Cameby Downs Mine

Cameby Downs Continued Operations Project

Environmental Values Assessment

APPENDIX F

Aquatic Ecology Assessment

YANCOAL
兖煤澳大利亚有限公司

DPM ENVIROSCIENCES

Cameby Downs Continued Operations Project - Aquatic Ecology Assessment

June 2018

Cameby Downs Continued Operations Project - Aquatic Ecology Assessment

June 2018

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Aquatic Ecology Assessment of the Cameby Downs Continued Operations Project
June 2018

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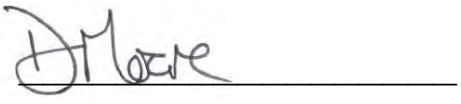

David Moore
Principal Environmental Scientist

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EXECUTIVE SUMMARY

The Cameby Downs Mine is an open cut coal mine, located approximately 360 kilometres west-north-west of Brisbane in the Western Downs Regional Council local government area. The Cameby Downs Mine Continued Operations Project (the Project) involves the continued operation and progression of the existing mine within and surrounding its current location.

This report describes the aquatic ecological values of a study area encompassing the Project, assesses the potential impacts that may arise during the construction, operation and decommissioning of the Project, and describes management measures to avoid or minimise these impacts.

The majority of the Study area drains to the south, however the northern extent drains to the north. All drainage lines in the Study area are ephemeral, with some pools expected to hold water for extended periods. Regionally, the Project forms part of the far-upper reaches of the Balonne River drainage sub-basin, within the Balonne-Condamine drainage basin of the broader Queensland Murray-Darling Basin.

Existing aquatic ecological values within the Study area have been described based on a review of desktop sources (databases and literature) and field surveys. The field surveys by DPM Enviros supplemented previous field surveys undertaken at the Cameby Downs Mine. The field survey methods included an assessment of aquatic habitat attributes, measurement of in-situ physico-chemical water quality, fish survey, turtle survey, freshwater macroinvertebrate sampling, and ground-truthing mapped lacustrine waterbodies.

The field surveys found that the waterways in the Study area provide only marginal aquatic habitat (with a low aquatic habitat rating), with exception of the Drainage Line 1 (and associated pools) which provide moderate aquatic habitat. The field surveys also found that the Study area contains a number of constructed and highly modified lacustrine waterbodies (farm dams and mine water dams). No natural lacustrine waterbodies or wetlands have been identified within the Study area.

No threatened aquatic ecological communities, as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), were detected within the Study area, nor are any expected to occur. Further, no Endangered, Vulnerable or Near Threatened aquatic flora or fauna species, as listed under the EPBC Act or the Queensland *Nature Conservation Act 1992*, were detected within the Study area, nor are they expected to occur.

The aquatic flora and fauna of the Study area are generally well adapted to environmental extremes, including the wetting and drying cycles expected in these ephemeral systems. This is expected to include tolerance of a wide range of water quality conditions, such as elevated conductivity and decreased dissolved oxygen in senescing pools between flow events.

There is a potential for thin, discontinuous and temporal alluvial aquifers to occur (which may be used by localised areas of terrestrial vegetation), however these would consist of a perched groundwater system hydraulically separated from the underlying Walloon Coal Measures by the very low permeability, approximately 15 m thick aquitard overburden that separates the Springbok Sandstone and the upper Walloon Coal Measures (AGE 2017).

The only Matter of State Environment Significance relevant to this aquatic ecology assessment for the Project is ‘waterway for fish passage’ as Drainage Line 1 is recognised in regional mapping as providing fish movement.

Potential impacts on aquatic ecology associated with the Project include the discharge of mine-affected water, stormwater runoff from disturbed areas and drawdown and contamination of groundwater. The discharge of mine-affected water would continue to be managed in accordance with the Site Water Management Plan. Water intercepted would continue to be segregated into mine-affected water, sediment-laden runoff and clean water. Most mine-affected and sediment-laden water would be reused on site, including for dust suppression. Surplus water would be stored and released in accordance with Environmental Authority release conditions.

The existing surface water and groundwater monitoring network would be augmented to accommodate the Project. Monitoring data would be assessed against relevant surface water release limits and contaminant criteria and groundwater level and quality criteria.

Given that the site releases would be conducted in accordance with the EA release criteria and informed by ongoing monitoring of discharge and receiving environment water quality and quantity, significant adverse impacts on aquatic ecosystems are not likely.

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1 INTRODUCTION

The Cameby Downs Mine is owned and operated by Syntech and is managed by Yancoal Australia Ltd (Yancoal). Syntech Resources has lodged an amendment application to the Cameby Downs Mine Environmental Authority (EA) EPML00900113 in accordance with section 224 of the Queensland *Environmental Protection Act 1994* (EP Act) to approve the Cameby Downs Mine Continued Operations Project (the Project).

The approved Cameby Downs Mine is located approximately 360 kilometres (km) west-north-west of Brisbane in the Western Downs Regional Council (WDRC) local government area. The regional location of the Project is shown on Figure 1. The Cameby Downs Mine has been operating for six years, with excavation of overburden commencing in July 2010 and first coal excavated in August of that year. The coal handling and preparation plant (CHPP) was commissioned in November 2010 with first railing of coal occurring in December 2010.

The Project involves the extension of operations within Mining Lease (ML) 50233 and into Mining Lease Applications (MLAs) 50258, 50259, 50260 and 50269 and an increase in the run-of-mine (ROM) coal mining rate from the currently approved 2.8 million tonnes per annum (Mtpa) to 3.5 Mtpa (Figure 2). The Project life would be for approximately 75 years.

Syntech Resources is seeking approval of the Project through a major amendment of the EA in accordance with Chapter 5, Part 7, section 224 of the EP Act. The EA amendment application was lodged with the Department of Environment and Heritage Protection (EHP) on 21 November 2016. EHP subsequently made its Assessment Level Decision on 30 November 2016 that the proposed amendment is a major EA amendment application. EHP issued an Information Request on 12 January 2017 to request additional information from Syntech Resources to enable it to make a decision on the application.

Syntech Resources has responded to EHP's Information Request through an Environmental Values Assessment (EVA). This report supports the EVA to assess the potential environmental impacts associated with the development of the Project in accordance with the EHP's Information Request.

DPM Enviroscience Pty Ltd (DPM) has been commissioned by Syntech Resources to undertake an aquatic ecology assessment as part of an EVA to accompany the EA amendment application for the Project.

The findings discussed in this report are based on a desktop assessment of readily available information for the Study area supplemented by a 'late wet' field survey undertaken 25-29 July 2016. The desktop assessment includes review of an aquatic ecology assessment undertaken by AustralAsian Resource Consultants Pty Ltd (AARC) 2013, based on fieldwork conducted in January 2010.

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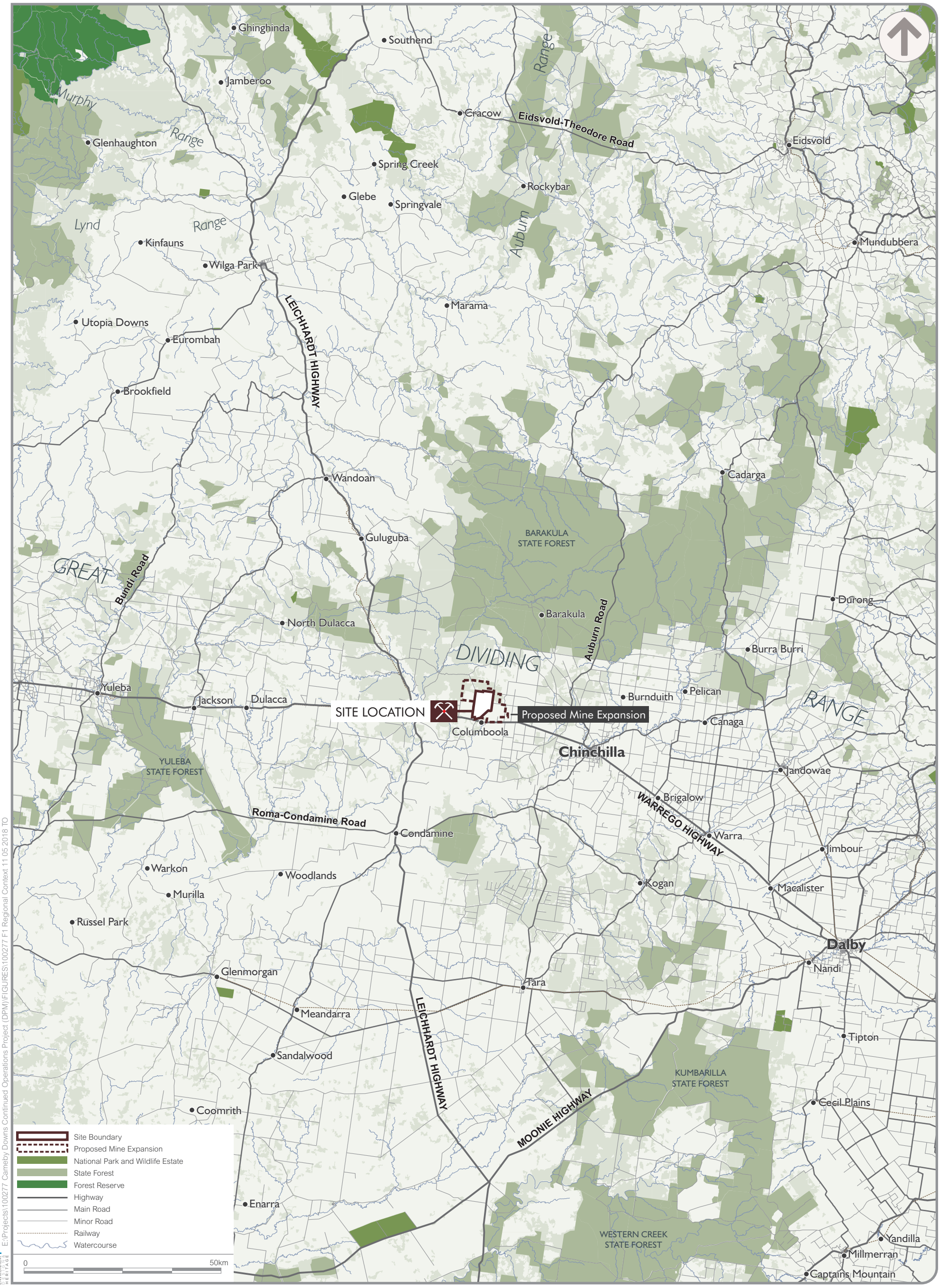

DPM ENVIROSCIENCES

REGIONAL CONTEXT

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 1

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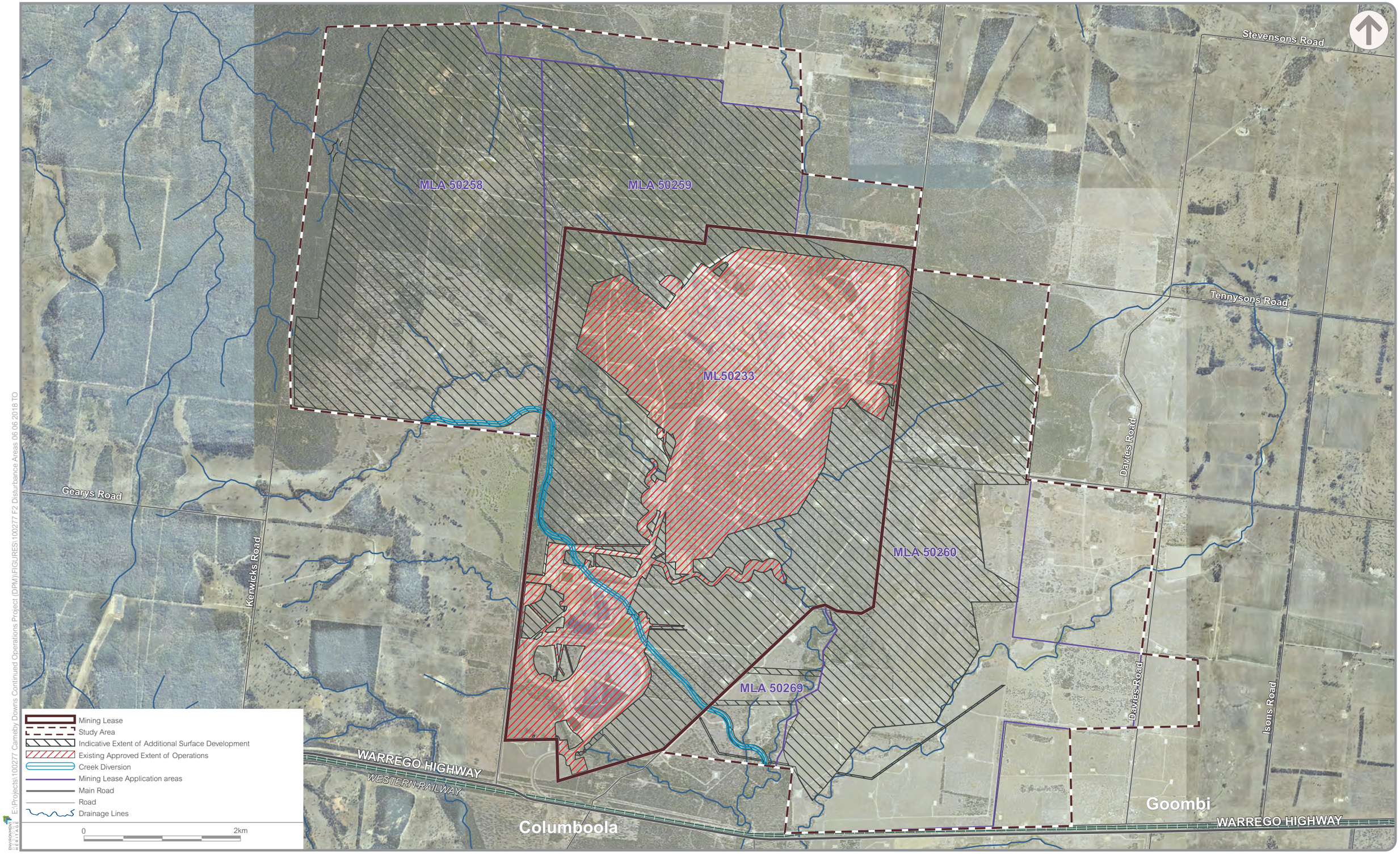

E:\Projects\100277 Cameby Downs Continued Operations Project (DPM)\FIGURES\100277 F2 Disturbance Areas 06.06.2018.TO

DPM ENVIROSCIENCES

DISTURBANCE AREAS - INDICATIVE PROJECT GENERAL ARRANGEMENT

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 2

1.1 Purpose

The overall objective of this report is to assess the existing aquatic ecological values of areas that may be impacted by the Project, and to identify measures to avoid, minimise or mitigate potential impacts.

This report identifies existing environmental values with respect to aquatic ecology which includes mapped waterways and wetlands and the potential occurrence of Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Matters of State Environmental Significance (MSES) listed under the Queensland *Environmental Offsets Regulation 2014*.

In addition, this report considers potential occurrences of Priority species as identified by the Back on Track Actions for Biodiversity (BoT) (the former Department of Environment and Resource Management [DERM] 2010) and the Aquatic Conservation Assessment (ACA) framework for the wetlands of the Queensland Murray-Darling Basin (QMDB) (Fielder et al. 2011). Aquatic weeds listed under the Queensland *Biosecurity Act 2014* and Commonwealth Weeds of National Significance (WoNS) database are also discussed. Where relevant, general biodiversity values, evaluated in terms of Least Concern aquatic flora and fauna as defined by the Queensland *Nature Conservation Act 1992* (NC Act), are also considered.

1.2 Scope of work

The scope of work for this aquatic ecology assessment responds to items relating to aquatic ecology in the *EHP Information Request for an Amendment Application for an Environmental Authority* for this Project. The scope of work included:

- describe aquatic habitats, including features such as substrate, stream type, water quality condition, and surrounding land uses;
- describe aquatic flora and fauna (including mammals, fish, reptiles and aquatic invertebrates) present, or likely to be present at any time of the year;
- identify and describe any listed threatened aquatic species, and any introduced aquatic species, that are present or likely to be present in the Study area;
- consider relevant State and Commonwealth guidelines associated with threatened species likely to occur in the Study area (e.g. survey guidelines, referral guidelines, recovery plans and threat abatement plans);
- identify and describe wetlands present, and their value and importance;
- identify and describe groundwater-dependent ecosystems;
- assess the likely ecological impacts of the Project, and recommend appropriate impact mitigation measures where necessary; and
- provide relevant field survey data and methodologies used to identify the presence or absence of threatened flora or fauna.

In addition to the aquatic ecology assessment, DPM Enviros completed a targeted survey for conservation significant woodland snails in suitable habitats of the Study area in December 2017.

2 BACKGROUND

2.1 Regional setting

The Project is located within the WDRC area and the Barakula subregion of the Brigalow Belt South Bioregion (Commonwealth Department of the Environment [DotE], 2013a).

Locally, the majority of the Study area drains into Drainage Line 1 to the south (Figure 5). The northern extent of the Study area drains into Punch-Bowl Creek and then Dogwood Creek, which passes through Miles. All drainage lines in the Study area are ephemeral, with some pools on Drainage Line 1 expected to hold water for extended periods.

Regionally, the Study area is located in the far-upper reaches of the Balonne River drainage sub-basin, within the Balonne-Condamine drainage basin of the broader QMDB. Environmental values for the Balonne River sub-basin are yet to be established under the Queensland *Environmental Protection (Water) Policy 2009*, but are expected to be consistent with other Queensland catchments and include:

- the intrinsic value of aquatic ecosystems, habitat and wildlife;
- the suitability of water supply for production of healthy livestock;
- visual amenity of waterways; and
- cultural and spiritual values.

2.2 Rainfall and hydrology

The waterways of the Study area are subject to seasonality, which can be broadly categorised as either dry season or wet season. Rainfall across the Study area is expected to be greatest in mid-summer, with the lowest rainfall expected to occur in late winter, as inferred from data collected at the Miles Post Office monitoring station 42023 (BoM 2016) (Figure 3), located approximately 14 km west of the Study area.

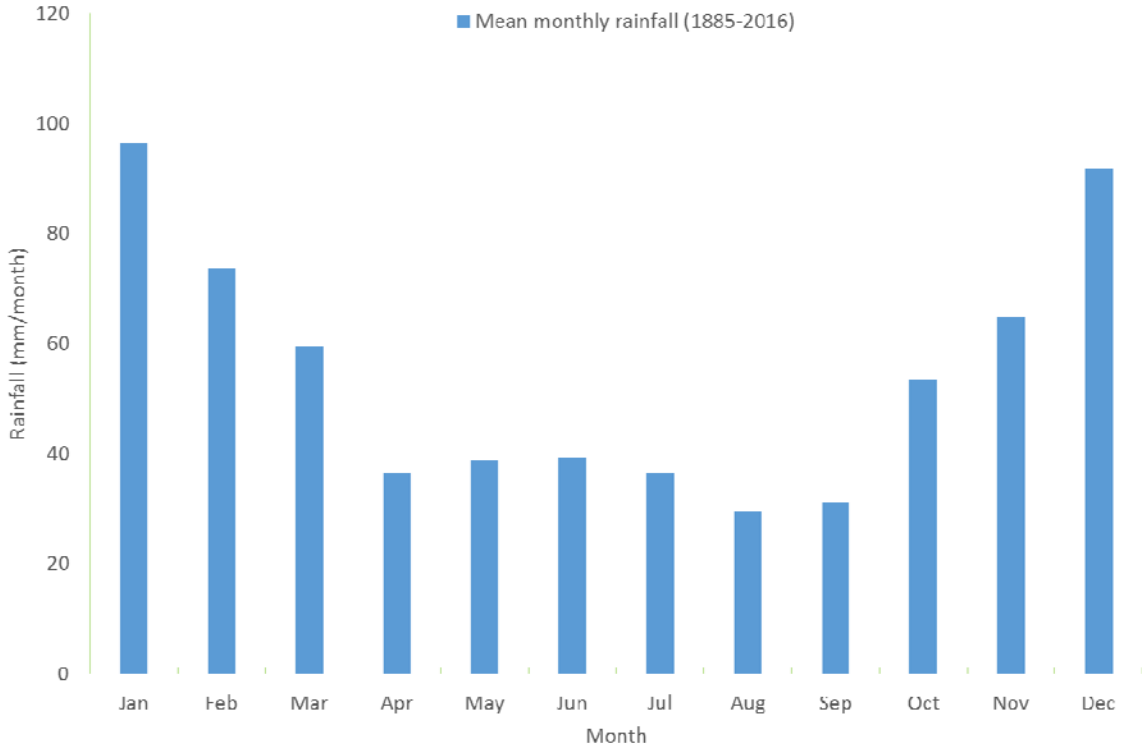

Figure 3 Historical rainfall at Miles Post Office meteorological station 42023 (BoM 2016)

The waterways of the Study area are ephemeral and expected to experience flow only after sustained or intense rainfall in the catchment. Stream flows are expected to be highly variable, with most channels drying out during winter to early spring when rainfall and runoff is historically low. During these times, aquatic fauna are likely to concentrate in senescing pools. As a consequence, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

Historical flow and river height monitoring data (1949-2016) for Dogwood Creek at Gilweir (DNRM monitoring station 422202B), located approximately 5 km south of Miles, provides an indication of the local flow regime. It is noted that although Dogwood Creek receives runoff from Study area, the gauging station is upstream of the confluence with Drainage Line 1, which drains the majority of the Study area. However, historical flow and river height data for this monitoring station suggests that waterways of the broader area are likely to incur reduced flows between March and September (Figure 4) (DNRM 2016).

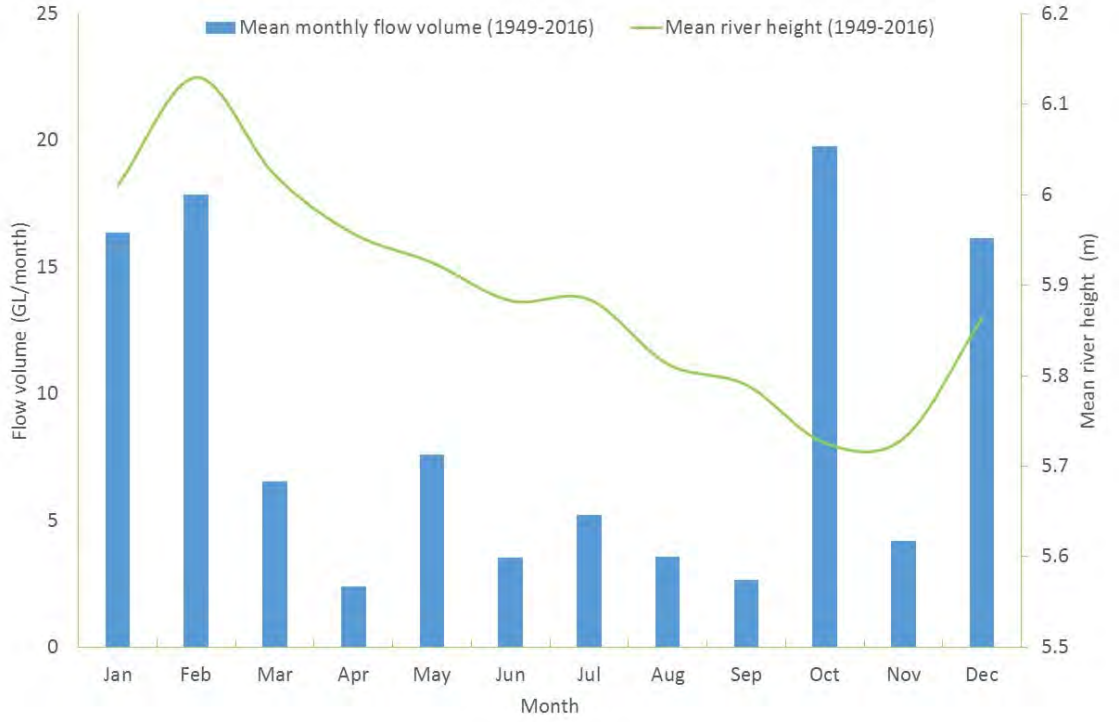

Figure 4 Flow volume and river height for Dogwood Creek at Gilweir (DNRM station 422202B, located approximately 5 km south of Miles)

3 METHODS

3.1 Desktop assessment

Desktop searches were undertaken in July 2016 and included a review of the following:

- Department of the Environment (DotE; now the Department of the Environment and Energy) EPBC Act Protected Matters Search Tool, to identify aquatic MNES within approximately 10 km of the Study area. The search area was defined by the Geocentric Datum of Australia 1994 coordinates:
  - -26.4917, 150.2008;
  - -26.4917, 150.5181;
  - -26.7669, 150.5181; and
  - -26.7669, 150.2008.
- Department of State Development, Infrastructure and Planning (DSDIP; now the Department of Infrastructure, Local Government and Planning) State Planning Policy (SPP) Interactive Mapping System (2016), to identify aquatic matters of state interest under the SPP.
- Queensland Wetlands 2013 mapping (Department of Science, Information Technology and Innovation [DSITI] 2017), to determine the classification, extent and significance of lacustrine, palustrine and riverine systems within the Study area.
- EHP Wetland*Info* Wetland Summary Information (including species listings) for the Balonne-Condamine drainage basin, incorporating data from the EHP Wildlife Online database, Queensland Museum and Queensland Herbarium.
- Queensland Waterways for Waterway Barrier Works mapping (Department of Agriculture, Fisheries and Forestry [DAFF] 2013).
- Queensland Groundwater Dependent Ecosystems (GDE) and Potential GDE Aquifer Mapping (DSITI 2016).
- The Condamine Natural Resource Management (NRM) Region BoT Actions for Biodiversity (DERM 2010).
- The ACAs, using AquaBAMM, for the wetlands of the QMDB (Fielder et al. 2011).
- Published ecological information on EVNT and Special Least Concern (SLC) aquatic flora and fauna species.
- Cameby Downs Mine Continued Operations Project Section 226 Consideration Report (Yancoal 2015).
- Cameby Downs Expansion Project: Waterway Morphology and Ecology Assessment Report (AARC 2013).

Aquatic flora and fauna species of conservation significance were grouped into either EVNT species or Priority species, defined as:

- **EVNT species** listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act and/or Endangered, Vulnerable or Near Threatened under the NC Act.
- **Priority species** for conservation, identified in the BoT Actions for Biodiversity for the Condamine NRM region (DERM 2010) and in the Expert Panel Report of the ACAs for the wetlands of the QMDB (Fielder et al. 2011).

3.2 Field survey

3.2.1 Survey timing and site selection

Field surveys were undertaken across the Study area by DPM over the period 25-29 July 2016, falling within the AusRivAS 'late wet' sampling season (May to July). 'Wet season' surveys were undertaken across the Study area by AARC over the period 19-23 January 2010 (AARC 2013) and the relevant findings from AARC (2013) are presented in this report.

Desktop investigations, including review of available aerial imagery, were used to identify representative stream reaches and wetlands for in-field assessment. Detailed aquatic survey was undertaken at eight locations by DPM in July 2016 (Figure 5), comprising:

- six riverine system drainage lines:
  - two stream order 1 sites (R3 and R6);
  - three stream order 2 sites (R1, R4 and R5); and
  - one stream order 3 site (R2);
- two waterbodies mapped as lacustrine waterbodies (dam sites L1 and L2).

Aquatic survey was undertaken at five locations by AARC in January 2010 (Figure 5), comprising:

- five riverine system drainage lines:
  - two stream order 1 sites (A2 and A4);
  - one stream order 2 site (A5); and
  - two stream order 3 sites (A1 and A3).

The sampling sites and survey effort are identified in Table 1.

