

CHAPTER 11

Flora and Fauna

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Contents

11.	FLORA AND FAUNA	11-1	11.9	Environmental offsets	11-235
11.1	Introduction and scope	11-1	11.9.1	Matters of national environmental significance	11-235
11.2	Regulatory environment	11-1	11.9.2	Matters of State environmental significance	11-236
11.3	Flora and fauna updates	11-10	11.9.3	Provision of offsets	11-238
11.3.1	Overview	11-10	11.10	Cumulative impacts	11-238
11.3.2	Summary of updates	11-10	11.11	Conclusions	11-253
11.3.3	Draft EIS assessment of flora and fauna	11-11	Figures		
11.3.4	Project updates and reduced environmental impacts	11-12	Figure 11-1	Location of Project and Study area	11-18
11.3.5	Revised flora and fauna assessment methodology and mitigation framework	11-13	Figure 11-2	Field survey locations	11-30
11.3.6	Comparative outcomes to the Draft EIS	11-15	Figure 11-3	Flooding impact Assessment Process	11-62
11.4	Methodology	11-17	Figure 11-4	Ground Truthed Regional Ecosystems	11-69
11.4.1	Overview	11-17	Figure 11-5	Location of broad habitat types within the Project footprint	11-103
11.4.2	Study area and key terms	11-17	Figure 11-6	Matters of State environmental significance wildlife habitat and essential habitat mapping	11-146
11.4.3	Desktop assessment	11-22	Figure 11-7	Koala mapping as prescribed under the Nature Conservation (Koala) Conservation Plan 2017	11-176
11.4.4	Preliminary field surveys	11-26	Figure 11-8	State and regional terrestrial and riparian ecological corridors	11-177
11.4.5	Revised draft EIS field surveys	11-27	Figure 11-9	Location of projects that have been included in the cumulative impacts assessment area	11-242
11.4.6	Habitat mapping	11-60	Tables		
11.4.7	Impact assessment	11-60	Table 11-1	Legislation, Policies, standards and guidelines relevant to this assessment	11-1
11.4.8	Cumulative impact assessment	11-63	Table 11-2	Flora and fauna documents in the assessment and post approval phases	11-14
11.5	Existing environment	11-63	Table 11-3	Key project statistics and fieldwork assessments of the Draft EIS and Revised Draft EIS	11-15
11.5.1	Regional and local context	11-63	Table 11-4	Flora, fauna and ecosystems considered in the draft EIS and revised draft EIS	11-16
11.5.2	Regional ecosystems	11-66	Table 11-5	Summary of data sources accessed for the Ecological assessment	11-22
11.5.3	Habitat types	11-99	Table 11-6	Likelihood of occurrence criteria	11-25
11.5.4	Threatened ecological communities	11-133	Table 11-7	Preliminary field surveys	11-26
11.5.5	Flora	11-133	Table 11-8	Summary of revised draft EIS field investigations	11-28
11.5.6	Fauna	11-135	Table 11-9	Ground-truthed Regional Ecosystems within the Project footprint	11-67
11.5.7	Whetstone Material Distribution Centre ecological surveys	11-137	Table 11-10	Ground-truthed habitat Types within the Study area and Project footprint	11-99
11.5.8	Borrow pit ecological surveys	11-138	Table 11-11	Threatened flora species known, likely or with the potential to occur within the Project footprint, including potentially occurring MNES	11-134
11.5.9	Aquatic ecosystems	11-138	Table 11-12	Special least concern flora species recorded within the Study area	11-134
11.5.10	Matters of national environmental significance	11-142			
11.5.11	Matters of State environmental significance	11-143			
11.5.12	Matters of local environmental significance	11-181			
11.5.13	Invasive species biosecurity areas	11-182			
11.6	Potential impacts	11-183			
11.6.1	Project activities	11-183			
11.6.2	Potential impacts to terrestrial ecological values	11-186			
11.6.3	Potential impacts to aquatic ecological values	11-199			
11.7	Avoidance, mitigation and management measures	11-203			
11.7.1	Principles of ecologically sustainable development	11-203			
11.7.2	Avoidance and mitigation through the revised reference design stage	11-206			
11.7.3	Proposed mitigation measures	11-207			
11.7.4	Flora and fauna monitoring	11-222			
11.8	Impact assessment	11-223			
11.8.1	Summary of potential impacts	11-223			
11.8.2	Significant residual impact assessment results	11-231			

Table 11-13	Restricted matters (noxious weeds) identified within the Study area	11-135	Table 11-33	Estimation of potential magnitude of disturbance for NC Act Threatened and special least concern (NC Act) flora and fauna species (excluding MNES) for the Project	11-226
Table 11-14	Threatened fauna species known, likely or with the potential to occur within the Project footprint	11-135	Table 11-34	Estimation of potential magnitude of disturbance for MSES identified for the Project and assessment of the same or substantially the same impact	11-228
Table 11-15	Special least concern fauna species known or likely to occur within the project footprint	11-137	Table 11-35	Summary of the significant impact assessment of EPBC Act controlling provisions for the Project	11-231
Table 11-16	Restricted matter fauna species identified within the Project footprint	11-137	Table 11-36	Summary of the significant impact assessment of Prescribed environmental matters for the Project	11-233
Table 11-17	Waterways for waterway barrier works that intercept the Project footprint	11-139	Table 11-37	Quantification of anticipated significant residual impacts to MNES	11-235
Table 11-18	High ecological significance wetlands present within the study area and project footprint	11-140	Table 11-38	Quantity of significant residual impacts to MSES	11-236
Table 11-19	Specific Riverine AquaBAMM Aquascore for all water quality monitoring sites	11-141	Table 11-39	Prescribed regional ecosystems that are endangered or of concern requiring offset	11-237
Table 11-20	Ground-truthed Threatened Ecological Communities within the Project footprint	11-142	Table 11-40	Category B (remnant) prescribed regional ecosystems within 50 m of a mapped wetland requiring offset	11-237
Table 11-21	Ground-truthed habitat for threatened flora and fauna species (MNES)	11-142	Table 11-41	Category B (remnant) prescribed regional ecosystems within a defined distance of a watercourse requiring offset	11-237
Table 11-22	Matters of state environmental significance within the Project footprint	11-144	Table 11-42	Projects included in the ecological cumulative impact assessment	11-239
Table 11-23	Summary of impacts and affected ecological values	11-183	Table 11-43	Cumulative impacts as calculated within the cumulative Study area	11-243
Table 11-24	Summary of Project related activities associated with construction, commissioning and reinstatement and operation Stage	11-184	Table 11-44	Significance assessment of cumulative impacts within the cumulative Study area	11-247
Table 11-25	Typical hearing range for various animal species	11-191			
Table 11-26	Likely effects on terrestrial fauna as a result of Project construction activities	11-191			
Table 11-27	Project impact mitigation measures during detailed design	11-208			
Table 11-28	Project impact mitigation measures during pre-construction and construction	11-212			
Table 11-29	Project impact mitigation measures during operation	11-219			
Table 11-30	Project impact mitigation measures specific to matters of national environmental significance	11-220			
Table 11-31	Proposed mitigation measures specific to matters of State environmental significance	11-222			
Table 11-32	Estimation of potential magnitude of disturbance to threatened (EPBC Act) flora, fauna species and ecological communities identified for the Project	11-224			

Photographs

Photograph 11-1	Example of mature trees retained within a road reserve, surrounded by anthropogenic disturbance within the Millmerran region	11-64
Photograph 11-2	Example of mature trees retained within a road reserve, surrounded by anthropogenic disturbance south of Toowoomba	11-64
Photograph 11-3	Portion of the Project footprint on the Condamine floodplain	11-64
Photograph 11-4	Project footprint north of the Condamine floodplain	11-64
Photograph 11-5	Cabbage tree Creek on the Condamine river floodplain, showing the narrow band of mature vegetation	11-65
Photograph 11-6	Fertile soils of the Condamine floodplain are used extensively for cropping	11-65

11. Flora and Fauna

11.1 Introduction and scope

This chapter describes the flora and fauna components for the study area of the Inland Rail New South Wales (NSW)/Queensland (QLD) Border to Gowrie Project (B2G) (the Project) including a summary of matters of national environmental significance (MNES), matters of State environmental significance (MSES) and matters of local environmental significance (MLES) relevant to the Project. Potential impacts associated with construction and operation of the Project in relation to ecological values are described and a summary provided of proposed mitigation measures that will be implemented. An assessment of significant impacts for MNES and MSES is provided and proposed offsets that will be provisioned by the Project are outlined.

The chapter addresses the flora and fauna section of the Terms of Reference (ToR), inclusive of Sections 11.1 to 11.35 and 11.94 to 11.106. This chapter has been updated in accordance with additional information requested by the Coordinator-General following the public notification of the draft Environmental Impact Statement (EIS) in 2021. Consideration has also been given to matters raised in consultation with key stakeholders during the development of the EIS. Both the scientific and common names (where available) are used in the identification of flora and fauna species in this chapter.

This chapter should be read in conjunction with the following appendices to the revised draft EIS:

- ▶ Appendix L: Terrestrial and Aquatic Ecology Technical Report
- ▶ Appendix M: Draft Koala Management Plan
- ▶ Appendix N: Draft Fauna Management Plan
- ▶ Appendix O: Matters of National Environmental Significance Report
- ▶ Appendix P: Fauna Connectivity Strategy
- ▶ Appendix Q: Environmental Offset Delivery Strategy.

11.2 Regulatory environment

This section provides the statutory context for which the ecological assessment has been undertaken see (Table 11-1).

The Commonwealth and State legislation and approvals applicable to the Project is discussed in Chapter 3: Legislation and Project Approvals Process.

TABLE 11-1 LEGISLATION, POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THIS ASSESSMENT

Policy, standard or guideline (jurisdiction/ applicable matter)	Relevance to the Project
Commonwealth	
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act)	The EPBC Act is the Australian Government's central piece of environmental legislation and provides the legal basis for the management and protection of nationally and internationally important flora, fauna, ecological communities and heritage places—defined under the Act as Matters of National Environmental Significance (MNES). Under Section 45 of the EPBC Act, the Australian Government and Queensland Government have implemented a bilateral agreement relating to environmental assessment. This agreement allows the Australian Government Minister for the Environment to rely on specified environmental impact assessment processes of Queensland in assessing actions under the EPBC Act. The bilateral agreement specifically aims to achieve the following objectives: ▶ Protect the environment in accordance with the requirements of the EPBC Act, ▶ Promote the conservation and sustainable use of natural resources, and ▶ Ensure an efficient, timely and effective process for environmental assessment and approval of actions. ▶ Australian Rail Track Corporation submitted an EPBC Act referral to the Department of the Environment and Energy (DotEE), now the Department of Climate Change Energy, the Environment and Water (DCCEEW), in February 2018 (EPBC 2018/8165).

Policy, standard or guideline (jurisdiction/ applicable matter)	Relevance to the Project
	▶ The Minister for the Environment determined the Project to be a 'controlled action' on 9 April 2018 requiring the preparation of an EIS. The controlling provision for the controlled action is: Listed Threatened species and communities. ▶ In accordance with Section 158A of the EPBC Act, the EPBC Act controlling provision will be assessed in accordance with their EPBC Act status at the time of the referral decision (i.e. 9 April 2018). ▶ No Project works that are part of the referred action will commence prior to the Minister's decision on the EPBC Act controlled action. ▶ The EPBC Act controlled action will be assessed under the bilateral agreement with the Queensland Government.
<i>EPBC Act Environmental Offsets Policy (2012)</i> (EPBC Act Offsets Policy)	The EPBC Act Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 2012a) was developed to support the management and protection of MNES under the EPBC Act and outlines the Australian Government's approach to the use of environmental offsets for impacts to MNES. Eight principles for the use of environmental offset under the EPBC Act are noted in the policy. These principles are used to assess any proposed environmental offset for MNES to ensure consistency, transparency and equity under the Act. The Australian Government's position is that environmental offsets must: ▶ Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action ▶ Be built around direct offsets but may include other compensatory measures ▶ Be in proportion to the level of statutory protection that applies to the protected matter ▶ Be of a size and scale proportionate to the residual impacts on the protected matter ▶ Effectively account for and manage the risks of the offset not succeeding ▶ Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs (this does not preclude the recognition of State or territory offsets that may be suitable as offsets under the Act for the same action) ▶ Be efficient, effective, timely, transparent, scientifically robust and reasonable ▶ Have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced. The Australian Government defines offsets as measures that compensate for the residual adverse impacts of an action on the environment (DSEWPC, 2012a). The Project will implement a range of mitigation measures during the Project works to avoid and minimise significant residual adverse impacts on MNES. Implementing mitigation measures including offsets will be consistent across the Inland Rail Program. Offsets provided for under the policy include direct offsets, and other compensatory methods (or indirect offsets). It is likely that a combination of methods will be applicable to the Project, based on the extent of the significant adverse residual impacts on MNES identified separately in Appendix O: Matters of National Environmental Significance Report. ARTC's Environmental Offset Delivery Strategy—Queensland (see Appendix Q: Environmental Offset Delivery Strategy) has been prepared in consultation with the relevant State and Commonwealth departments, to ensure compliance with relevant offsets policies and guidelines. This strategy informs the development of offset delivery components for the Project including specific management intent to drive matter specific conservation outcomes across each offset property presented in the Strategy. The provision of offsets for the Project is discussed in Section 11.9.
Matters of National Environmental Significance: Significant Impact Guidelines 1.1	The purpose of the guidelines is to assist any person who proposes to take an action to decide whether or not they should submit a referral to the DCCEE for a decision by the Australian Minister for the Environment on whether assessment and approval is required under the EPBC Act. The Significant Impact Guidelines outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether or not referral may be required. Important terms and phrases are explained in the guideline. Assessment of MNES against the Significant Impact Guidelines will facilitate the determination of a significant residual impact to MNES. This has been undertaken and is discussed further in Section 11.8.2.1.

Policy, standard or guideline (jurisdiction/ applicable matter)	Relevance to the Project
Species recovery plans (MNES)	Recovery plans for listed Threatened species and ecological communities have been made or adopted under the EPBC Act. These plans remain in force until their legislated sunseting date (1 April or 1 October, 10 years after the creation or adoption) unless the species is removed from the Threatened list. A recovery plan is a document stating the research and management actions necessary to stop the decline, support the recovery and enhance the chance of long-term survival in the wild, of a protected community, animal or plant species. In deciding on whether to approve an action, the Australian Government Minister for the Environment and Water (Minister) must not act inconsistently with the recovery plan that is in force. Where there is no available species recovery plan, DCCEEW will rely on the approved conservation advice (see below). Where available, these species recovery plans were used to guide the impact assessment in relation to the <i>MNES Significant impact guidelines 1.1—Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) and <i>Biodiversity Conservation Act 1999</i> (Cth), and in the development of mitigation measures.
Threat abatement plans (MNES)	Threat abatement plans provide for the research, management and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities. Implementing the plan should assist the long-term survival in the wild of affected native species or ecological communities. Where available, these threat abatement plans were used to guide significant impact assessment in relation to the <i>Matters of National Environmental Significance: Significant impact guidelines 1.1—Environment Protection</i> (Department of Environment, 2013).
Approved conservation advices (MNES)	Approved conservation advices are developed to assist with the recovery of MNES under the EPBC Act. They are documents that guide recovery planning and identify actions required for the conservation and recovery of the MNES. They are approved and come into force from the time of any new species or ecological community listing. Although only intended to be used as a guide, the Minister must take advices into consideration when making an assessment of whether to approve an action.
State	
Biodiversity Planning Assessments (BPA) (Queensland)	BPA's for each of Queensland's bioregions have been prepared based on the methodology outlined in the <i>Biodiversity Assessment and Mapping Methodology</i> (BAMM) (Department of Environment and Heritage Protection (DEHP), 2014b). The BPA's draw on the Department of Environment and Heritage Protection (DEHP)-certified Regional Ecosystem (RE) mapping, database information, and expert panel reports, and incorporate information about threatened ecosystems and/or species, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, as well as buffers to wetlands or other types of important areas for ecological processes. The BPA assigns areas to one of three biodiversity significance levels, including: ▶ State significance — areas assessed as being significant for biodiversity at the bioregional or State scales ▶ Regional significance — areas assessed as being significant for biodiversity at the sub-bioregional scale ▶ Local significance and/or other values — local values that are of significance at the local government scale. All remnant vegetation will qualify into one of the above three categories. Although it is not legislated, the BPA provides a framework for biodiversity assessment when determining ecological values. In addition to terrestrial BPA's, aquatic BPA's utilises and assesses the conservation and ecological value of wetland systems based on a series of national and international criteria, including naturalness (aquatic and catchment), diversity and richness, threatened species/ecosystems, priority species/ecosystem, special features, connectivity, and representativeness to provide aquatic conservation assessments for SEQ (Department of Environment and Heritage Protection, 2015). The Project is located within the Brigalow Belt BPA area. The <i>Biodiversity Planning Assessment for the Brigalow Belt Bioregion: Expert Panel Report v2.1</i> (Department of Environment and Science (DES), 2018a) outlines the BPA's conducted within the study area.

<i>Biosecurity Act 2014</i> (Qld) (Biosecurity Act)	The Biosecurity Act seeks to provide a framework for an effective biosecurity system for Queensland that helps to manage and minimise State biosecurity risks, as well as facilitate the response to biosecurity issues and events in a timely and effective way, so as to align with national and international obligations. The Act introduces the general biosecurity obligation upon all persons to take all reasonable and practical measures to prevent or minimise biosecurity risks. The Biosecurity Act defines Prohibited Matter and Restricted Matter in which specific actions are required to limit the spread and impact of this matter by reducing, controlling or containing it, depending on the category. The Biosecurity Act also identifies requirements for invasive animal barrier fencing including authority for building and maintaining the wild dog check fence, rabbit fence and agreements that are required in order to make an opening in the barrier fences. The Project will involve interaction with restricted matters and prohibited matters (potentially including pests, diseases or contaminants) and will therefore require compliance with the Biosecurity Act. The Project interacts with the wild dog check fence for the purposes of construction, therefore approvals under the Biosecurity Act will be required.
<i>Environmental Offsets Act 2014</i> (Qld) (EO Act)	The EO Act and associated <i>Environmental Offsets Regulation 2014</i> (Qld) (EO Reg) seeks to 'counterbalance the significant residual impacts of particular activities on prescribed environmental matters through the use of environmental offsets. Introduced on 1 July 2014, the Act is administered by DESI. Under the EO Act, an environmental offset is defined as 'an activity undertaken to counterbalance a significant residual impact of a prescribed activity on a prescribed environmental matter'. The Act defines the type of activities for which offsets may be imposed (i.e. 'prescribed activities') where these activities are determined to result in a 'significant residual impact' (SRI). MSES are defined in Schedule 2 of the EO reg. The Project will deliver environmental offsets consistent with the EO Act and associated regulation. The MSES relevant to the Project are defined in Section 11.5.11, with the residual significant impact to these MSES requiring an offset is provided in Section 11.8 and 11.9. ARTC has developed an Environmental Offset Delivery Strategy (see Appendix Q: Environmental Offset Delivery Strategy) addressing the MSES SRIs identified.
<i>Environmental Protection Act 1994</i> (Qld) (EP Act)	The objective of the EP Act is to protect Queensland's environment by promoting ecologically sustainable development. The EP Act has been designed to achieve its objective by setting out a program for the identification and protection of environmental values and through a range of regulatory tools. The EP Act outlines a 'general environmental duty', which specifies that persons must not carry out an activity that causes, or is likely to cause, environmental harm, unless the person takes all reasonable and practical measures to prevent or minimise the harm. The quality of Queensland waters is protected under the <i>Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP Water and Wetland Biodiversity)</i>, which is a subordinate instrument to the EP Act. The identification of any prescribed environmentally relevant activity (ERA) that will require an environmental authority has been identified in Chapter 3: Legislation and Project Approvals Process. Confirmation of these ERAs will be undertaken as part of the post-EIS approvals process. The EP Act also lists obligations and duties to prevent environmental harm, nuisances and contamination. The two primary duties that apply to everyone in Queensland are: ▶ General environmental duty – which means a person must not carry out any activity that causes or is likely to cause environmental harm, unless all reasonable and practicable measures to prevent or minimise the harm have been taken by that person (Section 319(1) of the EP Act). Environmental harm is defined in Section 14 of the EP Act as 'any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an ecological value and includes environmental nuisance' ▶ Duty to notify of environmental harm – to inform the administering authority and landowner or occupier when an incident has occurred that may have caused or threatens serious or material environmental harm that is not authorised. Mitigation strategies (Section 11.7.3) and an Environmental Offset Delivery Strategy (see Appendix Q: Environmental Offset Delivery Strategy) has been prepared to achieve compliance with relevant offsets policies and guidelines to mitigate potential environmental harm.

Policy, standard or guideline (jurisdiction/ applicable matter)

Relevance to the Project

Fisheries Act 1994 (Qld)
(Fisheries Act)

The Fisheries Act provides for the management, use, development and protection of fish habitats and resources, together with the management of aquaculture activities. The Act covers both marine and freshwaters and natural and artificial waterbodies. Administered by the Department of Agriculture and Fisheries (DAF), the Fisheries Act applies to, but is not limited to:

- ▶ Works in a declared FHA (there are none in the Project area)
- ▶ Waterway barrier works resulting in the construction of instream structures inhibiting the free movement of fish along waterways.

Waterway barrier works:

A waterway includes a river, creek, stream, watercourse, or inlet of the sea as defined in the schedule under the Fisheries Act and mapped according to the spatial data layer, Queensland waterways for waterway barrier works. Waterways providing for fish passage are MSES. A waterway barrier is defined under the Fisheries Act as a dam, weir, or other barrier across a waterway if the barrier limits fish stock access and movement along a waterway.

Under the provisions of the Fisheries Act and Planning Act, a Development Permit for Operational Works involving Waterway Barrier Works is required for works which pose a barrier to fish passage (including permanent, partial and temporary barriers) within a waterway which is mapped by DAF on the spatial data layer '*Queensland waterways for waterway barrier works*' unless:

- ▶ The works have a low impact to fisheries productivity and comply with DAF's requirements for 'works which are not waterway barrier works' which include (subject to specific design and construction requirements):
- ▶ New single or multi-span bridges
- ▶ Maintenance of existing bridge structures not subject to an existing permit
- ▶ Bank revetment
- ▶ Road resurfacing at waterway crossings
- ▶ Stormwater outlet construction.

Works that occur within these waterways will be defined as waterway barrier works, unless the works comply with the: *accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Agriculture and Fisheries (DAF), 2018a).

The Project transverses mapped waterways for waterway barrier works and therefore will trigger the requirement to obtain a Development Permit for Operational Works that is constructing or raising waterway barrier works (refer to the State Development Assessment Provisions (SDAP) State Code 18 – Constructing or raising waterway barrier works in fish habitats), unless an exemption applies, or where works can be shown to comply with the accepted development requirements. The Project does not involve the removal, destruction or damage of marine plants, works involving aquaculture, or work that is completely or partly within a declared FHA.

If dewatering of existing storages is required, fish salvage should occur in accordance with the DAF Guidelines for fish salvage.

Nature Conservation Act 1992 (Qld) (NC Act)

The NC Act provides for the conservation of nature through protection of all native plants, birds, reptiles, mammals and amphibians in Queensland (along with a limited range of invertebrates and freshwater fish). Classes of threatened species under the NC Act include 'Extinct', 'Extinct in the Wild', 'Critically Endangered', 'Endangered', 'Vulnerable', 'Near Threatened' and 'Least Concern'.

The NC Act is based on principles aimed at conserving biological diversity, ecologically sustainable use of wildlife, ecologically sustainable development and international criteria developed by the International Union for the Conservation of Nature for establishing and managing protected areas.

The following permits and management plans may be required for the Project:

- ▶ Wildlife Movement Permits (Sections 88 and 97 of the NC Act) – for wildlife protected under the NC Act, and those found in certain areas covered by conservation plans created and implemented under the NC Act:
- ▶ Clearing Permit (Protected Plants) (Section 89 of the NC Act) – for the clearing of vegetation contained within high-risk areas identified on the Department of Environment and Science (DES) flora survey trigger map, or where protected plants have been identified in a Project survey within a proposed clearing area
- ▶ Rehabilitation Permit (spotter catcher endorsement) (Part 14 of the *Nature Conservation (Animals) Regulation 2020*)
- ▶ Damage Mitigation Permit (removal and relocation) Part 10 of the *Nature Conservation (Animals) Regulation 2020*)
- ▶ Species Management Program (SMP) must be submitted to the DES for approval for tampering with animal breeding places (Section 33 of the *Nature Conservation (Animals) Regulation 2020*).

Policy, standard or guideline (jurisdiction/ applicable matter)	Relevance to the Project
<i>Nature Conservation (Koala) Conservation Plan 2017</i> (Queensland Government, 2017b)	The Nature Conservation (Koala) Conservation Plan 2017 requires any clearing in certain areas to be undertaken sequentially and in the presence of a suitably qualified koala spotter. The Koala Plan also prescribes three mapped koala districts (A, B and C) and includes requirements relating to the release or rehabilitation of sick or injured koalas. The Project will require clearing mostly within Koala District C, with a small portion within Koala District A, which is defined as south-east Queensland under the <i>Planning Regulation 2020</i> (Planning Regulation). Clearing works in koala habitat within District A require 'sequential clearing' and the presence of koala spotters. A Draft Koala Management Plan has been prepared for the Project which provides management strategies to reduce impact to the koala (see Appendix M: Draft Koala Management Plan).
<i>Planning Act 2016</i> (Qld) (Planning Act)	The purpose of the Planning Act is to provide an efficient, effective, transparent, integrated, coordinated and accountable system of land use planning, development assessment and dispute resolution to facilitate the achievement of ecological sustainability. Together with a development assessment system, Chapter 1 of the Planning Act establishes a hierarchy of planning instruments which comprises: ▶ State planning policies (including temporary policies) ▶ Regional plans ▶ Planning schemes ▶ Temporary local planning instruments ▶ Planning scheme policies. Schedule 6 of the Planning Regulation identifies developments that cannot be made assessable under a local government planning scheme, including government supported infrastructure. Government supported transport infrastructure (GSTI) means infrastructure for transport that is: ▶ Funded, wholly or partly, by the State or Commonwealth ▶ Provided by a person, other than under a development approval or infrastructure agreement, on terms that: ▶ are agreed to by the State or Commonwealth ▶ are intended to support the commercial viability of the infrastructure. The Project may trigger the requirement to obtain approval for aspects of development that are assessable under Schedule 10 of the <i>Planning Regulation 2017</i>, such as for the modification of the Yelarbon levee which may have potential impacts on aquatic ecological values (see Schedule 10 of the Water Regulation 2016) and integrated through other legislation as part of the Development Assessment Rules process following completion of the EIS process.
<i>Queensland Environmental Offsets Policy</i> (Qld) (QEOP)	The QEOP (Department of Environment, Science and Innovation, 2024a) aims to provide a framework for environmental offsets in Queensland, including principles and guidelines for using environmental offsets and guidance on when offsets should be used. The QEOP outlines seven principles that direct the way offsets must be used to contribute to environmentally sustainable development as follows: ▶ Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy ▶ Impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact ▶ Offsets must reasonably avoid or minimise harm to Aboriginal and Torres Strait Islander cultural heritage to ensure the obligations under existing cultural heritage legislation are reflected ▶ Offsets must achieve a conservation outcome that achieves an equivalent environmental outcome ▶ Offsets must provide ecological values as similar as possible to those being lost ▶ Offset provision must minimise the time-lag between the impact and delivery of the offset ▶ Offsets must provide additional protection to ecological values at risk or additional management actions to improve ecological values.

	To avoid duplication of offset conditions between jurisdictions, state and local governments can only impose an offset condition in relation to a prescribed activity if the same or substantially the same impact and the same or substantially the same matter has not been subject to assessment under one of the following Commonwealth Acts: ▶ The EPBC Act, to the extent the assessment relates to an activity that has been declared a 'controlled action' by the Commonwealth Minister ▶ The Great Barrier Reef Marine Park 1975 ▶ Another Commonwealth Act prescribed by regulation – there are currently no listings. This includes if the Commonwealth could have imposed an offset condition but did not do so. Where legal security is required, offsets must be legally secured for the duration of the impact on the prescribed environmental matter. The Project will implement avoidance and mitigation measures to minimise the significant impacts on MSES. Implementing mitigation measures including offsets will be consistent across the Inland Rail Program. Offsets provided for under the policy include direct offsets, and other compensatory methods (or indirect offsets). Where a significant residual impact to MSES has been identified, the Project will compensate for it in accordance with the QEOP. ARTC's Environmental Offset Delivery Strategy is contained in Appendix Q: Environmental Offset Delivery Strategy. This strategy informs the development of offset delivery components for the Project including specific management intent to drive matter specific conservation outcomes across each relevant offset property presented in the strategy. Property specific Offset Area Management Plans (OAMPs) will be developed and submitted for approval. Property specific OAMPs will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to commencement of Project works.
Regional plans (Qld)— <i>Darling Downs Regional Plan</i> (Department of State Development, Infrastructure and Planning, 2013a) (Queensland. Specifically, activities that are regulated through the Planning Act)	Regional plans are State planning instruments made under the <i>Planning Act 2016</i> (Qld) (Planning Act). Regional plans seek to provide strategic direction to achieve regional outcomes that align with the State planning and development interests. The regional plan identifies the need to plan strategically for the protection and enhancement of biodiversity values and landscape function and processes. Local governments of the Darling Downs region applicable to the Project include TRC and GRC. Each of these LGAs have planning schemes that identify MLES. Refer to 'Local' section below for applicability to the Project.
<i>Vegetation Management Act 1999</i> (Qld) (VM Act)	The VM Act regulates the conservation and management of vegetation communities and clearing of vegetation identified as 'Regulated vegetation' identified as Category A, B, C and R. The VM Act provides a framework for identification, description, and mapping of remnant Regional Ecosystems (REs) certified by DES as 'Endangered', 'Of Concern' or 'Least Concern'. It also provides a framework for the identification, description and mapping of High Value Regrowth (HVR) vegetation as 'Endangered', 'Of Concern' or 'Least Concern'. The clearing of vegetation regulated under the VM Act (e.g. Category B and Category C regulated vegetation) is considered to be eligible for exemption under Schedule 21 of the Planning Regulation (i.e. government supported transport infrastructure) and does not require a development approval. This includes clearing for early works and pre-construction activities, including the establishment of laydown areas and access roads as described in Chapter 5: Project Description and Chapter 3: Legislation and Project Approvals Process.

Policy, standard or guideline (jurisdiction/ applicable matter)	Relevance to the Project
<i>Water Act 2000</i> (Qld) (Water Act)	The Water Act provides for the sustainable management of non-tidal waters and other resources, together with the establishment and operation of water authorities, and for other purposes. The Queensland Government maintains Watercourse Identification Mapping, which identifies defined watercourses under the Water Act, as well as drainage features (not regulated under the Water Act). Through the Planning Act, certain water related development under the Water Act is assessable. In addition to the approvals triggered under Planning Act, the Water Act regulates the undertaking of works that involve the excavating or placing fill in a watercourse, lake or spring. Under the Water Act, a proponent must obtain a Riverine Protection Permit in order to lawfully undertake these works unless the works can be undertaken in accordance with Riverine Protection Permit Exemption Requirements (Department of Regional Development, Manufacturing and Water, 2023a). The Water Plan (Condamine and Balonne) 2019 made under the Water Act documents the plan for the water within the Project is proposed. The purpose of this plan is to: - Define the availability of water to which the plan applies - Provide a framework for sustainably managing water to which the plan applies - Identify priorities and mechanisms for dealing with the future water requirements in the plan area - Provide framework for managing water allocations - Provide a framework for reversing, where practicable, the degradation of natural ecosystems caused by the taking of, or interference with, water to which this plan applies. The Project involves works within defined mapped watercourses and as such the provisions of the Water Act may apply. Other unmapped drainage features or watercourses will be required to be verified during the detailed design stage to determine their status under the Water Act. Further, the Project involves the removal of vegetation, excavation or placing fill in a watercourse, lake or spring. ARTC is an approved entity for the purpose of the Department of Resources (DoR) Riverine Protection Permit exemption requirements, and works can be undertaken providing that they meet the guidelines of the exemption; however, activities falling outside this exemption may trigger requirements for approval. Watercourse diversions required by Project activities will require approval under a diversion for resource activities under works that take or interfere with watercourse, lake or spring (for interference with overland flow). The applicability of the Water Plan will be to minimise adverse environmental impacts relating to water to which the plan applies, caused by the Project in the plan area.
Significant Residual Impact Guideline for matters of state environmental significance and prescribed activities assessable under the <i>Nature Conservation Act 1992</i> (Department of Environment and Heritage Protection (DEHP), 2014a) (SRI Guidelines)	The purpose of this guideline is to assist in deciding whether or not a prescribed activity will or is likely to have a significant residual impact on a MSES. This guideline applies to any activity prescribed in the Environmental Offsets Regulation 2014 that requires an approval in relation to MSES, under any of the following: ▶ <i>Nature Conservation Act 1992</i> ▶ <i>Marine Parks Act 2004</i> ▶ <i>Environment Protection Act 1994.</i>
<i>Terrestrial ecology—EIS information guideline</i> (Department of Environment and Science (DES), 2022c, Version 1.02)	This guideline advises proponents about the information requirements in relation to terrestrial ecology when preparing an environmental impact statement.

Policy, standard or guideline (jurisdiction/ applicable matter)

Relevance to the Project

<i>Aquatic ecology— EIS information guideline</i> (Department of Environment and Science (DES), 2022d, Version 1.02)	This guideline advises proponents about the information requirements in relation to aquatic ecology when preparing an environmental impact statement.
<i>Fauna Sensitive Transport Infrastructure Delivery manual</i> (Department of Transport and Main Roads (DTMR), 2024)	These best-practice and evidence-based guidelines provide information for making roads and railways more fauna friendly to guide the planning, design, construction, operation and maintenance of roads and rail. It has replaced the <i>TMR Fauna Sensitive Road Design Manual—Vol 1 & 2</i>

Local

Goondiwindi Regional Planning Scheme 2018	The Goondiwindi Region Planning Scheme was adopted by Goondiwindi Regional Council (GRC) in March 2018 and is the primary planning document for land located within the Goondiwindi LGA. The Goondiwindi Regional Planning Scheme was prepared in accordance with the repealed Sustainable Planning Act 2009 (Qld) and was amended for alignment with the Planning Act. The Goondiwindi Region Planning Scheme sets the intention for future development in the planning scheme area over a 20-year period. The Goondiwindi Regional Planning Scheme includes codes relating to environmental and ecological significance and biodiversity overlays. Matters of Local Environmental Significance (MLES) within or in close proximity to the Project footprint have been identified. Project is exempt from assessment against the Environmental Significance Code and MLES of the Planning Schemes as it is GSTI.
Goondiwindi Regional Council Biosecurity Plan (Goondiwindi Regional Council (GRC), 2022a)	The Goondiwindi Regional Council Biosecurity Plan sets out strategic guidelines for landholders and stakeholders to ensure that the impacts of pest plants and pest animals are controlled and reduced if already established in the region, and prevented from establishing if not. ARTC will ensure that the management of weeds and pest species is consistent with the Goondiwindi Regional Council Biosecurity Plan.
Toowoomba Regional Planning Scheme 2012 – Environmental Significance Overlay	The Toowoomba Regional Planning Scheme commenced in July 2012 and is the primary planning document for land located within the Toowoomba LGA. The Toowoomba Regional Planning Scheme was prepared in accordance with the repealed <i>Sustainable Planning Act 2009</i> (Qld) and was amended for alignment with the Planning Act. The Toowoomba Regional Planning Scheme intends to provide a strategic vision for development in the LGA over a 20-year period. The Toowoomba Regional Planning Scheme includes the Environmental Significance Overlay and codes relating to environmental and ecological significance. MLES matters within or in close proximity to the Project footprint have been identified. Project is exempt from assessment against the Environmental Significance Code and MLES of the Planning Schemes as it is GSTI.
Toowoomba Regional Council Biosecurity Plan (Toowoomba Regional Council (TRC), 2020a)	The purpose of this plan is to monitor compliance under the Biosecurity Act regarding the management of invasive biosecurity matter within the region, confirm the presence and extent of biosecurity matter, promote best practice management and provide advice and information aimed at enhancing community awareness of biosecurity matter. ARTC will ensure that the management of weeds and pest species is consistent with the Toowoomba Regional Council Biosecurity Plan.

11.3 Flora and fauna updates

11.3.1 Overview

This section explains how the flora and fauna assessment process has evolved following public notification of the draft EIS in 2021. The flora and fauna assessment has been revised and enhanced through adoption of a more resilient approach that has benefited from additional field survey and verification, and a greater robustness of consideration of species presence and distribution. The updated assessment and findings supersede those of the draft EIS, which relied in part on assumed presence, and resulted in conservative conclusions and residual impact determinations.

Following public notification of the draft EIS in 2021, this chapter and associated technical appendices (including the MNES Report) have been updated in response to:

- ▶ Submissions received during public notification of the draft EIS
- ▶ Findings from extensive flora and fauna surveys in consultation with species experts
- ▶ Feedback from key stakeholders from consultation with agencies, landowners, communities, technical authorities, and councils
- ▶ Updated guidelines, policy positions and other regulatory documents
- ▶ Ongoing research on key ecological species
- ▶ Updates to various Project design and construction elements, including those in response to updated ecological information to further avoid and reduce impacts as part of the EIS process.

The updated assessment and findings presented in this revised draft EIS, including residual impact determinations, replace those presented in the draft EIS, and any comparison to superseded information is not appropriate. Where the quantification of impacts differs from that shown in the draft EIS, this may be a result of a greater understanding of the extent of the affected environmental value and Project impact, updated regulatory documentation, or as a result of design revisions that have responded to stakeholder feedback, and enabled the avoidance and reduction of impacts to environmental values. These changes reflect the updated scope of the assessment and incorporation of feedback from key stakeholders and subject matter experts.

11.3.2 Summary of updates

Key updates to the chapter and associated appendices include:

- ▶ Revised species information, including survey adequacy and species profiles
- ▶ Updated habitat definitions and mapping in consultation with species experts, incorporating habitat function where applicable. Updates have considered new survey data, regulatory guidance, conservation advice, recovery plans, and listing advice. Species-specific essential habitat and MSES wildlife habitat have been included.
- ▶ Updated likelihood of occurrence of species tables
- ▶ Quantification of species-specific essential habitat
- ▶ Enhanced direct and indirect impact assessments, including significant impact evaluations
- ▶ Field verification and mapping of all watercourses intersected by the project, assessing ecological, hydrological, and geomorphological impacts
- ▶ Revised mitigation and management measures, monitoring and corrective actions
- ▶ A detailed fauna connectivity assessment and inclusion of a stand-alone Fauna Connectivity Strategy, ensuring best-practice integration of connectivity functions to manage habitat fragmentation and wildlife train strike risk
- ▶ Inclusion of a stand-alone Draft Koala Management Plan, aligned with industry research and regulatory guidance, to mitigate risks to koalas during construction and operation
- ▶ Inclusion of a stand-alone Draft Fauna Management Plan that describes the management strategies, actions and controls, to mitigate potential impacts during construction and operation
- ▶ Research partnerships with local universities on target flora and fauna
- ▶ An updated Environmental Offset Delivery Strategy based on revised significant residual impacts, in line with Commonwealth and State offset policies.

11.3.3 Draft EIS assessment of flora and fauna

The flora and fauna assessment as reported in the 2021 draft EIS was undertaken with reference to the Project's Terms of Reference. The assessment considered the ecological values present in the study area, evaluated the potential impacts of the Project, and established mitigation measures in response. The chapter was supported by:

- ▶ A terrestrial ecology technical report
- ▶ An aquatic ecology technical report
- ▶ A MNES technical report
- ▶ A preliminary fauna movement provision and fencing strategy
- ▶ A preliminary Environmental Offset Delivery Strategy based on anticipated significant residual impacts.

The draft EIS used an Impact Assessment Area based on a 1 km buffer of the Project footprint. The area was widened in locations where multiple design options remained under consideration. The area also formed the basis of the EPBC referral and ultimately the extent of the controlled action assessment.

The adopted methodology was based on an iterative approach to impact assessment and generally included the following:

- ▶ Identification of sensitive environmental receptors, through:
 - ▶ Review of existing literature and previous studies
 - ▶ Desktop analysis using existing publicly available datasets
 - ▶ Creation of predictive habitat mapping using publicly available datasets, supported by where available by species recovery plans, conservation advice and relevant scientific studies.
- ▶ Targeted validation of the predictive habitat mapping through terrestrial and aquatic ecological surveys where land access was available
- ▶ Significant impact assessments for sensitive environmental receptors, to determine instances where the risk of potentially significant residual impacts may occur
- ▶ Residual impact assessments for at-risk matters, applying the relevant significant impact guidelines in place at the time. These assessments informed potential offset requirements
- ▶ Cumulative impact assessments using predictive habitat mapping outside the Project footprint. This assessment evaluated potential overlapping impacts associated with other Projects within a 50 km radius of the Project.

Utilising the predictive habitat mapping approach, the draft EIS identified species listed under the NC Act and the EPBC Act as being present or likely to be present, adopting a precautionary approach of assumed presence. From that, a total of 5 TECs, 21 flora and 24 fauna species listed as threatened under the EPBC Act, were assessed for significant residual impacts. Significant residual impacts were considered likely for:

- ▶ Three TECs
- ▶ Eight flora species
- ▶ Nine fauna species.

A total of 15 EPBC Act non-threatened migratory species were assessed for significant residual impacts, which concluded there were no significant impact likely for any species.

Significant residual impacts for MSES were concluded as likely to occur for:

- ▶ 'Endangered' or 'of concern' regional ecosystem (RE);
- ▶ A prescribed RE (Category B other than grassland) within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature
- ▶ Essential habitat
- ▶ Connectivity areas
- ▶ An area that contains plants that are endangered wildlife or vulnerable wildlife
- ▶ Habitat for a number of animals that are listed as threatened.

The assessment found significant residual impacts were uncertain for a number of further matters, due to an absence of presence data for some and the preliminary nature of design elements for other matters.

A range of mitigation measures were established for implementation in the further phases of the Project, grouped as:

- ▶ Overarching measures for all ecological values
- ▶ Measures specific to MNES matters
- ▶ Measures specific to MSES.

The mitigation measures included a Preliminary Fauna Movement Provision and Fencing Strategy, which set out fauna crossing methods and preferred locations.

Lastly, the draft EIS presented a preliminary Environmental Offset Delivery Strategy based on anticipated significant residual impacts for the Project.

11.3.4 Project updates and reduced environmental impacts

Following public notification of the draft EIS, the Project's reference design, disturbance footprint and approach to construction have been updated. Changes to reduce ecological impacts were made in response to submissions on the draft EIS and issues raised in ongoing consultation activities with key stakeholders, including landowners, contractors, agencies and technical authorities. Design revisions have also followed further assessments of scientific data, field-verified survey outputs, and a review of opportunities to increase efficiencies while avoiding and reducing impacts to ecological receptors. Consequently, the net impact of the Project on the receiving environment differs due to the evolution of the Project scope and delivery approach.

Details of these modifications and how avoidance strategies have been incorporated in the Project design, including adjustments to reduce impacts on ecological values and local communities, are outlined in Chapter 5: Project Description and Appendix B3: Changes to Reference Design since the Draft EIS.

Key design updates made since the draft EIS relevant to flora and fauna include:

- ▶ Project footprint reductions including through the Bringalily and Whetstone State Forests. Design refinements at Bringalily State Forest reduced clearing by approximately 21.5 ha, minimising impacts on remnant vegetation and habitats for species including the koala, south-eastern long-eared bat, and spotted-tailed quoll. Adjustments included relocating a laydown area outside the State Forest into an adjacent road corridor.
- ▶ Project areas associated with construction activities such as laydown areas were reassessed against construction needs in conjunction with field survey information to avoid and reduce impacts to ecological values and rehabilitation land requirements. Construction laydown areas were relocated away from environmentally sensitive zones to minimise impacts on wildlife and habitat.
- ▶ Adjusting road access configuration and other design refinements to avoid impacts on verified Threatened Ecological Communities (TEC) including Semi-evergreen Vine Thicket (SEVT), White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum)
- ▶ Consideration of essential habitat and other environmental values when locating the Millmerran alternative realignment to reduce clearing requirements and minimise disturbance to vegetated corridors providing fauna connectivity function
- ▶ Modifying workforce accommodation and borrow pit locations to reduce risks to protected species
- ▶ Relocating the Whetstone Material Distribution Centre from an unmapped Brigalow TEC area to a previously cleared site located south of the rail alignment
- ▶ Update of drainage structures, including additional bridges, culverts, and scour protection, based on soil, geomorphological, and ecological surveys. These improvements minimised impacts on riparian vegetation, banks, instream habitats, aquatic fauna passage and areas of ecological importance in the Condamine and Macintyre floodplains.

11.3.5 Revised flora and fauna assessment methodology and mitigation framework

Updates to the flora and fauna assessments were undertaken using refined methodologies developed in consultation with species experts.

These updates include the following:

- ▶ Enhanced understanding of habitats and species present across the Project area. This approach included the establishment and completion of revised methods for defining habitats and habitat quality, establishing consistent approaches for evaluating the likelihood of species presence, and refining impact assessment techniques. Methods applied addressed:
 - ▶ field verification and mapping of all watercourses intersected by the Project, assessing ecological, hydrological, and geomorphological impacts
 - ▶ preparation of updated species likelihood of occurrence (LoO) tables
 - ▶ revised species information, including survey adequacy and species profiles.
- ▶ Updated habitat definitions and mapping, developed in consultation with species experts, incorporating habitat function where applicable. Updates have considered new survey data, regulatory guidance, conservation advice, recovery plans, listing advice and scientific literature. Species-specific essential habitat and MSES wildlife habitat have been included.
- ▶ Quantification of species-specific essential habitat
- ▶ Completion of a field survey program (2021–2024) within the Project footprint and adjacent areas to assess and validate the ecological values. Survey methods and seasonality-considered species requirements and were informed by the results of the database assessments and preliminary survey data. These surveys were devised in consultation with species experts, included verification of the locations of sensitive ecological values and their associated habitats within the Project footprint, along with appropriate reference sites and targeted areas beyond the Project footprint. Compared to the draft EIS fieldwork where there was limited land access availability, these surveys resulted in the collection and consideration of substantially more data across a broader landscape. In turn this resulted in a more comprehensive and robust basis for consideration of habitat quality, species presence, habitat function, connectivity, the quantification of impacts and efficacy of proposed mitigation measures.
- ▶ Expanded direct and indirect impact assessments to evaluate the potential effects of Project construction and operation on environmental values. This now includes the addition of a detailed fauna connectivity assessment, significant impact evaluations, and the ecological impacts of noise and vibration and altered hydrology and flooding patterns. This resulted in the completion of significant residual impact (SRI) assessments for relevant MSES and MNES. MSES were assessed in accordance with the criteria provided in the *Significant Residual Impact Guidelines* (DEHP, 2014). Detailed significant impact assessments (SIAs) were undertaken for each MNES in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013). MSES that are also considered MNES were assessed in accordance with the *Queensland Environmental Offsets Policy* (DESI 2024). It was considered that the areas included in this assessment were the same, or substantially the same, as what would be assessed under an MSES SRI.
- ▶ Based on impact assessment findings, mitigation and management measures have been revised and expanded, and applied to the updated reference design to the extent presently possible. Monitoring and corrective actions have been updated. Embedded in the Draft Outline Environmental Management Plan, these measures comprise of a suite of plans and strategies that will guide the detailed design process, construction activities and operation management. Table 11-2 below indicates the role of various plans in these subsequent project stages.
- ▶ Implementation of an iterative feedback loop where updated environmental values from the above actions have informed Project scope, the incorporation of design progression and change into the biodiversity assessments, and consideration of the updated mitigation measures.
- ▶ An updated Environmental Offset Delivery Strategy, consistent with the updated assessments of impact and significant residual impacts. The updated Strategy will inform the development of offset delivery components, including the development of Offset Area Management Plans to support Project approvals.

The methodology for flora and fauna assessment of the revised draft EIS was prepared, refined and confirmed through an iterative process from 2022 to 2024, guided by feedback, requests for further information and advice provided as the methodology was applied and tested. The methodology is summarised in Chapter 11.4 below and described in the revised draft EIS technical reports, principally Appendix L Terrestrial and Aquatic Technical Report.

Table 11-2 indicates the relationship and evolution of the EIS chapters and supporting technical reports, role of mitigation measures and the range of supporting management plans. These management plans provide the basis to inform and guide design tasks and construction activities. For example, Appendix M of the Draft EIS Preliminary Fauna Movement Provision and Fencing Strategy Assessment Report", has now been developed into the Draft Koala Management Plan, the Draft Fauna Management Plan and the Fauna Connectivity Strategy in the revised draft EIS. These documents would be refined and finalised as detailed design is completed, as discussed in below Section 11.7.

TABLE 11-2 FLORA AND FAUNA DOCUMENTS IN THE ASSESSMENT AND POST APPROVAL PHASES

Draft EIS	Revised Draft EIS	Construction Stage	Operational Stage
Increasing detail of assessments, mitigation measures, management strategies and monitoring programs over time			
2021	2025	Post approval management plans	
Chapter 10 Flora and Fauna	Chapter 11 Flora and Fauna	Fauna Management Plan	
Appendix J Terrestrial Ecology Tech Report	Appendix L Terrestrial & Aquatic Tech Report	Koala Management Plan	
Appendix K Aquatic Ecology Tech Report		Wildlife Connectivity Plan	
Appendix L MNES Assessment Report	Appendix O MNES Assessment Report	Wildlife Lighting Management Plan	Wildlife Lighting Management Plan
Appendix M Preliminary Fauna Movement Provision and Fencing Strategy Assessment Report	Appendix N Draft Fauna Management Plan	Construction Environmental Management Plan Biodiversity Management Plan Biosecurity Management Plan Soil Management Plan Rehabilitation and Landscaping Management Plan	Operational Environmental Management Plan Biodiversity Management Plan Biosecurity Management Plan
	Appendix M Draft Koala Management Plan		
	Appendix P Fauna Connectivity Strategy		
Chapter 22 Outline Environmental Management Plan	Chapter 24 Outline Environmental Management Plan		
Appendix N Preliminary Offsets Delivery Strategy	Appendix Q Offsets Delivery Strategy	Offset Area Management Plans	

11.3.6 Comparative outcomes to the Draft EIS

The detailed quantification and assessment of potential impacts to ecological values as a result of the Project's design revisions and the updated methodology are summarised in the balance of this Chapter.

Table 11-3 below presents a comparison of key project statistics and the fieldwork completed. The Project updates and changes to reduce ecological impacts have resulted in the alteration of the Project extent and track lengths shown below. Consequently, the net impact of the Project on the receiving environment differs.

TABLE 11-3 KEY PROJECT STATISTICS AND FIELDWORK ASSESSMENTS OF THE DRAFT EIS AND REVISED DRAFT EIS

	Draft EIS	Revised draft EIS
Project extent	3203.78 ha	3382 ha
Track length		
Standard gauge length	7.0km	7.0km
Dual gauge length	209.2 km	210.48 km
Total length	216.2 km	217.48 km
Flora and fauna fieldwork*		
Years completed	2018-2021	2021-2024
Terrestrial survey campaigns	2 campaigns Totalling 14 days Opportunistic targeted species surveys No seasonality	Over 36 campaigns Over 200 days / nights Extensive targeted species surveys Seasonally based Threatened species research programs
Aquatic survey campaigns	1 campaign 5 periods at 12 sites Aquatic habitat assessments, macroinvertebrate and fish surveys	1 campaign 6 days, 10 sites eDNA surveys

* The revised draft EIS drew upon the results of all field surveys conducted for the Project. Flora and fauna fieldwork details listed under the revised draft EIS are additional to those listed under the draft EIS.

Table 11-4 below presents a summary of the quantum of flora and fauna species, TECs and REs in the Project footprint of the draft EIS and revised draft EIS. Due to the revised footprints and updated assessment methodologies, the draft EIS is superseded and is not appropriate to be directly compared with the revised draft EIS. The table presents the number of affected matters anticipated to be present using the methodologies adopted, field verified and residual impacts.

For the revised draft EIS, the updated desktop review and LoO approach formed the basis of analysis and identification of anticipated species, which were then confirmed through the extensive fieldwork campaigns. This verification of presence validated the LoO approach and has reduced reliance on the assumed presence. Whilst the total number of matters noted in Table 11-3 are similar, this approach, in conjunction with the Project revisions, has resulted in assessment of a different range of matters, with an updated quantum of impacts. as a result of updated information. Detail on these impacted matters is provided in Chapter, in Appendix L Terrestrial and Aquatic Technical Report and Appendix O MNES Assessment Report.

TABLE 11-4 FLORA, FAUNA AND ECOSYSTEMS CONSIDERED IN THE DRAFT EIS AND REVISED DRAFT EIS

	Draft EIS ¹		Revised draft EIS ¹	
	MNES	MSES ²	MNES	MSES ²
Floral species (no.)				
Desktop and/or existing mapping	31	3	22	19
Verified presence	1	2	8	9
Residual Impact	5	2	5	2
Fauna species (no.)				
Desktop and/or existing mapping	33	5	23	27
Verified presence	3	0	13	11
Residual Impact	7	2	10	4
TECs (MNES only)				
Desktop and/or existing mapping (no.)	5	N/A	8	N/A
Field verified (no.)	1	N/A	3	N/A
Impacted (no.)	3	N/A	3	N/A
Desktop and/or existing mapping (ha)	142.3	N/A	173.2	N/A
Field verified (ha)	226.7*	N/A	172.3	N/A
Impacted (ha)	226.7*	N/A	173.1	N/A
Habitat within Project footprint (MSES only)				
Essential habitat (ha)	N/A	117.3	N/A	113.19
Koala Habitat Area under the NC Act (ha)	N/A	81.7	N/A	7.44
Regional Ecosystems (MSES only)				
State mapping				
Endangered REs		3		2
Of Concern REs		6		7
Category A - "Protected" (ha)		0		0.07
Category B - Remnant (ha)		563.2		475.4
Category C - High-value regrowth (ha)		34.6		26.35
Field verified				
Endangered REs		N/A		4
Of Concern REs		N/A		8
Category A - "Protected" (ha)		0		0
Category B - Remnant (ha)		N/A		570.75
Category C - High-value regrowth (ha)		N/A		287.4
Residual Impact				
Endangered REs		2		2
Of Concern REs		4		5
Endangered REs (ha)		62.7		24.7
Of Concern REs (ha)		151.5		85.1

Notes:

1. The revised draft EIS incorporates updated information and supersedes any potential extent of impacts associated with MNES and MSES as presented in the draft EIS. Accordingly, comparisons may not be directly equivalent.
2. MSES values are presented in context of MNES equivalency as appropriate.

11.4 Methodology

11.4.1 Overview

The methodology for this assessment includes a compilation of data from the numerous investigations that have been undertaken for the Project since 2016.

The technical reports which form the bases of this chapter have been prepared in accordance with *Terrestrial ecology — EIS information guideline* (DES, 2022c, Version 1.02) and *Aquatic ecology — EIS information guideline* (DES, 2022d, Version 1.02).

The methodology undertaken to support the draft EIS released in 2021 included a desktop analysis of available datasets, existing literature, and previous studies to identify the listed threatened flora and fauna species and other MNES and MSES that potentially occur in and surrounding the Project footprint. Following development of the potential threatened species list, ecological field surveys were undertaken to validate mapped habitat and desktop-based mapping and to identify baseline conditions to inform the reference design of the Project.

The updated desktop assessment (Section 11.4.3) for the revised draft EIS includes the following information available from the draft EIS (released in 2021):

- ▶ Field surveys conducted and discussed in the draft EIS and appendices, treated as preliminary field studies
- ▶ Knowledge gaps
- ▶ The results of the updated desktop assessment and gap assessment were then used to design a comprehensive field program for within the Project footprint
- ▶ While field-based assessments assessed species listing and status at the time of survey, subsequent assessments of this report use the most up to date species listing and status.

The likelihood and impact assessments completed are informed by the complete set of available information for the study area and Project footprint. The methodologies employed for each stage of the ecological assessment process are discussed in further detail in the following sections:

- ▶ Desktop assessment (Section 11.4.3)
- ▶ Field surveys (Section 11.4.5)
- ▶ Habitat mapping (Section 11.4.6)
- ▶ Impact assessment Section 11.4.7)
- ▶ Cumulative impacts assessment (Section 11.4.8).

11.4.2 Study area and key terms

Desktop ecological assessments were undertaken within the Project footprint with a 1 km buffer (the study area). The study area has changed in size through the development of the revised reference design. Generally, field ecological assessments were undertaken within the Project footprint.

The assessment of potential impacts has focused on the Project footprint (see Figure 11-1); however, indirect impacts in the broader study area were also considered where appropriate. The Project footprint (3,382.17 ha) is the land required to accommodate all permanent and temporary components of the Project, as described in Chapter 5: Project Description, including the:

- ▶ Temporary footprint (3,382.17 ha): the area required to accommodate construction activities and facilities of a temporary nature and duration to support the Project. The temporary footprint includes the permanent footprint (for the duration of the construction stage); however, it is generally wider than the permanent footprint to allow for the construction of Project elements including fencing, erosion and sediment control measures, temporary stockpiling of soil and cleared vegetation, and to allow necessary construction access and turnaround provisions. Temporary Project facilities include laydowns, site office areas, non-resident workforce accommodation, a material distribution centre, concrete batch plants and borrow pits.
- ▶ Permanent footprint (2,544.86 ha): the area required to accommodate permanent infrastructure associated with the Project including rail, road and other miscellaneous infrastructure. Rail infrastructure includes rail tracks, crossing loops, turnouts, earthworks, bridges, drainage, level crossings, grade separations, rail maintenance access roads, signalling and fencing. Road-related works resulting from the Project encompasses new and upgraded roads, realignments and diversions, intersection improvements and closures.

The Project footprint includes all areas where vegetation will be cleared to accommodate both permanent infrastructure and temporary construction-related activities and facilities.

Cumulative, indirect and facilitated impacts occurring outside the Project footprint have been assessed at a scale relevant to the impact being assessed.



Figure 11-1 Location of the Project and the Study Area

MAP 1 OF 4



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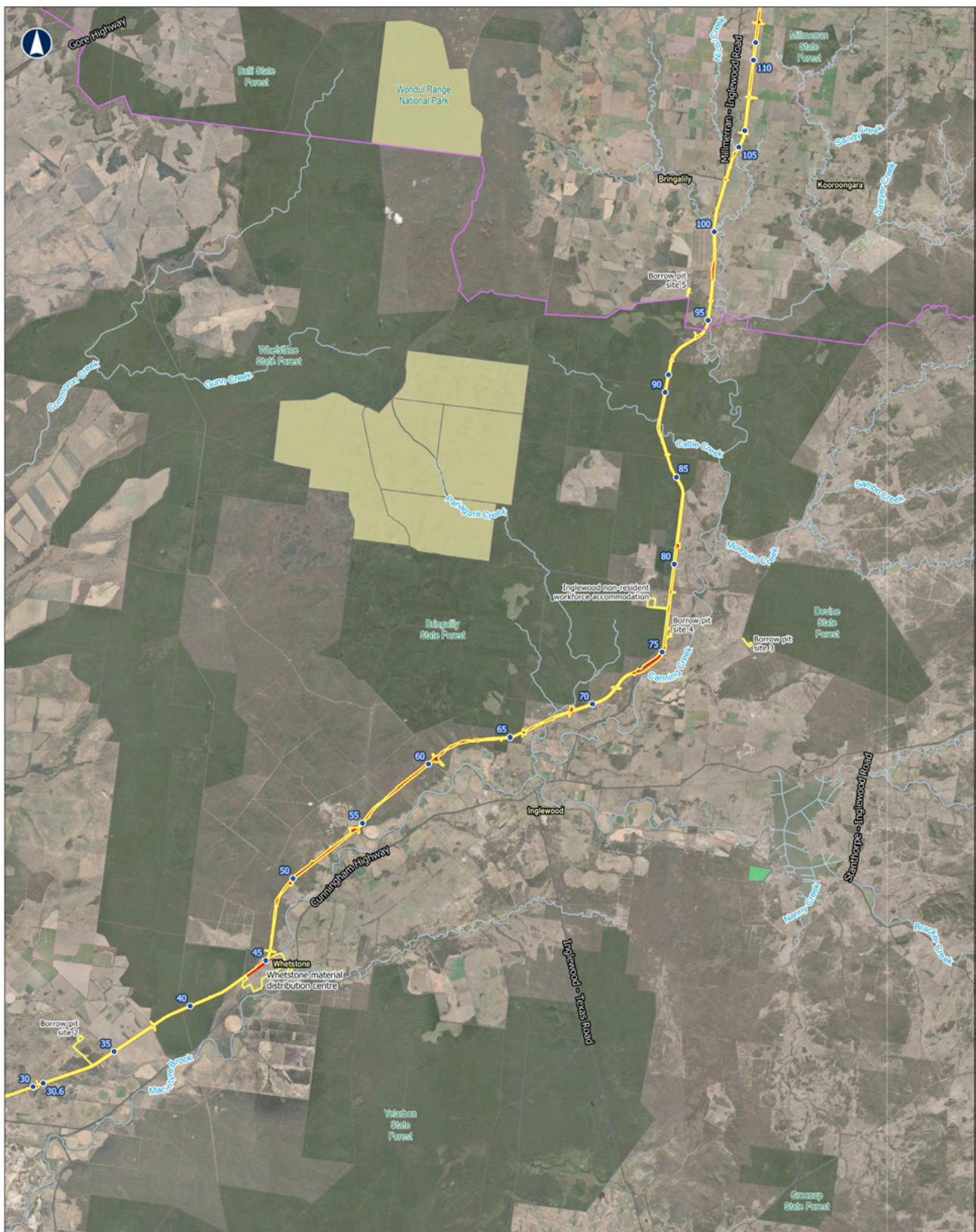
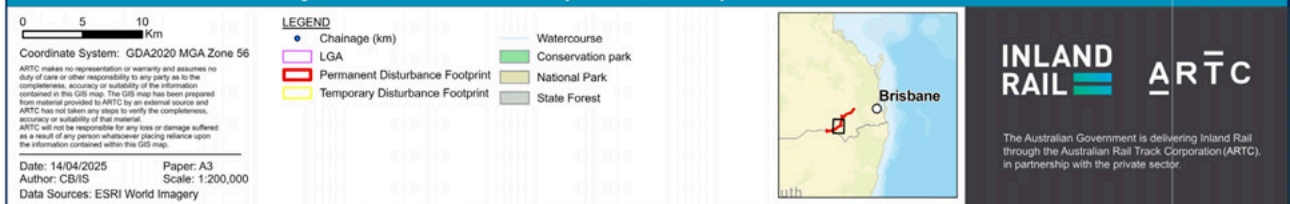


Figure 11-1 Location of the Project and the Study Area

MAP 2 OF 4

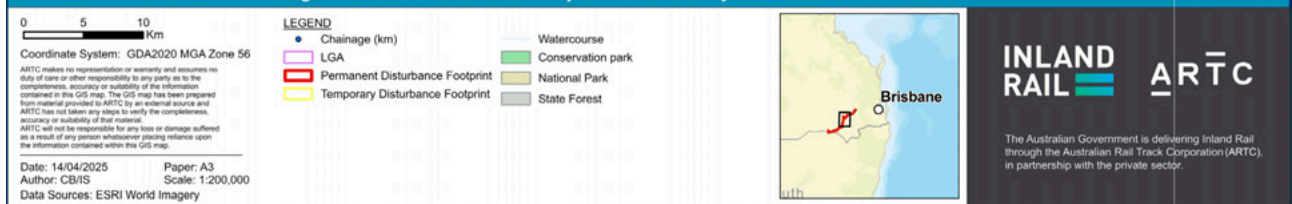


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Figure 11-1 Location of the Project and the Study Area

MAP 3 OF 4



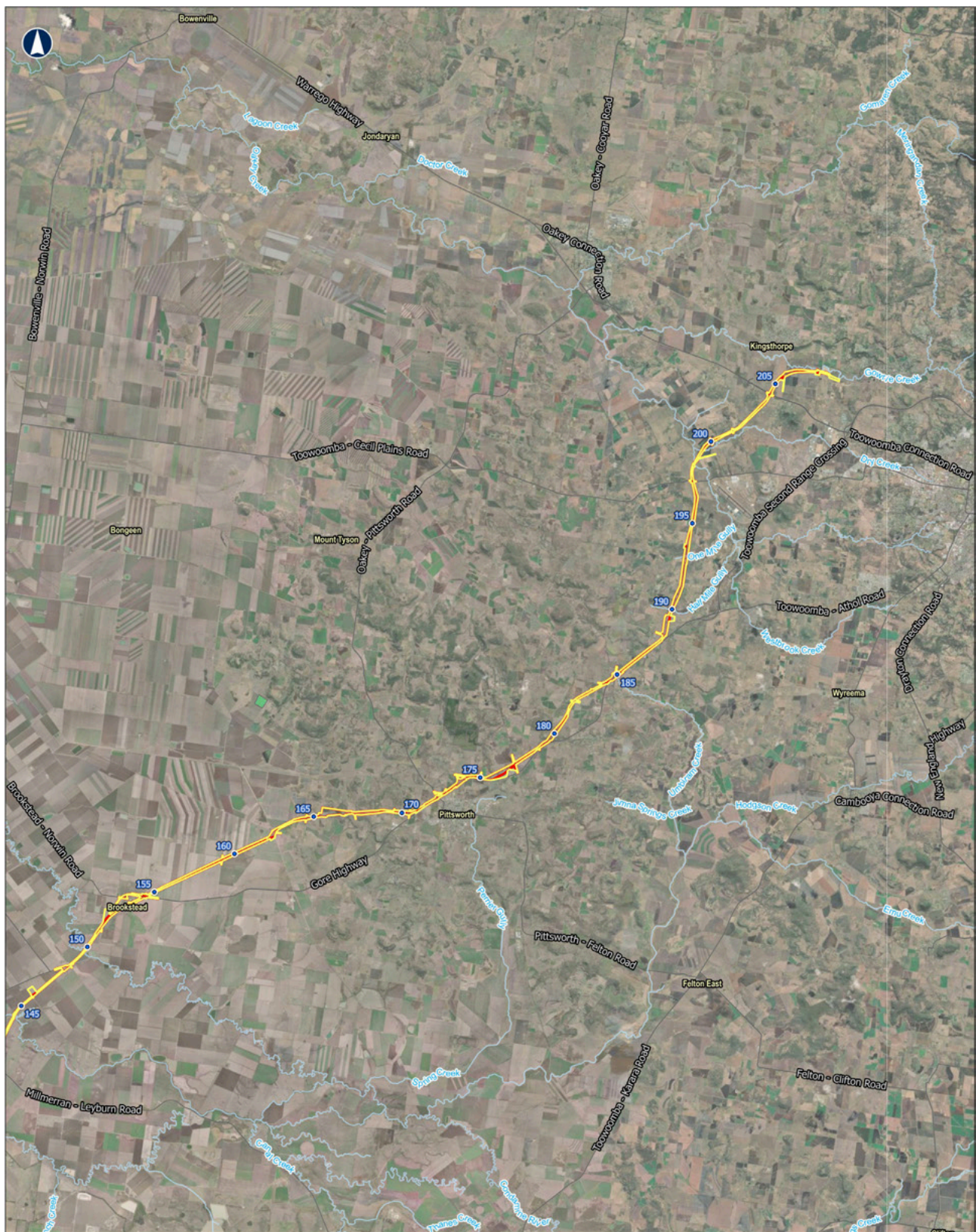


Figure 11-1 Location of the Project and the Study Area

MAP 4 OF 4

0 5 10 Km

Coordinate System: GDA2020 MGA Zone 56

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Date: 14/04/2025 Paper: A3
 Author: CB/IS Scale: 1:200,000
 Data Sources: ESRI World Imagery

LEGEND

- Chainage (km)
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- Conservation park
- State Forest

Brisbane

INLAND RAIL **ARTC**

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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11.4.3 Desktop assessment

A desktop assessment was conducted to identify information on existing terrestrial and aquatic ecological values within the study area and surrounds. The data was reviewed to identify the presence or potential presence of listed Threatened species, other MLES, MSES and MNES. The desktop assessment included a literature review of previous ecological studies, collation of environmental databases and searches, maps and scientific literature. Likelihood of occurrence assessments were undertaken prior to preliminary field investigations and updated following the completion of field surveys.

Survey methods were based on this information and prepared in accordance with relevant Commonwealth and State survey guidelines (Department of Environment and Science (DES), 2020a).

The objectives of the desktop assessment undertaken were to:

- ▶ Identify terrestrial and aquatic ecological values known, likely or potentially present within the study area
- ▶ Identify all relevant information related to the study area and all known and potential impacts
- ▶ Identify gaps in data in relation to terrestrial and aquatic ecological values in the study area
- ▶ Allow refinement of the field survey methodology to ensure relevant values were targeted appropriately.

11.4.3.1 Database review

A database review was initially undertaken in 2017 prior to preliminary field investigations. Searches were re-run in 2019, 2022 and 2024 to enable any relevant updates, or additional species observations, to be incorporated into the assessment. Details of the relevant database sources, the most recent search dates and purpose of the data are summarised in Table 11-5.

Limitations of the database information are addressed in the relevant technical reports. Limitations were minimised wherever possible by ensuring that the most recent datasets were used, datapoints with ambiguous metadata or of very low precision were excluded from analysis, and any ground-truthed data was prioritised over that of desktop-based datasets. In addition, specimen backed records older than 20 years were generally excluded from analysis due to concerns related to currency and recent human induced disturbance to the broader area. Where older records have been used, their recency is noted. Any Project-based ground-truthed data was used in preference over those from desktop-based datasets.

TABLE 11-5 SUMMARY OF DATA SOURCES ACCESSED FOR THE ECOLOGICAL ASSESSMENT

Database/data source name	Database search date	Database search areas	Data type
Atlas of Living Australia	12/2023 and 01/2024	Study area	Records of flora and vertebrate fauna, including conservation-significant species (i.e. both MNES and MSES).
Birds Australia	29/03/2019	Study area	Records of avian fauna, including Threatened and migratory species listed under the EPBC Act and/or NC Act.
BPA and Aquatic Conservation Assessments Mapping (Queensland Government)	11/04/2022 and 05/06/2024	Study area	State, regional and locally significant biodiversity matters mapping. This mapping has been used to indicate the location of bioregional corridors (i.e. in the State, regional and local context). This mapping has also been used in the predictive habitat mapping to identify core habitat areas.
EPBC Act Protected Matters Search Tool (PMST) (Australian Government) (Australian Government, 2018c)	24/03/2022 and 08/11/2024	Study area	Provides a 'predictive' account of MNES listed under the EPBC Act and/or the NC Act, including World Heritage properties, National Heritage places, wetlands of international importance, Great Barrier Reef Marine Park, Commonwealth marine area and listed Threatened ecological communities, Threatened species and/or migratory species (controlling provision).
Species Profile and Threats Database (Department of Agriculture, Water and the Environment, 2020)	24/03/2022 and 02/2024	Study area	Location of MNES, including: ▶ Threatened species ▶ Threatened ecological community (TEC) ▶ Critical habitats.

Database/data source name	Database search date	Database search areas	Data type
National Flying-fox Monitoring Viewer and DESI Flying Fox Monitoring Program	06/11/2024	Study area	Shows the location of flying-fox roosts in Queensland recorded by DCCEEW and DESI and include monitoring data of continuously and periodically (seasonally or irregularly) used roosts. The exact location of roosts may vary within a small, localised area.
Pre-clearing Regional Ecosystem Mapping	11/04/2022	Study area	Pre-clearing REs by Broad Vegetation Group, and wetland and riparian associated vegetation communities.
Protected Plants Flora Survey Trigger Map (Queensland)	30/06/2022 and 05/06/2024	Study area	Records and habitat for NC Act Threatened flora and areas where particular provisions of the NC Act apply to the clearing of protected plants. Determined the extent of the survey area occurring within a high-risk area for protected plants.
Regulated Vegetation Management Map and Vegetation Management Supporting Map (Queensland Government)	30/06/2022	Study area	Mapping of REs and HVR REs that provide habitat for TEC and conservation-significant species under the EPBC Act and/or NC Act, including categories of mapped vegetation (e.g. Category B – Endangered or Of Concern, Category C – freehold, indigenous land and area that has not been cleared, Category R – REs intersecting with watercourses and wetlands) to determine clearing requirements. Determined the likely type and extent of vegetation communities within the study area.
Register of Critical Habitat (Australian Government)	30/06/2022	Australian extent	Critical habitat listed under the EPBC Act and for those species dually listed under the NC Act.
Wetland Info Database (Queensland Government)	30/06/2022	Study area	Provides interactive maps, species records, case studies and legislation associated with Queensland wetlands.
Wetland Maps Report (Queensland Government)	07/04/2022 and 05/06/2024	Study area	Report based on mapping of water bodies and wetland REs across Queensland.
WildNet Records (Queensland Government)	7/04/2022 and 01/2024	Study area	Records of species listed as Threatened or Special Least Concern (SLC) species under the NC Act.
Wildlife Online (Queensland Government)	07/04/2022 and 05/06/2024	Study area	Modelled potential habitat of state listed conservation significant flora and fauna species, including conservation-significant species listed under the EPBC Act and/or NC Act. Models taken from records of fauna species occurrence compiled for the purposes of Biodiversity Assessment by the DES (Environmental Protection Agency, 2002) and specimen backed flora records compiled from the Queensland Herbarium's Herbreccs database.
Queensland Waterways For Waterway Barrier Works (Queensland Government)	26/06/2022	Study area	Identifies waterways defined by the Fisheries Act and determines whether the site of proposed waterway barrier works requires approval under the Planning Act.
Watercourse Identification Mapping (Queensland Government,)	30/06/2022	Study area	Mapped extent of watercourses and drainage features that are managed under the Water Act.
Fish Habitat Area (FHAs) (Queensland Government)	30/06/2022	Study area	Boundaries of gazetted, declared FHAs.
Queensland Springs Database (State of Queensland)	30/06/2022	Regional extent	The dataset provides a comprehensive catalogue of permanently saturated springs that have fixed locations and any associated surface expression groundwater-dependent ecosystems (GDEs).

Database/data source name	Database search date	Database search areas	Data type
Matters of State Environmental Significance (MSES) (Queensland Government)	7/04/2022	Study area	Location of relevant MSES: ▶ Protected wildlife habitat for Threatened and SLC wildlife listed under the NC Act, ▶ Regulated vegetation under the VM Act: – intersecting a VM Act wetland – Category B Endangered or Of Concern – essential habitat – intersecting a watercourse – 100 m from wetland ▶ Connectivity ▶ Protected areas, special wildlife reserves, estates, and nature refuges ▶ Essential habitat (EH) ▶ Wetlands in a wetland protection area or wetlands of high ecological significance (HES) ▶ Wetlands and watercourses in high ecological value (HEV) waters as defined in the <i>Environmental Protection (Water) Policy 2009, Schedule 2</i> ▶ Strategic environmental areas ▶ Legally secured offset areas.
Aquatic Biodiversity Assessment Mapping Method (AquaBAMM)/Aquatic Conservation Assessments (ACA) (Department of Environment and Heritage Protection, 2015)	26/02/2020 and 05/06/2024	Aquatic survey sites	Conservation values of aquatic ecosystems for: ▶ Biodiversity and species richness ▶ Presence of Threatened species or community ▶ Presence of priority species or ecosystem ▶ Ecosystem complexity (e.g. uniqueness of geomorphology) ▶ Landscape connectivity A summary score (Aquascore) is produced and classified into one of five rankings: ▶ Very high ▶ High ▶ Medium ▶ Low ▶ Very low.
Goondiwindi Regional Planning Scheme – environmental overlays and codes relating to biodiversity and ecological significance	2022	Study area (to the extent that is covered by the Regional Plan)	Codes relating to environmental and ecological significance and biodiversity overlays. Identified any MLES matters within or in close proximity to the Project footprint.
Toowoomba Regional Planning Scheme – environmental overlays and codes relating to biodiversity and ecological significance	2022	Study area (to the extent that is covered by the Regional Plan)	Codes relating to environmental and ecological significance and biodiversity overlays. Identified any MLES matters within or in close proximity to the Project footprint.

11.4.3.2 Preliminary mapping of threatened ecological communities

To develop preliminary mapping of TECs for the study area, a desktop level assessment was undertaken using geospatial datasets, administered by the State of Queensland. The preliminary mapping development also used REs associated with the TEC, as identified in the relevant approved conservation advice, or listing advice for each TEC.

11.4.3.3 Pre-survey predictive habitat mapping

Predictive habitat mapping was prepared by FFJV to identify and map potential habitat for threatened flora and fauna within the study area. This was conducted following preliminary surveys, but prior to targeted field surveys. The aim was to use this mapping to undertake an initial likelihood of occurrence assessment and to target field surveys.

The predictive habitat mapping is a geographic information system (GIS) layer based on known habitat associations, as defined in scientific literature and conservation listing advice/recovery programs available for each species.

After development of predictive habitat mapping for the study area, detailed field surveys were undertaken within the Project footprint (Section 11.4.4). This ground-truthed habitat mapping now supersedes the predictive habitat mapping within the Project footprint.

Predictive habitat mapping within the study area and a larger buffer of 50 km (excluding the Project footprint) was used to inform the assessment of cumulative impacts. A distance of 50 km from the Project was selected as many of the ecological values of relevance to the Project do not extend beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent.

11.4.3.4 Likelihood of occurrence

An initial likelihood of MNES and MSES occurring within the Project footprint was determined based on the results of the desktop assessment and preliminary field surveys described in Section 11.4.4.

During the desktop assessment, the likelihood of occurrence assessment was based on historic datasets, consideration of a species current (known) distribution range, the presence and condition of suitable habitat in the Project footprint and preliminary field survey results. Each species in the likelihood of occurrence was assigned to one of the categories in Table 11-6, being known, likely, potential or unlikely to occur.

TABLE 11-6 LIKELIHOOD OF OCCURRENCE CRITERIA

	Preferred habitat exists ⁴	General habitat exists ⁵	Habitat does not exist ⁶
Recent ¹ records within the Project footprint ²	Known	Known	Known
Recent records in the locality ³	Likely	Potential	Unlikely
No records within the locality, but the Project footprint is within the distribution ⁷	Potential	Unlikely	Unlikely
No records in the locality, and the Project footprint is outside of the distribution	Unlikely	Unlikely	Unlikely

1 Recent records are those that have been recorded in the last 20 years.

2 'Project footprint' is the land required to accommodate all permanent and temporary components of the Project as described in Chapter 5: Project Description.

3 'Locality' refers to a 10 km buffer around the Project footprint and is inclusive of the Project footprint.

4 Preferred habitat includes breeding, denning, roosting, and/or foraging habitats for fauna species; and habitat containing associated floristic species, vegetation communities, suitable substrates, and/or landforms for flora species.

5 General habitat includes dispersal habitat and other areas where the species may occasionally be found, but do not contain all required habitat features to constitute preferred habitat.

6 Based on sources reviewed and/or field survey results.

7 Distribution is defined as the may/likely distribution as per the SPRAT profile or other source, as available.

If the likelihood of occurrence was uncertain, for example where the habitat preferences of the species are not well known or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. The results of the desktop and likelihood of occurrence assessments were used to identify gaps in the knowledge of the identified ecological values, especially in areas where reliable field data was not available. Field surveys were designed to address these gaps. Following field surveys (see Section 11.4.4), the likelihood of occurrence assessment was re-visited to incorporate field verified habitat assessments and flora and fauna records using the same criteria used above.

The draft likelihood of occurrence assessment was provided to DCCEEW/OCG for review prior to being finalised. This review resulted in the addition of one Threatened flora species, being the slender darling pea (*Swainsona murrayana*) which has been assessed as unlikely to occur.

Further details related to the likelihood of occurrence assessment are provided within Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

11.4.4 Preliminary field surveys

The preliminary field surveys undertaken for the Project are summarised in Section 11.5. Their methods are provided in more detail in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report. The findings of each of the studies were used to supplement knowledge gaps identified from database searches.

Not all studies in the literature review and preliminary field surveys that inform the desktop assessment were undertaken within the current Project footprint, partly because the footprint has evolved over time. Changes to the Project reference design since the draft EIS are presented in Appendix B3: Changes to Reference Design since Draft EIS; however, observations from the surveys were still of use in confirming the presence of threatened species or their habitat, other MSES and MNES and other habitat types in proximity to the Project footprint and were sufficient to determine the potential nature and magnitude of the impact on MNES and MSES as a result of the Project.

TABLE 11-7 PRELIMINARY FIELD SURVEYS

Document/ investigation title	Consultant/year	Timing of investigations	Season	Summary of methods, significant findings and notes
Summary of ecological constraints to inform the initial advice statement	Eco Logical Australia (2016)	26 to 29 April 2016	Autumn	Survey of alignment and corridor options. Included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at three sites.
		12 to 15 September 2016	Spring	Survey of further corridor options. Included identification of EREs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at two sites.
		25 to 28 October 2016	Spring	Survey of further corridor options. Included identification of EREs, TECs, opportunistic searches for flora species and fauna habitat assessments.
Terrestrial ecology report for the EIS	Future Freight Joint Venture (FFJV) (2018a)	16 to 23 April 2018	Autumn and spring	Active searches for cryptic species
		1 and 4 to 10 September 2018		Opportunistic fauna observations
		17 to 19 April 2018		Census of flora species Habitat assessment.
Pre-clearance and protected plant surveys associated with geotechnical investigations	FFJV (2018b)	April 2018 November 2018	Autumn	Protected plants surveys (meander surveys – minimum 30 minutes) throughout alignment Habitat surveys Confirmation of vegetation communities.
	FFJV (2019)	April 2019	Autumn	Protected plants surveys (meander surveys – minimum 30 minutes) throughout alignment Habitat surveys Confirmation of vegetation communities.
Aquatic Ecology Report	Eco Logical Australia (2019)	June and November 2018 May 2019	Winter, summer and autumn	Aquatic ecology surveys (34 sites) including targeted fish surveys (12 sites).

11.4.5 Revised draft EIS field surveys

Following the preliminary field surveys, a field survey program was designed within the Project footprint to assess and validate the ecological values. The field surveys undertaken for the Project as part of this ecological assessment are described in Table 11-8.

Detailed methodologies for these field surveys are provided in the respective reports in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report. Survey methods were based on the results of database assessments and preliminary surveys including:

- ▶ Commonwealth published guidelines for Threatened species, where applicable (environment.gov.au/epbc/policy-statements)
- ▶ *Methodology for survey and mapping of REs and vegetation communities in Queensland* (Neldner et al., 2023)
- ▶ *Terrestrial vertebrate fauna survey guidelines for Queensland* (Eyre et al., 2018; Eyre et al., 2022a)
- ▶ *Queensland species-specific targeted species survey guidelines* (Queensland Government, 2012-2014)
- ▶ *Draft referral guidelines for the nationally listed Brigalow Belt reptiles* (Department of Sustainability, Environment, Water, Populations and Communities, 2011a)
- ▶ *Guide to greater glider habitat in Queensland* (Eyre et al., 2022b)
- ▶ *Flora Survey Guidelines — Protected Plants, NC Act* (DES, 2020a)
- ▶ *BioCondition assessment* (Eyre et al., 2015)
- ▶ *Guide to Determining Terrestrial Habitat Quality – version 1.2* (Department of Environment and Heritage Protection, 2017a).

Aquatic surveys conducted by Hydrobiology were undertaken using modern eDNA methods that are more efficient and effective than current aquatic fauna survey guidelines. An assessment of the adequacy of surveys undertaken against relevant survey guidelines is provided in Appendix O) Matters of National Environmental Significance Report.

The field surveys undertaken were concentrated within the Project footprint. Field survey locations (see Figure 11-2) considered the revised reference design, and locations of previous survey sites, aiming to undertake comprehensive field surveys within the Project footprint. Field survey sites were positioned in areas within the Project footprint which had not been previously subject to adequate surveys as part of the preliminary field surveys, ensuring inclusion of:

- ▶ Representative examples of each distinct vegetation community (RE) and, where appropriate, accounting for remnant regrowth and non-remnant areas
- ▶ Landscape features that were considered likely to support threatened species based on known habitat preferences
- ▶ Areas known or predicted to support threatened species or other ecological values.

11.4.5.1 Survey locations and timing

Seasonal sampling in spring (mid-September to mid-December) and autumn (late February to April) are recommended for the Brigalow Belt South bioregion (Eyre et al. 2018). Field surveys were undertaken within both periods (see Table 11-8).

The field surveys undertaken for this assessment were primarily concentrated within the Project footprint; however, targeted field surveys were also undertaken in areas adjoining the Project footprint to determine the extent of potential indirect impacts. Field survey locations (see Figure 11-2) considered the revised reference design, and locations of previous survey sites, aiming to undertake comprehensive field surveys within the Project footprint. Field survey sites were positioned in areas within the Project footprint which had not been previously subject to adequate surveys, ensuring inclusion of:

- ▶ Representative examples of each distinct RE and, where appropriate, accounting for remnant regrowth and non-remnant areas
- ▶ Landscape features that were considered likely to support threatened species based on known habitat preferences
- ▶ Areas known or predicted to support threatened species or other ecological values.

TABLE 11-8 SUMMARY OF REVISED DRAFT EIS FIELD INVESTIGATIONS

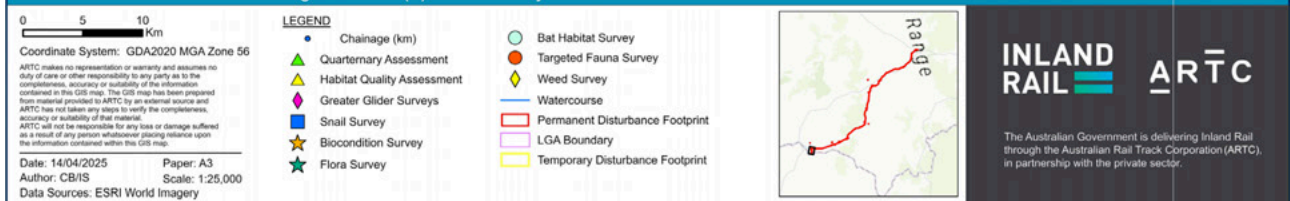
Study/ investigation	Consultant/ year	Timing of investigations	Season	Methodologies and notes
Terrestrial Ecological Assessment Report	▶ Cardno (2021)	▶ 19 October to 13 November 2020 ▶ 15 February to 27 March 2021 ▶ 26 February to 13 March 2021	▶ Spring, summer, autumn	▶ Verified presence of REs within the Project footprint ▶ BioCondition assessments ▶ Targeted Threatened flora and fauna surveys ▶ Incidental recording of animal breeding places.
Supplementary Terrestrial Ecological Assessment Report	▶ Ausecology (2023)	▶ 30 August to 3 September 2021 ▶ 6 to 11 September, 27 to 29 September 2021 ▶ 5 to 7 October 25 to 28 October 2021 ▶ 2 to 5 November 11 November 23 November 2021 ▶ 6 December 9 to 11 December 14 December 30 December 2021 ▶ 15 to 17 March 2022	▶ Winter, spring, summer, and autumn	▶ Verified presence of REs within the Project footprint ▶ BioCondition assessments ▶ Detailed habitat assessments ▶ Incidental recordings of Threatened species ▶ Incidental recording of animal breeding places.
Fauna Survey Report: Targeted survey for Brigalow Woodland Snail <i>Adclarkia cameroni</i> , Queensland	▶ Boobook Consulting (2022)	▶ November 2022	▶ Summer	▶ Targeted survey within selected parts of the Project footprint for Brigalow Woodland Snail (<i>Adclarkia cameroni</i>).
Ecology Assessment Whetstone Temporary Material Distribution Centre	▶ Umwelt (2022)	▶ 20 September 2022	▶ Spring	▶ Quaternary assessments ▶ Opportunistic Threatened flora searches ▶ Fauna habitat assessments ▶ Active searches, bird surveys and opportunistic fauna sightings.
eDNA Survey	▶ Hydrobiology (2023)	▶ 20 to 25 November 2022	▶ Summer	▶ eDNA sampling of waterways within the study area targeting Murray cod, silver perch and other aquatic species.
Microbat Surveys and Research Inland Rail: N2N and B2G	▶ BAAM (Williams, 2023)	▶ 24 February to 10 March 2023 ▶ 16 March to 6 April 2023	▶ Summer, autumn	▶ Targeted microbat surveys and tracking research within two forested segments of Project footprint ▶ Two Threatened microbat species south-eastern long-eared bat (<i>Nyctophilus corbeni</i>) and large-eared pied bat (<i>Chalinolobus dwyeri</i>).

