

# **Aquatic Ecology Baseline Assessment**

## **Blackwater Mine - North Extension Project**

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Prepared for BM Alliance Coal Operations Pty Ltd

July 2023

# Aquatic Ecology Baseline Assessment

## Blackwater Mine - North Extension Project

BM Alliance Coal Operations Pty Ltd

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July 2023

Version	Date	Prepared by	Approved by	Comments
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# Executive Summary

BM Alliance Coal Operations Pty Ltd (BMA) owns and operates the Blackwater Mine (BWM), situated approximately 20 kilometres (km) south of Blackwater, Queensland. The mine has been in operation since the 1960s and currently operates under an Environmental Authority (EA) EPML00717813, with existing coal production at c.16 million tonnes per annum (Mtpa).

BMA is planning an expansion of its current mining footprint to the east of the existing operation. EMM Consulting Pty Limited (EMM) were commissioned by BMA to undertake seasonal aquatic ecology surveys and assessments across the proposed mine expansion areas defined as the BWM North Extension Project. The study area assessed is shown in Figure 1.1.

This aquatic ecology survey report aims to describe the aquatic values of the BWM North Extension Project area referred to as study area, identify any conservation significant species under the Queensland *Nature Conservation Act 1992* (NC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), to identify the potential for aquatic groundwater dependent ecosystems (GDEs) to occur, and to identify and describe any Matters of State or National Environmental Significance that may occur in the study area (relating to aquatic ecology) based on desktop assessments and seasonal surveys undertaken in December 2019 and May 2020. The broader desktop assessment area, as applied in desktop searches, comprises of a 25 km buffer from a central point in the study area.

The waterways of the study area range from small first order tributaries to larger fourth order streams being: Two Mile Gully and Taurus Creek. Other named waterways in the study area include Sagittarius and Deep Creek. Mapped wetlands in the study area are limited to one lacustrine wetland waterbody (farm dam). A number of smaller, unmapped lacustrine wetland waterbodies (farm dams and a flood channel wetland) also occur. The waterways of the study area are ephemeral and are generally expected to experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are expected to be highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is lower. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to vary seasonally.

Aquatic survey was attempted at nine locations in December 2019, comprising seven waterways, and two lacustrine wetland waterbodies. With most waterways being dry at the time of assessment, habitat assessments were undertaken in place of detailed aquatic survey at most riverine sites. Most lacustrine waterbodies (farm dams) held water at the time of assessment. The same sites were again sampled in May 2020 to capture a complete seasonal dataset. An additional site, site RW1 – being an unmapped flood channel wetland on Taurus Creek – was opportunistically sampled in May 2020 due to the persistence of wetted habitat that was not encountered in this area in December 2019. In total, 10 aquatic sites were surveyed.

Overall aquatic values across the study area ranged from low to moderate aquatic values. Riverine sites on Sagittarius, Taurus Creeks and Two Mile Gully were rated as having moderate aquatic values due largely to their importance as conduits for fish passage. Riverine sites with a stream order 1-2 were rated as having low aquatic values. Wetland waterbody sites L1 and L2 were rated as having moderate aquatic values, considering their suitability as dry season refuge for Least Concern fish and turtle species.

Aquatic macroinvertebrate indices, including taxa richness, PET richness, SIGNAL2, tolerant taxa and AusRivAS scores, were variable, likely reflecting seasonality more than catchment impacts.

Fish, macroinvertebrates and turtles were surveyed at wetted sites, including isolated pools on Taurus Creek (site R4), a flood channel wetland on Taurus Creek (site RW1), and a farm dam (site L1). The sampling effort detected 10 fish species (nine Least Concern native species and one exotic species), one Least Concern turtle species and a diversity of aquatic macroinvertebrates. Flora surveys across all wetted and dry sites detected 20 species of aquatic or semi-aquatic flora (18 Least Concern native species and two introduced species).

No conservation significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded during survey efforts. Due to a lack of suitable habitat present and distributional range, it is unlikely that any critically endangered, endangered, vulnerable or near threatened (CEEVNT) aquatic flora or fauna species occur within the waterways or wetlands of the study area as either resident or transient occurrences.

There are no Wetlands of International Importance or National Importance identified within the study area.

Matters of State Environmental Significance (MSES) of relevance to this aquatic ecology assessment include waterways providing for fish passage. A waterway providing for fish passage is a MSES only if a waterway barrier work is proposed that would limit the passage of fish along the waterway.

GDEs are a component of the water resource MNES. State mapping indicates no 'known' or 'derived' surface expression GDEs within the study area. Prolonged dry conditions in the lead-up to the December 2019 surveys provided ideal conditions for identifying surface expressions of groundwater (i.e aquatic GDEs). However, no flows, salt seeps, hydrophytes, or other obvious indicators of aquatic GDEs were encountered. Further, the concentration and relative proportion of major anions and cations in surface water samples collected from the survey area in December 2019 and May 2020 showed no obvious groundwater influence. Field verification of riparian vegetation and aquatic habitats of the survey area found no obvious on-ground indicators of aquatic GDEs.

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# 1 Introduction

## 1.1 Background

BM Alliance Coal Operations Pty Ltd (BMA) owns and operates the Blackwater Mine (BWM), situated approximately 20 kilometres (km) south of Blackwater, Queensland. The mine has been in operation since 1967 and currently operates under an Environmental Authority (EA) EPML00717813, with existing coal production at c.16 million tonnes per annum (Mtpa).

BMA is planning to extend its approved mining lease (ML) footprint within ML1759 and ML1762 eastward, to mine within Surface Area (SA) 10 on ML1759 and SA7 on ML1762 (Figure 1.1). Mining within these surface areas would require both State and Federal environmental approvals. The extent of SA10 and SA7 are illustrated in Figure 1.1 and represent the 'study area' for this Aquatic Ecology Baseline Assessment.

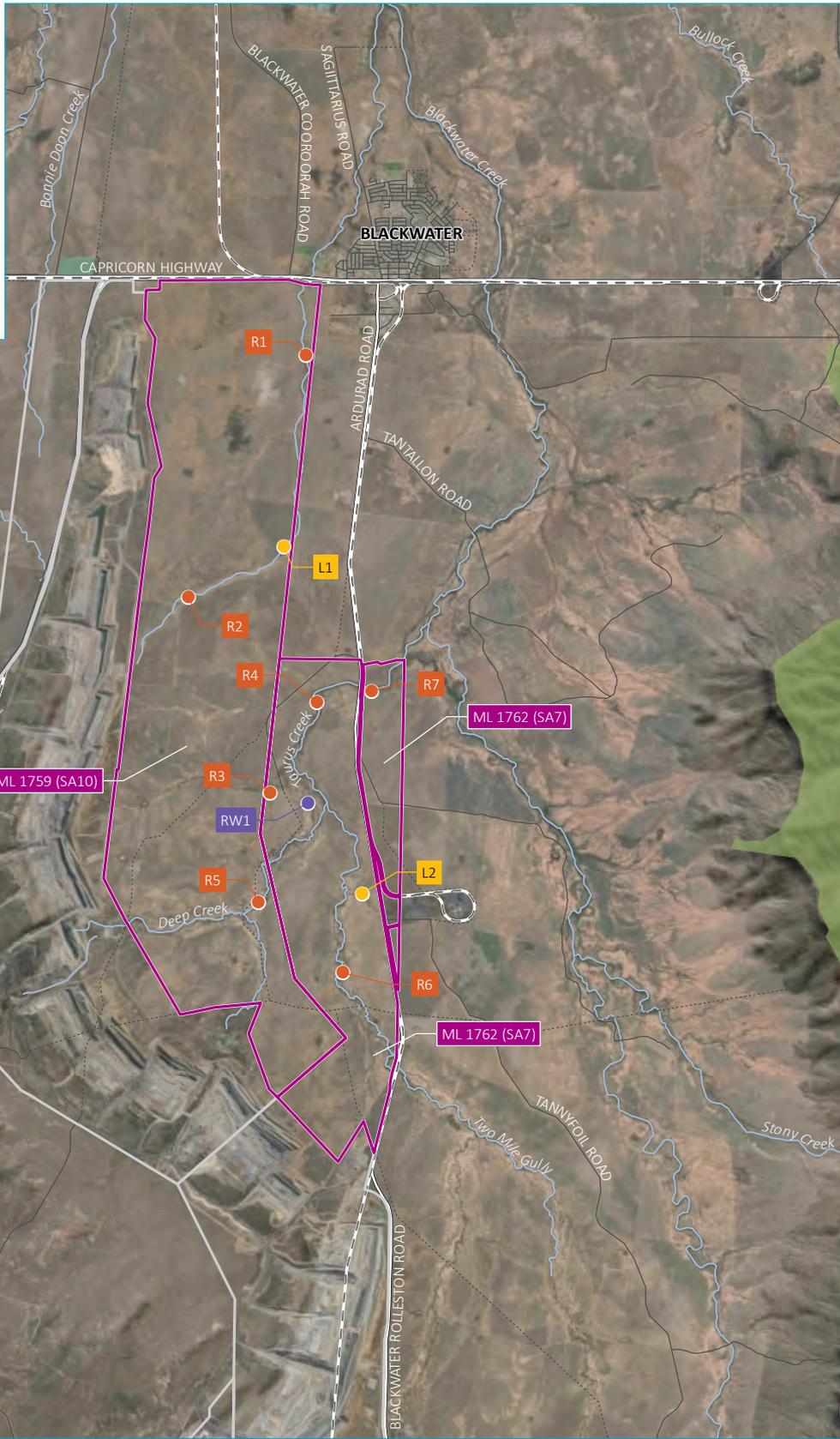
BMA has identified a need for contemporary baseline information on aquatic ecology addressing applicable environmental survey guidelines to support future impact assessments and identify the presence of significant biodiversity values.

## 1.2 Purpose of this report

The purpose of this report is to describe the aquatic values of the study area as relevant to current Commonwealth and State legislation. The report presents a baseline assessment of aquatic ecological values based on a desktop assessment of available information, and seasonal surveys undertaken in December 2019 and May 2020.

The content of this aquatic ecology baseline assessment is limited to aquatic ecology, including aquatic (surface expression) groundwater dependent ecosystems (GDEs). It does not address subterranean or terrestrial ecology, as these are being addressed in separate EMM studies and reporting. Further, aquatic sites surveyed in the field were concentrated within the study area, as defined as the BMA Northern Extension area (SA7 and SA10).

This aquatic ecology baseline assessment will be used to inform a subsequent impact assessment.



Source: EMM (2023); ABS (2021); DES (2022); DNRME (2023); ESRI (2023); GA (2011)



**KEY**

- Study area
- Mining lease surface area
- Aquatic sites surveyed
- Riverine drainage system
- Riverine wetland/waterbody
- Lacustrine waterbody
- Existing environment
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- National park/nature reserve
- State forest

Study area

BMA - Blackwater Mine  
 Aquatic Ecology Baseline Assessment  
 Figure 1.1



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## 2 Legislative context

A summary of the key legislation that has informed the design and implementation of the aquatic ecological assessment is provided in the following sections.

### 2.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation that provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as Matters of National Environmental Significance (MNES).

If a proposed development or other action ('proposed action') is likely to have a significant impact upon a protected matter, then it must be referred for assessment under the EPBC Act. Protected matters under EPBC Act are:

- World Heritage Properties;
- National Heritage Places;
- wetlands of international importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- the environment, where nuclear actions are involved; and
- a water resource, in relation to coal seam gas and large coal mining developments.

The aquatic ecology surveys include assessing the presence, or likely presence, of listed aquatic flora and fauna species under the EPBC Act. The aquatic surveys were designed and implemented with consideration of the Commonwealth survey guidelines for Australia's threatened fish (DSEWPC 2011a) and reptiles (DSEWPC 2011b).

Of the nine MNES that are regulated by the EPBC Act, the following may be applicable to aquatic ecology:

- listed threatened aquatic species and communities;
- Ramsar wetlands of international importance ('Ramsar wetlands'); and/or
- a water resource (which includes GDEs).

#### 2.1.1 Matters of National Environmental Significance - Significant Impact Guidelines 1.1

Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a MNES. The *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE 2013) outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether or not referral may be required and if the proposed action may have a 'significant' impact on MNES.

The EPBC Act includes a requirement that where a significant impact to a MNES is assessed as likely to occur, an environmental offset is required to compensate for that impact.

## 2.2 Queensland Environmental Protection Act 1994 (EP Act)

The Queensland *Environmental Protection Act 1994* aims to promote ecologically sustainable development for the protection of Queensland's natural environment. The EP Act provides a wide range of tools, including Environmental Protection Policies (EPPs), environmental impact assessment process, the establishment of a general environmental duty and, a duty to notify of environmental harm. The EP Act also governs the environmental regulation of mining activities which are authorised and managed through the provision of an EA.

An EA amendment under the Qld EP Act will be required to authorise future mining within SA10 and SA7. Prior to the granting of an EA amendment, an environmental impact assessment is required to be undertaken to assess the potential for environmental impacts, and identify how those impacts will be avoided, reduced and mitigated.

The EA also authorises those Environmentally Relevant Activities (ERAs) that are to be carried out on the mining lease. Schedule 2 of the *Environmental Protection Regulation 2019* (EP Regulation) outlines activities that are ERAs. Another function performed by the EP Regulation allows for the identification of Environmentally Sensitive Areas (ESAs) through the codes of compliance, tenures relating to mining and activities. ESAs are divided into Categories A, B and C. Category A and B ESAs are defined by the EP Regulation, and Category C ESAs are defined in a relevant model conditions document or ERA standard. Category A and B ESAs include:

### Category A:

- national park
- conservation park
- special wildlife reserve
- forest reserve
- wet tropics area
- Great Barrier Reef Marine Park
- part of a marine park that is not a general use zone.

### Category B:

- coordinated conservation area
- international agreement area (e.g., Bonn, Ramsar)
- critical habitat or major interest area under a conservation plan
- an area subject to an interim conservation order
- the coastal zone (i.e., seaward of the highest astronomical tide)
- a cultural heritage place or a registered place of heritage
- state forest or scientific reserve
- declared fish habitat or a place where a marine plant is situated

- endangered regional ecosystem.

No ESAs relevant to aquatic ecology are identified within the study area. A separate terrestrial ecology report assesses ESAs relevant to terrestrial ecology.

Environmental Protection Policy (EPP) applicable to aquatic ecology is the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water and Wetland Biodiversity)). The EPP (Water and Wetland Biodiversity) achieves the object of the EP Act to protect Queensland's waters while supporting ecologically sustainable development. Queensland waters include water in rivers, streams, wetlands, lakes, groundwater aquifers, estuaries and coastal areas. Environmental values (EVs) and water quality objectives (WQOs) are being progressively determined for areas of Queensland. In high ecological value (HEV) areas, WQOs are to be maintained. In slightly disturbed (SD) areas, water quality is to be improved where needed, to achieve WQOs.

### 2.3 Nature Conservation Act 1992 (NC Act)

The NC Act deals with the legal status and management of native flora and fauna species listed under the *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation) and the *Nature Conservation (Wildlife Management) Regulation 2006*. It prohibits the destruction or removal, unless authorised, of native flora and fauna species in the wild. The NC Act also provides an integrated and comprehensive strategy for conserving nature. Under the NC Act (and the subordinate NC Regulation), protected species are assigned a conservation status of either Extinct in the Wild, Endangered, Vulnerable, Near Threatened (EVNT), Special Least Concern (SLC) or Least Concern (LC).

Aquatic fauna species protected under the NC Act include SLC and LC mammals, EVNT and LC reptiles, and EVNT fishes. LC fishes are protected under the *Fisheries Act 1994*.

A number of LC aquatic flora (Section 5.4) and fauna (Section 5.5) species were recorded from the study area during the aquatic surveys undertaken in December 2019 and May 2020.

### 2.4 Water Act 2000

The *Water Act 2000* (Water Act) provides a framework for the planning and regulation of use and control of water. Statutory water plans are prepared under the Water Act to advance the responsible and productive management of water. The water planning process addresses general ecological outcomes relating to wetlands. The Water Act also addresses requirements associated with watercourse diversions. No watercourse diversions are proposed.

### 2.5 Fisheries Act 1994 (Fisheries Act)

The *Fisheries Act 1994* (Fisheries Act) regulates fishing, development in fisheries habitat areas, and damage to marine plants. The Fisheries Act incorporates fish passage and provides legislation to manage developments that may impact on fish passage through activities such as construction of a waterway barrier. The Fisheries Act defines waterway barrier works as a dam, weir, or other barrier across a waterway, if the barrier limits fish stock access and movement along a waterway.

Mining activities authorised under the *Mineral Resources Act 1989* are exempt from requirements under the *Planning Act 2016*, including the requirements for obtaining waterway barrier works development approvals. However, impacts of exempt waterway barrier works associated with mining activities on fish movement are managed through conditions imposed in an EA.

The Queensland Waterways and Waterway Barrier Works mapping (DAF 2016) assists in the determination of whether a site of proposed waterway barrier works requires assessment and approval under the Fisheries Act. It maps waterways from a low to major risk of impact on fish movement. Major risk is generally associated with larger waterways, higher quality habitat and bigger populations of fish (DAF 2013). Any impacts to watercourses

and fish passage will be assessed and approved through the EA and associated environmental impact assessment process.

## 2.6 Biosecurity Act 2014

The Queensland *Biosecurity Act 2014* (Biosecurity Act) provides biosecurity measures to safeguard Queensland's economy, agricultural and tourism industries, environment, and way of life, from pests, disease, and contaminants.

All persons have a 'general biosecurity obligation' under the Biosecurity Act. This means that everyone is responsible for managing biosecurity risks that are under their control and that they know about or should reasonably be expected to know about. Under the 'general biosecurity obligation', individuals and organisations whose activities pose a biosecurity risk must:

- take all reasonable and practical steps to prevent or minimise each biosecurity risk
- minimise the likelihood of causing a biosecurity event, and limit the consequences if such an event is caused
- prevent or minimise the harmful effects a risk could have, and not do anything that might make any harmful effects worse.

### 2.6.1 Prohibited matter

Prohibited matter is listed in Schedule 1 of the Biosecurity Act and refers to biosecurity matter that is not currently found in Queensland but would have a significant adverse impact on our health, way of life, the economy, and the environment if it entered the state.

### 2.6.2 Restricted matter

Restricted matter is listed in Schedule 2 of the Biosecurity Act and refers to biosecurity matter (including invasive plants) that are currently found in Queensland and that are known to have a significant impact on human health, social amenity, the economy, or the environment. Specific actions are required to limit the spread and impact of this matter by reducing, controlling, or containing it.

Restricted aquatic matter in the study area includes the pest fish species mosquitofish (*Gambusia holbrooki*) (Section 5.5.1).

## 2.7 Environmental Offsets Act 2014 (EO Act)

The environmental offsets framework in Queensland includes the *Environmental Offsets Act 2014*, the *Environmental Offsets Regulation 2014* (EO Regulation) and the Queensland Environmental Offsets Policy (QEOP). The EO Act coordinates the delivery of environmental offsets across jurisdictions and provides a single, coordinated approach to offsets in Queensland. The EO Regulation provides details of the prescribed activities regulated under existing legislation and prescribed environmental matters to which the Act applies. The QEOP provides a consistent, whole-of-government policy for the assessment of offset proposals to satisfy offset conditions.

Matters of State Environmental Significance (MSES) are defined in the EO Regulation and are a component of the biodiversity state interest identified in the Queensland State Planning Policy. Significant, residual impacts to MSES will require provision of environmental offsets.

MSES relevant to aquatic ecology include:

- Wetlands and watercourses, including:

- a High Ecological Significance (HES) wetland in a Wetland Protection Area (WPA) shown on the Map of Great Barrier Reef Wetland Protection Areas
- a wetland or watercourse in High Ecological Value Waters
- Highly protected zones of State marine parks
- Fish Habitat Areas
- A waterway providing for fish passage, if the construction, installation, or modification of waterway barrier works would limit the passage of fish along the waterway
- Marine plants, if outside of an urban area.

Other MSES which may have an association with aquatic values include:

- Regulated Vegetation, including:
  - Endangered and Of Concern REs
  - a RE that intersects with an area shown as a wetland on the Vegetation Management Wetlands Map
  - an area of essential habitat on the Essential Habitat Map for Endangered or Vulnerable flora or fauna
  - an area located within a defined distance (identified in the QEOP) from the defining banks of a relevant watercourse.
- Protected wildlife habitat, including:
  - High Risk Areas (HRAs) identified on the flora survey trigger map and that contain Endangered or Vulnerable flora
  - areas not shown as a HRA on the flora survey trigger map, to the extent the area contains Endangered or Vulnerable flora
  - habitat for Endangered, Vulnerable or SLC fauna
- Protected areas
- Legally secured offset areas.

An environmental offset may be required as a condition of approval where – following consideration of avoidance and mitigation measures – the activity is likely to result in a significant residual impact on a MSES. To determine if a residual impact from a prescribed activity is significant, the Significant Residual Impact Guideline (DSDIP 2014) is used for consideration of applications made under the EP Act, NC Act and *Marine Parks Act 2004*.

Where required, the QEOP allows for environmental offsets to be delivered as:

- financial settlement offsets
- proponent-driven offsets – including land-based offsets and / or delivery of actions in Direct Benefit Management Plans
- a combination of both.

This baseline aquatic ecology survey report identifies those aquatic related MSES within the study area.

## 3 Existing environment

### 3.1 Climate and weather

Blackwater is located in the Central Highlands Region of Queensland. The region's climate is sub-tropical, sub-humid with nearly half its annual rainfall occurring in summer. In the three months preceding the December 2019 surveys, Blackwater Airport weather station (station 035134) recorded 0.0 millimetres (mm) of rainfall in September, 8.2 mm in October and 1.4 mm in November (BOM 2020). Substantial rainfall (270.2 mm) was recorded in January to February 2020 (BOM 2020). This included intense rainfall, runoff, and consequent flooding at each riverine site, as evidenced by flood debris (Appendix C). Only 0.4 mm was recorded at Blackwater Airport in the three months preceding the May 2020 surveys (BOM 2020), leading to dry conditions at most riverine sites at the time of assessment in May 2020 (Appendix C).

Mean minimum and maximum temperatures for December 2019 at Blackwater Airport were 21.9°C and 38.2°C, respectively (BOM 2020). Mean minimum and maximum temperatures for May 2020 at Blackwater Airport were 12.3°C and 25.0°C, respectively (BOM 2020).

### 3.2 Topography

The topography of the study area is gently undulating and low-lying (less than 300 m Australian Height Datum [mAHD]). Elevation ranges from about 235 mAHD near tributaries of Two Mile Gully to about 170 mAHD in the downstream-most reach of Sagittarius Creek.

### 3.3 Catchments

The study area lies within the Fitzroy Basin and within the Mackenzie River sub-basin. Within the study area, Two Mile Gully and Deep Creek flow into Taurus Creek, which flows into Blackwater Creek, flowing north and passing to the east of Blackwater (Figure 1.1). Sagittarius Creek flows north and passes to the west of Blackwater, meeting Blackwater Creek to the north of Blackwater, then into the Mackenzie River.

At a regional scale, the Mackenzie River sub-basin is approximately 12,985 square kilometres (km<sup>2</sup>) and the broader Fitzroy River basin is approximately 142,545 km<sup>2</sup> (DES 2020a).

The document titled *Environmental Protection (Water) Policy 2009: Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (DEHP 2011a) and accompanying maps have been considered as they identify environmental values (EVs) for the study area. The relevant EVs, being for the Mackenzie southern tributaries, are:

- aquatic ecosystems
- farm supply/use
- stock water
- human consumption
- primary, secondary and visual recreation
- drinking water
- industrial use
- cultural and spiritual values.

### 3.4 Land zones and soils

The following land zones occur within the study area.

- Land zone 3 - Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence, inland lakes and associated wave-built lunettes. Excludes colluvial deposits such as talus slopes and pediments. Includes a diverse range of soils, predominantly Vertosols and Sodosols; also, with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols; and Organosols in high rainfall areas.
- Land zone 4 - Tertiary-early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems. Excludes clay plains formed in-situ on bedrock. Mainly Vertosols with gilgai microrelief, but includes thin sandy or loamy surfaced Sodosols and Chromosols with the same paleo-clay subsoil deposits.

### 3.5 Land use

The study area is located in the Bowen Basin, where coal mining is a primary land use. Coal and coal seam gas mining and exploration have been conducted around the study area for decades. Land within the study area is predominantly used for grazing with large areas that have been cleared of native vegetation. Land in the study area is owned by both private landholders and BMA. A number of farm dams (lacustrine waterbody) occur within the study area as shown on Figure 4.1.

## 4 Methods

### 4.1 Determination of significance level

CEEVNT species are defined as those taxa listed in the EPBC Act or NC Act as Critically Endangered (CE), Endangered (E), Vulnerable (V) or Near Threatened (NT). Priority species are those listed as such in the Back on Track Actions for Biodiversity for the Fitzroy NRM Region (DERM 2010) or in the Expert Panel Reports of the Aquatic Conservation Assessments (ACA) for riverine and non-riverine wetlands of the Fitzroy section of the Great Barrier Reef (GBR) catchment (Inglis and Howell 2009; Rollason and Howell 2012). All other native fauna species are either Special Least Concern (SLC) or Least Concern (LC) under the NC Act.

### 4.2 Desktop assessment

Database searches were undertaken prior to field surveys in December 2019 (and revised in 2020 where relevant). This included:

- Department Agriculture, Water and the Environment (DAWE) EPBC Act Protected Matters Search Tool (PMST), to identify aquatic MNES within approximately 20 km of the study area (Appendix A) (DAWE 2020a; Appendix A)
- Department of Environment and Science (DES) (2020a) Wetland *Info* Wetland Summary Information (including species listings) for the Mackenzie River drainage sub-basin and the broader Fitzroy Basin, incorporating data from the DES Wildlife Online database, Queensland Museum and Queensland Herbarium
- DES Queensland Wetland Data Series Version 5 – Queensland Wetlands Map (DES 2020b), to determine the classification, extent, and significance of lacustrine, palustrine, and riverine systems within the study area and surrounds
- DES (2020c) mapping of Matters of State Environmental Significance, to identify aquatic matters of state interest under the State Planning Policy 2017 (SPP)
- Atlas of Living Australia (ALA) (2020), to interrogate existing species records
- Queensland Waterways for Waterway Barrier Works mapping (Queensland Department of Agriculture and Fisheries [DAF] 2016)
- Queensland Groundwater Dependent Ecosystems and Potential Aquifer Mapping 2018 (DES 2020d)
- The Fitzroy Natural Resource Management Region Back-on-Track Actions for Biodiversity (the former Queensland Department of Environment and Mines [DERM] 2010)
- Aquatic Conservation Assessments (ACAs) for the riverine (Inglis and Howell 2009) and non-riverine (Rollason and Howell 2012) wetlands of the Great Barrier Reef catchment
- Published ecological information on EVNT and SLC aquatic flora and fauna species
- Relevant survey guidelines, including the Australian River Assessment System (AusRivAS) protocols for Queensland streams (the former Queensland Department of Natural Resources and Mines [DNRM] 2001).

## 4.3 Desktop assessment of aquatic groundwater dependent ecosystems

A desktop assessment was completed to identify aquatic ecosystems which potentially utilise and/or are reliant on groundwater in the study area, referred to as groundwater dependent ecosystems (GDEs). This included reviewing:

- the Queensland Groundwater Dependent Ecosystems and Potential Aquifer Mapping 2018 (DES 2020d);
- groundwater monitoring data from BMA bore sites; and
- ground-truthed regional ecosystem mapping.

In Queensland, GDEs are defined as ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (DEHP 2016).

There are three types of GDE classified by Richardson et al. (2011a) being:

1. Type 1 GDE: Aquifer and cave ecosystems (including stygofauna ecosystems) that occur underground. These ecosystems typically include karst aquifer systems, fractured rock and hyporheic zones of rivers, floodplains and coastal environments.
2. Type 2 GDE: Ecosystems dependent on surface expression of groundwater such as wetlands, lakes, springs and river baseflow. In these cases, groundwater extends above earth surface, as a visible expression. These can be obligate or facultative GDEs.
3. Type 3 GDE: Ecosystems dependent on sub-surface presence of groundwater which are terrestrial vegetation using the water table below the natural surface. These communities can fully depend on groundwater or use it on a seasonal or episodic basis to prevent water stress and avoid adverse conditions. These types can exist wherever the water table is within the root zone of the plants either permanently or episodically.

This report assesses only Type 2 (aquatic GDEs). Type 1 and 3 GDEs are assessed in separate reports.

## 4.4 Field survey

### 4.4.1 Survey timing, site selection and effort

Aquatic surveys were initially undertaken across the study area between 10 December 2019 to 12 December 2019, aligning with the AusRivAS 'early wet' sampling season (October to December), although conditions were representative of dry season/drought conditions. Follow-up 'late wet' season surveys were undertaken across the study area between 19 May 2020 to 21 May 2020, aligning with the AusRivAS 'late wet' sampling season (May to July).

Desktop investigations, including review of available aerial imagery and review of the Queensland Wetlands Map (DES 2020b), were used to identify representative stream reaches and wetland waterbodies for field assessment. Detailed aquatic survey was attempted at 10 locations, comprising of (Figure 1.1 and Figure 5.5):

- seven riverine system drainage lines based on the Strahler stream order (SO) system (joining of streams of the same order):
  - **Site R3:** one SO 1 site on an un-named tributary
  - **Site R2:** one SO 2 site on Sagittarius Creek

- **Site R1 and Site R5:** two SO 3 sites, including one on Sagittarius Creek (site R1) and one on Taurus Creek (site R5)
- **Sites R6, R4 and R7:** three SO 4 sites, including one on Two Mile Gully (site R6) and two on Taurus Creek (sites R4 and R7).
- three lacustrine wetland waterbodies:
  - **Sites L1 and L2:** two farm dams
  - **Site RW1:** one flood channel wetland (RE 11.3.27b), in May 2020.

A total of 9.4 mm of rainfall was recorded in the three months preceding the December 2019 ‘early wet’ surveys (Section 3.1), with most waterways being dry at the time of assessment. Consequently, habitat assessments were undertaken in place of detailed aquatic surveys at most riverine sites (Table 4.1). Isolated pools were detected and sampled on Taurus Creek (site R4). Two representative lacustrine wetland waterbodies (farm dams) (sites L1 and L2) were also sampled.

Combined rainfall of 270.2 mm was recorded in January and February 2020, with periods of intense rainfall resulting in flooding at each riverine site (Section 3.1, Appendix C). Only 0.4 mm was recorded in the three months preceding the May 2020 ‘late wet’ surveys (Section 3.1), leading to dry conditions at most riverine sites at the time of assessment (Appendix C). Most sites had returned to dry conditions at the time of assessment in May 2020, with isolated pools remaining at site R4 on Taurus Creek.

Lacustrine wetland waterbody sites L1 and L2 were sampled in May 2020, as was the new site RW1 – being a riverine wetland waterbody on a flood channel of Taurus Creek (which was dry at the time of the site visit in December 2019).

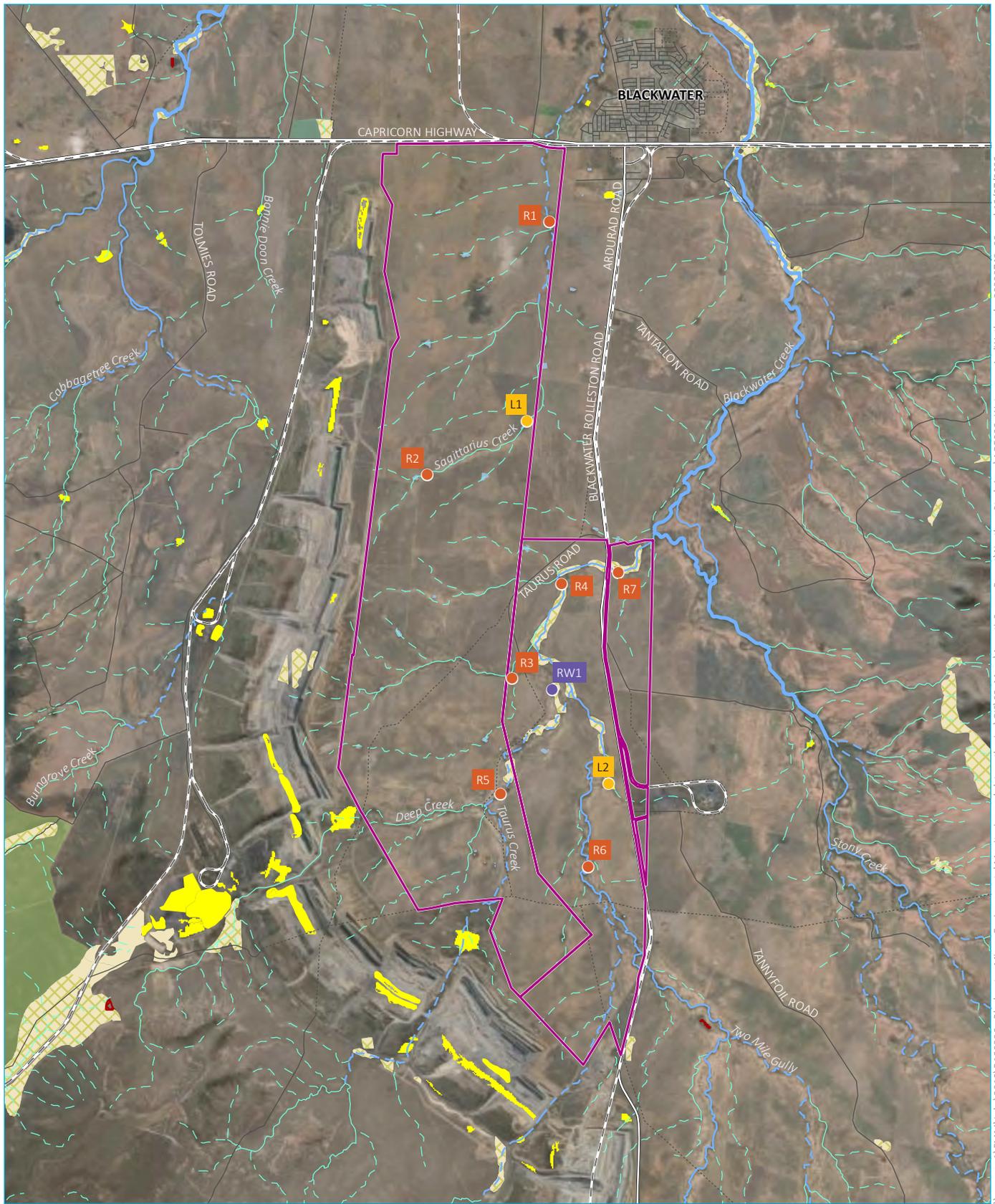
The sampling sites and survey effort conducted in December 2019 are summarised in Table 4.1 and sampling sites and survey effort conducted in May 2020 are summarised in Table 4.2. Survey sites, palustrine waterbodies and lacustrine waterbodies within the study area and surrounds are illustrated in Figure 4.1. It should be noted that several mapped waterbodies shown on Figure 4.1 are artificially created mine waterbodies (e.g., pit lakes or mine dams) to the west of the study area.