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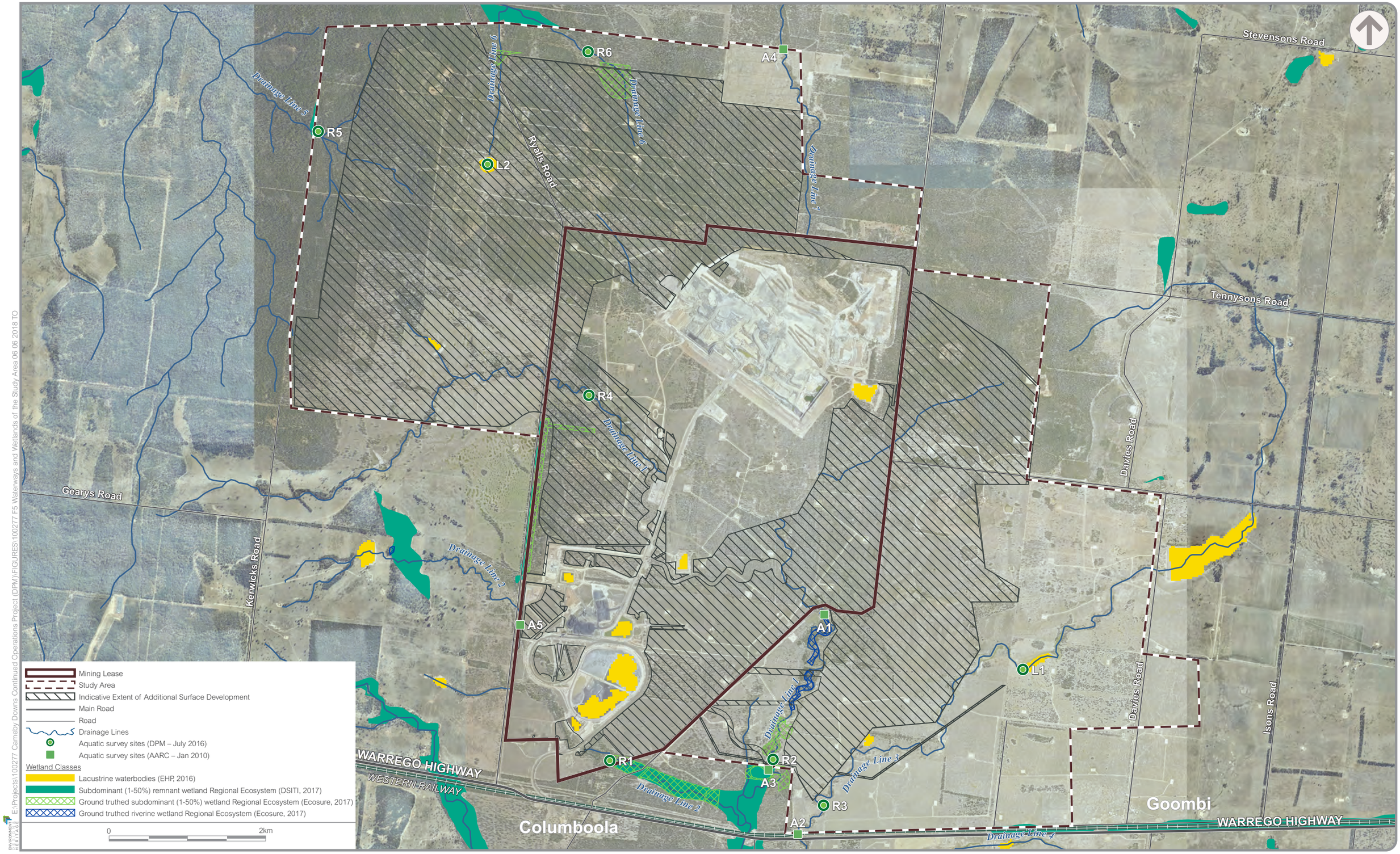

DPM ENVIROSCIENCES

WATERWAYS, MAPPED WETLANDS AND SURVEY SITES

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 5

Table 1 Assessment sites and survey effort across the Study Area by DPM (2016) and AARC (2010)

Site	Site code	Assess. by	Date	Stream order (Strahler)	Lat. (GDA 1994)	Long. (GDA 1994)	Fish (and turtle) survey effort						Aquatic macro-invert. sampling	Physico-chem. water quality	Habitat assess.
							Electro-fishing	Fyke nets	Box traps	Dip-net	Seine net	Cast net			
Drainage Line 2	R1	DPM	28/07/16	2	-26.6678	150.3414	✓	✓	✓	✓			✓	✓	✓
Drainage Line 1	R2	DPM	26/07/16	3	-26.6681	150.3624	✓	✓	✓	✓			✓	✓	✓
Drainage Line 1	R3	DPM	26/07/16	1	-26.6734	150.3688	✓	✓	✓	✓			✓	✓	✓
Drainage Line 1	R4	DPM	27/07/16	2	-26.6253	150.3397	✓			✓			✓	✓	✓
Minor Drainage Feature of Drainage Line 5	R5	DPM	28/07/16	2	-26.5940	150.3054								Dry	✓
Minor Drainage Feature of Drainage Line 6	R6	DPM	28/07/16	1	-26.5854	150.3405								Dry	✓
Dam on Drainage Line 1	L1	DPM	27/07/16	-	-26.6582	150.3950	✓	✓	✓	✓			✓	✓	✓
Dam on Minor Drainage Feature of Drainage Line 6	L2	DPM	29/07/16	-	-26.5983	150.3272	✓	✓	✓	✓			✓	✓	✓
Drainage Line 1	A1	AARC	19-23/01/10	3	-26.6514	150.3695			✓	✓				✓	✓
Drainage Line 1	A2	AARC	19-23/01/10	1	-26.6768	150.3654			✓	✓			✓	✓	✓
Drainage Line 1	A3	AARC	19-23/01/10	3	-26.6692	150.3618			✓	✓	✓	✓	✓	✓	✓
Drainage Line 7	A4	AARC	19-23/01/10	1	-26.5856	150.3657			✓	✓				✓	✓
Drainage Line 1	A5	AARC	19-23/01/10	2	-26.6518	150.3302			✓	✓				✓	✓

3.2.2 Aquatic habitats

Aquatic habitats were described in accordance with AusRivAS protocols for Queensland streams (Department of Natural Resources and Mines [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 (Table 2). 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 B.

Table 2 Aquatic habitat assessment variables and categories

Habitat variable	Poor	Fair	Good	Excellent
Bottom substrate/available cover	0 – 5	6 – 10	11 – 15	16 – 20
Embeddedness	0 – 5	6 – 10	11 – 15	16 – 20
Velocity/depth category	0 – 5	6 – 10	11 – 15	16 – 20
Channel alteration	0 – 3	4 – 7	8 – 11	12 – 15
Bottom scouring and deposition	0 – 3	4 – 7	8 – 11	12 – 15
Pool/riffle, run/bend ratio	0 – 3	4 – 7	8 – 11	12 – 15
Bank stability	0 – 2	3 – 5	6 – 8	9 – 10
Bank vegetative stability	0 – 2	3 – 5	6 – 8	9 – 10
Streamside cover	0 – 2	3 – 5	6 – 8	9 – 10
Total	**0 – 38**	**39 – 74**	**75 – 110**	**111 – 135**

3.2.3 Physico-chemical water quality

In-situ physico-chemical water quality parameters were measured at each wetted survey site visited by DPM in July 2016 (Figure 5) using a YSI Professional Plus multi-parameter water quality meter and Hach Turbidimeter 2100Q, each calibrated both prior to and following sampling. Alkalinity was measured in the field by acid titration. Water quality parameters measured included:

- temperature (°C);
- pH;
- electrical conductivity (EC) (microSiemens per centermetre (µS/cm))
- turbidity (NTU);
- dissolved oxygen(DO) (milligrams per litre (mg/L) and % saturation); and
- total alkalinity (mg$CaCO_3$/L).

AARC measured pH and EC at each sampling site in January 2010 (AARC 2013).

For the purposes of this assessment, the measure of salinity is based on the following EC ranges (DAFF 2012):

- Fresh – water with EC <800 µS/cm.
- Marginal – 800 to 1,600 µS/cm.
- Brackish – 1,600 to 4,800 µS/cm.
- Slightly saline – 4,800 to 10,000 µS/cm.
- Moderately saline – 10,000 to 20,000 µS/cm.
- Saline – >20,000 µS/cm.

3.2.4 Fish

Fish were surveyed by DPM at each wetted site (R1, R2, R3, R4, L1 and L2) using a combination of backpack electrofishing, dip-netting and overnight deployment of fyke nets and baited box traps in July 2016. Fish were surveyed by AARC in January 2010 by dip-netting and baited traps at sites A1, A2, A3, A4 and A5, supplemented by cast and seine netting at site A3.

Fish survey effort employed by DPM at each wetted site included:

- backpack electrofishing using a Smith-Root LR-24 electrofisher for up to 1200 seconds power-on time (100Hz frequency; 20% duty cycle; 250-550v, 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 metre (m) wing lengths, 0.6 m drop, 3 millimetre (mm) mesh – deployed overnight to capture mobile fish (and turtles);
- box traps – with 5 x traps, 22 centimetre (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 euthanized as per DPM's General Fisheries Permit and Animal Ethics Committee Approval.

3.2.5 Turtles

Freshwater turtles were surveyed at sites R1, R2, R3, L1 and L2 by overnight deployment of fyke nets, as well as observation of the bank and water surface for sunning and breaching turtles, respectively. Water depths were insufficient for deployment of baited cathedral traps. Water clarity was too poor (opaque) to enable snorkelling surveys.

3.2.6 Platypus

Habitat assessment and searches for signs and occupancy of platypus were undertaken at each riverine assessment site. This comprised targeted searches for burrows along the banks of each site (100 m study reach), as well as assessment of bank sediment composition to determine suitability for burrow construction.

3.2.7 Freshwater macroinvertebrates

Freshwater macroinvertebrate samples were collected during low flow conditions by DPM from sites R1, R2, R3, R4, L1 and L2 (Figure 5) to gain an improved understanding of the aquatic values, waterway health and trophic interactions occurring at each site. Samples were collected by an AusRivAS accredited ecologist following AusRivAS protocols for Queensland streams (DNRM 2001). AusRivAS specifies 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 R1, R2, R3 and R4. A combined bed/edge habitat sample was collected at dam sites L1 and L2.

A standard sized dip net with 250 micrometre (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 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.

Macroinvertebrate samples were collected by AARC from the edge habitat of sites A2 and A3 (Figure 5) in January 2010, and were live-picked for 40 minutes. Picked specimens were placed into specimen jars with 70% methylated spirits and sent to FRC Environmental for taxonomic identification (AARC 2013).

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 (EHP 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.

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).

Tolerant taxa

The percentage of tolerant taxa was calculated using the SIGNAL2 sensitivity grades derived from aquatic macroinvertebrate taxa at the Family level. Tolerant taxa are those with a SIGNAL2 sensitivity score of 4 or less. Families in this group are expected to be able to tolerate changes to their environment, including habitat degradation and some pollution. Other taxa could be considered as sensitive (SIGNAL2 grades of 5 to 7) and highly sensitive (SIGNAL2 grades of 8 to 10). The absence of these more sensitive taxa groups generally indicates harsh environmental conditions through unfavourable habitat or a reduction in water quality.

AusRivAS

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 following AusRivAS models were used, based on location, date and habitats sampled (Table 3).

Table 3 AusRivAS habitat predictor model variables for QLD Regional Western sampling

Code	Description	Input value			
		R1	R2	R3	R4
QLD Regional – Western – Autumn – Edge habitat					
DRYRANGE	Range in dry season monthly rainfall means	9.9	9.9	9.9	9.9
LATITUDE	Latitude of site – decimal degrees to four decimal points	-26.6678	-26.6681	-26.6734	-26.6253
MINTEMP	Mean daily minimum temperature (°C)	12.9	12.9	12.9	12.9
MWMR	Mean wet season monthly rainfall (mm)	18.0	18.0	18.0	18.0
STORDER	Strahler stream order	2	3	1	2
WETPERCENT	Percentage rainfall in wet season (%)	70	70	70	70
QLD Regional – Western – Autumn – Pool/Bed habitat					
PROCESSZONE	Process zone category: erosional (2), transport (1) or depositional (0).	2	2	2	2
STORDER	Strahler stream order	2	3	1	2
WETR	Range in wet season monthly rainfall means (mm)	42.8	42.8	42.8	42.8

Notes:
Meteorology data derived from Bureau of Meteorology monitoring sites at Miles Post Office (042023) and Miles Constance Street (042112).

3.2.8 Macro-crustaceans

Macro-crustaceans were collected as by-catch using fish sampling techniques (Section 3.2.4). Additionally, macro-crustacean specimens collected during macroinvertebrate sampling were retained for identification. All macro-crustaceans collected using fishing apparatus were returned to the water following identification. Identifications were undertaken to species level.

3.2.9 Aquatic flora

Aquatic plants were surveyed by DPM 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 categories: extensive (>75% cover), moderate (50-75%), some (10-50%) or little (1-10%).

3.2.10 Woodland snails

Target species

Brigalow woodland snail (*Adclarkia cameroni*)

The brigalow woodland snail is listed as Endangered under the EPBC Act and as Vulnerable under the NC Act. This species occurs in a small number of remnant and scattered brigalow (*Acacia harpophylla*) and eucalypt woodland patches on the Condamine River floodplain, and is likely to occur in or be associated with the 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' TEC (Stanisic 2011, cited in DotE 2016a). The brigalow woodland snail lives under logs (Stanisic et al. 2010, cited in DotE 2016a), where it likely feeds on fungi, algae and detritus, and needs both canopy and on-ground timber cover for survival and egg-laying (Stanisic 2011, cited in DotE 2016a).

The closest existing record of the brigalow woodland snail was from approximately 9 km south of the Study area in 2009 (ALA 2017).

Dulacca woodland snail (*Adclarkia dulacca*)

The Dulacca woodland snail is listed as Endangered under both the EPBC Act and the NC Act. This species inhabits remnant and scattered vine thicket and brigalow woodland patches on rocky outcrops with clay to loam soils (DotE 2016b). It lives under rocks and timber (Stanisic et al. 2010, cited in DotE 2016b), where it likely feeds on fungi, lichen and other biofilm (Stanisic 2011). It requires both canopy and on-ground timber cover for survival and egg-laying (Stanisic 2011).

The closest record of the Dulacca woodland snail is from approximately 24 km south-west of the Study area in 2010 (ALA 2017), from the Condamine River riparian corridor.

Approach

Consideration of the ground truthed RE mapping for the Study area (Ecosure 2018), and known habitat preferences (DotE 2016a, 2016b), determined that potential habitat for the brigalow woodland snail and the Dulacca woodland snail within the Study area is best represented by:

- RE 11.3.1 – *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains;
- RE 11.4.3 – *Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains; and
- RE 11.4.10 – *Eucalyptus populnea* or *E. woollsiana*, *Acacia harpophylla*, *Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.

Each occurrence of RE 11.3.1, 11.4.3 and 11.4.10 within the Study area was intensively surveyed by two ecologists actively searching for woodland snails over a period of two full days (four person days, or approximately 32 person hours) within the Study area from 13-15 December 2017. Methods employed to search specific micro-habitats within each RE included hand searches assisted by the use of a garden cultivator and pinch bar to rake and / or lift leaf litter and woody debris. Logs that could be lifted and reinstated by the field team were also

searched. Each of these REs were thoroughly and systematically searched until a representative selection of all available suitable micro-habitats had been searched.

3.3 Ground-truthing mapped lacustrine waterbodies

Those waterbodies mapped as lacustrine under the Queensland Wetlands 2013 mapping (DSITI 2017) (Figure 5) were field-validated to establish whether they are natural or constructed. The Wetland Field Assessment Tool (in preparation by EHP) was not available for use. Mapped lacustrine waterbodies were photographed from up to 120 m above ground level using a high-definition geo-referencing camera mounted beneath a DJI Inspire 1 remotely piloted aircraft (RPA) operated in accordance with DPM's RPA Operator's Certificate. Field validation focussed on the identification of features such as constructed dam walls. Photographs are presented in Section 4.4.4, along with each mapped lacustrine waterbody's status as natural or constructed.

3.4 Aquatic values rating

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).

Table 4 Criteria for assigning aquatic values rating

Aquatic Values/Sensitivity	Criteria
Low	▪ Ephemeral stream
	▪ No EVNT, platypus or Priority species habitat
	▪ In-stream habitat highly modified/disturbed
	▪ Poor to Fair habitat bioassessment score (0 – 74)
Moderate	▪ Ephemeral or semi-permanent stream
	▪ Priority species or platypus habitat present
	▪ Known presence of Priority species
	▪ Some good quality in-stream habitat
	▪ Good habitat bioassessment score (75 – 110)
	▪ Dry season refuge for common (Least Concern) species
High	▪ Semi-permanent or permanent stream
	▪ EVNT species habitat present
	▪ Known presence of platypus breeding place
	▪ Near natural/excellent in-stream habitat
	▪ Excellent habitat bioassessment score (111 – 135)

4 RESULTS

4.1 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 (DotE 2016c).

Wetlands of International Importance

No wetlands of International Importance are identified within the search area in the EPBC Act Protected Matters Report (DotE 2016c). Wetlands of International Importance nearest to the Search Area include Banrock Station Wetland Complex (1200-1300 km away), Narran Lake Nature Reserve (400-500 km away), Riverland (1100-1200 km away) and 'The Coorong, and Lakes Alexandrina and Albert Wetland' (1400-1500 km away).

Aquatic Threatened Ecological Communities

No EPBC Act listed Threatened Ecological Communities (TECs), relevant to aquatic ecology, are identified from the search area in the EPBC Act Protected Matters Report (DotE 2016c).

Threatened Species – Aquatic

The EPBC Act Protected Matters Report (DotE 2016c) identifies that the Vulnerable Murray cod (*Maccullochella peelii*), or its habitat, may occur within a wider search area covering the Study area. However, this species is considered unlikely to occur within the Study area due to lack of suitable habitat (Sections 4.6.2 and 4.9.1).

Threatened Species – Land snails

The EPBC Act Protected Matters Report (DEE 2017) identifies that the brigalow woodland snail (*Adclarkia cameroni*) and Dulacca woodland snail (*A. dulacca*) are known to occur within the wider search area encompassing the Study area. The brigalow woodland snail was recorded during targeted surveys for these species within the Study area 13-15 December 2017. The locations of these species records are shown in Figure 9 (Section 4.11).

Aquatic Migratory Species

The EPBC Act Protected Matters Report (DotE 2016c) identifies a number of migratory species that may occur in the search area. This includes wader birds and waterfowl, which are addressed in the terrestrial ecology assessment. No aquatic migratory species (i.e. migratory species that live in water for most or all of their lives) are identified from the search area.

4.2 Matters of State Environmental Significance

Table 5 provides a list of MSES relevant to aquatic ecology and a summary of the relevance of each to the Study Area.

Table 5 Matters of State Environmental Significance

MSES relevant to aquatic ecology	Relevance to the Study area
Regulated Vegetation	This MSES has been assessed separately by Ecosure (2018).
Wetlands and watercourses ▪ a wetland in a Wetland Protection Area (WPA) or of High Ecological Significance (HES) shown on the Map of Referable Wetlands; and ▪ a wetland or watercourse in High Ecological Value Waters.	The Study area does not contain any wetlands or watercourses that are MSES (Section 4.4.3).
Designated precinct in a strategic environmental area	The Study area is not in a designated precinct in a strategic environmental area.
Protected wildlife habitat	It is unlikely that any EVNT aquatic species use habitat in the Study area (Section 4.9). The brigalow woodland snail (*Adclarkia cameroni*) is an MSES species listed as Vulnerable under the NC Act. This species is not likely to be significantly impacted by the Project.
Protected areas	There are no protected areas in the Study area.
Highly protected zones of State marine parks	There are no State marine parks in the Study area.
Fish habitat areas	There are no areas of declared fish habitat in the Study area.
Waterway providing for fish passage	Drainage Line 1 provides fish movement (discussed further below this table).
Marine plants	Marine plants are highly unlikely to occur in the Study area.

Apart from *Regulated Vegetation* assessed separately by Ecosure (2018), *Waterways Providing for Fish Passage* is the only MSES relevant to aquatic ecology within the Study area. Any part of a waterway providing for fish passage is a MSES only if the construction, installation or modification of waterway barrier works carried out under an authority would limit the passage of fish along the waterway (EO Regulation).

The DAFF (2013) Queensland Waterways for Waterway Barrier Works mapping for the region (Figure 6) indicates Drainage Line 1 as being at high risk of adverse impact from waterway barrier works on fish movement (due to the fish habitat present). 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.

The potential impacts on fish passage are discussed in Sections 5.2 and 5.8, along with mitigation measures considered sufficient to avoid significant impacts on MSES.

The brigalow woodland snail (*Adclarkia cameroni*) is an MSES species listed as Vulnerable under the NC Act. This species is also an MNES species listed as Endangered under the EPBC Act, and is addressed in Sections 4.11, 5.6, 5.10 and 6. An Assessment of Significance concluded that impacts on this species are unlikely to be significant (Appendix E).

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R6
A4
R5
L2
Ryalls Road
Stevensons Road
Tennysons Road
Davies Road
Gearys Road
Kerwicks Road
R4
A5
A1
L1
Davies Road
Isons Road
Site Boundary
Study Area
Indicative Extent of Additional Surface Development
Main Road
Road
Waterway
Aquatic survey sites (DPM – July 2016)
Aquatic survey sites (AARC – Jan 2010)
Waterway Risk of Impact (Department of Agriculture and Fisheries)
Low
Moderate
High
0
2km
WARREGO HIGHWAY
R1
R2
A3
R3
A2
Columboola
Goombi
WARREGO HIGHWAY

E:\Projects\100277 Cameby Downs Continued Operations Project (DPM)\FIGURES\100277 F6 Waterways for Waterway Barrier Works Mapping 06 06 2018.TO

DPM ENVIROSCIENCES

WATERWAYS FOR WATERWAY BARRIER WORKS MAPPING

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 6

4.3 Drainage lines / waterways

The Queensland Wetlands Map 2013 (DSITI 2017) identifies riverine systems, watercourses, waterways or drainage lines (here referred to collectively as waterways) for the Study area, sharing the same data set mapped at the 1:100,000 scale. There are 19 waterway sections mapped for the Study area, including:

- 14 waterways of (Strahler) stream order 1;
- four waterways of stream order 2; and
- one waterway of stream order 3 (Drainage Line 1).

Photographs of each riverine survey site, taken at the time of survey, are presented in Plates 1 to 6, along with a location reference corresponding with Figure 5.

All waterways in the vicinity of the Study area are ephemeral (most often dry), with some pools expected to hold water for extended periods. All waterways observed within the Study area in July 2016 were either dry or contained isolated pools. Bed substrates were dominated by fine sediments, comprising either sand (sites R1, R5 and R6) or silt/clay (sites R2, R3, R4) (Appendix B). No bedrock outcrops or boulders were detected, and only minor occurrences of cobble, pebble and gravel were observed. Bed geomorphology suggests that pool-run sequences would be prevalent in times of flow, but that pool-riffle sequences are unlikely. Observations of channel alteration, bottom scouring and deposition, bank stability and bank vegetative stability (Appendix B) suggest that bed profiles and pool locations are likely to be relatively stable, being unlikely to exhibit either rapid or frequent change in their existing state.

In May 2015, a watercourse determination by DNRM confirmed Drainage Line 1 within the limits of the Project area is not a watercourse as defined under the *Water Act 2000*.

Waterways, as defined by the *Fisheries Act 1994*, includes a river, creek, stream, watercourse or inlet of the sea. The upstream limits of waterways are identified by Peterken et al. (2009) as including features relevant to fisheries resources, such as the following physical and hydrological attributes:

- Defined bed and banks – the bed and banks need to be continuous rather than isolated and broken sections of a depression.
- An extended, if non-permanent, period of flow – flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall.
- Flow adequacy – The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature.

Waterways in the Study area and surrounds are considered to be in poor to moderate condition, which is reflected in the Sustainable Rivers Audit 2 (MDBA 2012) for the slopes zone of the Condamine Valley river system (incorporating the Balonne River). This means that most ecosystem health indicators fail to meet, or only adequately meet, desired standards, with:

- Poor ecosystem health.
- Moderate condition of macroinvertebrate communities.
- Moderate condition of the fish community.
- Moderate condition (including abundance, diversity, quality and integrity) of riverine vegetation.
- Moderate physical form, including Moderate channel form and bed dynamics, and Good bank dynamics and floodplain dynamics.
- Moderate to Good hydrology condition.

Plate 1 Drainage Line 2 (R1), stream order 2, 27/07/2016

Plate 2 Drainage Line 1 (R2), stream order 3, 25/07/2016

Plate 3 Drainage Line 1 (R3), stream order 1, 25/07/2016

Plate 4 Drainage Line 1 (R4), stream order 2, 27/07/2016

Plate 5 Minor Drainage Feature of Drainage Line 5 (R5), stream order 2, 28/07/2016

Plate 6 Minor Drainage Feature of Drainage Line 6 (R6), stream order 1, 28/07/2016

4.4 Wetlands

4.4.1 Wetlands of International Importance

As identified in Section 4.1, there are no Ramsar internationally important wetlands located in proximity to the Study area.

4.4.2 Wetlands of National Importance

As indicated in Section 4.1, there are no Nationally Important Wetlands in proximity to the Study area.

4.4.3 Referrable wetlands

Referable wetlands are areas shown as wetlands on the Map of Referable Wetlands, a document approved by the Chief Executive of, and published by, EHP (s.12 *Environmental Protection Regulation 2008*). The map of referable wetlands identifies:

- WPAs – including wetlands and their trigger area buffers;
- HES wetlands; and
- General Ecological Significance (GES) wetlands.

A review of the referable wetlands mapping (Appendix A) indicates that no WPAs, HES wetlands or GES wetlands occur within the Study area.

4.4.4 Other mapped wetlands

The Queensland Wetlands Mapping 2013 (version 4.0, DSITI 2017) identifies marine, estuarine, riverine, lacustrine and palustrine waterbodies and wetland Regional Ecosystems (RE) in Qld. Within the Study area, this mapping includes:

- 11 lacustrine waterbodies;
- Remnant riverine wetland RE (assessed separately by Ecosure [2018]); and
- Remnant RE 1-50% wetland (mosaic units) (assessed separately by Ecosure [2018]).

No natural lacustrine waterbodies or wetlands were detected within the Study area as each of the 11 mapped lacustrine waterbodies were ground-truthed as being either farm dams or mine water dams during the site visit conducted 25-29 July 2016. Photographs of each waterbody are presented in Plates 7 to 15, along with a location reference corresponding with Figure 7.

Plate 7 Constructed dam (L1) mapped as lacustrine waterbody, 26/07/2016

Plate 8 Constructed dam (L2) mapped as lacustrine waterbody, 29/07/2016

Plate 9 Constructed dam (L3) mapped as lacustrine waterbody, 27/08/2016

Plate 10 Constructed dam (L4) mapped as lacustrine waterbody, 28/07/2016

Plate 11 Constructed dam (L5) mapped as lacustrine waterbody, 29/07/2016

Plate 12 Constructed dam (L6) mapped as lacustrine waterbody, 29/07/2016

Plate 13 Constructed dam (L7) mapped as lacustrine waterbody, 28/07/2016

Plate 14 Constructed dams (L8 [top right], L9 [middle] and L10 [left]) mapped as lacustrine waterbodies, 28/07/2016

Plate 15 Constructed dam (L11) mapped as lacustrine waterbody, 26/07/2016

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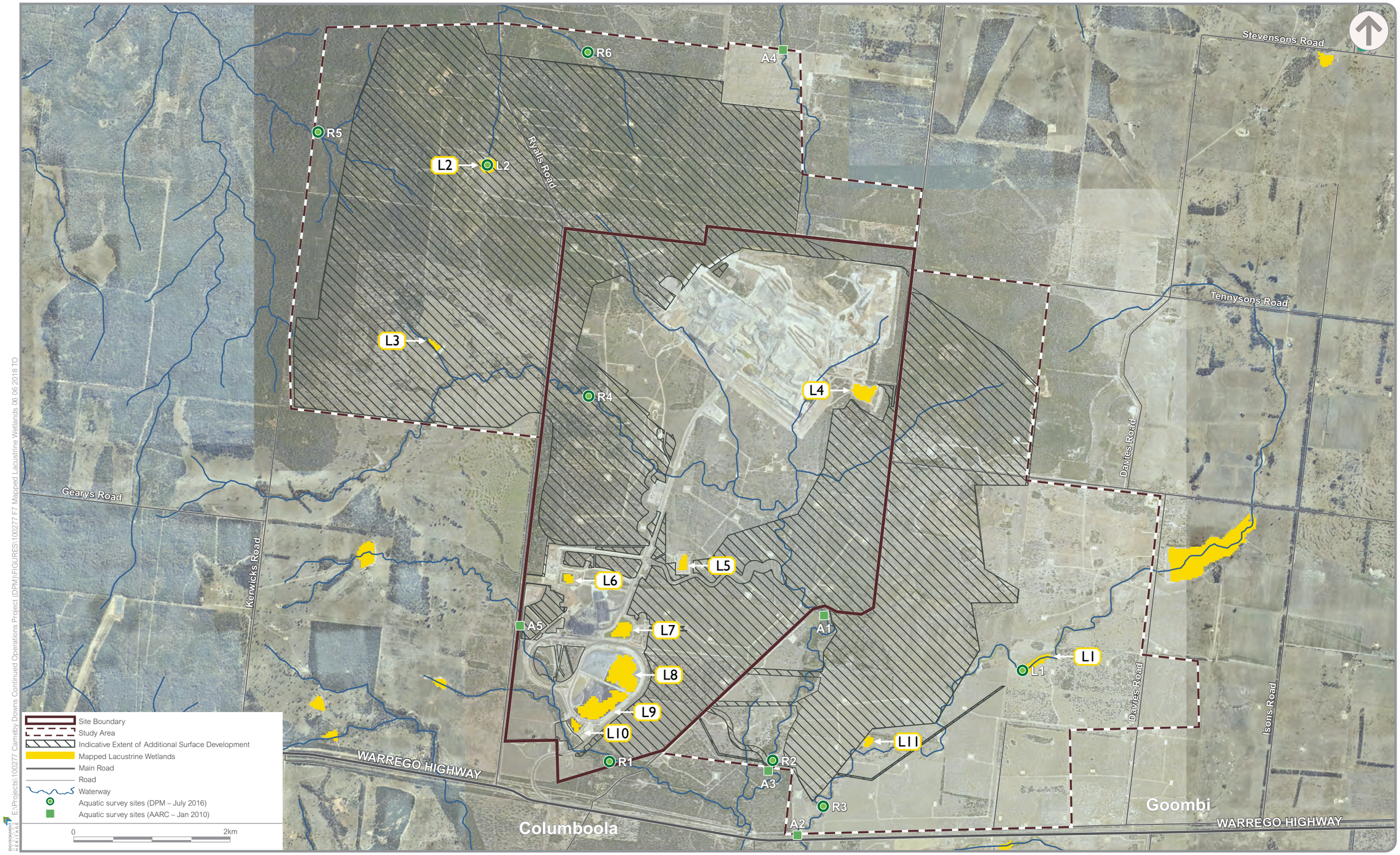

E:\Projects\100277 Cameby Downs Continued Operations Project (DPM)\FIGURES\100277 F7 Mapped Lacustrine Wetlands 06 06 2018 TO

DPM ENVIROSCIENCES

MAPPED LACUSTRINE WETLANDS

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 7

4.5 Groundwater dependent ecosystems

A groundwater dependent ecosystem (GDE) is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function. Desktop mapping of potential GDEs throughout Queensland (DSITI 2017 and BoM 2017) indicates that areas of terrestrial vegetation and aquatic ecosystems in the Project area and surrounds may be GDEs (Figure 1). Specifically, the desktop GDE mapping (DSITI 2017 and BoM 2017) indicates:

- drainage features in the north of the Project area (mainly Drainage Lines 5 and 6 [and associated minor drainage features] – Figure 1) potentially receive surface expression of groundwater (possibly supporting an aquatic ecosystem) and are potentially associated with subsurface presence of groundwater (possibly supporting terrestrial riparian vegetation – mapped as 'treed vegetation fringing channels on unweathered sandstones');
- a patch of terrestrial vegetation in ML 50233 (ground-truthed by Ecosure as RE 11.5.1) is potentially associated with subsurface presence of groundwater (mapped as 'treed non-wetland vegetation on alluvia'); and
- patches of terrestrial vegetation south of ML 50233 are potentially associated with subsurface presence of groundwater (mapped as 'treed non-wetland vegetation on alluvia') (Figure 1).

The desktop GDE mapping (DSITI 2017 and BoM 2017) of the Project locality is not based on site specific work and has a moderate confidence level in regard to the potential for GDEs along the drainage features and a low confidence level in regard to the patch of terrestrial vegetation in ML 50233.

There are no GDEs associated with watercourses, wetlands or springs in the Project area or surrounds based on the desktop review and site inspections by AGE 2018.