Study/ investigation	Consultant/ year	Timing of investigations	Season	Methodologies and notes
ARTC Inland Rail Border to Gowrie (B2G) Ecology Partnership	▶ University of Southern Queensland (2023)	▶ Various January 2023 to 30 June 2024	▶ Winter, spring, summer and autumn	▶ Ecological fauna surveys, monitoring and research targeting Threatened fauna including koalas (<i>Phascolarctos cinereus</i>) and reptiles (yakka skink, Dunmall's snake, collared delma, five-clawed worm skink and Condamine earless dragon) ▶ Dietary analysis of koalas (<i>Phascolarctos cinereus</i>) ▶ Habitat assessments ▶ Genetic assessments ▶ Threat assessment of wild dogs to koalas.
ARTC Inland Rail Border to Gowrie (B2G) Threatened Species Flora Studies	▶ University of Sunshine Coast (2024)	▶ Various July 2023 to June 2024	▶ Winter, spring, summer, autumn	▶ Document populations sizes, demographic attributes, and locations of populations of <i>Eucalyptus virens</i>, <i>Xerothamnella herbacea</i>, <i>Lepidium monoplacoides</i>, <i>Thesium australe</i>, <i>Westringia parvifolia</i> and <i>Acacia laeta</i> ▶ Test propagation approaches for <i>Eucalyptus virens</i>, <i>Westringia parvifolia</i> and <i>Acacia laeta</i> ▶ Genetic assessments.
B2G Borrow Pit Ecological Surveys	▶ Ausecology (2024c)	▶ 5 to 6 September 2023	▶ Spring	▶ Site selection survey ▶ General vegetation assessment at potential borrow pit and track sites to guide the selection of suitable locations with the absence of threatened flora and fauna.
B2G Supplementary Ecology Survey Report Memo	▶ Environmental Resource Management (2024a)	▶ December 2023	▶ Summer	▶ Targeted survey within selected parts of the Project footprint for greater glider (<i>Petauroides</i> spp.) ▶ Verification of TEC within the Project footprint.
White Box TEC Assessment	▶ Ausecology (2024b)	▶ 14 to 15 March 2024	▶ Autumn	▶ Verification of box-gum (white box) TEC outside of the Project footprint.
Telstra/Nextgen Cable Realignment, Gowrie Junction Protected Plant Survey Report	▶ EMM (2024)	▶ 18 to 19 December 2023 ▶ 22 February 2024	▶ Summer	▶ Targeted Threatened flora survey as prescribed by the NC Act ▶ Verified presence of RE within Project footprint
Koala Genetics Study Project: Inland Rail Program	▶ Environmental Resource Management (2024b)	▶ June 2022 ▶ July 2023	▶ Winter	▶ Targeted surveys utilising detection dogs within previously identified hotspot areas to identify koala scats for collection. ▶ Targeted vegetation and habitat assessments.



Figure 11 - 2 (1) Field Survey Locations

MAP 1 OF 30

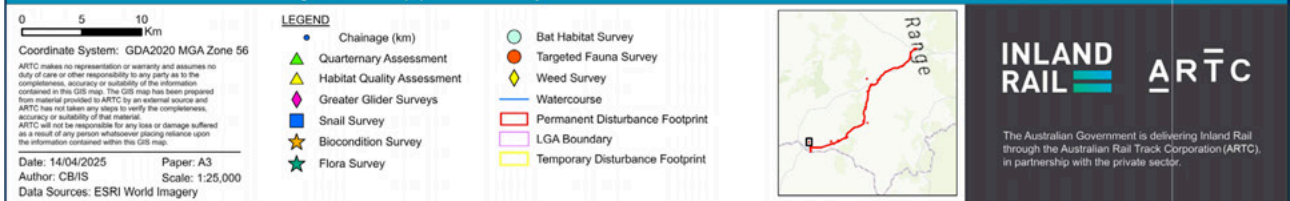


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Figure 11 - 2 (2) Field Survey Locations

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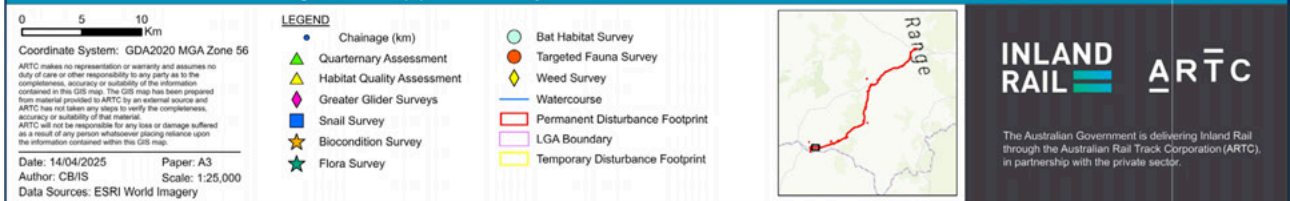


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Figure 11 - 2 (3) Field Survey Locations

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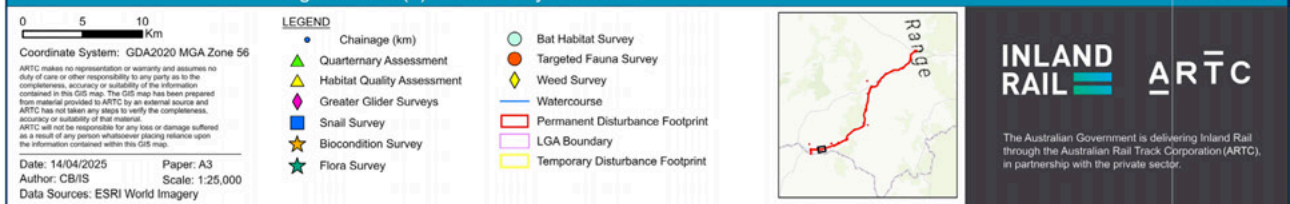


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Figure 11 - 2 (4) Field Survey Locations

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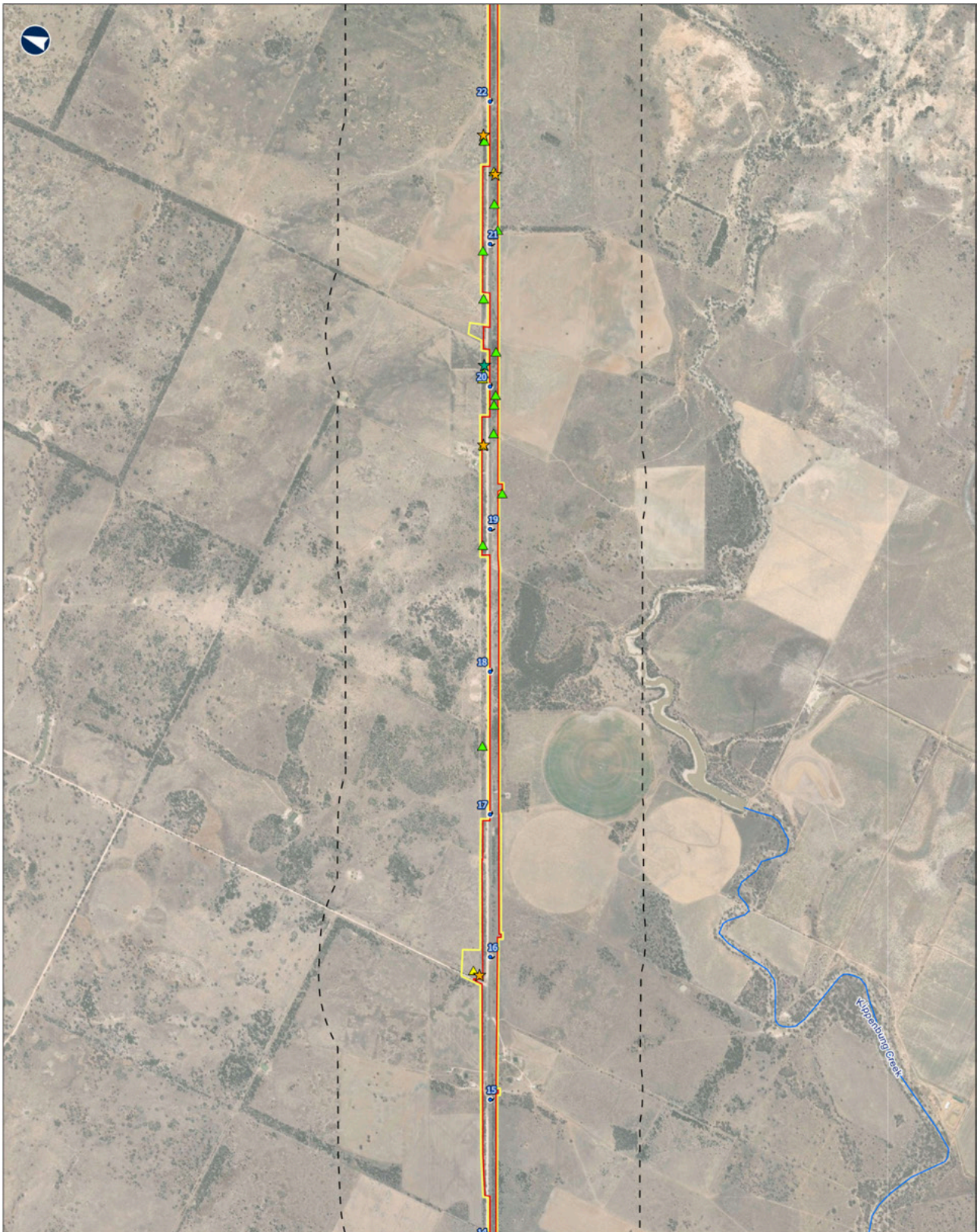


Figure 11 - 2 (5) Field Survey Locations

MAP 5 OF 30



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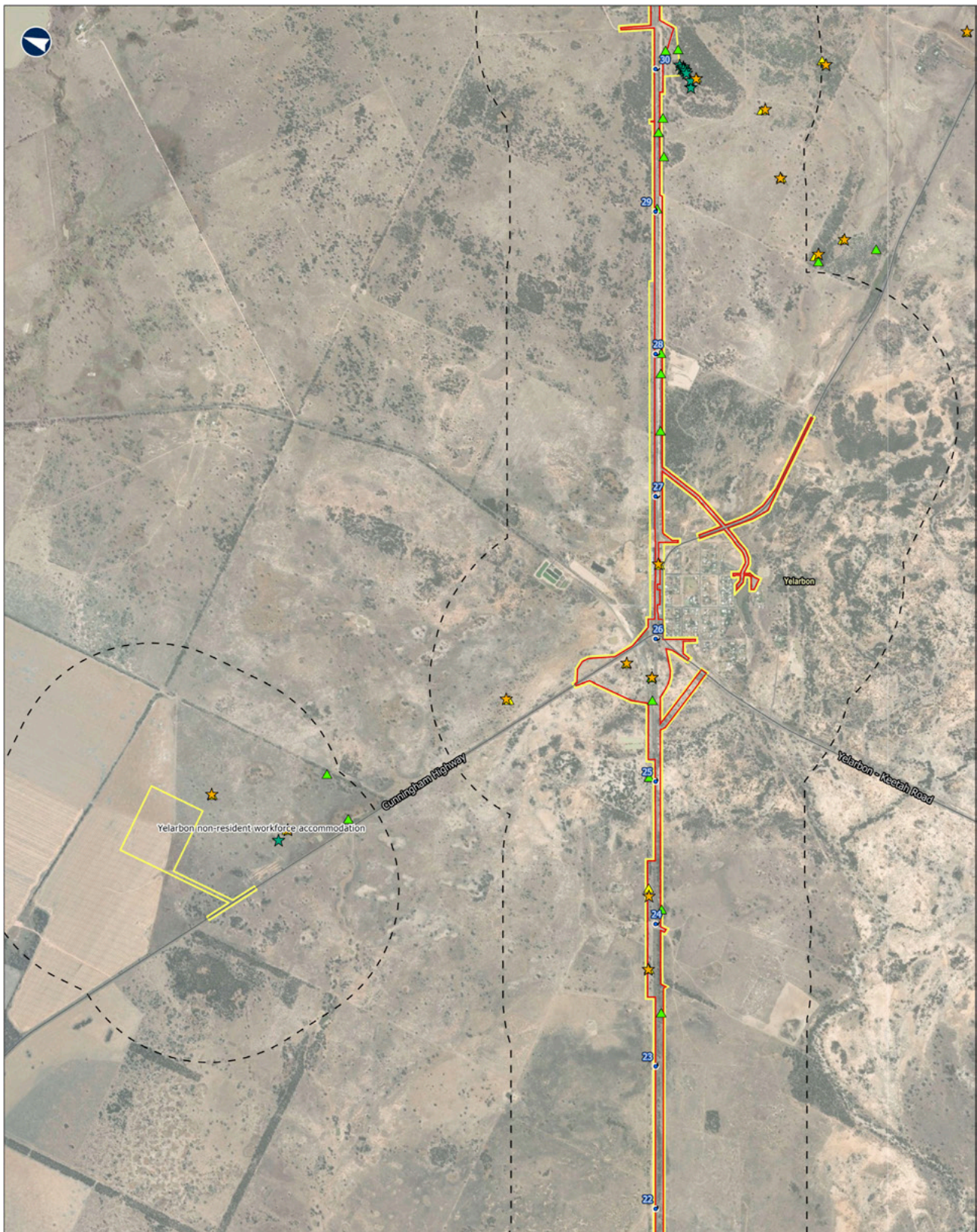
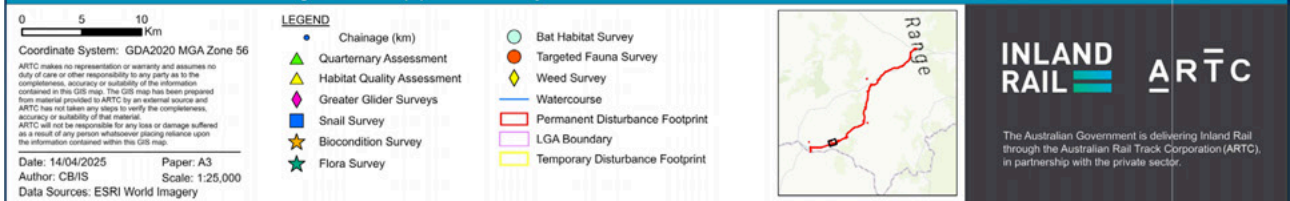


Figure 11 - 2 (6) Field Survey Locations

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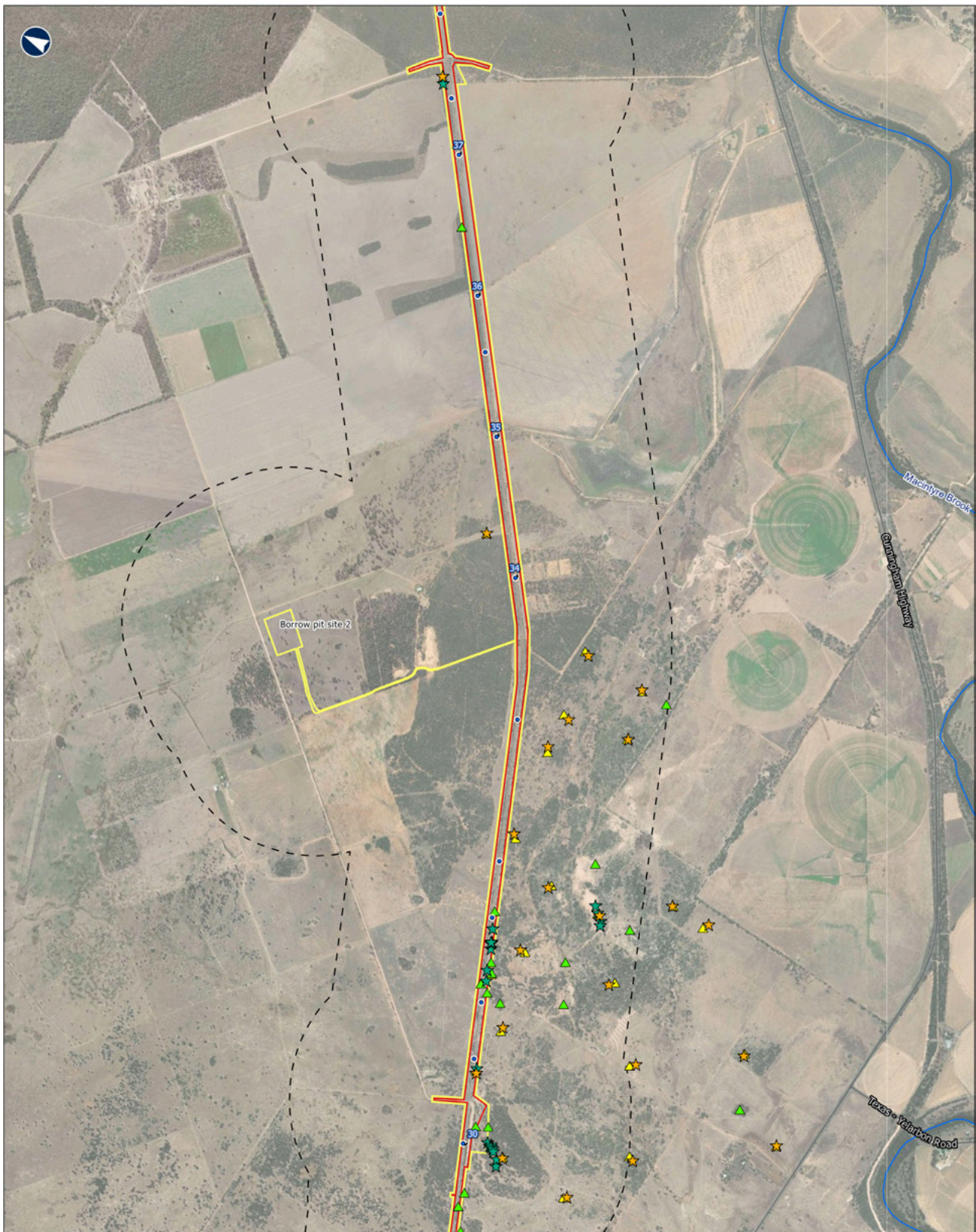
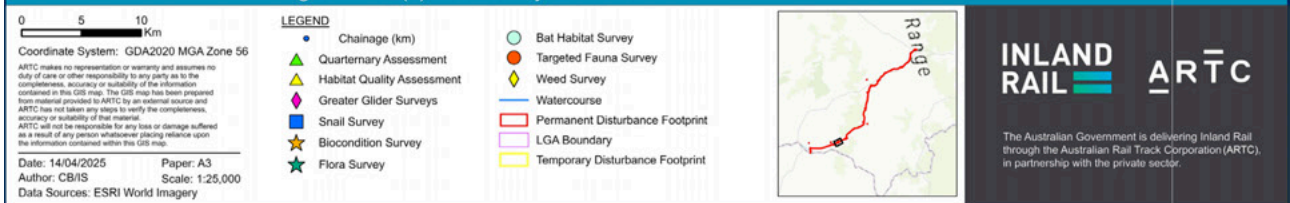


Figure 11 - 2 (7) Field Survey Locations

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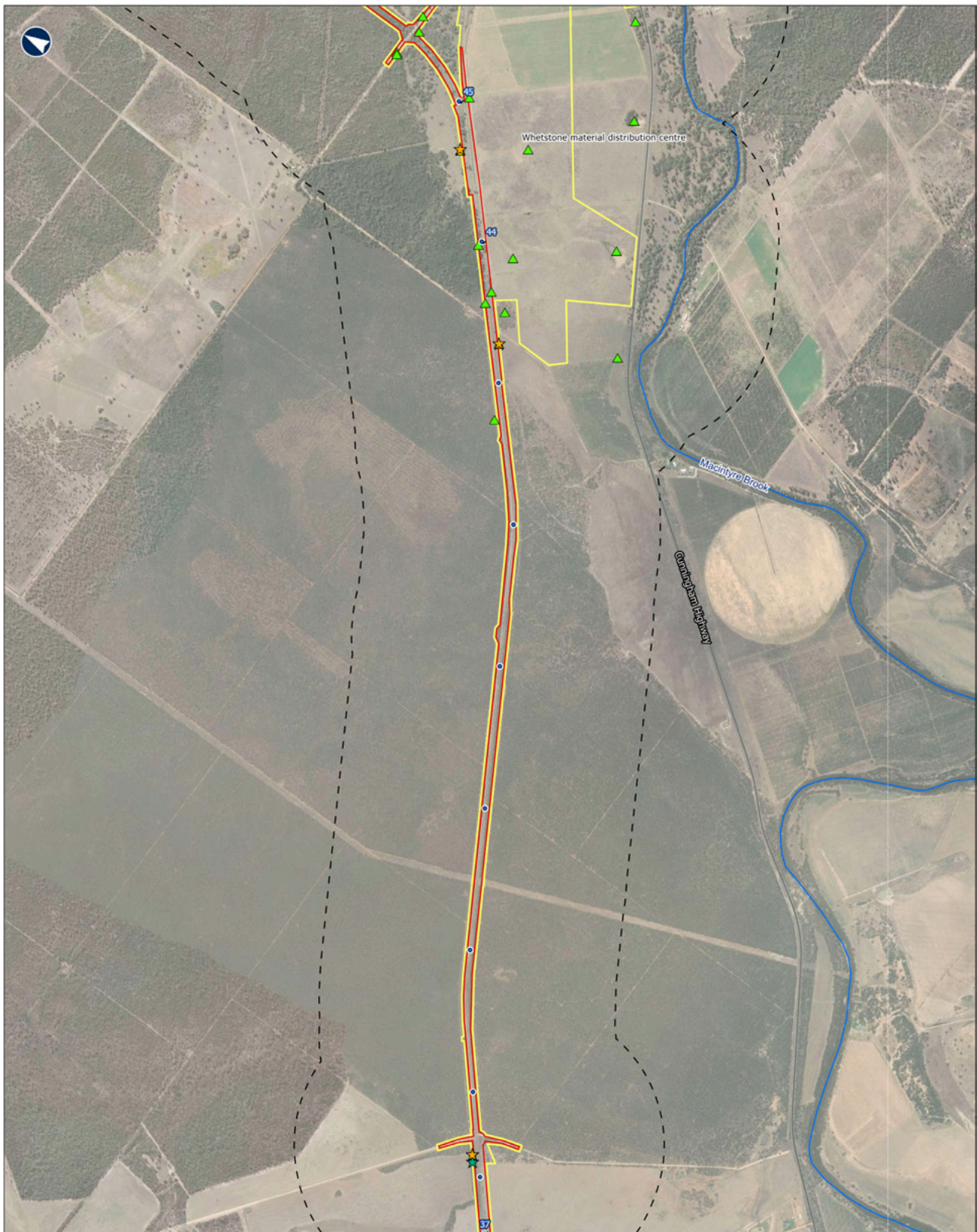
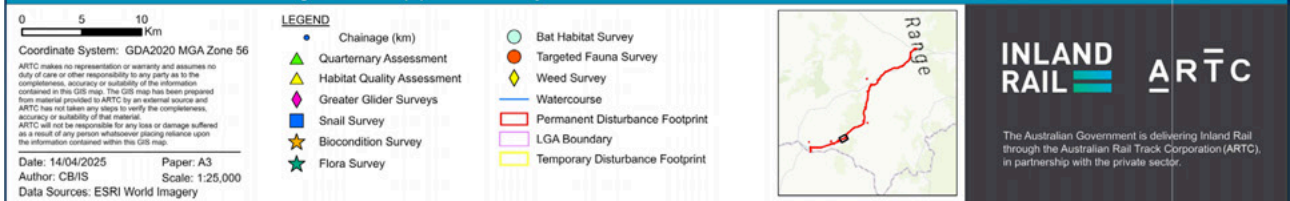


Figure 11 - 2 (8) Field Survey Locations

MAP 8 OF 30



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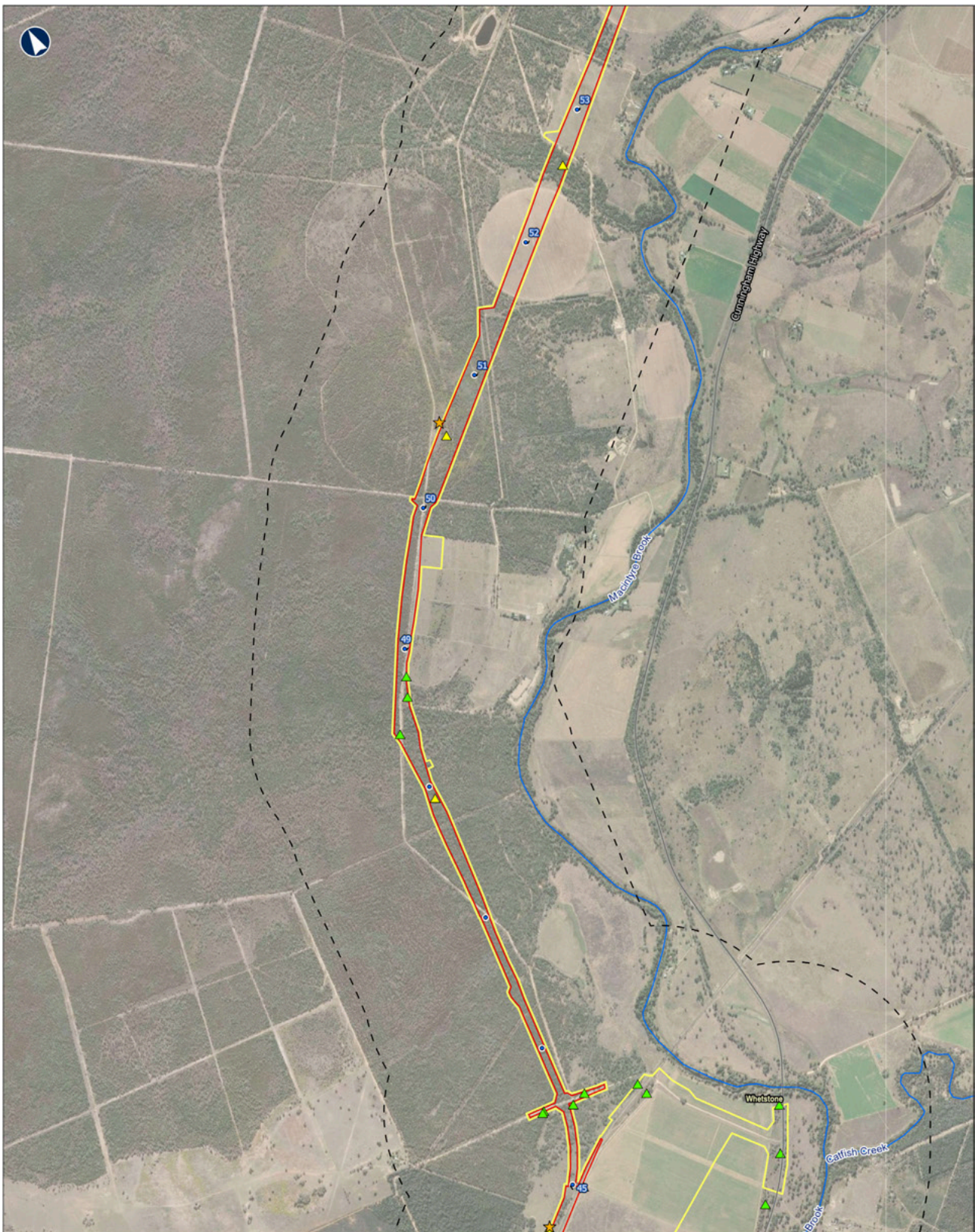
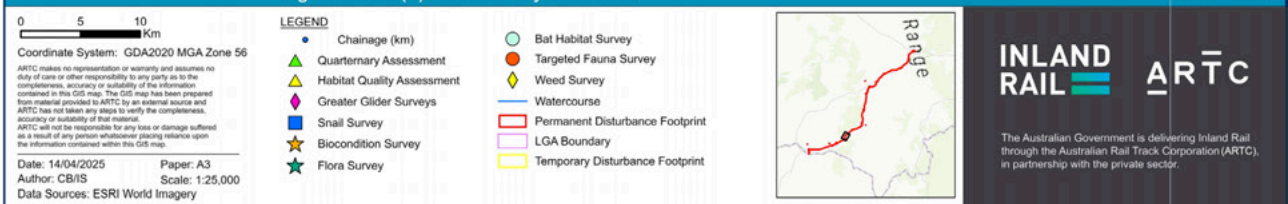


Figure 11 - 2 (9) Field Survey Locations

MAP 9 OF 30

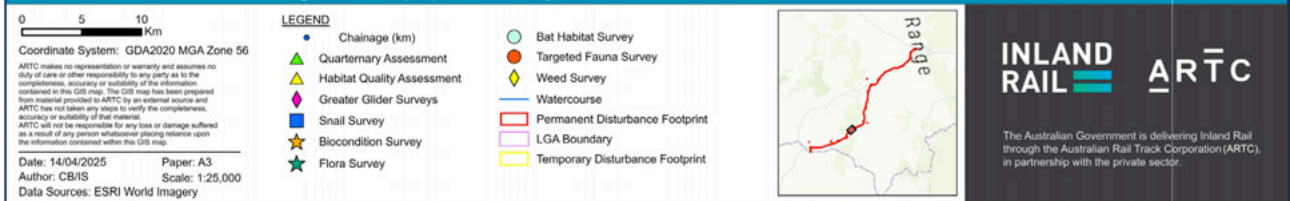


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Figure 11 - 2 (10) Field Survey Locations

MAP 10 OF 30



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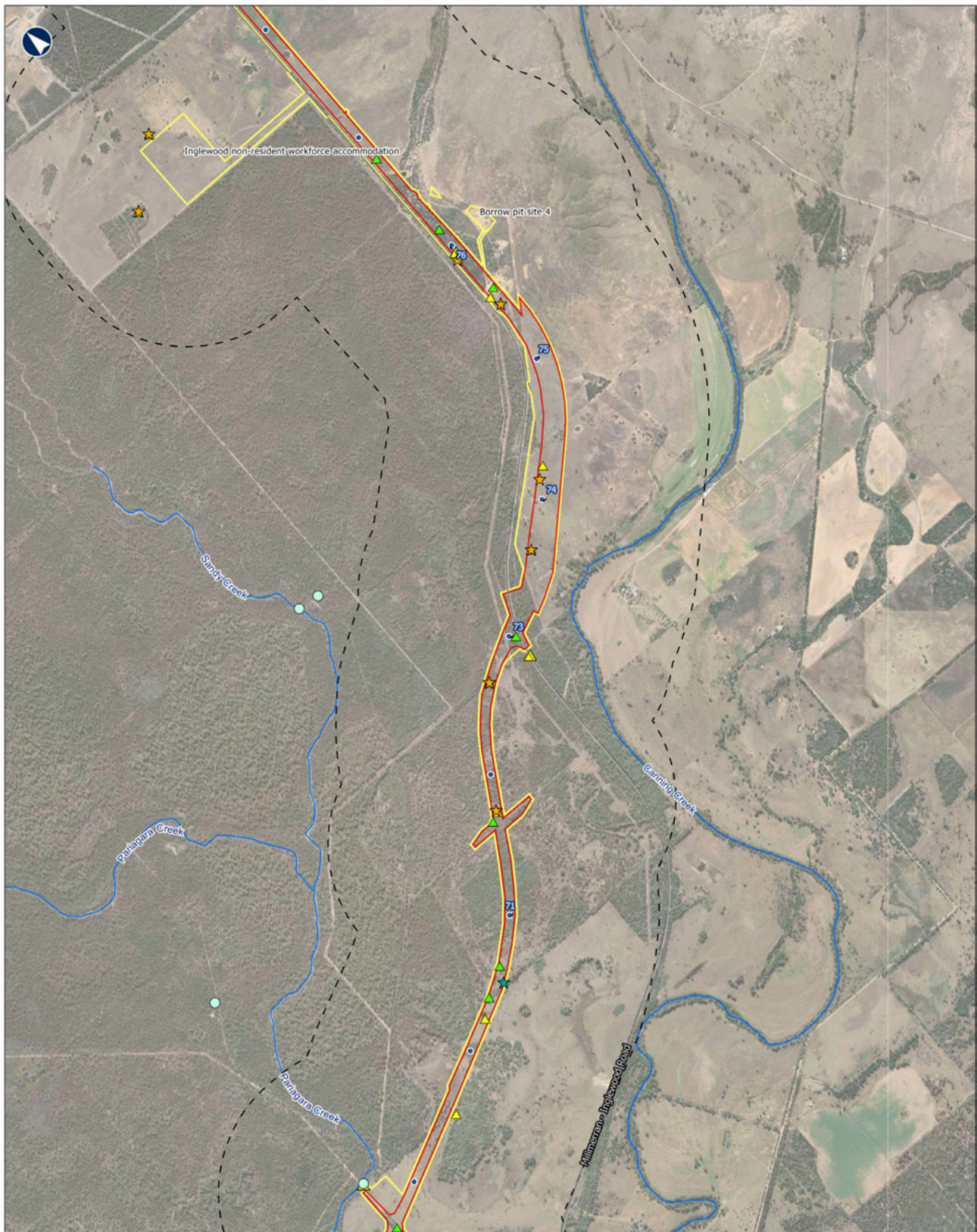
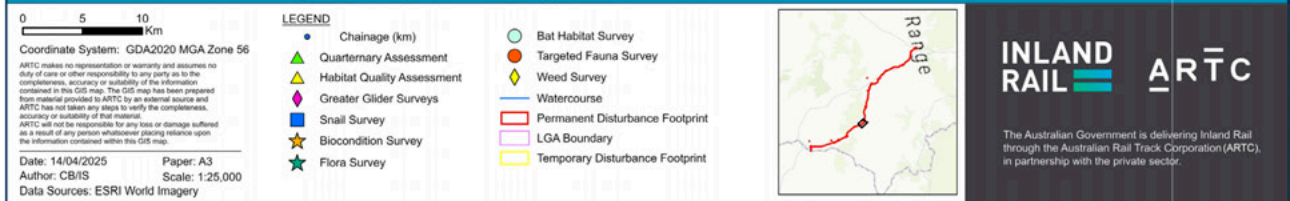


Figure 11 - 2 (12) Field Survey Locations

MAP 12 OF 30



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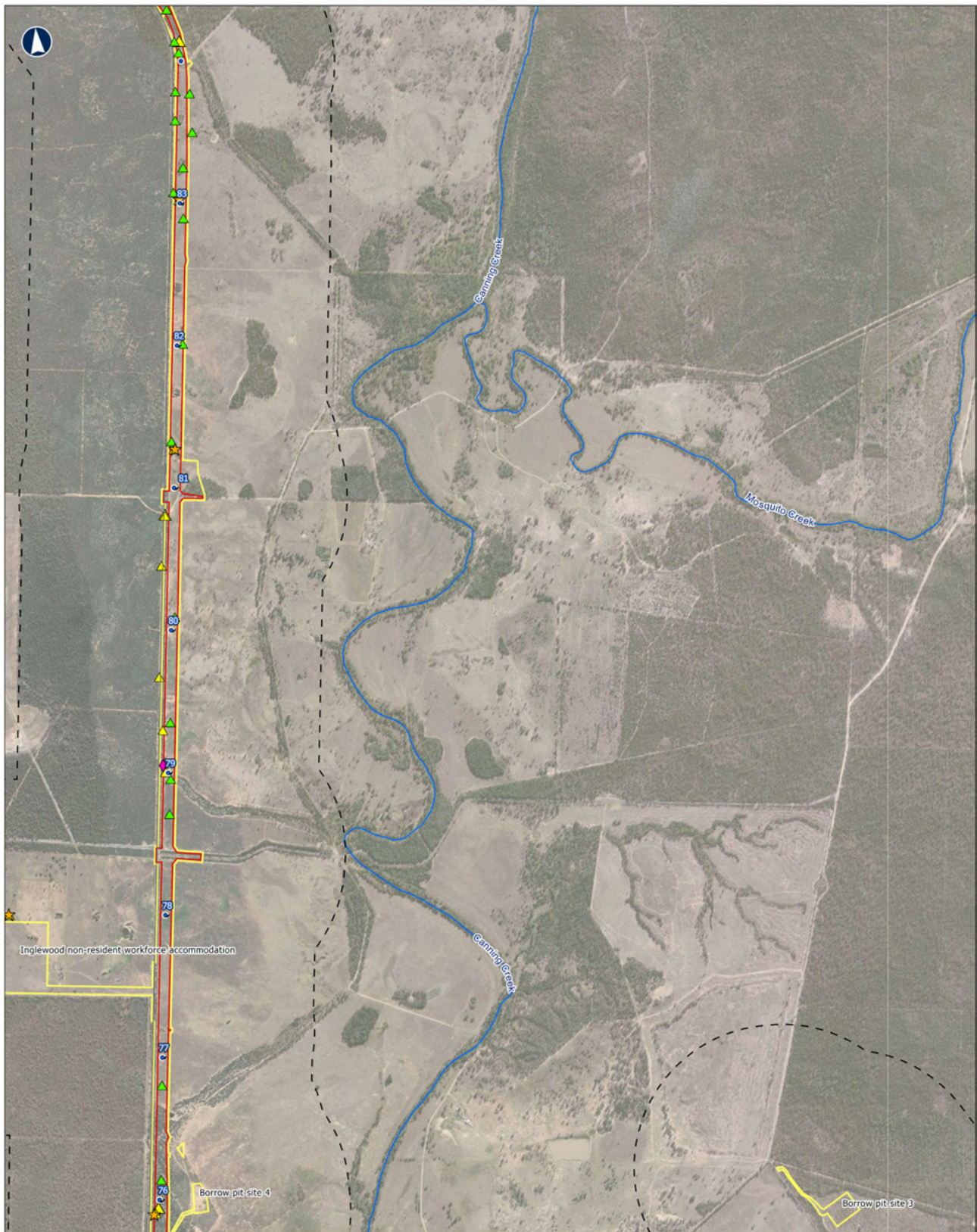
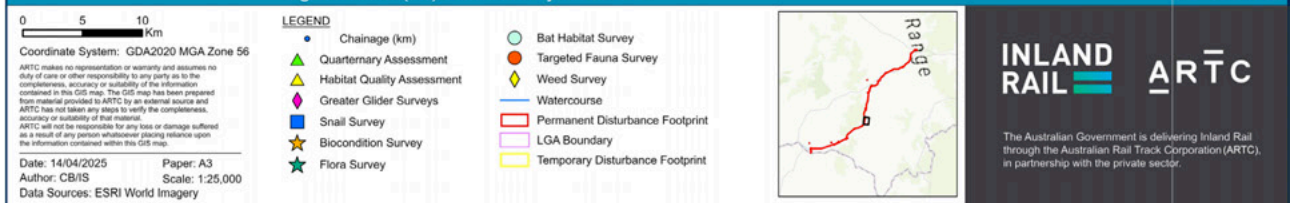


Figure 11 - 2 (13) Field Survey Locations

MAP 13 OF 30



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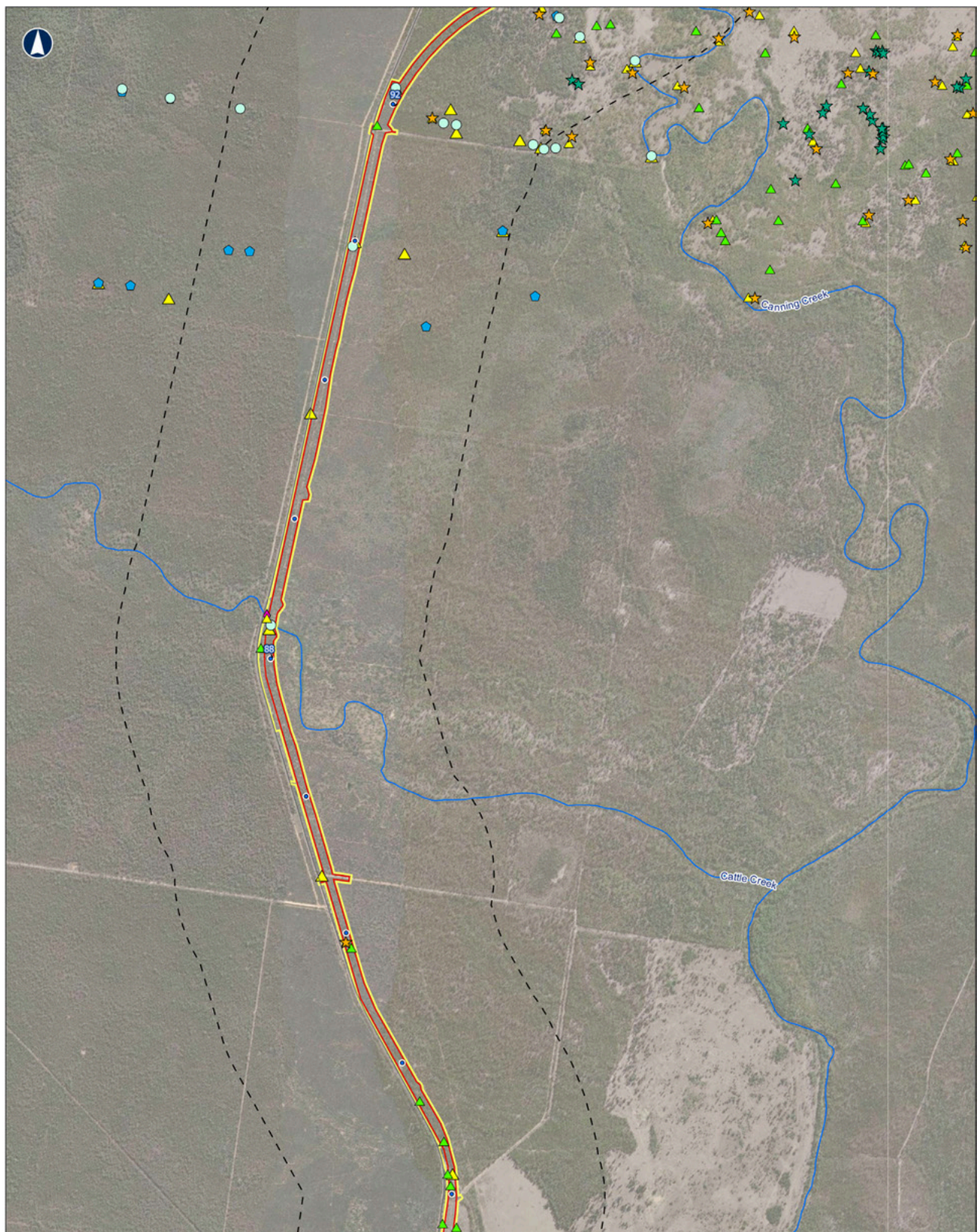


Figure 11 - 2 (14) Field Survey Locations

MAP 14 OF 30

0 5 10
Km

Coordinate System: GDA2020 MGA Zone 56

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Date: 14/04/2025 Paper: A3
Author: CB/IS Scale: 1:25,000
Data Sources: ESRI World Imagery

LEGEND

- Chainage (km)
- ▲ Quaternary Assessment
- ▲ Habitat Quality Assessment
- ◆ Greater Glider Surveys
- Snail Survey
- ★ Biocondition Survey
- ★ Flora Survey
- Bat Habitat Survey
- Targeted Fauna Survey
- ◆ Weed Survey
- Watercourse
- Permanent Disturbance Footprint
- LGA Boundary
- Temporary Disturbance Footprint



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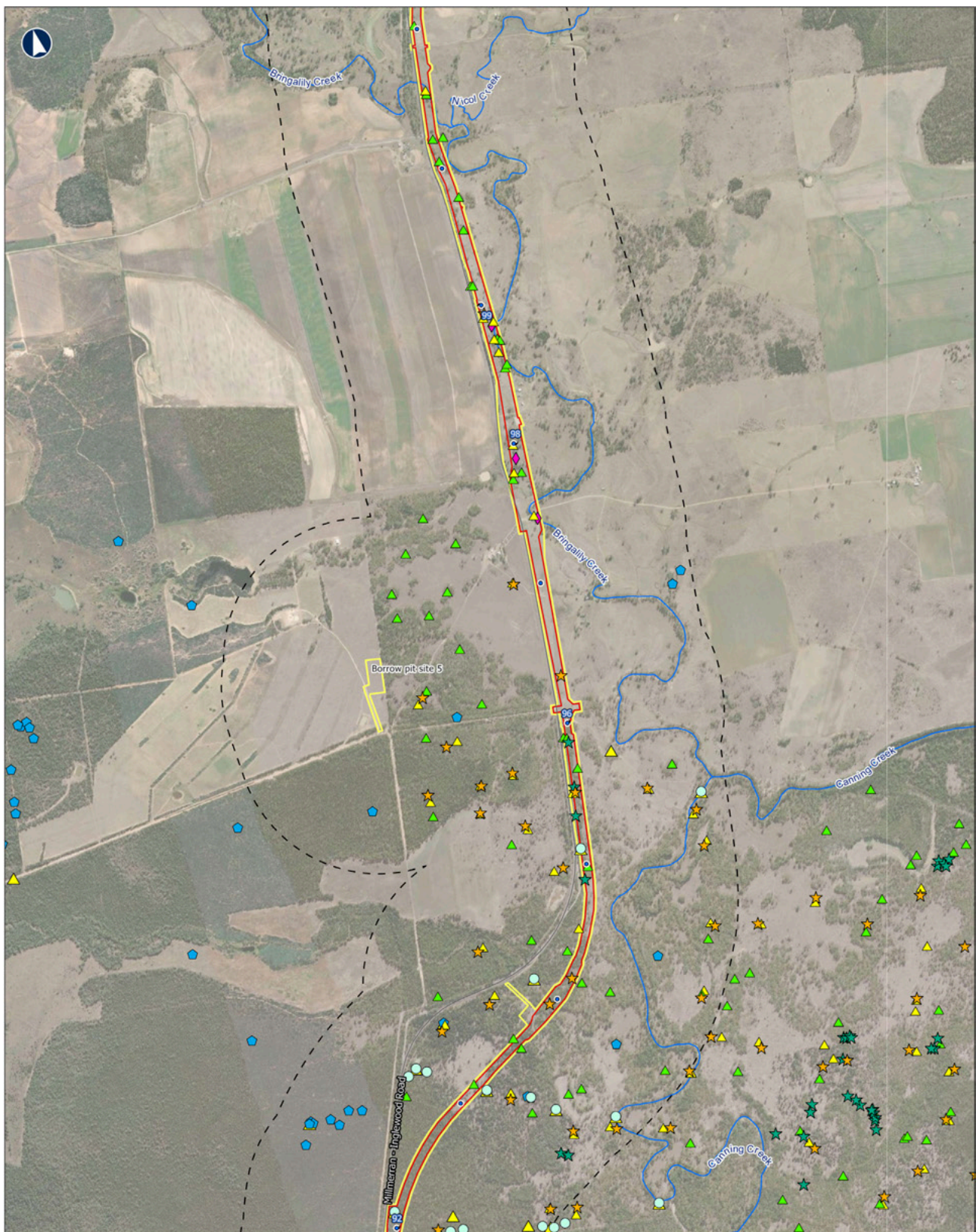


Figure 11 - 2 (15) Field Survey Locations

MAP 15 OF 30

0 5 10
Km
Coordinate System: GDA2020 MGA Zone 56
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Date: 14/04/2025 Paper: A3
Author: CB/IS Scale: 1:25,000
Data Sources: ESRI World Imagery

LEGEND
● Chainage (km)
▲ Quaternary Assessment
▲ Habitat Quality Assessment
◆ Greater Glider Surveys
■ Snail Survey
★ Biocondition Survey
★ Flora Survey
● Bat Habitat Survey
● Targeted Fauna Survey
● Weed Survey
— Watercourse
— Permanent Disturbance Footprint
— LGA Boundary
— Temporary Disturbance Footprint



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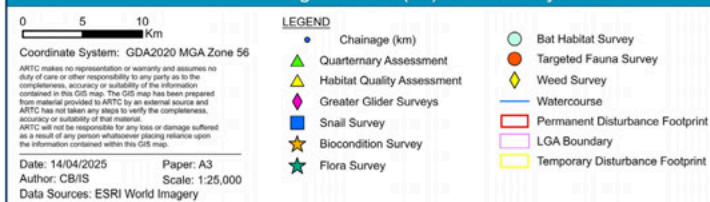
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Figure 11 - 2 (16) Field Survey Locations

MAP 16 OF 30



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Figure 11 - 2 (18) Field Survey Locations

MAP 18 OF 30

0 5 10 Km
Coordinate System: GDA2020 MGA Zone 56
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Date: 14/04/2025 Paper: A3
Author: CB/IS Scale: 1:25,000
Data Sources: ESRI World Imagery

- LEGEND**
- Chainage (km)
 - Quaternary Assessment
 - Habitat Quality Assessment
 - Greater Glider Surveys
 - Snail Survey
 - Biocondition Survey
 - Flora Survey
 - Bat Habitat Survey
 - Targeted Fauna Survey
 - Weed Survey
 - Watercourse
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 - LGA Boundary
 - Temporary Disturbance Footprint



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Figure 11 - 2 (19) Field Survey Locations

MAP 19 OF 30

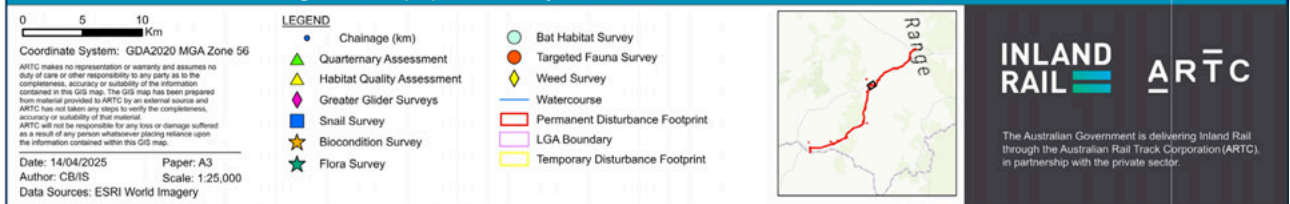


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Figure 11 - 2 (20) Field Survey Locations

MAP 20 OF 30



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Figure 11 - 2 (21) Field Survey Locations

MAP 21 OF 30

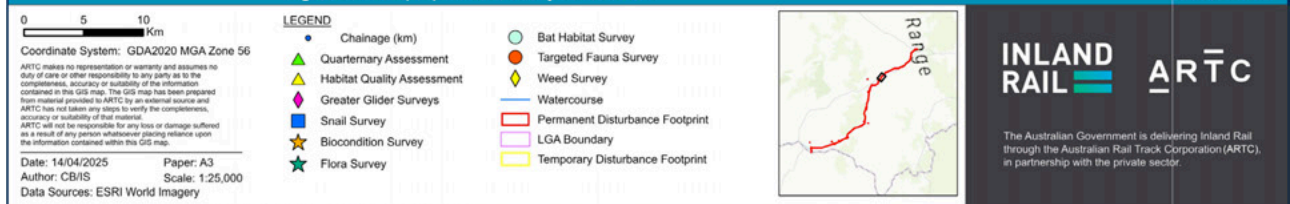


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Figure 11 - 2 (22) Field Survey Locations

MAP 22 OF 30

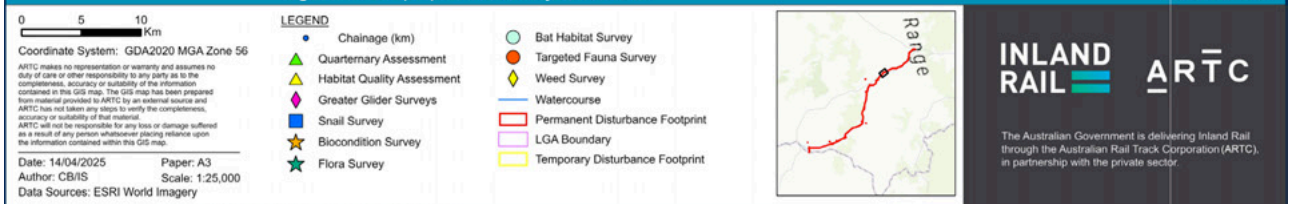


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Figure 11 - 2 (23) Field Survey Locations

MAP 23 OF 30

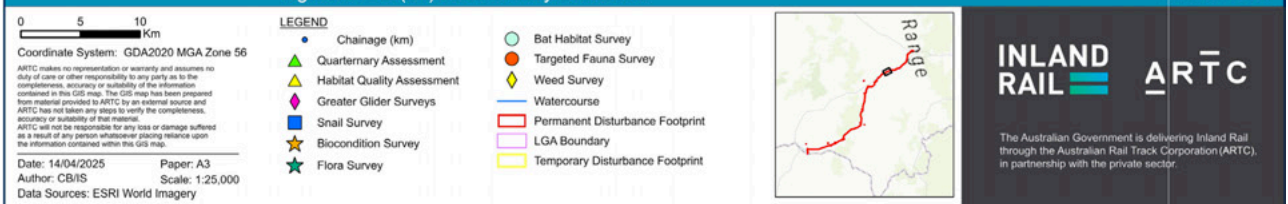


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Figure 11 - 2 (24) Field Survey Locations

MAP 24 OF 30



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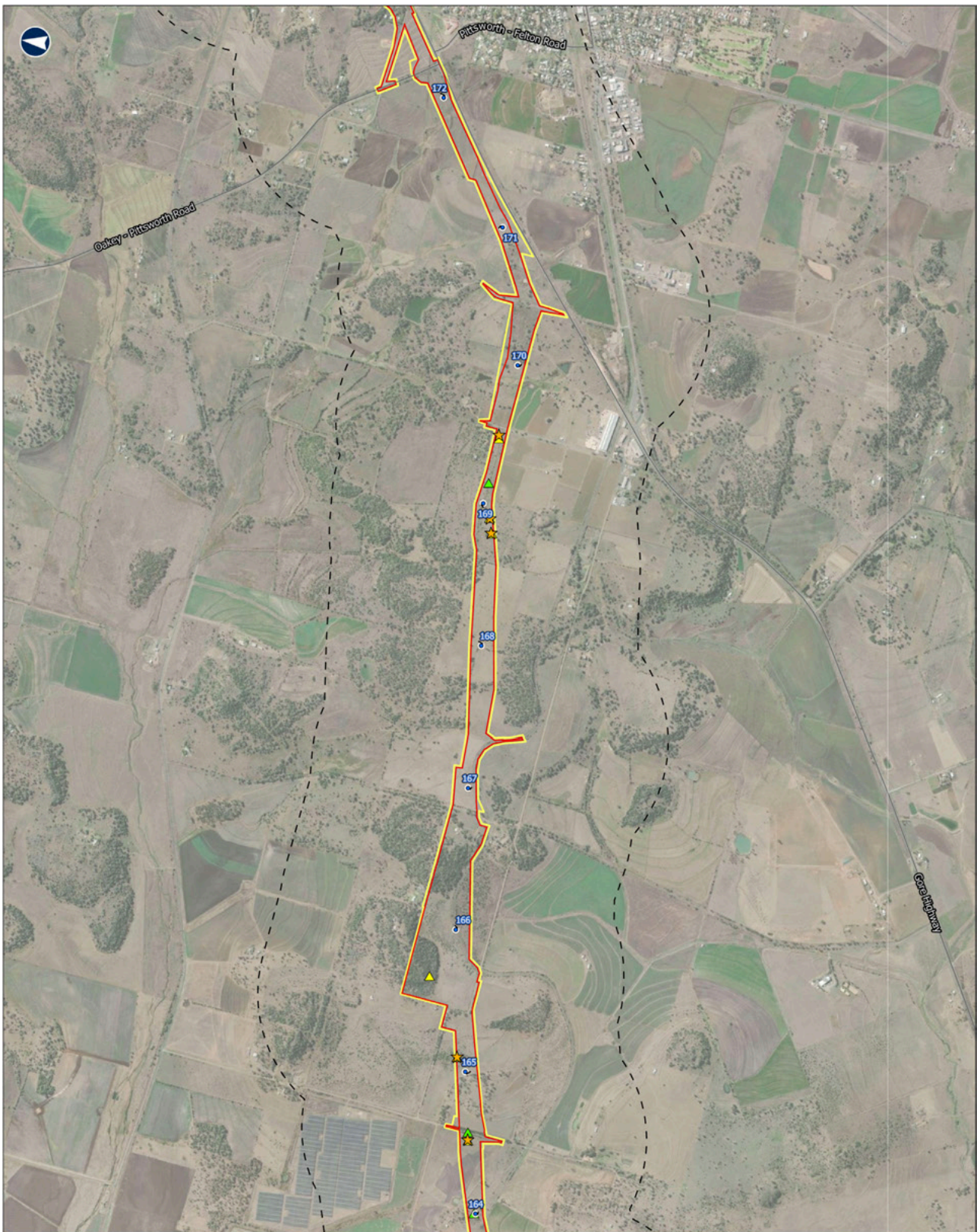
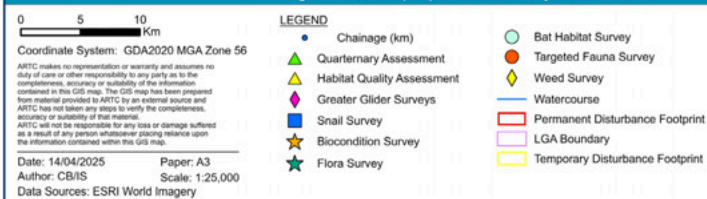


Figure 11 - 2 (25) Field Survey Locations

MAP 25 OF 30



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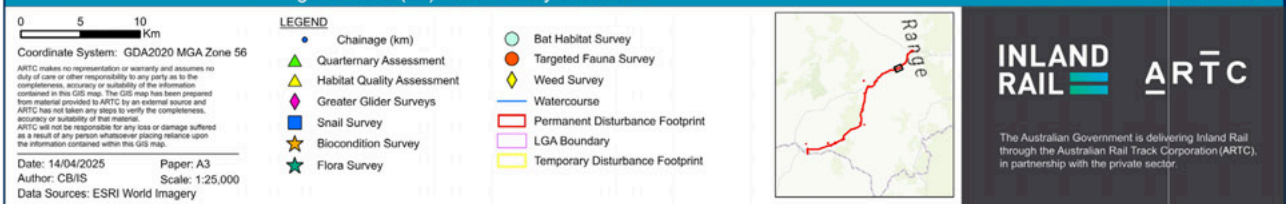
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Figure 11 - 2 (26) Field Survey Locations

MAP 26 OF 30

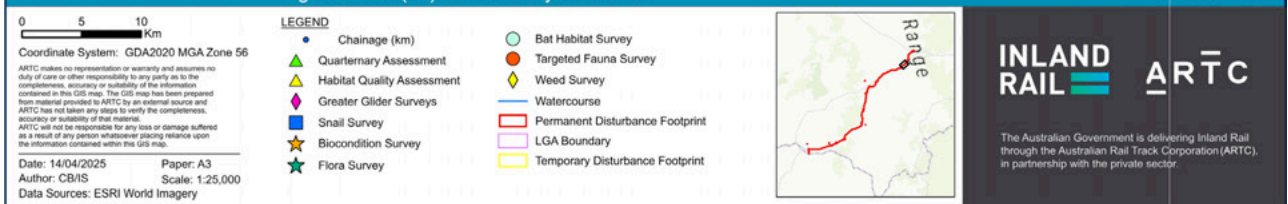


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Figure 11 - 2 (27) Field Survey Locations

MAP 27 OF 30



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Figure 11 - 2 (28) Field Survey Locations

MAP 28 OF 30

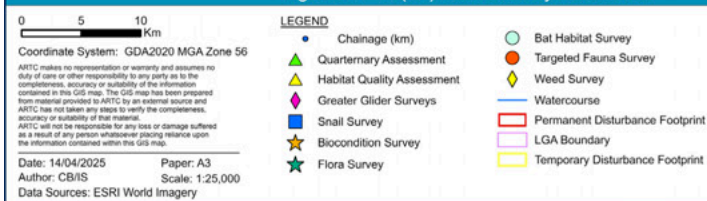


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Figure 11 - 2 (29) Field Survey Locations

MAP 29 OF 30



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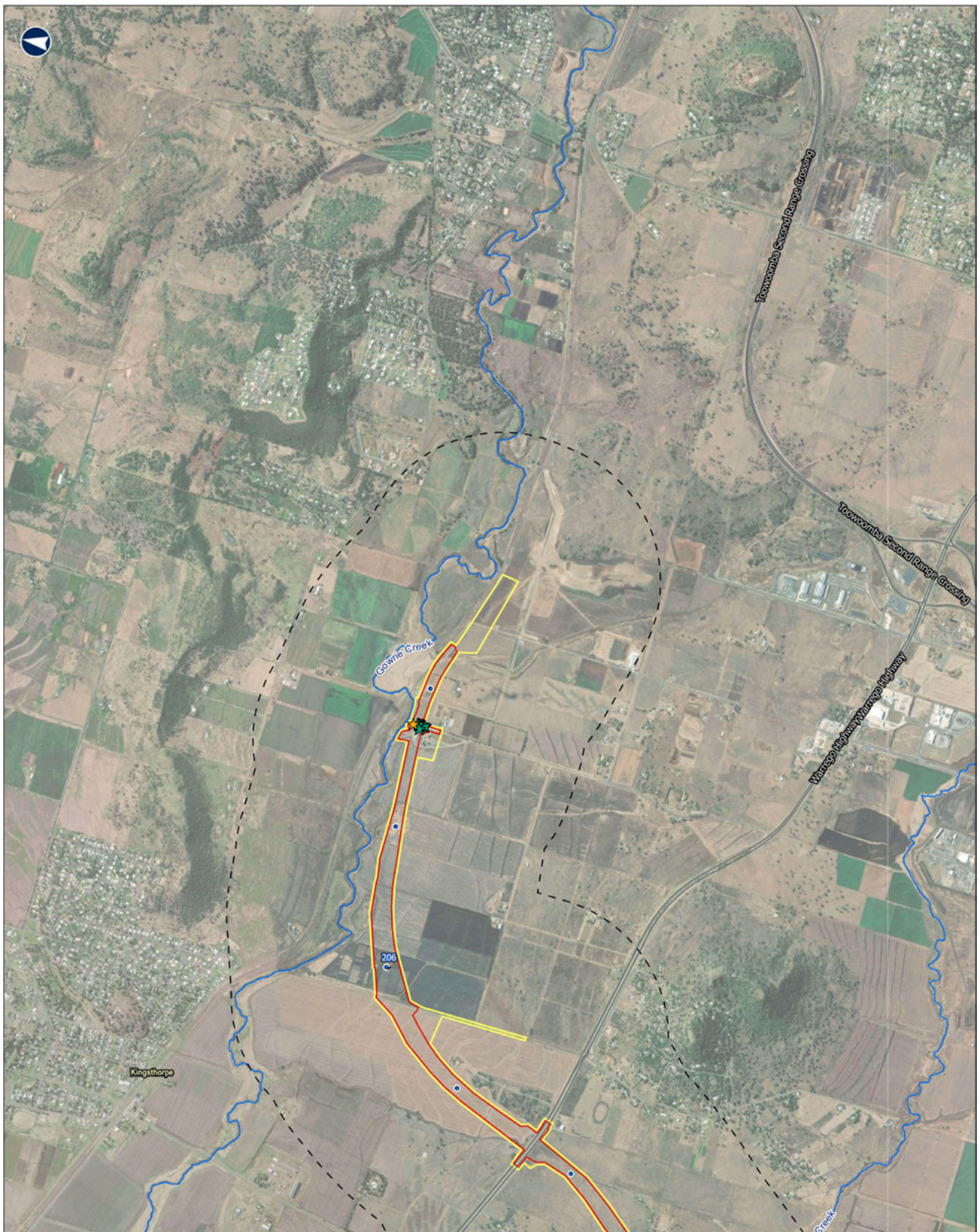
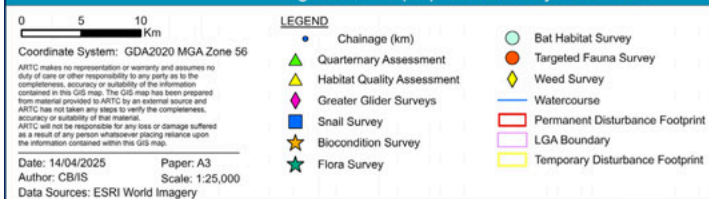


Figure 11 - 2 (30) Field Survey Locations

MAP 30 OF 30



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11.4.5.2 Whetstone MDC and borrow pit surveys

Whetstone Material Distribution Centre environmental assessment

Umwelt (2022) conducted an environmental assessment within the Whetstone MDC development footprint comprising 212.62 ha. Investigations focused on MNES and MSES. Prior to field investigations, Umwelt completed a desktop analysis of publicly available environmental databases and historic field surveys. Methodologies included quaternary assessments, fauna habitat assessments and active searches, diurnal bird surveys and opportunistic flora and fauna sightings.

Results are summarised in Appendix L: Terrestrial and Aquatic Ecology Technical Report. The detailed survey methodology is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report – Appendix A.

Borrow Pit Ecological Surveys

Ausecology (2024c) conducted field surveys for seven borrow pits at six sites (one site having dual pits) in 2023 (inclusive of access tracks). These surveys included ground-truthing REs, BioCondition assessments, targeted flora surveys and incidental fauna surveys. Results are summarised in Appendix L: Terrestrial and Aquatic Ecology Technical Report. The detailed survey methodology is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report (see Appendix A).

11.4.6 Habitat mapping

Post-field analysis of ground-truthed data was undertaken to produce detailed mapping within the Project footprint for threatened flora and fauna species identified as known or likely, or which have the potential to occur, within the Project footprint.

Habitat analysis identified whether suitable and/or preferred habitat is present, what functional types of habitats occur, and whether the Project footprint supports important habitat (as a surrogate for important populations) or habitat critical to the survival of each threatened species.

Habitat definitions were prepared for each threatened species with a known, likely or potential occurrence within the Project footprint, and were reviewed by species experts and underwent refinement where advised. These final habitat descriptions and mapping rules were used by Ausecology to produce species specific maps, which were reviewed by Ausecology, ERM, ARTC and/or species experts until all consultants were satisfied with the final mapping. The detailed habitat mapping methodology undertaken is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

11.4.7 Impact assessment

For the purpose of an impact assessment, terrestrial MNES and MSES have been assessed both quantitatively (e.g. quantity measurements for direct impacts) and qualitatively (e.g. via categorisation for indirect impacts). The aquatic assessment employed a qualitative assessment, based on the sensitivity of environmental receptors. This method has been targeted to areas where an impact will occur, to assess the sensitivity or vulnerability of the ecological values and the magnitude of the impact. The aquatic conservation assessment using AquaBAMM assesses the conservation and ecological value of wetland systems.

Noise and vibration impact assessments involved:

- ▶ A review of available literature to understand the likely impacts of noise and vibration based on the current understanding of the different tolerance and behavioural responses of wildlife to noise and vibration impacts
- ▶ Review of modelling contours for construction (LAeq(15 min) dB(A) for the modelled construction scenarios) and operations (single maximum event levels) to understand the likely extent of noise impacts (i.e. the distance Project-related noise travels to the point where it attenuates to levels where only minimal impacts are likely to occur)
- ▶ Qualitative assessment of likely impacts based on generalised behavioural responses of wildlife to noise (i.e. literature indicates that moderate impacts to habitat use may occur when noise levels are above 60 to 65 dB(A) and fauna are likely to leave the area when noise levels are around 80 dB(A) or above) and the extent (distance from the source) to which those impacts may occur.

Altered hydrology and flooding impacts were assessed using the following approach, which is detailed further in Figure 11-3 and Section 11.6.2.10:

1. Risk assessment: of listed Threatened species known, likely and with the potential to occur, and TECs known to occur, to determine those protected matters that are subject to a negligible, low, medium or high risk of changes to hydrology.
2. Habitat mapping outside of the Project footprint: for those protected matters with a low to high rating in the risk assessment, habitat mapping was prepared outside of the footprint within 5 km of the centre of the rail line.
3. Assessment of susceptibility: the 1% annual exceedance probability (AEP) (1 in 100-year flood) scenario was overlaid on the habitat mapping and used to identify those protected matters that are susceptible to changes in flooding, requiring detailed quantification of impacts.
4. Quantification of flooding impacts: detailed quantification of changes in inundation area, duration, depth, and velocity as modelled under three scenarios, 20% AEP (1 in 5-year flood), 10% AEP (1 in 10-year flood), and 5% AEP (1 in 20-year flood) for relevant at-risk protected matters.
5. Impact assessment: Impact assessment of the outcomes of the quantification and determination of significant residual impacts.

A significant residual impact (SRI) assessment has been undertaken for relevant MSES within the Project footprint in accordance with the criteria provided in the Significant Residual Impact Guidelines (DEHP, 2014a). Detailed significant impact assessments (SIAs) were undertaken for each MNES in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* DoE, 2013). MSES that are also considered MNES were assessed in accordance with the Significant Impact Guidelines. It was considered that the areas included in this assessment were the same, or substantially the same, as what would be assessed under an MSES SRI.

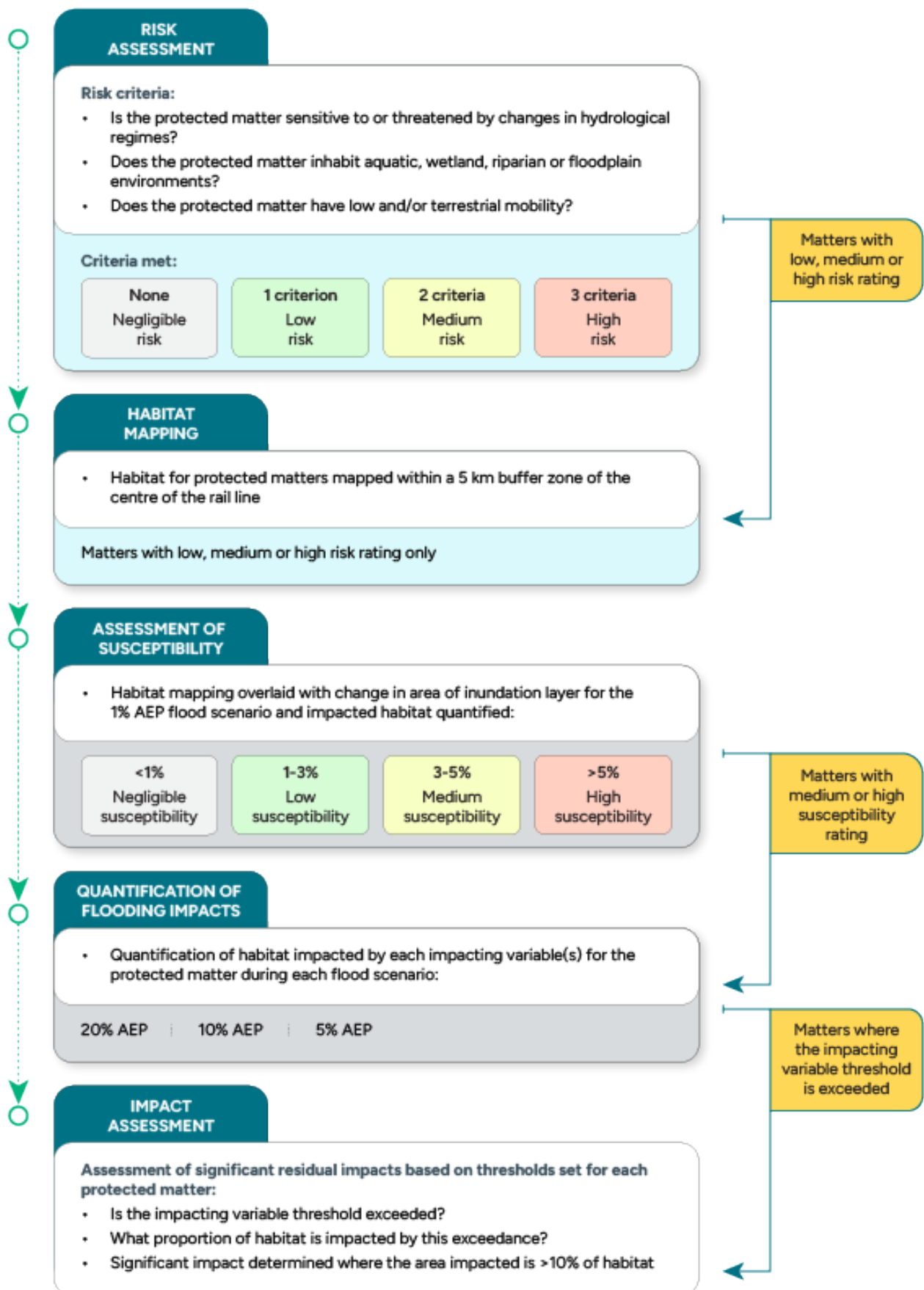


FIGURE 11-3 FLOODING IMPACT ASSESSMENT PROCESS

Significant impact assessments (SIAs) for MNES have been undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE 2013). MSES have been assessed in accordance with the *QEO Significant Residual Impact Guideline* (DEHP, 2014a). For MSES that are also considered MNES, an SIA was undertaken in accordance with the MNES Significant Impact Guidelines.

In accordance with Section 158A of the EPBC Act, MNES are assessed in accordance with their EPBC Act status at the time of the referral decision (i.e. 9 April 2018). Therefore, any changes in conservation status or new species listings were not considered in this report including as part of the significant impact assessment for flora and fauna. However, information in contemporary approved conservation advices and any other data more recent than the controlled action decision date, were considered in the assessment. The NC Act listed species are considered and assessed in accordance with their NC Act status at the time the latest survey efforts were undertaken, which was 17 March 2022.

Further detail regarding flora, fauna and aquatic ecology impact assessments for the revised draft EIS is discussed in the following reports:

- ▶ Appendix L: Terrestrial and Aquatic Ecology Technical Report
- ▶ Appendix M: Draft Koala Management Plan
- ▶ Appendix N: Draft Fauna Management Plan
- ▶ Appendix O: Matters of National Environmental Significance Report
- ▶ Appendix P: Fauna Connectivity Strategy.

11.4.8 Cumulative impact assessment

When multiple projects occur in a region they may result in cumulative impact, which differ from those of an individual project when considered in isolation. Cumulative impacts may be positive or negative, and their severity and duration will depend on the project spatial overlap.

Cumulative impacts are most appropriately considered at a biologically relevant spatial scale. A distance of 50 km from the Project was selected as many of the ecological values (incorporating all habitat categories) of relevance to the Project do not occur beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent. Predictive habitat mapping was used to estimate habitat within this area.

Operational projects were included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes.

Following the identification of each potential cumulative impact, a relevance factor score of Low, Medium and High has been determined in consideration of the impacts. Further detail regarding cumulative impact assessment method is described in Appendix L: Terrestrial and Aquatic Ecology Technical Report, Section 9 and Appendix O: Matters of National Environmental Significance Report, Section 9.

11.5 Existing environment

11.5.1 Regional and local context

The Project is located within the Brigalow Belt South bioregion. From west to east, the Project is located within the Commonon Creek floodout subregion (on the New South Wales (NSW)/QLD border to Yelarbon), Inglewood Sandstones subregion (from Yelarbon to Millmerran) and the Eastern Darling Downs subregion (from Millmerran north to Gowrie). The Brigalow Belt South bioregion is characterised by a dry subtropical climate with no pronounced dry season, with rainfall increasing with proximity to the coast. The bioregion has experienced a long history of human disturbance as a result of agricultural practices and resource development. At a regional level, most remaining areas of vegetation are now fragmented, occurring on the rockier hilly areas of ranges, as part of State protected lands (e.g. State forests), as roadside vegetation, or as relatively small isolated remnants (see Photograph 11-1 and Photograph 11-2).

Within the study area, the majority of lands are highly modified having been cleared for pasture, agricultural production (see Photograph 11-6) and for rural and urban residential settlements. Other areas of planned future development include the Wellcamp Business Park, Witmack Industry Park, and Charlton Logistic Park which will be subject to future infrastructure and industrial development.

Agricultural activities are prominent within the low-lying fertile floodplains associated with the Dumaresq River, Macintyre River, Macintyre Brook and Condamine River, which have fertile soils and productive agricultural landscapes. Tracts of remnant vegetation are present (largely to the south of Millmerran), generally being limited to steeper terrain on isolated mountains and hills (typically associated with granite and basaltic outcrops and sandstone hills), road reserves and State forests.

Despite the disturbances within the study area, the Biodiversity Planning Assessment (BPA) mapping for Brigalow Belt (DES, 2018a) identifies regional and State corridors within the study area which portrays vegetation that is significant for the connectivity and movement of flora and fauna. Both riparian and terrestrial State ecological corridors have been mapped across the Project footprint.



PHOTOGRAPH 11-1 EXAMPLE OF MATURE TREES RETAINED WITHIN A ROAD RESERVE, SURROUNDED BY ANTHROPOGENIC DISTURBANCE WITHIN THE MILLMERRAN REGION

Source: FFJV, 2018



PHOTOGRAPH 11-2 EXAMPLE OF MATURE TREES RETAINED WITHIN A ROAD RESERVE, SURROUNDED BY ANTHROPOGENIC DISTURBANCE SOUTH OF TOOWOOMBA

Source: FFJV, 2018

The Project footprint includes areas of agricultural land and State forest. The Project footprint has been subject to historical disturbance/clearing and approximately one third of its length is co-located with existing rail corridors in brownfield sites (i.e. areas already subject to development). The remaining greenfield portions of the Project footprint extends largely through areas subject to agricultural land uses (see Photograph 11-3, Photograph 11-4, Photograph 11-5 and Photograph 11-6). Outside of the State forests in the Inglewood area, the remaining patches of vegetation within the Project footprint are highly fragmented.



PHOTOGRAPH 11-3 PORTION OF THE PROJECT FOOTPRINT ON THE CONDAMINE FLOODPLAIN

Source: FFJV, 2019



PHOTOGRAPH 11-4 PROJECT FOOTPRINT NORTH OF THE CONDAMINE FLOODPLAIN

Source: FFJV, 2019

In the southern extent of the Project footprint, between the NSW/QLD border and Inglewood, the landscape is dominated by dryland cropping, irrigated agriculture and intensive animal production on the fertile soils and floodplains associated with the Macintyre River, Dumaresq River and Macintyre Brook. North of Inglewood, the Project passes through the undulating and densely forested landscapes of Whetstone and Bringalily State forests. The Project then traverses the gently undulating agricultural areas near Millmerran before crossing the Condamine River floodplain (see Photograph 11-5 and Photograph 11-6). The rail alignment deviates from the existing railway line north of Yarranlea to pass through the hilly landscapes surrounding Pittsworth, Southbrook and Athol before crossing Westbrook Creek near Toowoomba Wellcamp Airport and joining the Gowrie to Helidon section of Inland Rail near Gowrie Junction.



PHOTOGRAPH 11-5 CABBAGE TREE CREEK ON THE CONDAMINE RIVER FLOODPLAIN, SHOWING THE NARROW BAND OF MATURE VEGETATION

Source: FFJV, 2019



PHOTOGRAPH 11-6 FERTILE SOILS OF THE CONDAMINE FLOODPLAIN ARE USED EXTENSIVELY FOR CROPPING

Source: FFJV, 2019

Wondul Range National Park is located approximately 8 km from the Project footprint. This national park is not within the study area.

There are two State forests that are intersected by the Project:

- ▶ Bringalily State Forest (35,695 ha (north of Inglewood)
- ▶ Whetstone State Forest (41,282 ha) (west of Inglewood.).

There are five State forests within the vicinity of the study area not intersected by the Project. These are:

- ▶ McEwan State Forest (306 ha) – 1.25 km from Project footprint
- ▶ Domville State Forest (228 ha) – 0.83 km from Project footprint
- ▶ Millmerran State Forest (583 ha) – 1.3 km from Project footprint
- ▶ Devine State Forest (4,665 ha) – 4.3 km from Project footprint
- ▶ Yelarbon State Forest (30,772 ha) – 3.7 km from Project footprint.

The Irongate Conservation Park (29 ha), protected under the NC Act, is located 6.5 km from the Project footprint, outside the study area. Additionally, there is on council reserve, the Mount Basalt Environmental Park, located 5 km from the Project footprint, outside of the study area. These areas are dominated by eucalypt woodlands on sandy plains or shallow soils in areas of higher elevation. They support a high diversity of terrestrial fauna.

The Project footprint traverses two catchment areas of the Condamine and Border Rivers. The Condamine River catchment is one of the largest catchments in the Murray-Darling Basin (Murray-Darling Basin Authority, 2023). The main rivers of the catchment, the Condamine and the Maranoa, rise in elevated country and join to become the Balonne River; however, two-thirds of the catchment is flat floodplain country (the Lower Balonne Floodplain) with a complex system of rivers and creeks joining and breaking away from the Balonne River. The catchment's extensive floodplains provide habitat for a diverse range of plants and endangered plant communities (Murray—Darling Basin Authority, 2023), though this region is not within the study area. The Darling Downs region is significant for its agricultural diversity, with a wide range of winter and summer crops produced on the Darling Downs, as well as very large cotton production areas in the west (Murray—Darling Basin Authority, 2023).

The Border Rivers catchment is made up of a group of rivers in a region straddling the NSW/QLD border. The rivers of the catchment rise on the western slopes of the Great Dividing Range and run westward, gradually merging with one another to become the Barwon River on the floodplains upstream of Mungindi (Murray—Darling Basin Authority, 2023). The catchment consists of approximately 450 km of rivers. The landscape of the Border Rivers catchment is diverse, containing tablelands and slopes as well as semi-arid plains (Murray–Darling Basin Authority, 2023).

Further information on geology, surface water and groundwater are reported in Chapter 9: Land Resources, Chapter 13: Surface Water and Chapter 15: Groundwater.

The Project is located within the Goondiwindi and Toowoomba local government areas (LGAs) in the Brigalow B Belt bioregion.

11.5.2 Regional ecosystems

A total of 25 REs, including two Endangered, seven Of Concern and 16 Least Concern REs (VM Act status) are mapped within the Project footprint. The Project footprint consists of a total of 0.07 ha of Category A vegetation, 475.37 ha of Category B vegetation, 26.35 ha of Category C vegetation, and 2,880.37 ha of Category X vegetation. The small area of Category A vegetation was investigated through publicly available databases and reports, and it was determined that this area is not a trigger for MSES. During field surveys, this area was identified as RE 11.4.3 and brigalow (*Acacia harpophylla* dominant and co-dominant) TEC.

The ground-truthed mapping frequently differed from the State RE mapping, regarding description, VM Act status, extent, and condition (e.g. remnant, non-remnant, and regrowth). Ground-truthing resulted in a total of 32 REs identified within the Project footprint, with 25 REs contributing to remnant, mature regrowth and immature regrowth areas (see). This includes four Endangered, eight Of Concern, and 13 Least Concern REs (VM Act status).

Excluding non-remnant areas, ground-truthed RE (GTRE) mapping included six REs that were additional to State mapped REs (i.e. 11.3.1, 11.3.17, 11.3.27i, 11.4.10, 11.8.11 and 11.9.10). Conversely, the presence of six State mapped REs were not found during ground-truthing (i.e. 11.3.18, 11.3.27b, 11.7.4, 11.7.5, 11.8.3 and 11.9.7).

Of the 3,382.17 ha of the Project footprint, the majority (74.6 per cent) of the area is comprised of non-remnant areas, with the remainder consisting of either remnant vegetation (16.9 per cent), mature regrowth vegetation (0.5 per cent) or immature regrowth vegetation (8 per cent). For detailed field descriptions of the REs, refer to Appendix L: Terrestrial and Aquatic Ecology Technical Report.

Ground-truthed REs are shown on Figure 11-4 and a summary is provided in Table 11-9.