**Table 4.1** Dry season aquatic survey effort across the study area, December 2019

Site	Site ID	Date / Season	Stream order	Latitude (GDA94)	Longitude (GDA94)	Fish survey effort			Turtle survey effort		Macroinvert. sampling		Physico-chem. water quality	Water sample retained for ion analysis	Habitat assessment/aquatic plant survey/ photos
						Electro-fishing	Fyke nets	Box traps	Fyke nets	Cathedral traps	Bed habitat	Edge habitat			
<b>Riverine drainage system sites</b>															
Sagittarius Creek	R1	10/12/19	3	-23.6017	148.8635							Dry			✓
Sagittarius Creek	R2	10/12/19	2	-23.6527	148.8377							Dry			✓
Unnamed tributary	R3	11/12/19	1	-23.6933	148.8567							Dry			✓
Taurus Creek	R4	11/12/19	4	-23.6743	148.8671	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
Taurus Creek	R5	12/12/19	3	-23.7165	148.8544							Dry			✓
Two Mile Gully	R6	12/12/19	4	-23.7309	148.8737							Dry			✓
Taurus Creek	R7	12/12/19	4	-23.6717	148.8793							Dry			✓
<b>Lacustrine waterbody sites</b>															
Farm dam	L1	10/12/19	2	-23.6417	148.8591	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
Farm dam	L2	12/12/19	1	-23.7142	148.8777	-	-	-	-	-	-	✓	✓		✓

**Table 4.2 Post wet season aquatic survey effort across the study area, May 2020**

Site	Site ID	Date / Season	Stream order	Latitude (GDA94)	Longitude (GDA94)	Fish survey effort			Turtle survey effort		Macroinvert. sampling		Physico-chem. water quality	Water sample retained for ion analysis	Habitat assessment/aquatic plant survey/photos
						Electro-fishing	Fyke nets	Box traps	Fyke nets	Cathedral traps	Bed habitat	Edge habitat			
<b>Riverine drainage system sites</b>															
Sagittarius Creek	R1	19/05/20	3	-23.6017	148.8635							Dry			✓
Sagittarius Creek	R2	19/05/20	2	-23.6527	148.8377							Dry			✓
Unnamed tributary	R3	21/05/20	1	-23.6933	148.8567							Dry			✓
Taurus Creek	R4	20/05/20	4	-23.6743	148.8671	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
Taurus Creek	R5	21/05/20	3	-23.7165	148.8544							Dry			✓
Two Mile Gully	R6	21/05/20	4	-23.7309	148.8737							Dry			✓
Taurus Creek	R7	20/05/20	4	-23.6717	148.8793							Dry			✓
<b>Riverine wetland waterbody sites</b>															
Taurus Creek flood channel	RW1	21/05/20	3	-23.6954	148.8653	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
<b>Lacustrine wetland waterbody sites</b>															
Farm dam	L1	10/12/19	2	-23.6417	148.8591	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
Farm dam	L2	12/12/19	1	-23.7142	148.8777	-	-	-	-	-	-	✓	✓	✓	✓



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)



**KEY**

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li><span style="border: 2px solid purple; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Study area</li> <li>Queensland wetland mapping (v4)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; margin-right: 5px;"></span> Lacustrine Waterbodies</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red; margin-right: 5px;"></span> Palustrine Waterbodies</li> <li><span style="display: inline-block; width: 15px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px); border: 1px solid red; margin-right: 5px;"></span> Palustrine RE</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #f0e68c; border: 1px solid black; margin-right: 5px;"></span> RE 51-80% wetland (mosaic units)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #f0e68c; border: 1px dashed black; margin-right: 5px;"></span> RE 1-50% wetland (mosaic units)</li> </ul> | <ul style="list-style-type: none"> <li><b>Aquatic sites surveyed</b></li> <li><span style="color: orange;">●</span> Riverine drainage system</li> <li><span style="color: blue;">●</span> Riverine wetland/waterbody</li> <li><span style="color: yellow;">●</span> Lacustrine waterbody</li> <li><b>Stream order</b></li> <li><span style="color: lightgreen;">—</span> 1st</li> <li><span style="color: teal;">—</span> 2nd</li> <li><span style="color: blue;">—</span> 3rd</li> <li><span style="color: darkblue;">—</span> 4th</li> <li><span style="color: blue;">—</span> 5th</li> </ul> | <ul style="list-style-type: none"> <li><b>Existing environment</b></li> <li><span style="border-bottom: 1px dashed grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Rail line</li> <li><span style="border-bottom: 2px solid grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Major road</li> <li><span style="border-bottom: 1px solid grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Minor road</li> <li><span style="border-bottom: 1px dotted grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Vehicular track</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #add8e6; border: 1px solid black; margin-right: 5px;"></span> Dam/waterbody</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #90ee90; border: 1px solid black; margin-right: 5px;"></span> National park/nature reserve</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #808000; border: 1px solid black; margin-right: 5px;"></span> State forest</li> </ul> |
|--|---|---|

Waterways, wetlands and survey locations

BMA - Blackwater Mine  
Aquatic Ecology Baseline Assessment  
Figure 4.1



\\emmsvr1\EMM\Jobs\2018\180329 - Blackwater Mine - Environmental Monitoring and data gathering\GIS02\_Maps\AquaticSurvey\Report\NorthernStudyArea\AQE002 - WaterwaysAndWetlands\_20230713\_08.mxd 13/07/2023

#### 4.4.2 Aquatic habitats

Aquatic habitats were described in accordance with AusRivAS protocols for Queensland streams (DNRM 2001). This established a general description of the environment of each site and its immediate surrounds. The classifications are based on flow level, depth, velocity, width, canopy cover, substrate types, habitat attributes, local catchment erosion, sediment deposits, water colour, algae, water odour, substrate odour, presence of large woody debris, riparian zone width and cover, and general signs of disturbance.

Variable flow, caused by natural events such as rainfall, runoff and drought / flood cycles can influence the aquatic ecosystems of an area. This should be taken into consideration for future studies which may utilise results contained in this report.

Habitat assessment scores (out of 135) were made for each site based on the nine AusRivAS categories (DNRM 2001). Aquatic habitat at each site was classified as Poor, Fair, Good or Excellent based on the overall scores.

A detailed description of the aquatic habitat encountered at each site is included in the site profiles in Appendix C.

#### 4.4.3 Surface water quality

In-situ physico-chemical water quality was assessed as a component of the AusRivAS aquatic habitat assessments, to inform initial equipment settings for backpack electrofishing, and to assist in the interpretation of collected macroinvertebrate data. The ionic composition of surface water was sampled and assessed to assist in characterising surface waters of the study site, including their likely interaction with groundwater.

##### **In-situ measurements**

In-situ physico-chemical water quality parameters were measured at each wetted survey site using a YSI Professional Plus multi-parameter water quality meter and Hach Turbidimeter 2100Q, each calibrated both prior to and following sampling. Water quality parameters measured included:

- temperature (°C)
- pH
- electrical conductivity (EC;  $\mu\text{S}/\text{cm}$ )
- turbidity (NTU)
- dissolved oxygen (mg/L and % saturation).

##### **Ions**

Water samples were obtained from each wetted site in accordance with the Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES 2018). Samples were chilled and delivered to ALS Environmental (a NATA accredited laboratory) and were analysed for the following major ions to assist in characterising surface waters of the study site:

- major anions (Cl,  $\text{SO}_4$ , F and Alkalinity)
- major cations (Ca, Mg, Na and K) and hardness.

## Data analysis

Physico-chemical water quality measurements were compared against Water Quality Objectives (WQOs) nominated in Environmental Protection (Water) Policy 2009: Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin (DEHP 2011a). This document includes WQOs for moderately disturbed aquatic ecosystems (applied to riverine sites) and WQOs for lakes/reservoirs (applied to wetland waterbody sites).

### 4.4.4 Fish

Fish were surveyed at sites R4, RW1 and L1 using a combination of backpack electrofishing, dip-netting, and overnight deployment of baited box traps and fyke nets, dependent on conditions encountered at each site.

Fish survey methods included:

- backpack electrofishing using a Smith-Root LR-24 electrofisher for up to 1,200 seconds power-on time (100 Hz frequency; 20% duty cycle; 150–500 v, to suit conductivity)
- dip-netting in combination with backpack electrofishing, using an Environet® manoeuvred through the water column
- fyke netting – with 2 x fyke nets, dual wing, 4-m wing lengths, 0.6-m drop, 3-mm mesh, baited with beef heart, banana, apple, spinach and rinsed sardines – deployed overnight to capture active fish (and turtles)
- box traps – with 5 x traps, 22 cm x 22 cm x 40 cm, 2-mm mesh, 50-mm opening, baited with dry cat food.

Captured fish were identified, with native species released at the point of capture. Pest fish were euthanised as per DPM Envirosciences' General Fisheries Permit and Animal Ethics Committee Approval. DPM Enviroscience were subcontracted with EMM to complete aquatic surveys.

### 4.4.5 Turtles

The Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011b) suggest that the Fitzroy River turtle (*Rheodytes leukops*) can be readily observed in riffle zones by diving with a face mask and snorkel, or collected by seine netting, and that the partly carnivorous diet of this species indicates it might be attracted to meat baits in traps. Survey guidelines for the southern snapping turtle (*Elseya albagula*) are not identified by DSEWPC (2011b), due to the subsequent listing of this species as Critically Endangered (from common / Least Concern) in November 2014. However, DPM Enviroscience has successfully captured this species using baited cathedral traps on other projects in the Fitzroy River Basin.

The Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DSITIA 2014) suggest that freshwater turtle surveys should employ one or more of the following capture techniques:

- visual survey
- snorkelling
- spotlighting
- trapping
- seine netting.

Freshwater turtles were surveyed at sites R4, RW1 and L1 by overnight deployment of baited fyke nets (i.e., trapping), as well as observations of the bank and water surface for sunning and breaching turtles. Suitable habitat for the deployment of cathedral traps (i.e., trees or snags overhanging deep pools) was not encountered.

Snorkelling surveys were noted permitted by BMA safety policy.

#### 4.4.6 Platypus

Habitat suitability for platypus (*Ornithorhynchus anatinus*) was assessed at each site. This included targeted searches for burrows along banks.

#### 4.4.7 Freshwater macroinvertebrates

Freshwater macroinvertebrate samples were collected from suitable habitats in December 2019 (sites R4 and L1) and May 2020 (sites R4, RW1 and L1) to gain an improved understanding of the health, trophic interactions and ecological values of representative aquatic sites. Samples were collected by an AusRivAS accredited ecologist following AusRivAS protocols for Queensland streams (DNRM 2001). AusRivAS protocols specify a standardised, qualitative, rapid bioassessment method that aims to consistently sample a wide diversity of macroinvertebrates within a defined timeframe. The bed and edge habitats were sampled separately at riverine sites R4 and RW1 in accordance with AusRivAS protocols. At farm dam site L1, a composite sample was collected incorporating all macro habitat conditions available (i.e., woody debris, macrophytes, bed and edge habitats).

A standard sized dip net with 250 µm mesh was used to sample macroinvertebrates. Following collection, the samples were transferred to plastic sorting trays, where the contents were sorted and live picked for 30 minutes. Picked specimens were placed into specimen jars with 70% ethanol.

Samples were identified by AusRivAS accredited taxonomists to AusRivAS taxonomic level in the laboratory under stereomicroscope. AusRivAS taxonomic identification is primarily to Family level, with the exception of lower Phyla such as *Porifera*, *Nematoda* and *Nemertea*, *Oligochaetes* (freshwater worms), *Acarina* (mites), and microcrustacea such as *Ostracoda*, *Copepoda* and *Cladocera*. *Chironomids* (midges) are identified to sub-family taxonomic level.

#### Data analysis

The macroinvertebrate data was used to calculate a number of community descriptors as described in the following sections.

##### *Taxonomic richness*

Taxonomic richness was calculated from the number of taxa present in each sample, providing an indication of community diversity at the site, with richness typically increasing with ecological condition.

##### *PET*

The Plecoptera, Ephemeroptera and Trichoptera (PET) richness was calculated from the number of taxa belonging to the three PET orders. These three orders are widely accepted as being most sensitive to environmental change, such as habitat degradation and pollution (DEHP 2009). A low PET richness score suggests that a site may be impacted by degradation or pollution, due to the absence of these pollution-sensitive taxa. Conversely, a high PET richness suggests a system free from degradation or pollution.

##### *Pollution-tolerant taxa*

The percentage of pollution-tolerant taxa was calculated based on the SIGNAL2 indices. Tolerant taxa are classified as those with a SIGNAL2 score of 3 or less (Marshall et al. 2001). Macroinvertebrate families in this group are expected to be able to tolerate changes to their environment, including habitat degradation and some pollution. An absence of more sensitive taxa suggests environmental conditions may be too harsh for sensitive taxa (those with SIGNAL2 scores above 3) to tolerate.

## *SIGNAL2*

SIGNAL2 (Stream Invertebrate Grade Number – Average Level Version 2) indices were calculated, with each taxon allocated a score from 1 to 10 based on Chessman (2003). Taxa with a low score are most tolerant of a range of environmental conditions, and those with a high score are more sensitive to pollution. The presence / absence data of each taxon were used to calculate the SIGNAL2 average for the site, in accordance with the protocols described by Chessman (2003).

## *AusRivAS OE50*

For riverine sites R4 and RW1, the macroinvertebrate and predictor variables (habitat) data were analysed using the AusRivAS macroinvertebrate predictive modelling program, version 3.2.0 (Ransom and Blackman 2003). The predictive models are typically based on semi-permanent to permanent reference streams. Although the models provide another useful macroinvertebrate community descriptor, the results are applied to ephemeral waterways with caution.

The AusRivAS models utilised, based on location, date and habitats sampled, were the QLD Regional Coastal bed and edge habitat models.

### 4.4.8 Aquatic flora

Aquatic plants were surveyed at each site. All aquatic plants were identified to species using available literature and taxonomic keys where needed. The abundance of each species was estimated using the AusRivAS categories: extensive (>75% cover), moderate (50–75%), some (10–50%) or little (1–10%).

### 4.4.9 Overall aquatic values

An aquatic values rating of Low, Moderate or High was assigned to each site based on the summation of all available information from the desktop and field assessments (Table 4.3). When assessing each site, the overall aquatic value criteria that fit the situation best is applied. The criteria in Table 4.3 are listed from most to least important.

**Table 4.3**      **Adopted criteria for assigning aquatic values ratings**

Aquatic Values / Sensitivity	Key aquatic values / criteria
High	<p>A site can have one or more of the following to be considered ‘high’:</p> <ul style="list-style-type: none"> <li>• semi-permanent or permanent waterbody</li> <li>• mapped as a wetland of High Ecological Significance</li> <li>• confirmed CEEVNT species habitat</li> <li>• confirmed presence of platypus breeding place</li> <li>• near natural/excellent in-stream habitat</li> <li>• excellent habitat bioassessment score (111-135).</li> </ul>
Moderate	<p>A site can have one or more of the following to be considered ‘moderate’:</p> <ul style="list-style-type: none"> <li>• ephemeral or semi-permanent waterbody</li> <li>• mapped as a wetland of General Ecological Significance</li> <li>• priority aquatic flora species cover moderate or extensive</li> <li>• platypus habitat present</li> <li>• some good quality in-stream habitat</li> <li>• mapped as Major or High risk of impact from fish barriers</li> <li>• good habitat bioassessment score (75-110)</li> <li>• dry season refuge for common (Least Concern) species.</li> </ul>
Low	<p>A site can have one or more of the following to be considered ‘low’:</p> <ul style="list-style-type: none"> <li>• ephemeral waterbody</li> <li>• no CEEVNT species or platypus habitat present</li> <li>• in-stream habitat highly modified / disturbed</li> <li>• poor to fair habitat bioassessment score (0-74).</li> </ul>

## 5 Results

### 5.1 Waterways

The Queensland Wetlands Map 2015 (DES 2020b) identifies riverine systems, watercourses, waterways, or drainage lines (here referred to collectively as waterways) for the study area.

As shown in Figure 4.1 the study area predominantly includes minor ephemeral waterways classified as SO1 and SO2. In the eastern and southern portions of the study area are sections of SO3 and SO4 associated with Taurus Creek, Sagittarius Creek and Two Mile Gully which becomes Taurus Creek. Taurus Creek then flows north into Blackwater Creek as a SO5.

The DNRME (2020) Watercourse Identification Map (Figure 5.1) identifies Taurus Creek, downstream of its confluence with Two Mile Gully, as a waterway that exhibits the characteristics of a watercourse as defined by the *Water Act 2000*. All other waterways of the study area are yet to be mapped by DNRME (2020) at the time of this assessment.

The Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM) (Clayton et al. 2006), was developed to assess conservation values of wetlands and waterways in Queensland. It is a comprehensive method that uses available data (including data resulting from expert opinion), to identify relative non-social, non-economic conservation/ecological values within a specified study area. The criteria in AquaBAMM are: naturalness (aquatic); naturalness (catchment); diversity and richness; threatened species and ecosystems; Priority species and ecosystems; special features; connectivity and representativeness. The Aquatic Conservation Assessment (ACA) for the riverine (Inglis and Howell 2009) and non-riverine (Rollason and Howell 2012) wetlands of the Great Barrier Reef catchment (produced by the former Queensland Department of Environment and Resource Management [DERM]) is a product of applying this method. The ACA identifies (Figure 5.2):

- Sagittarius Creek and its tributaries as being of medium conservation significance;
- Taurus Creek and its tributaries as being of very low conservation significance; and
- Lacustrine waterbodies (farm dams), where mapped, as being of very low conservation significance.

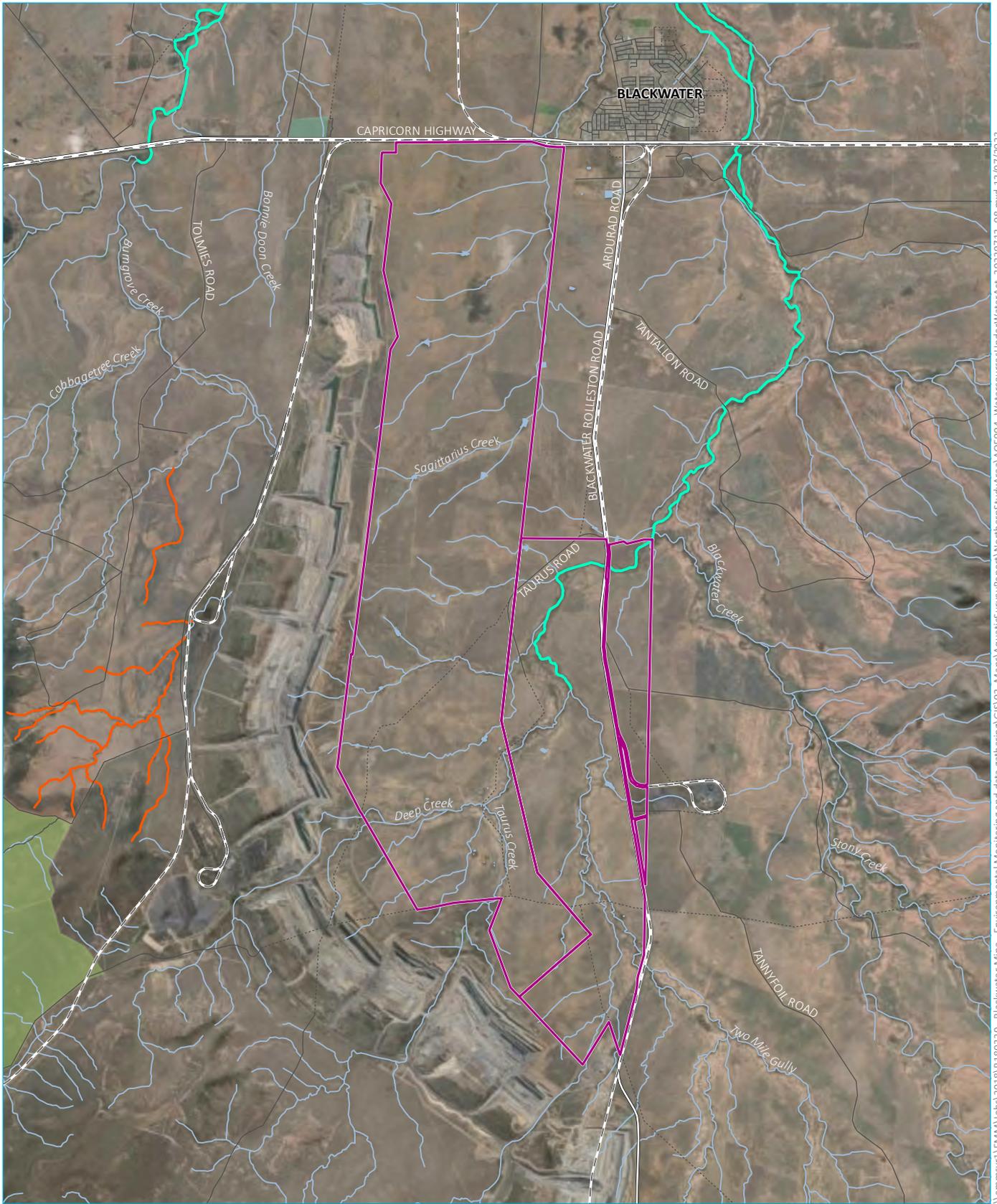
#### 5.1.1 Waterways for fish passage

Fish passage is being considered in this report as it is a MSES value. It is acknowledged having to obtain a waterway barrier works permit is not required where the works occur in a ML under an EA.

The DAF (2016) Queensland Waterways for Waterway Barrier Works 2016 mapping (Figure 5.3) indicates the level of 'risk' associated with undertaking waterway barrier works within Queensland waterways. Waterways with higher stream orders, steeper slopes, higher flow rates, greater numbers of fish present and fish with stronger swimming abilities are allocated a higher level of risk (DAFF 2013).

In consideration of these factors, Two Mile Gully and Taurus Creek are mapped as being of high and major risk of adverse impact from waterway barrier works on fish movement (DAF 2016). Sections of Sagittarius Creek are mapped as being of moderate and high risk of adverse impact, and other mapped waterways within the study area are indicated as being of low to moderate risk of adverse impact from waterway barrier works on fish movement (DAF 2020) (Figure 5.3).

In summary the waterways with potential for greater impact on fish passage are in the eastern and southern sections of the study area along the larger stream orders as shown in Figure 5.3.



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)

**KEY**

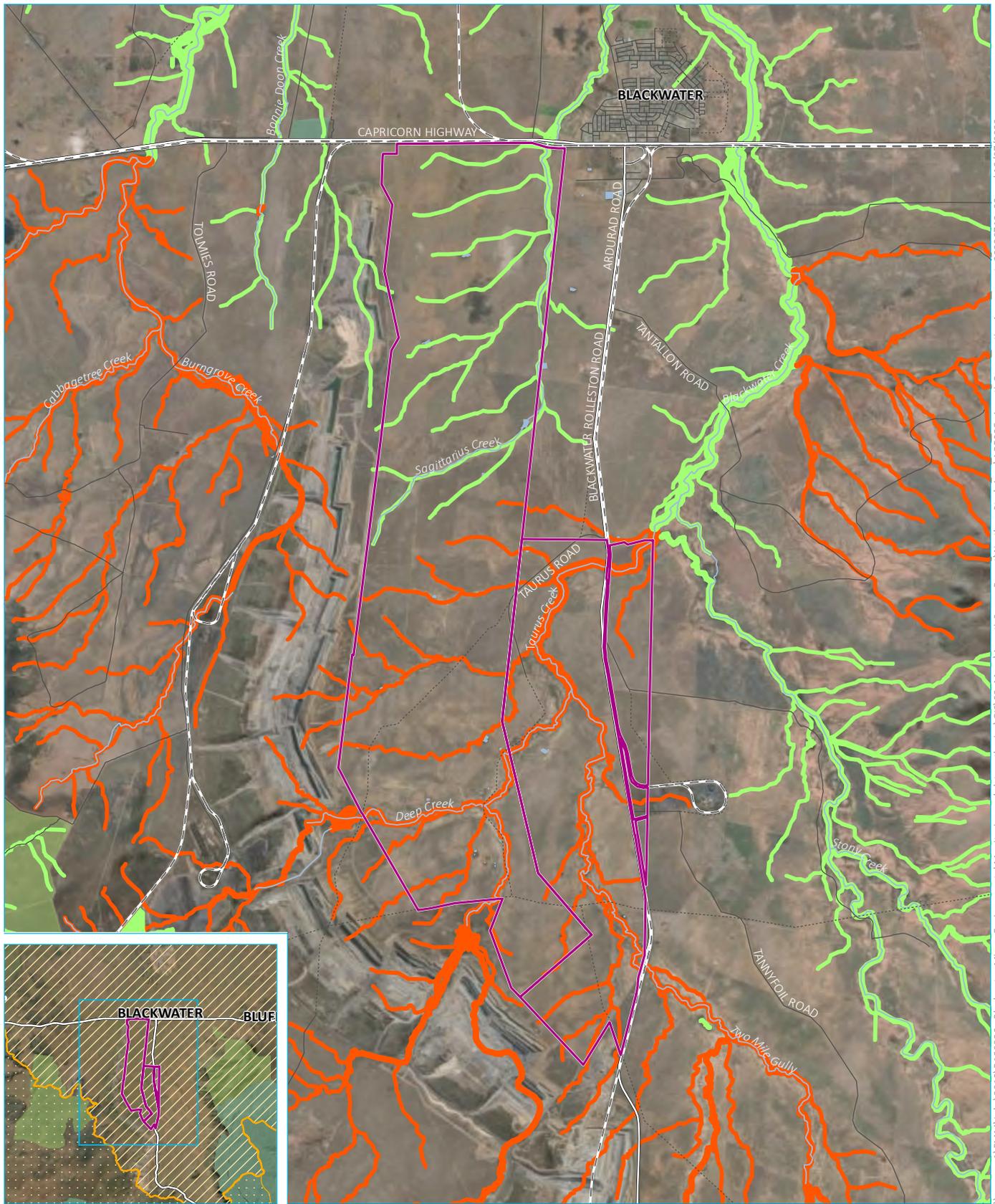
- |  |  |
|--|--|
| <span style="border: 1px solid pink; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Study area                              | Existing environment   |
| Watercourse identification map (DNRME 2019)  | --- Rail line  |
| <span style="border-bottom: 2px solid cyan; width: 20px; display: inline-block; margin-right: 5px;"></span> Watercourse (defined by Water Act 2000)        | <span style="border-bottom: 2px solid grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Major road                           |
| <span style="border-bottom: 2px solid orange; width: 20px; display: inline-block; margin-right: 5px;"></span> Drainage feature (defined by Water Act 2000) | <span style="border-bottom: 1px solid grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Minor road                           |
| <span style="border-bottom: 1px solid blue; width: 20px; display: inline-block; margin-right: 5px;"></span> Yet to be mapped                               | <span style="border-bottom: 1px dashed grey; width: 20px; display: inline-block; margin-right: 5px;"></span> Vehicular track                     |
|  | <span style="display: inline-block; width: 10px; height: 10px; background-color: blue; margin-right: 5px;"></span> Dam/waterbody                 |
|  | <span style="display: inline-block; width: 10px; height: 10px; background-color: green; margin-right: 5px;"></span> National park/nature reserve |
|  | <span style="display: inline-block; width: 10px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> State forest            |

Watercourses under the Water Act 2000

BMA - Blackwater Mine  
 Aquatic Ecology Baseline Assessment  
 Figure 5.1



\\emmsvr1\EMM\Jobs\2018\B-180329 - Blackwater Mine - Environmental Monitoring and data gathering\GIS\02\_Maps\Aquatics\survey\report\NorthernStudyArea\AQE004\_WatercoursesUnderWaterAct\_20230713\_08.mxd 13/07/2023



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)

**KEY**

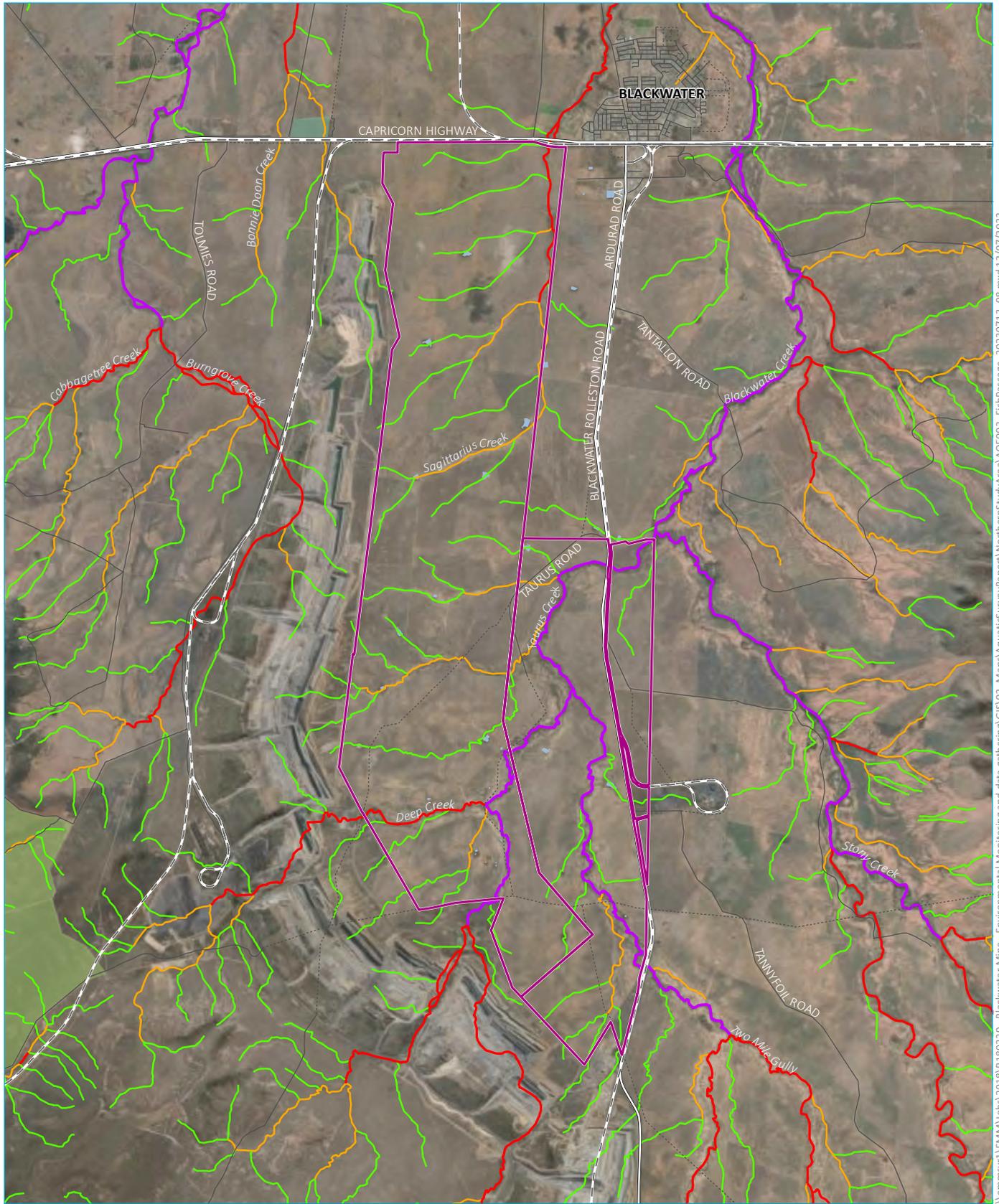
- Study area
- Aquatic conservation significance
  - Medium
  - Very Low
- Great Barrier Reef - aquatic conservation assessment study area (refer inset)
  - Comet
  - Mackenzie
- Existing environment
  - Rail line
  - Major road
  - Minor road
  - Vehicular track
  - Dam/waterbody
  - National park/nature reserve
  - State forest

**Great Barrier Reef - aquatic conservation assessment areas**

BMA - Blackwater Mine  
Aquatic Ecology Baseline Assessment  
Figure 5.2



\\emmsvr1\EMM\Jobs\2018\B 180329 - Blackwater Mine - Environmental Monitoring and data gathering\GIS\02\_Maps\AquaticSurvey\Report\NorthernStudyArea\AQE005\_AquaticConservationAssessment\_2023\0713\_08.mxd 13/07/2023



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)

**KEY**

- |                |                              |
|----------------|------------------------------|
| Study area     | Existing environment         |
| Fish passage   | Rail line                    |
| Risk of impact | Major road                   |
| Major          | Minor road                   |
| High           | Vehicular track              |
| Moderate       | Dam/waterbody                |
| Low            | National park/nature reserve |
|                | State forest                 |

**Fish passage**

BMA - Blackwater Mine  
 Aquatic Ecology Baseline Assessment  
 Figure 5.3



\\emmsvr1\EMM\Jobs\2018\B-180329 - Blackwater Mine - Environmental Monitoring and data gathering\GIS\02\_Maps\AquaticSurvey\Report\NorthernStudyArea\AQE003\_FishPassage\_20230713\_08.mxd 13/07/2023

## 5.2 Aquatic habitat

### 5.2.1 Waterways

The waterways of the study area are ephemeral and experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are expected to be highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is historically low. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

### 5.2.2 Surface water quality

#### Physico—chemical water quality

Surface water temperatures at the time of assessment in December 2019 ranged from 26.7°C (warm) to 35.6°C (hot), and in May 2020 ranged from 19.0 to 20.0 (cool) (Table 5.1). Water temperatures are influenced by season, time of day, shading / exposure, and waterbody depth.

pH levels in December 2019 were mildly alkaline (7.9) at riverine site R4 and moderately alkaline (8.1) to strongly alkaline (8.6) at the lacustrine wetland waterbody (farm dam) sites L1 and L2, respectively (Table 5.1). pH levels in May 2020 were mildly alkaline (7.6) at riverine site R4 and ranged from mildly alkaline (7.8) to strongly alkaline (8.6) at the lacustrine wetlands waterbody sites (L1, L2 and RW1). The higher pH levels likely reflect the clay rich soils of the catchment as well as the high contact time with silt/clay substrates in these waterbodies.