The accuracy of the desktop GDE mapping (DSITI 2017 and BoM 2017) of the Project locality has been reviewed by AGE (2018), DPM Enviros ciences and Ecosure (2018) and the following conclusions have been made in relation to the presence / likely absence of GDEs based on detailed site surveys and assessments:

- Drainage Lines 5 and 6 (and associated minor drainage features) (Figure 1) are not likely to support aquatic or terrestrial GDEs because:
    - thin, discontinuous and temporal alluvial aquifers (perched and hydraulically separated from the regional groundwater system) may be associated with these drainage features, however, there is no permanent alluvial aquifers (AGE 2018);
    - the vegetation that occurs along these drainage lines (RE 11.7.4 and RE 11.7.7) also occurs more widely across the landscape and not restricted to areas where the vegetation could potentially access groundwater (Ecosure 2018); and
    - the aquatic flora and fauna present along these drainage lines are generally well adapted to wetting and drying cycles expected in these ephemeral systems.
- The patch of terrestrial vegetation in ML 50233 (mapped as RE 11.5.1) is not likely to be dependent on groundwater because the occurrence of this regional ecosystem is dominated by Ironbark Woodlands and comprises tree species that are more widely distributed across the landscape and not restricted to areas where the vegetation could potentially access groundwater (Ecosure 2018).

- There are no other drainage lines, watercourses, wetlands or springs surrounding the Project in the maximum drawdown zone (including those patches of terrestrial vegetation south of ML 50233) that are likely to support GDEs which are connected to the regional groundwater system and subject to any predicted drawdown impacts by the Project (AGE 2018).

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E:\Projects\100277 Cameby Downs Continued Operations Project (DPM)\FIGURES\100277 F8 Groundwater Dependent Ecosystems 06 06 2018 TO

DPM ENVIROSCIENCES

Note: DSITI - Department of Science, Information Technology and Innovation

GROUNDWATER DEPENDENT ECOSYSTEMS MAPPING

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 8

4.6 Aquatic habitat

4.6.1 Waterways

The waterways of the Study area are ephemeral, likely to incur flow for relatively short duration following intense or sustained rainfall and runoff in the catchment. However, the clay rich substrates are likely to allow pooled water to persist for longer periods, as evidenced by the presence of surface water at sites R1, R2, R3 and R4 (Appendix B) at the time of the site visits 25-29 July 2016.

4.6.2 Instream habitat

The instream (aquatic) habitat assessment scores were Fair for each riverine survey site (R1, R2, R3, R4, R5 and R6) within the Study area (Table 6). Bottom substrate/available cover was rated Poor at each site, owing to the dominance of fine sediments (silt/clay and sand) and general lack of pebble, cobble and boulder substrates at each site. However, each site exhibited at least some detritus, sticks, branches and logs, providing some instream habitat and refugia for aquatic fauna in times of flow. Embeddedness rated Poor at each site, as did the velocity/depth category which rated Poor at most sites due to lack of flow, and Fair at sites R1 and R2 owing to the presence of both shallow (<0.5 m) and deep (>0.5 m) wetted habitat.

4.6.3 Bank stability / erosion

Bank vegetative stability was either Good or Excellent across all sites, indicating that at least 50% (typically over 80%) of the stream banks were covered by vegetation. Local catchment erosion (although only 'little') was recorded at most sites, evident from sediment deposits and bare ground within the riparian zone. Banks were stable or moderately stable at each site, with only small, infrequent areas of erosion mostly healed over at sites R1, R3 and R6. There remains some potential for erosion in extreme flooding at these sites.

4.6.4 Adjacent land use

Land use across the Study area includes cattle grazing as well as open cut mining and associated activities. Stock were excluded from most sites (R1, R4, R5 and R6). Grazing intensity at other sites (estimated by grass cover and height) ranged from light (R2) to moderate (R3). Exclusion of cattle resulted in substantially better riparian zones then those stream reaches left open to direct cattle access. However, streamside cover was still dominated by trees at each site.

Riparian zone widths ranged from 10 to 15 m (single bank measurements on each bank). Trees commonly encountered in riparian zones across the Study area included forest red gum (*Eucalyptus tereticornis*), poplar box (*E. populnea*), narrow-leaved ironbark (*E. crebra*), smooth-barked apple (*Angophora leiocarpa*), white cypress pine (*Callitris glaucophylla*), bull oak (*Allocasuarina luehmannii*), belah (*Casuarina cristata*), brigalow (*Acacia harpophylla*) and lancewood (*Acacia shirleyi*). Commonly encountered shrubs included limebush (*Citrus glauca*), wilga (*Geijera parviflora*), false sandalwood (*Eremophila mitchellii*) and scrub boonaree (*Alectryon diversifolius*). Groundcover was variable across the site (Appendix B).

Table 6 Aquatic habitat assessment scores for riverine survey sites across the Study area, July 2016

Habitat variable	R1	R2	R3	R4	R5	R6
Bottom substrate/available cover	P (5)	P (5)	P (5)	P (5)	P (5)	P (1)
Embeddedness	P (5)	P (3)	P (3)	P (5)	P (5)	P (3)
Velocity/depth category	F (6)	F (6)	P (3)	P (1)	P (0)	P (0)
Channel alteration	G (8)	G (10)	G (10)	E (12)	E (12)	E (12)
Bottom scouring and deposition	F (6)	G (9)	G (9)	E (12)	E (12)	E (12)
Pool/riffle, run/bend ratio	F (4)	F (5)	F (4)	F (5)	F (4)	P (2)
Bank stability	G (8)	E (9)	G (7)	E (9)	E (9)	G (7)
Bank vegetative stability	E (9)	E (9)	G (7)	E (9)	E (9)	E (9)
Streamside cover	E (9)	E (9)	E (9)	E (10)	E (10)	E (9)
Total (out of 135)	**60**	**65**	**57**	**68**	**66**	**56**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**

4.7 Physico-chemical water quality

The most relevant in situ water quality guidelines for the Balonne-Condamine drainage basin are the default ANZECC/ARMCANZ (2000) guidelines (Table 7).

EVs and WQOs for the Maranoa-Balonne (and Lower Condamine) Sub-basin are currently being developed by the DEHP. DEHP have been developing the EV's and WQO's in collaboration within the Queensland Murray Darling Committee (QMDC). DEHP have republished a draft report by QMDC entitled *Healthy Waters Management Plan Draft Environmental Values and Community Consultation Report* (DEHP, 2017). Although this document is only in draft form, it is likely to be used to inform the subsequent development of EV's, WQO's and future water quality guidelines under the EPP Water.

Water temperatures were relatively consistent across the Study area, ranging from 12.1°C to 15.0°C (Table 7). Water temperatures were likely influenced by time of day, shading and waterbody depth.

EC levels fell within the guideline range of 30-350 µS/cm at each site, with the exception of farm dam L1 which was marginally saline as indicated by an EC of 954 µS/cm.

pH levels ranged from slightly acidic (6.12 pH units) at R3 to moderately alkaline (8.02 pH units) at farm dam L1.

DO levels fell below the guideline range of 90-110% saturation at riverine sites R2, R3 and R4. The particularly low DO level of 13% at site R3 is likely due to the breakdown of organic matter by aerobic bacteria in this drying pool that was subject to direct and regular disturbance by cattle.

Turbidity levels exceeded the guideline range of 2-25 NTU at all sites. The high turbidity is likely a result of washload (clay and silt carried in suspension from catchment runoff), typical of streams with banks containing high proportions of silt and clay. The particularly elevated levels at R2 and L1 are likely due to continued disturbance of substrates by cattle directly accessing these waterbodies. The elevated level at R3 is likely exacerbated by the feeding habitats of European carp (*Cyprinus carpio*) collected from this site (Section 4.9.1).

Water hardness, measured by total alkalinity, ranged from soft waters at most sites, to very hard waters at farm dam site L1, which is likely due to the high contact time of water with sediments as well as continued disturbance by cattle directly accessing this waterbody.

Table 7 Physico-chemical water quality parameters, 25-29 July 2016

Parameter	Units	ANZECC/ARMCANZ guideline (2000)	Riverine sites						Dam sites	
			R1	R2	R3	R4	R5	R6	L1	L2
Date/time	DD/MM/YY 00:00	-	27/07/16 15:45	26/07/16 07:50	26/07/16 12:10	27/07/16 13:00	28/07/16 14:15	28/07/16 12:30	27/07/16 07:30	29/07/16 09:15
Temperature	°C	-	15.0	12.1	12.6	12.3	Dry	Dry	13.5	14.0
Electrical conductivity	µS/cm	30-350	263	217	167	146			954	121
pH	pH units	6.5-7.5	7.11	7.15	6.12	6.84			8.02	7.66
Dissolved oxygen	% saturation	90-110	92	60	13	61			81	89
	mg/L	-	9.26	6.42	1.2	7.38			8.41	9.16
Turbidity	NTU	2-25	639	>1000	>1000	151			>1000	117
Total alkalinity	$mgCaCO_3/L$	-	50	25	47	35			200	50

4.8 Aquatic flora

Desktop assessment results

The Wetland*Info* database identifies 217 wetland indicator plant species as having previously been recorded from the Balonne-Condamine drainage basin (EHP 2016). Of these, two are EVNT species, being the Endangered (NC Act) *Fimbristylis vagans* and the Endangered (EPBC Act and NC Act) *Phaius australis*. The nearest record of *F. vagans* is from Chinchilla in 1935 (Living Atlas of Australia (ALA) 2016). The nearest known records of *P. australis* are from the Sunshine Coast region in 1995 (ALA 2016). Neither species was encountered during the site surveys by DPM in July 2016 or by AARC in January 2010.

The EPBC Act Protected Matters Report identifies a number of EVNT flora species as potentially occurring within the search area. However, none of these are aquatic species.

No aquatic plant species were recorded in the BoT Actions for Biodiversity for the Condamine NRM region (DERM 2010), with the exception of *Eleocharis blakeana*, which was listed in the BoT Actions due to its previous listing as Near Threatened under the NC Act. This species has since been delisted and has not been considered further. Twenty aquatic flora species are listed as Priority species for the Balonne-Condamine drainage basin under the ACA (Fielder et al. 2011). Table 8 describes these species and assesses the likelihood of their occurrence within the Study area.

Table 8 EVNT and Priority aquatic flora recorded from the Condamine-Balonne drainage basin in Queensland

Scientific name	Common name	Status			Preferred habitat and importance	Likelihood of occurrence within Study Area	Data Source	
		EPBC Act[1]	NC Act[2]	ACA[3]			Fielder et al. 2011	EHP 2016
EVNT species								
Fimbristylis vagans	Fringing rush		E	✓	Clay pans, open sedge land and sparse-tussock grasslands on shallow alluvial sand plains. Conservation significant under the NC Act.	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Phaius australis	-	E	E		Grows in areas where soils are almost always damp, but not flooded for lengthy periods. Sands are generally the underlying soil type. Usually found in coastal habitats between swamps and forests or in suitable areas further inland.	**Unlikely**.		✓
Priority species								
Bacopa monnieri	Herb of grace		LC	✓	Grows on the edge of freshwater or brackish pools or streams, sometimes submerged. Important for stream stabilisation. Provides stream bank or bed stabilisation, or has soil-binding properties (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Baumea articulata	Jointed twigrush		LC	✓	Grows in standing water of lagoons, deeper swamps, and streams. Provides important bird nesting material and food source for waterbirds (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Casuarina cunninghamiana	River oak		LC	✓	Grows along permanent freshwater streams. Provides bank stabilisation in upper tributaries (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓

Table 8 (Continued) EVNT and Priority aquatic flora recorded from the Condamine-Balonne drainage basin in Queensland

Scientific name	Common name	Status			Preferred habitat and importance	Likelihood of occurrence within Study Area	Data Source	
		EPBC Act[1]	NC Act[2]	ACA[3]			Fielder et al. 2011	EHP 2016
Priority species (Continued)								
Ceratophyllum demersum	Hornwort		LC	✓	Widespread, in water to 10 m deep. Tolerant of low light levels. Forms large macrophyte beds. Forms significant macrophyte beds (in shallow or deep water) (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Damasonium minus	Starfruit		LC	✓	Grows in shallow freshwater in a range of habitats. Widespread. Fringing plant usually found in wetlands, but also occurs along flowing streams. Provides food for waterbirds. It is an important/critical food source (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Eucalyptus largiflorens	Black box		LC	✓	Grows in grassy woodland on heavy black clay soils in seasonally flooded areas. At the northern limited of its distribution. Like *E. camaldulensis*, it is a local species which serves as a useful indicator of wetland ecosystem health (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Glycyrrhiza acanthocarpa	Native liquorice		LC	✓	Grows in various habitats, especially on heavy soils prone to flooding. There is only one known extant population in Queensland ('The Gums' near Tara) (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Goodenia macbarronii	Narrow goodenia		LC	✓	Grows in ephemeral damp or wet sites. Often occurs at sites after good winter rainfall periods. Made obsolete from EPBC Act in 2006 (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	

Table 8 (Continued) EVNT and Priority aquatic flora recorded from the Condamine-Balonne drainage basin in Queensland

Scientific name	Common name	Status			Preferred habitat and importance	Likelihood of occurrence within Study Area	Data Source	
		EPBC Act[1]	NC Act[2]	ACA[3]			Fielder et al. 2011	EHP 2016
Priority species (Continued)								
Isoetes drummondii subsp. drummondii	Plain quilwort		LC	✓	Grows in mud or temporary water and in damp soil depressions. Unique and very seldom recorded (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Ludwigia peploides subsp. montevidensis	Water primrose		LC	✓	Found mainly in freshwater swamps/soaks, or lake/river banks. Stabilises stream banks, forming large macrophyte beds. Seeds are a food source for waterbirds. Important/critical food source (Fielder et al. 2011).	**Known**^.	✓	✓
Marsilea drummondii	Common nardoo		LC	✓	Widespread in inland areas, in moist depressions, around waterholes. *Marsilea spp.* provide bank stability and retain surface moisture in wetlands during dry periods. They provide habitat for amphibians and macroinvertebrates (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Marsilea hirsuta	Hairy nardoo		LC	✓	Widespread, mostly in shallow swamps of floodplains. *Marsilea spp.* provide bank stability and retain surface moisture in wetlands during dry periods. They provide habitat for amphibians and macroinvertebrates (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Marsilea mutica	Shiny nardoo		LC	✓	Widespread, often in deeper water than other species. *Marsilea spp.* provide bank stability and retain surface moisture in wetlands during dry periods. They provide habitat for amphibians and macroinvertebrates (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓

Table 8 (Continued) EVNT and Priority aquatic flora recorded from the Condamine-Balonne drainage basin in Queensland

Scientific name	Common name	Status			Preferred habitat and importance	Likelihood of occurrence within Study Area	Data Source	
		EPBC Act[1]	NC Act[2]	ACA[3]			Fielder et al. 2011	EHP 2016
Priority species (Continued)								
Melaleuca bracteata	Black tea-tree		LC	✓	Widespread, along watercourses or on heavier inland soils in depressions. Provides bank stabilisation in upper tributaries, and habitat for birds (Fielder et al. 2011).	**Known**^.	✓	✓
Melaleuca densispicata	Mile honey-myrtle		LC	✓	Grows around depressions or along stream channels. This species has a disjunct distribution in Queensland/northern NSW. It represents a very distinctive component of flora (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Melaleuca viminalis	Weeping bottlebrush		LC	✓	Mostly grows along watercourses, chiefly in sandstone or granite areas. Provides bank stabilisation in upper tributaries, and habitat for birds (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓
Najas tenuifolia	Water nymph		LC	✓	Grows in freshwater less than 3 m deep, widespread. Submerged aquatic species. Provides important habitat for in-stream fauna. Important/critical food source (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.		✓
Nelumbo nucifera	Pink waterlily		LC	✓	Occurs in deep lagoons and deep slow-moving streams. Disjunct population, this is the very southern limit of its distribution. It is at its distributional limit or is a disjunct population (Fielder et al. 2011). Observed by DPM in 2015 at Chinaman's lagoon on the southern periphery of Miles.	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓

Table 8 (Continued) EVNT and Priority aquatic flora recorded from the Condamine-Balonne drainage basin in Queensland

Scientific name	Common name	Status			Preferred habitat and importance	Likelihood of occurrence within Study Area	Data Source	
		EPBC Act[1]	NC Act[2]	ACA[3]			Fielder et al. 2011	EHP 2016
Priority species (Continued)								
Cycnogeton procerus	Water ribbons		LC	✓	Grows in stationary or flowing freshwater in a variety of habitats. Important food source and habitat for waterbirds, fish and snails (Fielder et al. 2011).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	
Vallisneria nana	Ribbonweed		LC	✓	Grows in still or slow moving waters up to 0.7 m deep. Forms large beds, critical food resource, basis of complex food webs and in-stream diversity. Forms significant macrophyte beds (in shallow or deep water).	**Potential**, although not detected within wetted habitats at the time of survey.	✓	✓

Notes:

E = endangered, LC = least concern,

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. ACA = status under the Aquatic Conservation Assessments, using AquaBAMM, for the QMDB (Fielderet al. 2011).

^ Recorded during field surveys in July 2016.

References:

- Fielder et al. 2011, ACAs, using AquaBAMM, for the QMDB, DERM, Brisbane.
- DERM 2010, Condamine NRM Region BoT Actions for Biodiversity, DERM, Brisbane.
- EHP 2016, Wetland*Info* – Balonne-Condamine Drainage Basin – Wetland Summary Information.

Introduced aquatic flora

The Commonwealth Government recognises 32 WoNS across Australia, based on their:

- Invasiveness and impact characteristics;
- Current distribution and potential area of spread; and
- Current primary industry, environmental and socio-economic impact.

The Queensland *Biosecurity Act 2014* lists Prohibited and Restricted biosecurity matter (including weed species) for Queensland.

There are 22 introduced wetland indicator plant species known from the Balonne-Condamine drainage basin (EHP 2016). Those invasive species, including WoNS and other introduced plants considered to pose a particular threat to aquatic biodiversity, and that could potentially occur within the Study area, are listed in Table 9.

Table 9 Introduced wetland indicator plants known to occur in the Balonne-Condamine drainage basin, and potentially in the Study area

Scientific name	Common name	National status^	Biosecurity Act status*
Alopecurus geniculatus	marsh foxtail		
Arundo donax			
Berula erecta	water parsnip		
Callitriche stagnalis			
Cotula coronopifolia	water buttons		
Cyperus eragrostis			
Cyperus esculentus	yellow nutgrass		
Cyperus involucratus			
Cyperus papyrus	papyrus		
Diplachne fusca			
Diplachne fusca var. uninervia			
Echinochloa colona	awnless barnyard grass		
Echinochloa crus-galli	barnyard grass		
Eclipta prostrata	white eclipta		
Egeria densa	dense waterweed		
Eichhornia crassipes	water hyacinth	WoNS	Restricted 3
Juncus articulatus	jointed rush		
Juncus bufonius	toad rush		
Pistia stratiotes	water lettuce		Restricted 3
Polypogon monspeliensis	annual beardgrass		
Salix babylonica	weeping willow		
Rorippa nasturtium-aquaticum	watercress		

Notes:

^ Species listed as WoNS; * species listed under the Queensland Biosecurity Act 2014.

Field assessment results

Twelve species of aquatic plants were detected from the Study area 25-29 July 2016 (Table 10). No EVNT aquatic flora species were detected. Two Priority aquatic flora species were detected, being water primrose (*Ludwigia peploides* subsp. *montevidensis*) detected at farm dam sites L1 and L2, and black tea-tree (*Melaleuca bracteata*) detected at riverine site R4.

Table 10 Aquatic flora detected within the Study area, July 2016

Scientific name	Common name	R1	R2	R3	R4	R5	R6	L1	L2
Arundinella nepalensis	Reedgrass	S	L			S			
Cyperus exaltatus	Tall flatsedge	L	S	L		L			L
Cyperus haspan	Flatsedge	L	L		L		L		L
Eleocharis cylindrostachys	Spikerush								L
Eleocharis plana	Ribbed spikerush								L
Juncus usitatus	Common rush	L	L	L				L	L
Leptochloa digitata	Umbrella canegrass				L		L		
Ludwigia peploides subsp. *montevidensis*	Water primrose							L	S
Melaleuca bracteata	Black tea-tree				S				
Nymphoides crenata	Wavy marshwort		L						S
Persicaria decipiens	Slender knotweed								L
Polygonum plebeium	Small knotweed							L	

Notes:

L = little (1-10% cover); S = some (10-50%); as per AusRivAS protocol (DNRM 2001).

The majority of aquatic flora species encountered during the July 2016 field survey are common emergent species such as aquatic (or semi-aquatic) grasses and rushes.

The lack of both diversity and abundance of aquatic plants at some sites is likely indicative of harsh physical conditions, cattle grazing and trampling, or a combination of these factors. The lack of diversity may also be due to seasonal variation, with the late wet/dry season conditions expected to affect both the diversity and abundance of aquatic plants. More diverse aquatic communities may occur through recruitment during sustained flows over the wetter months of the year.

Aquatic flora was not surveyed by AARC (2013) in the January 2010 aquatic ecology survey.

4.9 Aquatic fauna

4.9.1 Fishes

EVNT and Priority fishes

The Wetland*Info* database identifies 32 fish species that have previously been recorded from the Balonne-Condamine drainage basin (EHP 2016). Of these, two are listed as EVNT:

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

The Murray cod naturally occurs within the Balonne-Condamine drainage basin, and is found within Queensland and other Australian states. This species prefers deep water with in-stream habitat such as boulders, logs, and overhanging vegetation, and is sensitive to habitat alterations, such as altered flow regimes and overfishing (Allen et al. 2002).

The silver perch prefers faster-flowing water, including rapids and races, and more open sections of river, throughout the MDB (Clunie and Koehn 2001, cited in TSSC 2013).

Due to habitat requirements, it is unlikely that EVNT fishes would occur within waterbodies of the Study area as either resident or transient occurrences (Table 11).

In addition to EVNT species, six fish species are listed as Priority species for the Condamine-Balonne drainage basin under the ACA Expert Panel report (Fielder et al. 2011) (Table 11). The Murray cod is also listed for the Condamine NRM region BoT Actions for Biodiversity (DERM 2010).

Table 11 EVNT and Priority fish species recorded from the Balonne-Condamine drainage basin or Condamine NRM region

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within Study area	Data Source			
		EPBC Act[1]	NC Act[2]	BoT[3]	ACA[4]			Fielder et al. 2011	DotE 2016c	DERM 2010	EHP 2016
EVNT species											
Bidyanus bidyanus	Silver perch	CE	LC		✓	Faster-flowing water, including rapids and races, and more open sections of river, throughout the MDB (Clunie and Koehn 2001, cited in TSSC 2013).	**Unlikely**. Potential habitat not encountered within Study area.	✓			✓
Maccullochella peelii	Murray cod	V	LC	C	✓	Deep water with in-stream habitat including boulders, logs, and overhanging vegetation (Allen et al. 2002). Fast-moving clear upland streams to slow-flowing, turbid lowland waters. Most individuals stay within a 10 km reach of the river (Pusey et al. 2004; Allen et al. 2002).	**Unlikely**. Potential habitat not encountered within Study area.	✓	✓	✓	✓
Priority species											
Ambassis agassizii	Agassiz's glassfish				✓	Vegetated edges of lakes, creeks, swamps, wetlands and rivers; often associated with woody habitat and aquatic vegetation in areas with little or no flow, particularly backwaters (Lintermans 2007).	**Known^**. Captured from site R2.	✓			✓
Gadopsis marmoratus	River blackfish				✓	Found in clear, gently flowing streams with abundant log snags, preferring habitats with good instream cover such as woody debris, aquatic vegetation or boulders (Lintermans 2007).	**Unlikely**. Preferred habitat not encountered within Study area.	✓			✓

Table 10 (Continued) EVNT and Priority fish species recorded from the Balonne-Condamine drainage basin or Condamine NRM region

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within Study area	Data Source			
		EPBC Act[1]	NC Act[2]	BoT[3]	ACA[4]			Fielder et al. 2011	DotE 2016c	DERM 2010	EHP 2016
Priority species (Continued)											
Galaxias olidus	Mountain galaxias				✓	Clear pools of flowing streams, typically in cold water, around rocks or logs (Allen et al. 2002).	**Unlikely**. Preferred habitat not encountered within Study Area.	✓			✓
Mogurnda adspersa	Southern purple-spotted gudgeon				✓	Slow-moving or still waters of rivers, creeks and billabongs, preferring slower flowing, deeper habitats (Lintermans 2007).	**Potential**. Preferred habitat available in Drainage Line 1.	✓			✓
Porochilus rendahli	Rendahl's catfish				✓	Mud-bottoms of lowland lagoons, flowing creeks and backwaters near aquatic vegetation (Allen et al. 2002).	**Potential**. Preferred habitat available in Drainage Line 1.	✓			✓
Tandanus tandanus	Freshwater catfish				✓	Sluggish or still waters of rivers, creeks, lakes, billabongs and lagoons (Allen et al. 2002).	**Likely**. Preferred habitat available in Drainage Line 1.	✓			✓

Notes:

CE – critically endangered, E = endangered, V = vulnerable, LC = least concern, C = critical priority, H = high priority, M = medium priority, P = priority, R&T = rare and threatened.

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. BoT = status under the DERM (2010) Condamine NRM Region – BoT Actions for Biodiversity.
4. ACA = status under the Aquatic Conservation Assessments, using AquaBAMM, for the QMDB (Fielder et al. 2011).

^ Recorded during field surveys in July 2016.

Fish encountered during the field surveys

AARC (2013) encountered three fish in the Study area during aquatic surveys in January 2010, being: Agassiz's glassfish (*Ambassis agassizii*), gudgeon (*Hypseleotris sp.*) and mosquitofish (*Gambusia affinis* [sic, assumed to be *G. holbrooki*]). These species were encountered again in July 2016 by DPM, along with a number of other species.

Seven species were recorded from 80 fishes captured by DPM at sites R2 and L2 in July 2016 using a combination of backpack electrofishing and overnight deployment of fyke nets and baited box traps. No fish were encountered at sites R1, R3, R4 or L1 despite thorough fish survey effort. Only one fish species was encountered within farm dam L2, being spangled perch (*Leiopotherapon unicolor*). Seven fish species were captured from site R2 on Drainage Line 1, comprising:

- golden perch (*Macquaria australasica*) – size range 250-300 mm;
- spangled perch (*Leiopotherapon unicolor*) – 130-140 mm;
- glassfish (*Ambassis agassizii*) – 35 mm;
- gudgeon (*Hypseleotris sp.*) – size range 30-50 mm;
- European carp (*Cyprinus carpio*) (introduced) – 300 mm;
- goldfish (*Carassius auratus*) (introduced) – 200 mm; and
- mosquitofish (*Gambusia holbrooki*) (introduced) – 25-30 mm.

A specimen of each species was photographed on site (Plates 16 to 22).

Each of these species commonly occur throughout the Balonne-Condamine drainage basin. All specimens appeared healthy, with no signs of stress or disease. Introduced species were euthanised in accordance with DPM's Animal Ethics Committee approval and General Fisheries Permit.

Plate 16 Golden perch (*Macquaria australasica*), 26/07/2016

Plate 17 Spangled perch (*Leiopotherapon unicolor*), 26/07/2016

Plate 18 Glassfish (*Ambassis agassizii*), 26/07/2016

Plate 19 Gudgeon (*Hypseleotris* sp.), 26/07/2016

Plate 20 European carp (*Cyprinus carpio*) – pest species, 26/07/2016

Plate 21 Goldfish (*Carassius auratus*) – pest species, 26/07/2016

Plate 22 Mosquitofish (*Gambusia holbrooki*) – pest species, 26/07/2016

Plates 16-22 Fish captured from site R2 on Drainage Line 1, 26 July 2016

Introduced aquatic fishes

Five introduced fish species have previously been recorded from the Balonne-Condamine drainage basin: mosquitofish, guppy (*Poecilia reticulata*), goldfish and European carp (EHP 2016). Three of these species: mosquitofish, goldfish and European carp, were recorded from the Study area during the fish surveys 25-29 July 2016.

Introduced fishes can cause a variety of issues within the aquatic environment, such as competing with native fish for food and habitat, preying on native species, habitat disturbance and introduction of disease. Typically, established introduced species have a wide range of environmental tolerances, habitat requirements and food requirements. In addition, they tend to have high reproductive rates and be early maturing, allowing populations to become readily established. These attributes often allow introduced fishes to be more adaptable to changes in the environment, whether natural or manmade, than some native fish species.

4.9.2 Turtles

Desktop assessment results

EVNT and Priority species

The Wetland*Info* database identifies six turtle species as having previously been recorded from the Balonne-Condamine drainage basin (EHP 2016): broad-shelled river turtle (*Chelodina expansa*); eastern snake-necked turtle (*Chelodina longicollis*); Krefft's river turtle (*Emydura macquarii krefftii*), Murray turtle (*Emydura macquarii macquarii*), saw-shelled turtle (*Wollumbinia latisternum*), and the EVNT southern snapping turtle (*Elseya albagula*) (E – NC Act, CE – EPBC Act).

The southern snapping turtle is not typically found in the Balonne-Condamine drainage basin, but is generally found throughout the Fitzroy, Burnett, and Mary Rivers to the north. This species prefers flowing waters (Cogger 2014), but has been captured by DPM in a variety of habitats including deep, isolated, yet permanent, pools in both the Fitzroy and Burnett River catchments. The southern snapping turtle's appearance is superficially very similar to that of the Least Concern saw-shelled turtle, being differentiated by the intergular scutes on their plastron (belly). It is suspected that a number of database records may be misidentifications by less experienced observers who have not handled and carefully inspected the plastron of suspected southern snapping turtles. It is unlikely that the southern snapping turtle occurs within the Balonne-Condamine drainage basin, and even less likely that it occurs within the Study area.

Introduced aquatic reptiles

No introduced aquatic reptiles were identified from the desktop review as having potential to occur in the Study area.

Field assessment results

No turtles were recorded within the Study area by DPM during the 'late wet' field survey of July 2016, nor by AARC in their wet season survey of January 2010. Although there remains potential for turtles to occur within the larger riverine pools and dams of the Study area, turtles are unlikely to occur in substantial numbers.

No potential habitat for EVNT turtle species occurs within the Study area.

4.9.3 Platypus

Desktop assessment results

The Wetland*Info* database for the Balonne-Condamine drainage basin (EHP 2016) identifies the platypus (*Ornithorhynchus anatinus*) as having previously been recorded from the broader drainage basin. This species is listed as SLC, for cultural reasons, under the NC Act.

Field assessment results

Although some stream reaches of the Study area provided bank substrates suitable for platypus burrow construction (being dominated by silt/clay, as opposed to apedal sediments such as sand), the ephemeral nature of the waterways and dams of the Study area are not conducive to sustaining a population of platypus. No platypus burrows were encountered during the site visit, despite targeted searches.

4.9.4 Aquatic invertebrates

EVNT and Priority aquatic invertebrates

No aquatic macroinvertebrates or macro-crustaceans are listed as EVNT or Priority species for the Balonne-Condamine drainage basin in Queensland.