TABLE 11-9 GROUND-TRUTHED REGIONAL ECOSYSTEMS WITHIN THE PROJECT FOOTPRINT

RE code	RE description	VM Act status	Area (ha)			
			Remnant	Mature regrowth	Immature regrowth	Non-remnant ¹
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains.	Endangered	1.46	0.00	0.00	0.00
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	33.09	1.08	27.31	459.95
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains.	Of Concern	9.53	0.38	8.39	162.34
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains.	Least Concern	22.01	0.01	6.57	23.31
11.3.17	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains.	Of Concern	4.07	0.00	0.00	0.06
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium.	Least Concern	0.00	0.00	0.00	26.53
11.3.21	<i>Dichanthium sericeum</i> and/or <i>Astrebla spp.</i> grassland on alluvial plains. Cracking clay soils.	Of Concern	17.45	0.00	0.00	182.71
11.3.24	<i>Themeda avenacea</i> grassland on alluvial plains. Basalt derived soils.	Endangered	0.00	0.00	0.00	3.63
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	Least Concern	14.39	0.00	1.83	79.30
11.3.27	Freshwater wetlands.	Least Concern	0.60	0.00	0.00	0.00
11.3.27b	Vegetation ranges from open water +/- aquatics and emergents. Often with fringing woodland.	Least Concern	0.00	0.00	0.00	3.75
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer.	Least Concern	7.91	0.00	0.00	0.00
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains.	Endangered	31.42	5.32	60.20	290.00
11.4.10	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains.	Endangered	21.57	0.35	3.61	15.02
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces.	Least Concern	115.26	7.73	21.41	168.17
11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer.	Least Concern	0.24	0.09	0.00	10.21
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces.	Least Concern	109.49	0.89	55.10	69.16
11.5.14	<i>Triodia sp.</i> open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils.	Of Concern	31.68	0.00	4.42	24.00

RE code	RE description	VM Act status	Area (ha)			
			Remnant	Mature regrowth	Immature regrowth	Non-remnant ¹
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains.	Least Concern	10.80	0.63	10.34	92.39
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust.	Least Concern	0.00	0.00	0.00	0.54
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	Least Concern	0.00	0.00	0.00	2.87
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust.	Least Concern	20.38	0.00	17.65	8.07
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks.	Of Concern	0.00	0.00	0.00	9.27
11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks.	Least Concern	21.96	0.00	6.17	131.08
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks.	Least Concern	66.71	0.00	24.48	376.35
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks.	Of Concern	24.18	0.00	0.00	93.35
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks.	Endangered	2.42	0.00	23.43	232.47
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks.	Of Concern	0.00	0.00	0.00	38.35
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks.	Least Concern	0.09	0.00	0.00	1.75
11.9.9a	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland. Occurs in southern part of bioregion.	Least Concern	2.49	0.00	0.00	0.00
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks.	Of Concern	1.40	0.00	0.00	10.48
11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks.	Of Concern	0.13	0.00	0.00	1.75
Water	Dam surrounded by cleared land.	-	0.00	0.00	0.00	7.15
Total			570.75	16.48	270.92	2,524.02

Table note:

1 Areas associated with non-remnant are based on State pre-clearing mapping.

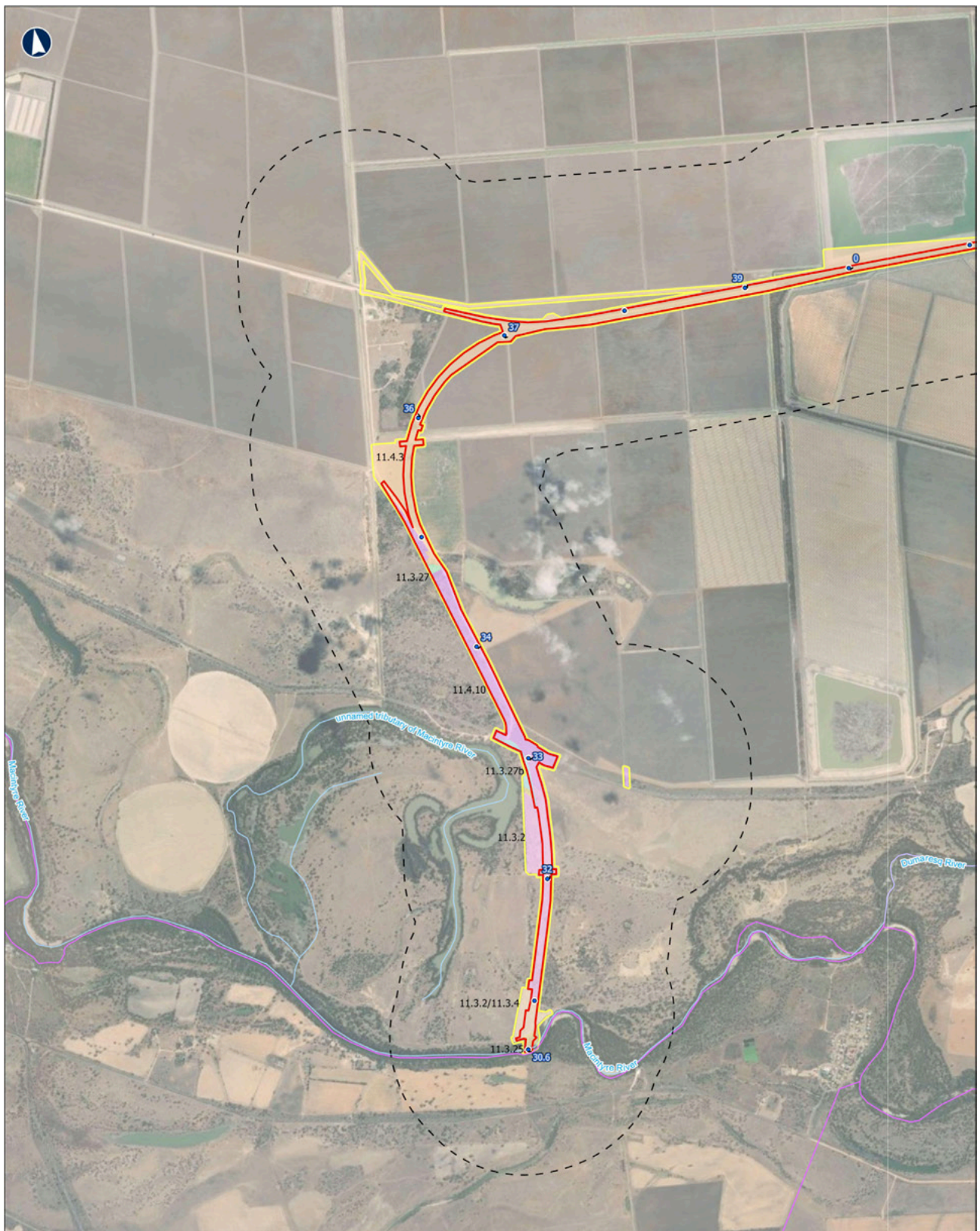


Figure 11 - 4 (1) Ground Truthed Regional Ecosystem Vegetation

MAP 1 OF 30

0 5 10 Km
Coordinate System: GDA2020 MGA Zone 56
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LEGEND
● Chainage (km)
Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.2
11.3.2/11.3.4
11.3.25
11.3.27
11.3.27b
11.4.10
11.4.3



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Figure 11 - 4 (2) Ground Truthed Regional Ecosystem Vegetation

MAP 2 OF 30

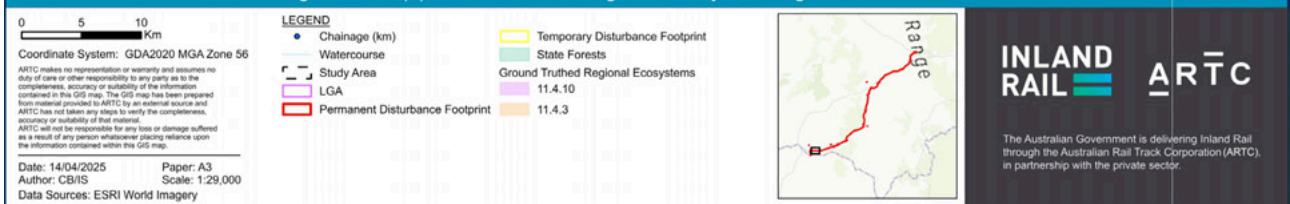


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Figure 11 - 4 (3) Ground Truthed Regional Ecosystem Vegetation

MAP 3 OF 30

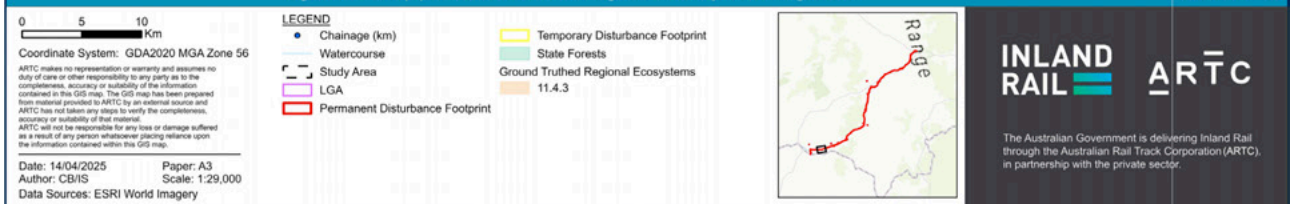


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Figure 11 - 4 (4) Ground Truthed Regional Ecosystem Vegetation

MAP 4 OF 30



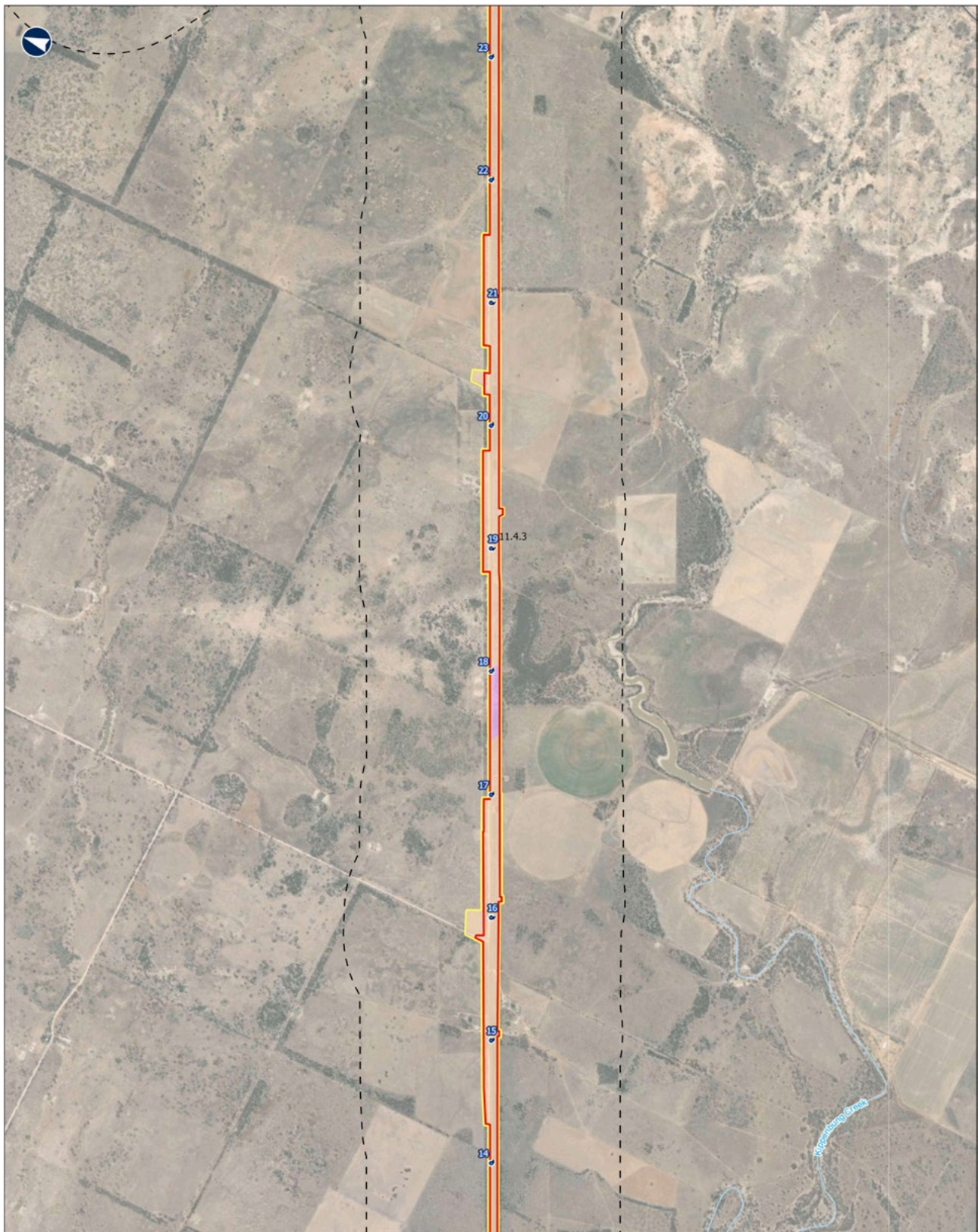
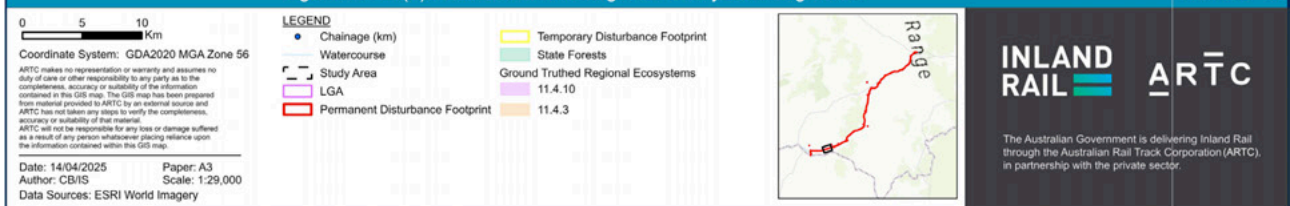


Figure 11 - 4 (5) Ground Truthed Regional Ecosystem Vegetation

MAP 5 OF 30



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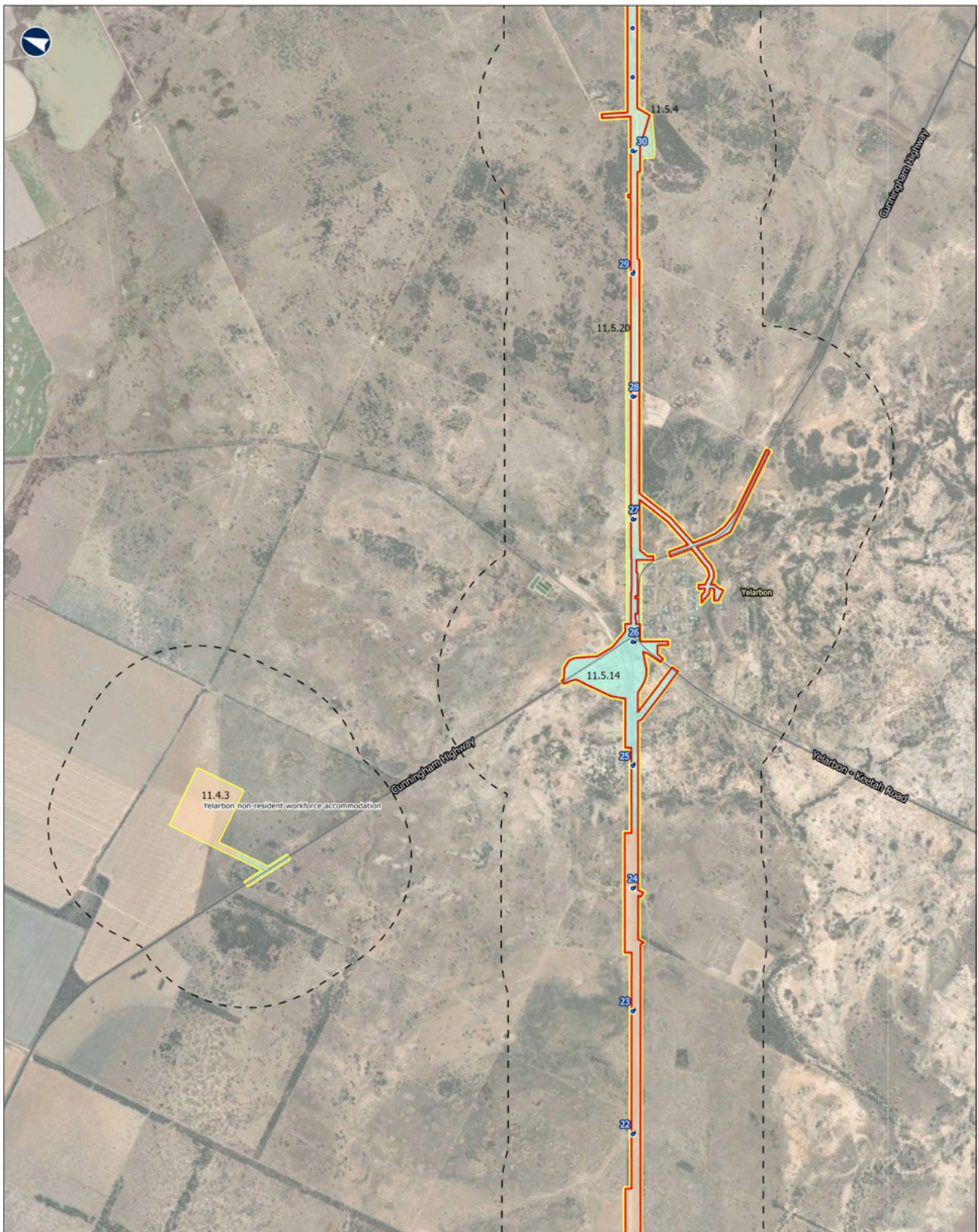


Figure 11 - 4 (6) Ground Truthed Regional Ecosystem Vegetation

MAP 6 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
— Watercourse
--- Study Area
--- LGA
--- Permanent Disturbance Footprint
--- Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.4.3
11.5.14
11.5.20
11.5.4



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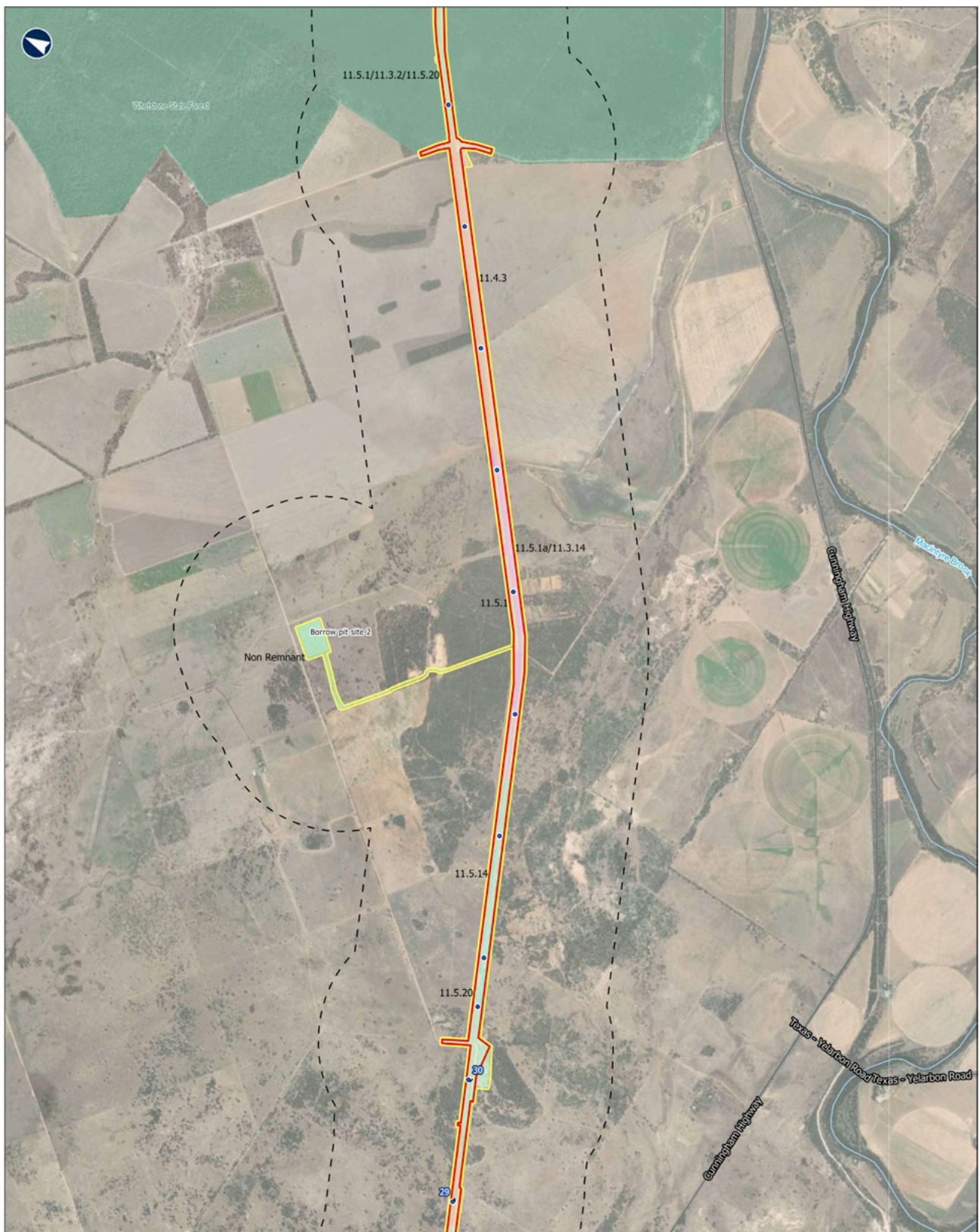


Figure 11 - 4 (7) Ground Truthed Regional Ecosystem Vegetation

MAP 7 OF 30



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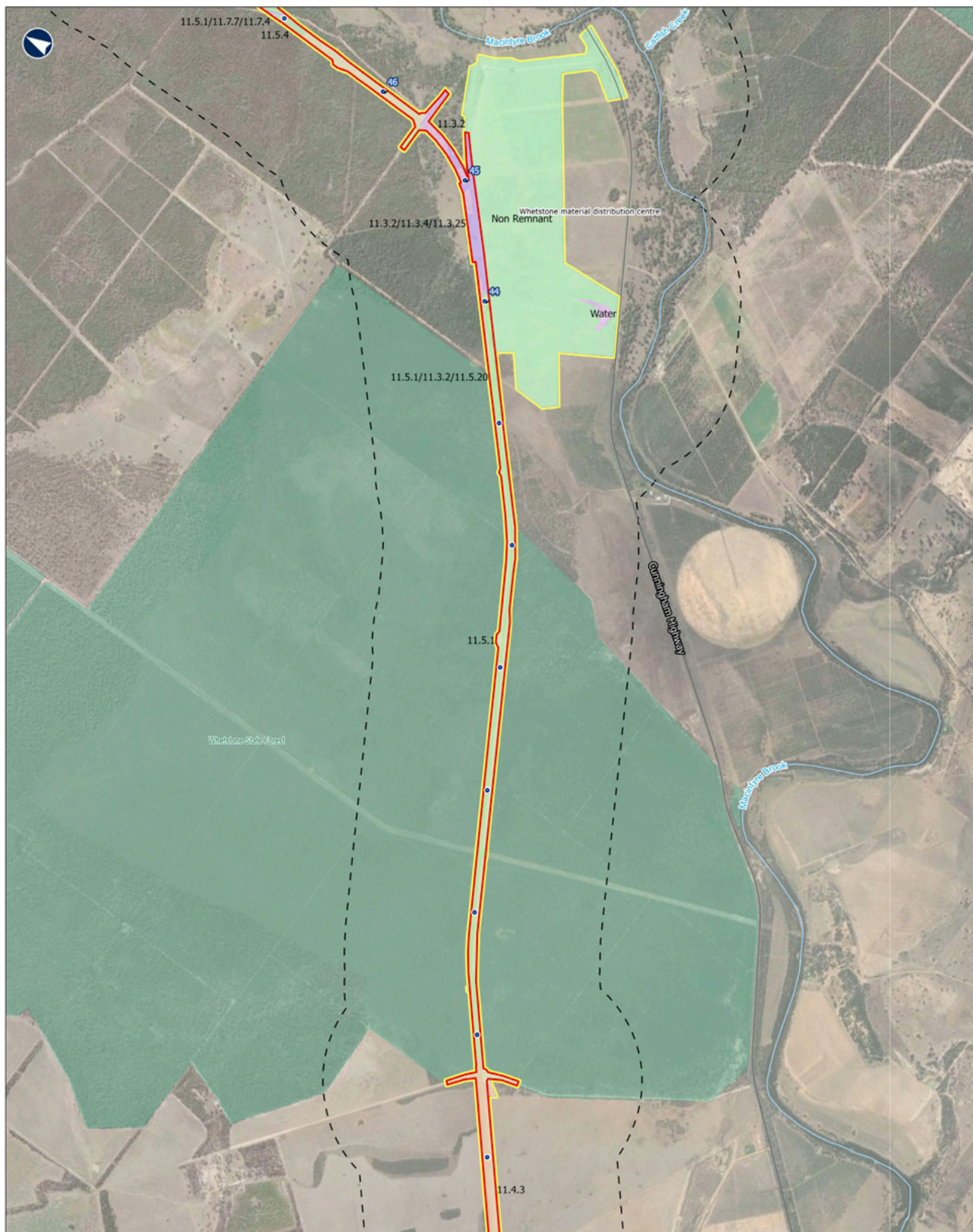


Figure 11 - 4 (8) Ground Truthed Regional Ecosystem Vegetation

MAP 8 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.2
11.3.2/11.3.4/11.3.25
11.4.3
11.5.1
11.5.1/11.3.2/11.5.20
11.5.1/11.7.7/11.7.4
11.5.20
11.5.4
Non Remnant



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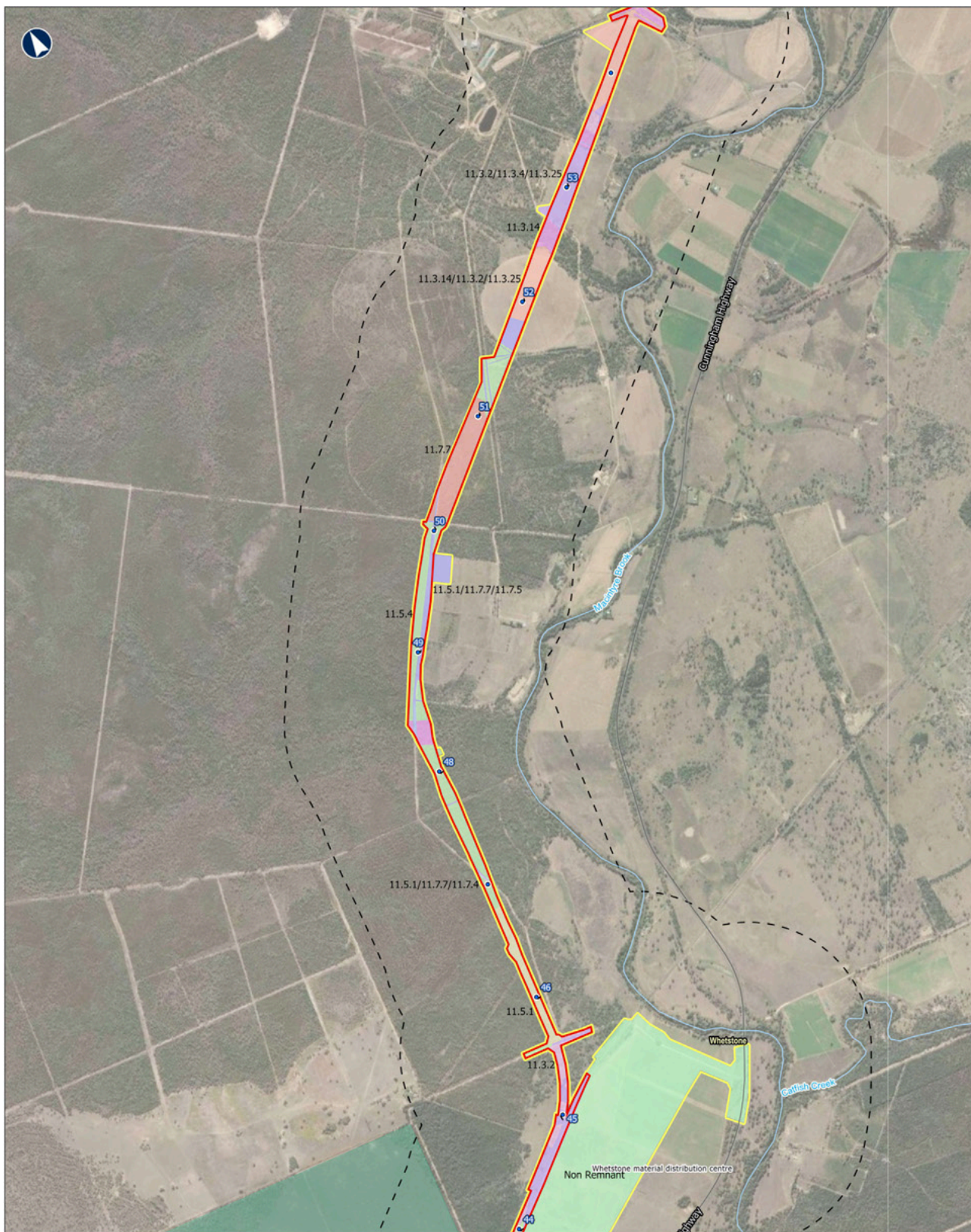
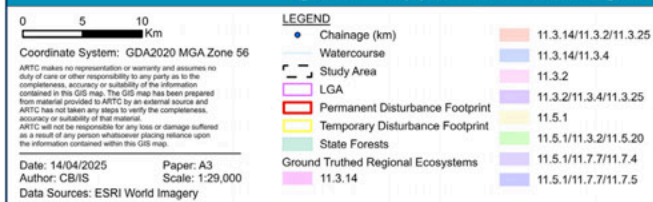


Figure 11 - 4 (9) Ground Truthed Regional Ecosystem Vegetation

MAP 9 OF 30



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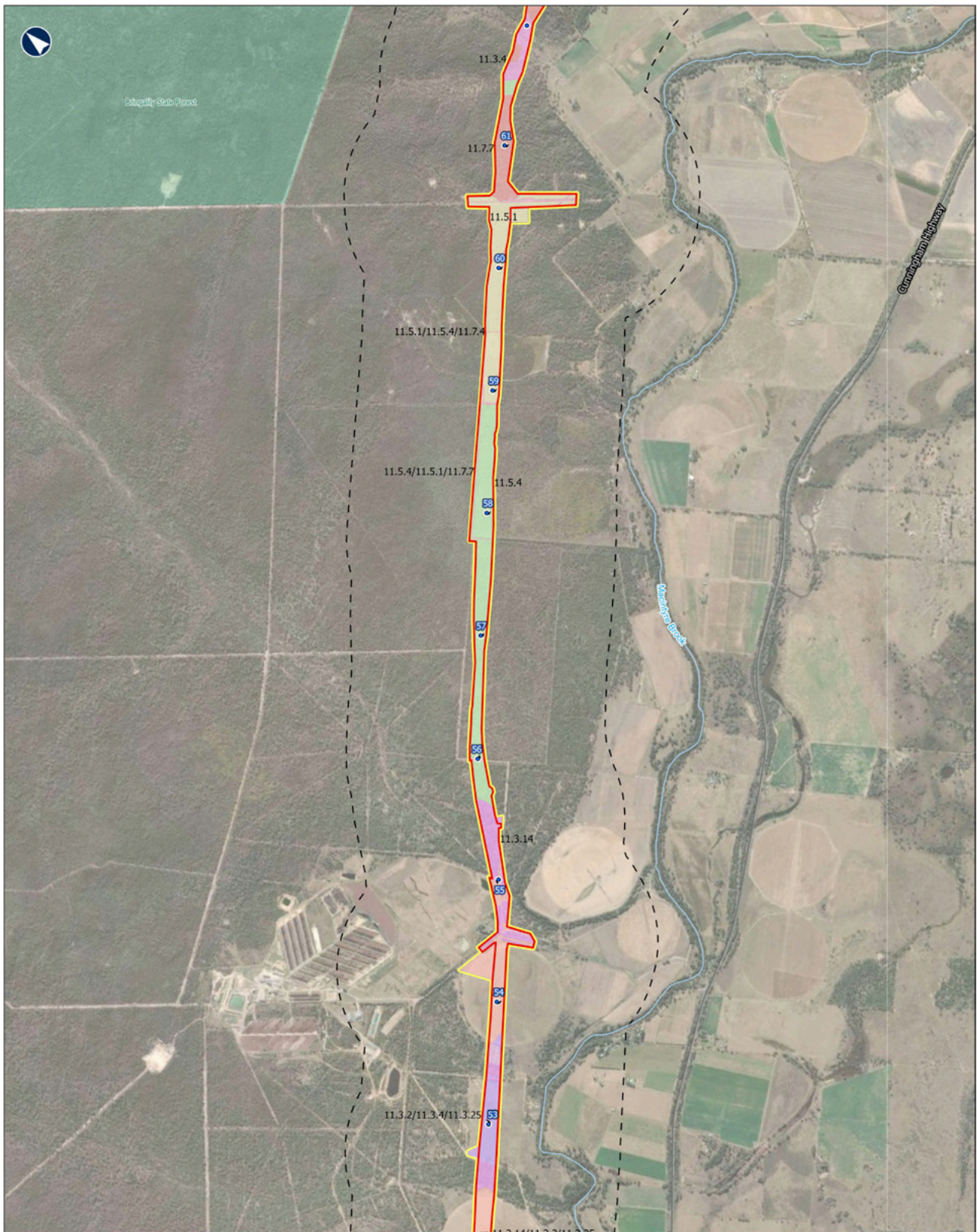


Figure 11 - 4 (10) Ground Truthed Regional Ecosystem Vegetation

MAP 10 OF 30



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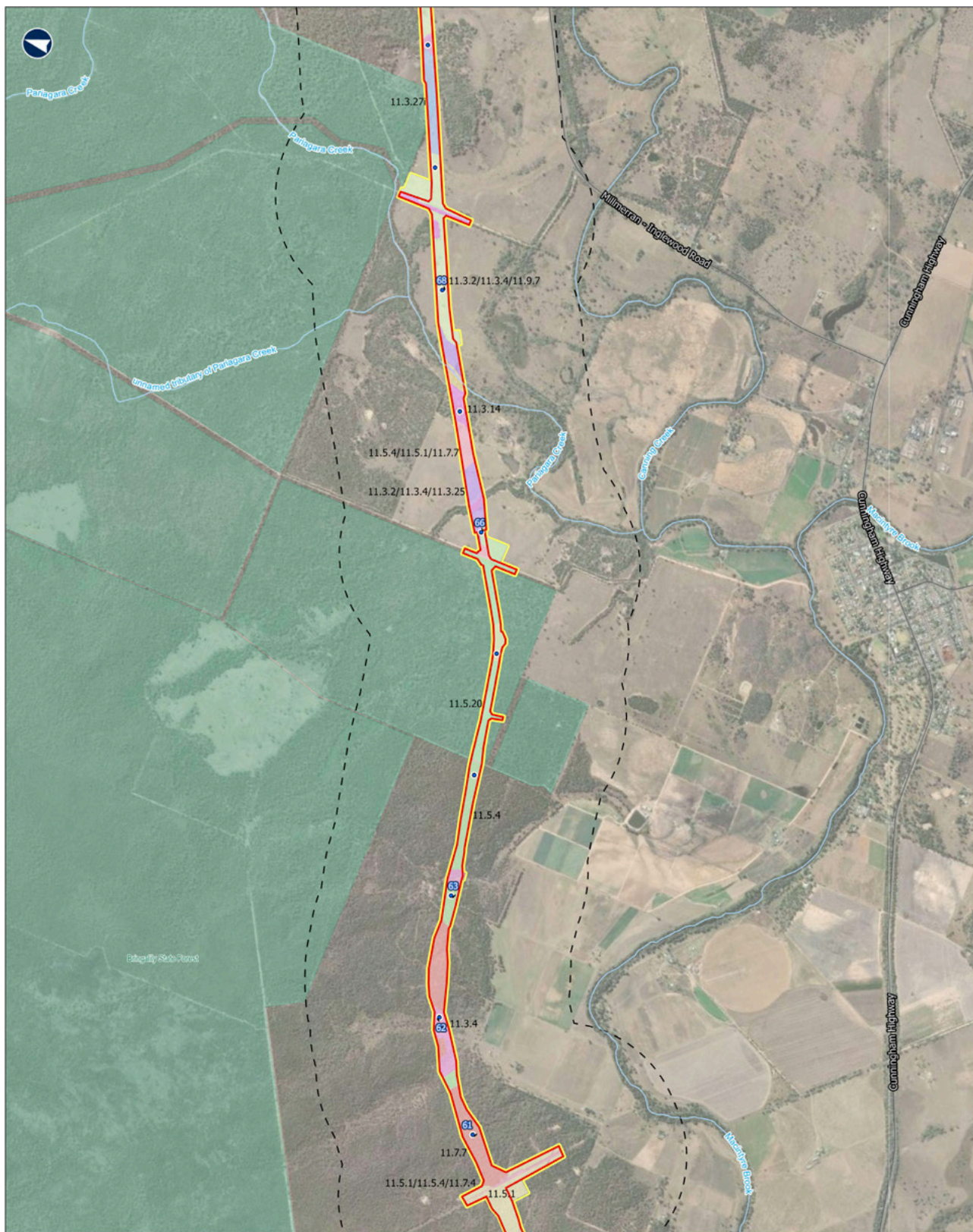


Figure 11 - 4 (11) Ground Truthed Regional Ecosystem Vegetation

MAP 11 OF 30

0 5 10
Km

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- LEGEND**
- Chainage (km)
 - Watercourse
 - Study Area
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - State Forests
 - Ground Truthed Regional Ecosystems
 - 11.3.14
 - 11.3.2/11.3.4
 - 11.3.2/11.3.4/11.3.25
 - 11.3.2/11.3.4/11.9.7
 - 11.3.25
 - 11.3.27
 - 11.3.4
 - 11.5.1
 - 11.5.1/11.5.4/11.7.4



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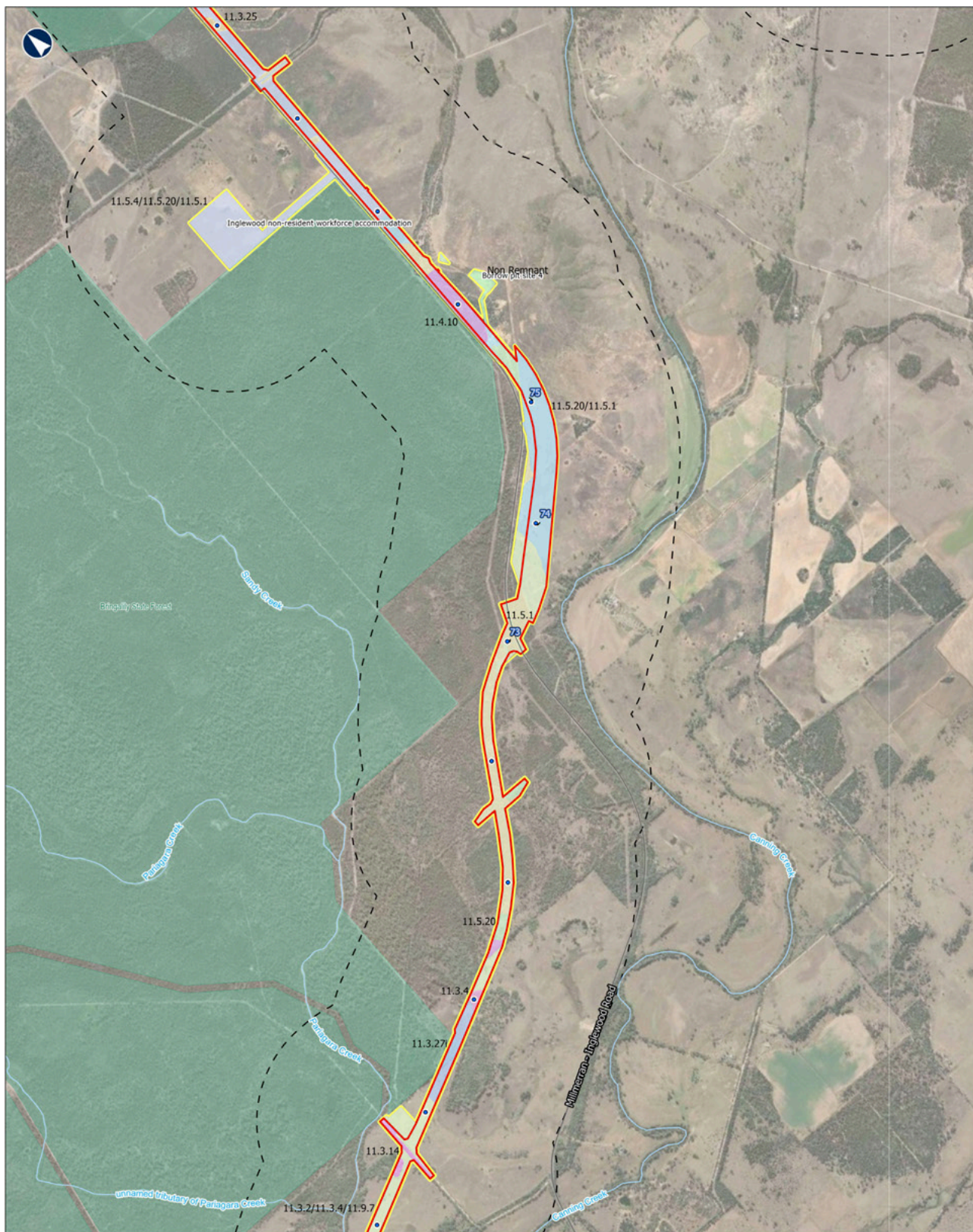


Figure 11 - 4 (12) Ground Truthed Regional Ecosystem Vegetation

MAP 12 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.14
11.3.2/11.3.4/11.3.25
11.3.2/11.3.4/11.9.7
11.3.25
11.3.27
11.3.4
11.4.10
11.5.1
11.5.20



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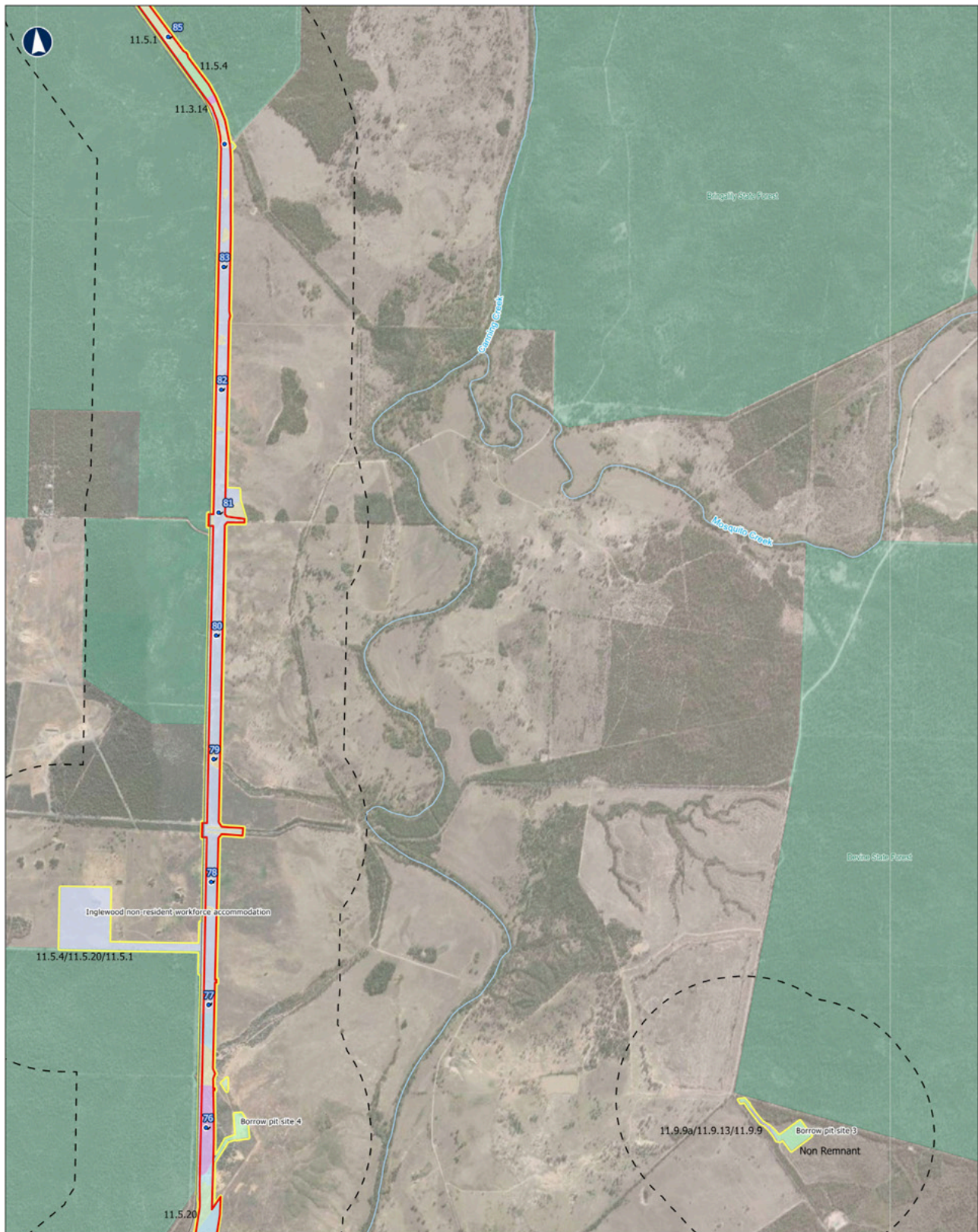


Figure 11 - 4 (13) Ground Truthed Regional Ecosystem Vegetation

MAP 13 OF 30



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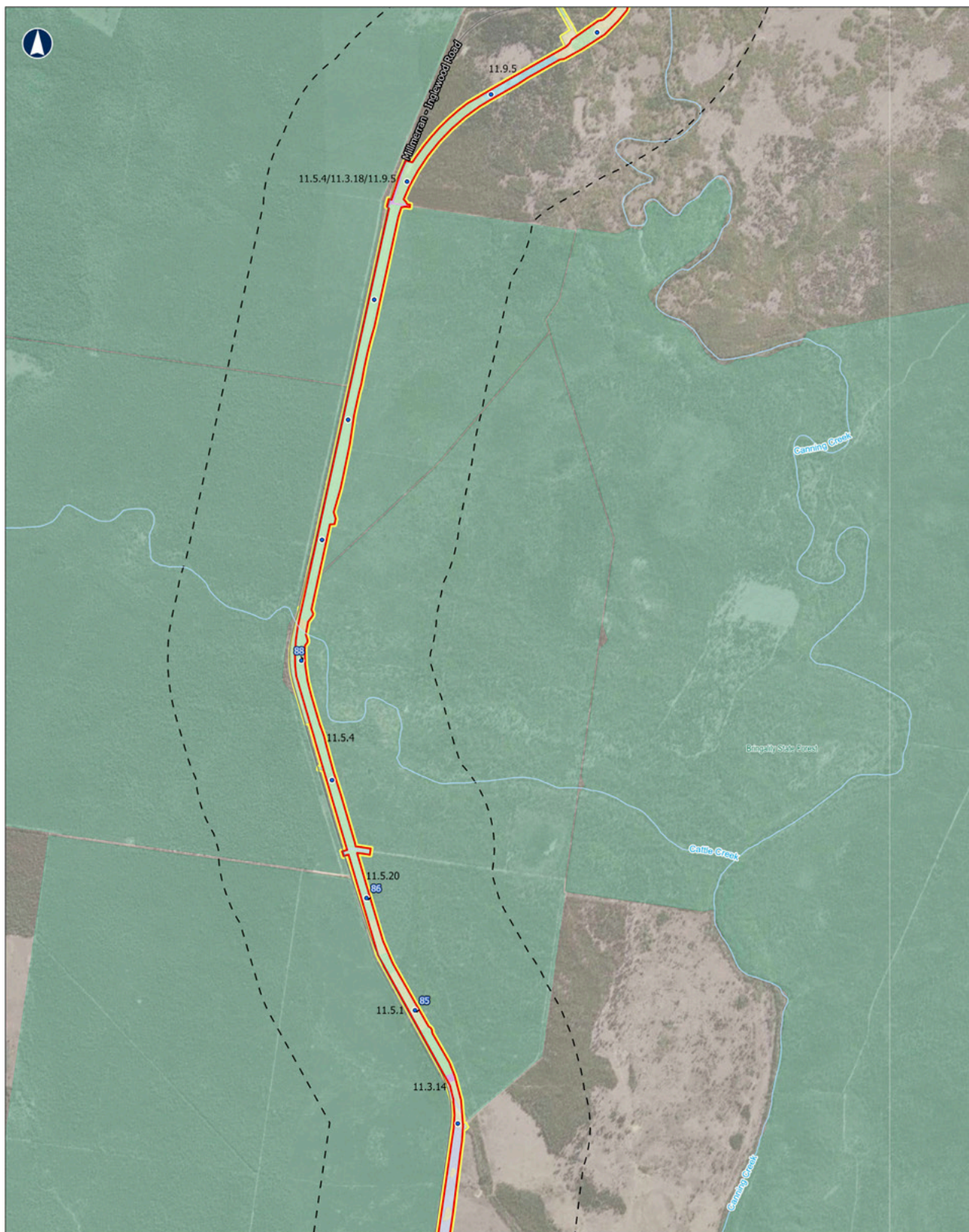


Figure 11 - 4 (14) Ground Truthed Regional Ecosystem Vegetation

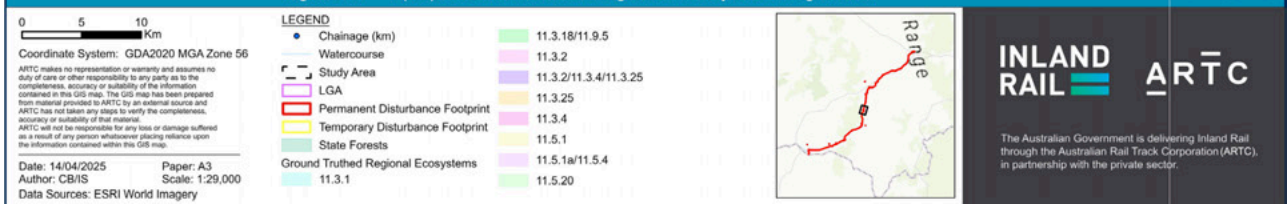
MAP 14 OF 30





Figure 11 - 4 (15) Ground Truthed Regional Ecosystem Vegetation

MAP 15 OF 30



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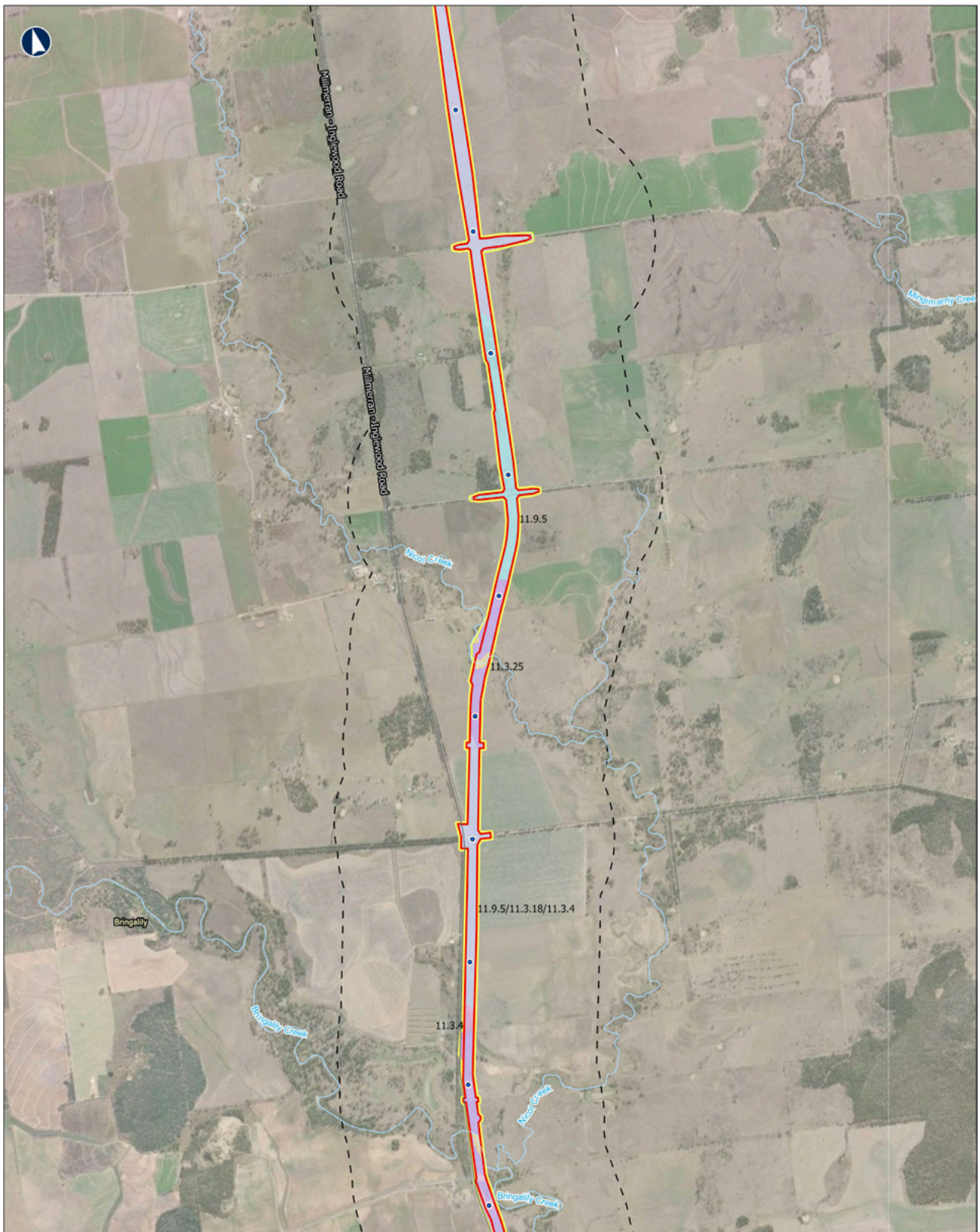


Figure 11 - 4 (16) Ground Truthed Regional Ecosystem Vegetation

MAP 16 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
— Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.1
11.3.2
11.3.2/11.3.4/11.3.25
11.3.25
11.3.4
11.9.5
11.9.5/11.3.18/11.3.4



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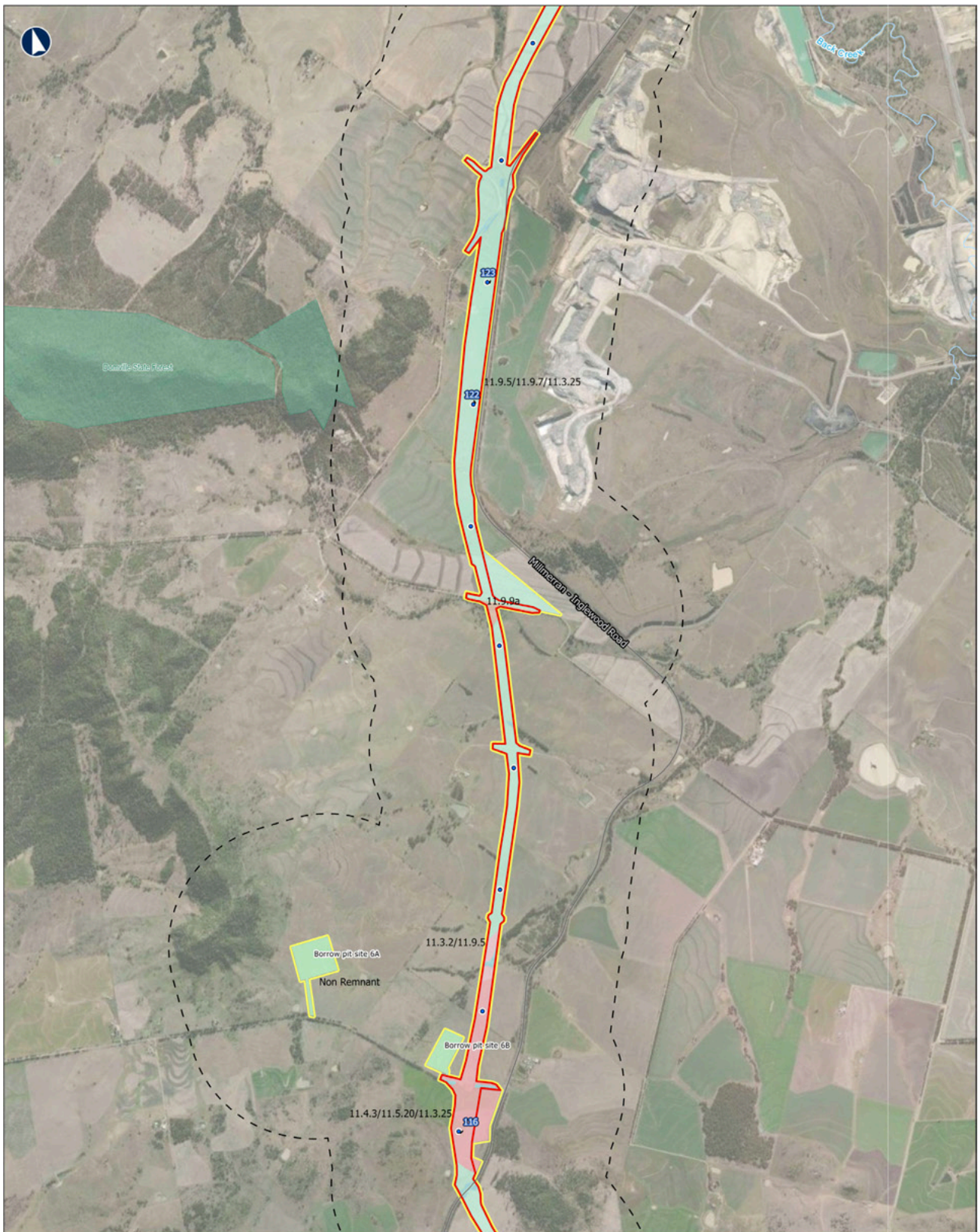


Figure 11 - 4 (18) Ground Truthed Regional Ecosystem Vegetation

MAP 18 OF 30



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Figure 11 - 4 (19) Ground Truthed Regional Ecosystem Vegetation

MAP 19 OF 30

0 5 10 Km
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- LEGEND**
- Chainage (km)
 - Watercourse
 - Study Area
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - State Forests
 - Ground Truthed Regional Ecosystems
 - 11.3.2
 - 11.3.2/11.3.25



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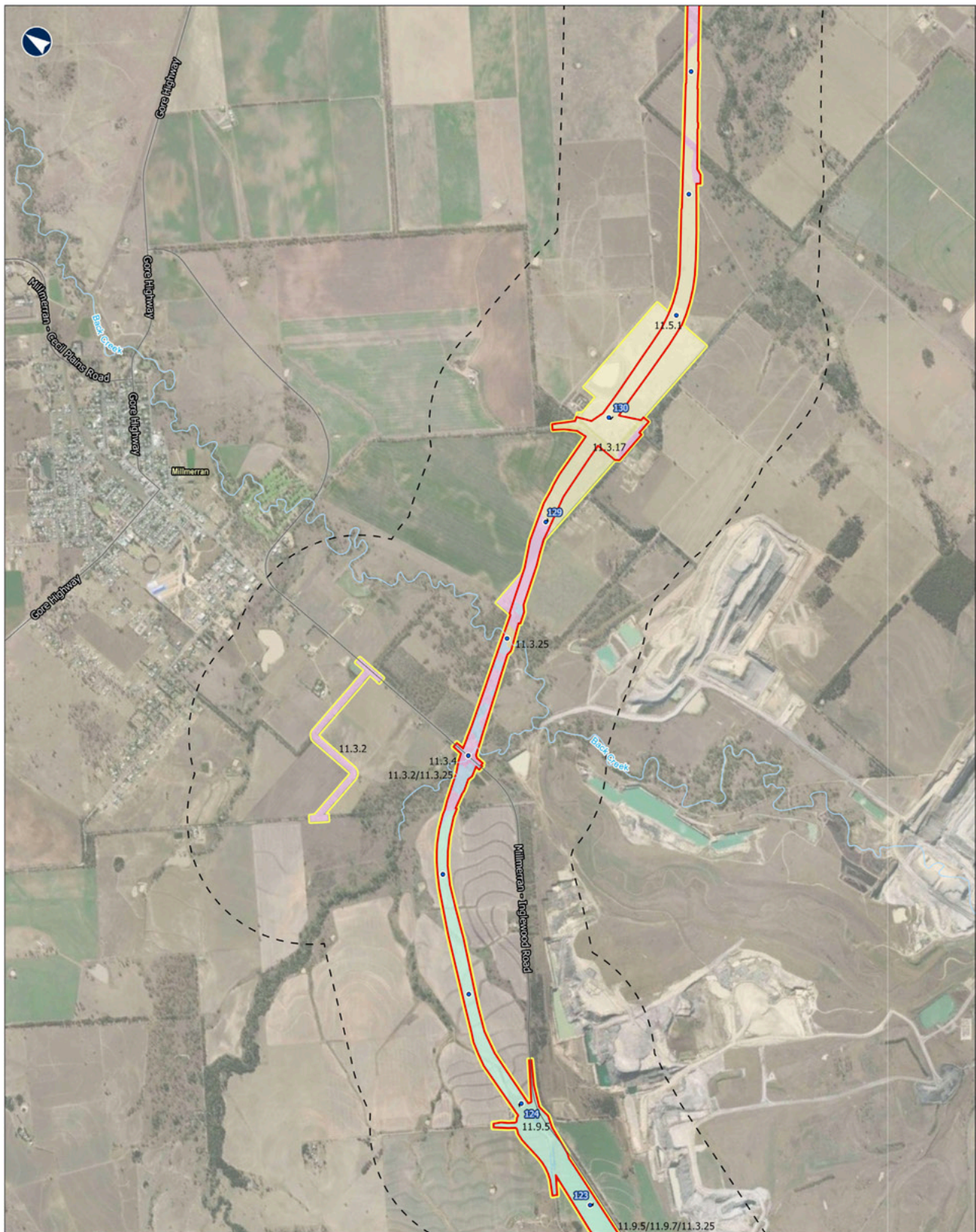
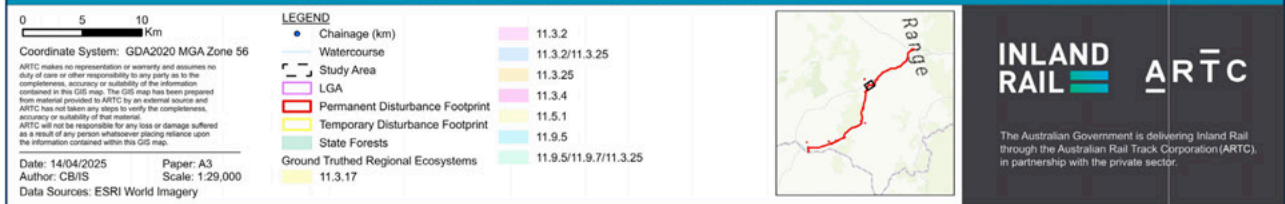


Figure 11 - 4 (20) Ground Truthed Regional Ecosystem Vegetation

MAP 20 OF 30



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Figure 11 - 4 (21) Ground Truthed Regional Ecosystem Vegetation

MAP 21 OF 30

0 5 10 Km
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LEGEND
Chainage (km)
Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.2
11.3.21
11.3.25
11.5.1



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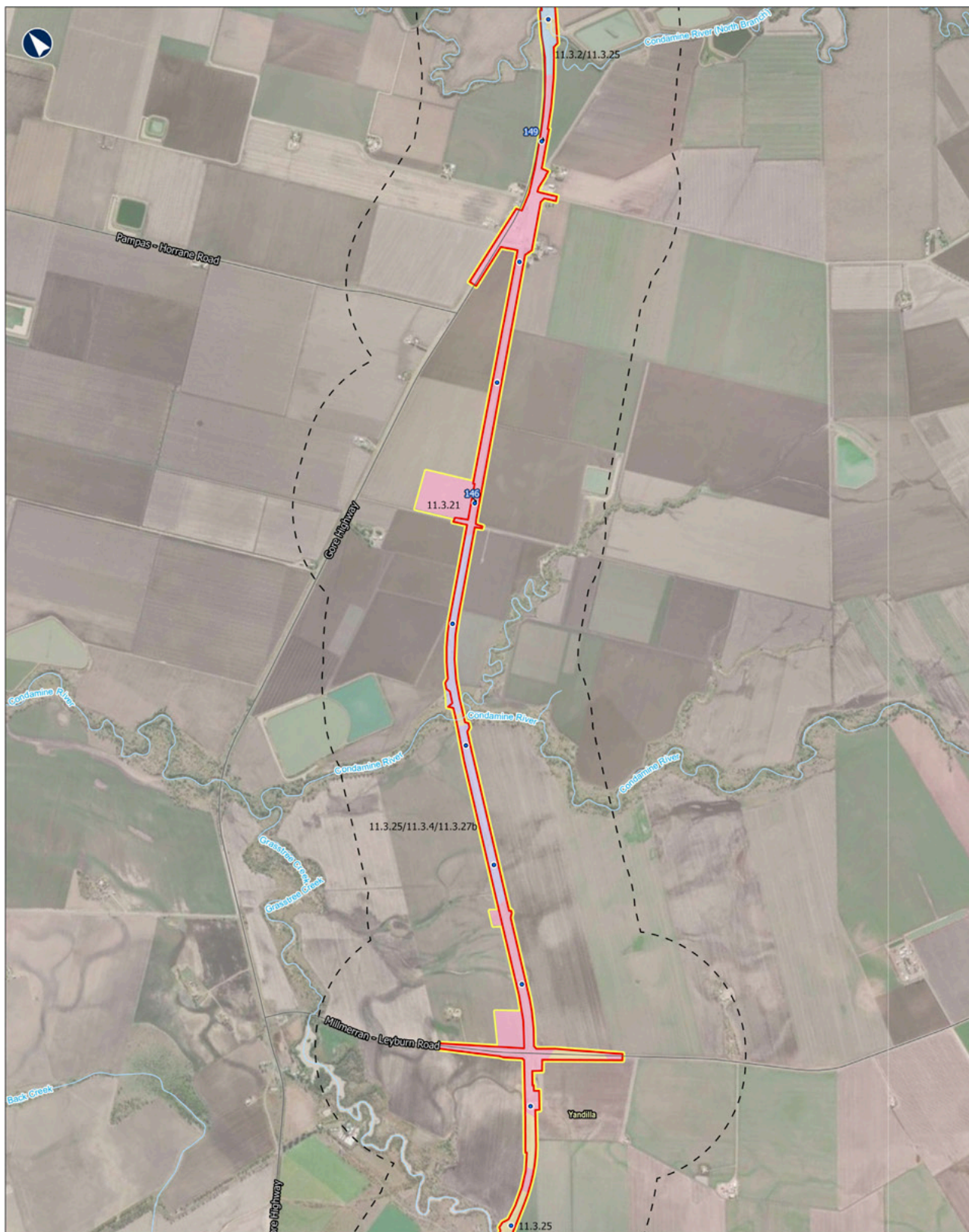
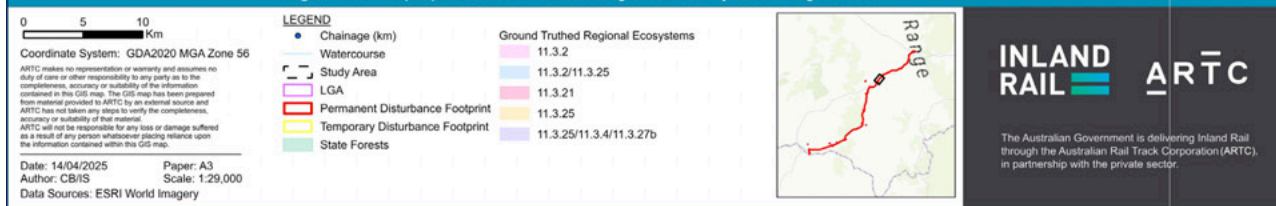


Figure 11 - 4 (22) Ground Truthed Regional Ecosystem Vegetation

MAP 22 OF 30



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Figure 11 - 4 (23) Ground Truthed Regional Ecosystem Vegetation

MAP 23 OF 30



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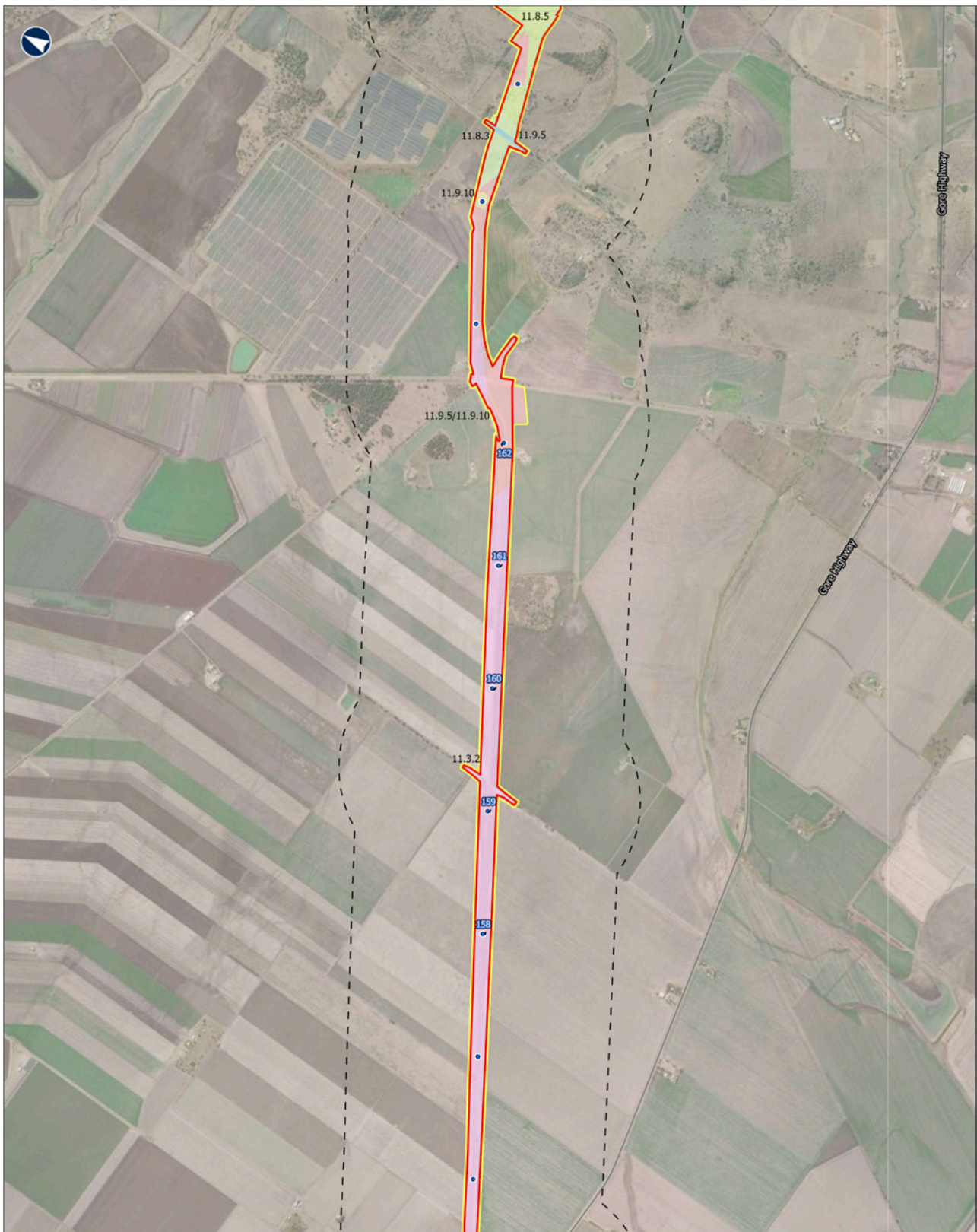


Figure 11 - 4 (24) Ground Truthed Regional Ecosystem Vegetation

MAP 24 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests
Ground Truthed Regional Ecosystems
11.3.2
11.3.21
11.8.3
11.8.5
11.9.10
11.9.5
11.9.5/11.9.10



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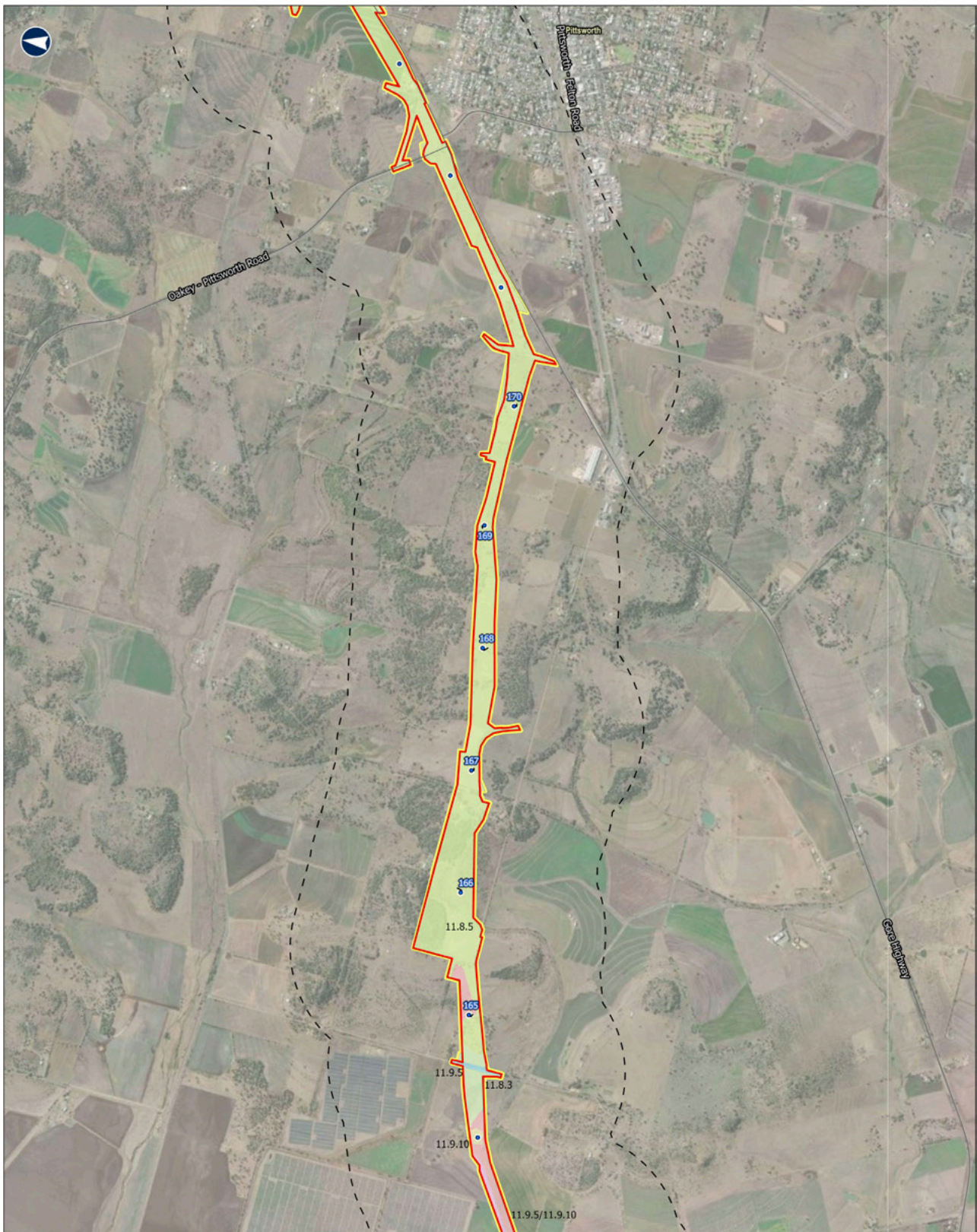


Figure 11 - 4 (25) Ground Truthed Regional Ecosystem Vegetation

MAP 25 OF 30



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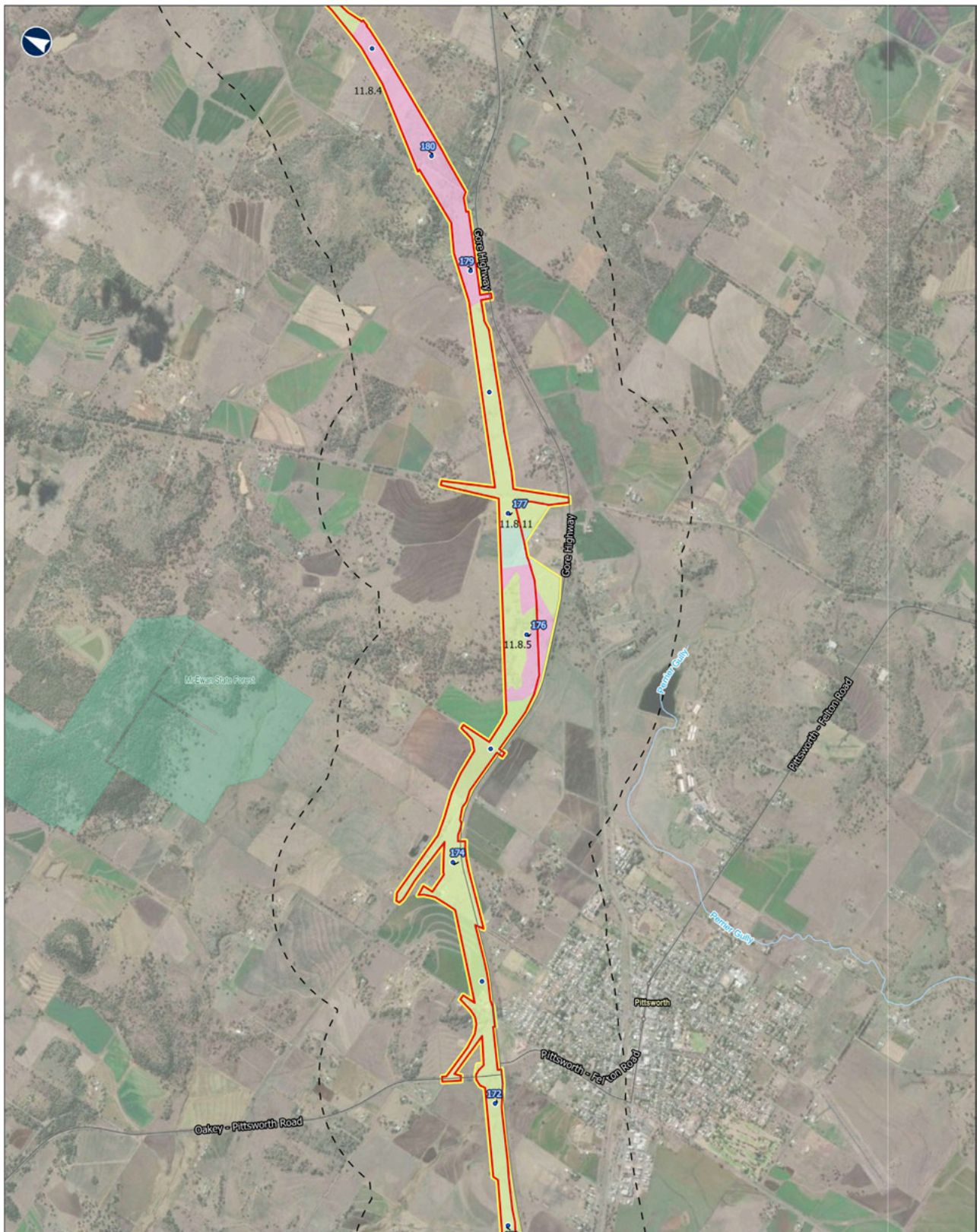


Figure 11 - 4 (26) Ground Truthed Regional Ecosystem Vegetation

MAP 26 OF 30



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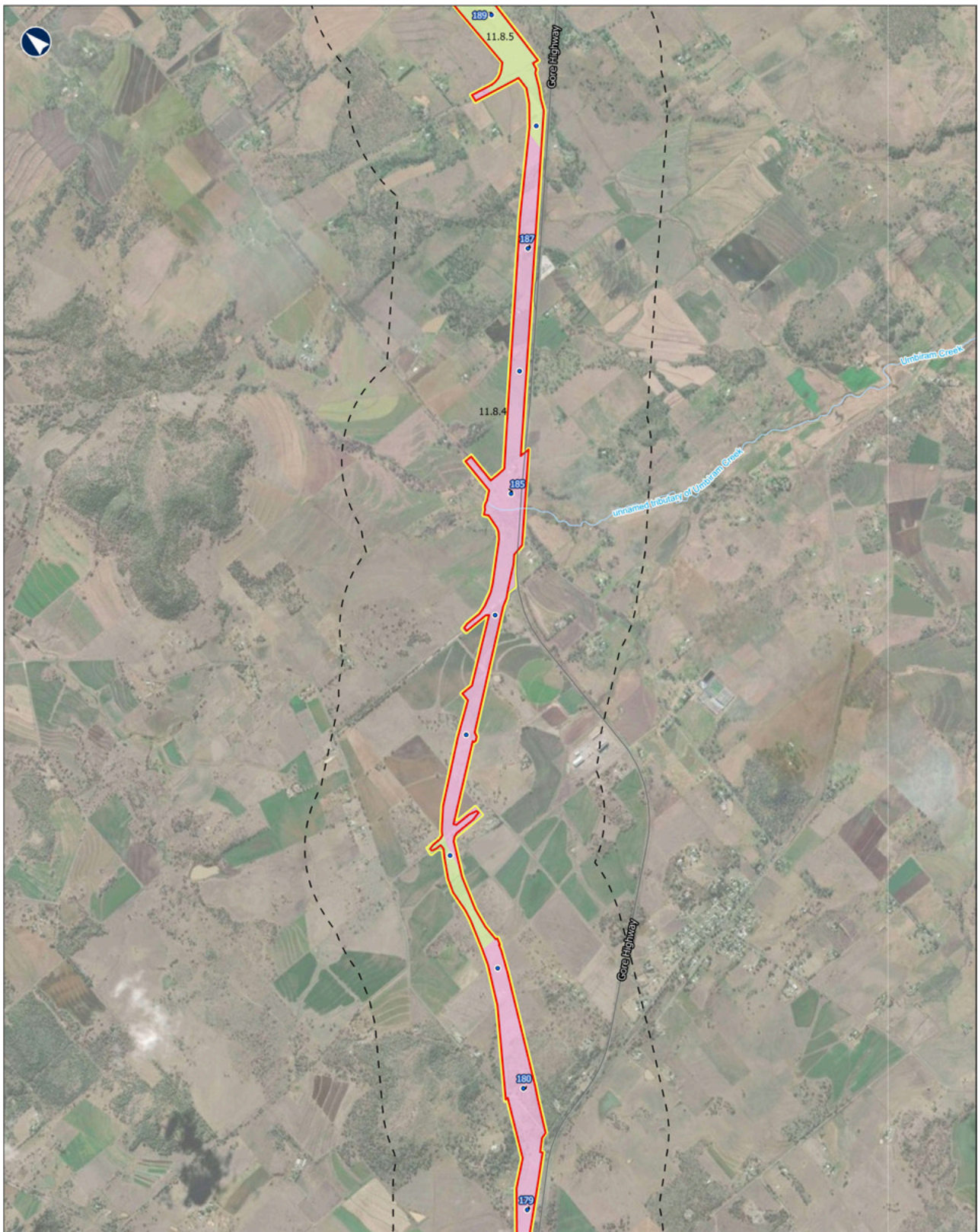


Figure 11 - 4 (27) Ground Truthed Regional Ecosystem Vegetation

MAP 27 OF 30



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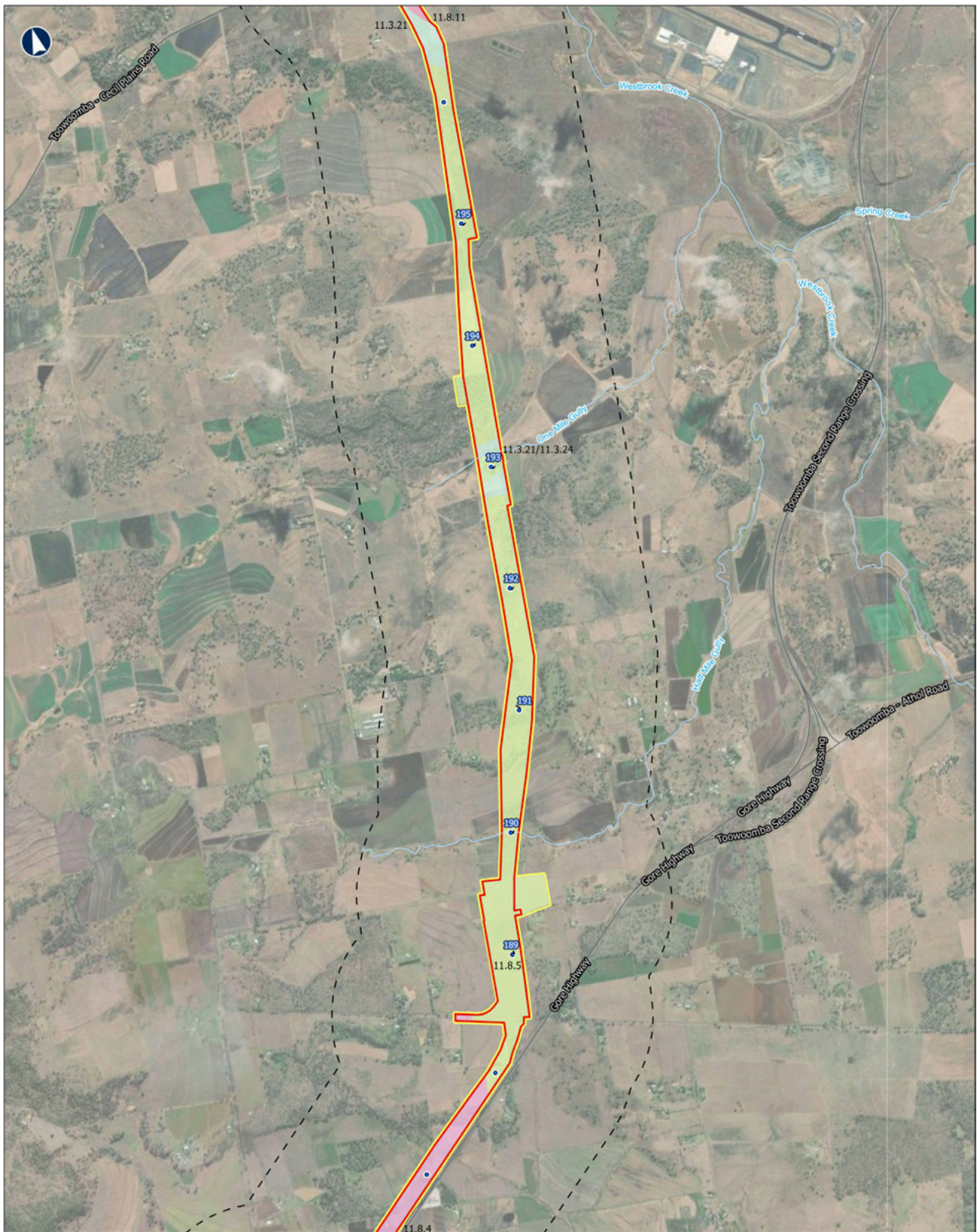


Figure 11 - 4 (28) Ground Truthed Regional Ecosystem Vegetation

MAP 28 OF 30



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Figure 11 - 4 (29) Ground Truthed Regional Ecosystem Vegetation

MAP 29 OF 30

0 5 10 Km
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 - 11.3.21
 - 11.3.21/11.3.24
 - 11.8.11
 - 11.8.5



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Figure 11 - 4 (30) Ground Truthed Regional Ecosystem Vegetation

MAP 30 OF 30



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11.5.3 Habitat types

A total of eight broad habitat types have been identified within the Project footprint (see Table 11-10 noting that groundwater dependent ecosystems are minor occurrences within other habitat types. The broad habitat types were delineated by grouping vegetation communities according to their vegetation structure, composition and geomorphological characteristics.

The extent of ground-truthed habitat types within the Project footprint is provided in Table 11-10. As a result of the dry conditions during the survey period, the extent of GDEs and watercourses were unable to be ground-truthed and are included as minor components of the broad habitat types. The location of broad habitat types within the Project footprint are shown in Figure 11-5.

TABLE 11-10 GROUND-TRUTHED HABITAT TYPES WITHIN THE STUDY AREA AND PROJECT FOOTPRINT

Broad habitat type	Extent with Project footprint	
	Area (ha)	Percentage (%)
Non-remnant disturbed pasture, cropping areas and other land uses	2,516.87	74.42
Remnant dry sclerophyll eucalypt woodlands	430.65	12.73
Regrowth eucalypt communities	190.07	5.62
<i>Acacia harpophylla</i> - <i>Casuarina cristata</i> open forest	151.19	4.47
Natural grasslands	77.73	2.30
Freshwater wetlands	15.67	0.46
Total	3,382.17	100.00

11.5.3.1 Non-remnant disturbed pasture, cropping areas and other land uses

This habitat type includes cultivated land, non-native grasslands, non-remnant vegetation and areas of other land use, and is the dominant habitat type of the Project footprint. Cultivated land is extensive in the Project footprint and includes irrigated and dryland crops, stubble fields and fallow fields. Common crops include winter cereals and irrigated cotton.

Disturbed areas and non-native grasslands are dominated by exotic pasture grasses and are represented by areas of non-remnant vegetation (excluding cultivated land), previously cleared of native vegetation for agriculture. Dominant pasture grasses include Rhodes grass (*Chloris gayana*), green panic (*Megathyrsus maximus*), and Johnson grass (*Sorghum halepense*). Native grass species are also interspersed amongst the beforementioned exotic species and include Queensland blue grass (*Dichanthium sericeum*), *Digitaria* spp., *Panicum* spp., and *Bothriochloa* spp.

Non-remnant and cultivated areas are known to provide habitat for squatter pigeon southern (*Geophaps scripta scripta*), Condamine earless dragon (*Tympanocryptis condaminensis*), and Belson's panic (*Homopholis belsonii*). The availability of soil cracks and other microhabitat refugia is greatly reduced by soil cultivation, reducing the likelihood of occurrence of soil crack dwelling fauna species. Within grasslands on basalt soils, potential habitat for NC Act listed *Digitaria porrecta*, *Cyperus clarus*, and *Picris barbarorum* occurs, regardless of the degraded state of some areas.

These areas are devoid of canopy cover, but isolated paddock trees can provide dispersal habitat for fauna species including the MNES listed species painted honeyeater (*Grantiella picta*) and the koala (*Phascolarctos cinereus*).

11.5.3.2 Remnant dry sclerophyll eucalypt woodlands

Dry sclerophyll eucalypt woodlands are present on a variety of substrates, including sedimentary and igneous rocks, duricrusts, sand plains, alluvial plains and in riparian areas alongside channels. The mature woodland, open forest or forest canopies are dominated by a variety of eucalypt species including mountain grey gum (*Eucalyptus orgadophila*), narrow-leaved ironbark (*Eucalyptus crebra*), Queensland blue gum (*Eucalyptus tereticornis*), river red gum (*Eucalyptus camaldulensis*), broad-leaved red ironbark (*Eucalyptus fibrosa* subsp. *nubilis*), poplar box (*Eucalyptus populnea*) and yellow box (*Eucalyptus melliodora*). Dry sclerophyll eucalypt woodlands in the west of the Project footprint regularly had a subdominant tree layer of *Acacia* and/or *Casuarina/Allocasuarina* species and an abundance of mistletoe, both of which provide good foraging habitat for various bird species and roosting habitat for various microchiropteran bat species. Overall, this habitat type was found to contain a low to medium abundance of small to medium sized tree hollows; however, it supported a shallow layer of leaf litter and a moderate abundance of woody debris that can provide important refuge and foraging opportunities for a range of reptiles, amphibians and small mammal taxa.

Areas of mature eucalypt open forest and woodland on sedimentary and igneous rock within the Project footprint may provide suitable habitat for MNES fauna species including the south-eastern long-eared bat (*Nyctophilus corbeni*), squatter pigeon (*Geophaps scripta scripta*), koala (*Phascolarctos cinereus*) and grey-headed flying fox (*Pteropus poliocephalus*). Eucalypt forests and woodlands on sand plains and on duricrusts may provide habitat for south-eastern long-eared bat (*Nyctophilus corbeni*).

Structurally complex habitat present in riparian and alluvial open forest and woodland habitat may be suitable for the MNES fauna species, painted honeyeater (*Grantiella picta*), greater glider (*Petauroides volans*), yakka skink (*Egernia rugosa*) and koala (*Phascolarctos cinereus*). During the wet season, riparian and alluvial areas may temporarily flood, effectively becoming a wetland habitat (riverine wetland) that may be suitable for the Australian painted snipe (*Rostratula australis*). Bullock cones may provide suitable foraging habitat for NC Act listed glossy-black cockatoo (*Calyptorhynchus lathami*) and areas of thick leaf litter provide suitable habitat for the ambush species, the common death adder (*Acanthophs antarcticus*).