With the exception of site L2, each wetted site exhibited 'fresh' (<800 µS/cm) water, with similar electrical conductivity (EC) levels across the riverine and lacustrine waterbody sites (Table 5.1). EC levels in riverine site R4 exceeded the conservative WQO guidelines of 310 µS/cm (Mackenzie River drainage sub-basin) in both sampling events. EC levels in the lacustrine waterbody wetland sites ranged from 414 µS/cm at site L1 in May 2020 to 2,401 µS/cm (brackish) at site L2 in May 2020.

Surface water dissolved oxygen (DO) levels were highly variable across the study area, reflecting time of day, temperature, organic load, biological activity and rate of transfer from the atmosphere. DO measurements ranged from 20.3% saturation (low) at site R4 in May 2020 to 89.0% at site RW1 in May 2020 (Table 5.1). The low DO levels reflect a number of factors, including time of day and likely oxygen consumption by aerobic bacteria during the breakdown of organic matter in these isolated and drying waterbodies.

Turbidity measurements at site R4 ranged from 24 to 40 NTU (high to moderate clarity) (Table 5.1). Turbidity levels in the lacustrine wetland waterbody sites ranged from 23.5 NTU (high clarity) at site L2 in May 2020 to 41 NTU (moderate clarity) at site L1 in May 2020. The higher clarity at site L2 likely reflects the brackish conditions (sediments flocced by salts).

Water hardness ranged from 95 mg/L (moderate) at L1 in December 2019 to 634 mg/L (extremely hard) at site L2 in May 2020. The hard water at most sites is likely due to the high contact time with the substrates.

**Table 5.1 Surface water quality measurements, December 2019 and May 2020**

Parameter	Units	WQO							
		R4 (R-M)		RW1		Riverine		Lacustrine	
			R4 (R-M)	R4 (R-M)	RW1	L1	L1	L2	L2
Date	DD/MM/YY	-	11/12/19	20/05/20	21/05/20	10/12/19	19/05/20	12/12/19	21/05/20
Time	HH:MM	-	12:00	10:30	13:45	11:30	12:00	10:20	12:10
<b>Physico-chemical water quality</b>									
Temperature	°C	-	26.7	19.0	20.0	26.9	19.1	30.1	19.7
pH	pH units	6.5 <sup>(R-M)</sup> , 6.5-8.0 <sup>(L)</sup>	7.9	7.6	<b>8.6</b>	<b>8.6</b>	7.8	<b>8.1</b>	7.9
Electrical	µS/cm	<310 <sup>(R-M, B)</sup>	<b>387</b>	<b>676</b>	<b>573</b>	<b>437</b>	<b>414</b>	<b>595</b>	<b>2,401</b>
DO	% saturation	85 <sup>(R-M)</sup> , 90-110 <sup>(L)</sup>	<b>36.0</b>	<b>20.3</b>	<b>89.0</b>	<b>76.0</b>	<b>75.1</b>	<b>87.9</b>	<b>66.0</b>
	mg/L	-	2.9	1.9	8.1	5.7	6.9	6.6	5.98
Turbidity	NTU	<50 <sup>(R-M)</sup> , 1-20 <sup>(L)</sup>	24	40	<b>27</b>	<b>40</b>	<b>41</b>	<b>31</b>	<b>23.5</b>
Hardness (as	mg/L	-	133	193	117	95	134	187	634
Alkalinity (as	mg/L	-	136	282	123	176	194	206	298
<b>Major cations</b>									
Calcium (Ca <sup>2+</sup> )	mg/L	-	32	51	27	20	34	42	132
Magnesium	mg/L	-	13	16	12	11	12	20	74
Sodium (Na <sup>+</sup> )	mg/L	-	27	68	67	65	34	59	286
Potassium (K <sup>+</sup> )	mg/L	-	7	8	7	6	7	13	16

**Table 5.1** Surface water quality measurements, December 2019 and May 2020

Parameter	Units	WQO							
		R4 (R-M)		RW1	Riverine		Lacustrine		
					L1	L1	L2	L2	
<b>Major anions</b>									
Chloride (Cl)	mg/L	-	40	51	68	36	23	60	248
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	mg/L	<10 <sup>(R-M)</sup>	3	14	62	<1	<1	<b>16</b>	<b>643</b>
Fluoride (F)	mg/L	-	0.2	0.4	0.4	0.9	0.5	0.4	0.3
Carbonate (CO <sub>3</sub> )	mgCaCO <sub>3</sub> /L	-	<1	<1	<1	16	<1	6	<1
Bicarbonate	mgCaCO <sub>3</sub> /L	-	136	282	123	160	194	200	298

Notes:

<sup>R-M</sup> Applies to riverine sites of the Mackenzie River drainage sub-basin; <sup>B</sup> Applies to baseflow conditions (as opposed to high flow conditions); <sup>L</sup> Applies to freshwater lakes / reservoirs

**Bold** text indicates exceedance of the relevant WQO.

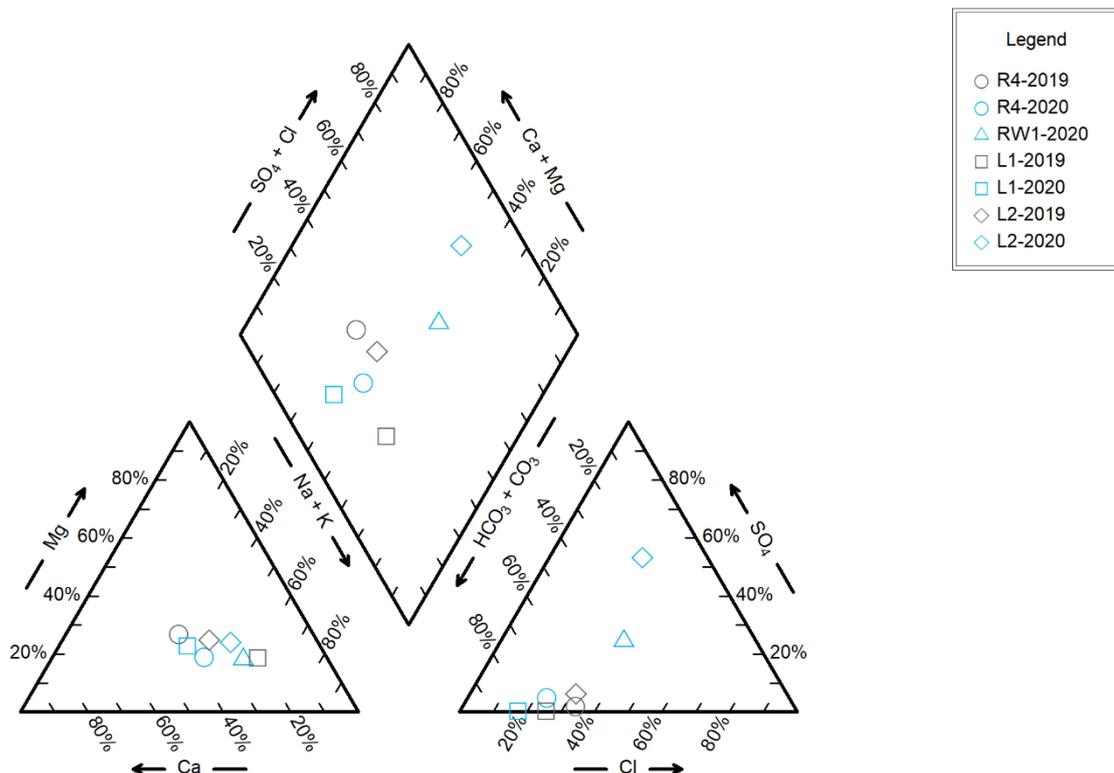
## Ions

The concentration and proportion of ions in surface waters depends on the location of the waterway (geology, land-use and topography), climate, the proportionate contributions of groundwater flow, interflow and overland flow (Boulton and Brock 1999), and anthropogenic disturbances. These proportionate contributions will vary depending on seasonal and climatic patterns and so the source of ions will also vary. In low to no flow conditions, groundwater sources and/or evaporative processes typically dominate, and during high flows, catchment and atmospheric sources typically dominate.

The concentration of major anions and cations in surface water samples collected from the study area in December 2019 and May 2020 are presented in Table 5.1 and Appendix B.

Surface water samples generally indicate bicarbonate waters with no dominant cation (Plate 5.1). The dominance of bicarbonate is typical of surface waters. Rainwater accumulates dissolved carbon dioxide from the atmosphere and may pick up more as it trickles over calcareous sediments or organic soil (Boulton and Brock 1999).

The moderate concentration (based on the logarithmic scale of Gibbs [1970]) of total dissolved salts at most sites (approximately 263 to 460 mg/L, inferred from EC levels of 387 to 676  $\mu\text{S}/\text{cm}$ ) in these bicarbonate dominated waters suggests that catchment soils or geology are the main source of dissolved material; i.e. the dissolution of soil/rock is the major process controlling surface water chemistry, rather than atmospheric precipitation or evaporation/crystallization. Elevated levels of sulphate, sodium and chloride were found at site L2.



**Plate 5.1** Relative abundance of major cations and anions from surface water samples collected from the study area, December 2019 and May 2020

### 5.2.3 Instream habitat

Instream (aquatic) habitat assessment scores ranged from poor to fair for the riverine survey sites across the study area, with most sites scoring fair (Table 5.2 and Table 5.3Table 5.2). Bottom substrate/available cover and embeddedness was mostly rated poor or fair, owing to the dominance of fine sediments (silt/clay and sand) and general lack of the larger pebble, cobble, and boulder substrates at each site. However, most sites exhibited at

least some detritus, sticks, branches, and logs, providing some instream habitat and refugia for aquatic fauna. Velocity/depth category rated poor at each site due to lack of water or flow. Streamside cover rated excellent at most sites, reflecting riparian vegetation dominated by trees.

**Table 5.2 Aquatic habitat assessment scores for riverine survey sites across the study area, December 2019**

Habitat variable	R1	R2	R3	R4	R5	R6	R7
Bottom substrate/available cover	P (3)	F (6)	P (1)	P (5)	P (2)	F (7)	G (11)
Embeddedness	P (3)	F (6)	P (5)	P (5)	P (2)	F (8)	F (8)
Velocity/depth category	P (0)	P (0)	P (0)	P (2)	P (0)	P (0)	P (0)
Channel alteration	E (12)	F (5)	P (2)	G (11)	F (6)	G (8)	E (12)
Bottom scouring and deposition	E (12)	G (11)	P (3)	G (10)	F (6)	F (7)	E (12)
Pool/riffle, run/bend ratio	F (4)	F (4)	F (4)	F (5)	F (5)	F (6)	F (6)
Bank stability	F (5)	F (5)	P (1)	F (5)	F (4)	F (5)	G (6)
Bank vegetative stability	G (6)	F (5)	F (4)	G (7)	F (3)	F (3)	F (5)
Streamside cover	E (9)	E (10)					
<b>Total (out of 135)</b>	<b>54</b>	<b>51</b>	<b>29</b>	<b>59</b>	<b>37</b>	<b>53</b>	<b>70</b>
<b>Rating</b>	<b>Fair</b>	<b>Fair</b>	<b>Poor</b>	<b>Fair</b>	<b>Poor</b>	<b>Fair</b>	<b>Fair</b>

Notes: AusRivAS habitat assessment scoring and categories consistent with DNRM (2001).  
 Legend Green: Excellent (E), Yellow: Good (G), Orange: Fair (F), Pink: Poor (P)

**Table 5.3 Aquatic habitat assessment scores for riverine survey sites across the study area, May 2020**

Habitat variable	R1	R2	R3	R4	R5	R6	R7	RW1
Bottom substrate/available cover	P (3)	F (6)	P (1)	P (5)	P (2)	F (7)	G (11)	P (5)
Embeddedness	P (3)	F (6)	P (5)	P (5)	P (2)	F (8)	F (8)	P (5)
Velocity/depth category	P (0)	P (0)	P (0)	P (2)	P (0)	P (0)	P (0)	P (5)
Channel alteration	E (12)	F (5)	P (2)	G (11)	F (6)	G (8)	E (12)	G (11)
Bottom scouring and deposition	E (12)	G (11)	P (3)	G (10)	F (6)	F (7)	E (12)	F (6)
Pool/riffle, run/bend ratio	F (4)	F (4)	F (4)	F (5)	F (5)	F (6)	F (6)	P (5)
Bank stability	F (5)	F (5)	P (1)	F (5)	F (4)	F (5)	G (6)	G (6)

**Table 5.3 Aquatic habitat assessment scores for riverine survey sites across the study area, May 2020**

Habitat variable	R1	R2	R3	R4	R5	R6	R7	RW1
Bank vegetative stability	G (6)	G (6)	F (4)	G (7)	F (5)	F (3)	F (5)	F (5)
Streamside cover	E (9)	E (10)	E (9)					
<b>Total (out of 135)</b>	<b>54</b>	<b>52</b>	<b>29</b>	<b>59</b>	<b>39</b>	<b>53</b>	<b>70</b>	<b>57</b>
<b>Rating</b>	<b>Fair</b>	<b>Fair</b>	<b>Poor</b>	<b>Fair</b>	<b>Poor</b>	<b>Fair</b>	<b>Fair</b>	<b>Fair</b>

Notes: AusRivAS habitat assessment scoring and categories consistent with DNRM (2001).  
 Legend Green: Excellent (E), Yellow: Good (G), Orange: Fair (F), Pink: Poor (P)

## 5.2.4 Bank stability/erosion

Bank stability ranged from poor (unstable) at site R3 to good (moderately stable) at site R7. Bank stability rated fair (moderately unstable) at all other riverine sites, where the moderate frequency and size of erosional areas and/or bank slopes of up to 60% suggests high erosion potential during a high flow event. However, bank vegetative stability rated fair to good at most riverine sites, indicating that at least 50% of the stream bank surfaces were covered by vegetation at the time of assessment. Bank vegetative stability improved slightly at some sites from December 2019 to May 2020.

## 5.2.5 Adjacent land use

Land use across the study area is dominated by cattle grazing of varying intensity. Riparian zone widths were approximately 20 m (single bank measurements) at site R5 (Taurus Creek) (Appendix C). Trees commonly encountered in riparian zones across the study area included yellowwood (*Terminalia oblongata*), brigalow (*Acacia harpophylla*), coolabah (*Eucalyptus coolabah*), forest red gum (*E. tereticornis*), silver-leaved ironbark (*E. melanophloia*), poplar box (*E. populnea*), red bauhinia (*Lysiphyllum carronii*) and narrow-leaved bottlebrush (*Brachychiton rupestris*). The shrub layer and groundcover was variable across the site (Appendix C).

## 5.2.6 Aquatic values

Aquatic values for each site are presented in the site profiles in Appendix C. Ratings for aquatic values were determined for each site based on the criteria in Section 4.4.9 and are presented in Table 5.4. There was no change in aquatic values ratings between December 2019 and May 2020.

Riverine sites on Sagittarius and Taurus Creeks and Two Mile Gully were rated as having moderate aquatic values due largely to their importance as conduits for fish passage and being classified as high or major risk of impact on fish passage. Riverine sites with a stream order 1–2 were rated as having low aquatic values.

Lacustrine wetland waterbody (farm dam) sites L1 and L2 were rated as having moderate aquatic values, based on being a dry season refuge for Least Concern fish and turtle species.

**Table 5.4 Aquatic value ratings for the survey area, December 2019 and May 2020**

Site	Waterway	Stream order	Key aquatic values / criteria	Aquatic values rating
R1	Sagittarius Creek	3	<ul style="list-style-type: none"> <li>Ephemeral waterway</li> <li>Fair habitat bioassessment score</li> <li>No CEEVNT or SLC aquatic species detected</li> <li>No Priority flora species detected</li> <li>Important (High risk of impact) conduit for fish passage.</li> </ul>	• Moderate
R2	Sagittarius Creek	2	<ul style="list-style-type: none"> <li>Ephemeral waterway</li> <li>Fair habitat bioassessment score</li> <li>No CEEVNT or SLC aquatic species detected</li> <li>No Priority flora species detected.</li> </ul>	• Low
R3	Unnamed tributary	1	<ul style="list-style-type: none"> <li>Ephemeral waterway</li> <li>Poor habitat bioassessment score</li> <li>No CEEVNT or SLC aquatic species detected</li> <li>No Priority flora species detected.</li> </ul>	• Low
R4	Taurus Creek	4	<ul style="list-style-type: none"> <li>Ephemeral waterway</li> </ul>	• Moderate

**Table 5.4 Aquatic value ratings for the survey area, December 2019 and May 2020**

Site	Waterway	Stream order	Key aquatic values / criteria	Aquatic values rating
			<ul style="list-style-type: none"> <li>• Accidental dry season refuge for common fish and turtle species (burst pipe nearby)</li> <li>• Fair habitat bioassessment score</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• No Priority flora species detected</li> <li>• Important (Major risk of impact) conduit for fish passage.</li> </ul>	
R5	Taurus Creek	3	<ul style="list-style-type: none"> <li>• Ephemeral waterway</li> <li>• Poor habitat bioassessment score</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• No Priority flora species detected</li> <li>• Important (Major risk of impact) conduit for fish passage.</li> </ul>	• Moderate
R6	Two Mile Gully	4	<ul style="list-style-type: none"> <li>• Ephemeral waterway</li> <li>• Fair habitat bioassessment score</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• No Priority flora species detected</li> <li>• Important (Major risk of impact) conduit for fish passage.</li> </ul>	• Moderate
R7	Taurus Creek	4	<ul style="list-style-type: none"> <li>• Ephemeral waterway</li> <li>• Fair habitat bioassessment score</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• Little cover of Priority flora species</li> <li>• Important (Major risk of impact) conduit for fish passage.</li> </ul>	• Moderate
RW1	Taurus Creek flood channel wetland	3	<ul style="list-style-type: none"> <li>• Ephemeral wetland waterbody</li> <li>• Fair habitat bioassessment score</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• No Priority flora species detected</li> </ul>	• Low
L1	Farm dam	2	<ul style="list-style-type: none"> <li>• Modified (dammed) wetland waterbody</li> <li>• Semi-permanent</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• Least concern Eastern snake-necked turtle detected</li> <li>• No Priority flora species detected</li> <li>• Likely dry season refuge for common fish and turtles.</li> </ul>	• Moderate
L2	Farm dam	1	<ul style="list-style-type: none"> <li>• Modified (dammed) wetland waterbody</li> <li>• Semi-permanent</li> <li>• No CEEVNT or SLC aquatic species detected</li> <li>• No Priority flora species detected</li> <li>• Likely dry season refuge for common fish and turtles.</li> </ul>	• Moderate

## 5.3 Wetlands

### 5.3.1 Wetlands of International Importance

There are no wetlands of International Importance identified within the study area or broader desktop search area in the PMST search (DEE 2020a). Wetlands of International Importance nearest to the study area include those of the Shoalwater and Corio Bays Area, approximately 200 km to the northeast (DEE 2020b).

### 5.3.2 Wetlands of National Importance

No nationally important wetlands occur in the Mackenzie River drainage sub-basin.

### 5.3.3 Referrable wetlands

#### **Wetland Protection Areas**

The Map of Great Barrier Reef Wetland Protection Areas (DES 2020b) shows the location of Wetland Protection Areas (WPAs), comprising wetlands of HES and their surrounding policy trigger area buffers. These wetlands have been assessed as containing high ecological values by a bioregional aquatic conservation assessment, as per the AquaBAMM (Rollason and Howell 2012).

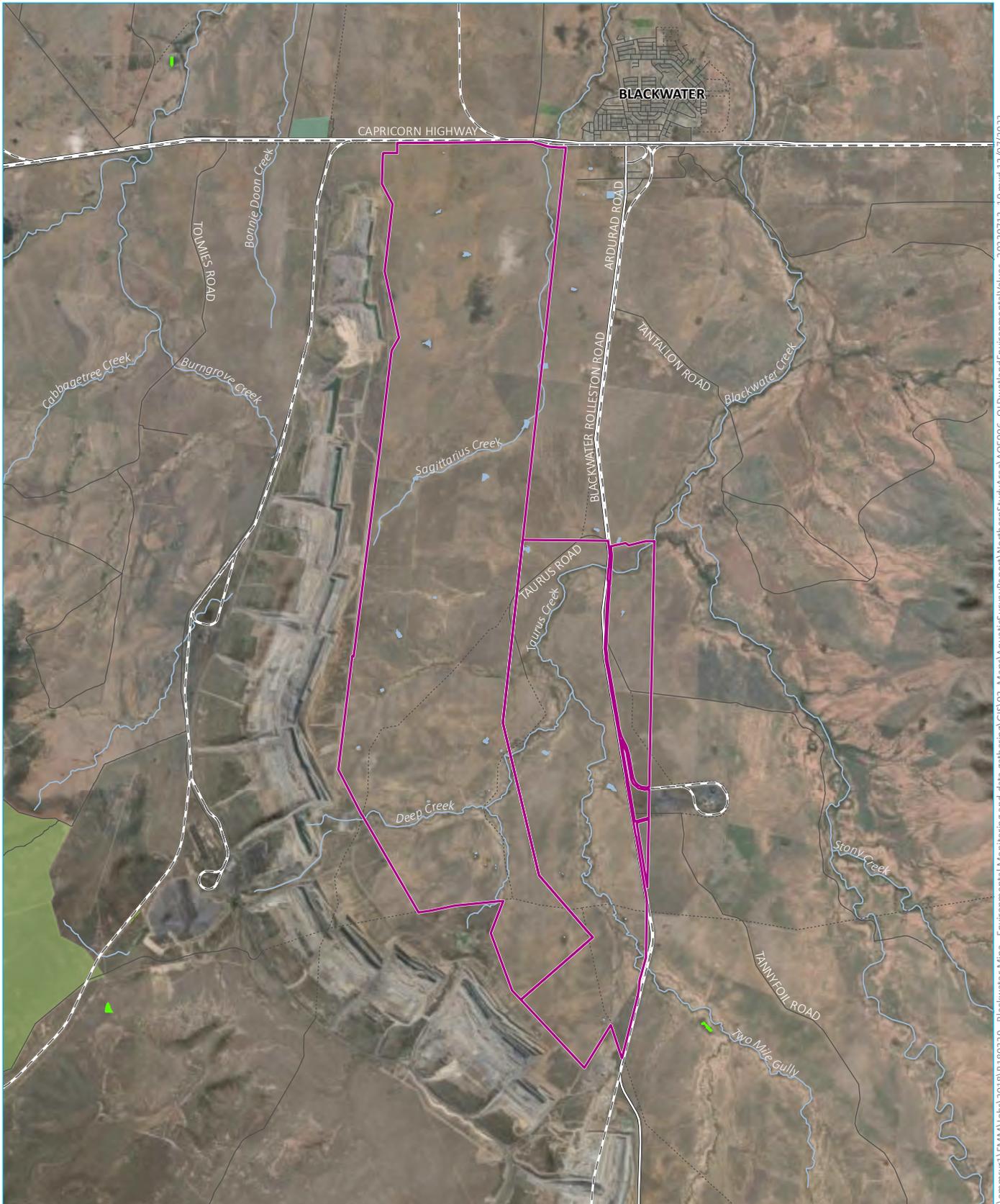
No HES wetlands are mapped as occurring in the study area or surrounds (Figure 5.4).

#### **Queensland Wetland Environmental Values**

The Map of Queensland Wetland Environmental Values (MQWEV) identifies the location and ecological significance of wetlands using the environmental values for wetlands in section 7 of the *Environmental Protection (Wetland and Water Biodiversity) Policy 2019* (EPP 2019). Wetlands are considered either HES or of General Ecological Significance (GES) for the purposes of allocating environmental values. The MQWEV also shows High Ecological Value (HEV) waters management intent under Schedule 2 of the EPP 2019.

No State-mapped GES wetlands are mapped as occurring in the study area. One GES wetland is mapped upstream of the study area on Two Mile Gully (Figure 5.4).

No HEV waters are identified for the study area or surrounds in the MQWEV.



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)

**KEY**

- Study area
- Wetland environmental values
  - Wetland of general ecological significance
- Existing environment
  - Rail line
  - Major road
  - Minor road
  - Vehicular track
  - Dam/waterbody
  - National park/nature reserve
  - State forest

**Queensland wetland environmental values**

BMA - Blackwater Mine  
Aquatic Ecology Baseline Assessment  
Figure 5.4



## 5.4 Aquatic flora

Fourteen species of aquatic or semi-aquatic flora species were recorded from the study area during the December 2019 surveys (Table 5.5). An additional seven aquatic or semi-aquatic flora species were recorded from the study area during the May 2020 surveys (Table 5.6).

All aquatic flora species detected are considered Least Concern under the NC Act. Three priority aquatic flora species were detected:

- Tall flatsedge (*Cyperus exaltatus*);
- Water snowflake (*Nymphoides indica*); and
- Swamp lily (*Ottelia alismoides*).

Aquatic flora species encountered consisted predominately of semi-aquatic species including forbs, grasses, rushes, and sedges.

The lack of both diversity and abundance of aquatic plants at some sites reflects the harsh physical conditions, cattle grazing and trampling, or a combination of these factors.

**Table 5.5** Aquatic flora recorded from the study area, December 2019

Scientific name	Common name	Riverine sites							Lacustrine sites	
		R1	R2	R3	R4	R5	R6	R7	L1	L2
<i>Cyperus</i> sp.	Sedge	L						L		L
<i>Cyperus difformis</i>	Rice sedge									L
<i>Cyperus exaltatus</i>	Tall flatsedge				L					
<i>Cyperus pygmaeus</i>	Dwarf sedge								L	
<i>Juncus usitatus</i>	Common rush									L
<i>Leptochloa digitata</i>	Umbrella canegrass	L			L			L	L	L
<i>Ludwigia octovalvis</i>	Willow primrose								L	
<i>Ludwigia peploides</i>	Water primrose				S					S
<i>Nymphoides indica</i>	Water snowflake									L
<i>Ottelia ovalifolia</i>	Swamp lily								L	
<i>Persicaria attenuata</i>	Smartweed								M	L
<i>Persicaria decipiens</i>	Slender knotweed									L
<i>Potamogeton crispus</i>	Curly pondweed								M	
<i>Typha domingensis</i>	Cumbungi								S	S
<b>Species richness</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>7</b>	<b>9</b>

AusRivAS categories: Little (L), Some (S), Moderate (M), and Extensive (E) consistent with DNRM (2001) methodology.

**Table 5.6 Aquatic flora recorded from the study area, May 2020**

Scientific name	Common name	Riverine sites							Wetland sites			
		R1	R2	R3	R4	R5	R6	R7	RW1	L1	L2	
<i>Cyperus</i> sp.	Sedge											L
<i>Cyperus betchei</i>	-	L			L		L	L		L		
<i>Cyperus concinnus</i>	-							L		L		
<i>Cyperus difformis</i>	Rice sedge	L								L		L
<i>Cyperus exaltatus</i>	Tall flatsedge	L								L		
<i>Cyperus iria</i>	Rice flatsedge				L							
<i>Cyperus pygmaeus</i>	Dwarf sedge	L							L	L		
<i>Diplachne fusca fusca</i>	Brown beetle grass									L		
<i>Echinochloa colona</i> *	Awnless barnyard grass*	L								L		
<i>Eclipta prostrata</i> *	White eclipta*	L					L					L
<i>Juncus usitatus</i>	Common rush											L
<i>Leptochloa digitata</i>	Umbrella canegrass	L						L		L		L
<i>Ludwigia octovalvis</i>	Willow primrose									L		L
<i>Ludwigia peploides</i>	Water primrose				L					L		L
<i>Nymphoides indica</i>	Water snowflake											M
<i>Persicaria attenuata</i>	smartweed									L		
<i>Persicaria lapathifolia</i>	Pale knotweed	L								L		
<i>Potamogeton crispus</i>	Curly pondweed									M		

**Table 5.6** Aquatic flora recorded from the study area, May 2020

Scientific name	Common name	Riverine sites							Wetland sites		
		R1	R2	R3	R4	R5	R6	R7	RW1	L1	L2
<i>Typha domingensis</i>	Cumbungi									M	S
<b>Species richness</b>		<b>8</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>14</b>	<b>8</b>

AusRivAS categories: Little (L), Some (S), Moderate (M), and Extensive (E) consistent with DNRM (2001) methodology.

\*Exotic species

## 5.5 Aquatic fauna

### 5.5.1 Fish

Nine species were recorded from 741 fishes captured from two locations in the December 2019 surveys (Table 5.6) and seven species were recorded from 2,148 fishes captured from three locations in the May 2020 surveys (Table 5.7). This comprised eight common (Least Concern) native species and one exotic species. Each of the native species had previously been recorded in the *Wetlandinfo* database (DES 2020a) for the Mackenzie River drainage sub-basin. The exotic species, mosquitofish (*Gambusia holbrooki*), was not previously listed in *Wetlandinfo* for the Mackenzie River sub-basin (in which site L1 is positioned).

All native fishes captured appeared healthy, with little sign of stress and no obvious signs of disease. Native fishes were released at the point of capture. Pest fish were humanely euthanised in accordance with DPM Envirosiences' Animal Ethics Committee approval and General Fisheries Permit.

The species composition is typical of ephemeral waterways and farm dams in the region.

**Table 5.7 Fish recorded from the study area, December 2019**

Scientific name	Common name	Riverine site R4	Lacustrine site L1
<i>Ambassis agassizii</i>	Agassiz's glassfish	39	429
<i>Craterocephalus stercusmuscarum</i>	Flyspecked hardyhead	1	
<i>Gambusia holbrooki</i> *	Mosquitofish		41
<i>Hypseleotris galii</i> / sp. 1	Firetail / Midgley's gudgeon		42
<i>Hypseleotris klunzingeri</i>	Western carp gudgeon	2	9
<i>Leiopotherapon unicolor</i>	Spangled perch	21	11
<i>Melanotaenia splendida splendida</i>	Eastern rainbowfish	9	4
<i>Mogurnda adspersa</i>	Purple-spotted gudgeon	52	19
<i>Neosilurus hyrtlii</i>	Hyrtyl's tandan		62
<b>Number of individuals</b>		<b>124</b>	<b>617</b>
<b>Species richness</b>		<b>6</b>	<b>8</b>

\* Exotic species

**Table 5.8 Fish recorded from the study area, May 2020**

Scientific name	Common name	Riverine site R4	Flood channel wetland site RW1	Lacustrine wetland site L1
<i>Ambassis agassizii</i>	Agassiz's glassfish	156	60	78
<i>Gambusia holbrooki</i> *	Mosquitofish			529
<i>Hypseleotris galii</i> / sp. 1	Firetail / Midgley's gudgeon	30	256	75

**Table 5.8 Fish recorded from the study area, May 2020**

Scientific name	Common name	Riverine site R4	Flood channel wetland site RW1	Lacustrine wetland site L1
<i>Leiopotherapon unicolor</i>	Spangled perch	46	28	269
<i>Melanotaenia splendida splendida</i>	Eastern rainbowfish	40	229	111
<i>Mogurnda adspersa</i>	Purple-spotted gudgeon	15	1	59
<i>Nematalosa erebi</i>	Bony bream	36	8	
<i>Neosilurus hyrtlii</i>	Hyrtyl's tandan	10	2	110
<b>Number of individuals</b>		<b>333</b>	<b>584</b>	<b>1,231</b>
<b>Species richness</b>		<b>7</b>	<b>7</b>	<b>7</b>

\* Exotic species

### 5.5.2 Turtles

The Least Concern eastern snake-necked turtle (*Chelodina longicollis*) was recorded at site L1 in December 2019. No CEEVNT turtles were detected within the study area, nor was suitable habitat for CEEVNT turtles encountered (Section 5.6.3).

### 5.5.3 Platypus

The platypus (*Ornithorhynchus anatinus*) is listed as Special Least Concern (SLC) under the NC Act. The Wetland/Info database (DES 2020a) identifies the platypus as having previously been recorded from the Mackenzie River drainage sub-basin. The nearest record of platypus is from the Dawson Range State Forest, approximately 30 km east of the survey area (ALA 2020).

No platypus were observed during aquatic surveys, and no survey locations were found to have suitable habitat for the species.