Macroinvertebrates and stream health

AARC (2013) collected 18 taxa from 192 aquatic macroinvertebrates collected from two sites within the Study area in January 2010. Seven taxa were each represented by only one specimen, suggesting a relatively depauperate macroinvertebrate community, which may have been influenced by abnormal climatic conditions. The following macroinvertebrate indices focus on the dataset obtained by DPM in July 2016.

Taxonomic composition

A total of 39 taxa were identified from 1,905 aquatic macroinvertebrates collected from six sites across the Study area in July 2016. Taxa richness was most diverse at the largest (stream order 3) site R2 (30 taxa), followed by farm dam site L2 (Appendix C). Taxa richness was greater in the edge habitat of each riverine site than in the bed habitat, owing to the greater habitat complexity and food sources.

The most taxa-rich orders were Coleoptera (beetles) and Diptera (true flies), each represented by seven macroinvertebrate families. Other orders included Decapoda (in this case prawns, shrimp and yabbies), Acarina (mites), Ephemeroptera (mayflies), Hemiptera (aquatic bugs), Trichoptera (caddis flies), Epiproctophora (dragonflies), Zygoptera (damselfies), Lepidoptera (aquatic caterpillars), Gastropoda (aquatic snails), Collembola (springtails), Ostracoda (seed shrimp), Copepoda (copepods) and Cladocera (water fleas), Oligochaeta (segmented worms) and Turbellaria (flatworms).

PET taxa

Only four PET taxa were detected in samples collected from across the Study area (Appendix C). This included one taxon at R1, four taxa at R2 and three taxa at farm dam site L2. PET taxa consisted of two Ephemeroptera (mayflies) taxa: Baetidae and Caenidae; and two Trichoptera (caddis flies) taxa: Ecnomidae and Leptoceridae. No Plecoptera (stoneflies) were detected.

SIGNAL2 scores

SIGNAL2 scores were greater for the edge habitat samples than for the bed habitat samples at each riverine site sampled (R1, R2, R3 and R4), and ranged from 1.67 in the bed habitat of site R3 to 3.25 in the edge habitat of site R1. SIGNAL2 scores for the combined bed/edge sample at both L1 and L2 were 3.00 and 3.25 respectively. No SIGNAL2 guidelines are yet available for the Balonne-Condamine catchment. However, the SIGNAL2 scores for each site fall below the 20:80 percentile guideline range of 3.33-3.85 for the bed habitat and 3.31-4.20 for the edge habitat of slightly to moderately disturbed waters of the Queensland Central Region (as a guide for comparison) (EHP 2009).

Tolerant taxa

The percentage of tolerant macroinvertebrate taxa (i.e. those with SIGNAL2 score of four or less) ranged from 82 to 100 % in the edge habitat and from 80 to 100% in the bed habitat of each riverine site sampled (R1, R2, R3 and R4). Tolerant taxa in the combined bed/edge sample at both L1 and L2 were 88% and 85%, respectively. No tolerant taxa guidelines are yet available for the Balonne-Condamine catchment. However, the tolerant taxa percentages for each site fall unfavourably below the 20:80 percentile guideline range of 25-50% for the bed habitat and 44-56% for the edge habitat of slightly to moderately disturbed waters of the Queensland Central Region (as a guide for comparison) (EHP 2009).

AusRivAS OE50

Aquatic macroinvertebrate assemblages in the edge habitat of site R2 (Drainage Line 1) were in reference condition (Band A) (Table 12), suggesting that most/all of the expected taxa were found and that existing upstream impacts on water quality and/or habitat condition have not resulted in a loss of macroinvertebrate diversity. However, aquatic macroinvertebrate assemblages in the bed habitat were slightly impaired (Band B) (Table 12). Both the bed and edge habitat samples collected from site R1 were slightly impaired (Band B). Macroinvertebrate assemblages were slightly impaired (Band B) in the bed habitat of site R3, and severely impaired (Band C) in the edge habitat, which was subject to direct access and extensive trampling by cattle. Macroinvertebrate assemblages were severely impaired (Band C) in both the bed and edge habitats of site R4. Site R4 was represented by only small, isolated pools at the time of sampling in July 2016. These pools may have only recently formed as a result of rainfall in the preceding weeks. As such, the Band C rating is most likely a reflection of seasonality, as opposed to catchment impacts at this site.

Table 12 AusRivAS model outputs for sites sampled within the Study area in July 2016

Site	Bed habitat		Edge habitat		Overall Band
	OE50	Band	OE50	Band	
R1	0.67	B	0.60	B	B
R2	0.59	B	1.10	A	B
R3	0.37	B	0.42	C	C
R4	0.27	C	0.30	C	C

4.9.5 Macro-crustaceans

Three macro-crustacean families: Palaemonidae (freshwater prawns), Atyidae (freshwater shrimp) and Parasticidae (freshwater crayfish), were encountered within the Study area. Individuals from the family Palaemonidae were identified as *Macrobrachium australiense*. Individuals from the family Atyidae were identified as *Paratya australiense*. The family Parasticidae was represented by inland yabby (*Cherax destructor*), which occurs commonly throughout the Balonne-Condamine drainage basin.

4.10 Aquatic values

Aquatic values for each site are presented in the site profiles in Appendix B. Ratings for aquatic values were determined for each site based on the criteria in Section 3.4 and are presented in Table 13. One site was rated with a Moderate aquatic value, and the remaining seven sites as Low. Sites rated with a Low aquatic value are expected to be more ephemeral in nature than other sites, and exhibited lower habitat complexity. Site R2 on Drainage Line 1 was rated with a Moderate aquatic value as it provided better habitat complexity, including semi-permanence of wetted habitat, and forms a dry season refuge for native fish.

Table 13 Aquatic values ratings for the Study area, July 2016 ('late wet' season)

Site	Waterway	Stream order	Key aquatic values/criteria	Aquatic values rating
R1	Drainage Line 2	2	▪ Ephemeral stream ▪ Poor quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Fair (60) habitat bioassessment score	Low
R2	Drainage Line 1	3	▪ Semi-permanent pool in ephemeral stream ▪ Some good quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Dry season refuge for native fish	Moderate
R3	Drainage Line 1	1	▪ Ephemeral stream ▪ Poor quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Fair (57) habitat bioassessment score	Low
R4	Drainage Line 1	2	▪ Ephemeral stream ▪ Poor quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Fair (68) habitat bioassessment score	Low
R5	Minor Drainage Feature of Drainage Line 5	2	▪ Ephemeral stream ▪ Poor quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Fair (66) habitat bioassessment score	Low
R6	Minor Drainage Feature of Drainage Line 6	1	▪ Ephemeral stream ▪ Poor quality instream habitat ▪ No EVNT, platypus or Priority species habitat ▪ Fair (56) habitat bioassessment score	Low
L1	Dam on Drainage Line 1	1	▪ Artificial waterbody (dam) ▪ Fluctuating water levels ▪ Poor quality habitat ▪ No EVNT, platypus or Priority species habitat ▪ Poor (20) habitat bioassessment score	Low
L2	Dam on Minor Drainage Feature of Drainage Line 6	1	▪ Artificial waterbody (dam) ▪ Fluctuating water levels ▪ Poor quality habitat ▪ No EVNT, platypus or Priority species habitat ▪ Poor (27) habitat bioassessment score ▪ Only highly mobile fish species present	Low

4.11 Woodland snails

Three species were recorded from 98 land snails detected by DPM Enviroscienses within brigalow habitat patches A, B, C and D (Figure 9) over the period 13-15 December 2017, comprising:

- brigalow woodland snail (*Adclarkia cameroni*) – E (EPBC Act), V (NC Act);
- Chinchilla woodland snail (*Pallidelix chinchilla*); and
- Brigalow carnivorous snail (*Scagacola brigalow*).

A total of 25 brigalow woodland snails were detected, comprising four live individuals and 21 empty shells (Table 14). Photographs of brigalow woodland snail were captured and are provided as Plates 23 to 26. Live specimens were placed back into habitat in which they were found. A number of empty shells were retained for further identification under microscope back in the laboratory to confirm the species of *Adclarkia*. This included confirmation of shell features such as a pustulose protoconch (embryonic whorls), as well as fine scaly pustules and a microsculpture of wavy ridglets on the teleoconch (adult whorls), consistent with *A. cameroni* (Stanisic et al. 2010).

Plate 23 *A. cameroni*, Site A, 13/12/2017

Plate 24 *A. cameroni*, Site B, 14/12/2017

Plate 25 *A. cameroni*, Site B, 14/12/2017

Plate 26 Pustulose protoconch of *A. cameroni*, Site B, 14/12/17

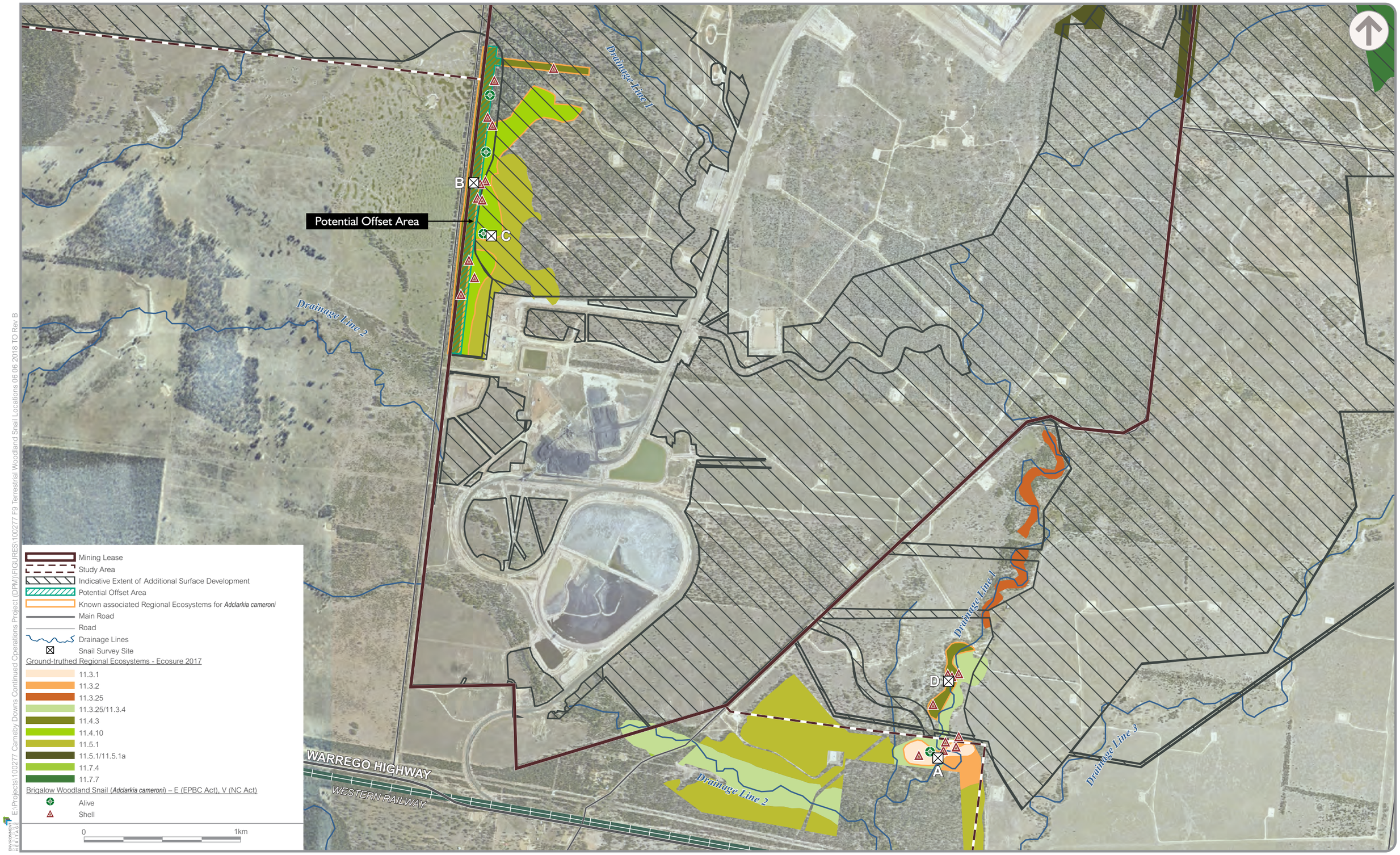
Plates 23-26 Brigalow woodland snail (*Adclarkia cameroni*) recorded from the Study area

Table 14 Land snails detected within the Study area, December 2017

Date	Site / Habitat (refer to Figure 9)	Person hours searching	Common name	Species name	Status		Records		
					EPBC Act[1]	NC Act[2]	Alive	Empty shells	Total
13/12/17 and 15/12/17	A (RE 11.3.1)	8	Brigalow carnivorous snail	*Scagacola brigalow*	-	LC	3	16	19
			Chinchilla woodland snail	*Pallidelix chinchilla*	-	LC		7	7
			Brigalow woodland snail	*Adclarkia cameroni*	E	V	1	4	5
14/12/17	B (RE 11.4.3)	8	Brigalow carnivorous snail	*Scagacola brigalow*	-	LC	3	19	22
			Chinchilla woodland snail	*Pallidelix chinchilla*	-	LC		1	1
			Brigalow woodland snail	*Adclarkia cameroni*	E	V	2	7	9
14/12/17	C (RE 11.4.10)	8	Brigalow carnivorous snail	*Scagacola brigalow*	-	LC	1	17	18
			Brigalow woodland snail	*Adclarkia cameroni*	E	V	1	4	5
15/12/17	D (RE 11.4.3)	8	Brigalow carnivorous snail	*Scagacola brigalow*	-	LC	1	5	6
			Brigalow woodland snail	*Adclarkia cameroni*	E	V		6	6

Notes:
Identification of *Adclarkia cameroni* shells confirmed by both macroscopic features (reddish subsutural band, depressedly globose) and microscopic features (protoconch pustulose; teleconch with fine scaly pustules and microsculpture of wavy ridglets.
E = endangered, V = vulnerable, LC = least concern.
1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.

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



E:\Projects\100277 Cameby Downs Continued Operations Project (DPM)\FIGURES\100277 F9 Terrestrial Woodland Snail Locations 06 06 2018 TO Rev B

DPM ENVIROSCIENCES

LOCATIONS OF BRIGALOW WOODLAND SNAIL

Aquatic Ecology Assessment
Cameby Downs Continued Operations Project

FIGURE 9

5 POTENTIAL IMPACTS AND MITIGATION MEASURES

The following potential impacts are assessed below:

- aquatic habitat removal (Section 5.1);
- obstruction of fish passage (Section 5.2);
- surface water quality impacts (Section 5.3);
- surface water flow (Section 5.4);
- drawdown and contamination of groundwater resources (Section 5.5); and
- removal and modification of habitat for the brigalow woodland snail (Section 5.6).

An Aquatic Ecological Risk Assessment for the potential impacts listed above is provided in Appendix D.

5.1 Aquatic habitat removal

The land clearance for the Project would be undertaken in stages over 75 years.

The Project would remove aquatic habitat in the Project area, comprising ephemeral drainage lines, sections of the Drainage Line 1 and farm dams (Figure 5). None of these habitats are expected to support aquatic species of conservation significance listed under the NC Act or EPBC Act (Sections 4.8 and 4.9).

The unnamed ephemeral drainage lines in the Project area provide only marginal aquatic habitat (with Low aquatic values ratings – Table 13). Approximately 11 km of mapped drainage lines of stream order 1 and 2 occur in the Project area. These drain to Drainage Line 1 in the south or Punch-bowl Creek in the north.

Aquatic habitat along sections of the Drainage Line 1 (approximately 3.3 km in the Project area) would be lost as part of the Project and these sections of the watercourse would be diverted (Section 5.1.2). Drainage Line 1 provides aquatic habitat of Moderate value, including semi-permanent pools which form dry season refuge for common native fish species, including golden perch, spangled perch, glassfish and gudgeon.

A number of farm dams fall within the Project area (Figure 6, Section 4.4.4). Although these waterbodies are artificial (with a Low aquatic values ratings – Table 13), the farm dams provide habitat for fish and potential habitat for turtles (although turtles were not detected during the field surveys).

Removal of aquatic habitat can also result in surface water quality impacts as described in Section 5.3.1.

Mitigation

Where possible, any land disturbance within stream beds and adjacent to their bank would be minimised and stabilised as soon as practical, prior to work equipment demobilising from the work area.

5.2 Obstruction of fish passage

Waterway crossings for vehicles can cause a barrier or obstruction to fish movement depending on how the crossing is constructed. Many of the native fish found in ephemeral waterways migrate up and downstream and between different habitats at particular stages of their lifecycle. Bridge crossings of permanent or semi-permanent streams generally pose little problem to these migrating species if the stream bed morphology and stream hydraulics remain largely unaltered. However, causeway and culvert crossings can create discontinuities in the water flow pattern and bed morphology of a waterway, or if there is a tunnel effect created (NSW Fisheries 1999). Fish may be physically unable, or unwilling, to negotiate such discontinuities. It is therefore important not to create a barrier or obstacle within the waterways.

Mitigation

Waterway crossings would be constructed with consideration of the *Queensland Fisheries Guidelines for Design of Stream Crossings* (Cotterell 1998, under revision) using box culverts to permit crossing during low flow events, enabling fish passage to be maintained within / through the Project area. Waterway crossings would be monitored during operations to ensure that they remain operable.

The use of box culverts would maintain low flow characteristics within the waterways.

5.3 Surface water quality impacts

5.3.1 Surface water quality

Construction of the Project has the potential to impact surface water quality through increased erosion of sediments left exposed following vegetation clearing. In the absence of suitable controls, mobilised sediments can lead to increased suspended sediment loads in waterways, can affect water chemistry, reduce waterway depths, change drainage patterns and smother benthic flora and fauna. Although past land clearing and agricultural activities are likely to have contributed sediment to waterways draining the Project area, without adequate controls accelerated sedimentation from Project activities could result in a decline in the abundance and diversity of both invertebrate and fish communities in downstream receiving waters.

The aquatic ecosystems within and downstream of the Project area also have the potential to be impacted by salts, nutrients, metals or other contaminants adsorbed onto mobilised sediments. Increased nutrient loads can promote excessive growth of aquatic flora and algae, provided environmental conditions also favour photosynthesis (i.e. light availability). The excessive growth of aquatic flora can lead to extreme diurnal ranges in DO, including low overnight DO levels, which, if severe enough, can lead to mortality of gill breathing fauna. Excessive growth of surface aquatic flora can block sunlight for submerged flora, limiting their photosynthetic activity and potentially leading to reduced species richness and reduced habitat complexity.

Leaks or spills of hydrocarbon based fluids from construction equipment and spread of coal dust also represent potential risks. Hydrocarbons are toxic to aquatic flora and fauna at relatively low concentrations. Runoff of spilled fuels and oils into waterways is only likely to occur if spills occur in close proximity to waterways (natural stormwater channels and constructed diversions channels), or if the spill or leak is left uncontrolled. A fuel or oil spill in excess of ten litres that ends up in a waterway is likely to have more immediate impacts on aquatic ecosystems. The severity and duration of impacts would depend on the type and quantity of any fuel or oil spilled, and the effectiveness of containment measures. Coal dust entering waterways is most likely to occur where haulage routes cross waterways, and can lead to increased localised salinity.

Through application of the mitigation measures described below, the likelihood of the Project construction phase activities impacting on surface water quality are low.

Mitigation

Measures to minimise and mitigate impacts on water quality are provided in Section 5.7.

5.3.2 Discharge of mine-affected water

The Project would alter the topography and drainage characteristics of the Project area in a similar fashion to what has been observed at the existing Cameby Downs Mine. Pumped releases from regulated mine water storages and sediment dams to the environment may be undertaken if the water quality is within the end-of-pipe and downstream receiving environment limits specified in the proposed future Cameby Downs EA conditions, subject to its approval.

A Surface Water Assessment specific to the Project has been conducted and can be reviewed as a separate document (WRM 2018). It includes:

- revision of the existing site water balance model;
- an assessment of potential impacts of discharges;
- an assessment of potential flooding impacts, including consideration of a 1:1,000 Annual Exceedance Probability flood event; and
- a description of the Project surface water management system.

Given that the site releases would be conducted in accordance with the EA release criteria and informed by ongoing monitoring of discharge and receiving environment water quality and quantity, adverse impacts on aquatic ecosystems are not likely.

Mitigation

Measures to minimise and mitigate impacts on water quality are provided in Section 5.7.

5.3.3 Stormwater run-off

A potential impact from this activity is the sedimentation of waterways as stormwater washes loose or dispersive sediment into the creeks.

Mitigation

Measures to minimise and mitigate impacts on water quality are provided in Section 5.7.

5.4 Surface water flow

The Project would alter the topography and drainage characteristics of the Project area in a similar fashion to what has been observed at the existing Cameby Downs Mine. A Surface Water Assessment specific to the Project has been conducted and can be viewed as a separate document (WRM 2018).

Surface water hydrology would be altered by the Project as a result of capturing runoff in dams, water loss due to use for Project operation or pond evaporation, and releasing water during flow events. The waterways of the Project area are ephemeral, flowing only after sustained or intense rainfall in the catchment. The ephemeral nature of the waterways of the Project area is likely to remain unchanged, as no permanent or semi-permanent water releases from the site are proposed.

Water quality may be affected by sedimentation, eutrophication and contamination. Even small changes in habitat quality in a stream system may affect aquatic flora or fauna, such that

species composition may change. Given the low likelihood of aquatic EVNT species or TECs occurring in the Project area, any impact is highly unlikely to affect a threatened aquatic species or ecological community.

Mitigation

An extensive surface water monitoring network has been established at the Cameby Downs Mine which includes automatic and manual surface water level and quality monitoring stations. The monitoring network would be augmented as required to accommodate the Project. Consistent with the measures for the existing Cameby Downs Mine, monitoring would include the receiving surface water flow.

5.4.1 Diversion of Drainage Line 1 Extension

A diversion to Drainage Line 1 is approved as part of the approved extent of operations at the Cameby Downs Mine (EPM 00900113), but the diversion has not yet been constructed. As the Project extends the open cut extent, and includes the construction of a new rejects dam within MLA 50258, the diversion of Drainage Line 1 would be required to commence further upstream, within MLA 50258 (Figure 2).

The existing Cameby Downs Mine is approved to divert Drainage Line 1. A longer diversion is proposed as part of the Project (Figure 2), up to 13.6 km in length.

It is proposed to divert approximately 13.6 km of the existing Drainage Line 1 along the south-western side of the mining operations. The stream length of the proposed Diversion of Drainage Line 1 would be approximately 7.9 km.

Consistent with the approved mine, the proposed Diversion of Drainage Line 1 has been designed to replicate as close as possible the Drainage Line 1 sections that it would replace. The diversion would commence on Drainage Line 1 just downstream of where it enters the Project area and would drain back into Drainage Line 1 channel about 0.9 km upstream of the Western Railway. The diversions have been designed and assessed using the Australian Coal Association Research Program (ACARP) stream diversion design criteria as detailed in WRM (2018).

Potential changes in flow conditions (hydrology) and behaviour (hydraulics) associated with the diversion are detailed in WRM (2018), who conclude that potential impacts would be minor. Macrophytes and other aquatic flora are expected to rapidly colonise the diversion channel, as they are present both upstream and downstream of the disturbance area. It is expected that the diversion channel would be colonised by macroinvertebrate species through mobile adult immigration. As a result, the impact on these communities is not likely to be long term.

In the medium to long term, this is expected to provide a corridor which has the same or very similar stream processes as those occurring now. This diversion channel would include provision for dry season refuge, including a number of deeper pools with a compacted clay base or similar. Instream habitat (such as large woody debris) would be positioned within the Creek Diversion channel to provide structure and resting opportunities for fish moving upstream and downstream during times of flow.

Mitigation

The diversion design has been assessed using the ACARP stream diversion design criteria (Fisher Stewart 2002) as detailed in WRM (2018).

The Diversion of Drainage Line 1 Monitoring Program would be revised to incorporate the Project. Monitoring of the diverted section of Drainage Line 1 enables assessment of the establishment of the aquatic and riparian zones. If monitoring results indicate a significant

decline in the pre-determined values or ecological condition of Drainage Line 1, Syntech Resources would provide actions to address the actual or potential harm to Drainage Line 1 and its downstream reaches.

5.5 Drawdown and contamination of groundwater resources

The Project is unlikely to adversely impact any aquatic or terrestrial GDEs since GDEs are unlikely to occur surrounding the Project area (Section 2). There is a potential for thin, discontinuous and temporal alluvial aquifers to occur (which may be used by localised areas of terrestrial vegetation), however these would consist of a perched groundwater system hydraulically separated from the underlying Walloon Coal Measures by the very low permeability, approximately 15 m thick aquitard overburden sequence that separates the Springbok Sandstone and the upper Walloon Coal Measures (AGE 2018).

5.6 Removal and modification of habitat for the brigalow woodland snail

The Project would clear approximately 20 ha of habitat for the brigalow woodland snail in which four brigalow woodland snail specimens were recorded.

The Project is unlikely to significantly impact the brigalow woodland snail because:

- a greater area of habitat for the snail would be avoided / retained (approximately 32 ha) which contains the majority of the brigalow woodland snail specimens recorded (21 specimens);
- the brigalow woodland snail is likely to persist within the Study area due to the extent of habitat to be avoided / retained, and evidence of its use by the species;
- the Project would not further fragment the local population of brigalow woodland snail; and
- the habitat to be cleared is not critical to the survival of the brigalow woodland snail.

Potential indirect impacts (including pests and bushfires) on the retained habitat would be minimised by controlling feral animals at the mine (including rats, mice and pigs, which are known to prey on land snails [Stanisic 2011, cited in TSSC 2016]) and implementation of bushfire management measures.

5.7 Mine rehabilitation

The post-mine landform would be progressively rehabilitated. The integrity of the landscape would be maintained by providing safe and stable post-mining landforms.

In accordance with the currently approved Rehabilitation Operational Management Plan (Yancoal 2016) and existing EA for the Cameby Downs Mine (EPML00900113), the final landform would be rehabilitated to a stable landform with a self-sustaining vegetation cover. The approved final landform would be returned to grazing pasture land, however would also include concentrated tree plantings to provide potential wildlife corridors (Yancoal 2016).

The Project includes continued development of final voids within the existing mine operation. Final voids are not expected to overtop, and discharges to surface waters are not anticipated (WRM 2018). For this reason no impacts on aquatic ecology are likely to result from the final voids.

5.8 Summary of impacts and mitigation measures

The Project water management system would generally be based on the existing water management system with augmentations (e.g. additional up-catchment diversion structures, sediment dams and contained water storages) undertaken progressively over the life of the Project.

A summary of the impacts and mitigations measures for the construction and operation of the Project is provided in Table 14.

Table 15 Summary table of impacts and mitigation measures

Impact	Mitigation measures
Existing measures	
Direct removal of aquatic habitat (Section 5.1)	Where practicable, land clearance associated with waterways would occur during the dry season when the extent of wetted habitat is greatly reduced, and when waterways are expected to support the lowest diversity and abundance of aquatic species.
	Where possible, land disturbance within stream beds and adjacent to their bank would be minimised and stabilised as soon as practicable, prior to work equipment demobilising from the work area.
	The Project would include progressive rehabilitation of the majority of the site to a land use generally consistent with the existing land use. Rehabilitation goals, objectives, indicators and completion criteria for the Project would be described in the Plan of Operations.
Diversion of Drainage Line 1 Extension (Section 5.4.1)	A conceptual design for the Diversion of Drainage Line 1 has been prepared by Syntech Resources and includes: ▪ diversion of approximately 13.6 km of Drainage Line 1; and ▪ a final diversion stream length of approximately 7.9 km.
	Diversion of Drainage Line 1 would be in accordance with an approved Diversion Management Plan. Measures would include: ▪ Revegetation of the diversion with species naturally occurring along Drainage Line 1. Where possible, snags would be placed along the creek diversion to assist in restoring the natural ecology of the creek.
	Monitoring of diverted section of Drainage Line 1 in accordance with a Diversion of Drainage Line 1 Monitoring Program, enabling assessment of the establishment of the aquatic and riparian zones.
	Riparian zones would be established along the proposed creek diversions to provide fauna habitat and stabilise the diversion corridors.
Surface water quality impacts (Section 5.3)	Erosion and sedimentation would continue to be managed in accordance with the Site Water Management Plan. Measures would include installation of sediment dams, diversions, and storm water controls. In addition, all major land disturbances on the Project that may have the potential to produce soil erosion or excessive sediment during storm events (i.e. waste rock dumps) would be drained via sediment traps to drop out suspended sediment.
	Where practicable, infrastructure has been located away from the riparian zone of drainage lines.
	A Spill Emergency Response Plan would be included with the Plan of Operations.
	Clearly defined access and work use areas for plant and equipment.

Table 14 (Continued) Summary table of impacts and mitigation measures

Impact	Mitigation measures
Existing measures (Continued)	
Surface water quality impacts (Section 5.3) (Continued)	A half-yearly (December and June) monitoring program would be implemented for stream sediment, sampling rivers and streams both downstream of any mining or infrastructure disturbances as well as upstream to take into account any natural variations in stream sediment quality and morphology.
	An event-based monitoring program would be implemented for receiving water quality, sampling streams downstream of any mining or infrastructure disturbances and comparing with upstream reference sites, to take into account any natural variations in water quality.
	The default ANZECC and ARMCANZ (2000) trigger values for Aquatic Ecosystems would be used for the monitoring of stream sediments for the suite of parameters outlined in the REMP (DPM Enviros ciences, 2018). Any concentrations detected downstream that exceed these limits would be investigated.
Obstruction of fish passage (Section 5.2)	The Project would not result in any obstruction to fish passage.
Discharge of mine-affected water (Section 5.3.2)	Discharge of mine-affected water would continue to be managed in accordance with the Site Water Management Plan and the Environmental Authority.
Stormwater runoff from disturbed areas (Section 5.3.3)	Runoff from undisturbed areas is separated from disturbed areas by up-catchment diversions and channels.
	Clean stormwater that originates from upstream would be diverted around the disturbed mining areas into the same catchment downstream.
Drawdown and contamination of groundwater resources (Section 5.5)	An extensive groundwater monitoring network has been established at the Cameby Downs Mine which includes automatic and manual groundwater level and quality monitoring stations. The monitoring network would be augmented as required to accommodate the Project.
Surface water flow (Section 5.4)	An extensive surface water monitoring network has been established at the Cameby Downs Mine which includes automatic and manual surface water level and quality monitoring stations. The monitoring network would be augmented as required to accommodate the Project. Consistent with the measures for the existing Cameby Downs Mine, monitoring would include the receiving surface water flow.