11.5.3.3 Regrowth eucalypt communities

Areas of regrowth vegetation, largely represented by the HVR vegetation mapping, are present throughout the Project footprint. These areas are generally in poor condition, with extensive weed invasion and disturbance from cattle grazing practices. Areas of regrowth habitat may provide foraging and roosting habitat for transitional bird species and suitable microhabitats, including cracking clay soils for reptile species.

11.5.3.4 *Acacia harpophylla*-*Casuarina cristata* open forest

Acacia harpophylla-*Casuarina cristata* open forest habitat is present within the Project footprint on sedimentary rocks and clay plains.

This habitat type typically occurs on cracking clays that are usually black or grey to brown or reddish-brown in colour, often self-mulching and sometimes with gilgai microrelief in flatter areas. This open forest habitat lacked an abundance of medium or large sized tree hollows; however, the ground layer can be dense, with coarse woody debris and leaf litter providing important habitat for reptiles. Deep cracking clay soils also provide important habitat for a range of amphibians, particularly during the wet season when the gilgais are inundated. Some open forest habitat areas also contained an abundance of mistletoe, providing important habitat for birds.

This habitat type is suitable for MNES species including Dunmall's snake (*Furina dunmali*) and south-eastern long-eared bat (*Nyctophilus corbeni*) where shelter-sites such as logs, rocks, tree hollows, decorticating bark and root cavities are available. The brigalow woodland snail (*Adclarkia cameroni*) is associated with this habitat type and suitable habitat for painted honeyeater (*Grantiella picta*) is present in areas with abundant mistletoe (*Amyema* spp.). This habitat provides suitable habitat for grey snake (*Hemiaspis damelii*) and common death adder (*Acanthophs antarcticus*), particularly where it occurs on Cainozoic clay plains with cracking clay soils which are often with a weak gilgai microrelief.

11.5.3.5 Natural grasslands

Natural grassland habitats within the Project footprint include remnant native grasslands and derived native grasslands. Small remnants of native grassland include *Dichanthium sericeum* grassland on Cainozoic igneous rocks, *Themeda avenacea* grassland on alluvial plains, and *Triodia scariosa* grassland.

Derived native grasslands are dominated by native grass species and are represented by areas of non-remnant vegetation (excluding cultivated land), previously cleared of woody species (i.e. trees and shrubs) for agriculture. Dominant grass species include Queensland panic (*Panicum queenslandicum*), Queensland bluegrass (*Dichanthium sericeum*), *Digitaria* spp., *Themeda* spp., and *Bothriochloa* spp; however, exotic pasture grasses sometimes occur, such as Rhodes grass (*Chloris gayana*).

Native and derived grasslands are considered as one fauna habitat type due to similarities in structure and floristics. Natural grassland habitat is extensive within the Project footprint and is typically located on alluvial floodplains and creek flats, as well as basalt plains. Grasslands in road reserves provide the least impacted representation of this habitat within the study area.

Grassland within the Project footprint provides foraging habitats for granivorous bird species, such as finches, parrots and pigeons. Natural grassland habitats with microhabitat features such as cracking clay soils, may also provide important microhabitat refugia (i.e. soil cracks) for small ground fauna such as native rodents, skinks, and snakes. Scattered paddock trees occur across many grassland habitats, acting as 'stepping stones' between patches of native vegetation and aid in connectivity in otherwise cleared and fragmented landscapes.

Grassland habitat varies in extent, quality and suitability for conservation significant fauna and flora species. Grasslands may provide suitable habitat for flora species such as Belson's panic (*Homopholis belsonii*), king bluegrass (*Dichanthium queenslandicum*) and toadflax (*Thesium australe*). Grasslands on basalt soils provides potential habitat for *Digitaria porrecta*, *Cyperus clarus* and *Picris barbarorum*, regardless of the degraded state of some areas. Fauna species such as squatter pigeon southern (*Geophaps scripta scripta*), common death adder (*Acanthopis antarcticus*) and short-beaked echidna (*Tachyglossus aculeatus*) may utilise grassland habitat within the Project footprint and where microhabitat features such as cracking clay soils are present, grassland habitats may support reptile species such as the Condamine earless dragon (*Tympanocryptis condaminensis*) and five-clawed worm-skink (*Anomalopus mackayi*).

11.5.3.6 Freshwater wetlands

Wetland habitats within the study area include farm dams and reservoirs (lacustrine), wetlands associated with the floodplains of major watercourses (riverine), and vegetated swamps (palustrine). Farm dams, which are abundant across agricultural landscapes, are included as they can provide suitable wetland alternatives for vertebrate fauna. These include typically small stock-watering dams and much larger turkey-nest dams associated with irrigated cropping, as well as drinking water supply reservoirs. Riverine wetlands associated with floodplains are ephemeral and typically vegetated by a mixture of native and non-native grasses and grass-like plants.

Remnant palustrine wetland vegetation is represented by RE 11.3.27b and represents a very minor area within the Project footprint (0.97 ha). Typical aquatic and emergent plants include *Chara* spp., *Nitella* spp., *Myriophyllum verrucosum*, blue lily (*Nymphaea violacea*), *Pyrgillus javanicus*, curled pondweed (*Potamogeton crispus*), *P. tricarinatus*, swamp lily (*Ottelia ovalifolia*), *Vallisneria caulescens* and marshwort (*Nymphoides indica*). A narrow fringing woodland commonly dominated by river red gum (*Eucalyptus camaldulensis*) or *E. coolabah* may occur. Wetland habitats within the region are highly ephemeral, particularly in the southern and drier sections of the alignment.

Wetland habitats within the Project footprint are considered to provide suitable habitat for a variety of amphibian, reptile (including turtles) and bird species, such as glossy ibis (*Plegadis falcinellus*) and sharp-tailed sandpiper (*Calidris acuminata*). Larger palustrine-wetlands potentially provide important refuge habitat for many bird species and may act as stepping stones during periods of travel. MNES fauna species that may utilise wetland habitats within the study area include the Australasian bittern (*Botaurus poiciloptilus*) and Australian painted snipe (*Rostratula australis*) although both species are reliant on the presence of dense vegetation either aquatic (for the Australian bittern) or as nearby cover (for Australian painted snipe).

Wetland areas associated with the Yelarbon scald provide habitat for MNES flora species such as winged peppergrass (*Lepidium monoplacoides*) and *Xerothermella herbacea*. The MNES aquatic species Murray cod (*Maccullochella peelii*) has been recorded in the Macintyre River and in the Macintyre Brook. Bringalily Creek may also provide habitat for this species. Murray cod is known from the Condamine River system and may utilise channels within the study area during prolonged wetter periods.

There are 9.85 ha of State mapped wetlands (as mapped by DESI) considered as high ecological significance (HES) wetlands that occur within the study area; however, none lie within the Project footprint. This includes two discrete HES wetlands in the vicinity of Kurumbul at the western end of the study area. The closest mapped HES wetland is approximately 25 km east of the Gowrie end of Project footprint (located outside of the study area).

Other wetland values within the study area are represented through ACA modelling based on water quality monitoring values. The catchment ACA indicates a skew towards higher value riverine wetlands throughout the alignment, with most sites recorded as either 'medium' or 'very high' value. No spring fed wetlands mapped on the Queensland wetland mapping layer (DES, 2018a) were identified within the study area.

Further information regarding wetland values is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report.

11.5.3.7 Watercourses

Watercourse areas within the study area include permanent and ephemeral rivers, creeks and tributaries. Rivers intersecting the Project footprint include the Condamine River and the Macintyre River and their tributaries. Creeks intersecting the Project footprint include Dry Creek, Umbiram Creek, Grasstree Creek, Back Creek, Nicol Creek, Bringalily Creek, Native Dog Creek, Cattle Creek, Pariagara Creek, and their tributaries. Additionally, gullies intersected by the Project footprint include Four Mile Gully, One Mile Gully and Half Mile Gully.

Targeted aquatic ecology assessments were carried out by Eco Logical Australia (2019) and Hydrobiology (2023) across several waterways intersected by the Project footprint. Aquatic ecology and surface water values were variable across the Project footprint. Ephemeral watercourses, which have been subject to previous disturbance from agricultural development and public infrastructure such as road crossings are dominant. Many of the waterways surveyed were dry at the time of the assessments and were not deemed to provide suitable habitat for Threatened aquatic species; however, those that contain permanent waterbodies may provide suitable habitat for the platypus (*Ornithorhynchus anatinus*) and Murray cod (*Maccullochella peelii*) including Macintyre Brook, Condamine River, Back Creek, Bringalily Creek, and Cabbage Creek.

MNES aquatic species, Murray cod, has been recorded in the Macintyre River and in the Macintyre Brook (Eco Logical Australia, 2019; Hydrological, 2023). Key sites in Bringalily Creek, Pariagara Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek have also been identified as potential habitat for this species (Aquatic Biopassage Services, 2024). Murray cod is known from the Condamine River system and may utilise channels within the study area and the broader river system during prolonged wet periods.

MSES aquatics species, platypus, was recorded in the Condamine River, Bringalily Creek and in three sites in Back Creek. Hydrobiology (2023) reported that it was likely the individuals recorded in Back Creek and the Condamine River are within the same population due to their close geographic proximity. Platypus is known from both the Condamine River system and the Dumaresq River, of which Bringalily Creek is a tributary.

Water flow and occurrence is variable and dependent on seasons. Sites on the Condamine River floodplain were generally dry with very little water in the channel, with water generally present in small pools with infrequent deeper pools during the Eco Logical Australia inspection (2019); however, the area of Condamine River inspected during the Hydrobiology survey (2023) was observed to be flowing.

Further information regarding watercourse values has been provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report.

11.5.3.8 Groundwater dependent ecosystems

Groundwater plays an important role in sustaining certain species utilising aquatic and terrestrial ecosystems, such as springs, wetlands, and rivers. DESI groundwater dependent ecosystem mapping (GDE Atlas) shows terrestrial groundwater dependent ecosystems mapped within the Project footprint. Shallow (alluvial) groundwater may sustain associated riparian canopy vegetation during dry conditions including river red gum (*E. camaldulensis*) which is used by species which is used by species such as koala (*Phascolarctos cinereus*) and greater glider (*Petauroides volans*). Groundwater dependent ecosystems are minor occurrences within other habitat types.

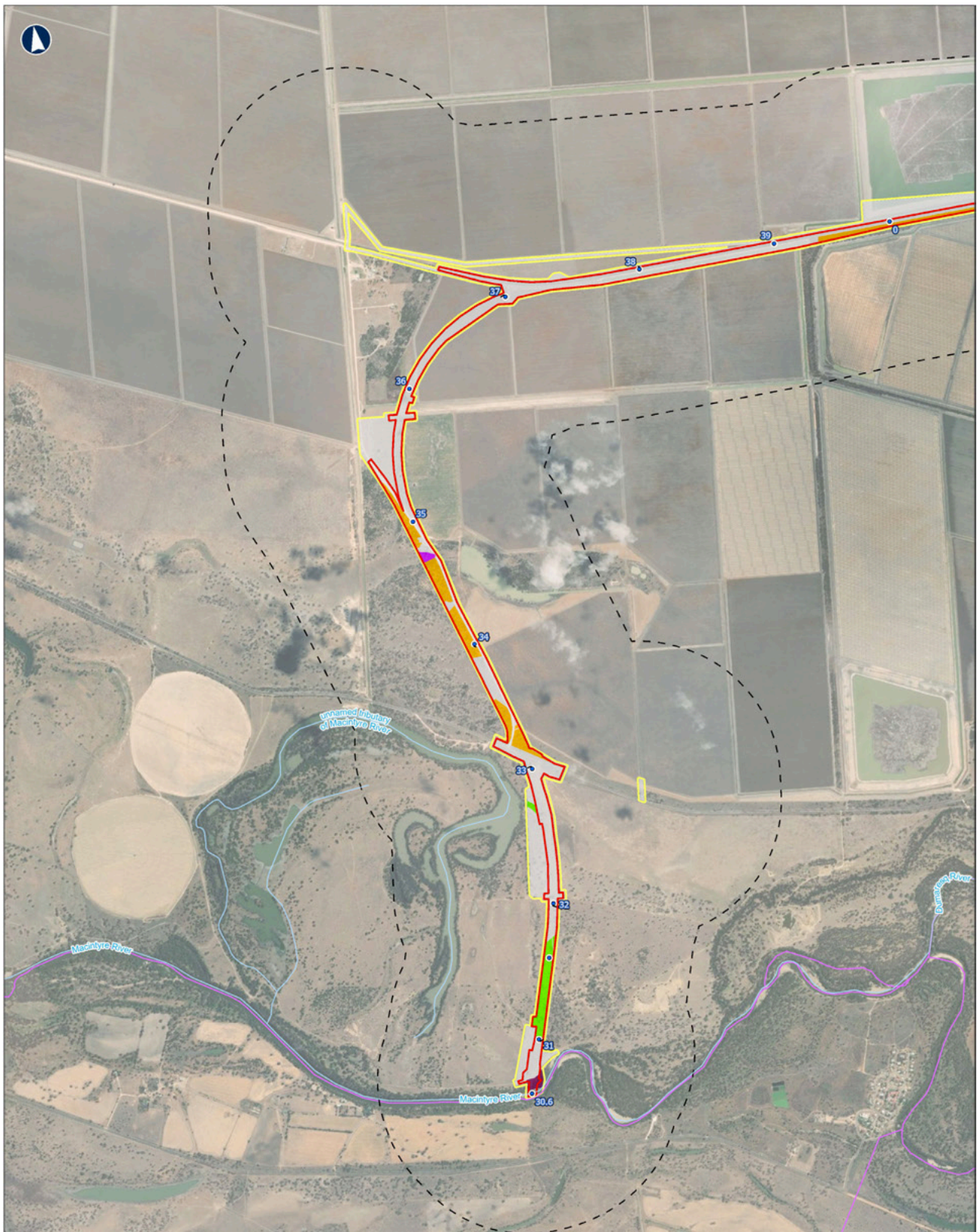
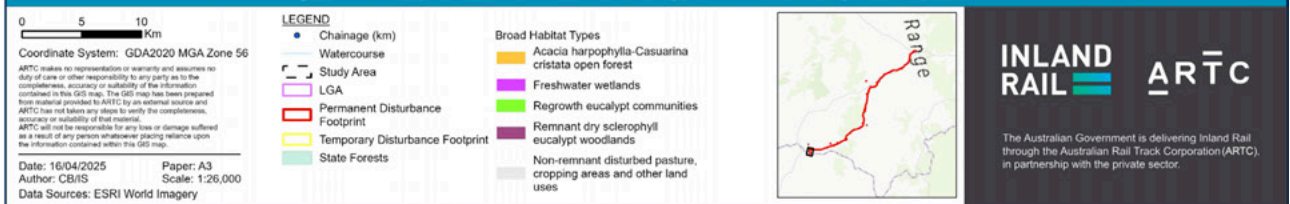


Figure 11 - 5 (1) Location of Broad Habitat types within the Project Footprint

MAP 1 OF 30

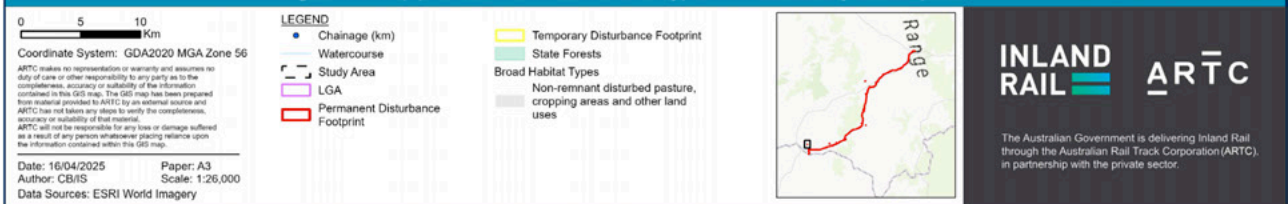


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Figure 11 - 5 (2) Location of Broad Habitat types within the Project Footprint

MAP 2 OF 30

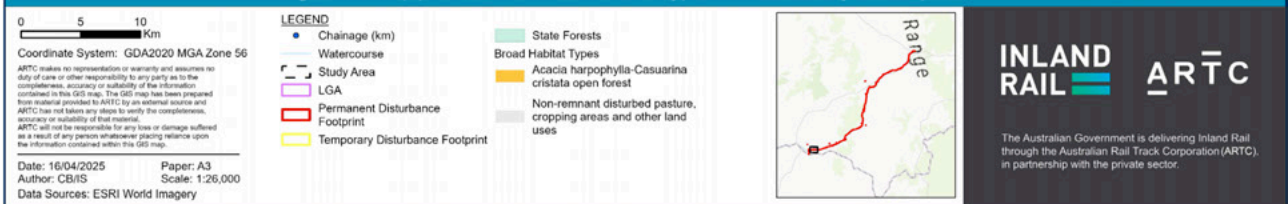


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Figure 11 - 5 (3) Location of Broad Habitat types within the Project Footprint

MAP 3 OF 30

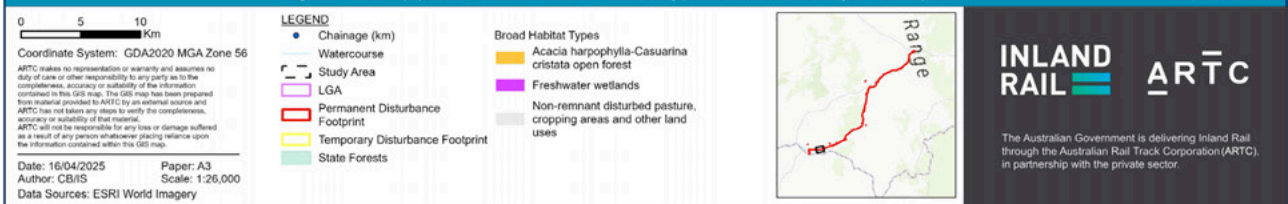


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Figure 11 - 5 (4) Location of Broad Habitat types within the Project Footprint

MAP 4 OF 30



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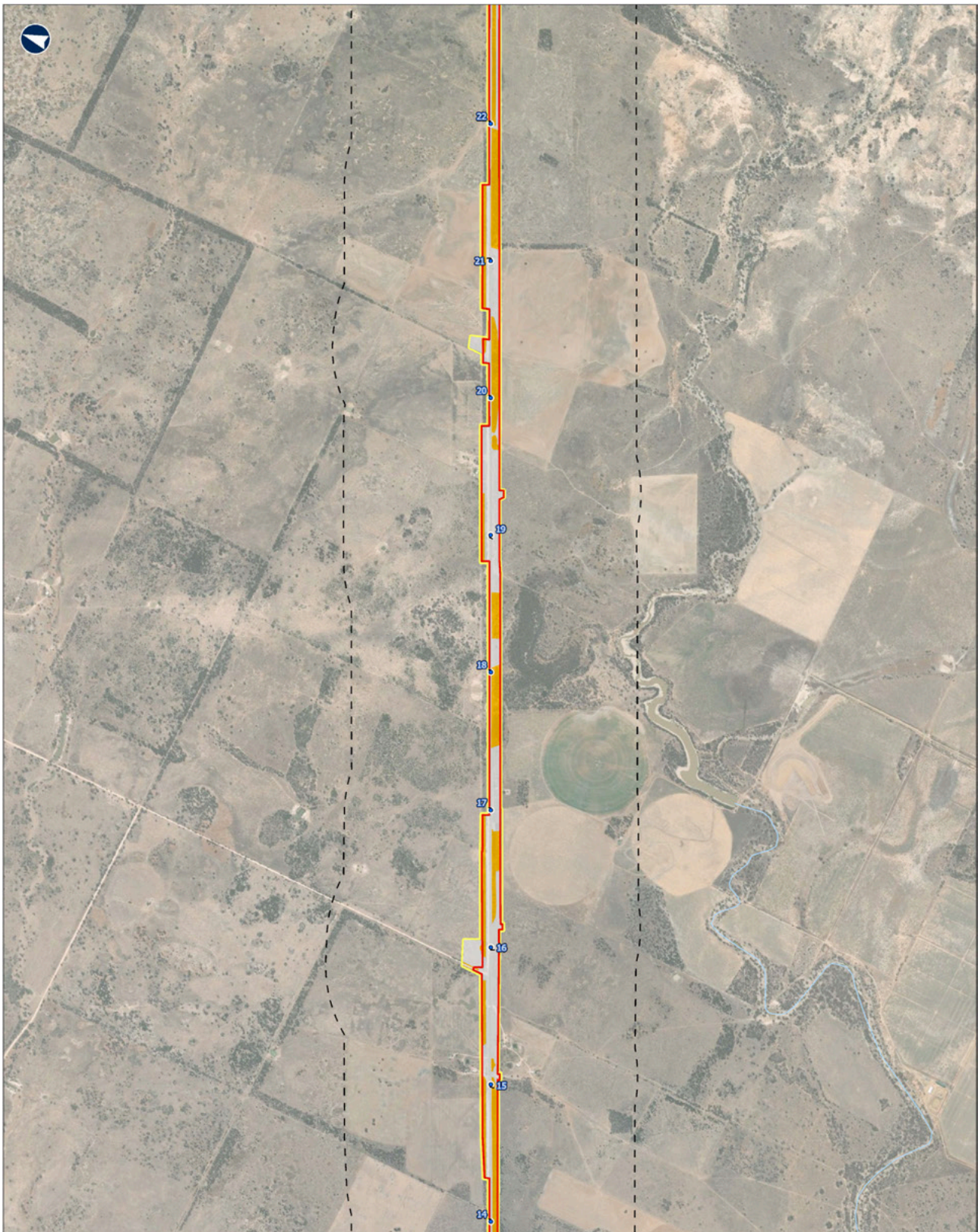
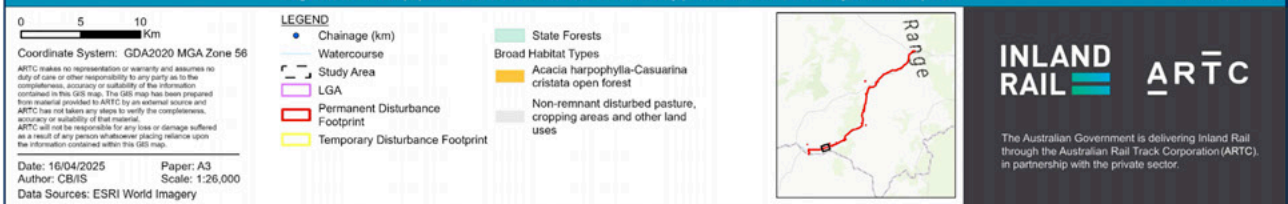


Figure 11 - 5 (5) Location of Broad Habitat types within the Project Footprint

MAP 5 OF 30



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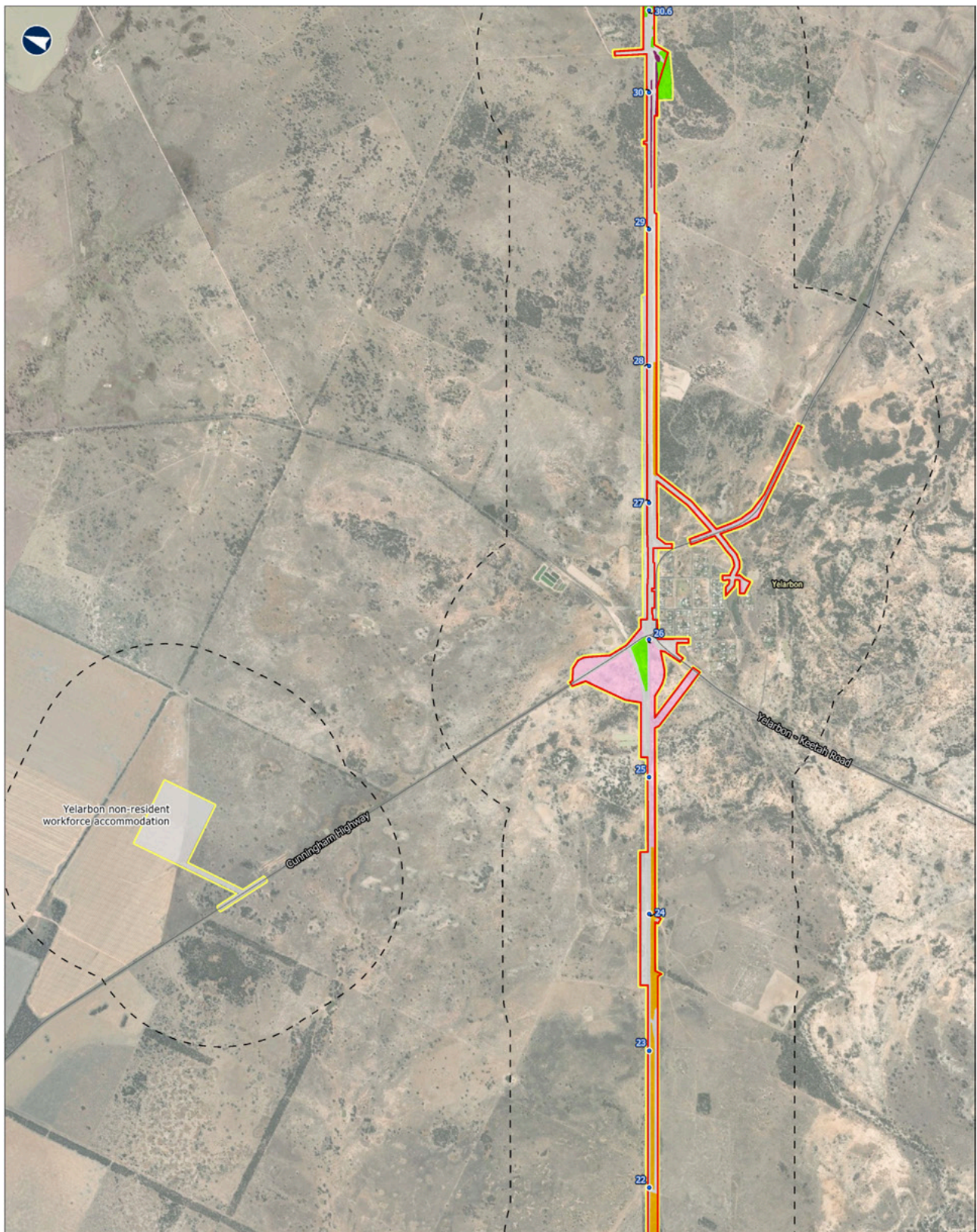
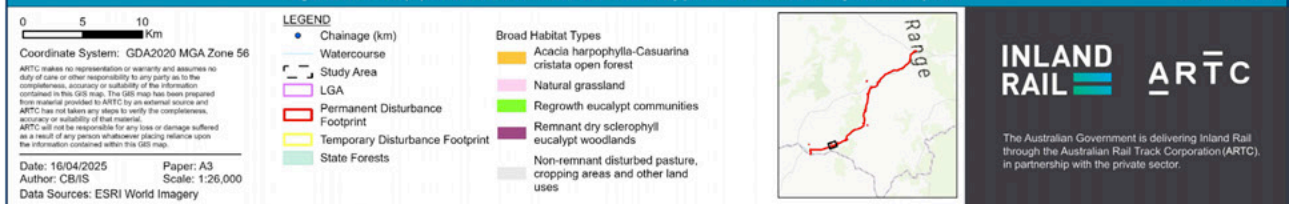


Figure 11 - 5 (6) Location of Broad Habitat types within the Project Footprint

MAP 6 OF 30



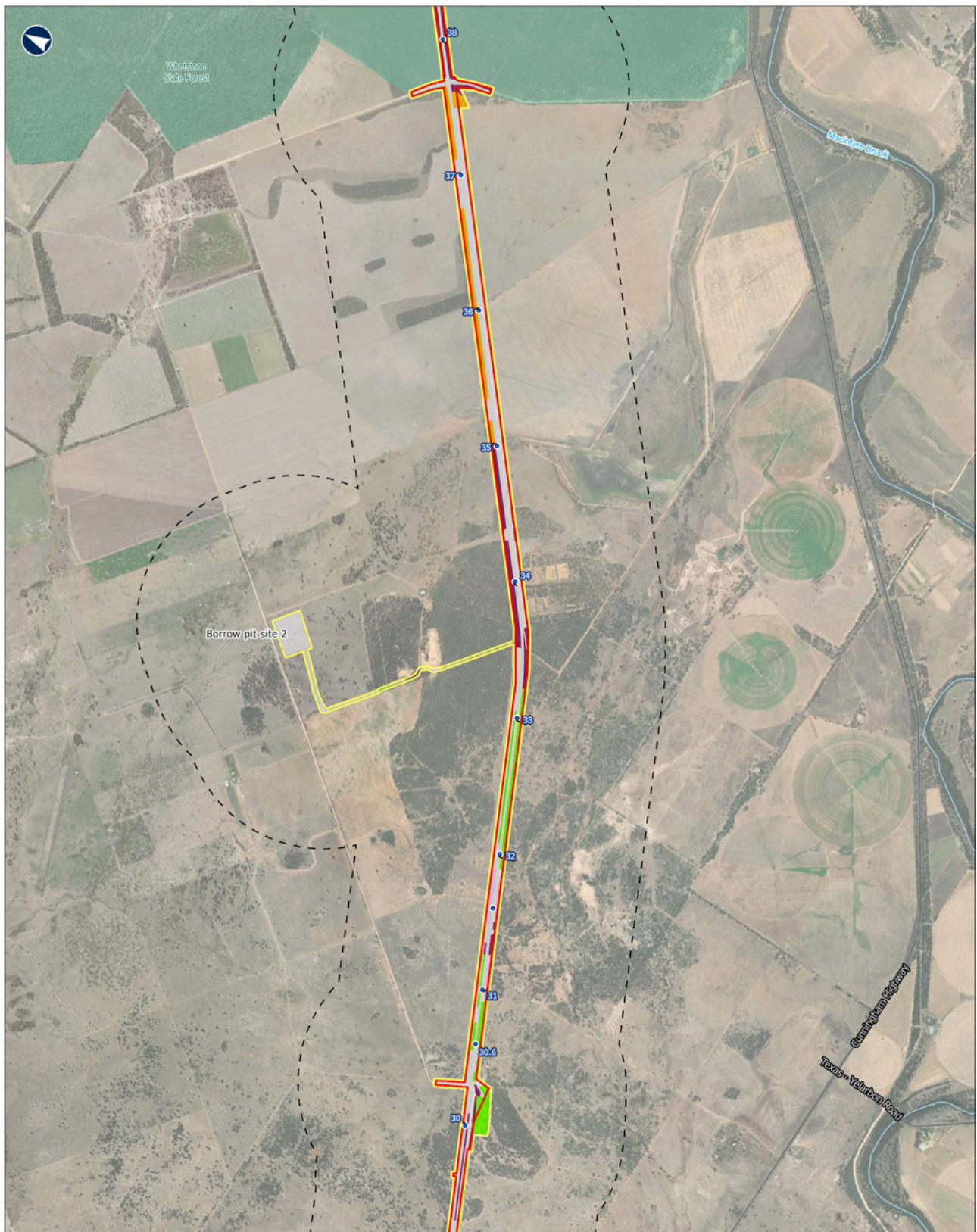
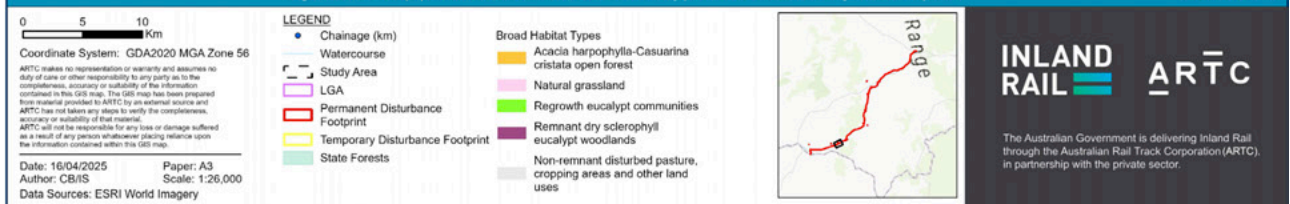


Figure 11 - 5 (7) Location of Broad Habitat types within the Project Footprint

MAP 7 OF 30



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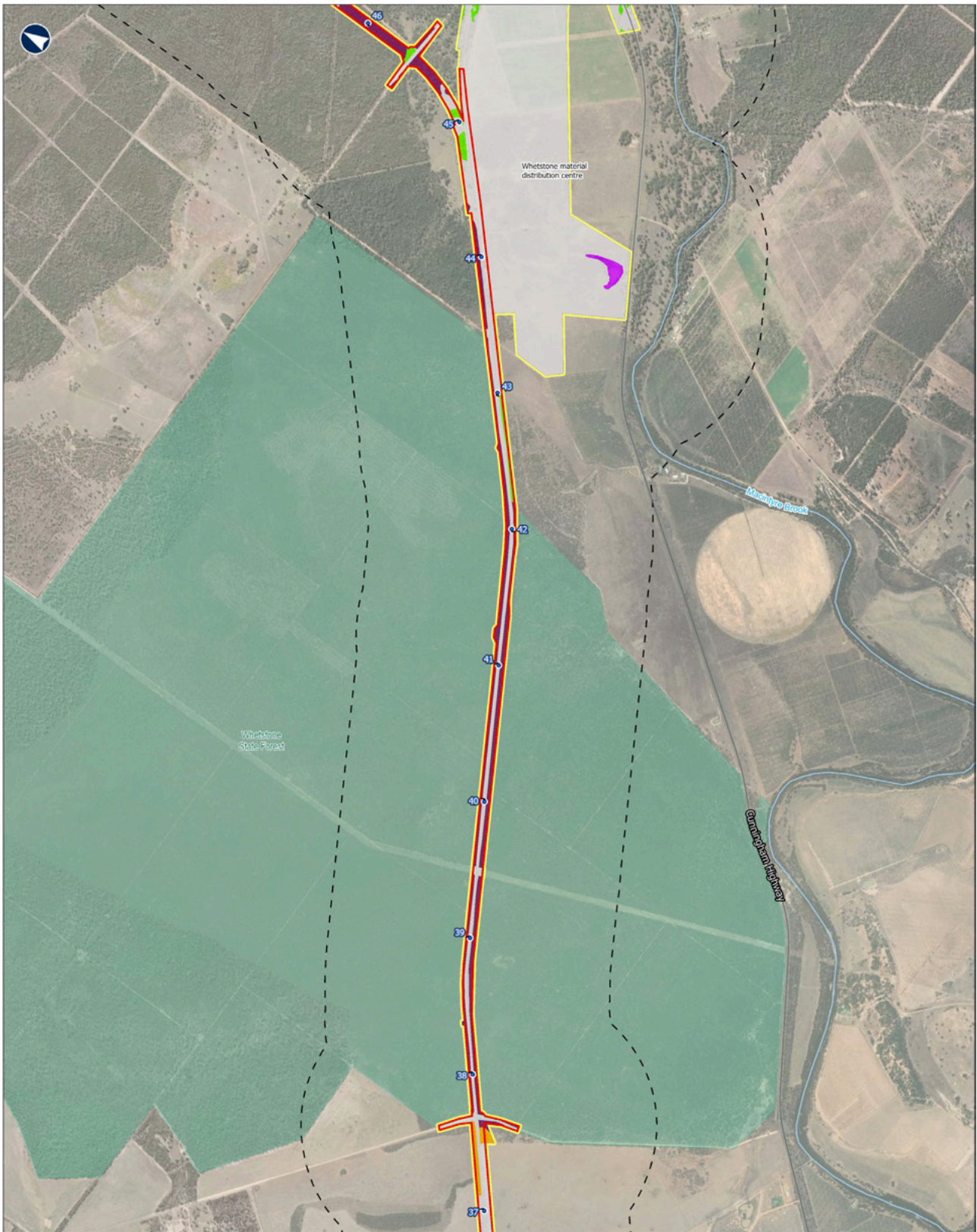
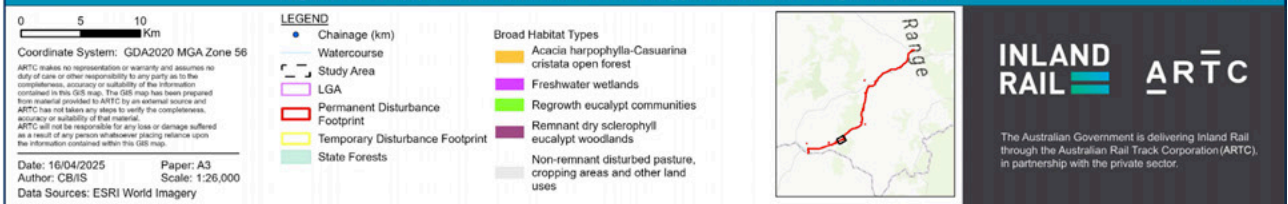


Figure 11 - 5 (8) Location of Broad Habitat types within the Project Footprint

MAP 8 OF 30



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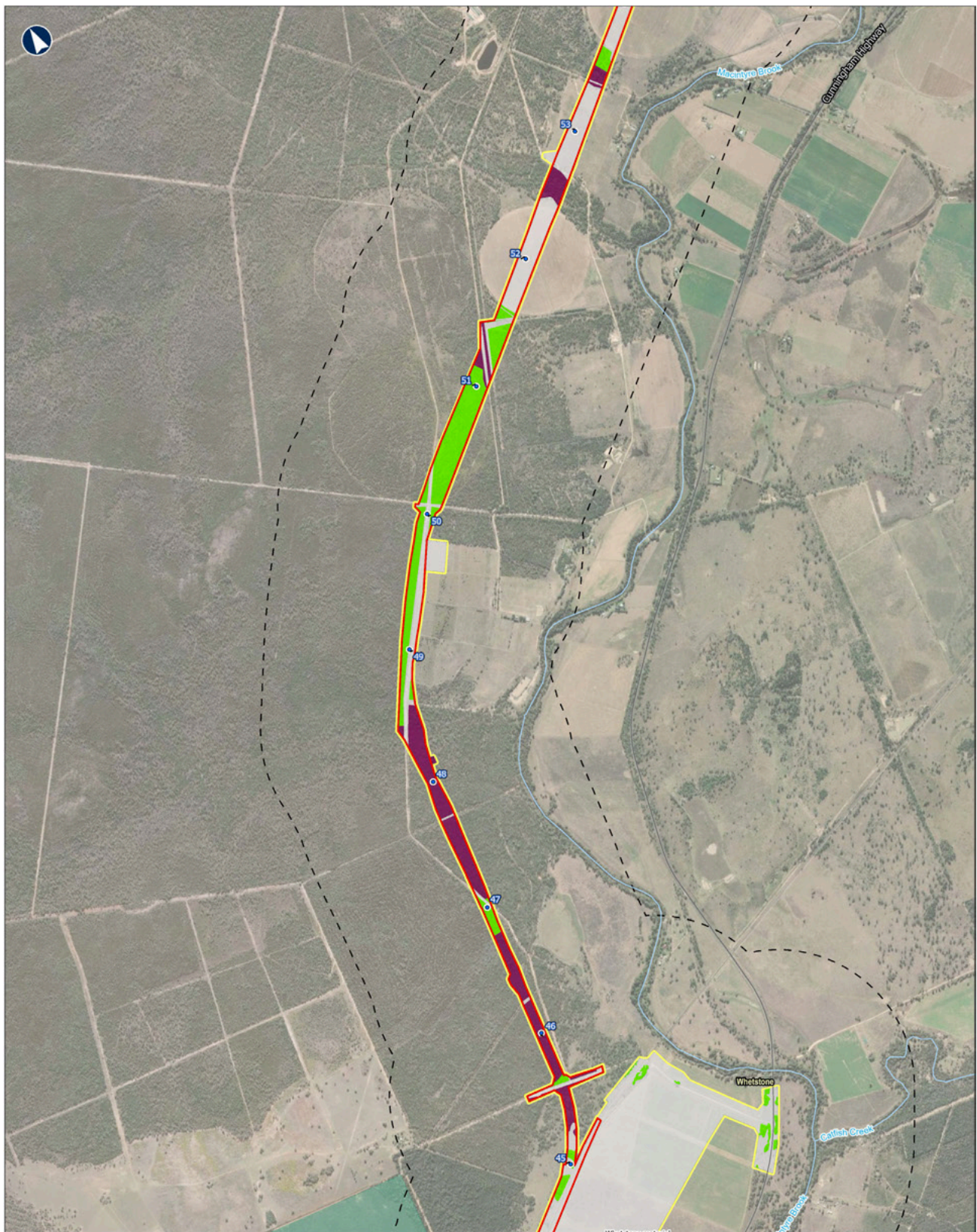


Figure 11 - 5 (9) Location of Broad Habitat types within the Project Footprint

MAP 9 OF 30

0 5 10 Km
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LEGEND
● Chainage (km)
Watercourse
Study Area
LGA
Permanent Disturbance Footprint
Temporary Disturbance Footprint
State Forests

Broad Habitat Types
Regrowth eucalypt communities
Remnant dry sclerophyll eucalypt woodlands
Non-remnant disturbed pasture, cropping areas and other land uses



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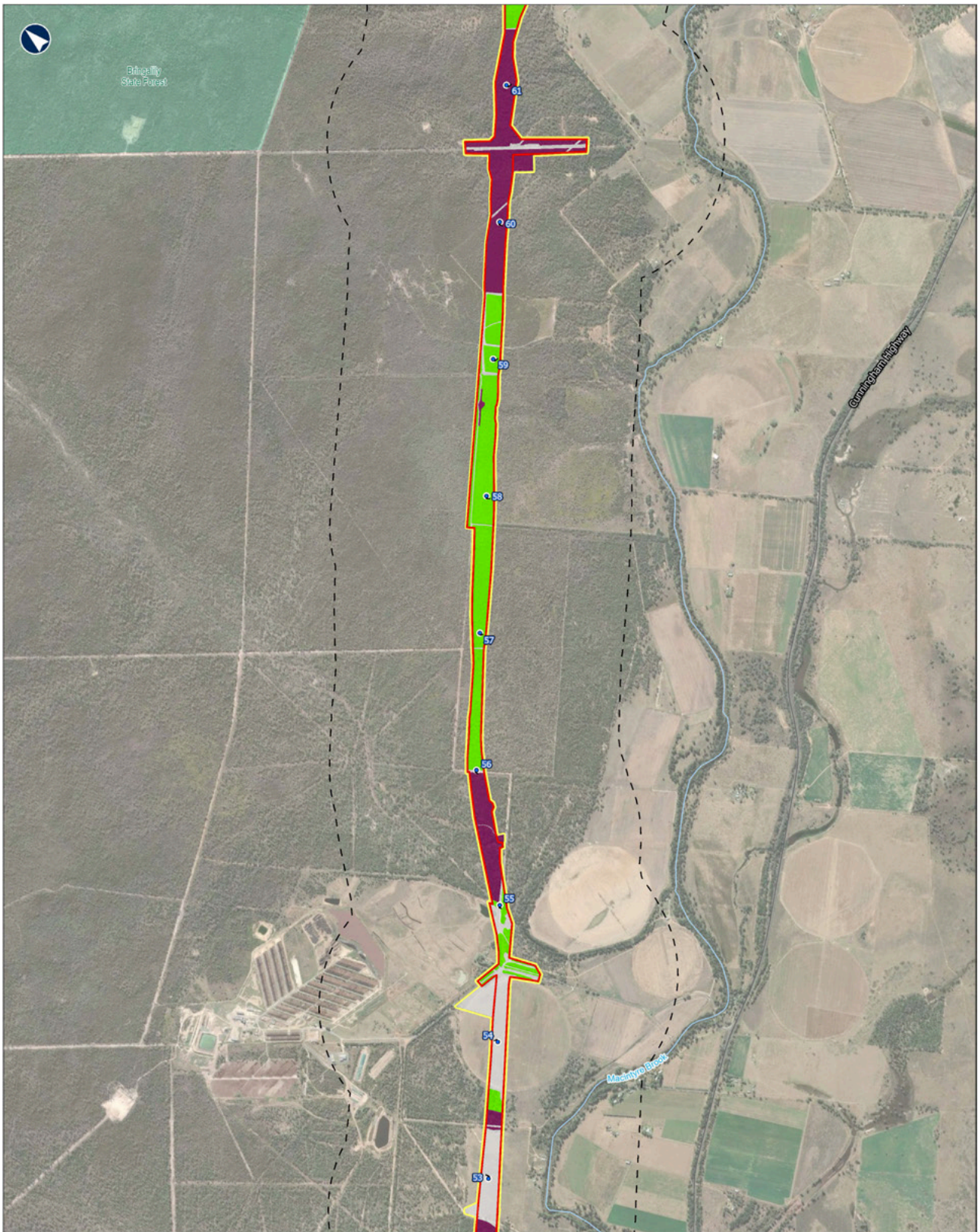
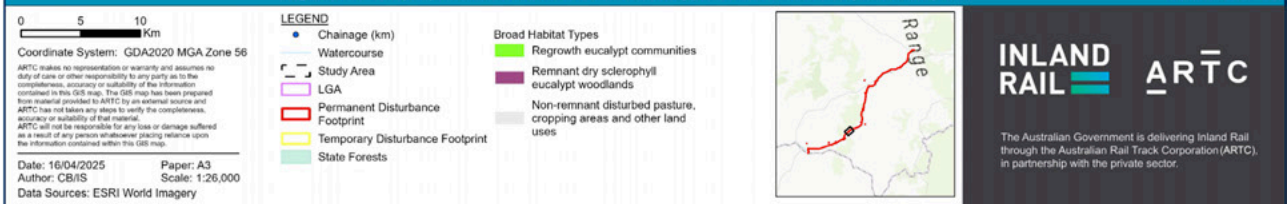


Figure 11 - 5 (10) Location of Broad Habitat types within the Project Footprint

MAP 10 OF 30



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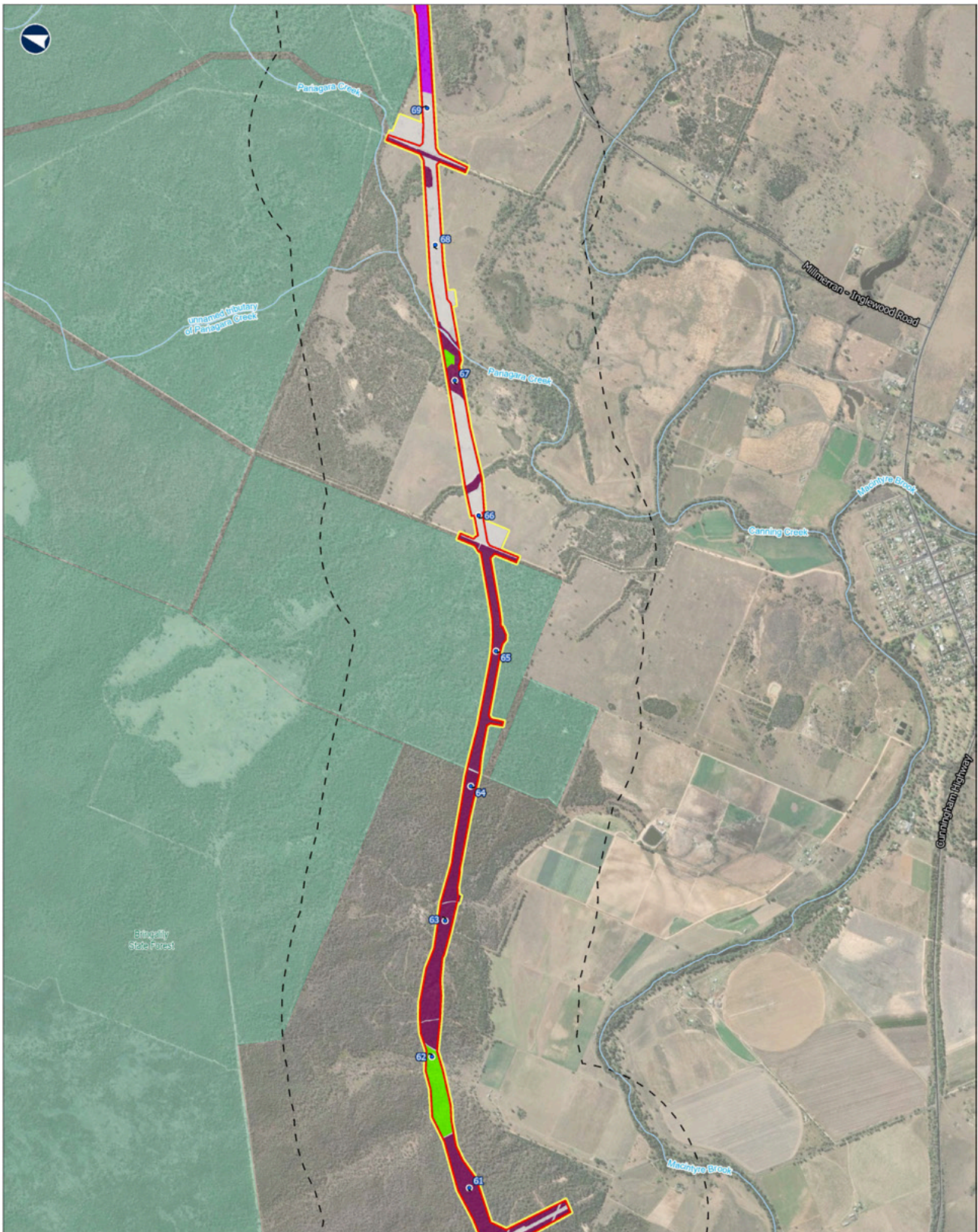


Figure 11 - 5 (11) Location of Broad Habitat types within the Project Footprint

MAP 11 OF 30



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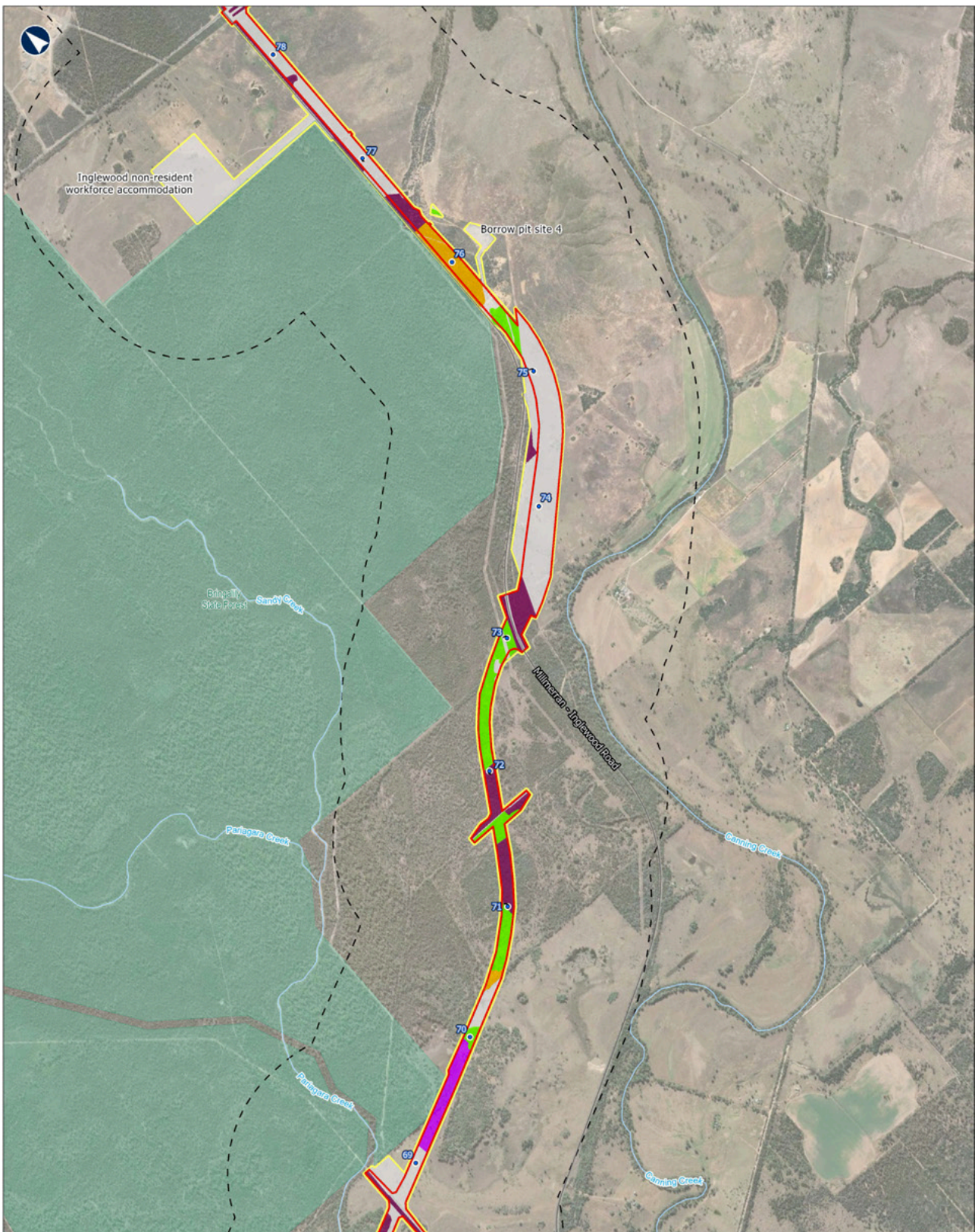
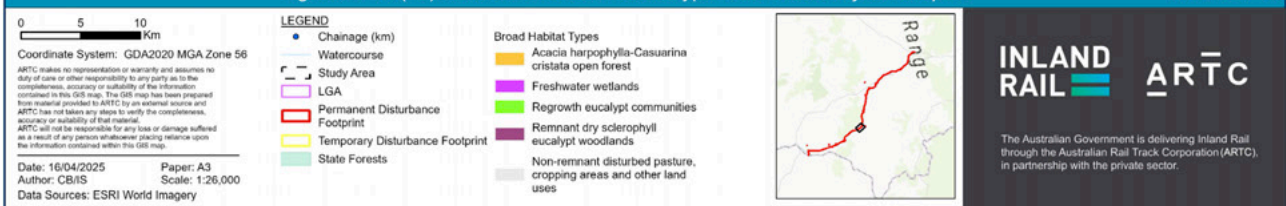


Figure 11 - 5 (12) Location of Broad Habitat types within the Project Footprint

MAP 12 OF 30



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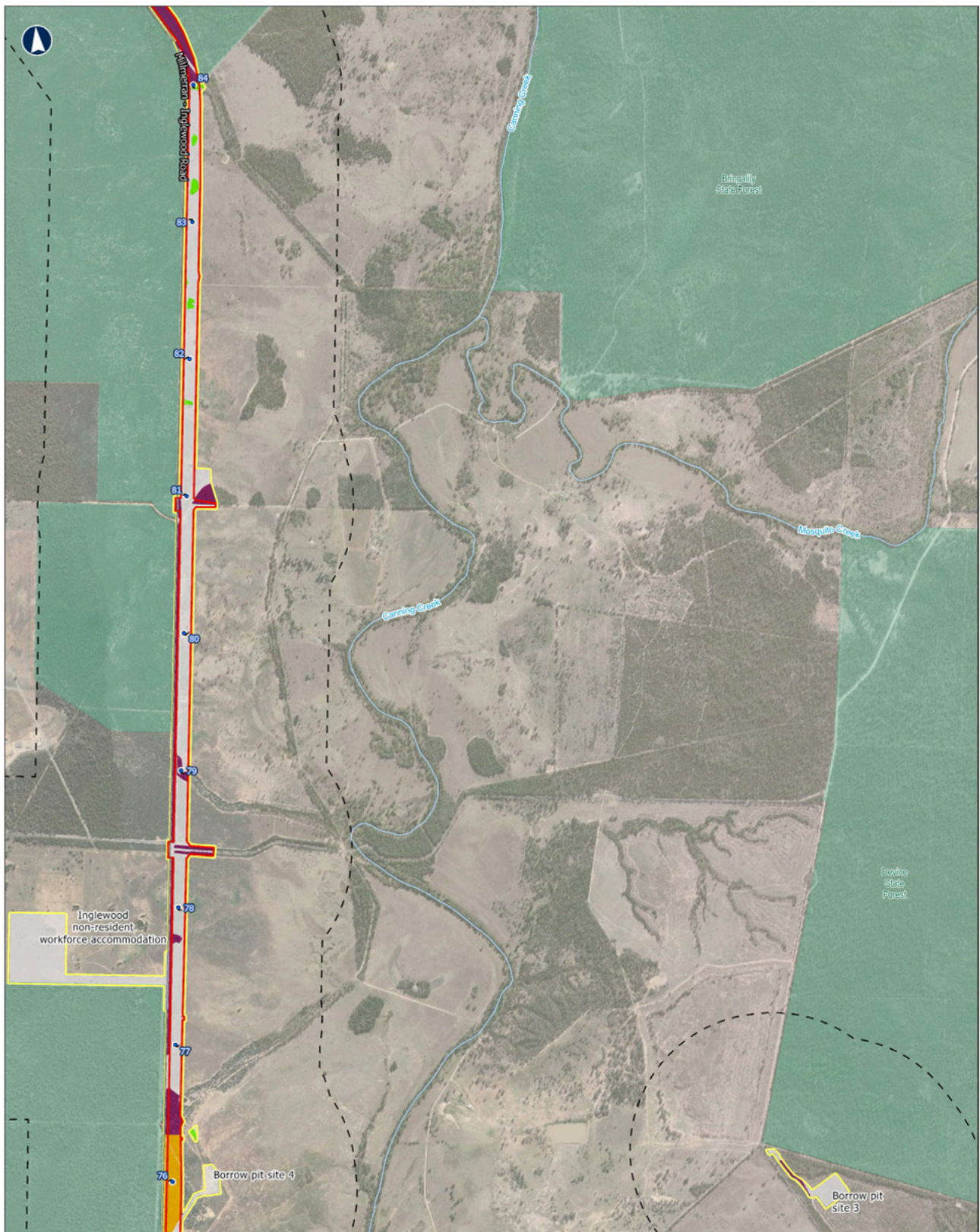
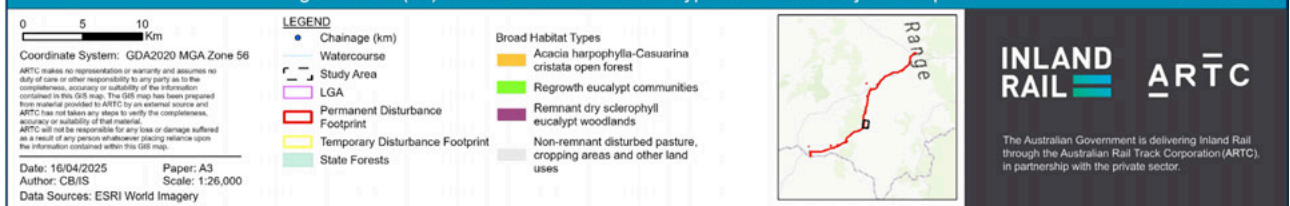


Figure 11 - 5 (13) Location of Broad Habitat types within the Project Footprint

MAP 13 OF 30



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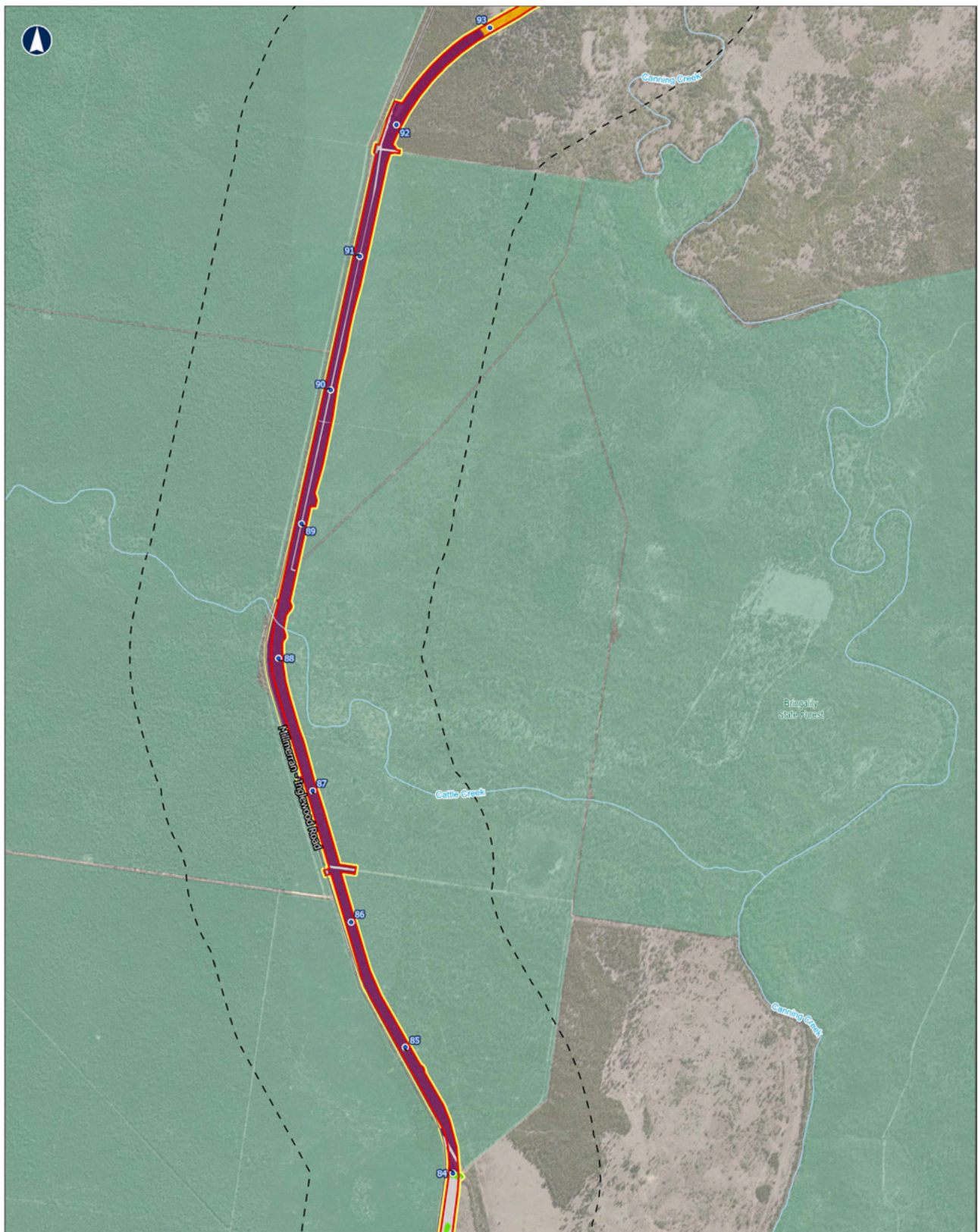
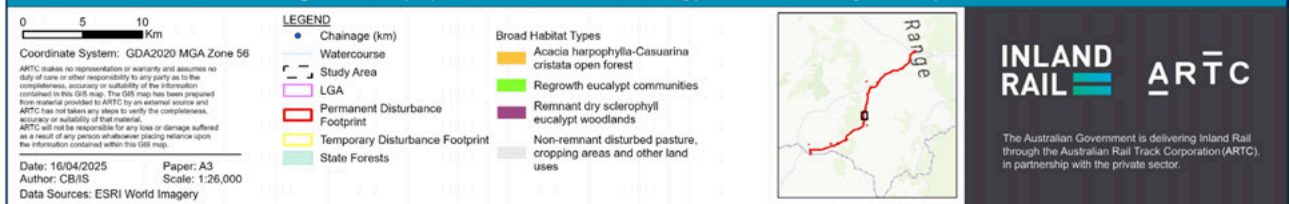


Figure 11 - 5 (14) Location of Broad Habitat types within the Project Footprint

MAP 14 OF 30



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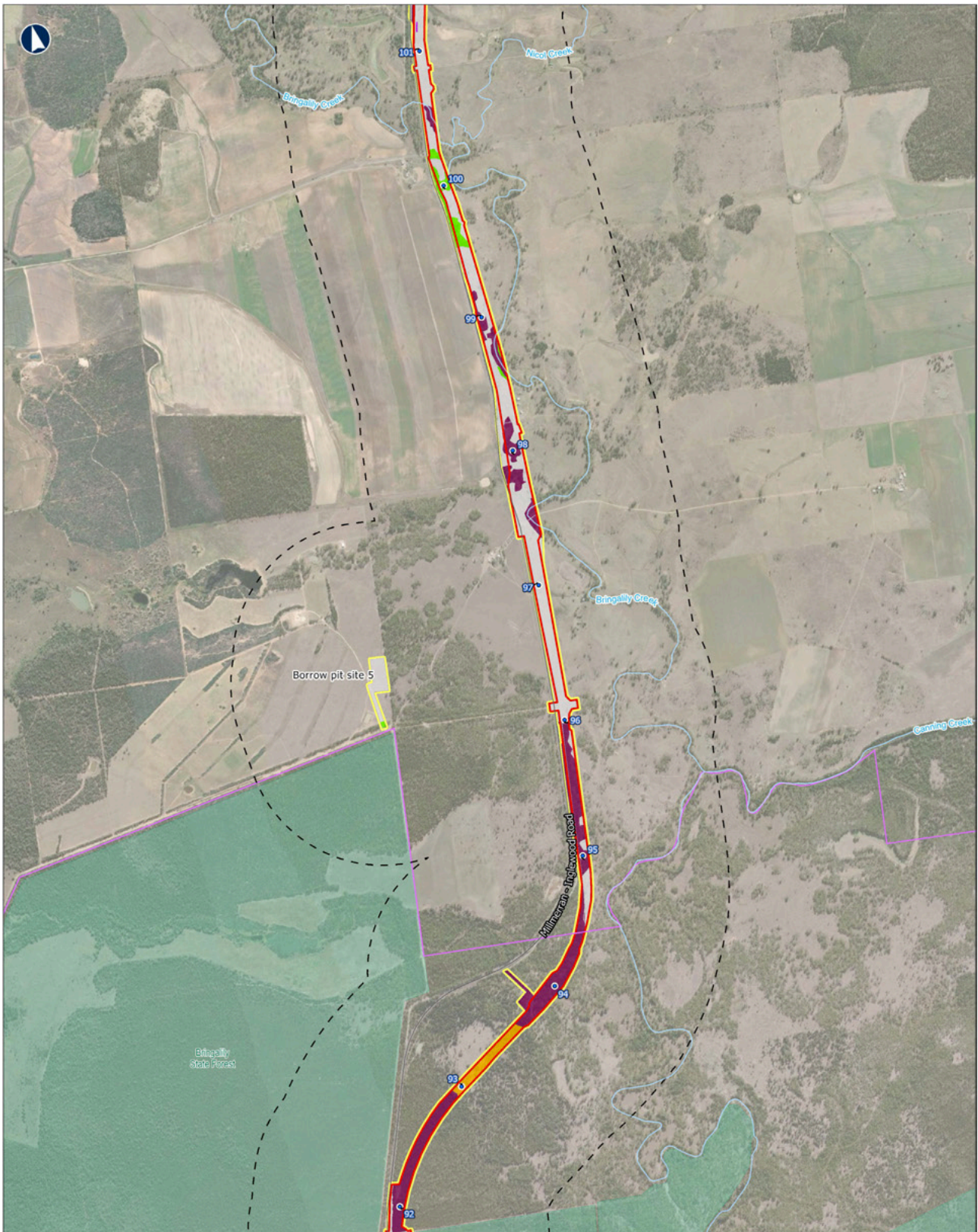
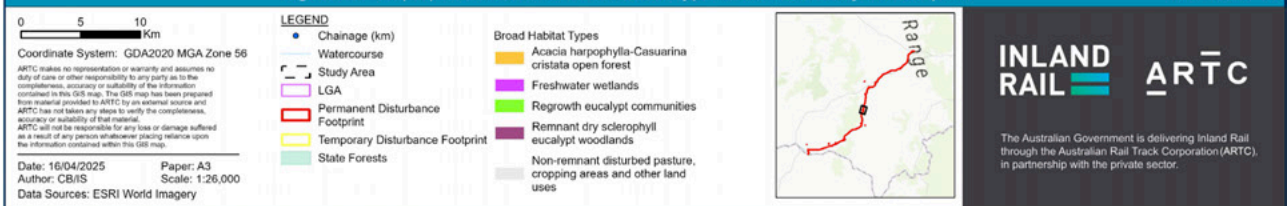


Figure 11 - 5 (15) Location of Broad Habitat types within the Project Footprint

MAP 15 OF 30

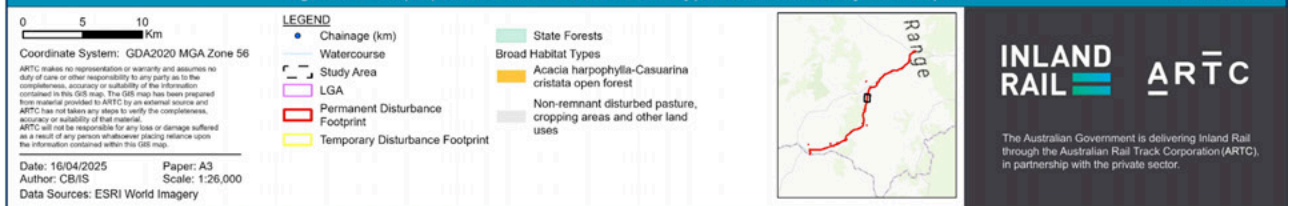


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Figure 11 - 5 (17) Location of Broad Habitat types within the Project Footprint

MAP 17 OF 30

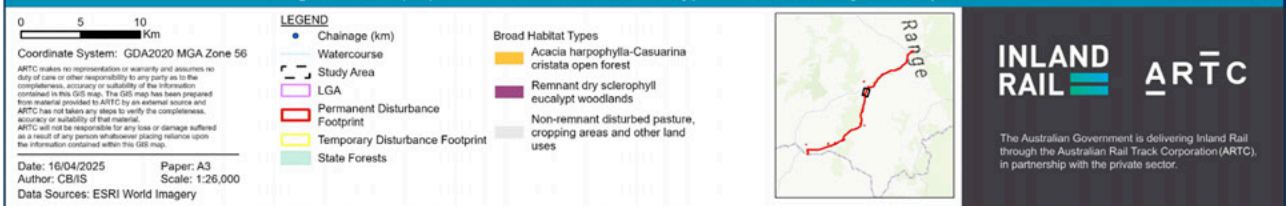


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Figure 11 - 5 (18) Location of Broad Habitat types within the Project Footprint

MAP 18 OF 30



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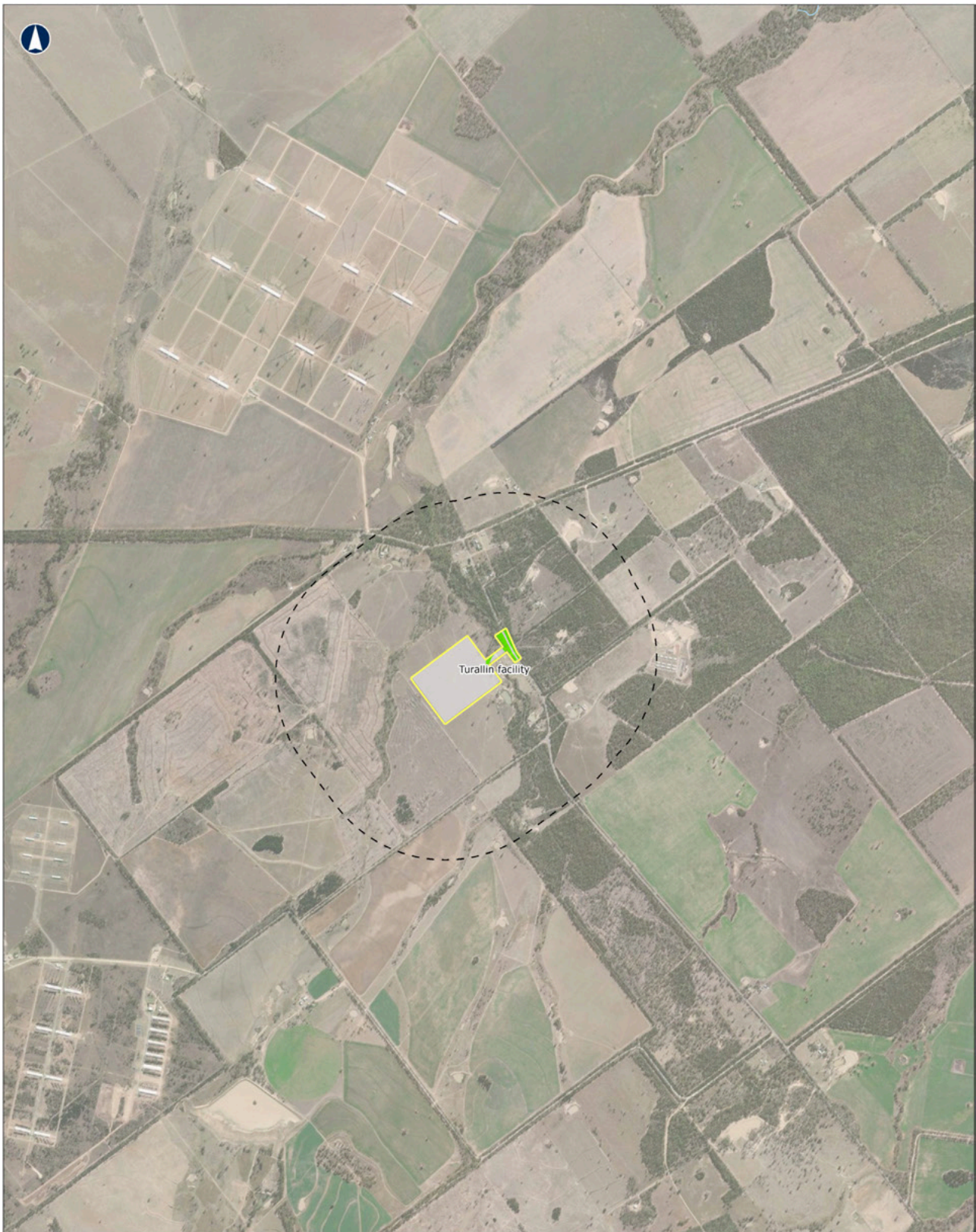


Figure 11 - 5 (19) Location of Broad Habitat types within the Project Footprint

MAP 19 OF 30



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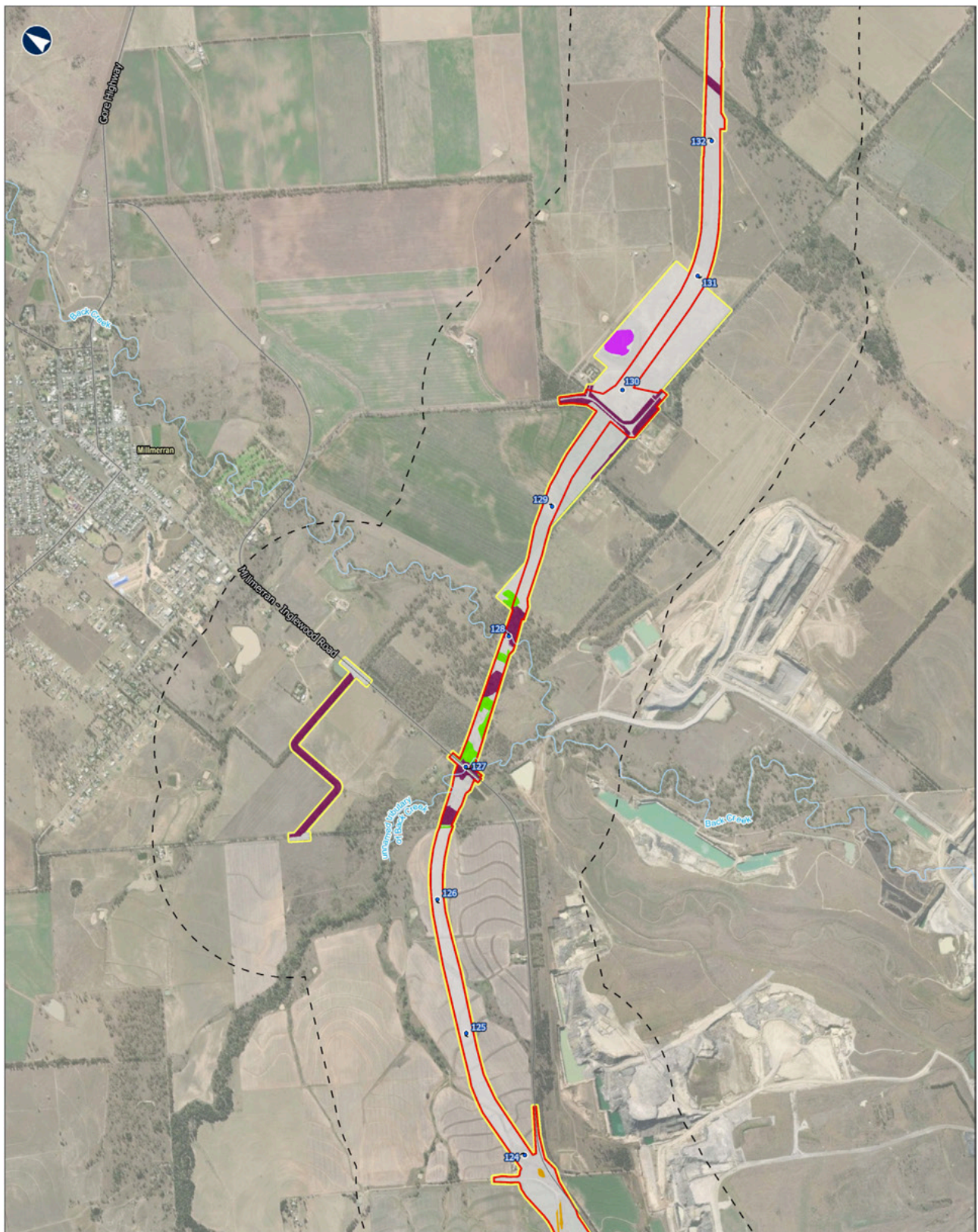
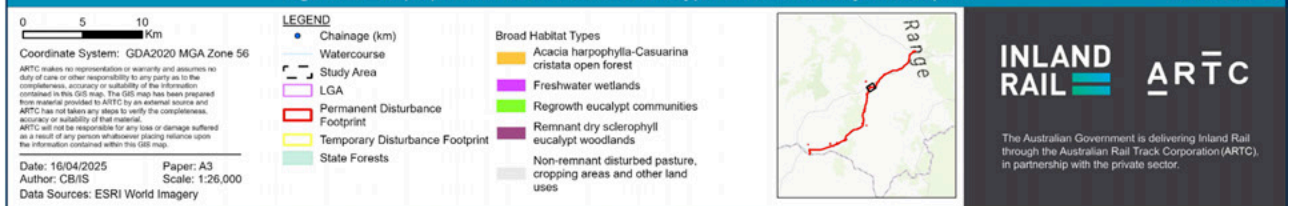


Figure 11 - 5 (20) Location of Broad Habitat types within the Project Footprint

MAP 20 OF 30



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Figure 11 - 5 (21) Location of Broad Habitat types within the Project Footprint

MAP 21 OF 30

0 5 10 Km

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LEGEND

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests

Broad Habitat Types

- Regrowth eucalypt communities
- Remnant dry sclerophyll eucalypt woodlands
- Non-remnant disturbed pasture, cropping areas and other land uses

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Figure 11 - 5 (22) Location of Broad Habitat types within the Project Footprint

MAP 22 OF 30



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Figure 11 - 5 (23) Location of Broad Habitat types within the Project Footprint

MAP 23 OF 30

0 5 10
Km

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LEGEND

- Chainage (km)
- Watercourse
- - - Study Area
- - - LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint

- State Forests
- Broad Habitat Types
- Natural grassland
- Regrowth eucalypt communities
- Non-remnant disturbed pasture, cropping areas and other land uses



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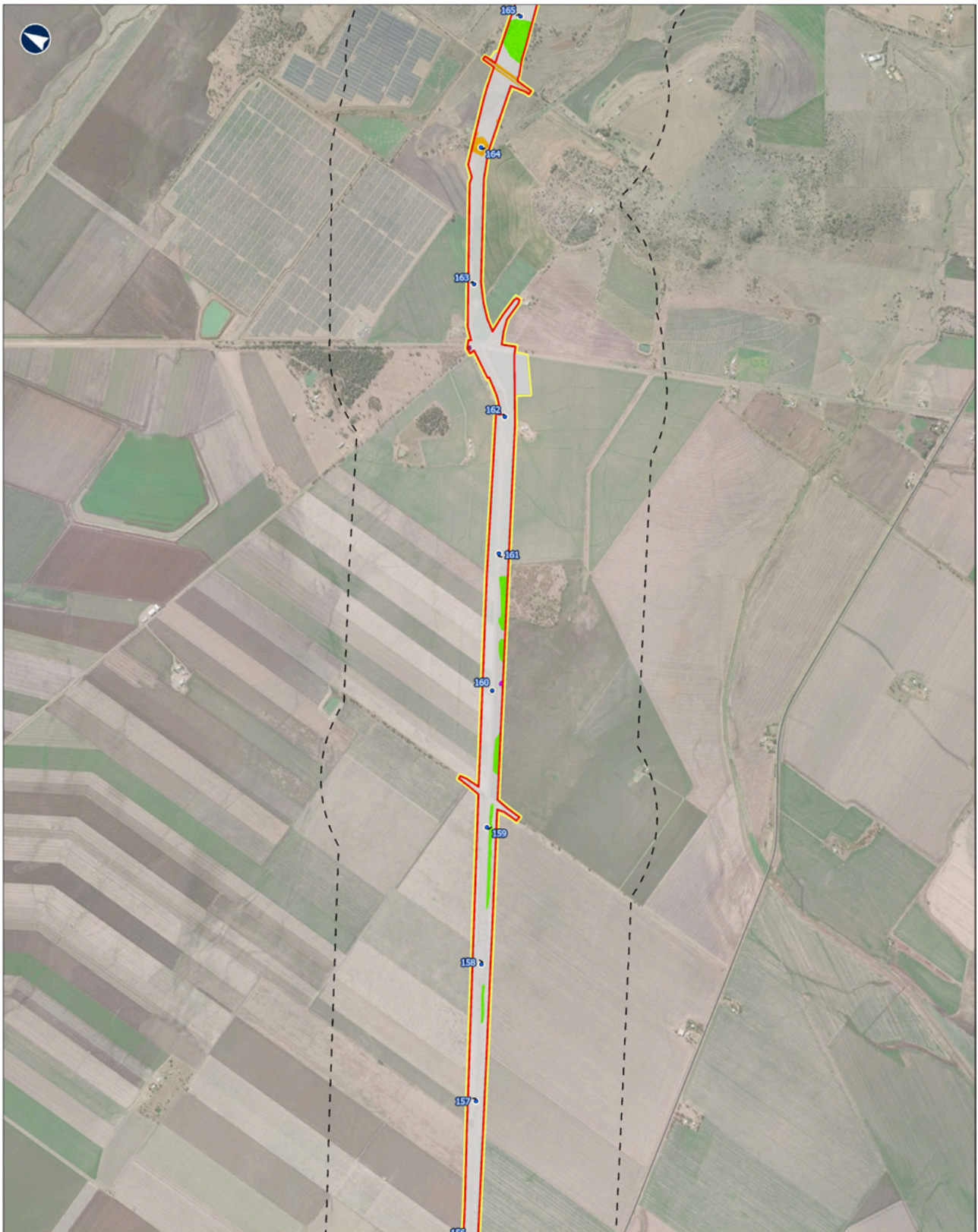
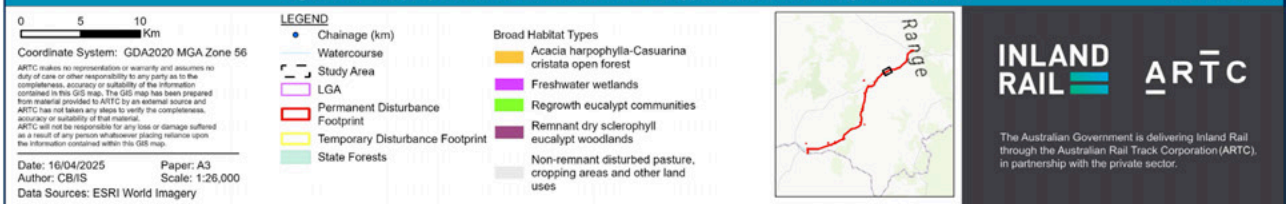


Figure 11 - 5 (24) Location of Broad Habitat types within the Project Footprint

MAP 24 OF 30



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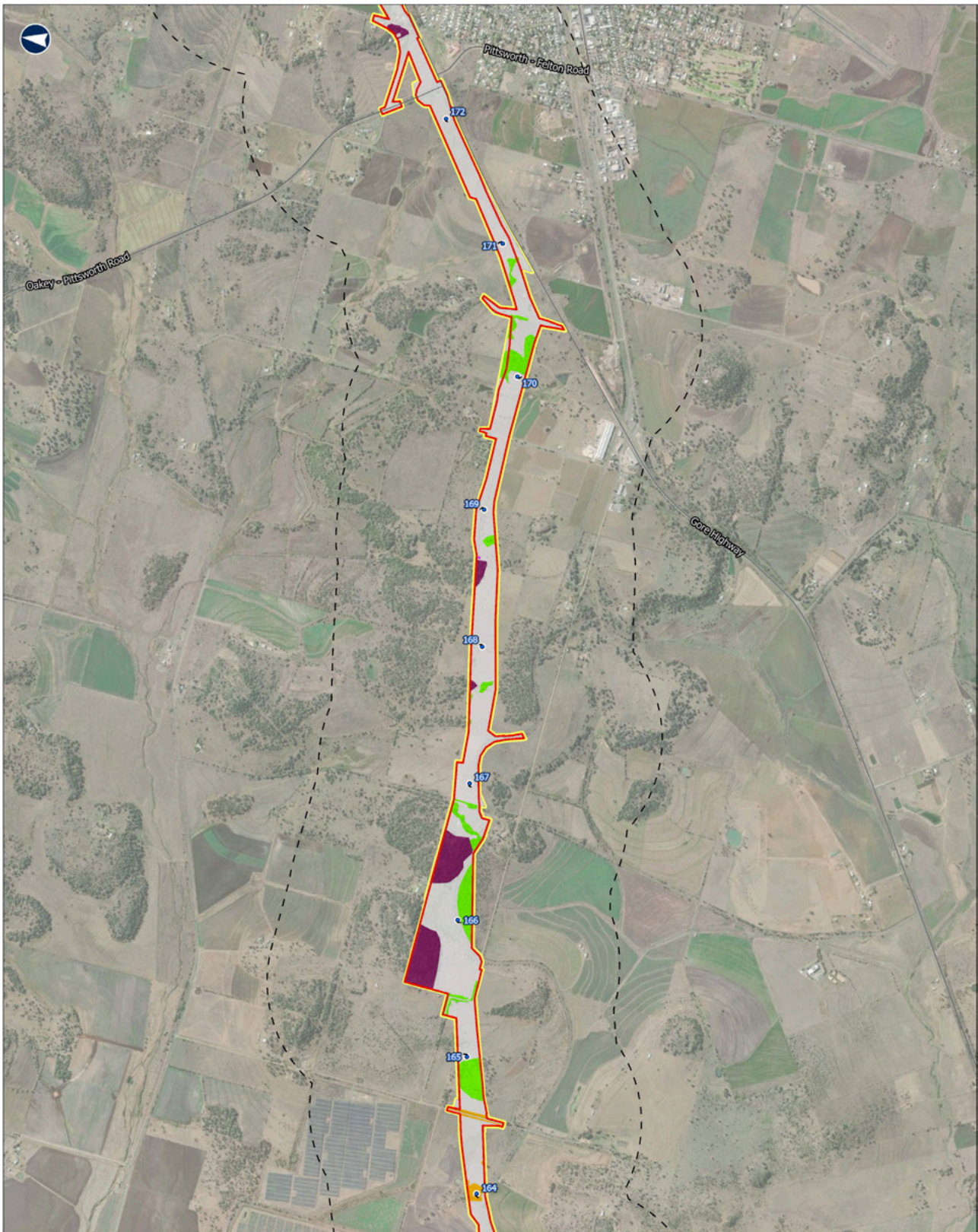
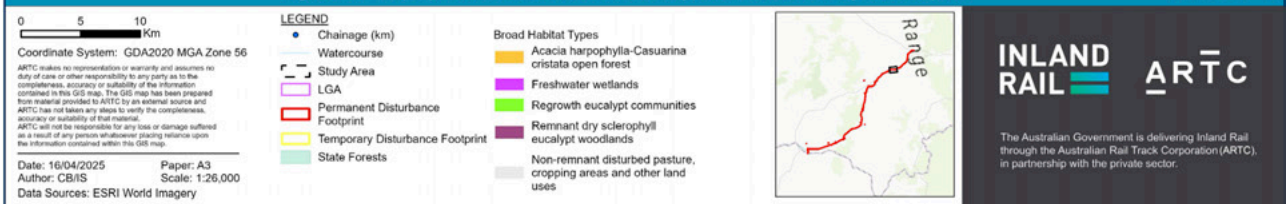