### 5.5.4 Aquatic Macroinvertebrates

#### Aquatic macroinvertebrates and stream health

A total of 34 aquatic macroinvertebrate taxa were identified from 499 specimens collected from two sites in December 2019, and 36 aquatic macroinvertebrate taxa were identified from 607 specimens collected from three sites in May 2020. A total of 40 taxa were recorded from the 1,106 specimens collected in December 2019 and May 2020 combined.

Sampling effort for riverine sites was limited by the availability of wetted habitat. The December 2019 sampling consisted of a riverine bed and edge sample from each of sites R4 and RW1, and a composite bed/edge sample from farm dam site L1.

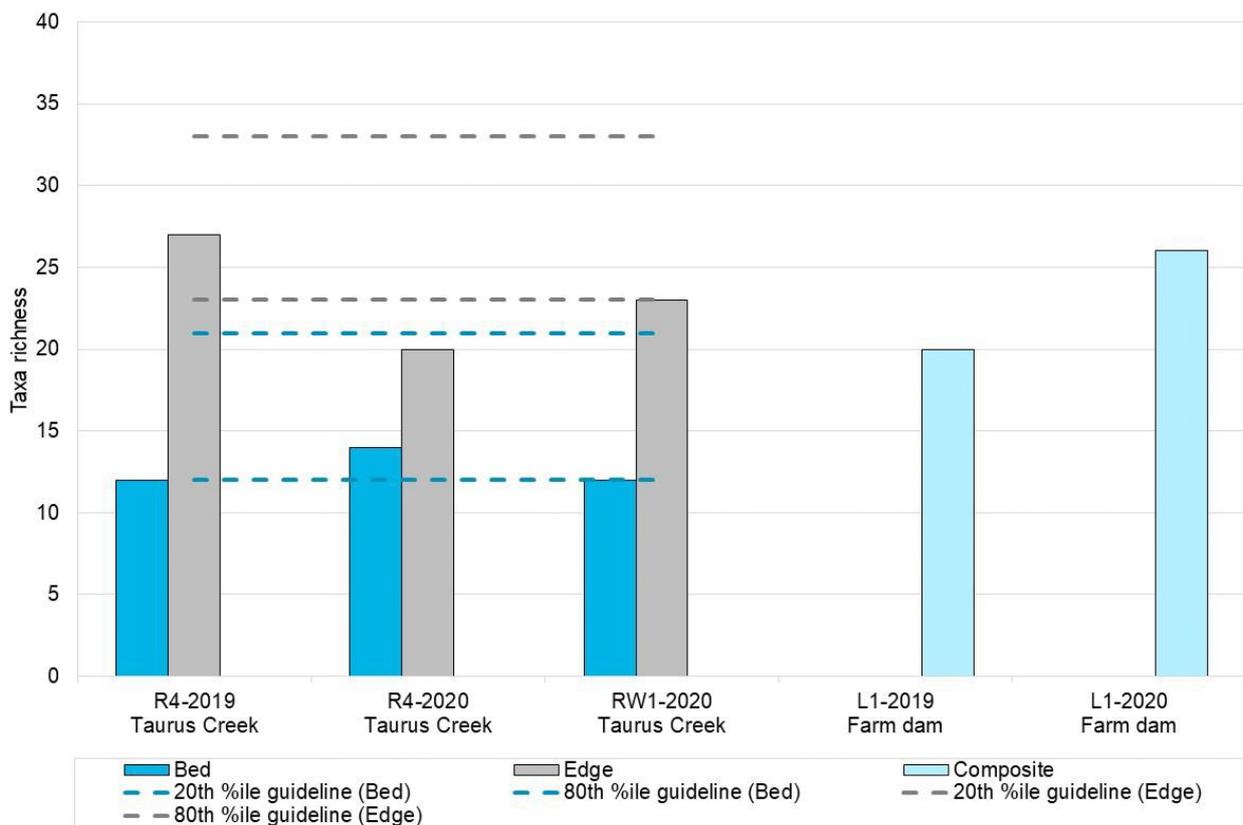
#### Taxonomic composition

The most taxa-rich order of aquatic macroinvertebrates collected from the study area was *Hemiptera* (true bugs), with ten families identified. *Diptera* (true flies) and *Coleoptera* (beetles) were also well represented, with seven and six families, respectively. Other taxa included *Ephemeroptera* (mayflies), *Trichoptera* (caddis flies), *Zygoptera* (damselflies), *Epiprocta* (dragonflies), *Nematoda* (roundworms), *Oligochaeta* (segmented worms), *Lepidoptera*

(moths [aquatic caterpillars]), *Acarina* (mites), *Decapoda* (yabby, river prawns and glass shrimp); *Gastropoda* (snails); *Cladocera* (water fleas), *Copepoda* (copepods) and *Ostracoda* (seed shrimp).

Taxa richness in the riverine bed habitat samples ranged from 12 taxa (sites R4 in December 2019 and RW1 in May 2020) to 14 taxa at site R4 in May 2020 (Plate 5.2). Taxa richness in the riverine edge habitat samples ranged from 20 taxa at site R4 in May 2020 to 27 taxa at site R4 in December 2019. Composite samples (bed and edge habitats combined) collected from farm dam site L1 ranged from 20 taxa in December 2019 to 26 taxa in May 2020. Data is presented alongside the DEHP WQOs for the Mackenzie River Sub-basin waters (DEHP 2011a). The WQOs apply to riverine systems only. No taxa richness guidelines are available for lakes / reservoirs.

The taxa richness of riverine bed habitat samples fell within the DEHP (2011a) 20:80 percentile guideline range. The taxa richness of riverine edge habitat samples fell within the DEHP (2011a) 20:80 percentile guideline range in December 2019, falling slightly below this range in May 2020.



**Plate 5.2 Taxa richness of aquatic macroinvertebrate samples collected from the study area, December 2019 and May 2020**

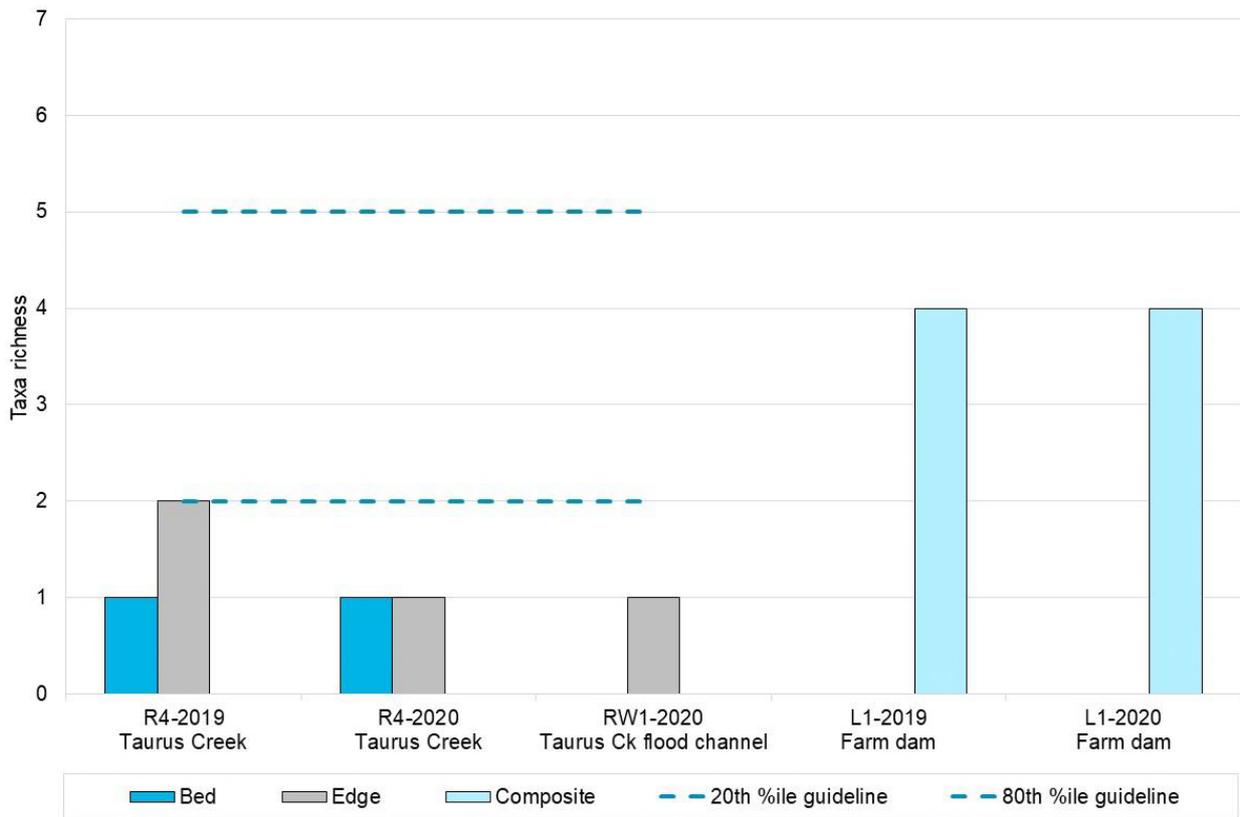
**PET taxa**

Four PET taxa were recorded from the study area, including two *Ephemeroptera* (mayfly) families (*Baetidae* and *Caenidae*) and two *Trichoptera* (caddisfly) families (*Ecnomidae* and *Leptoceridae*). No *Plecoptera* (stoneflies) families were recorded, nor are they expected to occur due to lack of riffle habitat.

Up to one PET taxon was recorded from the riverine bed samples and up to two PET taxa were recorded from the riverine edge samples. All four PET taxa were recorded from farm dam site L1 in December 2019 and May 2020. Data is presented alongside the DEHP (2011a) WQOs for the Mackenzie River Sub-basin waters. The WQOs apply to riverine systems only. As such, no guidelines are presented for the farm dam site.

PET taxa richness in the edge habitat sample collected from site R4 aligned with the DEHP (2011a) 20:80 percentile guideline range in December 2019, indicating an expected number of pollutant sensitive taxa. PET taxa

richness fell below the guideline range in the bed habitat sample from site R4 in December 2019 and in the bed and edge habitat samples from sites R4 and RW1 in May 2020, reflecting poorer habitat complexity (Plate 5.3).



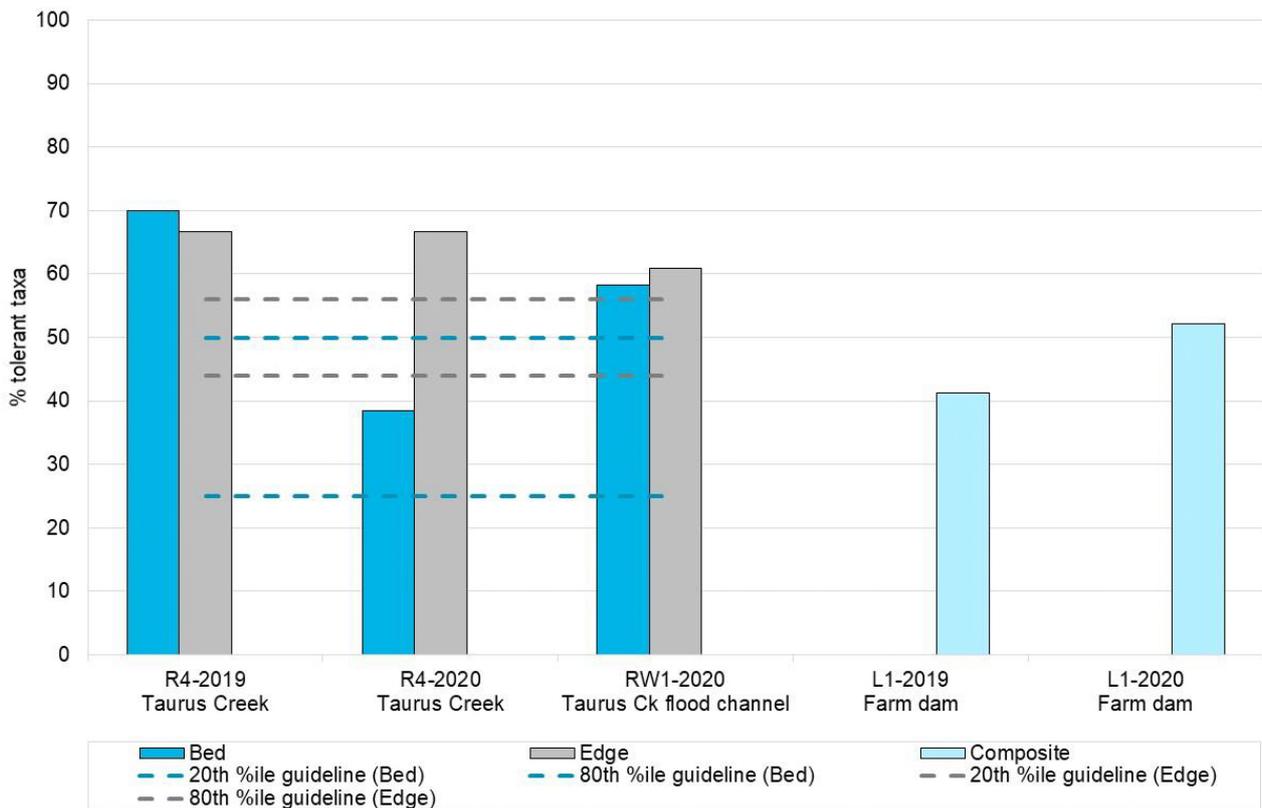
**Plate 5.3** PET taxa richness of aquatic macroinvertebrate samples collected from the study area, December 2019 and May 2020

*Pollution-tolerant taxa*

The percentage of pollution tolerant taxa (SIGNAL 2 score of 1-3) ranged from 38 to 70% in the riverine bed samples, from 61 to 67% in the riverine edge sample, and from 41 to 52% in the farm dam samples. Data is presented against the DEHP (2011a) WQOs for the Mackenzie River Sub-basin waters. The WQOs apply to riverine systems only. As such, no guidelines are presented for the farm dam site L1.

The percentage of pollution tolerant taxa exceeded the DEHP (2011a) 20:80 percentile guideline range in most riverine samples, indicating unfavourable physical conditions and/or reduced habitat quality, and likely reflecting the highly ephemeral flow regime.

The composite sample collected from lacustrine wetland waterbody site L1 exhibited a favourably lower percentages of pollutant tolerant taxa compared to the riverine sites. This likely reflects the permanent wetted habitat at this site (Plate 5.4).



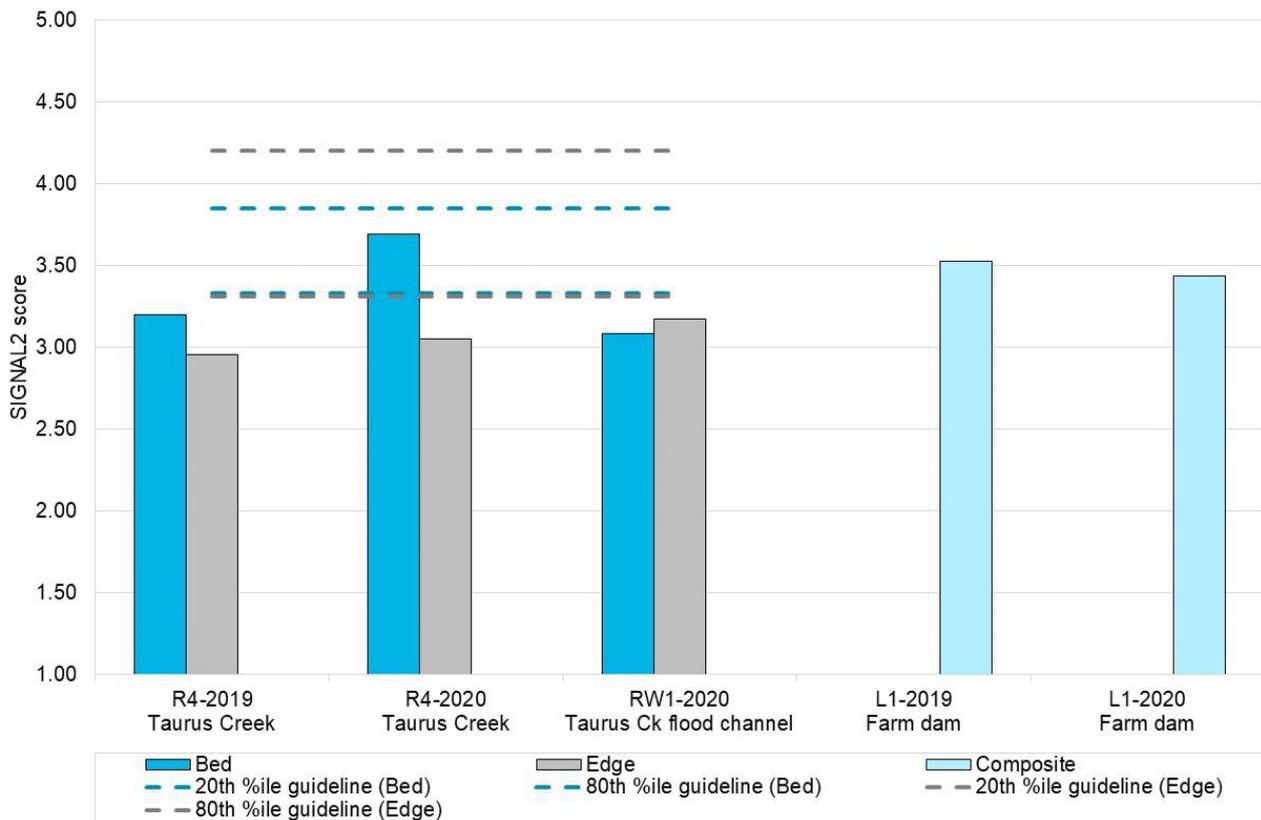
**Plate 5.4 Percentage of tolerant taxa in aquatic macroinvertebrate samples collected from the study area, December 2019 and May 2020**

*SIGNAL2 scores*

SIGNAL2 scores ranged from 3.08 to 3.69 for the riverine bed habitat samples, from 2.96 to 3.17 for the riverine edge habitat samples, and from 3.43 to 3.53 for the farm dam samples collected in December 2019 and May 2020. SIGNAL2 results are presented against the DEHP (2011a) WQOs for the Mackenzie River Sub-basin waters. The WQOs apply to riverine systems only. As such, no guidelines are presented for the farm dam site L1.

The SIGNAL2 scores for most bed and edge samples fell below the DEHP (2011a) 20:80 percentile guideline range, reflecting a lower composition of pollution sensitive taxa (and a higher composition of pollutant tolerant taxa) than what is expected for the Mackenzie River Sub-basin waters. This likely indicates unfavourable physical conditions and/or reduced habitat quality associated with high ephemerality.

SIGNAL2 scores for the composite samples collected from farm dam site L1 exhibited a favourably higher SIGNAL2 score compared to most other sites (Plate 5.5). This reflects the more stable wetted habitat and physico-chemical water quality expected in this more permanent waterbody.



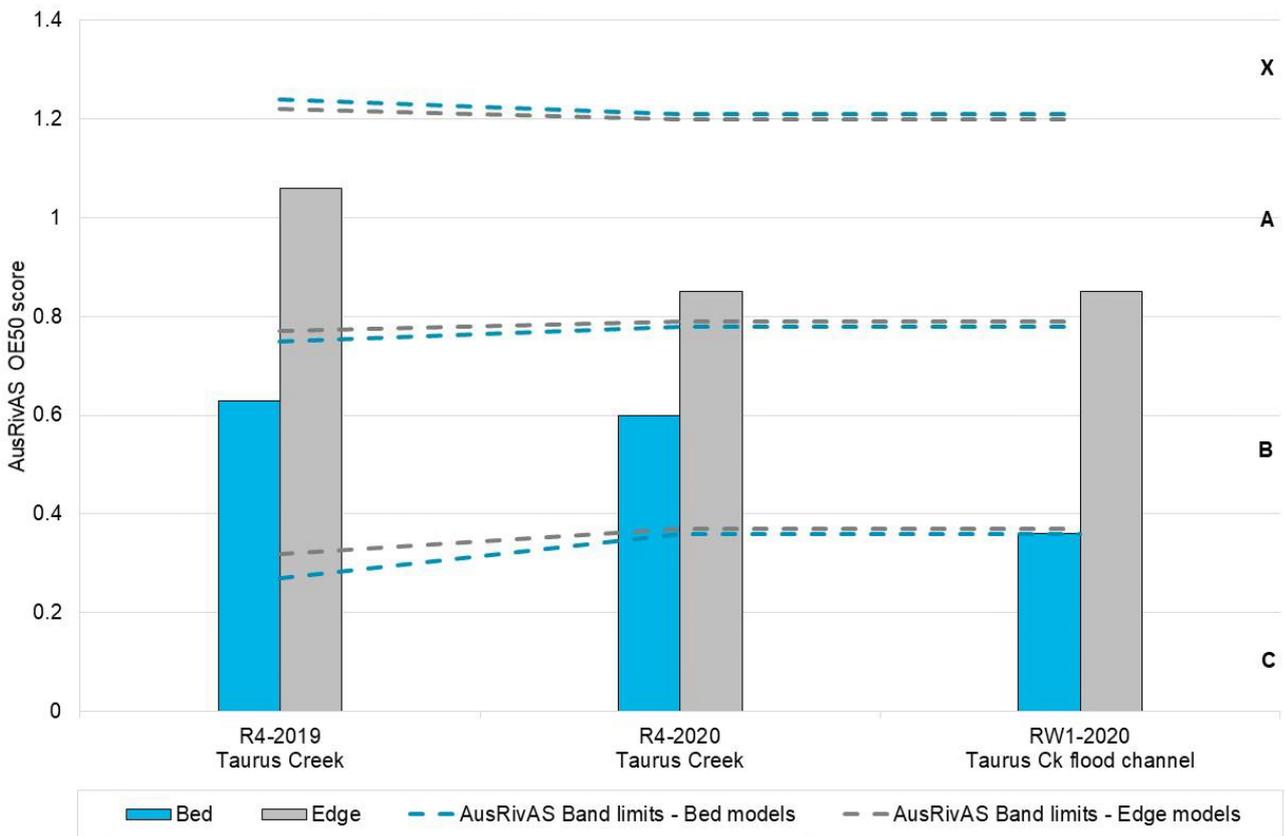
**Plate 5.5** SIGNAL2 scores for aquatic macroinvertebrate samples collected from the study area, December 2019 and May 2020

*AusRivAS OE50*

Aquatic macroinvertebrate data from the December 2019 riverine sampling was modelled using the AusRivAS Queensland regional coastal spring models for the habitats sampled. Data from the May 2020 riverine sampling was modelled using the AusRivAS Queensland regional coastal autumn models for the habitats sampled.

AusRivAS observed to expected (OE50) taxa scores indicate that the bed habitat samples were impaired (Band B) at site R4 in December 2019 and May 2020 and severely impaired (Band C) at site RW1. No sites received a score within Band D (extremely impaired) (Plate 5.6). The edge habitat samples collected from site R4 in December 2019 and May 2020, and from site RW1 in May 2020, were in reference condition (Band A), representative of minimally disturbed sites used to build the AusRivAS models. The better scores in the edge habitats than in the bed habitats are reflective of the greater habitat complexity in the edge habitats.

The prevalence of wetted habitat is likely to be a key driver in macroinvertebrate community structure and ecosystem functioning, and caution is applied to the use of AusRivAS ratings in ephemeral systems. The lower (Band B and Band C) OE50 taxa scores for the bed habitat samples may be more reflective of seasonality than catchment impacts.



**Plate 5.6** AusRivAS OE50 scores for riverine macroinvertebrate samples collected from the study area, December 2019 and May 2020

## 5.6 Conservation significant species

### 5.6.1 Aquatic flora

No CEEVNT aquatic flora species were recorded during the surveys. The *WetlandInfo* database identifies five CEEVNT flora species that have previously been recorded from the broader Fitzroy Basin (DES 2020a) (Table 5.8), none of which were found as likely to occur within the study area.

**Table 5.9 CEEVNT aquatic flora species recorded from the Fitzroy Basin**

Scientific name	Common name	EPBC Act status <sup>1</sup>	NC Act status <sup>2</sup>	Preferred habitat	Likelihood of occurrence
<i>Eriocaulon carsonii</i> (including subsp. <i>orientale</i> )	salt pipewort/ button grass	E	E	Restricted to saturated soil adjacent to flowing mound springs (Sainty and Jacobs 2003).	<b>Unlikely.</b> Current known distribution (ALA 2020) is not in proximity to the study area. Mound springs not known to occur within the study area or surrounds. Species or species habitat not detected during field surveys.
<i>Maundia triglochmoides</i>	-	-	V	Grows in coastal freshwater swamps and streams (Sainty and Jacobs 2003), in waters up to 0.5 m deep, or shallow waters that may dry up seasonally.	<b>Unlikely.</b> Current known distribution (ALA 2020) is not in proximity to the study area. Species or species habitat not detected during field surveys.
<i>Myriophyllum artesium</i>	-	-	E	Wetlands and creek lines associated with springs emanating from the Great Artesian Basin and associated basins (DES 2020e).	<b>Unlikely.</b> Current known distribution (ALA 2020) is not in proximity to the study area. GAB spring fed wetlands and creeks not known to occur within the study area or surrounds. Species or species habitat not detected during field surveys.
<i>Phaius australis</i>	lesser swamp orchid	E	E	Grows in sandy areas where soils are almost always damp, but not flooded for lengthy periods; occurring in southern Queensland and northern NSW (DES 2020f).	<b>Unlikely.</b> Current known distribution (ALA 2020) is not in proximity to the study area. Species or species habitat not detected during field surveys.
<i>Thelypteris confluens</i>	swamp fern	-	V	Found in permanently swampy areas and mound springs (DES 2020g). Occurs in the Queensland pastoral districts on Leichhardt, Moreton and Wide Bay (DES 2020g).	<b>Unlikely.</b> Current known distribution (ALA 2020) is not in proximity to the study area. Species or species habitat not detected during field surveys.

1. EPBC Act status: CE – critically endangered, E – endangered, V – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened, SLC – special least concern, LC – Least Concern

### 5.6.2 Fish

No CEEVNT fish species were recorded during the surveys. The *WetlandInfo* database identifies 53 fish species that have previously been recorded from the broader Fitzroy Basin (DES 2020a). Of these, two are listed as CEEVNT:

- Silver perch (*Bidyanus bidyanus*) – Critically Endangered (EPBC Act)
- Murray cod (*Maccullochella peelii*) – Vulnerable (EPBC Act).

Due to habitat requirements and distributional range (Table 5.10), it is unlikely these CEEVNT species occur within waterbodies of the study area as either resident or transient occurrences.

**Table 5.10 CEEVNT fish species recorded from the Fitzroy Basin**

Scientific name	Common name	EPBC Act status <sup>1</sup>	NC Act status <sup>2</sup>	Preferred habitat	Likelihood of occurrence
<i>Bidyanus bidyanus</i>	Silver perch	CE	LC	Faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin (MDB) (Clunie and Koehn 2001, cited in TSSC 2013).	<b>Unlikely.</b> Distributional range is naturally in the MDB, although translocated to coast streams in south-east Queensland (and other states). Species or species habitat not detected during field surveys.
<i>Maccullochella peelii</i>	Murray cod	V	LC	Deep water with in-stream habitat such as boulders, logs, and overhanging vegetation (Allen et al. 2002). From fast-moving, clear upland streams to slow-flowing, turbid lowland waters. Most individuals stay within 10 km reach of the river (Pusey et al. 2004; Allen et al. 2002).	<b>Unlikely.</b> Outside of natural area of distribution (ALA 2020). Species or species habitat not detected during field surveys.

1. EPBC Act status: CE – critically endangered, E – endangered, V – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened, SLC – special least concern, LC – Least Concern

### 5.6.3 Turtles

No CEEVNT freshwater turtle species were recorded during the surveys.

The WetlandInfo database identifies seven freshwater turtle species as having previously been recorded from the Fitzroy Basin (DES 2020a). Of these, two are listed as CEEVNT:

- Southern snapping turtle (*Eseya albagula*) – Critically Endangered (EPBC Act), Endangered (NC Act); and
- Fitzroy River turtle (*Rheodytes leukops*) – Vulnerable (EPBC Act and NC Act).

The southern snapping turtle and Fitzroy River turtle are ‘known’ from the search area for the EPBC Act PMST report (DEE 2020a) (Appendix A). However, due to habitat requirements and distributional range, it is unlikely that these CEEVNT turtle species occur within waterbodies of the study area as either resident or transient occurrences (Table 5.11).

**Table 5.11 CEEVNT freshwater turtle species recorded from the Fitzroy Basin**

Scientific name	Common name	EPBC Act status <sup>1</sup>	NC Act status <sup>2</sup>	Preferred habitat	Likelihood of occurrence
<i>Rheodytes leukops</i>	Fitzroy River turtle	V	V	Fast-flowing water of the Fitzroy River and its tributaries (Cogger 2014). Rivers with large deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed ( <i>Vallisneria</i> sp.) (DEE 2020c).	<b>Unlikely.</b> Current known distribution is within the Fitzroy Basin. However due to a lack of suitable habitat, including ephemeral waterways with no deep pools, it is unlikely the species would occur in waterbodies of the study area. Both as residents or transient occurrences.
<i>Eseyia albagula</i>	Southern snapping turtle	CE	E	Permanent flowing water habitats where there are suitable shelters and refuges (DES 2020h); clear, flowing, well-oxygenated waters (Todd et al. 2013) of the Fitzroy, Mary and Burnett catchments.	<b>Unlikely.</b> Current known distribution is within the Fitzroy Basin. However due to a lack of suitable habitat, including ephemeral waterways with no permanent flowing water, it is unlikely the species would occur in waterbodies of the study area. Both as residents or transient occurrences.

1. EPBC Act status: CE – critically endangered, E – endangered, V – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened, SLC – special least concern, LC – Least Concern

#### 5.6.4 Platypus

The platypus (*Ornithorhynchus anatinus*) was not recorded during field surveys.

The seasonal nature of the riverine waterbodies of the study area are not conducive to sustaining a population of platypus. Similarly, the lacustrine waterbodies (i.e., farm dams) of the study area are unlikely to sustain a population of platypus as, despite relative permanence of wetted habitat, these waterbodies lack the banks suitable for platypus burrow construction.

#### 5.6.5 Invertebrates

No aquatic invertebrates are identified in the EPBC Act PMST report (DEE 2020a). The Wetland*info* database for the Fitzroy Basin (DES 2020a) identifies two macro-crustaceans and 23 wetland indicator insects as having previously been recorded from the Fitzroy Basin, none of which are listed in the EPBC Act or NC Act.

### 5.7 Introduced species

#### 5.7.1 Introduced aquatic flora

There are 23 introduced wetland indicator plant species known from the Fitzroy Basin (DES 2020a). Those invasive species considered to pose a particular threat to aquatic biodiversity, and that could potentially occur within the study area, are listed in either a Weed of National Significance (WoNS) (DEE 2020d) or Restricted matter category 3 under the *Queensland Biosecurity Act 2014*. Only two of these species were recorded in the study area: Awnless Barnyard Grass (*Echinochloa colona*) and White Eclipta (*Eclipta prostrata*). Neither are of ecological significance.

**Table 5.12**      **Introduced aquatic flora**

Scientific name	Common name	National status <sup>1</sup>	Qld Biosecurity Act status <sup>2</sup>
<i>Arundo donax</i>	Giant Reed		
<i>Cyperus esculentus</i>	Yellow Nutgrass		
<i>Cyperus involucratus</i>	Umbrella Sedge		
<i>Cyperus papyrus</i>	Papyrus		
<i>Diplachne fusca var. uninervia</i>	-		
<b><i>Echinochloa colona</i></b>	<b>Awnless Barnyard Grass</b>		
<i>Echinochloa crus-galli</i>	Barnyard Grass		
<b><i>Eclipta prostrata</i></b>	<b>White Eclipta</b>		
<i>Eichhornia crassipes</i>	Water Hyacinth	WoNS	Restricted 3
<i>Eleocharis minuta</i>	Spike Rush		
<i>Hymenachne amplexicaulis</i> 'Olive'	Olive Hymenachne	WoNS	Restricted 3
<i>Juncus bufonius</i>	Toad Rush		
<i>Nymphaea caerulea</i>	Cape Waterlily		
<i>Paspalum distichum</i>	Water Couch		
<i>Paspalum vaginatum</i>	Saltwater Couch		
<i>Pistia stratiotes</i>	Water Lettuce		Restricted 3
<i>Polypogon monspeliensis</i>	Annual Beardgrass		
<i>Rorippa nasturtium-aquaticum</i>	Watercress		
<i>Salix babylonica</i>	Weeping Willow		
<i>Salvinia molesta</i>	Salvinia	WoNS	Restricted 3
<i>Sparganium erectum</i> subsp. <i>stoloniferum</i>	Erect Bur-Reed		
<i>Stenotaphrum secundatum</i>	Buffalo Grass		
<i>Urochloa mutica</i>	Para Grass		

1. Species listed as WoNS

2. Species listed under the Queensland Biosecurity Act 2014

3. Bold text indicates species detected from the study area in December 2019 and/or May 2020.

### 5.7.2 Pest fish species

Six introduced fish species have been recorded from the Fitzroy Basin: mosquitofish (*Gambusia holbrooki*), guppy (*Poecilia reticulata*), goldfish (*Carassius auratus*), European carp (*Cyprinus carpio*) (DES 2020a), tilapia (*Oreochromis mossambicus*) (DPM Envirosciences 2018; Catchment Solutions 2015) and platy (*Xiphophorus maculatus*) (Catchment Solutions 2015).

One pest fish species was encountered during the December 2019 and May 2020 aquatic surveys, being mosquitofish (*Gambusia holbrooki*), recorded from lacustrine waterbody (farm dam) site L1 on Sagittarius Creek.

