TECHNICAL PAPER

2

Aquatic Biodiversity Assessment

ILLABO TO STOCKINBINGAL ENVIRONMENTAL IMPACT STATEMENT

ARTC

INLAND RAIL - ILLABO TO STOCKINBINGAL

AQUATIC BIODIVERSITY ASSESSMENT

2-0001-220-EAP-00-RP-0009

Job No: 170426

Date: 25/07/2022

COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

PO Box 3005 Wamberal NSW 2260
T: 0404 858573 E: kristy@coastecology.com.au W: www.coastecology.com.au
Kristy McQueen operates as a Sole Trader under registered business name Coast Ecology ABN: 24 924 674 371

EXECUTIVE SUMMARY

The proposal

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane. Inland Rail involves the design and construction of a new inland rail connection, about 1,700 kilometre long, between Melbourne and Brisbane. Inland Rail is a major national proposal that will enhance Australia's existing national rail network and serve the interstate freight market.

Australian Rail Track Corporation Ltd (ARTC) is seeking approval to construct and operate the Illabo to Stockinbingal section of Inland Rail ('the proposal'), which consists of about 39 kilometres of new, greenfield single track standard gauge railway and associated infrastructure between Illabo and Stockinbingal.

This report

This report has been prepared by Inland Rail Design Joint Venture (WSP/Mott Macdonald/Coast Ecology) as part of the environmental impact statement (EIS) for the proposal and responds to the Secretary's Environmental Assessment Requirements (SEARs) for aquatic biodiversity.

The assessment presented in this report has included a review of relevant legislation, consideration of the existing conditions, an impact assessment to determine the significance of impacts to aquatic biodiversity as a direct result of the construction and operation of the proposal and the potential impacts of the proposal on threatened aquatic species which are predicted to occur within the region. Recommended mitigation and management measures were identified in response to the impact assessment findings.

This report builds on findings of the Biodiversity Assessment, Surface Water Quality Assessment and the Hydrology and Flooding Assessment prepared for the proposal, which are addressed in separate reports.

Existing aquatic environment

The proposal is located within the Murrumbidgee River and Lachlan River catchments, which are sub-catchments within the Murray-Darling Basin. The catchment divide lies closer to Stockinbingal and therefore most of the proposal site is within the Murrumbidgee catchment. The proposal site crosses six named creeks including Dudauman Creek, Powder Horn Creek, Isobel Creek, Run Boundary Creek, Ulandra Creek and Billabong Creek and numerous other crossings over small shallow ephemeral creeks and tributaries.

Most watercourses along the proposal site between Illabo and Stockinbingal are 1st or 2nd order streams (determined using the Strahler stream ordering method) with intermittent flow following rain events, little or poorly defined channels with no aquatic flora species. The watercourses have been modified by crossing structures for rail and road and agricultural land practices with minimal native vegetation retained along the banks of the watercourses. Accordingly, following NSW Department of Primary Industries Fisheries (DPI) guidelines these watercourses have been classified as Class 4 unlikely key fish habitats (KFH) and Type 3 minimally sensitive fish habitat.

Within the proposal site, Dudauman Creek, Powder Horn Creek, Run Boundary Creek (3rd order streams), Ulandra Creek (a 5th order stream) and Billabong Creek (a 6th order stream) have all been assessed as being Type 3 minimally sensitive fish habitats as they are ephemeral and they lack habitat features such as in-stream gravel bed, rocks, snags and native aquatic or wetland vegetation. They are also defined as Class 3 minimal fish habitat as despite having defined channels, they are highly ephemeral, with no connected wetland areas and semi-permanent waters in pools occur only briefly after rain events. Isobel Creek has been assessed as Class 2 moderate fish habitat as it contains shallow

pools over bedrock during drought conditions and Type 2 moderately sensitive fish habitat as it contains some isolated, emergent sedges within the creek bed. Despite being higher order streams, all of these named watercourses were mapped by DPI (2016) as having poor to very poor fish community status.

Potential impacts

Potential impacts of the proposal on the aquatic environment during construction include:

- removal of riparian corridor vegetation
- removal of instream vegetation and large woody debris
- obstruction of fish passage for temporary crossings
- impacts on water quality
- impacts on protected fauna in farm dams
- spread of exotic aquatic weeds.

As all the watercourses that cross the proposal site are ephemeral, the risk of impact is low as watercourses would mostly be dry when construction takes place, therefore water and aquatic species would not be present and at risk of being impacted. Removal of riparian vegetation would be mitigated through implementation of a rehabilitation strategy and large woody debris would be relocated upstream or downstream of the area of impact. Temporary watercourse crossings would be designed and maintained in accordance with relevant guidelines and the spread of exotic weeds would be managed in accordance with the requirements of the *Biosecurity Act 2015*. Farm dams would be decommissioned in accordance with a dam dewatering protocol developed as part of the soil and water management plan. Indirect impacts on water quality during flow events would be managed through appropriate erosion and sediment control measures.

Potential impacts of the proposal on the aquatic environment during operation include:

- obstruction of fish passage
- impacts on water quality
- spread of exotic aquatic weeds.

The risk of impact from operation is also considered low as water crossing structures have been designed to be fish-friendly in accordance with recommended crossing types outlined in relevant guidelines (Fairfull and Witheridge, 2003). The Water Quality Impact Assessment Report (Technical Paper 5) concluded that implementation of recommended mitigation measures will result in a low likelihood of ongoing impact to water quality during operation and the increased risk of the spread of exotic aquatic weeds from passing trains and maintenance vehicles would be managed in accordance with the requirements of the *Biosecurity Act 2015*.

Sensitive lands potentially impacted include:

- protected areas
- key fish habitat
- waterfront land
- critical habitat
- groundwater dependent ecosystems (GDEs).

No protected areas or critical habitat occur within the proposal site. The fish habitat in watercourses that cross the proposal site does not include highly sensitive key fish habitat (KFH) and consists mainly of minimally sensitive KFH. As such, the proposal is unlikely to permanently impact or disrupt areas of KFH and therefore apart from reinstatement of riparian vegetation, no additional aquatic biodiversity offsets would be required under the *Fisheries Management Act 1994* (FM Act). Opportunities to enhance the existing fish habitat have been provided.

A total of 4.94 hectares of riparian corridor which is defined as sensitive waterfront land, would be impacted by the proposal. This represents 8.6% of the total vegetation within the proposal site that requires clearing. This would be mitigated through the rehabilitation strategy.

The groundwater impact assessment (Technical Paper 6) identified four aquatic high priority GDEs within their study area:

- Billabong Creek
- Ulandra Creek
- Ironbong Creek
- Dudauman Creek.

Technical Paper 6 concluded that the proposal would have negligible to low risk of impacts on groundwater during both construction and operation. As such, impacts on GDEs are unlikely.

Threatened species, populations and ecological communities

Six threatened species and one endangered population listed under the FM Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were determined as target species as they have been recorded or predicted to occur in watercourses within the proposal site:

- Flathead Galaxias *Galaxias rostratus*
- Hanley's River Snail *Notopala hanleyi*
- Murray Cod *Maccullochella peelii*
- Murray Crayfish *Euastacus armatus*
- Southern Purple Spotted Gudgeon *Mogurnda adspersa*
- Trout Cod *Maccullochella macquariensis*
- Western population of Olive Perchlet *Ambassis agassizii*.

Following site survey and a likelihood of occurrence assessment, none of these threatened species or endangered population are considered likely to occur in the watercourses within the proposal site due the ephemeral nature of the watercourses and a lack of preferred habitat.

Two aquatic endangered ecological communities (EECs) listed under the FM Act occur within the proposal site:

- Lowland Lachlan River aquatic ecological community
- Lowland Murray River aquatic ecological community.

Dudauman Creek is a tributary of Bland Creek and as such, is part of the Lowland Lachlan River aquatic ecological community. However, within the proposal site, Dudauman Creek has minimal to unlikely fish habitat and has been assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Bland Creek as poor-to very poor.

Billabong Creek and its tributaries (Ironbong Creek, Isobel Creek, Run Boundary Creek & Ulandra Creek) are part of the Lowland Murray River aquatic ecological community. Within the proposal site, Billabong Creek and its tributaries have minimal to unlikely fish habitat and have been assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat, with the exception of Isobel Creek, which has been assessed as Type 2 moderately sensitivity key fish habitat and Class 2 moderate fish habitat. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Billabong Creek as poor.

In accordance with the FM Act, an assessment of significance of impact was carried out and concluded that the proposal was unlikely to significantly impact these EECs, with the

adoption of appropriately designed fish friendly crossing structures and other mitigation measures to further reduce impacts.

No matters of national environmental significance (MNES), including nationally listed aquatic dependent threatened species, endangered populations, EECs or aquatic migratory species are expected to occur in the watercourses within the proposal site or be impacted by the proposal. As such, an assessment of significance of impact in accordance with the EPBC Act was not required.

Mitigation Measures

The mitigation measures to manage impacts to aquatic biodiversity from the proposal during detailed design / pre-construction, construction and operation phases include:

- Watercourse crossing structures, both temporary and permanent in nature, would meet Inland Rail design standards and be designed in accordance with relevant guidelines.
- Aquatic fauna salvage in watercourses or residual pools within 50 metres of the construction footprint, and in areas that would be enclosed by silt curtains (eg. piling locations).
- The clearing extents/site boundary/limit of works would be clearly defined with flagging or marking tape, signage or other suitable means to delineate no go areas.
- Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable by establishing appropriate setback distances.
- A biodiversity management plan would be prepared prior to construction and implemented as part of the CEMP.
- A rehabilitation strategy would be prepared to guide rehabilitation planning, implementation, monitoring and maintenance of disturbed areas once construction is complete.
- Where it is not practicable to work in the dry, a sediment or silt curtain attached to the same sides of the bank and around the works area would be installed for erosion and sediment control and to maintain fish passage.
- A soil and water management plan would be prepared and implemented as part of the CEMP.
- A dam dewatering protocol would be developed as part of the soil and water management plan.
- All wastewater from concrete batching plants would be captured and disposed of appropriately
- Weed management protocols for the operational rail corridor and other ARTC facilities would be in accordance with the requirements of the Biosecurity Act 2015
- Culverts that provide for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may contribute to the blockage of fish passage.

Glossary

ARTC	Australian Rail Track Corporation
AUSRIVAS	Australian River Assessment System
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
BDAR	Biodiversity Development Assessment Report
CEMP	Construction Environmental Management Plan
CMA	Subregion Catchment Management Authority Subregion
DCCEEW	Australian Government Department of Climate Change, Energy, the Environment and Water, formerly Department of Agriculture, Water and the Environment
DPE	NSW Department of Planning and Environment, formerly Department of Planning, Industry and Environment
DPI	Department of Primary Industries – Fisheries (NSW)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPs	Endangered Populations
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	*Fisheries Management Act 1994*
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
Inspection sites	Watercourses that were viewed outside of the proposal site from public land or roadside locations. A full aquatic assessment (100 metre reach) was not possible due to access restrictions.
KTP	Key Threatening Process
LEP	Local Environmental Plans
Locality	The Murrumbidgee and Lachlan River catchments
MGA	Map Grid of Australia
MNES	Matters of national environmental significance
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NPW Act	*National Parks and Wildlife Act 1974*
OEH	Office of Environment and Heritage (NSW) (NB. The functions of OEH were transferred to the Environment, Energy & Science Group within DPIE on 1 July 2019)
PCT	Plant Community Type

PMST	Protected Matters Search Tool
Proposal	Construction and operation of the Illabo to Stockinbingal section of the Melbourne to Brisbane Inland Rail.
Proposal site	The area of impact associated with construction and operation of the proposal. Also known as the 'construction footprint'.
CSSI	Critical State Significant Infrastructure
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
Strahler Stream Order	Classification system that gives a watercourse an 'order' according to the number of tributaries associated with it. Mapped at 1:50 000 scale
Survey Site	The location (100 metre reach along watercourses crossed by the proposal site or farm dams) within which habitat assessments and surveys were undertaken.
TEC	Threatened Ecological Community

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1. INTRODUCTION

1.1 Overview

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane. Inland Rail involves the design and construction of a new inland rail connection, about 1,700 kilometre long, between Melbourne and Brisbane. Inland Rail is a major national proposal that will enhance Australia's existing national rail network and serve the interstate freight market.

Australian Rail Track Corporation Ltd (ARTC) is seeking approval to construct and operate the Illabo to Stockinbingal section of Inland Rail ('the proposal'), which has a total extent of about 42.5 kilometres, and consists of about 39 kilometres of new, greenfield single track standard gauge railway and associated infrastructure between Illabo and Stockinbingal.

The proposal requires approval from the NSW Minister for Planning under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal is also a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and requires approval from the Australian Government Minister for the Environment.

This report has been prepared by Inland Rail Design Joint Venture (WSP/Mott Macdonald)/Coast Ecology) as part of the environmental impact statement (EIS) for the proposal. The EIS has been prepared to accompany the application for approval of the proposal and addresses the Secretary's Environmental Assessment Requirements (SEARs) from the Secretary of the (then) NSW Department of Planning, Industry and Environment (now Department of Planning and Environment (DPE)), issued on 30 April 2021.

1.2 The proposal

The proposal is located between Illabo and Stockinbingal within the Riverina region of NSW. The location of the proposal is shown in Figure 1-1.

1.2.1 Key features

The key features of the proposal (which would be confirmed during detailed design) are shown in Figure 1-2 and includes:

- a total extent of about 42.5 kilometres, including about 39 kilometres of new, greenfield single track standard gauge railway between Illabo and Stockinbingal, including:
    - a combination of track vertical alignments on existing ground level, on embankments and in cuttings
    - 8 new bridges at watercourses, two road overbridges and one grade separated (road over rail) at Burley Griffin Way
    - one crossing loop and associated maintenance siding
    - construction of new level crossings and alterations of existing level crossings (at public roads and private accesses)
    - stock underpasses and other vehicular crossings on private land to allow for the movement of livestock and vehicles across the rail line
    - installation and upgrade of about 88 new and existing cross drainage culverts below the rail formation and 27 longitudinal drainage culverts below level crossings
    - removal of redundant sections of track along the existing Stockinbingal to Parkes line and Lake Cargelligo line at Stockinbingal
- upgrades of about three kilometres of existing track for the tie-in works to the existing Main South rail line at Illabo, and tie ins to the Stockinbingal to Parkes rail line at Stockinbingal

- construction of about 1.7 kilometres of new track to maintain the existing connection of the Lake Cargelligo rail line either side of the proposal
- realignment of a 1.4 kilometre section of the Burley Griffin Way to provide a road over rail bridge at Stockinbingal
- realignment of Ironbong Road to allow for safe sight lines at the new active level crossing.

Associated infrastructure would include signalling and communications, signage, fencing and services and utilities. The construction of the proposal would also require the following works:

- construction access roads and access tracks
- watercourse crossings
- temporary changes to the road network
- construction compounds.

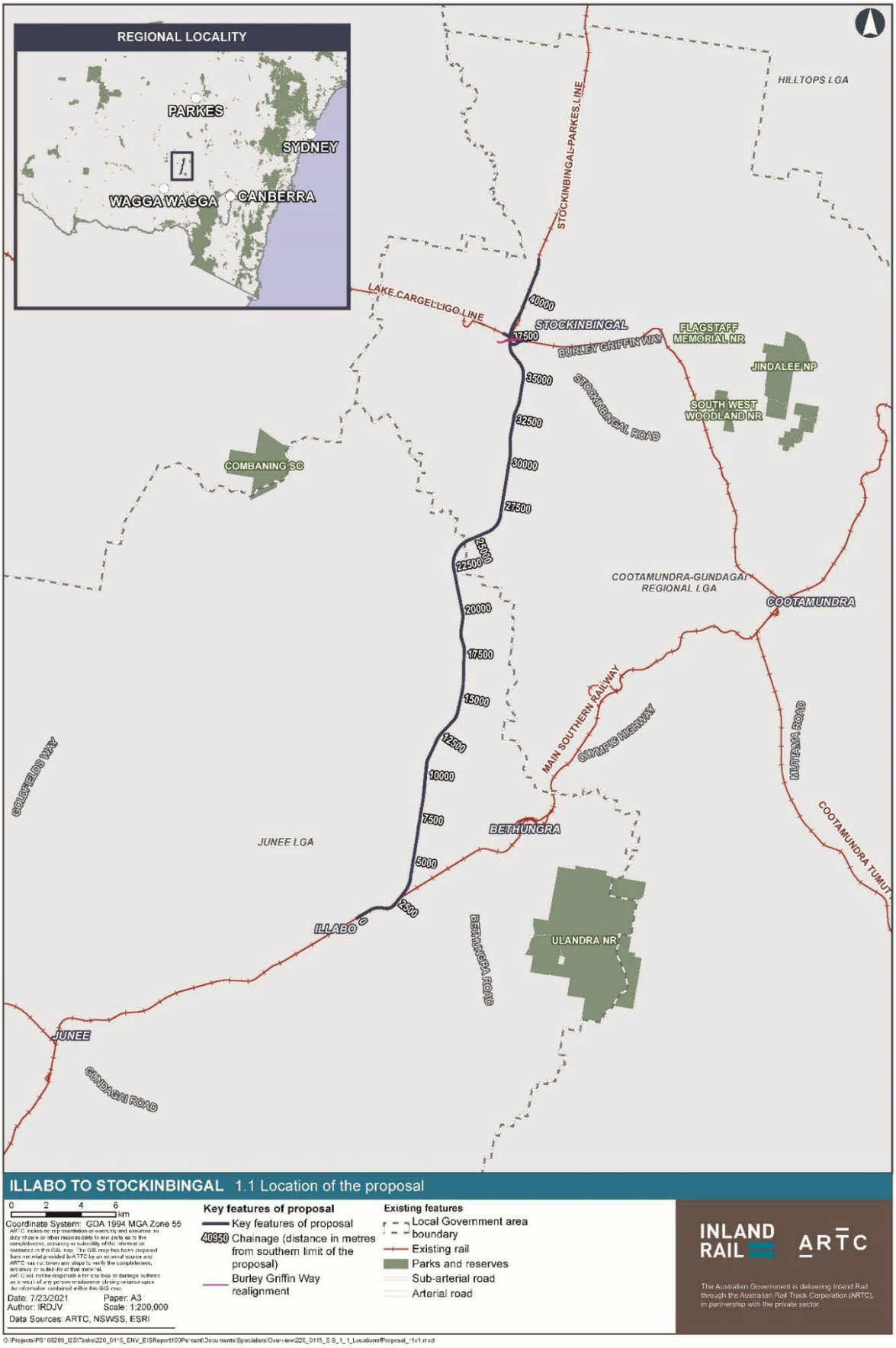


Figure 1-1 Location of the proposal

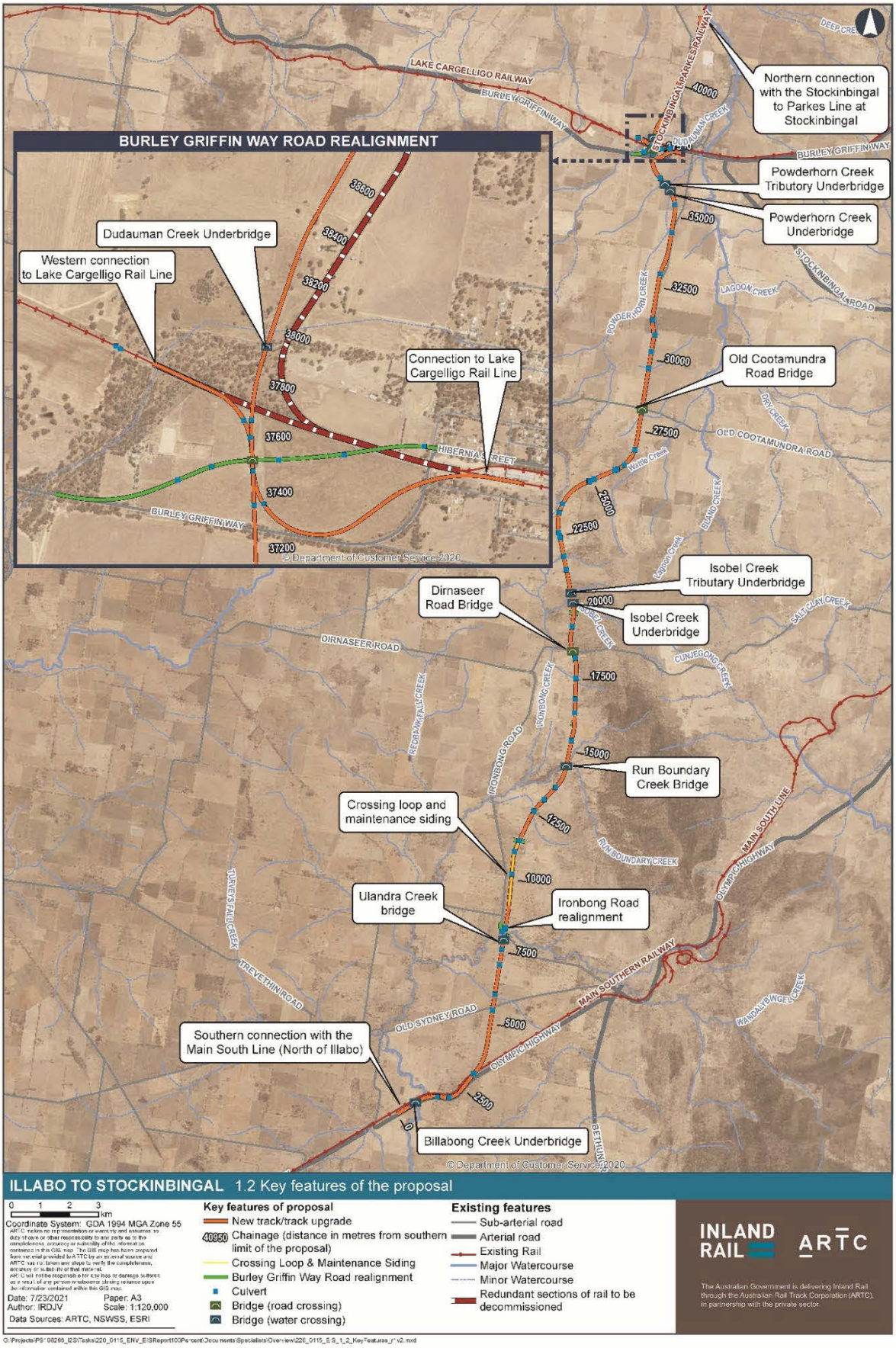


Figure 1-2 Key features of the proposal

1.2.2 Timing and operation

Subject to approval of the proposal, construction of the proposal is planned to start in mid-2024 and is expected to take about 14 months. Construction is expected to be completed by mid-2026.

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. It is estimated the Illabo to Stockinbingal section of Inland Rail would be trafficked by an average of 6 trains per day (both directions) from commencement of operations in late 2026, increasing to about 11 trains per day (both directions) in 2040.

The new rail line will be a faster, more efficient route that bypasses the Sydney rail network and will enable the use of double stacked trains (up to 6.5m high) along its entire length.

The trains would be diesel powered, and would be a mix of grain, intermodal (freight), and other general transport trains up to 1,800 metres in length.

The proposal is expected to be operational, as part of Inland Rail as a whole, once all 13 sections are complete, which is estimated to be in 2027. Prior to that, regional rail movements may occur on the Illabo to Stockinbingal section once complete.

1.3 Scope and purpose of the report

This report has been prepared to specifically address the SEARs issued by the (then) Department of Planning, Industry and Environment on 30 April 2021. The SEARs relevant to the aquatic biodiversity assessment, and references to sections where they have been addressed in the report are presented below in Table 1-1.

Table 1-1 Relevant SEARs

Key Issues	Requirement	Where addressed in this report
KEY ISSUE SEARS		
1. Biodiversity	7. Impacts on biodiversity values not covered by the BAM. This includes a threatened aquatic species assessment (Part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the *Fisheries Management Act 1994* (FM Act).	Section 4.7. Section 4.8 & Section 5.3
	8. Identify whether the project, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the *Biodiversity Conservation Act 2016* (BC Act), FM Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).	Table 5.3, Section 5.6
2. Protected and Sensitive Lands	1. Assess the impacts of the project on environmentally sensitive land and processes (and the impact of processes on the project) including, but not limited to:	
	(a) protected areas (including land and water) managed by DPE BCD and/or DPI Fisheries under the National Parks and Wildlife Act 1974 and the Marine Estate Management Act 2014;	Section 5.5.1
	(b) Key Fish Habitat as mapped and defined in accordance with the FM Act;	Section 5.5.2
	(c) waterfront land as defined in the *Water Management Act 2000;*	Section 5.5.3
	(d) land or waters identified as Critical Habitat under the BC Act, FM Act or EPBC Act; and	Section 5.5.4
	(e) biobank sites, private conservation lands and other lands identified as offsets.	Addressed in the Biodiversity Development Assessment Report (BDAR) (Technical Paper1)

1.4 Structure of this report

The structure of the report is outlined below:

Chapter 1 – provides an introduction to the report and outlines relevant SEARs to be addressed.

Chapter 2 – provides an overview of relevant legislation, policies and guidelines applicable to the assessment.

Chapter 3 – describes the methodology and approach for the assessment.

Chapter 4 – describes the existing environment with respect to catchments, watercourses and target threatened aquatic species and ecological communities.

Chapter 5 – provides an assessment of the impacts to aquatic biodiversity from the construction and operational of the proposal along with potential impacts on threatened species, populations and EECs.

Chapter 6 – provides recommended avoidance and mitigation measures.

Chapter 7 – concludes the key findings and recommendations from the investigation.

Chapter 8 – provides a list of references.

2. STATUTORY CONTEXT

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The objective of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to protect and manage prescribed Matters of National Environmental Significance (MNES). Under the EPBC Act, proposed 'actions' that have the potential to significantly impact on MNES, the environment of Commonwealth land, or that are being carried out by a Federal Government agency, must be referred to the Federal Minister for the Environment for assessment.

As a result of the potential for impacts on protected matters, the proposal was referred to the (then) Australian Government Minister for the Environment in June 2018 (EPBC Referral No 2018/8233). On 6 August 2018, the (then) Australian Government Department of the Environment and Energy notified that the proposal is a controlled action, with the controlling provisions being 'listed threatened species and communities' (under section 18 & 18A of the EPBC Act).

Relevant MNES are considered in section 4.9.

2.2 State (NSW)

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) establish a framework for the assessment and approval of developments in NSW. They also provide for the making of environmental planning instruments, including state environmental planning policies (SEPPs) and local environmental plans (LEPs), which determine the permissibility and approval pathway for development proposals and form a part of the environmental assessment process. In accordance with the provisions of the EP&A Act, the proposal is State Significant Infrastructure.

SSI may also be declared to be critical State significant infrastructure (CSSI) in accordance with section 5.13 of the EP&A Act, if it is of a category that, in the opinion of the NSW Minister for Planning, is essential for the State for economic, environmental or social reasons. The proposal was declared as CSSI in 2021.

Under section 5.14 of the EP&A Act, the approval of the NSW Minister for Planning is required for State significant infrastructure (including CSSI), and an EIS has been prepared under Division 5.2 of the EP&A Act.

Section 5.23 of the EP&A Act identifies various authorisations which are not required for a CSSI project. Of relevance to this assessment, the following authorisations are not required for approved SSI (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

- a permit under section 201, 205 or 219 of the FM Act
- a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000* (WM Act).

2.2.2 Fisheries Management Act 1994

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The FM Act establishes mechanisms for:

- the listing of threatened species, populations and ecological communities or key threatening processes
- the declaration of critical habitat, and
- consideration and assessment of threatened species impacts in the development assessment process.