Figure 11 - 5 (25) Location of Broad Habitat types within the Project Footprint

MAP 25 OF 30



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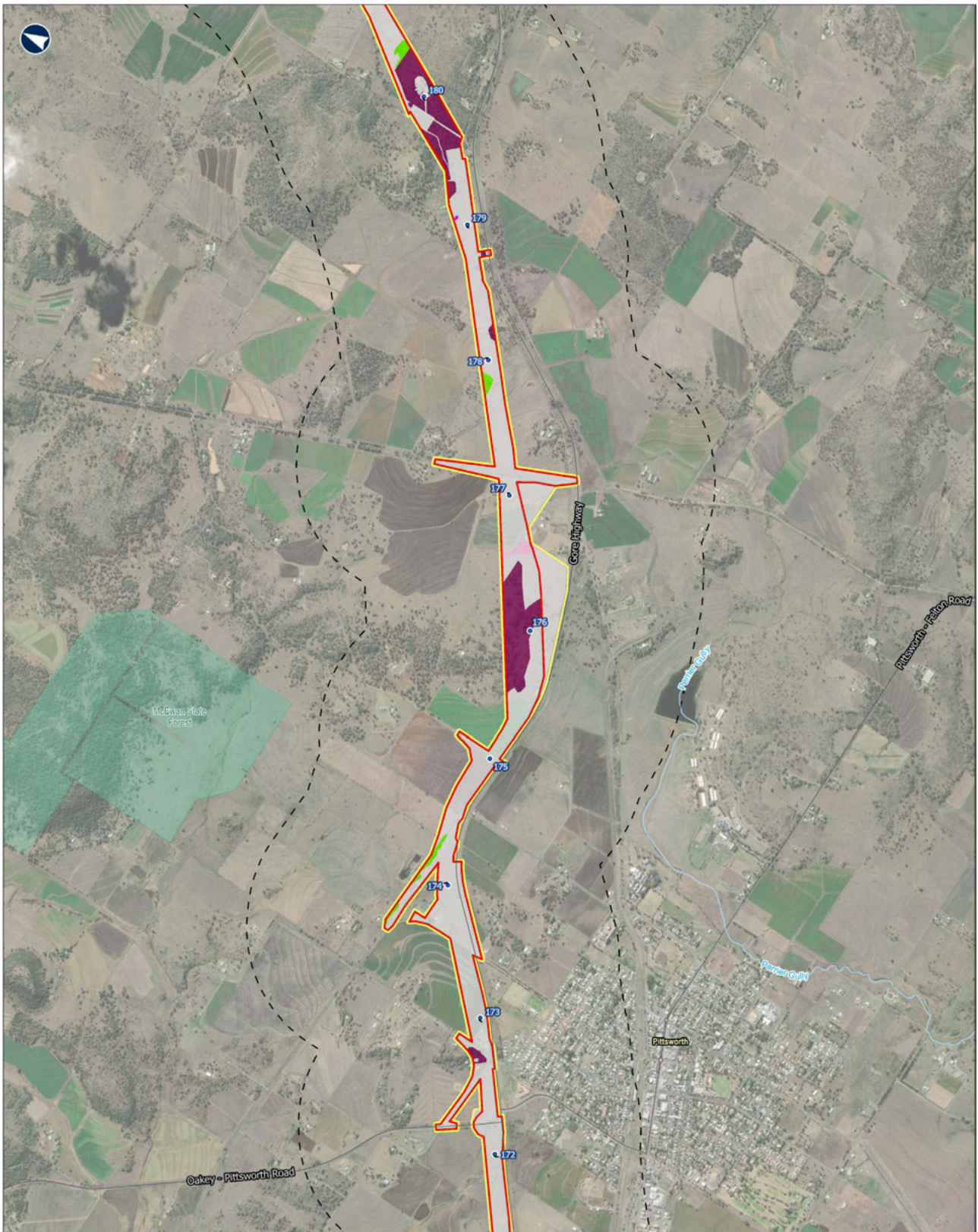
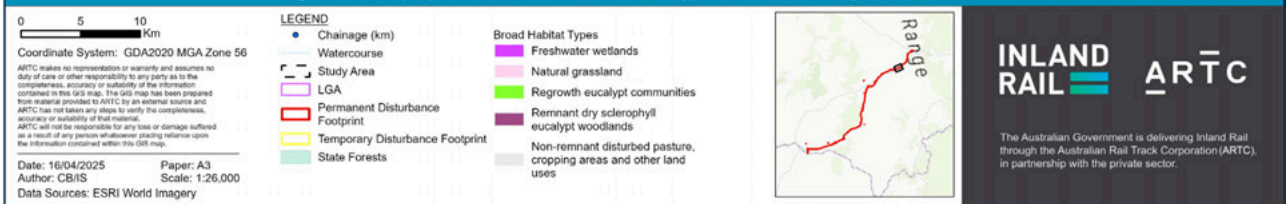


Figure 11 - 5 (26) Location of Broad Habitat types within the Project Footprint

MAP 26 OF 30



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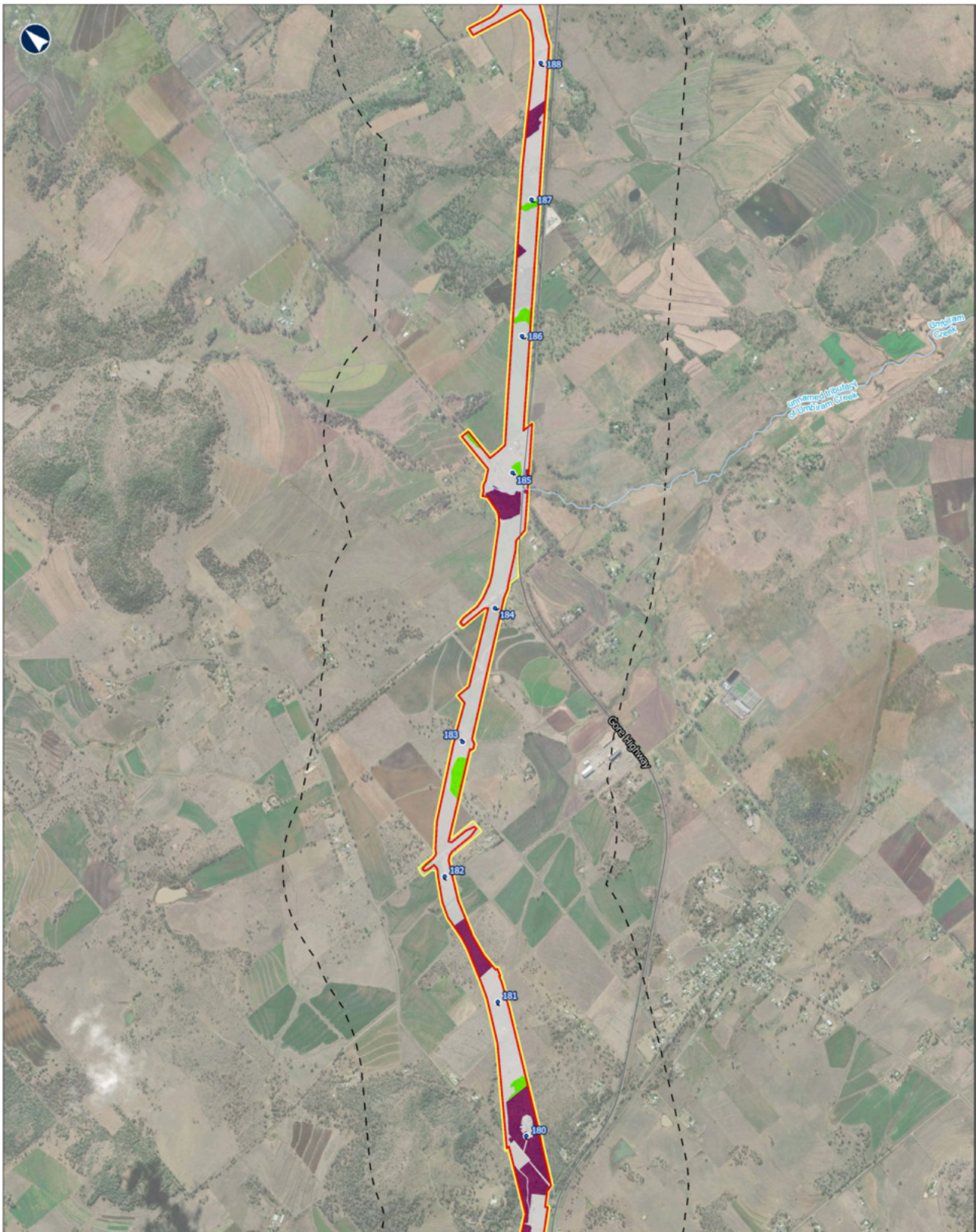
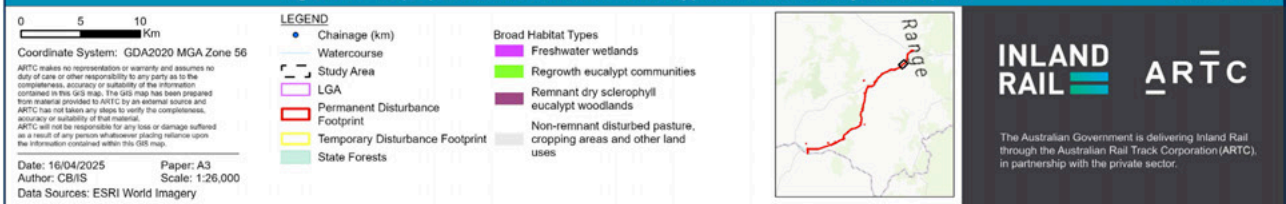


Figure 11 - 5 (27) Location of Broad Habitat types within the Project Footprint

MAP 27 OF 30



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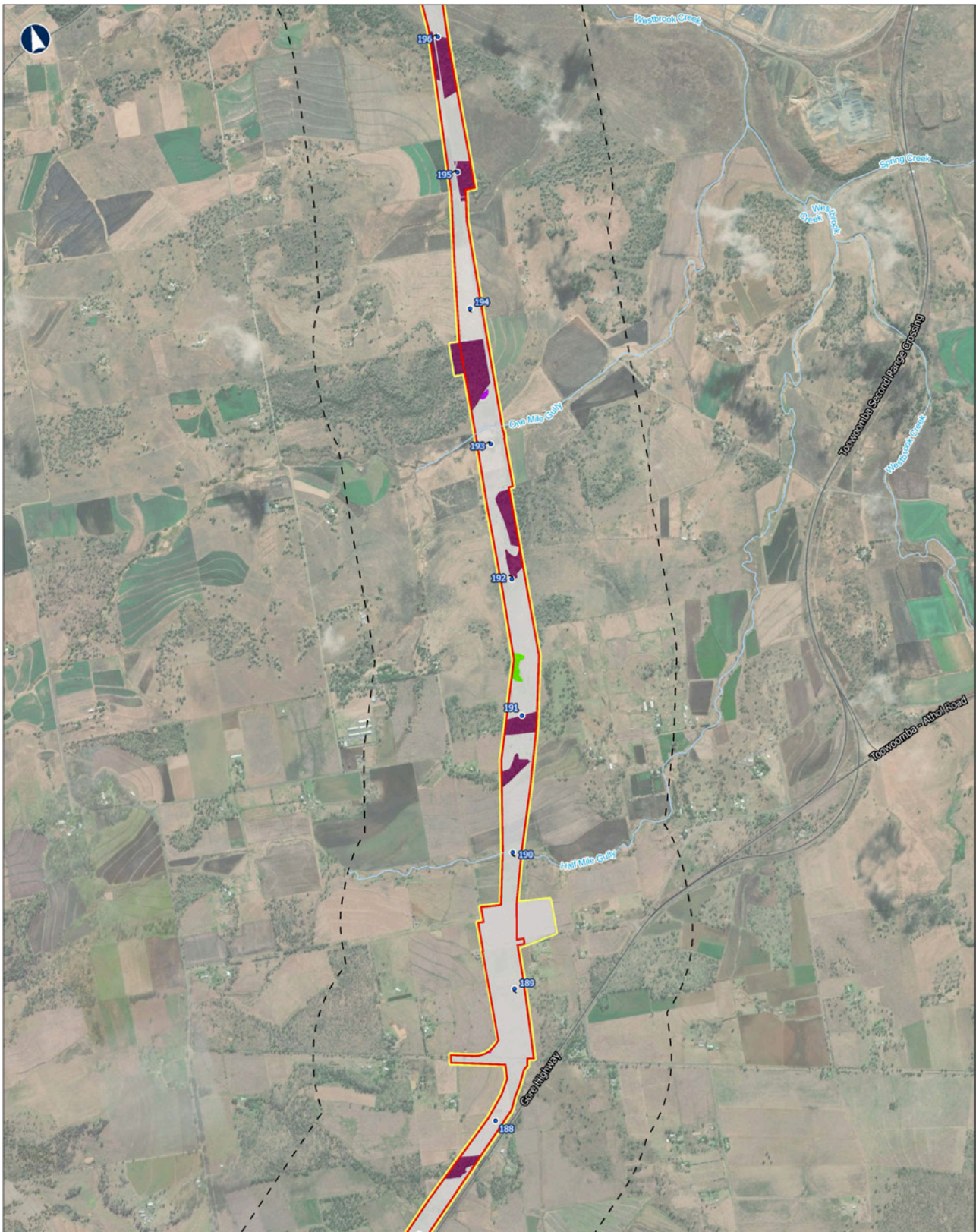
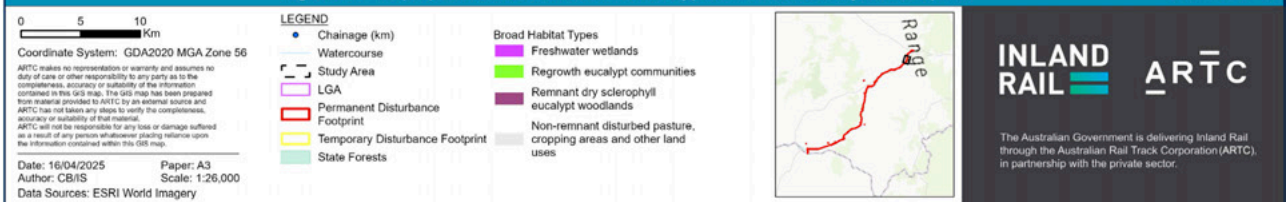


Figure 11 - 5 (28) Location of Broad Habitat types within the Project Footprint

MAP 28 OF 30



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Figure 11 - 5 (29) Location of Broad Habitat types within the Project Footprint

MAP 29 OF 30

0 5 10 Km

Coordinate System: GDA2020 MGA Zone 56

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Author: CB/IS Scale: 1:26,000
Data Sources: ESRI World Imagery

LEGEND

- Chainage (km)
- Watercourse
- ▭ Study Area
- ▭ LGA
- ▭ Permanent Disturbance Footprint
- ▭ Temporary Disturbance Footprint
- ▭ State Forests

Broad Habitat Types

- ▭ Natural grassland
- ▭ Regrowth eucalypt communities
- ▭ Remnant dry sclerophyll eucalypt woodlands
- ▭ Non-remnant disturbed pasture, cropping areas and other land uses

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Figure 11 - 5 (30) Location of Broad Habitat types within the Project Footprint

MAP 30 OF 30



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11.5.4 Threatened ecological communities

Three TECs were identified within the Project footprint during field surveys. The nature and extent of these TECs that are:

- ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant) – within the Project footprint, this TEC met the description of four REs (RE 11.3.1, RE 11.4.3, RE 11.4.10 and RE 11.9.5) where brigalow patches were >0.5 ha in size, and total vegetation cover consisting of <50% exotic perennial plants. Brigalow TEC within the Project footprint totals an area of 103.69 ha.
- ▶ Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland – within the Project footprint this TEC met the diagnostic criteria within two REs: RE 11.3.21 and RE 11.8.11, where patches aligned with the good quality and best quality criteria, totalling an area of 66.07 ha.
- ▶ White Box-Yellow Box-Blakey's Red Gum Grassy Woodland and Derived Native Grassland – within the Project footprint this TEC met the diagnostic criteria within a patch of RE 11.9.9a, totalling an area of 2.54 ha.
- ▶ Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (north and south) and Nandewar bioregions were also identified within the study area. Originally located within the Project footprint, this TEC met the diagnostic criteria within RE 11.8.3, totalling an area of 0.08 ha. It should be noted that the area of this TEC has been reduced since the Cardno surveys in 2021 and Ausecology surveys in 2022 (stated as ~0.2 ha in Cardno, 2021 and 0.16 ha in Ausecology, 2022) as subsequent assessments surveyed the patch in more detail to assess its size and location more accurately in relation to the Project footprint. The Project footprint has since been adjusted to avoid SEVT TEC; however, it has been included for consideration in the significant impact assessment (see Section 11.8.2).

The distribution and extent of TECs within the Project footprint is presented in the species and community profiles in Appendix F of Appendix O: Matters of National Environmental Significance Report. Detailed information on the location and condition of TECs within the Project footprint is provided in Appendix O: Matters of National Environmental Significance Report.

11.5.5 Flora

11.5.5.1 Species richness

A total of 418 (404 terrestrial and 14 aquatic) flora species were identified within the Project footprint during field surveys, including 283 (70 per cent) native terrestrial species and 121 non-native terrestrial species (30 per cent).

Non-native species were typically more abundant and diverse in areas of high anthropogenic disturbance when compared to remnant areas; however, encroachment of non-native species, particularly those spread by birds (e.g. *Lantana camara* and *Lantana montevidensis*) was evident in relatively undisturbed areas.

The majority of aquatic flora species were common emergent species such as aquatic (or semi-aquatic) grasses, sedges, and rushes. The lack of both diversity and abundance of aquatic plants at some sites is likely to be indicative of dry physical conditions. More diverse aquatic communities may occur through recruitment during sustained flows or water pooling over the wetter months of the year.

A comprehensive list of flora species recorded within the study area is available in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

11.5.5.2 Threatened flora

Ten Threatened flora species listed under the provisions of the NC Act and/or EPBC Act are known to occur within the Project footprint based on the results of desktop assessment and field surveys (see Table 11-11). A further 13 species were considered to have the potential to occur; however, habitat was only mapped for MNES potential flora species. The location of records and habitat for these species within the Project footprint is provided in the species and community profiles in Appendix F of Appendix O: Matters of National Environmental Significance Report for MNES and the species profiles in Appendix G of Appendix L: Terrestrial and Aquatic Ecology Technical Report for MSES. Additional information is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

TABLE 11-11 THREATENED FLORA SPECIES KNOWN, LIKELY OR WITH THE POTENTIAL TO OCCUR WITHIN THE PROJECT FOOTPRINT, INCLUDING POTENTIALLY OCCURRING MNES

Species name	Common name	NC Act status	EPBC Act status	Likelihood of occurrence	Total habitat within Project footprint (ha)	Essential habitat (ha) ¹
<i>Acacia argyrotricha</i>	Bracker wattle	V	-	Potential	-	-
<i>Acacia lauta</i>	Tara wattle	V	V	Potential	410.00	-
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Potential	13.13	-
<i>Camptacra perdita</i>	-	E	-	Potential	-	-
<i>Clematis fawcettii</i>	Stream clematis	V	V	Potential	2.27	-
<i>Coleus insularis</i>	Millmerran mint bush	CE	-	Potential	-	-
<i>Combonotus maidenii</i>	-	E	-	Potential	-	-
<i>Cyperus clarus</i>	-	V	-	Known	166.07	0.20
<i>Dichanthium queenslandicum</i>	King bluegrass	V	V	Known	50.31	33.09
<i>Dichanthium setosum</i>	Bluegrass	-	V	Potential	260.52	-
<i>Homopholis belsonii</i>	Belson's panic	E	V	Known	242.25	0.21
<i>Lepidium monoplacoides</i>	Winged peppergrass	-	E	Known	79.86	-
<i>Picris barbarorum</i>	-	V	-	Known	174.98	-
<i>Picris evae</i>	Hawkweed	V	V	Known	110.67	15.89
<i>Pomaderris coomingalensis</i>	-	E	-	Potential	-	-
<i>Rhaponticum australe</i>	Austral cornflower	V	V	Known	83.49	-
<i>Solanum papverifolium</i>	-	E	-	Potential	-	-
<i>Solanum stenopterum</i>	-	V	-	Potential	-	-
<i>Thesium australe</i>	Austral toadflax	V	V	Known	46.44	-
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	Known	27.19	1.69
<i>Xerothamnella herbacea</i>	-	E	E	Known	11.99	8.45

Table notes:

- = Species not listed E = Endangered V = Vulnerable

¹ Essential habitat is included in, not in addition to, total habitat areas.

11.5.5.3 Special Least Concern flora

Six flora species listed as SLC under the NC Act were observed as relatively common within the Project footprint and study area (see Table 11-12).

TABLE 11-12 SPECIAL LEAST CONCERN FLORA SPECIES RECORDED WITHIN THE STUDY AREA

Species name	Common name	NC Act status
<i>Crinum arenarium</i>	Crinum lily	SLC
<i>Wahlenbergia communis</i>	Tufted bluebell	SLC
<i>Wahlenbergia gracilis</i>	Sprawling bluebell	SLC
<i>Wahlenbergia stricta</i>	Bluebell	SLC
<i>Caladenia carnea</i>	Pink fingers	SLC
<i>Cymbidium canaliculatum</i>	Black orchid	SLC

11.5.5.4 Weeds (restricted matters and Weeds of National Significance)

A total of 121 introduced flora species were identified during the Project field investigations. Weeds were prevalent across the study area; however, highest densities were recorded in areas subject to anthropogenic disturbance such as roadsides, areas subject to cattle grazing, and along fence lines.

Eight Category 3 restricted matter flora species (under the Biosecurity Act) were identified within the Project footprint (see Table 11-13). Of these species, six species are also listed as Weeds of National Significance (WoNS).

TABLE 11-13 RESTRICTED MATTERS (NOXIOUS WEEDS) IDENTIFIED WITHIN THE STUDY AREA

Species name	Common name	WoNS	Biosecurity Act	Relative abundance within study area
<i>Bryophyllum delagoense</i>	Mother-of-millions	Yes	Category 3	Widespread and common. Highest densities south of Inglewood.
<i>Eichhornia crassipes</i>	Water hyacinth	Yes	Category 3	Occurs in aquatic areas.
<i>Harrisia martinii</i>	Harrisia cactus	No	Category 3	Widespread and common. Highest densities south of Inglewood.
<i>Lantana camara</i>	Lantana	Yes	Category 3	Widespread and common.
<i>Lantana montevidensis</i>	Creeping lantana	No	Category 3	Widespread and common.
<i>Opuntia aurantiaca</i>	Tiger pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood.
<i>Opuntia stricta</i>	Prickly pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood.
<i>Opuntia tomentosa</i>	Velvety tree pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood.

11.5.6 Fauna

11.5.6.1 Species richness

Field surveys identified a total of 281 terrestrial fauna species, including 264 (93.95 per cent) native species and 17 (6.05 per cent) non-native species, nine of which are restricted matters. Recorded species consisted of 164 (58.36 per cent) birds, 48 (17.08 per cent) mammals, 43 (15.30 per cent) reptiles, 23 (8.19 per cent) amphibians, two (0.71 per cent) gastropods and one (0.36 per cent) crustacean (see Appendix L: Terrestrial and Aquatic Ecology Technical Report). Birds were the dominant fauna group observed, which could be an artefact of their detectability when compared to more cryptic species such as amphibians and reptiles.

A total of 15 fish species were identified during field surveys including 12 native and three non-native species.

A comprehensive list of fauna species recorded within the study area is available in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

11.5.6.2 Threatened fauna

A total of 30 Threatened fauna species listed under the provisions of the NC Act and/or EPBC Act are known, likely or have the potential to occur within the Project footprint based on the results of desktop assessment and field surveys (see Table 11-14). Of these, 13 are considered known to occur, 6 species are considered likely to occur and 11 species have potential to occur within the Project footprint based on the results of targeted field surveys and habitat mapping.

The location of records and habitat for these species within the Project footprint is provided in Appendix F of Appendix O: Matters of National Environmental Significance Report for MNES and in Appendix G of Appendix L: Terrestrial and Aquatic Ecology Technical Report for MSES. Additional information is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

TABLE 11-14 THREATENED FAUNA SPECIES KNOWN, LIKELY OR WITH THE POTENTIAL TO OCCUR WITHIN THE PROJECT FOOTPRINT

Scientific name	Common name	NC Act status	EPBC Act status	Field verified likelihood of occurrence	Total habitat within Project footprint (ha)	Essential habitat (ha) ⁴
<i>Acanthopis antarcticus</i>	Common death adder	V	-	Known	277.27	2.85
<i>Adclarkia cameroni</i>	Brigalow woodland snail	-	E	Known	146.72	-
<i>Anomalopus mackayi</i>	Five clawed worm-skink	E	V	Likely	241.61	33.09
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	Potential	285.01	-

Scientific name	Common name	NC Act status	EPBC Act status	Field verified likelihood of occurrence	Total habitat within Project footprint (ha)	Essential habitat (ha) ⁴
<i>Aphelocephala leucopsis</i>	Southern whiteface	V	V ¹	Known	216.89	-
<i>Botaurus poiciloptilus</i>	Australasian bittern	-	E	Likely	7.91	-
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE	Potential	-	-
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (eastern)	V	V ¹	Known	120.01	-
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V	V ¹	Known	240.66	5.87
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll	E	E	Likely	387.48	-
<i>Delma torquata</i>	Collared delma	V	V	Potential	36.83	-
<i>Egernia rugosa</i>	Yakka skink	V	V	Potential	241.13	-
<i>Furina dunmalli</i>	Dunmall's snake	V	V	Known	262.69	49.04
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	Likely	421.42	-
<i>Grantiella picta</i>	Painted honeyeater	V	V	Known	330.66	-
<i>Hemiaspis damelii</i>	Grey snake	E	-	Known	259.80	-
<i>Hirundapus caudacutus</i>	White-throated needletail	V	M, Ma	Known	2,853.24	-
<i>Hypochrysops piceatus</i>	Bullock jewel butterfly	CE	CE ¹	Potential	231.29	-
<i>Lathamus discolor</i>	Swift parrot	E	CE	Potential	614.93	-
<i>Maccullochella peelii</i>	Murray cod	-	V	Known	60.50	-
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E	E ¹	Potential	216.89	-
<i>Ninox strenua</i>	Powerful owl	V	-	Potential	8.64	-
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V ²	Known	696.25	49.04
<i>Petauroides volans</i>	Greater glider (southern and central)	V	V ¹	Potential	15.97	-
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V	V ¹	Potential	298.05	-
<i>Phascolarctos cinereus</i>	Koala	E	E ³	Known	1,362.53	74.02
<i>Pteropus poliocephalus</i>	Grey-headed flying fox	-	V	Known	788.39	-
<i>Rostratula australis</i>	Australian painted snipe	E	E	Likely	7.91	-
<i>Stagonopleura guttata</i>	Diamond firetail	V	V ¹	Likely	216.89	-
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	Known	51.20	-
<i>Jalmenus eubulus</i> ⁵	Pale imperial hairstreak ⁵	V	-	Unlikely	-	26.59

Table notes:

- = Species not listed CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory Ma = Marine

- Species listed after controlled action date, for specific dates see likelihood of occurrence tables presented in Appendix B of Appendix L: Terrestrial and Aquatic Ecology Technical Report.
- South-east long-eared bat uplisted to Endangered effective 15 November 2023, after controlled action date.
- Koala uplisted to Endangered effective 12 February 2022, after controlled action date.
- Essential habitat is included in, not in addition to, total habitat areas (except for the pale imperial hairstreak; see note 5).
- Essential habitat for the pale imperial hairstreak is mapped within the Project footprint; however, this species remains unlikely to occur within the Project footprint due to inconsistencies between the GTRE and State-based mapping (see Appendix B of Appendix L: Terrestrial and Aquatic Ecology Technical Report for detailed justification). Therefore, habitat was not mapped for this species.

11.5.6.3 NC Act Special Least Concern fauna

Eight SLC fauna species are known or likely to occur within the Project footprint (see Table 11-15).

TABLE 11-15 SPECIAL LEAST CONCERN FAUNA SPECIES KNOWN OR LIKELY TO OCCUR WITHIN THE PROJECT FOOTPRINT

Scientific name	Common name	NC Act status	Field verified likelihood of occurrence
<i>Apus pacificus</i>	Fork-tailed swift	SLC	Known
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	SLC	Likely
<i>Gallinago hardwickii</i>	Latham's snipe	SLC	Known
<i>Myiagra cyanoleuca</i>	Satin flycatcher	SLC	Known
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	Known
<i>Plegadis falcinellus</i>	Glossy ibis	SLC	Known
<i>Rhipidura rufifrons</i>	Rufous fantail	SLC	Likely
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	Known

11.5.6.4 Animal breeding places

The presence of potential animal breeding places and habitat features for a diversity of native fauna species was recorded to be widespread throughout the Project footprint. These habitat features ranged from observed nests, fallen woody debris, hollows, cracks and crevices in trees, burrows, termite mounds, dense wetland vegetation, and rocky outcrops/piles.

Hollows were observed to be the most abundant potential breeding feature, ranging from small to large sized hollows. Smaller hollows have the potential to provide habitat for hollow-breeding microbats, birds, and reptiles. The larger hollows have potential to be used by glossy black-cockatoo (*Calyptorhynchus lathami lathami*), greater glider (southern and central) (*Petauroides volans*) and yellow-bellied gliders (*Petaurus australis australis*).

Other habitat features such as fallen bark and leaf litter could not be quantified; however, provide potential habitat for breeding common death adder (*Acanthophis antarcticus*), while soil cracks provide potential breeding habitat for grey snake (*Hemiaspis damelii*).

11.5.6.5 Pests (restricted matters)

Nine non-native fauna species declared as restricted matters under the *Biosecurity Act 2014* (Qld) were recorded within the Project footprint during field surveys. These species were widespread across the entire study area (see Table 11-16).

TABLE 11-16 RESTRICTED MATTER FAUNA SPECIES IDENTIFIED WITHIN THE PROJECT FOOTPRINT

Species name	Common name	Biosecurity Act status
<i>Canis lupus dingo</i>	Dingo	Category 3
<i>Canis lupus familiaris</i>	Dog	Category 3
<i>Cyprinus carpio</i>	European carp	Category 3, 5, 6
<i>Felis catus</i>	Cat	Category 3
<i>Gambusia holbrooki</i>	Mosquitofish	Category 3, 5, 6
<i>Lepus europaeus</i>	Hare	Category 3
<i>Oryctolagus cuniculus</i>	Rabbit	Category 3
<i>Sus scrofa</i>	Feral pig	Category 3
<i>Vulpes vulpes</i>	European fox	Category 3

11.5.7 Whetstone Material Distribution Centre ecological surveys

Ecological values validated by Umwelt within the MDC development footprint are largely comprised of historically cleared open paddock dominated by exotic grasslands (42.9 ha) and wheat cropping (25.3 ha), with invasive species such as buffel grass (*Cenchrus ciliaris*), and velvety tree pear (*Opuntia tomentosa*) found commonly throughout (Umwelt, 2022).

Along the boundary and existing tracks, occasional small patches of regrowth eucalypt vegetation with scattered mature silver-leaved ironbark (*Eucalyptus melanophloia*), Queensland blue gum (*E. tereticornis*), poplar box (*E. populnea*), and Moreton Bay ash (*Corymbia tessellaris*) were identified (total of 1.1 ha). These areas of regrowth vegetation supported some habitat values, resources and potential animal breeding places (for Least Concern, Special Least Concern, Threatened and Colonial Species) and for a diversity of flora and fauna species, including listed Threatened and migratory species; however, despite the presence of potential habitat, field investigations did not confirm the presence (via direct or indirect methods) of any conservation significant fauna or flora species.

Further information related to the assessment of environmental values of the MDC and the outcomes of the significant impact assessment are contained within Appendix AE: Whetstone Material Distribution Centre Preliminary Environmental Assessment and in Appendix L: Terrestrial and Aquatic Ecology Technical Report.

11.5.8 Borrow pit ecological surveys

No MNES or MSES were recorded during field efforts. Vegetation that could qualify as box-gum TEC under the EPBC Act was identified at Borrow Pit site 3; however, impacts to this vegetation will be avoided through the use of an existing track from the entrance gate to access the borrow pit. Larger/mature trees will be retained that may provide dispersal function or habitat for koala or other species at Borrow Pit site 2 and 4.

11.5.9 Aquatic ecosystems

11.5.9.1 Aquatic habitat assessments

Physical habitat assessments were undertaken at thirteen sites throughout the Project footprint, located in Cattle Creek, Condamine River (including the northern branch), Dry Creek, Grasstree Creek, Macintyre River, Nicol Creek, Pariagara Creek, Westbrook Creek, and several unnamed waterways.

Each site assessed had an overall physical assessment score of fair to good. Most sites scored poorly for channel flow status due to the dry conditions encountered at the time of assessment. As a result of the natural clay-rich bed substrates and their lack of substrate complexity, the epifaunal substrate/available cover also scored poorly in many sites. Bed and bank stability scored highly across most sites, owing to largely intact riparian vegetation across the Project footprint. Fourteen species of aquatic plants were identified and were all common emergent species of aquatic or semi-aquatic sedges, rushes, and grasses.

Due to dry conditions, macroinvertebrate sampling was limited to a total of six sites in Bringalily Creek (two sites), Dry Creek, Macintyre Brook (two sites), and the Macintyre River, which was sampled twice. A total of 26 taxa were identified across the two sites (Bringalily Creek and Macintyre River) sampled in November 2018, while 54 taxa were identified across the five sites (Bringalily Creek, Dry Creek, Macintyre River, and both Macintyre Brook sites) sampled in May 2019. The most taxa-rich orders were Coleoptera (beetles), Diptera (true flies), and Hemiptera (true bugs) in both the November 2018 and May 2019 sampling rounds. A total of seven PET (orders Plecoptera, Ephemeroptera, and Trichoptera) taxa were recorded across both sampling events. Three Ephemeroptera (mayfly) taxa and four Trichoptera (caddis fly) taxa were recorded. It was not expected that Plecoptera (stoneflies) would occur, as the sites sampled lacked the riffles and substrates required.

Overall, AusRivAS band ratings ranged from Band A (reference condition) to Band B (significantly impaired). Reference condition indicates that the expected taxa for each site were identified and that upstream impacts to habitat condition and/or water quality have not had a significant impact on macroinvertebrate diversity.

11.5.9.2 Springs and groundwater dependent ecosystems

Aquatic GDEs have been mapped by DESI along the Project footprint between the NSW/QLD border and Millmerran. Aquatic GDEs are scattered towards the NSW/QLD border end of the Project. The GDE Atlas indicates there are no high potential aquatic GDEs (i.e. surface water expression) located within 5 km of the Project footprint.

Areas where potential aquatic GDEs are identified within 5 km of the Project include:

- ▶ Between Ch 40.0 km and Ch 95.0 km of the Project footprint which crosses numerous unnamed tributaries associated with Macintyre Brook and Canning Creek with a moderate potential to be aquatic GDEs
- ▶ Unnamed creeks with moderate potential for aquatic GDEs to occur to the southwest of Millmerran within and surrounding the Project footprint between Ch 115.0 km to Ch 125.0 km
- ▶ The Condamine River, which the Project footprint crosses near Ch 142.9 km, is considered to have a low potential to be aquatic GDEs
- ▶ Low to moderate potential aquatic GDEs are associated with narrow, unnamed creeks underlain by the between Ch 160.0 km to Ch 206.9 km.

Several ephemeral springs (sourced from bedrock aquifer systems) have been mapped by DESI at the Gowrie end of the Project footprint; however, they occur outside the Project footprint.

11.5.9.3 Queensland Waterways for waterway barrier works

A review of the DAF *Queensland Waterways for Waterway Barrier Works* mapping was undertaken, identifying a total of 100 waterways for waterway barrier works which are intersected by the Project footprint, namely:

- ▶ The alignment intersects 10 waterways mapped as purple (major risk)
- ▶ The alignment intersects nine waterways mapped as red (high risk)
- ▶ The alignment intersects 15 waterways mapped as amber (moderate risk)
- ▶ The alignment intersects 66 waterways mapped as green (low risk).

These waterways are identified in Table 11-17.

The Project does not impact any tidal waterways (major risk, mapped as grey). Appendix S: Surface Water Quality Technical Report and Eco Logical Australia (2019) provide more detail on the water quality and condition of some of these waterways.

The level of risk relating to each waterway will be considered by the detailed design team responsible for the design of infrastructure such as culverts, bridges, and other potential barriers. Designs will need to be in accordance with accepted development requirements for operational work that is constructing or raising waterway barrier works, or under a relevant development approval.

TABLE 11-17 WATERWAYS FOR WATERWAY BARRIER WORKS THAT INTERCEPT THE PROJECT FOOTPRINT

Waterway impact risk (DAF)	Waterway and approximate chainage (Ch) of intersection (km)
Purple (major risk)	▶ Unnamed tributary of Macintyre Brook (Ch 55.6 km) ▶ Pariagara Creek (Ch 67.3 km) ▶ Unnamed tributary of Piagara Creek (Ch 67.3 km) ▶ Bringalily Creek (Ch 100.6 km) ▶ Nicol Creek (Ch 104.4 km) ▶ Back Creek (Ch 128.0 km) ▶ Grasstree Creek (Ch 139.9 km) ▶ Condamine River (Ch 144.2 km) ▶ Condamine River (Northern Branch) (Ch 150.0 km) ▶ Westbrook Creek drainage feature (Ch 198.5 km)
Red (high risk)	▶ Unnamed tributary of Macintyre Brook (Ch 52.6 km) ▶ Cattle Creek (Ch 88.2 km) ▶ Native Dog Creek (Ch 93.9 km) ▶ Back Creek (Ch 97.6 km) ▶ Unnamed tributary of Back Creek Gully (Ch 120.3 km) ▶ Unnamed tributary of Back Creek Gully (Ch 127.0 km) ▶ One Mile Gully tributary of Westbrook Creek (Ch 193.1 km) ▶ Four Mile Gully tributary of Westbrook Creek (Ch 197.4 km) ▶ Dry Creek drainage feature (Ch 199 km)
Amber (moderate risk)	▶ Unnamed tributary of Macintyre Brook (Ch 48.4 km, Ch 60.5 km, Ch 61.9 km Ch 63.1 km) ▶ Unnamed tributary of Pariagara Creek (Ch 66.2 km) ▶ Unnamed tributary of Canning Creek (Ch 91.0 km) ▶ Unnamed tributary of Nicol Creek (Ch 109.4 km, Ch 114.4 km) ▶ Unnamed tributary of Grasstree Creek (Ch 141.0 km) ▶ Unnamed drainage feature (Ch 160.0 km) ▶ Unnamed tributary of Umbiram Creek (Ch 184.9 km, Ch 187.2 km) ▶ Half Mile Creek (Ch 190.0 km) ▶ Unnamed tributary of Westbrook Creek (Ch 194.7 km) ▶ Unnamed tributary of Pine Creek near Turallin Facility

Waterway impact risk (DAF)	Waterway and approximate chainage (Ch) of intersection (km)
Green (low risk)	▶ Unnamed tributary of Macintyre Brook (Ch 43.2 km (also crosses Whetstone Material Distribution Centre), Ch 58.2 km, Ch 59km, Ch 59.6 km, Ch 61.6 km, Ch 62.9 km, Ch 63.9 km) ▶ Unnamed tributary of Pariagara Creek (Ch 64.7 km, Ch 66.8 km, Ch 67.55 km, Ch 67.56 km, Ch 68.0 km, Ch 68.7 km) ▶ Unnamed tributary of Canning Creek (Ch 73.7 km, Ch 78.9 km, Ch 80.0 km, Ch 81.1, Ch 82.3 km, Ch 84.4 km, Ch 85.4 km) ▶ Unnamed tributary of Cattle Creek (Ch 87.4 km) ▶ Unnamed tributary of Canning Creek (Ch 92.1 km, Ch 92.9 km) ▶ Unnamed tributary of Nicol Creek (Ch 107.2 km, Ch 108.5 km, Ch 110.9 km, Ch 111.3 km, Ch111.9 km) ▶ Unnamed drainage feature (Ch 112.3 km, Ch 113.0 km) ▶ Unnamed tributary of Nicol Creek (Ch 113.3 km, Ch 114.9 km, Ch 115.5 km, Ch 115.6 km, Ch 116.2 km) ▶ Unnamed tributary of Leonard (Back Creek) Gully (Ch 117.4 km) ▶ Unnamed tributary of Back Creek Gully (Ch 118.4 km, 119.4 km, Ch 120.8 km, Ch 121.4 km, Ch 124.3 km, Ch 124.4 km, Ch 125.5 km) ▶ Unnamed drainage feature (Ch 130.2 km) ▶ Unnamed drainage feature (Ch 162.2 km, Ch 162.8 km) ▶ Unnamed tributary of Fourteen Mile Creek (Ch 164.2 km, Ch 164.4 km, Ch 165.1 km, Ch 168.6 km, Ch 169.9 km, Ch 170.6 km, Ch 171.9 km, Ch 172.2 km, Ch 173.6 km) ▶ Unnamed tributary of Perrier Gully (Ch 176.9 km, Ch 177.7 km, Ch 178.7 km) ▶ Unnamed tributary of Umbiram Creek (181.1 km, Ch 181.8 km, Ch 182.9 km) ▶ Unnamed tributary of Umbiram Creek (Ch 186.20) ▶ Unnamed tributary of One Mile Gully (Ch 191.9 km) ▶ Unnamed tributary of Four Mile Gully (Ch 197.9 km) ▶ Unnamed tributary of Dry Creek (Ch 202.8 km)

11.5.9.4 Wetlands

No HEV wetlands are mapped as occurring within the study area. Riverine wetlands and REs that potentially contain riverine wetland values are common throughout the Project footprint as are palustrine wetlands and their RE counterparts. Lacustrine wetlands are also mapped within proximity to the Project footprint; however, these water bodies are relatively small. For the majority, areas consisting of a mosaic of REs containing a small proportion of potential wetland values (1 to 50 per cent) frequently intersect the Project footprint.

There are no wetlands of international importance (Ramsar wetlands) or national importance located in, or within 10 km of the Project footprint. Multiple palustrine wetlands and some REs (11.3.4 and 11.3.5) have been identified in the Queensland Referable Wetland Mapping as HES as recognised under the Environmental Protection Regulation 2008; however, none of these mapped wetlands occur within mapped HEV waters as outlined in the EPP (Water and Wetland Biodiversity). The closest HES wetland mapped within HEV waters is approximately 25 km east of the Gowrie end of Project footprint.

Similarly, many of the wetlands (e.g. palustrine, lacustrine and mosaic) mapped along the Project footprint are also mapped as wetlands under the VM Act. These wetlands predominantly occur in the eastern and western extents of the Project footprint.

The area that the HEV and HES wetlands occur in the study area and Project footprint is presented in Table 11-18.

TABLE 11-18 HIGH ECOLOGICAL SIGNIFICANCE WETLANDS PRESENT WITHIN THE STUDY AREA AND PROJECT FOOTPRINT

Habitat values	Extent contained within the study area (ha)	Extent contains within the Project footprint (ha)
HEV Wetlands	0.0	0.0
HES Wetlands	10.32	0.0

Numerous anthropogenic wetlands or artificially constructed waterbodies are present within the Project footprint. These are predominantly rural farm dams and typically occur along unnamed watercourses, waterways and other drainage features. These areas may have the potential to provide important resources for local fauna species.

The Project footprint passes through a diversity of aquatic systems which have been assessed and mapped according to available AquaBAMM spatial data and reporting. The resulting modelled score (see Table 11-19) shows the Project footprint scored an average of a 'medium' rating.

TABLE 11-19 SPECIFIC RIVERINE AQUABAMM AQUAScore FOR ALL WATER QUALITY MONITORING SITES

Aquascore ¹	Monitoring site
Very Low	-
Low	16, 27
Medium	18, 20R, 23, 24, 32, 33, 39, 40, 42
High	14
Very High	2, 2R, 3, 6, 7, 11, 29, 30

Table note:

1. For each spatial unit, a single summary score is derived by combining all the final criterion scores. This summary score is called AquaScore. The AquaScore for a wetland is determined by a filter table decision number. The filtering table is the process used in AquaBAMM to arrive at an overall AquaScore (i.e. very low, low, medium, high or very high) for each spatial unit or wetland. It is based on unique combinations of the individual AquaBAMM criteria ratings. The table provides an ordered series of decisions that are tested against the final combination of criteria ratings for each of the spatial units. Each decision number and consequent AquaScore represents a unique combination of criteria ratings. The filtering table performs a similar function to a weighting process where the individual criteria are weighted based on their individual or combined contribution to the overall AquaScore. This filtering table technique has previously been successfully applied in the Biodiversity Assessment and Mapping Methodology.

11.5.9.5 Watercourses and drainage features

A number of defined watercourses under the Water Act and unmapped waterways and waterbodies occur within the study area. There are 18 defined watercourses crossed by the Project, which include:

- ▶ Macintyre River – at Ch 30.6 km (NS2B)
- ▶ Macintyre Brook – at Ch 52.4 km and Ch 55.4 km
- ▶ Pariagara Creek – at Ch 67.3 km
- ▶ Cattle Creek – at Ch 88.2 km
- ▶ Canning Creek – at Ch 94.5 km
- ▶ Bringalily Creek – at Ch 100.6 km
- ▶ Nicol Creek – at Ch 104.4 km
- ▶ Back Creek unnamed tributary – at Ch 126.9 km
- ▶ Back Creek – at Ch 128.0 km
- ▶ Grasstree Creek – at Ch 139.9 km
- ▶ Condamine River (Main Branch) – at Ch 144.2 km
- ▶ Condamine River (North Branch) – at Ch 149.9 km
- ▶ Umbiram Creek unnamed tributary – at Ch 184.9 km
- ▶ Half Mile Gully – at Ch 190.0 km
- ▶ One Mile Gully – at Ch 193.1 km
- ▶ Westbrook Creek – at Ch 198.5 km
- ▶ Dry Creek – at Ch 199.3 km
- ▶ Gowrie Creek – at Ch 206.9 km.

Habitats with permanent water are likely to support the most diverse and abundant aquatic communities; however, areas with seasonal water provide periodically available habitat and act as pathways for fauna. Waterways and watercourses intersected by the Project footprint are mostly ephemeral and were assessed to be in fair condition overall. Land uses in the region, particularly agriculture, are likely to have resulted in some degradation of surface water quality and aquatic ecology values in local waterways.

11.5.10 Matters of national environmental significance

Matters of national environmental significance relevant to the Project are:

- ▶ Threatened ecological communities (Section 11.5.4)
- ▶ Threatened flora and fauna species and their associated habitat (Section 11.5.5.2 and Section 11.5.6.2).

Habitat for three TECs and 12 Threatened flora species and 19 Threatened fauna species considered known, likely or with potential to occur has been ground-truthed, mapped and quantified within the Project footprint (see Table 11-20 and Table 11-11).

Appendix O: Matters of National Environmental Significance Report provides further detail and ground-truthed mapping of MNES within the Project footprint.

TABLE 11-20 GROUND-TRUTHED THREATENED ECOLOGICAL COMMUNITIES WITHIN THE PROJECT FOOTPRINT

TEC	EPBC Act status	Total area (ha)
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	E	103.69
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	66.07
White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands	CE	2.54

TABLE 11-21 GROUND-TRUTHED HABITAT FOR THREATENED FLORA AND FAUNA SPECIES (MNES)

Species name	Common name	EPBC Act status	Ground-truthed habitat within the Project footprint (ha)
Threatened flora species			
<i>Acacia lauta</i>	Tara wattle	V	410.00
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	13.13
<i>Clematis fawcettii</i>	Stream clematis	V	2.27
<i>Dichanthium queenslandicum</i>	King bluegrass	E	50.31
<i>Dichanthium setosum</i>	Bluegrass	V	260.52 (on the edge of the Project footprint)
<i>Homopholis belsonii</i>	Belson's panic	V	242.25 (~100 individuals)
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	79.86 (~180 individuals)
<i>Picris evae</i>	Hawkweed	V	110.67 (~448,842 individuals)
<i>Rhaponticum australe</i>	Austral cornflower	V	83.49 (~164 individuals)
<i>Thesium australe</i>	Austral toadflax	V	46.44 (~474 individuals)
<i>Westringia parvifolia</i>	Small-flowered westringia	V	27.19 (~214 individuals)
<i>Xerothamnella herbacea</i>	-	E	11.99 (~70 individuals)
Threatened fauna species			
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	146.72
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	241.61
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	285.01
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	7.91
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Not mapped
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (SE mainland population)	E	▶ High quality – 259.93 ▶ Low quality – 127.55 - Total habitat – 387.48
<i>Delma torquata</i>	Collared delma	V	36.83

Species name	Common name	EPBC Act status	Ground-truthed habitat within the Project footprint (ha)
<i>Egernia rugosa</i>	Yakka skink	V	241.13
<i>Furina dunmalli</i>	Dunmall's snake	V	262.69
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	▶ Breeding habitat – 166.89 ▶ Foraging habitat – 254.53 - Total habitat – 421.42
<i>Grantiella picta</i>	Painted honeyeater	V	330.66
<i>Lathamus discolor</i>	Swift parrot	CE	Foraging habitat only – 614.93
<i>Maccullochella peelii</i>	Murray cod	V	60.50
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	▶ Roosting habitat – 301.28 ▶ Foraging habitat – 394.97 - Total habitat – 696.25
<i>Phascolarctos cinereus</i>	Koala	V	▶ Breeding and foraging habitat – 769.40 ▶ Dispersal habitat – 593.13 - Total habitat – 1,362.53
<i>Petauroides volans</i>	Greater glider (southern and central)	V	▶ Breeding and denning habitat – 1.60 ▶ Foraging habitat – 14.37 - Total habitat – 15.97
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	Foraging habitat only – 788.39
<i>Rostratula australis</i>	Australian painted snipe	E	7.91
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	51.20

Table notes:

E = Endangered V = Vulnerable

11.5.11 Matters of State environmental significance

Matters of State environmental significance, as defined in Schedule 2 of the *Environmental Offsets Regulation 2014*, within the Project footprint include:

- ▶ Regulated vegetation:
 - ▶ remnant vegetation (Category B) that is an Endangered or Of Concern RE
 - ▶ remnant vegetation (Category B) that intersects wetlands identified on the vegetation management wetlands map
 - ▶ remnant (Category B) REs intersecting a watercourse
 - ▶ essential habitat
- ▶ Connectivity areas
- ▶ Protected wildlife habitat, including MSES wildlife habitat
- ▶ Waterways providing for fish passage.

The extent of MSES within the Project footprint is presented in Table 11-22 and shown on Figure 11-6, Figure 11-7 and Figure 11-8.

TABLE 11-22 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE PROJECT FOOTPRINT

MSES	Area (ha)
Regulated vegetation¹	
Prescribed REs that are Endangered	49.39
Prescribed REs that Of Concern	85.06
Prescribed REs that are within 50 m of a VM Act wetland	11.71
Prescribed REs within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature	11.31
Essential habitat	113.19
Protected Wildlife Habitat	
Koala habitat areas under the <i>Nature Conservation (Koala) Conservation Plan 2017</i>	7.44
Fauna species	
Australasian bittern (<i>Botaurus poiciloptilus</i>)	7.91
Australian painted snipe (<i>Rostratula australis</i>)	7.91
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	146.72
Brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>)	240.66
Bullock jewel butterfly (<i>Hypochrysops piceatus</i>)	231.29
Collared delma (<i>Delma torquata</i>)	36.83
Common death adder (<i>Acanthophis antarcticus</i>)	277.27
Condamine earless dragon (<i>Tympanocryptis condaminensis</i>)	51.20
Curlew sandpiper (<i>Calidris ferruginea</i>)	Not mapped
Diamond firetail (<i>Stagonopleura guttata</i>)	216.89
Dunmall's snake (<i>Furina dunmalli</i>)	262.69
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	241.61
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	▶ Breeding and roosting habitat – 1.08 ▶ Foraging habitat – 118.94 - Total habitat – 120.01
Greater glider (southern and central) (<i>Petauroides volans</i>)	▶ Breeding and denning habitat – 1.60 ▶ Foraging habitat – 14.37 - Total habitat – 15.97
Grey snake (<i>Hemiaspis damelii</i>)	259.80
Hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>)	216.89
Koala (<i>Phascolarctos cinereus</i>)	▶ Breeding and foraging habitat – 769.40 ▶ Dispersal habitat – 593.13 - Total habitat – 1,362.53
Painted honeyeater (<i>Grantiella picta</i>)	330.66
Platypus (<i>Ornithorhynchus anatinus</i>)	24.81
Powerful owl (<i>Ninox strenua</i>)	▶ Breeding and roosting habitat – 8.28 ▶ Foraging habitat – 0.36 - Total habitat – 8.64
Regent honeyeater (<i>Anthochaera phrygia</i>)	285.01

MSES	Area (ha)
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	1,397.48
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	▶ Roosting habitat – 301.28 ▶ Foraging habitat – 394.97 Total habitat – 696.25
Southern whiteface (<i>Aphelocephala leucopsis</i>)	216.89
Spotted-tailed quoll (south-eastern) (<i>Dasyurus maculatus maculatus</i>)	▶ High quality – 259.93 ▶ Low quality – 127.55 Total habitat – 387.48
Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>)	▶ Breeding habitat – 166.89 ▶ Foraging habitat – 254.53 Total habitat – 421.42
Swift parrot (<i>Lathamus discolor</i>)	Foraging habitat only – 614.93
White-throated needletail (<i>Hirundapus caudacutus</i>)	Foraging habitat only – 2,853.24
Yakka skink (<i>Egernia rugosa</i>)	241.13
Yellow-bellied glider (<i>Petaurus australis australis</i>)	▶ Breeding and denning habitat – 164.80 ▶ Foraging habitat – 21.99 ▶ Dispersal habitat – 111.27 Total habitat – 298.05
Flora species	
Austral cornflower (<i>Rhaponticum australe</i>)	83.49
Austral toadflax (<i>Thesium australe</i>)	46.44
Belson's panic (<i>Homopholis belsonii</i>)	242.25
<i>Cyperus clarus</i>	166.07
Hairy-joint grass (<i>Arthraxon hispidus</i>)	13.13
Hawkweed (<i>Picris evae</i>)	110.67
King bluegrass (<i>Dichanthium queenslandicum</i>)	50.31
<i>Picris barbarorum</i>	174.98
Tara wattle (<i>Acacia lauta</i>)	410.00
<i>Westringia parvifolia</i>	27.19
<i>Xerothamnella herbacea</i>	11.99
Waterways providing for fish passage	
100 waterways intersect the Project footprint and are classified (DAF mapped waterways) as follows:	N/A
▶ 66 waterways mapped as green (low risk) ▶ 15 waterways mapped as amber (moderate risk) ▶ 9 waterways mapped as red (high risk) ▶ 10 waterways mapped as purple (major risk)	
Connectivity	
Remnant vegetation	475.33

Table Notes:

1. Prescribed vegetation is defined and described in Section 11.5.2.



Figure 11 - 6 (1) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 1 OF 30



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Figure 11 - 6 (2) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 2 OF 30

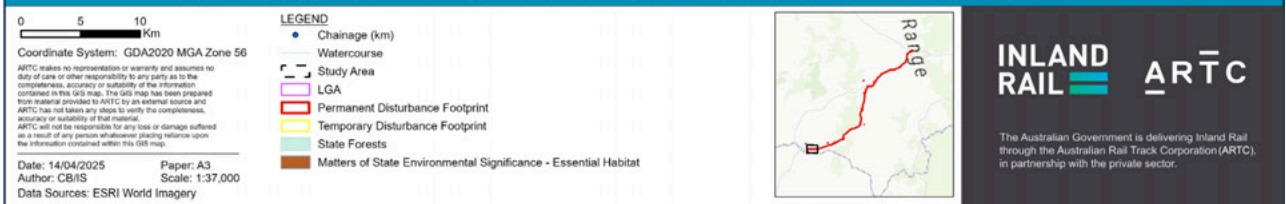


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Figure 11 - 6 (3) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 3 OF 30

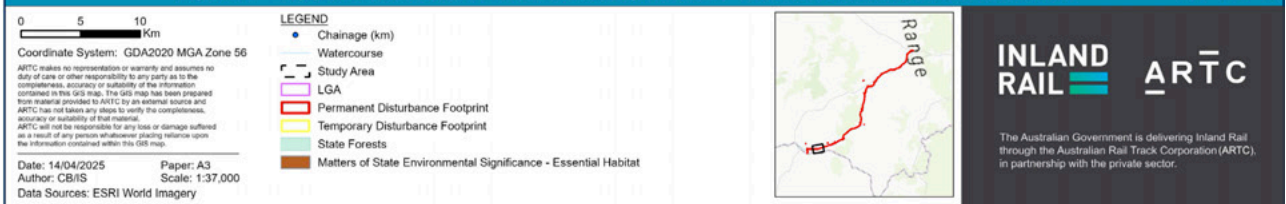


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Figure 11 - 6 (4) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 4 OF 30

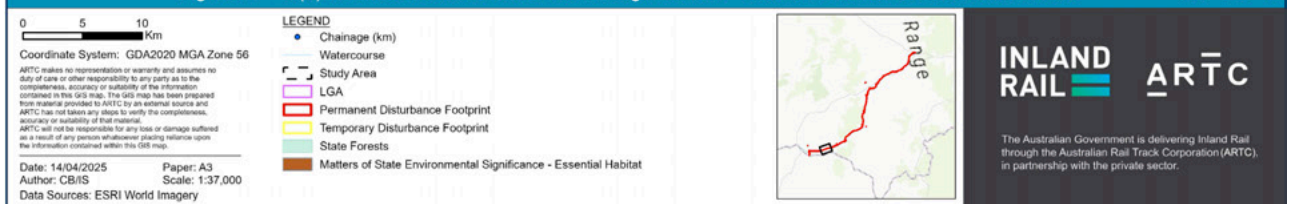


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Figure 11 - 6 (5) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 5 OF 30



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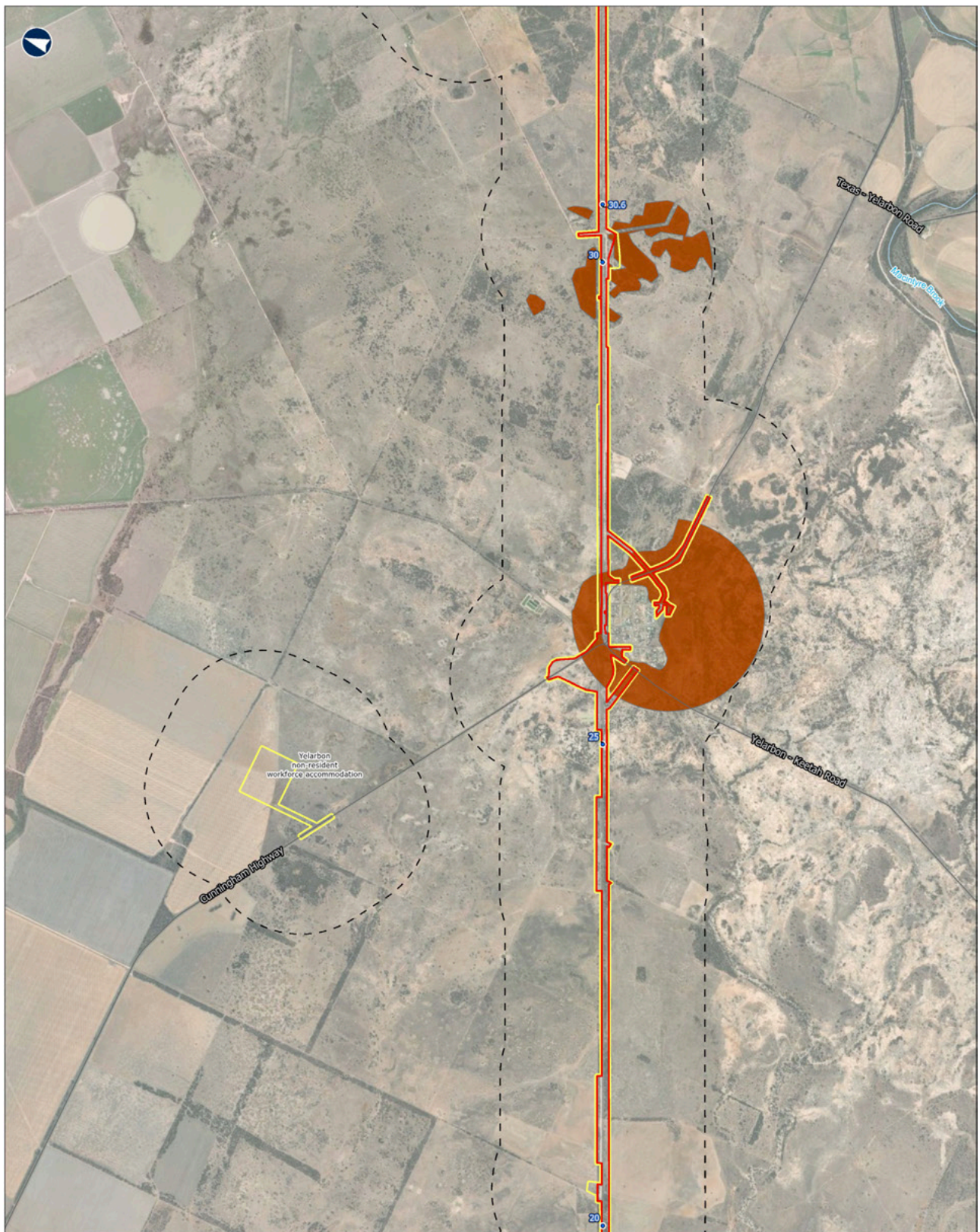
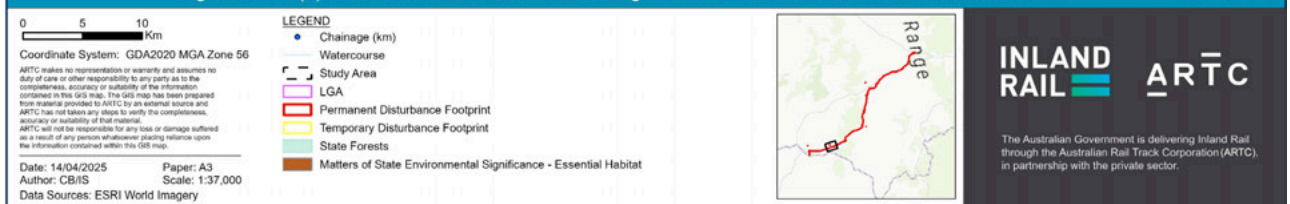


Figure 11 - 6 (6) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 6 OF 30



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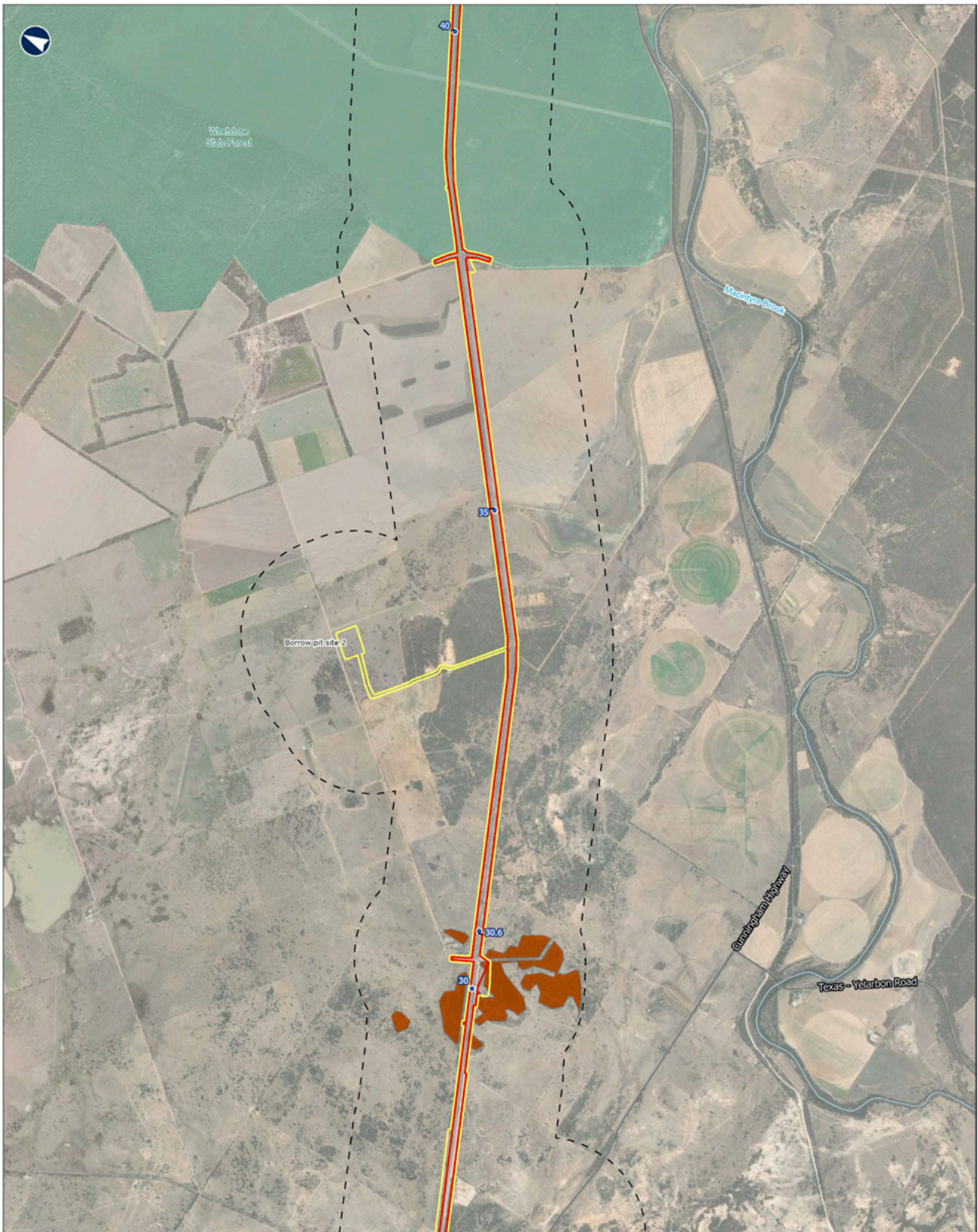
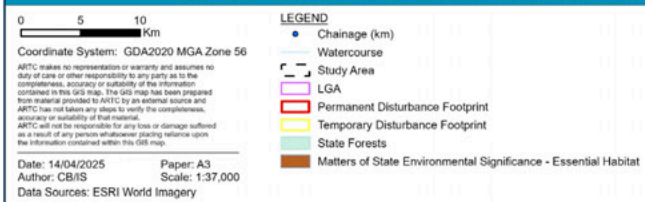


Figure 11 - 6 (7) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 7 OF 30



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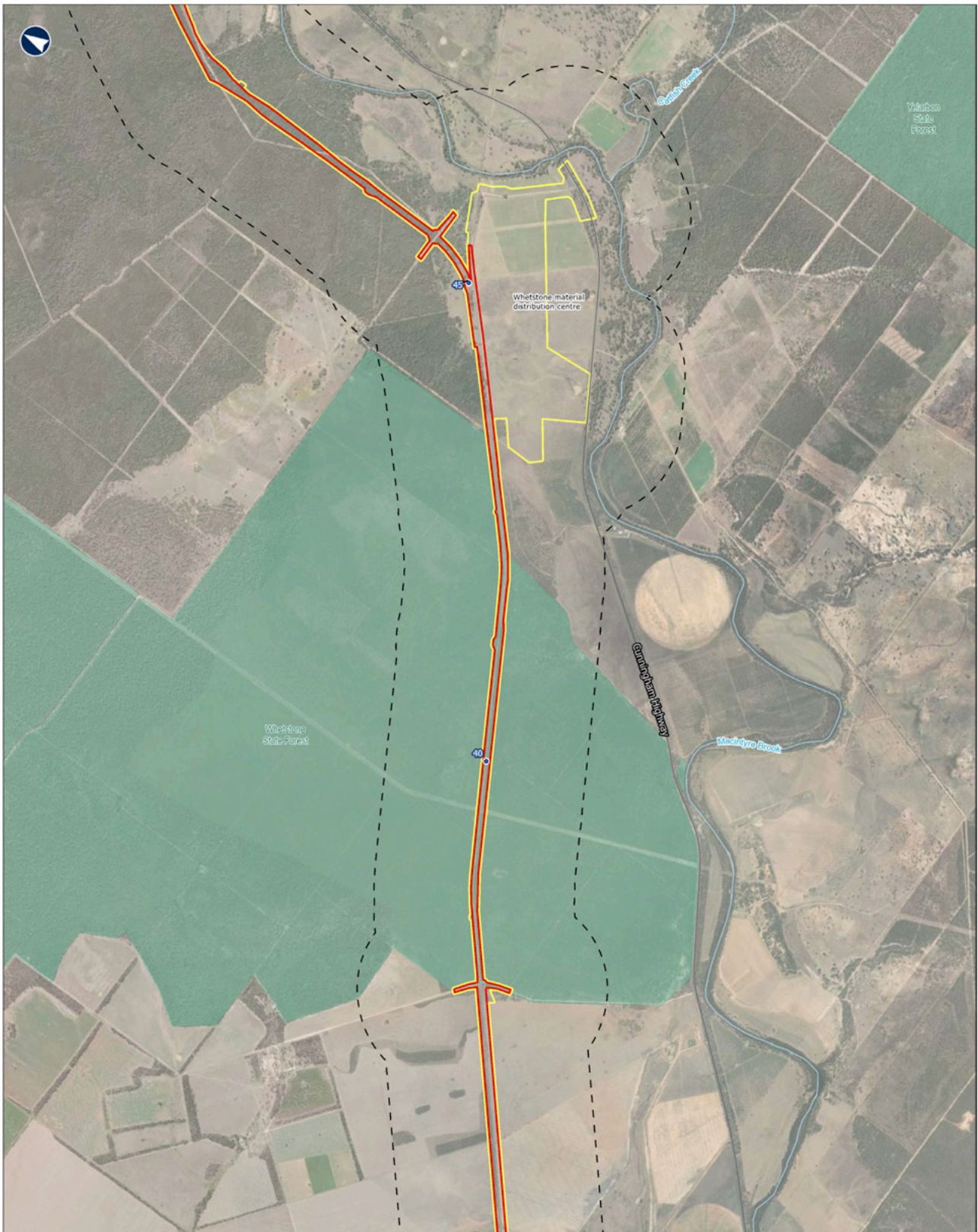
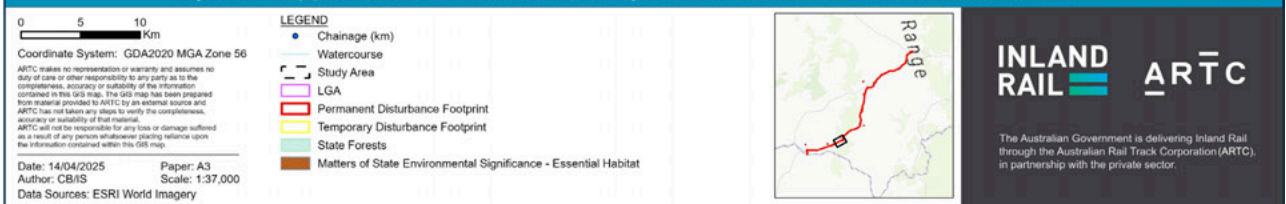


Figure 11 - 6 (8) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 8 OF 30

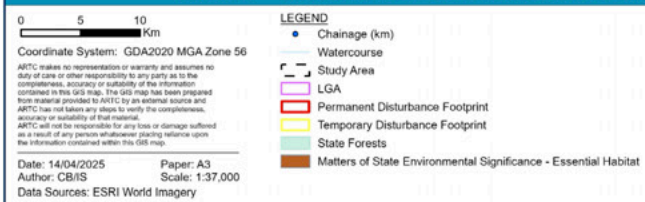


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Figure 11 - 6 (9) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 9 OF 30



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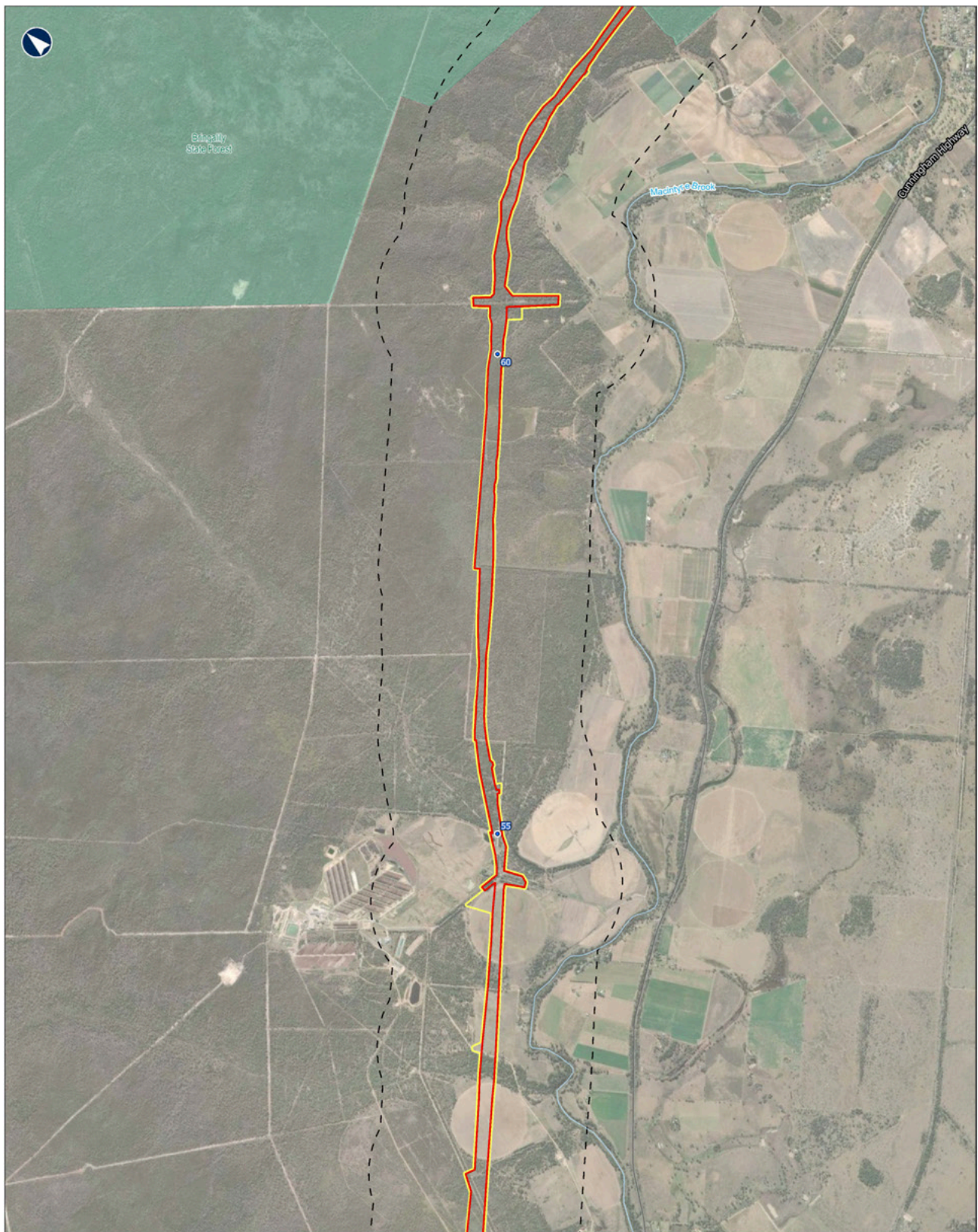
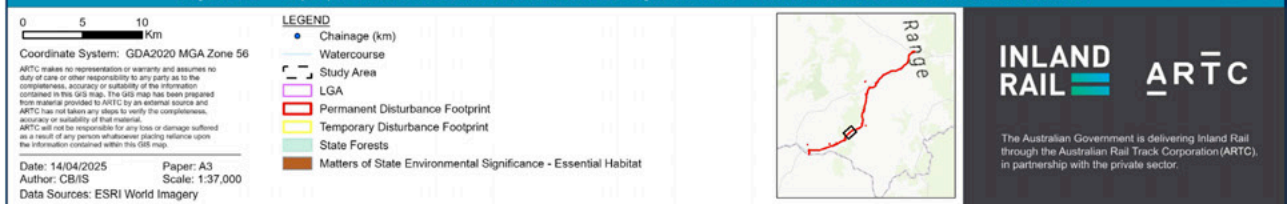


Figure 11 - 6 (10) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 10 OF 30



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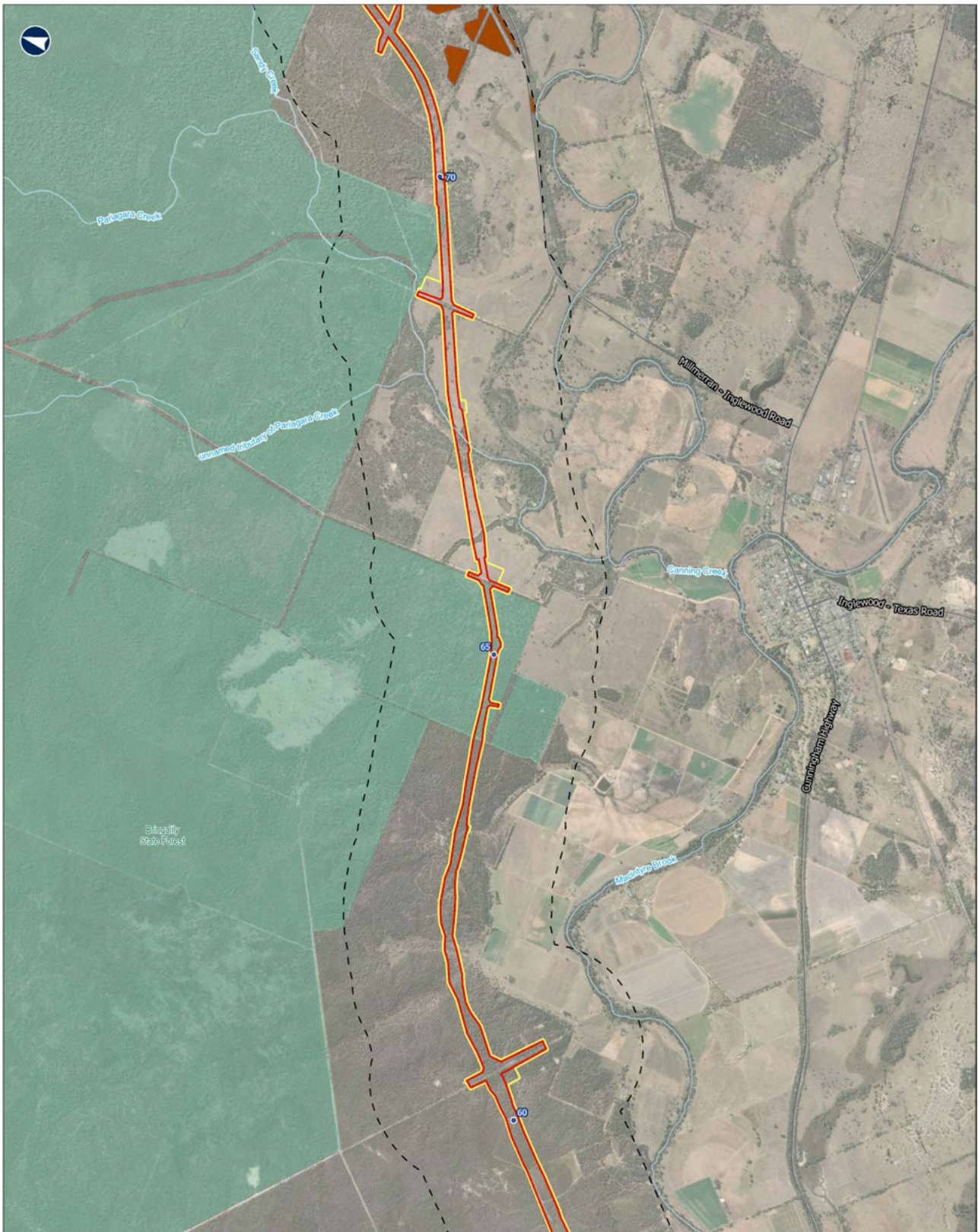
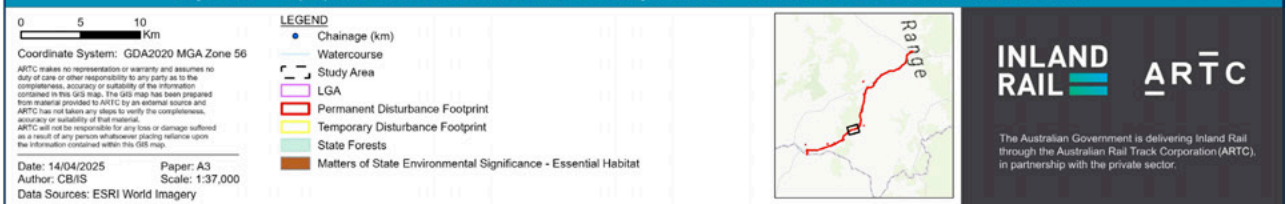


Figure 11 - 6 (11) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 11 OF 30



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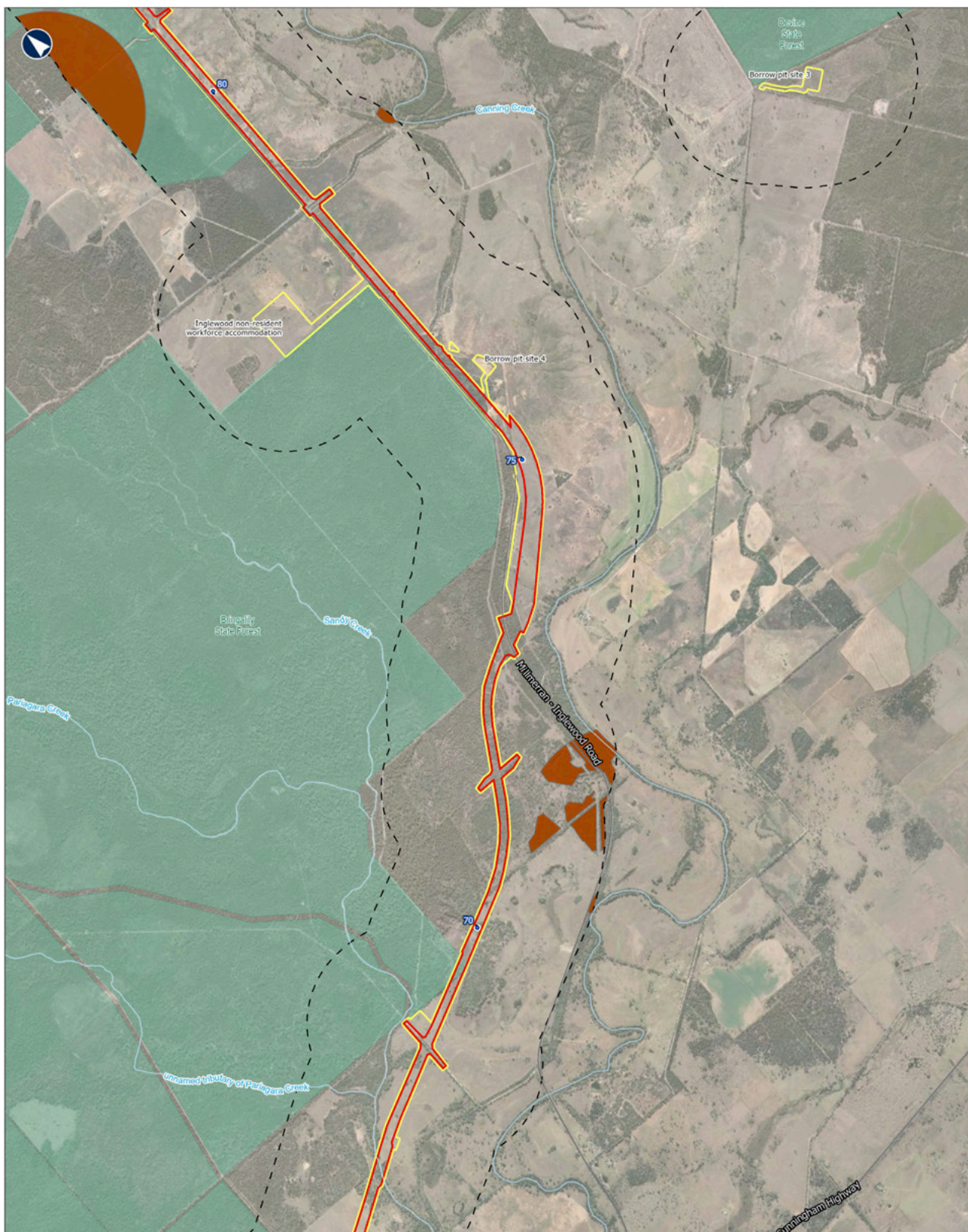


Figure 11 - 6 (12) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 12 OF 30



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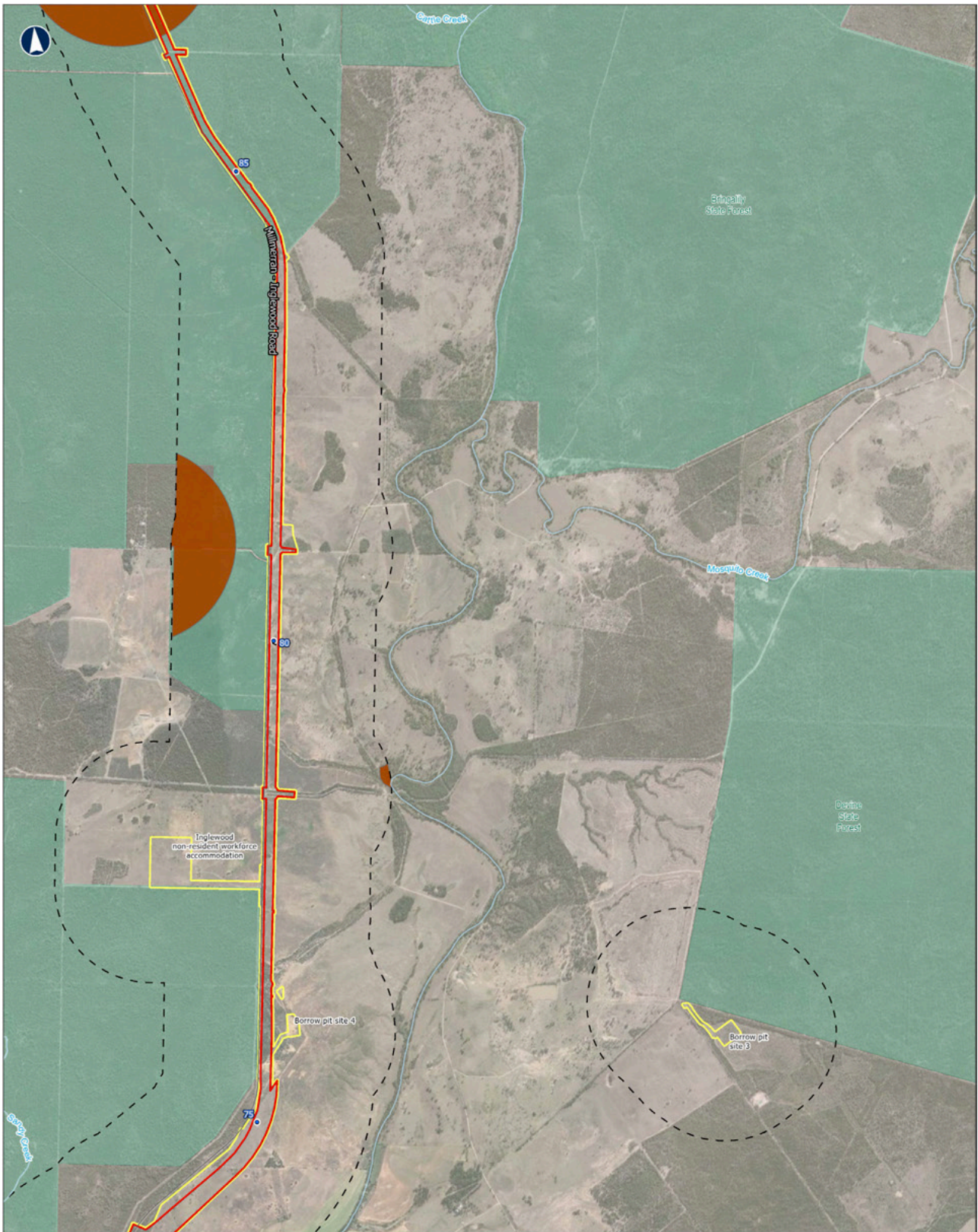
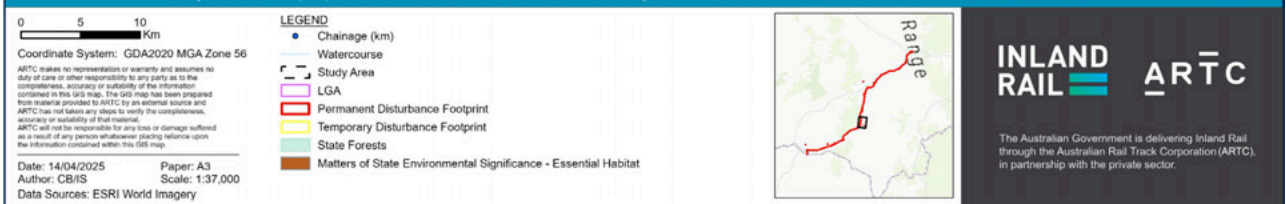