The mosquitofish is a noxious species listed as restricted categories 3, 5, 6 and 7 in the *Biosecurity Act 2014*. This species was introduced into Australia from North America in 1929 as a biological control for mosquitos; however, this was unsuccessful and the species is now regarded as one of the greatest threats to Australia's native biodiversity (Business Queensland 2020). The mosquitofish has many traits that make them a good invader such as high reproductive potential, flexible diet, broad environmental tolerances and low vulnerability to predation due to burrowing habit, and they have the potential to rapidly outnumber native fish and dominate aquatic communities (Business Queensland 2020).

Native fish or macroinvertebrate communities within site L1 did not appear to be adversely affected by the presence of mosquitofish.

### 5.7.3 Introduced aquatic reptiles

No introduced aquatic reptile species were recorded during the surveys and none were identified from the desktop review as having potential to occur in the study area.

## 5.8 Groundwater dependent ecosystems

The EPBC Act lists 'a water resource, in relation to coal seam gas development and large coal mining development' as a MNES. A water resource is defined under the Commonwealth *Water Act 2007* and incorporates ecosystems that contribute to the physical state and environmental value of the water resource. As such, environmental assessments for large coal mines are required to identify potential GDEs and assess and manage potential impacts to GDEs (IESC 2018).

The GDE Assessment Framework allows technical investigations to determine where GDEs exist within the landscape, and provides the necessary technical information to establish the ecological water requirements (EWRs), which define the intrinsic requirement an ecosystem has for water (Richardson et al. 2011a).

The framework contains three stages of assessment which should be applied to determine EWRs for GDEs. They are:

- **Stage 1 assessment:** defines the extent and location of potential GDEs. This includes determining where the ecosystems are potentially using groundwater and what the broad type of GDE is (further discussed below).
- **Stage 2 assessment:** characterises the potential reliance of the GDE on groundwater and determines if groundwater is part of the ecosystem.
- **Stage 3 assessment:** determining threats to the groundwater system and ecosystem, and how might the current ecosystem change if the groundwater system changes. The long-term state of the ecosystem is also assessed.

This report assesses the potential presence of Type 2 GDEs.

Type 1 and Type 3 GDEs are assessed in separate reports. For Type 2 GDEs also referred to as aquatic GDEs, only stage 1 and stage 2 assessments were conducted. Type 2 GDEs are ecosystems dependent on surface expression of groundwater such as wetlands, lakes, springs and river baseflow. In these cases, groundwater extends above earth surface, as a visible expression. These can be obligate or facultative GDEs (Richardson et al. 2011a).

GDEs within the study area were placed into one of the three types described by Richardson et al. (2011a). They were then allocated into groundwater dependency types being:

1. Facultative (i.e., have some degree of dependence on groundwater)
2. Entirely dependent/obligate (i.e., essential to ecosystem functioning).

Ecosystems with a facultative dependence can be further divided into three sub-categories, including:

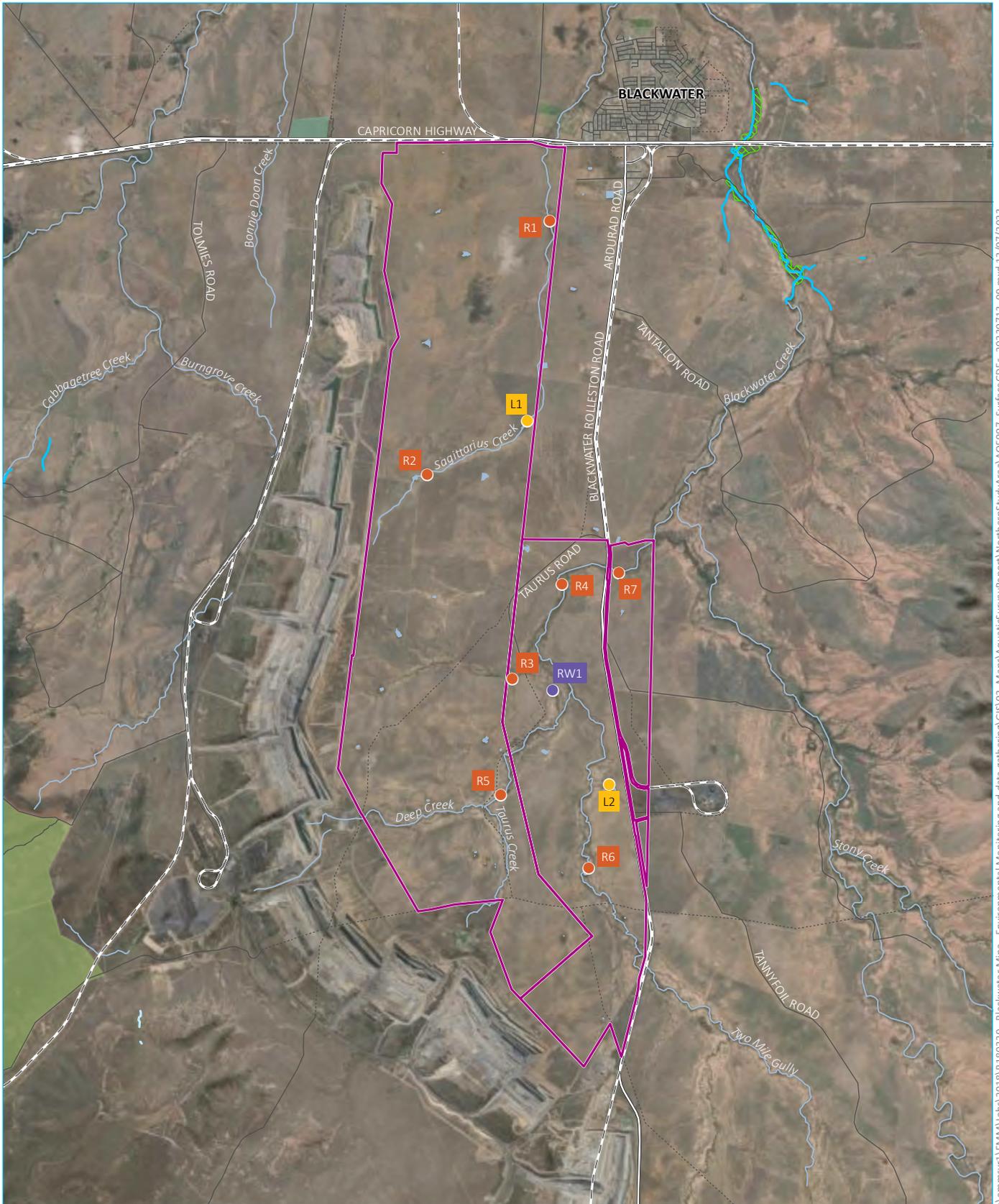
- opportunistic: these ecosystems will use groundwater where available, but can exist without the input of groundwater, as long as there is no prolonged drought. Examples of opportunistic ecosystems include some swamp forests, riparian forests and woodlands.
- proportional: these ecosystems take a proportion of their water requirements from groundwater, however there is no absolute threshold for groundwater availability below which ecosystem structure or function is impaired, and can respond to changes in groundwater at any level. Examples of proportional ecosystems include glacial lakes and alpine bogs.
- highly dependent: these ecosystems take a high proportion of their water requirements from groundwater and can only tolerate small changes in groundwater levels for short periods of time. Examples of highly dependent ecosystems include upland swamps in the Sydney Basin, Paperbark swamps in northern Australia and wetlands of the basalt plains in Victoria.

Type 2 GDEs are identified within the study area in broad-scale potential GDE mapping (DES 2020d). No aquatic GDE's were identified within the study area, however, were identified to the north-east/ east of the study area, east of the town of Blackwater, in Blackwater Creek.

### 5.8.1 Type 2 GDEs - aquatic GDEs

Desktop mapping of potential aquatic GDEs throughout Queensland (DES 2020d) shows no 'known' or 'derived' surface expression GDEs within the study area. 'Derived' surface expression GDE lines and areas of 'moderate confidence' are identified in the DES (2020d) mapping (Figure 5.5) to the north-east/ east of the study area on Blackwater Creek.

Surveys in December 2019 were undertaken following a prolonged dry period (Section 3.1). The minimal rainfall and runoff in the lead-up to the survey assisted in differentiating aquatic ecosystems dependent on surface water runoff, and those potentially dependent on the surface expression of groundwater. The concentration and relative proportion of major anions and cations in surface water samples collected from the study area in December 2019 and May 2020 show no obvious groundwater influence (Section 5.2.2). No surface GDEs were encountered within the study area.



Source: EMM (2023); DES (2022); DNRME (2023); ESRI (2023); GA (2011)



**KEY**

- Study area
- Existing environment
- Rail line
- Major road
- Minor road
- Vehicular track
- Dam/waterbody
- National park/nature reserve
- State forest
- Surface GDE lines
- Derived GDE - moderate confidence
- Derived GDE - low confidence
- Surface GDE areas
- 01-80% derived GDE - moderate confidence
- Aquatic sites surveyed
- Riverine drainage system
- Riverine wetland/waterbody
- Lacustrine waterbody

**State mapped surface expression  
groundwater dependent ecosystems (GDEs)**

BMA - Blackwater Mine  
Aquatic Ecology Baseline Assessment  
Figure 5.5



\\emmsvr1\EMM\Jobs\2018\B-180329 - Blackwater Mine - Environmental Monitoring and data gathering\GIS\02\_Maps\Aquatic\survey\report\NorthernStudyArea\AQE007\_SurfaceGDEs\_20230713\_09.mxd 13/07/2023

## 5.9 Matters of National Environmental Significance

### World and National Heritage properties

No World Heritage Properties or National Heritage Places are identified for the search area in the EPBC Act Protected Matters report (DEE 2020a, Appendix A).

### Wetlands of International Importance

No wetlands of international importance are identified within the search area in the EPBC Act Protected Matters Report (DAWE 2020a, Appendix A). Wetlands of international importance nearest to the study area include those of the Shoalwater and Corio Bays Area (DAWE 2020b), approximately 200 km to the northeast. These wetlands are well removed from the study area and are hydraulically connected only by the Coral Sea.

### Threatened Ecological Communities

No EPBC Act listed TECs, relevant to aquatic ecology, are identified from the search area (DAWE 2020a). No aquatic TECs are expected to occur within the study area.

### Threatened species

No MNES aquatic flora or fauna species were detected during field surveys.

Aquatic fauna species that are MNES which are considered to have potential to occur in the broader desktop search area include the Critically Endangered southern snapping turtle (*Elseya albagula*), Critically Endangered silver perch (*Bidyanus bidyanus*), Vulnerable Murray cod (*Maccullochella peelii*), and the Vulnerable Fitzroy River turtle (*Rheodytes leukops*), each listed under the EPBC Act. However, due to habitat requirements, it is unlikely these species occur within waterbodies of the study area as either resident or transient occurrences. Suitable habitat for these species was not encountered within the study area.

No MNES aquatic flora species are likely to occur within the study area.

### Aquatic Migratory Species

No aquatic migratory species (ie migratory species that live in water for most or all their lives) are identified from the search area.

### Commonwealth Marine Areas

The study area is located approximately 200 km west (direct line) of any marine area (DAWE 2020b) and is separated hydraulically by at least two sub-catchments (Dawson River and the Fitzroy River) with varying land use and water quality.

### Nuclear actions (including uranium mines)

The Action does not involve any nuclear actions.

### Water resource

A water resource, in relation to coal seam gas development and large coal mining development, is a controlling provision under the EPBC Act of relevance to the proposed extension of mining into SA10 and SA7 and would be addressed as per the Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals (IESC 2018).

## 5.10 Matters of State Environmental Significance

The environmental offsets framework in Queensland includes the EO Act, the EO Regulation and the EO Policy. MSES are defined in the EO Regulation and are a component of the biodiversity state interest identified in the Queensland State Planning Policy.

MSES were identified during the desktop review as occurring within the study area (Table 5.13). MSES of relevance to this aquatic ecology assessment comprise 'waterways providing for fish passage' (Figure 5.3).

**Table 5.13 Aquatic Matters of State Environmental Significance located in the study area**

Prescribed Environmental Matter	Present in the study area	Detail
Regulated vegetation	-	Refer to terrestrial ecology assessment.
Connectivity areas	-	Refer to terrestrial ecology assessment.
Wetlands and watercourses	No	No wetlands of high ecological significance or wetlands or watercourses in high ecological value waters are identified for the study area or surrounds (Figure 5.1, Figure 5.2, and Figure 5.4). Watercourse vegetation is assessed in terrestrial ecology assessment.
Protected Wildlife Habitat	-	Refer to terrestrial ecology assessment. No CEEVNT aquatic species observed or assessed as likely to occur. SLC platypus is more likely to be encountered within semi-permanent riverine waterbodies such as those upstream from a weir. No burrows were observed in the study area, nor are they considered likely to occur.
Koala Habitat in South-East Queensland	-	The study area is not located in South-east Queensland.
Protected Areas	-	Refer to terrestrial ecology assessment.
Fish Habitat Areas and Highly Protected Zones of State Marine Parks	No	The study area is not located in a State Marine Park.
Waterway providing for fish passage	Yes	Waterways within the study area provide for fish passage (Table 5.3)
Marine Plants	No	The study area is not located in a marine environment.
Secured Offset Area	-	Refer to terrestrial ecology assessment.

## 6 Conclusion

The waterways of the study area are predominantly first and second order tributaries. There are sections of waterways ranging up to the fourth order including Two Mile Gully and Taurus Creek. Taurus Creek then flows north into Blackwater Creek as a fifth order stream. Mapped wetlands in the north are comprised of one small lacustrine wetland waterbody (farm dam). A number of smaller, unmapped lacustrine wetland waterbodies (farm dams and a flood channel wetland) also occur.

The waterways of the study area are ephemeral and are generally expected to experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are expected to be highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is historically low. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

Aquatic survey was attempted at nine locations in December 2019, comprising six waterways, and two lacustrine wetland waterbodies. With most waterways being dry at the time of assessment, habitat assessments were undertaken in place of detailed aquatic survey at most riverine sites. Most lacustrine waterbodies (farm dams) held water at the time of assessment. The same sites were again sampled in May 2020 to capture a complete seasonal dataset. An additional site, site RW1 – being an unmapped flood channel wetland on Taurus Creek – was opportunistically sampled in May 2020 due to the persistence of wetted habitat that was not encountered in this area in December 2019.

No conservation significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded from the study area. Due to habitat requirements and distributional range, it is unlikely that any CEEVNT aquatic flora or fauna species occur within the waterways or wetlands of the study area as either resident or transient occurrences.

There are no wetlands of International Importance or National Importance identified within the study area.

MSES of relevance to this aquatic ecology assessment include waterways providing for fish passage, which is an MSES only if a waterway barrier work is proposed that would limit the passage of fish along the waterway. There were no HES wetlands in the study area and no aquatic species listed under EPBC Act or NC Act were observed or assessed as likely to occur.

A water resource, in relation to coal seam gas development and large coal mining development, is an MNES relevant to aquatic ecology. GDEs are a component of the water resource MNES. State mapping indicates no 'known' or 'derived' surface expression GDEs within the study area. Prolonged dry conditions in the lead-up to the December 2019 surveys provided ideal conditions for identifying surface expressions of groundwater (i.e. aquatic GDEs). However, no flows, salt seeps, hydrophytes or other obvious indicators of aquatic GDEs were encountered. Further, the concentration and relative proportion of major anions and cations in surface water samples collected from the survey area in December 2019 and May 2020 showed no obvious groundwater influence. Field verification of riparian vegetation and aquatic habitats of the study area found no obvious on-ground indicators of aquatic GDEs.

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# Appendix A

## Desktop searches

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# 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.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 10/01/20 10:06:07

[Summary](#)

[Details](#)

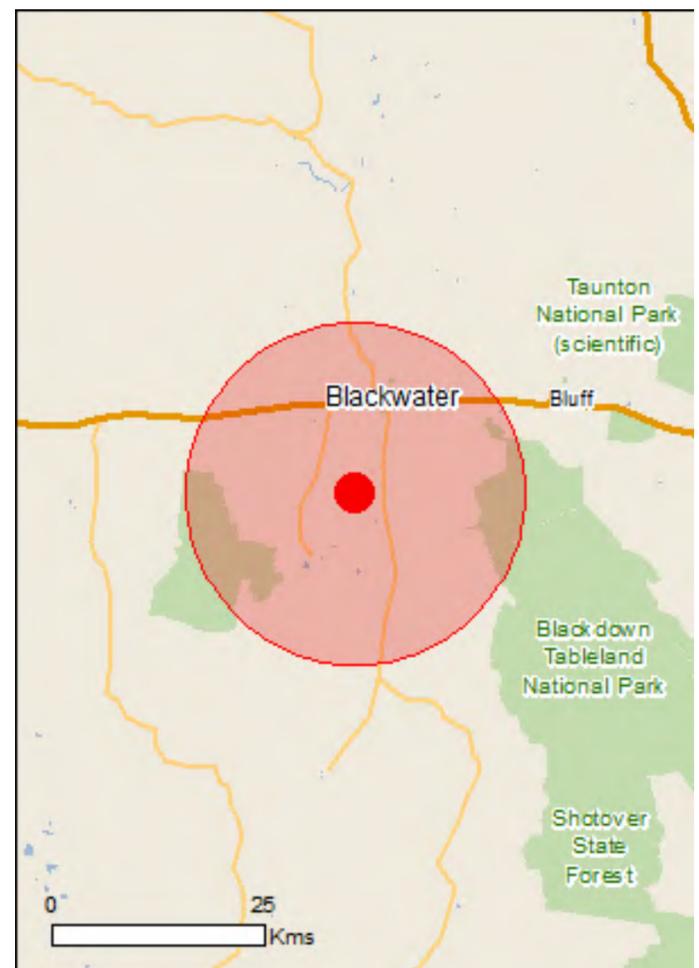
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 20.0Km



# Summary

## Matters of National Environmental 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](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	6
<a href="#">Listed Threatened Species:</a>	28
<a href="#">Listed Migratory Species:</a>	12

## 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 environment anywhere.

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.

<a href="#">Commonwealth Land:</a>	1
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	18
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None

## Extra Information

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

<a href="#">State and Territory Reserves:</a>	2
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	21
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	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.

Name	Status	Type of Presence
<a href="#">Brigalow (Acacia harpophylla dominant and co-dominant)</a>	Endangered	Community known to occur within area
<a href="#">Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions</a>	Endangered	Community may occur within area
<a href="#">Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin</a>	Endangered	Community likely to occur within area
<a href="#">Poplar Box Grassy Woodland on Alluvial Plains</a>	Endangered	Community likely to occur within area
<a href="#">Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions</a>	Endangered	Community likely to occur within area
<a href="#">Weeping Myall Woodlands</a>	Endangered	Community likely to occur within area

### Listed Threatened Species

[\[ Resource Information \]](#)

Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Erythrotriorchis radiatus</a> Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Geophaps scripta scripta</a> Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Grantiella picta</a> Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
<a href="#">Neochmia ruficauda ruficauda</a> Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
<a href="#">Poephila cincta cincta</a> Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
<a href="#">Turnix melanogaster</a> Black-breasted Button-quail [923]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
<b>Mammals</b>		
<a href="#">Chalinolobus dwyeri</a> Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Dasyurus hallucatus</a> Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
<a href="#">Macroderma gigas</a> Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Nyctophilus corbeni</a> Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
<a href="#">Petauroides volans</a> Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</a> Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
<b>Plants</b>		
<a href="#">Bertya opposens</a> [13792]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Cadellia pentastylis</a> Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Daviesia discolor</a> [3567]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Dichanthium queenslandicum</a> King Blue-grass [5481]	Endangered	Species or species habitat may occur within area
<a href="#">Dichanthium setosum</a> bluegrass [14159]	Vulnerable	Species or species habitat may occur within area
<a href="#">Homoranthus decumbens</a> a shrub [55186]	Endangered	Species or species habitat may occur within area
<a href="#">Macrozamia platyrhachis</a> cycad [3412]	Endangered	Species or species habitat likely to occur within area
<a href="#">Polianthion minutiflorum</a> [82772]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Solanum dissectum</a> [75720]	Endangered	Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Delma torquata</a> Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Denisonia maculata</a> Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Egernia rugosa</a> Yakka Skink [1420]	Vulnerable	Species or species

Name	Status	Type of Presence
<a href="#">Elseya albagula</a> Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	habitat known to occur within area Species or species habitat likely to occur within area
<a href="#">Rheodytes leukops</a> Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat likely to occur within area

### Listed Migratory Species [ [Resource Information](#) ]

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
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#### Migratory Marine Birds

<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
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#### Migratory Terrestrial Species

<a href="#">Cuculus optatus</a> Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
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<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat likely to occur within area
--	--	--

<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat may occur within area
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<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat may occur within area
--	--	--

<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat may occur within area
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#### Migratory Wetlands Species

<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
--	--	--

<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
--	--	--

<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
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<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
--	--	--

<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
--	--	--

<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat likely to occur within area
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## Other Matters Protected by the EPBC Act

### Commonwealth Land

[ [Resource Information](#) ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

#### Name

Defence - BLACKWATER TRAINING DEPOT

### Listed Marine Species

[ [Resource Information](#) ]

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Anseranas semipalmata</a> Magpie Goose [978]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Chrysococcyx osculans</a> Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat likely to occur within area
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat may occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat likely to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat may occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

## Extra Information

State and Territory Reserves	[ <a href="#">Resource Information</a> ]
Name	State
Blackdown Tableland	QLD
Blackwater	QLD

## Invasive Species [ [Resource Information](#) ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
<b>Birds</b>		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
<b>Frogs</b>		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
<b>Mammals</b>		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
<b>Plants</b>		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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.

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

Where very little information is available for 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 reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

# Coordinates

-23.67025 148.84309

# 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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# Appendix B

## Water sampling analytical results

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## CERTIFICATE OF ANALYSIS

**Work Order** : **EB1934247**  
**Client** : **DPM ENVIROSCIENCES**  
**Contact** : MR DAVID MOORE  
**Address** : PO BOX 1298  
 MOOLOOLABA QLD, AUSTRALIA 4557  
  
**Telephone** : ----  
**Project** : BMA Blackwater  
**Order number** : DPM19014  
**C-O-C number** : ----  
**Sampler** : DAVID MOORE  
**Site** : ----  
**Quote number** : EN/333  
**No. of samples received** : 6  
**No. of samples analysed** : 6

**Page** : 1 of 4  
**Laboratory** : Environmental Division Brisbane  
**Contact** : Customer Services EB  
**Address** : 2 Byth Street Stafford QLD Australia 4053  
  
**Telephone** : +61-7-3243 7222  
**Date Samples Received** : 19-Dec-2019 10:15  
**Date Analysis Commenced** : 20-Dec-2019  
**Issue Date** : 08-Jan-2020 16:32



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
^ = This result is computed from individual analyte detections at or above the level of reporting  
ø = ALS is not NATA accredited for these tests.  
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	R4	R11	L1	L2	L3
Client sampling date / time				11-Dec-2019 00:00	14-Dec-2019 00:00	10-Dec-2019 00:00	12-Dec-2019 00:00	14-Dec-2019 00:00	
Compound	CAS Number	LOR	Unit	EB1934247-001	EB1934247-002	EB1934247-003	EB1934247-004	EB1934247-005	
				Result	Result	Result	Result	Result	
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	16	6	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	136	209	160	200	146	
Total Alkalinity as CaCO3	----	1	mg/L	136	209	176	206	146	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	3	<1	<1	16	<1	
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L	40	35	36	60	24	
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	32	43	20	42	21	
Magnesium	7439-95-4	1	mg/L	13	20	11	20	12	
Sodium	7440-23-5	1	mg/L	27	32	65	59	35	
Potassium	7440-09-7	1	mg/L	7	16	6	13	13	
<b>ED093F: SAR and Hardness Calculations</b>									
Total Hardness as CaCO3	----	1	mg/L	133	190	95	187	102	
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L	0.2	0.4	0.9	0.4	0.3	
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L	3.91	5.16	4.53	6.14	3.59	
∅ Total Cations	----	0.01	meq/L	4.02	5.59	4.88	6.64	3.89	
∅ Ionic Balance	----	0.01	%	1.41	4.00	3.74	3.90	3.96	



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	L4	----	----	----	----
Client sampling date / time				13-Dec-2019 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EB1934247-006	-----	-----	-----	-----	
				Result	----	----	----	----	
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	149	----	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	70	----	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	219	----	----	----	----	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	----	----	----	----	
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L	88	----	----	----	----	
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	15	----	----	----	----	
Magnesium	7439-95-4	1	mg/L	21	----	----	----	----	
Sodium	7440-23-5	1	mg/L	74	----	----	----	----	
Potassium	7440-09-7	1	mg/L	62	----	----	----	----	
<b>ED093F: SAR and Hardness Calculations</b>									
Total Hardness as CaCO3	----	1	mg/L	124	----	----	----	----	
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L	0.6	----	----	----	----	
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L	6.86	----	----	----	----	
∅ Total Cations	----	0.01	meq/L	7.28	----	----	----	----	
∅ Ionic Balance	----	0.01	%	2.99	----	----	----	----	

## QUALITY CONTROL REPORT

<b>Work Order</b>	<b>: EB1934247</b>	<b>Page</b>	: 1 of 4
<b>Client</b>	<b>: DPM ENVIROSCIENCES</b>	<b>Laboratory</b>	: Environmental Division Brisbane
<b>Contact</b>	: MR DAVID MOORE	<b>Contact</b>	: Customer Services EB
<b>Address</b>	: PO BOX 1298 MOOLOOLABA QLD, AUSTRALIA 4557	<b>Address</b>	: 2 Byth Street Stafford QLD Australia 4053
<b>Telephone</b>	: ----	<b>Telephone</b>	: +61-7-3243 7222
<b>Project</b>	: BMA Blackwater	<b>Date Samples Received</b>	: 19-Dec-2019
<b>Order number</b>	: DPM19014	<b>Date Analysis Commenced</b>	: 20-Dec-2019
<b>C-O-C number</b>	: ----	<b>Issue Date</b>	: 08-Jan-2020
<b>Sampler</b>	: DAVID MOORE		
<b>Site</b>	: ----		
<b>Quote number</b>	: EN/333		
<b>No. of samples received</b>	: 6		
<b>No. of samples analysed</b>	: 6		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

### *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :  
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
 LOR = Limit of reporting  
 RPD = Relative Percentage Difference  
 # = Indicates failed QC

## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 2783840)</b>									
EB1934205-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	278	289	3.75	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	278	289	3.75	0% - 20%
EB1934458-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	244	245	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	244	245	0.00	0% - 20%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2786741)</b>									
EB1934247-001	R4	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	3	3	0.00	No Limit
EB1934274-005	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	238	243	2.03	0% - 20%
<b>ED045G: Chloride by Discrete Analyser (QC Lot: 2786742)</b>									
EB1934247-001	R4	ED045G: Chloride	16887-00-6	1	mg/L	40	38	3.63	No Limit
EB1934274-005	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	7070	7140	1.02	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 2777926)</b>									
EB1934208-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	32	31	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	13	13	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	50	51	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	12	11	0.00	0% - 50%
EB1934208-009	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	32	32	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	13	13	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	48	48	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	11	11	0.00	0% - 50%
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2783839)</b>									

Page : 3 of 4  
 Work Order : EB1934247  
 Client : DPM ENVIROSCIENCES  
 Project : BMA Blackwater



Sub-Matrix: **WATER**

				<i>Laboratory Duplicate (DUP) Report</i>					
<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Method: Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	<i>Original Result</i>	<i>Duplicate Result</i>	<i>RPD (%)</i>	<i>Recovery Limits (%)</i>
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2783839) - continued</b>									
EB1934205-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB1934458-002	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.1	0.1	0.00	No Limit



### Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
<b>ED037P: Alkalinity by PC Titrator (QCLot: 2783840)</b>								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	112	80.0	120
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2786741)</b>								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	96.3	85.0	118
				<1	100 mg/L	114	85.0	118
<b>ED045G: Chloride by Discrete Analyser (QCLot: 2786742)</b>								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	102	90.0	115
				<1	1000 mg/L	100	90.0	115
<b>ED093F: Dissolved Major Cations (QCLot: 2777926)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	110	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	103	70.0	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2783839)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	96.0	80.0	117

### Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%) Low High	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2786741)</b>							
EB1934247-002	R11	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	102	70.0	130
<b>ED045G: Chloride by Discrete Analyser (QCLot: 2786742)</b>							
EB1934247-002	R11	ED045G: Chloride	16887-00-6	400 mg/L	109	70.0	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2783839)</b>							
EB1934205-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	75.2	70.0	130

## QA/QC Compliance Assessment to assist with Quality Review

Work Order	: <b>EB1934247</b>	Page	: 1 of 5
Client	: <b>DPM ENVIROSCIENCES</b>	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3243 7222
Project	: BMA Blackwater	Date Samples Received	: 19-Dec-2019
Site	: ----	Issue Date	: 08-Jan-2020
Sampler	: DAVID MOORE	No. of samples received	: 6
Order number	: DPM19014	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

### Summary of Outliers

#### Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

#### Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

#### Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**



## Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>ED037P: Alkalinity by PC Titrator</b>							
Clear Plastic Bottle - Natural (ED037-P) L1	10-Dec-2019	----	----	----	24-Dec-2019	24-Dec-2019	✓
Clear Plastic Bottle - Natural (ED037-P) R4	11-Dec-2019	----	----	----	24-Dec-2019	25-Dec-2019	✓
Clear Plastic Bottle - Natural (ED037-P) L2	12-Dec-2019	----	----	----	24-Dec-2019	26-Dec-2019	✓
Clear Plastic Bottle - Natural (ED037-P) L4	13-Dec-2019	----	----	----	24-Dec-2019	27-Dec-2019	✓
Clear Plastic Bottle - Natural (ED037-P) R11, L3	14-Dec-2019	----	----	----	24-Dec-2019	28-Dec-2019	✓
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>							
Clear Plastic Bottle - Natural (ED041G) L1	10-Dec-2019	----	----	----	27-Dec-2019	07-Jan-2020	✓
Clear Plastic Bottle - Natural (ED041G) R4	11-Dec-2019	----	----	----	27-Dec-2019	08-Jan-2020	✓
Clear Plastic Bottle - Natural (ED041G) L2	12-Dec-2019	----	----	----	27-Dec-2019	09-Jan-2020	✓
Clear Plastic Bottle - Natural (ED041G) L4	13-Dec-2019	----	----	----	27-Dec-2019	10-Jan-2020	✓
Clear Plastic Bottle - Natural (ED041G) R11, L3	14-Dec-2019	----	----	----	27-Dec-2019	11-Jan-2020	✓
<b>ED045G: Chloride by Discrete Analyser</b>							
Clear Plastic Bottle - Natural (ED045G) L1	10-Dec-2019	----	----	----	27-Dec-2019	07-Jan-2020	✓
Clear Plastic Bottle - Natural (ED045G) R4	11-Dec-2019	----	----	----	27-Dec-2019	08-Jan-2020	✓
Clear Plastic Bottle - Natural (ED045G) L2	12-Dec-2019	----	----	----	27-Dec-2019	09-Jan-2020	✓
Clear Plastic Bottle - Natural (ED045G) L4	13-Dec-2019	----	----	----	27-Dec-2019	10-Jan-2020	✓
Clear Plastic Bottle - Natural (ED045G) R11, L3	14-Dec-2019	----	----	----	27-Dec-2019	11-Jan-2020	✓



Matrix: WATER

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>ED093F: Dissolved Major Cations</b>							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1	10-Dec-2019	----	----	----	20-Dec-2019	07-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R4	11-Dec-2019	----	----	----	20-Dec-2019	08-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L2	12-Dec-2019	----	----	----	20-Dec-2019	09-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L4	13-Dec-2019	----	----	----	20-Dec-2019	10-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R11, L3	14-Dec-2019	----	----	----	20-Dec-2019	11-Jan-2020	✓
<b>ED093F: SAR and Hardness Calculations</b>							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1	10-Dec-2019	----	----	----	20-Dec-2019	07-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R4	11-Dec-2019	----	----	----	20-Dec-2019	08-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L2	12-Dec-2019	----	----	----	20-Dec-2019	09-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L4	13-Dec-2019	----	----	----	20-Dec-2019	10-Jan-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R11, L3	14-Dec-2019	----	----	----	20-Dec-2019	11-Jan-2020	✓
<b>EK040P: Fluoride by PC Titrator</b>							
Clear Plastic Bottle - Natural (EK040P) L1	10-Dec-2019	----	----	----	24-Dec-2019	07-Jan-2020	✓
Clear Plastic Bottle - Natural (EK040P) R4	11-Dec-2019	----	----	----	24-Dec-2019	08-Jan-2020	✓
Clear Plastic Bottle - Natural (EK040P) L2	12-Dec-2019	----	----	----	24-Dec-2019	09-Jan-2020	✓
Clear Plastic Bottle - Natural (EK040P) L4	13-Dec-2019	----	----	----	24-Dec-2019	10-Jan-2020	✓
Clear Plastic Bottle - Natural (EK040P) R11, L3	14-Dec-2019	----	----	----	24-Dec-2019	11-Jan-2020	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Duplicates (DUP)</b>							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
<b>Laboratory Control Samples (LCS)</b>							
Alkalinity by PC Titrator	ED037-P	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
<b>Method Blanks (MB)</b>							
Chloride by Discrete Analyser	ED045G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
<b>Matrix Spikes (MS)</b>							
Chloride by Discrete Analyser	ED045G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO <sub>4</sub> <sup>2-</sup> by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO <sub>4</sub> . Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO <sub>4</sub> suspension is measured by a photometer and the SO <sub>4</sub> <sup>2-</sup> concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)  Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3)  Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO <sub>4</sub> DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)



# CHAIN OF CUSTODY

ALS Laboratory: please tick →

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MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 5224 0177 E: mackay@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9800 E: samples.melbourne@alsglobal.com