In NSW, legislative responsibility for the conservation of threatened aquatic species, populations and ecological community's rests with the NSW Department of Primary Industries (DPI) through administration of Part 7A of the FM Act. DPI has responsibility for the conservation of all 'fish', which by definition also includes freshwater, estuarine and marine aquatic invertebrates (such as crustaceans, molluscs and polychaetes), as well as marine vegetation, including saltmarshes, mangroves, seagrasses and macroalgae.

Any watercourse structures and/or crossings need to consider fish habitat class and the use of an appropriately designed structure that does not obstruct fish passage in accordance with section 218 and 219 of the FM Act. CSSI developments are however exempt from the need to obtain a permit under section 219 of the FM Act through the effect of section 5.23(1)(b) of the EP&A Act. Section 4.3 of this report describes fish habitat class and identifies appropriately designed structures for watercourses.

2.2.3 Biodiversity Conservation Act 2016

The BC Act aims to avoid, minimise and offset impacts on biodiversity from development and conserve biodiversity at a bioregional and state scale. It lists a number of threatened species, populations and ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats.

A BDAR (Technical Paper 1) has been prepared in accordance with section 7.9 of the BC Act as part of the EIS. The likelihood of threatened and protected aquatic species listed under the BC Act occurring in the study area is considered in section 4.7.

Of relevance to this assessment, aquatic groundwater dependent ecosystems (GDEs) that are protected under the BC Act have been identified within the study area and therefore have been considered (refer to section 4.10)

2.2.4 Water Management Act 2000

Controlled activities carried out in, on, or under waterfront land are regulated by the WM Act. The Natural Resources Access Regulator (NRAR) administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. It includes drainage lines however where a watercourse does not exhibit the features of a defined channel with bed and banks, the Office of Water may determine that the watercourse is not waterfront land for the purposes of the WM Act.

CSSI developments are however exempt from the need to obtain a permit under section 89, section 90 or section 91 of the WM Act through the effect of section 5.23(1)(b) of the EP&A Act. Section 5.5.3 of this report considers potential impacts of the proposal on waterfront land.

2.3 Policy and guidelines

2.3.1 Policy and guidelines for fish habitat conservation and management

The *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) outlines policies and guidelines aimed at maintaining and enhancing fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments. It is applicable to all planning and development proposals and various activities that affect aquatic ecosystems in NSW.

The document provides a definition of key fish habitats (KFH) and a classification scheme for the conservation and management of sensitive fish habitat types and watercourse classes which may be affected by land use planning and development activities. It contains policies and guidelines aimed at maintaining and enhancing fish passage, guidelines for construction and maintenance of in-stream structures and barriers, various types of foreshore works and waterfront development, urban streams and stormwater management, sediment extraction in watercourses and use of explosives, electrical devices and other dangerous substances in watercourse. The KFH Type and Class for watercourses that cross the proposal site are defined in sections 4.3.

The guideline states that *"to ensure "no net loss" of aquatic habitats, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon KFH. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works".*

Mitigation may include re-establishing habitat that has been removed or otherwise damaged, re-instating fish passage along watercourses (removing barriers or building fishways) and improving water quality.

No areas of KFH would be permanently lost or disrupted by the proposal. This is further discussed in section 5.5.2.

2.3.2 Why do fish need to cross the road? Fish passage requirements for waterway crossings

The DPI guideline *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003) provides guidelines for the planning, design, construction and maintenance of watercourse crossings aimed at minimising impacts of fish passage and aquatic ecology. It outlines potential impacts of instream structures and subsequently provide guidance on suitable crossing structures to avoid barriers to fish passage.

The proposal includes water crossing structures designed in accordance with minimum crossing requirements outlined in these guidelines. Table 4.3 defines the Type and Class of the watercourse at each survey site and Table 5.2 considers if the proposed crossing structures meet the requirements.

2.3.3 Aquatic Ecology in Environmental Impact Assessment – EIA Guideline

DPE's *Aquatic Ecology in Environmental Impact Assessment - EIA guideline* (NSW Department of Planning, 2003) (the EIA guideline) aim to:

- encourage a standardised, rigorous approach to aquatic investigations in environmental impact assessment
- provide information which can be used to understand and manage changes to the aquatic environment in NSW.

The guidelines provide reference for:

- the extent to which the existing environment needs to be described
- the extent to which a proposal is likely to affect aquatic ecology
- the minimal acceptable standard for assessment of potential impacts on aquatic ecology
- predicting cumulative impacts within a body of water

- when monitoring should be done and what components of aquatic ecology (biotic and abiotic) should be monitored
- requirements for adequate information to manage potential impacts and initiate feedback from monitoring to management.

The existing environment, assessment and sampling methodology, potential impacts, as well as recommendations for mitigation measures and monitoring programs which are outlined in this report have taken into consideration the EIA guidelines.

2.3.4 Guideline for controlled activities on waterfront land

Controlled activities carried out in, on or under waterfront land are regulated by the WM Act. This Act defines waterfront land to include the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river lake or estuary.

A key objective of the controlled activities provisions of the WM Act as set out in DPI (2012) is to establish and preserve the integrity of riparian corridors. Ideally, the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System
- if a watercourse is present, define the riparian corridor on a map in accordance with Table 2-1
- seek to maintain or rehabilitate a riparian corridor with fully structured native vegetation
- seek to minimise disturbance and harm to the recommended riparian corridor
- minimise the number of creek crossings and provide perimeter road separating development from the riparian corridor;
- locate services and infrastructure outside of the riparian corridor. Within the riparian corridor provide multiple service easements and/or utilise road crossings where possible; and
- treat stormwater run-off before discharging into the riparian corridor.

Non-riparian corridor works such as infrastructure, can be authorised within the outer riparian corridor, so long as the average width of the riparian corridor can be achieved over the length of the watercourse within the development site.

Table 2-1 Recommended riparian corridor widths (DPI, 2012)

Watercourse type	Total riparian corridor width
First order	20 metres + channel width
Second order	40 metres + channel width
Third order	60 metres + channel width
Forth order and greater	80 metres + channel width

The calculation of riparian corridor within the proposal site is described in section 3.2 and impacts of the proposal on the riparian corridor is considered in section 5.1.1 in accordance with 2.1c of the SEARS.

3. ASSESSMENT METHODOLOGY

The study area is defined as the land surrounding the proposal site, with the potential to be directly or indirectly affected by the proposal. For database searches and consideration of previous threatened and protected aquatic species records, it includes Junee Shire Council and Cootamundra-Gundagai Regional Council LGAs. For consideration of aquatic species habitat, it includes the extent of all watercourses that cross the Proposal site.

3.1 Literature review

3.1.1 Database review

A desktop review of relevant guidelines, previous species sighting records, documents and reports relevant to the proposal was undertaken from the locality using the following public ecological databases:

- An area search within the Junee Shire Council and Cootamundra Shire Council (now Cootamundra-Gundagai Regional Council) on the Protected Matters Search Tool (PMST) for MNES (DoE 2016 – accessed 30 August 2017 and 29 December 2020).
- A search of the NSW Fisheries threatened species list (DPI, undated a) and distribution maps (DPI, undated b) which provide the indicative (or known and expected) distributions for a number of NSW freshwater threatened species based on modelling. The indicative distribution means there is a high probability that the species will occur in a stream segment, given the species has been recorded there or the environmental conditions are the same as a stream segment where the species is already known to occur. Modelled indicative distribution maps are not available for all NSW freshwater threatened species due to the limited number of records for some species or the limited number of correlated environmental attributes.
- For threatened species where distribution maps are not available, habitat assessment and review of Primefacts for each individual species were used to determine their likely presence (DPI, undated c).
- An area search was conducted within the BioNet website for the Atlas of NSW Wildlife (OEH, 2018). BioNet is a portal for accessing government held information about plants and animals in NSW. It is supported by several NSW government held agencies including the Environment, Energy and Science (EES) Group of DPE (formerly OEH), including National Parks and Wildlife, and Royal Botanic Gardens and Domain Trust, DPI and the Australian Museum. BioNet contains records for aquatic threatened species and endangered ecological communities (EEC's) listed under the BC Act and the EPBC Act which have been recorded within the locality. The search was conducted on 24 October 2018 and 29 December 2020 under Junee Shire Council and Cootamundra Shire Council (now Cootamundra-Gundagai Regional Council) LGA's for all protected species (threatened and non-threatened).
- Atlas of Living Australia (ALA) records. ALA is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources, making it accessible and reusable. It receives support from the Australian Government through the National Collaborative Research Infrastructure Strategy (NCRIS) and is hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). A search of the ALA was conducted on 1 October 2019 and 29 December 2020 within Junee Shire Council and Cootamundra Shire Council (now Cootamundra-Gundagai Regional Council) LGA's for platypus, fishes, crustaceans and reptiles.
- Review of Key Fish Habitat mapping on the Fisheries spatial data portal (DPI, 2007).
- Review of Fish Community Status of NSW mapping and Fish Communities and Threatened Species Distribution of NSW, Report prepared by DPI (2016). The condition of fish communities is rated as Very Good, Good, Moderate, Poor or Very Poor.
- Review of Mitchell Landscapes electronic mapping.

- Review of vegetation mapping from the BDAR (Technical Paper 1).
- Review of Survey Guidelines for Australia's threatened fish (DSEWPC, 2011) to determine the likelihood of a species presence or absence at a site. The guidelines are not mandatory however, and desktop analysis of historic data can be used as an alternative survey approach.
- Discussion with DPI District Fisheries Officer (South West Slopes District) in November 2017 prior to surveys.

The information obtained was used to inform survey design and assist in the description of ecological context, assessment of potentially occurring threatened species, endangered populations (Eps) and TECs.

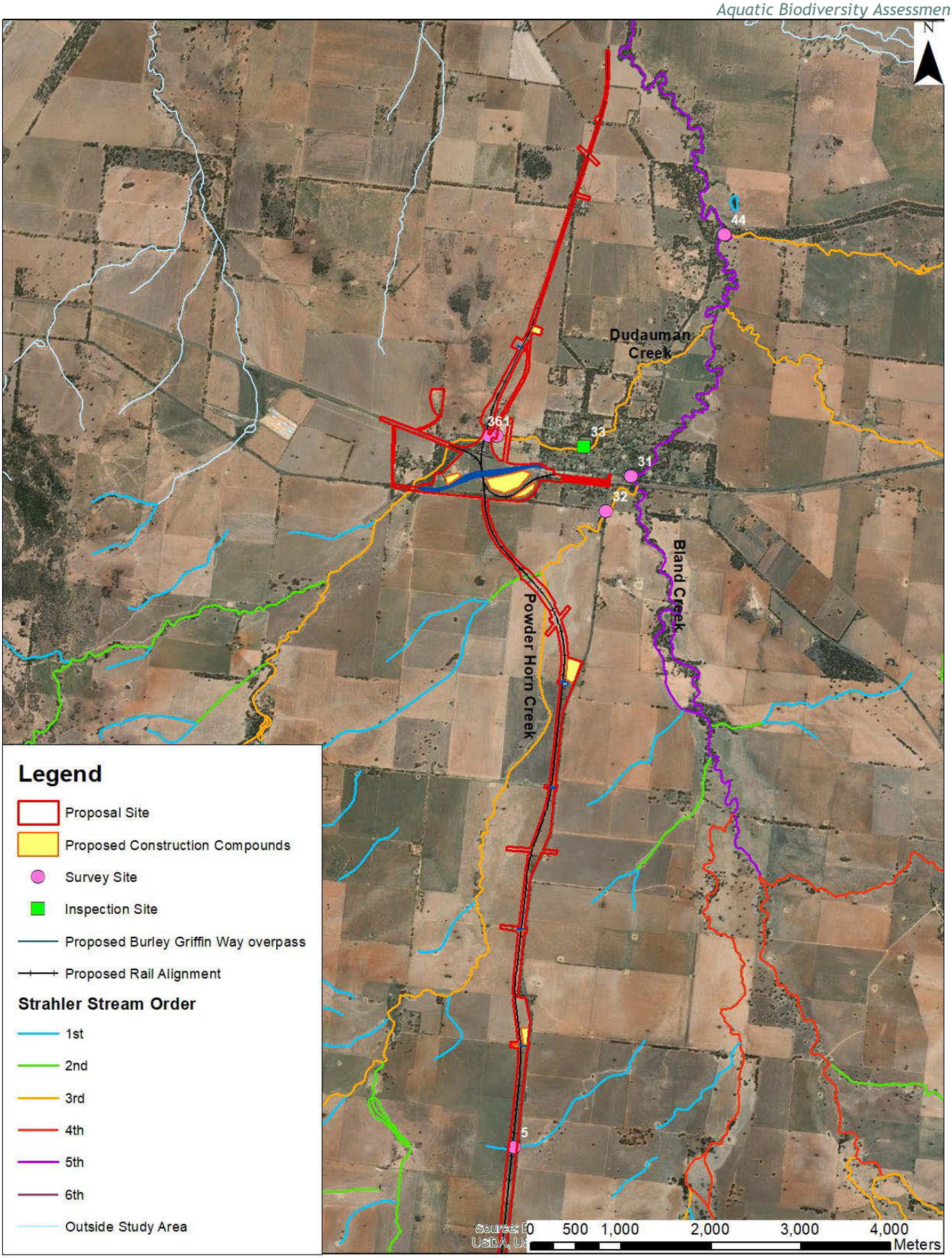
3.1.2 Stream order mapping

In characterising the watercourses in the area, consideration has been given to the Strahler ordering system (Strahler, 1952), as described in NSW Government Gazette no. 37 on 24 March 2006.

The Strahler ordering system is a hierarchical numbering system based on the degree of branching within a watercourse and provides an indication of the complexity of a creek system. For the purposes of this order, watercourses are deemed to be continuous even if they lose definition and then reappear downstream. The methodology used is as follows:

- Starting at the top of a catchment, any watercourse which has no other watercourses flowing into it is classed as a 1st order stream.
- Where two 1st order streams join, the stream becomes a 2nd order stream.
- If a 2nd order stream is joined by a 1st order stream - it remains a 2nd order stream.
- When two 2nd order streams join, they form a 3rd order stream.
- A 3rd order stream does not become a 4th order stream until it is joined by another 3rd order stream and so on.

Stream orders have been mapped at 1:50,000 scale (Figure 3-1, Figure 3-2 and Figure 3-3) and at 1:10,000 scale (Appendix C, Figures C1-C15).



COAST ECOLOGY
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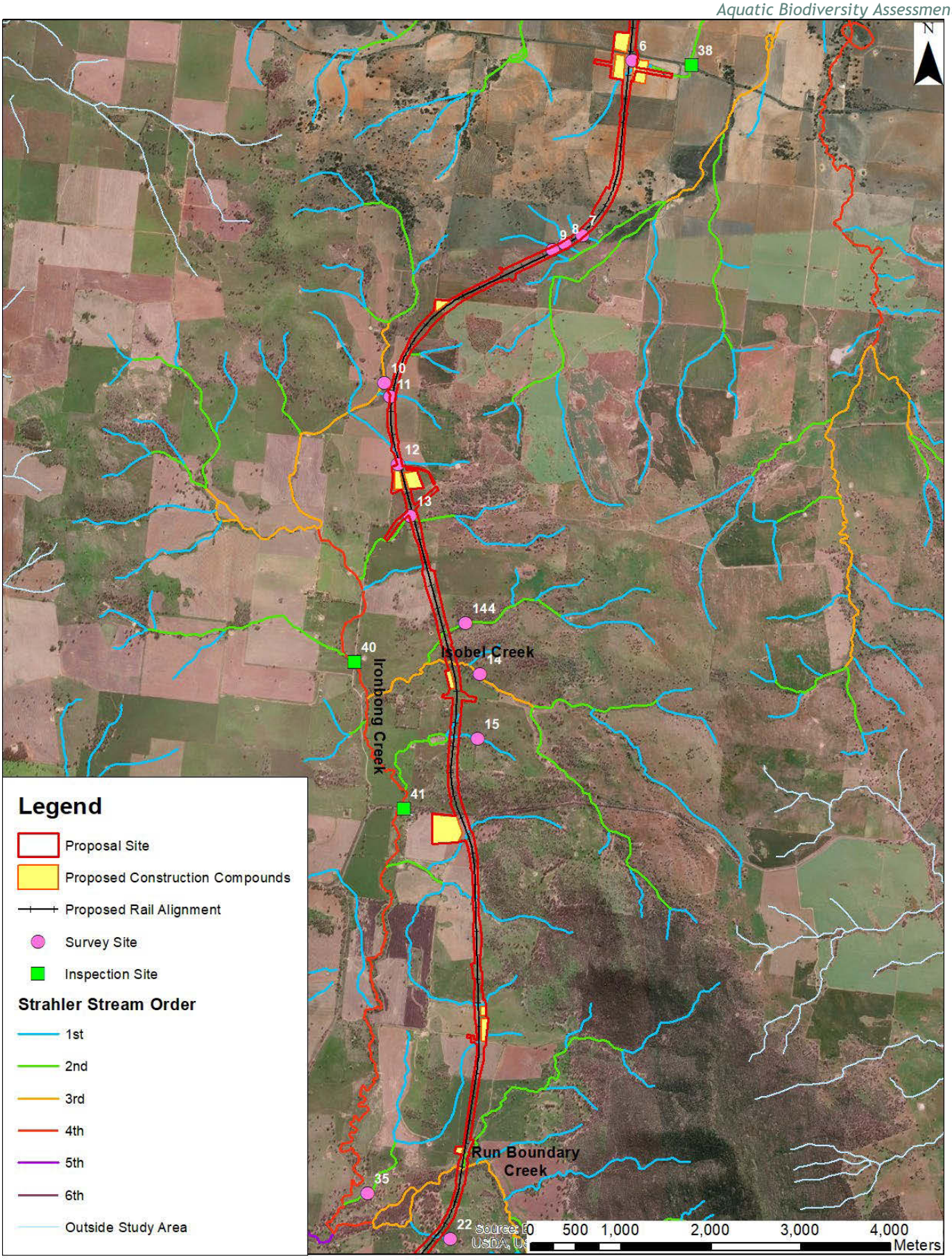
Figure 3.1a. Strahler Stream Order and Survey Sites
Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

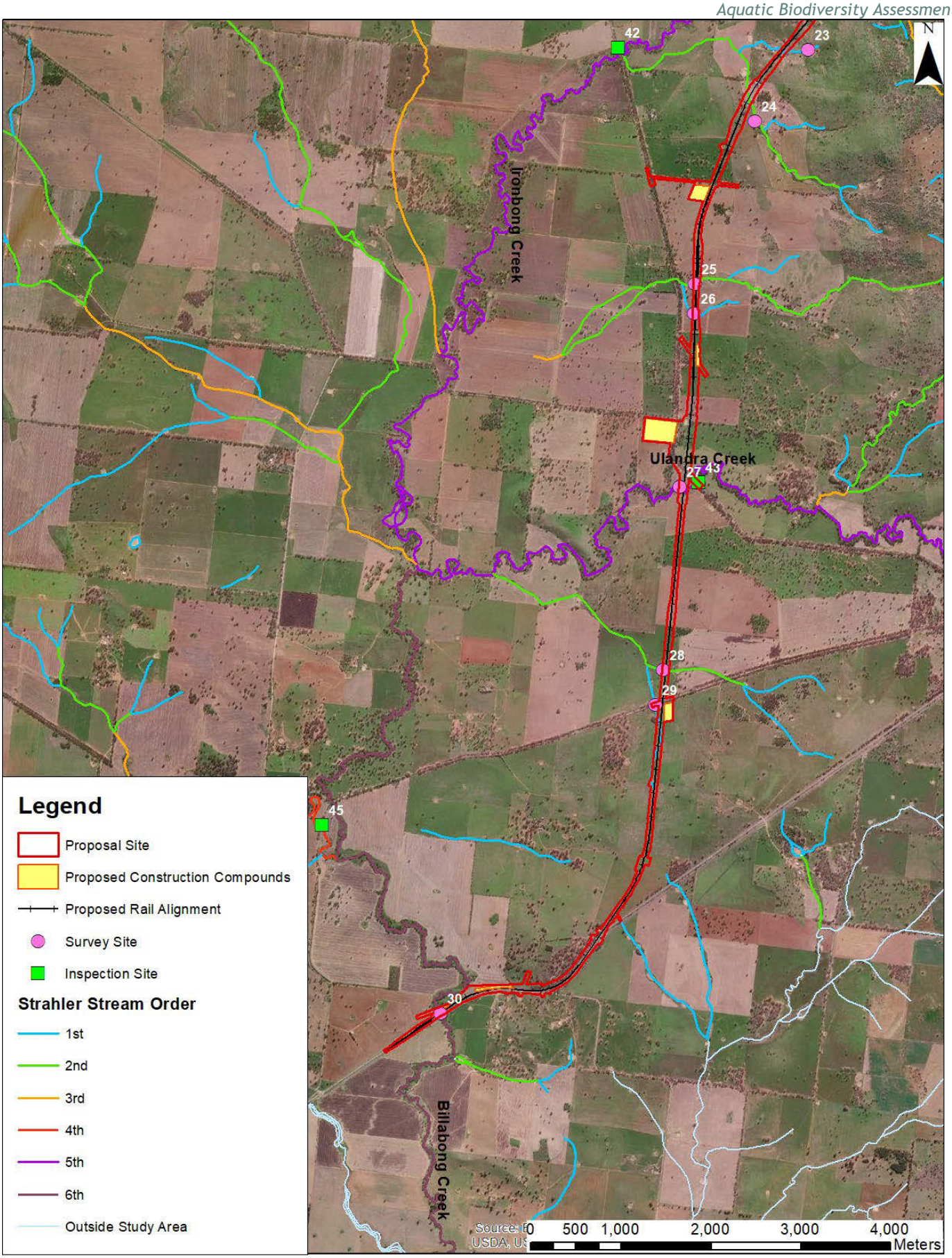
Figure 3-1 Strahler stream order and survey sites: northern section



COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

Figure 3.1b. Strahler Stream Order and Survey Sites
Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

Figure 3-2 Strahler stream order and survey sites: middle section



COAST ECOLOGY
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Figure 3.1c. Strahler Stream Order and Survey Sites
Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

Figure 3-3 Strahler stream order and survey sites: southern section

3.1.3 Aquatic habitat description and mapping

Preliminary mapping of the broad scale aquatic habitats within the study area was undertaken using recent aerial photography in conjunction with topographic maps prior to field surveys. Topographic maps were used to gain a broad understanding of catchment characteristics including adjacent land use, elevation, access routes, distance from source and location of barriers to fish passage, such as dams and weirs.

3.2 Riparian and aquatic vegetation survey and mapping

On waterfront land, the NRAR recommends a riparian corridor width based on watercourse order as classified under the Strahler System of ordering watercourses (Table 2-1). The amount of riparian corridor within the proposal site, including the construction impact zone, was calculated using the recommended widths in Table 2-1 applied to electronic vegetation mapping (Technical Paper 1) along the watercourses within the proposal site.

The riparian vegetation was surveyed with plot/transect data collected to inform the BDAR (Technical Paper 1) however it is noted that there are limitations to the vegetation data as some areas could not be field verified and as such, assessment was based on aerial imagery and state vegetation mapping. The methodology is discussed further in the Technical Paper 1.

Aquatic vegetation (macrophytes) were recorded as part of this aquatic biodiversity assessment report using standard recording sheets (NSW AUSRIVAS, 2007).

3.3 Field survey

Two aquatic surveys were undertaken to detect temporal (climatic) variation in accordance with Survey Guidelines for Australia's threatened fish (DSEWPC, 2011). Aquatic surveys were undertaken during the following dates:

- 3-6 December 2018
- 16-18 December 2020.

3.3.1 Habitat assessment

An assessment of the aquatic habitat at each of the survey sites was undertaken, and indicators of stream condition noted. The aquatic habitat characteristics were recorded using standard recording sheets (NSW AUSRIVAS, 2007) along with the suitability of the habitat for threatened species with potential to occur in the area.

Habitat features and stream condition indicators assessed include:

- topography
- water level (height of bank and evidence of erosion)
- shading of the river
- Riparian vegetation (percent cover of upper, middle and lower stratum)
- Stream width (min., max., mode)
- Stream depth (min., max., mode)
- Identification of macrophytes
- Percent cover of aquatic vegetation (algae, moss, macrophytes)
- Percent cover of detritus
- Description of natural substrate (percent bedrock, boulder, cobble, clay etc)
- Percent of total macrophytes that are submerged, emergent or floating.
- presence of drought and flood refuge areas
- presence of pool, riffle and edge habitats
- the presence of natural or artificial barriers to fish passage upstream and downstream
- colour and clarity of water, and any visual evidence of water quality
- photographs.

During the December 2018 field surveys, sites were selected where the 2018 proposal site (250 metre) crossed a watercourse. Where site access was granted, sites where the 2018 proposal site crossed a watercourse were inspected along a 100-metre reach and are referred

to as survey sites. Where access to properties was restricted, the watercourses were assessed outside of the 2018 proposal site from public land, roadsides or neighbouring properties. A total of 26 sites were surveyed (Table 3-1; Figure 3-1, Figure 3-2, Figure 3-3 and Figures C1-C15; Appendix C).

During the December 2020 field surveys, a total of 16 sites were inspected including three new survey sites (31, 36 & 44) and re-assessment of five original survey sites (6, 28, 29, 30 & 32). Eight new sites were inspected from public land or roadside locations where a full physical evaluation was not possible (i.e. a 100 metre reach) due to access restrictions. These eight new sites are referred to as inspection sites (Table 3-1; Figure 3-1, Figure 3-2, Figure 3-3 and Figures C1-C15; Appendix C).

Due to changes in the design, 12 out of 27 survey sites were located outside of the proposal site either due to a change in the proposal rail alignment or access restrictions. The distance from these 12 survey sites to the proposal site along each creek is included in Table 3-1.

Field survey effort is considered adequate to assess the aquatic habitat of the watercourses that cross the proposal site. Watercourses were inspected at numerous locations on both survey dates (both within and outside of the proposal site) and there was little visible difference in the condition of the watercourses, despite the change in climatic conditions. Desktop studies (i.e. vegetation type, soil landscape, terrain and catchment pressures) were also used to inform the assessment of these watercourses.

