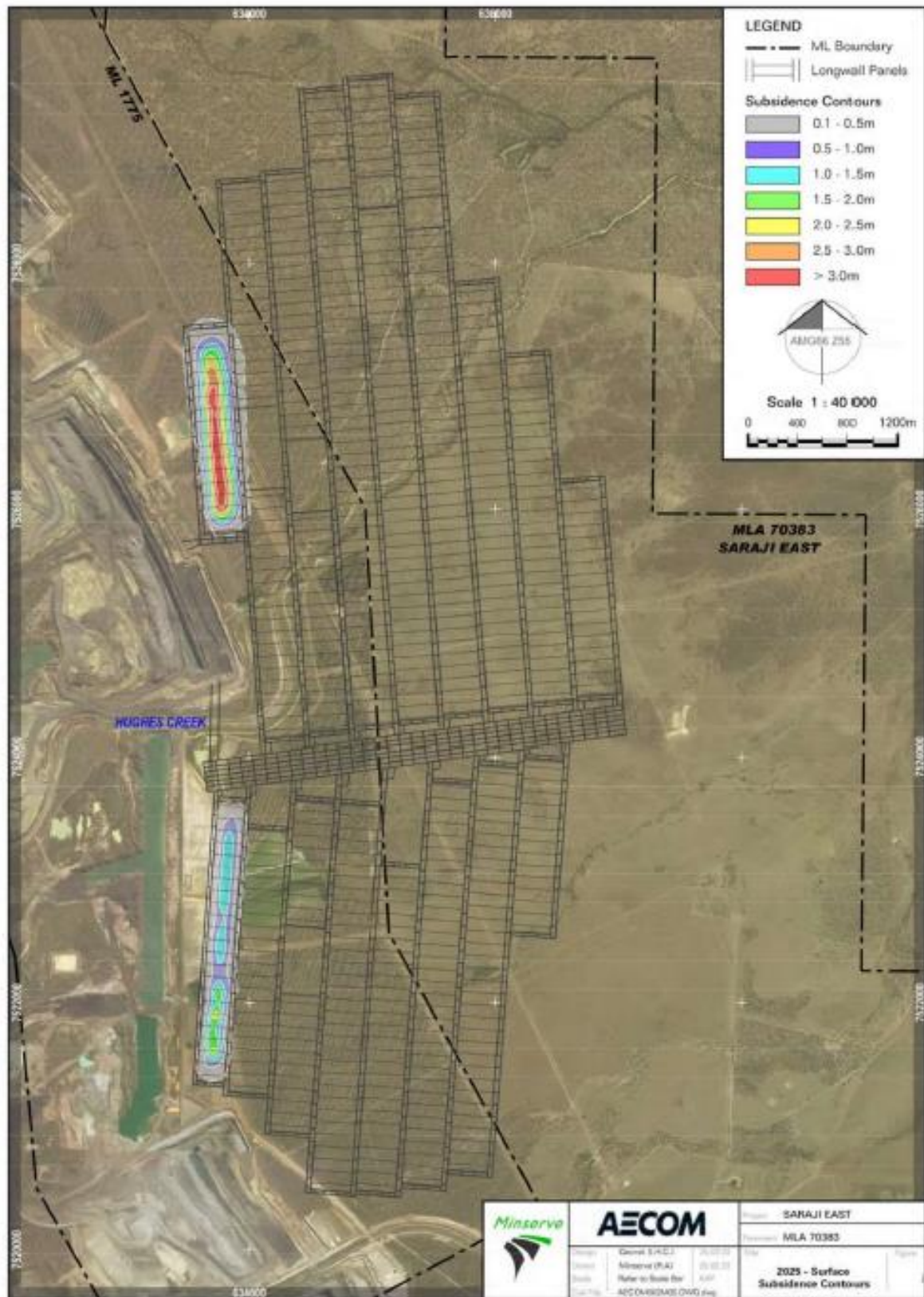
Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
	Operation	Moderate	Short term	Almost certain	Medium	Releases are to be managed in a way which will not increase peak discharge rates to local waterways.	Minor	Short term	Almost certain	Insignificant
Changes to Water Quality										
Runoff from the infrastructure and stockpiles	Construction	Moderate	Short term	Almost certain	Medium	- The clearing footprint will clearly delineated and minimised as far as practicable. - Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. Quality targets will achieve minimum gross pollutant reductions outlined in DES (2021).	Moderate	Short term	Possible	Low
	Operation	Moderate	Short term	Almost Certain	Medium	Runoff from stockpiles and infrastructure areas will be captured via a stormwater management system.	Moderate	Short term	Possible	Low