Table 14 (Continued) Summary table of impacts and mitigation measures

Impact	Mitigation measures
Existing measures (Continued)	
Decommissioning and rehabilitation	In order to reduce the amount of disturbed land at any one time, rehabilitation would be progressively undertaken on areas that cease to be used for mining or mining-related activities soon after becoming available.
	The rehabilitation works at the Project area would aim to achieve the rehabilitation goals and return all land disturbed at the Project area to a state that is: ▪ safe to humans and wildlife; ▪ non-polluting; ▪ stable; and able to sustain the agreed post mining land use.
	Tracts of riparian land adjacent to the proposed drainage line diversions would be rehabilitated with native vegetation to provide habitat and landform stability.
	Rehabilitation success would be measured in an evidence based manner against a number of criteria in accordance with the Rehabilitation Management Plan.
Additional measures	
Surface water quality impacts (Section 5.3)	Clearly defined access and work use areas for plant and equipment would be established to minimise the potential for uncontrolled spills or leaks.
	Appropriately stocked spill kits to be kept readily available during site establishment works.
	Maintenance and daily checks of plant and equipment would be undertaken.
	Emergency spill kits would be made available and readily accessible.
	Any contaminant spills (including fuel, hydraulic fluid etc.) would be contained (where safe to do so) and immediately reported.
	Areas for vehicle and machinery maintenance, refuelling, and storage of fuels, lubricants, and batteries, would be bunded in accordance with AS 1940.

Table 14 (Continued) Summary table of impacts and mitigation measures

Impact	Mitigation measures
Additional measures (Continued)	
Obstruction of fish passage (Section 5.2)	Waterway crossings would be constructed with consideration of the Queensland Fisheries Guidelines for Design of Stream Crossings (Cotterell 1998, under revision), ensuring that fish passage is maintained within / through the Project area. Waterway crossings would be monitored during operations to ensure that they remain operable.
Discharge of mine-affected water (Section 5.3.2)	Where possible, mine-affected water would be harvested and used operationally within the mine. Remaining mine-affected water would be conveyed to dams at the surface where it would be contained and managed until there is sufficient dilution to allow release to the environment and still achieve water quality objectives in accordance with the release conditions.
	Monitor receiving surface water quality, receiving surface water flow, mine-affected release water quality and release rate, and groundwater levels and quality. Investigate and manage exceedances.

5.9 Matters of State Environmental Significance

The Queensland EO Act requires offsets for significant residual impacts to MSES. As described in Section 4.2, apart from *Regulated Vegetation* assessed separately by Ecosure (2018), *Waterways Providing for Fish Passage* is the only MSES relevant to aquatic ecology within the Project area.

As described in Section 5.2, waterway crossings would be constructed with consideration to the Queensland Fisheries Guidelines for Design of Stream Crossings (Cotterell 1998, under revision), ensuring that fish passage is maintained where required.

The Diversion of Drainage Line 1 Management Plan to be prepared for the Diversion of Drainage Line 1 would aim to maintain fish passage during the construction and operation of the diversion channel. This would include monitoring to establish the success of fish passage along the diversion.

Table 16 provides an assessment against the Significant Residual Impact Guideline (EHP 2014).

Table 16 Significant residual impact criteria (EHP 2014) and assessment

Criteria	Assessment/consideration
An action is likely to have a significant impact on a waterway providing fish passage if there is a real possibility that the action will:	
Result in the mortality or injury of fish	The action is unlikely to result in barriers that cause the mortality or injury of native fish because: ▪ waterway crossings would be constructed with consideration to the Queensland Fisheries Guidelines for Design of Stream Crossings (Cotterell 1998, under revision) so as not to create a barrier to fish movement; ▪ the Diversion of Drainage Line 1 would be sensitively designed to replicate natural features where possible and provide similar conditions to the original waterway, including stream hydraulics, geomorphology, instream habitat, bank profiles and bank vegetation, to provide habitat and refuge for fish inhabiting or passing through the Diversion of Drainage Line 1; and ▪ fish encountered in waterbodies that are dewatered would be relocated in accordance with a General Fisheries Permit or equivalent approval/advice from DAFF.
Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish.	The action is unlikely to result in conditions that would substantially increase risks to the health, wellbeing and productivity of fish seeking passage because: ▪ waterway crossings would be constructed so as not to create a barrier to fish movement; and ▪ the Diversion of Drainage Line 1 would be designed to replicate similar conditions to the original waterway, including stream hydraulics, geomorphology, instream habitat, bank profiles and bank vegetation, to provide habitat and refuge for fish inhabiting or passing through the Diversion of Drainage Line 1.

Table 15 (Continued) Significant residual impact criteria (EHP 2014) and assessment

Criteria	Assessment/consideration
Reduce the extent, frequency or duration of fish passage previously found at a site.	The action is unlikely to reduce the extent, frequency or duration of fish passage previously found at the Project area because: ▪ waterway crossings would be constructed with consideration to the Queensland Fisheries Guidelines for Design of Stream Crossings (Cotterell 1998, under revision) so as not to create a barrier to fish movement; and ▪ the Diversion of Drainage Line 1 would be sensitively designed to replicate natural features where possible and provide similar conditions to the original waterway, including stream hydraulics, geomorphology, instream habitat, bank profiles and bank vegetation, to provide habitat and refuge for fish inhabiting or passing through the Diversion of Drainage Line 1. Further, the Surface Water Assessment (WRM 2018) concludes that the Project Life of Mine Plan after closure is unlikely to result in a significant reduction to the extent, frequency and duration of flows encountered in waterways draining the Project area.
Substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish.	Waterways mapped as Moderate and Low impact to fish passage would be removed or otherwise impacted by mining activities. However, these waterways are generally of low stream order (1 or 2), are highly ephemeral, and are not considered to constitute, nor provide a conduit to, fish habitat areas essential for the breeding and/or survival of native fish. An approximate 3.3 km reach of a third order stream (Drainage Line 1) would be diverted to the south of its existing alignment to make way for mining. Within this reach, Drainage Line 1 contains isolated pools that form dry season refuge for native fish, and also likely provides fish breeding habitat in the wet season. Review of aerial imagery indicates that these pools are not unique in a local or regional context, and that similar pools occur commonly on Drainage Line 1 downstream of the reach proposed to be impacted. Furthermore, the proposed Diversion of Drainage Line 1 would be sensitively designed to replicate natural features where possible and to simulate aquatic habitat attributes of the affected reach of Drainage Line 1. A Diversion of Drainage Line 1 Management Plan would be implemented for the Creek Diversion and would include commissioning the Creek Diversion prior to isolating or dewatering Drainage Line 1. Although the proposed diversion of Drainage Line 1 represents modification of fish habitat, the diversion, if designed and executed appropriately, would mitigate the impacts on fish passage and fish habitat. As such, the Project is considered unlikely to result in a significant residual impact on waterways providing for fish passage.

Table 15 (Continued) Significant residual impact criteria (EHP 2014) and assessment

Criteria	Assessment/consideration
Result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows.	Surface water hydrology would be altered by the Project as a result of capturing water in dams, water loss due to use for Project operation or pond evaporation, and releasing water during flow events. The relationship between groundwater and surface water may also have impacts, particularly on GDEs. The volume, depth, timing, duration and frequency of flows would continue to reflect the ephemeral and variable flow nature of the waterways draining the Project area. The action is considered unlikely to result in a substantial and measurable change in the hydrological regime of these waterways. The seasonality of fish movements is unlikely to be affected.
Lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues to movement in local fish species.	The action is unlikely to lead to an abrupt or otherwise significant change in water quality parameters that would be expected to cue local fish movement. The Diversion of Drainage Line 1 would be less shaded by riparian vegetation than the existing Drainage Line 1, at least until riparian vegetation is well established. This is likely to affect the temperature and dissolved oxygen levels of water in this channel to some extent. However, these changes would be temporary and are expected to occur gradually, reflecting ambient temperatures and diurnal ranges. As such, the risk of affecting cues for the migration of native fish species is expected to be minimal. Any water releases required by the Project would be managed in accordance with the EA Conditions. The risk of deteriorating water quality would be mitigated by monitoring stream and release water quality and quantity in accordance with the EA.

Brigalow Woodland Snail

The brigalow woodland snail (an MSES and MNES terrestrial species) occurs in the Project area and surrounds (Section 5.6). The Project would clear approximately 20 ha of habitat for the brigalow woodland snail, in which four brigalow woodland snail specimens were recorded.

The Project is unlikely to significantly impact the brigalow woodland snail because:

- a greater area of habitat for the snail would be avoided / retained (approximately 32 ha). which contains the majority of the brigalow woodland snail specimens recorded (21 specimens);
- the brigalow woodland snail is likely to persist within the Study area due to the extent of habitat to be avoided / retained, and evidence of its use by the species;
- the Project would not further fragment the local population of brigalow woodland snail; and
- the habitat to be cleared is not critical to the survival of the brigalow woodland snail.

Potential indirect impacts (including pests and bushfires) on the retained habitat would be minimised by controlling feral animals at the mine (including rats, mice and pigs, which are known to prey on land snails [Stanisic 2011, cited in TSSC 2016]) and implementation of bushfire management measures.

Further assessment is provided in Appendix D.

5.10 Matters of National Environmental Significance

MNES have been considered in Section 4.1, which concludes that the Project is unlikely to interfere with any MNES relevant to aquatic ecology, including wetlands of international importance, listed aquatic TECs or MNES aquatic species.

As described in Section 5.9, the brigalow woodland snail (an MSES and MNES terrestrial species) occurs in the Project area and surrounds (Section 5.6). The Project would clear approximately 20 ah of habitat for the brigalow woodland snail, in which four brigalow woodland snail specimens were recorded.

The Project is unlikely to significantly impact the brigalow woodland snail because:

- a greater area of habitat for the snail would be avoided / retained (approximately 32 ha). which contains the majority of the brigalow woodland snail specimens recorded (21 specimens);
- the brigalow woodland snail is likely to persist within the Study area due to the extent of habitat to be avoided / retained, and evidence of its use by the species;
- the Project would not further fragment the local population of brigalow woodland snail; and
- the habitat to be cleared is not critical to the survival of the brigalow woodland snail.

Potential indirect impacts (including pests and bushfires) on the retained habitat would be minimised by controlling feral animals at the mine (including rats, mice and pigs, which are known to prey on land snails [Stanisic 2011, cited in TSSC 2016]) and implementation of bushfire management measures.

Further assessment is provided in Appendix D.

6 CONCLUSION

Existing aquatic ecological values within the Study area have been described based on a review of desktop sources (databases and literature) and field surveys. The field surveys by DPM supplemented previous field surveys undertaken at the Cameby Downs Mine. The field survey methods included an assessment of aquatic habitat attributes, measurement of in-situ physico-chemical water quality, fish survey, turtle survey, freshwater macroinvertebrate sampling, and ground-truthing the mapping of lacustrine waterbodies. Field survey for woodland snails was also undertaken.

The field surveys found that the waterways in the Study area provide only marginal aquatic habitat (with a Low aquatic habitat rating), with the exception of Drainage Line 1 (and associated pools) which provide Moderate aquatic habitat. The field surveys also found that the Study area contains a number of farm dams and mine water dams mapped as lacustrine waterbodies in the Queensland Wetlands Mapping 2013 (DSITI 2017). No natural lacustrine waterbodies or wetlands were detected within the Study area.

The aquatic flora and fauna of the Study area are generally well adapted to environmental extremes, including the wetting and drying cycles expected in these ephemeral systems. This is expected to include tolerance of a wide range of water quality conditions, such as elevated conductivity and decreased DO in senescing pools between flow events.

No threatened aquatic ecological communities, as listed under the Commonwealth EPBC Act, were detected within the Study area, nor are any expected to occur. Further, no EVNT aquatic flora or fauna species, as listed under the EPBC Act or the Queensland NC Act, were detected within the Study area, nor are they expected to occur.

Potential GDEs in the vicinity of the Project are considered to be reliant on the shallow alluvial groundwater systems, given their proximity to drainage lines and their association with alluvia. Given that no measurable impacts on surface water quantity or quality are likely to occur from changes in groundwater (drawdown), no adverse impacts are likely to occur on GDEs.

The only MSES relevant to aquatic ecology on this Project is ‘waterway for fish passage’ as Drainage Line 1 is recognised to provide fish movement.

The potential impacts on aquatic ecology associated with the construction phase of the Project include aquatic habitat removal, extending the Diversion of Drainage Line 1, deteriorating surface water quality and vehicle waterway crossings obstructing fauna passage. With implementation of measures to maintain fish passage, the Project is unlikely to impede fish passage through the Project area. This includes constructing crossings across the drainage lines in the Project area with consideration to the Queensland Fisheries Guideline for Design of Stream Crossings (Cotterell 1998, under revision), designing the Diversion of Drainage Line 1 to provide similar conditions to the original waterway, and commissioning the Creek Diversion prior to isolating or dewatering Drainage Line 1. Where practical, land clearance associated with waterways would occur during the dry season when the extent of wetted habitat is greatly reduced, and when waterways are expected to support the lowest diversity and abundance of aquatic species.

Potential impacts on aquatic ecology associated with the Project include the discharge of mine-affected water, stormwater runoff from disturbed areas, drawdown and contamination of groundwater. The discharge of mine-affected water would continue to be managed in accordance with the Site Water Management Plan. Water intercepted within the Study area would continue to be segregated into mine-affected water, sediment-laden runoff and clean water. Most mine-affected and sediment-laden water would be reused on site, including for dust suppression. Surplus water would be stored and released in accordance with EA release conditions.

The existing surface water monitoring network would be augmented to accommodate the Project. Groundwater monitoring would also be incorporated into the monitoring program. Monitoring data would be assessed against groundwater quality and level triggers and surface water release limits and contaminant trigger levels. If the assessments identify that relevant triggers have been exceeded, Syntech Resources would conduct investigations in accordance with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000).

Given that the site releases would be conducted in accordance with the EA release criteria and informed by ongoing monitoring of discharge and receiving environment water quality and quantity, adverse impacts on aquatic ecosystems are not likely.

Habitat used by the brigalow woodland snail will be impacted by the Project, although the majority of known associated habitat within the Study area will be retained. The population of brigalow woodland snail is expected to persist both within the Study area and the broader region. An assessment of significance using the Significant Impact Guidelines 1.1 (DotE 2013b) determined that the Project is unlikely to result in a significant impact on the population of brigalow woodland snail.

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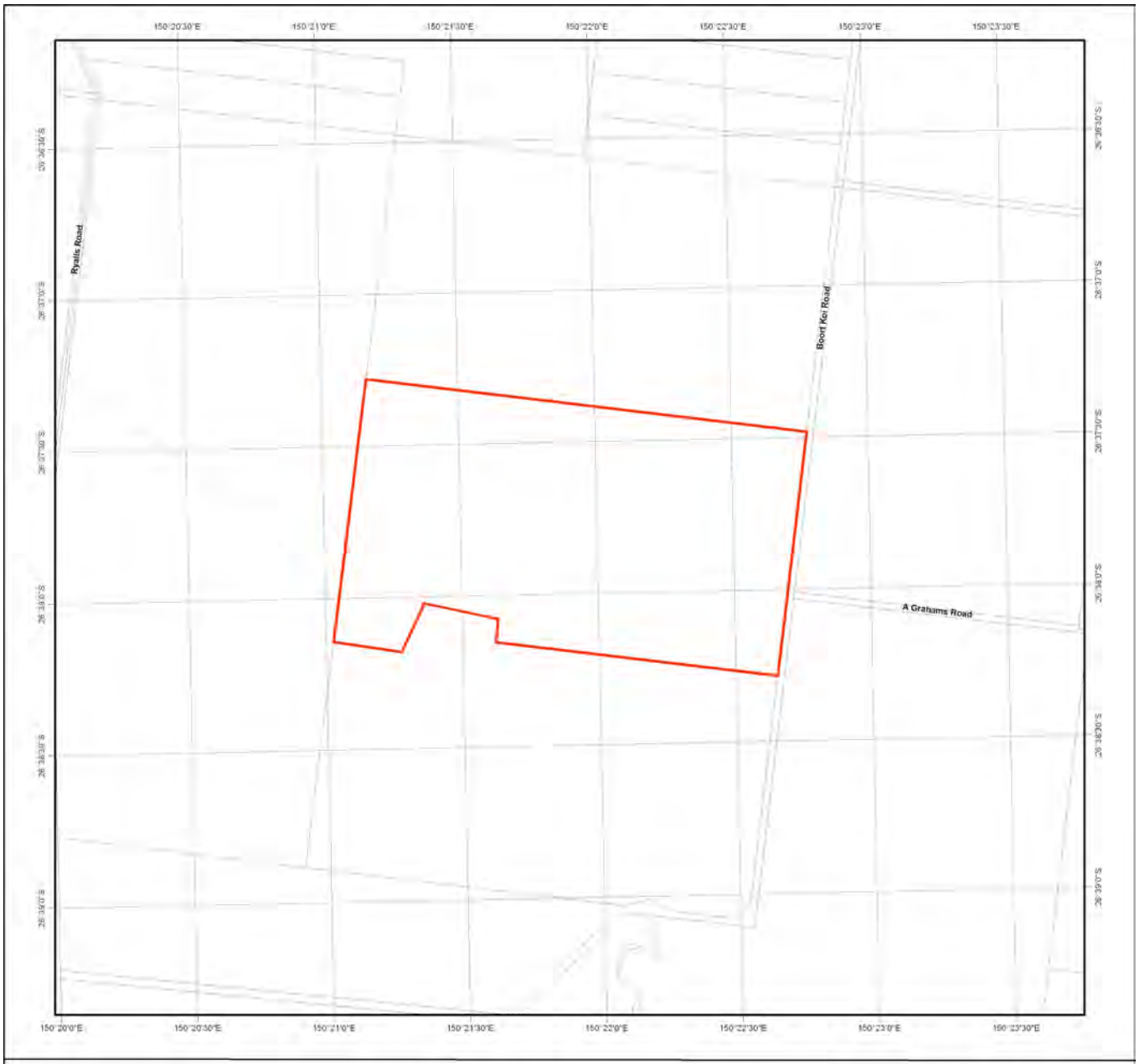
Appendix A: Referable Wetland Maps



Map of Referable Wetlands
Wetland Protection Areas

Lot and Plan
Cadastral Boundary
Wetland Protection Areas
Wetland
Trigger Area

LOCALITY DIAGRAM

N

Note:
This map shows the location of wetland protection areas which are defined under the Environmental Protection Regulation 2008. Within wetland protection areas, certain types of development involving high impact earthworks are made assessable under Schedule 3 of the Sustainable Planning Regulation 2009.

The Department of State Development Infrastructure and Planning is the State Assessment Referral Agency (SARA) under Schedule 7 of the Sustainable Planning Regulation 2009 for assessable development involving high impact earthworks within wetland protection areas. The Department of Environment and Heritage Protection is a technical agency.

The policy outcome and assessment criteria for assessing these applications are described in the State Development Assessment Provisions (SDAP) *Module 11: Wetlands and wild rivers.*

This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

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Map of Referable Wetlands for the Environmental Protection Act 1994

Lot and Plan
Cadastral Boundary
HES Wetland
GES Wetland

LOCALITY DIAGRAM

N

Note:
This map shows the location of wetlands on the Map of Referable Wetlands which are defined under the Environmental Protection Regulation 2008.

Wetlands are assessed for ecological significance using the environmental values for wetlands in section 81A of the Environmental Protection Regulation 2008. Wetlands are considered either High Ecological Significance (HES) or of General Ecological Significance (GES) for the purposes of the environmental values.

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Map of Referable Wetlands
Wetland Protection Areas

Lot and Plan

Cadastral Boundary

Wetland Protection Areas

Wetland

Trigger Area

N

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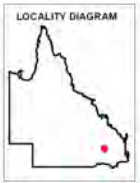
Map of Referable Wetlands for the Environmental Protection Act 1994

Lot and Plan
Cadastral Boundary
HES Wetland
GES Wetland



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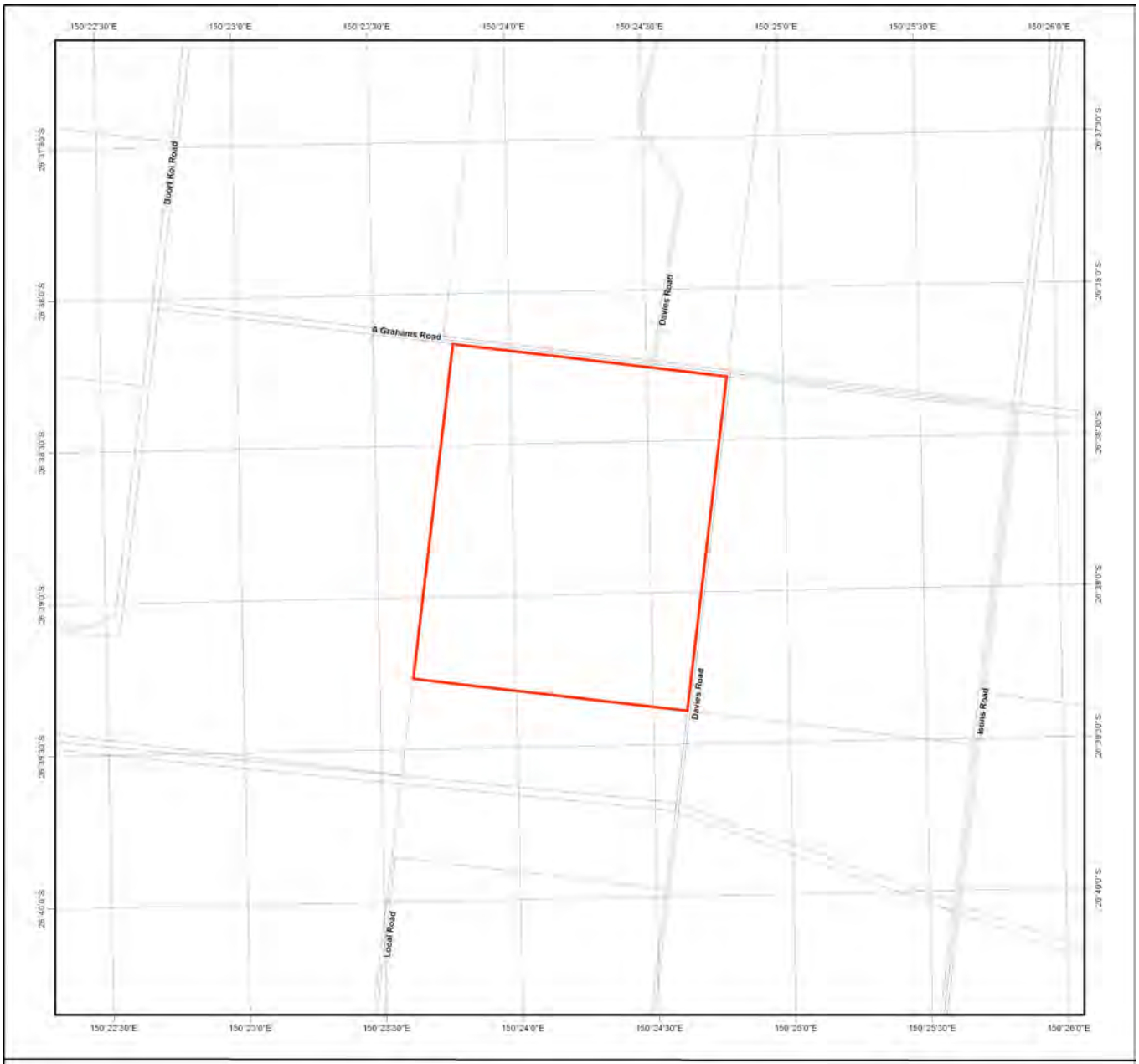

Map of Referable Wetlands
Wetland Protection Areas

Lot and Plan
Cadastral Boundary
Wetland Protection Areas
Wetland
Trigger Area

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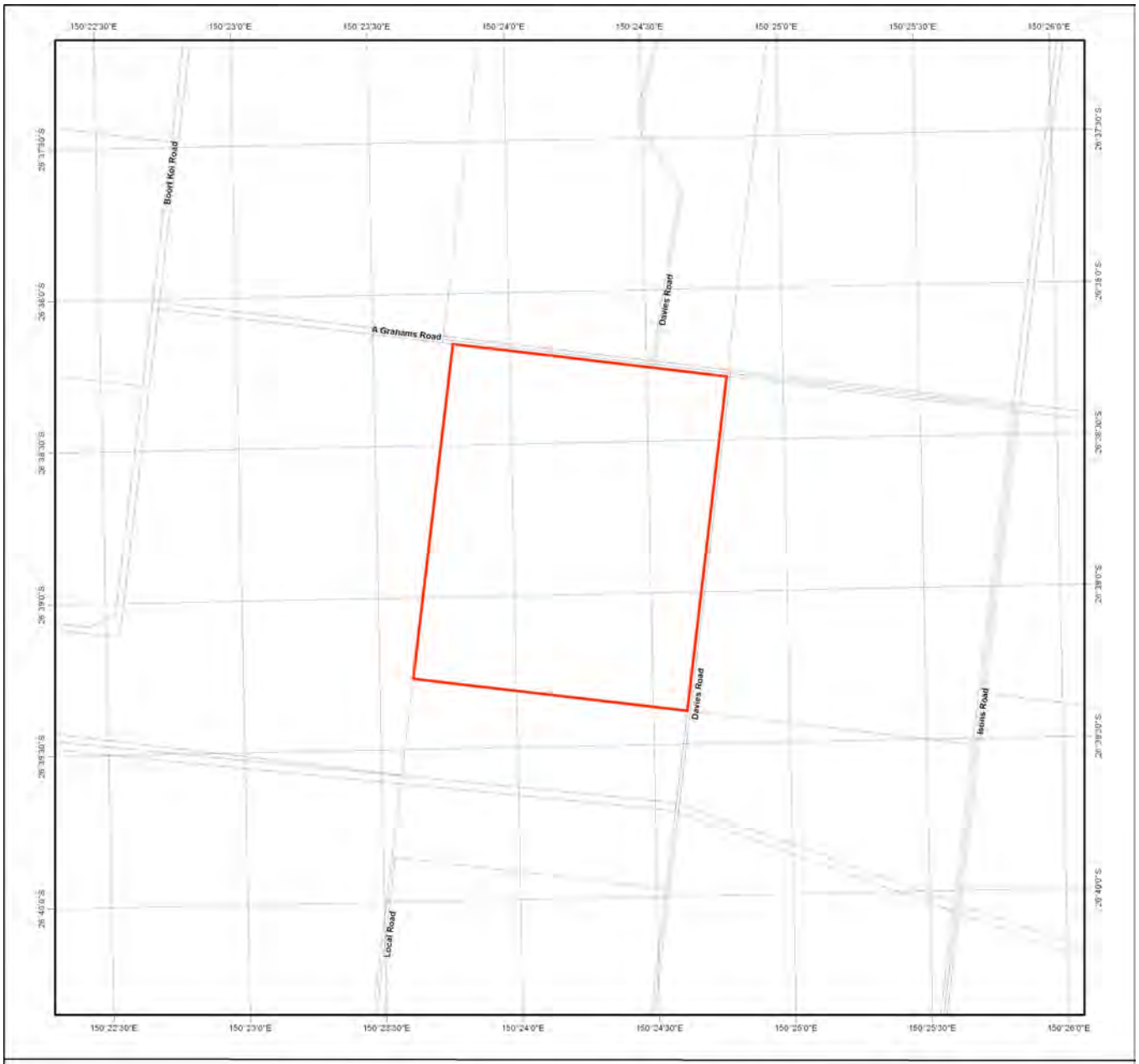

Map of Referable Wetlands for the Environmental Protection Act 1994

Lot and Plan
Cadastral Boundary
HES Wetland
GES Wetland

LOCALITY DIAGRAM

N

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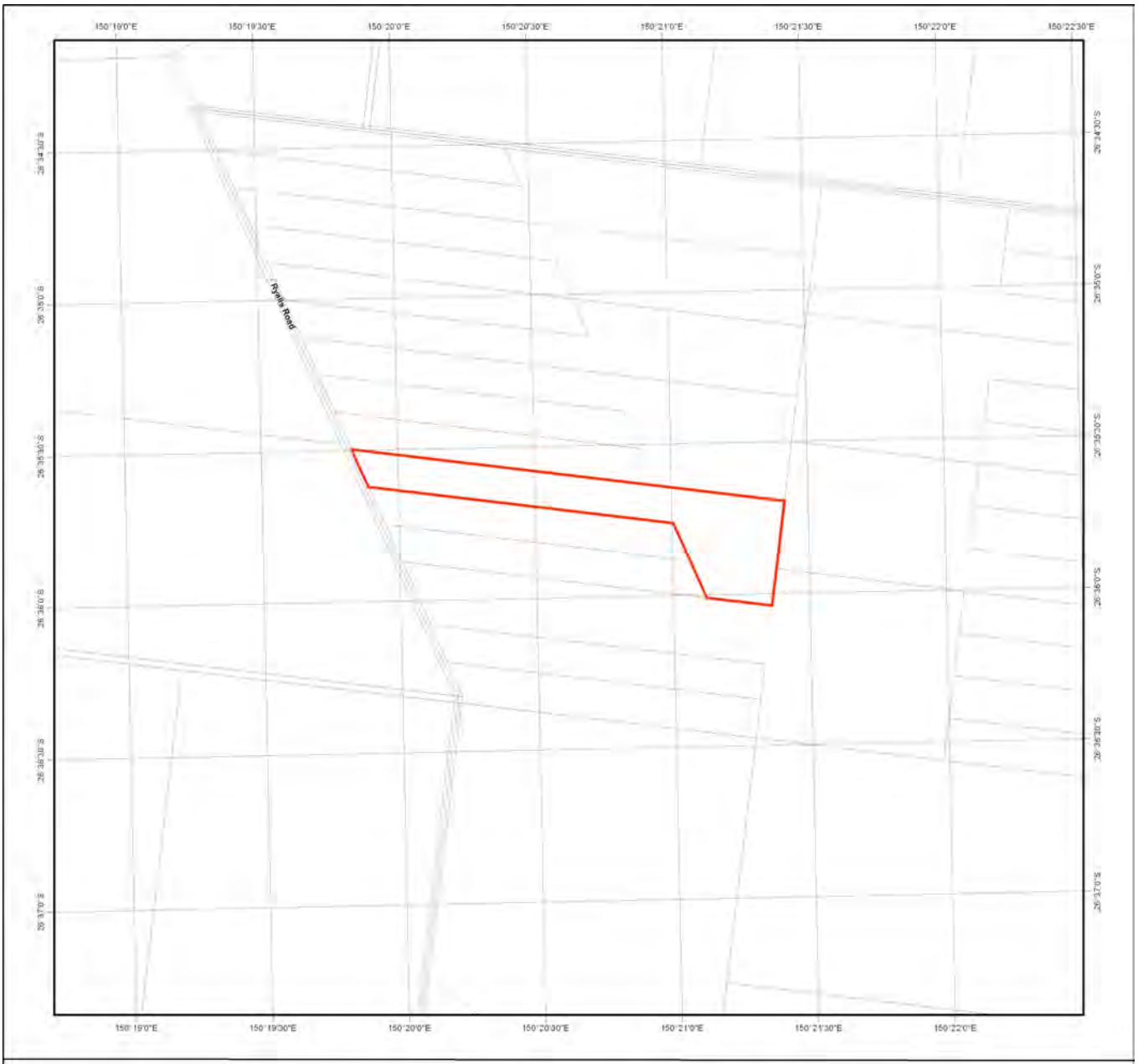