Table 3-1 Survey sites/inspection sites, co-ordinates and watercourse name

Survey/inspection site number & distance from proposal site	Survey year	Map X[a]	Map Y[a]	Watercourse	Location
1 50 m upstream from proposal site	2018	28618.55	6170882.54	Dudauman Creek	Lot 1 DP 537977 Denza Farm
5 Within proposal site	2018	28848.68	6162970.51	unnamed tributary of Bland Creek	near Lot 1 DP 540611 Dudauman Rd
6 Within proposal site	2018 2020	28715.11	6161477.58	unnamed tributary of Bland Creek	near Lot A DP 32837 Dudauman Rd
7, 8 &9 Within proposal site	2018	28088.06	6159300.61	3 x unnamed tributaries off Bland Creek	Lot 22 DP 750598 near Wattle Retreat
10 250 m downstream of proposal site	2018	25904.34	6157849.17	Ironbong Creek	Lot 1 DP 631000 north Dudauman Rd
11 Within proposal site	2018	25960.71	6157784.04	unnamed tributary of Ironbong Creek	Lot 1 DP 631000 north Dudauman Rd
12 Within proposal site	2018	26058.28	6156929.48	unnamed tributary of Ironbong Creek	Lot 2 DP 631000 north Dudauman Rd

Survey/inspection site number & distance from proposal site	Survey year	Map X[a]	Map Y[a]	Watercourse	Location
13 Within proposal site	2018	26153.32	6156343.27	unnamed tributary of Ironbong Creek	Lot 2 DP 631000 north Dudauman Rd
14a 200 m upstream from proposal site	2018	26805.44	6155175.16	unnamed tributary of Isobel Creek	Lot 174 DP 751401
14 200 m upstream of proposal site	2018	26986.05	6154592.16	Isobel Creek	Lot 174 DP 751401
15 220 m upstream of proposal site	2018	26982.02	6153870.01	unnamed tributary of Ironbong Creek	Lot 199 DP 751401 north Dirnaseer Rd
22 120 m upstream of proposal site	2018	26362.10	6148343.67	unnamed tributary of Run Boundary Creek	Lot 3 DP 591854
23 260 m upstream of proposal site	2018	26093.12	6147838.45	unnamed tributary of Ironbong Creek	Lot 3 DP 591854
24 180 m upstream of proposal site	2018	25754.32	6147097.34	unnamed tributary of Ironbong Creek	Lot 184 DP 751396
25 Within proposal site	2018	24925.51	6145294.47	unnamed tributary not connected to a network of watercourses	Lot 20 DP 1116265
26 Within proposal site	2018	24976.07	6145104.34	unnamed tributary not connected to a network of watercourses	Lot 20 DP 1116265
27 Within proposal site	2018	24903.07	6143034.27	Ulandra Creek	Lot 1 DP 533415
28 Within proposal site	2018 2020	24767	6140971	unnamed tributary of Ulandra Creek	Lot 3 DP 237404
29 Within proposal site	2018 2020	24651.5	6140587	unnamed tributary of Ulandra Creek	Lot 3 DP 237404
30 Within proposal site	2018 2020	22256.26	6137153	Billabong Ck	Lot 1 DP 939264 or from JWC Beveridge Bridge

Survey/inspection site number & distance from proposal site	Survey year	Map X[a]	Map Y[a]	Watercourse	Location
31 1.7 km upstream of proposal site	2020	30126.42	6170424	Bland Creek	near Lot 7007 DP 94354 under Burley Griffin Highway bridge
32 1 km upstream from proposal site	2018 2020	29833.79	6170040	Powder Horn Creek	Dudauman Rd near Lot 1 DP 581864
35 1.7 km downstream of proposal site	2018	25716.93	6148828.07	unnamed tributary of Ironbong Creek	Lot 114 DP 751396
36 Within proposal site	2020	28530.14	6170881	Dudauman Creek	Lot 1 DP 537977 Denza Farm
44 5 km upstream of proposal site	2020	31152.8	6173118	Bland Creek	Old Wallendbeen Rd near Lot 7004 DP 94544
Inspection Sites					
33 1 km upstream of proposal site	2020	29585.54	6170762	Dudauman Creek	Crogan Rd near Lot 154 DP 750619
38 250 m upstream of proposal site	2020	29328.32	6161385	unnamed tributary of Bland Creek	Old Cootamundra Rd near Lot B DP 32837
40 1.5 km downstream of proposal site	2020	25576.57	6154746	Ironbong Creek	Dudauman Rd near Lot 4 DP 751401 Ferndale Farm
41 1.6 km downstream of proposal site	2020	26126.68	6153109	Ironbong Creek	Dirnaseer Rd near Lot 28 DP 751401
42 2.8 km upstream of proposal site	2020	24239.94	6147905	Ironbong Creek	Ironbong Rd near Lot 3 DP 591854
43 100 m downstream of proposal site	2020	25140.8	6143062	Ulandra Creek	Ironbong Rd near Lot 21 DP 1116265
45 3 km downstream of proposal site	2020	20939.11	6139245	Turvey Fall Creek (upstream of Billabong Creek)	Warren Rd near Lot 123 DP 751398

Survey/inspection site number & distance from proposal site	Survey year	Map X[a]	Map Y[a]	Watercourse	Location
46 5 km upstream of proposal site	2020	22061.11	6133727	Billabong Creek (downstream of survey site 30)	Allawah Rd near Lot 20 DP 751418

[a] Coordinates taken from field Garmin GPS Map Datum WGS 84

3.3.2 Fauna sampling

Guidelines are available for sampling threatened aquatic species listed under the EPBC Act, however they are not available for threatened aquatic species listed under state legislation. Where available, recommended sampling techniques targeting threatened species are summarised in Table 3-2.

Results from desktop studies and literature review were used to inform suitable survey techniques for native and protected aquatic species. DPI District Fisheries Officers were contacted regarding the watercourses within the proposal site. Phone conversations indicated that the creeks within the proposal site were intermittent and were unlikely to contain water unless rainfall immediately preceded the survey dates. The South West Slopes district officer indicted that the only remnant pools that he was aware of were springs (near survey site 35) and that the creeks within the proposal site were: *"rapid rise and rapid fall and flood out during heavy rain the water may flow underground and rise and fall dependant on atmospheric pressure"* (A. Day, email 12/11/2018).

Table 3-2 Recommended sampling techniques for target threatened species

Target Species	FM Act	EPBC Act	Recommended Sampling Techniques (DSEWPC, 2011)
Flathead Galaxias *Galaxias rostratus*	CE	CE	No specific survey technique is available for this species. General recommendations for sampling galaxiids include: • Night sampling • Electrofishing • Scoop nets • Plastic traps (bait traps) • Soft mesh fyke nets left overnight (cod ends out of the water or buoyed)
Hanley's River Snail *Notopala hanleyi*	CE	-	N/A
Murray Cod *Maccullochella peelii*	-	V	• Larval sampling • Boat-based electrofishing • Daytime snorkelling • Lure fishing and angling • along with techniques listed for Trout Cod below
Murray Crayfish *Euastacus armatus*	V	-	N/A

Target Species	FM Act	EPBC Act	Recommended Sampling Techniques (DSEWPC, 2011)
Southern Purple Spotted Gudgeon *Mogurnda adspersa*	E	-	No specific survey technique is available for this species. General recommendations for sampling gudgeons include: • Bait traps
Trout Cod *Maccullochella macquariensis*	E	E	• Boat-based and/or backpack electrofishing (however can result in high mortality rates for this species) • Fyke nets • Drum nets • Set-lines • Light traps • Yabby Traps • Set-lining gillnets • Angling (most successful method if experienced anglers are used)
Western population of Olive Perchlet *Ambassis agassizii*	EP	-	N/A

N/A = Survey guidelines do not contain specific survey techniques for this species nor any general survey techniques for this genus.

The recommended sampling techniques targeting threatened species described in Table 3-2 were generally not suitable for watercourses that crossed the proposal site.

At the time of survey, watercourses lacked flowing water and only some contained remnant pools. Most of the remnant pools were small and shallow and bait traps were considered the most appropriate survey technique. Bait traps were also suitable for use in farm dams. Bait traps (dimensions: 0.5 m long x 0.24 m wide x 0.24 m high) were baited with a mixture of sardines and oatmeal and left *in-situ* overnight (12 hours) at seven sites (Table 3-3).

Bland Creek (site 44) contained sufficient water in remnant pools for the use of fyke nets in addition to bait traps. Two fyke nets were set and left *in-situ* overnight (12 hours).

Seine netting (12 m length x 2 m drop) was undertaken in one farm dam where access was available and water depth and width was sufficient. Three sweeps of the dam were undertaken using the seine net.

Table 3-3 Fauna survey techniques

Survey/inspection site	Watercourse	Sample Technique
December 2018		
28	Farm dam	Seine net (12 m length x 2 m drop; 3 sweeps)
35	Farm dam	3 bait traps
35	Spring on an unnamed tributary of Ironbong Creek	3 bait traps
December 2020		
30	Billabong Creek	3 bait traps
31	Bland Creek	3 bait traps
42	Ironbong Creek	3 bait traps
44	Bland Creek	3 bait traps 2 fyke nets
45	Turveys Fall Creek (upstream of Billabong Creek)	3 bait traps

4. EXISTING ENVIRONMENT

4.1 Weather and climatic conditions

The weather during surveys in December 2018 was hot and dry. At the time of survey, 18.2 mm of rain had been recorded at Cootamundra in the week preceding surveys (i.e. from 25 November to-03 December 2018) (Rainfall data taken from Bureau of Meteorology (BoM): Cootamundra Airport site No. 73142). Surveys in December 2018 occurred during an extended drought. 2018 was the warmest year on record and was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record and its driest year since 2002 (BoM, 2018). Similar declines in rainfall are known to contribute to large reductions in stream flows in the Murray-Darling Basin (CSIRO 2010).

The weather during surveys in December 2020 was hot and dry. At the time of survey, no rainfall had been recorded at Cootamundra airport in the week preceding surveys (i.e. from 9 – 15 December 2020) (Rainfall data taken from Bureau of Meteorology (BoM): Cootamundra Airport site No. 73142). However, December 2020 was at the commencement of a La Niña year (BoM, 2020a), which is associated with above average rainfall in Australia. For 2020, the annual rainfall at Cootamundra airport was 748.7mm, which is above the mean annual rainfall (averaged over 25 years from 1995-2020) of 575.8mm (BoM, 2020b). Due to property access restrictions, the 2020 survey did not cover all watercourses where they crossed the proposal site, however surveys and inspections of watercourses accessed outside of the proposal site were representative enough to make conclusions on the results of 2018 surveys conducted during drought conditions.

Thus, the first survey was conducted during drought conditions while the second survey was conducted in a year with above average rainfall. The results of temporal replication in the occurrence and detectability of aquatic fauna are reflected in the presence of a small number of ephemeral pools (located mostly outside of the proposal site) during 2020 surveys.

4.2 Stream flow

During the 2018 aquatic survey, no flowing water was observed in the watercourses that cross the proposal site and small refuge pools were observed at only two survey sites: one on Isobel Creek (survey site 14) and the second on a tributary of Isobel Creek (survey site 14a). No refuge pools were observed in watercourses where they occurred outside of the proposal site (viewed from public access locations such as roadsides) nor were any refuge pools observed in Bland Creek, a 6th order stream that occurs outside and to the northeast of the proposal site.

During the 2020 aquatic survey, no flowing water was observed in the watercourses that cross the proposal site and small refuge pools were recorded at only one survey site (Billabong Creek; survey site 30). However, small refuge pools were observed on three other creeks outside of the proposal site where they were accessed from the road:

1. Bland Creek (survey sites 31 & 44)
2. Ironbong Creek (inspection site 42); and
3. Turvey Fall Creek (inspection site 45).

The lack of flowing water and only limited refuge areas observed in December 2020 (outside of drought) is consistent with the 2018 assessment, confirming that the watercourses are highly ephemeral, only holding water for a short period following rainfall events, and draining away quickly, leaving limited refuge areas.

4.3 Key fish habitat classification and sensitivity analysis

One of the key objectives of the FM Act is to conserve KFH. KFH's are defined to include all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank. Small

headwater creeks and gullies (known as 1st and 2nd order streams), that only flow for a short period after rain are generally excluded, as are farm dams constructed on such systems. Wholly artificial waterbodies such as irrigation channels, urban drains and ponds, salt and evaporation ponds are also excluded except where they are known to support populations of threatened fish or invertebrates.

DPI assesses activity and development proposals in relation to general policies and with consideration for the 'sensitivity' of the affected fish habitat. In this context, 'sensitivity' is defined by the importance of the habitat to the survival of fish (noting that 'fish' under the FM Act includes all aquatic invertebrates) and its robustness (ability to withstand disturbance).

If the aquatic habitat in question is defined as Key Fish Habitat, it is then assigned a fish habitat sensitivity ranking which is used within the policy and guideline statements to differentiate between permissible and prohibited activities or developments related to the importance of the 'Type' of key fish habitat. Table 4-1 defines those habitats that are considered 'key fish habitats' for the purpose of the application of the FM Act.

'Key Fish Habitat' maps have been compiled by DPI and are available on the DPI Spatial Data Portal (DPI, 2007). The proposal site crosses 5 watercourses that are defined by DPI as Key Fish Habitat (Figure 4-1).

It is noted that for the purposes of the *Policy and Guidelines for Fish Habitat Conservation and Management* that 1st and 2nd order streams on gaining streams (streams where the channel bottom is lower than the level of the surrounding groundwater table so that water potentially moves from the ground into the channel) are not considered key fish habitat (DPI 2013).

Table 4-1 Key fish habitat (KFH) and associated sensitivity classification scheme

Sensitivity Ranking	Watercourse Description
Type 1 Highly sensitive key fish habitat	• Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants • Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act
Type 2 Moderately sensitive key fish habitat	• Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in Type 1 • Weir pools and dams up to full supply level where the weir or dam is across a natural watercourse
Type 3 Minimally sensitive key fish habitat may include	• Coastal and freshwater habitats not included in Type 1 or 2 • Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

In addition to habitat sensitivity type, DPI assesses proposals in relation to watercourse Class. The watercourse classification scheme has been adapted from Fairfull and Witheridge (2003) and factors in the functionality of the watercourse as fish habitat (Table 4-2). It classifies these streams using indicators such as:

- hydraulic geometry (stream shape and size)
- frequency of stream flows (perennial, intermittent or ephemeral)
- presence of aquatic habitat units (pools, riffles, vegetation, snags)
- presence of threatened or protected fish species and other native fish, and
- connection to adjacent habitats (e.g. floodplain wetlands).

Watercourse Class can be used to assess the impacts of certain activities on fish habitats in conjunction with the habitat sensitivity Type. The watercourse Class scheme can also be used to make management recommendations to minimise impacts on different fish habitats, including minimum recommended watercourse crossing types (Table 4-2).

Table 4-2 Classification of watercourses for fish passage

Classification	**Characteristics of watercourse class**	**Minimum [1] Recommended Crossing type (Fairfull & Witheridge, 2003)**
Class 1 Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	Bridge, arch structure or tunnel
Class 2 Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. Type 1 and 2 habitats present.	Bridge, arch structure, culvert [2] or ford.
Class 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other Class 1-3 fish habitats.	Culvert [3] or ford
Class 4 Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).	Culvert [4], causeway or ford
Notes [1] In all cases bridges are preferred to arch structures, culverts, fords and causeways (in that order). [2] High priority given to the "High Flow Design" procedures presented for the design of these culverts - refer to Design Considerations section of this document, or engineering guidelines (Witheridge, 2002). [3] Minimum culvert design using the "Low Flow Design" procedures; however, "High Flow Design" and "Medium Flow Design" should be given priority where affordable (refer to Witheridge (2002)). [4] Fish friendly waterway crossing designs possibly unwarranted. Fish passage requirements should be confirmed with the local fisheries department/authority.		

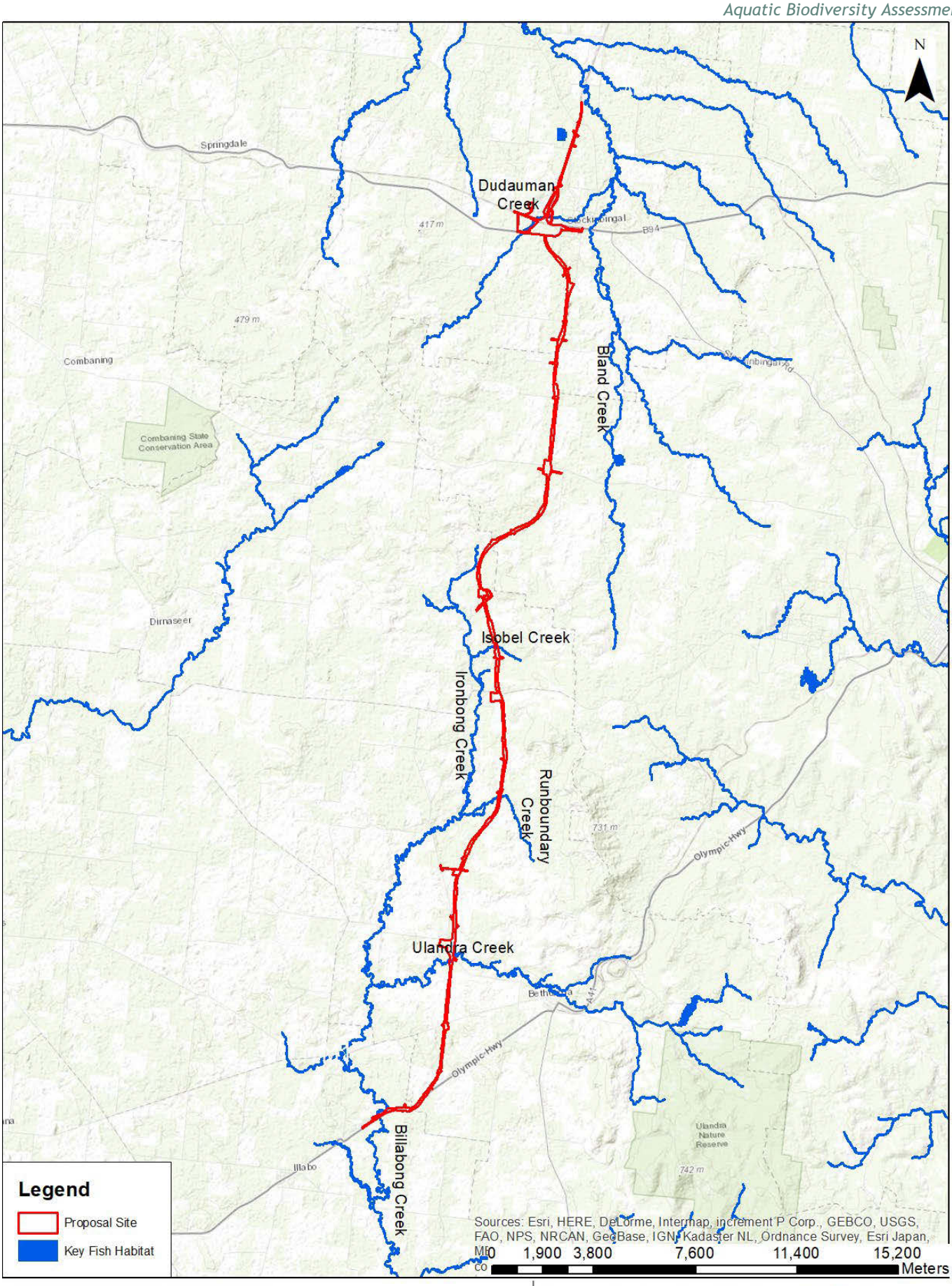

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Figure 4.1. Key Fish Habitat (NSW DPI)
Inland Rail: Illabo to Stockinbingal
Project No. 170429 Date:30/04/2021

Figure 4-1 Key fish habitat mapping (DPI)

4.4 Catchment description and watercourse classification

The proposal site crosses six named creeks including Dudauman Creek, Powder Horn Creek, Isobel Creek, Run Boundary Creek, Ulandra Creek and Billabong Creek and numerous other crossings over small shallow ephemeral creeks and tributaries. Ironbong Creek is outside of the proposal site but does have 1st and 2nd order tributaries that cross the proposal site. Bland Creek is also outside of the proposal site however Dudauman Creek and Powder Horn Creek are tributaries of Bland Creek. All of these watercourses are at the top of the catchments for their respective valleys and only flow during rainfall events.

In total, the proposal site crosses 32 mapped hydrolines using the Strahler stream order mapping. This includes:

- 18 x 1st order streams
- 8 x 2nd order streams
- 4 x 3rd order streams
- 1 x 5th order stream
- 1 x 6th order stream.

Table 4-3 provides (from north to south) the name of watercourses within the proposal site, Strahler stream order at each survey site, whether it is mapped as KFH by DPI (2007), a brief description of the survey site, the habitat sensitivity Type, the Class of each watercourse and a photograph at each survey site. The habitat sensitivity Type and Class for each survey site are also shown in Figures C1-C15 (Appendix C).

Sites defined by DPI as KFH are summarised in Table 4-4 (from north to south), including a summary of their habitat sensitivity Type and Class for fish passage assessed during site inspections.

Most of the survey sites were dry at the time of inspection. The watercourses within the proposal site are largely ephemeral, flowing only after rainfall and quickly receding.

Most of the watercourses along the proposal site are 1st and 2nd order streams with intermittent flow following rain events, little or poorly defined channels with no aquatic flora species. The watercourses at all survey sites have been modified by agricultural land practices with minimal native vegetation retained along the banks of the watercourses. Accordingly, watercourses at 15 survey sites have been classified as Class 4 unlikely key fish habitats that are Type 3 minimally sensitive fish habitat. For Class 4 Unlikely fish habitat, fish friendly watercourse crossing designs are unwarranted (Fairfull & Witheridge, 2003).

Five named watercourses: Dudauman Creek, Run Boundary Creek, Ironbong Creek, Ulandra Creek and Billabong Creek (Figure 3-1, Figure 3-2, Figure 3-3) had well defined banks and were defined as Class 3 Minimal key fish habitat that are Type 3 minimally sensitive fish habitat. These sites lack habitat features such as in-stream gravel bed, rocks, snags and contained limited to no refuge pools and aquatic vegetation was limited to exotic *Juncus acutus*. They did however contain riparian vegetation/shading and in some cases, associated farm dams that may provide refuge for aquatic fauna. For Class 3 Minimal key fish habitat, the minimum recommended crossing type is a culvert or ford. The minimum culvert design should use the “low flow design’ procedures; however “high flow design” and “medium flow design” should be given priority where possible. In all cases bridges are preferred to arch structures, culverts, fords and causeways (in that order of preference) (Fairfull & Witheridge, 2003).

Isobel Creek was defined as Type 2 moderately sensitive KFH and Class 2 Moderate KFH as it contained small refuge pools in bedrock during drought periods, with some sparse emergent aquatic vegetation present in the dry creek bed (refer photograph in Table 4-3). The minimum recommended crossing type for Class 2 watercourses is a bridge, arch structure, culvert (high flow design) or ford, in that order of preference (Fairfull & Witheridge, 2003).

Table 4-3 Survey Sites at watercourses along the proposal site, stream order, watercourse description, habitat sensitivity Type and Class

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
1	Dudauman Creek	3	YES	No water was present at this survey site during the site visit. Good cover of juvenile trees, farm dam located within 50m of creek line, existing rail track across watercourse, de-vegetation, exotic plant invasion, well defined banks however bank degradation evident through erosion. Impacts from within the catchment include the existing rail line, grazing and agriculture. No aquatic vegetation. Substrate consisted of 20% artificial gravel (from rail crossing), 70% sand & 10% clay	Type 3 – minimal Class 3 - minimal	
5	Unnamed tributary of Bland Creek	1	NO	No water was present at this survey site during the site visit. A farm dam located within 50m of creek line, de-vegetation, exotic plant invasion, no defined banks, point sources of pollution (Dudauman Rd), grazing and agriculture within the catchment, 2 pipe culvert under the road. No aquatic vegetation. Substrate consisted of 50% sand, 25% silt & 25% clay.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
6	Unnamed tributary of Bland Creek	1	NO	No water was present at this survey site during the site visits. An artificially formed drainage line ~6 m wide, shallow banks, grazing and agriculture within the catchment. The riparian vegetation was absent, with only exotic plants present. No aquatic vegetation was recorded. Substrate consisted of 50% sand, 25% silt & 25% clay. A farm dam was located within 50m of the creek line.	Type 3 – minimal Class 4 - unlikely	
7, 8 &9	3 x unnamed tributaries off Bland Creek	1	NO	No water was present at these survey sites during the site visit. Drainage lines not defined. Degraded pasture dominated by exotic grasses and herbs (*Rostraria cristata, Lolium perenne, Austrostipa rudis ssp nervosa*), de-vegetation, exotic plant invasion, artificially formed drainage line ~6 m wide, shallow banks, grazing and agriculture within the catchment. High level of weed invasion. No aquatic vegetation. Substrate consisted of 15% sand, 10% silt & 75% clay.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
10	Ironbong Creek Ironbong Creek is not within the proposal site. Additional survey was included to assess potential indirect impacts of the proposal.	3	YES	No water was present at this survey site during the site visit. A farm dam was located within 50m of creek line, exotic plant invasion dominated by exotic grasses and herbs up to 2 m tall (*Setaria spacelata*, *Juncus acutus*), grazing and agriculture within the catchment. North of Site 10 on the edge of the proposal site, this creek was more defined and re-vegetation of Ironbong creek was evident with juvenile trees. No aquatic vegetation. Substrate consisted of 40% sand, 10% silt & 50% clay.	Type 3 – minimal Class 3 – minimal	
11	Unnamed tributary of Ironbong Creek	1	NO	No water was present at this survey site during the site visit. A farm dam was located within the watercourse, exotic plant invasion dominated by exotic rushes *Juncus acutus* and exotic grasses, grazing and agriculture within the catchment, no defined channel. Substrate consisted of 1% gravel, 20% sand, 19%silt & 60%clay.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
12	Unnamed tributary of Ironbong Creek	1	NO	No water was present at this survey site during the site visit. No defined banks, past de-vegetation however re-vegetation evident through juvenile trees, exotic plant invasion, grazing and agriculture within the catchment. No aquatic vegetation. Substrate consisted of 30% sand, 10% silt & 60%clay.	Type 3 – minimal Class 4 - unlikely	
13	Unnamed tributary of Ironbong Creek	2	NO	No water was present at this survey site during the site visit. Exotic plant invasion (*Festuca elatior, Juncus acutus, Avena sativa*), bank definition however degraded (shallow, eroded banks, creek approximately 3 m wide), grazing and agriculture within the catchment. Some Cumbungi present *Typha sp*. Substrate consisted of 30% sand, 10% silt & 60% clay.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
14a	Unnamed tributary of Isobel Creek	2	NO	This tributary is an example of a gaining stream, as an underground water source exit point was observed and water was present in shallow pools over bedrock. DPI do not define 1st or 2nd order gaining streams as KFH. De-vegetation (sections with no riparian vegetation), exotic plant invasion (*Festuca elatior, Juncus acutus, Avena sativa*), bank degradation (erosion of banks), agriculture and grazing within catchment. Isolated patches of Cumbungi present *Typha sp*. Substrate consisted of 5% bedrock, 10% boulder, 2% cobble, 1% pebble, 1% gravel, 5% sand, 5% silt & 71% clay.	Type 3 – minimal Class 3 - minimal	
14	Isobel Creek	3	YES	Water was present at this survey site in shallow pools over bedrock. Mature trees within watercourse, low-flow channel approximately 1m wide however watercourse up to 13 m wide with 3m high banks, bank erosion, exotic plant invasion (areas of dense *Juncus acutus*) however evidence of re-vegetation and fencing of watercourse, small (<2m^2), shallow (< 0.2 m) pools over bedrock were observed along the 100m reach. Native macrophytes Knobby club rush *F. nodosa* also observed. Substrate consisted of 10% bedrock, 25% boulder,10 % cobble, 10% pebble, 2% gravel, 10% sand, 15% silt & 18% clay.	Type 2 – moderate Class 2 - moderate	 Broad, dry watercourse with low-flow channel