Riparian clearing for infrastructure	Construction	Moderate	Short term	Almost certain	Medium	- The clearing footprint will clearly delineated and minimised as far as practicable. - Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. Quality targets will achieve minimum gross pollutant reductions outlined in DES (2021). - Vegetative material will be stockpiled away from the waterways.	Minor	Short term	Possible	Insignificant
Hazardous substance - contamination and spills	Construction	Moderate	Short term	Possible	Low	- All vehicles, plant and equipment required on-site will be in good condition, and will be regularly maintained and inspected for leakages, in order to minimise the risk of contaminant spill - Bulk chemicals and fuels will be stored within the project area at locations away from surface water bodies and will be managed in accordance with: - the WHS Act and regulation - AS 1940:2017 Storage and Flammable or Combustible Substances - AS 3780:2008 The storage and Handling of Corrosive Substances - Refuelling of mobile plant and vehicles will occur at designated areas within the Project. These areas will be suitably distanced from surface water bodies and drainage lines. Spill kits for chemical and hydrocarbon spills will be available at refuelling points. - In the event of an accidental spill or release of contaminants, works will cease immediately, and preventative actions implemented as per the CEMP - Spill kits will be located at appropriate points during construction and staff instructed in their use - Development of a waste/refuse management plan.	Minor	Short term	Possible	Insignificant

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