Map of Referable Wetlands
Wetland Protection Areas

Lot and Plan
Cadastral Boundary
Wetland Protection Areas
Wetland
Trigger Area

LOCALITY DIAGRAM

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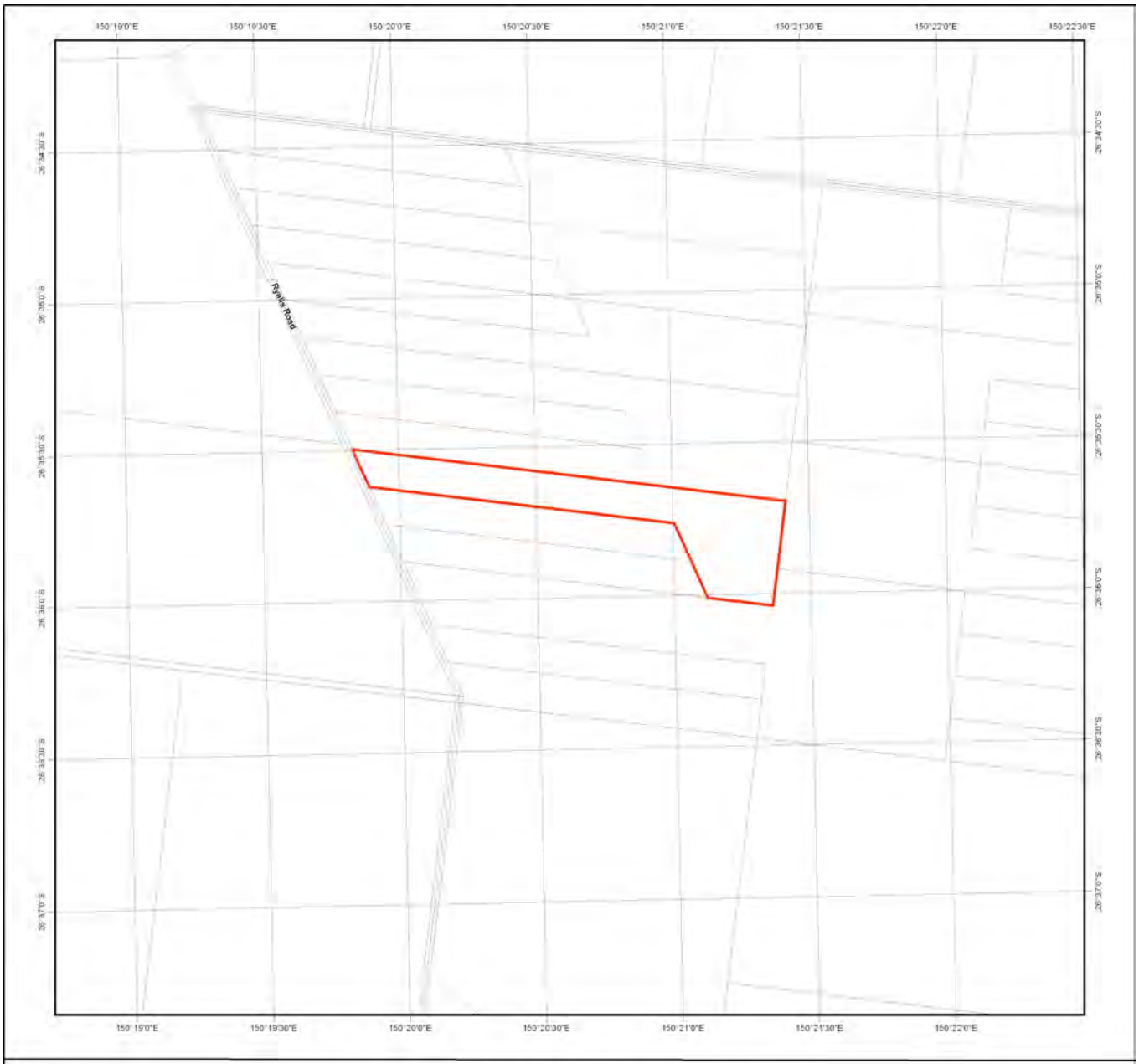
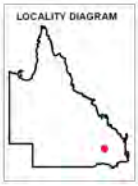


Map of Referable Wetlands for the Environmental Protection Act 1994

Lot and Plan
Cadastral Boundary
HES Wetland
GES Wetland

LOCALITY DIAGRAM



N

Note:
This map shows the location of wetlands on the Map of Referable Wetlands which are defined under the Environmental Protection Regulation 2008.

Wetlands are assessed for ecological significance using the environmental values for wetlands in section 81A of the Environmental Protection Regulation 2008. Wetlands are considered either High Ecological Significance (HES) or of General Ecological Significance (GES) for the purposes of the environmental values.

This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at <www.ehp.qld.gov.au> or email <planning.support@ehp.qld.gov.au>

0 340 680 1020 1360 1700 m

This product is projected into GDA 1994 MGA Zone 56

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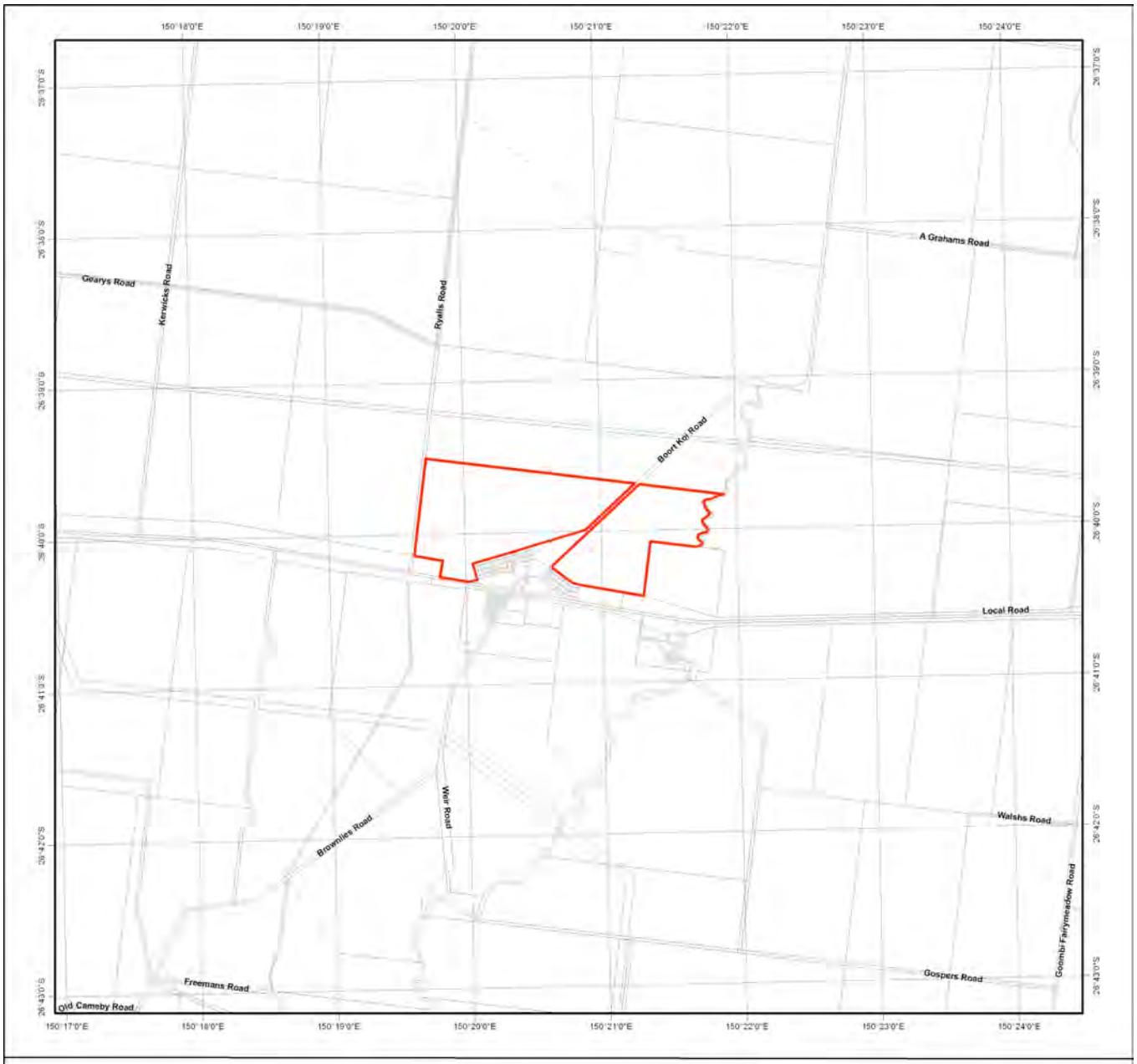

Map of Referable Wetlands
Wetland Protection Areas

Lot and Plan
Cadastral Boundary
Wetland Protection Areas
Wetland
Trigger Area

N

Note:
This map shows the location of wetland protection areas which are defined under the Environmental Protection Regulation 2008. Within wetland protection areas, certain types of development involving high impact earthworks are made assessable under Schedule 3 of the Sustainable Planning Regulation 2009.

The Department of State Development Infrastructure and Planning is the State Assessment Referral Agency (SARA) under Schedule 7 of the Sustainable Planning Regulation 2009 for assessable development involving high impact earthworks within wetland protection areas. The Department of Environment and Heritage Protection is a technical agency.

The policy outcome and assessment criteria for assessing these applications are described in the State Development Assessment Provisions (SDAP) *Module 11: Wetlands and wild rivers.*

This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at www.ehp.qld.gov.au or email planning.support@ehp.qld.gov.au.

0 680 1360 2040 2720 3400 m

This product is projected into GDA 1994 MGA Zone 56

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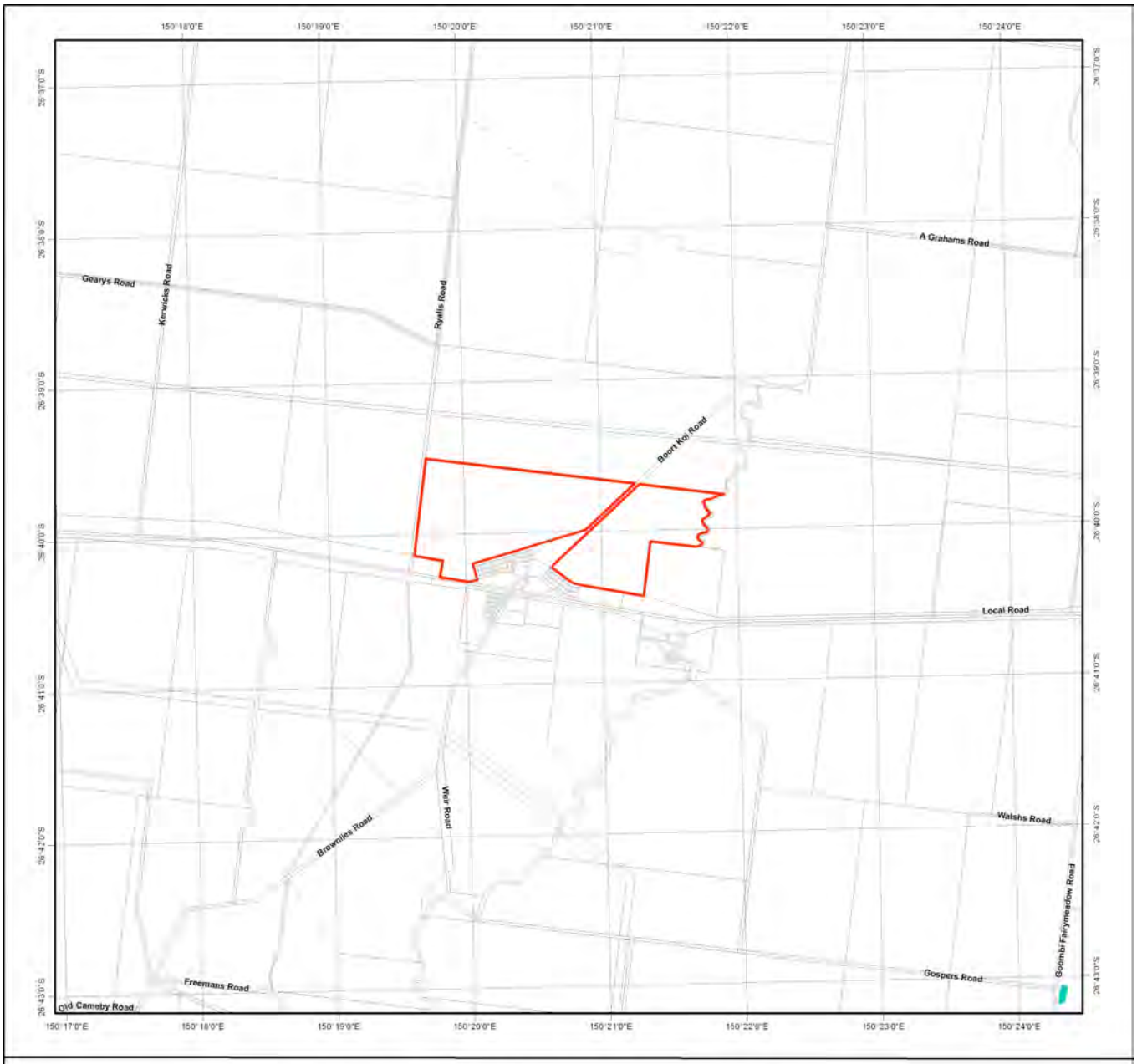
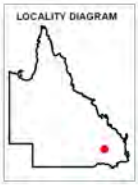


Map of Referable Wetlands for the Environmental Protection Act 1994

Lot and Plan
Cadastral Boundary
HES Wetland
GES Wetland

LOCALITY DIAGRAM



N

Note:
This map shows the location of wetlands on the Map of Referable Wetlands which are defined under the Environmental Protection Regulation 2008.

Wetlands are assessed for ecological significance using the environmental values for wetlands in section 81A of the Environmental Protection Regulation 2008. Wetlands are considered either High Ecological Significance (HES) or of General Ecological Significance (GES) for the purposes of the environmental values.

This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

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0 680 1360 2040 2720 3400 m

This product is projected into GDA 1994 MGA Zone 56

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Appendix B: Aquatic Survey Site Profiles

Site Code: R1 **Location:** Drainage Line 2 **Stream order:** 2 **Latitude:** -26.6678 **Longitude:** 150.3414 **Date:** 27-28/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral second order stream; study reach positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity sand bed; well defined bed and banks; some local catchment erosion; at the time of the site visit, the water level was slightly lower than normal (<watermark), with no flow; the wetted width along the 100 m survey reach ranged from 0.0 – 2.5 m, with a mean width of 1.5 m (estimated); depth ranged from 0.0 – 0.8 m, with a mean depth of 0.1 m (estimated); bankfull width was approx. 8 m and bankfull height approx. 1.5 m (from the stream bed); in-stream habitat included shallow (<0.5 m) pools and limited deep pools; substrates comprised 20% silt/clay (<0.05 mm) and 80% sand (0.05 - 2 mm) in the bed habitat, and 15% silt/clay and 85% sand in the edge habitat; no large woody debris or floating, submerged or emergent macrophytes detected, although occasional macrophytes detected in the edge habitat.

Riparian vegetation

Study reach positioned within remnant vegetation and regrowth of RE 11.3.25. Riparian zone approximately 10 m on the left bank and 10 m on the right, dominated by forest red gum (*Eucalyptus tereticornis*), with abundant white cypress pine (*Callitris glaucophylla*) and frequent narrow-leaved ironbark (*E. crebra*) and bull oak (*Allocasuarina luehmannii*). Mid-storey species included occasional white cypress pine regrowth and long leaved matrush (*Lomandra longifolia*). The groundcover of the lower bank was dominated by reedgrass (*Arundinella nepalensis*), with occasional tall flatsedge (*Cyperus exaltatus*), flatsedge (*C. haspan*), common rush (*Juncus usitatus*) and long-leaved matrush. The groundcover of the upper bank was dominated by African lovegrass (*Eragrostis curvula*), with abundant reedgrass, frequent mother-of-millions (*Bryophyllum delagoense*), and occasional many-headed wiregrass (*Aristida caput-medusae*) and barbedwire grass (*Cymbopogon refractus*).

Erosion risk

Low – banks appeared to be moderately stable, and over 80% of streambank surfaces were covered by vegetation.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes included tall flatsedge (*C. exaltatus*) (little), flatsedge (*C. haspan*) (little) and common rush (*J. usitatus*) (little). The study reach provides potential wet season breeding habitat for fish. Aquatic fauna detected during the survey included inland yabby (*Cherax destructor*), and a number of other aquatic macroinvertebrates (Section 5.9.4). No

fish were detected, despite thorough backpack electrofishing and overnight deployment of two fyke nets and five baited box traps.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The study reach lacks habitat features for these species. The study reach also lacks valuable foraging habitat or suitable breeding habitat (i.e. banks suitable for burrow construction) for the SLC platypus (*Ornithorhynchus anatinus*).

Physico-chemical water quality

Collection time: 15:45 EST; water temp.: 15.0 °C; conductivity: 263 µS/cm (fresh); turbidity: 639 NTU (poor clarity/opaque); dissolved oxygen: 92% (saturated); pH 7.11 (neutral); total alkalinity 50 mg$CaCO_3$/L.

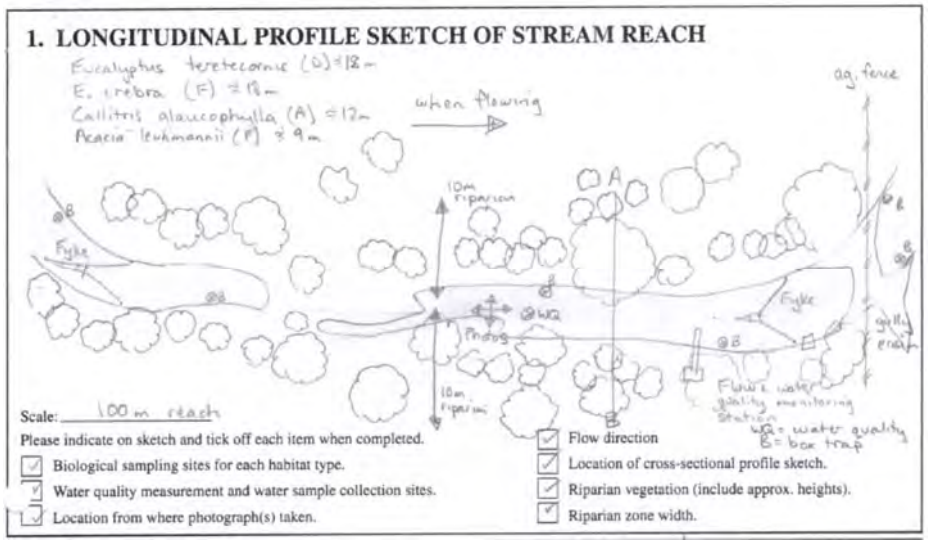
Summary: normal.

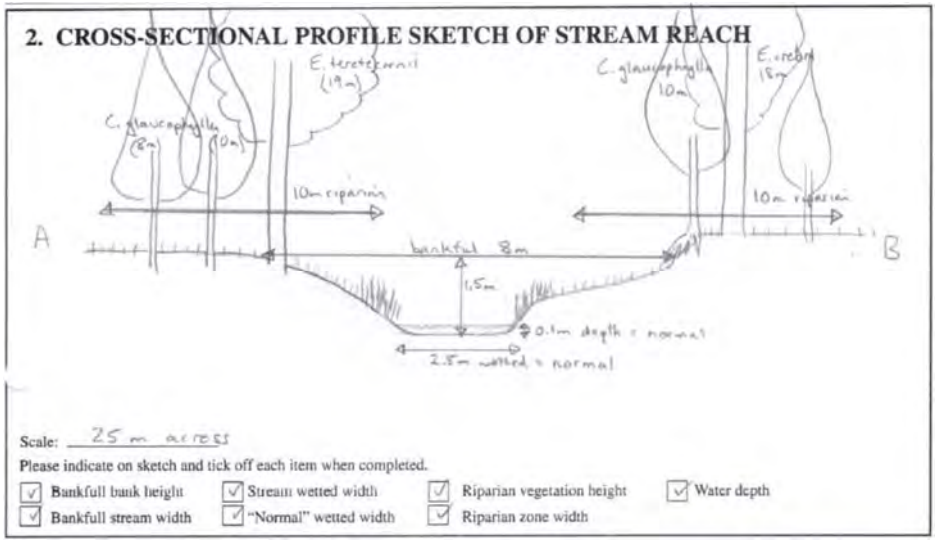
Bioassessment scores

Habitat assessment score for 'late wet' season: 60 (Fair); AusRivAS taxonomic richness: 7 (bed), 14 (edge); EPT richness: 1 (bed), 1 (edge); SIGNAL 2 score: 3.20 (bed), 3.25 (edge); AusRivAS OE50 score: 0.67 (Band B – bed); 0.60 (Band B – edge).

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: R2 **Location:** Drainage Line 1 **Stream order:** 3 **Latitude:** -26.6681 **Longitude:** 150.3624 **Date:** 25-26/07/2016

Upstream

Left Bank

Downstream

Right Bank

General Site Description

Site attributes

Ephemeral third order stream, containing semi-permanent pools; positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity fine-grained (silt/clay) bed; well defined bed and banks; little local catchment erosion; water level low (<watermark) at time of site visit, with no flow; the wetted width along the 100 m survey reach ranged from 0 – 15 m, with a mean width of 10 m (estimated); depth ranging from 0.0 – 1.2 m, and mean depth of 0.5 m (estimated); bankfull width was approx. 20 m and bankfull height approx. 2 m (from the stream bed); in-stream habitat included shallow (<0.5 m) pools, deep pools, large woody debris, and emergent macrophytes (little); substrates comprised 100% silt/clay (<0.05 mm) in the bed and edge habitats; no runs, riffles or undercut banks were detected.

Riparian vegetation

Study reach positioned within remnant vegetation and regrowth of RE 11.3.25. Riparian zone approximately 15 m on the left bank and 15 m on the right, dominated by forest red gum (*Eucalyptus tereticornis*), with abundant belah (*Casuarina cristata*), frequent poplar box (*E. populnea*), and occasional white cypress pine (*Callitris glaucophylla*) and brigalow (*Acacia harpophylla*). Mid-storey species included occasional false sandalwood (*Eremophila mitchellii*) and limebush (*Citrus glauca*). The groundcover of the lower bank was dominated by common couch (*Cynodon dactylon*), with frequent reedgrass (*Arundinella nepalensis*), tall flatsedge (*Cyperus exaltatus*) and common sneezeweed (*Centipeda cunninghamii*), and occasional flatsedge (*C. haspan*) and common rush (*Juncus usitatus*). The groundcover of the upper bank was dominated by twirly windmill grass (*Enteropogon ramosus*), wiregrasses (Aristida spp.) and *Poa* sp., with frequent weeds including mother-of-millions (*Bryophyllum delagoense*), and occasional queen of the night (*Cereus uruguayensis*), pest pear (*Opuntia stricta*) and velvety tree pear (*O. tomentosa*).

Erosion risk

Low – banks appeared to be moderately stable, with over 80% of streambank surfaces were covered by vegetation or tree roots.

Aquatic flora and fauna, including breeding habitat

Occasional emergent macrophytes, including wavy marshwort (*Nymphoides crenata*). Occasional fringing macrophytes, including tall flatsedge (*C. exaltatus*), flatsedge (*C. haspan*) and common rush (*J. usitatus*). The reach provides potential breeding habitat for fish. Aquatic fauna detected by backpack electrofishing and overnight deployment of two fyke nets and five baited box traps included golden perch (*Macquaria ambigua*), spangled perch (*Leiopotherapon unicolor*) and gudgeons (*Hypseleotris* spp.), and pest species European carp (*Cyprinus carpio*), mosquitofish (*Gambusia holbrooki*) and goldfish (*Carassius auratus*). A number of macroinvertebrates were also recorded (Section 5.9.4).

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The study reach lacks preferred habitat features for these species. The reach also lacks valuable foraging habitat or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*). No platypus burrows were detected, despite targeted searches.

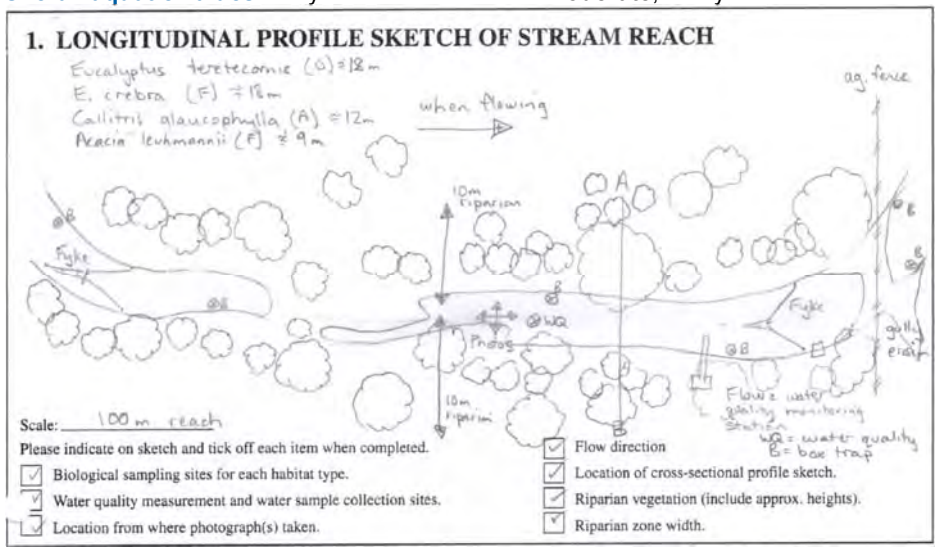
Physico-chemical water quality

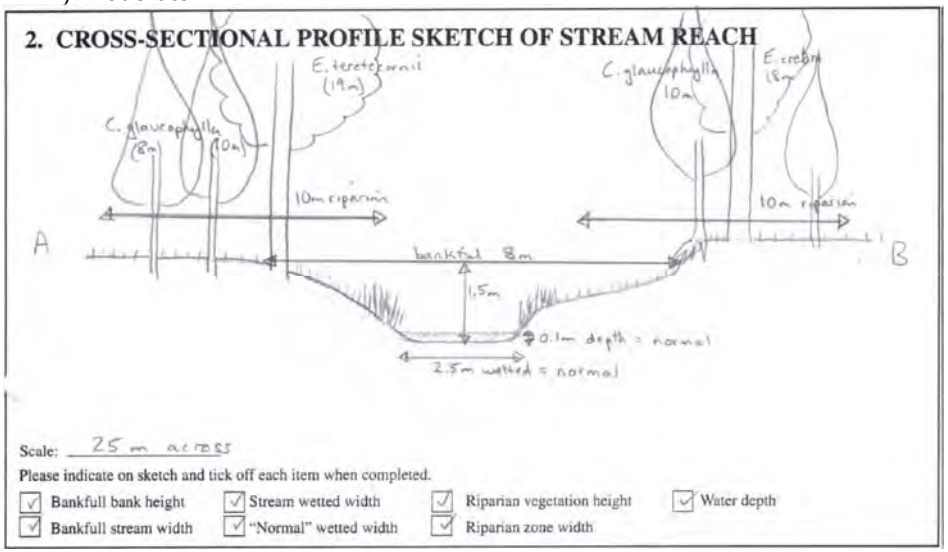
Collection time: 07:50 EST; water temp.: 12.1 °C; conductivity: 217 µS/cm (fresh); turbidity: >1000 NTU (poor clarity/opaque); dissolved oxygen: 60%; pH 7.15 (neutral); total alkalinity 25 mg$CaCO_3$/L. Summary: normal.

Bioassessment scores

Habitat assessment score for 'late wet' season: 65 (Fair); AusRivAS taxonomic richness: 7 (bed), 29 (edge); EPT richness: 0 (bed), 4 (edge); SIGNAL 2 score: 3.00 (bed), 3.15 (edge); AusRivAS OE50 score: 0.59 (Band B – bed); 1.10 (Band A – edge).

Overall aquatic values – Dry or 'late wet' season: **Moderate**; 'Early wet' or wet season (inferred): **Moderate**.





Site Code: R3 **Location:** Tributary of Drainage Line 1 **Stream order:** 1 **Latitude:** -26.6734 **Longitude:** 150.3688 **Date:** 25-26/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral first order stream; positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity fine-grained (silt/clay) bed; defined bed and banks; some local catchment erosion; subject to direct access by cattle; water level low (<watermark) at time of site visit, with no flow; the wetted width along the 100 m survey reach ranged from 0 – 3 m, with a mean width of 2 m (estimated); depth ranging from 0.0 – 3 m, and mean depth of 0.25 m (estimated); bankfull width was approx. 12 m and bankfull height approx. 1.5 m (from the stream bed); in-stream habitat included shallow (<0.5 m) pools and large woody debris. Substrates comprised 95% silt/clay (<0.05 mm) and 5% sand (0.05 - 2 mm) in both the bed and edge habitats; no deep (>0.5 m) pools, runs, riffles, undercut banks or instream macrophytes detected.

Riparian vegetation

Study reach positioned within cleared, moderately grazed land. Riparian zone approximately 10 m on the left bank and 10 m on the right, dominated by poplar box (*Eucalyptus populnea*), with frequent brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*). Mid-storey species included frequent false sandalwood (*Eremophila mitchellii*) and wilga (*Geijera parviflora*), and occasional limebush (*Citrus glauca*). The groundcover of the lower bank was dominated by common couch (*Cynodon dactylon*), with occasional tall flatsedge (*Cyperus exaltatus*), common rush (*Juncus usitatus*) and umbrella canegrass (*Leptochloa digitata*). The groundcover of the upper bank was dominated by twirly windmill grass (*Enteropogon ramosus*) and many-headed wiregrass (*Aristida caput-medusae*), with occasional queen of the night (*Cereus uruguayensis*) and velvety tree pear (*Opuntia tomentosa*).