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
						 Shallow pools over bedrock
15	Unnamed tributary of Ironbong Creek	1	NO	No water was present at this survey site during the site visit. De-vegetation (no mature riparian vegetation), exotic plant invasion (*Juncus acutus*, exotic grasses), no defined bank, modification of water flow through construction of berms, agriculture and grazing within catchment. Substrate consisted of 20% sand, 40% silt & 40% clay.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
22	Unnamed tributary of Run Boundary Creek	1	NO	No water was present at this survey site during the site visit. Un-defined channel through paddock, exotic plant invasion, grazing and agriculture in catchment.	Type 3 – minimal Class 4 - unlikely	
23	Unnamed tributary of Ironbong Creek	1	NO	No water was present at this survey site during the site visit. Un-defined channel which has been diverted, exotic plant invasion, grazing and agriculture in catchment.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
24	Unnamed tributary of Ironbong Creek	2	NO	No water was present at this survey site during the site visit. Poorly defined channel, exotic plant invasion (*Juncus acutus* and exotic grasses and herbs), some re-vegetation evident with juvenile trees present, grazing and agriculture in catchment. Substrate consisted of 1% pebble, 30% sand, 40% silt & 29% clay.	Type 3 – minimal Class 4 - unlikely	
25	Unnamed tributary of Ironbong Creek	2	NO	No water was present at this survey site during the site visit. Undefined channel, highly modified landscape.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
26	Unnamed tributary of Ironbong Creek	1	NO	No water was present at this survey site during the site visit. Undefined channel, highly modified landscape.	Type 3 – minimal Class 4 - unlikely	
27	Ulandra Creek	5	YES	No water was present at this survey site during the site visit. Mature trees within riparian zone however no middle stratum vegetation, exotic grasses (*Triticum aestivum* x Secale cereal (Wheat x Rye) and herbs as sparsely covered lower stratum, banks up to 3m high with evidence of erosion, watercourse 6-9m wide, snags within watercourse grazing and agriculture within catchment. No aquatic vegetation present. Substrate consisted of 75% sand, 15% silt & 10% clay.	Type 3 – minimal Class 3 - minimal	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
28	Unnamed tributary of Ulandra Creek	2	NO	No water was present at this survey site during the site visits. No defined channel, a farm dam is present within the watercourse. No riparian vegetation, water quality turbid but no algal/macrophyte blooms.	Type 3 – minimal Class 4 - unlikely	
29	Unnamed tributary of Ulandra Creek	1	NO	No water was present at this survey site during the site visits. No defined channel, no riparian vegetation.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
30	Billabong Creek	6	YES	No water was present at this survey site during the 2018 site visit and one small, remnant pool (<50 cm depth) was observed upstream of the bridge during the 2020 site visit. Mature native trees in riparian zone, exotic grasses and rushes in lower stratum (*Lolium perenne, P. dilatatuml, Avena sativa, Rostraria cristrata, J. acutus*), eroded banks 2-6m high, watercourse 3-10 m wide, snags within watercourse, point sources (existing road and rail crossing (Olympic Hwy)), grazing and agriculture within catchment. Substrate consisted of 5% artificial gravel (from bridge), 60% sand, 15% silt & 20% clay. Three bait traps were set overnight in remnant pool during 2020 surveys.	Type 3 – minimal Class 3 - minimal	 December 2018  December 2020

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
31	Bland Creek Outside proposal site	6	Yes	No flowing water was present at this survey site during either site visit. In the 2020 site visit however a ponded area occurred under the bridge. Mature trees within riparian zone, minimal middle stratum vegetation and lower stratum was dominated by exotic grasses (*Triticum aestivum* x Secale cereal (Wheat x Rye), *Paspalum dilatatum*), *Typha sp* and exotic herbs, banks up to 2m high with evidence of erosion, watercourse 20-50m wide, dense exotic grasses and herbs in-stream, residential, grazing and agriculture within catchment. No aquatic vegetation present. Substrate consisted of 50% sand, 25% silt & 25% clay. 2 bait traps set overnight in ponded area.	Type 3 – minimal Class 3 - minimal	 December 2020
32	Powder Horn Creek	3	NO	No access was available to Powder Horn Creek within the proposal site. Powder Horn Creek was therefore assessed from Dudauman Rd (Site 32) outside of the proposal site. No water was present at this survey site during the site visits. Banks defined, dry clay/sandy bed, eroded banks and minimal middle and lower stratum riparian vegetation. No aquatic vegetation.	Type 3 – minimal Class 4 - unlikely	

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
35	Unnamed tributary of Ironbong Creek	3	YES	Springs approximately 1 meter in diameter and containing water were observed in an unnamed tributary of Ironbong Creek. No access to Run Boundary Creek was possible at the time of the field survey – Site 35 was the closest watercourse to Run Boundary Creek. Run Boundary Creek and the unnamed creek are both tributaries of Ironbong creek. Run Boundary Creek was observed from Site 35. It is assumed to have defined banks and based on aerial photography, a riparian corridor is present. Discussions with neighboring property owners indicate Run Boundary Creek is ephemeral.	Type 3 – minimal Class 3 - minimal	
36	Dudauman Creek	3	YES	A small pond was present at this survey site during the 2020 site visit however there was insufficient depth for sampling. Moderate cover of juvenile trees, existing rail track across watercourse, de-vegetation, exotic plant invasion, well defined banks however bank degradation evident through erosion. Impacts from within the catchment include the existing rail line, grazing and agriculture. No aquatic vegetation. Substrate consisted of 10% gravel, 70% sand & 20% clay.	Type 3 – minimal Class 3 - minimal	 December 2020

Survey Site	Watercourse	Strahler Stream Order	KFH	Description of the watercourse within a 100m reach [a]	Habitat Sensitivity Type[b] & Class[c]	Plates
44	Bland Creek (this creek does not cross the proposal site however some of its tributaries do)	5	YES	This survey site had the most significant size and number of refuge pools relative to other sites inspected in the study area. A series of ponds was present at this survey site during the 2020 site visit. Mature riparian cover present, minimal evidence of juvenile trees, sparse middle stratum, lower stratum consisted primarily of dense exotic grasses and herbs, moderate bank definition however bank degradation evident through erosion. Stream width 1-8m, bank height 2m. Impacts from within the catchment include grazing and agriculture. No aquatic vegetation present. Substrate consisted of 20% sand, 40% silt & 40% clay. 2 bait traps and 2 fyke nets set overnight in ponded area.	Type 3 - minimal Class 3 - minimal	 December 2020

[a] Descriptions based on a 100 m reach centered on the survey site; [b] Habitat Sensitivity Type: Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013); [c] Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003); KFH=Key Fish Habitat.

Table 4-4 Summary of key fish habitats, habitat sensitivity and watercourse class within the proposal site

Survey site	Strahler Stream Order	Watercourse	Habitat Sensitivity Type	Class
1	3	Dudauman Creek	Type 3 – minimal	Class 3 - minimal
32	3	Powder Horn Creek	Type 3 – minimal	Class 4 - unlikely
14	3	Isobel Creek	Type 2 – moderate	Class 2 - moderate
35	3	Run Boundary Creek	Type 3 – minimal	Class 3 - minimal
27	5	Ulandra Creek	Type 3 – minimal	Class 3 - minimal
30	6	Billabong Creek	Type 3 – minimal	Class 3 - minimal

4.4.1 Aquatic habitat characteristics of watercourses

Watercourses within the proposal site are considered in further detail if they are 3rd order stream or above and were Class 3 minimal fish habitat potential.

4.4.1.1 Dudauman Creek

Dudauman Creek flows north east into Bland Creek which flows predominantly north west for approximately 100 kilometres until it flows into Lake Cowal.

In the proposal site, Dudauman Creek is a 3rd order stream in the Frampton Hills Mitchell Landscape. It is mapped as key fish habitat by DPI however following an aquatic habitat assessments in December 2018 and December 2020, Dudauman Creek (at survey sites 1 & 36) has been assessed as Type 3 minimally sensitive habitat and Class 3 minimal fish habitat.

Dudauman Creek is in a broad valley with no water flow and moderate shading of the river. The creek bed had no bedrock, boulders, cobbles or pebbles present however there was approximately 20% gravel (likely washed from base material from the existing rail track upstream). The substrate was largely comprised of sand and clay. There was limited detritus cover, bank overhang or trailing bank vegetation. The stream width ranged from 2-4 meters wide and except for *Juncus acutus*, no macrophytes were recorded however this is not unexpected as there was no water in the creek at the time of the site visits. The riparian strip was approximately 8 metres wide either side of the creek line and consisted primarily of juvenile trees. The riparian vegetation has been mapped as PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion (Technical Paper 1). The riparian vegetation was degraded from past farming practices, with no native lower or middle stratum vegetation and the exotic grasses present were sparse. The creek had well defined banks however bank degradation was evident through erosion (Plate 1). Point sources of pollution included the rail line and associated culverts (Plate 2) along with grazing and agricultural practices within the catchment.

Plate 1 Dudauman Creek: Survey site 36 facing upstream

Plate 2 Dudauman Creek: Survey site 36 facing downstream

4.4.1.2 Ironbong Creek

Ironbong Creek is outside of the proposal site however 1st and 2nd order tributaries of Ironbong Creek cross the proposal site in several locations. At survey sites 10, 40 & 41, Ironbong Creek is a 3rd order stream and at survey site 42 it is a 5th order stream in the Frampton Hills Mitchell Landscape. It is mapped as key fish habitat by DPI however following an aquatic habitat assessment in December 2018 and December 2020, Ironbong Creek (at the survey sites) has been assessed as Type 3 minimally sensitive habitat and Class 3 minimal fish habitat.

Ironbong Creek is located on a floodplain with low shading of the river and no water flow however at the time of the 2020 inspection, a small remnant pool was observed at survey site 42. The stream width was approximately 2 metres wide and except for *Juncus acutus*, no macrophytes were recorded however this is not unexpected as there was no water in the majority of the creek at the time of the site visits. The creek bed had no bedrock, boulders, cobbles, pebbles or gravel with only sand and clay present. There was limited detritus cover and bank overhang but a high percentage of trailing bank vegetation (grasses) were recorded. The riparian vegetation varied between sites however it predominantly consisted of a moderate tree cover, sparse middle stratum, with a dense cover of exotic grasses and sedges only (i.e. *Setaria spacelata* and *Juncus acutus*: Plate 3 and Plate 4). The riparian vegetation has been mapped as miscellaneous Ecosystem (Planted Vegetation (PCT) (Technical Paper 1)). Impacts from within the catchment include grazing and agriculture.

From survey site 10, Ironbong Creek flows south and numerous tributaries and creeks merge with Ironbong Creek until it becomes a 6th order stream. Ironbong Creek merges with Billabong Creek approximately 39 kilometres south of survey site 10.

Plate 3 Ironbong Creek: Survey site 42 facing upstream

Plate 4 Ironbong Creek: Survey site 42 downstream

4.4.1.3 Isobel Creek

Isobel Creek flows west for approximately 1.3 kilometres from the point where the proposal site crosses Isobel Creek to its confluence with Ironbong Creek. At survey site 14, Isobel Creek is a 3rd order stream in the Frampton Hills Mitchell Landscape. It is mapped as key fish habitat by DPI and following an aquatic habitat assessment, Isobel Creek (at the survey site) has been assessed as Type 2 moderately sensitive habitat and Class 2 moderate fish habitat. There was no approved access to Isobel Creek in December 2020 survey.

Isobel Creek is located in a broad valley with no water flow at the time of inspection and low to moderate shading of the river. The creek bed had equal amounts of bedrock, boulders, cobbles, pebbles, sand and clay present with only a small percentage of gravel observed. There was limited detritus cover, bank overhang or trailing bank vegetation. The riparian zone varied but was up to 15 metres wide either side of the creek and contained mature trees (planted eucalyptus species) along the watercourse. The riparian vegetation on the northern side of the creek at survey site 14 has been mapped as PCT 796 Derived grassland of the NSW South Western Slopes while the riparian vegetation on the southern side of the creek was mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Technical Paper 1). There was a low-flow channel cut approximately 1 metre wide however the bankfull width varied from 5-13 metres wide with 3-metre-high banks (Plate 5 and Plate 6). Bank erosion and exotic plant invasion (areas of dense Spiny rush (*Juncus acutus*)) were evident along the creek however re-vegetation and fencing of the watercourse was evident. At the time of survey, small (<2m^2), shallow (< 0.2 m) pools over bedrock were observed along the 100 metre reach. This was the only water observed within watercourses crossed by the proposal site during the December 2018 survey. Native macrophytes Knobby club rush (*F. nodosa*) were recorded however this species can survive in drier environments. Isobel Creek lacked macrophytes that would provide potential refuge such as floating, submerged or emergent broad-leaf macrophytes and it did not contain trailing bank vegetation.

Plate 5 Isobel Creek: Survey site 14 facing upstream

Plate 6 Isobel Creek: Survey site 14 facing downstream

4.4.1.4 Run Boundary Creek

Run Boundary Creek, a tributary of Ironbong Creek, crosses the proposal site where it is a 3rd order stream in the Frampton Hills Mitchell Landscape. It is mapped as key fish habitat by DPI. An aquatic assessment of the creek was not possible due to access restrictions. The creek is assumed to have defined banks and based on aerial photography and view from adjoining properties, a riparian corridor is present. This creek has been surmised as being a Type 3 minimally sensitive habitat and Class 3 minimal fish habitat based on the condition of Ironbong Creek upstream on the junction (i.e. survey site 42). The riparian vegetation was not mapped at this site due to access restrictions.

Run Boundary Creek flows 2 kilometres west to its confluence with Ironbong Creek.

4.4.1.5 Ulandra Creek

The proposal site crosses Ulandra Creek near survey sites 27 & 43 where it is a 5th order stream in the Murrumbidgee-Tarcutta Channels and Floodplains Mitchell Landscape. It is mapped as key fish habitat by DPI however following an aquatic habitat assessment, Ulandra Creek (at the survey sites) has been assessed as Type 3 minimally sensitive habitat and Class 3 minimal fish habitat.

Ulandra Creek is located on a floodplain with no water flow at the time of inspection and moderate shading of the river. The creek bed had no bedrock, boulders, cobbles, pebbles or gravel and consisted mainly of sand and clay. There was a small amount of detritus cover but limited bank overhang or trailing bank vegetation. The riparian zone varied but was up to 10 metres wide either side of the creek and contained mature trees. There was no middle stratum vegetation and the lower stratum was sparse and consisted of exotic grasses, including farmed grains Wheat x Rye cereals (*Triticum aestivum x Secale*) and herbs. The riparian vegetation has been mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Technical Paper 1).

The creek banks were up to 3 metres high with evidence of erosion (Plate 7 and Plate 8). The bed of the creek was between 6-9 metres wide and contained snags. Impacts from within the catchment include grazing and agriculture. No aquatic vegetation was present.

Ulandra Creek flows into Ironbong Creek approximately 6 kilometres west of survey site 27, at which point Ironbong Creek becomes a 6th order stream.

Plate 7 Ulandra Creek: Survey site 27 facing upstream

Plate 8 Ulandra Creek: Survey site 27 facing downstream

4.4.1.6 Billabong Creek

The proposal site crosses Billabong Creek at survey site 30 where it is a 6th order stream in the Murrumbidgee-Tarcutta Channels and Floodplains Mitchell Landscape. It is mapped as key fish habitat by DPI however following an aquatic habitat assessment, Billabong Creek (at survey sites 30 & 46) has been assessed as Type 3 minimally sensitive habitat and Class 3 minimal fish habitat.

Billabong Creek is located on a floodplain with moderate shading of the river and no water flow at the time of inspection however a small, shallow (< 50 cm depth) refuge pool was present at survey site 30 during the December 2020 site visit. The creek bed had no bedrock, boulders, cobbles or pebbles and small amount of gravel present is likely from the bridge construction. The substrate consisted mainly of sand and clay. There was a moderate amount of detritus cover but limited bank overhang or trailing bank vegetation. The riparian zone varied but was up to 10 metres wide either side of the creek and contained mature trees within the watercourse (Plate 9 and Plate 10). The riparian vegetation has been mapped as PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Technical Paper 1). The creek banks were 2-6 metres high and showed signs of bank erosion from de-vegetation. The width of the creek varied from 3-10 metres wide and contained snags. Impacts from within the catchment include the existing road and rail crossing (Olympic Hwy) and grazing and agriculture.

From survey site 30, Billabong Creek flows south for approximately 44 kilometres before its confluence with the Murrumbidgee River.

The Murrumbidgee River is the 3rd longest river in Australia, with its catchments located in NSW and the ACT. It flows west to its confluence with the River Murray near Balranald. The River Murray reaches the ocean in South Australia at Lake Alexandrina.

Plate 9 Billabong Creek: Survey site 30 facing upstream

Plate 10 Billabong Creek: Survey site 30 facing downstream

4.5 Fish community status mapping

The *Fish Communities and Threatened Species Distributions of NSW* project (FCTSD) combined data collected over twenty years of biological surveys with standard statistical analysis and spatial distribution models, to provide mapping of the status of fish communities and threatened species distributions across NSW (DPI, 2016). The FCTSD project mapped the status of fish communities across NSW as Very Good, Good, Moderate, Poor, or Very Poor.

Fish community status within watercourses that cross the proposal site as mapped by DPI (Figure 4-2) have the following ratings:

- Bland Creek (poor – very poor)
- Ironbong Creek (poor)
- Ulandra Creek (very poor)
- Billabong Creek (poor)

The FCTSD project also mapped threatened species distributions for some species. Threatened species distribution mapping was used to determine target threatened species (refer Table A2; Appendix A for distribution maps viewed).

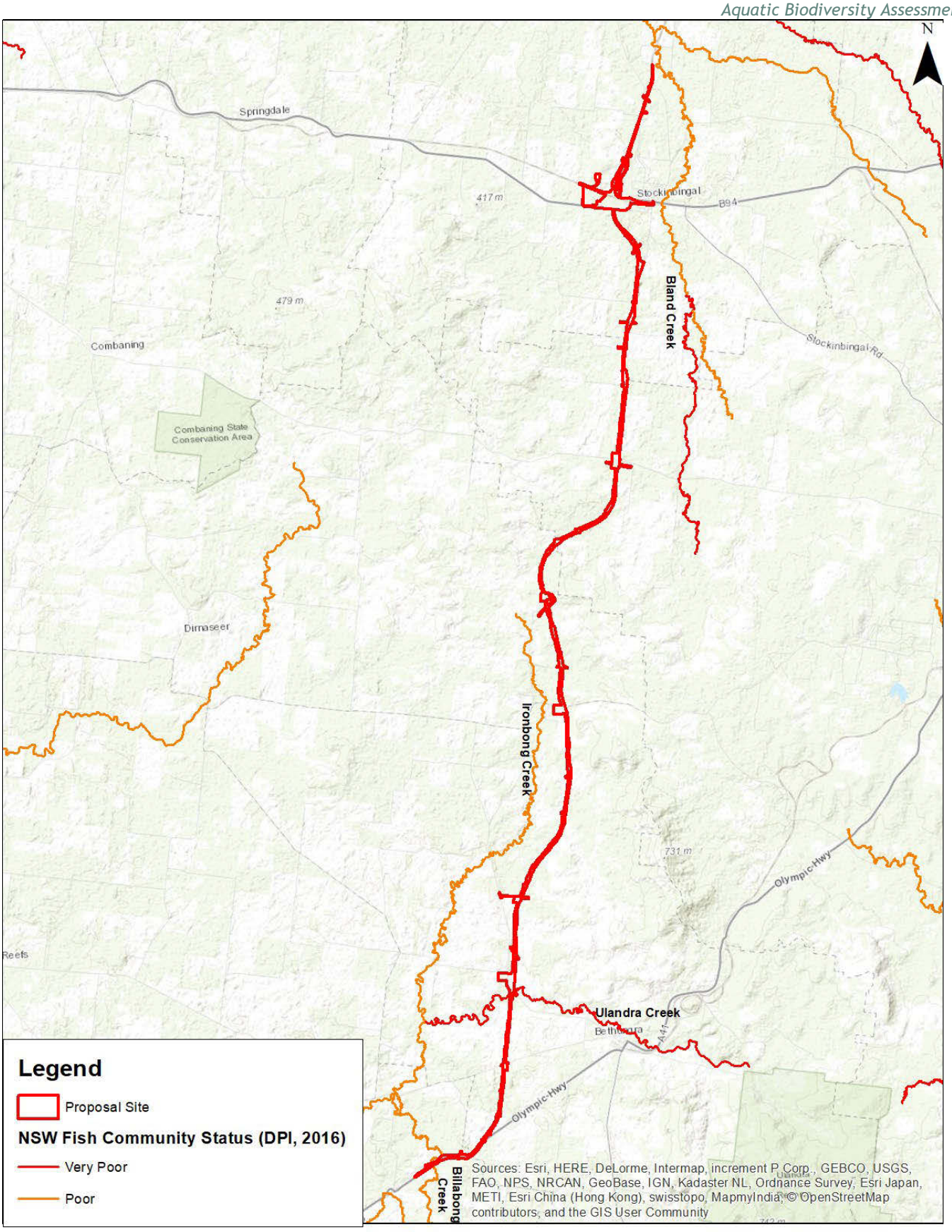

Figure 4-2 Fish community status mapping (DPI)

4.6 Aquatic fauna

As most watercourses at survey sites were dry at the time of the December 2018 field assessment, fauna sampling opportunities were limited. The two survey sites where water was present (14 & 14a) did not have enough water in pools to undertake sampling (< 0.2 m depth). The farm dams within the proposal site did not provide refuge habitat for threatened aquatic fauna however were considered likely to provide habitat for commonly occurring aquatic fauna such as eels, turtles and hardy fish species.

Despite 2020 being an above average year for rainfall, none of the watercourses that cross the proposal site were flowing during the site inspection. A total of five survey/inspection sites within the broader study area were identified as containing small pools suitable for sampling, only one of which was within the proposal site (survey site 30).

Survey techniques utilised were based on the habitat sampled. At all but one site (survey site 44), the remnant pools were small and shallow (< 0.2 m depth) and bait traps were considered the most appropriate sampling technique. Bland Creek (site 44) was the only watercourse with remnant pools of sufficient size to survey using fyke nets.

Capture results are summarised in Table 4-5.

Table 4-5 Fauna capture results

Survey/inspection site	Creek	Capture Results
December 2018		
28	Farm dam	1 Eastern long-necked turtle (*Chelodina longicollis*) 15 European Carp (*Cyprinus carpio*)
35	Farm dam	Nil
35	Spring on an unnamed tributary of Ironbong Creek	Nil
December 2020		
30	Billabong Creek	35 tadpoles
31	Bland Creek	4 tadpoles
42	Ironbong Creek	4 tadpoles; 1 Common Yabby (*Cherax destructor*)
44	Bland Creek	16 tadpoles 5 Eastern long-necked turtle (*Chelodina longicollis*) (Plate 11)
45	Turveys Fall Creek (upstream of Billabong Creek)	37 tadpoles 3 Common Yabby (*Cherax destructor* (Plate 12)

Fauna trapping on watercourses containing refuge pools did not result in the capture any fish species, which is consistent with the poor-very poor fish community status mapping by DPI (2016). Trapping resulted in the capture of Pobblebonk tadpoles *L. dumerilli,* Common Yabby's *C. destructor,* Eastern long-necked turtle *C. longicollis* and the exotic European Carp *C. carpio.*

Other native species commonly likely to occur in farm dams in the study area are the longfin eel (*Anguilla reinhardtii*) and the shortfin eel (*Anguilla australis*) although these were not captured during surveys.

The locations of farm dams were identified from aerial photography (1:10,000 maps). A total of 14 farm dams were identified within the proposal site and construction impact zone, 10 of which have been identified for decommissioning (Figure 4-3 and Figures C1-C15).

Plate 11 Long-necked Turtle *Chelodina longicollis* captured in fyke nets

Plate 12 Common Yabby *Cherax destructor* captured in bait traps

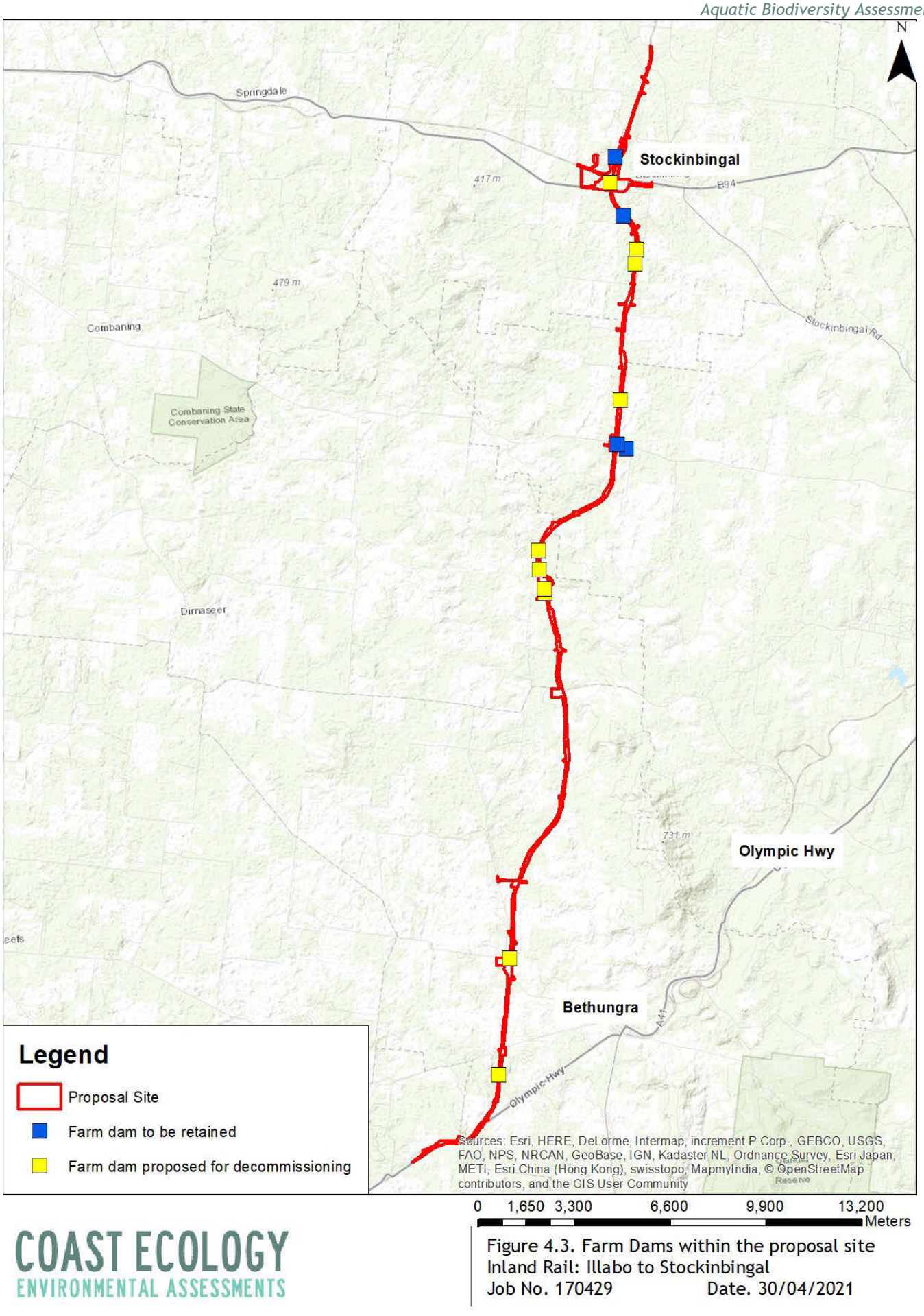

Figure 4-3 Farm dams within the proposal site

4.7 Threatened species and populations

Following review of DPI distribution maps and species Primefacts for listed threatened species under the FM Act (Appendix A), 6 threatened fauna species listed under the FM Act were defined as target species for this assessment:

- Flathead Galaxias *Galaxias rostratus*
- Hanley's River Snail *Notopala hanleyi*
- Murray Crayfish *Euastacus armatus*
- Southern Purple Spotted Gudgeon *Mogurnda adspersa*
- Trout Cod *Maccullochella macquariensis*
- Western population of Olive Perchlet *Ambassis agassizii*.

The PMST (Appendix B) identified four threatened fish species listed under the EPBC Act, which may have potential habitat within the search area:

- Murray Cod *Maccullochella peelii*
- Macquarie Perch *Macquaria australasica*
- Flathead Galaxias *Galaxias rostratus*
- Trout Cod *Maccullochella macquariensis*.

The PMST is a predictive, not record based data set and the proposal area is outside of the indicative distribution of the Macquarie Perch. As such, only the remaining three species were considered target species.