Figure 11 - 6 (13) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 13 OF 30



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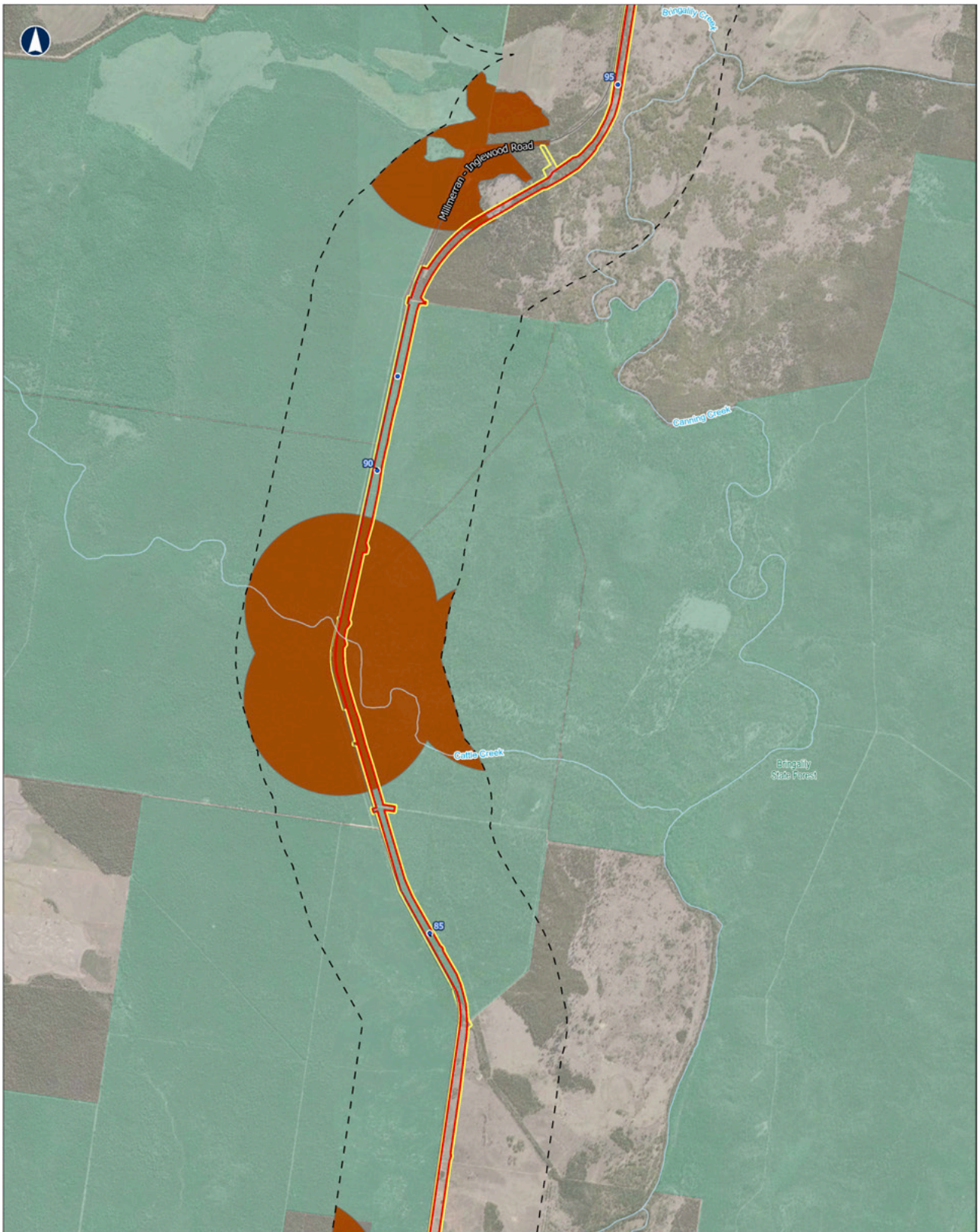


Figure 11 - 6 (14) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 14 OF 30

0 5 10 Km

Coordinate System: GDA2020 MGA Zone 56

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Date: 14/04/2025 Paper: A3
Author: CB/IS Scale: 1:37,000
Data Sources: ESRI World Imagery

LEGEND

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Matters of State Environmental Significance - Essential Habitat

INLAND RAIL

ARTC

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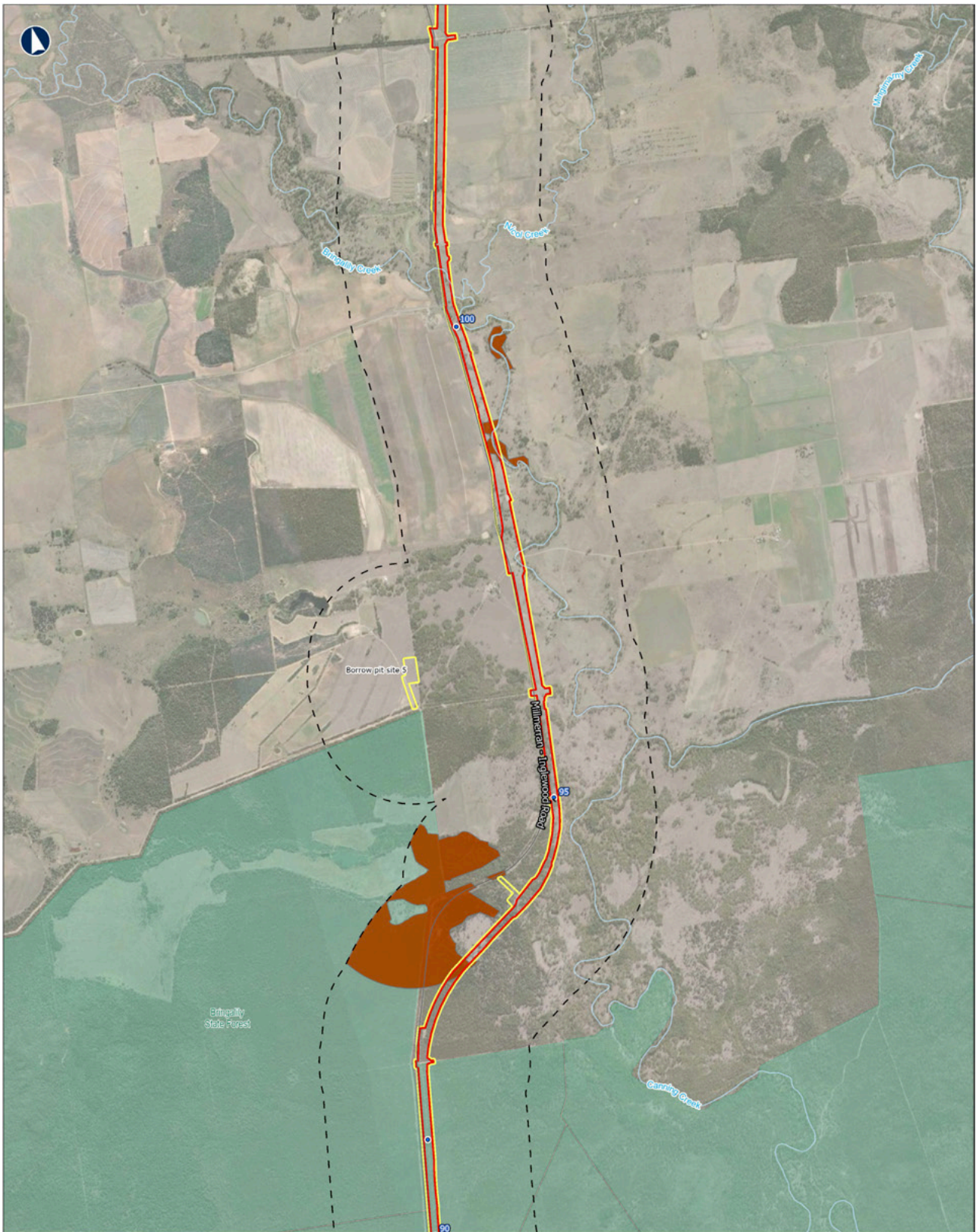
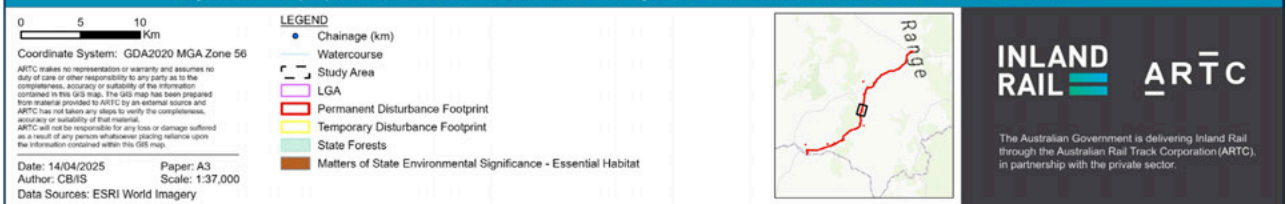


Figure 11 - 6 (15) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 15 OF 30

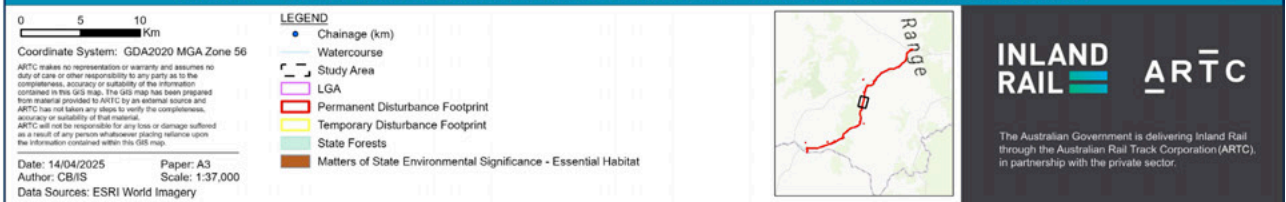


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Figure 11 - 6 (16) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 16 OF 30

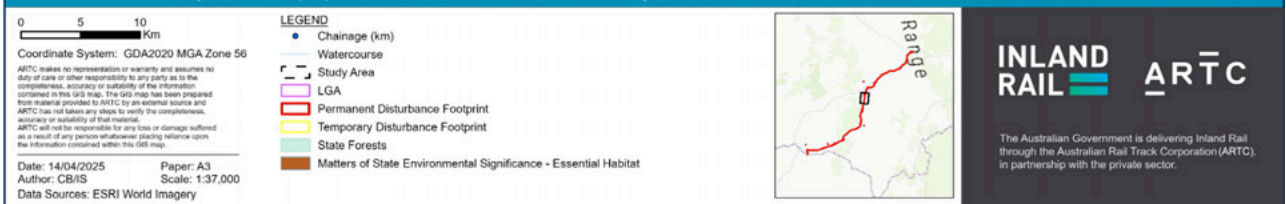


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Figure 11 - 6 (17) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 17 OF 30

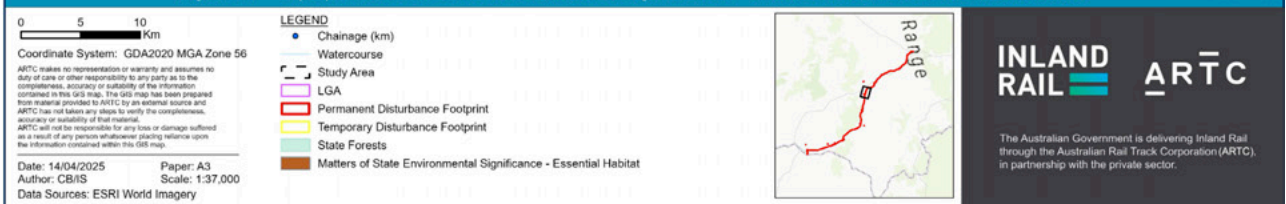


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Figure 11 - 6 (18) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 18 OF 30



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Figure 11 - 6 (19) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 19 OF 30



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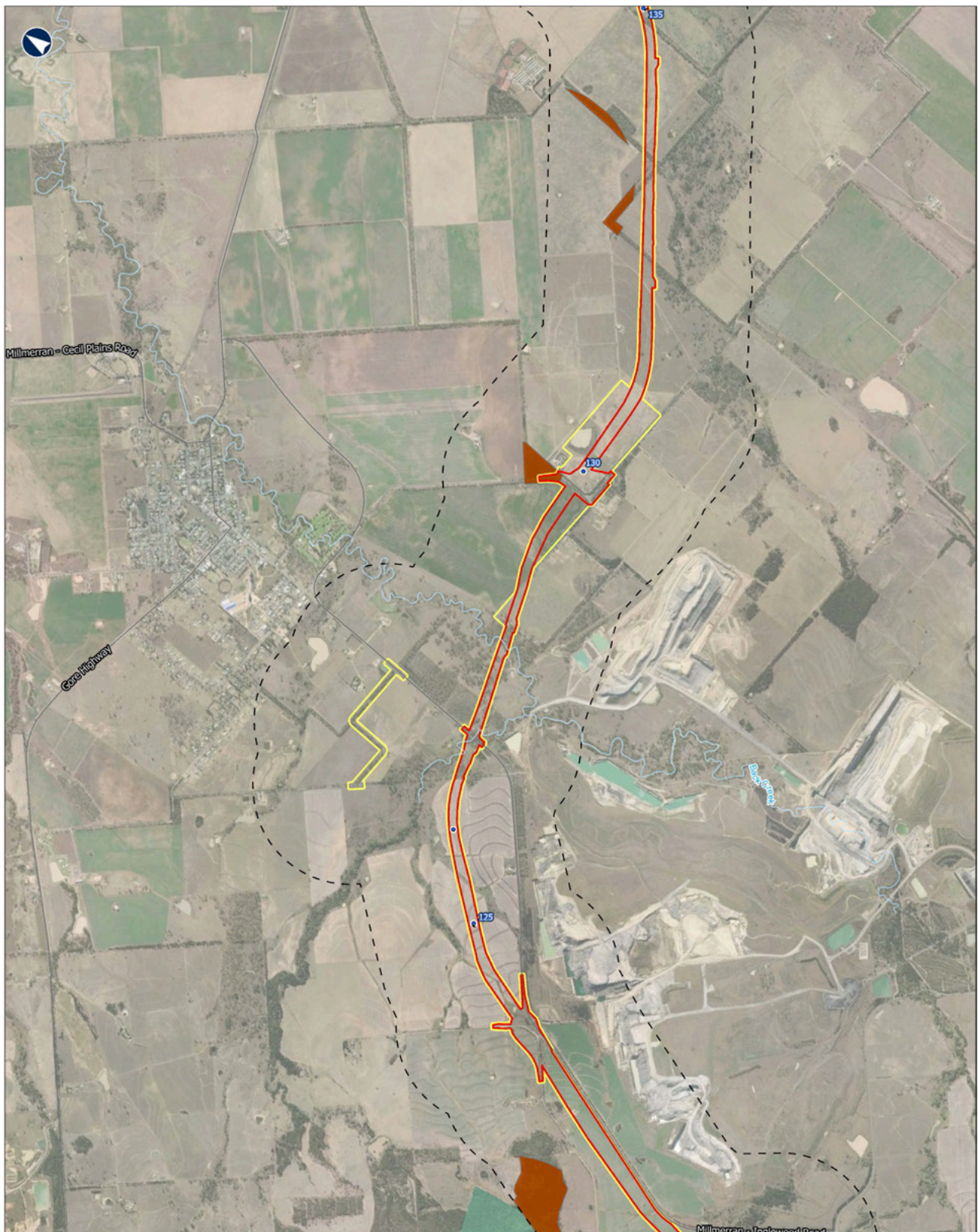


Figure 11 - 6 (20) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 20 OF 30



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Figure 11 - 6 (21) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 21 OF 30



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Figure 11 - 6 (22) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 22 OF 30



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Figure 11 - 6 (23) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 23 OF 30



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Figure 11 - 6 (24) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 24 OF 30



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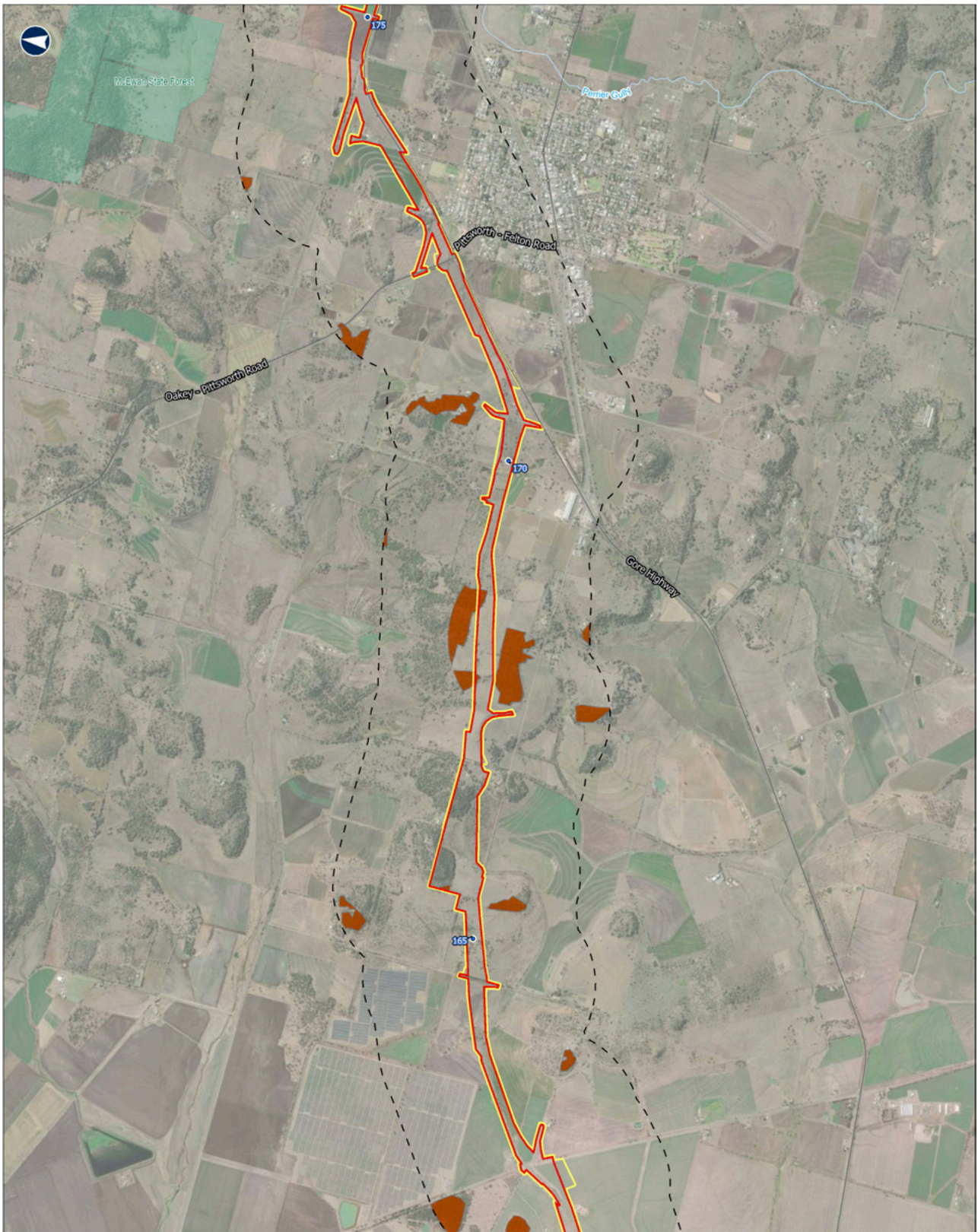
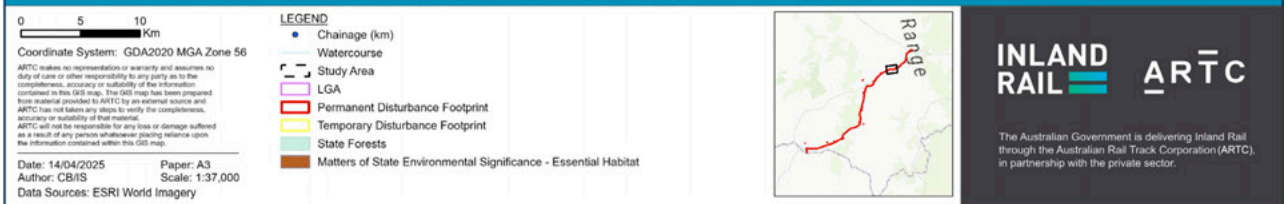


Figure 11 - 6 (25) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 25 OF 30



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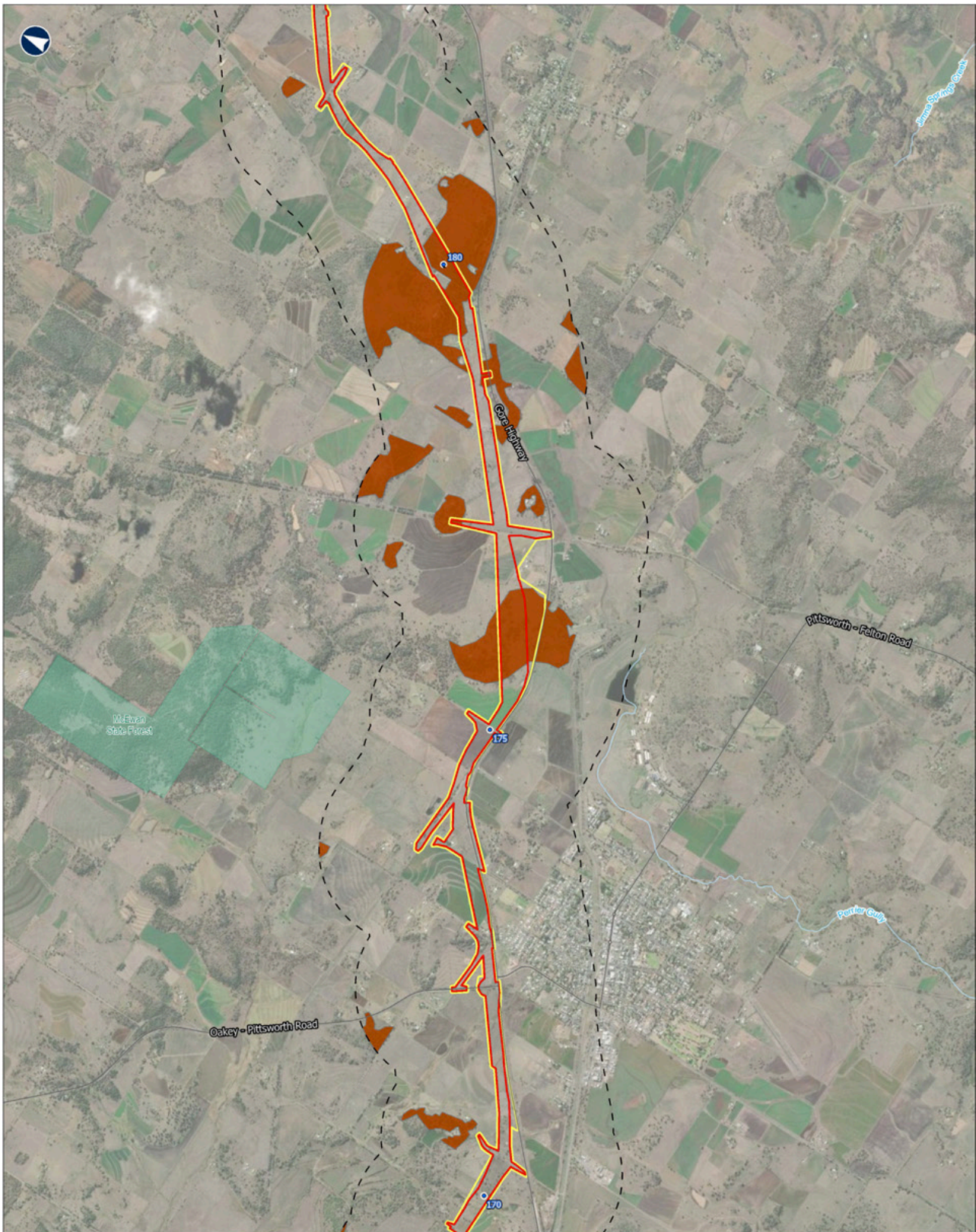
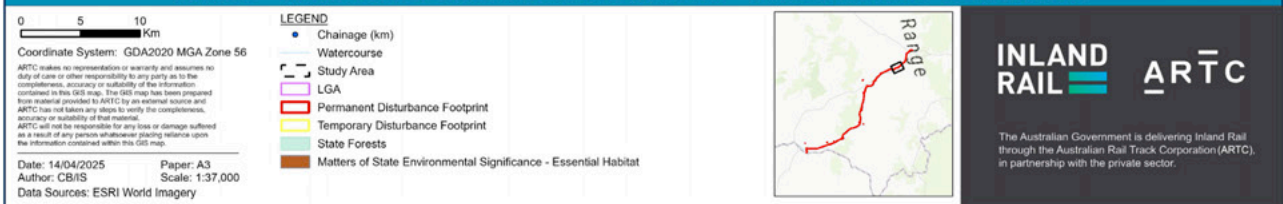


Figure 11 - 6 (26) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 26 OF 30



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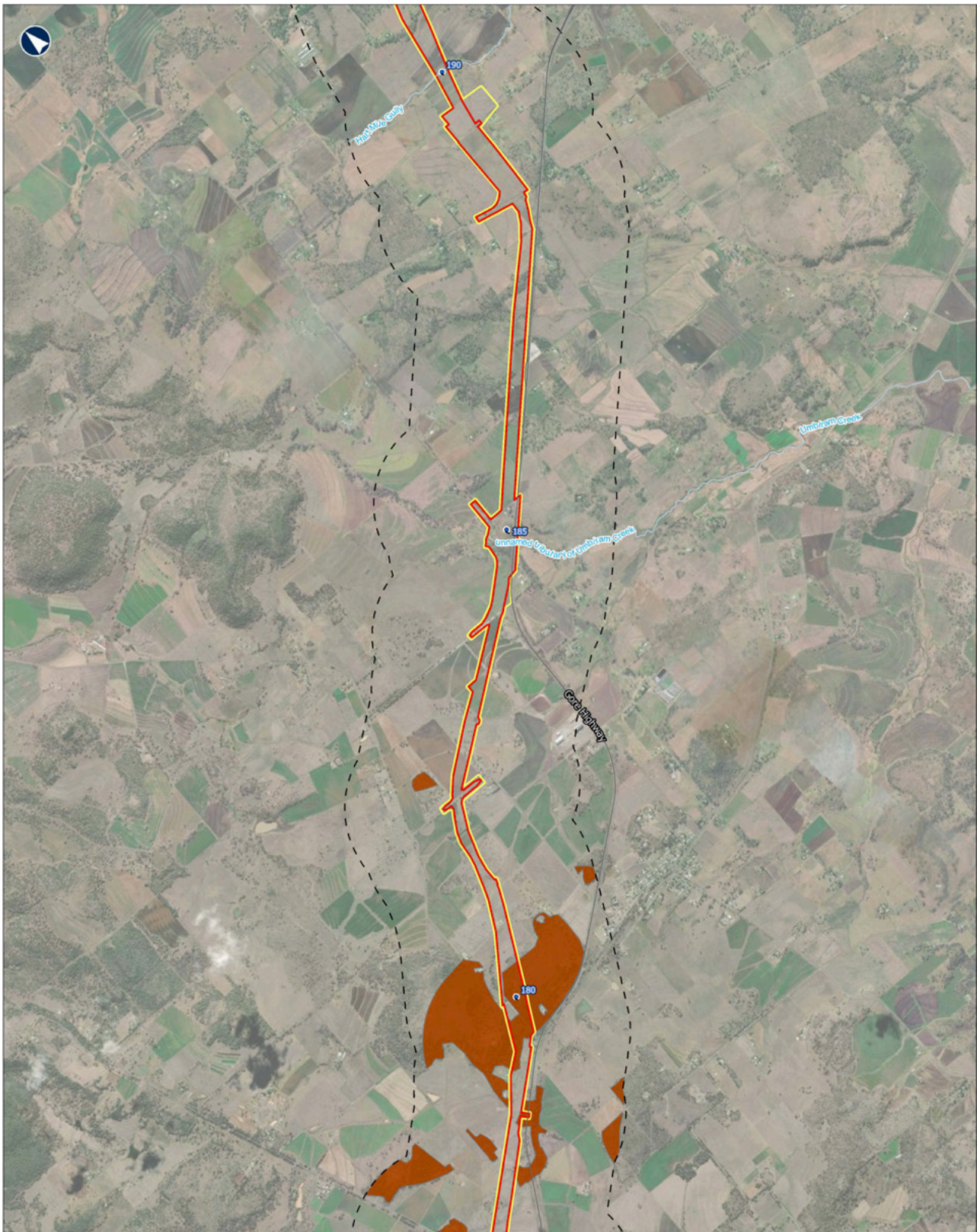
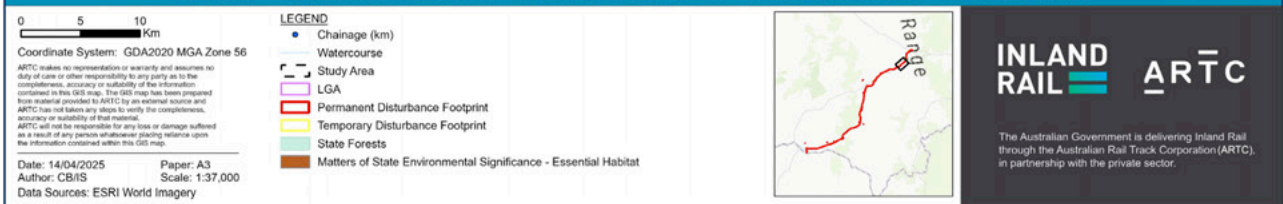


Figure 11 - 6 (27) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 27 OF 30



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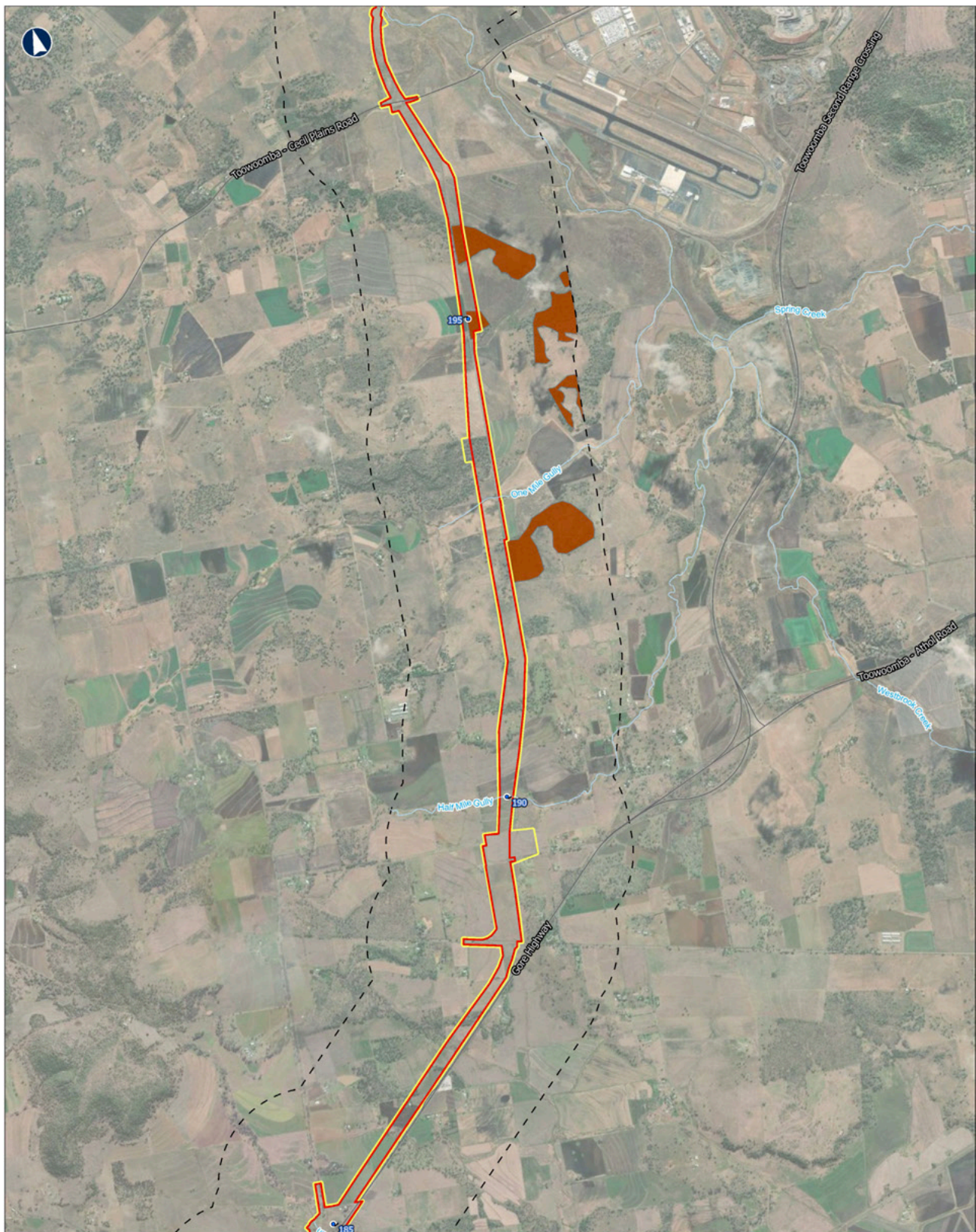
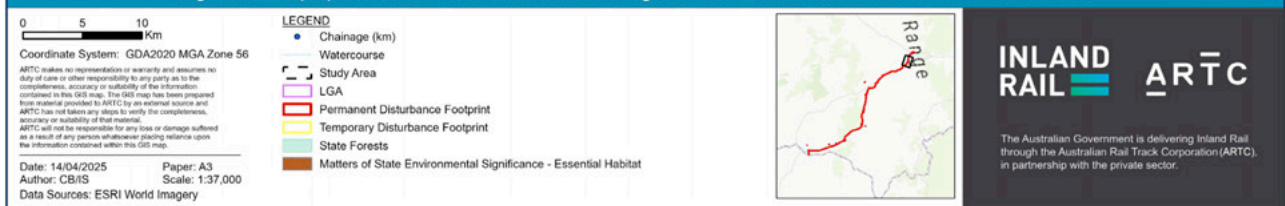


Figure 11 - 6 (28) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 28 OF 30



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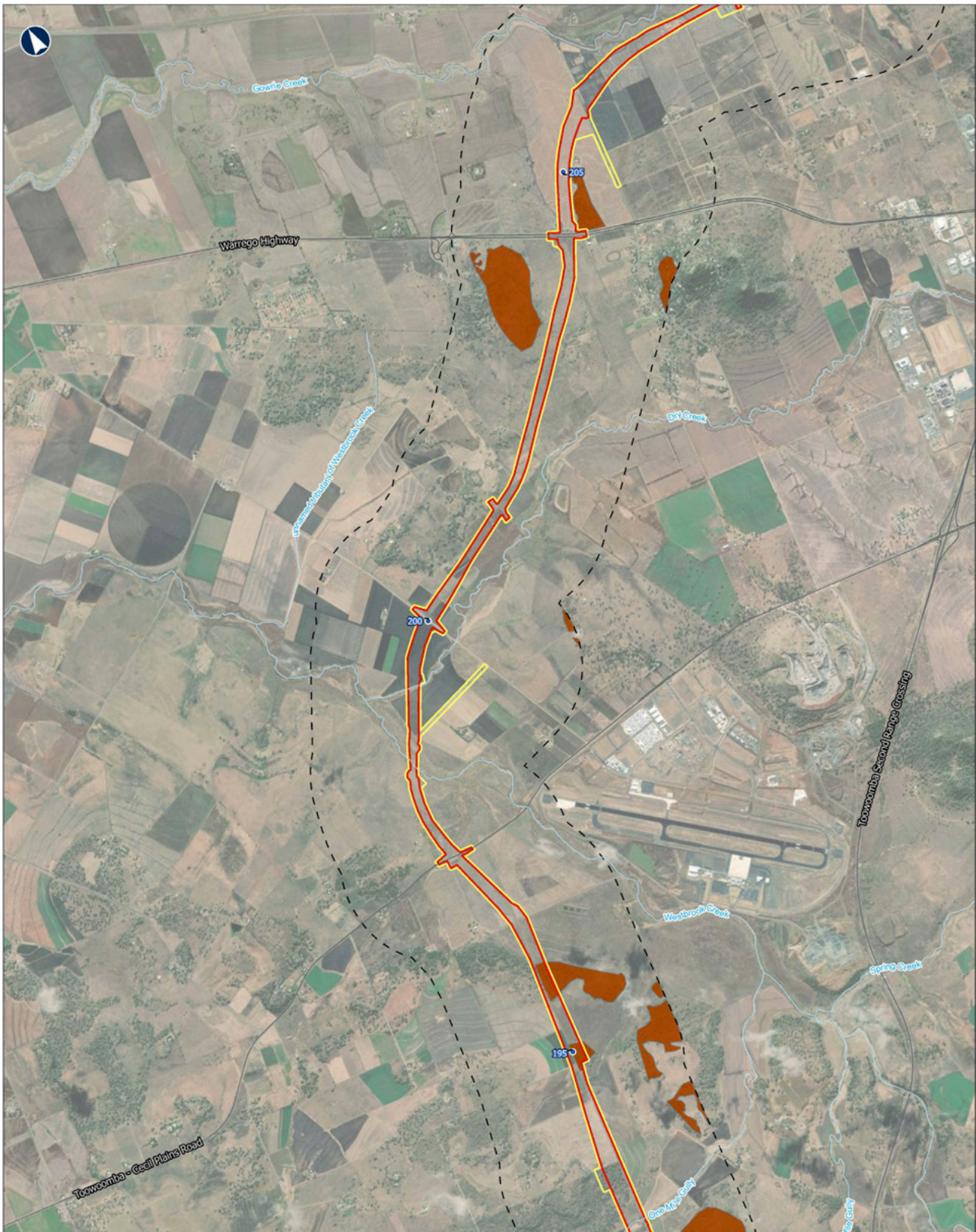


Figure 11 - 6 (29) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 29 OF 30



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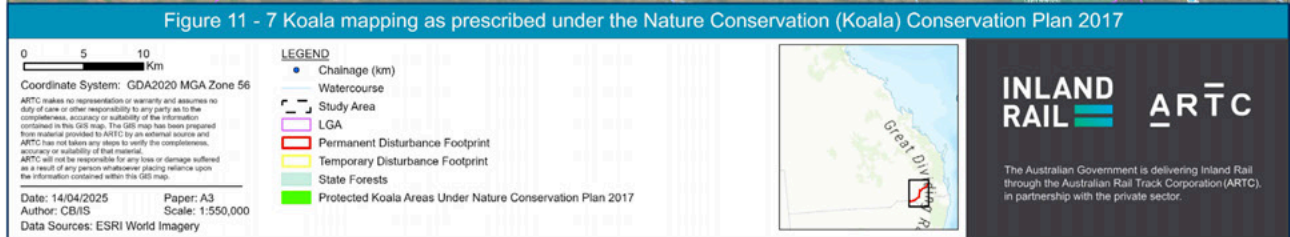
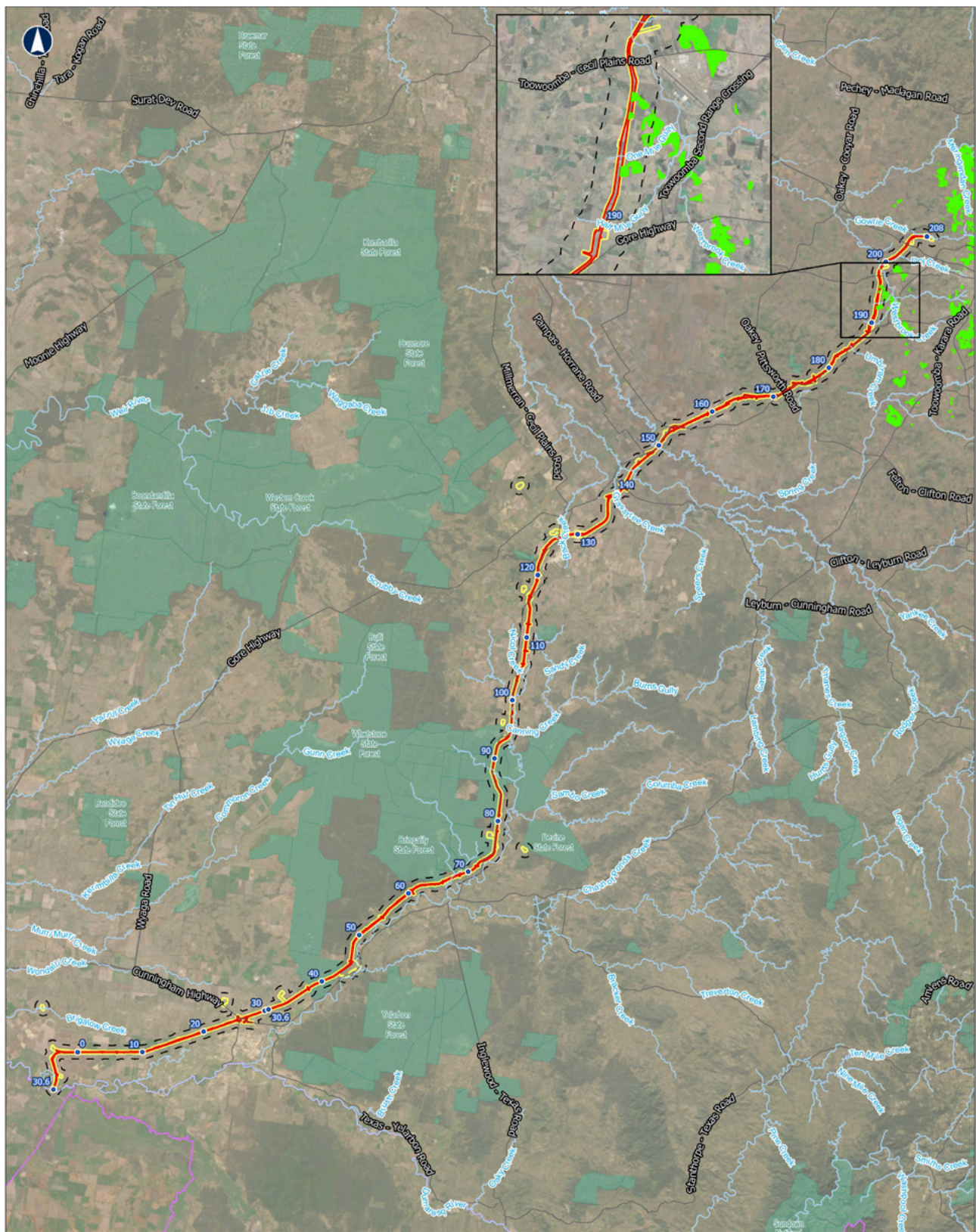


Figure 11 - 6 (30) Matters of State Environmental Significance - Wildlife Habitat and Essential Habitat

MAP 30 OF 30



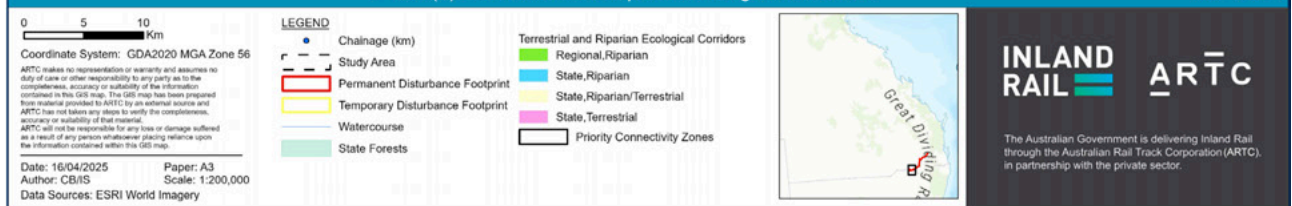
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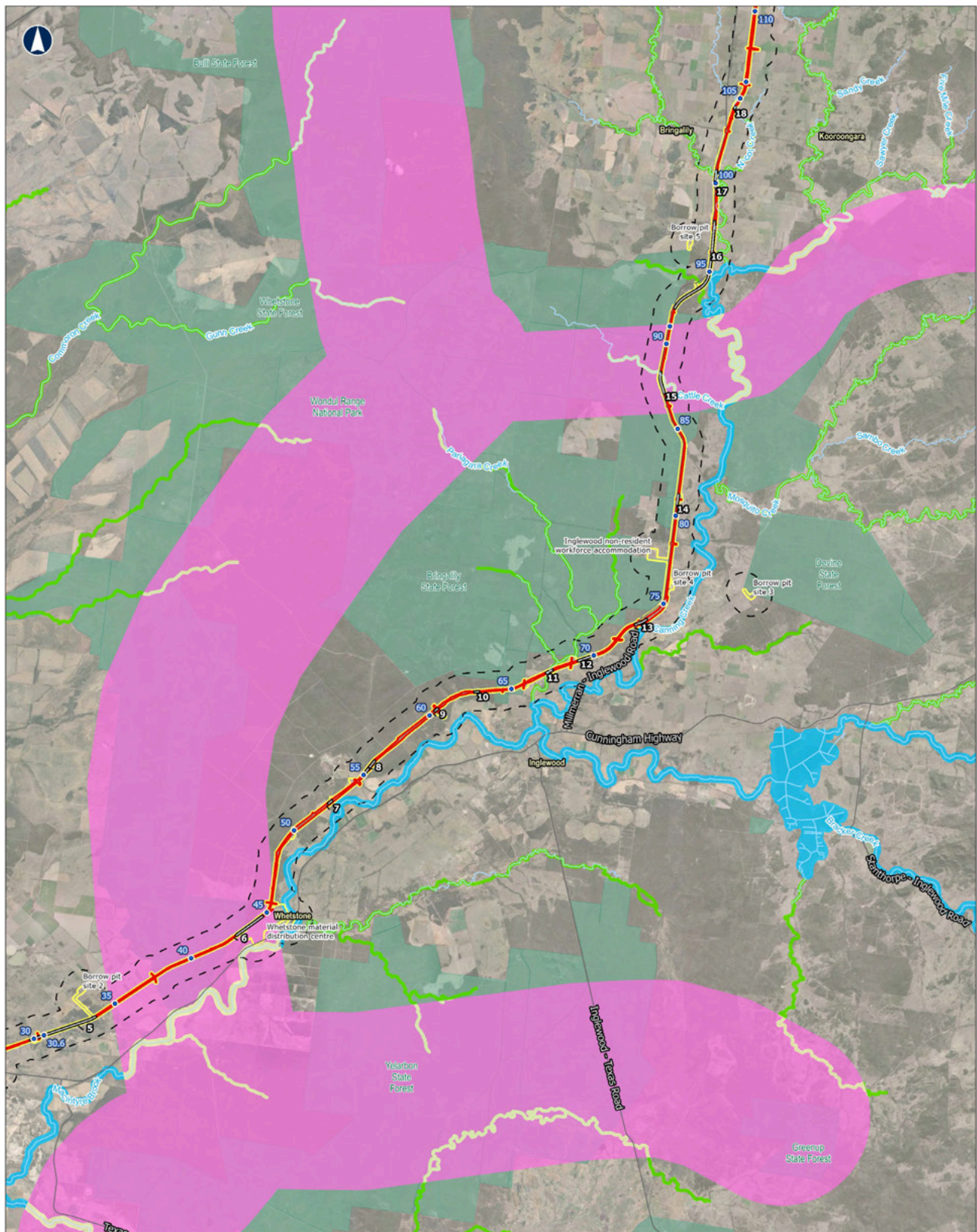


F11-8 (1) - Terrestrial and Riparian Ecological Corridors

MAP 1 OF 4



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F11-8 (2) - Terrestrial and Riparian Ecological Corridors

MAP 2 OF 4

0 5 10 Km
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Data Sources: ESRI World Imagery
Paper: A3
Scale: 1:200,000

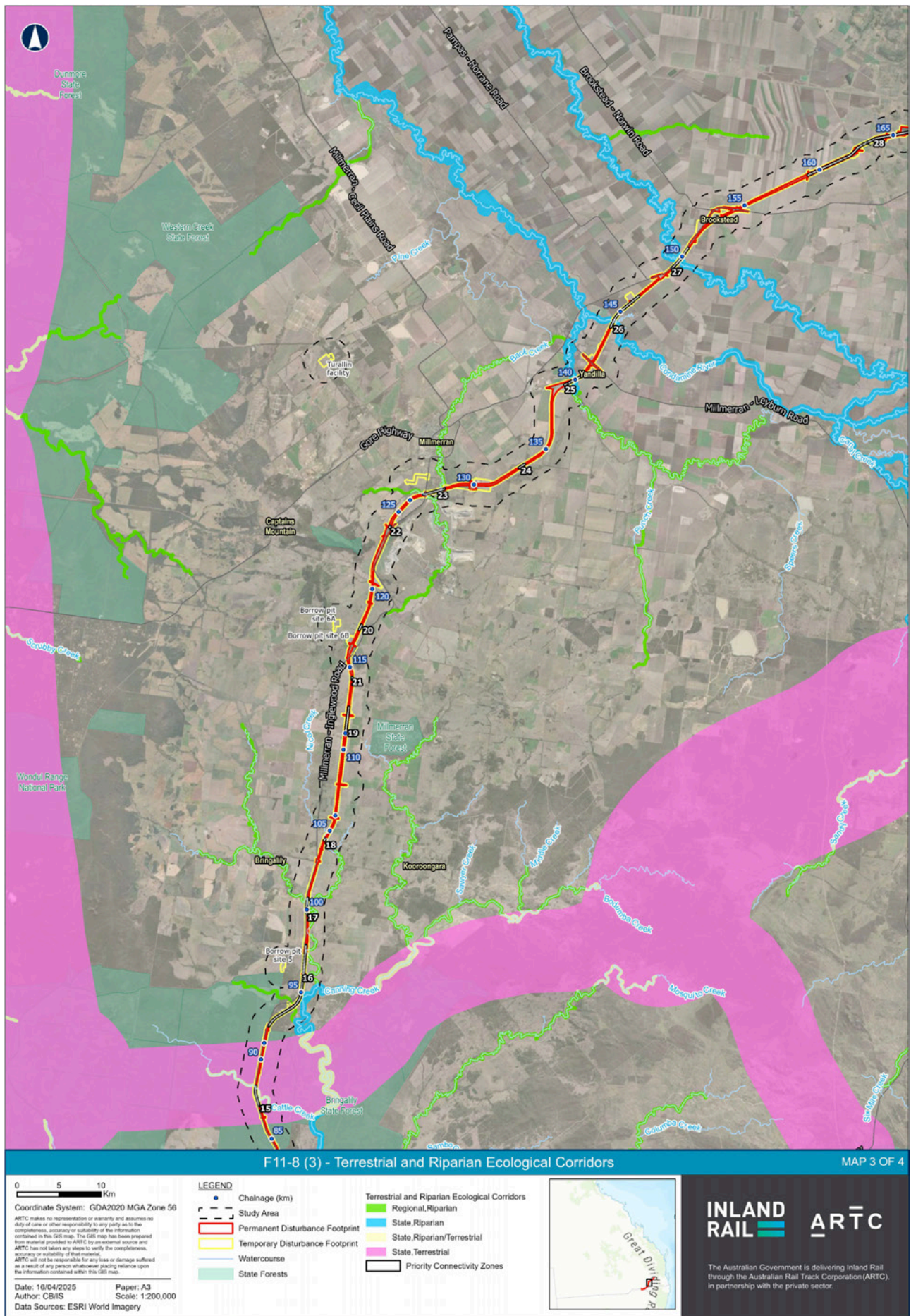
LEGEND
● Chainage (km)
--- Study Area
--- Permanent Disturbance Footprint
--- Temporary Disturbance Footprint
--- Watercourse
--- State Forests
Terrestrial and Riparian Ecological Corridors
--- Regional/Riparian
--- State/Riparian
--- State/Riparian/Terrestrial
--- State/Terrestrial
--- Priority Connectivity Zones

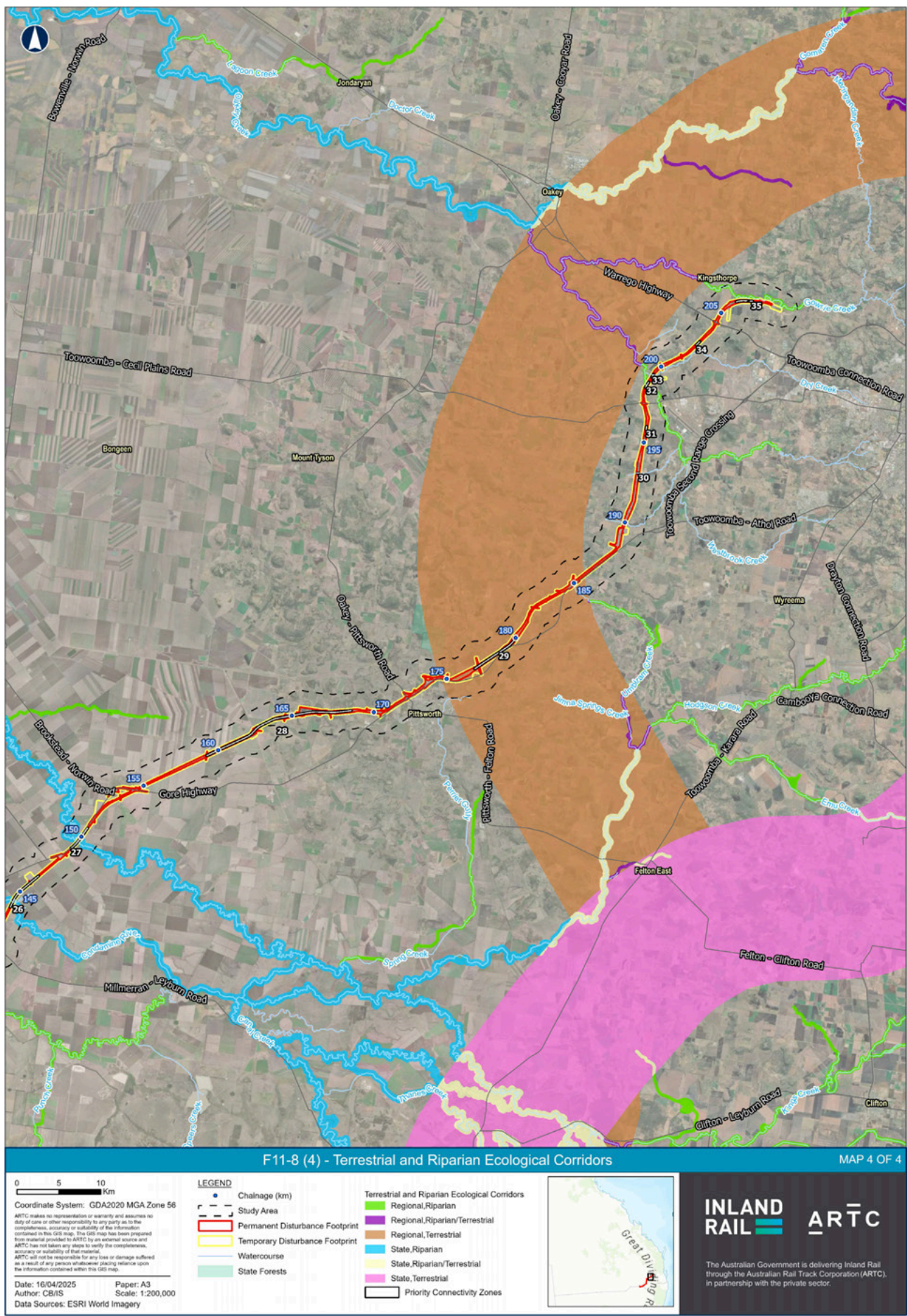


INLAND RAIL **ARTC**

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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11.5.12 Matters of local environmental significance

The Project intersects both Goondiwindi and Toowoomba LGAs who have their own Planning Scheme Environmental Overlays and associated overlay codes. Assessment of the purpose and overall outcomes of these codes are provided in the following sections. While the Project footprint intersects areas mapped as MLES under the TRC Planning Scheme, the Project is exempt from assessment against the Environmental Significance Code and MLES of the Planning Schemes as it is GSTI.

11.5.12.1 Goondiwindi Regional Council

Areas of the Project footprint are mapped within the Biodiversity Overlay Code under the GRC Planning Scheme; however, as the Project is GSTI, this will not trigger an assessment against the provisions of the Biodiversity Overlay Code. The purpose and overall outcomes of this code states:

1. The purpose of the Biodiversity areas Overlay Code is to ensure that matters of environmental significance are identified and protected.
2. The purpose of the code will be achieved through the following overall outcomes:
 - A: development protects MSES to maintain ecological integrity
 - B: development manages impacts on MSES to avoid adverse impacts on environmental values
 - C: development enhances the health and resilience of ecological systems and supports ecological connectivity.

MSES are assessed under relevant State legislation.

11.5.12.2 Toowoomba Regional Council

Areas of the Project footprint are mapped within the TRC Planning Scheme Environmental Significance Overlay Code, including biodiversity corridors and areas of ecological significance; however, as the Project is GSTI, this will not trigger an assessment against the provisions of the Environmental Significance Overlay Code. The purpose and overall outcomes of this code states:

1. The purpose of the Environmental Significance Overlay Code is to avoid or minimise the impacts of development on:
 - a) The biodiversity values of ecosystems, ecological processes, areas of ecological significance and biodiversity corridors
 - b) The ecological, hydrological and water quality values of natural waterways and wetlands.
2. The purpose of the code will be achieved through the following overall outcomes:
 - a) *Impacts on biodiversity values of ecosystems, areas of ecological significance and biodiversity corridors are avoided, or where they cannot be avoided impacts are minimised and impacts on biodiversity values are offset consistent with the Queensland Government Environmental Offsets Policy and other applicable biodiversity/environmental offsets policies*
 - b) *Ecological processes and the ecosystem services provided by areas of ecological significance are maintained*
 - c) *Habitat areas are connected by viable biodiversity corridors*
 - d) *Degraded ecosystems, habitats and corridors are restored*
 - e) *Ecological values and processes of waterways and wetlands are protected*
 - f) *The hydrological regime of wetlands and waterways is protected and rehabilitated to its natural state*
 - g) *Water quality is maintained or improved.*

The Project footprint intersects biodiversity corridors, waterways and wetlands, and areas of ecological significance identified by the TRC Planning Scheme overlay mapping and these align with those mapped within the State mapping, particularly with areas mapped as regulated vegetation Category B, defined watercourses and essential habitat.

There are several areas of remnant vegetation within the Project footprint which have local environmental importance, including the following:

- ▶ Remnant roadside trees along the Gore Highway
- ▶ Koala habitat trees at Southbrook west of Geitz Road, Southbrook
- ▶ Remnant patches near Murlaggan Road, Pittsworth
- ▶ Trees along existing rail line near Ware Street, Brookstead
- ▶ Remnant riparian vegetation at both the main branch and northern branch of the Condamine River
- ▶ Remnant riparian vegetation at Grasstree Creek
- ▶ Vegetation along Owen's Scrub Road, Millmerran
- ▶ Remnant riparian vegetation at Back Creek
- ▶ Remnant riparian vegetation at Bringalily Creek
- ▶ Remnant riparian vegetation at Native Dog Creek.

As the Project is GSTI, assessment against the provisions of the Environmental Significance Overlay Code is not triggered; however, direct impact to vegetation in some of these areas has already been reduced through the revised reference design. Further opportunities to avoid or minimise impacts to these areas will be investigated in consultation with TRC and incorporated into the detailed design for the Project.

MSES are assessed under relevant State legislation.

11.5.13 Invasive species biosecurity areas

The Project footprint intersects the wild dog check fence at three locations and will be realigned in three locations, between Ch 37.7 km to Ch 43.5 km, Ch 50.2 km to Ch 51.2 km and Ch 54.6 km to Ch 56.0 km. The GRC is responsible for the maintenance of approximately 283 km of the wild dog check fence.

In addition, the Project intersects the 555 km long Darling Downs Moreton Rabbit Board (DDMRB) rabbit-proof fence through the locality of Clontarf, at approximate Ch 102.2 km. Management and maintenance of the fence is undertaken by the DDMRB. The fence stretches from Lamington National Park in the east, to Goombi in the southwest, where it connects to the wild dog fence.

The Project footprint does not traverse any current fire ant biosecurity zones. Fire ant biosecurity zones are in place in areas of Queensland to restrict the movement of materials that could spread the red imported fire ant (*Solenopsis invicta*). Regardless of the Project being outside fire ant biosecurity zones, there are restrictions and obligations regarding the movement of certain materials such as soil, baled hay or mulch, manure, quarry products, potted plants, and tuft from fire ant biosecurity zones 1 and 2. Works will be undertaken in accordance with the *Biosecurity Act 2014* (Qld), the *Qld Biosecurity Regulation* (2016) and the GRC 2022 Strategic Biosecurity Plan. Any material that is to be transported across the NSW and Queensland border will require an Interstate Biosecurity Certificate. Additionally, thorough inspections of all earth moving equipment and delivery trucks containing machines, quarry and soil materials will be conducted prior to travel.

The general biosecurity obligations as outlined in the National Fire Ant Eradication Program are as follows:

- ▶ Understand what fire ants and their nests look like
- ▶ Check the fire ant biosecurity zones
- ▶ Find out what materials fire ants can be moved in
- ▶ Inspect material for any fire ant activity before moving it
- ▶ Follow movement controls relevant to the materials you or your business are working with, including when buying and selling products. Use our material movement advice tool to find out what rules apply in specific situations
- ▶ Report suspected ants: Complete the online reporting form or call 13 25 23
- ▶ Clean machinery and equipment used when working with materials that can carry fire ants, before moving it off-site
- ▶ Treat any fire ants you find to reduce the risk of them spreading (DAF, 2022).

11.6 Potential impacts

Potential impacts to ecological values may occur during all applicable Project stages including pre-construction and early works, construction and commissioning and operations. The potential impacts are summarised in Table 11-23. This section outlines unmitigated potential impacts to ecological values associated with the Project. Whether each pathway is a direct or indirect impact may be unclear at times; however, the purpose of this table is to recognise all potential impact pathways.

TABLE 11-23 SUMMARY OF IMPACTS AND AFFECTED ECOLOGICAL VALUES

Potential impact pathways	Impact type	Susceptible ecological values		
		TECs	Flora	Fauna
Habitat loss from vegetation clearing	Direct and indirect	Yes	Yes	Yes
Fauna species injury or mortality	Direct	No	No	Yes
Reduction in biological viability of soil to support plant growth	Direct	Yes	Yes	No
Invasion of weeds, pathogens and pest species	Indirect	Yes	Yes	Yes
Habitat fragmentation	Indirect	Yes	Yes	Yes
Reduction in the connectivity of biodiversity corridors	Indirect	No	Yes	Yes
Barrier effects	Indirect	No	Yes	Yes
Edge effects	Indirect	Yes	Yes	Yes
Traffic and transport	Direct and indirect	No	No	Yes
Noise and vibration	Indirect	No	No	Yes
Dust	Indirect	Yes	Yes	Yes
Lighting	Indirect	No	No	Yes
Contamination	Indirect	Yes	Yes	Yes
Changes to groundwater resources	Indirect	Yes	Yes	No
Waste management	Indirect	No	No	Yes
Aquatic habitat degradation	Indirect	No	No	Yes
Erosion and sedimentation	Indirect	Yes	Yes	Yes
Flooding	Indirect	Yes	Yes	Yes

11.6.1 Project activities

Activities proposed as part of the Project have been categorised into two stages: pre-construction and construction, and commissioning and operation. Impacts of decommissioning are not assessed as it is too far in the future. A summary of Project-related activities and the duration of their disturbance is provided in Table 11-24. The Project-related activities and the duration of disturbance associated with them have been used for the following purposes:

- ▶ Assessment of the nature and extent of potential impacts to ecological values
- ▶ Extent of potential impacts to ecological values.

Clearing associated with the Project as well as full description of Project activities contained within the Project footprint is provided in Chapter 5: Project Description.

TABLE 11-24 SUMMARY OF PROJECT RELATED ACTIVITIES ASSOCIATED WITH CONSTRUCTION, COMMISSIONING AND REINSTATEMENT AND OPERATION STAGE

Stage	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
Pre-construction and construction	Site preparation (relating to all work sites)	Vegetation clearing	Permanent
		Topsoil stripping	Medium term
		Construction of temporary site compounds including fencing	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water storage	Medium term
		Installation of offices, hardstands.	Medium term
		Stockpiling	Medium term
		Establishment of initial laydown areas	Medium term
		Establishment of temporary drainage infrastructure (e.g. sediment ponds)	Medium term
		Borrow pit establishment and excavation of fill	Medium term
	Additional surveys	Potential further geotechnical investigations	Short term
	Traffic and transport	Delivery of materials to the Project footprint	Medium term
		Movement of workforce	Medium term
		Transportation/collection of plant, equipment and other machinery	Medium term
		Delivery of non-resident workforce accommodation cabins to site	Medium term
		Rail-to-road diversions due to track closures	Medium term
	Fencing	Modification of biosecurity fencing	Long term
		Installation of boundary fencing	Short term
	Relocation of QR assets and utilities/services	Moving/protection of QR assets	Medium term
		Establishing utilities and services	Medium term
	Accommodation	Establishment of non-resident workforce accommodation	Medium term
	Utility diversions	Excavation	Short term
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/medium term
	Drainage	Installation of drainage infrastructure (culverts, longitudinal drainage, scour)	Permanent
	Structures	Construction of waterway crossings (bridges and piers)	Permanent
		Road/rail bridge construction	Permanent
	Civil works	Earthworks and embankment construction involving excavation for cuts, cut to fill, importation of fill from quarries and other external sources where required and bank stabilisation	Medium term
		Construction of temporary haul roads	Medium term
	Road works	Road realignment	Permanent
		Construction of permanent rail maintenance access roads	Permanent
	Rail logistics	Sleeper stockpiling	Medium term
		Rail stockpiling	Medium term

Stage	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
	Rail construction	Drilling	Short term
		Ballast installation	Short term
		Sleeper placement	Long term
		Rail placement	Permanent
		Installation of train signals and communications infrastructure	Long term
		Demobilising site compounds	Short term
	Signals and communications installation	Installation of telecommunications and signalling infrastructure	Short term
	Demobilisation	Temporary site offices, accommodation facilities, laydowns, fencing, stockpile areas, temporary drainage, concrete batch plants, and associated facilities removed. Construction sites, borrow pits, compounds, and access routes will be reinstated or rehabilitated progressively once available.	Short term
		Removal of temporary waterway crossings as soon as they are no longer needed to support construction works	Short term
		Decommissioning and decontamination of any impact areas (e.g. around fuel transfer locations)	Short term
		Stabilisation of landforms	Permanent
		Progressive establishment of permanent fencing	Short term
		Decommissioning of access roads no longer required	Short term
Commissioning and operation	Testing and commissioning	Testing and checking of the rail line and communication/signalling systems	Short term
	Training	Driver training and test trains	Short term
	Train operations	Train movement along railway	Permanent
	Operational maintenance works	Ongoing vehicle movement within railway corridor	Long term
		Minor maintenance works:	Short term
		▶ Bridge inspections	
		▶ Culvert cleanout	
		▶ Sleeper replacement	
		▶ Rail welding and grinding	
		▶ Ballast profile management	
		▶ Track tamping	
		▶ Vegetation management – slashing/clearing	
		Major periodic maintenance:	Short term
		▶ Ballast cleaning	
		▶ Formation work	
		▶ Reconditioning of track	
		▶ Adjustment	
		▶ Turnout replacement	
		▶ Correction of track level and line	
		▶ Maintenance of structures including waterproofing, jointing	

Table note:

* Duration of disturbance timeframes (DSDI, 2024):

▶ Short term – up to 12 months ▶ Medium term – from 1 to 3 years ▶ Long term – from 3 to 100 years ▶ Permanent.

11.6.2 Potential impacts to terrestrial ecological values

11.6.2.1 Habitat loss from vegetation clearing

Habitat loss through vegetation clearing will pose the largest risk of direct adverse impacts for biodiversity arising from the Project construction. Vegetation clearing will occur during the pre-construction and construction stages and will result in the loss of available habitat within the Project footprint for EPBC Act and NC Act Threatened and SLC Special Least Concern species, as well as other MSES.

The Project footprint encompasses a total of 3,382.17 ha, with 2,544.86 ha being within the permanent footprint and 837.31 ha being temporarily disturbed. Ground-truthed vegetation mapping indicates that the Project footprint includes approximately 570.76 ha of remnant vegetation, 16.48 ha of mature regrowth vegetation and 270.92 ha of immature regrowth vegetation. The remaining 2,524.02 ha (74.6 per cent of the Project footprint) has been subject to previous clearing for agriculture, grazing, mining, industry, or transport (road and rail corridors) and is classified as non-remnant areas.

11.6.2.2 Fauna species injury or mortality

Refinement of the Project footprint has considered fauna movement pathways with the aim of minimising the amount of fauna injury/mortality that will occur as a result of the Project; however, fauna injury or fatality has the potential to occur during all stages of the Project with the highest potential likelihood during construction activities that involve vegetation clearing, earthworks and trenching.

Physical trauma to MNES fauna species causing injury or mortality may occur through:

- ▶ Vegetation clearing
- ▶ Vehicle strike related to construction or maintenance traffic (both onsite and offsite)
- ▶ Fauna being trapped in trenches or other excavations
- ▶ Barbed wire entanglement
- ▶ Construction within waterways that may impact on aquatic fauna
- ▶ Train strike during the operational stage.

Vegetation clearing, earthworks and trenching

The highest potential likelihood of physical trauma to fauna is during construction activities within the Project footprint that involve vegetation clearing, earthworks and trenching. This impact will be proportionate to the extent of vegetation and habitat potential for species that is removed.

Some diurnal (active during the day) and mobile species, such as birds, may move away from areas being disturbed and may not be adversely affected unless they are nesting; however, less mobile species (i.e. ground-dwelling reptile and mammal species), species restricted to constrained habitats (i.e. aquatic species), or those that are nocturnal and nest or roost in trees or tree hollows during the day (i.e. arboreal mammals such as listed gliders and koala), may find it difficult to move away from roosts or active breeding places.

Entrapment of fauna in trenches or other excavations may also cause physical trauma to fauna. Open trenches for underground utilities, or other pits are known to be effective at trapping a wide variety of wildlife and often result in mortality (Ayres and Wallace 1997; Doody et al. 2003; Woinarski et al. 2006). Species most likely to become trapped are ground dwelling species that are capable of moving across modified areas and arboreal species which ascend to the ground to disperse.

Vehicle strike

Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia (Coffin 2007; Rowden et al., 2008). The construction of tracks, the general use of access tracks and roads within the Project footprint, and the increase in traffic across the broader region as a result of the Project construction, will result in increased potential for vehicle strike. There may be increased risk around concentrated areas such as laydown areas and camps. In addition, once operational, train strikes with fauna may also occur.

Mammals, reptiles, amphibians and birds are all at risk of vehicle strike, particularly common species (e.g. macropods) that are tolerant of disturbance and/or those species that can utilise roads or railway corridors for movement pathways or as foraging habitat.

Within the Condamine floodplain region of the Project footprint, while there is limited corridor fencing proposed due to flooding constraints, the drainage design in this area includes oversize culverts and bridges very closely spaced throughout the floodplain due to the need to cater for the large amounts of overland flow. This series of continuous drainage infrastructure will facilitate safe passage of fauna across the floodplain, as well as some species being able to freely traverse the floodplain without the need to access specific crossing infrastructure.

Fence entanglement

The use of fauna fencing is one mechanism that would be implemented for the Project in order to reduce the likelihood of interaction between vehicles (including trains) and fauna species. By reducing the likelihood of interaction between fauna and vehicles, impacts to individual fauna (and population numbers) can be minimised; however, fauna entanglement within pest exclusion fencing or barbed wire fences is a known hazard for a large range of wildlife, in particular flying foxes, gliders, macropods, waterbirds, and nocturnal birds. Wildlife flies or glides into pest exclusion fencing or barbed wire fences, becoming entangled and succumbing to exposure or predation. Several species were recorded deceased on barbed wire fences during surveys including little red flying foxes, black flying foxes and white-faced heron. Entanglements are possible on all barbed wire fences, regardless of surrounding water or vegetation, with deceased flying foxes located on fences intersecting cleared paddocks.

Due to the length to be constructed, fauna exclusion fencing constructed for the Project has the potential to cause widespread mortality and injury to a large variety of resident fauna species. The fencing approach for the Project is described in Chapter 5: Project Description. Many kilometres of such fencing already exist in the area and Project fencing will in part replace existing fencing. For example, the existing wild dog fence will need to be reinstated on the northwest side of the rail corridor in a number of locations as rectification for severance of this fence, as described in Chapter 5: Project Description.

11.6.2.3 Reduction in biological viability of soil

Project activities can lead to soil compaction which may result in a reduction in biological viability of soils to support plant growth. Compaction of soil and loss of topsoil may result in direct impacts to soil consistency (i.e. the strength and coherence of a soil) and soil structure (i.e. the arrangement of soil particles). The most direct effect of soil compaction is restriction of plant root growth and function. Due to the increase in bulk density, large pores essential for water and air movement in soil are primarily affected. As a result, the effects of soil compaction may negatively impact TECs and threatened flora species; however, soil compaction will be limited to the Project footprint and will not impact uncleared areas outside the Project footprint.

The loss of nutrient rich topsoil as a result of Project activities may also impact the ability of the soil to support flora. Reduction in soil viability and nutrient loss associated with erosion, especially topsoil, may negatively impact TECs and threatened flora species. Impacts to soil may also have flow on effects to MNES fauna through degradation of their associated habitat. This impact may extend outside the Project footprint if erosion is unmitigated.

11.6.2.4 Introduction and spread of weeds, pathogens and pest species

Weeds, pathogens and pest species have the potential to impact on terrestrial and aquatic biodiversity through displacement, health impacts, predation and competition. Pest species can also damage native vegetation by grazing and trampling (Adair and Groves, 1998; Clarke et al., 2000; Thorp and Lynch, 2011). Accordingly, it is possible that proliferation of weed, pathogen and pest species may reduce the extent of available habitat and hence population size for specific threatened flora and fauna species. This may have the effect of increasing mortality and reducing the size and viability of population sizes through resource limitation and associated stresses. Pathogens have the potential to impact on flora directly (e.g. Myrtle rust or *Phytophthora*), fauna directly (e.g. beak and feather disease) and/or the quality of habitat for flora and fauna species. This may have the effect of increasing mortality and reducing the size and viability of populations through resource limitation and associated stresses.

Proliferation of weed, pathogen and pest species have the potential to occur during all stages of the Project; however, colonisation potential is increased during vegetation clearing and soil disturbance activities during the construction stage, and also during rehabilitation activities of the temporary disturbance footprint.

It should be noted that weed and pest species are already present and often widespread within the study area, as demonstrated through the field surveys. A total of 21 Category 3 restricted matter flora species (under the Biosecurity Act) are known to occur within the study area, with 13 species of these also listed as WoNS. Additionally, nine non-native fauna species, all declared as restricted matters (invasive animals) under the Biosecurity Act, were identified within study area during field investigations.

Activities associated with all stages of the Project also have the potential to increase the spread of pathogens including myrtle rust. Myrtle rust is caused by the fungus *Austropuccinia psidii* and threatens the tree and shrub species of the *Myrtaceae* family, including *Melaleuca spp.*, *Eucalyptus spp.*, *Angophora spp.*, and *Corymbia spp.* Myrtle rust spreads and reproduces via spores carried on: clothing; infected plants and plant material; equipment, machinery and vehicles; and insects and animals (DCCEEW, 2024c).

Without appropriate management strategies, the Project activities have the potential to disperse and introduce weeds, pathogens and pests into areas of surrounding vegetation (outside of the Project footprint). Project activities also have the potential to introduce new weed species into the study area through earthworks, movement and disturbance of soil and attachment of seed (and other propagules) to vehicles and machinery.

11.6.2.5 Habitat fragmentation

Habitat fragmentation relates to the physical separation of a continuous habitat into disjointed smaller fragments (Fahrig, 2002). The habitat fragments are smaller and separated from each other by a matrix of less suitable habitat. The habitat fragments tend to be separated from each other by a matrix of less suitable habitat. The new habitat type situated fragments is often artificial (e.g. a railway or road) and less suitable to the species remaining within the newly created fragments (Bennett, 1990) or is generally only used by adaptive and aggressive generalist species (e.g. noisy miners) (Loyn et al., 1983) which further decreases population levels of other species remaining in the fragments. Fragmentation reduces patch size, thereby increases edge effects within a patch and reduces the area of undisturbed 'core' habitat for the fauna species present in an area.

The landscape in which the Project is situated is already highly fragmented, with most vegetation occurring as small fragments due to previous agricultural practices. Within the study area, many patches of vegetation are small, irregularly shaped, and fragmented, and as such are already subject to considerable edge effects.

The Project will result in localised fragmentation to remaining vegetation and habitats. This has the potential to be detrimental to ecological communities, flora species and the dispersal of fauna species. Fauna groups most susceptible include terrestrial invertebrates, small mammals, frogs, and reptiles; however, larger terrestrial species are also susceptible, particularly where fencing creates an additional barrier.

Habitat fragmentation has been identified as an important threatening process to MNES such as greater glider (southern and central) (*Petauroides volans*), and koala (*Phascolarctos cinereus*). This is due to the importance of connectivity, dispersal opportunities and habitat quality for species at a local scale and the cumulative impacts at a regional scale. In some instances, the Project may not result in significant fragmentation of populations identified as relevant to the area given the capacity of some species such as large birds and bats to disperse widely across the landscape (e.g. migratory birds).

Potential habitat fragmentation (and associated edge/barrier effects) have been reduced as much as possible through the revised reference design.

Loss of connectivity in biodiversity corridors

Biodiversity corridors (including those associated with waterways) can be defined as systems of linear habitat that enhance the connectivity of wildlife habitat and may help to overcome the main consequences of habitat fragmentation (Wilson and Lindenmayer, 1995). While not every species utilises them, corridors can assist ecological functioning at a variety of spatial and temporal scales, from daily foraging movements, to broad-scale genetic gradients across biogeographical regions, and fragmentation of such corridors have been identified as important threatening process to many threatened species such as greater glider (southern and central) (*Petauroides volans*), and koala (*Phascolarctos cinereus*).

Most of the study area exists in a generally fragmented environment, approximately 74.6 per cent comprising non-remnant environments. Despite this, functional connectivity is retained through local linkages of remnant and regrowth vegetation, associated with roadside and riparian corridors linking larger patches of vegetation throughout the landscape.

State-based Biodiversity Planning Assessment (BPA) mapping for the Brigalow Belt (DES, 2018a) depicts State corridors within the study area where the Project footprint intersects vegetation associated with Yelarbon, Whetstone and Bringalily State forests. The Project footprint also intersects a regional corridor comprising patchy fragmented vegetation to the north of Pittsworth. The corridor mapping shows vegetation that is significant for the spread and movement of flora and fauna, including MNES and MSES. The Fauna Connectivity Strategy identifies a total of 35 priority connectivity zones (PCZs) along the Project (Figure 11.8 and Figure 4.10 in Appendix P). These zones include higher priority locations in the landscape where ecological connectivity for target fauna species currently exists and intersects with the Project. PCZs have been identified for the Project based on detailed connectivity modelling and a Project-specific approach as described in the Fauna Connectivity Strategy. Project identified PCZs include areas where:

- ▶ There are high levels of existing connectivity, such as a BPA State or Regional Corridor, a local vegetation corridor, least cost paths and corridors and waterways
- ▶ Least cost paths contributed to the identification of the PCZs but were not definitive in prioritisation of movement pathways
- ▶ Presence of habitat for threatened species with geographically restricted ranges or species with very small movement capacity (e.g. Murray cod, Condamine earless dragon, Brigalow woodland snail)
- ▶ The presence of broader connectivity elements such as stepping stone habitat, in areas parallel or adjacent to a waterway, or adjacent to waterways connecting to higher order streams, BPA corridors, or State forest

- ▶ Known koala movement paths and home ranges, based on the results of tracking of koalas being undertaken by the University of Southern Queensland, research commissioned and funded by ARTC for the Project to better understand the ecology of koalas in the area and inform mitigation strategies.
- ▶ There is long-term security of ecological communities in areas adjacent to the Project footprint, such as proposed ARTC offset properties that contain habitat for threatened species and/or existing high levels of existing connectivity. The presence of these properties provides long-term security for crossing structures and prescribed land management that increases the long-term success of mitigation effectiveness through land-use control.

The spatial extent of each PCZ conservatively corresponds with various relevant spatial features such as the abutment of bridges (e.g. the spatial extent of an identified PCZ encompasses the entire length of a bridged zone, rather than part of a bridge), the whole extent of an array of culverts, high-quality habitats within BPA corridors, and entire strips of riparian and/or roadside habitat."

The potential impacts of linear infrastructure traversing these biodiversity corridors include habitat fragmentation, edge effects and barrier effects. These potential impacts are discussed further in the following sections. An additional potential impact upon biodiversity corridors resulting from the Project is the proliferation of weeds and pest species.

The unmitigated potential impacts to biodiversity corridors resulting from the Project are likely to be long term and irreversible.

Biodiversity corridors and fauna connectivity is discussed in further detail in Appendix P: Fauna Connectivity Strategy, Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

Terrestrial barrier effects

Barrier effects (permanent and/or temporary) occur where species are either unable or unwilling to move between suitable areas of habitat due to the imposition of a barrier. This can include:

- ▶ A habitat type that has become unsuitable (e.g. cleared areas devoid of vegetation or structure)
- ▶ A physical barrier such as a fence, railway line, road or track, earthworks embankments, cuttings, noise barriers, or alteration to a waterway or a culvert that does not provide movement opportunities to fauna
- ▶ A non-physical barrier created by noise or light.

Various Project activities may create temporary and/or permanent barrier effects, particularly those that may create a hard barrier that restricts fauna movement (e.g. fences, noise and light walls, temporary waterway barrier works, retaining walls and sections of cliff or cutting, operational rail corridor, construction laydown areas). This is considered a potential impact in the area north of Inglewood (associated with State forests) due to the highly modified nature of much of the landscape elsewhere in the Project footprint.

Potential barriers to fauna movement were assessed as part of Appendix P: Fauna Connectivity Strategy.

Existing fencing such as the WDCF and the rabbit fence will be reinstated along the Project footprint. New sections of fencing will also be implemented to prevent fauna from crossing the Project footprint to reduce the risk of vehicle strike. Barbed wire and knot mesh fencing will be used minimally, and the majority of the fencing implemented will be plain mesh to reduce risk to fauna. Barbed wire and knot mesh wire will not be used at designated crossing points with appropriate infrastructure. While the unmitigated implementation of fencing has the potential to create barrier effects that will have long lasting negative impacts to fauna, the implementation of crossing structures such as culverts, glider poles, and bridges will ensure connectivity can be maintained.

Human activity and infrastructure (e.g. creating noise, dust, light, and movement) are likely to create a barrier as many species are known to avoid areas of human activity resulting in indirect habitat loss and degradation. Human presence may affect species in different ways. Some species display avoidance behaviour while others may habituate and become attracted to areas of human activity.

The unmitigated potential impacts of barrier effects resulting from the Project are in most cases short term and temporary (restricted to the construction stage) but may in some cases be long term and irreversible (related to the railway and access track).

Terrestrial barrier effects and species-specific responses are discussed in further detail in Appendix P: Fauna Connectivity Strategy, Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

Edge effects

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. Clearing and fragmentation creates more edges. These new environmental conditions can promote the growth of different vegetation types (including weed species), promote invasion by pest animals and/or native species specialising in edge habitats, or change the behaviour of resident native animals (Moenting and Morris, 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effect influences can vary and has been previously recorded from 50 m to greater than 1 km in from an edge (Forman et al., 2000; Bali, 2005).

Within the study area, many patches of vegetation are small, irregularly shaped, and fragmented, and are already subject to considerable edge effects. Therefore, it is unlikely that the Project would increase the overall extent of edge effects in these areas; however, in large habitat patches with low edge to area ratios, Project activities (e.g. vegetation clearing) may result in reduction of existing habitat along with associated edge effects.

Edge effects have the potential to impact on the range of flora and fauna species identified as occurring in the Project footprint, especially upon the species with specific micro-habitat requirements that are less tolerant to disturbance (e.g. *Xerothermella herbacea*, glossy black-cockatoo and five-clawed worm-skink). Conversely, some threatened species appear to respond positively to edge effects, particularly ground disturbance, and colonise these edge areas reasonably quickly (e.g. king bluegrass (*Dichanthium queenslandicum*), Belson's panic (*Homopholis belsonii*), hawkweed (*Picris evae*), austral cornflower (*Rhaponticum australe*), austral toadflax (*Thesium australe*) and squatter pigeon (*Geophaps scripta scripta*)). Additionally, some species (e.g. *Picris barbarorum*) are generally tolerant of edge related impacts and are often found within road reserves.

It is anticipated that MNES involving threatened species and wetland and waterway habitat, including habitat and microhabitat features for Murray cod (*Maccullochella peelii*), may be impacted greatest from edge effects, where avoidance of vegetated areas is not practicable. Clearing of this vegetation would result in a reduction of the microhabitat features that Murray cod rely on for breeding and spawning, creating an edge effect.

Unmitigated potential impacts of edge effects resulting from the Project are long term and irreversible.

11.6.2.6 Noise and vibration

This section has been prepared to provide an assessment of the potential noise and vibration impacts to native fauna during construction and operation.

Sound that is clearly perceptible does not necessarily mean that it will be unpleasant, annoying or disturbing in nature. Often, the effects of sound and vibration are masked by the sounds in the daily environment; however, noise and vibration may adversely affect wildlife by interfering with communication, masking the sound of predators and prey, causing stress or avoidance responses, and in some cases, may lead to changes in reproductive or nesting behaviour. Excessive noise may lead some species to avoid noisy areas, potentially resulting in the fragmentation of species habitat. On the other hand, many animals initially react to new noise as a potential threat, but quickly habituate, or 'learn' that the noise is not associated with a threat (Radle, 2007).

There are no current State or Commonwealth government policies, guidelines or standards that recommend noise thresholds or limits associated with impacts to fauna, in part because the effects of noise on most fauna species are poorly understood. This is because hearing characteristics are species specific. Where the hearing range of humans is typically 20 Hz to 20,000 Hz, fauna have varying hearing ranges (see Table 11-25).

It should be noted that as predicted sound pressure levels are generally assessed in A-weighted decibels (i.e. an expression of the relative loudness of sounds as perceived by the human ear) and given fauna species have varying hearing ranges to humans, the actual loudness of sounds as perceived by different species may not be accurately described; however, in the absence of an established weighting for the hearing characteristics of animals, the A-weighted sound level continues to be used.