Erosion risk

Moderate – Bank vegetative cover relatively low and trampled by stock; however, no bank slumping or gullying detected.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes included tall flatsedge (*C. exaltatus*) (little) and common rush (*J. usitatus*) (little). The study reach provides marginal wet season breeding habitat for fish. Aquatic fauna detected during the survey included inland yabby (*Cherax destructor*), and a number of other aquatic macroinvertebrates (Section 5.9.4). No fish were detected, despite thorough electrofishing and overnight deployment of one fyke net and five baited box traps.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The study reach lacks preferred habitat features for these species. The reach also lacks valuable foraging habitat or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*). No platypus burrows were detected, despite targeted searches.

Physico-chemical water quality

Collection time: 12:10 EST; water temp.: 12.6 °C; conductivity: 167 µS/cm (fresh); turbidity: >1000 NTU (poor clarity/opaque); dissolved oxygen: 13% (low); pH 6.12 (slightly acid); total alkalinity 47 mg$CaCO_3$/L.

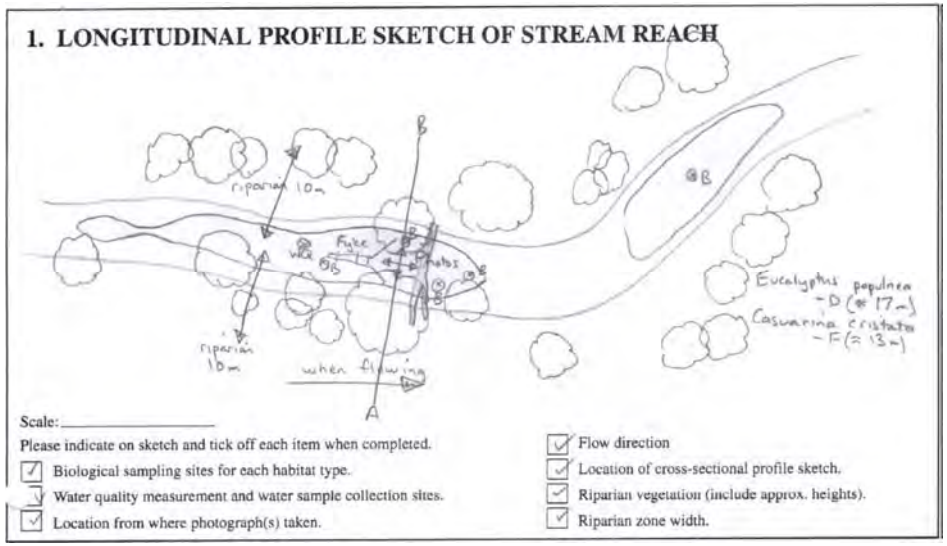
Summary: normal.

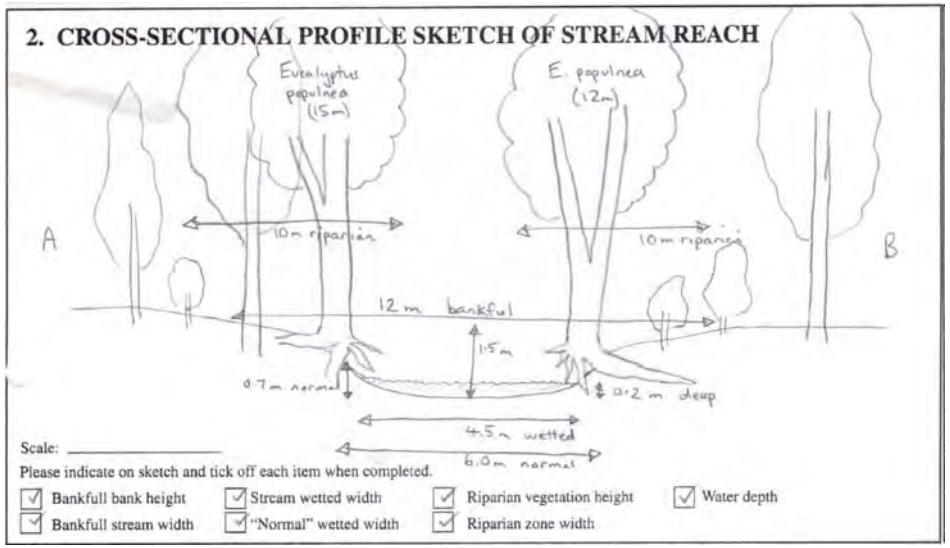
Bioassessment scores

Habitat assessment score for 'late wet' season: 57 (Fair); AusRivAS taxonomic richness: 5 (bed), 10 (edge); EPT richness: 0 (bed), 0 (edge); SIGNAL 2 score: 1.67 (bed), 1.86 (edge); AusRivAS OE50 score: 0.37 (Band B – bed); 0.42 (Band C – edge).

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: R4 **Location:** Tributary of Drainage Line 1 **Stream order:** 2 **Latitude:** -26.6253 **Longitude:** 150.3397 **Date:** 27/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral second order stream; positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity fine-grained (silt/clay) bed; defined bed and banks; little local catchment erosion; water level low (<watermark) at time of site visit, with standing water reduced to a few isolated pools; the wetted width of these pools averaged 1.2 m (estimated); with depth ranging from 0.0 – 0.2m, and mean depth of 0.1 m (estimated); bankfull width was approx. 10 m and bankfull height approx. 2.5 m (from the stream bed); in-stream habitat included shallow (<0.5 m) pools and large woody debris. Substrates comprised 97% silt/clay (<0.05 mm) and 3% sand (0.05 - 2 mm) in the bed habitat, and 98% silt/clay and 2% sand in the edge habitat; no deep (>0.5 m) pools, runs, riffles, undercut banks or instream macrophytes were detected.

Riparian vegetation

Study reach positioned within regrowth woodland. Riparian zone approximately 10 m on the left bank and 10 m on the right, dominated by poplar box (*Eucalyptus populnea*) and belah (*Casuarina cristata*), with abundant black tea-tree (*Melaleuca bracteata*) and frequent brigalow (*Acacia harpophylla*). Mid-storey species included frequent belah (*C. cristata*) regrowth, and occasional wilga (*Geijera parviflora*), limebush (*Citrus glauca*) and scrub boonaree (*Alectryon diversifolius*). The groundcover of the lower bank contained occasional flatsedge (*Cyperus haspan*) and umbrella canegrass (*Leptochloa digitata*). The groundcover of the upper bank was dominated by twirly windmill grass (*Enteropogon ramosus*), with occasional many-headed wiregrass (*Aristida caput-medusae*) and barbedwire grass (*Cymbopogon refractus*), with abundant mother-of-millions (*Bryophyllum delagoense*) and occasional velvety tree pear (*Opuntia tomentosa*).

Erosion risk

Low – Bank vegetative cover relatively low; however, no stock impacts evident, and no bank slumping or gullying detected.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes included occasional flatsedge (*C. haspan*) and umbrella canegrass (*L. digitata*). The study reach may provide some wet season breeding habitat for fish. Aquatic fauna detected during the survey included inland yabby (*Cherax destructor*), and a number of other aquatic macroinvertebrates (Section 5.9.4). No fish were detected, despite thorough backpack electrofishing. No nets were deployed due to marginal habitat and inadequate depth.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The study reach lacks preferred habitat features for these species. The reach also lacks foraging or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*). No platypus burrows were detected.

Physico-chemical water quality

Collection time: 12:30 EST; water temp.: 12.3 °C; conductivity: 146 µS/cm (fresh); turbidity: >151 NTU (moderate to poor clarity); dissolved oxygen: 61% (low); pH 6.84 (neutral); total alkalinity 35 mg$CaCO_3$/L.

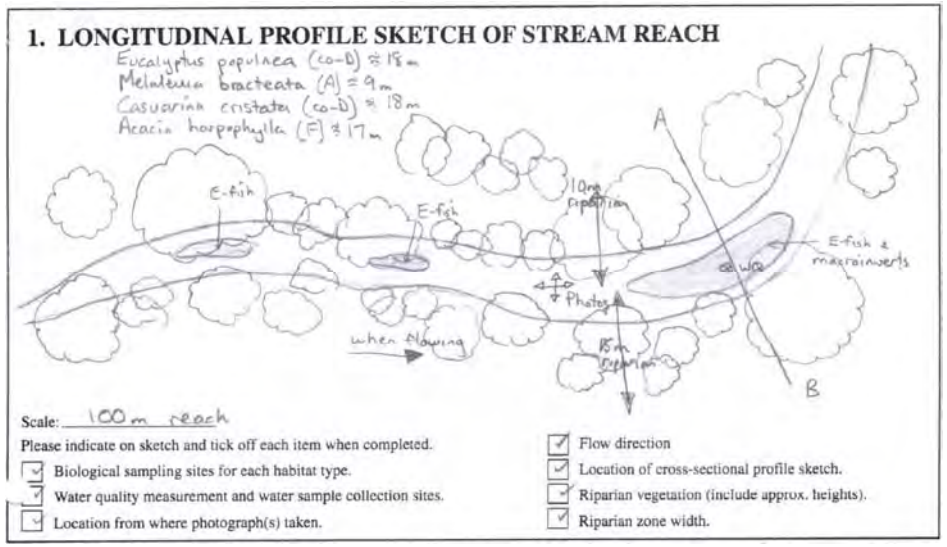
Summary: normal.

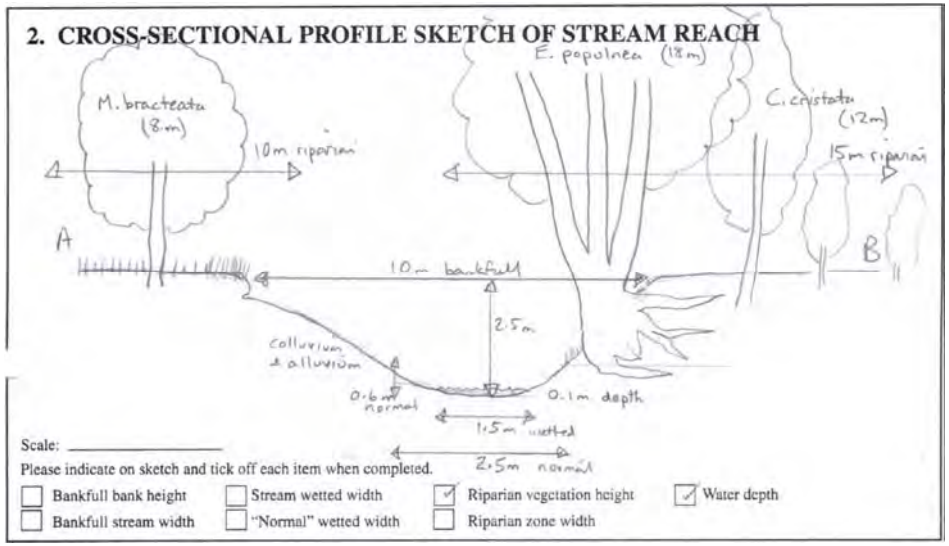
Bioassessment scores

Habitat assessment score for 'late wet' season: 68 (Fair); AusRivAS taxonomic richness: 7 (bed), 14 (edge); EPT richness: 0 (bed), 0 (edge); SIGNAL 2 score: 2.80 (bed), 2.91 (edge); AusRivAS OE50 score: 0.27 (Band C – bed); 0.30 (Band C – edge).

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: R5 **Location:** Tributary of Punch-Bowl Creek **Stream order:** 2 **Latitude:** -26.5940 **Longitude:** 150.3054 **Date:** 28/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral second order stream; positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity fine-grained (silt/clay) bed; defined bed and banks; minimal local catchment erosion; study reach dry at the time of site visit, and likely to remain dry throughout most of the year; channel width approximately 2 m; bankfull width was approx. 10 m and bankfull height approx. 3 m; substrates comprised 45% silt/clay (<0.05 mm), 50% sand (0.05 - 2 mm), 2% gravel (2 - 4 mm), 2% pebble (4 - 64 mm) and 1% cobble (64 - 256 mm) in the bed habitat and 34% silt/clay, 55% sand, 5% gravel, 5% pebble and 1% cobble in the edge (lower bank) habitat; no pools, runs, riffles, undercut banks or instream macrophytes were detected.

Riparian vegetation

Study reach positioned within regrowth woodland. Riparian zone approximately 15 m on the left bank and 15 m on the right, dominated by smooth-barked apple (*Angophora leiocarpa*), with abundant forest red gum (*Eucalyptus tereticornis*) and lancewood (*Acacia shirleyi*), and occasional white cypress pine (*Callitris glaucophylla*). Mid-storey species included frequent *Leptospermum* sp. and occasional wattles (*Acacia* spp.). Groundcover of the banks was dominated by leaf litter, with abundant reedgrass (*Arundinella nepalensis*), and occasional tall flatsedge (*Cyperus exaltatus*) and *Gahnia* sp. No weeds were detected.

Erosion risk

Low – No evidence of erosion or bank failure; over 80% of the streambank surfaces covered by vegetation or woody debris.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes included occasional flatsedge (*C. haspan*) and reedgrass (*A nepalensis*). The study reach is unlikely to provide breeding habitat for fish. No aquatic fauna were detected during the site visit. No macroinvertebrate sampling was undertaken.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP

2016). The study reach lacks preferred habitat features for these species. The reach also lacks foraging or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*).

Physico-chemical water quality

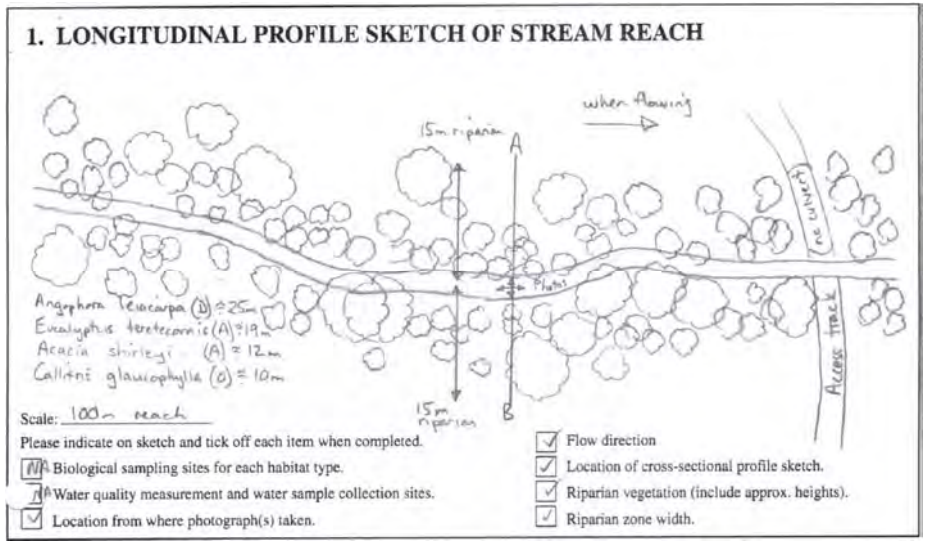
Not recorded due to lack of water.

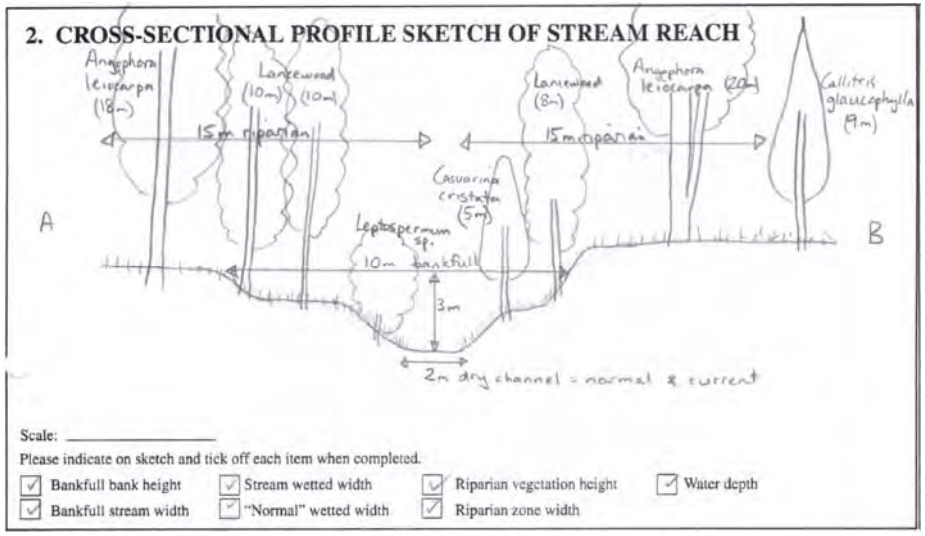
Bioassessment scores

Habitat assessment score for 'late wet' season: 66 (Fair).

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: R6 **Location:** Tributary of Punch-Bowl Creek **Stream order:** 1 **Latitude:** -26.5854 **Longitude:** 150.3405 **Date:** 28/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral 1st order drainage feature; poorly defined bed and banks; some local catchment erosion; study reach dry at the time of site visit, and likely to remain dry throughout most of the year; channel width approximately 2 m; bankfull width was approx. 3 m and bankfull height approx. 0.3 m; substrates comprised 40% silt/clay (<0.05 mm) and 60% sand (0.05 - 2 mm) in the bed habitat, and 60% silt/clay and 40% sand in the edge (lower bank) habitat; no pools, runs, riffles, undercut banks or instream macrophytes were detected.

Riparian vegetation

Study reach positioned within remnant and regrowth woodland. Riparian zone approximately 10 m on the left bank and 10 m on the right, dominated by poplar box (*Eucalyptus populnea*), with abundant white cypress pine (*Callitris glaucophylla*) and bull oak (*Allocasuarina luehmannii*). Mid-storey species included frequent bull oak saplings, and occasional wattles (*Acacia* spp.) hopbushes (*Dodonaea* spp.). Sparse groundcover of the lower bank included flatsedge (*Cyperus haspan*) and umbrella canegrass (*Leptochloa digitata*). The groundcover of the upper bank was dominated by many-headed wiregrass (*Aristida caput-medusae*), *Sporobolus* sp., frequent twirly windmill grass (*Enteropogon ramosus*), and occasional *Eragrostis* sp., *Poa* sp., *Lomandra* sp., *Bothriochloa* sp. and umbrella canegrass (*L. digitata*). Weeds included occasional velvety tree pear (*Opuntia tomentosa*).

Erosion risk

Moderate – Infrequent, small areas of erosion mostly healed over. 50-79% of the streambank surfaces covered by vegetation.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes included occasional flatsedge (*C. haspan*) and umbrella canegrass (*L. digitata*). The study reach is unlikely to provide breeding habitat for fish. No aquatic fauna were detected during the site visit. No macroinvertebrate sampling was undertaken.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The study reach lacks preferred habitat features for these species. The reach also lacks foraging or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*).

Physico-chemical water quality

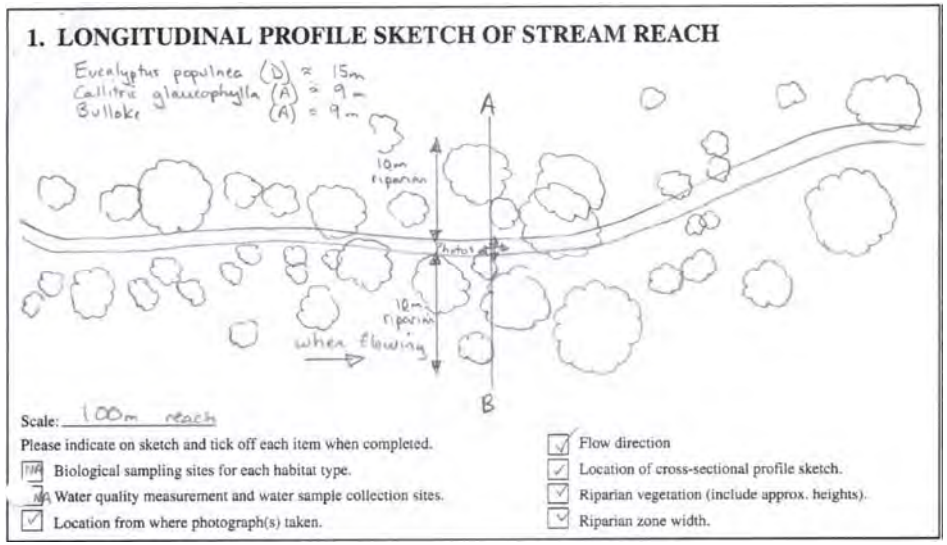
Not recorded due to lack of water.

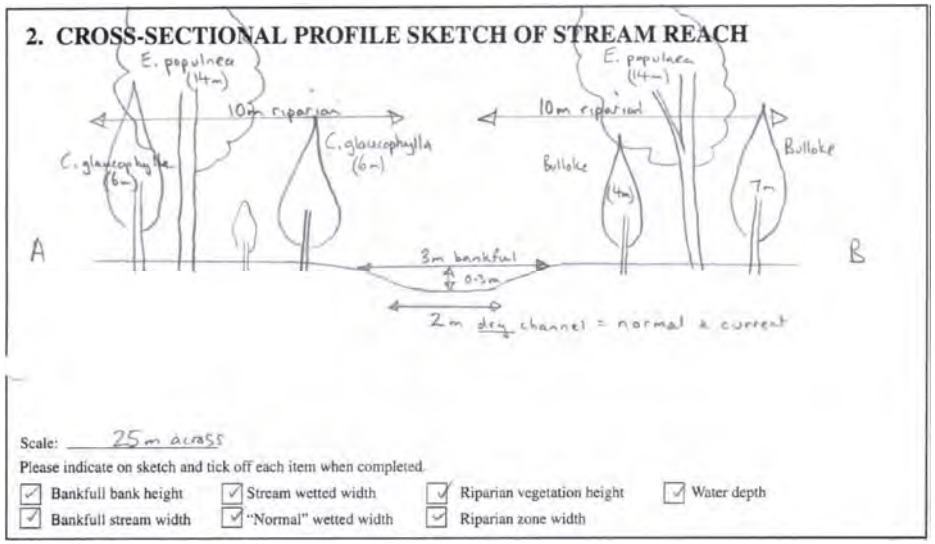
Bioassessment scores

Habitat assessment score for 'late wet' season: 56 (Fair).

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: L1 **Waterbody:** Farm dam (mapped as lacustrine waterbody) **Latitude:** -26.6582 **Longitude:** 150.3950 **Date:** 26-27/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Farm dam on first order stream; positioned within laterally-unconfined broad valley-setting with low-moderate sinuosity fine-grained (silt/clay) bed; subject to direct access by cattle; little local catchment erosion; water level low (<watermark) at time of site visit, with no flow; waterbody depth ranged from 0 – 1.3 m; the widest section had a wetted width of approximately 50 m, and depth of 0.8 m; maximum bankfull width was approx. 85 m; the dam spillway (i.e. bankfull height) was approximately 3 m above the deepest section of bed; bed substrates comprised 98% silt/clay (<0.05 mm) and 2% sand (0.05 - 2 mm); in-stream habitat included shallow (<0.5 m) and deep pool habitat; no runs, riffles, undercut banks, large woody debris or instream macrophytes were detected.

Riparian vegetation

Study reach positioned within cleared, heavily grazed land; negligible riparian zone; lower bank sparsely vegetated by small knotweed (*Polygonum plebeium*), water primrose (*Ludwigia peploides* subsp. *montevidensis*) and hairy carpet-weed (*Glinus lotoides*); upper bank dominated by common couch (*Cynodon dactylon*) and black rolypoly (*Sclerolaena muricata*), with frequent common rush (*Juncus usitatus*), saltbush (*Enchylaena* sp.), curly windmill grass (*Enteropogon ramosus*), *Bothriochloa* sp., ribbed spikerush (*Eleocharis plana*), pigweed (*portulaca oleracea*) and mallow (*Malva* sp.).

Erosion risk

Moderate – Bank vegetative cover relatively low and trampled by stock; however, no bank slumping or gullying detected.

Aquatic flora and fauna, including breeding habitat

Fringing macrophytes limited to occasional water primrose (*L. peploides* subsp. *montevidensis*) and small knotweed (*P. plebeium*). The study reach provides marginal habitat for fish, with a dam immediately downstream and another dam approx. 2.9 km upstream. A number of aquatic macroinvertebrates were collected (Section 5.9.4). No fish or yabbies were detected, despite thorough backpack electrofishing and overnight deployment of two fyke nets and five baited box traps.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The waterbody lacks preferred habitat features for these species. The waterbody also lacks foraging or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*).

Physico-chemical water quality

Collection time: 07:30 EST; water temp.: 13.5 °C; conductivity: 954 µS/cm (marginal); turbidity: >1000 NTU (poor clarity/opaque); dissolved oxygen: 81% (good, likely a result of the high surface area to volume ratio); pH 8.02 (moderately alkaline, likely due to high contact time with substrates); total alkalinity 200 mg$CaCO_3$/L.

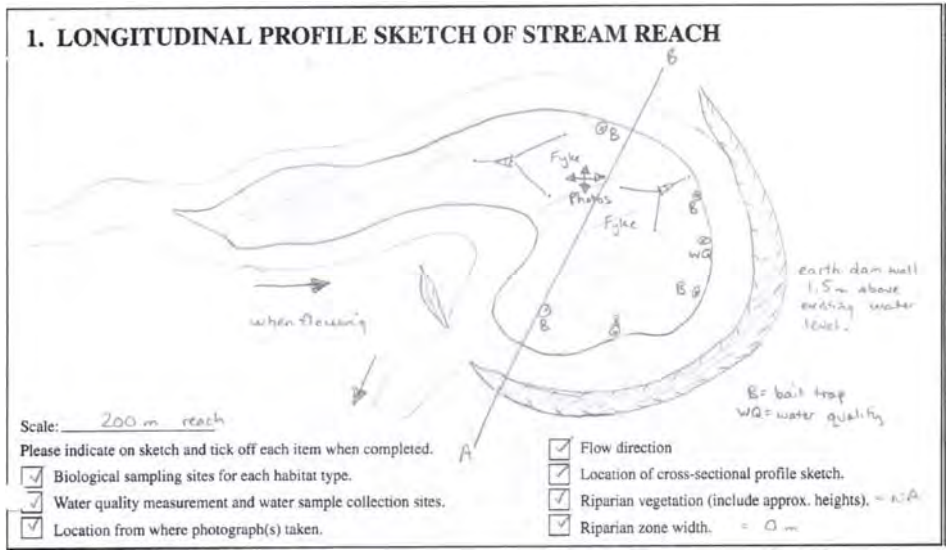
Summary: normal.

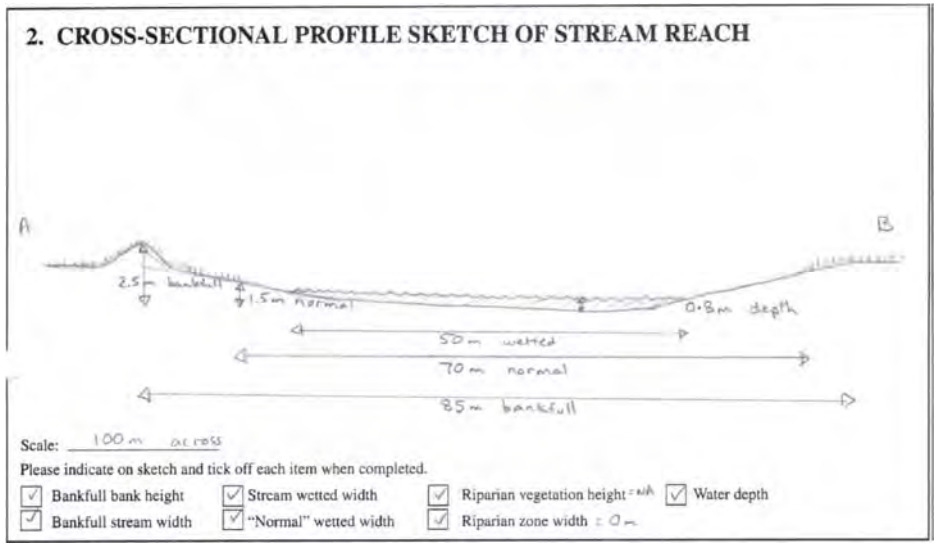
Bioassessment scores

Habitat assessment score for 'late wet' season: 20 (Poor); AusRivAS taxonomic richness: 10 (combined bed/edge sample); EPT richness: 0; SIGNAL 2 score: 3.00.

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Site Code: L2 **Waterbody:** Farm dam (mapped as lacustrine waterbody) **Latitude:** -26.5983 **Longitude:** 150.3272 **Date:** 28-29/07/2016


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Farm dam at commencement of first order stream; subject to direct access by cattle; little local catchment erosion; water level low (<watermark) at time of site visit, with no inflow or outflow; waterbody depth ranged from 0 – >1.5 m; the widest section had a wetted width of approximately 100 m, and depth of >1.5 m; the dam spillway (i.e. bankfull height) appeared to be approximately 4 m above the deepest section of bed; bed substrates comprised 92% silt/clay (<0.05 mm) and 8% sand (0.05 - 2 mm); in-stream habitat included shallow (<0.5 m) and deep pool habitat, and instream macrophytes (wavy marshwort [*Nymphoides crenata*]) in the edge habitat; no runs, riffles, undercut banks or large woody debris were detected.

Riparian vegetation

Study reach positioned within cleared, moderately grazed land; negligible riparian zone; lower bank sparsely vegetated by water primrose (*Ludwigia peploides* subsp. *montevidensis*), slender knotweed (*Persicaria decipiens*), tall flatsedge (*Cyperus exaltatus*), flatsedge (*C. haspan*), ribbed spikerush (*Eleocharis plana*), spike-rush (*E. cylindrostachys*) and common rush (*J. usitatus*); upper bank sparsely vegetated by many-headed wiregrass (*Aristida caput-medusae*), with occasional black roly-poly (*Sclerolaena muricata*) and common rush (*Juncus usitatus*).

Erosion risk

Moderate – Bank vegetative cover relatively low and trampled by stock; however, no bank slumping or gullying detected.

Aquatic flora and fauna, including breeding habitat

Emergent and trailing bank macrophytes, including abundant wavy marshwort (*Nymphoides crenata*) and occasional water primrose (*Ludwigia peploides* subsp. *montevidensis*). The waterbody provides habitat for mobile, far-reaching fish species. Spangled perch (*Leiopotherapon unicolor*) captured by fyke nets (5 individuals) and backpack electrofishing (57 individuals). High species richness of aquatic macroinvertebrates (Section 5.9.4). No yabbies detected, despite overnight deployment of five bait traps.