No threatened aquatic species listed under the BC Act have been previously recorded on ALA or BioNet (Appendix A). Seven native non-threatened aquatic species protected under the BC Act previously recorded in the study area include:

- Eastern Snake-necked turtle *Chelodina longicollis*
- Flatback Turtle *Natator depressus*
- Side-neck turtle *Emydura sp*
- Common Yabby *Cherax destructor*
- Freshwater Crayfish *Euastacus sp*.
- Platypus *Ornithorhynchus anatinus*
- Brown Trout *Salmo truttas*.

The likelihood of occurrence of the target threatened aquatic species within the proposal site is considered in Table 4-6.

In summary, the watercourses within the proposal site lacked important habitat requirements for all of the target species such as flowing water, instream macrophytes, bank overhangs, trailing bank vegetation and pool and riffle sections.

Protected species such as native turtles, Common Yabby and Freshwater Crayfish are considered likely to occur in the proposal site however Platypus were considered unlikely to occur.

As such, no further assessment was required.

4.8 Threatened ecological communities

Two aquatic ecological communities listed as endangered under the FM Act occur within the study area:

- Lowland Lachlan River aquatic ecological community
- Lowland Murray River aquatic ecological community.

An assessment of the likelihood of occurrence of these two endangered aquatic ecological communities in the study area is provided in Table 4-6.

In summary, Dudauman Creek is a tributary of Bland Creek and as such, is part of the Lowland Lachlan River aquatic ecological community. However, within the proposal site, Dudauman Creek has minimal to unlikely fish habitat and has been assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Bland Creek as poor-to very poor.

Billabong Creek and its tributaries (Ironbong Creek, Isobel Creek, Run Boundary Creek & Ulandra Creek) are part of the Lowland Murray River aquatic ecological community. Within the proposal site, Billabong Creek and its tributaries have minimal to unlikely fish habitat and have been assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat, with the exception of Isobel Creek, which has been assessed as Type 2 moderately sensitivity key fish habitat and Class 2 moderate fish habitat. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Billabong Creek as poor.

Table 4-6 Habitat likelihood of occurrence in the study area of target threatened aquatic species listed under the *Fisheries Management Act 1994* and/or *Environment Protection & Biodiversity Conservation Act 1999* and protected aquatic species which have been previously recorded in the locality

Species	**Legislative Status**			**Habitat Requirements**	**Likelihood of occurrence in the study area** [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
Flathead Galaxias *Galaxias rostratus*		CE	CE	Flathead Galaxias are a small native fish that are known from the southern part of the Murray-Darling Basin. They have been recorded in the Macquarie, Lachlan, Murrumbidgee and Murray Rivers in NSW. Despite extensive scientific sampling over the past 15 years there have been very few recorded sightings of Flathead Galaxias. They have not been recorded and are considered locally extinct in the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers. The species is now only known from the upper Murray River near Tintaldra and wetland areas near Howlong. They are found in still or slow moving water bodies such as wetlands and lowland streams. The species has been recorded forming shoals. They have been associated with a range of habitats including rock and sandy bottoms and aquatic vegetation.	Low The watercourses in the proposal site are highly ephemeral and there are very limited refuge opportunities during dry periods when there is no water in the creeks. As such, the watercourses crossed by the proposal site are considered unlikely to provide habitat for this species.
Hanley's River Snail		CE	-	Hanley's River Snail is a freshwater snail that was once common and widespread in the	Low

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
Notopala hanleyi				Murray River catchment, including the Lachlan and Murrumbidgee Rivers. They are now virtually extinct throughout their natural range and living specimens have only been found from within irrigation pipelines in South Australia and Far South-West NSW. This species once occurred in flowing, well oxygenated waters throughout the Murray River catchment. Artificially introduced hard surfaces now provide habitat for the species with populations being recorded as surviving in irrigation pipelines.	This species is considered unlikely to occur in the study area. The watercourses in the study area do not provide flowing water suitable for the survival of this species. While irrigation pipes do occur in the study area, this species has only been recorded in irrigation pipelines in South Australia and far South-West NSW, which is outside of the study area.
Murray Cod *Maccullochella peelii*		-	V	The Murray Cod is the largest freshwater fish in Australia. The Murray Cod was historically distributed throughout the Murray-Darling Basin (the Basin), with the exception of the upper reaches of some tributaries. The species still occurs in most parts of this natural distribution up to approximately 1000 m above sea level. The Basin contains approximately 13 245 kilometres of watercourses that may encompass areas of suitable habitat for the Murray Cod. The species' estimated extent of occurrence, based on areas with an average river width of 50m, is 660 km^2.	Low The ephemeral watercourses, including farm dams, within the study area are unlikely to sustain a population of Murray Cod as they lack permanent flows and refuge areas. Similarly, there are no refuge areas upstream of the proposal site to support a population of this species so even during flooding, the watercourses within the proposal site are unlikely to provide habitat for this species. The Office of the Environment distribution map shows a small portion

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW, to slow-flowing, turbid lowland rivers and billabongs. Murray Cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water. They also serve as predatory ambush points for foraging, particularly during the day Riparian vegetation, not only provides an ongoing supply of structural habitat for the Murray Cod in the form of coarse woody debris or snags, but aids stream bank stability and protects riparian soils from water and wind erosion	of Billabong Creek (near survey site 30) as "species or species habitat may occur", however it likely refers to refuge ponds along Jeralgambeth Creek to the west which is outside the proposal site. No refuge areas were observed along Billabong Creek within the proposal site.

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				There have been numerous attempts to translocate hatchery-bred and wild-caught Murray Cod by government authorities, acclimatisation societies and private individuals outside the species' natural range. Many introduced populations persisted for several years though few self-sustaining populations have been established. In NSW, introduced populations persist in Cataract Dam and the Nepean River system (Department of Environment & Energy, undated).	
Murray Crayfish *Euastacus armatus*		V	-	The Murray Crayfish is endemic to the southern tributaries of the Murray-Darling Basin. They can be found in a variety of habitats, ranging from pasture-lands to sclerophyll forest, in a range of stream sizes and throughout a broad altitudinal range. They prefer cool, flowing water that is well oxygenated. The species is tolerant of water temperatures up to 27°C and moderate salinities, but are intolerant to low dissolved oxygen concentrations. They create burrows that vary in complexity, from deep burrows with multiple entrances to simple burrows under a rock or log.	Low The ephemeral watercourses within the study area lack flowing water and refuge areas that are cool and well oxygenated. The watercourses within the proposal site are unlikely to provide habitat for this species.

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				The proposal site is outside of the indicative distribution of the Murray Crayfish in NSW.	
Southern Purple Spotted Gudgeon *Mogurnda adspersa*		E	-	Southern Purple Spotted Gudgeon is a small freshwater fish native to Australia. Two populations of Southern Purple Spotted Gudgeon occur in NSW; an eastern population found in coastal catchments north of the Clarence River, and a western population found throughout Murray-Darling Basin. During the early 1980s, the Murray-Darling Basin population experienced rapid and dramatic reductions in distribution and abundance. The population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. Since all remaining populations in the western region are small, isolated and disconnected from each other, there is limited gene flow between populations. Southern Purple Spotted Gudgeons are now extremely rare in inland NSW, having been recorded from this area only once since 1983. Southern Purple Spotted Gudgeon are a benthic species that can be found in a variety of habitat types	Low While this species occurs in smaller streams with slow moving water, they do require some water and overhanging vegetation and aquatic plants for refuge. The watercourses within the proposal site are not only ephemeral, but they also lack macrophytes and given the retracted distribution of this species, they are unlikely to provide habitat for this species.

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams. They feed mainly on terrestrial insects and their larvae, worms, small fish, tadpoles, and some plant matter.	
Trout Cod *Maccullochella macquariensis*		E	E	The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central NSW. The species was once widespread and abundant in these areas but has undergone dramatic declines in its distribution and abundance over the past century. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal. Trout Cod tend to occupy areas which have lots of large in-stream woody debris or 'snags', which provide complex habitats for each stage of the species' life cycle. They tend to remain at the one site with limited home ranges. Trout Cod are carnivores,	Low The proposal site is upstream of Yarrawonga and watercourses within the proposal site lack suitable habitat such as large instream woody debris and suitable refuge areas during low flow. The proposal site is outside the indicative distribution mapped for this species.

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				preying mainly on crustaceans and aquatic insects but also on other fishes. The proposal site is outside the indicative distribution mapped for this species.	
Threatened Population					
Western population of Olive Perchlet *Ambassis agassizii*		EP	-	The western population of the Olive Perchlet was once widespread throughout the Murray-Darling system of South Australia, Victoria, western New South Wales and southern Queensland. This population has suffered a serious decline and is now found only at a few sites in the Darling River drainage. Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slow flowing or still waters. They are usually found in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night. The proposal site is outside of the current known distribution of this species but is within its historical distribution range.	Low While this species occurs in smaller streams with slow moving water, they do require some water and overhanging vegetation and aquatic plants for refuge. The watercourses within the proposal site lack macrophytes and given the retracted distribution of this species, they are unlikely to provide habitat for this species.

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
Threatened Ecological Communities					
Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River.		EEC	-	The Lowland Catchment of the Lachlan River is part of the Murray-Darling Basin. The lower Lachlan River endangered ecological community includes all fish and aquatic invertebrates within all natural rivers, creeks, streams and associated lagoons, billabongs, lakes, wetlands, paleochannels, floodrunners, effluent streams (those that flow away from the river) and the floodplains of the Lachlan River within the State of New South Wales, and including Lake Brewster, Lake Cargelligo and Lake Cowal. Bland Creek and its tributaries are included in this community. The community has a diverse assemblage of native species including 19 species of fish, 10 species of crustacean, 8 species of mollusc, 2 species of sponges, and many insects. Many water bodies in the lowland Lachlan River catchment are characterised by variable and unpredictable patterns of high and low flows and water levels. The variability in environmental conditions has led to adaptations in the native aquatic flora	Moderate Dudauman Creek is a tributary of Bland Creek and as such, is part of this aquatic ecological community. Within the proposal site, Dudauman Creek has minimal to unlikely fish habitat and following habitat assessment, it has been assessed as Type 3 minimal sensitivity key fish habitat as it lacks habitat features such as in-stream gravel bed, rocks, snags and native aquatic or wetland vegetation and a Class 3 minimal key fish habitat as despite having defined channels, it is highly ephemeral, with no connected wetland areas and semi-permanent waters in pools only for a short time after rain events. Crustaceans and turtles were recorded in ephemeral pools located outside of the proposal site, however the watercourses within proposal site did

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				and fauna. For example, many species rely on floods to trigger spawning and create suitable breeding habitats. The lowland Lachlan River provides a wide range of habitats for fish and invertebrates, including pools, runs or riffles, backwaters and billabongs, in-stream woody habitat, and aquatic plants. The Lachlan River floodplain also provides a mosaic of habitat types, including permanent and temporary wetlands, and terrestrial habitats.	not contain refuge pools capable of supporting these aquatic species. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Bland Creek as poor-to very poor.
Aquatic ecological community in the natural drainage system of the lower Murray River catchment		EEC	-	The lower Murray River endangered ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River (also known as the River Murray) downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria. Excluded from this recommendation are the	Moderate Billabong Creek and its tributaries (Ironbong Creek, Isobel Creek, Run Boundary Creek & Ulandra Creek) are part of this aquatic ecological community. Within the proposal site, Billabong Creek and its tributaries have minimal to unlikely fish habitat and have been assessed as Type 3 minimal sensitivity key fish habitat as they lack habitat features such as in-stream gravel bed, rocks, snags and native aquatic or wetland vegetation and Class 3 minimal key fish habitat as despite having defined channels, they are highly ephemeral, with no connected wetland areas and semi-

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				Lachlan River and the Darling River and their tributaries, and artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs.	permanent waters in pools only after rain events. Isobel Creek was defined as Type 2 moderately sensitive key fish habitat and Class 2 moderate fish habitat as it retained some small pools and recorded sparse native emergent aquatic vegetation, however it is noted that the *F. nodosa* recorded can survive out of aquatic environments and that the remnant pools were unlikely to provide fish refuge during drought as they were very shallow. The NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in Billabong Creek as poor.
Protected species					
Platypus *Ornithorhynchus anatinus*	P			Platypus are found in eastern Australia in a range of habitats from the tropics of far north Queensland to the Tasmania. Platypus make their home in and near freshwater creeks, slow-moving rivers, lakes	Low The BioNet has historical records of this species occurring within the locality, south of the study area closer to the Murrumbidgee River. There are

Species	Legislative Status			Habitat Requirements	Likelihood of occurrence in the study area [b]
Threatened Species	**BC Act**	**FM Act**	**EPBC Act**		
				joined by rivers, and built water storages such as farm dams. They build a simple burrow in a river bank, just above water level and often among a tangle of tree roots. Habitat requirements of the Platypus include a river or a stream with earth banks and native vegetation that provides shading of the stream and cover near the bank. The presence of logs, twigs, and roots, as well as cobbled or gravel water substrate are also required for foraging of microinvertebrates, which is their main food source (Divljan, 2019).	no past records of this species occurring within the proposal site. The watercourses within the proposal site are considered highly unlikely to provide habitat for the Platypus as they lack suitable habitat features for foraging such as roots, cobbles and gravel substrate. The main limiting factor however is the highly ephemeral nature of the watercourses in the proposal site. As the watercourses are dry for most of the year, they are unable to provide the aquatic habitat required by this species. Farm dams within the proposal site are also considered unlikely to provide habitat for Platypus as they are highly turbid, devoid of native vegetation and do not have suitable habitat to provide foraging opportunities for this species.

[a] Information on species, populations and endangered ecological communities was obtained from DPI website (www.dpi.nsw.gov.au/fishing/species-protection/what-current) and associated Primefacts unless otherwise stated. CE=Critically Endangered, E=Endangered, V=Vulnerable, EP=Endangered Population, EEC=Endangered Ecological Community under FM Act and EPBC Act.

[b] In line with DPI definition, 'Fish' also includes freshwater, estuarine and marine aquatic invertebrates (such as crustaceans, molluscs and polychaetes), as well as marine vegetation, including saltmarshes, mangroves, seagrasses and macroalgae.

4.9 Matters of national environmental significance

The results of a search of the online PMST are provided in full in Appendix B and summarised in Table 4-7. Terrestrial threatened and migratory species and terrestrial EEC's are considered in the BDAR ((Technical Paper 1). Only MNES relating to the aquatic environment are considered further in this aquatic assessment.

Table 4-7 Matters of national environmental significance within the study area and a 10 kilometre buffer

MNES	Results of PMST Report	Relevance to the Aquatic Assessment
Listed threatened species	40	Four of the 40 threatened species are fish: • Murray Cod (V) • Macquarie Perch (E) • Flathead Galaxias (CE) • Trout Cod (E) Macquarie Perch were not a target species as the proposal site is outside of its range (Appendix A). Table 4-6 assessed the likelihood of occurrence of the remaining three species within the study area as low.
Listed Threatened Ecological Communities	5	The five TECs are terrestrial and have been assessed in the BDAR (Technical Paper 1).
Listed Migratory species	11	All migratory species are birds and have been assessed in the BDAR (Technical Paper 1)
Ramsar wetlands of international importance	4	Refer to section 4.9.1
Commonwealth Marine Area	None	N/A
World Heritage properties	None	N/A
National Heritage places	None	N/A
Great Barrier Reef Marine Park	None	N/A

4.9.1 Ramsar listed wetlands

The PMST (Appendix B) identified that the proposal site and 10-kilometre buffer occur within the catchment of four Ramsar wetlands of international importance:

- Banrock Station wetland complex
- Hattah-kulkyne Lakes
- Riverland
- the Coorong, and Lakes Alexandrina and Albert wetland.

All international wetlands of importance occur greater than 400 kilometres from the proposal site and have not been considered further.

4.10 Groundwater dependent ecosystems

The Groundwater Impact Assessment (Technical paper 6) identified two existing groundwater sources within the study area:

- the Lachlan fractured rock groundwater source governed by the Murray-Darling Basin Fractured Rock water sharing plan (fractured rock)
- the Lachlan alluvium governed by the Lachlan Unregulated and Alluvial water sources water sharing plan (Lachlan alluvial).

The NSW Office of Water definition of a groundwater dependent ecosystem (GDE) is:

'Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater.'

Based on these definitions, GDEs include any ecosystem that uses groundwater at any time or for any duration to maintain its composition and condition.

The Bureau of Meteorology's GDE Atlas identify four high potential aquatic GDEs which the proposal site crosses:

- Billabong Creek
- Ulandra Creek
- Ironbong Creek
- Dudauman Creek.

Further details regarding aquatic GDEs are available in Technical paper 6 and terrestrial GDEs are discussed in the BDAR (Technical paper 1).

5. Impact assessment

Potential construction and operational impacts of the proposal on watercourses within the proposal site are considered in section 5.1 and section 5.2 respectively. These potential impacts are further considered in the assessment of impacts on sensitive land and threatened species, populations and EEC's listed under State and Commonwealth legislation.

5.1 Construction

Impacts on the aquatic environment at watercourses within the proposal site resulting from construction of the proposal include:

- removal of riparian corridor vegetation
- removal of instream vegetation and large woody debris
- temporary obstruction of fish passage during construction
- impacts on water quality
- loss of habitat for aquatic species in farm dams within the proposal site
- an increase in the rate of spread of exotic macrophyte species.

5.1.1 Removal of riparian corridor vegetation

The riparian corridor forms a transition zone between the land and the watercourse. The protection, restoration or rehabilitation of riparian corridors is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of a watercourse (DPI, 2012).

The riparian corridor reduces the risk of erosion by reinforcing and increasing cohesion of the soil, and by providing a protective surface matting. Vegetation also uses water in the banks and increase the drainage of the soils which reduces the risk of bank failure due to heavy saturated soils. The riparian corridor and the associated layer of litter and debris also increases channel roughness, slowing the flow and reducing the capacity of the flowing water to erode and transport sediment.

Most pollutants and nutrients are attached to sediment particles and riparian vegetation plays an important role in trapping this sediment and associated nutrients and pollutants before they reach the channel. The potential impacts to water quality are discussed further in section 5.1.4. The wider the riparian corridor buffer zone, the more effective it is at trapping sediment.

The riparian corridor also plays an important role in ecological function. Healthy, native riparian vegetation reduces the water temperature of aquatic habitats by shading. Without shading, water temperature increases, which can result in unfavourable conditions and can lead to fish kills.

Impacts of the proposal includes clearing of riparian corridor vegetation, which is environmentally sensitive land (i.e. waterfront land as defined under the WM Act). The total area of the proposal site is 369.35 hectares and within the proposal site, 55.37 hectares of vegetation (including exotic and planted species) requires clearing for the proposal. The proposed works require the clearing of 4.94 hectares of riparian corridor (on waterfront land) as summarised in Table 5-1 and shown in Figures C1-C15 (Appendix C). This represents 8.6 percent of the total vegetation to be cleared as part of the proposal.

Degradation of native riparian vegetation along New South Wales watercourses is listed as a KTP under the FM Act and is considered further in section 5.6.

Table 5-1 Area of clearance of riparian vegetation in the proposal site

Vegetation Communities Occurring within 40 m buffer of Watercourse	Area of Permanent Impact (ha)
Miscellaneous Ecosystem (Planted vegetation)	0.10
Miscellaneous Ecosystem (Exotic species)	0.04
PCT 266 White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	0.31
PCT 276 Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	0.04
PCT 277 Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	1.51
PCT 309 Black Cypress Pine - Red Stringybark - red gum - box low open forest on siliceous rocky outcrops in the NSW South Western Slopes Bioregion	0.05
PCT 5 River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion	2.33
PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	0.27
PCT 796 Derived grassland of the NSW South Western Slopes	0.18
PCT 80 Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	0.11
Total	**4.94**

5.1.2 Removal of instream vegetation/large woody debris

Large woody debris and macrophytes within the stream provides shelter, feeding and spawning habitat for many native birds, fish and invertebrates. Instream or aquatic vegetation is also effective at water purification by further removing nutrients.

Instream vegetation in the proposal site consisted mainly of exotic grasses and herbs. In addition, the exotic Spiny Rush *Juncus acutus* was recorded at a number of survey sites including along Dudauman Creek, Ironbong Creek and its tributaries, Isobel Creek and Billabong Creek. Native macrophytes recorded at survey sites were very limited, with Cumbungi *Typha sp* recorded along a 2nd order tributary of Ironbong Creek and native rushes (*Ficinia nodosa* and *Juncus sp*). recorded along Isobel Creek. As such, the impacts of the proposal on macrophytes would be minimal.

Removal of large woody debris (snags) is a KTP under the FM Act and is considered further in section 5.6.

5.1.3 Obstruction of fish passage

While all of the watercourses crossed by the proposal site have been defined as ephemeral, they have the potential to connect isolated water bodies to defined watercourses during times of flow. Fish passage along our watercourses is critical to the survival of Australian native fish and maintaining fish passage in KFH is a requirement of DPI policy and guidelines (Fairfull and Witheridge, 2003). Species of both fresh and saltwater fish move within waters at different times to access food and shelter, to avoid

predators, and to seek out mates to breed and reproduce. Examples of the various types and reasons for fish movement include:

- local movement to access food, avoid predators and shelter during daylight
- daily movement to access habitat, food and shelter, defend territory and avoid predators
- seasonal movement to complete part of their breeding cycle in response to rising water levels or temperatures
- upstream movement to access new habitats or established spawning areas
- downstream movement post-spawning and to avoid predators
- lateral movement to access food, complete their breeding cycle and for juvenile recruitment to habitat areas (Fairfull and Witheridge, 2003).

Potential impacts to fish passage during construction phase include earthworks or placement of structures that physically block the creek or installed erosion and sediment control measures, all of which may prevent fish passage during times of flow.

Temporary culvert crossings are required for dry weather access across Isobel Creek and Powder Horn Creek. The temporary culvert crossings would typically consist of one or more sections of pipe covered or embedded in a suitable rock and aggregate embankment formed as a bridging structure across an open channel. While the establishment of temporary culvert crossings will minimise the risk of direct contamination of stream flow by construction traffic, they may also temporarily impact fish passage during times of flow.

Isobel Creek and Powder Horn Creek are ephemeral, generally lacked instream fish habitat features such as remnant pools capable of supporting fish, instream aquatic vegetation, bank overhangs and trailing bank vegetation. As such, the sites were defined as moderately and minimally sensitive KFH and the risk of impact to aquatic biodiversity because of temporary crossings at these sites is considered low.

5.1.4 Impacts on water quality

There is potential for increased turbidity (increased suspended solids) in receiving waters during construction following sediment disturbance and subsequent rainfall events. High turbidity in receiving waters results in shading of macrophytes which limits their ability to photosynthesise, leading to vegetation dieback. High turbidity can directly impact fauna by clogging the filter apparatus of filter feeding aquatic fauna or blocking the gills of fish, preventing oxygen flow leading to fauna mortality. High turbidity can also make it difficult for fish to see and catch prey, and it may bury and kill eggs laid on the bottom of rivers.

Excess nutrients mobilised from the soil can result in algal blooms in receiving waters, which can affect fish because when large amounts of algae die, oxygen is used up to decompose them, leaving less oxygen for the fish.

Potential pollution impacts on the aquatic environment are mainly associated with management of stockpiles, compounds, refuelling methods and spills/leaks of fuel or hydraulic fluids from heavy machinery during operation.

Pollutants spilled into ephemeral watercourses can collect along the banks and become mobilised following rainfall events. Pollutants such as petroleum, diesel, hydraulic fluids and oils can impact freshwater organisms, particularly microorganisms, invertebrates and vegetation, resulting in a level of toxicity and sometimes mortality. The effects of toxicity and mortality can move up the food chain and indirectly impact higher order species such as fish, birds and mammals.

The Water Quality Impact Assessment Report (Technical Paper 5) concluded that while there are potential risks for impacts to water quality during construction and operation of the proposal, appropriate soil and water construction management measures will minimise

any potential impacts during construction and recommended mitigation measures will result in a low likelihood of ongoing impact to watercourses and sensitive receiving environments during operation.

5.1.5 Farm dams

There are 14 farm dams located within the proposal site and 10 have been identified for decommissioning (Figure 4-3). The dams may contain protected native species such as turtles and eels. These dams will require dewatering and as such, will result in a loss of aquatic habitat for non-threatened aquatic species. The dewatering process also has the potential to impact water quality in receiving waters, through the input of mobilised sediments and associated nutrients and pollutants (refer section 5.1.4).

5.1.6 Spread of exotic aquatic weeds

Due to the highly ephemeral nature of the watercourses in the proposal site, limited aquatic vegetation was recorded during surveys. The exotic Spiny Rush *J. acutus* was however recorded at several sites. This species is highly adaptable, and its distribution is not restricted to areas of permanent or semi-permanent water. The spread of exotic aquatic weeds such as Spiny Rush *J. acutus* is potentially accelerated by construction activities and machinery moving across the proposal site. Spiny rush is regarded as a serious environmental weed in NSW as infestations can obstruct water flow, out complete native aquatic species and can reduce the productivity of pastures.

5.2 Operation

During the operational phase of the proposal, the proposed railway line and upgrades would be complete and cleared areas would be landscaped and stabilised as required. Areas with high risk of soil erodibility would be stabilised and therefore there would be little or no risk of soil erosion and subsequent transport of sediment into nearby watercourses.

Impacts on the aquatic environment at sites within the proposal site resulting from operation phase of the proposal include:

- obstruction of fish passage
- impacts on water quality
- an increase in the rate of spread of exotic macrophyte species.

5.2.1 Blockage of fish passage

As discussed in section 5.1.3, maintaining fish passage is important to the survival of Australian native fish. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams is also listed as a KTP under the FM Act.

Bridges and arch structures generally have the least impact on fish passage as they normally involve limited disturbance to the flow or the aquatic habitat of a watercourse, however potential impacts include:

- potential to cause knickpoints and erosion of the stream bed associated with turbulence around bridge piers
- increased flood flow velocities
- changes to in-stream and bank vegetation affecting water shading, habitat values and water velocities
- blockage of fish passage along floodplains caused by elevated approach roads
- limited light penetration under the bridge deck creating a nonphysical barrier for some fish species that may avoid dark areas during daylight hours (Fairfull & Witheridge, 2003).

A culvert uses a pipe or box shaped cell to allow water to pass underneath a roadway. Flow conditions can be significantly modified both within and immediately adjacent to these crossings resulting in reduced opportunities for fish passage over a wide range of flow conditions. At worst culverts can cause a complete blockage to fish passage for all flow conditions. The most common fish passage problems associated with both pipe and box culverts include:

- excessive flow velocities within the culvert
- inadequate flow depth within the culvert
- excessive water turbulence
- debris blockage of the culvert
- excessive culvert length and a lack of aquatic habitat and "rest" areas within the culvert
- inadequate lighting within the culvert
- excessive variation in water level across the culvert outlet (waterfall effect; Fairfull & Witheridge, 2003).

All watercourse crossings, even "fish friendly" crossings, have the potential to impact upon the natural passage of aquatic and terrestrial wildlife. Table 5-2 considers the suitability of the proposed bridge designs and compliance with fish friendly crossing designs for watercourses mapped as KFH and Figure 1-2 and Figures C1-C15 (Appendix C) shows the location of proposed bridges (over watercourses) and culverts. The proposed bridge crossings are above the minimum watercourse crossing requirement for their respective watercourse Class. The proposed culverts also meet DPI design requirements as they are on 1st or 2nd order streams defined as Class 4 unlikely key fish habitats on which fish friendly watercourse crossing designs are potentially unwarranted (Fairfull and Witheridge, 2003).

Sixteen watercourses along the proposal site were defined as Class 4 Unlikely fish habitat, which do not require any specific design treatments. Five watercourses were defined as Class 3 Minimal key fish habitat. The minimum recommended crossing type is a culvert or ford, with the minimum design using the “low flow design’ procedures; however, “high flow design” and “medium flow design” should be given priority where possible. In all cases bridges are preferred to arch structures, culverts, fords and causeways (in that order) (Fairfull and Witheridge, 2003). With the exception of one of the Dudauman Creek crossings, the proposal includes bridges across all five of these watercourses, which is the preferred structure.