GLADSTONE 48 Callenmondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com

MUDGEES 129 Sydney Road Mudgee NSW 2850 Ph: 02 6372 8735 E: mudgee.mai@alsglobal.com

NEWCASTLE 5/585 Mattland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com  
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

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PERTH 10 Hood Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Envirosiences Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date): (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)		FOR LABORATORY USE ONLY (Circle)	
OFFICE: 12 Lauren Drive, BUDERIM QLD 4556		<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Custody Seal Intact? Yes No N/A	
PROJECT: Glencore Valeria	PROJECT NO DPM19014	ALS QUOTE NO.:	Free ice / frozen ice bricks present upon receipt? Yes No N/A		
ORDER NUMBER:	PURCHASE ORDER NO.:	COUNTRY OF ORIGIN: Australia	Random Sample Temperature on Receipt: °C		
PROJECT MANAGER: David Moore	CONTACT PH: 0427 694 433	COC SEQUENCE NUMBER (Circle)		Other comment:	
SAMPLER: David Moore	SAMPLER MOBILE: 0427 694 433	COC: 1 2 3 4 5 6 7			
COC Emailed to ALS? ( YES / NO)	EDD FORMAT (or default):	OF: 1 2 3 4 5 6 7			
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au	RELINQUISHED BY: <b>David Moore</b>	RECEIVED BY: <b>[Signature]</b>		RELINQUISHED BY:	
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au	DATE/TIME: <b>19/12/19 10:15</b>	DATE/TIME: <b>19/12/19 10:15</b>		RECEIVED BY:	
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:					

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION				Additional information				
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	NT-1D (Major cations [Ca, Mg, Na, K] + Hardness)	NT-2A (Major anions [Cl, SO4, F, Alkalinity])					Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
61934247	R4	11/12/2019	W	P, N	2	✓	✓					
	R11	14/12/2019	W	P, N	2	✓	✓					
	L1	10/12/2019	W	P, N	2	✓	✓					
	L2	12/12/2019	W	P, N	2	✓	✓					
	L3	14/12/2019	W	P, N	2	✓	✓					
	L4	13/12/2019	W	P, N	2	✓	✓					
TOTAL					12							

Environmental Division  
Brisbane  
Work Order Reference  
**EB1934247**



Telephone : + 61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic  
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SQ = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;  
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

## CERTIFICATE OF ANALYSIS

**Work Order** : **EB2014980**  
**Client** : **DPM ENVIROSCIENCES**  
**Contact** : MR DAVID MOORE  
**Address** : PO BOX 1298  
 MOOLOOLABA QLD, AUSTRALIA 4557  
  
**Telephone** : ----  
**Project** : DPM19014 BMA Blackwater  
**Order number** : ----  
**C-O-C number** : ----  
**Sampler** : DAVID MOORE  
**Site** : ----  
**Quote number** : EN/333  
**No. of samples received** : 10  
**No. of samples analysed** : 10

**Page** : 1 of 4  
**Laboratory** : Environmental Division Brisbane  
**Contact** : Customer Services EB  
**Address** : 2 Byth Street Stafford QLD Australia 4053  
  
**Telephone** : +61-7-3243 7222  
**Date Samples Received** : 05-Jun-2020 10:30  
**Date Analysis Commenced** : 05-Jun-2020  
**Issue Date** : 11-Jun-2020 09:51



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD



## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
^ = This result is computed from individual analyte detections at or above the level of reporting  
ø = ALS is not NATA accredited for these tests.  
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	L1	R4	L2	RW1	L3
Client sampling date / time				19-May-2020 00:00	20-May-2020 00:00	21-May-2020 00:00	21-May-2020 00:00	25-May-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2014980-001	EB2014980-002	EB2014980-003	EB2014980-004	EB2014980-005	
				Result	Result	Result	Result	Result	
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	194	282	298	123	105	
Total Alkalinity as CaCO3	----	1	mg/L	194	282	298	123	105	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	14	643	62	<1	
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L	23	51	248	68	13	
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	34	51	132	27	15	
Magnesium	7439-95-4	1	mg/L	12	16	74	12	8	
Sodium	7440-23-5	1	mg/L	34	68	286	67	20	
Potassium	7440-09-7	1	mg/L	7	8	16	7	9	
<b>ED093F: SAR and Hardness Calculations</b>									
Total Hardness as CaCO3	----	1	mg/L	134	193	634	117	70	
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L	0.5	0.4	0.3	0.4	0.2	
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L	4.52	7.36	26.3	5.67	2.46	
∅ Total Cations	----	0.01	meq/L	4.34	7.02	25.5	5.43	2.51	
∅ Ionic Balance	----	0.01	%	2.06	2.36	1.56	2.15	----	



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	R9	R11	P1	R12	L4
Client sampling date / time				25-May-2020 00:00	26-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	28-May-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2014980-006	EB2014980-007	EB2014980-008	EB2014980-009	EB2014980-010	
				Result	Result	Result	Result	Result	
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	100	98	82	134	96	
Total Alkalinity as CaCO3	----	1	mg/L	100	98	82	134	96	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	3	<1	4	<1	
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L	17	11	2	26	15	
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	17	18	22	25	14	
Magnesium	7439-95-4	1	mg/L	7	7	3	12	8	
Sodium	7440-23-5	1	mg/L	16	15	2	23	10	
Potassium	7440-09-7	1	mg/L	8	7	10	7	17	
<b>ED093F: SAR and Hardness Calculations</b>									
Total Hardness as CaCO3	----	1	mg/L	71	74	67	112	68	
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L	0.2	0.3	<0.1	0.3	0.2	
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L	2.52	2.33	1.69	3.49	2.34	
∅ Total Cations	----	0.01	meq/L	2.32	2.30	1.69	3.41	2.23	
∅ Ionic Balance	----	0.01	%	----	----	----	1.15	----	

## QUALITY CONTROL REPORT

<b>Work Order</b>	: <b>EB2014980</b>	Page	: 1 of 4
<b>Client</b>	: <b>DPM ENVIROSCIENCES</b>	<b>Laboratory</b>	: Environmental Division Brisbane
<b>Contact</b>	: MR DAVID MOORE	<b>Contact</b>	: Customer Services EB
<b>Address</b>	: PO BOX 1298 MOOLOOLABA QLD, AUSTRALIA 4557	<b>Address</b>	: 2 Byth Street Stafford QLD Australia 4053
<b>Telephone</b>	: ----	<b>Telephone</b>	: +61-7-3243 7222
<b>Project</b>	: DPM19014 BMA Blackwater	<b>Date Samples Received</b>	: 05-Jun-2020
<b>Order number</b>	: ----	<b>Date Analysis Commenced</b>	: 05-Jun-2020
<b>C-O-C number</b>	: ----	<b>Issue Date</b>	: 11-Jun-2020
<b>Sampler</b>	: DAVID MOORE		
<b>Site</b>	: ----		
<b>Quote number</b>	: EN/333		
<b>No. of samples received</b>	: 10		
<b>No. of samples analysed</b>	: 10		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

### *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD



## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :  
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
 LOR = Limit of reporting  
 RPD = Relative Percentage Difference  
 # = Indicates failed QC

## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 3062842)</b>									
EB2014805-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	235	233	0.573	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	235	233	0.573	0% - 20%
EB2014916-006	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	407	409	0.559	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	123	119	3.41	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	530	528	0.353	0% - 20%
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 3062844)</b>									
EB2014980-005	L3	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	105	103	1.85	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	105	103	1.85	0% - 20%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3068547)</b>									
EB2014980-001	L1	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.00	No Limit
EB2015067-016	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	10	10	0.00	0% - 50%
<b>ED045G: Chloride by Discrete Analyser (QC Lot: 3068548)</b>									
EB2014980-001	L1	ED045G: Chloride	16887-00-6	1	mg/L	23	23	0.00	0% - 20%
EB2015067-016	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	66	65	0.00	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 3064351)</b>									
EB2014890-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	347	347	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.00	No Limit

Page : 3 of 4  
 Work Order : EB2014980  
 Client : DPM ENVIROSCIENCES  
 Project : DPM19014 BMA Blackwater



Sub-Matrix: **WATER**

				<i>Laboratory Duplicate (DUP) Report</i>					
<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Method: Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	<i>Original Result</i>	<i>Duplicate Result</i>	<i>RPD (%)</i>	<i>Recovery Limits (%)</i>
<b>ED093F: Dissolved Major Cations (QC Lot: 3064351) - continued</b>									
EB2014980-005	L3	ED093F: Calcium	7440-70-2	1	mg/L	15	14	0.00	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	8	7	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	20	20	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	9	9	0.00	No Limit
<b>EK040P: Fluoride by PC Titrator (QC Lot: 3062843)</b>									
EB2014980-001	L1	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.5	0.5	0.00	No Limit



### Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
<b>ED037P: Alkalinity by PC Titrator (QCLot: 3062842)</b>								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	110	80.0	120
<b>ED037P: Alkalinity by PC Titrator (QCLot: 3062844)</b>								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	102	80.0	120
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3068547)</b>								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	106	85.0	118
				<1	100 mg/L	103	85.0	118
<b>ED045G: Chloride by Discrete Analyser (QCLot: 3068548)</b>								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	93.4	90.0	115
				<1	1000 mg/L	103	90.0	115
<b>ED093F: Dissolved Major Cations (QCLot: 3064351)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	94.8	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	96.9	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.2	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	97.7	70.0	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 3062843)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	100	80.0	117

### Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%) Low High	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3068547)</b>							
EB2014980-002	R4	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	96.2	70.0	130
<b>ED045G: Chloride by Discrete Analyser (QCLot: 3068548)</b>							
EB2014980-002	R4	ED045G: Chloride	16887-00-6	400 mg/L	108	70.0	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 3062843)</b>							
EB2014980-002	R4	EK040P: Fluoride	16984-48-8	5 mg/L	95.6	70.0	130

## QA/QC Compliance Assessment to assist with Quality Review

Work Order	: <b>EB2014980</b>	Page	: 1 of 6
Client	: <b>DPM ENVIROSCIENCES</b>	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3243 7222
Project	: DPM19014 BMA Blackwater	Date Samples Received	: 05-Jun-2020
Site	: ----	Issue Date	: 11-Jun-2020
Sampler	: DAVID MOORE	No. of samples received	: 10
Order number	: ----	No. of samples analysed	: 10

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

### Summary of Outliers

#### Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

#### Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

#### Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**



### Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>ED037P: Alkalinity by PC Titrator</b>						
Clear Plastic Bottle - Natural L1	----	----	----	05-Jun-2020	02-Jun-2020	3
Clear Plastic Bottle - Natural R4	----	----	----	05-Jun-2020	03-Jun-2020	2
Clear Plastic Bottle - Natural L2, RW1	----	----	----	05-Jun-2020	04-Jun-2020	1

### Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>ED037P: Alkalinity by PC Titrator</b>							
Clear Plastic Bottle - Natural (ED037-P) L1	19-May-2020	----	----	----	05-Jun-2020	02-Jun-2020	✖
Clear Plastic Bottle - Natural (ED037-P) R4	20-May-2020	----	----	----	05-Jun-2020	03-Jun-2020	✖
Clear Plastic Bottle - Natural (ED037-P) L2, RW1	21-May-2020	----	----	----	05-Jun-2020	04-Jun-2020	✖
Clear Plastic Bottle - Natural (ED037-P) L3, R9	25-May-2020	----	----	----	05-Jun-2020	08-Jun-2020	✔
Clear Plastic Bottle - Natural (ED037-P) R11	26-May-2020	----	----	----	05-Jun-2020	09-Jun-2020	✔
Clear Plastic Bottle - Natural (ED037-P) P1, R12	27-May-2020	----	----	----	05-Jun-2020	10-Jun-2020	✔
Clear Plastic Bottle - Natural (ED037-P) L4	28-May-2020	----	----	----	05-Jun-2020	11-Jun-2020	✔



Matrix: WATER

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>							
Clear Plastic Bottle - Natural (ED041G) L1	19-May-2020	----	----	----	09-Jun-2020	16-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) R4	20-May-2020	----	----	----	09-Jun-2020	17-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) L2, RW1	21-May-2020	----	----	----	09-Jun-2020	18-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) L3, R9	25-May-2020	----	----	----	09-Jun-2020	22-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) R11	26-May-2020	----	----	----	09-Jun-2020	23-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) P1, R12	27-May-2020	----	----	----	09-Jun-2020	24-Jun-2020	✓
Clear Plastic Bottle - Natural (ED041G) L4	28-May-2020	----	----	----	09-Jun-2020	25-Jun-2020	✓
<b>ED045G: Chloride by Discrete Analyser</b>							
Clear Plastic Bottle - Natural (ED045G) L1	19-May-2020	----	----	----	09-Jun-2020	16-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) R4	20-May-2020	----	----	----	09-Jun-2020	17-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) L2, RW1	21-May-2020	----	----	----	09-Jun-2020	18-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) L3, R9	25-May-2020	----	----	----	09-Jun-2020	22-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) R11	26-May-2020	----	----	----	09-Jun-2020	23-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) P1, R12	27-May-2020	----	----	----	09-Jun-2020	24-Jun-2020	✓
Clear Plastic Bottle - Natural (ED045G) L4	28-May-2020	----	----	----	09-Jun-2020	25-Jun-2020	✓
<b>ED093F: Dissolved Major Cations</b>							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1	19-May-2020	----	----	----	10-Jun-2020	16-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R4	20-May-2020	----	----	----	10-Jun-2020	17-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L2, RW1	21-May-2020	----	----	----	10-Jun-2020	18-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L3, R9	25-May-2020	----	----	----	10-Jun-2020	22-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R11	26-May-2020	----	----	----	10-Jun-2020	23-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) P1, R12	27-May-2020	----	----	----	10-Jun-2020	24-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L4	28-May-2020	----	----	----	10-Jun-2020	25-Jun-2020	✓



Matrix: **WATER** Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>ED093F: SAR and Hardness Calculations</b>							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1	19-May-2020	----	----	----	10-Jun-2020	16-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R4	20-May-2020	----	----	----	10-Jun-2020	17-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L2, RW1	21-May-2020	----	----	----	10-Jun-2020	18-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L3, R9	25-May-2020	----	----	----	10-Jun-2020	22-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R11	26-May-2020	----	----	----	10-Jun-2020	23-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) P1, R12	27-May-2020	----	----	----	10-Jun-2020	24-Jun-2020	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L4	28-May-2020	----	----	----	10-Jun-2020	25-Jun-2020	✓
<b>EK040P: Fluoride by PC Titrator</b>							
Clear Plastic Bottle - Natural (EK040P) L1	19-May-2020	----	----	----	05-Jun-2020	16-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) R4	20-May-2020	----	----	----	05-Jun-2020	17-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) L2, RW1	21-May-2020	----	----	----	05-Jun-2020	18-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) L3, R9	25-May-2020	----	----	----	05-Jun-2020	22-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) R11	26-May-2020	----	----	----	05-Jun-2020	23-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) P1, R12	27-May-2020	----	----	----	05-Jun-2020	24-Jun-2020	✓
Clear Plastic Bottle - Natural (EK040P) L4	28-May-2020	----	----	----	05-Jun-2020	25-Jun-2020	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Duplicates (DUP)</b>							
Alkalinity by PC Titrator	ED037-P	3	26	11.54	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	10	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
<b>Laboratory Control Samples (LCS)</b>							
Alkalinity by PC Titrator	ED037-P	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
<b>Method Blanks (MB)</b>							
Chloride by Discrete Analyser	ED045G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
<b>Matrix Spikes (MS)</b>							
Chloride by Discrete Analyser	ED045G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO <sub>4</sub> <sup>2-</sup> by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO <sub>4</sub> . Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO <sub>4</sub> suspension is measured by a photometer and the SO <sub>4</sub> <sup>2-</sup> concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)  Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3)  Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO <sub>4</sub> DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)



# CHAIN OF CUSTODY

ALS Laboratory: please tick →

BRISBANE 2 Byth Street Stafford QLD 4053  
Ph: 07 5243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 48 Callemondah Drive Gladstone QLD 4680  
Ph: 07 4978 7944 E: gladstone@alsglobal.com

ADELAIDE 3/1 Burma Road Pooraka SA 5034  
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Ph: 03 8548 9600 E: samples.melbourne@alsglobal.com

MUDGEE 129 Sydney Road Mudgee NSW 2850  
Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2305  
Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Gaery Place North Nowra NSW 2541  
Ph: 02 4423 2053 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090  
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SYDNEY 277-289 Woodpark Road Smithfield NSW 2164  
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818  
Ph: 07 4796 0500 E: townsville.environmental@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500  
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Envirosiences Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: 12 Lauren Drive, BUDERIM QLD 4556		(Standard TAT may be longer for some tests e.g. Ultra Trace Organics)		Custody Seal Intact? Yes No N/A	
PROJECT: BMA Blackwater		<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Free ice / frozen ice bricks present upon receipt? Yes No N/A	
PROJECT NO DPM19014		ALS QUOTE NO.:		Random Sample Temperature on Receipt: °C	
ORDER NUMBER:		COUNTRY OF ORIGIN: Australia		Other comment:	
PURCHASE ORDER NO.:		COC SEQUENCE NUMBER (Circle)			
PROJECT MANAGER: David Moore		CONTACT PH: 0427 694 433			
SAMPLER: David Moore		SAMPLER MOBILE: 0427 694 433		RECEIVED BY: <i>Renata</i>	
COC Emailed to ALS? ( YES / NO)		EDD FORMAT (or default):		RELINQUISHED BY: DAVID MOORE	
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au		DATE/TIME: 5/6/2020 10:30		DATE/TIME: 5.6.2020 10:30	
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au				DATE/TIME:	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION				Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	NT-1D (Major cations [Ca, Mg, Na, K] + Hardness)	NT-2A (Major anions [Cl, SO4, F, Alkalinity])	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	L1	19/05/2020	W	P, N	2	✓	✓	
2	R4	20/05/2020	W	P, N	2	✓	✓	
3	L2	21/05/2020	W	P, N	2	✓	✓	
4	RW1	21/05/2020	W	P, N	2	✓	✓	
5	L3	25/05/2020	W	P, N	2	✓	✓	
6	R9	25/05/2020	W	P, N	2	✓	✓	
7	R11	26/05/2020	W	P, N	2	✓	✓	
8	P1	27/05/2020	W	P, N	2	✓	✓	
9	R12	27/05/2020	W	P, N	2	✓	✓	
10	L4	28/05/2020	W	P, N	2	✓	✓	
TOTAL					20			

Environmental Division  
Brisbane  
Work Order Reference  
**EB2014980**



Telephone + 61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic  
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;  
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

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# Appendix C

## Aquatic survey site profiles

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**Table 1** Sagittarius Creek – Dry

Site: R1 Property: Mountain View Stream order: 3 Latitude (GDA 94): -23.6017 Longitude (GDA 94): 148.8635 Date: 10/12/2019 Season: Dry



Upstream



Left bank



Downstream



Right bank

#### General site description

#### Site attributes

Ephemeral third order drainage line; dry at the time of assessment; well defined bed and banks; some local catchment erosion detected, including bank slumping; U shaped channel; concave banks; clay loam banks; banks moderately unstable (side slopes up to 60% on some banks), but with good bank vegetative stability; bankfull width approx. 7 m and bankfull height approx. 2 m; in-stream habitat features in times of flow would include some (10–50%) detritus, little (1-10%) sticks, branches and logs; bed substrates comprised approximately 5% bedrock, 1% boulder (>256 mm), 1% cobble (64–256 mm), 1% pebble (4–64 mm) and 92% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.1 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’; riparian zone (of main channel) approximately 10 m on the left bank and 10 m on the right, comprising tall (11 m) open (25% crown cover) woodland dominated by brigalow (*Acacia harpophylla*), yellowwood (*Terminalia oblongata*) and coolabah (*Eucalyptus coolabah*), with frequent red bauhinia (*Lysiphyllum carronii*) and narrow-leaved bottle tree (*Brachychiton rupestris*); shrub layer dominated by brigalow, with frequent currant bush (*Carissa ovata*) and native jasmine (*Jasminum didymum*), occasional soft turkey bush (*Acalypha eremorum*), false sandalwood (*Eremophila mitchellii*), boonaree (*Alectryon oleifolius*), limebush (*Citrus glauca*), sally wattle (*Acacia salicina*) and small-leaved ebony (*Diospyros humilis*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent curly windmill grass (*Enteropogon acicularis*), occasional green panic (*Megathyrsus maximus*)\*, mother-of-millions (*Bryophyllum delagoense*)\* and Harrisia cactus (*Harrisia martinii*)\*; semi-aquatic macrophytes in adjacent flood channel included little (1–10%) sedge (*Cyperus* sp.) and umbrella canegrass (*Leptochloa digitata*).

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with 50–79% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected. Freshwater crab and mussel shells observed.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 1** Sagittarius Creek – Dry

Site: R1	Property: Mountain View	Stream order: 3	Latitude (GDA 94): -23.6017	Longitude (GDA 94): 148.8635	Date: 10/12/2019	Season: Dry
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**Physico-chemical water quality**

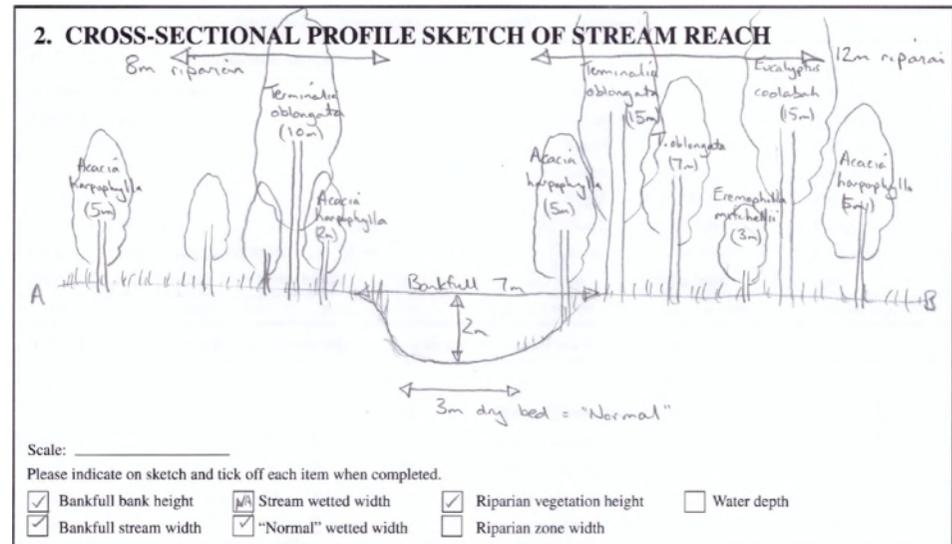
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (54).

**Overall aquatic values**

Dry season: **Low-Moderate**



**Table 2** Sagittarius Creek – Late wet

Site: R1 Property: Mountain View Stream order: 3 Latitude (GDA 94): -23.6017 Longitude (GDA 94): 148.8635 Date: 19/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral third order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; well defined bed and banks; some local catchment erosion detected, including bank slumping; U shaped channel; concave banks; clay loam banks; banks moderately unstable (side slopes up to 60% on some banks), but with good bank vegetative stability; bankfull width approx. 7 m and bankfull height approx. 2 m; in-stream habitat features in times of flow would include some (10–50%) detritus, little (1–10%) sticks, branches and logs; bed substrates comprised approximately 5% bedrock, 1% boulder (>256 mm), 1% cobble (64–256 mm), 1% pebble (4–64 mm) and 92% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.1 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’; riparian zone (of main channel) approximately 10 m on the left bank and 10 m on the right, comprising tall (11 m) open (25% crown cover) woodland dominated by brigalow (*Acacia harpophylla*), yellowwood (*Terminalia oblongata*) and coolabah (*Eucalyptus coolabah*), with frequent red bauhinia (*Lysiphyllum carronii*) and narrow-leaved bottle tree (*Brachychiton rupestris*); shrub layer dominated by brigalow, with frequent currant bush (*Carissa ovata*) and native jasmine (*Jasminum didymum*), occasional soft turkey bush (*Acalypha eremorum*), false sandalwood (*Eremophila mitchellii*), boonaree (*Alectryon oleifolius*), limebush (*Citrus glauca*), sally wattle (*Acacia salicina*) and small-leaved ebony (*Diospyros humilis*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent curly windmill grass (*Enteropogon acicularis*), *Malvastrum* sp. and *Senna* sp., occasional parthenium (*Parthenium hysterophorus*)\*, green panic (*Megathyrsus maximus*)\*, mother-of-millions (*Bryophyllum delagoense*)\* and *Harrisia* cactus (*Harrisia martinii*)\*; semi-aquatic macrophytes included little (1–10%) *Cyperus betchei* and awnless barnyard grass (*Echinochloa colona*)\*; semi-aquatic macrophytes in nearby flood channel included little (1–10%) pale knotweed (*Persicaria lapathifolia*), rice sedge (*Cyperus difformis*), dwarf sedge (*C. pygmaeus*), tall flatsedge (*C. exaltatus*), awnless barnyard grass\*, umbrella canegrass (*Leptochloa digitata*) and white eclipta (*Eclipta prostrata*)\*.

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with 50–79% of the streambank surfaces covered by vegetation (including tree roots).

**Table 2** Sagittarius Creek – Late wet

Site: R1 Property: Mountain View Stream order: 3 Latitude (GDA 94): -23.6017 Longitude (GDA 94): 148.8635 Date: 19/05/2020 Season: Late wet

**Aquatic fauna, including breeding habitat**

No aquatic fauna detected. May provide foraging habitat and limited breeding habitat for fish in times of flow. No turtle or platypus breeding habitat detected. Freshwater crab and mussel shells observed.

**Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna**

No EVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Physico-chemical water quality**

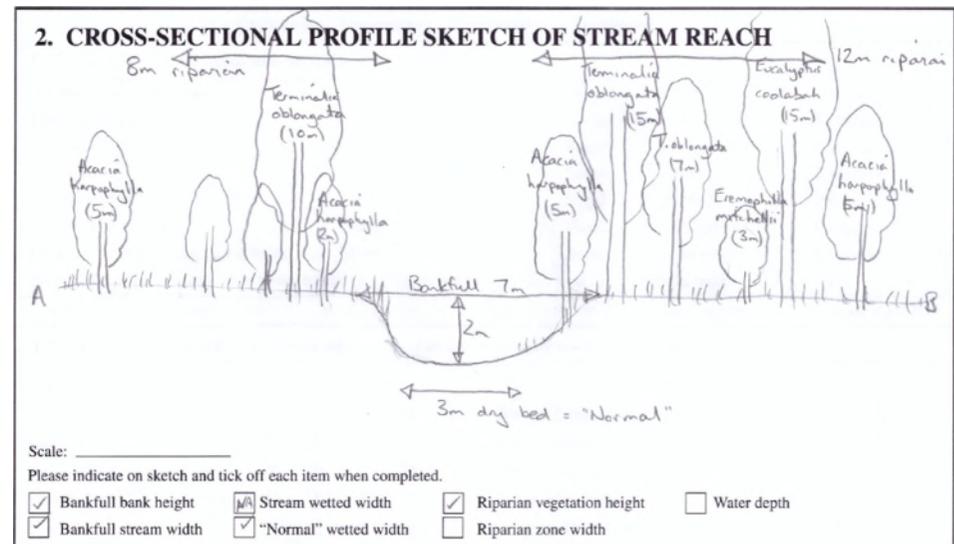
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (54).

**Overall aquatic values**

Dry season: **Low-moderate**



**Table 3** Sagittarius Creek – Dry

Site: R2 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6527 Longitude (GDA 94): 148.8377 Date: 10/12/2019 Season: Dry



Upstream



Left bank



Downstream



Right bank

#### General Site Description

#### Site attributes

Ephemeral second order drainage line; dry at the time of assessment; moderately defined bed and banks; some local catchment erosion, including rill erosion; extensive gully erosion 100 m upstream; flat U shaped channel; convex banks; clay banks; banks moderately unstable (moderate frequency and size of erosional areas), fair bank vegetative stability; bankfull width approx. 8 m and bankfull height approx. 0.8 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks and branches; bed substrates comprised 4% pebble (4–64 mm), 25% gravel (2–4 mm), 40% sand (0.05–2 mm) and 31% silt/clay (<0.05 mm); upstream land use includes coal mining and moderate cattle grazing on land cleared of native vegetation; adjacent land use includes moderate cattle grazing on land cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within regrowth woodland State-mapped as non-remnant; field-verified as non-remnant regrowth RE 11.4.9 or 11.9.5 – ‘*Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains’ / ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks’; riparian zone approximately 5 m on the left bank and 5 m on the right, comprising low (4–5 m) very sparse (10–15% crown cover) woodland; canopy dominated by brigalow (*Acacia harpophylla*), with occasional whitewood (*Atalaya hemiglauca*) and yellowwood (*Terminalia oblongata*); very sparse shrub layer, dominated by brigalow suckers, with frequent currant bush (*Carissa ovata*) and harrisia cactus (*Harrisia martinii*)\*, and occasional nipan (*Capparis lasiantha*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent curly windmill grass (*Enteropogon acicularis*), soft roly-poly (*Salsola australis*), bluegrass (*Bothriochloa* sp.), and occasional common couch (*Cynodon dactylon*)\*; no macrophytes detected.

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with fair bank vegetative stability (24–49% of stream bank covered by vegetation, gravel or larger material). Further loss of riparian vegetation would result in high erosion risk.

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide foraging habitat for highly mobile fish in times of flow. No fish, turtle or platypus breeding habitat detected.

**Table 3** Sagittarius Creek – Dry

Site: R2 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6527 Longitude (GDA 94): 148.8377 Date: 10/12/2019 Season: Dry

Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Physico-chemical water quality**

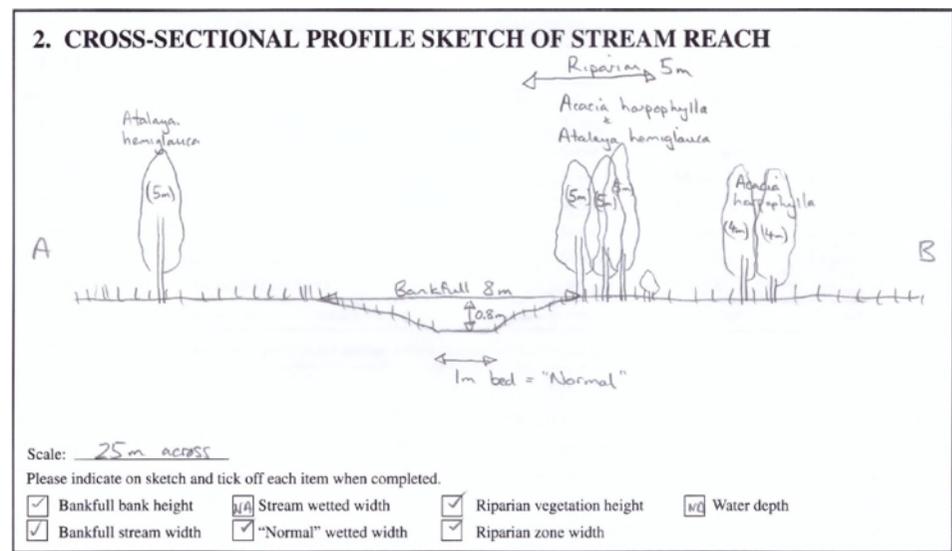
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (51).

**Overall aquatic values**

Dry season: Low



**Table 4** Sagittarius Creek – Late wet

Site: R2 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6527 Longitude (GDA 94): 148.8377 Date: 19/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral second order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; moderately defined bed and banks; some local catchment erosion, including rill erosion; extensive gully erosion 100 m upstream; flat U shaped channel; convex banks; clay banks; banks moderately unstable (moderate frequency and size of erosional areas), fair bank vegetative stability; bankfull width approx. 8 m and bankfull height approx. 0.8 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks and branches; bed substrates comprised approx. 4% pebble (4–64 mm), 25% gravel (2–4 mm), 40% sand (0.05–2 mm) and 31% silt/clay (<0.05 mm); upstream land use includes coal mining and moderate cattle grazing on land cleared of native vegetation; adjacent land use includes moderate cattle grazing on land cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within regrowth woodland State-mapped as non-remnant; field-verified as non-remnant regrowth RE 11.4.9 or 11.9.5 – ‘*Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains’ / ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks’; riparian zone approximately 5 m on the left bank and 5 m on the right, comprising low (4–5 m) very sparse (10–15% crown cover) woodland; canopy dominated by brigalow (*Acacia harpophylla*), with occasional whitewood (*Atalaya hemiglauca*) and yellowwood (*Terminalia oblongata*); very sparse shrub layer, dominated by brigalow suckers, with frequent currant bush (*Carissa ovata*) and harrisia cactus (*Harrisia martinii*)\*, and occasional nipan (*Capparis lasiantha*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent curly windmill grass (*Enteropogon acicularis*), red spinach (*Trianthema triquetra*), soft roly-poly (*Salsola australis*) and forest bluegrass (*Bothriochloa bladhii*), and occasional common couch (*Cynodon dactylon*)\*, button grass (*Dactyloctenium radulans*), nodding saltbush (*Einadia nutans*) and black roly-poly (*Sclerolaena muricata*); no macrophytes detected.

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with fair bank vegetative stability (24–49% of stream bank covered by vegetation, gravel or larger material). Further loss of riparian vegetation would result in high erosion risk.