TABLE 11-25 TYPICAL HEARING RANGE FOR VARIOUS ANIMAL SPECIES

Species	Typical hearing range (Hz)
Human (for reference)	64 – 23,000
Lizards	100 – 4,000 (Wever, 2022)
Cow	23 – 35,000
Grey-headed flying fox	2 – 54,000
Horse	55 – 33,500
Sheep	100 – 30,000
Poultry	125 – 2,000
Bat (microbat)	2,000 – 110,000
Terrestrial frog	100 – 3,000
Treefrog	50 – 4,000
Small parrot (e.g. cockatiel)	250 – 8,000
Large parrot (e.g. glossy black-cockatoo)	200 – 8,500
Owl	200 – 12,000
Koala	20 – 1,290 (Charlton, 2015)
Insects	10 – 100,000

Source: Adapted from Fay and Popper (1994)

The United States Department of Transportation (2004) summarises the hearing sensitivities of various wildlife groups as:

- ▶ Mammals: <10 Hz to 150 kHz (kilohertz)
- ▶ Birds (more uniform than mammals): 100 Hz to 8-10 kHz
- ▶ Reptiles (poorer hearing than birds): 50 Hz to 2 kHz
- ▶ Amphibians: 100 Hz to 2 kHz.

Additional considerations to understanding the effects of noise on fauna include the varying responses to noise disturbance across species and genera. These are discussed in further detail in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

As discussed above, the scientific and published literature is inconclusive with regard to thresholds or threshold criteria for terrestrial fauna; however, available literature indicates that moderate impacts to habitat use may occur when noise levels are above 60 to 65 dB(A) and fauna are likely to leave the area when noise levels are around 80 dB(A) or above. Table 11-26 provides a summary of the typical activities potentially impacted. Only minor disturbance of terrestrial fauna is anticipated at noise levels below 60 to 65 dB(A). This is consistent with *the Fauna Sensitive Transport Infrastructure Delivery Manual* (TMR, 2024), which concludes that studies and reviews suggest that to minimise impacts on birds, traffic noise should ideally be kept below 55 to 60 dB(A) (18 hr exposure), especially during the morning chorus. These noise levels in *the Fauna Sensitive Transport Infrastructure Delivery Manual* (TMR, 2024) have not been used as a threshold as they are applicable to more continuous noise levels of road traffic, which is not comparable with outputs associated with construction, nor the intermittent impacts of train pass-bys.

TABLE 11-26 LIKELY EFFECTS ON TERRESTRIAL FAUNA AS A RESULT OF PROJECT CONSTRUCTION ACTIVITIES

Disturbance effect	Steady or continuous noise sources (L _{Aeq} (15min) dB(A))	Episodic (single event or short-term) noise sources (L _{Amax} dB(A))	Typical activities potentially impacted
Occasional (alert) – minor impacts on habitat use for most species	50 to 65	45 to 60	Nesting
Frequent (alarm or flight) – moderate impacts on habitat use	65 to 85	60 to 80	Nesting Roosting
Avoidance of area – by most of the population of some species	≥85	≥80	Nesting Roosting Foraging

Notes: Source: Appendix L

Activities are based on bird responses but are considered representative across a range of species.

Masking impacts, particularly on smaller songbirds, may occur at noise levels of approximately the alert threshold right up until the point of avoidance.

L_{Amax} limits have been specifically set below the L_{Aeq} limits in recognition of considerations related to startle responses.

Construction noise and vibration

The noise impact assessment undertaken for the Project (see Chapter 16, Appendix V: Construction Noise) has broken up acoustically significant construction activities/stages of works into a series of construction scenarios, each defined as a set of activities involving several scheduled equipment items, each operating within a specific area of authority, during specified times.

It is expected that the noise levels would frequently be lower than the assessed scenarios, as the predicted worst-case noise levels are based on each scenario occurring at the work site boundary and assumes all construction equipment operating simultaneously. Sound is also likely to travel shorter distances within vegetated areas, particularly woodland habitats associated with the State forests in the Inglewood area, which provides substantial habitat for a range of species. This is due to the noise reduction effect associated with the extant vegetation and structurally complex environments. Outside of this area, the landscape is heavily disturbed (through agriculture and grazing impacts) and the presence of fauna is expected to be limited to species tolerant of disturbance such as grassland bird and reptile species and other ubiquitous animals; however, it is noted that several threatened species have habitat outside of the state forests and other structurally complex vegetated areas, including Condamine earless dragon, five-clawed worm-skink, brigalow woodland snail, squatter pigeon, grey snake and common death adder.

Analysis of the sound power and frequency range associated with construction activities (around 63 Hz to 8 kHz) indicates that the harmonic ranges produced (i.e. Hz) overlap with the typical hearing range for species likely to occur within the area (see Table 11-25).

The extent of potential impacts of Project noise is determined by the distance Project-related noise travels to the point where it attenuates to levels where only minimal impacts are likely to occur. Modelling indicates that for most construction scenarios, while the unmitigated construction noise is typically loud at the source, noise levels generally reach less impactful levels (in the vicinity of 65 dB(A)) within 100 m to 200 m of the Project footprint. Fauna located close to work areas are likely to temporarily move away when construction starts, due to disturbance including noise; however, fauna located greater than 100 m from the works are expected to experience only minor temporary disturbance, with minimal impact. From the modelling it can be derived that the habitat areas that will be at most risk of noise impacts include the surrounds of the Bringalily State Forest, small riparian areas and patches of small woodlands, as these areas provide higher quality and a larger quantity of habitat compared to other areas of agricultural lands.

Landon et al. (2003) completed a study that examined impacts from noise and found that fauna vacated the area close to the noise disturbance as the first behavioural response. As most construction stage activities will be conducted in stages moving along the alignment, and are therefore considered short term (i.e. around one to four months), fauna are likely to return when construction works are completed.

Construction scenarios which are exceptions to this include:

- ▶ Whetstone MDC site establishment
- ▶ Whetstone MDC combined activity noise with laydown areas
- ▶ Borrow pit operations
- ▶ Project structures (bridges).

Noise modelling indicates that these scenarios are likely to emit a higher level of sound which dissipates over a greater distance from the source. Additionally, the works associated with these scenarios will continue for a longer duration (up to 48 months) and are therefore likely to have a greater impact on fauna. These construction scenarios are discussed in more detail below.

Whetstone MDC and Borrow pits

Noise modelling indicates that noise levels will be above 90 dB(A)_(LAeq,15min) at the boundary of work areas during construction and operation of the Whetstone MDC and the borrow pits, reducing to around 65 dB(A)_(LAeq,15min) within approximately 250 m. Construction and establishment of the borrow pits is anticipated to be completed in 1 month, and construction of the Whetstone MDC is anticipated to be between 6 and 12 months. Operation of the Whetstone MDC and borrow pits is anticipated to continue for up to 5 years (see Chapter 16, Appendix V: Construction Noise); however, it should be noted that noise levels associated with these construction and operation activities will not be continuous and predicted noise levels will not occur on a daily basis.

Habitat for a number of MNES and MSES fauna species is likely to be indirectly impacted by noise associated with works at the Whetstone MDC and borrow pit sites during construction, including:

- ▶ Australasian bittern (*Botaurus poiciloptilus*)
- ▶ Australian painted snipe (*Rostratula australis*)
- ▶ Brigalow woodland snail (*Adclarkia cameroni*)
- ▶ Collared delma (*Delma torquata*)
- ▶ Common death adder (*Acanthophs antarcticus*)
- ▶ Dunmall's snake (*Furina dunmalli*)
- ▶ Five-clawed worm-skink (*Anomalopus mackayi*)
- ▶ Grey snake (*Hemiaspis damelii*)
- ▶ Koala (*Phascolarctos cinereus*)
- ▶ Short-beaked echidna (*Tachyglossus aculeatus*)
- ▶ Spotted-tailed quoll (*Dasyurus maculatus maculatus*).

Project structures (bridges)

Bridge construction is comprised of three key stages:

- ▶ Substructure construction (both bored and driven piling scenarios)
- ▶ Pier construction
- ▶ Superstructure construction.

Each of the bridge construction stages will take between 20 and 160 days (approximately 5 months), and noise levels will vary depending on the scale of the bridge, the equipment used and the methods required for construction. Noise levels associated with construction of Project structures, notably foundations and piers are predicted to be above 90 dB(A) _(LAeq,15min) at the boundary of the work area during construction, reducing to 65 dB(A) _(LAeq,15min) within approximately 200 m. Noise levels of up to 75 dB(A) _(LAeq,15min) are predicted for superstructure construction, dissipating to 65 dB(A) _(LAeq,15min) within approximately 50 m.

However, the degree to which fauna will be impacted is likely to vary. Where noise levels at the source are around 85 dB(A) or above, mobile species (i.e. birds, yellow-bellied glider, and common death adder) are likely to move away from the immediate area. Less mobile species such as the Brigalow woodland snail (*Adclarkia cameroni*) and grey snake (*Hemiaspis damelii*), while less able to move away from the source due to their dependence on specific habitat, may potentially experience lower levels of impact given that terrestrial gastropod molluscs have no acoustic sense and snakes have limited acoustic sense and are unlikely to be impacted by airborne noise (Barker, 2001; Christensen et al., 2012). They are, however, sensitive to vibration associated with the Project.

Predicted noise levels associated with construction of Project structures, notably foundations and piers have the potential to impact fauna within 400 m of the construction area; however, these impacts will be short term (three to four months). Terrestrial fauna are likely to move away during construction and return when activities cease and therefore any potential impacts are not considered to be significant; however, only airborne sound pressure levels are reported in Chapter 16: Noise and Vibration, and there is no equivalent assessment of waterborne sound levels. Therefore, impacts on aquatic or semi-aquatic fauna (e.g. Murray cod (*Maccullochella peelii*) and platypus (*Ornithorhynchus anatinus*) cannot be fully assessed. As such a conservative approach must be taken.

Given the temporary nature of construction works, it is considered likely that fauna will initially move away from the source of the noise disturbance. In this time, use of habitat areas for foraging, nesting and roosting may be affected; however, species will either habituate to the sound when they realise that it is not associated with danger, or return on completion of works.

Potential impacts to use of breeding habitat during construction is considered to potentially have the largest impact, especially for construction activities that persist over a longer period of time, potentially effecting multiple breeding seasons. Murray cod (*Maccullochella peelii*) spawn between September and November (inclusive) and platypus (*Ornithorhynchus anatinus*) breed in spring and this will need to be considered in impact management. Additionally, koala (*Phascolarctos cinereus*) breeding season is October to May. Noise associated with the Project may cause disturbance to breeding, albeit temporarily during the construction period. Appendix M: Draft Koala Management Plan includes measures to ensure noise restrictions will be in place and relevant guidelines regarding continuous exposure are enforced during construction.

Further information on species and genera specific construction noise and vibration impacts is detailed in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

Operational noise and vibration

The Project introduces new railway operations to areas where there is no existing railway infrastructure and increases train movements in brownfield areas where the South Western Line and Millmerran Branch Line rail corridors already occur.

The main sources of noise for a freight train are the diesel engine, the engine exhaust located near the top of the locomotive and the interaction of the wheels with the rails at the lower section of the train. The wheel-rail interaction results in rolling noise and vibration from both the locomotives and the wagons. Discrete noise events can also occur as trains transfer between tracks at turnouts, and when trains travel uphill, downhill, or along curved track sections. At crossing hoops, noise can be produced by locomotive or train horns, crossing bells, idling locomotive engines, acceleration and braking operations and wagon bunching. Noise from railway operations will be infrequent and only occur when trains are passing in the immediate local area. Once a train has passed through, there will be no further railway noise until the next train is scheduled. It is estimated that once operational, the Project will involve an annual average of 14 train services per day during initial years of operation. This is likely to increase to an average of 20 trains per day after 15 years, and approximately one train an hour during peak operational periods. Operational rail activities that may result in the generation of noise, and their anticipated power level are summarised in Chapter 16: Noise and Vibration. Operational rail noise levels considered have been based on the single event maximum (SEM) levels which are an average L_{max} level from rail pass-by events. The unmitigated noise modelling completed shows that areas approximately 500m on average, on either side of the rail line will be impacted by 80 + dB(A) levels, reducing to around 60 dB(A) within approximately 1,500 m from the rail line. It should be noted that sound levels that exceed 80 dB(A) will only occur during locomotive pass by and is usually a result of locomotive or train horns.

The potential impacts from noise levels are heavily dependent upon landscape and topography (with open and flat areas allowing noise to travel further when compared to forested or hilly areas (Lucas et al., 2017)) and the species present. For instance, a study in the Netherlands found a reduction in the density of meadow birds close to railways (Waterman et al., 2002). In contrast, Wiącek et al. (2015) counted birds at three different distances (30, 280 and 530 m) from the tracks and found, despite the noise level falling distinctly with increasing distance from the tracks, the abundance of birds and the number of species were the highest near the railway tracks and the noise from the trains did not adversely affect the birds within the study area.

Linear transport infrastructure already occurs throughout the study area, in the form of highways, local roads and rail. Approximately 68 km of the Project will utilise existing rail corridor and, while the Project will result in an increased intensity of rail operation, operational rail noise is an existing component of the local conditions in these areas. Based on this, it is expected that most, if not all resident species in these areas are accustomed to some form of transport noise and are likely to have mechanisms to adapt to the increased train movements. For example, Ghosh et al. (2010) illustrated that house sparrows (*Passer domesticus*) were able to adapt to loud noise from passing trains (between 35 – 95 dB(A)) on rail lines (Ghosh et al., 2010; Lucas et al., 2017). The greatest noise impacts to wildlife are likely to be in areas of newly constructed rail, particularly within the state forests, small riparian areas and patches of small woodlands, and undeveloped areas where noise mitigation measures are not in place to minimise impacts to human sensitive receptors. Operational noise may lead to some fauna temporarily vacating/avoiding nearby habitat, particularly mobile species, such as Australasian bittern (*Botaurus poiciloptilus*), spotted-tailed quoll (*Dasyurus maculatus maculatus*), koala (*Phascolarctos cinereus*) brown treecreeper (south-eastern) (*Climacteris picumnus victoriae*), southern whiteface (*Aphelocephala leucopsis*), and glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*). A study which examined fauna response to noise impacts found that the most frequently reported response to traffic noise from cars, trains and aircraft is animal movement away from the noise source (Erbe et al., 2022); however, many animals become habituated to noise (Radle, 2007). Wiącek et al. (2015) found that the noise generated by passing trains did not have a negative impact on either the abundance of birds or the numbers of woodland bird species.

Operational noise does have the potential to interfere with fauna connectivity, where fauna may be disinclined to use crossing structures as a result of higher levels of noise close to the rail line. This will be an important consideration to avoid indirect impacts of fragmentation, especially in areas where the rail line intersects known wildlife corridors. Mitigation measures to reduce the impacts of noise and vibration to sensitive receptors are discussed in Section 11.7.3

Further information on species and genera specific operational noise and vibration impacts is detailed in Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report.

11.6.2.7 Air quality and dust

The Project will lead to increases of airborne dust levels during construction across the Project footprint if unmanaged. Increased dust can result in respiratory issues in fauna, adverse impacts on plant photosynthesis and productivity (Chaston and Doley, 2006), changes in soil properties ultimately impacting plant species assemblages' (Farmer, 1993), and mortality and/or decrease in aquatic health on aquatic communities from poor water quality. Evidence of potential impacts on entire vegetation communities is scarce. Many studies focus on specific impacts to single species. Recent research on threatened flora in a semi-arid environment in Western Australia found no significant impact on plant health because of a range of dust accumulation loads caused by vehicle movements (Matsuki et al., 2016). The deposition of (unpaved) road dust on nearby freshwater wetlands caused by heavy traffic increases due to energy development projects found minimal impact on water quality or soils (Creuzer et al., 2016).

Project impacts associated with air quality and dust are assessed in detail in Appendix O: Air Quality Technical Report. The assessment predicted that cumulative pollutant concentrations and deposition levels would be below the relevant air quality goals at all identified ecological values for all pollutants Of Concern except for 24-hour average PM₁₀. Based on the intention of the Environmental Protection (Air) Policy 2019, the operation of the Project (as determined by CALPUFF) is not expected to significantly impact flora and fauna species or their habitat.

11.6.2.8 Lighting

Fauna perceives light differently, depending upon physical adaptations associated with their biological makeup and visual systems. Vision is a critical cue for animals to orient themselves in their environment, find food, avoid predation and communicate; some species (e.g. birds and insects) are highly sensitive to light, while many other species, including many mammals and reptiles, are less sensitive to the varying light wavelengths as they are unable to perceive frequencies into the red-light spectrum.

Artificial light can disrupt critical behaviour and cause physiological changes in wildlife, and consequently, has the potential to hinder the recovery of threatened species. For migratory species, the impact of artificial light may compromise an animal's ability to undertake long-distance migrations essential to its lifecycle. Artificial light impacts on terrestrial mammals can include reduced activity, reduced foraging times and increased predation. Australian bats may be affected at roost sites, along commuting corridors or when foraging, with artificial light potentially causing changes in prey availability, habitat degradation and attraction or avoidance of artificial light (DCCEEW, 2023).

Lighting associated with construction of the Project will include security lighting at laydowns and office, flashing beacons and temporary spotlights in support of short-duration night works, if required, and will be relatively short term in nature. Lighting associated with the operational stage (e.g. head lamps on rollingstock and safety lighting at road-rail interfaces) will exist as pulses of shorter duration (for rollingstock) at frequencies determined by operational schedules.

Potential impacts and mitigation measures to reduce light spill are contained within Chapter 10: Landscape and Visual Impact Assessment, and Appendix K: Landscape and Visual Impact Assessment Technical Report (see Appendix 3: Obtrusive Lighting Assessment). Appendix K: Landscape and Visual Impact Assessment Technical Report also contains an obtrusive lighting assessment, which has been developed in compliance with the Australian New Zealand Standard, ASNZS4282:2019 Control of Obtrusive Effects of Outdoor Lighting criteria, which also recognises the impact of artificial light on biota.

11.6.2.9 Waste management

Improper waste disposal (i.e. of wire and large packaging waste) has the potential to cause injury to wildlife. When discarded as litter, human-made materials such as plastic, glass and aluminium have the potential to cause external injury to wildlife, entanglement, and if accidentally ingested, may cause starvation or suffocation. Littered objects may also provide suitable habitat for disease-spreading insects, such as flies and mosquitoes (Healthy Land and Water, 2019). Inappropriate storage and handling of waste materials may also result in changes to soil qualities, increased fire risk, release of contaminants and an increase in pest fauna.

Ecological values affected include all threatened flora (through habitat degradation, and alterations in recruitment and nutrient cycles) and fauna species (direct consumption, declines in habitat suitability and entanglement). This type of impact has the highest risk of occurring during the construction stage and the potential to be long in duration due to the varying times of decomposition; however, it is likely to be localised and manageable through construction waste management processes.

Regulated waste will be generated by the Project, and disposal of it will be managed in accordance with the *Environmental Protection Act 1994* (Qld), and the *Environmental Protection Regulation 2019*. As such, it is considered not likely to have an impact to ecological values.

11.6.2.10 Altered hydrology and flooding

The Project has the potential to alter flooding and hydrological regimes. Modification of existing landforms and introduction of Project components such as the railway line foundation and the installation of drainage structures such as culverts has the potential to alter natural stream flows and flow paths in some locations (see Chapter 14: Flooding and Geomorphology).

Potential short and long-term impacts on local and regional flooding behaviour, the community, and the environment have been assessed based on a review of the Project's construction works and operations stages. A detailed hydraulic assessment has been undertaken to establish the existing flooding regime (the 'existing case'), and the development of hydraulic models based on the revised reference design to model expected change (the 'developed case'). Modelling and analysis have identified changes to the existing flooding and fluvial geomorphic regime that can be expected as a result of the Project and identified areas where additional mitigation is required.

The hydraulic models were run for a suite of flood events (i.e. 20% annual exceedance probability (AEP), 10% AEP, 5% AEP, 2% AEP, 1% AEP, 1 in 2,000 AEP, 1 in 10,000 AEP, and the probable maximum flood (PMF)). Changes in peak water levels, velocities, flow patterns and flood inundation extents and durations between the existing case and developed case were also mapped (see Chapter 14: Flooding and Geomorphology, and Appendix T1: Hydrology and Flooding Technical Report).

The hydraulic and flooding assessment undertaken has demonstrated that the Project is predicted to result in impacts on the existing flooding regime that generally comply with the adopted flood impact objectives, as specified in Chapter 14: Flooding and Geomorphology. Additionally, assessment of the flooding impacts concluded that residual risks are likely to be of low or medium magnitude (see Table 14-124 in Chapter 14: Flooding and Geomorphology). It should also be noted that changes to flood conditions due to the Project in one area during one flood scenario (e.g. 10% AEP may closely represent the existing conditions under slightly different flood scenarios (e.g. 9.9% AEP or 10.1% AEP). Furthermore, sections of existing rail track (the South Western and Millmerran Branch Lines forming the brownfield portions of the Project), currently designed to approximately 20% AEP and featuring limited drainage infrastructure in many areas, will be decommissioned and replaced with the new Inland Rail track infrastructure incorporating a minimum flood immunity of 1% AEP with significantly increased drainage infrastructure. This is expected to provide opportunity for improved conditions in many locations currently experiencing active scour, erosion and constriction of flow associated with the dated infrastructure, with the return of drainage and overland flow conditions more closely aligned to original natural state.

Changes to the flow distribution, water depth, water velocity and duration of inundation during flood events have the potential to impact protected matters in a variety of ways. This may include greater erosion and mobilisation of soils in areas of increased inundation and velocities, flushing of more coarse woody debris, snags and other microhabitat features due to increased water velocities, drying of areas in areas of decreased inundation, and increased stress on both plants and animals in areas of increased inundation duration. It should be noted that the species and habitats being impacted often inhabit floodplain environments and can persist through a variety of flood events and conditions.

Potential impacts to protected matters and associated habitat can include both abiotic and biotic components of habitat. These impacts include potential drowning of individuals, waterlogging causing anoxia for plants and TECs, reduction in inundated areas (and therefore habitat for wetland and floodplain species), flushing of coarse woody debris on floodplains or snags in waterways, loss of soil, scouring and erosion exposing roots of plants, changes in sediment distribution, and potential increased prevalence of invasive weeds to areas of increased inundation.

Unmitigated, the Project has the potential to impact the surrounding environment (including TECs, MNES and MSES species and associated habitat) by altering flooding and hydrological regimes, including increased and decreased areas of inundation. The assessment of impacts associated with flooding were assessed using a stepped approach (see Figure 11-3), which included a risk assessment, habitat mapping outside of the Project footprint, and assessment of susceptibility. These steps identified three MNES flora species that had a medium or high susceptibility and required detailed assessment, namely hairy-joint grass (*Arthraxon hispidus*), winged peppergrass (*Lepidium monoplacoides*), and small-flowered westringia (*Westringia parvifolia*). No other flora habitat, fauna habitat, or TECs were triggered for further assessment.

Water flow changes for the flood events 20% AEP, 10% AEP, and 5% AEP were used to quantify and assess impacts to the three flora species and their habitats. These more frequent flood events are likely to be more relevant to threatened species, communities and their habitats.

Impacting variables and thresholds for significant impact used were species-specific. For flora species, this generally included areas of increased or decreased inundation, duration of inundation exceeding 36 hours (only where this was below 36 hours for the existing case) and increases in velocity greater than 1 m/s. The threshold of 36 hours for flora was used as an estimation of the inundation time for anoxia to occur. For hairy-joint grass (*Arthraxon hispidus*) and small-flowered westringia (*Westringia parvifolia*), increased habitat areas experiencing inundation were considered to potentially impact the species. Alternately, for winged peppergrass (*Lepidium monophlooides*), decreased habitat areas experiencing inundation were considered to potentially impact the species. This is because winged peppergrass inhabits areas that are periodically inundated and can suffer losses when drying occurs. Additionally, changes in velocity were not considered important for small-flowered westringia, as this species is a shrub and likely to be resilient to flood velocities predicted to be experienced in overland flow (estimated to be below 1.5 m/s in its habitat for the developed case). Changes to peak flood depth was not considered to be a significantly impacting variable when assessing potential impacts for these species.

Quantification of potential significant impacts for these three flora species represented relatively small areas of habitat outside of the Project footprint. Therefore, it is unlikely that there will be residual significant impacts on any of these three species as a result of changes to flood conditions.

The assessment of impacts associated with flooding were assessed using a stepped approach. The Project impacts on hydrology and flooding are discussed in detail in Appendix T1: Hydrology and Flooding Technical Report and analysis of these potential impacts on ecological values are further detailed in Appendix L: Terrestrial and Aquatic Ecology Report and Appendix O: Matters of National Environmental Significance Report.

11.6.2.11 Erosion and sedimentation

During construction and operation of the Project, there is potential for significant impact to soils resulting from disturbance and exposure of subsurface soils vulnerable to accelerated erosion, dispersivity, and/or salinity due to their physical and chemical characteristics. Soils within the Project footprint are described in detail in Chapter 9: Land Resources and Appendix J: Soil Assessment Report.

Soils of particular concern for management and stability will be those that are dispersive, erosion prone soils (i.e. sodosols and, to a lesser extent, chromosols); however, regardless of soil type, erosion risk will be increased where the following activities occur:

- ▶ Clearing and disturbance of vegetative cover, including groundcover
- ▶ Changes in topography, drainage patterns and localised concentration of storm water flows due to construction of both access tracks and the rail corridor
- ▶ Excavation or cuttings and stockpiling of material
- ▶ Construction during high rainfall events, particularly erosive rainfall events
- ▶ Constructing through areas with high soil erodibility risks (e.g. sodosols).

Terrestrial impacts associated with erosion and sedimentation include compaction of soil, loss of soil structure, nutrient degradation, and increased soil salinity all of which can lead to reductions in the carrying capacity of the terrestrial environment due to decreasing habitat value.

The primary impact of erosion on terrestrial habitat has the potential to occur within areas of exposed soil, stockpile locations, or localised areas in proximity to Project infrastructure (e.g. culverts and bridges) during rainfall events. The changes to overland flow paths from erosion have the potential to have a localised direct impact on terrestrial habitats. These impacts are principally associated with a loss of substrate stability around vegetation and may result in a loss of vegetation quality and cover.

11.6.2.12 Changes to groundwater resources

Construction for the Project includes activities that have the potential to impact on groundwater resources. These activities include site preparation, bulk earthworks (e.g. cut-and-fill sections), drainage construction, haul road and access track construction, bridge pilings, and the excavation of borrow pits for construction materials. These potentially impact groundwater resources through groundwater level reduction, alteration of aquifer flow patterns, the settlement of compressible substrates, and reductions in groundwater quality.

During operations, the Project has the potential to result in alterations in existing groundwater flow pathways due to the new infrastructure and/or modified landforms, drawdown due to seepage, and contamination of groundwater as a result of unintended spills and leaks of hydrocarbons (e.g. oils, fuels, and lubricants) and other chemicals related to maintenance activities (e.g. accidental discharge, grinding and blasting) or rail incidents (e.g. loss of load).

Terrestrial GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sourced from impacted aquifers.

An evaluation of the potential impacts of the Project on groundwater resources (see Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction stage of the Project. A small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources; however, it is unlikely that the Project will have a significant impact on drawdown, and any impact will be temporary. Several studies in the region have concluded that a significant impact to vegetation condition within GDEs occurs when drawdown is reduced by nine metres or greater (Kath et al., 2014; Pfautsch et al., 2015). As such, engineering controls were assessed to be sufficient to mitigate the extent of impacts. Additionally, due to the nature of the floodplain, the region is accustomed to seasonal variation in surface water levels (Holland et al., 2016; DES, 2019) to recharge the groundwater aquifer. Further details on the predicted changes to groundwater resources are provided in the Appendix U: Groundwater Technical Report.

11.6.2.13 Contamination

Creation of contaminated land

Land contamination may be created by activities undertaken during the construction and operation of the Project. Broadly, the potentially contaminating activities through these Project stages include:

- ▶ Movement of contaminated materials (soils or water) from a source of contamination to an uncontaminated location, for example:
- ▶ The stockpiling of contaminated material on land that is not contaminated
- ▶ The discharge or dispersion of contaminated water onto land that is not contaminated
- ▶ Accidental leaks or spills leading to migration of contaminants through surface water, soil and/or groundwater. Such incidents may arise due to inappropriate storage of dangerous goods and hazardous materials or poor handling of these materials.

Significant soil and water contamination has the potential to impact on the health of species exposed to the contaminants and lead to habitat degradation.

During the construction stages, the following facilities will be provided for safe storage and distribution of construction chemicals:

- ▶ Laydown areas – small quantities of lubricants and oil (i.e. drum in intermediate bulk container package stores) will be stored at these locations
- ▶ Diesel fuel depots – up to 20,000 L will be stored at two nominated laydown areas.

During construction, laydown areas will be used for the storage and distribution of hazardous materials required for construction purposes. Storage areas will be bunded, capacity restricted to no larger than required for reasonable operations, and preferentially stored at the furthest point away from watercourses.

During operations, the Project has the potential to result in contamination as a result of unintended spills and leaks of hydrocarbons (e.g. oils, fuels and lubricants) and other chemicals related to maintenance activities (e.g. accidental discharge, grinding and blasting) or rail incidents (e.g. loss of load).

Disturbance of contaminated land

An assessment of contaminated land within the study area was undertaken using a contaminated land risk assessment (see Chapter 9: Land Resources) based on a contaminant (source)-pathway-receptor methodology whereby:

- ▶ Contaminant (source): a substance present in or on land, water or site at above background concentrations that presents, or has the potential to present, a risk to human health, the environment, or any ecological value.
- ▶ Pathway: the route by which the source is brought into contact with the receptor. This can include the transport of contamination via water (i.e. surface and groundwater), aeolian deposition, vapours, excavation, and deposition.
- ▶ Receptor: humans, other living organisms, physical systems and built structures that could be affected by the source. A receptor will only be affected if a pathway from the source to the receptor is present. Groundwater and surface water systems can be considered as receptors in their own right and as pathways for contaminant migration to other receptors.

Based on the land uses within the Project footprint, and the finding of the desktop assessment and field investigations, the potential sources of contamination in the vicinity of the Project footprint are considered to include:

- ▶ Agricultural activities: hydrocarbons (e.g. fuel and oil storage and use), pesticides and herbicides, asbestos and lead paint, arsenic (cattle dips) and landfilling
- ▶ Quarries: hydrocarbons (e.g. fuel and oil storage and use), metals/metalloids and hazardous materials
- ▶ Landfilling, waste disposal: hazardous materials, hydrocarbons, metals/metalloids, phenols, polychlorinated biphenyls, phthalates, volatiles and pesticides and herbicides
- ▶ Existing rail corridor: metals, asbestos, hydrocarbons and pesticides/herbicides
- ▶ Road crossings: metals and hydrocarbons.

Construction activities for the Project have the potential to disturb existing contaminated land. The disturbance of contaminated soil or groundwater during Project activities have the potential to contaminate previously unaffected soil or groundwater, degrade ecosystem health and affect human health through dermal contact or ingestion of contaminants.

11.6.3 Potential impacts to aquatic ecological values

11.6.3.1 Clearing of riparian vegetation

Disturbance to riparian vegetation and aquatic environments within the bed and banks of watercourses will be minimised as much as practicable; however, disturbance will be unavoidable during the construction of infrastructure such as piers and bridge structures. Crossings have been designed to reduce impacts to riparian vegetation and the bed and banks of defined watercourses as much as possible while still meeting the performance specifications for Inland Rail, including hydraulic and structural requirements of the crossing infrastructure in terms of structures placement, size, and design criteria.

Clearing of riparian vegetation will result in the removal of habitat including woody debris for some aquatic species including platypus (*Ornithorhynchus anatinus*) and the Murray cod (*Maccullochella peelii*), and may result in minor changes in physical attributes of waterways (e.g. reduced shading and increased light penetration). The degree of riparian vegetation clearing and the scale of impact, will vary across the Project, depending on the size and scale of waterways and the extent of existing disturbance (e.g. existing rail infrastructure).

Clearing of vegetation for construction has the potential to alter temperature and light regimes of aquatic habitats. Increased light penetration into creeks which originally had dense canopy cover may potentially affect the flora composition of aquatic habitats, resulting in a reduction in the abundance and distribution of light-sensitive aquatic plants. Increased light can also be expected to promote the growth of algae and invasive aquatic plants, which may outcompete other plant species and reduce the complexity of aquatic habitats and species diversity. Increased light can also be expected to result in an increase in daytime water temperatures, affecting biological processes such as respiration rates of aquatic organisms, and displacing native species that are not tolerant of high temperatures.

11.6.3.2 Modification of aquatic habitat

The installation of artificial structures such as culverts and bridge pylons within waterways will result in impacts on aquatic flora and fauna habitat values including the natural materials, such as rocks and gravel, that comprise the habitat, the types of vegetation present, such as snags and aquatic plants, and the shape and nature of the habitat (e.g. pools and riffles).

Temporary waterway crossings may be necessary during construction where there is bridge infrastructure in the actual watercourse and construction is required in that specific area, to enable safe and efficient construction of waterway crossing structures. Temporary waterway crossings typically consist of rock-filled embankments, with culverts providing continuity of stream flow through the embankment. Culverts will be of appropriate size and number to ensure there is no impoundment of water upstream of the crossing.

Such works may involve the disturbance and removal of stream bed sediments, and changes in habitat structure from a soft bottom to a hard bottom both during construction as a result of access requirements and permanently. Some types of infrastructure may increase habitat availability for native and exotic fauna species that are able to utilise a broad range of habitat types, which are lacking in structural complexity. This will reduce available habitat for species that require structural complexity for habitation, nesting or breeding. For example, naturally occurring woody debris habitat generated by riparian vegetation may be replaced with bridge pylons or culverts, resulting in a change in the abundance and diversity of fish species in that location and adjacent areas.

11.6.3.3 Waterway barrier effects

Permanent and temporary instream structures would be required for the Project at waterway crossings, such as pylons and culverts, which may impact aquatic ecosystems due to physical and behavioural barriers to fish passage. Physical barriers would generally relate to where the Project introduces a new physical obstruction in the watercourse that may become a physical barrier to fish moving downstream. Behavioural barriers may relate to changes to the conditions of the watercourse at a particular area that may affect fish passage, such as shading from culverts or bridges affecting water temperatures or localised changes in flow speed/direction caused by instream structures that may present a barrier to movement for some species.

There are six major creeks (Pariagara Creek, Bringalily Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek) and two major rivers (Macintyre River and Condamine River) which will be intersected by the Project with potential habitat for Murray cod (*Maccullochella peelii*). Fish-friendly bridge crossings are proposed at most higher order waterway crossings to minimise potential physical and behavioural fish movement impacts.

The design of bridges and culverts for the Project have considered the requirements for fish passage in accordance with the *Fisheries Act 1994* (Qld) and where required conform with the: 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (DAF, 2018a).

11.6.3.4 Altered hydrology

The installation of artificial structures such as culverts has the potential to alter natural stream flows and flow paths in some locations (see Chapter 14: Flooding and Geomorphology). Hydrologic and hydraulic modelling predicted minimal impacts from Project infrastructure on flood flows, floodplain coverage and flow velocities under a range of flow scenarios, including extreme events. Predicted changes in flow velocities were limited in scale to immediately upstream and downstream of culverts. At these locations, such changes may cause minor changes to the location, abundance and structure of aquatic habitats, such as pools, channels, riffles and dry creek beds. This can be expected to result in minor changes to the composition and diversity of aquatic organisms in affected locations and disturbance of aquatic species lifecycles may occur. Additionally, changes to hydrologic flow may result in habitat degradation through the introduction and establishment of weeds.

Murray cod (*Maccullochella peelii*) have the potential to be impacted by changes to hydrology which may occur as a result of the Project. Flooding is a natural phenomenon and a component to which cod has become particularly well adapted. Murray cod recruitment success has been linked to increased water flow and the associated impacts, as higher water levels enhance the survival of eggs, larvae and juveniles; however, a flood event or water release coinciding with spawning and the hatching and early development of larvae can flush larvae downstream out of the nest before they are ready to disperse. These larvae can then be diverted out of the main channel and into areas without suitable microhabitat features. Increased flow rate associated with high flood events also negatively impact adult individuals as they prefer slow-flowing, turbid water (see Appendix L).

Platypus (*Ornithorhynchus anatinus*) has the potential to be impacted by changes to hydrology which may occur as a result of the Project. Flooding is a natural phenomenon; however, a flood event or water release coinciding with nesting and early development of young can flood nesting burrows and drown juveniles. Platypus juveniles are particularly susceptible to drowning when they are still confined to the nesting burrow and shortly after they first emerge, as they have little swimming experience (Serena and Williams, 2010; Serena and Grant, 2017).

Changes to the timing and quantity of water flow downstream during major rainfall events are expected to be minor. These changes have some potential to affect fauna migration and breeding activities such as spawning in fish, which are often linked to water levels and flow rates.

The platypus and Murray cod were included in the flooding impact assessment (see Section 11.6.2.10) and it was determined that the impacts are likely to be insignificant, with detailed quantification and assessment not being required.

Further details on the predicted changes to hydrology are provided in Appendix T1: Hydrology and Flooding Technical Report.

11.6.3.5 Water quality

As discussed in Section 11.6.2.13, construction activities have the potential to result in the introduction of contaminants into waterways, resulting in declines in water quality (e.g. from fuel spills). Similarly, the use of herbicides during future track maintenance has the potential to impact on vegetation and fauna living in and adjacent to waterways. An increase in access to aquatic habitat by people during construction (i.e. construction workforce) has the potential to result in litter being deposited within or adjacent to waterways. Such contaminants can be expected to reduce water quality and the quality of aquatic habitats in areas affected, and adjacent areas downstream.

Reduced water quality is a major threat impacting Murray cod (*Maccullochella peelii*). Construction activities have the potential to result in the introduction of contaminants into waterways, leading to declines in water quality.

Increased turbidity and sedimentation

Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and may cause environmental degradation. Mobilised coarse sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep, permanent river pools, that are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by coarse sediments, which may render them ineffective in relation to their ability to support aquatic species. Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion. Transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat.

Works adjacent to waterways, and disturbance of bed and banks, will result in the exposure of soils which may be mobilised by rainfall and run off into adjacent aquatic habitats and also affect areas downstream. Stockpiling of soils close to waterways is also a potential source of sediment inputs into aquatic habitats. Increased runoff to waterways is likely to result in a decline in water quality, through an increase in turbidity and TSS concentrations, and potentially, an increase in the concentration of sediment-bound contaminants such as metals.

Suspended solids have the potential to impact on fish by disrupting the function of gills, reducing underwater visibility for predatory species such as EPBC Act listed Murray cod (*Maccullochella peelii*), and displacing species that are not tolerant of variable and turbid water quality conditions. This may result in localised fish kills or the displacement of aquatic species to adjacent areas. Metals and other contaminants bound to sediments that wash into waterways may have a toxic effect on aquatic organisms or reduce the quality of drinking water for stock. Such effects are likely to be relatively localised (over a scale of hundreds of metres) and will reduce with distance downstream from the source.

Mobilised coarse sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep permanent river pools, that are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by coarse sediments, which may render them ineffective in relation to their ability to support aquatic and terrestrial species.

Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion and transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat.

Altered water chemistry

Alterations to water chemistry include changes in salinity, nutrients or contaminants other than sediments. Alterations may impact on the aquatic ecosystem condition of the downstream waterway system and may be altered as a result of the following processes:

- ▶ Clearing and construction activities
- ▶ Accidental spills and leaks of chemicals or fuels from construction equipment or fuel storages
- ▶ Flow diversions
- ▶ Erosion of stockpiled materials, which could lead to increased nutrient concentrations in overland flow.

Disturbance and exposure of saline soils during construction has the potential to increase salinity in overland flows. The Project footprint directly intersects moderate to high salinity hazard rating areas, which may result in discharge of saline runoff into proximal waterways. The risk is low where there is existing disturbance at points where the Project alignment crosses the waterways (e.g. existing rail corridor). Changes to riparian vegetation communities, stockpiling of sediment and Project-associated earthworks may result in saline discharge at drainage points into watercourses proximal to high salinity hazard areas.

Nutrient loading occurs when nutrients migrate into waterways with sediment lost from cleared areas, stockpiles and rehabilitation areas. This has the potential to:

- ▶ Change light conditions and water temperature
- ▶ Smother aquatic life and prevent photosynthesis for aquatic flora
- ▶ Affect downstream environments
- ▶ Impact upon breeding and lifecycle of aquatic fauna.

Contamination of waterways may occur as a result of accidental spills and leaks of chemicals or fuels from construction equipment or fuel storages, which could introduce chemicals into overland flows and chemical spills or, due to inappropriate storage controls, result in an introduction into waterways of fuels and oils used for construction machinery.

Contaminants may also leach from the following sources during construction:

- ▶ Residual heavy metals from rail grinding and welding
- ▶ Pollutants within ballast materials
- ▶ Dewatering activities leading to liberation of toxicants from potentially contaminated land
- ▶ Contaminated land disturbance, which has the potential to result in contaminated runoff into waterways.

11.6.3.6 Invasion of aquatic weeds and pest species

Construction of new rail infrastructure has the potential to increase the abundance of weeds and pests and introduce new weed and pest species. The disturbance of existing weeds along the riparian corridor may result in the spread of propagules downstream, or the transport of propagules to other areas either on machinery or through natural dispersal once disturbed. Weed seeds and some pests may also be present on machinery brought in from other areas and be introduced to the local environment.

Some farm dams likely to contain exotic species will need to be dewatered to facilitate construction of the Project. This may result in the spread of pest (e.g. exotic fish species) and weed species, such as alligator weed (*Alternanthera philoxeroides*) and para grass (*Urochloa mutica*), to adjacent waterways, if not managed appropriately, resulting in a reduction in aquatic habitat quality and species diversity.

There are some aquatic weed species that are present in the Goondiwindi and Toowoomba local government areas that are present in one and not the other or the surrounding local government areas (GRC 2022a; TRC 2020a). The movement of machinery and vehicles across the study area during the pre-construction, construction and operational stages of the Project has the potential to spread weeds into new localities.

Introduced fish species such as mosquitofish (*Gambusia holbrooki*) or carp (*Cyprinus carpio*) are a known threat to Murray cod (*Maccullochella peelii*), with associated impacts including the predation, competition, habitat alteration, and spread of parasites and infectious diseases (Murray Cod Recovery Team, 2010).

11.6.3.7 Disturbance from noise, vibration and lighting

A range of construction activities are likely to result in an increase in noise and vibrations in the vicinity of waterways, reducing habitat quality and increasing disturbance to sensitive fauna. Noise modelling conducted for the Project did not assess noise impacts in water (as modelling was primarily an assessment of airborne noise; however, noise impacts in water have not been assessed). Therefore, impacts to native fauna that reside within waterways (i.e. aquatic in nature) have not been quantitatively assessed with respect to noise and vibrations for either the construction or operation stages of the Project.

Noise may be created by earthworks, use of heavy machinery or piling in or adjacent to aquatic habitats. Species that are easily disturbed, such as platypus, may move to adjacent areas to avoid being disturbed, if suitable habitat exists. Such noise and vibration may persist into the operation stage, at a reduced magnitude, and occur at frequent intervals each time that a train traverses the alignment. Night works will involve the installation of temporary lighting for safety and operational purposes which may also result in disturbance to sensitive aquatic fauna. Increased light intensity may significantly impact Murray cod juvenile growth rate; however, photoperiod was not found to have a significant impact (Di et al., 2023). Such effects are likely to result in a reduction in aquatic habitat quality and species diversity at the locations affected, and adjacent areas.

11.6.3.8 Changes to groundwater resources affecting groundwater dependent ecosystems

Project activities have the potential to impact on groundwater resources through effects such as groundwater level reduction, alteration of aquifer flow patterns, the settlement of compressible substrates and reductions in groundwater quality. GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sourced from impacted aquifers.

Regional aquatic GDE data from the GDE Atlas indicates that there are no high potential aquatic GDEs traversed by, or in proximity to, the Project footprint and one high potential terrestrial GDE located near Yelarbon. The nearest spring is Stone Spring, located two km west of Ch 173.0. There are numerous areas with low-to-moderate potential to support aquatic GDEs; therefore, there is potential for such GDEs to be impacted by possible dewatering or changes in groundwater quality and/or levels during the construction stage of the Project.

An evaluation of the potential impacts of the Project on groundwater resources (see Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction stage of the Project. As discussed in Section 11.6.2.12, a small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources; however, engineering controls were assessed to be sufficient to mitigate the extent of impacts. Controls to reduce the risk of contamination of groundwater quality from Project activities (e.g. spills) are also in place and are similar to those related to surface water quality. Further details on the predicted changes to groundwater resources are provided in Appendix U: Groundwater Technical Report.

11.7 Avoidance, mitigation and management measures

The revised draft EIS has identified the proposed approach to environmental management and the mitigation measures that would be implemented to avoid or minimise the potential impacts of the Project. This section provides discussion of mitigation measures and controls that have been incorporated into the revised reference design development process (see Section 11.7.2), and those measures that are proposed to be adopted for future stages of Project delivery (see Section 11.7.3).

11.7.1 Principles of ecologically sustainable development

Ecologically sustainable development refers to using, conserving, and enhancing the community's resources so that ecological processes are maintained and the total quality of life, both now and in the future, can be increased. There are four principles of ecologically sustainable development:

- ▶ Precautionary principle
- ▶ Principle of inter-generational equity
- ▶ Conservation of biological diversity and ecological integrity
- ▶ Improved valuation and pricing of environmental resources.

It is impossible to construct major transport infrastructure, such as this Project, without causing environmental, social and/or economic impacts (either beneficial or adverse). During Project development, the four principles of ecologically sustainable development were used as a guide to identify potential impacts and develop mitigation measures that afford equal weighting to environmental, social, economic, and engineering opportunities and constraints.

11.7.1.1 Precautionary principle

The precautionary principle stipulates that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In applying the precautionary principle, decisions should be guided by:

- ▶ Careful evaluation to avoid, wherever practicable, serious, or irreversible damage to the environment
- ▶ An assessment of the risk-weighted consequences of various options.

The Project is aligned with the precautionary principle in the following ways:

- ▶ The assessment of potential impacts is based on best practice, using the best available information. The assessment has involved key stakeholders and the relevant government agencies.
- ▶ The impact assessment considered the maximum area of disturbance.
- ▶ The broader Inland Rail Program has been subject to a number of options assessments considering various route options, in consultation with key stakeholders, to inform the finalised route cognisant of the various constraints. This has been undertaken to lead to the most optimal outcome for the delivery of the Project in a manner that avoids and minimises impacts to the greatest extent practicable.
- ▶ The revised draft EIS draws attention to aspects of the Project that may cause serious and/or irreversible environmental damage, especially if the nature and extent of the damage is uncertain. Where environmental damage cannot be avoided, mitigation and management measures to protect the receiving environment are proposed. This includes securing offsets for unavoidable impacts to biodiversity values.

- ▶ Lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental damage. For example, if the likelihood of a threatened species occurring within the Project footprint was uncertain, where the habitat preferences of the species are not well known, or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. Measures to avoid and/or mitigate impacts on threatened species are proposed, on the basis that these threatened species may be present within the study area.
- ▶ The detailed design stage will aim to further minimise impacts, and site and species-specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable, and the significant impacts are offset.
- ▶ During development of the Project, the Project footprint has been refined to:
- ▶ Avoid sensitive vegetation, areas with known threatened flora and fauna communities, and key habitat areas, where possible
- ▶ Avoid known items/areas of cultural heritage significance where practicable
- ▶ Minimise flooding impacts
- ▶ Minimise impacts on existing agricultural land and infrastructure, while also considering potential future land uses.

11.7.1.2 Intergenerational equity

The principle of intergenerational equity is that the present generation should maintain or enhance the health, diversity, and productivity of the environment for the benefit of future generations.

The Project is aligned with the principle of intergenerational equity in the following ways:

- ▶ When developing the revised reference design, minimising potential environmental impacts was a key consideration. This conserves ecological values (e.g. hydrological regimes, water quality, habitat connectivity, and cultural heritage sites) for existing and future generations.
- ▶ Climate change projections were factored into flood modelling for the Project, and climate change-specific mitigation measures are proposed.
- ▶ A Sustainability Management Plan will be developed prior to Project works and sustainability initiatives will include engaging meaningfully with stakeholders, promoting long-term economic benefits and training and development opportunities for locals. The Sustainability Management Plan will guide detailed design and construction of the Project.

As part of the wider Inland Rail Program, the Project would benefit existing and future generations by providing a safer, more efficient, means of transporting freight between Melbourne and Brisbane.

Conversely, should the Project (and therefore, the Inland Rail) not proceed, the principle of intergenerational equity may be compromised. Future generations would experience increasingly worse safety and environmental impacts due to continued growth in road transport between Melbourne and Brisbane, particularly along the Newell Highway.

11.7.1.3 Conservation of biological diversity and ecological integrity

Conservation of biological diversity is defined as the preservation and protection of flora and fauna species in order to maintain a healthy and balanced ecosystem. While ecological integrity is defined as the maintenance of the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations.

A broad range of impact reduction initiatives were identified and incorporated into the Project during the development of feasibility design which included protecting environmental values by rationalising the Project footprint.

Impacts on biological diversity and ecological integrity have been avoided to the greatest extent possible given the stage of the Project. For example, surveys were conducted to verify the presence, extent and quality of threatened species' habitat and ecological communities within the Project footprint. The results were used to inform the development of the revised reference design. For example, the Project footprint has been adjusted to avoid direct and indirect impacts to SEVT TEC, and narrowed to reduce impacts to box-gum grassy woodland TEC as a result of further surveys that were undertaken.

Consideration by the Project of biological diversity and ecological integrity, include the following:

- ▶ The revised reference design has been developed with the objectives of minimising potential impacts on the surrounding environment and land use. The Project alignment was selected to avoid intersecting watercourses in the first instance, and where not possible, achieving hydraulic design criteria including 1% AEP flood immunity to rail formation level. A flooding and drainage regime has been developed that minimise impacts to the surrounding environment through the development of a flooding mitigation approach aligned to strict flooding targets (for velocity, afflux and time of inundation). Aligned with this approach, the Project has incorporated bridge and oversized culvert structures to maintain existing flow paths and flood-flow distributions through the surrounding hydraulic environment and riparian corridors.
- ▶ Regional fauna connectivity corridors for relevant target species that intersect the proposed Project alignment have been identified. This has enabled regional fauna connectivity requirements to be recognised in the Project's on-going design development for required consideration of aspects such as fauna crossing structures. Cross drainage structures will be designed with consideration for DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works when designing bridges and culverts across mapped Queensland waterways for waterway barriers works.
- ▶ A Rehabilitation and Landscaping Management Plan will be developed to guide the approach to rehabilitating disturbed areas. Rehabilitation will occur progressively throughout the construction stage to reduce the impact of the Project on the surrounding environment.
- ▶ Other plans that will be developed to minimise potential impacts on biodiversity during the construction stage include a Biodiversity Management Plan, Biosecurity Management Plan and a Soil Management Plan as components of the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (Operational EMP).

Where impacts cannot be avoided, mitigation and management measures will be implemented. Where required, biodiversity offsets will be secured, and the principles will be complied. Appendix Q: Environmental Offset Delivery Strategy for the Project has been prepared and will inform the delivery of offsets in relation to significant impact upon protected matters.

11.7.1.4 Improved valuation, pricing, and incentive mechanisms

The principle of improved valuation, pricing and incentive mechanisms requires that environmental factors should be included in the valuation of assets and services, such as:

- ▶ Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance, or abatement
- ▶ The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste
- ▶ Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

It is difficult to place a monetary value on the Project's environmental impacts. However, the value placed on environmental resources within and surrounding the Project footprint is apparent in the breadth and depth of environmental investigations undertaken to inform the revised reference design and mitigation measures.

The costs associated with environmental design and mitigation measures will be built into the overall Project cost. This includes the following:

- ▶ Offsets will be secured to achieve a neutral or net positive biodiversity outcome for the region
- ▶ A range of mitigation measures will be implemented such that, during construction and operation, waste is avoided, reused, or recycled, wherever possible. Waste mitigation measures will be documented in a Waste Management Plan of the CEMP and the Operational EMP, including:
 - ▶ The management of waste activities associated with the Project will be underpinned by the 2018 *National Waste Policy* and *Waste Reduction and Recycling Act 2011* (Qld) waste and resource management hierarchy, as listed below in the preferred order to be considered:

– avoid or reduce	– recycle	– treat
– reuse	– recover energy	– dispose
- ▶ Increased economic growth and reduced freight transport costs because of Inland Rail have been outlined in Chapter 18: Economics.

11.7.2 Avoidance and mitigation through the revised reference design stage

Development of the revised reference design has progressed in parallel with the impact assessment process, and considered relevant statutory documents for protected matters. Consequently, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the revised reference design, including:

- ▶ The Project has been positioned to maximise the use of existing rail corridors and, where possible, to be co-located with existing road infrastructure. Co-location with existing linear infrastructure minimises the need to develop natural and rural landscapes that have not previously been subject to disturbance.
- ▶ The Project footprint has been restricted to the area required to construct and operate the works in a safe and efficient manner. Restricting the temporary construction footprint and the permanent operational footprint minimises the extent of disturbance required to vegetation and habitats during construction and operation. The location and layout of the Project, including construction laydowns and workforce accommodation was reviewed iteratively in conjunction with field survey information to avoid and reduce impacts to protected matters.
- ▶ Greenfield components of the Project have been aligned to minimise the extent of impact to:
 - ▶ habitat for EPBC Act and NC Act threatened flora and fauna species
 - ▶ TECs
 - ▶ remnant vegetation and HVR Endangered and Of Concern REs
 - ▶ Bringalily and Whetstone State Forests
 - ▶ watercourses
 - ▶ riparian vegetation and associated riverbanks
 - ▶ steep slopes.
- ▶ Watercourse crossing structures (including culverts and bridges) have been designed to maintain aquatic fauna passage and minimise the risk of blockages.
- ▶ The Project has been designed to minimise impacts to watercourses, riparian vegetation and instream habitats, and to maintain aquatic fauna passage by adopting high flood standards and through the incorporation of bridges and large culverts for permeability of overland flow and hydrological conditions through the landscape and catchments
- ▶ Bridge and culvert structures have been located and sized to mitigate increases in peak water levels, flow velocities, and durations of inundation
- ▶ Scour and erosion protection measures have been incorporated into the design in areas determined to be at risk, such as around culvert headwalls, drainage discharge pathways and bridge abutments
- ▶ The Project's drainage design was updated to include scour and erosion protection measures such as around culvert headwalls, drainage discharge pathways and bridge abutments to further reduce impacts at environmentally sensitive locations
- ▶ The Project incorporates bridge and culvert structures designed to high flood standards to minimise change to the existing flood regimes and the potential for indirect impacts to threatened fauna and flora in the surrounding environment.
- ▶ As part of the development of the revised reference design, and to reduce potential impacts to protected matters within the disturbance footprint (including workforce accommodation and laydown areas), the following actions were undertaken:
 - ▶ Proposed railway and access tracks and potential Project laydown areas were located in areas where maximum disturbance footprints had already been proposed
 - ▶ Potential habitat for ecological values (flora and fauna) was identified and avoided where possible, utilising ground-truthed habitat mapping, including the identification of where multiple species existed within the same area
 - ▶ Both the permanent and temporary footprint was adjusted in response to field surveys to avoid and minimise impact upon ecological values.

Information related to the revised reference design is provided in Chapter 5: Project Description.

Waterway and watercourse crossings are part of the Project and have been incorporated into the design of bridges, viaducts and culvert arrays associated with permanent road, railway, and railway maintenance infrastructure. The flooding infrastructure associated with the Project involves the construction of 18 rail-over-watercourse bridges, 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts and a series of viaducts/bridge structures spanning 12 km of watercourses and floodplains. The Project has been designed to minimise change to overland flow and surrounding hydrological profiles attributable to the Project, including minimising impacts to riparian vegetation and the bed and banks of watercourses and floodplains. This has been achieved through:

- ▶ High flood immunity design standards applied to the Project (a minimum of 1% AEP) resulting in large flooding infrastructure such as bridges and culverts capable of achieving hydraulic permeability through the landscape and ensuring watercourses remain unconstrained for well drained regional and local catchments. This includes the existing (i.e. brownfields) portions of the rail alignment, currently 20% AEP, which will be replaced with the inland rail alignment designed to significantly higher design standards for flooding (>1% AEP) leading to less constrained watercourses as fauna passageways.
- ▶ The adoption of flood impact objectives (FIOs) for guiding design outcomes for flooding infrastructure (as measured by quantitative measures of flooding metrics afflux, time of inundation and velocity) ensuring changes to hydrological conditions as a result of the Project are minimised, including flow features relevant to aquatic ecological values such as passage, flow velocities and stream depth.
- ▶ An effective inspections and maintenance program for stormwater infrastructure in the operational stage ensuring any blockages of stormwater infrastructure are rectified in a timely manner to maintain the ongoing function of flooding infrastructure for its intended purpose and that unnecessary impact to the surrounding environment (waterways and scour/erosion) is avoided.

11.7.3 Proposed mitigation measures

Mitigation measures that are proposed to be implemented to avoid or minimise the potential impacts of the Project are described in Section 11.7.3.1 to Section 11.7.3.3 for the detailed design, pre-construction and construction, and operation stages, respectively. These mitigation measures address Project specific issues and opportunities and will form the basis for the development of the Project Biodiversity Management Plan, or where indicated, highlight how mitigation will be achieved through the implementation of other relevant plans. These mitigation measures have been considered in the assessment of significant residual impacts for all MNES/MSES protected matters in Section 11.7.3.4.

Information related to government conservation advices, threat abatement plans and recovery plans has been incorporated into the identified mitigation measures wherever applicable. Mitigation measures have been selected based on the best available information, including government guidelines (e.g. TMR's *Fauna Sensitive Transport Infrastructure Delivery Manual* (DTMR, 2024)), and the appropriateness and effectiveness in managing the identified impacts including mitigation measures used on similar projects that have been subject to legislative approval.

Chapter 24: Draft Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures. A summary of inspections, monitoring, auditing, and reporting to be undertaken for the Project during the pre-construction and construction stage is provided in Table 11-32.

11.7.3.1 Mitigation measures during detailed design

Table 11-27 outlines the proposed mitigation measures that have been developed and will be implemented during detailed design.

TABLE 11-27 PROJECT IMPACT MITIGATION MEASURES DURING DETAILED DESIGN

Aspect	Mitigation and management measures
Habitat loss through clearing	▶ Undertake targeted detailed ecological surveys of the Project footprint in accordance with the relevant survey guidelines for nationally threatened species. Data obtained from these detailed surveys will be used to refine the detailed design, including minimisation of the Project footprint and impacts to identified habitat, to the extent required for construction and safe operation. They will also be used to inform the construction methodology for the Project. Surveys will include the following: ▶ protected plant surveys, during appropriate seasons, in accordance with the requirements of the <i>Flora Survey Guidelines — Protected Plants</i> (DES, 2020a). Relevant flora MNES species will be targeted through these surveys. ▶ terrestrial and aquatic fauna surveys, according to relevant fauna survey guidelines. Relevant fauna MNES species will be targeted through these surveys. Surveys for some species will need to be conducted during seasons when the species is likely to be present in the region. Aquatic surveys will occur during periods of surface water flow. ▶ Opportunities for potential translocation of threatened flora identified within the Project footprint will be investigated. This will include the following: ▶ appropriate habitat outside the Project footprint will be identified and surveyed during pre-construction surveys to inform potential translocation recipient sites. Offset sites will be used as a first preference for potential translocation recipient sites. ▶ If required, a species-specific Translocation Management Plan, in accordance with the <i>Guidelines for the Translocation of Threatened Plants in Australia</i> (Commander et al., 2018) will be developed and relevant additional approvals will be sought. ▶ Detailed design and construction methodology will seek to minimise the construction and operation footprints and avoid impacts on mature native vegetation, protected matters and other ecologically important areas such as biodiversity corridors and PCZs as far as reasonably practicable. ▶ Consult with TRC and GRC to further inform mitigation and management measures specific to MLES where practicable. This will include consultation with TRC to identify measures to avoid, retain or mitigate clearing of particular areas of remnant vegetation that are Of Concern where it is possible and reasonable to do so. These areas will include, but may not be limited to: ▶ remnant roadside trees along the Gore Highway ▶ Koala habitat trees at Southbrook west of Geitz Road, Southbrook ▶ remnant patches near Murlaggan Road, Pittsworth ▶ trees along existing rail line near Ware Street, Brookstead ▶ remnant riparian vegetation at both the main branch and northern branch of the Condamine River ▶ remnant riparian vegetation at Grasstree Creek ▶ vegetation along Owen's Scrub Road, Millmerran ▶ remnant riparian vegetation at Back Creek ▶ remnant riparian vegetation at Bringalily Creek ▶ remnant riparian vegetation at Native Dog Creek.
Fauna species injury and mortality	▶ Opportunities for potential translocation of threatened fauna individuals within the Project footprint will be investigated, particularly for reptile species and the brigalow woodland snail. This will include the following: ▶ appropriate habitat outside the Project footprint will be identified and surveyed during pre-construction surveys to inform potential translocation recipient sites. Offset sites will be used as a first preference for potential translocation recipient sites. ▶ development of a species-specific Translocation Management Plan, in accordance with the <i>Protected Animal Translocation Interim Policy</i> (DES, 2022e).

Aspect	Mitigation and management measures
Fauna species injury and mortality <i>continued</i>	▶ reduce train strike risk through the assessment and development of the design and location of fauna exclusion fencing, pursuant to the Fauna Connectivity Strategy, having regard for the following: – the compatibility of each crossing structure approach with the general fencing principles at each location – safety requirements for the rail corridor and adjoining properties (e.g. rail corridor fencing has not been proposed across the Condamine River floodplain to prevent the possibility of debris accumulation in fencing during flood events) – consultation with adjoining landowners to confirm the acceptability of a localised fencing approach and confirm compatibility with their land use operation – maintenance constraints that a fauna connectivity or fencing opportunity may introduce – the provision of escape mechanisms such as jump outs, escape poles and one-way gates at regular intervals, which will be based on a review of results of monitoring of fauna fence escape mechanisms on other sections of Inland Rail (and other relevant studies) and incorporate these results into the detailed design of the Project – guidelines documented in the <i>Fauna Sensitive Transport Infrastructure Delivery Manual</i> (DTMR, 2024). Where required, additional expert guidance in relation to specific design features will be sought during the detailed design process as required. ▶ Priority will be given to fauna exclusion fencing in PCZs identified as important zones for landscape-scale corridor connectivity to channel fauna toward safe movement options (i.e. culverts) to limit vehicle strikes and associated incidents.
Introduction and spread of weeds, pathogens and pest species	▶ Consultation with TRC and GRC on the approach and priorities of biosecurity management for the Project to be consistent with the Toowoomba Region Biosecurity Plan 2020 and the Goondiwindi Regional Council Strategic Biosecurity Plan 2022. ▶ Liaison with GRC and DDMRB will be undertaken to confirm the fencing specifications for the wild dog check and rabbit exclusion fence, respectively. ▶ Where the Project footprint impacts the operational sections of the wild dog check fence, the detailed design will require reinstatement of the fence on a like-for-like basis in consultation and agreement with the relevant stakeholders, including DESI, impacted landholders and lessees, DAF and GRC.
Habitat fragmentation (loss of connectivity and barrier effects)	▶ Incorporation of design requirements outlined in Appendix P: Fauna Connectivity Strategy the Project's detailed design and documented in the Wildlife Connectivity Plan. Fauna crossing structures and other design features will be progressively developed over the Project's design duration to integrate fauna connectivity in design decisions iteratively at the appropriate level of design maturity in conjunction with other requirements and constraints such as safety, cost, engineering and flooding through detailed design review gates. This will provide for ecological connectivity and dispersal function through the following: ▶ The provision of additional fauna crossing structures, where suitable crossing opportunities are currently absent and considered required for the target species. ▶ Modification of revised reference design drainage structures (size, configuration, shape) to facilitate fauna movement through the structure where required. For example, converting pipe culverts to box culverts, converting culverts to a bridge structure, or modifying dimensions. ▶ Location and configuration of glider poles and canopy bridges to bridge gaps in canopy cover for successful crossing by arboreal mammals. These structures will extend to adjacent habitat trees that are a safe distance from the rail corridor to enable direct tree canopy to crossing structure movements for arboreal species. ▶ Inclusion of fauna furniture within and adjacent to approaches of crossing structures, including but not limited to koala refuge poles and rails. ▶ Vegetation clearing to be minimised as much as possible at watercourse crossings and PCZs identified as important zones for landscape-scale corridor connectivity, to reduce the size of gaps in tree-cover to facilitate movement of gap-sensitive woodland birds and other target species. ▶ Fauna-exclusion fencing to funnel fauna into crossing structures and prevent them from accessing the railway to reduce the risk of wildlife-train collisions. ▶ Noise and light controls (e.g. baffles or walls) where noise and light impacts have the potential to impede the use of the fauna crossing structures. These controls will be detailed in the Wildlife Connectivity Plan. ▶ Landscaping and strategic revegetation within PCZs and in approaches to all fauna crossing structures to enable consideration of ground coverings and low shrubs for fauna movement. ▶ Bridge design at major watercourses will aim to minimise disturbance to riparian vegetation as far as practicable to support fauna movement, particularly in PCZs.

Aspect	Mitigation and management measures
Habitat fragmentation (loss of connectivity and barrier effects) <i>continued</i>	▶ Permanent physical barriers will not be created in defined watercourses that could present a risk to aquatic fauna by restricting flow or result in changed flow conditions such as increased velocity, changed flooding behaviour or introduced turbulence that may adversely impact aquatic fauna. ▶ Placement of bridge piers and other infrastructure required in the bed of defined waterways will avoid low flow zones to minimise disturbance to aquatic fauna passage and water flow during periods of low flow.
Noise and vibration	▶ Management measures for any indirect noise and vibration impacts will be considered and detailed in the Wildlife Connectivity Plan where required, with reference to the rationale and approach of the Fauna Connectivity Strategy and <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024).
Lighting	▶ A risk-based Wildlife Lighting Assessment will be undertaken and a Wildlife Lighting Management Plan would be prepared in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023) to consider and manage impacts of artificial light on wildlife for both the construction and operational Project stages. The Wildlife Lighting Management Plan would also incorporate mitigation recommendations outlined in the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024). The outcomes of the assessment will be incorporated into construction methodology and design attenuation measures to manage artificial light for those species where artificial light has been demonstrated to affect behaviour, survivorship or reproduction. Mitigation measures will consider the use of blue light filters, shields for reducing light spillage, at-receptor treatments and any attenuation measures required to mitigate adverse impacts of artificial light on biodiversity corridors and fauna passage function. Project lighting will be developed in accordance with the minimum level required to meet safety requirements for the Project.
Altered hydrology and flooding	▶ The Project design will continue to refine the cross drainage to preserve existing flood patterns and characteristics as far as practicable to minimise and manage indirect impacts to ecological receptors through the following: ▶ Minimising changes in natural flow patterns and changes to flood-flow distribution across floodplain areas ▶ Maintaining drainage paths that are conveying runoff from adjoining terrain, minor watercourses, and gullies, to avoid ponding of water and/or excessive duration of inundation ▶ Reassessing flooding mitigations, if required based on the outcomes of additional ETV analysis using site-specific and direct assessments by a suitably qualified specialist (e.g. flume method) ▶ Minimising water ponding through surface levelling and use of cross-drainage and longitudinal drains within the rail corridor ▶ Designing water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar ▶ Avoiding, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	▶ Additional geotechnical and soils investigations will be undertaken to inform the design of earthworks, drainage infrastructure, foundations, and construction methodology for the Project including: ▶ cuts and embankments ▶ bridge piers and abutments ▶ floodplains, streams and gullies ▶ disturbance of potentially erodible soils and in areas in or near high value receiving environments such as watercourses, floodplains, high value vegetation and agricultural land ▶ Disturbance of any potentially hazardous soils, specifically material within or on the floodplains in cut off relict streams and billabongs or lakes adjacent to Macintyre River, Macintyre Brook, Condamine River and Oxley Creek. ▶ The following will be considered during detailed design as described in Chapter 9: Land Resources: ▶ the erosive threshold velocity (ETV) for natural ground surfaces will be established from a site-specific assessment by a suitably qualified specialist, and in consideration of engineering guidelines. Drainage design and mitigations will be re-visited in response to updated assessments. ▶ identify and pursue further opportunities to minimise disturbance to existing landform to construct, operate and maintain the Project safely and efficiently.

Aspect	Mitigation and management measures
Erosion and sedimentation <i>continued</i>	▶ Opportunities for embankment batter slope optimisation will be investigated with respect to soil type and geological profiles to incorporate: ▶ best practice treatment controls and erosion protection in the final Project design. ▶ optimise civil earthworks to minimise the overall fill deficit of the Project, maximise opportunities for material re-use and lead to as close to a net balance in earthworks as possible, including reusing excess material for works within the permanent footprint (e.g. landscaping) and for restoration of modified landform within the temporary footprint (e.g. restoring borrow pits). ▶ reuse of excess material for other developments (i.e. neighbouring construction activities), with priority given to adjoining Inland Rail projects. ▶ identify opportunities for optimised embankment and batter slopes for optimal stability and erosion protection. ▶ identify sources of materials which may be needed for any soil stabilisation requirements (e.g. lime) from licenced facilities and seek required approvals. ▶ Appropriate risk mitigation and safety measures will be identified for the safe transport and onsite storage of stabilisation materials including to lime and gypsum, to avoid spillage and minimise associated dust. The placement and treatment of the stabilisers during construction will also be planned to avoid spillage and minimise associated dust. ▶ The Project will be designed to avoid, then minimise, the potential for diversion of watercourses (as defined under the Water Act) and waterways (as defined under the Fisheries Act) where practicable. ▶ Develop the detailed design to further minimise impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with the intent of the following: ▶ adopting a waterway crossing structure hierarchy: bridges will be preferred to culverts to maintain permeability for fauna through identified priority connectivity zones such as riverine corridors, and biodiversity corridors for target fauna; however, local conditions and constructability impacts must be considered when determining the preferred environmental solution. ▶ continuing to refine the Project in response to hydraulic modelling outcomes. This includes addressing flood impact objectives which include consideration of peak water levels, flow distribution, velocities, and duration of inundation, and implications for fish passage. This will confirm bridge lengths, culvert sizing and numbers, localised scour, and erosion protection measures for both rail, road and other permanent Project infrastructure. ▶ an in-stream monitoring program will be developed and commenced to inform design and management measures to be used at proposed waterway crossing activities during construction. ▶ watercourse crossing structures (including culverts and bridges) will be designed to maintain fish passage where applicable in accordance with accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF, 2018a) or conditions of development approval for operational work that is constructing or raising waterway barrier works. Detailed design will minimise the need for ongoing maintenance and inspection to maintain fish passage. ▶ further seasonal fish surveys, for any waterway intersections that do not meet accepted development requirements for waterway barrier works requirements, to be conducted during times of adequate flow to gain an understanding of the baseline fish species composition and population abundance of these species. ▶ stormwater controls, such as scour protection, will be developed and incorporated, where necessary, in accordance with the Project's flooding and geomorphology mitigation framework to manage impacts to the surrounding environment including water quality of wetlands and waterways and subsequent impacts to aquatic and terrestrial species that rely upon receiving environments a source of water. Measures will be appropriate to the site conditions, responding to the erosion risk assessment, environmental receptors, climatic zone, and seasonal factors. ▶ design modifications during the detailed design stage will be subject to re-runs of the existing flood models to demonstrate continued compliance with the design objectives of the Project, including for extent and time of inundation, afflux and flow velocities.

11.7.3.2 Mitigation measures during pre-construction and construction

Table 11-28 outlines the proposed mitigation measures that have been developed and will be implemented during pre-construction and construction. Table 11-28 outlines that auditing, monitoring and reporting the will be conducted during pre-construction and construction.

TABLE 11-28 PROJECT IMPACT MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION

Aspect	Mitigation and management measures
Habitat loss through clearing	▶ A Biodiversity Management Plan will be developed and implemented as part of the CEMP for relevant works. This plan will include appropriate criteria, directives and procedures in relation to the following: ▶ methods and sequencing of protected plant preclearance surveys. Flora species will be targeted through these surveys include MNES and MSES flora identified as known, likely or with potential to occur within the Project footprint. ▶ methods and sequencing of pre-clearance fauna surveys for relevant species. ▶ staging works so that they avoid animal breeding periods (for species that breed within Australia) as much as possible within areas of habitat where relevant works are proposed. ▶ staged and sequential clearing protocols to all areas impacted by the Project where threatened species have been identified. ▶ animal handling protocols, including engagement of an approved fauna handler with a valid damage mitigation permit. ▶ relocation of plants and habitat features for threatened species, where possible, and documented evidence of previous relocation success. ▶ requirements for inspections and corrective actions during construction and rehabilitation activities. ▶ Biodiversity/fauna and flora management actions will be undertaken by suitably qualified persons. ▶ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction. ▶ Corrective actions if the outcomes do not achieve the adopted objectives. ▶ Clearing limits and location of known sensitive areas (e.g., known MNES/MSES threatened species records and habitat areas) identified through pre-construction habitat surveys undertaken during the detailed design stage, will be supplied to the principal contractor via environmental constraints maps. ▶ Construction personnel are to be informed of the environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing vegetation communities, important flora and fauna habitat areas, and locations where threatened species, populations or ecological communities have been recorded. ▶ Clearing of native vegetation is to be minimised to the greatest extent practicable with the objective of reducing impacts to threatened ecological communities and threatened species. Clearing extents will be limited to the area safely and reasonably required for permanent and temporary works, avoiding impacts to native vegetation and habitats as far as practicable. ▶ Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined and marked. Designated revegetation/rehabilitation zones and other no-go areas (including large significant trees and any threatened flora to be retained) will also be marked. High-visibility tape, barricade webbing or similar will be used. All contractors will be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. Construction areas, including compounds, stockpiles, fuel storage areas, laydown areas and staff parking, will be located and established outside the tree protection zone as defined in AS4970-2009 Protection of trees on development sites. ▶ Pre-clearance surveys, including terrestrial and aquatic habitats undertaken in accordance with the Fauna Management Plan to include demarcation of habitat resources and habitat features that are suitable for translocation or salvage. ▶ Salvage and relocation of microhabitat features for offset properties or other adjacent suitable habitat will be undertaken as part of rehabilitation, reinstatement, habitat enhancement and beneficial re-use activities, as far as practicable, including in areas identified as important for functional movement corridors (e.g. priority connectivity zones) with consideration of the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024). Destruction and disposal of microhabitat features will only be considered where there are no practicable re-use options. ▶ Post-clearance surveys of disturbed areas to be undertaken to record extent of clearing that has occurred and to confirm that approved clearing limits have not been exceeded. ▶ Where necessary, clearing activities are to be conducted in accordance with approved performance requirements under the accepted development vegetation management codes. ▶ Where threatened flora species are retained or found to occur within the Project footprint, species-specific biosecurity controls will be implemented in proximity to the area of occurrence where required.

Aspect	Mitigation and management measures
Habitat loss through clearing <i>continued</i>	▶ A Rehabilitation and Landscaping Management Plan will be prepared as a component of the CEMP and finalised prior to Project works. A Rehabilitation and Landscaping Management Plan will be prepared as a component of the CEMP, finalised prior to commencement of relevant Project works, and will establish the following: ▶ location-specific objectives, indicators, and success criteria for rehabilitation, reinstatement and/or stabilisation based on the hierarchy for rehabilitation ▶ procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved) ▶ consideration for maintenance or performance issues of rehabilitation (e.g. use of groundcover that does not grow and obscure signals or impact the longevity of rail infrastructure) and suitable monitoring and contingency procedures for rehabilitation maintenance and redesign if required ▶ how the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation. ▶ details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, while minimising the duration of exposure in disturbed areas. ▶ how the reinstatement approach considers native flora species to the Darling Downs and Toowoomba regions, the pre-cleared regional ecosystems and other suitable species appropriate to the landscape context and nursery/seed stock sources ▶ fauna connectivity requirements as detailed in the Wildlife Connectivity Plan including consideration of vegetated areas and fauna movement infrastructure. ▶ Revegetation and stabilisation of areas disturbed by the Project will occur including cut and fill embankments as appropriate.
Fauna species injury or mortality	▶ Rehabilitation requirements such as: ▶ milling and removal of bitumen pavement ▶ removal of any decommissioned culverts ▶ tining and ripping of base and sub-base material ▶ application of soil ameliorants ▶ topsoiling and/or compost blanket ▶ stabilisation and rehabilitation (e.g. planting and/or seeding). ▶ Timeframes, measurable performance objectives and responsibilities for the success of rehabilitation and/or reinstatement/stabilisation areas ▶ Where appropriate, how the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation ▶ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved. ▶ Where temporary construction facilities are required, land will be returned to a stable condition that complies with the applicable landowner agreements and if relevant, regulatory approvals. ▶ Reinstatement, stabilisation and rehabilitation of disturbed areas will be undertaken progressively, as work fronts are completed. ▶ In accordance with the Fauna Management Plan, the following mitigation measures will be incorporated into the Biodiversity Management Plan and implemented as part of the CEMP to prevent fauna injury or mortality during vegetation clearing activities: ▶ Local wildlife groups will be contacted at least seven days prior to clearing to confirm they can receive any injured wildlife ▶ Pre-clearance surveys to be undertaken by a suitably qualified ecologist within 48 hours of tree felling works and include the following: ▶ Identification and marking of habitat resources and habitat trees (e.g. those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage and other habitat features including fallen timber/hollow logs, burrows and boulder piles) ▶ Identification of threatened species or habitat features that are suitable for translocation or salvage ▶ Tree felling to be completed within 48 hours of pre-clearance surveys to limit the potential for new issues to arise (such as new active nests being built), adhering to recommendations made during the pre-clearance surveys. ▶ Tree felling supervision will be undertaken by a suitably qualified fauna spotter catcher after pre-clearance surveys have identified potential habitat features. ▶ Prior to felling habitat trees identified in the pre-clearance survey, the following must be undertaken: ▶ Completion of actions recommended from the pre-clearing surveys including salvage of identified habitat trees, additional assessments to determine threatened fauna usage of the area, identification of active burrows or dens, and any actions required to discourage fauna occupation and weed or feral animal requirements ▶ Removal of any non-habitat trees/vegetation as close to the habitat tree as possible in order to create disturbance to discourage fauna usage of the habitat trees

Aspect	Mitigation and management measures
	▶ Shaking of habitat trees (with heavy machinery) as appropriate may be undertaken to encourage fauna to abandon trees
Fauna species injury or mortality <i>continued</i>	▶ On the day of felling habitat trees, the following must be undertaken: ▶ all habitat trees will be subject to a visual inspection to survey for threatened species ▶ trees previously identified as containing fauna will be shaken and then felled, providing no fauna are identified ▶ the lowering of hollow-bearing trees will be done as gently as possible with heavy machinery ▶ if fauna are identified in a habitat tree on the day of felling, the fauna spotter catcher is to advise of the most appropriate method to minimise harm including leaving the tree overnight, further shaking, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in place, or measures to capture and relocate the animal to secure habitat ▶ uninjured animals shall be released on the day of capture into nearby secure habitat and should not be held for extended periods of time ▶ felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised ▶ all felled trees shall remain in place for at least one night to allow any remaining fauna to escape ▶ handling and relocation of terrestrial and aquatic fauna to suitable habitat will be undertaken to ensure injured and/or sick fauna are assessed and treated accordingly and recorded by a suitably qualified fauna spotter catcher ▶ allow the safe and responsible handling of fauna (where required) and repatriation in pre-identified appropriate habitat outside of the Project footprint, in consultation with applicable landholders. ▶ If any fauna is to sustain injury at any time during construction, the fauna must be handed over to an appropriate wildlife carer personnel or veterinary clinic within 24 hours and the correct ARTC personnel notified. ▶ Management measures will be implemented to minimise fauna entrapment in excavations, including: ▶ minimising to the extent practicable, the period of time the excavation is left open ▶ providing opportunities for fauna to exit the excavation ▶ daily pre-start inspections of work areas and removal of trapped fauna by suitably qualified fauna handler as required. ▶ In the event that native fauna are detected within the construction footprint, all mobile construction in the area will cease work. Mobile construction equipment will not recommence until a wildlife handler has removed the individual or it has been confirmed that the individual has left the workspace. Any captured wildlife will be removed and relocated to nearby adjacent habitat away from the construction area in accordance with the fauna handling procedure and recorded in the fauna handling record sheet. ▶ Works which have the potential to impact on a protected animal breeding place will be subject to a Species Management Program. ▶ A protected matters unexpected finds procedure will be prepared prior to construction and implemented as part of the CEMP Biodiversity Management Plan. In the event that unexpected threatened flora, fauna or TECs are discovered during construction, the unexpected finds procedure will be implemented as follows: ▶ stop works, protect threatened species and inform ARTC ▶ engage suitably qualified ecologist to undertake assessment and provide recommendations for management ▶ where impacts can be avoided: ▶ works may proceed. ▶ Where impacts cannot be avoided: ▶ consult with agencies and submit management plan for approval ▶ recommence works with updated controls where necessary ▶ update Biodiversity Management Plan and include species in subsequent inductions, toolbox talks ▶ vehicle speed limits will be controlled onsite to no more than 40 km/hr. ▶ Temporary fencing will be installed around construction works where practicable, to discourage fauna from entering active construction zones. ▶ The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with <i>Guidelines for fish salvage</i> (DAF, 2018d): ▶ an appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and other aquatic fauna, as required. As a minimum, the following will be implemented: – relocation will be undertaken by a suitably qualified person – dewatering pumps will have an intake screen – all fish recovered will be recorded, and the location of their release will be maintained. ▶ Dewatering of dams/waterbodies to be supervised by a suitably qualified fauna spotter catcher. ▶ In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.

Aspect	Mitigation and management measures
Reduction in biological viability of soil	▶ A Soil Management Plan will be developed and implemented as part of the CEMP which will include measures to avoid compaction and manage topsoils. ▶ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species. Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank. ▶ Structural impacts to soils will be minimised by restricting the temporary construction footprint to what is required to enable safe and efficient construction of the Project. ▶ Construction activities will be sequenced to avoid longer than necessary duration of land disturbance and to enable timely rehabilitation post occupation when the land is no longer required to support the Project establishment. ▶ High traffic and heavy load works within areas of clayey and silty soils will be minimised during wet periods where possible. ▶ Land that is temporarily disturbed in support of construction activities (e.g. for access tracks, laydown areas and storage areas) will be rehabilitated at the end of its use for construction progressively and as soon as possible, in accordance with the Rehabilitation and Landscaping Management Plan.
Introduction and spread of weeds, pathogens and pest species	▶ A Biosecurity Management Plan will be developed and implemented in accordance with the requirements of the <i>Biosecurity Act 2014</i> (Qld), as part of the CEMP. This will be developed in consultation with TRC and GRC to provide an approach and priorities that align with the Toowoomba Region Biosecurity Plan 2020 and the Goondiwindi Regional Council Strategic Biosecurity Plan 2022. The plan will be based on current weed and pest listing advice and will include the following: ▶ requirements for pre-clearing surveys to determine current risks of weeds or pest animals being present within the Project footprint ▶ maps of the existing extent, confirmed through surveys, and severity of weed infestation including restricted matters including mother-of-millions (<i>Bryophyllum delagoense</i>), opuntoid cacti, African boxthorn (<i>Lycium ferocissimum</i>), lippia (<i>Phyla canescens</i>) and lantana (<i>Lantana camara</i>) and weed management requirements ▶ pest animal management controls, including protocols for severing, realigning, and reinstating the wild dog check fence and the DDMRB rabbit fence ▶ measures to confirm that soil movement complies with Queensland biosecurity requirements for managing the spread of imported fire ants (<i>Solenopsis invicta</i>) ▶ site hygiene and waste management procedures to deter pest animals ▶ locations and procedures for vehicle washdown (light vehicle and oversize vehicles), wheel washes and rumble grids ▶ weed surveillance and treatment during construction and rehabilitation activities such as: – vehicle and plant washdown requirements for fleet moving from low-risk areas to and high-risk areas – weed certification requirements for vehicles, plant and materials arriving onto the construction site – requirements in relation to pesticide and herbicide use, including any limitations on use, met particularly in proximity to watercourses, known areas of MNES or MSES habitat, or land uses sensitive to spray-drift from the application of pesticides and herbicides (e.g. organic farming practices) – erosion and sediment control risks associated with broad scale weed removal or treatment – monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project – corrective actions, should the outcomes not achieve the adopted objectives. ▶ Property-specific weed hygiene requirements will be developed in consultation with the relevant landowners/operators prior to pre-construction/construction activities occurring on that property, outside of the permanent footprint. Protocols will be documented in individual property management agreements. ▶ Where the Project crosses the DDMRB fence at Ch 120.2 km, the fence will be reinstated, and a rabbit trap will be established in accordance with the design solution developed in consultation with DDMRB through the detailed design process. ▶ Any vegetated material containing, or with the potential to contain, weed seed material, will not be used for onsite mulching or erosion protection. ▶ A complaints management system will be developed to enable members of the public, landholders or other stakeholders to make enquires or complaints, including concerns regarding weeds and pests on a 24-hour, seven-day-a-week basis, during the construction stage.

Aspect	Mitigation and management measures
Habitat fragmentation	▶ Implementation of the Wildlife Connectivity Plan, in accordance with the Fauna Connectivity Strategy to construct connectivity opportunities to maintain ecological connectivity and dispersal function is maintained. ▶ Fauna movement opportunities will be constructed to reinstate safe fauna passage as soon as possible, in accordance with the detailed design and Wildlife Connectivity Plan. ▶ Cleared vegetation, which may be mulched or stored as is depending on the reinstatement/rehabilitation requirements for specific areas, will be stockpiled separately in a manner that does not unreasonably impede wildlife. ▶ Rehabilitation to the banks of watercourses will occur as soon as possible after construction works in the area have been completed and will consist of suitable substrate to support fauna movement, with details documented in the Wildlife Connectivity Plan. ▶ Construction works will be undertaken sequentially to allow fauna to move around construction work areas.
Noise and vibration	▶ A Noise and Vibration Management Plan will be prepared and implemented as a component of the CEMP, to minimise noise and vibration impacts as a result of construction of the Project, through the following: ▶ plant and equipment will be selected to minimise noise emissions, in-so-far-as possible while maintaining efficiency of function. Mufflers will be fitted, and all noise control equipment will be maintained in good working order. ▶ where possible, plant will be located away from ecologically sensitive receptors. Appropriate mitigation measures will be investigated. If required, site access roads will be located as far as practicable away from noise sensitive areas. ▶ Construction personnel are to be informed of any environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing fauna breeding habitat within a 500 m buffer, identified during pre-clearance surveys, and locations where threatened species, populations or ecological communities have been recorded. ▶ Works are to be staged so that they avoid animal breeding periods as much as possible within areas of breeding habitat. Works which have the potential to impact an identified protected animal breeding place will be subject to a Species Management Program. ▶ Where possible, works will be located/oriented to direct noise away from ecologically sensitive receptors. Materials and stockpiles are to be used to increase acoustic shielding, where feasible. If required, site access roads will be located as far as practicable away from noise sensitive areas. ▶ Where practicable, night works near ecologically sensitive receptors (e.g. breeding places, 'koala hotspots') will be scheduled to a restricted number of nights per week, with night-time traffic redirected away from noise-sensitive receptors. ▶ All workers will be briefed on the importance of threatened fauna species, their location (where they are found to occur within or near the Project footprint), and procedures for working around them. Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration impacts.
Air quality and dust	▶ Implement controls to prevent or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast (e.g. use water sprays or water carts for dust suppression as required) in accordance with the Air Quality Management Plan that will be prepared and implemented as part of the CEMP. This will reduce impacts to flora species and vegetation communities, as increased dust and reduced air quality can impact photosynthesis, and therefore the health of individual plants and vegetation.
Lighting	▶ Implementation of the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife during construction in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023). ▶ As a minimum, offsite lighting impacts will be minimised by: ▶ external lighting installed as low intensity lighting (except where required for safety or emergency purposes) ▶ external lighting does not shine above the horizontal ▶ management of light generated during construction complies with Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting, or its latest version.
Increase in waste	▶ Implementation of the Waste Management Plan as part of the CEMP to manage site hygiene and waste to avoid impacts relating to fauna. ▶ After implementing reuse opportunities where practicable, dispose of spoil (material with no reuse potential) offsite at a licensed facility.