One Class 2 watercourse was identified within the proposal site (Isobel Creek). The minimum recommended crossing type is a bridge, arch structure, culvert or ford. The proposal includes a bridge at this location, which meets the minimum requirements.

No Class 1 watercourses were identified within the proposal site.

Crossing structures such as culverts or bridges are often blocked by debris during flooding, and without maintenance may obstruct fish passage.

Table 5-2 Bridge compliance with DPI design requirements

Bridge Location	Stream Order	Watercourse Class	Meets minimum requirement for watercourse class?
Billabong Creek Underbridge	6th	3	Yes
Ulandra Creek Underbridge	5th	3	Yes
Run Boundary Creek Underbridge	3rd	3	Yes
Isobel Creek Underbridge	3rd	3	Yes
Isobel Creek Tributary Underbridge	2nd	3	Yes
Powder Horn Creek Underbridge	3rd	4	Yes
Powder Horn Creek Tributary Underbridge	2nd	4	Yes
Dudauman Creek Underbridge	3rd	3	Yes

5.2.2 Impacts on water quality

For the operational phase, the risks include potential downstream impacts on water quality from mobilisation of stormwater runoff from new impervious surfaces, as well as from possible leaks or spills from maintenance vehicles on the permanent access tracks or from cargo in train carriages. Maintenance works required during the life of the proposal could also result in dispersion of sediment, pollutants and pesticides from weed control and minor vegetation clearing.

It is anticipated, however, that train operations would be carried out in accordance with ARTC protocols and standards that would ensure appropriate maintenance and usage of the rail. Accidental pollution due to train operations would therefore be negligible and is unlikely to impact watercourses. Additionally, the likelihood of an accidental spill from a train derailment is very low as the rail track would be maintained in accordance with ARTC protocols and standard control measures would be in place to avoid such an event.

The Water Quality Impact Assessment Report (Technical Paper 5) concluded that while there are potential risks for impacts to water quality during operation, recommended mitigation measures will result in a low likelihood of ongoing impact to watercourses and sensitive receiving environments.

5.2.3 Spread of exotic aquatic weeds

The spread of exotic Spiny Rush *J. acutus* is potentially accelerated by constant passing of trains and maintenance vehicles.

5.3 Threatened species, endangered populations and TECs assessed under the FM Act

Following a site inspection and likelihood of occurrence assessment, target threatened species and the endangered populations were considered to have a low likelihood of occurrence in watercourses in the proposal site (Table 4-6). Therefore, no impacts on these species are anticipated and no further assessment of the impact of the proposal on these aquatic threatened species and/or population is required.

The proposal site intersects two aquatic ecological communities listed as endangered under the FM Act:

- aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River
- aquatic ecological community in the natural drainage system of the lower Murray River catchment.

An assessment of significance for the two aquatic ecological communities (Table 5-3) concluded that the proposal is unlikely to have a significant impact on these aquatic ecological communities.

Table 5-3 Assessment of significance of impact of the proposal on threatened species listed under the BC Act (7 part test)

Seven Part Test of Significance	Assessment
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;	As the proposal site does not provide potential habitat for any threatened aquatic species, an assessment of significance of impact in accordance with the FM Act is not required.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	As the proposal site does not provide potential habitat for any threatened aquatic populations, an assessment of significance of impact in accordance with the FM Act is not required.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed; I. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and II. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;	The proposal intersects watercourses that are part of the natural drainage system of the lowland catchment of the Lachlan River and lower Murray River. All of the watercourses are at the upper extent of the catchment of the two ecological communities and have been modified by: • clearing in the catchment for farming (grazing and agriculture) resulting in altered creek bed composition • clearing of remnant native vegetation in the riparian zone (despite recent efforts of riparian rehabilitation at some sites) • ongoing bank erosion from cattle grazing • instream structures associated with road and railway crossings. The proposal would require localised disturbance of watercourses within the proposal site for the installation of crossing structures and will include clearance of adjoining riparian vegetation. The rehabilitation plan will address areas of rehabilitation. The proposed watercourse structures would be designed to avoid blockage of fish passage, minimise disturbance of remnant vegetation upstream and downstream of the work area and minimise changes to the morphology of the watercourse. Appropriate erosion and sediment control measures would be installed prior to the commencement of works to minimise turbidity in receiving waters during and after works. As such, the proposal is unlikely to: • have an adverse effect on extent of these ecological communities such that its local occurrence is likely to be place ad risk of extinction; or • substantially and adversely modify the composition of the community.

Seven Part Test of Significance	Assessment
d) in relation to the habitat of a threatened species, population or ecological community; i. the extent to which habitat is likely to be removed or modified as a result of the action proposed; ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;	The proposal would require localised disturbance of the watercourse to install watercourse crossing structures and will include clearance of adjoining riparian vegetation. The maximum extent of disturbance to riparian vegetation in the proposal site is 4.94 hectares as discussed in section 5.1.1. Disturbance is limited to the proposal site and construction impact zone. This represents a minimal to negligible area of both of the ecological communities. The watercourse structures would be designed to avoid blockage of fish passage and minimise disturbance of remnant vegetation upstream and downstream of the work area. The proposal intersects the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River* in the Bland Creek catchment, as defined by the determination. A tributary of Bland Creek within the proposal site includes Dudauman Creek which was assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat. This watercourse is considered of only minor importance to the long-term survival of the ecological community in the locality. The proposal intersects the *Aquatic ecological community in the natural drainage system of the lower Murray River catchment* along Billabong Creek, as defined by the determination. Tributaries of Billabong Creek within the proposal site include Ironbong Creek tributaries, Isobel Creek, Run Boundary Creek & Ulandra Creek. Within the proposal site, Billabong Creek and its tributaries have minimal to unlikely fish habitat and have been assessed as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat (with the exception of Isobel Creek which has been assigned a higher Type and Class as it contains remnant pools, albeit small, during drought). As such, they are considered of only minor importance to the long-term survival of the ecological community in the locality. In addition, the NSW fish community status mapping (DPI, 2016) rated the condition of fish communities in the watercourses in the proposal site as poor-to very poor (i.e. Bland Creek and Billabong Creek). With the exception of Billabong Creek, no other watercourses within the proposal site were mapped has having potential to provide habitat for fish communities (DPI, 2016).
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);	No critical habitat has been identified in the proposal site.

Seven Part Test of Significance	Assessment
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and	Priority action statements for Lowland Darling River and Lowland Lachlan River include following recovery actions: • provide advice to consent and determining authorities and management authorities regarding habitat protection and threatened species provisions to assist the decision-making process • collate and review existing information in relation to native species and their distribution • community and stakeholder liaison, awareness and education • implement and enforce relevant fishing regulations and improve reporting of illegal activities • ensure that information on native species is considered in state and national management programs for introduced species and diseases • review regulatory and voluntary incentive-based mechanisms to enhance habitat protection • implement habitat rehabilitation priorities • pest eradication and control • continue research and monitoring of distribution and abundance of native species, their biology and ecology • stocking/translocation • survey and mapping to facilitate habitat rehabilitation projects. The proposal would require the installation of watercourse structures designed and constructed in accordance with the national guidelines *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003). This is in keeping with recovery actions.

Seven Part Test of Significance	Assessment
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The proposal may contribute to the following key threatening processes: • installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams (section 5.2.2) • degradation of native riparian vegetation (section 5.1.1) • removal of large woody debris (section 5.1.2). The proposal may require removal of large woody debris in the proposal site. Woody debris was recorded at survey sites along Dudauman Creek, Ulandra Creek and Billabong Creek. Any large woody debris in the proposal site would be relocated upstream or downstream. The above threatening processes would be minimised through appropriate design of the watercourse crossing structures and avoiding/minimising disturbance of riparian vegetation and site rehabilitation.

5.4 Matters of national significance assessed under the Commonwealth EPBC Act

No nationally listed threatened aquatic species, endangered populations, TECs or aquatic migratory species are expected to occur in the watercourses within the study area and therefore no impacts are predicted.

Accordingly, an assessment of the impact of the proposal on matters of national significance is not required.

5.5 Impacts on sensitive land

5.5.1 Protected areas

Under the *National Parks and Wildlife Act 1974* (NPW Act) and the *Marine Estate Management Act 2014* (MEM Act), protected areas include NSW marine parks and aquatic reserves. The National Parks and Wildlife Service (NPWS) is responsible for management of NSW National Parks and other conservation reserves.

The proposal would not impact on any protected area managed by NPWS or DPI because:

- the proposal is not located in the coastal region of NSW and therefore would not impact any marine parks
- no aquatic reserves are located within the study area
- the proposal does not traverse any national parks or conservation areas. The closest national park, Jindalee National Park, is located approximately 13 kilometres east of the proposal at its nearest point at Stockinbingal.

Forestry Corporation of NSW is responsible for managing State Forests. The proposal site does not cross any State Forests.

5.5.2 Key fish habitat

As described in section 4.4, the proposal crosses 32 mapped hydrolines, 5 of which are mapped by DPI as KFH:

1. Dudauman Creek
2. Powder Horn Creek
3. Isobel Creek
4. Run Boundary Creek
5. Ulandra Creek
6. Billabong Creek.

Following site inspections, except for Isobel Creek which was defined as Type 2 moderately sensitive KFH, all other watercourses that crossed the proposal site were defined as Type 3 minimally sensitive KFH. None of the watercourses are permanently flowing (perennial) and all are defined as ephemeral. Potential impacts to these minimally to moderately sensitive KFHs are as follows:

- Permanent built structures within KFH areas in ephemeral streams are expected to be negligible as all water crossing structures proposed are bridges, and depending on the size of the bridge, instream pylons may or may not be required. Where required, the proposal design and location, construction methodology and mitigation strategy has aimed to minimise disturbance of habitat features as far as practicable.
- Some permanent clearance of riparian vegetation may be required on the banks of ephemeral watercourses however it would be managed through the rehabilitation strategy. Riparian vegetation would also be re-established where practicable within the riparian zones which are not within in the operational corridor.

- No direct impacts on important instream habitat features such as riffle sections or aquatic vegetation is expected as these features are largely absent from the watercourses that cross the proposal site.
- Removal of large woody debris would be temporary and would be reinstated upstream or downstream of the area of impact.
- No indirect impacts to aquatic habitat due to sedimentation or changes in water quality is expected as all water crossing structures across ephemeral watercourses would be built when the streambed is dry, and erosion and sediment controls would be established prior to any construction activities in accordance with the soil and water management plan.

The potential impacts on downstream receiving watercourses that occur outside of the proposal site but have tributaries crossed by the proposal site (i.e., Ironbong Creek and Bland Creek), are also highly ephemeral and as such, indirect impacts due to sedimentation or changes in water quality are unlikely.

As the fish habitat in watercourses that cross the proposal site does not include highly sensitive KFH, and consists mainly of minimally sensitive KFH, the proposal is unlikely to permanently impact or disrupt areas of KFH and therefore no aquatic biodiversity offsets would be required under the FM Act.

Opportunities to enhance fish habitat include log revetment works and/or re-snagging within the bed of the watercourse, potentially using riparian vegetation removed during construction. Other fish habitat enhancement opportunities include bank stabilisation through revegetation to improve water quality.

5.5.3 Waterfront land

The construction and operation of the proposal would involve works on the bed and bank of watercourses and all land in the construction zone which is within 40 metres of the riverbanks. Activities that are expected to impact waterfront land include:

- riparian vegetation clearing (4.94 ha)
- instream works
- earthworks, including cuttings and embankments and movement/use of vehicles across exposed soil
- construction compounds and associated activities.

Where possible, the construction footprint would be minimised to reduce clearing in the riparian corridor and practises would be implemented to minimise disturbance of the banks. Bank stabilisation would also be undertaken after installation of water crossing structures as part of the rehabilitation plan.

5.5.4 Lands or waters identified as critical habitat under the FM Act

There are no areas identified as ‘critical habitat’ within the proposal site.

5.6 Key threatening processes

Eight KTPs are listed under the FM Act however only three are of relevance to the proposal:

1. Degradation of native riparian vegetation along New South Wales water courses

A total of 4.94 hectares of riparian corridor would be impacted by the proposal. This represents 8.6% of the total vegetation within the proposal site that requires clearing. A rehabilitation plan would be incorporated into the construction documentation in accordance to minimise the impacts of removal of riparian corridor. As such, the proposal is unlikely to significantly contribute to this KTP.

2. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

The proposal includes 8 new bridges at watercourses, 88 new and existing cross drainage culverts below the rail formation and 27 longitudinal drainage culverts below level crossings. These would be designed in accordance with DPI fish passage guidelines and all crossing structures proposed are above the minimum recommended crossing type (Fairfull and Witheridge, 2003). As such, the proposal is unlikely to significantly contribute to this KTP.

3. Removal of large woody debris from New South Wales rivers and streams

Large woody debris removed from watercourses within the proposal site would be reinstated upstream or downstream of the area of impact. Relocated debris would be aligned so that it points downstream to deflect water towards the centre of the stream (DPI, 2013). As such, the proposal is unlikely to significantly contribute to this KTP.

In addition, fish habitat enhancement opportunities have been recommended using log revetment works and/or re-snagging within the bed of the watercourse, potentially using riparian vegetation removed during construction.

5.7 Groundwater dependent ecosystems

Five primary risks on groundwater and subsequently GDEs, resulting from the construction and operation of the proposal were identified in Technical Paper 6:

- groundwater take (dewatering)
- changes to groundwater flow paths or groundwater discharge impacting surface water and groundwater quality
- degradation of water quality through the movement of potentially existing contamination plumes within the groundwater environment
- contamination of groundwater from construction activities during the construction phase and maintenance procedures during the operational phase
- changes to groundwater recharge through altering surface infiltration.

The impact of the proposal on the underlying groundwater sources was assessed to contain a negligible to low risk to the groundwater environment during both construction and operation. This is principally due to the proposal's cut depths not anticipated to intersect the regional groundwater table for the Lachlan alluvial or Fracture rock groundwater sources. In addition, groundwater is currently not a preferred option to be used to support water supply for construction.

The potential groundwater impacts were assessed against the minimal impact considerations of the NSW Aquifer Interference Policy, with the predicted impacts anticipated to be less than level 1 impact considerations.

Potential risks and mitigation measures are discussed further in in Technical Paper 6.

6. Mitigation measures

6.1 Approach to mitigation and management

Environmental management for the proposal would be carried out in accordance with the approach detailed in Chapter 27 (Approach to environmental management and mitigation) of the EIS.

This would include a biodiversity management-plan, a rehabilitation strategy and a soil and water management plan, all of which would be prepared as part of the Construction Environmental Management Plan (CEMP) and an operational environmental management framework (EMF).

6.2 Summary of mitigation measures

The mitigation measures to manage impacts to aquatic biodiversity from the proposal during detailed design / pre-construction, construction and operation phases are outlined in Table 6-1.

Table 6-1 Proposal specific mitigation measures for aquatic biodiversity

Issue/impact	Mitigation and management measure	Project phase
Impacts on fish passage	Watercourse crossing structures, both temporary and permanent in nature, would meet Inland Rail design standards and be designed in accordance with Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull, S. and Witheridge, G., 2003) and Policy and Guidelines for fish habitat conservation and management (DPI, 2013) as far as practicable.	Detailed design / pre-construction
Managing the potential for biodiversity impacts during construction	Pre-clearing surveys would be undertaken prior to construction by a suitably qualified ecologist in accordance with the biodiversity management plan. Specific surveys would include: • aquatic fauna salvage in watercourses or residual pools within 50 metres of the construction footprint, and in areas that would be enclosed by silt curtains (eg. piling locations).	Detailed design / pre-construction
Managing the potential for biodiversity impacts during construction	Clearing extents/site boundary/limit of works would be consistent with project extents defined in a condition of approval.	Detailed design / pre-construction
Managing the potential for biodiversity impacts during construction	The clearing extents/site boundary/limit of works would be clearly defined with flagging or marking tape, signage or other suitable means to delineate no go areas. This delineation and marking process would align with the project flagging/marking tape process and specifications.	Detailed design / pre-construction
Managing the potential for biodiversity (aquatic) impacts during construction	Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable by establishing appropriate setback distances.	Detailed design / pre-construction

Issue/impact	Mitigation and management measure	Project phase
Water quality	The construction impact zone defined for the project would allow sufficient room for provision of temporary and permanent erosion and sediment control measures/pollution control measures where required based on consideration of overland flow paths and flood risk.	Detailed design / pre-construction
Managing the potential for biodiversity impacts during construction	A biodiversity management plan would be prepared prior to construction and implemented as part of the CEMP. The plan would include measures to manage biodiversity and minimise the potential for impacts during construction. The plan would be prepared in accordance with relevant legislation, guidelines and standards. The plan would include, but not be limited to: • locations and requirements for pre-clearing surveys, including terrestrial and aquatic habitats • an unexpected finds protocol • measures to manage biosecurity risks in accordance with the *Biosecurity Act 2015* • measures to reduce the risk of terrestrial and aquatic fauna mortality/injury.	Construction
Rehabilitation of vegetation subject to temporary disturbance	A rehabilitation strategy would be prepared to guide rehabilitation planning, implementation, monitoring and maintenance of disturbed areas once construction is complete. The strategy would include clear objectives for rehabilitation of native vegetation in temporary disturbances areas and in riparian areas.	Construction
Managing the potential for biodiversity (aquatic) impacts during construction	Scheduling of construction activities to minimise time of works in or adjacent to drainage lines and waterfront land (creek bed and land within 40 metres of the highest bank of the watercourse (DPI, 2012), particularly during periods of flow.	Construction
Managing the potential for biodiversity (aquatic) impacts during construction	Where it is not practicable to work in the dry, a sediment or silt curtain attached to the same sides of the bank and around the works area would be installed for erosion and sediment control and to maintain fish passage.	Construction
Sedimentation and erosion management	A soil and water management plan would be prepared and implemented as part of the CEMP. The plan would include measures, processes and responsibilities to minimise the potential for soil and water impacts (including impacts to groundwater and geomorphology) during construction.	Construction

Issue/impact	Mitigation and management measure	Project phase
Dewatering of farm dams that require relocation and/or decommissioning	A dam dewatering protocol would be developed as part of the soil and water management plan. It would consider: • options for reuse of water in the dam • licensing and approval requirements, where relevant • the quality and quantity of the water to be released, where relevant • strategies to minimise impacts on native, threatened or protected species • strategies to minimise spread of nuisance flora and fauna species.	Construction
Disposal of wastewater (concrete batching plants)	All wastewater from concrete batching plants would be captured and would either be disposed of to an appropriately licensed facility or treated prior to discharge to surface water bodies. All discharge water would comply with the water quality objectives and the relevant environment protection licence requirements.	Construction
Weed management	Weed management protocols for the operational rail corridor and other ARTC facilities would be in accordance with the requirements of the *Biosecurity Act 2015* and incorporated into the operational environmental management framework. These protocols would include: • site hygiene and waste-management procedures to deter pest animals • weed surveillance and treatment during operation and maintenance activities • requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of Matters of National Environmental Significance, or *Biodiversity Conservation Act 2016* (NSW) listed receptors, habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides • erosion and sediment control risks associated with broad-scale weed removal or treatment.	Operation
Aquatic ecology	Culverts that provide for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may contribute to the blockage of fish passage.	Operation

7. Summary and conclusion

The aquatic ecological assessment for the proposed Inland Rail from Illabo to Stockinbingal has been prepared based on review of relevant databases, aerial and satellite imagery, topographic maps, literature, policies and guidelines and field investigations conducted during drought and non-drought conditions. The proposal consists of about 39 kilometres of new track and associated infrastructure and facilities. The proposal site lies in the catchment of the Murrumbidgee and Lachlan Rivers, which are sub-catchments within the Murray-Darling Basin. The catchment divide lies closer to Stockinbingal and therefore most of the proposal site is within the Murrumbidgee catchment.

The proposal site crosses 32 mapped hydrolines using the Strahler stream order mapping, which includes:

- 18 x 1st order streams
- 8 x 2nd order streams
- 4 x 3rd order streams
- 1 x 5th order stream
- 1 x 6th order stream.

All of the watercourses within the proposal site are highly ephemeral, flowing only after rainfall and quickly receding. Watercourses at 15 survey sites have little or poorly defined channels with no aquatic (macrophyte) flora species. The watercourses have been modified by agricultural land practices with minimal native riparian vegetation retained along the banks of the watercourses. Accordingly, they have been classified as Class 4 unlikely key fish habitats that are Type 3 minimally sensitive fish habitat.

Six named watercourses cross the proposal site and except for Powder Horn Creek, are defined by DPI as KFH:

1. Dudauman Creek
2. Powder Horn Creek
3. Run Boundary Creek
4. Isobel Creek
5. Ulandra Creek
6. Billabong Creek.

All six named watercourses contained well defined banks and riparian vegetation for shading. Billabong Creek contained semi-permanent pools after rain events and Isobel Creek contained shallow pools (< 0.2 m) over bedrock during drought conditions. Knobby club rush *F. nodosa* was observed in sparse clumps at Isobel Creek. Except for Isobel Creek, none of the watercourses can be defined as containing “semi-permanent to permanent water in pools or in connected wetland areas with freshwater aquatic vegetation” which is a requirement of Class 2 watercourses. As such, five of the six watercourses were defined as Class 3 minimal key fish habitat and Type 3 minimally sensitive fish habitat. Isobel Creek was defined as Class 2 Moderate key fish habitat and Type 2 moderately sensitive key fish habitat.

Potential impacts of the proposal on the aquatic environment include:

- removal of riparian corridor vegetation
- removal of instream vegetation/large woody debris
- obstruction of fish passage
- impacts on water quality
- impacts on protected fauna in farm dams
- spread of exotic aquatic weeds.

As all the watercourses that cross the proposal site are ephemeral, the risk of impact is low as watercourses would mostly be dry when construction takes place, therefore water and aquatic species would not be present and at risk of being impacted. Removal of riparian vegetation would be mitigated through implementation of a rehabilitation strategy and large woody debris would be relocated upstream or downstream of the area of impact. Temporary watercourse crossings would be designed and maintained in accordance with relevant guidelines and the spread of exotic weeds would be managed in accordance with the requirements of the *Biosecurity Act 2015*. Farm dams would be decommissioned in accordance with a dam dewatering protocol developed as part of the soil and water management plan. Indirect impacts on water quality during flow events would be managed through appropriate erosion and sediment control measures.

The risk of impact from operation is also considered low as water crossing structures have been designed to be fish-friendly in accordance with recommended crossing types outlined in relevant guidelines (Fairfull and Witheridge, 2003). The Water Quality Impact Assessment Report (Technical Paper 5) concluded that implementation of recommended mitigation measures will result in a low likelihood of ongoing impact to water quality during operation and the increased risk of the spread of exotic aquatic weeds from passing trains and maintenance vehicles would be managed in accordance with the requirements of the *Biosecurity Act 2015*.

Potential impacts on sensitive land include:

- Protected areas

No protected areas in accordance with the NPW Act and MEM Act occur within the study area.

- Key Fish Habitat

The fish habitat in watercourses that cross the proposal site does not include highly sensitive KFH and consists mainly of minimally sensitive KFH. As such, the proposal is unlikely to permanently impact or disrupt areas of KFH and therefore apart from reinstatement of riparian vegetation, no additional aquatic biodiversity offsets would be required under the FM Act. Opportunities to enhance the existing fish habitat are provided.

- Waterfront land.

A total of 4.94 hectares of riparian corridor which is defined as sensitive waterfront land, would be impacted by the proposal. This represents 8.6% of the total vegetation within the proposal site that requires clearing. A rehabilitation strategy would be incorporated into the construction documentation in accordance to mitigate impacts of riparian vegetation removal.

- Critical habitat

No lands or waters identified as critical habitat under the FM Act occur within the study area.

- Groundwater dependent ecosystems

Technical Paper 6 identified four aquatic high priority GDEs within their study area:

- Billabong Creek
- Ulandra Creek
- Ironbong Creek
- Dudauman Creek.

Technical Paper 6 concluded that the proposal would have negligible to low risk of impacts on groundwater during both construction and operation. As such, impacts on GDEs are unlikely.

A number of State and Commonwealth listed threatened fish species, endangered populations and TECs have been recorded on BioNet or predicted to occur in the PMST in the locality (i.e. Murrumbidgee and Lachlan River catchments) however none of the threatened species or endangered populations are likely to occur in the watercourses within the proposal site due to the highly ephemeral nature of the watercourses and the absence of preferred habitat.

The proposal intersects watercourses associated with the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River* and the *Aquatic ecological community in the natural drainage system of the lower Murray River catchment*, which are listed as EEC's under the FM Act. Within the proposal site, all watercourses except for Isobel Creek were defined as Type 3 minimal sensitivity key fish habitat and Class 3 minimal fish habitat. In addition, the fish community status of all watercourses within the proposal site has been defined by DPI (2016) as poor to very poor. As such, the watercourses within the proposal site are not consistent with the EEC definitions and are of only minor importance to the long-term survival of the EEC's in the locality. An assessment of significance of impact of the proposal on these two EECs has identified that the proposal is unlikely to have an adverse impact on either of these EEC's. In addition, the adoption of appropriately designed fish friendly crossing structures and other mitigation measures proposed will minimise potential impacts to the EEC's.

No matters of national environmental significance (MNES), including nationally listed aquatic dependent threatened species, endangered populations, EECs or aquatic migratory species are expected to occur in the watercourses within the proposal site or be impacted by the proposal. As such, an assessment of significance of impact in accordance with the EPBC Act was not required.

The aquatic biodiversity assessment concludes that the impacts of the proposal would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area.

8. References

Australian National Committee on Large Dams Inc (ANCOLD) (2003), Guidelines on Dam Safety Management, Australian National Committee on Large Dams Incorporated, Australia Atlas of Living Australia (ALA) (undated). Accessed 1 October 2019 and 29 December 2020 https://biocache.ala.org.au/search#tab_advanceSearch

AUSRIVAS, (2007) AUSRIVAS, Australian River Assessment System http://ausrivas.ewater.com.au/

Bureau of Meteorology (BoM) (2018) New South Wales in 2018: warmest year on record http://www.bom.gov.au/climate/current/annual/nsw/archive/2018.summary.shtml

Bureau of Meteorology (BoM) (2020a). State of the Climate 2020 http://www.bom.gov.au/climate/enso/

Bureau of Meteorology (BoM) (2020b). Cootamundra, New South Wales Daily Weather Observations http://www.bom.gov.au/climate/dwo/202012/html/IDCJDW2036.202012.shtml

Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2010) Climate variability and change in south eastern Australia – a synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative (SEACI). SEACI report. CSIRO Marine and Atmospheric Research, Aspendale

Department of Environment and Climate Change (DECC) (2007). Storing and Handling Liquids: Environmental Protection, Participant's Manual.

Department of Environment and Climate Change (DECC) (2008) Managing Urban Stormwater – Soils and Construction, Volume 2A, 2C, 2D and 2E (the Blue Book).

Department of Primary Industries (DPI) (2004) Policy and Guidelines for Fish Friendly Waterway Crossings

Department of Primary Industries (DPI) (2007), Key Fish Habitat Maps. Available at https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal.

Department of Primary Industries (DPI) (2012). Guidelines for controlled activities on waterfront land: Riparian Corridors, Natural Resources Access Regulator.