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide foraging habitat for highly mobile fish in times of flow. No fish, turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No EVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 4** Sagittarius Creek – Late wet

Site: R2 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6527 Longitude (GDA 94): 148.8377 Date: 19/05/2020 Season: Late wet

**Physico-chemical water quality**

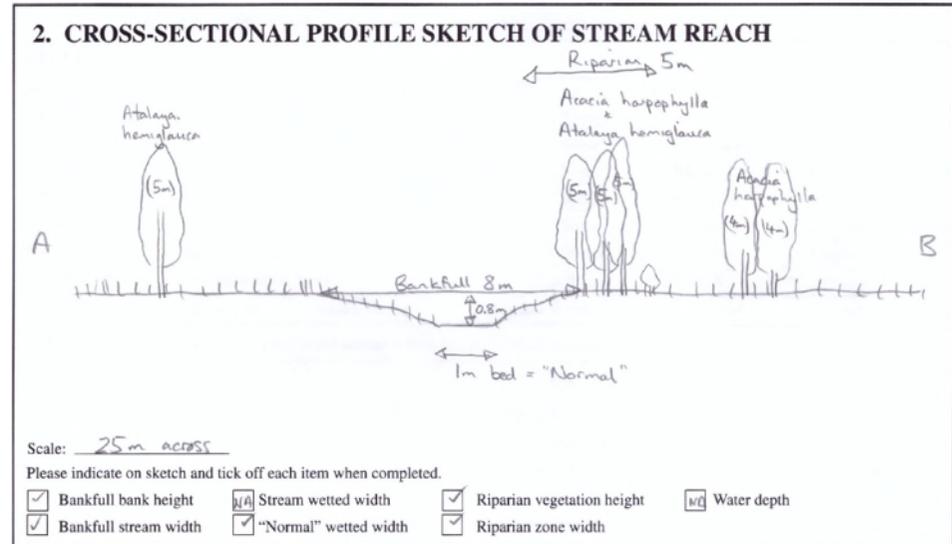
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (51).

**Overall aquatic values**

Dry season: **Low**



**Table 5** Unnamed tributary – Dry

Site: R3 Property: Taurus Stream order: 1 Latitude (GDA 94): -23.6933 Longitude (GDA 94): 148.8567 Date: 11/12/2019 Season: Dry



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral first order drainage line; dry at the time of assessment; well defined bed and banks; moderate local catchment erosion, including bank slumping; U shaped channel; clay banks; banks unstable (many eroded areas with side slopes >60% common), but with fair bank vegetative stability; bankfull width approx. 5 m and bankfull height approx. 1.5 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks, branches and logs; bed substrates comprised approx. 10% gravel (2–4 mm), 70% sand (0.05–2 mm) and 20% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified small patch of RE 11.4.9, surrounded by regrowth; riparian zone (of main channel) approximately 10 m on the left bank and 10 m on the right, comprising medium-tall (10 m) open (30% crown cover) woodland dominated by brigalow (*Acacia harpophylla*), with frequent yellowwood (*Terminalia oblongata*) and red bauhinia (*Lysiphyllum carronii*); sparse sub-canopy, with frequent brigalow, false sandalwood (*Eremophila mitchellii*), occasional red bauhinia and rare emu apple (*Owenia acidula*); very sparse shrub layer dominated by brigalow, with frequent *Harrisia cactus* (*Harrisia martinii*)\*, occasional red bauhinia, scrub boonaree (*Alectryon diversifolius*), currant bush (*Carissa ovata*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent curly windmill grass (*Enteropogon acicularis*), occasional mother-of-millions (*Bryophyllum delagoense*)\* and rare occurrence of the Endangered (NC Act) *Solanum elachophyllum*. No aquatic macrophytes detected.

#### Erosion risk

Moderate-high – Banks unstable, but with fair bank vegetative stability (24–49% of stream bank covered by vegetation [including roots], gravel or larger material). Further loss of riparian vegetation would result in high erosion risk.

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide foraging habitat for highly mobile fish in times of flow. No fish, turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 5** Unnamed tributary – Dry

Site: R3	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.6933	Longitude (GDA 94): 148.8567	Date: 11/12/2019	Season: Dry
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**Physico-chemical water quality**

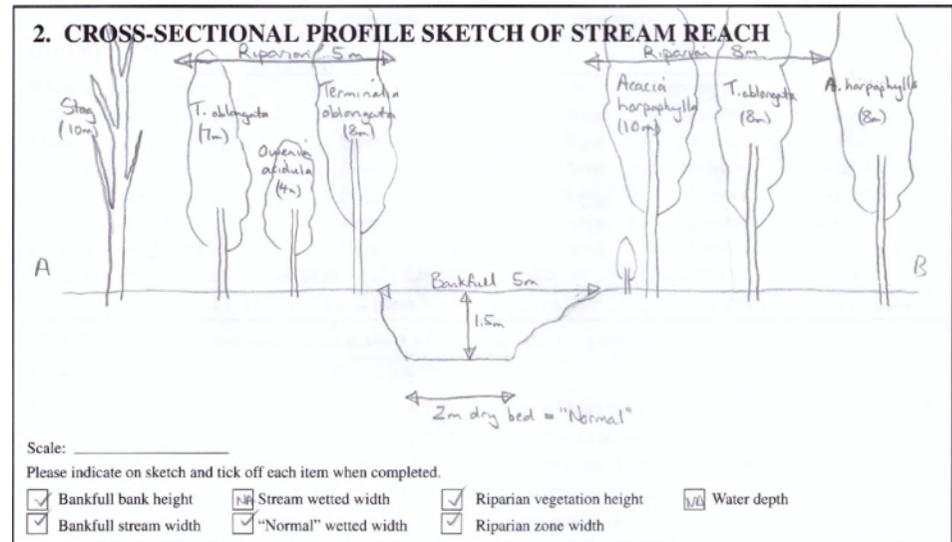
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Poor (29).

**Overall aquatic values**

Dry season: **Low**



**Table 6** Unnamed tributary – Late wet

Site: R3 Property: Taurus Stream order: 1 Latitude (GDA 94): -23.6933 Longitude (GDA 94): 148.8567 Date: 21/05/2020 Season: Late wet



Upstream

Left bank

Downstream

Right bank

### General Site Description

#### Site attributes

Ephemeral first order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; well defined bed and banks; moderate local catchment erosion, including bank slumping; U shaped channel; clay banks; banks unstable (many eroded areas with side slopes >60% common), but with fair bank vegetative stability; bankfull width approx. 5 m and bankfull height approx. 1.5 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks, branches and logs; bed substrates comprised approx. 10% gravel (2–4 mm), 70% sand (0.05–2 mm) and 20% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified small patch of RE 11.4.9, surrounded by regrowth; riparian zone (of main channel) approximately 10 m on the left bank and 10 m on the right, comprising medium-tall (10 m) open (30% crown cover) woodland dominated by brigalow (*Acacia harpophylla*), with frequent yellowwood (*Terminalia oblongata*) and red bauhinia (*Lysiphyllum carronii*); sparse sub-canopy with frequent brigalow, false sandalwood (*Eremophila mitchellii*), occasional red bauhinia and rare emu apple (*Owenia acidula*); very sparse shrub layer dominated by brigalow, with frequent *Harrisia cactus* (*Harrisia martinii*)\*, occasional red bauhinia, scrub boonaree (*Alectryon diversifolius*), currant bush (*Carissa ovata*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant parthenium (*Parthenium hysterophorus*)\*, frequent curly windmill grass (*Enteropogon acicularis*), desert petunia (*Dipteracanthus australasicus*), ruby saltbush (*Enchylaena tomentosa*), spiked malvastrum (*Malvastrum americanum*), flannel weed (*Abutilon oxycarpum*), occasional mother-of-millions (*Bryophyllum delagoense*)\* and rare occurrence of the Endangered (NC Act) *Solanum elachophyllum*. No aquatic macrophytes detected.

#### Erosion risk

Moderate-high – Banks unstable, but with fair bank vegetative stability (24–49% of stream bank covered by vegetation [including roots], gravel or larger material). Further loss of riparian vegetation would result in high erosion risk.

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide foraging habitat for highly mobile fish in times of flow. No fish, turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 6** Unnamed tributary – Late wet

Site: R3	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.6933	Longitude (GDA 94): 148.8567	Date: 21/05/2020	Season: Late wet
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**Physico-chemical water quality**

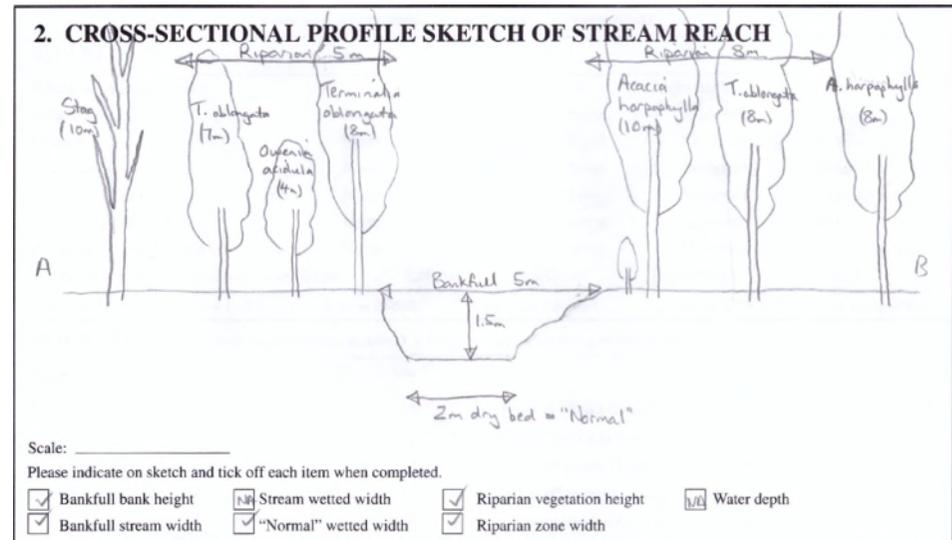
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Poor (29).

**Overall aquatic values**

Dry season: **Low**



**Table 7** Taurus Creek – Dry

Site: R4 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6743 Longitude (GDA 94): 148.8671 Date: 11/12/2019 Season: Dry



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; pooled water at the time of assessment due to burst stock watering pipe nearby, that had since been repaired; well defined bed and banks; little local catchment erosion, including rill, gully and bank slumping; U shaped channel; concave banks; clay banks; banks moderately unstable (side slopes up to 60% on some banks), but with good bank vegetative stability; bankfull width approx. 20 m and bankfull height approx. 4.5 m; in-stream habitat features included shallow and deep (>0.5 m) pool, macrophytes, detritus, sticks, branches and logs; bed substrates comprised approx. 30% sand (0.05–2 mm) and 70% silt/clay (<0.05 mm); edge habitat substrates comprised approx. 20% sand and 80% silt/clay; upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation; feral pig (*Sus scrofa*) resting in waterbody on arrival.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as mixed RE 11.3.2 / 11.3.25 / 11.3.1; field-verified as RE 11.3.1 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’; riparian zone approximately 10 m on the left bank and 10 m on the right, comprising tall (20 m) open (30% crown cover) woodland dominated by (infested with) rubber vine (*Cryptostegia grandiflora*)\*, with abundant brigalow (*Acacia harpophylla*), frequent yellowwood (*Terminalia oblongata*), coolabah (*Eucalyptus coolabah*) and narrow-leaved bottle tree (*Brachychiton rupestris*); sparse sub-canopy dominated by rubber vine\*, with frequent yellowwood, occasional white bauhinia (*Lysiphyllum hookeri*) and bean tree (*Cassia brewsteri*), very sparse shrub layer, including yellowwood; ground layer of the upper bank dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant mother-of-millions (*Bryophyllum delagoense*)\*; ground layer of the lower bank dominated by water primrose (*Ludwigia peploides*), with occasional umbrella canegrass (*Leptochloa digitata*) and tall flatsedge (*Cyperus exaltatus*); semi-aquatic macrophytes included some (10–50%) water primrose, little (1–10%) umbrella canegrass and *C. exaltatus*.

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with 50–79% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

The reach provides potential foraging and breeding habitat for fish and common turtle species. No suitable platypus breeding habitat detected. Aquatic fauna detected by backpack electrofishing and overnight deployment of two baited fyke nets and five baited box traps included gudgeon (*Hypseleotris galii* / sp. 1), western carp gudgeon (*H. klunzingeri*), eastern rainbowfish (*Melanotaenia splendida*), fly-specked hardyhead (*Craterocephalus stercusmuscarum*), Agassiz’s glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*) and purple-spotted gudgeon (*Magurnda adspersa*).

**Table 7** Taurus Creek – Dry

Site: R4	Property: Mountain View	Stream order: 4	Latitude (GDA 94): -23.6743	Longitude (GDA 94): 148.8671	Date: 11/12/2019	Season: Dry
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Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eiseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Physico-chemical water quality**

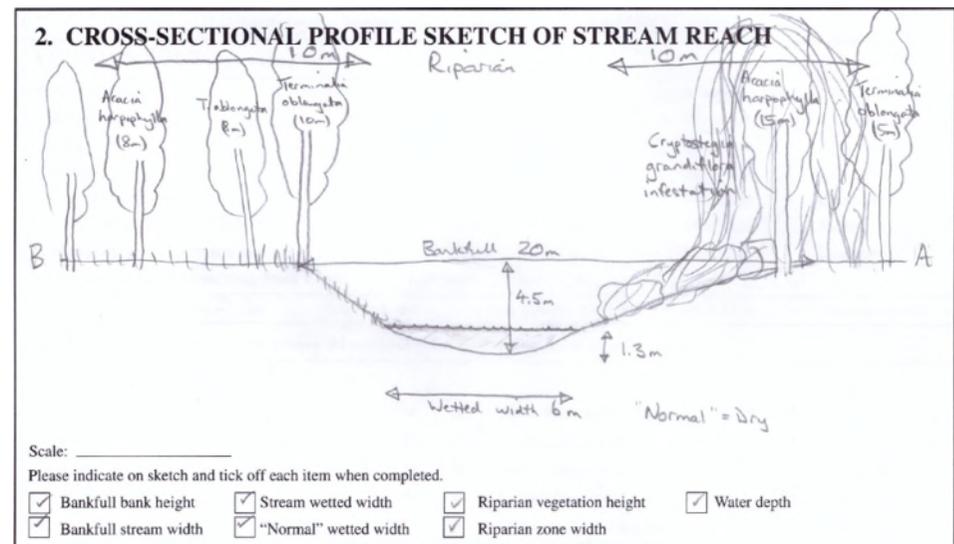
Collection time: 12:00; water temp: 26.7°C; specific conductivity: 387 µS/cm (fresh); turbidity: 24 NTU (good clarity); dissolved oxygen: 36.0%, 2.9 mg/L (low for time of day when DO levels should be nearing their diurnal peak); pH: 7.9 (moderately alkaline, likely reflecting the clay catchment). Comments: Most parameters normal; low DO likely due to a combination of factors, including oxygen consumption by bacteria during the breakdown of organic matter, and shading by rubber vine\* leading to reduced photosynthetic respiration of oxygen by algae and macrophytes.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (59).

**Overall aquatic values**

Dry season: **Moderate**



**Table 8** Taurus Creek – Late wet

Site: R4 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6743 Longitude (GDA 94): 148.8671 Date: 20/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; isolated pools at the time of assessment; debris indicates flood event since December 2019 survey; well defined bed and banks; little local catchment erosion, including rill, gully and bank slumping; U shaped channel; concave banks; clay banks; banks moderately unstable (side slopes up to 60% on some banks), but with good bank vegetative stability; bankfull width approx. 20 m and bankfull height approx. 4.5 m; in-stream habitat features included shallow and deep (>0.5 m) pool, macrophytes, detritus, sticks, branches and logs; bed substrates comprised approx. 30% sand (0.05–2 mm) and 70% silt/clay (<0.05 mm); edge habitat substrates comprised approx. 20% sand and 80% silt/clay; upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as mixed RE 11.3.2 / 11.3.25 / 11.3.1; field-verified as RE 11.3.1 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’; riparian zone approximately 10 m on the left bank and 10 m on the right, comprising tall (20 m) open (30% crown cover) woodland dominated by (infested with) rubber vine (*Cryptostegia grandiflora*)\*, with abundant brigalow (*Acacia harpophylla*), frequent yellowwood (*Terminalia oblongata*), coolabah (*Eucalyptus coolabah*) and narrow-leaved bottle tree (*Brachychiton rupestris*); sparse sub-canopy dominated by rubber vine\*, with frequent yellowwood, occasional white bauhinia (*Lysiphyllum hookeri*) and bean tree (*Cassia brewsteri*), very sparse shrub layer, including yellowwood; ground layer of the upper bank dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant parthenium (*Parthenium hysterophorus*)\* and frequent mother-of-millions (*Bryophyllum delagoense*)\*; semi-aquatic macrophytes included little (1–10%) water primrose (*Ludwigia peploides*), *Cyperus betchei* and rice flatsedge (*C. iria*).

#### Erosion risk

Moderate – Banks appeared to be moderately unstable, but with 50–79% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

The reach provides potential foraging and breeding habitat for fish and common turtle species. No suitable platypus breeding habitat detected. Aquatic fauna detected by backpack electrofishing and overnight deployment of two baited fyke nets and five baited box traps included gudgeon (*Hypseleotris galii* / sp. 1), eastern rainbowfish (*Melanotaenia splendida*), Agassiz’s glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*), bony bream (*Nematalosa erebi*), purple-spotted gudgeon (*Mogurnda adspersa*), Rendahl’s catfish (*Porochilus rendahli*) and Hyrtly’s tandan (*Neosilurus hyrtlii*).

**Table 8** Taurus Creek – Late wet

Site: R4 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6743 Longitude (GDA 94): 148.8671 Date: 20/05/2020 Season: Late wet

Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Physico-chemical water quality**

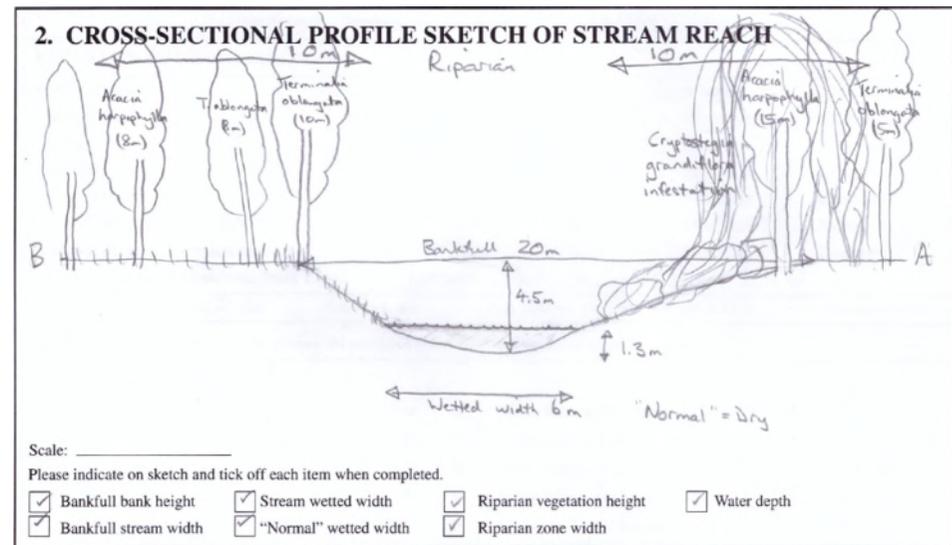
Collection time: 10:30; water temp.: 19.0°C; specific conductivity: 676 µS/cm (fresh); turbidity: 40 NTU (good clarity); dissolved oxygen: 20.3%, 1.9 mg/L (low); pH: 7.6 (mildly alkaline, likely reflecting the clay catchment). Comments: Most parameters normal; low DO likely due to a combination of factors, including oxygen consumption by bacteria during the breakdown of organic matter, and shading by rubber vine\* leading to reduced photosynthetic respiration of oxygen by algae and macrophytes.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (59).

**Overall aquatic values**

Dry season: **Moderate**



**Table 9** Taurus Creek – Dry

Site: R5 Property: Taurus Stream order: 3 Latitude (GDA 94): -23.7165 Longitude (GDA 94): 148.8544 Date: 12/12/2019 Season: Dry



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral third order drainage line; dry at the time of assessment; well defined bed and banks; some local catchment erosion detected, including bank slumping; convex banks, flat U shaped channel, as a result of sand deposition; both clay and sandy loam banks; banks moderately unstable (side slopes up to 60% on some banks); fair bank vegetative stability; bankfull width approx. 22 m and bankfull height approx. 3 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks and branches; bed substrates comprised approximately 10% gravel (2–4 mm) and 90% sand (0.05–2 mm); upstream land use includes mining and moderate cattle grazing on land predominantly cleared of remnant vegetation; adjacent land use includes light cattle grazing.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as mixed RE 11.3.1 / 11.3.25 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’ / ‘*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines’; riparian zone approximately 20 m on the left bank and 20 m on the right, comprising tall (17 m) open (20% crown cover) woodland dominated by yellowwood (*Terminalia oblongata*), with frequent brigalow (*Acacia harpophylla*), narrow-leaved bottle tree (*Brachychiton rupestris*), occasional Queensland blue gum (*Eucalyptus tereticornis*), silver-leaved ironbark (*E. melanophloia*), poplar box (*E. populnea*) and boonaree (*Alectryon oleifolius*); sparse sub-canopy dominated by white bauhinia (*Lysiphyllum hookeri*), yellowwood and brigalow, with occasional false sandalwood (*Eremophila mitchellii*), emu apple (*Owenia acidula*), sally wattle (*Acacia salicina*), carbeen (*Corymbia tessellaris*) and sandalwood (*Santalum lanceolatum*); very sparse shrub layer, including currant bush (*Carissa ovata*), nipan (*Capparis lasiantha*), soft turkey bush (*Acalypha eremorum*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with occasional wiregrass (*Aristida* sp.), green panic (*Megathyrsus maximus*)\*, Harrisia cactus (*Harrisia martinii*)\* and velvet tree pear (*Opuntia tomentosa*)\*; no macrophytes detected.

#### Erosion risk

Moderate-high – Banks appeared to be moderately unstable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 9** Taurus Creek – Dry

Site: R5	Property: Taurus	Stream order: 3	Latitude (GDA 94): -23.7165	Longitude (GDA 94): 148.8544	Date: 12/12/2019	Season: Dry
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**Physico-chemical water quality**

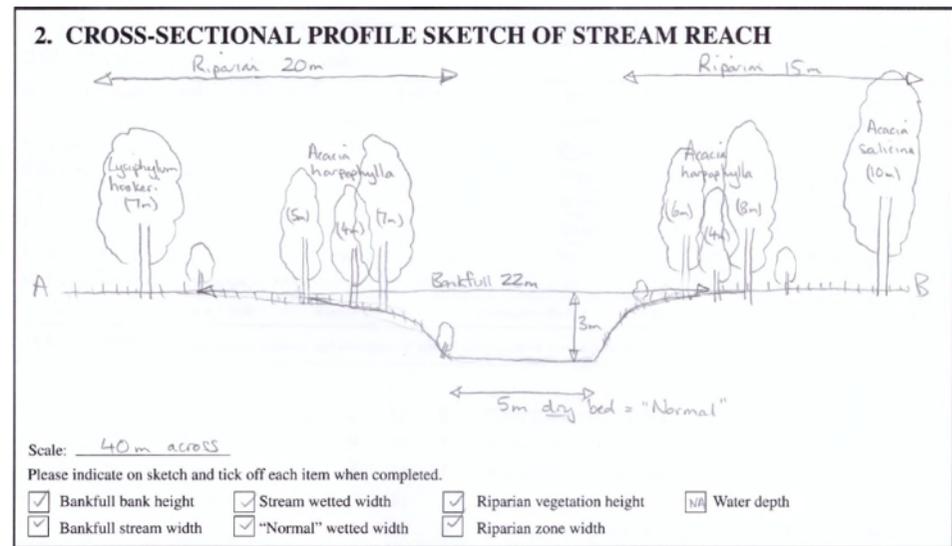
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Poor (37).

**Overall aquatic values**

Dry season: **Moderate**



**Table10**      **Taurus Creek – Late wet**

**Site: R5**      **Property: Taurus**      **Stream order: 3**      **Latitude (GDA 94): -23.7165**      **Longitude (GDA 94): 148.8544**      **Date: 21/05/2020**      **Season: Late wet**



Upstream

Left bank

Downstream

Right bank

### General Site Description

#### Site attributes

Ephemeral third order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; well defined bed and banks; some local catchment erosion detected, including bank slumping; convex banks, flat U shaped channel, as a result of sand deposition; both clay and sandy loam banks; banks moderately unstable (side slopes up to 60% on some banks); fair bank vegetative stability; bankfull width approx. 22 m and bankfull height approx. 3 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks and branches; bed substrates comprised approximately 10% gravel (2–4 mm), 75% sand (0.05–2 mm) and a thin veneer of approximately 15% silt (<0.05 mm); upstream land use includes mining and moderate cattle grazing on land predominantly cleared of remnant vegetation; adjacent land use includes light cattle grazing.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as mixed RE 11.3.1 / 11.3.25 – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’ / ‘*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines’; riparian zone approximately 20 m on the left bank and 20 m on the right, comprising tall (17 m) open (20% crown cover) woodland dominated by yellowwood (*Terminalia oblongata*), with frequent brigalow (*Acacia harpophylla*), narrow-leaved bottle tree (*Brachychiton rupestris*), occasional Queensland blue gum (*Eucalyptus tereticornis*), silver-leaved ironbark (*E. melanophloia*), poplar box (*E. populnea*) and boonaree (*Alectryon oleifolius*); sparse sub-canopy dominated by white bauhinia (*Lysiphyllum hookeri*), yellowwood and brigalow, with occasional false sandalwood (*Eremophila mitchellii*), emu apple (*Owenia acidula*), sally wattle (*Acacia salicina*), carbeen (*Corymbia tessellaris*) and sandalwood (*Santalum lanceolatum*); very sparse shrub layer, including currant bush (*Carissa ovata*), nipan (*Capparis lasiantha*), soft turkey bush (*Acalypha eremorum*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with occasional wiregrass (*Aristida* sp.), green panic (*Megathyrsus maximus*)\*, Harrisia cactus (*Harrisia martinii*)\* and velvet tree pear (*Opuntia tomentosa*)\*; no macrophytes detected.

#### Erosion risk

Moderate-high – Banks appeared to be moderately unstable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table10 Taurus Creek – Late wet**

Site: R5 Property: Taurus Stream order: 3 Latitude (GDA 94): -23.7165 Longitude (GDA 94): 148.8544 Date: 21/05/2020 Season: Late wet

**Physico-chemical water quality**

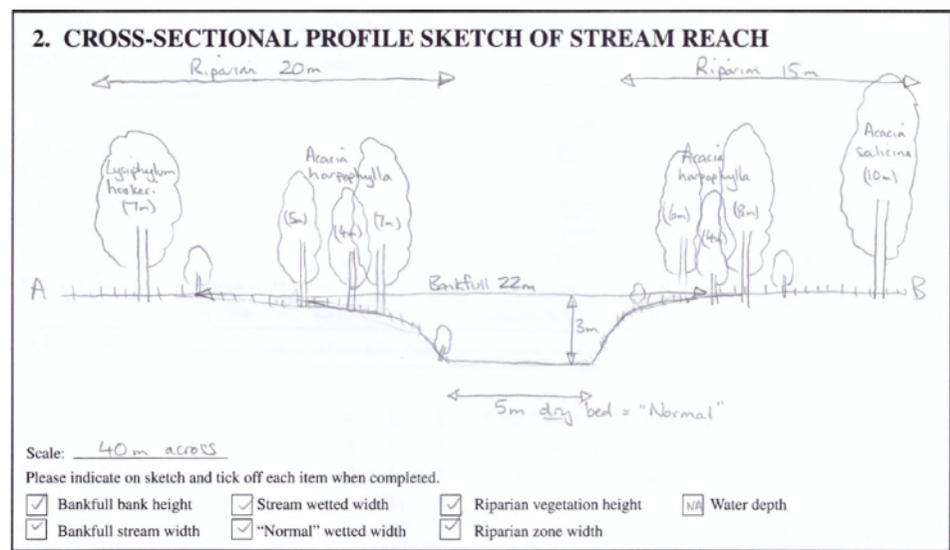
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Poor (37).

**Overall aquatic values**

Dry season: **Moderate**



**Table 11** Two Mile Gully - Dry

Site: R6 Property: Taurus Stream order: 4 Latitude (GDA 94): -23.7309 Longitude (GDA 94): 148.8737 Date: 12/12/2019 Season: Dry



Upstream

Left bank

Downstream

Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; dry at the time of assessment; well defined bed and banks; little local catchment erosion, including bank slumping; convex banks, flat U shaped channel, as a result of sand deposition; sandy clay banks; banks moderately unstable (side slopes up to 60% on some banks); fair bank vegetative stability; bankfull width approx. 15 m and bankfull height approx. 4 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks, branches and logs; bed substrates comprised approximately 2% pebble (4–64 mm), 40% gravel (2–4 mm) and 58% sand (0.05–2 mm); upstream and adjacent land use includes cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.2 – ‘*Eucalyptus populnea* woodland on alluvial plains’; riparian zone approximately 15 m on the left bank and 15 m on the right, comprising tall (15 m) open (25% crown cover) woodland dominated by yellowwood (*Terminalia oblongata*), silver-leaved ironbark (*E. melanophloia*) and poplar box (*E. populnea*), with occasional narrow-leaved bottlebrush (*Brachychiton rupestris*), Queensland blue gum (*Eucalyptus tereticornis*) and boonaree (*Alectryon oleifolius*); sparse sub-canopy with frequent white bauhinia (*Lysiphyllum hookeri*), occasional red bauhinia (*Lysiphyllum carronii*), sally wattle (*Acacia salicina*), brigalow (*A. harpophylla*), Nelia (*A. oswaldii*), false sandalwood (*Eremophila mitchellii*), warrior bush (*Apophyllum anomalum*) and limebush (*Citrus glauca*); sparse shrub layer with frequent soft turkey bush (*Acalypha eremorum*), occasional currant bush (*Carissa ovata*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent mother-of-millions (*Bryophyllum delagoense*)\*, brigalow burr (*Sclerolaena tetracuspis*), occasional Harrisia cactus (*Harrisia martinii*)\* and velvet tree pear (*Opuntia tomentosa*)\*; no macrophytes detected.

#### Erosion risk

Moderate-high – Banks appeared to be moderately unstable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 11** Two Mile Gully - Dry

Site: R6	Property: Taurus	Stream order: 4	Latitude (GDA 94): -23.7309	Longitude (GDA 94): 148.8737	Date: 12/12/2019	Season: Dry
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**Physico-chemical water quality**

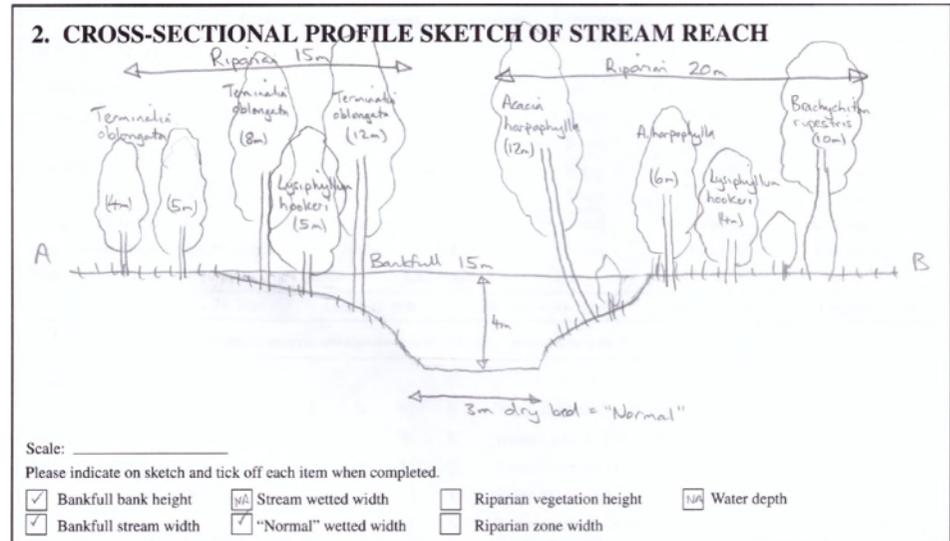
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (53).

**Overall aquatic values**

Dry season: **Moderate**



**Table 12** Two Mile Gully – Late wet

Site: R6 Property: Taurus Stream order: 4 Latitude (GDA 94): -23.7309 Longitude (GDA 94): 148.8737 Date: 21/05/2020 Season: Late wet



Upstream

Left bank

Downstream

Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; well defined bed and banks; little local catchment erosion, including bank slumping; convex banks, flat U shaped channel, as a result of sand deposition; sandy clay banks; banks moderately unstable (side slopes up to 60% on some banks); fair bank vegetative stability; bankfull width approx. 15 m and bankfull height approx. 4 m; in-stream habitat features in times of flow would include little (1–10%) detritus, sticks, branches and logs; bed substrates comprised approximately 2% pebble (4–64 mm), 40% gravel (2–4 mm) and 58% sand (0.05–2 mm); upstream and adjacent land use includes cattle grazing on land predominantly cleared of remnant vegetation.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.2 – ‘*Eucalyptus populnea* woodland on alluvial plains’; riparian zone approximately 15 m on the left bank and 15 m on the right, comprising tall (15 m) open (25% crown cover) woodland dominated by yellowwood (*Terminalia oblongata*), silver-leaved ironbark (*E. melanophloia*) and poplar box (*E. populnea*), with occasional narrow-leaved bottlebrush (*Brachychiton rupestris*), Queensland blue gum (*Eucalyptus tereticornis*) and boonaree (*Alectryon oleifolius*); sparse sub-canopy with frequent white bauhinia (*Lysiphyllum hookeri*), occasional red bauhinia (*Lysiphyllum carronii*), sally wattle (*Acacia salicina*), brigalow (*A. harpophylla*), Nelia (*A. oswaldii*), false sandalwood (*Eremophila mitchellii*), warrior bush (*Apophyllum anomalum*) and limebush (*Citrus glauca*); sparse shrub layer with frequent soft turkey bush (*Acalypha eremorum*) and rubber vine (*Cryptostegia grandiflora*)\*, occasional currant bush (*Carissa ovata*) and whitewood (*Atalaya hemiglauca*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant parthenium (*Parthenium hysterophorus*)\*, frequent mother-of-millions (*Bryophyllum delagoense*)\*, brigalow burr (*Sclerolaena tetraacuspis*), occasional Harrisia cactus (*Harrisia martinii*)\* and velvet tree pear (*Opuntia tomentosa*)\*; semi-aquatic macrophytes included little (1–10%) *Cyperus betchei* and white eclipta (*Eclipta prostrata*)\*.