Aspect	Mitigation and management measures
Altered hydrology and flooding	▶ Short term impacts to fauna as a result of altered hydrology and flooding will be mitigated through construction planning and the layout of construction work sites and compounds which would be undertaken with consideration of overland flow paths and flood risk, avoiding flood liable land and flood events where practicable. ▶ Design of temporary earthworks for the Project will avoid unwanted water ponding. This objective will be achieved through surface levelling and drainage, where required. ▶ Design water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar. ▶ Avoid, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	▶ A Soil Management Plan will be developed and implemented as part of the CEMP. The plan will include measures, process and responsibilities to minimise the potential for soil and water impacts, including impacts to groundwater, during construction. ▶ An Erosion and Sediment Control Plan (ESCP), as a component of the CEMP, will be developed prior to commencement of Project works to manage Project activities and works in a manner that minimizes harm to the surrounding environmental values. The ESCP will guide development of area, site, or section-specific ESCPs and include detailed erosion hazard assessments and erosion and sediment control structure designs. The erosion and sediment control measures will be developed by a certified practitioner in erosion and sediment control and be in accordance with the International <i>Erosion Control Association Best Practice Erosion and Sediment Control</i> (2008). Details will include the following: ▶ locations for specific temporary/permanent erosion and sediment control measures, such as: – sediment retention basins – scour protection (included in the revised reference design) – sediment fencing – berms and other surface flow diversions – nomination of location-specific erosion controls including consideration of site conditions, proximity to environmental receptors, adjoining land uses, climatic and seasonal factors, and will be based on an erosion risk assessment – minimisation of the area of disturbance during each stage enable the safe construction, operation and maintenance of the Project – revegetating sites in a timely manner following completion of construction – minimising disturbance (e.g. timing of clearing to minimise amount of exposed soil) – scheduling of works with consideration to periods of higher rainfall (e.g. during summer months) – establishing and specifying the monitoring and performance objectives for handover on completion of construction. ▶ stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material. Establishing and specifying the monitoring and performance objectives for handover on completion of construction.
Contamination of land	▶ A Contaminated Land Management Plan will be developed by a suitably qualified person, as recognised under the EP Act, and incorporated into the CEMP prior to commencement of Project works. To minimise/remove adverse impacts to ecological receptors during Project earthworks. This plan will include the following: ▶ specify management controls for works on land that is known or suspected of being contaminated and will outline the process to identify, document and manage contaminated sites ▶ seek to minimise soil disturbance in areas listed on the Environmental Management Register (EMR) ▶ establish the methodology and sampling and analysis plan for environmental site investigation where soil disturbance is required on an EMR site in the potentially contaminated area ▶ establish an unexpected finds protocol/procedure if potentially contaminated materials, including unexploded ordnance (UXO), are encountered during construction activities.
Modification of aquatic habitat	▶ Avoid, then minimise, the extent of temporary and permanent waterway diversions. Where temporary diversions are unavoidable, implement water quality and ESCP measures to minimise impacts to downstream environments and water users. Where permanent diversions are unavoidable, waterway diversion design will include simulation of natural features (e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections, and different types of sub-strata) depending on the pre-disturbance environmental values, as per relevant guidelines and legislation. Maintenance activity locations, construction compounds and storage areas will be positioned away from waterways to the extent possible. ▶ Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways, or watercourses particularly during periods of flow. ▶ Laydown sites and stockpiles will be located an appropriate distance from riparian habitat to avoid indirect impacts on aquatic habitats. Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided, as far as practicable.

Aspect	Mitigation and management measures
Waterway barrier effects	▶ Works within the bed and banks of a waterway or adjacent to watercourses will be conducted in accordance with the intent of the following: ▶ riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project. ▶ accepted development requirements (ADR) for construction works that is constructing or raising waterway barrier works (DAF, 2018a), (e.g. construction methodologies within waterways). Where the Project is unable to comply with the ADR for construction works that is constructing or raising waterway barrier works, a development approval will be sought. ▶ vehicle crossings for construction of the Project will, in the first instance, aim to meet the requirements for bed level crossings within the ADR for operational work that is constructing or raising waterway barrier works. Any waterway crossings that cannot meet the specifications within the ADR will require a development approval.
Water quality	▶ A Surface Water Management Plan will be prepared and finalised prior to Project works and implemented as a component of the CEMP. The plan will be prepared in consultation with local governments, relevant agencies and other stakeholders, after the establishment of location-specific water quality objectives and prior to construction commencing. The Plan will provide a surface water monitoring framework which will be prepared in accordance with the <i>Receiving Environment Monitoring Program Guideline – FUWERA For Use With Environmentally Relevant Activities under the EP Act</i> (DESI, 2024). The Surface Water Management Plan will provide information to support an evaluation of the potential impacts of releases of contaminants into wetlands and waterways (both ephemeral and permanent), including impacts on aquatic species, aquatic habitats, and species that rely upon the receiving environment as a water source. As a minimum the plan will establish: ▶ a description of the Project and construction activities of relevance to surface water quality ▶ a description of the receiving waters ▶ water quality indicators (e.g. chemistry, turbidity, temperature, turbidity, electroconductivity) as specified in the Water Quality Guidelines ▶ management strategies and mitigation measures proposed to satisfy the performance criteria and achieve the surface water environmental outcomes ▶ monitoring details such as locations of monitoring sites, sampling frequency and timing having regard to seasonal variations, sampling methods and analysis of results ▶ spill prevention measures, as well as spill response procedures (should an accidental discharge take place) ▶ spill management and discharge permitting system to reduce the risk of accidental discharge from site ▶ compliance and corrective action requirements ▶ reporting requirements and schedule ▶ the Surface Water Monitoring Framework (see Chapter 13: Surface Water) will consider, where appropriate, aligning with the in-stream monitoring program. The in-stream monitoring program is to be developed for the purposes of monitoring impacts to riparian vegetation, aquatic fauna and habitats. It will be developed through the detailed design process to inform engineering design and management measures to be used at proposed waterway crossing activities during construction. ▶ Refuelling will only occur at designated locations within the Project footprint and sited at suitable separation distances from ecological values, including surface water features and drainage lines. These refuelling locations will be equipped with on-site chemical and hydrocarbon absorbent socks/booms, spill kits and bunded as appropriate. ▶ Where the dewatering of excavations (e.g. trenches, pier holes.) is required, water will need to meet the established water quality objectives for receiving waterways before being released/discharged into local waterways. This will be managed in accordance with applicable guidelines and standards.
Invasion of aquatic weeds and pest species	▶ If dewatering of existing storages is required, dewatering strategies will be required to comply with the Biosecurity Act to take reasonable measures to avoid the spread of pest species, for example, screening of pump intake.
Changes to groundwater resources affecting GDEs	▶ A Construction Groundwater Management and Monitoring Program will be developed, with monitoring and sampling requirements dependent on the likelihood of construction activities encountering groundwater and the location of such activities. Monitoring will be targeted in areas where construction activities have potential to impact on groundwater quality and/or levels, as confirmed through detailed design.

11.7.3.3 Mitigation measures during operation

Table 11-29 outlines the proposed mitigation measures that have been developed and will be implemented during operation.

TABLE 11-29 PROJECT IMPACT MITIGATION MEASURES DURING OPERATION

Aspect	Mitigation and management measures
Threatened flora	Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted for three years and corrective actions to be implemented where Project-associated impacts are identified.
Fauna species injury or mortality	- ARTC will provide a communication mechanism for members of the public to notify ARTC of issues, including concerns regarding fauna injury or mortality, and the spread of weeds, pest animals and pathogens. - Fauna exclusion fencing, fence escape mechanisms, connectivity structures and adjoining fauna furniture and vegetation within the rail corridor will be inspected and maintained in accordance with the Wildlife Connectivity Plan to retain integrity and reduce the likelihood of interaction between trains and fauna species. - Vegetation maintenance on the habitat side of the fauna exclusion fencing will be required to maintain a clearance zone such that species cannot use vegetation to climb onto the exclusion fencing, in accordance with the Wildlife Connectivity Plan. - The rail corridor will be inspected for trapped fauna during standard operational maintenance, in accordance with ARTC's rail corridor maintenance procedures and policies. - When an animal is detected within the rail corridor, if possible and safe to do so, the animal will be encouraged towards a fauna escape ramp, other escape mechanism or fence end, whichever is closest and provides a safe exit from the corridor - Where required, a suitably qualified wildlife carer/handler will be engaged to remove trapped fauna and a health assessment will be undertaken by a wildlife veterinarian - Information on the likely location of fauna breach of the fence will be used inform potential further measures to be applied to minimise/eliminate the risk of future incidents. - All fauna detected within the rail corridor including healthy, injured, sick or dead fauna will be recorded and reported in the operations fauna management and incident register. - Injured or sick fauna as assessed by a wildlife veterinarian must be handed over to appropriate wildlife carer personnel or veterinary clinic in accordance with the Fauna Management Plan. - Permanent boundary fencing will be inspected and maintained as part of standard operational maintenance, in accordance with the ARTC's rail corridor maintenance procedures and policies to maintain integrity and reduce the likelihood of fauna entanglement. - Rail maintenance access roads will be speed limited to no more than 40 km/hr to reduce the risk of vehicle strike. - A Biosecurity Management Plan will be developed in accordance with the requirements of the Biosecurity Act, GRC and TRC biosecurity plans and ARTC operation and maintenance procedures and policies, as part of the Operational EMP and implemented. This plan will be based on relevant weed and pest listing advice and will include the following: - identification, locations and procedures for vehicle wash down, requirements for operational surveys to determine current risks of weeds or pest animals and appropriate weed management procedures - maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters and Weeds of National Significance) and weed management requirements - pest animal management controls - site hygiene and waste management procedures to deter pest animals - weed surveillance and treatment during 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 MNES or MSES receptors and 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. - monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project. Ongoing weed monitoring within the rail corridor will aim to maintain the pre-construction condition of TECs and habitats that adjoin the rail corridor. - Any outbreak of priority weeds and/or weeds of national environmental significance would be managed in accordance with the Biosecurity Act, the Weeds of National Significance Weed Management Guide, and the requirements of relevant authorities.
Introduction and spread of weeds, pathogens and pest species condition	- Where threatened flora species are found to occur within the Project footprint and will be retained, species-specific biosecurity controls will be implemented in proximity to the area of occurrence. - A predator monitor and control program will be developed as a component of the Wildlife Connectivity Plan to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species. The program will be implemented for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
Habitat fragmentation and fauna connectivity	The post construction monitoring, evaluation and reporting program will be developed and detailed the Wildlife Connectivity Plan and will include monitoring of target fauna movements at crossings to assess the success of the fauna connectivity measures and crossing structures at managing fauna train strike risk and managing connectivity.

Aspect	Mitigation and management measures
Lighting	▶ Lighting associated with operation of the Project including from rollingstock and static infrastructure such as safety lighting at road-rail interfaces will be maintained in accordance with the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife in accordance with <i>National Light Pollution Guidelines for Wildlife</i> (DCCEE, 2023).
Aquatic habitat degradation	▶ Maintenance activities within or adjacent to watercourses will be conducted in accordance with riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project.
Waterway barrier effects	▶ Works will be conducted in accordance with the <i>Accepted Development Requirements For Operational Work That Is Constructing or Raising Waterway Barrier Works</i> (DAF, 2018a) or conditions of development approval for operational work that is constructing or raising waterway barrier works as required. ▶ Drainage infrastructure that provides 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.
Erosion and sediment control	▶ The effectiveness and maintenance of permanent erosion controls (e.g. scour protection or vegetated swales) and surface and subsurface drains (including longitudinal drainage) would be monitored in accordance with ARTC's standard operating procedures. This will minimise detrimental effects on adjacent TECs, threatened flora species, wildlife habitat, wetlands and waterways, particularly downstream environments. ▶ Additional inspections would be undertaken during and/or after flood events, dependent on the ability of operators to complete an inspection safely. ▶ Controls that are found to be failing or not performing as intended will either be modified or replaced. ▶ Where defects are identified and where it is deemed necessary, corrective actions will be undertaken as soon as reasonably practicable and where it is safe to do so. ▶ Rail embankment slopes will be maintained to prevent slope face degradation.

11.7.3.4 Mitigation measures specific to MNES and MSES

Table 11-30 outlines proposed mitigation measures that are specific to an MNES protected matters.

TABLE 11-30 PROJECT IMPACT MITIGATION MEASURES SPECIFIC TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

MNES	MNES specific mitigation and management measures
Detailed design (in addition to those specified in Table 11-27)	
Koala (<i>Phascolarctos cinereus</i>)	▶ Update and finalise the Koala Management Plan prior to construction. This will include implementation of any relevant detailed design mitigation measures.
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	▶ Opportunities for potential translocation of individuals within the Project footprint will be investigated. This will include: ▶ targeted surveys for brigalow woodland snail in identified habitat (Condamine River floodplain brigalow and eucalypt woodland). Surveys to be carried out in accordance with expert advice. Appropriate habitat outside the Project footprint will also be identified to inform potential translocation recipient sites. ▶ development of a species-specific Translocation Management Plan, in accordance with the <i>Protected Animal Translocation Interim Policy</i> (DES, 2022e).
Pre-construction and construction (in addition to those specified in Table 11-28)	
TECs:	▶ Surveys will be carried out during detailed design to confirm identified TECs within, or adjacent to the Project footprint. Surveys will be carried out using a diagnostic criteria/condition threshold detailed in relevant approved conservation advice for the community. Where TECs are found to occur, condition assessment will be undertaken (using a BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified.
▶ Brigalow	
▶ Natural grasslands	
▶ Box-gum grassy woodlands	▶ The area of TECs to be removed will be quantified to enable the Environmental Offsets Delivery Strategy to be refined.
▶ SEVT	▶ The CEMP Biosecurity Management Plan will include reference to relevant guidelines to control potential deleterious pathogens including <i>Phytophthora cinnamomi</i> and Myrtle rust (e.g. DoE, 2015) which may impact eucalypt species and TEC areas adjacent to the construction zone. ▶ Rehabilitation of disturbed areas including on land required for temporary construction activities and within the permanent footprint but outside the rail corridor. This may include using locally native species that may constitute a TEC, subject to landholder agreement.

MNES	MNES specific mitigation and management measures
Murray cod (<i>Maccullochella peelii</i>)	▶ Construction activities to avoid/minimise instream works and associated riparian habitat in identified Murray cod habitat, where practicable. ▶ Construction works will, where practicable, take place outside of the wet season when low flows in floodplain systems are more likely and potential impacts to Murray cod habitat can be reduced (e.g. erosion and sedimentation impacts to water quality, and barriers to fish passage). ▶ High-risk construction activities will not be carried out in known Murray cod habitat during the Murray cod spawning period between September and November, unless otherwise agreed by the Queensland Department of Agriculture and Fisheries (DAF). High-risk construction activities are defined as: ▶ piling within the waterway and within the bed and banks ▶ construction and/or removal of temporary work platforms within the waterway ▶ installation and removal of temporary waterway crossings ▶ high noise impact noise generating construction activities, including construction of foundations and piers. ▶ Consider alternative construction methodologies to driven piling (i.e. bored piles with a screw in casing) in Murray cod habitat to avoid the potential for impacts associated with noise. ▶ Where a temporary impoundment or diversion is required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and will follow relevant State (DAF) fish salvage guidelines during construction activities. ▶ Where possible, instream habitat will be reinstated to pre-construction state immediately upstream and downstream of bridges (e.g. replacement of large woody debris to provide no or limited change to instream flows and allow fish passage). ▶ Prior to construction, beneficial aquatic habitat for Murray cod is to be provided within one km upstream of the bridge crossing of the Macintyre River. The beneficial aquatic habitat must be placed on the northern bank of the Macintyre River within Queensland and must include the placement of woody debris (i.e. snags) to provide Murray cod breeding habitat. Prior to the commencement of these habitat improvement works, consultation must be undertaken with DAF on the location, type and timing of Murray cod habitat improvement works.
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	▶ Undertake pre-clearance surveys for south-eastern long-eared bat and retrieval of tree hollows, where safe to do so, prior to vegetation clearing allowing for inspections for denning or roosting for the south-eastern long-eared bat. Allow safe daytime storage of roosting bats and evening release of individuals. This will be undertaken by a fauna spotter catcher who is trained and experienced in the safe and appropriate handling and relocation of bats.
Koala (<i>Phascolarctos cinereus</i>)	▶ Implementation of the Koala Management Plan, including the following: ▶ qualified koala specialists will undergo baseline surveys (koala scent detection dogs and visual assessments that can include the use of drones to determine areas of high-koala activity and focal areas for heightened koala management. The surveys will be guided by the ongoing research conducted by the University of Southern Queensland and may commence up to six months prior to commencement of Project works in suitable habitat areas. ▶ Koala-specific clearing protocols ▶ Koala encounter procedures, including treating sick or injured koalas and relocation of koalas. ▶ sequential clearing protocols will be undertaken in all areas where koalas have been identified, including all koala districts, areas with known koala records and mapped koala habitat. Sequential clearing will comply with the sequential clearing conditions provided in the Nature Conservation (Koala) Conservation Plan 2017. ▶ Vegetation clearing within the Project footprint in koala habitat will be carried out in a manner to minimise stress on potential individuals as much as is practicably possible (e.g. sequential clearing and minimising time of disturbance to animals). Where practicable, clearing activities will take place outside the breeding season for koala (October— to May). ▶ The CEMP Biosecurity Management Plan will include reference to relevant guidelines to control potential deleterious pathogens including <i>Phytophthora cinnamomi</i> and Myrtle rust (DCCEEW, 2024c) associated with Project activities both of which may impact eucalypt species and therefore koala. ▶ Rehabilitation of temporary construction areas where woodland habitat has been cleared (depending on agreement with the landowner). Revegetation plant species will be obtained from a reliable source that is certified free of pathogens and should include some locally important koala tree species, such as <i>E. tereticornis</i>, <i>E. chloroclada</i>, <i>E. melliodora</i>, <i>E. camaldulensis</i>, <i>E. crebra</i>, <i>E. fibrosa</i>, <i>E. melanophloia</i>, <i>E. orgadophila</i>, and <i>E. populnea</i>. Plantings of these species in temporary construction areas near crossing structures targeted for koalas may assist in encouraging use of structures.

MNES	MNES specific mitigation and management measures
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	▶ Surveys of riparian habitat will be conducted during detailed design. The surveys will identify whether camps occur within or near to the Project footprint including the known flying-fox roost site in Inglewood (3 km south of Project). ▶ Should a roost site be found to occur, the Project will comply with the mitigation standards detailed in the Commonwealth's referral guideline for management actions in grey-headed and spectacled flying-fox camps (DoE, 2015b).
Operation (in addition to those specified in Table 11-29)	
TECs:	▶ Should a TEC patch be retained within the Project footprint, annual monitoring will be conducted against the initial BioCondition assessment for five years. Corrective actions to be implemented where Project-associated impacts are identified.
▶ Brigalow	
▶ Natural grasslands	
▶ Box-gum grassy woodlands	

Table 11-31 outlines proposed mitigation measures that are specific to MSES.

TABLE 11-31 PROPOSED MITIGATION MEASURES SPECIFIC TO MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

MSES	MSES specific mitigation and management measures
Pre-construction and construction (in addition to those specified in Table 11-27)	
Aquatic SLC species: Platypus (<i>Ornithorhynchus anatinus</i>)	▶ Construction activities scheduled to avoid/minimise instream works and associated riparian habitat in identified habitat, where possible. ▶ Construction works will, where possible, take place outside of the wet season when low flows in floodplain systems are more likely and potential impacts to platypus habitat can be reduced (e.g. erosion and sedimentation impacts to water quality). ▶ Where a temporary impoundment or diversion is required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the requirement for a species management program, should breeding places (i.e. burrows) be present. ▶ Where possible, instream habitat will be reinstated to pre-construction state immediately upstream and downstream of bridges (e.g. replacement of large woody debris and excavated substrate to provide no or limited change to instream flows and passage). ▶ No high noise impact generating construction activities, including construction of foundations and piers, to be undertaken in known platypus habitat during breeding/spawning periods (August to September, inclusive). ▶ Consider alternative construction methodologies to driven piling (i.e. bored piles with a screw in casing) in platypus habitat to avoid the potential for impacts associated with noise.

11.7.4 Flora and fauna monitoring

ARTC will monitor the effectiveness of the proposed mitigation measures for up to five years following commencement of operations or as deemed appropriate for specific measures. Learnings through the Project monitoring, evaluation and reporting will be used to inform adaptive management of the Project. An adaptive management framework will facilitate change and improvement to the management strategies where the objectives of the proposed measures are not met.

Ecological monitoring to be conducted during operation of the Project include the following:

- ▶ Should a TEC patch be retained within the Project footprint, annual monitoring will be conducted against the initial BioCondition assessment for five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.
- ▶ Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted against the pre-construction flora surveys and will be continued for five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.

- ▶ Evidence of fauna incursions into the fenced rail corridor will be recorded and investigated, including wildlife-train collisions.
- ▶ An ongoing weed monitoring program will measure the effectiveness of weed hygiene and control measures and target problem areas for weed control.
- ▶ Ongoing collection and analysis of koala DNA samples from adjacent and broader areas from the Project and an analysis of gene flow at five-yearly intervals for 20 years.
- ▶ A monitoring program to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species will be undertaken in accordance with the Wildlife Connectivity Plan. A predator control program will be undertaken at crossing structures within priority connectivity zones for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
- ▶ The fauna crossing structures and wildlife populations on either side of the Project will be monitored where practicable before construction, during construction and after construction to determine their level of effectiveness in maintaining ecological connectivity, avoiding risk to ecological function due to habitat fragmentation and minimising the risk of injury and mortality of fauna from wildlife-train collisions. Preliminary SMART mitigation goals and survey methods to evaluate the effectiveness of the crossing structures are outlined in Appendix P: Fauna Connectivity Strategy. These will be finalised and detailed in the Wildlife Connectivity Plan, the monitoring, evaluation and reporting (MER) and the wild dog predation monitoring program. This monitoring and evaluation program will adopt a scientifically robust approach in accordance with the *Fauna Sensitive Transport Infrastructure Delivery* manual (DTMR, 2024).
- ▶ Noise and vibration monitoring at fauna crossing structures may be considered if monitoring of structures indicates the level of effectiveness of the structures is inadequate, to determine whether levels may be a deterrent for utilisation, particularly within areas of known wildlife corridors. This will be used to determine behavioural responses of fauna to train passbys and inform potential modifications to structures should noise or vibration from train passbys be identified as discouraging use of the structures by wildlife.

11.8 Impact assessment

This section summarises the detailed quantification and assessment of potential impacts to ecological values as a result of the Project undertaken within Appendix L: Terrestrial and Aquatic Ecology Technical Report and Appendix O: Matters of National Environmental Significance Report. The impact assessment has been undertaken in accordance with the methodology discussed in Section 11.4.7 and in Chapter 4: Assessment Methodology.

11.8.1 Summary of potential impacts

Estimation of the potential magnitude of disturbance was undertaken for each of the ecological values identified during the desktop assessment and field surveys. This assessment of impact magnitude was undertaken using field-validated datasets.

Calculated estimates of potential disturbance for each of the ecological values is provided in the following:

- ▶ Table 11-32 for EPBC Act controlling provisions of the Project
- ▶ Table 11-33 for NC Act threatened and SLC species
- ▶ Table 11-34 for State-based ecological values and NC Act threatened species and the same or substantially the same assessment.

TABLE 11-32 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE TO THREATENED (EPBC ACT) FLORA, FAUNA SPECIES AND ECOLOGICAL COMMUNITIES IDENTIFIED FOR THE PROJECT

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat within the Project footprint (ha)
Threatened ecological communities				
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) TEC		-	E	103.69
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC		-	CE	66.07
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC		-	E	0.0
White box–yellow box–Blakely's red gum grassy woodland and derived native grassland TEC		-	CE	2.54
Flora (threatened)				
<i>Acacia lauta</i>	Tara wattle	V	V	410.00
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	13.13
<i>Clematis fawcettii</i>	Stream clematis	V	V	2.27
<i>Dichanthium queenslandicum</i>	King bluegrass	E	E	50.31
<i>Dichanthium setosum</i>	Bluegrass	V	V	260.52
<i>Homopholis belsonii</i>	Belson's panic	V	V	242.25
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	E	79.86
<i>Picris evae</i>	Hawkweed	V	V	110.67
<i>Rhaponticum australe</i>	Austral cornflower	V	V	83.49
<i>Thesium australe</i>	Austral toadflax	V	V	46.44
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	27.19
<i>Xerothamnella herbacea</i>	-	E	E	11.99
Fauna (threatened)				
Birds				
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	285.01
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	E	7.91
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE	Not mapped
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	421.42
<i>Grantiella picta</i>	Painted honeyeater	V	V	330.66
<i>Lathamus discolor</i>	Swift parrot	E	CE	614.93
<i>Rostratula australis</i>	Australian painted snipe	E	E	7.91

Scientific Name	Common Name	NC Act status	EPBC Act status	Habitat within the Project footprint (ha)
Mammals				
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (SE mainland population)	E	E	387.48
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V	696.25
<i>Petauroides volans</i>	Greater glider (southern and central)	E	E ²	15.97
<i>Phascolarctos cinereus</i>	Koala	E	E ²	1,362.53
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	-	V	788.39
Reptiles				
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	E	V	241.61
<i>Delma torquata</i>	Collared delma	V	V	36.83
<i>Egernia rugosa</i>	Yakka skink	V	V	241.13
<i>Furina dunmalli</i>	Dunmall's snake	V	V	262.69
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	51.20
Fish				
<i>Maccullochella peelii</i>	Murray cod	-	V	60.50
Invertebrates				
<i>Adclarkia cameroni</i>	Brigalow woodland snail	V	E	146.72

Table notes:

CE = Critically endangered, E = Endangered, V = Vulnerable, M = Migratory

1. Some ecological value impacts overlap spatially. As a result, addition of disturbance values presented in the above table would not represent a true reflection of the total Project footprint.
2. Species uplisted from Vulnerable to Endangered after controlled action date, for specific dates see likelihood of occurrence tables.

TABLE 11-33 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR NC ACT THREATENED AND SPECIAL LEAST CONCERN (NC ACT) FLORA AND FAUNA SPECIES (EXCLUDING MNES) FOR THE PROJECT

Scientific name	Common name	NC Act status	EPBC Act	Habitat within the Project footprint (ha) ¹
NC Act threatened flora				
<i>Cyperus clarus</i>	-	V	-	166.07
<i>Picris barbarorum</i>	-	V	-	174.98
NC Act threatened and SLC fauna				
Birds				
<i>Aphelocephala leucopsis</i>	Southern whiteface	V	V ²	216.89
<i>Apus pacificus</i>	Fork-tailed swift	SLC	Migratory	Not quantified
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	SLC	V ² ; Migratory	Not quantified
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V	V ²	120.01
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V	V ²	240.66
<i>Gallinago hardwickii</i>	Latham's snipe	SLC	V ² ; Migratory	Not quantified
<i>Hirundapus caudacutus</i>	White-throated needletail	V	V ²	2,853.24
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E	E ²	216.89
<i>Myiagra cyanoleuca</i>	Satin flycatcher	SLC	Migratory	Not quantified
<i>Ninox strenua</i>	Powerful owl	V	-	8.64
<i>Plegadis falcinellus</i>	Glossy ibis	SLC	Migratory	Not quantified
<i>Rhipidura rufifrons</i>	Rufous fantail	SLC	Migratory	Not quantified
<i>Stagonopleura guttata</i>	Diamond firetail	V	V ²	216.89
<i>Tringa nebularia</i>	Common greenshank	SLC	E ² ; Migratory	Not quantified
Mammals				
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	24.81
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V	V ²	298.05
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	-	1,397.48

Scientific name	Common name	NC Act status	EPBC Act	Habitat within the Project footprint (ha) ¹
Reptiles				
<i>Acanthophis antarcticus</i>	Common death adder	V	-	277.27
<i>Hemiaspis damelii</i>	Grey snake	E	E ²	259.80
Invertebrates				
<i>Hypochrysops piceatus</i>	Bulloak jewel butterfly	CE	CE ²	231.29
<i>Jalmenus eubulus</i> ³	Pale imperial hairstreak ³	V	-	-

Table notes:

CE = Critically Endangered, E = Endangered, V = Vulnerable, SLC = Special Least Concern

1. Some ecological value impacts overlap spatially. As a result, addition of disturbance values presented in the above table would not represent a true reflection of the total Project footprint.
2. Species listed after controlled action date, for specific dates see likelihood of occurrence tables
3. Essential habitat for the pale imperial hairstreak is mapped within the Project footprint; however, this species remains unlikely to occur within the Project footprint due to inconsistencies between the GTRE and State-based mapping. Therefore, habitat was not mapped for this species.

TABLE 11-34 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR MSES IDENTIFIED FOR THE PROJECT AND ASSESSMENT OF THE SAME OR SUBSTANTIALLY THE SAME IMPACT

Ecological value/Scientific name	Common name	EPBC Act listing	NC Act listing	Total coverage of ecological value within the Project footprint (ha)	Assessment as MNES or MSES ³
State significant environmental constraints (MSES)					
Regulated vegetation (VM Act)					
Prescribed REs that are Endangered or Of Concern REs		Box-gum TEC — CE Brigalow TEC — E Natural Grasslands TEC — CE	N/A	A total of 172.30 ha documented and assessed as TECs in Appendix O MNES Report. Of this area, 24.98 ha were prescribed REs that are Endangered or Of Concern.	MNES
		N/A	E or OC	109.73	MSES
Prescribed REs within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature REs		N/A	N/A	11.31	MSES
Prescribed REs that are within 50 m of a VM Act wetland		N/A	N/A	11.71	MSES
Essential habitat Note that essential habitat was integrated into habitat mapping rules for all relevant species and has therefore been assessed on a species-by-species basis.		N/A	N/A	113.19	MSES
Protected wildlife habitat					
Koala Habitat Areas under the Nature Conservation (Koala) Conservation Plan 2017		N/A	N/A	7.44	MSES
MSES Flora					
<i>Acacia lauta</i>	Tara wattle	V	V	410.00	MNES
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	13.13	MNES
<i>Clematis fawcettii</i>	Stream clematis	V	V	2.27	MNES
<i>Cyperus clarus</i>	-	-	V	166.07	MSES
<i>Dichanthium queenslandicum</i>	King bluegrass	E	V	50.31	MNES
<i>Homopholis belsonii</i>	Belson's panic	V	E	242.25	MNES
<i>Picris barbarorum</i>	-	-	V	174.98	MSES

Ecological value/Scientific name	Common name	EPBC Act listing	NC Act listing	Total coverage of ecological value within the Project footprint (ha)	Assessment as MNES or MSES ³
<i>Picris evae</i>	Hawkweed	V	V	110.67	MNES
<i>Rhaponticum australe</i>	Austral cornflower	V	V	83.49	MNES
<i>Thesium australe</i>	Austral toadflax	V	V	46.44	MNES
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	27.19	MNES
<i>Xerothamnella herbacea</i>	-	E	E	11.99	MNES
MSES Fauna					
<i>Acanthophis antarcticus</i>	Common death adder	-	V	277.27	MSES
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	V	146.72	MNES
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	E	241.61	MNES
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	285.01	MNES
<i>Aphelocephala leucopsis</i>	Southern whiteface	V ⁴	V	216.89	MSES
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	E	7.91	MNES
<i>Calidris ferruginea</i>	Curlew sandpiper	CE; Migratory	CE	Not quantified	MNES
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V ⁴	V	120.01	MSES
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V ⁴	V	240.66	MSES
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	E	387.48	MNES
<i>Delma torquata</i>	Collared delma	V	V	36.83	MNES
<i>Egernia rugosa</i>	Yakka skink	V	V	241.13	MNES
<i>Furina dunmali</i>	Dunmall's snake	V	V	262.69	MNES
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	421.42	MNES
<i>Grantiella picta</i>	Painted honeyeater	V	V	330.66	MNES
<i>Hemiaspis damelii</i>	Grey snake	E ⁴	E	259.80	MSES
<i>Hirundapus caudacutus</i>	White-throated needletail	V ⁴ ; Migratory	V	2,853.24	MSES
<i>Hypochrysops piceatus</i>	Bullock jewel butterfly	CE ⁴	CE	231.29	MSES

Ecological value/Scientific name	Common name	EPBC Act listing	NC Act listing	Total coverage of ecological value within the Project footprint (ha)	Assessment as MNES or MSES ³
<i>Lathamus discolor</i>	Swift parrot	CE	E	614.93	MNES
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E ⁴	E	216.89	MSES
<i>Ninox strenua</i>	Powerful owl	-	V	8.64	MSES
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V	696.25	MNES
<i>Petauroides volans</i>	Greater glider (southern and central)	E ⁵	E	15.97	MNES
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V ⁴	V	298.05	MSES
<i>Phascolarctos cinereus</i>	Koala	E ⁵	E	1,362.53	MNES
<i>Rostratula australis</i>	Australian painted snipe	E	E	7.91	MNES
<i>Stagonopleura guttata</i>	Diamond firetail	V ⁴	V	216.89	MSES
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	51.20	MNES
Waterways providing for fish passage					
100 waterways intersect the Project footprint and are classified (DAF mapped waterways) as follows:					MSES
▶ 66 waterways mapped as green (low risk)		N/A	N/A	N/A	
▶ 15 waterways mapped as amber (moderate risk)					
▶ 9 waterways mapped as red (high risk)					
▶ 10 waterways mapped as purple (major risk)					
Connectivity					
Remnant vegetation		N/A	N/A	475.33	MSES

Table notes:

CE = Critically Endangered, E = Endangered, V = Vulnerable

1. Area of Project footprint: 3,139.1 ha.

2. There is potential for each of the MSES impacts to overlap spatially. Therefore, numbers should not be taken as cumulative, but rather, the total impact associated to individual MSES.

3. MNES are documented and assessed in Appendix O MNES Report. MSES are documented and assessed in Appendix L Terrestrial and Aquatic Ecology Technical Report.

4. Species listed after controlled action date, for specific dates see likelihood of occurrence tables.

5. Species uplisted from Vulnerable to Endangered after controlled action date, for specific dates see likelihood of occurrence tables.

11.8.2 Significant residual impact assessment results

11.8.2.1 Residual significant impact assessment for matters of national environmental significance (threatened species and communities)

This section summarises assessment of the potential for significant residual impacts as a result of the Project on the EPBC Act controlling provisions of the Project. Assessment has been undertaken using the relevant criteria outlined in the *Matters of National Environmental Significance: Significant impact guidelines 1.1– Environment Protection and Biodiversity Conservation Act 1999* (Cth) (DEWHA, 2013). Within these guidelines there are specific criteria depending on whether the species/community is listed as Critically Endangered, Endangered or Vulnerable. A summary of the outcomes of this assessment is provided in Table 11-35. Full assessment in accordance with the guidelines is provided in Appendix O: Matters of National Environmental Significance Report.

TABLE 11-35 SUMMARY OF THE SIGNIFICANT IMPACT ASSESSMENT OF EPBC ACT CONTROLLING PROVISIONS FOR THE PROJECT

Scientific name	Common name	NC Act status	EPBC Act status	Significant impact assessment result	Area of significant impact
TECs					
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) TEC		-	E	Likely	104.50 ha ¹
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC		-	E	Likely	66.07 ha
Semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar Bioregions TEC		-	E	Unlikely	-
White box–yellow box–Blakely’s red gum grassy woodland and derived native grassland TEC		-	E	Likely	2.54 ha
Flora					
<i>Acacia lauta</i>	Tara wattle	V	V	Unlikely	-
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Unlikely	-
<i>Clematis fawcettii</i>	Stream clematis		V	Unlikely	-
<i>Dichanthium queenslandicum</i>	King bluegrass	V	V	Unlikely	-
<i>Dichanthium setosum</i>	Bluegrass	V	V	Unlikely	-
<i>Homopholis belsonii</i>	Belson’s panic	V	V	Likely	242.25 ha
<i>Lepidium monoplacoides</i>	Winged peppergrass	LC	V	Likely	79.86 ha
<i>Picris evae</i>	Hawkweed	V	V	Likely	110.67 ha
<i>Rhaponticum australe</i>	Austral cornflower	V	V	Unlikely	-
<i>Thesium australe</i>	Austral toadflax	V	E	Unlikely	-
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	Likely	27.19 ha
<i>Xerothamnella herbacea</i>	-	E	V	Likely	11.99 ha
Fauna					
<i>Adclarkia cameroni</i>	Brigalow woodland snail	-	E	Likely	146.72 ha
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	E	V	Likely	241.61 ha
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	Unlikely	-

Scientific name	Common name	NC Act status	EPBC Act status	Significant impact assessment result	Area of significant impact
<i>Botaurus poiciloptilus</i>	Australasian bittern	LC	E	Unlikely	-
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE	Unlikely	-
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll	E	E	Likely	387.48 ha ▶ 259.93 ha of high-quality habitat ▶ 127.55 ha of low-quality habitat
<i>Delma torquata</i>	Collared delma	V	V	Unlikely	-
<i>Egernia rugosa</i>	Yakka skink	V	V	Unlikely	-
<i>Furina dunmalli</i>	Dunmall's snake	V	V	Likely	262.69 ha
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	Likely	421.42 ha ▶ 166.89 ha of breeding habitat ▶ 254.53 ha of foraging habitat
<i>Grantiella picta</i>	Painted honeyeater	V	V	Likely	330.66 ha
<i>Lathamus discolor</i>	Swift parrot	E	CE	Unlikely	-
<i>Maccullochella peelii</i>	Murray cod	-	V	Unlikely	-
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V	Likely	696.25 ha ▶ 301.28 ha of roosting habitat ▶ 394.97 ha of foraging habitat
<i>Petauroides volans</i>	Greater glider (southern and central)	V	V	Unlikely	-
<i>Phascolarctos cinereus</i>	Koala	E	V	Likely	769.40 of breeding and foraging habitat ²
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	LC	V	Unlikely	-
<i>Rostratula australis</i>	Australian painted snipe	E	E	Likely	7.91 ha
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	Likely	51.20 ha

Table notes:

CE = Critically endangered, E = Endangered, V = Vulnerable, LC – Least Concern, - = Not listed

- Three patches of Brigalow TEC outside of the Project footprint would be made unviable due to the Project reducing the areas to less than the minimum viable patch size of 0.5 ha. This added a total of 0.81 ha of Brigalow TEC to the areas significantly impacted.
- The significant impact assessment for the koala determined there to be no residual significant impacts on dispersal habitat. This reduced the total area of habitat to be impacted to 769.40 ha of breeding and foraging habitat.

11.8.2.2 Significant residual impact assessment for matters of state environmental significance

This section summarises assessment of the potential for significant residual impacts as a result of the Project on prescribed environmental matters associated with Queensland (MSES). The *Queensland Environmental Offsets Policy Significant Residual Impact Guidelines* (DEHP, 2014a) details when an action is likely to have a 'significant residual impact' to a MSES as defined in the *Environmental Offsets Regulation 2014*. Although migratory birds are not a prescribed environmental matter under the SRI Guideline (DEHP, 2014b), they have been included in the SRI assessments as SLC species to outline potential residual impacts to these species.

A summary of the outcomes of this assessment is provided in Table 11-36. Full assessment in accordance with the guidelines is provided in Appendix L: Terrestrial and Aquatic Ecology Technical Report.

TABLE 11-36 SUMMARY OF THE SIGNIFICANT IMPACT ASSESSMENT OF PRESCRIBED ENVIRONMENTAL MATTERS FOR THE PROJECT

Matter	NC Act listing	Significant impact assessment result	Area of significant impact
Regulated vegetation			
Prescribed REs that are Endangered or Of Concern	N/A	Likely	109.73 ha
Clearing in the portion of a regional ecosystem that lies within a mapped wetland	N/A	Likely	5.52 ha
A total of 11.71 ha will be cleared within 50 m of the defining bank			
Clearing in a regional ecosystem that is within the defined distance of a watercourse	N/A	Likely	11.31 ha (total) ▶ 5.56 ha of a stream order 1 or 2 watercourse ▶ 5.75 ha of a stream order 3 or 4 watercourse 3.72 ha will be cleared within 5 m of the defined bank: ▶ 2.69 ha of a stream order 1 or 2 watercourse ▶ 1.03 ha of a stream order 3 or 4 watercourse
Connectivity areas			
Remnant Category B vegetation	N/A	Likely	475.33 ha
Wetlands and watercourses			
Wetlands in a Wetland Protection Area	N/A	Unlikely	-
Wetlands of High Ecological Significance	N/A	Unlikely	-
Wetland or watercourse in High Ecological Value waters	N/A	Unlikely	-
Protected wildlife habitat (Flora)			
<i>Cyperus clarus</i>	V	Likely	166.07 ha
<i>Picris barbarorum</i>	V	Likely	174.98 ha
Protected wildlife habitat (Fauna)			
Common death adder (<i>Acanthophis antarcticus</i>)	V	Unlikely	-
Southern whiteface (<i>Aphelocephala leucopsis</i>)	V	Likely	216.89 ha
Fork-tailed swift (<i>Apus pacificus</i>)	SLC	Unlikely	-

Matter	NC Act listing	Significant impact assessment result	Area of significant impact
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	SLC	Unlikely	-
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	V	Likely	120.01 ha ▶ 1.08 ha of breeding and roosting habitat ▶ 118.94 ha of foraging habitat
Brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>)	V	Unlikely	-
Latham's snipe (<i>Gallinago hardwickii</i>)	SLC	Unlikely	-
Grey snake (<i>Hemiaspis damelii</i>)	E	Unlikely	-
White-throated needletail (<i>Hirundapus caudacutus</i>)	V	Unlikely	-
Bullock jewel butterfly (<i>Hypochrysops piceatus</i>)	CE	Unlikely	-
Hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>)	E	Unlikely	-
Satin flycatcher (<i>Myiagra cyanoleuca</i>)	SLC	Unlikely	-
Powerful owl (<i>Ninox strenua</i>)	V	Unlikely	-
Platypus (<i>Ornithorhynchus anatinus</i>)	SLC	Unlikely	-
Yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>)	V	Unlikely	-
Glossy ibis (<i>Plegadis falcinellus</i>)	SLC	Unlikely	-
Rufous fantail (<i>Rhipidura rufifrons</i>)	SLC	Unlikely	-
Diamond firetail (<i>Stagonopleura guttata</i>)	V	Likely	216.89 ha
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	SLC	Unlikely	-
Common greenshank (<i>Tringa nebularia</i>)	SLC	Unlikely	-
Koala Habitat in south-east Queensland			
Koala habitat	N/A	Unlikely	-
Protected areas			
Protected areas	N/A	Unlikely	-
Waterway providing for fish passage			
Any part of a waterway providing for passage of fish, only if the construction, installation or modification of waterway barrier works will limit the passage of fish along the waterway	N/A	Unlikely	-

11.9 Environmental offsets

Impacts to ecological values will be avoided where possible and then minimised and mitigated to the greatest extent practicable (see Section 11.7). Residual impacts are those impacts that remain after the implementation of an avoidance hierarchy and mitigation measures. In some instances, the magnitude and significance of potential impacts will remain unchanged following the implementation of the mitigation measures.

This section summarises the quantification of significant residual impacts to MNES and MSES and provides discussion on how ARTC proposes to provide its offset obligations for the Project.

ARTC's *Environmental Offset Delivery Strategy—Qld* has been developed for the Project and is provided as Appendix Q: Environmental Offset Delivery Strategy.

11.9.1 Matters of national environmental significance

The EPBC Act Offsets Policy states: “Offsets provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation measures. These remaining, unavoidable impacts are termed ‘residual impacts’. For assessments under the EPBC Act, offsets are only required if residual impacts are significant.”

An assessment of MNES relevant to the Project has been undertaken in accordance with the significant impact criteria (see Section 11.8) and determined that significant residual impacts are likely to occur for MNES as presented in Table 11-37.

TABLE 11-37 QUANTIFICATION OF ANTICIPATED SIGNIFICANT RESIDUAL IMPACTS TO MNES

Scientific name	Common name	Identified significant residual impact
TECs		
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) TEC		104.50 ha
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC		66.07 ha
SEVT of the Brigalow Belt (north and south) and Nandewar bioregions TEC		-
White box–yellow box–Blakely’s red gum grassy woodland and derived native grassland TEC		2.54 ha
Flora		
<i>Homopholis belsonii</i>	Belson’s panic	242.25 ha
<i>Lepidium monoplacoides</i>	Winged peppergrass	79.86 ha
<i>Picris evae</i>	Hawkweed	110.67 ha
<i>Westringia parvifolia</i>	Small-flowered westringia	27.19 ha
<i>Xerothamnella herbacea</i>	-	11.99 ha
Fauna		
<i>Adclarkia cameroni</i>	Brigalow woodland snail	146.72 ha
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	241.61 ha
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll	Total: 387.48 ha ▶ 259.92 ha of high-quality denning/breeding and foraging habitat ▶ 127.55 ha of low quality denning/breeding and foraging habitat
<i>Furina dunmalli</i>	Dunmall’s snake	262.69 ha
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	Total: 421.42 ha ▶ 166.89 ha of breeding habitat ▶ 254.53 ha of foraging habitat
<i>Grantiella picta</i>	Painted honeyeater	330.66 ha
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	Total: 696.25 ha ▶ 301.28 ha of roosting habitat ▶ 394.97 ha of foraging habitat
<i>Phascolarctos cinereus</i>	Koala	769.40 ha of breeding and foraging habitat
<i>Rostratula australis</i>	Australian painted snipe	7.91 ha
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	51.20 ha

11.9.2 Matters of State environmental significance

For MSES, impacts to prescribed environmental matters that are considered to constitute significant residual impacts are required to be offset consistent with the *Environmental Offsets Act 2014* (Qld). The *Environmental Offsets Regulation 2014* and associated Queensland Environmental Offsets Policy (the Qld Offsets Policy), provide guidance regarding those offsets for MSES. The purpose of the Qld Offsets Policy is to provide a decision-support tool to enable administering agencies the ability to assess offset proposals to ensure that they meet the requirements of the Offsets Act.

Some of the species listed as Threatened under the EPBC Act (assessed as MNES in Appendix O: Matters of National Environmental Significance Report, and presented above in Sections 11.8.2.1 and 11.9.1) are also listed as Threatened under the NC Act and are therefore considered MSES. Where species specific habitat was considered in impact assessments documented in Appendix O, and where it can be demonstrated that the habitat mapped for the listed Threatened species listed under both the EPBC Act and NC Act is the same or substantially the same according to the definition of prescribed environmental matters under the EO Regulation, then an impact assessment in accordance with the *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (DEHP, 2014a) is not required and no additional offset is considered.

Assessment of MSES of relevance to the Project has been undertaken in accordance with the MSES significant impact criteria (see Section 11.8.2.2 and Appendix L: Terrestrial and Aquatic Ecology Report). Analysis, based on ground-truthed values within the Project footprint and predictive habitat mapping for areas outside the Project footprint (to the extent they are within the study area), indicates that there are significant residual impacts for the MSES presented in Table 11-38.

TABLE 11-38 QUANTITY OF SIGNIFICANT RESIDUAL IMPACTS TO MSES

Environmental value (MSES)	Identified significant residual impact area
Regulated vegetation	
Prescribed REs that are Endangered and Of Concern REs*	109.73 ha (see Table 11-39)
Prescribed REs that are with 50 m of wetlands identified on the vegetation management wetlands map*	0.86 ha (see Table 11-40)
Prescribed REs within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature	8.06 ha (see Table 11-41)
Connectivity	
Remnant Category B vegetation	475.33 ha
Protected wildlife habitat	
Flora	
<i>Cyperus clarus</i>	166.07 ha
<i>Picris barbarorum</i>	174.98 ha
Fauna	
Diamond firetail (<i>Stagonopleura guttata</i>)	216.89 ha
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	Total: 120.01 ha ▶ 1.08 ha of breeding habitat ▶ 118.94 ha of foraging habitat
Southern whiteface (<i>Aphelocephala leucopsis</i>)	216.89 ha
Pale imperial hairstreak (<i>Jalmenus eubulus</i>) essential habitat only	26.59 ha

Table note:

*See Section 8 in the Appendix L: Terrestrial and Aquatic Ecology Technical Report.

TABLE 11-39 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE ENDANGERED OR OF CONCERN REQUIRING OFFSET

VM Act status	Regional ecosystem	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	25.90
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	7.57
E	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	24.01
OC	11.5.14	<i>Triodia</i> spp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils.	49.07
E	11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	0.67
OC	11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	2.39
OC	11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks	0.13
Total			109.73

Table note:

Two areas are too small to be triggered for offsetting and have been excluded from this table. These areas are 0.0038 ha of RE 11.8.3 and 0.0003 ha of RE 11.3.21.

TABLE 11-40 CATEGORY B (REMNANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN 50 M OF A MAPPED WETLAND REQUIRING OFFSET

VM Act status	Regional ecosystem	Description	Area (ha)
LC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	0.66
LC	11.3.27	Freshwater wetlands	0.13
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.07
Total			0.86

Table note:

This table excludes REs listed as either Endangered or Of Concern, as these are included in the offset areas in Table 11-39.

TABLE 11-41 CATEGORY B (REMNANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN A DEFINED DISTANCE OF A WATERCOURSE REQUIRING OFFSET

VM Act status	Regional ecosystem	Description	Area (ha)
LC	11.3.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	1.49
LC	11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	0.15
LC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	1.88
LC	11.3.27	Freshwater wetlands	0.02
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.02
LC	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.37
LC	11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.82
LC	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	0.34
LC	11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	0.28

VM Act status	Regional ecosystem	Description	Area (ha)
LC	11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	0.22
LC	11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks	0.27
LC	11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	0.18
LC	11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rock	0.01
LC	11.9.9a	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland	0.01
Total			8.06

Table note:

This table excludes REs listed as either Endangered or Of Concern, as these are included in the offset areas in Table 11-39.

11.9.3 Provision of offsets

ARTC's Environmental Offset Delivery Strategy – B2G (see Appendix Q: Environmental Offset Delivery Strategy) informs the development of offset delivery components for the Project including specific management intent to drive matter specific conservation outcomes across each relevant offset property presented in the strategy. It is proposed that property specific Offset Area Management Plans (OAMPs) will be developed and submitted following public exhibition to facilitate the EIS assessment and decision stages. Property specific OAMPs will be implemented by ARTC prior to construction commencement subject to approval under the EPBC Act.

The Environmental Offset Delivery Strategy — B2G contained in Appendix Q: Environmental Offset Strategy will:

- ▶ Quantify the significant residual impact of the Project on MNES and MSES
- ▶ Detail offsets to address significant residual impacts for MSES (except where those matters are also significant residual impacts on MNES)
- ▶ Detail offsets to address significant residual impacts for MNES
- ▶ Include:
 - ▶ any overview of the environmental offset compliance framework, principles and objectives at a Commonwealth and State level
 - ▶ an outline of the Project and detail the SRIs the Project is predicted to have on MNES and MSES
 - ▶ a summary the offset property selection process, including desktop assessments and the methodology of rapid and detailed field surveys
 - ▶ identification of the offset property portfolio selected for the Project offset portfolio based on the predicted MNES SRIs and assessment through OAG
 - ▶ specific matters management intent to drive matter specific conservation outcomes across each relevant offset property
 - ▶ an outline of the content that will be contained within the property specific OAMP
 - ▶ details of the options for legally securing each proposed offset area
 - ▶ an identification and assessment of the risks associated with delivering environmental offsets and what controls will be put in place to manage these risks.

11.10 Cumulative impacts

- ▶ Cumulative impacts have been assessed using the methodology described in Section 11.4.8. The assessment was undertaken for all MSES and MNES identified as known or likely to occur within the Project footprint. Under the *Environmental Offset Regulation*, the definition of protected wildlife habitat does not include near threatened species, therefore excludes *D. porrecta* and the definition of SLC is limited to echidna and platypus. As a result, habitat for the species listed as migratory SLC has not been quantified and therefore these species were not included in the Cumulative Impacts Assessment (CIA). It should be noted that three species were added to the revised draft EIS assessment as MSES (due to their recent listing in December 2023). As these species were not listed under the NC Act at the time of the assessments for the projects within the Area of Influence (AOI), there is no information on the impacts of these species. Therefore, these species have also not been included in the CIA.

- ▶ A number of projects were initially identified as having potential to contribute to ecological cumulative impacts in combination with the Project. These projects are either operational, may undergo future expansion or are going through an approval process. A full list of projects, with a description of each, is presented in Chapter 23: Cumulative Impacts.
- ▶ Cumulative impacts are most appropriately considered at a biologically relevant scale. A distance of 50 km from the Project was selected as many of the MSES of relevance to the Project do not occur beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent. A total of 23 projects have been identified for preliminary consideration for their potential to contribute to cumulative impacts in combination with the Project (see Table 11-42 and Figure 11-9). Operational projects have been included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes, for example, through the degradation of adjoining habitats or disturbance of species through noise, operational emissions, light, weed incursion. The total cumulative impact assessment area of significant ecological values (i.e. MNES and MSES) contained within the combined footprint of the 23 projects identified has been quantified and is provided in Table 11-43. It must be noted that the areas of assessment varied between MNES and MSES. For MNES, assessment included areas contained within NSW as well as Queensland, considering projects within both states. For MSES, the cumulative impact assessment only considered projects and areas within Queensland as MSES are bound by State borders.

The quantitative method of assessment that has been applied establishes a percentage of impact to each Significant Environmental Value as a combined consequence of all projects identified for the cumulative impact assessment. The results of the significance assessment of these cumulative impacts are presented in aggregated form in Table 11-44 (i.e. a level of cumulative impact significance is not attributed for each project).

Unmitigated, the cumulative impacts resulting from existing and proposed developments within the CIA area include some that can be considered irreversible and permanent. Without targeted mitigation measures, the potential cumulative impacts upon protected matters within the CIA area have been assessed to be low to moderate significance.

The potential for cumulative impacts to protected matters from this Project will be managed through implementation of mitigation measures specified in Section 11.7.

TABLE 11-42 PROJECTS INCLUDED IN THE ECOLOGICAL CUMULATIVE IMPACT ASSESSMENT

Projects	Location	Description
Wetalla Water Pipeline	From the Wetalla Wastewater Reclamation Facility in Toowoomba to the New Acland coal mine, 35 km northwest of the city Adjacent to Ch 210.48 km of the Project	A 45 km underground water pipeline to supply up to 5,500 megalitres of treated wastewater to the New Acland coal mine.
Wagners Intermodal Terminal	Wellcamp Airport, Queensland East of Ch 196.00 km of the Project	Major freight terminal, designed to benefit the freight network and future Inland Rail. The terminal will be 24/7 facility, designed to operate 78,000 containers for almost 400 freight customers and utilising approximately 150 locomotives and 1,500 wagons. Unique features of Wagners Intermodal terminal include a 2.7 km frontage for 1,800 m freight trains, a daily-use fully licensed and bonded international air cargo terminal and reach up to 500,000 containers capacity by 2040.
New Acland Coal Mine Stage 3	35 km northwest of Toowoomba 18 km north of Ch 210.48 km of the Project	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.
Australia Pacific LNG Project	Walloon gas fields (approximately 20 km west of Millmerran) 13 km west of the Project footprint	Integrated liquefied natural gas (LNG) project. The Walloon gas fields, located to the west of the Project, supplies Coal Seam Gas to support the LNG Facility on Curtis Island.

Projects	Location	Description
Toowoomba Bypass (formerly the Toowoomba Second Range Crossing)	The 41 km-long bypass route extends from the Warrego Highway at Helidon Spa in the east to the Gore Highway at Athol in the west, via Charlton 1 km to south and east of Ch 126.00 km of the Project	This bypass takes heavy vehicle through-traffic around the north of Toowoomba.
InterLinkSQ	13 km west of Toowoomba Adjacent to south of Ch 210.48 km of the Project.	A 200 ha transport, logistics and business hub. Located on the narrow gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego, and New England highways.
Toowoomba Wellcamp Airport	Wellcamp, Queensland 1 km east of the Project footprint	Airport servicing Toowoomba, promoting interstate, intrastate and international connection for the Darling Downs, Granite Belt, Surat Basin and Southern Downs regions.
Wellcamp Business Park	Wellcamp, Queensland 1.5 km east of Ch 196.00 km of the Project.	A 500 ha industrial and commercial park that forms part of the Toowoomba Enterprise Hub. The Business Park is located in close proximity to the Toowoomba Wellcamp Airport and other major transportation infrastructure.
Witmack Industry Park and Charlton Logistics Park	Wellcamp, Queensland 3 km southeast of Ch 200.00 km of the Project (Witmack Industry Park) Charlton, Queensland 3 km south of Ch 200.00 km of the Project (Charlton Logistics Park)	The Witmack Industry Park is a large industrial land development that offers large size industrial land parcels. Businesses situated within the Witmack Industrial Park include the Toowoomba Pulse Data Centre. The Charlton Logistics Park is part of the Toowoomba Enterprise Hub and provides fully serviced 2 ha sites and is well situated for potential transport and logistics operators due to its proximity to transport infrastructure.
Asterion Medicinal Cannabis Project	Wellcamp, Queensland Adjoins the Project footprint 1 km south of Toowoomba-Cecil Plains Road, east of Ch 196.00 km of the Project	A high-tech medicinal cannabis cultivation, research, and manufacturing facility. The project involves construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products, including single patient packs, cannabis oils, gels, salts and related products, destined solely for the medicinal market. This facility is anticipated to be the largest facility of its kind in the world. Major Project status was granted 14 July 2020.
Commodore Mine and Millmerran Power Station	Domville, Queensland Intersects the Project, located at approximately Ch 122.00 km, primarily to the east	The Commodore Mine is an open cut coal mine which provides coal for the 850 WMW Millmerran Power Station (Mininglink, 2018). The Millmerran Power Station is a coal-fired power station that supplies enough electricity to power approximately 1.1 million homes (Power Technology, 2018)
Pittsworth Industrial Precinct and Enabling Project	Pittsworth, Queensland 500 m to south of the Project footprint, west of Ch 160.00 km of the Project	Road and sewerage infrastructure upgrades at the Pittsworth Industrial Precinct to allow for industrial land for industries servicing agriculture and the wider region.

Projects	Location	Description
Doug Hall Poultry	Millmerran, Queensland Intersects the Project footprint, located primarily to north-west of Ch 138.00 km of the Project	Poultry farming operation with capacity of approximately 20,000 chickens. Operations include egg grading, a feed mill with output of 1,500 tonnes per week, a piggery, cropping and solar farm.
Yarranbrook Feedlot	Whetstone, Queensland Intersects the Project footprint, located predominantly to north	Cattle feedlot licenced for 25,000 head.
Sapphire Feedlot	Kildonan, Queensland Adjacent to south of the Project at Ch 10.00 km	Cattle feedlot which currently has a 6,000 head capacity, which expanded to 20,000 head in 2020.
Wyemo Piggery	Glenarbon, Queensland 8 km south of Ch 30.00 km of the Project footprint	Piggery with approval for 55,000 pig units.
Yarranlea Solar	Yarranlea, Queensland Intersects the Project footprint, located Ch 163.5 km at Yarranlea Road, Yarranlea	Solar Farm Stage 1 will span over 250 ha area consisting of 360,000 solar panels. Projected to have a generation capacity of up to 100 WMW once completed.
MacIntyre Wind Farm	Karara, Queensland 40 km east of Ch 80.00 km of the Project, 10 km south of Karara	The Wind Farm Precinct will span approximately 40,000 hectares (ha), predominantly built on sheep farming land. The MacIntyre Wind Farm is expected to generate 1,026 megawatts (MW), using up to 120 turbines.
Goondiwindi Abattoir	Goondiwindi, Queensland 19 km northwest of Ch 1 km of the Project	A new beef Abattoir located on the outskirts of Goondiwindi with beef processing of up to 72,000 tonnes per year.
Gowrie to Helidon Project (Inland Rail)	Rail alignment from Gowrie to Helidon, Queensland Adjoins the Project footprint at the northern point of the Project, located at Ch 210.48 km	New 26 km dual gauge track between Gowrie (northwest of Toowoomba) and Helidon (east of Toowoomba), extending through the Local Government Areas of Toowoomba and Lockyer Valley. The project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.
Helidon to Calvert (Inland Rail)	Rail alignment from Helidon to Calvert, Queensland 26 km east of the Project footprint	New 47 km dual gauge rail line connecting Helidon (east of Toowoomba) with Calvert (near Ipswich), via Placid Hills, Gatton, Forest Hill, Laidley, and Grandchester, extending through the Local Government Areas of Lockyer Valley and Ipswich City. The project includes a 1.1 km tunnel to create an efficient route through the steep terrain of the Little Liverpool Range.
Narrabri to North Star Project (Inland Rail)	Rail alignment from Narrabri to North Star, NSW. Adjoins the North Star to NSW/QLD Border (Inland Rail)	Upgrade of 189 km of existing rail corridor and construct 2 km of new track to connect Narrabri to North Star (NSW).
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project footprint at the southern end of the Project, located at the NSW/QLD border	New 37 km rail corridor to connect North Star (NSW) to the South Western Line just over the NSW/QLD border.

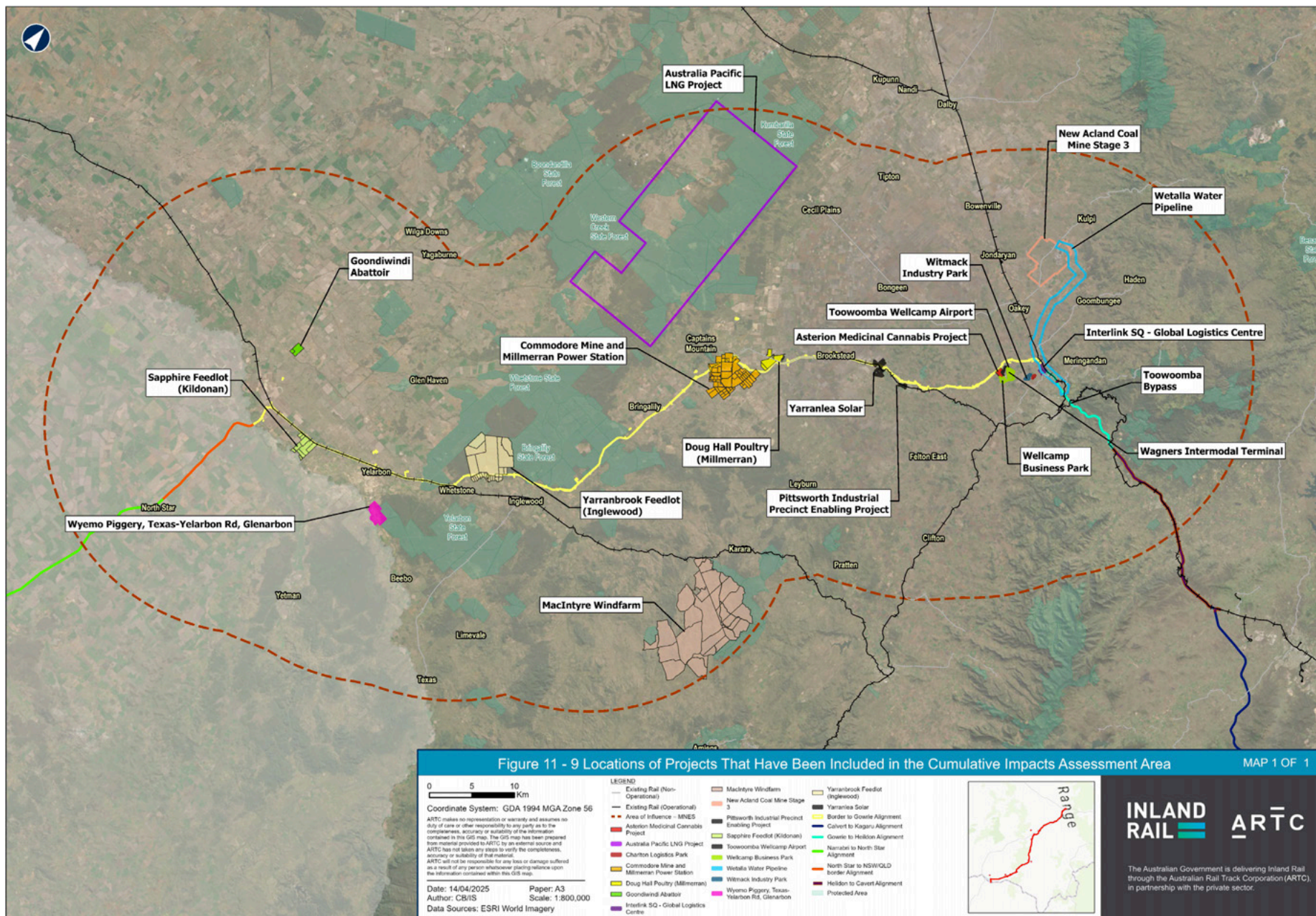


TABLE 11-43 CUMULATIVE IMPACTS AS CALCULATED WITHIN THE CUMULATIVE STUDY AREA

Ecological value	Occurrence in cumulative study area (50 km) (ha)	Occurrence in cumulative impact project area (excluding Project footprint) (ha)	Occurrence in Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
TECs (EPBC Act)							
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	21,457.68	729.23	103.69	832.92	3.88	0.48	Low
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	2,721.27	308.45	66.07	374.52	13.76	2.43	Low
Semi-evergreen vine thicket within the Brigalow Belt (north and south) and Nandewar bioregions (SEVT)	2,073.39	73.08	0.00	73.08	3.52	0.00	Low
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	115,393.38	26.66	2.54	29.20	0.03	0.00	Low
Threatened flora habitat (EPBC Act)							
King bluegrass (<i>Dichanthium queenslandicum</i>)	40,161.13	908.71	50.31	959.02	2.39	0.13	Low
Belson's panic (<i>Homopholis belsonii</i>)	76,372.56	7,593.34	260.52	7,853.86	10.28	0.34	Low
Winged peppercress (<i>Lepidium monoplacoides</i>)	224,744.96	59,510.29	79.86	59,590.15	26.51	0.04	Low
Hawkweed (<i>Picris evae</i>)	231,977.32	35,564.49	110.67	35,675.16	15.38	0.05	Low
Austral cornflower (<i>Rhaponticum australe</i>)	51,370.32	2,244.33	83.49	2,327.82	4.53	0.16	Low
Austral toadflax (<i>Thesium australe</i>)	49,881.87	1,091.90	46.44	1,138.34	2.28	0.09	Low
Small-flowered westringia (<i>Westringia parvifolia</i>)	960.91	0.00	27.19	27.19	2.83	2.83	Low
<i>Xerothamnella herbacea</i>	17,272.17	654.69	11.99	666.68	3.86	0.07	Low
Threatened fauna habitat (EPBC Act)							
Birds							
Australasian bittern (<i>Botaurus poiciloptilus</i>)	47,239.09	547.46	7.91	555.37	1.18	0.02	Low
Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>)	19,832.41	1,026.00	421.42	1,447.42	7.30	2.12	Low
Painted honeyeater (<i>Grantiella picta</i>)	30,624.83	178.93	330.66	509.59	1.66	1.08	Low
Australian painted snipe (<i>Rostratula australis</i>)	47,386.54	547.46	7.91	555.37	1.17	0.02	Low
Fish							
Murray cod (<i>Maccullochella peelii</i>)	20,899.39	101.47	60.50	161.97	0.77	0.29	Low
Mammals							
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	386,856.92	88,063.03	696.25	88,759.28	22.94	0.18	Low

Ecological value	Occurrence in cumulative study area (50 km) (ha)	Occurrence in cumulative impact project area (excluding Project footprint) (ha)	Occurrence in Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
Koala (<i>Phascolarctos cinereus</i>)	284,426.65	33,849.54	1,362.53	35,210.07	12.38	0.48	Low
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	804,185.50	17,672.78	788.39	18,461.17	2.30	0.10	Low
Reptiles							
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	40,247.30	2048.44	241.61	2,290.05	5.69	0.60	Low
Collared delma (<i>Delma torquata</i>)	273,942.02	8,243.10	36.83	8,279.93	3.02	0.01	Low
Dunmall's snake (<i>Furina dunmalli</i>)	57,552.21	7,921.64	262.69	8,184.33	14.22	0.46	Low
Condamine earless dragon (<i>Tympanocryptis condaminensis</i>)	58,139.65	2,419.50	51.20	2,470.70	4.25	0.09	Low
Invertebrates							
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	150,415.22	2,218.55	146.72	2,365.27	1.57	0.10	Low
State significant ecological constraints							
Protected nature areas:	7,946.28	0.00	0.00	0.00	0.00	0.00	N/A
▶ Alice Creek Nature Refuge							
▶ Berlin Scrub Nature Refuge							
▶ Dilladerri Nature Refuge							
▶ Ellangowan Nature Refuge							
▶ Fair Hills Nature Refuge							
▶ Gattonview Nature Refuge							
▶ JAL Nature Refuge							
▶ Kalisha Nature Refuge							
▶ Long Grass Nature Refuge							
▶ Myall Park Nature Refuge							
▶ Pine Cliffs Nature Refuge							
▶ Ravensbourne Nature Refuge							
▶ The Gullies Nature Refuge							
▶ Thompson's Nature refuge							
▶ Walker's Wilderness Nature Refuge							
▶ Whilaloo Nature Refuge							
▶ Wilga Park Nature Refuge							
▶ Xanthorrhoea Nature Refuge							

Ecological value	Occurrence in cumulative study area (50 km) (ha)	Occurrence in cumulative impact project area (excluding Project footprint) (ha)	Occurrence in Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
Protected area estates (<i>excluding State forests</i>):	295,306.56	4,450.10	0.00	4,450.10	1.51	0.00	Low
▶ Bendidee National Park							
▶ Coolmunda Conservation Park							
▶ Crow's Nest National Park							
▶ Dwyers Scrub Conservation Park							
▶ Esk National Park							
▶ Flagstone Creek Conservation Park							
▶ Gatton National Park							
▶ Geham National Park							
▶ Hampton National Park							
▶ Irongate Conservation Park							
▶ Lockyer National Park							
▶ Lockyer Resources Reserve							
▶ Mount Binga National Park							
▶ Ravensbourne National Park							
▶ Tenthill Conservation Park							
▶ Wondul Range National Park							
<i>Note: State forests are not an MSES</i>							
Regulated vegetation (VM Act)							
Category B – Endangered REs:	46,668.45	201.32	49.39	250.71	0.54	0.11	Low
Category B – Of Concern REs:	202,417.66	3,530.07	85.06	3,615.13	1.79	0.04	Low
Essential habitat (EH)	84,262.99	1,263.97	113.19	1377.16	1.63	0.13	Low
State significant wetlands (HES Wetlands)	7,476.06	22.02	0.00	22.02	0.29	0.00	Low
MSES protected wildlife habitat (flora) (NC Act)							
<i>Cyperus clarus</i>	41,397.45	936.65	166.07	1,102.72	2.66	0.40	Low
<i>Picris barbarorum</i>	452,656.34	70,447.80	174.98	70,622.78	15.60	0.04	Low

Ecological value	Occurrence in cumulative study area (50 km) (ha)	Occurrence in cumulative impact project area (excluding Project footprint) (ha)	Occurrence in Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
MSES protected wildlife habitat (fauna) (NC Act)							
Common death adder (<i>Acanthopis antarcticus</i>)	775,562.91	98,486.02	277.27	98,763.29	12.73	0.04	Low
Glossy black-cockatoo (<i>Calyptrorhynchus lathami lathami</i>)	362,917.60	72,079.64	120.01	72,199.65	19.89	0.03	Low
Grey snake (<i>Hemiaspis damelii</i>)	61,039.51	2,136.76	259.80	2,396.56	3.93	0.43	Low
White-throated needletail (<i>Hirundapus caudacutus</i>)	2,395,033.14	156,019.14	2,853.24	158,872.38	6.63	0.12	Low
MSES Special LCLeast Concern fauna (NC Act)							
Platypus (<i>Ornithorhynchus anatinus</i>)	135,748.44	7,266.51	24.81	7,291.32	5.37	0.02	Low
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	45,563.01	2,804.14	1,397.48	4,201.62	9.22	3.07	Low
MSES connectivity (BPA)							
Corridor (Regional terrestrial)	122,194.40	1,723.52	220.39	1,943.91	1.59	0.18	Low
Corridor (State riparian)	58,074.21	305.42	31.82	337.24	0.58	0.05	Low
Corridor (State terrestrial)	415,966.65	7,268.32	305.04	7,573.36	1.82	0.07	Low

Table notes:

1. Magnitude is calculated based on the proportional disturbance from the Project to each receptor within the cumulative study area and the percentage contribution of the Project to the overall disturbance of that receptor. Low magnitude = Project contribution of less than 2 per cent or an overall cumulative impact of <10 per cent.

TABLE 11-44 SIGNIFICANCE ASSESSMENT OF CUMULATIVE IMPACTS WITHIN THE CUMULATIVE STUDY AREA

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance	
		Probability	Duration	Magnitude	Sensitivity			
MNES								
Australian Government significant ecological constraint (community listed under the EPBC Act) ▶ Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ▶ Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ▶ Semi-evergreen vine thicket within the Brigalow Belt (north and south) and Nandewar bioregions ▶ White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	▶ Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium	
	▶ Edge effects	1	2	1	3	7	Medium	
	▶ Habitat fragmentation							
	▶ Barrier effects							
	▶ Reduction in connectivity of biodiversity corridors							
	▶ Fauna species injury or mortality	1	1	1	3	6	Low	
	▶ Dust and light and contaminant disturbance	1	1	1	3	6	Low	
	▶ Increase in litter (waste)	1	1	1	3	6	Low	
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium	
▶ Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low		
Australian Government significant ecological constraint (species listed under the EPBC Act): Flora ▶ King bluegrass (<i>Dichanthium queenslandicum</i>) ▶ Belson's panic (<i>Homopholis belsonii</i>) ▶ Winged peppercress (<i>Lepidium monoplacoides</i>) ▶ Hawkweed (<i>Picris evae</i>) ▶ Austral cornflower (<i>Rhaponticum australe</i>) ▶ Austral toadflax (<i>Thesium australe</i>) ▶ Small-flowered westringia (<i>Westringia parvifolia</i>) ▶ Xerothamnella herbacea Fauna ▶ Australasian bittern (<i>Botaurus poiciloptilus</i>) ▶ Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>) ▶ Painted honeyeater (<i>Grantiella picta</i>)	▶ Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium	
	▶ Edge effects	2	2	1	3	8	Medium	
	▶ Habitat fragmentation							
	▶ Barrier effects							
	▶ Reduction in connectivity of biodiversity corridors							
	▶ Fauna species injury or mortality	1	1	1	3	6	Low	
	▶ Dust and light and contaminant disturbance	1	1	1	3	6	Low	
	▶ Increase in litter (waste)	1	1	1	3	6	Low	
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium	
	▶ Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low	

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
- Australian painted snipe (<i>Rostratula australis</i>) - Murray cod (<i>Maccullochella peelii</i>) - South-eastern long-eared bat (<i>Nyctophilus corbeni</i>) - Koala (<i>Phascolarctos cinereus</i>) - Grey-headed flying-fox (<i>Pteropus poliocephalus</i>) - Five-clawed worm-skink (<i>Anomalopus mackayi</i>) - Collared delma (<i>Delma torquata</i>) - Dunmall's snake (<i>Furina dunmalli</i>) - Condamine earless dragon (<i>Tympanocryptis condaminensis</i>) Brigalow woodland snail (<i>Adclarkia cameroni</i>)							
MSES							
State significant ecological constraint (VM Act):	Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
Category B — ‘Endangered’ remnant vegetation (REs)	Edge effects	1	2	1	3	7	Medium
	Habitat fragmentation						
	Barrier effects						
	Reduction in connectivity of biodiversity corridors						
	Fauna species injury or mortality	1	1	1	3	6	Low
	Dust and light and contaminant disturbance	1	1	1	3	6	Low
	Increase in litter (waste)	1	1	1	3	6	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
State significant ecological constraint (VM Act): ▶ Regulated vegetation — Category B — Of Concern remnant vegetation (REs)	▶ Habitat loss from vegetation clearing/removal	2	3	1	2	8	Medium
	▶ Edge effects	1	2	1	2	6	Low
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						
	▶ Fauna species injury or mortality	1	1	1	2	5	Low
	▶ Dust and light and contaminant disturbance	1	1	1	2	5	Low
	▶ Increase in litter (waste)	1	1	1	2	5	Low
State significant ecological constraint (VM Act): ▶ Regulated vegetation — Category B — Least Concern remnant vegetation (REs)	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	▶ Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
	▶ Habitat loss from vegetation clearing/removal	2	3	1	1	7	Medium
	▶ Edge effects	1	2	1	1	5	Low
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						
	▶ Fauna species injury or mortality	1	1	1	1	4	Low
State significant ecological constraint (VM Act): ▶ Regulated vegetation (Category C — HVR)	▶ Dust and light and contaminant disturbance	1	1	1	1	4	Low
	▶ Increase in litter (waste)	1	1	1	1	4	Low
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	1	5	Low
	▶ Displacement of species from invasion of weed and pest species	1	1	1	1	4	Low
	▶ Habitat loss from vegetation clearing/removal	2	3	1	2	8	Medium
	▶ Edge effects	1	2	1	2	6	Low
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	▶ Fauna species injury or mortality	1	1	1	2	5	Low
	▶ Dust and light and contaminant disturbance	1	1	1	2	5	Low
	▶ Increase in litter (waste)	1	1	1	2	5	Low
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	▶ Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
State significant ecological constraint:	▶ Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
▶ State significant wetlands (HES)	▶ Edge effects	1	2	1	3	7	Medium
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						
	▶ Fauna species injury or mortality	1	1	1	3	6	Low
	▶ Dust and light and contaminant disturbance	1	1	1	3	6	Low
	▶ Increase in litter (waste)	1	1	1	3	6	Low
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	▶ Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
State significant ecological constraint (species listed as Threatened under the NC Act):	▶ Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
Flora	▶ Edge effects	1	2	1	3	7	Medium
▶ <i>Cyperus clarus</i>	▶ Habitat fragmentation						
▶ <i>Picris barbarorum</i> (tall hawkweed)	▶ Barrier effects						
Fauna	▶ Reduction in connectivity of biodiversity corridors						
▶ Common death adder (<i>Acanthophis antarcticus</i>)	▶ Fauna species injury or mortality	1	1	1	3	6	Low
▶ Southern whiteface (<i>Aphelocephala leucopsis</i>)	▶ Dust and light and contaminant disturbance	1	1	1	3	6	Low
▶ Glossy black-cockatoo (<i>Calyptorhynchus lathami lathami</i>)	▶ Increase in litter (waste)	1	1	1	3	6	Low
▶ Brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>)	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
- Grey snake (<i>Hemiaspis damelii</i>) - Hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) - Diamond firetail (<i>Stagonopleura guttata</i>) - White-throated needletail (<i>Hirundapus caudacutus</i>)	Displacement of species from invasion of weed and pest species	1	2	1	3	6	Medium
State Significant ecological constraint (SLC fauna species):	Habitat loss from clearing riparian vegetation and associated aquatic microhabitat features	1	3	1	2	7	Medium
- Fork-tailed swift (<i>Apus pacificus</i>) - Latham's snipe (<i>Gallinago hardwickii</i>) - Satin flycatcher (<i>Myiagra cyanoleuca</i>) - Glossy ibis (<i>Plegadis falcinellus</i>) - Common greenshank (<i>Tringa nebularia</i>) - Rufous fantail (<i>Rhipidura rufifrons</i>) - Platypus (<i>Ornithorhynchus anatinus</i>) - Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	- Edge effects - Habitat fragmentation - Barrier effects - Reduction in connectivity of biodiversity corridors	1	2	1	2	6	Low
	Fauna species injury or mortality	1	1	1	2	5	Low
	Dust and light and contaminant disturbance	1	1	1	2	5	Low
	Increase in litter (waste)	1	1	1	2	5	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
State significant ecological constraint (BPA):	Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
- BPA habitat values (State) - Corridor (State terrestrial) - Corridor (State riparian)	- Edge effects - Habitat fragmentation - Barrier effects - Reduction in connectivity of biodiversity corridors	1	2	1	3	7	Medium
	Fauna species injury or mortality	1	1	1	3	6	Low
	Dust and light and contaminant disturbance	1	1	1	3	6	Low
	Increase in litter (waste)	1	1	1	3	6	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low

Ecological value(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
State significant ecological constraint (BPA): ▶ BPA habitat values (regional) ▶ Corridor (regional terrestrial)	▶ Habitat loss from vegetation clearing/removal	1	3	1	2	7	Medium
	▶ Edge effects	1	2	1	2	6	Low
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						
	▶ Fauna species injury or mortality	1	1	1	2	5	Low
	▶ Dust and light and contaminant disturbance	1	1	1	2	5	Low
	▶ Increase in litter (waste)	1	1	1	2	5	Low
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	▶ Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
State significant ecological constraint (BPA): ▶ BPA habitat values (local or other) (MLES)	▶ Habitat loss from vegetation clearing/removal	1	3	1	1	6	Low
	▶ Edge effects	1	2	1	1	5	Low
	▶ Habitat fragmentation						
	▶ Barrier effects						
	▶ Reduction in connectivity of biodiversity corridors						
	▶ Fauna species injury or mortality	1	1	1	1	4	Low
	▶ Dust and light and contaminant disturbance	1	1	1	1	4	Low
	▶ Increase in litter (waste)	1	1	1	1	4	Low
	▶ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	1	5	Low
	▶ Displacement of species from invasion of weed and pest species	1	1	1	1	4	Low

Table notes:

Relevance factors between 1 and 3 were determined using professional judgement to select most appropriate relevance factor for each aspect and summing the relevance factors.

Sum of relevant factors definition:

- ▶ Low (1–6): Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general Project monitoring program.
- ▶ Medium (7–9): Mitigation measure likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
- ▶ High (10–12): Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

Following the cumulative impact assessment, all MNES and MNES were assessed as having a 'low' magnitude of disturbance (refer to Table 11-38), with impacts to be managed by standard environmental management practices, and monitoring to be part of the general Project monitoring program. No MNES or MSES were assessed as having a 'medium' or 'high' magnitude of disturbance.

Impacts with the potential to cause a 'medium' significant impact, as per Table 11-44, include:

- ▶ Habitat loss from vegetation clearing/removal
- ▶ Habitat fragmentation
 - ▶ edge effects
 - ▶ barrier effects
 - ▶ reduction in connectivity of biodiversity corridors
- ▶ Reduction in biological viability of soil to support growth due to soil compaction
- ▶ Displacement of species from invasion of weed and pest species.

These impacts will be managed through implementation of mitigation measures outlined in Section 11.7.

No MSES or MNES were assessed as having a 'high' significant impact.

11.11 Conclusions

This chapter has been prepared in accordance with Sections 11.1 to 11.35 and 11.94 to 11.106 of the ToR and additional information requested for the Project by the Office of the Coordinator-General.

The study area provides suitable habitat for MNES Threatened species (controlling provisions under the EPBC Act), non-Threatened MNES species (migratory birds), State-listed Threatened species and SLC species (listed under the NC Act). In addition, a number of Endangered, Of Concern and Least Concern REs are also present within the Project footprint that are protected under the VM Act.

Ecological values or their associated habitat were identified within the Project footprint for the purposes of this assessment, varying from broad-scale ecological values, such as protected areas and bioregional corridors, down to finer species-scale ecological values, including conservation significant and migratory species.

The construction and operation of the Project has the potential to impact on ecological values via the following processes:

- ▶ Habitat loss and degradation from vegetation clearing/removal
- ▶ Fauna species injury or mortality
- ▶ Reduction in biological viability of soil to support growth due to soil compaction
- ▶ Introduction and spread of weeds, pathogens and pest species
- ▶ Habitat fragmentation
 - ▶ loss of connectivity in biodiversity corridors
 - ▶ barrier effects
 - ▶ edge effects
- ▶ Noise, dust, and light
- ▶ Waste management
- ▶ Aquatic habitat degradation
- ▶ Altered hydrology and flooding
- ▶ Erosion and sedimentation
- ▶ Changes to groundwater resources
- ▶ Clearing of riparian vegetation
- ▶ Modification of aquatic habitats
- ▶ Waterway barrier effect
- ▶ Altered hydrology
- ▶ Water quality degradation.

The revised reference design has been developed in parallel with the EIS to avoid the occurrence of impacts to ecological values. Where avoidance has not been possible, design development has sought to minimise the likelihood and/or consequence of these impacts, as far as possible. Mitigation measures and controls that have been factored into the design, or otherwise implemented during the reference design stage of the Project, are summarised in Section 11.7.

Where potential impacts to ecological values have not been fully avoided or mitigated through the reference design stage, additional mitigation measures have been nominated for implementation in future stages of the Project. These proposed mitigation and management measures have been detailed in Section 11.7.3.

The impacts to identified ecological values are generally expected to be reduced following the application of the nominated mitigation strategies; however, mitigation is not likely to significantly reduce impacts associated with the direct loss of vegetation/habitat through clearing/removal, thereby resulting in a residual impact to ecological values.

Where residual impacts are anticipated to occur, further analysis has been undertaken to determine if the Project would likely result in significant residual impact in accordance with the relevant Australian Government or State significant impact guidelines (see Section 11.8.2).

Following the implementation of a hierarchical approach to impact management (i.e. avoidance, minimisation, mitigation) and the implementation of a range of mitigation measures and management plans, the significance of potential impacts on MNES ecological values was determined in accordance with the Australian Government Significant Impact Guidelines (see Section 11.10.2). This analysis, based on ground-truthed values within the Project footprint and predictive habitat mapping for areas outside the Project footprint (to the extent they are within the study area), indicates that significant residual impacts for the following MNES have potential to occur:

- ▶ **TECs:**
 - ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
 - ▶ Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC
 - ▶ White box–yellow box–Blakely’s red gum grassy woodland and derived native grassland TEC
- ▶ **Threatened flora:**
 - ▶ King blue-grass (*Dichanthium queenslandicum*)
 - ▶ Belson's panic (*Homopholis belsonii*)
 - ▶ Winged peppergrass (*Lepidium monolocoides*)
 - ▶ Hawkweed (*Picris evae*)
 - ▶ *Xerothamnella herbacea*
 - ▶ Small-flowered westringia (*Westringia parvifolia*)
- ▶ **Threatened fauna:**
 - ▶ Brigalow woodland snail (*Adclarkia cameroni*)
 - ▶ Condamine earless dragon (*Tympanocryptis condaminensis*)
 - ▶ Dunmall's snake (*Furina dunmali*)
 - ▶ Five-clawed worm-skink (*Anomalopus mackayi*)
 - ▶ Koala (*Phascolarctos cinereus*)
 - ▶ Painted honeyeater (*Grantiella picta*)
 - ▶ South-eastern long-eared bat (*Nyctophilus corbeni*)
 - ▶ Spotted-tailed quoll (*Dasyurus maculatus maculatus*)
 - ▶ Squatter pigeon (*Geophaps scripta scripta*)
 - ▶ Yakka skink (*Egernia rugosa*).

Significant residual impact assessment of prescribed environmental matters (MSES) was undertaken in accordance with the MSES significant impact criteria. This analysis indicated that, based on ground-truthed values within the Project footprint and predictive habitat mapping for areas outside the Project footprint (to the extent they are within the study area), the Project is likely to result in significant residual impacts to following MSES:

- ▶ Regulated vegetation:
 - ▶ prescribed REs that are Endangered or Of Concern
 - ▶ clearing in a regional ecosystem that is within the defined distance of a watercourse
 - ▶ clearing in the portion of a regional ecosystem that lies within a mapped wetland
 - ▶ connectivity areas – Remnant Category B vegetation
- ▶ Protected wildlife habitat for the following species:
 - ▶ *Cyperus clarus*
 - ▶ Tall hawkweed (*Picris barbarorum*)
 - ▶ Diamond firetail (*Stagonopleura guttata*)
 - ▶ Glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*)
 - ▶ Southern whiteface (*Aphelocephala leucopsis*).

These potential significant residual impacts are based on the extensive ground-truthing of the Project footprint which has occurred following the submission of the draft EIS.

Predicted cumulative impacts were assessed, incorporating the footprints of 21 other projects that are located within the Project cumulative impact area. Cumulative impacts are most appropriately considered at a biologically relevant spatial scale (e.g. 50 km from the disturbance footprint). The cumulative impacts of multiple similar projects occurring in the vicinity of the Project will potentially include habitat loss from vegetation removal, species injury or mortality, soil compaction, introduction and/or spread of invasive weeds and pest species, severance of biodiversity corridors, proliferation of edge effects, habitat fragmentation, barrier effects, noise, dust, and light impacts and litter.

Mitigation measures identified as part of the Project commitments are likely to reduce the Project's contribution to cumulative project impacts within the broader region.

The Project will result in significant residual impacts, even after the implementation of all mitigation measures, including rehabilitation. As such, the provisions of offsets for the MNES and MSES presented above is required under the *EPBC Act Environmental Offsets Policy* and delivered consistent with the *Queensland Environmental Offsets Policy*.

ARTC's *Environmental Offset Delivery Strategy — Qld* (see Appendix Q: Environmental Offset Delivery Strategy) will inform the development of offset delivery components including an Environmental Offset Delivery Plan and Offset Area Management Plans. A detailed Environmental Offset Delivery Plan and Offset Area Management Plans will be developed and implemented by ARTC prior to the commencement of construction.