Department of Primary Industries (DPI) (2013). Policy and Guidelines for Fish Habitat Conservation and Management – Update

Department of Primary Industries (DPI) (2016). Fish Communities and Threatened Species Distributions of NSW https://www.dpi.nsw.gov.au/fishing/habitat/your-catchment/condition-of-fish-communities-in-nsw

Department of Primary Industries (DPI) (undated a). Department of Primary Industries, Threatened species lists. https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current

Department of Primary Industries (DPI) (undated b). Department of Primary Industries, distribution maps https://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw/freshwater-threatened-species-distribution-maps

Department of Primary Industries (DPI) (undated c). Department of Primary Industries, Primefacts for individual species. https://www.dpi.nsw.gov.au/fishing/species-protection/what-current

Department of the Environment (DoE) (2013). Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.

Department of the Environment (DoE) (2016) Protected Matters Search Tool http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf accessed 30 August 2017

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). Survey Guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the *Environment Protection and Biodiversity Conservation Act, 1999*.

Divljan, A (2019) Discover and learn. Platypus *Ornithorhynchus anatinus* https://australian.museum/learn/animals/mammals/platypus/

Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla

Inland Rail Development Joint Venture (IRDJV) (2019). Biodiversity Assessment Report (BDAR).

NSW Department of Planning (2003) *Aquatic Ecology in Environmental Impact Assessment EIA Guideline* prepared by Lincoln Smith, M.

Office of Environment and Heritage (OEH) (2018 & 2020). BioNet Atlas of NSW Wildlife database and mapping tool, accessed in October 2018 and December 2020. http://www.bionet.nsw.gov.au/

Strahler, A.N. (1952) Dynamic Basis of Geomorphology. *Geological Society of America Bulletin*, 63, 923-938.

The Hills Shire Council (undated). Guidelines for preparing a dam dewatering report file:///C:/Users/Kristy/Downloads/Dewartering_Dams_Fact_Sheet%20(1).pdf

Witheridge, G. (2002) Fish Passage Requirements for Waterway Crossings - Engineering Guidelines. Institute of Public Works Engineering, Brisbane.

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Aquatic Biodiversity Assessment

Appendix A Database with search results

Appendix A. Database search results

Table A1. BioNet and Atlas of Living Australia Search Results for aquatic species (threatened and non-threatened) listed under the Biodiversity Conservation Act 2016, Fisheries Management Act 1994 and Environment Protection & Biodiversity Conservation Act 1999 within the study area (search date:29/12/2020)

Species	Legislative Status			Records	
	BC Act	FM Act	EPBC Act	BioNet	ALA
Eastern Snake-necked turtle *Chelodina longicollis*	P			10	6
Flatback Turtle *Natator depressus*	P				2
Side-neck turtle *Emydura sp*	P				1
Dam Yabby *Cherax destructor*		P		2	
Euastacus sp.		P		1	
Freshwater Crayfish		P			11
Platypus *Ornithorhynchus anatinus*	P			24	3
Brown Trout *Salmo trutta*		P			1
Mosquito fish (exotic) *Gambusia holbrooki*				1	1

Table A2. NSW Fisheries threatened species list (search date:29/12/2020)

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Adams Emerald Dragonfly	E	N/A	No The species is only known from a few sites in the greater Sydney region.
Alpine Redspot Dragonfly	V	2018	No Distribution around Kosciuszko National Park only.
Australian Grayling	E	2016	No. Distribution around south coast of NSW.
Bousfield Marsh Hopper	V	N/A	No Collected only from a small, isolated location in mangroves at South West Rocks Creek, New South Wales.
Buchanans Fairy Shrimp	V	N/A	No They are known only from Lake Buchanan in southwest Queensland, and Gidgee and Burkanoko Lakes in the north-west of NSW.
Darling River Snail	CE	2018	No The species is restricted to a few populations in irrigation pipes near Bourke, Brewarrina and Walgett.
Eastern Freshwater Cod	E	2016	No Only found in the Clarence and Richmond River catchments of northern NSW.
Fitzroy Falls Spiny Crayfish	CE	2016	No Only found in Wildes Meadow Creek NSW, surviving as a remnant population, restricted to a small length of the watercourse upstream from Fitzroy Falls.
Flathead Galaxias	CE	2016	Yes

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Hanley's River Snail	CE	2018	Yes
Macquarie Perch	E	2016	No Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. However, the proposed corridor is outside the indicative distribution mapped for this species.
Murray Crayfish	V	2016	Yes
Murray Hardyhead	CE	2016	No Murray Hardyhead is a species of small freshwater fish, native to inland parts of south-eastern Australia. They were once widespread and abundant in the Murray and Murrumbidgee river systems in southern NSW and northern Victoria; however, they have suffered a serious population decline, and now seem to be limited to a few sites, mainly in northern Victoria. There are very few recent records of Murray Hardyhead in NSW. The proposed corridor is outside the indicative distribution mapped for this species.
Oxleyan Pygmy Perch	E	2016	No Oxleyan Pygmy Perch are a small freshwater fish endemic to the coastal region of eastern Australia, from northern NSW to south-eastern Queensland. The proposed corridor is outside the indicative distribution mapped for this species.

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Silver Perch	V	2016	No Silver Perch were once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. They are generally found in faster-flowing water including rapids and races and more open sections of river. Individuals sometimes form large shoals in open water. They are omnivorous, feeding on a variety of small prey including aquatic insects, molluscs, worms, crustaceans, zooplankton and algae. Only one remaining secure and self sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries. The proposal site is upstream of Yarrawonga weir therefore this species is unlikely to occur.
Southern Purple Spotted Gudgeon	E	2016	Yes
Southern Pygmy Perch	E	2016	No Southern Pygmy Perch were once widely distributed throughout the Murrumbidgee and Murray River systems, as well as coastal streams in South Australia and Victoria, north-eastern Tasmania and King and Flinders Islands in Bass Strait. There have been large-scale reductions in their range since European settlement, particularly in inland regions. Populations of Southern Pygmy Perch have recently been discovered in tributaries of the upper Lachlan and upper Murray River catchments however the proposed corridor is outside the indicative distribution mapped for this species.

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Stocky Galaxias	CE	2018	No Only known from one locality – the headwaters of Tantangara Creek, upstream of the Tantangara Reservoir, Kosciusko National Park NSW.
Sydney Hawk Dragonfly	E	N/A	No The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages.
Trout Cod	E	2016	Yes
Endangered Populations			
Darling River Hardyhead in the Hunter River catchment	Ep	2016	No The Darling River Hardyhead is found in the upper tributaries of the Darling River near the Queensland and New South Wales border. A small population is also found in the Hunter catchment which has always been relatively uncommon.
Murray-Darling Basin population of Eel Tailed Catfish -	Ep	N/A	No Recorded in Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle however the proposed corridor is outside the indicative distribution mapped for this species. Eel Tailed Catfish numbers in the Murray-Darling Basin have declined due to a range of impacts including invasive species, habitat degradation, cold water pollution and fishing pressures and are now virtually absent from the Murray, Murrumbidgee and Lachlan catchments.

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Snowy River population of River Blackfish	Ep	N/A	No River Blackfish are a medium sized native fish that occur in the Snowy River catchment of the eastern (coastal) flowing drainages and the Murray-Darling basin in NSW, but these populations are genetically distinct and may in fact be separate species. River Blackfish were once abundant in the Snowy River catchment, being caught right throughout the mid and upper reaches. This population has suffered a serious decline and is now found only along about 50 km of watercourses of the Delegate River and some of its tributaries.
Western population of Olive Perchlet	Ep	2016	Yes
Endangered Ecological Communities			
Lowland Darling River aquatic ecological community	EEC	N/A	No The Darling River endangered ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within the State of New South Wales, and including Menindee Lakes and the Barwon River.
Lowland Lachlan River aquatic ecological community	EEC	N/A	Yes
Lowland Murray River aquatic ecological community	EEC	N/A	Yes

Threatened Species Name	Listing status	Indicative distribution map date released	Target Species?
Snowy River aquatic ecological community	EEC	N/A	No The aquatic ecological community of the Snowy River catchment in NSW has been listed as an endangered ecological community under the NSW Fisheries Management Act 1994. The listing includes all native fish and aquatic invertebrates within all rivers, creeks and streams of the Snowy River catchment.

PEx=Presumed Extinct; CE=Critically Endangered; E=Endangered, V=Vulnerable; Ep=Endangered population; EEC=Endangered Ecological Community

Exclusively marine species were excluded from database results

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Aquatic Biodiversity Assessment

Appendix B Protected Matters Search Tool report

ILLABO TO STOCKINBINGAL ENVIRONMENTAL IMPACT STATEMENT

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

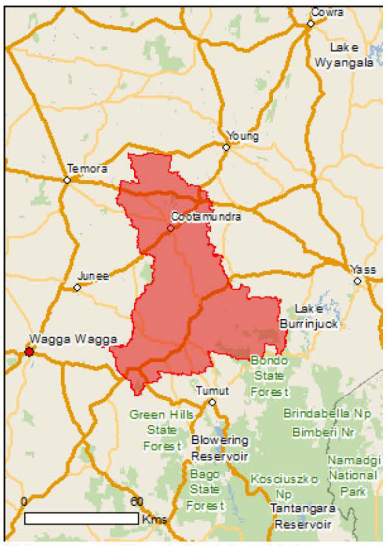
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

LGA COOTAMUNDRA-GUNDAGAI REGIONAL COUNCIL, NSW

Report created: 30/08/18 11:51:25



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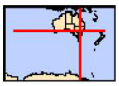

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://environment.gov.au/protection/environment-assessments

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	5
Threatened Species:	40
Migratory Species:	11

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits-and-application-forms

Commonwealth Lands:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	9
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	600 - 700km upstream
Hattah-kulkyne lakes	400 - 500km upstream
Riverland	600 - 700km upstream
The coorong, and lakes alexandrina and albert wetland	700 - 800km upstream

Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
FISH		
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat may occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Translocated population known to occur within area
FROGS		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat known to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat may occur within area
INSECTS		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
MAMMALS		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANTS		
Ammobium craspedioides Yass Daisy [20758]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat may occur within area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat may occur within area
Caladenia arenaria Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat may occur within area
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat likely to occur within area
Grevillea wilkinsonii Tumut Grevillea [56396]	Endangered	Species or species habitat known to occur within area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Pterostylis oreophila Blue-tongued Orchid, Kiandra Greenhood [22903]	Critically Endangered	Species or species habitat may occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
REPTILES		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat known to occur within area

Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

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

Name
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Telstra Corporation Limited

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Black Andrew	NSW
Ellerslie	NSW
Flagstaff Memorial	NSW
Forestry Management Areas in Tumut	NSW
Jindalee	NSW
Old Jeremiah	NSW
South West Woodland	NSW
Tumblong	NSW
Ulandra	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Southern RFA	New South Wales

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
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Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Austrocylindropuntia spp. Prickly Pears [85132]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

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

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

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

- migratory and
- marine

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

- threatened species listed as extinct or considered as vagrants
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- some terrestrial species that overfly the Commonwealth marine area
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The following groups have been mapped, but may not cover the complete distribution of the species:

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

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

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

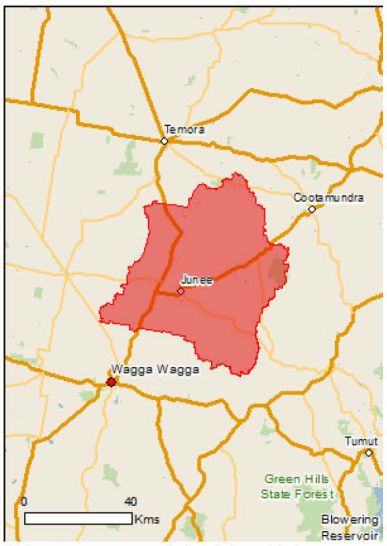
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

LGA JUNEE SHIRE COUNCIL, NSW

Report created: 30/08/18 11:50:55



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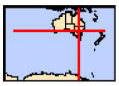

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://environment.gov.au/protection/environment-assessments

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	3
Threatened Species:	29
Migratory Species:	11

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits-and-application-forms

Commonwealth Lands:	3
Commonwealth Heritage Places:	1
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	29
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	600 - 700km upstream
Hattah-kulkyne lakes	400 - 500km upstream
Riverland	500 - 600km upstream
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream

Threatened Ecological Communities		[Resource Information]
For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.		
Name	Status	Type of Presence
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
FISH		
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat may occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
FROGS		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
MAMMALS		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANTS		
Ammobium craspedioides Yass Daisy [20758]	Vulnerable	Species or species habitat likely to occur within area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat likely to occur within area
Caladenia arenaria Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat may occur within area
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat may occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Tylophora linearis [55231]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
REPTILES		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat may occur within area

Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

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

Name
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Junee Post Office	NSW	Listed place

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

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Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
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Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Combaning	NSW
Ulandra	NSW

Invasive Species	[Resource Information]

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Name	Status	Type of Presence
Birds		
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
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Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
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Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
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Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
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Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
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		area
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Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
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Ulex europaeus		
Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Bethungra Dam Reserve	NSW

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

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

TECHNICAL PAPER 2

Aquatic Biodiversity Assessment

Appendix C Riparian vegetation mapping, watercourses, farm dams, and proposed bridge and culvert locations

Appendix C: Riparian Vegetation Mapping, Watercourses, Farm Dams and Proposed Bridge and Culvert Locations

Figures C1-C15 Legend Map Scale 1:10,000

Legend

- Proposal Site
- Construction Compounds
- Existing Farm Dam
- Survey Site
- Inspection Site
- Proposed Burley Griffin Way Overpass
- Proposed Bridges
- Proposed Culverts
- Proposed Track

Strahler Stream Order

- 1st Order
- 2nd Order
- 3rd Order
- 4th Order
- 5th Order
- 6th Order

Riparian Corridor Vegetation

- Miscellaneous Ecosystem (Planted vegetation)
- PCT 5 River Red Gum herbaceous-grassy very tall open forest
- PCT 76 Western Grey Box tall grassy woodland
- PCT 80 Western Grey Box - White Cypress Pine tall woodland
- PCT 266 White Box grassy woodland
- PCT 276 Yellow Box grassy tall woodland
- PCT 277 Blakelys Red Gum - Yellow Box grassy tall woodland
- PCT 309 Black Cypress Pine - Red Stringybark - red gum - box low open forest
- PCT 796 Derived grassland

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Figure C1. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

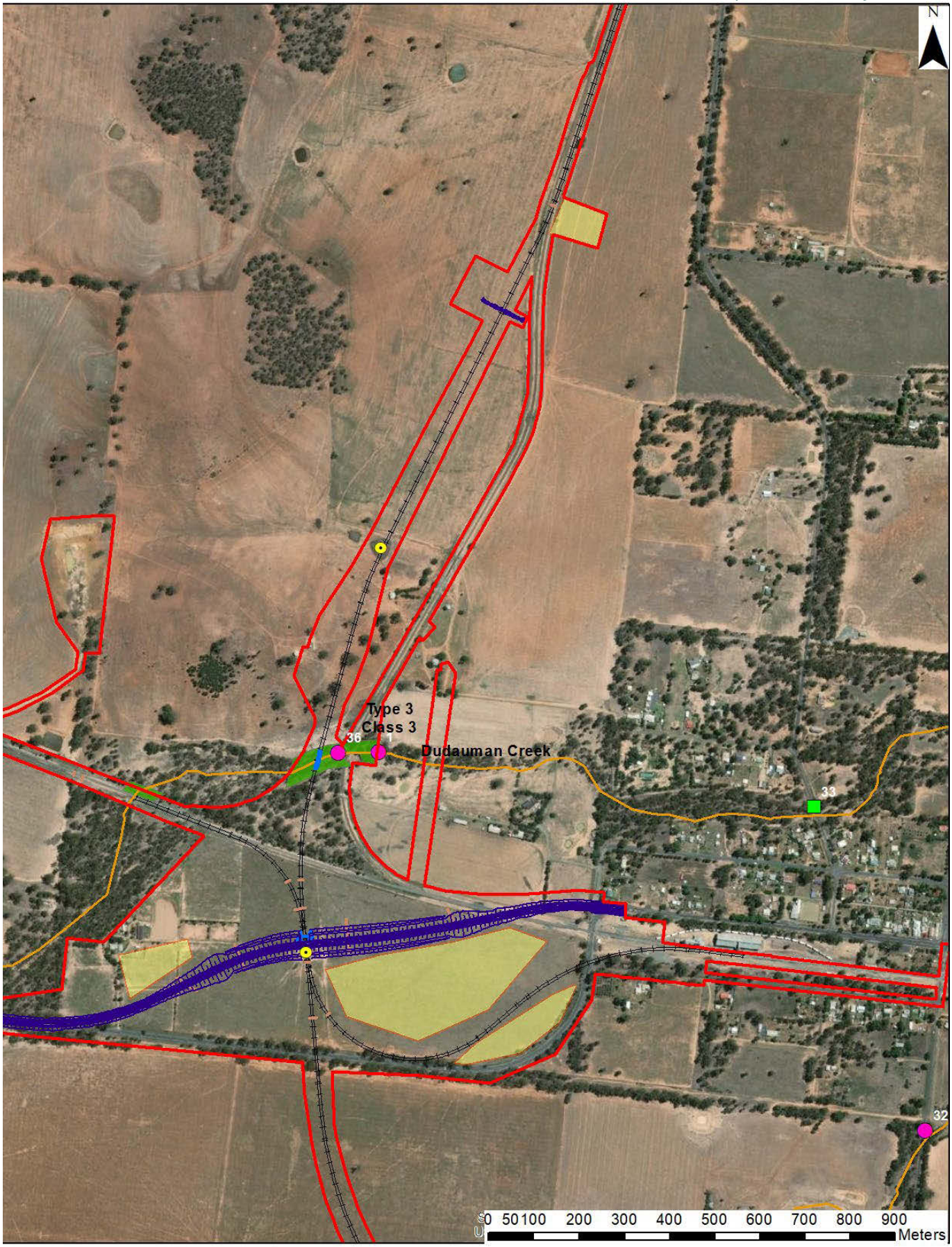

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Figure C2. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

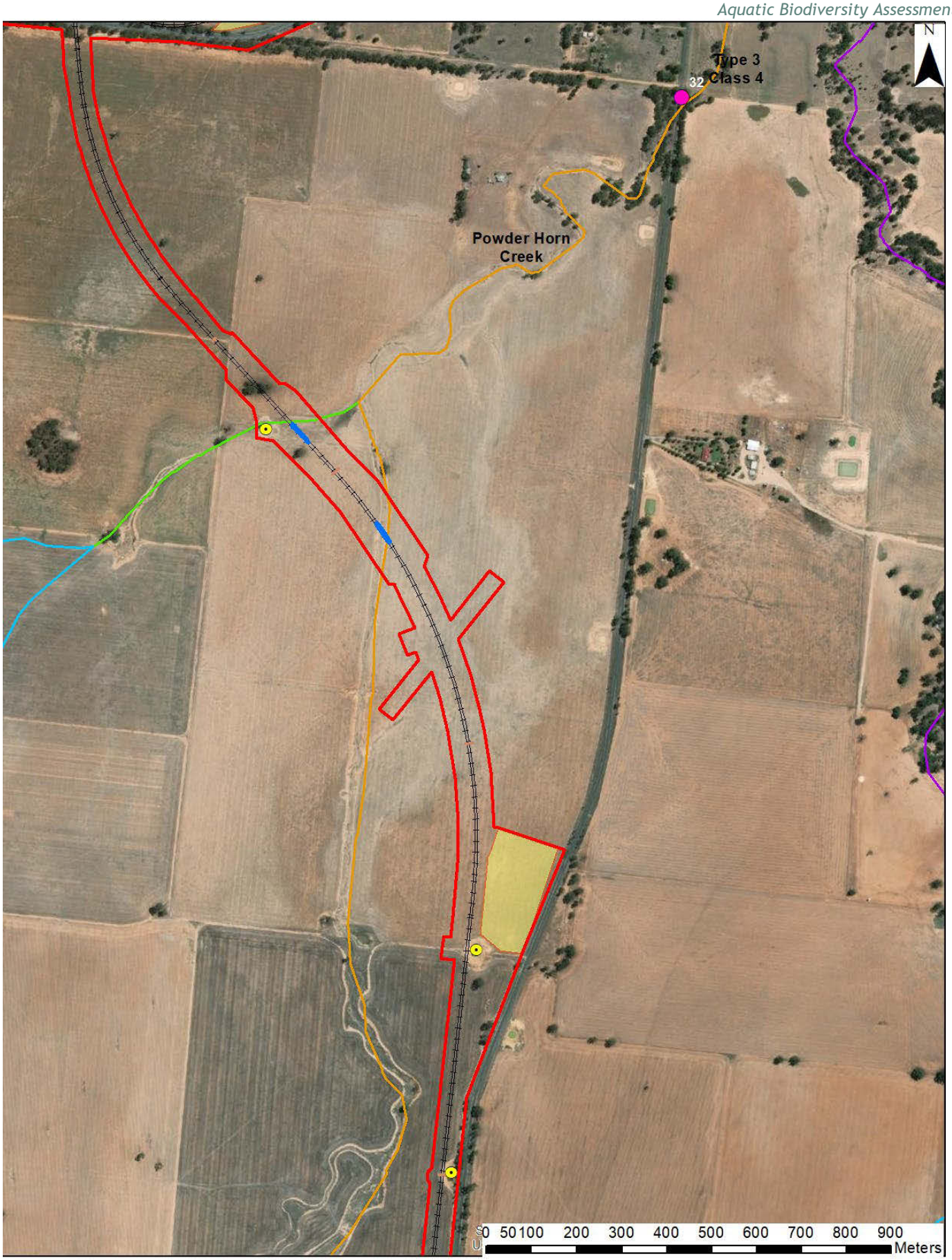

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Figure C3. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

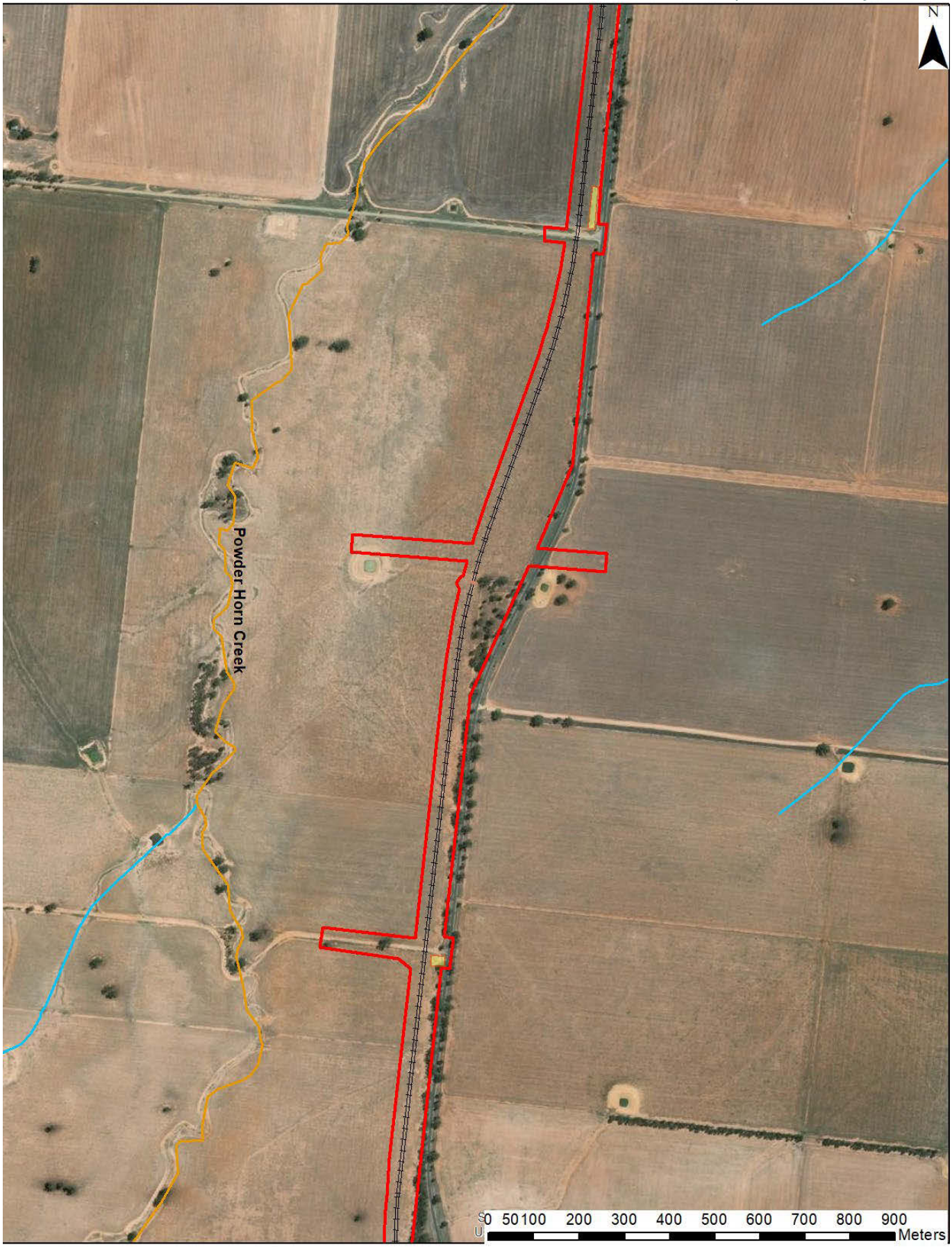

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Figure C4. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