Endangered, Vulnerable, Near Threatened (EVNT) aquatic flora and fauna and Special Least Concern (SLC) fauna

No EVNT aquatic flora or fauna species were detected during the site visit. The Vulnerable (EPBC Act) Murray cod (*Maccullochella peelii*), Vulnerable (EPBC Act) Australian lungfish (*Neoceratodus forsteri*) and the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*) are recorded from the broader Balonne-Condamine catchment (EHP 2016). The waterbody lacks preferred habitat features for these species. The waterbody also lacks preferred foraging or breeding habitat for the SLC platypus (*Ornithorhynchus anatinus*).

Physico-chemical water quality

Collection time: 09:15 EST; water temp.: 14.0 °C; conductivity: 121 µS/cm (fresh); turbidity: 117 (moderate clarity); dissolved oxygen: 89% (good, likely a result of the high surface area to volume ratio); pH 7.66 (mildly alkaline, likely due to high contact time with substrates); total alkalinity 50 mg$CaCO_3$/L.

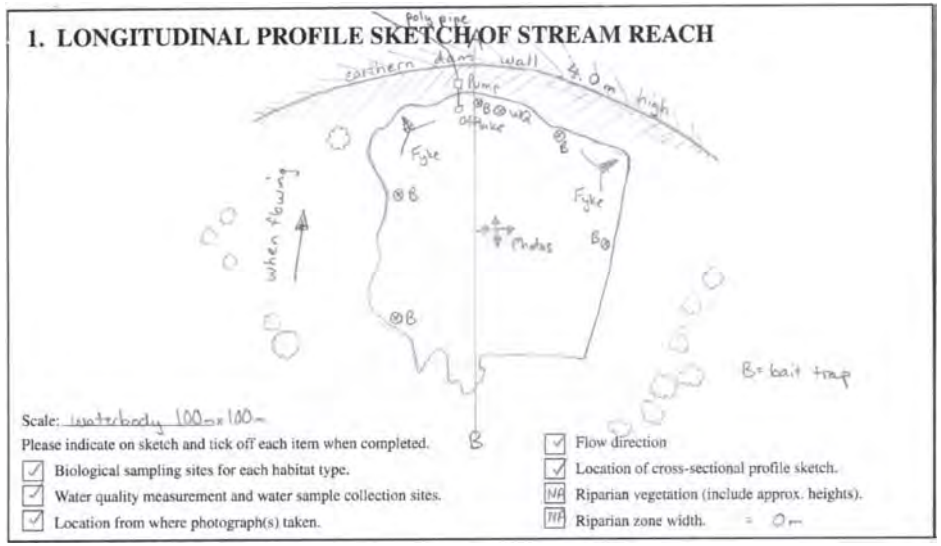
Summary: normal.

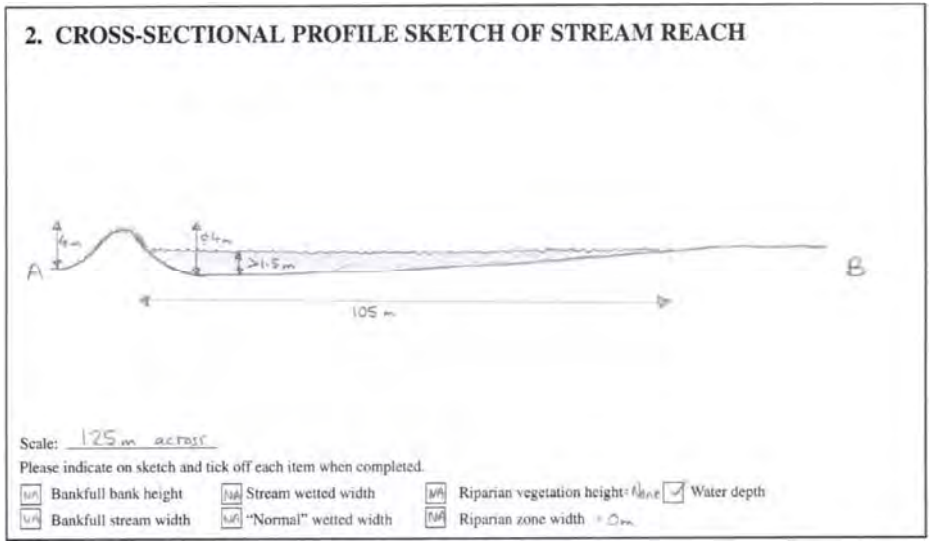
Bioassessment scores

Habitat assessment score for 'late wet' season: 27 (Poor); AusRivAS taxonomic richness: 22 (combined bed/edge sample); EPT richness: 3; SIGNAL 2 score: 3.25.

Overall aquatic values

Dry or 'late wet' season: **Low**; 'Early wet' or wet season (inferred): **Low**.





Appendix C: Aquatic Macroinvertebrate Data

Table D1 Macroinvertebrate AusRivAS taxonomy data from samples collected 26-29 July 2016

Class/Order	Family/Sub-Family	SIGNAL2 score	R1 Edge 28/7/16	R1 Bed 28/7/16	R2 Edge 26/7/16	R2 Bed 26/7/16	R3 Edge 26/7/16	R3 Bed 26/7/16	R4 Edge 27/7/16	R4 Bed 27/7/16	L1 27/7/16	L2 29/7/16
OLIGOCHAETA	OLIGOCHAETA - unid.	2				2			1			1
DECAPODA	PARASTACIDAE	4	1		2				2	1		
	ATYIDAE	3			5							13
	PALAEMONIDAE	4			8						3	
ACARINA	ACARINA	8										136
EPHEMEROPTERA	BAETIDAE (N)	5	3	1	6							5
	CAENIDAE (N)	4			2							34
HEMIPTERA	CORIXIDAE (A+N)	2			14						2	33
	NAUCORIDAE (A)	2										1
	NOTONECTIDAE (A+N)	1	2		3		1				5	
	PLEIDAE (A)	2			1							4
	VELIIDAE (A+N)	3	1		5				2			1
TRICHOPTERA	ECNOMIDAE (L)	4			3							
	LEPTOCERIDAE (L)	6			2							2
COLEOPTERA	CURCULIONIDAE (A)	2			1							
	DYTISCIDAE (A)	2	7	1	1		13	2	1	5		52
	HYDRAENIDAE (A)	3	1		1							
	HYDROCHIDAE (A)	4	2						2	1		
	HYGROBIIDAE (A)	1										1
	HYDROPHILIDAE (A)	2					1					
	SCIRTIDAE (L)	6	2						4			
ODONATA	COENAGRIONIDAE (N)	2			3							1
	ISOSTICTIDAE (L)	3			1							
EPIPROCTOPHORA	HEMICORDULIIDAE (N)	5			1						1	
	SYNTHEMISTIDAE (N)	2					3		1			
DIPTERA	CERATOPOGONIDAE (L)	4	1	1	2	4					2	31

Class/Order	Family/Sub-Family	SIGNAL2 score	R1 Edge 28/7/16	R1 Bed 28/7/16	R2 Edge 26/7/16	R2 Bed 26/7/16	R3 Edge 26/7/16	R3 Bed 26/7/16	R4 Edge 27/7/16	R4 Bed 27/7/16	L1 27/7/16	L2 29/7/16
	CHAOBORIDAE (L)	2		2	6	88					1	3
	CHIRONOMINAE (L)	3	1	2	20	26	8					22
	ORTHOCLADIINAE (L)	4			1							22
	TANYPODINAE (L)	4			5	10					1	57
	CULICIDAE (L)	1	5		15		2	31	7	11		
	EPHYDRIDAE (L)	2			11			16			1	
	DIPTERA - pupae	3	1		5	2				1		1
LEPIDOPTERA	PYRALIDAE (L)	3										1
GASTROPODA	PLANORBIDAE	2			2		1		6			
TURBELLARIA	TEMNOCEPHALA	5			1				2			
COLLEMBOLA	COLLEMBOLA	1							1			
OSTRACODA	OSTRACODA		5		5		1		2	3		7
COPEPODA	COPEPODA		36	8	74	58	8	2	2	5	13	412
CLADOCERA	CLADOCERA	2	6	4	16	186	61	47	20	34	18	16
TOTAL ABUNDANCE			74	19	222	376	99	98	53	61	47	856
TOTAL NO. TAXA (RICHNESS)			14	7	29	7	10	5	14	7	10	22
TOTAL NO. TAXA EACH SITE			15		30		11		14		10	22

Notes: A = adult; N = nymph; L = larvae.

Appendix D: Aquatic Ecological Risk Assessment

The Project has the potential to result in a range of direct and indirect impacts on aquatic ecology, including:

- aquatic habitat removal;
- obstruction of fish passage;
- surface water and sediment quality impacts;
- changes in sediment transport, or smothering of habitat; and
- drawdown and contamination of groundwater resources.

Assessment of significance method

The significance of potential aquatic ecological impacts has been assessed by considering the likelihood of potential impacts and the expected magnitude of impacts, in consideration of the mitigation and management measures proposed to be implemented by Syntech Resources. The significance of the residual impact is assessed, assuming successful implementation of proposed impact mitigation and management measures.

Likelihood of impact occurring

The criteria for likelihood of occurrence of an impact (i.e. probability) includes ratings of almost certain, likely, possible / occasional, unlikely and rare.

Table D1 identifies the criteria adopted for assessing the likelihood of an impact occurring.

Table D1 Qualitative measures of likelihood

Descriptor	Description
Almost certain	Is expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Possible / Occasional	Could occur
Unlikely	Could occur but not expected
Rare	Occurs only in exceptional circumstances

Magnitude of impact

The magnitude of an impact on aquatic ecological values was assessed by considering the geographical extent, duration and severity of the impact as follows:

- geographical extent – assessing the spatial extent of the impact where the extent of impact may be contained to the site, local waterways, sub-catchment or broader catchment / basin;
- duration – the timescale of the effect; and
- severity – the scale or degree of change (positive or negative) from the existing conditions, as a result of the impact.

Applying these attributes enabled the magnitude of an impact to be ranked as high, moderate or low. Table D2 identifies the criteria adopted for magnitude of impact.

Table D2 Criteria for magnitude of impact

Magnitude	Description
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the ecological value. Avoidance through appropriate design or the implementation of site-specific environmental management controls are required to address the impact.
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the local area where the project is being developed. The impacts are short-term and result in changes that can be ameliorated with specific environmental management controls.
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.

Level of risk

The aquatic ecological risk matrix (Table D3) shows how, using the criteria above, the level of risk of an impact was determined for the purposes of this assessment.

Table D3 Aquatic ecological risk assessment matrix

		Magnitude of Impact		
		High	Moderate	Low
Likelihood	Almost certain	Major	High	Moderate
	Likely	High	Moderate	Low
	Possible/Occasional	Moderate	Low	Low
	Unlikely	Low	Low	Negligible
	Rare	Low	Negligible	Negligible

The classifications adopted for significance of an impact were as follows:

- **Major** significance of impact – when an impact may cause irreversible or widespread harm to aquatic ecological value that are irreplaceable for reasons of uniqueness or rarity. Avoidance through appropriate design is the only effective mitigation.
- **High** significance of impact – when the proposed activities are likely to exacerbate threatening processes affecting the characteristics and structural elements of the aquatic ecological value. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve intactness or conservation value.
- **Moderate** significance of impact – although reasonably resilient to change, the aquatic ecological values would be further degraded due to the scale of the impact or its susceptibility to further change. The abundance of the aquatic ecological values ensure they are adequately represented in the region, and that replacement, if required, is achievable.

- **Low** significance of impact – where the aquatic ecological values are of local importance and temporary and transient changes are not expected to adversely affect viability, provided standard environmental management controls are implemented.
- **Negligible** significance of impact – when an impact on aquatic ecological values is not expected to result in any noticeable change in the intrinsic value, and hence the proposed activities will have negligible effect on their viability.

The impact magnitude has been assessed in consideration of the application of mitigation measures. The significance of impacts has been derived based on the product of the likelihood of the impact occurring and the impact magnitude, with impact mitigation to determine the residual risk (Table D4). The residual impacts on aquatic values are discussed in Section 5 of this report.

Table D4 Residual impacts on aquatic ecological values

Project component	Associated potential impacts	Applicable mitigation measures	Likelihood of impact occurring	Magnitude of impact	Level of Risk
Aquatic habitat removal	Removal of aquatic habitat of low aquatic ecological value in unnamed ephemeral drainage lines.	Where possible, any land disturbance within stream beds and adjacent to their bank would be minimised and stabilised as soon as practical, prior to work equipment demobilizing from the work area.	Likely	Low	Low
	Removal of aquatic habitat of moderate aquatic ecological value in Drainage Line 1.	The diversion design has been assessed using the ACARP stream diversion design criteria (Fisher Stewart 2001, as detailed by WRM (2018). The Diversion of Drainage Line 1 Monitoring Program would be revised to incorporate the Project. Monitoring of the diverted section of Drainage Line 1 enables assessment of the establishment of the aquatic and riparian zones. If monitoring results indicate a significant decline in the pre-determined values or ecological condition of Drainage Line 1, Syntech Resources would provide actions to address the actual or potential harm to Drainage Line 1 and downstream reaches. In addition, management actions would be implemented if the results of the monitoring proposed within the Receiving Environment Monitoring Program (REMP) indicate that they are required (DPM Enviroscience 2018).	Likely	Low	Low
	Removal of a number of farm dams of low aquatic ecological value.	Where possible, any land disturbance within stream beds and adjacent to their bank would be minimised and stabilised as soon as practical, prior to work equipment demobilizing from the work area.	Likely	Low	Low
Obstruction of fish passage	Waterway crossings for vehicles can cause a barrier or obstruction to fish movement, depending on how the crossing is constructed.	Waterway crossings would be constructed with consideration of the Queensland Fisheries Guidelines for Design of Stream Crossings (Cotterell 1998, under revision) using box culverts to permit crossing during low flow events, enabling fish passage to be maintained within / through the Project area. Waterway crossings would be monitored during operations to	Unlikely	Low	Negligible

Project component	Associated potential impacts	Applicable mitigation measures	Likelihood of impact occurring	Magnitude of impact	Level of Risk
		ensure that they remain operable. The Diversion of Drainage Line 1 Management Plan to be prepared for the Diversion of Drainage Line 1 would aim to maintain fish passage during the construction and operation of the diversion channel. This would include monitoring to establish the success of fish passage along the diversion.			
Surface water quality and sediment impacts	Increased erosion of sediments left exposed following vegetation clearing, leading to suspended sediment loads in waterways, altered water chemistry, reduced waterway depth, changed drainage patterns and smothering of benthic flora and fauna, resulting in a decline in the abundance and diversity of both invertebrate and fish communities in downstream receiving waters.	Erosion and sedimentation would continue to be managed in accordance with the Site Water Management Plan. Measures would include the installation of sediment dams, diversions, and stormwater controls. In addition, all major disturbances on the Project that may have the potential to produce soil erosion or excessive sediment during storm events (i.e. waste rock dumps) would be drained via sediment traps to drop out suspended sediment. Implementation of a half-yearly (December and June) monitoring program for stream sediment, sampling rivers and streams both downstream of any mining or infrastructure disturbances as well as upstream, to take into account any natural variations in stream sediment quality and morphology. An event-based monitoring program would be implemented for receiving water quality, sampling streams downstream of any mining or infrastructure disturbances and comparing with upstream reference sites, to take into account any natural variations in water quality. The default ANZECC and ARMCANZ (2000) trigger values for Aquatic Ecosystems would be used for the monitoring of stream sediments for the suite of parameters outlined in the REMP (DPM Enviroscences, 2018). Any concentrations detected downstream that exceed these limits would be investigated.	Unlikely	Low	Negligible
	Downstream impacts as a result of salts, nutrients, metals or other contaminants adsorbed onto mobilised sediments. Increased nutrient loads can promote excessive growth of aquatic flora and algae. The excessive growth of aquatic flora can lead to extreme diurnal ranges in DO, including low overnight DO levels, which, if severe enough, can lead to mortality of gill-breathing fauna. Excessive growth of surface aquatic flora can block sunlight for submerged flora, limiting their photosynthetic activity and potentially leading to reduced			Low	Low

Project component	Associated potential impacts	Applicable mitigation measures	Likelihood of impact occurring	Magnitude of impact	Level of Risk
	species richness and reduced habitat complexity.				
	Leaks or spills of hydrocarbon based fluids from construction equipment from spills in close proximity to waterways (natural stormwater channels and constructed diversion channels), or spills or leaks that are left uncontrolled.	A Spill Emergency Response Plan would be included with the Plan of Operations. Clearly defined access and work use areas for plant and equipment. Appropriately stocked spill kits to be kept readily available during site establishment works. Maintenance and daily checks of plant and equipment to be undertaken. Any contaminant spills (including fuel, hydraulic fluid etc.) would be contained (where safe to do so) and immediately reported. Areas for vehicle and machinery maintenance, refuelling, and storage of fuels, lubricants and batteries, would be bunded in accordance with AS 1940.	Rare	Low	Negligible
Discharge of mine-affected water	Discharge of mine-affected water leading to decrease in water quality and subsequent adverse impacts on aquatic ecology.	Discharge of mine-affected water would continue to be managed in accordance with the Site Water Management Plan. Where possible, mine-affected water would be harvested and used operationally within the mine. Remaining mine-affected water would be conveyed to dams at the surface where it would be contained and managed until there is sufficient dilution to allow release to the environment and still achieve water quality objectives in accordance with the EA release conditions. Any exceedance of the EA release conditions would be investigated, reported and managed. An event-based monitoring program would be implemented for receiving water quality, sampling streams downstream of any mining or infrastructure disturbances and comparing with upstream reference sites, to take into account any natural variations in	Possible / Occasional	Low	Low

Project component	Associated potential impacts	Applicable mitigation measures	Likelihood of impact occurring	Magnitude of impact	Level of Risk
		water quality.			
Surface water flow – general	Alteration of surface water hydrology as a result of capturing runoff in dams, water loss due to use for Project operation or pond evaporation, and releasing water during flow events.	The ephemeral nature of the waterways of the Project area is likely to remain unchanged, as no permanent or semi-permanent water releases from the site are proposed. An extensive surface water monitoring network has been established at the Cameby Downs Mine which includes automatic and manual surface water level and quality monitoring stations. The monitoring network would be augmented as required to accommodate the Project. Consistent with the measures for the existing Cameby Downs Mine, monitoring would include the receiving surface water flow.	Unlikely	Low	Negligible
Surface water flow – diversion of Drainage Line 1 Extension	Alteration of surface water hydrology as a result of the extension of an already approved diversion to Drainage Line 1 resulting in changes to the aquatic habitat downstream of the Project area.	Potential changes in flow conditions and behaviour associated with the diversion are detailed by WRM (2018), who concluded that potential impacts would be minor. Macrophytes and other aquatic flora are expected to rapidly colonise the diversion channel, as they are present both upstream and downstream of the disturbance area. It is expected that the diversion channel would be colonised by aquatic macroinvertebrate species through mobile adult immigration. Consistent with the approved mine, the proposed Diversion of Drainage Line 1 has been designed to replicate as close as possible the Drainage Line sections that it would replace. The diversion design has been assessed using the ACARP stream diversion design criteria (Fisher Stewart 2001, as detailed in WRM 2018). The Diversion of Drainage Line 1 Monitoring Program would be revised to incorporate the Project. Monitoring of the diverted section of Drainage Line 1 enables assessment of the establishment of the aquatic and	Likely	Low	Low

Project component	Associated potential impacts	Applicable mitigation measures	Likelihood of impact occurring	Magnitude of impact	Level of Risk
		riparian zones. If monitoring results indicate a significant declines in the pre-determined values or ecological condition of Drainage Line 1, Syntech Resources would provide actions to address the actual or potential harm to Drainage Line 1 and downstream reaches.			
Drawdown and contamination of groundwater resources	Adverse impact on aquatic or terrestrial groundwater-dependent ecosystems (GDEs).	The Project is unlikely to adversely impact aquatic or terrestrial GDEs, since GDEs are unlikely to occur surrounding the Project area. There is a potential for thin, discontinuous and temporal alluvial aquifers to occur (which may be used by localised areas of terrestrial vegetation), however these would consist of a perched groundwater system hydraulically separated from the underlying Walloon Coal Measures by the very low permeability overburden comprising the Springbok Sandstone and the upper Walloon Coal Measures (AGE 2018). An extensive groundwater monitoring network has been established at the Cameby Downs Mine which includes automatic and manual groundwater level and quality monitoring stations. The monitoring network would be augmented as required to accommodate the Project.	Unlikely	Low	Negligible

Potential impacts on aquatic ecology associated with the Project include aquatic habitat removal, obstruction of fish passage, surface water and sediment quality impacts, changes in sediment transport, and drawdown and contamination of groundwater resources.

Through implementation of suitable impact mitigation measures (Table D4), the level of risk of residual impacts on aquatic ecology is expected to range from low to negligible. This includes the implementation of impact mitigation measures to ensure that adverse downstream impacts, such as the risk of sedimentation and / or contamination of downstream environments, are effectively controlled on-site, and before such impacts can extend into downstream areas of higher aquatic ecological value / sensitivity.

Appendix E: Significant Impact Assessment – Brigalow woodland snail

Significant Impact Assessment for Endangered Species

An action is likely to have a significant impact on an Endangered species is there is a real chance or possibility that it will (DotE 2013b):

1) lead to a long-term decrease in the size of a population;
2) reduce the area of occupancy of the species;
3) fragment an existing population into two or more populations;
4) adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan);
5) disrupt the breeding cycle of a population;
6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
7) result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat;
8) introduce disease that may cause the species to decline; or
9) interfere with the recovery of the species.

A 'population' of a species is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to Critically Endangered, Endangered or Vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of location populations, or
- a population, or collection of local populations, that occurs within a particular bioregion.

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and / or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

The Department of Environment and Heritage Protection (EHP) (2014) Significant Residual Impact Guideline states:

An action is likely to have a significant impact on Endangered and Vulnerable wildlife if the impact on the habitat is likely to:

- *lead to a long-term decrease in the size of a local population; or*
- *reduce the extent of occurrence of the species; or*
- *fragment an existing population; or*
- *result in genetically distinct populations forming as a result of habitat isolation; or*
- *result in invasive species that are harmful to an Endangered or Vulnerable species becoming established in the Endangered or Vulnerable species' habitat; or*
- *introduce disease that may cause the population to decline, or*
- *interfere with the recovery of the species; or*
- *cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.*

Table D1: Significant impact assessment

Topic	Criteria	Brigalow woodland snail (*Adclarkia cameroni*)
Legal status	**EPBC Act**	Endangered
	NC Act	Vulnerable
Life History and Occurrence	**Distribution**	The brigalow woodland snail is endemic to south-east Queensland, where it occurs in areas including the Condamine River floodplain, especially around Dalby and Chinchilla (Stanisic 2011, cited in DotE 2016a). The currently known distribution extends from around Glenaubyn in the north and west of this species' range, between Dalby and Oakey to the east, to south of Tara in the south (ALA 2017). The Study area falls within this area of known distribution. The extent of occurrence (EEO) is calculated to be 27,924 km^2, and the area of occupancy (AOO) 76 km^2, based on locality records from 1976 to 2016 (DotE 2016a). However, the EOO and AOO are likely to be much less, because the approximately 19 previously known records included only seven with live individuals (Stanisic 2013, cited in DotE 2016a). The current distribution of this species is severely fragmented. The brigalow communities within the Condamine River floodplain that were once contiguous in the area of the species' historical distribution have been extensively cleared for agriculture and farming, and the current distribution of the brigalow woodland snail reflects this broad scale clearing (Stanisic 2011, cited in DotE 2016a).
	General habitat requirements	The brigalow woodland snail occurs in a small number of remnant and scattered brigalow (*Acacia harpophylla*) and eucalypt woodland patches (including road verges and riparian corridors) on the Condamine River floodplain (Stanisic 2011, cited in DotE 2016a). The brigalow patches occur on alluvial black soils. The narrow Condamine River riparian corridor is an important refuge for the species (DotE 2016a). Here the canopy cover is dense, scattered timber (flood debris) is greatest and environmental moisture is at its most stable, even in drier times (Stanisic 2011, cited in DotE 2016a).
	Ecology	The brigalow woodland snail lives under logs (Stanisic et al. 2010, cited in DotE 2016a), where it likely feeds on fungi, algae and other detritus (Stanisic 2011, cited in DotE 2016a). Feeding by this species has not been observed, but likely occurs during periods of higher humidity, such as evenings and rain events. The brigalow woodland snail needs both canopy and on-ground timber cover for survival and egg-laying (Stanisic 2011, cited in DotE 2016a). Generally, snails of the family Camaenidae lay their eggs in depressions in the soil under logs and other debris, and although egg-laying has not been recorded for this species, it is highly likely that it follows a similar pattern (Stanisic 2011, cited in DotE 2016a). An overstorey of trees and shrubs is required in order to maintain high levels of relative humidity at the substrate level, to keep eggs from desiccating (Stanisic 2011, cited DotE 2016a). Land snails can aestivate during drier phases but the extent of this hibernation is limited by their body reserves (Stanisic 2011, DotE 2016a). The brigalow woodland snail is of very limited mobility. Under favourable conditions, such as rain, this species can move between suitable areas of microhabitat, but the extent to which this occurs will be limited by the spatial arrangement of habitat patches (DotE 2016a).
Occurrence within the Study area		This species was recorded during the field surveys during targeted searches within known associated Regional Ecosystems 11.3.1, 11.4.3 and 11.4.10. A total of 25 specimens (including four live individuals and 21 empty shells) were observed in the search areas (Figure 9). This includes 21 specimens within habitat to be retained, and four specimens within the Indicative Extent of Additional Surface Development (Figure 9).
Threats		General threats impacting the brigalow woodland snail in Qld, in approximate order of severity of risk, include (DotE 2016a): ▪ habitat loss and fragmentation, including land clearing and habitat disturbance; ▪ invasive species, including predation by rats (*Rattus* spp.), mice (*Mus musculus*) and feral pigs (*Sus scrofa*), as well as invasion by buffel grass (*Cenchrus ciliaris*); ▪ impacts from domestic species, including trampling by cattle and horses; and

Topic	Criteria	Brigalow woodland snail (*Adclarkia cameroni*)
		▪ fire – in particular high intensity fire.
Importance of the on-site population		Searches for the brigalow woodland snail between 13-15 December 2017 confirmed that the Study area is used by the brigalow woodland snail. These searches yielded higher numbers (21 specimens) in the more intact habitats that will be retained (Figure 9). A relatively smaller number of specimens (four) were detected within the Indicative Extent of Additional Surface Development (Figure 9). This local (Study area) population forms part of a regional population extending from around Glenaubyn in the north and west of the currently known distribution, to between Dalby and Oakey to the east, and south of Tara to the south (ALA 2017).
Significant Impact Assessment (from EPBC Act Policy Statement 1.1 [DotE 2013a])	**Will the action lead to a long-term decrease in the size of a population?**	**Unlikely**. The majority of known associated habitat within the Study area will be retained. The more intact areas of habitat for the brigalow woodland snail will be retained, and the species is expected to persist in these more intact areas. Within the Study area, approximately 36% (approximately 20 ha) of the known associated habitat (approximately 52 ha) for the brigalow woodland snail will be impacted by the Project. The Project is considered unlikely to lead to a long term decrease in the size of the brigalow woodland snail population from a regional or local (Study area) perspective.
	Will the action reduce the area of occupancy of the species?	**Unlikely**. The Project will reduce the available habitat for the brigalow woodland snail by removing approximately 36% (approximately 20 ha) of the known associated habitat (approximately 52 ha) within the Study area. The majority of known associated habitat within the Study area will be retained. The brigalow woodland snail is expected to persist within the Study area, and as such is expected to continue to occupy the Study area. No range contraction for this species is expected to result from the Project.
	Will the action fragment an existing population into two or more populations?	**Unlikely**. From a local (Study area) perspective, the western and southern sub-populations of brigalow woodland snail are disconnected by historic vegetation clearing associated with the existing mining operations. The Project is unlikely to further fragment any local or regional population into two or more populations or sub-populations.
	Will the action adversely affect habitat critical to the survival of the species?	**Unlikely**. No critical habitat for the species has been identified. The Project is unlikely to remove habitat critical to the survival of the brigalow woodland snail at the local (Study area) or regional scale.
	Will the action disrupt the breeding cycle of a population?	**Unlikely**. The majority of known associated habitat within the Study area (i.e. approximately 32 ha of REs 11.4.3, 11.4.10 and 11.3.1) will be retained, and the majority of the local population of brigalow woodland snails within the Study area will remain largely unaffected in the habitat retention areas, where normal foraging and breeding activity is expected to occur, resulting in the ongoing persistence of the population of brigalow woodland snails within the Study area.
	Will the action modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**Unlikely**. The Project will result in the loss of approximately 20 ha of known associated habitat for the brigalow woodland snail. However, the majority of known associated habitat within the Study area (i.e. approximately 32 ha of REs 11.4.3, 11.4.10 and 11.3.1) will be retained. Consequently, the Project is unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline at the local (Study area) or regional scale.
	Will the action result in establishment of harmful invasive species in the species' habitat?	**Unlikely**. Potential indirect impacts on the retained habitat would be minimised by controlling feral animals at the mine (including rats, mice and pigs, which are known to prey on land snails [Stanisic 2011, cited in TSSC 2016]).

Topic	Criteria	Brigalow woodland snail (*Adclarkia cameroni*)
	Will the action result in the introduction of disease(s) that may cause the species to decline?	**Unlikely**. No specific diseases have been identified as a threat to the species.
	Will the action interfere substantially with the recovery of the species?	**Unlikely**. A small reduction in the area of occupancy of a larger population is unlikely to interfere with the recovery of the species.
Conclusion		The Project would clear approximately 20 ha of habitat for the brigalow woodland snail in which four brigalow woodland snail specimens were recorded. The Project is unlikely to significantly impact the brigalow woodland snail because: ▪ a greater area of habitat for the snail would be avoided/retained (approximately 32 ha), which contains the majority of the brigalow woodland snail specimens recorded (21 specimens); ▪ the brigalow woodland snail is likely to persist within the Study area due to the size and of the area of habitat to be avoided / retained and evidence of its use by the species; ▪ the Project would not further fragment the local population of brigalow woodland snail; and ▪ the habitat to be cleared is not critical to the survival of the brigalow woodland snail. Potential indirect impacts on the retained habitat (including pests and bushfires) would be minimised by controlling feral animals at the mine (including rats, mice and pigs, which are known to prey on land snails [Stanisic 2011, cited in TSSC 2016]), and implementation of bushfire management measures.