						- Development of a spills emergency response plan including appropriate spills containment and training that is consistent with good practice. - Good practice and corporate stewardship that will seek to continually improve in areas such as material handling training and waste management.				
	Operation	Moderate	Short term	Possible	Low	As per the above for construction	Minor	Short term	Possible	Insignificant
Subsidence	Operation	Moderate	Short term – adaptive management will occur following impact	Almost certain	Medium	- Subsidence management in accordance with BMA (2023). This will include drainage of ponding areas and surface crack repairs. - Monitoring of water quality in accordance with the developed Subsidence Management Plan (BMA, 2023).	The impact rating does not change from the unmitigated scenario. The impact will occur; however the impact will ameliorated in accordance with the developed management plan (BMA, 2023).			
Mine affected water release	Construction	Moderate	Short term	Almost certain	Medium	Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. Quality targets will achieve minimum gross pollutant reductions outlined in DES (2021).	Moderate	Short term	Possible	Insignificant
	Operation	Moderate	Short term	Almost certain	Medium	Release of mine affected waters are to conform with release quality criteria stipulated in 5.2.5.	Minor	Short term	Rare	Insignificant

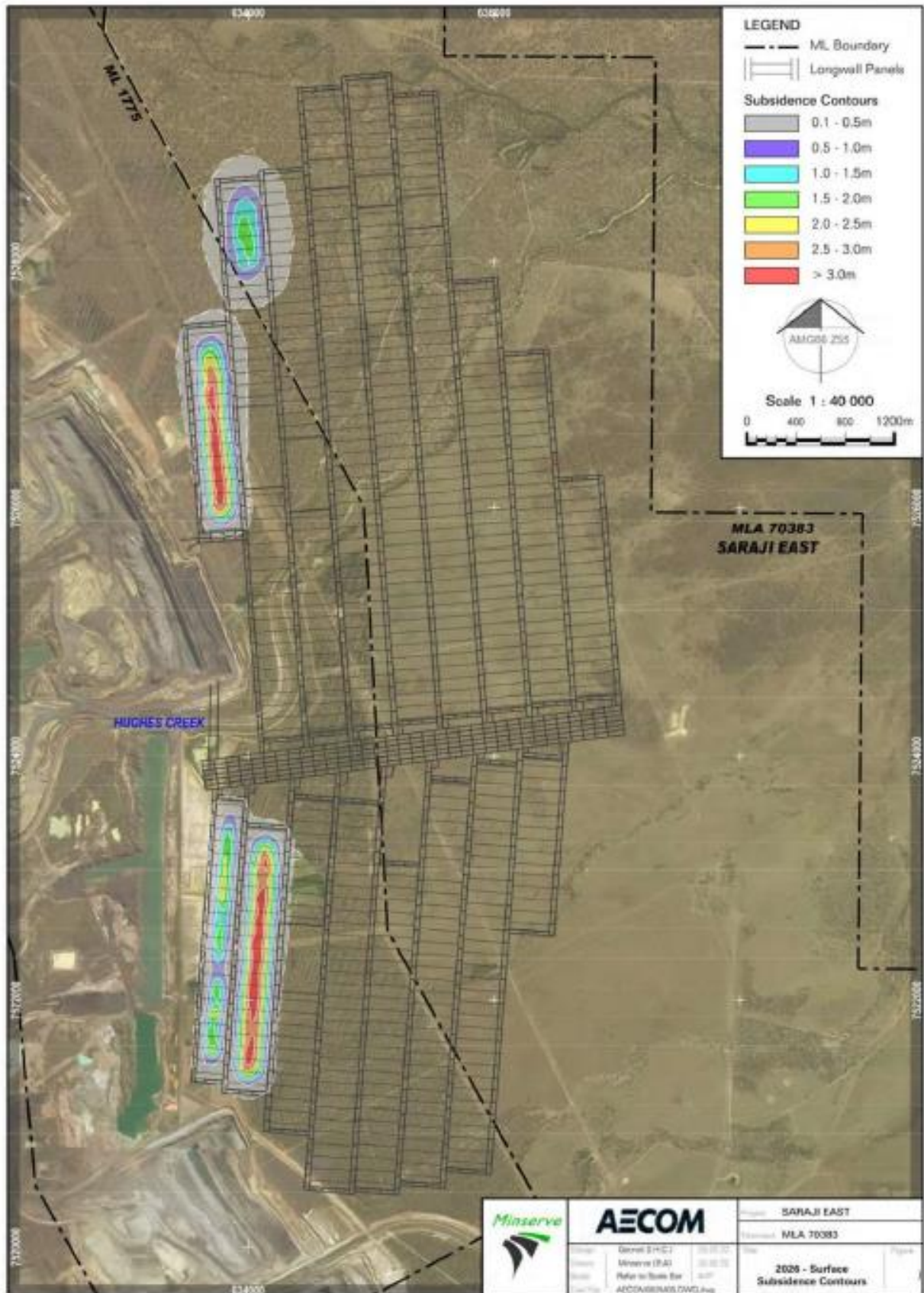
APPENDIX F. SURFACE SUBSIDENCE CONTOURS



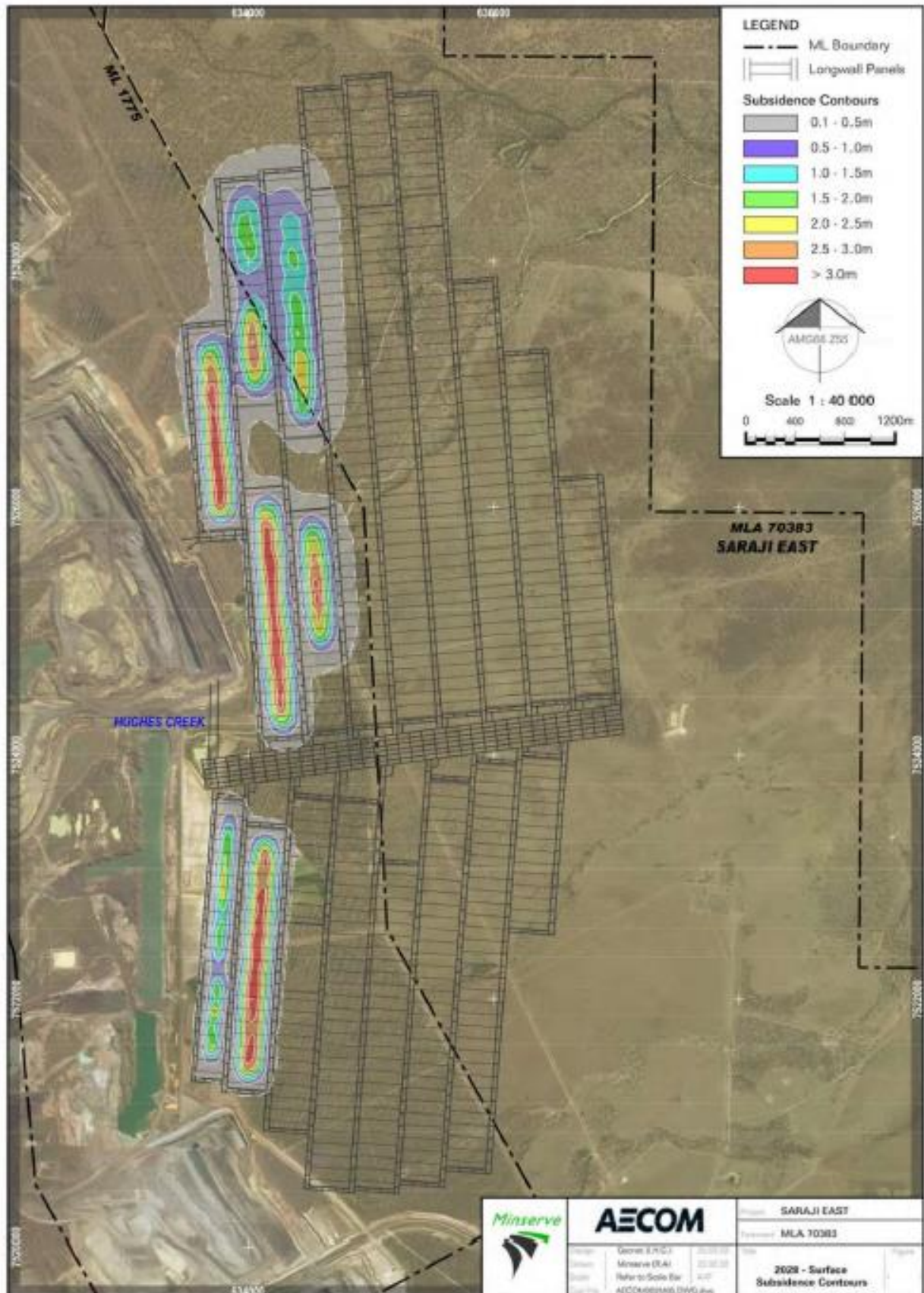
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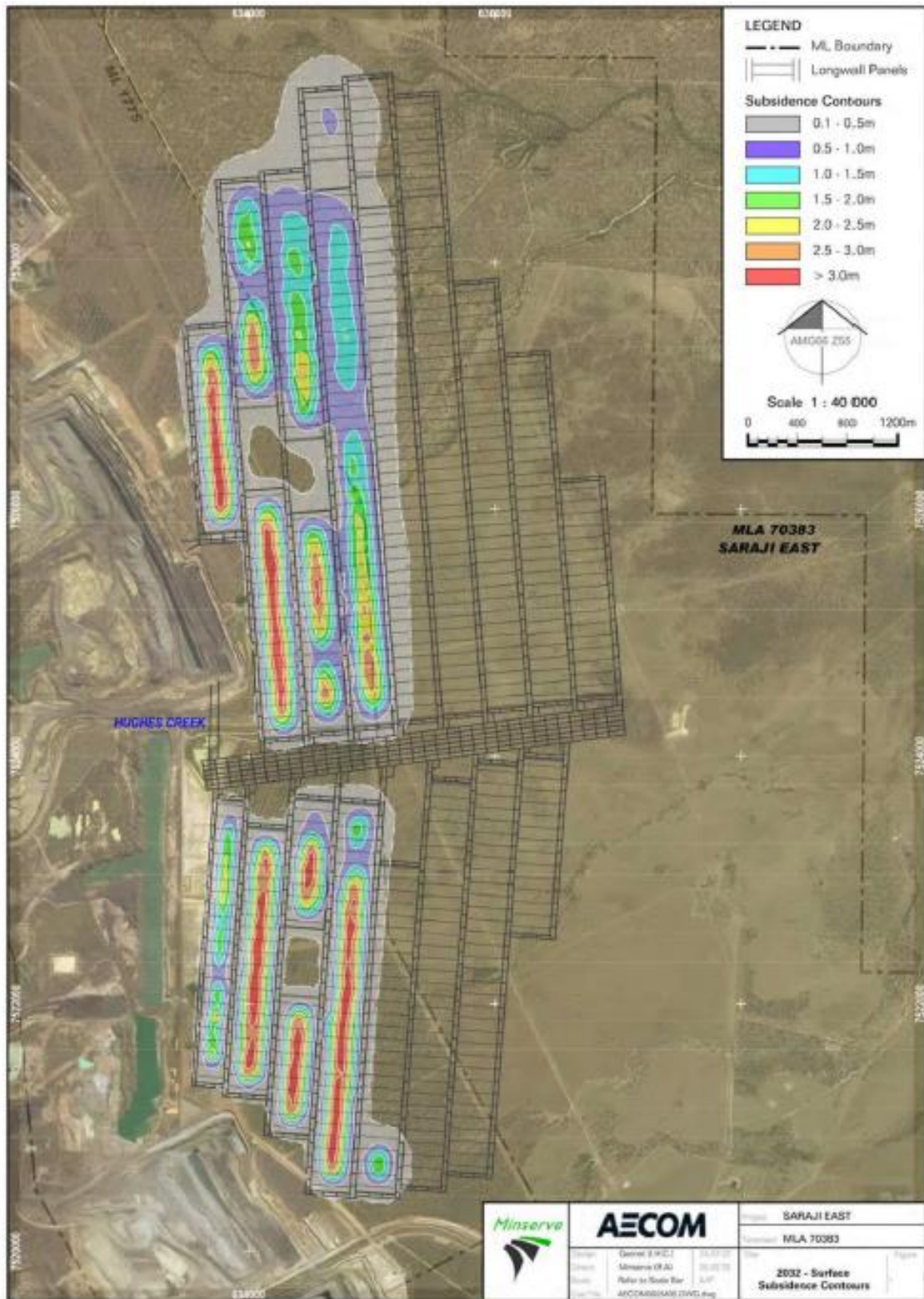
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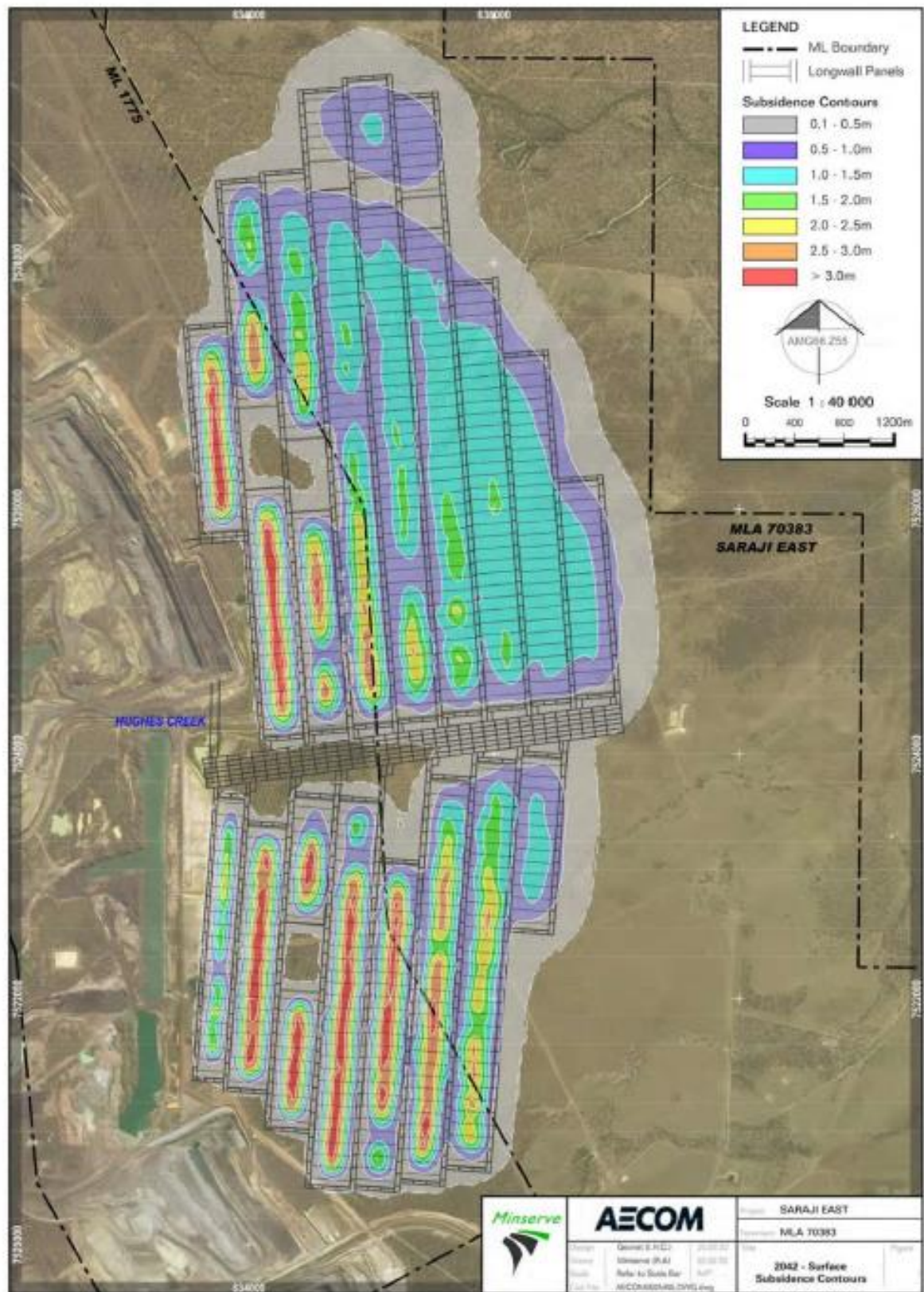
Year 6



Year 10



Year 20





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