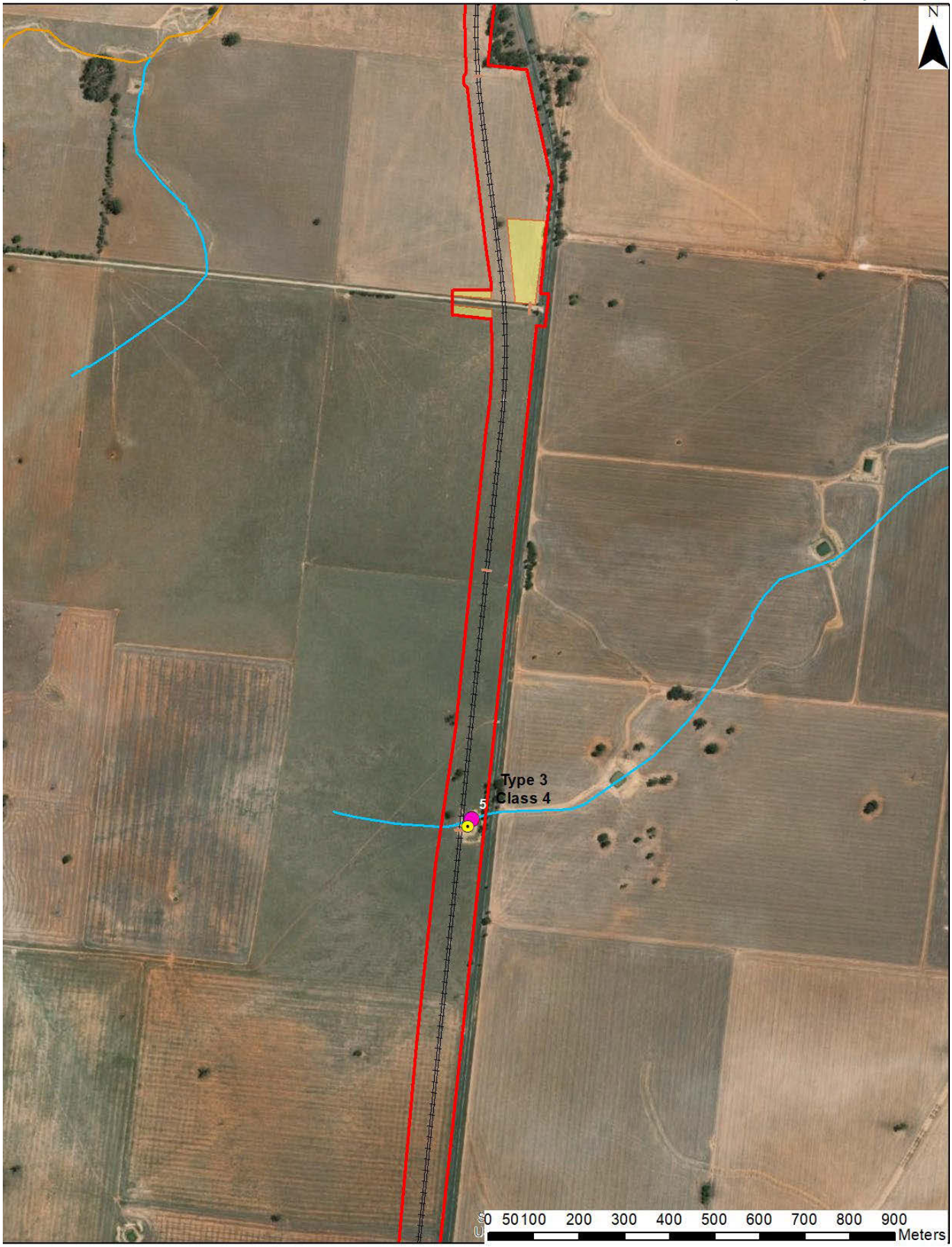

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Figure C5. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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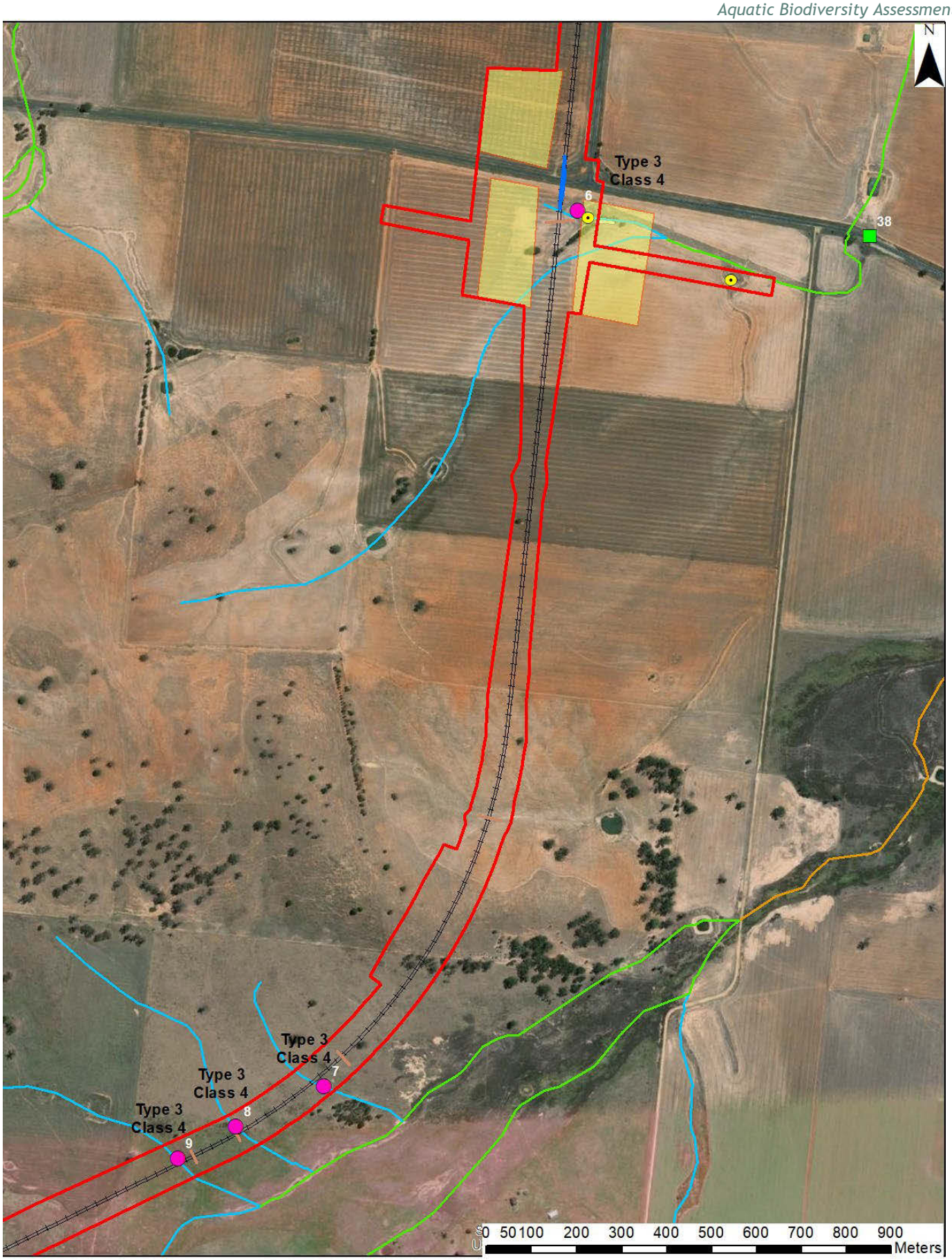

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Figure C6. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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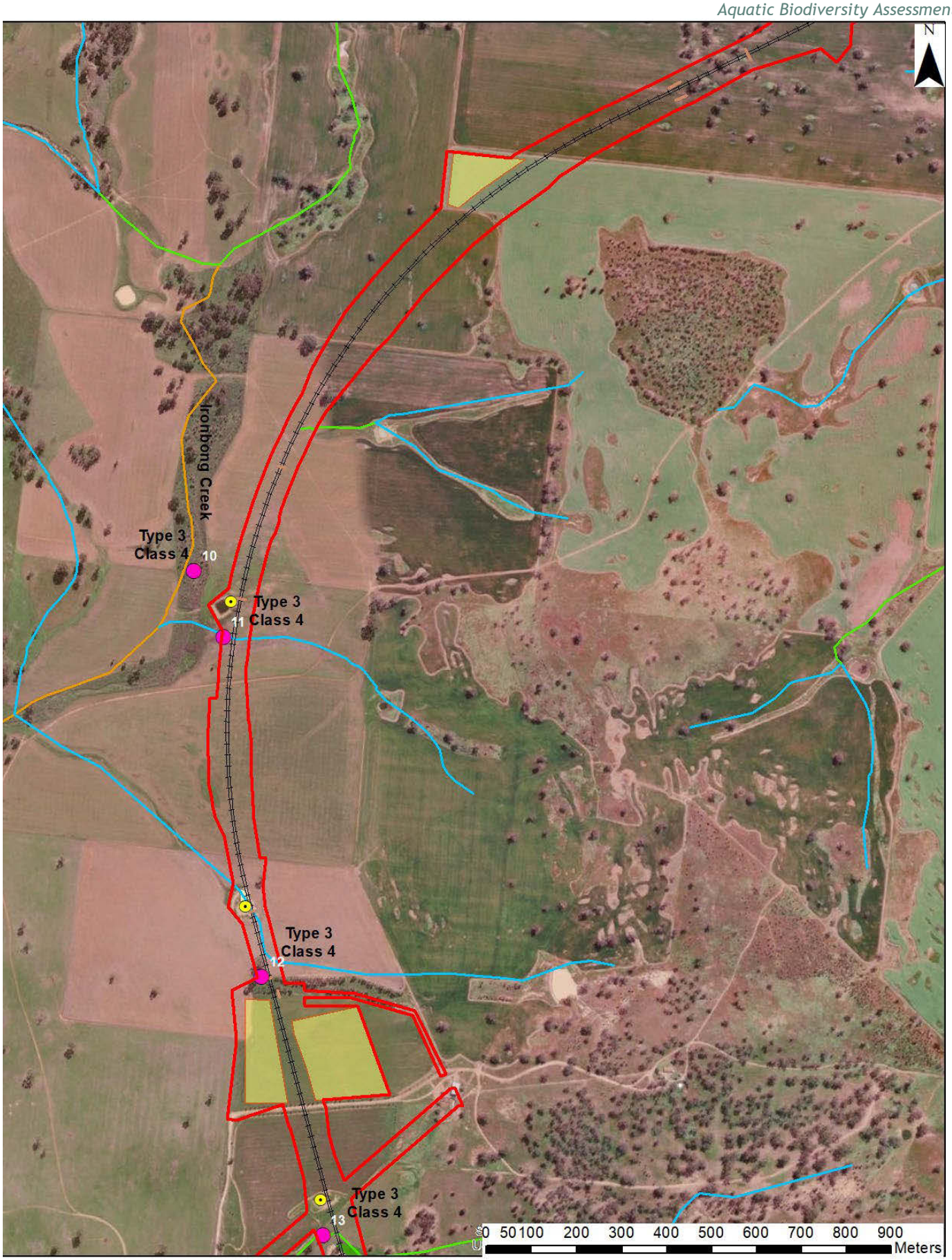

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Figure C7. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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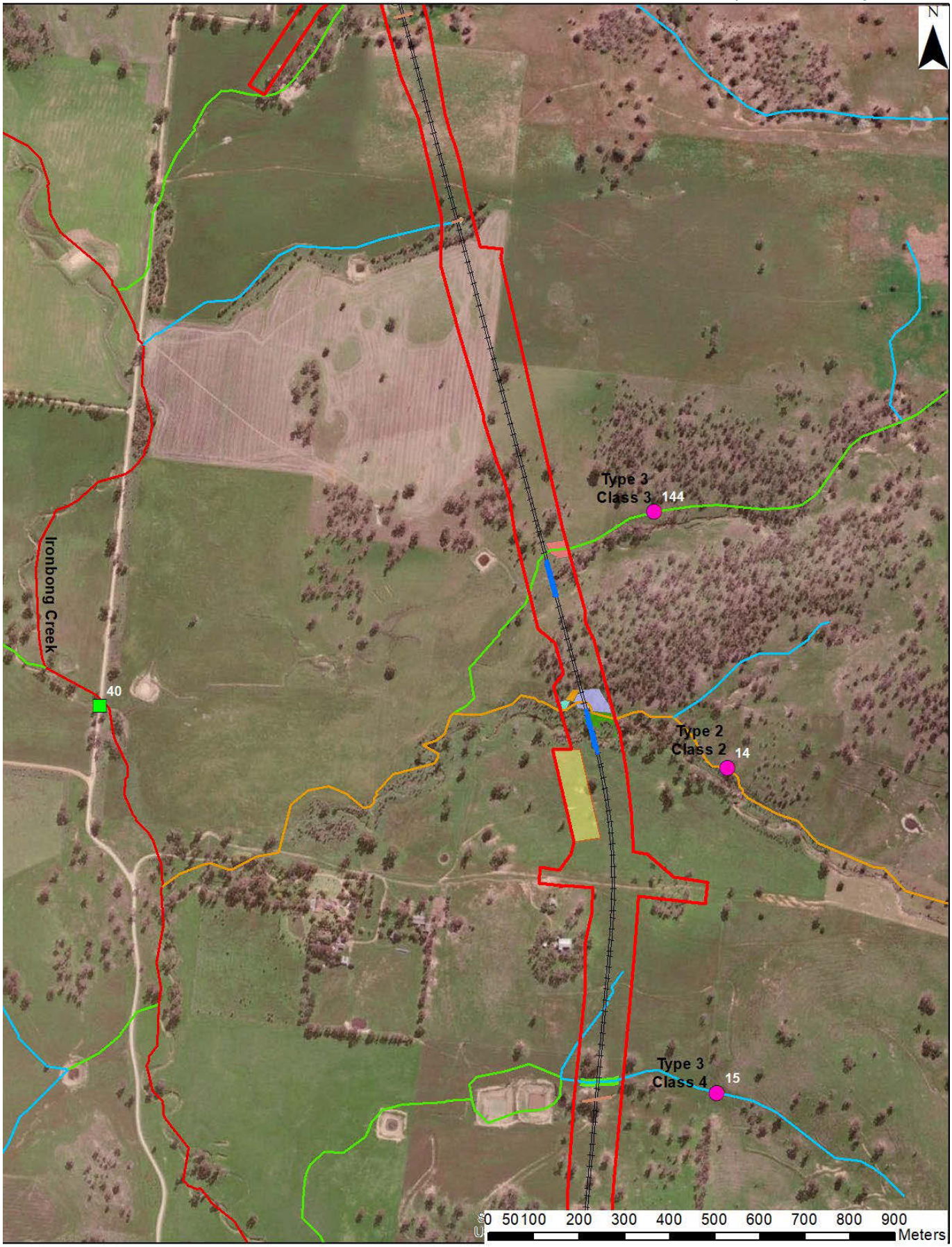

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Figure C8. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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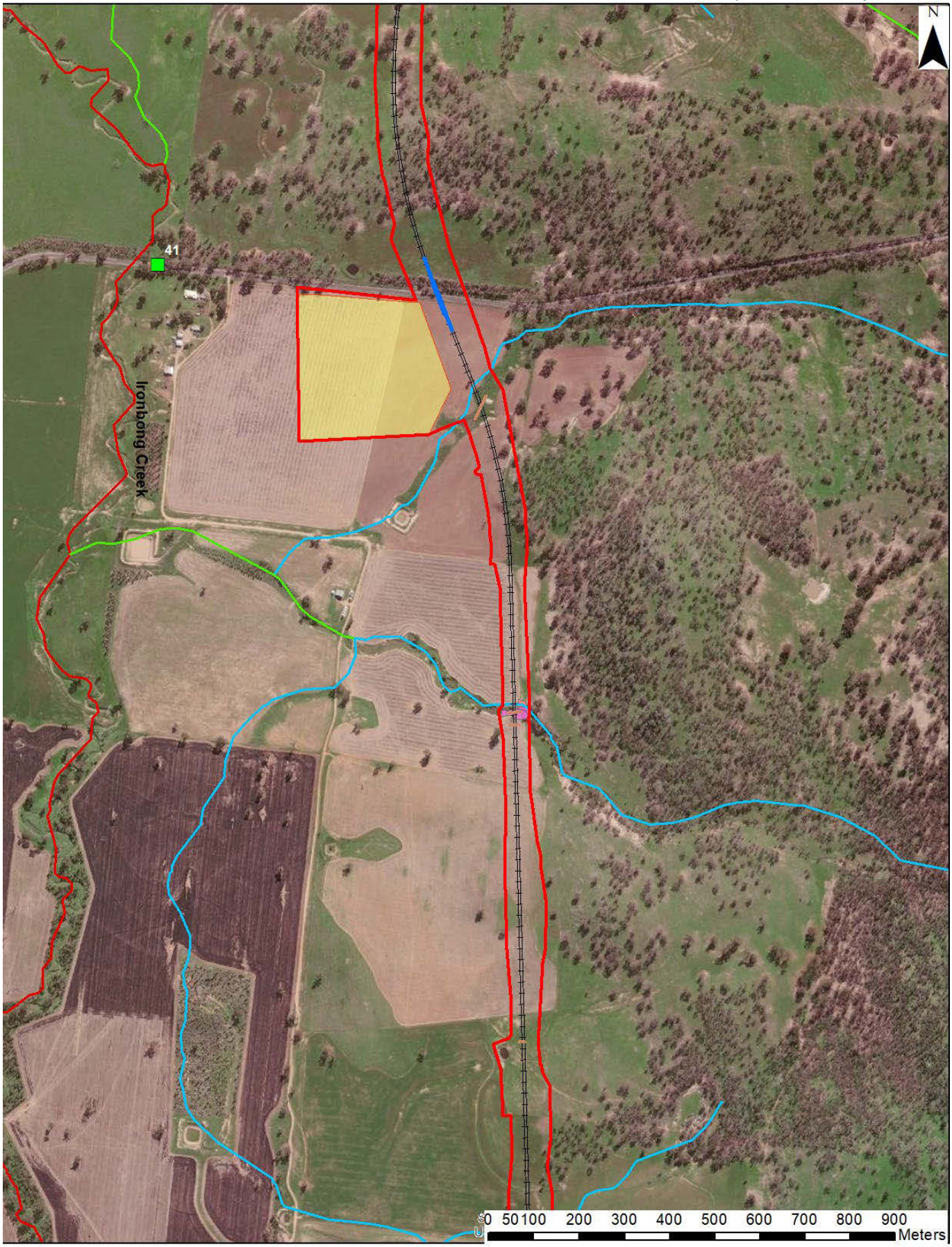

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Figure C9. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

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Figure C10. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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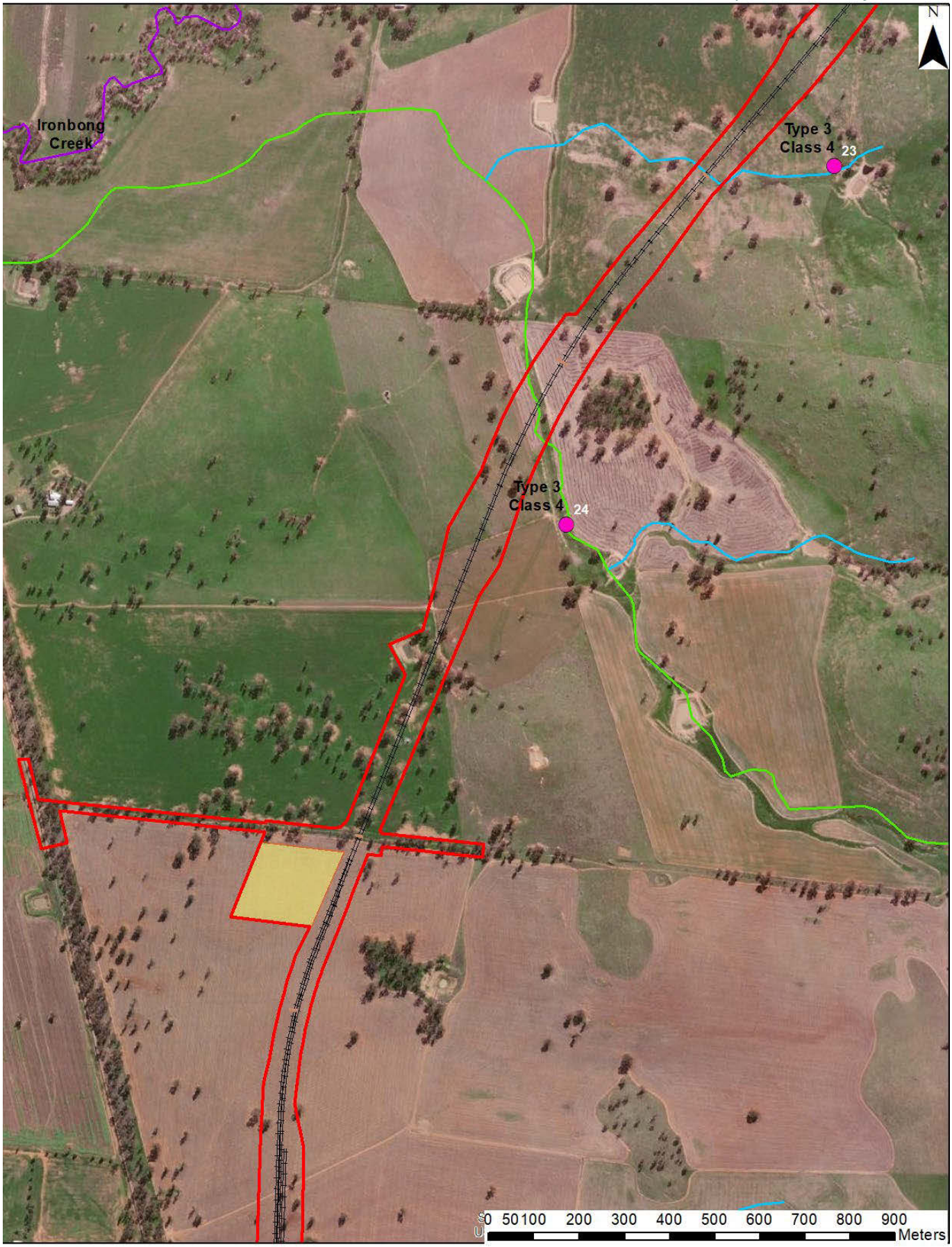

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Figure C11. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

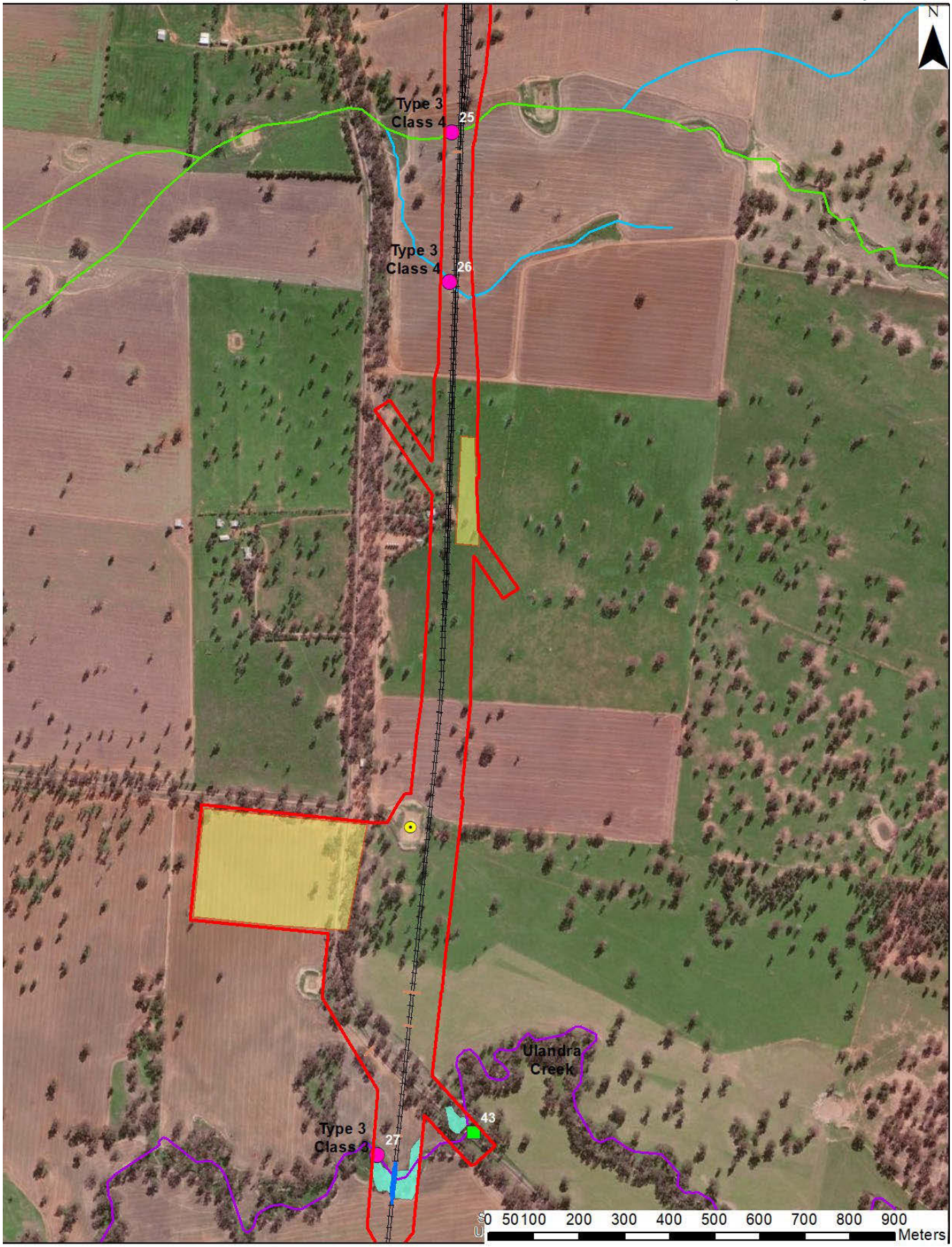

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Figure C12. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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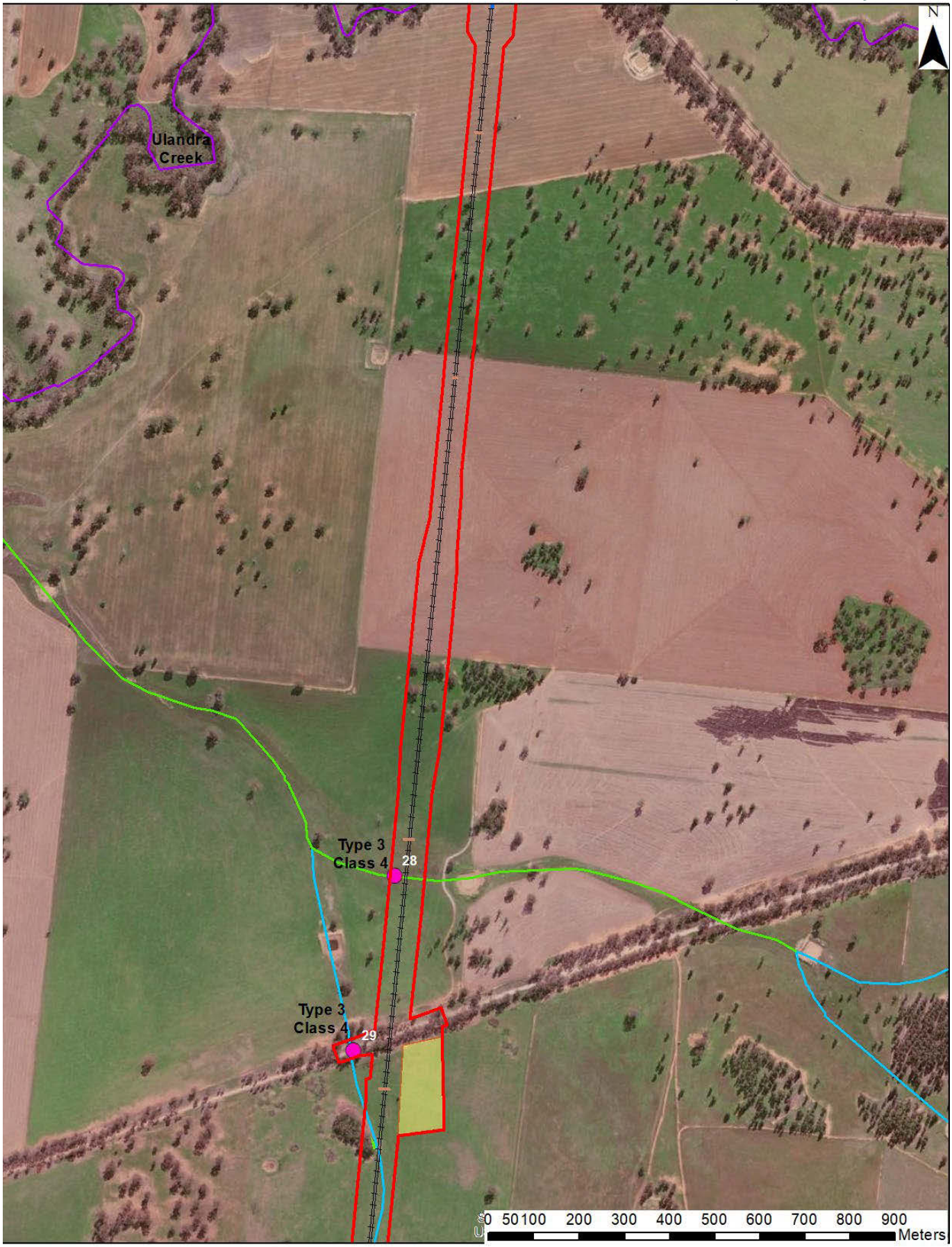

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Figure C13. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

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Figure C14. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
Job No. 170429 Date. 30/04/2021

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Figure C15. Riparian Vegetation Mapping, Watercourse Type, Class, Order & Bridge & Culvert Locations, Illabo to Stockinbingal Inland Rail Programme
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