#### Erosion risk

Moderate-high – Banks appeared to be moderately unstable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 12** Two Mile Gully – Late wet

Site: R6 Property: Taurus Stream order: 4 Latitude (GDA 94): -23.7309 Longitude (GDA 94): 148.8737 Date: 21/05/2020 Season: Late wet

**Physico-chemical water quality**

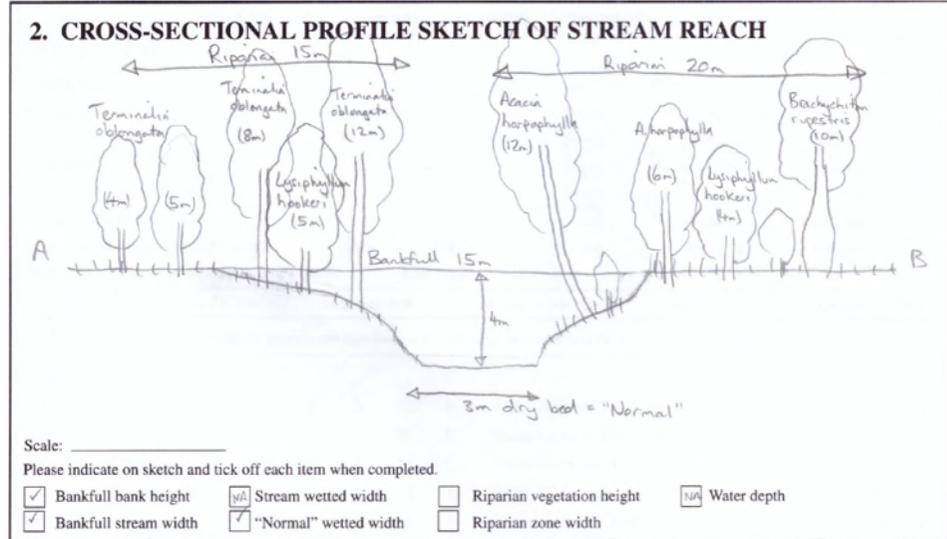
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (53).

**Overall aquatic values**

Dry season: **Moderate**



**Table 13** Taurus Creek – Dry

Site: R7 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6717 Longitude (GDA 94): 148.8793 Date: 12/12/2019 Season: Dry



Upstream

Left bank

Downstream

Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; dry at the time of assessment; well defined bed and banks; little local catchment erosion detected, including bank slumping; concave banks; U shaped channel; loamy clay banks; banks moderately stable, with infrequent small areas of erosion mostly healed over; bank vegetative stability fair; bankfull width approx. 19 m and bankfull height approx. 3 m; in-stream habitat features in times of flow would include some (10–50%) detritus, little (1–10%) sticks, branches and logs; bed substrates comprised approximately 5% bedrock, 10% boulder (>256 mm), 10% cobble (64–256 mm), 5% pebble (4–64 mm), 10% gravel (2–4 mm) and 55% sand and 5% silt/clay (<0.05 mm); upstream land use includes mining, moderate cattle grazing on land predominantly cleared of remnant vegetation, the Blackwater Rolleston Road and the Blackwater System rail; adjacent land use includes light cattle grazing.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.3 – ‘*Eucalyptus coolabah* woodland on alluvial plains’; vegetation corridor approx. 180 m wide; riparian zone approximately 10 m on the left bank and 15 m on the right, comprising tall (18 m) open (35–40%) woodland dominated by coolabah (*Eucalyptus coolabah*), with occasional yellowwood (*Terminalia oblongata*), silver-leaved ironbark (*E. melanophloia*) and brigalow (*Acacia harpophylla*); sparse sub-canopy with frequent brigalow and yellowwood, and occasional wilga (*Geijera parviflora*); sparse shrub layer with occasional sally wattle (*Acacia salicina*), yellowwood, soft turkey bush (*Acalypha eremorum*) and currant bush (*Carissa ovata*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent black speargrass (*Heteropogon contortus*), occasional curly windmill grass (*Enteropogon acicularis*), *Cyperus* sp. and umbrella canegrass (*Leptochloa digitata*); semi-aquatic macrophytes included little (1–10%) sedge (*Cyperus* sp.) and umbrella canegrass (*Leptochloa digitata*).

#### Erosion risk

Low-moderate – Banks appeared to be moderately stable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected. Freshwater crab and mussel shells observed.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 13** Taurus Creek – Dry

Site: R7 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6717 Longitude (GDA 94): 148.8793 Date: 12/12/2019 Season: Dry

**Physico-chemical water quality**

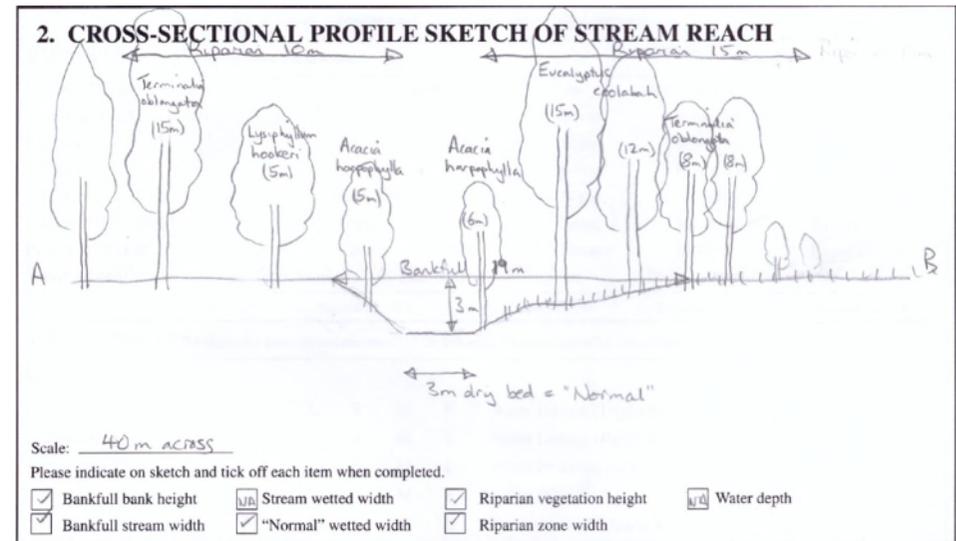
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (70).

**Overall aquatic values**

Dry season: **Moderate**



**Table 14** Taurus Creek – Late wet

Site: R7 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6717 Longitude (GDA 94): 148.8793 Date: 20/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Ephemeral fourth order drainage line; debris indicates flood event since December 2019 survey, but dry at the time of assessment in May 2020; well defined bed and banks; little local catchment erosion detected, including bank slumping; concave banks; U shaped channel; loamy clay banks; banks moderately stable, with infrequent small areas of erosion mostly healed over; bank vegetative stability fair; bankfull width approx. 19 m and bankfull height approx. 3 m; in-stream habitat features in times of flow would include some (10–50%) detritus, little (1–10%) sticks, branches and logs; bed substrates comprised approximately 5% bedrock, 10% boulder (>256 mm), 10% cobble (64–256 mm), 5% pebble (4–64 mm), 10% gravel (2–4 mm) and 55% sand and 5% silt/clay (<0.05 mm); upstream land use includes mining, moderate cattle grazing on land predominantly cleared of remnant vegetation, the Blackwater Rolleston Road and the Blackwater System rail; adjacent land use includes light cattle grazing.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.3 – ‘*Eucalyptus coolabah* woodland on alluvial plains’; vegetation corridor approx. 180 m wide; riparian zone approximately 10 m on the left bank and 15 m on the right, comprising tall (18 m) open (35–40%) woodland dominated by coolabah (*Eucalyptus coolabah*), with occasional yellowwood (*Terminalia oblongata*), silver-leaved ironbark (*E. melanophloia*) and brigalow (*Acacia harpophylla*); sparse sub-canopy with frequent brigalow and yellowwood, and occasional wilga (*Geijera parviflora*); sparse shrub layer with occasional sally wattle (*Acacia salicina*), yellowwood, soft turkey bush (*Acalypha eremorum*) and currant bush (*Carissa ovata*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent black speargrass (*Heteropogon contortus*), occasional parthenium (*Parthenium hysterophorus*)\*, curly windmill grass (*Enteropogon acicularis*), *Cyperus betchei* and umbrella canegrass (*Leptochloa digitata*); semi-aquatic macrophytes included little (1–10%) *C. betchei*, *C. concinnus* and umbrella canegrass.

#### Erosion risk

Low-moderate – Banks appeared to be moderately stable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

No aquatic fauna detected. May provide breeding and foraging habitat for fish in times of flow. No turtle or platypus breeding habitat detected. Freshwater crab and mussel shells observed.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Elseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Table 14** Taurus Creek – Late wet

Site: R7 Property: Mountain View Stream order: 4 Latitude (GDA 94): -23.6717 Longitude (GDA 94): 148.8793 Date: 20/05/2020 Season: Late wet

**Physico-chemical water quality**

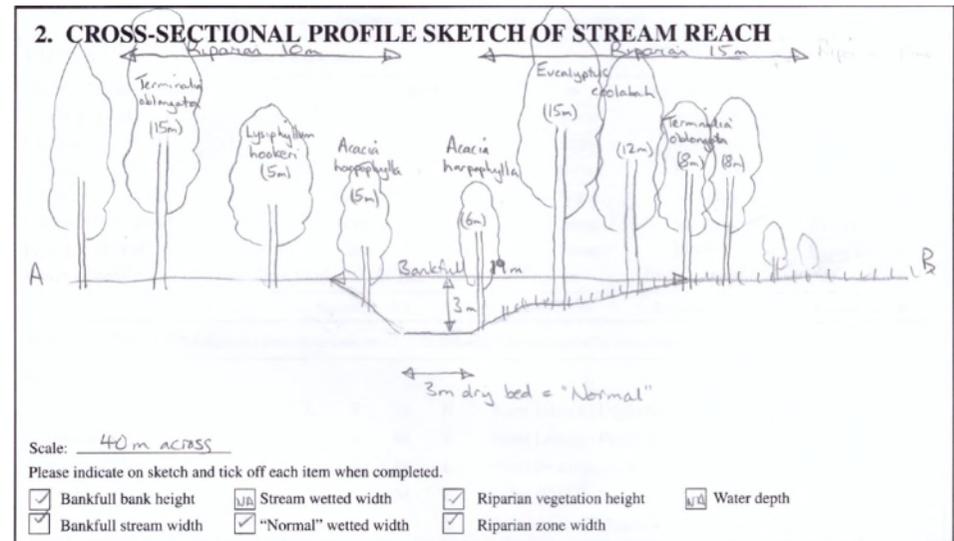
Dry at the time of assessment.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (70).

**Overall aquatic values**

Dry season: **Moderate**



**Table 15** Flood-channel on Taurus Creek – Late wet

Site: RW1 Property: Mountain View Stream order: 3 Latitude (GDA 94): -23.6954 Longitude (GDA 94): 148.8653 Date: 21/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Flood channel on third order Taurus Creek; dry at the time of aerial (drone) assessment in December 2019; large isolated pool at the time of assessment in May 2020; well defined bed and banks; little local catchment erosion detected, including rill erosion; concave banks; U shaped channel; loamy clay banks; banks moderately stable, with infrequent small areas of erosion mostly healed over; bank vegetative stability fair; bankfull width approx. 18 m and bankfull height approx. 2.3 m; in-stream habitat features include little (1–10%) detritus, sticks, branches and logs; bed substrates comprised 100% silt/clay (<0.05 mm); edge substrates comprised 5% sand (0.5–2 mm) and 95% silt/clay; upstream land use includes mining and moderate cattle grazing on land predominantly cleared of remnant vegetation; adjacent land use includes light cattle grazing.

#### Aquatic and riparian vegetation

Study reach positioned within riparian woodland State-mapped as non-remnant; field-verified as RE 11.3.1 / 11.3.27b – ‘*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains’ / ‘Lacustrine wetland’; riparian zone approximately 10 m on the left bank and 10 m on the right, comprising tall (18 m) open (35–40%) woodland dominated by Queensland blue gum (*Eucalyptus tereticornis*) – both alive and dead (stags), with frequent brigalow (*Acacia harpophylla*) and yellowwood (*Terminalia oblongata*); sparse sub-canopy with frequent white bauhinia (*Lysiphyllum hookeri*), ironwood (*Acacia excelsa*) and occasional sally wattle (*Acacia salicina*); sparse shrub layer, including native cocaine (*Erythroxylum australe*), whitewood (*Atalaya hemiglauca*), mimosa bush (*Vachellia farnesiana*)\* and velvet tree pear (*Opuntia tomentosa*)\*; ground layer dominated by buffel grass (*Cenchrus ciliaris*)\* and green panic (*Megathyrsus maximus*)\*; semi-aquatic macrophytes included little (1–10%) dwarf sedge (*Cyperus pygmaeus*).

#### Erosion risk

Low-moderate – Banks appeared to be moderately stable, with 25–49% of the streambank surfaces covered by vegetation (including tree roots).

#### Aquatic fauna, including breeding habitat

The reach provides potential foraging and breeding habitat for fish and common turtle species. No suitable platypus breeding habitat detected. Aquatic fauna detected by backpack electrofishing and overnight deployment of two baited fyke nets and five baited box traps included gudgeon (*Hypseleotris galii* / sp. 1), eastern rainbowfish (*Melanotaenia splendida*), Agassiz’s glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*), bony bream (*Nematalosa erebi*), purple-spotted gudgeon (*Mogurnda adspersa*), Rendahl’s catfish (*Porochilus rendahli*) and Hyrtly’s tandan (*Neosilurus hyrtlii*).

**Table 15 Flood-channel on Taurus Creek – Late wet**

Site: RW1 Property: Mountain View Stream order: 3 Latitude (GDA 94): -23.6954 Longitude (GDA 94): 148.8653 Date: 21/05/2020 Season: Late wet

Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eiseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the study reach does not provide suitable habitat for these species.

**Physico-chemical water quality**

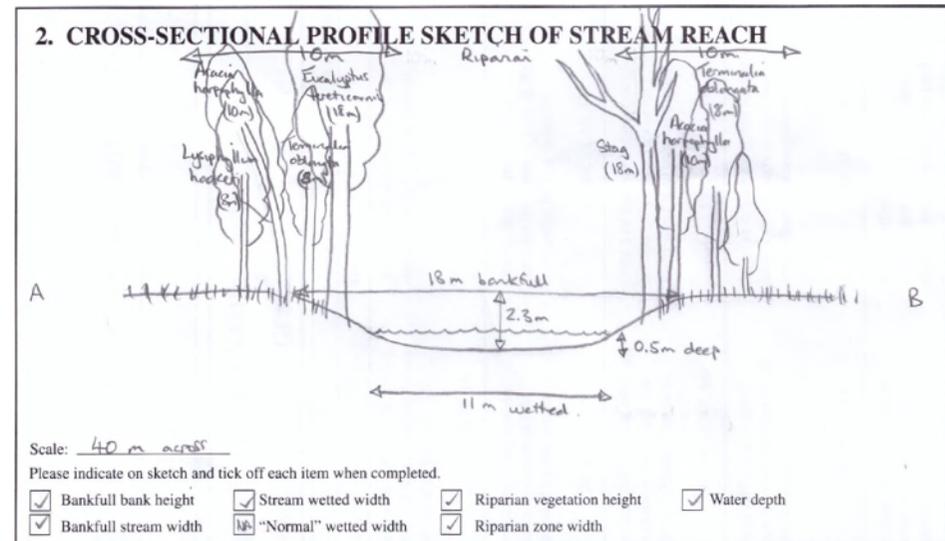
Collection time: 13:45; water temp.: 20.0°C; specific conductivity: 573 µS/cm (fresh); turbidity: 27 NTU (good clarity); dissolved oxygen: 89.0%, 8.1 (normal); pH: 8.6 (strongly alkaline, likely reflecting the clay-rich catchment). Comments: Normal.

**Bioassessment scores**

Habitat assessment score for dry season: Fair (57).

**Overall aquatic values**

Dry season: **Moderate**



**Table16 Lacustrine wetland waterbody – Dry**

Site: L1 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6417 Longitude (GDA 94): 148.8591 Date: 10/12/2019 Season: Dry



Vertical (from 100 magl)



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Small unmapped lacustrine waterbody (farm dam) on Sagittarius Creek; approx. 0.25 ha; little local catchment erosion, including rilling; >1.5 m deep; clay banks; in-stream habitat included shallow (<0.5 m) pool, deep pool and macrophytes; bed substrates comprised 100% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of native vegetation.

#### Aquatic and riparian vegetation

Assessment site positioned within agricultural grassland State-mapped as non-remnant in the RE mapping; field-verified as non-remnant; fringing vegetation included a low (4–5 m) sparse (15%) tree layer dominated by brigalow (*Acacia harpophylla*), with occasional red bauhinia (*Lysiphyllum carronii*), whitewood (*Atalaya hemiglauca*), sally wattle (*Acacia salicina*) and yellowwood (*Terminalia oblongata*); very sparse shrub layer including currant bush (*Carissa ovata*) and warrior bush (*Apophyllum anomalum*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent bluegrass (*Bothriochloa* sp.) and occasional Harrisia cactus (*Harrisia martinii*)\*; submerged macrophytes included moderate (50–75%) cover of curly pondweed (*Potamogeton crispus*) and little (1–10%) swamp lily (*Ottelia ovalifolia*); emergent macrophytes included moderate (50–75%) cover of smartweed (*Persicaria attenuata*) and some (10–50%) cumbungi (*Typha domingensis*); fringing macrophytes included little (1–10%) umbrella canegrass (*Leptochloa digitata*), willow primrose (*Ludwigia octovalvis*) and dwarf sedge (*Cyperus pygmaeus*).

#### Aquatic fauna, including breeding habitat

The waterbody provides potential foraging and breeding habitat for fish and common turtle species. No suitable platypus breeding habitat detected. Aquatic fauna detected by backpack electrofishing and overnight deployment of two baited fyke nets and five baited box traps included gudgeon (*Hypseleotris galii* / sp. 1), western carp gudgeon (*H. klunzingeri*), eastern rainbowfish (*Melanotaenia splendida*), Rendahl's tandan (*Porochilus rendahli*), Hyrtl's tandan (*Neosilurus hyrtlii*), Agassiz's glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*), bony bream (*Nematalosa erebi*), purple-spotted gudgeon (*Mogurnda adspersa*), mosquitofish (*Gambusia holbrooki*)\* and eastern snake-necked turtle (*Chelodina longicollis*).

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eiseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the waterbody does not provide suitable habitat for these species.

**Table16** Lacustrine wetland waterbody – Dry

Site: L1 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6417 Longitude (GDA 94): 148.8591 Date: 10/12/2019 Season: Dry

**Physico-chemical water quality**

Collection time: 11:30; water temp.: 26.9°C; specific conductivity: 437  $\mu\text{S}/\text{cm}$  (fresh); turbidity: 40 NTU (good clarity); dissolved oxygen: 76.0%, 5.7 mg/L (relatively low for time of day when DO levels should be nearing their diurnal peak); pH: 8.6 (strongly alkaline, reflecting the clay catchment). Comments: Most parameters normal; relatively low DO likely due to oxygen consumption by bacteria during the breakdown of organic matter.

**Overall aquatic values**

Dry season: **Moderate**



**Table 17** Lacustrine wetland waterbody – Late wet

Site: L1 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6417 Longitude (GDA 94): 148.8591 Date: 19/05/2020 Season: Late wet



Upstream



Left bank



Downstream



Right bank

### General Site Description

#### Site attributes

Small unmapped lacustrine waterbody (farm dam) on Sagittarius Creek; 0.25 ha; little local catchment erosion, including rill erosion; >1.5 m deep; clay banks; in-stream habitat included shallow (<0.5 m) pool, deep pool and macrophytes; bed substrates comprised 100% silt/clay (<0.05 mm); upstream and adjacent land use includes moderate cattle grazing on land predominantly cleared of native vegetation.

#### Aquatic and riparian vegetation

Assessment site positioned within agricultural grassland State-mapped as non-remnant in the RE mapping; field-verified as non-remnant; fringing vegetation included a low (4–5 m) sparse (15%) tree layer dominated by brigalow (*Acacia harpophylla*), with occasional red bauhinia (*Lysiphyllum carronii*), whitewood (*Atalaya hemiglauca*), sally wattle (*Acacia salicina*) and yellowwood (*Terminalia oblongata*); very sparse shrub layer including currant bush (*Carissa ovata*) and warrior bush (*Apophyllum anomalum*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with frequent bluegrass (*Bothriochloa* sp.) and occasional Harrisia cactus (*Harrisia martinii*)\*; submerged macrophytes included moderate (50–75%) cover of curly pondweed (*Potamogeton crispus*) and little (1–10%) swamp lily (*Ottelia ovalifolia*); emergent macrophytes included moderate (50–75%) cover of cumbungi (*Typha domingensis*); fringing macrophytes included little (1–10%) *Cyperus betchei*, *C. concinnus*, rice sedge (*C. difformis*), tall flatsedge (*C. exaltatus*), dwarf sedge (*C. pygmaeus*), pale knotweed (*Persicaria lapathifolia*), umbrella canegrass (*Leptochloa digitata*), willow primrose (*Ludwigia octovalvis*), water primrose (*L. peploides*), brown beetle grass (*Diplachne fusca fusca*), white eclipta (*Eclipta prostrata*)\*.

#### Aquatic fauna, including breeding habitat

The waterbody provides potential foraging and breeding habitat for fish and common turtle species. No suitable platypus breeding habitat detected. Aquatic fauna detected by backpack electrofishing and overnight deployment of two baited fyke nets and five baited box traps included gudgeon (*Hypseleotris galii* / sp. 1), eastern rainbowfish (*Melanotaenia splendida*), Rendahl's tandan (*Porochilus rendahli*), Hyrtl's tandan (*Neosilurus hyrtlii*), Agassiz's glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*), bony bream (*Nematalosa erebi*), purple-spotted gudgeon (*Mogurnda adspersa*), mosquitofish (*Gambusia holbrooki*)\*.

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the waterbody does not provide suitable habitat for these species.

**Table 17** Lacustrine wetland waterbody – Late wet

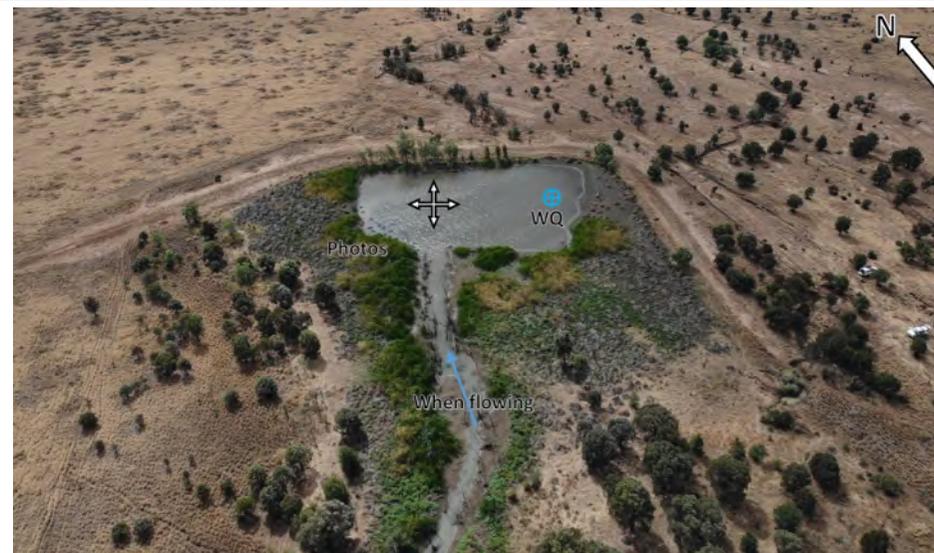
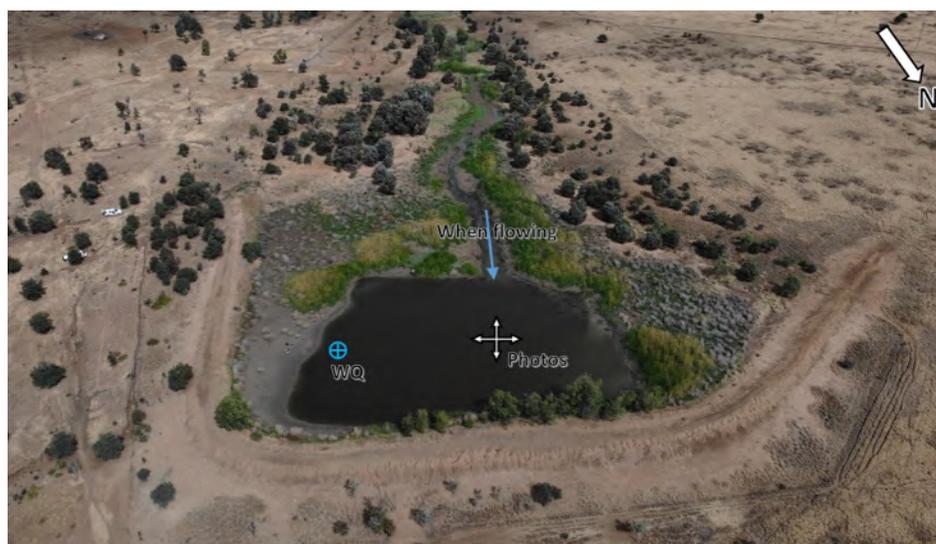
Site: L1 Property: Mountain View Stream order: 2 Latitude (GDA 94): -23.6417 Longitude (GDA 94): 148.8591 Date: 19/05/2020 Season: Late wet

**Physico-chemical water quality**

Collection time: 12:00; water temp.: 19.1°C; specific conductivity: 414  $\mu\text{S}/\text{cm}$  (fresh); turbidity: 41 NTU (good clarity); dissolved oxygen: 75.1%, 6.9 mg/L (relatively low for time of day when DO levels should be nearing their diurnal peak); pH: 7.8 (mildly alkaline, reflecting the clay-rich catchment). Comments: Parameters normal; relatively low DO likely due to oxygen consumption by bacteria during the breakdown of organic matter, including decomposing smartweed (*Persicaria attenuata*) inundated since the December 2019 survey.

**Overall aquatic values**

Dry season: **Moderate**



**Table 18** Lacustrine wetland waterbody – Dry

Site: L2	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.7142	Longitude (GDA 94): 148.8777	Date: 12/12/2019	Season: Dry
						
Upstream	Left bank	Downstream	Right bank			

### General Site Description

#### Site attributes

Approximate 1.5 ha mapped lacustrine waterbody (farm dam) on a first order tributary of Two Mile Gully, and subsequently Taurus Creek; no local catchment erosion detected; clay banks; in-stream habitat included shallow (<0.5 m) pool, deep pool and macrophytes; bed substrates comprised 100% silt/clay (<0.05 mm); upstream land use dominated by a Coal Handling and Processing Facility (CHPP); adjacent land use includes moderate cattle grazing on land predominantly cleared of native vegetation.

#### Aquatic and riparian vegetation

Waterbody positioned within agricultural grassland State-mapped as non-remnant; field-verified as non-remnant; waterbody mapped as lacustrine waterbody in the Queensland Wetlands Mapping; fringing vegetation included a tall (15 m) very sparse (10%) tree layer dominated by poplar box (*Eucalyptus populnea*), with frequent brigalow (*Acacia harpophylla*) and sally wattle (*Acacia salicina*); sparse sub-canopy with frequent sally wattle, boonaree (*Alectryon oleifolius*), dead finish (*Archidendropsis basaltica*), occasional wilga (*Geijera parviflora*), *Elaeodendron 35ttenua*, bean tree (*Cassia brewsteri*) and small-leaved ebony (*Diospyros humilis*); very sparse shrub layer, including currant bush (*Carissa ovata*), limebush (*Citrus glauca*), nipan (*Capparis lasiantha*) and bumble tree (*Capparis mitchellii*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant common couch (*Cynodon dactylon*)\*, frequent water primrose (*Ludwigia peploides*), small knotweed (*Polygonum plebeium*), occasional umbrella canegrass (*Leptochloa digitata*) and *Cyperus* sp.; emergent macrophytes included some (10–50%) cumbungi (*Typha domingensis*) and water primrose, little (1–10%) smartweed (*Persicaria attenuata*), slender knotweed (*P. decipiens*) and *Nymphoides* sp. (not flowering); fringing macrophytes included little (1–10%) umbrella canegrass, rice sedge (*Cyperus difformis*), *Cyperus* sp. (heavily grazed) and common rush (*Juncus usitatus*).

#### Aquatic fauna, including breeding habitat

The waterbody provides potential foraging and breeding habitat for fish, water birds and common turtle species. No suitable platypus breeding habitat detected. No fish or turtle survey undertaken (habitat assessment only).

#### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eiseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the waterbody does not provide suitable habitat for these species.

**Table 18** Lacustrine wetland waterbody – Dry

Site: L2	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.7142	Longitude (GDA 94): 148.8777	Date: 12/12/2019	Season: Dry
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**Physico-chemical water quality**

Collection time: 10:20; water temp.: 30.1°C; specific conductivity: 595  $\mu\text{S}/\text{cm}$  (fresh); turbidity: 31 NTU (good clarity); dissolved oxygen: 87.9%, 6.6 mg/L (normal); pH: 8.1 (moderately alkaline), reflecting the clay catchment. Comments: Normal.

**Overall aquatic values**

Dry season: **Moderate**



**Table 19 Lacustrine wetland waterbody – Late wet**

Site: L2	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.7142	Longitude (GDA 94): 148.8777	Date: 21/05/2020	Season: Dry	
				Upstream	Left bank	Downstream	Right bank

#### General Site Description

##### Site attributes

Approximate 1.5 ha mapped lacustrine waterbody (farm dam) on a first order tributary of Two Mile Gully, and subsequently Taurus Creek; the farm dam is located downstream of the Cook Colliery Coal Handling and Processing Facility (CHPP); in-stream habitat included shallow (<0.5 m) pool, deep pool and macrophytes; adjacent land use includes moderate cattle grazing on land predominantly cleared of native vegetation. Bed substrate noted to display coal fines.

##### Aquatic and riparian vegetation

Wetland waterbody positioned within agricultural grassland State-mapped as non-remnant; field-verified as non-remnant; waterbody mapped as lacustrine waterbody in the Queensland Wetlands Mapping; fringing vegetation included a tall (15 m) very sparse (10%) tree layer dominated by poplar box (*Eucalyptus populnea*), with frequent brigalow (*Acacia harpophylla*) and sally wattle (*Acacia salicina*); sparse sub-canopy with frequent sally wattle, boonaree (*Alectryon oleifolius*), dead finish (*Archidendropsis basaltica*), occasional wilga (*Geijera parviflora*), *Elaeodendron australe*, bean tree (*Cassia brewsteri*) and small-leaved ebony (*Diospyros humilis*); very sparse shrub layer, including currant bush (*Carissa ovata*), limebush (*Citrus glauca*), nipan (*Capparis lasiantha*) and bumle tree (*Capparis mitchellii*); ground layer dominated by buffel grass (*Cenchrus ciliaris*)\*, with abundant common couch (*Cynodon dactylon*)\*, occasional water primrose (*Ludwigia peploides*), small knotweed (*Polygonum plebeium*), umbrella canegrass (*Leptochloa digitata*) and *Cyperus* sp.; emergent macrophytes included moderate (50–75%) cover of water snowflake (*Nymphoides indica*), some (10–50%) cumbungi (*Typha domingensis*) and little (1–10%) water primrose; fringing macrophytes included little (1–10%) willow primrose (*Ludwigia octovalvis*), white eclipta (*Eclipta prostrata*)\*, umbrella canegrass, rice sedge (*Cyperus difformis*), *Cyperus* sp. (grazed) and common rush (*Juncus usitatus*).

##### Aquatic fauna, including breeding habitat

The waterbody provides potential foraging and breeding habitat for fish, water birds and common turtle species. No suitable platypus breeding habitat detected. No fish or turtle survey undertaken (habitat assessment only).

##### Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern (SLC), or Priority flora and fauna

No CEEVNT, SLC or Priority aquatic flora or fauna species detected. The Critically Endangered (EPBC Act; Endangered – NC Act) southern snapping turtle (*Eiseya albagula*) and Vulnerable (EPBC Act and NC Act) Fitzroy River turtle (*Rheodytes leukops*) are recorded from the Mackenzie River Sub-basin (DES 2020). However, the waterbody does not provide suitable habitat for these species.

**Table 19** Lacustrine wetland waterbody – Late wet

Site: L2	Property: Taurus	Stream order: 1	Latitude (GDA 94): -23.7142	Longitude (GDA 94): 148.8777	Date: 21/05/2020	Season: Dry
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**Physico-chemical water quality**

Collection time: 12:10; water temp.: 19.7°C; specific conductivity: 2,401  $\mu\text{S}/\text{cm}$  (brackish); turbidity: 23.5 NTU (high clarity); dissolved oxygen: 66.0%, 5.98 mg/L (low for time of day); pH: 7.9 (moderately alkaline). Comments: Downstream of Cook Colliery CHPP.

**Overall aquatic values**

Dry season: **Moderate**



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